MICRO-EPSILON

More Precision

eddyNCDT 3020 // Robust inductive measuring system for industrial applications

Robust inductive controller for precise displacement measurement
eddyNCDT 3020

- Extremely high temperature resistance and stability up to 105 °C
- Analog / RS485 / PROFINET / EtherNet/IP, EtherCAT
- High resolution and 3-point linearization
- Frequency response 5 kHz (-3dB)
- Measuring rate 80 kSa/s
- Configurable via sensorTOOL
- Switching output (NPN, PNP, TTL, HTL)

Robust and precise for industrial series applications

The eddyNCDT 3020 is an inductive eddy current measuring system for precise displacement and position measurements. The powerful controller offers high resolution and detects fast movements reliably and with high precision. Its robust, compact design, and flexible connection and configuration options make it particularly suitable for industrial environments and machine integration. The system is used, for example, for distance measurement in welding applications, steel selection processes or in die casting systems.

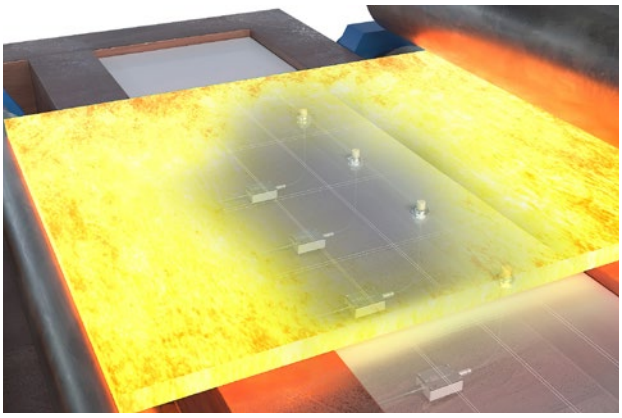
Due to the extremely high temperature resistance of the sensor (up to 200 °C) and controller (up to 105 °C), the complete measuring channel can be used at high ambient temperatures, which reduces temperature influences on the cable and increases measuring accuracy. Digital or analog interfaces also transmit the processed signal over long distances.

Wide range of sensors and easy setup

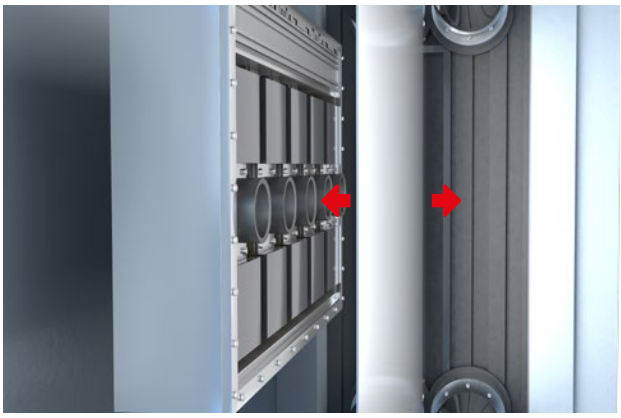
The combination of this controller and the extensive sensor portfolio covers measuring ranges from 1 to 80 mm.

The system is configured conveniently using the sensorTOOL, which offers great application flexibility due to numerous setting options:

- Customizable scaling of analog output and measuring range
- Wide range of options for Condition Monitoring (limit value monitoring via switching output)
- Data processing through averaging, mastering or data reduction
- 3-point linearization for customer-specific installation situations



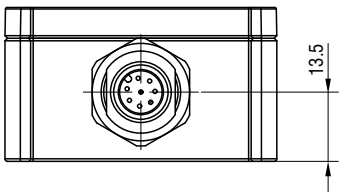
Flatness measurement during flat rolling of crude steel

