MICRO-EPSILON

Operating Instructions

eddyNCDT 3060

eddyNCDT 3061

ES-U1
ES-S2
ES-U3
ES-S4

Non-contact Compact Displacement Measuring System Based on Eddy Currents

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Contents

1. Safety

System operation assumes knowledge of the operating instructions.

1.1 Symbols Used

The following symbols are used in this operating instructions.

| ⚠ CAUTION | Indicates a hazardous situation which, if not avoided, may result in minor or moderate injury. |
| NOTICE | Indicates a situation that may result in property damage if not avoided. |

➡   Indicates a user action.

i   Indicates a tip for users.

Measure   Indicates hardware or a software button/menu.

↑↑↑   Sensor measurement direction.

1.2 Warnings

⚠ CAUTION

Connect the power supply and the display/output device according to the safety regulations for electrical equipment.
> Risk of injury
> Damage to or destruction of the sensor and controller

NOTICE

Avoid shocks and impacts to the sensor and controller.
> Damage to or destruction of the sensor and/or controller

The supply voltage must not exceed the specified limits.
> Damage to or destruction of the sensor and controller

Protect the sensor cable against damage.
> Destruction of the sensor

> Failure of the measuring device

1.3 Notes on CE Marking

The following apply to the eddyNCDT 306x:
- EU Directive 2014/30/EU
- EU Directive 2011/65/EU, "RoHS" category 9

Products which carry the CE mark satisfy the requirements of the EU directives cited and the European harmonized standards (EN) listed therein.

The EU Declaration of Conformity is available to the responsible authorities according to EU Directive, articel 10, at:

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The measuring system is designed for use in industrial environments and meets the requirements.

1.4 Intended Use

- The measuring system is designed for use in an industrial environment. It is used for
  - measuring displacement, distance, movement and thickness,
  - measuring the position of parts or machine components.
- The system may only be operated within the limits specified in the technical data, see Chap. 2.5.

➡ The measuring system must be used in such a way that no persons are endangered or machines and other material goods are damaged in the event of malfunction or total failure of the controller.

➡ Take additional precautions for safety and damage prevention in case of safety-related applications.

1.5 Proper Environment

- Protection class:
  - Sensor, sensor cable: IP 68 (plugged)
  - Controller: IP 67 (plugged)
- Temperature range:
  - Operation:
    - Sensor, sensor cable: -20 ... +180 °C (-4 ... +356 °F), valid for sensor ES-U1
      -20 ... +200 °C (-4 ... +392 °F), valid for standard sensors
    - Controller: 0 ... +50 °C (+32 ... +122 °F)
  - Storage:
    - Sensor, sensor cable: -50 ... +180 °C (-58 ... +356 °F), valid for sensor ES-U1
      -50 ... +200 °C (-58 ... +392 °F), valid for standard sensors
    - Controller: -10 ... +70 °C (+14 ... +158 °F)
- Humidity: 5 - 95 % (non-condensing)
- Ambient pressure: Atmospheric pressure

2. Functional Principle, Technical Data

2.1 Field of Application

The eddyNCDT 306x non-contact, compact displacement measuring systems are designed for industrial applications in production plants, for machine supervision and for measuring and testing in in-process quality assurance.

2.2 Measuring Principle

The eddyNCDT 306x (Non-Contacting Displacement Transducers) displacement measuring system operates without contact using eddy current technology. It is used for making measurements on targets made of either ferromagnetic or non-ferromagnetic electrically conductive materials.
A high frequency alternating current is passed through a coil installed in a sensor housing.
The electromagnetic coilfield induces eddy currents in the conductive target thus changing the AC resistance of the coil. This change in impedance is interpreted by demodulation electronics which generate an electrical signal proportional to the distance of the target from the sensor.
A patented electronic compensation technique reduces temperature-dependent measuring errors to a minimum.

2.3 Structure of the Complete Measuring System

The eddyNCDT 306x non-contact single channel displacement measuring system consits of
- Sensor
- Sensor cable
- Connection cable
- Controller

i The components are matched to one another. The allocation of the sensor and the controller is determined by the serial number.

Fig. 1 eddyNCDT 306x with controller and sensors

2.4 Glossary, Analog Output Displacement
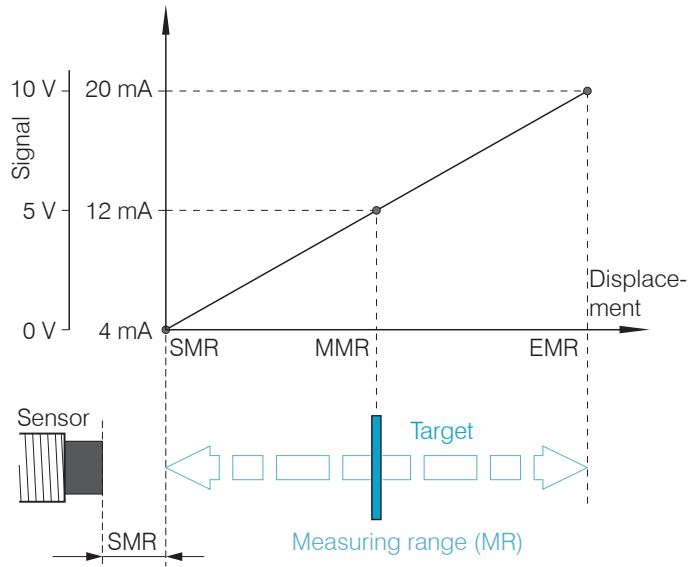
SMR	Start of measuring range
	Minimum distance between sensor front and measuring object, sensor specific
MMR	Mid of measuring range
EMR	End of measuring range (Start of measuring range + measuring range) Maximum distance between sensor front and measuring object
MR	Measuring range

2.5   Technical Data

Sensor		ES-U1	ES-S2	ES-U3	ES-S4
Measuring range		1 mm	2 mm	3 mm	4 mm
Start of measuring range		0.1 mm	0.2 mm	0.3 mm	0.4 mm
End of measuring range		1.1 mm	2.2 mm	3.3 mm	4.4 mm
Resolution[2,3]	static (20 Hz)	0.02 μm	0.04 μm	0.06 μm	0.08 μm
	dynamic (20kHz)	0.1 μm	0.2 μm	0.3 μm	0.4 μm
Frequency response		selectable 20 kHz, 5 kHz, 20 Hz			
Measuring rate		50 kSa/s			
Linearity	3-point linearization	≤ ± 2 μm	≤ ± 4 μm	≤ ± 6 μm	≤ ± 8 μm
	5-point linearization [1]	≤ ± 1 μm	≤ ± 2 μm	≤ ± 3 μm	≤ ± 4 μm
Temperature stability	sensors [2]	≤ 0.15 μm / K	≤ 0.3 μm / K	≤ 0.45 μm / K	≤ 0.6 μm / K
	controller	≤ 0.015 % d.M. / K			
Temperature compensation	sensors	+10 … +180 ℃ (+50 … +356 °F)			
	controller	+10 … +50 ℃ (+50 … +122 °F)			
Target material		ferromagnetic, non-ferromagnetic			
Minimum target size (flat)	operation	ø18 mm		ø36 mm	ø27 mm
Sensor type		unshielded	shielded	unshielded	shielded
Temperature range	sensors — operation	-20 … +180 ℃ (-4 … +356 °F)	-20 … +200 ℃ (-4 … +392 °F)		
	sensors — storage	-50 … +180 ℃ (-58 … +356 °F)	-50 … +200 ℃ (-58 … +392 °F)		
	controller — operation	0 … +50 ℃ (+32 ... +122 °F)			
	controller — storage	-10 … +70 ℃ (+14 ... +158 °F)			
Supply voltage (power consumption)		12 … 32 VDC (2.5 W)			
Pressure resistance	front	20 bar			
	rear	5 bar			

Sensor		ES-U1	ES-S2	ES-U3	ES-S4
Analog output		0 … 10 V (short circuit proof); 4 … 20 mA (load max. 500 Ohm)			
Weight	sensors (without nuts)	2,4 g	11 g	12 g	30 g
	controller	ca. 230 g			
Shock (DIN-EN 60068-2-29)		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)	sensors	IP68 (plugged)			
	controller	IP67 (plugged)			

FSO = Full Scale Output

1) Valid for operation with DT3061 controller
2) Relates to mid of measuring range
3) RMS value of the signal noise

3.   Delivery

3.1   Unpacking, Included in Delivery

1 Sensor incl. sensor cable
1 Controller
1 Test log
1 Quick manual
1 PC3/8-M12 (analog output/ power supply)
1 SCD2/4/RJ45 Ethernet adapter cable

➡ Carefully remove the components of the measuring system from the packaging and ensure that the goods are forwarded in such a way that no damage can occur.

➡ Check the delivery for completeness and shipping damage immediately after unpacking.

➡ If there is damage or parts are missing, immediately contact the manufacturer or supplier.

You will find optional accessories in appendix, see Chap. A 1.

3.2   Storage
- Temperature range storage:
  - Sensors: -50 ... +180 °C (-58 ... +356 °F), valid for sensor ES-U1
                               -50 ... +200 °C (-58 ... +392 °F), valid for standard sensors
  - Controller: -10 ... +70 °C (+14 ... +158 °F)
- Humidity: 5 - 95 % (non condensing)

4.   Installation and Assembly

4.1   General

No sharp or heavy objects should be allowed to affect the cable sheath of the sensor cable, the supply cable and the output cable.

