



Serie IN 5 *plus*

IMPAC-Pyrometer

Operation Manual - Betriebsanleitung



Contents

General	2
Information about the user manual	2
Types of instruments	2
Limit of liability and warranty	2
Copyright	5
Legend	5
Terminology	5
Disposal / decommissioning	5
1 Technical data	5
1.1 Dimensions	7
2 Overview	8
2.1 Appropriate use	8
2.2 Scope of delivery	8
3 Safety	9
3.1 General	9
3.2 Laser targeting light	9
3.3 Electrical connection	9
4 Electrical Installation	9
4.1 Pin assignment for the connector on the back of the pyrometer	10
4.2 Connecting the pyrometer to a PC	10
4.2.1 Connecting to RS232 interface	10
4.2.2 Connecting to RS485 interface	11
4.3 Connection of additional analyzing devices	11
5 Mechanical installation	11
5.1 Accessories (option)	11
6 Sighting	12
6.1 Alignment with laser targeting light	12
6.2 Thermal alignment	13
7 Optics	13
8 Instrument settings	15
8.1 Switches at the instrument	15
8.1.1 Instrument switches	16
8.2 Online- / offline mode (ONL/OFFL)	16
8.3 Factory settings	16
9 Parameters / Settings	16
9.1 Settings at the pyrometer or via serial interface	16
9.1.1 Emissivity (Emi)	16
9.1.2 Exposure time t_{90}	17
9.1.3 Analog output 0/4 to 20 mA	18
9.2 Settings <i>only</i> via serial interface	18
9.2.1 Maximum / minimum value storage	18
9.2.2 Subrange	19
9.2.3 Baud rate	19
9.2.4 Address	19
9.2.5 Ambient temperature compensation	19
9.2.6 Wait time t_w (only available via interface commands, see 14, Data format UPP®)	20
9.2.7 Internal temperature of the pyrometer	20
9.3 Avoiding reading errors caused by faulty assembly	20

10	Settings via interface / software	20
10.1	Connecting the pyrometer to a PC.....	20
10.2	Installation	20
10.3	Program start	21
10.4	The start menu	21
10.5	Beginning	21
10.6	Number of devices	21
10.7	Basic settings	21
10.8	Measurement color bar	22
10.9	Measurement online trend	23
10.10	Listing (analyzing)	23
10.11	Trend output (analyzing)	24
10.12	Output .TXT file (analyzing)	24
10.13	PC sampling rate (time interval between two measurements)	24
10.14	Spot size calculator	24
11	Transport, packaging, storage.....	24
12	Maintenance.....	25
12.1	Safety	25
12.2	Service	25
13	Trouble shooting	25
14	Data format UPP® (Universal Pyrometer Protocol).....	26
15	Reference numbers	28
15.1	Reference numbers instruments	28
15.2	Reference numbers accessories	29
	Index.....	30

Copyright

All copyrights reserved. This document may not be copied or published, in part or completely, without the prior written permission of LumaSense Technologies GmbH. Contraventions are liable to prosecution and compensation. All rights reserved.

Legend

	Note: The note symbol indicates tips and useful information in this manual. All notes should be read with regard to an effective operation of the instrument.
	Security note laser beam: Indicates to the danger of a built-in laser targeting light.
MB	Shortcut for Temperature range (in German: Messbereich)

Terminology

The used terminology corresponds to the VDI- / VDE-directives 3511, page 4.

Disposal / decommissioning

Inoperable IMPAC pyrometers have to be disposed corresponding to the local regulations of electro or electronic material.

1 Technical data

Temperature ranges:	IN 5 plus -32 to 900°C (MB 9) IN 5-H plus -32 to 900°C (MB 9) IN 5-L plus 0 to 900°C (MB 9) IN 5/5 plus 100 to 1300°C (MB 13) 400 to 2500°C (MB 25) IN 5/5-H plus 200 to 1300°C (MB 13) 400 to 2500°C (MB 25) IN 5/5-L plus 200 to 1300°C (MB 13) 400 to 2500°C (MB 25) IN 5/4 plus 300 to 1300°C (MB 13) 500 to 2500°C (MB 25)
Sub range	any range adjustable within the temperature range minimum span 51°C
Spectral range:	IN 5 plus, IN 5-H plus, IN 5-L plus: 8 to 14 µm IN 5/5 plus, IN 5/5-H plus, IN 5/5-L plus: 5.14 µm IN 5/4 plus: 3.9 µm
Lens:	IN 5 plus, IN 5-H plus: Zinc-Sulfide (ZnS) IN 5-L plus: Zinc-Selenide (ZnSe) IN 5/5 plus, IN 5/5-H plus, IN 5/5-L plus: Zinc-Sulfide (ZnS) IN 5/4 plus: Zinc-Sulfide (ZnS)
Measurement uncertainty: dependent on object temperature T and am- bient temperature T _{amb} (ε = 1, t ₉₀ = 1 s):	IN 5 plus T= -32...0°C : 1.5°C (T _{amb} = 15...30°C); 2°C (T _{amb} = 0...15 or 30...63°C) T=0...300°C: 0.6% of reading in °C or 1°C (T _{amb} = 15...30°C) ¹⁾ 1% of reading in °C or 1.5°C (T _{amb} = 0...15 or 30...63°C) ¹⁾ T=300...900°C: 1% of reading in °C (T _{amb} = 15...30°C) 1.3 % of reading in °C (T _{amb} = 0...15 or 30...63°C) IN 5-H plus T= -32...0°C : 3°C (T _{amb} = 15...30°C); 4°C (T _{amb} = 0...15 or 30...63°C) T=0...300°C: 0.6% of reading in °C or 1.5°C (T _{amb} = 15...30°C) ¹⁾ 1% of reading in °C or 2°C (T _{amb} = 0...15 or 30...63°C) ¹⁾ T=300...900°C: 1% of reading in °C (T _{amb} = 15...30°C) 1.3 % of reading in °C (T _{amb} = 0...15 or 30...63°C)

¹⁾ Whichever value is greater. The instrument must be at a constant ambient temperature for a minimum of 15 minutes and has to be connected to the power supply.

	<p>IN 5-L plus T=0...300°C: 0.6% of reading in °C or 2°C ($T_{amb} = 15...30^{\circ}C$) ¹⁾ 1% of reading in °C or 3°C ($T_{amb} = 0...15$ or $30...63^{\circ}C$) ²⁾ T=300...900°C: 1% of reading in °C ($T_{amb} = 15...30^{\circ}C$) 1.5 % of reading in °C ($T_{amb} = 0...15$ or $30...63^{\circ}C$)</p> <p>IN 5/5 plus T=100...1300°C : 0.6% of reading in °C or 2°C ($T_{amb} = 15...30^{\circ}C$) ¹⁾ 1% of reading in °C or 1.5°C ($T_{amb} = 0...15$ or $30...63^{\circ}C$) ¹⁾ T=1300...1800°C: 0.8% of reading in °C ($T_{amb} = 15...30^{\circ}C$) ¹⁾ 1.2% of reading in °C ($T_{amb} = 0...15$ or $30...63^{\circ}C$) ¹⁾ T=1800...2500°C: 1% of reading in °C ($T_{amb} = 15...30^{\circ}C$) 1.4 % of reading in °C ($T_{amb} = 0...15$ or $30...63^{\circ}C$)</p> <p>IN 5/5-H plus T=200...1300°C : 0.6% of reading in °C or 2°C ($T_{amb} = 15...30^{\circ}C$) ¹⁾ 1% of reading in °C or 1.5°C ($T_{amb} = 0...15$ or $30...63^{\circ}C$) ¹⁾ T=1300...1800°C: 0.8% of reading in °C ($T_{amb} = 15...30^{\circ}C$) ¹⁾ 1.2% of reading in °C ($T_{amb} = 0...15$ or $30...63^{\circ}C$) ¹⁾ T=1800...2500°C: 1% of reading in °C ($T_{amb} = 15...30^{\circ}C$) 1.4 % of reading in °C ($T_{amb} = 0...15$ or $30...63^{\circ}C$)</p> <p>IN 5/5-L plus T=200...1300°C : 0.8% of reading in °C or 3°C ($T_{amb} = 15...30^{\circ}C$) ¹⁾ 1% of reading in °C or 4°C ($T_{amb} = 0...15$ or $30...63^{\circ}C$) ²⁾ T=1300...1800°C: 0.8% of reading in °C ($T_{amb} = 15...30^{\circ}C$) ¹⁾ 1.2% of reading in °C ($T_{amb} = 0...15$ or $30...63^{\circ}C$) ¹⁾ T=1800...2500°C: 1% of reading in °C ($T_{amb} = 15...30^{\circ}C$) 1.4 % of reading in °C ($T_{amb} = 0...15$ or $30...63^{\circ}C$)</p> <p>IN 5/4 plus T=300...1300°C : 0.6% of reading in °C or 4°C ($T_{amb} = 15...30^{\circ}C$) ¹⁾ 1% of reading in °C or 6°C ($T_{amb} = 0...15$ or $30...63^{\circ}C$) ¹⁾ T=1300...1800°C: 0.8% of reading in °C ($T_{amb} = 15...30^{\circ}C$) [*] 1.2% of reading in °C ($T_{amb} = 0...15$ or $30...63^{\circ}C$) ¹⁾ T=1800...2500°C: 1% of reading in °C ($T_{amb} = 15...30^{\circ}C$) 1.4 % of reading in °C ($T_{amb} = 0...15$ or $30...63^{\circ}C$)</p>
Repeatability: ($\epsilon = 1, t_{90} = 1$ s)	0.3 % of measured value in °C or 0.6 °C (whichever value is greater. The instrument must be at a constant ambient temperature for a minimum of 15 or 30 minutes; ¹⁾ and ²⁾ as stated above)
Noise Equivalent Temperature Difference (NETD): ($\epsilon = 1, \sigma = 1, T_U = 23^{\circ}C$)	<p>IN 5 plus: at $t_{90} = 80$ ms: 0.2°C (at 23°C meas. temperature) at $t_{90} = 1$ s: 0.05°C (at 23°C meas. temperature)</p> <p>IN 5-H plus: at $t_{90} = 10$ ms: 0.7°C (at 23°C meas. temperature) at $t_{90} = 1$ s: 0.1°C (at 23°C meas. temperature)</p> <p>IN 5-L plus: at $t_{90} = 180$ ms: 0.3 °C (at 23°C meas. temperature) at $t_{90} = 180$ ms: 0.2 °C (at 200°C meas. temperature) at $t_{90} = 1$ s: 0.15°C (at 23°C meas. temperature) at $t_{90} = 1$ s: 0.1°C (at 200°C meas. temperature)</p> <p>IN 5/5 plus: at $t_{90} = 80$ ms: 0.7°C (at 110°C meas. temperature) at $t_{90} = 1$ s: 0.4°C (at 110°C meas. temperature)</p> <p>IN 5/5-H plus: at $t_{90} = 10$ ms: 0.5°C (at 500°C meas. temperature) at $t_{90} = 10$ ms: 0.3°C (at 1100°C meas. temperature)</p> <p>IN 5/5-L plus: at $t_{90} = 80$ ms: 1.5°C (at 300°C meas. temperature) at $t_{90} = 80$ ms: 0.6°C (at 500°C meas. temperature) at $t_{90} = 1$ s: 0.4°C (at 300°C meas. temperature) at $t_{90} = 1$ s: 0.2°C (at 500°C meas. temperature)</p> <p>IN 5/4 plus: at $t_{90} = 80$ ms: 0.6°C (at 500°C meas. temperature) at $t_{90} = 80$ ms: 0.2°C (at 1100°C meas. temperature)</p>
Exposure time t_{90} :	IN 5 plus, IN 5/5 plus, IN 5/5-L plus, IN 5/4 plus: 0.08 s; adjustable in the pyrometer: 0.5 s; 1 s; 2 s; 5 s, adjustable via interface: 0.5 s; 1 s; 2 s; 5 s; 10 s; 30 s

¹ Whichever value is greater. The instrument must be at a constant ambient temperature for a minimum of 15 minutes and has to be connected to the power supply.

