Pyrometers
METIS MB35 / MB39 / MP23 / MP25

Versions with rotary switch or switchable serial interface, display and parameter buttons or Profibus

Operating Manual

Content

1 General

1.1 Information to this Manual

This manual enables the safe and efficient use with the device. The manual is part of the instrument and has to be kept in a location where users always have access to.
Read this manual carefully before operating. For secure working all security notes and operation procedures in this manual has to be followed.
Additionally, the local accident prevention regulations and common safety regulations of the instruments' operational area are valid.
The descriptions may differ from the current delivery status since the pyrometer is continuously developed. Illustrations in this manual are for basic understanding and can differ from the actual construction.

1.2 CE Conformity and Standards

The product conforms to the following standards:
CE conformity: DIN EN 61326-1 (electromagnetic compatibility)
Laser safety: IEC 60825-1, laser class 2 (only devices equipped with laser targeting light)
RoHS: 2011/65/EU

1.3 Limitation of Liability

All information and notes in this manual are made under consideration of valid standards and rules, state of technology and our expert knowledge for many years.
The producer assumes no liability for damages due to:
- Non-observance of this manual
- Usage out of intended use
- Assignment of unskilled personnel
- Unauthorized modifications
- Technical modifications
- Usage of spare parts not approved

The responsibilities of the delivery contract are valid as well as our general terms and conditions and terms of delivery and the valid statutory rule at date of the conclusion of contract.

1.4 Terms of Warranty

A warranty period is 24 months from date of shipment form the Sensortherm facility. The seller will repair or replace the device at its own discretion. Further claims of the buyer against the seller or its agents are excluded, especially claims for damages that are not incurred in the delivery itself. This shall not apply in cases of intent, gross negligence, or the absence of assured properties. Damage or misuse of the product will be determined and void the warranty coverage. Repairs paid by the customer will include a 180 days warranty from date of shipment. Transportation costs are to be paid by the customer. Any claims for damage caused by misuse, neglect or tampering with the sensor are excluded.

1.5 Copyright

This manual is protected by copyrights and are intended solely for internal purposes.
It is not permitted to transfer these instructions to third parties, duplication in any kind and form - including excerpts - as well as recovery and / or notification of contents without written permission of the manufacturer, except are internal purposes.
Contraventions are liable for damages. All other rights reserved.

1.6   Explanation of Symbols

Signal words in combination with symbols indicate safety and information in this manual. Please note these instructions for safety reasons.

> **CAUTION:** This combination of symbol and signal word indicates a potentially dangerous situation that can result in minor or moderate injury if not avoided.

> **CAUTION, LASER RADIATION:** This combination of laser radiation symbol and signal word indicates the dangers of a laser targeting light.

> **NOTE:** This combination of symbol and signal word indicates a potentially hazardous situation that can lead to property and environmental damage if not avoided.

> **INFO:** This symbol indicates useful tips, recommendations and information for efficient and trouble free operation.

1.7   Disposal

Dispose of the product properly when it is no longer usable: pyrometers include electrical and electronic waste and have to be recycled or disposed environmentally friendly or to send to the manufacturer for disposal.

1.8   Intended Use
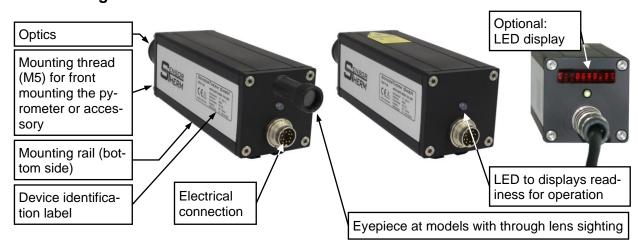
Metis pyrometers of series MB / MP are devices for non-contact temperature measurement. They differ from each other by their different spectral sensitivity that has an influence on the temperature to be measured, the temperature range and the material to be measured.
Their spectral range is designed already to measure metal surfaces at very low temperatures.

1.9   Scope of Delivery

Pyrometer, software *SensorTools*, works certificate, user manual
(A connection cables is not included in scope of delivery and has to be ordered separately).

1.10   Model Designs

Optics

Mounting thread (M5) for front mounting the pyrometer or accessory

Mounting rail (bottom side)

Device identification label

Electrical connection

Optional: LED display

LED to displays readiness for operation

Eyepiece at models with through lens sighting

2 Safety

2.1 General

Any person who is tasked to carry out work with the device must have read and understood the operating instructions before beginning. Operation and maintenance of the system may only be performed by trained personnel.

2.2 Electrical Connection

When connecting or when working on the mains voltage, the general safety guidelines are observed, e.g. when connecting power transformers. Supply voltage can be lethal when touching. Improper installation can cause serious injury or physical damage. Only qualified personnel are allowed to work with mains voltage.

2.3 Laser Targeting Light

For easy alignment, the pyrometers may be equipped with a laser targeting light, laser class 2 (according to IEC 60825-1. The laser emits a visible red light with a maximum power of < 1 mW and a wavelength around 650 nm.

Laser warning label on the device (depending on the country of delivery)**:**
US sticker   EU sticker

⚠ CAUTION
Class 2 Laser Product
1 mW at 500-680 nm
**Laser Radiation -
Do Not Stare into Beam**

Laser 2
IEC 60825-1:2014

Safety precautions:
- Never look into the direct or reflected laser beam.
- Do not point the laser to anyone.
- If laser radiation hits the eye, avert your eyes immediately.

2.4 Through Lens Sighting

Devices with through lens sighting and temperature range above 1400°C are equipped with an adjustable eye protection filter in the eyepiece to reduce glare at high measurement temperatures. The unprotected look at temperatures >1400°C can damage the eyes function permanently.

Safety precaution:
- Only look with darkened eyepiece at objects with temperatures above 1400°C / 2552°F to protect the eyes against glare at high radiation temperatures.
- Before looking at the high temperatures, always first adjust the eyepiece by turning it to the darkest position.

2.5 Device Labels

On top of the pyrometers a nameplate and on devices with laser targeting light a corresponding warning label.
- The device must be mounted in a manner that the labels after installation are still clearly visible.
- Keep the warning signs in always legible condition
- Replace damaged labels

2.6 Responsibility of the Operators

If the device is used in the commercial sector the operator is subject to the legal responsibilities for workplace safety.
In addition to the safety instructions in this manual follow the regulations of safety, accident prevention and environmental protection.

3 Electrical Connection

3.1 Cable Colors and Pin Assignment (14-wire connection cables)

The electrical connection of the pyrometer (supply voltage and measuring signal) will be done via the connector on the Mains filter and voltage stabilization box. For this purpose, pre-assembled connection cables are available as accessories (see **8.4 Accessories**). To prevent accidental short circuits, not used cable wires need to be placed, for example to the supplied screw terminals.

Cable colors	No.	Function	Pin	
White	1	+ 24 V DC or AC power supply (possible range: (15–30 V DC or 15–30 V AC, 48–62 Hz)	K	
Brown	2	0 V DC power supply (ground)	A	
Green	3	+ Analog output (0 / 4–20 mA)	L	
Yellow	4	- Analog output (0 / 4–20 mA)	B	
White-green	14	(No function, do not connect)	D	
Brown-green	15	(No function, do not connect)	B	
Grey	5	Targeting light external switch on (bridge to + 24V)	H	
Pink	6	External clar of peak picker (with bridge to + 24V)	J	
Blue	13	(No function, do not connect)	E	
Black	9	RS232: RxD	F	Connector pins of the 12-pin connector (view from outside)
Grey-pink	11	RS485: B (+)		
Violet	10	RS232: TxD	C	
Red-blue	12	RS485: A (-)		
Red	8	DGND (ground for interface)	G	
Orange	7	Shield (connect only for cable extension, do not connect in the control cabinet)	M and plug housing	
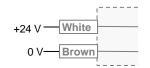
3.1.1 Factory Settings

Meas. parameters	Factory settings
Temperature sub range	corresponds to basic range
Response time t_{90}	intrinsic time constant
Emissivity ε	100%
Rotary switch S3	RS (interface operation)
Devices with switchable interface:	RS485

Parameters	Factory settings
Baud rate	19.2 kBd
Device address	00
Interface delay	00 (RS232) 01 (RS485)
Peak picker	off
Analog output	4–20 mA

3.1.2 Power Supply

With connection of the supply voltage (standard 24 V DC or AC, possible range 15–30 V) the unit is ready for operation with the following factory settings (changing the settings is possible via software *SensorTools* or via interface commands.

+24 V —— White
0 V —— Brown

Interrupt the power supply to turn off the pyrometer, e.g. by disconnecting the connector.

Power status LED:
- **Orange** in the starting phase (up to 3 minutes).
  In this time the device detector is thermostated to operating temperature.
- **Green** in interface operation (seee **5.5**), that is, if the parameters response time and emissivity are set via interface by software (devices with rotary switch in position RS).
- **Red** with settings made directly on the device. That is, the parameters response time and emissivity set in the device are valid.
- **Flashing red** device failures: (unit ha to be repaired or replaced)
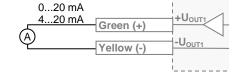
Devices with Display:
- **7777** in the starting phase during detector is thermostated
- **1/10°C below beginning of temperature range:** measuring temperature is below beginning of temperature range.
- **8888** if measuring temperature is above end of range.

