OPERATING MANUAL


# DEEneo-ISC-IP68 | Digital Inline Signal Conditioner for inductive sensors (LVDT)

eddylab

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# 1 Safety

This manual is valid for DEEneo-ISC-IP68 electronics. It contains information on functionality, installation, operation and maintenance.

Read the operating instructions carefully before putting the device into operation. Observe the following safety instructions.

## 1.1 Safety instructions

The following symbols are used in this document:

Indicates a dangerous situation that could lead to personal injury or damage to the appliance.

Indicates an important note or user tip.

## 1.2 CE-marking

All products with a CE marking meet the requirements of the listed EU directives and the applicable harmonized standards (EN). The EU Declaration of Conformity and the technical documentation are kept at the disposal of the competent authorities.

The following EU directives apply to DEEneo-ISC electronics:

| Directive | Description |
|---|---|
| 2014/30/EU | EMC-directive: electromagnetic compatibility |
| 2012/19/EU | WEEE-directive: waste of electrical and electronic equipment |
| 2011/65/EU | RoHS-directive: Restriction of Hazardous Substances |

## 1.3 Intended use

DEEneo-ISC is designed for use in industrial applications and is used to operate inductive sensors based on the LVDT principle, so-called linear variable differential transformers.

The electronics may only be operated within the values specified in the technical data. Modifications to the device are not permitted.

## 1.4 Intended environment

DEEneo-ISC-IP68 electronics is designed for installation in the sensor connection cable. When laying the cable, ensure that the following limit values for storage and operation are not exceeded.

| Condition | |
|---|---|
| Operating temperature | -40…+85 °C |
| Storage temperature | -40…+85 °C |
| Humidity | 5…100 % |
| Shock | 30 g / 11 ms |
| Vibration | 1 g |
| Protection class | IP68 / 10 bar |

# 2 Introduction

## 2.1 Functional principle

DEEneo-ISC-IP68 electronics is a digital measuring amplifier for operating inductive sensors according to the LVDT principle. It is integrated into the sensor connection cable as so-called cable electronics (inline signal conditioner) and has a specially sealed, milled housing made of anodized, seawater-resistant aluminum. This achieves a protection class IP68 for permanent use in water depths of up to 100 m (10 bar).

The electronics supply the connected sensor with an alternating current of constant frequency and amplitude. These values can be set individually by the user for the best possible performance. A teach button is available for convenient parameterization. To determine the sensor position, the secondary coils are evaluated differentially and output as an analog signal. The internal, ratiometric signal processing is digital and guarantees high resolution and immunity to external influences (EMC).

Frequency and amplitude of the sensor supply can also be set using the eddySetup configuration software for optimum performance of the measuring chain. A push button (SET button) is used for basic configuration and for setting the measuring range limits - this enables quick and easy adaptation to the customer's application. Extended functions can be configured as required via the USB interface. Compensation of the sensor's phase shift is no longer necessary thanks to the intelligent signal processing.

DEEneo-ISC-IP68 supports the operation of nearly all commercially available LVDT sensors. The use of eddylab LVDT sensors is recommended, as the electronics and cabling are optimally matched to them. To connect third-party devices, please contact eddylab at sales@eddylab.de.

In principle, every sensor manufactured by eddylab is adjusted and calibrated together with the electronics. You receive a traceably calibrated measuring chain, adjusted and tested in our calibration laboratory, as well as proof in the form of a calibration certificate. Please note that the sensor, cable and electronics always form a measuring chain. If a component is replaced or modified, the measuring system should be recalibrated.

The sensor can be connected to DEEneo-ISC-IP68 in a variety of ways:

Sensor side:

1. connection cable with female M12 connector in the direction of the sensor (for sensors with M12 connector output)
2. connection cable permanently connected to sensor (see illustration below)

Output side:

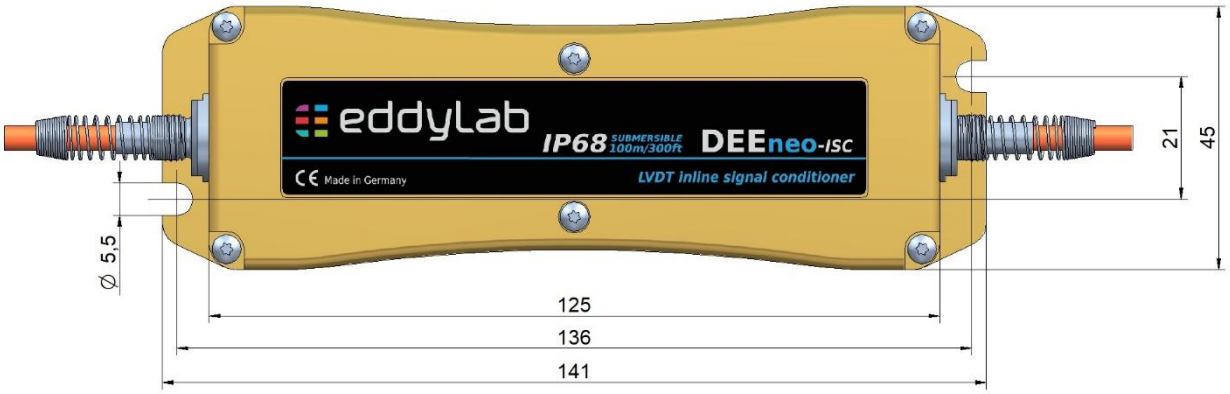
1. cable 1 m with open strands and wire end ferrules (see illustration below)

Example: Sensor with fixed cable output. DEEneo-ISC-IP68 is integrated in sensor connection cable. 1 m cable with open strands on connection side.

## 2.2 Technical data

| Model | DEEneo-ISC-IP68 |
|---|---|
| Output signal | 0...20 mA, 4...20 mA, ±20 mA (load < 500 Ohm), 0...5 V, ± 5 V; 0...10 V, ± 10 V (load > 150 Ohm) |
| Power supply | 9...36 VDC |
| Power consumption | 70 mA at 24 VDC, 130 mA at 12 VDC |
| Sensor supply | standard: 3V / 3,3 kHz, can be modified by software |
| Settings | frequency, amplitude, output signal |
| Resolution | 16 bit |
| Signal processing | digital via microcontroller |
| Signal adjustment | via SET-button or software |
| Filter corner frequency | hardware filter 270 Hz (40 dB/decade), software filter adjustable 20 dB/decade |
| Linearisation of sensor | yes, optionally possible |
| Isolation voltage | > 500 VDC |
| Reverse polarity protection | yes |
| Overvoltage protection | output: bipolar suppressor diode 16 V / permanent overvoltage up to 24 V |
| | input: bipolar suppressor diode 36 V / Polyfuse 0.5 A |
| | on sensor side: 12 V |
| Cable break detection | yes |
| Protection class | IP68 / 10 bar |
| Operating temperature | -40...+85 °C |
| Storage temperature | -40...+85 °C |
| EMC | EN IEC 61326-1:2021 |
| Mounting | bore ø5.5 mm |
| Dimensions | 141 x 45 x 24 mm |

## 2.3 Dimensions

# 3 Delivery

## 3.1 Scope of delivery

Check the delivery immediately after unpacking for completeness and transport damage. In the event of damage or incompleteness, please contact eddylab or your supplier immediately.

| Scope of delivery | Quantity |
|---|---|
| Signal conditioner DEEneo-ISC-IP68 | 1 |
| Test report or calibration certificate | 1 |
| Assembly instructions | 1 |

## 3.2 Storage

The following table lists the permissible ambient conditions for storage:

| Ambient conditions | |
|---|---|
| 1. | Dry and dust-free |
| 2. | Avoid shocks and impacts. |
| 3. | Storage temperature: -40...+85 °C |
| 4. | Humidity: 5...95 %, non-condensing |

# 4 Installation / Mounting

**Note**

Connection, installation and start-up may only be carried out by qualified personnel.

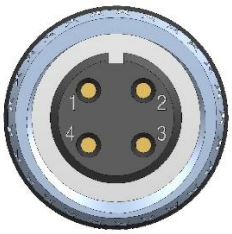
## 4.1 Mounting

Mount the DEEneo-ISC on a flat surface in an environment protected from temperature. The housing has 2 mounting holes with ø5.5 mm. When mounting, ensure that no tension or torsion is exerted on the cable.

## 4.2 Connections / Assignment

DEEneo-ISC is designed for the operation of eddylab LVDT sensors with fixed cable output or 4-pin, male M12 connector output. Operation of nearly all commercially available LVDT sensors is also possible. Please contact eddylab for the connection of sensors from other manufacturers at sales@eddylab.de.

