MICRO-EPSILON


Operating Instructions

# capaNCDT 6240
# PROFINET

Non-contact Capacitive Displacement Measuring

MICRO-EPSILON
MESSTECHNIK
GmbH & Co. KG
Koenigbacher Str. 15

94496 Ortenburg / Germany

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

Contents

# 1. Safety

System operation assumes knowledge of the operating instructions.

## 1.1 Symbols Used

The following symbols are used in these 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. |

## 1.2 Warnings

⚠ CAUTION

Disconnect the power supply before touching the sensor surface.

> Risk of injury
> Static discharge

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/or 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/or 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 capaNCDT 6240:
- EU directive 2014/30/EU
- EU directive 2011/65/EU

Products which carry the CE mark satisfy the requirements of the EU directives cited and the relevant applicable harmonized European standards (EN). The measuring system is designed for use in industrial environments.

The EU Declaration of Conformity and the technical documentation are available to the responsible authorities according to the EU Directives.

## 1.4 Intended Use

- The capaNCDT 6240 measuring system is designed for use in industrial and laboratory applications. It is used for
  - displacement, distance, thickness and movement measurement
  - position measuring of parts or machine components
- The system must only be operated within the limits specified in the technical data.

➡ The 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 system.

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

## 1.5 Proper Environment

| Temperature range sensor | CSx, CSxHP<br>CSEx<br>CSEx/Mx | CSHx-CAmx<br>CSHxFL-CRmx | CSGx-CAmx<br>CSFx-CRgx | CSFx |
|---|---|---|---|---|
| Storage | -50 … +200 °C<br>(-58 to +392 °F) | | -50 … +100 °C<br>(-58 to +212 °F) | -40 … +100 °C<br>(-40 to +212 °F) |
| Operation, sensor with connector | -50 … +200 °C<br>(-58 to +392 °F) | - | - | -40 … +100 °C<br>(-40 to +212 °F) |
| Operation, sensor with cable | - | -50 … +200 °C<br>(-58 to +392 °F) | -50 … +100 °C<br>(-58 to +212 °F) | - |

| Temperature range sensor cable | CCgx<br>CCgx/90 | CCmx<br>CCmx/90 |
|---|---|---|
| Storage | -50 … +80 °C<br>(-58 to +176 °F) | -50 … +200 °C<br>(-58 to +392 °F) |
| Operation, permanently | -20 … +80 °C<br>(-4 to +176 °F) | -100 ... +200 C<br>(-148 to +392 °F) |
| Operation, 10,000 h max. | -20 … +100 °C<br>(-4 to +212 °F) | - |

| Temperature range controller | |
|---|---|
| Storage | -10 ... +75 °C (+14 to +167 °F) |
| Operation | +10 ... +60 °C (+50 to +140 °F) |

- Protection class: IP 40
- Humidity: 5 - 95 % (non-condensing)
- Ambient pressure: Atmospheric pressure
- The space between the sensor surface and the target must have an unvarying dielectric constant.
- The space between the sensor surface and the target may not be contaminated (for example water, rubbed-off parts, dust, etc.)

# 2. Functional Principle, Technical Data

## 2.1 Measuring Principle

The principle of capacitive distance measurement with the capaNCDT system is based on the principle of the parallel plate capacitor. For conductive targets, the sensor and the target opposite form the two plate electrodes.

If a constant AC current flows through the sensor capacitor, the amplitude of the AC voltage at the sensor is proportional to the distance between the capacitor electrodes. The AC voltage is demodulated, amplified and output as an analog signal.

The capaNCDT system evaluates the reactance $X_C$ of the plate capacitor which changes strictly in proportion to the distance.

$$X_C = \frac{1}{j\omega C}; \quad \text{capacitance } C = \varepsilon_r * \varepsilon_o * \frac{\text{area}}{\text{distance}}$$

i A small target and bent (uneven) surfaces cause a non-linear characteristic.

This theoretical relationship is realized almost ideally in practice by designing the sensors as guard ring capacitors.

The linear characteristic of the measuring signal is achieved for electrically conductive target materials (metals) without any additional electronic linearization. Slight changes in the conductivity or magnetic properties do not affect the sensitivity or linearity.

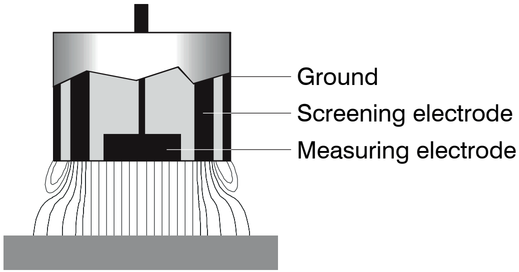



*Fig. 1 Functional principle of the guard ring capacitor*

## 2.2 Structure

The non-contact, multi-channel measuring system, installed in an aluminum housing, consists of:

- A basic module DT6240
- A demodulator module DL6220 or DL6230, each with integrated preamplifier per sensor
- Sensor, sensor cable
- Power supply cable
- Ethernet cable
- Signal output cable

The modular assembly allows to join up to 4 channels (module system).

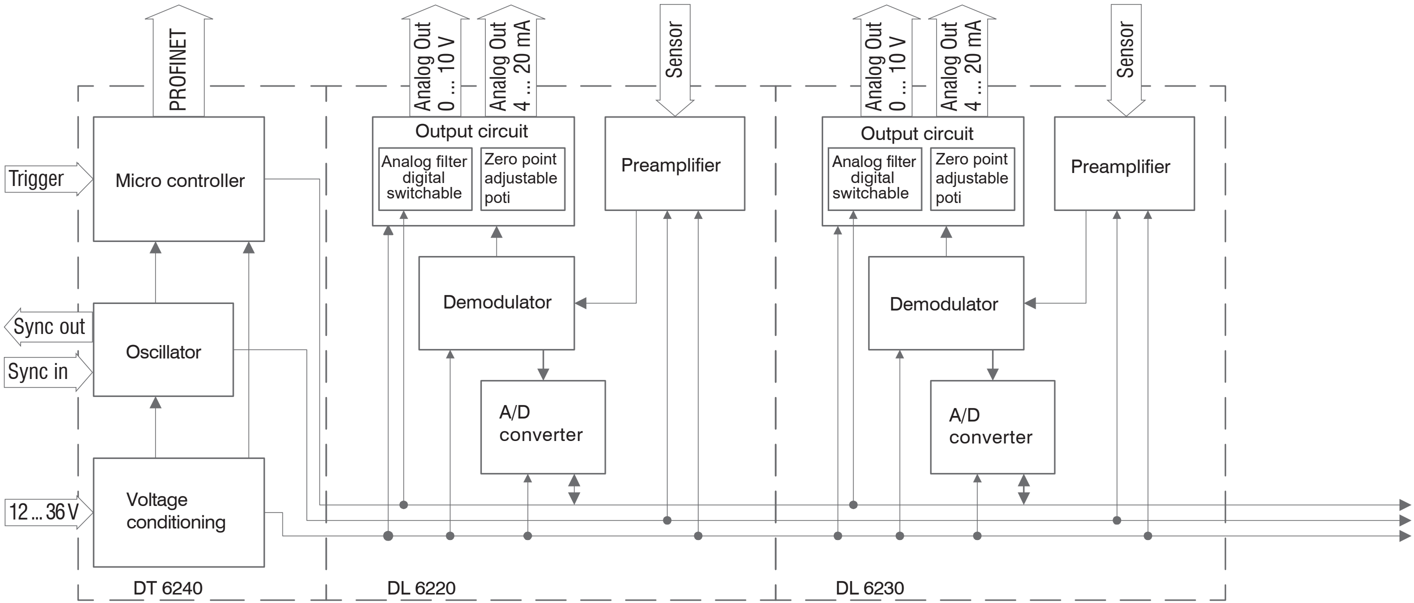



*Fig. 2 Block diagram capaNCDT 6240*

### 2.2.1 Sensors

For this measurement system, several sensors can be used.

➡ In order to obtain accurate measuring results, keep the surface of the sensor clean and free from damage.

The capacitive measuring process is area-related. A minimum area (see table) is required depending on the sensor model and measuring range. In the case of insulators the dielectric constant and the target thickness also play an important role.

**Sensors for electrical conducting targets (metals)**

| Sensor model | Measuring range | Min. target diameter |
|---|---|---|
| CS005 | 0.05 mm | 3 mm |
| CS02 | 0.2 mm | 5 mm |
| CSH02 | 0.2 mm | 7 mm |
| CSH02FL | 0.2 mm | 7 mm |
| CS05 | 0.5 mm | 7 mm |
| CSE05 | 0.5 mm | 6 mm |
| CSE05/M6 | 0.5 mm | 6 mm |
| CSH05 | 0.5 mm | 7 mm |
| CSH05FL | 0.5 mm | 7 mm |
| CS08 | 0.8 mm | 9 mm |
| CS1 | 1 mm | 9 mm |
| CSE1 | 1 mm | 8 mm |
| CSE1,25/M12 | 1.25 mm | 10 mm |
| CSH1 | 1 mm | 11 mm |
| CSH1FL | 1 mm | 11 mm |
| CS1HP | 1 mm | 9 mm |

| Sensor model | Measuring range | Min. target diameter |
|---|---|---|
| CSH1,2 | 1.2 mm | 11 mm |
| CSH1.FL | 1.2 mm | 11 mm |
| CSH2FL | 2 mm | 17 mm |
| CS2 | 2 mm | 17 mm |
| CSH2 | 2 mm | 17 mm |
| CSE2 | 2 mm | 14 mm |
| CSE2/M16 | 2 mm | 14 mm |
| CS3 | 3 mm | 27 mm |
| CSE3/M24 | 3 mm | 20 mm |
| CSH3FL | 3 mm | 24 mm |
| CS5 | 5 mm | 37 mm |
| CS10 | 10 mm | 57 mm |
| CSG0.50 | 0.5 mm | approx. 7 x 8 mm |
| CSG1.00 | 1.00 mm | approx. 8 x 9 mm |

### 2.2.2 Sensor Cable

Sensor and controller are connected by a special, double screened sensor cable.

Do not shorten or lengthen these special cables.

Usually, a damaged cable can not be repaired.

**NOTICE**

Switch off the device when plugging and removing connectors.
Do not crush the sensor cable.
Do not modify to the sensor cable.
Lost of functionality.

| Model | Cable length | Cable ø | 2 axial connector | 1x axial + 1x 90 ° | Measuring range sensors | Min. bending radius | |
|---|---|---|---|---|---|---|---|
| | | | | | | once | permanently |
| CCgxC | 2/4 or 6 m | 3.1 mm | • | | 0.05 - 0.8 mm | 10 mm | 22 mm |
| CCgxC/90 | 2/4 or 6 m | 3.1 mm | | • | 0.05 - 0.8 mm | | |
| CCgxB | 2/4 or 6 m | 3.1 mm | • | | 1 ... 10 mm | | |
| CCgxB/90 | 2/4 or 6 m | 3.1 mm | | • | 1 ... 10 mm | | |
| CCmxC | 1.4/2.8 or 4.2 m | 2.1 mm | • | | 0.05 - 0.8 mm | 7 mm | 15 mm |
| CCmxC/90 | 1.4/2.8 or 4.2 m | 2.1 mm | | • | 0.05 - 0.8 mm | | |
| CCmxB | 1.4/2.8 or 4.2 m | 2.1 mm | • | | 1 ... 10 mm | | |
| CCmxB/90 | 1.4/2.8 or 4.2 m | 2.1 mm | | • | 1 ... 10 mm | | |

The sensors of type CSH have integrated a 1.4 long sensor cable. Cable lengths of 2.8 m are available too if required.

Other cable lengths are also available on request.

The sensor model CSE1 (measuring range 1 mm) has the connector type C.

### 2.2.3 Controller

The capaNCDT 6240 Multi-channel measuring system consists of a basic module DT6240 and one up to four demodulator modules DL62xx, according to requirements. The components are stored in aluminum housings.

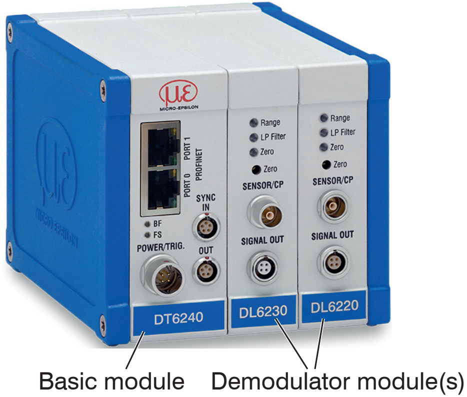



*Fig. 3 Front view basic module DT6240 with demodulator module DL6220 and DL6230*

**Basic module DT6240**

The basic module consists of the units voltage conditioning, oscillator and digital unit.

The voltage conditioning generates all required internal voltages from the supply voltage, both for the basic module as well as the connected demodulator modules. The oscillator supplies the demodulator modules with constant frequency and amplitude-stable alternating current. The frequency is 31 kHz. The digital unit controls the A/D converter of the demodulator modules and measures the actual measuring values. The measuring values can be read out via the Profinet interface in digital form.

**Demodulator module DL62xx**

The demodulator module DL6220/DL6230 consists of an internal preamplifier, demodulator, output stage and A/D converter per sensor channel. The internal preamplifier generates and amplifies the distance-dependent measurement signal. The demodulator and output stage transform the measurement signal into a standardized voltage or current signal. The A/D converter helps process the measurement values digitally.

The trim potentiometer zero allows a special zero adjustment of the analog output signals, see Fig. 3.

**NOTICE** The output voltage can reach a maximum value of 15 VDC if the sensor is unplugged or if the measuring range is exceeded. Observe possible restrictions for the evaluation or display units to be connected.

## 2.3 Technical Data

| Model | | DT6240 | |
|---|---|---|---|
| with demodulator | | DL6220 | DL6230 |
| Resolution [1] | static (20 Hz) | 0.004 % FSO | 0.0005 % FSO |
| | dynamic (5 kHz) | 0.02 % FSO | 0.005 % FSO |
| Bandwidth (-3db) | | 5 kHz, switchable to 20 Hz | |
| Data rate output digital | | max. 3,906 kSa/s | |
| Linearity [2] | | < ±0.05 % FSO | < ±0.025 % FSO |
| Temperature stability | | < 200 ppm FSO / K | |
| Sensitivity deviation | | < ±0.1 % FSO | |
| Long term stability | | < 0.02 % FSO / month | |
| Synchronization | | yes | yes |
| Supply | | 15 … 36 VDC | 15 … 36 VDC |
| Power consumption | | 3.9 W (24 VDC) + 1.9 W / demodulator | |
| Trigger | | TTL (5V) | |
| Digital interface | | PROFINET | |
| | Speed | 1 ms PROFINET RT; 0.5 ms PROFINET IRT | |
| Analog output | | 0 … 10 V / 4 … 20 mA | |
| Montage | | Table-top device or DIN rail | |
| Temperature range | Storage | -10 … +75 °C(+14 ... +167 °F) | |
| | Operation | +10 … +60 °C (+50 ... +140 °F) | |
| Shock (DIN-EN 60068-2-27) | | 15 g / 6 ms in 3 axis, 2 directions and 1000 shocks each | |
| Vibration (DIN-EN 60068-2-6) | | 0.75 mm / 10 … 500 Hz in 3 axis, 2 directions and 10 cycles each<br>2 g / 10 … 500 Hz in 3 axis, 2 directions and 10 cycles each | |
| Protection class (DIN-EN 60529) | | IP40 | |

| Model | DT6240 | |
|---|---|---|
| with demodulator | DL6220 | DL6230 |
| Weight | appr. 720 g + 185 g / demodulator | appr. 720 g + 210 g / demodulator |
| Sensors | suitable for all sensors | |
| No. of channels | max. 4 | |

FSO = Full scale output

1) RMS noise related to mid of measuring range

2) Applies only to the controller. The total linearity of the measuring channel is composed of the values for controller and sensor.

