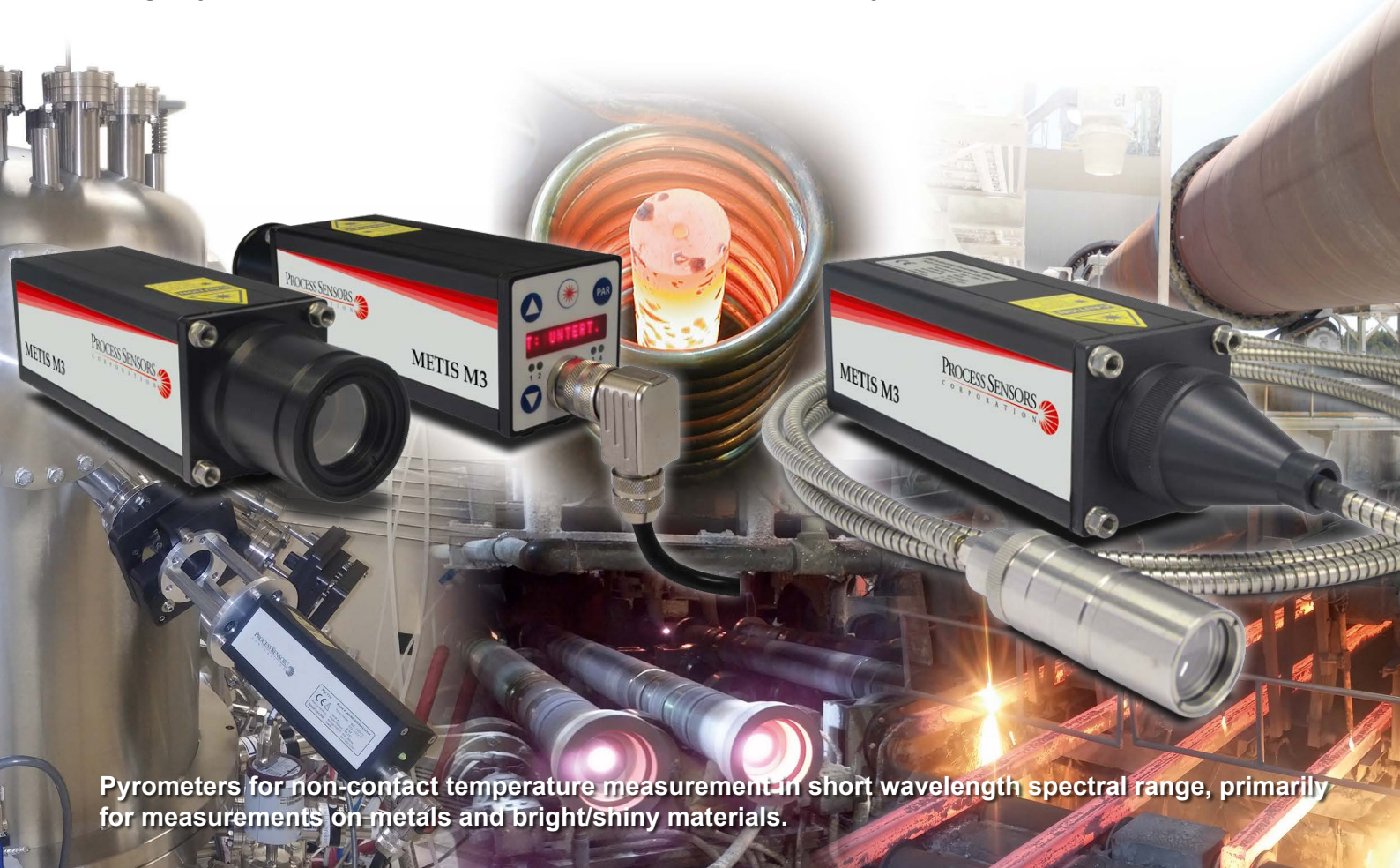


# Metis M309 / M316 / M318

Highly Advanced, Full Featured 1-color Pyrometer



Pyrometers for non-contact temperature measurement in short wavelength spectral range, primarily for measurements on metals and bright/shiny materials.