² Whichever value is greater. The instrument must be at a constant ambient temperature for a minimum of 30 minutes and has to be connected to the power supply.

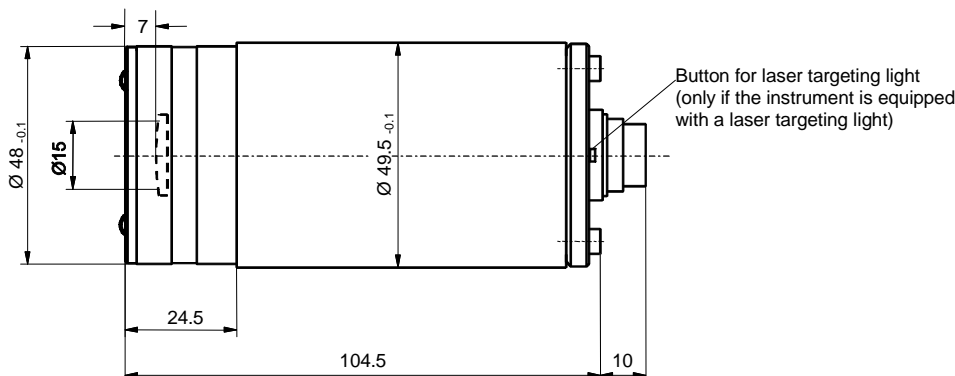
	IN 5-H plus, IN 5/5-H plus: 0.01 s; adjustable in the pyrometer: 0.5 s; 1 s; 2 s; 5 s, adjustable via interface: 0.5 s; 1 s; 2 s; 5 s; 10 s; 30 s IN 5-L plus: 0.18 s; adjustable in the pyrometer: 0.5 s; 1 s; 2 s; 5 s, adjustable via interface: 0.5 s; 1 s; 2 s; 5 s; 10 s; 30 s
Data handling:	Digital
IR-Detektor:	Thermopile

Power supply	24 V DC (18 to 30V DC) nominal, ripple must be less than 0.5 V
Power consumption:	Max. 70 mA
Analog output:	adjustable 0 to 20 mA or 4 to 20 mA (linear)
Load:	max. 500 Ω at 24 V (max. 200 Ω at 18 V)
Digital interface:	RS232 or RS485 (addressable, half-duplex) baud rate 1200 to 19200 Bd, resolution 0.1°C
Isolation:	Power supply, analog outputs and digital interfaces are electrically isolated from each other

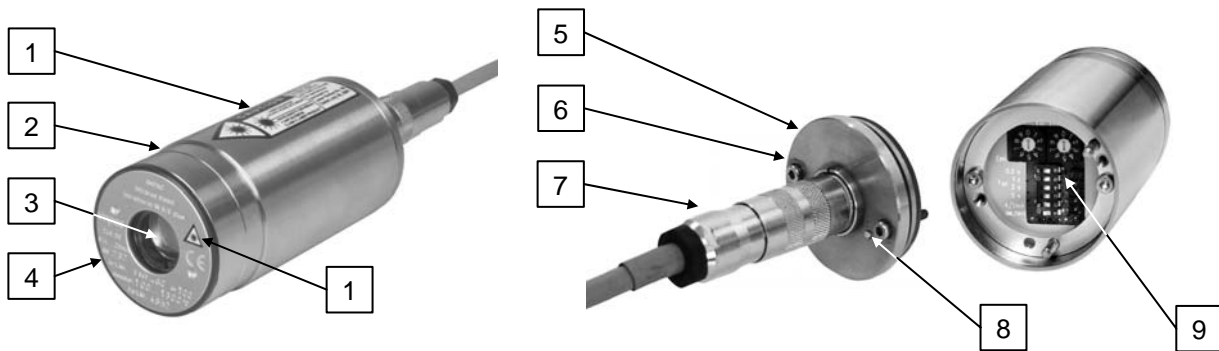
Parameters:	Adjustable on the pyrometer (in offline mode): Emissivity, exposure time, 0/4 to 20 mA analog output range, online- / offline switch Readable and adjustable via interface / PC (in online mode): Emissivity, exposure time, 0/4 to 20 mA analog output range, sub temperature range, automatic clearing of the max./min value storage, external clearing of the max./min value storage, clear times of the max/min value storage, address, baud rate, internal temperature °C / °F, max. / min. selection, activation of ambient temperature correction		
Emissivity:	0.2 to 1 switchable in the instrument (offline mode) or with the software <i>InfraWin</i> (online mode) in steps of 0.01		
Maximum value store/ Minimum value store	Built-in single and double store. Clearing with clear time t_{CL} (0.1 s; 0.25 s; 0.5 s; 1 s; 5 s; 25 s), external contact or via interface or also automatically with each new item to be measured		
Sighting (optional):	Laser targeting light (max. power level < 1 mW, $\lambda = 630-680$ nm, CDRH class II) <table border="1" style="float: right; margin-top: 10px;"> <tr> <td style="text-align: center;">CAUTION</td> </tr> <tr> <td style="text-align: center;"> LASER RADIATION DO NOT STARE INTO BEAM WAVELENGTH: 630-680nm < 1 mW MAXIMUM CLASS II LASER PRODUCT </td> </tr> </table>	CAUTION	LASER RADIATION DO NOT STARE INTO BEAM WAVELENGTH: 630-680nm < 1 mW MAXIMUM CLASS II LASER PRODUCT
CAUTION			
LASER RADIATION DO NOT STARE INTO BEAM WAVELENGTH: 630-680nm < 1 mW MAXIMUM CLASS II LASER PRODUCT			

Weight:	410 g
Housing:	Stainless steel
Relative humidity	Non condensing conditions
Operating position:	Any
Ambient temperature:	0 to 63°C (0 to 60°C for IN 5/5 plus MB 25)
Storage temperature:	-20 to 70°C
Protection class:	IP65 (DIN 40050)
CE-label:	according to EU directives about electromagnetic immunity

1.1 Dimensions



2 Overview



- | | | | |
|---|---|---|--|
| 1 | Laser warning label (only instruments with laser targeting light) | 5 | Housing rear panel |
| 2 | Stainless steel housing | 6 | Fixing screws for rear panel |
| 3 | Optics | 7 | Electrical connector |
| 4 | Type label | 8 | Laser targeting light button (only instruments with laser targeting light) |
| | | 9 | Setting keys at the pyrometer |

2.1 Appropriate use

IN 5 *plus*: The IMPAC pyrometer IN 5 *plus* is a stationary infrared thermometer for non-contact temperature measurement of non-metallic surfaces or painted, coated or anodized metals with a temperature range from -32 to 900°C.

IN 5-L *plus*: as IN 5 *plus*, with small spot size.

IN 5-H *plus*: as IN 5 *plus*, with shorter exposure time.

IN 5/5 *plus*: The IMPAC pyrometer IN 5/5 *plus* is a stationary pyrometer especially for non-contact temperature measurement of glass surfaces and quartz surfaces with temperature ranges between 100 and 2500°C.

IN 5/5-L *plus*: as IN 5/5 *plus*, with small spot size (temperature ranges between 200 and 2500°C).

IN 5/5-H *plus*: as IN 5/5 *plus*, with shorter exposure time (temperature ranges between 200 and 2500°C).

IN 5/4 *plus*: The IMPAC pyrometer IN 5/4 *plus* is a special pyrometer for non-contact temperature measurement of metal parts in flame heated furnaces and the measurement of glass if a small penetration into the glass is necessary (e.g. glass drop) (temperature ranges between 300 and 2500°C).

For optimal match of the instrument to the application the pyrometers are equipped ex works with the desired optics (for every instrument 3 different optics are available).

All settings which are necessary for a correct temperature measurement can be adjusted at the pyrometer itself (emissivity, exposure time, analog output (0 or 4 to 20 mA) and online- / offline-mode). Additionally further pyrometer settings can be made via serial interface RS232 or RS485 (specified when ordering) and a PC and the standard software *InfraWin*. Also temperature indication, analyzing of the measurement and data logging can be done with this software.

The type IN 5/5 *plus* can optionally be equipped with a laser targeting light for the exact alignment on the measuring object, all other types are always equipped with a laser targeting light.

2.2 Scope of delivery

Instrument with selectable optics, PC measurement and evaluation software „*InfraWin*“, allen key 2.5 mm, works certificate, operation manual.



Note:

A connection cable is not included with the instrument and has to be ordered separately (see section 15, Reference numbers).

3 Safety

This section offers an overview about important safety aspects. Additionally in the several sections there are concrete safety aspects to avert danger. These aspects are indicated with symbols. Labels and markings at the instrument have to be noticed and kept in a permanent readable condition.

3.1 General

Each person working with the pyrometer must have read and understood the user manual before operation. Also this has to be done if the person already used similar instruments or was already trained by the manufacturer.

The pyrometer has only to be used for the purpose described in the manual. It is recommended to use only accessories offered by the manufacturer.

3.2 Laser targeting light

For easy alignment to the measuring object the pyrometers can be equipped with a laser targeting light. This is a visible red light with a wavelength between 630 and 680 nm and a maximum power of 1 mW. The laser is classified as product of laser class II.



Warning: To reduce the risk of injury to the eyes, do not look directly into the targeting laser and do not point the targeting laser into anyone's eyes. The instrument is equipped with a class II laser that emits radiation.



Safety regulations:

- Never look directly into the laser beam. The beam and spot can be watched safely from side.
- Make sure that the beam will not be reflected into eyes of people by mirrors or shiny surfaces.

3.3 Electrical connection

Follow common safety regulations for mains voltage (230 or 115 V AC) connecting additional devices operating with this mains voltage (e.g. transformers). Touching mains voltage can be fatal. An incorrect connection and mounting can cause serious health or material damages.

Only qualified specialists are allowed to connect such devices to the mains voltage.

4 Electrical Installation

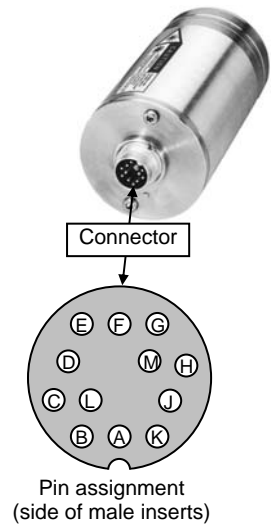
The series 5 pyrometers are powered by 24 V DC nominal (possible range: 18 to 30 V DC, ripple must be less than 0.5 V). When connecting the device to the power supply ensure correct polarity. The instrument has no warm-up time, with connection to the power the instrument operates immediately, but still needs 15 or 30 min (depending on the type, see technical data) to achieve its full accuracy. To switch off the instrument, interrupt the power supply or unplug the electrical connector.

To meet the electromagnetic requirements (EMV), a shielded connecting cable must be used. The shield of the connecting cable has to be connected only on the pyrometer's side. On side of the power supply (switch board) the shield must be open to avoid ground loops.

LumaSense offers connecting cables, they are not part of standard scope of delivery. The connecting cable has wires for power supply, interface, analog output, external laser switch and external clear of maximum value storage via contact (see section 15, **Reference numbers**) and 12 pin connector. The cable includes a short RS232 adapter cable with a 9 pin SUB-D connector for direct PC communication. This adapter is not used in combination with RS485 interface.

4.1 Pin assignment for the connector on the back of the pyrometer

Pin	Color	Indication
K	white	+ 24 V power supply (18 to 30 V)
A	brown	0 V power supply
L	green	+ I _{output} . analog output
B	yellow	- I _{output} . analog output
H	gray	external switch for targeting light (bridge to K)
J	pink	external clearing of maximum value storage (bridge to K) *)
G	red	DGND (ground for interface)
F	black	RxD (RS232) or B1 (RS485)
C	violet	TxD (RS232) or A1 (RS485)
D	gray/pink	B2 (RS485) (bridge to F)
E	red/blue	A2 (RS485) (bridge to C)
M	orange	screen only for cable extension, don't connect at the switchboard



*) for setting of clear time to "extern" (see 9.2.1 Maximum / minimum value storage)

4.2 Connecting the pyrometer to a PC

The pyrometers are equipped with a serial interface RS232 or RS485 (switchable at the pyrometer). Standard on a PC is the RS232 interface. At this interface one pyrometer can be connected if the interface is set to RS232. Only short distances can be transmitted with RS232 and electromagnetic interferences can affect the transmission.

