MICRO-EPSILON

Quick Manual

confocalDT IFD2412/2417

Ethernet

IFC2412
IFC2417

Contents

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You can find more information about the measuring system in the operating instructions. They are available online at:

https://www.micro-epsilon.com/download-file/man--confocalDT-IFC241x-Ethernet--en.pdf

Safety, Glossar

Symbols Used

The following symbols are used in this document:

⚠ 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.

Warnings

⚠ CAUTION

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

When all interfaces are used, the sensor surface heats up to more than 50 °C.
> Risk of injury

NOTICE

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

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

Protect the cables against damage.
> Failure of the measuring device

Intended Use

- The measuring system 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 measuring system must only be operated within the limits specified in the technical data.

➪ 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.

Proper Environment

	Sensor	Controller
Protection class	IP64, front side	IP40
Operating temperature rang	+5 ... +70 °C (+41 ... +158 °F)	+5 ... +50 °C (+41 ... +122 °F)
Storage temperature range	-20 ... +70 °C (-4 ... +158 °F)	
Humidity	5 ... 95 % (non-condensing)	
Ambient pressure:	Atmospheric pressure	
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	

Glossary

SMR Start of measuring range

MR Measuring range

MMR Mid of measuring range

EMR End of measuring range

Minimum target thickness see Technical Data, Operating Instructions

Maximum target thickness Sensor measuring range x Refractive index of target

Mechanical Fastening

Sensor

The optical sensors operate in the nanometer range. Observe the maximum tilt angle between sensor and target.

i Ensure careful handling during installation and operation!

The dimensional drawings for the IFS240x sensors and MA240x mounting adapters are compiled in a separate document. You can find these online at:

https://www.micro-epsilon.com/download-file/set--confocalDT-Sensoren--en.pdf

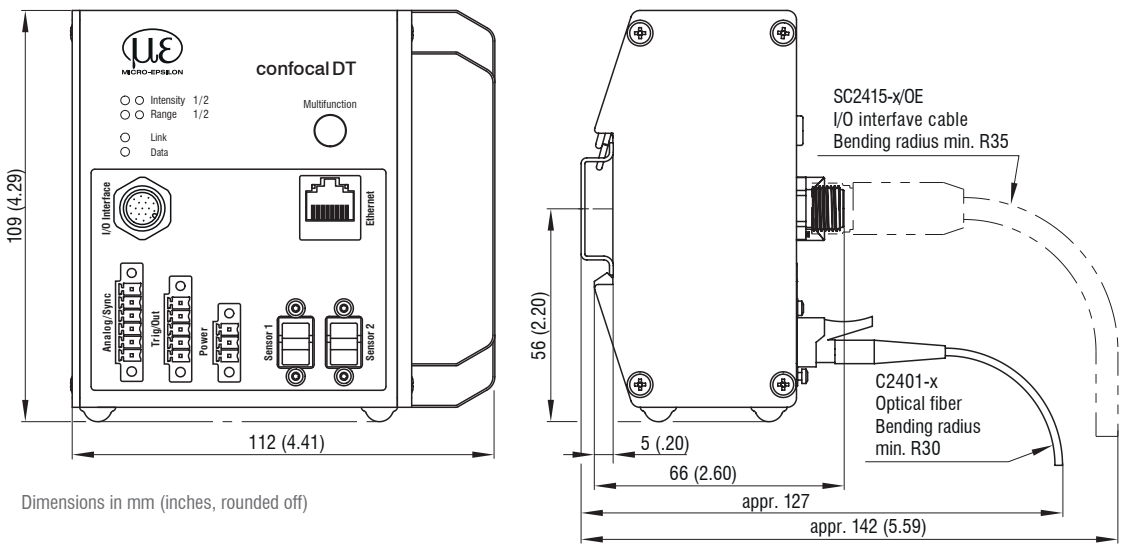
Circumferential clamping with MA240x mounting adapter

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. This is absolutely necessary in difficult installation situations, such as on machines, production lines, etc.

Controller

The IFC2412/2417 controllers can be mounted, e.g., in a control cabinet using a top-hat rail TH 35 according to DIN EN 60715.