## APPLICATIONS

- Induction heating
- Steel/metals
- Metal pour streams
- Kilns
- Vacuum furnaces
- Welding
- Ceramics
- Composites
- Sintering
- Nuclear
- Research and development.

## FEATURES

- Highest accuracy and repeatability, even at high temperatures and up to 80°C (176°F) without cooling
- Wide temperature ranges between 100°C and 3300°C (212°F and 5972°F)
- Fully digital and very fast with response time <1 ms
- Different optics with extremely small spot sizes from 0.4 mm can be selected
- 10-digit matrix display for temperature and IR sensor parameters
- Push button device configuration or via software
- 2 high resolution 16 bit analog 0/4 to 20 mA outputs
- 3 versatile configurable inputs or outputs
- Analogue input for external setpoint or emissivity setting
- Laser targeting, color video or thru-lens sighting
- Serial interfaces RS232 and RS485 (switchable)
- Optional fieldbus connection: Ethernet, Profinet, or Profibus

## Technical Data

| Model  | M309   | M316   | M318   |
|--|--|--|--|
| Temperature ranges   | 550 – 1400°C<br>600 – 1600°C<br>650 – 1800°C<br>750 – 2500°C<br>900 – 3000°C *)<br>1000 – 3300°C *)  | 200 – 1300°C<br>250 – 1300°C<br>350 – 1800°C<br>400 – 2500°C<br>500 – 3300°C **) | 100 – 700°C<br>150 – 1200°C<br>180 – 1300°C                      |
| Temp. sub ranges   | Any temperature sub-range adjustable within the temperature range (minimum span 50°C)  |  |  |
| Spectral range   | 0.7–1.1 µm<br>*) 0.87 µm   | 1.45–1.8 µm<br>**) 1.4 µm  | 1.65–2.1 µm  |
| Detector   | Silicon  | InGaAs   | InGaAs   |
| Response time $t_{90}$   | < 1 ms (with dynamical adaptation at low signal levels), adjustable up to 10 s   |  |  |
| Exposure time  | < 0.5 ms   |  |  |
| Uncertainty<br>( $\epsilon = 1$ , $t_{90} = 1$ s, $T_A = 23^\circ\text{C}$ )   | Full-scale temp. up to 2500°C: 0.25% of reading in °C+1K<br>Full-scale temp. above 2500°C: 0.5% of reading in °C   | 0.4% of reading in °C + 1 K or 2°C (the higher value is valid)                   | 0.2% of reading in °C + 1 K or 1.6°C (the higher value is valid) |
| Repeatability<br>( $\epsilon = 1$ , $t_{90} = 1$ s, $T_A = 23^\circ\text{C}$ ) | 0.1% of reading in °C + 1 K  |  |  |
| Temperature coefficient<br>(deviations from 23°C)                              | From 10 to 60°C: 0.02%/K<br>From 0 to 10°C and 60 to 80°C: 0.04%/K   | 10 to 60°C: 0.02%/K<br>0 to 10°C: 0.04%/K  |  |
| Emissivity $\epsilon$  | 0.050–1.200 (corresponds 5–120% in 0.1% steps)   |  |  |
| Transmission   | 0.050–1.000 (corresponds 5–100% in 0.1% steps)   |  |  |
| Fill factor spot size  | 0.050–1.000 (corresponds 5–100% in 0.1% steps)   |  |  |
| Analog output signal   | 2 configurable analog outputs 0 or 4–20 mA, max. load: 500 Ω. Resolution 0.0015% of the adjusted temperature (16 Bit). Outputs can be set individually, inside or outside the measuring range.   |  |  |
| Serial interface   | RS232 (max. 115 kBd) or RS485 (max. 921 kBd), switchable. Resolution 0.1°C or 0.1°F  |  |  |
