LUMASENSE®
TECHNOLOGIES

MANUAL

IMPAC Pyrometer
IN 6/78-L • IN 6/78-H

LUMASENSE
TECHNOLOGIES
IMPAC IN 6/78-L

24V DC
4...20 mA

RS 485

Art.No. 3 906 010
Range 400 ...1100 °C
Ser.No. 0092

CE

certified
ISO 9001
zertifiziert

Contents

2 Introduction

2.1 Appropriate use

The IMPAC IN 6/78 is a stationary and reliable pyrometer created for non-contact temperature measurement of sub milimeter thin glass surfaces with temperature ranges between 150 and 1100 °C.

The version IN 6/78-L is equipped with optics with a better field of view for the measurement of small objects and covers a range from 400 to 1100 °C.

The version IN 6/78-H has a shorter exposure time and is suited for fast measuring tasks. It covers a range from 150 to 800 °C.

2.2 Scope of delivery

Instrument, PC measurement and evaluation software *InfraWin*, works certificate, and an operation manual.

Note: A connection cable is not included with the instrument and has to be ordered separately (see Chapter **8, Reference numbers**).

2.3 Technical Data

Temperature range:	IN 6/78-L: 400 … 1100 °C IN 6/78-H: 150 … 800 °C
Sub range:	Adjustable to any range within the temperature range. Min. span is 51 °C

Spectral range:	7.8 µm (FWHM: 0.6 µm)
Optics:	Silicon

Power supply:	24 V DC (18 to 30 V DC) nominal, ripple must be less than 0.5 V
Power consumption:	Max. 50 mA
Analog output:	Adjustable, 0 to 20 mA or 4 … 20 mA (linear)
Load:	Max. 500 Ohm
Digital Interface:	RS485 (half-duplex)
RS485 Bus Address:	Set via digital interface
RS485 Baud Rate:	1200 Bd to 115.2 kBd
Resolution:	0.1 °C on interface; < 0.1% of temperature range at the analog output
Isolation:	Power supply, analog output, and digital interface are electrically isolated from each other

Parameters:	Adjustable via interface: InfraWin 4.14s or higher or InfraWin 5: Emissivity ε, transmittance τ, exposure time t_{90}, 0/4 to 20 mA analog output range, sub temperature range, automatic clearing of the max. value storage, external clearing of the max. value storage, clear times of the max. value storage, address, baud rate, internal temperature, °C / °F
Emissivity ε:	10.0 to 125.0% adjustable via interface in steps of 0.1%
Transmittance τ:	10.0 to 100.0% adjustable via interface in steps of 0.1%

Exposure time t_{90}:	IN 6/78-L: 80 ms; adjustable to 0.5 s; 1 s; 2 s; 5 s; 10 s; 30 s
	IN 6/78-H: 30 ms; adjustable to 0.5 s; 1 s; 2 s; 5 s; 10 s; 30 s

Maximum / minimum value storage:	Built-in single or double storage. Clearing with clear time t_{clear} (off; 0.1 s; 0.25 s; 0.5 s; 1 s; 5 s; 25 s), via interface or automatically with the next measuring object

Measurement Uncertainty: (with ε =1, t_{90}=1 s)	0.7% of reading or 3.5 °C, whatever is greater, in °C
	(T_{amb} = 44 °C)
	(Note: the pyrometer must be operate at least 30 min before these values are valid)

Repeatability: (ε =1, t_{90}=1 s)	1 °C			
	(Note: the pyrometer must be operate at least 30 min before these values are valid)			
Noise Equivalent Temperature Difference (NETD) $\sigma = 1$ ($\varepsilon = 1$, $T_{amb.} = 44$ °C)	IN 6/78-L	Temperature	NETD/°C at t_{90} = 80 ms	NETD/°C at t_{90} = 1 s
		500 °C	0.3	0.1
		800 °C	0.3	0.1
	IN 6/78-H	Temperature	NETD/°C at t_{90} = 30 ms	NETD/°C at t_{90} = 1 s
		200 °C	0.9	0.2
		500 °C	0.5	0.1

Protection class:	IP 65 IEC 60529 (value in mated condition)
Operation position:	Any
Operating temperature on housing surface:	0 to 70 °C
Storage temperature:	-20 to 80 °C
Rel. humidity:	Non-condensing conditions
Weight:	410 g
Housing:	Stainless steel
Connector:	12-pin connector

Sighting:	None
CE-label:	According to EN directives about electromagnetic immunity

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.