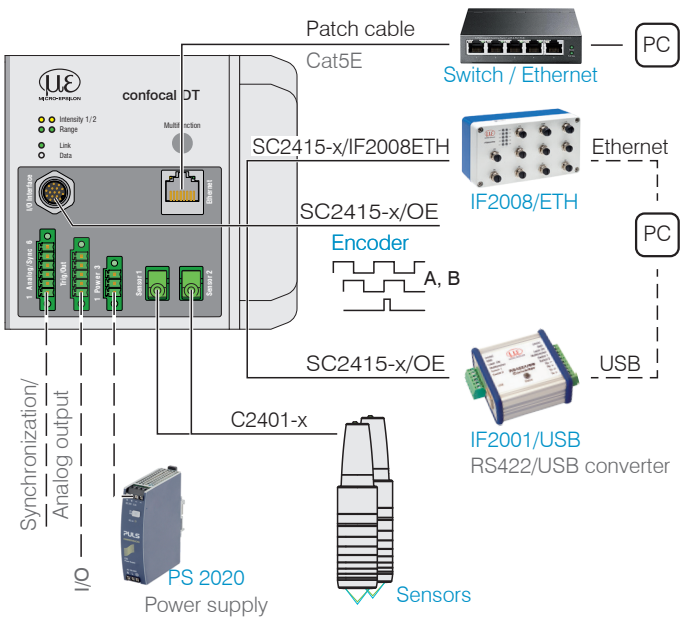
When attaching the controller, ensure that no connections, operating or display elements are covered.



Dimensions in mm (inches, rounded off)

Dimensional drawing IFC2412/2417

Electrical Connections

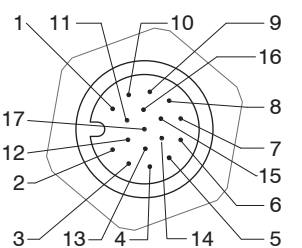


Characteristics SC2415-x/OE signal line:
- RS422
- Encoder

The SC2415-x/OE cable is not in delivery.

17-pin connector, M12	SC2415-x/OE wire color	IFC2412/2417	
		Standard	Alternative
3	Black	Data Tx -	Encoder 2B -
5	Red	Encoder 2Ref+	Encoder 2Ref+
8	Grey	Encoder 1B+	
9	Green	Encoder 1Ref+	
10	Brown	Data Rx+	Encoder 2A+
11	White	Data Rx -	Encoder 2A -
12	Red/Blue	Encoder 1A -	
13	Purple	Data Tx +	Encoder 2B+
14	Blue	Encoder 2Ref -	Encoder 2Ref -
15	Pink	Encoder 1B -	
16	Yellow	Encoder 1Ref -	
17	Grey/Pink	Encoder 1A+	

Pin assignment SC2415-x/OE

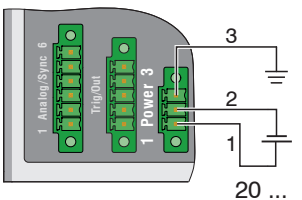


The GND connections are not electrically separated.

17-pin controller male connector, pin side

Supply Voltage

Nominal value: 24 V DC (20 ... 28 V)
Power consumption: < 9 W (IFC2412), <12 W (IFC2417)



Controller 3-pin screw terminal	Power supply
3	Screen
2	GND
1	V_+

Voltage 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 an optional available power supply unit PS2020 for the controller.

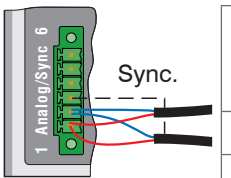
- Only turn on the power supply after wiring has been completed.
- Connect the inputs Pin 1 and Pin 2 at the controller with a 24V power supply.

Analog Output

Up to two distance values or calculated values can be transmitted. The output is via the 6-pin terminal block, see adjacent figure. You can choose between voltage and current output.

Synchronization

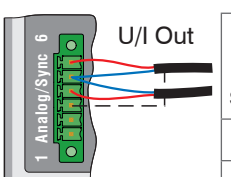
- Interconnected all GND, if the controllers are not supplied from a common power supply.



Controller 6-pin screw terminal	Signal	Level
3	Cable shield	
2	Sync -	RS422
1	Sync +	RS422

Star- or Cascaded synchronization

- Connect Pins 1 and 2 of controller 1 (master) with the correct polarity to Pins 1 and 2 of controller 2 (slave) to controller n, in order to synchronize two or more controllers.



Controller 6-pin screw terminal	Signal
6	Analog 2
5	Analog GND
4	Analog 1
3	Cable shield

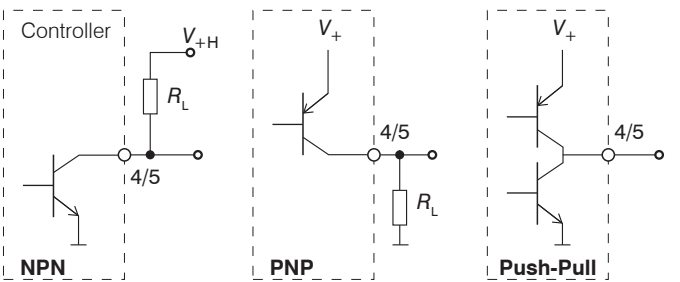
Switching Output

The switching output on the 5-pin pluggable screw terminal are electrically connected to the supply voltage.

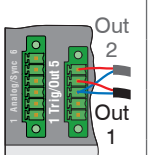
The switching behavior (NPN, PNP, Push-Pull) is programmable, I_{max} 70 mA.