With RS485 the transmission is to a large extend free of problems, long transmission distances can be realized and several pyrometers can be connected in a bus system. If RS485 is not available at the PC, it can be realized with an external converter which converts the RS485 in RS232 for a standard connection to a PC.

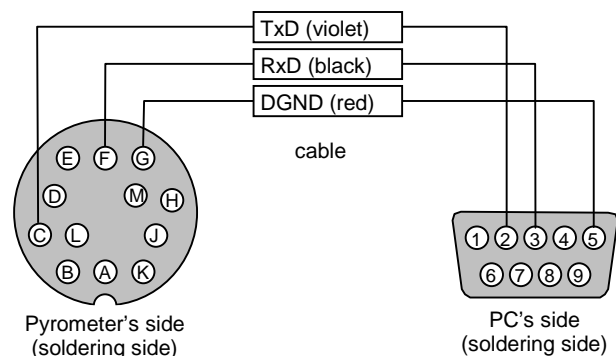
When using a converter RS485 ⇔ RS232 take care, that the converter is fast enough to receive the pyrometer's answer to an instruction of the master. Most of the commonly used converters are too slow for fast measuring equipment. So it is recommended to use the LumaSense converter I-7520 (order no. 3 852 430).

4.2.1 Connecting to RS232 interface

The transmission rate (in baud) of the serial interface is dependent on the length of the cable. Values between 1200 and 19200 Bd may be set.

The baud rate has to be reduced by 50% when the transmission distance is doubled (see also 9.2.3 Baud rate)

Typical cable length for RS232 at 19200 Bd is 7 m.

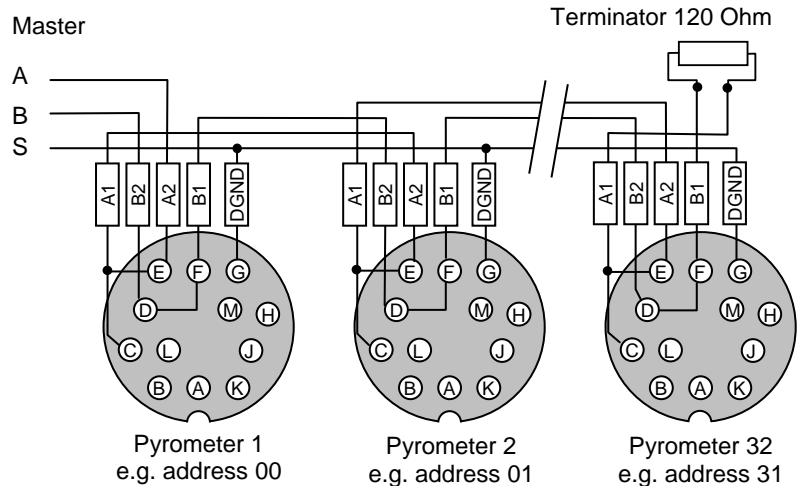


4.2.2 Connecting to RS485 interface

Half-duplex mode:

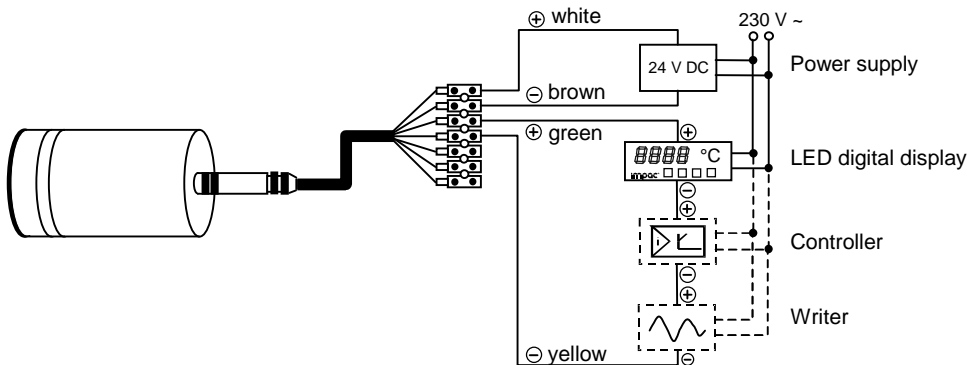
A1 and A2 as well as B1 and B2 are bridged in the 12-pin round connector of the connecting cable, to prevent reflections due to long stubs. It also safeguards against the interruption of the RS485 Bus system should a connecting plug be pulled out. The master labels mark the connections on the RS485 converter. The transmission rate of the serial interface in Baud (Bd) is dependent on the length of the cable. Values between 1200 and 19200 Bd may be set.

The baud rate is reduced by 50% when the transmission distance is doubled (see **9.2.3 Baud rate**). Typical cable length for 19200 Bd is 2 km.



4.3 Connection of additional analyzing devices

Additional analyzing instruments, for example a LED digital display instrument only needs to be connected to a power supply and the analog outputs from the pyrometer. Another Instruments like a controller or printer can be connected to the display in series as shown above (total load of resistance max. 500 Ohm).



5 Mechanical installation

5.1 Accessories (option)

Numerous accessories guarantee easy installation of the pyrometers. The following overview shows a selection of suitable accessories. You can find the entire accessory program with all reference numbers on section 15, **Reference numbers**.

Mounting:

For easy mounting and aligning the pyrometer to the measured object an adjustable *mounting angle* is available.



Mounting angle

Cooling:

The completely covered water cooling jacket made from stainless steel protects the pyrometer if exposed to a hot environment. It is designed for ambient temperatures up to 180°C.



Water cooling jacket with integrated air purge

Miscellaneous:

The *air purge* protects the lens from contamination with dust and moisture. It has to be supplied with dry and oil-free pressurized air and generates an air stream shaped like a cone.

The pyrometer can be easily fixed on a vacuum chamber with the KF 16 vacuum support with sighting window.



Air purge units



Vacuum support

Displays:

For temperature indication of the pyrometer LumaSense offers several digital displays which can also be used for remote parametrizing of the pyrometer.



Digital display DA 6000



LED large display

6 Sighting

For exact measurement of the object temperature the pyrometer must be aligned correctly onto the object. For this alignment the pyrometers are equipped with a laser targeting light (IN 5/5 plus optional). This laser enables the simple and accurate alignment even onto small objects. Pyrometers without laser targeting light are normally used for measurement of bigger objects for which exact alignment is not absolutely necessary. These pyrometers can be aligned only with the thermal method:

6.1 Alignment with laser targeting light

The laser point marks the center of the spot, not the exact size. The correct focusing distance with the smallest spot size is achieved when the laser point has its smallest size. The laser does not effect the temperature measurement.

The laser targeting light can be activated either by pressing the button at the rear side of the housing, by using an external contact (see **4.1 Pin assignment for the connector on the back of the pyrometer**), or with the *InfraWin* software. The laser can be switched off by pressing the button again or it is automatically switched off after approx. two minutes.



Laser targeting light button



Warning: To reduce the risk of injury to the eyes, do not look directly into the targeting laser and do not point the targeting laser into anyone's eyes. The instrument is equipped with a class II laser that emits radiation.



Note: The laser warning signs on the pyrometer should be easily viewable at all times, even after it has been installed.



Note: To prevent the damage of the laser, the pilot light switches off automatically if the internal temperature of the device exceeds approx. 50°C (it can switched-on again, if the internal temperature is lower than 50°C).

6.2 Thermal alignment

When measuring a hot object in front of a cooler background, it usually suffices to align the pyrometer to achieve the highest temperature reading.

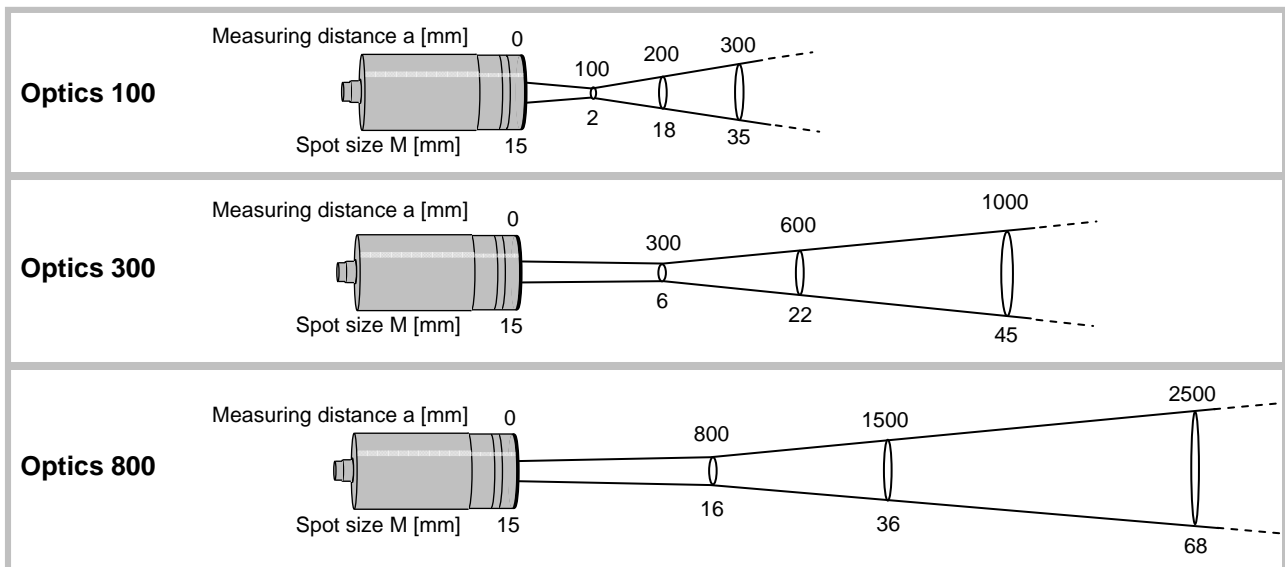
7 Optics

The pyrometers are equipped ex works with one of the following optics. These lenses are focusing to certain distances. In these distances each lens achieves its smallest spot size. The spot size will enlarge in any other distance (shorter or longer). Please notice that the measuring object must be as least as big as the spot size.

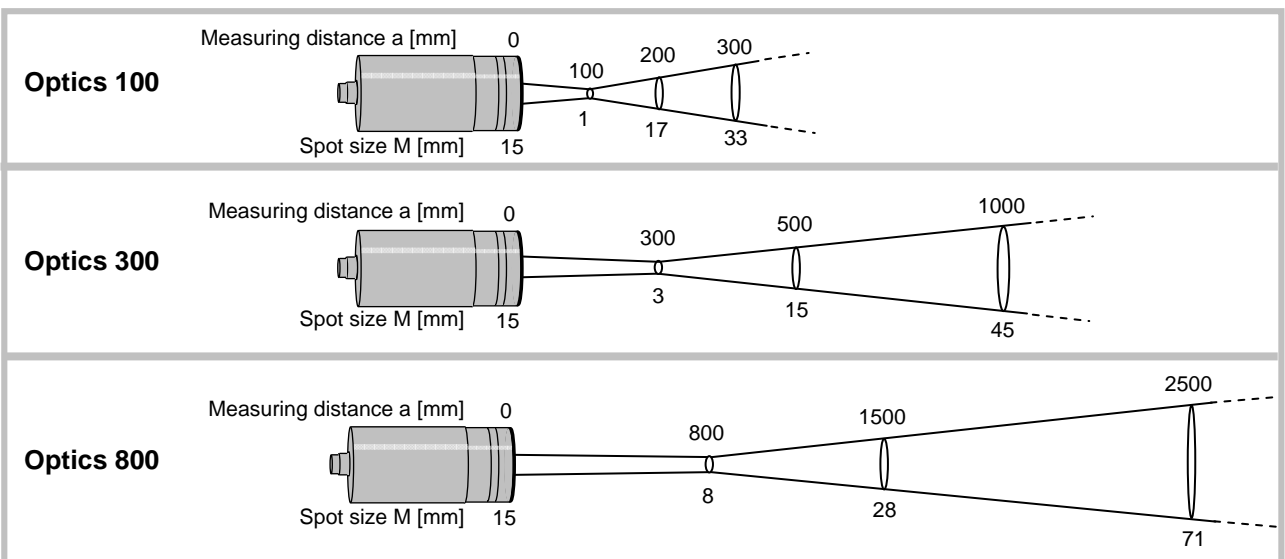
The name of the optics (e.g. optics 300) shows the measuring distance in mm (e.g. 300 mm) in which it has the smallest spot size (IN 5 plus, e.g. 6 mm).