3.1.3 Analog Output
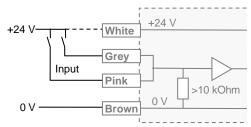
The analog output can be set to 0–20 mA or 4–20 mA

3.1.4 Digital Inputs

By applying the supply voltage to the cable gray (pin H) or pink (Pin J) it can be
- Externally reset the maximum value of the peak picker (pink cable). Tthe clear settings have to be set to "external clear" via Software *SensorTools* or interface command to enable the function.
- Externally switch on / off the targeting light (grey cable).

Note to laser targeting light: the targeting light will automatically switched off after approx. 2 minutes.

CAUTION, Laser Radiation, Laser Class 2:
- Never look into the direct or reflected laser beam.
- Do not point the laser to anyone.
- If laser radiation hits the eye, the eye should be averted immediately.

3.1.5 Serial Interface (devices with rotary switches: either RS232 or RS485; devices with switchable interface: switchable between RS232 and RS485)

The serial interface is used for digital communication of the pyrometer with another computer, for example a PC for data transmission to the software *SensorTools*.
The maximum transmission speed (in Baud) is limited by the cable length; it is halved with each doubling of the transmission path.

- **RS232:** about 7 m cable length with 19.2 Bd.
- **RS485:** about 2 km with 19.2 kBd.

- Devices with rotary switch are adjustable between 1.2 and 57.6 kBd.
- Devices with switchable interface are adjustable between 1.2 and 115.2 kBd.
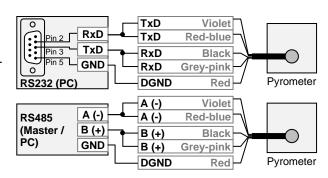
Connecting one pyrometer via RS232 or RS485:
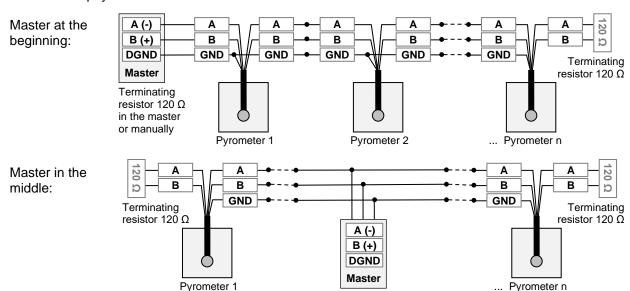
In a short RS232 or RS485 connection to the master (computer receiving the data), the pyrometer is connected directly as a point-to-point connection with the master.

It is advantageous to connect all interface cables in order to avoid reflections.

Connecting several pyrometers via RS485:

For a reflection-free operation with longer cables, pay attention to the correct cable termination. Termination at the physical bus is on front and rear.

Master at the beginning:

Master in the middle:

When operating multiple devices (up to 32 are possible), each device needs to assign its own address (directly on the device or via software *SensorTools*), under which it can be addressed later. For this purpose, initially, each device must be connected individually and provided with an address (00-97). After that, all devices can be connected.

If specific parameters for all devices should be changed simultaneously, the global address 98 is used (there is no response from the device). If the address of a device is unknown, you have the opportunity to address each device independently of the set address with the global address 99 (connect only one device).

3.1.5.1 Interface Converter (Accessory)

A quick and easy way to connect the pyrometer with a PC is to use an interface converter or a connecting cable with integrated interface converter (see **8.4 Accessories**). Depending on the operating system, suitable drivers are installed automatically or can be found on the CD supplied with the software

Cable colors pyrometer		Cable colors interface converter RS232⇔USB (TxD / RxD) RS485⇔USB (A⁻ / B⁺)
Red (GND)	⇔	Black (GND)
Grey-pink / black (B⁺ / RxD)	⇔	Orange (B⁺ / TxD)
Red-blue / violet (A⁻ / TxD)	⇔	Yellow (A⁻ / RxD)

SensorTools in the directory Drivers → FTDI_USB_COM, or after installing *SensorTools* in the installation directory (updated driver for Windows from the FTDI website: http://www.ftdichip.com/Drivers/VCP.htm).

To achieve the maximum transfer speed, it is absolutely necessary to change the latency time in the advanced connection settings from 16 ms to 1 ms (settings in the Control Panel → device manager → Ports (COM & LPT) → USB Serial Port → Port Settings → Advanced → Latency Timer (at BM options)). More information is available in the FTDI application note AN_107 - Advanced Driver Options.
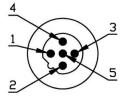
3.1.6 Shielding
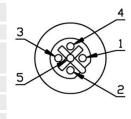
To meet the requirements for electromagnetic compatibility (EMC), only shielded cables should be used. The shield of the connection cable is connected to the pyrometer side in the plug housing, on side of the connecting wires (voltage source) it remains open to prevent ground loops.

3.2 Profibus Devices

Input Profibus

Pin	Meaning
1	Not used
2	Profibus cable A (green)
3	Not used
4	Profibus cable B (red)
5	Shield
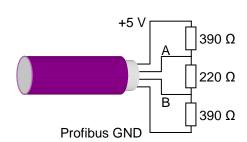
Output Profibus

Pin	Meaning
1	+5V Bus
2	Profibus cable A (green)
3	GND Bus
4	Profibus cable B (red)
5	Shield
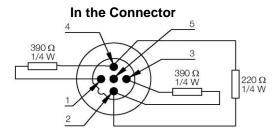
Terminator: If the output is not connected with any further Profibus device, the output must be terminated with resistors (see right drawing: two internal resistors 390 Ohm / 0.25 Watt, one internal resistor 220 Ohm/ 0.25 Watt.

This circuit corresponds to the Profibus connector AK81-00 and can be ordered as an accessory (see **8.4**)

Circuit

In the Connector

Status-LED: The status LED indicates the Profibus status.

LED	Meaning
Off	No bus operation or not connected
green (continuously)	Profibus in state data exchange
green (flashes)	Profibus in state clear
red (continuously)	Profibus initialisation error
red (flashes)	Profibus parameter or configuration error

4 Mechanical Installation

4.1 Mounting

- The **mounting rail** on the bottom case is for the stable take-up of for example of a ball and socket mounting (for fiber optics devices a mounting angle is recommended, see **8.4 Accessories**).
- Front M5 **threaded holes** can also be used for mounting (all 4 threads has to be used for fixing).
- The slightest deviation from the optical axis is achieved with the **optics adapter/holder** of motor focus and fixed focus devices.
- Note that the **installation** of the pyrometer is free of vibrations, if necessary, helps the use of rubber absorbers when mounting.
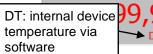
> **INFO:** Through manufacturing tolerances the optical and mechanical axis are not running 100% collinear. The pyrometer should be realigned if it is installed again and twisted in the same holder (see **4.3 Alignment onto the measuring object**).

4.2 Ambient Temperature

Metis MB / MP pyrometers are designed for ambient temperatures between 0 and 70°C. Operation outside this temperature leads to incorrect measurements and may damage the unit.

To comply with the permitted ambient temperature sufficient distance from the (hot) measuring object is observed.

- The internal housing temperature can be read out via the software *SensorTools* (see **7**).

DT: internal device temperature via software

99,9 °C
DT: 31 °C
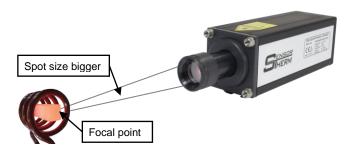
Accessory: The use in ambient temperatures outside the permissible ambient temperature is possible with an additional cooling housing (see **8.4 Accessories**). This is already recommended from an ambient temperature of 45°C, because with the internal thermostatic control the temperature otherwise rises too fast.
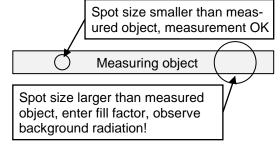
4.3 Alignment onto the Measuring Object

To detect the temperature correctly, the pyrometer must be aligned properly with the measuring object. In the focal point of the optics (focal distance) the spot size diameter is the smallest. Also, measurements in the defocused area can be done to determine the average temperature of a bigger spot. If the target under measurement is smaller than the spot size, the result is falsified accordingly.

Spot size bigger

Focal point

To get a correct measurement result, the following requirements must be observed:
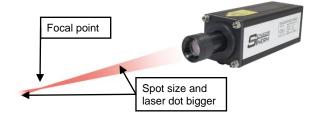
- The optical path between pyrometer and the target must be free of interfering objects and vapors, fumes or dust (if necessary, use air purge or sight tube).
- A viewing window between pyrometer and the measured object should have constant transmission properties in the spectral range of the pyrometer (e.g. quartz glass or sapphire for MP 23/25 and calcium fluoride for MB35). The transmission loss must be compensated by correction of the emissivity (see **6.3**).
- If the target is smaller than the spot size, there will be measuring errors because background temperatures go with the measurement.

