LUMASENSE® TECHNOLOGIES

OPERATION MANUAL

IMPAC Pyrometer

IS 140 • IGA 140

DISAI Automatic Systems

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Contents

1 General

1.1 Information about the user manual

Congratulations on your LumaSense Technologies, Inc. IMPAC brand pyrometer purchase!

Please read this manual carefully, step by step, including all safety, security, operations and maintenance notes, before installing and using your pyrometer, as this manual is an important source of information and reference. Keep this manual in an easily accessible location to avoid handling errors. When operating the instrument, be sure to follow all general safety instructions (see Section 1.2, Safety).

Please also read all included accessory and component manuals.

Should you require further assistance, please call our customer service hotline in Frankfurt, Germany, +49 (0)69 9 73 73-0 or +1 800-631-0176 in the U.S.

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 used terminology corresponds to the VDI- / VDE-directives 3511, part 4.

1.2 Safety

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

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

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

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

1.2.1 Laser Targeting Light

For easy alignment to the measuring object, the pyrometer can be equipped with a laser targeting light. This is a visible red light has a wavelength between 630 and 680 nm and a maximum power of 1 mW. The laser is classified as product of laser class II.

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

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

1.2.2 Electrical connection

Follow common safety regulations for 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, maintaining, 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* Infrawin 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.

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 Malfunction or Service Request

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

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

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

Technical Support can be contacted by telephone or email:

Santa Clara, California

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

Frankfurt, Germany

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

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 airfreight, priority one.

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

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

Send RMA Shipments to your nearest technical service center:

Santa Clara, California

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

Email:
support@lumasenseinc.com

Frankfurt, Germany

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

Email:
eusupport@lumasenseinc.com

1.7 Transport, packaging, storage

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

The pyrometer is designed for a storage temperature of -20 to 80 °C with non-condensing conditions. Storing the instrument out of these conditions can cause damage or result in malfunction of the pyrometer.

1.8 Disposal / decommissioning

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

2 Introduction

2.1 Appropriate use

The IS 140 and IGA 140 are highly accurate digital pyrometers for non-contact temperature measurement on metals, ceramics, graphite etc. with temperature ranges between 220 and 3500 °C.

The IS 140/055 and IS 140/067 are special versions with extremely short wavelength for measurements of metals with high emissivity.

The IS 140 and IGA 140 can optionally be equipped with a built-in color video module for alignment. The color camera module enables the optical alignment of the pyrometer to the measuring object via video screen or monitor. The video output of the pyrometer will be connected directly to the video input of a monitor or a TV card. A target circle on the monitor allows the exact alignment to the measuring object. The target circle marks the place of the measuring spot but not its exact size.

2.2 Scope of Delivery

Pyrometer with one selectable optic, works certificate, InfraWin operating and analyzing software, Allen key 3 mm, 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 140:** 550 to 1400 °C (MB 14) 600 to 1600 °C (MB 16) 650 to 1800 °C (MB 18) 750 to 2500 °C (MB 25) 900 to 3300 °C (MB 33) 550 to 1800 °C (MB 18L) 700 to 3500 °C (MB 35L) 650 to 1400 °C (MB 14, Forging Version) **IS 140/055:** 1000 to 2000 °C (MB 20) **IS 140/067:** 1100 to 3500 °C (MB 35L)	**IGA 140:** 300 to 1300 °C (MB 13) 350 to 1800 °C (MB 18) 450 to 2500 °C (MB 25) 220 to 1150 °C (MB 11.5L) 250 to 1350 °C (MB 13.5L) 300 to 2000 °C (MB 20L) 350 to 2500 °C (MB 25L) 300 to 3000 °C (MB 30L) **Note:** "L" means "long" temperature ranges **Note:** Other temperature ranges available upon request
Sub Range:	Any range adjustable within the temperature range, min. span 51 °C	
Spectral Range:	IS 140 0.7 to 1.1 µm IS 140/055 0.55 µm IS 140/067 0.676 µm IGA 140 1.45 to 1.8 µm	
IR Detector:	IS 140: Silicon photodiode (Si) IGA 140: Indium Gallium Arsenide photodiode (InGaAs)	
Signal Processing:	photoelectric current, digitized immediately	

Power Supply:	24 V AC or DC (12 to 30 V AC or DC) (AC: 48 to 62 Hz)
Power Consumption:	Max. 2 W
Analog Output:	0 to 20 mA or 4 to 20 mA (linear), switchable; Test current 10 mA or 12 mA by pressing test key
Load:	0 to 500 Ω
Switch Contact:	max. 0.15 A (only active with automatic clear mode or $t_{CL} \geq 0.25$ s)

Digital Interface:	RS232 or RS485 addressable (half duplex), switchable; Baud rate 1200 up to 115200 Bd
Resolution:	0.1 °C on interface and display; < 0.1% of temperature range at the analog output
Isolation:	Power supply, analog output, and digital interface are galvanically isolated from each other
Operation signal:	green LED
LC display:	Illuminated LC display for temperature indication or parameter settings

Parameters:	*Adjustable at the device or via interface:* Emissivity ε, exposure time t_{90}, 0 to 20 or 4 to 20 mA, sub range, clear times for maximum value storage, automatically or external deletion of maximum value storage, address, baud rate, wait time t_W *Readable at the device or via interface*: Measuring temperature, internal instrument temperature.
Emissivity ε:	10.0 to 100.0% adjustable 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 / 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), extern, via interface or automatically with the next measuring object
Uncertainty*: (with 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 measured value in °C + 1 °C
Protection Class:	IP65 (DIN 40050)
Ambient Temperature:	0 to 70 °C (Note: The laser targeting light switches off automatically if the internal temperature of the instrument goes above 55 °C, above 75 °C at the 4 to 20 mA output a thermo switch sets the analog output to 0 mA)
Storage Temperature:	-20 to 80 °C
Weight:	Approx. 550 g
Sighting:	Laser targeting light (max. power level < 1 mW, λ = 630-680 nm, CDRH class II) or built-in optimized thru-lens view finder 
CE-Label:	According to EU directives about electromagnetic immunity

