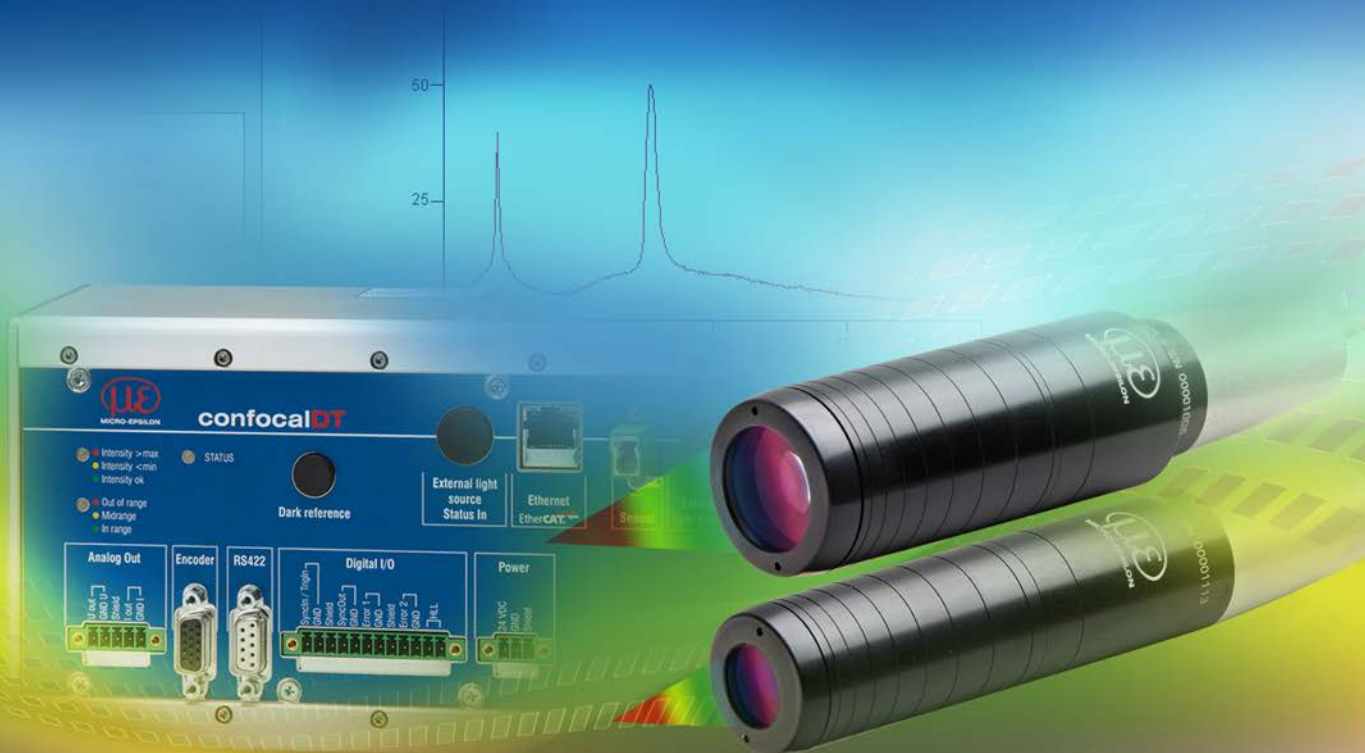




More Precision

confocalDT // Confocal chromatic measurement system





The new generation of confocal chromatic measurement systems

The confocalDT stands for high precision confocal chromatic measurement technology. The measurement system includes the fastest controller currently available, achieving high precision measurement results in displacement and distance measurement tasks, as well as thickness measurement of transparent objects. A large range of sensors and different controller interfaces open versatile fields of application, e.g. in the semiconductor industry, glass industry, medical engineering and plastics production.

System design

The confocalDT confocal chromatic measurement system includes a controller and a sensor connected via a fibre optic cable. Due to a user-friendly web interface, the entire configuration process is carried out without using any additional software.

The range of sensors comprises the universally applicable IFS2405 sensors and the IFS2402 / IFS2403 miniature sensors. With these miniature sensors, geometrical features can be measured inside narrow holes and recesses. Furthermore, the IFS2406 sensors are used for vacuum applications.

Special features

The controller provides an excellent signal-to-noise ratio and enables high precision measurement. The fast surface compensation regulates the exposure cycles in order to achieve high signal stability. In contrast to systems using an oscillating lens, confocalDT is entirely wear-free. The sensors are designed for passive measurements and do not need any electrical components. They do not give off heat, which makes them suitable for use in sensitive environments. The unique measuring principle enables high precision displacement and distance measurements – including on diffuse and reflecting surfaces. With transparent measurement objects, thickness measurement is possible.



The web interface for controller configuration opens via Ethernet.

Table of content confocalDT

Confocal miniature sensors

Page 6 - 7

confocalDT IFS2402

- Miniature sensors $\varnothing 4\text{mm}$
- Measure inside bores and cavities from $\varnothing 4.5\text{mm}$
- Robust steel case
- Axial or radial (90°) measuring direction
- Displacement and position measurement



Confocal hybrid sensors

Page 8 - 9

confocalDT IFS2403

- Hybrid sensors $\varnothing 8\text{mm}$
- Displacement and position measurement and one-sided thickness measurement of transparent materials and multi-layers
- Robust steel case
- Gradient index lens with relay optics
- Axial or radial (90°) measuring direction



Precise confocal sensors

Page 10 - 11

confocalDT IFS2405

- Compact sensors with large offset
- Displacement and position measurement and one-sided thickness measurement of transparent materials and multi-layers
- Extreme high spatial resolution for microscopic surface profiling



Confocal sensors (vacuum compatible)

Page 12 - 13

confocalDT IFS2406

- Sensors with axial or radial beam path
- Displacement and position measurement and one-sided thickness measurement of transparent materials and multi-layers
- Very small measurement spot size
- Submicrometer resolution
- Vacuum applications



High-End Controller

Page 14 - 15

confocalDT 2451/2471

- IFC2471 high-speed applications with a measuring rate up to 70kHz
- Excellent signal-to-noise ratio
- Fast surface compensation due to exposure time regulation
- Thickness calibration for precise thickness measurement



