LumaSense® TECHNOLOGIES

Series 320

IGA 320/23-LO IMPAC Pyrometer

Service Centers

LumaSense Technologies, Inc.
North America
Sales & Service
Santa Clara, CA, USA
Ph: +1 800 631 0176
Ph: +1 408 727 1600
Fax: +1 408 727 1677

LumaSense Technologies GmbH
Other Than North America
Sales & Support
Frankfurt, Germany
Ph: +49 (0) 69 97373 0
Fax: +49 (0) 69 97373 167

Global and Regional Centers

Our Headquarter
LumaSense Technologies, Inc.
Santa Clara, CA, USA
Ph: +1 800 631 0176
Fax: +1 408 727 1677

Americas, Australia, & Other Asia
LumaSense Technologies, Inc.
Santa Clara, CA, USA
Ph: +1 800 631 0176
Fax: +1 408 727 1677

Europe, Middle East, Africa
LumaSense Technologies GmbH
Frankfurt, Germany
Ph: +49 (0) 69 97373 0
Fax: +49 (0) 69 97373 167

Brazil
LumaSense, Vendas Brasil
Campinas, Brasil
Ph: +55 19 3367 6533
Fax: +55 19 3367 6533

India
LumaSense Technologies, India
Mumbai, India
Ph: + 91 22 67419203
Fax: + 91 22 67419201

China
LumaSense Technologies, China
Shanghai, China
Ph: +86 133 1182 7766
Fax: +86 21 5877 2383

E-mail   info@lumasenseinc.com
support@lumasenseinc.com
eusupport@lumasenseinc.com
Website   http://www.lumasenseinc.com

Part No 39003068-EN
Revision B
June 2015

Contents

---

1 General

1.1 Information about the user manual

Congratulations on choosing this 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.

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 IGA 320/23-LO 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. 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: eusupport@lumasenseinc.com

Erstein, France

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

1.6 Shipments to LumaSense for Repair

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

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

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

Send RMA Shipments to your nearest technical service center:

Customers in **North America** should send RMA Shipments to:	All other customers should send RMA Shipments to:
Santa Clara, California	**Frankfurt, Germany**
LumaSense Technologies, Inc. 3301 Leonard Court Santa Clara, CA 95054 USA Telephone: +1 408 727 1600 +1 800 631 0176	LumaSense Technologies GmbH Kleyerstr. 90 60326 Frankfurt Germany Telephone: +49 (0)69-97373 0
Email: support@lumasenseinc.com	**Email:** eusupport@lumasenseinc.com

1.7 Transport, packaging, storage

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

The pyrometer is designed for a storage temperature of -20 to 70 °C with non-condensing conditions. Storing the insturment out of these conditions can cause damage or result in malfunction of the pyrometer.

1.8 Disposal / decommissioning

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

To ensure consistent document formatting, this page was intentionally left blank.

2 Introduction

2.1 Appropriate use

The IGA 320/23-LO is a short wavelength temperature measuring instrument with fiber optics and internal digital signal processing capabilities. This pyrometer is used for non-contact temperature measurements on metals, ceramics, graphite, etc. with a temperature range between 85 and 1200 °C.

For optimal match of the instrument to the application, two different optical heads are available. The small dimensions of the optics allow easy integration into compact production machines. The instrument is equipped with a fiber and an exchangeable optical head. The fiber and optical head are unaffected by electromagnetic interferences (e.g. induction) and can be used in high ambient temperatures up to 200 °C without additional cooling.

The LED targeting light enables precise alignment on the measurement object. It is automatically active and can be used during measurement. In addition to the analog output, the pyrometer is equipped with a digital RS485 interface, which enables secure data transmission to a PC or a PLC over long distances.

The included *InfraWin* software enables graphical display and storage of measurement values, as well as easy set-up of all instrument parameters.

2.2 Scope of delivery

Pyrometer IGA 320/23-LO, PC adjustment and evaluation software "*InfraWin*", inspection sheet, manual. Fiber, one selectable optical head.

> **(i)** **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

Temperature ranges:	85 … 600 °C (MB 6) 100 ... 700 °C (MB 7) 150 … 1200 °C (MB 12)
Sub range:	Any range adjustable within the temperature range minimum span 51 °C

Spectral range:	2 to 2.6 µm (main wavelength 2.3 µm)
IR detector:	Extended InGaAs
Optics:	Optical head Type I or Type II (short distances only, see table below) fiber Ø 0.6 mm (green fiber mark) for MB 6 fiber Ø 0.4 mm (blue fiber mark) for MB 7 fiber Ø 0.2 mm (red fiber mark) for MB 12 DIN connector electronics side SMA connector optics side

Power supply:	24 V DC (10 to 30 V DC), ripple must be less than 0.5 V
Power consumption:	Max. 1 W
Analog output:	0 to 20 mA or 4 to 20 mA (linear), switchable
Load:	0 to 500 Ω
Switch contact:	Opto relays; max. 50 V DC, 0.2 A; max. P_{max} = 300 mW

Hysteresis:	2 to 20 °C
Digital Interface:	RS485 addressable (half duplex), baud rate 1200 up to 38400 Bd
Resolution:	0.1 °C on interface; < 0.025% of the adjusted temperature sub range at the analog output
Isolation:	Power supply, analog output, and digital interface are galvanically isolated from each other

Parameters:	Adjustable via interface: Emissivity ε, transmittance τ, exposure time t_{90}, clear times for max. / min. max./min. value storage, analog output, sub temperature range, ambient temperature compensation, pyrometer address, switch contact, hysteresis, baud rate, wait time t_W, targeting light
Emissivity ε:	10.0 to 100.0% adjustable via interface in steps of 0.1%
Transmittance τ:	10.0 to 100.0% adjustable via interface in steps of 0.1%
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 / minimum 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 or automatically with the next measuring object

Uncertainty:* (with ε =1, t_{90}=1 s, $T_{amb.}$=23°C)	Up to 400 °C: 2 °C Above 400 °C: 0.3% of measured value in °C + 1 °C (Note: the pyrometer must be operate at least 30 min before these values are valid)
Repeatability:* (ε =1, t_{90}=1 s, $T_{amb.}$=23°C)	0.1% of measured value in °C + 1 °C

