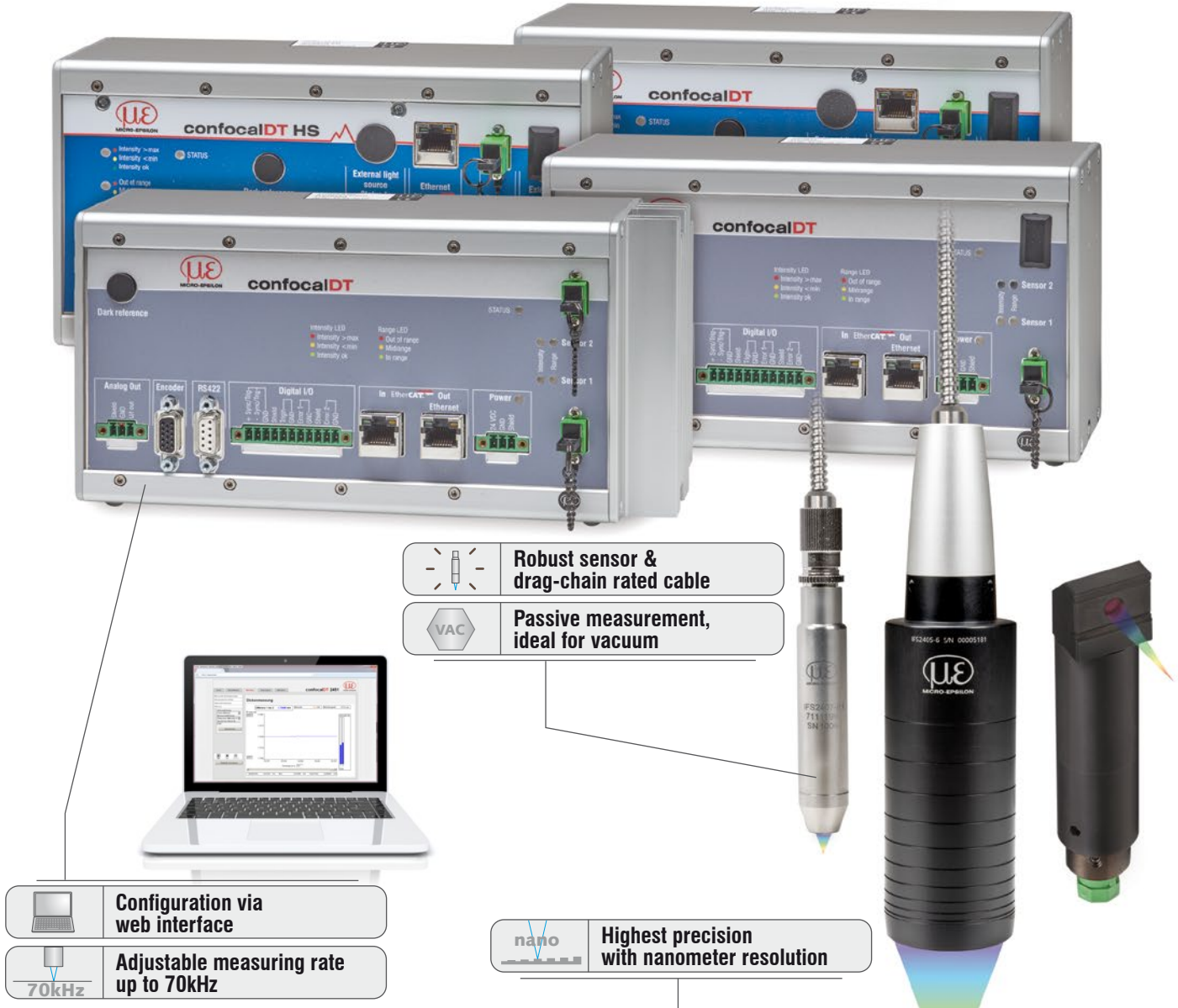
MICRO-EPSILON

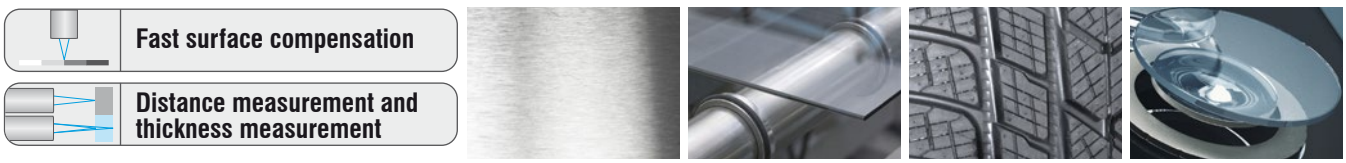
More Precision

confocalDT // Confocal chromatic sensor system



Highest precision in confocal chromatic displacement and thickness measurements

The confocalDT product range stands for highest precision and dynamics in the confocal chromatic measurement technology. The measuring system includes the fastest controller currently available, enabling high precision measurement results in displacement and distance measurement tasks, as well as thickness measurement of transparent objects. A large number of sensors and different interfaces can be used in versatile measurement tasks, e.g., in the semiconductor industry, glass industry, medical engineering and machine building.



confocalDT

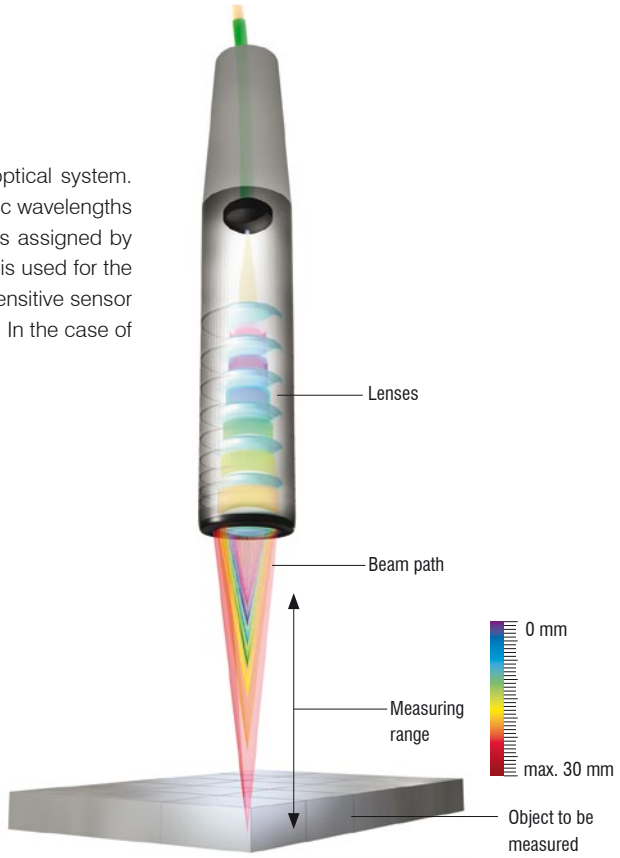
Sensor type		Measuring range	Measurement direction	Measurement mode	Page
confocalDT IFS2402	Miniature sensors Ø4 mm	0.4 mm ... 3.5 mm		Distance measurement	8 - 9
confocalDT IFS2403	Hybrid sensors ø8 mm	0.4 mm ... 10 mm		Distance measurement Thickness measurement	10 - 11
confocalDT IFS2404	Compact sensors ø12 mm	2 mm		Distance measurement Thickness measurement	12
confocalDT IFS2405	Robust & universal sensors ø27 - 64 mm	0.3 mm ... 30 mm		Distance measurement Thickness measurement	13 - 15
confocalDT IFS2406	Special sensors ø20 - 27 mm	2.5 mm ... 10 mm		Distance measurement Thickness measurement	16 - 17
confocalDT IFS2407	High precision sensors ø12 - 54 mm	0.1 mm ... 3 mm		Distance measurement Thickness measurement	18 - 19

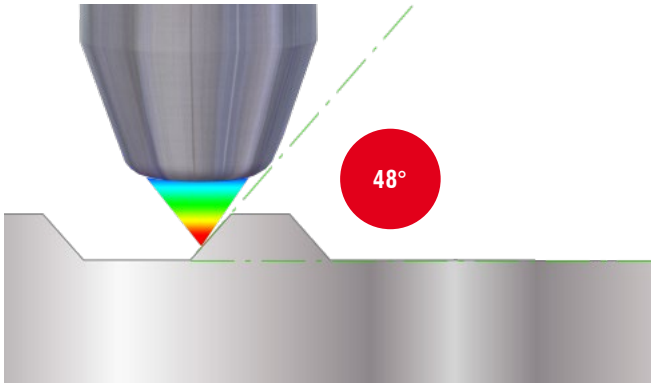
Each sensor can be operated with every confocalDT controller.

Controller type		Measurement channels	Measuring rate	Page
confocalDT IFC242x	Confocal controller for industrial applications	1 or 2	up to 6.5 kHz	20 - 21
confocalDT IFC2461	High-performance controller	1	up to 25 kHz	22 - 23
confocalDT IFC2471 HS	Confocal high-speed controller	1	up to 70 kHz	24 - 25

The confocal chromatic measuring principle

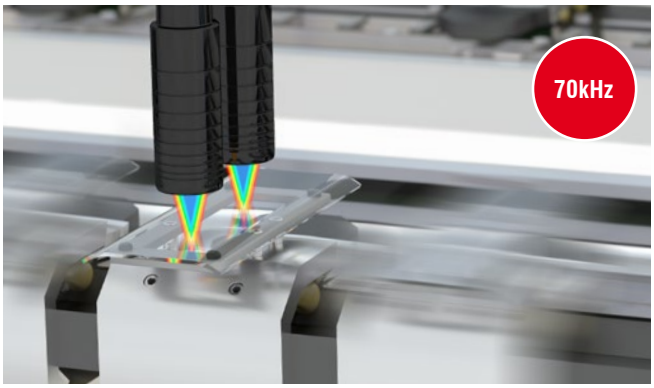
Polychromatic white light is focused onto the target surface by a multilens optical system. The lenses are arranged so that the white light is dispersed into monochromatic wavelengths by controlled chromatic aberration. To each wavelength, a specific distance is assigned by factory calibration. Only the wavelength which is exactly focused on the target is used for the measurement. An optical arrangement images the light reflected onto a light sensitive sensor element, on which the corresponding spectral color is detected and evaluated. In the case of multi-peak measurements, several distance points are evaluated accordingly.





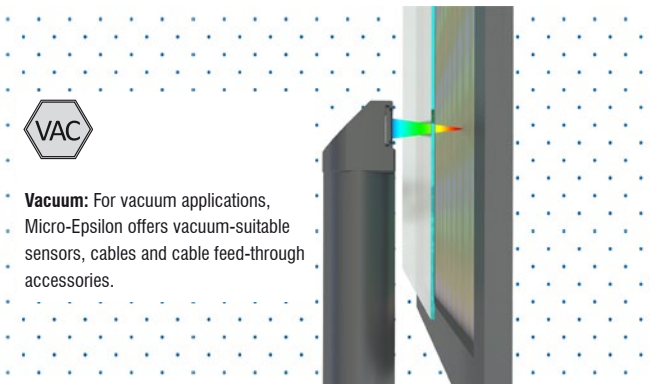
Extremely large tilt angle

The confocalDT IFS sensors tolerate a large tilt angle up to 48°. Therefore, curved and structured surfaces can be detected reliably to generate stable signals.



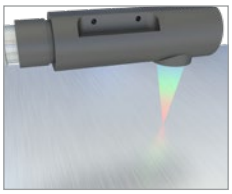
Fastest measuring rates for dynamic measurement tasks

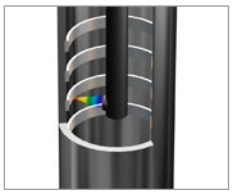
IFC2471HS controllers offer with 70 kHz the highest measuring rate in the world. However, it is important to adapt the exposure to the respective surface. Therefore, the confocalDT controller dynamically regulates the exposure of the CCD line. This exposure control compensates for color and reflectivity changes of the measurement object in order to increase the measurement accuracy at high measuring rates.



