LumaSense® TECHNOLOGIES

An Advanced Energy Company

MANUAL

IMPAC Pyrometer

ISR 12-LO/GS

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Contents

1 General Information

1.1 Information about the user manual

Congratulations on choosing the high quality and highly efficient IMPAC 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.
	**Security note laser beam** Indicates to the danger of a built-in laser targeting light.
Text	Text written in gray color explains integrated functions of the pyrometer which are not used in pouring stream mode.
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 is to be observed and maintained in legible condition.

1.2.1 Electrical connection

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

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

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. Final claim and negotiations with the carrier must be completed by the customer.

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: support@lumasenseinc.com

Erstein, France

- Telephone: +33 (0)3 88 98 98 01
- Email: support@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 Technical Support has not already assigned one). 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: support@lumasenseinc.com

1.7 Transport, Packing, 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 instrument out of these conditions can cause damage or result in malfunction of the pyrometer.

1.8 Disposal / decommissioning

Inoperable instruments must be disposed of in compliance with local regulations for electronic materials.

2 Introduction

2.1 Appropriate use

The pyrometers ISR 12-LO/GS is a special foundry system for the measurement of the pouring stream in foundries. This system is useful in automatic or semi automatic pouring machines and displays the temperature after each single pouring process.

A ratio pyrometer is required for this application because

- molten metal has a very low and fluctuating emissivity
- the position of the pouring stream is moving so that the measuring spot of the pyrometer is only partially filled

The pyrometer is equipped with a special pouring stream mode which calculates one average temperature value for each single casting process. Temperature values in the beginning and the end of the casting process can be eliminated which can affect the correct measurement. The shape of the spot size of the optics is a line which guarantees that even a moving pouring stream is always within the spot.

The pouring stream temperature of each single casting process and with that of each single casted part can be recorded automatically with the ISR 12-LO/GS. The temperature value of each finished casting process is displayed on the pyrometer and available as analog and digital output. With that the casting can be con-trolled very accurately to achieve the high-quality requirements of casted parts.

The measured values can be stored and displayed via analog and digital output.

Note: If the pyrometer should be used in other applications, the pouring stream mode can be switched off to use the pyrometer in standard 2-color or 1-color mode to use like a conventional pyrometer. In this case the descriptions printed in grey color have to be noticed.

2.2 Scope of delivery

Converter, optical fiber and optical head as per configuration, works certificate, PC software InfraWin, and user manual.

Note: A connection cable is not included with the instrument and has to be ordered separately (see Chapter **8**, **Reference numbers**).

2.3 Technical Data

Measurement

Temperature Ranges:	600 ... 1300 °C (MB 13) 750 ... 1800 °C (MB 18) 900 ... 2500 °C (MB 25)
Sub Range:	Any range adjustable within the temperature range, minimum span 51 °C
Signal processing:	Photoelectric current, digitized
Spectral Ranges:	λ_1: 0,8 µm / λ_2: 1,05 µm
Measuring modes:	Pouring stream / ratio- (2-color-) / mono- / metal mode switchable
Resolution:	Display: 1 °C Interface: 0.1 °C Analog output: < 0.025% of temperature range
Emissivity slope K:	ε_1 / ε_2: 0.8 … 1.2 (adjustable in steps of 0.001)
Emissivity ε:	0.1 … 1 (adjustable in steps of 0.001)
Switch-off limit:	2% … 50% (in 1%-steps)
Measurement Uncertainty: (ε = 1, t_{90} = 1 s, $T_{Umg.}$ = 23 °C)	0.4% of reading in °C + 1 °C (< 1500 °C) 0.6% of reading in °C + 1 °C (> 1500 °C)
Repeatability: (ε = 1, t_{90} = 1 s, $T_{Umg.}$ = 23 °C)	0.2% of reading in °C + 1 °C
Pre-run time:	0 … 9.9 s adjustable in steps of 0.1 s
Follow-up time:	0 … 9.9 s adjustable in steps of 0.1 s
Start condition:	0 … 99% (amount of measurement values in %, which must exceed the beginning of the adjusted temperature range)

Environment

Protection Class:	IP 65 (DIN 40 050)
Ambient Temperature:	Converter housing: 0 … 60 °C Optical head: up to 250 °C
Storage Temperature:	-20 … 70 °C
Relative Humidity:	Non condensing conditions
Weight:	2.2 kg
CE-Label:	According to EU directives about electromagnetic immunity

Interface

Control panel:	4 function keys, switch for serial interface, push button for test current
Sighting: 	Laser targeting light (max. power level < 1 mW, λ = 630 … 680 nm, CDRH class II). (Measurement is stopped while laser targeting light is switched on).
Parameters:	Adjustable or readable at the device or via interface: Emissivity ε, emissivity slope K, exposure time t_{90}, clear times for maximum value storage t_{CL}, automatically or external deletion of maximum value storage, switching measuring mode, switch-off limit, 0 … 20 or 4 … 20 mA, sub range, address, baud rate, °C/°F Readable at the device or via interface: Pouring stream temperature (in 1-color mode: measuring temperature) Adjustable only via interface commands: Pre-run time, follow-up time, start condition, wait time t_W, keyboard lock

Communication

Analog Output:	0 … 20 mA or 4 … 20 mA switchable, load 0 … 500 Ohm Test current 10 mA by pressing test key
Digital Interface:	Switchable: RS232 or RS485 addressable (half duplex), baud rate 2.4 up to 115.2 kBd
Display:	Built-in 4-digit 7-segment-LED, height 13 mm; LED's for: - °C/°F; - clear mode "auto","ext"; - ratio- (2-color) / mono- / metal mode
Exposure Time t_{90}:	2 ms (with dynamical adaptation at low signal levels), adjustable to 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, hold function to freeze the actual displayed pouring stream temperature

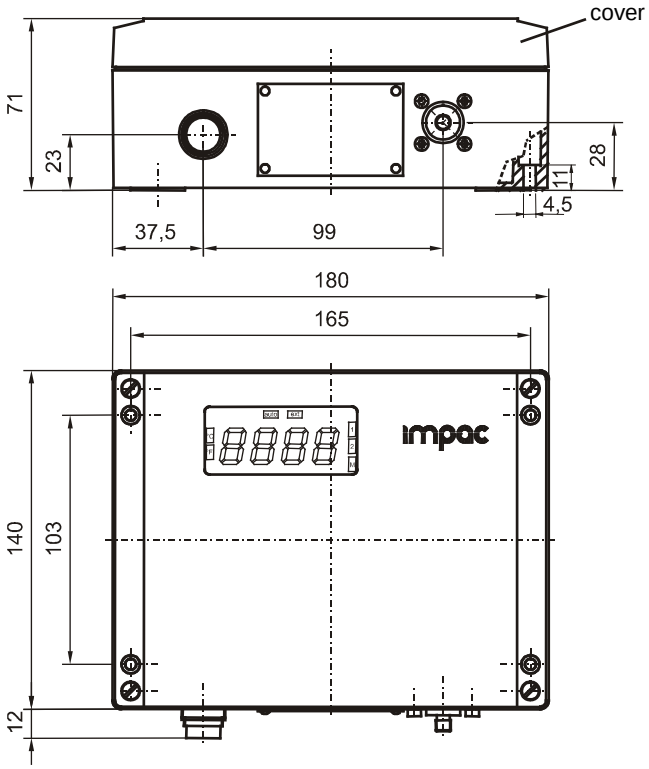
Electrical

Power Supply:	24 V DC (15 … 40 V DC) or 24 V AC (12 … 30 V AC), 48 … 62Hz
Power Consumption:	Max. 10 W
Switch Contact:	Max. 0.15 A (only active with automatic clear mode or $t_{CL} \geq 0.5$ s)
Isolation:	Power supply, analog output and digital interface are galvanically isolated from each other