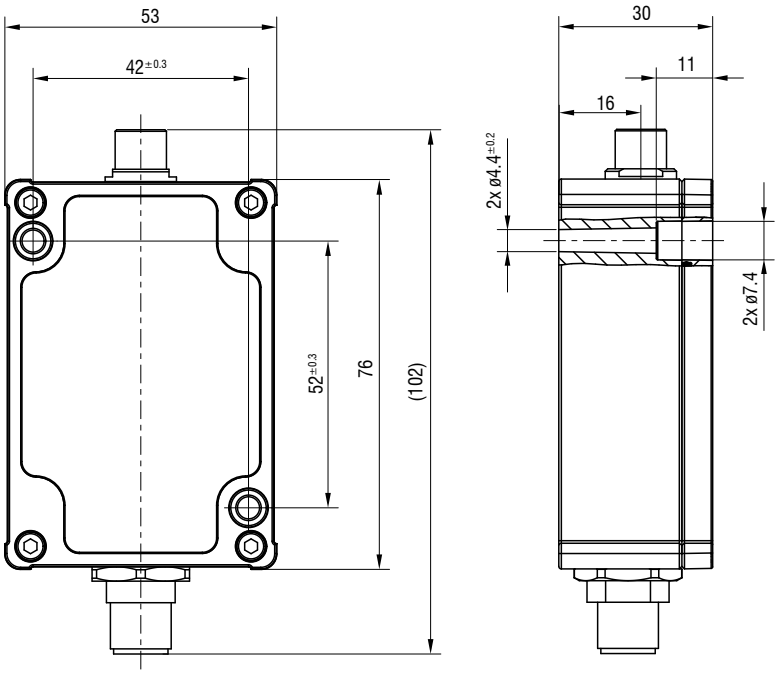


Distance measurement for stabilizing metal strips, e.g. in the galvanizing process

Model		DT3020
Resolution [1]	Static	0.004 % FSO
	Dynamic	0.01 % FSO
Frequency response (-3dB) [2]		9 adjustable stages: 10 Hz ... 5 kHz
Measuring rate	Analog output	80 kSa/s
	Digital output	10 kSa/s
Linearity [3]		< ±0.2 % FSO
Temperature stability [4]		< 0.025 % FSO / K
Temperature compensation		10 ... 105 °C
Target material [5]		Steel, aluminum
No. of characteristic curves		1
Supply voltage		12 ... 32 VDC
Power consumption		< 1.7 W
Digital interface [6]		RS485 / USB / Ethernet / EtherCAT / PROFINET / EtherNet/IP
Analog output		4 ... 20 mA (max. 500 Ω load, freely scalable 0 ... 20 mA)
Switching output		Selectable: NPN, PNP, push-pull
Connection		Sensor: plug connector triaxial socket; supply/signal: 8-pole M12 connector
Mounting		Through-bores (Ø 4.4 mm)
Temperature range	Storage	-20 … 105 °C (non-condensing)
	Operation	-20 … 105 °C (non-condensing)
Shock (DIN EN 60068-2-27)		15 g / 6 ms in 3 axes, 2 directions and 1000 shocks each
Vibration (DIN EN 60068-2-6)		5 g / 10 … 500 Hz in 3 axes, 2 directions and 10 cycles each
Protection class (DIN EN 60529)		IP67 (plugged)
Material		Aluminum die-cast
Weight		approx. 190 g
Control and indicator elements [7]		Configurable via sensorTOOL software: 3-point linearization, scaling of the analog output, filter & averaging, interface selection

[1] FSO = Full Scale Output, RMS noise relates to the mid of the measuring range, static: 20 Hz, dynamic: 5 kHz
[2] Factory setting 5 kHz
[3] Value valid with 3-point linearization
[4] Value valid in the temperature-compensated range
[5] Steel: St37 1.0037; Aluminum: AlMg3 3.3535
[6] Connection via an interface module is required for USB, Ethernet, EtherCAT, PROFINET and EtherNet/IP
[7] Access to sensorTOOL requires connection to PC via an interface module

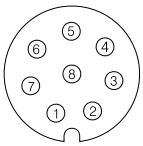




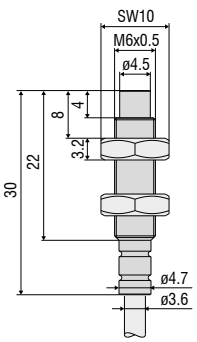
Pin assignment for power supply and signal

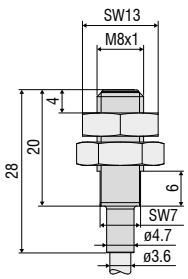
Pin	Assignment	Color (Cable: PC5/8-M12/105)
1	Not assigned	White
2	Supply: +24 V	Brown
3	Switching output	Green
4	RS485 A/+	Yellow
5	RS485 B/-	Gray
6	GND analog output	Pink
7	GND supply	Blue
8	Analog output $I_{Displacement}$	Red

