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eddyMOTION LVDT 2.0.7.1 Manual

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Glossary

Magnescale Digital Gauge The Magnescale Digital Gauges product use a high-grade magnetic recording and detecting principle. Magnescale Digital Gauges feature high resolution and accuracy, along with environmental, shock and vibration resistance. Sub-micron repeatability and improved torsion resistance comes from an innovative spindle design that enables environmental protection up to IP67 [MC21a].. 11

TX-Driver LVDTs (Linear Variable Differential Transformers) are inductive sensors excellent for use in harsh industrial environments e.g., high temperature and pressure ranges, as well as high accelerations and measuring cycles.

The linearity optimization represents the main issue to LVDT transducers. The linearity is typically at a value of 0.3 %, values of less than 0.1 % are hardly to realize. The LVDT digital controller from eddylab, to which either one or two sensors can be connected, now considerably improves the linearity of inductive displacement transducers.

The measurement chain, consisting of LVDT, cable and electronics, is adjusted and calibrated at the eddylab calibration laboratory. At the beginning eddylab adjusts the TX LVDT controller to

the connected transducer to maximize the sensitivity of the sensor. After a first calibration, the controller conditions, digitizes and linearizes the transducer signal and outputs it as an analog voltage or current signal as well as via CAN bus or USB Interface [[eG16]]. The customer receives a traceable calibration certificate as a confirmation of the superior performance. . 1, 3, 4, 6, 7, 10,

Figure 1: Basic module TX1 LVDT

Figure 2: Basic module TX2 LVDT

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List of Frequently Asked Questions

1 Preface

TX-Driver - References to the glossary of the document are marked in this form.

3 - References to other parts of the document are marked in this form.

2 eddyMOTION LVDT overview

eddyMOTION LVDT is a powerful windows software used in conjunction with the TX-Driver. The targeted area of application is the visualisation and documentation of mechanical motion and the on-site Linearization of eddy current sensors.

2.1 eddyMOTION LVDT as analysis tool

eddyMOTION LVDT is made up as an universal analysis tool for the USB based data stream from the TX-Driver. The requirements in signal analysis can be of various nature – therefore eddyMOTION LVDT is structured in several modules. The different modules can be used to monitor fast and slow motion. The measured data can be displayed in the time- and in the frequency domain. The underlying sampling rates are $22.5\,\mathrm{kSa/s}$ in the two-channel version and $38\,\mathrm{kSa/s}$ in the single channel version.

2.2 eddyMOTION LVDT as configuration tool of the TX-Driver

With eddyMOTION LVDT you can configure your TX-Driver as well as create and edit scalings and run system diagnostics. Further information can be found in the section 7.1 .

3 Functionality of the eddyMOTION LVDT version

The version eddyMOTION LVDT *Standard* provides a multitude of additional functions for analysis and data recording (analysis, data logger).

The TX-Driver also contains a CAN Bus interface. A description to this interface is given in the document 'eddyCAN-Protocol'. The CAN -Bus is not related to eddyMOTION LVDT – except for the definition of the baudrate and node-id.

3.1 Analysis module Oscilloscope

Sampled data is displayed with basic measurements in the style of a classical Oscilloscope.

- single- and dual-channel Oscilloscope. Samplingrates: $38\,\mathrm{kSa/s}$ (single); $22.5\,\mathrm{kSa/s}$ (dual)

- AC/DC-coupling

- variable time base $14\,\mathrm{ms}...5\,\mathrm{s}$

- scalable Y-axis & autoscale function

- user-defined trigger level, hysteresis and pre-trigger, trigger source, falling and rising edge

- essential measurements on dynamic data can be taken: amplitude, frequency, max & min values

- data export as image (bmp) and text file

4 Installation

4.1 System requirements

For the correct use of eddyMOTION LVDT the following minimum requirements have to be set:

#	Hardware	Parameterization
1	CPU	x86-compatible processor from 1 GHz
2	Main memory	1 GB or more, 4 GB recommended
3	Hard disk	space 1 GB free space, of which at least 500 MB on the system partition
4	Graphics card	color depth from 24 or 32 bit (True Color)
5	Screen resolution	from 1024x768, multiple external monitors supported

Table 1: System requirements hardware eddyMOTION LVDT

#	Operating system	variant
1	Windows 10	32 Bit
2	Windows 10	64 Bit (as 32 bit application)

Table 2: System requirements operating system eddyMOTION LVDT

The use of the software eddyMOTION LVDT under the operating systems Windows 7, 8 and 11 is at your own risk. eddylab does not provide support for this.

4.2 Installation steps

The installation of eddyMOTION LVDT is done under Microsoft Windows.

ℹ️ Note
For the Installation and the first start of eddyMOTION LVDT you need administrator rights on your computer.

ℹ️ Note
Uninstall previous eddyMOTION LVDT versions [e.g., eddyLab 2.0.7] before installing the current version. Under no circumstances should you install into a directory where an earlier version of eddyMOTION LVDT is installed.

ℹ️ Note
During the Installation of eddyMOTION LVDT it is advisable to deactivate virus scanners and the firewall.

1. The ZIP loaded from our homepage is to be unpacked in a temporary folder. The following description refers to this unpacked directory structure.

2. Connect the TX-Driver to a power-supply.

3. Connect the Device to your PC via USB: two cases are possible

   - The PC is connected to the internet. A TX-Driver is connected to the PC for the first time. This will cause the case described in FAQ case 1 . Continue with step 4.

   - The PC is not connected to the internet. An eddylab-device will be detected and the 'Found new Hardware Wizard' will prompt you for the Device-Driver. Continue with step 4.

4. Select the directory 'D2XXsigned' to install or update the driver. After an successful installation of the TX-Driver , the lights 'power' and 'usb' should be on continuously.

5. Run the 'setup.exe' in eddyMOTION LVDT 2.0.7.1 Installer and follow the instructions. Question if asked: 'Disable Windows Fast Startup'. The fast startup introduced in Microsoft Windows 8 may cause problems with installing or removing hardware. eddylab recommends to set the checkbox.

6. The program will guide you through the installation. The installation is carried out for all users of the PC (Directory for eddyMOTION LVDT 'Program Files (x86)').

7. Your system now contains the new shortcut entry in the Start Menu>Programs>eddyMOTION LVDT 2.0.7.1 ...>eddyMOTION LVDT 2.0.7.1 ... .

8. eddyMOTION LVDT *Standard* can now be started.

4.3 Export files

All export files created by the software are stored in the public documents folder under '\ Users \ Public \ Documents \ eddylab Data' saved.

5 How to Use

5.1 User Interface

When loaded your screen should look like in figure 3 .

Figure 3: eddyMOTION LVDT after Startup

When connected to the USB – eddyMOTION LVDT will automatically establish a connection to the TX-Driver. Four LEDs indicate the connection state (see figure 4).

Figure 4: Connection state

USB indicates a connected and powered TX-Driver. **Init** indicates initialisation. **Ready** indicates the finished initialisation. **Data** indicates an active data stream in all analysis modes. By default, the startup-mode is the Oscilloscope like shown in figure 3 – Other modes can be accessed from the menu bar under 'Application'.

5.2 Context Help

A context help is given for most of the functionality. The context help can be activated in the menu bar.

6 Analysis features

6.1 Oscilloscope

Data is displayed in the style of a classical Oscilloscope. Before measurements are taken consider the following aspects:

- Set the appropriate timescale (**Duration**). The range is $14\,\mathrm{ms}...5\,\mathrm{s}$.

- For sinusoidal data (in particular for small scales on a dual-channel-device) – consider using **AC-Coupling**.

- By default, the trigger-mode is set to 'auto'. In this mode data is displayed regardless whether a trigger is detected or not. For non-periodic motion (like a closing valve) it might be desirable to capture a single sequence. For this purpose, set the trigger-mode to 'normal' – data will only be displayed if a trigger is detected.