DEEneo-ISC is integrated into the sensor connection cable. If the sensor has an M12 connector output, variants with M12 connection cables are available. The appropriate, female M12 connector is located on the sensor side. A cable with open strands is available for the connection side.

| Sensor side | | | Connection side | | |
|---|---|---|---|---|---|
| Function | M12 connector, female (Pin) | | Function | Wire colour eddylab-cable | |
| | | | | TPE | PTFE-UL |
| Primary + | 2 |  | V + | brown | yellow |
| Primary - | 1 | | GND | Blue | brown |
| Secondary 1 | 3 | | Signal | white | white |
| Secondary 2 | 4 | | Signal GND | black | green |



eddylab offers customized solutions for sensor variants from other manufacturers with 5/6-pole connectors/cables. In this case, please contact eddylab at sales@eddylab.de. The following information must be provided:

- Sensors with cable output: number of wires, cable diameter, wire cross-section, assignment
- Sensors with connector output: connector type, number of poles, size, assignment

# 5 Operation

Before starting a measurement or setting, allow the electronics to warm up for at least 5 minutes with the supply voltage switched on.

**Note: If the sensor and electronics are ordered together, eddylab will calibrate the devices to each other. You will receive a plug-and-play ready-to-use measuring system. No further adjustment is required.** Please refer to the enclosed calibration certificate for the assignment. If a component is replaced, the output signal must be recalibrated.

## 5.1 Start-up

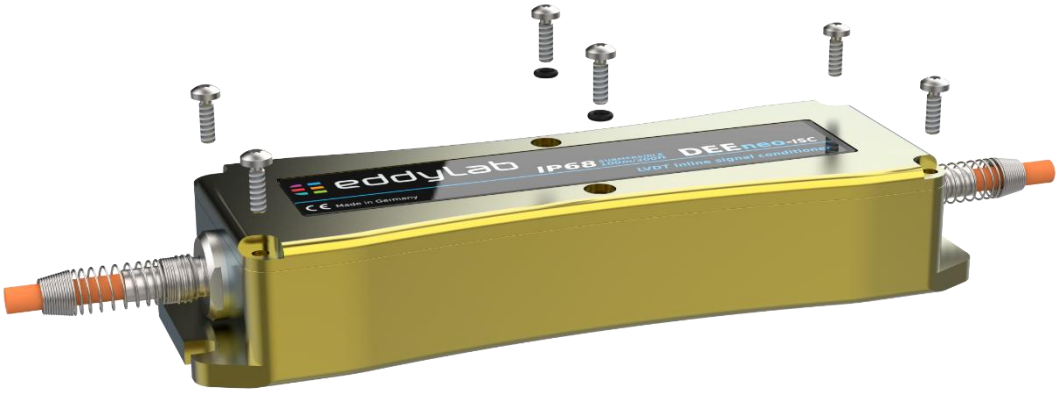
Failure to observe the following instructions may result in damage or failure of the device!

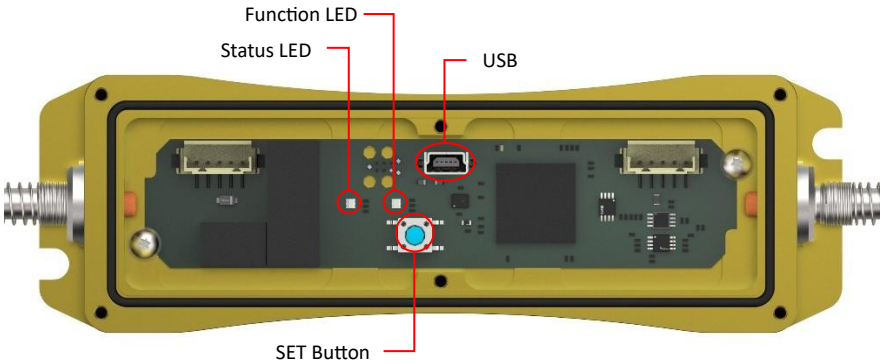
Check that all connections are wired correctly before connecting the electronics to the power supply. Then switch on the supply voltage.

## 5.2 Display and control elements

For reasons of tightness, all display and operating elements are located inside the housing and are not visible or accessible from the outside.