Technical Data for video Module (only TV version):

Video signal:	CVBS approx. 1 V_{pp} at 75 Ohm, PAL (B), 50 Hz (optional NTSC (M), 60 Hz)
Resolution:	628 x 582 Pixel (510 x 492 at NTSC)
Illumination control:	Automatic or adjustable (via keyboard or software)
Field of view:	Approx. 6.3% x 4.6% (5.1% x 3.9% for NTSC) of the adjusted measuring distance
Connection video signal:	Separate round plug (at the pyrometer); connections galvanically isolated; video signal can be switched off via software

Date / time:	Real time clock with about 3 days buffer (GoldCap capacitor, free of harmful substances)
Screen display:	Circular target marker; instrument's number or text to your choice (max. 12 characters); time and / or date (switchable); measured temperature, emissivity

*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 140, MB 18L	550…1800	635
IS 140, MB 25	750…2500	760
IGA 140, MB 13	300…1300	335
IGA 140, MB 13,5L	250…1350	343
IGA 140, MB 18	350…1800	400
IGA 140, MB 25	450…2500	462
IGA 140, MB 20	300…2000	420
IGA 140, MB 25	350…2500	462
IGA 140, MB 30	300…3000	496

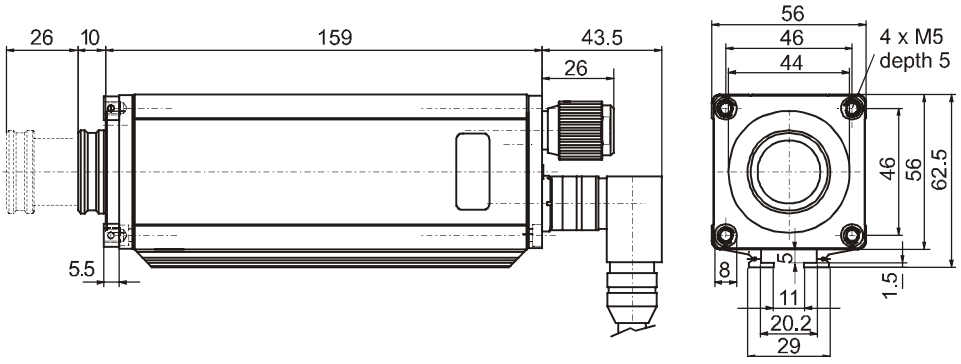
Note: The determination of the technical data of this pyrometer is carried out in accordance with VDI/VDE directive IEC TS 62942-2, "Determination of the technical data for radiation thermometers".

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.

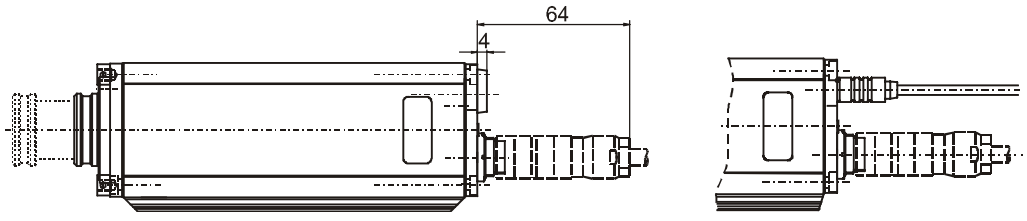
For additional details on this directive, see http://info.lumasenseinc.com/calibration or order the directive from "Beuth Verlag GmbH" in D-10772 Berlin, Germany.

2.4 Dimensions

Pyrometer with thru-lens view finder:

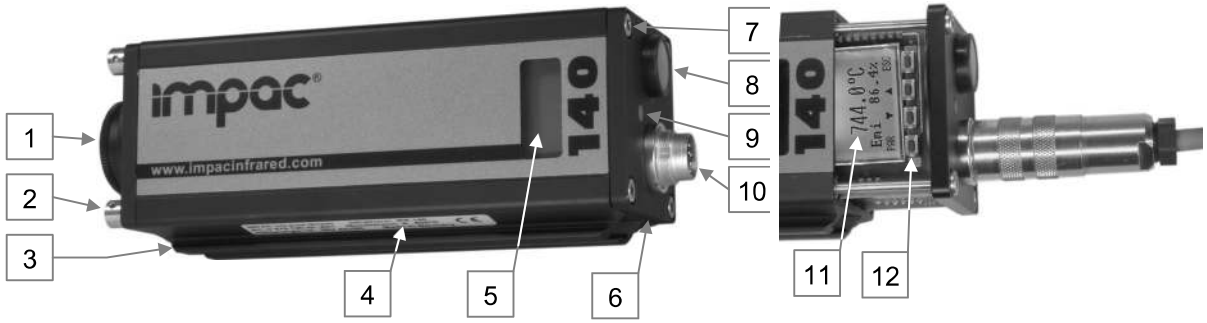


Pyrometer with laser targeting light or video module:



All dimensions in mm

2.5 Physical User Interface



1 Focusable optics (with label with optical data)

2 4 threads for fixing the pyrometer or accessory parts

3 Mounting rail

4 Type label

5 LC display

6 Extendable back cover

7 screws for rear cover (3 mm allen screws)

8 Laser targeting light on/off switch or parallax free view finder, dependent on the instrument's type)

9 Operating status pilot light / laser (on instruments with laser targeting light)

10 Male socket for electrical connections

11 LC display, extended

12 Setting keys

2.6 Accessories (option)

Numerous accessories provide for easy installation of the pyrometer. The following overview shows a selection of suitable accessories. You can find a list of accessories with reference numbers in Chapter 10 **Reference Numbers**.

Mounting:

For mounting and aligning the pyrometer to the measured object, a *mounting angle* or a *ball and socket mounting* is available.

Ball and socket mounting is an easy way to align the pyrometer to the measured object. The quick-clamping-screws enable an easy and fast adjustment of the pyrometer in all directions.

