Operating Instructions

confocalDT IFD2410/2411/2415 EtherNet/IP

IFD2410-1
IFD2410-3
IFD2410-6

IFD2411-1
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IFD2411/90-2
IFD2411-3
IFD2411-6

IFD2415-1
IFD2415-3
IFD2415-10

Confocal chromatic distance and thickness measurement

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.
`Measurement`	Indicates hardware or a software button/menu.

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 controller

The surface of the sensors or controller heats up to a temperature of over 50°C when all interfaces are used.

> Risk of injury

NOTICE

The supply voltage must not exceed the specified limits.

> Damage to or destruction of the controller

Avoid shocks and impacts to the controller and the sensor.

> Damage to or destruction of the components

Never fold the optical fiber and do not bend it in tight radii.

> Damage to or destruction of the optical fiber, failure of measuring device

Protect the ends of the optical fiber against contamination (use protective caps).

> Incorrect measurement

> Failure of the measuring device

Protect the cables against damage.

> Failure of the measuring device

1.3 Notes on Product Marking

1.3.1 Notes on CE Marking

Please note the following for the confocalDT IFD2410/2411/2415 measuring system:

- 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 IFD241x is designed for use in industrial and home applications and meets the requirements.

The EU Declaration of Conformity is available to the responsible authorities according to EU Directive, Article 10.

1.3.2 Notes on UKCA Marking

Please note the following for the confocalDT IFD2410/2411/2415 measuring system:

- SI 2016 No. 1091:2016-11-16 The Electromagnetic Compatibility Regulations 2016
- SI 2012 No. 3032:2012-12-07 The Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations 2012

Products which bear the CE mark meet the requirements of the EU directives cited and the relevant applicable harmonized European standards. The IFD241x is designed for use in industrial environments.

The UKCA marking and the technical documentation are available to the responsible authorities according to UKCA directives.

1.4 Intended Use

- The IFD241x is designed for use in an industrial environment. It is used for
  - Displacement, distance, movement and thickness measurement,
  - measuring the position of parts or machine components
- The IFD241x must only be operated within the limits specified in the technical data see Chap. 2.4.

➡ The measuring system must only be used in such a way that no persons are endangered or machines are damaged in the event of malfunction or total failure of the sensor.

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

1.5 Proper Environment

	confocalDT IFD2410/2415	confocalDT IFD2411	
		Sensor	Controller
Protection class	IP64, front side	IP64, front side	IP40
Operating temperature range	+5 ... +50 °C	+5 ... +70 °C	+5 ... +50 °C
Storage temperature range	-20 ... +70 °C		
Humidity	5 ... 95% (non-condensing)		
Ambient pressure:	Atmospheric pressure		
Shock (DIN EN 60068-2-27)	15 g/6 ms on XY axis, 1000 shocks each		
Vibration (DIN EN 60068-2-6)	2 g / 20 ... 500 Hz on XY axis, 10 cycles each		
EMC	As per EN 61000-6-3 / EN 61326-1 (Class B) Emitted interference; EN 61000-6-2 / EN 61326-1 Immunity to interference		

2. Functional Principle, Technical Data

2.1 Short Description

The measuring systems consists of:

Controller

(IFD2410-x,

IFD2415-x)

Sensor

confocalDT IFD2410/2415

With the IFD2410/2415, the sensor and controller form a single unit. It is not possible to exchange the sensor.

Controller

(IFC2411)

Optical fiber (sensor cable)

Sensor

(IFS2404-x)

confocalDT IFD2411

IFC2411 series controllers can be operated with different sensors. The calibration tables of the sensors required to do so need to be saved in the controller.

The measuring systems use a white LED as an internal light source.

The IFSxxx sensor is passive, since it does not contain any heat sources or moving parts. This prevents heat expansion, which makes for a highly accurate measurement process.

The controller converts the light signals received from the sensor with a spectrometer, calculates distance or thickness values with the integrated signal processor (CPU) and transfers the measured data via the interfaces or analog output.

2.2 Measuring Principle

Polychromatic light (white light) is beamed through the sensor onto the target surface. The sensor’s lenses are designed to focus each wavelength of light used at a specific distance through controlled chromatic aberrations. The light reflected by the target surface is received by the sensor on the way back and directed to the controller. This is followed by spectral analysis and the calculation of distances using calibration data saved in the controller.

i The sensor and controller form a single unit, as the linearization table of the sensor is saved in the controller.

This unique measuring principle enables high-precision measurement of applications. It can capture both diffuse and reflective surfaces. With transparent layer materials, a direct thickness measurement can be carried out in addition to the displacement measurement. The transmitter and receiver are arranged on one axis to prevent shadowing.

Excellent resolution and small light spot diameter make it possible to measure surface structures. However, it should be noted that deviations in measured values can occur as soon as the structure is in the order of magnitude of the light spot diameter or the permissible tilt is exceeded, for example at groove walls.

2.3 Term Definitions, Glossary

SMR Start of measuring range. A start of measuring range (SMR) must be kept between each sensor and the target. Minimal distance between the front sensor face and the target.

MMR Mid of measuring range

EMR End of measuring range (start of measuring range + measuring range)

Maximum distance between the front sensor face and the target.

MB Measuring range

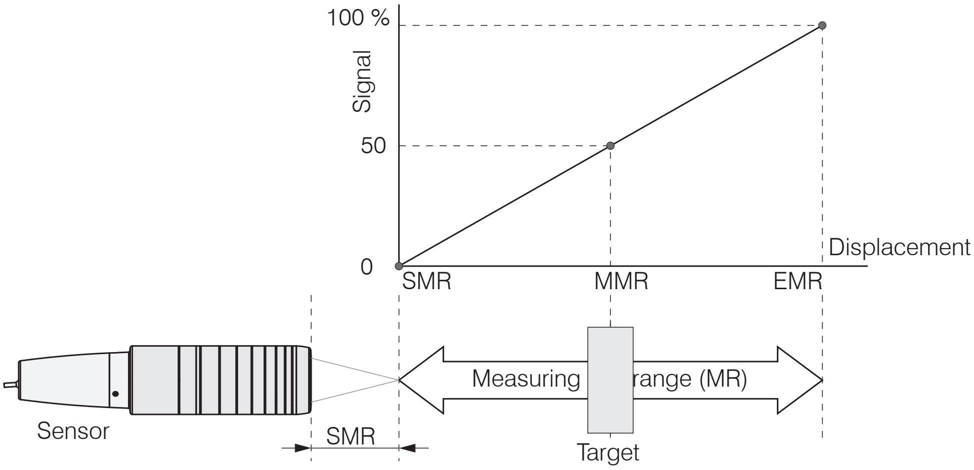


Fig. 1 Measuring range and output measuring system

Minimum target thickness see Chapter Technical Data

Maximum target thickness Sensor measuring range x refractive index of target

2.4 Technical Data for confocalDT IFD2410

Model		IFD2410-1	IFD2410-3	IFD2410-6
Measuring range		1.0 mm	3.0 mm	6.0 mm
Start of measuring range	approx.	approx. 15 mm	approx. 25 mm	approx. 35 mm
Resolution	static [1]	< 12 nm	< 36 nm	< 80 nm
	dynamic [2]	< 50 nm	< 125 nm	< 250 nm
Measuring rate		continuously adjustable from 100 Hz to 8 kHz		
Linearity [3]	Displacement and distance	< ±0.5 µm	< ±1.5 µm	< ±3.0 µm
	Thickness	< ±1.0 µm	< ±3.0 µm	< ±6.0 µm
Light source		internal white LED		
Permissible ambient light		30,000 lx		
Light spot diameter [4]		12 µm	18 µm	24 µm
Measuring angle [5]		±25°	±19°	±10°
Numerical aperture (NA)		0.45	0.35	0.18
Min. target thickness		0.05 mm	0.15 mm	0.3 mm
Target material		Reflective, diffuse as well as transparent surfaces (e.g. glass)		
Supply voltage		24 VDC ±10 %		
Power consumption		<5 W (24 V)		
Signal input		2 x encoders (A+, A-, B+, B-, index); 3 x encoders (A+, A-, B+, B-) 2x HTL/TTL multifunction inputs: trigger in, slave in, zero setting, mastering, teach; 1x RS422 synchronization input: trigger in, sync in, master/slave, master/slave alternating		
Digital interface		EtherCAT / PROFINET / EtherNet/IP / RS422 / Ethernet (for parameter setting)		
Analog output		4 … 20 mA / 0 … 5 V / 0 ... 10 V (16 bit D/A converter)		
Switching output		Error1-Out, Error2-Out		
Digital output		sync out		
Connection		12-pin M12 connector for supply, encoder, EtherCAT, PROFINET, EtherNet/IP, RS422 and Sync 17-pin M12 plug for I/O analog and encoder optional extension to 3 m / 6 m / 9 m / 15 m (see accessories for suitable connection cables)		
Installation		radial clamping, threaded hole, mounting adapter (see accessories)		
Temperature range	Storage	-20 … +70 °C		
	Operation	+5 … +50 °C		
Shock (DIN EN 60068-2-27)		15 g / 6 ms in XY axis, 1000 shocks each		
Vibration (DIN EN 60068-2-6)		2 g / 20 … 500 Hz in XY axis, 10 cycles each		
Protection class (DIN EN 60529)	Sensor	IP64 (front)		
	Controller	IP65		
Material		Aluminum housing, passive cooling		
Weight		490 g	490 g	490 g
Control and indicator elements		Correct button: interfaces selection, two adjustable functions and reset to factory settings after 10 s; 4x color LEDs for Intensity, Range, RUN and ERR		

All data on constant ambient temperature (24 ± 2°C)

1) Average from 512 values at 1 kHz, in the mid of the measuring range onto optical flat

2) RMS noise relates to mid of measuring range (1 kHz)

3) Maximum deviation from reference system over the entire measuring range, measured on front surface of ND filter

4) In the mid of the measuring range

5) Maximum sensor tilt angle that produces a usable signal on polished glass (n = 1.5) in the mid of the measuring range. The accuracy decreases when approaching the limit values.

2.5 Technical Data for confocalDT 2415

Model		IFD2415-1	IFD2415-3	IFD2415-10
Measuring range		1.0 mm	3.0 mm	10.0 mm
Start of measuring range	approx.	approx. 10 mm	approx. 20 mm	approx. 50 mm
Resolution	static [1]	< 8 nm	< 15 nm	< 36 nm
	dynamic [2]	< 38 nm	< 80 nm	< 204 nm
Measuring rate		continuously adjustable from 100 Hz to 25 kHz		
Linearity [3]	Displacement and distance	< ±0.25 µm	< ±0.75 µm	< ±2.5 µm
	Thickness	< ±0.5 µm	< ±1.5 µm	< ±5.0 µm
Light source		internal white LED		
Permissible ambient light		30,000 lx		
Light spot diameter [4]		8 µm	9 µm	16 µm
Measuring angle [5]		±30°	±24°	±17°
Numerical aperture (NA)		0.55	0.45	0.3
Min. target thickness		0.05 mm	0.15 mm	0.5 mm
Target material		Reflective, diffuse as well as transparent surfaces (e.g. glass)		
Supply voltage		24 VDC ±10 %		
Power consumption		<7W (24 V)		
Signal input		2x encoders (A+, A-, B+, B-, index); 3x encoders (A+, A-, B+, B-) 2x HTL/TTL multi-function inputs: trigger in, slave in, zero setting, mastering, teach-in; 1x RS422 synchronization input: trigger in, sync in, master/slave, master/slave alternating		
Digital interface		EtherCAT / PROFINET / Ethernet/IP / RS422 / Ethernet (for parameter setting)		
Analog output		4 … 20 mA / 0 … 5 V / 0 ... 10 V (16 bit D/A converter)		
Switching output		Error1-Out, Error2-Out		
Digital output		sync out		
Connection		12-pin M12 connector for supply, encoder, EtherCAT, PROFINET, Ethernet/IP, RS422 and Sync 17-pin M12 connector for I/O analog and encoder optional extension to 3 m / 6 m / 9 m / 15 m possible (see accessories for suitable connection cables)		
Installation		radial clamping, threaded hole, mounting adapter (see accessories)		
Temperature range	Storage	-20 … +70 °C		
	Operation	+5 … +50 °C		
Shock (DIN EN 60068-2-27)		15 g / 6 ms in XY axis, 1000 shocks each		
Vibration (DIN EN 60068-2-6)		2 g / 20 … 500 Hz in XY axis, 10 cycles each		
Protection class (DIN EN 60529)	Sensor	IP64 (front)		
	Controller	IP65		
Material		Aluminum housing, passive cooling		
Weight		approx. 500 g	approx. 600 g	approx. 800 g
Control and indicator elements		Correct button: interfaces selection, two adjustable functions and reset to factory settings after 10 s; 4x color LEDs for Intensity, Range, RUN and ERR		

All data at constant ambient temperature (24 ±2 °C)

1) Average from 512 values at 1 kHz, in the mid of the measuring range onto optical flat

2) RMS noise relates to mid of measuring range (1 kHz)

3) Maximum deviation from reference system over the entire measuring range, measured on front surface of ND filter

4) In the mid of the measuring range

5) Maximum sensor tilt angle that produces a usable signal on polished glass (n = 1.5) in the mid of the measuring range. The accuracy decreases when approaching the limit values.

2.6 Technical Data confocalDT IFD2411

Model		IFD2411-1	IFD2411-2	IFD2411/90-2	IFD2411-3	IFD2411-6
Measuring range		1.0 mm	2.0 mm		3.0 mm	6.0 mm
Start of measuring range	approx.	15 mm	14 mm	9.6 mm [1]	25 mm	35 mm
Resolution	static [2]	< 12 nm	< 40 nm		< 40 nm	< 80 nm
	dynamic [3]	< 50 nm	< 125 nm		< 125 nm	< 250 nm
Measuring rate		continuously adjustable from 100 Hz to 8 kHz				
Linearity [4]	Distance	< ±0.5 µm	< ±1.0 µm		< ±1.5 µm	< ±3.0 µm
	Thickness	< ±1.0 µm	< ±2.0 µm		< ±3.0 µm	< ±6.0 µm
Multi-peak measurement		1 layer				
Light source		internal white LED				
No. of characteristic curves		up to 10 characteristic curves for different sensors per channel, selection via table in the menu				
Permissible ambient light [5]		30,000 lx				
Light spot diameter		12 µm	10 µm		18 µm	24 µm
Max. measuring angle [6]		±25°	±12°		±19°	±10°
Numerical aperture (NA)		0.45	0.25		0.35	0.18
Min. target thickness [7]		0.05 mm	0.1 mm		0.15 mm	0.3 mm
Target material		reflective, diffuse as well as transparent surfaces (e.g. glass)				
Synchronization		yes				
Supply voltage		24 VDC ±10 %				
Power consumption		< 7 W (24V)				
Signal input		sync-in / trig-in; 1x encoder (A+, A-, B+, B-, index)				
Digital interface		EtherCAT / PROFINET / Ethernet/IP / RS422 / Ethernet (for parameter setting)				
Analog output		Current: 4 … 20 mA; voltage: 0 ... 5V & 0 … 10 V (16 bit D/A converter)				
Digital output		sync-out				
Connection	Optical	pluggable optical fiber via E2000 socket, length 2 m ... 50 m, min. bending radius 30 mm				
	Electrical	3-pin supply terminal strip; 5-pin I/O terminal strip (max. cable length 30 m); 17-pin M12 connector for RS422, analog and encoder; RJ45 socket for Ethernet (out) / EtherCAT / PROFINET / Ethernet/IP (in/out) (max. cable length 100 m)				
Installation		Free-standing, DIN rail mounting				
Temperature range	Storage	-20 … +70 °C				
	Operation	Sensor: +5 … +70 °C; controller: +5 … +50 °C				
Shock (DIN EN 60068-2-27)		15 g / 6 ms in XYZ axis, 1000 shocks each				
Vibration (DIN EN 60068-2-6)		2 g / 20 … 500 Hz in XYZ axis, 10 cycles each				
Protection class (DIN EN 60529)	Sensor	IP64				
	Controller	IP40				
Material		Aluminum				
Weight	Sensor	approx. 100 g	approx. 20 g	approx. 30 g	approx. 100 g	approx. 100 g
	Controller	approx. 335 g				
No. of measurement channels [8)]		1				
Control and indicator elements		Multifunction button: interfaces selection, two adjustable functions and reset to factory settings after 10 s; 4x color LEDs for Intensity, Range, RUN and ERR				

FSO = Full Scale Output

1) Start of measuring range measured from sensor axis

2) Average from 512 values at 1 kHz, in the mid of the measuring range onto optical flat

3) RMS noise relates to mid of measuring range (1 kHz)

4) All data at constant ambient temperature (25 ±1 °C) against optical flat; specifications can change when measuring different objects.

5) Illuminant: light bulb

6) Maximum measuring angle of the sensor that produces a usable signal on reflecting surfaces. The accuracy decreases when approaching the limit values.

7) Glass sheet with refractive index n = 1.5 in midrange

8) No loss of intensity and linearity due to two synchronous measurement channels

3. Delivery

3.1 Scope of Delivery confocalDT IFD2410/2415

1 Sensor	IFD241x-x
1 PC2415-1/Y	Length 1 m
1 acceptance report	
1 quick manual	

- 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.

3.2 Scope of Delivery confocalDT IFD2411

1 Controller	IFC2411
1 Sensor	IFS2404-x
1 RJ patch cable Cat5	2 m
1 acceptance report	
1 quick manual	

- 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.

3.3 Storage

Temperature range for storage: -20 ... +70 °C

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

i Protect the lens of the sensor from getting dirty.
Protect the ends of the sensor cable (optical fibers) from getting dirty (applies to the IFD2411).

4. Mounting

4.1 Preliminary Remarks

The optical sensors/measuring systems of the confocalDT IFD2410/2411/2415 series measure in the nanometer range. Observe the maximum tilt between sensor and target.

i Ensure careful handling during installation and operation!

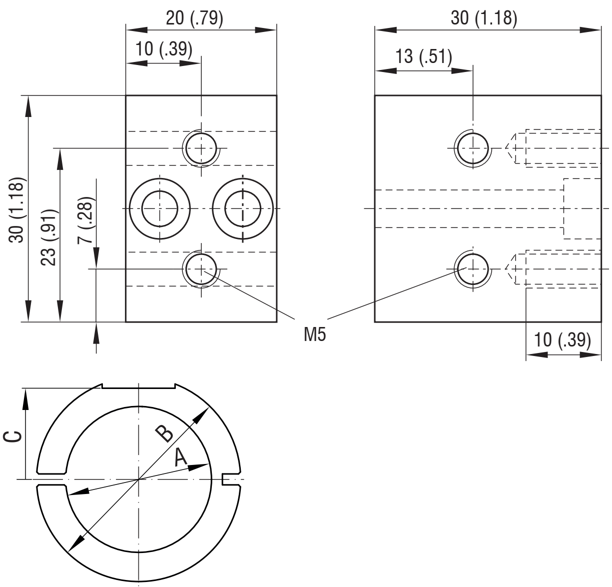
4.2 confocalDT IFD2410/2415

4.2.1 Circumferential Clamping

➡ Mount the IFD241x using a mounting adapter.

Fig. 2 Circumferential clamping with MA240x mounting ring, consisting of mounting block and mounting ring

i Micro-Epsilon recommends using the circumferential clamping.

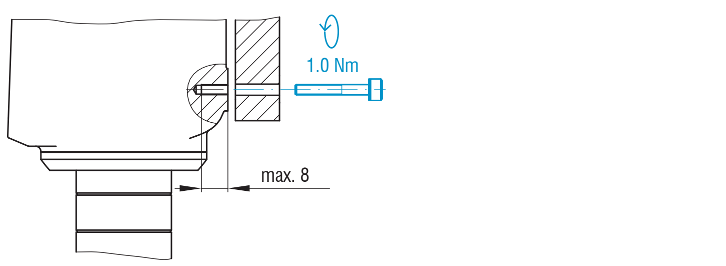


Mounting ring	Dimension A	Dimension B	Dimension C
MA2400-27	ø27	ø46	19.75
MA2405-34	ø34	ø50	22
MA2405-54	ø54	ø70	32

Fig. 3 Mounting block and mounting ring MA240x

4.2.2 Direct Screw Connection

➡ Mount the IFD241x using three M3 screws.



Screwing depth		Screw	Tightening torque screw
Minimum	Maximum	ISO 4762	
mm	mm	3 pieces	Nm
6	8	M3	1.0

Fig. 4 Installation conditions IFD2410 / IFD2415

IFD2410-	1	3	6
MR	1	3	6
SMR	15	25	35
A	56		
B	33		
C	150		
D	27		

IFD2415-	1	3	10
MR	1	3	10
SMR	10	20	50
A	82	85	118
B	59	62	---
C	176	179	212
D	27	34	54

Dimension in millimeters

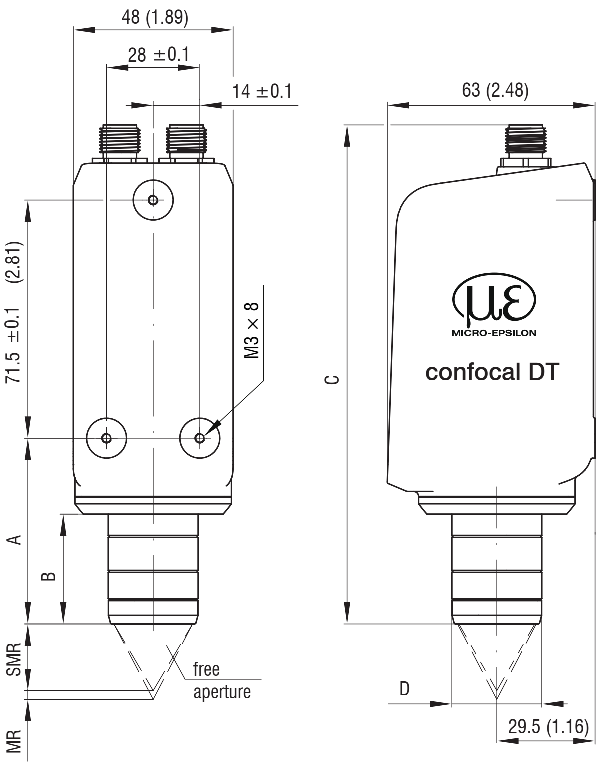


Fig. 5 Dimensional drawing IFD2410 / IFD2415, dimensions in mm

The support surfaces around the fastening holes are slightly raised.

4.2.3 Electrical Connections, Pin Assignment

Source	Cable/power supply	Interface	Terminal

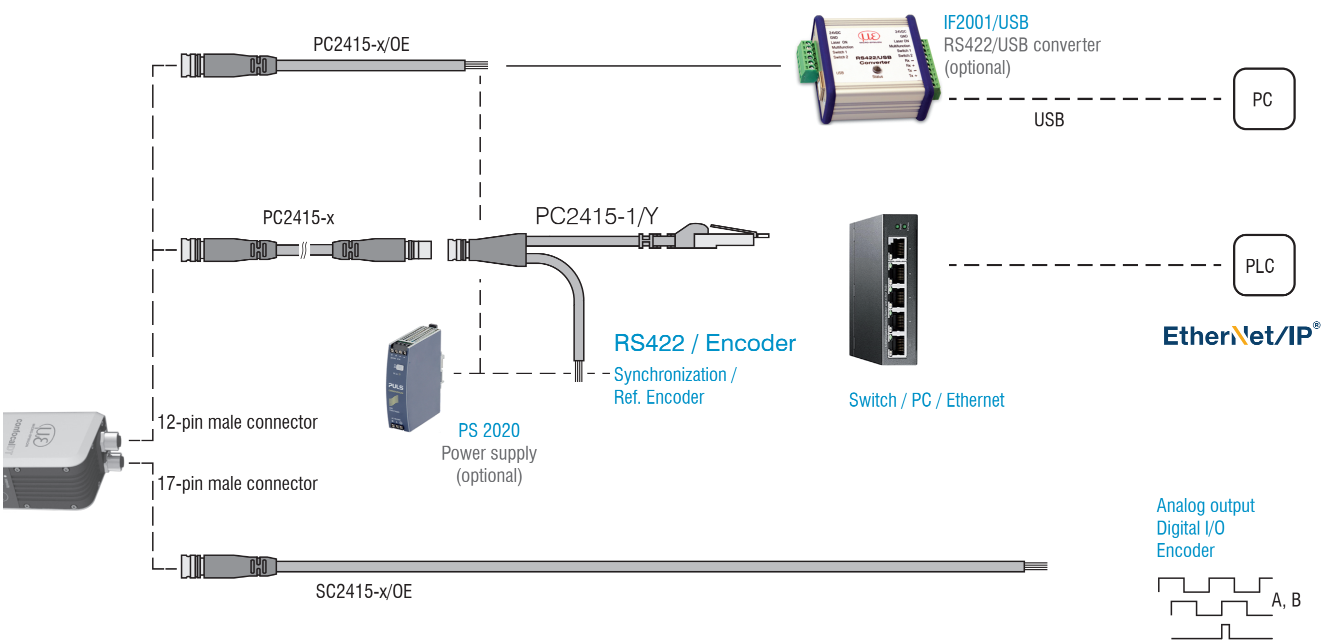


Fig. 6 Connection examples for confocalDT IFD2410/2415

IFD2410/2415, 12-pin connector			PC2415-x/OE	PC2415-1/Y		IF2001
Signal		Pin	Wire color	Wire color	RJ45, pin	Signal
V_+		1	Red	Red	---	24VDC
Supply GND		2	Blue	Blue	---	GND
Data Rx+	Encoder 2A+ [1]	3	Brown	Brown	---	Tx+
Data Rx-	Encoder 2A-	4	White	White	---	Tx-
Data Tx+	Encoder 2B+	5	Green	Green	---	Rx+
Data Tx-	Encoder 2B+	6	Yellow	Yellow	---	Rx-
SYNC+	Encoder 2Ref+	7	Gray	Gray	---	---
SYNC-	Encoder 2Ref-	8	Pink	Pink	---	---
Shield		Housing	Black	Black	---	---
Industrial Ethernet		9	White/green	---	3	---
		10	Green	---	6	---
		11	White/orange	---	1	---
		12	Orange	---	2	---

Fig. 7 Pin assignment for 12-pin sensor connector

The PC2415-1/Y cable is included in the scope of delivery.

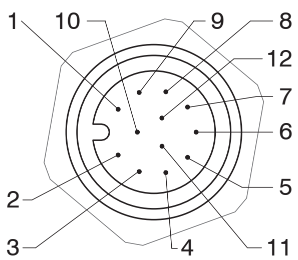


Fig. 8 12-pin sensor connector, pin side

1) The pins can be used for either:
- serial communication (TIA/EIA-422-B) and synchronization or
- encoder signals.

IFD2410/2415, 17-pin connector		SC2415-x/OE
Signal	Pin	Wire color
Analog output	1	White, inside
Analog GND	2	Black
Switching output 2 GND	3	Black
Switching output 2	13	Purple
Multifunction input 1	5	Red
Multifunction input 2	14	Blue
Encoder 1B+	8	Gray
Encoder 1B-	15	Pink
Encoder 1Ref+	9	Green
Encoder 1Ref-	16	Yellow
Switching output 1 GND	10	Brown
Switching output 1	11	White
Encoder 1A-	12	Red/blue
Encoder 1A+	17	Gray/pink
Shield	Housing	Black

Fig. 10 Pin assignment for 17-pin sensor connector

The SC2415-x/OE cable is available as an optional accessory.

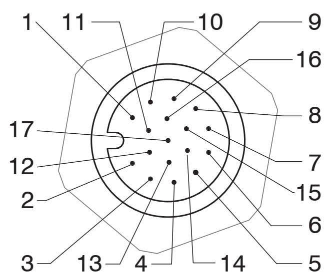


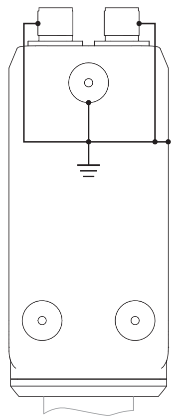
Fig. 9 17-pin sensor connector, pin side

4.2.4 Grounding Concept, Shielding

All inputs and outputs are galvanically connected to the power supply ground (`supply GND`); the EtherNet/IP connections are potential-free.

The ground connections (`supply GND`, `switching output GND` and `analog GND`) of each connection group are galvanically connected to one another by filters.

The shield connections of each connection group are only connected to the controller housing. They are used to connect the cable shieldings for individual connections (power, analog output, switching outputs, synchronization and trigger input).

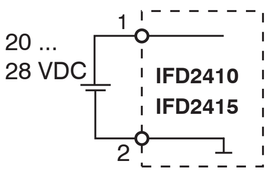


i For reasons of interference resistance, use the corresponding GND connection for the analog output and the two switching outputs.
Only use shielded cables shorter than 30 m and connect the cable shield to the shield or the connector housings.

4.2.5 Supply Voltage (Power)

Nominal value: 24 V DC (20 ... 28 V, *P* < 7 W).

The sensor is supplied via cable PC2415-1/Y or PC2415-x/OE.



IFD2410/2415 12-pin connector	**Power supply**	**PC2415-1/Y PC2415-x/OE**
1	V_+	Red
2	GND	Blue

Only turn on the power supply after wiring has been completed.

➡ Connect the inputs for pin 1 and pin 2 on the sensor to a 24 V power supply.

i Power supply only for measuring devices, not to be used for drives or similar sources of impulse interference at the same time. MICRO-EPSILON recommends using the optionally available PS2020 power supply, for the sensor.

4.2.6 RS422

In addition to Industrial Ethernet, the IFD2410/2415 also supports serial communication via RS422. The PC2415-1/Y or PC2415-x/OE cables enable serial communication. The IF2001/USB RS422-to-USB converter is available as an optional accessory.

- Differential signals to EIA-422, galvanically connected to supply voltage.
- Receiver Rx with 120 Ohm internal terminating resistor.

➡ Use a shielded cable with twisted wires. Cable length less than 30 m.

➡ Connect the ground connections.

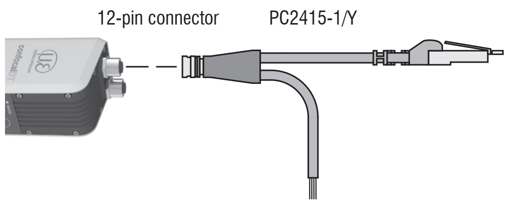
IFD2410/2415 12-pin connector	**Signal**	**PC2415-1/Y PC2415-x/OE**	**IF2001/USB**
3	RX +	Brown	TX +
4	RX -	White	TX -
2	Supply GND (blue)		GND
5	TX +	Green	RX +
6	TX -	Yellow	RX -
Housing	Shield	Cable shield	---

4.2.7 Ethernet, EtherNet/IP

Connection

- with an Ethernet network (PC) or
- with the bus system.

IFD2410/2415, 12-pin connector		**PC2415-x/OE**	**PC2415-1/Y**
Signal	Pin	Wire color	RJ45, pin
Industrial Ethernet	9	White/green	3
	10	Green	6
	11	White/orange	1
	12	Orange	2



➡ Connect the IFD2410/2415 and network with a shielded Ethernet cable (Cat5E, 2 m patch cable from the scope of delivery, total cable length shorter than 30 m).

The two LEDs `MS` and `NS` indicate that the connection was successful and is active.

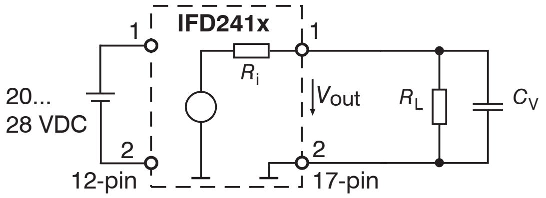
The measuring device can be configured via objects (EtherNet/IP), the web interface or by ASCII commands at command level (e.g. Telnet).

4.2.8 Analog Output

The alternative analog output (voltage or current) is connected to the 17-pin sensor plug and is galvanically connected to the supply voltage.

IFD2410/2415, 17-pin connector			SC2415-x/OE
Signal	Pin		Wire color
Analog output	1		White, inside
Analog GND	2		Black [1]

Voltage: Pin V/I_{out} and Pin GND,

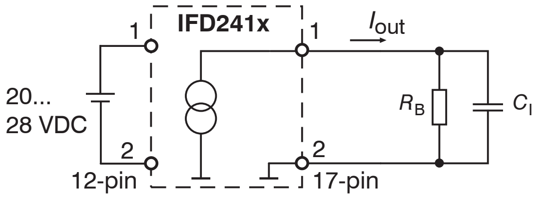


R_i approx. 50 Ohm, R_L > 10 MOhm

Slew rate (without C_V, $R_L \geq 1$ kOhm) typ. 0.5 V/µs

Slew rate (with C_V = 10 nF, $R_L \geq 1$ kOhm) typ. 0.4 V/µs

Current: Pin U/I_{out} and Pin GND



$R_B \leq 500$ Ohm

Slew rate (without C_I, R_B = 500 Ohm) typ. 1.6 mA/µs

Slew rate (with C_I= 10 nF, R_B = 500 Ohm) typ. 0.6 mA/µs

➡ Use a shielded cable. Cable length less than 30 m.

As an alternative, the output range can be set to the following values:

Voltage: 0 ... 5 V; 0 ... 10 V;

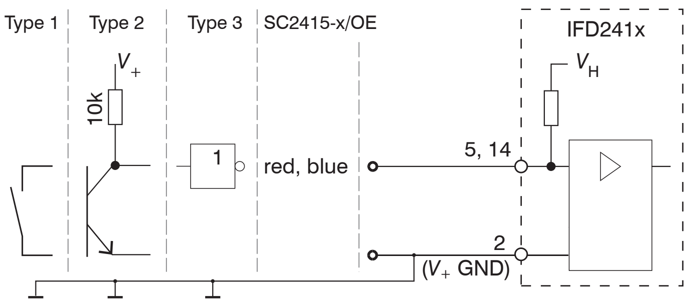
Current: 4 ... 20 mA.

The measured values can only be output as voltage or current.

1) Analog output in shielded cable area

4.2.9 Multifunction inputs

A switching transistor with an open collector (e.g. in an optocoupler), a relay contact or a digital TTL or HTL signal are suitable for switching.



The inputs are not electrically separated.

24V logic (HTL): Low ≤ 3 V; High ≥ 8 V (max 30 V),

5V logic (TTL): Low ≤ 0.8 V; High ≥ 2 V

Minimal pulse width 50 µs

Internal pull-up resistor, an open input is detected as High.

Maximum switching frequency 25 kHz

An external resistor is not required for current limitation. The ground of the logic circuit must be galvanically connected to the supply ground.

4.2.10 Switching Outputs (digital I/O)

The GND connections of the switching outputs are separated from the supply GND by filters.

The switching behavior (NPN, PNP, Push-Pull) is programmable I_{max} 100 mA.

The maximum auxiliary voltage for a switching output with NPN switching behavior is 28 V.

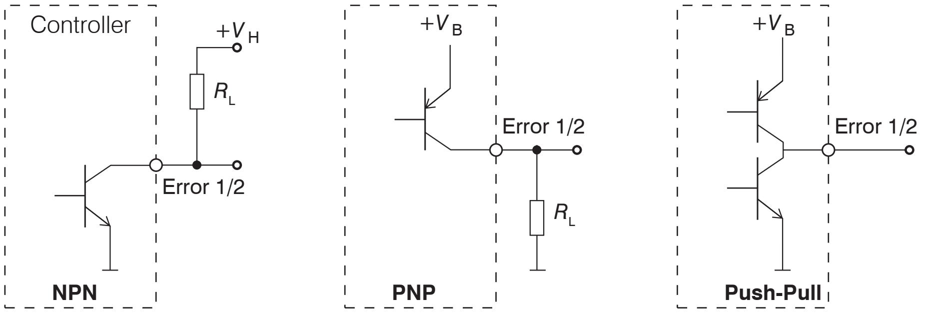


Fig. 11 Output characteristics and circuitry of the TTL switching outputs `Error 1/2`

IFD2410/2415, 17-pin connector		**SC2415-x/OE**
Signal	Pin	Wire color
Switching output 2 GND	3	Black
Switching output 2	13	Purple
Switching output 1 GND	10	Brown
Switching output 1	11	White

All GND conductors are interconnected with one another and to the supply ground.

➡ Use a shielded cable. Cable length less than 30 m.

Output level (without load resistor) at a supply voltage of 24 VDC	Low < 1 V; High > 23 V
Saturation voltage at I_{max} = 100 mA	Low < 2.5 V (output - GND)
	High < 2.5 V (output - + V_B)

The saturation voltage is measured:

- between output and GND, at output = Low, or
- between output and V_B, at output = High.

Name	**Output active (error)**	**Output passive (no error)**
NPN (Low side)	GND	+ V_B
PNP (High side)	+ V_B	GND
Push-pull	+ V_B	GND
Push-pull, negative	GND	+ V_B

Fig. 12 Switching behavior of the switching outputs

NOTICE

The load resistor R_L can be dimensioned according to the limit values (I_{max} = 100 mA, V_{Hmax} = 28 V). When connecting inductive loads, such as a relay, the parallel protective diode must not be missing.

4.2.11 Synchronization (Inputs/Outputs)

4.2.11.1 General

- The SYNC+ and Sync- pins on the 12-pin sensor connector: Symmetrical output/input for synchronization of two or more sensors
- The pins multifunction input 1 or multifunction input 2 on the 17-pin sensor connector: Input for synchronization of a sensor with an external synchronization source, such as a function generator
- The termination resistor R_T (120 Ohm) can be switched on or off via software.

4.2.11.2 Internal Synchronization

An IFD2410/2415 (master) synchronizes one or more sensors (slaves).

IFD2410/2415, 12-pin connector				**PC2415-x/OE**	**PC2415-1/Y**
Signal	Pin	Level		Wire color	Wire color
Supply GND	2			Blue	Blue
SYNC+	7	RS422 (EIA422)		Gray	Gray
SYNC-	8			Pink	Pink

Fig. 13 Connections and signal level internal synchronization

➡ Activate the termination resistor (120 Ohm) in the last sensor (slave n) in the chain.

Star synchronization

➡ Connect pins Sync+ and Sync– from sensor 1 (master) in a star shape to pins Sync+ and Sync– from sensor 2 (slave) to sensor n, in order to synchronize two or more sensors to one another, see Fig. 14

- Sub-loop length less than 30 m in star synchronization

Chain synchronization

➡ Connect pins Sync+ and Sync– from sensor 1 (master) to pins Sync+ and Sync– from sensor 2 (slave 1). Connect the pins of the following sensors to synchronize two or more sensors to one another, see Fig. 14

- Total line length less than 30 m in chain synchronization

➡ Use shielded cables with twisted wires.

➡ Connect the cable shield to the housing.

➡ Program sensor 1 to Master and all other sensors to Slave.

Fig. 14 Synchronization of multiple sensors, star-shaped on the left, daisy-chained on the right

➡ Connect all GND connections of the supply to one another if the sensors are not fed by a common power supply.

i If the sensors are operated by way of the EtherNet/IP interface, then synchronization can also be achieved without the sync line.

4.2.11.3 External Synchronization

An external synchronous source synchronizes one or more IFD2410/2415 (slaves).

IFD2410/2415, 17-pin connector				SC2415-x/OE
Signal	Pin	Level		Wire color
Multifunction input 1	5	TTL Low Level ≤ 0.8 V; High Level ≥ 2 V Minimal pulse width 50 µs	HTL Low Level ≤ 3 V; High Level ≥ 8 V (max. 30 V) Minimal pulse width 50 µs	Red
Multifunction input 2	14			Blue

IFD2410/2415, 12-pin connector		PC2415-x/OE	PC2415-1/Y
Signal	Pin	Wire color	Wire color
Supply GND	2	Blue	Blue

Fig. 15 Connections and signal level external synchronization

➡ Activate the termination resistor (120 Ohm) in the last sensor (slave n) in the chain.

Star synchronization

➡ Connect the pin `multifunction input 1` or `2` of slave 1 to the external synchronization source.

➡ Connect the `supply GND` of the sensor to the ground connection of the synchronization source.

Further sensors can be synchronized in the same schematic.

- Sub-loop length less than 30 m in star synchronization

➡ Use shielded cables with twisted wires.

➡ Connect the cable shield to the housing.

➡ Program all sensors to `Slave`.

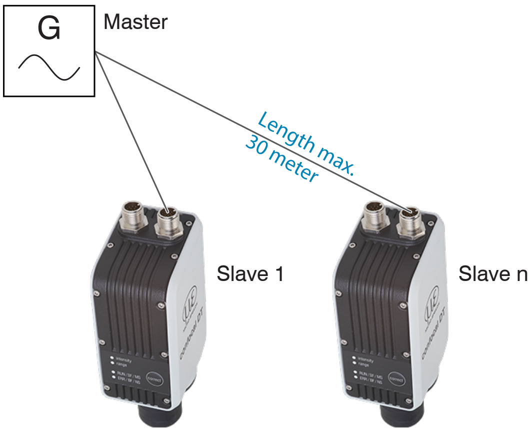


Fig. 16 Synchronization of multiple sensors, star-shaped

➡ Connect all GND connections of the supply to one another if the sensors are not fed by a common power supply.

ℹ If the IFD2410/2415 are operated by way of the EtherNet/IP interface, then synchronization can also be achieved without the sync line.

4.2.12 Triggering

4.2.12.1 General

Data recording or output can be triggered with:

- multifunction inputs 1/2,
- synchronization inputs Sync+ and Sync-,
- encoder 1.

➡ Use a shielded cable with twisted wires. Cable length less than 30 m.

Switching contacts, transistors (NPN, N-channel FET) or PLC outputs can be used as trigger sources.

4.2.12.2 Triggering with Multifunction Input

IFD2410/2415, 17-pin connector					**SC2415-x/OE**
Signal	Pin	Level			Wire color
Multifunction input 1	5	TTL Low Level ≤ 0.8 V; High Level ≥ 2 V Minimal pulse width 50 µs	HTL Low Level ≤ 3 V; High Level ≥ 8 V (max. 30 V) Minimal pulse width 50 µs		Red
Multifunction input 2	14				Blue

➡ Connect the pin `multifunction input 1` or `2` to the external trigger source.

➡ Connect the `supply GND` of the sensor to the ground connection of the external trigger source.

Program the sensor's `multifunction input` connections to the trigger input function.

4.2.12.3 Triggering with Synchronization Input

IFD2410/2415, 12-pin connector				**PC2415-x/OE**	**PC2415-1/Y**
Signal	Pin	Level		Wire color	Wire color
SYNC+	7	RS422 (EIA422)		Gray	Gray
SYNC-	8			Pink	Pink

➡ Connect pins `Sync+` and `Sync-` to the external trigger source.

Program the sensor's sync connections to the trigger input function.

The trigger source (master) must supply a symmetrical output signal according to the RS422 standard. For asymmetrical trigger sources, Micro-Epsilon recommends inserting the SU4 level converter (3 channels TTL/HTL to RS422) between trigger signal source and sensor.

4.2.12.4 Triggering with Input Encoder 1

A connected encoder at the encoder 1 inputs can be used for triggering.