To gain access to the SET button, the cover of the electronics housing must be removed. To do this, the 6 screws (TX 8) must be removed. The cover can now be lifted upwards. Please note that the middle screws are sealed with two O-rings. These must be reinstalled during assembly to ensure tightness. Please also ensure that the circumferential O-ring is correctly seated in the groove.




| Button / LED | Function | Description |
|---|---|---|
| Teach Button „SET“ | Menu navigation, confirmation | The SET button is used to start the menu, to navigate within the menu and to confirm. |
| LED Function | Function display | Blue during startup process |
| | | Green during normal operation |
| | | Yellow when measuring range is exceeded. |
| | | Red in the event of an error (defective sensor, sensor cable or sensor not connected) |
| LED Status | Status and operating display | Standard OFF |
| | | e.g. yellow (set start of measuring range) |
| | | For more colors, see 5.4.1 |
| | | LED flashes in the respective color as confirmation. |
| USB Port | Data connection | A connection to a PC can be established using a USB cable (USB mini B plug). |

## 5.3 Factory Setting

The following configuration is set at the factory:

- Sensor supply: 3 $V_{RMS}$ / 3.3 kHz
- Output signal: see article designation, e.g. DEEneo-ISC-IP68-10V for 0...10 V

The preconfigured sensor supply is suitable for many inductive sensors. Please adhere to the recommended values in the data sheet of the connected sensor. The sensor supply can be changed using the eddySetup software.

## 5.4 Configuration / setting via SET button

The following section explains the settings using the SET button. This can be used to configure the following parameters:

- Teaching of measuring range: Set start of measuring range ($MB_A$)
- Teaching of measuring range: Set end of measuring range ($MB_E$)
- Invert signal direction
- Factory reset: Restore factory settings

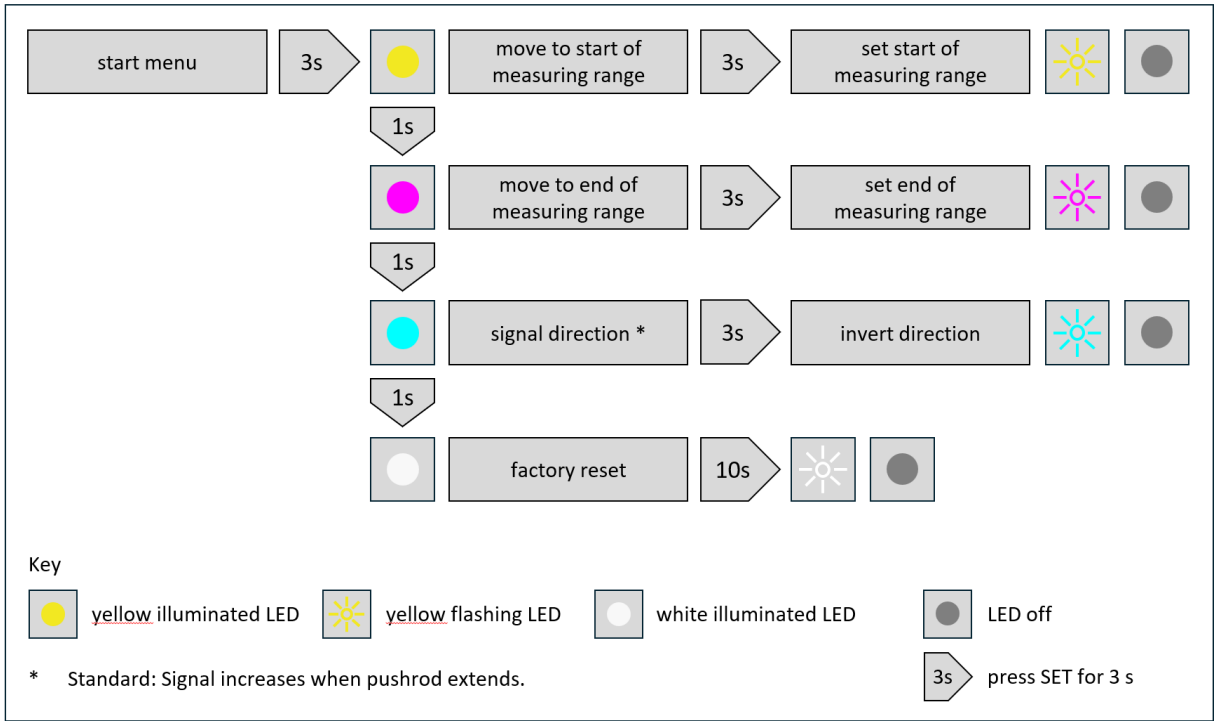
Other parameters are set using the eddySetup software. Please see chapter 6.