The following drawings show the size of the spots in mm in dependence of the measuring distance. Values between the mentioned data can be calculated by interpolation. The spot size for measuring distance 0 is the aperture diameter of the optics.

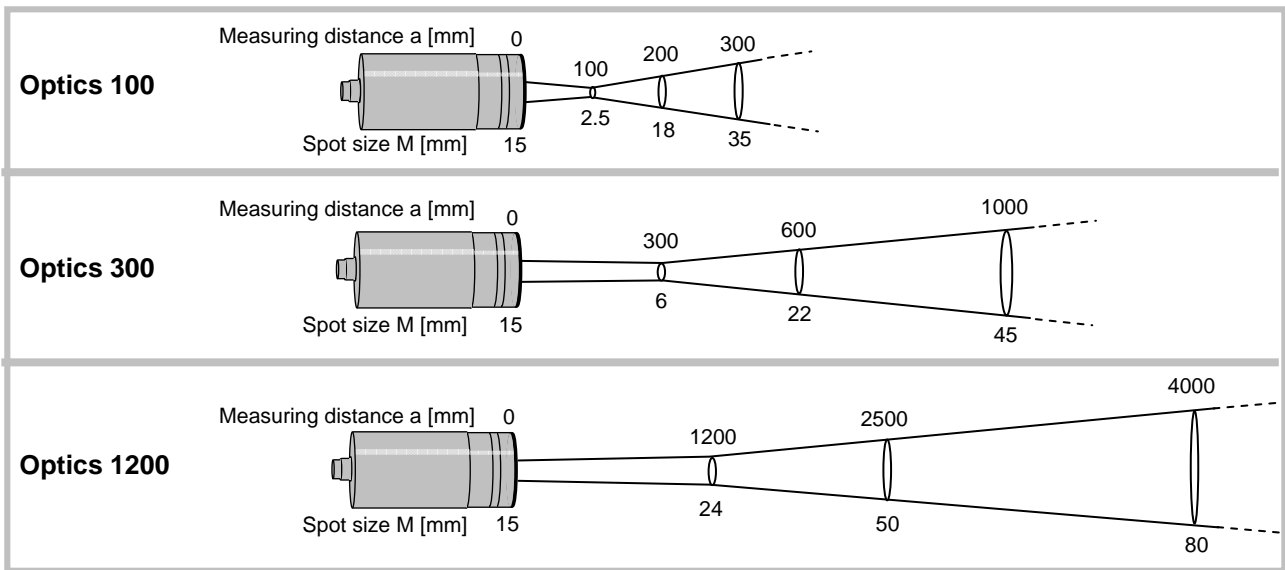
IN 5 plus, IN 5-H plus



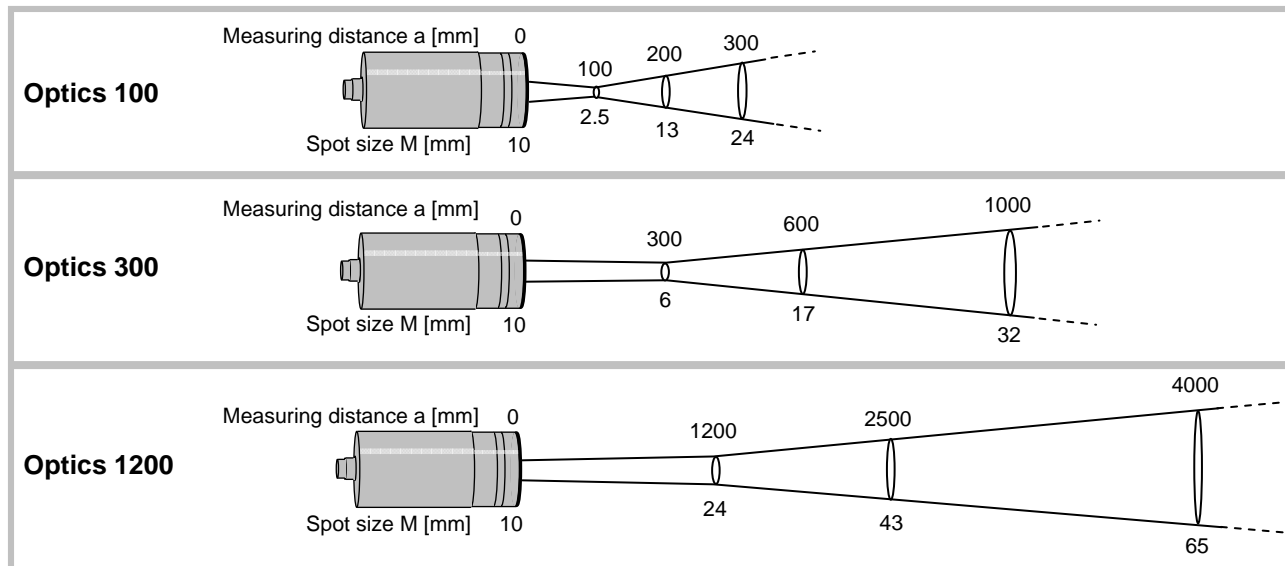
IN 5-L plus



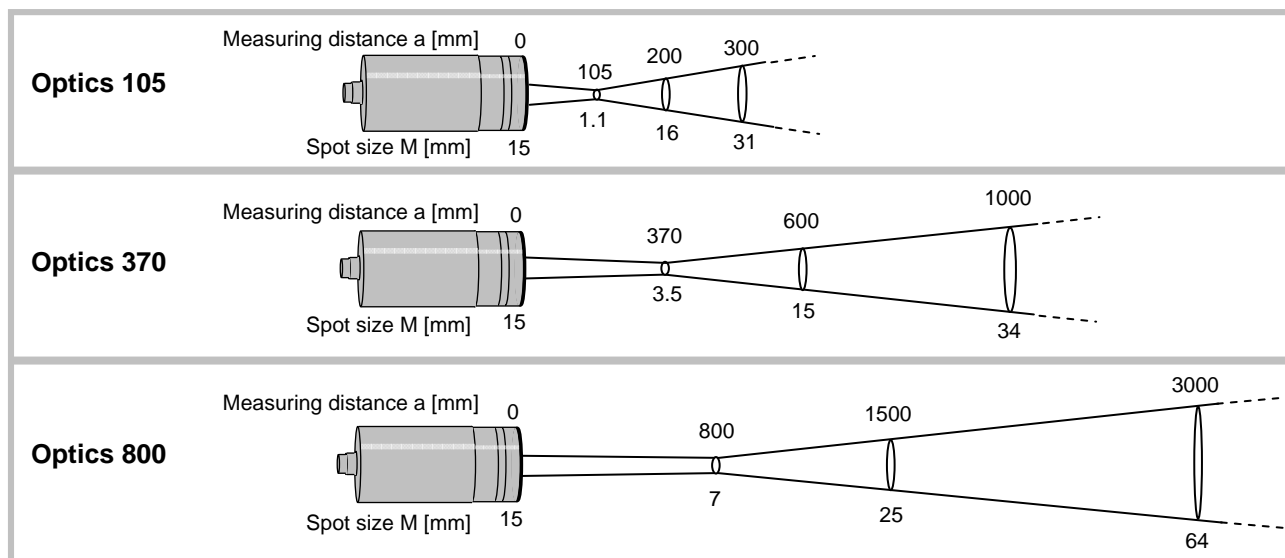
IN 5/5 plus, IN 5/5-H plus, IN 5/4 plus (each MB 13)



IN 5/5 plus, IN 5/5-H plus, IN 5/4 plus (each MB 25)



IN 5/5-L plus





Note: Please note that the optical profiles show nominal dimensions. The spot size diameter or the focal distance may be slightly different due to *lens tolerances*.

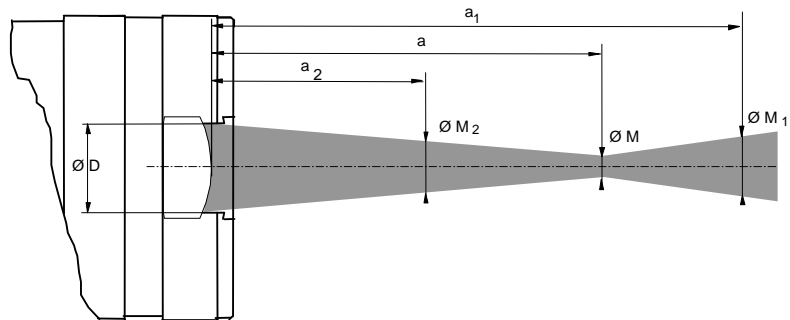


Note: The *InfraWin* program includes a **Spot size calculator** that roughly estimates the unknown values. The values represented here are for reference purposes.

Spot sizes for intermediate distances, that are not shown on the optical profiles, may be calculated using the following formula:

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

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



8 Instrument settings

Before using the pyrometer some basic settings should be taken. The basic settings can be done at the pyrometer itself, some further settings can be done via interface and software *InfraWin*.

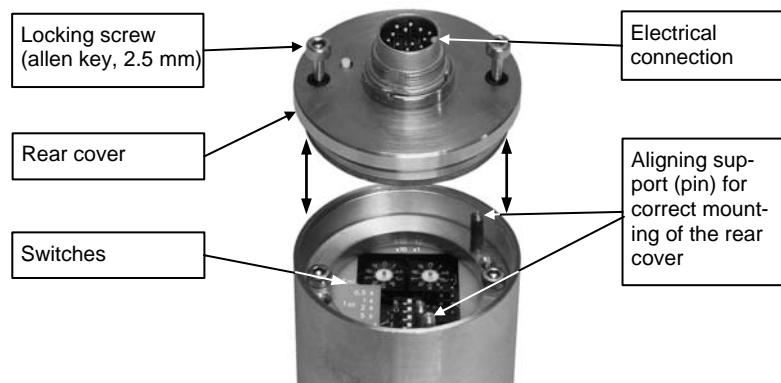
Settings at the instrument: The basic settings are emissivity, exposure time, analog output. These settings can be adjusted at the pyrometer only in offline mode (see **8.2 Online- / offline mode (ONL/OFFL)**).

Settings via serial interface: The pyrometer is equipped with a serial interface RS232 or RS485 (corresponding to the ordered version) which can be used for connection to a PC. With the standard software *InfraWin* (or a self written communication software) the following settings can be done (the pyrometer must be in online mode (ONL) to use this functions, see **8.2**): emissivity, exposure time, analog output, maximum value storage, minimum value storage, reading of the instrument's internal temperature, setting of an address for bus control with RS485 interface, setting of the baud rate, function for compensating of the off-set of the ambient temperature). Additionally *InfraWin* enables the temperature display and analysis.

