LUMASENSE TECHNOLOGIES

MANUAL

IMPAC Pyrometer

IS 12 • IGA 12 • IS 12-S • IGA 12-S

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Part No 3 839 017 - EN
Revision C
July 2018

Contents

1 General Information

1.1 Information about the user manual

Congratulations on choosing this high quality and highly efficient pyrometer.

This manual provides important information about the instrument and can be used as a work of reference for installing, operating, and maintaining your pyrometer. It is important that you carefully read the information contained in this manual and follow all safety procedures before you install or operate the instrument.

To avoid handling errors, keep this manual in a location where it will be readily accessible.

1.1.1 Legend

	**Note:** The note symbol indicates tips and useful information in this manual. All notes should be read to effectively operate the instrument.
	**Attention**: This sign indicates special information which is necessary for a correct temperature measurement.
	**Warnings and Cautions:** The general warnings and cautions symbol signifies the potential for bodily harm or damage to equipment.
MB	Shortcut for Temperature range (in German: **M**ess**b**ereich).

1.1.2 Terminology

The terminology used in this manual corresponds to the VDI- / VDE-directives 3511, Part 4.

1.2 Safety

This manual provides important information on safely installing and operating the pyrometer. Several sections of this manual provide safety warnings to avert danger. These safety warnings are specified with a warning symbol. You must read and understand the contents of this manual before operating the instrument even if you have used similar instruments or have already been trained by the manufacturer.

It is also important to continually pay attention to all labels and markings on the instrument and to keep the labels and markings in a permanent readable condition.

	**Warning:** The pyrometer is only to be used as described in this manual. It is recommended that you only use accessories provided by the manufacturer.

In addition, signs and markings on the device are to be observed and maintained in a legible condition.

1.2.1 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.

- 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.

1.2.2 Electrical connection

Follow common safety regulations for main voltage (230 or 115 V AC) when connecting additional devices. Touching the main voltage can be fatal. An incorrect connection and/or mounting can cause serious health or material damages.

Only qualified specialists should connect such devices to the main voltage.

1.2.3 Ambient temperature

The pyrometer is designed for ambient temperatures of 0 to 70 °C with non-condensing conditions. An operation out of these conditions can damage or malfunction the pyrometer.

1.3 Limit of liability and warranty

All general information and notes for handling, maintenance, and cleaning of this instrument are offered according to the best of our knowledge and experience.

LumaSense Technologies is not liable for any damages that arise from the use of any examples or processes mentioned in this manual or in case the content of this document should be incomplete or incorrect. LumaSense Technologies reserves the right to revise this document and to make changes from time to time in the content hereof without obligation to notify any person or persons of such revisions or changes.

All instruments from LumaSense Technologies have a regionally effective warranty period. Please check our website at http://info.lumasenseinc.com/warranty for up-to-date warranty information. This warranty covers manufacturing defects and faults, which arise during operation, only if they are the result of defects caused by LumaSense Technologies.

The Windows compatible software was thoroughly tested on a wide range of Windows operating systems and in several world languages. Nevertheless, there is always a possibility that a Windows or PC configuration or some other unforeseen condition exists that would cause the software not to run smoothly. The manufacturer assumes no responsibility or liability and will not guarantee the performance of the software. Liability regarding any direct or indirect damage caused by this software is excluded.

The warranty is VOID if the instrument is disassembled, tampered with, altered, or otherwise damaged without prior written consent from LumaSense Technologies; or if considered by LumaSense Technologies to be abused or used in abnormal conditions. There are no user-serviceable components in the instrument.

1.4 Unpacking the Instrument

Thoroughly inspect the instrument upon delivery to purchaser. Check all materials in the container against the enclosed packing list. LumaSense Technologies cannot be responsible for shortages against the packing list unless a claim is immediately filed with the carrier. The customer must complete final claim and negotiations with the carrier.

Save all packing materials, including the carrier's identification codes, until you have inspected the pyrometer and find that there is no obvious or hidden damage. Before shipment, the pyrometer was examined and has been tested. If you note any damage or suspect damage, immediately contact the carrier and LumaSense Technologies, Inc.

1.5 Service Request, Repair, or Support

Contact LumaSense Technologies Technical Support in case of a malfunction or service request. Provide clearly stated details of the problem as well as the instrument model number and serial number. Upon receipt of this information, Technical Support will attempt to locate the fault and, if possible, solve the problem over the telephone.

If Technical Support concludes that the instrument must be returned to LumaSense Technologies for repair, they will issue a Return Material Authorization (RMA) number.

Return the instrument upon receipt of the RMA number, transportation prepaid. Clearly indicate the assigned RMA number on the shipping package exterior. Refer to Section 1.6, Shipments to LumaSense for Repair, for shipping instructions.

Technical Support can be contacted by telephone or email:

Santa Clara, California

- Telephone: +1 408 727 1600 or +1 800 631 0176
- Email: support@lumasenseinc.com

Frankfurt, Germany

- Telephone: +49 (0) 69 97373 0
- Email: eusupport@lumasenseinc.com

Erstein, France

- Telephone +33 (0)3 88 98 98 01
- Email: eusupport@lumasenseinc.com

1.6 Shipments to LumaSense for Repair

All RMA shipments of LumaSense Technologies instruments are to be prepaid and insured by way of United Parcel Service (UPS) or preferred choice. For overseas customers, ship units air-freight, priority one.

The instrument must be shipped in the original packing container or its equivalent. LumaSense Technologies is not responsible for freight damage to instruments that are improperly packed.

Contact us to obtain an RMA number (if one has not already been assigned by Technical Support). Clearly indicate the assigned RMA number on the shipping package exterior.

Send RMA Shipments to your nearest technical service center:

Santa Clara, California

LumaSense Technologies, Inc.
3301 Leonard Court
Santa Clara, CA 95054 USA
Telephone: +1 408 727 1600
+1 800 631 0176

Email: support@lumasenseinc.com

Frankfurt, Germany

LumaSense Technologies GmbH
Kleyerstr. 90
60326 Frankfurt
Germany
Telephone: +49 (0)69-97373 0

Email: eusupport@lumasenseinc.com

1.7 Transport, packing, and storage

With faulty shipping, the instrument can be damaged or destroyed. 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. Storing the insturment out of these conditions can cause damage or result in malfunction of the pyrometer.

1.8 Disposal / decommissioning

Inoperable IMPAC pyrometers must be disposed of in compliance with local regulations for electro or electronic material.

2 Introduction

2.1 Appropriate use

The IMPAC pyrometers IS 12, IS 12-S, IGA 12, and IGA 12-S are very robust, digital, and highly accurate infrared thermometers with temperature ranges between 250 and 3500 °C for non-contact temperature measurement on metals, ceramics, graphite etc.

For optimal match of the instrument to the application, six different fixed optics and three different focusable optics with extremely small spot sizes are available. The pyrometer parameters can be selected via keys and settings are indicated on the built-in LED display. In measuring mode, the actual temperature is indicated. The pyrometers are equipped with RS232 and RS485 serial interfaces (switchable via the keys). This enables the reading of temperature as well as reading and adjusting pyrometer parameters using the provided software *InfraWin*. Two adjustable limit switches can be used to trigger a switch process, e.g. to recognize hot objects located in the measuring beam. A thru-lens view finder or additionally a laser targeting light for exact alignment of the pyrometer is available. The instruments IS 12-S and IGA 12-S are equipped with an integrated scanner which moves the measuring beam adjustable up and down up to 4°.

Typical applications: preheating, annealing, tempering, welding, forging, hardening, sintering, melting, soldering, rolling, brazing, normalizing.

2.2 Scope of delivery

Instrument with selectable optics, PC measurement and evaluation software InfraWin, works certificate, and operation manual.

Note: The connection cable is not included with the instrument and has to be ordered separately (see Chapter 10, Reference numbers).

