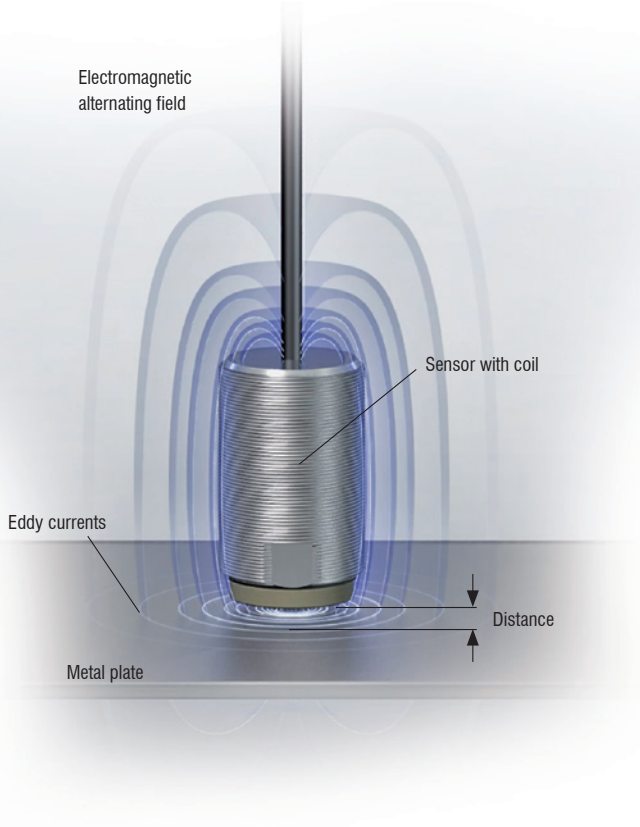
MICRO-EPSILON

More Precision

eddyNCDT // Inductive sensors based on eddy currents

Measuring principle & fields of application
eddyNCDT



Measuring principle

Among inductive displacement sensors, the eddy current principle occupies a unique position. Measuring via eddy current is based on the extraction of energy from an oscillating circuit. This energy is needed for the induction of eddy currents in electrically-conductive materials. Here, a coil is supplied with an alternating current, causing a magnetic field to form around the coil. If an electrically conducting object is placed in this magnetic field, eddy currents are induced which form a field according to Faraday's induction law. This field acts against the field of the coil, which also causes a change in the impedance of the coil. The controller detects the impedance as a change in amplitude and phase of the sensor coil.

High precision measurement using inductive displacement sensors based on eddy currents

For many years, Micro-Epsilon has been a pioneer in displacement measurement using the eddy current technology. The eddyNCDT displacement sensors are designed for the non-contact measurement of displacements, distances, positions, oscillation and vibrations. Considered as extremely precise and robust, they are preferably used in industrial environments.

Advantages

- Wear-free and non-contact measurement
- Highest precision and resolution
- High temperature stability
- Ferromagnetic and non-ferromagnetic materials
- For demanding, industrial environments: dirt, pressure, temperature
- Fast measurements up to 20 kHz

Overview

Industrial displacement measurement with highest precision
eddyNCDT

Robust sensors with maximum precision

Eddy current sensors from Micro-Epsilon are often used in applications requiring maximum precision in harsh enviorenmental conditions. They are characterized by immunity to dirt, pressure and extreme temperature.

Advantages over conventional inductive sensors

- High frequency response for dynamic measurements
- High resolution in the submicron range
- High linearity and temperature stability
- Measurement of ferromagnetic and non-ferromagnetic targets

Extensive range of models

- More than 400 sensor models
- Miniature sensors smaller than 2 mm
- Customized adaptions and OEM

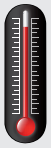
Oil Dust Dirt Water Vapors

Resistant to media in the measuring gap

- Protection class IP67
- Pressure-resistant versions up to 2000 bar

Measuring ranges 0.5 mm to 80 mm

St 37 Al **Factory-calibrated for 100% FSO of steel or aluminum (other alloys also possible)**



Best temperature stability in the world

- Active temperature compensation of sensor and controller
- Temperature range -40 °C to 200 °C and higher

Specific sensors for OEM applications

Application examples are often found where the standard versions of the sensors and the controllers are performing at their limits. For these special tasks, we modify your measuring system according to your individual requirements. Changes requested include, for example, modified designs, target calibration, mounting options, individual cable lengths, modified measuring ranges or sensors with integrated controller.

Standard installation situation

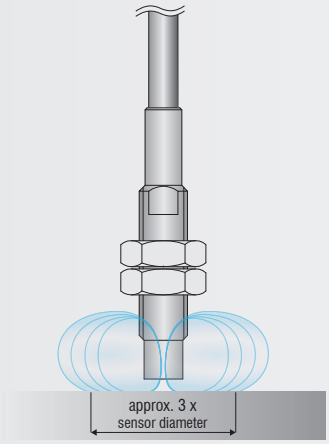
Each eddyNCDT sensor is factory-calibrated under standardized installation conditions. These installation conditions involve mounting, positioning of the nut and surrounding materials. Deviations installation situations may affect the linearity and accuracy. Field linearization or special tuning in the factory may counteract this effect.

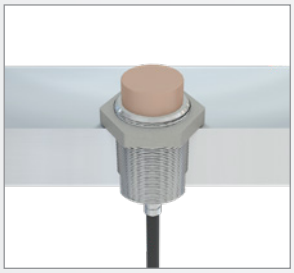
Standard target materials

eddyNCDT sensors are factory-calibrated for the following materials:

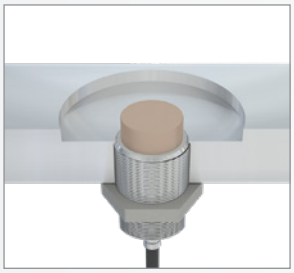
Ferromagnetic target:	Steel (St37) DIN1.0037
Non-ferromagnetic target:	Aluminum AlMg3 DIN3.3535

Customer-specific adjustment for other materials is also possible.

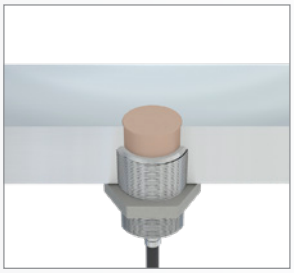




Standard installation with unshielded sensors
no linearization required



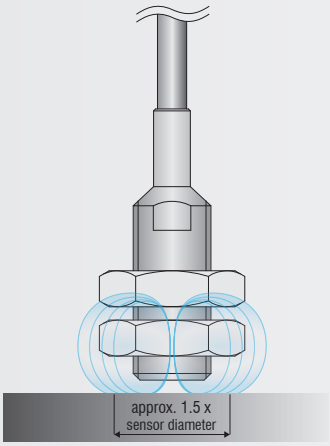
Installation of unshielded sensors in a recess
requires field linearization (DT306x / DT3300)



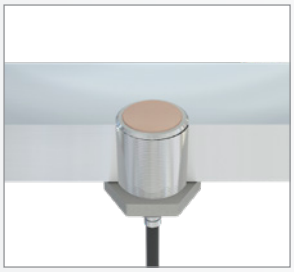
Flush installation with unshielded sensors
requires factory calibration

Unshielded sensors (e.g. EU1)

Unshielded sensors are more compact than shielded sensors with the same measuring range. With unshielded sensors, the field lines emerge also at the side of the sensor which extends its measuring range. Nevertheless, the sensor design remains compact. The measurement spot is approximately three times the sensor diameter.



Standard installation with shielded sensors
no linearization required



Flush installation with shielded sensors:
requires field linearization (DT306x / DT3300)

Shielded sensors (e.g. ES1)

Shielded sensors are larger than unshielded sensors with the same measuring range. A separate sheath enables a narrower distribution of the field lines, which makes them insensitive to radially adjacent metals. The measurement spot is approximately one and a half times the sensor diameter.

Compact eddy current sensor with integrated controller
eddyNCDT 3001

- Compact M12 design with integrated controller
- Frequency response 5 kHz (-3dB)
- Measuring rate 75 kSa/s
- Versions for ferro- and non-ferromagnetic targets
- Temperature compensation up to 70 °C
- Easy operation (plug and play)
- Robust design IP67

Robust M12 miniature eddy current sensor

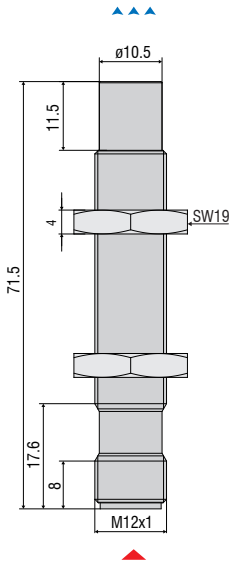
The two eddyNCDT 3001 U2 and U4 models are powerful eddy current sensors whose compact dimensions have to date only been reserved for inductive sensors and proximity sensors. These compact sensors are equipped with an integrated controller including temperature compensation while offering an excellent price-performance ratio, as well as easy operation. Therefore, the sensors are ideally suited to OEM integration and machine building applications.

The temperature-compensated design provides high stability even when surrounded by fluctuating ambient temperatures. The sensors are factory-calibrated for ferromagnetic and non-ferromagnetic materials, which eliminates the need for on-site linearization of the sensor. Its robust design combined with the eddy current measuring principle enables measurements in harsh industrial environments (oil, pressure, dirt). In addition, the eddyNCDT 3001 is suitable for offshore/marine applications (salt water).

Model		DT3001-U2-A-SA	DT3001-U2-M-SA	DT3001-U4-A-SA	DT3001-U4-M-SA	DT3001-U4-A-Cx	DT3001-U4-M-Cx
Measuring range		2 mm		4 mm			
Start of measuring range		0.4 mm					
Resolution [1]		4 µm					
Frequency response (-3dB)		5 kHz					
Measuring rate	Analog output	75 kSa/s (16 bit)					
Linearity		< ±28 µm					
Temperature stability [2]		< 0.6 µm / K		< 1.2 µm / K			
Temperature compensation		0 …+70 °C					
Sensor type		unshielded					
Min. target size (flat)		Ø 48 mm					
Target material [3]		Aluminum	Steel	Aluminum	Steel	Aluminum	Steel
Supply voltage		12 … 32 VDC					
Power consumption		0.5 W					
Analog output		0.5 ... 9.5 V				0.5 ... 4.5 V	
Connection		Supply/signal: 5-pole M12 connector (cable see accessories)				integrated cable, 5-pin, lengths: 3/6/9 m	
Temperature range	Storage	-20 … +80 °C					
	Operation	0 …+70 °C					
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)				IP67	
Weight		25 g				60 g (3 m) 100 g (6 m) 140 g (9 m)	

[1] RMS noise relates to mid of measuring range at a frequency response of 5 kHz
[2] Values are referenced to the mid of the measuring range within the compensated temperature range
[3] Steel: St37 steel DIN1.0037; aluminum: AlMg3

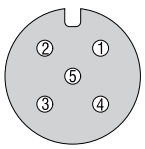
DT3001-U2-SA
DT3001-U4-SA



Pin assignment for power supply and signal

Pin	Assignment	Color (cable: PCx/5-M12)
1	Supply +24 V	Brown
2	Displacement signal	White
3	GND	Blue
4	assigned internally	Black
5	assigned internally	Gray

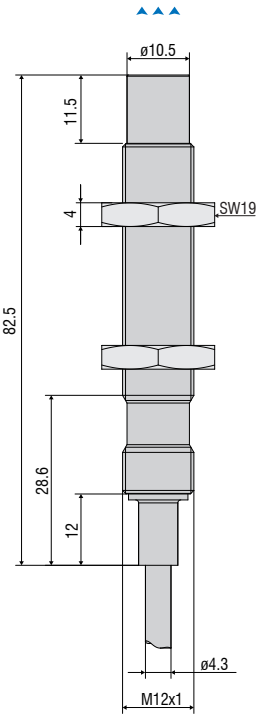
5-pole M12x1 housing connector
View on pin side



Measurement direction Connector side

All dimensions in mm, not to scale

DT3001-U4-Cx



Pin assignment of integrated supply and signal cable

Assignment	Cable color
Supply +24 V	Brown
Displacement signal	Green
GND	White
assigned internally	Yellow
assigned internally	Gray

Compact eddy current sensor with integrated controller
eddyNCDT 3001

- Compact M18 design with integrated controller
- Frequency response 5 kHz (-3dB)
- Measuring rate 75 kSa/s
- Versions for ferro- and non-ferromagnetic targets
- Temperature compensation up to 70 °C
- Easy operation (plug and play)
- Robust design IP67

Robust miniature sensors in M18 housing

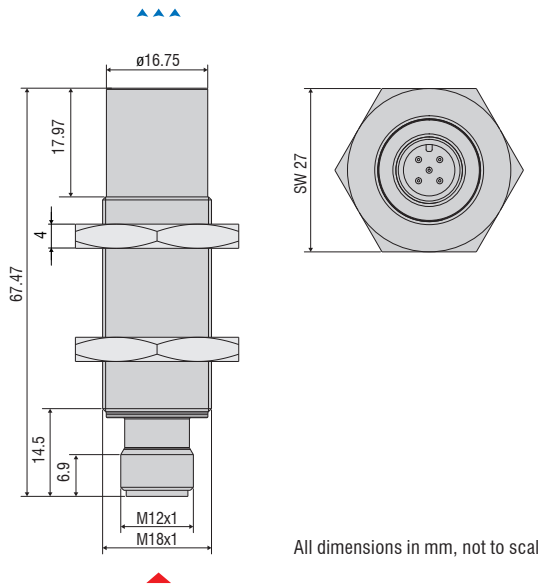
The U6 and U8 models of the eddyNCDT 3001 series are powerful eddy current sensors with integrated controller in an M18 design. Calibrated for ferromagnetic and non-ferromagnetic materials, these compact sensors offer measuring ranges of 6 mm or 8 mm.

As these sensors are temperature-compensated, they provide high signal stability even in fluctuating ambient temperatures. Due to their robust design, these sensors are used for measurement tasks in harsh, industrial environments.

