MICRO-EPSILON

# More Precision

## interferoMETER IMS5420 // High precision inline wafer thickness measurement

# High precision inline wafer thickness measurement
# interferoMETER 5420

- Nanometer-precise thickness measurement from 0.05 to 1.05 mm (SI wafers)
- Undoped, doped and highly doped wafers
- Multi-peak: up to 5 layers in one measurement
- High resolution 1 nm
- Measuring rate up to 6 kHz for high speed measurements
- Ethernet / EtherCAT / RS422 / PROFINET / EtherNet/IP
- Easy configuration via web interface
- Flexible industrial integration
- Pilot laser for exact visualization of the measuring point


**Stable wafer thickness measurement in inline processes**

The IMS5420-TH absolute interferometer opens up new perspectives in the industrial thickness measurement of monocrystalline silicon wafers and silicon carbide wafers and comparable materials that are transparent for a wavelength range of 1,100 nm. Due to its broadband superluminescent diode (SLED), the IMS5420-TH can be used for undoped, doped and highly doped Si wafers. In wafer thickness measurements, the IMS5420-TH impresses with an excellent price-performance ratio.

Due to the optical transparency of silicon wafers in the wavelength range of 1,100 nm, interferometers can precisely detect their thickness. This enables wafer thickness measurements up to 1.05 mm. The measurable thickness of air gaps is even up to 4 mm.

The absolute interferometer achieves signal stability in the submicrometer range. Depending on the field of application, sensors with large offset distance or air purge system are available. The measuring system is therefore ideally suited for inline measurements.

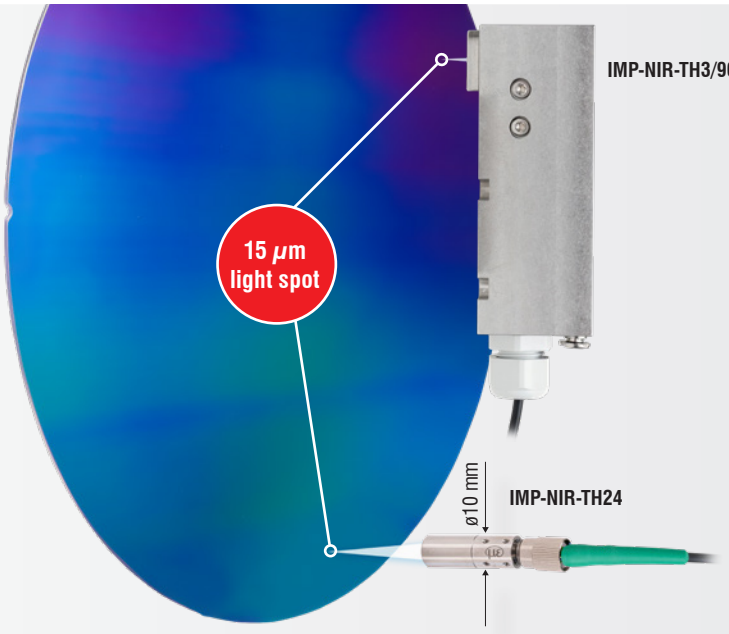
It is also available as a multipeak thickness measuring system which detects thicknesses of up to five layers, e.g., wafer thickness, air gap, films and coatings.

For thickness measurements in challenging environmental conditions such as wafer lapping, the IMS5420/IP67 controller with protection class IP67 and stainless steel housing is available.

| Doping | Element | Specific resistance |
|---|---|---|
| P- | Boron | 1-150 Ω·cm |
| N- | Phosphorus | 1-200 Ω·cm |
| P+ | Boron | 0.01-0.02 Ω·cm |
| P++ | Boron | 0.005-0.01 Ω·cm |

With multi-layer thickness measurements of silicon wafers, up to 5 layers from 50 to 1050 µm can be detected.

The measuring range for air gap measurement (with refractive index ~1) is 0.2 to 4.0 mm and for wafer thickness measurement (with refractive index ~3.82) 50 µm to 1.05 mm.



