



MANUAL

IMPAC Pyrometer
ISR 6-TI Advanced



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2 Introduction

2.1 Appropriate use

The IMPAC ISR 6-TI Advanced pyrometer is a stationary, digital pyrometer for non-contact temperature measurement of metals, ceramics, graphite, etc. in ranges between 700 and 1800 °C. It consists of the high-quality, 2-color ratio pyrometer, ISR 6 Advanced with a built-in video camera system. The video camera has an infrared filter with a wavelength close to the wavelength range of the pyrometer. This makes it possible to display a "simple" thermal image using the standard pyrometer Software, InfraWin.

The thermal image is not absolutely calibrated, but only relative on the accurate temperature reading of the ratio pyrometer.

The ISR 6-TI measures in 2-color mode (ratio principle) in which two adjacent wavelengths are used to calculate the temperature. This technique offers the following advantages when compared with standard one-color pyrometers:

- The temperature measurement is independent of the emissivity of the object in wide ranges.
- The measuring object can be smaller than the spot size.
- Measurements are unaffected by dust and other "grey" contaminants in the field of view or by dirty viewing windows.

The pyrometer can also be switched to 1-color mode and used like a conventional pyrometer. In addition, the pyrometer can also be operated in a special metal mode.



Note: The display of thermal images is only possible if pyrometer is operated in 2-color mode!

2.2 Scope of delivery

Pyrometer, Video Grabber, Video cable (5 m), PC adjustment, and evaluation software *InfraWin*, works certificate, and operating instructions.



Note: The ISR 6-TI Advanced can only be used with the video grabber and video cable that have been calibrated into the system by the factory. These parts will display the same serial number as the instrument.



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

Measurement

Temperature Range:	700 to 1800 °C (MB18)
Sub Range:	Any range adjustable within the temperature range, minimum span 50 °C
Spectral Ranges:	Channel 1: 0.9 µm, channel 2: 1.05 µm
Resolution:	0.1 °C or 0.2 °F at interface; < 0.0015% of selected sub range at analog output, min. 0.1 °C, 16 bit; 1 °C or 1 °F on display
Emissivity ε:	0.050 to 1.000 in steps of 1/1000 (1-color mode)
Transmittance τ:	0.050 to 1.000 in steps of 1/1000 (1-color mode)
Emissivity Slope K:	0.800 to 1.200 in steps of 1/1000 (2-color mode)
Measurement Uncertainty: (K = 1, t ₉₀ = 1 s, T _{amb.} = 25 °C)	< 1500 °C: 0.3% of reading in °C + 2 °C > 1500 °C: 0.6% of reading in °C
Repeatability: (K = 1, t ₉₀ = 1 s, T _{amb.} = 25 °C)	0.15% of reading in °C + 1 °C

Optics

Sighting:	Thermal Image with marked pyrometer spot
Optics:	Manually focusable from rear cover with measuring distance a = 210 to 5000 mm
Distance ratio:	Approximately 190 : 1

Environment

Protection Class:	IP 65 IEC 60529 (value in mated condition)
Operating Position:	Any
Ambient Temperature:	0 to 60 °C at housing
Storage Temperature:	-20 to 80 °C
Relative Humidity:	Non condensing conditions
Weight:	0.755 kg
Housing:	Stainless steel
CE-label:	According to EU directives about electromagnetic immunity



Note: During operation the instruments will warm up and might reach an intrinsic temperature of up to 58 °C.

Interface

Connection:	12-pin connector
Connection Video signal:	Separate triaxial contact at pyrometer for double screened signal transmission. Connection cable with BNC-connector on user's side
Display (in rear cover):	LED, 4 digit matrix, 5 mm high for 2-color or 1-color temperature signal or measuring distance
Parameters:	Adjustable via interface: 2-color / 1-color temperature signal, metal mode, accordingly emissivity slope or emissivity, temperature sub range, settings for maximum value storage, address, baud rate, switch off limit, warning level lens contamination monitoring system, transmittance, response time t ₉₀ , 0 to 20 mA or 4 to 20 mA analog output range, °C / °F. Readable via interface: measured value, internal temperature of the unit, measuring distance

Communication

Analog Output:	Adjustable via interface 0 to 20 mA; or 4 to 20 mA, linear
Digital Interface:	RS485 addressable (half-duplex) Baud rate: 1200 to 115.2 kBd (on request RS232, not addressable)
Video-Signal:	FBA5-Signal approx. 1 VSS on 75 Ohm, PAL (B), 50 Hz, CCIR656
Switch Off Limit:	2% to 50% (adjustable via interface)
"Dirty Window" Warning:	Relay contact, max. continuous current 0.4 A, setting of the warning level: 0 (off) to 99%
Exposure Time t_{90} :	<2 ms (with dynamical adaption at low signal levels); adjustable to min; 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), via interface, automatically with the next measuring object, external contact, hold-function

Electrical

Power Supply:	24 V DC $\pm$ 25%, ripple must be less than 50 mV If instrument is used in combination with an I/O module, a power supply with min. 1 A is required
Power Consumption:	Approximately 8.5 W
Load (analog output):	0 to 500 Ω
Isolation:	Power supply, analog output, digital interface, and video signal are electrically isolated from each other

Thermal Imaging Feature*

Relative temperature span in one image (depends on temperature):	100...200 °C distributed around the spot temperature (for one dynamic range) Combination of multiple ranges possible - thereby complete temperature range of pyrometer can be displayed.
Pixels:	768 x 576
Frequency (fps):	Up to 25 Hz
Signal:	Analog Video (PAL), USB (video grabber)
Field of view:	6.0° x 4.5° (e.g. 105 mm x 78 mm at 1000 mm distance)
Calibration of thermal image:	Relative to central pyrometer spot

*The thermal imaging function is only available if the pyrometer is operated in 2-color mode!

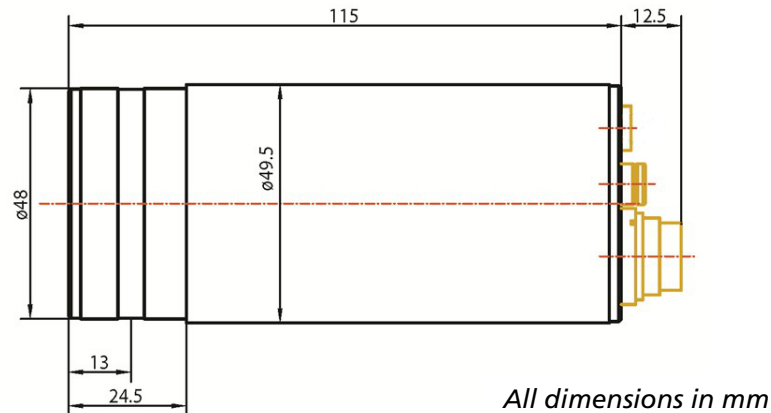
Note: The determination of the technical data of this pyrometer is carried out in accordance with VDI/VDE directive IEC TS 62942-2, "Determination of the technical data for radiation thermometers".



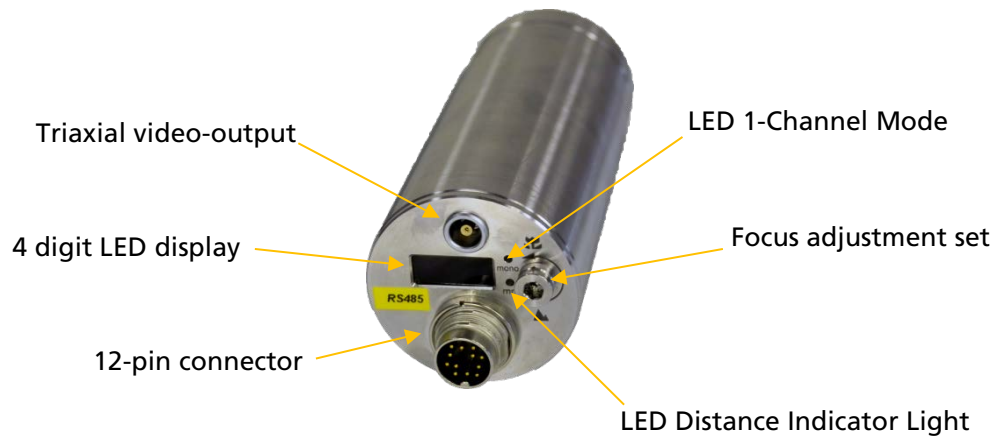
The calibration / adjustment of the instruments was carried out in accordance with VDI/VDE directive "Temperature measurement in industry, Radiation thermometry, Calibration of radiation thermometers", VDI/VDE 3511, Part 4.4.

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

2.4 Dimensions



2.5 Physical User Interface



Rear View of the Pyrometer

2.6 Thermal Image

The thermal image is used for aligning the pyrometer to the measuring object and to show the temperature distribution of the direct ambience of the spot. A comprehensive description of the available "thermal imaging functionality" is provided in section [5.4](#) (InfraWin).

2.7 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**.

2.7.1 Mounting

An adjustable mounting angle is available to easily mount the pyrometer and align it to the measured object.



2.7.2 Cooling Jacket

The completely covered water cooling jacket is made from stainless steel and serves to protect 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

2.7.3 Air Purge

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



2.7.4 Vacuum support

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



2.7.5 Flange System

The flange system is a modular mounting system to fix the pyrometer on furnaces, vacuum chambers, etc.

It can consist of e.g. mounting support, tube support with air purge and flange and an open ceramic sighting tube. The mounting support can be equipped with a quartz window for vacuum applications. It may consist of an equipment rack, flange, and an open or closed ceramic tube. The equipment rack can be equipped for vacuum applications with a fused silica.

3 Controls and Installation

3.1 Electrical Installation

The pyrometer is powered by 24 V DC $\pm$ 25% (very well stabilized, ripple max. 50 mV). 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.

If the instrument is used in combination with an I/O module (e.g. Ref. No. 3 826 770), a power supply with min. 1 A is required.

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.

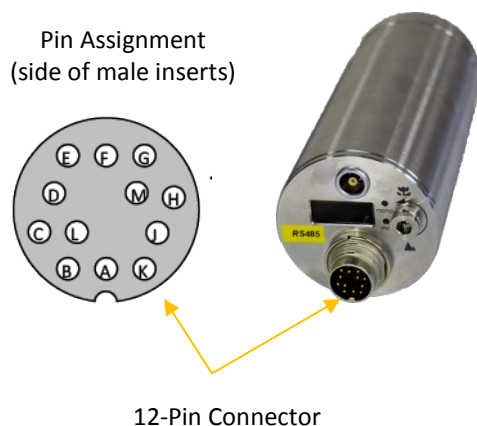
The connecting cable has wires for the power supply, interface, analog output, external laser switch, and external clearing of maximum value storage via contact and 12 pin connector. The cable includes a short adapter cable with a 9-pin D-SUB connector. This connector may be used in combination with the RS485 to USB adapter (Ref. No. 3 826 750).

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.



Warning: When connecting the power supply, ensure the polarity is correct.

3.1.1 Pin assignment of the connector



Pin	Color	Function
K	white	+24 V DC power supply
A	brown	0 V DC power supply
L	green	+ I _{out} . analog output
B	yellow	– I _{out} . analog output
H	gray	Targeting light activate / deactivate via external switch (bridged with K)
J	pink	External clearing of max. value storage (bridge to K), hold function, or output for "dirty window" monitoring (*see notes below)
G	red	DGND (GND for interface)
F	black	B1 (RS485) or RxD (RS232)
C	violet	A1 (RS485) or TxD (RS232)
D	gray/pink	B2 (RS485) (bridged with F)
E	red/blue	A2 (RS485) (bridged with C)
M	orange	Screen only for cable extension, don't connect to the switchboard

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

1. External clearing of the maximum value storage:

When the pyrometer is in operating mode, pin J can be used for external clearing of maximum value storage. When external clearing is selected from the t_{clear} dropdown menu, pin J is connected for a short time to pin K (power supply voltage) to clear the stored maximum value.

The function “external clearing” is triggered with the following conditions:

- The clear time is set to “extern”.
- The “dirty window” warning system is switched off. This can be done through the InfraWin software in the “color-bar” window.
- The warning level “dirty window” must be set to 0%.

2. Hold function:

When the hold function mode is activated, the current temperature reading is frozen as long as pin J and pin K are connected. (See section [4.6](#) for clear time for the maximum value storage).

3. “Dirty Window” Warning system:

The pyrometer is equipped with a “dirty window” warning system. The accuracy of the pyrometer will be seriously affected if the lens is not clean and the sight path is obscured by dirt, process material, smoke or steam (this can also happen if the object is smaller than the spot size of the pyrometer).

To avoid incorrect measurements, a warning signal can be set to detect when the signal level becomes too low or reaches a certain level. When activated, a built in relay (max. continuous current 0.4 A) connects pin J to pin K (power supply voltage).

The setting of the warning level (0 to 99%) can be done through the “color-bar” window of the InfraWin software. If the warning level “dirty window” is set to 0% (factory setting), the “dirty window” warning system is switched off and pin J can perform one of the functions of “external clearing” or “hold”.

The “dirty window” warning system is triggered with the following conditions:

- The clear time is not set to “extern” or “hold”.
- The pyrometer is operating in “2-color mode”.

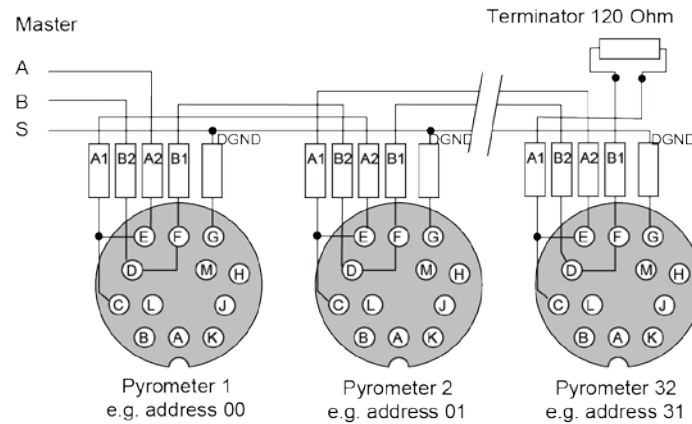
3.1.2 Connecting the pyrometer to a PC

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

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

3.1.3 Connection to RS485

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.



RS485 Bus System

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.

3.1.4 Connection schematic for analyzing devices

For temperature indication of the pyrometer, LumaSense offers pure indicators (series DA 4000). LumaSense also offers indicators with features to change pyrometer parameters (DA 6000 and DA 6000-N) as well as a fast digital PID controller PI 6000.



Digital Display

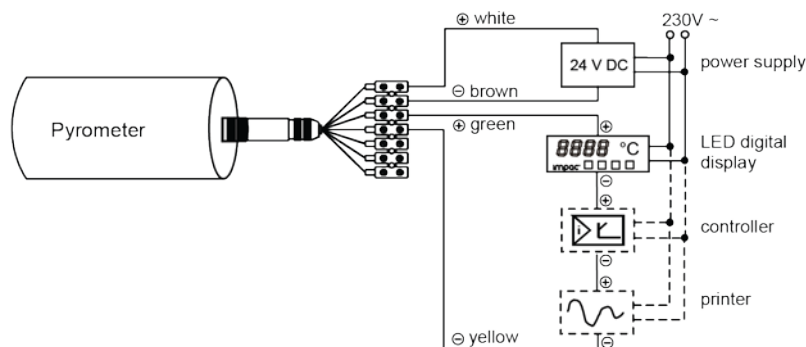


Parameterizing Indicator



Digital Controller

Additional analyzing instruments, including LED digital displays only need to be connected to a power supply and the analog outputs of the pyrometer (exception: the digital display DA 6000 can also be connected with its serial interface, whereas the digital display DA 6000-N has to be connected with its serial interface).

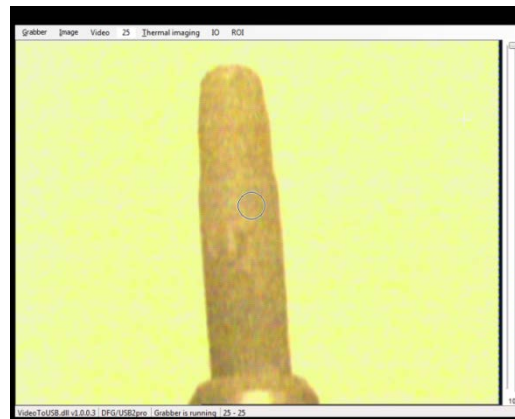


Connection Schematic for Analyzing Devices

Instruments like an analog controller or printer can be connected to the display in a series as shown above (total load of resistance max. 500 Ohm).

