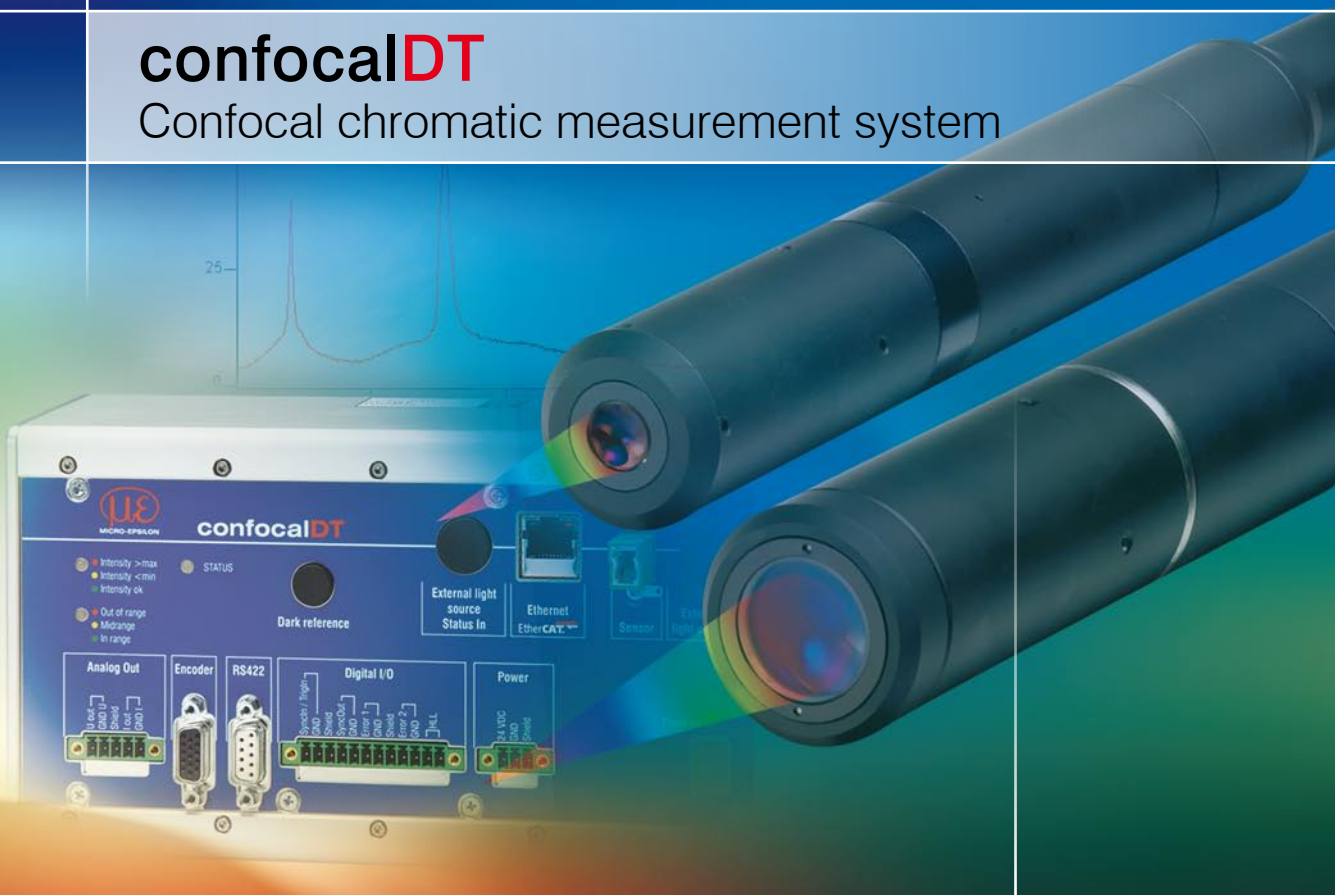











More Precision.

confocalDT

Confocal chromatic measurement system





- 
Wear free measurement and passive sensor design
- 
Highest precision with submicrometer resolution
- 
Fast surface compensation
- 
Adjustable measuring rate up to 70 kHz
- 
Displacement measurement and thickness measurement
- 
Tiny measurement spot
- 
Configuration via web interface

Next-generation confocal chromatic measuring systems

The confocalDT introduces a new generation of confocal chromatic measuring solutions. This system includes the fastest controller currently available in the world and produces highly accurate results for distance and displacement measurements, and for measuring the thickness of transparent objects. A large selection of sensors, extensive interfaces, and simplified, web browser-based operation provide great potential for applications in semiconductor manufacturing, glass production, medical devices and plastics processing.

Special features

This unique measuring principle enables high precision distance and displacement measurement, both for diffuse and reflecting surfaces. In addition, thickness measurements can be carried out for transparent measuring objects. The web browser interface provides an extensive materials database, which can be individually edited and extended. Up to six peaks can be evaluated to facilitate measuring multi-layer objects.

The new controller offers an excellent signal/noise ratio for high precision measurements. Rapid surface compensation helps to control illumination cycles for achieving high signal stability.

System design

The confocalDT confocal measuring system consists of a controller and sensor, which are linked through a light conductor cable. The controller is connected to an external Xenon light source to facilitate fast measurements of up to 70kHz. The controller is easily configured via a web interface. In contrast to swinging lens systems, the confocalDT design is wear-free. The sensor range includes IFS 2400/2401 standard sensors, the worldwide unique IFS 2402 miniature sensors, and the IFS 2403 series of hybrid sensors. Using confocal miniature sensors with a diameter of 4.5mm or more facilitates measurements in narrow cavities, recesses and bore holes. In addition, the sensors can be used in potentially explosive atmospheres and vacuums.