ⓘ   A damaged cable cannot be repaired. Tension on the cable is not permitted!

4.1.1   Model

The eddyNCDT measuring system will be used with unshielded or shielded sensors.

Unshielded sensors
- Type designation: ES-Ux
- Construction: The sensor cap with encapsulated coil consists of electrically non-conducting materials.

ⓘ   In the radial direction metal parts in the vicinity may behave similar to the measuring object, rendering the measurement result inaccurate. Please note this by selection of material for sensor mounting and their setup.

Fig. 2 Unshielded sensor

Shielded sensors
- Type designation: ES-Sx
- Construction: The sensor enclosed up to its front face with a steel housing with a mounting thread. With it the sensor is shielded from interference through radially near located metal parts.

Fig. 3 Shielded sensor
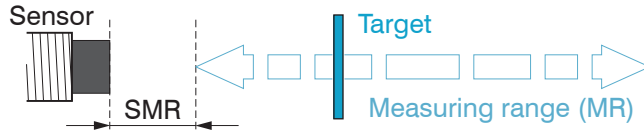
4.1.2   Start of Measuring Range

Fig. 4 Start of measuring range (SMR), the minimum distance between sensor face and target

For each sensor a minimum distance to the measuring object must be maintained.
This avoids a measurement uncertainty due to the sensor pressing on the measuring object and mechanical damage to the sensor/target.
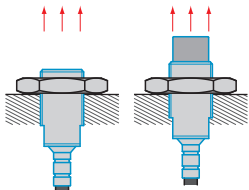Eddy current displacement sensors can be affected in their measurement properties by a metallic holder.
Depending on the sensor type, the following sensor mounting should be preferred:
 - unshielded sensors: Standard mounting
 - shielded sensors: Flush mounting

4.2 Installation Scenario Sensor

4.2.1 Standard Mounting

The sensors protrude beyond the metal holder.
The installation scenario depicted is used for factory calibration of the sensors at Micro-Epsilon.
The technical sensor data correspond to standard installation conditions. If you want to achieve the values indicated in the data sheet, we recommend to install the sensor in the same way as it was during calibration.

Sensors with a thread

➡ Insert the sensor through the hole in the sensor holder.

➡ Screw the sensor tight.

➡ Turn the mounting nuts from the delivery on both sides on the thread protruding from the holder.

➡ Tighten the mounting nuts carefully to avoid damage, particularly to smaller sensors.

i Prefer the standard mounting of the sensor, because the optimum measurement results can be achieved with this method!
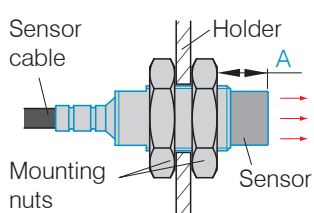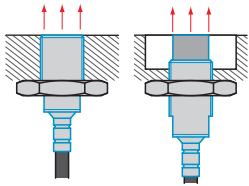

Sensor	ES-U1	ES-U3
Dimension A	8 mm	10 mm

Fig. 5 Unshielded sensor with thread in standard mounting
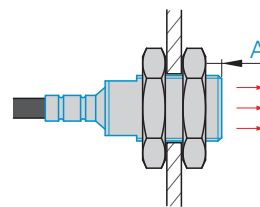
Sensor	ES-S2	ES-S4
Dimension A	4 mm	4 mm

Fig. 6 Shielded sensor with thread in standard mounting

i During calibration maintain the same relative position of the sensor to the holder as for the measurement!

4.2.2 Flush Mounting

Flush mounting does not correspond to factory calibration. Micro-Epsilon recommends to carry out at least a 3-point field linearization.

i Linearize the measuring system, if possible, when it is exactly arranged (in the same way as it will be arranged later during the measurement process).

Sensors with a thread

➡ Mount shielded or unshielded sensors flush in a sensor holder of insulating material (plastic, ceramic, et cetera).

➡ Mount the shielded sensors flush in a metal sensor holder, see Fig. 8.

➡ Mount unshielded sensors flush in a metal sensor holder, see Fig. 7. Make sure that a recess of a size three times the sensor diameter is used.

➡ In all mounting cases screw the sensor into the threaded hole and lock it with the mounting nut.

➡ Tighten carefully to avoid damage, particularly to smaller sensors.

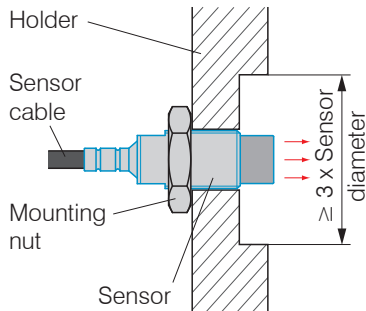i Calibrate the measuring system in the measuring setup with actual mounted sensor.

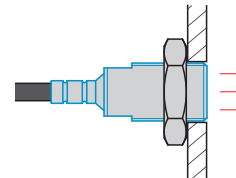*Fig. 7 Flush mounting of an unshielded sensor in a metal holder*

Fig. 8 Flush mounting of a shielded sensor in a metal holder

4.3 Measurement Setup, Operating Multiple Sensors

Sensors of the eddyNCDT 306x series cannot be synchronized. Observe the following installation information regarding the minimum distance between two sensors:

- 3x sensor diameter distance between two unshielded sensors with equal carrier frequency (e. g. low frequency)
- 1.5x sensor diameter distance between two shielded sensors with equal carrier frequency (e. g. low frequency)
- two nearby mounted sensors only as low frequency and high frequency models
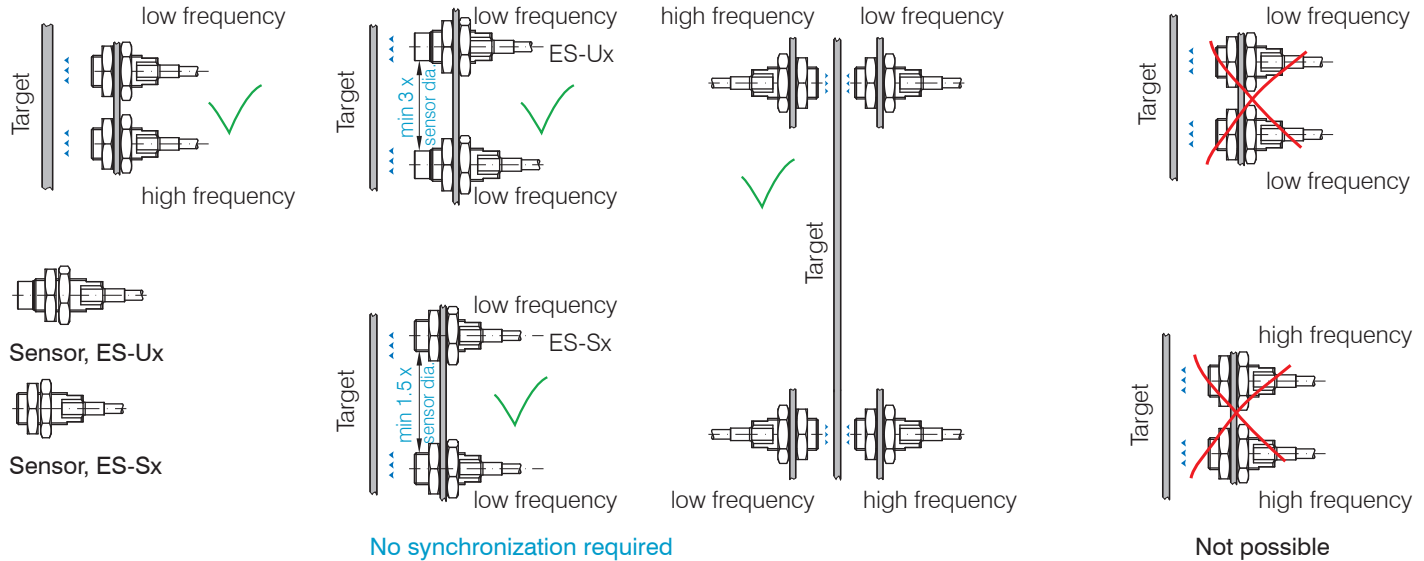
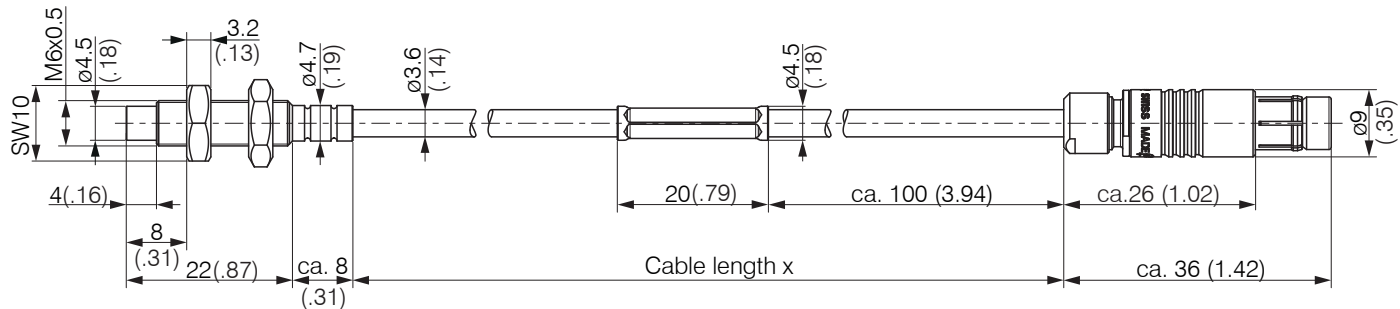## 4.4 Dimensional Drawings Sensors

