Product Overview

Infrared measuring technology for industrial applications

Pyrometers

- 1-color pyrometers
- 2-color pyrometers
- Transfer Standard Pyrometers

System Components

- Temperature displays
- PID program controller
- Line scanner

Calibration Sources

- High temperature
- Mid temperature
- Temperature sources

Software

- Adjustment
- Evaluation
- Calibration / Adjustment

Measuring, controlling, calibration – Complete IR systems

Device Designs

◼ Model Variety in Robust Industrial Housings

CAPELLA

Handheld pyrometers in shock-proof aluminum housing.

METIS / METIS M3 / H3 / DIADEM

Stationary devices in a cuboid aluminum housing with integrated optics or as optical fiber version.

HELIOS H4

Stationary devices with motorized focus fiber optics.

METIS HD

Heavy-duty stainless steel measuring system for M3 and H3 pyrometers. For measurements under harshest conditions in the steel industry.

SIRIUS / POLARIS

Compact stainless steel housing with thread.

◼ Optics Options for the Adapted Object Focusing

Manually adjustable optics are integrated in the pyrometer or designed as fiber optics. They are adjusted to the required measuring distance or focus distance by by moving the optics tube.

Motorized focus optics are available integrated into the pyrometer or as a separate fiber optic version. The focus distance can be read out and adjusted via input.
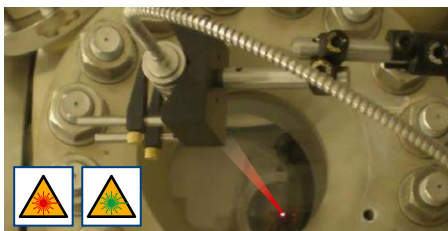
Fixed focus optics have a fixed set focus distance.

◼ Sighting Methods for Simple Measurement Object Detection

The **laser targeting light** shows a red or green light spot indicating the focus distance and center of the measuring field. At the focus point of the optics the light spot is the smallest..

The **through lens sighting** provides upright imagery so that the target under measurement can be viewed visually. For stationary devices, the focus point is found on the sharp adjusted eyepiece, handhelds show the spot size.

The **color camera** can be used to connect a TV or monitor. A target circle in the TV picture is used for alignment. With the automatic, highly dynamic image brightness adjustment, the camera is also ideal for process monitoring.

◼ Inner Values for Best Performance

The **optics lenses** are optimized according to the infrared range to be measured in the various applications of the industry. 2-color pyrometers use specially calculated achromatic lenses to compensate for color errors at the 2 measurement wavelengths.

Detectors convert the infrared energy radiated by the measuring object into a photocurrent. Depending on the application high quality Si, InGaAs, extended InGaAs or PbSe detectors are used.

Especially our 2-color pyrometers are equipped with two separate InGaAs or Si detectors for accurate wavelength approximation and maximum signal strength.

The measuring signal is **digitized directly** behind the detector and then digitally linearized (Sensortherm development). Measurement parameters, such as the emissivity can thus be calculated digitally in the micro controller without additional errors, instead of being corrected with analog compensating currents, that are subjects to error.
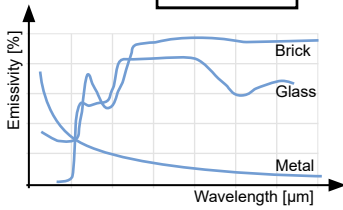
Detector

AD converter

Micro controller
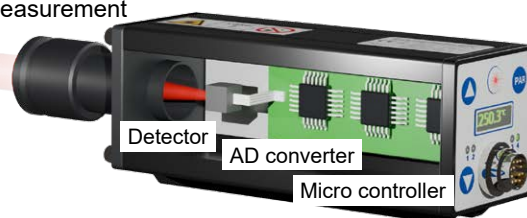
Therefore very high measurement speeds and signal outputs (response time) are reached with high accuracy, both on the serial interface and the analog output.