Ball and socket mounting

Mounting angle

Cooling:

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

The *cooling plate* is used to protect the pyrometer from heat coming from the front. The completely covered water cooling jacket is made from stainless steel and protects the pyrometer if exposed to a hot environment. It is designed for ambient temperatures up to 180 °C.

Water cooling jacket

Cooling plate

Displays:

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

Digital display DA 6000

LED Large Display

Miscellaneous:

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

The *scanning attachment SCA 140* moves the measuring beam of the pyrometer from 0 to 12°. This angle is adjustable to smaller values. The scanning frequency is also adjustable from 1 to 5 Hz. In most cases, the scanning attachment SCA 140 is used as a peak picker for measuring smaller objects like thin wires that may be moving.

Air purge

Scanning attachment SCA 140

The *90° mirror* enables the capture of objects at an angle of 90° to the pyrometer axis.

90° mirror

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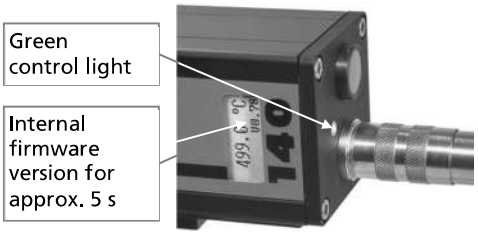
3 Controls and Installation

3.1 Electrical Installation

The IS 140 and IGA 140 are powered by a voltage of 24 V DC (possible range 12 to 30 V) or AC (48 to 62 Hz). With the connection to the power the instruments operate immediately and the display shows the measuring temperature. For switching off the instrument, interrupt the power supply or unplug the electrical connector.



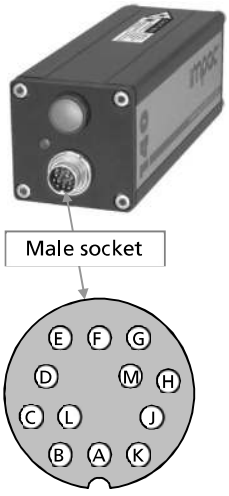
Directly after connecting the power supply the display shows the internal firmware version for approximately 5 s. The green control light on the rear cover is switched on permanently to show the operating state. This control light is blinking as long as the laser targeting light is switched on (only for instruments equipped with a targeting light).

To meet the electromagnetic requirements (EMV), a shielded connecting cable must be used. The shield of the connecting cable has to be connected only on the pyrometer's side. On side of the power supply (switch board) the shield must be open to avoid ground loops.

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

3.1.1 Pin Assignment of the Male Socket 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 extensions, don't connect at the switchboard



Pin-assignment
(side of male inserts)

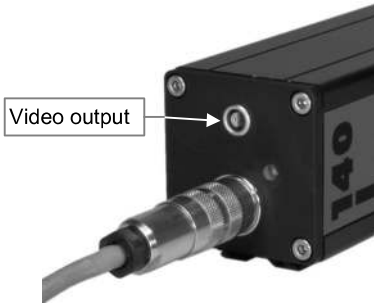
Connector pin J

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

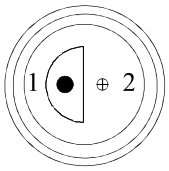
1) **Switch contact:** The pyrometer is equipped with a switch contact for use as a thermo switch. This function enables the detection of a hot object in the measuring beam of the pyrometer. The contact is activated only in combination with a clear time settings "auto" or clear times ≥ 0.25 s (see **5.4 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 see **5.4**), 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 **5.4 clear time for the maximum value storage**).

3.1.2 Video Output

The pyrometers IS 140-TV and IGA 140-TV are equipped with an additional 2 pin connector for video output on the rear cover. LumaSense offers ready made video connection cables in different length which have Cinch and SCART plug for connection to a video monitor.



Using self-made cables: A 2-wire shielded cable must be used, the shield has to be connected to the housing of the plug on pyrometer side only. Video ground and pyrometer housing are galvanically separated. The maximum cable length should not exceed 40 m.



(fixed socket: model ERA.0S.302.CLL,
straight cable plug: model FFE.0S.302.CLAC50
Fa. Lemosa GmbH, http://www.lemo.de)

Pin 1	Video output: CVBS (white)	→	Cinch: middle pin	SCART: pin 20
Pin 2	Video output: ground (brown)	→	Cinch: shield	SCART: pin 17

3.1.3 Connecting the pyrometer to a PC

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

With RS485 the transmission is to a large extend free of problems, long transmission distances can be realized and several pyrometers can be connected in a bus system. If RS485 is not available at the PC, it can be realized with an external converter which converts the RS485 in RS232 for a standard connection to a PC.

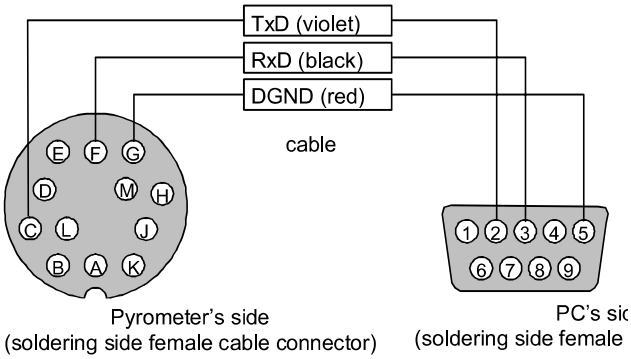
When using a converter RS485 ⇔ RS232 take care, that the converter is fast enough to receive the pyrometer's answer to an instruction of the master. Most of the commonly used converters are too slow for fast measuring equipment. So it is recommended to use the LumaSense converter I-7520 (order no. 3 852 430).

With a slow RS485 connection it is also possible to set a wait time at the pyrometer, which delays the response of a command to the pyrometer (see **5.10 Wait time t_w**).

Connecting to the 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.

