

IMPAC Pyrometers ISR 6 Advanced



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Contents

1	General Information	5
1.1	Information about the user manual	5
1.1.1	Legend	5
1.1.2	Terminology	5
1.2	Safety	5
1.3	Limit of liability and warranty	5
1.4	Unpacking the Instrument	6
1.5	Malfunction or Service Request	6
1.6	Shipments to LumaSense for Repair	7
1.7	Transport, Packing, Storage	7
1.8	Disposal / decommissioning	7
2	Introduction	9
2.1	Appropriate use	9
2.2	Scope of delivery	9
2.3	Technical Data	9
2.4	Dimensions	11
2.5	Physical User Interface	12
2.6	Accessories (Optional)	12
2.6.1	Mounting	12
2.6.2	Cooling Jacket	12
2.6.3	Air Purge	13
2.6.4	Vacuum support	13
2.6.5	Scanning Mirror	13
2.6.6	Flange System	13
3	Controls and Installation	15
3.1	Electrical Installation	15
3.1.1	Pin assignment of the connector	15
3.1.2	Connecting the pyrometer to a PC	16
3.1.3	Connection to RS485	17
3.1.4	Connection schematic for analyzing devices	17
3.2	Sighting	18
3.2.1	Viewfinder	18
3.2.2	Laser Targeting Light	18
3.3	Optics	19
3.3.1	Spot Sizes	19
3.3.2	Optional Integrated Line Optics	20
3.3.3	Deviation from the focused measuring distance	20
3.3.4	Adjusting the required measuring distance	21
4	Settings / parameter descriptions	23
4.1	Factory Settings	23
4.2	Temperature Display	23
4.3	Emissivity (ϵ)	24
4.4	Emissivity Slope K	24

4.4.1	Slope Adjustment	24
4.4.2	Temperature Errors Cause by Non-Graybodies.....	25
4.5	Transmittance τ	26
4.6	Response Time (t_{90})	26
4.7	Clear Peak Memory (t_{CLEAR})	26
4.7.1	Single and Double Storage Modes	27
4.7.2	Clear Time Settings	27
4.8	Analog Output	28
4.9	Relative Signal Strength	28
4.10	"Dirty Window" Warning	28
4.11	Minimum Intensity Switch-Off Level.....	28
4.12	Operating Modes	29
4.12.1	2-color mode	29
4.12.2	1-color mode	29
4.12.3	Metal mode.....	29
4.13	Sub Range	29
4.14	Device Address.....	30
4.15	Focused Distance	30
4.16	Baud Rate.....	30
4.17	Pyrometer Internal Temperature	30
5	Software InfraWin.....	31
5.1	Connecting the pyrometer to a PC	31
5.2	Installation	31
5.3	Program start	31
6	Maintenance	33
6.1	Cleaning ISR 6 Window	33
6.2	Calibration	33
6.2.1	Laboratory Calibration	33
6.2.2	On-Site Calibration	34
7	Data format UPP (Universal Pyrometer Protocol)	35
8	Reference Numbers.....	39
8.1	Reference numbers instrument	39
8.2	Reference numbers accessories	39
9	Troubleshooting	41
Index	45

1 General Information

1.1 Information about the user manual

Congratulations on choosing the high quality and highly efficient IMPAC ISR 6 Advanced pyrometer.

This manual provides important information about the instrument and can be used as a work of reference for installing, operating, and maintaining your IMPAC Series 6 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.



Laser Beam Safety Warning: The laser beam safety warning symbol signifies hazards relating to the built-in laser targeting light.



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: **Messbereich**)

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 IMPAC ISR 6 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.

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 Malfunction or Service Request

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 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:

Customers in **North America** should send RMA Shipments to:

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

All other customers should send RMA Shipments to:

Frankfurt, Germany

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

Email: eusupport@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 80 °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 IMPAC pyrometers must be disposed of in compliance with local regulations for electro or electronic material.

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2 Introduction

2.1 Appropriate use

The IMPAC ISR 6 pyrometer is a stationary, digital pyrometer for non-contact temperature measurement of metals, ceramics, graphite, etc. in ranges between 600 and 3000 °C.

The pyrometer measures in 2-color mode (ratio principle) in which two adjacent wavelengths are used to calculate the temperature. This technique offers the following advantages when compared with standard one-color pyrometers:

- The temperature measurement is independent of the emissivity of the object in wide ranges.
- The measuring object can be smaller than the spot size.
- Measurements are unaffected by dust and other “grey” contaminants in the field of view or by dirty viewing windows.

The pyrometer can also be switched to 1-color mode and used like a conventional pyrometer. In addition, the pyrometer can also be operated in a special metal mode.

2.2 Scope of delivery

Pyrometer, PC adjustment, and evaluation software *InfraWin*, works certificate, and operating instructions.




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 to 1400 °C (MB14) 700 to 1800 °C (MB18) 800 to 2500 °C (MB25) 1000 to 3000 °C (MB30)
Sub Range:	Any range adjustable within the temperature range, minimum span 50 °C
Spectral Ranges:	Channel 1: 0.9 µm, channel 2: 1.05 µm
Resolution:	0.1 °C or 0.2 °F at interface; < 0.0015% of selected sub range at analog output, min. 0.1 °C, 16 bit; 1 °C or 1 °F on display
Emissivity ϵ :	0.050 to 1.000 in steps of 1/1000 (1-color mode)
Transmittance τ :	0.050 to 1.000 in steps of 1/1000 (1-color mode)
Emissivity Slope K:	0.800 to 1.200 in steps of 1/1000 (2-color mode)
Measurement Uncertainty: (K = 1, t_{90} = 1 s, $T_{amb.}$ = 25 °C)	< 1500 °C: 0.3% of reading in °C + 2 °C > 1500 °C: 0.6% of reading in °C
Repeatability: (K = 1, t_{90} = 1 s, $T_{amb.}$ = 25 °C)	0.15% of reading in °C + 1 °C

Optics

Sighting:	Built-in laser aiming light (max. power level < 1 mW, $\lambda = 630\text{-}680\text{ nm}$, CDRH class II) or through-lens sighting	
Optics:	Manually focusable from rear cover with measuring distance $a = 210\text{ to }5000\text{ mm}$	
Distance ratio:	MB 14 approximately 100 : 1 MB 18 approximately 190 : 1 MB 25 and MB 30 approximately 350 : 1	

Environment

Protection Class:	IP 65 IEC 60529 (value in mated condition)
Operating Position:	Any
Ambient Temperature:	0 to 65 °C at housing <i>Note: During operation the instruments will warm up and might reach an intrinsic temperature of up to 58 °C</i>
Storage Temperature:	-20 to + 80 °C
Relative Humidity:	Non condensing conditions
Weight:	0.6 kg
Housing:	Stainless steel
CE-label:	According to EU directives about electromagnetic immunity

Interface

Connection:	12-pin connector
Display (in rear cover):	LED, 4 digit matrix, 5 mm high for 2-color or 1-color temperature signal or measuring distance
Parameters:	Adjustable via interface: 2-color / 1-color temperature signal, metal mode, accordingly emissivity slope or emissivity, temperature sub range, settings for maximum value storage, address, baud rate, switch off limit, warning level lens contamination monitoring system, transmittance, response time t_{90} , 0 to 20 mA or 4 or 20 mA analog output range, °C/°F. Readable via interface: measured value, internal temperature of the unit, measuring distance.