Spot size smaller than measured object, measurement OK

Measuring object

Spot size larger than measured object, enter fill factor, observe background radiation!

4.3.1 Alignment with the Laser Targeting Light

The laser targeting light is a conical red laser beam with the largest diameter directly at the lens and the smallest in the focal distance, i.e. at the point where the spot size is the smallest.

Focal point

Spot size and laser dot bigger

INFO: The size of the laser point does not match to the spot size, spot sizes are given in the spot size tables (see **4.5**)

CAUTION, Laser Radiation, Laser Class 2:
▪ Never look into the direct or reflected laser beam.
▪ Do not point the laser to anyone.
▪ If laser radiation hits the eye, the eye should be averted immediately.

Turn on / off: By connecting the power supply (hwite cable) to pin H (grey caqble) or via the targeting light button or the button if using a connection cable with angled connector and laser targeting button or via software *SensorTools* (see **7.4 Control window**.

Laser targeting light button

Software

off   on

The targeting light will be automatically switched off after approximately 2 minutes.
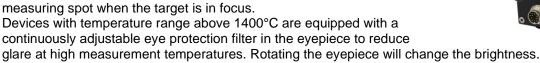
INFO: The laser targeting light is turned off at a device temperature above 60°C.
If the targeting light does not turn on, probably the device's internal temperature is too high. In this case, the installation place should be checked (excessive heat radiated from the measuring object). When temperature falls below 60°C the laser is working again.

4.3.2 Alignment with the Through Lens Sighting / View Finder

The view finder provides upright imagery so that the target under measurement can be viewed visually. A target circle shows the measuring spot when the target is in focus.
Devices with temperature range above 1400°C are equipped with a continuously adjustable eye protection filter in the eyepiece to reduce glare at high measurement temperatures. Rotating the eyepiece will change the brightness.

View finder

INFO: The size of the target circle does not match to the spot size, spot sizes are given in the spot size tables (see **4.5**).

CAUTION, Danger of eye damage at measuring temperatures above 1400°C!
To protect the eyes at high measuring temperatures, first, before alignment, the eyepiece must be adjusted to the darkest position, a safe method is the adjustment by looking at a replacement light source, e.g. a lamp.

4.4 Setting the Measuring / Focus Distance

The focal distance is the distance at which the optics achieves its smallest spot size. In most cases, this distance is also the required measuring distance.

▪ With focusable optics the focus distance can be changed continuously within a predetermined range, so the smallest possible spot size is always achieved.
▪ For fixed focus optics, the focus distance is set to a fixed distance and can not be changed.

Mechanical Installation

4.4.1 Manually Focusable Optics

- Release optics turn counterclockwise
- Move optics in or out until the measured distance is found (see **4.3 Alignment onto the measuring object** or via the optics pull-out in the **Spot Size Tables**).
  - Pulled optics: short measuring distance
  - Inserted optics: long distance measurement
- Lock optics turn clockwise (hand-screwed, without tools).

1. Release
2. Adjust
3. Lock

4.4.2 Fixed Focus Optics

Fixed focus optics are set to a fixed measuring distance. To measure with the smallest possible spot size, the pyrometer must be installed in the specified distance to object. Additionally, the built-in laser targeting light or view finder helps aligning the pyrometer to the target exactly.

4.5 Spot Size Tables

The following tables show the optical data of the different device types. The values in the tables are exemplary, intermediate measurement distances must be determined by interpolation. If the measuring distance (= focused distance) differs from the adjusted or specified, a measurement is also possible, but the spot size changes (usually it is larger, see **4.5.1 Calculation of the spot size diameter outside the focused distance**). Measuring distances are specified from lens front.

Optics pull-out S [mm]

MB35 / MB39 (Focusable optics)

Optics	Meas. distance a [mm]	Optics pull-out S [mm]	Spot size Ø M [mm]				Aperture Ø D [mm]
			MB35	**MB39**	**MB35**	**MB39**	
			50-700°C 100-1000°C	**500-2500°C**	**35-700 °C**	**150-1000°C**	
OM35-**A**0	83	26	0.7		1.3		14-16 (MB35: FSC < 800°C; MB39: FSC >1200°C)
	93	11.6	0.8		1.45		
	104	0	0.9		1.6		
OM35-**B**0	130	26	1.1		2		
	165	8.4	1.6		2.9		
	195	0	2		3.6		
OM35-**C**0	350	26	3		5.5		8-9 (MB35: FSC < 800°C; MB39: FSC > 1200°C)
	600	12.4	6		11		
	1000	6.2	10.5		19		
	2000	2	22		40		
	4000	0	46		83		

FSC = Full scale temperature

MB35 / MB39 (Fixed focus optics)

Optics	Meas. distance a [mm]	Optics pull-out S [mm]	Spot size Ø M [mm]				Aperture Ø D [mm]
			MB35	**MB39**	**MB35**	**MB39**	
			50-700°C 100-1000°C	**500-2500°C**	**35-700 °C**	**150-1000°C**	
OM35-0**D**	200	45	2.5		2.8		
OM35-0**E**	240	89	1.6		2.1		
OM35-0**F**	350	89	2.4		3		27 mm
OM35-0**G**	480	45	4.6		5.8		
OM35-0**H**	1000	45	10		12.5		

MP23 / MP25 (Focusable optics)

Optics (Color code)	Meas. distance a [mm]	Optics pull-out S [mm]	Spot size Ø M [mm]					Aperture Ø D [mm]
			MP23	MP25	MP25	MP25	MP25	
			130-700°C	75-550°C	100-700°C	160-1200°C	200-1300°C	
OM25-**A**0 (Pink)	100	26	0.6	0.85	0.6	0.4	0.23	
	105	20	0.65	1.9	0.65	0.42	0.25	
	110	14.9	0.72	1	0.7	0.45	0.27	
	115	10.7	0.78	1.1	0.75	0.48	0.29	
	120	7.2	0.85	1.3	0.85	0.5	0.31	
	125	4.1	0.9	1.4	0.9	0.55	0.33	
	130	1.5	0.95	1.5	0.95	0.57	0.36	
	133	0	1	1.6	1	0.6	0.4	
OM25-**B**0 (Black)	190	26	1	1.5	1	0.7	0.35	14-16 (FSC < 800°C) 8-9 (FSC > 800°C)
	200	22	1.2	1.6	1.1	0.8	0.4	
	220	16.2	1.33	1.9	1.3	0.85	0.45	
	240	12	1.47	2.2	1.5	0.95	0.5	
	260	8.8	1.6	2.4	1.6	1.1	0.55	
	280	6.2	1.8	2.6	1.8	1.2	0.6	
	300	3.9	1.95	2.9	2	1.3	0.65	
	320	2.1	2.1	3.1	2.1	1.4	0.7	
	340	0	2.3	3.4	2.3	1.6	0.8	
OM25-**C**0 (Blue)	350	26	1.85	2.7	1.85	1.25	0.65	
	400	21.2	2.3	3.2	2.2	1.5	0.75	
	450	17.9	2.7	3.8	2.55	1.7	0.85	
	500	15.3	3.2	4.3	2.9	1.9	1	
	600	11.8	3.8	5.3	3.6	2.4	1.2	
	800	7.6	5	7.4	5	3.3	1.7	
	1000	5.3	6.5	9.5	6.4	4.3	2.2	
	1200	3.8	7.8	11.5	7.8	5.2	2.6	
	1400	2.7	9.2	13.6	9.2	6.1	3.1	
	1600	2	10.7	15.7	10.6	7	3.5	
	2000	1	14	19.8	13.5	8.9	4.5	
	2600	0	17.5	26	17.5	11.6	5.8	

FSC = Full scale temperature

4.5.1 Calculation of the Spot Size Diameter outside the Focused Distance

The spt size diameter determines the area on the measurement object from which 90% of the temperature radiation is detected by the pyrometer; therefore the spot size tables specify spot sizes for different measuring distances (= focused distances). For calculating intermediate values in front of and behind the focused measuring distance, the following formula can be used or the spot size calculator integrated in *SensorTools* (see **7.7**):

a   Focused distance
M   Spot size diameter in the focused distance
a_1 Measuring distance longer than focused distance
M_1 Resulting spot size on measuring distance a_1
a_2 Measuring distance shorter than focused distance
M_2 Resulting spot size on measuring distance a_2
D   Aperture (spot size directly on the lens, it differs depending on the optics pull-out. The largest value applies at a fully extended optics, the lowest value is with inserted optics)

$$M_1 = \frac{a_1}{a}(M+D) - D$$

$$M_2 = \frac{a_2}{a}(M-D) + D$$

5 Settings on the Device

The pyrometer has setting elements in the device. To access to them, the rear panel must be un-screwed and the electronics pulled out a little.