IFD2410/2415, 17-pin connector				**SC2415-x/OE**
Signal	Pin	Level		Wire color
Encoder 1B+	8	RS422 (EIA422)		Gray
Encoder 1B-	15			Pink
Encoder 1A-	12			Red/blue
Encoder 1A+	17			Gray/pink

Program the encoder's sync connections to the trigger input function.

4.2.13 Encoder Inputs

The measuring system supports up to three encoders.

Two encoder inputs:

- Incremental signals A, B
- Reference pulse

The maximum pulse frequency is 1 MHz.

RS422 level (symmetrical) for A, B, Ref

IFD2410/2415, 12-pin connector			**PC2415-x/OE**	**PC2415-1/Y**
Signal	Pin		Wire color	Wire color
Supply GND	2		Blue	Blue
Encoder 2A+ [1]	3		Brown	Brown
Encoder 2A-	4		White	White
Encoder 2B+	5		Green	Green
Encoder 2B+	6		Yellow	Yellow
Encoder 2Ref+	7		Gray	Gray
Encoder 2Ref-	8		Pink	Pink

IFD2410/2415, 17-pin connector			**SC2415-x/OE**
Signal	Pin		Wire color
Encoder 1B+	8		Gray
Encoder 1B-	15		Pink
Encoder 1Ref+	9		Green
Encoder 1Ref-	16		Yellow
Encoder 1A-	12		Red/blue
Encoder 1A+	17		Gray/pink

Fig. 17 Pin assignment for two encoder inputs

Three encoder inputs:

- Incremental signals A, B

The maximum pulse frequency is 1 MHz; no reference pulse.

RS422 level (symmetrical) for A, B, Ref

IFD2410/2415, 12-pin connector			**PC2415-x/OE**	**PC2415-1/Y**
Signal	Pin		Wire color	Wire color
Supply GND	2		Blue	Blue
Encoder 2A+ [1]	3		Brown	Brown
Encoder 2A-	4		White	White
Encoder 2B+	5		Green	Green
Encoder 2B+	6		Yellow	Yellow
Encoder 3B+	7		Gray	Gray
Encoder 3B-	8		Pink	Pink

IFD2410/2415, 17-pin connector			**SC2415-x/OE**
Signal	Pin		Wire color
Encoder 1B+	8		Gray
Encoder 1B-	15		Pink
Encoder 3A+	9		Green
Encoder 3A-	16		Yellow
Encoder 1A-	12		Red/blue
Encoder 1A+	17		Gray/pink

Fig. 18 Pin assignment for three encoder inputs

➡ Use a shielded cable. Cable length shorter than 3 m. Connect the cable shield to the housing.

Connection conditions

- The encoders must supply symmetrical RS422 signals.
- If there are no RS422 outputs on the encoder, Micro-Epsilon recommends inserting the SU4 level converter (3 channels TTL/HTL to RS422) between trigger signal source and controller.

1) If encoders 2 and 3 are used, neither serial communication via RS422 and nor synchronization of the IFD2410/2415 will be possible.

4.3 confocalDT 2411

4.3.1 IFC2411 Controller

The IFC2411 controller can be placed on a flat surface or mounted with a TH 35 top-hat rail according to DIN EN 60715, e.g. in a control cabinet. The minimum distance between controllers is 10 mm.

i Position the controller so that the connections, controls and displays are not concealed.

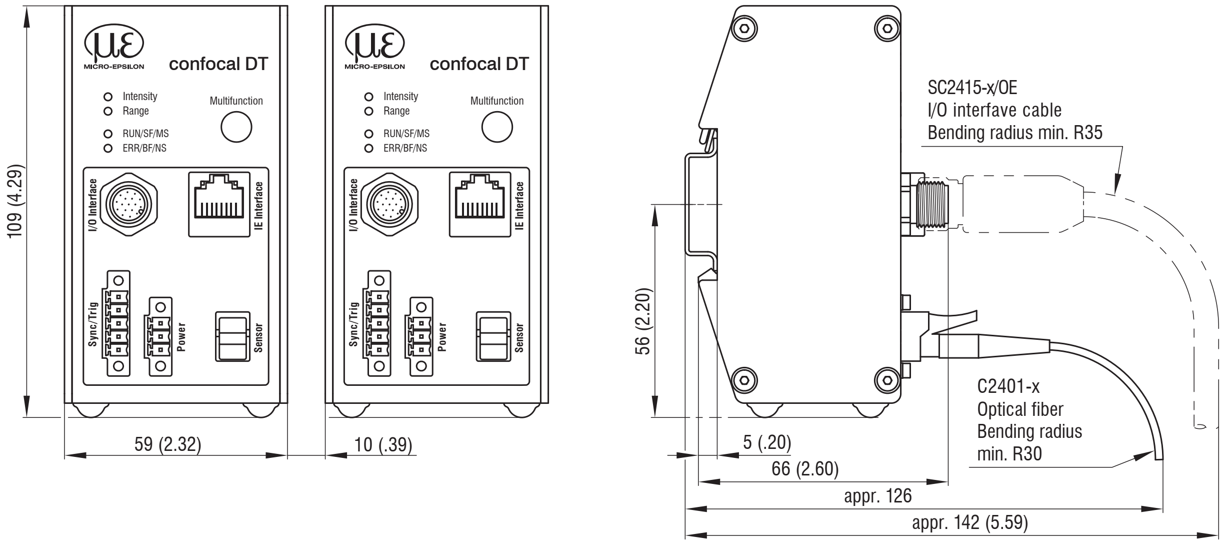


Fig. 19 IFC2411 dimensional drawing, dimensions *in mm*

4.3.2 Sensor Cable, Optical Fiber

The sensor is connected to the controller by means of an optical fiber.

- Do not shorten or extend the optical fiber.
- Do not pull or carry the sensor by the cable.
- The glass fiber has a diameter of 50 µm.

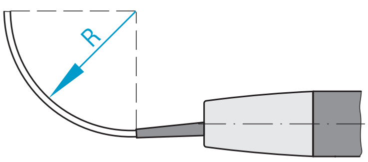
The connector must not be dirty under any circumstances, as this will cause particles to build up in the controller and severe loss of light. The plugs may only be cleaned by persons with the appropriate expertise using a fiber microscope for control.

General Rules

Do not

- getting the plugs dirty, e.g. through dust or fingerprints, and unnecessary plugging operations
- applying any mechanical stress to the optical fiber (bending, pinching, pulling, drilling, knotting, etc.)
- tight curvature of the cable, because the glass fiber is damaged in the process and this causes permanent damage through microscopic cracks

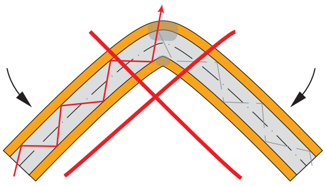
Never bend the sensor cable more tightly than the permitted bending radius.



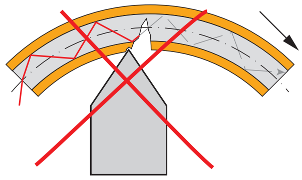
If the cable is immovably routed:
R = 30 mm or more

If the cable is movably routed:
R = 40 mm or more

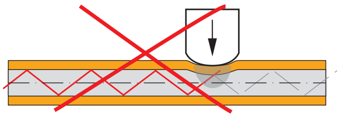
Do not kink the sensor cable.



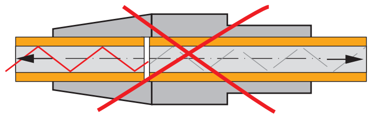
Do not pull the sensor cable over sharp edges.



Do not crush the sensor cable, do not use cable ties to secure it.

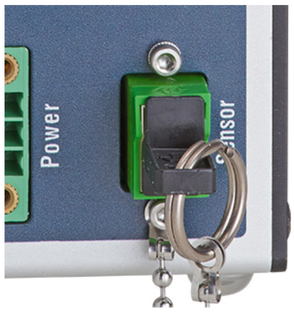


Do not pull on the sensor cable.



Connect sensor cable to controller

- Remove the dummy plug of the green optical fiber socket `sensor` on the controller.
- Plug the sensor cable with green plug (E2000/APC) into the optical fiber socket, making sure that the sensor connector is properly oriented.
- Insert the sensor plug until it locks into place.



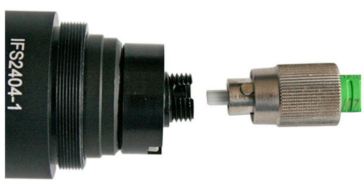
Connect sensor cable to controller

- Press down the release lever on the sensor plug and pull the sensor connector out of the socket.
- Re-insert the dummy plug.

Close the optical inputs/outputs with protective caps when no optical fiber cable is connected.

Connect sensor cable to sensor

- Remove the dummy plugs from the sensor and sensor cable.
- Insert the sensor cable into the optical fiber socket. Make sure that the sensor connector is properly oriented.
- Screw the sensor and sensor cable together with the knurled-head screw on the sensor cable.



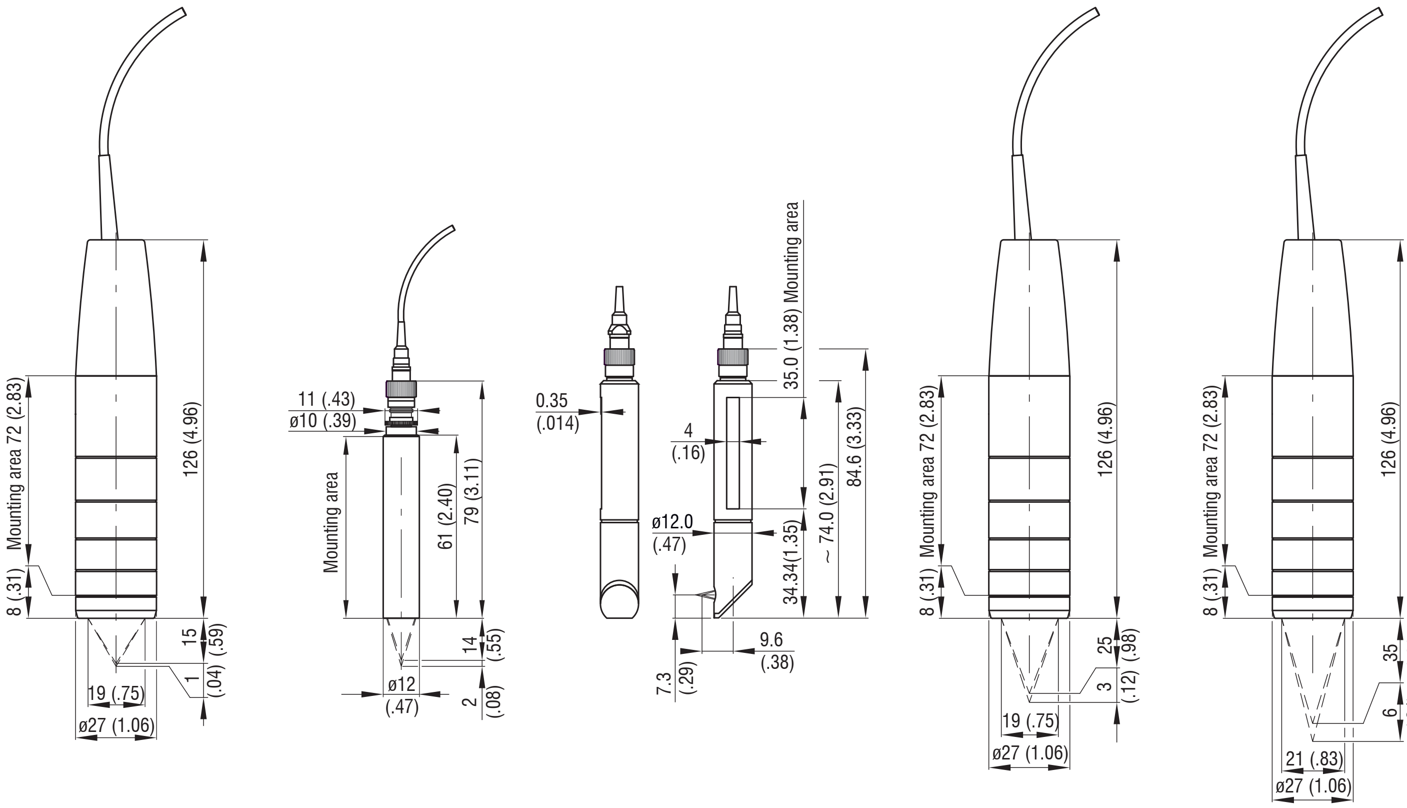
Pay attention to the orientation of the socket and guide lug.

Fig. 20 Groove of the socket on the sensor (left) and guide lug of an FC sensor plug (right)

Connect sensor cable to sensor

- Open the knurled-head screw on the sensor cable. Disconnect the sensor cable from the sensor.
- Stop up the sensor and sensor cable with the dummy plugs.

4.3.3 Dimensional Drawing of Sensors



IFS2404-1 IFS2404-2 IFS2404/90-2(001) IFS2404-3 IFS2404-6

4.3.4 Fastening, Mounting Adapter

4.3.4.1 General

The sensors measure in the nanometer range. Observe the maximum tilt between sensor and target.

i Ensure careful handling during installation and operation!

Fasten the sensors with a circumferential clamp. This type of sensor mounting ensures the highest level of reliability because the sensor's cylindrical housing is clamped over a relatively large area. It is essential to have in difficult installation situations, such as on machines, production lines, etc.

4.3.4.2 Circumferential Clamping

➡ Mount the IFS2404-1 (IFD2411-1), IFD2404-3 (IFD2411-3) and IFD2404-6 (IFD2411-6) sensors using an MA240x mounting adapter.

Mounting ring	Dimension A	Dimension B	Dimension C
MA2400-27	ø27	ø46	19.75

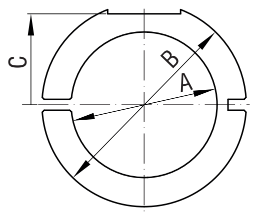


Fig. 21 Mounting ring MA2400-27

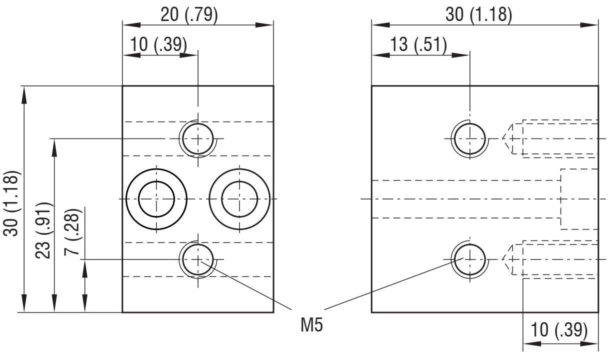


Fig. 22 Mounting block MA240x

➡ Mount the IFS2404-2 (IFD2411-2) sensors using an MA2404-12 mounting adapter.

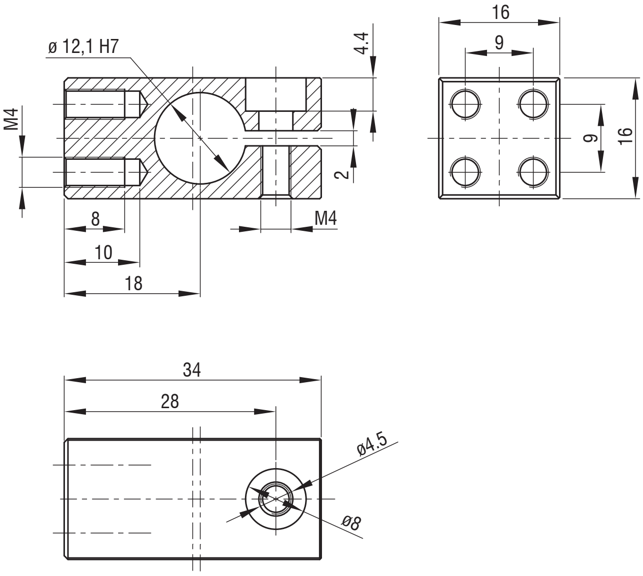


Fig. 23 Mounting block MA2404-12

4.3.5 Electrical Connections, Pin Assignment

Source	Cable/power supply	Interface	Terminal

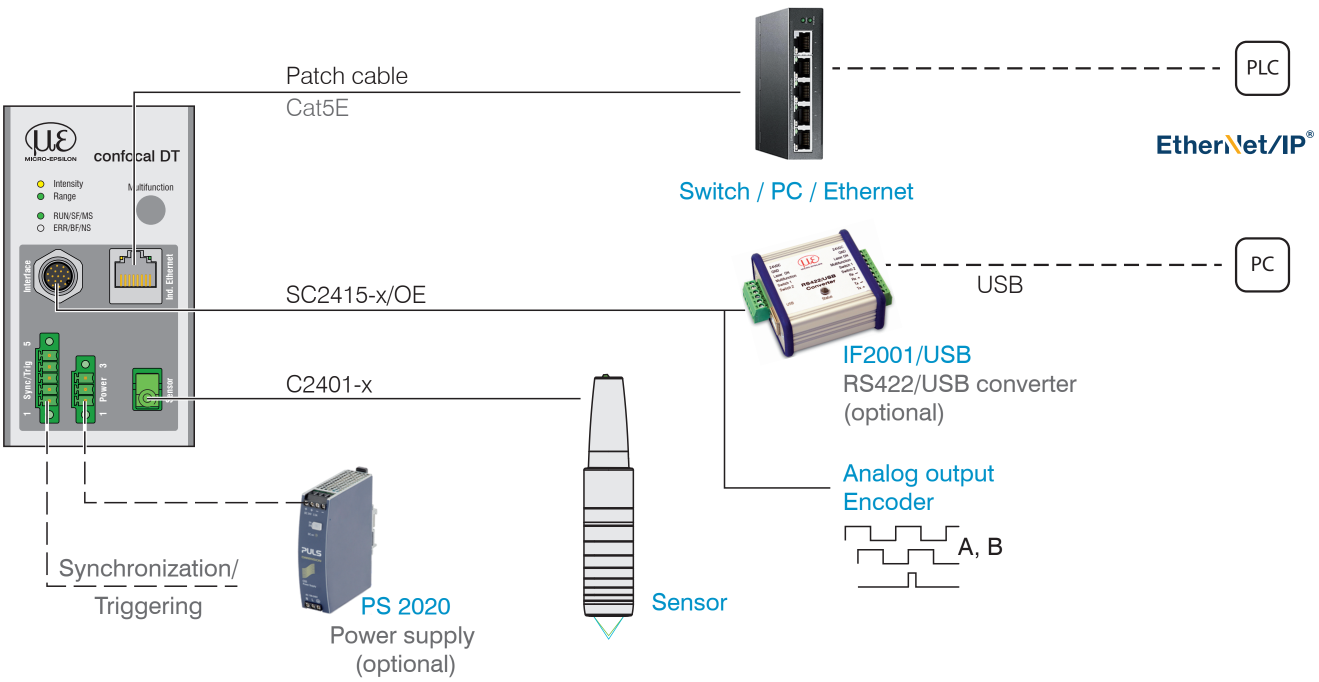
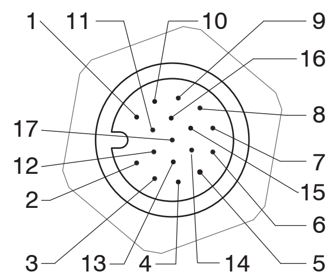


Fig. 24 Connection examples for confocalDT IFD2411

IFC2411, 17-pin connector		SC2415-x/OE
Signal	Pin	Wire color
Analog output	1	white, inside
Analog GND	2	black [1]
Data Tx-	3	black
Data Tx+	13	purple
n.c.	5	red
n.c.	14	Blue
Encoder 1B+	8	Gray
Encoder 1B-	15	Pink
Encoder 1Ref+	9	Green
Encoder 1Ref-	16	Yellow
Data Rx+	10	Brown
Data Rx-	11	White
Encoder 1A-	12	red/blue
Encoder 1A+	17	gray/pink
Shield	Housing	Black

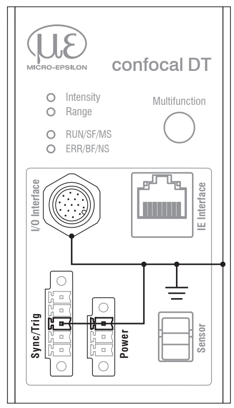
The SC2415-x/OE cable is available as an optional accessory.



17-pin sensor connector, pin side

Fig. 25 Pin assignment for 17-pin controller connector, pin side

4.3.6 Grounding Concept, Shielding



All inputs and outputs are galvanically connected to the power supply ground (`supply GND`); the Ethernet connections are potential-free.

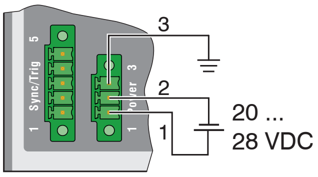
The ground connections (`supply GND` and `analog GND`) of each connection group are galvanically connected to one another by filters.

The shield connections of each connection group are only connected to the controller housing. They are used to connect the cable shieldings for individual connections (power, analog output, switching outputs, synchronization and trigger input).

i For reasons of interference resistance, use the corresponding GND connection for the analog output.
Only use shielded cables shorter than 30 m and connect the cable shield to the shield or the connector housings.

4.3.7 Supply Voltage (Power)

Nominal value: 24 V DC (20 ... 28 V, P < 7 W).



IFC2411 3-pin clamping sleeve	Power supply
1	V_+
2	GND
3	Shield

Only turn on the power supply after wiring has been completed.

Connect the inputs for pin 1 and pin 2 on the controller to a 24 V power supply.

i Power supply only for measuring devices, not to be used for drives or similar sources of pulse interference at the same time. MICRO-EPSILON recommends using the optionally available PS2020 power supply, for the sensor.

4.3.8 RS422

In addition to Industrial Ethernet, the IFC2411 also supports serial communication via RS422. The SC2415-x/OE cable enables serial communication. The IF2001/USB RS422-to-USB converter is available as an optional accessory.

- Differential signals to EIA-422, galvanically connected to supply voltage.
- Receiver Rx with 120 Ohm internal terminating resistor.

Use a shielded cable with twisted wires. Cable length less than 30 m.

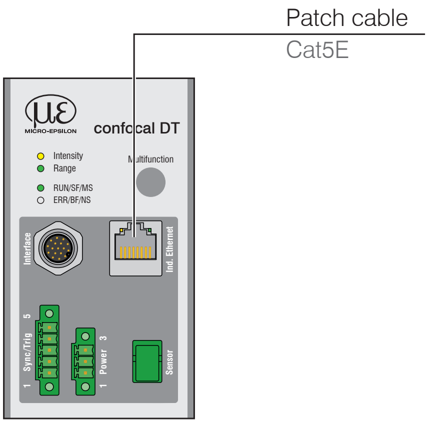
Connect the ground connections.

IFC2411 17-pin con-nector	Signal	SC2415-x/OE	IF2001/USB
3	Tx -	Black	Rx -
13	Tx +	Purple	Rx +
10	Rx +	Brown	Tx +
11	Rx -	White	Tx -
Housing	Shield	Cable shield	---

4.3.9 Ethernet, EtherNet/IP

Connection

- with an Ethernet network (PC) or
- with the bus system.



Connect the IFC2411 and network with a shielded Ethernet cable (Cat5E, 2 m patch cable from the scope of delivery, total cable length shorter than 100 m).

The two LEDs `MS` and `NS` indicate that the connection was successful and is active.

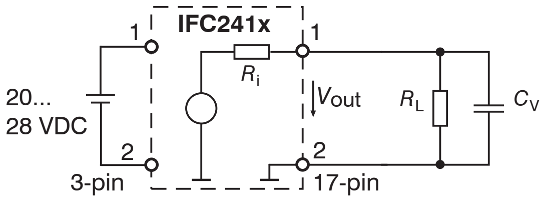
The measuring device can be configured via objects (EtherNet/IP), the web interface or by ASCII commands at command level (e.g. Telnet).

4.3.10 Analog Output

The alternative analog output (voltage or current) is connected to the 17-pin connector and is galvanically connected to the supply voltage.

IFC2411, 17-pin connector		**SC2415-x/OE**
Signal	Pin	Wire color
Analog output	1	White, inside
Analog GND	2	Black [1]
Shield	Housing	Black

Voltage: Pin V/I_{out} and Pin GND,

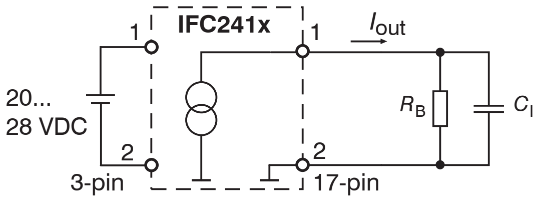


R_i approx. 50 Ohm, R_L > 10 MOhm

Slew rate (without C_V, $R_L \geq 1$ kOhm) typ. 0.5 V/µs

Slew rate (with C_V = 10 nF, $R_L \geq 1$ kOhm) typ. 0.4 V/µs

Current: Pin U/I_{out} and Pin GND



$R_B \leq 500$ Ohm

Slew rate (without C_I, R_B = 500 Ohm) typ. 1.6 mA/µs

Slew rate (with C_I= 10 nF, R_B = 500 Ohm) typ. 0.6 mA/µs

➡ Use a shielded cable. Cable length less than 30 m.

As an alternative, the output range can be set to the following values:

Voltage: 0 ... 5 V; 0 ... 10 V;

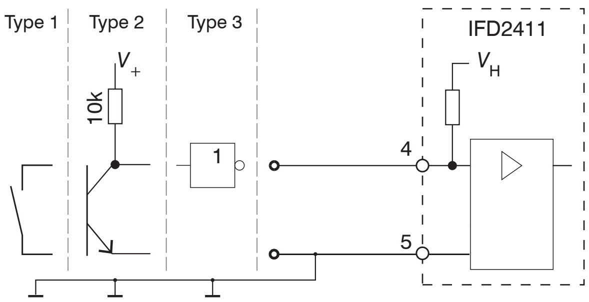
Current: 4 ... 20 mA.

The measured values can only be output as voltage or current.

1) Analog output in shielded cable area

4.3.11 Multifunction Input

A switching transistor with an open collector (e.g. in an optocoupler), a relay contact or a digital TTL or HTL signal are suitable for switching.



24V logic (HTL): Low ≤ 3 V; High ≥ 8 V (max 30 V),

5V logic (TTL): Low ≤ 0.8 V; High ≥ 2 V

Minimal pulse width 50 µs

Internal pull-up resistor, an open input is detected as High.

Maximum switching frequency 25 kHz

An external resistor is not required for current limitation. The ground of the logic circuit must be galvanically connected to the supply ground.

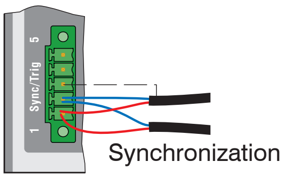
4.3.12 Synchronization (Inputs/Outputs)

4.3.12.1 General

- The `SYNC+` and `Sync-` pins on the 5-pin clamping sleeve: Symmetrical output/input for synchronization of two or more controllers
- The pin `multifunction input 1` on the 5-pin clamping sleeve: Input for synchronization of a controller with an external synchronization source, such as a function generator
- The termination resistor R_T (120 Ohm) can be switched on or off via software.

4.3.12.2 Internal Synchronization

One IFC2411 controller (master) synchronizes one or more controllers (slaves).



IFC2411 5-pin clamping sleeve	**Signal**	**Level**
1	Sync +	RS422
2	Sync -	RS422
3	Cable shield	
5	GND	

Fig. 26 Connections and signal level internal synchronization

➡ Activate the termination resistor (120 Ohm) in the last controller (slave n) in the chain.

Star synchronization

➡ Connect pins `Sync+` and `Sync-` from controller 1 (master) in a star shape to pins `Sync+` and `Sync-` from controller 2 (slave) to controller n, in order to synchronize two or more controller to one another, see Fig. 27

- Sub-loop length less than 30 m in star synchronization

Chain synchronization

➡ Connect pins `Sync+` and `Sync-` from controller 1 (master) to pins `Sync+` and `Sync-` from controller 2 (slave 1).
Connect the pins of the following controller to synchronize two or more controller to one another, see Fig. 27

- Total line length less than 30 m in chain synchronization

➡ Use shielded cables with twisted wires.

➡ Connect the cable shield to pin 3 of the 5-pin terminal block.

➡ Program controller 1 to `Master` and all other controller to `Slave`.

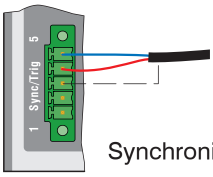
Fig. 27 Synchronization of multiple controllers, star-shaped on the left, daisy-chained on the right

➡ Connect all GND connections of the supply to one another if the controllers are not fed by a common power supply.

ℹ If the sensors are operated by way of the EtherNet/IP interface, then synchronization can also be achieved without the synchronization line.

4.3.12.3 External Synchronization Controller

An external synchronous source synchronizes one or more controller (slaves).



IFC2411 5-pin clamping sleeve	Signal	Level	
4	Multifunction	TTL Low Level ≤ 0.8 V; High Level ≥ 2 V Minimal pulse width 50 µs	HTL Low Level ≤ 3 V; High Level ≥ 8 V (max. 30 V) Minimal pulse width 50 µs
3	Cable shield		
5	GND		

Fig. 28 Connections and signal level external synchronization

➡ Activate the termination resistor (120 Ohm) in the last controller (slave n) in the chain.

Star synchronization

➡ Connect the `multifunction` pin of slave 1 to the external synchronization source.

➡ Connect the `GND` of the controller to the ground connection of the synchronization source.

Further controllers can be synchronized in the same schematic.

- Sub-loop length less than 30 m in star synchronization

➡ Use shielded cables with twisted wires.

➡ Connect the cable shield to pin 3 of the 5-pin terminal block.

➡ Program all controllers to `Slave`.

Fig. 29 Synchronization of multiple controllers, star-shaped

➡ Connect all GND connections of the supply to one another if the controllers are not fed by a common power supply.

i If the controllers are operated by way of the EtherNet/IP interface, then synchronization can also be achieved without the synchronization line.

4.3.13 Triggering

4.3.13.1 General

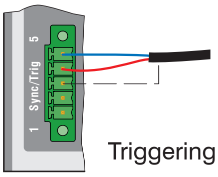
Data recording or output can be triggered with:

- the multifunction input,
- synchronization inputs Sync+ and Sync-,
- encoder 1.

➡ Use a shielded cable with twisted wires. Cable length less than 30 m.

Switching contacts, transistors (NPN, N-channel FET) or PLC outputs can be used as trigger sources.

4.3.13.2 Triggering with Multifunction Input



IFC2411 5-pin clamping sleeve	Signal	Level	
4	Multifunction	TTL Low Level ≤ 0.8 V; High Level ≥ 2 V Minimal pulse width 50 µs	HTL Low Level ≤ 3 V; High Level ≥ 8 V (max. 30 V) Minimal pulse width 50 µs
3	Cable shield		
5	GND		

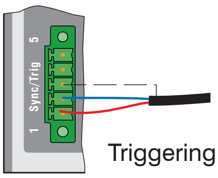
➡ Connect the `multifunction` pin to the external trigger source.

➡ Connect the `GND` of the controller to the ground connection of the external trigger source.

➡ Connect the trigger cable shielding to pin 3.

Program the controller's `multifunction` connection to the trigger input function.

4.3.13.3 Triggering with Synchronization Input



IFC2411 5-pin clamping sleeve	Signal	Level
1	Sync +	RS422
2	Sync -	RS422
3	Cable shield	

➡ Connect pin 1 (`Sync+`) and pin 2 (Sync-) to the external trigger source.

➡ Connect the trigger cable shielding to pin 3.

Program the controller's `multifunction` connection to the trigger input function.

➡ Connect pins `Sync+` and `Sync–` to the external trigger source.

Program the sensor's sync connections to the trigger input function.

The trigger source (master) must supply a symmetrical output signal according to the RS422 standard. For asymmetrical trigger sources, Micro-Epsilon recommends inserting the SU4 level converter (3 channels TTL/HTL to RS422) between trigger signal source and sensor.

4.3.13.4 Triggering with Input Encoder 1

A connected encoder at the input of encoder 1 can be used for triggering.

IFC2411, 17-pin connector				**SC2415-x/OE**
Signal	Pin	Level		Wire color
Encoder 1B+	8	RS422 (EIA422)		Gray
Encoder 1B-	15			Pink
Encoder 1A-	12			Red/blue
Encoder 1A+	17			Gray/pink

Program the controller’s encoder connections to the trigger input function.

4.3.14 Encoder Input

The measuring system supports one encoder.

Encoder inputs:

- Incremental signals A, B
- Reference pulse

The maximum pulse frequency is 1 MHz.

RS422 level (symmetrical) for A, B, Ref

The encoder supply is not provided.

Sensor, 17-pin connector			**SC2415-x/OE**
Signal	Pin		Wire color
Encoder 1B+	8		Gray
Encoder 1B-	15		Pink
Encoder 1Ref+	9		Green
Encoder 1Ref-	16		Yellow
Encoder 1A-	12		Red/blue
Encoder 1A+	17		Gray/pink

Fig. 30 Pin assignment for encoder input

➡ Use a shielded cable. Cable length shorter than 3 m. Connect the cable shield to the housing.

Connection conditions

- The encoders must supply signals with TTL level. .

4.3.15 Handling of the Plug-In Screw Terminals

The controller has two plug-in screw terminals for supply, synchronization and triggering. These are included as accessories.

➡ Remove the insulation of the connection wires (0.14 ... 1.5 mm^2) over a length of 7 mm.

➡ Connect the connection wires.

i The screw terminals can be fastened with two captured screws.

4.3.16 Dark Correction IFD2411

A dark correction must be carried out after the sensor or sensor cable is changed. Find the details on this in the `Commissioning` see Chap. 5 section.

4.4 LEDs

LED **Intensity** / Color / State			Meaning
	red	Flashing	Dark signal acquisition in progress
	red	On	Signal saturated
	yellow	On	Signal too low
	green	On	Signal OK
LED **Range** / Color / State			Meaning
	red	Flashing	Dark signal acquisition in progress
	red	On	No target present, outside of measuring range
	yellow	On	Target close to mid of measuring range
	green	On	Target within the measuring range
LED **MS** / Color / State			Meaning
		Off	No voltage: If the device is not supplied with voltage, the module status indication is constantly off.
	green	On	Device is functional: When the device is operating properly, the module status indication lights up constantly green.
	green	Flashing	Standby: If the device has not yet been configured, the module status indication flashes green.
	red	Flashing	Major Recoverable Fault: If the device has detected a Major Recoverable Fault, the module status indication flashes red. NOTE: An invalid or incoherent configuration is considered a minor error.
	red	On	Major Unrecoverable Fault: When the device has detected a Major Unrecoverable Fault, the module status indication will be constantly red.
	red / green	Flashing	Self test: While the device is performing its power up test, the module status indication flashes green/red.
LED **NS** / Color / State			Meaning
		Off	No voltage, no IP address: When the device has no IP address (or is powered off), the network status indication is constantly off.
	green	Flashing	No connections: An IP address was configured, but no CIP connection was established and no Exclusive Owner Connection had a timeout.
	green	On	Connected: An IP address has been configured. At least one CIP Connection was established and no Exclusive Owner Connection had a timeout.
	red	Flashing	Connection timeout: IP address was configured and an Exclusive Owner Connection, for which the device is the target, had a time out. The network status indication will return to permanently green when all Exclusive Owner Connections have been reestablished with timeout.
	red	On	IP address assigned twice: If the device has detected that its IP address is already in use, the network status indication will be constantly red.
	red / green	Flashing	Self test: While the device is performing its power up test, the network status indication flashes green/red.

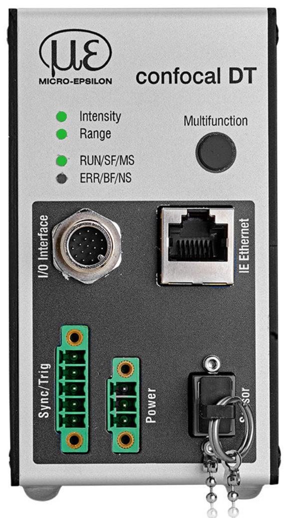


Fig. 31 Meaning of LEDs on measuring system

4.5 Correct and Multifunction Key

The `Correct` keys on the IFD241x or `Multifunction` keys on the IFC2411 are assigned for multiple functions. The key is assigned the `dark correction` function from the factory.

Function	Dark correction	*Dark correction starts*
	Factory settings	Resets the device and measurement settings to factory settings.

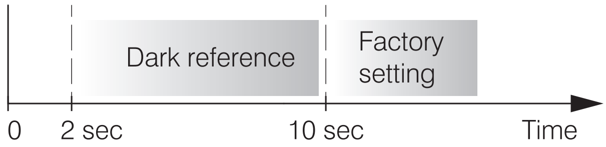


Fig. 32 `Correct` *key actuation time*

The key is not assigned a key lock from the factory. You can optionally deactivate or lock the key to prevent incorrect operation.

Set to factory setting: Hold the key for longer than 10 s.

5. Commissioning

5.1 Communication Options

i The measuring system is ready for operation approx. 3 s after the supply voltage is applied.
To ensure precise measurements, let the measuring system warm up for approx. 50 minutes.

The measuring system starts with the last saved operating mode. EtherNet/IP is standard.

i The measuring system is delivered in DHCP mode. A DHCP server is required, to assign an IP address to the measuring system. Subsequently, it is also possible to assign a static IP address.

A web server is implemented in the measuring system; the web interface displays, among other things, the current settings of the measuring system. Operation is only possible while there is an Ethernet connection to the measuring system.

Standard

EtherNet/IP Operation

➡ Integrate the device description file (EDS) into your PLC development environment.

You can find these online at:

- https://www.micro-epsilon.com/service/download/software-and-drivers/?sLang=en.

➡ Assign an IP address to the sensor.

With EtherNet/IP the web interface can be accessed without switching to the Ethernet setup mode.

➡ Start your web browser and type the IP address of the sensor into the address bar.

In addition to the website, you can also use the firmware update tool to install new firmware via Ethernet.

Further information for EtherNet/IP operation can be found here, see Chap. 8.

Alternative Communication

RS422 Communication

- Programming via web interface,
- Programming at command level, e.g. via Telnet,
- Parallel output of measurement data is possible via EtheNet/IP and RS422

➡ Connect the measuring system to a PC e.g. via an RS422 converter IF2001/USB from Micro-Epsilon via USB.

➡ Start the `sensorTOOL` program.

Download at https://www.micro-epsilon.de/download/software/sensorTOOL.exe.

➡ Click the `sensor` button.

The program searches for connected measuring systems.

➡ Select the desired measuring system. Click on the `Open website` button.

Saved settings remain residually in the measuring system and across interfaces, see Chap. 5.9.

5.2 Access via Web Interface

➡ Launch the web interface of the measuring system, see Chap. 5.1.

Interactive web pages for configuring the measuring system now appear in the web browser. The measuring system is active and provides measured values. Real-time measurement with the web interface is not guaranteed. The ongoing measurement can be controlled with the function buttons in the `chart type`.

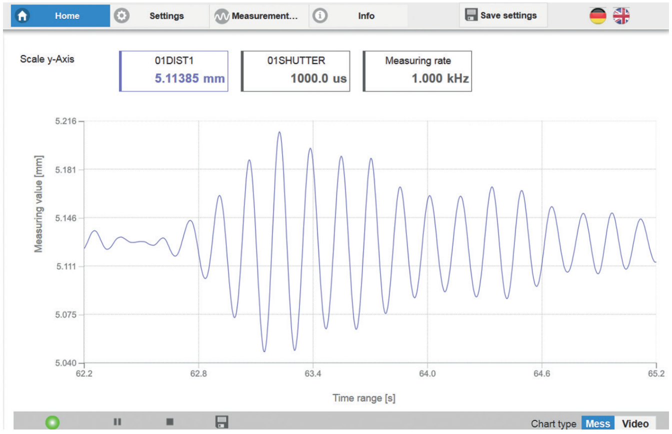


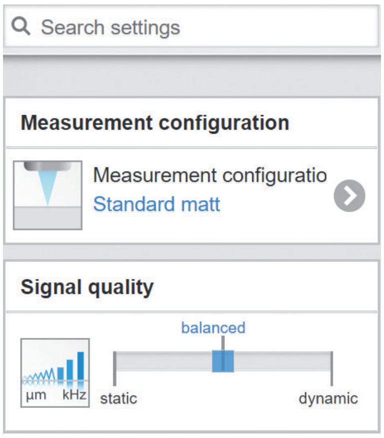
Fig. 33 Start page after accessing the web interface in Ethernet mode

You can switch between the video signal and a display of the measured values over time for configuration. The appearance of the web sites can change depending on the functions. Dynamic help texts with excerpts from the operating instructions aid you in configuring the measuring system.

ℹ Depending on the selected measuring rate and the PC used, there may be a dynamic reduction of the measured value in the display. This means that not all measured values are sent to the webinterface for display and saving.

The horizontal navigation contains the following functions:

- `Home`. The web interface automatically starts in this view with measurement chart, `measurement configuration` and `signal quality`.
- `Settings`. Configuration parameters, including triggering, measuring rate and zeroing/mastering.
- `Measurement chart`. Measurement chart or show video signal.
- `Info`. Contains information on the sensor, including measuring range, serial number and software version.
- Web interface language selection

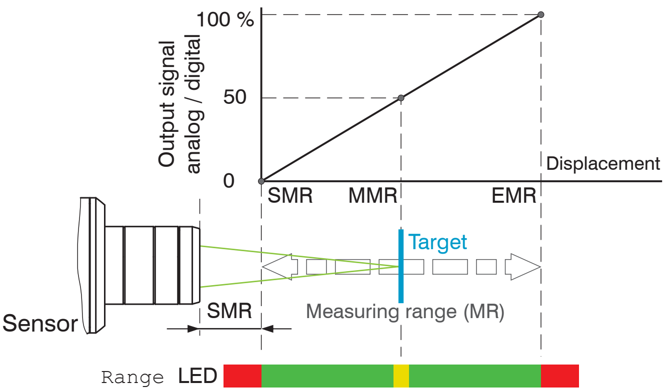


The vertical navigation is related to the context of the selection in the horizontal navigation and contains the following functions for the `Home` menu:

- The `Find settings` function enables time-saving access to functions and parameters.
- `Measurement configuration`. Enables selection of predefined measurement settings.
- `Signal quality`. You can switch between three predefined basic settings for the measuring rate and averaging with a mouse click.

5.3 Positioning the Target

➡ Position the target as centrally as possible within the measuring range.



LED Range	
Red	No target present or target outside of measuring range
Yellow	Target close to mid of measuring range
Green	Target within the measuring range

The `Range` LED on the front of the measuring system indicates the position of the target relative to the sensor.

