DATASHEET

TX SERIES | EDDY CURRENT PROBES

High-quality eddy current probes: Beside robustness, high dynamics and high resolution the TX-Series also stands out with a wide temperature range from -60 °C up to 180 °C.

- High precision measurement
- High resolution (submicrometer)
- High dynamics (124 kSa/s)
- Minimal temperature coefficient
- High noise immunity
- Custom-made probes

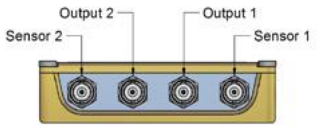
SENSEL MEASUREMENT
CAPTEURS, ELECTRONIQUES & ACQUISITION DE DONNEES

eddylab

EDDY CURRENT BASIC MODULE TX

The processor based design admits linearities less than 0.1 % – which is an exceptional feature for this sensor technology. Remarkable performance allows highly dynamic measurements with 124 kSa/s.
The TX-Driver is available as single- or dual-channel device. As standard, the device provides a USB and a CAN-bus Interface. The power supply is a galvanically isolated wide input from 10.5..36 (27) VDC.

All available sensor heads can be connected with the basic module TX (page 5-6).



- **Probe and analogue output:** Isolated output and high-speed signals via BNC connector. Selectable output signals 10 V, 5 V, ± 5 V, 0...20 mA, 4...20 mA.
- **Benefit 2-channel unit:** 2 different probes can be connected to one TX-driver.
- **Benefit 1-channel unit:** Highest dynamic performance. The output sampling rate is 124 kSa/s.

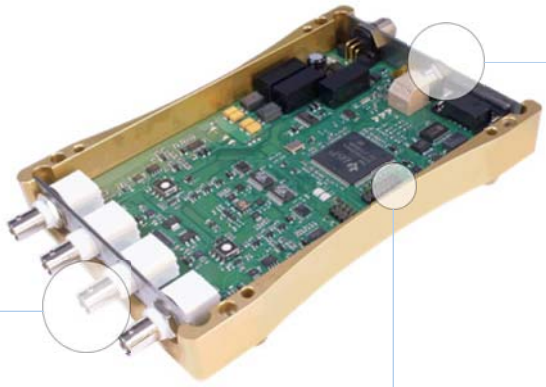
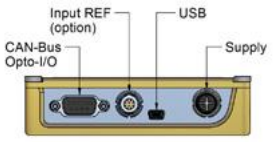


Illustration shows the 2-channel unit

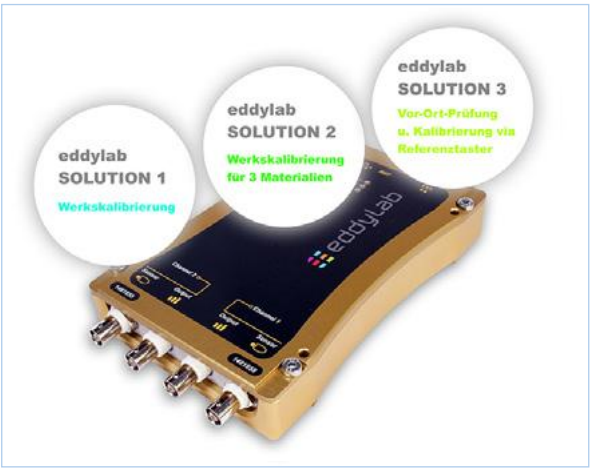
Processor linearised signal conditioning

- linearisation and calibration with 50 points
- high dynamic performance with selectable digital filter
- high resolution and precision



- **Supply:** Wide-Input-supply 10,5...36 (27) VDC, screwable M12 connector for shielded cables; galvanically isolated.
- **CAN-Bus:** Data transfer via CAN bus for diverse systems with multi channel measurement.
- **USB connection:** Interface to PC and data transfer. Usage of eddylab software. Direct communication via USB protocol.
- **Reference input:** Optional high-speed counter for linearisation- and rpm-function (eddylab reference).