8.1 Switches at the instrument

The *controls / switches* are located under the rear cover of the pyrometer and can be accessed by removing the rear cover in the following way:

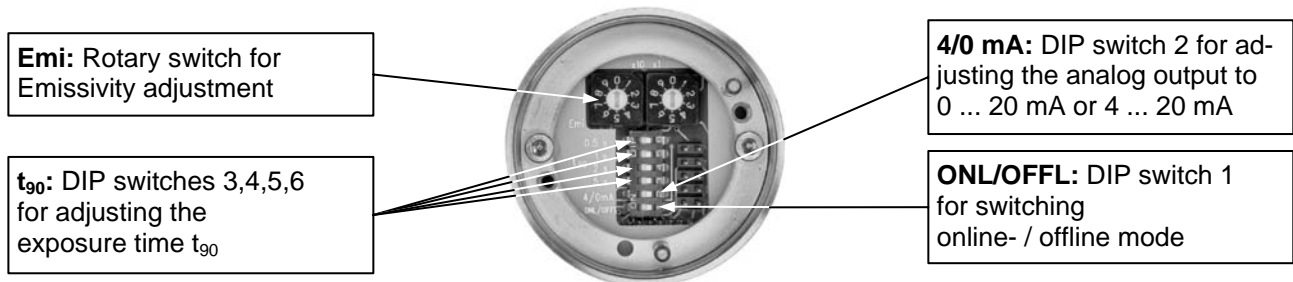
1. Disconnect the electrical connection
2. Unscrew the rear screws with a 2.5 mm allen screw
3. Take the cover off, making sure it remains straight (without bending or twisting it).



Assembling:

When reassembling the cover, insert it carefully into the guide pins and then fasten it with the screws. The connector cable can now be plugged in.

8.1.1 Instrument switches



For a description of the setting see section 9, Parameters / Settings

8.2 Online- / offline mode (ONL/OFFL)

Offline (OFFL): If the settings directly at the pyrometer should be used (emissivity, exposure time and analog output) the pyrometer must be switched into offline mode (OFFL). In the offline mode these parameters can not be adjusted via digital interface and PC, they can only be read! This prevents incorrect set-up or undesired changes via the interface. All additional available parameters (see 9.2 Settings **only via serial interface**) always can be altered via serial interface.

Online (ONL):

When switched to the online mode (ONL), only the serial interface can be used to set the values for the parameters - the instrument's switch settings are ignored. The device is initialized in "online" mode, i.e. it uses the last values set via serial interface!

8.3 Factory settings

Instrument settings:

Emissivity (**Emi**) = 100%
 Exposure time (**t₉₀**) = 0.08 s
 Analog output (**4/0 mA**) = 0... 20 mA
 Online- / offline mode (**ONL/OFFL**) = offline

Interface settings:

Emissivity (**Emi**) = 100%
 Exposure time (**t₉₀**) = 0.08 s
 Analog output (**4/0 mA**) = 0... 20 mA
 Baud rate = 19200 Bd
 Address = 00
 Max./min. value storage = max.
 Clear time of max./min. value storage = OFF
 Ambient temperature compensation = auto
 Wait time **t_w** = 02 Bit

9 Parameters / Settings

9.1 Settings at the pyrometer or via serial interface

9.1.1 Emissivity (Emi)

For a correct measurement it is necessary to adjust the emissivity. This *emissivity* is the relationship between the emission of a real object and the emission of a black body radiation source (this is an object which absorbs all incoming rays and has an emissivity of 100%) at the same temperature. Different materials have different emissivities ranging between 0% and 100% (settings at the pyrometer between 20 and 100%). Additionally the emissivity is depending on the surface condition of the material, the spectral range of the pyrometer and the measuring temperature. The emissivity setting of the pyrometer has to be adjusted accordingly. Typical emissivity values of various common materials for the two spectral ranges of the instruments are listed below. The tolerance of the emissivity values for each material is mainly dependent on the surface conditions. Rough surfaces have higher emissivities.

Settings:
100%
⋮
20%



Note: The minimum emissivity setting for the pyrometer is 20%!

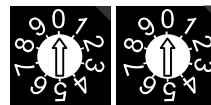
Measuring object	Emi (at 8 ... 14 μm)
"Black body furnace"	100%
Human skin	98%
Black dull varnish	95%
Carbon soot	95%
Wood	80 to 92%
Paper	92 to 95%
Asphalt	85%
Glass / quartz glass	72 to 87%
Textile	75 to 95%
Graphite	75 to 92%
Cement	90%
Water	95%

Measuring object	Emi (at 8 ... 14 μm)	
Brickwork	85 to 95%	
Fire clay		
Rubber		
Porcelain		
Ceramics		
Varnish		
Plaster		
Oil paint	60 to 80%	
Steel (oxidized)		
Steel (smooth)		10 to 30%
Aluminum (smooth)		2 to 15%
Aluminum (anodized)	90%	

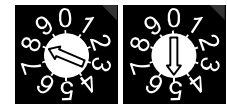
Measuring object	Emi (at 5.14 μm)
Glass / quartz glass	97%

One way to determine an accurate emissivity value for a material is to make a comparison measurement as follows: If possible, coat a portion of the object with dull black paint or carbon soot. Paint and carbon soot have high emissivities (95%) and take on the same temperature as the object. Measure the temperature of the painted area with the emissivity control set to 95%. Then measure the temperature of an adjacent unpainted area of the object and adjust the emissivity until the pyrometer displays the same temperature.

Setting examples at the instrument: Emi = 100%:



Emi = 85%:



If the settings directly at the pyrometer should be used the pyrometer must be switched into offline mode (OFFL, see 8.2). To adjust the emissivity via software see section 10, Settings via interface / software).



Note:

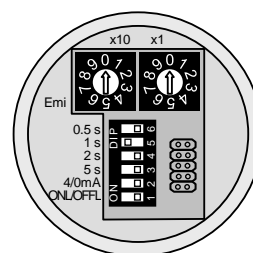
If the emissivity is set to a incorrect value (below 20%) the instrument will automatically utilize an emissivity value of 100%. The setting 00 is interpreted as Emi = 100%.

9.1.2 Exposure time t_{90}

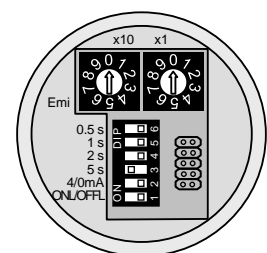
The *exposure time* is the time interval when the measured temperature has to be present after an abrupt change so that the output value of the pyrometer reaches a given measurement value. The time taken is to reach 90% of the recorded temperature difference. Slower response time can be an advantage when trying to measure an object that has a rapidly fluctuating temperature.

To change the exposure time the corresponding DIP switch for 0.5 s, 1 s, 2 s or 5 s must be set in the ON position. A longer response time of 10 s can be set if the switch for 0.5 s and 5 s is set to the ON position at the same time, a longer response time of 30 s can be set if the switch for 1 s and 5 s is set at to the ON position the same time. In the "OFF" position (Software *InfraWin*: t_{90} = min), the device operates using its time constant (see technical data).

Setting examples at the instrument:



Example: t_{90} = 1 s



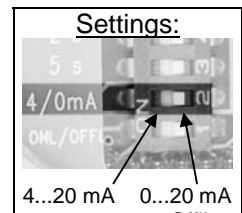
Example: t_{90} = 5 s

If the settings directly at the pyrometer should be used the pyrometer must be switched into offline mode (OFFL, see 8.2). To adjust the exposure time via software see section 10, Settings via interface / software).

9.1.3 Analog output 0/4 to 20 mA

When the DIP switch 2 is in the ON position, the analog output will be 4 - 20 mA, in the OFF position, the analog output will be 0 - 20 mA. The analog output has to be selected according to the signal input of the connected instrument (controller, PLC, etc.).

If the settings directly at the pyrometer should be used the pyrometer must be switched into offline mode (OFFL, see 8.2). To adjust the analog output via software see section 10, **Settings via interface and software**).

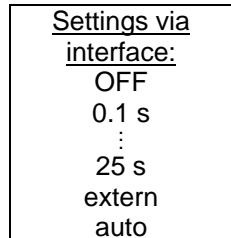


9.2 Settings only via serial interface

9.2.1 Maximum / minimum value storage

If the maximum value storage is switched on always the highest last temperature value will be displayed and stored. The minimum value storage saves the lowest measurement taken during a reading (e.g. practical when monitoring cooled goods such as frozen foods). You The storage has to be cleared at regular intervals for exchanging by a new and actual value.

This feature is particularly useful when fluctuating object temperatures cause the display or the analog outputs to change too rapidly, or the pyrometer is not constantly viewing an object to be measured. In addition, it may also be beneficial to periodically delete and reset the stored maximum values.



The following settings are possible:

- off:** The max. value storage is switched off and only momentary values are measured.
- 0.01...25 s:** If any clear time between 0.01 s and 25 s is set, the maximum value is estimated and held in *double storage mode*. After the entered time the storage will be deleted.
- extern:** The external clearing can be activated and used within an own software (see section 14, **Data format UPP®**) or via an external contact (for connection see 4.1 **Pin assignment for the connector on the back side of the pyrometer**). In this case, the storage operates only in *single storage*, because only a single deletion mechanism is used.
- auto:** The "auto" mode is used for discontinuous measuring tasks. For example objects are transported on a conveyer belt and pass the measuring beam of the pyrometer only for a few seconds. Here the maximum value for each object has to be indicated. In this mode the maximum value is stored until a new hot object appears in the measuring beam. The temperature which has to be recognized as "hot" is defined by the low limit of the adjusted sub range. The stored maximum value will be deleted when the temperature of the new hot object exceeds the low limit "from" of the sub range by 1% or at least 2°C. If a lower limit is not entered, the maximum value storage will be deleted whenever the lower level of the full measuring range has been exceeded.
- The *minimum value function* operates in the opposite manner. The minimum value stored will be deleted when the upper limit of the set range is below it by 1% (at least 2°C). If an upper limit is not entered, the minimum value stored will be deleted whenever it drops below the upper level of the full measuring range.

Operation note: dependent on the settings the maximum value storage either works in *single storage* mode or in *double storage* mode:

Single storage: the *single storage* is used when you want to reset the stored value using an external impulse via *one* contact closure from an external relay (i.e. between two measured objects). The relay contact is connected directly to the pyrometer between pins J and K. This mode allows a new value to be established, after each impulse from the reset signal.

double storage: when entering the reset intervals via push buttons or PC interface the *double storage* is automatically selected. This mode utilizes *two* memories in which the highest measured value is held and is deleted alternately in the time interval set (clear time). The other memory retains the maximum value throughout the next time interval. The disadvantages of fluctuations in the display with the clock frequency are thereby eliminated.



Note: The maximum value storage follows the function of adjustment of exposure time.

- This results in:
- clear time \leq the adjusted response time is useless
 - clear times must be at least 3 times longer than the response time
 - only maxima with full maximum value can be recorded, which appear at least 3 times longer than the response time.

9.2.2 Subrange

You have the opportunity to choose a subrange (minimum 51°C) within the basic measuring range of the pyrometer. This subrange corresponds to the complete analog output. The lower value (0 or 4 mA) describes the beginning of this measuring range, the upper value (20 mA) the end of the range.

Additionally with the setting of a subrange it is possible to fulfill the requirements of the "auto" clear mode of the maximum value storage (see **9.2.1 Maximum / minimum value storage**).

9.2.3 Baud rate

The transmission rate of the serial interface in Baud (Bd) is dependent on the length of the cable. A standard cable length with RS232 for 19200 Bd is 7 m, with RS485 2 km. The baud rate is reduced by 50% if the transmission distance is doubled.

<u>Settings via interface:</u>
1.2 kBd
⋮
19.2 kBd

9.2.4 Address

For the connecting of several pyrometers with RS485 with one serial interface it is necessary to give each instrument an individual address for communication. First it is necessary to connect each single instrument to give it an address. After that all instruments can be connected and addressed individually. If parameters may be changed simultaneously on all pyrometers, the global **Address 98** can be used. This allows you to program all pyrometers at the same time, regardless of the addresses that have already been assigned. If the address of a pyrometer is unknown, it is possible to communicate with it using the global **Address 99** (connect only one pyrometer).

<u>Settings via interface:</u>
00
⋮
97

9.2.5 Ambient temperature compensation

Each object has an emissivity ε (maximum 100%). If the measured object is not transparent and has an emissivity of less than 1 (as in most cases), a portion of the resulting radiation will be reflected.