The maximum auxiliary voltage for a switching output with NPN switching behavior is 30 V.

➨ Connect Pins 6 and 5 to the downstream evaluation unit; cable length less than 30 meters.



Description	Output active	Output passive
NPN (Low side)	GND	V_+
PNP (High side)	V_+	GND
Push-Pull	V_+	GND
Push-Pull, negiert	GND	V_+



RS422 Communication

In addition to Ethernet, the controller also supports serial communication via RS422. Serial communication is possible with SC2415-x/OE cables.

Properties: Differential signals according to EIA-422, galvanically connected to the supply voltage.

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

➨ Connect the ground connections.

Controller 12-pin connector	**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	---

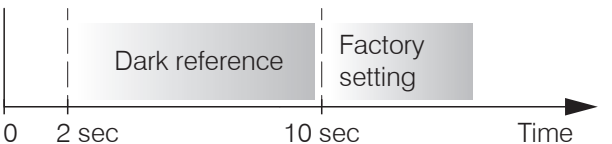
The IFC2412/2417 controllers support one encoder. Without serial communication via RS422 the controllers support up to three encoders.

Multifunction Button

The `Multifunction` button is assigned multiple functions. As default, the button is assigned the `Dark reference` function.

Function	Dark reference	*Starts dark referencing for channel 1 and channel 2.*
	Factory setting	Reset the device and measurement settings to factory settings.

The selected function is indicated by the flashing/illuminated `Range` and `Intensity` LEDs.

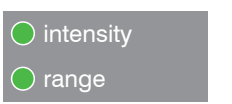


`Multifunction` *button actuation time*

The `Multifunction` button is not assigned a key lock in the factory. Optionally, you can deactivate or lock the `Multifunction` button, see the operating instructions for the controller.

Controller LEDs

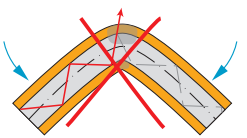
LED	Color	Status	Meaning
Intensity	Red	flashes	Dark signal acquisition in progress
	Red	lights up	Signal saturated
	Yellow	lights up	Signal too low
	Green	lights up	Signal OK
Range	Red	flashes	Dark signal acquisition in progress
	Red	lights up	No target present, outside of measuring range
	Yellow	lights up	Target close to mid of measuring range
	Green	lights up	Measuring object within the measuring range



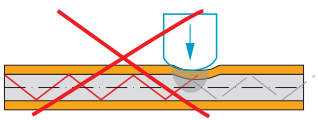
Sensor Cable, Optical Fiber

Sensor and controller are connected through an optical fiber.

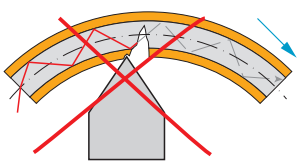
- Do not shorten or lengthen the optical fibers.
- Do not pull or hold the sensor on the optical fiber.



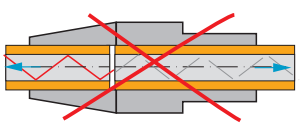
Do not kink the sensor cable.



Please do neither squeeze the sensor cable nor fix it by using cable ties.



Please do not grind the sensor cable over sharp corners.



Do not pull the sensor cable.

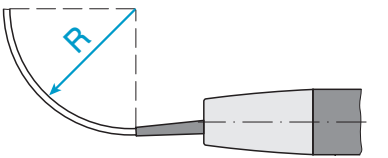
Cleaning of the connectors requires the corresponding know-how.

Basic Rules

Avoid

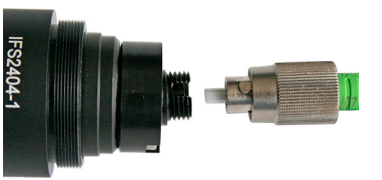
- any contamination of the connector, e. g. dust
- any mechanical stress of the fiber
- strong bending of the fiber

Please never underrun the allowed bending radius.



Fixed:
R = 30 mm or more

Flexible:
R = 40 mm or more



Socket groove on the sensor (left) and guiding peg of an FC sensor plug (right)

Sensor and fiber optic

i *Note the orientation of the socket and the guiding peg.*

Initial Operation

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

Communication with the sensor

Ethernet-Setup-Mode

- Programming via web interface,
- Output of measurement data via Ethernet
- Programming on command level e.g. with Telnet,

➨ Connect the sensor and the PC with a LAN cable.

➨ Start your web browser and type the standard IP address 169.254.168.150 of the sensor into the address bar.

RS422 Communication [1]

- Programming via web interface;
- programming on command level e.g. with Telnet,
- Output of measurement data via RS422

➨ Connect the sensor, e.g. via an IF2001/USB RS422 converter from Micro-Epsilon via USB to a PC.

➨ Start the `sensorTOOL` program.

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

➨ Click the `Sensor` button.

The program will now search for connected sensors.