| 3 configurable<br>Inputs / outputs   | <ul style="list-style-type: none"> <li>■ Digital inputs (max. 3 inputs, protected against reverse polarity): laser targeting light on/off, clearing of peak picker, load pyrometer configuration, trigger input for start / stop of measured value recording.</li> <li>■ Digital outputs (max. 3 outputs, max. 50 mA, protected against short circuit): limit switch, exceeding the beginning of temperature range (for material recognition), device ready after self-test, device over-temperature, signal strength too low.</li> <li>■ Analog input (0–20 mA, protected against reverse polarity and incorrect connection): analog adjustment of emissivity, or measuring distance (devices with motorized focus).</li> </ul> |  |  |
| Ethernet   | Ethernet (100 Mbit) TCIP data protocol   |  |  |
| Display  | 10-digit LED display (5 mm high) for temperature or settings of IR sensor parameters<br>Resolution 0.1°C or 0.1°F  |  |  |
| Parameter settings   | Push buttons on the device, serial interface, PC software <i>SensorTools</i> or via self-compiled communication program: Emissivity, transmission, fill factor, temperature sub range, settings for peak picker, device address, baud rate, response time, selecting analog outputs 0/4–20 mA, interface RS232/RS485 (selection on the device only), °C/°F, language (English / German), measuring distance with motorized focus optics.   |  |  |
| Power requirement  | 24 V DC (18–30 V DC), max. 6 VA; protected against reverse polarity  |  |  |
| Isolation  | Voltage supply, analog outputs and serial interface are galvanically isolated from each other  |  |  |
| Sightings<br>(optional)  | <ul style="list-style-type: none"> <li>■ Thru-the-lens sighting with adjustable attenuation filter for eye protection of bright targets</li> <li>■ Laser targeting light (red, <math>\lambda=650</math> nm, <math>P &lt; 1</math> mW, class II to IEC 60825-1)</li> <li>■ High dynamic color CCD camera, field of view: ca. 3.6% x 2.7% of measuring distance<br/>output signal: FBAS signal ca. 1 V<sub>pp</sub>, 75 Ω, CCIR, NTSC / PAL switchable<br/>Resolution: NTSC: 720 x 480 pixel; PAL: 720 x 576 pixel; frame rate: NTSC: 60 Hz, PAL: 50 Hz</li> </ul>   |  |  |
| Optics (optional)  | Manual focusable or optional motorized focus or fixed focus optics   |  |  |
| Ambient temperature  | 0 to 80°C, focusable lens assembly: -20 to 250°C (-4 to 482°F) (The laser targeting light is deactivated at a device temperature from 60°C, the camera module from 55°C to prevent its overheating)  |  |  |
| Storage temperature  | -20 to 85°C (-4 to 185°F)  |  |  |
| Relative humidity  | No condensing conditions   |  |  |
| Housing / protection class   | Aluminum, IP65 to DIN 40 050 with connector  |  |  |
| Weight   | 650 g (1 lb. 6.9 oz.)  |  |  |
| CE label   | According to EU directives for electromagnetic immunity  |  |  |

