LumaSense® TECHNOLOGIES

MANUAL

IMPAC Pyrometer

IS 50-LO plus • IGA 50-LO plus

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Contents

1 General Information

1.1 Information about the user manual

Congratulations on choosing the high quality and highly efficient Series 50-LO plus pyrometer.

This manual provides important information about the instrument and can be used as a work of reference for installing, operating, and maintaining your Series 50-LO plus 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 Series 50-LO plus 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.

1.2.1 Laser Targeting Light

For easy alignment to the measuring object the pyrometers are equipped with a laser targeting light. This is a visible red light with a wavelength between 630 and 660 nm and a maximum power of 1 mW. The laser is classified as product of laser class 2.

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

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

1.2.2 Electrical connection

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

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

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:

- No adjustments may be made to the targeting laser. It is fixed at the factory.
- No adjustments may be made to the targeting laser's power level.

1.4 Unpacking the Instrument

Before shipment, each instrument is assembled, calibrated, and tested at the LumaSense Factory. When unpacking and inspecting your system components, you need to do the following:

1. 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.

2. Carefully unpack and inspect all components for visible damage. If you note any damage or suspect damage, immediately contact the carrier and LumaSense Technologies, Inc.
3. Save all packing materials, including the carrier's identification codes, until you have inspected all components and find that there is no obvious or hidden damage.

Note: LumaSense encourages you to register your product with us to receive updates, product information, and special service offers: http://www.info.lumasenseinc.com/registration.

1.5 Transport, packing, and storage

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

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

1.6 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 1.7, 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

1.7 Shipments to LumaSense for Repair

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

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

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

Send RMA Shipments to your nearest technical service center:

Santa Clara, California

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

Email: support@lumasenseinc.com

Frankfurt, Germany

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

Email: eusupport@lumasenseinc.com

1.8 Disposal / decommissioning

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

2 Introduction

2.1 Appropriate use

The pyrometers **IS 50-LO plus** and **IGA 50-LO plus** are digital, highly accurate pyrometers with fiber optics for non-contact temperature measurement on metals, ceramics, graphite etc. between 250 °C and 3500 °C.

The **IS 50/055-LO plus** and **IS 50/067-LO plus** are special versions with extremely short wavelengths where e.g. molten metal has a very high emissivity.

The instrument type **IS 50-Si-LO plus** is optimized for measurements on silicon wafers, e. g. in vacuum chambers.

The **IS 50-Al-LO plus** is specially designed for measurements on aluminium parts and profiles.

2.2 Scope of delivery

Converter, mono fibre 2.5 m, one selectable optical head (please specify when ordering), works certificate, InfraWin operating and analizing software, user manual.

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

2.3 Technical data

Temperature Ranges:	IS 50-LO plus	550 ... 1400 °C (MB 14) 600 ... 1600 °C (MB 16) 650 ... 1800 °C (MB 18) 550 ... 1800 °C (MB 18L) 750 ... 2500 °C (MB 25) 900 ... 3300 °C (MB 33)
	IS 50/055-LO plus	1000…2300 °C (MB 23)
	IS 50/067-LO plus	1100…3500 °C (MB 35)
	IS 50-AI-LO plus	400 ... 1000 °C (MB 10)
	IS 50-Si-LO plus	400 ... 1300 °C (MB 13) 500 ... 1600 °C (MB 16)
	IGA 50-LO plus	300 ... 1300 °C (MB 13) 350 ... 1800 °C (MB 18) 450 ... 2500 °C (MB 25) 250 ... 1350 °C (MB 13.5L) 300 ... 2000 °C (MB 20L) 350 ... 2500 °C (MB 25L)
Temperature Subrange:	Any range adjustable within the temperature range, minimum span 51 °C	

Spectral Ranges:	IS 50-LO plus: 0.7 ... 1.1 µm IS 50/055-LO plus: 0.55 µm IS 50/067-LO plus: 0.676 µm IS 50-Si-LO plus & IS 50-Al-LO plus: narrow band in the near infrared IGA 50-LO plus: 1.45 ... 1.8 µm
Signal Processing:	Photo current, digitized immediately
Detector:	IS 50-LO plus; IS 50/055-LO plus; IS 50/067-LO plus; IS 50-Si-LO plus; IS 50-Al-LO plus: Si IGA 50-LO plus: InGaAs
Power supply:	24 V AC or DC (12 … 30 V AC or DC) (AC: 48 … 62 Hz)
Power consumption:	Max. 2 W
Analog output:	0 … 20 mA or 4 … 20 mA (linear), switchable; load: 0 … 500 Ω
Test current output:	Fixed 10 mA (for 0 … 20 mA analog output) or fixed 12 mA (for 4 … 20 mA analog output)
Serial interface:	RS232 or RS485 addressable (half duplex), switchable, baud rate 1.2 up to 115 kBd
Resolution:	Interface and display: 0.1°C Analog output:< 0.1 % of the adjusted temperature range
Isolation:	Power supply, digital interface, analog output are galvanically isolated against each other
Display:	Illuminated LC display for temperature indication or parameter settings
Parameters:	Adjustable at the instrument or via serial interface: emissivity; response time; analog output; address; baud rate; waiting time; °C or °F; setting of the maximum value storage; temperature sub range
Emissivity ε:	20 … 100% adjustable inside the instrument or via interface in steps of 0.1%
Exposure time t_{90}:	< 1 ms; adjustable to 0.01 s; 0.05 s; 0.25 s; 1 s; 3 s; 10 s
Maximum value storage:	Single or double storage; cleared by: preselected time interval or external deletion contact or via digital interface or automatically with the next measuring object
Switch contact:	Max. 0.15 A (to recognize a hot object in the measuring beam. Contact switches if the measuring temperature is minimum 1% above the beginning of the temperature range (only active with automatic clearing or t_{CL} < 0.5 s))
Sighting:	Laser targeting light (class 2, max. power level < 1 mW, λ = 630-680 nm) 
Meas. Uncertainty*: (ε = 1, t_{90} = 1 s, $T_{amb.}$ = 23 °C)	Up to 1500 °C: 0.3% of reading in °C + 1 °C Above 1500 °C: 0.5% of reading in °C
Repeatability: (ε = 1, t_{90} = 1 s, $T_{amb.}$ = 23 °C)	0.1% of reading in °C + 1 °C
Ambient temperature:	IS 50-LO *plus*; IGA 50-LO *plus*: 0 ... 60 °C on the converter, up to 250 °C on side of fiber and optical head IS 50-Si-LO *plus*; IS 50-Al-LO *plus*: 20 ... 30 °C on the converter, up to 250 °C on side of fiber and optical head (The laser targeting light switches off automatically if the internal temperature of the instrument goes above 55 °C, above 70 °C at the 4 ... 20 mA output a thermo switch sets the analog output to 0 mA)