> **NOTE:**
> The electronics of the pyrometer can be damaged by debris ingress tool. Before starting any work:
> - Remove any contaminants from the pyrometer housing.
> - Switch off power supply or disconnect the pyrometer connector.

- Unscrew the four allen screws (1) on the rear panel of the device.
- Pull the electronics (2) far enough out of the pyrometer housing to get access to the setting elements.
- Depending on the device equipment (rotary or protection switch), configure the settings using a small screwdriver or set the switches.

- To close the pyrometer, completely move back the rear panel in-to the housing. Make sure the rubber seal is not clamped to the rear panel.
- Retighten the rear panel with the four allen screws until the rubber seal slightly protrudes between housing and the rear panel.

5.1 Devices with Rotary Switches

1 Response time:
To select a response time in the range of 3 ms-10 s (in switch position 1 ms, the device operates with the fastest possible response time of 3 ms).
RS (interface operation): When the switch is in the RS posi-tion, are all rotary switches are inoperable and the settings that have been made by software are valid.

2 Emissivity in percent x 1%.
3 Emissivity in percent x 10%.

Emissivity 100%: set both rotary switches to zero.
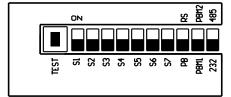
Note: The emissivity can be adjusted between 20 and 100%. Settings below 20% are interpreted as 20%.

5.2 Devices with Switchable Serial Interface

Devices with switchable serial interface are configured via inter-face and PC.

S1-S7: The miniature switches S1-S7 have no function in stand-ard units (without Profibus) and should all be set to "off" (down). These switches only have a function with Profibus devices.

PBM1 / PBM2 is also only required with Profibus devices and may be set arbitrarily for standard devices without Profibus.

PB / RS: must be set to RS to activate the switch RS**232 / 485**. This allows to change the interface mode between RS232 and RS485.

The **TEST** button is used to check the current output. Pressing the TEST button sets a 10 mA current in 0-20 mA mode and a 12 mA current in 4-20 mA mode. Pressing TEST again, the pyrometer is set back to normal measurement mode. Otherwise, after about 45 sec., the pyrometer is automatically set back to measuring mode.

5.3 Devices with Switchable Serial Interface, Display and Parameter Buttons

Devices with display and parameter buttons are additionally equipped with 4 keys (opposite side of the miniature switches). After selection, the menu parameters will be displayed on the 10-digit display on the rear panel.

| PAR | ◀ ▶ | SUB |

Menu navigation:
PAR button: Select the desired parameter by repeatedly pressing. After the last parameter, the first parameter is selected again.

◀ ▶ Press an arrow key to change a parameter value, the parameter value is flashing now. When the desired value appears, wait about 2-3 seconds until the parameter value stops blinking, the new value is taken over and the next parameter can be selected or changed.

Keep the arrow keys pressed longer to change the parameter values quickly.

Parameter	Display
Temperature display	T: 299.9 °C
Emissivity	E: 100.0 %
Response time	T90: MINI.
Peak picker	MAXI: OFF
Output	OUT:0-20mA
Zero scale temperature	ZSC: 300°C
Full scale temperature	FSC:1300°C
Address	ADR: 00
Baud rate	BAUD:19200
device temperature	DTMP: 25°C

If no buttons are pushed for about 15 seconds, the unit automatically returns to the temperature display.

SUB is not used in standard equipment. It is only used to enter a submenu (for example, for devices with controller). A submenu is shown with the name marked with the "less than" and "greater than" signs. For example: <CONTROLLER>

5.4 Devices with Profibus

With the universal Profibus connection you have the possibility to adapt a pyrometer of Metis series to a Profibus DP slave.

The housing has got a prolongation of approx. 20 cm to integrate the profibus adapter.

5.4.1 Preparation of the Slave (Pyrometer)

Baud rate: The baud rate will be recognized automatically. The following Profibus baud rates will be supported:
12 MBaud, 6 MBaud, 3 MBaud, 1.5 MBaud, 500 KBaud, 187.6 KBaud, 93.75 KBaud, 45.45 KBaud, 19.2 KBaud, 9.6 KBaud.

Open the rear panel of the device (see section **5**).
Here you find 10 miniature switches.

- **PB / RS:**
  - **PB:** Profibus operation
  - **RS:** interface operation (RS232 / RS485). On this position the pyrometer connector provides a RS232 (or RS485) serial interface, e.g. to change the parameters of the pyrometer via a terminal program or *SensorTools* software.

- **232 / 485** (only active, if PB/RS is set to RS)**:**
  - **232:** Serial interface RS232 on the pyrometer connector
  - **485:** Serial interface RS485 on the pyrometer connector

- **S1-S7:** corresponds to the Profibus address in binary code (with switch S1 is the LSB and switch S7 the MSB).

  Before commissioning the Profibus slaves, assign a unique Profibus address.
  The standard Profibus address at delivery is the address. 9

  With the switches S1-S7 an address between 0 and 127th can be set.

  Example: Profibus address 23:
  corresponds in binary: 00101111_2 =>
  S7=OFF, S6=OFF, S5=ON, S4=OFF, S3=ON, S2=ON, S1=ON.

Address	S7	S6	S5	S4	S3	S2	S1
0	OFF	OFF	OFF	OFF	OFF	OFF	OFF
1	OFF	OFF	OFF	OFF	OFF	OFF	ON
2	OFF	OFF	OFF	OFF	OFF	ON	OFF
3	OFF	OFF	OFF	OFF	OFF	ON	ON
4	OFF	OFF	OFF	OFF	ON	OFF	OFF
5	OFF	OFF	OFF	OFF	ON	OFF	ON
6	OFF	OFF	OFF	OFF	ON	ON	OFF
7	OFF	OFF	OFF	OFF	ON	ON	ON
8	OFF	OFF	OFF	ON	OFF	OFF	OFF
9	OFF	OFF	OFF	ON	OFF	OFF	ON
10	OFF	OFF	OFF	ON	OFF	ON	OFF
...	...	...	...	...	...	...	...
63	OFF	OFF	ON	ON	ON	ON	ON
64	ON	OFF	OFF	OFF	OFF	OFF	OFF
...	...	...	...	...	...	...	...
127	ON	ON	ON	ON	ON	ON	ON

- **Switch PBM1 / PBM2:** Format of the Profibus mode:
  - **PBM2:** Compatibility format to earlier formats (19 Bytes Input, 3 Bytes Output).
    For Metis MQ devices this mode is not available. The switch position is ignored in this unit.
  - **PBM1:** Newer format (32 Bytes Input, 16 Bytes Output).
    Recommended if compatibility with previous Profibus adapter is not necessary.

- **TEST:** in Profibus mode without function.

5.4.2 Slave Installation to the Master

- **Device master file** (**GSD file):** Included in the CD (*SensorTools*) is also a device master file, named **hms_1810.gsd**. When installing *SensorTools* this file is also copied to the installation directory.
  As with Profibus usual, this file must be included in the configuration of the master (PLC). As the name of the Master "AnyBus IC PDP" is specified.

- **Input / output configuration:** Please use your master to read out the I/O configuration directly or adjust the configuration manually to 19 byte input and 3 byte output for configuration.

  Specify at the older format **19 bytes input** and **3 bytes output**.
  Specify at the newer format **32 bytes input** and **16 bytes output**.

- **Assignment of I /O bytes:** the input / output bytes have a fixed assignment for interpretation the data by the master. A distinction is made between input bytes (data from the pyrometer to Master) and output bytes (data from the master to the pyrometer)

5.4.3 Older Profibus Format PBM2

Assignment of the 19 input bytes:

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
A	A	A	A	B	B	B	B	C	D	E	F	G	G	H	H	I I I I I	J J J J	K K K K	L L L L	M M M M

Bytes	Meaning
AAAA	Temperature value (4 digit. hex. in 1/10°C) Special case: F000h = invalid measuring value (overflow)
BBBB	Emissivity (4 digit. dec. in ‰) 1000 = 100%

C	Response time (1 digit hex.; 0...6) 0=Intrinsic time constandt	1=0.01 s 2=0.05 s	3=0.25 s 4=1 s	5=3 s 6=10 s
D	Clear time (1 digit hex. 0...8) 0 = peak picker off	1=0.01 s 2=0.05 s 3=0.25 s 4=1 s	5=5 s 6=25 s 7=external clear 8=automatic clear	
E	Output (1 digit hex. ; 0, 1) 00 = 0–20mA 01 = 4–20mA			
F	Unused			
GG	Device temp. (2 digit. hex) refer to gt command *			
HH	Error status (2 digit. hex) refer to fs command *			
IIIIII	Manufacturer ID (6 digit. hex) (internal use only)			
JJJJ	ZSC (zero scale temperature of basic range) refer to mb command *			
KKKK	FSC (full scale temperature of basic range) refer to mb command *			
LLLL	ZSC (zero scale temperature of sub range) refer to me command *			
MMMM	FSC (full scale temperature of sub range) refer to me command *			

 * See **10**, **Interface commands**

Assignment of 3 output bytes:
The 1st byte is always the writing command. The 2nd and 3rd byte specifies the parameters of the write command.