Criteria selecting a Sensortherm Pyrometer

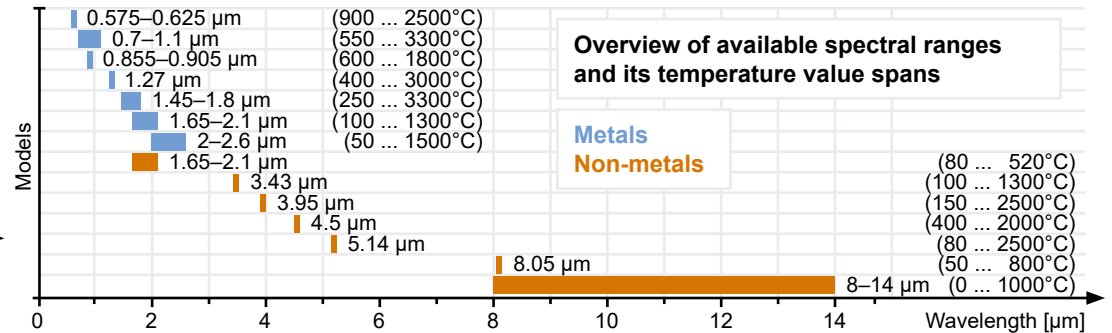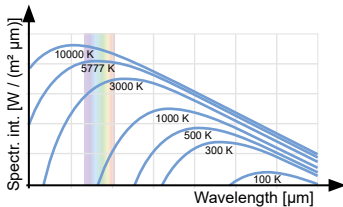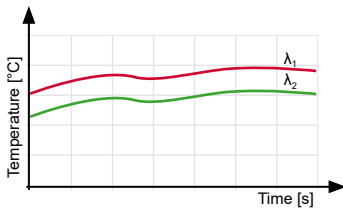**Measuring object**

1095 °C

Measuring Temperature

The pyrometer measuring range is selected according to the required temperature of the object.

Material / Spectral Range

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.

Overview of available spectral ranges and its temperature value spans

Metals
Non-metals

| Spectral range	Temperature span
0.575–0.625 μm	(900 ... 2500°C)
0.7–1.1 μm	(550 ... 3300°C)
0.855–0.905 μm	(600 ... 1800°C)
1.27 μm	(400 ... 3000°C)
1.45–1.8 μm	(250 ... 3300°C)
1.65–2.1 μm	(100 ... 1300°C)
2–2.6 μm	(50 ... 1500°C)
1.65–2.1 μm	
3.43 μm	(80 ... 520°C)
3.95 μm	(100 ... 1300°C)
4.5 μm	(150 ... 2500°C)
5.14 μm	(400 ... 2000°C)
8.05 μm	(80 ... 2500°C)
	(50 ... 800°C)
8–14 μm	(0 ... 1000°C)

All devices are equipped with an adjustable emissivity setting for adaptation to the material properties. Some materials are measured in specially rated pyrometer wavelength that have been found by material analysis as suited for this purpose. The field of application is explained by the respective pyrometer models, but also we are pleased to advise you.
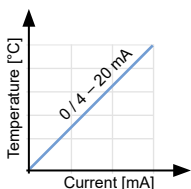
Pyrometer Type

Most measuring object temperatures can be determined well with standard 1-color pyrometers. However, in some cases the choice of a 2-color pyrometer (ratio pyrometer) may be required, which simultaneously measures in two spectral ranges and determines the temperature by quotient formation. The common use of such devices is at measurements through polluting viewing windows or strong smoke or dust exposure in the field of view or even at measuring objects that are smaller than the pyrometer's spot size.

