ELMODIS

# SDMS-VMS-E Installation manual

**Documentation**

# Table of Contents

# 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 If any damage is found, the device should be withdrawn from use and have it repaired at the manufacturer's service centre.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.

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Email: biuro@elmodis.com

Web: http://www.elmodis.com

# 2 Introduction & approvals

Vibration Module is part of the Elmodis system for monitoring machines driven by induction electric motors. The Vibration Module is an extension to the system, in which the Electro Module is the basic module. The purpose of the Vibration Module is to read and preprocess the data coming from the vibration sensors. The signals from the vibration sensors are sampled at a frequency of 32 kHz. In order to synchronize the electrical measurements with the vibration measurements, the module is equipped with an additional phase marker input installed on the machine shaft. This allows a spectral analysis of the signal over a wide frequency range and the detection of anomalies in the vibration waveform related to a specific angular position of the shaft. Communication between the Electro and Vibration modules is via Ethernet.

## 2.1 Basic features

- Supports up to four vibration sensors
- Support for IEPE (Integrated Electronic Piezoelectric) sensors
- Temperature measurement from vibration sensors with integrated temperature sensor
- Sensor signal sampling with frequency of 32kHz
- Ethernet interface for communication with the Internet and other SDMS modules
- 24 VDC power supply
- Mounting 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

| | |
|---|---|
| Vibration sensor standard | IEPE (Integrated Electronic Piezoelectric) |
| Vibration measurement range | 0 ÷ 30 [g] (for a sensor with the sensitivity of 100 mV/g) |
| Nominal supply current of vibration sensors | 4.7 mA |
| Measurement track according to | ISO 2954 standard |
| Temperature measurement range | 10 ÷ 120 [°C] (for a sensor with the sensitivity of 10 mV/ °C) |
| Temperature measurement accuracy | ±0.5 °C |
| Power supply (SELV) | 24 VDC |
| Power consumption | < 7.5 W |
| Communication | 10/100 Mbit Ethernet |
| Operating temperature | -20 ÷ 50 [°C] |
| Storage temperature | -20 ÷ 85 [°C] |
| Operating humidity range | 5% to 90% without condensation |
| Maximum altitude | 2000 m |
| Mounting method | TH35 rail (acc. to PN-EN 60715 standard) |
| Dimensions | 46 x 115 x 125 [mm] |
| Weight | 0.4 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 |
| [1]<br>[2]<br>[3]<br>[4] | BLINKING | Collecting vibration measurements |
| | STEADY | Sensor properly connected, in stand-by mode |
| | STEADY | No vibration sensor or open circuit |
| | BLINKING | Sensor circuit shorted / sensor damaged |
| 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 connector pins are marked with a dot.


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

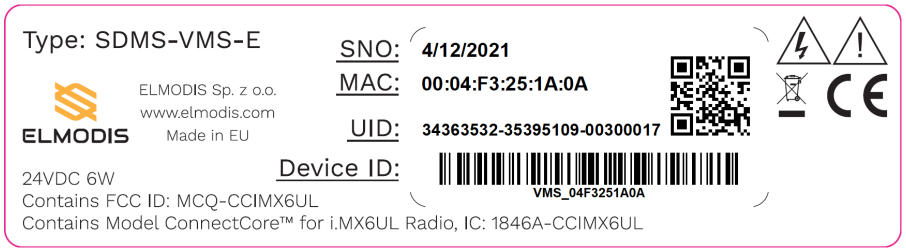



Fig 2. Nameplate

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: 4/12/2021 (4th SDMS-VMS-E module manufactured in December 2021)

## 3.4 Wiring diagram

The following figures shows the basic measurement scheme.

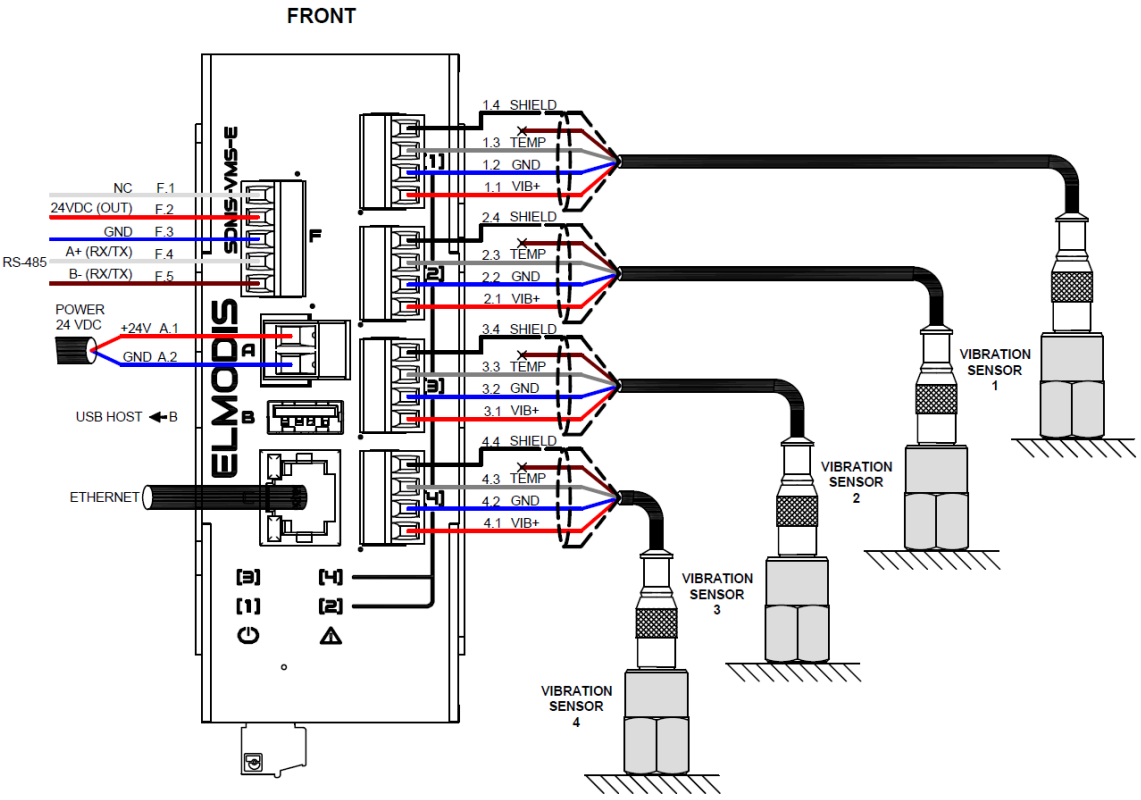



Fig 3. Basic measurement scheme of SDMS-VMS-E module (front view)

