LUMASENSE® TECHNOLOGIES

MANUAL

Series IS 12

IS 12-AI • IS 12-AI/S

IMPAC Pyrometers

certified ISO 9001

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Contents

1 General

1.1 Information about the user manual

Congratulations on choosing this high quality and highly efficient pyrometer.

This manual provides important information about the instrument and can be used as a work of reference for installing, operating, and maintaining your pyrometer. It is important that you carefully read the information contained in this manual and follow all safety procedures before you install or operate the instrument.

To avoid handling errors, keep this manual in a location where it will be readily accessible.

1.1.1 Legend

Note: The note symbol indicates tips and useful information in this manual. All notes should be read to effectively operate the instrument.

Attention: This sign indicates special information which is necessary for a correct temperature measurement.

Warnings and Cautions: The general warnings and cautions symbol signifies the potential for bodily harm or damage to equipment.

MB Shortcut for Temperature range (in German: **M**ess**b**ereich)

1.1.2 Terminology

The terminology used in this manual corresponds to the VDI- / VDE-directives 3511, Part 4.

1.2 Safety

This manual provides important information on safely installing and operating the 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 pyrometers can be equipped with a laser targeting light. This is a visible red light with a wavelength between 630 and 680 nm and a maximum power of 1 mW. The laser is classified as product of laser class II.

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

- 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 main voltage (230 or 115 V AC) when connecting additional devices. Touching the main voltage can be fatal. An incorrect connection and/or 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 Service Request, Repair, or Support

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

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

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

Technical Support can be contacted by telephone or email:

Santa Clara, California

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

Frankfurt, Germany

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

Erstein, France

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

1.6 Shipments to LumaSense for Repair

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

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

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

Send RMA Shipments to your nearest technical service center:

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, 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.

1.8 Disposal / decommissioning

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

2 Introduction

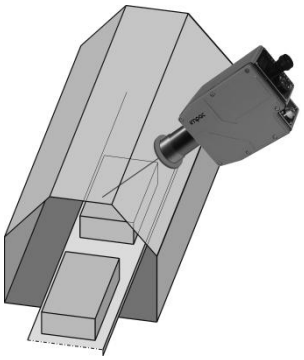
2.1 Appropriate use

The IS 12-Al is a special version of the pyrometer IS 12, designed for the measurement of aluminum. The robust die-cast housing with protection class IP65 is designed for the use in industrial environments.

The instruments IS 12-Al/S is equipped with an integrated scanner which moves the measuring beam adjustable up and down up to 4°.

2.1.1 Application

The IS 12-Al is a special development of the well proven IS 10-Al for aluminum applications in temperature ranges between 350 and 1050 °C.



Conventional pyrometers – even 2-color pyrometers – are not able to measure the temperature of aluminum correctly due to the special physical properties of aluminum. To avoid the negative influence of these properties in the non-contact temperature measurement the IS 12-Al operates in a special spectral range. In this spectral range solid aluminum has a very high and stable emissivity between 30 and 43%. That is why the instrument is suitable for aluminum applications such as extrusion, rolling, billet heating and other heating processes.

Note: Due to physical reasons the IS 12-Al is sensitive to light at the beginning of the temperature range. This sensitivity decreases with increasing temperature. In applications with low temperatures (at the start of the temperature range) the measuring area has to be screened against light to avoid its influence (see drawing).

2.2 Scope of Delivery

Instrument with selectable optics, PC measurement and evaluation software InfraWin, works certificate, and operation manual.

2.3 Technical Data

Temperature ranges:	350 to 900 °C (MB 9) 400 to 1050 °C (MB 10.5)
Sub range:	any range adjustable within the temperature range, minimum span 51 °C
Signal processing:	photoelectric current, digitized
Spectral ranges:	narrow band in the near infrared

Power supply:	24 V DC (15 to 40 V DC) or 24 V AC (12 to 30 V AC), 48 to 62 Hz
Power consumption:	max. 7 W
Analog output:	0 to 20 mA or 4 to 20 mA switchable, load 0 to 500 Ohm
Test current output:	10 mA, fixed
Digital interface:	switchable: RS232 or RS485 addressable (half duplex), baud rate 2.4 up to 115.2 kBd
Display:	built-in 5 digit LED display, height 13 mm, additional function LED's

Resolution:	0.1 °C at interface and display, < 0.025% of temperature range at the analog output
Isolation:	power supply, digital interface, analog output are galvanically isolated against each other and housing

Parameters:	adjustable at the instrument or via serial interface: emissivity ε; response time t_{90}; clear times t_{CL} of the maximum value storage; temperature sub range; analog output 0 to 20 or 4 to 20 mA; switch points for limit contacts; °C or °F; interface RS232 or RS485; address; baud rate; test current output additionally (only via interface adjustable): key lock, wait time, recalibration (with special software)
Emissivity ε:	0.100 to 1.000 in 1/1000 steps
Exposure time t_{90}:	< 1.5 ms (with dynamical adaptation at low signal levels); adjustable at 0.01 s; 0.05 s; 0.25 s; 1 s; 3 s; 10 s
Maximum value storage:	built-in single or double storage. Clearing with adjusted time t_{clear} (off; 0.01 s; 0.05 s; 0.25 s; 1 s; 5 s; 25 s), extern, via interface or automatically with the next measuring object
Limit switches:	2 relay outputs (switch-over relay contacts), switch power max. 30 W (I_{max}: 1 A, U_{max}: 60 V DC) Rise and fall times: exposure time of the pyrometer + 2 ms
Accuracy:	0.3% of measured value in °C + 1 °C (ε = 1, t_{90} = 1 s, T_U = 15...40 °C, $T_M \geq$ 400 °C)
Repeatability:	0.1% of measured value in °C + 1 °C
Scanner adjustments (nur IS 12-AI/S):	scanning angle: 0 to 4° scanning frequency: 4 to 10 Hz