Storage temperature:	-20 … 70 °C
Protection class:	IP54
Weight:	Converter: approx. 600 g Optical head II: approx. 140 g Fiber (2.5 m): approx. 250 g
Dimensions:	125 mm x 80 mm x 57 mm (L x B x H)
Dimensions (Optics):	See Section 2.4
Mounting position:	Any
CE label:	According to EU directives about electromagnetic immunity

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

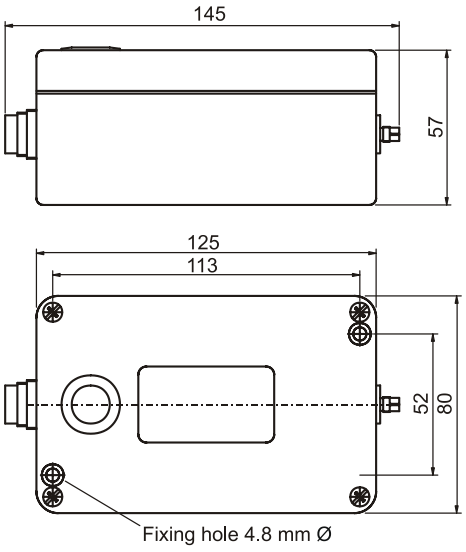
Type	**MB/°C**	**Tc/°C**
IS 50-LO plus, MB 25	750…2500	760
IGA 50-LO plus, MB 13	300…1300	335
IGA 50-LO plus, MB 13.5L	250…1350	343
IGA 50-LO plus, MB 18	350…1800	400
IGA 50-LO plus, MB 25	450…2500	462
IGA 50-LO plus, MB 20	300…2000	420
IGA 50-LO plus, MB 25	350…2500	362

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.

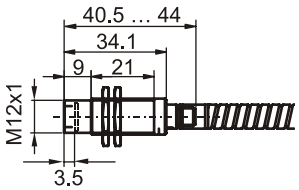
For additional details on this directive, see http://info.lumasenseinc.com/calibration or order the directive from "Beuth Verlag GmbH" in D-10772 Berlin, Germany.

2.4 Dimensions

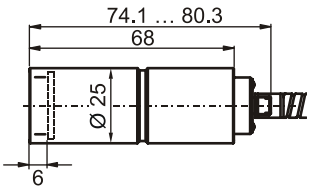
Converter:



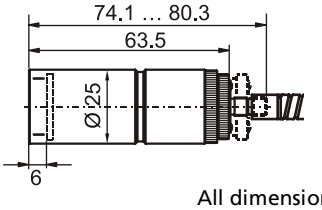
Optical head I:



Optical head II:
(fixed adjusted)

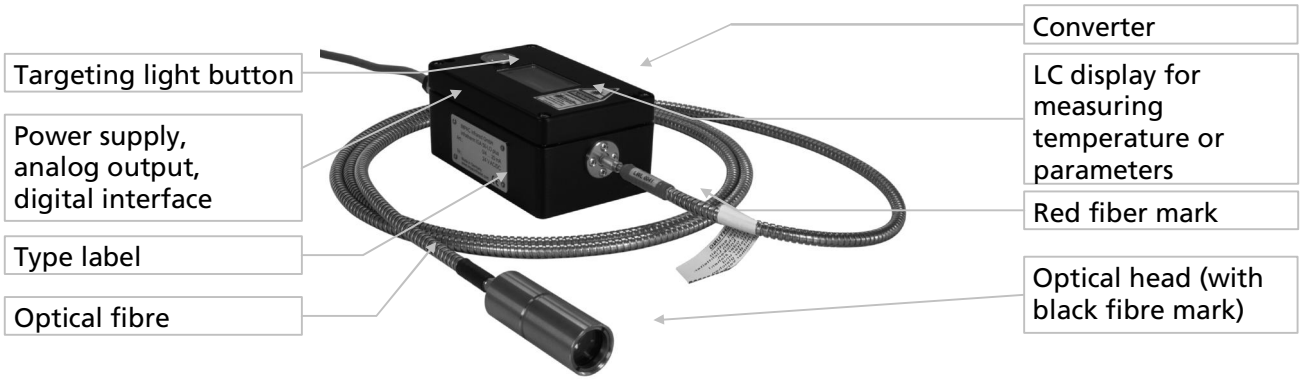


Optical head II:
(focusable)



All dimensions in mm

2.5 Physical user interface



2.6 Accessories (option)

Numerous accessories guarantee easy installation of the pyrometers. The following overview shows a selection of suitable accessories. You can find the entire accessory list with all reference numbers in **Section 10.2 Reference numbers accessories**).

2.6.1 Mounting

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

Mounting angles

Ball and socket mounting

2.6.2 Air purge

The *air purge* protects the lens from contamination with 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

In addition to the built-in temperature indicator of the pyrometer, LumaSense offers several digital displays which can also be used for remote parametrizing of the pyrometer.