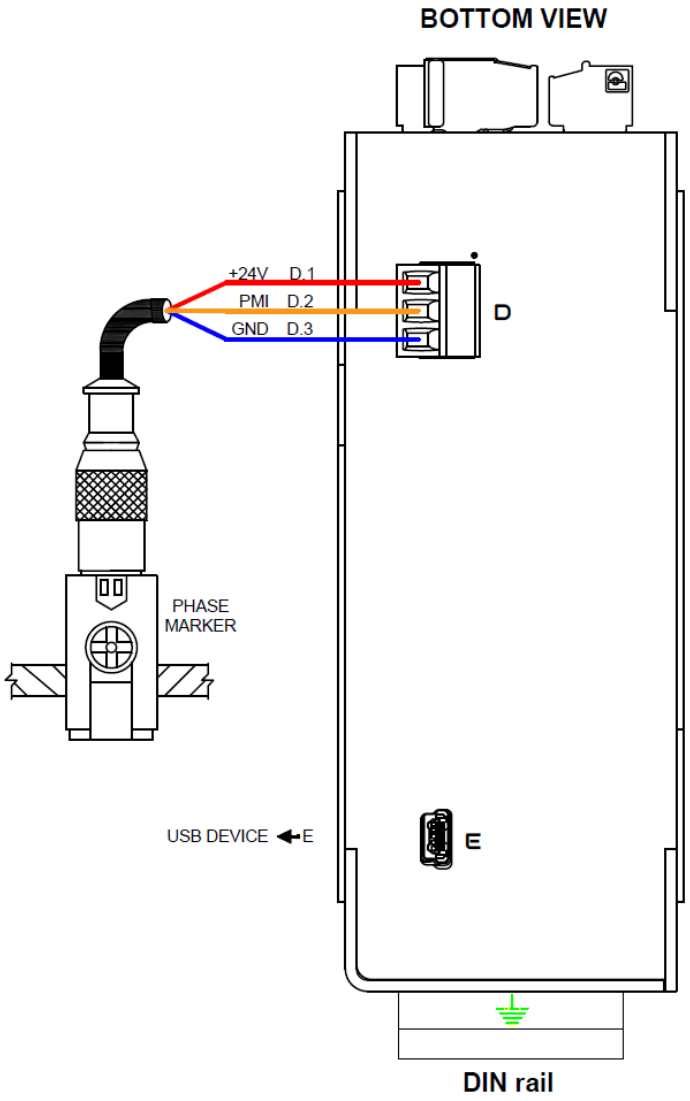



Fig 4. Basic measurement scheme of SDMS-VMS-E module (bottom view)

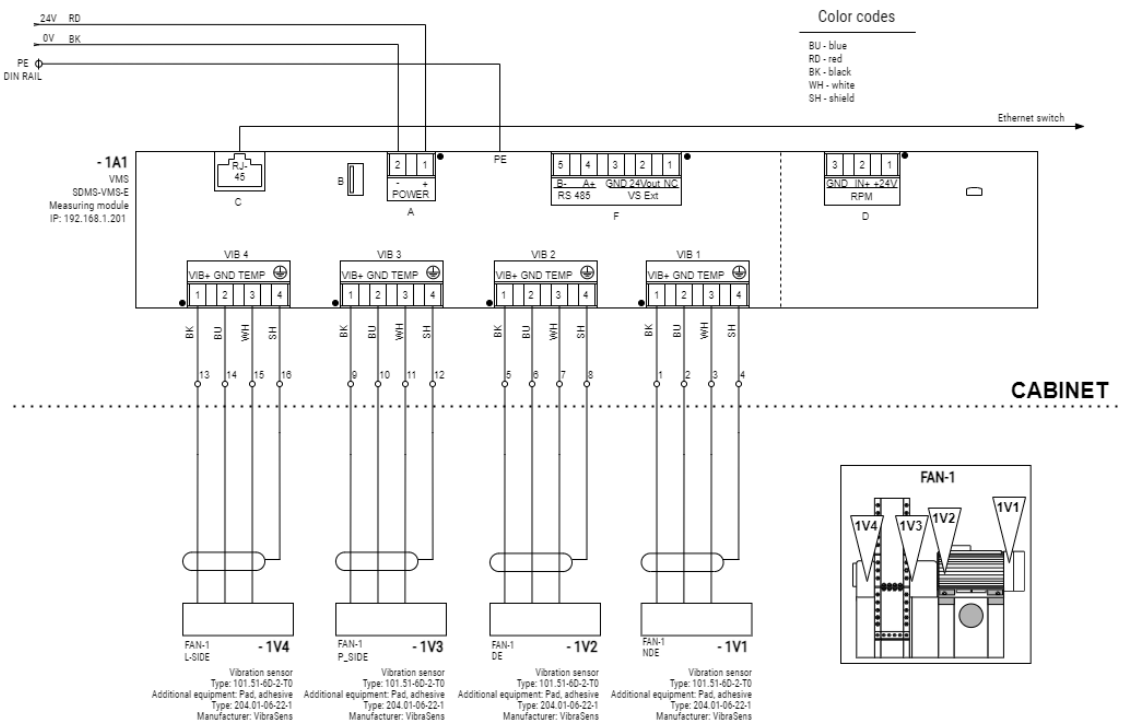



Fig 5. CAD drawing example of connections to the module connectors, including marking standards