* The temperature of fiber and optical head must be at least 30 °C lower than the measuring temperature to get a correct temperature reading

Protection class:	IP 54 (IEC 60529)
Installation:	Any
Ambient temperature:	0 to 70 °C on housing, up to 200 °C on side of fiber and optical head
Storage temperature:	-20 to 70 °C
Rel. humidity:	Non condensing conditions
Weight:	0.53 kg incl. optical fiber and lens assembly
Housing:	Stainless steel
Connector:	8 pin connector

Sighting:	Built-in LED targeting light (default: continuously on)
CE-label:	According to EN 61326-1:2006-10

Note: The determination of the technical data of this pyrometer is carried out in accordance with VDI/VDE directive IEC TS 62942-2, "Determination of the technical data for radiation thermometers".

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

2.4.1 Instrument
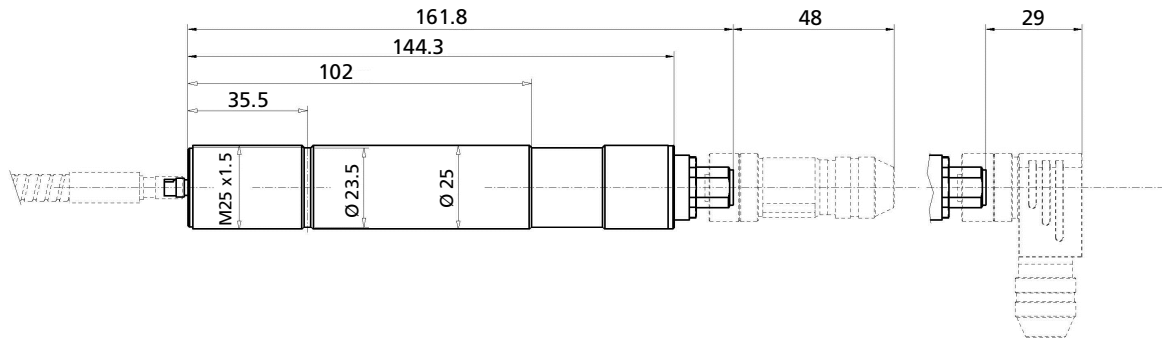
2.4.2 Optics

Optical Head Type I (Fixed Adjusted)

Optical Head Type II (Fixed Adjusted)

Optical Head Type II (Focusable)
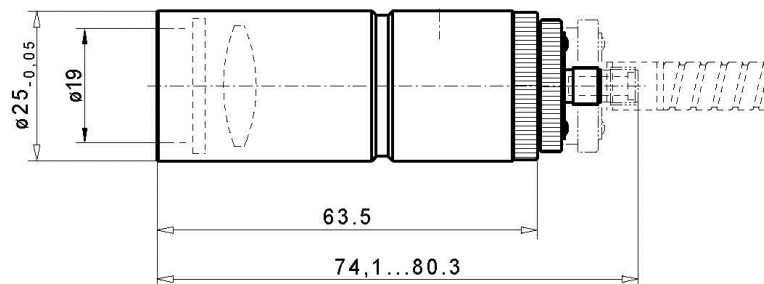
2.5   Physical User Interface

*Robust stainless steel housing
with small dimensions*

*Connection cable with
connector and cables for:*
- *Power supply*
- *LED targeting light
  switch on/off*
- *RS485 interface*
- *Analog output*
- *Switch contact*

*Monofiber in
stainless steel, flexible
protection tube*

Precision optics

*LED targeting light shows middle
of spot size and optics focus*
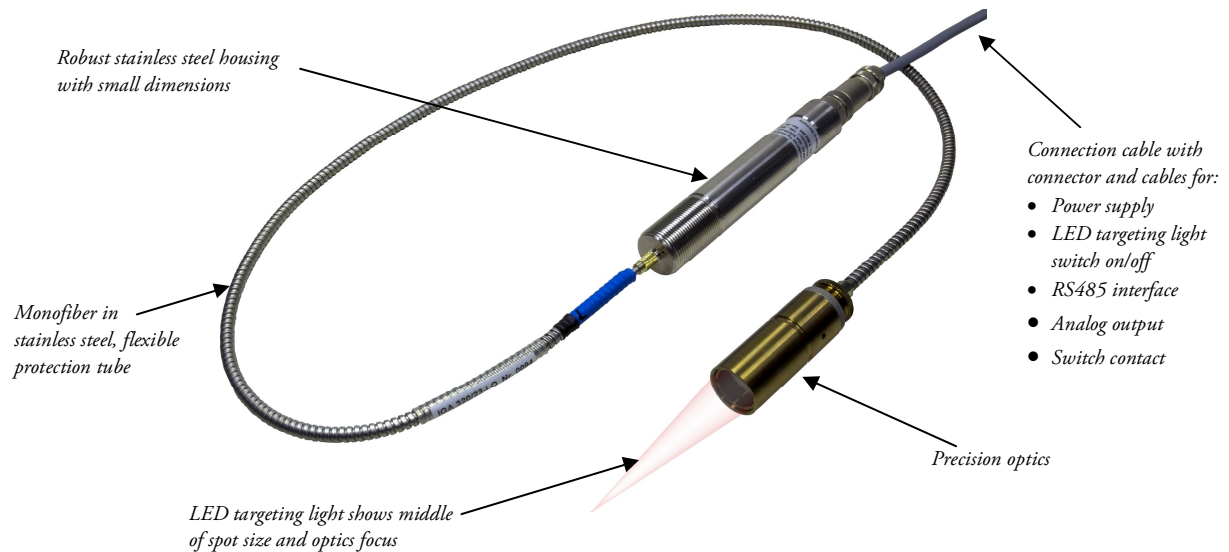
2.6   Accessories (optional)

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**, **Reference numbers**.