The choice of the optics also plays an important role. Optics with adjustable focus distance can be set to different measuring distances where the spot size then is always as small as possible. For measurements in the defocused area, the temperature of a larger measuring surface is determined; the accuracy of the measurement is the same.
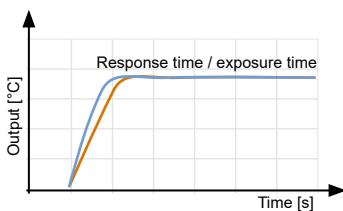
Response Time / Exposure Time

For all Sensortherm pyrometers the response time t_{90} is specified. It indicates the time that the pyrometer needs to reach 90% signal height of a 100% temperature step event. Within the response time two measurements and the complete signal processing will be performed, so the exposure time is twice as high. The shorter the response time of a pyrometer, the faster a measured value is provided to the output. This is particularly important when measuring parts move quickly, or when using a scanner, or if the pyrometer's measuring value should be used to further system control.
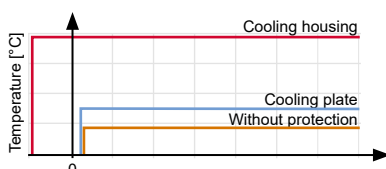
Outputs / Interfaces

All stationary pyrometers are equipped with at least one standard analog output 0/4-20 mA (selectable) and a serial interface RS232 or RS485. Via interface the pyrometer can be parameterized remotely, or a measurement data evaluation or the entire system can be controlled via PC program or a PLC. The data transmission with RS232 is only possible over relatively short distances, via RS485 very long transmission distances can be realized and multiple pyrometers be connected in a bus system to an interface.

Pyrometers with an integrated PID controller are equipped with a manipulated variable output for direct connection to a heating system. Metis models can be equipped with 12-pin or 17-pin connection, depending on how many inputs and outputs are required, in addition, a connection to Profinet / Profibus is possible. Handheld devices are read out via USB.

Ambient Temperature

The device temperature must be within the specified limits in order to avoid inaccuracies or failures. For operations outside the ambient temperature the pyrometer must be installed in an appropriate protective housing (accessory).
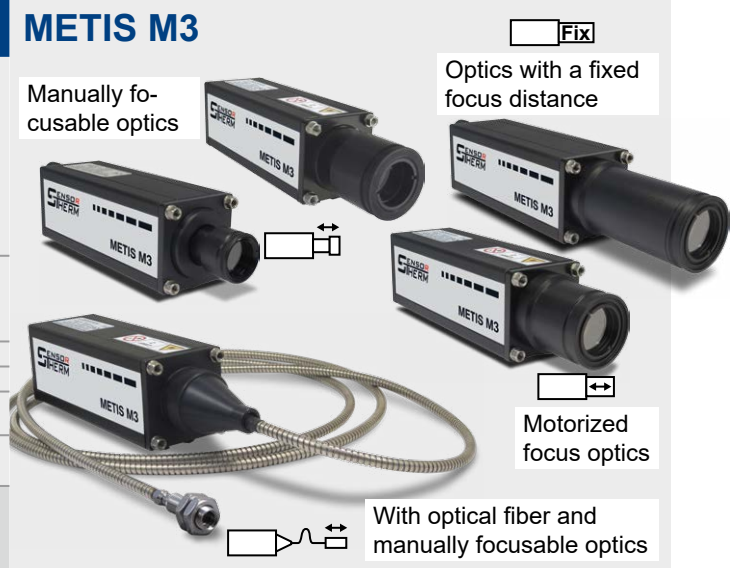
Pyrometer Overview

METIS M3 Series — 1-color pyrometers

METIS M3 Series	M323	M318	M316	M309	M313	M308	M306
Temperature ranges [°C]	50–800 80–1200 100–1500	100–700 150–1200 180–1300	200–1300 250–1300 350–1800 400–2500 500–3300	550–1400 600–1600 650–1800 750–2500 900–3000 1000–3300	400–1400 450–1800 500–2200 550–3000 600–3800	600–1400 700–1800	900–2500
Spectral range [µm]	2–2.6	1.65–2.1	1.45–1.8 1.4	0.7–1.1 0.87	1.27	0.88	0.6
Response time t_{90}	< 1 ms						
Smallest spot size	0.6 mm		0.4 mm		0.3 mm	0.7 mm	1.3 mm
Optics types							
Sighting method							
Typical application	Metals, ceramics, composites, semiconductor, wafers, molten glass, graphite...				Tungsten in a vacuum under protective gas	Titan under oxidizing conditions	Melting metal / pouring stream