Controller for measuring rates up to 25kHz

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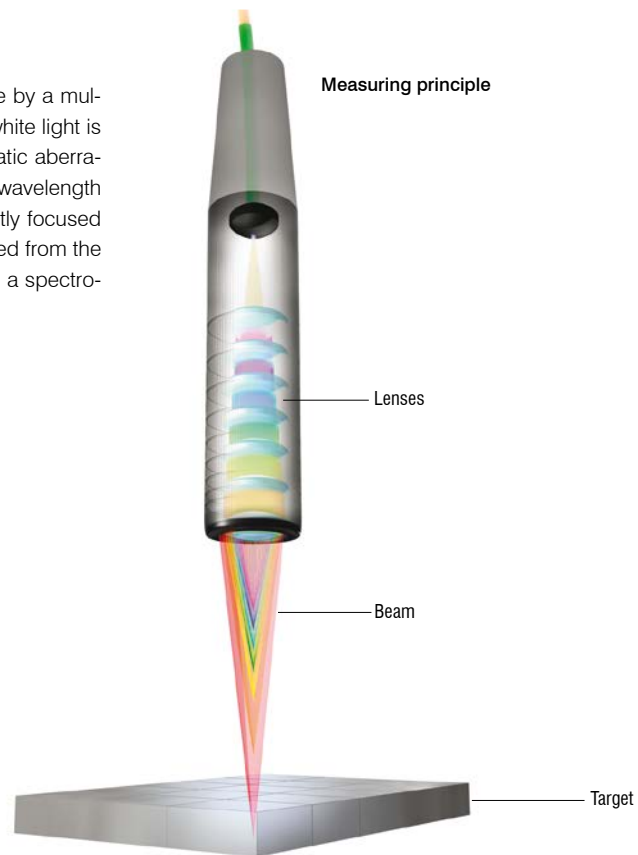
confocalDT 2461

- Controller with integrated light source
- High-performance optical components
- Fast surface compensation due to exposure time regulation
- Thickness calibration for precise thickness measurement



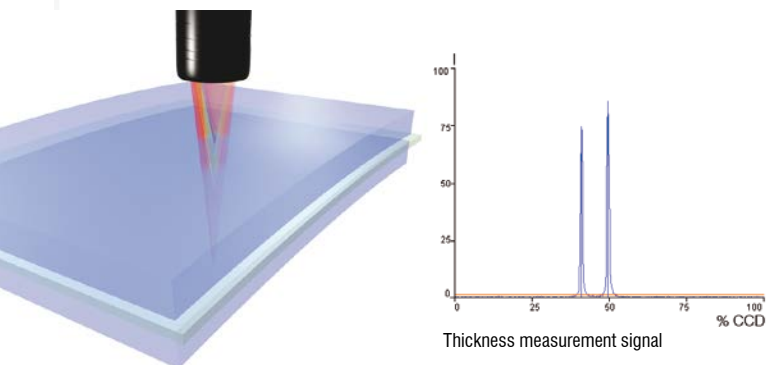
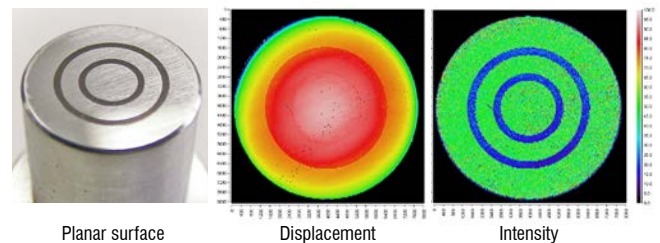
The confocal measuring principle

Polychromatic white light is focused onto the target surface by a multi-lens optical system. The lenses are arranged so that the white light is dispersed into a monochromatic light by controlled chromatic aberration. A specific distance to the target is assigned to each wavelength by a factory calibration. Only the wavelength which is exactly focused on the target is used for the measurement. This light reflected from the target surface is passed through a confocal aperture onto a spectrometer which detects and processes the spectral changes.



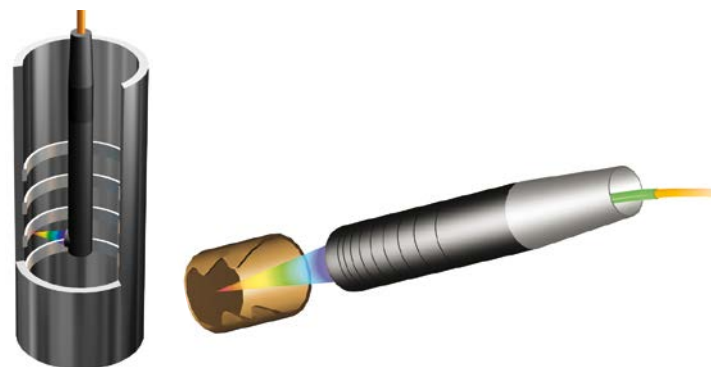
Displacement and intensity measurement

Another option, in addition to displacement measurement, is to perform measurements using signal intensity. Intensity evaluations are particularly well suited for capturing even the finest structures. The adjacent example shows a measurement for a planed surface. Intensity evaluations help to display areas that cannot be detected using distance measurements.



Thickness measurement of transparent material

The unique measuring principle enables one-sided thickness measurement of transparent materials such as glass. The material thickness is detected to micrometer accuracy using just one single sensor. The controller provides a comprehensive materials database that is editable and expandable via the web interface. The evaluation of up to 6 peaks enables measurements of multi-layer objects such as laminated glass.



Cavity inspection

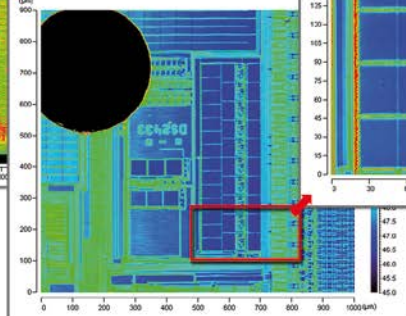
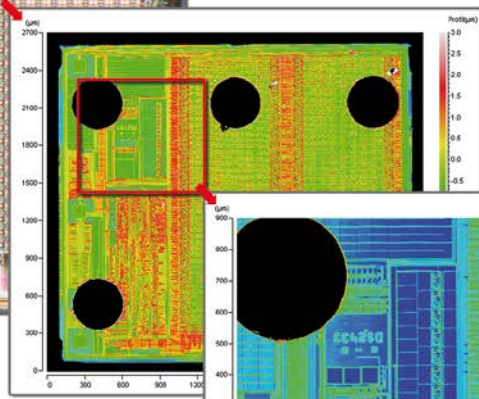
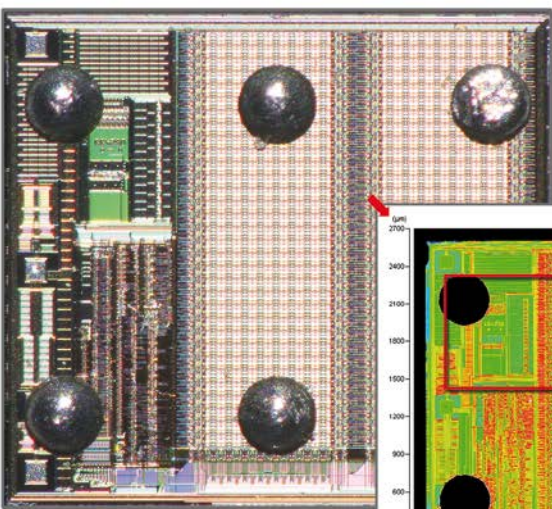
The miniaturised IFS2402 and IFS2403 sensors include a 90°-version which is ideal for detecting grooves or inner wall features of small gaps and cavities.