For bright, smooth surfaces, such as mirrors, the reflected radiation is more focused; on rough, harsh surfaces it is diffuse. The rate of diffuse reflection is, in this case $(1 - \varepsilon)$.

If the measured object's temperature is the same as the ambient temperature (this is most often the case), you only need to set the emissivity on the pyrometer (when using the *InfraWin* program the off-set compensation for the ambient temperature must be in "auto"; see **10.7 Basic settings**).

If the object to be measured is in an oven, where the temperature is higher than the ambient temperature, a portion of the radiation, corresponding to the rate of diffuse reflection, will be "reflected" by the measured object to the pyrometer, resulting in an inaccurate reading (the reading will be too high due to the oven temperature).

In this case, it makes sense to activate the off-set compensation for the ambient temperature (in the parameter window of the *InfraWin* program: Compensating for the off-set of the ambient temperature switched to "man." (= manual) and then enter the ambient temperature value (in this case, the oven temperature) in the corresponding field (also see section **10.7 Basic settings**). The program also makes a compensation calculation in order to display the correct temperature.

Be aware that the accuracy of such a correction is highly dependent on accuracy of the emissivity value that was set. The off-set compensation for the ambient temperature uses the rate of diffuse reflection when performing its calculation. If you alter the emissivity (ε), you are also altering the rate of diffuse reflection $(1 - \varepsilon)$ and in turn, the displayed temperature. The following observation shows how a faulty emissivity reading in conjunction with the compensation for the ambient temperature affects results:

Entry of $\varepsilon = 91\%$ instead of 92% indicates:

A relative change in emissivity of 1.1 %.

Likewise the assumed rate of reflection changes from 8 % to 9 %.

This results in a relative increase in reflection of 12.5 %.

This change also impacts the displayed result, thereby causing a fairly inaccurate compensation calculation. For hot environments, this calculation will probably serve as a much more accurate assessment than the standard calculation, which assumes that the ambient temperature is the same as that of the object measured.

9.2.6 Wait time t_w (only available via interface commands, see 14, Data format UPP®)

Using a pyrometer with RS485 it is possible that the connection is not fast enough to receive the pyrometer's answer to an instruction of the master. In this case a wait time can be set to slow down the data transfer (e.g.: $t_w = 02$ at a baud rate 9600 means a wait time of $2/9600$ sec).

<u>Settings:</u>
00 Bit
⋮
99 Bit

9.2.7 Internal temperature of the pyrometer

The internal temperature of the pyrometer can be read via interface. It is a few degrees above the ambient temperature due to the warming generated by the pyrometer electronics.

9.3 Avoiding reading errors caused by faulty assembly

To avoid reading errors, please note the following points when mounting the pyrometer:

1. The diameter of the measuring object cannot be smaller than the pyrometer's *spot size* (see section 7, **Optics**).
2. A source of radiation behind or around the measuring object can influence the result. If the object is transparent or partly transparent another material behind the object could transmit its radiation to the pyrometer as well. In this case the location of the pyrometer should be changed, or, if the background radiation remains constant it can be compensated for by changing the emissivity setting respectively.
3. Please take into account that radiation, from other hot materials around the measured object, can be reflected by these materials and influence the result. If the measured object has a low emissivity, the temperature measured will be mainly that from the reflected object - not from the intended measured object itself. To prevent ambient radiation from reaching the spot area, a mounting tube should be used. The mounting tube should be placed as near as possible to the measured object so that the tube's shadow blocks out all the ambient radiation from the side. Consider whether **9.2.5 Ambient temperature compensating** applies to the measurement application.

10 Settings via interface / software

The operating and analyzing software *InfraWin* is included in delivery of the pyrometer. With this software all pyrometer functions also can be used on the PC. Also temperature indication, analyzing of the measurement and data logging can be done with this software.



Note:

If the settings directly at the pyrometer should be used the pyrometer must be switched into online mode (ONL, see 8.2).

This section gives an overview about the functions of the software. Additionally there is a description of the individual icons in the program's help menu. Click on the **F1** button after *InfraWin* has been loaded or click on the **?** in the menu bar.

The following descriptions require minimum the program version 4.0. The latest version is available for free as download from the homepage www.lumasenseinc.com.

10.1 Connecting the pyrometer to a PC

The program *InfraWin* can operate up to two devices. For two devices using the RS232 interface, two PC interfaces must be used. Two devices using RS485 may be operated simultaneously by the same interface, if two different addresses have been properly entered (see **9.2.4 Address**).

10.2 Installation

For installation select the setup program "setup.exe" from the *InfraWin*-CD or from the downloaded and unpacked zip file from the internet and follow the installation instructions.

10.3 Program start

After installation and the first program start a language must be chosen (German, English, Italian, Spanish. The language also can be changed in the program). On the start page the screen shows the following icons:

10.4 The start menu

	Open file	Opens a saved file
	Save as	Storage of measured values for further processing
	Measurement (color bar)	Online measurement with color bar display
	Measurement (online trend)	Online measurement with graphic display
	Pyrometer parameters	Setting of the parameters of the instrument
	Computer (COM, Addr)	Setting of interface, baud rate and pyrometer addresses (RS485)
	PC sampling rate	Time interval between two measurements
1	Number of devices	Number of connected instruments (max. 2)
	Output listing	Listing of measured or stored values in tabular form
	Output trend	Processing of measured (stored) readings in graph form
	Output .TXT file	Processing of measured (stored) readings in a text file
	Calculate spot size	Calculation of spot sizes in various measuring distances
	PI 6000 Controller	Only if available: controls the programmable controller PI 6000

10.5 Beginning



Before using the software, the serial interface connected to the pyrometer has to be selected under the **Computer** icon. For two devices using the RS232 interface, two PC interfaces must be used. Two devices using RS485 may be operated simultaneously by the same interface, if two different addresses have been properly entered (see **9.2.4 Address**).

10.6 Number of devices



With a click on “number of devices” *InfraWin* changes to the display of 1 or 2 devices. If 2 devices are selected, always 2 windows are displayed for settings or evaluation.

10.7 Basic settings



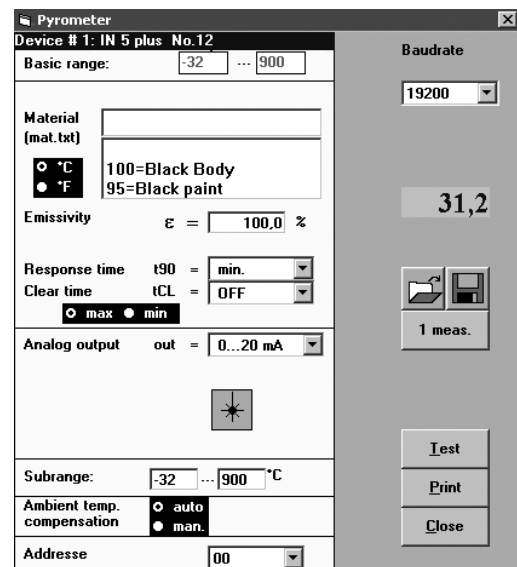
Under **pyrometer parameters** all preset values can be displayed and modified if necessary.

The window **Pyrometer parameters** contains all parameter settings described in section **9, Parameters**.

Choose the correct setting for your application, the actual setting is displayed.

Notes:

- “Basic range” displays the total range of the pyrometer automatically and cannot be changed. If the sub range is changed, the new values must be verified with “OK”
- Under “Material” you have the possibility to store the names of different measuring objects with their emissivity values and to recall them from the list.
- Choose whether the temperature should be displayed in °C (Celsius) or °F (Fahrenheit).

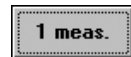


- When entering a reset time interval other than 0, it must also be determined with “max” or “min” if the *maximum or minimum value storage* will be activated.
- If the pyrometer is equipped with a laser targeting light the laser icon is visible. A click on the laser targeting light icon (☀) turns the laser targeting light on or off at this point. After approx. two minutes the laser targeting light is switched off automatically.
- After switching over to “man”, you can decide if the off-set compensation for the ambient temperature should be activated (also see **9.2.5 Ambient temperature compensation**). The corresponding data field T(Umg) is then activated so that the ambient temperature value can be entered. In the “auto” mode position, the device assumes that the ambient temperature of the measured object is equal to that of the pyrometer.

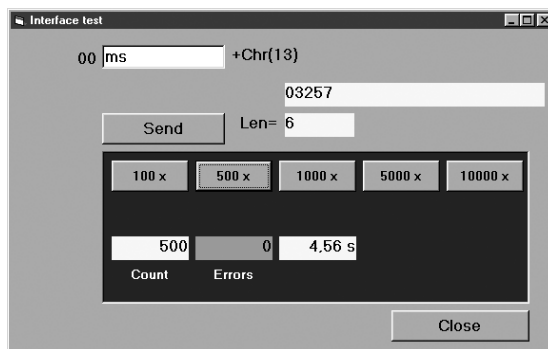
The open / save button enable to store and recall own pyrometer configurations.



“1 meas.” shows the current measuring temperature in the pyrometer parameters window for approx. 1 second.



A click on the “Test” icon opens a window that allows the direct communication with the pyrometer via the interface commands (see section 14, **Data format UPP®**).



After entering an interface command (00 is the adjusted address ex works, “ms” is the command “reading temperature value”) and a click on “Send” the following window is opened: This window already shows the answer of the pyrometer in $1/10^\circ$. The actual temperature reading is 325.7°C.

“Len” indicates the length of the answered data string, incl. Carriage Return (Chr(13)). In the lower part of the window the connection with the preset baud rate can be checked. Here the command was send 500 times with 19200 baud. It has taken 4.56 seconds without transmission errors.

10.8 Measurement color bar

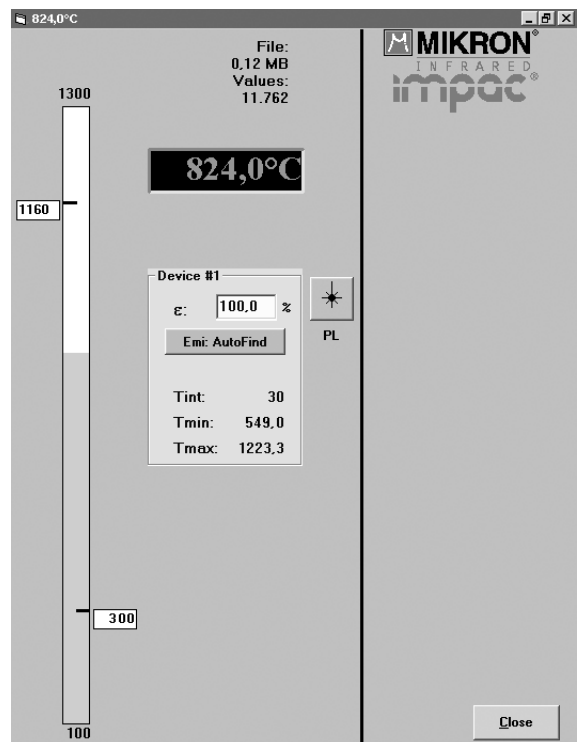


This window displays:

- current temperature, graphically as color bar and numerically
- temperature range or adjusted sub range
- file size and quantity of the measured values of the current measurement
- emissivity ϵ
- the internal temperature of the instrument (T_{int})
- minimum (T_{min}) and maximum values (T_{max})
- temperature of the limit contacts

The color bar display shows the span of the temperature range or the adjusted sub-range. Entering temperature values in the white fields on the left and right side of the color bar, limits for the color change of the color bar can be set. These limits can also be changed by moving the small bar with the PC mouse. The color bar displays temperatures within the two limits in green color, outside the limits in red color.

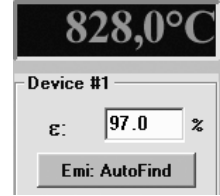
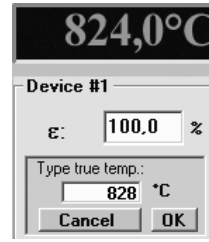
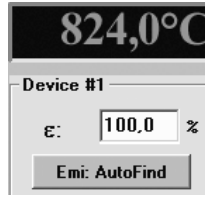
The targeting light (☀) can be switched on or off at this point is the pyrometer is equipped with it.