Table of content confocalDT



Page 6-7

confocalDT 2451/2471 Controller

Currently the fastest confocal controller worldwide
Adjustable measuring rate up to 70kHz
Very fast surface compensation due to exposure time regulation
Multi peak measurement with predefined thickness data



Page 8-9

confocalDT IFS 2400/2401 Confocal displacement sensors

Compact sensors with large stand off distance possible
Displacement and position measurement and one-sided thickness measurement of transparent materials and multi-layers
Extreme high spatial resolution for microscopic surface profiling
ATEX / EX approved for hazardous areas



Page 10-11

confocalDT IFS 2402 Confocal miniature sensors

Miniature sensors \varnothing 4mm
Measure inside bores and cavities from \varnothing 4.5mm
Robust steel case
Axial or radial (90°) measuring direction
Displacement and position measurement
ATEX / EX approved for hazardous areas



Page 12-13

confocalDT IFS 2403 Confocal hybrid sensors

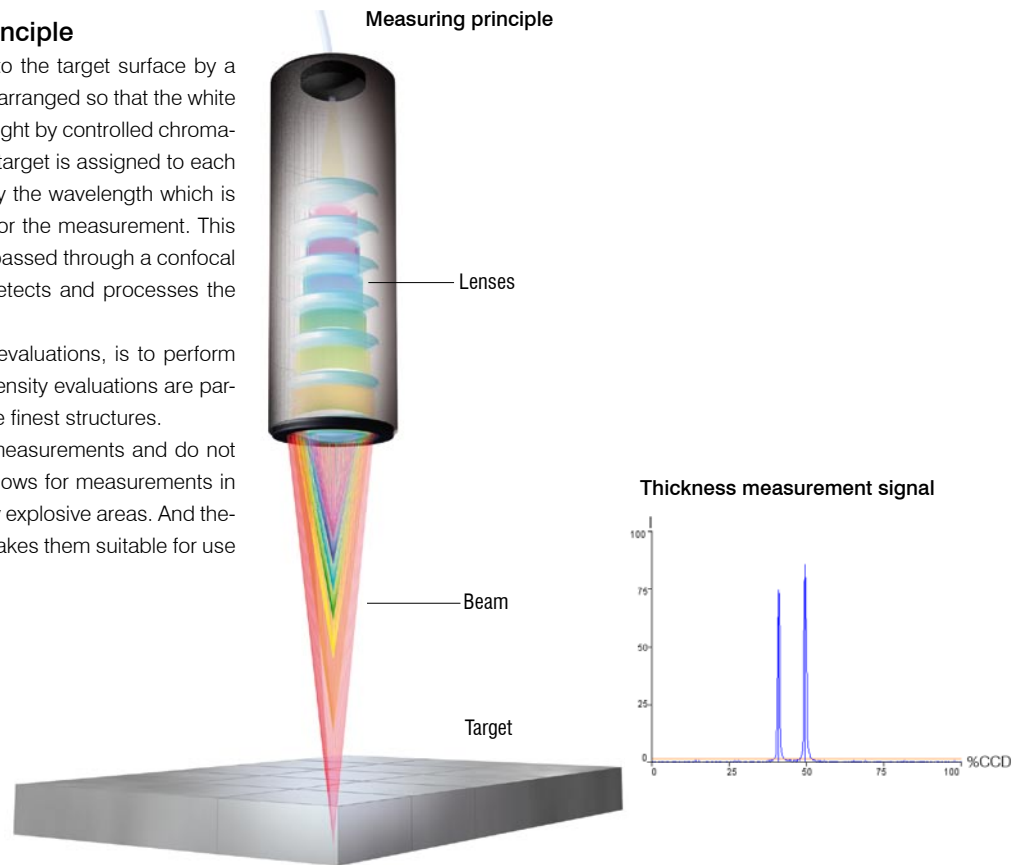
Hybrid sensors \varnothing 8mm
Displacement and position measurement and one-sided thickness measurement of transparent materials and multi-layers
Robust steel case
Gradient index lens with relay optics
Axial or radial (90°) measuring direction
ATEX / EX approved for hazardous areas

The confocal measurement 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 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 focussed 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.

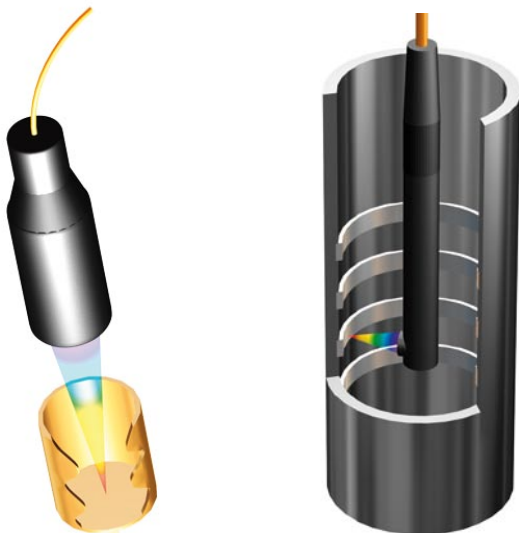
Another option, in addition to distance evaluations, is to perform measurements using signal intensity. Intensity evaluations are particularly well suited for capturing even the finest structures.

The sensors are designed for passive measurements and do not need any electrical components. This allows for measurements in difficult environments, such as potentially explosive areas. And these sensors do not give off heat, which makes them suitable for use in sensitive environments.