## 2.4 Options

| **Article number** | **Designation** | **Description** | **Suitable for articles** | | | |
|---|---|---|---|---|---|---|
| | | | 2303018 DL6220 | 2303022 DL6220/ECL2 | 2303023 DL6220/ECL3 | 2303029 DL6220/LC |
| 2982044 | LC DL62x0 digital | Special calibration of linearity on digital output | ○ | ○ | ○ | • |
| 2982045 | LC DL62x0 analog | Special calibration on linearity on analog output | ○ | ○ | ○ | • |
| 2982046 | ECL2 DL6220 | Special tuning for 2 times sensor cable length | - | • | - | • |
| 2982047 | ECL3 DL6220 | Special tuning for 3 times sensor cable length | - | - | • | • |
| 2982048 | EMR2 DL6220 | Extended measuring range (factor: 2) | ○ | ○ | ○ | • |
| 2982049 | RMR1/2 DL6220 | Shortened measuring range (factor: 1/2) | ○ | ○ | ○ | • |

| Article number | Designation | Description | Suitable for articles | | | |
|---|---|---|---|---|---|---|
| | | | 2303019 DL6230 | 2303024 DL6230/ECL2 | 2303025 DL6230/ECL3 | 2303030 DL6230/LC |
| 2982044 | LC DL62x0 digital | Special calibration of linearity on digital output | ○ | ○ | ○ | • |
| 2982045 | LC DL62x0 analog | Special calibration of linearity on analog output | ○ | ○ | ○ | • |
| 2982054 | ECL2 DL6230 | Special tuning for 2 times sensor cable length | - | • | - | • |
| 2982055 | ECL3 DL6230 | Special tuning for 3 times sensor cable length | - | - | • | • |
| 2982051 | EMR2 DL6230 | Extended measuring range (factor: 2) | ○ | ○ | ○ | • |
| 2982052 | EMR3 DL6230 | Extended measuring range (factor: 3) | ○ | ○ | ○ | • |
| 2982053 | RMR1/2 DL6230 | Shortened measuring range (factor: 1/2) | ○ | ○ | ○ | • |

• Articles already contain the option

○ Option available

- No option available

# 3. Delivery

## 3.1 Unpacking, Included in Delivery

1 Basic module DT62x0 with 1 - 4 demodulator modules DL62x0

1 Power supply and trigger cable PC6200-3/4, 3 m long, see Chap. A 1.1.

1 Ethernet cable, 3 m long

**Optional accessories:**

1 sensor per measuring channel

1 sensor cable with connector per measuring channel

1 Signal output cable, synchronization 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 for completeness and shipping damages immediately after unpacking.
- If there is damage or parts are missing, immediately contact the manufacturer or supplier.

## 3.2 Download

GSDML file <GSDML-V2.42-MICRO-EPSILON-DT6x40PNET-202x.xml> is available at https://www.micro-epsilon.com/service/download/

TIA function components for easier configuration, available at https://www.micro-epsilon.com/service/download/

## 3.3 Storage

| Sensor | CSx, CSxHP<br>CSEx<br>CSEx/Mx | CSHx-CAmx<br>CSHxFL-CRmx | CSGx-CAmx<br>CSFx-CRgx | CSFx |
|---|---|---|---|---|
| | -50 … +200 °C<br>(-58 to +392 °F) | | -50 … +100 °C<br>(-58 to +212 °F) | -40 … +100 °C<br>(-40 to +212 °F) |

| Sensor cable | CCgx<br>CCgx/90 | CCmx<br>CCmx/90 |
|---|---|---|
| | -50 … +80 °C<br>(-58 to +176 °F) | -50 … +200 °C<br>(-58 to +392 °F) |

| | |
|---|---|
| Controller | -10 ... +75 °C (+14 to +167 °F) |

- Humidity: 5 - 95 % RH (non-condensing)

# 4. Installation and Assembly

## 4.1 Precautionary Measures

No sharp-edged or heavy objects may get into contact with the sensor cable sheath.

- Protect the cable against pressure loads in pressurised rooms.
- Avoid kinks in any case.
- Check the connections for tight fit.

i A damaged cable cannot be repaired.

## 4.2 Sensor

The sensors may be mounted free-standing or flush.
When assembling, make sure that the polished sensor surface is not scratched.

### 4.2.1 Radial Point Clamping with Grub Screw, Cylindric Sensors

This simple type of fixture is only recommended for a force and vibration-free installation position. The grub screw must be made of plastic so that it cannot damage or deform the sensor housing.

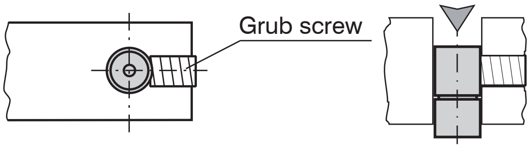
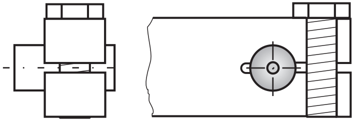



*Fig. 4 Radial point clamping with grub screw*

**NOTICE** Do not use metal grub screws!
Danger of damaging the sensor.

### 4.2.2 Circumferential Clamping, Cylindric Sensors

This sensor mounting option offers maximum reliability because the sensor is clamped around its cylindrical housing. It is absolutely necessary in difficult installation environments, for example on machines, production plants et cetera.



Mounting with clamping ring

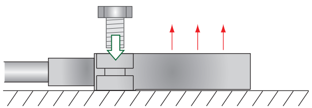
*Fig. 5 Circumferential clamping*

i Tension at the cable is inadmissible!

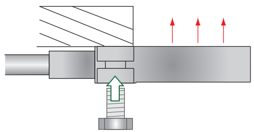
### 4.2.3 Flat Sensors

Flat sensors are mounted by means of a tap hole for M2 (in case of sensors 0.2 and 0.5 mm) or by a through hole for M2 screws. The sensors can be bolted on top or below.

**Screwing from above**

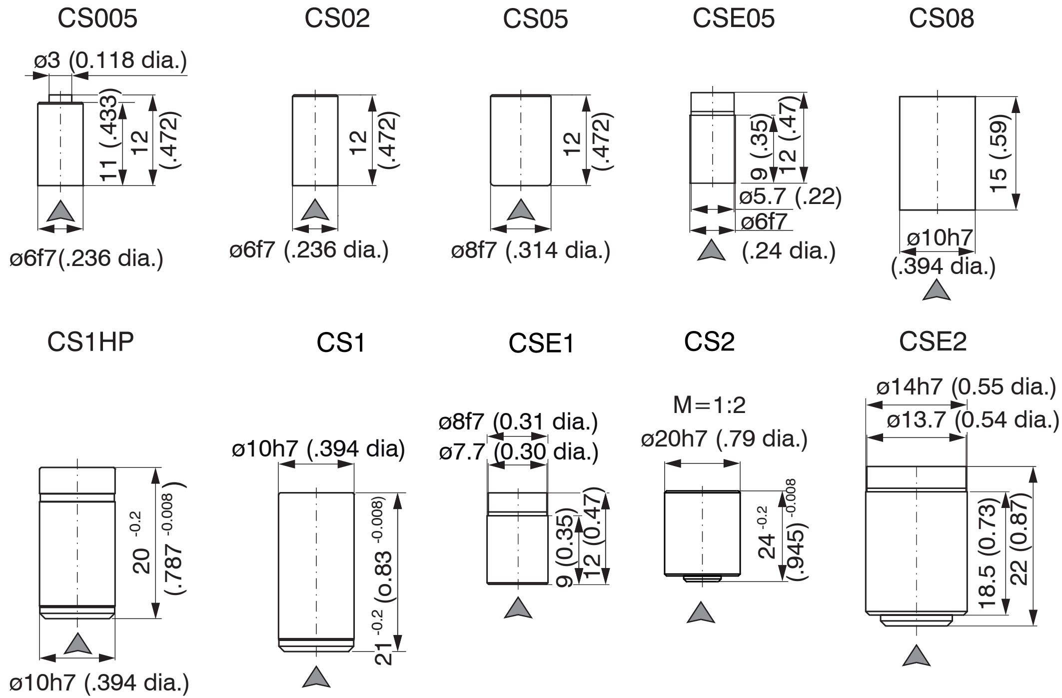


**Screwing from bottom**



### 4.2.4 Dimensional Drawings Sensors

**Cylindric sensors**

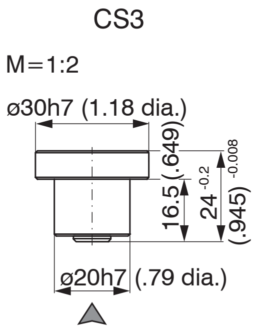


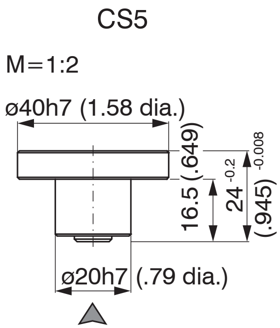

Die Trennung von Controller und Sensor wird zu einem späteren Zeitpunkt umgestzt, wenn Montage u. ä. in einer separaten BA oder MA umgesetzt ist.

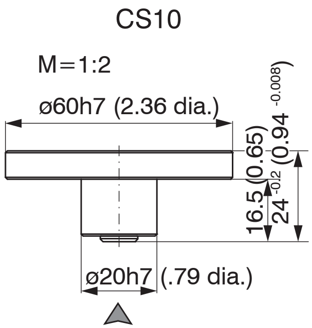
△ Connector side

Dimensions in mm (inches)
Circumferential clamping possible from 3 mm behind the front face.
Dimensional drawings of other sensors are available on request.

**Cylindric sensors**

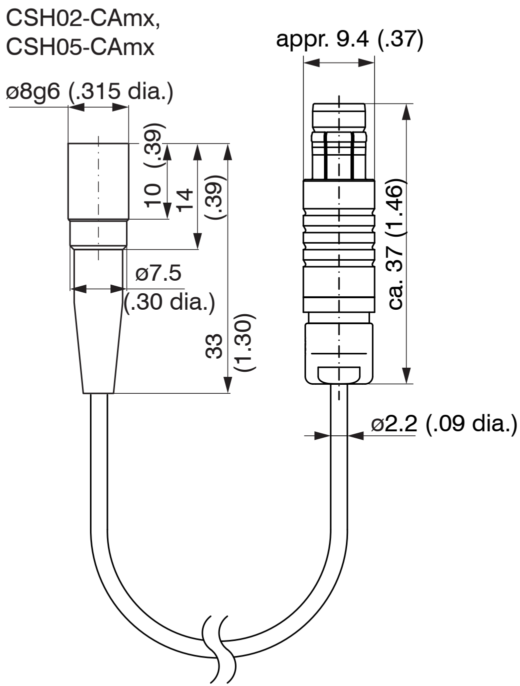


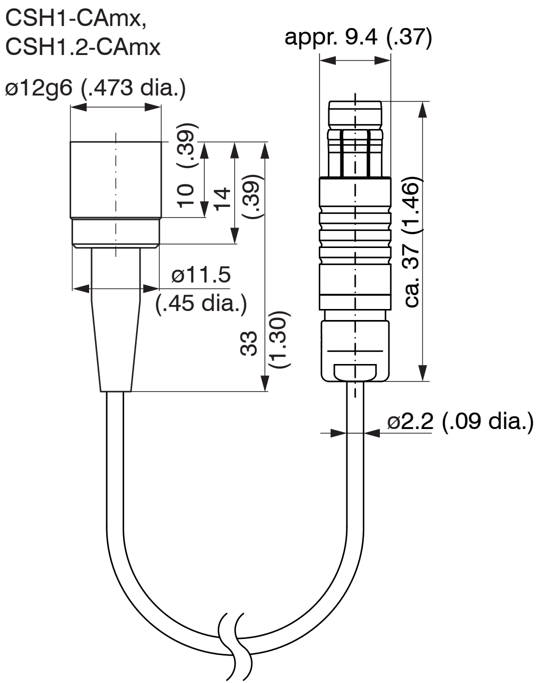




△ Connector side

Dimensions in mm (inches)
Circumferential clamping possible from 3 mm behind the front face.
Dimensional drawings of other sensors are available on request.

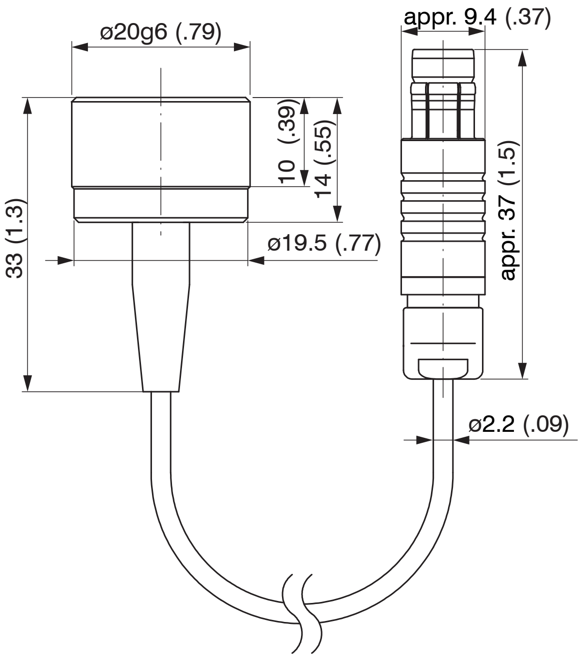



Dimensions in mm (inches), not to scale

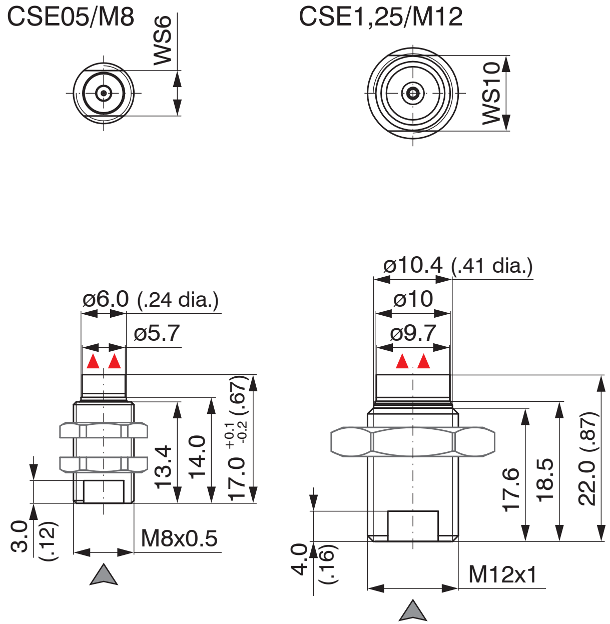
**Cylindric sensors**

CSH2-CAmx




Dimensions in mm (inches), not to scale

**Cylindrical sensors with thread**

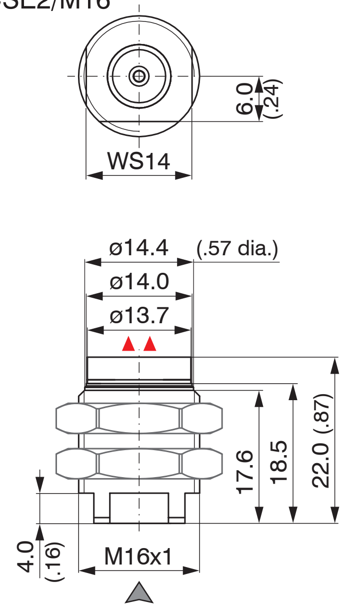



△ Connector side

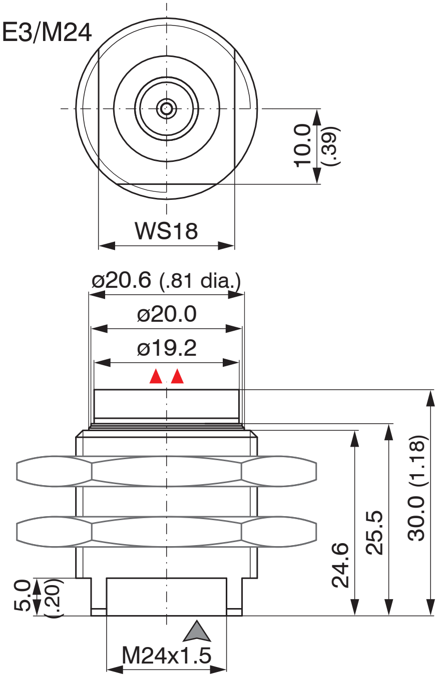
Dimensions in mm (inches)

▲▲ Active measuring surface sensor
Dimensional drawings of other sensors are available on request.

CSE2/M16




CSE3/M24



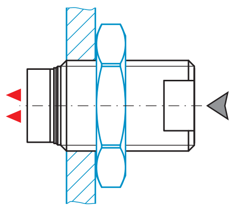

▲ Connector side

Dimensions in mm (inches)

▲▲ Active measuring surface sensor

Dimensional drawings of other sensors are available on request.