Digital display DA 6000

LED large display

3 Controls and Installation

3.1 Electrical Installation

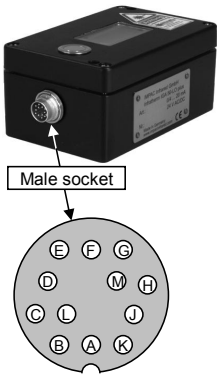
The series 50 pyrometers are powered by a voltage of 24 V DC (possible range 12 ... 30 V) or AC (48 ... 62 Hz). Once connected to power, the instrument operates immediately and needs no warm-up time. To switch off the instrument, unplug the connector.

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

LumaSense offers connecting cables, but they are not part of standard scope of delivery. The main connecting cable has wires for power supply, interface, analog output, external laser switch and external clear of maximum value storage via contact and 12 pin angle connector (see **Chapter 10**, **Reference numbers**). The cable includes a short RS232 adapter cable with a 9 pin SUB-D connector for direct PC communication. This adapter is not used in combination with RS485 interface.

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

Pin	Color	Indication
K	white	+ 24 V power supply (or 24 V AC)
A	brown	0 V power supply
L	green	+ $I_{outp.}$ analog output
B	yellow	– $I_{outp.}$ analog output
H	gray	external switch for targeting light (bridge to K)
J	pink	see below: output for switch contact, external clearing of maximum value storage or input for hold function
G	red	DGND (Ground for interface)
F	black	RxD (RS232) or B1 (RS485)
C	violet	TxD (RS232) or A1 (RS485)
D	gray/pink	B2 (RS485) (bridge to F)
E	red/blue	A2 (RS485) (bridge to C)
M	orange	Screen only for cable extension, don't connect at the switchboard



Pin assignment
(side of male inserts)

Connector pin J

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

1) **Switch contact:** The pyrometer is equipped with a switch contact for use as a thermo switch. This function enables the detection of a hot object in the measuring beam of the pyrometer. The contact is activated only in combination with a clear time setting "auto" or a minimum time setting of 1 s (see **5.3 Clear time for the maximum value storage**). If the temperature exceeds 2 °C min. or 1% of the span of the temperature range above the minimum range, the power supply (pin K) is connected to pin „J".

2) **External clearing of the maximum value storage:** If the clear time is set to "extern" (settings also see **5.3**), pin J can be used as input for external clearing of the maximum value storage. To clear the maximum value storage, connect pin J for a short time to pin K (power supply voltage).

3) **hold function:** when the hold function mode is activated the current temperature reading is frozen as long as J and pin K are connected (see **5.3 Clear time for the maximum value storage**).

3.1.2 Connecting the pyrometer to a PC

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

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

If an RS485 connection is not available at the PC, it can be accomplished using an RS485 or RS232 to USB connector. When using a RS485 to USB adapter, make sure that the adapter is fast enough to receive the pyrometer's answer to an instruction of the master. Most of the commonly used adapters are too slow for fast measuring equipment, so it is recommended to use the RS485 ⇔ USB converter "USB nano" (ref. no. 3 852 600).

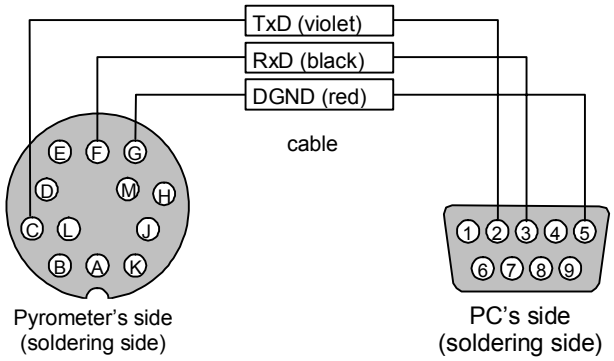
With a slow RS485 connection it is also possible to set a wait time at the pyrometer which delay the response of a command to the pyrometer (see **5.9 Wait time tw**).

Connecting to RS232 interface

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

The baud rate has to be reduced by 50% when the transmission distance is doubled (see also **5.7 kBaud (baud rate)**).

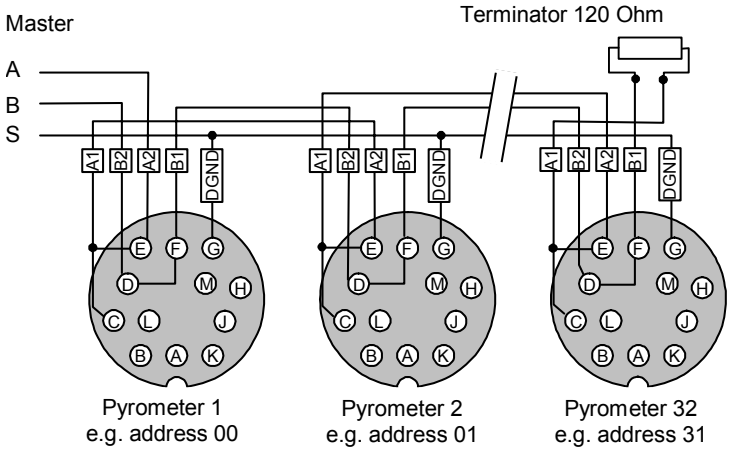
Typical cable length for RS232 at 19200 Bd is 7 m.



Connecting to RS485 interface

Half-duplex mode:

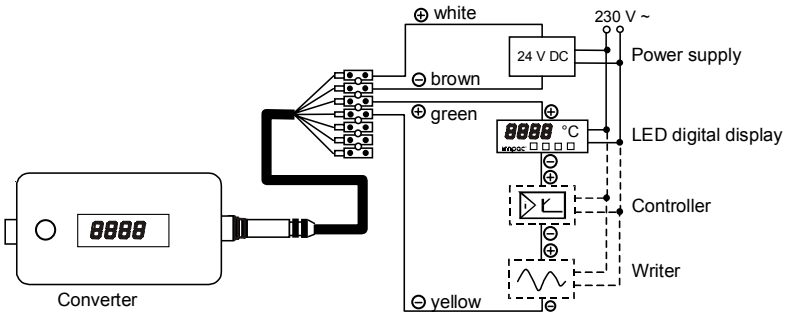
A1 and A2 as well as B1 and B2 are bridged in the 12-pin round connector of the connecting cable, to prevent reflections due to long stubs. It also safeguards against the interruption of the RS485 Bus system should a connecting plug be pulled out. The master labels mark the connections on the RS485 converter. The transmission rate of the serial interface in Baud (Bd) is dependent on the length of the cable. Values between 2400 and 115200 Bd may be set.



