Metis H311 / H322

Highly Advanced, Ultra-Fast, Full Featured 2-Color Pyrometers

The Advantages and benefits for using an ultra-fast self-contained 2-color pyrometer:

■ **Automatic compensation for viewing through dirty windows, dust and partial smoke**
■ **Compensates for changes in target emissivity**
■ **Measures smaller target than sensor's field of view (FOV)**
■ **Unaffected by moving targets within FOV**

APPLICATIONS

■ **Laser applications (laser hardening, laser cutting, laser welding, soldering, etc.)**
■ **R&D**
■ **Turbine Blades**
■ **Combustion engines**
■ **Medical**
■ **Plasma measurements**
■ **Airbag testing**
■ **Wafer control**
■ **Explosion processes**

FEATURES

■ **Fully digital and very fast with response time < 80 µs for more than 25,000 measurements per second**
■ **Temperature ranges between 350°C and 3300°C (662°F and 5972°F)**
■ **Highest accuracy and repeatability**
■ **Small spot sizes from 0.9 mm**
■ **Laser, color video or thru-lens sighting**
■ **Dirty window programmable alarm**
■ **10-digit matrix display for temperature and IR sensor parameters**
■ **Configuration via push button device or supplied software**
■ **2 high resolution 16 bit analog 0/4 to 20 mA outputs**
■ **3 versatile configurable inputs or outputs**
■ **Analog input for external emissivity setting**
■ **Serial RS-485 high-speed interface**
■ **Optional fieldbus connection: Profinet or Profibus**

Technical Data

Model	H311	H322
Temperature ranges	600 – 1100°C (1112 – 2012°F) 650 – 1300°C (1202 – 2372°F) 750 – 1400°C (1382 – 2552°F) 900 – 1800°C (1652 – 3272°F) 1000 – 2000°C (1832 – 3632°F) 1100 – 2200°C (2012 – 3992°F) 1300 – 2500°C (2372 – 4532°F) 1600 – 3300°C (2912 – 5972°F) *)	350 – 800°C (662 – 1472°F) 400 – 1200°C (752 – 2192°F) 500 – 1300°C (932 – 2372°F) 550 – 1400°C (1022 – 2552°F) 700 – 2300°C (1292 – 4172°F) 1000 – 2500°C (1832 – 4532°F) 1300 – 3000°C (2372 – 5432°F) **)
Temp. sub ranges	Any temperature sub-range adjustable within the temperature range (minimum span 50°C)	
Spectral range	Channel 1: 0.93–1.1 µm / Channel 2: 0.75–0.93 µm *) Channel 1: 0.99 µm / Channel 2: 0.78 µm	Channel 1: 1.65–1.8 µm / Channel 2: 1.45–1.65 µm **) Channel 1: 1.64 µm / Channel 2: 1.4 µm
Detector	2 x Silicon	2 x InGaAs
Response time t_{90}	< 80 µs, adjustable up to 10 s	
Exposure time	< 40 µs	
Uncertainty ($\varepsilon = 1$, $t_{90} = 1s$, $T_A = 23°C$)	0.5% of measured value in °C	
Repeatability ($\varepsilon = 1$, $t_{90} = 1s$, $T_A = 23°C$)	0.2% of measured value in °C + 1 K	
Slope / ratio	0.800–1.200	
Emissivity ε	0.050–1.200 (per channel, corresponds 5–120% in 0.1% steps)	
Transmittance	0.050–1.000 (per channel, corresponds 5–100% in 0.1% steps)	
Fill factor spot size	0.050–1.000 (per channel, corresponds 5–100% in 0.1% steps)	
Analog output	2 configurable analog outputs 0 or 4–20 mA, max. load: 500 Ω. Resolution 0.0015% of the adjusted temperature (16 Bit). User selectable: 2-color temperature, 1-color channel 1 or 1-color channel 2 temperature. Outputs can be set individually, inside or outside the temperature range.	
Serial interface	RS-485 (max. 921.6 kBd), resolution 0.1°C or 0.1°F	
Configurable inputs / outputs	12-pin connector model: 3 ports, configurable as digital input or output. 17-pin connector model: 4 digital inputs, 2 digital outputs, 1 analog input ■ Inputs (protected against reverse polarity): laser targeting light on/off, clear peak picker, trigger input for start / stop recording of measured values, load pyrometer configurations, controller start. 0–10 V analog input (only with 17-pin connector models) for analog setpoint preset for PID controller. ■ Outputs (12-pin models: max. 50 mA, protected against short circuit; 17-pin models: max. 100 mA): limit switch, exceeding the beginning of temperature range (for material recognition), device ready after self-test, device over-temperature, signal strength too low.	
Peak picker	Automatic hold mode or manual time settings to clear (reset)	
Display	Only 12-pin connector models: 10-digit LED display (5 mm high) for temperature or settings of IR sensor parameters. Resolution 0.1°C or 0.1°F	
Parameter settings	12-pin connector models: via push buttons on the device, serial interface or software *SensorTools*. 17-pin connector models: only via serial interface / software *SensorTools*. Settings: Slope/ratio, switch-off level for measurement, switch-off level for dirty window alarm, emissivity, transmittance, fill factor, temperature sub range, peak picker settings, device address, baud rate, response time, analog outputs 0 or 4–20 mA, Temperature unit °C/°F, language (English / German).	
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 (optional)	■ Thru-lens sighting with adjustable attenuation filter for eye protection from bright targets ■ Laser targeting light (red, λ=650 nm, P<1 mW, class II to IEC 60825-1) ■ High dynamic color CCD camera, field of view: ca. 3.6% x 2.7% of measuring distance output signal: FBAS signal ca. 1 V_{PP}, 75 Ω, CCIR, NTSC / PAL switchable Resolution: NTSC: 720 x 480 Pixels; PAL: 720 x 576 Pixels; frame rate: NTSC: 60 Hz, PAL: 50 Hz	
Optics	Manual focusable optics (integrated or as fiber optic version)	
Ambient temperature	Operation: 0 to 60°C (32 to 140°F), fiber optic and optics on optics side: -20 to 250°C (-4 to 482°F) Storage: -20 to 85°C (-4 to 185°F) (The camera module is deactivated at a device temperature from 55°C to prevent its overheating)	
Relative humidity	No condensing conditions	
Housing / protection class	Aluminum, IP65 to DIN 40 050 with connector	
Weight	650 g	
CE label	According to EU directives for electromagnetic immunity	