CALIBRATION



THE FOLLOWING VARIANTS OF CALIBRATION ARE AVAILABLE:

- Factory calibration for one material including certificate.
- Factory calibration for three different materials. The materials are chosen with eddylab lite/ standard/reference including three certificates.
- Factory calibration including certificate plus customer based linearisation on-site with a digital gauge and eddylab reference (requires REF option for the TX-driver). The accuracy behaviour of an eddy current sensor can be proved and improved on-site with a digital gauge as reference.

All of our probes are tested and calibrated before shipping. The calibration is based on 50 positions. Every probe has a unique setup – therefore the probes may not be interchanged among different drivers.
The certificate of calibration contains the measured and reference data, the sensitivity, the target material and the linearity as a chart.
The certificate of calibration is provided as standard – but it is also available subsequently.

TARGET-MATERIAL

Eddy current measurements depend on the target's conductivity and permittivity. The default material for factory calibration is steel of type 16MnCr5. Calibration is also possible with other conductive material such as aluminium, titanium, carbon fibre etc.

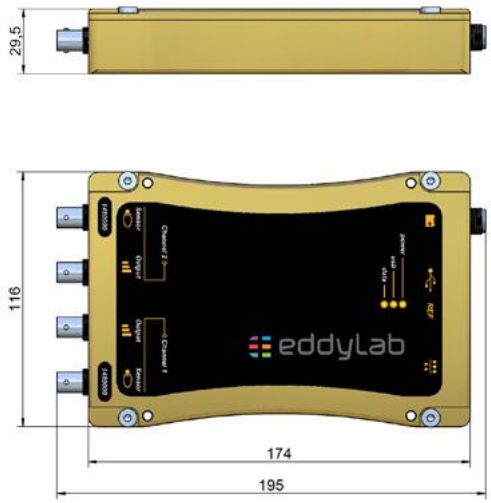
The following list shows available material for calibration. If you desire to use a different material we recommend to provide a probe (50x50 mm) for calibration.

MATERIALS TO CHOOSE FROM FOR CALIBRATION		
16MnCr5	1.2379	AlMgSi0,5
42CrMo4	1.2738	AlMg4,5Mn
St52	1.4301	AlMgCuPb
C45E	1.4305	9SMn28k
also eligible for calibration: zinc plate, titanium, carbon fiber		

TECHNICAL DATA – EDDY CURRENT BASIC MODULE TX

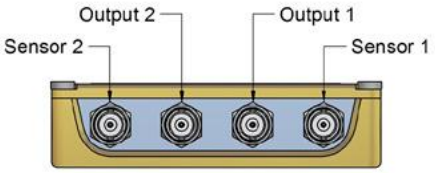
EDDY CURRENT-BASIC MODULE	TX1	TX2
channels	1 channel	2 channel
operating temperature range	-40...+50 °C	
storage temperature range	-40...+85 °C	
humidity	95 % (no condensation)	
vibration	5 g, DIN EN 60068-2-6	
shock	15 g / 11 ms, DIN EN 60068-2-27	
protection class	IP40	
housing	anodised aluminium and rubber feet, stackable	
housing size L x W x H	195 x 116 x 29,5 mm	
weight	665 g	694 g
optional reference input		
auxiliary voltage (for DK-gauges or encoder)	5 V maximum current 250 mA	
signal type	A / B pulses (RS422)	
Supply		
Supply Voltage	10.5...36 VDC Wide Input; 10.5...27 VDC Ref-Version	
current consumption	145 mA (24 V), 260 mA (12 V), 300 mA (10.5 V)	150 mA (24 V), 300 mA (12 V), 380 mA (10.5 V)
current consumption with DK-gauges	170 mA (24 V), 300 mA (12 V), 340 mA (10,5 V)	180 mA (24 V), 340 mA (12 V), 390 mA (10,5 V)
power on peek current	350 mA (24V), 470 mA (10,5V), < 30 ms	
reverse polarity protection	yes	
protection circuit	bipolar suppressor diode 36V / polyfuse 0.5A	
isolation voltage	min. 1 kV	
Analogue output		
output signals	0...10 V / 0...5 V / ±5 V / 0...20 mA / 4...20 mA	
dynamic / sampling rate	124 kSa/s	70 kSa/s
dyn. / samp. with simultaneous USB usage	76 kSa/s	45 kSa/s
filter corner frequency	10 Hz / 100 Hz / 1 kHz / 10 kHz / 35 kHz (-3 dB)	
max. working resistance (current output)	< 400 Ohm	
temperature coefficient electronic	-0.025 %/K	
switching-on delay (boot-time)	3.1 s	
switching-on drift	< 1% (see diagram)	
connection	1 x BNC female connector	2 x BNC female connector
output protection circuit	polyfuse 50mA	
General data and industrial standards		
electromagnetic compatibility	EN 61326-1 / EN 55011	
RoHS	appropriate standard 2002/95/EG	
MTBF	EN 61709, > 360.000 h	