2.6.1   Mounting

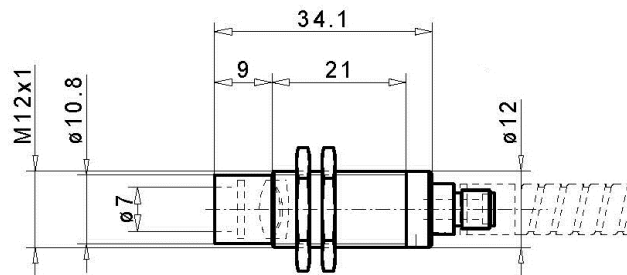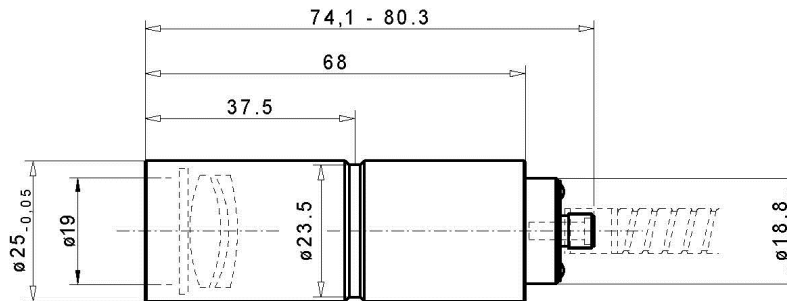To mount and align the optical head to the measured object, *mounting angles* or a *ball and socket mounting* are available. Both options allow you to easily mount the optical head and align it to the measured object. However, the clamping-screws of the ball and socket mounting also allow you to quickly adjust the pyrometer in all directions.

Mounting angles

Ball and socket mounting
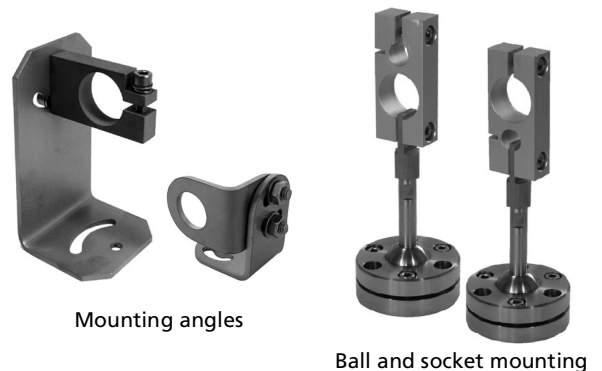
2.6.2   Air purge

The *air purge* protects the lens from contamination of dust and moisture. It has to be supplied with dry and oil-free pressurized air (1.5 m³ / h) and generates an air stream shaped like a cone.

Air purge

2.6.3   Displays

For temperature indication, several digital displays are available. Some of them can also be used for remote configuration of the pyrometer.

Digital display
DA 6000

LED large display
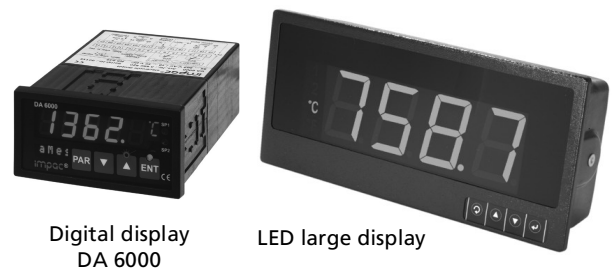
3 Controls and Connections

3.1 Electrical Installation

The IGA 320/23-LO is powered by a voltage of 24 V DC (possible range 10 to 30 V, ripple < 0.5 V). It is important to ensure correct polarity when connecting the device to the power supply.

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, switch contact, and external clearing of the maximum value storage via contact and 8-pin connector (see Chapter **8**, **Reference numbers**).

Warning: Follow common safety regulations for mains voltage (230 or 115 V AC) and connecting additional devices operating with this mains voltage (e.g. transformers). Touching mains voltage can be fatal. 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.

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.

3.1.1 Pin assignment of the male socket on the back of the pyrometer

Pin	Color	Indication
1	white	+ 24 V power supply
2	brown	0 V power supply
3	green	+ I_{out} analog output
4	yellow	− I_{out} analog output
5	grey	Switches on and off LED targeting light (via push button) (bridge to +24 V)
6	blue	switch contact (reference point 0 V)
7	violet	A1
8	black	B1
7	red/blue	A2 (bridge to A1)
8	gray/pink	B2 (bridge to B1)
	orange	Screen only for cable extension, don't connect at the switchboard

Male socket

Pin assignment (side of male inserts)
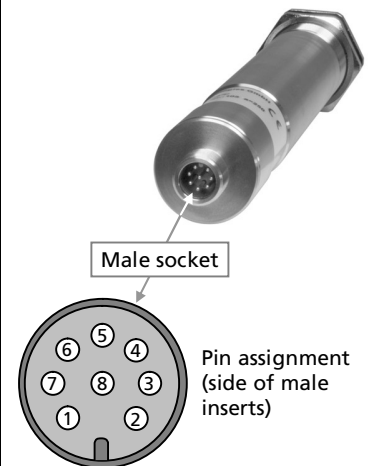
3.2 Connecting the pyrometer to a PC

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 RS485 ⇔ USB converter "USB nano"(ref. no. 3 852 600).

With a slow RS485 connection, it is also possible to set a wait time to the pyrometer (e.g. via the "Test" field of the software *InfraWin*) which delays the response of a command to the pyrometer (see also **3.2.2**, **Wait time t_w**).

3.2.1 Connecting to RS485 interface / baudrate

The pyrometer is operating in half-duplex mode. A1 and A2 as well as B1 and B2 are bridged in the 8-pin round connector of the connecting cable, to prevent reflections due to long stubs. It also safeguards against the interruption of the RS485 bus system, should a connecting plug be pulled out. The master labels mark the connections on the RS485 converter.