2.3 Technical data

Temperature Ranges:	**IS 12; IS 12-S:**		**IGA 12; IGA 12-S:**	
	550 to 1400 °C	(MB 14)	250 to 1000 °C	(MB 10)
	600 to 1600 °C	(MB 16)	300 to 1300 °C	(MB 13)
	650 to 1800 °C	(MB 18)	350 to 1800 °C	(MB 18)
	750 to 2500 °C	(MB 25)	400 to 2300 °C	(MB 23)
	550 to 2000 °C	(MB 20L)	250 to 1400 °C	(MB 14L)
	700 to 3500 °C	(MB 35L)		
Sub range:	Any range adjustable within the temperature range minimum span 51 °C			
Signal processing:	Photoelectric current, digitized			
Spectral ranges:	IS 12; IS 12-S: 0.7 to 1.1 µm IGA 12; IGA 12-S: 1.45 to 1.8 µm			

Power supply:	24 V DC (15 to 40 V DC) or 24 V AC (12 to 30 V AC), 48 to 62Hz
Power consumption:	Max. 7 W
Analog output:	0 to 20 mA or 4 to 20 mA switchable, load 0 ... 500 Ohm
Test current output:	10 mA, fixed

Digital interface:	Switchable: RS232 or RS485 addressable (half duplex), baud rate 2.4 up to 115.2 kBd
Display:	Built-in 5 digit LED display, height 13 mm, additional function LED's
Resolution:	0.1 °C at interface and display, < 0.025% of temperature range at the analog output
Isolation:	Power supply, digital interface, analog output are galvanically isolated against each other and housing

Parameters:	Adjustable at the instrument or via serial interface: emissivity ε; response time t_{90}; clear times t_{CL} of the maximum value storage; temperature sub range; analog output 0 to 20 or 4 to 20 mA; switch points for limit contacts; °C or °F; interface RS232 or RS485; address; baud rate; test current output Additionally (only adjustable via interface): key lock, wait time, recalibration (with special software)
Emissivity ε:	0.100 to 1.000 in 1/1000 steps
Exposure time t_{90}:	1 ms (at "L" temperature ranges with dynamical adaptation at low signal levels); adjustable at 0.01 s; 0.05 s; 0.25 s; 1 s; 3 s; 10 s
Maximum value storage:	Built-in single or double storage. Clearing with adjusted time t_{clear} (off; 0.01 s; 0.05 s; 0.25 s; 1 s; 5 s; 25 s), extern, via interface or automatically with the next measuring object
Limit switches:	2 relay outputs (switch-over relay contacts), switch power max. 30 W (I_{max}: 1 A, U_{max}: 60 V DC) Switch hysteresis (valid for both contacts): ±2 ... ± 20 °C Rise and fall times: exposure time of the pyrometer + 2 ms
Accuracy*: (ε = 1, t_{90} = 1 s, $T_{amb.}$ = 23 °C)	Up to 1500 °C: 0.3% of measured value in °C + 1 °C above 1500 °C: 0.5% of measured value in °C
Repeatability: (ε = 1, t_{90} = 1 s, $T_{amb.}$ = 23 °C)	0.1% of measured value in °C + 1 °C
Scanner adjustments: (only IS 12-S and IGA 12-S):	Adjustable scanning angle: 0 to 4° Adjustable scanning frequency: 4 to 10 Hz

Control panel:	4 keys, operate with tip of ball-point pen
Protection class:	IP65 (DIN 40 050)
Ambient temperature:	0 to 70 °C at housing
Storage temperature:	-20 to 70 °C
Relative humidity:	Non condensing conditions
Weight:	2.2 kg

Sighting:	Built-in parallax free thru-lens view finder, optionally with an additional built-in laser targeting light (max. power level < 1 mW, λ = 630-680 nm, CDRH class II) 
CE-label:	According to EU directives about electromagnetic immunity

*Additional measurement uncertainty due to offset drift of the signal converter at long temperature ranges. Tc = measuring temperature up to which an additional measurement uncertainty occurs when the ambient temperature differs from the reference temperature of 23 °C

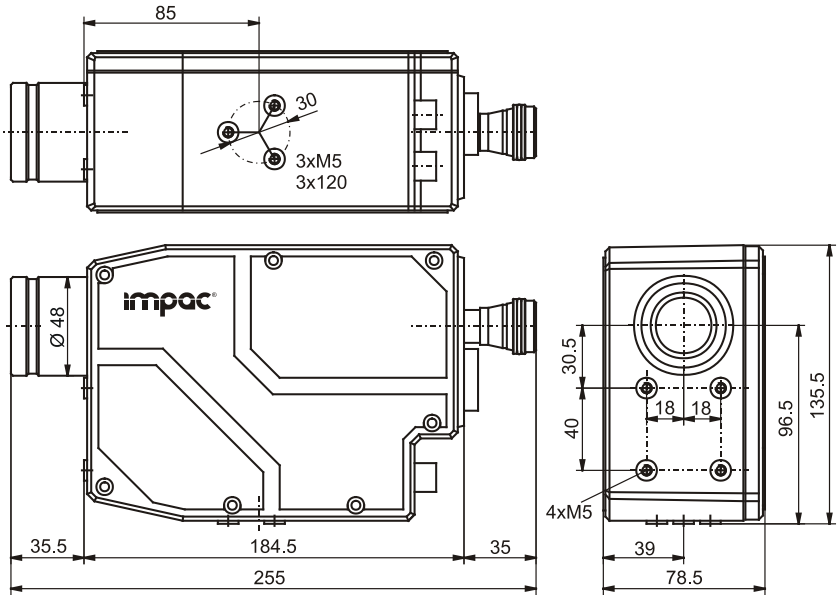
Type	MB/°C	Tc/°C
IS 12, MB 20L	550…2000	666
IS 12, MB 35L	700…3500	869
IGA 12, MB 10	250…1000	283
IGA 12, MB 13	300…1300	335
IGA 12, MB 18	350…1800	400
IGA 12, MB 23	400…2300	447
IGA 12, MB 14L	250…1400	350

Note: The calibration / adjustment of the instruments was carried out in accordance with VDI/VDE directive "Temperature measurement in industry, Radiation thermometry, Calibration of radiation thermometers", VDI/VDE 3511, Part 4.4.

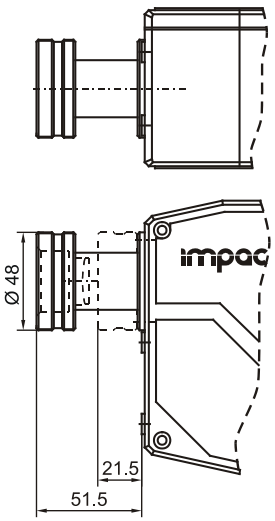
For additional details on this directive, see http://info.lumasenseinc.com/calibration or order the directive from "Beuth Verlag GmbH" in D-10772 Berlin, Germany.