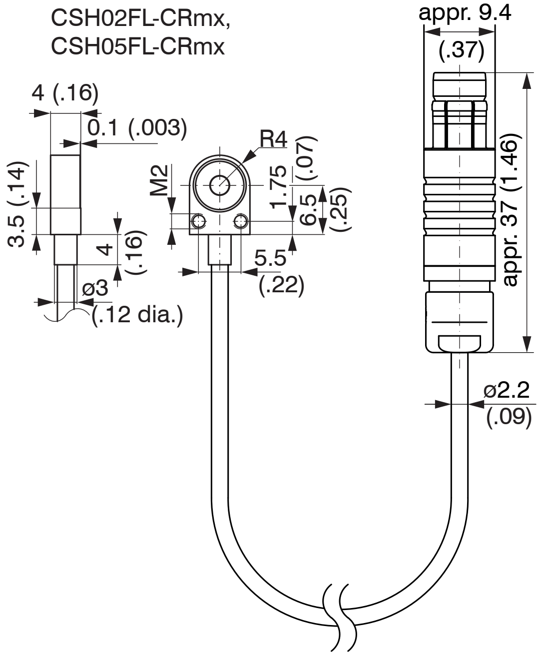
| Sensor | Torque |
|---|---|
| CSE05/M8 | 2.5 Nm max. |
| CSE1,5/M12 | 10 Nm max. |
| CSE2/M16 | 20 Nm max. |
| CSE3/M24 | 70 Nm max. |

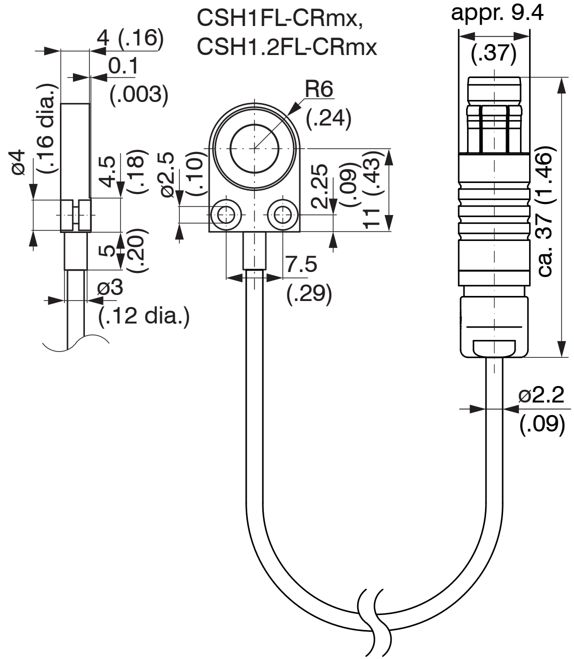


Preferred mounting:

- Screw the sensor into the sensor holder.
- Turn the mounting nut on. Do not exceed torques.

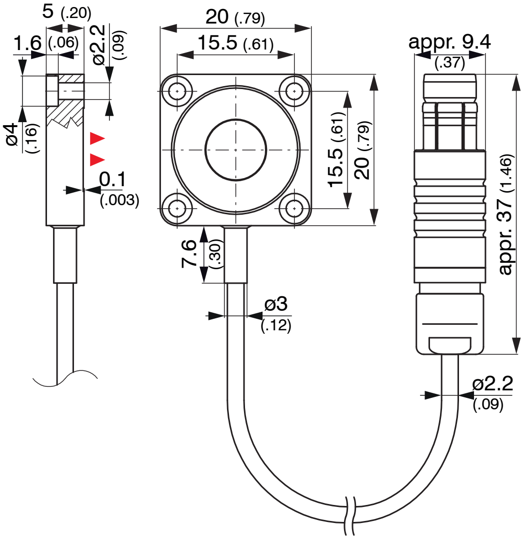
**Flat sensors**



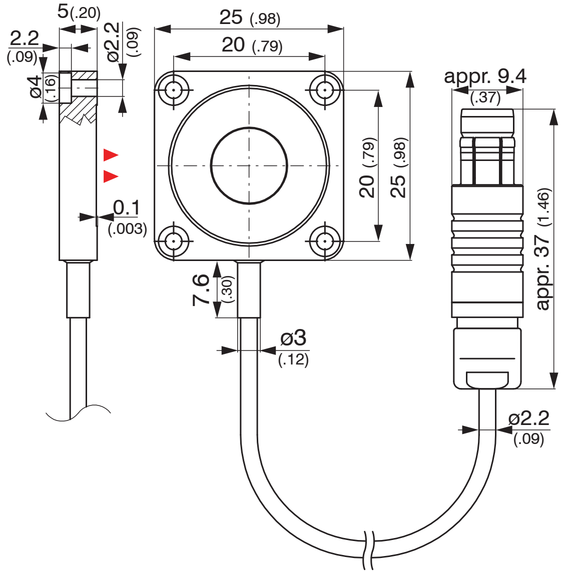




Dimensions in mm (inches), not to scale

CSH2FL-CRmx



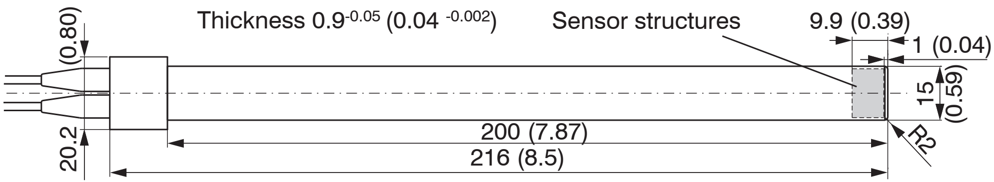

CSH3FL-CRmx



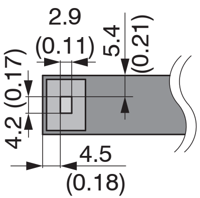

Cable length 1.4 m visible (incl. crimp sleeve)

Dimensions in mm (inches), not to scale

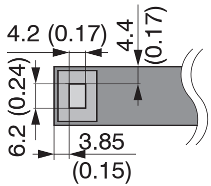
CSG0.50-CAm2.0 and CSG1.00-CAm2.0




**Sensor structures**




CSG0,50-CAm2,0



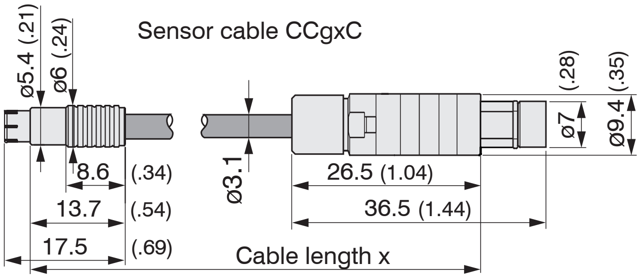

CSG1,00-CAm2,0

Dimensions in mm (inches), not to scale

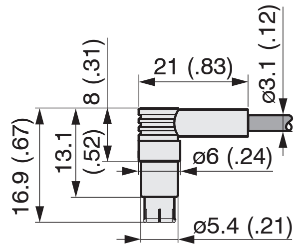
## 4.3 Sensor Cable

The sensor is connected to the controller by the sensor cable. The connection is made by simple plugging. The connector locks automatically. The tight fit can be checked by pulling the connector housing (cable bushing). The lock can be released and the connector can be opened by pulling the knurled housing sleeve of the cable bushing.

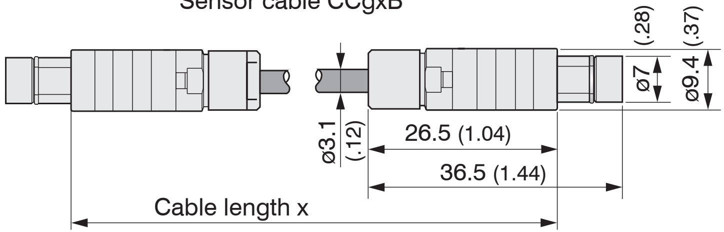
Sensor cable CCgxC



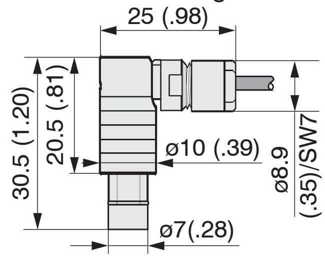

Sensor cable CCgxC/90




Sensor cable CCgxB



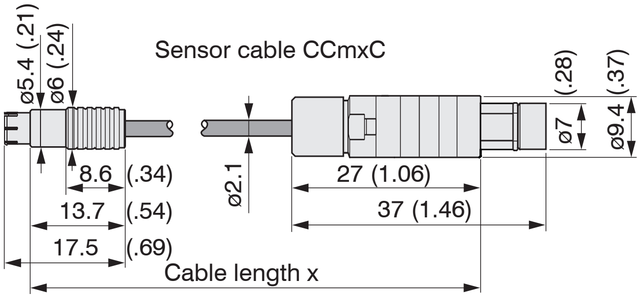

Sensor cable CCgxB/90



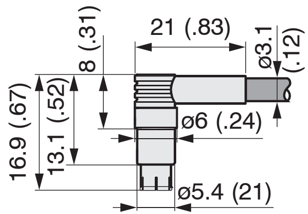

Dimensions in mm (inches), not to scale

| Model | Cable length | Cable ø | 2 axial connector | 1x axial + 1x 90 ⁰ | For sensors | Min. bending radius | |
|---|---|---|---|---|---|---|---|
| CCgxC | 2/4 or 6 m | 3.1 mm | • | | 0.05 - 0.8 mm | 10 mm (once) | 22 mm (permanently) |
| CCxgC/90 | 2/4 or 6 m | 3.1 mm | | • | 0.05 - 0.8 mm | | |
| CCgxB | 2/4 or 6 m | 3.1 mm | • | | 1 ... 10 mm | | |
| CCgxB/90 | 2/4 or 6 m | 3.1 mm | | • | 1 ... 10 mm | | |

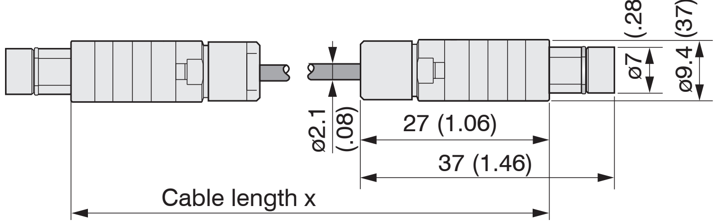
Sensor cable CCmxC



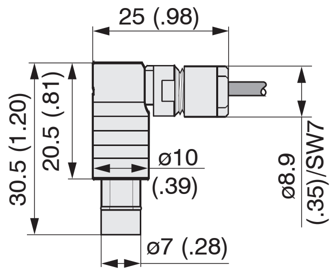

Sensor cable CCmxC/90




Sensor cable CCmxB




Sensor cable CCmxB/90

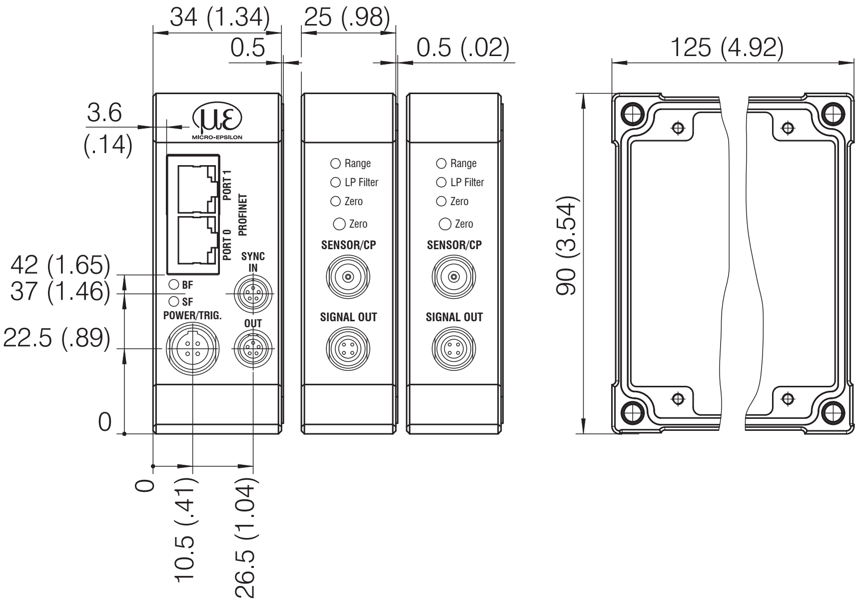



Dimensions in mm (inches), not to scale

| Model | Cable length | Cable ø | 2 axial connector | 1x axial + 1x 90 ° | For sensors | Min. bending radius | |
|---|---|---|---|---|---|---|---|
| CCmxC | 1.4/2.8 or 4.2 m | 2.1 mm | • | | 0.05 - 0.8 mm | 7 mm (once) | 15 mm (permanently) |
| CCmxC/90 | 1.4/2.8 or 4.2 m | 2.1 mm | | • | 0.05 - 0.8 mm | | |
| CCmxB | 1.4/2.8 or 4.2 m | 2.1 mm | • | | 1 ... 10 mm | | |
| CCmxB/90 | 1.4/2.8 or 4.2 m | 2.1 mm | | • | 1 ... 10 mm | | |

## 4.4 Controller

### 4.4.1 Basic Module, Demodulator Module




Dimensions in mm (inches rounded off)

The controller is mounted using mounting plates or retaining clips for a DIN rail mounting, which are included in an optional conversion kit.

*Fig. 6 Dimensional drawing basic module and demodulator*

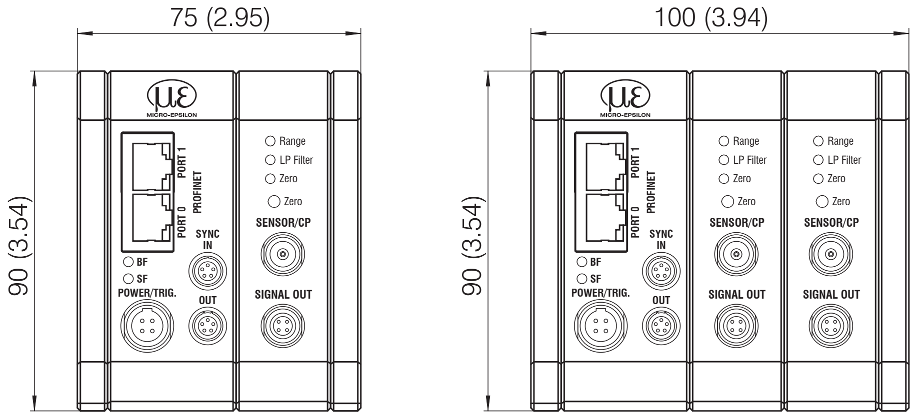



*Fig. 7 Dimensional drawing of controller with one or two demodulator modules*

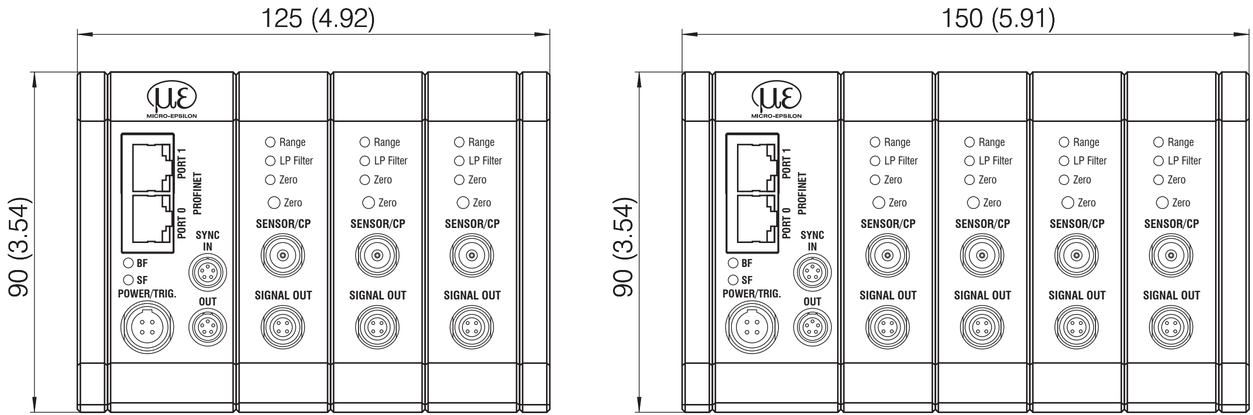



*Fig. 8 Dimensional drawing of controller with three or four demodulator modules*

Dimensions in mm (inches rounded off)

### 4.4.2 Housing Cover

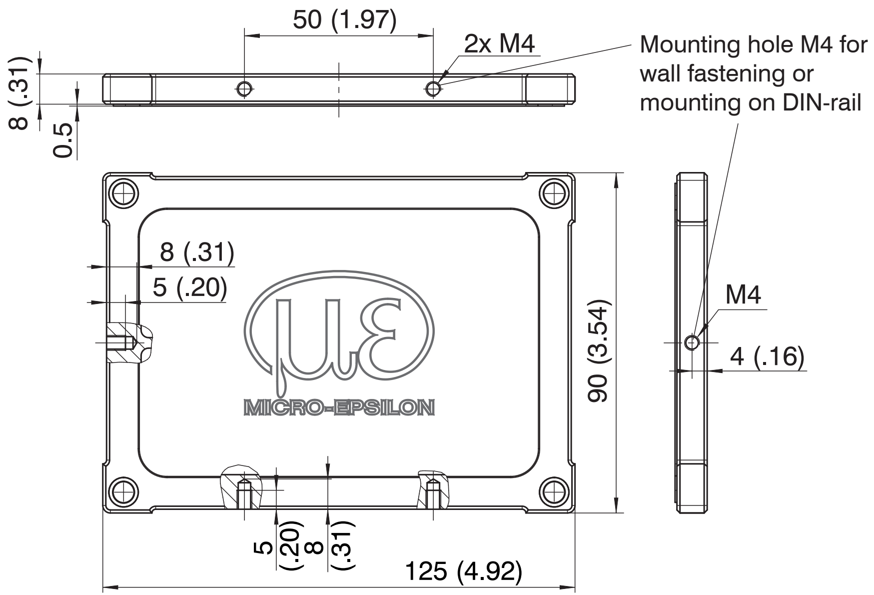



*Fig. 9 Dimensional drawing housing cover*

Dimensions in mm (inches rounded off)

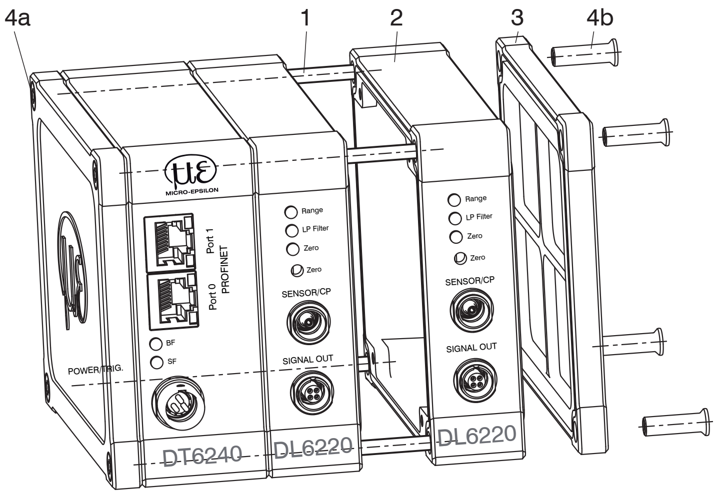
The controller is mounted using mounting plates or holding clamps for a mounting on DIN-rail.