Reference Numbers

Metis H311   Specify with temperature range, 12 pin or 17 pin model, sighting method and optics
Metis H322   Specify with temperature range, 12 pin or 17 pin model, 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.

25,000 Measurements per Second

The H3 Series stands out everywhere average pyrometers come up short. With an exposure time of only 40 µs the pyrometers measure 25,000 times per second. The response time is 80 µs. The response time or exposure time is the time it takes until the actual temperature from the measuring object is captured from the pyrometer and converted to an output signal. This makes the H3 Series fast enough to perform a laser power control in near real-time and respond to complex workpiece geometries.

Metis H3 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.

Features

Proven Sighting:
- More precise laser targeting
- Enhanced view finder
- New high dynamic color camera module

Clear Device Operation:
- Large, bright 10 digit display
- All settings directly on the device
- Display of active alarm limit outputs

Two Model Versions available:
- Standard models with quick adjustable optics
- Optical fiber models for ambient temperatures up to 250°C on the optics

Harsh Environmental Conditions:
- With Sapphire protection window (devices with integrated optics)

Fast, Accurate Outputs:
- Serial high-speed interface with 921 kBaud
- 2 high resolution 16 bit analog 0/4 to 20 mA outputs

Comprehensive Settings

■ For Material Properties

- **Emissivity slope:** The emissivity ratio can be adjusted when measuring objects whose emissivity is different at the two wavelengths (e.g. bright, non-oxidized metal surfaces). Targets with the same emissivity at the two wavelengths can be measured without adjustment of the slope/ratio setting.
- **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 can be adjusted based on the window material.
- **Fill factor measurement field:** When measuring on a cold background, the measurement object can be smaller than the spot size. At this point one can enter the percentage of the pyrometer's spot size that is filled.