The baud rate is reduced by 50% when the transmission distance is doubled (see **5.7 Baud Rate (kBaud)**). Typical cable length for 19200 Bd is 2 km.

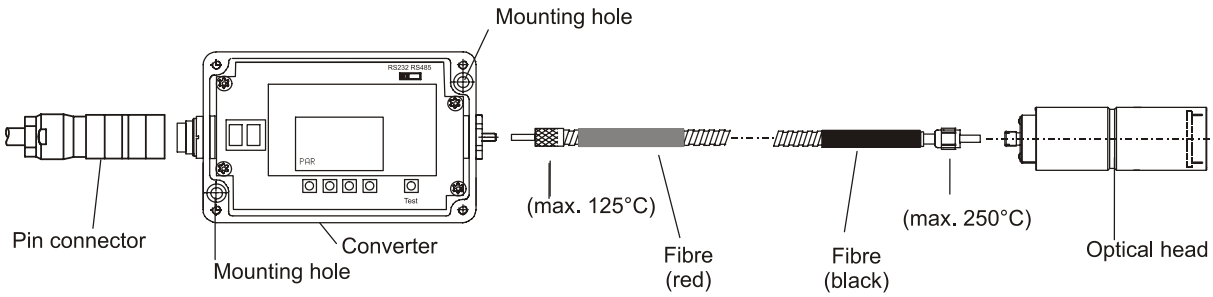
3.1.3 Connection of additional analyzing devices

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



3.2 Mechanical Installation

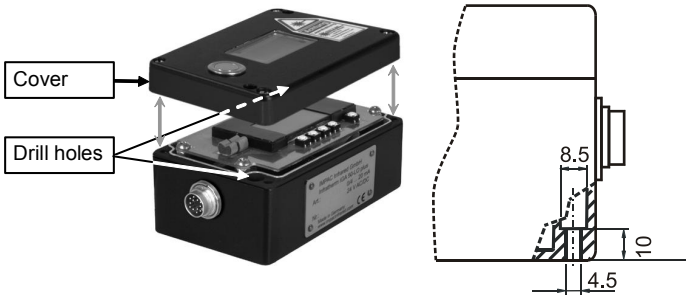
3.2.1 Overview



3.2.2 Converter

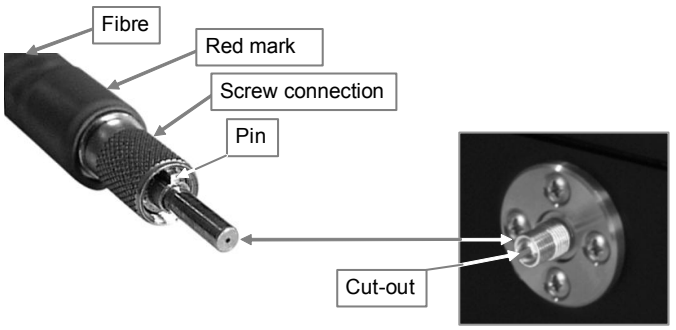
To fix the converter, 2 drill holes for screws with 4 mm diameter accessible after removing the cover.

For fixing and aligning the optical head, different mounting supports are available (see 2.6 Accessories (option)).



3.2.3 Fiber

The transmission between optical head and converter is done via 0.2 mm (red fiber mark) mono fiber with a stainless steel protection hose (exceptions: IS 50-Si-LO plus, MB 13: 0.4 mm mono fiber (blue mark) and IS 50-Al-LO plus: 0.6 mm mono fiber (green mark)). The optical head contains only the lens, the sensor and the electronics are located in the converter. Fiber and optical head can be used in ambient temperatures up to 250 °C without additional cooling (fiber at converter side max. 125 °C).



The fiber has a color mark for correct connection to the pyrometer. This color mark has to be mounted on the pyrometer's side. On side of the optical head no mark or a black mark is viewable.

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!

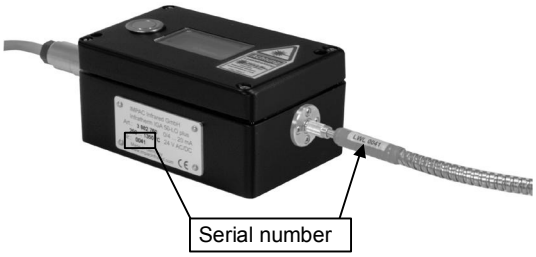
Minimum Bending Radius

	Red	Blue	Green
for short time (max. 250 °C):	50 mm	100 mm	150 mm
permanent (max. 250 °C) :	120 mm	300 mm	500 mm
wound up (max. 50 °C):	120 mm	300 mm	500 mm

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

Serial Number

The original fiber has a serial number which is also on the pyrometer's housing.



Attention: Faultless operation of the pyrometers is ensured only when using components with the same serial number.

The system must be re-calibrated if the fiber optic cable or the optical head are exchanged (service)!

Ambient Temperature

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

3.3 Sighting

3.3.1 Laser targeting light

For exact measurement of the object temperature, the pyrometer must be aligned correctly onto the object. For this alignment, the pyrometers are equipped with a laser targeting light. This laser enables the simple and accurate alignment even onto small objects.

The laser marks the center of the measuring spot. The laser targeting light can be used during operation without affecting the measurement.