Communication

Analog Output:	Adjustable 0 to 20 mA; or 4 to 20 mA, linear
Digital Interface:	RS485 addressable (half-duplex) Baud rate: 1200 to 115.2 kBd (on request RS232, not addressable)
Switch Off Limit:	2% to 50% (adjustable via interface)
"Dirty Window" Warning:	Relay contact, max. continuous current 0.4 A, setting of the warning level: 0 (off) to 99%
Exposure Time t_{90} :	<2 ms (with dynamical adaption at low signal levels); adjustable to min; 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), via interface, automatically with the next measuring object, external contact, hold-function

Electrical

Power Supply:	24 V DC \pm 25%, ripple must be less than 50mV
Power Consumption:	Max. 3 W (incl. laser)
Load (analog output):	0 to 500 Ω
Isolation:	Power supply, analog output and digital interface are electrically isolated from each other

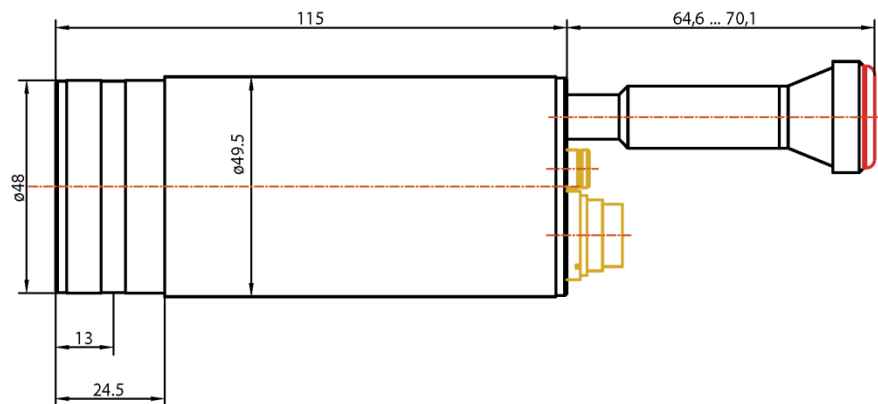


Note: The calibration / adjustment of the instruments was carried out in accordance with VDI/VDE directive "Temperature measurement in industry, Radiation thermometry, Calibration of radiation thermometers", VDI/VDE 3511, Part 4.4.

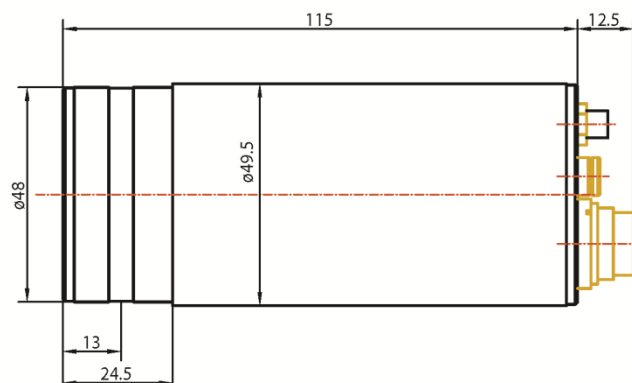
For additional details on this directive, see <http://info.lumasenseinc.com/calibration> or order the directive from "Beuth Verlag GmbH" in D-10772 Berlin, Germany.

2.4 Dimensions

ISR 6 Advanced
with Through-Lens
Sighting



ISR 6 Advanced
with Laser Aiming



All dimensions in mm

2.5 Physical User Interface



*ISR 6 Advanced
with Laser*



*ISR 6 Advanced
with Through Lens*

- | | | | |
|---|----------------------------|---|------------------------------------|
| 1 | 12-Pin Connector | 5 | LED Distance Indicator Light |
| 2 | Digital Display | 6 | LED 1-Channel Mode Indicator Light |
| 3 | Sighting Option | 7 | Viewfinder Adjustment Ring |
| 4 | Focus Adjustment Set Screw | | |

2.6 Accessories (Optional)

Numerous accessories guarantee easy installation of the pyrometer. The following overview shows a selection of suitable accessories. You can find the entire accessory program with all reference numbers in Chapter 8.

2.6.1 Mounting

An adjustable mounting angle is available to easily mount the pyrometer and align it to the measured object.



2.6.2 Cooling Jacket

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



*Water cooling jacket with
integrated air purge*

2.6.3 Air Purge

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



2.6.4 Vacuum support

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



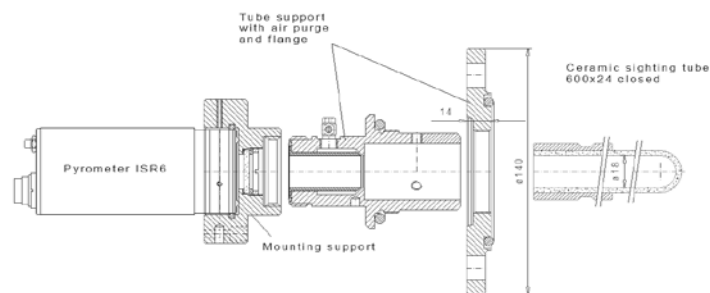
2.6.5 Scanning Mirror

The scanning mirror unit SCA 5 allows the measured object to be scanned over a certain range. The measuring beam of the pyrometer moves straight in one line across the object and collects temperature data of this line. This is useful when used in combination with the maximum value storage (peak picker) to measure objects which move out of the target area. The scanning angle of the mirror is 0 to 12° and the scanning frequency 0 to 5 Hz. Both values are easily adjustable at the scanner.



2.6.6 Flange System

The flange system is a modular mounting system to fix the pyrometer on furnaces, vacuum chambers, etc.



Schematic drawing of the flange system

It can consist of e.g. mounting support, tube support with air purge and flange and an open or closed ceramic sighting tube. The mounting support can be equipped with a quartz window for vacuum applications. It may consist of an equipment rack, flange, and an open or closed ceramic tube. The equipment rack can be equipped for vacuum applications with a fused silica.

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3 Controls and Installation

3.1 Electrical Installation

The pyrometer is powered by 24 V DC \pm 25% (very well stabilized, ripple max. 50 mV). It is important to ensure correct polarity when connecting the device to the power supply. 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.

To meet the electromagnetic requirements (EMV), a shielded connecting cable must be used. LumaSense offers connecting cables, which are not part of the standard scope of delivery.

The shield of the connecting cable has to be connected only on the pyrometer's side. If the connecting cable is extended, the shield of the extension also needs to be extended. The shield must be open on the power supply side (switch board), to avoid ground loops.

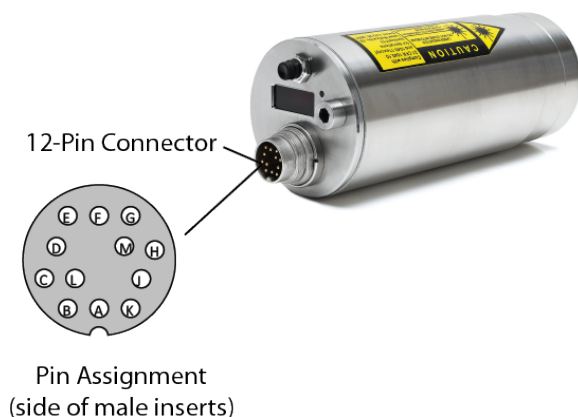
The connecting cable has wires for the power supply, interface, analog output, external laser switch, and external clear of maximum value storage via contact and 12 pin connector. The cable includes a short adapter cable with a 9-pin D-SUB connector. This connector may be used in combination with the RS485 to USB adapter.