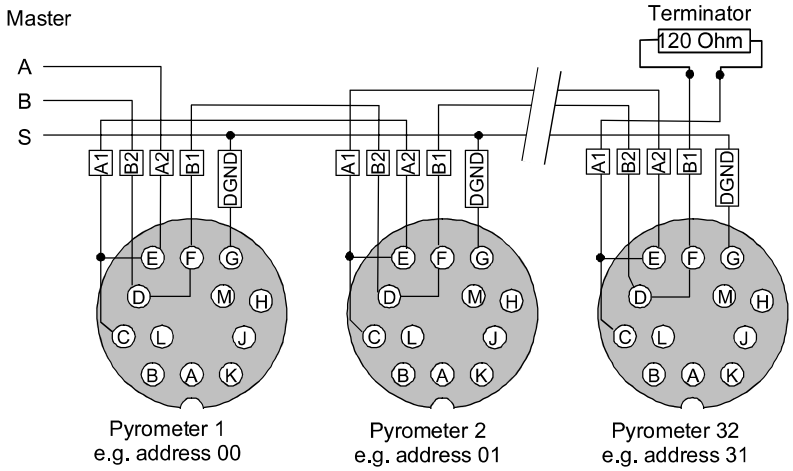
The baud rate has to be reduced by 50% when the transmission distance is doubled (see also **5.9 Baud rate**)



Connecting to the RS485 Interface

Half-duplex mode:

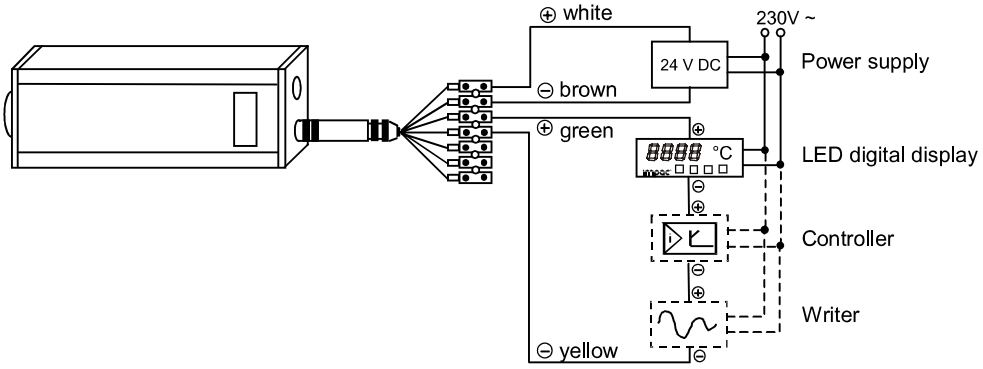
A1 and A2 as well as B1 and B2 are bridged in the 12-pin round connector of the connecting cable, to prevent reflections due to long stubs. It also safeguards against the interruption of the RS485 bus system should a connecting plug be pulled out. The master labels mark the connections on the RS485 converter. 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 5.9 Baud rate). Typical cable length for 19200 Bd is 2 km.

3.1.4 Connection of Additional Analyzing Devices

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



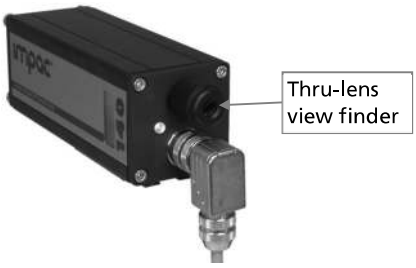
3.2 Mechanical Installation

For mounting the pyrometer is equipped with a mounting rail on the bottom. This rail allows easy fixing of an adjustable mounting angle or a ball and socket mounting. Another possibility for fixing the pyrometer is using the 4 thread holes M 5 on the front of the instrument.

3.3 Sighting

For exact aiming to the object the pyrometers are equipped with a thru-lens view finder, a laser targeting light or a color camera module.

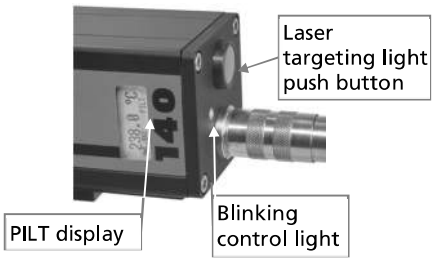
3.3.1 Thru-lens view finder



The view finder can be used to align the measured object through direct observation. The view finder is true-sided and parallax-free; a circle marks the position of the measuring area, but not the exact size.

The pyrometers are equipped with an adjustable eye protection filter. Turning the ocular changes the filter from bright to dark.

3.3.2 Laser targeting light



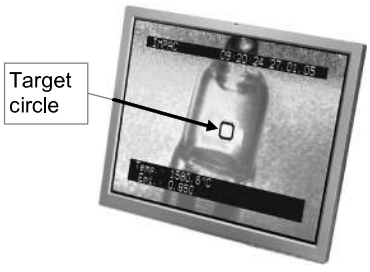
The laser targeting light is a red laser beam used to align the pyrometer at a target. The laser marks the center of the measuring spot. The laser targeting light can be used during operation without effecting the measurement.

When the laser targeting light is switched on, the green control light on the rear cover is blinking and the display shows “PILT”.

The laser targeting light can be switched on and off either by pressing the button at the housing or by using an external contact connecting pins H and K or connecting an external voltage (5 to 30 V DC) to pin H or via PC and *InfraWin* software (see **3.1.1 Pin assignment of the male socket on the back of the pyrometer**). After two minutes the laser targeting light is switched off automatically.

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 can not be switched on again until the temperature is lower again)!

3.3.3 Color camera module



The color camera module enables the optical alignment of the pyrometer to the measuring object via video screen or monitor.

The video output of the pyrometer will be connected directly to the video input of a monitor or a TV card. A target circle on the monitor allows the exact alignment to the measuring object. The target circle marks the place of the measuring spot but not its exact size.

The window displays the preset emissivity and the current measuring temperature. Additionally the date, time and a text can be displayed if activated via the software *InfraWin*.

