OPERATING MANUAL

DEEneo | Digital Signal Conditioner for inductive sensors (LVDT)

eddylab

Table of contents

1 Safety

This manual is valid for DEEneo 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 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 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 electronics is designed for installation on a DIN rail and is usually mounted in a switch cabinet. Please ensure that the following limit values for storage and operation are not exceeded.

Condition	Electronics
Operating temperature	-40…+85 °C
Storage temperature	-40…+85 °C
Humidity	5…95 % (non-condensing)
Shock	30 g / 11 ms
Vibration	1 g
Protection class	IP40

2 Introduction

2.1 Functional principle

DEEneo electronics is a digital measuring amplifier for operating inductive sensors according to the LVDT principle.

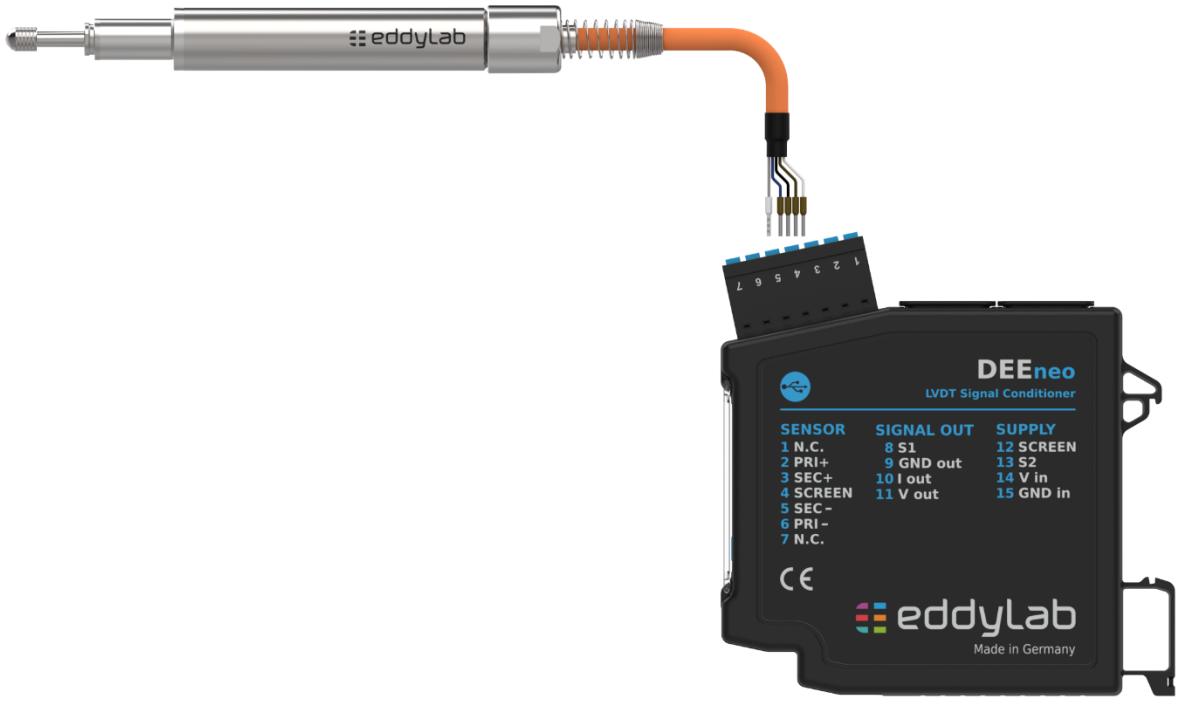
The electronics supply the connected sensor with an alternating current of constant frequency and amplitude. These values can be set individually by the user for the best possible performance. A teach button is available for convenient parameterization. To determine the sensor position, the secondary 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 such as alarm and switching outputs 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 supports the operation of nearly all commercially available LVDT sensors. The use of eddylab LVDT sensors is recommended, as the electronics is 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.