## 4.5 Insert Demodulator Module

- Unscrew the sleeve nuts (4b) on the right side of the controller, remove the right housing cover (3).
- Remove a sleeve nut (4a) with threaded rod (1).
- Successively replace the threaded rod (1) by a threaded rod next longer from the supplied conversion kit. Move the new threaded rod with the sleeve nut (4a) through the modules.
- Exchange the remaining 3 threaded rods in such a way.

i Touch the demodulator modules only at the housing, not at the electronics. This will prevent electrostatic discharges on the electronics.

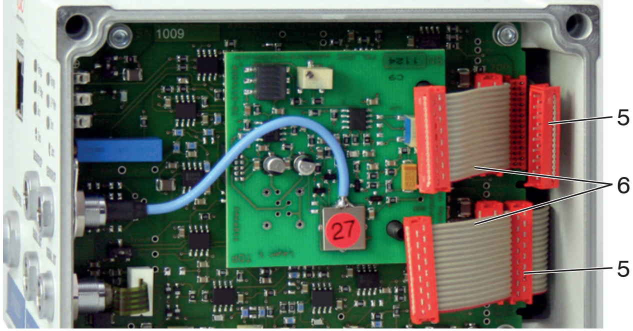
- Attach the additional demodulator module.




| Number demodulator modules | Length threaded rod M4 |
|---|---|
| 1 | 59 mm |
| 2 | 84 mm |
| 3 | 109 mm |
| 4 | 134 mm |

*Fig. 10 Mechanical components controller*

➡ Connect both flat flexible cables (5) of the preceding demodulator module with the new demodulator module (6).




5 Wiring preceding demodulator module

6 Wiring following demodulator module

*Fig. 11 Wiring demodulator modules*

➡ Put on the right housing cover (3).

➡ Screw the sleeve nuts (4b) on the threaded rods on the right side of the controller and tighten the sleeve nuts.

The wiring to the preceding demodulator module (5) can be solved using the supplied plugging off assistance as follows:

➡ 1. Press the plugging off assistance with the recess laterally to the connector (5).

➡ 2. Loosen the connector with a lever movement.

➡ 3. Loosen the other side of the connector in the same way.

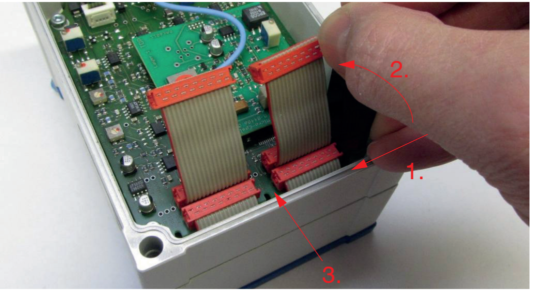



*Fig. 12 Use of the plugging off assistance for the wiring of the demodulator elements*

## 4.6 Ground Connection, Earthing

➡ Make sure you have a sufficient grounding of the measuring object, for example connect it with the sensor or the supply ground.

**Non-contact target earthing**

In several applications, the target earthing is difficult or even impossible.

Different to other systems, with capaNCDT systems is no target earthing necessary

The drawing below shows two synchronized capaNCDT sensors, measuring against a mill. Due to the unique synchronizing technique of MICRO-EPSILON a special target earthing is not needed in most cases.

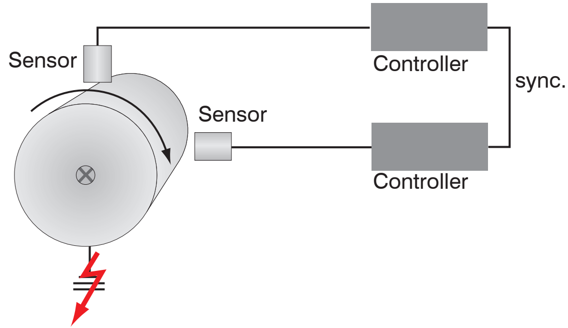



*Fig. 13 Position and unbalance measuring with two measuring systems*


*Fig. 14 Ground connection on the housing cover*

No target grounding required with two synchronized capaNCDT sensors.

If necessary use the ground connection on the housing cover.

## 4.7 Electrical Connections

### 4.7.1 Connectivity Options

The power supply and the signal output are located at the front side of the controller.

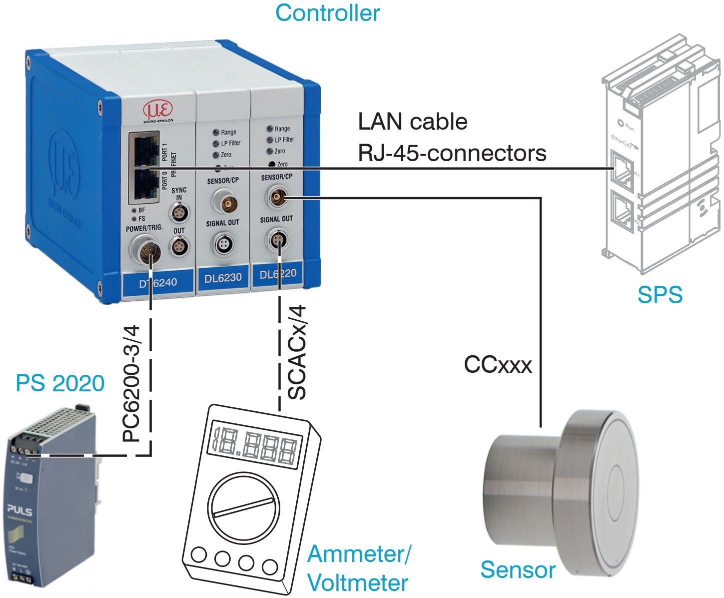
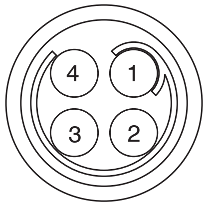



*Fig. 15 Measuring system assembly*

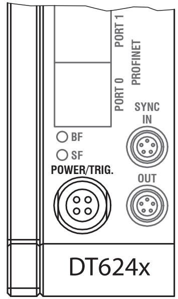
### 4.7.2 Pin Assignment Supply, Trigger

| PIN | Color PC6200-3/4 | Signal | Description |
|---|---|---|---|
| 1 | brown | +24VIN | +24 VDC Supply |
| 2 | white | Zero VIN | GND Supply |
| 3 | yellow | TRI_IN+ | Trigger IN+, TTL level |
| 4 | green | TRI_IN- | Trigger IN- |
| shield | | | |

PC6000-3/4 is a 3 m (13.12 ft) long, pre-assembled power supply and trigger cable.




View on solder pin side, 4-pole ODU female cable connector

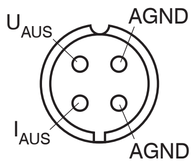



Power supply input on controller, 4-pole male cable connector

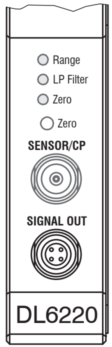
### 4.7.3 Pin Assignment Analog Output

| Pin | Color SCACx/4 | Signal | Description |
|---|---|---|---|
| 1 | brown | U-out | $U_{OUT}$, (Load min. 10 kOhm) |
| 2 | yellow | I-out | $I_{OUT}$, (Load max. 500 Ohm) |
| 3 | gray | AGND | Analog ground |
| 4 | white | AGND | Analog ground |
| shield | | | |

Analog grounds are connected internally. SCACx/4 is a 3 m (13.12 ft) long, 4-wire output cable. It is supplied as an optional accessory.




View on solder pin side, 4-pole male cable connector

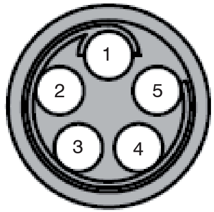



Signal output on controller, 4-pole male cable connector

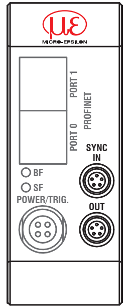
### 4.7.4 Pin Assignment Synchronization

| PIN | Assignment | Insulation | Color |
|---|---|---|---|
| 1 | n.c | - | - |
| 2 | Twisted Pair 1 | 1 | white 1 |
| 3 | Twisted Pair 1 | blue | blue |
| 4 | Twisted Pair 2 | 2 | white 2 |
| 5 | Twisted Pair 2 | orange | orange |

SC6000-x is a 0,3 or 1 m long, preassembled synchronization cable




View on solder pin side,
5-pin ODU male cable connector




Sync IN/OUT on controller,
5-pin female cable connector

Several measuring systems series capaNCDT 6240 can simultaneously be used as multi-channel system. With the synchronization of the systems, a mutual influence of the sensors is avoided.

- Plug the synchronization cable SC6000-x, see Chap. A 1.2, into the female connector SYNC OUT (Synchronisation output) at the controller 1.
- Plug the connector of SC6000-x into the female connector SYNC IN (synchronization input) at controller 2.

The oscillator of controller 2 switches automatically into synchronization, this means, depending on the oscillator 1 of Controller 1.

An influence of poor earthed target is excepted.

Synchronize possibly several measuring systems with a SC6000-x.

i Automatic synchronization. Every controller can be master.


Fig. 16 Synchronization of a second controller

## 4.8 Fieldbus Cabling

During cabling, channel 0 of the IO controller is connected to a port of the first IO device (slave device). The second port of the first slave device is connected to the input port of the next slave device, etc. One port of the last slave device and channel 1 of the master device remain unused.

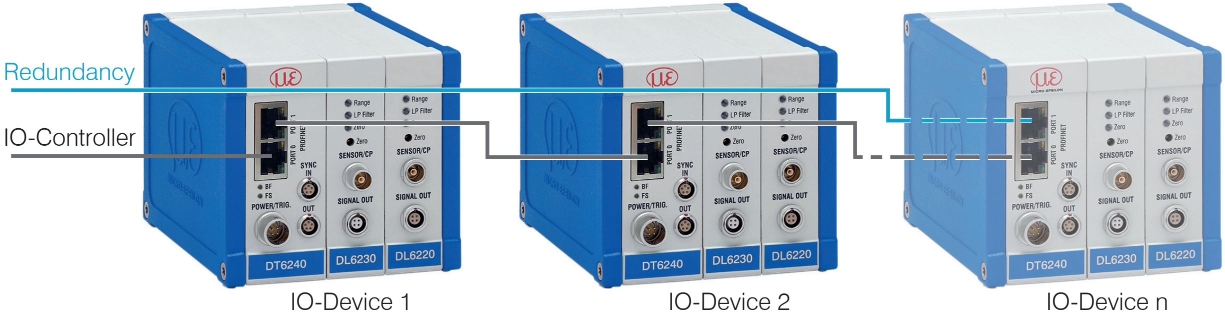



*Fig. 17 Cabling in the PROFINET IO network*

**Optional:** You achieve greater failsafe network performance if you implement an additional redundant connection (MRP = Media Redundancy Protocol) between the output port of the last slave device and channel 1 of the IO controller. The DT6240 can participate in an MRP ring as a client; however, it cannot manage the ring. To achieve ring functionality, all participants must be configured as ring participants.

# 5. Operation

## 5.1 Starting Up

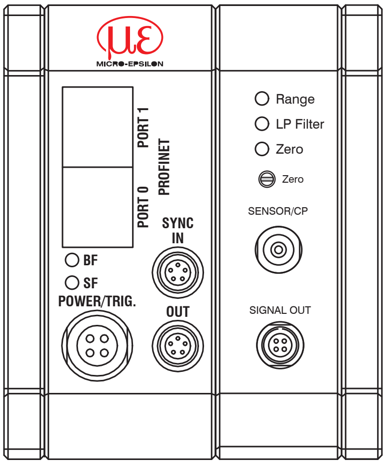
Connect the the display/output devices through the signal output socket, see Chap. 4.7, before connecting the device to the power supply and switching on the power supply.

i Allow the measuring system to warm up before the first measurement or calibration for approximately 15 min.

## 5.2 Operating or Display Elements

Kommentar:
„Range, LP Filter weg --> sind bei Kompaktsystem nicht verbaut“
LED‘s gibt es laut Foto doch.

### 5.2.1 LED‘s




| LED | Color | | Function |
|---|---|---|---|
| Range | ☼ | green | Target in measuring range |
| | | red | Measuring range exceeded |
| LP Filter [1] | ○ | off | Standard bandwidth active |
| | ☼ | red | 20 Hz Low-pass filter on the analog outputs enabled |
| Zero | ○ | off | Zero poti in basic position (right stop) |
| | ☼ | red | Zero poti adjusted |
| BF | ☼ | red | Bus failure |
| SF | ☼ | red | System failure |
| BF, SF | ○ | | No failure |

1) LP Filter only switchable via Ethernet.

### 5.2.2 Poti

The zero-poti on the demodulator modules is used for zero adjustment of the analog outputs.

End positions on the left or right stop are marked by a slight click.

The electrical zero point can be set across the whole measuring range with the “zero” potentiometer. The start of the measuring range (= mechanical zero point) is on the front face of the sensor.

A tilted sensor or measuring object results in a reduced measuring range and zero point shifting according to the tilting.

The potentiometer is ex factory set at the right stop (maximum level).

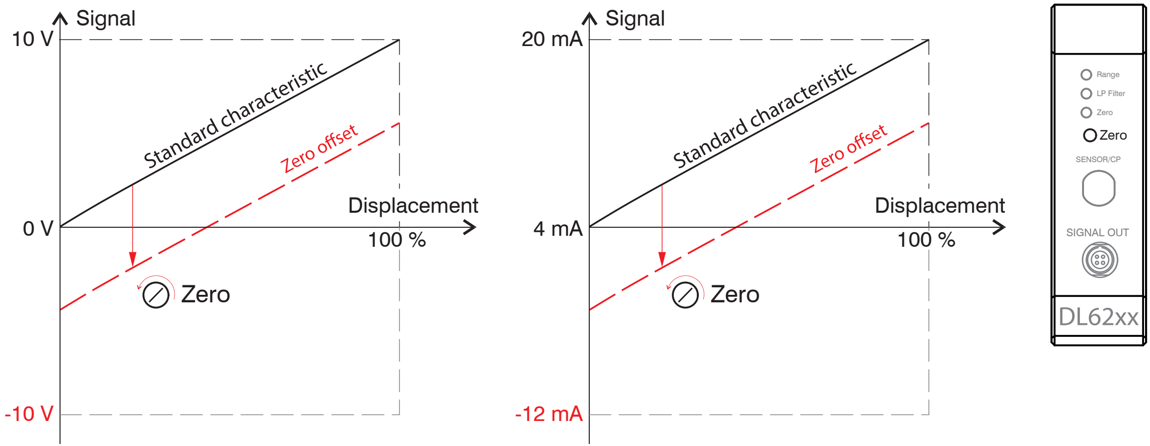



*Fig. 18 Zero point shifting with zero-poti*

## 5.3 Triggering

The measuring value output on capaNCDT 6240 is controllable by an external electrical trigger signal. Here, only the digital output is affected.

Triggering release by:
- Trigger input (pin 3 and pin 4 on 4-pole power supply connector or
- $U_{IN}$, HIGH ≥ 2,0 V
- $U_{IN}$, LOW ≤ 0,8 V

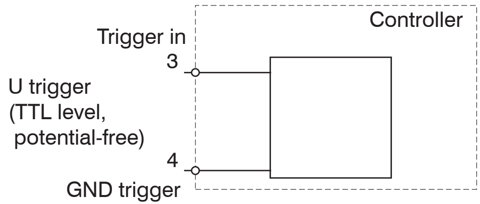



*Fig. 19 Trigger Input*

The trigger type is determined by the cparameters of the PROFINET device used.