Model		DT3001-U6-A-SA	DT3001-U6-M-SA	DT3001-U8-A-SA	DT3001-U8-M-SA
Measuring range		6 mm		8 mm	
Start of measuring range		0.6 mm		0.8 mm	
Resolution [1]		3 µm		4 µm	
Frequency response (-3dB)		5 kHz			
Measuring rate	Analog output	75 kSa/s (16 bit)			
Linearity		< ±15 µm		< ±20 µm	
Temperature stability [2]		< 1.5 µm / K		< 2 µm / K	
Temperature compensation		0 … +70 °C			
Sensor type		unshielded			
Min. target size (flat)		Ø 72 mm			
Target material [3]		Aluminum	Steel	Aluminum	Steel
Supply voltage		12 … 32 VDC			
Power consumption		0.6 W			
Analog output		0.5…9.5 V			
Connection		Supply/signal: 5-pole M12 connector (cable see accessories)			
Temperature range	Storage	-20 … +70 °C			
	Operation	-20 … +70 °C			
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)			
Weight		approx. 35 g (without nuts)			

[1] RMS noise relates to mid of measuring range at a frequency response of 5 kHz
[2] Values are referenced to the mid of the measuring range within the compensated temperature range
[3] Steel: St37 steel DIN1.0037; aluminum: AlMg3

DT3001-U6-SA
DT3001-U8-SA

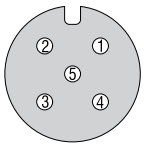


All dimensions in mm, not to scale

Pin assignment for power supply and signal

Pin	Assignment	Color (cable: PCx/5-M12)
1	Supply +24 V	Brown
2	Analog output	White
3	GND	Blue
4	assigned internally	Black
5	assigned internally	Gray

5-pole M12x1 housing connector
View on pin side



Measurement direction Connector side

Compact eddy current measuring system
eddyNCDT 3005

- Compact and robust design
- Temperature compensation up to 180 °C
- High measurement accuracy
- Frequency response 5 kHz (-3dB)
- Measuring rate 75 kSa/s
- Versions for ferromagnetic and non-ferromagnetic targets
- Robust design IP67

Robust eddy current measuring system

The eddyNCDT 3005 is a powerful eddy current measuring system for fast, high precision displacement measurements. The system comprises a compact controller, a sensor and an integrated cable and is factory-calibrated for ferromagnetic and non-ferromagnetic materials.

As sensor and controller are temperature-compensated, high measurement accuracies can be achieved even in fluctuating temperatures. The sensors are designed for ambient temperatures up to max. +125 °C but can optionally be custom engineered for temperatures from -20 °C to 180 °C. The measuring system is pressure-resistant up to 10 bar and so is ideally suited to machine integration.

Integration into plant and machinery

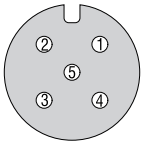
The eddyNCDT 3005 provides ease of use and high measurement accuracy, offering an outstanding price-performance ratio. Therefore, the sensor is ideal for OEM integration and serial applications in machine building, particularly where pressure, dirt, oil and high temperatures are present. When large quantities are required, customer-specific designs can be tailored to suit individual requirements.

Its compact M12 design allows for the controller to be easily installed in restricted and difficult-to-access places.

Pin assignment for power supply and signal

Pin	Assignment	Color (cable: PCx/5-M12)
1	Supply +24 V	Brown
2	Displacement signal	White
3	GND	Blue
4	RS485 A+	Black
5	RS485 B-	Gray

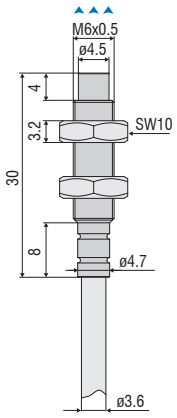
5-pole M12x1 housing connector
View on pin side



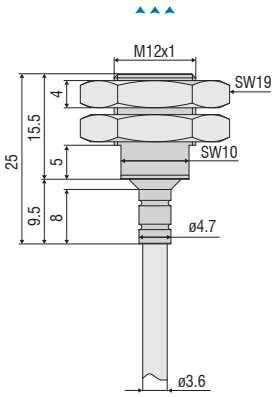
Model		DT3005-U1-A-C1	DT3005-U1-M-C1	DT3005-S2-A-C1	DT3005-S2-M-C1	DT3005-U3-A-C1	DT3005-U3-M-C1	DT3005-U6-A-C1	DT3005-U6-M-C1
Measuring range		1 mm		2 mm		3 mm		6 mm	
Start of measuring range		0.1 mm		0.2 mm		0.3 mm		0.6 mm	
Resolution [1]		0.5 µm		1 µm		1.5 µm		3 µm	
Frequency response (-3dB)		5 kHz							
Measuring rate	Analog output	75 kSa/s (16 bit)							
	Digital interface	1 kSa/s (16 bit)							
Linearity		< ±2.5 µm		< ±5 µm		< ±7.5 µm		< ±15 µm	
Repeatability		< 0.5 µm		< 1 µm		< 1.5 µm		<3 µm	
Temperature stability [2]	Sensor	< 0.25 µm / K		< 0.5 µm / K		< 0.75 µm / K		< 1.5 µm / K	
	Controller	< 0.25 µm / K		< 0.5 µm / K		< 0.75 µm / K		< 1.5 µm / K	
Temperature compensation	Sensor	+10 … +125 °C (optional -20 … +180 °C)							
	Controller	+10 … +60 °C (optionally -20 ... +70 °C)							
Sensor type		unshielded		shielded		unshielded		unshielded	
Min. target size (flat)		Ø 24 mm		Ø 24 mm		Ø 48 mm		Ø 72 mm	
Target material [3]		Aluminum	Steel	Aluminum	Steel	Aluminum	Steel	Aluminum	Steel
Supply voltage		12 … 32 VDC							
Power consumption		0.6 W							
Digital interface [4]		RS485 / USB / Ethernet / EtherCAT / PROFINET / EtherNet/IP							
Analog output		0.5…9.5 V							
Connection		Sensor: integrated cable, length 1 m, min. bending radius 27 mm (static) Supply/signal: 5-pin M12 connector (cable see accessories							
Temperature range	Storage	-20 … +80 °C							
	Operation	Sensor: -20 … +125 °C (optional -20 … +180 °C), controller: -20 … +70 °C							
Pressure resistance		10 bar (sensor, cable and controller on the front), controller on the rear IP67 (plugged in)							
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							
Weight [5]		approx. 70 g		approx. 75 g		approx. 77 g		approx. 95 g	

[1] RMS noise relates to mid of measuring range at a frequency response of 5 kHz
[2] Values are referenced to the mid of the measuring range within the compensated temperature range
[3] Steel: St37 steel DIN1.0037; aluminum: AlMg3 Steel: St37 steel DIN1.0037; aluminum: AlMg3
[4] USB, Ethernet, EtherCAT, PROFINET and EtherNet/IP require an interface module connection
[5] Total weight for controller, cable and sensor

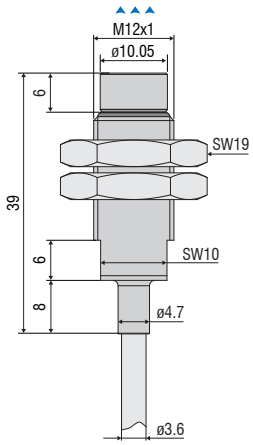
DT3005-U1



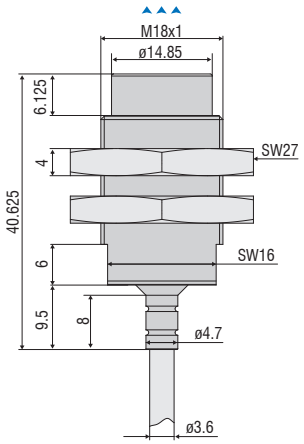
DT3005-S2



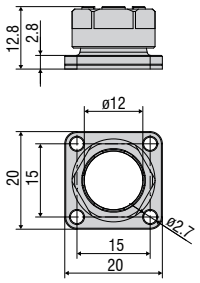
DT3005-U3



DT3005-U6

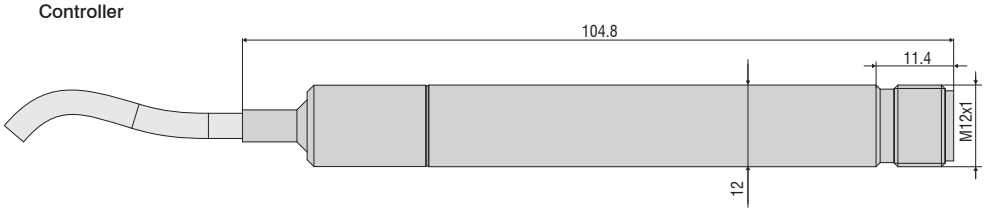


Clamping flange (optional)
Art. no.: 0801058



Measurement direction

Controller



All dimensions in mm, not to scale

Robust eddy current measuring system for industrial series applications
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 rolling processes or in die casting systems.

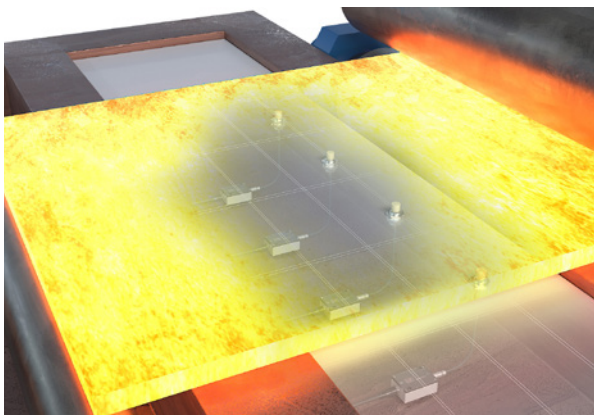
Due to the extremely high temperature resistance of the sensor (up to 200 °C) and controller (up to 105 °C), the complete measuring channel can be used at high ambient temperatures, which reduces temperature influences on the cable and increases measuring accuracy. Digital or analog interfaces also transmit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

Wide sensor portfolio and simple setup

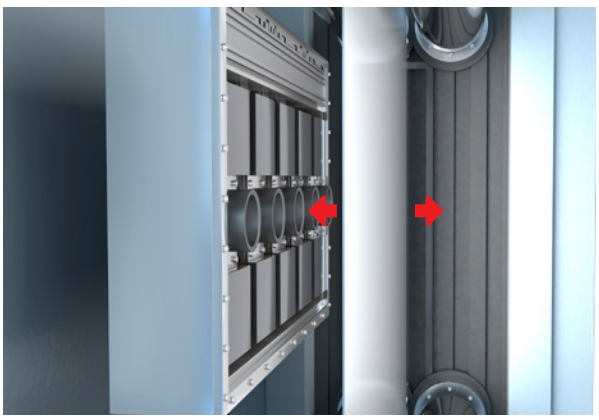
The combination of this controller and the extensive sensor portfolio covers measuring ranges from 1 to 80 mm.

The system can be configured very easily using the sensorTOOL, which offers great flexibility in use thanks 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



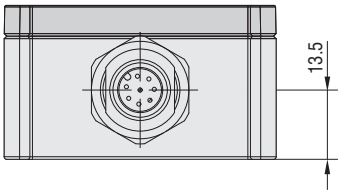
Flatness measurement during flat rolling of crude steel

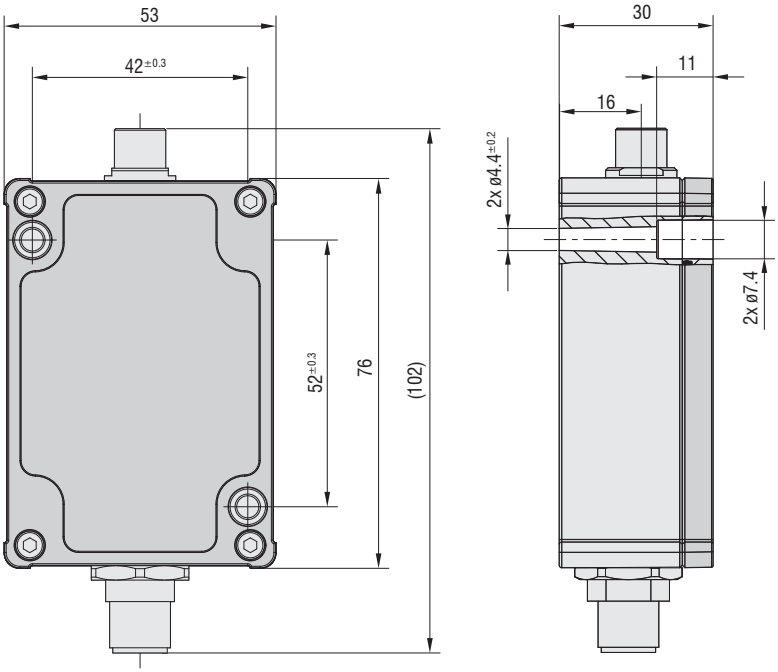


Distance measurement for stabilizing metal strips, e.g. in the galvanizing process

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)
Digital outputs		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 within 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 a PC via an interface module

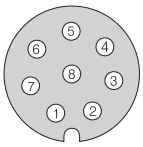




Pin assignment for power supply and signal

Pin	Assignment	Color (Cable: PC5/8-M12/105)
1	Not assigned	White
2	Supply: +24 V	Brown
3	Digital outputs	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



Powerful eddy current system for precise displacement measurement
eddyNCDT 3060

- Wide range of applications with more than 400 sensor models
- Extremely high temperature stability
- High resolution and linearity
- Frequency response 20 kHz (-3dB)
- Measuring rate 200 kSa/s
- Versions for ferromagnetic and non-ferromagnetic targets
- Analog output (U/I) digital output
- Intuitive configuration via web interface

High performance for the industry

The eddyNCDT 3060 is a powerful, inductive sensor system based on eddy currents for fast, high precision displacement measurements. The system comprises a compact controller, a sensor and an integrated cable and is factory-calibrated either for ferromagnetic or non-ferromagnetic materials.

Integration into plant and machinery

As sensor and controller are temperature-compensated, a high measurement accuracy can be achieved even in fluctuating temperatures. The sensors are designed for ambient temperatures up to a maximum of +200 °C and an ambient pressure up to 20 bar. The compact controller design as well as the sensor robustness make the measuring system ideal for integration into plant and machinery.

New benchmark in controller technology

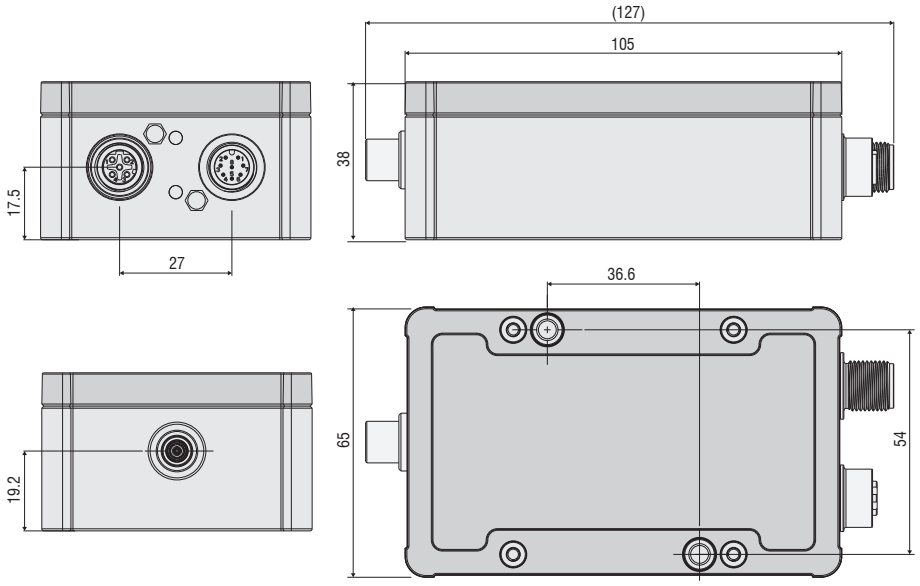
The industrial-grade M12 Ethernet interface offers a modern fieldbus connection. Configurable analog outputs enable to output the measured values as voltage or current. For multi-system operation, the systems offer a new kind of frequency separation (LF/HF) which enables to operate several sensors next to one another without requiring any synchronization.