In addition, there is an input field ϵ for the emissivity in the window. If the emissivity is changed, the temperature change connected with this can be read off directly.

Emi: AutoFind: If the true temperature of the measured object is known, you can calculate the emissivity of the measured object using the "Emi: AutoFind" function:

- A measured temperature is displayed with the current set emissivity (in this example 100%) (here: 824°C).
- If you press "Emi: Autofind" a window will open which allows you to enter the "true" temperature.
- Once the temperature entry has been entered and confirmed with "OK", *InfraWin* will then calculate the emissivity which occurs with the new temperature. This is displayed immediately and can be used for further temperature measurement.



10.9 Measurement online trend



This window displays:

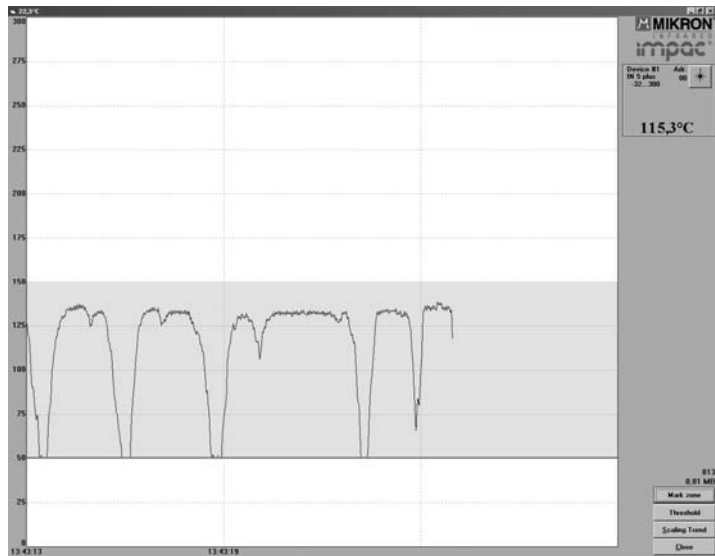
- temperature as graphical diagram
- current temperature
- quantity of the measured values and file size of the current measurement

The example shows a sample reading over the period of approx. 12 seconds with a temperature range between 0 and 300°C. The final temperature (at the end of the reading) is 115.3°C.

If the pyrometer is equipped with a laser targeting light this can be switched on or off.



- With "Mark zone" a temperature range can color marked for easier recognition.
- Setting a temperature under "Threshold" prevents the recording of values above or below this temperature to keep the file size small.
- With "Scaling trend" the view of the temperature range can be limited.



Note:

The measuring values of "measurement color bar" or "measurement online trend" are automatically saved as "standard.i12". Should you need to edit the data later, you need to save the file as another .i12-file because old values are over-written when a new measurement is taken.

Files from older program versions (.i10-files) can be opened and saved as .i12.

10.10 Listing (analyzing)



For analyzing the measured values in this field all measured data appears in a numeric list.

The date beside the time gives more exactly values to see what happened on time units smaller 1 s. The value specifies the time in seconds after midnight (0:00 h). The amount of data depends on the frequency that readings were taken (settings at **10.13 PC sampling rate**). As the amount of data increases, so does the amount of storage space required to save it. In order to save room, all .i12 data files are stored by a binary code.

MIKRON / IMPAC Standard.i12						
Device #1						
Count :	10038			AD =	00	
Start :	05.03.2004	12:36:08	Min:	374,0 °C	t90 =	min.
Stop :	05.03.2004	12:37:09	Max:	554,7 °C	tCL =	OFF
No.	Date	Time	Seconds after 0:00	Temp.	Emi	
1	05.03.2004	12:36:08	45368,169	438,2 °C	1,000	
2	05.03.2004	12:36:08	45368,176	435,6 °C	1,000	
3	05.03.2004	12:36:08	45368,182	435,0 °C	1,000	
4	05.03.2004	12:36:08	45368,188	437,5 °C	1,000	
5	05.03.2004	12:36:08	45368,193	434,4 °C	1,000	
6	05.03.2004	12:36:08	45368,199	438,2 °C	1,000	
7	05.03.2004	12:36:08	45368,205	436,1 °C	1,000	
8	05.03.2004	12:36:08	45368,211	439,3 °C	1,000	
9	05.03.2004	12:36:08	45368,217	440,1 °C	1,000	
10	05.03.2004	12:36:08	45368,231	443,4 °C	1,000	
11	05.03.2004	12:36:08	45368,237	443,3 °C	1,000	
12	05.03.2004	12:36:08	45368,243	442,1 °C	1,000	
13	05.03.2004	12:36:08	45368,249	445,7 °C	1,000	
14	05.03.2004	12:36:08	45368,255	442,1 °C	1,000	
15	05.03.2004	12:36:08	45368,261	444,3 °C	1,000	
16	05.03.2004	12:36:08	45368,267	442,9 °C	1,000	
17	05.03.2004	12:36:08	45368,273	441,1 °C	1,000	
18	05.03.2004	12:36:08	45368,279	443,6 °C	1,000	
..

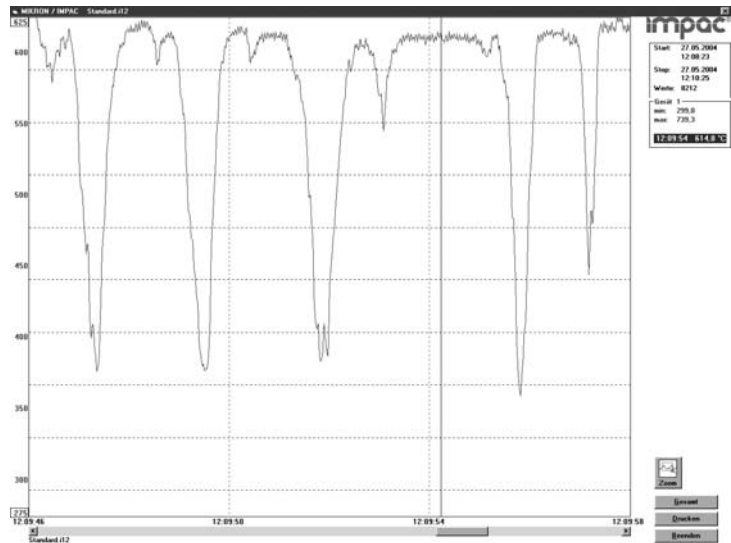
10.11 Trend output (analyzing)



The graph's curve depicts the temperature change over time within the specified temperature range.

Additionally, other information appears in this window; such as recorded time (x-axis) and temperature in degrees (y-axis) as well as the time and temperature at the vertical cursor line which can be dragged with the mouse.

- Selecting the *Trend output* initially causes all the saved data to be displayed.
- If the data exceeds an amount that can be represented reasonably, you may "Zoom" in on a partial segment using the mouse (such as the segment represented in the example). Under "Total" you can return to the representation of the entire curve.



Note:

The last reading is saved in the standard.i12 file and automatically appears in this form upon opening **Listing** or **Trend output**.
If **file open** was loaded using another file, the previous file will be overwritten and replaced by the standard.i12 file.

10.12 Output .TXT file (analyzing)

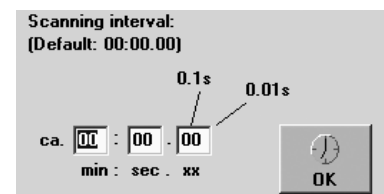


The same file as under "Output listing" may be converted into a text file and can be easily opened, for example with EXCEL. With the standard import settings EXCEL automatically formats the columns accordingly (tabulator as separators).

10.13 PC sampling rate (time interval between two measurements)



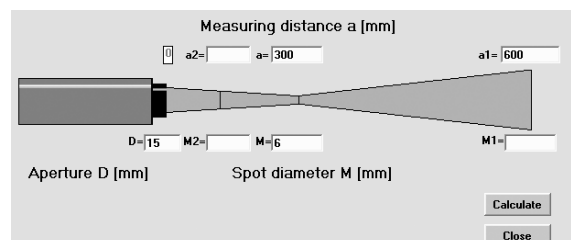
This function sets a time interval. After each interval one measured value is stored on the PC. The bigger the time interval the smaller will be the stored file. This function is mainly used for long term measurements.



10.14 Spot size calculator



After entering the aperture and the main spot size, the input of interim values calculates spot sizes in different measuring distances of the fixed optics.



11 Transport, packaging, storage

The instrument can be damaged or destroyed if shipped incorrectly. To transport or store the instrument, please use the original box or a box padded with sufficient shock-absorbing material. For storage in humid areas or shipment overseas, the device should be placed in welded foil (ideally along with silica gel) to protect it from humidity.

The pyrometer is designed for a storage temperature of -20 to 70°C with non-condensing conditions. Other kind of storage can damage or malfunction the pyrometer.

12 Maintenance

12.1 Safety

Attention during pyrometer services:

Should the pyrometer be integrated in a running machine process the machine has to be switched off and secured against restart before servicing the pyrometer.

12.2 Service

The pyrometer does not have any parts which require regular service, only the lens has to be kept clean. The lens can be cleaned with a soft cloth in combination with alcohol (do not use acid solutions or dilution). Also standard cloths for cleaning glasses or photo objectives can be used.

13 Trouble shooting

Before sending the pyrometer for repair, try to find the error and to solve the problem with the help of the following list.

Temperature indication too low

- Incorrect alignment of the pyrometer to the object
⇒ New correct alignment to achieve the max. temperature signal (see 6)
- Measuring object smaller than spot size
⇒ check measuring distance, smallest spot size is at nominal measuring distance (see 7)
- Measuring object is not always in the measuring spot of the pyrometer
⇒ Use max. value storage (see 9.2.1).
- Emissivity set too high
⇒ Set lower correct emissivity corresponding to the material (see 9.1.1)
- Lens contaminated
⇒ Clean lens carefully (see 12.2)

Temperature indication too high

- Emissivity set too low
⇒ Set lower correct emissivity corresponding to the material (see 9.1.1)
- The measurement is influenced by reflections of hot machine parts
⇒ Use mechanical construction to avoid the influence of the interfering radiation

Measuring errors

- Indicated temperature is decreasing during the use of the pyrometer, contamination of the lens
⇒ Clean lens. Recommendation: use of air purge (see 12.2, 5.1)
- Indicated temperature is decreasing during the use of the pyrometer, although the air purge unit is used. Probably compressed air is not clean or air failed
⇒ Clean the lens and use clean, dry and oil free compressed air
- Air contamination in the sighting path between pyrometer and object
⇒ Change position of the pyrometer with a clean sighting path (if necessary use a ratio pyrometer)
- HF-interferences
⇒ Correct the connection of the cable shield (see 4)
- Instrument overheated
⇒ Use cooling jacket with air or water cooling (see 5.1)
- Temperature Indication is fluctuating, probably caused by changing emissivity
⇒ Wrong pyrometer type, use of ratio pyrometer recommended

Laser targeting light

- Laser targeting light fails
⇒ Instruments temperature above 50°C. Use cooling jacket (see 5.1)

14 Data format UPP® (Universal Pyrometer Protocol)

Via interface and a suitable communication software or via "Test" function of the *InfraWin* software (see **10.7 Basic settings → Test**) commands can be exchanged directly with the pyrometer.



Note: The ONL/OFFL switch must be in the ONL position before adjusting the following parameters via the software (see **8.2**).

The data exchange occurs in ASCII format with the following transmission parameters:

The data format is: 8 data bits, 1 stop bit, even parity (8,1,e)

The device responds to the entry of a command with: output (e.g. the measuring value) + CR (Carriage Return, ASCII 13), to pure entry commands with "ok" + CR.

Every command starts with the 2-digit device address AA (e.g. "00").

This is followed by 2 small command letters (e.g. "em" for emissivity), followed, if necessary for that command, by the ASCII parameter "X" and finished with CR. If this parameter "X" is omitted, then the device answers with the current set parameter.