METIS M3 Series — 2-color pyrometers

METIS M3 Series	M322	M311	M3F1
Temperature ranges [°C]	300–1000 350–1300 400–1600 500–1800 600–2300 800–3000 1000–3300	600–1400 650–1500 750–1800 800–2100 900–2500 1000–3000 1100–3300	600–1300 750–1800 900–2500
Spectral range [µm]	1.45–1.65 / 1.65–1.8 1.4 / 1.64	0.75–0.93 / 0.93–1.1 0.87 / 0.99	0.7–0.93 / 0.93–1.1
Response time t_{90}	< 1 ms		10 ms
Smallest spot size	0,8 mm		
Optics types			
Sighting method			
Typical application	Metals, ceramics, composites, semiconductor, wafers, molten glass, graphite...		Flames

METIS M3

Manually focusable optics

Optics with a fixed focus distance

Motorized focus optics

With optical fiber and manually focusable optics

METIS M3 / H3

2 analog outputs 0/4-20 mA; M3: RS232+485, switchable; H3: RS485. Laser targeting light button, through lens sighting or camera connection.

2 versions:
- With display, adjustment keys, LED's to indicate operational readiness and active switching outputs, 3 configurable inputs / outputs. Optionally with PID controller or Profinet, Profibus or Ethernet
- Ready-to-operate LED, 4 digital inputs, 2 digital outputs, 1 analog input, PID controller

METIS H3 Series (High speed)

METIS H3 Series (High speed)	1-color pyrometers			2-color pyrometers	
	H318	H316	H309	H322	H311
Temperature ranges [°C]	120–520 180–800	250–800 300–900 350–1100 400–1200 500–1600 600–1800 700–2500	550–1200 600–1400 650–1600 700–1800 750–2000	350–800 400–1200 500–1300 550–1400 600–1600 700–2300 1000–2500 1300–3000	600–1100 650–1300 750–1400 900–1800 1000–2000 1100–2200 1300–2500 1600–3300
Spectral range [µm]	1.65–2.1	1.45–1.8	0.7–1.1	1.45–1.65 / 1.65–1.8 1.4 / 1.64	0.75–0.93 / 0.93–1.1 0.87 / 0.99
Response time t_{90}	< 40 µs			< 80 µs	
Smallest spot size	0.4 mm			0.8 mm	
Optics types					
Sighting method					
Typical application	Metals, ceramics, composites, semiconductor, wafers, molten glass, graphite...				

METIS H3

Manually focusable optics

With optical fiber and manually focusable optics

Pyrometer Overview

| HELIOS H4 Series (Highspeed system)	2-color pyrometers	
	H422	**H433**
Temperature range [°C]	700–2300	
Spectral range [µm]	1.45–1.65 / 1.65–1.8	1.6–1.85 / 1.85–2.1
Response time t_{90}	< 50 µs	
Smallest spot size	0,8 mm	
Optics type	⬜▷〰️↔️⬜	
Sighting method	🔺	
Typical application	Laser power control	

HELIOS

⬜▷〰️↔️⬜

0–10 V DC, RS485, Ethernet, switching inputs/outputs, motorized focus optics. The system also includes a deflection mirror adapter.

CAPELLA C3 Series	1-color pyrometers			2-color pyrometers	
	C309	**C316**	**C318**	**C322**	**C311**
Temperature ranges [°C]	550–1400 600–1600 750–2500 900–3000 1000–3300	250–1300 350–1800 400–2500	180–1300	300–1000 350–1300 500–1800	600–1400 750–1800 900–2500
Spectral range [µm]	0.7–1.1 0.87	1.45–1.8	1.65–2.1	1.45–1.65 / 1.65–1.8	0.75–0.93 / 0.93–1.1
Response time t_{90}	< 1 ms				
Smallest spot size	1.2 mm (0.4 mm with close-up lens)				
Optics type	⬜↔️⬜				
Sighting method	🔺 + 👁				
Typical application	Metals, ceramics, composites, semiconductor, wafers, molten glass, graphite...				