Once the instrument has been connected to the power supply, it is immediately ready for use. Although it does not need to be warmed up, it does need to run for approximately 15 to 30 minutes before achieving full accuracy. The instrument can be switched off by interrupting the power supply or unplugging the electrical connector.



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

3.1.1 Pin assignment of the connector



Pin	Color	Function
K	white	+24 V DC power supply
A	brown	0 V DC power supply
L	green	+ I _{out.} analog output
B	yellow	– I _{out.} analog output
H	gray	Targeting light activate / deactivate via external switch (bridged with K)
J	pink	External clearing of max. value storage (bridge to K), hold function, or output for "dirty window" monitoring (*see notes below)
G	red	DGND (GND for interface)
F	black	B1 (RS485) or Rx D (RS232)
C	violet	A1 (RS485) or Tx D (RS232)
D	gray/pink	B2 (RS485) (bridged with F)
E	red/blue	A2 (RS485) (bridged with C)
M	orange	Screen only for cable extension, don't connect to the switchboard

The connector pin J can be used for 3 different functions:

1. 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. When external clearing is selected from the t_{clear} dropdown menu, pin J is connected for a short time to pin K (power supply voltage) to clear the stored maximum value.

The function “external clearing” is triggered with the following conditions:

- The clear time is set to “extern”.
- The “dirty window” warning system is switched off. This can be done through the InfraWin software in the “color-bar” window.
- The warning level “dirty window” must be set to 0%.

2. Hold function:

When the hold function mode is activated, the current temperature reading is frozen as long as pin J and pin K are connected. (See section 4.7 for clear time for the maximum value storage).

3. “Dirty Window” Warning system:

The pyrometer is equipped with a “dirty window” warning system. The accuracy of the pyrometer will be seriously affected if the lens is not clean and the sight path is obscured by dirt, process material, smoke or steam (this can also happen if the object is smaller than the spot size of the pyrometer).

To avoid incorrect measurements, a warning signal can be set to detect when the signal level becomes too low or reaches a certain level. When activated, a built in relay (max. continuous current 0.4 A) connects pin J to pin K (power supply voltage).

The setting of the warning level (0 to 99%) can be done through the “color-bar” window of the InfraWin software. If the warning level “dirty window” is set to 0% (factory setting), the “dirty window” warning system is switched off and pin J can perform one of the functions of “external clearing” or “hold”.

The “dirty window” warning system is triggered with the following conditions:

- The clear time is not set to “extern” or “hold”.
- The pyrometer is operating in “2-color mode”.

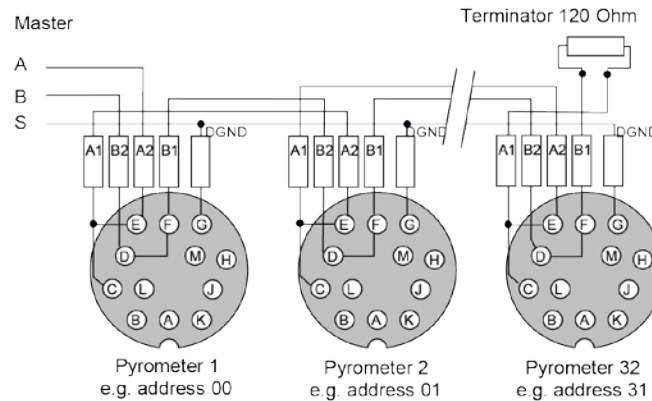
3.1.2 Connecting the pyrometer to a PC

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 the RS485 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 LumaSense adapter (order no. 3 826 750).

3.1.3 Connection to RS485

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.



RS485 Bus System

It also safeguards against the interruption of the RS485 Bus System should a connecting plug be pulled out. The master labels mark the connections on the RS485 converter. The transmission rate of the serial interface in Baud (Bd) is dependent on the length of the cable. Values between 1200 and 115200 Bd may be set.

3.1.4 Connection schematic for analyzing devices

For temperature indication of the pyrometer, LumaSense offers pure indicators (series DA 4000). LumaSense also offers indicators with features to change pyrometer parameters (DA 6000 and DA 6000-N) as well as a fast digital PID controller PI 6000.



Digital Display

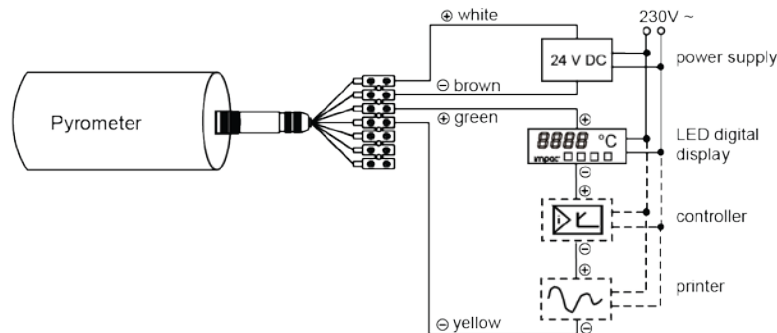


Parameterizing Indicator



Digital Controller

Additional analyzing instruments, including LED digital displays only need to be connected to a power supply and the analog outputs of the pyrometer (exception: the digital display DA 6000 can also be connected with its serial interface, whereas the digital display DA 6000-N has to be connected with its serial interface).



Connection Schematic for Analyzing Devices

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

3.2 Sighting

The ISR 6 Advanced can be purchased with Through-Lens Sighting or with a Laser targeting light. These sighting options allow you to easily align the pyrometer to the measuring object.

3.2.1 Viewfinder

The ISR 6 Advanced can be equipped with a viewfinder which offers through-lens sighting. The viewfinder is true-sided and parallax-free. A circle marks the position of the measuring spot, but not the exact spot size.



Warning: To ensure eye protection, make sure you use the shaded filter when viewing objects with temperatures of 1500 °C or higher.

The viewfinder is equipped with an adjustable eye-protection filter, which allows you to view hot objects without exposing your eye to high intensity light. When you are viewing hot objects, turn the adjustment ring on the viewfinder so the filter will let in less light.

When you are viewing low temperature objects, turn the viewfinder adjustment ring so the filter will let in more light.



Note: You can turn the adjustment ring on the viewfinder in both a clockwise and counterclockwise direction to change the filter from light to dark.

3.2.2 Laser Targeting Light

The ISR 6 Advanced can be equipped with a laser targeting light to assist with aligning the pyrometer to the measuring object. The laser targeting light 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.

The laser spot marks the center of the measuring spot on the target. The diameter does not correspond to the spot size. The smallest diameter of the laser spot approximately indicates the measuring distance.

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

The laser targeting light can be switched on and off by pressing the button of the rear cover of the housing.

The laser targeting light can also be switched on and off by using an external contact (see section 3.1.1 "Connector Pin Assignment") or through the InfraWin software. If it is not switched off by one of the above-mentioned methods, it will be switched off automatically after approximately 2 minutes.

To prevent damage to the laser, the targeting light is also switched off automatically if the internal temperature of the pyrometer exceeds 61 °C. It can only be used again once the temperature falls below 61 °C.





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



Laser Beam Safety Warning: The instrument is equipped with a class II laser that emits radiation. 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.

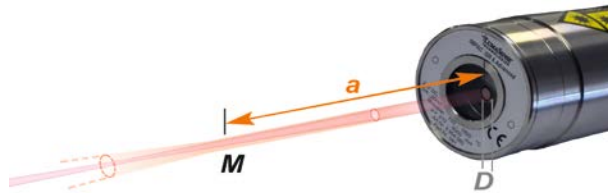


3.3 Optics

3.3.1 Spot Sizes

The ISR 6 Advanced has a Vario optics, which can be manually adjusted at all distances between 210 mm and 5000 mm.