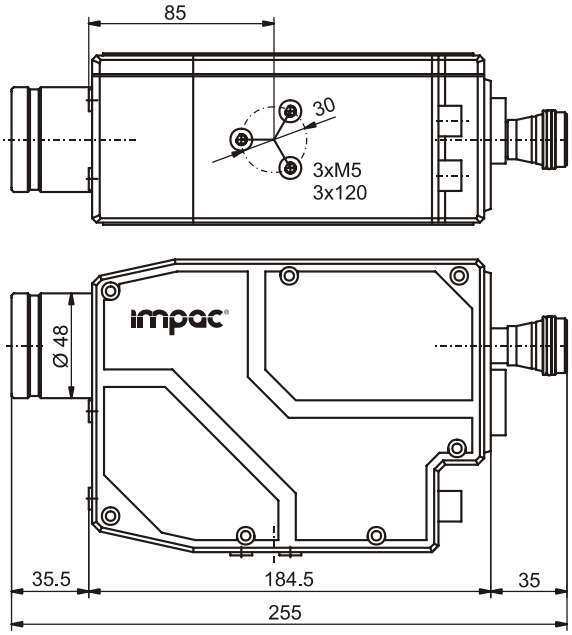
Protection class:	IP65 (DIN 40 050)
Control panel:	4 keys, operate with tip of ball-point pen
Ambient temperature:	0 to 70 °C at housing
Storage temperature:	-20 to 70 °C
Relative humidity	non condensing conditions
Weight:	2.2 kg

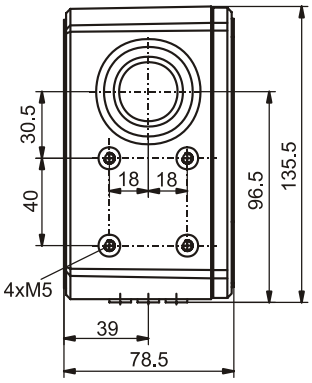
Sighting:	built-in parallax free thru-lens view finder, optionally with an additional built-in laser targeting light (max. power level < 1 mW, λ = 630-680 nm, CDRH class II) 
CE-label:	according to EU directives about electromagnetic immunity

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.

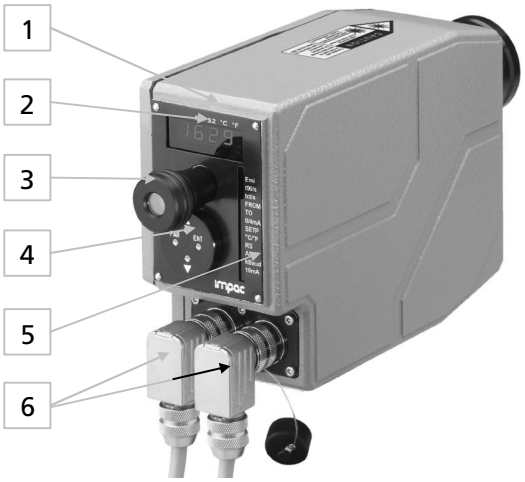
For additional details on this directive, see http://info.lumasenseinc.com/calibration or order the directive from "Beuth Verlag GmbH" in D-10772 Berlin, Germany.

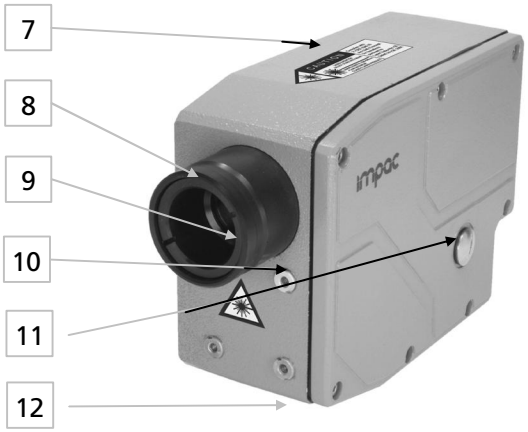
2.4 Dimensions





2.5 Physical User Interface





1 Display °C or °F as well as active limit switches
2 LED display
3 Parallax free thru-lens view finder
4 Setting keys (operate with Tip of ball-point pen)
5 Parameter indicator
6 Main connection cable and additional cable for limit contacts
7 Laser warning label (only instruments with laser targeting light)
8 Fixed or focusable optics
9 Label with optics information
10 Mounting holes
11 Cap for scanner adjustments (only IS 12-AI/S)
12 Type label (bottom side of the instrument)

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 program with all reference numbers on no. **Section 10.2 Reference numbers accessories.**

Mounting

For mounting and aligning the pyrometer to the measured object a *mounting angle* or *ball and socket mountings* are available. The ball and socket mounting is an easy way to align the pyrometer or water cooling jacket (ball and socket mounting steel) to the measured object. The quick-clamping-screws of the ball and socket mounting enable an easy and fast adjustment of the pyrometer in all directions.

ball and socket mounting

ball and socket mounting, steel

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 made from stainless steel protects the pyrometer if exposed to a hot environment. It is designed for ambient temperatures up to 180 °C.

water cooling jacket

cooling plate

Miscellaneous

The *air purge* protects the lens from contamination with 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 *rotary mirror attachment* ROT 10 can only be used in combination with pyrometers with fixed optics. A rotating mirror system moves the measuring beam in a line over the measuring object with a scanning angle up to 73°.