➨ Select a desired sensor. Click the `Open Website` button.

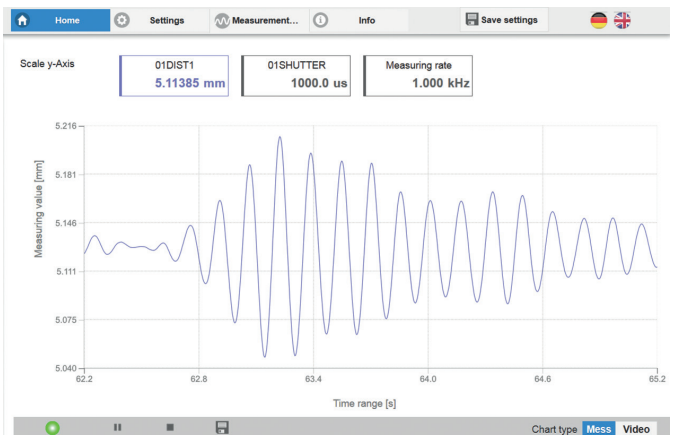
Saved settings remain in the sensor remanently across interfaces

1) The IFC2412/2417 controllers always support the use of a single encoder, regardless of whether Ethernet or RS422 communication is used. Serial communication via RS422 is not possible if two or three encoders are to be supported by the controller.

Access via Web Interface

Start the web interface of the controller, see section *Initial Operation*.

Interactive web pages you can use to configure the controller are now displayed in the web browser. The controller is active and supplies measurement values. The web interface does not guarantee real-time measurements. The currently running measurement can be controlled using the function buttons in the `Chart type` section.



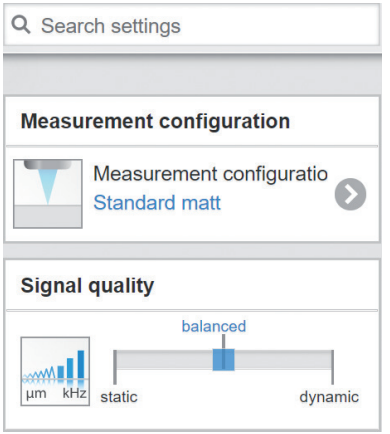
First page after web interface has been accessed

For configuration, you can switch between the video signal and a display of the measured values over time. The appearance of the websites depends on the functions. Dynamic help texts with excerpts from the operating instructions supports you during sensor configuration.

Depending on the selected measuring rate and the PC used, measured values may be reduced in the display. That is, not all measured values are transmitted to the web interface for display and saving.

The horizontal navigation includes the functions below:

- `Home`. The web interface automatically starts in this view with Measurement Chart, `Measurement configuration` and `Signal quality`.
- `Settings`. Sensor parameters configuration such as triggering, measuring rate and zero setting/mastering.
- `Measurement chart`. Measurement chart or video signal display.
- `Info`. Includes information about the sensor, such as measuring range, serial number and software status.

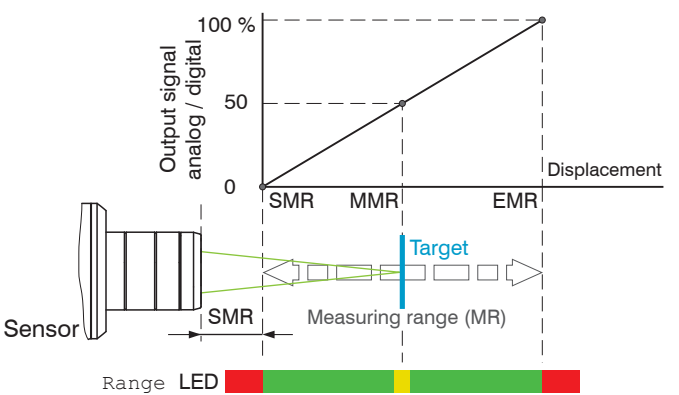


The vertical navigation is contextual to the selection in the horizontal navigation and contains the following functions for the `Home` menu:

- The `Search settings` function permits time-saving access to functions and parameters.
- `Measurement configuration`. Allows a selection of predefined measurement settings (presets).
- `Signal quality` By mouse click it is possible to switch between three predefined basic settings for the measuring rate and the averaging.
- `System configuration`. Displays the connected sensors for Channel 1 and Channel 2 and the peak number, etc.