The transmission rate of the serial interface in Baud (Bd) is dependent on the length of the cable. Values between 1200 and 38400 Bd may be set (via **software *InfraWin*** or the command "br" when using another communication software, see command table under **7**, **data format UPP**). The baud rate is reduced by 50% when the transmission distance is doubled. The typical cable length for 19200 Bd is 2 km.
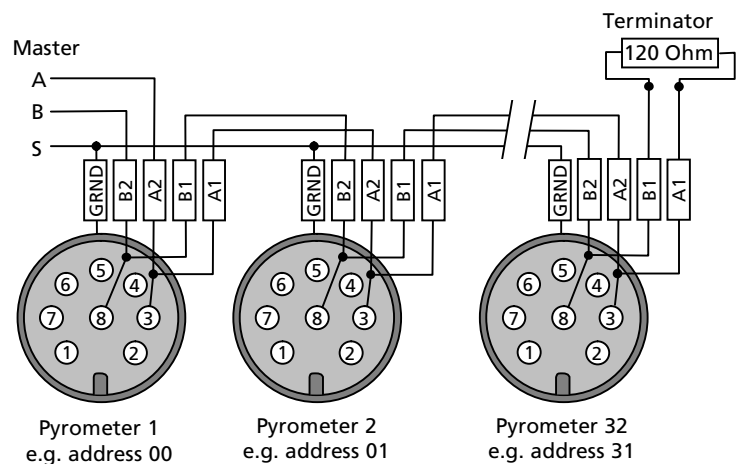
3.2.2 Wait time t_w

When 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 (between 00 and 99 bit) can be set to slow down the data transfer (e.g.: t_w = 02 at a baud rate 9600 means a wait time of $^2/_{9600}$ sec).

3.2.3 Connecting additional analyzing devices

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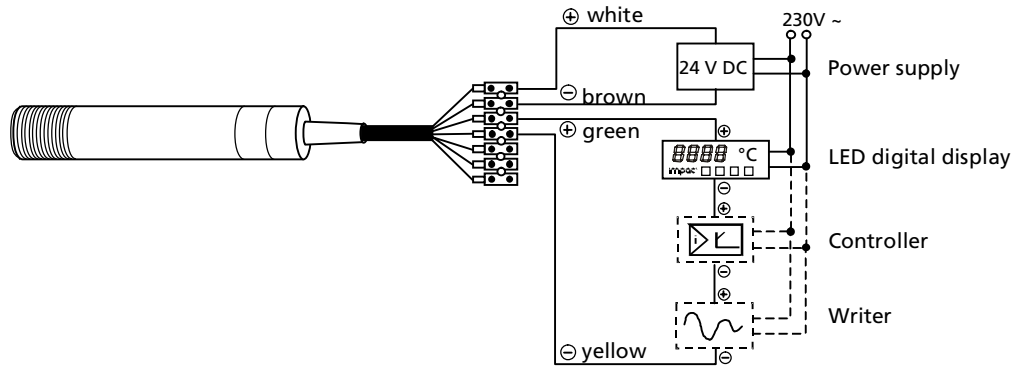
3.3 Mechanical Installation

3.3.1 Fiber optic

The fiber has either a green mark (MB 6) blue mark (MB 7) or a red mark (MB 12) for correct connection to the pyrometer. This color mark has to be mounted on the pyrometer's side.

Please note that the connector on the instrument side of the fiber has an alignment pin. When connecting to the socket, you have to turn the connector until the pin is in the right orientation before you can fix the connector with the knurled nut.
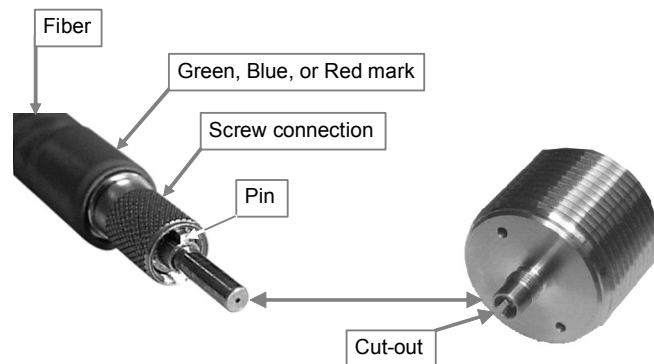
⚠ **Attention:** The light guide end of the fiber optic cable as well as the socket/connector and the optical head must always be protected with the caps when not connected!

Ambient temperature
The fiber and optical head can withstand ambient temperatures up to 200 °C without cooling on the side of the optical head.

⚠ **Attention:** The temperature of the fiber and optical head must be at least 30 °C lower than the measuring temperature to get a correct temperature reading.

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-brand fiber. In this case, the pyrometer has to be calibrated together with the fiber (service).

Minimum bending radius			
	Fiber Ø 0.6 mm (green mark)	Fiber Ø 0.4 mm (blue mark)	Fiber Ø 0.2 mm (red mark)
for short time (max. 200 °C)	150 mm	150 mm	50 mm
permanent (max. 200 °C)	500 mm	500 mm	120 mm
wound up (max. 50 °C)	500 mm	500 mm	120 mm

⚠️ **Attention:** A hot fiber optic cable should not be exposed to continual movement!

3.3.2   Optical head

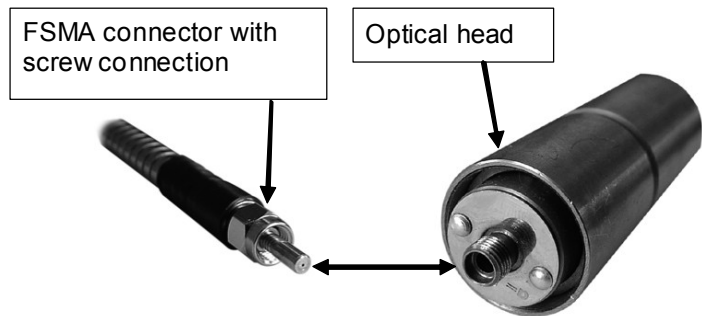The FSMA connector is equipped with a screw connection that allows you to easily attach an optical head. There is no alignment pin at the fiber connector – it can easily be plugged in and fixed by turning the knurled nut.

You can exchange optical heads of the same type without having to recalibrate the pyrometer.