Ready for vacuum

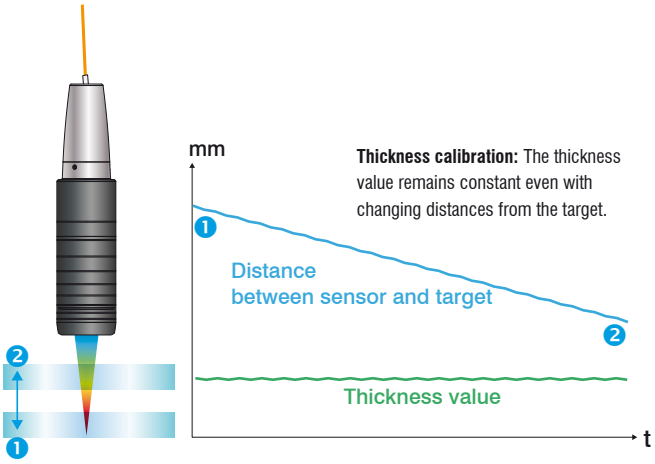
The confocalDT sensors consist of passive components and do not give off heat. Particularly for use in vacuum applications, Micro-Epsilon offers sensors, cables and accessories which can be used according to their respective specification.





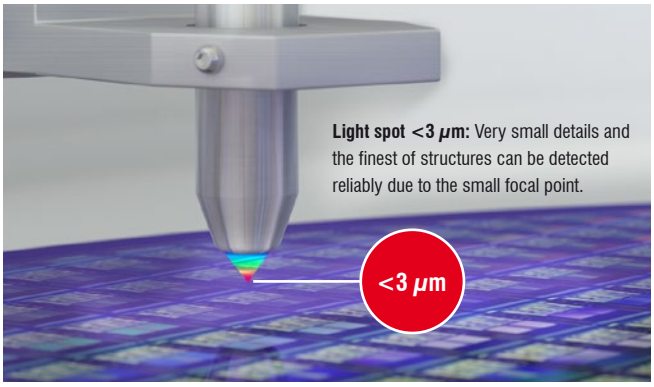
Ultra-small sensors for restricted installation spaces

The compact sensor design with diameters from 4 mm enables the integration in restricted spaces. With the 90° models, the required installation depth is again significantly reduced.



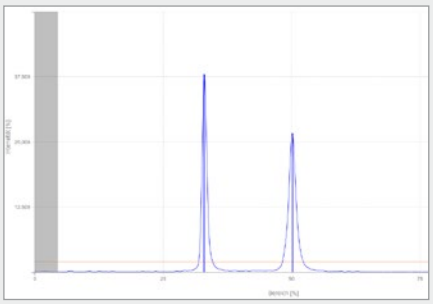
Thickness calibration for precise thickness measurements regardless of distance

Changing material thickness and a varying distance between the target and the sensor produce faulty measurement values. Therefore, confocalDT controllers from Micro-Epsilon offer a thickness calibration feature. The refractive indices (start of measuring range, mid of measuring range, end of measuring range) of different materials are stored in the controller and can be individually adapted. By selecting the respective target material, the distance-dependent error is automatically compensated for which enables to achieve the highest possible measurement accuracy.

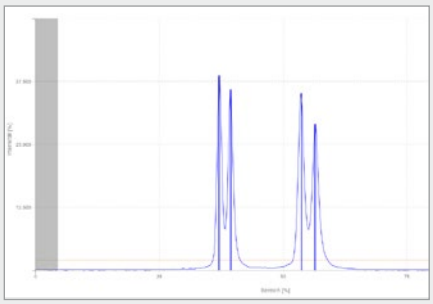


The world's smallest light spot for high lateral resolution

The confocalDT sensors from Micro-Epsilon are available with different aperture angles. Sensors with a large aperture angle or high numerical aperture (NA) generate a small light spot (X-Y resolution) and high Z resolution. The light spot size remains almost constant over the entire measuring range which enables to measure even finest details such as IC pins on PCBs, bonding wire or surface roughness. Due to the high measuring rate, roughness can be detected much more faster than with tactile measurements. In addition, the non-contact measuring principle is reactionless.



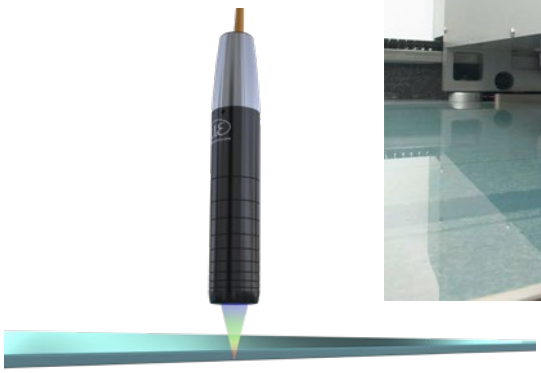
Thickness measurement signal



Signal with multi-layer thickness measurements (max. 6 peaks)

Thickness measurement of transparent materials in the micron range

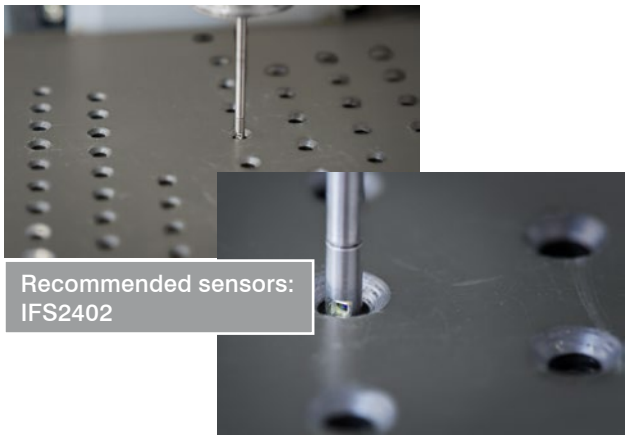
The confocalDT sensors enable thickness measurements of transparent materials. The material thickness is detected to micrometer accuracy using just one single sensor. Thanks to the integrated multi-layer measurement, the thickness of materials such as laminated glass can be evaluated.



Recommended sensors:
IFS2405

Thickness measurement of displays and flat glass

In display glass production, glass sheets with a homogeneous thickness profile are required. To monitor the thickness, confocal chromatic sensors from Micro-Epsilon are used for non-contact, one-sided thickness measurement. Due to their high measuring rate, the sensors are also applied in high speed processes.

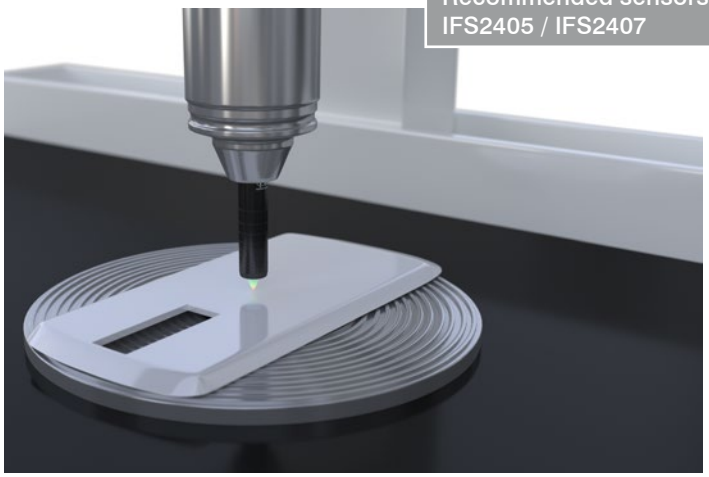


Recommended sensors:
IFS2402

Restricted installation space

Miniature sensors with a diameter of 4 mm measure in confined installation spaces, e.g., for the inspection of boreholes. Furthermore, the 90° version of these sensors enables to measure the finest interior contours.

Recommended sensors:
IFS2405 / IFS2407



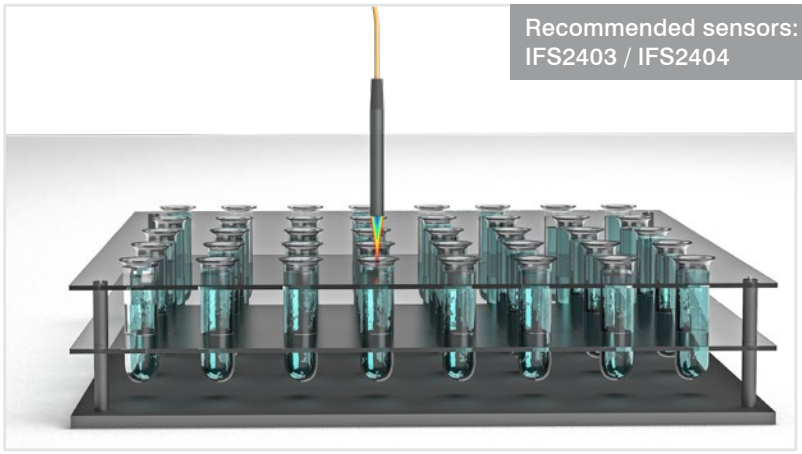
Coordinate measuring machines

The large aperture angle and the high numerical aperture of confocal chromatic sensors enable high resolution with a small light spot size. As the sensors also tolerate a large tilt angle, they are used in coordinate measuring machines for geometry testing and roughness measurements.

Recommended sensors:
IFS2406

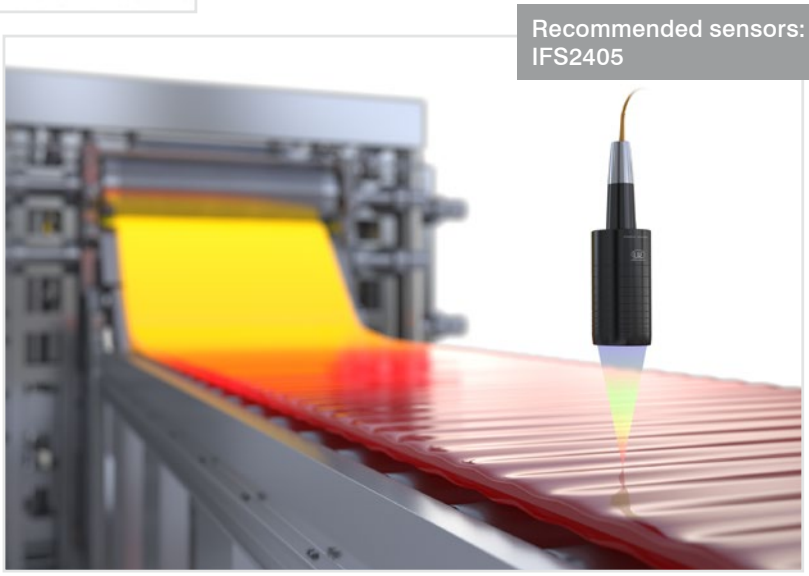
Wall thickness measurement of container glass

Wall thickness distribution is a crucial quality criterion for container glass. In order to determine the glass thickness of the bottom and the walls, confocal chromatic sensors from Micro-Epsilon are used. Measurements are performed without contact and at a high measuring rate.



Measurement in recesses

Their narrow beam path enables the confocal sensors to measure in recesses. With the confocal measuring principle, also measurements on liquids are possible, e.g., for precise filling level control in trays.