Features	Controller type	
	DT3060	DT3061
Active temperature compensation for sensor and controller	✔	✔
Frequency separation (LF & HF)	✔	✔
Ethernet interface	✔	✔
Intuitive web interface	✔	✔
Multipoint calibration regardless of the distance (up to 3-point calibration)	✔	✔
Scalable measuring range via analog output (teach function)	✔	✔
Scalable analog output	✔	✔
Switching and temperature outputs	-	✔
5-point calibration	-	✔
Storage of multiple characteristic curves	-	✔

When connecting a PC via the Ethernet interface, a modern web interface can be accessed without any further installation and enables the parameterization of sensor and controller. The DT3061 controller provides enhanced features such as 5-point calibration, setting of switching and temperature outputs, as well as storage of multiple characteristic curves.

Model		DT3060	DT3061
Resolution [1]	Static (20 Hz)	0.002 % FSO	
	Dynamic (20 kHz)	0.01 % FSO	
Frequency response (-3dB)		selectable (20 kHz, 5 kHz, 20 Hz)	
Measuring rate	Analog output	200 kSa/s (16 bit)	
	Digital interface	50 kSa/s (16 bit)	
Linearity [2]		< ±0.2 % FSO	< ±0.1 % FSO
Temperature stability [3]		< 0.015 % FSO / K	
Temperature compensation		+10 … +50 °C	
Target material [4]		Steel, aluminum	
No. of characteristic curves		1	max. 4
Supply voltage		12 … 32 VDC	
Power consumption		typ. 2.5 W (max. 2.8 W)	
Digital interface		Ethernet	Ethernet / selectable: switching output (TTL), temperature output (0...5 V)
Analog output		0 … 10 V; 4 … 20 mA (short circuit proof)	
Connection		Sensor: pluggable cable via triaxial socket; supply/signal: 8-pole M12 connector; Ethernet: 5-pole M12 connector (cable see accessories)	
Mounting		Through bores	
Temperature range	Storage	-10 … +70 °C	
	Operation	0 … +50 °C	
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. 230 g	

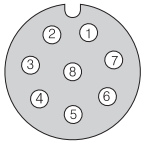
FSO = Full Scale Output
[1] RMS noise relates to mid of measuring range
[2] Value with 3-/5-point linearization
[3] Values are referenced to the mid of the measuring range within the compensated temperature range
[4] Steel: St37 steel DIN1.0037; aluminum: AlMg3



Pin assignment IN/OUT/24V IN

Pin	Assignment	Color (cable: PCx/8-M12)
1	Analog output $U_{Displacement}$	White
2	Supply +24 V	Brown
3	Limit value 1 / U_{Temp} sensor	Green
4	Limit value 2 / U_{Temp} controller	Yellow
5	GND Temperature, limit value	Gray
6	GND analog output	Pink
7	GND supply	Blue
8	Analog output $I_{Displacement}$	Red

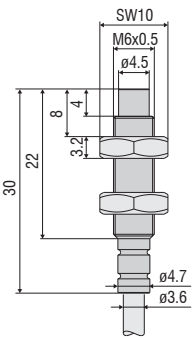
8-pole M12x1 housing connector
View on pin side

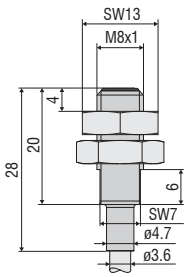


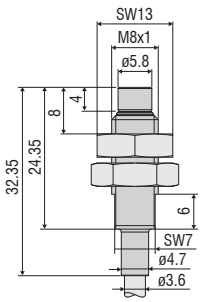
All dimensions in mm, not to scale

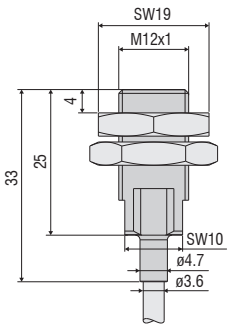
Standard sensors
eddyNCDT 3020 / 3060

Measurement direction





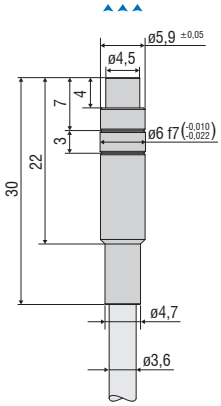




Model		ES-U1	ES-S1	ES-U2	ES-S2
Measuring range		1 mm	1 mm	2 mm	2 mm
Start of measuring range		0.1 mm	0.1 mm	0.2 mm	0.2 mm
Resolution [1] [2] [3]		0.02 µm	0.02 µm	0.04 µm	0.04 µm
Linearity [1] [4]		< ±1µm	< ±1µm	< ±2 µm	< ±2 µm
Temperature stability [1] [2]		< 0.15 µm / K	< 0.15 µm / K	< 0.3 µm / K	< 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; optionally 1 m, 6 m, 9 m [5]			
Mounting		Screw connection (M6)	Screw connection (M8)	Screw connection (M8)	Screw connection (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 & 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, referenced to the nominal measuring range
[2] Relates to the mid of the measuring range within 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 of sensor only, without nuts or cables

Additional design: ES-U1-T



ES-Ux-T design:

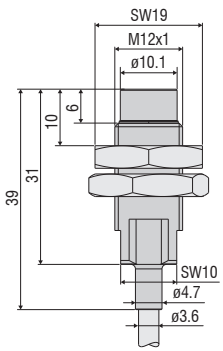
Sensors without threads

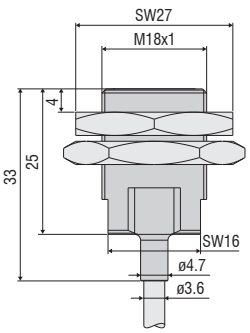
The ES-Ux-T design are sensors without threads.

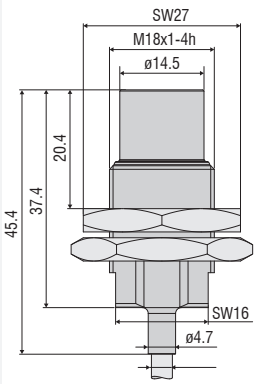
These offer additional advantages for installation and temperature stability.

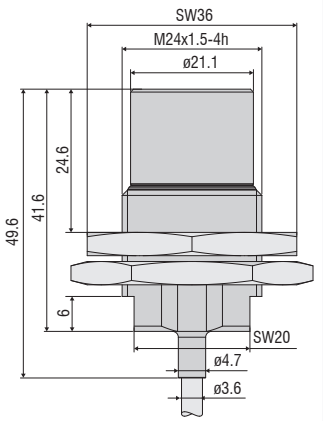
- Thanks to clamp mounting, the cable is not subjected to torsional stress, which prevents damage.
- The sensor has a defined clamping point, which minimizes thermal expansion in the measuring direction and enables high temperature stability.

Measurement direction





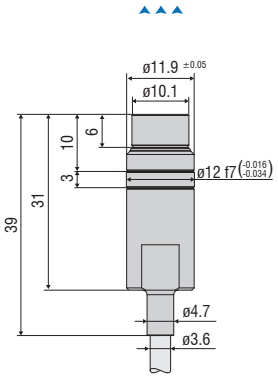




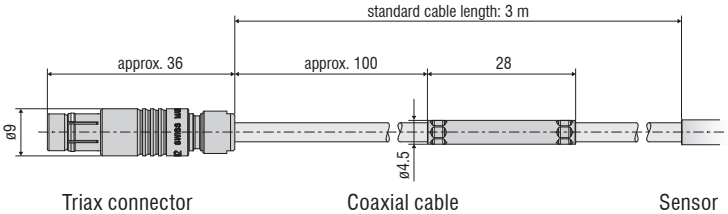
Model		ES-U3	ES-S4	ES-U6	ES-U8
Measuring range		3 mm	4 mm	6 mm	8 mm
Start of measuring range		0.3 mm	0.4 mm	0.6 mm	0.8 mm
Resolution [1] [2] [3]		0.06 µm	0.08 µm	0.12 µm	0.16 µm
Linearity [1] [4]		< ±3 µm	< ±4 µm	< ±6 µm	< ±8 µm
Temperature stability [1] [2]		< 0.45 µm / K	< 0.6 µm / K	< 0.9 µm / K	< 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; optionally 1 m, 6 m, 9 m [5]			
Mounting		Screw connection (M12)	Screw connection (M18)	Screw connection (M18)	Screw connection (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 & 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, referenced to the nominal measuring range
[2] Relates to the mid of the measuring range within 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 of sensor only, without nuts or cables

Additional design: ES-U3-T



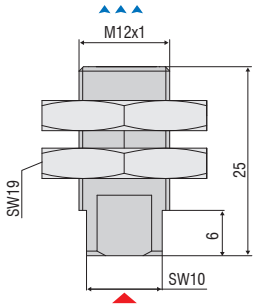
Connection of sensors with integrated cable:



Special sensors
eddyNCDT 3020 / 3060

Measurement direction

Connector side



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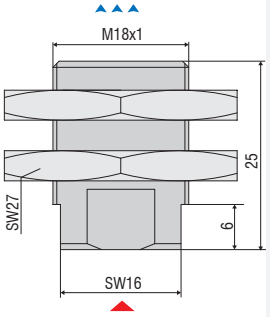

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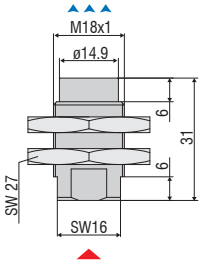
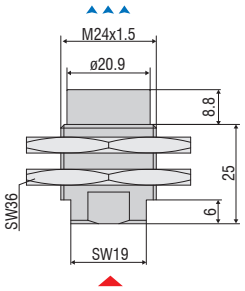


1:2



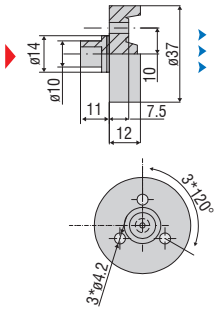
1:2

Model	ES2	ES4	EU6	EU8
Measuring range	2 mm	4 mm	6 mm	8 mm
Start of measuring range	0.2 mm	0.4 mm	0.6 mm	0.8 mm
Resolution [1] [2] [3]	0.04 µm	0.08 µm	0.12 µm	0.16 µm
Linearity [1] [4]	< 2 µm	<4 µm	6 µm	8 µm
Temperature stability [1] [2] [4]	0.5 µm / K	1 µm / K	1.5 µm / K	2 µm / K
Temperature compensation [4]	0 ... +150 °C	0 … +150 °C	0 … +150 °C	0 … +150 °C
Sensor type	shielded	shielded	unshielded	unshielded
Min. target size (flat)	Ø 18 mm	Ø 27 mm	Ø 54 mm	Ø 72 mm
Connection	Plug connection via triaxial socket	Plug connection via triaxial socket	Plug connection via triaxial socket	Plug connection via triaxial socket
Mounting	Screw connection (M12)	Screw connection (M18)	Screw connection (M18)	Screw connection (M24)
Temperature range – Storage	-20 ... +150 °C	-20 ... +150 °C	-20 ... +150 °C	-20 ... +150 °C
Temperature range – Operation	-20 … +150 °C	0 … +150 °C	-20 … +150 °C	0 … +150 °C
Pressure resistance	20 bar (front)	20 bar (front)	20 bar (front)	20 bar (front)
Protection class (DIN EN 60529)	IP64 (plugged)	IP50 (plugged)	IP64 (plugged)	IP64 (plugged)
Material	Stainless steel and plastic	Stainless steel and plastic	Stainless steel and plastic	Stainless steel and plastic

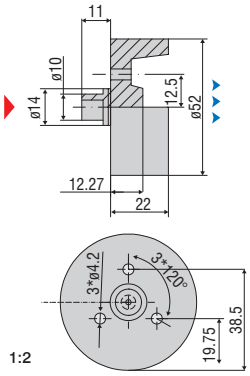
Operation with DT3020/306x requires special calibration (LC)
[1] Valid for operation with DT306x referenced to the nominal measuring range
[2] Relates to mid of measuring range
[3] RMS value of the signal noise, static (20 Hz)
[4] Only with DT3061 controller and 5-point linearization

Measurement direction

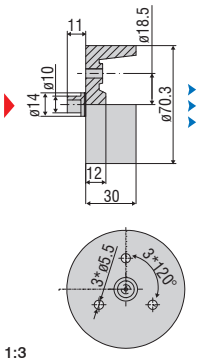
Connector side



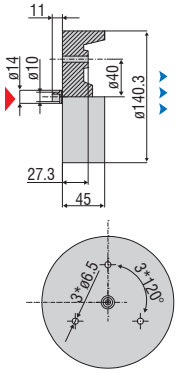
1:3



1:2



1:3



1:8

Model	EU15	EU22	EU40	EU80
Measuring range	15 mm	22 mm	40 mm	80 mm
Start of measuring range	1.5 mm	2.2 mm	4 mm	8 mm
Resolution [1] [2] [3]	0.3 µm	0.44 µm	0.8 µm	1.6 µm
Linearity [1] [4]	< ±15 µm	< ±22 µm	< ±40 µm	< ±80 µm
Temperature stability [1] [2] [4]	< 3.75 µm / K	< 5.5 µm / K	< 10 µm / K	< 20 µm / K
Temperature compensation [4]	0 … +150 °C	0 … +150 °C	0 … +150 °C	0 … +150 °C
Sensor type	unshielded	unshielded	unshielded	unshielded
Min. target size (flat)	Ø 111 mm	Ø 156 mm	Ø 210 mm	Ø 420 mm
Connection	Plug connection via triaxial socket	Plug connection via triaxial socket	Plug connection via triaxial socket	Plug connection via triaxial socket
Mounting	3 x through-holes	3 x through-holes	3 x through-holes	3 x through-holes
Temperature range – Storage	-20 ... +150 °C	-20 ... +150 °C	-20 ... +150 °C	-20 ... +150 °C
Temperature range – Operation	0 … +150 °C	0 … +150 °C	0 … +150 °C	0 … +150 °C
Protection class (DIN EN 60529)	IP64 (plugged)	IP64 (plugged)	IP64 (plugged)	IP64 (plugged)
Material	Epoxy	Epoxy	Epoxy	Epoxy