Positioning the Target

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



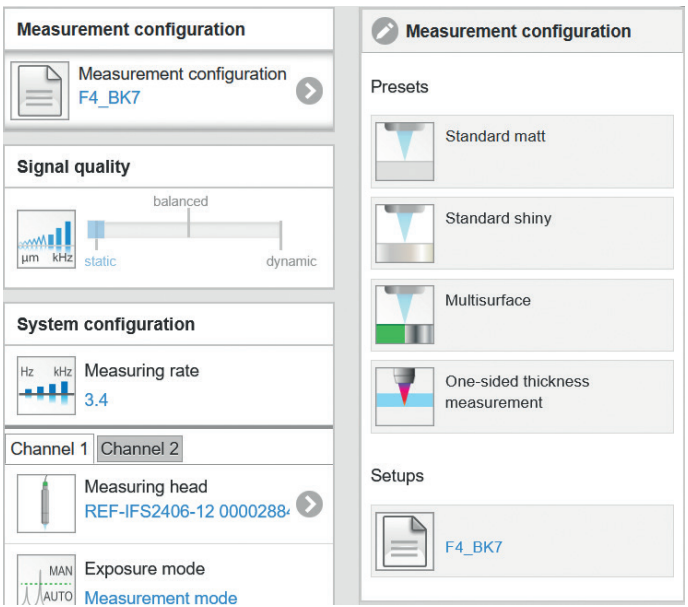
Range LED	
Red	No target present or target outside of measuring range
yellow	Target close to mid of measuring range
green	Measuring object within the measuring range

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

Presets, Setups, Measurement Configuration, Signal Quality

Definition

- Preset: Manufacturer-specific program with settings for frequent measurement tasks; cannot be overwritten
- Setup: User-specific program with relevant settings for a measurement task
- Initial setup at boot (sensor start): a favorite can be selected from the setups, which is automatically activated at sensor start. If no favorite is determined from the setups, the sensor activates the `Standard` preset at startup.



Upon delivery of the sensor from the factory

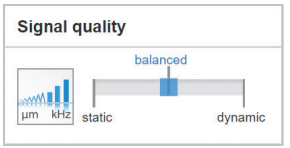
- the presets `Standard matt`, `Standard shiny`, `Multisurface` and `One-sided thickness measurement` are possible
- for the IFC2417 controller, the presets `Multilayer air gap` and `Multilayer laminated glass` are available.
- no setup is available.

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 the `System settings > Load & save` menu

A setup can be stored permanently in the sensor.

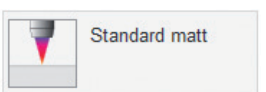
For all presets, the measurement task can be individually adapted via the `Signal quality` slider. Reducing the measuring rate increases the exposure time for the line and thus improves the measurement quality.



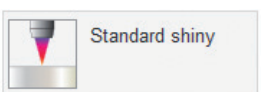
Measuring rate [1]	Averaging [1]	Description
0.2 kHz	Static Moving, 128 values	Three predefined basic settings (Static, Balanced and Dynamic); a change via mouse click is immediately visible in the diagram and the system configuration.
1 kHz	Balanced Moving, 16 values	
5 kHz	Dynamic Moving, 4 values	

i If the sensor starts up with a user-defined measurement setting (setup), the signal quality cannot be changed.

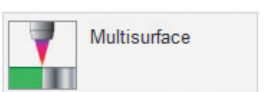
Presets allow a quick start into the individual measurement task. Basic features such as peak and material selection and the calculation functions are already set in the presets to match the target surface.



Distance measurement, e.g., for ceramic material, non-transparent plastics. Highest peak, averaging, distance calculation.

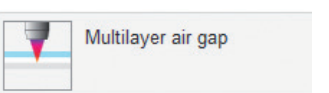


Distance measurement, e.g., for metal, polished surfaces. Highest peak, Median over 5 values, distance calculation.

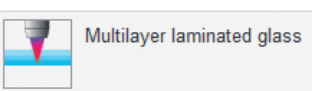


Distance measurement, e.g., for PCBs, hybrid materials. Highest peak, Median over 9 values, distance calculation.

One-sided thickness measurement, e.g., for glass, BK7 material. First and second peak, averaging, thickness calculation.



One-sided thickness measurement [2] 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.



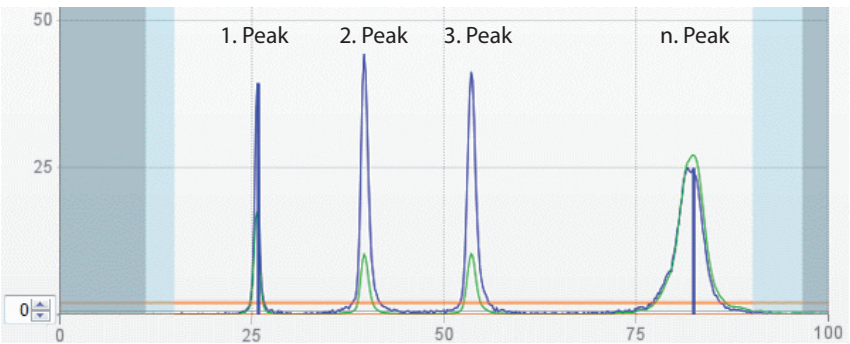
Layer thickness measurement [2] against laminated glass e.g. windshield, 1st layer BK7, 2nd layer PC, 3rd layer BK7, first and second peak, 4 measured values, thickness calculation, moving averaging over 16 values.