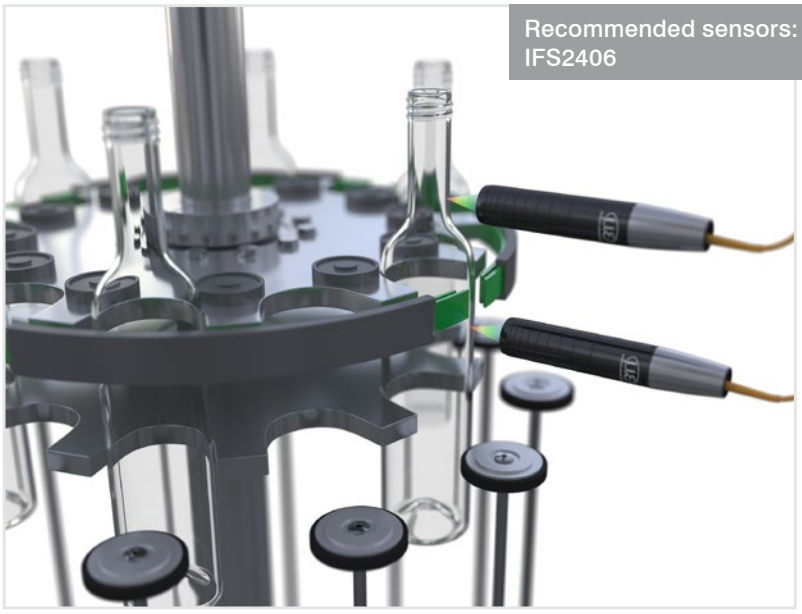


Measuring on hot glass

Protected with a housing provided by the customer, confocal sensors can also measure on hot glass. The large offset distance allows for the sensor to be mounted from a safe distance to the hot glass.

Interior diameter inspection

High precision diameter inspection of bores and cylinders using 90° sensor models.



Thickness measurement on the star wheel

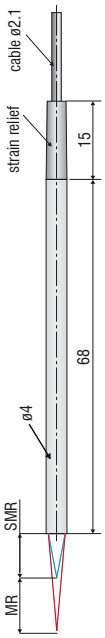
Fast dual-channel thickness measurement of glass bottles in the industrial production process.

Miniature sensors ø4mm with axial or radial (90°) measuring direction

Submicrometer resolution

Distance measurement

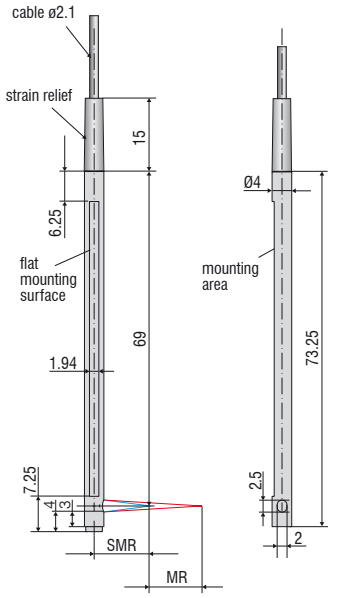
Extremely small spot size



MR = measuring range
SMR = start of measuring range
Dimensions in mm, not to scale

Model		IFS2402-0,4	IFS2402-1,5	IFS2402-4
Measuring range		0.4 mm	1.5 mm	3.5 mm
Start of measuring range	approx.	1.5 mm	0.9 mm	1.9 mm
Resolution	static [1]	16 nm	60 nm	100 nm
	dynamic [2]	48 nm	192 nm	480 nm
Linearity [3]	Displacement and distance	< ±0.3 µm	< ±1.2 µm	< ±3 µm
Light spot diameter		10 µm	20 µm	20 µm
Max. tilt angle [4]		±8°	±5°	±3°
Numerical aperture (NA)		0.25	0.20	0.10
Connection		integrated optical fiber 2 m with E2000/APC connector; extension up to 50 m; bending radius: static 30 mm; dynamic 40 mm		
Installation		Clamping, mounting adapter (see accessories)		
Temperature range	Storage	-20… +70 °C		
	Operation	+5 … +70 °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)		IP64, front operated		
Material		Stainless steel housing, glass lenses		
Weight		approx. 186 g (incl. optical fiber)		

[1] Average from 512 values at 1 kHz, near to the midrange onto optical flat
[2] RMS noise relates to mid of measuring range (1 kHz)
[3] All data at constant ambient temperature (25 ±1 °C) against optical flat; specifications can change when measuring different objects.
[4] Maximum sensor tilt angle that produces a usable signal on reflecting surfaces. The accuracy decreases when approaching the limit values.

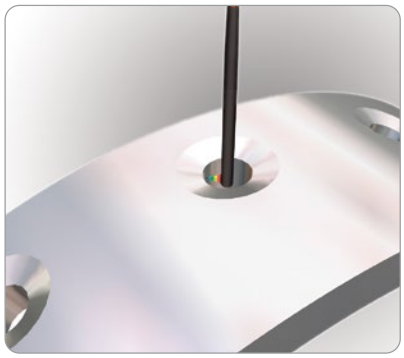


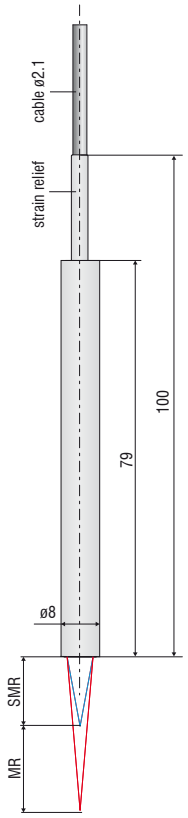
MR = measuring range
SMR = start of measuring range
Dimensions in mm, not to scale

Model		IFS2402/90-1,5	IFS2402/90-4
Measuring range		1.5 mm	2.5 mm
Start of measuring range	approx.	2.5 mm [1]	2.5 mm [1]
Resolution	static [2]	60 nm	100 nm
	dynamic [3]	192 nm	480 nm
Linearity [4]	Displacement and distance	< ±1.2 µm	< ±3 µm
Light spot diameter		20 µm	20 µm
Max. tilt angle [5]		±5°	±3°
Numerical aperture		0.20	0.10
Connection		integrated optical fiber 2 m with E2000/APC connector; extension up to 50 m; bending radius: static 30 mm, dynamic 40 mm	
Installation		Clamping, mounting adapter (see accessories)	
Temperature range	Storage	-20 … +70 °C	
	Operation	+5 … +70 °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)		IP40	
Material		Stainless steel housing, glass lenses	
Weight		approx. 186 g (incl. optical fiber)	

[1] Start of measuring range measured from sensor axis.
[2] Average from 512 values at 1 kHz, near to the midrange 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] Maximum sensor tilt angle that produces a usable signal on reflecting surfaces. The accuracy decreases when approaching the limit values.

- **Hybrid sensors ø8mm with axial or radial (90°) measuring direction**
- **Submicrometer resolution**
- **One-sided thickness measurement**
- **Distance measurement**
- **Extremely small spot size**

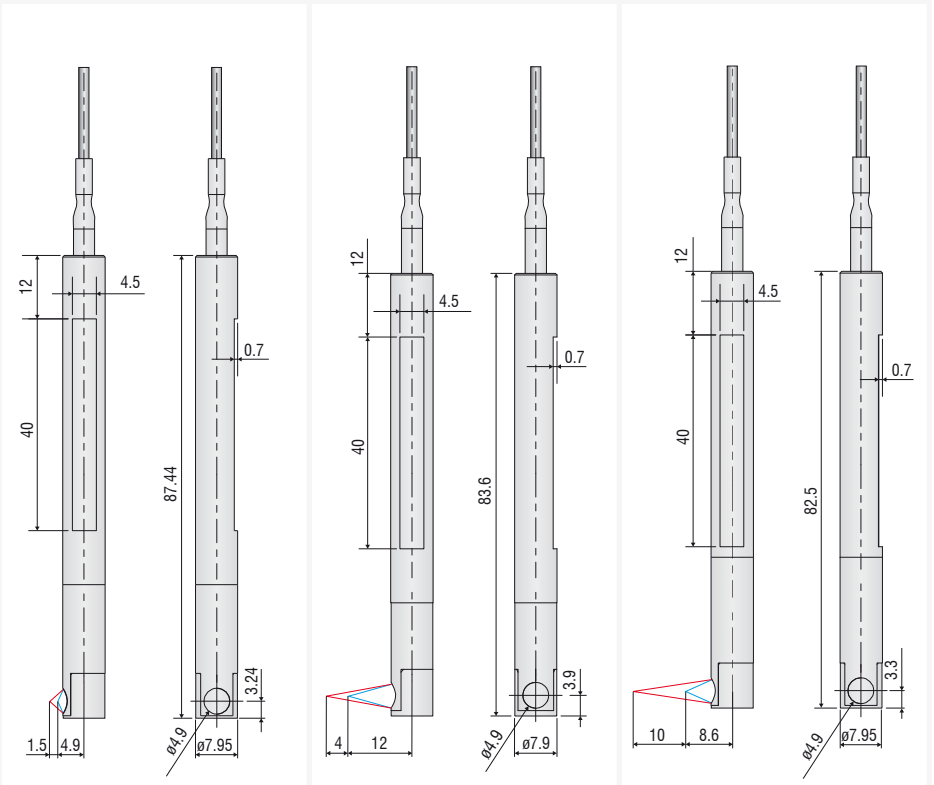




MR = measuring range
SMR = start of measuring range
Dimensions in mm, not to scale

Model		IFS2403-0.4	IFS2403-1.5	IFS2403-4	IFS2403-10
Measuring range		0.4 mm	1.5 mm	4 mm	10 mm
Start of measuring range	approx.	2.5 mm	8 mm	14.7 mm	11 mm
Resolution	static [1]	16 nm	60 nm	100 nm	250 nm
	dynamic [2]	47 nm	186 nm	460 nm	1250 nm
Linearity [3]	Displacement and distance	< ±0.3 µm	< ±1.2 µm	< ±3 µm	< ±20 µm
	Thickness	< ±0.6 µm	< ±2.4 µm	< ±6 µm	< ±40 µm
Light spot diameter		9 µm	15 µm	28 µm	56 µm
Max. tilt angle [4]		±20°	±16°	±6°	±6°
Numerical aperture (NA)		0.50	0.30	0.15	0.15
Min. target thickness [5]		0.06 mm	0.23 mm	0.6 mm	1.5 mm
Connection		integrated optical fiber 2 m with E2000/APC connector; extension up to 50 m; bending radius: static 30 mm, dynamic 40 mm			
Installation		Clamping, mounting adapter (see accessories)			
Temperature range	Storage	-20 … +70 °C			
	Operation	+5 … +70 °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)		IP64 (front)			
Material		Stainless steel housing, glass lenses			
Weight		approx. 200 g (incl. optical fiber)			

[1] Average from 512 values at 1 kHz, near to the midrange onto optical flat
[2] RMS noise relates to mid of measuring range (1 kHz)
[3] All data at constant ambient temperature (25 ±1 °C) against optical flat; specifications can change when measuring different objects.
[4] Maximum sensor tilt angle that produces a usable signal on reflecting surfaces. The accuracy decreases when approaching the limit values.
[5] Glass sheet with refractive index n = 1.5 in midrange

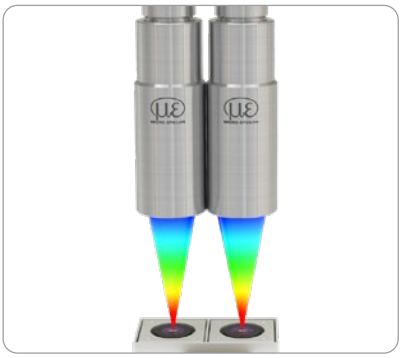


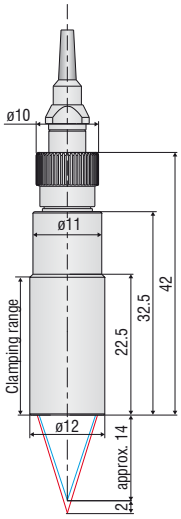
Dimensions in mm, not to scale

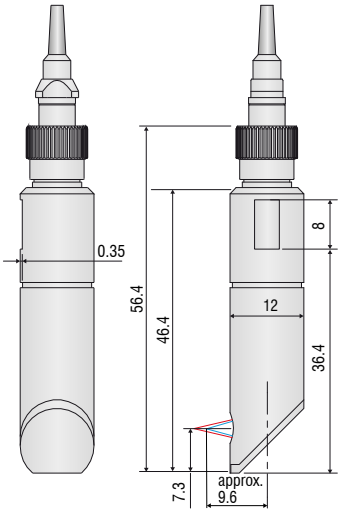
Model		IFS2403/90-1.5	IFS2403/90-4	IFS2403/90-10
Measuring range		1.5 mm	4 mm	10 mm
Start of measuring range	approx.	4.9 mm [1]	12 mm [1]	8.6 mm [1]
Resolution	static [2]	60 nm	100 nm	250 nm
	dynamic [3]	186 nm	460 nm	1250 nm
Linearity [4]	Displacement and distance	< ±1.2 µm	< ±3 µm	< ±20 µm
	Thickness	< ±2.4 µm	< ±6 µm	< ±40 µm
Light spot diameter		15 µm	28 µm	56 µm
Max. tilt angle [5]		±16°	±6°	±6°
Numerical aperture (NA)		0.30	0.15	0.15
Min. target thickness [6]		0.23 mm	0.6 mm	1.5 mm
Connection		integrated optical fiber 2 m with E2000/APC connector; extension up to 50 m; bending radius: static 30 mm, dynamic 40 mm		
Installation		Clamping, mounting adapter (see accessories)		
Temperature range	Storage	-20 … +70 °C		
	Operation	+5 … +70 °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)		IP64 (front)		
Material		Stainless steel housing, glass lenses		
Weight		approx. 200 g (incl. optical fiber)		