2.4 Dimensions

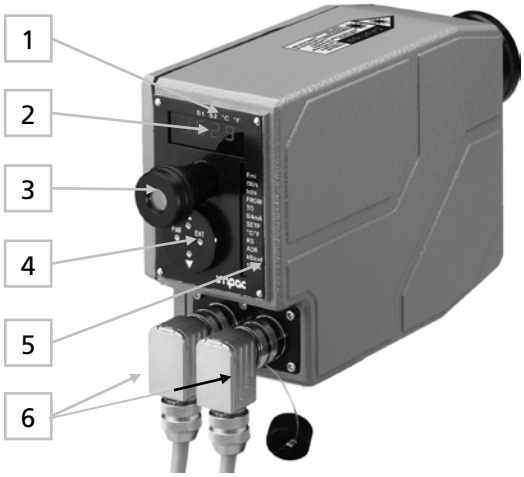
Pyrometer with fixed optics:

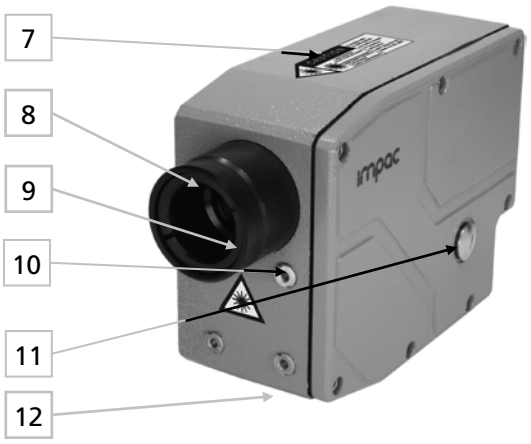


Pyrometer with focusable optics:



2.5 Physical user interface





1 Display °C or °F as well as active limit switches
2 LED display
3 Parallax free thru-lens view finder
4 Setting keys (operate with Tip of ball-point pen)
5 Parameter indicator
6 Main connection cable and additional cable for limit contacts
7 Laser warning label (only instruments with laser targeting light)
8 Fixed or focusable optics
9 Label with optics information
10 Mounting holes
11 Cap for scanner adjustments (only types IS 12-S or IGA 12-S)
12 Type label (bottom side of the instrument)

2.6 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 list with all reference numbers in **Section 10.2 Reference numbers accessories**).

2.6.1 Mounting

For mounting and aligning the pyrometer to the measured object, a *mounting angle* or *ball and socket mountings* are available. The ball and socket mounting is an easy way to align the pyrometer or water cooling jacket (ball and socket mounting steel) to the measured object. The quick-clamping-screws of the ball and socket mounting enable easy and fast adjustment of the pyrometer in all directions.

Ball and socket mounting

Ball and socket mounting, steel

Mounting angle

2.6.2 Cooling

The pyrometer can be used in ambient temperatures outside of the specifications if preventive maintenance is taken.

The *cooling plate* is used to protect the pyrometer from heat coming from the front. 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

Cooling plate

2.6.3 Miscellaneous

The *air purge* protects the lens from dust and moisture contamination. Using dry and oil-free pressurized air, it generates an air stream shaped like a cone.

The *rotary mirror attachment* ROT 10 can only be used in combination with pyrometers with fixed optics. A rotating mirror system moves the measuring beam in a line over the measuring object with a scanning angle up to 73°.

Air purge

Rotary mirror attachment ROT 10

2.6.4 Displays

In addition to the built-in temperature indicator 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

Note: In instances where strong incidence of daylight or lamp light into the view finder can affect the measurement, the ocular has to be covered.

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3 Controls and Installation

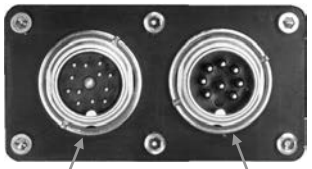
3.1 Electrical Installation

The pyrometers are powered by a voltage of either 24 V DC (15 to 40 V DC) or 24 V AC (12 to 30 V AC), 48 to 62 Hz. Once connected to power, the instrument operations immediately and needs no warm-up time. To switch off the instrument, unplug the connector.

To meet the electromagnetic requirements, a shielded connecting cable must be used. The shield of the connecting cable has to be connected only on the pyrometer side to avoid ground loops.

LumaSense offers connecting cables, but they are not part of standard scope of delivery. The main connecting cable has wires for power supply, interface, analog output, external laser switch and external clear of maximum value storage via contact (see **Chapter 10**, **Reference numbers**) and 12 pin angle 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.

For use of the limit contacts, the separate additional cable has to be used.



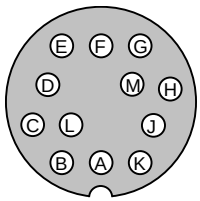
connector for main connection cable

connector for additional cable for limit switches

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

For the main connection cable

Pin	Color	Indication
K	white	+ 24 V power supply (or 24 V AC) (12 ... 30 V)
A	brown	0 V power supply
L	green	+ $I_{outp.}$ analog output
B	yellow	– $I_{outp.}$ analog output
H	gray	External switch for targeting light (bridge to K)
J	pink	External clearing of maximum value storage (bridge to K) *) or output for switch contact (see Section 5.13)
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



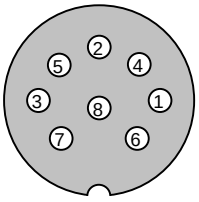
Pin assignment of left connector (side of male inserts)

*) For setting of clear time to "extern" (see 5.3, clear time for maximum value storage).

For additional limit contacts cable

The instrument is equipped with two independent relay limit switches. These are two separate switch-over relay contacts, changing its state if the adjusted temperatures are exceeded.

Pin	Color	Indication
7	pink	Limit contact S1
5	white	(drawing shows status without
1	yellow	power or with exceeded limits)
3	grey	Limit contact S2
6	green	(drawing shows status without
4	brown	power or with exceeded limits)
2	blue	
8	red	



Pin assignment
of right connector
(side of male inserts)

The drawing of the limit contacts indicates their switch status without power. The limit contacts switch after supplying the pyrometer with power. If the temperature exceeds the adjusted limit value, the corresponding limit contact switches back in the first position and is indicated by the corresponding LED on the pyrometer (see **4.2** under **Limit contacts**).

Any temperature value within the range of the pyrometer is adjustable. You can set the limits directly on the pyrometer (see **5.6 SETP (limit contacts)**) or via *InfraWin* software. The switch time of the relay contacts is 2 ms plus the response time of the pyrometer.

To avoid oscillating of the switch in the switch point, the contacts switch with a hysteresis (works setting ±2 °C, adjustable between ±2 and ±20 °C). If required, the hysteresis can be set via the InfraWin software. Setting hysteresis directly on the instrument is not possible.

3.1.2 Connecting the pyrometer to a PC

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

The pyrometer is equipped with an RS485 serial interface. With the RS485, long transmission distances can be realized and the transmission is, to a large extent, free of problems. The RS485 also allows several pyrometers to be connected in a bus system.

If an RS485 connection is not available at the PC, it can be accomplished using an RS485 or RS232 to USB connector. When using a RS485 to USB adapter, make sure that the adapter is fast enough to receive the pyrometer's answer to an instruction of the master. Most of the commonly used adapters are too slow for fast measuring equipment, so it is recommended to use the USB-RS485 adapter cable, part number 3 826 750.

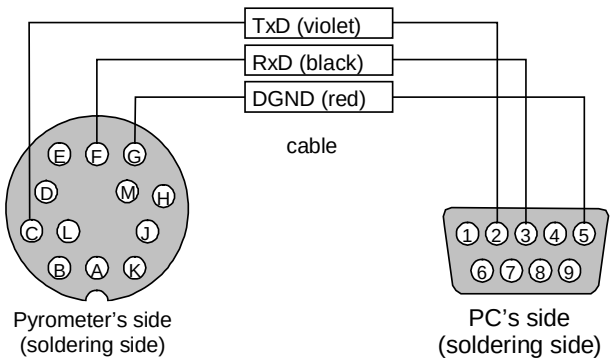
With a slow RS485 connection it is also possible to set a wait time at the pyrometer which delay the response of a command to the pyrometer (see **5.12 Wait time tw**).

Connecting to RS232 interface

The transmission rate (in baud) of the serial interface is dependent on the length of the cable. Values between 2400 and 115200 Bd may be set.

The baud rate has to be reduced by 50% when the transmission distance is doubled (see also **5.10 kBaud (baud rate)**).