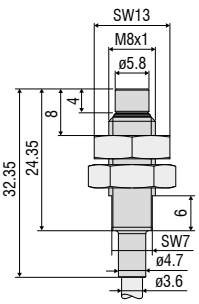
8-pole M12x1 housing connector
View on pin side

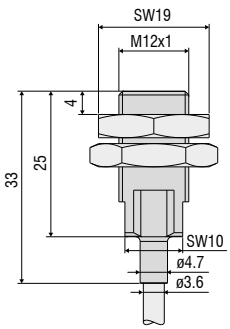


Measurement direction





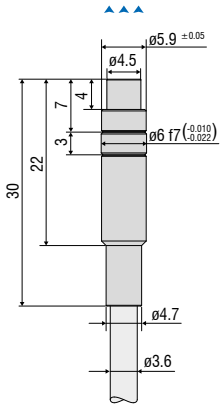




Model		ES-U1	ES-S1	ES-U2	ES-S2
Measuring range		1 mm	1 mm	2 mm	2 mm
Start of measuring range		0.1 mm	0.1 mm	0.2 mm	0.2 mm
Resolution [1) 2) 3)]		0.02 µm	0.02 µm	0.04 µm	0.04 µm
Linearity [1) 4)]		< ±1µm	< ±1µm	< ±2 µm	< ±2 µm
Temperature stability [1) 2)]		< 0.15 µm / K	< 0.15 µm / K	< 0.3 µm / K	< 0.3 µm / K
Temperature compensation		+10 … +180 °C	+10 … +180 °C	+10 … +180 °C	+10 … +180 °C
Sensor type		unshielded	shielded	unshielded	shielded
Min. target size (flat)		Ø 18 mm	Ø 12 mm	Ø 24 mm	Ø 18 mm
Connection		integrated cable, axial, standard length 3 m; 1 m, 6 m, 9 m optional [5)]			
Mounting		Cable gland (M6)	Cable gland (M8)	Cable gland (M8)	Cable gland (M12)
Temperature range	Storage	-20 … +180 °C	-20 ... +200°C	-20 … +200 °C	-20 … +200 °C
	Operation	-20 … +180 °C	-20 … +200 °C	-20 … +200 °C	-20 … +200 °C
Pressure resistance		20 bar front and rear			
Shock (DIN EN 60068-2-27)		15 g / 6 ms in 3 axes, 2 directions and 1000 shocks each			
Vibration (DIN EN 60068-2-6)		15 g / 49.85 … 2000 Hz in 3 axes ±3 mm / 10 … 49.85 Hz in 3 axes			
Protection class (DIN-EN 60529)		IP68 (plugged)			
Material		stainless steel and plastic			
Weight [6)]		approx. 2.4 g	approx. 2.4 g	approx. 4.7 g	approx. 11 g

[1)] Valid for operation with DT306x controller, referred to nominal measuring range
[2)] Relates to the mid of the measuring range, in the compensated temperature range
[3)] RMS value of the signal noise, static (20 Hz)
[4)] Only with DT3061 controller and 5-point linearization
[5)] Length tolerance cable: nominal value - 0 % / + 30 %
[6)] Weight only sensor without nuts without cable