■ Measuring Mode

- 2-color mode
- Switchable in 1-color modes (channel 1 or 2) for use as a standard radiation pyrometer.
- Simultaneous output of 2-color and 1-color temperature to the 2 analog outputs

■ Dirty Window Alarm

A signal strength monitoring function detects the degree of contamination of the pyrometer's optics or viewing window, and identifies interferences (dust...) in the IR sensor's sight path and triggers an alarm if activated.

■ Switch-off Level

The switch-off level defines a signal level at which the temperature measurement is switched off, due to low level signal strength (e.g. if too much of the pyrometer's field of view is blocked).

■ 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.

Intelligent Installation Possibilities

■ Serial RS-485 Interface

The pyrometer communicates with other digital devices such as a PLC, computer with free *SensorTools* software or self-written communication software program via serial interface.
Measured values can be recorded and device parameters can be set directly on the device. Long distance connections with high transmission speeds of up to 921 kBd can be realized via RS-485. The devices can be addressed and used in bus configuration. An interface converter, RS-485 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 scalable 0 or 4-20 mA set inputs, e.g. to connect additional temperature displays, chart recorders 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** a 0–20 mA current can be fed (0-10 V voltage at 17-pin models) for
  • Analog specification of emissivity slope or emissivity in 1-color mode
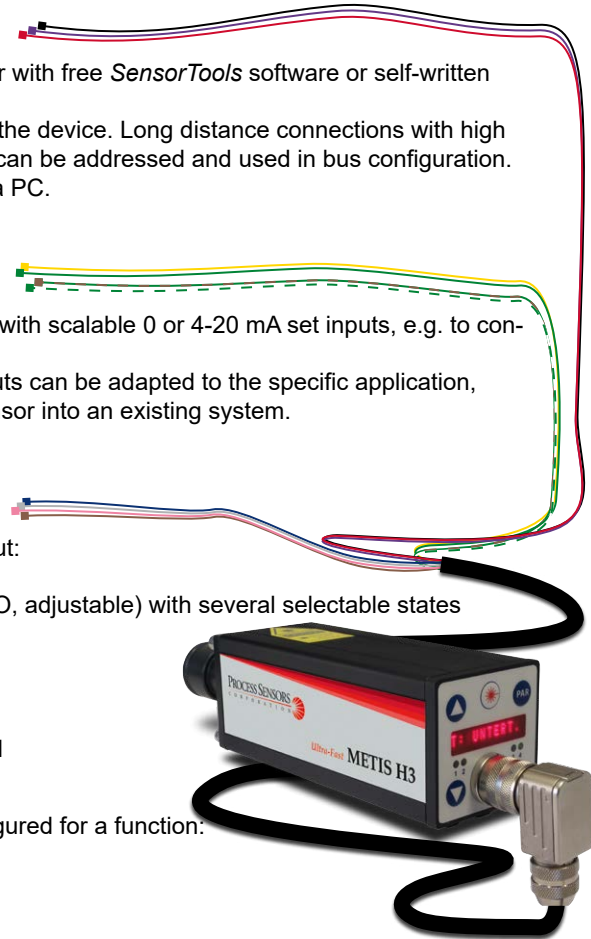

Sighting Method Selection

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

■ **Devices with integrated optics:** Thru-lens view finder, laser targeting light or color camera module