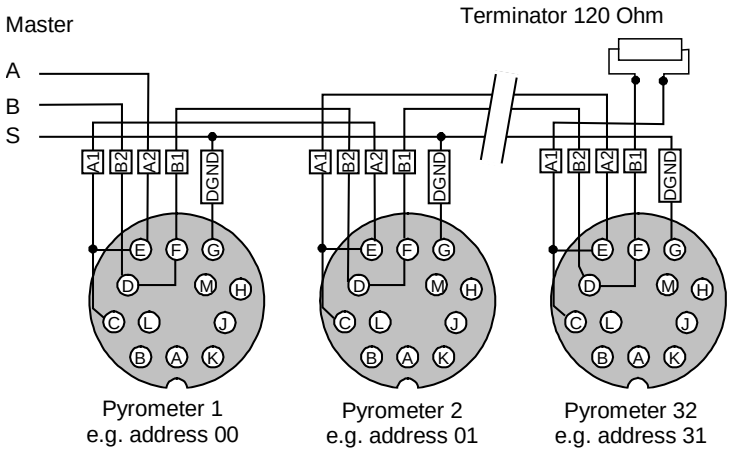
Typical cable length for RS232 at 19200 Bd is 7 m.



Connecting to RS485 interface

Half-duplex mode:

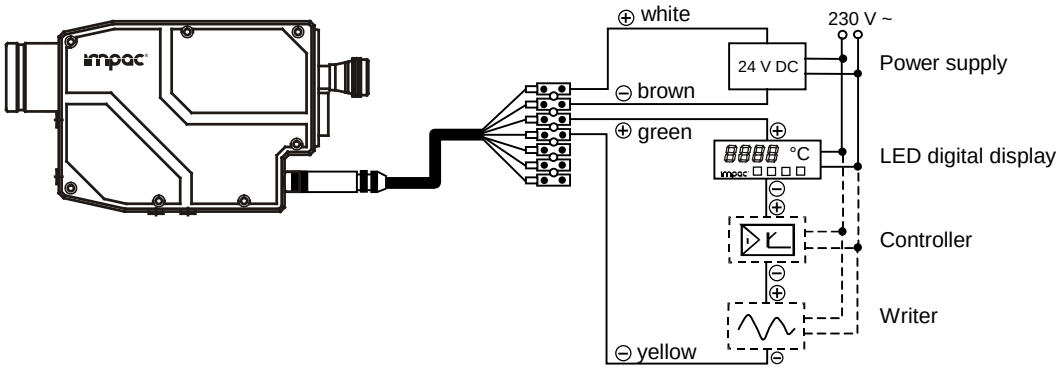
A1 and A2 as well as B1 and B2 are bridged in the 12-pin round connector of the connecting cable, to prevent reflections due to long stubs. It also safeguards against the interruption of the RS485 Bus system should a connecting plug be pulled out. The master labels mark the connections on the RS485 converter. The transmission rate of the serial interface in Baud (Bd) is dependent on the length of the cable. Values between 2400 and 115 kBd may be set.



The baud rate is reduced by 50% when the transmission distance is doubled (see **5.10 kBaud (baud rate)**). Typical cable length for 19200 Bd is 2 km.

3.1.3 Connection of additional analyzing devices

Additional analyzing instruments (such as LED digital display instruments) only need to be connected to a power supply and the analog outputs from the pyrometer. Another Instrument, such as a controller or printer, can be connected to the display in series as shown below (total load of resistance max. 500 Ohm).



3.2 Sighting

For exact aiming to the object, the pyrometers are equipped with a thru-lens view finder and optionally with an additional laser targeting light.

3.2.1 Thru-lens view finder

In the optimized thru-lens view finder, a circle marks the exact position and size of the measuring spot. Pyrometers with temperature ranges exceeding 1500 °C are equipped with an adjustable eye protection filter. Turning the ocular changes the filter from bright to dark.

3.2.2 Laser targeting light

In addition to the thru-lens view finder, the instruments can be equipped with a laser targeting light. The laser point marks the center of the spot, not the exact size. The laser targeting light can be used without affecting the measurement.

3.3 Optics

The pyrometers are equipped ex works with a fixed or a focusable optics. The smallest spot size for the **fixed optics** is shown for the specified measuring distance. With the **focusable optics**, the smallest possible spot size can always be adjusted for each distance within the optics limits.

The selection of a suitable fixed or focusable optics depends on different factors:

- Very short measuring distances up to 250 mm to achieve extremely small spot sizes are only available as fixed optics.
- The rotary mirror attachment ROT 10 can only be used in combination with fixed optics.
- The three focusable optics allow the exact adjustment of any required measuring distance from 277 mm.
- Focusable optics offer high flexibility to adapt the instrument to applications with different measuring distances.

3.3.1 Fixed optics

IS 12; IS 12-S:		MB 14		MB 16; 18; 20L	MB 25; 35L
IGA 12; IGA 12-S:		MB 10	MB 13; 14L	MB 18	MB 23
Optics	**Measuring distance a [mm]**	**Spot size M_{90} [mm]**			
1	a = 80 mm	0.9 mm	0.7 mm	0.3 mm	0.1 mm
2	a = 160 mm	0.7 mm	0.6 mm	0.4 mm	0.2 mm
3	a = 250 mm	1 mm	0.8 mm	0.5 mm	0.3 mm
4	a = 660 mm	2.3 mm	2 mm	1.2 mm	0.7 mm
5	a = 1300 mm	5.5 mm	3.8 mm	2.8 mm	1.4 mm
6	a = 5600 mm	19 mm	15 mm	12 mm	6.4 mm
Aperture D [mm] *		19 mm	13.5 mm	10 mm	7 mm

*) The aperture is the effective lens diameter.

Measuring distance
The spot sizes, mentioned in the table above, will be only achieved at the measuring distances of the corresponding optics. Decreasing or increasing the measuring distance enlarges the spot size. Make sure that the measuring object is at least as big as the spot size. A tape measure can be used to determine the distance between object and pyrometer. The measuring distance is always measured from the front of the lens.

- **Instruments equipped with thru-lens view finder:** The measuring object will be shown in the view finder of the pyrometer as a sharp image only in the measuring distance of the corresponding optics (e.g. optics 1 at 80 mm). The circle in the view finder marks the position of the spot.
- **Instruments equipped with thru-lens view finder and laser targeting light:** The laser shows its smallest spot in the measuring distance of the corresponding optics (e.g. optics 1 at 80 mm) and it marks the center of the spot, not its size.

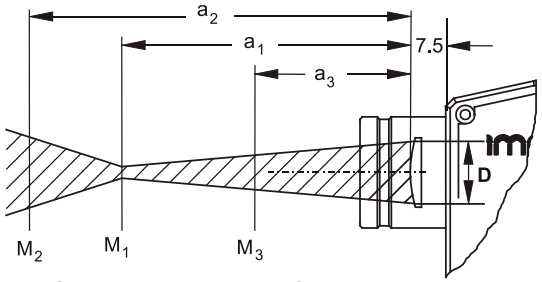
Warning: To reduce the risk of injury to the eyes, do not look directly into the targeting laser and do not point the targeting laser into anyone's eyes. The instrument is equipped with a class II laser that emits radiation.

Note: The pyrometer can measure objects at any distance but the object has to be bigger than or at least as big as the spot size of the pyrometer in the measuring distance.

Calculating the spot sizes on different measuring distances:

Spot sizes for other measuring distances can be calculated with the following equations or with the IR calculator of the *InfraWin* software.