3.4 Optics

The pyrometers are equipped with one of the following optics. This allows the adjustment to the needed measuring distance to offer the smallest possible spot sizes.

Note: The measuring object must be as least as big as the spot size.

3.4.1 Measuring Distance

Focusable optics 1: measuring distance 130 to 200 mm

Distance a [mm]	130	140	150	160	170	180	190	200
Spot size Ø M [mm]	0.35	0.4	0.45	0.50	0.55	0.60	0.65	0.7
Objective length S [mm]	26	18	13	9	5.7	3	0.7	0

Focusable optics 2: measuring distance 190 to 420 mm

Distance a [mm]	190	220	240	260	280	300	320	340	360	380	400	420
Spot size Ø M [mm]	0.5	0.6	0.65	0.7	0.75	0.8	0.85	0.95	1.0	1.1	1.2	1.3
Objective length S [mm]	26	17.7	13.8	10.8	8.3	6.3	4.6	3.1	1.9	1.0	0.3	0

Focusable optics 3: measuring distance 340 to 4000 mm

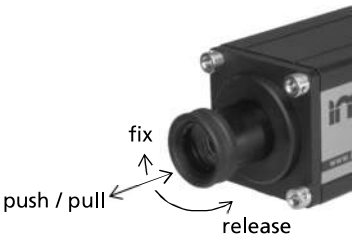
Distance a [mm]	340	400	450	500	600	800	1000	1500	2000	2500	3000	3500	4000
Spot size Ø M [mm]	0.9	1.15	1.3	1.45	1.8	2.4	3.2	4.8	6.5	8.2	10.0	12.0	15.0
Objective length S [mm]	26	20.9	17.9	15.6	12.5	8.6	6.5	3.8	2.5	1.8	1.3	0.9	0

Aperture D: temperature range up to 1500 °C: 14 to 16 mm
temperature range above 1500 °C: 8 to 9 mm

(The aperture is the effective lens diameter. It is depending on the objective length. The biggest aperture value belongs to the fully extended objective (S = 26), the smallest aperture value for objective length S = 0)

3.4.2 Adjusting the required measuring distance

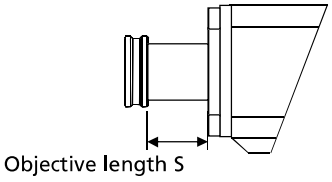
The required measuring distance must be adjusted to achieve the spot sizes mentioned in the tables above. This can be done between the smallest and the biggest limit value.



For releasing the optics has to be turned anticlockwise. Then it can be pushed or pulled to find the correct measuring distance. For fixing the optics has to be turned clockwise.

Adjusting the measuring distance with help of the table:

The table mentions the minimum and maximum measuring distance for each optics (this corresponds to the longest or the shortest objective length) as well as several other values. The objective length “S” can be measured with a caliper.



Adjusting the measuring distance with help of the thru-lens view finder

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

Adjusting the measuring distance with help of the laser targeting light:

On the focused measuring distance the laser has its smallest spot size and is illustrated exactly.

Adjusting the measuring distance with help of the video module:

The focusable optics is correctly adjusted to the required distance, if the measuring object is shown as a sharp image on the monitor. A circle marks the position of the measuring spot.

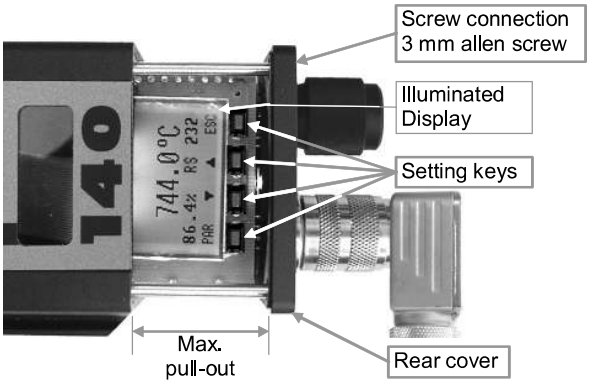
4 Instrument Settings

The series 140 pyrometers are equipped with a wide range of settings for optimal adaption to the required measuring condition and for getting the correct measuring temperature (description of all available parameters see Chapter **5**, **Parameter descriptions / settings**).

4.1 Settings at the instrument

The LC-display, as well as the push buttons for displaying and setting of the parameters, is found inside the unit. The pyrometer is opened by 4 hex (Allen) screws. If unscrewed, the rear cover can be pulled out along with the attached display and push buttons. The pullout is limited by the lengths of the screws.

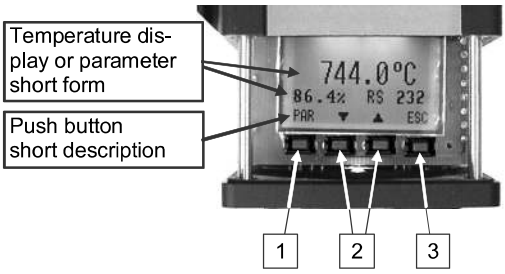
The backlight of the display is always powered in either status, opened or closed pyrometer.



Note: Take care to ensure that the pyrometer is not contaminated while open.

4.2 Key panel operation

1 PAR: With the PAR button, all available parameters are displayed. (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).

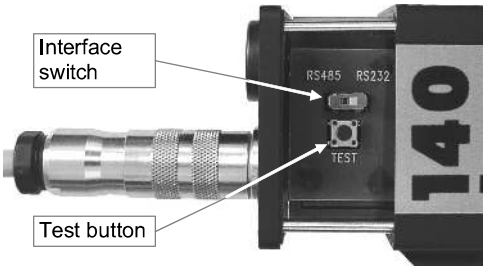


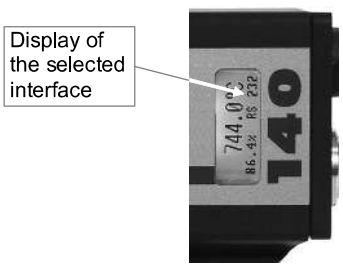
2 ▼▲: With the arrow keys ▼ and ▲, all parameter settings can be displayed. Pushing the button longer changes the settings in fast mode

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.