Byte 1	Byte 2	Byte3
Command	Parameter 1	Parameter 2

The following write commands are available

Command	Parameter 1	Parameter 2		
00h No Command	unused	unused		
01h Emissivity	Dec. 4 digit 1000 = 100% or 0990 = 99%			
02h Response time	00h	00h – minimum 01h – 0.01 s 02h – 0.05 s	03h – 0.25 s 04h – 1 s 05h – 5 s	06h – 10 s
03h Maximum storage	00h	00h – minimum 01h – 0.01 s 02h – 0.05 s	03h – 0.25 s 04h – 1 s 05h – 5 s	06h – 25 s 07h – ext clear 08h – autom. clear
04h Analog output	00h	00h – 0-20 mA 01h – 4-20 mA		
05h Subrange (Lower limit) no plausibility check!	Temperature value in Hex. HI-Byte	Temperature value in Hex. LO-Byte		
06h Subrange (Upper limit) no plausibility check!	Temperature value in Hex. HI-Byte	Temperature value in Hex. LO-Byte		
07h External clear of max. value	00h	01h		
08h Reset	unused	unused		

Note: Please ensure, the master will set all 3 bytes simultaneous. Otherwise, both parameter bytes must be set first, followed by the command byte some milliseconds later (depending on the profibus baud rate). After this operation set the command byte back to 00h. Now the parameter bytes can be changed again.
The pyrometer accepts all parameter changes, while the command byte is set.

5.4.4 New Profibus Format PBM1

Assignment of the 32 input bytes:

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
AAAA		BBBB		C	D	EE		GG	HH	--		II II II		JJ JJ		KKKK	

17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
LLLL		MMMM		----		----		----		----		----		----	

Bytes	Meaning
AAAA	Temperature value (4 digit. hex. in 1/10°C) Special case: F000h = invalid meas. Value (overflow)
BBBB	K1 Temperature value (4 digit. hex. in 1/10°C) Special case: F000h = invalid meas. value (overflow)
C	Response time (1 digit hex.; 0...6) 0=Intrinsic time constandt 1=0.01 s 3=0.25 s 5=3 s 2=0.05 s 4=1 s 6=10 s
D	Clear time (1 digit hex. 0...8) 1=0.01 s 5=5.00 s 0 = peak picker off 2=0.05 s 6=25.00 s 3=0.25 s 7=external clear 4=1.00 s 8=automatic clear
EE	Output (2 digit hex.; 0, 1) 00 = 0...20mA 01 = 4…20mA
GG	Device temp. (2 digit. hex) refer to gt command *
HH	Error status (2 digit. hex) refer to fs command *
IIIIII	Manufacturer ID (6 digit. hex) (internal use only)
JJJJ	ZSC (zero scale temperature of basic range) refer to mb command *
KKKK	FSC (full scale temperature of basic range) refer to mb command *
LLLL	ZSC (zero scale temperature of sub range) refer to me command *
MMMM	FSC (full scale temperature of sub range) refer to me command *
----	Unused

* See **10**, **Interface commands**

Assignment of the 16 output bytes: The assignment of the output bytes has been designed, that all pyrometer commands that can be set on the RS232 / 485 interface, may also set on the Profibus. The first 15 bytes contain the interface command + <CR> without the device address in ASCII format. If all ASCII-Characters are set, the 16th byte (command byte) will be set to 01h or 03h. This will send the command to pyrometer. If you send the command with 03h, the response is set to the 32 input bytes. Pay attention, the response will be displayed as long as the command byte is set to 03h! At this time no pyrometer data and values will be display or refreshed!

Byte 1...Byte 15	Byte16
V24Command in ASCII format + CR	Command 00h = no command 01h = command without response 03h = command with response

5.5 Interface Operation

Using the device in the interface mode (for devices with rotary switch: response time switch to "RS". Devices with parameter switch: miniature switches **PB / RS** to **RS** and select appropriate interface **232 / 485**), all settings and device configurations can be made using a PC and the supplied software *Sensor-Tools* (see **7**, **Software *SensorTools***).
Further the communication to the pyrometer can be done directly via interface commands (see **10**, **Interface commands**). The commands can be used for writing an own control or can be entered via a terminal software.

6 Pyrometer Parameters

6.1 Temperature Sub Range

The temperature range can be scaled down in order to adapt it to specific measurement conditions (minimum range 51°C), e.g. to configure the automatic clear function of the peak picker (see **6.5**).

6.2 Temperature Simulation

About *SensorTools* software, a test current can be set to the output in order to simulate a temperature.

6.3 Emissivity ε

The emissivity indicates the radiation capacity of an object to be measured relative to a black body with the same temperature. To obtain correct readings, the emissivity must be taken into account in the measurement and adapted for the respective measuring material on the pyrometer.
Adjustable are values between 5 and 100%.

Is a window located between the measured object and pyrometer, the transmission loss must be compensated by correction of emissivity:

- Emissivity of the object in %
  x transmittance of the window in %
  divided by 100
  = emissivity to be set in percent

> ⓘ **INFO:**
> In case of doubt, take a comparative measurement with a thermocouple to determine the correct emissivity.
> Emissivity that is set incorrectly by 10% causes the following measurement deviations at a temperature of 300°C:
> - MP23: +10% = 5°C; -10% = 4.5°C
> - MP25: +10% = 6°C; -10% = 6°C
> - MB35: +10% = 8.5°C; -10% = 9°C

Measuring object	Emissivity [%]	
	MP23/25	MB35/39
Black bodies	100	100
Iron (heavily scaled)	85-90	80
Iron mill scale	80-88	75
Copper	5	5
Copper (oxidized)	70-80	80
Inconel	30	20
Inconel (oxidized)	70-80	80
Brass	18	12
Brass (oxidized)	65-70	65
Titan (polished)	5	35
Titan (oxidized)	75-80	70
Molybdenum	25	15
Molybdenum (oxidized)	75-80	80
Nickel	15-20	15
Porcelain (glazed)	60	70
Porcelain (rough)	80-90	85
Graphite	80-90	80
Stoneware (glazed)	80-90	90
Brick	80–90	80–90
Soot	95	95

6.4 Response Time t₉₀

The response time specifies the time that the pyrometer requires to track 90% of a sudden temperature change on the signal output.
The response time depends on the requirements of the respective measuring task and can be adjusted.
- If a short response time is selected, the temperature measurement follows the actual temperature curve accurately. Short setting thus allowing the detection of briefly occurring temperature peaks, which occur especially in fast heating processes or fast moving samples.
- At longer response times, the measurement signal is smoothed and average values for temperature fluctuations are formed caused by the inertial measurement.

> ⓘ **INFO:** At the beginning of temperature range with a low emissivity setting and fastest response time, measurement uncertainties can be caused by noise. This can be compensated by changing the response time to a slower time.

Pyrometer Parameters

6.4.1.1 Dynamic Adaptation at Low Signal Levels

The dynamic response time adaption automatically creates longer response times at the beginning of the temperature range.
The following table shows the dependence of the response time to the measuring temperature:

Response time t_{90} [ms]	Temperature range [°C]							
	MP23	MP25				MB35		
	130-700	75-550	100-700	160-1200	200-1300	35-700	50-700	100-1000
125	130-170	75-130	100-160	160-250	200-260	35-140	50-140	100-180
8	170-250	130-190	160-240	250-360	260-380	140-230	140-230	180-280
3	250-700	190-550	240-700	360-1200	380-1300	230-700	230-700	280-1000

6.5 Peak Picker (Maximum Value Storage) / Clear Time t_{CL}

The maximum value storage always records the highest value during a measurement and holds it until it is deleted manually or automatically:

Off: The peak picker is switched off and the instantaneous value is measured.

Clear externally: The maximum value is cleared manually by an external button or machine contact (connection see **3.1.4 Digital Inputs**). The external clearing also can be carried out via interface command `lx` (see **10**).

Automatically: The maximum value is cleared, if after a "cold break" a new hot measuring object appears in the measuring beam. "Cold break" means that the measuring temperature must be below of the beginning of the temperature range. The "cold break" must correspond to at least the length of the set response time.

Time 0.01…25 s: Clears the maximum value after the specified time (**Note:** At too long clear times important temperature information can be lost at sinking temperatures).

6.6 Baud Rate

The baud rate of the serial interface can be set:
- for devices with rotary switches from 1.2 to 57.6 kBd
- for devices with switcheable interface RS232/485 from 1.2 to 115.2 kBd.

6.7 Address

In bus operation an address between 00 and 97 can be assigned.
Additionally, the global address 99 can be used to communicate with every pyrometer, independent of the set device address. This allows communication with devices which have unknown addresses. The address 98 is a group address used for RS485 devices. Devices do not answer with this address, useful to change parameters of all connected devices at the same time.