Table values: a_1 = measuring distance
M_1 = spot size
D = aperture



3.3.2 Focusable optics

Focusable optics IS 12

	Measuring distance a [mm]	Spot size M_{90} [mm]				Objective length S [mm]
		MB 14	MB 16	MB 18; 20L	MB 25; 35L	
Optics 1	a = 277 mm	0.9	0.6	0.6	0.4	30
	a = 400 mm	1	0.8	0.8	0.5	9.5
	a = 533 mm	1.4	1.1	1.1	0.7	0
Optics 2	a = 388 mm	1	0.8	0.8	0.45	30
	a = 700 mm	1.8	1.5	1.5	0.8	8.6
	a = 1170 mm	3	2.4	2.4	1.4	0
Optics 3	a = 550 mm	1.5	1	1	0.6	30
	a = 3000 mm	9	6	6	3.3	3.3
	a = 9500 mm	25	19	19	10.6	0
	Aperture D [mm]*	13.5 to 17	13.5 to 17	10 to 13	5 to 7	

Focusable optics IGA 12

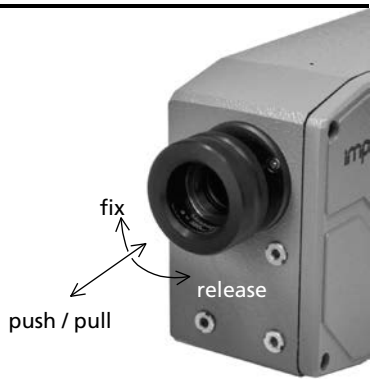
	Measuring distance a [mm]	Spot size M_{90} [mm]				Objective length S [mm]
		MB 10	MB 13; 14L	MB 18	MB 23	
Optics 1	a = 280 mm	1.3	0.9	0.5	0.4	30
	a = 400 mm	17	1.1	0.7	0.5	9
	a = 520 mm	2	1.2	0.8	0.7	0
Optics 2	a = 390 mm	1.4	1	0.6	0.45	30
	a = 700 mm	2.6	1.5	1	0.8	7.9
	a = 1090 mm	4.1	2.4	1.6	1.3	0
Optics 3	a = 550 mm	2	1.2	0.8	0.6	30
	a = 3000 mm	10.7	5.9	4.3	3.8	2.2
	a = 5600 mm	20	11	8	7	0
	Aperture D [mm] *)	13.5 to 17	13.5 to 17	13.5 to 17	10 to 13	

*) The aperture is the effective lens diameter. It is depending on the objective length. The biggest aperture value belongs to the fully extended objective (S = 30), the smallest aperture value for objective length S = 0. Intermediate values have to be interpolated.

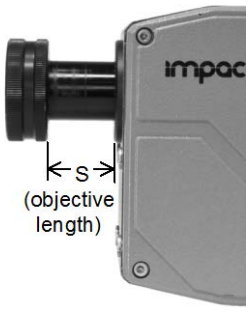
Adjusting the required measuring distance
The required measuring distance must be adjusted to achieve the spot size mentioned in the tables above. This can be done between the smallest and the biggest limit value.

Note: The measuring object has to be bigger than or at least as big as the spot size of the pyrometer.

To release the optics, turn it counterclockwise. Then it can be pushed or pulled to find the correct measuring distance. To fix the optics, turn the optics clockwise.



Adjusting the measuring distance with help of the table:
The table mentions the minimum and maximum measuring distance for each of the three focusable optics. This corresponds to the longest or the shortest objective length. As an example, a further value between max. and min. is shown. The objective length "S" can be measured with a caliper.



The following methods can be used for measuring distances:

Adjusting the measuring distance with help of the thru-lens view finder:
The focusable optics is correctly adjusted to the required distance, if the measuring object is shown as a sharp image in the view finder. A circle marks the position of the measuring spot.

Adjusting the measuring distance with help of the laser targeting light:
On the focused measuring distance the laser has its smallest spot size and is illustrated exactly.

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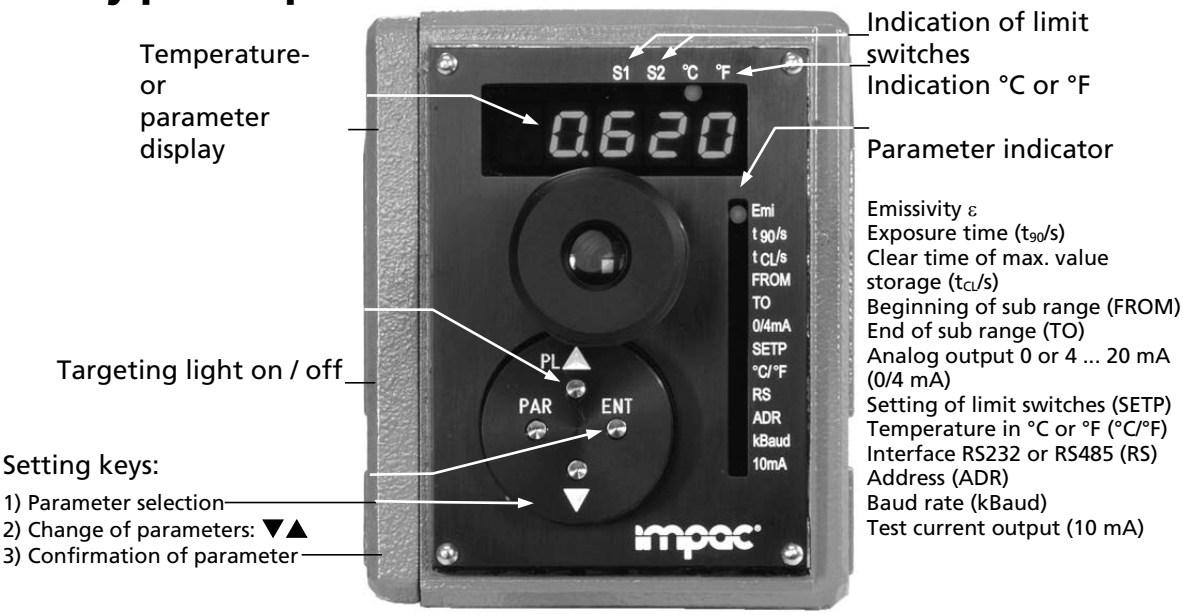
4 Instrument Settings

All instrument settings can be done directly at the instrument. Use the tip of a ball point pen to activate the adjusting keys. This avoids changing parameters by mistake.

4.1 Key panel operation



4.2 Functions and setting of parameters

Temperature or parameter display:	In measuring mode, the display shows the actual temperature reading. After pushing the parameter key, the display indicates the actual value of the selected parameter. Special indications: 8888 = measurement exceeds the end of sub range
Targeting light on / off:	When pushing the PL key in measuring mode, the laser targeting light is switched on. With the targeting light switched on, the pyrometer continuously measures and displays the actual temperature reading. The laser targeting light switches off automatically after approx. 2 min or after another push of the PL key. 
Setting keys: 1) PAR:	With the **PAR** button, all available parameters are displayed in the following description. Pushing the button again changes the display to the next parameter, after the last parameter it changes to the actual temperature reading.
2) ▼▲:	With the arrow keys ▼ and ▲ all parameter settings can be displayed. Pushing the button longer changes the settings in fast mode (the keys ▼▲ and **ENT** are blocked if the keyboard is locked via the interface commands or/and during a measurement in combination with *InfraWin* software).

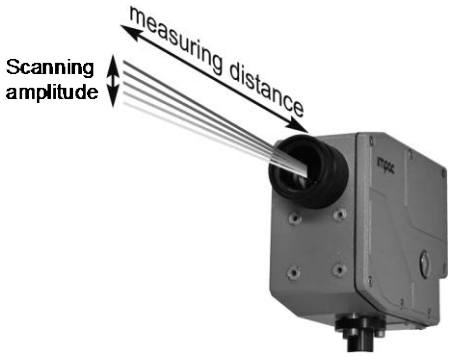
3) ENT:	If a parameter is changed with the arrow keys, the new value must be confirmed by pushing the **ENT** key. If it is not confirmed with **ENT**, the instrument will operate with the previous parameter value. If no key is pressed for approx. 30 s, the display changes to the temperature indication.
Limit contacts:	Two limit switches can be set. If the measuring temperature exceeds the adjusted limit contact temperature, the LED S1 or S2 displays the switch status.
Scale °C or °F:	The LED indicates the temperature scale in °C or °F.
Parameter indicator:	LED's indicate which pyrometer parameter is selected for reading or changing.