The table of spot sizes in relation to measuring distance shows examples of the pyrometer's spot size M [mm] in relation to the measuring distance a [mm] (min. 90% of the radiation intensity). Increasing or decreasing the measuring distance will change the spot size.



Aperture D for all temperature ranges is 13 to 15 mm with the aperture being the effective diameter of the lens. This is dependent on the optical setting. The largest value applies to a very small measuring distance, while the minimum value applies to the largest measuring distance.



Note: In the 1-color (mono) mode, the pyrometer can measure objects at any distance (whether focused or non-focused). However, the object has to be bigger than or at least as big as the spot size of the pyrometer in the measuring distance.
In the 2-color (ratio) mode, the object can be somewhat smaller than the spot diameter.

	Temperature Range			
	600 ... 1400 °C	700 ... 1800°C	800 ... 2500°C	1000 ... 3000°C
Measuring Distance a [mm]	Spot Diameter M [mm]			
210	2.1	1.1	0.6	0.6
300	3	1.6	0.9	0.9
500	5	2.7	1.5	1.5
800	8	4.2	2.3	2.3
1300	13	6.9	3.7	3.7
2000	20	10.6	5.8	5.8
5000	50	27	15	15

Examples of Spot Sizes in Relation to Measuring Distance

Focused spot sizes between the listed distances can be found by linear interpolation between the listed values. For example, for range 600 to 1400 °C, the spot size at 1600 mm distance would be about 16 mm.



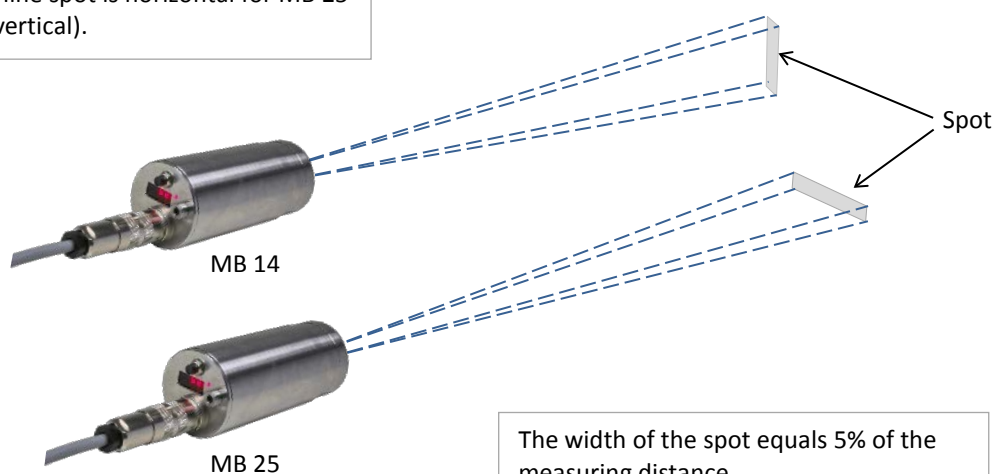
Note: Effective aperture D for all temperature ranges is 12 mm (focused to longest distance) to 16 mm (focused to shortest distance).

3.3.2 Optional Integrated Line Optics

Besides the standard optical heads these pyrometers are optionally also available with integrated line optics. The line optics feature a special spot in shape of a line and provide additional advantages for some applications such as wire production or pouring stream measurements.

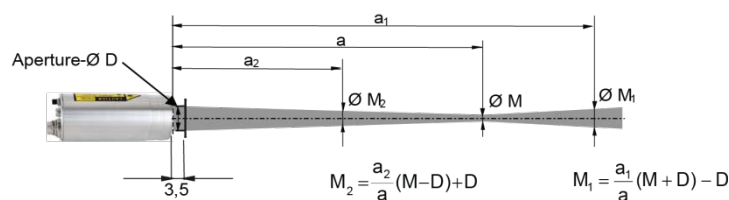
The orientation of the line spot is vertical for MB 14 (wire move horizontally).

The orientation of the line spot is horizontal for MB 25 (pouring stream runs vertical).



3.3.3 Deviation from the focused measuring distance

Spot sizes for non-focused distances (shorter or longer than the focused distance) may be calculated by using the formula below.



Formula for Calculating Spot Sizes

The InfraWin software also includes a Spot Size Calculator that calculates the data for the non-focused regions, if you enter the values of aperture D, focused measurement distance a, and focused measuring field diameter M as found in the above table (see section 3.3.1).

3.3.4 Adjusting the required measuring distance

The measuring distance can be set using the Focus Adjustment Screw on the back of the device. The focused distance value can be adjusted at all distances between 210 mm and 5000 mm. To focus, turn the focus adjustment set screw to make the target image appear sharp and clear.

The LED Distance Indicator Light (labeled mm) will turn red and the approximate focused measuring distance in mm will automatically be shown on the Digital Display for a few seconds after making an adjustment using the Focus Adjustment Set Screw.



Note: The optics are manually focusable with a measuring distance of a = 210 to 5000 mm.



Note: Turning the focus adjustment screw counterclockwise will shorten the measuring distance.
Turning the focus adjustment screw clockwise will lengthen the measuring distance.

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4 Settings / parameter descriptions

The pyrometer is equipped with a wide range of settings for optimal adaptation to the required measuring condition and to measure the temperature correctly.



The digital PC interface allows you to exchange data with a PC either by using the supplied InfraWin software or by using the Universal Pyrometer Protocol (UPP) commands with your own communication program (see Chapter 7 for the UPP Data Format commands).

Selecting the pyrometer parameters window shows the current settings of the pyrometer. You can change a value by typing a value in an input box or by selecting a preset value from the list field. The following settings can be made through the RS485 to USB connection.

4.1 Factory Settings

- Temperature display ($^{\circ}\text{C}$ / $^{\circ}\text{F}$) = $^{\circ}\text{C}$
- Emissivity (E_{mi}) = 1 (100%)
- Emissivity Slope K = 1
- Transmittance = 100%
- Exposure time (t_{90}) = min
- Clear Peak Memory (t_{clear}) = 0s (off)
- Analog Output (mA) = 0 ... 20 mA
- "Dirty Window" Warning = 0%
- Switch Off Limit = Off% = 10%
- Operating Modes = 2-color mode
- Sub Range = Basic Range
- Device Address (Adr) = 00
- Baud Rate (Baud) = 19200

4.2 Temperature Display

The Digital Display on the back of the pyrometer will show the temperature measurement in either $^{\circ}\text{C}$ or $^{\circ}\text{F}$. You can select which temperature scale you wish to use through the InfraWin software or by using the UPP Data Format commands.

The Measuring Value can also be viewed at any time through the InfraWin Software or by using the UPP Data Format commands.

4.3 Emissivity (ϵ)

Different materials have different emissivities ranging between 0% and 100%. The emissivity is also dependent upon 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.

Emissivity settings between 20% and 100% can be established through the InfraWin software or by using the UPP Data Format commands.



Note: Emissivity ϵ Settings: 5% to 100% in steps of 1/1000 (1-color mode).

4.4 Emissivity Slope K

In 2-color (ratio) mode, 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 conventional 1-color instruments. For example, with ratio pyrometers, measurement is independent of emissivity in wide areas. They are also unaffected by dust in the field of view and unaffected by dirty viewing windows or lenses, etc. as long as these disturbances are "grey" (not colored).