6.8 Interface Delay (Answer Delay)

(Not available on all models)
When using a pyrometer via RS485 (half-duplex), It may happen that the connection is not fast enough to detect the response of the pyrometer to a command from the master, e.g. because the line is still busy with sending before receiving. This sometimes occurs with older PCs or interface adapters or by slow switching-times of interface adapters and manifests itself in transmission errors of interface commands, so errors when parameters are changed or of measured values transmission.
In this case a delay for delaying the data transfer can be entered, the value specifies the main circulating time and can be set from 00-20. The transmission of commands to the pyrometer is thus somewhat delayed, but it can work with existing peripherals.

7 *SensorTools* Software

7.1 Installation

With the minimum requirements devices can be connect and configured. When capturing or recording data, the performance is potentially impaired, that is errors or interruptions in data transfer can occur. With the recommended requirements all software features should be fully available.

Min. system requirement: Pentium IV processor with min. 1.6 GHz and 2 GB RAM
20 MB hard drive capacity for the program
RS232 or RS485 interface or USB2 (pyrometer connection with optional interface converter)

Recommended: i7 multi-core processor with 3 GHz and 16 GB RAM
20 MB hard drive capacity for the program
RS485 interface

Screen resolution   min. 1024x768
Operation system: Windows Vista Ultimate, 7, 8, 8.1, 10

- Start the setup program setup from the provided CD or the downloaded file to install the software. A setup program received with an USB stick should be copied first to the hard drive.
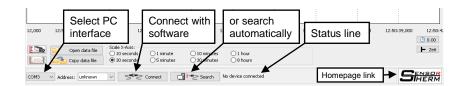- Follow the on-screen instructions

> **INFO:** There are regularly provided software upgrades available that add functionality or fix bugs. It is recommended always to install the latest software (available on the homepage in the download area under www.sensortherm.de/en/download-section or directly in *SensorTools* under **7.6 Communication / Options → Software version →** click: please check).

7.2 Program Start

Starting the software opens the main window of the program. The pyrometer is not connected automatically.

7.2.1 Connecting the Pyrometer

For successful communication with the pyrometer, it has to be connected first.

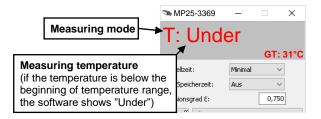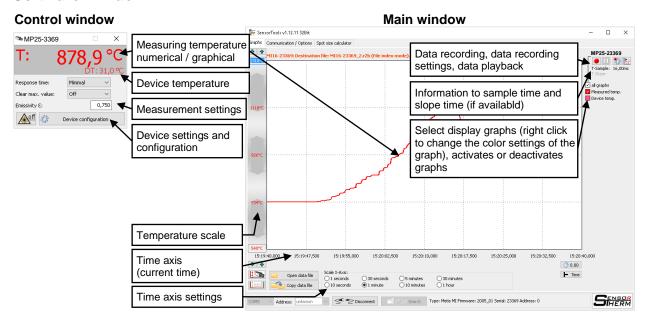|	
COM5	Select the computer's com port the pyrometer is connected to. Also a COM port must be selected when connecting via a USB converter.
Search	Press the search button if the com port is unknown. The pyrometer will be connected automatically if the port is found.
Connect	Press the connect button to connect the pyrometer to the software. All pyrometer settings will be read out and displayed in the software.
Disconnect	The button changes to "Disconnect" when connected. Click to disconnect.
Type: Metis MB Firmware: 2005_07 Serial: 910 Address: 00	The status line informs about device and connection status.

An identified pyrometer directly shows temperature information in temperature measuring mode (T) (numerically in the control windows and graphically in the graph window) as well as the internal device temperature (DT).
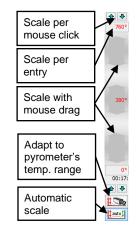

Measuring mode

Measuring temperature (if the temperature is below the beginning of temperature range, the software shows "Under")

7.3 Software Window

Control window   **Main window**

Measuring temperature numerical / graphical

Device temperature

Measurement settings

Device settings and configuration

Temperature scale

Time axis (current time)

Time axis settings

Data recording, data recording settings, data playback

Information to sample time and slope time (if availabld)

Select display graphs (right click to change the color settings of the graph), activates or deactivates graphs

7.3.1 Main Window → Graphs

The graph window in the main window shows the temperature profile in time.
- The **time axis** (horizontal axis labeling of the X-axis) indicates the current time.
- **Scale X-Axis** allows to set the time at which the graphs window is filled with measured values. If the time is changed, the graph rebuilds itself from the window center.
  - ├ Time rebuilds the graph from the left.
  - ⏱ 0.00 Sets a recording time to 0 (has only effect in the playback file)

- **Scale the graph:** Beginning and end of temperature scale (left) and control output (right) scale can be adjusted to represent the relevant area reasonable
  - **Scale per mouse click:** With the green arrows of the upper and lower scale range is changed
  - **Scale per entry:** The upper and lower temperature can be entered via the keyboard.
  - **Scale with mouse drag:** With click, hold and drag on the gray arrows, the start and end or the entire area can be moved.
  - **Automatic scale**
    - [icon] adapts the measuring temperature scale to the pyrometer's temperature range (+10°C above the maximum value and -10°C below the minimum value).
    - [auto icon] adapts the measuring temperature scale automatically when the current measured value runs out of the display window.
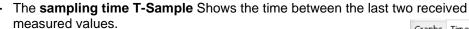
Scale per mouse click

Scale per entry

Scale with mouse drag

Adapt to pyrometer's temp. range

Automatic scale

- **Information field**
  - **MP25-3369** in the example on the right shows pyrometer model and serial number.
  - The **sampling time T-Sample** Shows the time between the last two received measured values.
  - When the **slope time measurement** is activated (If supported by the device), the slope time **T-Slope** shows the time elapsed between the start and the end temperature. The settings can be found in the "Time measurement" window.

MP25-3369
T-Sample: 16,00ms
T-Slope:

Graphs | Time measurement | Communication

☐ M309-7318: Slope measurement active
Start temp. 800,0 °C   Slope time:
End temp.: 500,0 °C   ms

- **Select display graphs:**
  - Depending on the device type, different graphs can be displayed or hidden; the color can be changed by right-clicking on a color field.
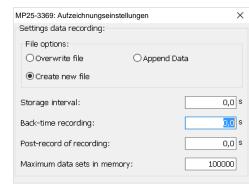
- ⏺️ ⏸️ **Record:**
  The transferred measured value data can be **recorded** on hard disk for subsequent analysis. Click the recording button to start and stop recording, the button flashes when recording is active (⏺️ ⚪), ⏸️ Pause interrupts the recording. When recording is active, a red reference text is displayed above the graphics window (pyrometer model-serial number: write file pyrometer model-serial ni-umber_sequential number.r2b).
  The amount of data that can be recorded depends on the baud rate (see **6.6**).

- 📈 The **playback button** opens the *SensorTools* viewer (see **7.5**) to display the last measured and, if necessary, the control values since the device was connected.

- 🔵 **Data Recording Settings**
  - window (colored) above the graph with pyrometer model and serial number, file name and a running number.
    - **Overwrite File** (**red**)**:** Overrides the same file with each new recording.
    - **Create new file** (**orange**) creates a separate file for each recording.
    - **Append data** (**green**)**:** With each new recording, the new values are appended to the previous one.
    - **Specify file name** (**violet**)**:** Each time a recording is started, first a window opens in which memory name and location must be entered.
  - **Storage interval:** Writes a reading in the file with the set storage interval. At 0.0 s, the storage is done as fast as possible (depending on baud rate and buffer mode).
  - **Back-time recording:** If the record button is pushed, values are stored retroactively for the entered time but only as many, as entered under "Maximum data sets in memory".
  - **Post-record of recording:** after stopping, recording can be continued for a while, e.g. to record a cool down process.
  - **Maximum data sets in memory:** Number of measurement data sets (consists of measuring temperature, emissivity, device temperature, setpoint-value...), the program maximum keeps in the memory to display this on back-time recording or in the playback window (MEM button), (data recording, however, is only limited by disk size).

- **Data Playback**
  - 📂 Open data file — Press the "**Load data**" button to open a saved file and display in the playback window (*SensorTools* viewer, see **7.5**). To compare several measurement curves, you can select several files, each file will be opened in a separate window.
  - 📂 Copy data file — Press "**Copy data file**" to copy one or separate files into another folder. Select the files you want to copy, the original files are not removed. In the next window a folder can be selected where files should be copied. Then a file name is suggested containing date and time. All selected files will be numbered in sequence with the chosen name.
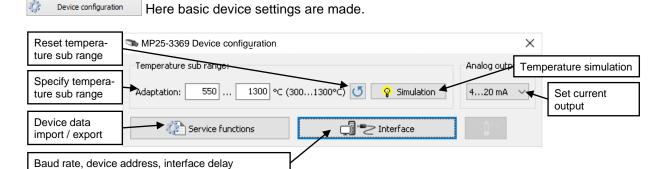
7.4 Control Window

- ▪ **T** stands for temperature and indicates the measuring temperature.
- ▪ The **internal device temperature (DT)** depends on the ambient temperature and the device self-heating.
  - ‑ Metis MB / MP models are permissible up to maximum 53°C, devices with Profibus up to 50°C.