1) Values apply to the `Standard matt` and `One-sided thickness measurement` presets.
2) Possible in IFC2417

Checking the Video Signal, Peak Selection

The video signal shows the determined reflections at the measuring object as a raw signal. The peaks are counted starting at the start of the measuring range toward the end of the measuring range. The corresponding measured value is marked by a vertical line (peak marking).

➪ Go to the `Measurement chart` menu. Select Channel 1 or Channel 2 in the signal selection. Display the video signal with `Video`. Adjust the settings for the exposure mode and measuring rate parameters.



The selection of peaks dictates which region in the signal is used for the distance or thickness measurement. For a measuring object consisting of several transparent layers, use the refractive index correction to compensate for the distance measurement errors caused by optical factors, see operating instructions.

Video signal of transparent measuring object with four peaks (optical boundary areas) in the measuring range

		IFC2412	IFC2417
1 measurement	first peak / highest peak / last peak	•	•
2 measurement values	first and second peak / first and last peak / second to last and last peak / highest and second highest peak	•	•
3 up to 6 measurement values	All peaks above the intensity threshold are evaluated in ascending distance order.		•

➪ In order to adjust the peak selection, go to `Settings` > `Data acquisition` > `Channel 1/2` > `Number of peaks`

Distance Measurement with Website Display

- Align the sensor perpendicularly to the object to be measured.
- Then, move the sensor (or the target) closer and closer to the start of the measuring range of the relevant sensor.

As soon as the object is within the measuring field of the sensor, the sensor's `Range` LED lights up (green or yellow). Alternatively, you can watch the video signal.

`Measurement` *(distance measurement) web page*

1 `Stop` pauses the chart; you can still use the data selection and zoom functions. `Save` opens a Windows selection dialog for the file name and storage location to save the last 10,000 values in a CSV file (separation using semicolon).

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

3 In the left-hand window, the signals 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.

- 01SHUTTER: exposure time
- 01xINTENSITY: Signal quality of the underlying peak in the video signal
- 01DIST: Distance signal curve over time

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

5 The 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 The peak intensity is displayed as a bar chart.

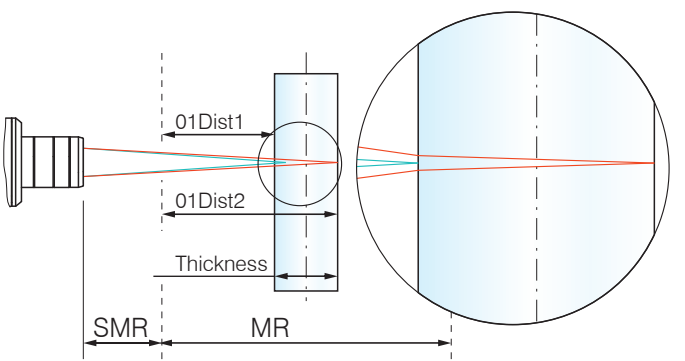
8 Scaling the x-axis: During an ongoing measurement, you can use the left-hand slider to enlarge the entire signal (zoom). The time range can also be defined using an input field under the time axis. When the chart has been stopped, the right-hand slider can also be used. You can also move the zoom window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

One-Sided Thickness Measurement, Transparent Target

The sensor evaluates two signals reflected on the surfaces. Based on these two signals, the sensor 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.



One-sided thickness measurement for a transparent target

Preset Selection

- Switch to the `Home` menu.
- Select `One-sided thickness measurement` in the `Measurement configuration` menu.

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

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.

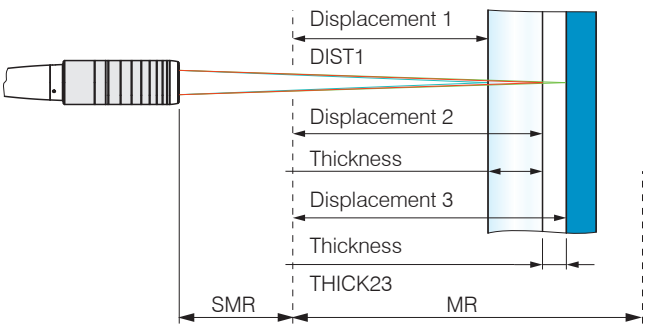
The material table includes predefined materials.

- Switch to the `Settings > Data acquisition > Channel 1/2 > Material selection` menu.
- Select the material of the target for Layer 1.

Layer Thickness Measurement, Transparent Target

This function is available with the IFC2417 controller. The controller evaluates signals reflected at the surfaces. The controller uses the max. 6 possible signals to calculate the distances from the surfaces and from this 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).