Level triggering (high level). Continuous measurement output with adjusted data rate, as long as the selected level is active. After that the controller outputs the last value. The measured value counter is no longer incremented.

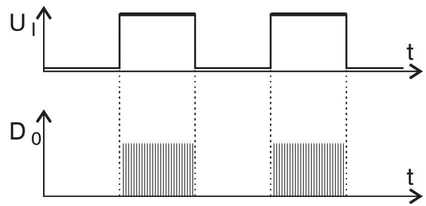



*Fig. 20 Active high level trigger ($U_I$), relevant digital signal ($D_0$)*

Edge triggering. Starts measuring value output, as soon as the rising edge on the trigger input is active. If trigger conditions are met, the controller outputs a measuring value. The set data rate must be greater than the maximum trigger frequency. If triggering is faster than the set data rate, individual measuring values are transmitted twice, because internally no new measuring values of the AD converter are active.

The duration of the pulse must be at least 5 $\mu$s.

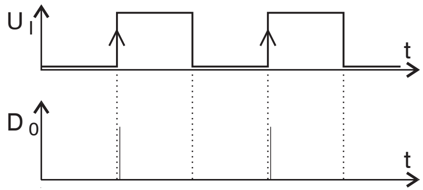



*Fig. 21 Rising edge trigger ($U_I$), relevant digital signal ($D_O$)*

Gate rising edge. Starts measuring value output with set data rate, as soon as the rising edge on the trigger input is active. Another rising edge stops the measuring value output respectively switches it on again.

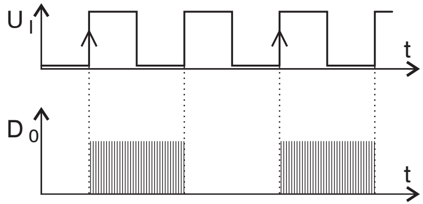



*Fig. 22 Rising edge trigger ($U_I$), relevant digital signal ($D_O$)*

No trigger is set ex factory. The controller starts the data transfer immediately after the switching on.

## 5.4 Measurement Averaging

### 5.4.1 Introduction

Measurement averaging is performed before the output of measuring values via the Ethernet interfaces.

Measurement averaging improves the resolution, allows masking individual interference points or “smoothes” the reading.

i Linearity is not affected by averaging. Averaging has no effect on measuring frequency and output rate.

The controller is delivered ex factory without measurement averaging.

### 5.4.2 Moving Average

The definable number N for successive measurements (window width) is used to calculate the arithmetic average $M_{mov}$ according to the following formula:

$$M_{mov} = \frac{\sum_{k=1}^{N} MV}{N}$$

MV = Measuring value
N = Number
k = Continuous index
$M_{mov}$ = Average value

*Fig. 23 Formula for the moving average*

**Method**

Each new measured value is added, and the first (oldest) value is removed from the averaging.

Example with N = 7:

.... 0 1 [2 3 4 5 6 7 8] gets to $\frac{2+3+4+5+6+7+8}{7}$ Average value n

.... 1 2 [3 4 5 6 7 8 9] gets to $\frac{3+4+5+6+7+8+9}{7}$ Average value n +1

### 5.4.3 Arithmetic Average Value

The arithmetic average value M is set and output over the selected number N of successive measuring values.

**Method**

Measuring values are collected and the average value is calculated consequently. This method leads to a reduction of the amount of data, because an average value is output only after every Nth measuring value.Example with N = 3:

.... 0 1 [2 3 4] ... gets to $\frac{2+3+4}{3}$ Average value n

.... 3 4 [5 6 7] ... gets to $\frac{5+6+7}{3}$ Average value n + 1

### 5.4.4 Median

A median value is formed from a preselected number of measurements. For this, the incoming values are sorted after each measurement. Then, the average value is provided as the median value.

If a even value is selected for the average number N, middle both measuring values are added and divided by two.

Example with N = 7:

... 2 4 [0 1 2 4 5 1 3] Sorted measuring value 0 1 1 [2] 3 4 5 Median $_n$ = 2

... 4 0 [1 2 4 5 1 3 4] Sorted measuring value 1 1 2 [3] 4 4 5 Median $_{n+1}$ = 3

#### 5.4.5 Dynamic Noise Rejection

This filter removes the noise of the measurement signal completely, but keeps the original bandwidth of the measurement signal.

For that purpose the signal noise is calculated dynamically and measurement changes are only transferred, if they exceed this calculated noise. Thereby at a change in direction of the measurement signal small hysteresis effects in the size of the calculated noise can occur.

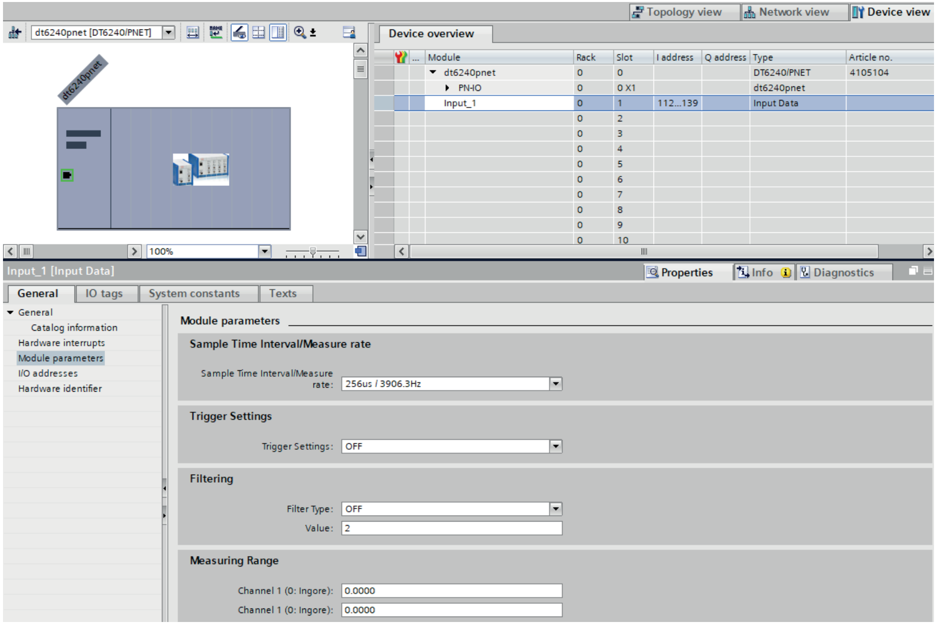
# 6. Initial Operation

## 6.1 General

This section describes how to use a SIMATIC S7 controller with Micro-Epsilon sensors (controller).

## 6.2 Basic Settings Module

After setting up the DT6240 in the TIA portal, see Chap. A 3, the `Input_1` module offers an easy way to specify the required settings.



## 6.3 Data Format

All configuration parameters and data are transmitted in Little Endian format.

| Byte | Content | Byte order |
|---|---|---|
| 1 | Timestamp (ms) DWord, Little Endian | LSB |
| 2 | | ... |
| 3 | | ... |
| 4 | | MSB |
| 5 | Error Code DWord, Little Endian | LSB |
| 6 | | ... |
| 7 | | ... |
| 8 | | MSB |
| 9 | Sensor Counter Word, Little Endian | LSB |
| 10 | | MSB |
| 11 | Number of Values, Byte | |
| 12 | Reserved | |
| 13 | Channel 1 (µm) Real 32bit, Little Endian | LSB |
| 14 | | ... |
| 15 | | ... |
| 16 | | MSB |
| 17 | Channel 2 (µm) Real 32bit, Little Endian | LSB |
| 18 | | ... |
| 19 | | ... |
| 20 | | MSB |
| 21 | Channel 3 (µm) Real 32bit, Little Endian | LSB |
| 22 | | ... |
| 23 | | ... |
| 24 | | MSB |
| 25 | Channel 4 (µm) Real 32bit, Little Endian | LSB |
| 26 | | ... |
| 27 | | ... |
| 28 | | MSB |

**Default tag table**

| | Name | Data type | Address | Retain | Acces... | Writa... | Visibl... |
|---|---|---|---|---|---|---|---|
| 1 | timestamp | DWord | %ID0 | ☐ | ☑ | ☑ | ☑ |
| 2 | lasterror | DWord | %ID4 | ☐ | ☑ | ☑ | ☑ |
| 3 | a | DWord | %ID8 | ☐ | ☑ | ☑ | ☑ |
| 4 | c1 | DWord | %ID12 | ☐ | ☑ | ☑ | ☑ |
| 5 | c2 | DWord | %ID16 | ☐ | ☑ | ☑ | ☑ |
| 6 | c3 | DWord | %ID20 | ☐ | ☑ | ☑ | ☑ |
| 7 | c4 | DWord | %ID24 | ☐ | ☑ | ☑ | ☑ |
| 8 | c1_le | Real | %ID28 | ☐ | ☑ | ☑ | ☑ |
| 9 | c2_le | Real | %ID32 | ☐ | ☑ | ☑ | ☑ |
| 10 | c3_le | Real | %ID36 | ☐ | ☑ | ☑ | ☑ |

```
#tmp_dword.%B0 := "c1".%B3;
#tmp_dword.%B1 := "c1".%B2;
#tmp_dword.%B2 := "c1".%B1;
#tmp_dword.%B3 := "c1".%B0;
"c1_le" := DWORD_TO_REAL(#tmp_dword);
```

*Fig. 24 Data format and conversion of a DWORD to REAL*

The IO-Area contains the data as shown see Fig. 24:

| | |
|---|---|
| Timestamp | Milliseconds passed since device power up |
| Error Code | Status code of the communication module |
| Sensor Counter | Sequential number of currently transmitted sample |
| Number of Values | Sensor values collected since last communication cycle |
| Reserved | Reserved |
| Channel 1 | Distance in µm calculated based on channel measurement range and offset |

....

## 6.4 Object Directory

### 6.4.1 Error Protocol

| Index | Subindex | Data type | | Name | Description |
|---|---|---|---|---|---|
| 0x2010 | 0 | Uint32[64] | R | device error log | Reads out the last 32 error codes with time stamp |

### 6.4.2 Reset Device

| Index | Subindex | Data type | | Name | Description |
|---|---|---|---|---|---|
| 0x2026 | 0 | Uint8 | W | reset device | One byte performs reset |

### 6.4.3 Triggering

| Index | Subindex | Data type | | Name | Description |
|---|---|---|---|---|---|
| 0x2031 | 1 | Uint16 | RW | Trigger settings | 0: No trigger<br>1: Rising edge, one measurement is output<br>2: Falling edge, one measurement is output<br>4: High level, value output, as long as the level is active<br>8: Low level, value output, as long as the level is active<br>16: Gate trigger with rising edge, starts resp. stops the measuring value output alternatively<br>32: Gate trigger with falling edge, starts resp. stops the measuring value output alternatively |

### 6.4.4 Filter Settings

| Index | Subindex | Data type | | Name | Description |
|---|---|---|---|---|---|
| 0x2032 | | 8 bytes | RW | Filter settings | |
| | 1 | Uint16 | | Filter type | 0: No filter<br>1: Moving average<br>2: Aritmetic average<br>4: Median |
| | | Uint16 | | reserved | |
| | | Uint32 | | Filter value | Length of filter: 2 / 3 / 4 / 5 / 6 / 7 / 8 |

### 6.4.5 Measuring Range

| Index | Subindex | Data type | | Name | Description |
|---|---|---|---|---|---|
| 0x2033 | 1 | Float[4] | RW | Measrange | Measrange per sensor |

### 6.4.6 Math Functions

| Index | Subindex | Data type | | Name | Description |
|---|---|---|---|---|---|
| 0x2035 | | 112 bytes | | Math Functions | |
| | 1 | uint8 | RW | MF Channel 1 Active | |
| | | uint8 | RW | MF Channel 2 Active | |
| | | uint8 | RW | MF Channel 3 Active | |
| | | uint8 | RW | MF Channel 4 Active | |
| | | uint8 | RW | MF Channel 5 Active / reserved | |
| | | uint8 | RW | MF Channel 6 Active / reserved | |
| | | uint8 | RW | MF Channel 7 Active / reserved | |
| | | uint8 | RW | MF Channel 8 Active / reserved | |
| | | uint8 | RW | reserved | |
| | | int8 | RW | Channel 1 Factor 1 | [-99..+99] => -9.9..+9.9 |
| | | int8 | RW | Channel 1 Factor 2 | |
| | | int8 | RW | Channel 1 Factor 3 | |
| | | int8 | RW | Channel 1 Factor 4 | |
| | | int8 | RW | Channel 1 Factor 5 / reserved | |
| | | int8 | RW | Channel 1 Factor 6 / reserved | |
| | | int8 | RW | Channel 1 Factor 7 / reserved | |
| | | int8 | RW | Channel 1 Factor 8 / reserved | |
| | | uint8 | RW | reserved | |
| | | int8 | RW | Channel 2 Factor 1 | [-99..+99] => -9.9..+9.9 |
| | | int8 | RW | Channel 2 Factor 2 | |
| | | int8 | RW | Channel 2 Factor 3 | |
| | | int8 | RW | Channel 2 Factor 4 | |
| | | int8 | RW | Channel 2 Factor 5 / reserved | |
| | | int8 | RW | Channel 2 Factor 6 / reserved | |
| | | int8 | RW | Channel 2 Factor 7 / reserved | |
| | | int8 | RW | Channel 2 Factor 8 / reserved | |
| | | uint8 | RW | reserved | |

| Index | Subindex | Data type | | Name | Description |
|---|---|---|---|---|---|
| 0x2035 | 1 | int8 | RW | Channel 3 Factor 1 | [-99..+99] => -9.9..+9.9 |
| | | int8 | RW | Channel 3 Factor 2 | |
| | | int8 | RW | Channel 3 Factor 3 | |
| | | int8 | RW | Channel 3 Factor 4 | |
| | | int8 | RW | Channel 3 Factor 5 / reserved | |
| | | int8 | RW | Channel 3 Factor 6 / reserved | |
| | | int8 | RW | Channel 3 Factor 7 / reserved | |
| | | int8 | RW | Channel 3 Factor 8 / reserved | |
| | | uint8 | RW | reserved | |
| | | int8 | RW | Channel 4 Factor 1 | [-99..+99] => -9.9..+9.9 |
| | | int8 | RW | Channel 4 Factor 2 | |
| | | int8 | RW | Channel 4 Factor 3 | |
| | | int8 | RW | Channel 4 Factor 4 | |
| | | int8 | RW | Channel 4 Factor 5 / reserved | |
| | | int8 | RW | Channel 4 Factor 6 / reserved | |
| | | int8 | RW | Channel 4 Factor 7 / reserved | |
| | | int8 | RW | Channel 4 Factor 8 / reserved | |
| | | uint8 | RW | reserved | |
| | | int8 | RW | Channel 5 Factor 1 / reserved | [-99..+99] => -9.9..+9.9 |
| | | int8 | RW | Channel 5 Factor 2 / reserved | |
| | | int8 | RW | Channel 5 Factor 3 / reserved | |
| | | int8 | RW | Channel 5 Factor 4 / reserved | |
| | | int8 | RW | Channel 5 Factor 5 / reserved | |
| | | int8 | RW | Channel 5 Factor 6 / reserved | |
| | | int8 | RW | Channel 5 Factor 7 / reserved | |
| | | int8 | RW | Channel 5 Factor 8 / reserved | |
| | | uint8 | RW | reserved | |

| Index | Subindex | Data type | | Name | Description |
|---|---|---|---|---|---|
| 0x2035 | 1 | int8 | RW | Channel 6 Factor 1 / reserved | [-99..+99] => -9.9..+9.9 |
| | | int8 | RW | Channel 6 Factor 2 / reserved | |
| | | int8 | RW | Channel 6 Factor 3 / reserved | |
| | | int8 | RW | Channel 6 Factor 4 / reserved | |
| | | int8 | RW | Channel 6 Factor 5 / reserved | |
| | | int8 | RW | Channel 6 Factor 6 / reserved | |
| | | int8 | RW | Channel 6 Factor 7 / reserved | |
| | | int8 | RW | Channel 6 Factor 8 / reserved | |
| | | uint8 | RW | reserved | |
| | | int8 | RW | Channel 7 Factor 1 / reserved | [-99..+99] => -9.9..+9.9 |
| | | int8 | RW | Channel 7 Factor 2 / reserved | |
| | | int8 | RW | Channel 7 Factor 3 / reserved | |
| | | int8 | RW | Channel 7 Factor 4 / reserved | |
| | | int8 | RW | Channel 7 Factor 5 / reserved | |
| | | int8 | RW | Channel 7 Factor 6 / reserved | |
| | | int8 | RW | Channel 7 Factor 7 / reserved | |
| | | int8 | RW | Channel 7 Factor 8 / reserved | |
| | | uint8 | RW | reserved | |
| | | int8 | RW | Channel 8 Factor 1 / reserved | [-99..+99] => -9.9..+9.9 |
| | | int8 | RW | Channel 8 Factor 2 / reserved | |
| | | int8 | RW | Channel 8 Factor 3 / reserved | |
| | | int8 | RW | Channel 8 Factor 4 / reserved | |
| | | int8 | RW | Channel 8 Factor 5 / reserved | |
| | | int8 | RW | Channel 8 Factor 6 / reserved | |
| | | int8 | RW | Channel 8 Factor 7 / reserved | |
| | | int8 | RW | Channel 8 Factor 8 / reserved | |

| Index | Subindex | Data type | | Name | Description |
|---|---|---|---|---|---|
| 0x2035 | 1 | Int32 | RW | Channel 1 constant Faktor | |
| | | Int32 | RW | Channel 2 constant Faktor | |
| | | Int32 | RW | Channel 3 constant Faktor | |
| | | Int32 | RW | Channel 4 constant Faktor | |
| | | Int32 | RW | Channel 5 constant Faktor / reserved | |
| | | Int32 | RW | Channel 6 constant Faktor / reserved | |
| | | Int32 | RW | Channel 7 constant Faktor / reserved | |
| | | Int32 | RW | Channel 8 constant Faktor / reserved | |