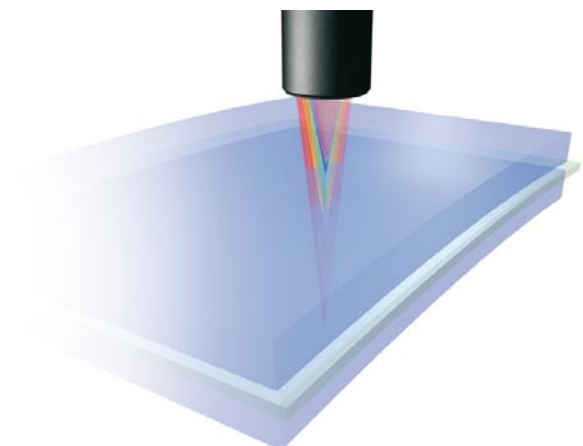
Cavity inspection

The 90°-version of the miniaturised sensors detects grooves or inner wall features of small gaps and cavities.



Wall thickness of transparent material

Due to one-sided thickness measurement, a single sensor is able to measure the thickness of glass, plastic tubes or any transparent coatings.

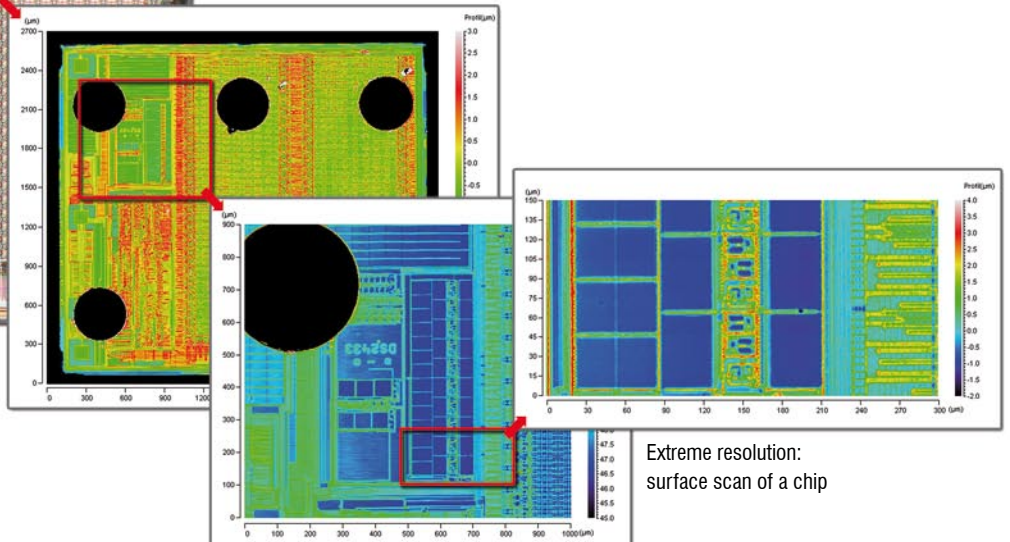
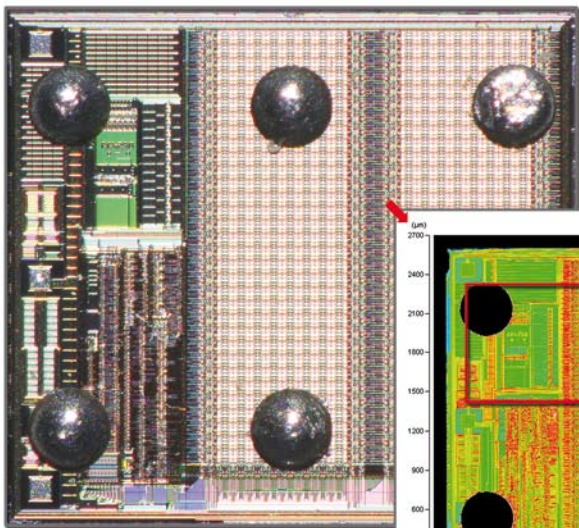




Diameter of stainless steel pipes










Surface scan of dental samples



Extreme resolution:
surface scan of a chip

confocalDT 2451/2471 Controller



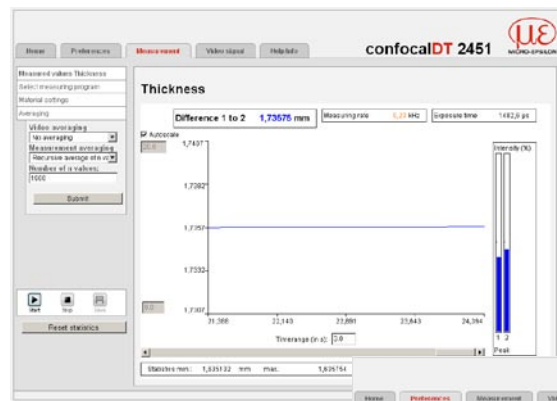
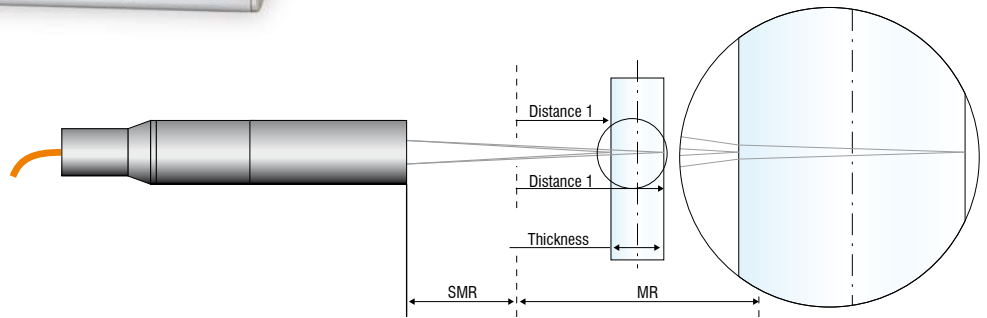
-  **The fastest confocal controller worldwide: up to 70 kHz**
-  **Interfaces: Ethernet / Ethercat / RS422 / Analog**
-  **Fast surface compensation**
-  **Configuration via web interface**
-  **Submicrometer resolution**
-  **Multilayer thickness measurement**
-  **Robust design with passive cooling**

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 and 70kHz 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 sensor 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 IFS sensor. Optical signals are transferred between sensor and controller via optical fibers.