TECHNICAL DRAWINGS BASIC MODULE TX

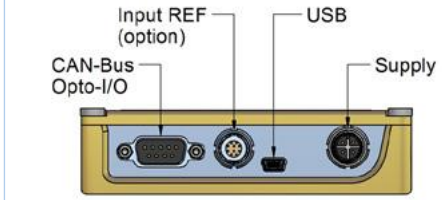


CONNECTION

FRONT OF UNIT



REAR OF UNIT



USB

- The eddy current basic module provides a USB port (USB 2.0 High Speed).
- device configuration (filter, linearisation, CAN bus)
- data exchange with a PC or notebook via eddylab Windows software or via protocol

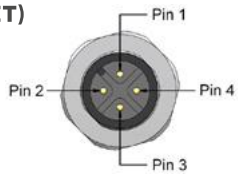
SAMPLING RATES	TX1	TX2
Analogue, no USB	124 kSa/s	70 kSa/s
Analogue, with USB	76 kSa/s	45 kSa/s
USB	38 kSa/s	22,5 kSa/s

REFERENCE INPUT

PIN	1	2	3	4	5	6	7	8	9	10
FUNCTION	A	A	B	B	Z	Z	0V	Vcc	Vsens	n.c.

SUPPLY VIA A 4-POLE M12 PLUG CONNECTOR (SOCKET)

PIN	FUNCTION
1 (brown)	+V (10,5...36 VDC)
3 (blue)	GND

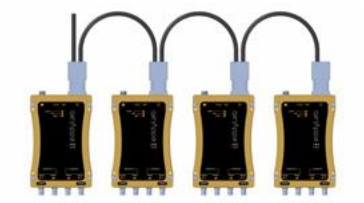


PLEASE USE ONLY SHIELDED SUPPLY CABLES AND SET THE SCREEN ON ONE SIDE (TO AVOID GROUND LOOPS)!

CAN-BUS

The TX-Driver also provides a CAN-bus interface (controller area network). Wiring is achieved with a CAN-bus cable. The first and the last device on a CAN bus must be terminated.

- data transfer rate 1 MBit, standard-identifier
- triggers: internal timer, remote request, sync.
- networking of many devices with minimal wiring effort
- highly reliable data transfer over wide ranges, ideal for applications with many devices (consider dynamics)
- economisation of analogue measuring equipment (analogue-to-digital converter)



PIN	FUNCTION	DESCRIPTION
1	EXT OPTO OUT 1	digital output I/O 1
2	CAN L	CAN low-signal
3	CAN GND	CAN ground
4	EXT IN 1	digital input I/O 1
5	EXT IN 2	digital input I/O 2
6	IN GND	ground I/O
7	CAN H	CAN high-signal
8	EXT OUT 2	digital output I/O 2
9	n. c.	n. c.