  The *Triggerlevel* can either be set manually or with the **Autoset Trigger**-function. Autosetting the trigger adjusts the trigger level and the vertical scale.

Measurements can be taken from the displayed data. For periodic motion, the *frequency* and the *amplitude* can be measured. Figure 5 shows the AC-coupled signal of a triggered tuning-fork which oscillates at a frequency of $440.3\,\text{Hz}$. The Min/Max values are $-212.3\,\mu\text{m}$ and $122\,\mu\text{m}$.
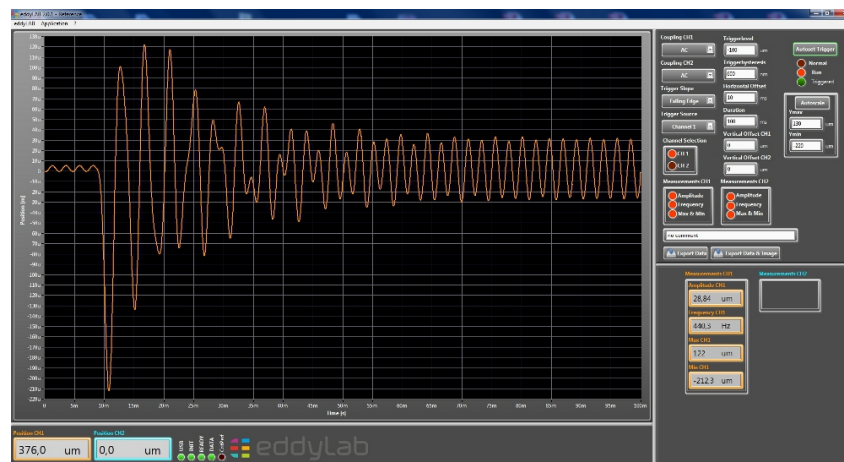

Figure 5: The AC-coupled Position of a tuning-fork

Documentation of the displayed data is accomplished easily. **Export Data** writes data to '\ Users \ Public \ Documents \ eddylab Data' in ASCII-Format.

The filename is 'date_time_Oscilloscope_no comment'. In order to distinguish various datasets a user-specific comment can be added instead of **'no comment'**.

Construction 'date' = JJJJMMTT [J=year, M=month, T=day]

Construction 'time' = hhmmss [h=hour, m=minute, s=second]

Export Data & Image adds a bitmap-image of the measured data, BMP format.

6.2 Datalogger

A Datalogger can be configured in order to observe slow mechanical motion over wide ranges of time. A typical example would be temperature induced movement or a tensile test. **Start logger** writes data to disc.

The sampling rate ranges from $100\,\text{ms}...10\,\text{s}$. The timescale in the display ranges from $1\,\text{min}...60\,\text{min}$.

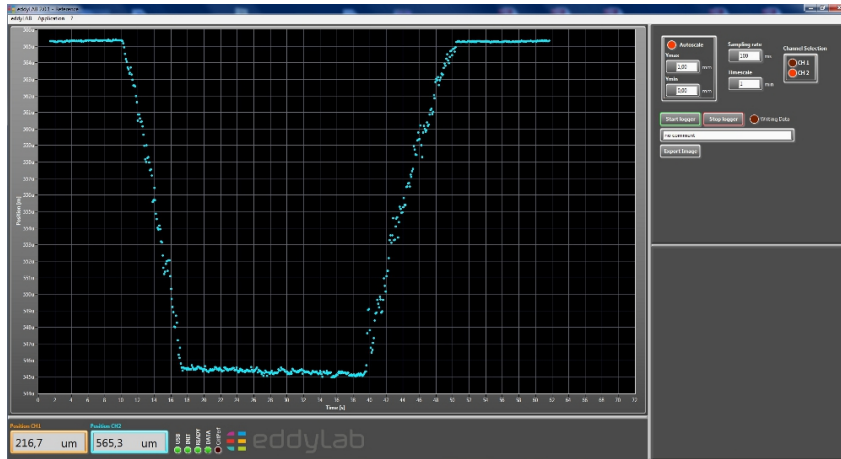Same as with the Oscilloscope an image can be exported, BMP format.