FSMA connector with screw connection

Optical head

3.4   LED targeting light

The pyrometer must be correctly aligned to the measurement object in order to obtain an exact measurement of the object temperature. The pyrometer is equipped with an LED targeting light that allows for simple and accurate alignment, even onto small objects.

When measuring bigger objects where exact alignment is not absolutely necessary, the pyrometer can be aligned using the thermal method. In this case, the instrument simply is aligned to the highest temperature reading.

LED targeting light beam
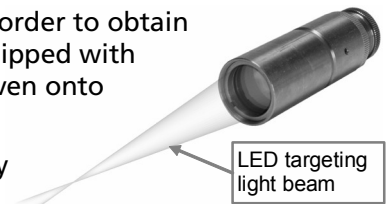
The LED targeting light can be switched on and off by using an external contact (see **3.1.1 Pin assignment for the connector on the back side of the pyrometer**) or via PC and the software *InfraWin* (see section **4.11 Settings via interface and software**).

3.5   Optical head

Depending on the application, the instrument will be delivered with a small or a big optical head.

Type I (small optical head, fixed adjusted): With very small dimensions, the optical head I is suited for use in confined spaces. The optics is adjusted ex works to one of the measuring distances mentioned in the table in section 3.5.1 The mentioned spot size will be achieved in exactly this distance (other distances can be realized on request).

Type II (large optical head, focusable): The optical head II is focusable, i.e. each measuring distance can be adjusted within the mentioned limits to achieve the smallest spot size in the required distance. The spot size at the shortest and longest distance is
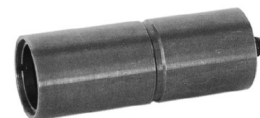
mentioned in the table in section 3.5.1. Spot sizes at intermediate distances have to be calculated by interpolation.

Type II (large optical head, fixed adjusted): The fixed adjusted optical head II has a similar size as the focusable optical head II but with a fixed focusing distance (see table 3.5.1) as type I (other distances can be realized on request).

ⓘ **Note:** The optical heads can be changed against another from the same type. A recalibration of the pyrometer is not necessary.

3.5.1 Spot size data (measuring distance from the front of the lens)

| Optical head	Meas. Distance a (mm)	Spot size M_{90} (mm) fiber ∅ 0.6 mm (MB 6)	Spot size M_{90} (mm) fiber ∅ 0.4 mm (MB 7)	Spot size M_{90} (mm) fiber ∅ 0.2 mm (MB 12)	Aperture D (mm)*
Type I	120	3.5	2.3	1.3	7
	260	8.3	5.5	3	7
Type II (focusable)	88 to 110	1.2 to 1.8	0.8 to 1.2	0.5 to 0.7	17.5 to 15.5
	95 to 129	1.5 to 2.1	1.0 to 1.4	0.6 to 0.8	16.5 to 14.5
	105 to 161	1.7 to 2.7	1.1 to 1.8	0.7 to 1.1	15 to 13.5
	200 to 346	2.9 to 5.1	1.9 to 3.4	1.1 to 2.0	17.5 to 15.5
Type II (fixed adjusted)	87	1.2	0.8	0.5	15
	200	2.9	1.9	1.1	15

*)The aperture is the effective lens diameter of the optics. The aperture is dependent on the objective length which changes if the focus distance is changed (only true for the focusable optical head II). The biggest aperture value belongs to the fully extended objective, the smallest aperture value if the objective is turned to its smallest size. Intermediate values have to be interpolated (e.g. calculating the spot size if the measuring distance varies from the adjusted value).

The spot sizes, mentioned in the table above, will only be achieved at the measuring distances of the corresponding optics or with the focusable optics at the adjusted distance. Decreasing or increasing the measuring distance enlarges the spot size.

$$M_2 = \frac{a_2}{a}(M-D)+D \qquad M_1 = \frac{a_1}{a}(M+D)-D$$
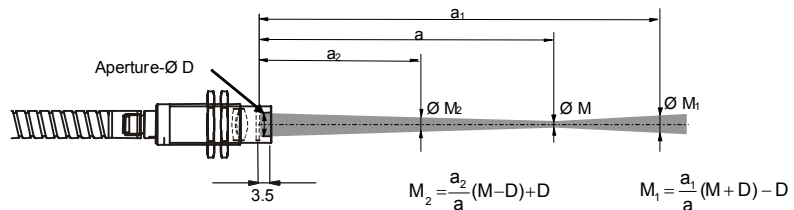
Spot sizes for intermediate distances that are not shown on the optical profiles may be calculated using the adjoining formula.

ⓘ **Note**: The *InfraWin* program includes a calculator ("IR calculator") that roughly estimates the unknown values.

ⓘ **Note:** The pyrometer can measure objects at any distance, but it has to be at least as big as the spot size of the pyrometer.

3.5.2 Adjusting the required measuring distance with optical head I or II, fixed adjusted

A tape can be used to determine the distance between the object and pyrometer. The measuring distance is always measured from the front of the lens.

If the LED is switched on, its smallest spot is in the measuring distance of the corresponding optics or adjusted distance and it marks the center of the spot.

3.5.3 Adjusting the required measuring distance with optical head II, focusable

To adjust the correct measuring distance, untighten the fixing nut and vary the length of the optical head by turning the lens tube. When correctly focused, the LED has its smallest spot size (sharpest image). After adjustment, tighten the fixing nut.

Lens tube   Fixing nut   Inner tube
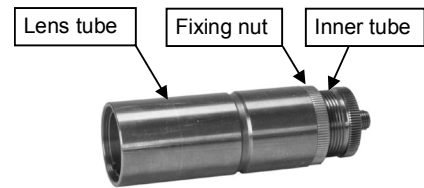
4 Settings / parameter descriptions

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

All settings can be read and set only in the **pyrometer parameters** window of the software *InfraWin*. Adjusting the settings at the instrument is not possible.

Selecting the pyrometer parameters window shows the current settings of the pyrometer. Changing a value can either be done by typing a value in an input box or by selecting a preset value from the list field.