ACCESSORIES

EDDYLAB

Powerful Windows software incorporating six major functions:

- Oscilloscope, FFT, Data logger, Waterfall, Waterfall-RPM and linearisation (details on pages 11-12).
- Delivery contents: software-CD, gold-plated USB cable, dual shields incl. 2 ferrites, length 1.8 m

DIGITAL GAUGES (DK-SERIES)

- Resolution: 0.1 µm
- Accuracy: 1 µm
- Output signal A/B reference point, TTL-linedriver according to EIA-422
- Displacement speed up to 250 m/min
- Working temperature 0...50 °C
- Protection class IP67

ADAPTER CABLE FOR DK-SERIES / REFERENCE INPUT

- Interface cable for the DK-Series on the TX-Driver
- Available lengths: 1 m, 3 m, 5 m

DIN RAIL CONNECTOR

- The DIN rail connector provides an easy and securemouting of the TX electronics in a switch cabinet by simply snapping it onto a 35 mm DIN rail (DIN50022).
- Disassembling can be done by pulling the easy accessible latch.
- Stacking of several electronics can save lots of space in the switch cabinet. Therefor, please use the included housing connectors.

M12 CABLE FOR POWER SUPPLY

Cable with straight connector:		Cable with angled connector:	
K4P2M-S-M12	2 m	K4P2M-SW-M12	2 m
K4P5M-S-M12	5 m	K4P5M-SW-M12	5 m
K4P10M-S-M12	10 m	K4P10M-SW-M12	10 m

BNC MEASUREMENT CABLE FOR THE ANALOGUE OUTPUT

XLSS-58

- Touch-safe coaxial measurement cable. BNC connectors on both ends. Connectors have nickel plated shields and gold plated pins.
- Length 2 m, temperature range -10...+70 °C
- Capacity 219 pF, inductance 680 nH, wave impedance 50 Ω

XLAM-446/SC

- Highly flexible, entirely shielded measurement cable. Touch-safe BNC connector on one end and two stackable Ø 4 mm connectors on the other end
- Length 1.6 m, temperature range -10...+70 °C
- Capacity 240 pF, inductance 1000 nH

ACCESSORIES

CABLE EXTENSION SMB-KOAX

- Additional extension accordingly to option 2 (see page 4 below). SMB connector to BNC connector.
- 3 m length: SMB-KOAX-3M
- 6 m length: SMB-KOAX-6M

Note: for probes with SMB connectors only. The probe is calibrated with an extension that can be ordered additionally.

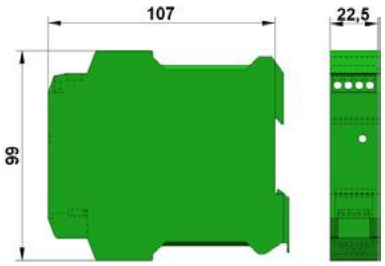
WALL PLUG TRANSFORMER FOR THE TX-DRIVER

nominal input voltage:	100-240 VAC, 50-60 Hz
output voltage:	12 VDC ±5 %
output current:	500 mA
temperatur range:	0...+40 °C
protection class	IP40
cable length	2 m
terminal	M12-plug, PIN 1 = +, PIN3 = GND

RAIL-POWER SUPPLY 24 VDC PS-100-240AC/24DC/1.3

Extra slim power supply - only 22.5 mm wide. Reliable start-up of several eddy current basic devices is guaranteed by a 100% power boost. Reliability is also achieved on difficult global networks. The supply will remain stable even if transient or static voltage failure occurs. Well dimensioned capacitors bypass power failures of more than 150 ms.

nominal input voltage:	100-240 VAC, 45-65 Hz
output voltage:	24 VDC
output current:	1,3 A (max. 1,6 A)
temperature range:	-25...+60 °C
efficiency:	> 85 %
protection class:	IP20



CALIBRATION RIG

Portable linear stage for the usage on-site

- Newport linear stage
- prism shaped socket for eddy current sensors
- 8 mm slot for linear encoders
- quick release socket for different targets (smallest dimension 50x50x5 mm, largest dimension 70x70x5 mm)