Air purge

Rotary mirror attachment ROT 10

Displays

Additionally 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

Installation Note: Strong incidence of daylight or lamp light into the view finder can affect the measurement. In this case the ocular has to be covered.

3 Controls and Installation

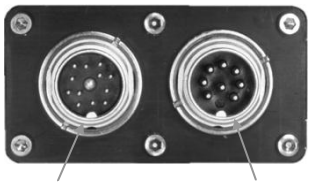
3.1 Electrical Installation

The IS 12-AI is powered by a voltage of either 24 V DC (15 to 40 V DC) or 24 V AC (12 to 30 V AC), 48 to 62 Hz. The instrument has no warm-up time. With connection to the power, the instrument operates immediately. 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; they are not part of standard scope of delivery. The main connecting cable has wires for power supply, interface, analog output, external laser switch and external clear of maximum value storage via contact (see **Chapter 10, Reference numbers**) and 12 pin angle 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.

For use of the limit contacts, the separate additional cable has to be used.



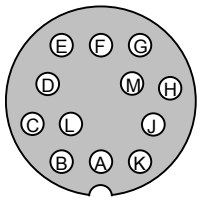
connector for main connection cable

connector for additional cable for limit switches

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

For main connection cable

Pin	Color	Indication
K	white	+ 24 V power supply (or 24 V AC) (12 ... 30 V)
A	brown	0 V power supply
L	green	+ $I_{outp.}$ analog output
B	yellow	– $I_{outp.}$ analog output
H	gray	external switch for targeting light (bridge to K)
J	pink	external clearing of maximum value storage (bridge to K) *) or output for switch contact (see Section 5.13)
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

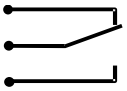
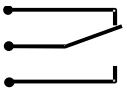


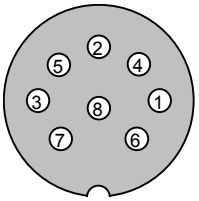
Pin assignment of left connector (side of male inserts)

*) for setting of clear time to "extern" (see 5.3 clear time for maximum value storage)

For additional limit contacts cable

The instrument is equipped with two independent relay limit switches. These are two separate switch-over relay contacts, changing its state if the adjusted temperatures are exceeded.

Pin	Color	Indication
7	pink	 Limit contact S1 (drawing shows status without power or with exceeded limits)
5	white	
1	yellow	
3	grey	 Limit contact S2 (drawing shows status without power or with exceeded limits)
6	green	
4	brown	
2	blue	
8	red	



Pin assignment of right connector

(side of male inserts)

The drawing of the limit contacts indicates their switch status without power. The limit contacts switch after supplying the pyrometer with power. If the temperature exceeds the adjusted limit value, the corresponding limit contact switches back in the first position and is indicated by the corresponding LED on the pyrometer (see **5.6** under **Limit contacts**).

Any temperature value within the range of the pyrometer is adjustable. The setting of the limits can be done directly at the pyrometer (see **5.6** under **Limit contacts**). or via PC and software *InfraWin*.The switch time of the relay contacts is 2 ms plus the response time of the pyrometer.

To avoid oscillating of the switch in the switch point, the contacts are switching with a hysteresis (works setting ±2 °C, adjustable between ±2 and ±20 °C). If required the hysteresis can be set via the *InfraWin* software, directly at the instrument a setting is not possible.

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).

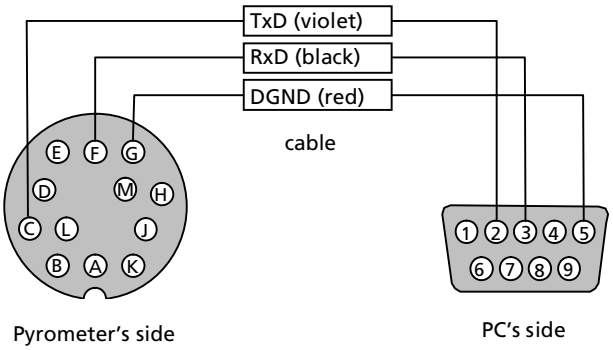
With a slow RS485 connection it is also possible to set a wait time at the pyrometer which delays the response of a command to the pyrometer (see **5.12 Wait time tw**).

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 **5.10 kBaud (baud rate)**).