2.3.1 Dimensions
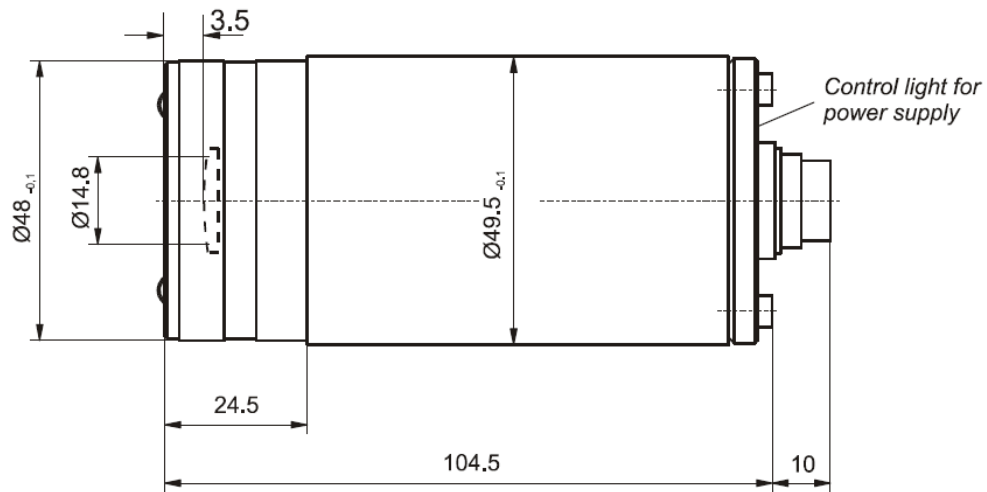
2.4 Physical User Interface
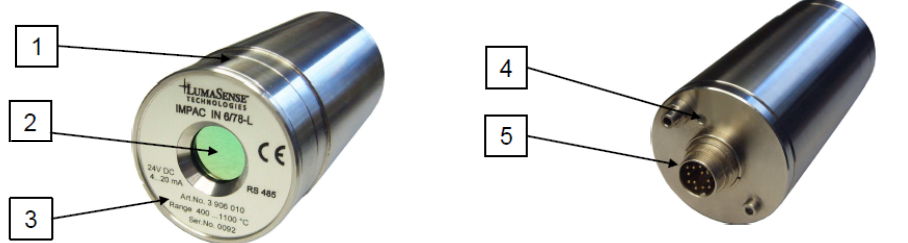
1	Stainless steel housing	**4**	Control light for power supply
2	Optics	**5**	Electrical connector
3	Type label		

2.5 Accessories (Optional)

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

2.5.1 Mounting

For easy mounting and aligning the pyrometer to the measured object an adjustable mounting angle is available.
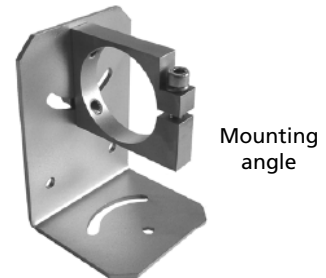
Mounting angle

2.5.2 Cooling

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 with integrated air purge

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

Air purge units   Vacuum support

2.5.4 Displays

For temperature indication of the pyrometer LumaSense offers several digital displays which can also be used for remote parametrizing (DA 6000) of the pyrometer.

Digital display DA 6000

LED large display

3 Controls and Connections

3.1 Electrical Installation

Series 6 pyrometers are powered by a voltage of 24 V DC nominal (possible range 18 to 30 V DC, ripple < 0.5 V). It is important to ensure correct polarity when connecting the device to the power supply. The length of the 24 V supply line should not be longer than 30 m. Hence the use of 24 V site internal supply network is also not recommended. This length restriction does not apply for the analog and digital signal lines.

To meet the electromagnetic requirements (EMV), a shielded connecting cable must be used. LumaSense offers connecting cables, which are not part of the standard scope of delivery. The shield of the connecting cable has to be connected only on the pyrometer's side. If the connecting cable is extended, the shield of the extension also needs to be extended. The shield must be open on the power supply side (switch board), to avoid ground loops.