Additional design: ES-U1-T

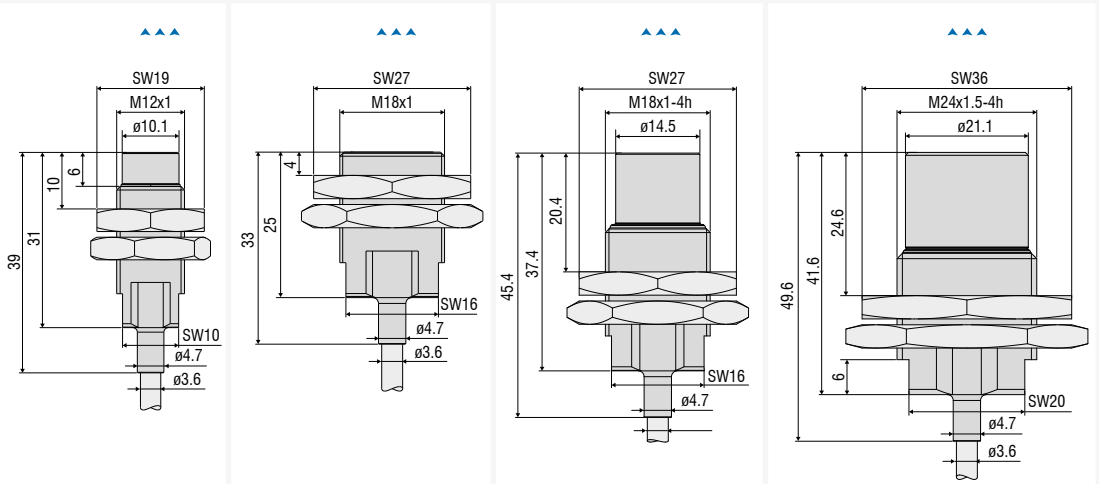


ES-Ux-T design:
Sensors without thread

The ES-Ux-T design are sensors without thread.
These offer additional advantages for installation and temperature stability.

- Thanks to clamp mounting, the cable is not subjected to torsional stress, which prevents damage.
- The sensor has a defined clamping point, which minimizes thermal expansion in the measuring direction and achieves high temperature stability.

▲▲▲ Measurement direction



Modell		ES-U3	ES-S4	ES-U6	ES-U8
Measuring range		3 mm	4 mm	6 mm	8 mm
Start of measuring range		0.3 mm	0.4 mm	0.6 mm	0.8 mm
Resolution [1) 2) 3)]		0.06 µm	0.08 µm	0.12 µm	0.16 µm
Linearity [1) 4)]		< ±3 µm	< ±4 µm	< ±6 µm	< ±8 µm
Temperature stability [1) 2)]		< 0.45 µm / K	< 0.6 µm / K	< 0.9 µm / K	< 1.2 µm / K
Temperature compensation		+10 … +180 °C	+10 … +180 °C	+10 … +180 °C	+10 … +180 °C
Sensor type		unshielded	shielded	unshielded	unshielded
Min. target size (flat)		Ø 36 mm	Ø 27 mm	Ø 54 mm	Ø 72 mm
Connection		integrated cable, axial, standard length 3 m; 1 m, 6 m, 9 m optional [5)]			
Mounting		Cable gland (M12)	Cable gland (M18)	Cable gland (M18)	Cable gland (M24)
Temperature range	Storage	-20 … +200 °C	-20 … +200 °C	-20 … +200 °C	-20 … +200 °C
	Operation	-20 … +200 °C	-20 … +200 °C	-20 … +200 °C	-20 … +200 °C
Pressure resistance		20 bar front and rear			
Shock (DIN EN 60068-2-27)		15 g / 6 ms in 3 axes, 2 directions and 1000 shocks each			
Vibration (DIN EN 60068-2-6)		15 g / 49.85 … 2000 Hz in 3 axes ±3 mm / 10 … 49.85 Hz in 3 axes			
Protection class (DIN-EN 60529)		IP68 (plugged)			
Material		stainless steel and plastic			
Weight [6)]		approx. 12 g	approx. 30 g	approx. 33 g	approx. 62 g

[1)] Valid for operation with DT306x controller, referred to nominal measuring range
[2)] Relates to the mid of the measuring range, in the compensated temperature range
[3)] RMS value of the signal noise, static (20 Hz)
[4)] Only with DT3061 controller and 5-point linearization
[5)] Length tolerance cable: nominal value - 0 % / + 30 %
[6)] Weight only sensor without nuts without cable

Additional design: ES-U3-T

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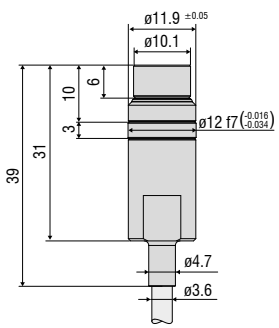
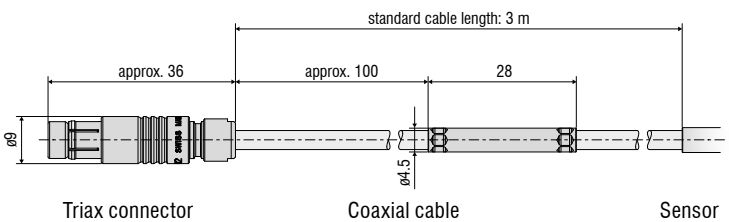