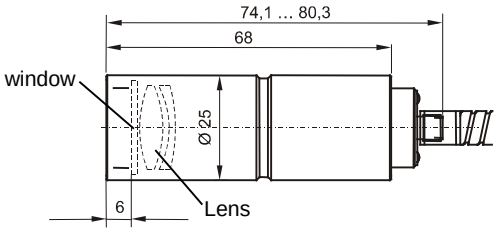
Note: The calibration / adjustment of the instruments was carried out in accordance with VDI/VDE directive "Temperature measurement in industry, Radiation thermometry, Calibration of radiation thermometers", VDI/VDE 3511, Part 4.4.
For additional details on this directive, see http://info.lumasenseinc.com/calibration or order the directive from "Beuth Verlag GmbH" in D-10772 Berlin, Germany.

2.4 Dimensions

Pyrometer housing:



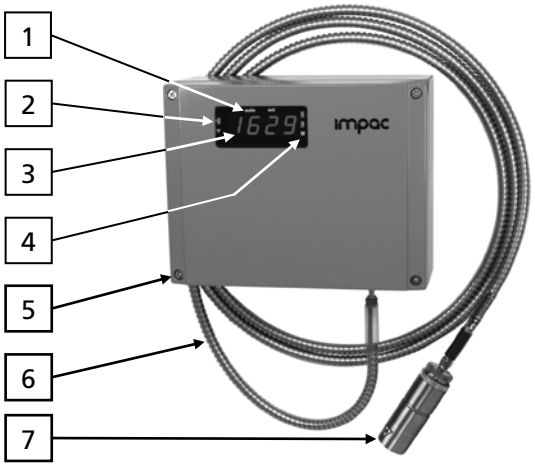
Optical head:



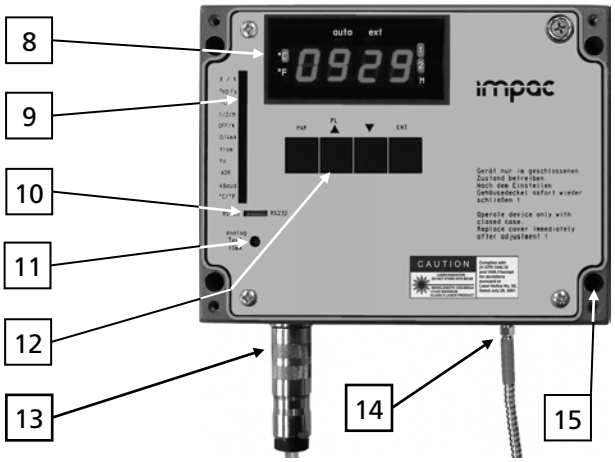
all dimensions in mm

2.5 Physical User Interface

Pyrometer



Pyrometer housing



1 Display for clear mode
2 Display °C or °F
3 LED display for temperature or parameter
4 Display for measuring mode
5 Mounting screws for cover (4 units)
6 Fibre optic
7 Optical head (with label about ex works setting of the measuring distance)
8 Display
9 Parameter indicator
10 Interface switch
11 Push button for test current
12 Setting keys
13 Electrical connection
14 Connection for optical fiber
15 Mounting holes

2.6 Accessories (Optional)

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 Chapter **8**, **Reference numbers**.

2.6.1 Mounting

Mounting:
For mounting and aligning the pyrometer to the measured object a *mounting angle* or *ball and socket mountings* is available. The ball and socket mounting is an easy way to align the pyrometer to the measured object. The clamping-screws of the ball and socket mounting enable an easy and fast adjustment of the pyrometer in all directions.

Protection housing:
Stainless steel (water cooling) *jacket with integrated air purge unit* as protection jacket for optical head protects the lens from contamination with dust and moisture. It must be supplied with dry and oil-free pressurized air (1,5 m³ / h) and generates an air stream shaped like a cone.

Protection housing with air purge unit

Displays:
Additionally, to the built-in temperature indicator of the pyrometer IMPAC offers several digital displays which can also be used for remote parametrizing of the pyrometer.

LED digital display

3 Controls and Installation

3.1 Electrical Installation

The ISR 12-LO/GS is powered by a voltage of 24 V DC or AC. The length of the 24 V supply line should not be longer than 30 m. Hence the use of 24 V site internal supply network is also not recommended. This length restriction does not apply for the analog and digital signal lines.

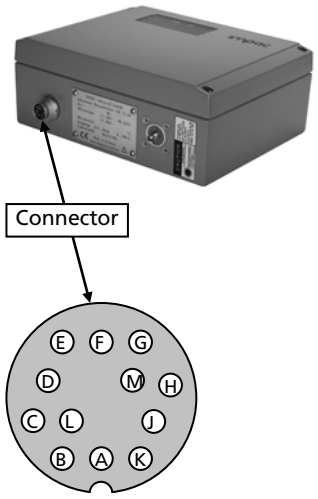
As the instrument is operating with heated and thermostatically controlled sensors, it needs a warm-up of up to 5 minutes (during this warm-up period the LED display indicates "7777"), after that the instrument is ready for use. To switch off the instrument, interrupt the power supply or unplug the electrical connector.
To meet the electromagnetic requirements (EMV), a shielded connecting cable must be used. The shield of the connecting cable must be connected only on the pyrometer side to avoid ground loops.

IMPAC offers connecting cables, 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 section 8, Reference numbers) and 12 pin connectors. 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.

Attention: When connecting the power supply, ensure the polarity is correct.