## 3.5 Dimensions

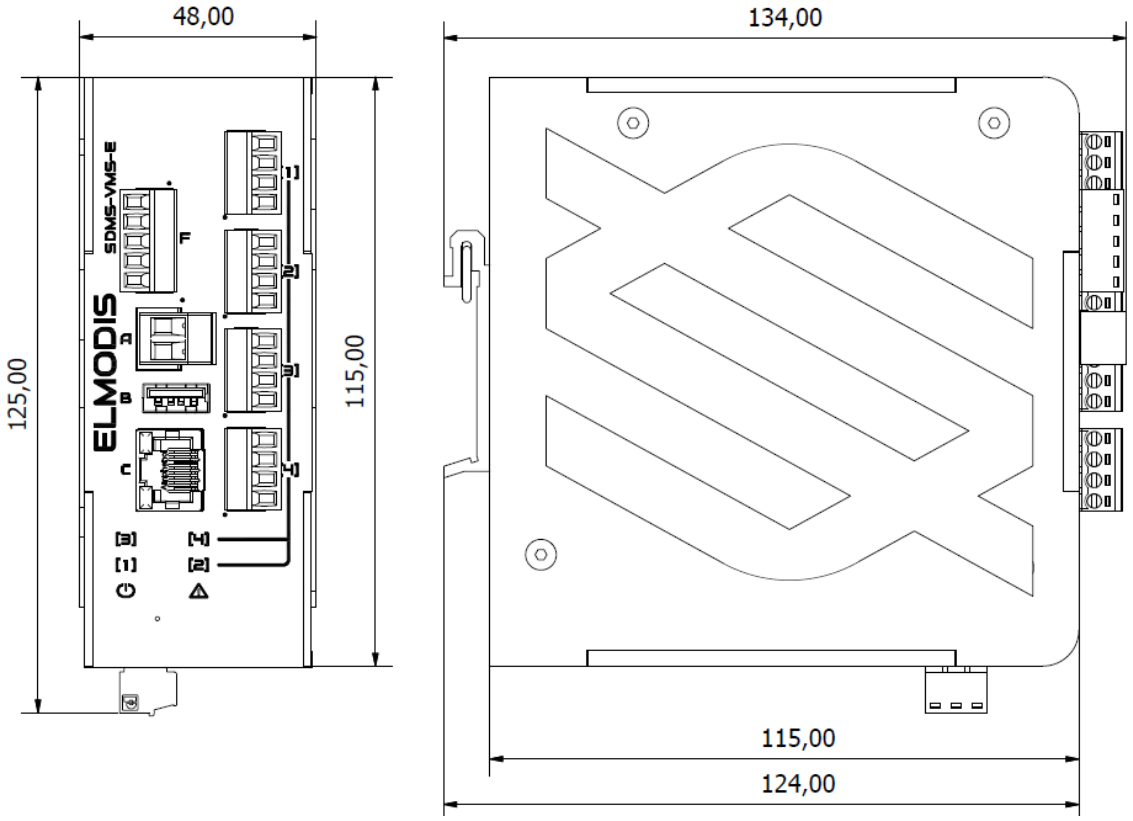



Fig 6. SDMS-VMS-E module dimensions [mm]

# 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 wires: 300 V.
- 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.

## 4.3 Installation requirements

- 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.
- The inputs are not insulated, so all sensors must be installed in such a way as to ensure adequate isolation from components / circuits at hazardous potentials.
- At least simple drawing, showing connections on the terminal in the cabinet where the devices are connected, should be prepared.

## 4.4 Measurement quality

- Proper type of cables for measurement (e.g. twisted-pair cable for vibration sensor).
- Connected cable shield.
- Do not leave the cables unattached.
- Do not bend or press the 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 | 7.5 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 A shown in the following figure.

| Pin of A connector | Marking |
|---|---|
| A.1 | +24V |
| A.2 | GND |

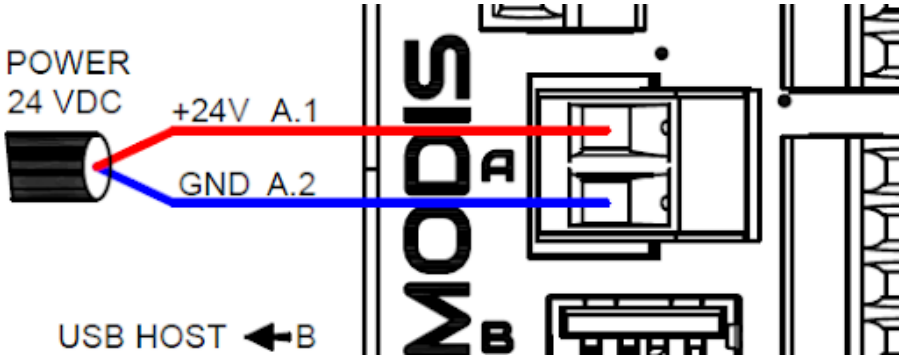



Fig 7. 24 VDC power supply

## 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

## 6.1 Ethernet

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

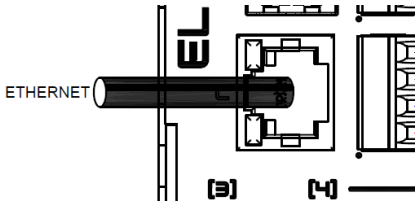



Fig 8. Ethernet

## 6.2 RS-485

The RS-485 communication interface is designed primarily for other ELMODIS devices with the same interface (e.g. SDMS-PV), so that the capabilities of the entire system can be expanded. It is used to configure and read the measurement data using the Modbus-RTU protocol. Additionally on the same connector there is 24VDC power supply output, which can supply up to 100mA. It is recommended that the cable wires are twisted in pairs (2-3, 4-5).

### 6.2.1 Parameters

| | |
|---|---|
| Cross section of the connection cables | 0.2-1.3 [$mm^2$] (24-16 AWG) |
| Tightening torque | 0.34 Nm (3 Lb-In) |
| Nominal output supply voltage | 24 VDC |
| Maximum output current | 100 mA |

The following table shows the description of the pins in connector F of the SDMS-VMS-E module according to the order in the figure below.

| Pin of F connector | Marking | Description |
|---|---|---|
| F.1 | NC | Pin not connected |
| F.2 | 24VDC (OUT) | Power output 24VDC (max. 100 mA) |
| F.3 | GND | Ground |
| F.4 | A+ (Rx/Tx) | Non-inverting output/input for RS-485 bus |
| F.5 | B- (Rx/Tx) | Inverting output/input for RS-485 bus |