■ **Devices with fiber optics:** Laser targeting light
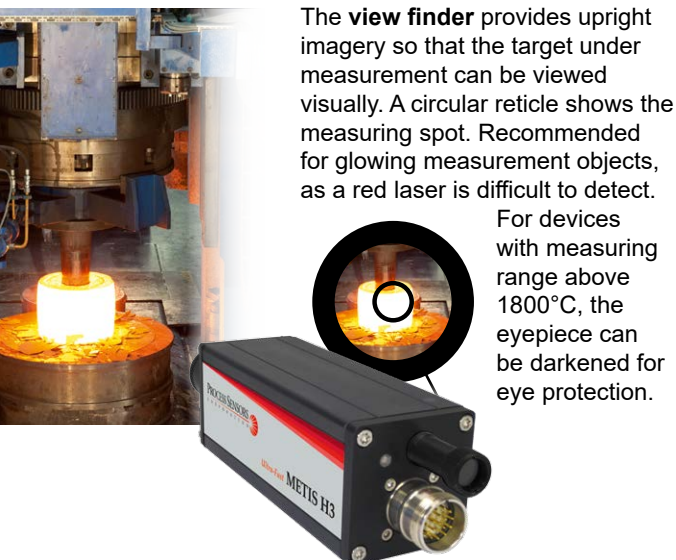
The **view finder** provides upright imagery so that the target under measurement can be viewed visually. A circular reticle shows the measuring spot. Recommended for glowing measurement objects, as a red laser is difficult to detect.
For devices with measuring range above 1800°C, the eyepiece can be darkened for eye protection.
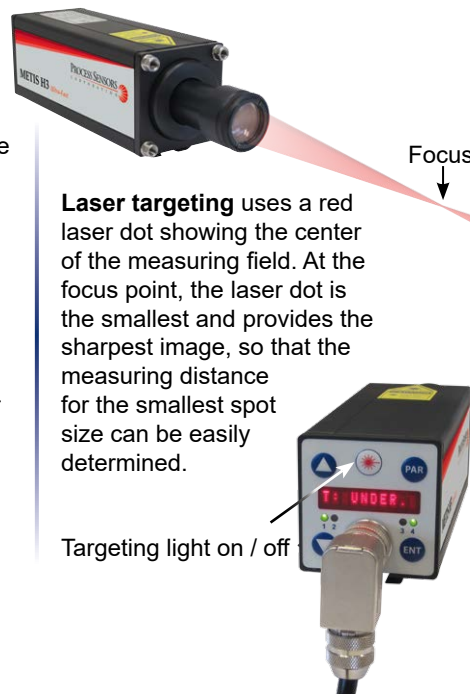
Laser targeting uses a red laser dot showing the center of the measuring field. At the focus point, the laser dot is the smallest and provides the sharpest image, so that the measuring distance for the smallest spot size can be easily determined.

Focus

Targeting light on / off

Pyrometers with a **color camera module** provide a composite video output that can be connected to a video monitor or PC with a converter. 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.

Device Designs / Optics

Process Sensors 2-color pyrometers are equipped with two separate silicon or indium-gallium-arsenide detectors, which differ from sandwich detectors with very high signal strengths on both channels, ensuring high stability and accuracy.

Specially designed lenses compensate the color aberration at the two measurement wavelengths and ensure that the focal distances of the two wavelengths are collimating at the same position.

In comparison to radiation pyrometers, 2-color pyrometers measure in two spectral ranges simultaneously (at two wavelengths) and determine the temperature by forming the radiation ratio (quotient).

In this method it is not necessary to know the emissivity of the target material or fill the sensor's spot size with the target.

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 a shorter or longer distance than the focus distance) to determine the average temperature of a bigger spot.

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.
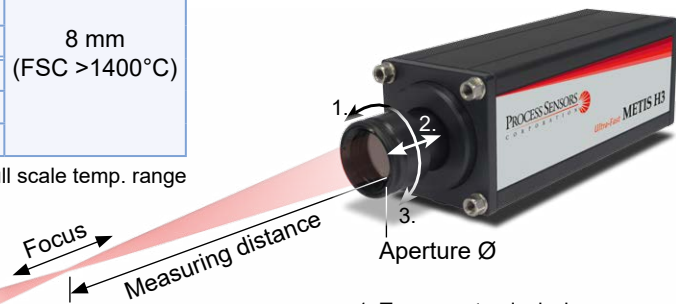
Focusable Optics

Optics	Measuring distance a [mm]	Spot size M [mm] H311 H322 <1200°C	Spot size M [mm] H311 H322 ≥1200°C	Aperture Ø D [mm]
H311: OQ11-**A1** H322: OQ22-**A2**	340 mm	1.5 mm	0.9 mm	16 mm (FSC≤1400°C) 8 mm (FSC >1400°C)
	500 mm	3 mm	1.7 mm	
	750 mm	4 mm	2 mm	
	1000 mm	5.6 mm	2.8 mm	
	2000 mm	10 mm	4.6 mm	
	3000 mm	17 mm	8.8 mm	
H311: OQ11-**F1** H322: OQ22-**F2**	1000 mm	5.6 mm	3 mm	
	5000 mm	26 mm	14.5 mm	
	10000 mm	51 mm	29 mm	