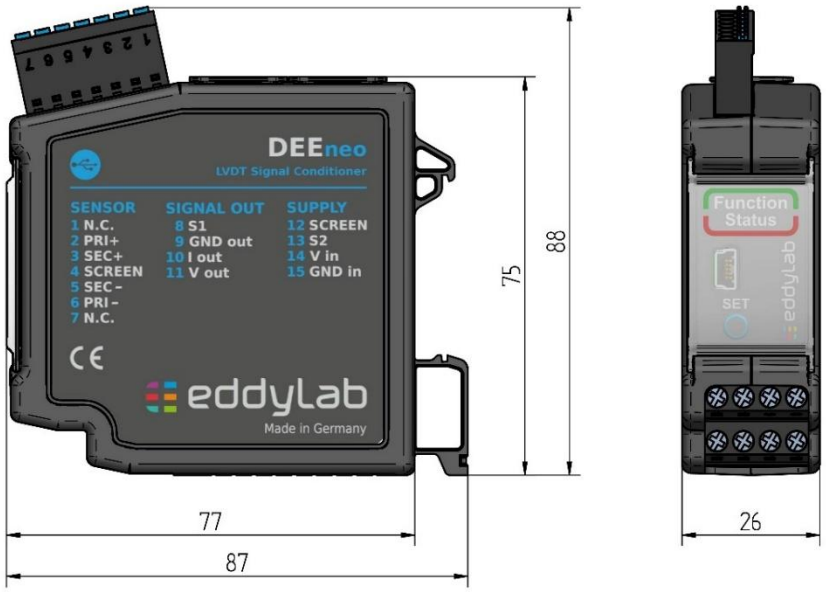
**: The cable can be integrated into the sensor (fixed cable outlet) or be a separate item.*



2.2 Technical data

Model	DEEneo
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, switching point, switching direction
Resolution	16 bit
Signal processing	digital via microcontroller
Signal adjustment	via SET-button or software
Filter corner frequency	digital adjustable, standard 300 Hz
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
Switching output	Open drain up to 60 V, max. 115 mA
Alarm output	Open drain up to 60 V, max. 115 mA
Cable break detection	yes
Operating temperature	-40...+85 °C
Storage temperature	-40...+85 °C
EMC	EN IEC 61326-1:2021
Mounting	on 35 mm DIN rail according to DIN EN 60715
Dimensions	77 x 75 x 26 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 (1)	1
Sensor connector, 7-pin (2)	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 DIN rail mounting

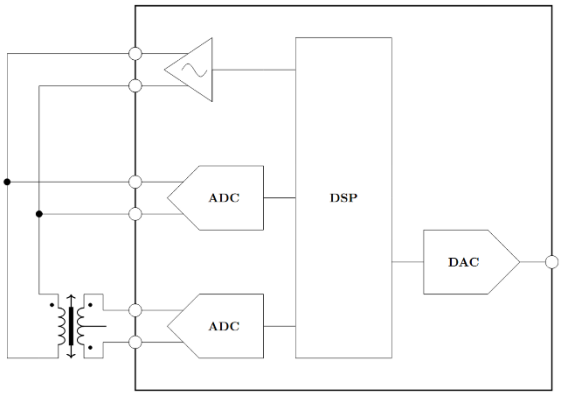
Mounting: Position the DEEneo on a 35 mm DIN rail in accordance with DIN EN 60715 and push it backwards until it clicks into place.

Disassembly: To disassemble, pull the locking mechanism down with a screwdriver, tilt the controller to remove it upwards from the rail.

4.2 Connections / Assignment

The DEEneo is designed to operate all commercially available LVDT sensors.

- LVDT sensors with 4-wire connection cable (e.g. eddylab LVDTs): Please follow the table below or the diagram on the right.
- LVDT sensors with 5-wire connection cable: The center tap (ends of both secondary windings) does not need to be connected. Alternatively, it can also be connected to terminal 1 or 7.
- LVDT sensors with 6-wire connection cable: The ends of both secondary windings (see sensor data sheet) must be connected to each other. These can then be connected to terminal 1 or 7.



ASSIGNMENT					CONNECTION DATA
Clamp	Function	Description	Wire colour eddylab cable		
			TPE	PTFE-UL	
1	n.c.	not connected			• clamp with push-in spring cage • wire cross-section max. 1,5 mm² • length of wire end ferrules min. 8 mm
2	PRI +	primary coil	white	white	
3	SEC +	secondary coil	black	green	
4	SCREEN	screen			
5	SEC -	secondary coil	blue	brown	
6	PRI -	primary coil	brown	yellow	
7	n.c.	not connected			
8	S1	switching output			• screw terminal • wire cross-section max. 2,5 mm² • tightening torque 0,5 Nm
9	GND out	GND signal			
10	I out	signal, e.g. 4...20 mA			
11	V out	signal, e.g. 0...10 V			
12	SCREEN	screen			
13	S2	alarm-/switching output			
14	V in	supply voltage			
15	GND in	GND supply			

Recommended sensor connection cable:

The use of a shielded cable is recommended. The longer the connection cable, the larger the cross-section should be. Twin-twisted pair cables are advantageous for long cable lengths to prevent crosstalk between the wires of primary and secondary coils.