Fig. 9 Dimensional drawing sensors ES-U1-C-CAx/mB0, dimensions in mm (inches)
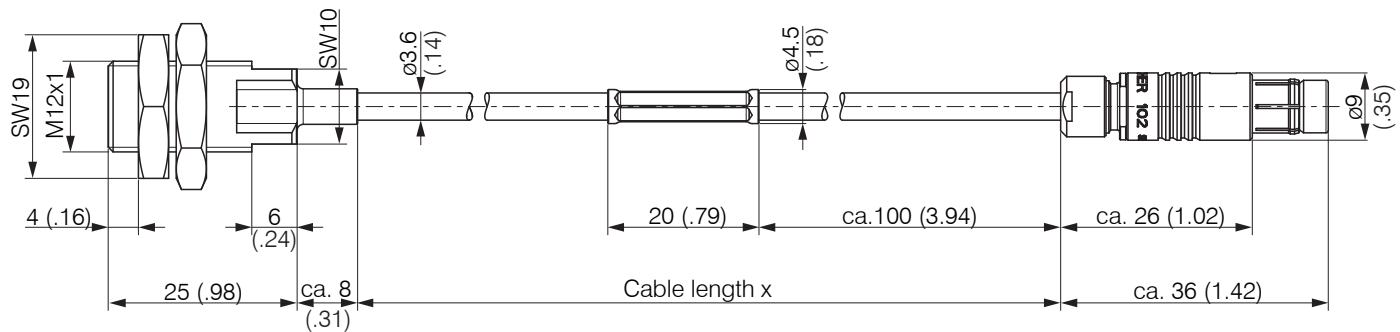

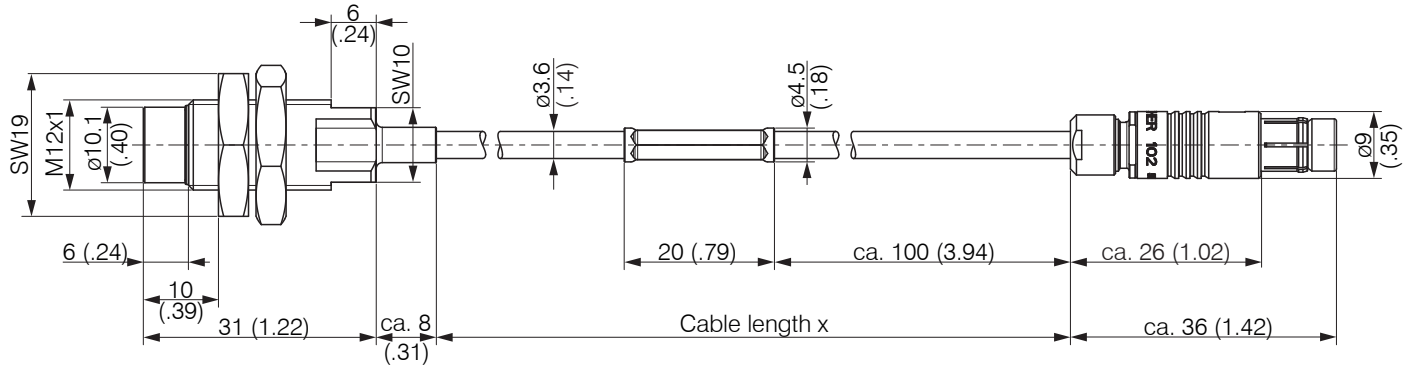*Fig. 10 Dimensional drawing sensors ES-S2-C-CAx/mB0, dimensions in mm (inches)*

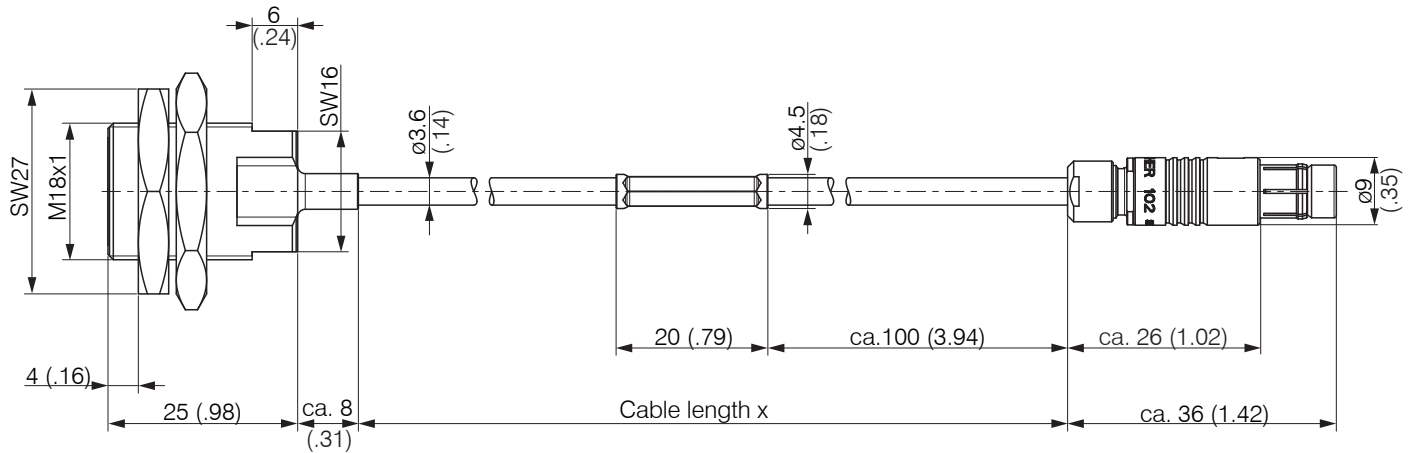*Fig. 11 Dimensional drawing sensors ES-U3-C-CAx/mB0, dimensions in mm (inches)*

Fig. 12 Dimensional drawing sensors ES-S4-C-CAx/mB0, dimensions in mm (inches)

4.5   Sensor Cable

▶ Do not kink the cable - the minimum bending radius is 20 mm (static) or 40 mm (moved).

▶ Route the sensor cable in such a way that no sharp-edged or heavy objects can affect the cable sheath.

▶ Connect the sensor cable to the controller.
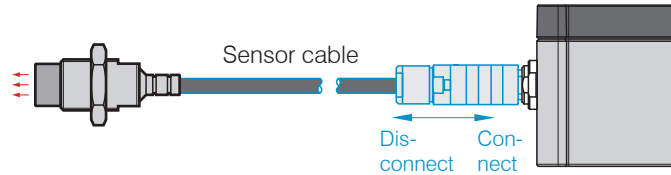
To release the plug-in connection, hold the plug-in connector on the grooved grips (outer sleeves) and pull apart in a straight line.

i   Pulling on the cable and the clamping nut locks the connector and does not release the connection. Avoid excessive pulling of the cables.

▶ Check the plugged connections for firm seating.

i   Do not shorten the sensor cable. Loss of the technical data specified.

4.6 Dimensional Drawing Controller
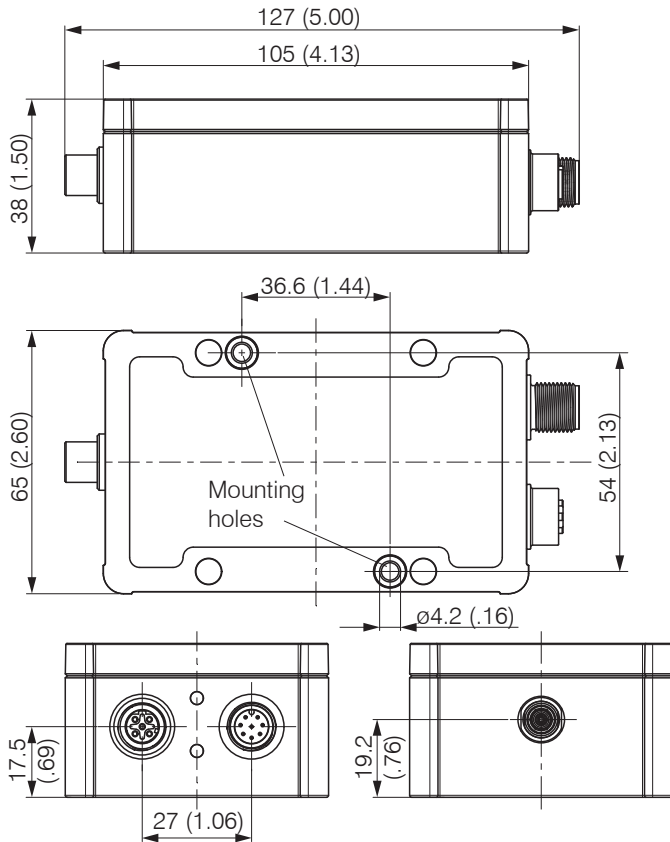
The controller DT306x is installed in an aluminum casing.
- The oscillator electronics feeds the sensor with a frequency and amplitude-stable AC voltage.
- The demodulator electronics demodulates, linearizes and amplifies the distance dependent measuring signal.