Operation with DT3020/306x requires special calibration (LC)

[1] Valid for operation with DT306x referenced to the nominal measuring range

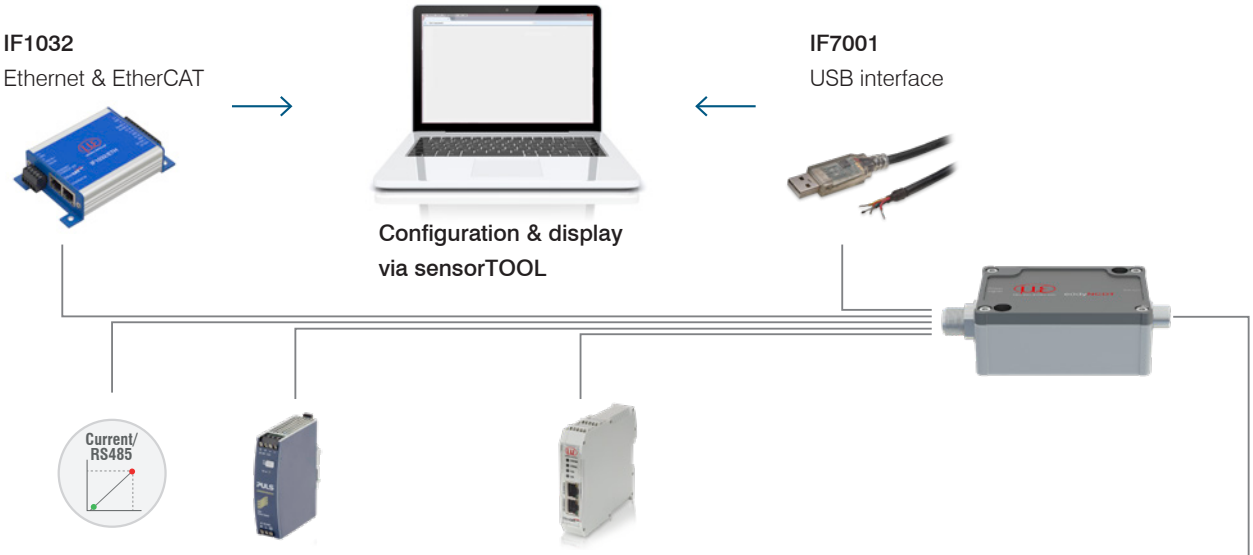
[2] Relates to mid of measuring range

[3] RMS value of the signal noise, static (20 Hz)

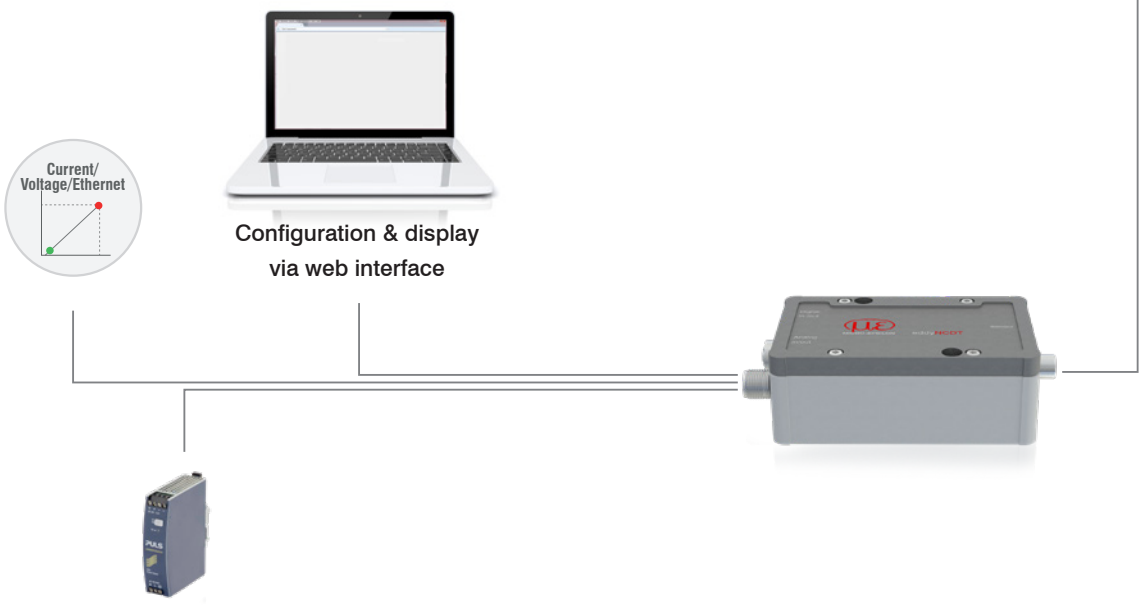
[4] Only with DT3061 controller and 5-point linearization

Connection possibilities
eddyNCDT 3020 / 3060

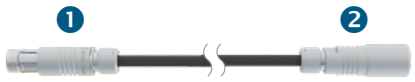
Connection possibilities DT3020



Connection possibilities DT3060



Extension cable (optional):
ECE-x/fB0/mB0



Sensors with integrated cable:
ES-xx

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)

Adapter cable: EC-x/mB0/mB0

Sensors with socket: ESxx / EUxx

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

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

Powerful eddy current measuring system for miniature sensors
eddyNCDT 3070

- Wide range of applications with multiple sensor models
- Extremely high temperature stability
- High resolution and linearity
- Frequency response 20 kHz (-3dB)
- Measuring rate 200 kSa/s
- Versions for ferromagnetic and non-ferromagnetic targets
- Analog output (U/I) digital output
- Intuitive configuration via web interface

High performance for the industry

The eddyNCDT 3070 is a powerful, inductive sensor system based on eddy currents for measuring ranges smaller than 1 mm. The system comprises a compact controller, a sensor and an integrated cable and is factory-calibrated either for ferromagnetic or non-ferromagnetic materials.

Integration into plant and machinery

As sensor and controller are temperature-compensated, a high measurement accuracy can be achieved even in fluctuating temperatures. The sensors are designed for ambient temperatures up to a maximum of +200 °C and an ambient pressure up to 700 bar. The compact controller design as well as the sensor robustness make the measuring system ideal for integration into plant and machinery.

New benchmark in controller technology

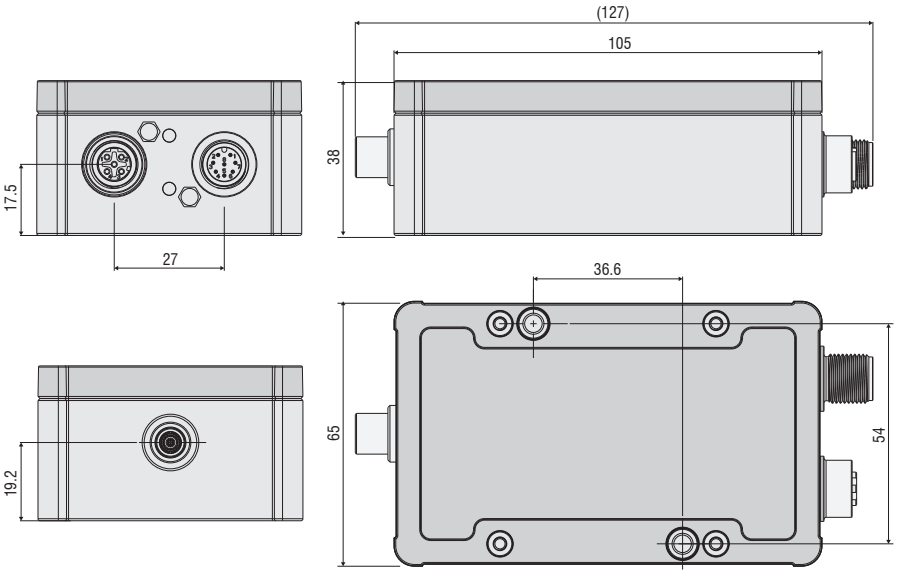
The industrial-grade M12 Ethernet interface offers a modern fieldbus connection. Configurable analog outputs enable to output the measured values as voltage or current. For multi-system operation, the systems offer a new kind of frequency separation (LF/HF) which enables to operate several sensors next to one another without requiring any synchronization.

Features	Controller type	
	DT3070	DT3071
Active temperature compensation for sensor and controller	✔	✔
Frequency separation (LF & HF)	✔	✔
Ethernet interface	✔	✔
Intuitive web interface	✔	✔
Multipoint calibration regardless of the distance (up to 3-point calibration)	✔	✔
Scalable measuring range via analog output (teach function)	✔	✔
Scalable analog output	✔	✔
Switching and temperature outputs	-	✔
5-point calibration	-	✔
Storage of multiple characteristic curves	-	✔

When connecting a PC via the Ethernet interface, a modern web interface can be accessed without any further installation and enables the parameterization of sensor and controller. The DT3071 controller provides enhanced features such as 5-point calibration, setting of switching and temperature outputs, as well as storage of multiple characteristic curves.

Model		DT3070	DT3071
Resolution [1]	Static (20 Hz)	0.005 % FSO	
	Dynamic (20 kHz)	0.025 % FSO	
Frequency response (-3dB)		selectable (20 kHz, 5 kHz, 20 Hz)	
Measuring rate	Analog output	200 kSa/s (16 bit)	
	Digital interface	50 kSa/s (16 bit)	
Linearity [2]		< ±0.2 % FSO	< ±0.1 % FSO
Temperature stability [3]		< 0.05 % FSO / K	
Temperature compensation		+10 ... +50 °C	
Target material [4]		Steel, aluminum	
No. of characteristic curves		1	max. 4
Supply voltage		12 … 32 VDC	
Power consumption		typ. 2.5 W (max. 2.8 W)	
Digital interface		Ethernet	Ethernet / selectable: switching output (TTL), temperature output (0...5 V)
Analog output		0 … 10 V; 4 … 20 mA (short circuit proof)	
Connection		Sensor: plug connector triaxial socket; supply/signal: 8-pole M12 connector; Ethernet: 5-pole M12 connector (cable see accessories)	
Mounting		Through bores	
Temperature range	Storage	-10 … +70 °C	
	Operation	0 … +50 °C	
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. 230 g	

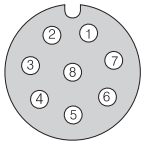
FSO = Full Scale Output
[1] RMS noise relates to mid of measuring range
[2] Value with 3-/5-point linearization
[3] Values are referenced to the mid of the measuring range within the compensated temperature range
[4] Steel: St37 steel DIN1.0037, aluminum: AlMg3



Pin assignment IN/OUT/24V IN

Pin	Assignment	Color (cable: PCx/8-M12)
1	Analog output $U_{Displacement}$	White
2	Supply +24 V	Brown
3	Limit value 1 / U_{Temp} sensor	Green
4	Limit value 2 / U_{Temp} controller	Yellow
5	GND Temperature, limit value	Gray
6	GND analog output	Pink
7	GND supply	Blue
8	Analog output $I_{Displacement}$	Red

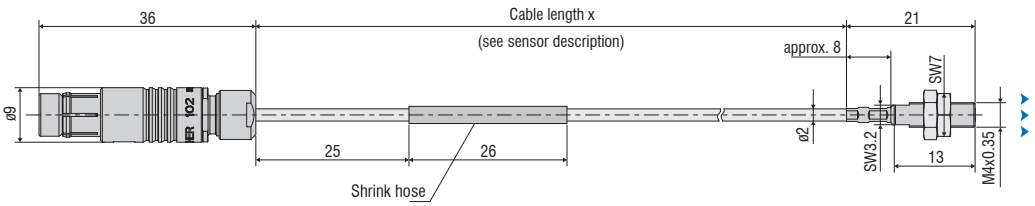
8-pole M12x1 housing connector
View on pin side



All dimensions in mm, not to scale

Standard sensors
eddyNCDT 3070

Measurement direction

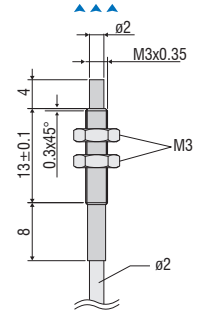


Model		ES-S04-C-CAx
Measuring range		0.4 mm
Start of measuring range		0.04 mm
Resolution [1] [2] [3]		0.02 µm
Linearity [1] [4]		< ±1 µm
Temperature stability [1] [2]		< 0.14 µm / K
Temperature compensation		+10 … +180 °C
Sensor type		shielded
Min. target size (flat)		Ø 5 mm
Connection		integrated cable, axial, length 0.25 m, 0.5 m or 0.75 m [5] bending radius: static ≥ 10 mm, dynamic ≥ 20 mm
Mounting		Screw connection (M4)
Temperature range	Storage	-20 ... +180°C
	Operation	-20 ... +180°C
Pressure resistance		100 bar (front)
Shock (DIN EN 60068-2-27)		30 g
Vibration (DIN EN 60068-2-6)		15 g
Protection class (DIN EN 60529)		IP50
Material		Stainless steel and ceramic
Weight		approx. 25 g

[1] Valid for operation with DT307x referenced to the nominal measuring range
[2] Relates to the mid of the measuring range within the compensated temperature range
[3] RMS value of the signal noise, static (20 Hz)
[4] Only with DT307x controller and 3-/5-point linearization
[5] Length tolerance cable: ±0.03 m

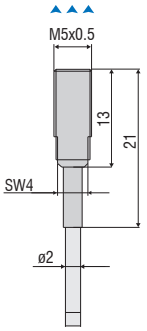
Special sensors
eddyNCDT 3070

Measurement direction



Cable length 0.25 m ±0.04 m

1:1



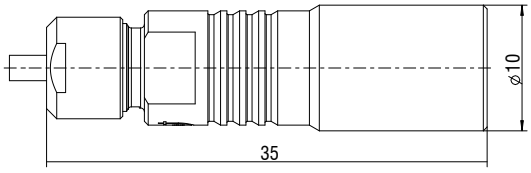
Cable length 0.25 m

1:1

Model	EU05	ES08
Measuring range	0.5 mm	0.8 mm
Start of measuring range	0.05 mm	0.08 mm
Resolution [1] [2] [3]	0.025 µm	0.04 µm
Linearity [1] [4]	< ±0.5 µm	< ±0.8 µm
Temperature stability [1] [2] [4]	< 0.175 µm / K	< 0.28 µm / K
Temperature compensation [4]	0 … +150 °C	0 … +150 °C
Sensor type	unshielded	shielded
Min. target size (flat)	Ø 9 mm	Ø 7.5 mm
Connection	integrated cable, axial, length approx. 0.25 m [5]	integrated cable, axial, length approx. 0.25 m [5]
Mounting	Screw connection (M3)	Screw connection (M5)
Temperature range – Storage	-20 ... +150 °C	-20 ... +150 °C
Temperature range – Operation	0 ... +150 °C	0 ... +150 °C
Pressure resistance	-	20 bar (front)
Protection class (DIN EN 60529)	IP64 (plugged)	IP64 (plugged)
Material	Stainless steel and ceramic	Stainless steel and plastic