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

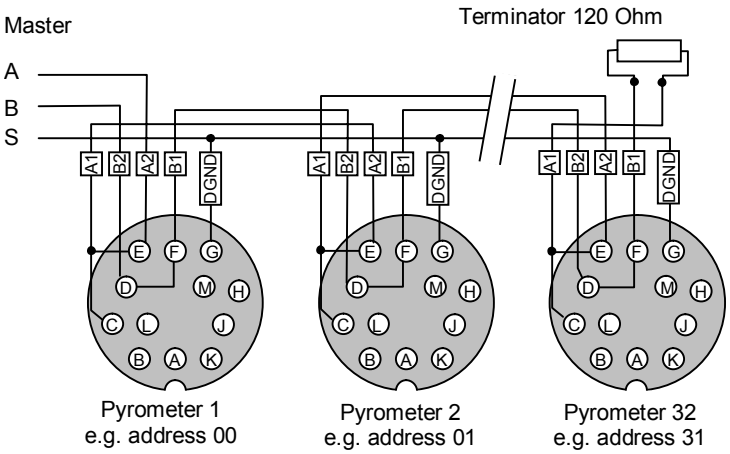


Connecting to RS485 interface

Half-duplex mode:

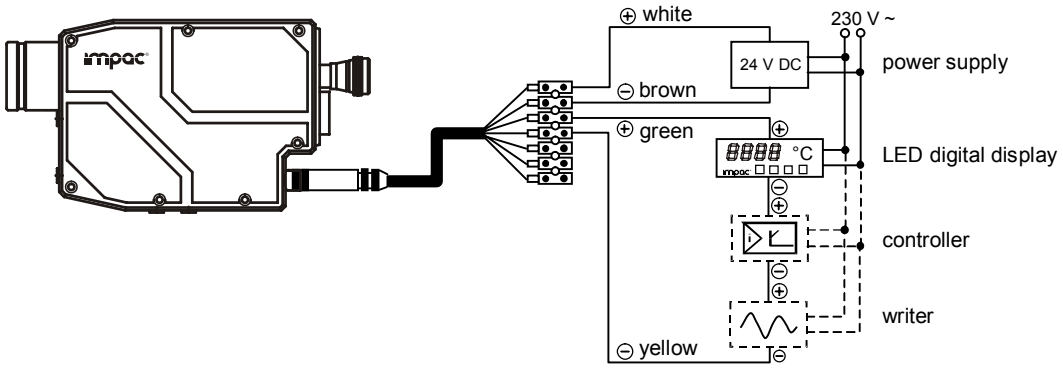
A1 and A2 as well as B1 and B2 are bridged in the 12-pin round connector of the connecting cable, to prevent reflections due to long stubs. It also safeguards against the interruption of the RS485 Bus system should a connecting plug be pulled out. The master labels mark the connections on the RS485 converter. The transmission rate of the serial interface in Baud (Bd) is dependent on the length of the cable. Values between 1200 and 115200 Bd may be set.

The baud rate is reduced by 50% when the transmission distance is doubled (see **5.10 kBaud (baud rate)**). Typical cable length for 19200 Bd is 2 km.



3.1.3 Connection of additional analyzing devices

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

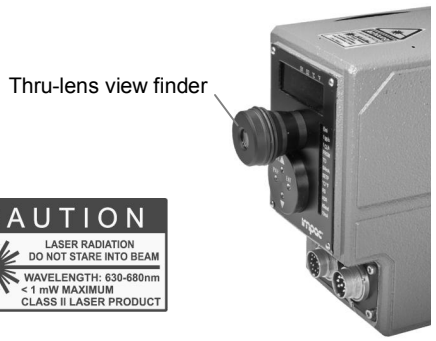


3.2 Sighting

For exact aiming to the object, the pyrometers are equipped with a thru-lens view finder and an additional laser targeting light

3.2.1 Thru-lens view finder

In the optimized thru-lens view finder, a circle marks the exact position and size of the measuring spot.



3.2.2 Laser targeting light

In addition to the thru-lens view finder, the instrument is equipped with a laser targeting light. The laser point marks the center of the spot, not the exact size. The laser targeting light can be used without affecting the measurement.

3.3 Optics

The pyrometers are equipped ex works with one of the below mentioned optics. The smallest spot size is shown for the specified measuring distance.

	MB 9: 350...900 °C
Optics (meas. distance a)	**Spot size M_{90}**
1-P (a = 112 mm)	2.5 mm
2-P (a = 240 mm)	4.5 mm
3-P (a = 660 mm)	11.5 mm
4-P (a = 1300 mm)	22 mm
5-P (a = 5600 mm)	92 mm
Aperture D *)	26 mm

	MB 10.5: 400...1050 °C
Optics (meas. distance a)	**Spot size M_{90}**
1 (a = 80 mm)	1.1 mm
2 (a = 160 mm)	1.5 mm
3 (a = 250 mm)	2.2 mm
4 (a = 660 mm)	5.5 mm
5 (a = 1300 mm)	11 mm
6 (a = 5600 mm)	45 mm
Aperture D *)	19 mm

*) The aperture is the effective lens diameter.

3.3.1 Measuring distance

The spot sizes, mentioned in the table above, will only be achieved at the measuring distances of the corresponding optics. Decreasing or increasing the measuring distance enlarges the spot size. In this case, make sure that the measuring object is at least as big as the spot size.

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.

The measuring object will be shown in the view finder of the pyrometer as a sharp image only in the measuring distance of the corresponding optics (e.g. optics 1 at 80 mm). The circle in the view finder marks the position and size of the spot.

The laser shows its smallest spot in the measuring distance of the corresponding optics (e.g. optics 1 at 80 mm) and it marks the center of the spot, not its size.

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

Note: The pyrometer can measure objects at any distance but the object has to be bigger than or at least as big as the spot size of the pyrometer in the measuring distance.