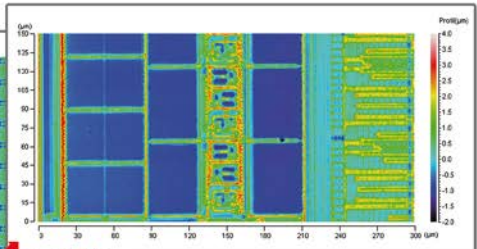
Diameter of stainless steel pipes



Surface scan of dental samples



Extreme resolution:
surface scan of a chip





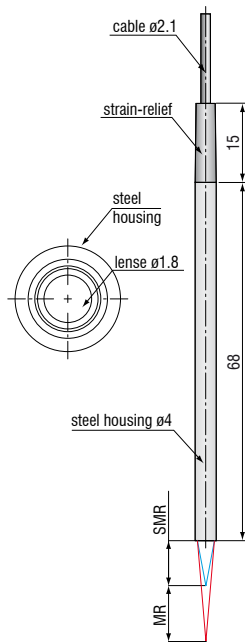
	Miniature sensors $\varnothing 4\text{mm}$ with axial or radial (90°) measuring direction
	Submicrometer resolution
	Displacement and position measurement
	Tiny spot size
	Suited for hazardous areas

The miniaturised series optoNCDT 2402 offers all advantages of the confocal measurement principle, with only 4mm outer diameter. Due to a unique and patented lens design, this compact sensor allows measuring in narrow cavities and bores. Sensors with axial measuring direction and sensors with 90° beam exit are available, which can measure radially in small cavities and bores. For mounting in magnetic environments sensors with titanium housing are available.



Diameter measurement in small bores with IFS2402/90 sensors

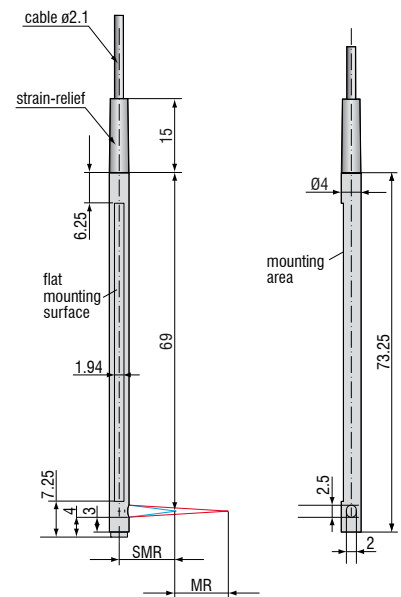
IFS2402-0.4/1.5/4/10



Tolerance $\pm 0.1\text{mm}$

MR= Measuring Range SMR = Start of Measuring Range Dimensions in mm.

IFS2402/90-1.5/4/10



Tolerance $\pm 0.1\text{mm}$

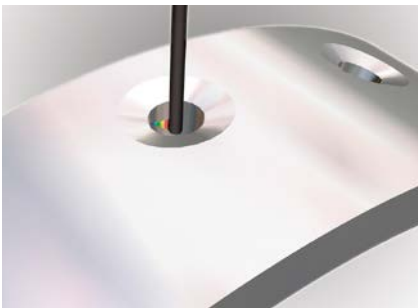
MR= Measuring Range SMR = Start of Measuring Range Dimensions in mm.



	Hybrid sensors $\varnothing 8\text{mm}$ with axial or radial (90°) measuring direction
	Submicrometer resolution
	One-sided thickness measurement of transparent material
	Displacement and position measurement
	Tiny spot size
	Suited for hazardous areas

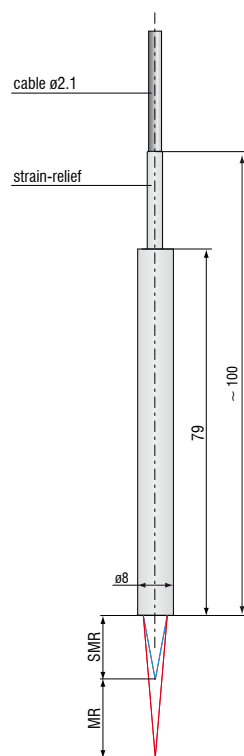
The combination of a gradient index lens (GRIN lens) with a relay lens represents a favorable compromise between the IFS2401 standard sensors and the IFS2402 miniature sensors. The sensors of the IFS2403 series with an external diameter of 8mm can still be used for precise measurement in relatively tight installation situations. Due to the larger numerical aperture in comparison with the IFS2402, significantly larger offset and steeper tilt angles can be realized than for the miniature sensors.

Sensors with axial measuring direction and sensors with 90° beam exit are available, which can measure radially in small cavities and bores.

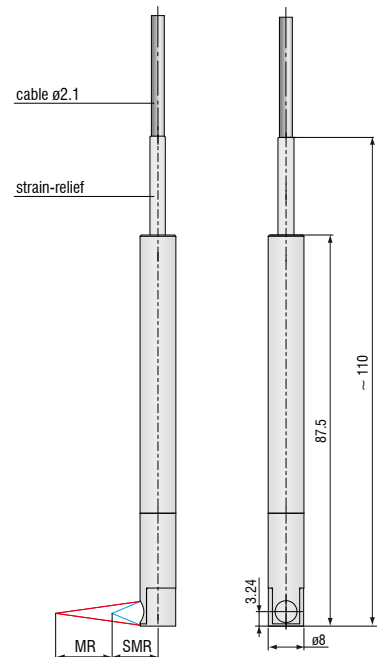


Measurement in bores with IFS2403/90 sensors

IFS2403-0.4/1.5/4/10



IFS2403/90-1.5/4/10



Tolerance $\pm 0.1\text{ mm}$
 MR = Measuring Range SMR = Start of Measuring Range Dimensions in mm.