In some cases the emissivities of the two wavelengths can differ so that it is necessary to correct the ratio of the two emissivities ($K = \epsilon_1 / \epsilon_2$) to get a correct temperature reading. This correction can be done by adjusting the emissivity slope setting K using the InfraWin software or the UPP data format commands.

The K-factors of metals are normally slightly higher than 1. For a correct measuring result, it is recommended that you make a comparison test. This comparison test may be performed by using a thermocouple probe or by knowing one process temperature point precisely from other sources. The K-factor can then be adjusted until the pyrometer shows the same temperature value.

The ISR 6 is factory calibrated for graybody targets that exhibit equal changes in emissivity within its two spectral bands.



Note: Emissivity Slope K Settings: 0.800 to 1.200 in steps of 1/1000 (2-color mode).

4.4.1 Slope Adjustment

In some cases the emissivities of the two wavelengths can differ so that it is necessary to correct the ratio of the two emissivities ($K = \epsilon_1 / \epsilon_2$) to get a correct temperature reading. This correction can be done by adjusting the emissivity slope setting K using the InfraWin software or the UPP data format commands.

The K-factors of metals are normally slightly higher than 1. For a correct measuring result, it is recommended that you make a comparison test. This comparison test may be performed by using a thermocouple probe or by knowing one process temperature point precisely from other sources. The K-factor can then be adjusted until the pyrometer shows the same temperature value.

The ISR 6 Advanced is factory calibrated for graybody targets that exhibit equal changes in emissivity within its two spectral bands.

4.4.2 Temperature Errors Cause by Non-Graybodies

A graybody target has emissivity that is the same at each of the two wavelengths used for measurements and is constant throughout the temperature range. The ratio of the emissivities, $\varepsilon_1 / \varepsilon_2 = 1$ and stays constant regardless of the target temperature. When a target deviates from this, that is when $\varepsilon_1 / \varepsilon_2$ does not equal 1.0 and a slope adjustment is required. For many materials, this is a one-time adjustment.

The following table illustrates the ISR 6 reading errors that can occur when the slope setting differs from the actual material emissivity ratio.

TABLE OF EXPECTED ERROR WHEN EMISSIVITY OF ONE WAVELENGTH IS 1% DIFFERENT FROM THE SECOND WAVELENGTH			
TEMPERATURE		ERROR DEG.	
°F	°C	°F	°C
1300	700	18	10
1500	815	20	11
1700	926	22	12
1900	1040	25	14
2100	1150	25	14
2300	1260	27	15
2500	1370	29	16
3000	1650	36	20
3500	1925	45	25
4000	2200	54	30
5000	2760	72	40

The table shows typical errors that can result when the emissivity of one wavelength differs from the other wavelength by only 1%. The errors can get quite large as temperatures increase. This error can be much larger than a 1-color IR pyrometer would produce for 1% emissivity change. Therefore, it is important to select the proper mode (2-color vs. 1-color) on the ISR 6 to measure a specific material.

Another source of error is dust or smoke in the optical path which alters the transmission in one wavelength more than the other. If the "dust" transmits 1% less energy at wavelength 1 than at wavelength 2, the error table above also applies. Since not all smoke, dust, or dense steam transmits equally at each wavelength, errors may become larger than expected for a 2-color instrument. Usually the smoke and dust are the result of the material being processed and can be cleared from the sight path by a fan or air purge tube.

In some materials, the emissivity may change at different rates with material temperature. Some materials exhibit great changes in emissivity with temperature or time as oxidation modifies the surface finish of the material. Such materials are not suited for measurement with 2-color instruments. When problems are compounded with spectrally absorbing dust or smoke (described above), obtaining reliable temperature readings with any 2-color instrument may be impossible. In cases like this, a single color instrument using the shortest wavelength possible would be the better choice. If this problem is encountered, switch the ISR 6 to 1-color mode. In some situations, the single color mode will outperform the ratio mode.

4.5 Transmittance τ

Transmittance is a parameter that can compensate for signal loss due to external windows etc. For example, if the emissivity of the material is 0.6 and the transmittance of an additional window is 0.9, then the product would be 0.54 which is well inside the allowed range.

The product of transmittance and emissivity ($\tau \times \varepsilon$) must not be less than 20%.



Note: Transmittance τ Settings: 5% to 100% in steps of 1/1000 (1-color mode)

4.6 Response Time (t_{90})

The response time t_{90} is the time interval for the analog output of the pyrometer to go from a low temperature value up to 90% of the temperature step to a high value when measuring an abrupt increase from said low to said high temperature.

Independently of this, the pyrometer performs a measurement every 10 ms and updates the analog output. Slower response times can be used to achieve a constant temperature reading for measuring objects that have rapidly fluctuating temperatures.

The response time is set using the InfraWin software or by using the UPP Data Format commands. When the setting is set to min., the ISR 6 Advanced operates using a time constant of <2 ms (with dynamic adaption at low signal levels). The response time can be extended to 0.01 s; 0.05 s; 0.25 s; 1 s; 3 s; 10 s.



Note: Settings for Response Time t_{90} : min, 0.01 s; 0.05 s; 0.25 s; 1 s; 3 s; 10 s

4.7 Clear Peak Memory (t_{CLEAR})

The integrated maximum value storage is activated when the parameter t_{clear} is set to something other than "OFF" or "HOLD".

If the maximum value storage is switched on, the highest last temperature value will always be displayed and stored. As such, it may be beneficial to periodically clear and reset the stored maximum values in order to obtain new temperature readings.

This storage also has to be cleared at regular intervals when fluctuating object temperatures cause the display or the analog outputs to change too rapidly or when the pyrometer is not constantly viewing an object to be measured.



Note: Settings for Clear Peak Memory t_{CLEAR} : OFF, 0.01 s, 0.05 s, 0.25 s, 1.0 s, 5.0 s, 25.0 s, EXTERN, AUTO, HOLD

4.7.1 Single and Double Storage Modes

Depending upon the selected settings, the maximum value storage will either work in single storage mode or in double storage mode.

Single Storage Mode: Single storage mode is used when you want to reset the stored value using an external impulse via one contact closure from an external relay (such as 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. Single storage mode also comes into effect when the Clear Peak Memory t_{clear} is set to AUTO.

Double Storage Mode: Double storage mode comes into effect when selecting one of the reset intervals. This mode utilizes two memories. With the first memory, the highest measured value is held and is deleted alternately in the time interval set (clear time). The other memory retains the maximum value throughout the next time interval. The disadvantages of fluctuations in the display with the clock frequency are thereby eliminated.



Note: The maximum value storage setting coincides with adjustments made to the response time. The response time setting (working like a low-pass filter) is applied first. After that, the maximum storage is processed. So when using both, the maximum storage takes the peak of the signal that was previously smoothed by the response time filter. So when using both, the maximum storage takes the peak of the signal that was previously smoothed by the response time filter.

4.7.2 Clear Time Settings

The following settings are available through the InfraWin software or by using the UPP data format commands.

OFF When set to **OFF**, the maximum value storage is switched off and all new temperature values are measured but not stored.

0.01s...25.0s If the clear time is set between **0.01 s** and **25.0 s**, the maximum value is held in double storage mode. After the entered time, the value will be cleared alternately from one of the storages, while the value of the other storage is shown.