3.1.1 Pin assignment for the male socket on the bottom side of the pyrometer

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
J	pink	See **4.8**: output for operating mode contact, external clearing of maximum value storage, lens contamination monitoring or extern hold
G	red	DGND (Ground for interface)
F	black	RxD (RS232) or B1 (RS485)
C	violet	TxD (RS232) or A1 (RS485)
D	gray/pink	RxD (RS232) or B2 (RS485) (bridge to F)
E	red/blue	TxD (RS232) or A2 (RS485) (bridge to C)
M	orange	Screen only for cable extension, don't connect at the switchboard



Pin assignment
(side of male inserts)

3.1.2 Connector pin J

The connector pin J can be used for 4 different functions:

1) Operating mode contact: During the warm-up of the pyrometer (after connection to the power supply, the LED display on the converter indicates "7777") pin J is connected to the power supply voltage. This voltage is connected by a relays switch (max. continuous current 0.4 A) to pin K (power supply voltage). This relays switch opens when the warm-up is finished, and the pyrometer is in operating mode. For that reason, this pin can be used as operating mode contact.

2) External clearing of the maximum value storage: When the pyrometer is in operating mode, pin J can be used for external clearing of maximum value storage (see **4.7**). To clear the maximum value storage, connect pin J for a short time to pin K (power supply voltage).

The function "external clearing" is activated with the following conditions:
- Warm-up is finished (no display "7777")
- The clear time is set to "extern" (see 4.7)
- The lens contamination monitoring is switched off. This can be done via software *InfraWin* in "color-bar" window. The warning level "dirty window" must be set to 0%.

3) Lens contamination monitoring system: The pyrometers are equipped with a contamination monitoring system. Contamination of lens or sighting window or dust in the sighting path of the pyrometer can interfere the signal in such a high level that a correct temperature measurement will be impossible (this can also happen if the object is smaller than the spot size of the pyrometer). To avoid wrong measurements in advance, a warning signal can be set to a certain contamination level. If contamination reaches this level (or at a certain too low signal level), a built-in relays (max. continuous current 0.4 A) connects pin J to pin K (power supply voltage). The setting of the switch level (0 … 99%) can be done via software *InfraWin* in "color-bar" window. If the warning level "dirty window" is set to 0% the lens contamination monitoring system is switched off and pin J has the function "external clearing" of maximum value storage (factory setting).

The lens contamination monitoring system is activated with the following conditions:
- Warm-up is finished (no display "7777")
- The clear time is not set to "extern" or "hold" (see **4.7**).
- The pyrometer is operating in "2-color mode" (see **4.8**)

4) Extern Hold: When the hold function mode is activated the current pouring stream temperature (or the current temperature reading if the instrument is not in pouring stream mode) is frozen if J and pin K are connected (see **4.7 clear time of the maximum value storage**).

3.2 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 IMPAC-converter (order no. 3 852 430).

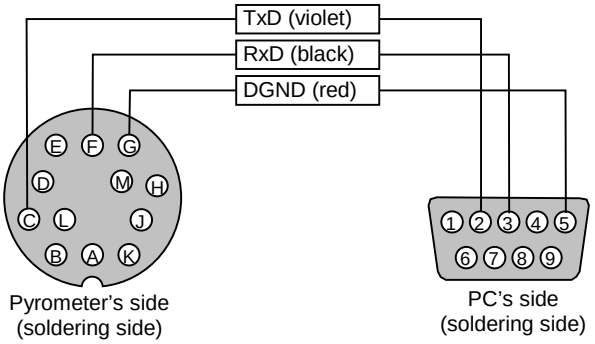
With a slow RS485 connection it is also possible to set a wait time at the pyrometer which delays the response of a command to the pyrometer (see **4.15 Wait time**).

3.2.1 Connecting to RS232 interface

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

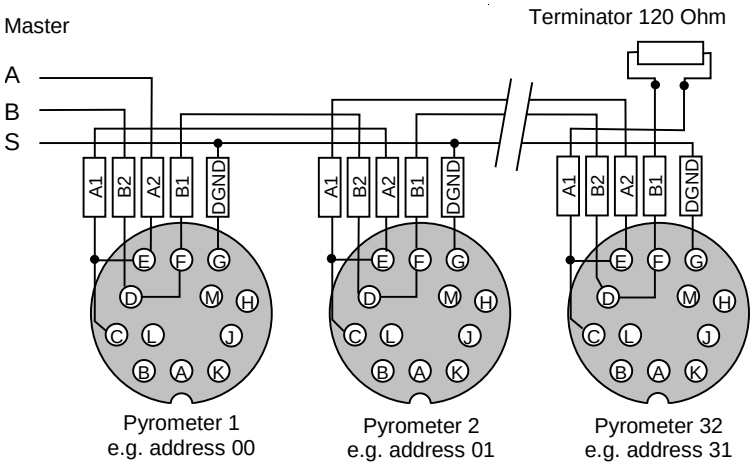
The baud rate must be reduced by 50% when the transmission distance is doubled (see **4.13 Baud rate (kBaud)**).

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



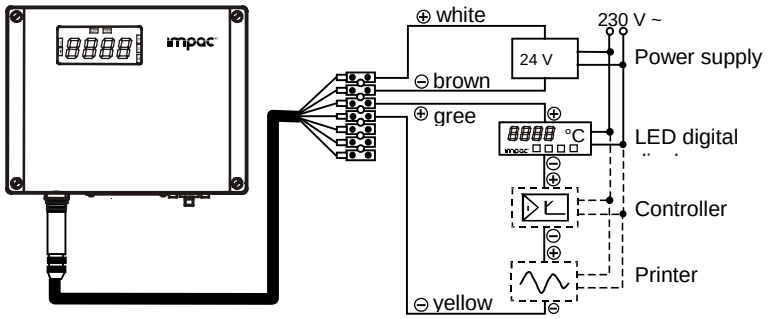
3.2.2 Connecting to RS485 interface

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 2400 and 115200 Bd may be set.
The baud rate is reduced by 50% when the transmission distance is doubled (see **4.13 Baud rate (kBaud)**). Typical cable length for 19200 Bd is 2 km.



3.3 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 instrument like a controller or printer can be connected to the display in series as shown above (total load of resistance max. 500 Ohm).



3.3.1 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.

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 persons by mirrors or shiny surfaces.

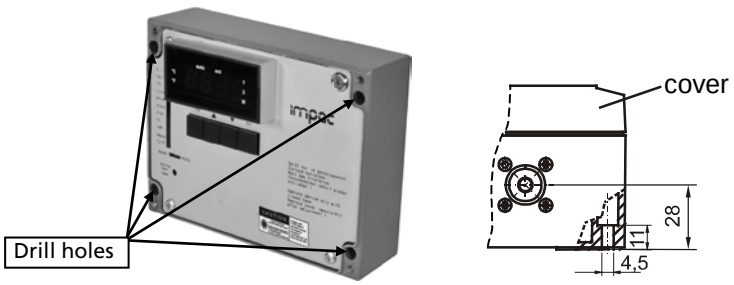
3.4 Mechanical installation

Note: The light guide end of the fiber optic cable as well as the socket/connector and the optical head must always be protected with the caps when not connected!

3.4.1 Pyrometer

To fix the converter 4 drill holes for screws with 4 mm diameter are visible after removing the cover.