### 5.4.1 Menu structure

Start the configuration mode: Press the SET button for 3 seconds. The controller jumps to the first menu item “Start measuring range” and signals this with a yellow illuminated STATUS LED.

Navigation within the menu: The next menu item is selected by briefly pressing SET (approx. 1s). The controller indicates this with a colored STATUS LED.

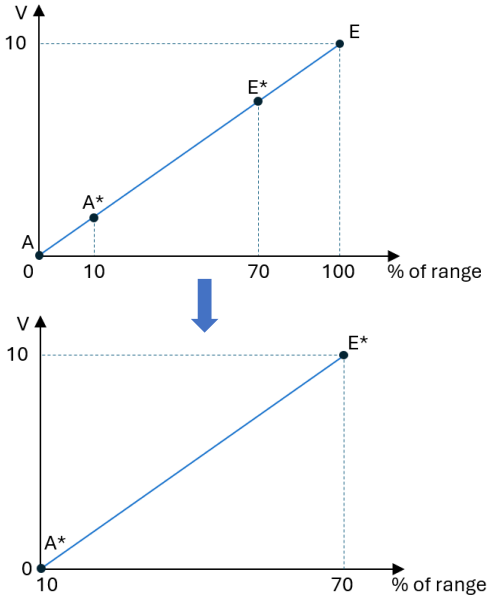
Confirming a setting: Press the SET button for 3 seconds to confirm the desired setting and the LED flashes briefly. The menu is then exited automatically, and the STATUS LED goes out. If a further setting is to be made, the menu must be started again.



### 5.4.2 Adjustment of output signal

- Please note that this step is not necessary if you have received a calibrated measuring system. You can recognize this by the calibration certificate supplied, which lists the type and serial number of the sensor and associated electronics.
- When connecting a third-party device, a new device without calibration or when subsequently replacing the sensor and/or electronics, the start and end values must be saved.

To put an uncalibrated LVDT into operation, the start and end values of the measuring range must be read in. In the first step, the start value A of the sensor measuring range is approached and confirmed by pressing the SET button. In the second step, the end value E of the measuring range must be approached and confirmed by pressing the SET button. The sensor now operates in its measuring range of 0...100 %.




Teaching a desired measuring range:

DEEneo-ISC also offers a convenient option for using any other points A* and B* to set the output signal. Here, any two points (A*, E*) within the sensor measuring range are approached and each confirmed by pressing the SET button and thus saved. The first value approached is defined as the start of the measuring range (A*). For 0...10 V output signal, this is 0 V. The second value represents the end of the measuring range. The output signal is scaled to the desired range.

In the illustrations on the right, the output signal is scaled from 0...10 V to a reduced measuring range of 10...70 % of the nominal sensor measuring range (0...100 %).

Please do not teach in a measuring range smaller than 10 % of the nominal measuring range of the connected sensor. The noise of the output signal would increase significantly.

**Example:**

1. Press and hold the SET button for 3 seconds until the STATUS LED lights up yellow to access the first item in the configuration menu.
2. Move to the start of the measuring range of the sensor and then confirm by pressing the SET button for approx. 3 seconds. The controller confirms that the position has been saved with a yellow flashing LED. The menu is then closed automatically, and the STATUS LED goes out.
3. To set the second point (end of measuring range), press the SET button again for 3 seconds to access the menu. The LED lights up yellow again.
4. Press SET once briefly for approx. 1 second to move to the next menu item. The LED color changes to magenta.
5. Move to the end of the measuring range of the sensor (E*) and confirm here too by pressing the SET button for 3 seconds. The LED flashes magenta as confirmation before the LED goes out.
6. The output signal is now scaled to the desired measuring range (A*-E*). The DEEneo automatically returns from setting mode to operating mode.

### 5.4.3 Changing the signal direction

By default, the output signal increases when the pushrod extends from the sensor housing. If an inverted signal is required, you can implement this as follows:

- Option 1: Swap the start and end of the measuring range during the teaching process.
- Option 2: Select “Invert signal direction” in the next menu item.

### 5.4.4 Factory Reset

If you want to reset the settings to the values mentioned in chapter 5.3, please follow these instructions.

Select “Factory Reset” in the menu and confirm this by pressing and holding the SET button for 10 seconds. A successful reset is indicated by a white flashing LED.