3.2 Sighting

The ISR 6-TI Advanced is equipped with a TV camera with infrared filter that provides a thermal image to align the pyrometer to the measuring object. In case the pyrometer shall be aligned to an object that cannot be displayed with a thermal image (e.g. temperature < 700 °C) the TI functionality needs to be disabled (please also see Section 5.4.1.9). With disabled TI functionality, the alignment can be done with the black and white TV image. For this, it might be necessary to adjust the image brightness using the slider at the right image border.



3.3 Electrical Connection of Video Output

On the back cover of Series 6-TI Advanced pyrometers, there is an additional coaxial connector for the video/imaging output. LumaSense offers ready-made video connection cables in various lengths, which are fitted with a BNC connector and a BNC-RCA adapter to connect to a monitor or video grabber.



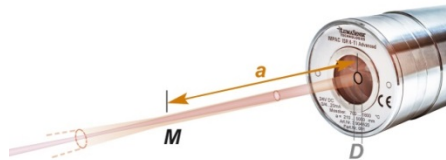
Note: Video cable and grabber have the same Serial number as the instrument and cannot be exchanged without new calibration in the factory.

3.4 Optics

3.4.1 Spot Sizes

The ISR 6-TI Advanced has a Vario optics, which can be manually adjusted at all distances between 210 mm and 5000 mm. The focus distance of the pyrometer corresponds to the focus distance of the thermal image, respectively the TV camera.

The table of spot sizes in relation to measuring distance shows examples of the pyrometer's spot size M [mm] in relation to the measuring distance a [mm] (min. 90% of the radiation intensity). Increasing or decreasing the measuring distance will change the spot size.



Aperture D for all temperature ranges is 12 to 14 mm with the aperture being the effective diameter of the lens. This is dependent on the optical setting. The largest value applies to a very small measuring distance, while the minimum value applies to the largest measuring distance.



Note: In the 1-color (mono) mode, the pyrometer can measure objects at any distance (whether focused or non-focused). However, the object has to be bigger than or at least as big as the spot size of the pyrometer in the measuring distance.

In the 2-color (ratio) mode, the object can be somewhat smaller than the spot diameter.

Temperature Range 700 ... 1800 °C	
Measuring Distance a [mm]	Spot Diameter M [mm]
210	1.1
300	1.6
500	2.7
800	4.2
1300	6.9
2000	10.6
5000	27

Examples of Spot Sizes in Relation to Measuring Distance

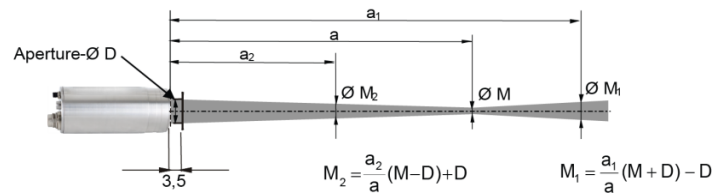
Focused spot sizes between the listed distances can be found by linear interpolation between the listed values. For example, for range 700 to 1800 °C, the spot size at 1600 mm distance would be about 8.5 mm.



Note: Effective aperture D for all temperature ranges is 12 mm (focused to longest distance) to 14 mm (focused to shortest distance).

3.4.2 Deviation from the focused measuring distance

Spot sizes for non-focused distances (shorter or longer than the focused distance) may be calculated by using the formula below.



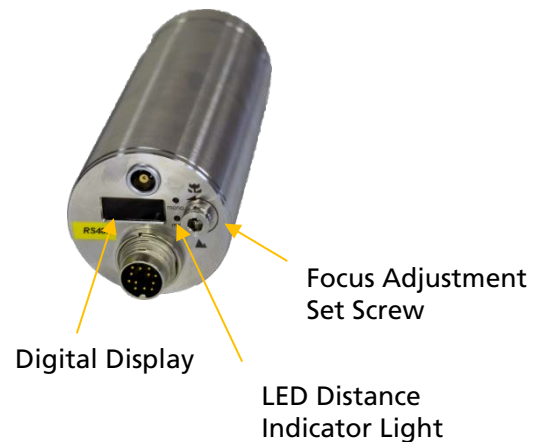
Formula for Calculating Spot Sizes

The InfraWin software also includes a Spot Size Calculator that calculates the data for the non-focused regions, if you enter the values of aperture D, focused measurement distance a, and focused measuring field diameter M as found in the above table (see section [3.4.1](#)).

3.4.3 Adjusting the required measuring distance

The measuring distance can be set using the Focus Adjustment Screw on the back of the device. The focused distance value can be adjusted at all distances between 210 mm and 5000 mm. To focus, turn the focus adjustment set screw to make the target image appear sharp and clear.

The LED Distance Indicator Light (labeled mm) will turn red and the approximate focused measuring distance in mm will automatically be shown on the Digital Display for a few seconds after making an adjustment using the Focus Adjustment Set Screw.



Note: The optics are manually focusable with a measuring distance of a = 210 to 5000 mm.



Note: Turning the focus adjustment screw counterclockwise will shorten the measuring distance.
Turning the focus adjustment screw clockwise will lengthen the measuring distance.

3.4.4 Thermal Image

The field of view of the TV camera, respectively the thermal image, is 6.0° x 4.5°. The field of view in the desired measuring distance can be calculated with the following formula:

$$(\tan(\alpha/2) \times a) \times 2 \quad \times \quad (\tan(\beta/2) \times a) \times 2$$

$$(\alpha = 6.0^\circ ; \beta = 4.5^\circ ; a = \text{measuring distance})$$

The measured spot of the pyrometer can be displayed in the thermal image (circle in the middle of the image) with the displayed size corresponding to the actual spot size of the pyrometer at the set focus distance.

3.5 Installation of the Video Grabber

In order to display the thermal image on a computer using the operating and analyzing software InfraWin, the video grabber (included in the scope of delivery) has to be installed on the computer.

The ISR 6-TI always has to be calibrated together with the video grabber and the TV-cable. We recommend the use of the grabber included in the scope of delivery, which can also be purchased as an accessory. Calibrating the system using a different grabber is possible on request.

The drivers for the grabber must be installed on the computer before the ISR 6-TI can be used with this PC.

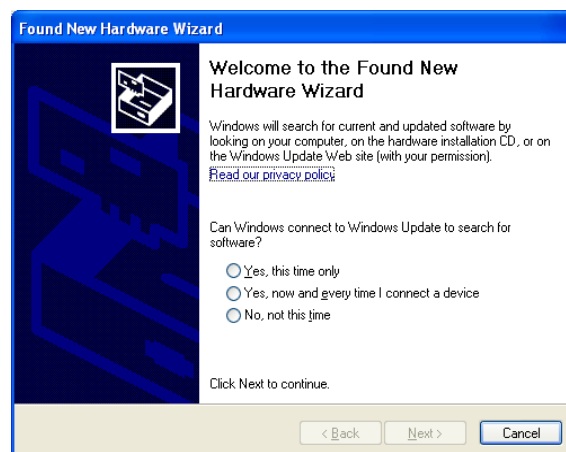
3.5.1 Installing the Driver

1. Install the drivers, located on the InfraWin CD (Grabber (Drivers)\ DFG_USB2pro\ drvInstaller.exe) which is included in the scope of delivery of the instrument. The drivers can also be downloaded from the LumaSense website:
http://info.lumasenseinc.com/DownloadRequests_English.html

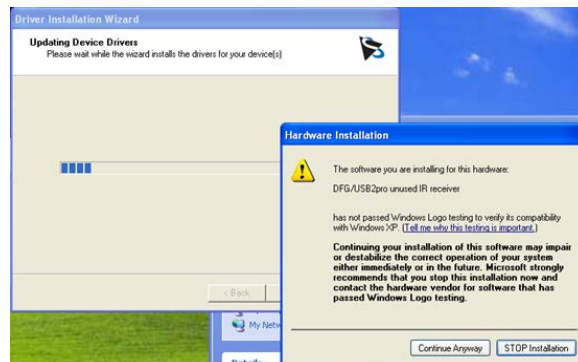
Once the "drvInstaller.exe" file is executed, the following window will appear:



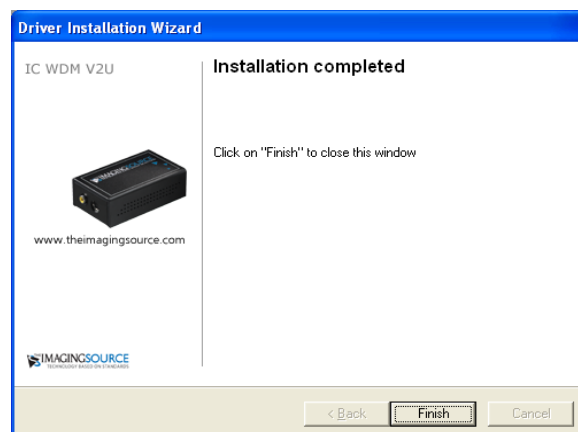
2. Connect the Grabber with the PC using the USB connection.



3. Cancel the messages as they appear and ignore the advice that the hardware may not work properly.



4. Click **Continue Anyway** to continue with the installation. The installation process might take a few minutes. The following window will appear after the driver is successfully installed.



5. Click **Finish** to finish the installation. Once the installation has been completed, the thermal imaging function will be able to be used with the InfraWin software.
6. Connect the ISR 6-TI video cable to the grabber.
7. Connect the ISR 6-TI to the PC using the interface cable.

4 Settings / Parameter Descriptions

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



The digital PC interface allows you to exchange data with a PC either by using the supplied InfraWin software or by using the Universal Pyrometer Protocol (UPP) commands with your own communication program (see chapter [2](#) for the UPP Data Format commands).

Selecting the pyrometer parameters window shows the current settings of the pyrometer. You can change a value by typing a value in an input box or by selecting a preset value from the list field. The following settings can be made through the RS485 to USB connection.

4.1 Factory Settings

Temperature display (°C / °F) = °C

Emissivity (Emi) = 1 (100%)

Emissivity Slope K = 1

Transmittance = 100%

Exposure time (t_{90}) = min

Clear Peak Memory (t_{clear}) = 0s (off)

Analog Output (mA) = 0 ... 20 mA

“Dirty Window” Warning = 0%

Switch Off Limit = Off% = 10%

Operating Modes = 2-color mode

Sub Range = Basic Range

Device Address (Adr) = 00

Baud Rate (Baud) = 19200

4.2 Temperature Display

The Digital Display on the back of the pyrometer will show the temperature measurement in either °C or °F. You can select which temperature scale you wish to use through the InfraWin software or by using the UPP Data Format commands.

The Measuring Value can also be viewed at any time through the InfraWin Software or by using the UPP Data Format commands.

4.3 Emissivity ϵ

Different materials have different emissivities ranging between 0% and 100%. The emissivity is also dependent upon 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.

Emissivity settings between 20% and 100% can be established through the InfraWin software or by using the UPP Data Format commands.



Note: Emissivity ϵ Settings: 5% to 100% in steps of 1/1000 (1-color mode).

4.4 Emissivity Slope K

In 2-color (ratio) mode, the pyrometer is measuring simultaneously with 2 sensors in adjacent wavelengths. It calculates the temperature by ratioing the radiation intensities of the two wavelengths. This ratio technique eliminates a number of factors that degrade the accuracy of conventional 1-color instruments. For example, with ratio pyrometers, measurement is independent of emissivity in wide areas. They are also unaffected by dust in the field of view and unaffected by dirty viewing windows or lenses, etc. as long as these disturbances are "grey" (not colored).

In some cases the emissivities of the two wavelengths can differ so that it is necessary to correct the ratio of the two emissivities ($K = \epsilon_1 / \epsilon_2$) to get a correct temperature reading. This correction can be done by adjusting the emissivity slope setting K using the InfraWin software or the UPP data format commands.

The K-factors of metals are normally slightly higher than 1. For a correct measuring result, it is recommended that you make a comparison test. This comparison test may be performed by using a thermocouple probe or by knowing one process temperature point precisely from other sources. The K-factor can then be adjusted until the pyrometer shows the same temperature value.

The ISR 6-TI is factory calibrated for graybody targets that exhibit equal changes in emissivity within its two spectral bands.



Note: Emissivity Slope K Settings: 0.800 to 1.200 in steps of 1/1000 (2-color mode).

4.4.1 Slope Adjustment

In some cases the emissivities of the two wavelengths can differ so that it is necessary to correct the ratio of the two emissivities ($K = \epsilon_1 / \epsilon_2$) to get a correct temperature reading. This correction can be done by adjusting the emissivity slope setting K using the InfraWin software or the UPP data format commands.

The K-factors of metals are normally slightly higher than 1. For a correct measuring result, it is recommended that you make a comparison test. This comparison test may be performed by using a thermocouple probe or by knowing one process temperature point precisely from other sources. The K-factor can then be adjusted until the pyrometer shows the same temperature value.

The ISR 6-TI Advanced is factory calibrated for graybody targets that exhibit equal changes in emissivity within its two spectral bands.

4.4.2 Temperature Errors Cause by Non-Graybodies

A graybody target has emissivity that is the same at each of the two wavelengths used for measurements and is constant throughout the temperature range. The ratio of the emissivities, $\varepsilon_1 / \varepsilon_2 = 1$ and stays constant regardless of the target temperature. When a target deviates from this, that is, when $\varepsilon_1 / \varepsilon_2$ does not equal 1.0 a slope adjustment is required. For many materials, this is a one-time adjustment.

The following table illustrates the ISR 6-TI reading errors that can occur when the slope setting differs from the actual material emissivity ratio.

TABLE OF EXPECTED ERROR WHEN EMISSIVITY OF ONE WAVELENGTH IS 1% DIFFERENT FROM THE SECOND WAVELENGTH			
TEMPERATURE		ERROR DEG.	
°F	°C	°F	°C
1300	700	18	10
1500	815	20	11
1700	926	22	12
1900	1040	25	14
2100	1150	25	14
2300	1260	27	15
2500	1370	29	16
3000	1650	36	20

The table shows typical errors that can result when the emissivity of one wavelength differs from the other wavelength by only 1%. The errors can get quite large as temperatures increase. This error can be much larger than a 1-color IR pyrometer would produce for 1% emissivity change. Therefore, it is important to select the proper mode (2-color vs. 1-color) on the ISR 6-TI to measure a specific material.

Another source of error is dust or smoke in the optical path which alters the transmission in one wavelength more than the other. If the "dust" transmits 1% less energy at wavelength 1 than at wavelength 2, the error table above also applies. Since not all smoke, dust, or dense steam transmits equally at each wavelength, errors may become larger than expected for a 2-color instrument. Usually the smoke and dust are the result of the material being processed and can be cleared from the sight path by a fan or air purge tube.

In some materials, the emissivity may change at different rates with material temperature. Some materials exhibit great changes in emissivity with temperature or time as oxidation modifies the surface finish of the material. Such materials are not suited for measurement with 2-color instruments. When problems are compounded with spectrally absorbing dust or smoke (described above), obtaining reliable temperature readings with any 2-color instrument may be impossible. In cases like this, a single color instrument using the shortest wavelength possible would be the better choice. If this problem is encountered, switch the ISR 6-TI to 1-color mode. In some situations, the single color mode will outperform the ratio mode.

4.5 Transmittance τ

Transmittance is a parameter that can compensate for signal loss due to external windows etc. For example, if the emissivity of the material is 0.6 and the transmittance of an additional window is 0.9, then the product would be 0.54 which is well inside the allowed range.

The product of transmittance and emissivity ($\tau \times \epsilon$) must not be less than 5%.



Note: Transmittance τ Settings: 5% to 100% in steps of 1/1000 (1-color mode)

4.6 Response Time (t_{90})

The response time t_{90} is the time interval for the analog output of the pyrometer to go from a low temperature value up to 90% of the temperature step to a high value when measuring an abrupt increase from said low to said high temperature.

Independently of this, the pyrometer performs a measurement every 10 ms and updates the analog output. Slower response times can be used to achieve a constant temperature reading for measuring objects that have rapidly fluctuating temperatures.

The response time is set using the InfraWin software or by using the UPP Data Format commands. When the setting is set to min., the ISR 6-TI Advanced operates using a time constant of <2 ms (with dynamic adaption at low signal levels). The response time can be extended to 0.01 s; 0.05 s; 0.25 s; 1 s; 3 s; 10 s.



Note: Settings for Response Time t_{90} : min, 0.01 s; 0.05 s; 0.25 s; 1 s; 3 s; 10 s.