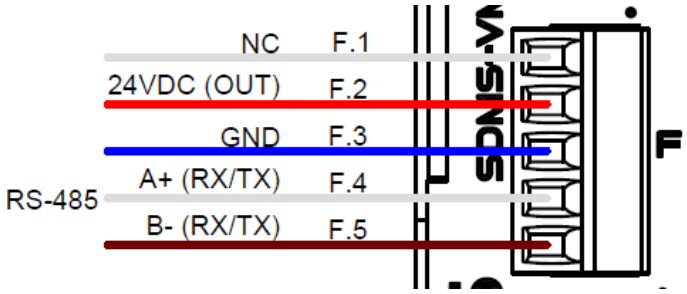



Fig 9. RS-485

# 7 Input signals

## 7.1 Vibration sensor input

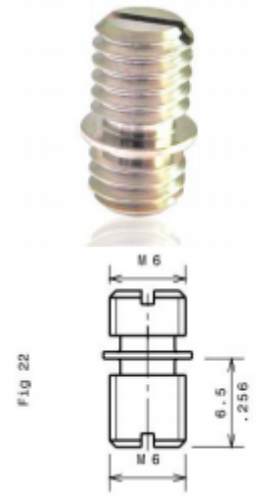
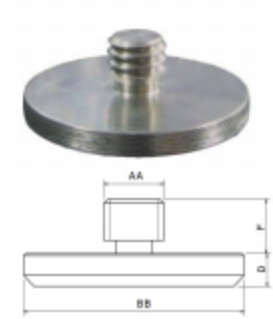
The purpose of this manual is to provide information on how to perform and verify proper installation of the vibration sensor. The mechanical vibration sensor is required in the Elmodis system to verify electrical measurements and to obtain additional diagnostic information related to the machine. The vibration measurement inputs are adapted to cooperate with acceleration sensors with IEPE type output.

### 7.1.1 Components

Vibration sensor

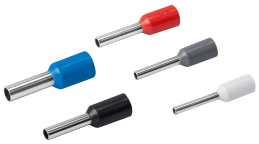
| Name | Type/Designation/ Manufacturer | Photo |
|---|---|---|
| Sensor with M12 connector: vibration only (sensor 100 mV/g ±10%, M12 4-pin connector, 80g Dynamic) | 101.51-6D-2-M6/VibraSens |  <br>1 - N.C. (not connected)<br>2 - N.C. or TEMP (if version with temperature measurement)<br>3 - (–) GND<br>4 - (+) VIB+ |
| Sensor with M12 connector: vibration + temperature (sensor 100 mV/g ±10%, M12 4-pin connector, 80g Dynamic, 10 mV/°C. range +2~+120 °C) | 101.51-6D-2-T0-M6/VibraSens | |
| Attention! There may also be other versions of sensors, e.g. with a MIL connector or with an integrated cable, not described in this manual (then refer to the instructions for the given type of sensor) | | |

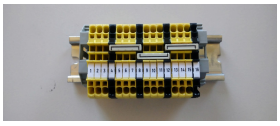
Accessories

| | Name | Type/Designation/ Manufacturer | Photo |
|---|---|---|---|
| 1 | Threaded stud M6 for mounting the sensor (to be screwed into a hole in the machine or prepared screw) | 191.01-06-06-1/VibraSens |   |
| 2 | Mounting pad for sensor with M6 thread (glued to machine housing, housing bearing housing) | 204.01-06-22/VibraSens |   AA - M6x1 BB - 22 mm D - 3mm F - 4,3 mm |

| | Name | Type/Designation/ Manufacturer | Photo |
|---|---|---|---|
| 3 | Surface remover | Loctite 7063/LOCTITE |  |
| 4 | Kit (glue + activator) | Glue: Loctite 330/LOCTITE<br>Activator: Loctite 7388/ LOCTITE |  |
| 5 | Angled M12 connector with black polyurethane cable, 4x0.34mm², shielded, cable end not connected, shield not connected to the plug | • 5m cable: 10.01-A01-E32-31-05<br>• 10m cable : 10.01-A01-E32-31-10 |  |

| | Name | Type/Designation/ Manufacturer | Photo |
|---|---|---|---|
| 6 | Straight M12 connector with black polyurethane cable, 4x0.34mm², shielded, end of cable not connected, shield not connected to the plug | • 5m cable: 10.01-A01-E02-31-05<br>• 10m cable: 10.01-A01-E02-31-10 |  |
| 7 | M12 straight connector (optional) | plastic connector - SAL-12-RKC4-S/150 CONEC |  |
| | | metal connector - SAL-12S-RKC5-S/075 CONEC |  |
| | | plastic connector - SAL-12-RKWC4-S/150 CONEC |  |
| 8 | Shielded cable for data transmission with color coding to DIN 47100, paired wires<br>• 2-wire | Unitronic LiYCY 2x0.5mm² / Lapp Kabel |  |

| | Name | Type/Designation/ Manufacturer | Photo |
|---|---|---|---|
| | • 4-wire | Unitronic LiYCY (TP) 2x2x0.5mm² / Lapp Kabel |  |
| | • 12-wire | Unitronic LiYCY (TP) 6x2x0.5mm² / Lapp Kabel |  |
| 9 | Sleeves (tips) insulated terminal blocks | HI 0.5/6 E08KH Erko/Ergom |  |
| 10 | Heat Shrinkable Tubing | |  |
| 11 | 4-pin connector SDMS-VMS-E module | 4 pieces/Elmodis |   |

| | Name | Type/Designation/ Manufacturer | Photo |
|---|---|---|---|
| 12 | 2-pin connector SDMS-VMS-E module | 1 piece/Elmodis |  |
| 13 | Junction box made of plastic or metal hermetic box with dimensions from 150x110 | |  |
| 14 | Cable glands for junction box | PG9, PG11, PG13 depending on the actual outer diameter of the cable |  |
| 15 | Terminal block for junction box - 2-way connectors | WAGO 2001/2002 |  |

### 7.1.2 Installation of the electrical part

- The vibration sensor can be connected directly to the SDMS-VMS-E module using the original prefabricated cable, which is terminated on one side with a plug matching the sensor (on the vibration sensor side).
- Depending on the vibration sensor, this may be a cable with an M12 plug (plug connected to the vibration sensor). There are also vibration sensors with other connector designs, such as MIL, in which case you must use a prefabricated cable with the appropriate connector.
- The vibration sensor can also be connected by means of a shielded cable laid in the place of installation, after fitting a suitable plug on it, e.g. M12 (or other suitable for the sensor), which will be connected to the vibration sensor (use a 2x2x0.5mm² cable - twisted pairs in the shield).
- If the distance between the SDMS-VMS-E module and the sensor is longer than the length of the prefabricated sensor cable (standard length is 5m, but other designs are available), it is necessary to make the cable yourself - use a plug suitable for the sensor and connect it to a properly made cable (see the description of cable preparation later in this manual).
- If the distance between the vibration sensor and the SDMS-VMS-E module is longer than the length of the prefabricated cable or the cable connected to the sensor, you can also use a patch box equipped with a suitable terminal to connect the prefabricated sensor cable on one side and the cable to the SDMS-VMS-E module on the other side. The same can be done if you want to group cables from up to 4 sensors in one place to run the signals through a single patch cable to the SDMS-VMS-E module.
- The maximum recommended distance for connecting the sensor is 200 meters. If you wish to mount the sensor over a longer distance, please contact Elmodis.