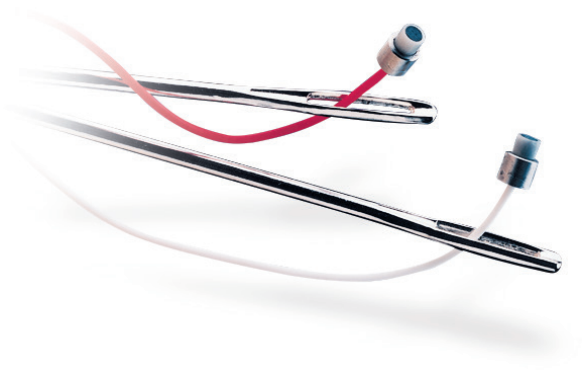
Operation with DT307x requires special calibration (LC)
[1] Valid for operation with DT307x referenced to the nominal measuring range
[2] Relates to the mid of the measuring range within the compensated temperature range
[3] RMS value of the signal noise, static (20 Hz)
[4] Only with DT307x controller and 3-point or 5-point linearization
[5] Length tolerance cable: ±10 %

Dimensions cable sockets ES05 and ES08



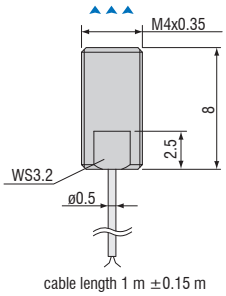
All dimensions in mm, not to scale

Special sensors
eddyNCDT 3070



Subminiature sensors for restricted spaces

As well as standard sensors in conventional designs, miniature sensors with the smallest possible dimensions that achieve high precision measurement results are also available. Pressure-resistant versions, screened housings, ceramic types and other special features characterize these sensors, which achieve highly accurate measurement results despite their small dimensions. These miniature sensors are primarily used in high pressure applications, for example, in combustion engines.



ES04/180(25) Shielded sensor

Measuring range 0.4 mm

Temperature stability: ≤ ±0.035% FSO/°C

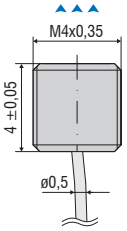
Connection: integrated coaxial cable, 1 m (ø 0.5 mm), short silicone tube at the cable outlet

Pressure resistance (static): front side 100 bar

Max. operating temperature: 180 °C

Housing material: stainless steel

2:1



ES04/180(102) Shielded miniature sensor

Measuring range 0.4 mm

Temperature stability: ≤ ±0.035% FSO/°C

Connection: integrated coaxial cable 0.8 m (ø 0.5 mm) with adapter PCB

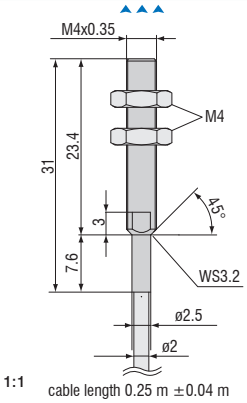
Pressure resistance (static): front side 100 bar / rear side splash water

Max. operating temperature: 150 °C

Housing material: stainless steel and ceramic

Connection cable: ECx/1, length ≤6 m

3:1



ES04(34) Shielded sensor

Measuring range 0.4 mm

Temperature stability: ≤ ±0.035% FSO/°C

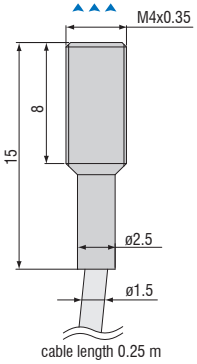
Connection: integrated coaxial cable 0.25 m (ø 2 mm) with protected triaxial socket

Pressure resistance (static): front side 100 bar / rear side splash water

Max. operating temperature: 150 °C

Housing material: stainless steel and ceramic

1:1



ES04(35) Shielded sensor

Measuring range 0.4 mm

Temperature stability: ≤ ±0.035% FSO/°C

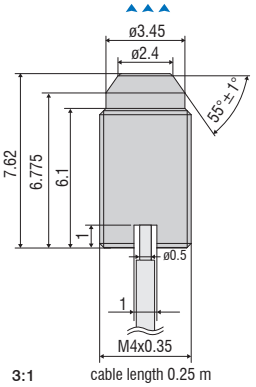
Connection: integrated coaxial cable 0.25 m (ø 1.5 mm) with protected triaxial socket

Pressure resistance (static): front side 100 bar / rear side 5 bar

Max. operating temperature: 150 °C

Housing material: stainless and ceramic

2:1



ES04(70) Shielded sensor

Measuring range 0.4 mm

Temperature stability: ≤ ±0.035% FSO/°C

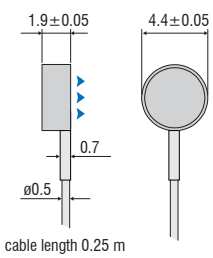
Connection: integrated coaxial cable 0.25 m (ø 0.5 mm) with adapter PCB

Pressure resistance (static): front side 100 bar / rear side splash water

Max. operating temperature: 150 °C

Housing material: stainless and ceramic

3:1



ES05/180(16) Shielded sensor

Measuring range 0.5 mm

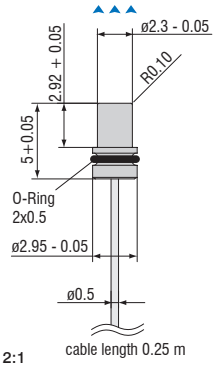
Temperature stability: ≤ ±0.035% FSO/°C

Connection: integrated coaxial cable 0.25 m (ø 0.5 mm) with adapter PCB

Max. operating temperature: 180 °C

Housing material: stainless steel and epoxy

3:1



2:1

EU05(65) Unshielded sensor

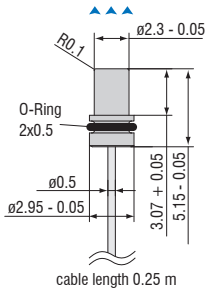
Measuring range 0.5 mm

Connection: integrated coaxial cable
0.25 m (ø 0.5 mm) with adapter PCB

Pressure resistance (static):
front side 700 bar / rear side splash water

Max. operating temperature: 150 °C

Housing material: ceramic



2:1

EU05(93) Unshielded sensor

Measuring range 0.4 mm

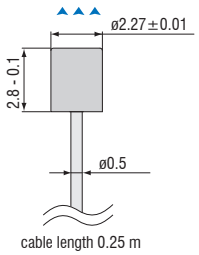
Temperature stability: ≤ ±0.035% FSO/°C

Connection: integrated coaxial cable
0.25 m (ø 0.5 mm) with adapter PCB

Pressure resistance (static):
front side 2000 bar / rear side splash water

Max. operating temperature: 150 °C

Housing material: ceramic



3:1

EU05(66) Unshielded sensor

Measuring range 0.5 mm

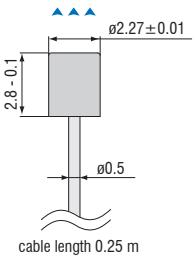
Temperature stability: ≤ ±0.035% FSO/°C

Connection: integrated coaxial cable
0.25 m (ø 0.5 mm) with adapter PCB

Pressure resistance (static):
front side 400 bar / rear side splash water

Max. operating temperature: 150 °C

Housing material: ceramic



3:1

EU05(72) Unshielded sensor

Measuring range 0.4 mm

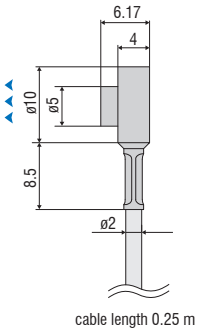
Temperature stability: ≤ ±0.035% FSO/°C

Connection: integrated coaxial cable
0.25 m (ø 0.5 mm) with adapter PCB

Pressure resistance (static):
front side 2000 bar / rear side splash water

Max. operating temperature: 150 °C

Housing material: ceramic



1:1

EU1FL Unshielded flat sensor

Measuring range 1 mm

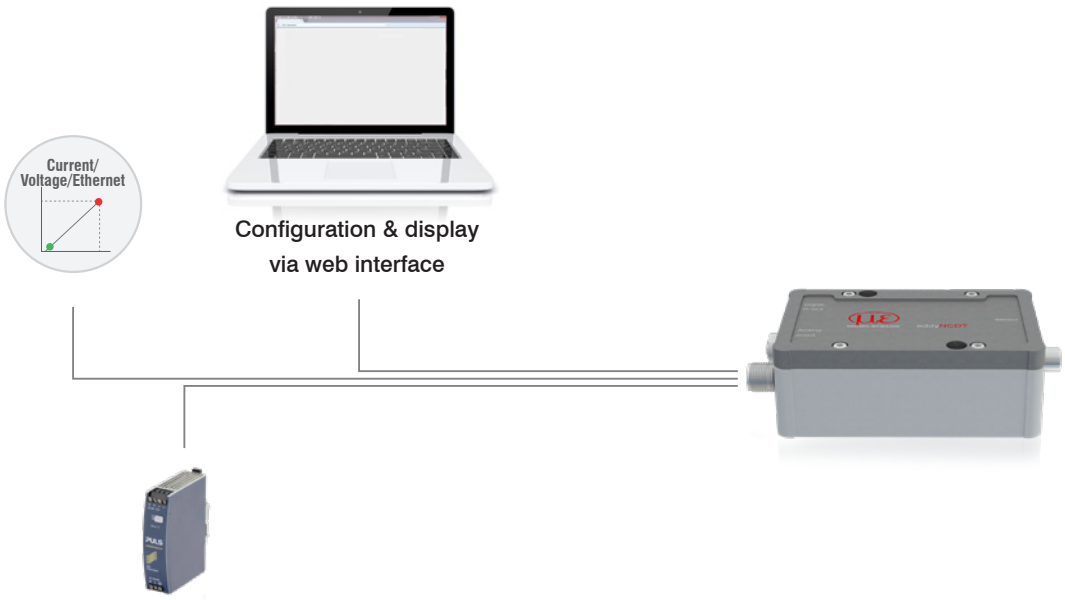
Temperature stability: ≤ ±0.025% FSO/°C

Connection: integrated coaxial cable
0.25 m (ø 2 mm) with protected triaxial socket

Max. operating temperature: 150 °C

Housing material:
stainless steel and epoxy molding

Connection possibilities
eddyNCDT 3070



PS2020
24V power supply

Plug/Socket

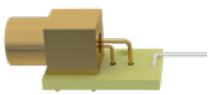
1 Plug Triax 0323118:
Type S 102 A014-120 D4,1
Triaxial plug: type bB0
Connection: push-pull
Temperature resistance: 200 °C

2 Socket Triax 0323141:
Type KE102 A014-120 D4,1
Triaxial socket: type fB0
Connection: push-pull
Temperature resistance: 200 °C

3 Plug Triax 0323727:
Type S 102 A014-120 D2,1
Triaxial plug: Type: mB0
Connection: push-pull
Temperature resistance: 200 °C

4 Plug Triax 0323174:
Type S101 A005-120 D4,1
Triaxial plug: type mA0
Connection: push-pull
Temperature resistance: 150 °C

5 Socket Triax 0323173
Triaxial socket: type fA0
Connection: push-pull
Temperature resistance: 150 °C



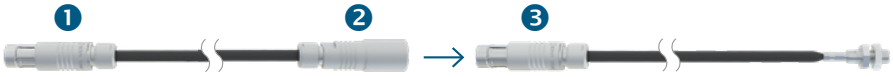
3 Socket Triax 0323121:
Type KE102 A014-120 D2,1
Triaxial socket: type fB0
Connection: push-pull
Temperature resistance: 130 °C

Sensors with socket: cable type EC-x/mB0/mB0

Miniature coaxial cable

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 on request)

Sensors with integrated cable: ES-S04-C-CAx/mB0/D2,0
and extension cable: ECE-x/fB0/mB0/D3,6

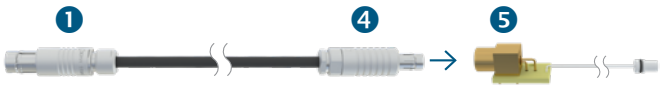


	Coaxial cable (extension cable)	Coaxial cable (sensor cable)
Cable diameter	3.6 mm	2 mm
Minimum bending radius	static approx. 27 mm / dynamic approx. 54 mm	static approx. 10 mm / dynamic approx. 20 mm
Temperature resistance	up to 200 °C	static up to 200 °C
Available lengths	1 m / 3 m (6 m on request)	0.25 m / 0.5 m / 0.75 m

Sensors with integrated cable and open ends
for solder connection via adapter cable: ECA-x/OE/mB0/D3,6

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 on request)

Sensors with integrated cable and A0 plug via
adapter cable: ECA-x/mA0/mB0/D3,6



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 on request)

Turbocharger speed measurement
turboSPEED DZ140

- Speed range from 200 to 400,000 rpm
- Miniature sensor ø3 mm
- Measurement of aluminum and titanium
- Large measurement distance up to 2.2 mm
- Highest interference immunity
- Sensor operating temperature up to 285 °C

Measuring principle

A coil integrated in the sensor housing is energized by a high-frequency alternating current. The emerging electromagnetic field changes when approaching a turbo charger blade. This is how every blade generates a pulse. The controller identifies the speed (analog 0–5 V) by considering the number of blades.

Robust miniature controller

As the controller is in a protected miniature housing and designed for ambient temperatures up to 115 °C, the controller is easy to integrate into the engine compartment. turboSPEED DZ140 offers excellent interference resistance for increased EMC requirements as well as in test cells and road tests.

Engine compartment application

The DZ140 eddy current measuring system is resistant to oil and dirt. This is a key advantage especially compared to optical speed measuring systems, as this immunity helps to achieve high precision measurements on a continuous basis.

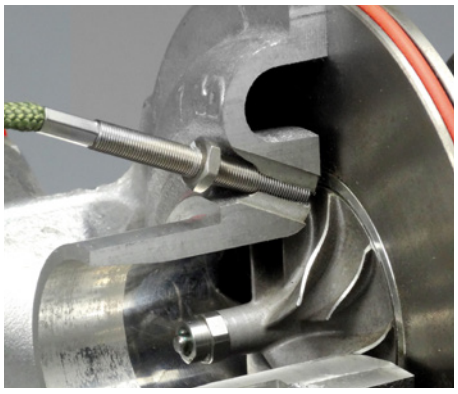
Easy handling

A tri-color ‘status’ LED on the controller indicates when the sensor has reached the ideal distance from the turbocharger blades. This simple feature enables greatly reduced installation time. As the sensor is connected with the controller via a special BNC connector, it is therefore downward compatible with all previous sensor models. An industrial push-pull connector ensures a reliable connection between the controller and the power supply as well as the analog outputs.