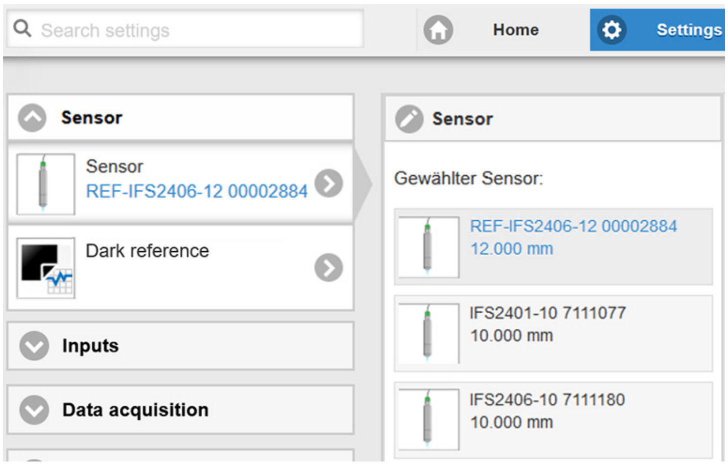
5.4 Select Sensor

The function is valid for the IFD2411 measuring system.

Controller and sensor(s) are coordinated to one another at the factory.

➡ Go to the `Settings > Sensor` menu.

➡ Select the required sensor from the list.

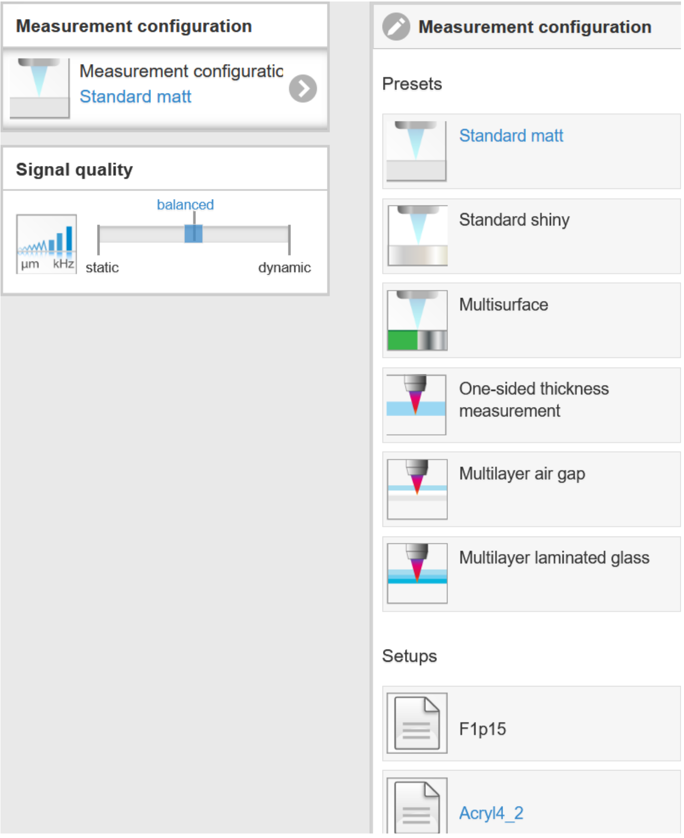


The calibration data of up to 20 different sensors can be saved in the controller. Calibration is only possible at Micro-Epsilon.

5.5 Presets, Setups, Measurement Configuration Selection

Definition

- Preset: Manufacturer-specific program containing settings for common measuring tasks that cannot be overwritten
- Setup: User-specific program containing the relevant settings for a measuring task
- Initial setup upon boot-up (start measuring system): a favorite setting which is automatically activated upon start-up can be selected from the setups. If no favorite is selected from the setups, the measuring system activates the `Standard` preset upon start-up.



Upon delivery of the measuring system from the factory:

- the presets `Standard`, `Standard shiny`, `Multisurface` and `One-sided thickness measurement` are available
- for the IFD2415 sensor, the presets `Multilayer airgap` and `Multilayer laminated glass` are additionally available,
- no setup is present.

You can select a preset in the tab

`Home` > `Measurement configuration`

You can select a setup in the tab

`Home` > `Measurement configuration` or

`Settings` in menu `System Settings` > `Load & Save`

A setup can be permanently saved in the measuring system.

These presets allow for a quick start in the individual measuring task. Basic features to suit the target surface, such as peak and material selection and the calculation functions are already set in the preset.

Standard matt	Distance measurement e.g. for ceramic material, non-transparent plastics. Highest peak, averaging, distance calculation.
Standard shiny	Distance measurement e.g. for metal, polished surfaces. Highest peak, median over 5 values, distance calculation.
Multisurface	Distance measurement e.g. for PCBs, hybrid materials. Highest peak, median over 9 values, distance calculation.
One-sided thickness measurement	One-sided thickness measurement e.g. against glass, material BK7. First and second peak, averaging, thickness calculation.
Multilayer air gap	One-sided thickness measurement [1] against glass, 1st layer BK7, 2nd layer vacuum, first and second peak, 3 measured values, median over five values, moving averaging over 16 values, thickness calculation.
Multilayer laminated glass	Layer thickness measurement [1] against laminated glass e.g. windshield, 1st layer BK7, 2nd layer PC, 3rd layer BK7, first and second peak, 4 measured values, thickness calculation, moving averaging over 16 values.

1) Possible in IFD2415.

5.6 Video Signal

➡ Go to the `Measurement chart menu`. Show video signal display with `Video`.

The diagram in the large graphic window on the right shows the video signal of the receiver line in different post-processing states.

The video signal in the graphics window shows the spectral distribution over the pixels of the receiver line. Left 0 % (small distance) and right 100 % (large distance). The corresponding measured value is marked by a vertical line (peak marking).

The diagram starts automatically when the website is accessed.

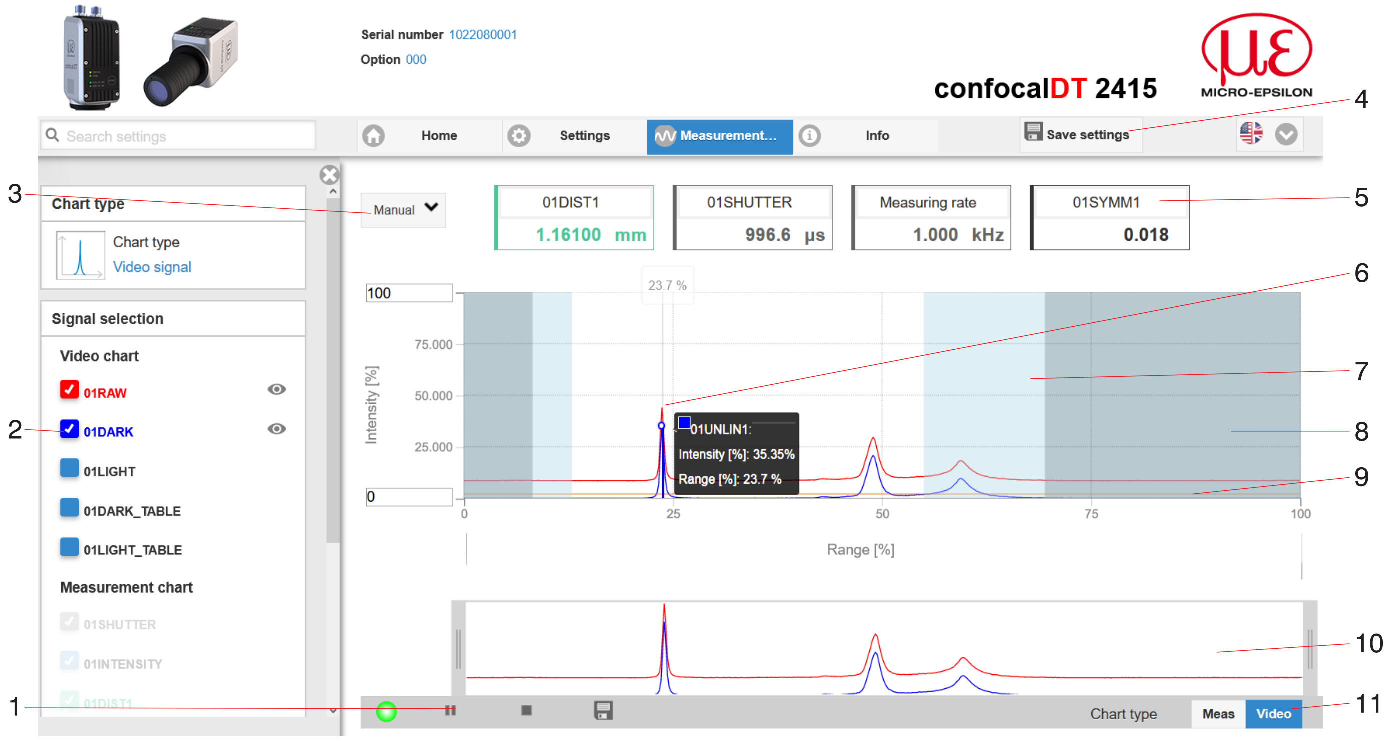


Fig. 34 `Video signal` *website*

The `Video Signal` website contains the following functions:

1 The LED visualizes the state of measurement value transmission.

- green: measured value transmission in progress
- yellow: waiting for data in trigger state
- gray: measured value transmission paused

The data query is controlled with the `Play/Pause/Stop/Save` buttons of the measured values transmitted. `Stop` stops the diagram; you can still continue to use the data selection and zoom functions. `Pause` pauses the recording. `Save` opens the Windows selection dialog for the file name and the save location to save the selected video signals to a CSV file. This contains all pixels, their (selected) intensity in % and other parameters.

➡ Click on the button ▶ (Start), display the measurement results.

2 In the left-hand window, the video curves to be displayed can be switched on or off during or after the measurement. Inactive curves are grayed out and can be added by clicking on the check mark. The changes become effective when you save the settings.
You can show or hide the individual signals using the eye symbols 👁. The calculation continues in the background.

- 0xRAW: Raw signal (uncorrected CCD signal)
- 0xDARK: Dark corrected signal (raw signal minus dark level table)
- 0xLIGHT: Light corrected signal (dark corrected signal corrected with the light source table)
- 0xDARK_TABLE: Dark value table (generated in response to dark referencing)
- 0xLIGHT_TABLE: Light value table (generated in response to light referencing)

3 To scale the intensity axis in the graph for the measured values (Y axis), you can use `Auto` (= automatic scaling) or `Manual` (= manual scaling).

4 All changes only become effective when you click on the `Save settings` button.

5 The current values, such as exposure time and selected measuring rate, are additionally displayed above the graphic.

6 Mouseover function. Moving the mouse over the graph, marks curve points or the peak marking with a circle symbol and displays the corresponding intensity. The corresponding x-position in % appears above the graph field.

7 The range of interest can be restricted if ambient light of a certain wavelength (blue, red, IR) causes interference in the video signal, for example. The value for the “Start of range” must be less than the value for the “End of range”. Value range between 0 and 100 %.

8 The linearized range lies between the gray shades in the diagram and cannot be changed. Only peaks whose middles lie within this range can be calculated as a measured value. The masked area can be restricted if necessary and is then limited by an additional light blue shading on the right and left. The peaks remaining in the resulting range are used for the evaluation.

9 The detection threshold, in relation to the dark corrected signal, is a horizontal straight line corresponding to the preselected value. It should be just high enough so that no unwanted peaks in the video signal are included in the evaluation. Aim for the lowest possible threshold to get a good signal-to-noise ratio. The detection threshold should not be changed if possible.

10 X axis scaling: The diagram shown above can be enlarged (zoomed in on) with the two sliders on the right and left in the lower entire signal. It can also be moved sideways with the mouse in the middle of the zoom window (four-sided arrow).

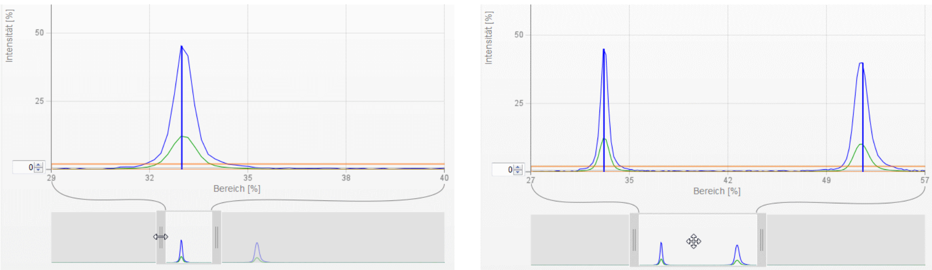


Fig. 35 Zooming with slider: one-sided or shifting range with four-sided arrow

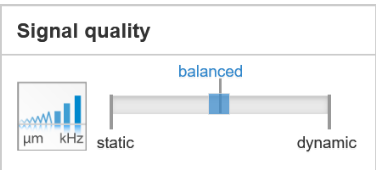
11 The two buttons allow you to switch between the display of the video signal and the measured value.

5.7 Signal Quality

A good measurement result can be achieved if the video signal is sufficiently intense. Reducing the measuring rate increases the exposure time for the CCD row and thus improves the measurement quality.

You can switch between three basic settings (Static, Balanced and Dynamic) in the `Signal quality` section. The reaction in the chart and system configuration is immediately visible.

➡ Go to the `Home` > `Signal quality` menu and adjust the measurement dynamics as required. Monitor the result in the video signal.



	Measuring rate	**Averaging** [1]
`Static`	200 Hz	Moving, 128 values
`Balanced`	1 kHz	Moving, 16 values
`Dynamic`	5 kHz	Moving, 4 values

i If the sensor starts up with a user-defined configuration (Setup), see Chap. 5.5, the signal quality cannot be changed.

1) Applies to the presets `Standard` and One-sided thickness measurement.

5.8 Distance Measurement with Website Display

➡ Align the sensor perpendicularly to the object to be measured.

➡ Then, remotely, move the sensor (or the target) closer and closer until the start of the measuring range for the relevant sensor is approximately reached.

As soon as the object is within the measuring field of the sensor, this is shown by the `Range` LED (green or yellow). Alternatively, you can watch the video signal.

LED	Status	Description
Intensity	Red	Signal saturated
	Yellow	Signal too low
	Green	Signal OK
Range	Red	No target or target outside of measuring range
	Yellow	Target in center of measuring range
	Green	Target within the measuring range

Fig. 36 Meaning of LEDs during distance measurement

Opening `Measurement Chart >` Chart type `Measure` opens the following website. The chart starts automatically when the website is accessed. The diagram in the large graphic window on the right shows the measured value-time diagram.

Fig. 37 `Measurement` *(distance measurement) web page*

1 The LED visualizes the state of measured value transmission.

- green: measured value transmission in progress
- yellow: waiting for data in trigger state
- gray: measured value transmission paused

The data query is controlled with the `Play/Pause/Stop/Save` buttons of the measured values transmitted. `Stop` stops the diagram; you can still continue to use the data selection and zoom functions. `Pause` pauses the recording. `Save` opens a Windows selection dialog for the file name and save location to save the last 10,000 values in a CSV file (separation using semicolon).

➡ Click on the button ▶ (Start), display the measurement results.

2 In the left-hand window, the signals of channel 1/2 to be displayed can be switched on or off during or after the measurement. Inactive curves are grayed out and can be added by clicking on the check mark. The changes become effective when you save the settings.
You can show or hide the individual signals using the eye symbols. The calculation continues in the background.

- 0xSHUTTER: Exposure time
- 0xINTENSITY: Signal quality of the underlying peak in the video signal
- 0xDIST: Distance signal curve over time

3 To scale the axis in the graph for the measured values (Y axis), you can use `Auto` (= automatic scaling) or `Manual` (= manual scaling).

4 All changes only become effective when you click on the `Save settings` button.

5 Current values for distance, exposure time, current measuring rate and time stamp are shown in the text boxes above the graph. Errors are also displayed.

6 Mouseover function. When the chart has been stopped and you move the mouse over the graph, points on the curve are marked with a circle and the associated values are displayed in the text boxes above the graph. The intensity bars are also updated.

7 Peak intensity is displayed as a bar chart.

8 X axis scaling: During an ongoing measurement, you can use the left-hand slider to enlarge the entire signal (zoom). The time range can also be defined using an input field under the time axis. When the chart has been stopped, the right-hand slider can also be used. You can also move the zoom window with the mouse in the center of the zoom window (four-sided arrow).

5.9 Save/Load Settings

This menu enables you to save current device settings in the controller or activate saved settings. You can permanently save eight different parameter sets in the controller.

Unsaved settings will be lost when the device is switched off. Save your settings in Setups.

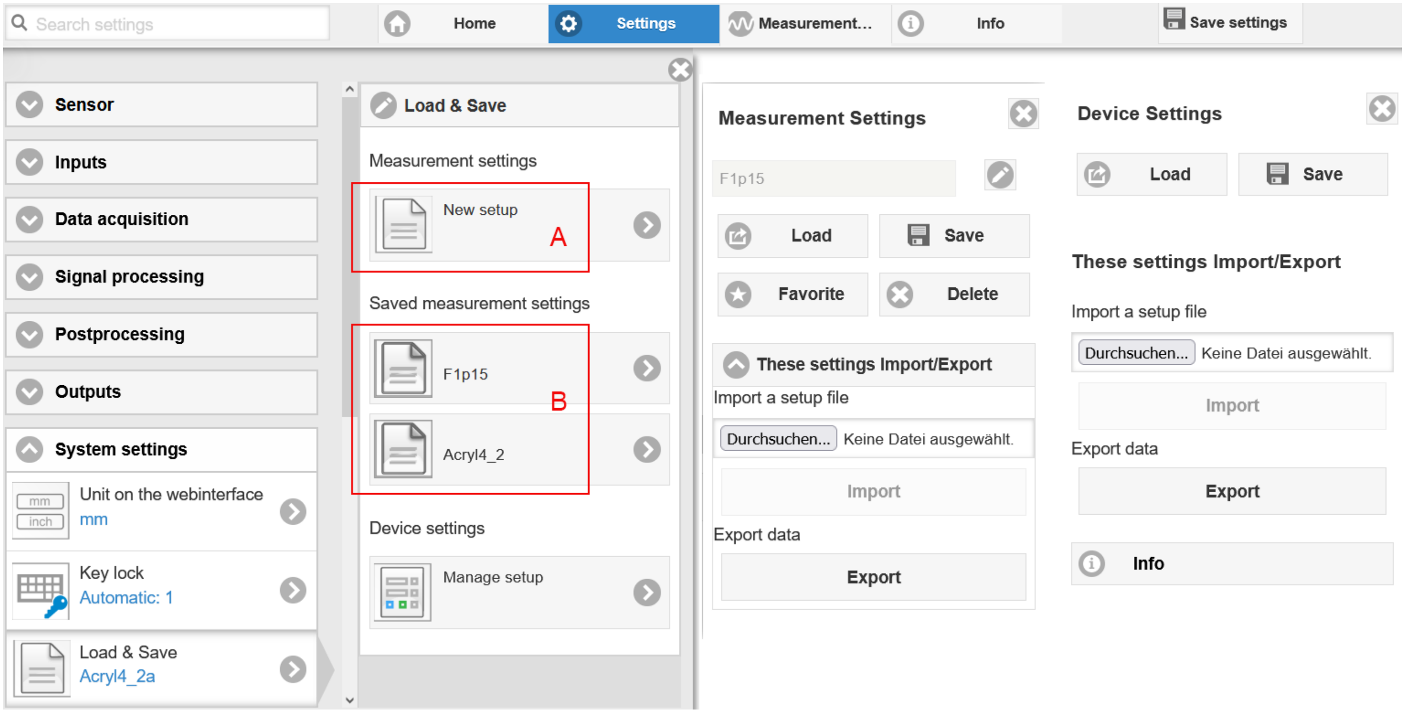


Fig. 38 Manage user programs

➡ Switch to the `Settings > Load & Save` menu.

Manage setups in the controller, options and sequence			
Saving the Settings	**Existing setup active**	**Save change in active setup**	**Determine setup after booting**
Menu `New Setup`, Range A	Menu `Load & Save`	Menu bar	Menu `Load & Save`
➡ Enter the name for the setup in the `Individual setup name` field, such as F1p15, and confirm the entry with the `Save` button.	➡ Click on the desired setup with the left mouse button, area B. The `Measurement Settings` dialog will open. ➡ Click on the `Load` button.	➡ Click on the `Save settings` button.	➡ Click on the desired setup with the left mouse button, area B. The `Measurement Settings` dialog will open. ➡ Click on the `Favorite` button.

The current settings will also be available in the controller after it has been switched off/on.

You can also use the `Save Settings` button at top right, in each settings page as quick cache for the last parameter set saved.

i The last parameter set saved in the controller is loaded when switched on.

Switch setups with PC/notebook, options	
Save setup on PC	**Load setup from PC**
Menu `Load & Save`	Menu `Load & Save`
➡ Click on the desired setup with the left mouse button, area B. The `Measurement Settings` dialog will open. ➡ Click on the `Export` button.	➡ Click on `Create setup` with the left mouse button. The `Measurement Settings` dialog will open. ➡ Click on the `Search` button. A Windows dialogue for file selection opens. ➡ Select the desired file and click the `Open` button. ➡ Click on the `IMPORT` button.

5.10 Dark Correction

The measuring system requires a warm-up time of approx. 30 min. before performing dark correction.

A dark correction is required after:

- Replacing a sensor
- Replacing a sensor cable
- Prolonged operating period, sensor getting dirty

The dark correction depends on the sensor and is saved separately in the controller for each measuring system. For that reason, the desired sensor must be connected before correction. For the IFD2411, the sensor must be selected in the `Settings > Sensor` menu.

Work steps:

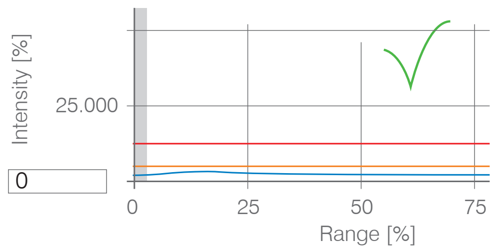
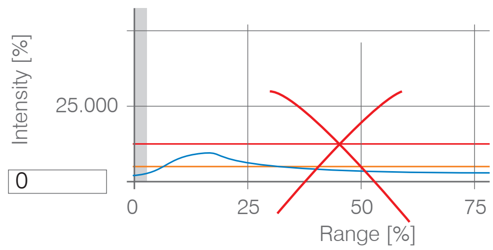
➡ Remove the target from the measuring range or cover the sensor front with a piece of dark paper.

i During the dark correction, there must be no objects within the measuring range nor ambient light reaching the sensor under any circumstances.

Correction with key function		Correction via software/web interface
IFD2410/2415	IFD2411	
➡ Press the `Correct` key on the IFD2410/2415 for approx. 4 s [1] in order to start the correction.	➡ Press the `multifunction` key on the IFC2411 for approx. 4 s in order to start the correction.	➡ Switch to the `Settings > Sensor > Dark correction` menu. ➡ Click on the `Start` button to start the correction.

The LEDs `Intensity` and `Range` start to flash. The sensor now records the current dark signal for about 50 s.

The dark corrected video signal after the adjustment is characterized by a signal curve that is an almost smooth directly at the X axis.

IFD2410/2415	Dark signal evaluation	IFD2411
➡ Remove the paper cover from the sensor. This sensor can be used normally again.	 Dark signal OK	➡ Remove the paper cover from the sensor. This sensor can be used normally again.
➡ Carefully clean the glass surface on the sensor. ➡ Repeat the dark correction.	 Dark signal too high	➡ Carefully clean the front surface of the E2000 connector of the sensor cable. ➡ Repeat the dark correction.

With each new dark correction, the current brightness value is determined as the quotient of the sum of all intensities and the current exposure time. If a major change is detected from the previously saved value, this can be interpreted as a degree of contamination and a warning is given.

You can also ignore this message. For time-critical measurements, however, you should remember the current exposure time.

1) If the key is pressed for more than 10 seconds, the factory setting is loaded.

Exclusively use pure alcohol and fresh lens cleaning paper for cleaning.

If cleaning the components does not have the desired result, the sensor cable may also have been damaged or the fiber connector in the controller may have become dirty.

Replace the sensor cable or send the entire system in for inspection.

You can use an ASCII command to set the warning threshold for contamination if required

- permissible deviation in %,
- the factory setting is 50 %.

The warning threshold is saved so that it is specific to the setup.

6. Set Sensor Parameters, Web Interface

6.1 Inputs

6.1.1 Synchronization

➡ Switch to the `Settings` tab in the `Inputs` menu.

Synchronization	*Master / Slave / Multifunction input 1 / Multifunction input 2*	*If multiple measuring systems are to measure the same target at the same time, the controllers can be synchronized with one another. The synchronization output of the first controller (master) controls the controllers (slaves) connected at the synchronization inputs*, see Chap. 4.2.11, see Chap. 4.3.12.
	Inactive	

If the measuring system is operated by way of a PLC, then synchronization can also be achieved without the synchronization line.

6.1.2 Encoder Inputs

6.1.2.1 Overview, Menu

The IFD2410/2415 supports up to three encoders, see Chap. 4.2.13.

The IFD2411 supports one encoder, see Chap. 4.3.14.

A maximum of three encoder values can be assigned to the measuring data exactly, output and also used as triggering condition. This exact assignment to the measured values is ensured by the fact that precisely those encoder values are output that were present in half of the exposure time of the measured value (the exposure time can vary due to the regulation). Tracks A and B enable direction recognition. Each of the encoders can be set separately.

Number of Encoders	1 / 2 / 3	
Encoder 1 / 2	Interpolation	*single / double / quadruple resolution*
	Maximum Value	*Value*
	Effect on Reference Track	*no effect / set once for mark / set for all marks*
	Set to Value	*Value*
	Set encoder value via software	
	Reset the detection of the first reference mark	

Encoder 3	Interpolation	*single / double / quadruple resolution*
	Maximum Value	*Value*
	Effect on Reference Track	*no effect*
	Set to Value	*Value*
	Set encoder value via software	
	Reset the detection of the first reference mark	

6.1.2.2 Number of Encoders

The number of encoders determines how many of the encoders are used. With 2 encoders, data output via RS422 and synchronization cannot be used. With 3 encoders, the reference tracks of encoder 1 and encoder 2 cannot be used.

Fields with gray background require a selection.

Value Fields with dark border require entry of a value.

6.1.2.3 Interpolation

Interpolation increases the resolution of an encoder. The counter reading is incremented or decremented with each interpolated pulse edge.

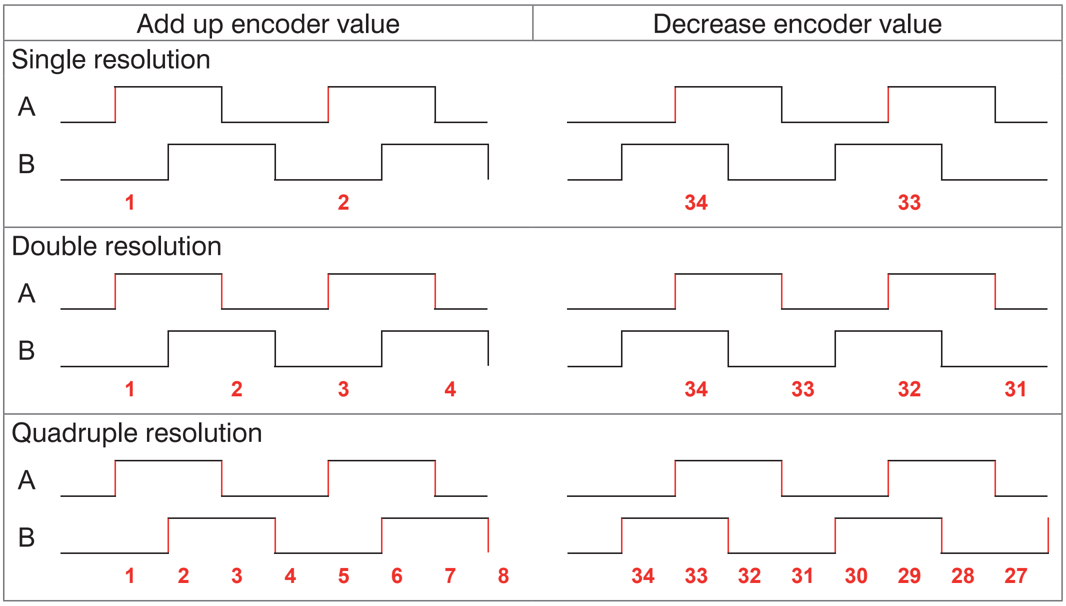


Fig. 39 Pulse image encoder signals

6.1.2.4 Maximum Value

If the encoder exceeds this maximum value, the encoder counter restarts the count at zero. This could be the pulse count of an encoder without zero pulse (reference track). The maximum counter reading before an overflow is 4,294,967,295 (2^32-1).

6.1.2.5 Effect of Reference Track

`No effect`. The encoder counter keeps on counting; the resetting takes place when the controller is switched on or when the `Set to value` button is pressed.

`One-time setting to value at marker`. Sets the encoder counter to the defined value when the first reference marker is reached. The first mark after the controller is switched on applies; without it being switching off, the marker only applies after pressing the `Use next marker` button.

`Set for all marks`. Sets the encoder counter to the starting value for all marks or when the marker is reached again, e.g. for traversing movements.

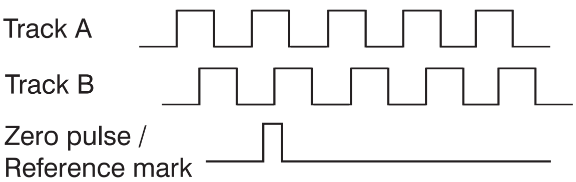


Fig. 40 Reference signal of an encoder

6.1.2.6 Set to Value

This function sets the encoders to this value

- every time the controller is switched on,
- with the `Set to value` button.

The start value must be less than the maximum value and is max. 4,294,967,294 (2^32-2).

6.1.2.7 Reset Reference Marker

Resets the reference marker detection.

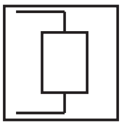
6.1.3 Level Function Inputs

The level must be selected for the inputs:

- Synchronization
- Multifunction

Input level	*TTL / HTL*	*Defines the input level for the input stages.* *TTL: Low ≤ 0.8 V, High ≥ 2 V* *HTL: Low ≤ 3 V; High ≥ 8 V*

6.1.4 Terminating Resistor



The terminating resistor at the Sync/Trig synchronization input is switched on or off to avoid reflections.
On: With terminating resistor
Off: No terminating resistor

The terminating resistor with 120 Ohm must be activated in the last slave.

Fields with gray background require a selection.

Value Fields with dark border require entry of a value.

6.2 Data Recording

6.2.1 Measuring Rate

IFD2410/2411: The measuring rate can be set continuously in a range from 0.1 kHz to 8 kHz. The increment is 1 Hz.

IFD2415: The measuring rate can be set continuously in a range from 0.1 kHz to 25 kHz. The increment is 1 Hz.

The selection of the measuring rate is made in the menu `Settings` > `Data recording` > `Measuring rate`.

➡ Select the desired measuring rate.

Observing the video signal is useful for selecting the measuring rate.

Procedure:

➡ Position the target in the middle of the measuring range, see Fig. 41. Keep adjusting the measuring rate until you get a high signal intensity that is not oversaturated.

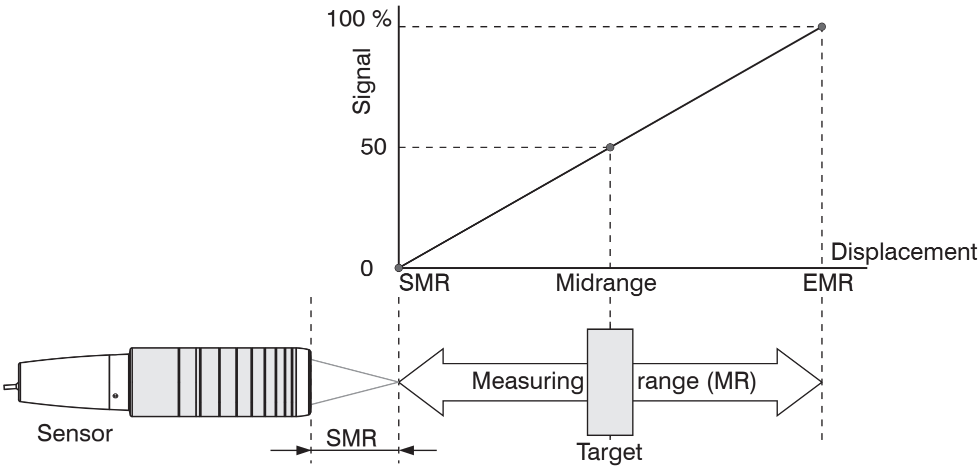


Fig. 41 Defining measuring range and output signal

➡ To do this, observe the `Intensity` LED.

LED	Status	Description
Intensity	Red	Signal saturated
	Yellow	Signal too low
	Green	Signal OK

- If the `Intensity` LED changes to red, increase the measuring rate.
- If the `Intensity` LED changes to yellow, increase the measuring rate.

➡ Choose a measuring rate that makes the `Intensity` LED light up green.

➡ If necessary, change the exposure mode, use the `manual mode,` see Chap. 6.2.5

➡ Use the required measuring rate, and adjust the exposure time. Or let the exposure time define possible measuring rates.

If the signal is low (`Intensity` LED is yellow) or saturated (`Intensity` LED is red), the controller will carry out measurements, but measuring accuracy might not correspond to the specified technical data.

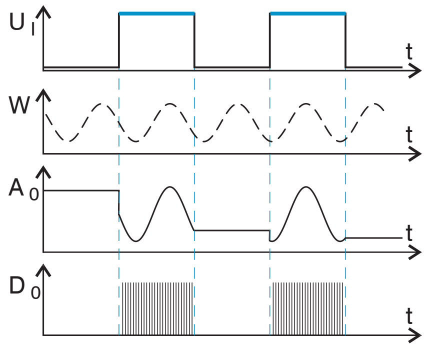
6.2.2 Triggering Data Acquisition

6.2.2.1 General

The data recording on the confocalDT IFD241x can be controlled using an external electrical trigger signal or commands.

- The triggering does not affect the preselected measuring rate.
- Factory setting: no triggering, the controller starts with the data transmission output immediately after being switched on.
- The pulse of the trigger signal is at least 5 µs.

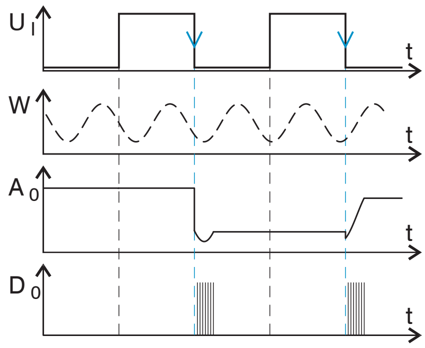
Sync / Multifunction input 1 / 2	Trigger type	*Level*	Trigger level	Low / falling edge	
		Edge	Trigger level	High / increasing edge	
			Number of measured values	*manual selection*	*Value*
				infinite	
Software			Number of measured values	*manual selection*	*Value*
				infinite	
Encoder 1			Lower limit		*Value*
			Upper limit		*Value*
			Increment		*Value*
Inactive			*Continuous data recording*		



`Level triggering`. Continuous data recording/output as long as the selected level is present. After that, the controller stops the data recording. The pulse duration must be at least as long as one cycle. The subsequent pause must also be at least as long as one cycle.

W = Displacement signal

Fig. 42 Triggering with active high level (U_I), associated analog signal (A_0) and digital signal (D_0)



`Edge triggering`. Starts measured value input/output as soon as the selected edge is active to the trigger input. The pulse must be at least 5 µs.

Fig. 43 Triggering with falling edge (U_I), associated analog signal (A_0) and digital signal (D_0)

`Software triggering`. Starts data recording as soon as a software command (instead of the trigger input) or the `Initiate trigger` button is activated.

`Encoder triggering`. Starts the data recording through Encoder 1.

6.2.2.2 Triggering Measured Value Acquisition

The current array signal is only processed and measured values are calculated from it after a valid trigger event. The measurement data is then transferred for further calculation (e.g. averaging), as well as the output via a digital or analog interface.

When calculating averages, measured values immediately before the trigger event cannot be included; instead older measured values are used, which had been entered during previous trigger events.

Fields with gray background require a selection.	*Value* Fields with dark border require entry of a value.

6.2.2.3 Trigger Time Difference

Since the exposure time is not started directly by the trigger input, the respective time difference to the measurement cycle can be output. This measured value can, for example, serve to accurately assign measurements to one place, when measuring objects are scanned at a constant speed and when each track starts with a trigger pulse.

The time from the start of the cycle until the trigger event is defined as a trigger time difference. The output of the time determined occurs 3 cycles later, due to the internal processing.

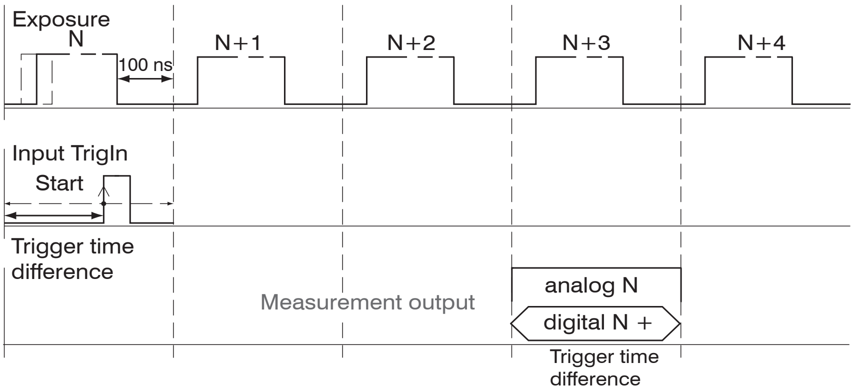


Fig. 44 Definition of the trigger time difference

i The start of the cycle does not mean the start of the exposure time. There is only a fixed difference of 100 ns between the start of the cycle and the end of the exposure time.

6.2.3 Reset Counter

The measured value counter can be used to check if the data are output completely or if a package is missing. Counting begins at zero. Time stamps and measured value counter can be reset by pressing the respective button.

6.2.4 Range of Interest Masking

Masking limits the range that the video signal uses for distance or thickness calculations. This feature is used, for example, if ambient light with certain wavelengths (blue, red, IR) causes video signal interference. It is also possible to mask the background if it reaches into the measuring range.

Masking (start and end) is entered into the two boxes on the left (in %). The factory settings are 0 % (start) and 100 % (end).

i If you limit the video signal area, a peak is detected only if it lies completely within the masked area, i. e. above the threshold. This can reduce the measuring range.

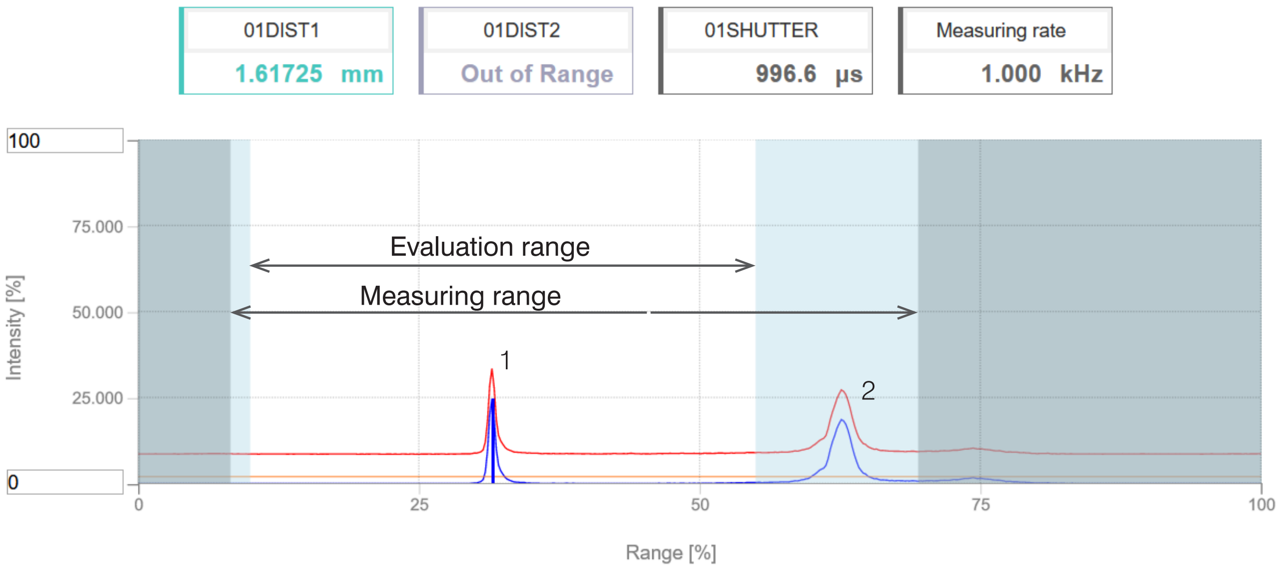


Fig. 45 Limiting the video signal used

The example shown in the figure uses peak (1) for the evaluation while peak (2) is not used.

6.2.5 Exposure Mode

Measurement mode		
Manual mode	Exposure time 1 in µs	*IFD2410/2411: Value (3 µs ... 10,000 µs)* *IFD2415: Value (3 µs ... 10,000 µs)*
Alternating two-time mode	Exposure time 1 in µs	*IFD2410/2411: Value (1 µs ... 10,000 µs)* *IFD2415: Value (3 µs ... 10,000 µs)*
	Exposure time 2 (shorter) in µs	*Value (value is lower than exposure time 1)*
Automatic two-time mode	Exposure time 1 in µs	*IFD2410/2411: Value (1 µs ... 10,000 µs)* *IFD2415: Value (3 µs ... 10,000 µs)*
	Exposure time 2 (shorter) in µs	*Value (value is lower than exposure time 1)*

➡ Select the desired exposure type.

`Measurement mode`. The required or appropriate measuring rate is maintained and only the exposure time is controlled. A smaller control range is used to achieve faster results. This mode also enables the user to work with targets with different reflections that have the same measuring rates. Lasts 1 up to a maximum of 7 measurement cycles (change from no target to good reflective target with 0.1 kHz measuring rate).

`Manual mode`. No automatic adjustments. Set optimized parameters are maintained. This makes sense for fast changes due to targets with identical surfaces moving in and out or for highly dynamic movements (no overshooting). It is not recommended to use this mode for strongly varying target surfaces. Manual mode can also be used for several layers if the brightest peak should not be captured. The video signal display can acquire suitable measuring rates and exposure times from automatic mode.

`Alternating two-time mode`. Operating mode with two manually preset exposure times that are always used alternately. Suitable for two very different high peaks when measuring thickness. We recommend using this mode in particular if the smaller peak disappears or the higher peak is overmodulated. Any video averaging which may be set is ignored here.

`Automatic two-time mode`. Fastest mode with two manually preset exposure times. The more suitable time is automatically selected. We recommend using this mode to measure distances for rapidly changing surface properties, such as mirrored or anti-glare glass.

Fields with gray background require a selection. *Value* Fields with dark border require entry of a value.

6.2.6 Peak Separation

6.2.6.1 Peak Modulation

Peak modulation is used e.g. when measuring thin layers. A peak detected with the detection threshold may consist of two or more overlapping peaks. The peak modulation indicates to which degree the video signal must be modulated in order to separate the peak again for the subsequent signal processing.