The connecting cable has wires for the power supply, interface, analog output, external laser switch, and external clear of maximum value storage via contact and 12 pin connector (see Chapter **8**, **Reference numbers**).The cable includes a short adapter cable with a 9-pin D-SUB connector. This connector may be used in combination with the RS485 to USB adapter.

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

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

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

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

Pin	Color	Indication
K	white	+ 24 V power supply
A	brown	0 V power supply
L	green	+ I_{out} analog output
B	yellow	– I_{out} analog output
H	gray	nc
J	pink	nc
G	red	nc
F	black	B1 (RS485)
C	violet	A1 (RS485)
D	gray/pink	B2 (RS485)
E	red/blue	A2 (RS485)
M	orange	Screen only for cable extension, don't connect at the switchboard

Connector

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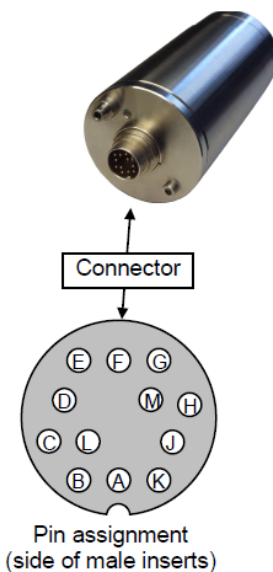
3.2 Connecting the pyrometer to a PC

The pyrometer is equipped with a 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 a RS485 connection is not available at the PC, it can be accomplished using the RS485 to USB connector. When using a RS485 to USB adapter, make sure that the adapter is fast enough to receive the pyrometer's answer to an instruction of the master. Most of the commonly used adapters are too slow for fast measuring equipment, so it is recommended to use the USB to RS485 adapter cable, HS-version (ref. no. 3 826 750).

3.2.1 Connecting to RS485 interface / baudrate

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 maximum transmission rate of the serial interface in Baud (Bd) is dependent on the length of the cable. Values between 1200 and 115000 Bd may be set.
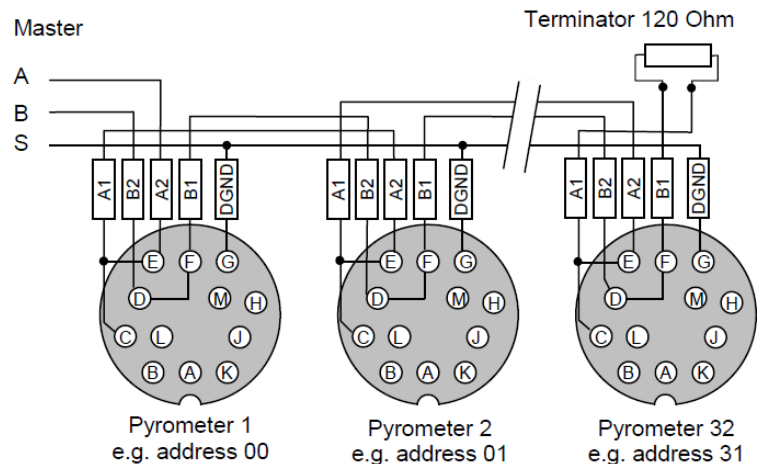
The baud rate has to be reduced by 50% when the transmission distance is doubled (see 4.7 Baud rate). Typical cable length for 19200 Bd is 2 km.

3.2.2 Connecting additional analyzing devices

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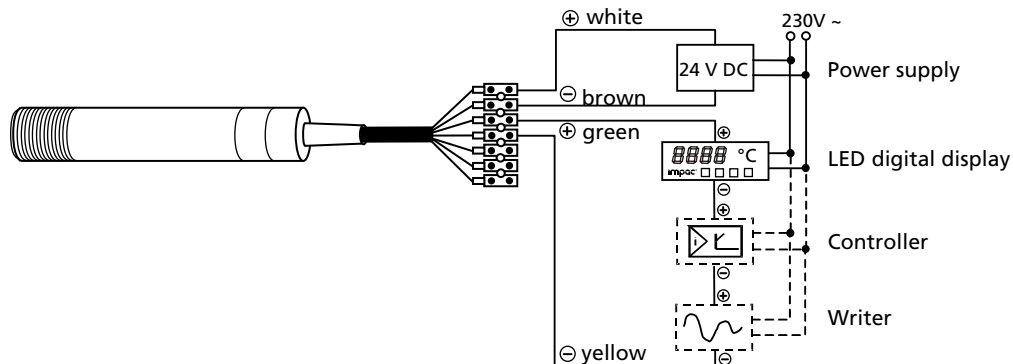
3.3 Sighting

For exact measurement of the object temperature the pyrometer must be aligned correctly onto the object. Pyrometers without sighting are normally used for measurement of bigger objects for which exact alignment is not absolutely necessary. These pyrometers can be aligned only with the thermal method.