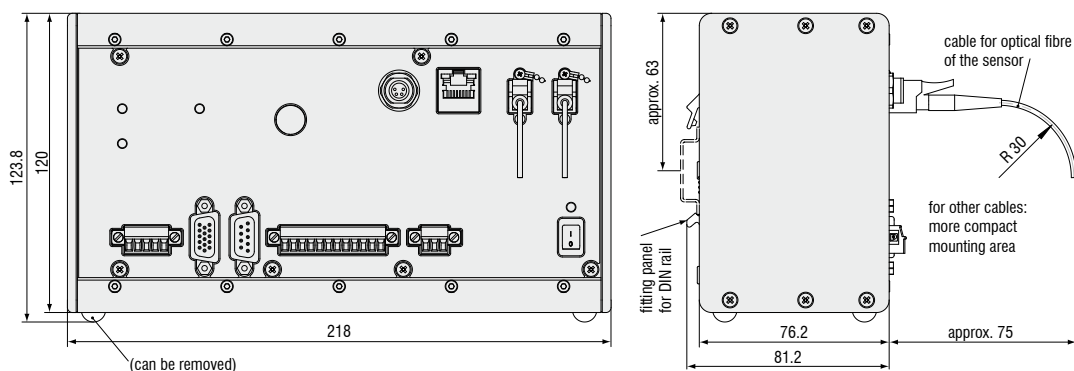


Material name	Description	Refractive index n at 488nm	Refractive index n at 587nm	Refractive index n at 650nm	Absorptance k at 488nm	Density
Vacuum	Vacuum, Luft (Luftdruckangewiesen, approximativ)	1.000000	1.000000	1.000000		
Air	Air	1.000270	1.000270	1.000270		
Water	Water	1.337121	1.333044	1.331162		
Ethanol	Alkohol (ethyl alcohol)	1.361400	1.361400	1.361400		
Acrylic	Acrylfaser, Kober, Lacke (Acryl, Acryl, Acryl, Acryl)	1.497838	1.497838	1.497838		
PMMA	Polydimethylsiloxan, Polymethylmethacrylat, Plexiglas, Acrylfaser (Acryl, Acryl)	1.497761	1.491756	1.489200		
PAMM	Polydimethylsiloxan, Polymethylmethacrylat, Plexiglas, Acrylfaser (Acryl, Acryl)	1.534000	1.534000	1.534000		
PE	Polyethylen, Polyethylen, ein Kunststoff (a plastic)	1.464079	1.456481	1.456481		
PC	Polycarbonat, Makrolon, Lexan, ein Kunststoff (a plastic)	1.594309	1.586470	1.579064		
Silicon	Quarzglas, Silikon, ein Kunststoff (a plastic)	1.463126	1.459464	1.456267		

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







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 IFC2471	
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		1nm			
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 analog: current, voltage (16 bit D/A converter)		sync-in / trigger-in, sync-out error1-out, error2-out encoder (3x A, B, Index) EtherCAT/Ethernet RS422 analog: current, voltage (16 bit D/A converter) IFC2471: temperature, light-bulb exchange	
Operating elements, controller display		On/Off switch Button for dark alignment (as well as for reset to factory setting after 10s) 4x LED for intensity, range, status, supply voltage			
Supply voltage, power consumption		24 VDC \pm 15 %, \sim 10 W -		24 VDC \pm 15 %, \sim 10 W 90 ... 265 VAC, \sim 100 W	
Housing		Aluminium case for DIN rail mounting			
Protection class		IP40			
Operating temperature		5°C up to 50°C -		5°C up to 50°C 5°C up to 40°C	
Storage temperature		-20°C up to 70°C			
Permissible ambient light		30,000lx			
Safety; EMC Interference emission Interference resistance		CE; UL certified 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 / 10 Hz ... 500Hz			
Optical fiber cable length		sensor		2 - 50m	
		xenon light source		-	
		connector		E2000	
Cable length (all cables are shielded)		EtherCAT, Ethernet		CAT5E; length <100 m	
		supply, RS422, sync./error		<30m	
		analog		<30m	
		encoder		<3m	

Controller



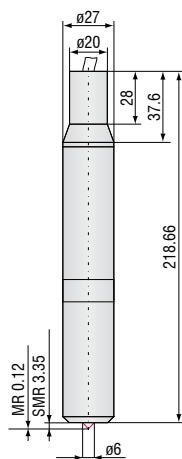
confocalDT IFS 2400/2401
Confocal chromatic displacement sensor



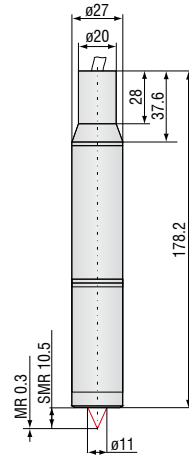
-  **Robust sensors for various applications**
-  **One-sided thickness measurement of transparent material**
-  **Displacement and position measurement**
-  **Tiny spot size**
-  **Submicrometer resolution**
-  **ATEX / EX approved for hazardous areas**

The confocal sensors of the series 2400 and 2401 are applicable for distance and one-sided thickness measurement. The large tilt angle and the relative long stand off distance allow the use in many application fields. Measuring distance on shiny and transparent objects, one-sided thickness measurement; this sensor is ideal for precision measurement against any diffuse and specular materials e.g. film, liquid, glass, metal, polymer and many more.