EXTERN With the external clearing function, the storage operates in single storage mode. The values are immediately cleared from the storage by contacting the wires connected to pins J and K, if the **EXTERN** mode was selected.

AUTO The **AUTO** mode is used for discontinuous measuring tasks. For example, when objects are being transported on a conveyer belt and pass the measuring beam of the pyrometer only for a few seconds. In this case, the maximum value for each object has to be obtained.

With the **AUTO** 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 once the temperature of the new hot object exceeds the low limit of the sub range by 1% (transition in positive direction) or by at least 2 °C. This is also valid if the sub range equals the basic range.

HOLD

The **HOLD** function allows you to freeze the current temperature reading at any moment. This feature is activated using an external switch that has been connected between connector pins J and K.

The temperature reading will remain frozen as long as the contact remains closed.

4.8 Analog Output

The analog output has to be selected according to the signal input of the connected instrument (controller, PLC, etc.). If 4 to 20 mA is set, the analog output gives 3.9 mA for temperatures below lower range limit.



Note: Settings for Analog Output: 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)

4.9 Relative Signal Strength

Relative signal strength stands for the product of emissivity, surface coverage, and transmission of the material between the object and the pyrometer.

4.10 “Dirty Window” Warning

The ISR 6 Advanced pyrometers are equipped with a warning level “dirty window” monitoring system. A correct temperature measurement might be impossible if the ratio pyrometer is working at a too low signal level. To avoid these wrong measurements in advance, a warning signal can be set to a certain contamination level. A built-in relay switch can be used to switch to a warning signal when the incoming radiation becomes too low.

The warning level can be set between 0 and 99%. 0% means the “dirty window” warning system is switched off (factory setting) and the relay can perform the function external clearing of maximum value storage, when it is activated (see section 4.7.2 Clear Time Settings).



Note: Settings for “Dirty Window” Warning: 0 (off) to 99%.

4.11 Minimum Intensity Switch-Off Level

The minimum intensity switch-off level is a function that is used to avoid measuring errors caused by signals which are too low. This may e.g. be caused by a dirty viewing window, dust in the field of view, or when the spot is not filled by the measuring object.



Note: Settings for Minimum Intensity Switch-Off Level: 2% to 50%

Ratio pyrometers are able to measure temperatures correctly even with very low signals. If the signal is too low for a correct measurement, the pyrometer interrupts the measurement and displays 1 °C below of beginning of the temperature range. If the signal intensity falls below the Switch-Off level the Analog Output will show 21 mA if one of the settings “.../21 Low” has been selected for the Analog Output.

Although the factory default is set to 10%, switch-off limit can be adjusted between 2 and 50%, depending on the application.



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

4.12 Operating Modes

Ratio (2-color) mode is the factory default operating mode for the ISR 6 pyrometer. However, the device can be set to mono (1-color) mode or metal mode using the InfraWin software or by using the UPP Data Format commands.

4.12.1 2-color mode

In 2-color mode (ratio method) two adjacent wavelengths are used for the temperature determination. This technique offers the following advantages compared to standard 1-color pyrometers:

- The temperature measurement is independent of the emissivity of the object in wide ranges.
- The measuring object can be smaller than the spot size.

Measurements are unaffected by dust and other “grey” contaminants in the field of view or by dirty viewing windows.

4.12.2 1-color mode

With 1-color mode, the device adjustments are simplified by sending the emissivity corrected one channel temperature to the analog output. This operating mode is indicated by a red LED in the back cover of the instrument.

For a correct measurement in the 1-color mode, it is necessary to adjust the emissivity using the InfraWin software or by using the UPP Data Format commands. This 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.



4.12.3 Metal mode

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 has to be switched back into 2-color mode and the temperature reading has to 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 $\epsilon = 1$ and $K = 1$. In this operating mode, the red LED on the back cover is blinking (shortly dark, long illuminated).

4.13 Sub Range

You have the opportunity to choose a sub range (minimum span 50 °C) within the basic measuring range of the pyrometer. This sub range corresponds to the analog output.

Example: Range 700...1800 °C, Sub Range 925...975 °C.

If a sub range is defined for the ratio mode it also automatically applies to the metal mode (and vice versa). The sub range setting also affects the maximum value storage when the Clear Peak Memory t_{clear} is set to AUTO. For more information on the t_{clear} AUTO setting, refer to Section 4.7.



Note: Settings for Sub Range: Any range adjustable within the temperature range with a minimum span of 50 °C.

4.14 Device Address

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: Settings for Device Address:

Individual Addresses: 00...97

Global Addresses: 98, 99

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).

4.15 Focused Distance

The focused distance value can be adjusted at all distances between 210 mm and 5000 mm using the Focus Adjustment Screw on the back of the device.

The LED Distance Indicator Light will turn red and the focused measuring distance in mm will automatically be shown on the Digital Display within a few seconds of making an adjustment using the Focus Adjustment Set Screw.

The focused distance can be viewed at any time through the InfraWin software or by using the UPP Data Format commands.



4.16 Baud Rate

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



Note: Settings for Baud Rate: 1200, 2400, 4800, 9600, 19200, 38400, 57600, or 115200.

4.17 Pyrometer Internal Temperature

The internal temperature of the pyrometer can be read through the PC interface using the InfraWin software or by using the UPP Data format commands. It is a few degrees higher than the ambient temperature due to the heat generated by the electronics.

When using the Laser Targeting Light, the targeting light is switched off automatically if the internal temperature of the pyrometer exceeds 55 °C. This safety feature is used to prevent damage to the laser. It can only be used again once the temperature falls below 55 °C.

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 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 **5.2.4 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* 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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6 Maintenance

6.1 Cleaning ISR 6 Window

Because there are no moving parts in the ISR 6, the only regular maintenance required is a periodic inspection of the front window for build-up of foreign particles which, in time, can influence the energy received by the instrument. The ISR 6 has a “Dirty Window” warning alarm feature that can measure the current window/optical path transmission and provide a contact closure alert when the window transmission falls below the user set point.

The ISR 6 window is not water soluble and; therefore, can be cleaned with standard lens tissue dampened with a camera-store lens-cleaning solution. A soft blower/brush (also at camera stores) should be used to remove any grit on the window before you rub the lens with lens tissue and solution.



Attention: NEVER CLEAN THE ISR 6 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.

6.2 Calibration

LumaSense calibrated your pyrometer at the factory and delivered your instrument with a Works Certificate. Normally we advise against changing the factory set calibration. If you believe that the calibration may have changed, perhaps because your operating environment is severe, an approximate field (on-site) calibration is possible. You have the choice of an on-site calibration or arranging a more precise calibration at the LumaSense factory.



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.

6.2.1 Laboratory Calibration

Contact LumaSense for information about calibration at the LumaSense factory. For most of our customers who do not have large numbers of infrared thermometers in service, we recommend that our laboratory be chosen to do calibration. When you have many infrared thermometers, you may find it most convenient and economical to have your own calibration laboratory. LumaSense has a variety of blackbody calibration sources including very economical ones. Among these you may find the source most suitable for your own laboratory.

6.2.2 On-Site Calibration

See the Chapter 9: Troubleshooting in this manual before attempting to perform your own calibration. The instrument was calibrated at the factory to its original accuracy as stated.

Nearly all erroneous temperature readings are caused by application problems such as:

- **Emissivity factor:** Carefully read "Emissivity Slope K" found in section 4.4 of this manual for information on this topic. Also use the InfraWin "K: AutoFind" function as described in the InfraWin manual to determine the actual emissivity ratio of the target.
- **Reflections:** Unexpectedly high readings may be caused by the ISR 6 "seeing" a reflection of another hotter source, especially if the target emissivity is less than 0.8.
- **Spot Sizes:** Ensure the ISR 6 is using a proper focused distance and takes into account the spot size in relation to measuring distance.

