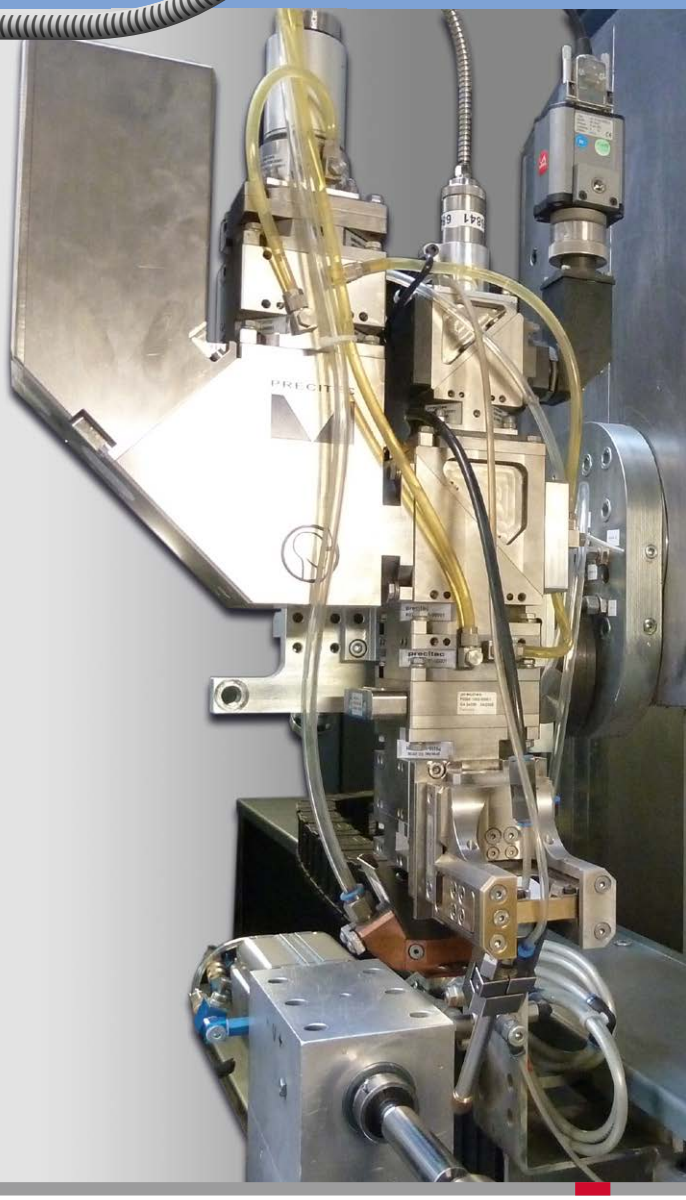
Digital High-Speed Pyrometers for Laser Power Control

Temperature-controlled process control

PID

HIGH-SPEED



Application:

- Laser hardening
- Laser cladding
- Heat conduction welding
- Additive manufacturing
- Plastic transmission welding
- Plastic bonding

- Stand-alone system in a very compact unit
  for temperature measurement and laser control
- Fully autonomous operation
- Easy integration into existing systems
- Adjustable optics
  - for easy coaxial measurement through laser optics
  - for flexible external measurements
- Built-in temperature adjustment without removing the optics

Laser Power Under Control

High speed pyrometers of Sensortherm with an integrated controller measure the temperature and thus control a given temperature level at the same time. The controlled laser power ensures a consistent quality of the processed material, even where changes of laser or material direction would cause discontinuities in temperatures.

A H3 pyrometer has a response time of only 40 µs at 1-color radiation pyrometers and 80 µs with ratio pyrometers, making it fast enough to perform a laser power control and respond to complex workpiece geometries.

Example: Laser cladding

Stand-Alone System

Metis H3 pyrometers are self contained, after preset they work stand-alone without the necessity of a PC. With direct inputs and outputs an easy integration in almost all application environments is guaranteed.

- **Easy connection to an existing control system:** via digital inputs and outputs or interface commands, parameter files of typically values once found, can be stored permanently and loaded at any time in the required process
- **Profinet connection:** Interface commands enable easy connection to Profinet
- **External control:** controller start / stop, external definition of setpoint or selection of stored process parameters via a system control, output of status signals