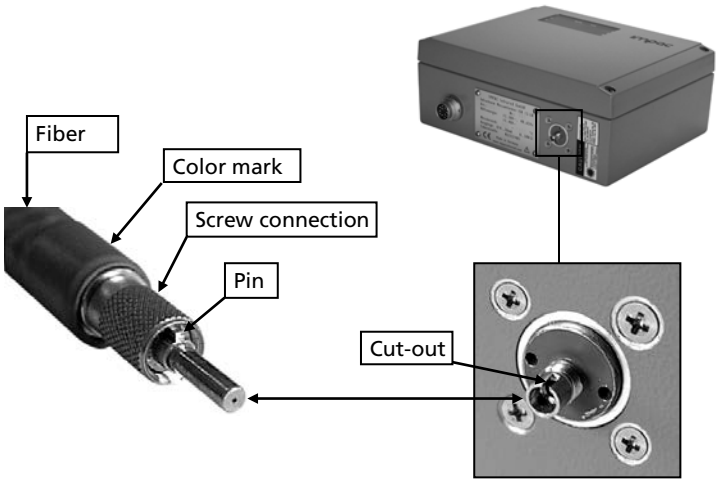
For fixing the optical heads different mounting supports are available (see **2.6 Accessories (optional)**).



3.4.2 Fiber optic

Depending on the measuring range two different fibers are used. They are marked red or blue. The color mark must be mounted on the pyrometer's side.

The fiber optic is equipped with a special connector which allows to fix the fiber only in one position. Please notice that the connector of the fiber with the pin is fixed in the correct position before plug and socket can be bold together.



3.4.3 Color mark at the fiber

Blue: MB 13

Red: MB 18, 25

3.4.4 Ambient temperature

Fiber and optical head can withstand ambient temperatures up to 250 °C without cooling on optical head's side.

3.4.5 Serial number

The original fiber has a serial number which is also on the pyrometer's housing. If required, the fiber can be replaced by a new original IMPAC fiber. A recalibration of the pyrometer is not necessary if it is only used in ratio mode or pouring stream mode. If the pyrometer is also used in mono mode or metal mode it must be calibrated together with the fiber (service).

3.4.6 Minimum bending radius

Blue: 100 mm for short time, 300 mm permanently

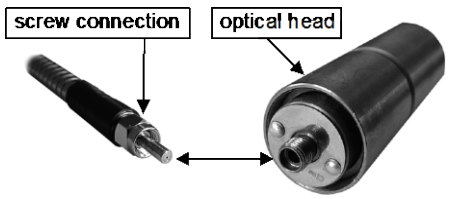
Red: 50 mm for short time, 120 mm permanently

Note: A hot fiber optic cable should not be exposed to continual movement!

3.4.7 Optical head

The FSMA connector on the side of the optical head doesn't need a special justification if bold together.

If required, the optical head can be replaced by another one (also without line spot size). A recalibration of the pyrometer is not necessary if it is only used in ratio mode. If the pyrometer also used in mono mode or metal mode it must be calibrated together with the fiber (service).

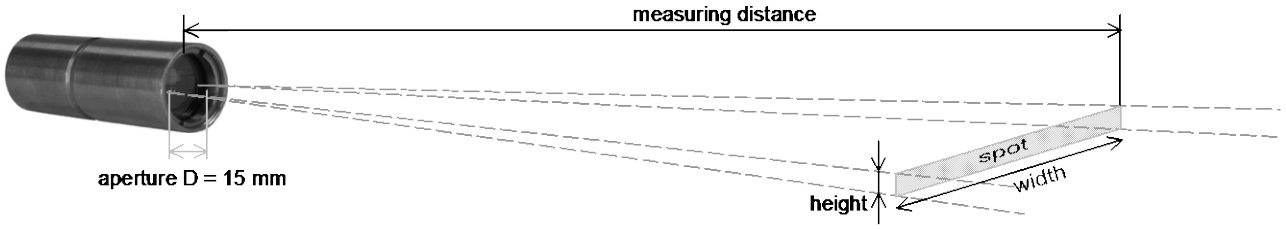


3.5 Optics

3.5.1 Spot Sizes

2 different optical heads are available. They have a special spot size in shape of a line which guarantees that even a moving pouring stream can always be captured.

The optical heads differ in its spot size depending on the measuring distance. The correct selection depends on the size of the pouring stream if the pouring stream is moving and the required distance to the stream.



The optical head must be adjusted to required measuring distance to reach the specified spot sizes. Distances between 340 and 4500 mm are possible (the adjusted value is mentioned on the back of the optical head.

The table above shows some examples for different measuring distances (distance measured from front of the lens to the object, see **2.4 Dimensions**)

3.5.2 Spot size table

Optical head with line spot width = 5% of measuring distance

	Spot [mm] Width x Height	
Measuring Distance *a* [mm]	**MB 18, 25**	**MB 13**
340	17 x 1.6	17 x 3.2
500	25 x 2.4	25 x 4.8
750	37.5 x 3.8	37.5 x 7.6
1000	50 x 5	50 x 10
2000	100 x 11	100 x 22
4500	225 x 22	225 x 44

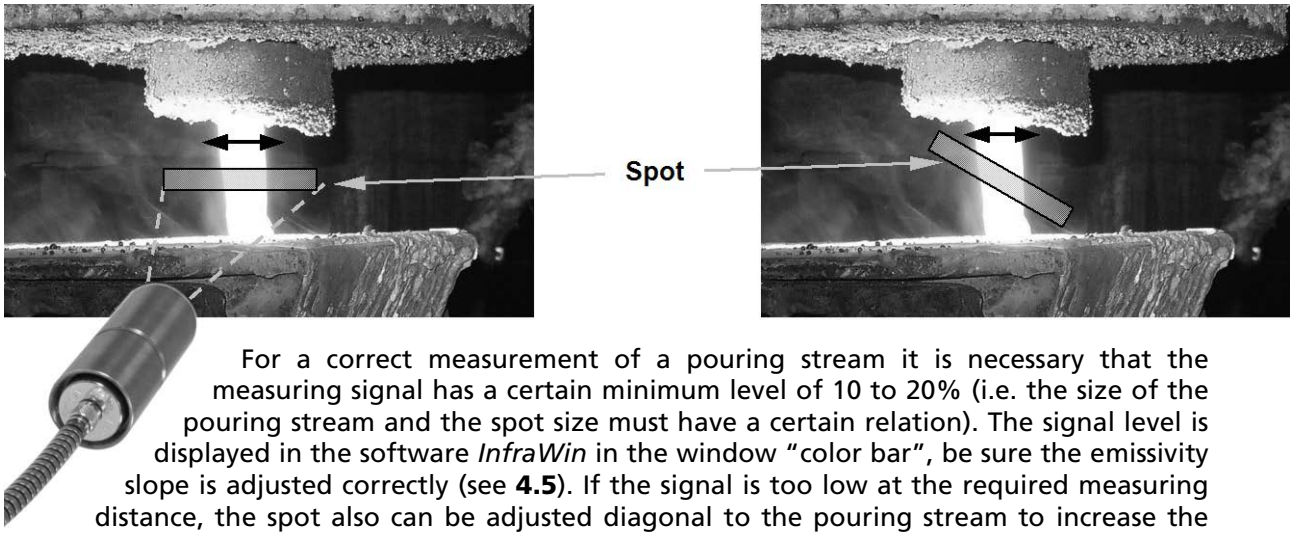
Optical head with line spot width = 12% of measuring distance