FSC = Full scale temp. range
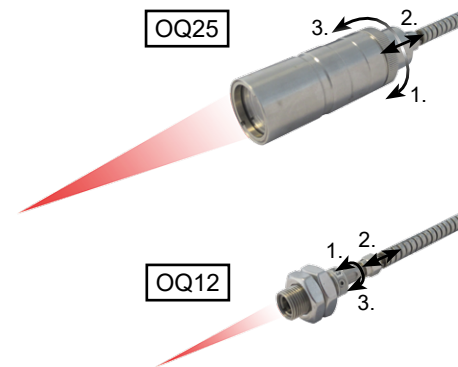
Focusable optics

can be continuously adjusted within the minimum and maximum specified measurement distance, providing the smallest possible spot size diameter at that focus distance.

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

Focusable Fiber Optics (Standard 25 mm outside diameter or Miniature 12 mm)

Optics	Measuring distance a [mm]	Spot size M [mm] H311 H322 <1200°C	Spot size M [mm] H311 H322 ≥1200°C	Aperture Ø D [mm]
Standard: H311: OQ25-**B1** H322: OQ25-**B2**	240 mm	2 mm	1 mm	13 mm
	500 mm	3.7 mm	2.5 mm	
	750 mm	5.6 mm	3.8 mm	
	1000 mm	7.7 mm	5 mm	
	2000 mm	15.4 mm	10 mm	
	3000 mm	23 mm	15 mm	
Miniature: H311: OQ12-**C0** H322: OQ12-**C0**	120 mm	2.2 mm	1.2 mm	7 mm
	250 mm	5 mm	2.5 mm	
	500 mm	12 mm	6 mm	
		Fiber Ø 0.4 mm	Fiber Ø 0.2 mm	

OQ25

OQ12

Typical Applications

Laser cladding

Laser hardening

Laser hardening
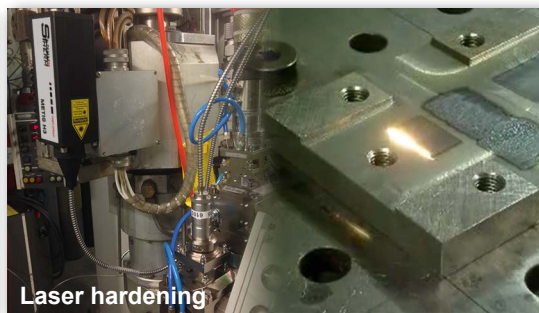
Model Selection Table - H311 / H322

| 1	2	3	4	5	6	7	8	9	10	11	12
H3xx	- xxxx	- xxxx	- x	- x	- x	- xx	- x	- x	- x	- x	- x

1   Model, Detector, Spectral Range:
H311 = Silicon, 0.7 – 1.1 µm
H322 = InGaAs, 1.45 – 1.8 µm

2   Zero Scale Temperature:
e.g. 0600 = 600°C

3   Full Scale Temperature:
e.g. 1100 = 1100°C

4   Sighting Method:
1 = Laser targeting
2 = Thru-lens view finder
4 = Color camera module

5   Serial Interface:
2 = RS485

6   Optics:
2 = Focusable optics manual
3 = Fiber Ø 0.2 mm (refer to brochure)
4 = Fiber Ø 0.4 mm (refer to brochure)
8 = Focusable optics motorized
B = Heavy-duty stainless steel braided hose assy for 0.2 mm
fiber with OQ25
C = Heavy-duty stainless steel braided hose assy for 0.4 mm
fiber with OQ25

7   Response Time:
81 = 80 µs, adjustable to 10 s

8   Version:
0 = Standard (12 pin connector, display, push buttons,
3 digital inputs / outputs)
5 = 17 pin connector (no display), 4 digital inputs,
2 digital output, (no push button)

9   Display:
4 = With display (12 pin connector)
0 = Without display (17 pin connector)

10   Analog Output:
2 = Two 0/4-20 mA analog outputs, standard

11   Digital Input / Output:
3 = 12 pin connector:
3 digital inputs / outputs /
1 analog input 0–20 mA
4 = 17 pin connector (no display):
4 digital inputs + 1 analog input +
2 digital outputs

12   Optics Type:
A,B or C
(Refer to product brochure)
Example for M311: A = OQ11-**A**1

Example: H311-0600-1100-1-2-2-81-0-4-2-3-A
This model refers to: Model H311, temperature range of 600-1100°C, laser targeting, RS485 communication, manual focus optics, 80 µs response time, std. version sensor, onboard temperature display,
two 0/4-20 mA outputs, 3 digital inputs/outputs, optics type A.