In the 1-color (mono) mode, the pyrometer can measure objects at any distance. However, the object has to be bigger than or at least as big as the spot size of the pyrometer in the measuring distance.

In the 2-color (ratio) mode, the object can be somewhat smaller than the spot diameter.

Information on this topic can be found in Section 3.3 Optics and Section 4.15 Focused Distance.

- **Obscured window:** Refer to Cleaning ISR 6 Window, Section 6.1.

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 (Carriage Return, 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
Analog output	AAasX	X=0 (0 to 20mA) X=1 (4 to 20mA)
Minimum intensity switch-off level	AAawXX AAaw	XX=02 to 50 (2% to 50%) Answer: DD 2 decimal digit 02 to 50
Reference number	AAbn	Output: XXXXXX (hex 6-digit)
Baud rate (set)	AAbrX	X = 0 to 6 or 8 (dec.) 0 = 1200 Baud 1 = 2400 Baud 2 = 4800 Baud 3 = 9600 Baud 4 = 19200 Baud 5 = 38400 Baud 6 = 57600 Baud 7 = is not allowed 8 = 115200 Baud
"Dirty Window" Warning	AAdwXX	XX = 00 ...99% (2 digit, hex.)

Description		Command	Parameters
Measuring value (one-channel and ratio temperature)		AAek	Answer: SSSSSQQQQQ 2x5 decimal digits (in °C or °F, last digit is 1/10 °C or °F), SSSSS = one-channel temperature QQQQQ=ratio temperature
Emissivity ε for one-channel temperature		AAemXXXX AAem	XXXX=0050 to 1000 ε =0.050 to 1.000 Answer: DDDD 4 decimal digits 0050 to 1000
Transmittance τ of window		AAetXXXX AAet	XXXX=0050 to 1000 τ =0.050 to 1.000 Answer: DDDD 4 decimal digits 0050 to 1000
$K = \varepsilon_1 / \varepsilon_2$ Emissivity ratio		AAevXXXX AAev	XXXX=0800 to 1200 $\varepsilon_1 / \varepsilon_2$ =0.800 to 1.200 Answer: DDDD 4 decimal digits 0800 to 1200
Response time t_{90}		AAezX	X=0 to 6 0=min. 1=0.01 s 2=0.05 s 3=0.25 s 4=1.00 s 5=3.00 s 6=10
Temp. Display °C or °F		AAfhX	Output: X = 0 display in °C X = 1 display in °F
Device Address:		AAgaXX	XX = (00 to 97) 00 to 97 = regular device addresses 98 = global address with response 99 = global address with response
internal temperature (read)		AAgt AAtm	Answer: DDD 3 decimal digits (000 to 098 °C or 032 to 210 °F) gt=current temp. tm=maximum temp. (memory)
Operation mode		AAkaX	X = 0 metal mode X = 1 mono mode (1 channel) X = 2 ratio mode (2 channel)
Laser		AAlaX AAla	X=0 off X=1 on Answer: 1 digit: "0" or "1"
Software simulation of external clearance		AAlx	Clears maximum storage
Clear peak memory t_{clear}		AAlzX	X=0 to 8 0= OFF 1=0.01s 2=0.05s 3=0.25s 4=1.0s 5=5.0s 6=25.0s 7=EXTERN 8=AUTO 9=HOLD
Basic range (read)		AAmb	Answer: XXXXYYYY 2x4 hex-digit for lower and upper range limit (°C or °F)
Sub range (read)		AAme	Answer: XXXXYYYY 2x4 hex-digit for lower and upper range limit (°C or °F)
Sub range (set)	1.	AAm1XXXXYYYY	XXXXYYYY=2x4 hex-digit for lower and upper sub range limit (°C or °F)
	2.	AAm2	AAm2 confirms the change (auto reset)
Measuring value		AAms	Answer: QQQQQ (88880=Overflow) 5 decimal digit (in °C or °F, last digit is 1/10 °C or °F)



Description	Command	Parameters
Device type	AAAna	Output: "ISR 6 Advanced " (16 ASCII-characters)
Read parameters	AApa	Answer: 15 decimal digits DD : Emissivity (see em) .. D : Response time (see ez) ... D : Clear peak memory (see lz) D : Analog output (see as) DD : Internal temperature (see gt) DD : Device address (see ga) 4 : Baud rate (see br) 0 , , , : always 0 DDDD : Ratio correction (see aw)
Serial number	AAsn	Output: XXXXX (hex 5-digit)
Read signal strength*	AAtr	Answer: DDDD 4 decimal digit 0000 to 1500
Device type/ software version	AAve	Answer: VMMMJJ VV=54 MM=Month JJ=Year of software version
Communication Module/ software version in detail	AAvc	tt.mm.jj XX.YY tt = day; mm = month; yy = year; XX.YY = software version
Software version in detail	AAvs	tt.mm.yy XX.YY tt = day; mm = month; yy = year; XX.YY = software version

*Read Signal Strength stands for product of emissivity, surface coverage and transmission of the measuring distance.

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

Additional instruction for the RS485 interface:

Requirements to the master system during half-duplex operation:

1. After an inquiry, the bus should be switched into a transmission time of 3 bits (some older interfaces are not fast enough for this).
2. The pyrometer's response will follow after 5 ms, at the latest.
3. If there is no response, there is a parity or syntax error and the inquiry has to be repeated.
4. After receiving the response, the master has to wait at least 1.5 ms before a new command can be entered.

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8 Reference Numbers

8.1 Reference numbers instrument

Temperature Range	With Viewfinder	With Laser Targeting	With Laser Targeting and Line Shaped Spot (5%)
600 to 1400 °C (MB 14)	3 904 020	3 904 010	3 904 050
700 to 1800 °C (MB 18)	3 904 080	3 904 070	-
800 to 2500 °C (MB 25)	3 904 150	3 904 140	3 904 180
1000 to 3000 °C (MB 30)	3 904 220	3 904 210	-

Ordering note:

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

8.2 Reference numbers accessories

3 820 320	Special connection cable with angled connector and additional targeting light push button, 5 m long	
3 820 330	5m connection cable with straight connector	
3 820 500	10m connection cable with straight connector	
3 820 510	15m connection cable with straight connector	
3 820 810	20m connection cable with straight connector	
3 820 820	25m connection cable with straight connector	
3 820 520	30m connection cable with straight connector	
3 820 340	5m connection cable with right angle connector	
3 820 530	10m connection cable with right angle connector	
3 820 540	15m connection cable with right angle connector	
3 820 830	20m connection cable with right angle connector	
3 820 840	25m connection cable with right angle connector	
3 820 550	30m connection cable with right angle connector	
3 852 290	Power supply NG DC for DIN rail mounting; 100 to 240 V AC \Rightarrow 24 V DC, 1 A	
3 852 550	Power supply NG 2D for DIN rail mounting; 85 to 265 V AC \Rightarrow 24 V DC, 600 mA with two settable limit switches	
3 826 750	USB to RS485 adapter cable, HS-Version, 1.8 m long	
3 852 440	Protocol transducer RS485/RS232 (switch.) \leftrightarrow Profibus-DP for 1 device	
3 852 460	Protocol transducer RS485 \leftrightarrow Profibus DP for 32 devices	
3 852 620	Protocol converter UPP RS485 or RS232 \leftrightarrow ProfiNet, for 1 pyrometer	
3 852 630	Protocol converter UPP RS485 \leftrightarrow ProfiNet, for max. 32 pyrometers	
3 891 220	DA 4000: LED-display, 2-wire power supply, 2 limit switches (relay contacts), 115 V AC	
3 890 650	DA 4000: LED-display, 2-wire power supply, 2 limit switches (relay contacts), 230 V AC	

(All connection cables include a short adapter cable with a 9-pin D-SUB connector. This connector may be used in combination with the RS485 to USB adapter.)