SOFTWARE EDDYLAB – OPTIONAL USE

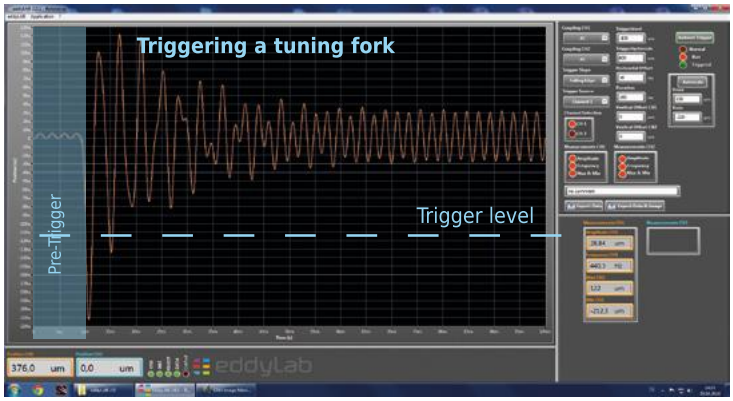
EDDYLAB – WINDOWS ANALYSIS-SOFTWARE VIA USB

eddylab 2.0 Standard is a powerful windows software which is available in three different versions: Lite, Standard and Reference. The Lite Version – delivered with every eddy current sensor system – offers an Oscilloscope function. The eddylab standard Version provides further features as **FFT analyser, Waterfall and Data logger**. The eddylab Reference Version enables the on-site linearisation of eddy current sensors with an active feedback system. The sampling rates are 38 kSa/s for a single-channel device and 22.5 kSa/s for a dual-channel device. Furthermore eddylab is used to configure the TX-Driver.

OSCILLOSCOPE

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

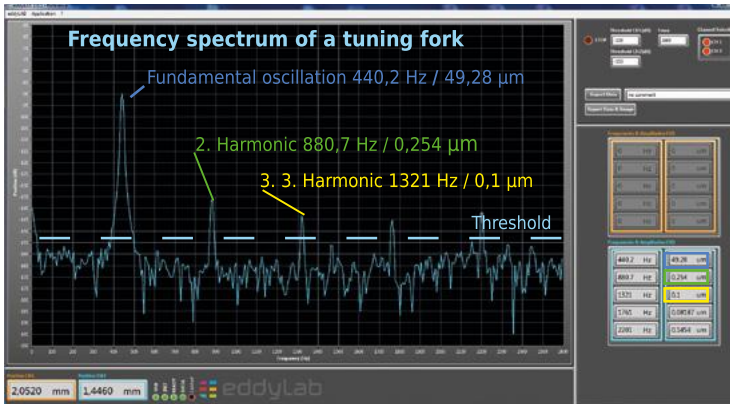
- single- and dual-channel oscilloscope. Samplingrates: 38 kSa/s (single); 22.5 kSa/s (dual)
- AC/DC-coupling
- variable time base 14 ms...5 sec
- scaleable Y-axis & autoscale function
- user-defined trigger level, hysteresis and pre-trigger, trigger source, falling and rising edge
- essential measurements on dynamic data can be taken: amplitude, frequency, max & min values
- data export as image (bmp) and text file



FFT ANALYSER

Fast-Fourier transformation. Spectral analysis of mechanical motion. Analysis of fundamental oscillation and harmonics.

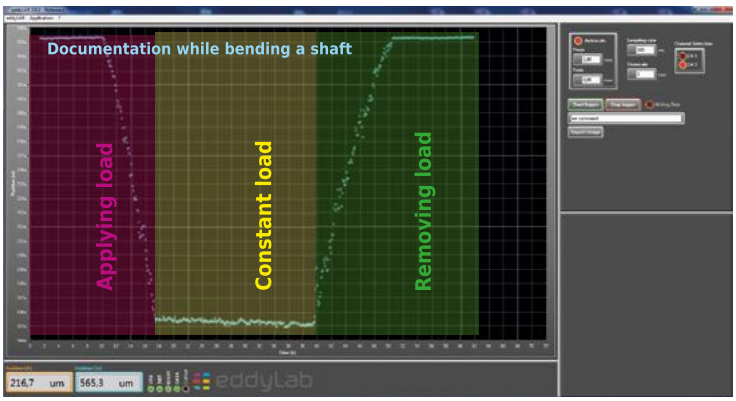
- visualisation of the frequency spectrum up to 19 kHz (single-channel); 1.25 kHz (dual-channel)
- threshold value for frequency detection can be selected
- detection of frequencies and amplitudes
- scalable frequency axis
- data export as image (bmp) and text file



DATA LOGGER

Record of measured data and storage on hard drive.