4.7 Clear Peak Memory (t_{CLEAR})

The integrated maximum value storage is activated when the parameter t_{clear} is set to something other than "OFF" or "HOLD".

If the maximum value storage is switched on, the highest last temperature value will always be displayed and stored. As such, it may be beneficial to periodically clear and reset the stored maximum values in order to obtain new temperature readings.

This storage also has to be cleared at regular intervals when fluctuating object temperatures cause the display or the analog outputs to change too rapidly or when the pyrometer is not constantly viewing an object to be measured.



Note: Settings for Clear Peak Memory t_{CLEAR} : OFF, 0.01 s, 0.05 s, 0.25 s, 1.0 s, 5.0 s, 25.0 s, EXTERN, AUTO, HOLD.

4.7.1 Single and Double Storage Modes

Depending upon the selected settings, the maximum value storage will either work in single storage mode or in double storage mode.

Single Storage Mode:

Single storage mode is used when you want to reset the stored value using an external impulse via one contact closure from an external relay (such as between two measured objects). The relay contact is connected directly to the pyrometer between pins J and K. This mode allows a new value to be established after each impulse from the reset signal. Single storage mode also comes into effect when the Clear Peak Memory t_{clear} is set to AUTO.

Double Storage Mode: Double storage mode comes into effect when selecting one of the reset intervals. This mode utilizes two memories. With the first memory, the highest measured value is held and is deleted alternately in the time interval set (clear time). The other memory retains the maximum value throughout the next time interval. The disadvantages of fluctuations in the display with the clock frequency are thereby eliminated.



Note: The maximum value storage setting coincides with adjustments made to the response time.

The response time setting (working like a low-pass filter) is applied first. After that, the maximum storage is processed. So when using both, the maximum storage takes the peak of the signal that was previously smoothed by the response time filter.

4.7.2 Clear Time Settings

The following settings are available through the InfraWin software or by using the UPP data format commands.

- OFF** When set to **OFF**, the maximum value storage is switched off and all new temperature values are measured but not stored.
- 0.01 s...25.0 s** If the clear time is set between **0.01 s** and **25.0 s**, the maximum value is held in double storage mode. After the entered time, the value will be cleared alternately from one of the storages, while the value of the other storage is shown.
- EXTERN** With the external clearing function, the storage operates in single storage mode. The values are immediately cleared from the storage by contacting the wires connected to pins J and K, if the **EXTERN** mode was selected.
- AUTO** The **AUTO** mode is used for discontinuous measuring tasks. For example, when objects are being transported on a conveyer belt and pass the measuring beam of the pyrometer only for a few seconds. In this case, the maximum value for each object has to be obtained.

With the **AUTO** 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 once the temperature of the new hot object exceeds the low limit of the sub range by 1% (transition in positive direction) or by at least 2 °C. This is also valid if the sub range equals the basic range.
- HOLD** The **HOLD** function allows you to freeze the current temperature reading at any moment. This feature is activated using an external switch that has been connected between connector pins J and K.

The temperature reading will remain frozen as long as the contact is closed.

4.8 Analog Output

The analog output has to be selected according to the signal input of the connected instrument (controller, PLC, etc.). If 4 to 20 mA is set, the analog output gives 3.9 mA for temperatures below lower range limit.



Note: Settings for Analog Output: 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).

4.9 Relative Signal Strength

Relative signal strength stands for the product of emissivity, surface coverage, and transmission of the material between the object and the pyrometer.

4.10 “Dirty Window” Warning

The ISR 6-TI Advanced pyrometers are equipped with a warning level “dirty window” monitoring system. A correct temperature measurement might be impossible if the ratio pyrometer is working at a too low signal level. To avoid these wrong measurements in advance, a warning signal can be set to a certain contamination level. A built-in relay switch can be used to switch to a warning signal when the incoming radiation becomes too low.

The warning level can be set between 0 and 99%. 0% means the “dirty window” warning system is switched off (factory setting) and the relay can perform the function external clearing of maximum value storage, when it is activated (see section [4.6.2](#) Clear Time Settings).



Note: Settings for “Dirty Window” Warning: 0 (off) to 99%.

4.11 Minimum Intensity Switch-Off Level

The minimum intensity switch-off level is a function that is used to avoid measuring errors caused by signals which are too low. This may e.g. be caused by a dirty viewing window, dust in the field of view, or when the spot is not filled by the measuring object.



Note: Settings for Minimum Intensity Switch-Off Level: 2% to 50%.

Ratio pyrometers are able to measure temperatures correctly even with very low signals. If the signal is too low for a correct measurement, the pyrometer interrupts the measurement and displays 1 °C below of beginning of the temperature range. If signal intensity falls below the Switch-Off level the Analog Output will show 21 mA if one of the settings “.../21 Low” has been selected for the Analog Output.

Although the factory default is set to 10%, switch-off limit can be adjusted between 2 and 50%, depending on the application.



Note: The smaller the value, the higher the chance that daylight or reflections will affect a correct temperature measurement.

4.12 Operating Modes

Ratio (2-color) mode is the factory default operating mode for the ISR 6-TI pyrometer. However, the device can be set to mono (1-color) mode or metal mode using the InfraWin software or by using the UPP Data Format commands.

4.12.1 2-color mode

In 2-color mode (ratio method) two adjacent wavelengths are used for the temperature determination. This technique offers the following advantages compared to standard 1-color pyrometers:

- The temperature measurement is independent of the emissivity of the object in wide ranges.
- The measuring object can be smaller than the spot size.

Measurements are unaffected by dust and other “grey” contaminants in the field of view or by dirty viewing windows.

4.12.2 1-color mode

With 1-color mode, the device adjustments are simplified by sending the emissivity corrected one channel temperature to the analog output. This operating mode is indicated by a red LED in the back cover of the instrument.

For a correct measurement in the 1-color mode, it is necessary to adjust the emissivity using the InfraWin software or by using the UPP Data Format commands. This emissivity is the relationship between the emission of a real object and the emission of a blackbody radiation source (this is an object which absorbs all incoming rays and has an emissivity of 100%) at the same temperature.



Mono (1 Channel)
mode LED
indicator

4.12.3 Metal mode

The metal mode is a special mode which calculates the temperature combining the ratio and the 1-color signal with an algorithm. The metal mode can be used to determine the temperature of metals and alloys with unknown emissivity ratio (K). It should be used only for a short time to achieve a good approximation of the object temperature if the temperature reading in 2-color or 1-color mode seems to be incorrect. After this the pyrometer has to be switched back into 2-color mode and the temperature reading has to be corrected with the adjustment of the emissivity slope K until the instrument shows the temperature determined in the metal mode. A condition for the use of the metal mode are settings of $\epsilon = 1$ and $K = 1$. In this operating mode, the red LED on the back cover is blinking (shortly dark, long illuminated).

4.13 Sub Range

You have the opportunity to choose a sub range (minimum span 50 °C) within the basic measuring range of the pyrometer. This sub range corresponds to the analog output.

Example: Range 700...1800 °C, Sub Range 925...975 °C.

The sub range setting also affects the maximum value storage when the Clear Peak Memory t_{clear} is set to AUTO. For more information on the t_{clear} AUTO setting, refer to section [4.6](#).



Note: Settings for Sub Range: Any range adjustable within the temperature range with a minimum span of 50 °C.

4.14 Device 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.

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).



Note: Settings for Device Address:

Individual Addresses: 00...97

Global Addresses: 98, 99

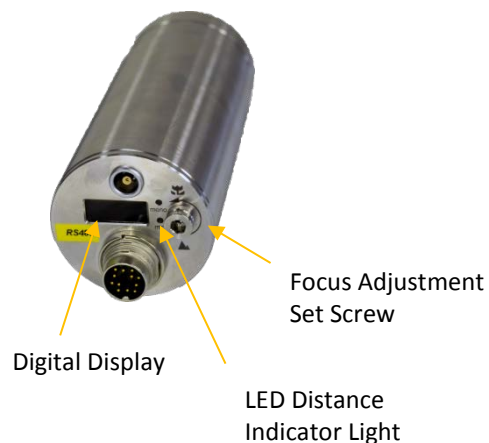
If the ISR 6-TI is used in connection with the IO module IO 8-6 (Ref. No. 3 826 770), the address 90 cannot be given to the pyrometer as the I/O module always automatically has the address 90.

4.15 Focused Distance

The focused distance value can be adjusted at all distances between 210 mm and 5000 mm using the Focus Adjustment Screw on the back of the device.

The LED Distance Indicator Light will turn red and the focused measuring distance in mm will automatically be shown on the Digital Display within a few seconds of making an adjustment using the Focus Adjustment Set Screw.

The focused distance can be viewed at any time through the InfraWin software or by using the UPP Data Format commands.



4.16 Baud Rate

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



Note: Settings for Baud Rate: 1200, 2400, 4800, 9600, 19200, 38400, 57600, or 115200.

4.17 Pyrometer Internal Temperature

The internal temperature of the pyrometer can be read through the PC interface using the InfraWin software or by using the UPP Data format commands. It is a few degrees higher than the ambient temperature due to the heat generated by the electronics.



Note: During operation the instruments will warm up and might reach an intrinsic temperature of up to 58 °C.

5 Software InfraWin

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

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

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

5.1 Connecting the pyrometer to a PC

The program *InfraWin* can operate up to two devices. Two devices using RS485 may be operated simultaneously by the same interface, if two different addresses have been properly entered (see section [4.13](#) Device Address for more information).

5.2 Installation

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

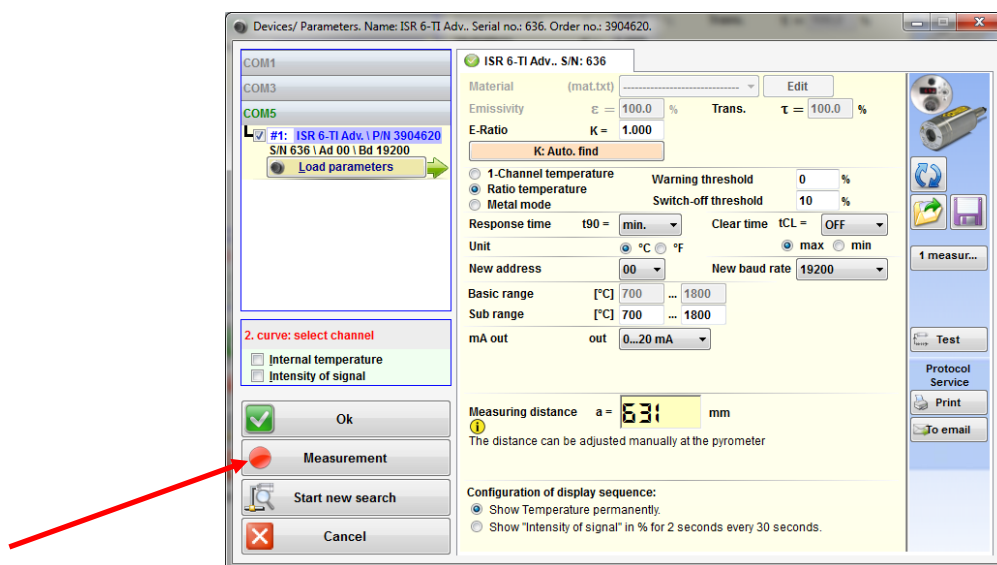
5.3 Program start

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

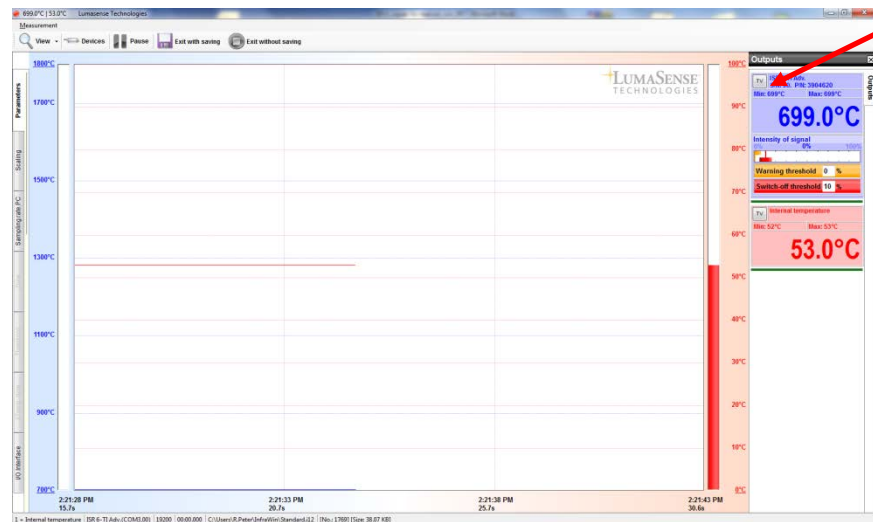
5.4 Thermal Imaging functionality of InfraWin

Using a PC and the InfraWin 5 software (Version 5.0.1.45 or newer), the thermal image and display options can be configured. The thermal image can be displayed as follows:

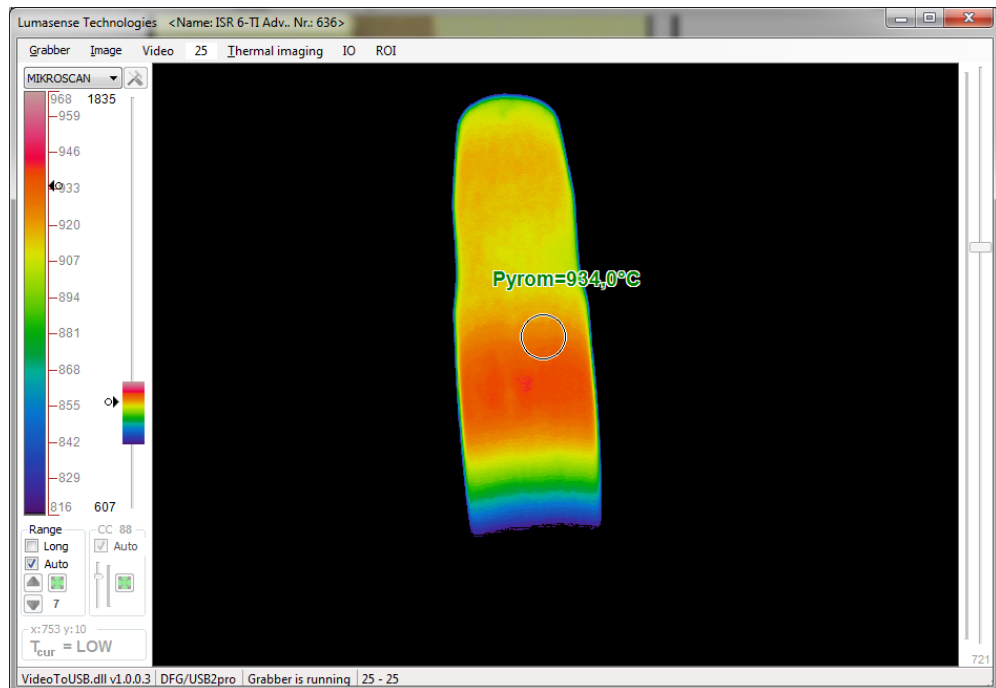
- Click on **"Measurement"**.



This will open a new window where you can click “TV” on the top right side of the screen.



This will open a window with the thermal image and allow you to change the current settings, but not the size of the window:



Note: When the Thermal imaging function is activated for the first time, it can take some seconds before the image will be displayed. After the first activation, the image will be displayed immediately.

Note: The thermal imaging function is only available if the pyrometer is operated in 2-color mode!