Calculating the spot sizes on different measuring distances:

The table above specifies, for each optic, the smallest spot size in a certain distance. Spot sizes for other measuring distances can be calculated with the following equations or with the **Spot Size Calculator** of the *InfraWin* software.

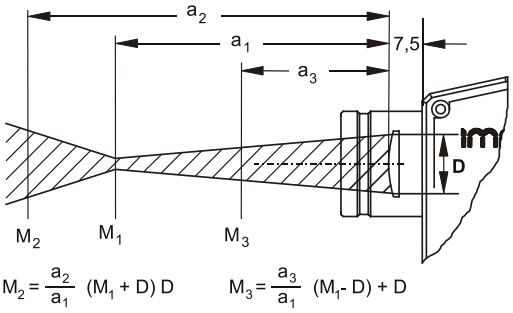


Table values: a_1 = measuring distance
M_1 = spot size
D = aperture

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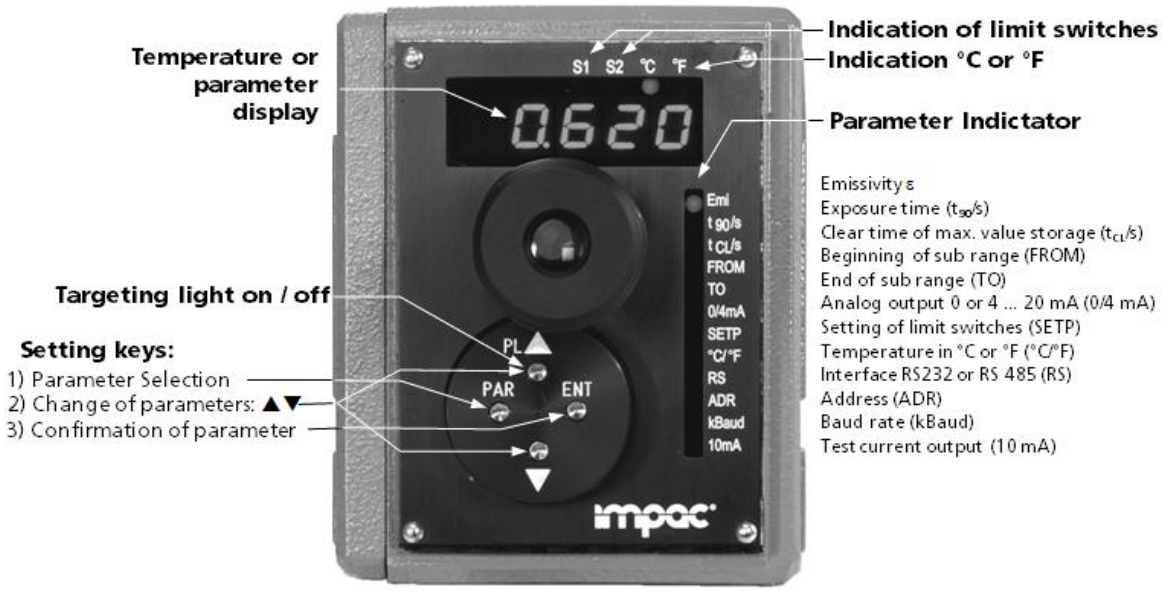
4 Instrument settings

All instrument settings can be done directly at the instrument. To activate the adjusting keys, a tip of ball pen must be used. This avoids changing parameters by mistake.

4.1 Key panel operation



4.2 Functions and setting of parameters

Temperature or parameter display	In the measuring mode the display shows the actual temperature reading. After pushing the parameter key the display indicates the actual value of one selected parameter. Special indications: 8888 = measurement exceeds the end of sub range
Targeting light on / off	Pushing the PL key in measuring mode the laser targeting light is switched on. The IS 12-AI measures continuously also with switched on targeting light and the display shows the actual temperature reading. The laser targeting light is switched off automatically after approx. 2 min or after a further push of the PL key. 
Setting keys 1) PAR	With the **PAR** button all available parameters are displayed in the following description. Pushing the button again changes the display to the next parameter, after the last parameter it changes to the actual temperature reading.
2) ▼▲	With the arrow keys ▲ and ▼ all parameter settings can be displayed. Pushing the button longer changes the settings in fast mode (the keys ▼▲ and **ENT** are blocked if the keyboard is locked via the interface commands or/and during a measurement in combination with a PC and InfraWin).

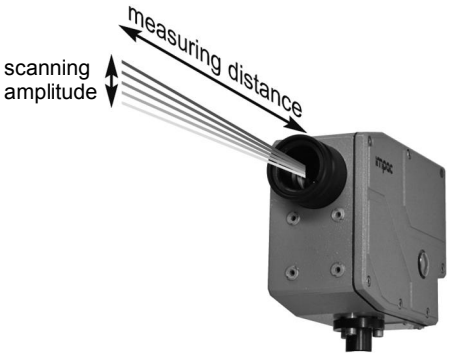
3) ENT	If a parameter is changed with the arrow keys, the new value must be confirmed by pushing the ENT key. If it is not confirmed with ENT, the instrument is still operating with the previous parameter value. If no key is pressed for approx. 30 s, the display changes to the temperature indication.
Limit contacts	Two limit switches can be set. If the measuring temperature exceeds the adjusted limit contact temperature, the LED S1 or S2 displays the switch status.
Scale °C or °F	The LED indicates the temperature scale in °C or °F.
Parameter indicator	LEDs indicate which pyrometer parameter is selected for reading or changing.