The laser targeting light can be switched on and off either by pressing the button at the housing or by using an external contact (see 3.1.1 Pin assignment for the connector on the back side of the pyrometer) or via PC and the software InfraWin. After two minutes, the laser targeting light switches off automatically.

If the converter cover is opened the laser targeting light can be switched with the button with the ∗ symbol. When the laser targeting light is switched on, the display shows "PILT".

Caution: Do not look directly into the laser beam! Laser class 2 according to IEC 60825-1-3-4

Note: To prevent damage to the laser, the laser targeting light switches off automatically if the internal temperature of the device goes above approx. 55 °C (then it cannot be switched on again until the temperature is lower again)!

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

3.4 Optics

Depending on the application the instrument will be delivered with a small or a large optical head. The selection of the optical head depends not only on its size but also on the required spot size (size of the measuring object) and the measuring distance.

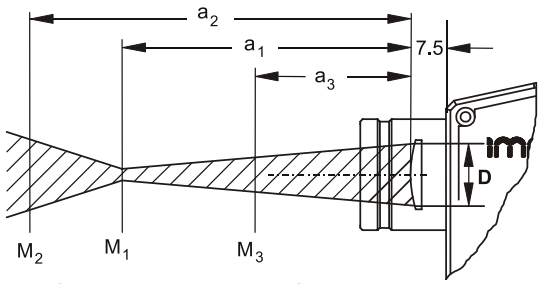
Optical head	Measuring distance *a* [mm]	Spot size M_{90} [mm]			Aperture *D* [mm]
		IS 50-LO plus IS 50/055-LO plus IS 50/067-LO plus IS 50-Si-LO plus, MB 16 IGA 50-LO plus	IS 50-Si-LO plus MB 13	IS 50-Al-LO plus	
Type I (small optics) 	120	1.2	2.2	3.3	7
	260	2.6	7.5	7.5	7
	700	7.2	14	21	7
Type II (fixed adjusted) 	87	0.45	0.75	1.1	17
	200	0.8	1.5	2.3	17
	600	2.7	5.3	8.0	15
	4500	22	4.2	63	15
Type II (focusable) 	88 … 110	0.45 … 0.6	0.8 … 1.1	1.2 … 1.7	17
	95 … 129	0.5 … 0.75	0.9 … 1.3	1.4 … 2.0	16
	105 … 161	0.6 … 1.0	1.1 … 1.7	1.7 … 2.6	15
	200 … 346	0.8 … 1.5	1.5 … 2.8	2.3 … 4.2	17
	247 … 606	1.1 … 2.7	2.0 … 5.2	3.0 … 7.8	16
	340 … 4500	1.5 … 22	2.8 … 42	4.2 … 63	15

- Measuring distance from the front of the lens
- Spot size *M* for focusing to the measuring distance *a* for 90% of the radiation
- The aperture is the effective lens diameter of the optics

3.4.1 Calculating spot sizes

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

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



$$M_2 = \frac{a_2}{a_1} (M_1 + D) D \qquad M_3 = \frac{a_3}{a_1} (M_1 - D) + D$$

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

3.4.2 Adjusting the required measuring distance

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

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

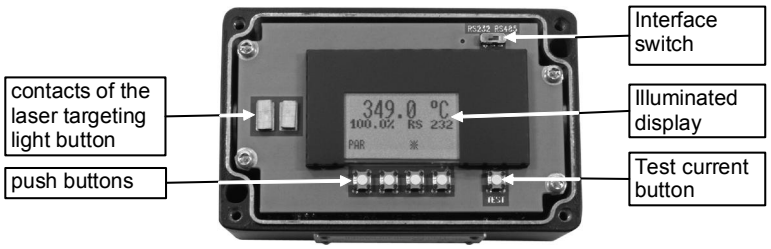
Caution: Do not look directly into the laser beam! Laser class 2 according to IEC 60825-1-3-4

4 Instrument settings

The pyrometers are equipped with a wide range of setting options for optimal adaption to the required measuring condition and for getting the correct measuring temperature (description of all available parameters see Chapter **5 Parameter description / settings**).

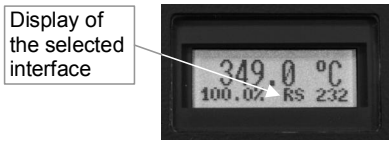
All instrument settings can be done directly at the instrument or via serial interface and software *InfraWin*.

The LC-display as well as the push buttons for displaying and setting of the parameters are located inside the converter. The pyrometer is opened by 4 Allen screws. ‘



Note: Please make sure that the pyrometer is not contaminated while open. Please close cover right after parameterization and keep cover closed for permanent use.

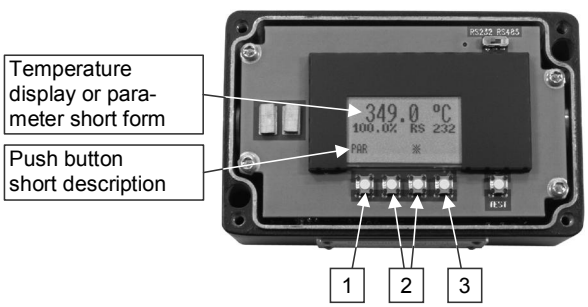
With the **interface switch** the interface operation mode RS232 or RS485 can be selected. The LC display shows as chosen either RS232 or RS485.



The *diagnostic push button* ***„test“*** generates a current on the analog output which is used to check if a connected external indicator shows the correct temperature value. The test current output is centered to the chosen analog output span, consequently 10 mA is supplied if the analog output is adjusted to 0 to 20 mA and 12 mA is supplied if the analog output span is set from 4 to 20 mA. The LC display indicates the respective current along with the corresponding temperature. For example if a measuring range of 700 °C to 1800 °C is selected the temperature shown in the display is 1250 °C). This temperature must be reflected exactly by the indicator which is supplied by the respective current. If this is not the case the selected analog input current span of the indicator is not equivalent to the chosen current output span of the pyrometer and one of the current spans or temperature range have to be modified. By pressing the „test“ push button once again or by pressing any push button of the LC-display the test current is switched off. Also after 1 minute idle time the “test” current is switched off. The unit will be in the measurement mode again.