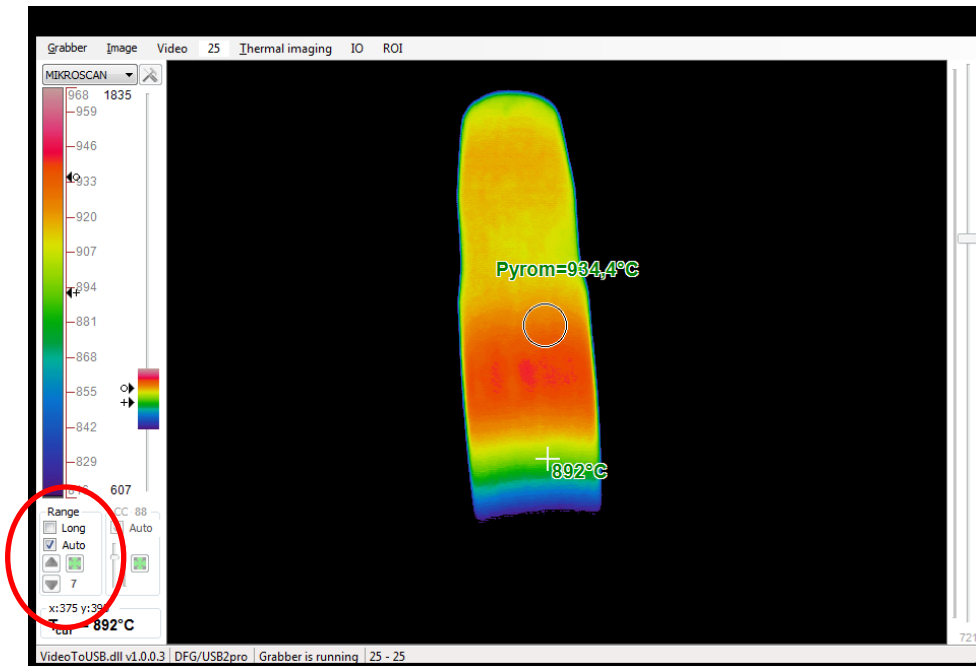
5.4.1 Setting Thermal Imaging Parameters

The following parameters / settings can be changed for the thermal image:

5.4.1.1 Dynamic Range (Range)

Selecting the dynamic range.

You can either manually select one of the given dynamic ranges (arrow buttons) or combine multiple dynamic ranges (check mark box **Long**) or check mark the **Auto** box for auto selection of the best dynamic range.



(Factory setting: **Auto** range). (**Auto** range will also automatically adjust the emissivity correction (CC)).

Auto Range

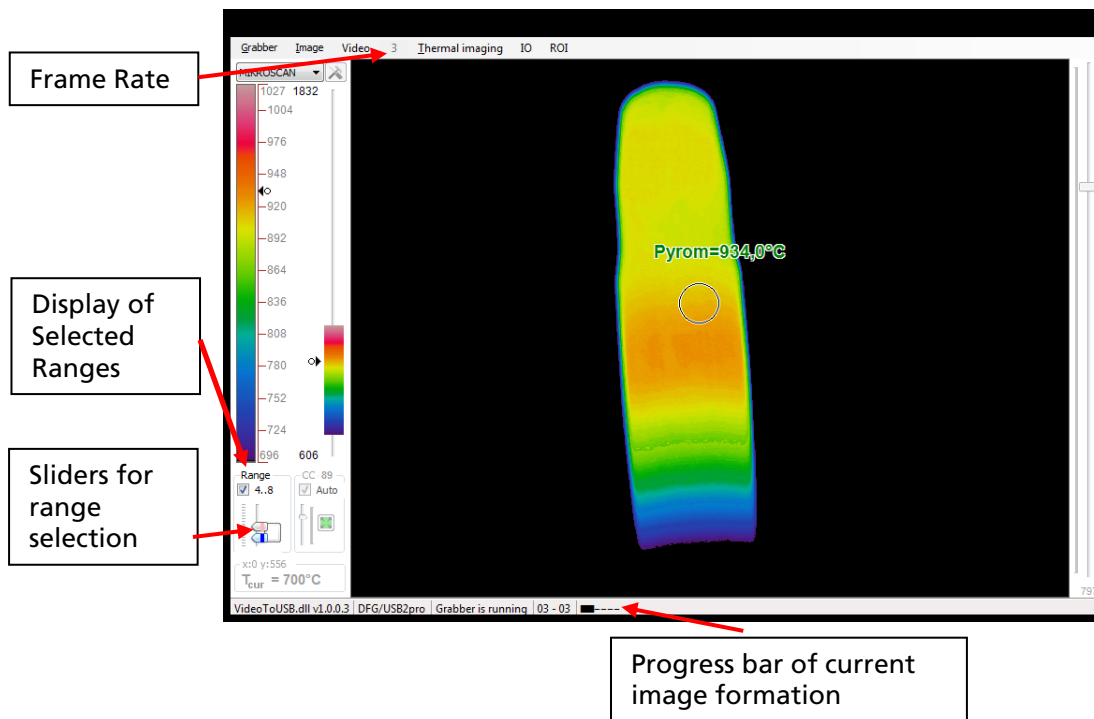
If **Auto** range is selected, the instrument will automatically switch to the best range relating to the temperature and the brightness of the spot measured by the pyrometer.



Note: If the chosen range is not correct, the small box next to the arrow buttons as well as the temperature indication in the image (if displayed) appears Red. If the chosen range is correct, the small box and temperature indication will turn Green.

Long Range

If **Long** is selected, multiple dynamic ranges can be merged and displayed in one thermal image.



The desired ranges can be selected using the two sliders below the **Range** check box. The currently chosen ranges are displayed next to the check box.

(The sliders can be moved with the mouse or can be clicked on and then be moved using the mouse wheel).

(If the **Long Range** function is selected, CC-Auto is automatically active. The image frame rate will automatically be set to **4**).

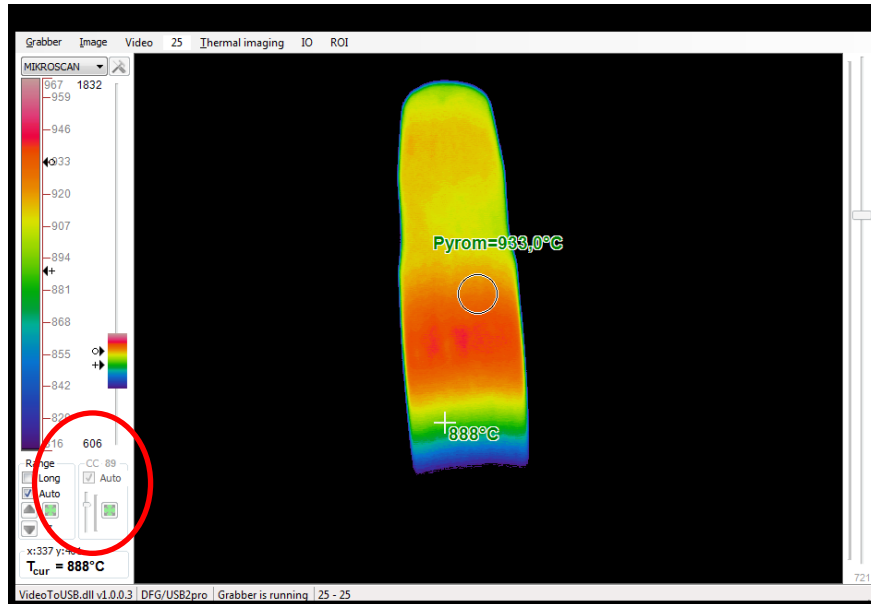


Note: The image formation does automatically slow down if multiple ranges are selected. It can take up to 4 seconds (if all ranges are selected).

5.4.1.2 Emissivity Correction (CC)

Selecting /changing the emissivity correction for the pyrometer spot

You can change the emissivity setting manually by using the scroll bar or automatically by using a check mark in the **Auto** box to auto select the correct emissivity.

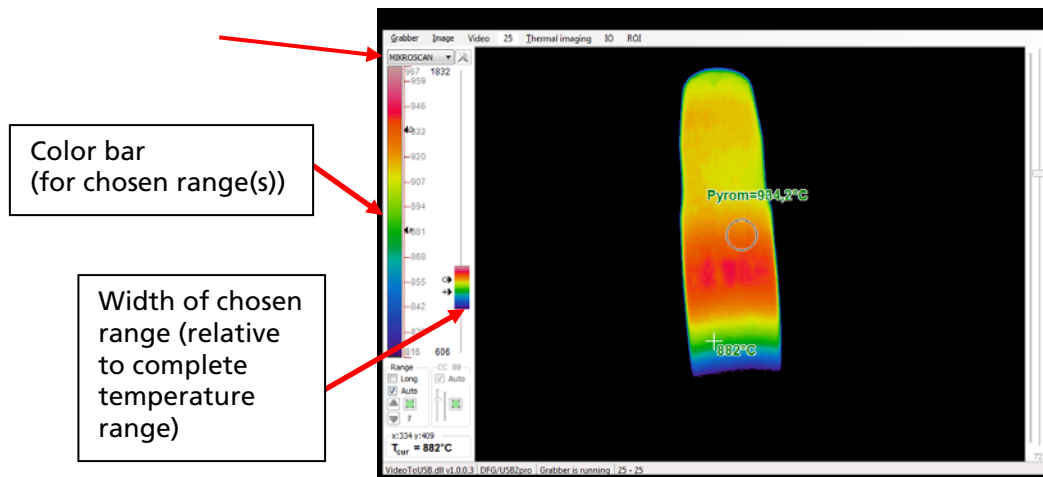


Note: If the chosen emissivity is not correct, the small box next to the arrow buttons as well as the temperature indication in the image (if displayed) appears Red. If the chosen emissivity is correct, the small box and temperature indication will turn Green. If the box is White, the grabber signal is not analyzable with the current settings. Moreover, a "CC" together with a small arrow is displayed in the thermal image in case of inappropriate settings. The arrow indicates in which direction the emissivity needs to be corrected.

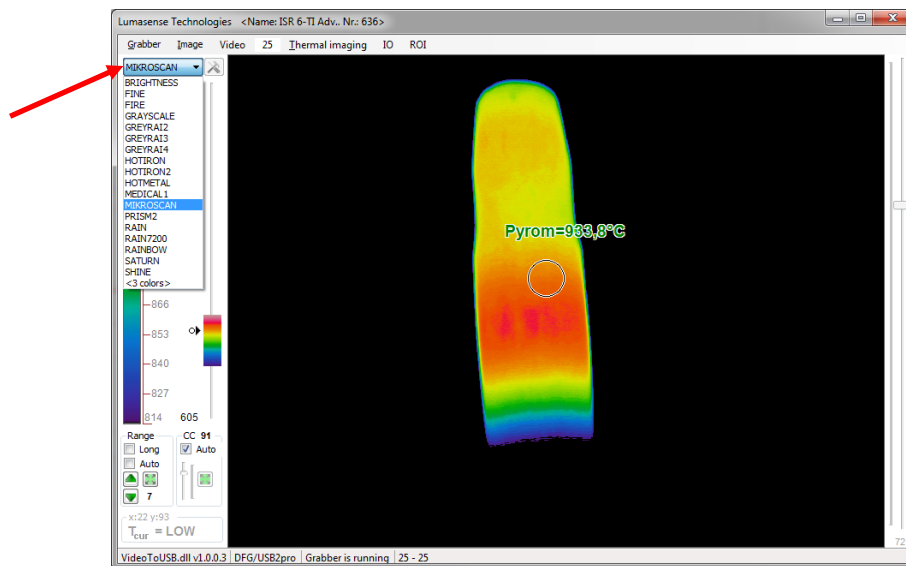
If either **Auto** or **Long** is selected for the dynamic range, the emissivity correction setting option is also automatically set to **Auto**. (Factory setting: **Auto**).

5.4.1.3 Temperature scale

The temperature scale shows the correlation of the temperature and the color in the thermal image. Temperatures will change if the dynamic range is changed or adjusted.

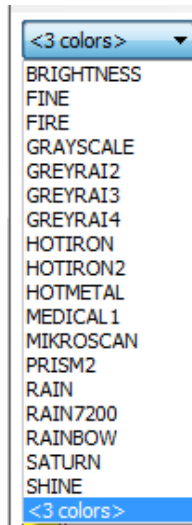


The color chart can be changed using the pull down menu above the color bar. (Nineteen different color charts are available. Standard factory setting: **Mikroskan**).



3 color display:

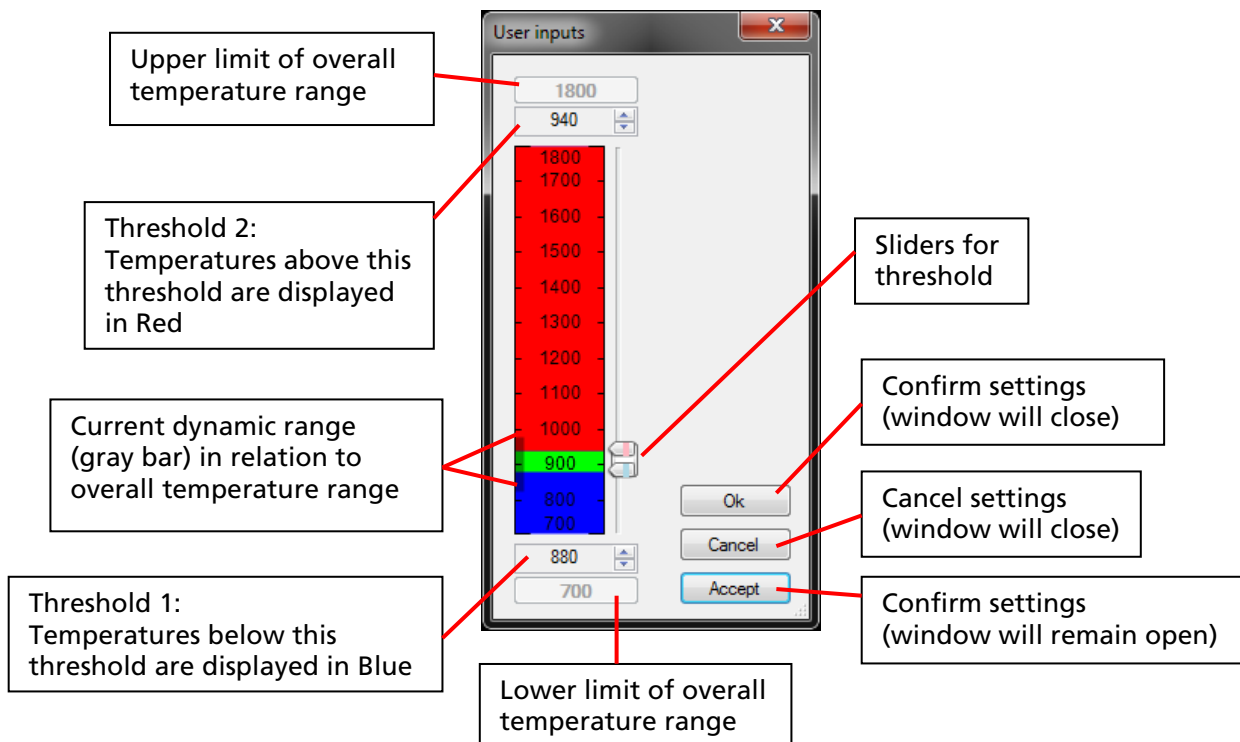
The last color scale in the list <3 colors> is a special option to display the thermal image in only 3 colors. All areas with a temperature below a definable threshold are displayed in Blue. All areas with a temperature above this threshold, but below a second definable threshold, are displayed in Green. All areas with a temperature above the second threshold are displayed in Red.



After selecting the <3 colors> scale, click on the "Adjustment button" right next to the temperature scale Dropdown menu:



This will open a window in which the desired thresholds can be defined.