### 6.4.7 Sample Time

| Index | Subindex | Data type | | Name | Description |
|---|---|---|---|---|---|
| 0x2036 | 1 | Uint32 | RW | Sample time interval | 256: 3906,3 Hz<br>480: 2083,3 Hz<br>960: 1041,7 Hz<br>1920: 520,8 Hz<br>9600: 104,2 Hz<br>16000: 62,5 Hz<br>19200: 52,1 Hz<br>32000: 31,3 Hz<br>38400: 26 Hz |

### 6.4.8 Device Info

| Index | Subindex | Data type | | Name | Description |
|---|---|---|---|---|---|
| 0x2210 | | | | Device Info | Read out the block of the current sensor |
| | 0 | Uint8 | R | NrOfObjects | |
| | 1 | Uint8 | R | Block version | Block version |
| | 2 | Uint8 | R | Endianness | Endian |
| | 3 | Uint16 | R | Software version | Software version |
| | 4 | Int32 | R | Article number | Part number |
| | 5 | Int32 | R | Option | Option |
| | 6 | Int32 | R | Batch number | Batch number |
| | 7 | Int32 | R | Serial number | Serial number |
| | 8 | Uint8 | R | Change index | Change index |
| | 9 | Uint8 | R | Calibration day | Day of calibration |
| | 10 | Uint8 | R | Calibration month | Month of calibration |
| | 11 | Uint8 | R | Calibration year | Year of calibration |
| | 12 | Uint16 | R | Calibration software version | Version of calibration software |
| | 13 | Uint16 | R | Test software version | |
| | 14 | Uint8 | R | Test hour | |
| | 15 | Uint8 | R | Test day | |
| | 16 | Uint8 | R | Test month | |
| | 17 | Uint8 | R | Test year | |
| | 18 | Int32 | R | Article number circuit board | |
| | 19 | Int32 | R | Serial number circuit board | |
| | 20 | Uint8[32] | R | Name | |
| | 21 | Uint8 | R | sensor/channel count | |
| | 22 | Uint8 | R | protocol block count | |
| | 23 | Uint8[164] | R | protocol blocks | |

### 6.4.9 Sensor Information

| Index | Subindex | Data type | | Name | Description |
|---|---|---|---|---|---|
| 0x2220 | | | | Sensor block | Request sensor information |
| | 0 | Uint8 | R | NrOfObjects | |
| | 1 | Uint8 | RW | block index offset | The offset lets you scroll through existing sensor blocks [0 - 0x1F] |
| | 2 | Uint8 | RW | page index to read | Specifying an index lets you scroll through existing pages |
| | 3 | Uint8 | R | number of pages | Max. number of pages |
| | 4 | Uint8 | R | measurement unit | Signal unit |
| | 5 | Int32 | R | article number | Part number |
| | 6 | Int32 | R | Option | Option |
| | 7 | Int32 | R | Batch number | Batch number |
| | 8 | Int32 | R | serial number | Serial number |
| | 9 | Float | R | Nominal measuring range | Nominal measuring range |
| | 10 | Float | R | Nominal offset | Nominal offset |
| | 11 | Float | R | current measuring range | Actual measuring range |
| | 12 | Float | R | current offset | Actual offset |
| | 13 | Uint8[32] | R | Target material | Target material |
| | 14 | Uint8[32] | R | Sensor/channel name | Sensor/channel name |
| | 15 | uint8 | R | extension length | Length of block extension |
| | 16 | uint8[138] | R | extension | |

### 6.4.10 Parameter Info

| Index | Subindex | Data type | | Name | Description |
|---|---|---|---|---|---|
| 0x2501 | | | | Parameter Info | Request configuration parameters, request via subindex 1, configure interface with objects 0x2510 through 0x2540 |
| | 0 | Uint8 | R | NrOfObjects | |
| | 1 | Uint16 | RW | Parameter ID | Please refer to the sensor documentation for available parameter IDs and their types |
| | 2 | Uint8[14] | R | Name | |
| | 3 | Uint8[8] | R | Unit | |
| | 4 | Uint8[8] | R | Type | |

### 6.4.11 Float Parameter

| Index | Subindex | Data type | | Name | Description |
|---|---|---|---|---|---|
| 0x2510 | | | | Float parameter | Read or write float parameter |
| | 0 | Uint8 | | NrOfObjects | |
| | 1 | Uint16 | RW | Parameter ID | Please refer to the sensor documentation for available parameter IDs and their types |
| | 2 | Uint8 | RW | Reserved | |
| | 3 | Float | RW | Value | Value |
| | 4 | Uint8[14] | R | Name | Designation |
| | 5 | Uint8[8] | R | Unit | Unit as a string |
| | 6 | Float | R | Min | |
| | 7 | Float | R | Max | |

### 6.4.12 Integer Parameter

| Index | Subindex | Data type | | Name | Description |
|---|---|---|---|---|---|
| 0x2520 | | | | Int Parameter | Read or write integer parameter |
| | 0 | Uint8 | | NrOfObjects | |
| | 1 | Uint16 | RW | Parameter ID | Please refer to the sensor documentation for available parameter IDs and their types |
| | 2 | Uint8 | RW | Reserved | |
| | 3 | Int32 | RW | Value | Value |
| | 4 | Uint8[14] | R | Name | Designation |
| | 5 | Uint8[8] | R | Unit | Unit as a string |
| | 6 | Int32 | R | Min | |
| | 7 | Int32 | R | Max | |

### 6.4.13 Unsigned Integer Parameter

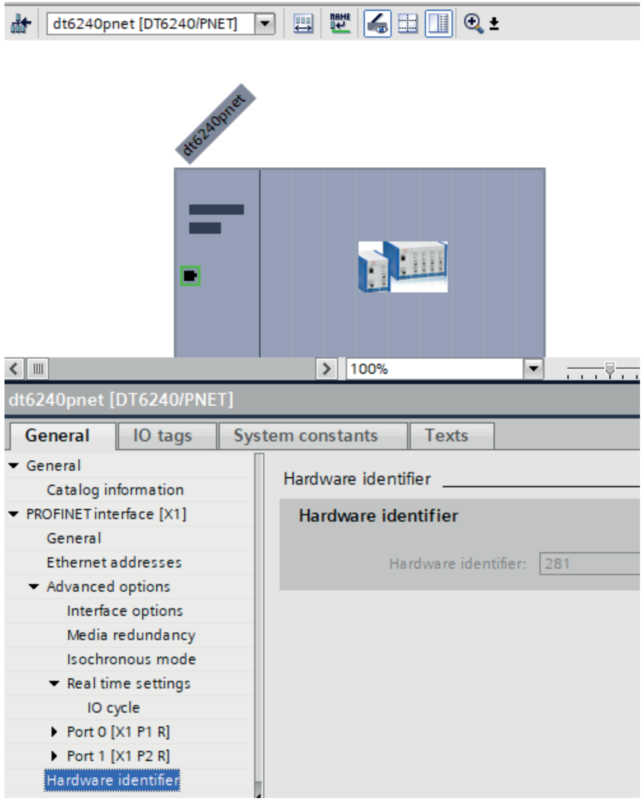
| Index | Subindex | Data type | | Name | Description |
|---|---|---|---|---|---|
| 0x2530 | | | | Uint Parameter | Read or write unsigned integer parameter |
| | 0 | Uint8 | | NrOfObjects | |
| | 1 | Uint16 | RW | Parameter ID | Please refer to the sensor documentation for available parameter IDs and their types |
| | 2 | Uint8 | RW | Reserved | |
| | 3 | Uint32 | RW | Value | Value |
| | 4 | Uint8[14] | R | Name | Designation |
| | 5 | Uint8[8] | R | Unit | Unit as a string |
| | 6 | Uint32 | R | Min | |
| | 7 | Uint32 | R | Max | |

### 6.4.14 String Parameter

| Index | Subindex | Data type | | Name | Description |
|---|---|---|---|---|---|
| 0x2540 | | | | String Parameter | Read or write string parameter |
| | 0 | Uint8 | | NrOfObjects | |
| | 1 | Uint16 | RW | Parameter ID | Please refer to the sensor documentation for available parameter IDs and their types |
| | 2 | Uint8 | RW | Reserved | |
| | 3 | Uint8[246] | RW | Value | Value |
| | 4 | Uint8[14] | R | Name | Designation |

## 6.5 Sequence When Writing and Reading Acyclical Data

➡ Determine the hardware identification (ID) of the module. To do so, switch to the `General` > `PROFINET-Interface` > `Advanced Options` tab.




In the example to the right, you get the value 281.

On the SPS, `WRREC_DB` with input parameters (:=) is called.

`REQ` // Start execution

`ID` // Hardware ID of the target device addressed

`INDEX` // Target address in the object directory

`LEN` // Length of the binary data block to be written

`RECORD` // Usable data for writing

`RECORD, VALID, BUSY, ERROR, STATUS` and `LEN` contain return parameters (=>) that allow for determining the success or progress of the write command.

## 6.6 Sequence When Writing Structured Data

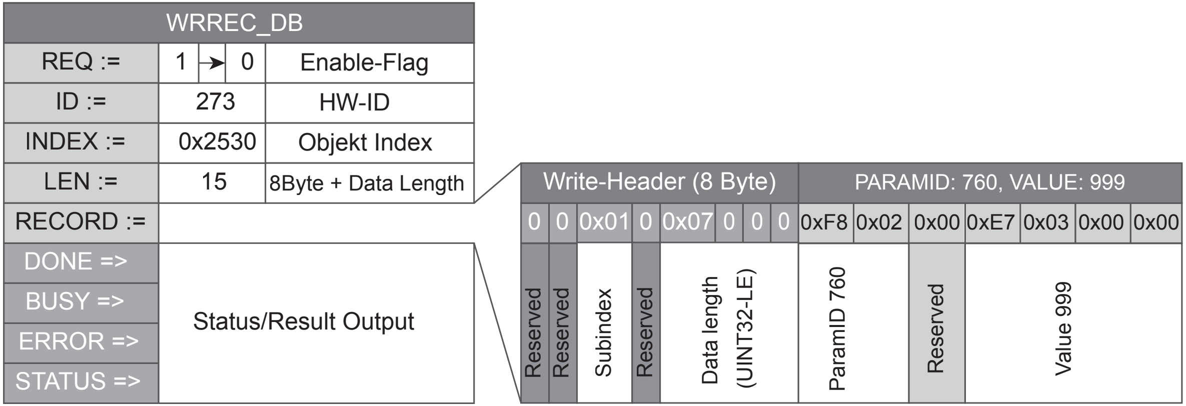



*Fig. 25 Write command with data from SPS to capaNCDT 6240*

# 7. Operation and Maintenance

Please take care of the following:

- Make sure that the sensor surface is always clean.
- Switch off the power supply before cleaning.
- Clean with a damp cloth; then rub the sensor surface dry.

Changing the target or very long operating times can lead to slight reductions in the operating quality (long term errors). These can be eliminated by recalibration.

**CAUTION** Disconnect the power supply before touching the sensor surface. Static discharge, danger of injury.

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

# 8. Disclaimer

All components of the device have been checked and tested for functionality in the factory. However, should any defects occur despite careful quality control, these shall be reported immediately to MICRO-EPSILON or to your distributor / retailer.

MICRO-EPSILON undertakes no liability whatsoever for damage, loss or costs caused by or related in any way to the product, in particular consequential damage, e.g., due to

- non-observance of these instructions/this manual,
- improper use or improper handling (in particular due to improper installation, commissioning, operation and maintenance) of the product,
- repairs or modifications by third parties,
- the use of force or other handling by unqualified persons.

This limitation of liability also applies to defects resulting from normal wear and tear (e.g., to wearing parts) and in the event of non-compliance with the specified maintenance intervals (if applicable).

MICRO-EPSILON is exclusively responsible for repairs. It is not permitted to make unauthorized structural and / or technical modifications or alterations to the product. In the interest of further development, MICRO-EPSILON reserves the right to modify the design.

In addition, the General Terms of Business of MICRO-EPSILON shall apply, which can be accessed under
Legal details | Micro-Epsilon https://www.micro-epsilon.com/impressum/.

For translations into other languages, the German version shall prevail.

# 9. Decommissioning, Disposal

In order to avoid the release of environmentally harmful substances and to ensure the reuse of valuable raw materials, we draw your attention to the following regulations and obligations:

- Remove all cables from the sensor and/or controller.
- Dispose of the sensor and/or the controller, 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.
- You are obliged to comply with all relevant national laws and regulations.

For Germany / the EU, the following (disposal) instructions apply in particular:

- Waste equipment marked with a crossed garbage can must not be disposed of with normal industrial waste (e.g. residual waste can or the yellow recycling bin) and must be disposed of separately. This avoids hazards to the environment due to incorrect disposal and ensures proper recycling of the old appliances.

- A list of national laws and contacts in the EU member states can be found at https://ec.europa.eu/environment/topics/waste-and-recycling/waste-electrical-and-electronic-equipment-weee_en. Here you can inform yourself about the respective national collection and return points.
- Old devices can also be returned for disposal to MICRO-EPSILON at the address given in the imprint at https://www.micro-epsilon.de/impressum/.
- We would like to point out that you are responsible for deleting the measurement-specific and personal data on the old devices to be disposed of.
- Under the registration number WEEE-Reg.-Nr. DE28605721, we are registered at the foundation Elektro-Altgeräte Register, Nordostpark 72, 90411 Nuremberg, as a manufacturer of electrical and/or electronic equipment.

# Appendix

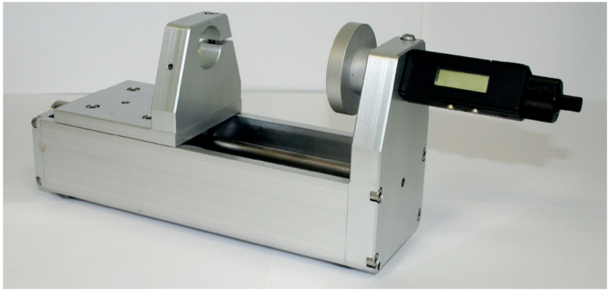
## A 1 Accessories, Service

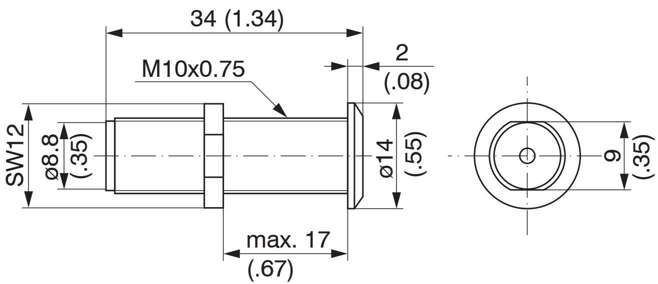
### A 1.1 PC6200-3/4

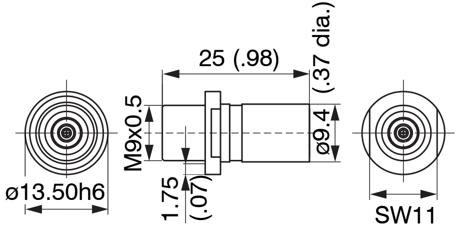
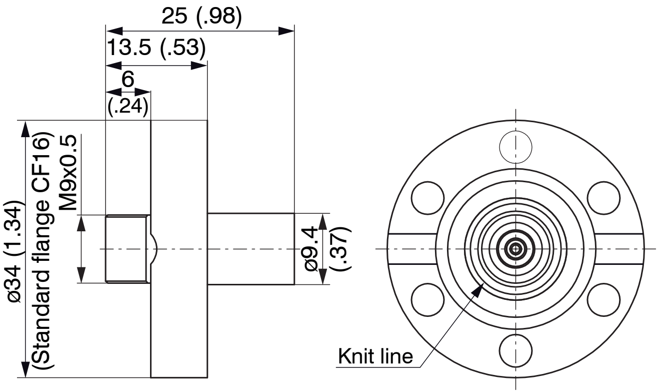
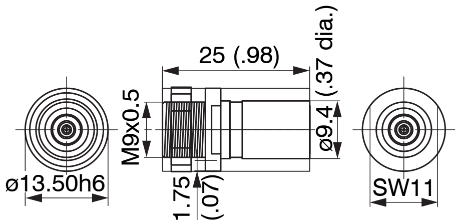
The PC6200-3/4 is contained in the scope of supply.

| | | |
|---|---|---|
| PC6200-3/4 |  | Power supply and trigger cable, 3 m long |

### A 1.2 Optional Accessories

| | | |
|---|---|---|
| MC2.5 |  | Micrometer calibration fixture,<br>setting range 0 - 2.5 mm, reading 0.1 µm,<br>for sensors CS005 to CS2 |
| MC25D |  | Digital micrometer calibration fixture,<br>setting range 0 - 25 mm, adjustable zero point for all sensors |

| | | |
|---|---|---|
| SWH.OS.650.CTMSV |  | Vacuum feed through,<br>Max. leak rate 1x10e-$^{7}$ mbar · l s$^{-1}$<br>Compatible with connector type B |

| | | |
|---|---|---|
| UHV/B |  | Vacuum feed through triax weldable<br>Max. leak rate 1x10e-[9] mbar · l $s^{-1}$<br>Compatible with connector type B |
| |  | Vacuum feed through triax with CF16 flange<br>Max. leak rate 1x10e-9 mbar · l $s^{-1}$<br>Compatible with connector type B |
| |  | Vacuum feed through triax screwable<br>Max. leak rate 1x10e-9 mbar · l $s^{-1}$<br>Compatible with connector type B |

| | | |
|---|---|---|
| All vacuum feed throughs are compatible to the connectors type B. | | |
| SCACx/4 |  | Signal output cable analog, x m long (necessarily for multi-channel operation) |
| SC6000-x |  | Synchronization cable |
| PS2020 |  | Power supply for mounting on DIN-rail<br>input 230 VAC (115 VAC)<br>output 24 VDC / 2.5 A;<br>L/W/H 120 x 120 x 40  mm |

## A 1.3 Service

Function and linearity check-out, inclusive 11-point protocol with grafic and post-calibration.