The controller is already factory-calibrated to the included sensor and sensor cable.

Fig. 13 Dimensional drawing of the controller DT306x, dimensions in mm (inches)

4.7 Target Size

The relative size of the target object compared with the sensor affects the linearity and slope deviation for eddy current sensors.
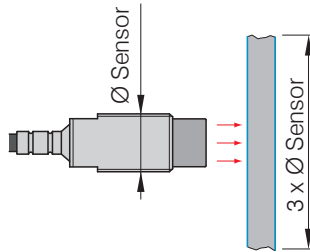

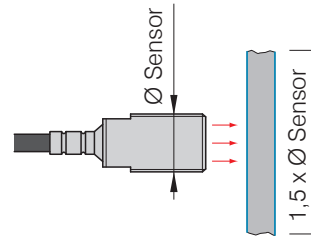Fig. 14 Minimum target size for unshielded sensors

Fig. 15 Minimum target size for shielded sensors

If the required object minimum size cannot be complied with, the following aspects must be taken into account for a sufficiently high linearity:
- The size of the target must not change.
- The target must not be moved laterally to the sensor face.

A successful calibration is a prerequisite to minimize linearity errors.

In order to achieve an optimal result, Micro-Epsilon recommends a linearity calibration on the corresponding measuring object. A change of the measuring object size has significant effects on the quality of the measurement results.

4.8 Electrical Connections

4.8.1 Connection Options

Power supply and signal output are provided via plug connectors on the front of the controller.
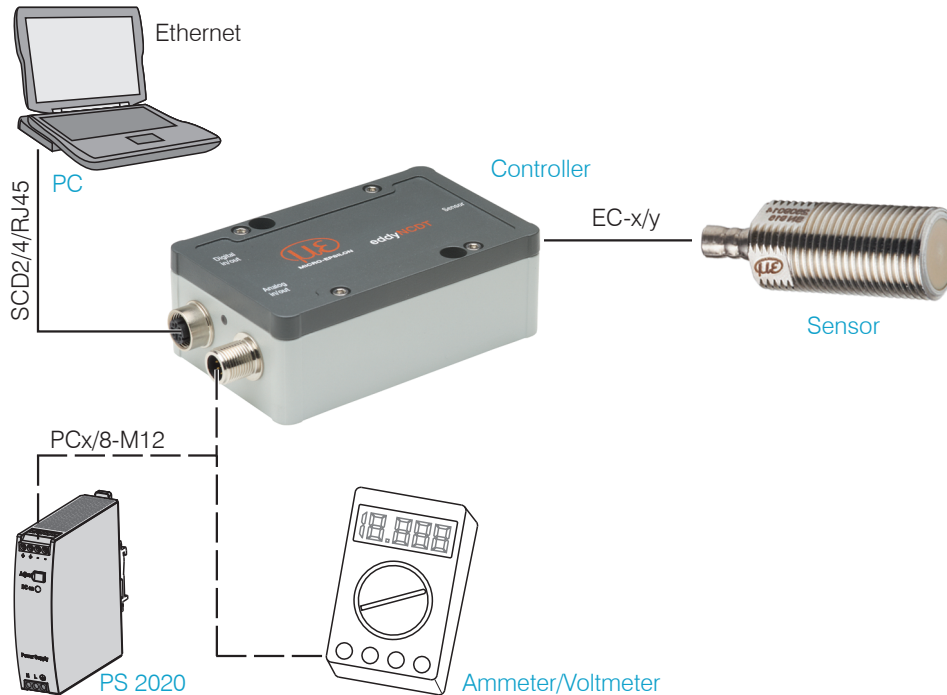
4.8.2   Pin Assignment

PIN	Wire color PCx/8-M12	Signal
2	brown	+24 VDC supply, polarity protection
7	blue	GND supply
1	white	$U_{displacement}$ (load min. 30 kOhm)
6	pink	$GND_{displacement}$
8	red	$I_{displacement}$ (load max. 500 Ohm)
3	green	Temperature and switching output 1 [1] $U_{temp\ sensor}$ / limit value 1
4	yellow	Temperature and switching output 2 [1] $U_{temp\ controller}$ / limit value 2
5	gray	GND temperature, threshold
Shield		

Fig. 17 Pin assignment and color codes
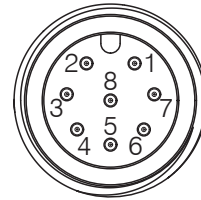
Fig. 16 Pin side 8-pin. housing plug
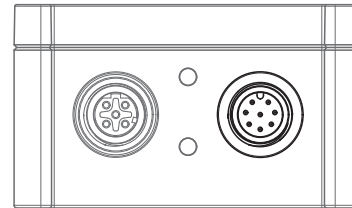
*Fig. 18 Supply and analog output controller, 8-pin male connector*

The PCx/8-M12 is a fully assembled power- and output cable; length is 3, 5 or 10 m. The GND analog grounds are connected internally. The outputs are short circuit proof.

1) Only available with controller DT3061

4.8.3   Supply Voltage

Nominal value: 24 V DC (12 ... 32 V, P < 2,5 W)

▶ Switch on the power supply unit once wiring is completed.

▶ Connect the inputs „2" and „7" at the controller with a 24 V voltage supply.

Controller Pin	PCx/8-M12 Color	Supply
2	brown	$+U_B$
7	blue	Ground
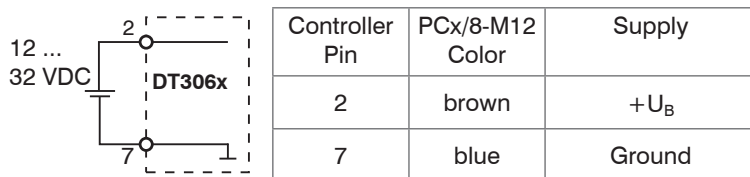
Use the supply voltage for measurement instruments only and not for drive units or similar sources of pulse interference at the same time. MICRO-EPSILON recommends using an optional available power supply unit PS2020 for the controller.

Fig. 19 Connection of supply voltage

4.8.4   Analog Output, Displacement

The controller provides a current output 4 ... 20 mA, voltage output 0 ... 10 V.

Voltage output:

▶ Connect the output 1 (white) and 6 (pink) on the controller to a measuring device.

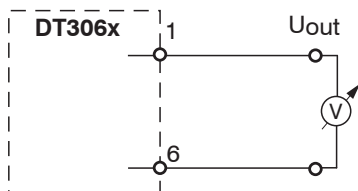| Controller	
8-pin M12 cable connector	Color PCx/8-M12
U_{OUT} (Pin 1)	white
I_{OUT} (Pin 8)	red
GND (Pin 6)	pink

Fig. 20 Wiring for voltage supply

Current output:

▶ Connect the output 8 (red) and 6 (pink) on the controller to a measuring device.
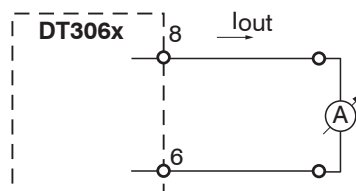
Fig. 21 Wiring for current output

4.8.5   Temperature and switching output

4.8.5.1   General

These functions are possible with the DT3061 controller. Depending on the programming, an output can be used as temperature or switching output.

4.8.5.2   Analog Output, Temperature

The temperature output enables to output the controller or sensor temperature.
This function is possible with the DT3061 controller.

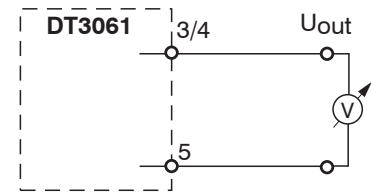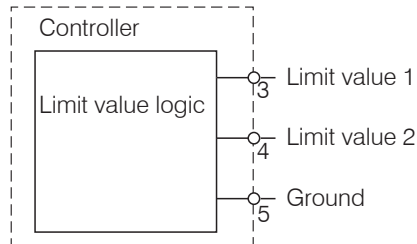| Controller		
8-pol. M12 cable connector	Color PCx/8-M12	
U $_{OUT}$ (Pin 3), Temperature sensor	green	
U $_{OUT}$ (Pin 4), Temperature controller	yellow	
GND (Pin 5)	gray	

Fig. 22 Circuit of temperature measurement

4.8.5.3   Switching Output for Limit Value

Both switching outputs can be used for limit value monitoring of the displacement signal,
Electrical properties of the switching outputs:
- 0 ... 5V (TTL), short circuit proof
- Load at least 10 kOhm

*Pin assignment of limit value outputs, reference mass pin 5*

5.   Operation

5.1   Checking the Measuring System Setup

1) Is the sensor adjusted for the application (target material)?
2) Are the sensor, sensor cable length and controller aligned (type and serial number)?
3) Is the sensor connected? Are the cable connections tight?