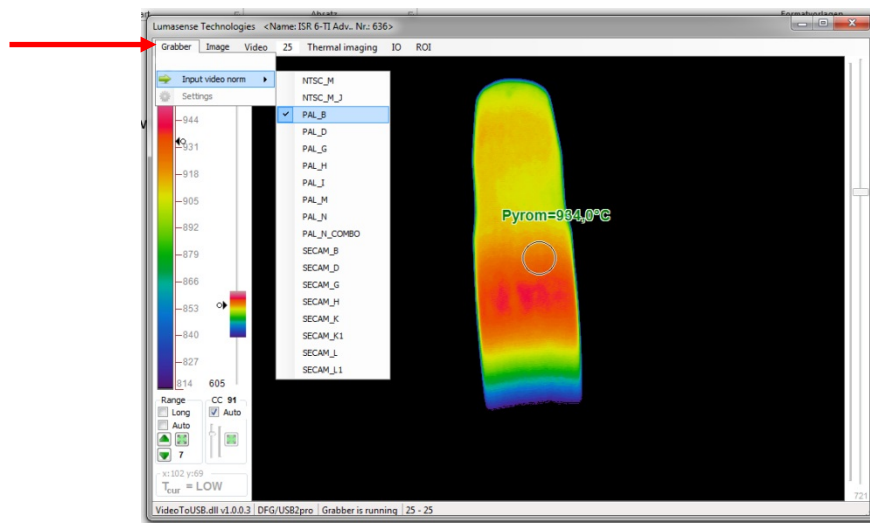
There are three ways to adjust the threshold temperatures:

1. Enter the desired temperatures into the input fields (Threshold 1 and Threshold 2)
2. Adjust the currently set temperatures using the arrow buttons 
3. Click and move slides using the mouse 

5.4.1.4 Grabber

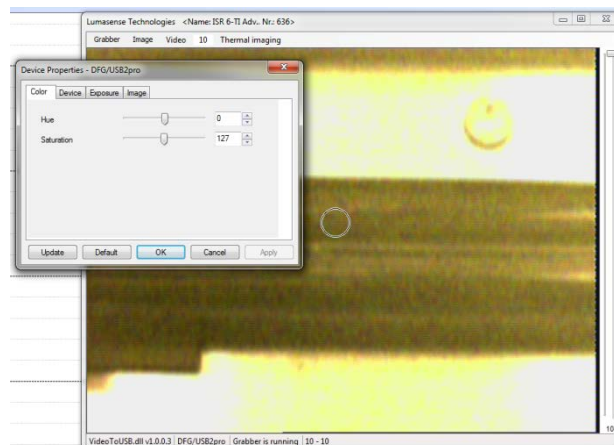
To change or select Grabber settings:

- **Input Video norm:** Selection of Video format



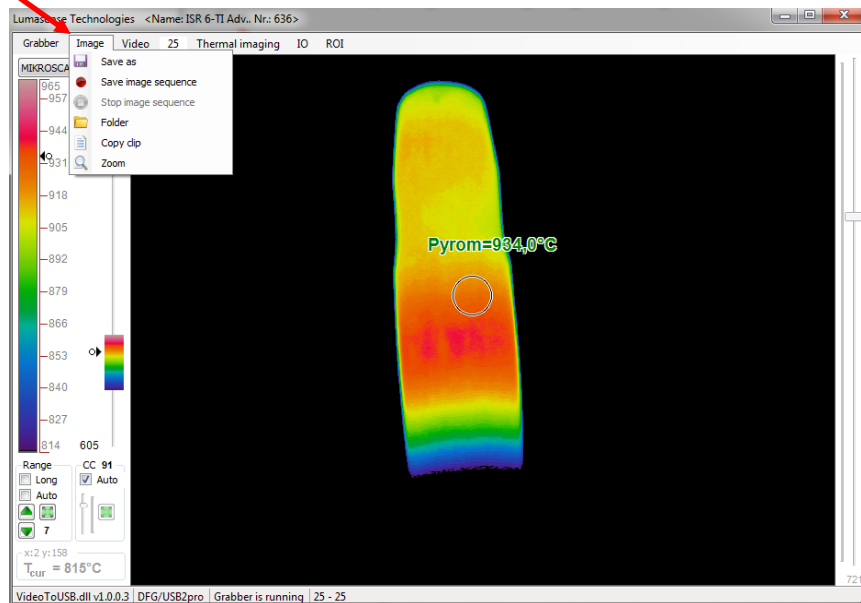
- **Settings:** only active if the Thermal Imaging function is deactivated. Changes general Grabber settings (e.g. Hue, Saturation, Brightness, Contrast, Sharpness).

If the thermal Imaging function is re-activated, Grabber settings will automatically be set to optimal values for the thermal image.



5.4.1.5 Image

Provides options for capturing and saving images or image sequences. Also provides a zoom function.



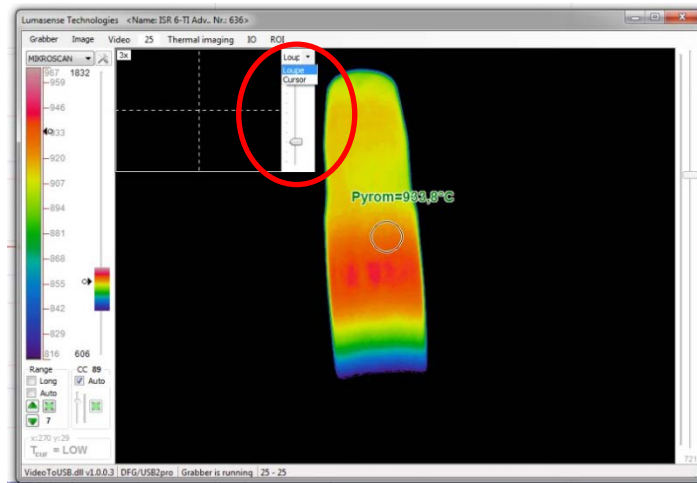
- **Save As:** Saves image / screenshot in desired folder
- **Save Image Sequence:** Allows thresholds and time intervals to be defined. Images / screenshots will be captured if the temperature is below or above the defined thresholds respectively after every defined timer interval.



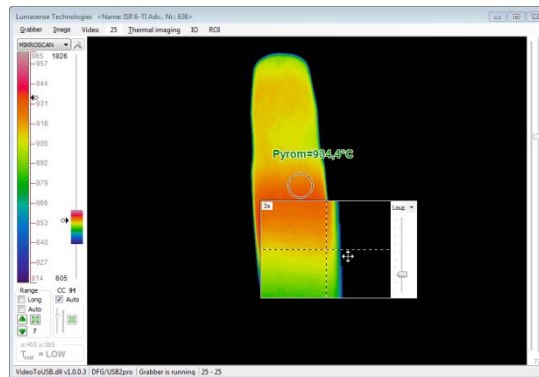
Note: For both the **Save As** option and the **Save Image Sequence** option, additional information such as color scale, dynamic range, Emi, etc. will be stored.

- **Stop image sequence:** will stop image sequences from recording.
- **Copy clip:** will copy the screenshot, which can then be pasted into a file.
- **Zoom:** when zoom is activated, a pop-up window will appear in the upper left corner of the thermal image:
 - The desired magnification can be selected using the scroll bar located on the right side of that window. The chosen magnification is displayed in the upper left corner as seen by the 3x zoom in the example below.

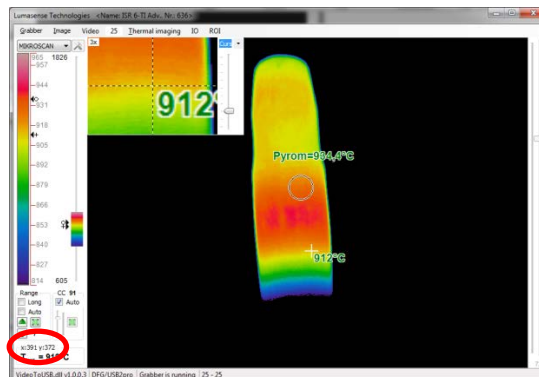
- Two options can be chosen using the pull down menu on the upper right. These options are **Loupe** and **Cursor**.



- Loupe:** The window itself can be used as a "magnifying glass" and can be moved over the thermal image (use mouse to move).

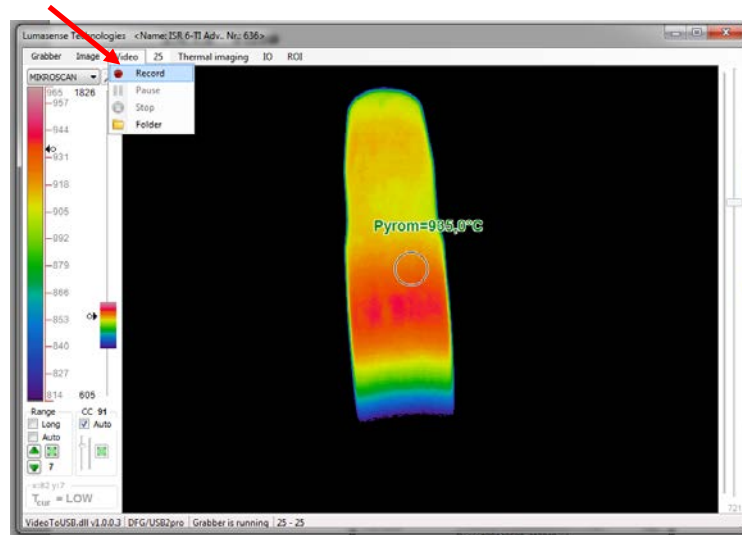


- Cursor (Curs):** The window shows the section of the thermal image where the cursor is currently located. The temperature in the current cursor position as well as its coordinates are displayed at the bottom left of the screen.



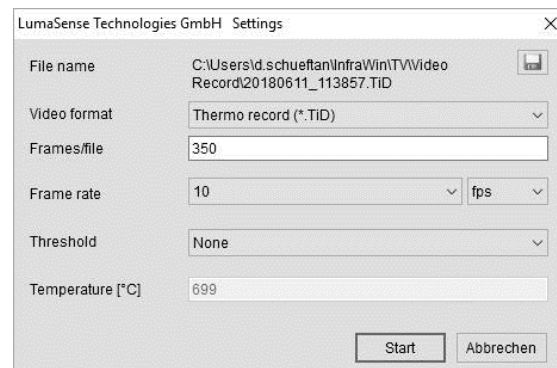
5.4.1.6 Video

Allows you to record and save videos.



Record:

Record current measurement as video.

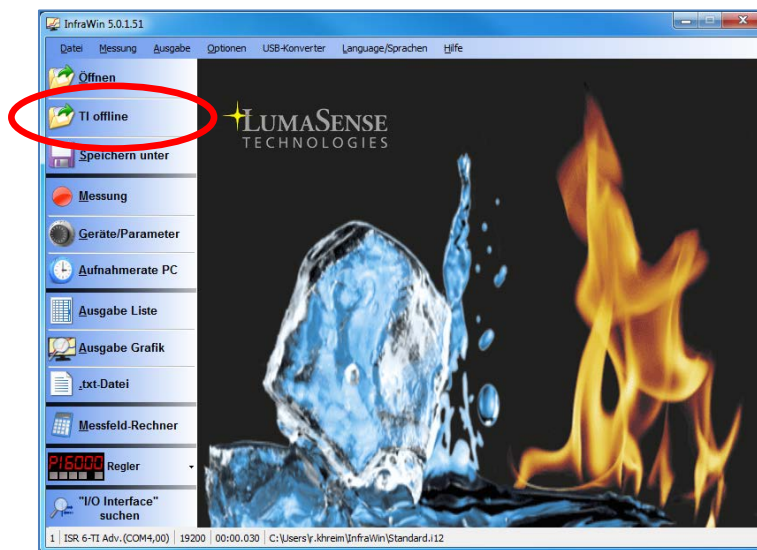


After clicking on **Record**, the following options can be set:

- **File name:** Enter name and select the path where the video will be saved.
- **Video Format:** choose the video format (Thermo record, MSMPGEP4v3 or Raw data). In order to use offline functions for videos (see 5.4.1.7 Offline Functions), the video file has to be recorded in "Thermo record" format!
- **Frame Rate:** choose the frames per second (Max. 25), frames per minute (max 60) or frames per hour (max 60)
- **Threshold:** select the threshold for recording (None / Above / Below).
- **Temperature:** If the threshold is set to **Above** or **Below**, the threshold temperature can be set here. The video will be recorded if the value (temperature in pyrometer spot) is above or below the set value.
- **Pause:** pause the recording of the current video.
- **Stop:** stop recording the current video.
- **Folder:** browse folders on the computer to open saved video files.

5.4.1.7 Offline Functions

Videos recorded in the “Thermo record” format can be opened via the **Ti offline** button in the InfraWin start screen.



In the following window, recorded videos can be opened, played, and edited:

Open video file

Properties / Settings for current video

List of recently viewed files

1 frame forwards or backwards (in paused video)

Range of frames that shall be shown in video (manual entry)

Current frame

Play Start / Stop

Switch between “play once” and “infinite loop”

The following offline functions are available for videos recorded in “Thermo record” format:

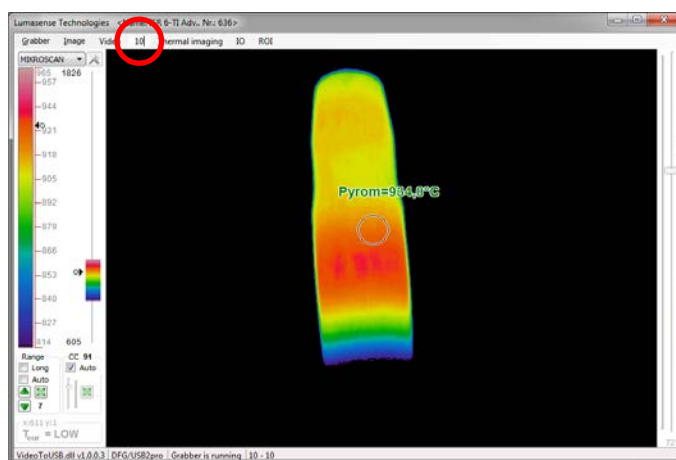
- All ROIs defined before recording are shown in the video and are available with all set parameters.
- Functions available in the “live image” (e.g. ROIs, change of temperature scale, zoom, video, frame rate, thermal imaging, etc) can also be used offline for the recorded video.

A subsequent definition or change of the dynamic range or the emissivity correction (CC) is not possible.

Files containing ROIs that have been defined before recording the video are write protected in offline mode, however a new video file can be recorded from that video.

- The cursor shows a temperature value for each pixel when moved over the thermal image.

5.4.1.8 Frame Rate

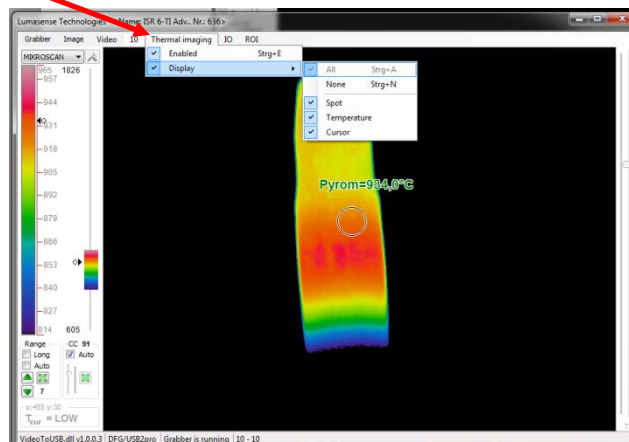


Shows the current frame rate (frames per second).

- Max. 25
- Factory setting: 10
- The frame rate can be changed by typing the desired value directly into this field.

5.4.1.9 Thermal Imaging

Allows you to activate / deactivate the thermal imaging function and data displayed in the thermal image.



Enabled:

This check mark box is used to activate the thermal imaging function (factory setting: enabled). If the thermal imaging function is deactivated, a low resolution black & white video image is shown and other setting options for the thermal image (e.g. Range, Emissivity, Color bar, etc.) will be inactive.

Display:

Allows you to activate / deactivate the data displayed in the thermal image: Choices include:

- **All / None:** activate / deactivate all displayable parameters.
- **Spot:** actual spot of the pyrometer.
- **Temperature:** Temperatures in the spot measured by the pyrometer.
- **Cursor:** calculated temperature in the current cursor position.