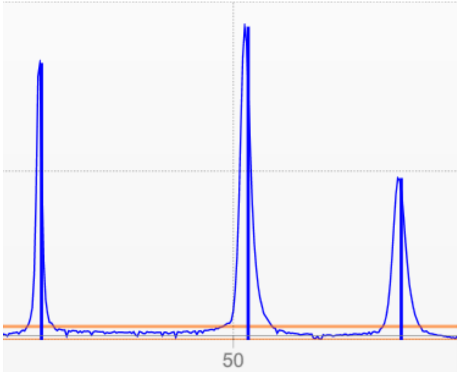


Fig. 46 Separated peaks: Measurement possible

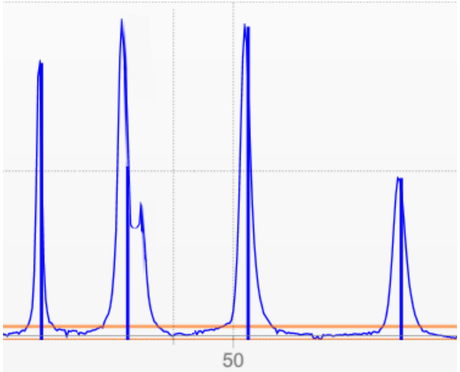


Fig. 47 Peaks interlocking: Measurement inaccuracy likely

The modulation is individually evaluated for each peak detected with the detection threshold.

Default value is 50 % as a compromise between the separability of the peaks and the measurement uncertainty due to mutual peak interference.

- Increase the value when the controller separates peaks which should be processed together.
- Decrease the value when the controller does not separate peaks which should be processed separately.

Example 1: With the default setting, no peak separation is carried out. The controller determines a distance from the center of gravity in the video signal.

Example 2: With a lower peak modulation value, the controller detects two separate peaks in the video signal and calculates the two distances.

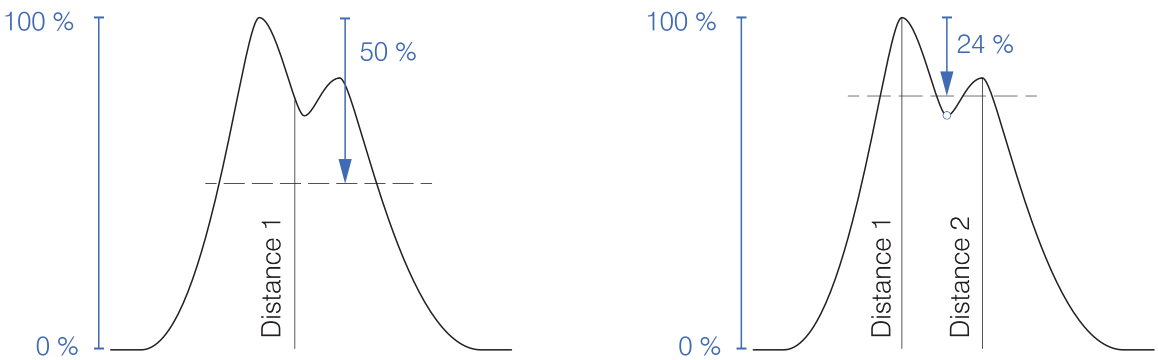


Fig. 48 Examples for peak modulation

Changing the `peak modulation` is only necessary in special cases. Use this function carefully.

6.2.6.2 Detection Threshold

The detection threshold (in % relative to the dark-corrected signal) defines the intensity as of which a peak in the video signal is included in the analysis. For that reason, it is essential to evaluate the video curve for this determination.

Minimum threshold	*Value*	*Value in %, default 2 %*

Defining the detection threshold.

- For very weak signals typical of extremely high measuring rates, choose a low detection threshold, as only signal parts above this threshold will be included in the calculation.
- In general, set the threshold high enough to prevent any interfering video signal peaks from being detected.

The detection threshold affects linearity, so it is recommended to adjust it as little as possible.

6.2.7 Number of Peaks, Peak Selection

The number of peaks is equivalent to the number of transitions between different materials of a target within the measuring range.

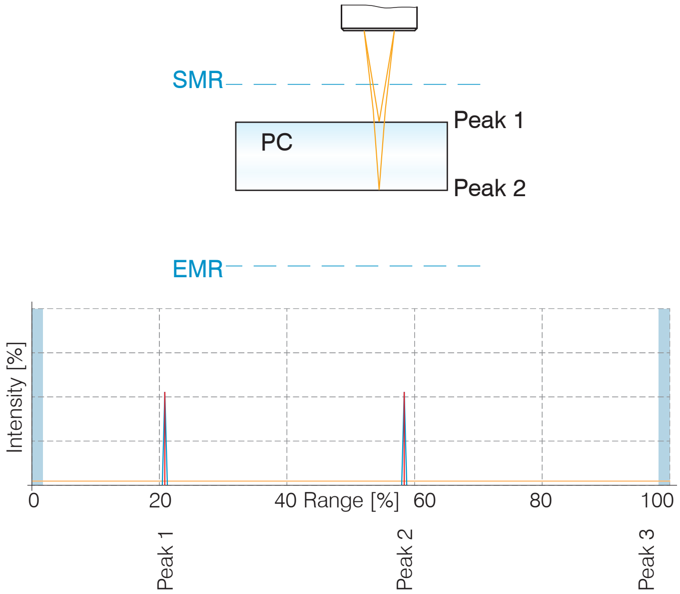


Fig. 49 Transparent target with one layer

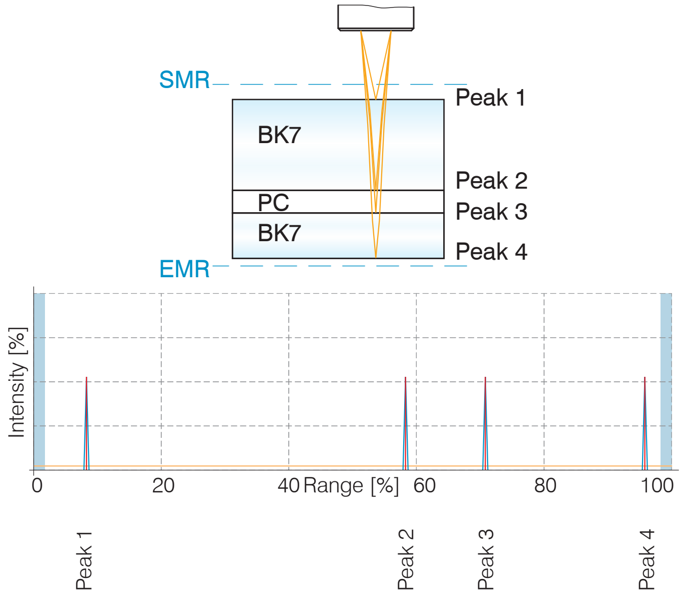
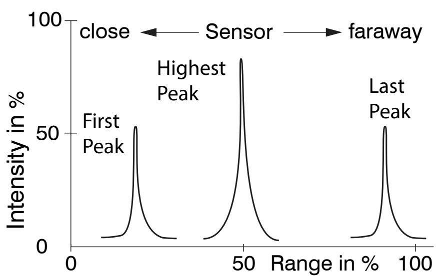


Fig. 50 Transparent target with three layers

i This function is used if, before or between the useful peaks, a material has even smaller interfering peaks caused by thin layers on the target. This function should be used with caution and should only be used by product specialists.

The selection of peak/peaks dictates which regions in the signal are used for the distance or thickness measurement. In the case of a target consisting of several transparent layers, the material must be assigned to the individual layers, see Chap. 6.2.8.

The peaks are counted starting at the start of the measuring range toward the end of the measuring range.

Peak selection	*First peak / Highest peak / Last peak*	*Defines which signal in the array signal is used for the evaluation. First peak: Closest peak to the sensor. Highest peak: Standard, peak with the highest intensity. Last peak: Farthest peak from the sensor.*	

IFD2410/2411	IFD2415	Measured values	Peak selection
•	•	1 measured value	First peak / Highest peak / Last peak
	•	2 measured values	first and second peak / first and last peak / highest and second highest peak / second to last and last peak
	•	3 measured values	Individual
	•	4 measured values	Individual
	•	5 measured values	Individual
	•	6 measured values	Individual

Fig. 51 Options for peak selection

The determination of the peak heights is performed based on light corrected signal.

The refractivity correction is performed with the standard setting. However, if more than two peaks are within the measuring range, an exact refractivity correction is performed with the same amount of peaks only. If, for example, the first or last peak of 3 peaks sometimes leaves the measuring range, it is better to switch off the refractivity correction, because then the refractivity correction will be applied to a different layer, it will not be possible to clearly assign the material.

6.2.8 Material Selection

Before selecting a material, define the number of layers of the target or the number of peaks to be expected in the video signal, see Chap. 6.2.7. Otherwise, it will not be possible to assign the material.

The refractive index needs to be corrected in the controller for an exact distance or thickness measurement.

- Switch to the menu `Settings` > `Data recording` > `Material selection`.
- Activate the refractivity correction. To do so, click the `On` button in the menu `On/off refractivity correction`.
- Assign the materials to the individual layers according to the target used.

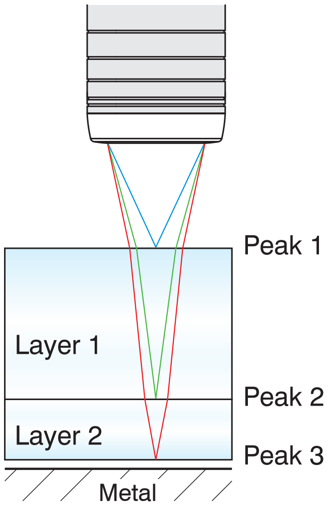


Fig. 52 Layer structure of a target

The `Link to material table` button can be used to expand or reduce the material database in the controller. For a new material, a refractive index and the Abbe number v_d are required or three refractive index numbers are required if there are different wavelengths (also approximately the same).

pos	material name	definition	nF at 486nm	nd at 587nm	nC at 656nm	VD - Abbe number	description
1	Vacuum	NX	1.000000	1.000000	1.000000		vacuum, air (approximately)
2	Water	NX	1.337121	1.333044	1.331152		a liquid
3	Ethanol	NX	1.361400	1.361400	1.361400		ethyl alcohol, pure alcohol (a liquid)
4	Acrylic	NX	1.497828	1.491668	1.488938		acrylic resin, adhesive, lacquer
5	PMMA	NX	1.497761	1.491756	1.489200		polymethyl methacrylate, acrylic glass (a plastic)

Fig. 53 Selection of material-specific refractivity indices

6.3 Signal Processing, Calculation

6.3.1 Data Source, Parameters, Calculation Programs

One calculation operation can be performed in each calculation block. The calculation program, the data sources and the parameters of the calculation program must be set for this.

`Thickness`	Calculating the difference	Two signals or results, Signal distance B < Signal distance A
Formula	Distance A - Distance B	
`Calculation`	Summation	Two signals or results
Formula	Factor 1 * Distance A + Factor 2 * Distance B + Offset	
`Median`	The measured values are sorted and the mean value is output as median	
`Moving averaging`	The arithmetic mean is formed	
`Recursive averaging`	Each new measured value is weighted and added to the sum of the previous mean values.	
`Duplicate`	Creates a copy of a signal	

Fig. 54 Available calculation programs

Sequence for creating a calculation block, see Fig. 55:

- ➡ Select a program ①, e.g. average.
- ➡ Define the parameters ②.
- ➡ Define the data source(s) ③.
- ➡ Enter a block name ④.
- ➡ Click on the `Apply calculation` button.

① ② ③ ② ④ ⑤

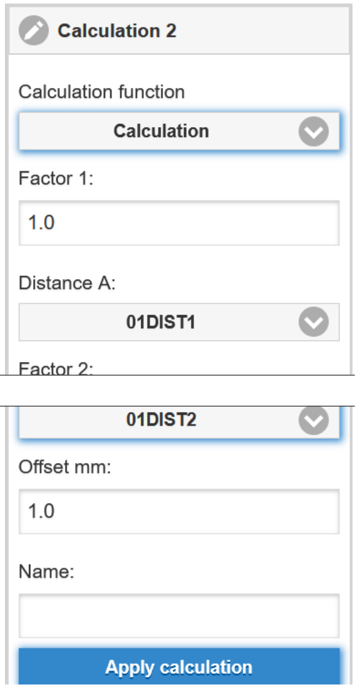
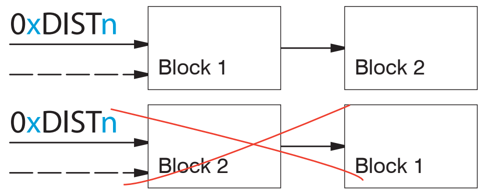
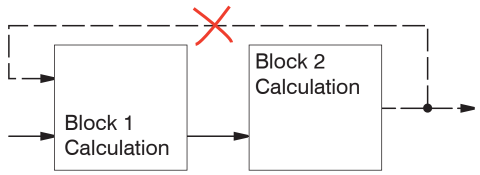


Fig. 55 Sequence for the program selection

The programs calculation and thickness have two data sources. Averaging programs each have one data source.

Calculation parameters (calculation program)	Factor 1 / 2	*Value*	-32768.0 ... 32767.0
	Offset	*Value*	-2147.0 ... 2147.0
Calculation parameters (Averaging)	Averaging type	Recursive / Moving / Median	
	Number of values	*Value*	Recursive: 2 ... 32000
			Moving: 2 / 4 / 8 / 16 / 32 / 64 / 128 / 256 / 512 / 1024 / 2048 / 4096
			Median: 3/5/7/9
The number of values states over how many sequential measured values in the controller should be averaged before a new measured value is output.			

6.3.2 Definitions

<table>
<tr><td>Distance value(s)</td><td>01DIST1, 01DIST2, ... 01DIST6</td></tr>
<tr><td>Max. 10 calculation blocks per channel/sensor. The calculation blocks are processed sequentially.</td><td>
</td></tr>
<tr><td>Feedback couplings (algebraic loops) over one or several blocks are not possible. Only the distance values or the calculated results from the previous calculation blocks can be used as data sources.</td><td>
</td></tr>
<tr><td>Processing sequence:
1. Unlinearized distances
2. Linearization of distances
3. Refractivity correction of distances
4. Error handling in the case of no valid measured value
5. Spike correction of distances
6. Calculation blocks
7. Statistics</td><td></td></tr>
</table>

6.3.3 Measurement Averaging

Measurement averaging is performed after measured values have been calculated, and before they are issued or processed through the relevant interfaces.

Measurement averaging

- improves the resolution,

- allows masking individual interference points, and

- "smoothes" the reading.

i Linearity is not affected by averaging. Averaging has no effect on measuring rate and output rate.
The internal average value is re-calculated for each measuring cycle.

i The defined type of average value and the number of values must be saved in the controller to ensure they are maintained after it has been switched off.

The controller is delivered with "moving average, averaging value = 16" as factory settings, i.e. averaging is not enabled by default.

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:

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

MV = measured value,
N = averaging value,
k = continuous index (in the window)
M_{mov} = average value or output value

Each new measured value is added, and the first (oldest) value is removed from the averaging (from the window). This produces short settling times in case of measurement jumps.

Example: N = 4

... 0, 1, 2, 2, 1, 3   ... 1, 2, 2, 1, 3, 4   Measured values

$$\frac{2, 2, 1, 3}{4} = M_{mov}(n) \qquad \frac{2, 1, 3, 4}{4} = M_{mov}(n+1)$$

Output value

i Moving average in the controller allows only potentials of 2 for N. The highest averaging value is 1024.

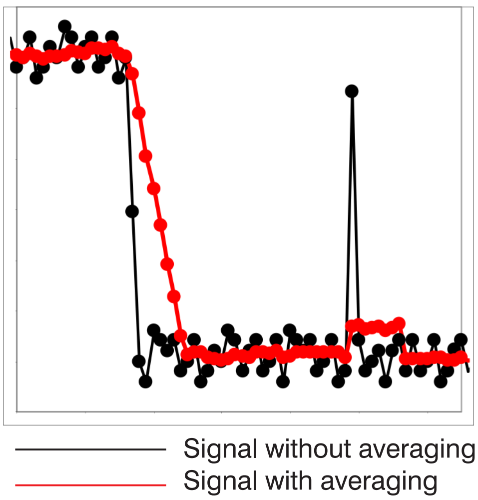


Fig. 56 Moving average, N = 8

Application tips

- Smoothing of measured values
- The effect can be finely controlled in comparison with the recursive averaging
- With uniform noise of the measured values without spikes
- In case of a slightly rough surface, in which the roughness should be eliminated
- Also suitable for measured value jumps with relatively short settling times

Recursive average

Formula:

$$M_{rec}(n) = \frac{MV_{(n)} + (N\text{-}1) \times M_{rec\,(n\text{-}1)}}{N}$$

MV = measured value,

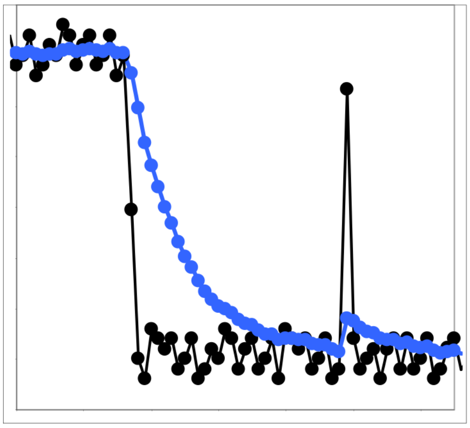
N = averaging value, N = 1 ... 32768

n = Measured value index

M_{rec} = average or output value

The weighted value of each new measured value MV(n) is added to the sum of the previous average values M_{rec} (n-1).

Recursive averaging allows for very strong smoothing of the measurements, however it requires long response times for measurement jumps. The recursive average value shows low-pass behavior.



Signal without averaging
Signal with averaging

Fig. 57 Recursive average, N = 8

Application tips

- Permits a high degree of smoothing of the measured values. Long transient recovery times in case of measured value jumps (low-pass behavior)
- High degree of smoothing for noise without strong spikes
- To especially smooth signal noise for static measurements
- To eliminate the roughness for dynamic measurements on rough surface, e.g. roughness of paper
- To eliminate structures, e.g., parts with uniform groove structures, knurled turned parts or coarsely milled parts
- Unsuitable for highly dynamic measurements

Median

A median value is formed from a preselected number of measured values.

When creating a median value for the controller, incoming measured values are sorted after each measurement. Then the average value is provided as the median value.

3, 5, 7 or 9 readings are taken into account. This means that individual interference pulses can be suppressed. However, smoothing of the measurement curves is not very strong.

Example: Median value from five readings

... 0 1 2 4 5 1 3 → Sorted measurement values: 1 2 [3] 4 5 Median $_{(n)}$ = 3

... 1 2 4 5 1 3 5 → Sorted measurement values: 1 3 [4] 5 5 Median $_{(n+1)}$ = 4

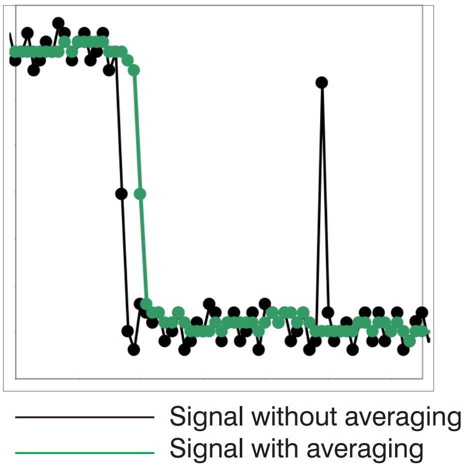


Fig. 58 Median, N = 7

Application tips

- The measured value curve is not smoothed to a great extent; it primarily eliminates spikes
- Suppresses individual interference pulses
- In short, strong signal peaks (spikes)
- Also suitable for edge jumps (only minor influence)
- To eliminate dirt or roughness in a rough, dusty or dirty environment
- Further averaging can be used after the median filter

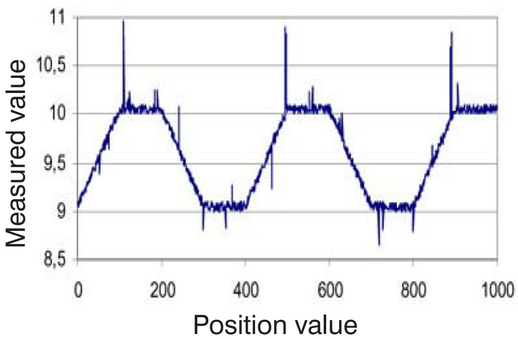


Fig. 59 Profile, original

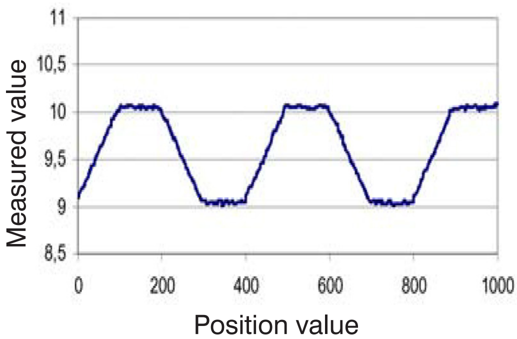


Fig. 60 Profile with median, N = 9

6.4 Post-Processing

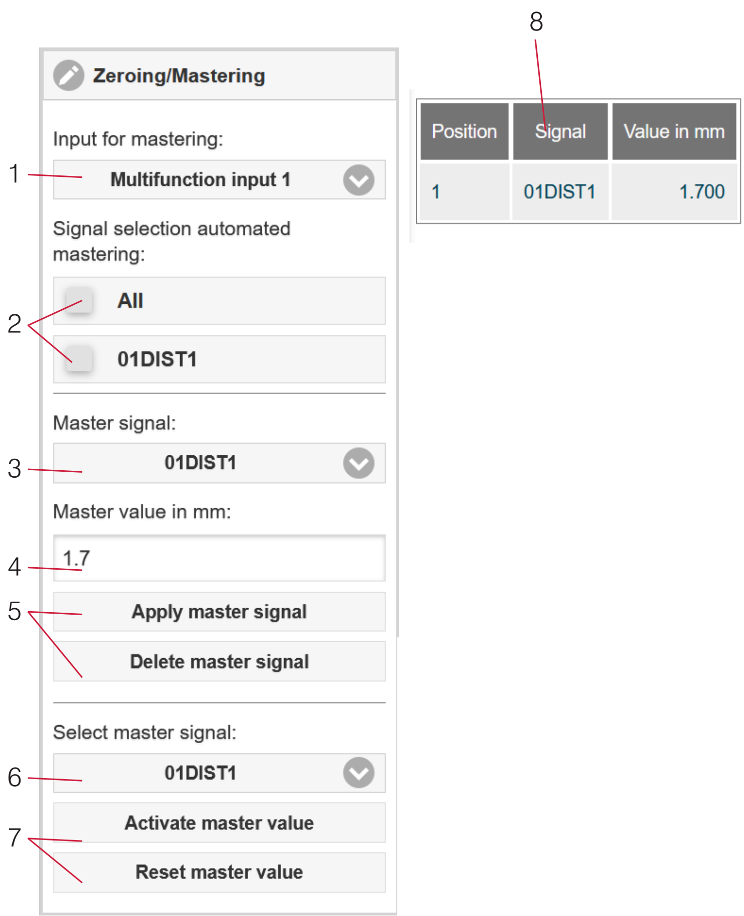
6.4.1 Zeroing, Mastering

Use zeroing and mastering to define a nominal value within the measuring range. This shifts the output range. This feature can be useful, for example, when several sensors carry out measurements simultaneously in thickness and planarity measurements. When measuring the thickness of a transparent target, you need to specify the actual thickness of a master object as `Master value`.

Master value in mm	*Value*	*Specify the thickness (or other parameter) of a master object.* *Value range: -2147.0 ... +2147.0 mm*

Mastering (setting masters) is used to compensate for mechanical tolerances in the sensor measurement setup or to correct chronological (thermal) changes to the measuring system. The master value, also called calibration value, is defined as the nominal value.

The `master value` is the reading that is issued as result of measuring a master object. Zeroing is a special feature of mastering, since the master value is “0” here.



The mastering/zeroing function is not channel-specific. The controller manages up to 10 master signals. These 10 signals can be applied to any internally determined value, including calculated values.

i “Mastering” or “zeroing” requires a target object to be present in the measuring range. “Mastering” and “zeroing” affect both analog and digital outputs, as well as the web interface display.

1 Trigger or undo mastering via multifunction inputs MFI 1/2 through an external source.

2 Selection of signals to be mastered via the multifunction inputs (1).

3 Overview of all existing signals for the function. Selection of a signal to assign the master value with (4) and (5).

4 Enter master value.

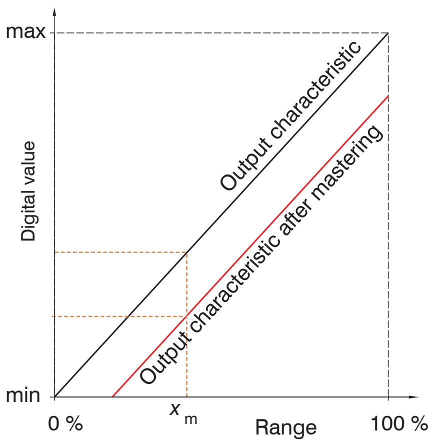
5 Button for storing or deleting a signal from (3).

6 Apply selection of a specific signal or master to all defined signals (8).

7 Start or stop function for signal (6) via software.

8 Overview of all existing signals and their master value for the function.

Fig. 61 Mastering dialog, overview of individual master values



When setting a master, the output characteristic is moved in parallel. Moving the characteristic reduces the relevant measuring range of a sensor (the further master value and master position are located, the greater the reduction).

Mastering / Zeroing Sequence:

- Place target and sensor into their desired positions to one another.
- Define the `Master value` (web interface/ASCII).

After setting the master, the controller will issue new readings that relate to the master value. If you click the `Reset master value` button to undo the mastering process, the system reverts to the state that existed before the master was set.

Fig. 62 Moving the characteristic when mastering

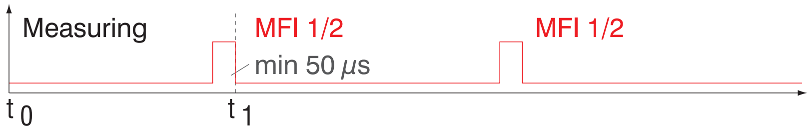


Fig. 63 Flowchart for zeroing, mastering (Multifunction key)

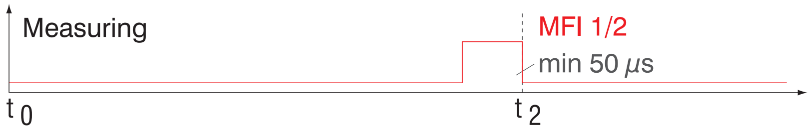


Fig. 64 Flowchart for undoing zeroing/mastering

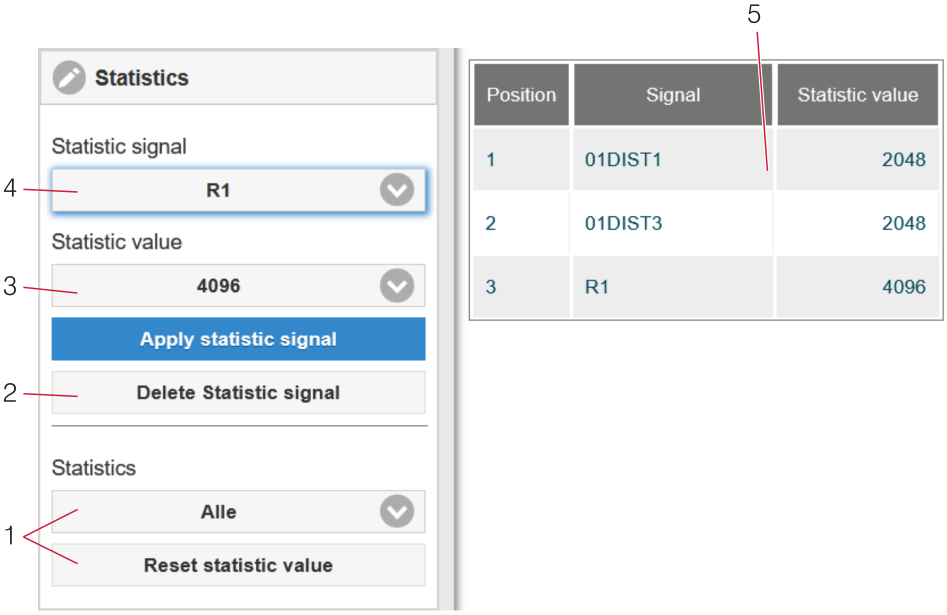
The zeroing/mastering function can be applied several times in a row.

6.4.2 Statistics

The controller derives the following statistical values from the measurement result:

- Minimum,
- Maximum and
- Peak-to-Peak.

Statistical values are calculated from measured values within the evaluation range. The evaluation range is updated with every new measurement value. Statistical values are displayed in the web interface, the `measurement chart` or are output via the interfaces.



The statistical values are not channel-specific. The controller manages up to 10 statistical values. These 10 signals can be applied to any internally determined value. This also applies for calculated values.

Fig. 65 Statistics dialog, overview of individual statistic values

1 Use the `Reset statistic value` button to reset a certain signal or all statistic signals in order to start a new evaluation cycle (storage period). When a new cycle starts, previous statistical values are deleted.

2 Deletes a signal.

3 Number of measurement values based on which minimum, maximum and peak-to-peak are determined for a signal. The range of values used for calculation can be between 2 and 16384 (in powers of 2) or include all measured values.

4 Selects a signal for the function.

5 Overview of all existing signals for the function.

Sequence for creating a statistical evaluation:

- Change to the tab `Settings > Postprocessing > Statistics`.
- Choose a signal (4) for which the statistical values should be calculated.
- Define the evaluation range via the `statistic value`.

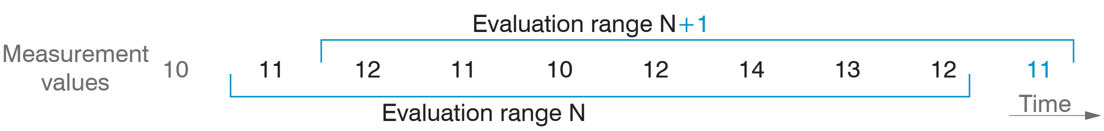


Fig. 66 Dynamic update of evaluation range via measurement values, statistical value = 8

6.4.3 Data Reduction, Output Data Rate

Data reduction	Value	*Instructs the controller which data are excluded from the output, thus reducing the volume of data transmitted.*
Reduction applies to	RS422 / Analog	*The interfaces which are provided for the sub-sampling are to be selected with the checkbox.*

You can reduce the measurement output in the sensor if you set the output of every nth measured value in the web interface or by command. Data reductions causes only every nth measured value to be output. The other measured values are rejected. The reduction value n can range from 1 (each measured value) to 3,000,000. This allows you to adjust slower processes, such as a PLC, to the fast sensor without having to reduce the measuring rate.

6.4.4 Error Handling (Hold Last Value)

If no valid measured value can be determined, an error is output. Alternatively, if this interferes with further processing, the last valid value can be held, i.e. output repeatedly, for a certain amount of time.

Error handling	Error output, no measured value	*Interfaces output an error instead of a value.*	
	Hold last value infinitely	*Interfaces output the last valid value until a new, valid measured value is available.*	
	Hold last value	Value	*Possible number of values to be maintained between 1 and 1024. When number = 0, the last value is maintained until a new, valid value is displayed.*

6.5 Outputs

6.5.1 Interface RS422

The RS422 interface has a maximum baud rate of 4000 kBaud. The baud rate is set to 115.2 kBaud when the interface is delivered. Use ASCII commands or the web interface to configure.

Transfer settings for controller and PC must match.

Data format: Binary.. Interface parameters: 8 data bits, no parity, one stop bit (8N1). Selectable baud rate.

The RS422 interface transmits 18 bits per output value.

The maximum number of measured values that can be transmitted for a measuring point depends on the measuring rate of the controller and the transmission rate set for the RS422 interface. Use the maximum available transmission rate (baud rate) where possible.
Parallel output of measuring data is not possible via RS422 and EtherNet/IP.

6.5.2 RS422

The selection of output data from all internally determined values and from the calculated values from the computing modules is done separately for both interfaces. These data are output in a rigidly defined order.

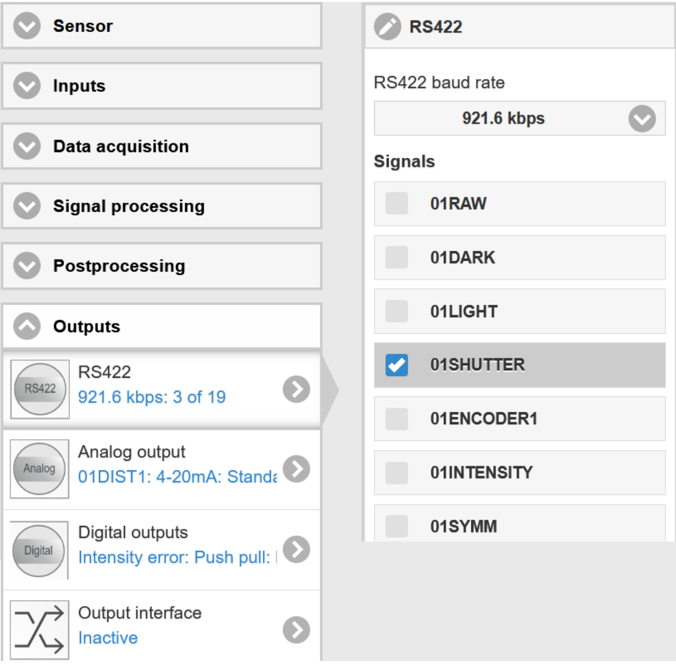


Fig. 67 Selecting the output data

6.5.3 Analog Output

Only one measured value can be transmitted. The resolution of the analog output is 16 bit.

Output signal	*01DIST1 / ... 01DIST6 / ...*	*The data selection depends on the current setting and includes the results from the calculation modules as well as the distance values.*	
Output range	*4 ... 20 mA / 0 ... 5 V / 0 ... 10 V*	*Either the voltage or the current output can be used on the IFD241x.*	
Scaling	*Standard scaling*	*Scaling to 0 ... Measuring range*	
	Two-point scaling	Start of range corresponds to (in mm):	*Value*
		End of range corresponds to (in mm):	*Value*

The first value corresponds to the start of the measuring range and the second value to the end of the measuring range. If the analog range needs to be moved, we recommend using the zeroing or mastering function.

Two-point scaling enables the user to specify separate start and end values (in mm) for the sensor's measuring range. The available output range of the analog output is then spread between the minimum and maximum measured values. This allows for decreasing analog characteristics, see Fig. 68.

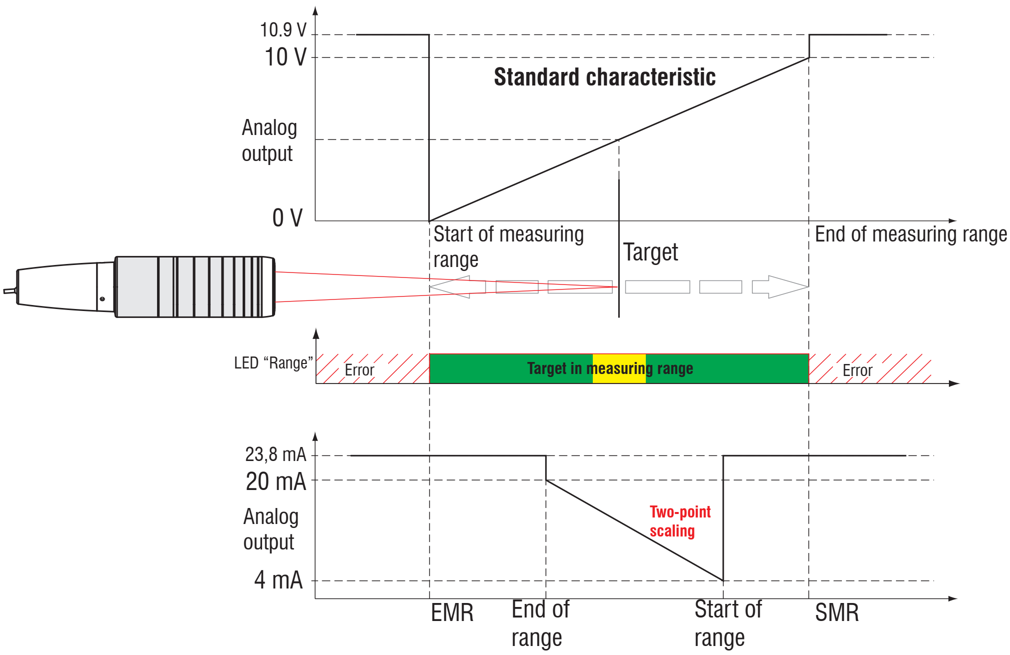


Fig. 68 Scaling the analog signal

6.5.3.1 Calculating Measured Value from Current Output

Current output (without mastering, without two-point scaling)

Variables	**Value range**	**Formula**
I_{OUT} = Current [mA]	[3.8; <4] SMR reserve [4; 20] measuring range [>20; 20.2] EMR reserve	$d = \frac{(I_{OUT} - 4)}{16} * MR$
MR = measuring range [mm]	{/1/2/3/6/10}	
d = Distance [mm]	[-0.01MB; 1.01MB]	

Current output (with two-point scaling)

Variables	Value range	Formula
I_{OUT} = Current [mA]	[3.8; <4] SMR reserve [4; 20] measuring range [>20; 20.2] EMR reserve	$d = \frac{(I_{OUT} - 4)}{16} * \lvert n - m \rvert$
MR = measuring range [mm]	{/1/2/3/6/10}	
m, n = Teach range [mm]	[0; MR]	
d = Distance [mm]	[m; n]	

6.5.3.2 Calculation measured value from Voltage Output

Voltage output (without mastering, without two-point scaling)

Variables	Value range	Formula
U_{OUT} = voltage [V]	[-0.05; <0] SMR reserve [0; 5] measuring range [>5; 5.05] EMR reserve	$d = \frac{V_{OUT}}{5} * MR$
	[-0.1; <0] SMR reserve [0; 10] measuring range [>10; 10.1] EMR reserve	$d = \frac{V_{OUT}}{10} * MR$
MR = measuring range [mm]	{/1/2/3/6/10}	
d = Distance [mm]	[-0.01MB; 1.01MB]	

Current output (with two-point scaling)

Variables	Value range	Formula
U_{OUT} = voltage [V]	[-0.05; <0] SMR reserve [0; 5] measuring range [>5; 5.05] EMR reserve	$d = \frac{V_{OUT}}{5} * \lvert n - m \rvert$
	[-0.1; <0] SMR reserve [0; 10] measuring range [>10; 10.1] EMR reserve	$d = \frac{V_{OUT}}{10} * \lvert n - m \rvert$
MR = measuring range [mm]	{/1/2/3/6/10}	
m, n = Teach range [mm]	[0; MR]	
d = Distance [mm]	[m; n]	

6.5.4 Data Output

Output interfaces	RS422 / analog output / switching output	Decides on the interface used for outputting the measured value. The measured values are output in parallel via the interfaces selected.

6.6 System Settings

6.6.1 Web Interface Unit

The web interface supports units in millimeters (mm) and inches in the display of the measurement results. The language in the web interface can be set to German or English. Switch the language in the menu bar.

6.6.2 Key Lock

The key lock prevents unauthorized or unintentional execution of the key functions. A key lock can be set individually for the `Multifunction` and/or `Correct` key.

Key Lock	Automatic	Value (1 ... 60 min)	*The button function will be blocked after a defined period of time has elapsed.*
	Active		*The key function is blocked immediately*
	Inactive		*No key lock*

The key lock can only be deactivated with `Professional` access authorization.

6.6.3 Loading and Saving

This chapter describes how to save a setup with either measurement settings or with device settings. You will also find the functions for importing and exporting the setups here, see Chap. 5.9.

6.6.4 Access Authorization

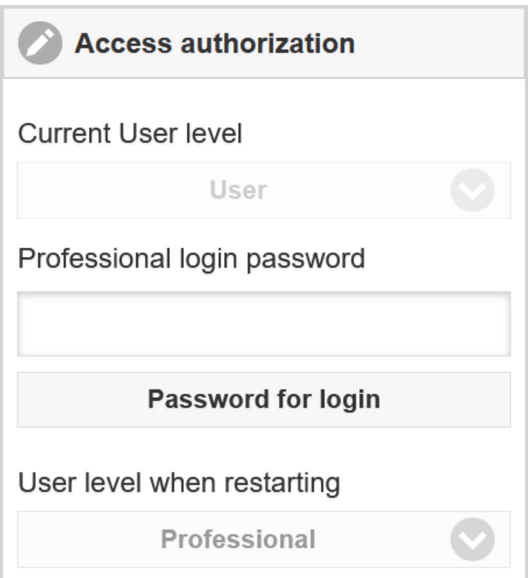
Assigning passwords prevents unauthorized changes to settings in the system. Password protection is not activated in the delivery state. The controller works on user level `Professional`. Once the controller has been configured, the password protection should be activated. The standard password for the Professional level is “000”.

i A software update will not change the standard password or a user-defined password. The Professional password is independent of the setup and is therefore not loaded or saved together with the setup.

Users have the following functions available:

	User	Professional
Password required	no	yes
View settings	yes	yes
Change settings, change passwords	no	yes
View measured values, video signals	yes	yes
Scale graphs	yes	yes
Restore factory settings	no	yes

Fig. 69 Rights in the user hierarchy



Type the standard password “000” or a user-defined password in the `Password` field and confirm the entry with `Login`.

Fig. 70 Switch to user level Professional

The user management enables the assignment of a user-defined password in operating mode `Professional`.

Password	*Value*	*All passwords are case-sensitive; numbers are allowed. Special characters are not permitted.*
User level when restarting	*User / Professional*	*Defines the user level which the system starts in after it has been switched on again.* *MICRO-EPSILON recommends the selection Professional here.*

6.6.5 Reset System

You can reset individual settings to the factory setting in this menu area.

Device settings	*The settings for the following commands are reset to the factory settings:* *ANALOG RANGE, BAUD RATE, ECHO, KEYLOCK, LED.*
Measurement settings	*Resets the preset to* `Standard matt` *and all parameters, except for interface settings, to the factory setting.*
Reset material database	*All settings for the material table are set to factory setting.*
Reset all	*Resets the device and measurement settings to factory settings.*
Restart sensor	*Starts the system with the last settings saved*

6.6.6 Light Source

You can switch the light source for the system on or off. This can be done via software or with the multifunctional inputs MFI1/2.

7. Thickness Measurement, One-Sided, Transparent Target

7.1 Requirement

For a one-sided thickness measurement of a transparent target, the controller evaluates two signals reflected at the surfaces. Based on these two signals, the controller calculates the distances from the surfaces and, from this, derives the thickness.

➡ Align the sensor perpendicularly to the object to be measured. Make sure that the target is approximately in the mid of the measuring range (SMR + 0.5 x MR).

i The light beam must strike the surface of the object at a perpendicular angle. Otherwise, measurements might be inaccurate.