4.3 Factory settings

Emissivity (ε) = 1,000
Exposure time (**t_{90} / s**) = 0,00
Clear time (**t_{CL}**) = 0,00
Sub range (**from / to**) same as temperature range
Analog output (**0 / 4 mA**) = 0 ... 20 mA
Limit contacts = end of temperature range
Hysteresis = ±2 °C
Scanning angle (only IS 12-S and IGA 12-S): 4°
Scanning frequency (only IS 12-S and IGA 12-S): 5 Hz

Temperature display (**°C / °F**) = °C
Interface (**RS**) = RS232
Address (**ADR**) = 00
Baud rate (**kBaud**) = 19.2 kBd
Test current output (**10 mA**) = off

4.4 Built-in Scanner (IS 12-S and IGA 12-S)



The pyrometers IS 12-S and IGA 12-S with fixed optics are equipped with a scanning mechanism built into the pyrometer housing which moves the measuring beam up and down. In combination with the pyrometer's maximum value storage (peak picker), the scanner is optimally used for scanning of thin oscillating wires, for finding scale-free spots on heavily scaled surfaces or for measuring small, hot objects whose position is not exactly determined.

All instruments are equipped with a thru-lens view finder and an additional laser targeting light for exact alignment to the position of the measuring object. The thru-lens view finder doesn't follow the scanning mirror movement; it always shows the center of the scanning amplitude. The laser targeting light follows the scanning mirror movement and always shows the position of the measuring spot. The moving measuring beam does not increase the spot sizes due to the very fast exposure time of the pyrometers.

The scanning length increases with increasing measuring distance. An overview of the scanning length at the different distances of the optics is shown in the table.

Distance a	Scanning distance at 4° scanning angle
a = 80 mm	5.6 mm
a = 160 mm	11.2 mm
a = 250 mm	17.5 mm
a = 660 mm	46 mm
a = 1300 mm	91 mm
a = 5600 mm	391 mm

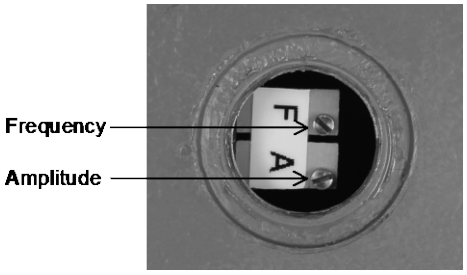
4.4.1 Adjustments

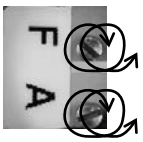
The scanning amplitude is adjustable with the scanning angle (0 to 4°) and when the scanning frequency is between 4 and 10 Hz.

On the left side of the pyrometer is a cover. Two adjusting potentiometers are under this cover, labeled with an A for amplitude and an F for frequency. For adjustments, a small screw driver is necessary. With the laser targeting light, the adjustments can be controlled.

Note: Please make sure that the pyrometer will not be contaminated while the cover is off.

The potentiometers can be turned 25 revolutions from min to max. To switch off the scanning mirror, the amplitude potentiometer has to be turned until the laser targeting light does not move. Then the measuring spot is centered. The speed of the scanning can be adjusted with the frequency potentiometer, the current speed can be watched by the speed of the moving laser spot.





4 to 10 Hz

0 to 4°

Note: The potentiometer has no mechanical stop position. Turning the potentiometer to the left decreases the values, turning right the values are increasing.

After making the required adjustments, ensure that you re-install the cover.

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5 Parameter Descriptions / Settings

5.1 Emissivity ε

For a correct measurement, it is necessary to adjust the emissivity. The *emissivity* is the relationship between the emission of a real object and the emission of a blackbody 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 10 and 100%, the set value is indicated on the display). Additionally, the emissivity is dependent 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.

Measuring object	**Emissivity [%]**	
	(at 0.7 to 1.1 µm)	(at 1.45 to 1.8 µm)
"Black body furnace"	100	100
Steel heavily scaled	93	85 to 90
Steel rolling skin	88	80 to 88
Steel, molten	30	20 to 25
Slag	85	80 to 85
Aluminum, bright	15	10
Chromium, bright	28 to 32	25 to 30
Brass oxidized (tarnished)	65 to 75	60 to 70
Bronze, bright	3	3
Copper, oxidized	88	70 to 85
Zinc	58	45 to 55
Nickel	22	15 to 20
Gold, Silver, bright	2	2
Porcelain glazed	60	60
Porcelain rough	80 to 90	80 to 90
Graphite	80 to 92	80 to 90
Fireclay	45 to 60	45 to 60
Stoneware, glazed	86 to 90	80 to 90
Brick	85 to 90	80 to 90
Soot	95	95

5.2 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. In the "0.00" position, the device operates using its time constant. The dynamic exposition time adjustment prolongs the exposure time at the lower range limit.

Settings:
0.00 s
0.01 s
0.05 s
.
.
10.00 s

5.3 Clear time of the maximum / minimum value storage (t_{CL})

Settings:
0.00 s
0.01 s
⋮
25 s
extern
auto

If the maximum value storage is always switched on, the highest last temperature value will be displayed and stored. The minimum value storage saves the lowest measurement taken during a reading. The storage has to be cleared at regular intervals and be replaced with 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 maximum value storage value has two different operating modes:

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 mode 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.

The following settings are possible:

Off: Clear time "0.00": the storage is switched off and only momentary values are measured.

0.01...25 s: If any clear time 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 of the storage can be activated and used within an own software (see Chapter 9 Data format UPP (Universal Pyrometer Protocol)) or via an external contact (for connection see 3.1.1 Pin assignment for the connector on the back 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 (or cold) 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.

Note: In the command structure, the maximum storage comes after the exposure time. This results in:

- clear time ≤ 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.

5.4 FROM / TO (beginning and end of sub range)

You have the opportunity to choose a sub range (minimum 51 °C) within the basic measuring range of the pyrometer. This sub range corresponds to the analog output. "**FROM**" describes the beginning of this measuring range, "**TO**" the end of the range.

With a sub range, it is possible to fulfill the requirements of the "auto" clear mode of the maximum value storage (see above).

5.5 Analog Output

Settings:
0 to 20 mA
4 to 20 mA

The analog output has to be selected according to the signal input of the connected instrument (controller, PLC, etc.).

5.6 SETP (limit contacts)

The instrument is equipped with two independent relay limit switches. These are two separate switch-over relay contacts, adjustable to any temperature of the pyrometer's temperature range. The switch-status is indicated in the display with the LED's S1 and S2. When the measuring temperature exceeds the adjusted limit contact temperature the relay switches and the LED indication is on.

5.7 Temperature display in °C or °F

The temperature can be displayed in °C (Celsius) or °F (Fahrenheit).

5.8 Digital Interface (RS)

Settings:
RS232
RS485

Selection between RS232 and RS485. (This adjustment can only be done on the pyrometer).

5.9 Address

Settings:
00
⋮
97

When connecting several pyrometers to one serial interface with RS485, it is necessary for each instrument to have its own device address for communication purposes. First, it is necessary to connect each instrument separately to give it an address. After that, all instruments can be connected and addressed individually.

Note: Only via own communication program with interface command (not possible with InfraWin, because InfraWin automatically detects a connected pyrometer): If parameters should 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).

5.10 Baud Rate (kBaud)

Settings:
2.4 kBd
⋮
115.2 kBd

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.