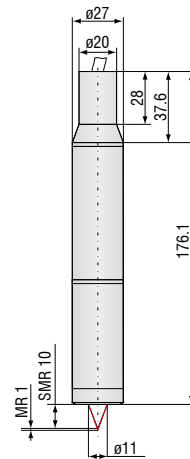
IFS 2401-0.12



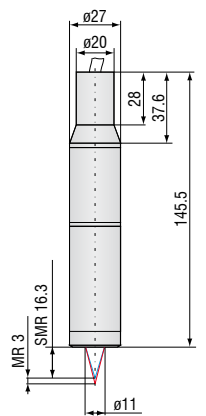
IFS 2401-0.4



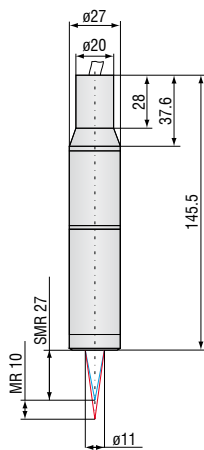
IFS 2401-1



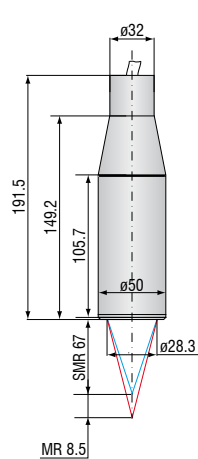
IFS 2401-3



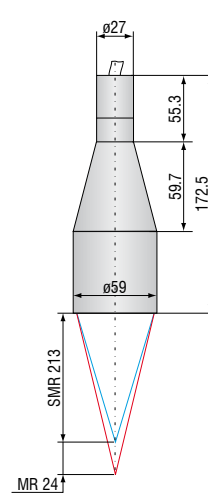
IFS 2401-10



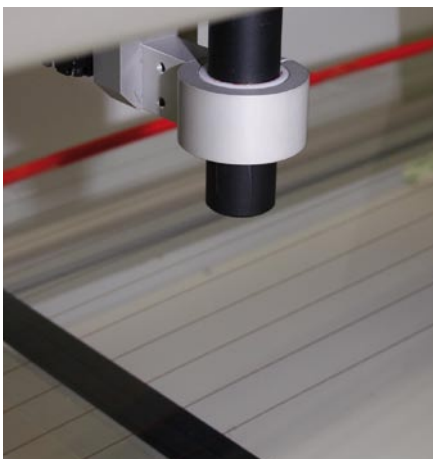
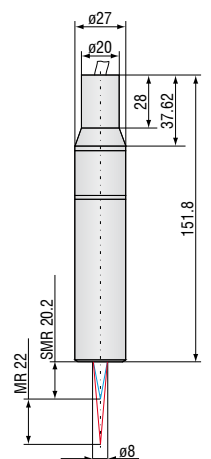
IFS2400-10



IFS 2400-24



IFS 2401-25



Thickness measurement of rear windows

Tolerance: Total diameter +0.2 / -0.1 mm ; Single components ±0.1 mm
MR= Measuring Range SMR = Start of Measuring Range

MR 24
Dimensions in mm.

Sensor model (standard)	IFS 2401-0.12	IFS 2401-0.4	IFS 2401-1	IFS 2401-3	IFS 2401-10	IFS 2400-10	IFS 2400-24	IFS 2401-25	
Measuring range	120μm	300μm	1mm	3mm	10mm	8.5mm	24mm	22mm	
Start of measuring range	ca. 3.4mm	10.5mm	10mm	16.3mm	27mm	67mm	213mm	20.2mm	
Spot diameter	7μm	10μm	10μm	25μm	50μm	50μm	100μm	100μm	
Linearity (displacement measurement)	0.12μm	0.3μm	0.5μm	1.5μm	5μm	5μm	12μm	11μm	
	≤ ± 0.1 % FSO			≤ ± 0.05 % FSO					
Linearity (thickness measurement)	0.24μm	0.6μm	1μm	3μm	10μm	10μm	24μm	22μm	
	≤ ± 0.2 % FSO			≤ ± 0.1 % FSO					
Resolution ¹⁾	4nm	10nm	30nm	50nm	0.12μm	0.5μm	1μm	0.2μm	
Weight	sensor	0.20kg	0.22kg	0.22kg	0.16kg	0.19kg	0.68kg	0.52kg	0.19kg
	sensor+MA 2400	0.38kg	0.40kg	0.40kg	0.34kg	0.37kg	0.90kg	0.76kg	0.37kg
Max. tilt ²⁾	±43°	±28°	±27°	±22°	±14°	±14°	±5°	±8.5°	
Ambient light	30,000 lx								
Protection class	IP 65								
Operation temperature	+10 ... +50°C								
Storage temperature	-30 ... +70°C								
Sensor cable (fiber optic cable)	length: standard 3m; option up to 50m bending radius: static 30mm; dynamic 40mm								
Shock	15 g; 6 ms								
Vibration	2g / 10 Hz ... 500 Hz								
Electromagnetic compatibility (EMC)	EN 50081-1 and EN 61000-6-2								

FSO = Full Scale Output

All data at constant ambient temperature (25±5°C) against optical flat; specifications can change when measuring different materials.