3.3.1 Thermal Alignment

When measuring a hot object in front of a cooler background, it is usually sufficient to align the pyrometer with the hottest spot on the object to achieve the highest temperature reading.

3.4 Optics

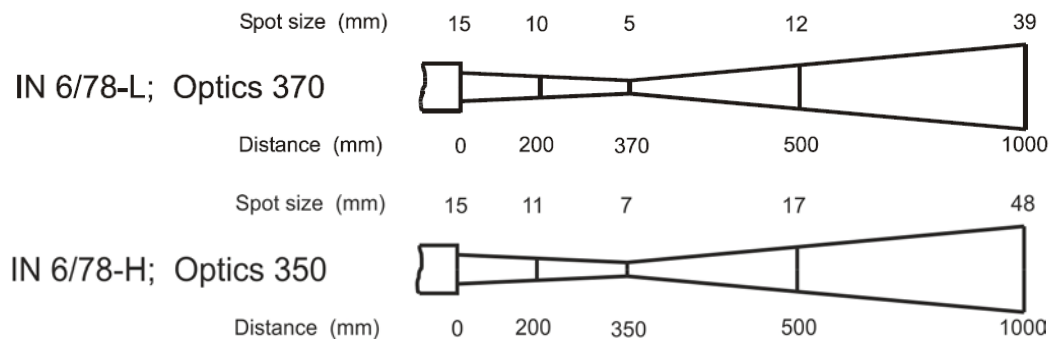The pyrometer is equipped ex works with the following optics. The spot size will enlarge in any other distance (shorter or longer). Please notice that the measuring object must be at least as big as the spot size. The following drawing shows the size of the spot in mm in dependence of the measuring distance. Values between the mentioned data can be calculated by interpolation. The spot size for measuring distance 0 is the aperture diameter of the optics.

Spot size (mm)	15	10	5	12	39

IN 6/78-L; Optics 370

Distance (mm)	0	200	370	500	1000

Spot size (mm)	15	11	7	17	48

IN 6/78-H; Optics 350

Distance (mm)	0	200	350	500	1000

Note: Please note that the optical profiles show nominal dimensions. The spot size diameter or the focal distance may be slightly different due to lens tolerances.
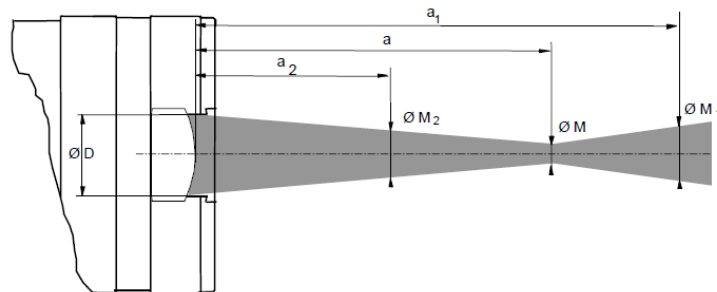
Note: The InfraWin program includes a Spot size calculator that roughly estimates the unknown values. The values represented here are for reference purposes.

Spot sizes for intermediate distances that are not shown on the optical profiles, may be calculated using the following formula:

$$M_2 = \frac{a_2}{a}(M - D) + D$$

$$M_1 = \frac{a_1}{a}(M + D) - D$$

3.5 Avoiding reading errors caused by faulty assembly

To avoid reading errors, please note the following points when mounting the pyrometer:

1. The diameter of the measuring object cannot be smaller than the pyrometer's *spot size* (see section **3.4**, **Optics**).

2. A source of radiation behind or around the measuring object can influence the result. If the object is transparent or partly transparent, another material behind the object could transmit its radiation to the pyrometer as well. In this case, the location of the pyrometer should be changed, or, if the background radiation remains constant it can be compensated for by changing the emissivity setting respectively.