Sensor model (GRIN lens with relay optics)	IFS 2403-0.4	IFS 2403-1.5	IFS 2403/90-1.5	IFS 2403-4	IFS 2403/90-4	IFS 2403-10	IFS 2403/90-10
Measuring range	400µm	1.5mm	1.5mm	4mm	4mm	10mm	10mm
Start of measuring range	appr. 2.5mm	8.0mm	4.9mm ¹⁾	14.7mm	12mm ¹⁾	11mm	8.6mm ¹⁾
Spot diameter	9µm	15µm	15µm	28µm	28µm	56µm	56µm
Linearity (displacement measurement)	0.3µm	1.2µm	1.2µm	3µm	3µm	20µm	20µm
	$\leq \pm 0.08\%$ FSO					$\leq \pm 0.2\%$ FSO	
Linearity (thickness measurement)	0.6µm	2.4µm	2.4µm	6µm	6µm	40µm	40µm
	$\leq \pm 0.16\%$ FSO					$\leq \pm 0.4\%$ FSO	
Resolution ²⁾	16nm	60nm	60nm	0.2µm	0.1µm	0.25µm	0.25µm
Weight	25g						
Max. tilt (direct reflexion)	$\pm 13^\circ$	$\pm 16^\circ$	$\pm 16^\circ$	$\pm 6^\circ$	$\pm 6^\circ$	$\pm 6^\circ$	$\pm 6^\circ$
Protection class	IP 40						
Operation temperature	+5 ... +70 °C						
Storage temperature	-30 ... +70°C						
Sensor cable (fibre optic cable)	length: integral cable 2m; option up to 50m; bending radius: static 30mm; dynamic 40mm						
Shock	15g, 6ms						
Vibration	2g / 10Hz ... 500Hz						

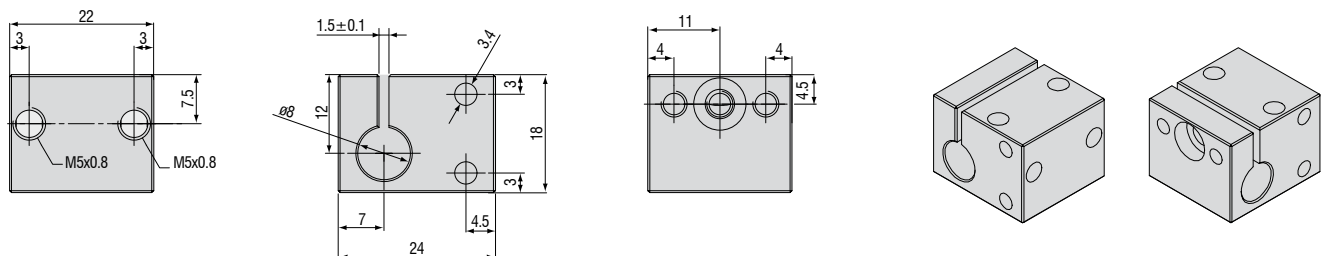
FSO = Full Scale Output

All data at constant ambient temperature (25±2°C) against optical flat; specifications can change when measuring different materials.







¹⁾ Distance from sensor axis

²⁾ Averaging factor 512

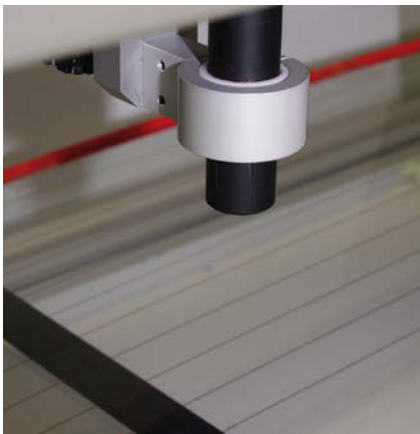
Accessories: mounting adapter MA2403 for sensors 2403



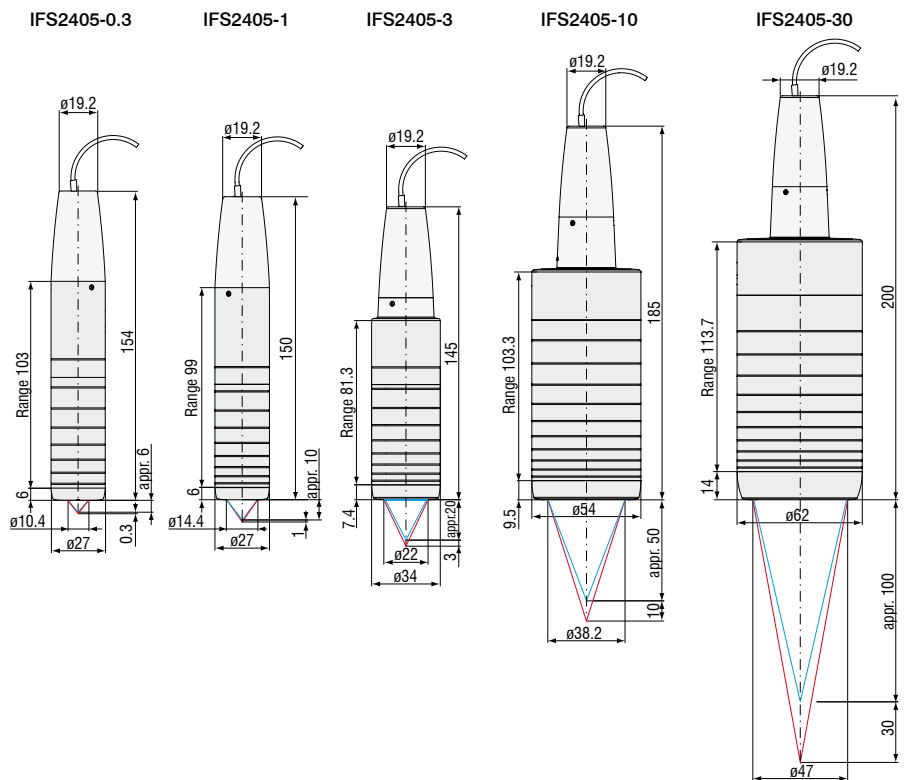


-  **Robust sensors for various applications**
-  **One-sided thickness measurement of transparent material**
-  **Displacement and position measurement**
-  **Tiny spot size**
-  **Submicrometer resolution**
-  **Suited for hazardous areas**

The confocal sensors in the IFS2405 series are designed for measurement tasks that require maximum precision. These new sensors excel through their high sensitivity. The high tilt angle and the relatively large base distance enable a great variety of potential applications. As well as distance measurements for reflective and transparent surfaces, the sensor can also be used for one-sided thickness measurement of clear film, boards or layers.