4.1 Factory settings

Temperature display (°**C** / °**F**) = °C

Emissivity (ε) = 100%

Transmittance (τ) = 100%

Exposure time (**t90**) = min

Clear time (**t$_{Clear}$**) = off

max / min = maximum value storage preset

Analog output (**out**) = 0 ... 20 mA

LED targeting light = active at Power-on

Sub range same as basic temperature range

Ambient temperature compensation = auto

Address = 00

Limit switch = Off

Baud rate = 19200 Bd

4.2 Basic range

Basic range automatically displays the total range of the pyrometer and can not be changed.

4.3 Material

The **Material** setting allows you to store the names of different measuring objects with their emissivity values and to recall them from the list. You can also add and change the materials listing through the text file "mat.txt" (provided in the folder **InfraWin** in the standard **Documents and Settings** path of Windows, normally C:\ Documents and Settings \ <user name> \ InfraWin).

4.4 Temperature display in °C or °F

Choose whether the temperature should be displayed in °C (Celsius) or °F (Fahrenheit).

4.5   Emissivity ε

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 blackbody radiation source (this is an object which absorbs all incoming rays and has an emissivity of 100%) at the same temperature. Different materials have different emissivities ranging between 0% and 100% (settings at the pyrometer between: 10 and 100%). As such, the emissivity is also dependent on the surface condition of the material, the spectral range of the pyrometer, and the measuring temperature. The emissivity setting of the pyrometer has to be adjusted accordingly. Typical emissivity values of various common materials for the spectral range of the instrument are listed below. The tolerance of the emissivity values for each material is mainly dependent on the surface conditions. Rough surfaces have higher emissivities.

Measuring object	Emissivity [%] (at 2.3 μm)	Measuring object	Emissivity [%] (at 2.3 μm)
"Black body furnace"	100	Steel, molten	20 to 30
Extruded Aluminum	13	Nickel	15 to 20
Brass	18	Titanium, non-oxidized	50
Brass oxidized (tarnished)	65 to 70	Titanium, oxidized	75 to 80
Copper	5	Molybdenum	10
Copper, oxidized	70 to 80	Molybdenum, oxidized	75 to 80
Inconel	30	Black Carbon	95
Inconel, oxidized	85	Graphite	80 to 90
Oxidized Iron	85 to 90	Stoneware, glazed	60
Steel rolling scale	80 to 88	Porcelain rough	80 to 90

4.6   Transmittance τ

Measurements through windows slightly attenuates the measuring signal (due to the transmittance). To obtain correct measuring results, the transmission of the window must be compensated. Alternatively, the emissivity ε can be adapted.

4.7   EmiAutoFind

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

4.8   Response time / exposure time (t90)

The exposure time is the time the measured temperature has to be present after an abrupt change so that the output value of the pyrometer reaches a given measurement value. The time taken is to reach 90% of the recorded temperature difference. In the "min" position, the device operates using its time constant.

The dynamic exposure time adjustment prolongs the exposure time at the lower range limit, also if t_{90} is set to a lower value.

Settings:
min
0.01 s
0.05 s
0.25 s
1 s
3 s
10 s

If the maximum value storage is selected and the measuring object has a low emissivity and the measuring temperature is at the beginning of the range, a higher exposure time must be chosen to prevent measurement errors. Longer exposure times can be used for the measurement of objects which have rapidly fluctuating temperatures to achieve constant temperature reading.

4.9 Clear time of the maximum / minimum value storage (tCL)

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

Settings:
off
0.01 s
0.05 s
1 s
5 s
25 s
extern
auto

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

The following settings are possible:

Off: The max. value storage is switched off and only momentary values are measured.

0.01...25 s: If any clear time between 0.01 s and 25 s is set, the maximum value is estimated and held in **double storage** *mode.* After the entered time the storage will be deleted.

extern: The external clearing can be activated and used within your own software using the clear command "lx" (see Chapter **7**, **Data format UPP**). 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 for only a few seconds. In this case, the maximum value for each object has to be indicated. In this mode the maximum value is stored until a new hot object appears in the measuring beam. The temperature which has to be recognized as **hot** is defined by the low limit of the adjusted sub range. The stored maximum value will be deleted when the temperature of the new hot object exceeds the low limit **from** of the sub range by 1% or at least 2 °C. If a lower limit is not entered, the maximum value storage will be deleted whenever the lower level of the full measuring range has been exceeded.

Operation note: Depending upon which setting is selected, the maximum value storage will either work in **single storage** mode or in **double storage** mode:

Single storage: The single storage mode is used when you want to reset the stored value using your own software with the clear command "lx". This mode allows a new value to be established after each impulse from the reset signal.

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

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

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

4.9.1 max / min

When entering a reset time interval other than OFF, you will also need to determine whether to activate the maximum "max" or the mimimum "min" storage value.

4.10 Analog output

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

Settings:
0 ... 20 mA
4 ... 20 mA

4.11 LED targeting light

If the pyrometer is supplied with power, the LED targeting light is automatically active. Once connected, it can be adjusted even if the targeting light is off. Independent of this setting, the targeting light can be switched on or off (targeting icon ✳) using the software *InfraWin.*

4.12 Subrange

You have the opportunity to choose a subrange (minimum span 51 °C) within the basic measuring range of the pyrometer. This subrange corresponds to the analog output. Reduction of the temperature range increases the accuracy of the analog output.

Also when setting the subrange, it is possible to fulfill the requirements of the "auto" clear mode of the maximum value storage (see **4.9**).

4.13 Ambient temperature compensation

The compensation of the ambient temperature can be set for temperatures within the basic measuring range. This compensation is only used for very few special applications. The standard setting of this parameter is "auto", because the temperature of the air around the pyrometer is normally the ambient temperature of the measured object. Should the measured object be placed in an area with a higher wall temperature (e.g. inside a furnace), the measurement might be falsified (probably too high temperature indication). This influence can be compensated by presetting the ambient temperature of the object (presetting within the measuring range of the instrument).

Settings:
auto
00 °C (32 °F)
⋮
70 °C (158 °F)

After switching over to "man" the corresponding data field T_{amb} is activated so that the ambient temperature value can be entered.

⚠ **Attention:** It has to be considered that this method only improves the results if the ambient temperature at the place of the measured object is always constant and the emissivity is well known.