#### Vibration sensors wiring diagram

The figure below shows the wiring diagram for the plugs on the module side (the dot next to the connector indicates terminal No. 1).

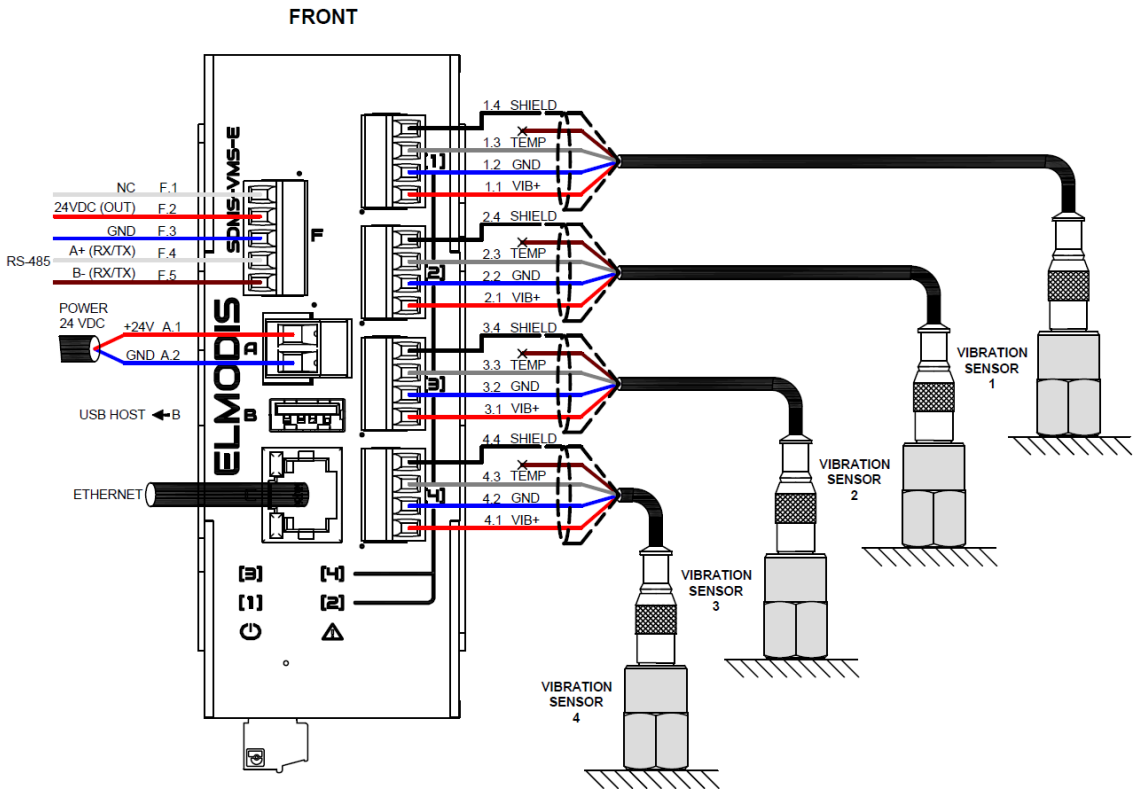



Fig 10. Schematic for connecting the sensor wires to the module plugs.

The following table shows the mechanical parameters of the vibration sensor plugs on the SDMS-VMS-E module side.

| | |
|---|---|
| Cross section of the connection cables | 0.2-1.3 [$mm^2$] (24-16 AWG) |
| Tightening torque | 0.34 Nm (3 Lb-In) |

The following table shows a description of the pins in the sockets/plugs on the SDMS-VMS-E module (connectors: [1], [2], [3], [4]) for connecting the signals from the vibration sensors.

| Connector pin | Marking | Description |
|---|---|---|
| 1 | VIB+ | Vibration signal input |
| 2 | GND | Ground |
| 3 | TEMP | Temperature signal input (0÷1.2 V) |
| 4 | SHIELD | Shield |

## Preparation of a prefabricated cable with open ends (cut end)

- Remove the outer insulation of the cable at a distance of 60 mm.
- Strip the braided shield.
- Cut the brown wire leaving 3 wires (white, blue, black).
- Twist the braided shield and put on the well-fitted heat-shrink jacket, shrink it with the help of e.g. heat gun, torch, hot-air soldering iron or lighter.
- Put on the cable about 30 mm of suitable heat-shrinkable tube, shrink it.
- Put the end sleeves on the cable wires (including the shield), crimp them (make sure the end sleeves have the right diameter and length for the connector and the diameter of the cable wires).

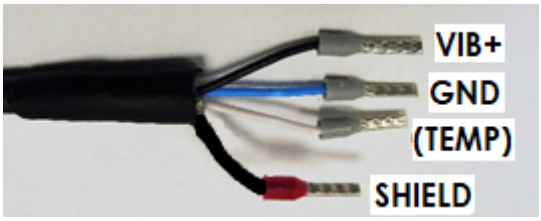



Fig 11. Original sensor cable prepared

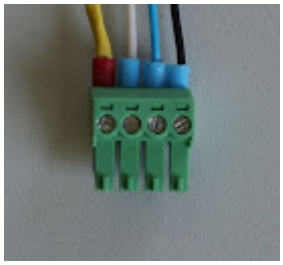


Fig 12. Connecting the original cable to the module plug for direct connection

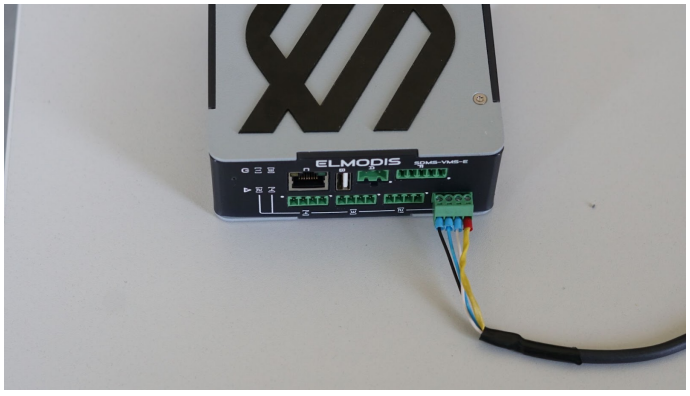



Fig 13. Example connection of sensor directly to the module

## Preparing the cable for connection to the vibration sensor - if not using prefabricated cables

Run a separate signal cable, shielded, with twisted pairs according to DIN47100, to each vibration sensor. Designation of the recommended cable (LAPP Cable):