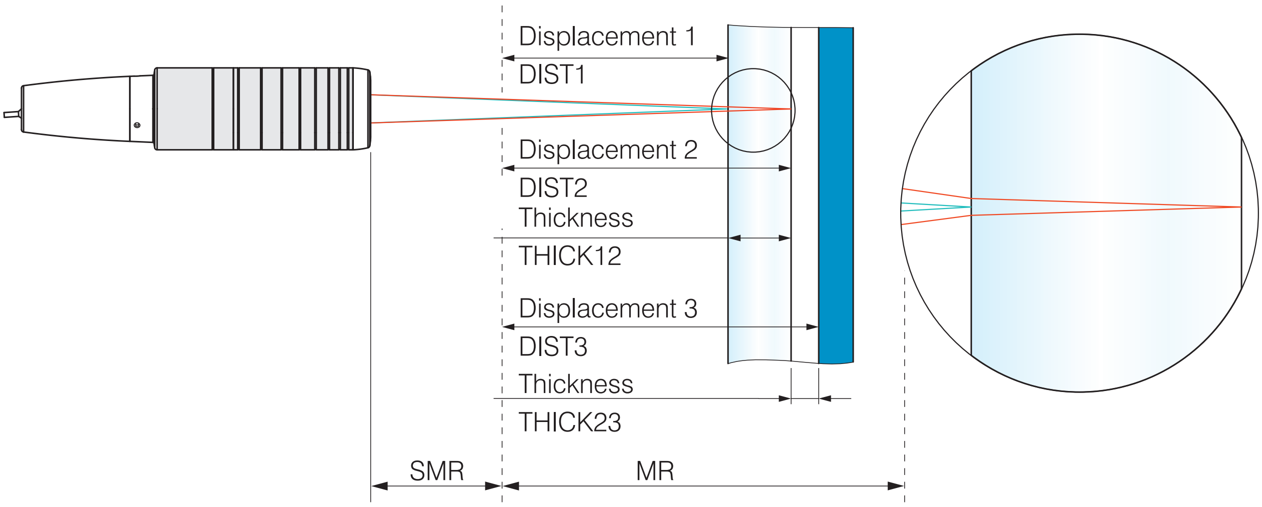


Fig. 71 One-sided thickness measurement on a transparent target

SMR	Start of measuring range
MR	Measuring range
Minimum target thickness Maximum target thickness	See Technical Data

7.2 Preset

confocalDT IFD2410/2415	confocalDT IFD2411
➡ Switch to the `Home` menu.	
➡ Select `Multilayer airgap` in the configuration selection.	➡ Select `One-sided thickness measurement` in the configuration selection.

This presetting prompts the controller to use the first and second peak in the video signal for the thickness calculation.

`Calculation 1` in controller: `Thickness` difference from `DIST2` and `DIST1`	`Calculation 1` in controller: `Thickness` difference from `DIST2` and `DIST1`
`Calculation 2` in controller: `Thickness` difference from `DIST3` and `DIST2`	---

7.3 Material Selection

Specifying the material is essential for calculating a correct thickness value. To compensate for the spectral change of the index of refraction, at least three refractive indices at different wavelengths or a refractive index and the Abbe number must be known.

➡ Switch to the `Settings > Data recording > Material selection` menu.

➡ Select the material of the target for `Layer 1` and `Layer 2` (if applicable).

7.4 Video Signal

If a surface of the target lies outside the measuring range, the controller will send only one signal for the distance, intensity and center of gravity. This may also occur if a signal is below the detection threshold.

Two boundary surfaces are active when the thickness of a transparent material is measured. As a result, two peaks are visible in the video signal, see Fig. 72.

Even if the detection threshold is just below the saddle between the two peaks, the controller can determine both distances and calculate the thickness from them.

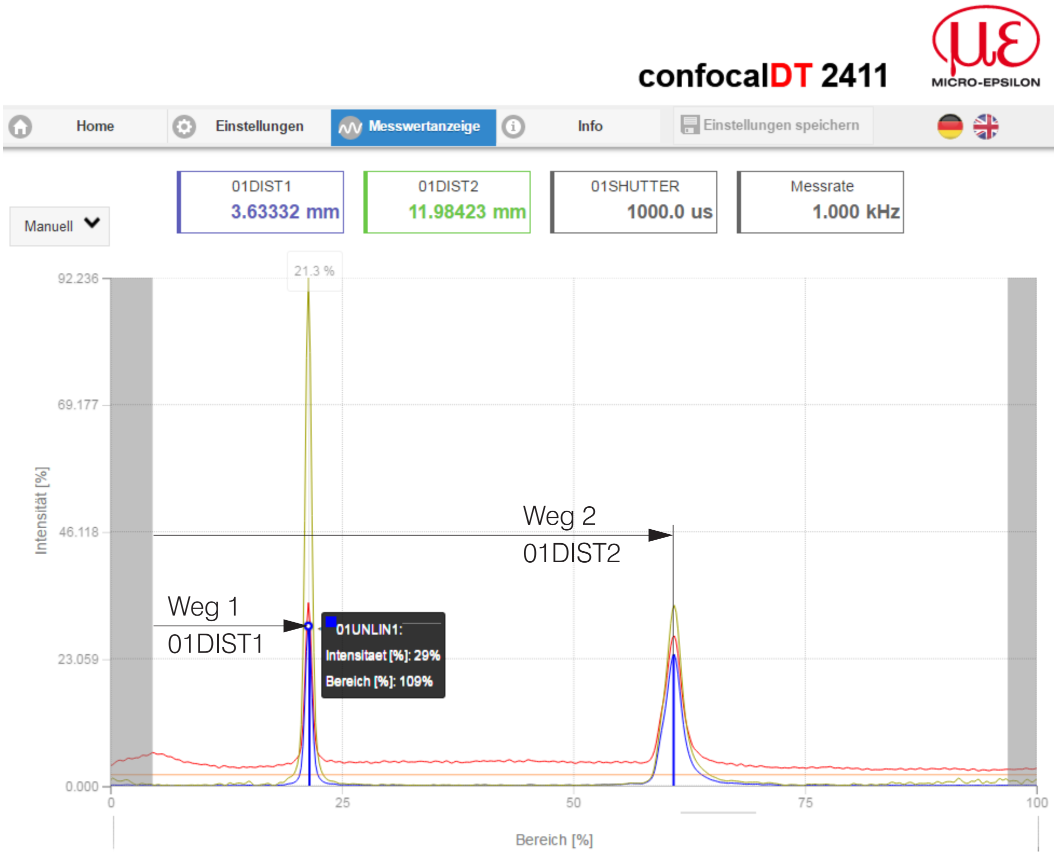


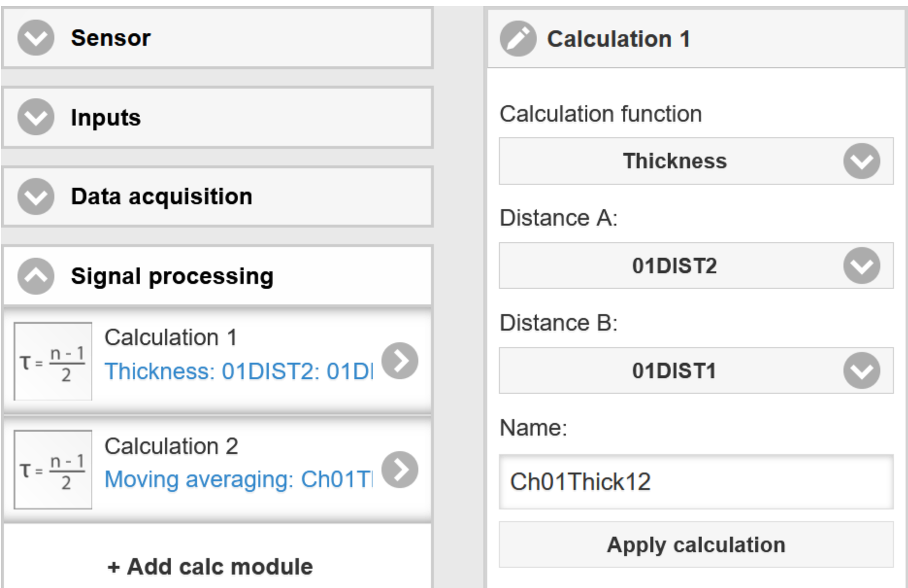
Fig. 72 Video signal web page, `One-sided thickness measurement`

7.5 Signal Processing

The configuration selection `One-sided thickness measurement` also contains the presets for thickness calculation from the two distance signals `Displacement1` and `Displacement2`, see Fig. 72.

In the downstream second calculation block `Calculation 2`, the thickness values undergo a moving averaging with an averaging depth of 16 values.

➡ Adapt the signal processing to your measuring task.



7.6 Measurement Chart

➡ Switch to the `Measurement chart` tab and select `Mess` as the chart type.

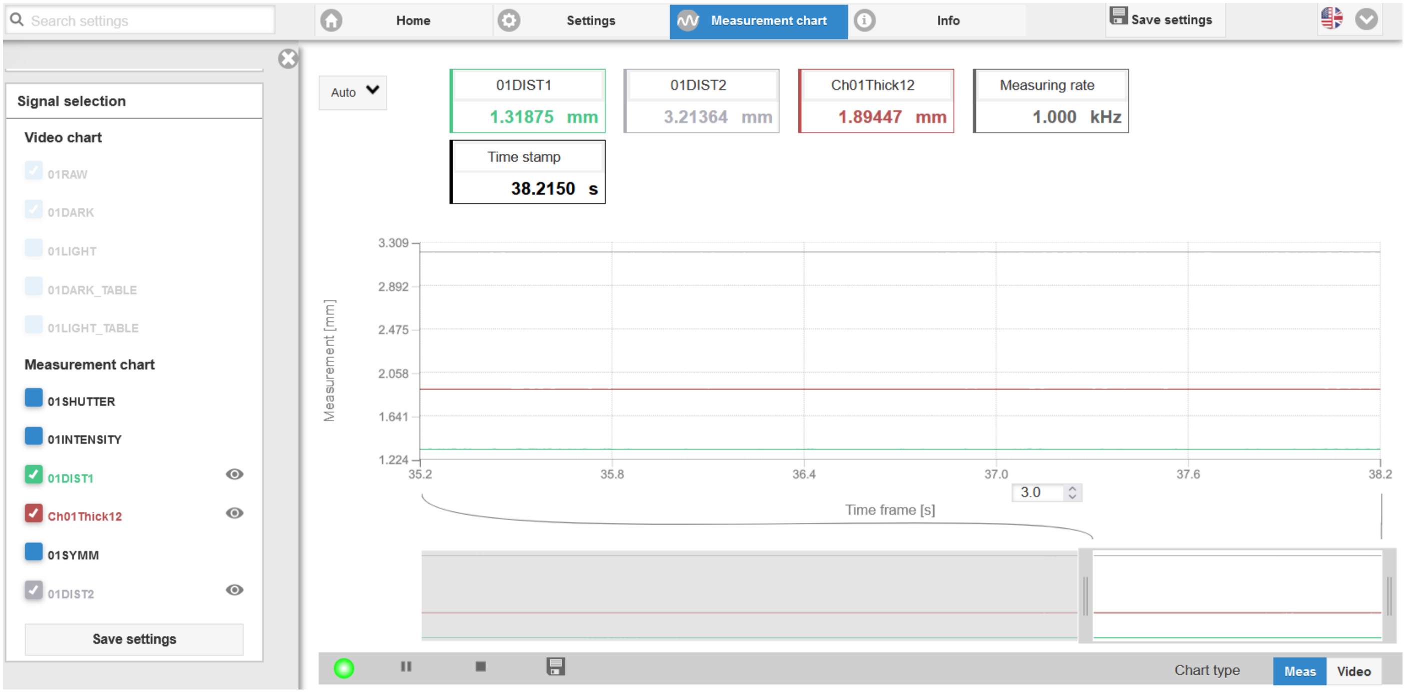


Fig. 73 Measured thickness results based on a one-sided thickness measurement with one sensor

The web page shows the two distances and the thickness (difference between `01DIST2` and `01DIST1`) graphically and numerically. Optionally, the intensities of both peaks (Peak 1 = near, Peak 2 = far) can also be displayed.

8. EtherNet/IP, Documentation

8.1 Preliminary Remarks

The sensor starts with the last stored operating mode. Standard is EtherNet/IP.

The EtherNet/IP mode, as well as the Ethernet setup mode, allow easy programming of a sensor.

8.2 Saving the Settings, Continuing EtherNet/IP Operation

Go to Settings > System settings > Load & Save or click the Save settings button.

The sensor now also saves the settings to the objects for use in EtherNet/IP operation.

Continue working in your PLC environment.

8.3 General

EtherNet/IP is an Ethernet-based fieldbus, which is based on the TCP and UDP protocols, developed by the Open DeviceNet Vendor Association (ODVA). The IP in EtherNet/IP stands for Industrial Protocol. The Common Industrial Protocol (CIP) is used as the application protocol. CIP decides between

- Implicit Messages: time-critical, cyclic process data; transmission via UDP,
- Explicit Messages: acyclic demand data; transmission is via TCP.

Explicit messages work according to the client/server model and Implicit Messages work according to the producer/consumer model.

Both require a CIP connection. It is also possible to exchange Explicit Messages without a CIP connection via so-called Unconnected Explicit Messages.

CIP (Common Industrial Protocol)		
Implicit Messages		Explicit Messages
UDP		TCP
I/O-Connections		Explicit Messaging Connections
Exchange of process data from a producer to one or more consumers		Exchange of data between two devices according to the client/server model

Fig. 74 CIP stack and transport of data according to the ISO/OSI reference model

EtherNet/IP distinguishes two types of devices: EtherNet/IP scanners and EtherNet/IP adapters. A Sensor/Controller with EtherNet/IP is an EtherNet/IP adapter. To exchange data with an EtherNet/IP adapter, an EtherNet/IP scanner is required.

8.4 Explicit Messaging

CIP is an object-oriented concept, which is based on object-oriented programming. An Ethernet/IP device is modeled by a set of CIP objects. An object consists of a class, of which in turn one or more instances may exist. Classes and instances still have attributes. Attributes are used to configure the EtherNet/IP device which is accessed by reading or writing. An object is addressed via the Class ID, Instance ID and Attribute ID. It is also important how an object is accessed, e.g. whether it is read or written. This information is defined by the service code.

Object 1			Object 2	Object n
Class (Class-ID)	Attribute 1 (Attribute-ID) ... Attribute n	read/write		
Instance 1 (Instance-ID) ... Instance n	Attribute 1 (Attribute-ID) ... Attribute n	read/write		
	Attribute 1 ... Attribute n	read/write		

Fig. 75 Example Explicit Message with the information about Class ID, Instance ID, Attribute ID and Service Code

The objects are distinguished between

- standard objects, which always have the same structure even with different devices, and
- manufacturer-specific objects, which have a different structure depending on the manufacturer.

The standard objects have a Class ID in the range from 0x0001 to 0x0043 or from 0x00F0 to 0x2FF. The Class ID of manufacturer specific objects ranges from 0x0064 to 0x00C1.

8.4.1 Standard Objects

8.4.1.1 Overview

Class ID	Name
0x01	Identity Object
0x04	Assembly Object
0xF5	TCP/IP Interface Object
0x43	Time Sync Object

Fig. 76 Overview of standard objects

8.4.1.2 Object 0x01h: Identity

Class attributes

Attribute ID	Name	Access	Description	Data type
1	Revision	Get	Revision of this object	UINT
2	Max. Instance	Get	Maximum instance number of an object currently created in this class level of the device	UINT
3	Number of Instances	Get	The number of instances currently created in this class	UINT
6	Maximum ID Number Class Attributes	Get	The attribute ID number of the last class attribute of the class definition implemented in the device.	UINT
7	Maximum ID Number Instance Attributes	Get	The attribute ID number of the last instance attribute of the class definition implemented in the device.	UINT

Instance attributes

Attribute ID	Name	Access	Description	Data type
1	Vendor ID	Get	Vendor Identification	UINT8
2	Device Type	Get	Indication of general type of product	UINT16
3	Product Code	Get	Identification of a particular product of an individual vendor	UINT16
4	Revision	Get	Revision of the product	UINT16
5	Status	Get	Summary status of device	UINT16
6	Serial Number	Get	Serial number of device	UINT32
7	Product Name	Get	Human readable identification	CHAR
8	State	Get	Present state of the device	UINT8

Services

Service Code	Name	Access		Description
		Class level	Instance level	
0x01	Get Attribute All	Yes	Yes	Retrieve all attribute values
0x05	Reset	Yes	Yes	Reset the decvice
0x4B	Flash LEDs	No	Yes	Flash the device’s LEDs for identification
0x0E	Get Attribute Single	Yes	Yes	Retrieve attribute value
0x10	Set Attribute Single	Yes	Yes	Modify attribute value

You can reset the sensor to factory settings via the service `Reset` (0x05 hex) of instance 1 or directly via the class of the Identity Object (0x01 hex). The reset service contains the parameter `Reset Type` of data type USINT, for which the following values are valid:

- 0 Performs a power cycle
- 1 Resets the sensor to factory settings and then performs a power cycle

i After resetting the sensor to factory settings, it is configured to DHCP.

8.4.1.3 Object 0x04 Assembly

Class Attributes

Attribute ID	Name	Access	Description	Data type
1	Revision	Get	Revision of this object	UINT
2	Max. Instance	Get	Maximum instance number of an object currently created in this class level of the device	UINT
3	Number of Instances	Get	The number of instances currently created in this class	UINT
6	Maximum ID Number Class Attributes	Get	The attribute ID number of the last class attribute of the class definition implemented in the device.	UINT
7	Maximum ID Number Instance Attributes	Get	The attribute ID number of the last instance attribute of the class definition implemented in the device.	UINT

Instance attributes

Attribute ID	Name	Access	Description	Data type
3	Assembly Object Data	Get/Set	Current process data	Array of OCTET
4	Assembly Object Size	Get	Process data size in number of bytes	UINT16

Attributes 1 and 2 are not available for configuration assembly instances.

Services

Service Code	Name	Access		Description
		Class level	Instance level	
0x0E	Get Attribute Single	Yes	Yes	Retrieve attribute value
0x10	Set Attribute Single	No	Yes	Modify attribute value
0x18	Get Member	No	Yes	Get a member of instance attribute 2

8.4.1.4 Object 0xF5 TCP/IP Interface

Class Attributes

Attribute ID	Name	Access	Description	Data type
1	Revision	Get	Revision of this object	UINT
2	Max. Instance	Get	Maximum instance number of an object currently created in this class level of the device	UINT
3	Number of Instances	Get	The number of instances currently created in this class	UINT
6	Maximum ID Number Class Attributes	Get	The attribute ID number of the last class attribute of the class definition implemented in the device.	UINT
7	Maximum ID Number Instance Attributes	Get	The attribute ID number of the last instance attribute of the class definition implemented in the device.	UINT

Instance Attributes

Attribute ID	Name	Access	Description	Data type
1	Status	Get	Interface status	DWORD
2	Configuration Capability	Get	Interface capability flags	DWORD
3	Configuration Control	Set	Interface control flags	DWORD
4	Physical Link Object	Get	Path to physical link object	STRUCT [1]
5	TCP/IP Interface Configuration	Get/Set	Interface Configuration (IP address, subnet mask, gateway address etc.)	STRUCT [1]
6	Host Name	Get/Set	The Host Name attribute contains the device's host name, which can be used for informational purposes.	STRING
8	TTL Value	Get/Set	TTL value for EtherNet/IP multicast packets	USINT
9	Mcast Config	Get/Set	IP multicast address Configuration	STRUCT [1]
10	SelectAcd	Get/Set	Activates the use of ACD	BOOL
11	LastConflictDetected	Get/Set	Structure containing information related to the last conflict detected	STRUCT [1]
13	Encapsulation Inactivity Timeout	Get/Set	Number of seconds till TCP connection is closed on encapsulation inactivity	UINT
14	IANA Port Admin	Get	IANA port admin configuration	STRUCT [1]

Assign an IP address to the sensor via DHCP. Via attribute 3 of instance 1 of the TCP/IP class (0xF5 hex) you can choose between DHCP, BOOTP and static IP address.

Attribute 3 has the data type DWORD (bit string - 32 bits). The individual bits have the following meaning:

Bits	Name	Description
0-3	IP configuration	0 = The device uses a static IP address 1 = The device obtains its IP address via BOOTP 2 = The device obtains its IP address via DHCP 3-15 = Reserved
4	DNS Enable	If 1 (TRUE), the device shall resolve hostnames by querying a DNS server.
5-31	Reserved	Reserved, should be set to 0.

1) More details for the data types `STRUCT` can be found in the `THE CIP NETWORKS LIBRARY, Volume 2.`

You can change the IP address and the network mask via attribute 5 of instance 1 of the TCP/IP class (0xF5).

Attribute 5 is a structure composed of the following data types:

Name	Data type	Description	Values
IP address	UDINT	IP address of the sensor	A value of 0 means that no IP address has been configured. Otherwise, the IP address should be set to a valid class A, B or C address. The IP address must not be set to the loopback address (127.0.0.1).
Network mask	UDINT	Network mask of the sensor	A value of 0 means that no network mask has been configured.
Gateway	UDINT	Gateway-IP address of the sensor	A value of 0 means that no IP address has been configured. Otherwise, the IP address should be set to a valid class A, B or C address. The IP address must not be set to the loopback address (127.0.0.1).
Name Server	UDINT	Primary Name Server	A value of 0 means that no name server address has been configured. The name server address should be a class A, B or C address.
Name Server 2	UDINT	Secondary Name Server	A value of 0 means that no name server address has been configured. The name server address should be a class A, B or C address.
Domain name	STRING	Standard domain name	The maximum length is 48 ASCII characters. The number of characterized must be filled up to an even number (length does not include fill characters). A length of 0 means that no domain name is configured.

Attribute 3 and attribute 5 are stored retentively in the sensor.

Services

Service Code	Name	Access		Description
		Class level	Instance level	
0x01	Get Attribute All	No	Yes	Returns content of instance or class attributes
0x0E	Get Attribute Single	Yes	Yes	Retrieve attribute value
0x10	Set Attribute Single	No	Yes	Modify attribute value

8.4.1.5 Object 0x43 Time Sync

Class Attributes

Attribute ID	Name	Access	Description	Data type
1	Revision	Get	Revision of this object	UINT
2	Max. Instance	Get	Maximum instance number of an object currently created in this class level of the device	UINT
3	Number of Instances	Get	The number of instances currently created in this class	ULINT
6	Maximum ID Number Class Attributes	Get	The attribute ID number of the last class attribute of the class definition implemented in the device.	UINT
7	Maximum ID Number Instance Attributes	Get	The attribute ID number of the last instance attribute of the class definition implemented in the device.	UINT

Instance Attributes

Attribute ID	Name	Access	Description	Data type
1	PTPEnable	Get/Set	PTP Enable	BOOL
2	IsSynchronized	Get	Local clock is synchronized with master	BOOL
3	SystemTimeMicroseconds	Get	Current value of system_time in microseconds	UINT
4	SystemTimeNanoseconds	Get	Current value of system_time in nanoseconds	ULINT
5	OffsetFromMaster	Get	Offset between local clock and master clock	LINT
6	MaxOffsetFromMaster	Get/Set	Maximum offset between local clock and master clock since last reset of this value.	ULINT
7	MeanPathDelayToMaster	Get	Mean path delay to master	LINT
8	GrandMasterClockInfo	Get	Grandmaster Clock Info	STRUCT [1]
9	ParentClockInfo	Get	Parent Clock Info	STRUCT [1]
10	LocalClockIno	Get	Local Clock Info	STRUCT [1]
11	NumberOfPorts	Get	Number of ports	UINT
12	PortStateInfo	Get	Port state info	STRUCT [1]
13	PortEnableCfg	Get/Set	Port enable cfg	STRUCT [1]
14	PortLogAnnounceIntervalCfg	Get/Set	Port log announce interval cfg	STRUCT [1]
15	PortLogSyncIntervalCfg	Get/Set	Port log sync interval cfg	STRUCT [1]
18	DomainNumber	Get/Set	Domain number	USINT
19	ClockType	Get	Clock type	WORD
20	ManufactureIdentity	Get	Manufacture identity	USINT[4]
21	ProductDescription	Get	Product description	STRUCT [1]
22	RevisionData	Get	Revision data	STRUCT [1]
23	UserDescription	Get	User description	STRUCT [1]
24	PortProfileIdentityInfo	Get	Port profile identity info	STRUCT [1]
25	PortPhysicalAddressInfo	Get	Port physical address info	STRUCT [1]
26	PortProtocolAddressInfo	Get	Port protocol address info	STRUCT [1]
27	StepsRemoved	Get	Steps removed	UINT
28	SystemTimeAndOffset	Get	System time and offset	STRUCT [1]
29	AssociatedInterfaceObjects	Get	Objects associated with PTP ports	STRUCT [1]
768	SyncParameters	Get/Set [2]	Synchronization Parameters	

Details to the object `Time Sync`, attribute 768 (0x300h):

Variable	Type	Value/Range	Description
Sync0Interval	UDINT	100.000 … 4.000.000 ns	Sync0 Interval in nanoseconds. This parameter specifies the interval of the Sync 0 signal in nanoseconds. The value 0 means the signal is deactivated. The starting point of the Sync0 signal is dependent on the Sync0 Offset (see parameter Sync0Offset).
Sync0Offset	UDINT	smaller than ulSync0Interval Default: 0	Sync 0 Offset in nanoseconds. This parameter specifies the offset for the Sync 0 signal relative to the system time (time of the Sync Master).
Sync1Interval	UDINT	0,10000 … 999999999 Default: 0	Sync1 Interval in nanoseconds. This parameter specifies the interval of the Sync 1 signal in nanoseconds. The value 0 means the signal is deactivated. The starting point of the Sync1 signal is dependent on the Sync1 Offset (see parameter ulSync1Offset).
Sync1Offset	UDINT	smaller than ulSync1Interval Default: 0	Sync 1 Offset in nanoseconds. This parameter specifies the offset for the Sync 1 signal relative to the system time (time of the Sync Master).
PulseLength	UDINT	1 … 500 and smaller than the mini-mum of the values Sync0Interval and Sync1Interval, when converted to microseconds. Default value: 4 µs	Pulse length of the Sync0 and Sync1 signals in microseconds

The sensors work exclusively with the Sync0 signal. The Sync1 signal is not used.

Services

Service Code	Name	Access		Description
		Class level	Instance level	
0x03	Get Attributes List All	No	Yes	The Get_Attribute_List service returns the contents of the selected attributes of the specified object class or instance
0x04	Set Attributes List	No	Yes	The Set_Attribute_List service sets the contents of selected attributes of the specified object class or instance
0x0E	Get Attribute Single	Yes	Yes	Retrieve attribute value
0x10	Set Attribute Single	No	Yes	Modify attribute value

8.4.2 Manufacturer Specific Objects

The manufacturer-specific objects do not have any instances. They exclusively support the services

- Get Attribute Single and
- Set Attribute Single.

Service Code	Name	Access		Description
		Class level	Instance level	
0x0E	Get Attribute Single	Yes	Yes	Retrieve attribute value
0x10	Set Attribute Single	Yes	Yes	Modify attribute value

Specify the following when addressing:

- Class ID,
- Attribute ID and
- Service Code.

For the Instance ID you can use any value, because it is not checked by the sensor.

You can find an overview of the objects in the Appendix, see Chap. A 8.

8.5 Implicit Messaging

8.5.1 General

Via implicit messaging, the IFD241x with EtherNet/IP cyclically sends input data to the EtherNet/IP scanner. To run implicit messaging, it is necessary to open an I/O connection. I/O connections contain so-called assemblies. An assembly contains one or more parameters that specify the structure of the process data.

There are three different types of I/O connections

- Input Only: The I/O connection contains only input process data
- Listen Only: The I/O connection contains only input process data
- Exclusive Owner: The I/O connection contains input and output process data

An I/O connection of the type Listen Only can only be established if an I/O connection of the type Input Only has already been established with the same assemblies. Thus, multiple participants can receive input process data from an adapter according to the producer/consumer model.

Since the IFD241x with EtherNet/IP only has input process data, the IFD241x with EtherNet/IP has no I/O connections of the Exclusive Owner type.

An I/O connection can contain up to 4 different assemblies. A basic distinction is made between input, output and configuration assemblies. While input and output assemblies are intended for permanent cyclic process data exchange, the data of a configuration assembly is sent once when the I/O connection is established.

- Input assembly: Cyclic process data, adapter > scanner
- Output assembly: Cyclic process data, scanner > adapter
- Input configuration assembly: One-time data when setting up the connection, adapter > scanner
- Output configuration assembly: one-time data when setting up the connection, scanner > adapter

The IFD241x with EtherNet/IP provides four different I/O connections:

Name	Size of the input assembly in bytes	Type
Fixed OV1 Input Only	24	Input Only
Fixed OV1 Listen Only	24	Listen Only
Mappable Input Only	0 - 500	Input Only
Mappable Listen Only	0 - 500	Listen Only

8.5.2 I/O-Connection Fixed OV1 Input Only

This I/O connection has only one input assembly with a fixed size of 36 bytes. All input process data available in the sensor are transmitted with an oversampling of 1. The I/O connection does not include output or configuration assemblies. The process data is structured as follows:

Bytes	Name Messwert	Description
0 - 3	Channel 1 distance 1	Distance
4 – 7	Channel 1 intensity 1	Intensity
8 - 11	Channel 1 shutter	Exposure time
12 - 15	Counter	Measured value counter
16 - 19	Time stamp	Time information
20 - 23	Frequency	Measurement frequency

8.5.3 I/O-Connection Fixed OV1 Listen Only

This I/O connection corresponds to the structure of the input process data of the I/O connection Fixed OV1 Input Only. The difference is that you can only use this I/O connection if the Fixed OV1 Input Only I/O connection already exists.

8.5.4 I/O Connection Mappable Input Only

The I/O connection contains an input assembly and an input configuration assembly. The input assembly has a variable size that depends on the mapped input process data. Unlike Fixed OV1 Input Only, you can configure the contents of the input assembly individually. This approach is called mapping.

You have two options to configure the mapping:

- Configuration assembly of the I/O connection or
- Mapping Object 0xC0.

The configuration assembly is structured as follows:

Byte	Name	Default	Min	Max	Description	Process data size in byte
0	Activation	0	0	1	If you set this value to 0, the sensor will ignore the data in the configuration assembly and use the last configured mapping in the mapping object 0xC0 instead. If you set this value to 1, the sensor will overwrite the mapping in the mapping object 0xC0 based on the transmitted data of the configuration assembly and use this configuration.	
1	Oversampling	1	1	8	Select an oversampling factor between 1 and 8. The process data size is then derived from the mapping multiplied by the oversampling factor.	
2	Mappings: Channel 1 distance 1	1	0	1		4
3	Mappings: Channel 1 distance 2	1	0	1		4
4	Mappings: Channel 1 intensity 1	1	0	1		4
5	Mappings: Channel 1 intensity 2	1	0	1		4
6	Mappings: Channel 1 shutter	1	0	1		4
7	Mappings: Channel 1 encoder 1	1	0	1		4
8	Mappings: Channel 1 encoder 2	1	0	1		4
9	Mappings: Channel 1 encoder 3	1	0	1		4
10	Mappings: Counter	1	0	1		4
11	Mappings: Time stamp	1	0	1		4
12	Mappings: Frequency	1	0	1		4
13	Mappings: User calc output 01	1	0	1		4
14	Mappings: User calc output 02	1	0	1		4
15	Mappings: User calc output 03	1	0	1		4
16	Mappings: User calc output 04	1	0	1	0 = Process data are not mapped	4
17	Mappings: User calc output 05	1	0	1	1 = Process data are mapped	4
18	Mappings: User calc output 06	1	0	1		4
19	Mappings: User calc output 07	1	0	1		4
20	Mappings: User calc output 08	1	0	1		4
21	Mappings: User calc output 09	1	0	1		4
22	Mappings: User calc output 10	1	0	1		4
23	Mappings: User calc output 11	1	0	1		4
24	Mappings: User calc output 12	1	0	1		4
25	Mappings: User calc output 13	1	0	1		4
26	Mappings: User calc output 14	1	0	1		4
27	Mappings: User calc output 15	1	0	1		4
28	Mappings: User calc output 16	1	0	1		4
29	Mappings: User calc output 17	1	0	1		4
30	Mappings: User calc output 18	1	0	1		4
31	Mappings: User calc output 19	1	0	1		4

Fig. 77 Configuration-Assembly IFD2410

Byte	Name	Default	Min	Max	Beschreibung	Prozessdaten-Größe in Bytes
0	Activation	0	0	1	Wenn Sie diesen Wert auf 0 setzen, wird der Sensor die Daten im Configuration-Assembly ignorieren und stattdessen das zuletzt konfigurierte Mapping im Mapping-Objekt 0xC0 verwenden. Wenn Sie diesen Wert auf 1 setzen, wird der Sensor anhand der übermittelten Daten des Configuration-Assemblies das Mapping im Mapping-Objekt 0xC0 überschreiben und diese Konfiguration verwenden.	
1	Oversampling	1	1	8	Wählen Sie einen Oversampling-Faktor zwischen 1 und 8 aus. Die Prozessdatengröße ergibt sich anschließend aus dem Mapping multipliziert mit dem Oversampling-Faktor.	
2	Mappings: Channel 1 distance 1	1	0	1	0 = Prozessdaten werden nicht gemapped 1 = Prozessdaten werden gemapped	4
3	Mappings: Channel 1 distance 2	1	0	1		4
4	Mappings: Channel 1 intensity 1	1	0	1		4
5	Mappings: Channel 1 intensity 2	1	0	1		4
6	Mappings: Channel 1 shutter	1	0	1		4
7	Mappings: Channel 1 encoder 1	1	0	1		4
8	Mappings: Channel 1 encoder 2	0	0	1		4
9	Mappings: Channel 1 encoder 3	0	0	1		4
10	Mappings: Counter	0	0	1		4
11	Mappings: Time stamp	0	0	1		4
12	Mappings: Frequency	0	0	1		4
13	Mappings: User calc output 01	0	0	1		4
14	Mappings: User calc output 02	0	0	1		4
15	Mappings: User calc output 03	0	0	1		4
16	Mappings: User calc output 04	0	0	1		4
17	Mappings: User calc output 05	0	0	1		4
18	Mappings: User calc output 06	0	0	1		4
19	Mappings: User calc output 07	0	0	1		4
20	Mappings: User calc output 08	0	0	1		4
21	Mappings: User calc output 09	0	0	1		4
22	Mappings: User calc output 10	0	0	1		4
23	Mappings: User calc output 11	0	0	1		4
24	Mappings: User calc output 12	0	0	1		4
25	Mappings: User calc output 13	0	0	1		4
26	Mappings: User calc output 14	0	0	1		4
27	Mappings: User calc output 15	0	0	1		4
28	Mappings: User calc output 16	0	0	1		4
29	Mappings: User calc output 17	0	0	1		4
30	Mappings: User calc output 18	0	0	1		4
31	Mappings: User calc output 19	0	0	1		4

Fig. 78 Configuration-Assembly IFD2411

Byte	Name	Default	Min	Max	Beschreibung	Prozessdaten-Größe in Bytes
0	Activation	0	0	1	Wenn Sie diesen Wert auf 0 setzen, wird der Sensor die Daten im Configuration-Assembly ignorieren und stattdessen das zuletzt konfigurierte Mapping im Mapping-Objekt 0xC0 verwenden. Wenn Sie diesen Wert auf 1 setzen, wird der Sensor anhand der übermittelten Daten des Configuration-Assemblies das Mapping im Mapping-Objekt 0xC0 überschreiben und diese Konfiguration verwenden.	
1	Oversampling	1	1	25	Wählen Sie einen Oversampling-Faktor zwischen 1 und 25 aus. Die Prozessdatengröße ergibt sich anschließend aus dem Mapping multipliziert mit dem Oversampling-Faktor.	
2	Mappings: Channel 1 distance 1	1	0	1	„0 = Prozessdaten werden nicht gemapped 1 = Prozessdaten werden gemapped“	4
3	Mappings: Channel 1 distance 2	1	0	1		4
4	Mappings: Channel 1 distance 3	1	0	1		4
5	Mappings: Channel 1 distance 4	1	0	1		4
6	Mappings: Channel 1 distance 5	1	0	1		4
7	Mappings: Channel 1 distance 6	1	0	1		4
8	Mappings: Channel 1 intensity 1	0	0	1		4
9	Mappings: Channel 1 intensity 2	0	0	1		4
10	Mappings: Channel 1 intensity 3	0	0	1		4
11	Mappings: Channel 1 intensity 4	0	0	1		4
12	Mappings: Channel 1 intensity 5	0	0	1		4
13	Mappings: Channel 1 intensity 6	0	0	1		4
14	Mappings: Channel 1 shutter	0	0	1		4
15	Mappings: Channel 1 peak symmetry 1	0	0	1		4
16	Mappings: Channel 1 peak symmetry 2	0	0	1		4
17	Mappings: Channel 1 peak symmetry 3	0	0	1		4
18	Mappings: Channel 1 peak symmetry 4	0	0	1		4
19	Mappings: Channel 1 peak symmetry 5	0	0	1		4
20	Mappings: Channel 1 peak symmetry 6	0	0	1		4
21	Mappings: Channel 1 encoder 1	0	0	1		4
22	Mappings: Channel 1 encoder 2	0	0	1		4
23	Mappings: Channel 1 encoder 3	0	0	1		4
24	Mappings: Counter	0	0	1		4
25	Mappings: Time stamp	0	0	1		4
26	Mappings: Frequency	0	0	1		4
27	Mappings: User calc output 01	0	0	1		4
28	Mappings: User calc output 02	0	0	1		4
29	Mappings: User calc output 03	0	0	1		4
30	Mappings: User calc output 04	0	0	1		4
31	Mappings: User calc output 05	0	0	1		4
32	Mappings: User calc output 06	0	0	1		4
33	Mappings: User calc output 07	0	0	1		4
34	Mappings: User calc output 08	0	0	1		4
...	Mappings: User calc output n	0	0	1		4
42	Mappings: User calc output 16	0	0	1		4
43	Mappings: User calc output 17	0	0	1		4
44	Mappings: User calc output 18	0	0	1		4
45	Mappings: User calc output 19	0	0	1		4

Fig. 79 Configuration-Assembly IFD2415

Provided that your PLC software supports this, the values for the configuration assembly can be stored permanently in your PLC project, so that the mapping is transmitted anew at each commissioning.

If you configure the mapping via the configuration assembly, you have to adjust the size of the input assembly accordingly. The size of the input assembly is calculated as follows:

Input assembly size = (mapping size 0 + mapping size 1 + ... + mapping size n) * oversampling

Example with IFD2410: Distance 1/2, Counter und Time stamp are mapped with an oversampling of 2.

Byte	Name	Value	Process data size
0	Activation	1	
1	Oversampling	2	
2	Mappings: Channel 1 distance 1	1	4
3	Mappings: Channel 1 distance 2	1	4
4	Mappings: Channel 1 intensity 1	0	4
5	Mappings: Channel 1 intensity 2	0	4
6	Mappings: Channel 1 shutter	0	4
7	Mappings: Channel 1 encoder 1	0	4
8	Mappings: Channel 1 encoder 2	0	4
9	Mappings: Channel 1 encoder 3	0	4
10	Mappings: Counter	1	4
11	Mappings: Time stamp	1	4
12	Mappings: Frequency	0	4
13	Mappings: User calc output 01	0	4
14	Mappings: User calc output 02	0	4
15	Mappings: User calc output 03	0	4
16	Mappings: User calc output 04	0	4
17	Mappings: User calc output 05	0	4
18	Mappings: User calc output 06	0	4
19	Mappings: User calc output 07	0	4
20	Mappings: User calc output 08	0	4
21	Mappings: User calc output 09	0	4
22	Mappings: User calc output 10	0	4
23	Mappings: User calc output 11	0	4
24	Mappings: User calc output 12	0	4
25	Mappings: User calc output 13	0	4
26	Mappings: User calc output 14	0	4
27	Mappings: User calc output 15	0	4
28	Mappings: User calc output 16	0	4
29	Mappings: User calc output 17	0	4
30	Mappings: User calc output 18	0	4
31	Mappings: User calc output 19	0	4

Size of the input assembly = (4 Byte + 4 Byte + 4 Byte + 4 Byte) * 2 = 32 byte

As an alternative to the configuration assembly, you can configure the mapping via the mapping object 0xC0. In this Object you will find the same mappings as well as the oversampling.

8.5.5 I/O Connection Mappable Listen Only

This I/O connection corresponds to the structure of the input process data of the I/O connection Mappable Input Only. The difference is that you can only use this I/O connection if the Mappable Input Only I/O connection already exists.

8.6 Device description file EDS

You must integrate the EDS file (Electronic Data Sheet) associated with the device into your PLC software in order to operate the IFD241x with EtherNet/IP. Each device is uniquely identified by the vendor ID, product code, and major and minor revision. You can find this information in your `*.eds` file. Make sure that the *.eds file matches the revision of your device.

You can read the revision from the device via attribute 4 of instance 1 of the Identity object (0x01).

8.7 Oversampling

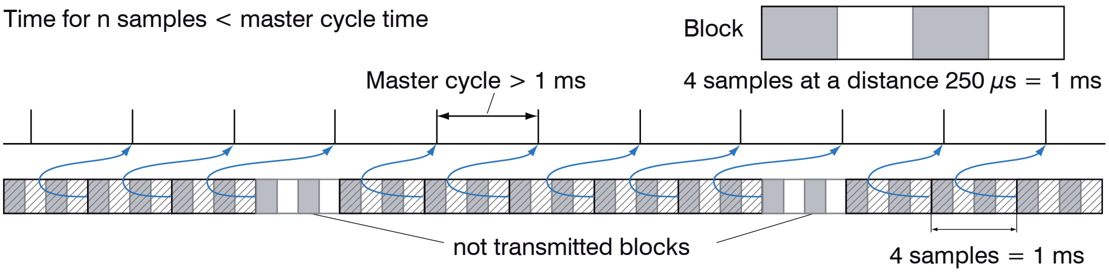
With the IFD241x with EtherNet/IP the oversampling is set globally via the assembly object 0x0004. The IFD2410 and IFD2411 support an oversampling from 1 up to 8. The IFD2415 supports an oversampling from 1 up to 25.

In operation without oversampling, the last accumulated measured value data set is transferred to the EtherNet/IP adapter with each fieldbus cycle. Therefore, for long fieldbus cycle periods data records with measured values are possibly not available. Configurable oversampling ensures that all (or selected) measured value data records are gathered and transmitted together to the adapter during the next fieldbus cycle. In general, a possible oversampling depends on the ratio of system measuring rate to fieldbus cycle time.