Measurement of a transparent target with multiple layers

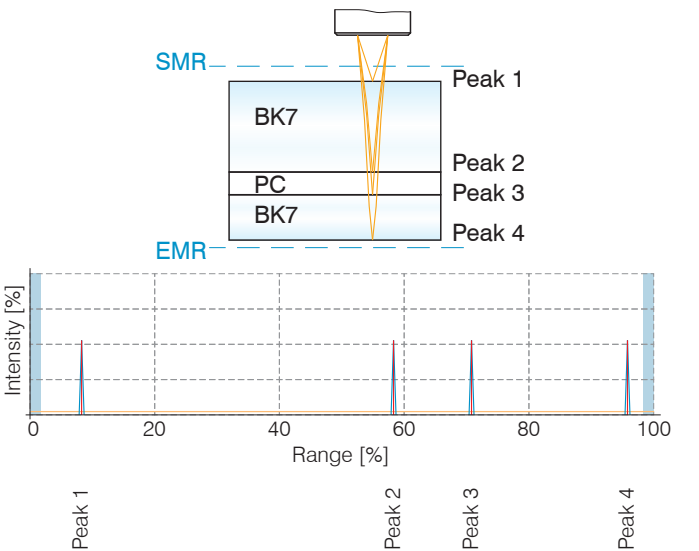
Preset Selection

- Switch to the `Home` menu.
- In the Measurement configuration menu, select the `Multilayer air gap` or `Multilayer laminated glass` preset.

Peak Selection

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

- Switch to `Settings` > `Data acquisition` > `Channel 1/2` > `Number of peaks` and select the required peaks.



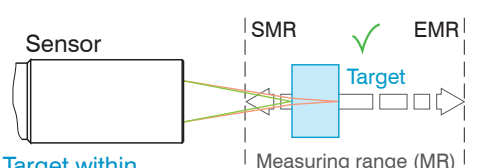
Transparent target with three layers

Video Signal

If a surface of the target lies outside the measuring range, the sensor will send only one signal for the displacement, intensity and center of gravity. This may also occur if a signal is below the detection threshold. Two boundary surfaces are active when the correct thickness of a transparent material is measured. As a result, two peaks are visible in the video signal.

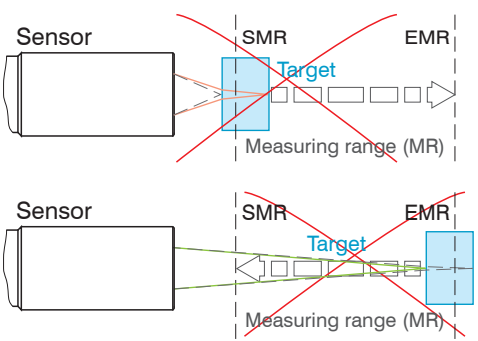
➪ Switch between Channels 1/2 in the video signal display to check both signals.

`Video signal` *(thickness measurement) web page*



Target within measuring range with two active boundary areas

Measurement arrangement thickness measurement



Measuring object only partially in the measuring range

No thickness measurement possible

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.

The material table includes predefined materials.

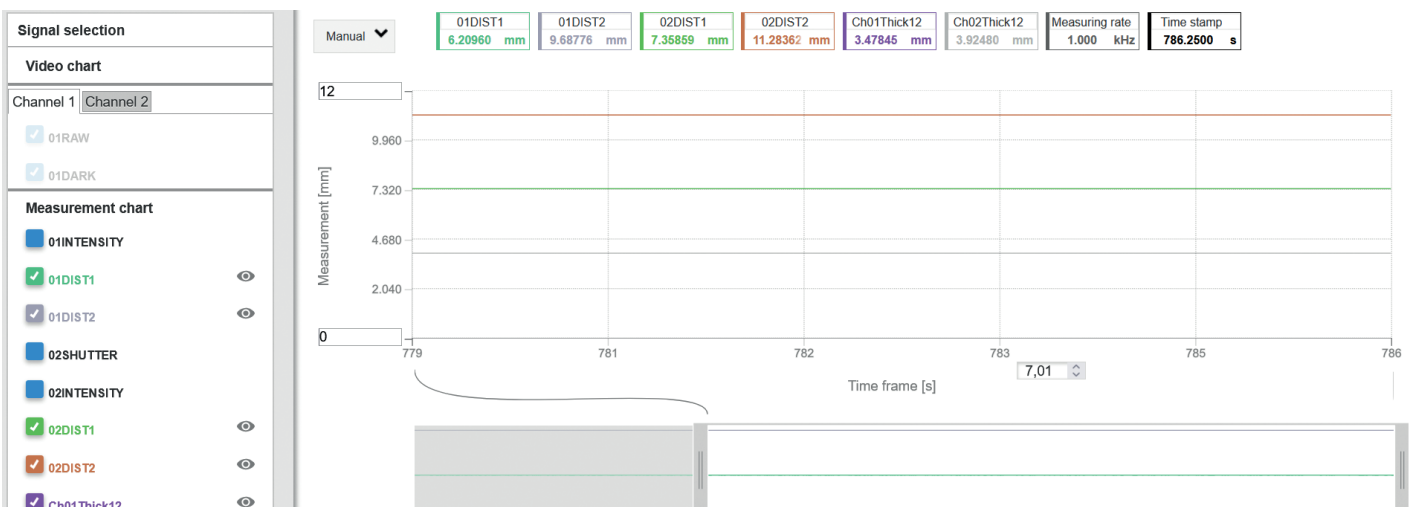
➡ Switch to the `Settings > Data acquisition > Channel 1/2 > Material selection` menu.