5.2   LED Controller

	LED State			
	green	orange	red	off
Controller in operation, measurement runs	●			
Software update	☀			
Sensor or target outside measuring range		☀		
No sensor connected, limit value or warning threshold exceeded, error			●	
No power supply				○

Legend LED

|					
●	on	☀	flashes	○	off

State

Ethernet
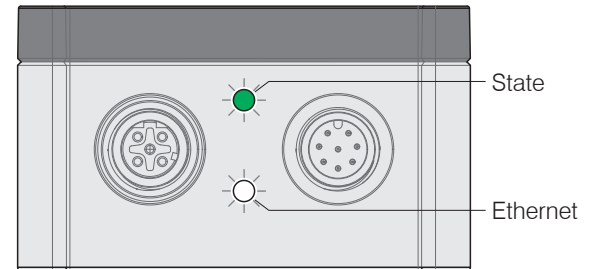
5.3 Control via Web Interface

5.3.1 Requirements

The controller generates dynamic web pages, that contain the current settings of the controller and the peripherals. The operation is only possible as long as there is an Ethernet connection to the controller.

You need a web browser that supports HTML5 (e. g. Firefox ≥ 3.5 or Internet Explorer ≥ 10) on a PC with a network connection. Use a LAN cable with M12 screw connection and RJ-45 connector, e.g. as SCD2/4/RJ45 cable available as optional accessory.
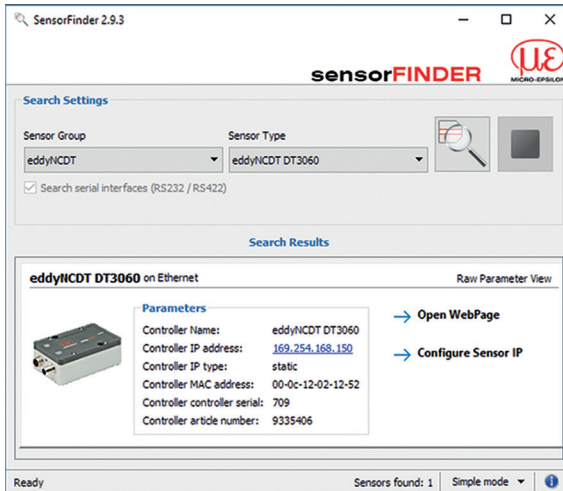
➡ Start the `SensorFinder V2.x.x.` program and click the button 🔍.

The tool searches for connected DT306x controller on available interfaces.

The controller is factory-set to direct connection with a static IP address to facilitate initial operation of the control.

Fig. 23 Auxiliary program for sensor search and to start web interface

If your browser is set to access the Internet via a proxy server, please add the controller IP address to the IP addresses in the browser settings, which are not to be routed over the proxy server. The MAC address of the measuring device is given on the controller rating plate.

"Javascript" and "CSS" must be enabled in the browser so that measurement results can be displayed graphically.

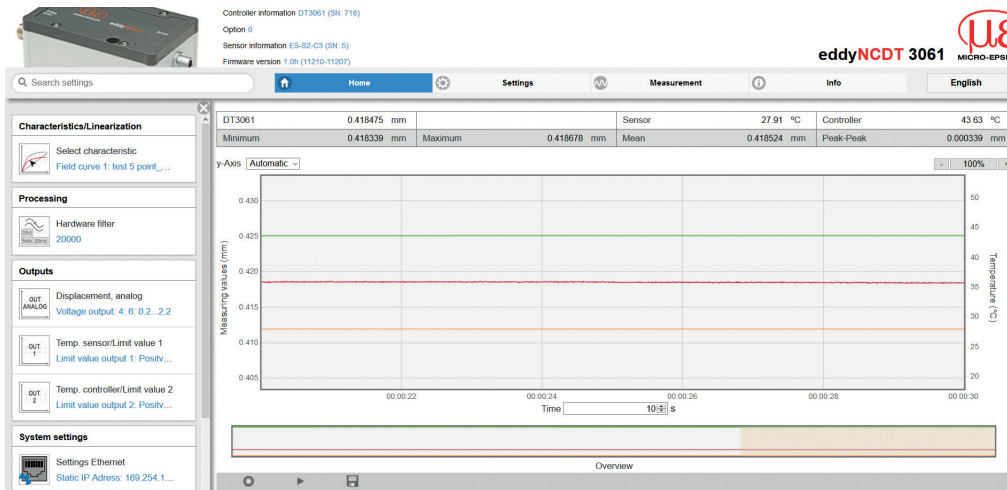| Direct connection to PC		Network
PC with static IP	PC with DHCP	Controller with dynamic IP, PC with DHCP
➡ Connect the controller to a PC via a direct Ethernet connection (LAN).		➡ Connect the controller to a switch.
➡ Start the SensorFinder.exe program. ➡ Click the button 🔍. Select the designated controller from the list. In order to change the address settings, click the button `Change IP...` . ▪ Address type: static IP-Address ▪ IP address: 169.254.168.150 [1] ▪ Subnet mask: 255.255.0.0 ➡ Click the button `Apply`, to transmit the changes to the controller. ➡ Click the button `Start Browser`, to connect the controller with your default browser. 1) Requires that the LAN connection on the PC uses, for example, the following IP address: 169.254.168.1.	➡ Wait until Windows has established a network connection (connection with limited connectivity). ➡ Start the SensorFinder.exe program. ➡ Click the button 🔍. Select the designated controller from the list. ➡ Click the button `Start Browser`, to connect the controller with your default browser.	➡ Enter the controller in the DHCP / register the controller in your IT department. The controller gets assigned an IP address from your DHCP server. You can check this IP address with the SensorFinder.exe program. ➡ Start the SensorFinder.exe program. ➡ Click the button 🔍. Select the designated controller from the list. ➡ Click the button `Start Browser` to connect the controller with your default browser. Alternatively: If DHCP is used and the DHCP server is linked to the DNS server, access to the controller via a host name of the structure „DT3060_<serial number>" is possible. ➡ Start a web browser on your PC. Type „DT3060_<serial number>"the address bar of your web browser.
Interactive websites for programming the controller and peripherals now appear in the web browser.		

5.3.2 Access via Web Interface

Fig. 24 Interactive website after selection of the web interface

Additional help functions (e.g. `Settings`) are available in the top navigation bar.
All settings on the web page are implemented in the controller immediately. Parallel operation with web browser and Telnet commands is possible; the last setting applies.
The appearance of the web pages can change depending on the functions and the peripherals.
Each page contains parameter descriptions and thus tips for configuring the controller.

5.3.3 Operating Menu, Setting Controller Parameters

You can program eddyNCDT 306x using different methods simultaneously:
- using the web browser via the sensor web interface
- using the ASCII command set and the terminal program via Ethernet (Telnet).

5.4   Characteristics and Linearization

5.4.1   General

⏩ Before the measurement, calibrate the measurement channel for the installation environment of the sensor and the measurement object, see Chap. 5.4.4.
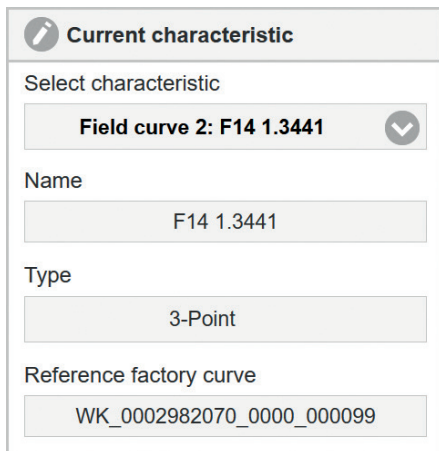
The distance points for the linearization types are defined by comparison standards or micrometers calibration devices.

5.4.2   Select Characteristic

⏩ Menu `Settings` > `Characteristics/Linearization` > `Current characteristic`.

The DT3060 can save one field characteristic curve.

The DT3061 can save up to four different field characteristic curves, which are based on one factory calibration respectively.

Therefore, you can e.g. store different target or installation scenarios as individual characteristic curve and load them into the controller for the desired application.

The `Type` field informs you about the underlying linearization type.

Current characteristic

Select characteristic

Field curve 2: F14 1.3441 ⌄

Name

F14 1.3441

Type

3-Point

Reference factory curve

WK_0002982070_0000_000099

⏩ Via the menu Select characteristic, choose the desired characteristic curve or linearization for your measurement.