5.11 Test Current Output (10 mA)

The test function activates a test current of 10 mA on the analog output, independently if the instrument is adjusted to 0 ... 20 mA or 4 ... 20 mA. This enables to test external indicators for correct scaling. The reading of the internal indicator should correspond to the reading of the external indicator. If both displays show different readings the external indicator has a wrong temperature range or input current setting. The test function is switched off automatically after 1 minute and the instrument is working in the measuring mode.

5.12 Wait Time

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.: tw = 02 at a baud rate 9600 means a wait time of $^{2}/_{9600}$ sec).

Settings:
00 Bit
⋮
99 Bit

Note: Only available via interface commands, see Chapter 9, Data format UPP.

5.13 Switch Contact

The pyrometer is equipped with a built-in switch contact which allows you to use the pyrometer as a thermo switch. This function enables the detection of a hot object in the measuring beam of the pyrometer. The contact is activated only in combination with a clear time settings "**auto**" or clear times ≥ 1 s (see **Section 5.3 t_{CL} / s (clear times of the maximum value storage)**). If the temperature exceeds 2 °C min. or 1% of the span of the temperature sub range above the minimum temperature, the supply voltage (pin K) is connected to pin J.

6 Software InfraWin

The operating and analyzing *InfraWin* software is included with delivery of the pyrometer. In addition to allowing you to make parameter adjustments via PC, the *InfraWin* software also provides temperature indication, data logging, and measurement analysis features.

A software description can be found in the program's help menu. Click on the F1 button after loading InfraWin or click on the ? in the menu bar.

The latest version is available for free as download from the homepage www.lumasenseinc.com.

6.1 Connecting the pyrometer to a PC

The program *InfraWin* can operate up to two devices. Two devices using RS485 may be operated simultaneously by the same interface, if two different addresses have been properly entered (see section **5.9 Device Address** for more information).

6.2 Installation

To install the *InfraWin* software, select setup.exe from the *InfraWin*-CD or from the downloaded and unpacked zip file from the internet and then follow the installation instructions.

6.3 Program start

The first time you load *InfraWin* 5, you will be prompted to select a default language. The *InfraWin* software is available in German, English, Spanish, French, Portuguese, and Chinese. Once installed, click **Language/Languages** if you would like to select another language.

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7 Maintenance

7.1 Cleaning the front window

Since the device does not contain parts that require regular maintenance, the only regular maintenance required is periodic inspection of the front window for build-up of foreign particiles. If allowed to build up, the particles can influence the energy received by the instrument.

The window is not water soluable and can be cleaned with standard lens tissue dampened with a commercially available glasses or camera lens cleaning solution. Use a soft blower/brush (available in camera stores) to remove any grit on the window before you rub the lens with lens tissue and solution.

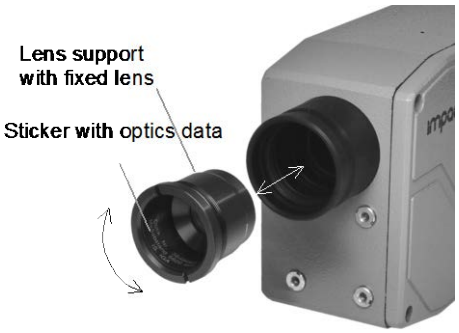
Attention: NEVER CLEAN THE WINDOW WITH A DRY TISSUE OF ANY KIND! The only time dry lens tissue may be used is to dry a window which has already been cleaned with wet lens tissue.

7.2 Changing of optics

Series 12 pyrometers are equipped either with a fixed optics or a focusable optics. Fixed or focusable optics cannot be changed against each other. Only the same type of optics can be replaced. Replacement optics with different measuring distances can be used without recalibration of the instrument. Replacement may be necessary if the lens is scratched or the pyrometer will be used for other measuring distances.

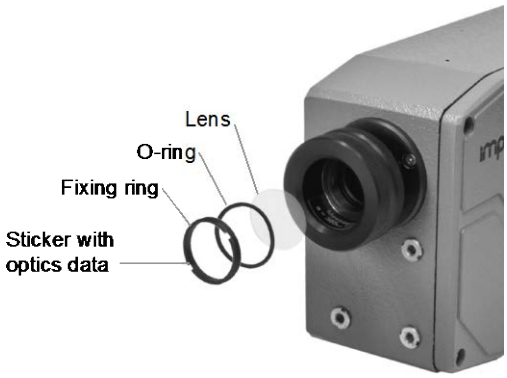
7.2.1 Fixed optics replacement

A suitable objective wrench is required to replace fixed optics. The replacement optics consists of the lens support and a fixed lens. A sticker with the optic data is fixed inside the lens support.



7.2.2 Focusable optics replacement

Only the lens will be replaced for changing the focusable optics. The fixing ring has to be removed with a suitable objective wrench. After removing the old lens, put in the new one with the convex side to the front. Fix the lens with a new O-ring and the new fixing ring. On the inside of this ring is the sticker with the optics data.



8 Troubleshooting

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
- Incorrect focusing of the optics
  ⇒ Focus correctly to the measuring distance, if necessary change lens
- Measuring object smaller than spot size
  ⇒ Change lens and measuring distance
- Measuring object is not always in the measuring spot of the pyrometer (e.g. swinging wire or pouring stream)
  ⇒ Use max. value storage or pyrometer with scanning system with max. value storage
- Emissivity set too high
  ⇒ Set lower correct emissivity corresponding to the material
- Lens contaminated or scratched
  ⇒ Clean lens carefully or replace it

Temperature indication too high

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

Measuring errors

- Indicated temperature is decreasing during the use of the pyrometer, contamination of the lens
  ⇒ Clean lens. Recommendation: use of air purge
- 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 or use a ratio pyrometer
- HF-interferences
  ⇒ Correct the connection of the cable shield
- Instrument overheated
  ⇒ Use cooling jacket with air or water cooling
- 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 55 °C. Use cooling jacket.

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9 Data Format UPP (Universal Pyrometer Protocol)

Via interface and suitable communication software or via **Test** function of the *InfraWin* software commands can be exchanged directly with the pyrometer.

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 (**C**arriage **R**eturn, 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 level of emissivity ε), finished with CR.

This is followed, if necessary for that command, by the ASCII parameter "X". If this parameter "X" is omitted, then the device resets with the current 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 = 0.97 or 97.0%

Description	Command	Parameters
Reading temperature value:	AAms	Output: XXXXX (dec., in $^1/_{10}$°C or. °F) last digit is the decimal place (88880 = Temp.-Overflow)
Reading temperature value repeated:	AAmsXXX	XXX = 000 …999 (XXX = number of measuring values)
Reading basic temperature range:	AAmb	Output: XXXXYYYY (hex 8-digit, °C or °F) XXXX = beginning of temp. range YYYY= end of temp. range
Reading temp. sub range:	AAme	Same as mb Changes only via PC software *InfraWin*
Reading emissivity:	AAem	Output: XXXX (dez. 0010 … 1000 in ‰)
Emissivity:	AAemXX	XX = (10…99%), 00 = 100% (decimal)
Emissivity:	AAemXXXX	XXXX = (0010 … 1000‰) (decimal)
Exposure time t_{90}:	AAezX	X = 0 ... 6 (decimal) 0 = intrinsic time constant of the device 1 = 0.01 s 3 = 0.25 s 5 = 3.00 s 2 = 0.05 s 4 = 1.00 s 6 = 10.00 s
External deletion:	AAlx	Simulation of an external deletion contact
Setting of temperature sub range:	AAm1XXXXYYYY	XXXX (hex 4-digit) beginning of temp. range (°C) YYYY (hex 4-digit) end of temp. range (°C)