Note: User-defined measuring range limits are deleted and must be taught in again if necessary. If the electronics has an inactive, saved linearization (Enable Sensor Linearization = false), this is reactivated during a factory reset.

## 5.5 Configuration / setting via eddySetup software

The following values can be set using the eddySetup software:

| Overview of settings | | |
|---|---|---|
| Setting | Value | Description |
| Enable Sensor Linearisation | True / False | eddylab performs a linearization of the sensor characteristic curve as part of the calibration of a sensor and a DEEneo-ISC. This can either be selected (True) or deselected (False). |
| Output Range Voltage [V] | -10 …. +10 | Defines the desired range of the voltage output (e.g. 0...10 V). |
| Output Range Current [mA] | -22 … 22 | Defines the desired range of the current output (e.g. 4...20 mA). |
| Carrier amplitude [V] | max. 7,07 $V_{RMS}$ | Sensor supply voltage (standard 3 $V_{RMS}$) |
| Carreir frequency [Hz] | 100-10000 Hz | Carrier/supply frequency (standard 3,3 kHz) |
| Current Output | True / False | Defines whether the current output (e.g. 4...20 mA) should be activated (True). The voltage output will be deactivated. |
| Filter Frequency [factor of carrier frequency], digital | 1 / 0.2 / 0.1 / 0.01 / 0.001 / 0.0001 | Defines the filter cut-off frequency depending on the carrier frequency. E.g: carrier frequency 3300 Hz, Filter 0.1 ⇨ cut off frequency 330 Hz |
| Enable Alarm | True / False | Activates (True) or deactivates (False) the red FUNCTION LED. |
| Alarm Threshold | 50 | Defines the threshold below which the alarm output (cable break detection) becomes active. |

### 5.5.1 Sensor supply

The preconfigured sensor supply ($3V_{RMS}$ / 3.3 kHz) is suitable for most inductive sensors. Please refer to the recommended values in the data sheet of the connected sensor. An incorrectly selected supply can lead to a lower sensitivity and a higher linearity deviation!

**Amplitude:** Level of the supply voltage (AC)

Please enter the desired value for the excitation voltage in $V_{RMS}$. Use the information given in the sensor data sheet as a guide. In the following table, usual values are converted from $V_{P-P}$ to $V_{RMS}$.

| $V_{P-P}$ | $V_{RMS}$ |
|---|---|
| 3,00 | 1,06 |
| 4,25 | 1,50 |
| 5,75 | 2,00 |
| 7,00 | 2,47 |
| 8,50 | 3,00 |
| 14,25 | 5,04 |
| 20,00 | 7,07 |

**Carrier frequency:** Frequency of the supply voltage (Hz)

### 5.5.2 Output signal

In the selection menu “Current Output”, you can specify whether the electronics should output a current signal (e.g. 4...20 mA). If it is set to “False”, the DEEneo outputs a voltage signal (e.g. 0...10 V).

The limits for voltage and current output can be set via the “Output Range” fields. For example, a signal ±5 V or 0.5...4.5 V can be generated.

### 5.5.3 Filter cut-off / corner frequency

The filter cut-off frequency can be set as a proportion of the carrier frequency (for sensor supply) in the following steps: 1 / 0.2 / 0.1 / 0.01 / 0.001 / 0.0001.

- Please note that the filter cut-off frequency should not be more than 20 % of the carrier frequency.
- Select the filter cut-off frequency as low as possible to achieve a high resolution.
- For dynamic applications, make sure to select a correspondingly high filter cut-off frequency.

### 5.5.4 Linearization

Eddylab optionally performs a linearization of the sensor characteristic curve as part of the calibration of a sensor and a DEEneo. The native linearity deviation of the sensor is corrected using 50 ideal measured values from a reference measuring system. This can either be selected (True) or deselected (False).