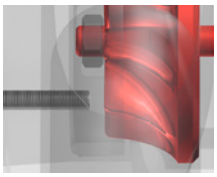
Measuring aluminum and titanium blades

The DZ140 measures both aluminum and titanium blades. The sensors can be mounted at a relatively large distance from the blade. The maximum distance of 2.2 mm enables reliable operation.

Extremely compact design



Large measuring distances both with aluminum and titanium



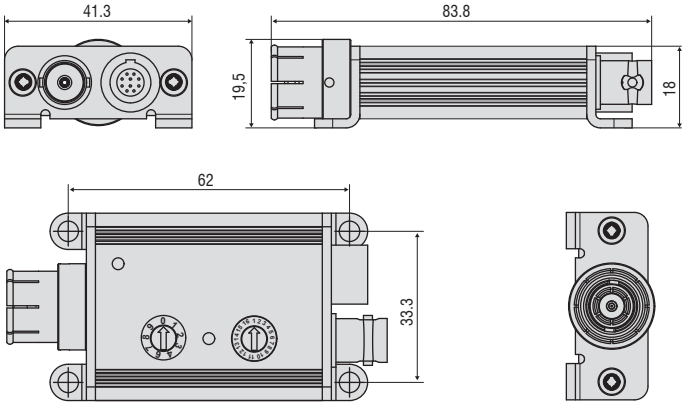
Axial installation

Radial installation

Model		DZ140
Resolution		10 bits
Speed range (measuring range)		200 ... 400,000 rpm
Linearity		< ±0.2 % FSO
Target material		aluminum or titanium
Supply voltage		9 ... 30 VDC (short-term up to 36 VDC)
Max. current consumption		50 mA
Digital output		TTL level (1 pulse / blade with variable pulse duration or 1 pulse / rotation with 100 µs pulse duration)
Analog output		0 … 5 V [1]
Connection		Sensor: triaxial connector; Supply/signal: 10-pole connector, raw signal: coaxial connector (cable see accessories)
Mounting		Screw connection with 4 through-holes
Temperature range	Storage	-40 ... +125 °C
	Operation	-40 ... +125 °C
Protection class (DIN EN 60529)		IP65 (plugged)
Weight		approx. 85 g
Number of blades		adjustable via rotary switch accessible from outside for 1 to 16 blades

FSO = Full Scale Output (speed range)
[1] Rotational speed adjustable via mode rotary switch

Controller DZ140

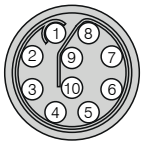


Dimensions in mm, not to scale.

Pin assignment for power supply and signal

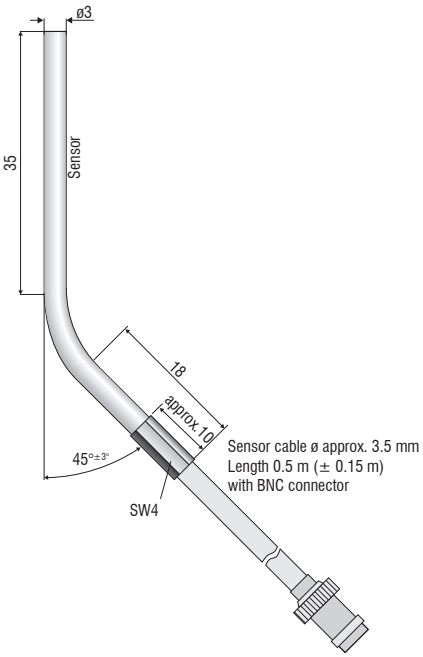
Pin	Assignment	Color (cable: PC140-x)
1	Analog output for rotational speed 0 … +5 V	Blue
2	reserved, not connected	Yellow
3	TTL pulses, digital	Green
4	reserved, not connected	-
5	GND	Black
6	reserved, not connected	-
7	Power supply -	White
8	Supply voltage +9 … 30 VDC	Brown
9	Not assigned	-
10	Not assigned	-

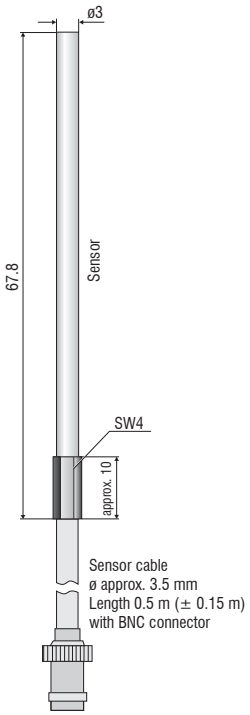
10-pin cable connector
View on solder side



Sensors
turboSPEED DZ140

Measurement direction

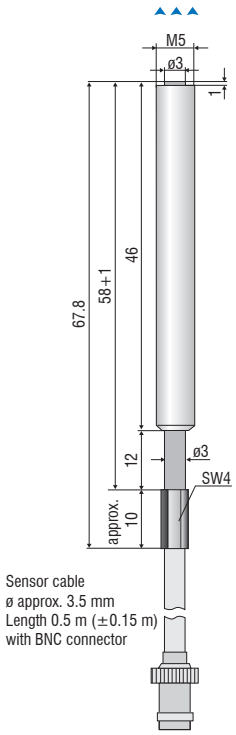


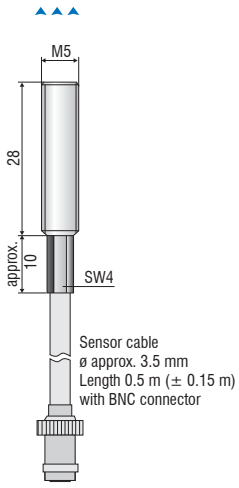


Model		DS 05(03)	DS 05(04)
Sensor type		shielded	shielded
Connection[1)]		integrated cable, axial, length 0.5 m	integrated cable, axial, length 0.5 m
Mounting		Clamping/adapter	Clamping/adapter
Temperature range	Storage	-40 ... +200 °C	-40 ... +200 °C
	Operation	-40 ... +200 °C	-40 ... +200 °C
Feature		curved housing	-

[1)] Length tolerance ± 0.15 m

Measurement direction



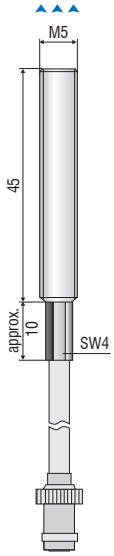


Model		DS 05(07)	DS 05(14)
Sensor type		shielded	shielded
Connection[1)]		integrated cable, axial, length 0.5 m	integrated cable, axial, length 0.5 m
Mounting		Screw connection (M5)	Screw connection (M5)
Temperature range	Storage	-40 ... +200 °C	-40 ... +200 °C
	Operation	-40 ... +200 °C	-40 ... +200 °C
Feature		-	Length of housing 42.5 mm

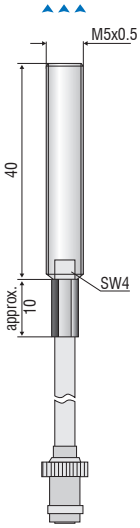
[1)] Length tolerance ± 0.15 m

Sensors
turboSPEED DZ140

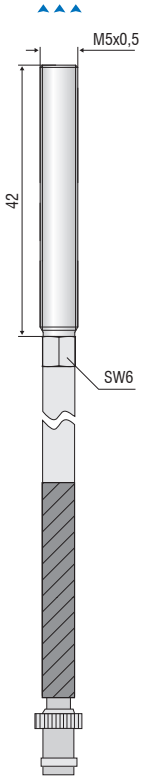
Measurement direction



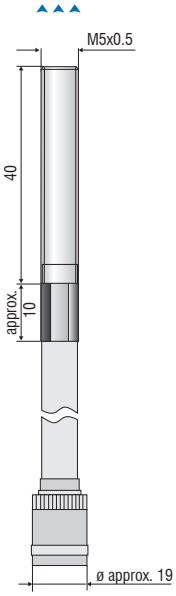
Sensor cable
ø approx. 3.5 mm
Length 0.5 m (± 0.15 m)
with BNC connector



Sensor cable
ø approx. 3.5mm
Length 0.75m (± 0.15 m)
with BNC connector



Sensor cable
ø approx. 6.0
Stainless steel IP 40
Length 0.8m (± 0.15 m)
with BNC connector



Sensor cable
ø approx. 4.5 mm
Length 0.8 m (± 0.15 m)
with triax BNC connector

Model		DS 05(15)	DS 1	DS 1(04)	DS 1/T
Sensor type		shielded	shielded	shielded	shielded
Connection[1)]		integrated cable, axial, length 0.5 m	integrated cable, axial, length 0.75 m	integrated cable, axial, length 0.8 m	integrated cable, axial, length 0.8 m
Mounting		Screw connection (M5)	Screw connection (M5)	Screw connection (M5)	Screw connection (M5)
Temperature range	Storage	-40 ... +200 °C	-40 ... +235 °C	-40 ... +235 °C	-40 ... +235 °C
	Operation	-40 ... +200 °C	-40 ... +235 °C	-40 ... +235 °C	-40 ... +235 °C (short-term +285 °C)
Feature		-	-	Protective hose (stainless steel)	-

[1)] Length tolerance ± 0.15 m

Cables
turboSPEED DZ140

Connection cables for DZ140 portfolio sensors

Miniature coaxial cable for DS05(x) and DS1 models
Diameter: approx. 3.5 mm
Sheath: thermal protection fabric hose (polyolefin shrink hose)
Temperature range: -50 °C to +200 °C (static)
Minimum bending radius: static approx. 18 mm / dynamic approx. 35 mm
Connection: BNC socket coaxial

Miniature coaxial cable for DS1(04) models
Diameter: approx. 6 mm
Sheath: metallic protective hose (stainless steel)
Temperature range: -50 °C to +200 °C (static)
Minimum bending radius: static approx. 30 mm / dynamic approx. 60 mm
Connection: BNC socket coaxial
Protection class: IP40

Triaxial cable for the DS1/T models
Diameter: approx. 3.5 mm
Sheath: thermal protection fabric hose (polyolefin shrink hose)
Temperature range: -50 °C to +200 °C
Minimum bending radius: static approx. 18 mm / dynamic approx. 35 mm
Connection: BNC socket triaxial

Spindle Growth System
eddyNCDT SGS4701

- Miniature sensor design
- M12 controller – integrable in spindle or mountable with flange
- Versions for ferromagnetic and non-ferromagnetic targets
- Integrated temperature measurement

Measuring the thermal extension of spindles

The SGS4701 displacement measuring system (Spindle Growth System) is developed specifically for high speed milling machine applications. Due to high machining speeds and the heat generated, the linear thermal expansion of the spindle in precision machine tools needs to be compensated for in order to keep the tool in a defined position at all times. The SGS sensor measures the thermal and centrifugal force expansion of the spindle. These measurement values are fed into the CNC machine tool as correctional values, compensating for any positioning errors.

The SGS4701 uses the eddy current measuring principle, providing a non-contact, wear-free measurement Furthermore, the measurement procedure is resistant to disturbances such as heat, dust and oil.

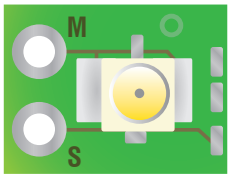
System design

The SGS 4701 consists of a sensor, a sensor cable and a controller, factory calibrated for ferromagnetic and non-ferromagnetic measuring objects. The miniature sensor design enables direct installation in the spindle, where measurements are typically performed on the spindle's labyrinth ring. In addition to measuring linear expansion, the temperature at the sensor is detected and output. The compact controller can be installed on the spindle housing using a flange or directly in the spindle.

The sensor cable must not be shortened as functionality loss may arise. Removing the connector is only permitted behind the plug-sided crimp when using the solder connections.

Customer-specific adjustment

For individual installation situations and measuring objects, sensor and controller can be adjusted in the factory which allows for the best possible measurement accuracy to be achieved.

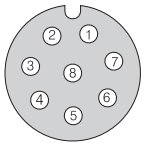


S = Signal = Inner conductor
M = Ground = Shield = Outer conductor

Pin assignment for power supply and signal

Pin	Assignment	Color (cable: PC4701-x)
1	GND	White
2	Supply 12 … 32 VDC	Brown
3	Displacement signal	Green
4	Temperature signal	Yellow
5	NC	Gray
6	assigned internally	Pink
7	assigned internally	Blue
8	NC	Red

8-pole M12x1 housing connector
View on pin side



Model		SGS4701
Measuring range		500 µm (optionally 250 µm [1])
Start of measuring range		100 µm (optionally 50 µm [1])
Measuring rate	Analog output	64 kSa/s (16 bit)
Resolution [2] [3]		0.5 µm
Frequency response (-3dB)		2000 Hz
Linearity		< ±2 µm
Temperature stability [3]	Sensor	< 150 ppm FSO/K
	Controller	< 500 ppm FSO/K
Temperature compensation	Sensor	+10 … +80 °C
	Controller	+10 … +70 °C
Min. target size (flat)		6 mm (optionally 3.5 mm [1])
Target material [4]		Steel, aluminum
Supply voltage		12 … 32 VDC
Power consumption		0.6 W
Analog output	Displacement	0.5 … 9.5 V (100 … 600 µm, optionally 50 … 300 µm [1])
	Temperature	0.5 … 9.5 V (0 … +90 °C)
Connection		Sensor: integrated cable [5], standard length 1 m (0.4 ... 1.5 m on request), min. bending radius 12 mm Supply/signal: 8-pole M12 connector (cable see accessories)
Temperature range	Sensor	0 … +90 °C
	Controller	+10 … +70 °C
Shock (DIN EN 60068-2-27)		50 g / 6 ms in each direction, 1000 shocks each
Vibration (DIN EN 60068-2-6)		20 g / 10 ... 3000 Hz
Protection class (DIN EN 60529)		IP67 (plugged) [6]
Weight [7]		approx. 85 g

FSO = Full Scale Output

[1] For OEM modifications: sensor with a measuring range of 250 µm and an offset of 50 µm possible

[2] Static, at mid of measuring range

[3] Values are referenced to the mid of the measuring range within the compensated temperature range

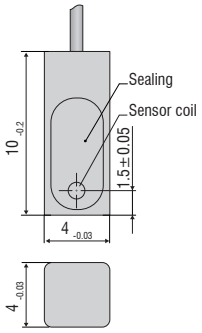
[4] Steel: St37 steel DIN1.0037, aluminum: AlMg

[5] Detailed cable specifications can be found in the operating instructions

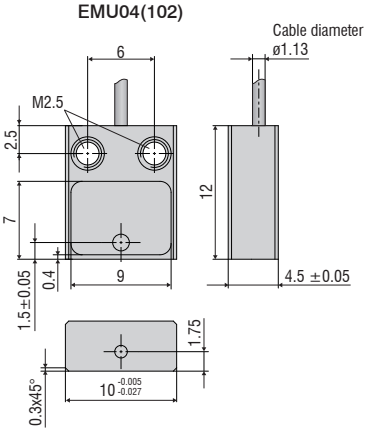
[6] Protection class does not apply for the controller sleeve!