## Controller

| Model | | IMS5420-TH | IMS5420MP-TH | IMS5420IP67-TH | IMS5420IP67MP-TH |
|---|---|---|---|---|---|
| Resolution [1] | | < 1 nm | | | |
| Measuring rate | | continuously adjustable from 100 Hz to 6 kHz | | | |
| Linearity [2] | | < ±100 nm | < ±100 nm with one layer;<br>< ±200 nm for other layers | < ±100 nm | < ±100 nm with one layer;<br>< ±200 nm for other layers |
| Temperature stability | | temperature compensated, stability < ±50 ppm between +10 ... +50 °C | | | |
| Multi-peak measurement | | 1 layer | up to 5 layers | 1 layer | up to 5 layers |
| Light source | | NIR-SLED, narrow wavelength band at approx. 1100 nm; pilot laser: laser LED, wavelength 635 nm | | NIR-SLED, narrow wavelength band at approx. 1100 nm | |
| Laser class | | Class 1 according to DIN EN 60825-1: 2022-07; Pilot laser: Class 1, power (< 0.2 mW) | | Class 1 in accordance with DIN EN 60825-1: 2022-07 | |
| Supply voltage | | 24 VDC ±15 % | | | |
| Power consumption | | approx. 10 W (24 V) | | | |
| Signal input | | Sync in, trigger in, 2x encoders (A+, A-, B+, B-, index) | | - | |
| Digital interface | | Ethernet / EtherCAT / RS422 / PROFINET [3]/ EtherNet/IP [3] | | Ethernet / RS422 / PROFINET [3]/ EtherNet/IP [3] | |
| Analog output | | 4 … 20 mA / 0 ... 10 V (16 bit D/A converter) | | - | |
| Switching output | | Error1-Out, Error2-Out | | - | |
| Digital output | | sync out | | - | |
| Connection | Optical | Pluggable fiber optic cable via E2000 socket (controller); see accessories for cable lengths; bending radius: static 30 mm, dynamic 40 mm | | Pluggable optical fiber via IP9 SC socket, standard lengths 1 m and 2 m, other cable lengths on request; bending radius: static 45 mm, dynamic 60 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) | | 4-pin M12 connector for supply; RS422 connector (5-pin, M12, max. cable length 30 m); RJ45 socket for Ethernet (out) / EtherCAT (in/out) (max. cable length 100 m) | |
| Mounting | | Free-standing, DIN rail mounting | | Through bores | |
| Temperature range | Storage | -20 ... +70 °C | | | |
| | Operation | +10 ... +50 °C | | | |
| Shock (DIN EN 60068-2-27) | | 15 g / 6 ms in XY axis, 1000 shocks each | | | |
| Vibration (DIN EN 60068-2-6) | | 2 g / 20 … 500 Hz in XY axis, 10 cycles each | | | |
| Protection class (DIN EN 60529) | | IP40 | | IP67 | |
| Material | | Aluminum housing, passive cooling | | Stainless steel housing | |
| Control and indicator elements | | Multifunction button: two adjustable functions and reset to factory settings after 10 s; web interface for setup: selectable presets, freely selectable averaging, data reduction, setup management; 6 x color LEDs for intensity, range, SLED, pilot laser, status and power; pilot laser: can be switched on for sensor alignment | | Web interface for setup: selectable presets, freely selectable averaging, data reduction, setup management; power LED | |

[1] All data at constant ambient temperature (22 ±3 °C). Measuring rate 0.5 kHz, moving average over 64 values, measured on an approx. 0.8 mm thick silicon (2 sigma) polished on both sides
[2] Maximum thickness deviation when measuring on an approx. 0.8 mm thick silicon polished on both sides (n = 3.8) when passing through the measuring range
[3] Optional connection via interface module (see accessories)

## Article designations


IMS5420xx-THxx wafer thickness measuring system
(e.g. IMS5420-TH24)

| IMS5xxx | -THxx |
|---|---|
| **Controller model** | **Sensor model** |
| IMS5420 | TH24 |
| IMS5420MP | TH24(204) |
| IMS5420IP67 | TH3/90/IP68 |
| IMS5420IP67MP | |