- UNITRONIC® LiYCY 1x2x0.5mm² (vibration measurement only)
- UNITRONIC® LiYCY (TP) 2x2x0.5mm² (vibration and temperature measurement)

When connecting the conductors to the SDMS-VMS-E module, use the wiring sequence according to DIN47100, i.e:

| Signal | Wire color | Pin number of the SDMS-VMS-E connector | Pin number of the M12 connector |
|---|---|---|---|
| VIB+ | White | 1 | 4 |
| GND | Brown | 2 | 3 |
| TEMP | Green | 3 | 2 |
| - | Yellow | Do not connect/cut | |
| SHIELD | - | 4 | Do not connect |

### Preparation of the cable on the module side

- Remove the outer insulation of the cable at a distance of 40 mm.
- Strip the braided shield.
- If using 4-wire cable, cut off the fourth wire.
- Twist the braided shield and place the heat shrink tubing over the braided shield, shrink it with a heat gun, hot air soldering iron or lighter.
- Draw the heat-shrink sleeve over the cable and shrink it to 30 mm.
- Put the end sleeves on the wires (including the shield), crimp them (make sure the end sleeves have the right diameter and length for the connectors and wires diameter).

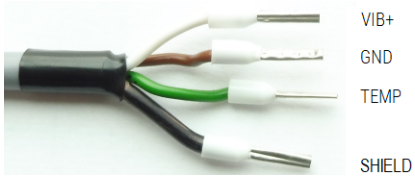



Fig 14. Prepared cable

### Connection preparation on the M12 connector side

The vibration sensor is connected using an M12 IEC60947-5-2 type plug (or other - depending on the sensor version).


Fig 15. Pin layout on M12 IEC60947-5-2 type connector in the sensor

Preparing the cable for the plug:

- Place the cable gland, nut, and plug housing on the cable.
- Remove the outer insulation of the cable over a distance of 30 mm.
- Cut the shield.
- If you are using a 4-wire cable, cut the yellow wire.
- Place the shrinking sleeve over the 30 mm length of the cable and shrink it so that the cut shield does not come into contact with the connector.
- Put the crimp end sleeves (suitable for the wire diameter and terminals in the plug) on the wires of the cable, and crimp them.
- Screw the wires to the corresponding pins according to the table at the beginning of the chapter (according to the sensor/connector type).

Fig 16. View of connector before twisting

## Verification

### Verification of site and installation environment

Before installing the sensor, visually verify that the installation site is not located near equipment that may generate electrical and magnetic interference. Check that the machine on which the sensor is mounted is properly grounded.

### Verification of cable and connections

Before laying the cable on the object with the plugs installed:

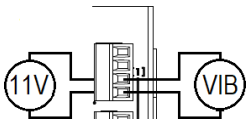
- Check for short circuits (between conductors and to shield - all combinations).
- Check continuity of conductors and shield.
- If necessary, use an insulation resistance tester.

After the cable has been laid, repeat the above steps to check if the cable has not been damaged during installation.

### Verification of the correct state of the inputs based on the module's LEDs indication

If the cable to the sensor is correct, the sensor is operational and the input of the SDMS-VMS-E measuring module is configured, the green LED on the module's front panel (at markings [1] - [4]) will light up (it may possibly blink if measurements are currently being performed on the channel).

| | | | |
|---|---|---|---|
| [ 1 ] |  | Status of the vibration measurement of the 1st channel | (flashes 0.5 s) - collecting vibration measurements<br>(on) - sensor connected correctly, in standby state |

| Measurements | Requirements | Connection diagram | Result |
|---|---|---|---|
| Voltage measurement on module terminals | Sensor connected |  | Measured voltage 10-12VDC |

In this situation the measured voltage (on terminals 1-2 of the plug) is in the range of 10-12VDC - the sensor is physically connected to the module - correct situation.

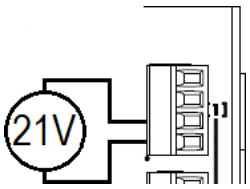
Troubleshotting based on the LED signaling of the module and the measurement of voltages at the module inputs

Problem: Vibration sensor connected (module indicates no sensor)

| | | | |
|---|---|---|---|
| [ 1 ] |  | Status of the vibration measurement of the 1st channel | (on ) - no vibration sensor or open sensor measuring circuit |

If this happens:

- Check the wiring of the 4-pin module plug.
- Check the connection of the plug to the vibration sensor.
- Measure voltage on terminals (1-2) of the 4-pin connector of the respective channel on the SDMS-VMS-E module (as shown in the diagram below).

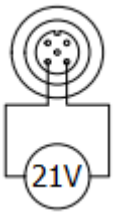
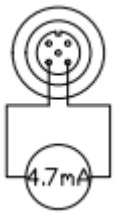
| Measurements | Requirements | Conection diagram | Result |
|---|---|---|---|
| Voltage measurement on module terminals | Sensor disconnected |  | Measured voltage 20-22VDC |

If the measured voltage on terminals (1-2) of the module 4-pin connector is in the range of 20-22VDC, it means that the sensor is **disconnected** or there is a **break** in the measuring circuit caused by the fact that:

- The measurement cable is faulty.
- Wrong connection of the leads in the plug for the vibration sensor.
- The connector to the vibration sensor is not screwed on firmly.
- The vibration sensor is defective.

Accordingly, you should:

1. Check the continuity of the measuring circuit by disconnecting the 4-pin plug from the given channel on the SDMS-VMS-E module and disconnecting the connector from the sensor - check the continuity of individual wires between the module's 4-pin plug and the sensor connector with a meter.
2. If the continuity of the wires is correct, connect the 4-pin connector to the SDMS-VMS-E module and take the measurements according to the table below.

| Measurements | Requirements | Connection diagram | Result |
|---|---|---|---|
| Voltage measurement in M12 connector (pins 3 and 4) | Cable connected to SDMS-VMS-E module |  | Measured voltage 20-22 VDC |
| Current measurement in M12 connector (pins 3 and 4) | Cable connected to SDMS-VMS-E module |  | Measured current approx. 4.7 mA |

If, after measuring voltages and currents (according to what is shown in the table above) and after tightening the cable plug to the vibration sensor, there are no green diodes on the module for a given channel but the red one is on - this may suggest that the vibration sensor is damaged.