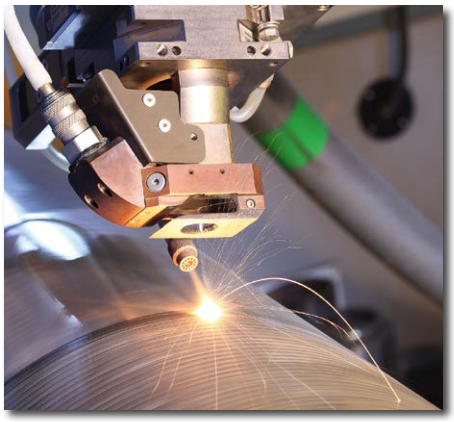
Online and Evaluation Software

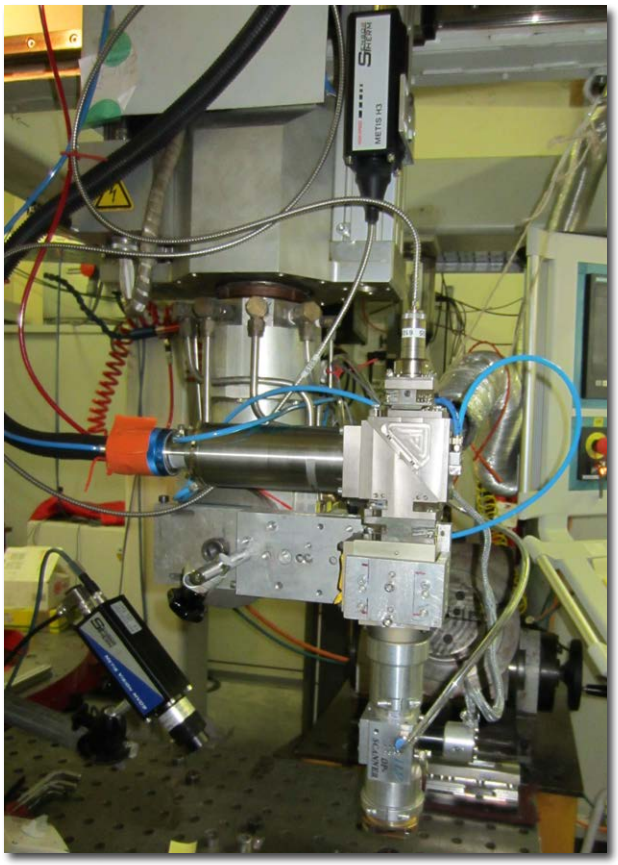
All devices are delivered with software. This provides a clean interface for configuration and programming of the control task and is ideally suited for “Online” sequence tracing, process recording and documentation as well as for the subsequent evaluation of the processes.

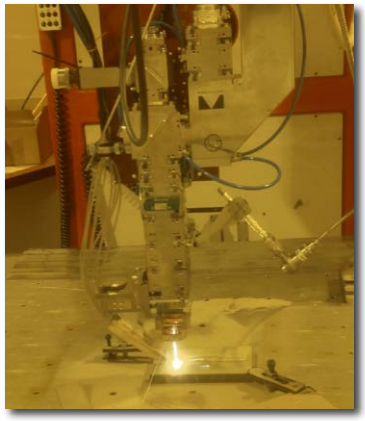
Materials

Metis H3 pyrometers are available as radiation or ratio pyrometers, models for coupling into a laser head are equipped with optical fiber and a small optics. With the different spectral ranges of models almost all materials can be measured.

Typical Application Hardening and Cladding







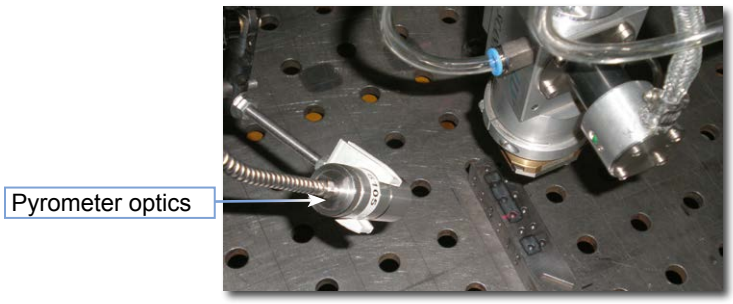
Measurement Methods / Pyrometer Coupling

According to the application the pyrometer optics can be aligned colinear or non-colinear to the object to be processed.

Off-Axis

In the non-collinear orientation, the pyrometer optics is mounted adjacent to the laser tool, aligned to the laser spot.