# Sensors for wafer thickness measurements
# interferoMETER 5420

## Sensors for the IMS5420 controller for wafer thickness measurement

| Model | | IMP TH24 | IMP-NIR-TH3/90/IP68 |
|---|---|---|---|
| Working distance | | 24 mm ±3.0 mm | 3 mm |
| Operating range | | 21 ... 27 mm [1] | 1 ... 6 mm [1] |
| Measuring range (Thickness) | Silicon | 0.05 ... 1.05 mm [2] | |
| | Air | 0.2 ... 4 mm [3] | |
| Temperature stability | | temperature compensated, stability < ±50 ppm between +10 ... +50 °C | |
| Light spot diameter [4] | | 15 µm | |
| Measuring angle [5] | | ±1.5° | |
| Connection | Optical | Pluggable fiber optic cable via FC socket (sensor); see accessories for cable lengths; bending radius: static 30 mm, dynamic 40 mm | Integrated optical fiber 4 m E2000/APC (controller) |
| Mounting | | Radial clamping, mounting adapter (see accessories) | Direct fastening M4; through-bolt connection M3 |
| Temperature range | Storage | -20 ... +70 °C | |
| | Operation | +10 ... +50 °C (front side) | |
| Dimensions | | Ø10 mm x 25 mm | 94 mm x 30 mm x 39 mm |
| Protection class (DIN EN 60529) | | IP65 (front; optional IP67) [6] | IP68 |
| Vacuum | | on request UHV (cable and sensor) | - |
| Special features | | - | with integrated air purge system |
| Material | | Stainless steel | |

[1] The object being measured must be completely within the working area.
[2] All data at constant ambient temperature (22 ±3 °C). Measuring range at n=3.82 (silicon); measurable thickness depends on doping (see table)
[3] For air gap measurement between two glass plates (n~1) the measuring range is 0.2 ... 4 mm. The measuring object must be within the working distance.
[4] With a working distance of 24 mm (TH-24) or 17.5 mm (204) and 3 mm for TH-3/90/IP68
[5] Maximum sensor tilt angle that produces a usable signal on an approx. 0.8 mm thick silicon in the mid of the measuring range. The accuracy decreases when approaching the limit values.
[6] Other protection classes on request

## Connection options for the IMS5420 controller

**Controller**

**IMS5420**

**IMS5420**

**Sensor cable**

**Standard E2000/APC (controller) and FC/APC connector (sensor)**

| | |
|---|---|
| C5421-1 | Optical fiber, length 1 m |
| C5421-2 | Optical fiber, length 2 m |
| C5421-3 | Optical fiber, length 3 m |
| C5421-5 | Optical fiber, length 5 m |

Other lengths up to 20 m on request

**With protection class IP67, IP9 SC socket (controller) and FC/APC connector (sensor)**

| | |
|---|---|
| C5421/IP67-0,5 | Optical fiber, length 0.5 m |
| C5421/IP67-1 | Optical fiber, length 1 m |
| C5421/IP67-2 | Optical fiber, length 2 m |