**Problem: Shorted vibration sensor**

If the vibration sensor connected to the module is short-circuited, the module signals the input short-circuit status by blinking the red LED at the corresponding input of the SDMS-VMS-E module.

| | | | |
|---|---|---|---|
| [ 1 ] |  | Status of the vibration measurement of the 1st channel | (flashes 0.5 s) - shorted vibration sensor measuring circuit (SHORT)/ sensor defective |

Therefore, you should:
Check the measuring circuit by unplugging the 4-pin plug from the respective channel on the SDMS-VMS-E module and disconnecting the plug on the sensor - check the individual wires between each other with a meter. If after checking it turns out that the measuring cable is good (there are no short circuits between the wires) connect the 4-pin plug to the SDMS-VMS-E module and the connector to the vibration sensor - if a short circuit is still indicated on the module, the vibration sensor is probably defective and should be replaced.

**Problem: No temperature indication (for sensors with temperature output)**

If the vibration sensor is connected to the input of the SDMS-VMS-E module and the correct operation is indicated on the module by the green LED lighting up/blinking (as shown in the table below)

| | | | |
|---|---|---|---|
| [ 1 ] |  | Status of the vibration measurement of the 1st channel | • (flashes 0.5 s, irregularly) - collecting vibration measurements<br>• (on) - sensor connected correctly, in stand-by mode |

and still there are no temperature measurements then you should measure the voltage between terminals 2-3 of the plug on the SDMS-VMS-E module of the given channel. The voltage value between terminals 2-3 is directly proportional to the temperature that the vibration sensor measures - the factor 10 mV/°C gives us, for example, 200mV on the terminals at 20°C and 300mV at 30°C.

## 7.2 Phase marker input

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.

### 7.2.1 Parameters

| | |
|---|---|
| Sensor supply voltage | 20V DC - 24V DC |
| Maximum sensor supply current | 25mA |
| Supported sensor configuration | NPN<br>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) |

### 7.2.2 Connection and installation

The table shows the description of the phase marker pins on the D connector.

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

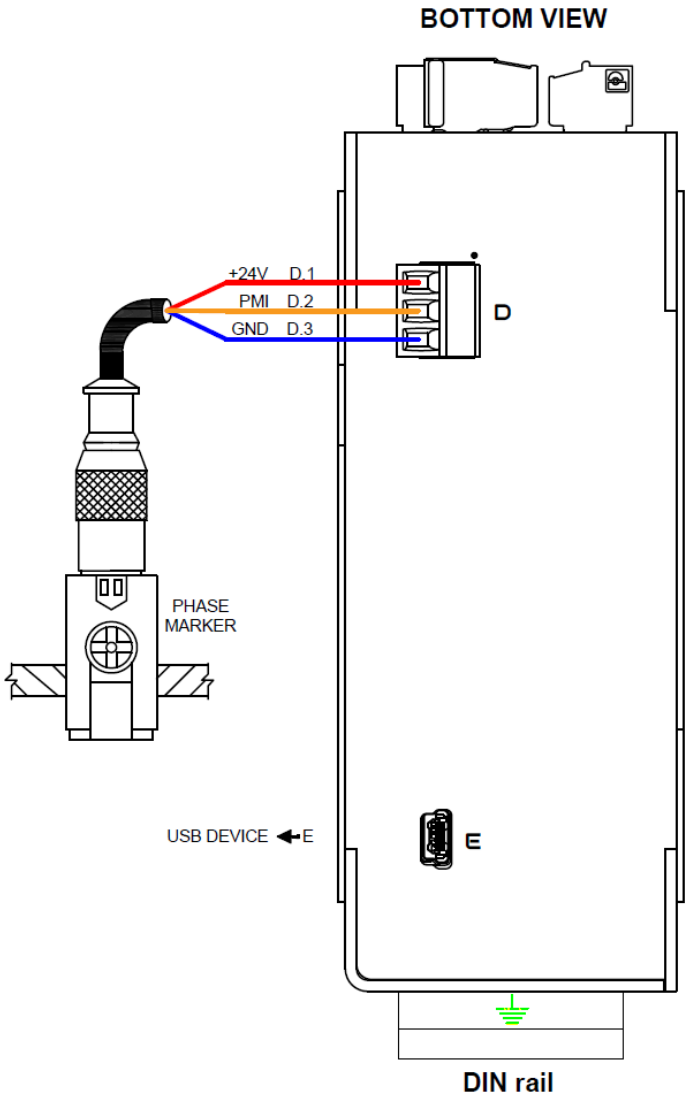



Fig 17. Connecting the phase marker to the D connector of the module

## Electrical installation of sensors

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

- 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).

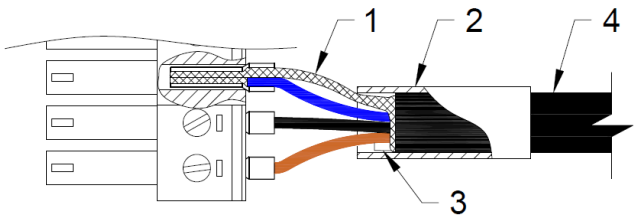



Fig 18. Mating the plug for the inductive sensor

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)

- 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.