3 890 570	DA 6000-N digital display to allow adjustment of the pyrometer through the RS485 interface
3 890 530	DA 6000: like DA 6000-N with analog input and 2 limit switches for the RS485 interface
3 826 510	PI 6000: PID programmable controller, very fast, for digital IMPAC pyrometers
3 843 490	SCA 5, External Scanner Series 5 & 6 with fused silica window; 24V AC/DC
3 846 260	Mounting support
3 834 210	Mounting support (adjustable)
3 846 290	Mounting support with fused silica window
3 835 590	90° mirror for Series 5 and Series 6, quartz glass window
3 843 250	ROT5 scanning mirror attachment up to 70°
3 835 160	Air purge unit, aluminum
3 837 230	Water cooling jacket (heavy duty) with integrated air purge
3 837 280	Water cooling jacket (heavy duty) with fused silica window
3 837 500	Water cooling jacket (light duty, with air purge unit (only for instruments with laser targeting)
3 837 510	Water cooling jacket (light duty), with fused silica window (only for instruments with laser targeting)
3 837 540	Cooling plate for series 5 and 6, with air purge
3 846 590	Vacuum support KF16 with quartz glass window

9 Troubleshooting

Symptom	Probable Cause	Comments
No analog output even if the display shows a temperature above lower range limit	Reversed leads to ISR 6.	The ISR 6 is diode protected if power leads are reversed. See Section 3.1.
	Reversed leads to other instruments in the current loop.	
	Open circuit in lines connecting all instruments in current loop.	
	Total burden higher than 500 Ohms	
	Insufficient supply voltage (See wiring diagram).	
Temperature reading differs between built-in display and external instrumentation	Pyrometer output setting differs from external instrument's input setting	Check the 0 to 20 mA or 4 to 20 mA on both sides Check the sub range setting on pyrometer against the range setting on the external instrument
Temperature readings are too low	Target size too small. Target is not at correct focus distance.	See Section 3.1.1. With small target/close focus models, aiming may require X-Y positioning table for fine adjustment during aiming.
	Incorrect alignment of the pyrometer to the object.	Realign pyrometer in 1-channel mode (mono) to achieve the maximum temperature signal.
	Dirty window or lens.	See Sections 4.10 and 6.1
	Target temperature too low.	
	Target emissivity much lower than expected.	Even 2-Color instruments depend on actual target emissivity to supply sufficient energy to the sensor. See Sections 4.3, 4.4, 4.5, 4.9, and 6.1
	Incorrect slope adjustments.	See Section 4.4.1.
	Faulty ISR 6	Contact LumaSense. See Section 1.5.

Symptom	Probable Cause	Comments
Temperature readings are too high	Targets hotter than expected. (This often happens with first time infrared Pyrometer users).	Verify target temperature with contact type method. (Thermocouples may not accurately determine surface temperature due to “heat sink” effect).
	Incorrect slope adjustments.	See Section 4.4.1.
	Target size is too small	See Section 3.1.1.
	The measurement is influenced by reflections of hot machine parts	Use mechanical accessories to avoid the influence of the interfering radiation.
	If target emissivity is less than 1, reflections from nearby hot objects will influence readings.	Block reflection paths to see if readings drop to expected temperature.
	Incorrect spectral response for application. ISR 6 may be “seeing” through target.	See Technical Specifications Consult LumaSense for analysis.
	Electrical noise in lead wires caused by intense magnetic fields and/or improper selection of interconnecting cable and/or cable run in same conduit as AC power lines.	See Section 3.1
	Lens or window clouding up.	Increase or decrease air purge rate and/or investigate other cause.
	Target leaving field of view or ISR 6 mount slipping.	
	Faulty ISR 6.	Contact LumaSense. See Section 1.5
	Improper grounding of cable shield and/or ISR 6 housing (or cooling jacket).	
	ISR 6 mounting not secure.	

Symptom	Probable Cause	Comments
Noisy readings (fast fluctuations).	Target moves more than 95% out of field of view. Conveyor type applications will also cause fluctuations as targets move by the field of view.	Application may require Maximum to be stored. Apply t_{clear} settings. See Section 4.7.2.
	Target may be changing temperature quickly. (Thermocouples do not respond as fast as the ISR 6).	Speed of response may be slowed down Apply t_{90} settings. See Section 4.6.
	Target may be reflecting nearby objects that have fluctuating temperatures.	
	Loose connection in wiring.	
	Electrical noise lead wires caused by intense magnetic fields, improper selection of inter-connecting cable.	
	Cable run into in same conduit as AC power lines.	
	Improper grounding of cable shield and/or ISR 6 housing.	
	Flame or reflections of flame may be entering the field of view.	
	Extremely dense steam, smoke, thick dust, personnel or moving machinery intermittently blocking 95% of optical path of ISR 6.	
	Non-uniform emissivity of large moving targets.	Slower response speed is required.
	Faulty ISR 6.	Contact LumaSense. See Section 1.5.
Laser Targeting Light fails	The instrument's internal temperature is higher than 55 °C.	Use cooling jacket. See Section 2.6.2.



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Index

A

- Accessories 12
- Air Purge 13
- Analog Output 28
- Appropriate use 9

B

- Baud Rate 30

C

- Calibration 33
 - Laboratory 33
 - On-Site 34
- Cleaning the front window 33
- Clear Peak Memory 26
- Clear Time Settings 27
- Connecting the pyrometer to a PC 16, 31
- Connection cable 9
- Connection to RS485 17
- Cooling Jacket 12

D

- Data format UPP 35
- Device Address 30
- Device Settings
 - Focused Distance 21
- Disposal 7
- Double Storage Mode 27

E

- Electrical Installation 15
- Emissivity 24

F

- Factory Settings 23

G

- General Information 5

I

- Installation, Electrical 15

- Integrated Line Optics 20

L

- Laboratory Calibration 33
- Language 31
- Laser Targeting Light 18
- Legend 5
- Liability 5

M

- Maintenance 33
- Measuring Distance
 - Adjusting Measuring Distance 21
- Metal mode 9, 29
- Mounting 12

O

- On-Site Calibration 34
- Optics 19
 - Focus Adjustment 21

P

- Physical User Interface 12
- Pin assignment 15
- Pyrometer Internal Temperature 30

R

- Reference numbers
 - Accessories 39
 - Instrument 39
- Reference Numbers 39
- Repair 7
- Response Time 26
- RS485 17

S

- Safety 5
- Scope of delivery 9
- Settings / parameter descriptions 23
- Sighting 18
- Single Storage Mode 27
- Software InfraWin 31
- Spot Sizes 19

Spot sizes for non-focused distances 20
Storage Modes 27
Sub Range 29
Support 6

T

Technical Data 9
Temperature Display 23
Transmittance 26
Troubleshooting 41

U

Unpacking the Instrument 6
UPP data format 35

V

Viewfinder 18

W

Warranty 5