## Reference Numbers

Metis M309 / M316 / M318 Specify each with temperature range, sighting method and optics

**Note:** *SensorTools* software is included in scope of delivery,

Connection cables are not included in scope of delivery and have to be ordered separately.



## Power Up and Measure Temperature

In principle the M3 series only requires connection to a power supply to start a measurement.


Metis M3 pyrometers are stand alone, self contained IR thermometers with direct outputs for easy integration in nearly all application environments.

The short-wave spectral ranges of the various models are specially designed for accurate temperature measurements of metals and other bright, reflective materials.

The models M309, M316 and M318 differ in their spectral ranges and associated in their ranges.

The material to be measured largely determines which spectral range of the pyrometer should be selected. For metal measurements, the shortest possible spectral range for a precise measurement is advantageous. Due to technical reasons the beginning of a temperature range may be limited, to a higher starting temperature therefore a model must be selected with a slightly higher spectral range, e.g. longer wavelength.

## Features



**Proven Sighting:**

- More precise laser target marking
- Enhanced view finder
- New high dynamic color camera module

**Clear Device Operation:**

- Large, bright 10 digit display
- All measurement settings directly on the device
- LEDs for the display of active limit outputs
- Simple setting of the measuring distance with motor focus

**Fast, Accurate Outputs:**

- Serial high-speed interface up to 921 kBaud
- 2 high resolution 16 bit analog 0/4 to 20mA outputs

**A Variety of Models:**

- Motorized focus optics
- Optics with manual adjustment of focus
- Fixed focus optics for smallest spot sizes
- Fiber optic version with small optical heads

**Harsh Environmental Conditions:**

- Advanced ambient temperature up to 80°C
- Fiber optic models up to 250°C (optics and fiber optic cable)
- With Sapphire protection window (devices with integrated optics)


**Additional Equipment:**

- Fieldbus interfaces: Profinet, Profibus


## Sighting Method Selection

Sighting is used to pinpoint the location of the measured target.


- **Devices with integrated optics:** Through lens view finder, laser targeting light or color camera module
- **Devices with fiber optics:** Laser targeting light



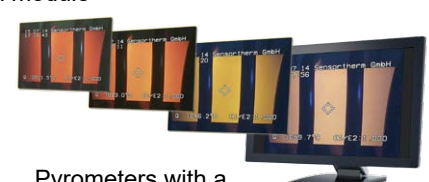
The **view finder** provides upright imagery so that the target under measurement can be viewed visually. A circular reticle shows the measuring spot. Recommended for glowing measurement objects, as a red laser is difficult to detect. For devices with measuring range above 1800°C, the eyepiece can be darkened for eye protection.



**Laser targeting** uses a red laser dot showing the center of the measuring field. At the focus point, the laser dot is the smallest and provides the sharpest image, so that the measuring distance for the smallest spot size can be easily determined.



**Pyrometers with a color camera module** provide a composite video output that can be connected to a video monitor or via video grabber to a PC. The pyrometer is aligned via a circular reticle on the TV screen and is recommended for remote observation of glowing hot targets or viewing down sight tubes. The camera provides automatic, highly dynamic adjustment of the picture brightness. Only available with optics OV09-D1/-D2 (340–4000 mm).



Targeting light on / off

## Intelligent Installation Possibilities

### Serial Interface RS232 or RS485 (Selectable)

Via serial interface, the pyrometer communicates with other digital devices such as a PLC, computer with free *SensorTools* software or a self-written communication software program. Measured values can be recorded and device parameters can be set directly on the device, via *SensorTools* software or serial interface RS232 or RS485.

- RS232 for short distances to the PC. Transfer rates of max. 115 kB
- RS485 for long distance connection. Max. of 921 kB, use in bus configuration.

An interface converter RS232 or RS485 to USB (accessory) allows for easy connection to a PC.

### 2 Analog Outputs

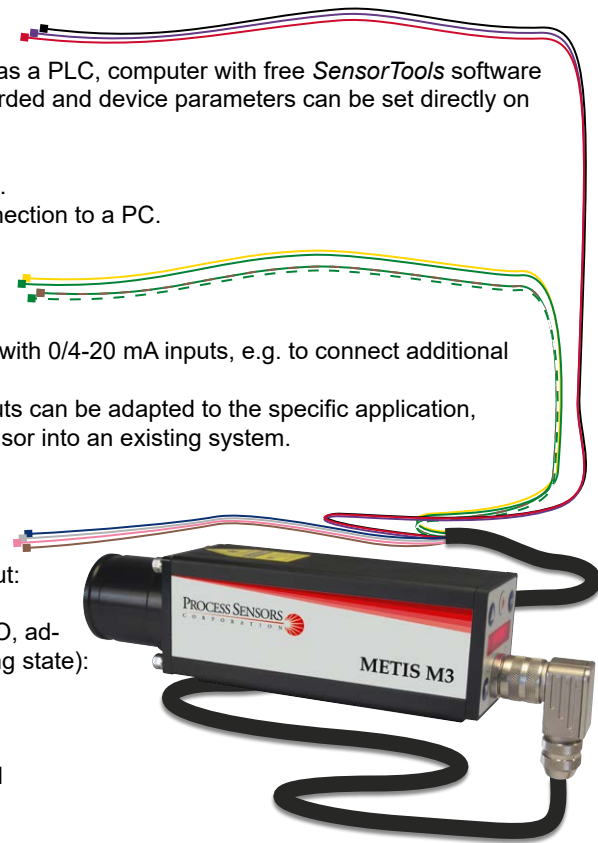
Each of the high-resolution analog outputs can be used for independent devices with 0/4-20 mA inputs, e.g. to connect additional temperature displays or other devices.