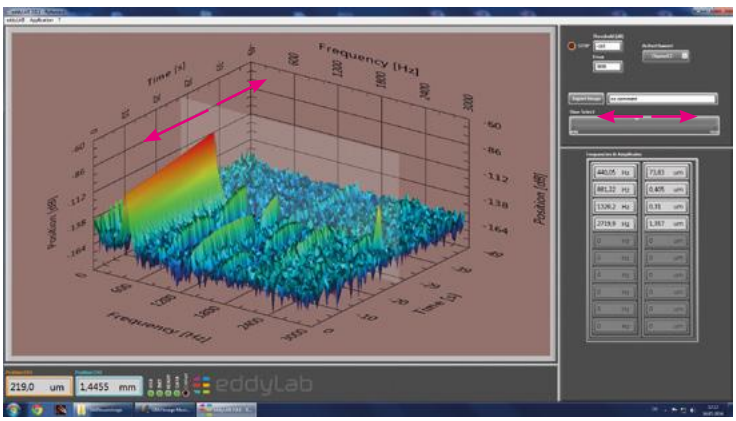
- user-defined sampling rate: 100 ms...10 s
- time base 1 min...60 min
- data export as image (bmp) and text file



WATERFALL

The FFT is expanded with a time axis. The 3D-plot provides a new view to your spectrum as it can be observed over time. The third axis emphasizes small peaks above the noise floor. In particular when these small peaks emerge and disappear over time.

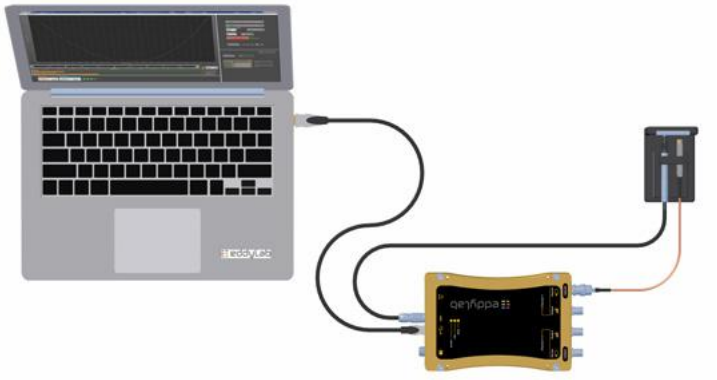
- spectrum like the two-dimensional FFT expanded with a time axis
- scalable frequency axis
- 3D-view can be rotated
- movable analysis plane along the time axis
- detection of frequencies and amplitudes within the anaylsis plane
- export as image

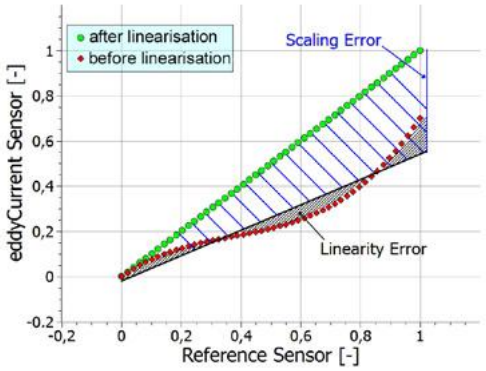


SOFTWARE EDDYLAB 2.0 REFERENCE

eddylab 2.0 reference is a powerful windows software with additional features. These are the linearisation and the rpm-based waterfall. eddylab reference requires a reference input on the TX-Driver.