4.14 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.

Settings:
00
⋮
97

ⓘ **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).

4.15 Limit switch (SP1)

The pyrometer is equipped with a switch contact (opto relays; max. 50 V DC, 0.2 A; max. power 300 mW), controlled from the measuring signal. The contact is activated with:

Close above: The contact closes (switches to ground), if the temperature entered in the **SP1** box is exceeded. If the temperature falls below that value minus the hysteresis the contact opens (a hysteresis between 2 and 20 °C can be set to avoid oscillating of the switch in the switch point).

Close below: The contact closes (switches to ground), if the temperature falls below the entered value in the **SP1** box. If the temperature exceeds that value plus the hysteresis the contact opens (a hysteresis between 2 and 20 °C can be set to avoid oscillating of the switch in the switch point).

4.16 Operating hours

Shows the operation time that the pyrometer has been in use.

To ensure consistent document formatting, this page was intentionally left blank.

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 **4.14 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* 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.

To ensure consistent document formatting, this page was intentionally left blank.

6 Maintenance

6.1 Safety

⚠️ **Attention during pyrometer services:** Should the pyrometer be integrated in a running machine process, the machine should 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 has to be kept clean. The lens can be cleaned with a soft cloth in combination with alcohol (do not use acid solutions or dilution). Also standard cloths for cleaning glasses or photo objectives can be used.

To ensure consistent document formatting, this page was intentionally left blank.

7 Data format UPP (Universal Pyrometer Protocol)

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

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

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

The device responds to the entry of a command with: output (e.g. the measuring value) + CR (**C**arriage **R**eturn, ASCII 13), to pure entry commands with **ok** + CR.

Every command starts with the 2-digit device address AA (e.g. "00"). This is followed by 2 small command letters (e.g. "em" for level of emissivity ε), finished with CR.

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

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

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

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

Answer: "0970" + <CR> means Emissivity = 0.97 or 97.0%

Description	Command	Parameters

Reading temperature value:	AAms	Output: XXXXX (dec., in 1/10 °C or °F)
		      (77770 = Instrument's temperature too high
		      88880 = temperature overflow)

Reading temperature value repeated:	AAmsXXX	XXX = 000...999 (XXX = number of measuring values)
Emissivity:	AAemXXXX	XXXX = (0100 ... 1000‰) (decimal)
Transmittance:	AAetXXXX	XXXX = (0100 ... 1000‰) (decimal)

Ambient temperature compensation:	AAutXXXX	XXXX = value of ambient temperature, 4-digit, hex
		      XXXX e.g. FFEC corresponds to -20 degrees
		      - 99_{dez} = $FF9D_{hex}$ means: automatic, no manual compensation

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

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 = automatic deletion
		      3 = 0.25 s 6 = 25.00 s

External clearing:	AAlx	Clearing the max. value storage (only with lz = 7, external)

Description	Command	Parameters
Analog output:	AAasX	X = 0 or 1 0 = 0 … 20 mA; 1 = 4 … 20 mA

Reading basic temperature range:	AAmb	Output: XXXXYYYY (hex 8-digit, °C or °F)
		    XXXX = beginning of temp. range
		    YYYY = end of temp. range

Reading temperature sub range:	AAme	Output: XXXXYYYY (hex 8-digit, °C or °F)
		    XXXX = beginning of temp. range (°C or °F)
		    YYYY = end of temp. range (°C or °F)

Setting of temperature sub range:	AAm1XXXXYYYY	XXXX (hex 4-digit) beginning of temp. range YYYY (hex 4-digit) end of temp. range

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=0…5 (decimal)
		    0 = 1200 Baud 2 = 4800 Baud 4 = 19200 Baud
		    1 = 2400 Baud 3 = 9600 Baud 5 = 38400 Baud

Temp. display °C / °F	AAfhX	Output: X = 0: display in °C; X = 1: display in °F
Wait time:	AAtwXX	XX = 00 … 99 (decimal, in bit time of the current baud rate)
Internal temperature:	AAgt	Output: XXX (dec. 000 … 099°C, 032 … 210°F)
Max. internal temperature:	AAtm	Output: XXX (dec. 000 … 099, always in °C)
Limit switch SP1:	AAslXXXX	XXXX = set Limit switch, hex 4-digit, °C or °F
Mode Limit switch SP1:	AAt1X	X = 0 Limit switch Off X = 1 Limit switch close above X = 2 Limit switch close below
Hysteresis Limit switch SP1:	AAhlXX	XX = set hysteresis, hex 2-digit, °C or °F

Error status:	AAfs	Output: XX;
		    XX=00…FF (00 = no error)
		    (01…FF: error code for LumaSense service)

LED aiming light:	AAlaX	X = 0 switch off aiming light X = 1 switch on aiming light
LED aiming light at Power-on	AAlpX	X = 0 aiming light off at Power-on X = 1 aiming light on at Power-on

Reading parameters:	AApa	Output 11-digit, decimal:
		    Digit 1 und 2 (10...99 or 00): Emissivity
		    Digit 3 (0 ... 6): Exposure time
		    Digit 4 (0 ... 8): Clear time max. / min. value storage
		    Digit 5 (0 ... 1): Analog output
		    Digit 6 und 7: (00 ... 98): Internal temperature
		    Digit 8 und 9 (00 ... 97): Address
		    Digit 10 (0 ... 6 or 8): Baud rate
		    Digit 11 always 0

Device type:	AAna	Output: "IGA 320/23-LO" (16 ASCII-characters)
Serial number:	AAsn	Output: XXXXX (dec. 5-digit)

Description	Command	Parameters
Device type / software version:	AAve	Output: XXYYZZ (6-digit decimal) XX = 56 (IGA 320/23) YY = Month of software version ZZ = Year of software version
Detailed Software version:	AAvs	tt.mm.yy XX.YY tt = day; mm = month; yy = year; XX.YY = software version
Reference number:	AAbn	Output: XXXXXX (hex 6-digit)

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

Additional instructions for the RS485 interface:
Requirements to the master system during half-duplex operation:
1. After an inquiry, the bus should be switched into a transmission time of 3 bits (some older interfaces are not fast enough for this).
2. The pyrometer's response will follow after 5 ms at latest.
3. If there is no response, there is a parity or syntax error and the inquiry has to be repeated.