4.3 Factory Settings

Emissivity (ε) = 1.000
Exposure time (**t_{90} / s**) = off
Clear time (**t_{CL}**) = off
Sub range (**from / to**) same as temperature range
Analog output (**0 / 4 mA**) = 0 ... 20 mA
Limit contacts = end of temperature range
Hysteresis = ±2°C
scanning angle (only IS 12-Al/S): 4°
scanning frequency (only IS 12-Al/S): 5 Hz
Temperature display (**°C / °F**) = °C
Interface (**RS**) = RS232
Address (**ADR**) = 00
Baud rate (**kBaud**) = 19.2 kBd
Test current output (**10 mA**) = off

4.4 Types IS 12-Al/S with built-in scanner

4.4.1 Function



The pyrometer IS 12-Al/S is equipped with a built-in scanning mechanism which moves the measuring beam up and down. In combination with the pyrometer's maximum value storage (peak picker) the scanner is used for finding the highest temperature. This function is very useful for extrusion applications with frequent changes of dies to produce different aluminum profiles. In that case, the pyrometer does not need new alignment after changing of die.

The instrument is equipped with a thru-lens view finder and an additional laser targeting light for exact alignment to the position of the measuring object. The thru-lens view finder doesn't follow the scanning mirror movement, it always shows the center of the scanning amplitude. The laser targeting light follows the scanning mirror movement and shows always the position of the measuring spot.

The moving measuring beam does not increase the spot sizes due to the fast exposure time of the pyrometers.

The scanning length increases with increasing measuring distance. An overview of the scanning length at the different distances of the optics is shown in the table.

distance a	scanning distance at 4° scanning angle
a = 80 mm	5.6 mm
a = 160 mm	11.2 mm
a = 250 mm	17.5 mm
a = 660 mm	46 mm
a = 1300 mm	91 mm
a = 5600 mm	391 mm

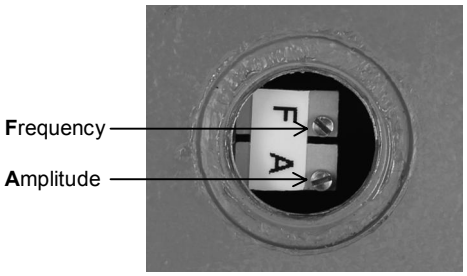
4.4.2 Adjustments

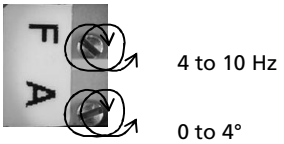
The scanning amplitude is adjustable with the scanning angle (0 to 4 °), the scanning frequency between 4 and 10 Hz.

On the left side of the pyrometer is a cap. Two adjusting potentiometers are under this cap, labeled with an A for amplitude and an F for frequency. For adjustments a small screw driver is necessary. With the laser targeting light the adjustments can be controlled.

Note: Please make sure that the pyrometer will not be contaminated while the cap is open.

The potentiometers can be turned 25 revolutions from min to max. To switch off the scanning mirror, the amplitude potentiometer has to be turned until the laser targeting light does not move. Then the measuring spot is centered. The speed of the scanning can be adjusted with the frequency potentiometer, the current speed can be watched by the speed of the moving laser spot.





Note: The potentiometer has no mechanical stop position. Turning the potentiometer to the left decreases the values, turning right the values are increasing.

After making the required adjustments, ensure that you re-install the cover.

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5 Parameters

5.1 Emi (emissivity ε)

For a correct measurement, it is necessary to adjust the emissivity. This *emissivity* is the relationship between the emission of a real object and the emission of a black body radiation source at the same temperature (this is an object which absorbs all incoming rays and has an emissivity of 100%). Different materials have different emissivities ranging between 0% and 100% (settings at the pyrometer between 10 and 100%). Materials with shiny surfaces have a lower emissivity than materials with rough surfaces. The emissivity setting of the pyrometer needs to be adjusted accordingly. Emissivity values of aluminum are listed below:

Aluminum temperature	ε of polished surfaces	ε of smooth surfaces
360 to 500 °C	14%	30 to 36%
> 500 °C	14%	33 to 43%

5.2 Exposure Time (t_{90})

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 "0.00" position, the device operates using its time constant.

Settings:
off
0.01 s
0.05 s
⋮
10.00 s

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

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

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

Settings:
off
0.01 s
⋮
25 s
extern
auto

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

The maximum value storage value has two different operating modes:

Single Storage: The single storage is used when you want to reset the stored value using an external impulse via one contact closure from an external relay (i.e. between two measured objects). The relay contact is connected directly to the pyrometer between pins J and K. This mode allows a new value to be established, after each impulse from the reset signal.

Double Storage: When entering the reset intervals via push buttons or PC interface the double storage mode is automatically selected. This mode utilizes two memories in which the highest measured value is held and is deleted alter-nately 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: Clear time "0.00": the storage is switched off and only momentary values are measured.

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.

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 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.

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

5.5 Analog Output (0 / 4 mA)

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

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

5.6 SETP (limit contacts)

The instrument is equipped with two independent relay limit switches. These are two separate switch-over relay contacts, adjustable to any temperature of the pyrometer's temperature range. The switch-status is indicated in the display with the LED's S1 and S2. When the measuring temperature exceeds the adjusted limit contact temperature the relay switches and the LED indication is on.