By “scalable” it is meant that the temperature range assigned to the analog outputs can be adapted to the specific application, allowing reduction or expansion of the range as needed when integrating the sensor into an existing system.

### 3 Configurable Inputs / Outputs

3 pyrometer connectors are available as digital input, digital output or analog input:

- Each **digital output** switches a low voltage output active or inactive (NC or NO, adjustable) with several selectable states (Rear panel LEDs indicate the switching state):
  - Limit switch for decreasing or exceeding a certain temperature threshold
  - Material detection (exceeding the beginning of temperature range)
  - Device state (device is ready for operation)
  - Over temperature, if the maximum allowed device temperature is exceeded
  - Signal strength is too low (dirty window alarm)
- Each **digital input** can be connected to an external contact closure and configured for a function:
  - Laser targeting light on and off
  - Manually delete (reset) of maximum value storage
  - Start / stop recording of measured values via the *SensorTools* software
  - Up to 7 pyrometer configurations can be saved and retrieved
- Using the **analog input** (available soon and to install via firmware update) a current can be fed for
  - Analog specification of the emissivity



### Ambient Temperature

The devices of the M3 series are designed with a very small temperature coefficient for ambient temperatures up to 80°C. Thus, many new applications can be entered and solved without external cooling equipment. To maintain the accuracy, M318 models should be used only up to 60°C ambient temperature due to the low initial temperature measurement.

### Material Properties

The entry options for material settings have been simplified:

- **Emissivity:** Each material has a max. emissivity of 1.00 which can be set, an adjustment up to 1.20 can be used. The emissivity adjustment above 1.00 allows for temperature corrections due to higher background reflection.
- **Transmittance:** For measurements through windows signal losses occur by transmission of the window. This value is included with each window and can be entered easily.

### Maximum Value Storage (Peak Picker)

The maximum value storage is a useful feature when the measured object appears only briefly in the pyrometer's field of view, or to capture peak temperatures while measuring a series of objects. The hottest value of the measured object is stored and disregards temperature valleys, e.g. steel surfaces with scale in hot rolling mill application. The maximum value can be reset automatically or manually or by a selectable clear time.

### Fieldbus Systems

Optional pyrometer control can be done with

- Profinet or Profibus

## Device Designs / Optics

The following tables show the optical data of the different device types. For reliable measurement the measurement object should be at least as large as the spot size.

Values in the optics tables illustrate the focused measuring distances and respective spot sizes. The spot size diameter for distances not given in the table can be interpolated.

The pyrometer can be used at distances other than its' focal distance, however the spot size is generally larger and therefore the target size must be larger.

**Focusable optics (manual or motorized focus)** can be continuously adjusted within the minimum and maximum specified measurement distance, providing the smallest possible spot size diameter at that focus distance.

**Fixed focus optics** are factory-set to a certain measurement distance reaching there the smallest possible spot size. The robust and precise design provides minimal axial deviations between mechanical and optical axis. This alignment is maintained even the device is rotated, useful in measurements through long sighting tubes.

The pyrometer must be properly aligned to the measurement object to detect the temperature correctly. In the focus point of the lens (focal distance) the spot size diameter is smallest. Measurements out of the focus distance are also possible (in front of or behind the focus distance) to determine the average temperature of a bigger spot.