Suitable cables and other accessories for optimum cabling and installation of sensors and electronics can be found at www.eddylab.com/.

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!

Connect the sensor before putting the controller into operation. To do this, follow the assignment described in section 4.2 and the information in the sensor data sheet.

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

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	Blue during startup process
		Green	Green during normal operation
		Yellow	Yellow when measuring range is exceeded.
		Red	Red in the event of an error (defective sensor, sensor cable or sensor not connected)
LED Status	Status and operating display	White	Standard OFF
		Yellow	e.g. set start of measuring range
		For more colors, see menu structure	
		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).	

Note: The transparent cover can be folded up to gain access to the SET button and USB port.

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-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
- Set switching point
- Invert switching 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 function LED.

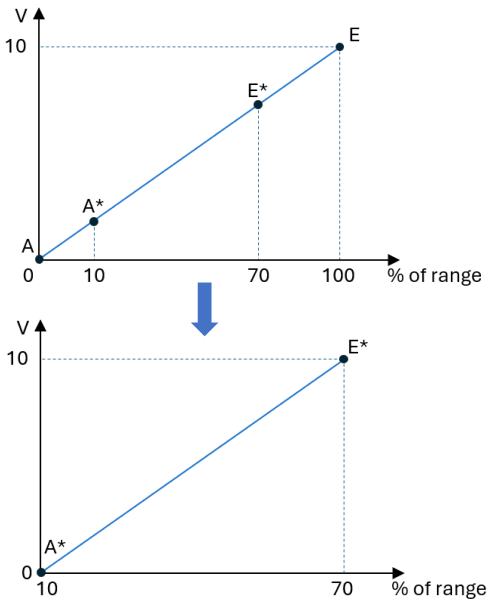
Navigation within the menu: The next menu item is selected by briefly pressing SET (approx. 1s). The controller indicates this with a colored Function LED.

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 Function LED goes out. If a further setting is to be made, the menu must be started again.

5.4.2 Adjustment of output signal (Teaching)

- 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 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 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 FUNCTION 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 FUNCTION 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 Switching output

The DEEneo offers a switching output that can be configured as required. For example, the switching output is activated when a defined value is exceeded. To do this, the desired switching point must be approached and confirmed.

The switching direction can be reversed via the menu item “Switching direction -> invert” if the output is to be activated when a value is undershot.

The switching output is designed as an open-drain output. The supply voltage of the connected device (e.g. +24 VDC of a signal light) is fed through in the active state.

- The hysteresis (difference between switching point and reset point) of the switching output can be set in % of the measuring range via eddySETUP. By default, the width of the hysteresis band is 1 % of the measuring range). Please follow the instructions under 5.5.6
- The alarm output can also be converted into a switching output so that a total of 2 switching outputs are available if required. See chapter 5.5.6.

5.4.5 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, switching points, etc., are deleted and must be taught in again if necessary.

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})
Carrier 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).
Filter Frequency [proportion 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. example: carrier frequency 3,3 kHz, Filter 0.1 ⇨ filter frequency 330 Hz
Enable Alarm	True / False	Activates (True) or deactivates (False) the alarm output S2 on clamp 13 as well as the red FUNCTION LED.
Alarm Threshold	50	Defines the threshold above which the alarm output becomes active.
Use Alarm As Switching Output	True / False	If required, the alarm output can be used as a second switching output (True).
Switching Output Treshold 1	0 … 1.00	Definition of threshold value of switching output 1: 0 ≙ 0 % / 1 ≙ 100 % of the measuring range or the corresponding output signal
Switching Output Hysteresis 1	0 … 1.00	Setting hysteresis switching output 1 in % of the measuring range or the corresponding output signal (default: 0.01 ≙ 1 %)
Invert Switching Output 1	True / False	Inverts the switching direction (False = standard)
Switching Output Treshold 2	0 … 1.00	Definition of threshold value of switching output 2 (see above)
Switching Output Hysteresis 2	0 … 1.00	Setting of hysteresis of switching output 1 (see above)
Invert Switching Output 2	True / False	Inverts the switching direction (False = standard)

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 in the following steps: 1 / 0.2 / 0.1 / 0.01 / 0.001 / 0.0001.