Connection of sensors with integrated cable:



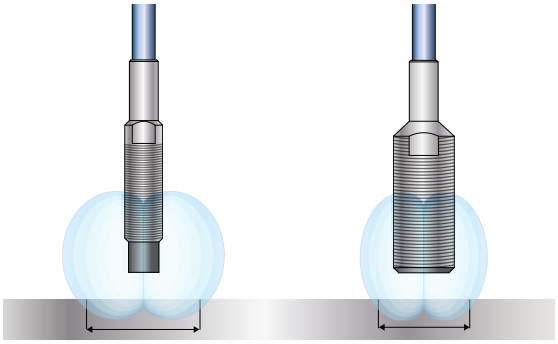
Influences on the measurement signal

Sensor installation

The notes mentioned under "Standard installation situation" for correct sensor installation affect the measurement signal.

Minimum diameter of the target (flat)

The relative size of the target has effects on the linearity deviation. Ideally, the target size with shielded sensors is at least 2 times the sensor diameter, with unshielded sensors it is 4 times the sensor diameter. From this size on, almost all field lines run from the sensor to the target. Here, nearly any field line penetrates the target via the front surface and therefore contributing to the formation of eddy currents. With smaller target diameters, field linearization is recommended.



Unshielded sensor
Measurement spot =
4x sensor diameter

Shielded sensor
Measurement spot =
2x sensor diameter

ø Target = 4x or 2x sensor diameter
recommended (no linearization is required)

ø Target = 3x or 1.5x sensor diameter
requires field linearization (DT306x / DT3300)

Minimum diameter of round targets

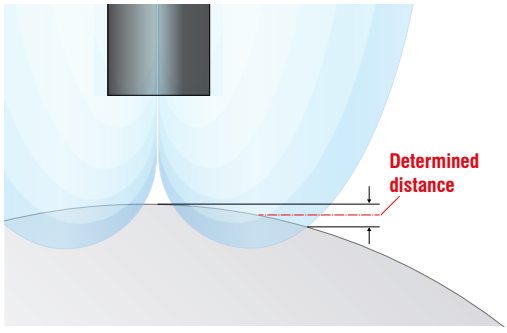
As well as the minimum size for flat geometries, a minimum diameter for round measurement objects is required.

Diameter > 10x sensor diameter
requires field linearization (DT306x / DT3300)

Diameter < 10x sensor diameter
requires factory calibration

Compensating the distance with curved measurement objects

When measuring on curved surfaces such as shafts, the sensors use the medium distance which results from the closest and the most distant field line range. However, this is not the distance between the vertex of the curved target and the sensor. For this reason, eddy current measuring systems from Micro-Epsilon enable the storage of the actual distance in the controller. This is how measurements can be performed on cylindrical objects such as rolls or shafts.



Material and thickness of the target

Stable measurement results require a certain target minimum thickness that depends on the target material used. For one-sided distance measurements, the following standard values are recommended:

Target material	Recommended target thickness
Aluminum	0.504 mm
Lead	1.377 mm
Gold	0.447 mm
Graphite	8.100 mm
Copper	0.402 mm
Magnesium	0.627 mm
Brass	0.747 mm
Nickel	0.081 mm
Permalloy	0.012 mm
Phosphor Bronze	0.906 mm
Silver	0.390 mm
Steel DIN 1.1141	0.069 mm
Steel DIN 1.4005	0.165 mm
Steel DIN 1.4301	2.544 mm

Tilt angle <3°
recommended (no linearization is required)

Tilt angle 3° to 6°
requires field linearization (DT306x / DT3300)

Tilt angle > 6°
requires factory calibration

Tilt angle

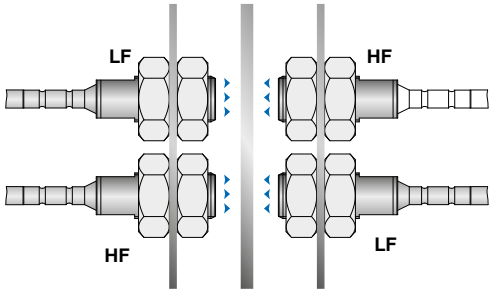
The high accuracy of the eddyNCDT sensors is only achieved with vertical sensor installation. When the sensor or the target are tilted, the measured results slightly deviate from those measured in the vertical position.