**Integrated Optics** (manually adjusted or motorized focus)

- with sighting method laser targeting light or view finder

| Optics<br>(focusable)                      | Measuring<br>distance<br>a [mm] | Spot size M [mm] |   | Aperture Ø<br>D [mm]            |
|--|---------------------------------|------------------|---|---------------------------------|
|  |                                 | M318 (100–700°C) | M309 (all ranges)<br>M316 (all ranges)<br>M318 (150–1200°C<br>180–1300°C) |                                 |
|  | adjustable                      |                  |   |                                 |
| OM09-A0                                    | from                            | 130 mm           | 0.6 mm  | 16 mm<br>(FSC≤1400°C)           |
|  | ...                             | 160 mm           | 0.8 mm  |                                 |
|  | to                              | 200 mm           | 1.1 mm  |                                 |
| OM09-B0                                    | from                            | 190 mm           | 0.8 mm  | 8 mm<br>(FSC>1400°C)            |
|  | ...                             | 300 mm           | 1.4 mm  |                                 |
|  | to                              | 420 mm           | 2 mm  |                                 |
| OM09-C0                                    | from                            | 340 mm           | 1.3 mm  | FSC = Full scale<br>temperature |
|  |                                 | 500 mm           | 2.3 mm  |                                 |
|  |                                 | 700 mm           | 3.3 mm  |                                 |
|  | ...                             | 1000 mm          | 4.5 mm  |                                 |
|  |                                 | 2000 mm          | 10.5 mm   |                                 |
|  | to                              | 4000 mm          | 18 mm   |                                 |
| - with sighting method color camera module |                                 |                  |   |                                 |
| M309: OV09-D1<br>M316/18: OV09-D2          | from                            | 340 mm           | 1.8 mm  | FSC = Full scale<br>temperature |
|  |                                 | 700 mm           | 3.8 mm  |                                 |
|  | ...                             | 1000 mm          | 5.6 mm  |                                 |
|  |                                 | 2000 mm          | 10 mm   |                                 |
|  | to                              | 4000 mm          | 19 mm   |                                 |

**Fiber Optics** with sighting method laser targeting light (25 mm outside diameter or miniature 12 mm)

|            |             |                |                |       |
|------------|-------------|----------------|----------------|-------|
| Standard:  | from 75 mm  | 0.6 mm         | 0.45 mm        | 13 mm |
| OL25-G0    | ... 130 mm  | 1.3 mm         | 1 mm           |       |
|            | to 180 mm   | 1.8 mm         | 1.4 mm         |       |
| Standard:  | from 170 mm | 1.6 mm         | 1 mm           | 7 mm  |
|            | 500 mm      | 5 mm           | 3.2 mm         |       |
|            | 700 mm      | 7.5 mm         | 4.8 mm         |       |
|            | ... 1000 mm | 11 mm          | 7 mm           |       |
|            | 2000 mm     | 23 mm          | 15 mm          |       |
| Miniature: | to 4500 mm  | 52 mm          | 34 mm          |       |
|            | from 100 mm | 1.5 mm         | 0.9 mm         | 7 mm  |
|            | ... 350 mm  | 6.2 mm         | 3.7 mm         |       |
| OL12-E0    | to 600 mm   | 10.9 mm        | 6 mm           |       |
|            |             | Fiber Ø 0.4 mm | Fiber Ø 0.2 mm |       |

**Integrated Fixed Focus Optics** with laser targeting light or view finder

|       |   |       |
|-------|---|-------|
| OM89  | Fixed focus optics for smallest spot sizes and long measuring distances available on request. Distance ratio up to 900:1 (tube lengths 89 and 160 mm) | 27 mm |
| OM160 |   |       |



### Manual Focus

1. Turn counterclockwise
2. Pull / push in
3. Lock turn clockwise

### Motor focus

- Via push buttons
- Via PC software



### Standard: OL25

1. Turn counterclockwise
2. Pull / push in
3. Lock turn clockwise

### Miniature: OL12



## Model Selection Table - M309 / M316 / M318

| 1    | 2 | 3    | 4 | 5    | 6 | 7 | 8 | 9 | 10 | 11 | 12 |   |   |   |   |   |   |   |
|------|---|------|---|------|---|---|---|---|----|----|----|---|---|---|---|---|---|---|
| M3xx | - | xxxx | - | xxxx | - | x | - | x | -  | xx | -  | x | - | x | - | x | - | x |