Thickness measurement of rear windows



Sensor model	IFS 2405-0,3	IFS 2405-1	IFS 2405-3	IFS 2405-10	IFS 2405-30
Measuring range	0.3mm	1mm	3mm	10mm	30mm
Start of measuring range	appr. 6mm	10mm	20mm	50mm	100mm
Spot diameter	6 μ m	8 μ m	9 μ m	16 μ m	50 μ m
Linearity (displacement measurement)	0.15 μ m	0.25 μ m	0.75 μ m	2.5 μ m	7.5 μ m
	± 0.05 % FSO	± 0.025 % FSO			
Linearity (thickness measurement)	0.3 μ m	0.5 μ m	1.5 μ m	5 μ m	15 μ m
	± 0.1 % FSO	± 0.05 % FSO			
Resolution ¹⁾	10nm	28nm	36nm	60nm	180nm
Weight	140g	125g	225g	500g	730g
Max. tilt ²⁾	$\pm 34^\circ$	$\pm 30^\circ$	$\pm 24^\circ$	$\pm 17^\circ$	$\pm 9^\circ$
Protection class	IP 65, front				
Operation temperature	+5 ... +70 °C				
Storage temperature	-20°C ... +70°C				
Sensor cable (fibre optic cable)	length: standard 3m; option up to 50m; bending radius: static 30mm; dynamic 40mm				
Shock	15g, 6ms				
Vibration	2g / 10Hz ... 500Hz				

FSO = Full Scale Output

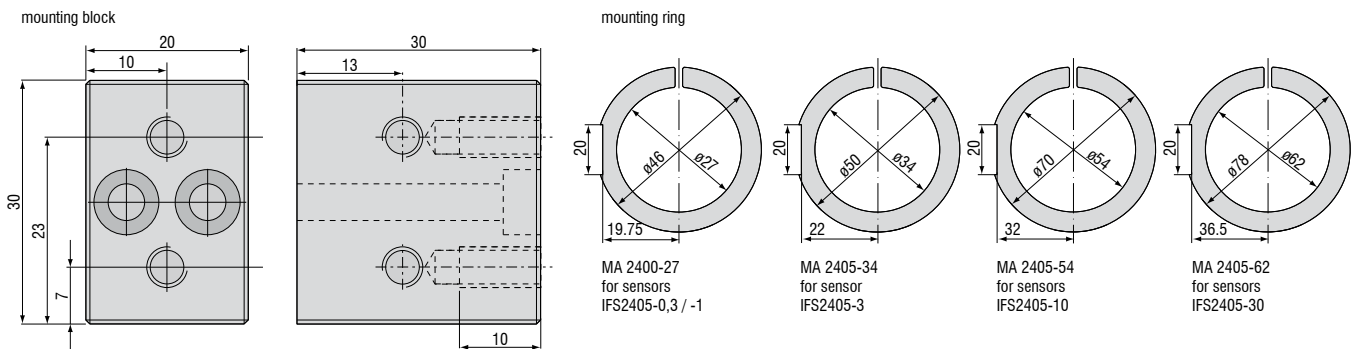
All data at constant ambient temperature (25 \pm 2°C) against optical flat; specifications can change when measuring different materials.

1) Average from 512 values at 1kHz, near to the centre of the measuring range

2) Maximum sensor tilt angle that produces a usable signal, near to the centre of the measuring range

Accessories: mounting adapter

MA2400 for sensors 2405 (consisting of a mounting block and a mounting ring)



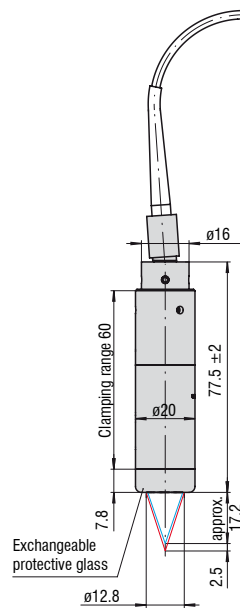


	Sensors with axial or radial beam path
	One-sided thickness measurement
	Distance measurement
	Very small measurement spot size
	Submicrometer resolution
	Vacuum applications

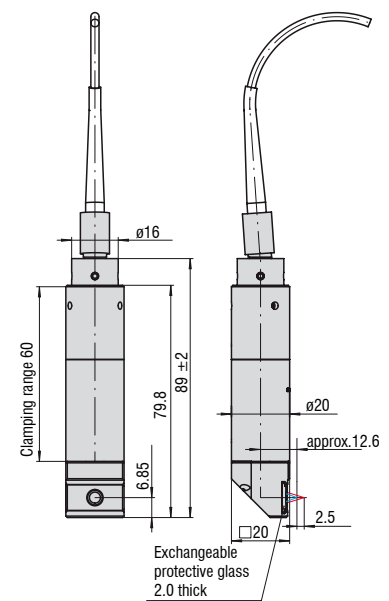
The IFS2406 series stands out due to its compact design and high precision. Due to its axial and radial measuring directions, the confocal sensor is suitable for vacuum applications and is extremely versatile in terms of its use.

As well as distance measurements on reflecting or transparent surfaces, the sensor can also be applied in one-sided thickness measurement of transparent film, plates or layers.

IFS2406-2.5/VAC(001)



IFS2406/90-2.5/VAC(001)



Sensor model	IFS 2406-2.5/VAC(001)	IFS 2406/90-2.5/VAC(001)
Measuring range	2.5mm	2.5mm
Start of measuring range	approx. 17.3mm measured from protective glass frame	12.6mm measured from sensor axis
Spot diameter	10µm	10µm
Linearity (displacement and distance measurement)	0.75 µm	0.75µm
	±0.03 % FSO	
Linearity (thickness measurement)	1.5µm	1.5µm
	±0.06 % FSO	
Resolution ¹⁾	24nm	24nm
Weight (without cable)	105g	130g
Max. tilt ²⁾	±16°	±16°
Protection class	IP 40, vacuum compatible	
Operating temperature	+5°C ... +70°C	
Storage temperature	-20°C ... +70°C	
Sensor cable (fibre optic cable)	length: standard 3m; option up to 50m; bending radius: static 30mm; dynamic 40mm	
Shock	15g, 6ms	
Vibration	2g / 10Hz ... 500Hz	

FSO = Full Scale Output

All data based on measurements with an optical cable of 26µm C2401-X(01) fibreglass at constant ambient temperature (25±2°C) against optical flat; specifications can change when measuring different materials.