Description	Command	Parameters
Analog output:	AAasX	X = 0 or 1 0 = 0 - 20 mA 1 = 4 - 20 mA
Limit contact 1:	AAs1XXXX	XXXX = switch point limit contact 1 (ASCII-hex, 4 digit, full degree in °C or °F)
Limit contact 2:	AAs2XXXX	XXXX = switch point limit contact 2 (ASCII-hex, 4 digit, full degree in °C or °F)
Setting hysteresis limit contacts:	AAhlXX	XX = 2 … 20, full degree in °C or °F
Changing °C / °F	AAfhX	Output: X = 0: display in °C; X = 1: display in °F
Interface type:	AAin	Output: X = 1 or 2; 1 = RS232, 2 = RS485
Address:	AAgaXX	XX = 00 ... 97 (00 ... 97 = regular device addresses) 99 = Global address with response 98 = Global address without response (only setting commands!)
Baud rate:	AAbrX	X = 1...6 or 8 (decimal) 1 = 2400 Baud 4 = 19200 Baud (7 is not allowed) 2 = 4800 Baud 5 = 38400 Baud 8 = 115200 Baud 3 = 9600 Baud 6 = 57600 Baud
Wait time:	AAtwXX	XX = 00 ... 99 (decimal)
Error status:	AAfs	Output: XX; XX=00…FF (00 = no error) (01…FF: error code for LumaSense service)
Lock keyboard:	AAlkX	X = 0 ... 3 1 = lock lk1, removal with command lk0 or power off-on 0 = removal of lock lk1 3 = continuous lock lk3, removal only with command lk2 2 = removal of lock lk3
Reading parameters:	AApa	Output decimal 11-digit: Digit 1 und 2 (10...99 or 00): emissivity ε Digit 3 (0 ... 6): t_{90} (exposure time) Digit 4 (0 ... 8): t_{CL} (max. storage clear mode) Digit 5 (0 ... 1): analog output Digit 6 und 7: (00 ... 98): temperature Digit 8 und 9 (00 ... 97): address Digit 10 (0 ... 6 or 8): baud rate Digit 11 (0): always 0
Laser targeting light:	AAlaX	X = 0 switch off laser X = 1 switch on laser
Internal temperature:	AAgt	Output: XXX (dec. 000 ... 098°C or 032 ... 208°F)
Max. internal temp.:	AAtm	Output: XXX (dec. 000 ... 098°C or 032 ... 208°F)
Ref. number:	AAbn	Output: XXXXXX (hex 6-digit)
Serial number:	AAsn	Output: XXXX (hex 4-digit)
Device type:	AAna	Output: “IS 12”, “IS 12-S”, “IGA 12” or “IGA 12-S” (16 ASCII-characters)
Device type / software version:	AAve	Output: XXYYZZ (6-digit decimal) XX = 07 (IS 12, IS 12-S, IGA 12, IGA 12-S) YY = Month of software version ZZ = Year of software version
Software version in detail:	AAvs	tt.mm.yy XX.YY tt = Day; mm = month; yy = year; XX.YY = software version

Note: the letter “l” means the lower case letter of “L”.

10 Reference Numbers

10.1 Reference numbers instrument

Type		With viewfinder, fixed optics	With viewfinder, fixed optics, Laser targeting light	With view finder, focusable optics, laser targeting light	With view finder, fixed optics, laser targeting light, scanner (type -S)
IS 12	550 to 1400 °C (MB 14)	3 839 100	3 839 110	3 839 120	3 839 130
	600 to 1600 °C (MB 16)	3 839 150	3 839 160	3 839 170	3 839 180
	650 to 1800 °C (MB 18)	3 839 200	3 839 210	3 839 220	3 839 230
	750 to 2500 °C (MB 25)	3 839 250	3 839 260	3 839 270	3 839 280
	550 to 2000 °C (MB 20L)	3 839 300	3 839 310	3 839 320	3 839 330
	700 to 3500 °C (MB 35L)	3 839 350	3 839 360	3 839 370	3 839 380
IGA 12	250 to 1000 °C (MB 10)	3 839 600	3 839 610	3 839 620	3 839 630
	300 to 1300 °C (MB 13)	3 839 650	3 839 660	3 839 670	3 839 680
	350 to 1800 °C (MB 18)	3 839 700	3 839 710	3 839 720	3 839 730
	400 to 2300 °C (MB 23)	3 839 750	3 839 760	3 839 770	3 839 780
	250 to 1400 °C (MB 14L)	3 839 800	3 839 810	3 839 820	3 839 830

Ordering note: When ordering, please select one optic (included in delivery) (see **3.3 Optics**).

A connection cable is not included in scope of delivery and has to be ordered separately.

10.2 Reference numbers accessories

3 820 340 Connection cable, length 5 m, 90° connector
3 820 530 Connection cable, length 10 m, 90° connector
3 820 540 Connection cable, length 15 m, 90° connector
3 820 830 Connection cable, length 20 m, 90° connector
3 820 840 Connection cable, length 25 m, 90° connector
3 820 550 Connection cable, length 30 m, 90° connector
3 820 750 Connection cable, length 5 m, 90° connector, temperature resistant up to 200 °C

3 821 120 Additional cable for limit contacts, 5 m
3 821 130 Additional cable for limit contacts, 10 m
3 821 140 Additional cable for limit contacts, 15 m
3 821 150 Additional cable for limit contacts, 20 m
3 821 160 Additional cable for limit contacts, 25 m
3 821 170 Additional cable for limit contacts, 30 m
3 821 200 Additional cable for limit contacts, 5 m, temperature resistant up to 200 °C

3 852 290 Power supply NG DC for DIN rail mounting; 100 to 240 V AC ⇒ 24 V DC, 1 A
3 852 540 Power supply NG 0D; DIN rail mount, 85...265 V AC, 24 V DC 600 mA
3 852 550 Power supply NG 2D, as NG 0D: additionally, with 2 limit switches (not for US sale)
3 826 750 USB to RS485 adapter cable, HS-Version,1.8 m long

3 852 580	Converter USB 2.0 ⇔ RS232
3 852 440	Protocol transducer RS485/RS232 (switch.) <-> Profbus-DP for 1 device
3 852 460	Protocol transducer RS485 <-> Profbus DP for 32 devices
3 852 620	Protocol converter UPP RS485 or RS232 <-> ProfNet, for 1 pyrometer
3 852 630	Protocol converter UPP RS485 <-> ProfNet, for max. 32 pyrometers
3 890 650	DA 4000: LED-display, 2-wire power supply, 2 limit switches (relay contacts), 230 V AC
3 891 220	DA 4000: LED-display, 2-wire power supply, 2 limit switches (relay contacts), 115 V AC
3 890 560	LED digital display DA 6000-N: with possibility for pyrometer parameter settings for digital IMPAC pyrometers; RS232 interface
3 890 570	DA 6000-N: with possibility for pyrometer parameter settings for digital IMPAC pyrometers; RS485 interface
3 890 520	DA 6000, digital display, digital and analog input, dual limit switch, maximum value storage, analog output, RS232
3 890 530	DA 6000, digital display, digital and analog input, dual limit switch, maximum value storage, analog output, RS485
3 826 510	PI 6000: PID programmable controller, very fast, for digital IMPAC pyrometers
3 835 060	Air purge
3 837 200	Cooling plate
3 837 330	Cooling jacket
3 834 200	Ball and socket mounting
3 834 140	Ball and socket mounting (steel) for rough ambience or cooling jacket
3 834 320	Mounting angle for Series 12
3 835 590	90° mirror for IS 12 & IGA 12 (for fixed optics only)
3 843 260	Rotary mirror attachment ROT 10
3 848 610	Exchangeable fixed optics 1
3 848 620	Exchangeable fixed optics 2
3 848 630	Exchangeable fixed optics 3
3 848 640	Exchangeable fixed optics 4
3 848 650	Exchangeable fixed optics 5
3 848 660	Exchangeable fixed optics 6
3 848 670	Exchangeable focusable optics 1
3 848 680	Exchangeable focusable optics 2
3 848 690	Exchangeable focusable optics 3

Index

S

T

U

W