|           |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|-----------|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|
| <b>1</b>  | <b>Model, Detector, Spectral Range:</b><br>M309 = Silicon, 0.7 – 1.1 $\mu\text{m}$<br>M316 = InGaAs, 1.45 – 1.8 $\mu\text{m}$<br>M318 = ext. InGaAs, 1.65 – 2.1 $\mu\text{m}$  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| <b>2</b>  | <b>Zero Scale Temperature:</b><br>e.g. 0650 = 650°C  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| <b>3</b>  | <b>Full Scale Temperature:</b><br>e.g. 1800 = 1800°C   |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| <b>4</b>  | <b>Sighting Method:</b><br>1 = Laser targeting<br>2 = Through lens sighting<br>4 = Color camera module   |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| <b>5</b>  | <b>Serial Interface:</b><br>3 = Profinet internally<br>4 = Profibus internally<br>5 = Switchable RS485 / RS232<br>6 = Ethernet IP / TCIP   |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| <b>6</b>  | <b>Optics:</b><br>1 = Fixed focus<br>2 = Manual focusable optics<br>3 = Fiber Ø 0.2 mm (ref. brochure)<br>4 = Fiber Ø 0.4 mm (ref. brochure)<br>8 = Motorized focusable optics<br>B = Heavy-duty stainless steel braided hose assy for 0.2 mm fiber with OL25<br>C = Heavy-duty stainless steel braided hose assy for 0.4 mm fiber with OL25 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| <b>7</b>  | <b>Response Time:</b><br>13 = 1 ms, adjustable to 10 s   |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| <b>8</b>  | <b>Version:</b><br>0 = Standard (12 pin connector, display, push buttons, 3 digital inputs / outputs)  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| <b>9</b>  | <b>Display:</b><br>4 = With display (12 pin connector)   |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| <b>10</b> | <b>Analog Output:</b><br>2 = Two 0/4-20 mA analog outputs, standard  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| <b>11</b> | <b>Digital Input / Output:</b><br>3 = 3 digital inputs / outputs / 1 analog input 0–20 mA (12 pin connector)   |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| <b>12</b> | <b>Optics Type:</b><br>A, B, C, D, E, G, or H (Refer to product brochure)  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

**Example:** M309-0650-1800-1-5-2-13-0-4-2-3-A

This model refers to: Model M309, temperature range of 650-1800°C, laser targeting, RS232 & RS485 communication, manual focus optics, 1 ms response time, std. version sensor, onboard temperature display, two 0/4-20 mA outputs, 3 digital inputs/outputs, optics type A.

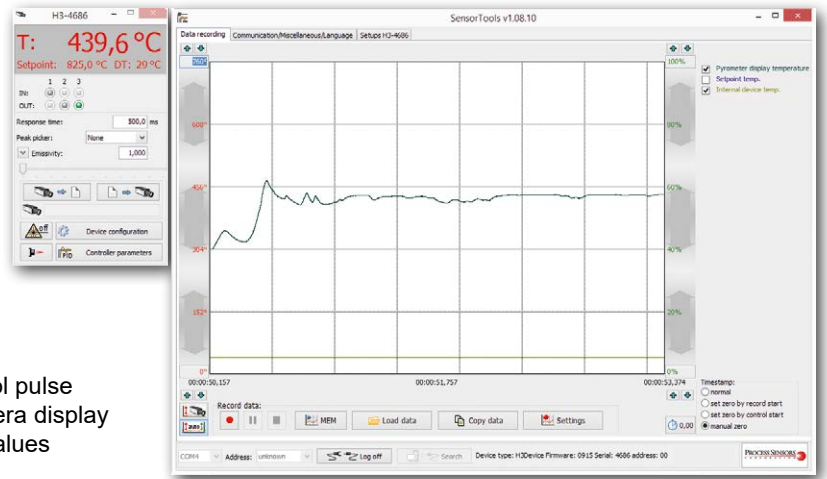


## SensorTools Software

- Measurement display
- Measured value recording
- Processing the results
- Display devices inside temperature
- Changing pyrometer parameters

Program functions:

- Change pyrometer parameters
- Playback of recorded data
- Adapted graphics mode to computer performance
- Export measured values in csv files
- Record interval setting for acceptable data size.
- Back time recording of measured values after control pulse
- Laser targeting light switching / configuring the camera display
- External start and stop of the recording measured values (via control input on the pyrometer)
- Create a service file with settings for remote diagnostics