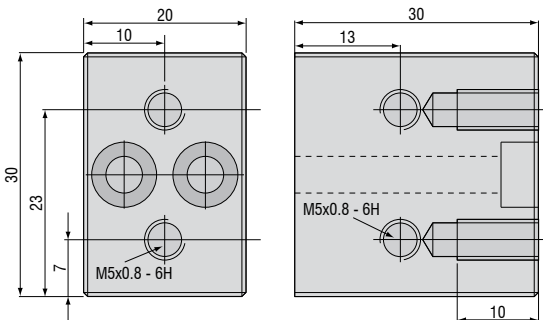
¹⁾Averaging factor 512

²⁾ Maximum tilt that allows a stable signal

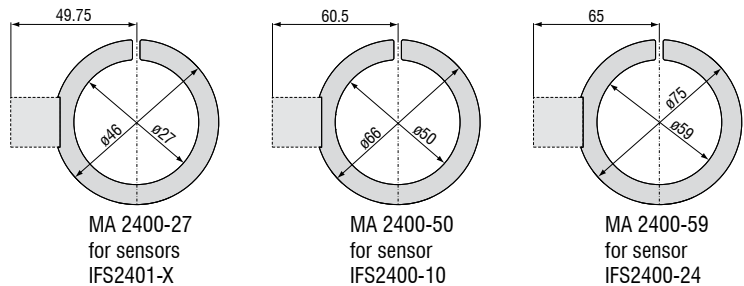
Accessories: mounting adapter

MA2400 for sensors 2400/2401 (consisting of a mounting block and a mounting ring)

mounting block








mounting ring



confocalDT IFS 2402
 Confocal chromatic miniature sensors



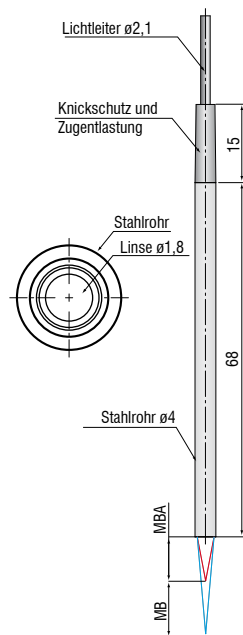
-  Miniature sensors $\varnothing 4$ mm with axial or radial (90°) measuring direction
-  Submicrometer resolution
-  Displacement and position measurement
-  Tiny spot size
-  ATEX / EX approved for hazardous areas

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.

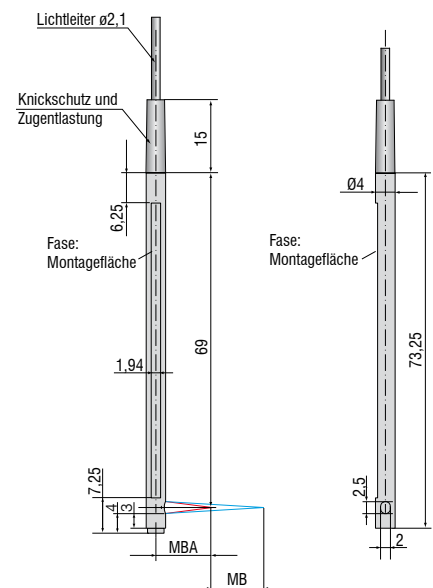


Diameter measurement in small bores with IFS2402/90 sensors

IFS 2402-0,4/1,5/4/10



IFS 2402/90-1,5/4/10



Mechanische Toleranzen $\pm 0,1$ mm
 MB = Messbereich MBA = Messbereichsanfang Alle Abmessungen in mm.

Sensor model (miniature)	IFS 2402-0,4	IFS 2402-1,5	IFS 2402/90-1,5	IFS 2402-4	IFS 2402/90-4	IFS 2402-10	IFS 2402/90-10
Measuring range	400 μ m	1.5mm	1.5mm	3.5mm	2.5mm	6.5mm	6.5mm
Start of measuring range approx.	1.5mm	0.9mm	2.5mm ¹⁾	1.9mm	2.5mm ¹⁾	2.5mm	3.5mm ¹⁾
Spot diameter	10 μ m	20 μ m	20 μ m	20 μ m	20 μ m	100 μ m	100 μ m
Linearity	\sim 0.3 μ m	1.2 μ m	1.2 μ m	\sim 3 μ m	2 μ m	13 μ m	13 μ m
Resolution	16 nm	60 nm	60 nm	0.1 μ m	0.1 μ m	0.2 μ m	0.2 μ m
Weight	15g						
Max. tilt (direct reflexion)	\pm 8°	\pm 5°	\pm 5°	\pm 3°	\pm 3°	\pm 1.5°	\pm 1.5°
Ambient light	30,000 lx						
Protection class	IP 40						
Operation temperature	+10 ... +50°C						
Storage temperature	-30 ... +70°C						
Sensor cable (fiber optic cable)	length: integral cable 2m; option up to 50m bending radius: static 30mm; dynamic 40mm						
Shock	15 g, 6ms						
Vibration	2g / 10 Hz ... 500Hz						
Electromagnetic compatibility (EMC)	EN 50081-1 and EN 61000-6-2						

FSO = Full Scale Output

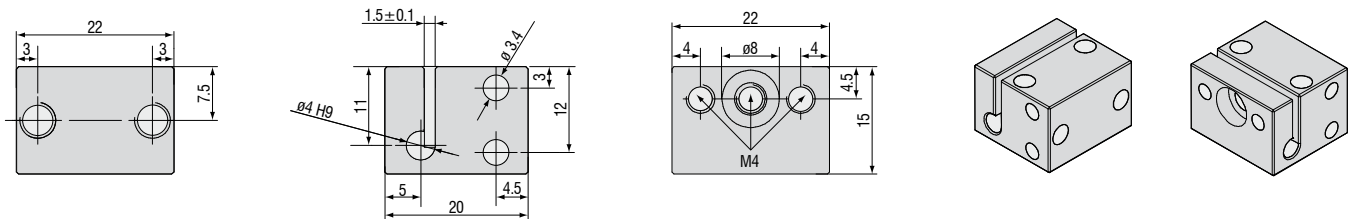
All data at constant ambient temperature (25 \pm 5°C) against optical flat; specifications can change when measuring different materials.