[7] Total weight for controller, cable and sensor

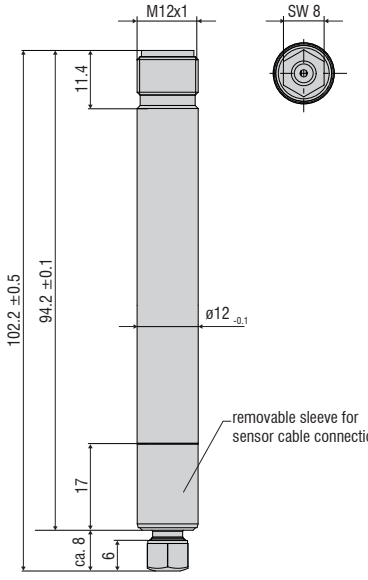
EMU04(121)



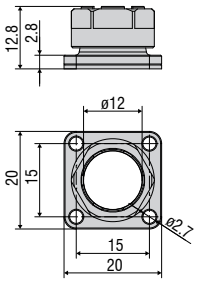
EMU04(102)



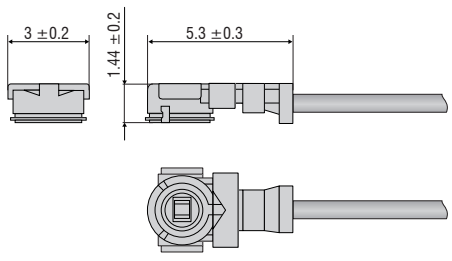
Controller



Clamping flange (optional)



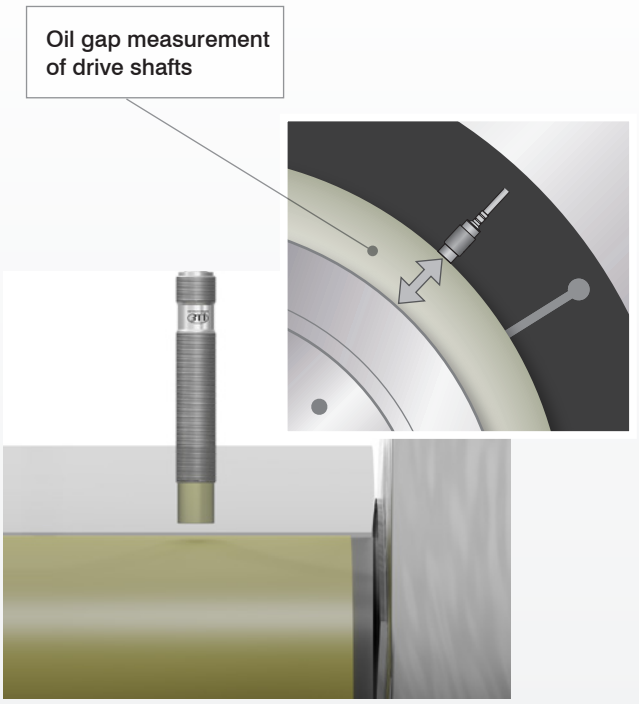
Connector (max. 20 mating cycles possible)

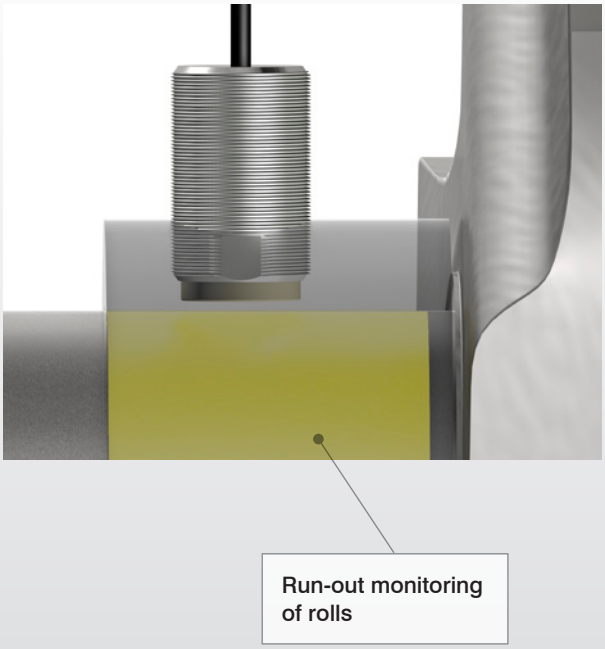


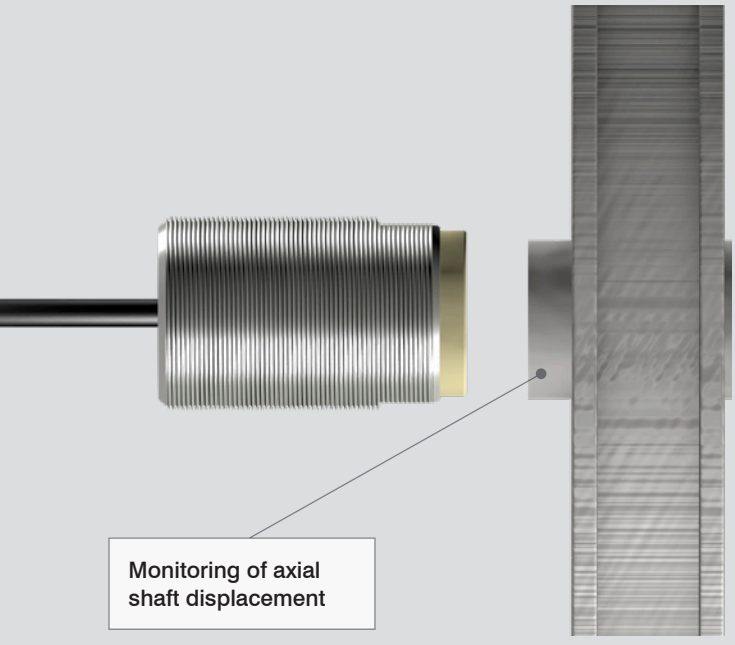
Dimensions in mm, not to scale.

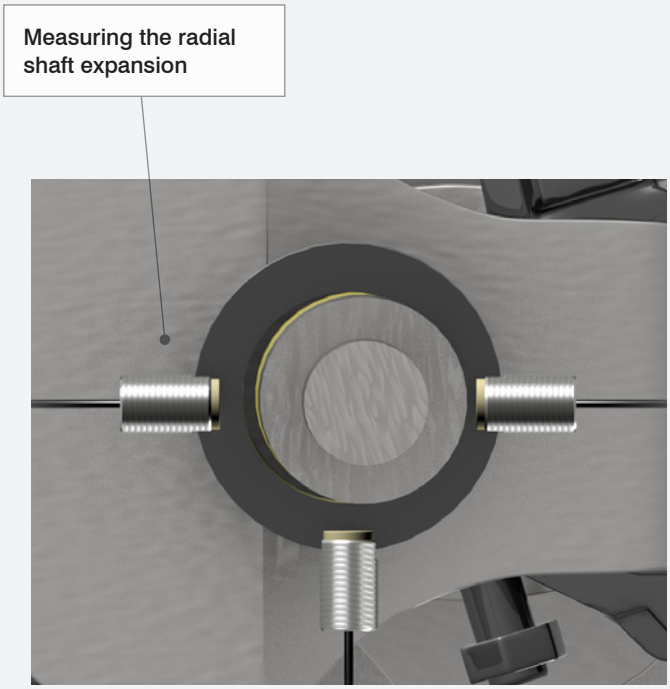
Application examples
eddyNCDT

Eddy current sensors from Micro-Epsilon have many possible fields of application. High measurement accuracy and increased frequency response together with an extremely robust design enable measurements where conventional sensors are not suitable.



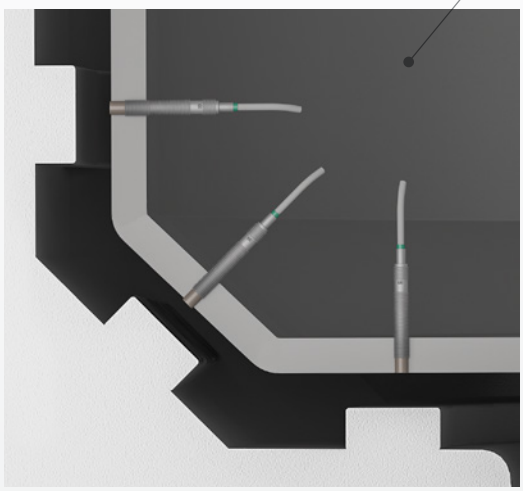


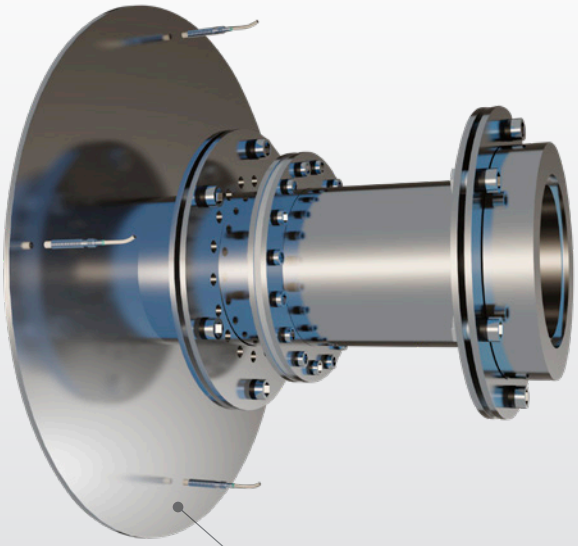




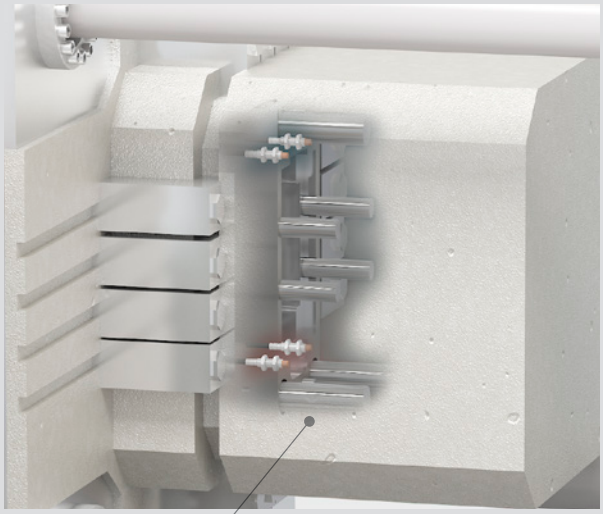
Environmental influences such as oil, temperature, pressure and moisture are largely compensated for and have a minimal effect on the signal. For this reason, the sensors are ideal in demanding application areas, such as industrial mechanical engineering and test bench construction.

Monitoring the supporting moments in wind turbines





Displacement measurement of the gear coupling



Gap measurement in aluminum die-casting molds

Run-out monitoring of gear shafts

Accessories
eddyNCDT

Item	Description	DT3001	DT3005	DT3020	DT3060	DT3070	DZ140	SGS
PCx/5-M12	**Power supply and signal cable** 5-pole with M12 connector Standard length: 5 m Optionally available: 10 m/20 m/40 m/80 m as drag-chain suitable variant	x	x					
PCx/8-M12	**Power supply and signal cable** 8-pole with M12 connector Standard length: 3 m Optionally available: 5 m/ 10 m /15 m / 10 m also as drag-chain suitable variant			x	x	x		
PC5/8-M12/105	**Power supply and signal cable** Increased temperature resistance up to 105 °C 8-pole with M12 connector Length: 5 m as drag-chain suitable variant			x	x	x		
PC4701-x	**Power supply and signal cable** 8-pole with M12 connector Standard length: 10 m Optionally available: 15 m 10 m also available as drag chain–suitable variant							x
SCD2/4/RJ45	**Ethernet cable** 4-pole with M12 connector on RJ45 connector Standard length: 2 m				x	x		
PC140-x	**Power supply and signal cable** 8-pole connector Standard length: 3 m Optionally available: 6 m						x	
PS2020	**Power supply unit** Input 100-240 VAC Output 24 VDC / 2.5 A; installation on symmetrical standard rail 35 mm x 7.5 mm, DIN 50022	x	x	x	x	x	x	x
IF2035	**Interface module for Industrial Ethernet connection** Connection of RS422 or RS485 interfaces to PROFINET / Ethernet/IP / EtherCAT 2 network connections for different network topologies Ideal for confined spaces due to a compact housing and DIN rail mounting		x	x				
IF1032	**Interface module for Ethernet/EtherCAT connection** 1x RS485 2x analog-in (14 bit, max. 4 ksps), voltage 1x analog-in, (14 bit, max. 4 ksps), current		x	x				
IF7001	**Single-channel converter cable from RS485 to USB** Conversion from RS485 to USB Easy sensor connection via USB Integration into plant and machinery		x	x				

Interfaces

RS485:
1 channel

Analog:
3 channels

Interface IF1032/ETH
Interface module for
Ethernet/EtherCAT connection

RS485:
Multi-channel

Interface IF7001
Single-channel converter cable
from RS485 to USB

RS485:
Multi-channel

Interface IF2035
Interface module for
Industrial Ethernet connection

Ethernet

EtherCAT

Ethernet

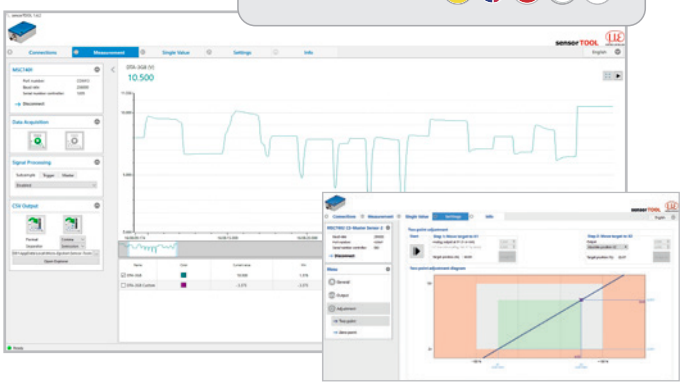
Web interface IF1032

Web interface for display and visualization of measured data
- Data display and scaling via Ethernet and web interface
- CSV export
- Easy integration without admin rights on PC
- Additional EtherCAT interface