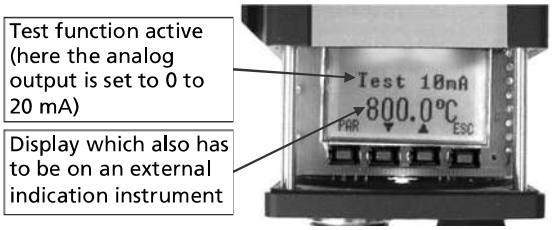
4.3 Selection of the serial interface

Opposite to the display there is a switch to select a serial interface RS232 or RS485. The LC display shows as chosen either RS232 or RS485.





4.4 Test function



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 300 °C to 1300 °C is selected the temperature shown in the display is 800 °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 30 seconds idle time the “test” current is switched off. The unit will be in the measurement mode again.

5 Settings/Parameter Descriptions

The pyrometer is equipped with a wide range of settings to ensure accurate temperature measurement and optimal adaptation to the required measuring conditions.

All instrument settings can be done directly at the instrument or via serial interface and software InfraWin, user of an own communication software find all interface commands in Chapter 9, Data format UPP.

Opening the pyrometer parameters window in InfraWin will display the current settings of the pyrometer. To change a value, either type a new value into an input box or select a preset value from the list field.

5.1 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

5.2 Emissivity ε (Emi)

For a correct temperature measurement, it is necessary to adjust the emissivity. 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 from 0% to 100%. The emissivity of an object 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 (by entering a number between 10 and 100%). Typical emissivity values of various common materials for the two spectral ranges of the instruments are listed below. The tolerance of the emissivity values for each material is mainly dependent on the surface conditions. Rough surfaces have higher emissivities.

Measuring object	Emissivity [%]	
	IS 140 (0.7...1.1 µm)	**IGA 140** (1.45...1.8 µm)
"Black body furnace"	100	100
Steel heavily scaled	93	85 to 90
Steel rolling skin	88	80 t 88
Steel, molten	30	20 to 25
Slag	85	80 to 85
Aluminum, bright	15	10
Chromium, bright	28 to 32	25 to 30
Brass oxidized (tarnished)	65 to 75	60 to 70
Bronze, bright	3	3
Copper, oxidized	88	70 to 85

Measuring object	Emissivity [%]	
	IS 140 (0.7...1.1 µm)	**IGA 140** (1.45...1.8 µm)
Zinc	58	45 to 55
Nickel	22	15 to 20
Gold, Silver, bright	2	2
Porcelain glazed	60	60
Porcelain rough	80 to 90	80 to 90
Graphite	80 to 92	80 to 90
Chamotte	45 to 60	45 to 60
Earthenware, glazed	86 to 90	80 to 90
Brick	85 to 90	80 to 90
Soot	95	95

5.3 Response Time/Exposure Time (t_{90})

Settings:
min
0.01 s
0.05 s
⋮
10.00 s

Exposure time is the amount of time that the measured temperature has to be present after an abrupt change before the output value of the pyrometer is updated. The time it takes to reach 90% of the recorded temperature difference is the response time. In the "min" position, the device operates using its time constant.

5.4 Clear Time of the Maximum/Minimum Value Storage (t_{CL})

Settings:
off
0.01 s
⋮
25 s
extern
auto

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

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

The following settings are possible:

Off: Maximum value storage is deactivated and only immediate 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: External clearing can be activated and used with other software and the clear command "lx" (see Chapter 9, Data format UPP) or via an external contact (see section 3.1.1). 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 under the measuring beam of the pyrometer for only 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 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 for connector pin J) which holds the temperature reading as long as the contacts are closed.

Operation note: Depending on the settings, the maximum value storage either works in *single storage* mode or in *double storage* mode:

Single storage: Single storage is used when you want to reset the stored value using other software and the clear ("lx") command. This mode allows a new value to be established after each impulse from the reset signal.

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

Note: Maximum value storage follows the function of adjustment of exposure time. This results in:

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

5.5 Analog Output (mA)

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

5.6 Subrange (from/to)

It is possible to configure a temperature subrange (minimum 51 °C) within the basic measuring range of the pyrometer. This subrange corresponds to the analog output where "from" describes the beginning of the measuring range, "to" the end of the range. Reduction of the temperature range increases the accuracy of the analog output.

Additionally, setting the subrange makes it possible to fulfill the requirements of the "auto" clear mode of the maximum value storage.

5.7 Address (Adr)

In order to connect several pyrometers with RS485 via one serial interface, it is necessary to give each instrument a unique address for communication. To give each instrument a unique address, connect each instrument individually.

Settings:
00
⋮
97

Using communication software other than InfraWin (InfraWin cannot be used because it automatically detects a connected pyrometer): If parameters may 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).

5.8 Baud Rate (Baud)

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

5.9 Temperature Display (°C or °F)

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

Settings:
°C
°F

5.10 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 a command of the master. In this case a minimum delay time (t_w) can be set. The pyrometer waits this time until it answers a master inquiry (e.g.: t_w = 02 at a baud rate 9600 means a wait time of 2/9600 sec).

Settings:
00 Bit
⋮
99 Bit

Note: The setting of a delay time (t_w) does not guarantee an answer to some commands directly after this time. Certain commands require an internal operation time of max. 3 ms.

5.11 Maximum internal temperature (MaxIntTemp)

Shows the maximum internal temperature the device ever reached.

5.12 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 **5.7 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 Safety

Attention during service to the pyrometer: If the pyrometer is integrated into a running machine process, ensure that the machine is switched off and secured against restart before servicing the pyrometer.