5.7 Temperature display in °C or °F

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

Settings:
°C
°F

5.8 Digital Inteface (RS)

Selection between RS232 and RS485 (this adjustment can only be done on the pyrometer).

Settings:
RS232
RS485

5.9 Address

Settings:
00
⋮
97

For the connecting of several pyrometers with RS485 with one serial interface it is necessary to give each instrument an individual address for communication. First, it is necessary to connect each single instrument to give it an address. After that, all instruments can be connected and addressed individually. 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).

5.10 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:
2.4 kBd
⋮
115.2 kBd

5.11 Test Current Output (10 mA)

The test function activates a test current of 10 mA on the analog output, independently if the instrument is adjusted to 0 ... 20 mA or 4 ... 20 mA. This enables to test external indicators for correct scaling. The reading of the internal indicator should correspond to the reading of the external indicator. If both displays show different readings the external indicator has a wrong temperature range or input current setting. The test function is switched off automatically after 1 minute and the instrument is working in the measuring mode.

5.12 Wait Time

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

Settings:
00 Bit
⋮
99 Bit

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

5.13 Switch Contact

The pyrometer is equipped with a built-in switch contact which allows you to use the pyrometer 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 ³ 1 s (see **Section 5.3 tCL / s (clear times of the maximum value storage**)). If the temperature exceeds 2 °C min. or 1% of the span of the temperature sub range above its minimum temperature, the supply voltage (pin K) is connected to pin J.

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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, 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 **5.9 Device 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.

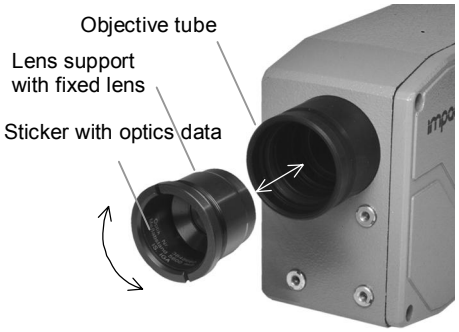
Attention: NEVER CLEAN THE WINDOW WITH A DRY TISSUE OF ANY KIND! The only time dry lens tissue may be used is to dry a window which has already been cleaned with wet lens tissue.

7.2 Changing of optics

The pyrometers are equipped with one optics which can be replaced by optics of the same type (dependent on the measuring range). For that reason optics for different measuring distances can be used without recalibration of the instrument. Replacement can be necessary if the lens is scratched or if the pyrometer will be used for another measuring distance.

Optics replacement:

A suitable objective wrench is required to replace the optics. The replacement optics consists of the lens support and a fixed lens. A sticker with the optics data is glued inside the lens support



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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
- Incorrect focusing of the optics
  ⇒ Focus correctly to the measuring distance, if necessary change lens
- Measuring object smaller than spot size
  ⇒ Change lens and 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 or pyrometer with scanning system with max. value storage
- Emissivity set too high
  ⇒ Set lower correct emissivity corresponding to the material
- Lens contaminated or scratched
  ⇒ Clean lens carefully or replace it

Temperature indication too high

- Emissivity set too low
  ⇒ Set lower correct emissivity corresponding to the material
- The measurement is influenced by reflections of hot machine parts
  ⇒ Use mechanical construction to avoid the influence of the interfering radiation (sighting tube)

Measuring errors

- Indicated temperature is decreasing during the use of the pyrometer, contamination of the lens
  ⇒ Clean lens. Recommendation: use of air purge
- Indicated temperature is decreasing during the use of the pyrometer, although the air purge unit is used. Probably compressed air is not clean or air failed
  ⇒ Clean the lens and use clean, dry and oil free compressed air
- Air contamination in the sighting path between pyrometer and object
  ⇒ Change position of the pyrometer with a clean sighting path or use a ratio pyrometer
- HF-interferences
  ⇒ Correct the connection of the cable shield
- 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 temperature above 55 °C. Use cooling jacket.

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9 Data format UPP (Universal Pyrometer Protocol)

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

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

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

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

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

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

Description	Command	Parameters
Reading temperature value:	AAms	Output: XXXXX (dec., in $^{1}/_{10}$°C or °F) last digit is the decimal place (88880 = Temp.-Overflow)
Reading temperature value repeated:	AAmsXXX	XXX = 000…999 (XXX = number of measuring values)
Reading basic temperature range:	AAmb	Output: XXXXYYYY (hex 8-digit, °C or °F) XXXX = beginning of temp. range YYYY= end of temp. range
Reading temperature sub range:	AAme	same as mb
Reading emissivity:	AAem	Output: XXXX (dez. 0010 … 1000 in ‰)
Emissivity:	AAemXX	XX = (10…99%), 00 = 100% (decimal)
Emissivity:	AAemXXXX	XXXX = (0010 … 1000‰) (decimal)
Exposition time t_{90}:	AAezX	X = 0 … 6 (decimal) 0 = intrinsic time constant 1 = 0.01 s 3 = 0.25 s 5 = 3.00 s 2 = 0.05 s 4 = 1.00 s 6 = 10.00 s
External deletion:	AAlx	Simulation of an external deletion contact
Delete maximum value:	AAlzX	X = 0 … 8 (dez.) 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
Setting of temperature sub range:	AAm1XXXXYYYY	XXXX (hex 4-digit) beginning of temp. range (°C) YYYY (hex 4-digit) end of temp. range (°C)
Analog output:	AAasX	X = 0 or 1; 0 = 0 to 20 mA 1 = 4 to 20 mA