**Sensor**

**IMP-NIR-TH3/90/IP68**

**Sensor**

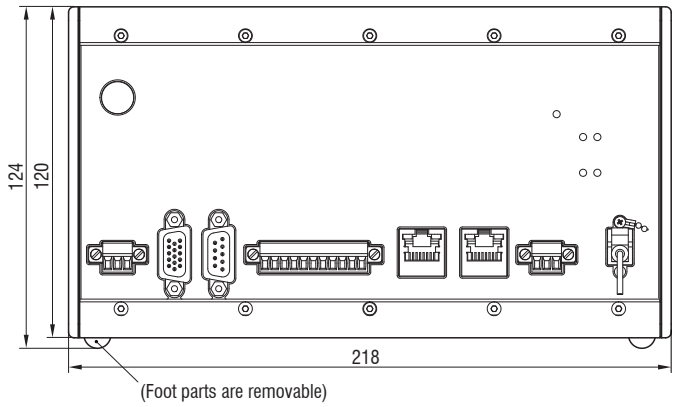
**IMP-NIR-TH24**

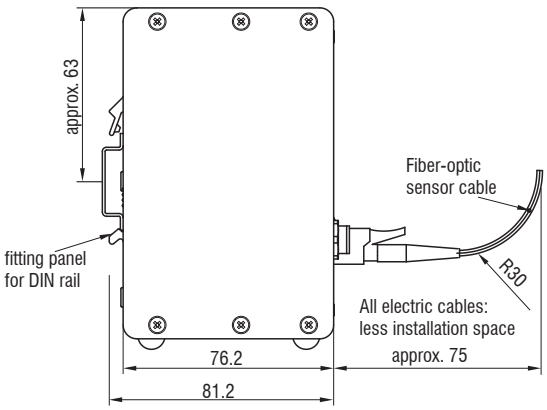
**Optional accessories**

**Adjustable mounting adapters**
**Sensor mounting adapter**

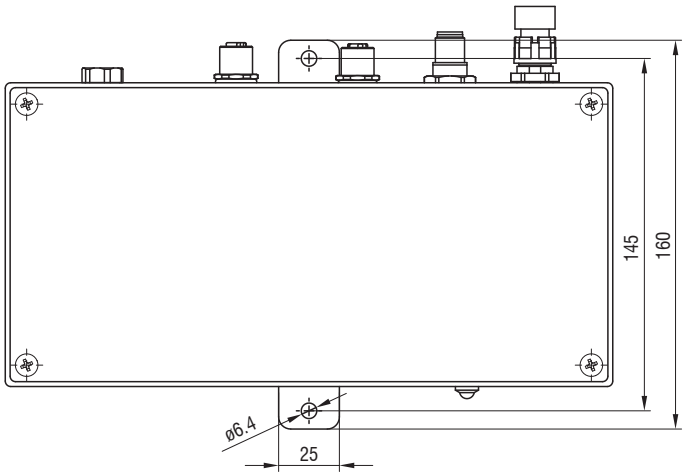
# Dimensions

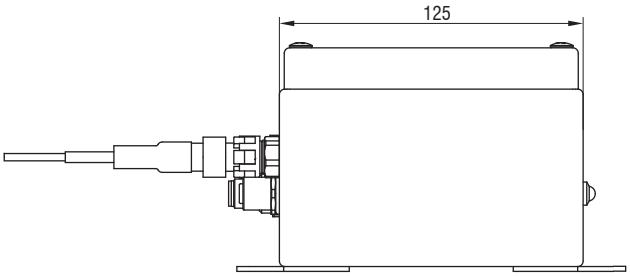
### IMC5420 Controller

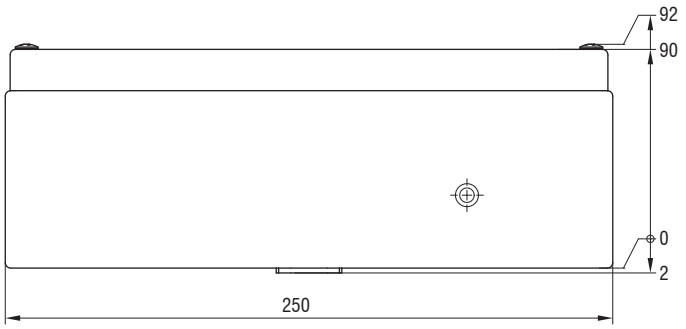