¹⁾Average from 512 values at 1kHz, near to the centre of the measuring range

²⁾ Maximum sensor tilt angle that produces a usable signal, near to the centre of the measuring range



- 70kHz** The fastest confocal controller worldwide: up to 70kHz
- INTERFACE** Interfaces: Ethernet / EtherCAT / RS422 / Analogue
- Fast surface compensation
- Configuration via web interface
- Submicrometer resolution
- Multi layer thickness measurement
- Robust design with passive cooling

The new confocalDT 2451/2471 high precision controllers are the next generation of confocal chromatic measuring technology. Due to their excellent signal/noise ratio, these new models can achieve measuring rates of 10kHz with white light LEDs (IFC2451) and 70kHz (IFC2471) using an external Xenon light source.

The new active exposure regulation feature in the CCD array enables accurate, fast surface compensation on difficult changing surfaces during dynamic measurement processes.

Thanks to a user-friendly web interface, the entire configuration can be carried out without using any additional software. Data output is via Ethernet, EtherCAT, RS422 or analogue output.

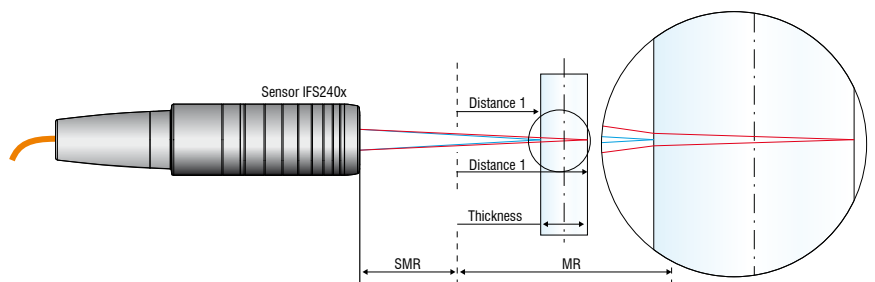
confocalDT 2451/2471 systems are used for complex distance and thickness measurements and can be used with any IFSsensor. Optical signals are transferred between sensor and controller via optical fibres.

Thickness
Difference 1 to 2: 1,73576 mm
Measuring rate: 10 kHz
Exposure time: 1482,0 µs



Material database

Material name	Description	Refractive index n ₀ at 633nm	Refractive index n ₀ at 587nm	Refractive index n ₀ at 650nm	Abbe value v _d	Delete
Vacuum, air	Vacuum, Luft (unverursagelos, approximativ)	1,000000	1,000000	1,000000		<input type="checkbox"/>
Water	Wasser	1,337121	1,333044	1,331162		<input type="checkbox"/>
Ethanol	Alkohol (ethyl alcohol)	1,361400	1,361400	1,361400		<input type="checkbox"/>
Acrylic	Acrylnat., Härter, Lacke, Klebstoffe, Kleber, Klebmittel	1,497528	1,491568	1,488528		<input type="checkbox"/>
PMMA	Polyethylmethacrylat, Plexiglas, Acrylglass (clear glass)	1,497761	1,491766	1,489200		<input type="checkbox"/>
PMMA	Polyethylmethacrylat, ein Kunststoff (a plastic)	1,534300	1,534300	1,534300		<input type="checkbox"/>
PS	Polystyrol, Styropor, ein Kunststoff (a plastic)	1,504279	1,500481	1,501649		<input type="checkbox"/>
PC	Polycarbonat, Makrolon, Lexan, ein Kunststoff (a plastic)	1,599429	1,595470	1,578664		<input type="checkbox"/>
Fused silica	Quarzglas, Siliziumdioxid	1,463120	1,459464	1,456267		<input type="checkbox"/>

All thickness measurement settings are configured through the web interface. A number of transparent materials are stored in the expandable materials database.

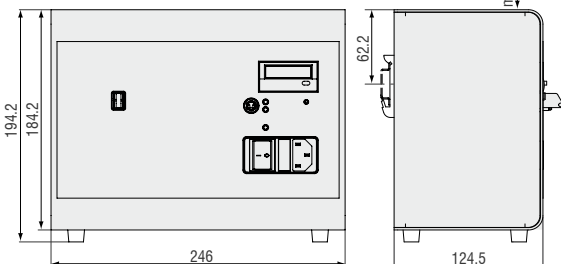
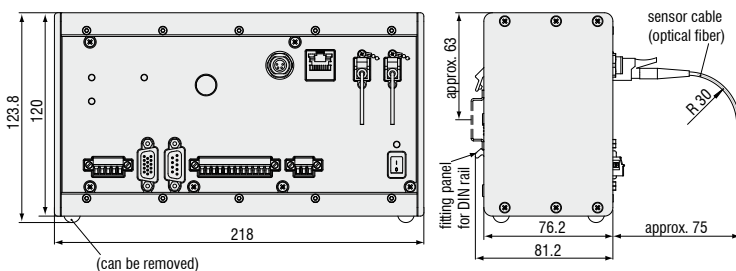


EtherCAT
Conformance tested
EtherCAT Conformance tested: IFC2451

Controller		IFC2451	IFC2451MP	IFC2471	IFC2471MP
Multi peak measurement		2 peaks	up to 6 peaks	2 peaks	up to 6 Peaks
Light source		internal white LED		external xenon light source IFX2471	
Measuring rate		adjustable 10 / 5 / 2.5 / 1 / 0.3 / 0.2 / 0.1kHz		adjustable 70 / 50 / 25 / 10 / 5 / 2.5 / 1 / 0.3kHz	
Resolution		Ethernet / EtherCAT RS422 Analogue		1nm 18bit 16bit	
Storage		up to 20 calibration tables for different sensors, menu selection			
Controller inputs / outputs		sync-in / trigger-in, sync-out error1-out, error2-out encoder (3x A, B, Index) EtherCAT/Ethernet RS422 analogue: current, voltage (16bit D/A converter)		sync-in / trigger-in, sync-out error1-out, error2-out encoder (3x A, B, Index) EtherCAT/Ethernet RS422 analogue: current, voltage (16bit D/A converter) IFX2471: temperature, light-bulb exchange	
EtherCAT					
Operating elements, controller display		On/Off switch; Button for dark alignment (as well as for reset to factory setting after 10sec) 4x LED for intensity, range, status, supply voltage			
Supply voltage, power consumption		controller 24VDC ±15%, ~10W		external light source 24VDC ±15%, ~10W 90 ... 265VAC, ~100W	
Housing		Aluminium case for DIN rail mounting			
Protection class		IP40			
Operating temperature		controller 5 °C ... 50 °C		external light source 5 °C ... 50 °C 5 °C ... 40 °C	
Storage temperature		-20 °C ... 70 °C			
Permissable ambient light		30,000lx			
Safety; EMC Interference emission Interference resistance		CE EN 61 000-6-3 / DIN EN 61326-1 (class B) EN 61 000-6-2 / DIN EN 61326-1			
Shock		15 g, 6ms			
Vibration		2g / 10Hz ... 500Hz			
Optical fibre cable length		sensor		2 ... 50m	
Cable length (all cables are shielded)		xenon light source		-	
		connector		E2000	
		EtherCAT, Ethernet		CAT5E; length <100m	
		supply, RS422, sync./ error		<30m	
		analogue		<30m	
		encoder		<3m	