4.1 Settings at the instrument

1 **PAR:** With the **PAR** button all available parameters are displayed in the order they are described in Chapter 5). Pushing the button again changes the display to the next parameter and on the display a corresponding short form is displayed (see Chapter 5, in brackets behind the parameter names).



2 ∗ If the converter cover is opened the laser targeting light can be switched with the button with the ∗ symbol. When the laser targeting light is switched on, the display shows "PILT".

▲▼: With the arrow keys ▲ and ▼ all parameter settings can be displayed. They are active after pushing the PAR button. Pushing the button longer changes the settings in fast mode.

3 **ESC / ENT:** Pushing the **ESC** button changes the pyrometer to measuring mode. If a parameter is changed with the arrow keys the indication of the ESC button changes to ENT. Pressing the button again confirms the value into the pyrometer. Changing the parameters again by pushing the PAR button doesn't confirm this value in the pyrometer. If no button is pressed for 30 s the pyrometer changes to the temperature indication without accepting the changed value.

4.2 Factory settings

Emissivity (**Emi**) = 100%
Exposure time ($\mathbf{t_{90}}$) = min
Clear time ($\mathbf{t_{Clear}}$) = off
Analog output (**mA**) = 0 … 20 mA
Sub range (**from / to**) same as temperature range
Address (**Adr**) = 00
Baud rate (**Baud**) = 19200 Bd
Temperature display (**C / F**) = °C
Wait time ($\mathbf{t_w}$) for RS485 = 10
Interface (**RS485 / RS232**) = RS232

5 Parameter descriptions / Settings

5.1 Emissivity ε

For a correct measurement, it is necessary to adjust the emissivity. The *emissivity* is the relationship between the emission of a real object and the emission of a blackbody radiation source (this is an object which absorbs all incoming rays and has an emissivity of 100%) at the same temperature.

Different materials have different emissivities ranging between 0% and 100% (settings at the pyrometer between 10 and 100%, the set value is indicated on the display). Additionally, the emissivity is dependent on the surface condition of the material, the spectral range of the pyrometer, and the measuring temperature. The emissivity setting of the pyrometer has to be adjusted accordingly.

Typical emissivity values of various common materials for the three spectral ranges of the instruments are listed below. The tolerance of the emissivity values for each material is mainly dependent on the surface conditions. Rough surfaces have higher emissivities.

Measuring object	Emissivity [%]	
	IS 50-LO *plus* (at 0.9 µm)	IGA 50-LO *plus* (at 1.6 µm)
„Black body furnace“	100	100
Steel heavily scaled	93	85...90
Steel rolling skin	88	80...88
Steel, molten	30	20...25
Slag	85	80...85
Aluminum, bright	15	10
Chromium, bright	28...32	25...30
Brass oxidized (tarnished)	65...75	60...70
Bronze, bright	3	3
Copper, oxidized	88	70...85

Measuring object	Emissivity [%]	
	IS 50-LO *plus* (at 0.9 µm)	IGA 50-LO *plus* (at 1.6 µm)
Zinc	58	45...55
Nickel	22	15...20
Gold, Silver, bright	2	2
Porcelain glazed	60	60
Porcelain rough	80...90	80...90
Graphite	80...92	80...90
Chamotte	45...60	45...60
Earthenware, glazed	86...90	80...90
Brick	85...90	80...90
Soot	95	95

Emissivity values for the IS 50-Al-LO *plus* are listed below:

Measuring object	Emissivity ε [%]			
Aluminium, polished surface	14	(360 ... 500 °C)	14	(> 500 °C)
Aluminium, smooth surface	30 ... 36	(360 ... 500 °C)	30 ... 36	(> 500 °C)
Silicon	67	(360 ... 800 °C)	27	(1400 °C)

Emissivity values for the IS 50-Si-LO *plus* are listed below:

Measuring object	Emissivity ε [%]			
Silicon	67	(360 ... 800 °C)	27	(1400 °C)

5.2 Exposure time (t_{90})

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

The exposure time is the time interval when the measured temperature has to be present after an abrupt change so that the output value of the pyrometer reaches a given measurement value. The time taken is to reach 90% of the recorded temperature difference. In the "min" position, the device operates using its time constant of < 1 ms.

Longer exposure times can be used for the measurement of objects which have rapidly fluctuating temperatures to achieve constant temperature reading.

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

Settings:
off
0.01 s
⋮
25 s
extern
auto
Hold

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.

The maximum value storage value has two different operating modes:

> **Single Storage:** 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:** 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.

The following settings are possible:

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

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

extern: The external clearing of the storage can be activated and used within an own software (see Chapter 9 Data format UPP (Universal Pyrometer Protocol)) or via an external contact (for connection see 3.1.1 Pin assignment for the connector on the back of the pyrometer). In this case, the storage operates only in single storage, because only a single deletion mechanism is used.

auto: The **auto** mode is used for discontinuous measuring tasks. For example objects are transported on a conveyer belt and pass the measuring beam of the pyrometer only for a few seconds. Here the maximum value for each object has to be indicated. In this mode the maximum value is stored until a new hot (or cold) object appears in the measuring beam. The temperature which has to be recognized as **hot** is defined by the low limit of the adjusted sub

range. The stored maximum value will be deleted when the temperature of the new hot object exceeds the low limit **from** of the sub range by 1% or at least 2 °C. If a lower limit is not entered, the maximum value storage will be deleted whenever the lower level of the full measuring range has been exceeded.

Hold: The function "hold" enables to freeze the current temperature reading at any moment. For this an external push button or switch has to be connected (see **3.1.1 connector pin J**) which holds the temperature reading as long as the contacts are closed.