7.2 Service

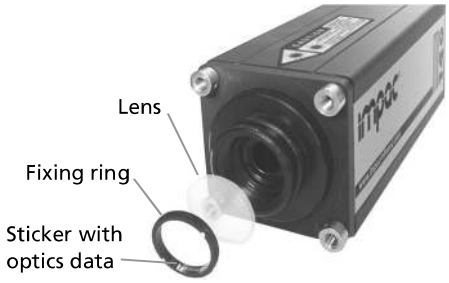
The pyrometer does not have any parts that require regular service. Only the lens has to be kept clean. The lens can be cleaned with a soft cloth in combination with alcohol (do not use acid solutions or dilution). Standard cloths for cleaning glasses or photographic equipment can be used.

7.3 Optics Replacement

The pyrometers of series 140 are equipped with a focusable optics. This optics can be changed against another. For replacement optics for different measuring distances can be used without recalibration of the instrument. Replacement can be necessary if the lens is scratched or the pyrometer will be used for other measuring distances.

7.3.1 Replacement

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



For differentiation they are marked with a color mark at the border of the lens:

Focusable optics 1:	(measuring distance 130 to 200 mm)	(yellow color mark)
Focusable optics 2:	(measuring distance 190 to 420 mm)	(green color mark)
Focusable optics 3:	(measuring distance 340 to 4000 mm)	(red color mark)

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8 Troubleshooting

Before sending the pyrometer for repair, it is recommended that you 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 with the object
  ⇒ realign to achieve the maximum temperature signal
- Measuring object smaller than spot size
  ⇒ check the measuring distance, the smallest spot size is at nominal measuring distance
- Measuring object is not always in the measuring spot of the pyrometer
  ⇒ Use maximum value storage
- Emissivity set too high
  ⇒ Enter a higher emissivity value suitable for the material
- Lens contaminated
  ⇒ Clean lens carefully

Temperature indication too high

- Emissivity set too low
  ⇒ Enter a lower emissivity value suitable for the material
- 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 due to contamination of the lens
  ⇒ Clean the lens. Recommendation: use of an air purge
- Air contamination in the sighting path between pyrometer and object
  ⇒ Change position of the pyrometer to a clean sighting path (if necessary use a ratio pyrometer)
- HF-interference
  ⇒ Correct the connection of the cable shield
- Temperature indication is fluctuating, probably due to changing emissivity
  ⇒ Wrong pyrometer type, use of ratio pyrometer recommended

Laser targeting light

- Laser targeting light fails
  ⇒ Instrument's maximum temperature is exceeded. Use cooling jacket (see 2.6).

Note: The wavelength band of the IS 140 and IGA 140 reacts at low measuring temperatures (below 600 and 300 °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 Protocol)

You can communicate directly with the pyrometer through the interface and a suitable communication software or via the “Test” function of the InfraWin software.

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), finished with CR.
- This is followed, if necessary for that command, by the ASCII "X” parameter. If the 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%

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 = (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 ... 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 9 = hold
External clearing:	AAlx	Simulation of an external deletion contact
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) XXXX = beginning of temperature range YYYY = end of temperature range
Reading temperature sub range:	AAme	same as mb Changes only via PC-software InfraWin

Description	Command	Parameters
Setting of temp. 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=0...6 or 8 (decimal) 0 = 1200 Baud 3 = 9600 Baud 6 = 57600 Baud 1 = 2400 Baud 4 = 19200 Baud (7 is not allowed) 2 = 4800 Baud 5 = 38400 Baud 8 = 115200 Baud
Temp. display °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 (dec. 00 ... 98, in °C) XXX (dec. 032 ... 208 °F)
Max. internal temperature:	AAtm	Output: XX (dec. 00 ... 98, in °C) XXX (dec. 032 ... 208 °F)
Error status:	AAfs	Output: X; X=0…F (0 = no error; 1…F: error code for LumaSense service)
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)
Lock keyboard:	AAlkX	X = 0 ... 3 1 = lock lk1, removal with command lk0 or power off-on 0 = removal of lock lk1 3 = continuous lock lk3, removal only with command lk2 2 = removal of lock lk3
Reading parameters:	AApa	Output 11-digit, decimal: Digits 1 and 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 Digits 6 and 7: (00 ... 98): Internal temperature Digits 8 and 9 (00 ... 97): Address Digit 10 (0 ... 6 or 8): Baud rate Digit 11: Fixed value
Device type:	AAna	Output: “IS 140” or “IGA 140” (16 ASCII-characters)
Serial number:	AAsn	Output: XXXX (hex 4-digit)
Device type / software version:	AAve	Output: XXYYZZ (6-digit decimal) XX = 60 (IS 140 and IGA 140) 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)

Description	Command	Parameters
Reading video-status:	AAos	Output: XX hexadecimal-Byte (bits 6, 5 and 3 unassigned) Bit 7 = 1 no watch/date implemented Bit 5 = 1/0 brightness control manual/automatically Bit 4 = 1 date/watch had a low voltage error Bit 2 = 1 date is indicated Bit 1 = 1 watch is indicated Bit 0 = 1 user text = 0 device number is indicated
	AAos0	switches off the video output driver (high-impedance)
	AAos1	switches on the video output driver
	98osXX	(only as broadcast command!) doesn't answer, switches on video output driver only for the instrument with the address XX and switches off for all other instruments in the bus system
User-text:	AAox	Output: "XXXXXXXXXXX" ASCII-symbol with " " limited
	AAox_	_ = space character → deletes bit 0 in video-status (auto reset!)
	AAoxTT … TT	TT ... TT text with max.! 12 ASCII, sets bit 0 in video-status (auto reset!)
Time:	AAot	Output: time in format: HHMMSS (6 ASCII-signs)
	AAotX	X = '0' or = '1' time indicator off/on (auto reset!)
	AAotHHMMSS	setting time to HHMMSS (auto reset!)
Date:	AAoj	Output: date in format: TTMMJJ (6 ASCII-signs)
	AAojX	X = '0' or = '1' date indicator off/on (auto reset!)
	AAojTTMMJJ	setting date to TTMMJJ (auto reset!)

Note: The letter "l" means the small type 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 3 ms at the latest.
3. If there is no response, there is a parity or syntax error and the inquiry should be repeated.