CALIBRATION AND LINEARISATION

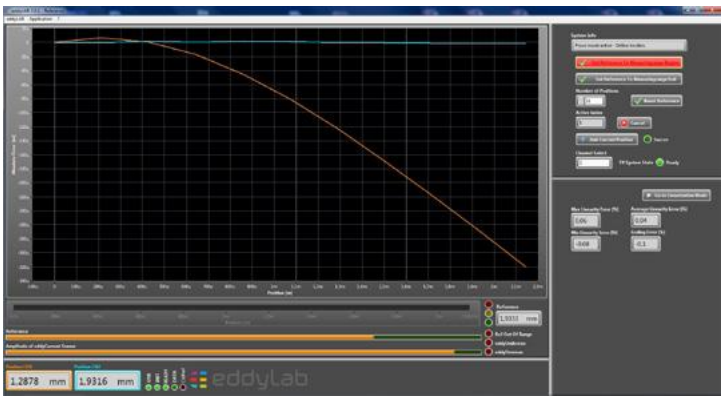




LINEARISATION

A well known issue when it comes to eddy current measurements is the strong sensitivity to varying target material and pre-attenuation.
The maximum scaling error under varying material can be 20 % or more. The linearity error can be 7 % or more. Another severe error source affecting the accuracy is pre-attenuation. This effect has to be taken in account when the sensor is mounted in narrow gaps and holes. The error due to pre-attenuation is hard to predict - but in most cases higher than expected. The TX-Driver in conjunction with eddylab resolves the issues with an integrated linearisation procedure.

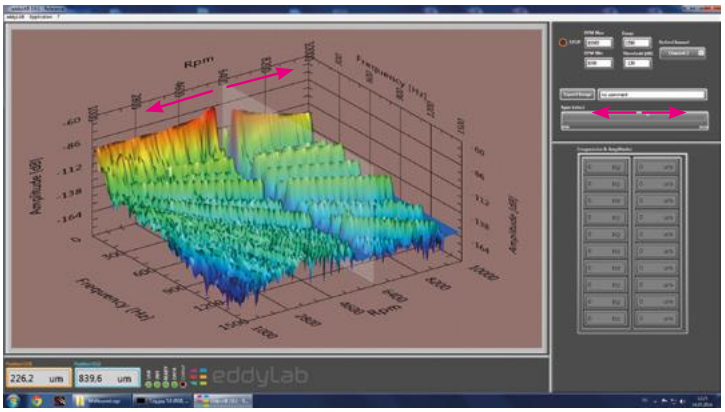
The backbone of the method is an interface to a linear encoder on the TX-Driver. The encoder is used as a reference signal. The reference can be used to either prove the accuracy of the sensor or to linearise the sensor. The linearisation is based on a user defined number of positions. The TX-Driver is capable of storing four user defined curves. In order to align the eddy current sensor with the linear encoder we provide a portable linear stage with a micrometer screw. This enables a linearisation on-site.

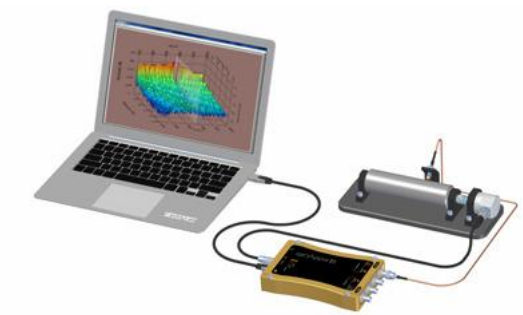


WATERFALL RPM

This function is only available in conjunction with a rotational incremental encoder. This admits the determination of the rotational speed of a rotating shaft. The FFT is expanded with a rpm axis. The correlation of rotational speed and FFT results in a characteristic 3D-plot. The plot may characterise the state of a rotating system depending on loads, oil-pressure, wear and similar aspects.