5.4.3 Scaling Measuring Range

➡ Menu `Settings > Characteristics/Linearization > Scale measuring range`

There are two ways to scale the measuring range of the eddyNCDT 306x:

- by using the mouse function directly in the graphic
- using the fields `Current measuring range begin` and `Current measuring range end`.
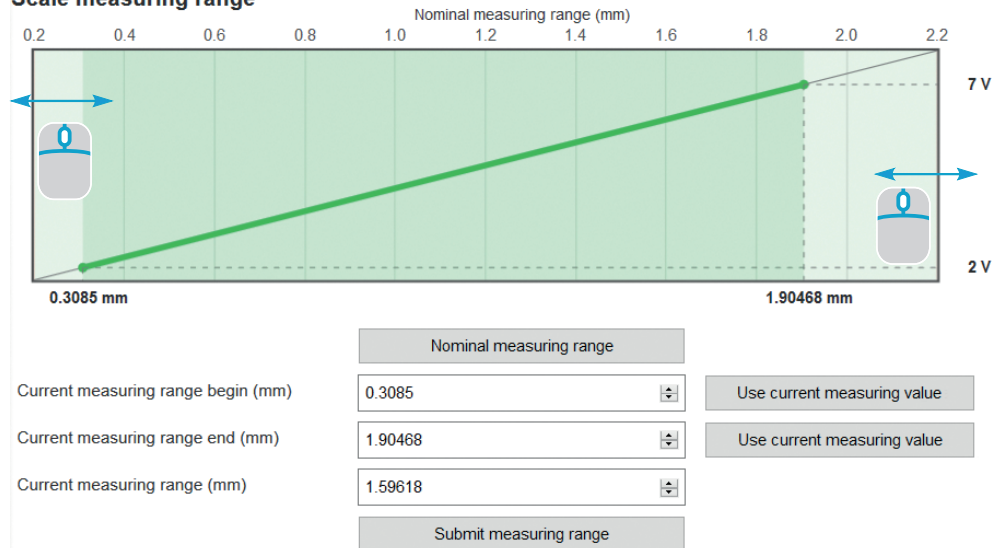

Fig. 25 Scaling the measuring range using the pointer

Scaling of the measuring range has an effect on the analog and digital outputs without increasing the resolution. The reference to the scaling of the analog output remains, i.e. the selected start of measuring range corresponds to 0 V on the voltage output.

With the Nominal measuring range button, you can reset a manual scaling.

5.4.4 Calibration and Linearization

5.4.4.1 Offset

ℹ️ Before a calibration is performed, the measuring device should warm up for about 30 minutes.

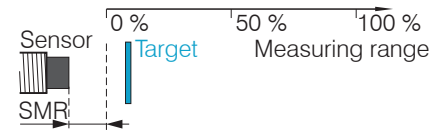The system is linearized, the mechanical zero point in the installed state should be redefined.

➡️ Menu `Settings > Characteristics/Linearization > Carry out field linearization.`

➡️ Choose `Offset` for linearization and the desired `unit`.

Fig. 26 Exemplary zero point shifting using an ES-U3 sensor

You can freely choose the zero point within the sensor measuring range.

➡️ Place the measurement object to the sensor in offset.

➡️ Enter the measurement value (offset).

➡️ Confirm offset with `Submit`.

➡️ Click on the button `Linearize`. The system executes the linearization.

You can permanently store the linearization result.

➡️ Select a memory location with `Select field characteristic.`

➡️ Enter a description for the linearization in the field `Set name.`

➡️ Click on the button `Save & activate.`

5.4.4.2 2-Point Linearization

➡️ Choose `2-point` for linearization and the desired `unit`.
The system is linearized and should be adapted to the ambient conditions in the machine.

➡️ Menu `Settings > Characteristics/Linearization > Carry out field linearization.`

ℹ️ Before a calibration is performed, the measuring device should warm up for about 30 minutes.

Fig. 27 Exemplary 2-point-linearization using an ES-U3 sensor

You can freely choose the linearization points within the sensor measuring range. A linear slope and offset correction of the characterisitic curve is performed.

➡️ Place the measurement object to the sensor in point 1.

➡️ Enter the measurement value (1).

➡️ Confirm point 1 with `Submit`.

➡️ Repeat this procedure for the linearization point 2.

➡️ Click on the button `Linearize`. The system executes the linearization.

You can permanently store the linearization result.

➡️ Select a memory location with `Select field characteristic.`

➡️ Enter a description for the linearization in the field `Set name.`

➡️ Click on the button `Save & activate.`

5.4.4.3   3-Point Linearization

▶ **Menu** `Settings > Characteristics/Linearization >`
`Carry out field linearization`.

If the sensor or the measurement object is changed by the user, a calibration must be carried out before the measurement.
Here, use the following if possible:
- the original sensor mounting,
- the original measurement object.

i   Before a calibration is performed, the measuring device should warm up for about 30 minutes.

▶ Choose `3-point` for linearization and the desired `unit`.

Linearization type	3-Point ⌄
Unit for linearization	mm ⌄

0.20000 mm		2.20000 mm
1	**2**	**3**

Point 1 (mm)	-	0,207	+	Submit
Point 2 (mm)	-	1,172	+	Submit
Point 3 (mm)	-	2,195	+	Submit

Save field characteristic	Linearize

Fig. 28 Exemplary linearization using an ES-U3 sensor

Sensor balancing occurs via three distance points which are specified by a comparison standard. You can freely choose the linearization points within the sensor measuring range.

▶ Place the measurement object to the sensor in point 1.

▶ Enter the measurement value (1).

Point 1 (mm)	-	①	+	Submit

▶ Confirm point 1 with `Submit`.

▶ Repeat this procedure for the linearization points 2 and 3.

	Linearize
Save field characteristic	
Select field characteristic	3: F2.1 St37 ⌄
Set name	F2.1 St37
	Save & activate

▶ Click on the button `Linearize`. The system executes the linearization.

You can permanently store the linearization result.

▶ Select a memory location with `Select field`
`characteristic`.

▶ Enter a description for the linearization in the field
`Set name`.

▶ Click on the button `Save & activate`.

5.4.4.4   5-Point Linearization

This function is available with controller DT3061.

▶ Menu `Settings > Characteristics/Linearization > Carry out field linearization`.

If the sensor or the measurement object is changed by the user, a calibration must be carried out before the measurement.

Here, use the following if possible:

- the original sensor mounting,
- the original measurement object.

i   Before a calibration is performed, the measuring device should warm up for about 30 minutes.

▶ Choose `5-point` for linearization and the desired `unit`.

Fig. 29 Exemplary linearization using an ES-U3 sensor

Sensor balancing occurs via five distance points which are specified by a comparison standard. You can freely choose the linearization points within the sensor measuring range.

▶ Place the measurement object to the sensor in point 1.

▶ Enter the measurement value (1).

▶ Confirm point 1 with `Submit`.

▶ Repeat this procedure for the linearization points 2 until 5.

▶ Click on the button `Linearize`. The system executes the linearization.

You can permanently store the linearization result.

▶ Select a memory location with `Select field characteristic`.

▶ Enter a description for the linearization in the field `Set name`.

▶ Click on the button `Save & activate`.

5.4.5 Manage characteristics

The menu `Settings > Characteristics/Linearization > Manage characteristic` enables the import/export of factory-set characteristics and field characteristics. In addition, the field characteristics can be deleted, renamed or overwritten. Importing the factory-set characteristics is possible only to a limited extent if these have been protected by the manufacturer.

Manage factory-set characteristics

	Name	Export	Import
1	WK_0002982070_0000_000099	⬆	⬇
2	WK_00000000-1_00-1_0000-1	⬆	⬇
3	WK_00000000-1_00-1_0000-1	⬆	⬇
4	WK_00000000-1_00-1_0000-1	⬆	⬇

Manage field characteristics

Name	Reference factory-set characteristic	Rename	Export	Import	Delete
F068 MaT1	1: WK_0002982070_0000_000099	Aa	⬆	⬇	✖
F14 1.3441	1: WK_0002982070_0000_000099	Aa	⬆	⬇	✖
F2.1 St37	1: WK_0002982070_0000_000099	Aa	⬆	⬇	✖
--	--	Aa	⬆	⬇	✖

Fig. 30 Characteristic management in the controller

5.5   Processing

5.5.1   Hardware filter

The `Hardware filter` parameter in the tab `Settings > Processing` influences the bandwidth of the analog low-pass filter. This affects the analog outputs and the digital output.
No data rate reduction.

Hardware filter	*20 / 5,000 / 20,000 Hz*

5.5.2   Sensor Temperature, Controller Temperature
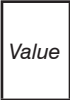
➡ Tab `Settings > Processing > Sensor/Controller temperature`.

The `warning threshold` parameters enable the monitoring of sensor or controller. Output of values exceeding/not reaching the thresholds is carried out via the switching outputs, see Chap. 4.8.5, or as warning message in the web interface.

Sensor temperature	Lower warning limit	+10 ... +180 °C [1] (+50 ... +356 °F)	*Value*
	Upper warning threshold		*Value*
Controller temperature	Lower warning limit	+10 ... +50 °C [1] (+50 ... +122 °F)	*Value*
	Upper warning threshold		*Value*

1) Typical range of values. The actual range depends on the sensor/controller used.

Gray shaded fields require a selection.

Value Dark-bordered fields require you to specify a value.

5.6   Outputs

5.6.1   Displacement, analog

⏩ Menu `Settings > Outputs > Displacement, analog`.

Max. output range: 4 mA ... 20 mA or 0 V ... 10 V
Output amplification ΔI_{OUT} : 16 mA or ΔU_{OUT} : 10 V; corresponds to 100 % MR
In every case, two points are used which characterize the start and the end of the analog output.