- ▪ Changes to the **measuring parameters** are activated immediately and be transferred to the pyrometer.

  - ‑ The **response time t$_{90}$** (see **6.4**) can be adapted to the measurement conditions.
    Selecting "Minimal" the pyrometer works with the shortest possible devices response time.
    Via the selector times up to 10 s can be selected.
  - ‑ **Peak picker** (see **6.5**): switches on (and off) the peak picker (maximum value storage) and allows clear settings.
  - ‑ Emissivity Ɛ (see **6.3**): Adjustment to the surface properties.

- ▪ **Laser targeting light on / off** (devices with laser targeting light)**:** [laser off icon] [laser on icon] switching on and off.
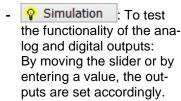
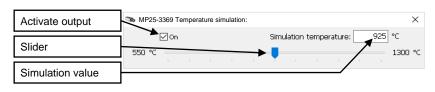> **CAUTION, Laser Radiation, Laser Class 2:**
> - ▪ Never look into the direct or reflected laser beam.
> - ▪ Do not point the laser to anyone.
> - ▪ If laser radiation hits the eye, the eye should be averted immediately.

Measuring value — Int. device temp. (DT) — Measurement parameters — Lasertargeting on / off (optional) — Device settings

7.4.1 Device Settings and Configuration

[Device configuration button] Here basic device settings are made.

Reset temperature sub range — Specify temperature sub range — Device data import / export — Baud rate, device address, interface delay — Temperature simulation — Set current output
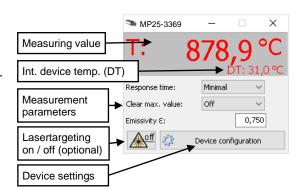
- ▪ **Temperature sub range** (also see **6.1**)**:** The temperature range span can be scaled down in order to adapt it to special measuring conditions (only in ° C).

  - ‑ [Simulation button]: To test the functionality of the analog and digital outputs:
    By moving the slider or by entering a value, the outputs are set accordingly.
    The output is only activated when the hook "on" is set.

Activate output — Slider — Simulation value
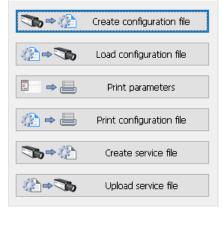
▪ **Service functions**

Service functions To back up, for printing or restore device parameters or create service files for remote diagnosis of problems.

- **Create configuration file:** A configuration file includes all device settings made by user. This can be used e.g. to setup a new pyrometer with the same values and settings or to save the current status in case of a device replacement.
- **Load configuration file:** Loading a previously saved configuration file to the pyrometer.
- **Print parameters:** Prints the parameters of the currently connected device.
- **Print configuration file:** Prints a saved file.
- **Create service file:** A service file includes all device data and all software settings made by user. Creating such a file can be useful where manufacturer's support is required.
- **Upload service file:** Transmitting a (possibly modified) file to the device it was created from.
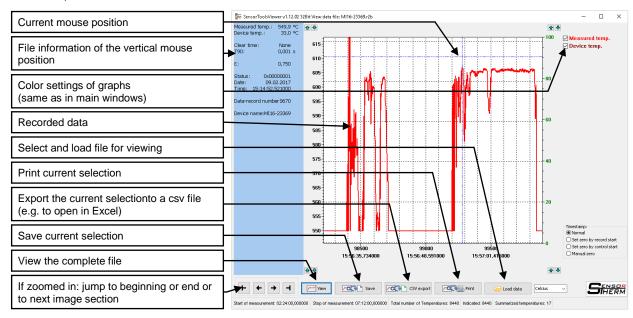
▪ **Interface**

Interface settings For setting the **baud rate** (see **6.6**), **device address** (see **6.7**) and **interface delay** (see **6.8**).

7.5 Data Playback

Press the playback button in the main windows to open a playback window and show the last measuring values. If no device is connected, press Load data (load data) to open and display a saved file in the playback window. Double-click on a data file, a separate viewer window opens with the same functions.

Hold down the mouse button and drag a selection to view a detail. To select details, a selection can be dragged with the mouse. To move the view, on the temperature or time scale the view can be moved with the mouse (middle of the scale) or the upper and lower limits are changed (upper or lower end of the scale).
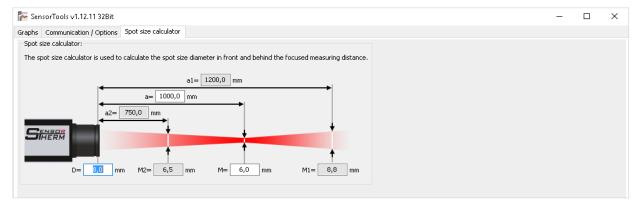
7.6 Communication / Options

- **Sprache/ Language:** Selects between German and English user interface.

- **Print configuration file** has the same function as in the device configuration under "service functions": Prints a stored device settings file.

- (Firmware Update H3 / M3 / DI / DS or CS / IF / RD / RF is not used at Metis pyrometers. The function is used to update the firmware of devices of the appropriate type).

- **Software version:** Clicking on "Please check" checks whether a *SensorTools* update is available. If a newer version than the Installed is available, the Download and Install button is activated.

- **Terminal:** The terminal field is a service field to communicate with a connected Sensortherm pyrometer via interface commands (see **10 Communication via Serial Interface / Interface Commands**). Type in commands without device address.
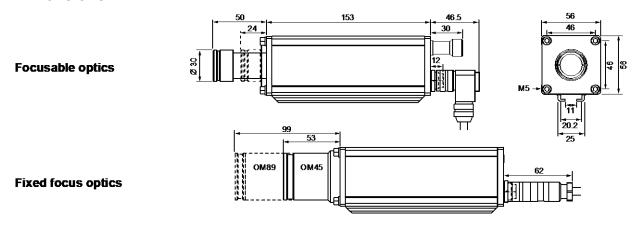
7.7 Spot Size Calculator

The spot size calculator is used to calculate the spot size diameter in front and behind the focused measuring distance (see **4.5.1**). To do this, fill the white fields with the basic data (see **4.5 Spot size tables**), then values in the gray fields can be calculated.

8 Technical Data

Model	MB35	MB39	MP23	MP25
Temperature ranges	35–700 50–700 100–1000	150-1000 500-2500	130–700	75–550 100–700 100–1200 200-1300
Temp. sub ranges	Any temperature sub-range adjustable within the temperature range (minimum span 50°C)			
Spectral range	2 – 5 µm	3.95 µm	2 – 2.6 µm	2 – 2.8 µm
Response time t_{90}	3 ms, adjustable up to 10 s			
Uncertainty (ε=1, t_{90}=1s, T_A=23°C)	± 0.5% of reading in °C + 1K		up to 400°C: ± 0.3% of reading in °C + 1K from 400°C: ± 0.5% of reading in °C + 1K	
Repeatability (ε=1, t_{90}=1s, T_A=23°C)	0.1% of reading in °C ± 1K			
Parameters	Via serial interface and PC software *SensorTools* or via self-compiled communication program: Emissivity, temperature sub range, settings for peak picker, device address (with RS485), baud rate, response time, selecting analog output 0 or 4–20 mA.			
Emissivity ε	5–100% in 1% steps			
Analog output	0/4–20 mA, switchable, isolated, max. load: 500 Ω.			
Serial interface	Devices with ▪ Rotary switch (interface RS232 or RS485): baud rate 1.2–57.6 kBd. ▪ Switchable interface RS232 / RS485: baud rate 1.2–115.2 kBd. Resolution 0.1°C			
Peak picker	Automatic hold mode or manual time settings to clear (reset)			
Power requirement	24 V DC (15–30V AC / DC), 48–62 Hz, maximal 6 VA, devices with Profibus max. 7 VA			
Isolation	Measurement circuit and connections galvanically separated from the operating voltage			
Sighting (optional)	▪ Through-lens sighting with adjustable attenuation filter for eye protection of bright targets ▪ Laser targeting light (red, λ=650 nm, P< 1 mW, class 2 to IEC 60825-1)			
Ambient temperature	0–53°C 0-50°C for devices with Profibus			
Storage temperature	-20–60°C			
Relative humidity	No condensing conditions			
Housing / protection class	Aluminum / IP65 (with connected connector)			
Weight	700 g			
CE label	According to EU directives for electromagnetic immunity			

8.1 Dimensions

Focusable optics

Fixed focus optics

8.2 Storage

Store packages under the following conditions:

- Do not store outdoors
- Store dry and dust-free
- Do not exposed to corrosive media
- Protect from direct sunlight

- Avoid mechanical vibrations
- Storage temperature: -20 to 60°C
- Relative humidity: max. 95%,
  no condensing conditions