5.4.1.10 Further (general) Displays in the Thermal Image

Various types of information can be displayed in the thermal image, such as:

- The temperature measured in the spot by the pyrometer
- The temperature in the current cursor position

For displaying the spot temperature, there are the following options:

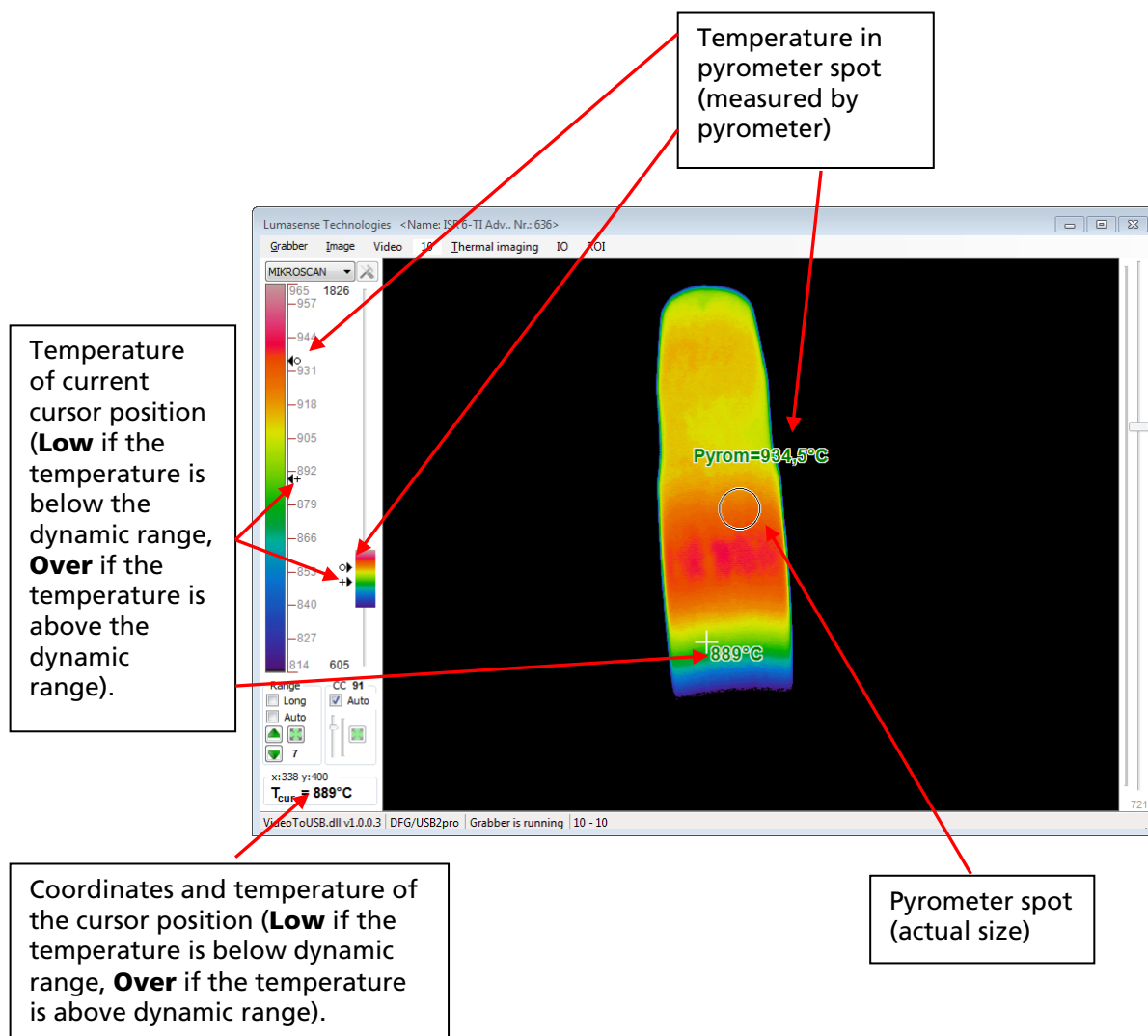
- Pyrom = xxx°C (currently measured temperature in pyrometer spot (is displayed in Red if the selected settings (Range / Emissivity correction) are inappropriate)

Additionally:

- Range ↓ : Measuring temperature lies above the chosen range - please select higher range
- Range ↑ : Measuring temperature lies below the chosen range - please select lower range
- Temp ↓ : Measuring temperature lies below the measuring range of the pyrometer
- Temp ↑ : Measuring temperature lies above the measuring range of the pyrometer
- CC Over: With currently received signals (grabber and pyrometer) emissivity of measuring object currently lies above calculable limits
- CC Under: With currently received signals (grabber and pyrometer) emissivity of measuring object currently lies below calculable limits

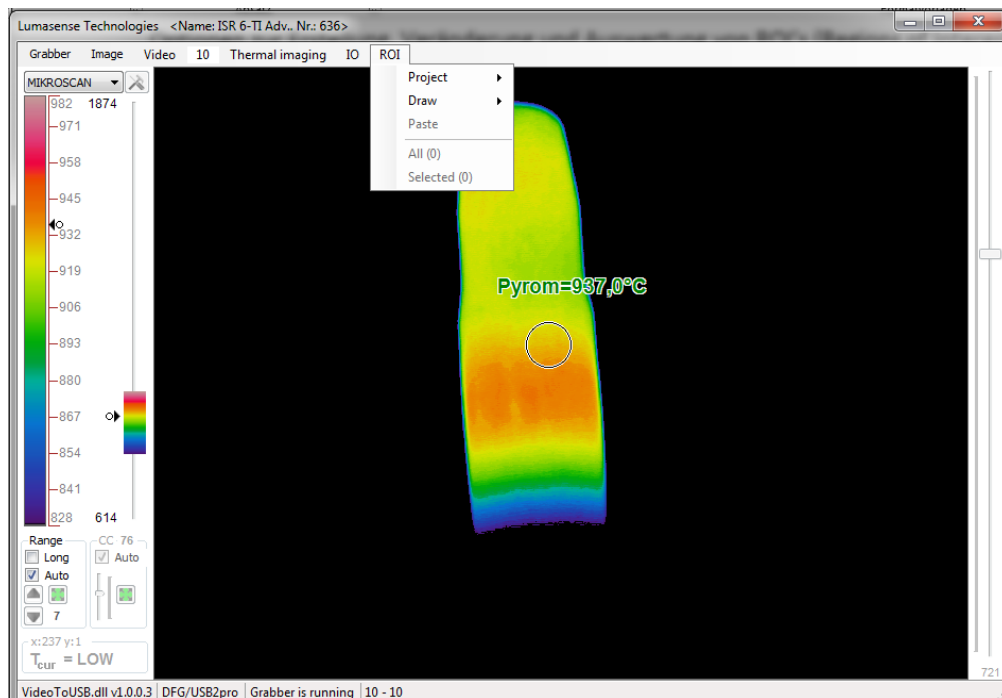
For displaying the cursor, there are the following options:

- Temperature: Temperature in current cursor position (is also displayed at the lower left corner of the screen)
- Wait: Software calculates values for temperature display
- Low: Temperature in current cursor position lies below the chosen range
- Over: Temperature in current cursor position lies above the chosen range



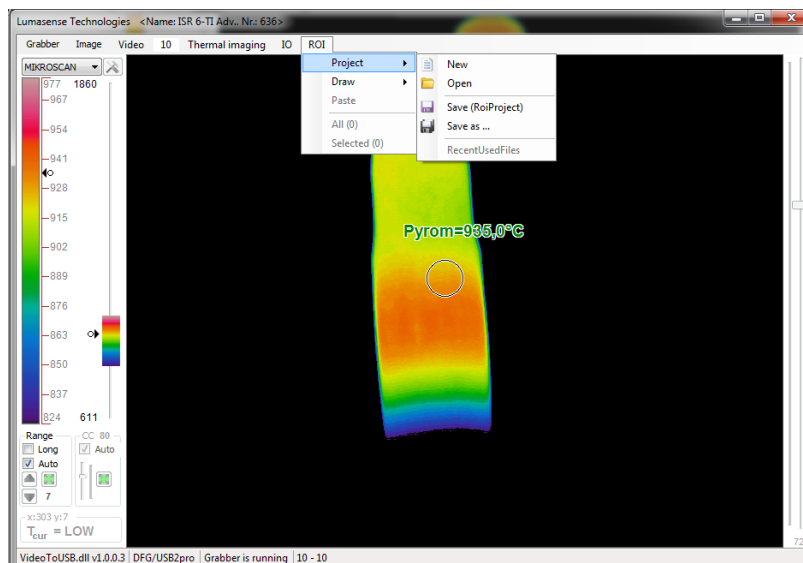
5.4.1.11 ROI

Allows you to create, edit, and evaluate ROIs (Regions of Interest) in the thermal image. (The ROI menu can also be accessed by right-clicking on the thermal image.)



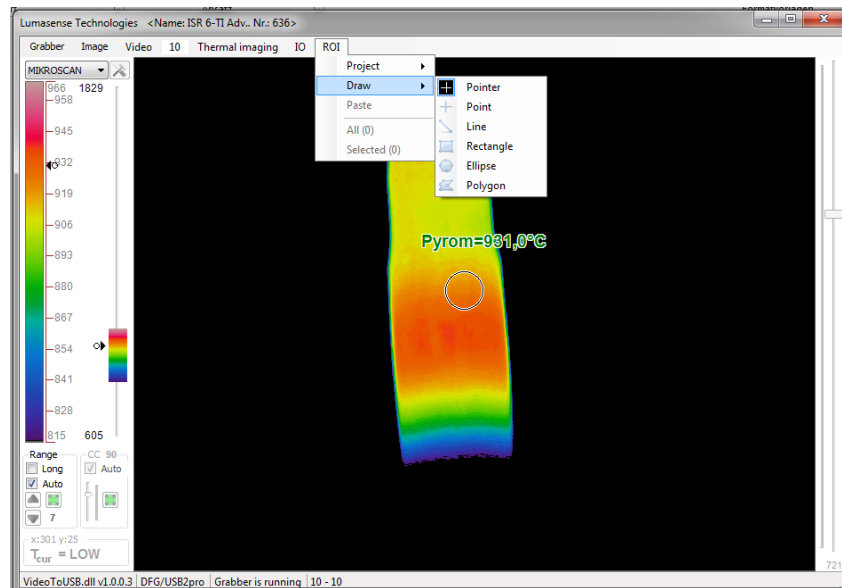
Project:

- New: Create new project
- Open: Open an existing project
- Save / Save as: Saving of the current project
- RecentUsedFiles: Recently used / edited files



Draw:

1. Select the desired ROI form.
OR,
Right-click on the thermal image > select Draw > select the desired ROI form.
2. Draw the ROI directly into the thermal image using the mouse.
3. After the ROI has been drawn, the cursor will automatically be set to "Pointer".
4. To continue drawing additional ROIs, you have two options:
 - Repeat steps 1 and 2, and draw directly into the thermal image
OR,
 - Mark one ROI, copy (Ctrl + C or use the ROI menu) and paste (Ctrl + V or use the ROI menu) it. If multiple ROIs are marked, they can be edited and copied/pasted simultaneously.



Pointer: Mouse pointer

Point: Point (1 Pixel)

Line: Line shaped ROI

Rectangle: Rectangular ROI

Ellipse: Elliptical ROI

Polygon: Arbitrary / user defined form

Paste:

Paste copied ROIs

All (number of created ROIs):

Allows for simultaneous editing of all ROIs

Selected (number of currently selected ROIs):

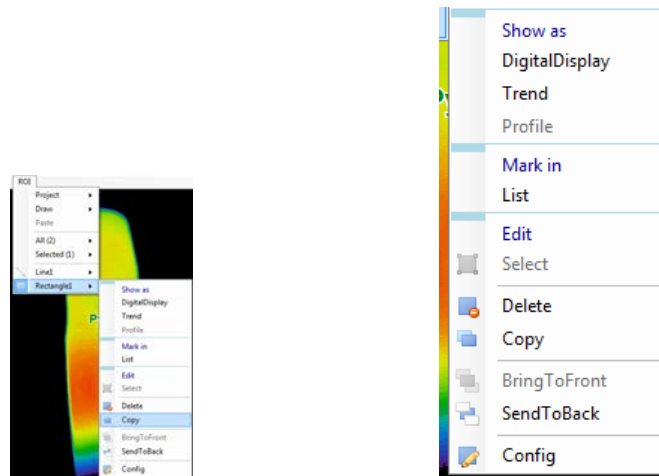
Allows for simultaneous editing of all selected ROIs

Name of ROI (appears for each ROI drawn):

Allows for editing of single ROIs

Editing ROIs

Options for editing ROIs are available through the main ROI menu.

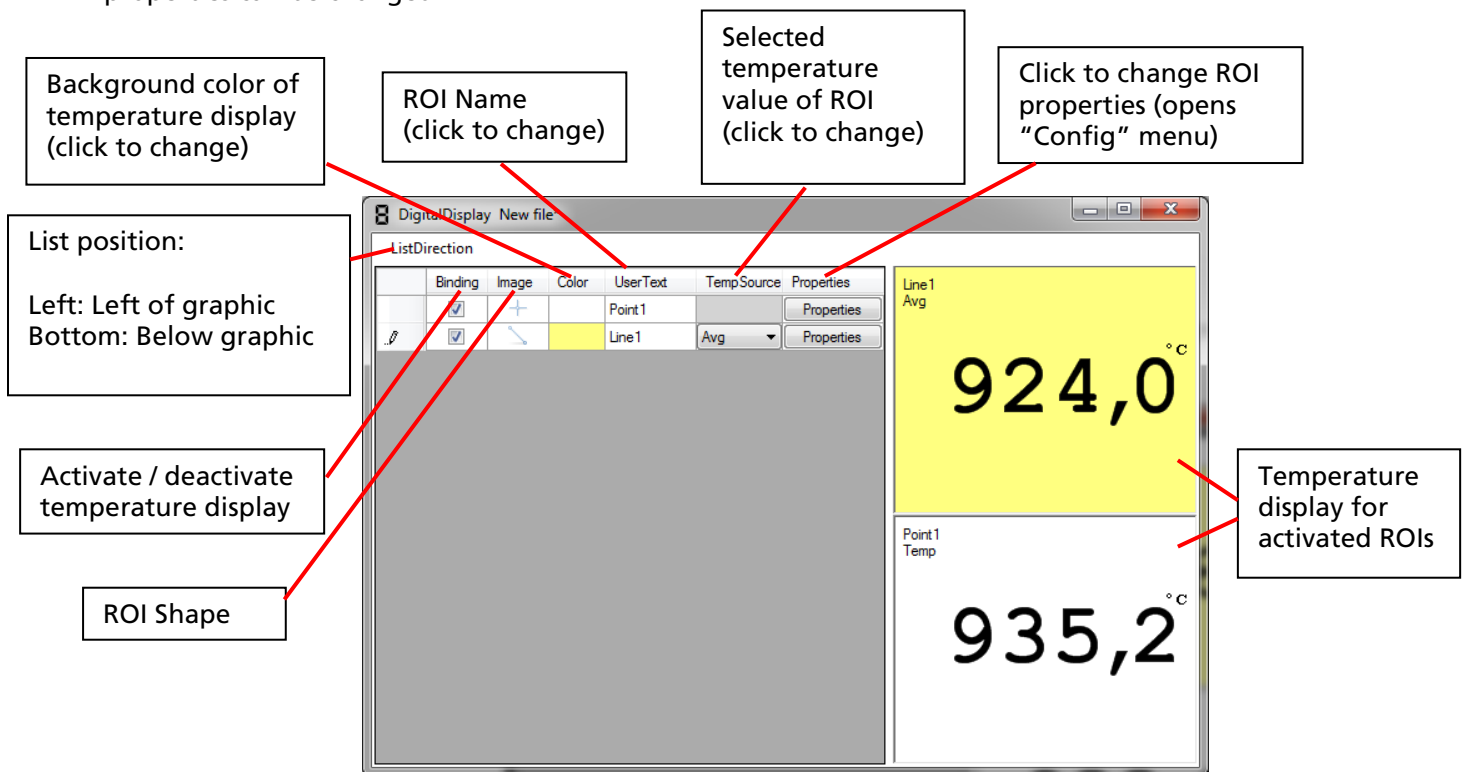


Show as

Additional information can be displayed for the selected ROIs. Possible options are written in Black, impossible options are written in Gray.

Digital Display:

The temperature values chosen for each ROI (Average temperature (Avg), Maximum temperature (Max), Minimum temperature (Min), Difference temperature (Dif)) are shown as a digital display in a separate window. In this window, some of the display options and ROI properties can be changed.



Trend:

The temperature values chosen for each ROI (Average temperature (Avg), Maximum temperature (Max), Minimum temperature (Min), Difference temperature (Dif)) are shown as a temperature curve in a separate window. In this window, some of the display options and ROI properties can be changed.

The screenshot shows the 'Trend' software interface with several callout boxes explaining its features:

- List position:**
Left: Left of graphic
Bottom: Below graphic
- Display speed of graphic (from slow (-4x) to fast (+4x))**
- ROI Name (click to change)**
- Selected temperature value of ROI (click to change)**
- Click to change ROI properties (opens "Config" menu)**
- Scaling of graphic:**
 - Fit to total range: Scaling to complete temperature range
 - Fit to sub range: Scaling to active dynamic range
 - Fit to dif range: Scaling to extent of active dynamic range
- ROI Shape**
- Color of temperature curve (click to change)**
- Activate / deactivate temperature curve**
- Temperature curves for active ROIs**

The software window displays a temperature curve on a black background with a color scale on the left ranging from 771°C to 912°C. The curve is labeled 'Line1' and 'Point1'.

Profile:

The temperature profiles of line-shaped ROIs are shown in a separate window. In this window, some of the display options and ROI properties can be changed.



Note: The option of displaying temperature profiles is only possible for line-shaped ROIs.

Scaling of graphic:

- Fit to total range: Scaling to complete temperature range
- Fit to sub range: Scaling to active dynamic range
- Fit to dif range: Scaling to extent of active dynamic range

List position:

- Left: Left of graphic
- Bottom: Below graphic

ROI Name (click to change)

Click to change ROI properties (opens "Config" menu)

Activate / deactivate temperature profile

ROI Shape

Color of temperature profile (click to change)

Temperature profile for active ROIs



Note: The scaling "Fit to dif range" for the "Trend" and "Profile" charts only makes sense if the temperatures to be displayed are lower than the extent of the currently selected dynamic range. In most instances, this will only be the case if "Dif" has been selected as the relevant temperature value for the particular ROI.