The extent of deviation differs from sensor to sensor. The tilt angle of ±3° can be neglected for most of the measurement tasks. With a tilt angle of larger than 6°, factory calibration is recommended. With a 3-point calibration, the tilt angle can be stored in the controller. This compensates for all influences affecting the signal.

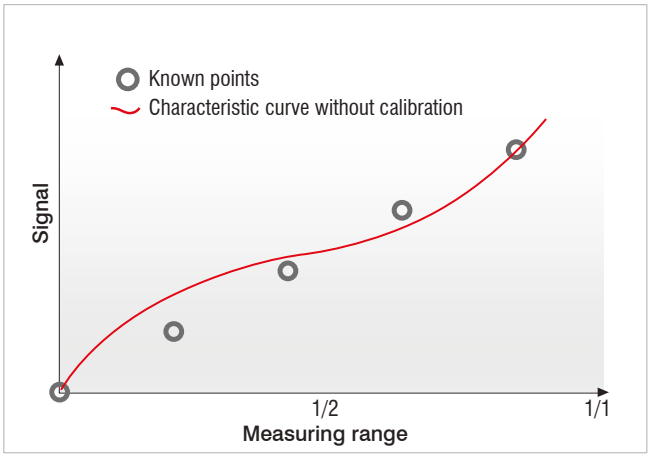
Terms
eddyNCDT

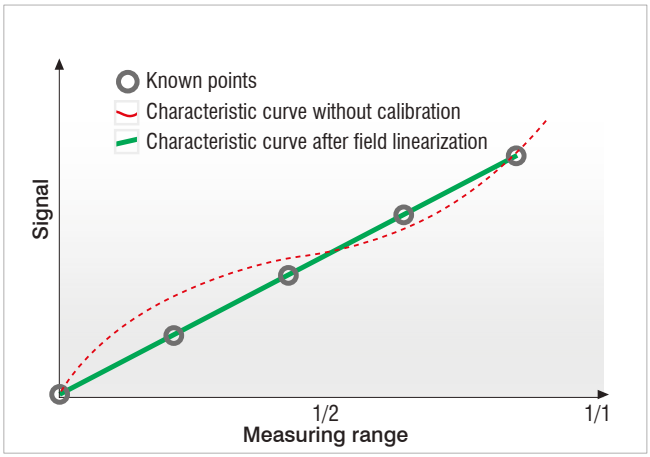
Frequency separation

For operating several eddyNCDT measuring systems, a new frequency separation (LF/HF) is provided. The frequency separation enables multi-channel operation without mutual influence. This function makes a synchronization cable unnecessary.