Example: Carrier frequency 3.3 kHz, filter 0.1 ⇨ cut-off frequency 330 Hz

- Please note that the filter cut-off frequency should not be more than 10 % of the excitation 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:

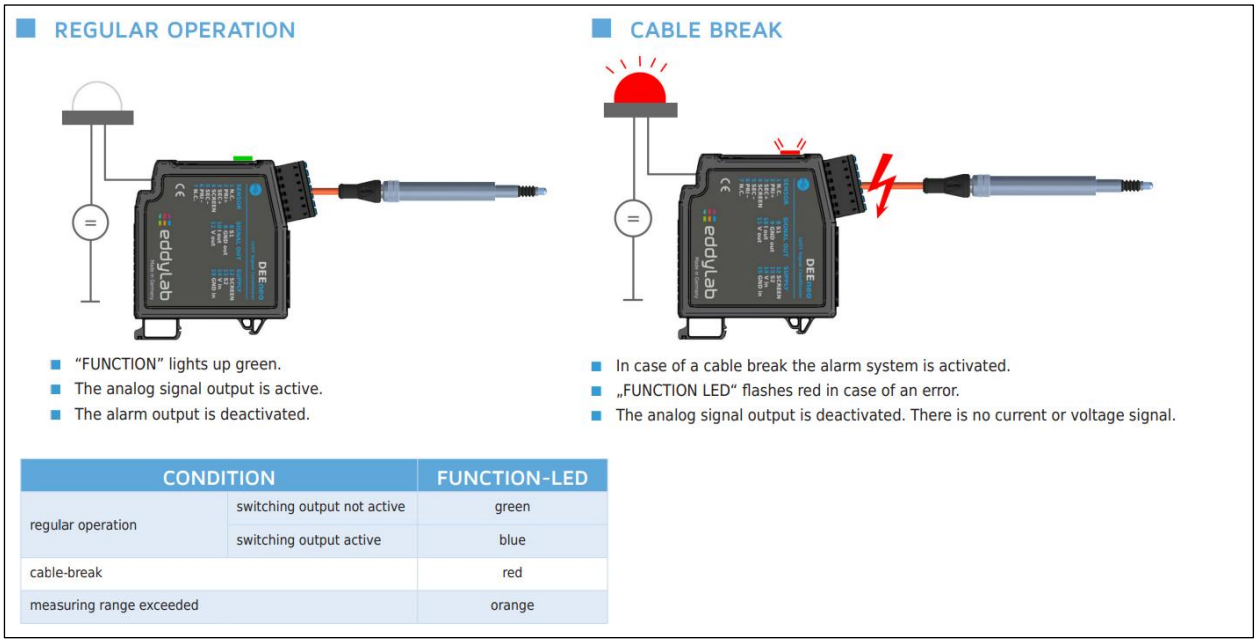
- If linearization is activated, the frequency and amplitude of the sensor supply cannot be adjusted. If this is desired, the linearization must be set to “False”.
- Linearization remains valid even if the signal direction is inverted.
- The measuring range can be taught when linearization is activated. Linearization remains valid.

5.5.5 Alarm output (cable break detection)

DEEneo 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 cut. A partial break only of the connections to the secondary coils does not activate this function. To use the cable break detection function, an alarm-emitting device (signal lamp, acoustic warning device) is connected to terminal 13 (alarm S2) or the terminals are connected to an alarm input of a control system (PLC).

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

The following figure illustrates the function of the cable break monitoring:



CONDITION		FUNCTION-LED
regular operation	switching output not active	green
	switching output active	blue
cable-break		red
measuring range exceeded		orange

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. 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.

The alarm output is designed as an open-drain output and is a type of switch. The supply voltage of the connected device (e.g. +24 VDC of a signal light) is fed through when active. When the switching output is inactive, the switch position is open.

Typical applications are a connected signal lamp or connection to a machine control input (PLC).

5.5.6 Switching output

By default, the DEEneo is preset with one switching and one alarm output. If desired, the alarm output can be converted into a second switching output. To do this, set the “Use Alarm As Switching Output” field to True.