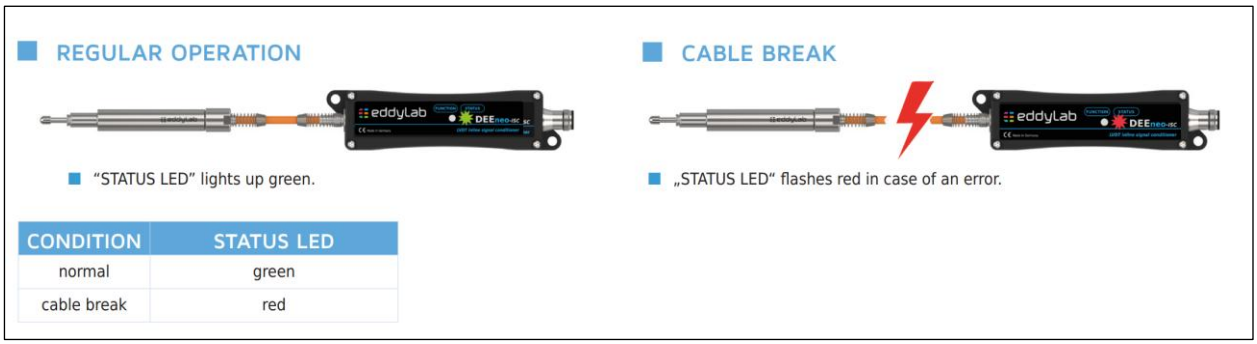
Please note:

- When linearization is activated, no adjustment can be made to the frequency and amplitude of the sensor supply. If this is desired, linearization must be set to “False”.
- The linearization remains valid even if the signal direction is inverted.
- The measuring range can be taught when linearization is activated. Linearization remains valid.

### 5.5.5 Cable break detection

The DEEneo-ISC electronics has an integrated cable break detection based on an impedance measurement of the LVDT's primary coil. If the sensor cable is cut, the impedance at the electronics changes independently of the core position and the cable break detection is triggered. This requires the connections of the primary coil of the sensor to be severed. A partial break only of the connections to the secondary coils does not activate this function.

The alarm output is also activated if the sensor cable is not connected, or the sensor itself (primary winding) is defective.




| CONDITION | STATUS LED |
|---|---|
| normal | green |
| cable break | red |

It may be necessary to reduce the sensitivity of the cable break detection if there is a high EMC load. Under certain circumstances, external faults can trigger an unintentional false alarm. This can also occur when operating third party devices on the DEEneo-ISC. In such cases, adjust the “Alarm Threshold” value. If desired, you can also completely deactivate cable break monitoring. To do this, set the “Enable Alarm” field to False.

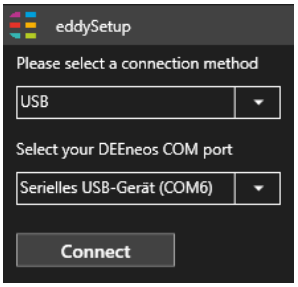
# 6 Software eddySetup

## 6.1 Installation

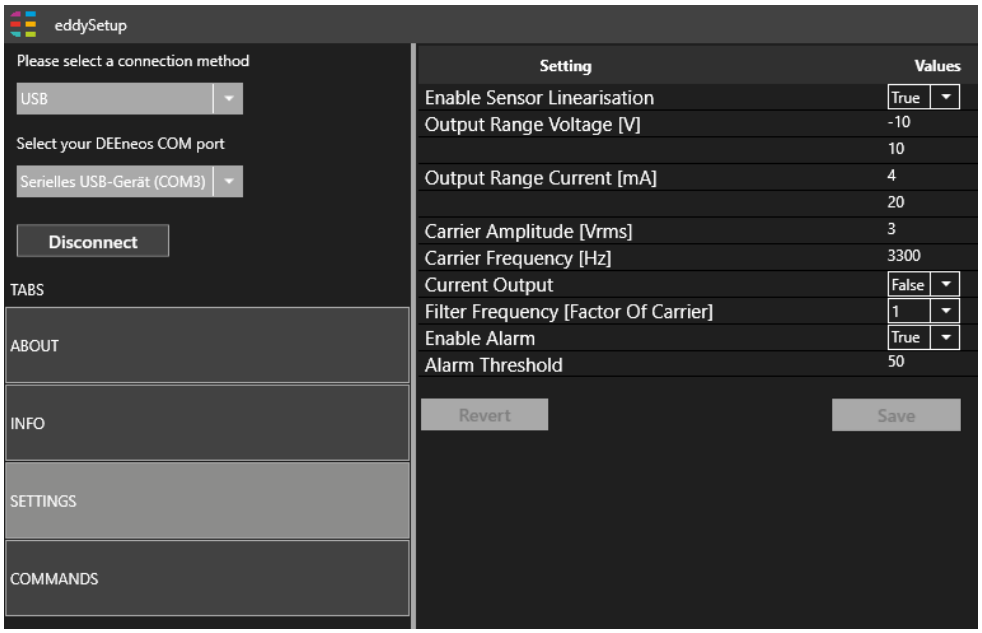
Download the software at https://www.eddylab.com/. You can easily execute the file. A separate installation is not necessary.