Field calibration



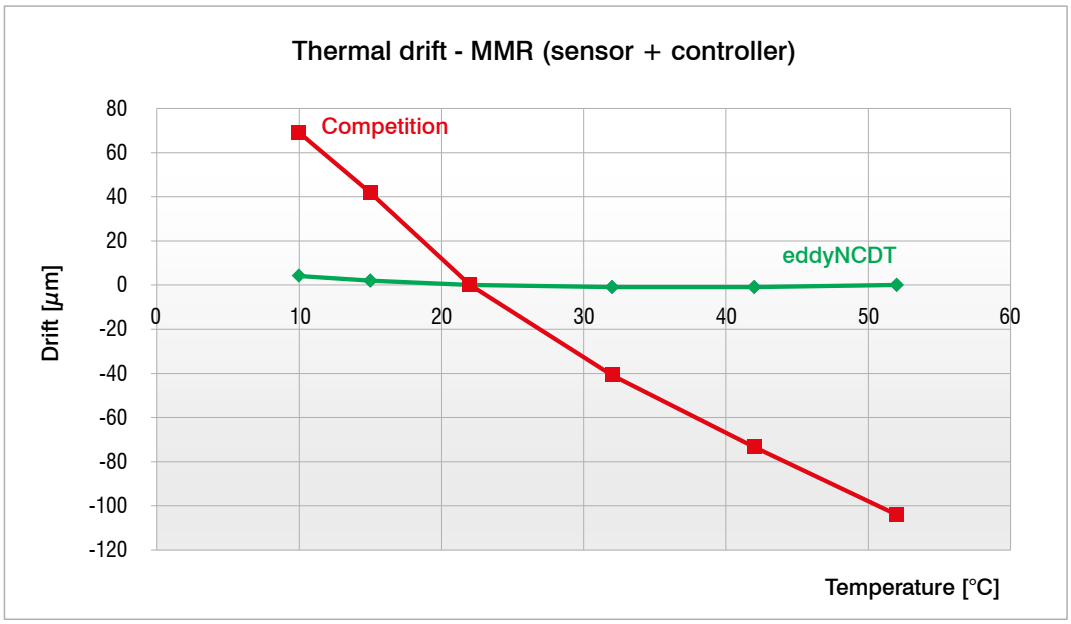


If the installation situation does not correspond to the standard installation conditions, field linearization is recommended (available with eddyNCDT 3060 and eddyNCDT 3300) This on-site calibration compensates for influences which result from the installation scenario or the target materials and shapes. Therefore, optimum measurement accuracies will always be achieved even in the case of difficult installation conditions.

For machine integration, linearization with 2 fixed points (start and end point) is sufficient in most cases. Using 3 or 5 points for linearization enables to increase the accuracy again.

For a linearization with 2 or more points, this applies only within the selected edge points. Outside this range, there may be larger linearity deviations.

Thermal drift of a Micro-Epsilon eddy current system compared with the competitors



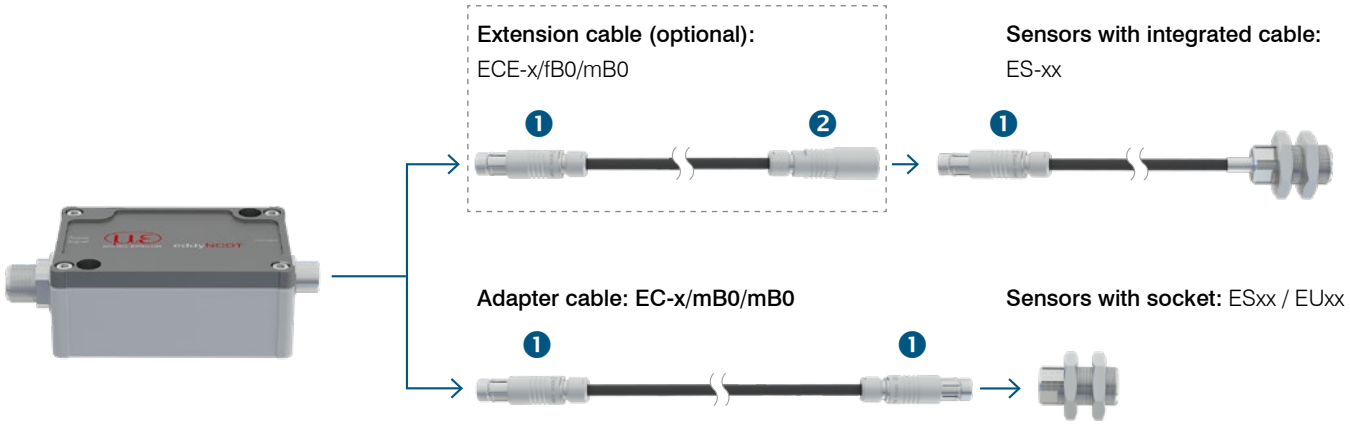
All eddyNCDT sensors and controllers are actively temperature-compensated (sensors up to max. 180 °C, controllers up to max. 50 °C). This means that the temperatures of the sensor and the controller are recorded during operation and considered in the measurement result. Consequently, you get an extremely stable measurement signal.