## A 2 Factory Setting

**Analog:**

- Zero-poti = Off (right-stop)
- LP filter 20 Hz = Off

**Digital:**

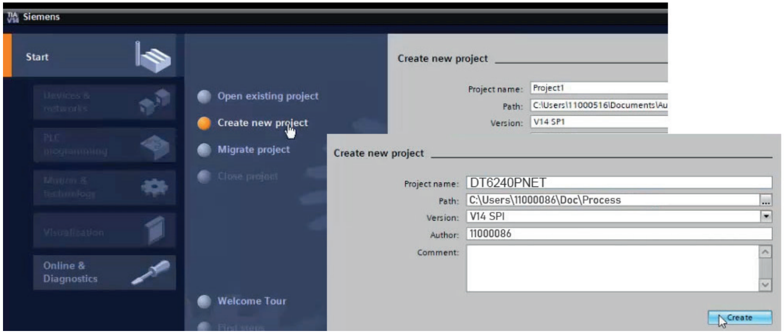
- Data rate = 3906 Sa/s
- Filter = Off
- Linearization = Off
- Trigger mode = Off
- Math functions = Off

# A 3 Integration Into TIA Portal

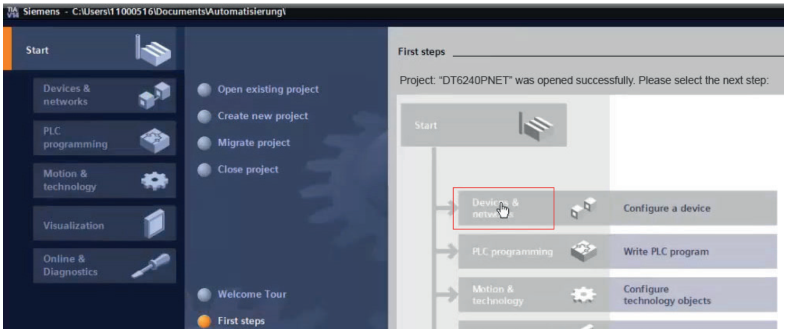
## A 3.1 Importing capaNCDT 6240 into the software

This section describes how to connect capaNCDT 6240 to SIMATIC S7 controllers.

- Start the `TIA` (Totally Integrated Automation) Portal. Therefore, either double-click the `TIA Portal icon` on your desktop or call up the framework via the `Start Menu`.
- Click the button `Create new project` which is at the top left of the `Start portal` view. Enter a project name and confirm by clicking the `Create` button.

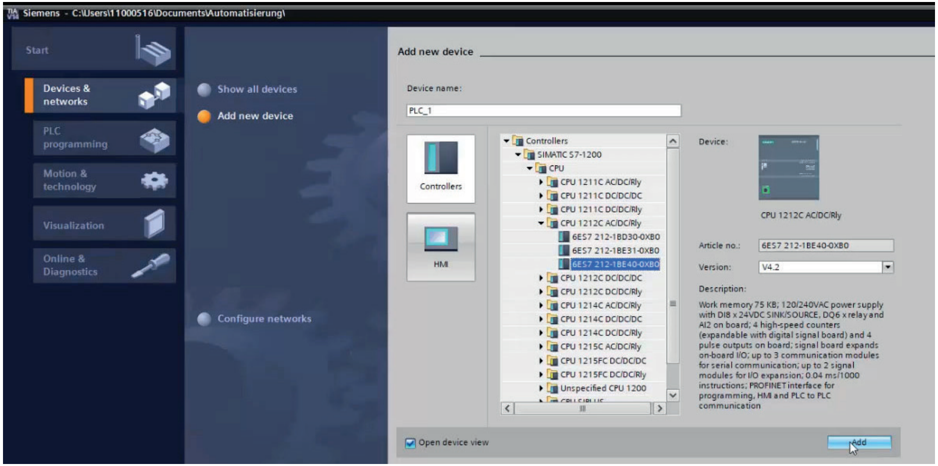



- Switch to the Devices & networks portal.



➡ Click `Add new device`. Select the S7 CPU series you are using in the device list and click the `Add` button. Make sure that the checkbox `Open device view` on the bottom left of the window is activated.

i Identify your CPU module based on the order number on the S7 device, its packaging, or the delivery note. Also select the correct firmware Version.




The software switches automatically to the `Project view` and displays the `Working window` (center of screen) in the `Device view`. Below, you can find the `Inspector window` which shows the parameterization options of the selected PLC in the `Properties` register.

i The TIA Portal automatically assigns the IP address and subnet mask. You can manually adjust these data here (`General > PROFINET interface > Ethernet addresses`) if necessary and save them by clicking the `Save project` button, see top left corner in the Toolbar.

The GSDML file contains information about a PROFINET device. This file is needed for the PROFINET controller and must be integrated into the corresponding configuration software. You get the GSDML file from Micro-Epsilon.

➡ Import the GSDML file. To do so, in the `Extras` > `Manage device description files (DDF)` menu, select the path for the file <`GSDML-Vx-MICRO-EPSILON-DT6240PNET-202x.xml`>.

➡ Click the `Install` button.

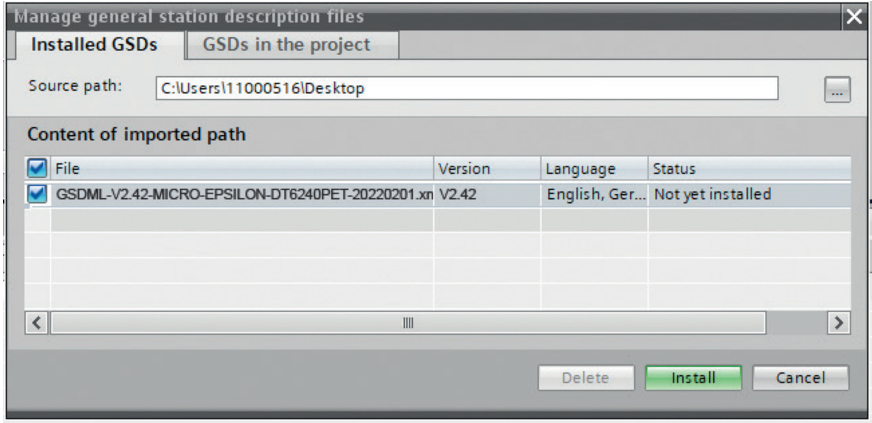
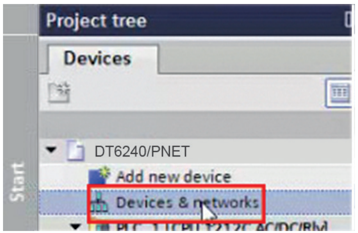



*Fig. 26 Importing the device description file*

After installation, switch to the project view.

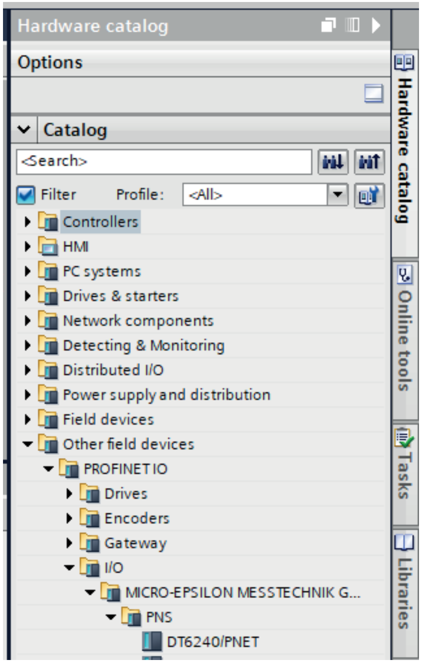
➡ In `Project navigation`, click `Devices & networks`.




Add capaNCDT 6240 to the project.

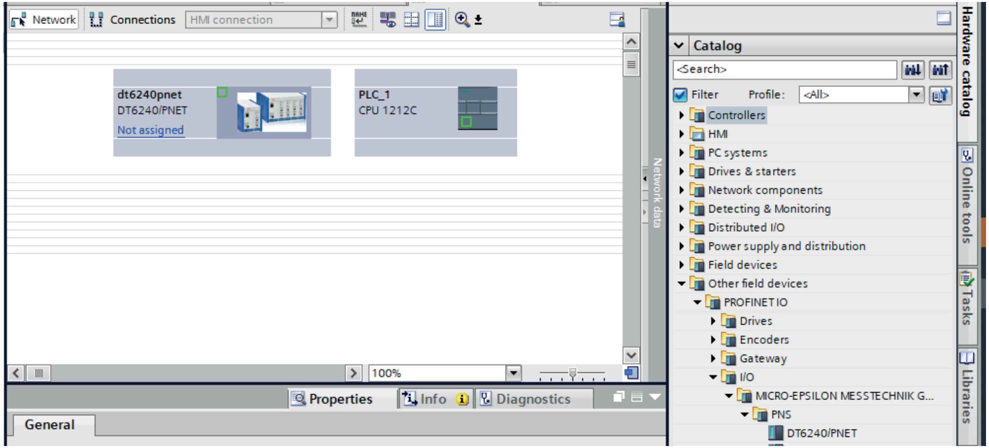
Make sure that capaNCDT 6240 has been integrated correctly.

- Switch to the `Hardware catalog` tab.
- In the menu, select `Other field devices > PROFINET IO > I/O > MICRO-EPSILON MESSTECHNIK GmbH > PNS > DT6240/PNET`.

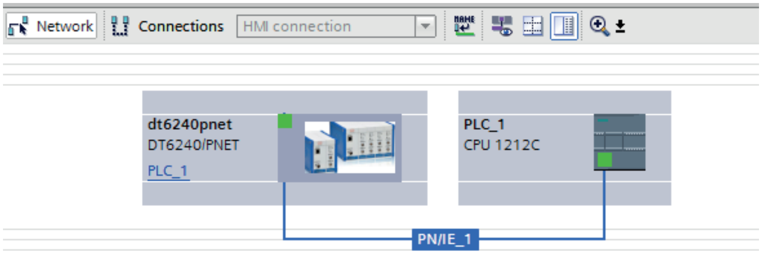


## A 3.2 Unique integration of capaNCDT 6240 into the PROFINET network

➡ Switch to the `Network view` of the `Working window` and add `DT6240/PNET` from the Hardware catalog by drag and drop.




➡ Connect the `Port 0` LAN socket of capaNCDT 6240 with the one of the PLC by clicking one of the green boxes with the left mouse button. Hold the button and draw the resulting line to the other green box in order to create a PROFINET subsystem.



Enter the device name for identification in the PN network.

➡ Switch to `Device view`, double-click your DT6240/PNET and assign a (device) Name in the `Inspector window` (tab `Properties > General`).

i This is one of several possibilities to change the device name.

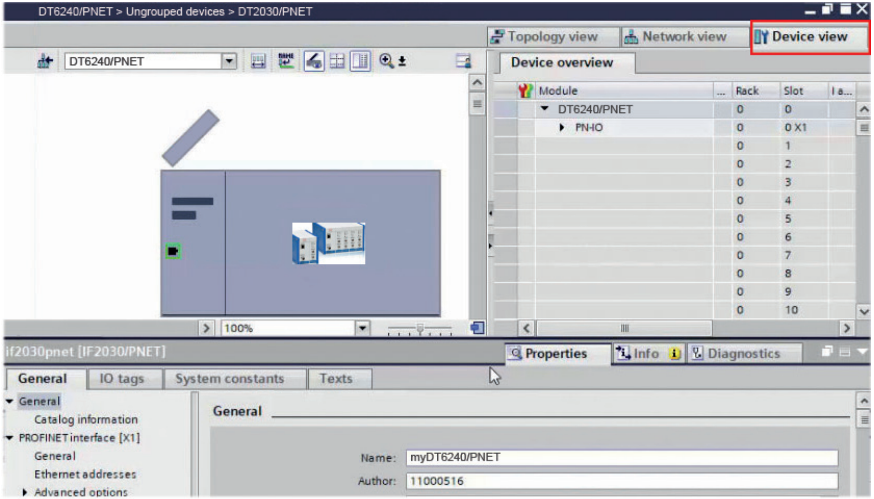



*Fig. 27 Assigning a device name*

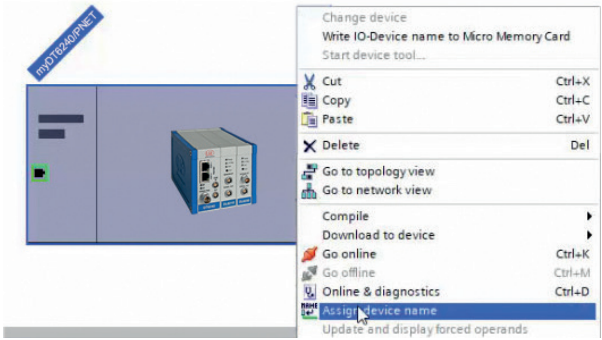
i The device name is used to identify the device on the PN network and as an address; it must be unique across the entire system.

The change of name must be communicated to the PN network.

➡ Right-click the DT6240/PNET.

You now reach the context menu shown.

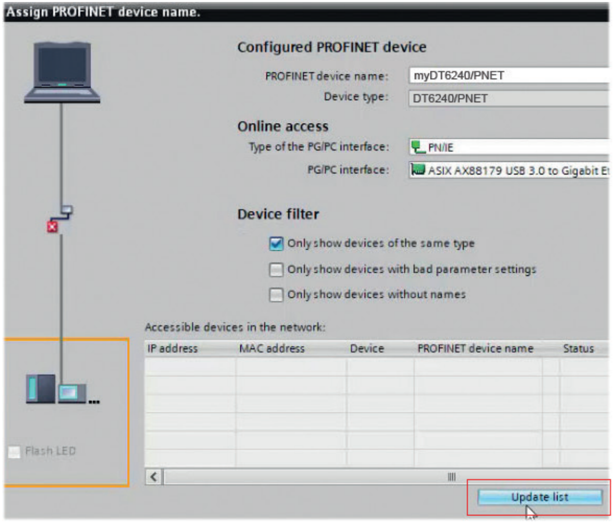
➡ Select the `Assign device name` entry.

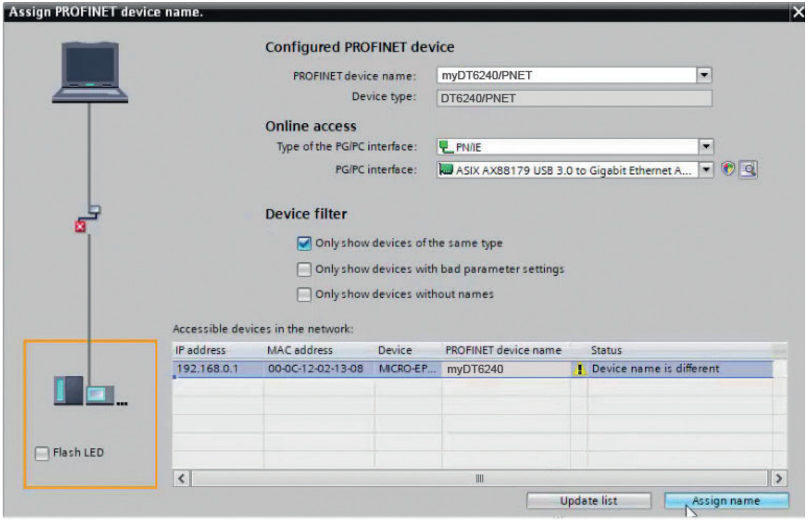


➡ In the open dialog window, click the `Update list` button.