Together with the `Change scaling measuring range` function, you can adapt the analog output to your individual requirements.
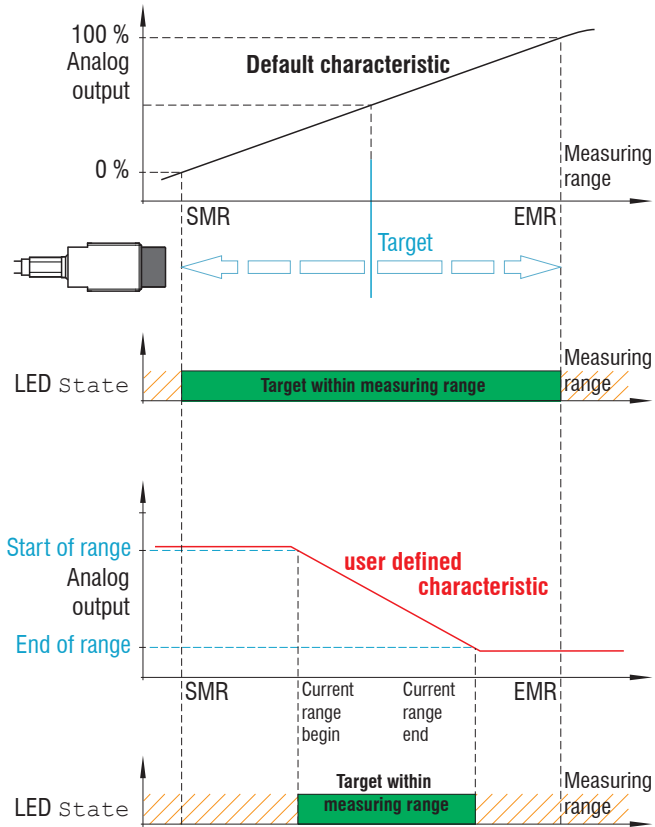
Default characteristic (black), reverse user defined characteristic (red)

5.6.2 Temperature and Limit Value Outputs

5.6.2.1 General

These functions are possible with the DT3061 controller. Depending on the configuration, an output can be used as temperature or switching output.

5.6.2.2 Temperature Output
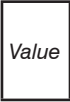
➡️ Menu `Settings > Outputs > Temperature`

Via the temperature outputs, the sensor and controller temperatures can be scaled and output as analog voltage.

Sensor temperature Limit value 1	*Temperature output Sensor /* *Limit value output 1 / Off*	Start of range	0 ... +5 V for temperatures from +10 ... +180 °C [1] (+50 ... +356 °F)	*Value*
		End of range		*Value*
Electronics temperature (controller) Limit value 2	*Temperature output electronics /* *Limit value output 2 / Off*	Start of range	0 ... +5 V for temperatures from +10 ... +50 °C 1 (+50 ... +122 °F)	*Value*
		End of range		*Value*

The accuracy of the temperature measurement depends on the installation scenario. Reproducibility is high.

1) Typical range of values. The actual range depends on the respective temperature compensation.

Gray shaded fields require a selection.

Value Dark-bordered fields require you to specify a value.

5.6.2.3 Limit Output

This function is available with controller DT3061.

➡️ Menu `Settings > Outputs > Limit value 1/2`.

The eddyNCDT 3061 can check the measurement result to adjustable limits. This means that threshold values can be monitored, impermissible tolerances detected and sorting criteria realized.

Type and reference for the limit monitoring are selectable and apply to the current characteristic.

Type: Relative | Peak-To-Peak | Dynamic.

Relative   The threshold values A/B refer to the set `Reference value`.

Peak-To-Peak   The threshold values A/B refer to the peak-to-peak value calculated in blocks (`Peak-to-Peak Δt` parameter).

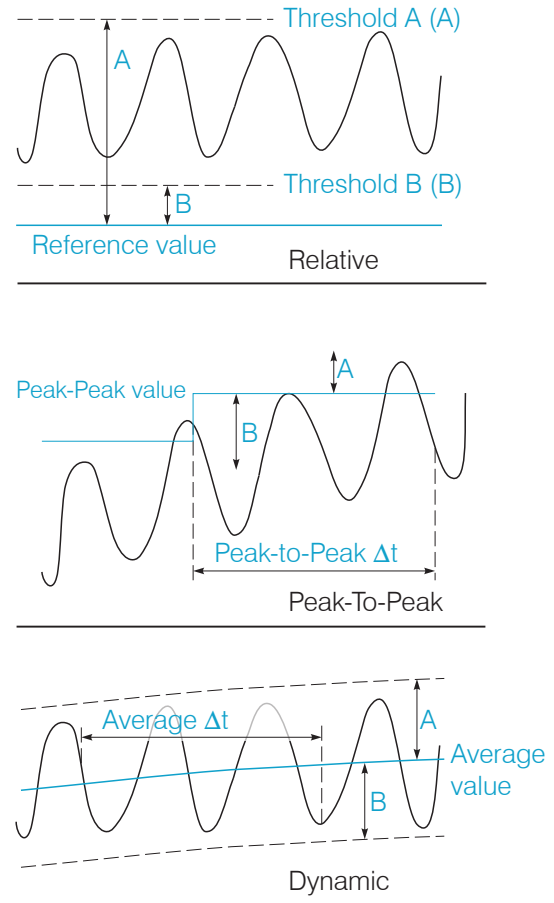Dynamic   The threshold values A/B refer to a continuously calculated, moving average (`Average Δt`).

Fig. 31 References for limit monitoring

Operation

Fig. 34 Parameters for limit monitoring
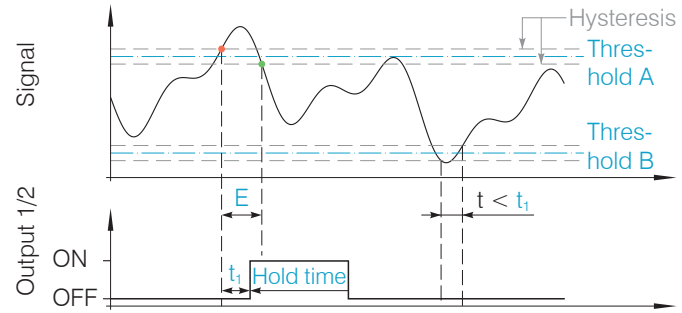

Fig. 32 Timing limit monitoring, event (E) < hold time, logic: `positive`

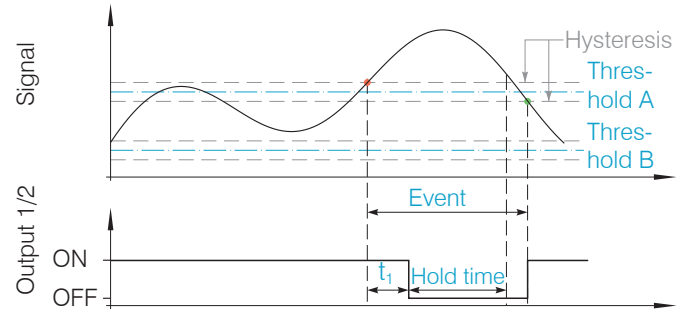Fig. 33 Timing limit monitoring, event (E) > hold time, logic: `negative`

t	Duration of limit infringement
t_1	Delay time
$t < t_1$	Limit output passive
$t \geq t_1$	Limit output active

5.7 System Settings

5.7.1 Language Selection

The web interface promotes the units millimeter (mm) when displaying measuring results.
You can choose Chinese, German, English, Japanese or Korean in the web interface. You can also change the language in the menu bar.

5.7.2 Login, Change of the User Level

➡ Menu Settings > System settings > Switch user

In the delivery state, the controller is set to Expert level.

Change to the User level by clicking the Logout button. Enter the password into the Password field, and confirm with Login in order to switch to the Expert user level.
In Professional mode, you can use the system settings to assign a user-defined password, see Chap. 5.7.3.

Fig. 35 Change in the professional user level

The current user level remains after leaving the web interface of restarting the controller.

The following functions are accessible for the user:

	User	Professional
Password required	no	yes
View settings	yes	yes
Change settings, linearization, anolog output, password	no	yes
Start measuring, scaling diagrams	yes	yes

Fig. 36 Permissions within the user hierarchy

5.7.3 Password

Assigning passwords and the `User level` prevent unauthorized changes to controller settings.
In the delivery state, no password is deposited in the controller.

i A firmware update will not change a custom password.

After the controller has been configured, you should enable password protection.
➡ Change to the menu `Settings > System settings > Change password`.

Password	Value	All passwords are case-sensitive. Letters and numbers are allowed, but special characters are not permitted. A password consists of max. 16 characters.

When a password is assigned for the first time, the field `Old password` remains empty.

5.7.4 Ethernet Settings

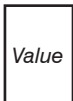➡ Menu `Settings > System settings > Settings Ethernet`.

The IP address of the controller is factory-set to 169.254.168.150. Communication with the controller is performed via a data port (factory-set 10001) for measurement data transmission.
You can change the IP settings and the data port at any time:
- using the web browser,
- using the SensorFinder Software.

Adress type	Static IP address / Dynamic (DHCP)	When using a static IP address it is necessary to enter the values for the IP address, netmask and gateway; this is not required when DHCP is used. When DHCP is activated, the controller is accessible in the network under its DHCP Host name. It contains the name and serial number and is unchangeable, see Chap. 5.3.1. With DHCP it may be necessary to enable the controller MAC address.
IP address	Value	
Netmask	Value	
Gateway	Value	
MAC address	Value	
UUID	Value	
Data port	Value	Setting the port on the measurement value server

Gray shaded fields require a selection.

Value Dark-bordered fields require you to specify a value.