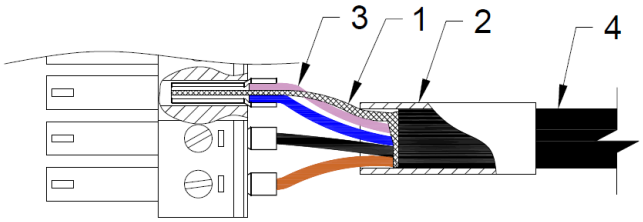



Fig 19. Mating the plug for the optical sensor

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

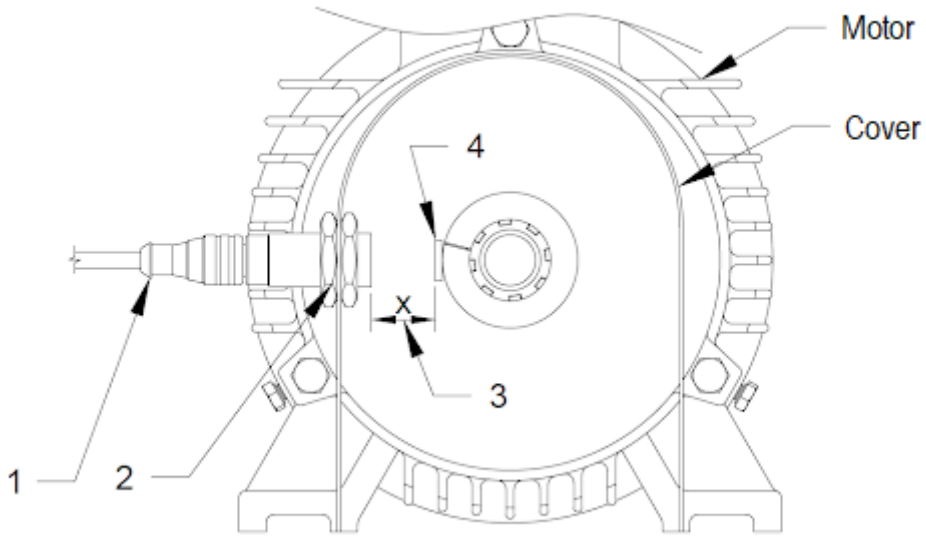



Fig 20. Mounting the inductive sensor

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

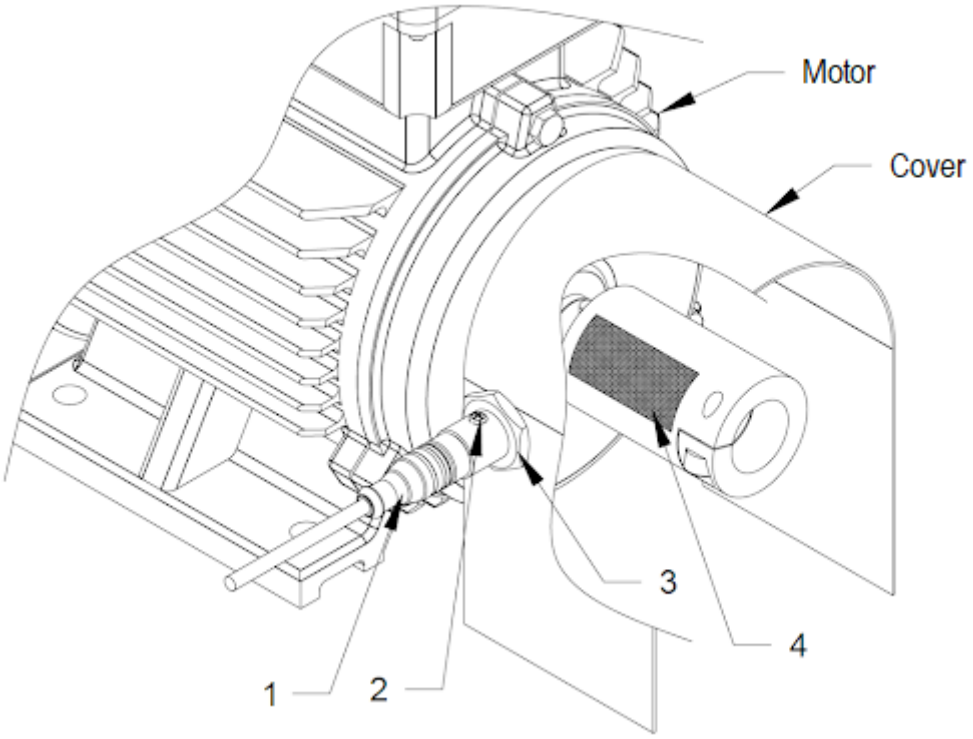



Fig 21. Mounting the optical sensor

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.

### 7.2.3 Connecting the Phase Marker Output from SDMS-MMS-E

It is possible to further transfer the phase marker signal from the SDMS-MMS-E device to the SDMS-VMS-E device as shown in the figure below.

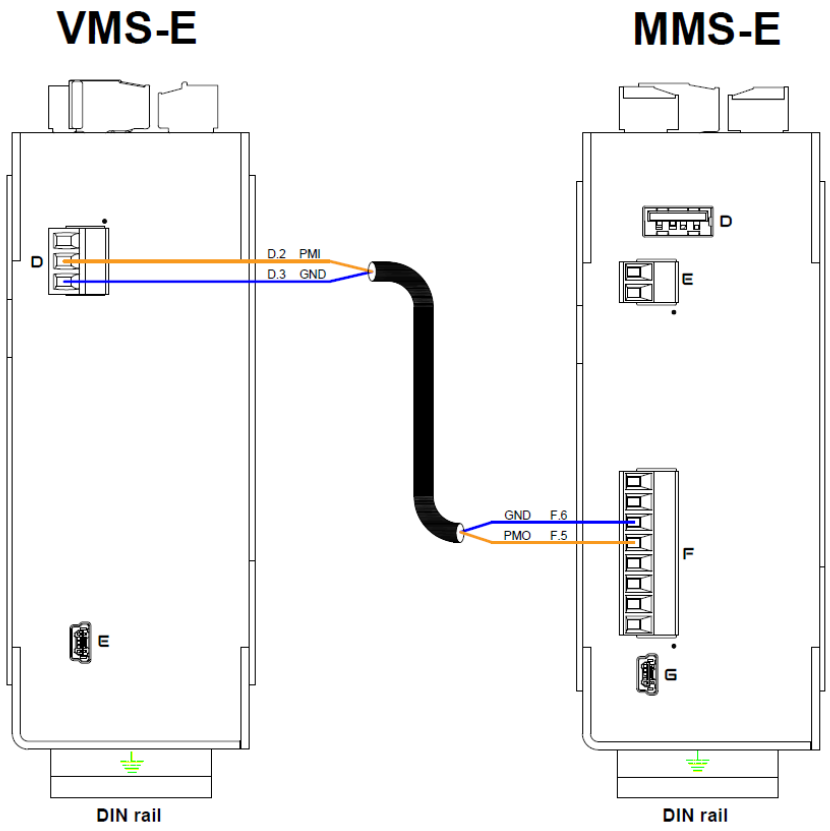



Fig 22. SDMS-MMS-E connection with SDMS-VMS-E

Transmission of the phase marker signal between devices shall be carried out with a two-core cable with a cross-section of min 0.34 $mm^2$.