Figure 6: Slow mechanical motion displayed with the Datalogger

Start logger writes data to '\ Users \ Public \ Documents \ eddylab Data' in ASCII-Format.

The filename is 'date_time_Log_no comment'. In order to distinguish various datasets a user-specific comment can be added instead of **'no comment'**.
Construction 'date' = JJJJMMTT [J=year, M=month, T=day]
Construction 'time' = hhmmss [h=hour, m=minute, s=second]

Export Image adds a bitmap-image of the measured data, BMP format.

7 Device Configuration

7.1 The basic Device Configuration

The device Configuration can be accessed from the menu bar under application. The available parameters are listed with short explanations. Modify these pararmeters with a double click on the middle column.

Parameter	Value	Description
---Basic Settings---		
Filter Select Ch1	10Hz	Set the edge frequency for Ch1
Filter Select Ch2		Set the edge frequency for Ch2
Startup Mode	Analog Only	Defines the operational state of the TX after power-on
---Can-Bus Interface---		
Can Bitrate	500k	Defines the bitrate of the network
Can Node ID	11	Defines the unique Node ID on the network
---Switching Output---		
Comparator Threshold Ch1 [-]	0,5000	Output ist high if the position is above threshold (Ch1)
Comparator Threshold Ch2 [-]	0,5000	Output ist high if the position is above threshold (Ch2 or Ch1)
---QEP Interface---		
Encoder type	Linear	Select if a rotary or linear encoder is connected to the TX
Reference Resolution (Linear Encoder) [nm]	100	Defines the resolution for linear encoders (4x encoding)
Increments per Revolution (Rotary Encoder)	65535	Defines the number of increments per revolution (4x encoding)
Encoder Direction	Standard	Reverse the encoder direction if desired
---Analog Output---		
Position at Analog Origin Ch1 [mm]	0,0000	Scale the analog interface within the desired range
Position at Analog End Ch1 [mm]	120,0000	Scale the analog interface within the desired range
Reset Analog Output Ch1	Reset	Set the analog output to full range
Position at Analog Origin Ch2 [mm]		Scale the analog interface within the desired range
Position at Analog End Ch2 [mm]		Scale the analog interface within the desired range
Reset Analog Output Ch2		Set the analog output to full range

Figure 7: The Configuration window

A lowpass filter: on the TX-Driver can be defined. The selected cut-off frequency should be higher than the highest frequency in your expected spectrum. Otherwise, the measured amplitudes will be attenuated. For near static or static measurements set the cut-off frequency to its lowest value – this will increase the resolution.

The start-up mode: can be defined. This option can be used to define the kind of operation after power-on. This is in particular interesting for the CAN Bus.

ⓘ Note

Depending on the configuration, the TX-Driver *also provides a USB and CAN Interface [[eG16]] for reading out the data. The operation of all these interfaces needs computation time, which becomes the maximum achievable sampling rates. Therefore, it is advisable to switch off unused interfaces. The following configurations are offered:*

- *Analog Only*

- *AnalogUsb*

- *AnalogUsb & Encoder*

- *AnalogTriggerUsb*

- *AnalogTriggerUsb & Encoder*

- *AnalogCan*

The CAN bitrate: can be defined in eddyMOTION. All nodes on the network need to be configured with the same bitrate. A restart is required after modifying this value to become valid.

The Node-ID: is the unique 7-bit-identifier on the network (value range 1...127). A restart is required after modifying this value to become valid.