CAPELLA

With display, adjustment keys and USB connector

SIRIUS Series	1-color pyrometers			
	SI23	**SI18**	**SI16**	**SS09**
Temperature ranges [°C]	50–400 100–600 150–900	100–600 150–850	250–1000 300–1300 350–1800	550–1400 650–1800
Spectral range [µm]	2–2.6	1.65–2.1	1.45–1.8	0.7–1.1
Response time t_{90}	5 ms			
Smallest spot size	1.3 mm			
Optics type	⬜ Fix (8 Pos.)		⬜↔️⬜	
Sighting method	🔺		🔺	
Typical application	Metals, ceramics, composites, semiconductor, wafers, molten glass, graphite...			

POLARIS Series	IR switches	
	PI16	**PS09**
Temperature / switch ranges [°C]	250–1000 300–1300 350–1800	550–1400 650–1800
Spectral range [µm]	1.45–1.8	0.7–1.1
Response time t_{90}	4 ms	
Smallest spot size	1.3 mm	
Optics type	⬜↔️⬜	
Sighting method	🔺	

SIRIUS

0/4-20 mA, RS232 or RS485, switch input (clearing peak picker manually), laser targeting light button

POLARIS

2 switching outputs (transistor), service interface RS232 or RS485

DIADEM Series	1-color pyrometers			
	DI16	**DS09**	**DS06**	**DI13**
Temperature ranges [°C]	250–1400°C 300–1500°C	600–1500°C 700–1800°C 1000–2500°C	900 – 3000°C	1000–3500°C
Spectral range [µm]	1.45–1.8 µm	0.7–1.1 µm	0.65 µm	1.27 µm
Response time t_{90}	5 ms			
Smallest spot size	1.4 mm	1.1 mm	1 mm	2.5 mm
Optics type	⬜ Fix			
Sighting method	🔺 / 👁			
Typical application	Verifying calibration sources			

METIS Series	MB39
Temperature ranges [°C]	150–1000 500–2500
Spectral range [µm]	3,95
Response time t_{90}	3 ms
Smallest spot size	0.7 mm
Optics type	⬜↔️⬜
Sighting method	🔺 / 👁
Typical application	Gas flames

DIADEM

0–10 V DC, RS485, Laser targeting light button or through-lens view finder

METIS

0/4-20 mA, RS232 or RS485, switch input (peak picker clearing)

System Components

Additional components for system integration expand the application possibilities of pyrometers.

■ Temperature display

Model	Adjust pyrometer	Switching outputs	Pyrometer connection	Separate interface
IF	✓	4	Interface	✓

External temperature **digital display IF** for installation in places where the display of the measuring temperature is required.

■ PID Program Controllers

Model REGULUS	For Pyrometers	Additionally for thermocouple type K / S	Programs / steps	Automatic control parameter determination
RD	2	2 (optional)	26 / 254	✓
RF	1	1 (optional)		

REGULUS program controllers are very fast **PID temperature controllers**. Programmable and optimized for pyrometers, they can perform complex control sequences of heating processes. They generate a direct manipulated variable from the measuring signal of the pyrometer.

■ Line Scanners

Model GALAXY	Scan angle	Measuring zones	Analog region outputs	Single steps, step speed or scanning frequency
SC71/81	3.6–90°	16	–	1600 single steps, 1–10000 steps/s or 6.25 – ca. 150 Hz
SC72/82			4	
SC73/83			8	
SC75/85			16	

GALAXY scanners are used for continuous scanning of measuring objects and always detects the temperatures on a line.
This results in temperature profiles of the workpieces, which provide information on temperature peaks, relevant details and possible weak points on slabs, billets or steel strips. They can be used with all METIS pyrometers.

Optional in protective housing

Calibration Sources / Temperature Sources

Model	Temperature range	Spectral-range	Opening Ø	Heating-up time
CS1500N	50–1500°C	0.9/1.6 µm	40 mm	ca. 35 min
HE1200N	ca. 100-1200°C	0.5–3.5 µm	20 mm	ca. 3 min

CS calibration sources with connectors for pyrometers and PC form a system for checking and readjusting pyrometers as well as for readjusting the calibration sources itself.