You can configure the switching outputs as follows using the eddySETUP software:

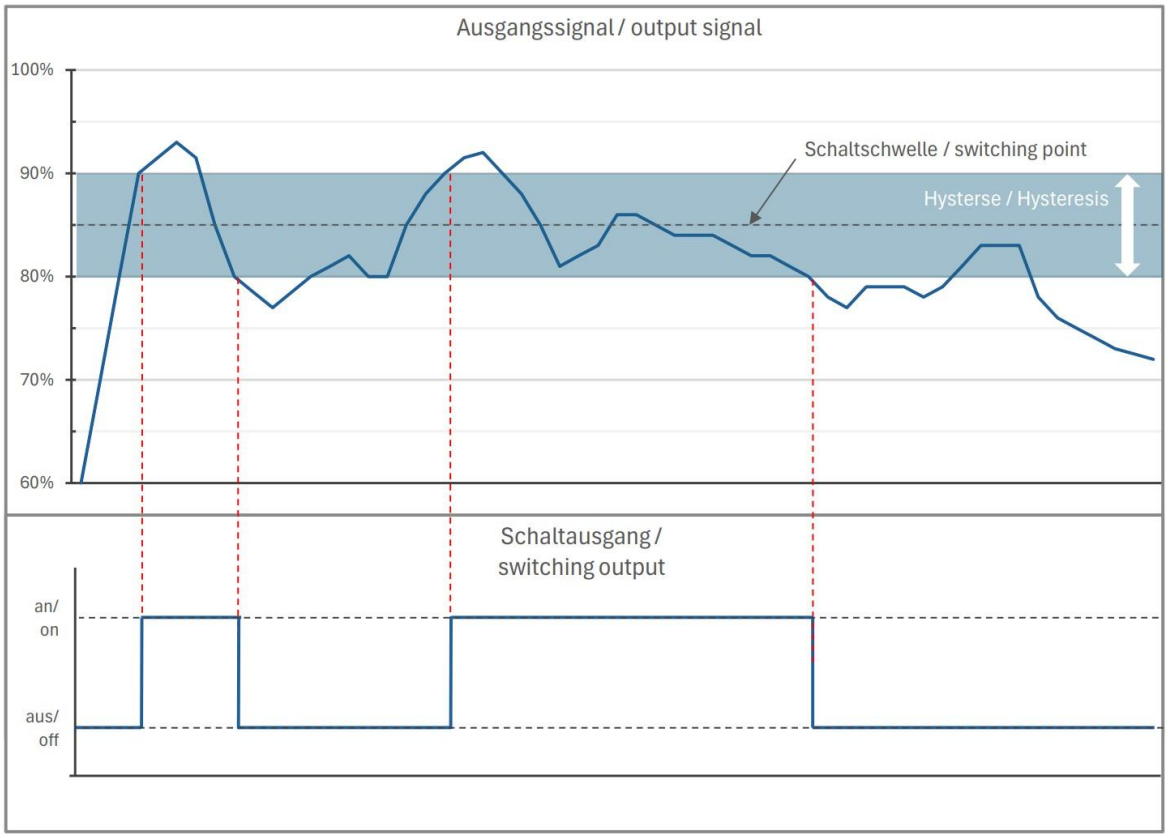
Switching Output Treshold 1 / 2: Set the switching point for switching output 1 or 2. Enter the desired switching threshold in % of the measuring range or the corresponding output signal.

Switching output hysteresis 1: Define the width of the hysteresis band as % of the measuring range or the corresponding output signal. The factory setting is 1 %.

Invert Switching Output 1: When this function is activated, the switching direction is inverted. If the value falls below the switching point, the switching output is activated.

The switching output is designed as an open-drain output. The supply voltage of the connected device (e.g. +24 VDC of a signal light) is fed through in the active state.

The switching output has a hysteresis (difference between switching point and reset point). This prevents the switching output from becoming unstable and oscillating around the switching point.



6 Software eddySETUP

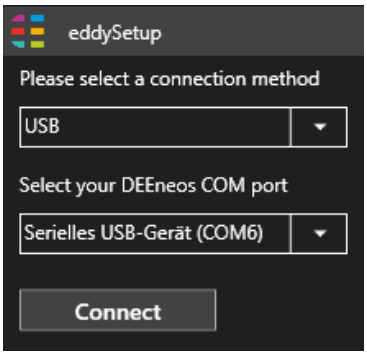
6.1 Installation

Download the software as a portable EXE file at https://www.eddylab.com/. Unzip the contents of the zip file into a folder of your choice. Please ensure that all files remain together in one folder to ensure proper functioning.