The temperature curve above compares a Micro-Epsilon sensor (green) with a competitive product (red). The maximum deviation over the entire temperature range is significantly below the 150 ppm/°C specified in the data sheet. Occasionally the deviation for the temperature increase of one degree amounts to a maximum of 150 ppm.

Conclusion: In order to keep precise measurement values in the µm range constant and reliable, the resolution to be achieved and the temperature influence are crucial factors. The temperature stability of the Micro-Epsilon system achieves such a high level that temperature fluctuations are actively compensated for. Due to the higher temperature influence of the competitor system, even daily temperature fluctuations of ±2.5 °C can cause a deviation of >20 µm. Measurements with micrometer accuracy are therefore not possible with the competitor system without active temperature compensation, even in normal environments.

Connection possibilities

Sensors:

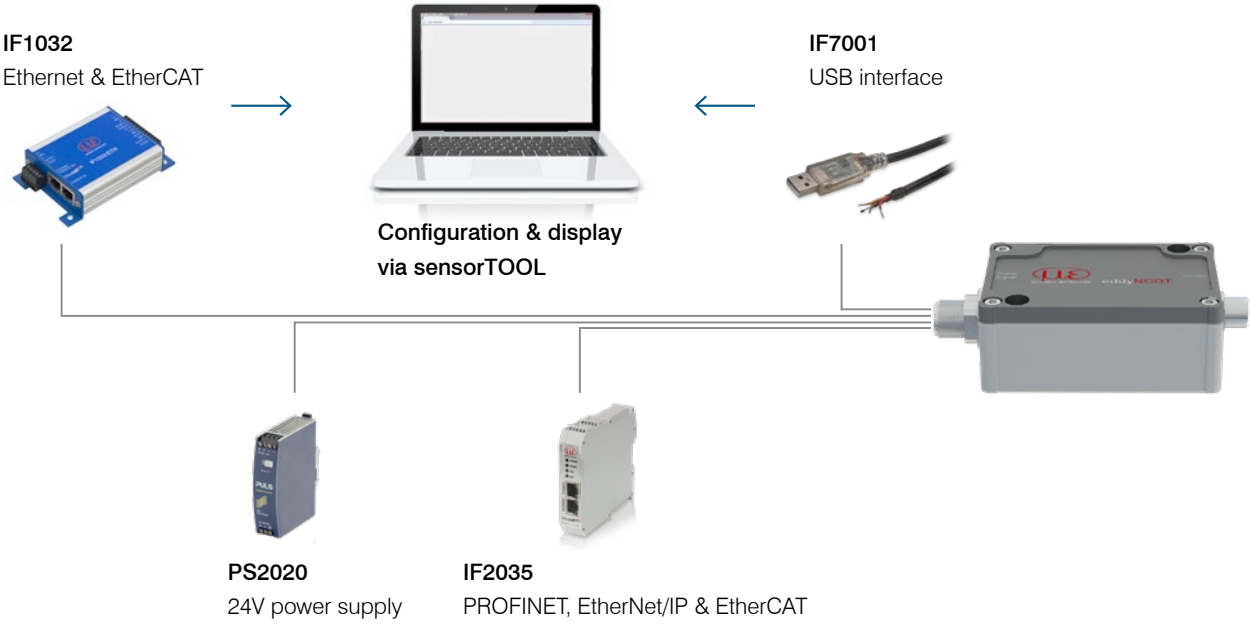


Connector mB0
Outer diameter: 9 mm
Mating length: 26 mm
Temperature resistance: up to 200 °C

Coaxial cable with Viton sheath
Cable diameter: 3.6 mm
Minimum bending radius: static approx. 27 mm / dynamic approx. 54 mm
Temperature resistance: up to 200 °C
Available lengths: 1 m / 3 m / 6 m (9 m on request)

Socket fB0
Outer diameter: 10 mm
Mating length: 35 mm
Temperature resistance: up to 200 °C

Accessories:



Cables:

29011506	PC5/8-M12/105	Supply/output cable, 5 m long, temperature-resistant up to 105 °C
29011159	PC3/8-M12	Supply/output cable, 3 m long
29011141	PC5/8-M12	Supply/output cable, 5 m long
29011058	PC10/8-M12	Supply/output cable, 10 m long
29011285	PC10/8-M12	Supply/output cable, drag-chain suitable, 10 m long

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