Note: The temperature for a ROI in shape of a Point is always the current temperature of the pixel in that point, so the settings Avg, Max and Min are always deactivated for point-shaped ROIs.

Mark in

List:

Display a complete ROI overview and markings of selected ROIs.

The screenshot shows the 'Listing Project*' window with a table of ROI data. Red callout boxes point to various elements: 'ROI Shape' points to the shape icons in the 'Image' column; 'ROI Color (click to change)' points to the 'Color' column; 'ROI Name (click to change)' points to the 'UserText' column; 'Worksheets for display of all ROIs respectively all ROIs with same shape' points to the tabs at the top; 'Click to change ROI properties (opens "Config" menu)' points to the 'Properties' buttons; and five boxes at the bottom describe the temperature columns: 'Temperature in pyrometer spot' (Pyr), 'Maximum temperature in ROI' (Max), 'Minimum temperature in ROI' (Min), 'Average temperature of ROI' (Avg), and 'Difference between maximum and minimum temperature' (Dif).

Image	Color	UserText	Pyr	Max	Min	Avg	Dif	Properties
		Rectangle1	1202°C	1202°C	1132°C	1181°C	70°C	Properties
		Point1	1202°C	1211°C				Properties
		Line1	1202°C	1188°C	1116°C	1158°C	72°C	Properties
		Ellipse1	1202°C	1187°C	1148°C	1169°C	39°C	Properties

Edit:

Editing of ROIs.

Select:

Select/mark ROIs (only reasonable for "All").

Delete:

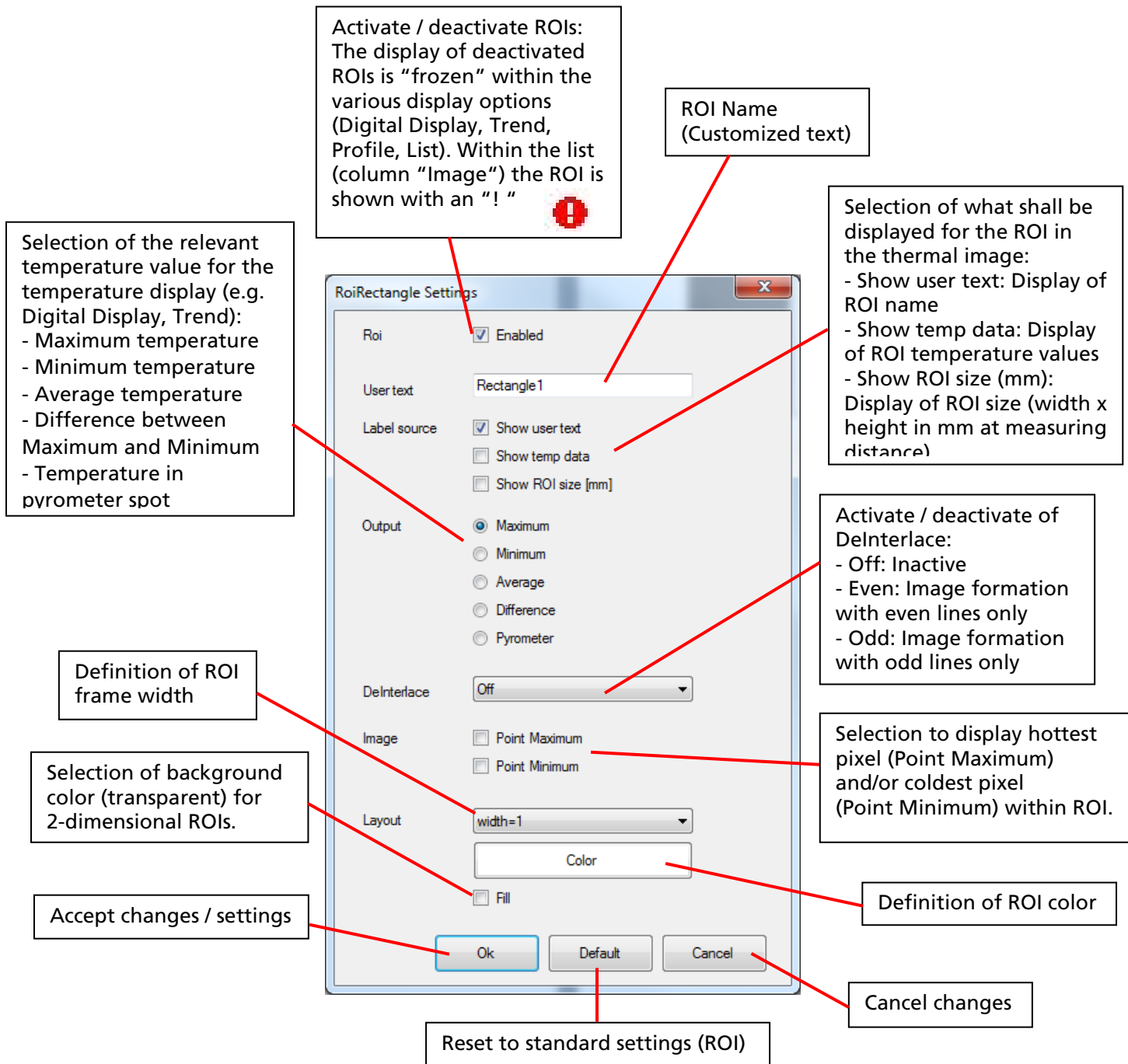
Delete selected/marked ROIs.

Copy:

Copy marked ROIs.

Config:

Open menu to edit ROI properties.



Note: When creating, evaluating, and editing ROIs, it is important to make sure that all temperature values inside a ROI are analyzable and presentable, i.e. they need to lie within the selected dynamic range. If a ROI does contain non-analyzable temperatures, the accordant (non-analyzable) temperature values (e.g. Avg, Dif) will not be shown and displayed. Instead, the system will display "Low" in case the non-analyzable temperatures are too low or "Over" in case they are too high.

5.4.1.12 I/O

The ISR 6-TI Advanced can be used together with I/O modules. LumaSense e.g. offers the following I/O modules:

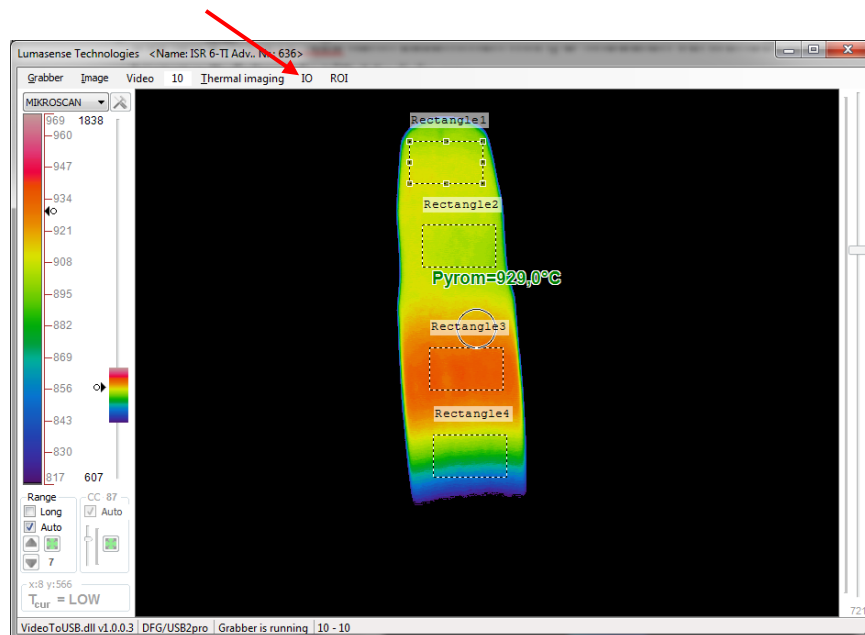
3 826 710 (USB-I/O Interface with USB cable – 1 channel) or

3 826 770 (IO 8-6, IO module with 8 Inputs and 6 Relay outputs, RS485)

The IO 8-6 module can additionally be combined with the Analog output module IA 2 (2 analog outputs, Ref. No. 3 826 780).

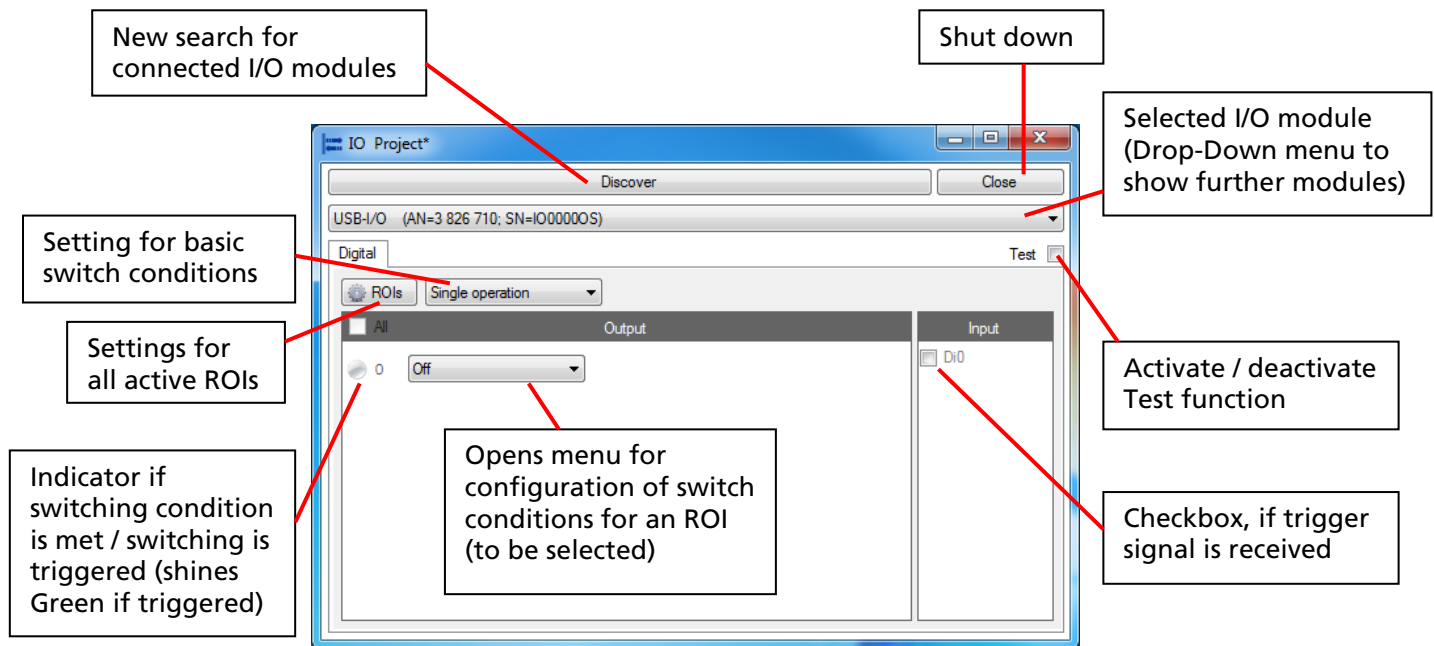
Instead of an I/A module, the pyrometer can also be defined and used as the source for the analog output (see end of chapter 5.4.1.12).

The combination with an I/O module is of particular interest if a switching contact shall be triggered based on the temperature data of one or several ROIs.



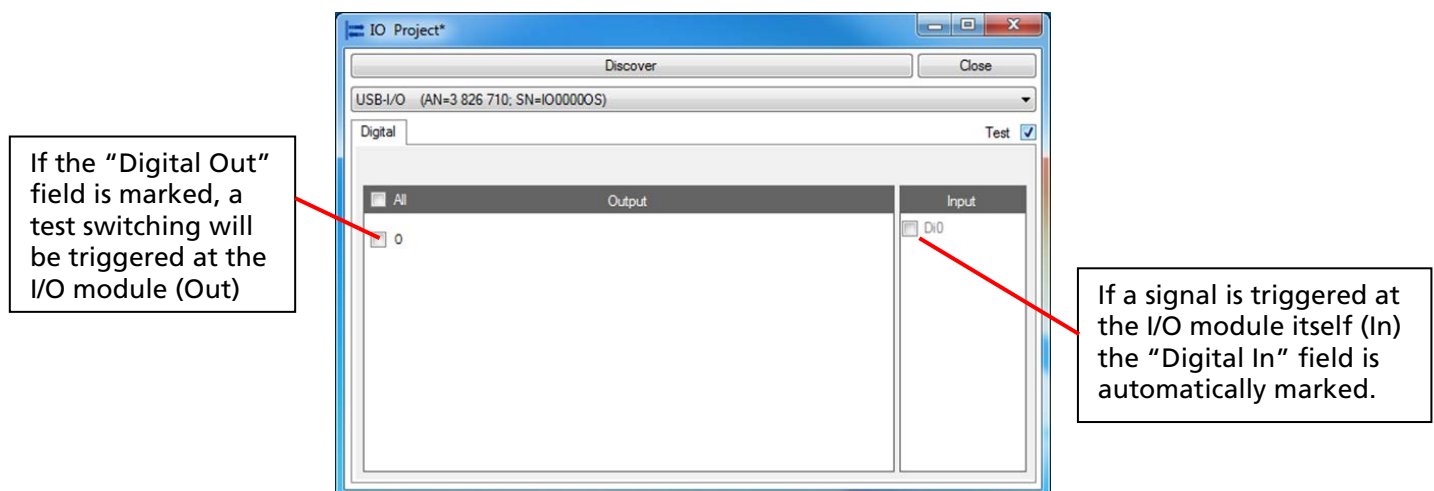
Option for configuring I/O conditions:

By clicking on "IO", InfraWin will search for connected I/O modules. The search result will be displayed in a separate window:

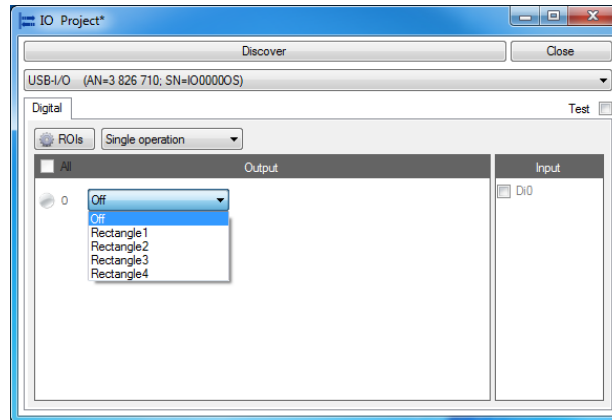


The following settings / functions are possible:

- Setting the basic switch condition:
 - o Single OP: switching conditions will be set individually for the selected ROI
 - o Find hottest ROI: switching will only be triggered if selected ROI meets the condition (= hottest active ROI)
 - o Find coldest ROI: switching will only be triggered if selected ROI meets the condition (= coldest ROI)
- Settings for all active ROIs: Opens ROI configuration window
- Test: Test mode can be used to check the correct communication between I/O module and InfraWin



- Configuring switching conditions:
Select the ROI in the Pull-Down menu for which the switching conditions shall be defined. The menu will always show all active ROIs (in the following example, these are the ROIs "Rectangle1" to "Rectangle4").