HE temperature sources are not used for calibration but are suitable for rapid on-site inspection of pyrometers.

HE1200N

■ Transfer Standard Pyrometers

DIADEM Transfer Standard Pyrometers are used for the exact pyrometric adjustment of a CS1500N or for the readjustment of a pyrometer by comparison measurement.

CS1500N

Heavy-Duty Measuring System for M3 and H3 fiber optics pyrometers

The **heavy-duty stainless steel measuring system** is designed for continuous temperature measurement in rolling mills, continuous casting plants, and similarly harsh industrial conditions. The lens system is designed for temperatures up to 250°C, and the purge air provides additional cooling and keeps the lens tube and thus the pyrometer field of view free of contamination.

Typical Accessories

Cooling plates

Cooling housing

Air purge units

Mounting brackets

Ball joint brackets

Tripod adapter

Wiring boxes

Motorized focus adapter

Power supplies

Flange systems

Scan adapter

USB interface converters

Connection cables

Software

PC software for adjusting, displaying, recording and evaluating.
All programs are continuously developed and can be downloaded for free permanently.

■ *SensorTools*

Software for communicating with pyrometers, scanners, controllers, displays and calibration sources.

- Display measurement temperatures numerically and graphically
- Display up to 16 device measurement data simultaneously
- Record measurement curves
- Adjust time view quickly
- Read out and adjust measuring parameters
- Perform all device settings
- Single-point adjustment for adaptation measurements through windows or lenses with unknown transmittance
- Program controller REGULUS: Automatically determine control parameters and define control steps

■ *SensorTools* Viewer

In the program package with *SensorTools*, for displaying recorded measurement data.

- View and compare up to 4 measurement data files simultaneously
- Duplicate, save, export measurement data
- Save current view of all graphs
- Show measurement data details from the location of the mouse cursor
- Show device model, measurement parameters and date of recording
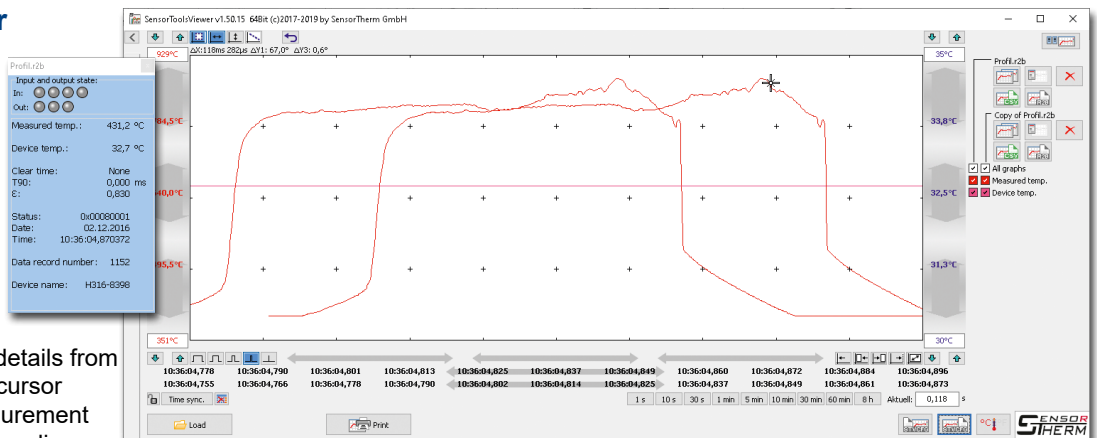
■ *SensorCal3*

Software for accuracy check and readjustment of pyrometers and calibration sources.