[1] Start of measuring range measured from sensor axis.
[2] Average from 512 values at 1 kHz, near to the midrange 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] Maximum sensor tilt angle that produces a usable signal on reflecting surfaces. The accuracy decreases when approaching the limit values.
[6] Glass sheet with refractive index n = 1.5 in midrange

- Compact sensor design ø12 mm
- Submicrometer resolution
- One-sided thickness measurement
- Distance measurement
- Extremely small spot size





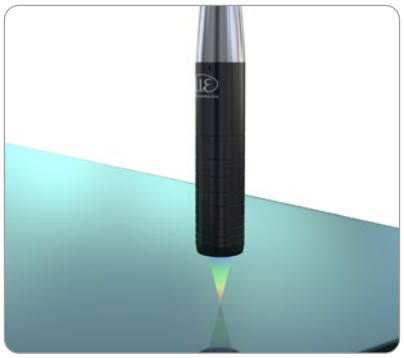


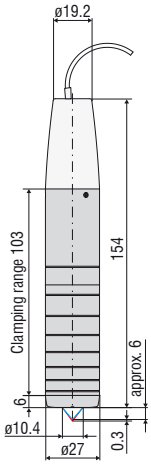
Dimensions in mm, not to scale

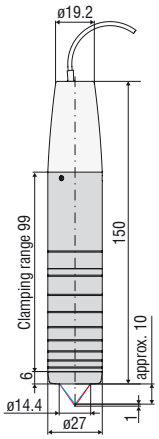
Model		IFS2404-2	IFS2404/90-2
Measuring range		2 mm	2 mm
Start of measuring range	approx.	14 mm	9.6 mm [1]
Resolution	static [2]	40 nm	40 nm
	dynamic [3]	125 nm	125 nm
Linearity [4]	Displacement and distance	< ±1 µm	< ±1 µm
	Thickness	< ±2 µm	< ±2 µm
Light spot diameter		10 µm	10 µm
Max. tilt angle [5]		±12°	±12°
Numerical aperture (NA)		0.25	0.25
Min. target thickness [6]		0.1 mm	0.1 mm
Connection		pluggable optical fiber via FC socket, type C2404-x; standard length 2 m; extension up to 50 m; bending radius: static 30 mm, dynamic 40 mm	
Installation		Clamping; mounting adapter (see accessories)	
Temperature range	Storage	-20 … +70 °C	
	Operation	+5 … +70 °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)		IP65 (front)	
Material		Stainless steel housing, glass lenses	
Weight		approx. 20 g	approx. 30 g

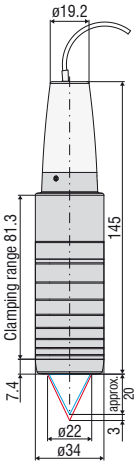
[1] Start of measuring range measured from sensor axis.
[2] Average from 512 values at 1 kHz, near to the midrange onto optical flat
[3] RMS noise relates to mid of measuring range (1 kHz)
[4] All data at constant ambient temperature (25 ±1 °C) against optical flat; specifications can change when measuring different objects.
[5] Maximum sensor tilt angle that produces a usable signal on reflecting surfaces. The accuracy decreases when approaching the limit values.
[6] Glass sheet with refractive index n = 1.5 throughout the entire measuring range. In the mid of the measuring range, also thinner layers can be measured.

- **Robust sensors for various applications**
- **One-sided thickness measurement**
- **Distance measurement**
- **Extremely small spot size**
- **Submicrometer resolution**
- **Large tilt angle**







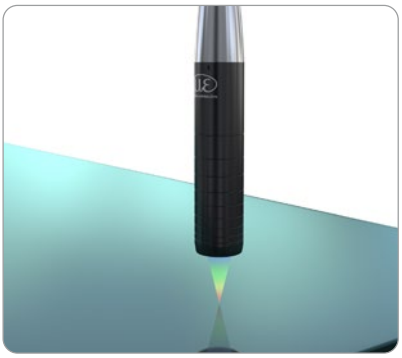


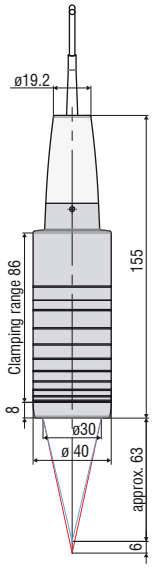
Dimensions in mm, not to scale

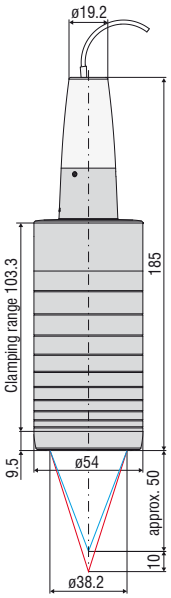
Model		IFS2405-0.3	IFS2405-1	IFS2405-3
Measuring range		0.3 mm	1 mm	3 mm
Start of measuring range	approx.	6 mm	10 mm	20 mm
Resolution	static [1]	4 nm	28 nm	60 nm
	dynamic [2]	20 nm	52 nm	126 nm
Linearity [3]	Displacement and distance	< ±0.15 µm	< ±0.25 µm	< ±0.75 µm
	Thickness	< ±0.3 µm	< ±0.5 µm	< ±1.5 µm
Light spot diameter		6 µm	8 µm	9 µm
Max. tilt angle [4]		±34°	±30°	±24°
Numerical aperture (NA)		0.60	0.55	0.45
Min. target thickness [5]		0.015 mm	0.05 mm	0.15 mm
Connection		pluggable optical fiber via FC socket, standard length 3 m; extension up to 50 m; bending radius: static 30 mm; dynamic 40 mm		
Installation		Clamping, mounting adapter (see accessories)		
Temperature range	Storage	-20 … +70 °C		
	Operation	+5 … +70 °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)		IP64 (front)		
Material		Aluminum housing, glass lenses		
Weight		approx. 140 g	approx. 125 g	approx. 225 g

[1] Average from 512 values at 1 kHz, near to the midrange onto optical flat
[2] RMS noise relates to mid of measuring range (1 kHz)
[3] All data at constant ambient temperature (25 ±1 °C) against optical flat; specifications can change when measuring different objects.
[4] Maximum sensor tilt angle that produces a usable signal on reflecting surfaces. The accuracy decreases when approaching the limit values.
[5] Glass with refractive index n = 1.5 throughout the entire measuring range. In the mid of the measuring range, also thinner layers can be measured.

- **Robust sensors for various applications**
- **One-sided thickness measurement**
- **Distance measurement**
- **Extremely small spot size**
- **Submicrometer resolution**
- **Large tilt angle**



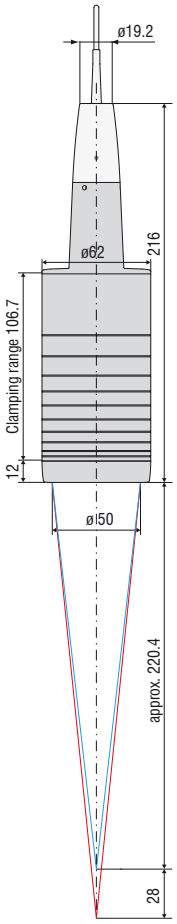


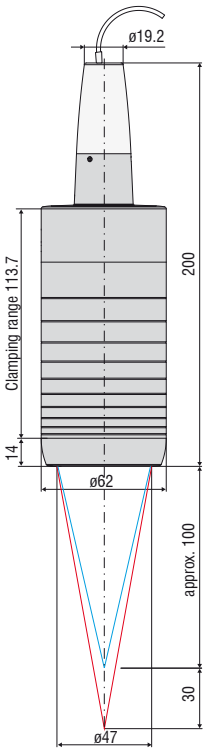


Dimensions in mm, not to scale

Model		IFS2405-6	IFS2405-10
Measuring range		6 mm	10 mm
Start of measuring range	approx.	63 mm	50 mm
Resolution	static [1]	18 nm	60 nm
	dynamic [2]	93 nm	386 nm
Linearity [3]	Displacement and distance	< ±1.5 µm	< ±2.5 µm
	Thickness	< ±3 µm	< ±5 µm
Light spot diameter		31 µm	16 µm
Max. tilt angle [4]		±10°	±17°
Numerical aperture (NA)		0.22	0.30
Min. target thickness [5]		0.3 mm	0.5 mm
Connection		pluggable optical fiber via FC socket, standard length 3 m; extension up to 50 m; bending radius: static 30 mm; dynamic 40 mm	
Installation		Clamping, mounting adapter (see accessories)	
Temperature range	Storage	-20 … +70 °C	
	Operation	+5 … +70 °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)		IP64 (front)	
Material		Aluminum housing, glass lenses	
Weight		approx. 217 g	approx. 500 g

[1] Average from 512 values at 1 kHz, near to the midrange onto optical flat
[2] RMS noise relates to mid of measuring range (1 kHz)
[3] All data at constant ambient temperature (25 ±1 °C) against optical flat; specifications can change when measuring different objects.
[4] Maximum sensor tilt angle that produces a usable signal on reflecting surfaces. The accuracy decreases when approaching the limit values.
[5] Glass with refractive index n = 1.5 throughout the entire measuring range. In the mid of the measuring range, also thinner layers can be measured.



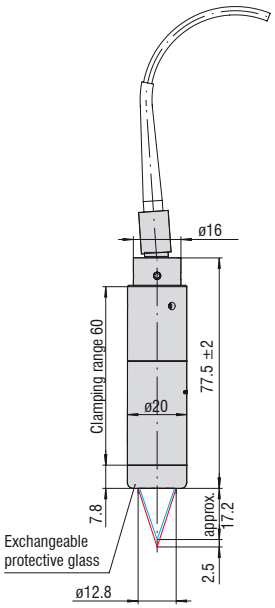


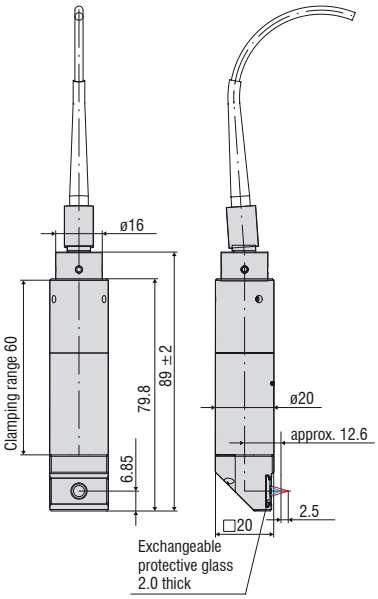
Dimensions in mm, not to scale

Model		IFS2405-28	IFS2405-30
Measuring range		28 mm	30 mm
Start of measuring range	approx.	220 mm	100 mm
Resolution	static [1]	250 nm	300 nm
	dynamic [2]	1420 nm	1040 nm
Linearity [3]	Displacement and distance	< ±7 µm	< ±7.5 µm
	Thickness	< ±14 µm	< ±15 µm
Light spot diameter		60 µm	50 µm
Max. tilt angle [4]		±5°	±9°
Numerical aperture (NA)		0.10	0.20
Min. target thickness [5]		2.2 mm	1.5 mm
Connection		pluggable optical fiber via FC socket, standard length 3 m; extension up to 50 m; bending radius: static 30 mm; dynamic 40 mm	
Installation		Clamping, mounting adapter (see accessories)	
Temperature range	Storage	-20 … +70 °C	
	Operation	+5 … +70 °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)		IP64 (front)	
Material		Aluminum housing, glass lenses	
Weight		approx. 750 g	approx. 730 g

[1] Average from 512 values at 1 kHz, near to the midrange onto optical flat
[2] RMS noise relates to mid of measuring range (1 kHz)
[3] All data at constant ambient temperature (25 ±1 °C) against optical flat; specifications can change when measuring different objects.
[4] Maximum sensor tilt angle that produces a usable signal on reflecting surfaces. The accuracy decreases when approaching the limit values.
[5] Glass with refractive index n = 1.5 throughout the entire measuring range. In the mid of the measuring range, also thinner layers can be measured.