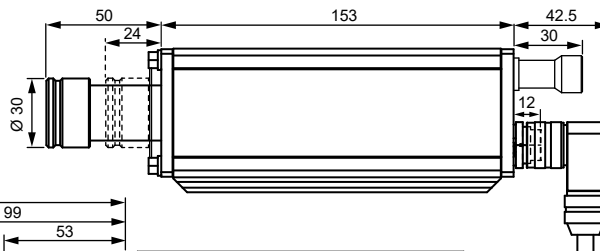
## Recommended Accessories

|                     |   |
|---------------------|---|
| HA20                | Ball and socket swivel mount for sensor alignment   |
| HA22                | Ball and socket swivel mount for water cooling housing  |
| HA10                | Mounting bracket  |
| HA12                | Mounting bracket for water cooling housing  |
| HA14 / HA15         | Adjustable mounting bracket for fiber optics OL12 / OL25  |
| KG10                | Aluminum water cooling housing  |
| KG20                | Aluminum cooling plate  |
| BL10 / BL11         | Air purge for devices with motor focus / manually focusable optics  |
| BL13 / BL14         | Air purge for fiber optics OL12 / OL25  |
| AL11 / AL43         | Connection cable, 14-wire (available in 5 m steps) with right angle connector / straight connector        |
| AU11 / AU43         | Connection cable, 14-wire, interface converter RS-232⇔USB with right angle connector / straight connector |
| AV11 / AV43         | Connection cable, 14-wire, interface converter RS-485⇔USB with right angle connector / straight connector |
| AK50                | Connection cable for camera module (Limosa-plug⇔Cinch-plug, available in 5 m steps)                       |
| AK54                | Profinet network cable, Ethernet CAT6 (available in 5-m-Schritten)  |
| AK72 / 73 / 76 / 81 | Profibus connection cable (input cable / output cable / devices connection cable / terminating resistor)  |
| IF00                | LED digital indicator for remote adjustment of IR sensor parameters                                       |
| 950-004             | Power supply 24 V DC  |

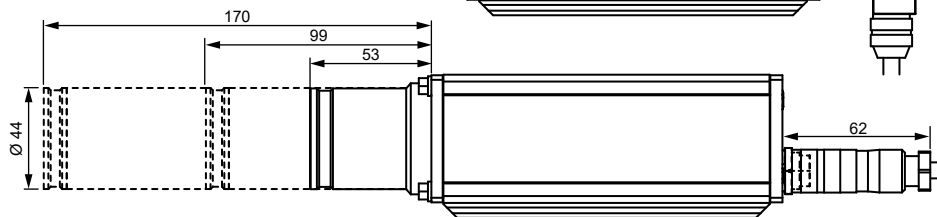


## Dimensions

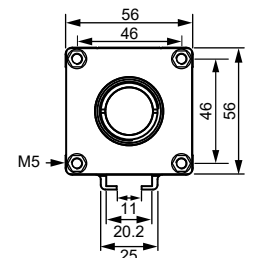
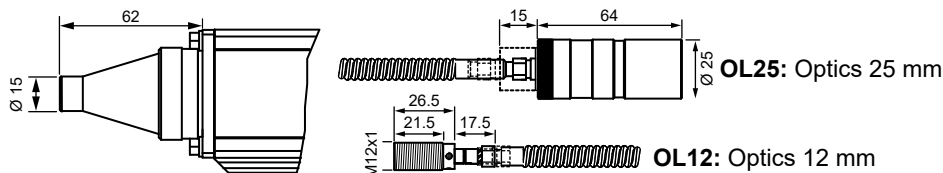
### Manual focusable optics



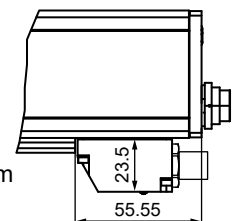
### Motorized focus optics Fixed focus optics



### Fiber optic devices, focusable optics



### Profibus / Profinet



Process Sensors reserves the right to make changes in scope of technical progress or further developments.

Metis-M309\_M316\_M318 (12/11/23)