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

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

5.4 Analog Output

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

Settings:
0 to 20 mA
4 to 20 mA

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

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

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

5.6 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).

5.7 Baud rate (kBaud)

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

Settings:
1.2 kBd
⋮
115.2 kBd

5.8 Temperature display in °C or °F

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

5.9 Wait time (t_w)

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

Settings:
00 Bit
⋮
99 Bit

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

5.10 Maximum internal temperature (MaxIntTemp)

Shows the maximum internal temperature the device ever reached.

5.11 Error status (Status)

In case of a device error the pyrometer displays a hex code which identifies this error to LumaSense service. The standard display at this point is "ok".

6 Software InfraWin

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

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

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

6.1 Connecting the pyrometer to a PC

The program *InfraWin* can operate up to two devices. Two devices using RS485 may be operated simultaneously by the same interface, if two different addresses have been properly entered (see section **5.6 Address** for more information).

6.2 Installation

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

6.3 Program start

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

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7 Maintenance

7.1 Cleaning the front window

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

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

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

7.2 Changing of optics or fiber

The pyrometers are equipped ex works with a small or a large optical head. The optical heads can be changed against each other. If changing the fiber or the optical head a recalibration of the pyrometer should be done. Replacement can be necessary if the lens is scratched or the pyrometer will be used for other measuring distances.

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8 Troubleshooting

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

Temperature indication too low

- Incorrect alignment of the pyrometer to the object
  ⇒ New correct alignment to achieve the max. temperature signal
- Measuring object is smaller than spot size. If needed, exchange optical head.
  ⇒ Choose correct measuring distance
- Measuring object is not always in the measuring spot of the pyrometer (e.g. swinging wire or pouring stream)
  ⇒ Use max. value storage
- Emissivity set too high
  ⇒ Set lower correct emissivity corresponding to the material
- Lens contaminated
  ⇒ Clean lens carefully

Temperature indication too high

- Emissivity set too low
  ⇒ Set higher correct emissivity corresponding to the material
- The temperature of fiber and optical head is not at least 30 °C lower than the measuring temperature.
  ⇒ Use cooling jacket with air or water cooling
- The measurement is influenced by reflections of hotter machine parts
  ⇒ Try to avoid the influence of the interfering radiation or change measuring position

Measuring errors

- Indicated temperature is decreasing during the use of the pyrometer, contamination of the lens
  ⇒ Clean lens
- Air contamination in the sighting path between pyrometer and object
  ⇒ Change position of the pyrometer with a clean sighting path
- Strong HF-interferences
  ⇒ Change position of the pyrometer
- Instrument overheated
  ⇒ Use cooling jacket with air or water cooling
- Temperature Indication is fluctuating, probably caused by changing emissivity
  ⇒ Wrong pyrometer type, use of ratio pyrometer recommended

Laser targeting light

- Laser targeting light fails
  ⇒ Instruments max. temperature is exceeded. Use cooling jacket

Note: The wavelength band of the pyrometers reacts at low measuring temperatures (below 130 °C) to incandescent lamps or very bright daylight (not valid for fluorescent tube). For a correct measurement, strong external light to the measured object should be avoided.

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9 Data format UPP (Universal Pyrometer Protocols)

Via interface and a 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 (Carriage Return, ASCII 13), to pure entry commands with "ok" + CR.

Every command starts with the 2-digit device address AA (e.g. "00"). This is followed by 2 small command letters (e.g. "em" for 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 (decimal, in °C) last digit is the decimal place (88880 = Temperature overflow)
Reading temperature value repeated:	AAmsXXX	XXX = 000...999 (XXX = number of measuring values)
Emissivity:	AAemXXXX	XXXX = (0010 ... 1000‰) (decimal)
Exposure time t_{90}:	AAezX	X = 0 ... 6 (decimal) 0 = intrinsic time constant of the device 1 = 0.01 s 3 = 0.25 s 5 = 3.00 s 2 = 0.05 s 4 = 1.00 s 6 = 10.00 s
Clear time maximum value storage:	AAlzX	X = 0 ... 8 (dec.) 0 = Maximum value storage off 1 = 0.01 s 4 = 1.00 s 7 = external deletion 2 = 0.05 s 5 = 5.00 s 8 = automatically deletion 3 = 0.25 s 6 = 25.00 s 9 = hold
External clearing:	AAlx	Simulation of an external deletion contact
Analog output:	AAasX	X = 0…10 = 0…20 mA 1 = 4…20 mA
Reading basic temperature range:	AAmb	Output: XXXXYYYY (hex 8-digit, °C) XXXX = beginning of temperature range YYYY = end of temperature range
Reading temperature sub range:	AAme	Output: XXXXYYYY (hex 8-digit, °C) XXXX = beginning of temperature range YYYY = end of temperature range
Setting of temperature sub range:	AAm1XXXXYYYY	XXXX (hex 4-digit) beginning of temp. range (°C) YYYY (hex 4-digit) end of temp. range (°C)