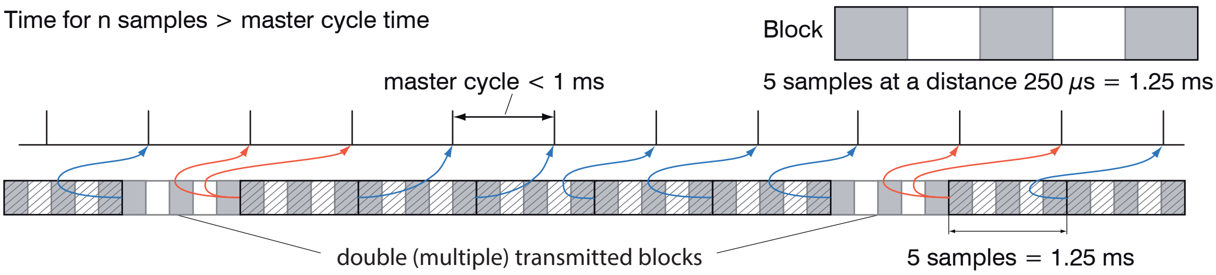
The oversampling factor specifies how many samples per bus cycle are transmitted. For example, an oversampling factor of 2 means that 2 samples are transferred per bus cycle.

To ensure that no samples are lost due to the asynchronous nature between the master cycle and slave cycle, the master cycle time should always be less than the time for building a block from n samples.

An entire block with the specified samples is only made available to the adapter side after all specified samples have been written to the block. If the time for filling a block is less than the master cycle time, individual blocks are not transferred. It can indeed happen that the next block is already being filled with samples before the previously filled block is picked up in a master cycle.



But if you select a number of samples sufficiently large so that the time for filling a block is greater than the master cycle time, each block will be picked up in a master cycle. Individual blocks (and therefore samples), however, will be transferred two or more times. This can be detected on the adapter side by transferring the timestamp or value counter.



8.8 IP Address Sensor Unknown

If you do not know the IP address of the sensor because your DHCP/BOOTP server does not display the address or because you have forgotten the static IP address, you can still find the sensor via a CIP List Identity Request. A CIP List Identity Request is sent as a broadcast via UPD or TCP.

The sensor will then reply as a unicast on its IP address. Check to what extent your PLC software supports the List Identity Request. A tool that also supports the List Identity Request is e.g. the EtherNet/IP tool from Molex.

8.9 IP Configuration

The sensor is delivered in DHCP mode. You need a DHCP server to assign an IP address to the sensor. Implicit and explicit messaging is only possible if the sensor has a valid IP address.

8.10 Synchronization of Sensors

8.10.1 General

Measuring with the Sync0 frequency of the PLC instead of the internal measuring rate

A sensor works with the internal measuring rate. Furthermore, you can let the sensor measure with the Sync0 frequency from the Time Sync object to reduce jitter.

Procedure:

- Use the object 0x43 Time Sync.
- Set the instance attribute 1 (PTPEnable, 0x1h) to 1 (=enabled).
- Set the values for the instance attribute 768 (SyncParameters, 0x300h).

i Note that the sensor only works with the `Sync0 signal`. The `Sync1 signal` is not used. You can therefore set `Sync1Interval` and `Sync1Offset` to `0`. For the pulse length we recommend to keep the default value of 4 µs.

If PTPEnable is set to 0 (disabled), then you must set PTPEnable to 1 (enabled) either before or after configuring the SyncParameter attribute.

If you want to measure with the internal measuring rate in the sensor instead of the Sync0 frequency, you must either set the attribute PTPEnable to 0 (Disabled) or the Sync0 frequency in the attribute SyncParameters to 0.

8.10.2 Simultaneous Synchronization

All sensors measure at the same time.

Example: The sensors should measure with a measuring rate of 2 kHz.

Procedure:

- Set the instance attribute 1 (PTPEnable, 0x1h) to 1 (=enabled) via Set Attribute Single service (0x10).
- Set the values for the instance attribute 768 (SyncParameters, 0x300h) in all sensors via Set Attribute Single service (0x10).

Variable	Type	Value/Range
Sync0Interval	UDINT	500.000 ns
Sync0Offset	UDINT	0 ns
PulseLength	UDINT	Default value: 4 µs

9. Error, Repair

9.1 Web Interface Communication

- If an error page is displayed in the web browser, please check the following points.

- Check to make sure the controller is connected correctly, see Chap. 5.1.
- Check the IP configuration of PC and controller, find the controller with the `sensorTOOL program`, see Chap. 5.1. If the controller and PC are connected directly, it can take up to two minutes for them to agree on the IP addresses.
- Check proxy settings used. If the controller is connected to the PC via a separate network card, then it will be necessary to disable the use of a proxy server for this connection. Please ask your network manager or administrator about this!

9.2 Changing the Sensor Cable on the Sensors

- Loosen the protective sleeve on the sensor. Remove the defective sensor cable.
- Feed the new sensor cable through the protective sleeve.
- Remove the protective cap on the sensor cable and save it for safe keeping.

- Guide the guide lug of the sensor connector into the groove of the port.
- Screw the sensor plug and sensor port together.
- Screw the protective sleeve back onto the sensor.

- Conduct a dark correction, see Chap. 5.10.

9.3 Replacing the Protective Glass on the Sensors

The protective glass must be replaced in case of:

- irreversible contamination,
- scratches.

i The sensor may not be used without a protective glass, as doing so will impair its measuring accuracy.

- Loosen the front frame incl. protective glass on the sensor.

- Remove the seal and insert the O-ring into the frame groove of the new protective glass.
- Screw the new frame incl. protective glass back onto the sensor.

10. Software Support with MEDAQLib

MEDAQLib is a documented driver DLL. This allows you to integrate the confocal measuring system into existing PC software or that of the customer.

Connection options:

- RS422/USB converter (optional accessories) and suitable PC2415-x/OE connection cable for IFD2410/2415 or SC2415-x/OE for IFC2411.

No knowledge of the underlying protocol of the respective controller is necessary to be able to contact the controller. The individual commands and parameters for the controller to be addressed are set via an abstract function and converted into the protocol of the controller by the MEDAQLib accordingly.

MEDAQLib

- contains a DLL that can be imported into C, C++, VB, Delphi and many other programs,
- takes care of data conversion for you,
- works regardless of the type of interface used,
- uses the same functions for communication (commands),
- provides a single transmission format for all MICRO-EPSILON sensors.

For C/C++ programmers, an additional header file and a library file are integrated into MEDAQLib.

You can find the current driver routine including documents at:

www.micro-epsilon.com/download
www.micro-epsilon.de/link/software/medaqlib

11. 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/legal-details/. For translations into other languages, the German version shall prevail.

12. Service, Repair

If the measuring system is defective:

- If possible, save the current settings in the PLC but not in the sensor/controller. When the PLC starts up, it distributes the settings to the sensor/controller again.
- 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
Königbacher 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

13. Decommissioning, Disposal

To prevent environmentally harmful substances from being released and to ensure the reuse of valuable raw materials, please note the following rules and obligations:

- All cables must be removed from the sensor and/or controller.
- The sensor and/or controller, its components and the accessories, as well as the packaging materials, are to be disposed of according to the country-specific waste treatment and disposal regulations for the respective area of use.
- You are obligated to observe all relevant national laws and provisions.

The following (disposal) instructions apply in Germany / the EU:

- old devices labeled with a crossed-out garbage can must not be disposed of in normal waste (e.g. garbage can or yellow bin) and must be disposed of separately. This prevents hazards to the environment due to improper disposal and proper further use of the old devices is ensured.

- A list of national legislation and contacts in 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 have the opportunity to learn about the respective national collection and return points.
- Old devices can also be sent back to MICRO-EPSILON for disposal, to the address provided in the Legal Notice at https://www.micro-epsilon.com/legal-details/.
- Please note that you yourself are responsible for deleting the measurement-specific and personal data from the old devices being disposed of.
- We are registered as a manufacturer of electrical and/or electronic devices under registration number WEEE-Reg.-Nr. DE28605721 with Stiftung Elektro-Altgeräte Register, Nordostpark 72, 90411 Nuremberg.

Appendix

A 1 Optional accessories, services

A 1.1 Optional accessories confocalDT IFD2410/2415

SC2415-x/OE	Connection cable with 17-pole M12 socket and open ends for analog output, digital I/O and encoder; drag chain-compatible, cable length x = 3 m, 6 m, 9 m or 15 m
PC2415-x	Cable extension with 12-pole M12 socket and 12-pole M12 plug for supply, RS422 or encoder, Industrial Ethernet; drag chain-compatible, cable length x = 3 m, 6 m, 9 m or 15 m
PC2415-x/OE	Connection cable with 12-pole M12 socket and open ends, suitable for PC2415-x, supply, RS422 or encoder, Industrial Ethernet; drag chain-compatible, cable length x = 3 m, 6 m, 9 m or 15 m
PC2415-1/Y	Supply and interface cable with 12-pole M12 socket; open ends and RJ45 connector, cable length 1 m
IF2001/USB	Converter from RS422 to USB, type: IF2001/USB, suitable for PC2415-x/OE cable, including driver, Connections: 1x 10-pin socket strip (cable clamp), type: Würth 691361100010; 1x 6-pin socket strip (cable clamp), type: Würth 691361100006
PS2020	Power supply for DIN rail installation, input 230 VAC, output 24 VDC/2.5 A

A 1.2 Optional Accessories confocalDT IFD2411

Cable C2401 with FC/APC and E2000/APC connector

C2401-x	Optical fiber (3 m, 5 m, 10 m, customer-specific length up to 50 m)
C2401/PT-x	Optical fiber with protective sleeve for mechanical strain (3 m, 5 m, 10 m, customer-specific length up to 50 m)
C2401-x(01)	Optical fiber core diameter 26 µm (3 m, 5 m, 15 m)
C2401-x(10)	Optical fiber in drag chain-compatible design (3 m, 5 m, 10 m)

Mounting adapter

MA2400-27	Mounting adapter for IFS2404-1 / IFS2404-3 / IFS2404-6 sensors
MA2404-12	Mounting adapter for IFS2404-2(001) / IFS2404/90-2(001) sensors
JMA-xx	Adjustable mounting adapter, see Chap. A 3

Other accessories

SC2415-x/OE	Connection cable with 17-pole M12 socket and open ends for analog output, digital I/O and encoder; drag chain-compatible, cable length x = 3 m, 6 m, 9 m or 15 m
IF2001/USB	Converter from RS422 to USB, type: IF2001/USB, suitable for SC2415-x/OE cable, including driver, Connections: 1x 10-pin socket strip (cable clamp), type: Würth 691361100010; 1x 6-pin socket strip (cable clamp), type: Würth 691361100006
PS2020	Power supply for DIN rail installation, input 230 VAC, output 24 VDC/2.5 A

Vacuum feedthrough

C2402/Vac/KF16	Vacuum feedthrough for optical fiber, 1 channel, vacuum-side FC/APC, non-vacuum-side E2000/APC, clamping flange type KF 16
C2405/Vac/1/KF16	Vacuum feedthrough on both sides FC/APC socket, 1 channel, clamping flange type KF 16
C2405/Vac/1/CF16	Vacuum feedthrough on both sides FC/APC socket, 1 channel, flange type CF 16
C2405/Vac/6/CF63	Vacuum feedthrough for optical fiber on both sides FC/APC socket, 6 channels, flange type CF 63

A 1.3 Services

- confocalDT measuring system linearity check and adjustment
- confocalDT measuring system calibration

A 2 Factory Settings

A 2.1 confocalDT IFD2410/2415

Number of Peaks	1 measured value, highest peak
Region of interest	Range start corresponds to 0 % Range end corresponds to 100 %
Exposure mode	Measurement mode
User group	Professional, password “000”
Data reduction	Inactive
Detection Threshold	2%
Error handling	Error output, no measured value
Measuring program	Distance measurement, “Standard matt”
Measuring Rate	1 kHz
Peak modulation	50 %

RS422	921.6 kBps
Switching output 1	Intensity error, switching level in case of error: Push Pull
Switching output 2	Measuring range error, switching level in case of error: Push Pull
Interface	EtherNet/IP
Signal Processing	01DIST1, moving averaging, 16 values
Synchronization	no synchronization
Key function	Change operating mode, dark correction, factory setting
Key Lock	Inactive
Trigger mode	No trigger

A 2.2 confocalDT IFD2411

Number of Peaks	1 measured value, highest peak
Region of interest	Range start corresponds to 0 % Range end corresponds to 100 %
Exposure mode	Measurement mode
User group	Professional, password “000”
Data reduction	Inactive
Detection Threshold	2%
Error handling	Error output, no measured value
Measuring program	Distance measurement, “Standard matt”
Measuring Rate	1 kHz
Peak modulation	50 %

RS422	921.6 kBps
Interface	EtherNet/IP
Signal Processing	01DIST1, moving averaging, 16 values
Synchronization	no synchronization
Key function	Change operating mode, dark correction, factory setting
Key Lock	Inactive
Trigger mode	No trigger

A 3 Adjustable Mounting Adapter JMA-xx

A 3.1 Functions

- Supports optimal sensor alignment for best possible measurement results
- Manual adjustment mechanism for easy and fast adjustment
  - Shift in X/Y: ±2 mm
  - Tilt angle: ±4°
- High resistance to shocks and vibrations due to radial clamping allows integration into machines
- Compatible with numerous confocalDT and interferoMETER sensor models

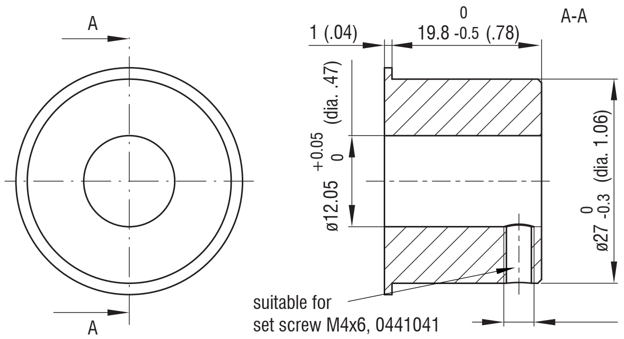
A 3.2 Sensor Mounting, Compatibility

Radial clamping for sensors with

ø 12 mm

Reducing sleeve
Adapter D27-D12

Sensor
- IFD2411-2



ø 27 mm

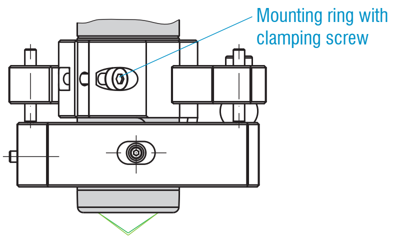
Sensor
- IFD2411-1
- FD2411-3
- IFD2411-6

A 3.3 Mounting

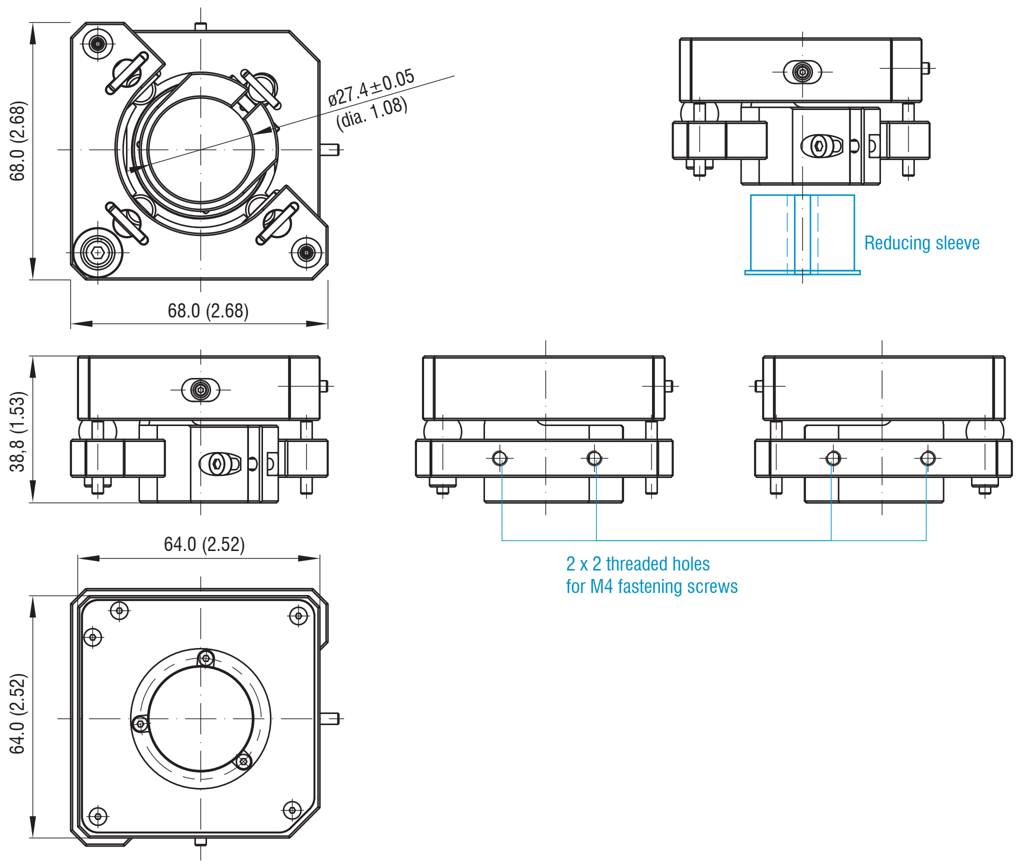
➡ Mount the sensor in the mounting ring, see figure.

➡ Use reducing sleeves for sensors with an outer diameter of less than 27 mm.

➡ Mount the mounting adapter with screws type M4, see dimensional drawing.



A 3.4 Dimensional Drawing of Mounting Adapter



A 3.5 Perpendicular Alignment of Sensor

➡ With the light source switched on, align the sensor with the measuring object.

Horizontal shift ±2 mm

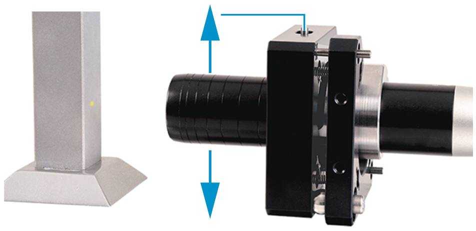
Shift to the left:

➡ Turn the hexagon socket screw clockwise

Shift to the right:

➡ Turn the hexagon socket screw counterclockwise

Vertical shift ±2 mm



Shift downwards:

➡ Turn the hexagon socket screw clockwise

Shift upwards:

➡ Turn the hexagon socket screw counterclockwise

Horizontal tilt angle ±4°

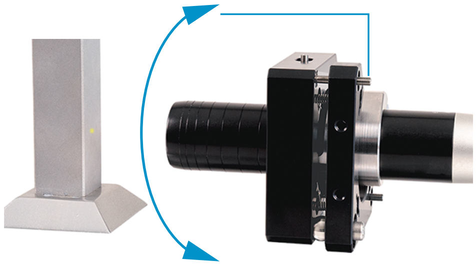
Tilt to the left:

➡ Turn the hexagon socket screw clockwise

Tilt to the right:

➡ Turn the hexagon socket screw counterclockwise

Vertical tilt angle ±4°



Shift downwards:

➡ Turn the hexagon socket screw clockwise

Shift upwards:

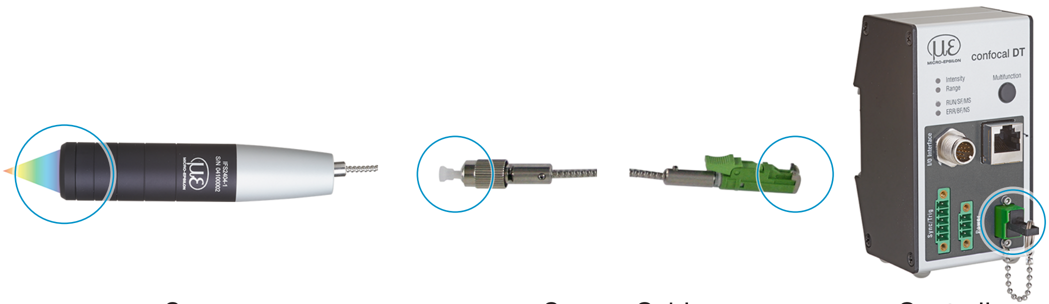
➡ Turn the hexagon socket screw counterclockwise

A 4 Cleaning Optical Components

A 4.1 Contamination

Contamination of optical surfaces and components can increase the dark value and affect sensitivity and accuracy. To prevent this, it is necessary to clean the optical components and record the dark value. “Dark value” refers to the interfering reflections at boundary surfaces along the optical signal path. At each boundary surface or material transition, the light waves are reflected to a certain extent at the transition and travel back in the fiber optics. The interfering signal overlaps with the useful signal and forms a kind of signal noise.

If the interference signal is sufficiently high and the useful signal is relatively weak, the useful signal can no longer be clearly identified. This may cause the controller to confuse a dark value peak with the measurement signal. Thus the calculated distance of the measuring object does not match the actual one.

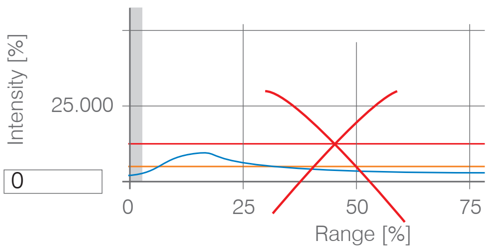


Sensor | Sensor Cable | Controller

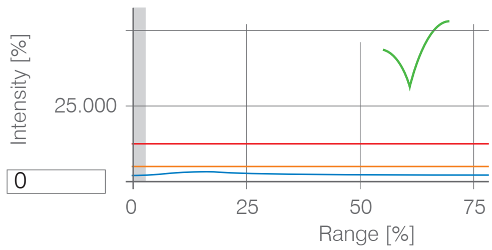
Protective glass | FC connector | E2000 connector

Fig. 80 Optical boundary surfaces of a confocal measuring system

➡ Conduct a dark correction, see Chap. 5.10.



Video signal before dark correction (high dark value, blue line)



Video signal after dark correction

If the video signal corresponds to the condition before the dark correction, you must clean the optical boundary surfaces within the measuring system. Clean the optical surfaces one by one to find the dirty component. You can observe how cleaning improves the result by watching the dark signal of the video signal.

➡ Continue with the section `Protective Glass of Sensor`.

i Check and clean the protective glass of the sensor at regular intervals depending on the operating conditions. Clean the system starting from the controller to the sensor. Always clean both components of a matched pair, i.e. plug and socket.

A 4.2 Tools and Cleaning Agents

One-Click™ Cleaner	Isopropyl alcohol	Q-Tip, suitable for clean rooms	Pressurized gas, dry and oil-free
			
For FC or E2000 type plug or socket	For the protective glass of the sensor	Use with isopropyl alcohol for protective glass of the sensor	Removes loose particles

A 4.3 Sensor Protective Glass

Loose particles

- Blow off loose particles with dry, oil-free pressurized air.

Stuck particles

- Clean the protective glass with a clean, soft, lint-free cloth or lens cleaning paper and pure alcohol (isopropyl alcohol).

For sensors with a small protective glass, e.g., the IFS2404-2(001) series:

- Soak a Q-Tip in isopropyl alcohol. Slowly rub the Q-Tip with a circular motion on the protective glass.

Fig. 81 Cross-section of protective glass

- Conduct a dark correction.

If the video signal corresponds to the condition before the dark correction, you must clean the boundary surfaces within the measuring system.

- Continue with the section `Interface between Controller and Sensor Cable`.

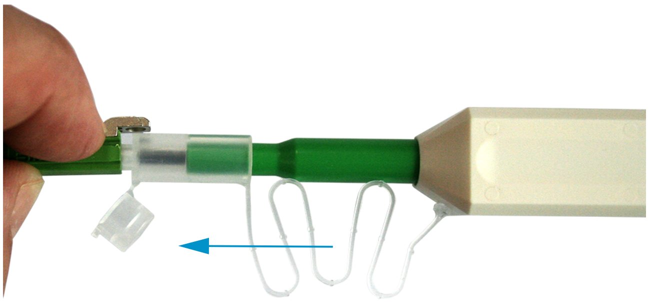
A 4.4 Interface between Controller and Sensor Cable

- Disconnect the sensor cable (fiber optic cable) from the controller.
- Remove the protective cap of the One-Click™ cleaner.
- Put the One-Click™ cleaner into the fiber optic connector of the controller, see figure.
- Press the outer sleeve of the One-Click™ cleaner onto the fiber optic connector until a click noise signalizes the end of cleaning.

Fig. 82 One-Click™ Cleaner *for cleaning E2000 optical fiber transitions*

- Plug the protective front cap on the controller into the optical fiber connection.

- Remove the front protective cap of the One-Click™ cleaner.
- Put the One-Click™ cleaner into the optical fiber, see figure.
- Press the outer sleeve of the One-Click™ cleaner onto the fiber optic connector until a click noise signalizes the end of cleaning.



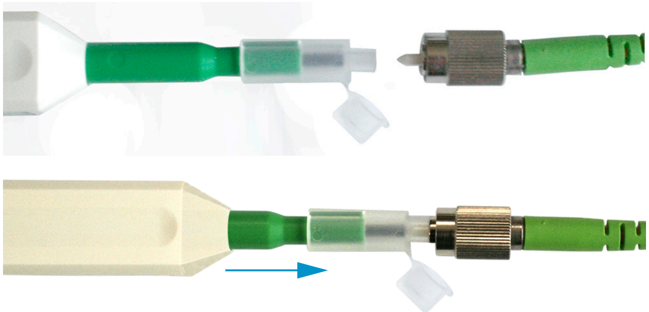
- Plug the sensor cable into the controller.
- Conduct a dark correction.

If the video signal corresponds to the condition before the dark correction, you must clean the boundary surfaces within the measuring system.

- Continue with the section `Interface between Sensor Cable and Sensor`.

A 4.5 Interface between Sensor Cable and Sensor

- Remove the sensor cable (fiber optic cable) from the sensor.
- Remove the front protective cap of the One-Click™ cleaner.
- Put the One-Click™ cleaner into the optical fiber, see figure.
- Press the outer sleeve of the One-Click™ cleaner onto the fiber optic connector until a click noise signalizes the end of cleaning.



- Plug a protective cap onto the optical fiber.

Sensor with optical fiber in the sensor:

- Remove the protective cap of the One-Click™ cleaner.
- Put the One-Click™ cleaner into the sensor, see figure.
- Press the outer sleeve of the One-Click™ cleaner onto the sensor until a click noise signalizes the end of cleaning.

- Put the sensor cable and sensor together.
- Conduct a dark correction.

If the video signal corresponds to the condition before the dark correction, you must clean the boundary surfaces within the measuring system.

- Continue with the section `Interface between Controller and Sensor Cable`.

A 4.6 Preventive Protection

Sensors and controllers of a confocal chromatic sensor system are supplied with protective caps. This prevents dust or similar contaminants from being deposited at the optical boundary surfaces.

- Cover all optical fiber connections immediately when replacing sensors or disconnecting a sensor cable from the controller.

A 5 ASCII Communication with Controller

A 5.1 General

The ASCII commands can be sent to the controller via the RS422 interface or Ethernet (Port 23). All commands, inputs and error reports are in English. A command always consists of the command name and zero or several parameters that are separated with a space and end in LF. If spaces are used in parameters, the parameter must be placed in quotation marks, e.g. “Password with space”.

Example: Switching on output via RS422

OUTPUT RS422 ↵

Note: ↵ Must contain LF, but can also be CR LF.

Explanation: LF Line feed (hex 0A)

CR Carriage return (hex 0D)

↵ Enter (depending on system, hex 0A or hex 0D0A)

The currently set parameter value is reset if a command is invoked without parameters.

The output format is:

<Command name> <Parameter1> [<Parameter2> […]]

The response can be used again without changes as a command for setting the password. Optional parameters are only returned as well if this is necessary.

After a command is processed, a line break and a prompt (“->”) is always returned. In the event of an error, an error message beginning withExx, where xx stands for a unique error number, comes before the prompt. Moreover, instead of error messages, warning messages (“Wxx”) may be output. Warnings are structured like error messages, such as “If Xenon lamp is too hot...”. Warnings do not prevent commands from being executed.

A 5.2 Commands Overview

Group	Chapter	Command	Brief information
General			
	Chap. A 5.3.1.1	HELP	Help
	Chap. A 5.3.2.2	GETINFO	Controller information
	Chap. A 5.3.1.3	ECHO	Reply type
	Chap. A 5.3.1.4	PRINT	Parameter overview
	Chap. A 5.3.1.5	SYNC	Synchronization
	Chap. A 5.3.1.6	TERMINATION	Termination resistor
	Chap. A 5.3.1.7	RESET	Boot sensor
	Chap. A 5.3.1.8	RESETCNT	Reset counter
User level			
	Chap. A 5.3.2.1	LOGIN	Change user level
	Chap. A 5.3.2.2	LOGOUT	Change to user level User
	Chap. A 5.3.2.3	GETUSERLEVEL	User level query
	Chap. A 5.3.2.4	STDUSER	Set standard user
	Chap. A 5.3.2.5	PASSWD	Change password
Inputs			
	Chap. A 5.3.3	MFILEVEL	Input level multifunction inputs
Sensor			
	Chap. A 5.3.4.1	SENSORTABLE	Display available sensors
	Chap. A 5.3.4.2	SENSORINFO	Information on sensor
	Chap. A 5.3.4.3	DARKCORR	Start dark correction
	Chap. A 5.3.4.4	LED	LED on/off
	Chap. A 5.3.4.5	LEDSOURCE	Control input measurement light source

Triggering			
	Chap. A 5.3.5.1	TRIGGERSOURCE	Trigger source
	Chap. A 5.3.5.2	TRIGGERAT	Effect of trigger input
	Chap. A 5.3.5.3	TRIGGERMODE	Trigger type
	Chap. A 5.3.5.4	TRIGGERLEVEL	Active level of trigger input
	Chap. A 5.3.5.5	TRIGGERSW	Generates a software trigger pulse
	Chap. A 5.3.5.6	TRIGGERCOUNT	Number of measured values to be specified
	Chap. A 5.3.5.7	TRIGINLEVEL	Trigger Level TrigIn (TTL / HTL)
	Chap. A 5.3.5.8	TRIGGERENCSTEPSIZE	Step Size Encoder Triggering
	Chap. A 5.3.5.9	TRIGGERENCMIN	Minimum Encoder Triggering
	Chap. A 5.3.5.10	TRIGGERENCMAX	Maximum Encoder Triggering
Encoder			
	Chap. A 5.3.6.1	META_ENCODERCOUNT	Number of Available Encoders
	Chap. A 5.3.6.2	ENCINTERPOLn	Setting Interpolation Depth
	Chap. A 5.3.6.3	ENCREFn	Setting the Reference Track
	Chap. A 5.3.6.4	ENCVALUEn	Setting Encoder Value
	Chap. A 5.3.6.5	ENCSET	Setting Encoder
	Chap. A 5.3.6.6	ENCRESET	Reset Encoder Value
	Chap. A 5.3.6.7	ENCMAXn	Setting Maximum Encoder Value
	Chap. A 5.3.6.8	ENCODERCOUNT	Number of Active Encoders
Interface			
	Chap. A 5.3.7	BAUDRATE	Setting RS422
Parameter Management, Load/Save Settings			
	Chap. A 5.3.8.1	BASICSETTINGS	Load Connection Settings
	Chap. A 5.3.8.2	CHANGESETTINGS	Show Changed Parameters
	Chap. A 5.3.8.3	EXPORT	Export Parameter Sets
	Chap. A 5.3.8.4	IMPORT	Import Parameter Sets
	Chap. A 5.3.8.5	SETDEFAULT	Set Factory Settings
	Chap. A 5.3.8.6	MEASSETTINGS	Edit Measurement Settings
Measurement			
	Chap. A 5.3.9.1	PEAKCOUNT	Number of Measurement Peaks
	Chap. A 5.3.9.2	MEASPEAK	Peak selection
	Chap. A 5.3.9.3	REFRACCORR	Refractivity Correction
	Chap. A 5.3.9.4	SHUTTERMODE	Exposure mode
	Chap. A 5.3.9.5	MEASRATE	Measuring frequency
	Chap. A 5.3.9.6	SHUTTER	Exposure time
	Chap. A 5.3.9.7	ROI	Range of interest
	Chap. A 5.3.9.8	MIN_THRESHOLD	Minimum Threshold Peak Detection
	Chap. A 5.3.9.9	PEAK_MODULATION	Modulation of Peaks
Material database			
	Chap. A 5.3.10.1	MATERIALTABLE	Material table
	Chap. A 5.3.10.2	MATERIAL	Select material
	Chap. A 5.3.10.3	MATERIALINFO	Show Material Property
	Chap. A 5.3.10.4	META_MATERIAL	Existing Materials, Material Names
	Chap. A 5.3.10.5	META_MATERIAL_PROTECTED	Protected Materials
	Chap. A 5.3.10.6	MATERIALEDIT	Edit Material Table
	Chap. A 5.3.10.7	MATERIALDELETE	Delete material
	Chap. A 5.3.10.8	MATERIALADD	Add Material

Edit measured value			
	Chap. A 5.3.11.1	STATISTIC	Selection of Signals for Statistics
	Chap. A 5.3.11.2	META_STATISTIC	List of Possible Statistics Signals
	Chap. A 5.3.11.3	STATISTICSIGNAL	Selection of Statistics signal
	Chap. A 5.3.11.4	META_STATISTICSIGNAL	List of Possible Statistics Signals to Select
	Chap. A 5.3.11.5	META_MASTERSIGNAL	List of Possible Signals to be Parameterized
	Chap. A 5.3.11.6	MASTERSIGNAL	Parameterization of Master Signals
	Chap. A 5.3.11.7	META_MASTER	List of Possible Signals for Mastering
	Chap. A 5.3.11.8	MASTER	Trigger Mastering
	Chap. A 5.3.11.9	MASTERSIGNALSELECT	Determine Signal for Mastering with External Source
	Chap. A 5.3.11.10	MASTERSOURCE	Select External Source for Mastering
	Chap. A 5.3.11.12	COMP	Calculation in Channel
	Chap. A 5.3.11.13	META_COMP	List of Possible Calculation Signals
	Chap. A 5.3.11.14	SYSSIGNALRANGE	Two-Point Scaling Data Outputs
Data Output			
	Chap. A 5.3.12.1	OUTPUT	Digital Output Selection
	Chap. A 5.3.12.2	OUTREDUCEDEVICE	Output Data Rate
	Chap. A 5.3.12.3	OUTREDUCECOUNT	Reduction Counter
	Chap. A 5.3.12.4	OUTHOLD	Error Handling
Selection of Measured Values to be Output via Interfaces			
	Chap. A 5.3.13.2	OUT_RS422	Data Selection for RS422
	Chap. A 5.3.13.3	META_OUT_RS422	List of Possible Signals RS422
	Chap. A 5.3.13.4	GETOUTINFO_RS422	List of Selected Signals, Sequence via Rs422
Switching Outputs			
	Chap. A 5.3.14.2	ERROROUTn	Selection of Error Signal for Output
	Chap. A 5.3.14.3	META_ERRORLIMITSIGNAL	List of Possible Signals for Error Output
	Chap. A 5.3.14.4	ERRORLIMITSIGNALn	Set Signal to be Evaluated
	Chap. A 5.3.14.5	ERRORLIMITCOMPARETOn	Set Limit Values
	Chap. A 5.3.14.6	ERRORLIMITVALUESn	Set Value
	Chap. A 5.3.14.7	ERRORLEVELOUTn	Switching Behavior of Switching Outputs
	Chap. A 5.3.14.8	ERRORHYSTERESIS	Switching Hysteresis of Switching Outputs
Analog Output			
	Chap. A 5.3.15.1	ANALOGOUT	Data Selection for Analog Output
	Chap. A 5.3.15.2	META_ANALOGOUT	List of Possible Signals for Analog Output
	Chap. A 5.3.15.3	ANALOGRANGE	Set Current/Voltage Range of Digital-to-Analog Converter (DAC)
	Chap. A 5.3.15.4	ANALOGSCALEMODE	Set Scaling for DAC
	Chap. A 5.3.15.5	ANALOGSCALERANGE	Set Scaling Range
System Settings for Key Functions			
	Chap. A 5.3.16.1	KEYLOCK	Selection of the Key Lock

A 5.3 General Commands

A 5.3.1 General

A 5.3.1.1 Help

```
HELP [<Command>]
```

Output help for each command. If no command is given, a general help is output.

A 5.3.1.2 Controller Information

```
GETINFO
```

Request sensor information. Output see example below:

```
->GETINFO
Name:             IFD2415-3/IE
Serial:           12345678
Option:           000
Article:          1234567
MAC address:      00-0C-12-01-E2-0C
Version:          004,004
Hardware-rev:     01
Boot version:     001,018
BuildID:          57
Output variant:   IE setup
->
```

Name: Model name of controller / controller series

Serial: Controller serial number

Option: Controller option number

Article: Controller article number

MAC address: Address of network adapter

Version: Version of software booted

Hardware-rev: Hardware revision used

Boot version: Bootloader version

BuildID: Identification number for software generated

A 5.3.1.3 Reply type

```
ECHO ON | OFF
```

The reply type describes the structure of a command reply.

ECHO ON: The command name and the command reply or an error message is output.

ECHO OFF: The command name and the command reply or an error message is output.

A 5.3.1.4 Parameter Overview

```
PRINT ALL
```

no parameters: This command outputs a list of all configuration parameters and their values.

- ALL : This command outputs a list of all configuration parameters and their values, such as sensor table or GETINFO, from

A 5.3.1.5 Synchronization

```
SYNC NONE | MASTER | SLAVE_SYNTRIG | SLAVE_TRIGIN
```

Set synchronization type:

- NONE: No synchronization
- MASTER: Controller is master, i.e., it outputs synchronization pulses at the Sync/Trig output
- SLAVE_SYNTRIG: Controller is slave and waits for synchronization pulses, e.g., from another IFC2421/2422/2465/2466 or similar pulse source, at the Sync/Trig input.
- SLAVE_TRIGIN: Controller is slave and waits for synchronization pulses from a frequency generator at the TrigIn input.

Input	Behavior
Sync/Trig	Differential
TrigIn	TTL / HTL

Sync/Trig is alternatively an input or an output, i.e. it must be ensured that one of the controllers is always switched to master and the other to slave.

The TrigIn input also serves as a trigger input for the trigger types edge and level triggering.

A 5.3.1.6 Termination Resistor at Sync/Trig

```
TERMINATION OFF | ON
```

The termination resistor 120 Ohm at the Sync/Trig synchronization input is switched on or off.

A 5.3.1.7 Boot Sensor

```
RESET
```

The controller is restarted.

A 5.3.1.8 Reset Counter

```
RESETCNT [TIMESTAMP] [MEASCNT]
```

The counter is reset after the selected trigger edge occurs.

- TIMESTAMP: resets the timestamp
- MEASCNT: resets the measured value counter

A 5.3.2 User level

A 5.3.2.1 Change User Level

```
LOGIN <Password>
```

Enter the password to access another user level. There are the following user levels:

- USER: Read access to all elements + use of web diagrams
- PROFESSIONAL: Read/write access to all elements

A 5.3.2.2 Switch to User Level

```
LOGOUT
```

Set user level to USER.

A 5.3.2.3 User Level Query

```
GETUSERLEVEL
```

Queries the current user level.

Possible outputs, see Chap. A 5.3.2.1, “Change User Level”.

A 5.3.2.4 Set Standard User

```
STDUSER USER|PROFESSIONAL
```

Sets the standard user who is logged in after the system starts.

A 5.3.2.5 Change Password

```
ASSWD <Old password> <New password> <New password>
```

Change the password for the PROFESSIONAL user. The factory standard password is “000”.

For this, the old password must be entered and the new password must be entered twice. If the new passwords do not match, an error message will be output. The password function is case-sensitive. A password may only contain the letters A to Z and numbers without umlauts/special characters. The maximum length is limited to 31 characters.

A 5.3.3 Level of Multifunction Inputs

```
MFILEVEL HTL | TTL
```

Selection of input level of the multifunction inputs. (MFI).

- HTL: HTL level
- TTL: TTL level

A 5.3.4 Sensor

A 5.3.4.1 Information on Calibration Tables

```
SENSORTABLE
```

```
->SENSOR TABLE
Position      Sensor name,        Measurement range,    Serial number
0,             IFS2404-3,         3.000mm,              05110005
1,             IFS2404-6,         6.000mm,              05120003
2,             IFS2404-2,         2.000mm,              00001335
->
```

Output of all available (taught-in) sensors.

The SENSORTABLE command is valid for the IFD2411.

A 5.3.4.2 Sensor Information

```
SENSORINFO
```

Output of information about the sensor (name, measuring range and serial number).

```
->SENSORINFO
Position:                 0
Name:                     BG
Measurement range:        3,000 mm
Serial:                   12345678
->
```

A 5.3.4.3 Dark Correction

```
DARKCORR
```

Performing the dark referencing for the current sensor. The dark referencing depends on the sensor and is saved separately for each individual sensor in the controller.

```
DARKCORR_PRINT
```

Lists the values of the dark correction table.

A 5.3.4.4 LED

```
LED OFF | ON
```

Switches the LED of the respective channel on or off.

A 5.3.4.5 Control Input Measurement Light Source

```
LEDSOURCE [SOFTWAREONLY | MFI1 | MFI2]
```

- SOFTWAREONLY: The measurement light source can only be controlled by software; via ASCII command LED ON/OFF or web interface
- MFI1: Control of the measurement light source via selected multifunction input MFI1
- MFI2: Control of the measurement light source via selected multifunction input MFI2

A 5.3.5 Triggering

A 5.3.5.1 Select Trigger Source

```
TRIGGERSOURCE NONE | SYNCTRIG | TRIGIN | SOFTWARE | ENCODER1 | ENCODER2
```

- NONE: No trigger source used
- SYNCTRIG: Use input `Sync/Trig`
- TRIGIN: Use the input `TrigIn`
- SOFTWARE: Triggering is initiated by the command TRIGGERSW.
- ENCODER1: Encoder triggering of encoder 1
- ENCODER2: Encoder triggering of encoder 2

A 5.3.5.2 Output of Triggered Values, with/without Averaging

```
TRIGGERAT INPUT | OUTPUT
```

- INPUT: Triggers measured value acquisition. Values measured immediately before the trigger event are not included in the average value calculation, but older measured values that were output during previous trigger events are included instead.
- OUTPUT: Triggers measured value output. Values measured immediately before the trigger event are included in the average value calculation.

Triggering of data recording is active as a factory setting.

A 5.3.5.3 Trigger Type

```
TRIGGERMODE EDGE | PULSE
```

Selection of trigger type.

- PULSE: Level triggering
- EDGE: Edge triggering

A 5.3.5.4 Active Level of Trigger Input

```
TRIGGERLEVEL HIGH | LOW
```

- HIGH: Edge triggering: Rising edge, level triggering: High active
- LOW: Edge triggering: Falling edge, level triggering: Low active

A 5.3.5.5 Software Trigger Pulse

```
TRIGGERSW
```

Generates a software trigger pulse when the trigger source is set to software.