3. Please take into account that radiation from other hot surfaces around the measured object can be reflected by the target and influence the result. If the measured object has a low emissivity, the temperature measured will be mainly that from the reflected object - not from the intended measured object itself. To prevent ambient radiation from reaching the spot area, a mounting tube should be used. The mounting tube should be placed as near as possible to the measured object so that the tube's shadow blocks out all the ambient radiation from the side. Consider whether 4.9 **Ambient temperature compensating** applies to the measurement application.

4 Settings / parameter descriptions

Before using the pyrometer some basic settings should be taken. The basic settings can be done via interface and software InfraWin.

Settings via serial interface: The pyrometer is equipped with a serial interface RS485 which can be used for connection to a PC. With the standard software InfraWin (or a self written communication software) the following settings can be done, to use this functions, emissivity, transmittance, exposure time, analog output, maximum value storage, minimum value storage, reading of the instrument's internal temperature, setting of an address for bus control with RS485 interface, setting of the baud rate, function for compensating of the off-set of the ambient temperature). Additionally, InfraWin enables the temperature display and analysis.

4.1 Factory settings

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

Emissivity (ϵ) = 100%

Transmittance (τ) = 100%

Exposure time (**t$_{90}$**) = IN 6/78-L: 0.08 s (min)

IN 6/78-H: 0.03 s (min)

Analog output (**out**) = 4 ... 20 mA

Baud rate = 19200 Bd

Address = 00

Max./min. value storage = max.

Clear time of max./min. value storage = OFF

Ambient temperature compensation = auto

Wait time t_w = 10

IN 678-L. S/N: 92				
Material	(mat.txt)	---------------------------- ▼	Edit	
Emissivity	ϵ = 100.0 %	Trans.	τ = 100.0 %	
Emi: Auto. find				
Response time	t90 =	min. ▼	Clear time tCL =	OFF ▼
Unit		⦿ °C ○ °F		⦿ max ○ min
New address		00 ▼	New baud rate	19200 ▼
Analog output	out	4...20 mA ▼		
Ambient temperature compensation		⦿ Auto. ○ Man.		
Basic range	[°C]	400 ... 1100		
Sub range	[°C]	400 ... 1100		
Operating hours		108		

4.2 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 (this is an object which absorbs all incoming rays and has an emissivity of 100%) at the same temperature. Different materials have different emissivities ranging between 0% and 100% (settings at the pyrometer between 10 and 125%). Additionally the emissivity is depending on the surface condition of the material, the spectral range of the pyrometer and the measuring temperature. The emissivity setting of the pyrometer has to be adjusted accordingly. Typical emissivity value of glass is listed below. The tolerance of the emissivity value for each material is mainly dependent on the surface conditions. Rough surfaces have higher emissivities.

Settings:
125%
.
.
.
10%

(i) Note: The minimum emissivity setting for the pyrometer is 10%.

Measuring object	Emissivity (at 7.8 µm)
Glass	98%

One way to determine an accurate emissivity value for a material is to make a comparison measurement as follows: If possible, coat a portion of the object with dull black paint or carbon soot. Paint and carbon soot have high emissivity (95%) and take on the same temperature as the object. Measure the temperature of the painted area with the emissivity control set to 95%. Then measure the temperature of an adjacent unpainted area of the object and adjust the emissivity until the pyrometer displays the same temperature.

4.3 Transmittance τ

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

4.4   Analog output

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

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

Note: Settings for Analog Output: 0 to 20 mA or 4 to 20 mA 0 to 20 mA/21 Low or 4 to 20 mA/21 Low (setting /21 Low = Analog Out shows 21 mA if signal intensity falls below Switch-Off level).

4.5   Maximum / minimum value storage

If the maximum value storage is switched on, the last highest temperature value will always 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
0.1 s
0.25 s
0.5 s
1 s
5 s
25 s
extern
auto

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

The following settings are possible:

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

0.1...25 s: If any clear time between 0.1 s and 25 s is set (0.1 s, 0.25 s, 0.5 s, 1 s, 5 s, 25 s), the maximum value is estimated and held in **double storage** *mode.* After the entered time the storage will be deleted.

Extern: The external clearing can be activated and used within your own software using the clear command "lx" (see Chapter **7**, **Data format UPP**). In this case, the storage operates only in single storage because only a single deletion mechanism is used.