	Spot [mm] Width x Height	
Measuring Distance *a* [mm]	**MB 18, 25**	**MB 13**
340	41 x 1.6	41 x 3.2
500	60 x 2.4	60 x 4.8
750	90 x 3.8	90 x 7.6
1000	120 x 5	120 x 10
2000	240 x 11	240 x 22
4500	540 x 24	540 x 44

Note: The table mentions spot sizes for different fixed measuring distances of the optical head. Deviations from the adjusted measuring distances create a certain blur, which results in an enlarged spot size.

3.6 Aligning the optical head to the pouring stream

The optical head must be aligned in that way that the spot is partially filled by the pouring stream. If the pouring stream is moving, the stream should not leave the spot.



For a correct measurement of a pouring stream it is necessary that the measuring signal has a certain minimum level of 10 to 20% (i.e. the size of the pouring stream and the spot size must have a certain relation). The signal level is displayed in the software *InfraWin* in the window "color bar", be sure the emissivity slope is adjusted correctly (see **4.5**). If the signal is too low at the required measuring distance, the spot also can be adjusted diagonal to the pouring stream to increase the signal strength, but regard not to touch the "beard" at the top or the form edge.

3.7 Aligning the optical head with help of the laser targeting light

For correct alignment of the optical head the built-in laser targeting light must be used. The laser creates a line spot in the dimensions of the measuring spot. The size of this line varies for the different measuring distances. As the alignment of the optical head is quite difficult during the pouring process it is recommended to do it before the process starts. This can be done with a white sheet of paper which is hold at the position of the pouring stream. The laser line can be easily recognized on the paper for an accurate alignment.

If the laser targeting light is switched on, the display is blinking with the value "8000", the analog output keeps the last measurement value.

The laser targeting light can be switched on and off either by pressing the button at the housing or by using an external contact (see **Pin assignment for the connector on the bottom side of the pyrometer**) or via PC and the software *InfraWin*. After two minutes the laser targeting light is switched off automatically.

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: To prevent the damage of the laser, the pilot light switches off automatically if the internal temperature of the device exceeds approx. 55 °C (it can switched-on again if the internal temperature is lower than 55 °C)!

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4 Settings / Parameter Descriptions

All setting keys and switches for operation the instrument are placed inside the housing and can only be used after removing the cover (four screws). Ex works the instrument is operating in pouring stream mode (setting of other modes only via software *InfraWin*, see Chapter **5**, **Software *InfraWin***).

4.1 Factory Settings

Pouring stream mode = On

Start-up condition = 50%

Pre-run time = 0.5 s

Measuring time = 0 (auto)

Follow-up time = 0.5 s

Temperature display (°C / °F) = °C

Emissivity slope (**K**) = 1.000

Emissivity (ε) = 1.000

Exposure time (t_{90} / s) = 0.00

Clear time (t_{Clear}) = 0.00

Analog output (**0 / 4 mA**) = 0 ... 20 mA

Sub range same as basic temperature range

Address = 00

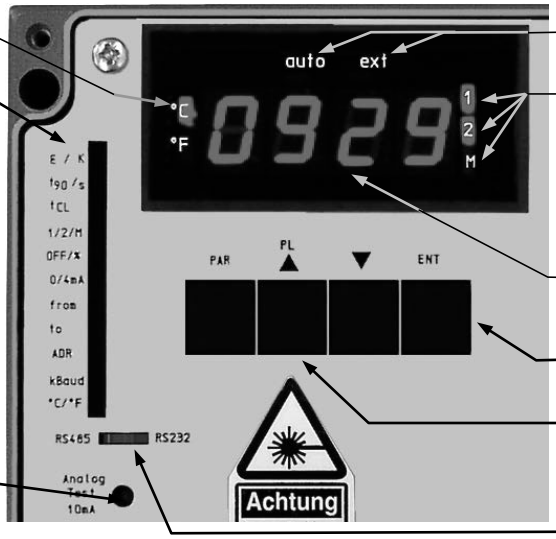
Baud rate (**kBaud**) = 19.2 kBd

Measuring mode (**1 / 2 / M**) = 2

Switch-off level (**OFF / %**) = 10%

Interface (**RS485 / RS232**) = RS232

4.2 Instrument settings



Display °C or °F

Parameter indicator:

Emissivity / emissivity slope (ε / K)
Exposition time (t_{90})
Clear time of maximum value storage (t_{CL})
Operating mode(1/2/M)
Switch-off limit (OFF)
Current output 0 or 4 ... 20 mA (0/4 mA)
Beginning of sub range (from)
End of sub range(to)
Address (ADR)
Baud rate (kBaud)
Temperature display in °C or °F (°C/°F)

Push-button for test current

LEDs for clear mode

Measuring mode display:
- mono mode
- ratio mode
- metal mode

Temperature- or parameter display

Setting keys

Targeting light on / off

Interface RS232 or RS485

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.

Push button for test current: The test button activates a test current of 10 mA on the analog output, independently if the instrument is adjusted to 0 to 20 mA or 4 to 20 mA. This enables to test external indicators for correct scaling. The readings 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. This test current can be switched off by pushing the test button again or any other setting key or it is switched off automatically after 30 seconds and the instrument is working in the measuring mode.

LED for clear mode: LED indicates if the maximum value storage is operating in automatic or external clearing mode.

Temperature or parameter display: In the pouring stream mode, the display always shows the last pouring stream temperature, in other modes the display shows the actual temperature reading. After pushing the parameter key the display indicates the actual value of one selected parameter.

Measuring mode display

LED 1 = mono mode
LED 1 and 2 = ratio mode with additional pouring stream mode
LED M = metal mode

Setting keys:

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.

▼ ▲: 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 a PC and *InfraWin*).

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 is still operating with the previous parameter value. If no key is pressed for approx. 30 s the display changes to the temperature indication.

4.2.1 Special indications

Display	Description
7777	Warming-up time after switching on
8888	Measurement exceeds the end of sub range
8000 (blinking)	Laser targeting light on (analog output keeps the last measurement value)
1° below beginning of sub range	Indication after warming up time while no pouring stream temperature is available
Display blinking	Signal strength in foundry mode is below the adjusted level.