- Sensors with axial or radial (90°) measuring direction
- One-sided thickness measurement
- Distance measurement
- Extremely small spot size
- Submicrometer resolution
- For vacuum applications

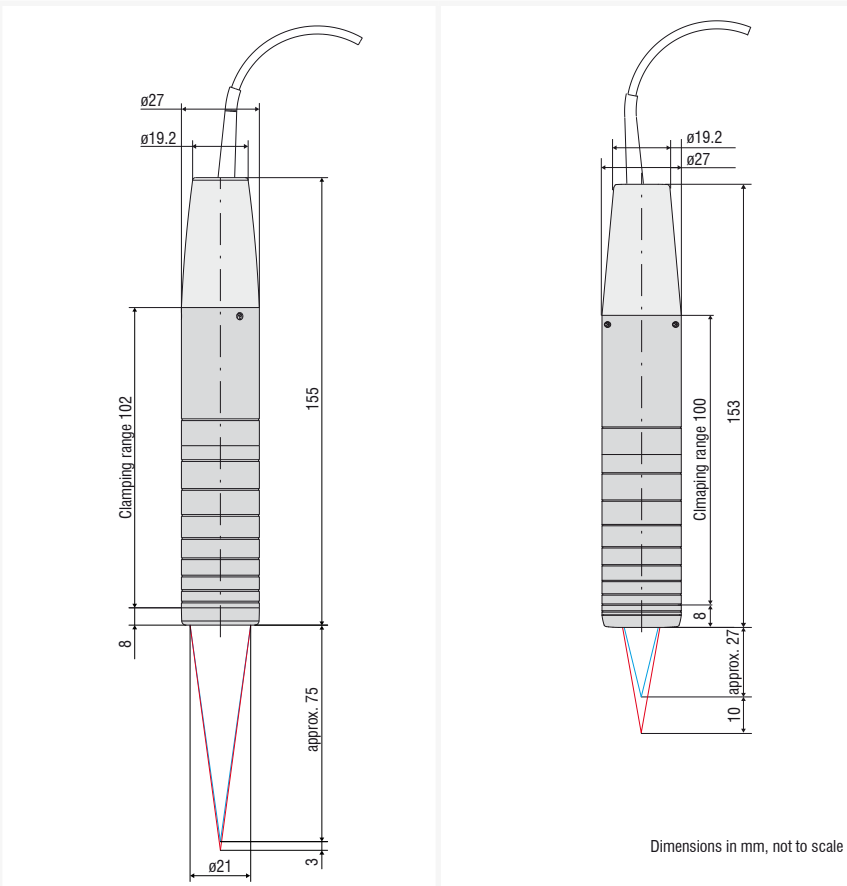




Dimensions in mm, not to scale

Model		IFS2406-2,5/VAC(003)	IFS2406/90-2,5/VAC(001)
Measuring range		2.5 mm	2.5 mm
Start of measuring range	approx.	17.2 mm	12.6 mm [1]
Resolution	static [2]	24 nm	24 nm
	dynamic [3]	106 nm	106 nm
Linearity [4]	Displacement and distance	< ±0.75 µm	< ±0.75 µm
	Thickness	< ±1.5 µm	< ±1.5 µm
Light spot diameter		10 µm	10 µm
Max. tilt angle [5]		±16°	±16°
Numerical aperture (NA)		0.30	0.30
Min. target thickness [6]		0.125 mm	0.125 mm
Connection		pluggable optical fiber via FC socket, type C240x-x (01); standard length 3 m; extension up to 50 m; bending radius: static 30 mm, dynamic 40 mm	
Installation		Clamping, mounting adapter (see accessories)	
Temperature range	Storage	-20 … +70 °C	
	Operation	+5 … +70 °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)		IP40 (vacuum compatible)	
Material		Stainless steel housing, glass lenses	
Weight		approx. 105 g	approx. 130 g

[1] Start of measuring range measured from sensor axis.
[2] Average from 512 values at 1 kHz, near to the midrange 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] Maximum sensor tilt angle that produces a usable signal on reflecting surfaces. The accuracy decreases when approaching the limit values.
[6] Glass sheet with refractive index n = 1.5 throughout the entire measuring range. In the mid of the measuring range, also thinner layers can be measured.

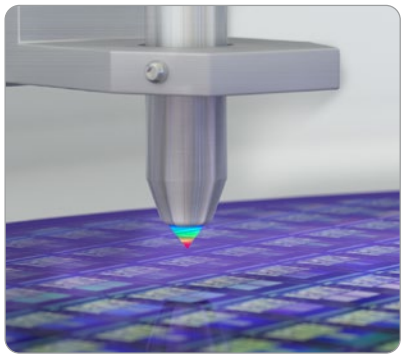


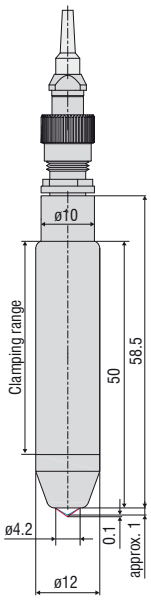
Dimensions in mm, not to scale

Model		IFS2406-3	IFS2406-10
Measuring range		3 mm	10 mm
Start of measuring range	approx.	75 mm	27 mm
Resolution	static [1]	50 nm	60 nm
	dynamic [2]	168 nm	385 nm
Linearity [3]	Displacement and distance	< ±1.5 µm	< ±2.5 µm
	Thickness	< ±3 µm	< ±5 µm
Light spot diameter		35 µm	15 µm
Max. tilt angle [4]		±6.5°	±13.5°
Numerical aperture (NA)		0.14	0.25
Min. target thickness [5]		0.15 mm	0.5 mm
Connection		pluggable optical fiber via FC socket, type C240x-x (01); standard length 3 m; extension up to 50 m; bending radius: static 30 mm, dynamic 40 mm	
Installation		Clamping, mounting adapter (see accessories)	
Temperature range	Storage	-20 … +70 °C	
	Operation	+5 … +70 °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)		IP65 (front)	
Material		Aluminum housing, glass lenses	
Weight		approx. 99 g	approx. 128 g

[1] Average from 512 values at 1 kHz, near to the midrange onto optical flat
[2] RMS noise relates to mid of measuring range (1 kHz)
[3] All data at constant ambient temperature (25 ±1 °C) against optical flat; specifications can change when measuring different objects.
[4] Maximum sensor tilt angle that produces a usable signal on reflecting surfaces. The accuracy decreases when approaching the limit values.
[5] Glass with refractive index n = 1.5 throughout the entire measuring range. In the mid of the measuring range, also thinner layers can be measured.

- Sensor design from ø12 mm
- Submicrometer resolution
- One-sided thickness measurement
- Distance measurement
- Extremely small spot size
- Large tilt angle

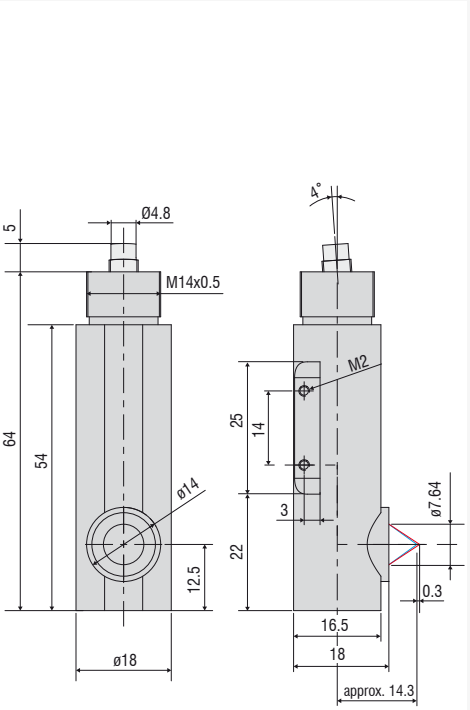


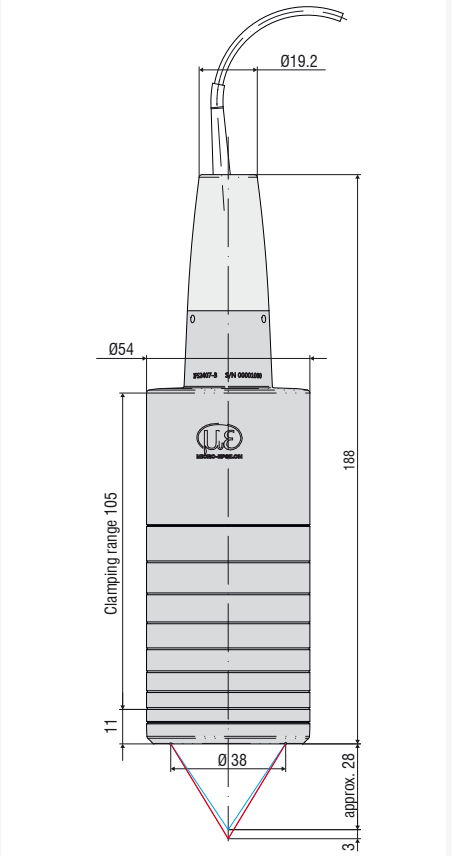


Dimensions in mm, not to scale

Model		IFS2407-0.1	IFS2407-0.1(001)
Measuring range		0.1 mm	0.1 mm
Start of measuring range	approx.	1 mm	1 mm
Resolution	static [1]	3 nm	3 nm
	dynamic [2]	6 nm	6 nm
Linearity [3]	Displacement and distance	< ±0.05 µm	< ±0.05 µm
	Thickness	< ±0.1 µm	< ±0.1 µm
Light spot diameter		3 µm	4 µm
Max. tilt angle [4]		±48°	±48°
Numerical aperture (NA)		0.80	0.70
Min. target thickness [5]		0.005 mm	0.005 mm
Connection		pluggable optical fiber via FC socket, standard length 3 m; extension up to 50 m; bending radius: static 30 mm; dynamic 40 mm	
Installation		Clamping, mounting adapter (see accessories)	
Temperature range	Storage	-20 … +70 °C	
	Operation	+5 … +70 °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)		IP65 (front)	
Material		Stainless steel housing, glass lenses	
Weight		approx. 36 g	approx. 36 g
Features		Sensor with high numerical aperture	Light-intensive sensor

[1] Average from 512 values at 1 kHz, near to the midrange onto optical flat
[2] RMS noise relates to mid of measuring range (1 kHz)
[3] All data at constant ambient temperature (25 ±1 °C) against optical flat; specifications can change when measuring different objects.
[4] Maximum sensor tilt angle that produces a usable signal on reflecting surfaces. The accuracy decreases when approaching the limit values.
[5] Glass with refractive index n = 1.5 throughout the entire measuring range. In the mid of the measuring range, also thinner layers can be measured.