A 5.3.5.6 Number of Measured Values to be Output

```
TRIGGERCOUNT NONE | INFINITE | <n>
```

- NONE: Stop triggering
- <n>: Number of measured values to be output after a trigger pulse (with edge triggering or software triggering)
- Infinite: Start of an infinite measured value output after a trigger pulse (with edge triggering or software triggering)

A 5.3.5.7 Level Section Trigger Input TrigIn

```
TRIGINLEVEL TTL | HTL
```

The level selection only applies to the input `TrigIn`. The input `Sync/Trig` waits for a differential signal.

- TTL: Input waits for TTL signal.
- HTL: Input waits for HTL signal.

A 5.3.5.8 Step Size Encoder Triggering

```
TRIGGERENCSTEPSIZE [value of step size]
```

Sets the number of encoder steps after which a measured value is output each time (min: 0, max: 2^{31}-1). At 0, measured values are continuously output between min and max.

A 5.3.5.9 Minimum Encoder Triggering

```
TRIGGERENCMIN [minimum value]
```

Sets the minimum encoder value starting at which triggering takes place (min: 0 max: 2^{32}-1).

A 5.3.5.10 Maximum Encoder Triggering

```
TRIGGERENCMAX [maximum value]
```

Sets the maximum encoder value up to which triggering takes place (min: 0 max: 2^{32}-1).

A 5.3.6 Encoder

A 5.3.6.1 Number of Available Encoders

```
META_ENCODERCOUNT
```

Lists the number of available encoders that can be selected with ENCODERCOUNT.

A 5.3.6.2 Encoder Interpolation Depth

```
ENCINTERPOL1 1 | 2 | 3
ENCINTERPOL2 1 | 2 | 3
ENCINTERPOL3 1 | 2 | 3
```

Sets the interpolation depth of the respective encoder input.

- 1 - Single interpolation
- 2 - Dual interpolation
- 3 - Quadruple interpolation

A 5.3.6.3 Effect of Reference Track

```
ENCREF1 NONE | ONE | EVER
ENCREF2 NONE | ONE | EVER
```

Sets the effect of the encoder reference track.

- NONE: Encoder reference marker has no effect.
- ONE: One-time setting (the first time the reference marker is reached, the encoder value, see Chap. A 5.3.6.4 will be adopted).
- EVER: Setting for all markers (every time the reference marker is reached, the encoder value, see Chap. A 5.3.6.4 will be adopted).

A 5.3.6.4 Encoder value

```
ENCVALUE1 <encoder value>
ENCVALUE2 <encoder value>
ENCVALUE3 <encoder value>
```

Indicates the value which the corresponding encoder should be set to when a reference marker is reached (or via software).

The encoder value can be between 0 and 2^{32}-1.

Setting the ENCVALUE automatically resets the algorithm for recognizing the first reference marker, see Chap. A 5.3.6.3.

A 5.3.6.5 Set Encoder Value via Software

```
ENCSET 1 | 2 | 3
```

Set the encoder value, see Chap. A 5.3.6.4, in the specified encoder via software (only possible with ENCREF NONE, otherwise the command immediately returns without an error message).

A 5.3.6.6 Reset Detection of First Reference Marker

```
ENCRESET 1 | 2
```

Resets the detection of the first reference marker, see Chap. A 5.3.6.3 (only possible with ENCREF ONE, otherwise the command immediately returns without an error message).

A 5.3.6.7 Maximum Encoder Value

```
ENCMAX1 <encoder value>
ENCMAX2 <encoder value>
ENCMAX3 <encoder value>
```

Indicates the maximum value of the encoder after which the encoder jumps back to 0. Can be used for rotary encoders without reference track.

The encoder value can be between 0 and 2^{32}-1.

A 5.3.6.8 Number of Active Encoders

```
ENCODERCOUNT 1 | 2 | 3
```

- 1: Encoder 1 is active, encoders 2 and 3 are inactive
- 2: Encoders 1 and 2 are active, encoder 3 is inactive
- 3: Encoder 1 to 3 are active

Command is valid with the IFD2410/2415.

A 5.3.7 Setting the RS422 Baud Rate

```
BAUDRATE <Baudrate>
```

Baud rates can be set in Bps for the RS422 interface:

9600, 115200, 230400, 460800, 691200, 921600, 2000000, 3000000, 4000000

A 5.3.8 Parameter Management, Load/Save Settings

A 5.3.8.1 Load / Save Connection Settings

```
BASICSETTINGS READ | STORE
```

- READ: Reads the connection settings from the controller flash.
- STORE: Saves the current connection settings from the controller RAM to the controller flash.

A 5.3.8.2 Show Changed Parameters

```
CHANGESETTINGS
```

Outputs all changed settings.

A 5.3.8.3 Export Parameter Sets to PC

```
EXPORT (MEASSETTINGS <SetupName>) | BASICSETTINGS | MEASSETTINGS_ALL | MATERIALTABLE |
ALL
```

Saves parameters in an external device, e.g. PC.

The export file is formatted as readable JavaScript Object Notation, or JSON for short.

- MEASSETTINGS <SetupName>: Exports the specified measurement settings. Nothing is deleted before importing.
- BASICSETTINGS: Export the currently saved basic settings. The basic settings are deleted before importing.
- MEASSETTINGS_ALL: Export all saved measurement settings, including the initial setting. All existing measurement settings are deleted before importing.
- MATERIALTABLE: Exports the saved material table. The existing material table is deleted before importing.
- ALL: Complete export of all saved settings (Basic and Meas), the material table and all sensor data saved. Everything is deleted before importing.

A 5.3.8.4 Import Parameter Sets from PC

```
IMPORT [FORCE] [APPLY] <Data>
```

Loads parameters from an external device, e.g. PC.

The import file is a JSON file previously saved with export.

- FORCE: Overwrite `measurement settings` with the same name, otherwise an error message is returned if the names are the same. If all `measurement settings` or `basic settings` are imported, `Force` must always be specified.
- APPLY : Apply the settings after importing and reading the initial settings.

A 5.3.8.5 Factory Settings

```
SETDEFAULT ALL | MEASSETTINGS | BASICSETTINGS | MATERIAL
```

Set the default values (reset to factory settings), delete the corresponding settings in the flash.

- ALL: All setups are deleted and the default parameters are loaded. The current material table is also overwritten by the standard material table.
- MEASSETTINGS: Settings for measurement task.
- BASICSETTINGS: Basic settings such as IP, baud rate, language, unit.
- MATERIAL: Only overwrite the current material table with the standard material table.

A 5.3.8.6 Editing, Storing, Displaying, Deleting Measurement Settings

```
MEASSETTINGS <Subcommand> [<Name>]
```

Settings for measurement task. Moves application-dependent measurement settings between controller RAM and controller flash. Either the manufacturer-specific presets or the user-defined settings are used. Each preset can be used as a user-defined setting.

Subcommands:

PRESETMODE <mode>	Defines the preset dynamics.
<mode> = NONE|STATIC|BALANCED|DYNAMIC	With NONE, there is no selection for a preset.
PRESETLIST	Lists all existing presets (names): “Name1” “Name2” “…”
READ <Name>	Loads a basic setting or measurement setting/preset (specify name) from the controller flash.
STORE <Name>	Saves a basic setting or measurement setting in the controller flash. Enter name or it will be saved under the current name.
DELETE <Name>	Deletes the named measurement setting from the controller flash.
RENAME <NameOld> <NameNew> [FORCE]	Changes the name of a measurement setting in the controller flash. An existing measurement setting can be overwritten with FORCE.
LIST	Lists all saved measurement settings (names) “Name1” “Name2” “...”. The order is based on the internal slot numbers, that is, not the order of saving.
CURRENT	Outputs the current measurement setting / preset (name)
INITIAL AUTO	Loads the last saved setting when the controller is started or the first preset if no setups are present.
INITIAL <Name>	Loads a named measurement setting upon starting the controller. Presets cannot be entered.

A 5.3.9 Measurement

A 5.3.9.1 Peak count

```
PEAKCOUNT <n>
```

Indicates the maximum number of peaks to be evaluated.

- For distance measurement <n> = 1
- For thickness measurement <n> = 2
- For multi-layer measurement <n> >2

A 5.3.9.2 Peak Selection

```
MEASPEAK F_L|L_SL|F_S|H_SH
```

Selection of the peaks used for the measurement

Distance measurement		Thickness measurements	
F_L:	first peak	F_L:	first and last peak
L_SL:	last peak	L_SL:	second-last and last peak
F_S:	first peak	F_S:	first and second peak
H_SH:	highest peak	H_SH:	highest and second highest

A 5.3.9.3 Number of Peaks and Switching Refractivity Correction On/Off

```
REFRACCORR on | off
```

- On: The refractivity correction is carried out with the set materials, standard setting.
- Off: The refractivity index 1.0 is assumed for all layers.

A 5.3.9.4 Exposure Mode

```
SHUTTERMODE MEAS|MANUAL|2TIMEALT|2TIMES
```

- MEAS: Automatic exposure time control with fixed measuring rate, recommended for measurement
- MANUAL: Selectable exposure time and measuring rate.
- 2TIMEALT: Mode with 2 manually set exposure times which are always applied alternately, for 2 peaks of very different height in the thickness measurement. We recommend using this mode in particular if the smaller peak disappears or the larger one is overmodulated.
- 2TIMES: Fastest mode with two manually preset exposure times. The more suitable time is automatically selected. Recommend for distance measurement for rapidly changing surface properties, such as mirrored or anti-glare glass.

A 5.3.9.5 Measuring rate

```
MEASRATE <measuring rate>
```

Enter the measuring rate in kHz:
IFD2410, IFD2411: Value range 0.100 … 8.000;
IFD2415: Value range 0.100 … 25.000.

A maximum of three decimal places can be specified, e.g. 0.100 for 0.1 kHz.

A 5.3.9.6 Exposure Time

```
SHUTTER <exposure time1> [<exposure time2>]
```

Indication of exposure times for manual and two-time exposure modes.

The exposure time is processed with three decimal places. The minimum step size is 0.1 μs.

A 5.3.9.7 Range of Interest (ROI)

```
ROI <Start> <End>
```

Sets the range of interest for the respective channel. Start and end must be between 0 and 511. The entry is made in the unit pixels. The start value must be less than the end value.

A 5.3.9.8 Minimum Threshold Peak Detection

```
MIN_THRESHOLD <n>
```

Sets the minimum detection threshold. A peak must be above this threshold for it to be recognized as peak.

The entry is made in % and relates to the dark corrected signal.

A 5.3.9.9 Peak Modulation

```
PEAK_MODULATION <n>
```

Specifies the peak modulation through so that peaks running into each other are separated. At 100%, there is no peak separation and at 0% (factory setting), all peaks are separated.

This way, the relevant peak artefacts can be removed or not be considered as individual peaks.

A 5.3.10 Material Database

A 5.3.10.1 Material Table

```
MATERIALTABLE
```

Output of the material table saved in the controller.

```
->MATERIALTABLE
                                   Refraction index              Abbe number
Item,  Name,         nF at 486nm,  nd at 587nm,  nC at 656nm,      vd          Description
0      Vacuum,       1.000000,     1.000000,     1.000000,         0.000000    Vacuum; air (approximate)
1      Water,        1.337121,     1.333044,     1.331152,         0.000000
1      Ethanol,      1.361400,     1.361400,     1.361400,         0.000000
7      PC,           1.599439,     1.585470,     1.579864,         0.000000    Polycarbonate
8      Quartz glass, 1.463126,     1.458464,     1.456367,         0.000000    Silicon dioxide, fused silica
9      BK7,          1.522380,     1.516800,     1.514320,         0.000000    Crown glass
->
```

A 5.3.10.2 Select Material

```
MATERIAL <Materialname>
```

Change the material between distance 1 and 2 for the respective channel.

The material name must be entered, including spaces. The command supports case sensitive input, distinguishing between uppercase and lowercase letters. The maximum length of the material name is 30 characters.

A 5.3.10.3 Show Material Property

```
MATERIALINFO
```

Output of the material properties of the selected layer. Layer 1 is between distance 1 and 2, Layer 2 between distance 2 and 3, etc. If there are no parameters, the information on layer 1 is output.

Example:

```
->MATERIALINFO
Name:                             BK7
Description:                      Crown glass
Refraction index nF at 486nm:     1.522380
Refraction index nd at 587nm:     1.516800
Refraction index nC at 656nm:     1.514320
Abbe value vd:                    0.000000
->
```

A 5.3.10.4 Existing Material in Controller

```
META_MATERIAL
```

Lists the material names already saved in the controller.

A 5.3.10.5 Protected Materials in Controller

```
META_MATERIAL_PROTECTED
```

Displays a list of all material names saved in the controller during calibration. These materials cannot be edited or deleted.

Displays a list of all material names saved in the controller during calibration. These materials cannot be edited or deleted.

A 5.3.10.6 Edit Material Table

```
MATERIALEDIT <Name> <Description> (NX <nF> <nd> <nC>)|(ABBE <nd> <vd>)
```

Edits an existing material. A material is characterized either by three refractive indices or by one refractive index and Abbe number.

- Name: Name of the material
- Description: Brief description of the material
- nF: Refractivity index nF at 670 nm (1.000000 ... 4.000000)
- nd: Refractivity index nd at 587 nm (1.000000 ... 4.000000)
- nC: Refractivity index nC at 656 nm (1.000000 ... 4.000000)
- vd: Abbe value (10.000000 ... 100.000000)

If the material name has already been assigned, this material will be edited. Otherwise, a new material will be created.

There is a maximum of 20 materials.

A 5.3.10.7 Delete a Material

```
MATERIALDELETE <Name>
```

Deletes a material.

- Name: Name of the material (length: max. 30 characters)

A 5.3.10.8 Add Material

```
MATERIALADD <Name> <Description> (NX <nF> <nd> <nC>)|(ABBE <nd> <vd>)
```

Adds a material to the material table. A material is characterized either by three refractive indices or by one refractive index and Abbe number.

- Name: Name of the material
- Description: Brief description of the material
- nF: Refractivity index nF at 670 nm (1.000000 ... 4.000000)
- nd: Refractivity index nd at 587 nm (1.000000 ... 4.000000)
- nC: Refractivity index nC at 656 nm (1.000000 ... 4.000000)
- vd: Abbe value (10.000000 ... 100.000000)

A 5.3.11 Edit measured value

A 5.3.11.1 Statistical Calculations

```
STATISTIC <signal> RESET
```

Resets individual statistics.

- <signal>: Statistical data Minimum, Maximum or Peak-Peak

A 5.3.11.2 List of Statistics Signals

```
META_STATISTIC
```

Provides a list of the active statistics signals.
These signals were defined under `STATISTICSIGNAL`.

A 5.3.11.3 Selection of Statistics Signal

```
STATISTICSIGNAL <signal>
```

The statistics are created for the selected signal. A list of possible signals can be found by using the command `META_STATISTICSIGNAL`.

New signals will be created, which can then be output via the interfaces.

- <signal>_MIN --> Minimum signal
- <signal>_MAX --> Maximum signal
- <signal>_PEAK --> <signal>_max - <signal>_min

A 5.3.11.4 List of Possible Statistics Signals to Select

```
META_STATISTICSIGNAL
```

Lists all possible signals that can be included in the statistics.

A 5.3.11.5 List of Possible Signals to be Parameterized

```
META_MASTERSIGNAL
```

Lists all possible signals that can be used for mastering.

A 5.3.11.6 Parameterization of Master Signals

```
MASTERSIGNAL [<signal>]
MASTERSIGNAL <signal> <master value>
MASTERSIGNAL <signal> NONE
```

Defines the signal to be mastered. The parameter `NONE` resets the signal. The function itself is triggered with MASTER.

- <signal>: select a specific measured or calculated signal which the master value is to be set to; see META_MASTERSIGNAL
- <master value> master value in mm, value range: -2147.0 ... 2147.0

A 5.3.11.7 List of Possible Signals for Mastering

```
META_MASTER
```

Lists all defined master signals from the `MASTERSIGNAL` command. These can be used with the command `MASTER`.

A 5.3.11.8 Mastering / Zeroing

```
MASTER [<signal>]
MASTER [ALL|<signal> [SET|RESET]]
```

The `MASTER` command is not channel-specific. There are up to 10 master signals in the controller. These 10 signals can be applied to any internally determined value, including calculated values.

This command sets or resets the mastering for the corresponding signal.

- ALL: use all signals for mastering
- <signal>: use a specific measured or calculated signal for mastering
- SET|RESET: Start or end function

If the master value is 0, the mastering function has the same functionality as zeroing.

The master command waits a maximum of 2 seconds for the next measured value and uses this as the master value. If no measured value was recorded within this time, in case of external triggering, for example, the command returns with the error “E32 Timeout”. The master value is processed with six decimal places.

A 5.3.11.9 Signal for Mastering with External Source

Select the measured or calculated signal that can be mastered with the multifunction inputs or with an external source. META_MASTER provides a list of all defined master signals. The signals are configured using MASTERSIGNAL.

```
MASTERSIGNALSELECT [ALL | NONE | <signal1> [ | <signal2> [...]]]
```

- ALL: All configured signals are mastered with the selected input source.
- NONE: no mastering.
- signal: Signal is mastered with external source

A 5.3.11.10 Mastering with External Source

```
MASTERSOURCE [NONE|MFI1|MFI2]
```

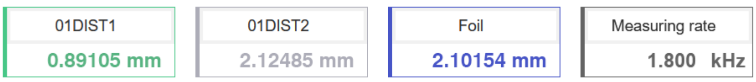
Select the input with which a mastering/zeroing is to be triggered.

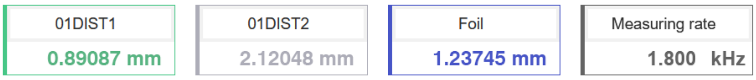
- NONE: No port selected. (Controlling by commands is possible.)
- MFI1: Use MFI1-port to control the mastering function.
- MFI2: Use MFI2-port to control the mastering function.

A 5.3.11.11 Example of Mastering

For the example, the preset option `Standard matt "Opposite thickness measurement"` was selected in the controller; execution of the commands with the Telnet program, no variables are defined.

->o 169.254.168.150	

->META_MASTERSIGNAL META_MASTERSIGNAL 01DIST1 01DIST1 FOIL	// List all variables that can be mastered to
->META_MASTER META_MASTER NONE	// List all variables that have been assigned a master value
->MASTERSIGNAL 01DIST1 1.0 ->MASTERSIGNAL FOIL 2.1	// Set variable 01DIST1 to the value 1.0 // Set variable FOIL to the value 2.1
->META_MASTER META_MASTER 01DIST1 FOIL	// List all variables that have been assigned a master value; the variable 01DIST1 has now been assigned
->MASTER ALL MASTER 01DIST1 INACTIVE MASTER FOIL INACTIVE MASTER NONE ... MASTER NONE MASTER NONE	// List all 10 possible variables and show their status 
->MASTER ALL SET	// Triggers a master measurement for all assigned variables 
->MASTER 01DIST1 RESET	// the offset (master value) is undone for the variable 01DIST1 

->MASTER ALL MASTER 01DIST1 INACTIVE MASTER FOIL ACTIVE MASTER NONE ... MASTER NONE MASTER NONE	
->MASTER FOIL RESET	// the offset (master value) is undone for the variable FOIL 
->MASTERSIGNAL 01DIST1 NONE ->MASTERSIGNAL FOIL NONE	// The variable 01DIST1 is deleted // The variable FOIL is deleted
->MASTER ALL MASTER NONE ... MASTER NONE	// no variable which a master measurement could be applied to is present

A 5.3.11.12 Calculation in channel

```
COMP [<channel> [<id>]]
COMP <channel> <id> MEDIAN <signal> <median data count>
COMP <channel> <id> MOVING <signal> <moving data count>
COMP <channel> <id> RECURSIVE <signal> <recursive data count>
COMP <channel> <id> CALC <factor1> <signal> <factor2> <signal> <offset> <name>
COMP <channel> <id> THICKNESS <signal> <signal> <name>
COMP <channel> <id> COPY <signal> <name>
COMP <channel> <id> NONE
```

This command defines all channel-specific as well as controller-specific calculations.

- <channel> CH01|CH02|SYS
  Channel selection
- <id> 1...10
  Calculation block number
- <signal>
  Measuring signal; you can query the available signals with the command META_COMP
- <median data count> 3|5|7|9
  Averaging depth median
- <moving data count> 2|4|8|16|32|64|128|256|512|1024|2048|4096
  Averaging depth moving average
- <recursive data count> 2 ... 32000
  Averaging depth recursive average
- <factor1>, <factor2> -32768.0 … 32767.0
  Multiplication factor
- <offset> -2147.0 ... 2147.0
  Correction value in mm
- <name>
  Name of calculation block; length min. 2 characters, max. 15 characters. Permitted characters a-zA-Z0-9, the name must start with a letter.

  Command names such as STATISTIC, MASTER, CALC, NONE, ALL are not permitted.

You can use the COMP command to create new calculation blocks, modify or delete calculation blocks.

Functions:

- MEDIAN, MOVING and RECURSIVE: Averaging functions
- CALC: Calculation function according to formula
  (<factor1> * <signal>) + (<factor2> * <signal>) + <offset>
- Thickness: Thickness calculation according to the formula <signal B>) - <signal A> under the condition that signal B is larger than signal A
- COPY: Duplicates a signal; the effect can also be achieved with the command CALC, e.g. with (1 * <signal>) + (0 * <signal>) + 0
- NONE: deletes a calculation block

A 5.3.11.13 List of Possible Calculation Signals

```
META_COMP
```

Lists all possible signals that can be used in the calculation.

A 5.3.11.14 Two-Point Scaling Data Outputs

```
SYSSIGNALRANGE <start of range> <end of range>
```

The values determined from the calculation can be greater than the values that the controller can display. The range of values is determined with this command.

Default is 0 to 10 mm

A 5.3.12 Data Output

A 5.3.12.1 Digital Output Selection

```
OUTPUT [NONE|([RS422 | IE] [ANALOG] [ERROROUT])]
```

- NONE: No output of measured values
- RS422: Output of measured values via RS422
- IE: Output of measured values via Industrial Ethernet, parallel with RS422 is possible
- ANALOG: Output of measured values via analog output
- ERROROUT: Error or status information via the error outputs

Command starts the output of measured values. The connection to the measured value server can already exist or can now be established.

A 5.3.12.2 Output Data Rate

```
OUTREDUCEDEVICE [NONE|([RS422] | [ANALOG])]
```

Reduction of output of measured values via specified interfaces.

- NONE: No reduction of output of measured values
- RS422: Reduction of output of measured values via RS422
- ANALOG: Reduction of output of measured values via analog interface

A 5.3.12.3 Reduction Counter for Output of measured values

```
OUTREDUCECOUNT <count>
```

Reduction counter for output of measured values.

Only each nth measured value is output. The other measured values are rejected.

- Number: 1...3000000 (1 means all frames)

A 5.3.12.4 Error Handling

```
OUTHOLD NONE|INFINITE|<count>
```

Sets the measured value output behavior in the event of an error.

- NONE: Last measured value not held; error value output
- INFINITE: Last measured value held indefinitely
- Number: Holds the last measured value via measurement cycle count and then outputs the error value (maximum 1024)

A 5.3.13 Selection of Measured Values to be Output

A 5.3.13.1 General

Setting the values to be output via the RS422 interface.

A limitation of the data volume via the RS422 depends on the measuring frequency and the baud rate.

In multi-layer measurement mode, any desired distances and differences can be selected for output.

A 5.3.13.2 Data Selection for RS422

```
OUT_RS422
```

Describes which data is output via this interface.

A 5.3.13.3 List of Possible Signals for RS422

```
META_OUT_RS422
```

List of possible data for the RS422.

A 5.3.13.4 List of Selected Signals, Sequence via Rs422

```
GETOUTINFO_RS422
```

Returns the order of the signals via this interface.

A 5.3.14 Switching Outputs

A 5.3.14.1 General

Commands are valid for the IFD2410/2415.

A 5.3.14.2 Error - Switching Outputs

```
ERROROUT1 [01ER1|01ER2|01ER12|ERRORLIMIT]
ERROROUT2 [01ER1|01ER2|01ER12|ERRORLIMIT]
```

Setting the error switching outputs.

- 01ER1: Switching output is switched in the event of an intensity error
- 01ER2: Switching output is switched in the event of a measuring range error
- 01ER12: Switching output is switched in the event of an intensity error or a measuring range error
- ERRORLIMIT: Switching output is switched when the measured value is outside the limit values; the basis is formed by the settings for ERRORLIMITSIGNAL1/2, ERRORLIMITCOMPARETO1/2 and ERRORLIMITVALUES1/2.

A 5.3.14.3 List of Possible Signals for Error Output

```
META_ERRORLIMITSIGNAL1
META_ERRORLIMITSIGNAL2
```

List of all signals that are possible for the ERRORLIMITSIGNALn command.

A 5.3.14.4 Set Signal to be Evaluated

```
ERRORLIMITSIGNAL1 [<signal>]
ERRORLIMITSIGNAL1 [<signal>]
```

Selection of the signal to be used for the limit value analysis.

A 5.3.14.5 Set Limit Values

```
ERRORLIMITCOMPARETO1 [LOWER | UPPER |BOTH]
ERRORLIMITCOMPARETO2 [LOWER | UPPER |BOTH]
```

Specifies whether the output should activate upon

- LOWER --> undershot
- UPPER --> exceeded
- BOTH --> undershot or exceeded

A 5.3.14.6 Set Value

```
ERRORLIMITVALUES1 [<lower limit [mm]> <upper limit [mm]>]
ERRORLIMITVALUES2 [<lower limit [mm]> <upper limit [mm]>]
```

Sets the values for Lower and Upper limit values.

- <lower limit [mm]> = -2147.0 ... 2147.0
- <upper limit [mm]> = -2147.0 ... 2147.0

A 5.3.14.7 Switching Behavior of Error Outputs

```
ERRORLEVELOUT1 [PNP|NPN|PUSHPULL|PUSHPULLNEG]
ERRORLEVELOUT2 [PNP|NPN|PUSHPULL|PUSHPULLNEG]
```

Switching behavior of error outputs Error 1 and Error 2.

- PNP: Switching output is High in the case of an error and open without error
- NPN: Switching output is Low in the case of an error and open without error
- PUSHPULL: Switching output is High in the case of an error and Low without error
- PUSHPULLNEG: Switching output is Low in the case of an error and High without error

A 5.3.14.8 Switching Hysteresis of Error Outputs

```
ERRORHYSTERESIS1 <hysteresis [mm]>
ERRORHYSTERESIS2 <hysteresis [mm]>
```

Sets the hysteresis for the switching outputs, see also function ERRORLIMIT.

- <hysteresis [mm]> = (0..2) * measurement range [mm]

A 5.3.15 Analog Output

A 5.3.15.1 Data Selection

```
ANALOGOUT signal
```

Selection of the signal to be output via the analog output. The signal is specified as a parameter. A list with the possible signals can be shown with META_ANALOGOUT, see Chap. A 5.3.15.2.

A 5.3.15.2 List of Possible Signals for Analog Output

```
META_ANALOGOUT
```

Lists all signals that can be connected to the analog output.

A 5.3.15.3 Output Range

```
ANALOGRANGE 0-5V | 0-10V | 4-20mA
```

- 0-5 V: The analog output puts out a voltage of 0 to 5 volts.
- 0-10 V: The analog output puts out a voltage of 0 to 10 volts.
- 4-20mA: The analog output puts out a current of 4 to 20 milliamperes.

A 5.3.15.4 Set Scaling for DAC

```
ANALOGSCALEMODE STANDARD | TWOPOINT
```

Selects whether to use one-point or two-point scaling of the analog output.

- STANDARD --> One-point scaling
- TWOPOINT --> Two-point scaling

The standard scaling is configured for distances -MB/2 to MB/2 and for thickness measurement from 0 to 2 MB (MB=measuring range).

Minimum and maximum measured values must be specified in millimeters. The available output range of the analog output is then spread between the minimum and maximum measured values. The minimum and maximum measured values must be between -2147.0 and 2147.0.

The minimum and maximum measured values are processed with three decimal places.

A 5.3.15.5 Set Scaling Range

```
ANALOGSCALERANGE <limit 1> <limit 2>
```

Two-point scaling requires the start and end of the range to be entered in millimeters.

- <limit 1> = (-2147.0 ... 2147.0) [mm], and different from <limit 2>.
- <limit 2> = (-2147.0 ... 2147.0) [mm], and different from <limit 1>.

The values cannot be identical.

A 5.3.16 System Settings

A 5.3.16.1 Key Lock

```
KEYLOCK NONE | ACTIVE | (AUTO [<value>])
```

Selection of the key lock.

- NONE: Key always functions; no key lock
- ACTIVE: Key lock activates immediately upon restart
- AUTO: Key lock is only activated <time> minutes after restart, value range 1 ... 60 min

A 5.4 Measured Value Format

A 5.4.1 Structure

The structure of measured value frames depends on the selection of the measured values or on the selection of a preset. In the following overview, you will find a summary of commands which you can use to query the available measured values via RS422.

Chap. A 5.3.13.2	OUT_RS422	Data selection for RS422
Chap. A 5.3.13.3	META_OUT_RS422	List of Possible Signals RS422
Chap. A 5.3.13.4	GETOUTINFO_RS422	List of Selected Signals, Sequence via RS422

Example for the structure of a data block, query via Telnet:

Preset `Standard matt`	Preset `Multisurface`
->META_OUT_RS422 META_OUT_RS422 01RAW 01DARK 01LIGHT 01SHUTTER 01ENCODER1 01INTENSITY 01SYMM 01DIST1 MEAS-RATE TRIGTIMEDIFF TIMESTAMP TIMESTAMP_HIGH TIMESTAMP_LOW COUNTER 01DIST1_MIN 01DIST1_PEAK 01DIST1_MAX ->	->META_OUT_RS422 META_OUT_RS422 01RAW 01DARK 01LIGHT 01SHUTTER 01ENCODER1 01INTENSITY 01SYMM 01DIST1 01DIST2 01DIST3 MEASRATE TRIGTIMEDIFF TIMESTAMP TIMESTAMP_HIGH TIMESTAMP_LOW COUNTER Ch01Thick12 Ch01Thick23 ->
->GETOUTINFO_RS422 GETOUTINFO_RS422 01SHUTTER 01IN-TENSITY1 01DIST1 ->	->GETOUTINFO_RS422 GETOUTINFO_RS422 01SHUTTER 01INTENSITY1 01DIST1 01INTENSITY2 01DIST2 01INTENSITY3 01DIST3 Ch01Thick12 Ch01Thick23 ->

A measured value frame is built dynamically, i.e., values not selected are not transmitted.

A 5.4.2 Video Signal

The video signals that have been calculated in the signal processing process can be transmitted. A video signal comprises 512 pixels. One pixel is described by a 16-bit word. The value range used is 0...16383.

There are five accessible video signals:

- Raw signal
- Dark corrected signal
- Light corrected signal

You can query the dark value table and the light value table with the commands `DARKCORR_PRINT` and `LIGHTCORR_PRINT`.

Pixel 0	**Pixel 1**	**..**	**Pixel 511**
Raw signal, 16 bit Dark corrected signal, 16 Bit Light corrected signal, 16 Bit	Raw signal Dark corrected signal Light corrected signal	..	Raw signal Dark corrected signal Light corrected signal

Fig. 83 Data structure of the video signals

A 5.4.3 Exposure Time

The output of the exposure time via the RS422 interface is done with a resolution of 100 ns. The data word is 18 bits wide.

A 5.4.4 Encoder

The encoder values for transmission can be selected individually. Only the lower 18 bits of the encoder values are transmitted when transmitting via RS422.

A 5.4.5 Measured Value Counter

Only the lower 18 bits of the profile counter are transmitted on the RS422 interface.

A 5.4.6 Timestamp

The system-internal resolution of the time stamp is 1 μs. When transmitting via RS422, two 18-bit data words are provided (`TIMESTAMP_LOW` and `TIMESTAMP_HIGH`).

A 5.4.7 Measuring Data (Distances and Intensities)

One intensity (if selected) and one measured value are transmitted for each selected distance.

Bit position	Description
0 - 10	Intensity of the peak (100 % corresponds to 1024)

Fig. 84 Intensity table

When transmitting via RS422, `Intensity of the peak` is transmitted with 10 bits.

The intensity value is determined based on the calculation rule below:

$$\text{Intensität} = \frac{\text{Max\_dark}}{\text{Sättigung - Max\_raw + Max\_dark}}$$

- Max_dark refers to the dark corrected signal.
- Max_dark refers to the raw signal.
- Saturation refers to the AD range (2 ^ 14-1).

Details for the format for RS422 can also be found in the Measurement Data Formats section, see Chap. A 5.5.1.

A 5.4.8 Trigger Time Difference

The trigger time difference is output via RS422 as an 18-bit unsigned integer with a resolution of 100 ns.

Value range 0….100000

A 5.4.9 Differences (thicknesses)

Calculated differences between two distances have the same format as the distances.

The selected differences between distance 1 and the other distances are output first, then those of distance 2, ...

Details for the format for RS422 can also be found in the Measurement Data Formats section, see Chap. A 5.5.1.

A 5.4.10 Statistical Values

The statistical values have the same format as the distances.

Minimum is transmitted first (if selected), then maximum and finally peak-to-peak.

A 5.4.11 Peak Symmetry

The peak symmetry value is output via RS422 as 18 bit (signed integer) with 4 bit decimal places.

A 5.5 Measuring Data Formats

A 5.5.1 Data Format RS422 Interface

A 5.5.1.1 Video Data

<Preamble>	**<Size>**	**<video data>**	**<End>**
Start identifier 64 bit 0xFFFF00FFFF000000	Size 32 Bit Volume of the video data in bytes	16 Bit unsigned	End identifier 32 bit 0xFEFE0000

Fig. 85 Structure of a video frame

Data structure, see Fig. 83.

A 5.5.1.2 Measured Values

The output of distance measured values and other measured values via RS422 requires subsequent conversion into the relevant unit. The measurement data, if requested, always follows a video frame.

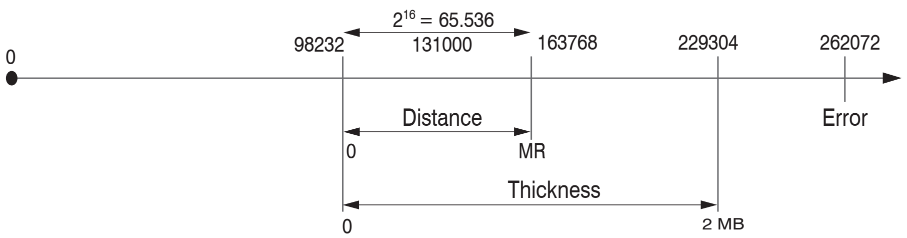
Output value 1:

	Preamble		Data bits					
L-Byte	0	0	D5	D4	D3	D2	D1	D0
M-Byte	0	1	D11	D10	D9	D8	D7	D6
H-Byte	1	0	D17	D16	D15	D14	D13	D12

Output value 2 .. 32:

	Preamble		Data bits					
L-Byte	0	0	D5	D4	D3	D2	D1	D0
M-Byte	0	1	D11	D10	D9	D8	D7	D6
H-Byte	1	1	D17	D16	D15	D14	D13	D12

Value range for the distance and thickness measurement:



131000 = mid of measuring range for the distance measurement

MB = measuring range

The linearized measured values can be converted into millimeters according to the following formula:

$$x = \frac{(d_{OUT} - 98232) * MR}{65536}$$

x = distance / thickness in mm

d_{OUT} = digital output value

MR = measuring range in mm

All values greater than 262072 are error values and are defined as follows:

Error code	Description
262073	Scaling error RS422 interface underflow
262074	Scaling error RS422 interface overflow
262075	Data volume too large for baud rate selected [1]
262076	No peak is present.
262077	Peak is before the measuring range (MB)
262078	Peak is behind the measuring range (MB)
262079	Measured value cannot be calculated

For all other data outputs except the measured value data, the limitations are defined in the relevant sections.

1) This error occurs when more data is to be output than can be transmitted at the selected baud rate at the selected measuring frequency. There are the following options of rectifying this error:

- Increase baud rate, see Chap. A 5.3.7
- Decrease measuring frequency, see Chap. A 5.3.9.5
- Reduce data volume; if 2 data words were selected, reduce to one data word, see Chap. A 5.3.13
- Reduce output data rate, see Chap. A 5.3.12.2

A 5.6 Warning and Error Messages

E200 I/O operation failed

E202 Access denied

E204 Received unsupported character

E205 Unexpected quotation mark

E210 Unknown command

E212 Command not available in current context

E214 Entered command is too long to be processed

E230 Unknown parameter

E231 Empty parameters are not allowed

E232 Wrong parameter count

E233 Command has too many parameters

E234 Wrong or unknown parameter type

E236 Value is out of range or the format is invalid

E262 Active signal transfer, please stop before

E270 No signals selected

E272 Invalid combination of signal parameters, please check measure mode and signal selection

E276 Given signal is not selected for output

E277 One or more values were unavailable. Please check output signal selection

E281 Not enough memory available

E282 Unknown output signal

E283 Output signal is unavailable with the current configuration

E284 No configuration entry was found for the given signal

E285 Name is too long

E286 Names must begin with an alphabetic character, and be 2 to 15 characters long. Permitted characters are: a-zA-Z0-9_

E320 Wrong info-data of the update

E321 Update file is too large

E322 Error during data transmission of the update

E323 Timeout during the update

E324 File is not valid for this sensor

E325 Invalid file type

E327 Invalid checksum

E331 Validation of import file failed

E332 Error during import

E333 No overwrite during import allowed

E340 Too many output values for RS422 selected

E350 The new passwords are not identical

E351 No password given

E360 Name already exists or not allowed

E361 Name begins or ends with spaces or is empty

E362 Storage region is full

E363 Setting name not found

E364 Setting is invalid

E500 Material table is empty

E502 Material table is full

E504 Material name not found

E600 ROI begin must be less than ROI end

E602 Master value is out of range

E603 One or more values were out of range

E610 Encoder: minimum is greater than maximum

E611 Encoder‘s start value must be less than the maximum value

E615 Synchronization as slave and triggering at level or edge are not possible at the same time

E616 Software triggering is not active

E618 Sensor head not available

E621 The entry already exists

E622 The requested dataset/table doesn‘t exist.

W505 Refractivity correction deactivated, vacuum is used as material

W526 Output signal selection modified by the system

W528 The shutter time has been changed to match the measurement rate and the system requirements.

W530 The IP settings has been changed.

A 6 Telnet

A 6.1 General

The Telnet service allows you to communicate with the IFD241x from your PC. To communicate with Telnet, you will need

- a connection between the IFD241x and your PC,
  - Ethernet
  - RS442 communication
- the ASCII commands, see Chap. A 5.

A 6.2 Establishing the Connection

➡ Start the program `Telnet.exe` via Start > Run.

➡ Type in the command `o 192.254.168.150` or the IP address of the controller.

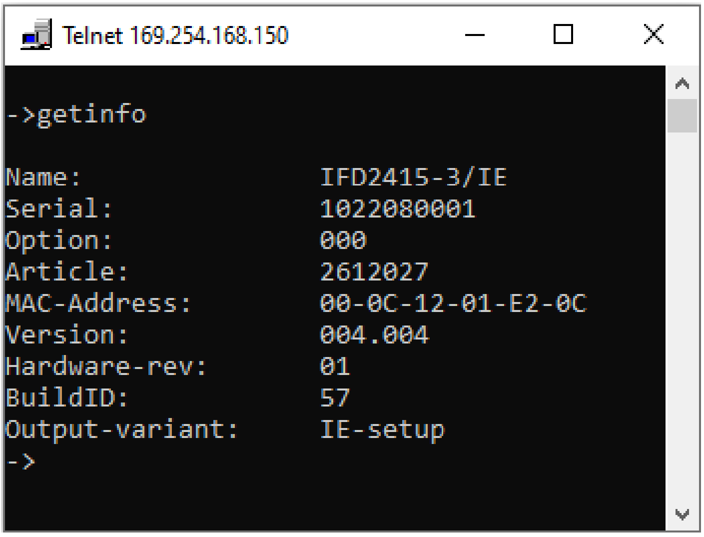


Fig. 86 Telnet start screen of IFD241x

A command always consists of the command name and zero or several parameters that are separated with a space. The currently set parameter value is reset if a command is invoked without parameters.

The output format is:

<Command name> <Parameter1> [<Parameter2> […]]

The returned command can be used again without changes for setting the password. After a command is processed, a line break and a prompt (“->”) is always returned. In the event of an error, an error message beginning with `Exx`, where xx stands for a unique error number, comes before the prompt.

i If no connection is successfully established after the IP address is sent, send a `c` to close the connection. Now send the command `o 192.254.168.150` again to establish the connection.

A 6.3 Help on a Command

Telnet can output information about a command. For this, enter the sequence “HELP <command name>”.

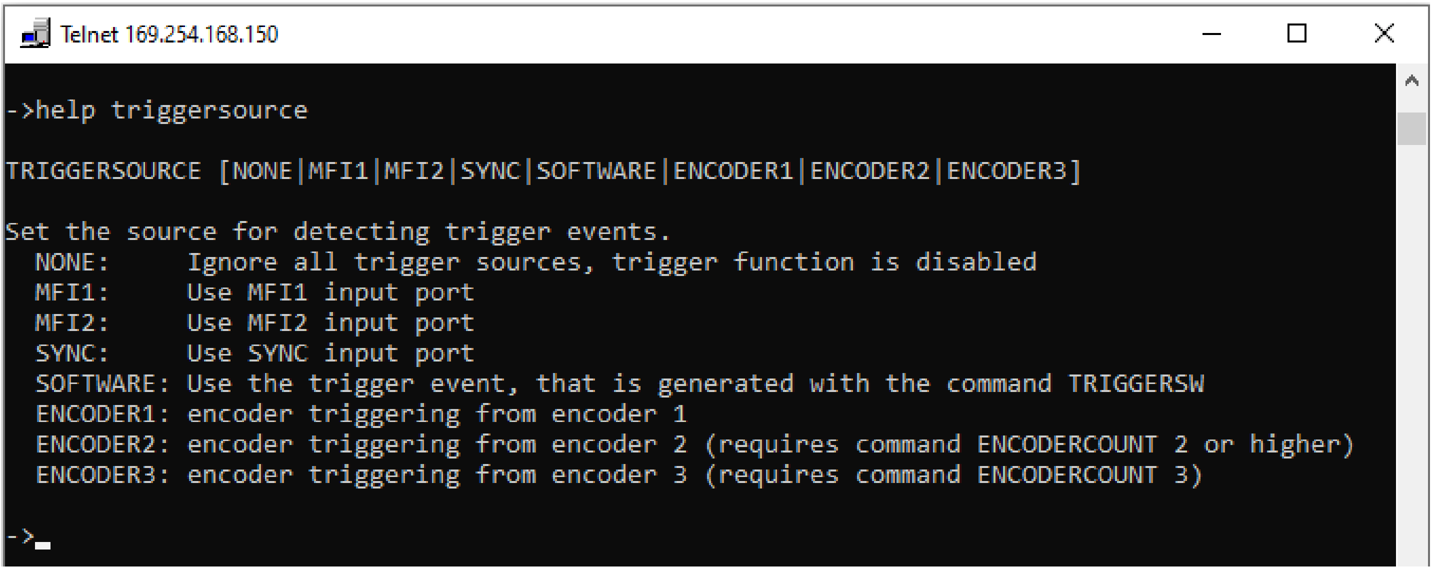


Fig. 87 Access the information about the TRIGGERSOURCE command

A 6.4 Error Messages

The following error messages may appear:

- E01 Unknown command: An unknown parameter ID was submitted.
- E06 Access denied: This parameter cannot be accessed at the present time. The controller may not be in Professional mode or the parameter may not be visible due to other settings.
- E08 Unknown parameter: Not enough parameters were submitted.
- E11 The input value is outside the validity range, or the format is invalid: The submitted value is outside the validity range.