Auto: The **auto** mode is used for discontinuous measuring tasks. For example, objects are transported on a conveyer belt and pass the measuring beam of the pyrometer for only a few seconds. In this case, the maximum value for each object has to be indicated. In this mode the maximum value is stored until a new hot object appears in the measuring beam. The temperature which has to be recognized as **hot** is defined by the low limit of the adjusted sub range. The stored maximum value will be deleted when the temperature of the new hot object exceeds the low limit **from** of the sub range by 1% or at least 2 °C. If a lower limit is not entered, the maximum value storage will be deleted whenever the lower level of the full measuring range has been exceeded.

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

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

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

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

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

4.6 Subrange

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

Also when setting the subrange, it is possible to fulfill the requirements of the "auto" clear mode of the maximum value storage (see **4.5 Maximum/minimum value storage**).

4.7 Baud Rate

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

Settings:
1200 bd
.
.
.
115000 bd

4.8 Address

When connecting several pyrometers to one serial interface with RS485, it is necessary for each instrument to have its own device address for communication purposes. First, it is necessary to connect each instrument separately to give it an address. After that, all instruments can be connected and addressed individually.

Settings:
00
:
97

ⓘ **Note: Only via own communication program with interface command** (not possible with InfraWin, because InfraWin automatically detects a connected pyrometer): If parameters should be changed simultaneously on all pyrometers, the global **Address 98** can be used. This allows you to program all pyrometers at the same time, regardless of the addresses that have already been assigned. If the address of a pyrometer is unknown, it is possible to communicate with it using the global **Address 99** (connect only one pyrometer).

4.9 Ambient temperature compensation

Each object has an emissivity ε (maximum 100%). If the measured object is not transparent and has an emissivity of less than 100% (as in most cases), a portion of the resulting radiation will be reflected. For bright, smooth surfaces, such as mirrors, the reflected radiation is more focused; on rough, harsh surfaces it is diffuse. The rate of diffuse reflection is, in this case (100% - ε).

If the measured object's temperature is the same as the ambient temperature (this is most often the case), you only need to set the emissivity on the pyrometer (when using the *InfraWin* program the off-set compensation for the ambient temperature must be in "auto". If the object to be measured is in an oven, where the temperature is higher than the ambient temperature, a portion of the radiation, corresponding to the rate of diffuse reflection, will be "reflected" by the measured object to the pyrometer, resulting in an inaccurate reading (the reading will be too high due to the oven temperature).

In this case, it makes sense to activate the off-set compensation for the ambient temperature (in the parameter window of the *InfraWin* program: Compensating for the off-set of the ambient temperature switched to "man." (= manual) and then enter the ambient temperature value (in this case, the oven temperature) in the corresponding field. The program also makes a compensation calculation in order to display the correct temperature.

Be aware that the accuracy of such a correction is highly dependent on accuracy of the emissivity value that was set. The off-set compensation for the ambient temperature uses the rate of diffuse reflection when performing its calculation. If you alter the emissivity (ε), you are also altering the rate of diffuse reflection (100% – ε) and in turn, the displayed temperature. The following observation shows how a faulty emissivity reading in conjunction with the compensation for the ambient temperature affects results:

> Entry of ε = 91% instead of 92% indicates:
> A relative change in emissivity of 1.1%.
> Likewise the assumed rate of reflection changes from 8% to 9%.
> This results in a relative increase in reflection of 12.5%.

This change also impacts the displayed result, thereby causing a fairly inaccurate compensation calculation. For hot environments, this calculation will probably serve as a much more accurate assessment than the standard calculation, which assumes that the ambient temperature is the same as that of the object measured.

4.10 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 an instruction of the master. In this case a wait time can be set to slow down the data transfer (e.g.: t_w = 02 at a baud rate 9600 means await time of $_{2/9600}$ sec).

Settings:
00 Bit
.
.
.
99 Bit

(i) **Note:** The pyrometer enters a waiting period after certain commands and may not respond right away because some commands have an internal processing time of up to 3 ms.

4.11 Internal Temperature of the Pyrometer

The internal temperature of the pyrometer can be read via interface. It is a few degrees above the ambient temperature due to the heat generated by the pyrometer electronics.

5 Software InfraWin

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

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

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

5.1 Connecting the pyrometer to a PC

The program InfraWin can operate up to two devices. Two devices using RS485 may be operated simultaneously by the same interface, if two different addresses have been properly entered (see section 4.8 Address for more information).

5.2 Installation

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

5.3 Program start

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

6 Maintenance

6.1 Safety

⚠️ **Attention during pyrometer services:** Should the pyrometer be integrated in a running machine process, the machine should be switched off and secured against restart before servicing the pyrometer.