Dimensions in mm, not to scale

Model		IFS2407/90-0,3	IFS2407-3
Measuring range		0.3 mm	3 mm
Start of measuring range	approx.	5.3 mm	28 mm
Resolution	static [1]	10 nm	20 nm
	dynamic [2]	20 nm	58 nm
Linearity [3]	Displacement and distance	< ±0.15 µm	< ±0.75 µm
	Thickness	< ±0.3 µm	< ±1.5 µm
Light spot diameter		6 µm	9 µm
Max. tilt angle [4]		±27°	±30°
Numerical aperture (NA)		0.50	0.53
Min. target thickness [5]		0.015 mm	0.15 mm
Connection		pluggable optical fiber via FC socket, type C2407-x; standard length 3 m; extension up to 50 m; bending radius: static 30 mm, dynamic 40 mm	pluggable optical fiber via FC socket, standard length 3 m; extension up to 50 m; bending radius: static 30 mm, dynamic 40 mm
Installation		Mounting holes (2x M2)	Clamping, mounting adapter (see accessories)
Temperature range	Storage	-20 … +70 °C	
	Operation	+5 … +70 °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)		IP65 (front)	
Material		Stainless steel housing, glass lenses	Aluminum housing, glass lenses
Weight		approx. 30 g	approx. 550 g

[1] Average from 512 values at 1 kHz, near to the midrange onto optical flat
[2] RMS noise relates to mid of measuring range (1 kHz)
[3] All data at constant ambient temperature (25 ±1 °C) against optical flat; specifications can change when measuring different objects.
[4] Maximum sensor tilt angle that produces a usable signal on reflecting surfaces. The accuracy decreases when approaching the limit values.
[5] Glass with refractive index n = 1.5 throughout the entire measuring range. In the mid of the measuring range, also thinner layers can be measured.

- Measuring rate up to 6.5kHz
- Ethernet / EtherCAT / RS422 / PROFINET / Ethernet/IP / Analog
- Fast surface compensation
- Configuration via web interface
- Submicrometer resolution
- Multi-layer thickness measurement
- Synchronous two-sided thickness measurement
- Robust design with passive cooling

The confocalDT 2421/22 controllers set the industrial standard in precise, confocal measurement technology.

Available as either a single- or a dual-channel version, these measuring systems are a low cost solution especially for serial applications. The active exposure regulation feature in the CCD line is for accurate, fast surface compensation on changing surfaces.

The controller can be operated with any IFS sensor and is available as a standard version for distance measurements or as a multi-peak version for multi-layer thickness measurements. Using a special calculation function, the confocalDT 2422 dual-channel version evaluates both channels. Measurement acquisition is synchronous and can be carried out while exploiting the full measuring rate for both channels.

Due to a user-friendly web interface, no additional software is necessary to configure the controller and the sensors. Data output is via Ethernet, EtherCAT, RS422 or analog output.

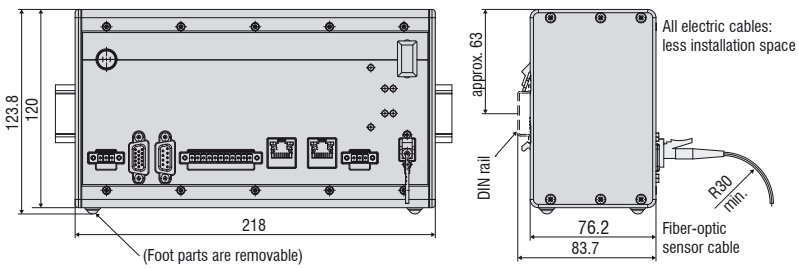
All settings are performed in the web interface. For thickness measurements, materials are stored in an expandable materials database.

Two sensors can be directly connected to a confocal IFC2422 controller.

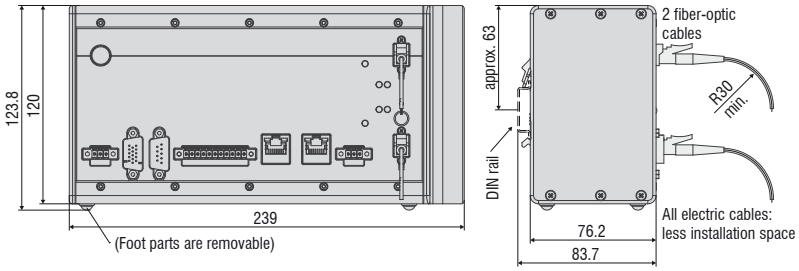
Model		IFC2421	IFC2421MP	IFC2422	IFC2422MP
Resolution	Ethernet/EtherCAT	1 nm			
	RS422	18 bit			
	analog	16 bits (teachable)			
Measuring rate		continuously adjustable from 100 Hz to 6.5 kHz			
Linearity		typ. < ±0.025 % FSO (depends on sensor)			
Multi peak measurement		1 layer	5 layers	1 layer	5 layers
Light source		internal white LED			
No. of characteristic curves		up to 20 characteristic curves for different sensors per channel, selection via table in the menu			
Permissible ambient light [1]		30,000 lx			
Synchronization		yes			
Supply voltage		24 VDC ±15 %			
Power consumption		approx. 10 W			
Signal input		sync-in / trig-in; 2x encoder (A+, A-, B+, B-, Index)			
Digital interface		Ethernet; EtherCAT; RS422; PROFINET [2]; EtherNet/IP [2]			
Analog output		Current: 4 … 20 mA; voltage: 0 ... 10 V (16 bit D/A converter)			
Switching output		Error1-Out, Error2-Out			
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; encoder connection (15-pin, HD-sub socket, max. cable length 3 m, 30 m with external encoder supply); RS422 connection socket (9-pin, Sub-D, max. cable length 30 m); 3-pin output terminal strip (max. cable length 30 m); 11-pin I/O terminal strip (max. cable length 30 m); RJ45 socket for Ethernet (out) / EtherCAT (in/out) (max. cable length 100 m)			
Installation		free-standing, DIN rail mounting			
Temperature range	Storage	-20 … +70 °C			
	Operation	+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)		IP40			
Material		Aluminum			
Weight		approx. 1.8 kg		approx. 2.25 kg	
Compatibility		compatible with all confocalDT sensors			
No. of measurement channels [3]		1		2	
Control and display elements		multifunction button (two adjustable functions and reset to factory setting after 10 s); 5x LEDs for intensity, range, status and supply voltage			

FSO = Full Scale Output
[1] Illuminant: light bulb
[2] Optional connection via interface module (see accessories)
[3] No loss of intensity and linearity due to two synchronous measurement channels

IFC2421 controller



IFC2422 controller

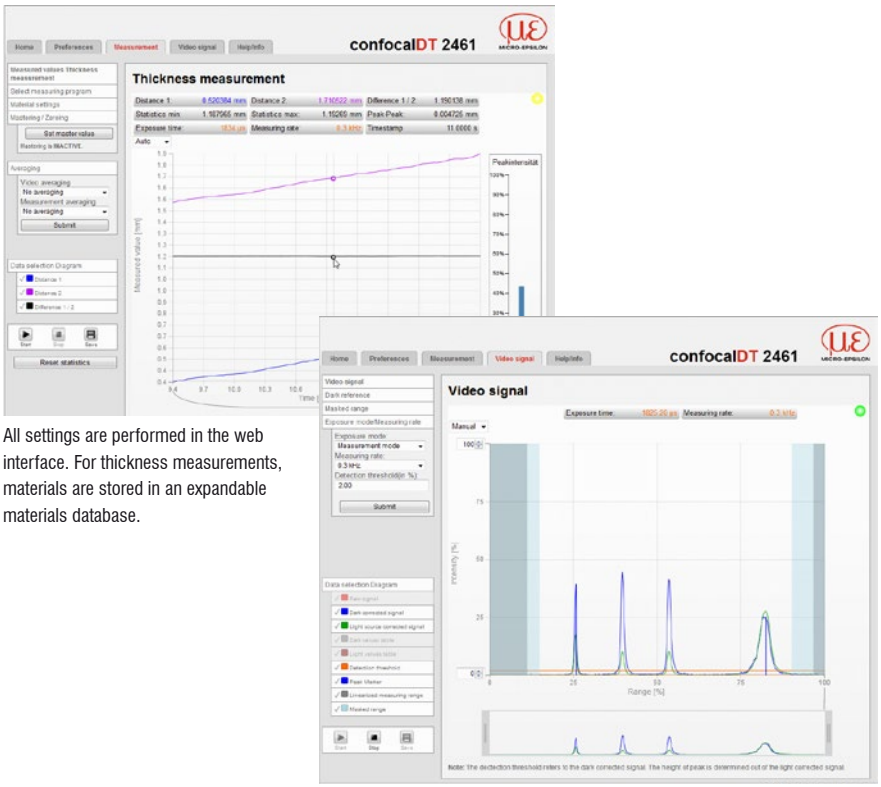


- Fast confocal controller: up to 25kHz
- Ethernet / EtherCAT / RS422 / PROFINET / Ethernet/IP / Analog
- Fast surface compensation
- Configuration via web interface
- Submicrometer resolution
- Multi-layer thickness measurement
- Robust design with passive cooling

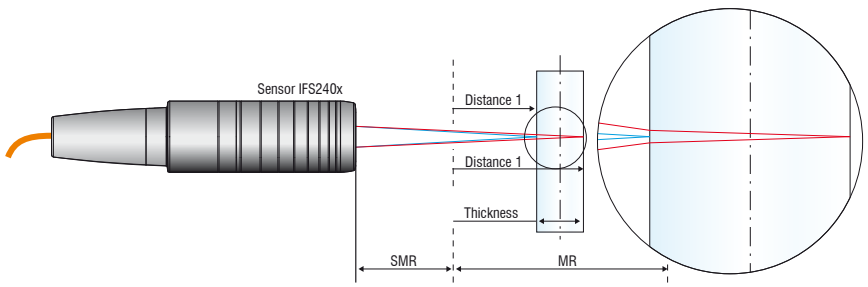
confocalDT IFC2461 systems are used for complex distance and thickness measurements. The IFC2461 controller is equipped with enhanced, optimized optical components for measuring rates up to 25 kHz without having to use an external light source. The high light intensity enables reliable measurements on difficult surfaces, e.g., on matt black objects or for multi-layer thickness measurement of glass. The active exposure regulation feature in the CCD line is for accurate, fast surface compensation on changing surfaces during dynamic measurement processes.

The controller can be operated with any IFS sensor and is available as a standard version for distance and thickness measurements or as a multi-peak version for multi-layer measurements.

Due to a user-friendly web interface, no additional software is necessary to configure the controller and the sensors. Data output is via Ethernet, EtherCAT, RS422 or analog output.



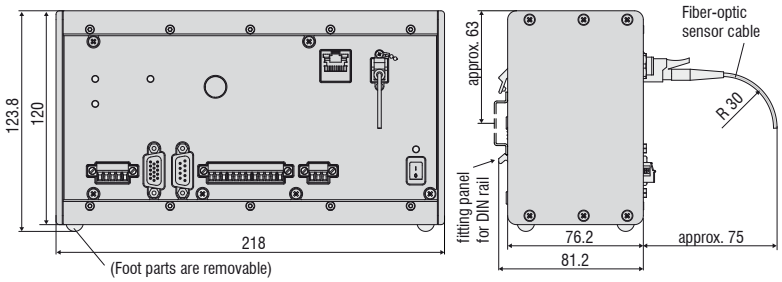
All settings are performed in the web interface. For thickness measurements, materials are stored in an expandable materials database.