Address:	AAgaXX	XX = (00 ... 97) 00 ... 97 = regular device addresses 99 = Global address with response 98 = Global address without response (only setting commands!)
Baud rate:	AAbrX	X = 1...6 or 8 (decimal) 1 = 2400 Baud 4 = 19200 Baud (7 7 is not allowed) 2 = 4800 Baud 5 = 38400 Baud 8 = 115200 Baud 3 = 9600 Baud 6 = 57600 Baud
Changing °C / °F	AAfhX	Output: X = 0: display in °C; X = 1: display in °F
Wait time:	AAtwXX	XX = 00 … 99 (decimal)
Internal temperature:	AAgt	Output: XX (decimal 00 … 98, in °C) XXX (decimal 032 … 208 °F)
Max. internal temperature:	AAtm	Output: XX (decimal 00 … 98, in °C) XXX (decimal 032 … 208 °F)
Error status:	AAfs	Output 1 byte hex (00 = no error) Bit 0 = 1: Measurement unit doesn't work Bit 1 = 1: Internal temperature measurement doesn't work
Laser targeting light:	AAlaX	X = 0 switch off laser; X = 1 switch on laser
Reading interface:	AAin	Output: 1 or 2 (1 = RS232, 2 = RS485)
Reading parameters:	AApa	Output decimal 11-digit: Digit 1 und 2 (10...99 or 00): Emissivity Digit 3 (0 ... 6): Exposure time Digit 4 (0 ... 8): Clear time max. storage Digit 5 (0 ... 1): Analog output Digit 6 and 7: (00 ... 98): Temperature Digit 8 and 9 (00 ... 97): Address Digit 10 (0 ... 6 or 8): Baud rate Digit 11 (0): always 0
Device type:	AAna	Output: "IS 50-LO *plus*" or "IGA 50-LO *plus*" (16 ASCII-characters)
Serial number:	AAsn	Output: XXXX (hex 4-digit)
Device type / software version:	AAve	Output: XXYYZZ (6-digit decimal) XX = 61 (IS 50-LO *plus* and IGA 50-LO *plus*) YY = Month of software version ZZ = Year of software version
Software version in detail:	AAvs	tt.mm.yy XX.YY tt = day; mm = month; yy = year; XX.YY = software version
Ref. number:	AAbn	Output: XXXXXX (hex 6-digit)

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 3 ms at latest.
3. If there is no response, there is a parity or syntax error and the inquiry has to be repeated.

10 Reference Numbers

10.1 Reference numbers instrument

Pyrometer	Temperature Range	Reference Number
IS 50-LO plus	550 … 1400 °C (MB 14)	3 882 500
	600 … 1600 °C (MB 16)	3 882 520
	650 … 1800 °C (MB 18)	3 882 540
	750 … 2500 °C (MB 25)	3 882 560
	900 … 3300 °C (MB 33)	3 882 580
	550 … 1800 °C (MB 18L)	3 882 600
IS 50/055-LO plus	1000 … 2300 °C (MB 23)	3 882 680
IS 50/067-LO plus	1100 … 3500 °C (MB 35)	3 882 690
IS 50-Si-LO plus	400 ... 1300 °C (MB 13)	3 882 660
	500 ... 1600 °C (MB 16)	3 882 640
IS 50-Al-LO plus	400 ... 1000 °C (MB 10)	3 882 840
IGA 50-LO plus	300 … 1300 °C (MB 13)	3 882 700
	350 … 1800 °C (MB 18)	3 882 720
	450 … 2500 °C (MB 25)	3 882 740
	250 … 1350 °C (MB 13,5L)	3 882 760
	300 … 2000 °C (MB 20L)	3 882 780
	350 … 2500 °C (MB 25L)	3 882 800

Scope of delivery:

Converter, mono fiber 2.5 m, one selectable optical head (please specify when ordering), works certificate, InfraWin operating and analizing software, user manual.

Ordering notes:
When ordering please select one optical head (see Section 3.4 Optics).
A connection cable is not included with the instrument and has to be ordered separately.

10.2 Reference numbers accessories

Replacement optical head type I:

3 873 320 measuring distance 120 mm
3 873 340 measuring distance 260 mm
3 873 350 measuring distance 700 mm

Replacement optical head type II:

3 873 420 measuring distance 87 mm
3 873 440 measuring distance 200 mm
3 873 460 measuring distance 600 mm
3 873 470 measuring distance 4500 mm

Replacement optical head type II, focusable:

3 838 210 measuring distance 88 … 110 mm
3 838 220 measuring distance 95 … 129 mm

3 838 230	measuring distance 105 … 161 mm
3 838 240	measuring distance 200 … 346 mm
3 838 250	measuring distance 247 … 606 mm
3 838 260	measuring distance 340 … 4500 mm
3 820 330	connection cable, length 5 m, straight connector
3 820 500	connection cable, length 10 m, straight connector
3 820 510	connection cable, length 15 m, straight connector
3 820 810	connection cable, length 20 m, straight connector
3 820 820	connection cable, length 25 m, straight connector
3 820 520	connection cable, length 30 m, straight connector
3 820 740	connection cable high temperature, length 5 m, straight connector
3 821 270	connection cable high temperature, length 10 m, straight connector
3 834 390	ball and socket mounting for optical head I or II
3 834 230	adjustable mounting support for optical head II
3 835 170	air purge for optical head I
3 835 180	air purge for optical head II
3 835 240	90° mirror for optical head II
3 852 540	power supply NG 0D for DIN rail mounting; 85 ... 265 V AC ⇒ 24 V DC, 600 mA
3 852 550	power supply NG 2D, as NG 0D: additionally with 2 limit switches
3 890 640	LED digital display DA 4000-N
3 890 650	LED digital display DA 4000: with 2 limit switches
3 890 560	LED digital display DA 6000-N: with possibility for pyrometer parameter settings for digital IMPAC-pyrometers; RS232 interface
3 890 520	LED digital display DA 6000; DA 6000-N additional with 2 limit switches and analog input and output
3 826 500	HT 6000, portable battery driven indicator and instrument for pyrometer parameter setting
3 826 510	PI 6000 programmable PID-controller (external), for fixed digital IMPAC pyrometers
3 852 600	Converter USB ⇔ RS485, Stick (NienTech USB-Nano)
3 852 430	Protocol transducer I-7520 for RS 485 ⇔ RS 232
3 852 440	Protocol transducer RS485/RS232 (switch.) ⇔ Profibus-DP for 1 device
3 852 460	Protocol transducer RS485 ⇔ Profibus DP for 32 devices
3 852 620	Protocol converter UPP RS485 or RS232 ⇔ ProfiNet, for 1 pyrometer
3 852 630	Protocol converter UPP RS485 ⇔ ProfiNet, for max. 32 pyrometers

Index

S

T

U

W