4.3 Pouring stream mode

The start and end processes of the pouring disturb the temperature calculation and must be separated. Unfortunately, these processes are not constant and vary for each pouring.
That is the reason why it is impossible to remove fixed periods for start and end processes for a correct calculation of a pouring stream temperature. An intelligent measuring system is necessary.

To enable the automatic operation of the system and to adapt it to the requirements of the pouring machine, a few presettings must be done via software *InfraWin.*

Temperature sub range:
To enable the system to recognize the start and end of the pouring process, the beginning of the temperature sub range must be set to a useful value (approx. 200 °C below the expected pouring temp.)

Start-up condition or measuring condition (0 to 1024 values, adjustable in %)**:**
The measuring condition controls continuously if an adequate pouring stream is in the spot size of the pyrometer. If the measuring temperature of the pyrometer exceeds the beginning of the sub range, the control starts. It ends if the temperature is fallen below this temperature. Only if the pyrometer detects continuously the adjusted values (0 to 1024) above the sub range, the measurement time starts. The internal measuring time of the pyrometer is approx. 1 ms, i.e. to detect 1024 temperature values is needs approx. 1 s.

At very short pouring times the amount of values can be reduced. E.g. if a value of 50% is adjusted, 512 measurement values must be above the beginning of temperature sub range to start the measurement of the pouring stream.

Pre-run time (0 to 9.9 s)**:**
A certain pre-run time can be set in addition to the start-up condition. This additional period delays the start of the temperature calculation and can be necessary e.g. if sparks disturb the measurement at the beginning.

Measuring time (0 to 9.9 s, 0 = auto)**:**
As a standard the measuring time is running in the auto mode, i.e. automatic recognition of start and end process in combination with a continuous controlling of the start-up condition. If the start-up condition is not longer fulfilled (temperature below beginning of sub range = end of pouring process), the system starts with the calculation of the pouring stream temperature. For this calculation it removes the last 1024 temperature values, makes an average of the remaining values and shows the calculated temperature on the display.

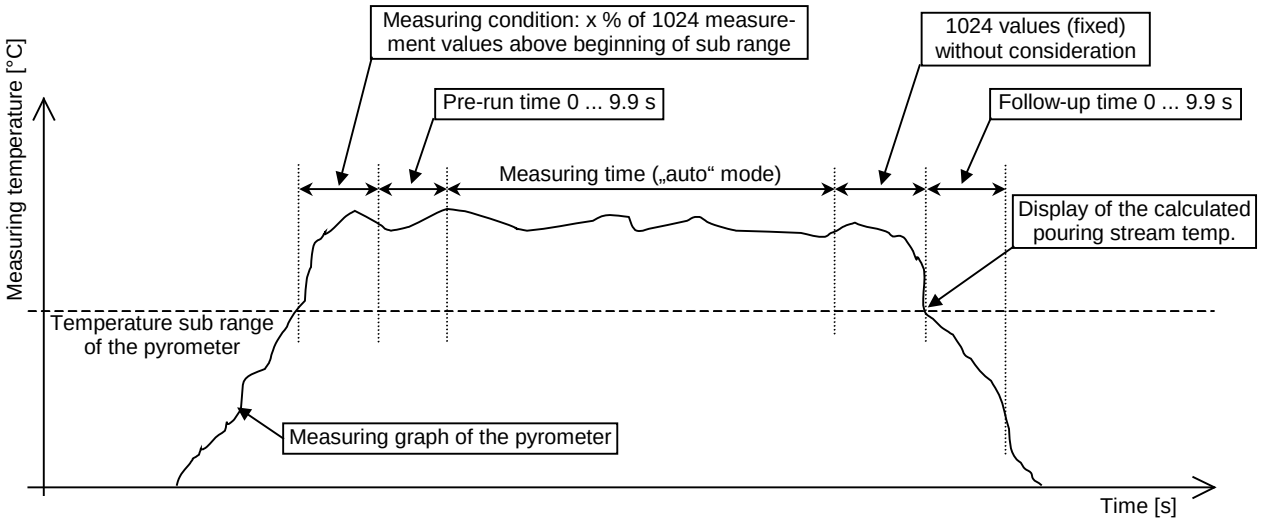
If a fixed measuring time is set, the system is recognizing the start process automatically and is using this period for the calculation of the temperature and shows the calculated temp. on the display.

In both modes the temperature is displayed until the next calculated temperature is available.

Follow-up time (0 to 9.9 s)**:**
Very often at the end of pouring processes liquid iron drops after closing the valve or the operator opens the valve for a short final refill manually. E.g. this can cause problems that the instrument starts a new pouring stream measurement although it belongs to the running process. A certain follow-up time can avoid an early restart of the measurement.

Conclusion:
These are all details which are necessary for a correct detection and measurement of a pouring stream. The calculation of the average temperature occurs if the measuring condition is not fulfilled anymore or the adjusted time is expired. The last 1024 measurement values are not included in the temperature calculation to avoid measurement errors (e.g. caused by sparks or iron drops).

Example graph:



4.4 Temperature display (°C / °F)

Settings:
°C
°F

The temperature can be displayed in °C or °F.

4.5 Emissivity ε / emissivity slope K

Emissivity slope (K = ε_1 / ε_2) only in ratio mode. Emissivity (ε) setting only in mono mode.

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 10 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 must 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.

In *ratio mode* (2-color mode) which is used for pouring stream measurements, the pyrometer is measuring simultaneously with 2 sensors in adjacent wavelengths. It calculates the temperature by ratioing the radiation intensities of the two wavelengths. This ratio technique eliminates a number of factors that degrade the accuracy of a conventional single-color instrument e.g. measurement independent of emissivity in wide areas, unaffected by dust in the field of view, unaffected by dirty viewing windows or lenses or if the measuring object is smaller than the spot size of the pyrometer (at pouring stream measurements), etc. In some cases, the emissivities of the two wavelengths can differ so that it is necessary to correct the ratio of the two emissivities (ε_1 / ε_2) to get a correct temperature reading. This correction can be done with the emissivity slope setting K. The K-factors of metals or a pouring stream are normally higher than 1. For a correct measuring result it is recommended to make a comparison test, e.g. with a thermocouple probe. Then the K-factor must be corrected until the pyrometer shows the same temperature value.

Emissivity values and emissivity slope values of various common materials are listed below:

Measuring object	Emissivity ε (at 0.9 µm)	Emissivity slope K
„Black body furnace“	1	1
Steel, molten	0.3	1.05
Steel heavily scaled	0.93	1
Steel rolling skin	0.88	1.00 ... 1.01
Slag	0.85	1
Chromium, bright	0.28 ... 0.32	
Brass oxidized (tarnished)	0.65 ... 0.75	
Bronze, bright	0.03	
Copper, oxidized	0.88	
Nickel	0.22	
Gold, Silver, bright	0.02	
Porcelain glazed	0.6	1
Porcelain rough	0.8 ... 0.9	1
Graphite	0.8 ... 0.92	1.01
Chamotte	0.45 ... 0.6	1
Earthenware, glazed	0.86 ... 0.9	1
Brick	0.85 ... 0.9	1
Soot	0.95	1

4.6 Exposure time (t_{90}/ s)

Settings:
min
0.01 s
0.05 s
⋮
9.99 s

The *exposure time* is the time interval when the measured temperature must 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 "min" position, the device operates using the time constant 2 ms.