To ensure consistent document formatting, this page was intentionally left blank.

8 Reference numbers

8.1 Reference numbers instrument

Temperature range	Ref. Number	Description
85 to 600 °C (MB 6)	3 913 930	Fiber length 1 m, Ø 0.6 mm (green fiber mark)
100 to 700 °C (MB 7)	3 913 970	Fiber length 2.5 m, Ø 0.4 mm (blue fiber mark)
100 to 700 °C (MB 7)	3 913 980	Fiber length 1 m, Ø 0.4 mm (blue fiber mark)
150 to 1200 °C (MB 12)	3 913 950	Fiber length 2.5 m, Ø 0.2 mm (red fiber mark)

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

8.2 Reference numbers accessories

3 920 030	Connection cable, 12 wire, with 8 pole straight connector, 2 m
3 920 040	Connection cable, 12 wire, with 8 pole straight connector, 5 m
3 920 050	Connection cable, 12 wire, with 8 pole straight connector, 10 m
3 920 060	Connection cable, 12 wire, with 8 pole straight connector, 15 m
3 920 070	Connection cable, 12 wire, with 8 pole straight connector, 20 m
3 920 080	Connection cable, 12 wire, with 8 pole straight connector, 25 m
3 920 090	Connection cable, 12 wire, with 8 pole straight connector, 30 m
3 920 130	Connection cable, 12 wire, with 8 pole angled connector, 2 m
3 920 140	Connection cable, 12 wire, with 8 pole angled connector, 5 m
3 920 150	Connection cable, 12 wire, with 8 pole angled connector, 10 m
3 920 160	Connection cable, 12 wire, with 8 pole angled connector, 15 m
3 920 170	Connection cable, 12 wire, with 8 pole angled connector, 20 m
3 920 180	Connection cable, 12 wire, with 8 pole angled connector, 25 m
3 920 190	Connection cable, 12 wire, with 8 pole angled connector, 30 m
3 920 100	Adapter cable (0.2 m) 8 pole onto 12-pole standard connector
3 852 290	Power supply NG DC for carrier rail mounting housing (100 ... 240 V AC, 50 ... 60 Hz ⇒ 24 V DC, 1 A)
3 852 550	Power supply NG 2D carrier rail mounting housing (85 ... 265 V AC ⇒ 24 V DC, 600 mA, with 2 limit switches)
3 890 640	DA 4000-N, LED-display, 2-wire power supply
3 890 650	DA 4000, LED-display, 2-wire power supply, 2 limit switches (relay contacts)
3 890 530	DA 6000, LED-display, RS485, max. value storage, analog output
3 826 510	PI 6000: PID programmable controller, extremely fast, for digital IMPAC pyrometers
3 826 520	PI 6000-N: PID programmable controller, extremely fast, for pyrometers with analog output
3 890 150	DA 6000-T, digital display for measurement of the cooling-off time from 800 °C to 500 °C (for welding processes), RS232 interface
3 852 580	RS232 to USB converter (matched to DA 6000-T)
3 852 600	USB nano: Converter RS485 ⇔ USB
3 853 610	USB LabKit, adapter RS485 to USB with targeting light push-button and analog output clamp, pyrometer cable, power supply 100 to 240 V AC
3 834 390	Ball and socket mounting for fiber optical head I and II
3 834 230	Adjustable mounting support for optical head II
3 846 170	Mounting tube (L 600 x Ø 70 mm)

3 835 180	Air purge unit, stainless steel
3 835 240	90° mirror (with air purge)
3 843 460	SCA 300, scanner with quartz glass window; 24 V AC/DC
3 835 290	Air purge for scanner
3 873 320	Replacement optical head design I, a = 120 mm
3 873 340	Replacement optical head design I, a = 260 mm
3 873 420	Replacement optical head design II, fixed adjusted, a = 87 mm
3 873 440	Replacement optical head design II, fixed adjusted, a = 200 mm
3 838 210	Focusable optics lens II for fiber optics (Ø25), a = 88...110
3 838 220	Focusable optics lens II for fiber optics (Ø25), a = 95...129
3 838 230	Focusable optics lens II for fiber optics (Ø25), a = 105...161
3 838 240	Focusable optics lens II for fiber optics (Ø25), a = 200...346

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.

Temperature indication too low
- Incorrect alignment of the pyrometer to the object
  ⇒ New correct alignment to achieve the max. temperature signal
- Measuring object smaller than spot size
  ⇒ check measuring distance, smallest spot size is at nominal measuring distance
- Measuring object is not always in the measuring spot of the pyrometer
  ⇒ Use max. value storage (see **4.9**)
- Emissivity set too high
  ⇒ Set lower correct emissivity corresponding to the material (see **4.5**)
- Lens contaminated
  ⇒ Clean lens carefully (see **6.2**)

Temperature indication too high
- Emissivity set too low
  ⇒ Set lower correct emissivity 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

Measuring errors
- Indicated temperature is decreasing during the use of the pyrometer, contamination of the lens
  ⇒ Clean lens. Recommendation: use of air purge (see **3.3**)
- Air contamination in the sighting path between pyrometer and object
  ⇒ Change position of the pyrometer with a clean sighting path (if necessary use a ratio pyrometer)
- HF-interferences
  ⇒ Correct the connection of the cable shield (see **3.1**)
- Temperature Indication is fluctuating, probably caused by changing emissivity
  ⇒ Wrong pyrometer type, use of ratio pyrometer recommended

To ensure consistent document formatting, this page was intentionally left blank.

Index

Software InfraWin 25
Spot size data 17
Storage 7
Subrange 22
Support 6

T

Technical data 9
Temperature display in °C or °F 19
transmittance 20
Transmittance • 20
Transport, packaging, storage 7
Trouble shooting 35

U

Unpacking 6
UPP data format 29

W

Wait time 14
Warranty 5