8.3 Composition of the Type Number

The equipment version of the pyrometer is encoded in the 18-digit model number (devices with rotary switch) or 21 digit model number (devices with digital display and switchable interface) as follows (example 18-digit type number MP25 with 75–550°C; laser targeting light, RS232):

Digit	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21
Example:	M	P	2	5	0	0	7	5	0	5	5	0	1	1	2	3	3	0	1	1	1

Digit	Indication of the various points	Code	Meaning / Example
01	Series Metis	M	Metis
02	Detektor type	P	Lead sulphide
		B	Lead selenide
03-04	Center spectral range	23	2.3 µm
		25	2.5 µm
		35	3.5 µm
		39	3.95 µm
05-08	Beginning of temp. range [°C]	0075	e.g. 75°C
09-12	End of temperature range [°C]	0550	e.g. 550°C
13	Sighting	1	Laser targeting light
		2	Through lens sighting
14	Serial interface	1	RS232
		2	RS485
		4	Profibus
		5	Switchable RS232 / RS485
15	Optics type	1	Fixed focus optics
		2	Focusable optics
16-17	Minimum response time	33	3 ms
18	Configuration	0	Standard
		9	Customer solution
19	Digital display	2	Without digital display
		1	With digital display and switchable serial interface RS232 / RS485)
20	Additional analog output	0	Without (standard)
21	Digital input / output	0	Without
		1	2 limit switches (only with and switchable serial interface)

8.4 Accessories

It is recommended to purchase spare parts and accessories direct from Sensortherm (manufacturer).

Ref. number	Meaning
AL10-XX *)	Connection cable with right angled connector and targeting light button
AL11-XX *)	Connection cable with right angled connector
AL43-XX *)	Connection cable with straight connector
AM10-XX *)	Connection cable with right angled connector and targeting light button + 1 m interface cable with SUB-D plug
AM11-XX *)	Connection cable with right angled connector + 1 m interface cable with SUB-D plug
AM43-XX *)	Connection cable with straight connector + 1 m interface cable with SUB-D plug
AU11-XX *)	Connection cable with right angled connector + RS232⇔USB interface converter
AU43-XX *)	Connection cable with straight connector + RS232⇔USB interface converter
AV10-XX *)	Connection cable with right angled connector and targeting light button + RS485⇔USB interface converter
AV11-XX *)	Connection cable with right angled connector + RS485⇔USB interface converter
AV43-XX *)	Connection cable with straight connector + RS485⇔USB interface converter
DK5232	Interface converter RS232⇔USB, 1.7 m cable, open wire ends
DK5485	Interface converter RS485⇔USB, 1.7 m cable, open wire ends
NG12-00	Din-rail power supply 24 V DC, 1.6 A
NG15-00	Desktop power supply 24 V DC, 2.5 A
WB23-2-1-05	Wiring-Box: pre-assembled connection kit with desktop power supply, 5 m pyrometer connection cable and interface converter RS485⇔USB
IF00-00	LED digital indicator for panel mounting
KG10-00	Cooling jacket to 200°C ambient temperature
KG20-00	Cooling plate for devices with focusable lens
KG31-00	Cooling cap for devices with focusable lens
BL10-00	Air purge accessory for devices with fixed focus lens
HA10-00	Mounting bracket
HA20-00	Swivel mounting base
HA22-00	Swivel mounting base for cooling jacket

*) XX Specify length in meters (available in 5 m steps)

9 Maintenance

⚠️ **CAUTION, switch off supply voltage.**
Before beginning any maintenance, switch off power supply or pull connector on the pyrometer to prevent injury by accidentally activated laser targeting light!

9.1 Cleaning

Clean the lens with a soft cloth and a little acetone. Use only high-purity acetone to avoid residues.
The objective lens is not
- to clean with solvents that contain acid
- immerse in water or other liquids to clean

9.2 Change Optics Lens at Devices with Focusable Optics

The lens in pyrometers with manual focusable optics can be changed, e.g. for different measuring tasks or if it is scratched. The optics lenses are interchangeable without recalibration.

Preparation:
- Perform the work in dirt-free environment to prevent the penetration of contaminant and dirt in the pyrometer.

Lens change:
- Grab the optics (1) and unscrew the screw ring (2) with spreading pliers.
- To ensure the protection class IP65, an O-ring is placed under the lens, a damaged ring has to be replaced.
- Insert the new objective lens and tighten the screw ring.

9.3 Pyrometer Calibration

To obtain the measurement accuracy, we recommend to re-calibrate the pyrometer periodically (annually) with the help of calibration sources and optionally adjust at Sensortherm.

10 Communication via Serial Interface / Interface Commands

Interface commands are used to communicate directly with a Sensortherm pyrometer. Commands can be used to write an own access control or can be entered in the terminal field of the software *Sensor-Tools* (see **7.6 Communication / Service**) or entered via a terminal software. Data is exchanged in ASCII format with the following transmission parameters: **8 bit, 1 stop bit, even parity (8,1,e)**.

Command structure:
For successful communication the following sequence of a command is used:

Device Address - Command - Parameter

- **Device address:** all interface commands are starting with the 2-digit device address (exception: in the terminal field of the *SensorTools* software no address is required). In factory setting the device address is 00 but can be change per command.
  Device addresses from 00 to 99 are valid but 98 and 99 are with special functions. The global address 99 can be used to communicate with every pyrometer, independent of the set device address. This allows communication with devices which have unknown addresses. The address 98 is a group address used for RS485 devices. Devices do not answer with this address, useful to change parameters of all connected devices at the same time.
- **Command:** command have to be completed with a carriage return <CR> (decimal 13).
- **Parameter** (Unless otherwise specified, coded hexadecimal)**:**
  without parameter the command reads out the current set value. The answer at request commands is the set value of the device corresponding to the possible settings described in the table. Answers are normally finished with a <CR>. Deviating read commands are in parentheses in the respective write commands.
  With parameter the parameter will be set into the device. A setting command answers with ok+<CR>, this means the command is accepted.

Command	Parameter	Description / Settings
ms		Read measuring temperature (5-digit decimal number) ▪ The fifth place is a decimal place ▪ 77770: Thermostat is heating ▪ 88880: measured temperature is above of the end of temperature range
as	X	Analog output (1-digit decimal number) X=0, 1; 0 = 0–20 mA; 1 = 4–20 mA
bn		Read reference number (18 or 21 digit ASCII sequence) Meaning: see 8.3 Type number
br	X	Baud rate (1-digit decimal number) X=1–6, Devices wirth switchabel interface additionally 7: 0 = 1200 Baud 3 = 9600 Baud 6 = 57600 Baud 1 = 2400 Baud 4 = 19200 Baud 7 = 115200 Baud (only with 2 = 4800 Baud switchable interface)
em	XX	Emissivity in % as 2-digit decimal number XX = 20–99 = Emissivity 20–99% XX = 00 = Emissivity 100%
ez	X	Response time t_{90} (1-digit decimal number) X = 0–6 0 = intrinsic time constant of the device 1 = 0.03 s 3 = 0.25 s 5 = 3 s 2 = 0.05 s 4 = 1 s 6 = 10 s
ga	XX	Device address (2-digit decimal number) XX = 0–97 (99 = global address with answer, 98 = global adresse without answer)
gt		Read device temperature (2-digit decimal number in °C (00–98 °C)
lz	X	Clear time t_{CL} peak picker (1-digit decimal number) X = 1–9: 0 = peak picker off 1 = 0.01 s 3 = 0.25 s 5 = 5 s 7 = external clear 2 = 0.05 s 4 = 1 s 6 = 25 s 8 = automatic clear
lx	X	External clearing the peak picker X = 1-digit decimal number 0 = off 1 = Maximum value is deleted (same function as triggering an external button to delete the maximum value)
mb		Read temperature range (8-digit hexadecimal number) ▪ The first four digits specify the beginning of temperature range in °C ▪ The last four digits specify the end of temperature range in °C
m1	XXXXYYYY	Temperature sub range XXXX = beginning of temperature range in °C as 4-digit hexadecimal number, YYYY = end of temperature range in °C as 4-digit hexadecimal number)
pa		Display all parameters (11-digit decimal number) ▪ 1. and 2. digit: Emissivity in % (2-digit, 00=100%) ▪ 3. digit: Response time t_{90} ▪ 4. digit: Peak picker t_{CL} ▪ 5. digit: Analog outptut ▪ 6. and 7. digit: Internal device temperature ▪ 8. and 9. digit: Device address ▪ 10. digit: Baud rate ▪ 11. digit: no meaning (always 0)
sn		Read serial number (5-digit decimal number)
tm		Read Maximum device temperature (2-digit decimal number), 00–98°C)
tw	XX	Write interface response delay (Reading not possible, only via *SensorTools* software under Device configuration → Interface → Answer delay (2-digit decimal number) XX = 00–20 = relative delay factor
ve		Read device type and software version (6-digit decimal number) ▪ 1. and 2. digit: Device type MB / MP ▪ 3. and 4. digit: Month of software version ▪ 5. and 6. digit: Year of software version

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