The dynamic exposure time adjustment prolongs the exposition time at the lower range limit.

4.7 Clear time of the maximum value storage (t_{CLEAR})

Settings:
OFF
0.01 s
⋮
25 s
extern
auto
hold

If the maximum value storage is switched on always the highest last temperature value will be displayed and stored. The storage must 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: At clear time "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 **7, Data format UPP**) or via an external contact (for connection see **3.1.1 Pin assignment for the male socket 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 must 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.

Hold: The function "hold" enables to freeze the actual displayed pouring stream temperature (or the current temperature reading if the instrument works not in foundry mode) at any moment. For this an external push button or switch must be connected (see **3.1.2 Connector pin J**) which holds the temperature reading as long as the contacts are closed.

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

Single Storage Mode: 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 Mode: 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: In pouring stream mode the exposition time follows the function of adjustment of maximum value storage. This can be used in case of interruptions in the pouring stream:

- The setting of a clear time for the maximum value storage stores always the highest value during the measurement value calculation
- Setting a value for the exposure time is smoothing this stored value so that even with interruptions in the pouring stream a reasonable temperature calculation can be done.

4.8 Operating mode (1 / 2 / M)

The series 12 pyrometers are designed for use in ratio mode. Additionally, the pyrometers can be used in two other modes:

Settings:
mono mode
ratio mode
metal mode

In the *mono mode* the pyrometer only, measures in one wavelength and the ratio mode is off. In this case the operating mode is equivalent to a conventional 1-color pyrometer (see **4.5 Emissivity**).

The *metal mode* is a special mode which calculates the temperature combining the ratio and the 1-color signal with an algorithm. The metal mode can be used to determine the temperature of metals and alloys with unknown emissivity ratio (K). It should be used only for a short time to achieve a good approximation of the object temperature if the temperature reading in 2-color or 1-color mode seems to be incorrect. After this the pyrometer must be switched back into 2-color mode and the temperature reading must be corrected with the adjustment of the emissivity slope K until the instrument shows the temperature determined in the metal mode. A condition for the use of the metal mode are settings of $\varepsilon = 1$ and $K = 1$.

Note: The metal mode can be affected by the setting of the switch-off limit, see **4.9.**

4.9 Switch-off limit (OFF / %)

Settings:
2%
⋮
50%

The switch-off limit is a function to avoid measuring errors caused by too low signals. Ratio pyrometers are able to measure temperatures correctly even with very low signals, i.e. for example through a dirty viewing window or if dust exists in the field of view or if the spot is not filled by the measuring object. If the signal is too low for a correct measurement, the pyrometer interrupts the measurement and displays 1° below of beginning of the temperature range. Depending of the application the switch-off limit can be adjusted between 2 and 50%, ex works at delivery set to 10%.

Note: The smaller the value the higher the chance that daylight or reflections affect a correct measurement.

4.10 Analog Output

Settings:
0 … 20 mA
4 … 20 mA

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

Note: Settings for Analog Output: 0 to 20 mA or 4 to 20 mA 0 to 20 mA/21 Low or 4 to 20 mA/21 Low (setting /21 Low = Analog Out shows 21 mA if signal intensity falls below Switch-Off level).

4.11 Sub Range

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

For automatic detection of a pouring stream the beginning of the temperature sub range must be set to a value that makes sense. Such a value is approx. 200 °C below the anticipated value.

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 **4.7**).

4.12 Device 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).

4.13 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.

Settings:
2400 Bd
⋮
115200 Bd

4.14 Analog Test 10 mA

The test function activates a test current of 10 mA on the analog output, independently if the instrument is adjusted to 0 to 20 mA or 4 to 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.

4.15 Wait time (t_w)

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 7, Data format UPP).

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5 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.

5.1 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 **4.12 Device Address** for more information).

5.2 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.

5.3 Program start

The first time you load *InfraWin*, 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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6 Maintenance

6.1 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.

6.2 Service

The pyrometer does not have any parts which require regular service, only the lens must 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.

6.3 Changing of optics

The pyrometers are equipped ex works with an optical head with a spot in shape of a line. The optical head can be changed against another if it is used only in ratio mode (2-color mode). Replacement can be necessary if the lens is scratched or the pyrometer will be used for other measuring distances

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7 Data format UPP (Universal Pyrometer Protocol)

Software commands can be exchanged directly with the pyrometer through an interface using suitable communication software or by using the "Test" function located in the "Pyrometer Parameters" window of the InfraWin software package.

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) no handshake;
- The device responds to the entry of a command with output (such as the measuring value) + CR (**C**arriage **R**eturn, ASCII 13), to pure entry commands with "ok" + CR, or "no" + CR.
- Every command starts with the 2-digit device address AA followed by two lower case command letters and finished with CR.

  Example Read Command: 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%
- The ASCII parameter "X" indicates a change to be made in a parameter. When used, the command contains the new value.

  Example Write Command: Entry: "00emXXXX" + <CR>

  The parameter used for the emissivity setting (ε) with the address 00 is changed.

  Answer: "00em0853" + <CR> changes the Emissivity to 0.853 or 85.3%
- A "?" after the lower case command letters answers with the limits of the respective settings (only at setting commands, not at query commands).

  Example Read Limits Command: Entry: "00em?" + ˜CR!

  Answer: Could be 00501000 + <CR>, which means that E can vary between 0.050 and 1.000 (or 5% and 100%)

Description	Command	Parameters
Reading temperature value:	AAms	Output: XXXXX (dec., in $^1/_{10}$ °C or °F) in the selected measuring mode 77770 = warm-up period of sensor or sensor heating failed 88880 = temperature overflow 80000 = targeting light on
Reading temperature value repeated:	AAmsXXX	XXX = 000 ... 999 (XXX = number of measuring values)
Reading measuring values:	AAek	Output: XXXXXYYYYY (dec., in 1/10 °C or °F) XXXXX = mono temperature YYYYY = ratio temperature 77770 = warm-up period of sensor or sensor heating failed 88880 = temperature overflow 80000 = laser targeting light on