### Controller IMC5420/IP67 Controller housing made of stainless steel and protection class IP67



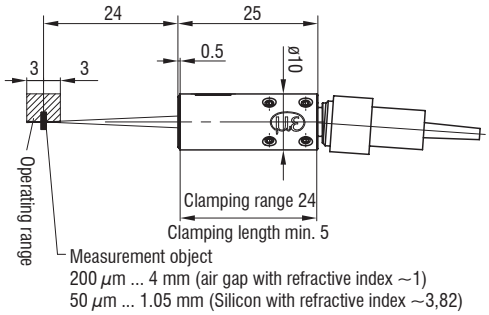



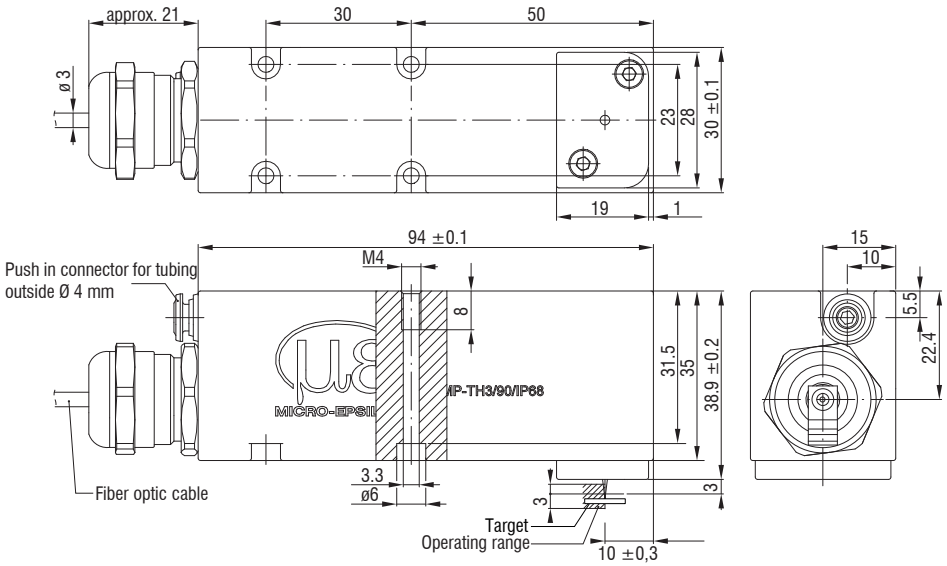
## Thickness sensors

### IMP-NIR-TH24

E2000/APC Standard connector



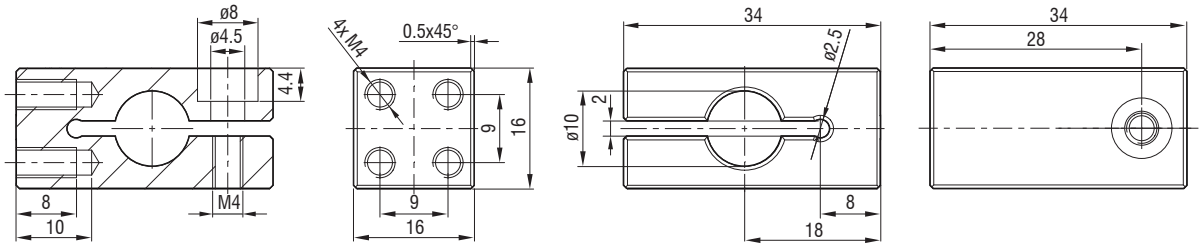

### IMP-NIR-TH3/90/IP68




# Optional accessories

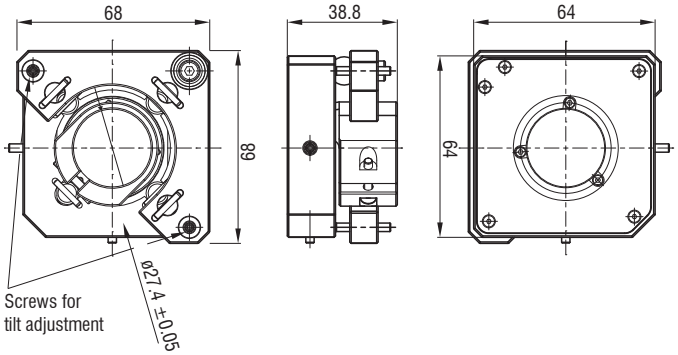
## Mounting adapter for IMP-NIR-TH24 sensors