SensorTools Software

- Measured values of all channels:
  2-color temperature + 1-color temperatures,
  at the same time, graphical and numerical
- Measured value recording
- Processing the results
- Display internal devices temperature
- Changing pyrometer parameters
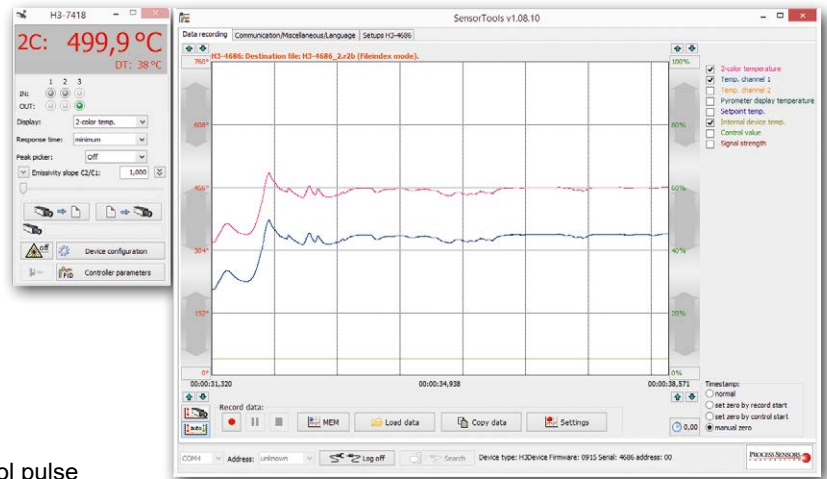
Program functions:

- 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 on and off / 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
HA10	Mounting bracket
HA14 / HA15	Adjustable mounting bracket for fiber optics OQ25 / OQ12
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 OQ12 / OQ25
AL11 / AL43	Connection cable (available in 5 m steps) with 12-pin right angle connector / straight connector
AS51 / AS53	Connection cable (available in 5 m steps) with 17-pin right angle connector / straight connector
AV11 / AV43	Connection cable, interface converter RS-485⇔USB with 12-pin right angle connector / straight connector
AS61 / AS63	Connection cable, interface converter RS-485⇔USB with 17-pin right angle connector / straight connector
AK50	Connection cable for camera module (Limosa-plug ⇔ Cinch-plug, available in 5 m steps)
IF0000	LED digital indicator for remote adjustment of IR sensor parameters
950-004	Power supply 24 V DC
950-060A-LCD	Plug & Play enclosure, with power supply and interface for setup parameters

Dimensions

Dimensions in mm

Manual focusable optics, version with 12-pin connector
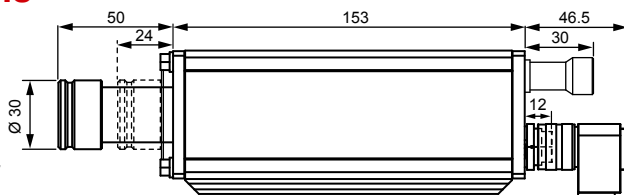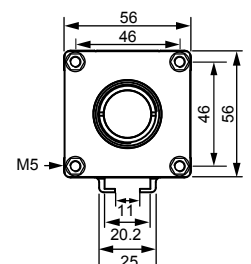
version with 17-pin connector

Fiber optic devices, focusable optics
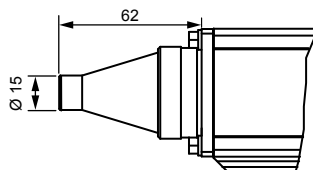
OQ12: Optics 12 mm   **OQ25:** Optics 25 mm

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

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