6.2 Service

The pyrometer does not have any parts which require regular service, only the lens has to be kept clean. The lens can be cleaned with a soft cloth in combination with alcohol (do not use acid solutions or dilution). Also standard cloths for cleaning glasses or photo objectives can be used.

7 Data format UPP (Universal Pyrometer Protocol)

Via interface and suitable communication software or via **Test** function of the *InfraWin* software (see Section 5.4 **Basic settings**) commands can be exchanged directly with the pyrometer.

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

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

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

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

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

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

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

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

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

Description	Command	Parameters
Reading measuring value:	AAms	Output: YYYYY 　　　5-digit decimal, in $1/10$°C or. °F 　　　88880 = temp. overflow 　　　02563 = 256.3 °C or °F
Emissivity:	AAemXXXX	XXXX = (0100 ... 1250%) (decimal)
Transmittance:	AAetXXXX	XXXX = (0100 ... 1000%) (decimal)
Exposure time t_{90}:	AAezX	X = 0 ... 6 (decimal) 0 = intrinsic time constant of the device 1 = 0.5 s　　3 = 2 s　　5 = 10 s 2 = 1 s　　　4 = 5 s　　6 = 30 s
Analog output*:	AAasX	X = 0 or 1　　　0 = 0 … 20 mA; 1 = 4 … 20 mA
Clear time of maximum / minimum value storage:	AAlzX	X = 0 ... 8 (decimal) 0 = Maximum value storage off 1 = 0.10 s　　4 = 1.00 s　　7 = externally deleted 2 = 0.25 s　　5 = 5.00 s　　8 = automatically deleted 3 = 0.50 s　　6 = 25.00 s
External clearing:	AAlx	Delete maximum storage value (only active with lz=7)
Changing °C / °F *:	AAfhX	X = 0;1 (decimal) 　　0 = Output Celsius 　　1 = Output Fahrenheit

Description	Command	Parameters

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

Reading temperature sub range:	AAme	as with mb
Repeatedly reading measuring values:	AAmsXXX	XXX = 000 to 999 XXX = No. of measuring values

Error status:	AAfs	Output 1 Byte hex
		    Bit 0 = 1: EEPROM error
		    Bit 1 = 1: Watch dog Reset
		    Bit 2 = 1: Under voltage reset

Reading parameters:	AApa	Output 11-digit decimal:
		    Digit 1 and 2 (10 to 99 or 00): emissivity
		    Digit 3 (0 to 6): t_{90} (exposure time)
		    Digit 4 (0 to 8): t_{CL} (storage delete mode)
		    Digit 5 (0 to 1): analog output
		    Digits 6 and 7 (00 to 99): temperature
		    Digits 8 and 9 (00 to 97): address
		    Digit 10 (0 to 6 or 8): baud rate
		    Digit 11 always 0

Device address*:	AAgaXX	XX: Device address decimal 00 to 97 variable device addresses 98 = global address without response (only setting commands!) 99 = global address with response
Baud rate:	AAbrX	X = 0 to 6 or 8 (dec.) 0: 1200 Bd 3: 9600 Bd 6: 57600 Bd 1: 2400 Bd 4: 19200 Bd 7: not allowed 2: 4800 Bd 5: 38400 Bd 8: 115200 Bd
Internal pyrometer temperature:	AAgt	Output: XXX (dec. 000 ... 099 °C, 032 ... 210 °F)
Max. internal pyrometer temperature:	AAtm	Output: XXX (dec. 000 ... 099 °C, 032 ... 210 °F)
Reset*:	AAre	Reset device
Command delay:	AAtwXX	XX = 00 to 99 relative delay value
Reading ambient temperature:	AAut	Output: stored value, 4-digit hex e.g. 0258 corresponds to 600 degrees
Entering ambient temperature:	AAutXXXX	XXXX = value of ambient temperature, 4-digit, hex XXXX e.g. FFEC corresponds to –20 degrees - 99$_{dez}$ = FF9D$_{hex}$ means: automatic, no manual compensation
Marginal values for ambient temperature:	AAut?	Output: marginal values for the entry, 2 x 4-digit, hex e.g. FF9D0384 corresponds to -99 to 900 degrees
Reading maximum/minimum values:	AAmi	Output: 0 or 1 0 = maximum value, 1 = minimum value
Setting of maximum/minimum values:	AAmiX	X = desired setting 0 = maximum value, 1 = minimum value