9.1 Extended data protocol for video module

Description	Command	Parameters
Reading video-status:	AAos	Output: XX hexadecimal-Byte (bits 6, 5 and 3 unassigned) Bit 7 = 1 no watch/date implemented Bit 5 = 1/0 brightness control manual/automatically Bit 4 = 1 date/watch had a low voltage error Bit 2 = 1 date is indicated Bit 1 = 1 watch is indicated Bit 0 = 1 user text = 0 device number is indicated
	AAos0	switches off the video output driver (high-impedance)
	AAos1	switches on the video output driver
	98osXX	(only as broadcast command!) doesn't answer, switches on video output driver only for the instrument with the address XX and switches off for all other instruments in the bus system
User-text:	AAox	Output: "XXXXXXXXXXXX" ASCII-symbol with "" limited
	AAox_	_ = space character → deletes bit 0 in video-status (auto reset!)
	AAoxTT … TT	TT ... TT user text with max.! 12 ASCII, sets bit 0 in video status (auto reset!)
Time:	AAot	Output: time in format: HHMMSS (6 ASCII-signs)
	AAotX	X = '0' or = '1' time indicator off/on (auto reset!)
	AAotHHMMSS	setting time to HHMMSS (auto reset!)
Date:	AAoj	Output: date in format: TTMMJJ (6 ASCII-signs)
	AAojX	X = '0' or = '1' date indicator off/on (auto reset!)
	AAojTTMMJJ	setting date to TTMMJJ (auto reset!)

10 Reference Numbers

10.1 Instrument Reference Numbers

Type	Temperature Range		Laser Targeting Light	Thru-Lens View Finder	Video Module PAL (B)	Video Module NTSC (M)
IS 140	MB 14	550 to 1400 °C	3 875 100	3 875 110	3 882 100	3 882 110
	MB 16	600 to 1600 °C	3 875 120	3 875 130	3 882 120	3 882 130
	MB 18	650 to 1800 °C	3 875 140	3 875 150	3 882 140	3 882 150
	MB 25	750 to 2500 °C	3 875 160	3 875 170	3 882 160	3 882 170
	MB 33	900 to 3300 °C	3 875 180	3 875 190	3 882 180	3 882 190
	MB 14 (Forging Version)	650 to 1400 °C	3 875 290	-	-	-
	MB 18L	550 to 1800 °C	3 875 200	3 875 210	3 882 200	3 882 210
	MB 35L	700 to 3500 °C	-	3 875 270	-	-
IS 140/055	MB 20	1000 to 2000 °C	3 875 240	-	-	-
IS 140/067	MB 35L	1100 to 3500 °C	-	3 875 280	-	-
IGA 140	MB 13	300 to 1300 °C	3 875 300	3 875 310	3 882 300	3 882 310
	MB 18	350 to 1800 °C	3 875 320	3 875 330	3 882 320	3 882 330
	MB 25	450 to 2500 °C	3 875 340	3 875 350	3 882 340	3 882 350
	MB 11.5L	220 to 1150 °C	3 875 440	-	-	-
	MB 13.5L	250 to 1350 °C	3 875 360	3 875 370	3 882 360	3 882 370
	MB 20L	300 to 2000 °C	3 875 380	3 875 390	3 882 380	3 882 390
	MB 25L	350 to 2500 °C	3 875 400	3 875 410	3 882 400	3 882 410
	MB 30L	300 to 3000 °C	-	3 875 470	-	-

Ordering notes: When ordering, please select one focusable optic (1, 2, or 3). See Section 3.4 Optics.

A connection cable and a video cable for the instruments with video module) is not included in scope of delivery and has to be ordered separately.

10.2 Reference Numbers Accessories

3 848 220 Optics 1 (130 to 200 mm)
3 848 230 Optics 2 (190 to 420 mm)
3 848 240 Optics 3 (340 to 4000 mm)

3 820 340 Connection cable, length 5 m, 90° connector
3 820 530 Connection cable, length 10 m, 90° connector
3 820 540 Connection cable, length 15 m, 90° connector
3 820 830 Connection cable, length 20 m, 90° connector
3 820 840 Connection cable, length 25 m, 90° connector
3 820 550 Connection cable, length 30 m, 90° connector
3 820 330 Connection cable, length 5 m, straight connector
3 820 500 Connection cable, length 10 m, straight connector
3 820 510 Connection cable, length 15 m, straight connector
3 820 810 Connection cable, length 20 m, straight connector
3 820 820 Connection cable, length 25 m, straight connector
3 820 520 Connection cable, length 30 m, straight connector

3 820 740	Connection cable, length 5 m, straight connector, temperature resistant up to 200 °C
3 820 750	Connection cable, length 5 m, 90° connector, temperature resistant up to 200 °C
3 834 280	Adjustable mounting angle
3 834 270	Ball and socket mounting
3 835 230	Air purge
3 837 290	Cooling jacket, stainless steel
3 835 060	Air purge for cooling jacket
3 834 140	Heavy ball and socket mounting for cooling jacket
3 837 240	Cooling plate
3 835 450	90° mirror with quartz glass window
3 843 520	Rugged scanner SCA 140, (scanning angle adjustable 0 to 12°, scanning frequency adjustable 1 to 5 Hz), with quartz glass window
3 835 290	Air purge for scanner SCA 140
3 852 290	Power supply for DIN rail mounting NG DC (100 to 240 V AC ⇒ 24 V DC, 1 A)
3 852 550	Power supply NG 2D, as NG 0D: additionally with 2 limit switches (not for US sale)
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: PID programmable controller, very fast, for digital IMPAC pyrometers
3 825 430	I-7520, RS232 ⇔ RS485 converter
3 820 430	Video cable with cinch and SCART connector, 5 m length
3 820 440	Video cable with cinch and SCART connector, 10 m length
3 820 450	Video cable with cinch and SCART connector, 15 m length
3 820 460	Video cable with cinch and SCART connector, 30 m length

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