Model		IFC2461	IFC2461MP
Resolution	Ethernet/EtherCAT	1 nm	
	RS422	18 bit	
	analog	16 bits (teachable)	
Measuring rate		continuously adjustable from 100 Hz to 25 kHz	
Linearity		typ. < ±0.025 % FSO (depends on sensor)	
Multi peak measurement		1 layer	5 layers
Light source		internal white LED	
No. of characteristic curves		up to 20 characteristic curves for different sensors per channel, selection via table in the menu	
Permissible ambient light [1]		30,000 lx	
Synchronization		yes	
Supply voltage		24 VDC ±15 %	
Power consumption		approx. 10 W	
Signal input		sync-in / trig-in; 3x encoder (A, B, index)	
Digital interface		Ethernet; EtherCAT; RS422; PROFINET [2]; EtherNet/IP [2]	
Analog output		Current: 4 … 20 mA; voltage: 0 ... 10 V / -10 … +10 V (16 bit D/A converter)	
Switching output		Error1-Out, Error2-Out	
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; Encoder connection (15-pin, HD-sub socket, max. cable length 3 m); RS422 connection socket (9-pin, Sub-D, max. cable length 30 m); 3-pin output terminal strip (max. cable length 30 m); 12-pin I/O terminal strip (max. cable length 30 m); RJ45 socket for Ethernet /(EtherCAT (max. cable length 100 m)	
Installation		free-standing, DIN rail mounting	
Temperature range	Storage	-20 … +70 °C	
	Operation	+5 … +50 °C	
Shock (DIN EN 60068-2-27)		15g / 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)		IP40	
Material		Aluminum	
Weight		approx. 2.2 kg	
Compatibility		compatible with all confocalDT sensors	
No. of measurement channels		1	
Control and display elements		ON/OFF multifunction button (as well as dark alignment and reset to factory setting after 10 s); 4x LEDs for intensity, range, status, supply voltage	
Features		particularly light-intensive	

FSO = Full Scale Output
[1] Illuminant: light bulb
[2] Optional connection via interface module (see accessories)

IFC2461 controller

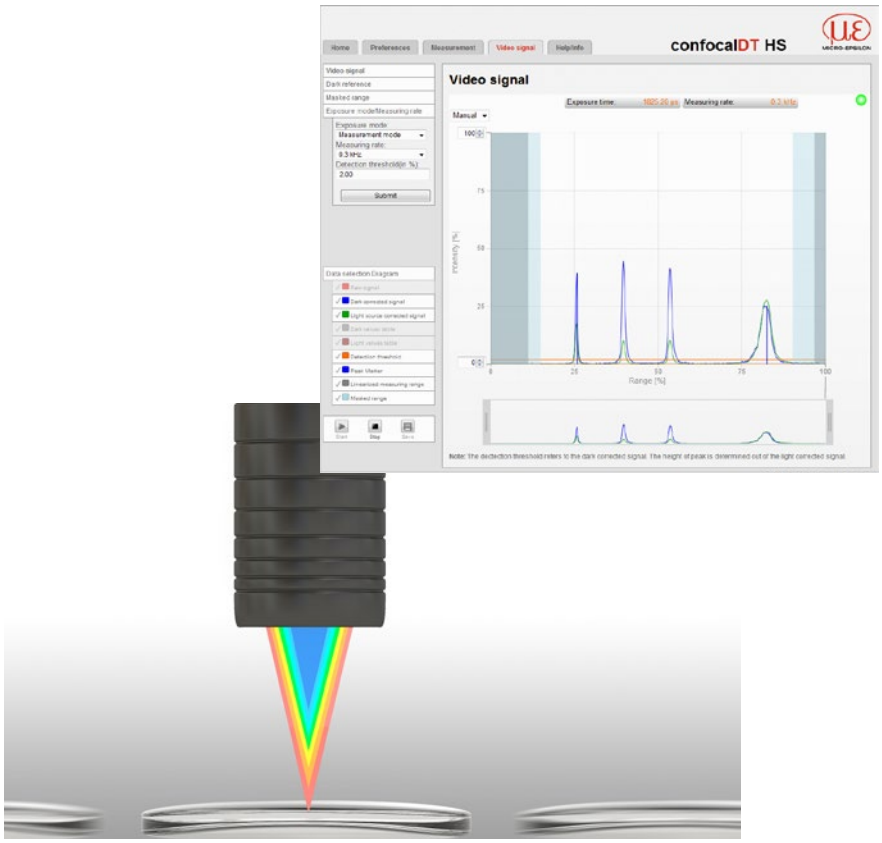


- Fastest controller worldwide: Measuring rate up to 70kHz
- Ethernet / EtherCAT / RS422 / PROFINET / Ethernet/IP / Analog
- Fast surface compensation
- Configuration via web interface
- Submicrometer resolution
- Multi-layer thickness measurement
- Robust design with passive cooling

The confocalDT 2471 HS controllers are used for fast distance and thickness measurements of highly reflecting and specular surfaces. The controllers are equipped with enhanced optical components enabling measuring rates up to 70 kHz on reflecting surfaces without having to use an external light source. The confocalDT HS controllers are one of the fastest confocal measuring systems in the world. The active exposure regulation feature in the CCD line enables accurate, fast surface compensation on changing surfaces during dynamic measurement processes.

The controller can be operated with any IFS sensor and is available as a standard version for distance and thickness measurements or as a multi-peak version for multi-layer measurements.

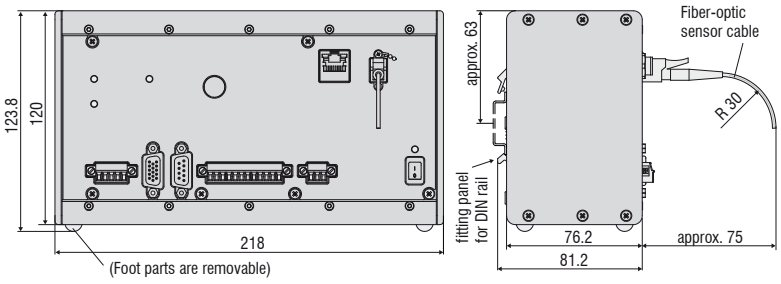
Due to a user-friendly web interface, no additional software is necessary to configure the controller and the sensors. Data output is via Ethernet, EtherCAT, RS422 or analog output.



Model		IFC2471LED	IFC2471MP LED
Resolution	Ethernet/EtherCAT	1 nm	
	RS422	18 bit	
	analog	16 bits (teachable)	
Measuring rate		continuously adjustable from 100 Hz to 70 kHz	
Linearity		typ. < ±0.025 % FSO (depends on sensor)	
Multi peak measurement		1 layer	5 layers
Light source		internal white LED	
No. of characteristic curves		up to 20 calibration tables for different sensors per channel, menu selection	
Permissible ambient light [1]		30,000 lx	
Synchronization		yes	
Supply voltage		24 VDC ±15 %	
Power consumption		approx. 10 W	
Signal input		sync-in / trig-in; 3x encoder (A, B, index)	
Digital interface		Ethernet; EtherCAT; RS422; PROFINET [2]; EtherNet/IP [2]	
Analog output		Current: 4 … 20 mA; voltage: 0 ... 10 V / -10 … +10 V (16 bit D/A converter)	
Switching output		Error1-Out, Error2-Out	
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; Encoder connection (15-pin, HD-sub socket, max. cable length 3 m); RS422 connection socket (9-pin, Sub-D, max. cable length 30 m); 3-pin output terminal strip (max. cable length 30 m); 12-pin I/O terminal strip (max. cable length 30 m); RJ45 socket for Ethernet /(EtherCAT (max. cable length 100 m)	
Installation		free-standing, DIN rail mounting	
Temperature range	Storage	-20 … +70 °C	
	Operation	+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)		IP40	
Material		Aluminum	
Weight		approx. 2.2 kg	
Compatibility		compatible with all confocalDT sensors	
No. of measurement channels		1	
Control and display elements		ON/OFF multifunction button (as well as dark alignment and reset to factory setting after 10 s); 4x LEDs for intensity, range, status, supply voltage	
Features		particularly light-intensive and high measuring rate	

FSO = Full Scale Output
[1] Illuminant: light bulb
[2] Optional connection via interface module (see accessories)

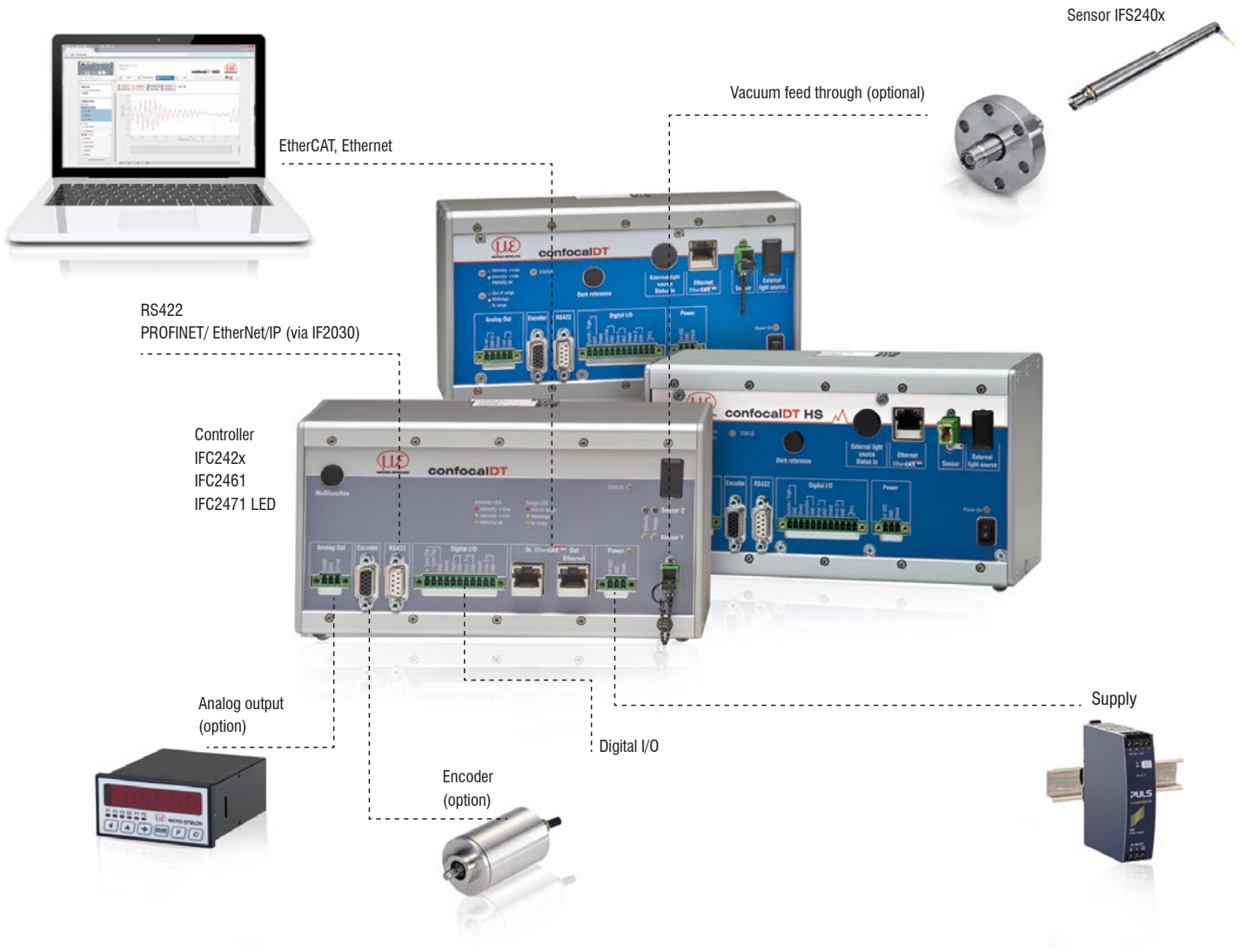
Controller IFC2471 LED



System design

The confocalDT system consists of:

- Sensor IFS240x
- Controller IFC24xx
- Fiber optic cable C24xx



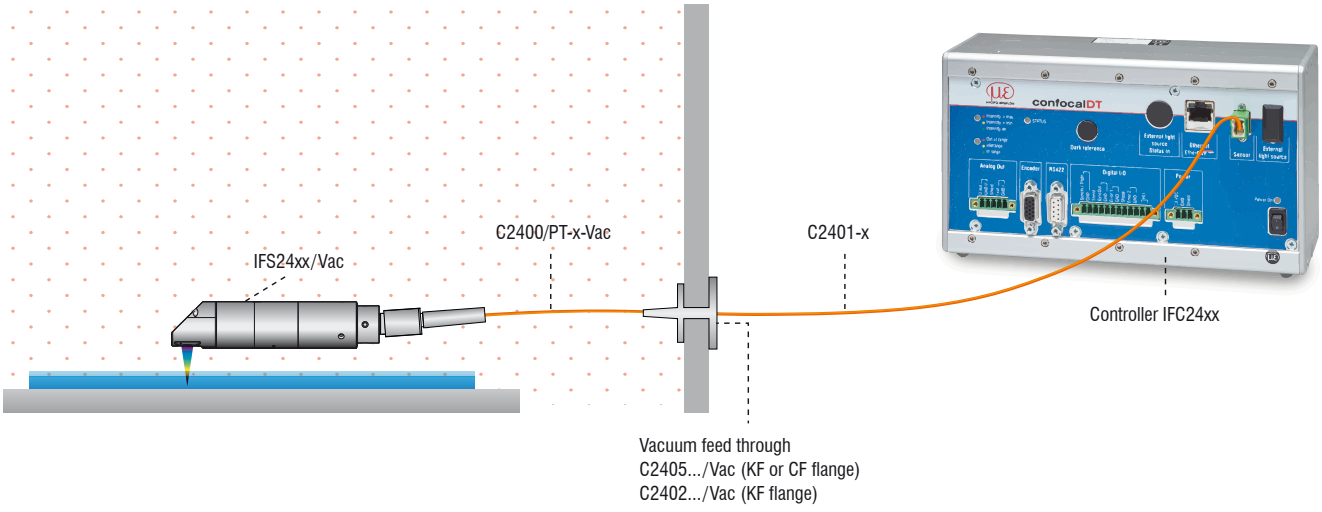
Customer-specific modifications

Application examples are often found where the standard versions of the sensors and the controllers are performing at their limits. To facilitate such special tasks, it is possible to customize the sensor design and to adjust the controller accordingly. Common requests for modifications include changes in design, mounting options, customized cable lengths and modified measuring ranges.

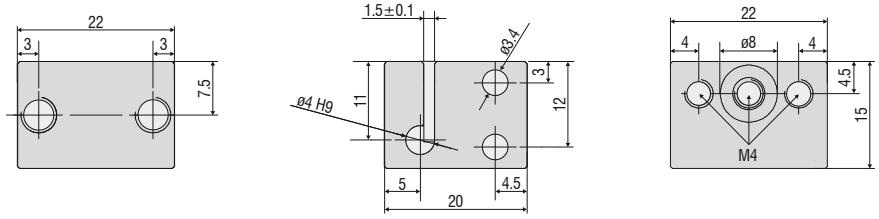
Possible modifications

- Sensors with connector
- Cable length
- Vacuum suitability up to UHV
- Specific lengths
- Customer-specific mounting options
- Optical filter for ambient light compensation
- Housing material
- Measuring range / Offset distance

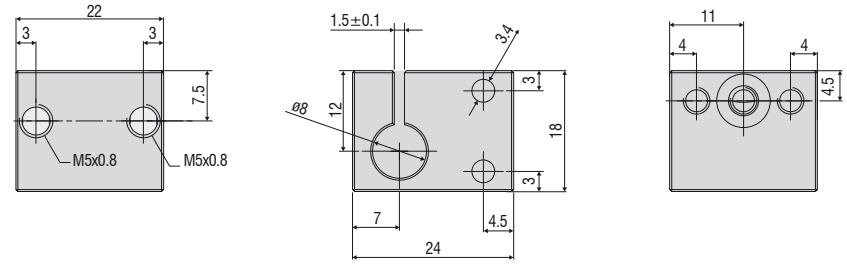
Vacuum setup



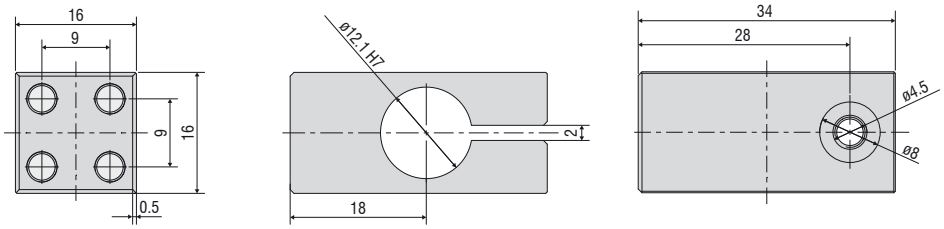
Accessories: mounting adapter
MA2402 for sensors 2402



Accessories: mounting adapter
MA2403 for sensors 2403

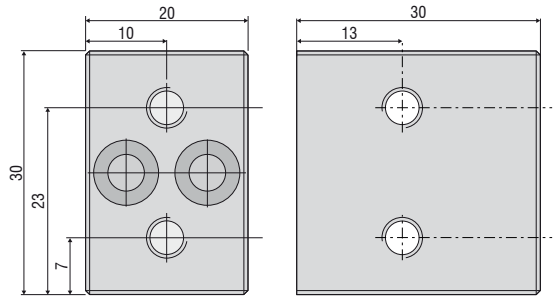


Accessories: mounting adapter
MA2404-12 for sensors IFS2404-2 / IFS2404/90-2 / IFS2407-0,1

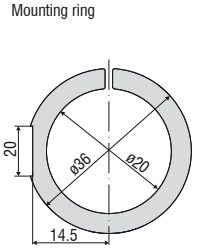


Accessories: mounting adapter
MA2400 for sensors IFS2405 / IFS2406 / IFS2407 (consisting of a mounting block and a mounting ring)

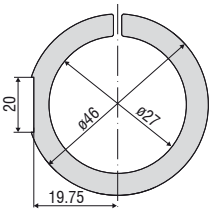
Mounting block



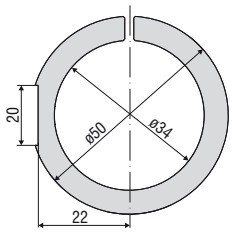
Mounting ring



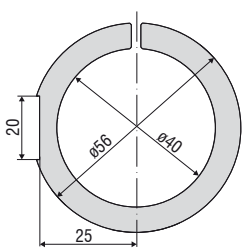
MA 2406-20
for sensors
IFS2406-2,5
IFS2406/90-2,5



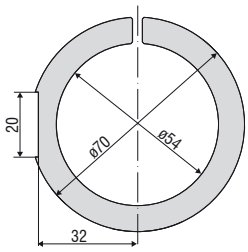
MA 2400-27
for sensors
IFS2405-0,3 / -1
IFS2406-3 / -10



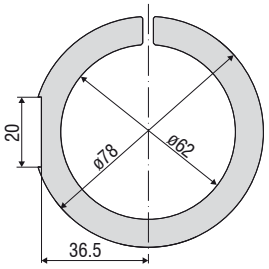
MA 2405-34
for sensors
IFS2405-3



MA 2405-40
for sensors
IFS 2405-6



MA 2405-54
for sensors
IFS2405-10 / IFS2407-3



MA 2405-62
for sensors
IFS2405-28 / -30

Accessories

Software

IFD24xx-Tool	Software demo tool included

Accessories light source

IFL2422/LE	Lamp module for IFC2422
IFL24x1/LED	Lamp module for IFC24x1

Cable extension for sensors

CE2402 cable with 2x E2000/APC connectors

CE2402-x	Extension for optical fiber (3 m, 10 m,13 m, 30 m, 50 m)
CE2402-x/PT	Extension for optical fiber with protection tube for mechanical stress (3 m, 10 m, customer-specific length up to 50 m)

Cable for IFS2404 sensors

C2404-x	Optical fiber with FC/APC and E2000/APC connectors Fiber core diameter 20 µm (2 m)

Cables for IFS2405/IFS2406/2407-0,1 sensors

C2401 cable with FC/APC and E2000/APC connectors

C2401-x	Optical fiber (3 m, 5 m, 10 m, customer-specific length up to 50 m)
C2401/PT-x	Optical fiber with protection tube for mechanical stress (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)	Drag-chain suitable optical fiber (3 m, 5 m, 10 m)

C2400 cable with 2x FC/APC connectors

C2400-x	Optical fiber (3 m, 5 m, 10 m, customer-specific length up to 50 m)
C2400/PT-x	Optical fiber with protection tube for mechanical stress (3 m, 5 m, 10 m, customer-specific length up to 50 m)
C2400/PT-x-Vac	Optical fiber with protection tube suitable for use in vacuum (3 m, 5 m, 10 m, customer-specific length up to 50 m)

Cable for IFS2407/90-0,3 sensors

C2407-x	Optical fiber with DIN connector and E2000/APC (2 m, 5 m)

Vacuum feed through

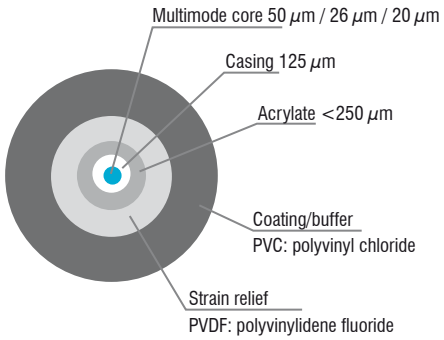
C2402/Vac/KF16	Vacuum feed through with optical fiber, 1 channel, vacuum side FC/APC non-vacuum side E2000/APC, clamping flange KF 16
C2405/Vac/1/KF16	Vacuum feed through on both sides FC/APC socket, 1 channel, clamping flange type KF 16
C2405/Vac/1/CF16	Vacuum feed through on both sides FC/APC socket,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

Other accessories

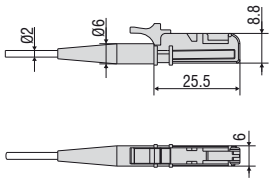
SC2471-x/USB/IND	Connector cable IFC2461/71, 3 m, 10 m, 20 m
SC2471-x/IF2008	Connector cable IFC2461/71-IF2008, 3 m, 10 m, 20 m
PS2020	Power supply 24V / 2.5A
EC2471-3/OE	Encoder cable, 3m
IF2030/PNET	Interface module for PROFINET connection
IF2030/ENETIP	Interface module for EtherNet/IP connection

Optical fiber

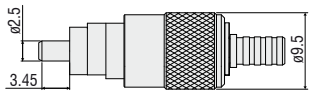
Temperature range : -50 °C to 90 °C
Bending radius: 30/40 mm



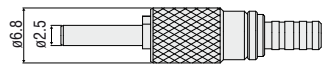
E2000/APC standard connector



FC/APC standard connector



DIN connector

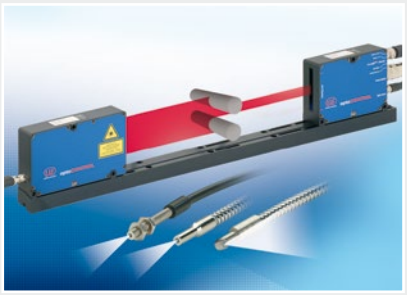


Sensors and Systems from Micro-Epsilon

Sensors and systems for displacement, distance and position

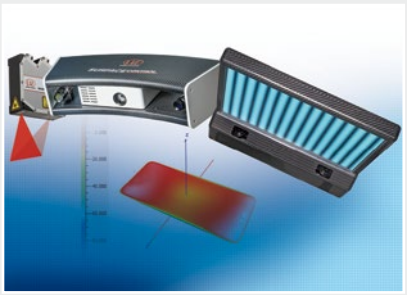
Sensors and measurement devices for non-contact temperature measurement

Measuring and inspection systems for metal strips, plastics and rubber



Optical micrometers and fiber optics, measuring and test amplifiers

Color recognition sensors, LED analyzers and inline color spectrometers



3D measurement technology for dimensional testing and surface inspection

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