A „?“ after the small command letters answers with the respective settings (only at setting commands, not at enquiry commands).

Example: Entry: "00em" + <CR>

The emissivity setting (ϵ) of the device with the address 00 is returned

Answer: "0970" + <CR> means Emissivity = 97.0%

Description	Command	Parameters
Reading measuring value:	AAms	Output: YYYYYY 5-digit decimal, in $1/10^\circ\text{C}$ or $^\circ\text{F}$ 88880 = temp. overflow 02563 = 256.3 $^\circ\text{C}$ or $^\circ\text{F}$ -0170 = -17.0 $^\circ\text{C}$ or $^\circ\text{F}$
Emissivity:	AAemXX AAemXXXX	XX = 20 to 99%, 00 = 100% (decimal) XXXX = 0200 to 1000 in ‰
Exposure time t_{90} :	AAezX	X = 0 to 6 (decimal) 0 = intrinsic time constant of the device 1 = 0.5 s 3 = 2 s 5 = 10 s 2 = 1 s 4 = 5 s 6 = 30 s
Analog output ¹⁾ :	AAasX	X = 0;1 0 = 0 - 20 mA 1 = 4 - 20 mA
Clear time of maximum / minimum value storage:	AAIzX	X = 0 to 8 (decimal) 0 = maximum/minimum value storage off 1 = 0.10 s 5 = 5.00 s 2 = 0.25 s 6 = 25.00 s 3 = 0.50 s 7 = externally deleted 4 = 1.00 s 8 = automatically cleared
External clearing:	AAIx	Simulation of an external clearing contact
Changing $^\circ\text{C} / ^\circ\text{F}$ ¹⁾ :	AAfhX	X = 0;1 (decimal) 0 = Output Celsius 1 = Output Fahrenheit
Reading basic temperature range:	AAmb	Output: YYYYYZZZ 8-digit hex in $^\circ\text{C}$ or $^\circ\text{F}$ YYYY = beginning of temperature range ZZZZ = end of temperature range
Reading sub range:	AAme	as with mb
Repeatedly reading measuring values:	AAmsXXX	XXX = 000 to 999 XXX = No. of measuring values
Laser targeting light:	AAIaX	X = 0;1 (decimal) 0 = switch off pilot light 1 = switch on pilot light



Error status:	AAfs	Output 1 Byte hex Bit 0 = 1: EEPROM error Bit 1 = 1: Watch dog Reset Bit 2 = 1: Under voltage reset
Reading parameter:	AApa	Output 11-digit decimal: Digit 1 and 2 (20 to 99 or 00): emissivity Digit 3 (0 to 6): t_{90} (exposure time) Digit 4 (0 to 8): t_{CL} (storage delete mode) Digit 5 (0 to 1): analog output Digits 6 and 7 (00 to 98): temperature Digits 8 and 9 (00 to 31): address Digit 10 (0 to 4): baud rate Digit 11 always 0
Device address ¹⁾ :	AAgaXX	XX: Device address decimal 00 to 31 variable device addresses
Baud rate:	AAbrX	X = 0 to 4 0: 1200 Bd 2: 4800 Bd 4: 19200 Bd 1: 2400 Bd 3: 9600 Bd
Internal pyrometer temperature:	AAgt	Output: XX (dec. 00 to 98, in °C)
Max. internal pyrometer temperature:	AAtm	Output: XX (dec. 00 to 98, in °C)
Reset ¹⁾ :	AAre	Reset device
Command delay:	AAtwXX	XX = 00 to 20 relative delay value
Reading ambient temperature:	AAut	Output: stored value, 4-digit hex e.g. 0258 corresponds to 600 degrees
Entering ambient temperature:	AAutXXXX	XXXX = value of ambient temperature, 4-digit, hex XXXX e.g. FFEC corresponds to -20 degrees - 99 _{dez} = FF9D _{hex} means: automatic, no manual compensation
Marginal values for ambient temperature:	AAut?	Output: marginal values for the entry, 2 x 4-digit, hex e.g. FF9D0384 corresponds to -99 to 900 degrees
Reading maximum/minimum values:	AAmi	Output: 0 or 1 0 = maximum value, 1 = minimum value
Setting maximum/minimum values:	AAmiX	X = desired setting 0 = maximum value, 1 = minimum value
Reading marginal values:	AAmi?	Output: marginal value for entry, always 01
Serial number:	AAsn	Output: XXXXX (5-digit decimal)
Device model / software version:	AAve	Output: XXYYZZ (6-digit decimal) XX = 70 (IN 5 plus) 71 (IN 5/5 plus) YY = month of the software version ZZ = year of the software version

Note: the letter "l" means the lower case letter of "L".

¹⁾ After entering these commands the device carries out an automatic reset. The device needs approx. 150 ms before it is ready to use and work with the changed settings.

Additional instruction for the RS485 interface:

Requirements to the master system during half-duplex operation:

1. After an inquiry, the bus should be switched into a transmission time of 3 bits (some older interfaces are not fast enough for this).
2. The pyrometer's response will follow after 5 ms at latest.
3. If there is no response, there is a parity or syntax error and the inquiry has to be repeated.

15 Reference numbers

15.1 Reference numbers instruments

Type	Optics	Temperature range	with laser targeting light Interface	
			RS232	RS485
			IN 5 plus	100
300	-32 to 900°C (MB 9)	3 869 420		3 869 430
800	-32 to 900°C (MB 9)	3 869 440		3 869 450

IN 5-H plus	100	-32 to 900°C (MB 9)	3 871 200	3 871 210
	300	-32 to 900°C (MB 9)	3 871 220	3 871 230
	800	-32 to 900°C (MB 9)	3 871 240	3 871 250

IN 5-L plus	100	0 to 900°C (MB 9)	3 871 600	3 871 610
	300	0 to 900°C (MB 9)	3 871 620	3 871 630
	800	0 to 900°C (MB 9)	3 871 640	3 871 650

Type	Optics	Temperature range	with laser targeting light Interface		without laser targeting light Interface	
			RS232	RS485	RS232	RS485
			IN 5/5 plus	100	100 to 1300°C (MB 13)	3 869 460
400 to 2500°C (MB 25)	3 869 520	3 869 530			3 869 320	3 869 330
300	100 to 1300°C (MB 13)	3 869 480		3 869 490	3 869 280	3 869 290
	400 to 2500°C (MB 25)	3 869 540		3 869 550	3 869 340	3 869 350
1200	100 to 1300°C (MB 13)	3 869 500		3 869 510	3 869 300	3 869 310
	400 to 2500°C (MB 25)	3 869 560		3 869 570	3 869 360	3 869 370

IN 5/5-H plus	100	200 to 1300°C (MB 13)	3 871 260	3 871 270
		400 to 2500°C (MB 25)	3 871 320	3 871 330
	300	200 to 1300°C (MB 13)	3 871 280	3 871 290
		400 to 2500°C (MB 25)	3 871 340	3 871 350
	1200	200 to 1300°C (MB 13)	3 871 300	3 871 310
		400 to 2500°C (MB 25)	3 871 360	3 871 370

IN 5/5-L plus	105	200 to 1300°C (MB 13)	3 871 660	3 871 670
		400 to 2500°C (MB 25)	3 871 720	3 871 730
	370	200 to 1300°C (MB 13)	3 871 680	3 871 690
		400 to 2500°C (MB 25)	3 871 740	3 871 750
	800	200 to 1300°C (MB 13)	3 871 700	3 871 710
		400 to 2500°C (MB 25)	3 871 760	3 871 770

Type	Optics	Temperature range	with laser targeting light Interface	
			RS232	RS485
			IN 5/4 plus	100
500 to 2500°C (MB 25)	3 869 760	3 869 770		
300	300 to 1300°C (MB 13)	3 869 620		3 869 630
	500 to 2500°C (MB 25)	3 869 780		3 869 790
1200	300 to 1300°C (MB 13)	3 869 640		3 869 650
	500 to 2500°C (MB 25)	3 869 800		3 869 810



Note:

A connection cable is not included with the instrument and has to be ordered separately.

15.2 Reference numbers accessories

3 820 330	Connection cable, length 5 m (straight connector, 12 pin)
3 820 500	Connection cable, length 10 m (straight connector, 12 pin)
3 820 510	Connection cable, length 15 m (straight connector, 12 pin)
3 820 810	Connection cable, length 20 m (straight connector, 12 pin)
3 820 820	Connection cable, length 25 m (straight connector, 12 pin)
3 820 520	Connection cable, length 30 m (straight connector, 12 pin)
3 820 320	Special connection cable with angled connector and additional laser targeting light push button, length 5 m
3 820 740	Connection cable, length 5 m, temperature resistant up to 200°C (straight connector, 12 pin)
3 852 290	Power supply for DIN rail mounting NG DC (100 to 240 V AC ⇒ 24 V DC, 1 A)
3 890 640	DA 4000-N: LED digital display for switchboard assembling
3 890 650	DA 4000: as DA 4000-N, additionally with 2 limit switches
3 890 560	DA 6000-N: LED digital display with digital input RS232 and possibility for pyrometer parameter settings
3 890 570	DA 6000-N RS485
3 890 520	DA 6000: LED digital display, digital- and analog input, 2 limit switches, maximum value storage, analog output, RS232
3 890 530	DA 6000 with RS485
3 826 500	HT 6000: portable battery driven indicator and instrument for pyrometer parameter settings; RS232 / RS485
3 826 510	PI 6000: PID programmable controller, very fast, for digital IMPAC pyrometers
3 852 430	Converter I-7520; RS 485 ⇔ RS 232 (half duplex)
3 852 440	Protocol converter RS485/RS232 (switchable) ⇔ Profibus-DP for 1 instrument
3 852 460	Protocol converter RS485 ⇔ Profibus-DP for 32 instruments
3 834 210	Adjustable mounting support
3 835 160	Air purge unit
3 835 440	Air purge unit, stainless steel
3 837 230	Water cooling jacket (heavy design) with integrated air purge unit
3 837 340	Water cooling jacket (heavy design) with CaF ₂ window for IN 5/5 <i>plus</i> and IN 5/4 <i>plus</i>
3 837 350	Water cooling jacket (heavy design) with ZnSe window for IN 5 <i>plus</i> , IN 5-H <i>plus</i> , IN 5-L <i>plus</i>
3 837 370	Water cooling jacket (lightweight design) with integrated air purge unit
3 837 390	Water cooling jacket (lightweight design) with CaF ₂ window for IN 5/5 <i>plus</i> and IN 5/4 <i>plus</i>
3 837 400	Water cooling jacket (lightweight design) with ZnSe window for IN 5 <i>plus</i> , IN 5-H <i>plus</i> , IN 5-L <i>plus</i>
3 846 100	Mounting tube
3 846 120	Flange tube
3 846 620	Vacuum flange KF16 with Calcium Fluoride window (CaF ₂) for IN 5/5 <i>plus</i> and IN 5/4 <i>plus</i>
3 846 630	Vacuum flange KF16 mit Zinc Selenide window (ZnSe) for IN 5 <i>plus</i> , IN 5-H <i>plus</i> , IN 5-L <i>plus</i>
3 846 650	Spare window CaF ₂ , Ø 25 x 3 with Viton-O-ring
3 846 660	Spare window ZnSe, Ø 25 x 3 with Viton-O-ring
3 843 500	SCA 5, scanning attachment with CaF ₂ window; 24 V AC/DC (for IN 5/5 <i>plus</i> and IN 5/4 <i>plus</i>)
3 835 290	Air purge unit for scanning attachment SCA 5

Flange System:

3 846 260	Instrument's support
3 846 600	Support with CaF ₂ window (for IN 5/5 <i>plus</i> and IN 5/4 <i>plus</i>)
3 846 610	Support with ZnSe window (for IN 5 <i>plus</i> , IN 5-H <i>plus</i> , IN 5-L <i>plus</i>)
3 846 240	Tube support with air purge nozzle
3 846 750	Window slide, without window