¹⁾ Distance from sensor axis

²⁾ Averaging factor 512







Accessories: mounting adapter

MA2402 for sensors 2402



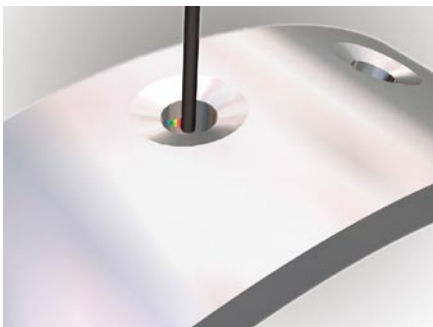
confocalDT IFS 2403
Confocal chromatic hybrid sensors



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

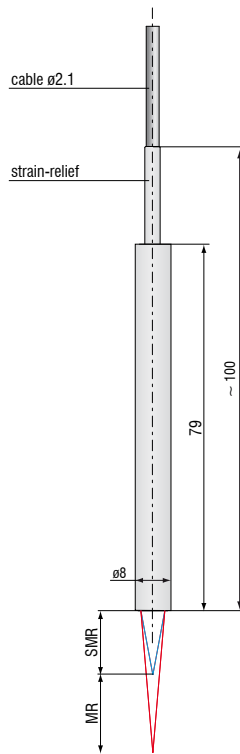
The combination of a gradient index lens (GRIN lens) with a relay lens represents a favourable compromise between the IFS2401 standard sensors and the IFS2402 miniature sensors. The sensors of the IFS2403 series with an external diameter of 8mm can still be used for precise measurement in relatively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

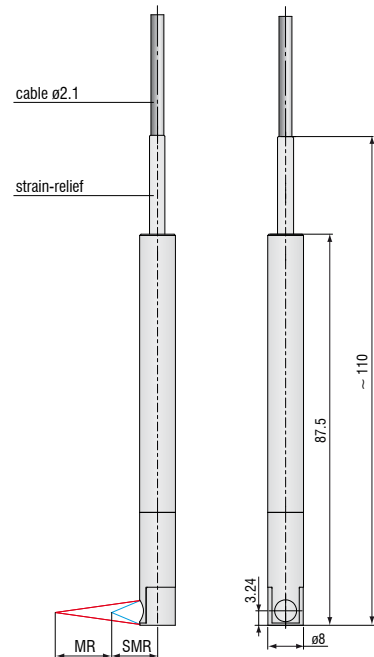


Measurement in bores with IFS2403/90 sensors

IFS 2403-0,4/1,5/4/10



IFS 2403/90-1,5/4/10



Tolerance ± 0.1 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	2.8mm	8.1mm	4.9mm	14.7mm	12mm	11mm	8.6mm
Spot diameter	9µm	15µm	15µm	28µm	28µm	56µm	56µm
Linearity (displacement measurement)	≤ ± 0.08 % FSO					≤ ± 0.2 % FSO	
	0.3µm	1.2µm	1.2µm	3µm	3µm	20µm	20µm
Linearity (thickness measurement)	≤ ± 0.16 % FSO					≤ ± 0.4 % FSO	
	0.6µm	2.4µm	2.4µm	6µm	6µm	40µm	40µm
Resolution ¹⁾	16 nm	60 nm	60 nm	0.2µm	0.1µm	0.2µm	0.2µm
Weight	25 g						
Max. tilt (direct reflexion)	± 13°	± 16°	± 16°	± 6°	± 6°	± 6°	± 6°
Ambient light	30,000 lx						
Light source	LED						
Protection class	IP 40						
Operation temperature	+10 ... +50 °C						
Storage temperature	-30 ... +70 °C						
Sensor cable (fiber optic cable)	length: integral cable 2m; option up to 50m bending radius: static 30mm; dynamic 40mm						
Shock	15 g, 6 ms						
Vibration	2g / 10 Hz ... 500 Hz						
Electromagnetic compatibility (EMC)	EN 50081-1 and EN 61000-6-2						

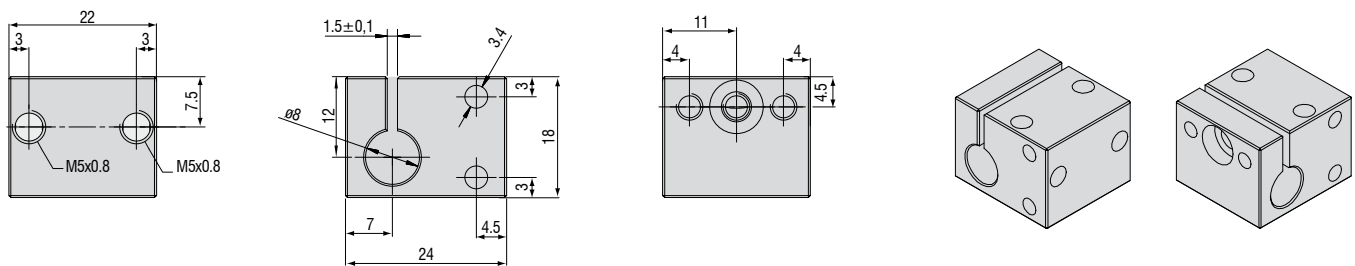
FSO = Full Scale Output

All data at constant ambient temperature (25±5°C) against optical flat; specifications can change when measuring different materials.