Potential devices on the PN network are displayed.

➡ In the list that is now displayed, mark the row with your DT6240/PNET that is to be renamed; field `Status`, "*Device name is different*". Finally, click the `Assign name` button.



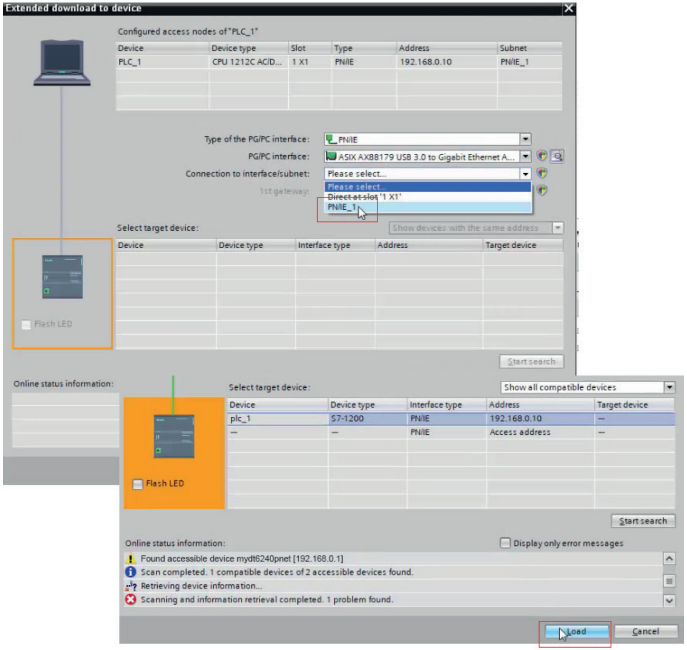




i If you activate the `Flash LED` checkbox in the orange highlighted area you can verify which device you are currently addressing. This is especially helpful in larger networks.

## A 3.3 Loading the configuration into the PLC

➡ Click the `Download to device` symbol button in the `Toolbar`. Alternatively, right-click the image of your S7 in the `Network view` and select the function in the `Shortcut menu`.

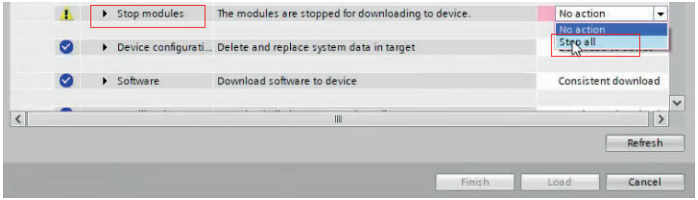
➡ In the open `Dialog box`, select the option `PN/IE_1` (the previously created PROFINET subsystem) in `Connection to interface/subnet`. Click the `Start search` button afterwards. Next, select your target PLC in the displayed list. Clicking the `Load` button transfers the hardware configuration.




The `Load preview` dialog box opens.

➡ Select the `Stop all` option in `Stop modules`.

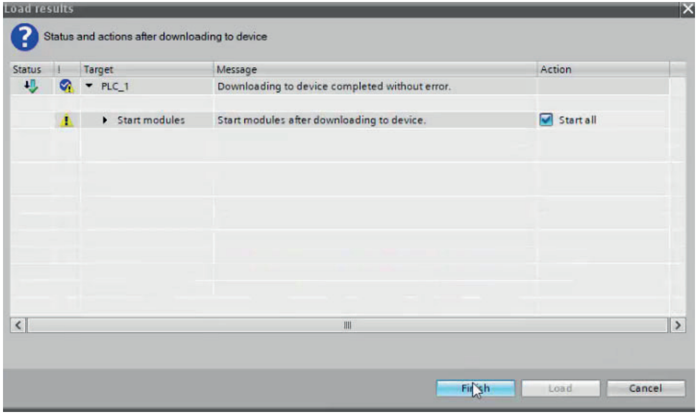
The device configuration can only be loaded when the CPU is in the operating state `STOP`.




i Depending on whether you created a new project or opened an existing one, it might be necessary to overwrite the so-called additional information. The latter is recommended to ensure an up-to-date data pool. This can be done by scrolling downwards within the same dialog and checking the `Overwrite all` box at `Additional information`.

Click the `Load` button. The PLC is thereby introduced to its environment for the first time. The loading process is indicated visually by a red flashing LED of the S7 device.

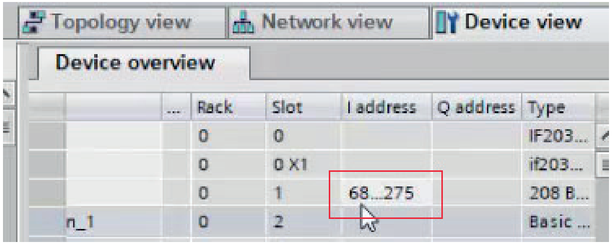
The results of the loading process are displayed in the following Dialog box. If the process was completed successful, start your S7. Activate the `Start all` checkbox, if necessary, and click the `Finish` button.




If no error occurs, the S7 changes to the operating state `RUN` which is indicated by the green RUN-LED.

## A 3.4 Accessing input and output data

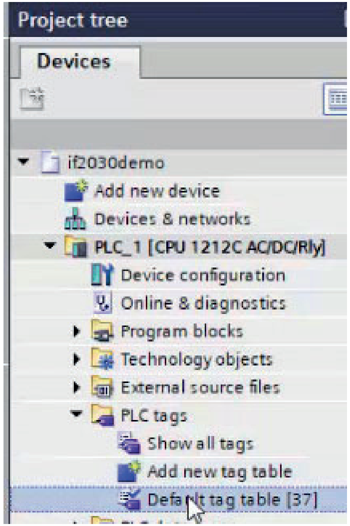
➡ Switch to the `Device view` and take a look at the `Device overview` of DT6240. Memorize the start address of the input module as an example.




Depending on the module, the address space (memory address bytes) is visible in the `I address` or the `Q address` columns. These addresses are automatically assigned to the respective module depending on the slot.

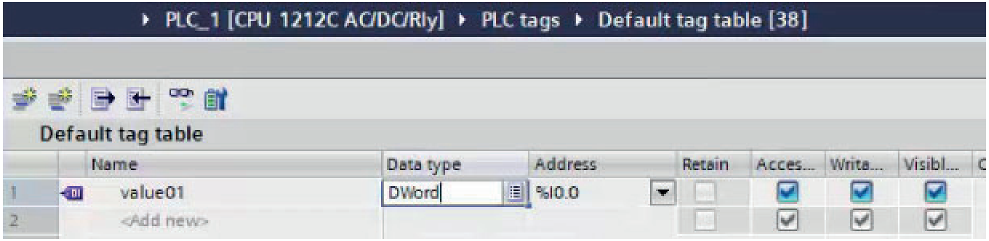
➡ Go to the `Project tree`. Follow this path in your PLC: `PLC tags > Default tag table`. The latter opens in the `Working window` by double-clicking.

You can now define variables in the Tag register to read out the desired memory locations. Each PLC tag is assigned a name, a data type, and an address.

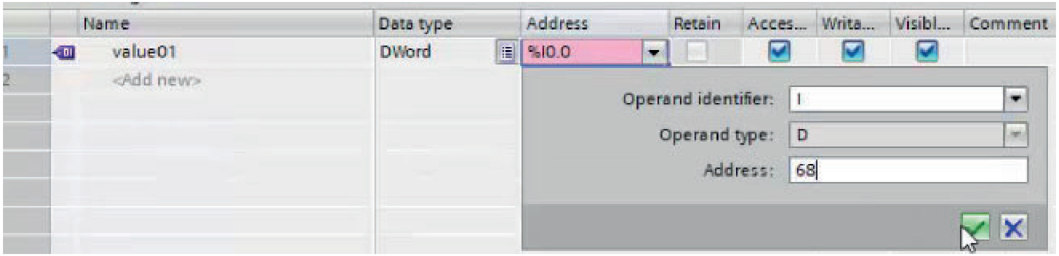



Proceed as follows to read out the content of the input module at its start address:

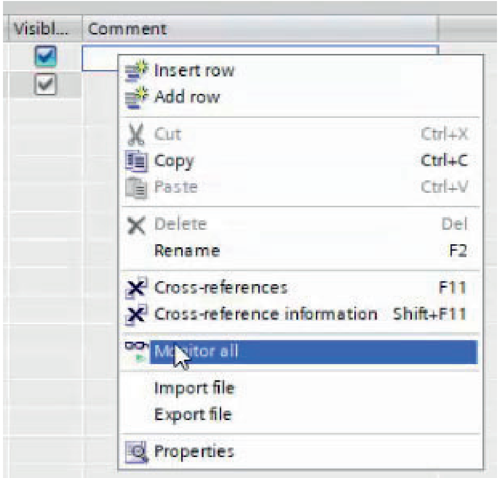
Assign a (tag) `Name` and select the Data type `DWord`.



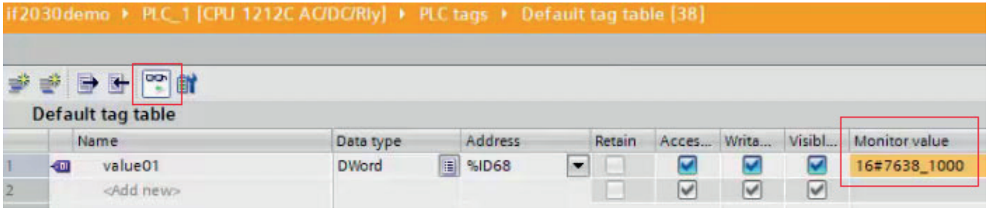

Open the extended view of the `address` definition. This facilitates the correct specification of operand and memory space. Enter the start address from `point 1` and confirm the entry by clicking the symbol button with the `green check` mark.



➡ You can monitor the values of the PLC tags in online mode directly via the `Default tag table`. Click either the `Moni-tor all` symbol button in the `Toolbar` or select this function by right-clicking within the tag table.




This leads to the online mode and the column `Monitor value` is displayed in the table. Clicking the symbol button once again quits the monitor mode.



## A 4 Tilt Angle Influence on the Capacitive Sensor

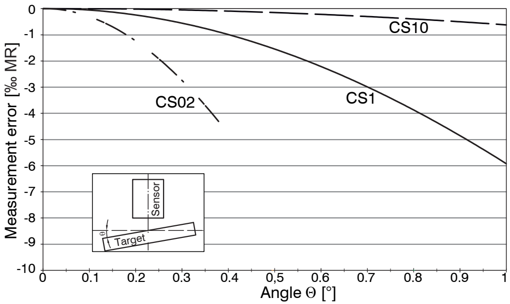



*Fig. 28 Example of measuring range deviation in the case of a sensor distance of 10 % of the measuring range*

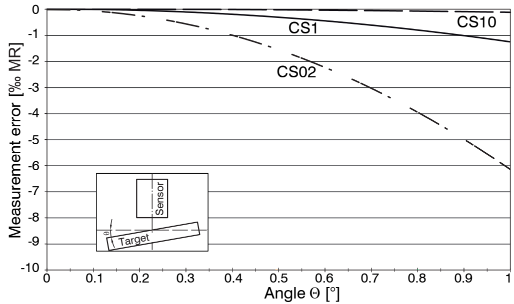



*Fig. 29 Example of measuring range deviation in the case of a sensor distance of 50 % of the measuring range*

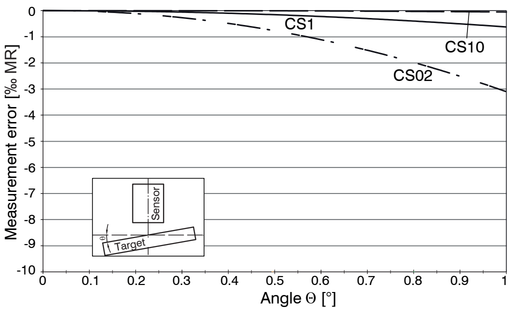



*Fig. 30 Example of measuring range deviation in the case of a sensor distance of 100 % of the measuring range*

i Figures give an influence example shown on the sensors CS02/CS1 and CS10 in the case of different sensor distances to the target. As this results from internal simulations and calculations, please request for detailed information.

# A 5 Measurement on Narrow Targets

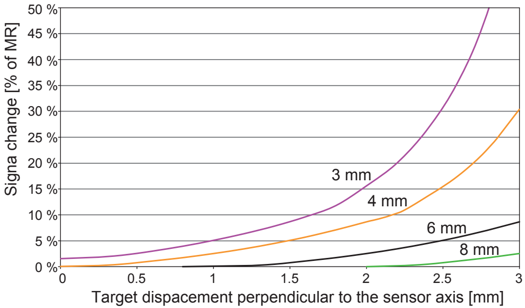



*Fig. 31 Example of measuring range deviation in the case of a sensor distance of 10 % of the measuring range*

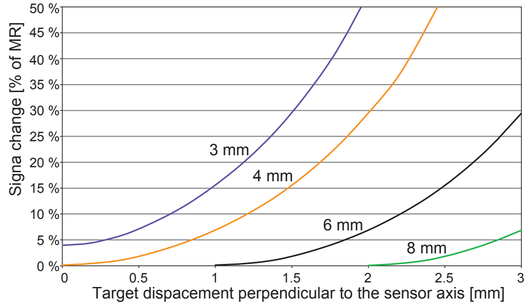



*Fig. 32 Example of measuring range deviation in the case of a sensor distance of 50 % of the measuring range*

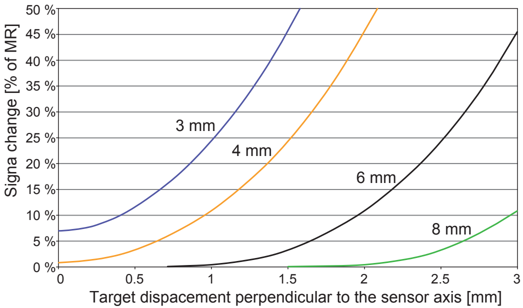



*Fig. 33 Example of measuring range deviation in the case of a sensor distance of 100 % of the measuring range*

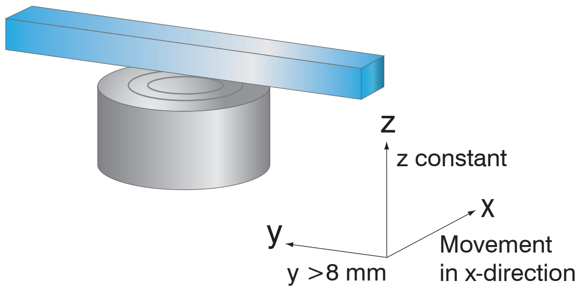



*Fig. 34 Signal change in the case of displacement of thin targets in the opposite direction to the measurement direction*

i Figures give an influence example shown on the sensors CS05 in the case of different sensor distances to the target as well as target widths. As this results from internal simulations and calculations, please request for detailed information.

## A 6 Measurements on Balls and Shafts

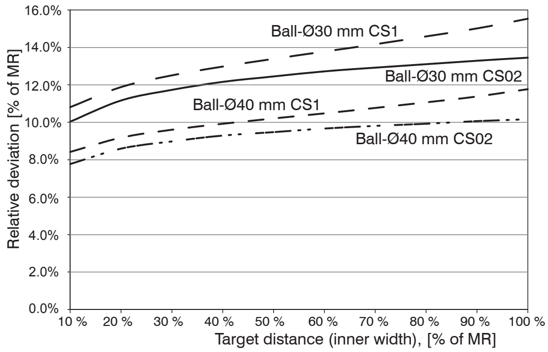



*Fig. 35 Measuring value deviation in the case of measurement on ball-shaped targets*

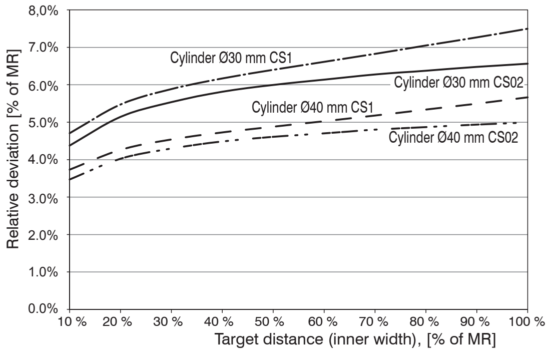



*Fig. 36 Measuring value deviation in the case of measurement on cylindrical targets*

i Figures give an influence example shown on the sensors CS02 and CS1 in the case of different sensor distances to the target as well as target diameters. As this results from internal simulations and calculations, please request for detailed information.

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
Your local contact: www.micro-epsilon.com/contact/worldwide/

X9751447-B012123MSC