5.7.5 Import, Export

➡ Menu Settings > System settings > Manage settings.
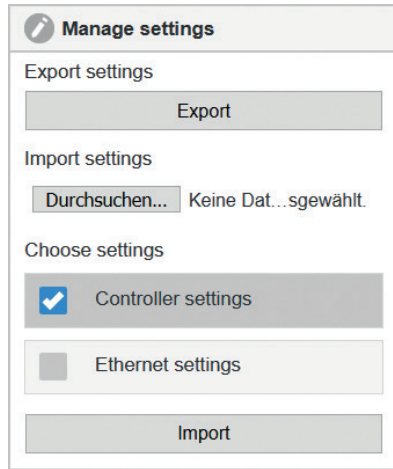
Here you can export all controller settings in a file or reimport them from a file.

Controller settings	e.g. hardware filter, limit value settings
Ethernet settings	e.g. IP address, subnet mask

When importing settings, consider if you want to replace the current controller and/or Ethernet settings.

➡ Choose the desired import option in the settings section.

5.8　　　Positioning the Target

▶ Position the target within the sensor measuring range.

The value for the start of the measuring range (SMR) depends on the sensor. This value can be found in the technical data of the sensor, see Chap. 2.5.

If the user restricts the measuring range, this possibly results in new values for SMR, MMR and EMR.
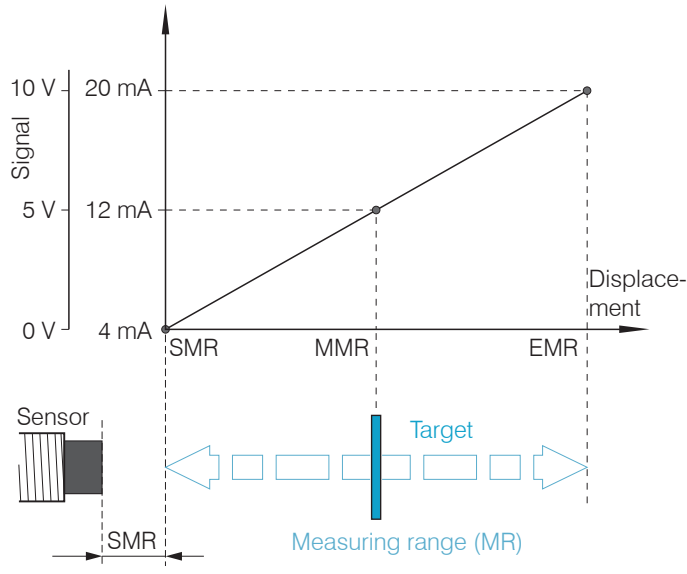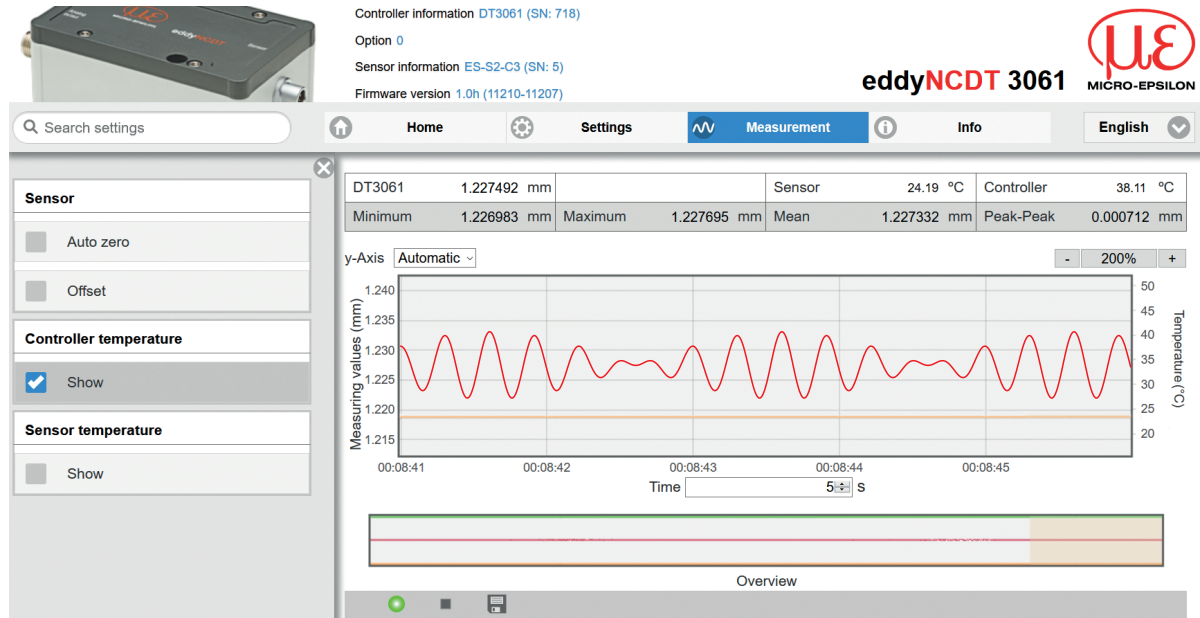
Factory-scaling of analog output

SMR	Start of measuring range
MMR	Mid of measuring range
EMR	End of measuring range

5.9 Distance Measurements

➡️ Switch to the `Measurement` menu.

➡️ Click the `Start measuring` ▶ button.

Statistic values are calculated in the web interface.

Clicking onto the `start /stop measuring` button starts/stops the calculation.

At the beginning of measurement, the statistic values are reset. During a measurement, the statistic values are updated with each new package received by the controller.

6.   Elimination Errors

Error	Cause and solution
Output signal in positive or negative saturation, depends on the scaling of the analog output.	- Cable and/or sensor not connected. - Sensor has open loop. - Cable is defective.
	➡ Please note the remarks in the web interface. Replace cable and/or sensor.
Output signal oscillates at low frequency in multi-channel mode.	- Interference between sensors
	➡ Please note the remarks for sensor arrangement with LF and HF band, see Chap. 4.3.
No change in output signal	➡ Check supply voltage.
	➡ Check allocation of sensor type and cable length.
	➡ Check sensor and cable.

7.   Liability for Material Defects

All components of the device have been checked and tested for functionality at the factory. However, if defects occur despite our careful quality control, MICRO-EPSILON or your dealer must be notified immediately. The liability for material defects is 12 months from delivery. Within this period, defective parts, except for wearing parts, will be repaired or replaced free of charge, if the device is returned to MICRO-EPSILON with shipping costs prepaid. Any damage that is caused by improper handling, the use of force or by repairs or modifications by third parties is not covered by the liability for material defects. Repairs are carried out exclusively by MICRO-EPSILON.

Further claims can not be made. Claims arising from the purchase contract remain unaffected. In particular, MICRO-EPSILON shall not be liable for any consequential, special, indirect or incidental damage. In the interest of further development, MICRO-EPSILON reserves the right to make design changes without notification. For translations into other languages, the German version shall prevail.

8.   Service, Repair

If the sensor, sensor cable or controller is defective please send us the affected parts for repair or exchange. If the cause of a fault cannot be clearly identified, please send the entire measuring system to:

MICRO-EPSILON MESSTECHNIK
GmbH & Co. KG
Koenigbacher Str. 15
94496 Ortenburg / Germany

Tel. +49 (0) 8542 / 168-0
Fax +49 (0) 8542 / 168-90
info@micro-epsilon.com
www.micro-epsilon.com

9.   Decommissioning, Disposal

➡ Remove the power supply and all output cables from the controller.

Incorrect disposal may cause harm to the environment.

➡ Dispose of the device, its components and accessories, as well as the packaging materials in compliance with the applicable country-specific waste treatment and disposal regulations of the region of use.

Appendix

A 1   Optional Accessories

PS2020		Power supply unit Input: 100-240 VAC Output: 24 VDC / 2.5 A Mounting onto symmetrical standard rail 35 mm x 7.5 mm DIN 50022
MC25D(01)		Micrometer calibration unit Setting range: 0-2.5 mm, with digital position reading and adjustable zero, for sensors type ES04-ES2 resp. type U05-S2
SCD2/4/ RJ45		Industrial Ethernet cable 4-pin with M12 connector on RJ45 connector Standard length: 2 m

PCx/8-M12		Supply and signal cable 8-pin with M12 connector Standard length: 3 m Optionally available: 3 / 10 / 15 m 10 m as drag-chain suitable variant

A 2   Model Designation Sensor

Eddy Sensor	Measuring range 1 / 2 / 3 / 4 mm	S = male connector C = integrated cable	Cable length [m]	A = mini B = normal C = large	Option
ES -	S 3	- C - S	A 2,0 / m	B 0	/ ☐
	S = shielded U = unshielded	C = cylindric A = axial F = flat R = radial	m = male f = female OE = open ends	0 = straight 90 = right angle	

A 3   Model Designation Sensor Cable

Controller side

m = male	A = mini	0 = straight
f = female	B = normal	90 = right angle
OE = open ends	C = groß	

EC = eddy cable ECE = eddy cable extension							
EC - 3,0 /	m	A	90 /	f	B	0 /	D3,9
	Nominal cable length [m]	m = male f = female OE = open ends	A = mini B = normal C = groß	0 = straight 90 = right angle			D = nominal cable diameter [mm]

Sensor side