Once an ROI is selected, the switching conditions can be set, e.g.:

Indicator if switching condition is met / switching is triggered (shines Green if triggered)

Selection of ROI

Relevant temperature value for selected ROI (Max, Min, Avg, Dif) (middle), display of accordant temperature (left) and opening of ROI configuration window (right)

Selection of comparison criterion: e.g. >, >=, <, <=

Relevant temperature value for selected comparison-ROI (Max, Min, Avg, Dif) (middle), display of accordant temperature (left) and opening of ROI configuration window (right)

Selection of comparison value:

Threshold: manual entry of a temperature value or other active ROI

Hysteresis: manual entry of a hysteresis for switching condition 0 = deactivated

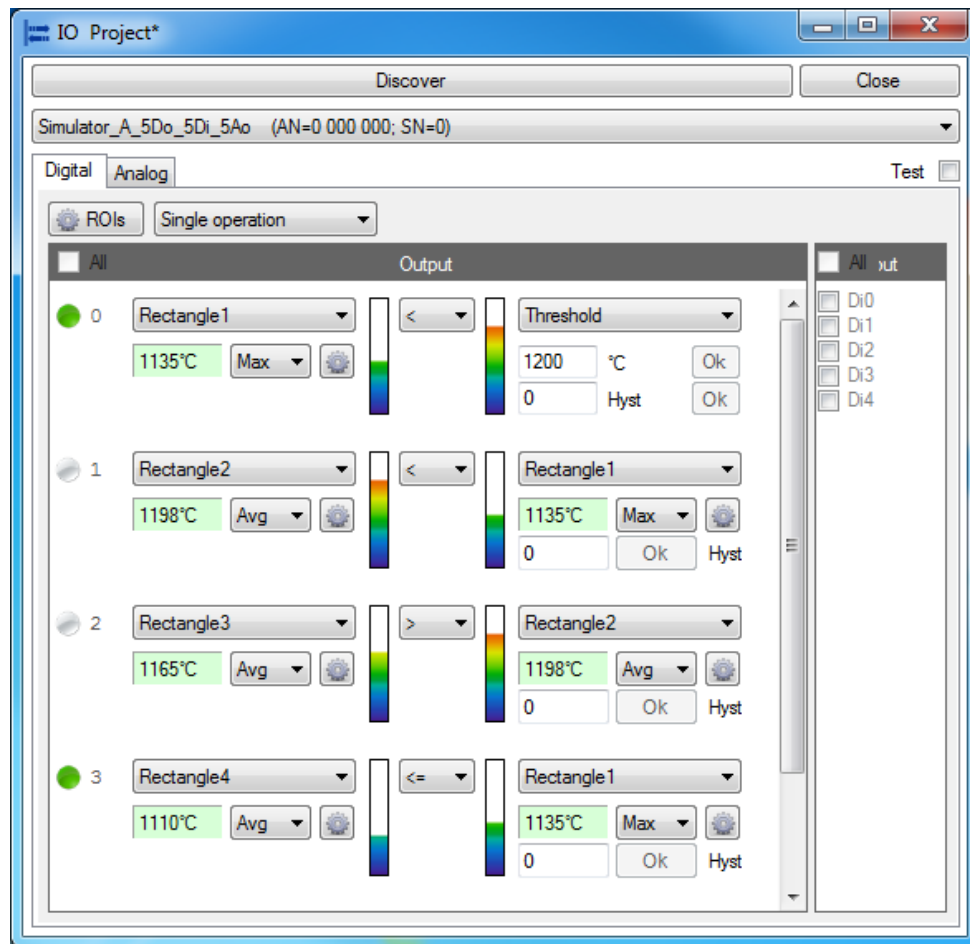
Positive value (up to 100 °C (200°F)): Switching on: at temperature value + hysteresis Switching out: at temperature value

Negative value (up to -100°C (-200°F)): Switching on: at temperature value Switching out: at temperature value - hysteresis

In the example above, a switching in the I/O module is triggered if the maximum temperature in ROI "Rectangle1" (= 1151 °C) <= the average temperature in ROI "Rectangle2" (= 1194 °C). The switching condition is met, the switching in the I/O module is triggered, and the indicator next to O shines in Green.

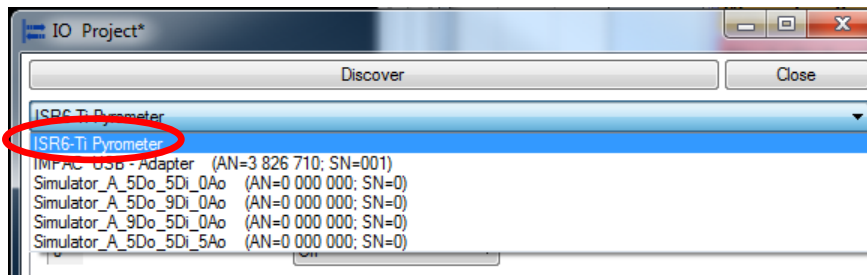
For multi-channel I/O modules, different switching conditions can be defined for different channels at the same time.

Example:



- Channel 0 shall be triggered, if the maximum temperature in "Rectangle1" is lower than 1200 °C (condition met).
- Channel 1 shall be triggered, if the average temperature in "Rectangle2" is lower than the maximum temperature in "Rectangle1" (condition not met).
- Channel 2 shall be triggered, if the average temperature in "Rectangle3" is higher than the average temperature in "Rectangle2" (condition not met).
- Channel 3 shall be triggered, if the average temperature in "Rectangle4" is lower or equal to the maximum temperature in "Rectangle1" (condition met).

Alternatively, the Pyrometer can also be selected as the source for the analog output:

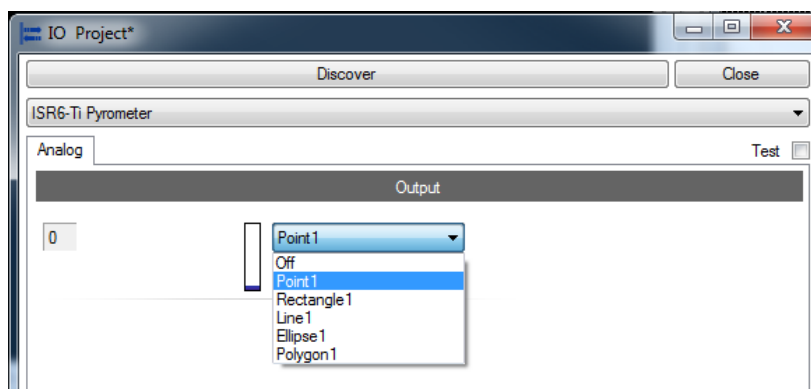


In the following window it can be selected which temperature information of the pyrometer shall be used for the analog output:

Off (=Pyrometer spot)

OR,

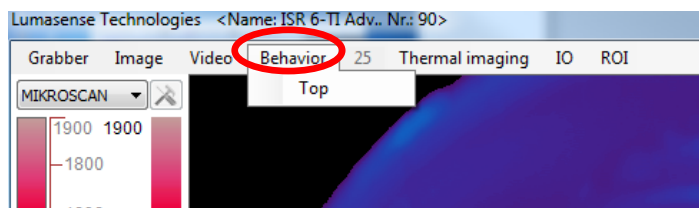
Defined ROI



Note: The I/O window remains active until a new ROI project is started or the thermal imaging function is closed.

5.4.1.13 Behavior

In new InfraWin versions (5.0.1.51 or newer) the thermal image window behavior can be defined. If **Top** in the Behavior menu is marked, the window with the thermal image is always in the foreground. If it is not marked, the window will behave like any other “normal” window.



6 Maintenance

6.1 Cleaning ISR 6-TI Window

Because there are no moving parts in the ISR 6-TI, the only regular maintenance required is a periodic inspection of the front window for build-up of foreign particles which, in time, can influence the energy received by the instrument. The ISR 6-TI has a "Dirty Window" warning alarm feature that can measure the current window/optical path transmission and provide a contact closure alert when the window transmission falls below the user set point.

The ISR 6-TI window is not water soluble and therefore, can be cleaned with standard lens tissue dampened with a camera-store lens-cleaning solution. A soft blower/brush (also at camera stores) should be used to remove any grit on the window before you rub the lens with lens tissue and solution.



Warning: NEVER CLEAN THE ISR 6-TI Advanced 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.

6.2 Calibration

LumaSense calibrated your pyrometer at the factory and delivered your instrument with a Works Certificate. Normally we advise against changing the factory set calibration. If you believe that the calibration may have changed, perhaps because your operating environment is severe, an approximate field (on-site) calibration is possible. You have the choice of an on-site calibration or arranging a more precise calibration at the LumaSense factory.



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.

6.2.1 Laboratory Calibration

Contact LumaSense for information about calibration at the LumaSense factory. For most of our customers who do not have large numbers of infrared thermometers in service, we recommend that our laboratory be chosen to do calibration. When you have many infrared thermometers, you may find it most convenient and economical to have your own calibration laboratory. LumaSense has a variety of blackbody calibration sources including very economical ones. Among these you may find the source most suitable for your own laboratory.

6.2.2 On-Site Calibration

See the Chapter [9](#): Troubleshooting in this manual before attempting to perform your own calibration. The instrument was calibrated at the factory to its original accuracy as stated.

Nearly all erroneous temperature readings are caused by application problems such as:

- **Emissivity factor:** Carefully read “Emissivity Slope K” found in section [4.3](#) of this manual for information on this topic. Also use the InfraWin “K: AutoFind” function as described in the InfraWin manual to determine the actual emissivity ratio of the target.
- **Reflections:** Unexpectedly high readings may be caused by the ISR 6-TI Advanced “seeing” a reflection of another hotter source, especially if the target emissivity is less than 0.8.
- **Spot Sizes:** Ensure the ISR 6-TI Advanced is using a proper focused distance and takes into account the spot size in relation to measuring distance.

In the 1-color (mono) mode, the pyrometer can measure objects at any distance. However, the object has to be bigger than or at least as big as the spot size of the pyrometer in the measuring distance.

In the 2-color (ratio) mode, the object can be somewhat smaller than the spot diameter.

Information on this topic can be found in section 3.4 Optics and section 4.14 Focused Distance.

- **Obscured window:** Refer to Cleaning ISR 6-TI Window, section [6.1](#).



Note: The ISR 6-TI Advanced can only be used with the video grabber and video cable that have been calibrated into the system by the factory. These parts will display the same serial number as the instrument.

7 Data format UPP (Universal Pyrometer Protocol)

Software commands can be exchanged directly with the pyrometer through an interface using suitable communication software or by using the **Test** function located in the **Pyrometer Parameters** window of the InfraWin software package.

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) no handshake;
- The device responds to the entry of a command with output (such as the measuring value) + CR (Carriage Return, ASCII 13), to pure entry commands with **ok** + **CR**, or **no** + **CR**.
- Every command starts with the 2-digit device address AA followed by two lower case command letters and finished with CR.

Example Read Command: 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%

- The ASCII parameter "X" indicates a change to be made in a parameter. When used, the command contains the new value.

Example Write Command: Entry: "00emXXXX" + CR

The parameter used for the emissivity setting (ε) with the address 00 is changed.

Answer: "00em0853" + <CR> changes the Emissivity to 0.853 or 85.3%

- A "?" after the lower case command letters answers with the limits of the respective settings (only at setting commands, not at query commands).

Example Read Limits Command: Entry: "00em?" + ~CR!

Answer: Could be 00501000 + <CR>, which means that E can vary between 0.050 and 1.000 (or 5% and 100%)

Description	Command	Parameters
Analog output	AAasX	X=0 (0 to 20mA) X=1 (4 to 20mA)
Minimum intensity switch-off level	AAawXX AAaw	XX=02 to 50 (2% to 50%) Answer: DD 2 decimal digit 02 to 50
Reference number	AAbn	Output: XXXXXX (hex 6-digit)
Baud rate (set)	AAbrX	X = 0 to 6 or 8 (dec.) 0 = 1200 Baud 1 = 2400 Baud 2 = 4800 Baud 3 = 9600 Baud 4 = 19200 Baud 5 = 38400 Baud 6 = 57600 Baud 7 = is not allowed 8 = 115200 Baud
"Dirty Window" Warning	AAdwXX	XX = 00 ...99% (2 digit, hex.)

Description	Command	Parameters
Read parameters	AApa	Answer: 15 decimal digits DD : Emissivity (see em) .. D : Response time (see ez) ... D : Clear peak memory (see lz) D : Analog output (see as) DD : Internal temperature (see gt) DD : Device address (see ga) 4 : Baud rate (see br) 0 , , , : always 0 DDDD : Ratio correction (see aw)
Serial number	AAsn	Output: XXXXX (hex 5-digit)
Read signal strength*	AAtr	Answer: DDDD 4 decimal digit 0000 to 1500
Device type/ software version	AAve	Answer: VMMJJ VV=54 MM=Month JJ=Year of software version
Communication Module/ software version in detail	AAvc	tt.mm.jj XX.YY tt = day; mm = month; yy = year; XX.YY = software version
Software version in detail	AAvs	tt.mm.yy XX.YY tt = day; mm = month; yy = year; XX.YY = software version

*Read Signal Strength stands for product of emissivity, surface coverage and transmission of the measuring distance.

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

Additional instruction for the RS485 interface:

Requirements to the master system during half-duplex operation:

1. After an inquiry, the bus should be switched into a transmission time of 3 bits (some older interfaces are not fast enough for this).
2. The pyrometer's response will follow after 5 ms, at the latest.
3. If there is no response, there is a parity or syntax error and the inquiry has to be repeated.
4. After receiving the response, the master has to wait at least 1.5 ms before a new command can be entered.

8 Reference Numbers

8.1 Reference number instrument

3 904 620	ISR 6-TI Advanced, 700...1800 °C (includes video grabber and 5 m video cable)
3 904 680	ISR 6-TI Advanced, 700...1800 °C (includes video grabber and 10 m video cable)
3 904 700	ISR 6-TI Advanced, 700...1800 °C (includes video grabber and 20 m video cable)
3 904 720	ISR 6-TI Advanced, 700...1800 °C (includes video grabber and 40 m video cable)

Ordering note:

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

8.2 Reference numbers accessories

3 820 330	5 m connection cable with straight connector	(All connection cables include a short adapter cable with a 9-pin D-SUB connector. This connector may be used in combination with the RS485 to USB adapter.)
3 820 500	10 m connection cable with straight connector	
3 820 510	15 m connection cable with straight connector	
3 820 810	20 m connection cable with straight connector	
3 820 820	25 m connection cable with straight connector	
3 820 520	30 m connection cable with straight connector	
3 820 340	5 m connection cable with right angle connector	
3 820 530	10 m connection cable with right angle connector	
3 820 540	15 m connection cable with right angle connector	
3 820 830	20 m connection cable with right angle connector	
3 820 840	25 m connection cable with right angle connector	
3 820 550	30 m connection cable with right angle connector	
3 920 600	5 m Video cable f. Series 6, BNC connector, adapter Cinch*	
3 920 610	10 m Video cable f. Series 6, BNC connector, adapter Cinch*	
3 920 630	20 m Video cable f. Series 6, BNC connector, adapter Cinch*	
3 920 660	40 m Video cable f. Series 6, BNC connector, adapter Cinch*	
3 826 730	Video grabber with USB cable*	
3 852 290	Power supply NG DC for DIN rail mounting; 100 to 240 V AC $\Rightarrow$ 24 V DC, 1 A	
3 852 550	Power supply NG 2D for DIN rail mounting; 85 to 265 V AC $\Rightarrow$ 24 V DC, 600 mA with two settable limit switches	
3 826 750	USB-RS485 adapter cable, 1.8 m, HS Version 4.5 Mbd	
3 852 440	Protocol transducer RS485/RS232 (switch.) $\leftrightarrow$ Profibus-DP for 1 device	
3 852 460	Protocol transducer RS485 $\leftrightarrow$ Profibus DP for 32 devices	
3 852 620	Protocol converter UPP RS485 or RS232 $\leftrightarrow$ ProfiNet, for 1 pyrometer	
3 852 630	Protocol converter UPP RS485 $\leftrightarrow$ ProfiNet, for max. 32 pyrometers	

3 891 220	DA 4000: LED-display, 2-wire power supply, 2 limit switches (relay contacts), 115 V AC
3 890 650	DA 4000: LED-display, 2-wire power supply, 2 limit switches (relay contacts), 230 V AC
3 890 570	DA 6000-N digital display to allow adjustment of the pyrometer through the RS485 interface
3 890 530	DA 6000: like DA 6000-N with analog input and 2 limit switches for the RS485 interface
3 826 510	PI 6000: PID programmable controller, very fast, for digital IMPAC pyrometers
3 846 260	Instrument's support (Series 5 & 6)
3 834 210	Adjustable mounting support (Series 5 & 6)
3 846 290	Instrument's support (Series' 5 & 6) with fused silica window
3 835 590	90° mirror for Series 5 and Series 6, quartz glass window
3 835 160	Air purge unit, aluminum
3 837 230	Water cooling jacket (heavy duty) with integrated air purge
3 837 280	Water cooling jacket (heavy duty) with fused silica window
3 837 540	Cooling plate for series 5 and 6, with air purge
3 846 590	Vacuum support KF16 with quartz glass window
3 826 770	IO 8-6: IO module with 8 Inputs and 6 Relay outputs, RS485
3 826 780	IA 2: Analog output module with 2 analog outputs (can only be used together with 3 826 770)
3 826 710	USB-I/O Interface with USB cable

* For replacement only: please note that video cable and grabber needs to be calibrated with the instrument. If a replacement video cable or grabber is ordered the instrument will have to be calibrated in the factory!

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