Description	Command	Parameters
Limit contact 1:	AAs1XXXX	XXXX = switch point limit contact 1 (ASCII-hex, 4 digit, full degree in °C or °F)
Limit contact 2:	AAs2XXXX	XXXX = switch point limit contact 2 (ASCII-hex, 4 digit, full degree in °C or °F)
Setting hysteresis of limit contacts:	AAhlXX	XX = 2 … 20, full degree in °C or °F
Changing °C / °F	AAfhX	Output: X = 0: display in °C; X = 1: display in °F
interface type:	AAin	Output: X = 1 or 2; 1 = RS232, 2 = RS485
Changing address:	AAgaXX	XX = (00 ... 97) 00 ... 97 = regular device addresses 99 = Global address with response 98 = Global address without response (only setting commands!)
Changing baud rate:	AAbrX	X=0...6 or 8 (dez.) 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
Wait time:	AAtwXX	XX = 00 ... 99 (decimal)
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
Lock keyboard:	AAlkX	X = 0 ... 3 1 = lock lk1, removal with command lk0 or power off-on 0 = removal of lock lk1 3 = continuous lock lk3, removal only with command lk2 2 = removal of lock lk3
Reading parameters:	AApa	Output decimal 11-digit: Digit 1 und 2 (10...99 or 00): e Digit 3 (0 ... 6): t_{90} (Exposition time) Digit 4 (0 ... 8): t_{CL} (max. storage clear mode) Digit 5 (0 ... 1): Analog output Digit 6 und 7: (00 ... 98): Temperature Digit 8 und 9 (00 ... 97): Address Digit 10 (0 ... 6 or 8): Baud rate Digit 11 (0): always 0
Laser targeting light:	AAlaX	X = 0 switch off laser X = 1 switch on laser 
Internal temperature:	AAgt	Output: XX (dez. 00 ... 98, in °C) XXX (dez. 032 ... 208 °F)
Max. internal temperature:	AAtm	Output: XX (dez. 00 ... 98, in °C) XXX (dez. 032 ... 208 °F)
Ref. number:	AAbn	Output: XXXXXX (hex 6-digit)
Serial number:	AAsn	Output: XXXX (hex 4-digit)
Device type:	AAna	Output: "IS 12-Al" or "IS 12-Al/S" (16 ASCII-characters)
Device type / software version:	AAve	Output: XXYYZZ (6-digit decimal) XX = 07 (IS 12-Al and S 12-AL/S) 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

Note: the letter "l" means the small type of "L"

10 Reference numbers

10.1 Reference numbers instruments

3 840 200 350 ... 900 °C (MB 9) with view finder and targeting light

3 840 210 350 ... 900 °C (MB 9) with view finder and targeting light and built-in scanner

3 840 220 400 ... 1050 °C (MB 10.5) with view finder and targeting light

3 840 230 400 ... 1050 °C (MB 10.5) with view finder and targeting light and built-in scanner

Ordering note: When ordering, please select one optics (included in delivery) (see **Section 3.3 Optics**). A connection cable and additional cable for limit contacts is not included in scope of delivery and has to be ordered separately.

10.2 Reference numbers accessories

3 848 610 Exchangeable fixed optics 1
3 848 620 Exchangeable fixed optics 2
3 848 630 Exchangeable fixed optics 3
3 848 640 Exchangeable fixed optics 4
3 848 650 Exchangeable fixed optics 5
3 848 660 Exchangeable fixed optics 6
3 848 670 Exchangeable focusable optics 1
3 848 680 Exchangeable focusable optics 2
3 848 690 Exchangeable focusable optics 3
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
3 820 740 Connection cable, length 5 m, 90° connector, temperature resistant up to 200 °C
3 821 120 Additional cable for limit contacts, 5 m
3 821 130 Additional cable for limit contacts, 10 m
3 821 140 Additional cable for limit contacts, 15 m
3 821 150 Additional cable for limit contacts, 20 m
3 821 160 Additional cable for limit contacts, 25 m
3 821 170 Additional cable for limit contacts, 30 m
3 821 200 Additional cable for limit contacts, 5 m, temperature resistant up to 200 °C
3 852 290 Power supply NG DC for DIN rail mounting; 100 to 240 V AC ⇒ 24 V DC, 1 A
3 852 540 Power supply NG 0D; 85...265 V AC, 24 V DC 600 mA
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
3 826 510 PI 6000: PID programmable controller, very fast, for digital IMPAC pyrometers
3 890 630 LDP 1224, LED display, large, height of digits 57 mm
3 826 720 USB-RS485 adapter cable, 1.8 m
3 852 580 Converter USB 2.0 ⇔ RS232

3 852 600	Converter USB ⇔ RS485, Stick (NienTech USB-Nano)
3 835 060	Air purge
3 837 200	Cooling plate
3 837 210	Cooling jacket
3 834 330	Ball and socket mounting
3 834 140	Ball and socket mounting (steel) for rough ambience or cooling jacket
3 843 260	Rotary mirror attachment ROT 10

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