### MA5400-10



# Optional accessories
# interferoMETER

### JMA

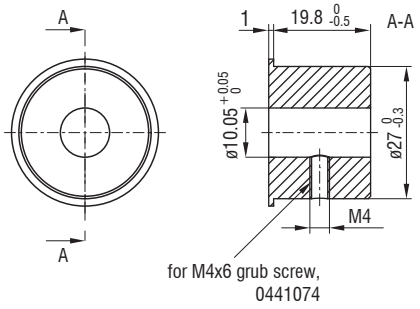



### Scope of supply

- Adjustable mounting adapter
- Sensor holder for sensors Ø10 (and Ø20 mm)
- Screwdriver for positioning
- Setup guide

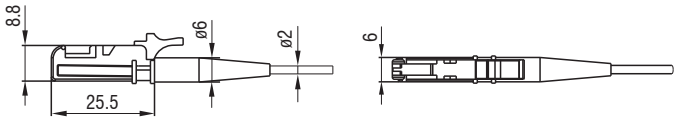
### Sensor holder

Sensor holder for JMA-10

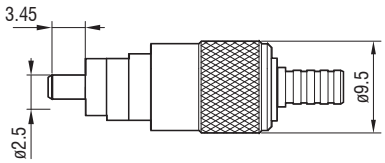



### Connector

E2000/APC Standard connector




FC/APC Standard connector




(dimensions in mm, not to scale)

## Cables

**Standard E2000/APC (controller) and FC/APC connector (sensor)**

| | |
|---|---|
| C5421-1 | Optical fiber, length 1 m |
| C5421-2 | Optical fiber, length 2 m |
| C5421-3 | Optical fiber, length 3 m |
| C5421-5 | Optical fiber, length 5 m |

Other lengths up to 20 m on request

**With protection class IP67, IP9 SC socket (controller) and FC/APC connector (sensor)**

| | |
|---|---|
| C5421/IP67-0,5 | Optical fiber, length 0.5 |
| C5421/IP67-1 | Optical fiber, length 1 |
| C5421/IP67-2 | Optical fiber, length 2 |

**Flange for vacuum feedthrough**

| | |
|---|---|
| C5405/VAC/1/CF16 | CF flange |
| C5405/VAC/1/KF16 | KF flange |

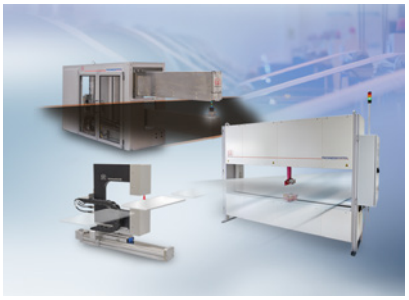
**Other accessories**

| | |
|---|---|
| SC2471-x/IF2008 | IMC5400/5600 connector cable+ IF2008/PCIE, length 3 m / 10 m |
| SC2471-x/RS422/OE | IMC5400/5600 interface cable + IF2001/USB, length 3 m / 10 m |
| IF2001/USB | RS422/USB converter |
| IF2008/PCIE | Interface card |
| IF2035/PNET | Interface module for PROFINET integration |
| IF2035-EIP | Interface module for EtherNet/IP with DIN rail housing |
| PS2020 | Power supply 24V / 2.5A |
| EC2471-3/OE | Encoder cable, 3 m |

## Sensors and Systems from Micro-Epsilon

Sensors and systems for displacement, distance and position

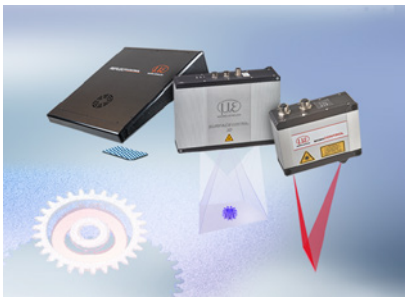
Sensors and measurement devices for non-contact temperature measurement



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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