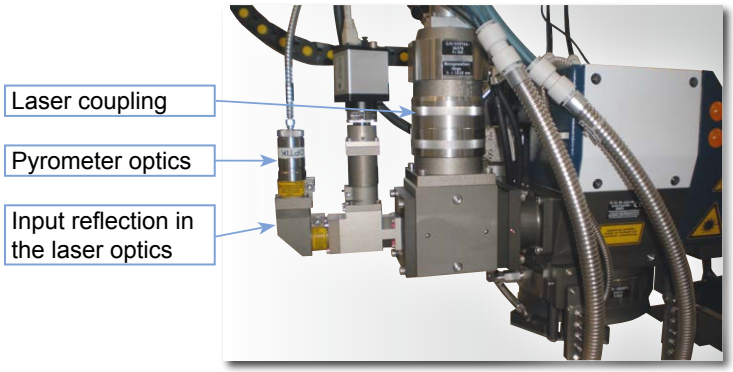
Advantages:
- Easy installation and integration



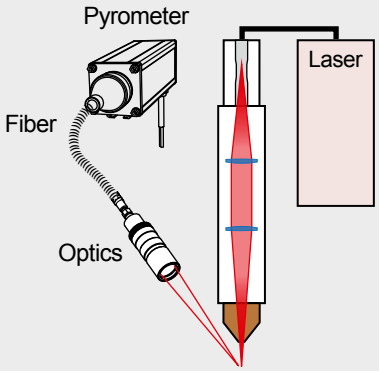
On-Axis

In the collinear alignment, the pyrometer optics is coupled to the laser head, then the measurement always takes place at the same location the laser is.

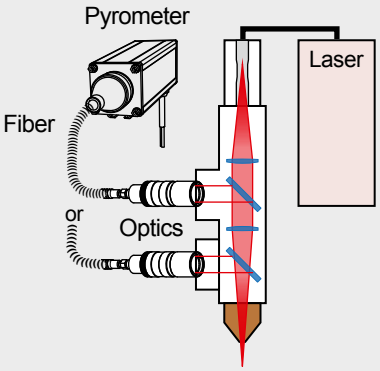
Advantages:
- Closed system without lens contamination
- On-Axis-couplings are also possible in laser heads with mirror and rotary scanners
- Measurement of complex workpiece geometries



Off-Axis

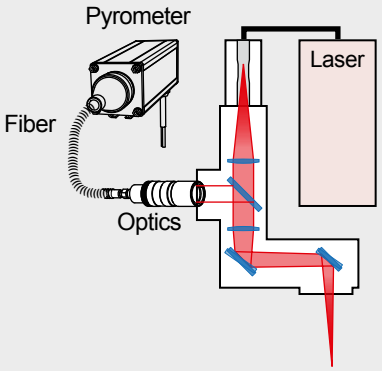


On-Axis (coaxial)



On-Axis

with mirror scanner or rotary scanner



Data Evaluation

The PC software enables to set the parameters required for the process. These values are written directly into the pyrometer and thus ensuring a fast and error-free integration into the measurement process.

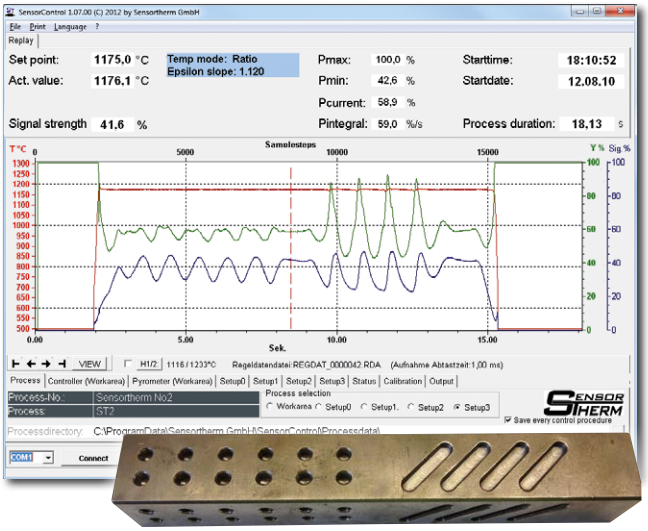
- Multiple parameter sets can be stored and activated also without software via an external control system.

If the pyrometer via the serial port stays connected to the software, the current measurement and control process can be

- Visually traced
- Recorded and documented

Further possibilities of the software:

- On-site calibration

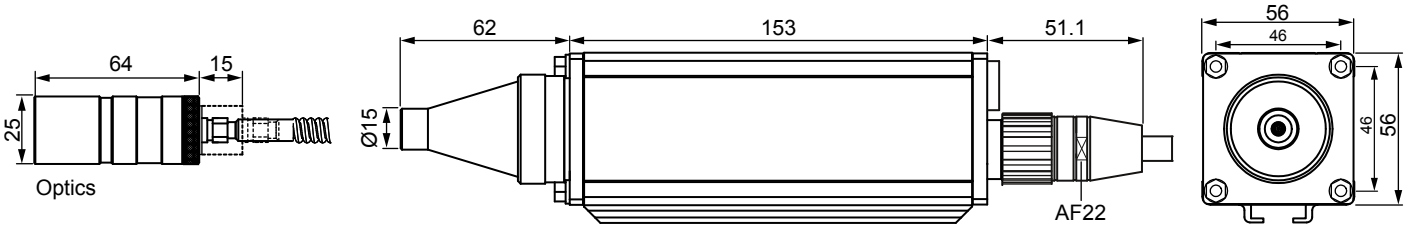


Technical Data

Model	Radiation Pyrometers (1-color) H316	H318	Ratio Pyrometer (2-color) H322
Applications	Hardening, heat conduction welding, annealing	Aluminum applications, annealing, processes with plastics, adhesive processes	Hardening, heat conduction welding, annealing, cladding
Temperature ranges	250 – 800°C 500 – 1600°C 300 – 900°C 600 – 1800°C 350 – 1100°C 700 – 2500°C 400 – 1200°C	120 – 520°C 180 – 800°C	350–800°C 700–2300°C 400–1200°C 1000–2500°C 500–1300°C 1300–3000°C **) 550–1400°C
Spectral range	1.45–1.8 µm	1.65–2.1 µm	Channel 1: 1.45–1.65 µm / Ch. 2: 1.65–1.8 µm **) Channel 1: 1.4 µm / Channel 2: 1.64 µm
Response time t_{90}	< 40 µs (exposure time < 20 µs)		< 80 µs (exposure time < 40 µs)
Uncertainty	0.5% of measured value in °C + 1K (ε = 1, t_{90} = 1s, T_A = 23°C)		
Repeatability	0.2% of measured value in °C + 1K (ε = 1, t_{90} = 1s, T_A = 23°C)		
Emissivity	Adjustable 0.050–1.200		0.800–1.200 (emissivity slope)
Analog output signal	2 configurable analog outputs for actual value and manipulated variable, resolution 0.0015% of the adjusted temperature (16 Bit)		
Serial interface	RS485 (max. 921 kBd), resolution 0.1°C or 0.1°F		
Configurable inputs / outputs (4 digital inputs, 2 digital outputs, 1 analog input)	■ Digital inputs: laser targeting light on/off, trigger input for start / stop of measured value recording, load pyrometer configuration, start controller ■ Digital outputs: limit switch, exceeding the beginning of temperature range, device ready after self-test, device over-temperature, controller active, control within limits, control finished,		Additionally: signal strength too low ■ Analog input (0–10 V): analog adjustment of setpoint or emissivity setpoint or emissivity slope
Parameter settings	Device parameters via interface (PC software, Profinet or customer supplied communications program)		
Power requirement	24 V DC (18–30 V DC), max. 12 VA; protected against reverse polarity		
Isolation	Voltage supply, analog outputs and serial interface are galvanically isolated from each other		
Sighting	Laser targeting light (red, λ=650 nm, P<1 mW, class II to IEC 60825-1)		
Ambient temperature	On optics side: -20–250°C, on pyrometer's side: 0–80°C, storage: -20–85°C		
Relative humidity	No condensing conditions		
Weight	1000 g (device with 2.5 m optical fiber and optics)		
CE label	According to EU directives for electromagnetic immunity		

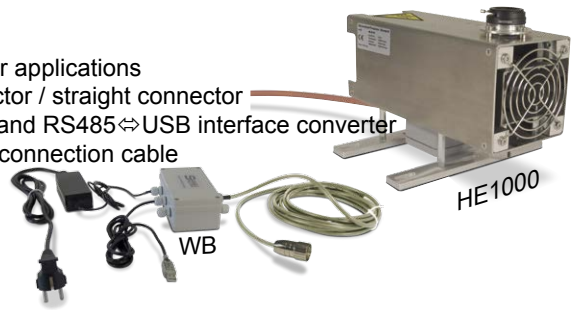
Dimensions

Dimensions in mm



Accessories

HE1000	Small thermal radiation source for the quick check of pyrometers in laser applications
AS51 / AS53	Connection cable (available in 5 m steps) with 17-pin right angle connector / straight connector
AS61 / AS63	Connection cable with 17-pin right angle connector / straight connector and RS485⇔USB interface converter
WB73-2-1-05	Wiring-Box: ready-made connection kit with desktop power supply, 5 m connection cable with 17-pin straight connector and RS485⇔USB interface converter
PN10	Profinet adapter for connection of up to 5 pyrometers via RS485 to a superordinate control system



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

Sensortherm-Datasheet_LaserPowerControl (Feb. 08, 2016)

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