A comparator value: can be defined for every channel. The value range is 0...1. A comparator value of 0.5 means that the output will be switched at 50 % of the sensor's measuring range. If the sensor's position is above 50 % the output will be high – otherwise low. For single channel devices both comparator values are assigned to one channel. This permits the definition of a low and a high threshold for one channel.

The encoder type: configures the encoder interface. If set to rotary encoder – the device assumes a rotary encoder. The linear encoder needs to be set for the Linearization.

The encoder Resolution: is the resolution of a linear encoder (4x encoding) in nm. A typical value is 100 nm.

Of interest is this parameter for linearization. How to proceed in order to find a meaningful entry will be described using the example of the Magnescale Digital Gauge DK-Series [[MC21b]], model DK812SBR. On the manufacturer page, see Figure 8 , one finds the information, that the model has a maximum resolution of $0.1\,\mu m$. This value has to be converted into nm. This would be $100\,nm$, to be entered for this parameter.

Specification

	High-resolution model DK812SAR, DK812SALR, DK81SAFR, DK812SAFLR, DK812SAVR	High-resolution model DK812SBR, DK812SBLR, DK812SBFR, DK812SBFLR, DK812SBVR	General-purpose resolution model DK812SAR5, DK812SALR5, DK812SAFR5, DK812SAFLR5, DK812SAVR5	General-purpose resolution model DK812SBR5, DK812SBLR5, DK812SBFR5, DK812SBFLR5, DK812SBVR5
Model				
Measuring range	12mm			
Maximum resolution	0.1μm		0.5μm	

Figure 8: Magnescale DK maximum resolution

Counts per Revolution: defines the number of increments of a rotary encoder (4x encoding). The value range is $1...65\,535$.

The encoder direction: can be reversed if desired.

7.2 Analog Output

7.2.1 Important note for the measuring range

The sensor has a valid measuring range specified in the data sheet. This must not be exceeded. If the plunger is moved beyond the valid measuring range, the signal freezes or an invalid output signal is generated.

7.2.2 Description Teach function

If the measuring stroke of the application is smaller than the measuring range of the sensor, the output signal can be adapted to this measuring stroke. The output signal can be scaled up to 20% of the total measuring range in any area using the eddyMOTION LVDT software.

7.2.3 Execution teach function

In the menu Application - Configuration, the actually used end values of the measuring stroke can be assigned to the analogue signal. The actual measuring position is displayed in the eddyMOTION LVDT software in the "Position" window.

Figure 9: The actual measuring position is displayed in the "Position" window.

The start and end values of the actual measuring stroke can be assigned to the analogue signal under "Configuration".

- Note the start value "Position" [mm] of the actual measuring stroke for an analogue signal of $0\,V/4\,mA$.

- Note the end value "Position" [mm] of the actual measuring stroke for an analogue signal of $10\,V/20\,mA$.

- Open the Application - Configuration window

- Enter the start value [mm] in the field "Position at Analog Origin". At this measuring position, the analogue signal is now set to $0\,V/4\,mA$.

- Enter the end value [mm] in the "Position at Analog End" field. At this measuring position, the analogue signal is now set to $10\,V/20\,mA$.

- To return to the calibrated factory settings click on the reset button.

- Exit the menu.