Controller IFC2451/2471

Xenon light source IFX2471

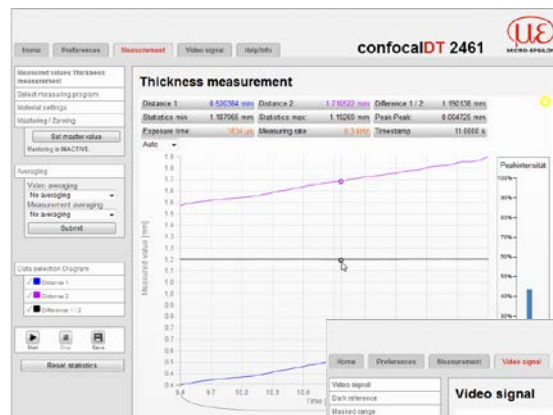




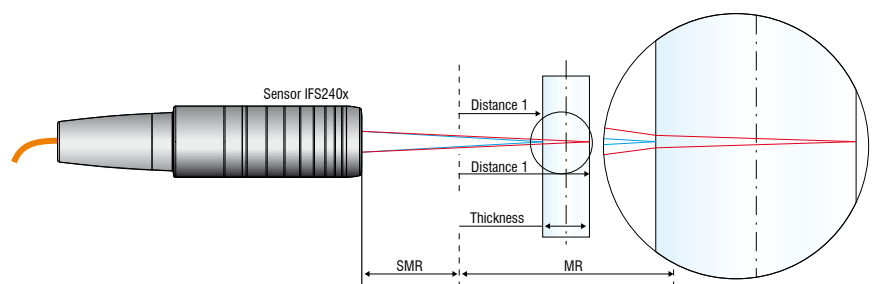
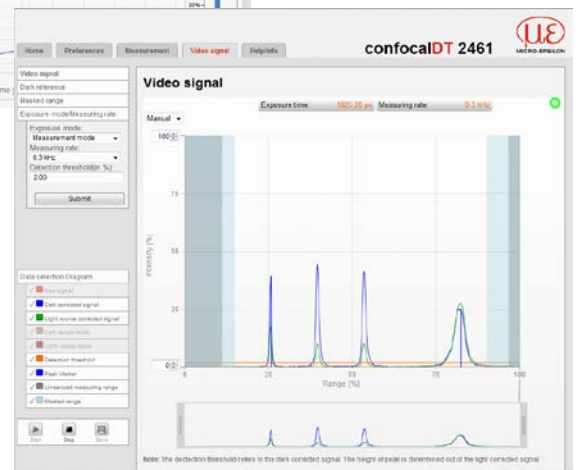
- 25kHz** Fast confocal controller: up to 25kHz
- INTERFACE** Interfaces: Ethernet / EtherCAT / RS422 / Analogue
- Fast surface compensation
- Configuration via web interface
- Submicrometer resolution
- Multi layer thickness measurement
- Robust design with passive cooling

confocalDT 2461 systems are used for complex distance and thickness measurements. The IFC2461 controller is equipped with enhanced, optimised optical components enabling measuring rates up to 25kHz 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 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 thickness measurements.

The active exposure regulation feature in the CCD array enables accurate, fast surface compensation on difficult changing surfaces during dynamic measurement processes. Thanks to a user-friendly web interface, the entire configuration can be carried out without using any additional software. Data output is via Ethernet, EtherCAT, RS422 or analogue output.

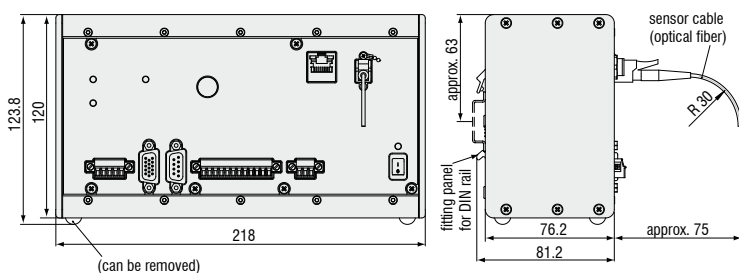


All thickness measurement settings are configured through the web interface. A number of transparent materials are stored in the expandable materials database.



Controller	IFC2461	IFC2461MP
Multi peak measurement	2 peaks	up to 6 peaks
Light source	internal white LED	
Measuring rate	adjustable 25 / 10 / 5 / 2.5 / 1 / 0.3 / 0.2 / 0.1kHz	
Resolution	Ethernet / EtherCAT	1nm
	RS422	18bit
	Analogue	16bit
Storage	up to 20 calibration tables for different sensors, menu selection	
Controller inputs / outputs	sync-in / trigger-in, sync-out error1-out, error2-out encoder (3x A, B, Index) EtherCAT/Ethernet RS422 analogue: current, voltage (16bit D/A converter)	
EtherCAT		
Operating elements, controller display	On/Off switch; Button for dark alignment (as well as for reset to factory setting after 10sec) 4x LED for intensity, range, status, supply voltage	
Supply voltage, power consumption	24VDC \pm 15%, \sim 10W	
Housing	Aluminium case for DIN rail mounting	
Protection class	IP40	
Operating temperature	5°C ... 50°C	
Storage temperature	-20°C ... 70°C	
Permissible ambient light	30,000lx	
Safety; EMC	CE	
Interference emission	EN 61 000-6-3 / DIN EN 61326-1 (class B)	
Interference resistance	EN 61 000-6-2 / DIN EN 61326-1	
Shock	15 g, 6ms	
Vibration	2g / 10Hz ... 500Hz	
Optical fibre cable length	sensor	2 ... 50m
	connector	E2000
Cable length (all cables are shielded)	EtherCAT, Ethernet	CAT5E; length <100m
	supply, RS422, sync./ error	<30m
	analogue	<30m
	encoder	<3m