1) Averaging factor 512

Accessories: mounting adapter

MA2402 for sensors 2402



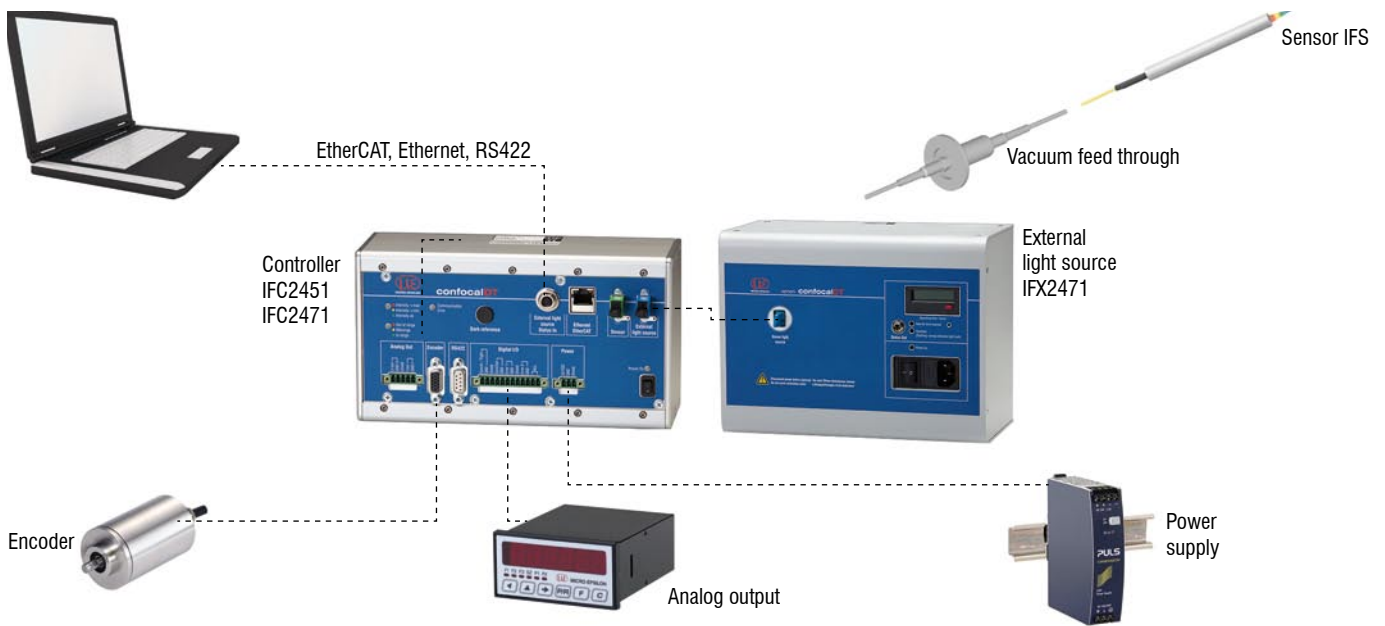
System setup

A measuring system confocalDT 2451 consists of:

- Sensor IFS240x
- Controller IFC2451

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 customise the sensor design and to adjust the controller accordingly. Common requests for modifications include changes in design, mounting options, customised 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
CL2471-1/Xe/Y4 Light source cable for 4 controller, 1m

Accessories 2400/2401

C2401-X Fiber optical cable (3 m, 10 m, customer specific length up to 50m)
C2401/PT-X Armored cable (3 m, 10 m, 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 2402/2403

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

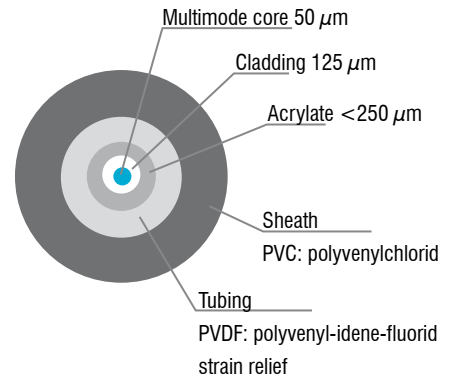
Accessories

SC2471-3/USB/IND Connector cable IFC2451/2471, 3m
SC2471-3/IF2008 Connector cable IFC2451/2471-IF2008, 3m
SC2471-3/CSP Connector cable IFC2471-CSP2008, 3m
SC2471-20/USB/IND Connector cable IFC2451/2471, 20m
SC2471-10/USB/IND Connector cable IFC2451/2471, 10m
SC2471-10/IF2008 Connector cable IFC2451/2471-IF2008, 10m
SC2471-10/CSP Connector cable IFC2471-CSP2008, 10m
PS2020 Power supply 24 V / 2,5 A
EC2471-3/OE Encoder cable, 3m

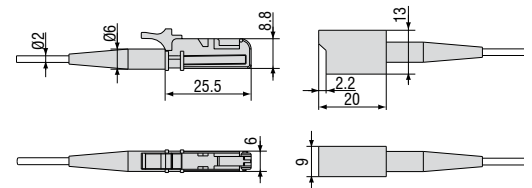
Fiber optic

Temperature range : -50°C bis 90°C

Bending radius: 30/40 mm



Easy to plug: E2000 standard connector



boreCONTROL

Non-contact internal wall inspection



Sensor with integrated rotation drive, plug connectors and exchangeable sensor lance

Exchangeable sensor lance

Confocal chromatic measuring beam

Precise detection of diameters, defects, notches and hollows

boreCONTROL is a optical bore hole sensor and functions with a special version of the standard IFS 2402/90 sensor. The sensor can be used for bore holes with diameters from 4mm upwards. The sensor is rotated by an electric motor and can measure the diameter, roundness, concentricity, tapering and the straightness of bore holes.

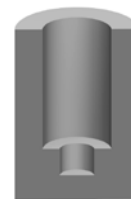
Features

- Completely non-contact and wear-free measurement
- High speed sampling rate 5kHz
- Intensity information for surface inspection
- Active temperature compensation
- High repeatability and measurement stability

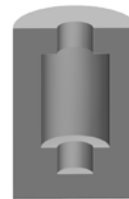
Typical applications



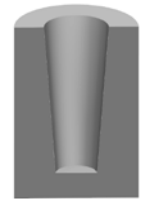
Diameter



Steps
Ovality
Roundness



Depressions
Concentricity
Coaxiality



Conicity
Straightness



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