- Note for the analogue signal $4\,mA...20\,mA$: If the tached limits are exceeded, the signal moves below $4\,mA$ or above $20\,mA$. However, the value cannot go below $2\,mA$ or above ca. $23\,mA$.
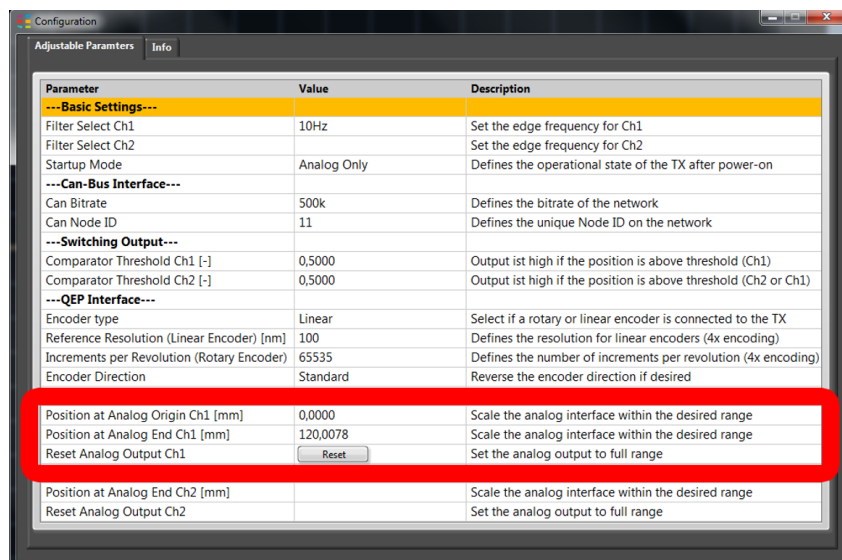

Figure 10: User interface

8 FAQ

> **TX-Driver** **- USB status-light on the device is off.**

The internet capable PC - connected to the TX-Driver for the first time - will show 'eddylab is being set up' and 'eddylab is being set up and ready'. However, the USB status-light is off. The device manager indicates the problem with an exclamation point in the hardware-tree.
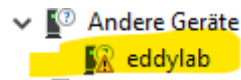

Figure 11: Device-manager with driver problem

A device driver is going to be installed automatically through the internet Windows support portal, which is not functional with Windows 10. This problem has to be fixed manually: - First select 'update driver' in the context-menu of the hardware-tree. Next follow steps from chapter 4.2 'Select the directory 'D2XXsigned'.' After the successful Driver-update you will see the figure below in the hardware-tree. The USB status-light should be on continuously.
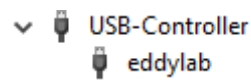

Figure 12: Device Manager with fixed driver issue

Here you can jump back to the 4.2 installation chapter.

> **eddyMOTION LVDT - 'USB' status-light is off.**

After the start of eddyMOTION LVDT the status display of the TX-Driver only shows the 'USB' light on the front panel. All other lights stay off. The TX-Driver can not be used even if the USB status-light is on.

Figure 13: eddyMOTION LVDT with driver issue

The problem can be fixed by disconnecting the TX-Driver from the power supply and USB . Reconnect the power supply and USB . Prevent this software issue by avoiding the plug in and plug out of the USB connector.

With an error-free operation the USB and POWER LED of the TX-Driver front panel light up. If only the 'USB' lamp lights up or 'USB' and 'INIT' flash when the software is started, something may be wrong with the device-specific calibration of the TX-Driver . Please contact the eddylab support.

Here you can jump back to the 4.2 installation chapter.

9 Revision History

This document was revised to include the following technical change(s).

9.1 eddyMOTION LVDT Version 2.0.7.1 / LVDT Firmware Version 6.00

9.1.1 eddyMOTION LVDT

#	Area	Additions, Deletions, Modifications
1	OS	Running with Windows 10
2	Installer	Selectable installation paths
3	Software	Storage of log files in public document folder
		The activation of the menu items has been completely revised depending on the firmware.
4	Firmware	permissible versions: 3.50, 3.51, 3.52, 6.00

Table 3: Changes made in version 2.0.7.1

9.1.2 LVDT Firmware

#	Area	Additions, Deletions, Modifications
1	Software	Possibility to adjust the teach range up to 20% of total range

Table 4: Changes made in version 6.00

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References

[eG16]   eddylab GmbH. *The eddyCAN interface on the TXx*. eddylab GmbH, 2016.

[MC21a] Ltd. Magnescale Co. Magnescale products.
         `https://www.magnescale.com/en/magnescale/`, 2021.

[MC21b] Ltd. Magnescale Co. Magnescale products.
         `https://www.magnescale.com/en/magnescale/`, 2021.

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