➡ Select the material of the target for Layer 1.

Measurement Chart for Thickness Measurement

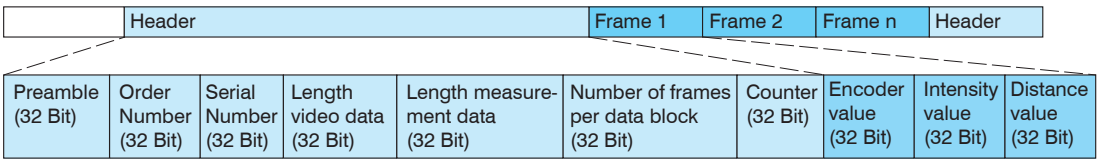
➡ Switch to the `Measurement chart` tab and select `Mess` as the chart type.

The website displays the distances and thicknesses graphically and numerically, according to the `signal selection`.



Data Format Ethernet Interface

All measurement data and the header are transmitted in the little Endian format. A data packet consists of at least one measurement data frame and typically includes several.



Example for data transmission with Ethernet

Value	Ethernet, min	Ethernet, max	Scaling	Unit	IFD2412	IFD2417
0xRAW (512 x 16Bit)	0	4095	value / 4096 * 100	%	X	X
0xSHUTTER	0	UINT32_MAX	value / 36	µs	X	X
0xENCODER1	0	UINT32_MAX	value	Encoder Ticks	X	X
0xENCODER2	0	UINT32_MAX	value	Encoder Ticks	X	X
0xENCODER3	0	UINT32_MAX	value	Encoder Ticks	X	X
0xINTENSITY[1..6]	0	0x3fffffff	(value & 0x7ff) / 1024 * 100	%	X	X
0xDIST[1..6]	INT32_MIN	0x7ffffeff	value / 1000000	mm	X	X
MEASRATE	4500	360000	36000 / value	kHz	X	-
MEASRATE	1440	360000	36000 / value	kHz	-	X
TIMESTAMP	0	UINT32_MAX	value	µs	X	X
COUNTER	0	UINT32_MAX	value		X	X
_MIN	INT32_MIN	0x7ffffeff	identical 0xDIST*	mm	X	X
_PEAK	INT32_MIN	0x7ffffeff	identical 0xDIST*	mm	X	X
_MAX	INT32_MIN	0x7ffffeff	identical 0xDIST*	mm	X	X

Excerpt output values with Ethernet

Data Format RS422 Interface

The output of distance and other measurements via RS422 requires subsequent conversion into the corresponding units. If requested, the measurement data 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

An overview of all output values is provided in the operating instructions.

Value	RS422, min	RS422, max	Scaling	Unit	IFD2412	IFD2417
0xRAW (512 x 16Bit)	0	4095	value / 4096 * 100	%	X	X
0xSHUTTER	0	262143	value / 9	µs	X	X
0xENCODER1	0	262143	value	Encoder Ticks	X	X
0xINTENSITY[1...6]	0	2048	value / 1024 * 100	%	X	X
0xDIST[1...6]	0	262071	(value - 98232) / 65536 * MB	mm	X	X
MEASRATE	2250	180000	18000 / value	kHz	X	-
MEASRATE	720	180000	18000 / value	kHz	-	X
TIMESTAMP_HI	0	65535	value * 65536	µs	X	X
TIMESTAMP_LO	0	65535	value	µs	X	X
_MIN	0	262071	identical 0xDIST	mm	X	X
_PEAK	0	262071	identical 0xDIST*	mm	X	X

Excerpt output values with RS422

Service, Repair

If the sensor is defective:

- If possible, save the current sensor settings in a parameter set to reload them into the sensor after the repair.
- Please send us the affected parts for repair or exchange.

If the cause of a fault cannot be clearly identified, please send the entire measuring system to:

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

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

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/.

Decommissioning, Disposal

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

- Remove all cables from the sensor.
- Dispose of the sensor, its components and accessories, as well as the packaging materials in compliance with the applicable country-specific waste treatment and disposal regulations of the region of use.
- You are obliged to comply with all relevant national laws and regulations

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

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

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

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