The text in the error messages depends on the set language. The error message identifier (Exx) is the same for every language.

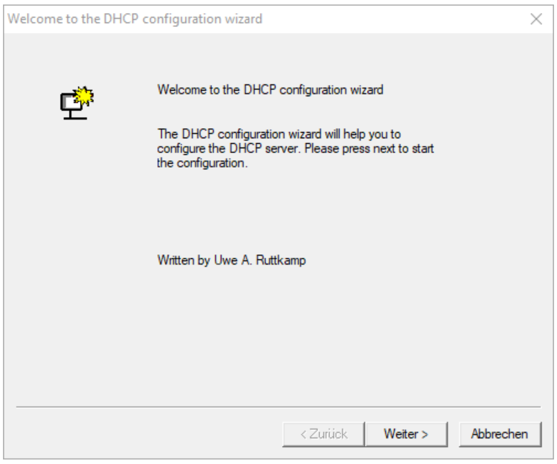
A 7 DHCP Server, IP Assignment

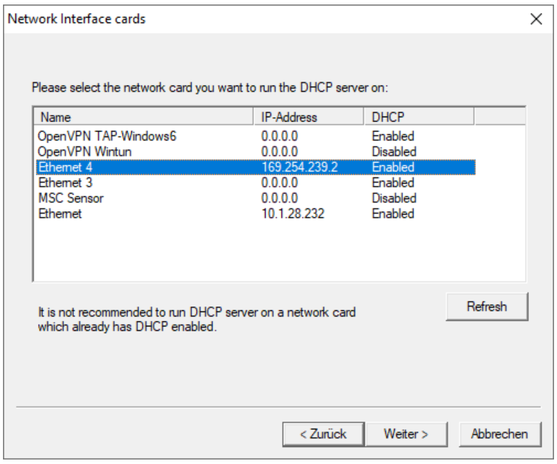
A IFD241x with EtherNet/IP is delivered in DHCP mode. A DHCP server is required, to assign an IP address to the sensor.

The following steps show an example of an address assignment. The freeware is included in the `DHCP Server V2.5.2` package. A free download is available at the following address: https://www.dhcpserver.de/cms/download/.

i You need admin rights to run this program.
Start this program from a local hard disk only..

- Connect the sensor to your PC/notebook.
- Start the program `dhcpwiz.exe`.

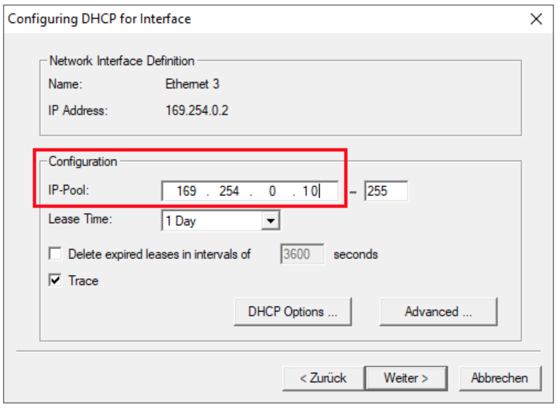




The wizard lists all available network connections.

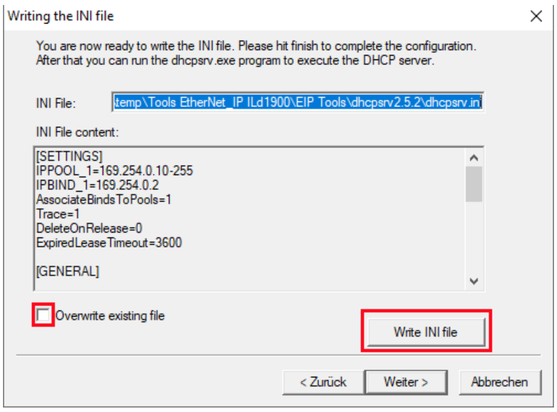
- Select the network port to which your measuring system is connected. Confirm with Next.

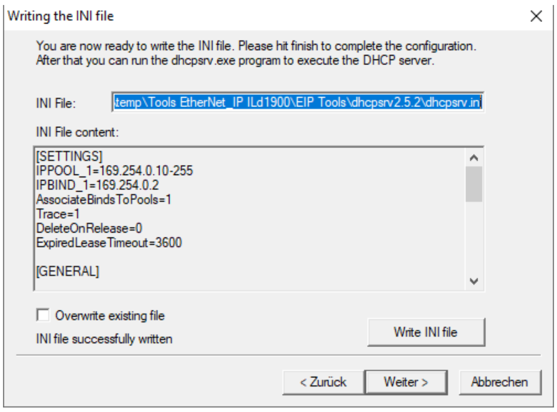
You can skip the following query about the supported protocols without specifying anything.



- Define the possible range for the IP addresses in the `Configuration` field.

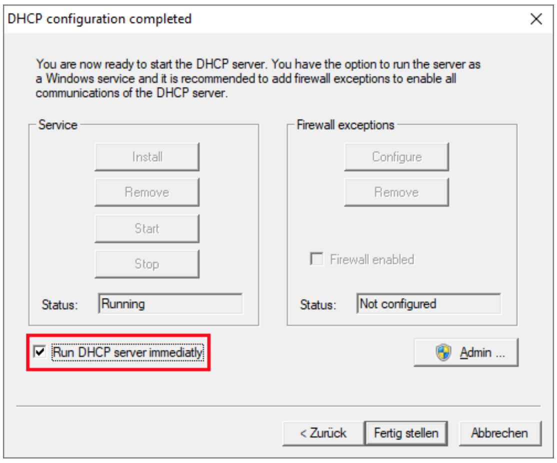
A client is assigned an IP address from this range.

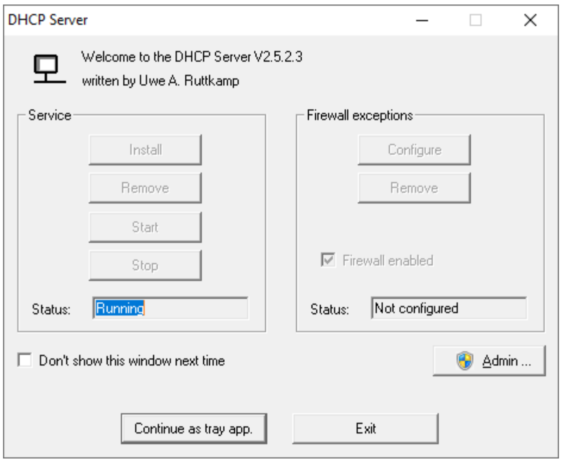




- Select the `Overwrite existing file` field and click `Write INI file`.
- Disconnect the power supply to the measuring system; then reconnect the measuring system to the power supply. This will force the measuring system to restart.

According to this example, the connected measuring system is available under the IP address 169.254.0.10.





➡ Click the `Finish` button to exit the wizard.

If you select the option `Run DHCP server immediately`, the `DHCP server` (dhcpsrv.exe) starts automatically.

The field `Status` reports a successful configuration with the entry `Running`.

A 8 Parameter Documentation

Index	Object name	Instanz-ID	Subindex	Subobject name	Access	Data type	IFD2410	2411	2415
0x0001	Identity	1	0	Reset	read-write	UINT8	x	x	x
		1	1	Vendor ID	read-only	UINT16			
		1	2	Device Type	read-only	UINT16			
		1	3	Product code	read-only	UINT16			
		1	4	Revision	read-only	UINT16			
		1	5	Status	read-only	UINT16			
		1	6	Serial Number	read-only	UINT32			
		1	7	Prodct name	read-only	CHAR			
		1	8	State	read-only	UINT8			
0x0004	Assembly Object	102	3	Assembly Object Data	read-write	Activation UINT8, Oversampling UINT8, Channel 1 distance 1 UINT8, Channel 1 distance 2 UINT8,	x	x	x
						Channel 1 distance 3 UINT8, Channel 1 distance 4 UINT8, Channel 1 distance 5 UINT8, Channel 1 distance 6 UINT8,			x
						Channel 1 intensity 1 UINT8, Channel 1 intensity 2 UINT8,	x	x	x
						Channel 1 intensity 3 UINT8, Channel 1 intensity 4 UINT8, Channel 1 intensity 5 UINT8, Channel 1 intensity 6 UINT8,			x
						Channel 1 shutter UINT8, Channel 1 encoder 1 UINT8, Channel 1 encoder 2 UINT8, Channel 1 encoder 3 UINT8,	x	x	x
						Channel 1 peak symmetry 1 UINT8, Channel 1 peak symmetry 2 UINT8, Channel 1 peak symmetry 3 UINT8, Channel 1 peak symmetry 4 UINT8, Channel 1 peak symmetry 5 UINT8, Channel 1 peak symmetry 6 UINT8,			x
						Counter UINT8, Time stamp UINT8, Frequency UINT8,	x	x	x
						User calc output 01 UINT8, User calc output 02 UINT8, User calc output 03 UINT8, User calc output 04 UINT8, ... User calc output 17 UINT8, User calc output 18 UINT8, User calc output 19 UINT8	x	x	x
		102	4	Assembly Object Size	read-only	UINT16	x	x	x

Index	Object name	Instanz-ID	Subindex	Subobject name	Access	Data type	IFD2410	2411	2415
0x0043	Time Sync	1	768	Time Sync Parameters	read-write	sync0_interval UINT32, sync0_offset UINT32, sync1_interval UINT32, sync1_offset UINT32, pulse_length UINT32	x	x	x
0x0064	Sensor information	1	0	Hardware version	read-only	STRING(32)	x	x	x
		1	256	Software version	read-only	STRING(32)			
		1	512	Name	read-only	STRING(34)			
		1	516	Serial number	read-only	STRING(38)			
		1	517	Option number	read-only	STRING(10)			
		1	519	Article number	read-only	STRING(38)			
		1	768	Error number	read-only	UINT16			
		1	769	Error description	read-only	STRING(235)			
0x0070	Settings	1	0	Actual user	read-only	UINT8	x	x	x
		1	1	Login	write-only	STRING(32)			
		1	2	Logout	write-only	BIT			
		1	3	User level when restarting	read-write	UINT8			
		1	4	Password old	write-only	STRING(32)			
		1	5	Password new	write-only	STRING(32)			
		1	6	PasswordRepeat	write-only	STRING(32)			
		1	256	Read	write-only	BIT			
		1	257	Store	write-only	BIT			
		1	258	Set default	write-only	BIT			
		1	512	Mode	read-write	UINT8			
		1	513	List	read-only	STRING(235)			
		1	514	Named read	write-only	STRING(32)			
		1	768	Current	read-only	STRING(32)			
		1	769	Named read	write-only	STRING(32)			
		1	770	Named store	write-only	STRING(32)			
		1	771	Named delete	write-only	STRING(32)			
		1	772	Initial	read-write	STRING(32)			
		1	773	List	read-only	STRING(235)			
		1	774	Set default	write-only	BIT			
		1	1024	Reboot sensor	write-only	BIT			
		1	1280	Factory reset	write-only	BIT			
		1	1536	Reset timestamp	write-only	BIT			
		1	1537	Reset counter	write-only	BIT			
		1	8192	Measuring rate	read-write	FLOAT			
		1	8448	Mode	read-write	UINT8			
		1	8449	Key lock countdown [min]	read-write	UINT8			

Index	Object name	Instanz-ID	Subindex	Subobject name	Access	Data type	IFD2410	2411	2415
0x0070	Settings	1	8704	Encoder 1 reference signal	read-write	UINT8	x	x	x
		1	8705	Encoder 1 interpolation	read-write	UINT8			
		1	8706	Encoder 1 initial value	read-write	UINT32			
		1	8707	Encoder 1 maximum value	read-write	UINT32			
		1	8708	Encoder 1 set value	write-only	BIT			
		1	8709	Encoder 2 reference signal	read-write	UINT8	x		x
		1	8710	Encoder 2 interpolation	read-write	UINT8			
		1	8711	Encoder 2 initial value	read-write	UINT32			
		1	8712	Encoder 2 maximum value	read-write	UINT32			
		1	8713	Encoder 2 set value	write-only	BIT			
		1	8714	Encoder 3 interpolation	read-write	UINT8			
		1	8715	Encoder 3 initial value	read-write	UINT32			
		1	8716	Encoder 3 maximum value	read-write	UINT32			
		1	8717	Encoder 3 set value	write-only	BIT			
		1	8718	Encoder count	read-write	UINT8	x	x	x
		1	8719	Set encoder	write-only	UINT8			
		1	8720	Reset encoder	write-only	UINT8			
		1	8960	Trigger At	read-write	UINT8			
		1	8961	Trigger source	read-write	UINT8			
		1	8962	Trigger mode	read-write	UINT8			
		1	8963	Trigger level	read-write	UINT8			
		1	8964	Trigger count type	read-write	UINT8			
		1	8965	Trigger count value	read-write	UINT16			
		1	8966	Trigger software	write-only	BIT			
		1	8967	Trigger endcoder minimum	read-write	UINT32			
		1	8968	Trigger encoder maximum	read-write	UINT32			
		1	8969	Trigger encoder step size	read-write	UINT32			
		1	8970	MFI level	read-write	UINT8			
		1	9216	Sync mode	read-write	UINT8			
		1	9217	Termination	read-write	BIT			
		1	12288	Name	read-write	STRING(32)			
		1	12289	Description	read-write	STRING(64)			
		1	12290	Type of refraction	read-write	UINT8			
		1	12291	nd value	read-write	FLOAT			
		1	12292	nF value	read-write	FLOAT			
		1	12293	nC value	read-write	FLOAT			
		1	12294	Abbe number	read-write	FLOAT			
		1	12544	Material delete	write-only	STRING(32)			
		1	12545	Reset materials	write-only	BIT			
		1	12546	New material	write-only	BIT			
		1	12547	Select material for edit	read-write	STRING(32)			
		1	12800	Existing materials part 0	read-only	STRING(235)			
		1	12801	Existing materials part 1	read-only	STRING(235)			
		1	12802	Existing materials part 2	read-only	STRING(235)			
		1	12803	Existing materials part 3	read-only	STRING(235)			
		1	12804	Existing materials part 4	read-only	STRING(235)			

Index	Object name	Instanz-ID	Subindex	Subobject name	Access	Data type	IFD2410	2411	2415
0x0070	Settings	1	16384	Range lower	read-write	FLOAT	x	x	x
		1	16385	Range upper	read-write	FLOAT	x	x	x
0x0080	Channel settings	1	0	LED on/off	read-write	BIT	x	x	x
		1	1	LED source	read-write	UINT8	x	x	x
		1	4096	Sensor info	read-only	STRING(32)	x	x	x
		1	4097	Sensor range	read-only	FLOAT	x	x	x
		1	4098	Sensor serial No	read-only	UINT32	x	x	x
		1	8192	Dark correction start	write-only	BIT	x	x	x
		1	8194	Dark correction state	read-only	UINT32	x	x	x
		1	12288	Peak count	read-write	UINT32	x	x	x
		1	12289	Disable refractivity correction	read-write	BIT	x	x	x
		1	16384	Peak position	read-write	UINT8	x	x	x
		1	16640	Minimum threshold	read-write	FLOAT	x	x	x
		1	16641	Peak modulation	read-write	FLOAT	x	x	x
		1	20480	Material 1	read-write	STRING(32)	x	x	x
		1	24576	Shutter mode channel 1	read-write	UINT8	x	x	x
		1	24578	Shutter value1 in us channel 1	read-write	FLOAT	x	x	x
		1	24579	Shutter value2 in us channel 1	read-write	FLOAT	x	x	x
		1	28682	Range of interest start	read-write	UINT16	x	x	x
		1	28683	Range of interest end	read-write	UINT16	x	x	x
		1	4352	Select sensor head	read-write	UINT8		x	
		1	4353	Sensor name	read-only	STRING(35)		x	
		1	4354	Measurement range	read-only	FLOAT		x	
		1	4355	Serial number	read-only	STRING(39)		x	
		1	4608	Position	read-write	UINT8		x	
		1	4609	Get next position	write-only	BIT		x	
		1	4610	Get previous position	write-only	BIT		x	
		1	4611	Sensor name	read-only	STRING(35)		x	
		1	4612	Measurement range	read-only	FLOAT		x	
		1	4613	Serial number	read-only	STRING(39)		x	
		1	20481	Material 2	read-write	STRING(32)			x
		1	20482	Material 3	read-write	STRING(32)			x
		1	20483	Material 4	read-write	STRING(32)			x
		1	20484	Material 5	read-write	STRING(32)			x

Index	Object name	Instanz-ID	Subindex	Subobject name	Access	Data type	IFD2410	2411	2415
0x0090	Compute	1	0	Type	read-write	UINT8	x	x	x
		1	1	Name	read-write	STRING(32)			
		1	3	Signal1	read-write	STRING(32)			
		1	4	Signal2	read-write	STRING(32)			
		1	12	Factor1	read-write	FLOAT			
		1	13	Factor2	read-write	FLOAT			
		1	16	Offset	read-write	FLOAT			
		1	17	Parameter	read-write	UINT32			
		1	49	Available signals part 0	read-only	STRING(235)			
		1	50	Available signals part 1	read-only	STRING(235)			
		1	51	Available signals part 2	read-only	STRING(235)			
		1	52	Available signals part 3	read-only	STRING(235)			
		1	53	Available signals part 4	read-only	STRING(235)			
		1	54	Available signals part 5	read-only	STRING(235)			
		1	256	Type	read-write	UINT8			
		1	257	Name	read-write	STRING(32)			
		1	259	Signal1	read-write	STRING(32)			
		1	260	Signal2	read-write	STRING(32)			
		1	268	Factor1	read-write	FLOAT			
		1	269	Factor2	read-write	FLOAT			
		1	272	Offset	read-write	FLOAT			
		1	273	Parameter	read-write	UINT32			
		1	305	Available signals part 0	read-only	STRING(235)			
		1	306	Available signals part 1	read-only	STRING(235)			
		1	307	Available signals part 2	read-only	STRING(235)			
		1	308	Available signals part 3	read-only	STRING(235)			
		1	309	Available signals part 4	read-only	STRING(235)			
		1	310	Available signals part 5	read-only	STRING(235)			
		1	512	Type	read-write	UINT8			
		1	513	Name	read-write	STRING(32)			
		1	515	Signal1	read-write	STRING(32)			
		1	516	Signal2	read-write	STRING(32)			
		1	524	Factor1	read-write	FLOAT			
		1	525	Factor2	read-write	FLOAT			
		1	528	Offset	read-write	FLOAT			
		1	529	Parameter	read-write	UINT32			
		1	561	Available signals part 0	read-only	STRING(235)			
		1	562	Available signals part 1	read-only	STRING(235)			
		1	563	Available signals part 2	read-only	STRING(235)			
		1	564	Available signals part 3	read-only	STRING(235)			
		1	565	Available signals part 4	read-only	STRING(235)			
		1	566	Available signals part 5	read-only	STRING(235)			

Index	Object name	Instanz-ID	Subindex	Subobject name	Access	Data type	IFD2410	2411	2415
0x0090	Compute	1	768	Type	read-write	UINT8	x	x	x
		1	769	Name	read-write	STRING(32)			
		1	771	Signal1	read-write	STRING(32)			
		1	772	Signal2	read-write	STRING(32)			
		1	780	Factor1	read-write	FLOAT			
		1	781	Factor2	read-write	FLOAT			
		1	784	Offset	read-write	FLOAT			
		1	785	Parameter	read-write	UINT32			
		1	817	Available signals part 0	read-only	STRING(235)			
		1	818	Available signals part 1	read-only	STRING(235)			
		1	819	Available signals part 2	read-only	STRING(235)			
		1	820	Available signals part 3	read-only	STRING(235)			
		1	821	Available signals part 4	read-only	STRING(235)			
		1	822	Available signals part 5	read-only	STRING(235)			
		1	1024	Type	read-write	UINT8			
		1	1025	Name	read-write	STRING(32)			
		1	1027	Signal1	read-write	STRING(32)			
		1	1028	Signal2	read-write	STRING(32)			
		1	1036	Factor1	read-write	FLOAT			
		1	1037	Factor2	read-write	FLOAT			
		1	1040	Offset	read-write	FLOAT			
		1	1041	Parameter	read-write	UINT32			
		1	1073	Available signals part 0	read-only	STRING(235)			
		1	1074	Available signals part 1	read-only	STRING(235)			
		1	1075	Available signals part 2	read-only	STRING(235)			
		1	1076	Available signals part 3	read-only	STRING(235)			
		1	1077	Available signals part 4	read-only	STRING(235)			
		1	1078	Available signals part 5	read-only	STRING(235)			
		1	1280	Type	read-write	UINT8			
		1	1281	Name	read-write	STRING(32)			
		1	1283	Signal1	read-write	STRING(32)			
		1	1284	Signal2	read-write	STRING(32)			
		1	1292	Factor1	read-write	FLOAT			
		1	1293	Factor2	read-write	FLOAT			
		1	1296	Offset	read-write	FLOAT			
		1	1297	Parameter	read-write	UINT32			
		1	1329	Available signals part 0	read-only	STRING(235)			
		1	1330	Available signals part 1	read-only	STRING(235)			
		1	1331	Available signals part 2	read-only	STRING(235)			
		1	1332	Available signals part 3	read-only	STRING(235)			
		1	1333	Available signals part 4	read-only	STRING(235)			
		1	1334	Available signals part 5	read-only	STRING(235)			

Index	Object name	Instanz-ID	Subindex	Subobject name	Access	Data type	IFD2410	2411	2415
0x0090	Compute	1	1536	Type	read-write	UINT8	x	x	x
		1	1537	Name	read-write	STRING(32)			
		1	1539	Signal1	read-write	STRING(32)			
		1	1540	Signal2	read-write	STRING(32)			
		1	1548	Factor1	read-write	FLOAT			
		1	1549	Factor2	read-write	FLOAT			
		1	1552	Offset	read-write	FLOAT			
		1	1553	Parameter	read-write	UINT32			
		1	1585	Available signals part 0	read-only	STRING(235)			
		1	1586	Available signals part 1	read-only	STRING(235)			
		1	1587	Available signals part 2	read-only	STRING(235)			
		1	1588	Available signals part 3	read-only	STRING(235)			
		1	1589	Available signals part 4	read-only	STRING(235)			
		1	1590	Available signals part 5	read-only	STRING(235)			
		1	1792	Type	read-write	UINT8			
		1	1793	Name	read-write	STRING(32)			
		1	1795	Signal1	read-write	STRING(32)			
		1	1796	Signal2	read-write	STRING(32)			
		1	1804	Factor1	read-write	FLOAT			
		1	1805	Factor2	read-write	FLOAT			
		1	1808	Offset	read-write	FLOAT			
		1	1809	Parameter	read-write	UINT32			
		1	1841	Available signals part 0	read-only	STRING(235)			
		1	1842	Available signals part 1	read-only	STRING(235)			
		1	1843	Available signals part 2	read-only	STRING(235)			
		1	1844	Available signals part 3	read-only	STRING(235)			
		1	1845	Available signals part 4	read-only	STRING(235)			
		1	1846	Available signals part 5	read-only	STRING(235)			
		1	2048	Type	read-write	UINT8			
		1	2049	Name	read-write	STRING(32)			
		1	2051	Signal1	read-write	STRING(32)			
		1	2052	Signal2	read-write	STRING(32)			
		1	2060	Factor1	read-write	FLOAT			
		1	2061	Factor2	read-write	FLOAT			
		1	2064	Offset	read-write	FLOAT			
		1	2065	Parameter	read-write	UINT32			
		1	2097	Available signals part 0	read-only	STRING(235)			
		1	2098	Available signals part 1	read-only	STRING(235)			
		1	2099	Available signals part 2	read-only	STRING(235)			
		1	2100	Available signals part 3	read-only	STRING(235)			
		1	2101	Available signals part 4	read-only	STRING(235)			
		1	2102	Available signals part 5	read-only	STRING(235)			

Index	Object name	Instanz-ID	Subindex	Subobject name	Access	Data type	IFD2410	2411	2415
0x0090	Compute	1	2304	Type	read-write	UINT8	x	x	x
		1	2305	Name	read-write	STRING(32)			
		1	2307	Signal1	read-write	STRING(32)			
		1	2308	Signal2	read-write	STRING(32)			
		1	2316	Factor1	read-write	FLOAT			
		1	2317	Factor2	read-write	FLOAT			
		1	2320	Offset	read-write	FLOAT			
		1	2321	Parameter	read-write	UINT32			
		1	2353	Available signals part 0	read-only	STRING(235)			
		1	2354	Available signals part 1	read-only	STRING(235)			
		1	2355	Available signals part 2	read-only	STRING(235)			
		1	2356	Available signals part 3	read-only	STRING(235)			
		1	2357	Available signals part 4	read-only	STRING(235)			
		1	2358	Available signals part 5	read-only	STRING(235)			
0x00A0	Processing	1	0	Error handling type	read-write	UINT8	x	x	x
		1	1	Error handling values	read-write	UINT32			
		1	3840	Master source	read-write	UINT8			
		1	4096	Enable	read-write	BIT			
		1	4097	Signal	read-write	STRING(32)			
		1	4099	Set/Reset	read-write	BIT			
		1	4100	Value	read-write	FLOAT			
		1	4145	Available signals part 0	read-only	STRING(235)			
		1	4146	Available signals part 1	read-only	STRING(235)			
		1	4147	Available signals part 2	read-only	STRING(235)			
		1	4148	Available signals part 3	read-only	STRING(235)			
		1	4149	Available signals part 4	read-only	STRING(235)			
		1	4150	Available signals part 5	read-only	STRING(235)			
		1	4352	Enable	read-write	BIT			
		1	4353	Signal	read-write	STRING(32)			
		1	4355	Set/Reset	read-write	BIT			
		1	4356	Value	read-write	FLOAT			
		1	4401	Available signals part 0	read-only	STRING(235)			
		1	4402	Available signals part 1	read-only	STRING(235)			
		1	4403	Available signals part 2	read-only	STRING(235)			
		1	4404	Available signals part 3	read-only	STRING(235)			
		1	4405	Available signals part 4	read-only	STRING(235)			
		1	4406	Available signals part 5	read-only	STRING(235)			
		1	4608	Enable	read-write	BIT			
		1	4609	Signal	read-write	STRING(32)			
		1	4611	Set/Reset	read-write	BIT			
		1	4612	Value	read-write	FLOAT			
		1	4657	Available signals part 0	read-only	STRING(235)			
		1	4658	Available signals part 1	read-only	STRING(235)			
		1	4659	Available signals part 2	read-only	STRING(235)			
		1	4660	Available signals part 3	read-only	STRING(235)			
		1	4661	Available signals part 4	read-only	STRING(235)			
		1	4662	Available signals part 5	read-only	STRING(235)			

Index	Object name	Instanz-ID	Subindex	Subobject name	Access	Data type	IFD2410	2411	2415
0x00A0	Processing	1	4864	Enable	read-write	BIT	x	x	x
		1	4865	Signal	read-write	STRING(32)			
		1	4867	Set/Reset	read-write	BIT			
		1	4868	Value	read-write	FLOAT			
		1	4913	Available signals part 0	read-only	STRING(235)			
		1	4914	Available signals part 1	read-only	STRING(235)			
		1	4915	Available signals part 2	read-only	STRING(235)			
		1	4916	Available signals part 3	read-only	STRING(235)			
		1	4917	Available signals part 4	read-only	STRING(235)			
		1	4918	Available signals part 5	read-only	STRING(235)			
		1	5120	Enable	read-write	BIT			
		1	5121	Signal	read-write	STRING(32)			
		1	5123	Set/Reset	read-write	BIT			
		1	5124	Value	read-write	FLOAT			
		1	5169	Available signals part 0	read-only	STRING(235)			
		1	5170	Available signals part 1	read-only	STRING(235)			
		1	5171	Available signals part 2	read-only	STRING(235)			
		1	5172	Available signals part 3	read-only	STRING(235)			
		1	5173	Available signals part 4	read-only	STRING(235)			
		1	5174	Available signals part 5	read-only	STRING(235)			
		1	5376	Enable	read-write	BIT			
		1	5377	Signal	read-write	STRING(32)			
		1	5379	Set/Reset	read-write	BIT			
		1	5380	Value	read-write	FLOAT			
		1	5425	Available signals part 0	read-only	STRING(235)			
		1	5426	Available signals part 1	read-only	STRING(235)			
		1	5427	Available signals part 2	read-only	STRING(235)			
		1	5428	Available signals part 3	read-only	STRING(235)			
		1	5429	Available signals part 4	read-only	STRING(235)			
		1	5430	Available signals part 5	read-only	STRING(235)			
		1	5632	Enable	read-write	BIT			
		1	5633	Signal	read-write	STRING(32)			
		1	5635	Set/Reset	read-write	BIT			
		1	5636	Value	read-write	FLOAT			
		1	5681	Available signals part 0	read-only	STRING(235)			
		1	5682	Available signals part 1	read-only	STRING(235)			
		1	5683	Available signals part 2	read-only	STRING(235)			
		1	5684	Available signals part 3	read-only	STRING(235)			
		1	5685	Available signals part 4	read-only	STRING(235)			
		1	5686	Available signals part 5	read-only	STRING(235)			
		1	5888	Enable	read-write	BIT			
		1	5889	Signal	read-write	STRING(32)			
		1	5891	Set/Reset	read-write	BIT			
		1	5892	Value	read-write	FLOAT			

Index	Object name	Instanz-ID	Subindex	Subobject name	Access	Data type	IFD2410	2411	2415
0x00A0	Processing	1	5937	Available signals part 0	read-only	STRING(235)	x	x	x
		1	5938	Available signals part 1	read-only	STRING(235)			
		1	5939	Available signals part 2	read-only	STRING(235)			
		1	5940	Available signals part 3	read-only	STRING(235)			
		1	5941	Available signals part 4	read-only	STRING(235)			
		1	5942	Available signals part 5	read-only	STRING(235)			
		1	6144	Enable	read-write	BIT			
		1	6145	Signal	read-write	STRING(32)			
		1	6147	Set/Reset	read-write	BIT			
		1	6148	Value	read-write	FLOAT			
		1	6193	Available signals part 0	read-only	STRING(235)			
		1	6194	Available signals part 1	read-only	STRING(235)			
		1	6195	Available signals part 2	read-only	STRING(235)			
		1	6196	Available signals part 3	read-only	STRING(235)			
		1	6197	Available signals part 4	read-only	STRING(235)			
		1	6198	Available signals part 5	read-only	STRING(235)			
		1	6400	Enable	read-write	BIT			
		1	6401	Signal	read-write	STRING(32)			
		1	6403	Set/Reset	read-write	BIT			
		1	6404	Value	read-write	FLOAT			
		1	6449	Available signals part 0	read-only	STRING(235)			
		1	6450	Available signals part 1	read-only	STRING(235)			
		1	6451	Available signals part 2	read-only	STRING(235)			
		1	6452	Available signals part 3	read-only	STRING(235)			
		1	6453	Available signals part 4	read-only	STRING(235)			
		1	6454	Available signals part 5	read-only	STRING(235)			
		1	8192	Enable	read-write	BIT			
		1	8193	Signal	read-write	STRING(32)			
		1	8195	Infinite	read-write	BIT			
		1	8196	Depth	read-write	UINT16			
		1	8197	Reset	write-only	BIT			
		1	8241	Available signals part 0	read-only	STRING(235)			
		1	8242	Available signals part 1	read-only	STRING(235)			
		1	8243	Available signals part 2	read-only	STRING(235)			
		1	8244	Available signals part 3	read-only	STRING(235)			
		1	8245	Available signals part 4	read-only	STRING(235)			
		1	8246	Available signals part 5	read-only	STRING(235)			
		1	8448	Enable	read-write	BIT			
		1	8449	Signal	read-write	STRING(32)			
		1	8451	Infinite	read-write	BIT			
		1	8452	Depth	read-write	UINT16			
		1	8453	Reset	write-only	BIT			

Index	Object name	Instanz-ID	Subindex	Subobject name	Access	Data type	IFD2410	2411	2415
0x00A0	Processing	1	8497	Available signals part 0	read-only	STRING(235)	x	x	x
		1	8498	Available signals part 1	read-only	STRING(235)			
		1	8499	Available signals part 2	read-only	STRING(235)			
		1	8500	Available signals part 3	read-only	STRING(235)			
		1	8501	Available signals part 4	read-only	STRING(235)			
		1	8502	Available signals part 5	read-only	STRING(235)			
		1	8704	Enable	read-write	BIT			
		1	8705	Signal	read-write	STRING(32)			
		1	8707	Infinite	read-write	BIT			
		1	8708	Depth	read-write	UINT16			
		1	8709	Reset	write-only	BIT			
		1	8753	Available signals part 0	read-only	STRING(235)			
		1	8754	Available signals part 1	read-only	STRING(235)			
		1	8755	Available signals part 2	read-only	STRING(235)			
		1	8756	Available signals part 3	read-only	STRING(235)			
		1	8757	Available signals part 4	read-only	STRING(235)			
		1	8758	Available signals part 5	read-only	STRING(235)			
		1	12288	User calc 00	read-only	STRING(40)			
		1	12289	User calc 01	read-only	STRING(40)			
		1	12290	User calc 02	read-only	STRING(40)			
		1	12291	User calc 03	read-only	STRING(40)			
		1	12292	User calc 04	read-only	STRING(40)			
		1	12293	User calc 05	read-only	STRING(40)			
		1	12294	User calc 06	read-only	STRING(40)			
		1	12295	User calc 07	read-only	STRING(40)			
		1	12296	User calc 08	read-only	STRING(40)			
		1	12297	User calc 09	read-only	STRING(40)			
		1	12298	User calc 10	read-only	STRING(40)			
		1	12299	User calc 11	read-only	STRING(40)			
		1	12300	User calc 12	read-only	STRING(40)			
		1	12301	User calc 13	read-only	STRING(40)			
		1	12302	User calc 14	read-only	STRING(40)			
		1	12303	User calc 15	read-only	STRING(40)			
		1	12304	User calc 16	read-only	STRING(40)			
		1	12305	User calc 17	read-only	STRING(40)			
		1	12306	User calc 18	read-only	STRING(40)			
0x00B0	Outputs	1	0	RS422	read-write	BIT	x	x	x
		1	2	Analog	read-write	BIT			
		1	3	Error outs	read-write	BIT			
		1	4	Industrial Ethernet	read-write	BIT			
		1	513	Reduction analog	read-write	BIT			
		1	514	Reduction rs422	read-write	BIT			
		1	515	Reduction factor	read-write	UINT32			
		1	8192	Analog output	read-write	UINT8			
		1	8193	Analog signal	read-write	STRING(32)			
		1	8195	Type of scaling	read-write	UINT8			
		1	8196	Two-Point-scaling start	read-write	FLOAT			

Index	Object name	Instanz-ID	Subindex	Subobject name	Access	Data type	IFD2410	2411	2415
0x00B0	Outputs	1	8197	Two-Point-scaling end	read-write	FLOAT	x	x	x
		1	8241	Available signals part 0	read-only	STRING(235)			
		1	8242	Available signals part 1	read-only	STRING(235)			
		1	8243	Available signals part 2	read-only	STRING(235)			
		1	8244	Available signals part 3	read-only	STRING(235)			
		1	8245	Available signals part 4	read-only	STRING(235)			
		1	8246	Available signals part 5	read-only	STRING(235)			
		1	16384	Output level	read-write	UINT8	x		x
		1	16385	Error out	read-write	UINT8			
		1	16386	Limit signal	read-write	STRING(32)			
		1	16388	Lower limit value	read-write	FLOAT			
		1	16389	Upper limit value	read-write	FLOAT			
		1	16390	Compare to	read-write	UINT8			
		1	16391	Error hysteresis	read-write	FLOAT			
		1	16433	Available signals part 0	read-only	STRING(235)			
		1	16434	Available signals part 1	read-only	STRING(235)			
		1	16435	Available signals part 2	read-only	STRING(235)			
		1	16436	Available signals part 3	read-only	STRING(235)			
		1	16437	Available signals part 4	read-only	STRING(235)			
		1	16438	Available signals part 5	read-only	STRING(235)			
		1	16640	Output level	read-write	UINT8			
		1	16641	Error out	read-write	UINT8			
		1	16642	Limit signal	read-write	STRING(32)			
		1	16644	Lower limit value	read-write	FLOAT			
		1	16645	Upper limit value	read-write	FLOAT			
		1	16646	Compare to	read-write	UINT8			
		1	16647	Error hysteresis	read-write	FLOAT			
		1	16689	Available signals part 0	read-only	STRING(235)			
		1	16690	Available signals part 1	read-only	STRING(235)			
		1	16691	Available signals part 2	read-only	STRING(235)			
		1	16692	Available signals part 3	read-only	STRING(235)			
		1	16693	Available signals part 4	read-only	STRING(235)			
		1	16694	Available signals part 5	read-only	STRING(235)			
		1	16896	RS422 add output signal	write-only	STRING(32)	x	x	x
		1	16897	RS422 remove output signal	write-only	STRING(235)			
		1	16898	RS422 reset output signals	write-only	BIT			
		1	16945	RS422 available signals part 0	read-only	STRING(235)			
		1	16946	RS422 available signals part 1	read-only	STRING(235)			
		1	16947	RS422 available signals part 2	read-only	STRING(235)			
		1	16948	RS422 available signals part 3	read-only	STRING(235)			
		1	16949	RS422 available signals part 4	read-only	STRING(235)			
		1	16950	RS422 available signals part 5	read-only	STRING(235)			
		1	16952	RS422 available signals part 6	read-only	STRING(235)			
		1	16953	RS422 available signals part 7	read-only	STRING(235)			
		1	16954	RS422 available signals part 8	read-only	STRING(235)			
		1	16955	RS422 available signals part 9	read-only	STRING(235)			
		1	16956	RS422 available signals part 10	read-only	STRING(235)			

Index	Object name	Instanz-ID	Subindex	Subobject name	Access	Data type	IFD2410	2411	2415
0x00B0	Outputs	1	16957	RS422 available signals part 11	read-only	STRING(235)	x	x	x
		1	16958	RS422 available signals part 12	read-only	STRING(235)			
		1	16976	Outputinfo RS422 part 0	read-only	STRING(235)			
		1	16977	Outputinfo RS422 part 1	read-only	STRING(235)			
		1	16978	Outputinfo RS422 part 2	read-only	STRING(235)			
		1	16979	Outputinfo RS422 part 3	read-only	STRING(235)			
		1	16980	Outputinfo RS422 part 4	read-only	STRING(235)			
		1	16981	Outputinfo RS422 part 5	read-only	STRING(235)			
		1	16982	Outputinfo RS422 part 6	read-only	STRING(235)			
		1	16983	Outputinfo RS422 part 7	read-only	STRING(235)			
		1	16984	Outputinfo RS422 part 8	read-only	STRING(235)			
		1	16985	Outputinfo RS422 part 9	read-only	STRING(235)			
		1	16986	Outputinfo RS422 part 10	read-only	STRING(235)			
		1	16987	Outputinfo RS422 part 11	read-only	STRING(235)			
		1	16988	Outputinfo RS422 part 12	read-only	STRING(235)			
		1	20481	RS422 baud rate	read-write	UINT32			
0x00C1	Process data	0	256	Mapping size	read-only	UINT8	x	x	x
		0	257	Oversampling	read-only	UINT8			
		0	512	Counter	read-only	UINT32			
		0	513	Time stamp	read-only	UINT32			
		0	514	Frequency	read-only	UINT32			
		0	3584	User calc output 01	read-only	UINT32			
		0	3585	User calc output 02	read-only	UINT32			
		0	3586	User calc output 03	read-only	UINT32			
		0	3587	User calc output 04	read-only	UINT32			
		0	3588	User calc output 05	read-only	UINT32			
		0	3589	User calc output 06	read-only	UINT32			
		0	3590	User calc output 07	read-only	UINT32			
		0	3591	User calc output 08	read-only	UINT32			
		0	3592	User calc output 09	read-only	UINT32			
		0	3593	User calc output 10	read-only	UINT32			
		0	3594	User calc output 11	read-only	UINT32			
		0	3595	User calc output 12	read-only	UINT32			
		0	3596	User calc output 13	read-only	UINT32			
		0	3597	User calc output 14	read-only	UINT32			
		0	3598	User calc output 15	read-only	UINT32			
		0	3599	User calc output 16	read-only	UINT32			
		0	3600	User calc output 17	read-only	UINT32			
		0	3601	User calc output 18	read-only	UINT32			
		0	3602	User calc output 19	read-only	UINT32			
		1	0	Channel 1 distance 1	read-only	UINT32			
		1	1	Channel 1 distance 2	read-only	UINT32			
		1	2	Channel 1 distance 3	read-only	UINT32			x
		1	3	Channel 1 distance 4	read-only	UINT32			
		1	4	Channel 1 distance 5	read-only	UINT32			
		1	5	Channel 1 distance 6	read-only	UINT32			

Index	Object name	Instanz-ID	Subindex	Subobject name	Access	Data type	IFD2410	2411	2415
0x00C1	Process data	1	16	Channel 1 intensity 1	read-only	UINT32	x	x	x
		1	17	Channel 1 intensity 2	read-only	UINT32			
		1	18	Channel 1 intensity 3	read-only	UINT32			x
		1	19	Channel 1 intensity 4	read-only	UINT32			
		1	20	Channel 1 intensity 5	read-only	UINT32			
		1	21	Channel 1 intensity 6	read-only	UINT32			
		1	48	Channel 1 shutter	read-only	UINT32	x	x	x
		1	49	Channel 1 encoder 1	read-only	UINT32			
		1	50	Channel 1 encoder 2	read-only	UINT32			
		1	51	Channel 1 encoder 3	read-only	UINT32			
		1	96	Channel 1 peak symmetry 1	read-only	UINT32			x
		1	97	Channel 1 peak symmetry 2	read-only	UINT32			
		1	98	Channel 1 peak symmetry 3	read-only	UINT32			
		1	99	Channel 1 peak symmetry 4	read-only	UINT32			
		1	100	Channel 1 peak symmetry 5	read-only	UINT32			
		1	101	Channel 1 peak symmetry 6	read-only	UINT32			
0x00F5	TCP/IP Interface	1	5	TCP/IP Interface Configuration	read-write	ip_address UINT32, network_mask UINT32, gateway UINT32, primary_name_server UINT32, secondary_name_server UINT32, default_domain_name CHAR	x	x	x

MICRO-EPSILON MESSTECHNIK GmbH & Co. KG
Königbacher 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/

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