Ethernet

USB

sensorTOOL



SensorTool for parameterization, data display, etc.
- Basic settings: sensor type, output signal, frequency response
- 2-point and zero point adjustments
- Scaling
- Visualization of data
- Sub-sampling
- Export

EtherCAT EtherNet/IP PROFINET

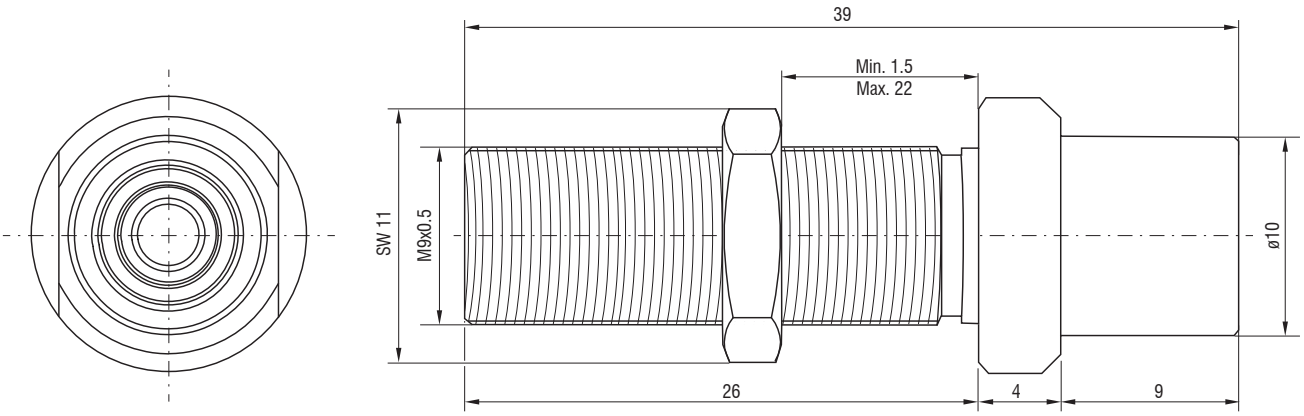
Plug system for vacuum applications
Vacuum feedthrough eddy/fB0/fB0/triax

The eddyNCDT series delivers high-precision measurement results even in airless rooms. The eddy/fB0/fB0/triax vacuum feedthrough also enables eddyNCDT products to be used in vacuum applications.

- Application in vacuums
- Application as a wall duct
- Pluggable version
- Compatible with all common eddyNCDT products

Vacuum feedthrough eddy/fB0/fB0/triax	
Housing material	CuZn39Pb3
O-ring material	FPM (Viton®)
Max. leakage rate (IEC standard 60068-2-17)	$<10^{-8}$ mbar*l/s
Operating temperature [1]	from -20 °C to 150 °C
Mating cycles (IEC 60512-5-9a)	10,000
Vibration (MIL-STD-202 Method 204 Condition B)	10 to 2,000 Hz, 1.5 mm or 15 g, 12 pass cycles per axis, 20 minutes per 10-2000-10 Hz pass cycle, no discontinuity >1 µs
Insulation resistance	10^{10} Ω

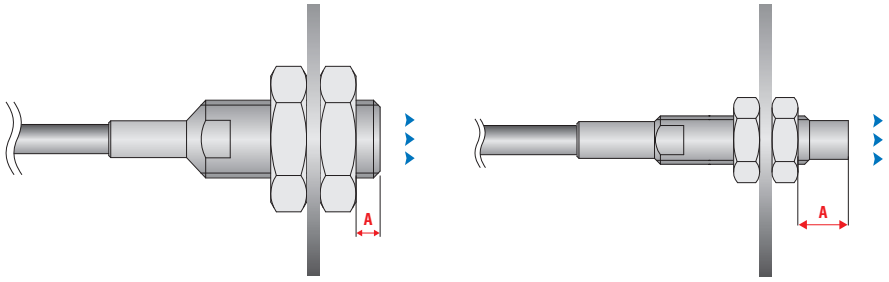
[1] Min. connection temperature: 0 °C



Standard installation situation

Distance between the nut and the measuring area

eddyNCDT sensors are mounted using the two mounting nuts included in the delivery. During the factory-calibration of the sensors, these were mounted in a defined distance A and included in the calibration. In order to achieve maximum linearity, the nut must be mounted in the defined distance indicated in the table.



Please note the respective distances recommended in the table below when mounting the sensors:

Series	Model	Distance A
DT3001-	U2-A-SA	22 mm (±0.2 mm)
	U2-M-SA	22 mm (±0.2 mm)
	U4-A-SA	22 mm (±0.2 mm)
	U4-M-SA	22 mm (±0.2 mm)
	U4-A-Cx	22 mm (±0.2 mm)
	U4-M-Cx	22 mm (±0.2 mm)
	U6-A-SA	22 mm (±0.2 mm)
	U6-M-SA	22 mm (±0.2 mm)
	U8-A-SA	22 mm (±0.2 mm)
	U8-M-SA	22 mm (±0.2 mm)
DT3005-	U1-A-C1	8 mm (±0.2 mm)
	U1-M-C1	8 mm (±0.2 mm)
	S2-A-C1	4 mm (±0.2 mm)
	S2-M-C1	4 mm (±0.2 mm)
	U3-A-C1	10 mm (±0.2 mm)
	U3-M-C1	10 mm (±0.2 mm)
	U6-A-C1	13 mm (±0.2 mm)
	U6-M-C1	13 mm (±0.2 mm)
DT3020 / DT3060	ES-U1	8 mm (±0.2 mm)
	ES-S1	4 mm (±0.2 mm)
	ES-U2	8 mm (±0.2 mm)
	ES-S2	4 mm (±0.2 mm)
	ES-U3	10 mm (±0.2 mm)
	ES-S4	4 mm (±0.2 mm)
	ES-U6	20.4 mm (±0.2 mm)
	ES-U8	24.6 mm (±0.2 mm)
	ES04	2.1 mm (±0.2 mm)
	EU05	5.5 mm (±0.2 mm)
	ES08	2.7 mm (±0.2 mm)
	ES1	4 mm (±0.2 mm)
	EU1	6.7 mm (±0.2 mm)
	ES2	4 mm (±0.2 mm)
	EU3	10 mm (±0.2 mm)
	ES4	4 mm (±0.2 mm)
	EU6	10.125 mm (±0.2 mm)
	EU8	12.8 mm (±0.2 mm)
DT3070-	ES-S04	2.4 mm (±0.2 mm)

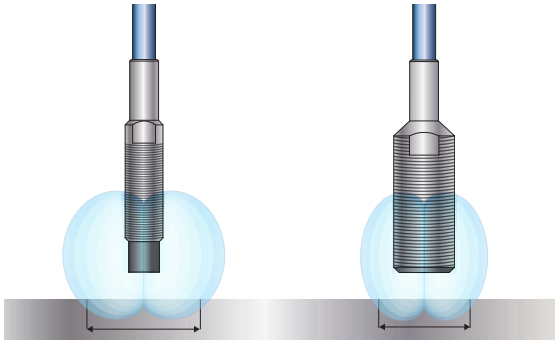
Influences on the measurement signal

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

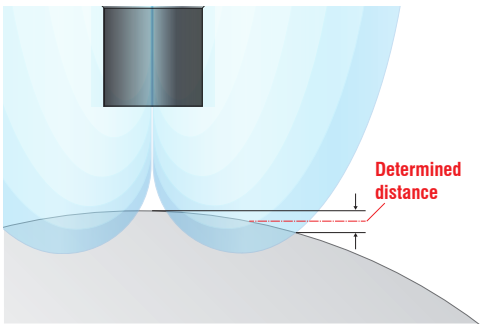
As well as the minimum size for flat geometries, a minimum diameter for round measuring objects is required.

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

Diameter < 10x sensor diameter
requires factory calibration

Compensating the distance with curved measuring 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

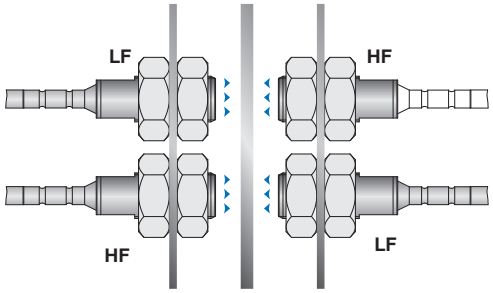
The high accuracy of the eddyNCDT sensors is only achieved with vertical sensor installation. When the sensor or the target are tilted, the measured results slightly deviate from those measured in the vertical position.

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.

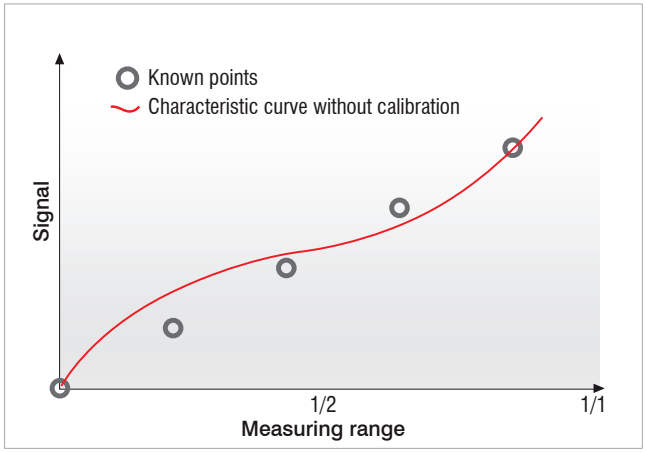
Terms
eddyNCDT

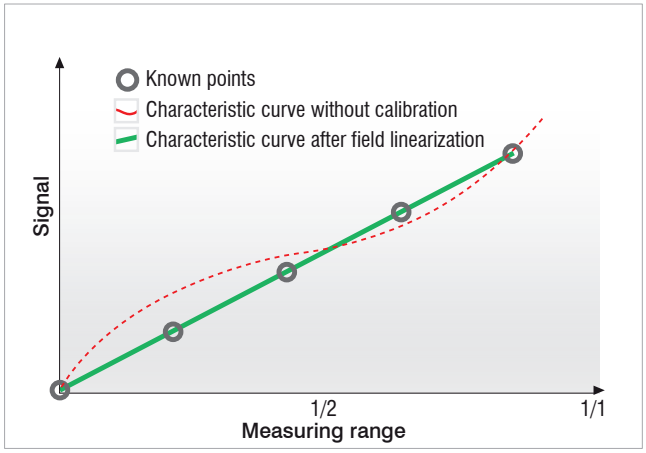
Frequency separation

For the simultaneous operation of several eddyNCDT measuring systems, these are available with a new type of frequency separation (LF/HF). The frequency separation enables multi-channel operation without mutual influence. This function makes a synchronization cable superfluous.



Field calibration



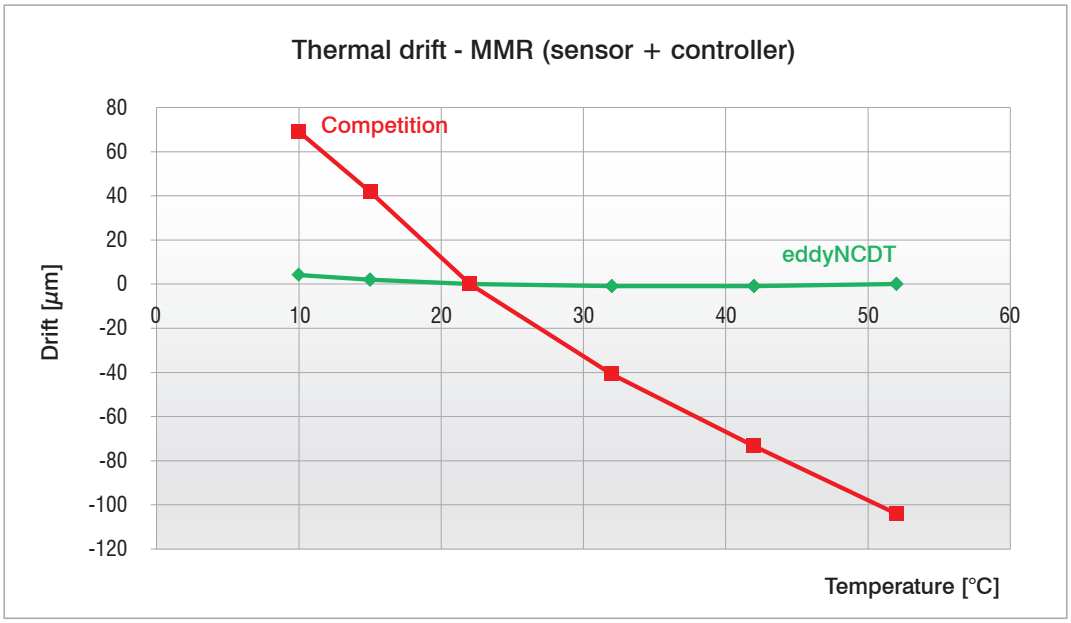


If the installation situation does not correspond to the standard installation conditions, field linearization is recommended (available with eddyNCDT 3060 and eddyNCDT 3300) This on-site calibration compensates for influences which result from the installation scenario or the target materials and shapes. 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. This results in an extremely stable measurement signal.

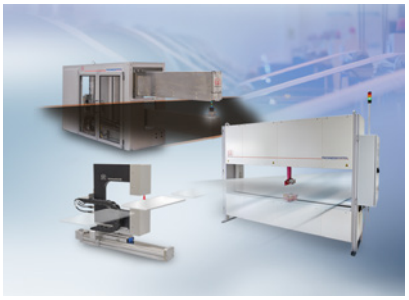
The figure shows a Micro-Epsilon sensor (green) compared with competing products (red). The maximum deviation over the entire temperature range is significantly below the 150 ppm/°C specified in the data sheet. Occasionally the deviation for the temperature increase of one degree amounts to a maximum 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.

Sensors and Systems from Micro-Epsilon

Sensors and systems for displacement, distance and position

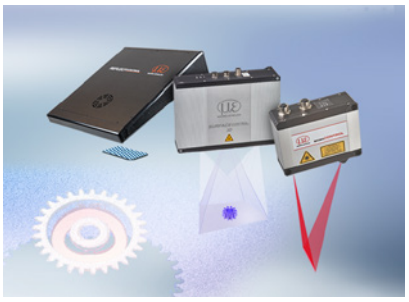
Sensors and measurement devices for non-contact temperature measurement



Measuring and inspection systems for metal strips, plastics and rubber

Optical micrometers and fiber optics, measuring and test amplifiers

Color recognition sensors, LED analyzers and inline color spectrometers



3D measurement technology for dimensional testing and surface inspection

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