Controller IFC2461



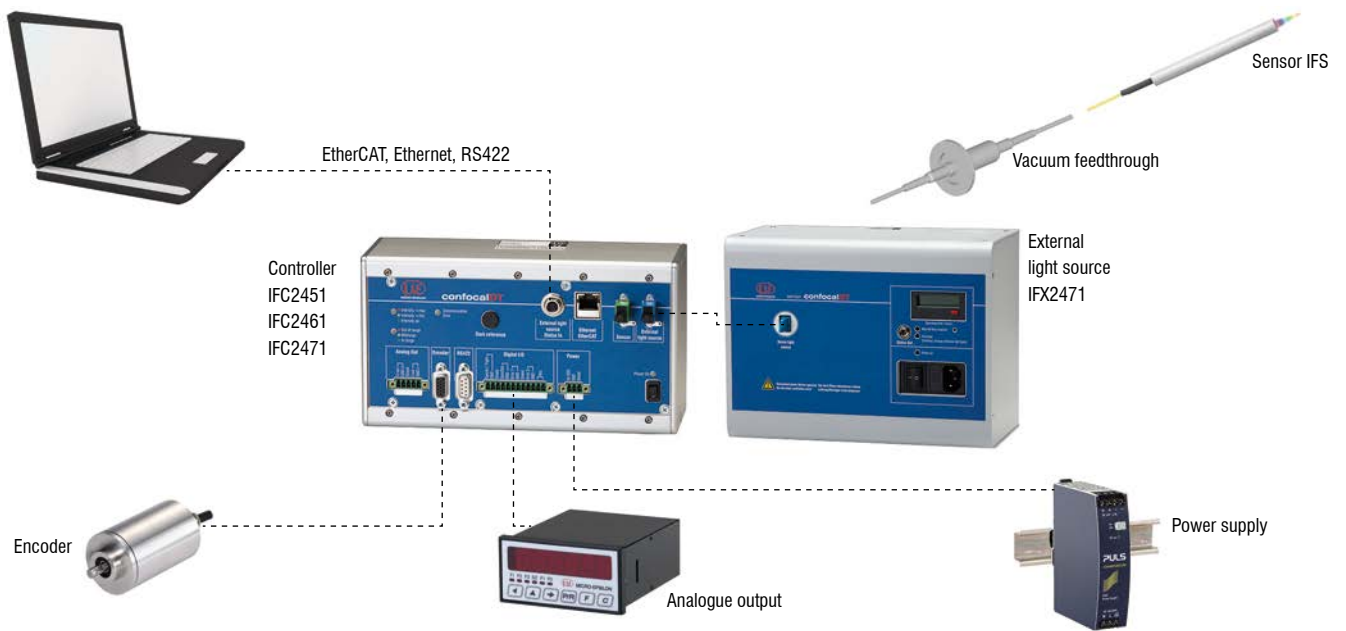
System setup

A measuring system confocalDT 2451/2461 consists of:

- Sensor IFS240x
- Controller IFC2451/ IFC2461

A measuring system confocalDT 2471 consists of:

- Sensor IFS240x
- Controller IFC2471 (for external light source)
- Xenon light source IFX2471



Customer specific modifications

On occasions, application requirements exceed the performance limits of standard sensors and controllers. 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
- 90° cable exit
- Vacuum suited sensors without outgassing
- Reduced sensor length
- Mounting options
- Extended sensor lance
- Optical filter for ambient light compensation
- Sensor material



Accessories

Software

IFD24n1-Tool Free demo software tool included in delivery

Accessories light source

IFX2471/Xe/75 external Xenon light source for controller IFC2471 (70 kHz)
 IFX2471/Xe/75-light-bulb for IFX2471
 IFL2451/LED-light-bulb for IFC2451
 IFL2451/LED(003)-light-bulb for IFC2451(003) with cooling element
 CL2471-1/Xe Light source cable, 1m

Accessories IFS2405

C2401-X Fibre optical cable (3m, 10m, customer specific length up to 50m)
 C2401/PT-X Armored cable (3m, 10m, customer specific length up to 50m)
 C2401-3(10) Sensor cable for drag chain use, 3m
 C2401-5(10) Sensor cable for drag chain use, 5m

Accessories IFS2402/2403

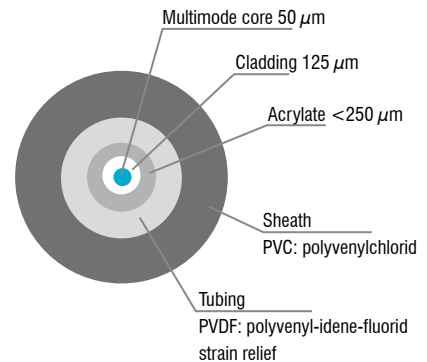
CE2402-X Extension for fibre optical cable (3/10/13/30/50m)
 CE2402-X/PT Sensor with armored cable
 (3/10m, customer specific length up to 50m)
 C2402/Vac/KF16 Vacuum feedthrough, 1 channel
 C2405/Vac/6/CF63 Vacuum feedthrough, 6 channel
 C2405/Vac/9/CF63 Vacuum feedthrough, 9 channel

Accessories

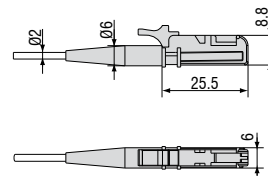
SC2471-3/USB/IND Connector cable IFC2451/61/71, 3m
 SC2471-3/IF2008 Connector cable IFC2451/61/71-IF2008, 3m
 SC2471-3/CSP Connector cable IFC2451/61/71-CSP2008, 3m
 SC2471-10/IF2008 Connector cable IFC2451/61/71-IF2008, 10m
 SC2471-10/CSP Connector cable IFC2451/61/71-CSP2008, 10m
 SC2471-10/USB/IND Connector cable IFC2451/61/71, 10m
 SC2471-20/USB/IND Connector cable IFC2451/61/71, 20m
 PS2020 Power supply 24 V / 2,5 A
 EC2471-3/OE Encoder cable, 3 m

Fibre optic

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



E2000/APC standard connector



High performance sensors made by Micro-Epsilon



Sensors and systems for displacement and position



Sensors and measurement devices for non-contact temperature measurement



2D/3D profile sensors (laser scanner)



Optical micrometers, fibre optic sensors and fibre optics



Colour recognition sensors, LED analyzers and colour online spectrometer



Measurement and inspection systems



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