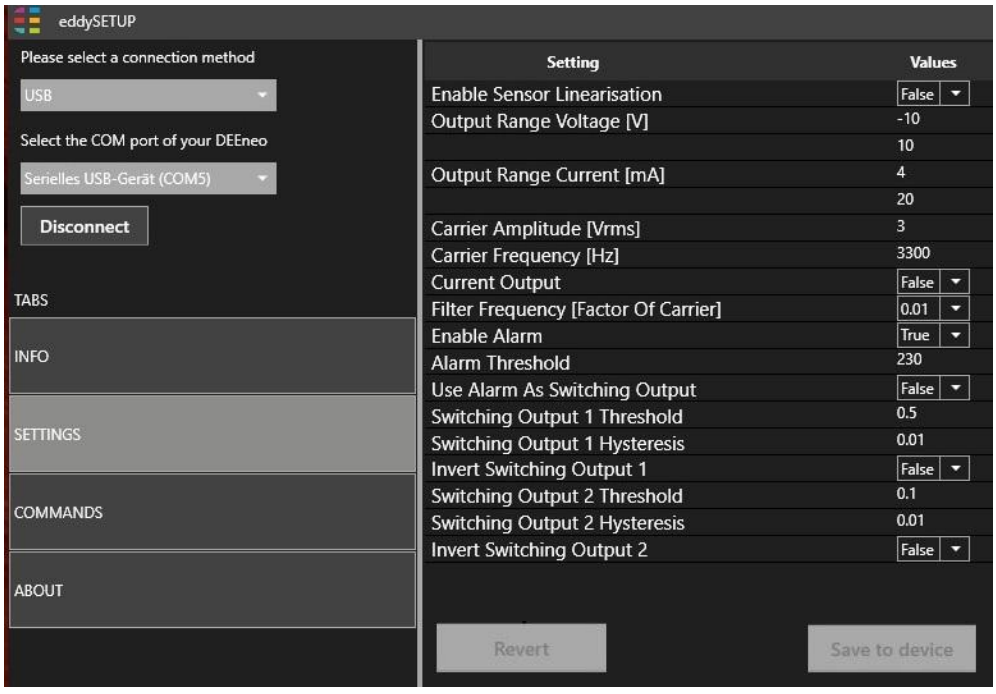
To start the program, double-click on the eddySETUP.exe file.

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



The menu is divided into 4 tabs in the left-hand column: About, Info, Settings and Commands. In the right-hand column, the settings and information associated with the respective tab are displayed.

6.3.1 About

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

6.3.2 Info

The “INFO” tab contains information about the connected electronics:

- Serial number
- firmware
- Mac address
- 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.

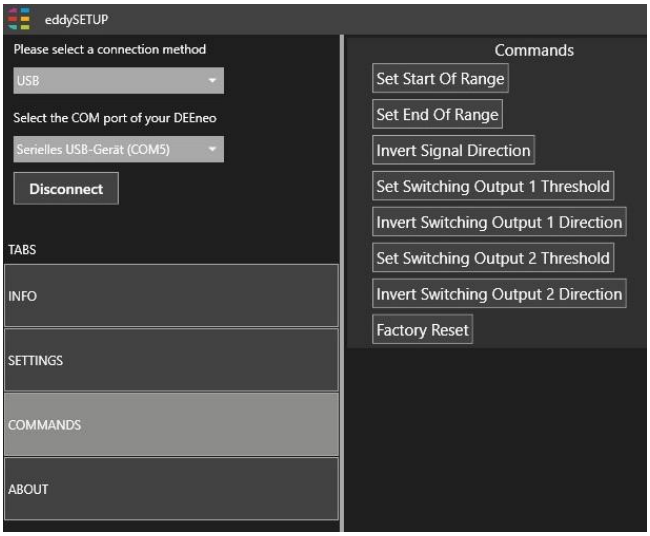
Changed values are highlighted in yellow. “Revert” resets the values to the default setting.

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

6.3.4 Commands

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

- Factory reset: Restore factory settings
- Invert: Invert the signal direction
- Set End of Range:
  Set end of measuring range
- Set Start of Range:
  Set start of measuring range



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.

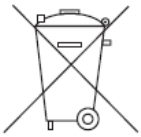
In addition, eddylab's General Terms and Conditions of Sale apply, which can be accessed at eddylab_AGB_EN.pdf

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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