Description	Command	Parameters
Reading emissivity:	AAem	Output: XXXX (dec. 0010 ... 1000 in ‰)
Emissivity:	AAemXXXX	XXXX = (0010 ... 1000‰) (decimal)
Emissivity slope:	AAevXXXX	XXXX = 0800 ... 1200 (equivalent to 0.8 ... 1.2)
Ratio part in metal mode:	AAmvXX *)	XX = 01 ... 99%
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
Clear times of the maximum value storage:	AAlzX	X = 0 ... 9 (decimal) 0 = maximum value storage off 1 = 0.01 s 4 = 1.00 s 7 = external deletion 2 = 0.05 s 5 = 5.00 s 8 = automatically deletion 3 = 0.25 s 6 = 25.00 s 9 = Extern hold
Operation mode:	AAkaX	X = 0 metal mode from channel 1 and 2 X = 1 mono mode (1 channel) X = 2 ratio temperature (2 channel)
Switch-of limit:	AAawXX	XX = 02 ... 50%
Analog output:	AAasX	X = 0 or 1 0 = 0 to 20 mA, 1 = 4 to 20 mA
Reading basic temperature range:	AAmb	Output: XXXXYYYY (hex 8-digit, °C or °F) XXXX = beginning of temperature range YYYY = end of temperature range
Reading temperature sub range:	AAme	Same as mb
Setting of temperature sub range:	AAm1XXXXYYYY	XXXX (hex 4-digit) beginning of temp. range (°C or °F) YYYY (hex 4-digit) end of temp. range (°C or °F)
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 (dec.) 1 = 2400 baud 4 = 19200 baud (7 is not available) 2 = 4800 baud 5 = 38400 baud 8 = 115200 baud 3 = 9600 baud 6 = 57600 baud
Temp. display °C / °F:	AAfhX	Output: X = 0: display in °C; X = 1: display in °F
Reading signal strength:	AAtr	Output: XXXX, 1000 equivalent to 100.0%
Wait time:	AAtwXX	XX = 00 ... 99 (decimal)
Warning level dirty window:	AAdwXX	XX = 00 … 99; 2 digit, dec. in %
Error status:	AAfs	Output: XX; XX=00…FF (00 = no error) (01…FF: error code for LumaSense service)
Internal temperature:	AAgt	Output: XXX (dec. 000 ... 099, at °C, 032 ... 210 at °F)
Max. Internal temp.:	AAtm	Output: XXX (dec. 000 ... 099, at °C, 032 ... 210 at °F)
Reading interface type:	AAin	Output: X = 1 or 2; 1 = RS232, 2 = RS485
Laser targeting light:	AAlaX	X = 0 switch off laser targeting light X = 1 switch on laser targeting light 

Description	Command	Parameters
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): ε Digit 3 (0 ... 6): t_{90} (exposition 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): (0 or 1): keyboard active or locked Digit 12 ... 15 (0800 ... 1200): emissivity slope
Autoreset:	AAre	Activating auto-reset, initializes the pyrometer new and resets the instrument to default settings
Reference number:	AAbn	Output: XXXXXX (hex 6-digit)
Serial number:	AAsn	Output: XXXX (hex 4-digit)
Device type / software version:	AAve	Output: XXYYZZ (6-digit decimal) XX = 06 (ISR 12-LO) 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
Device type:	AAna	Output: "ISR 12-LO" (16 ASCII-characters)

Special pouring stream commands

Description	Command	Parameters
Reading of data:	AAtg	Output: ABBBCCCC A = serial no. of pouring date, Ascii-Hex 0 … F BBB = time of pouring Ascii-Hex 000 … FFF in $^1/_{10}$ s (pre-run time + measuring time) CCCC = temp. value Ascii-Hex 0000 … FFFF in $^1/_{10}$°C or °F
Pouring stream mode:	AAtoXX	Output: XX XX = 00 pouring stream mode off XX = 01 pouring stream mode on
Measuring condition:	AAtqXX	XX = 00 … 99; 2 digit, dec. in % of 1024 meas. values
Pre-run time:	AAtpXX	XX = 00 … 99; 2 digit, dec. in $^1/_{10}$ s
Measuring time:	AAmtXX	XX = 00 … 99; 2 digit, dec. in $^1/_{10}$ s; 00=Automatic mode
Follow-up time:	AAtnXX	XX = 00 … 99; 2 digit, dec. in $^1/_{10}$ s

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

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8 Reference Numbers

8.1 Reference numbers instrument

Ordering note:
The ISR 12-LO/GS can be configured with different optical fiber lengths and optical heads (5% or 12%) as well as with various optional extras. To determine the part number and the price for the desired combination please contact LumaSense or your LumaSense sales representative.

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

8.2 Reference numbers accessories

3 820 330	Connection cable, length 5 m, straight connector
3 820 500	Connection cable, length 10 m, straight connector
3 820 510	Connection cable, length 15 m, straight connector
3 820 810	Connection cable, length 20 m, straight connector
3 820 820	Connection cable, length 25 m, straight connector
3 820 520	Connection cable, length 30 m, straight connector
3 820 740	Connection cable, length 5 m, straight connector, 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
3 852 550	Power supply NG 2D for DIN rail mounting; 85 to 265 V AC ⇒ 24 V DC, 600 mA with 2 settable limit switches
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, with 2 limit contacts, 230 V AC
3 891 220	DA 4000: LED display, 2 wire power supply, with 2 limit 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	LED digital display DA 6000-N with RS485 interface
3 890 520	LED digital display DA 6000; DA 6000-N additional with 2 limit switches and analog input and output, RS232 interface
3 890 530	LED digital display DA 6000 with RS485 interface
3 890 150	DA 6000-T, digital display, for measurement of the cool down time t_{8_5} from 800 °C to 500 °C (for welding processes)
3 826 510	PI 6000: PID programmable controller, very fast, for digital IMPAC pyrometers
3 834 390	Ball and socket mounting with clamp for optical head I or II
3 834 230	Adjustable mounting support for optical head II
3 835 180	Air purge unit, stainless steel, for optical head
3 837 160	Water cooling jacket with air purge unit
3 834 210	Adjustable mounting support for water cooling jacket

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9 Troubleshooting

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

Symptom	Probable Cause	Comments
Temperature indication too low	Emissivity slope set too high	Set lower correct emissivity slope corresponding to the material See section **4.5**
Temperature indication too high	Emissivity slope set too low	Set lower correct emissivity slope corresponding to the material (see **4.5**)
	The measurement is influenced by reflections of hot machine parts	Use mechanical construction to avoid the influence of the interfering radiation (sighting tube)
No temperature indication at the end of the pouring stream	Pouring stream is not in the spot of the pyrometer	New correct alignment of the optical head (see **3.6**)
	Optical head contaminated or scratched	Signal strength too low, clean or change optical head Recommendation: use of air purge
	Pouring stream is much smaller than spot size, thus the signal strength is too low (see **4.3**)	Choose shorter measuring distance
	No temperature indication during the use of the pyrometer, although the air purge unit is used	Probably compressed air is not clean or air failed. Clean optics and use clean and oil free air
	HF-interferences	Correct the connection of the cable shield

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