- Adjust pyrometer series METIS MS / MI / MB / MP and M3:
  - automatically on the CS1500N
  - semi-automatically or manually by comparison measurement with a high precision Transfer Standard Pyrometer DIADEM or by measurement on any calibration source
- Adjust the CS1500N calibration source pyrometrically: automatically with high precision Transfer Standard Pyrometer DIADEM or manually by measuring result of any reference pyrometer
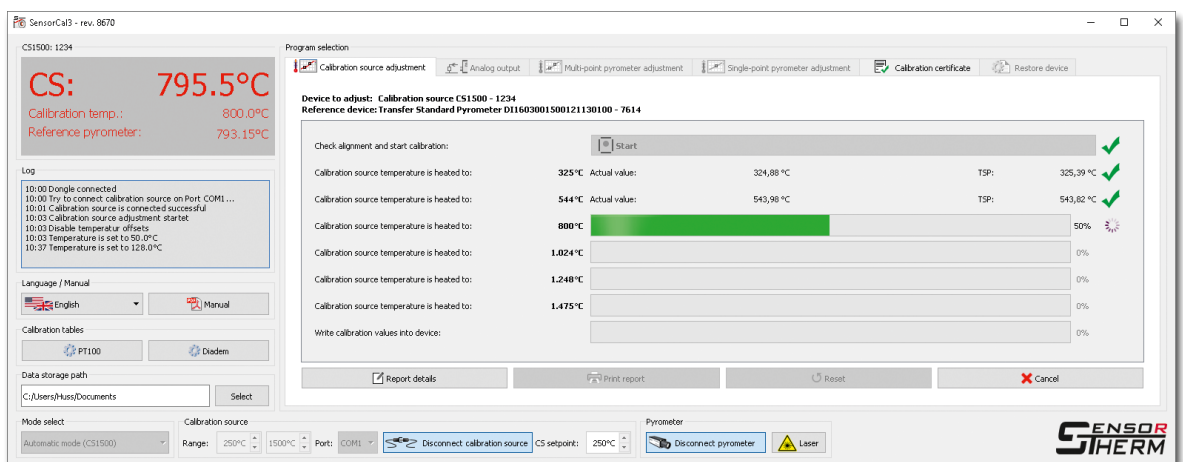
Quality Control

All assemblies are subjected to extensive testings before mounting and ready for shipping:

- Circuit board scan for assembly error detection
- Electrical function test of electronic components
- Microscopic examination of the optical components
- Initial functional testing of the assembled unit
- Climate chamber heating
- Vibration test
- Re-function test with check for deviations from the initial test
- 48-hour long time test

After all tests are passed, the pyrometers are checked again on calibration sources at several predetermined temperatures.

- A factory certificate is enclosed with all our pyrometers. It confirms the full functionality and traceability to national standards.

Now the devices are ready for delivery.

We are certified according to DIN EN ISO 9001:2015

Services

- Regular pyrometer maintenance / calibration
- Creation of factory certificates indicating the measurement deviation
- Device readjustment at measured value deviations, incl. factory certificate
- Creation of factory certificates at standard temperature measuring points or with self-defined or additional ones
- IEC 17025 calibration certificates at standard temperature measurement points or with self-defined or additional ones
- Advice to measurement problems, if necessary on-site
- Support at commissioning
- Quick repairs

Individual Advice

The non-contact temperature measurement with pyrometers is the contact measurement superior in many areas. However, often questions arise that can not be solved due to lack of experience. There is the spectral range that must be selected suitable to the material, the response time to the speed of a passing material or any interference at the site of installation has to be considered.

Let advise you individually when the measurement task raises too many questions. We are interested in the long and trouble-free operation of our products at your measurement tasks.

Made in Germany / International Sales

Sensortherm infrared measurement and control GmbH in Steinbach/Ts. is one of the technology leaders in digital pyrometer technology. Especially our 2-color pyrometers which are the world's fastest devices with digital output signals.

With more than 30 years of experience in development and production of infrared radiation thermometers, Sensortherm is constantly setting new standards in the digital pyrometry. Sensortherm provides its customers advanced economical and technical solutions from a single source.

All pyrometers and calibration sources are manufactured by Sensortherm "Made in Germany" at our headquarter in Steinbach. Our international sales contacts can be found across the globe, they are listed on our website **www.sensortherm.com**.