Description	Command	Parameters
Reading marginal values:	AAmi?	Output: marginal value for entry, always 01
Device type:	AAna	Output: "IN 6/78-L" or "IN 6/78-H" (16 ASCII-characters)
Serial number:	AAsn	Output: XXXXX (5-digit decimal)

Description	Command	Parameters
Reference number:	AAbn	Output: XXXXXX (6-digit hex)
Device model/ Software version:	AAve	Output: XXYYZZ (6-digit decimal) XX = 79 (IN 6/78) YY = month of the software version ZZ = year of the software version

Note: the letter "l" means the lower case letter of "L".
* After entering these commands the device carries out an automatic reset. The device needs approx. 150 ms before it is ready to use and work with the changed settings.

Additional instructions for the RS485 interface:
Requirements to the master system during half-duplex operation:

1. After an inquiry, the bus should be switched into a transmission time of 3 bits (some older interfaces are not fast enough for this).

2. The pyrometer's response will follow after 5 ms at latest.

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

8 Reference numbers

8.1 Reference numbers instrument

Type	Temperature Range	Reference Number
IN 6/78-L	400 ... 1100 °C	3 906 010
IN 6/78-H	150 … 800 °C	3 906 900

Ordering note:

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

8.2 Reference numbers accessories

3 820 740   Connection cable, length 5 m, temperature resistant up to
200 °C, straight connector, 12 pin

3 820 330   Connection cable, length 5 m, straight connector, 12 pin
3 820 500   Connection cable, length 10 m, straight connector, 12 pin
3 820 510   Connection cable, length 15 m, straight connector, 12 pin
3 820 810   Connection cable, length 20 m, straight connector, 12 pin
3 820 820   Connection cable, length 25 m, straight connector, 12 pin
3 820 520   Connection cable, length 30 m, straight connector, 12 pin

3 820 340   Connection cable, length 5 m, 90° connector, 12-pin
3 820 530   Connection cable, length 10 m, 90° connector, 12-pin
3 820 540   Connection cable, length 15 m, 90° connector, 12-pin
3 820 830   Connection cable, length 20 m, 90° connector, 12-pin
3 820 840   Connection cable, length 25 m, 90° connector, 12-pin
3 820 550   Connection cable, length 30 m, 90° connector, 12-pin

3 852 290   Power supply NG DC for carrier rail mounting housing
(100 ... 240 V AC, 50 ... 60 Hz $\Rightarrow$ 24 V DC, 1 A)
3 852 540   Power supply NG 0D (85...265 V AC $\Rightarrow$ 24 V DC, 600 mA)
3 852 550   Power supply NG 2D carrier rail mounting housing
(85 ... 265 V AC $\Rightarrow$ 24 V DC, 600 mA, with 2 limit switches)
3 826 750   USB to RS485 adapter cable, HS-Version, 1.8 m long

3 852 440   Protocol converter RS485 (switchable) $\Leftrightarrow$ Profibus-DP for 1 instrument
3 852 460   Protocol converter RS485 $\Leftrightarrow$ Profibus-DP for 32 instruments
3 852 620   Protocol converter UPP RS485 or RS232 <-> ProfNet, for 1 pyrometer
3 852 630   Protocol converter UPP RS485 <-> ProfNet, for max. 32 pyrometers

3 890 650   DA 4000: LED-display, 2-wire power supply, 2 limit switches (relay contacts),
230 V AC
3 891 220   DA 4000: LED-display, 2-wire power supply, 2 limit switches (relay contacts),
115 V AC
3 890 570   DA 6000-N: digital display, to allow adjustment of Pyrometer through
RS485 interface
3 890 530   DA 6000: like the DA 6000-N, but with analog input and 2 limit switches for
the RS485 interface

3 826 500	HT 6000: portable battery driven indicator and instrument for pyrometer parameter settings; RS232 / RS485
3 826 510	PI 6000: PID programmable controller, very fast, for digital IMPAC pyrometers
3 846 100	Mounting tube
3 846 120	Flange tube
3 834 210	Adjustable mounting support
3 385 160	Air purge unit
3 835 440	Air purge unit, stainless steel
5 837 410	Cooling jacket for IN 6/78
3 837 540	Cooling plate for series 5 and 6, with air purge