## 6.2 Establishing a connection with the PC

- Connect the electronics to the power supply, if not already done.
- Then connect the controller to the PC using the USB cable.
- Start eddySetup.
- Select USB as the connection method. The COM port is determined automatically.
- Then click on “Connect” to establish the connection.



## 6.3 Overview of functions




### 6.3.1 About

The “About” tab contains the legal information about the eddySETUP software and eddylab GmbH.

### 6.3.2 Info

Here you will find information on electronics:

- Model designation
- Firmware version
- Mac address
- Serial number
- Linearization of sensor characteristic curve by manufacturer

### 6.3.3 Settings

The electronics can be adapted to your requirements in the menu “Settings”. Depending on the field, there are drop-down lists or fields in which values can be freely entered.

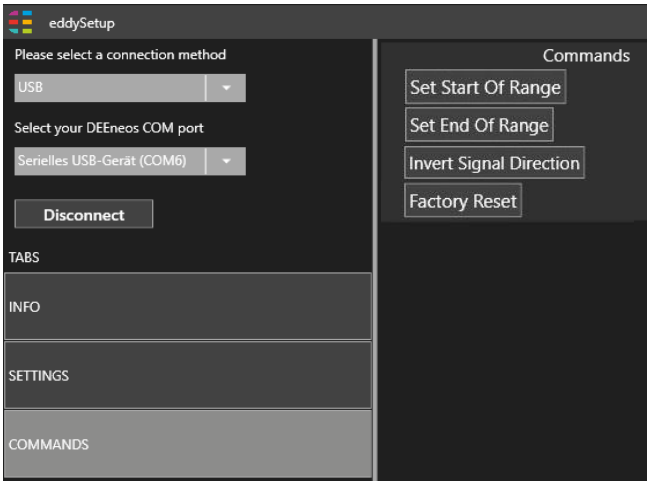
Changed values are highlighted in yellow. “Revert” resets the values to the default setting.

Press “Save” to save the new values and transfer them to the DEEneo-ISC.

### 6.3.4 Commands

You can carry out the following actions via the “Commands” menu item:

- Set Start of Range:
  Set start of measuring range
- Set End of Range:
  Set end of measuring range
- Invert Signal Direction:
  e.g. 0…10 V ⇨ 10…0 V
- Factory Reset: Restore factory settings




# 7 Maintenance, service, repair

The electronics is maintenance-free.

If the electronics or the connected sensor are defective, please send the relevant parts to the following service address for repair or replacement:

eddylab GmbH
Ludwig-Ganghofer-Straße 40
83624 Otterfing
Germany

Please contact service@eddylab.de in advance. You will receive an RMA number.
Alternatively, you can also use our repair form:

https://www.eddylab.com/eddylab/unternehmen/service/eddylab_Repairform.pdf

# 8 Disclaimer

All electronics have been checked and tested by eddylab for perfect function before delivery. However, should defects occur despite careful quality control, they must be reported to eddylab immediately.

The liability for material defects does not apply to natural wear and tear, to damage resulting from incorrect or negligent handling or from use not in accordance with the specifications or contract.

eddylab accepts no liability whatsoever for damage, loss or costs arising from, or in any way connected with, non-observance of these instructions, improper use or improper handling of the product, repairs or modifications by third parties, the use of force or other actions by unqualified personnel on the product, in particular consequential damage.

Repairs are the sole responsibility of eddylab. It is not permitted to make unauthorized changes or modifications to the product. In the interest of further development, eddylab reserves the right to make design changes.

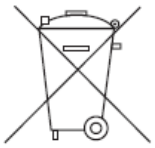
In addition, eddylab's General Terms and Conditions of Sale apply, which can be accessed at eddylab_AGB_EN.pdf

# 9 Decommissioning, disposal

Always dispose of defective appliances in an environmentally friendly manner in accordance with the country-specific regulations and applicable waste disposal regulations. This will prevent the release of environmentally harmful substances and ensure the reuse of valuable raw materials.

Electronics, sensors, accessories and packaging materials must be disposed of in accordance with the country-specific waste treatment and disposal regulations.

Old products marked with a crossed-out waste garbage can must not be disposed of with normal household waste (e.g. residual waste garbage can). They must be disposed of separately. You are also welcome to return old devices to eddylab for disposal.



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