- spectrum like the two-dimensional FFT expanded with a rpm axis
- scalable frequency axis
- 3D-view can be rotated
- moveable analysis plane along the rpm axis
- detection of frequencies and amplitudes within the analysis plane
- export as image





FUNCTION OVERVIEW	EDDYLAB LITE	EDDYLAB STANDARD	EDDYLAB REFERENCE
Oszilloscope	x	x	x
FFT		x	x
Data logger		x	x
Waterfall		x	x
Linearisation			x
Waterfall-RPM			x

PRECAUTIONS

- **Never shorten the probe‘s coaxial cable. The probe, cable and electronic system form a coordinated oscillating circuit.**
- **Lay the cable so that it is protected and avoid running it along objects with sharp edges. A cable that has been squashed or damaged in another manner can tamper with the signal or render the probe unusable.**
- **Please note that the sensors have been aligned with the electronic system. The alignment can be found in the calibration record or on the label on the unit, identified by the serial number. Do not switch the channels.**
- **Avoid placing the cable under tensile or torsional stress. Never turn the probes in the holders inwards or outwards without first loosening the fastenings.**
- **Avoid placing the cable under tensile or torsional stress. Never turn the probes in the holders inwards or outwards without first loosening the fastenings.**
- **Protect the plug connections in the coaxial line against humidity and wetness.**
- **The sensors may not be used in strong radioactive environment (nuclear power plant).**

ORDER CODE PROBE

probe type (a)	–	X (b)	X (c)	X (d)

a probe type
according to technical drawings, p. 5, p. 6 (e. g. T5-G-KA)

b cable length
1 = 3M: 3 m (standard)
2 = 6M: 6 m
3 = 9M: 9 m
4 = 12M: 12 m
5 = 15M: 15 m

c cable output
1 = BNC connector (standard)
2 = SMB connector

d others
1 = - (standard)
2 = shielded version

ORDER CODE BASIC MODULE

TX – □ – □ – □ – □ – □

1 channel 2 channel	1 2
power supply 10,5...36 (27) VDC	24
resolution 16 bit AD/DA	16

– REF IO	standard reference input switching input / switching output
	analogue output
020A 420A 10V 5V ± 5V	0...20 mA 4...20 mA 0...10 V 0...5 V ± 5 V

ACCESSORIES

SMB-KOAX-3M	extension cable for SMB connector 3 m
SMB-KOAX-6M	extension cable for SMB connector 6 m
BNC/SMB	adapter BNC/SMB for connection to TX module
Power supply cable with M12 mating connector	
K4P2M-S-M12	2 m, straight connector
K4P5M-S-M12	5 m, straight connector
K4P10M-S-M12	10 m, straight connector
K4P2M-SW-M12	2 m, angular connector
K4P5M-SW-M12	5 m, angular connector
K4P10M-SW-M12	10 m, angular connector
Digital gauge - accessories	
Sensor DK812SBR	Resolution 0,1 µm, accuracy < 0,5 µm
Sensor DK812SBR5	Resolution 0,5 µm, accuracy < 0,75 µm
Adapter cable DK-Series / Reference input	
CE22-01-TX-REF	length 1 m
CE22-03-TX-REF	length 3 m
CE22-05-TX-REF	length 5 m
FGG.1B.310.CLAD52	connector for reference input

BNC measurement cables for the analogue output	
XLSS-58	BNC into BNC, 2 m
XLAM-446/SC	BNC into ø4 mm banana plug, 1.6 m
Windows-software for USB	
eddylab 2.0 Lite	software-CD
eddylab 2.0 Standard	software-CD, USB-cable 1.8 m
eddylab 2.0 Reference	software-CD, USB-cable 1.8 m
Power supply units	
PS-100-240AC/24DC/1.3	24 VDC, 1.3 A / max. 1.6 A (DIN rail mounting)
PS-100-240AC/24DC/4	24 VDC, 4 A / max. 5 A (DIN rail mounting)
FW7662/12	12 VDC ±5%, 500 mA (wall plug transformer)
Micrometer calibration apparatus	
Micro-KALIB-V1	Linear stage for the usage on-site
TX housing fixation	
DIN rail connector	for TX housing

SENSEL MEASUREMENT
CAPTEURS, ELECTRONIQUES & ACQUISITION DE DONNEES

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