

# Pyrometer CellaTemp **PA 21, 31, 36**

Mat. No.: 103 9316 10/2018



Copyright prohibits the reproduction or distribution of this instruction manual, including text, photographs or images contained herein, in whole or in part, for any purpose whatsoever, without prior consent of the author. This applies to any form of mechanical or electronic reproduction as well as to electronic transmission in any form through any medium.

**Please note:**

Unless otherwise stated in this instruction manual, the instruments described herein are subject to change without prior notice, particularly modifications for the sake of technological advancement.

© 2010 KELLER HCW GmbH  
Carl-Keller-Straße 2 - 10  
D-49479 Ibbenbüren  
Germany  
[www.keller.de/its/](http://www.keller.de/its/)

# Contents

|          |  |           |
|----------|--|-----------|
| <b>1</b> | <b>Miscellaneous .....</b>   | <b>1</b>  |
| 1.1      | Information about this manual .....  | 1         |
| 1.2      | Explanation of symbols.....  | 1         |
| 1.3      | Liability and Warranty .....   | 1         |
| 1.4      | Copyright.....   | 2         |
| <b>2</b> | <b>Safety .....</b>  | <b>2</b>  |
| 2.1      | Intended use .....   | 2         |
| 2.2      | User's responsibility.....   | 3         |
| 2.3      | Safety requirements .....  | 3         |
| 2.4      | Electromagnetic Compatibility .....  | 3         |
| 2.5      | Quality Management Certification.....  | 3         |
| 2.1      | Environmental Management.....  | 3         |
| <b>3</b> | <b>General Description.....</b>  | <b>4</b>  |
| 3.1      | Integrated Digital Display.....  | 5         |
| <b>4</b> | <b>Quick Reference Guide .....</b>   | <b>6</b>  |
| 4.1      | PA Connector Pin Assignment .....  | 6         |
| 4.2      | Assembly fibre optic cable.....  | 6         |
| 4.3      | Current Outputs 0/4 - 20mA.....  | 7         |
| 4.4      | Switching output.....  | 8         |
| <b>5</b> | <b>Getting Started.....</b>  | <b>9</b>  |
| 5.1      | General installation tips .....  | 9         |
| 5.2      | Pyrometer Alignment to Target.....   | 9         |
| 5.3      | Safety instructions and precautions .....  | 11        |
| 5.3.1    | Laser Radiation Hazard .....   | 11        |
| 5.3.2    | Laser Power .....  | 11        |
| 5.3.3    | Laser Warning Label .....  | 11        |
| 5.3.4    | Laser warning label must be visible! .....   | 12        |
| 5.4      | Setting parameters at the pyrometer (basic configuration).....   | 12        |
| 5.5      | Setting Emissivity .....   | 13        |
| 5.6      | Output current range .....   | 14        |
| 5.7      | Simulated current signal for functional testing.....   | 14        |
| <b>6</b> | <b>Functioning of the pyrometer .....</b>  | <b>15</b> |
| 6.1      | Internal signal processing.....  | 15        |
| <b>7</b> | <b>Configuration and Setup .....</b>   | <b>16</b> |
| 7.1      | Signal Conditioning .....  | 16        |
| 7.1.1    | Emissivity and Transmittance .....   | 16        |
| 7.1.2    | Ambient Temperature Compensation .....   | 16        |
| 7.1.3    | Temperature offset using linear interpolation .....  | 17        |
| 7.1.4    | Signal Smoothing Filter.....   | 18        |
| 7.1.5    | Min/Max Data .....   | 19        |
| 7.2      | I/O Configuration .....  | 23        |
| 7.2.1    | Selectable current output range.....   | 23        |
| 7.2.2    | Digital outputs .....  | 24        |
| 7.2.3    | Function „Level“ .....   | 25        |
| 7.2.4    | Function „Range“ .....   | 26        |
| 7.2.5    | Digital inputs.....  | 27        |
| 7.2.6    | Analogue input for emissivity correction or ambient temperature compensation ....  | 27        |
| 7.3      | General functions (configuration layer $\llcorner \square \uparrow \uparrow$ ).....  | 28        |
| 7.3.1    | Green Status LED .....   | 28        |
| 7.3.2    | Activate Laser .....   | 28        |
| 7.4      | Simulate current signals for analogue output Ao1 and Ao2 (configuration layer: $\llcorner \square \square \square$ ) ..... | 28        |
| <b>8</b> | <b>Setting Parameters at the device.....</b>   | <b>29</b> |
| 8.1      | Configuration layers.....  | 29        |

|           |   |           |
|-----------|---|-----------|
| 8.1.1     | Temperature measurement via spectral channel 1 (configuration layer: $\llcorner \text{00} \text{!}$ ) | 29        |
| 8.1.2     | Configuration I/O (configuration layer: $\llcorner \text{0} \text{!0}$ )                              | 31        |
| 8.1.3     | General Functions (configuration layer: $\llcorner \text{0} \text{!1}$ )                              | 33        |
| 8.1.4     | Displayed temperature readings  | 33        |
| 8.1.5     | Simulated current signal for outputs Ao1 and Ao2  | 34        |
| <b>9</b>  | <b>CellaView software</b>   | <b>34</b> |
| <b>10</b> | <b>Installation of the USB driver</b>   | <b>34</b> |
| <b>11</b> | <b>How to operate the pyrometer with the CellaView software</b>                                       | <b>35</b> |
| 11.1      | CellaView via USB point-to-point connection   | 36        |
| 11.2      | CellaView via RS485 point-to-point connection   | 36        |
| 11.3      | CellaView via RS485 bus connection  | 37        |
| 11.4      | Termination of RS485 bus  | 39        |
| <b>12</b> | <b>Operation of the pyrometer via terminal program</b>  | <b>39</b> |
| 12.1      | Serial Data Transmission of Temperature Data  | 40        |
| 12.2      | Terminal connection via USB   | 41        |
| 12.3      | Terminal connection via RS485   | 41        |
| <b>13</b> | <b>User-defined calibration / scaling of the current output</b>                                       | <b>43</b> |
| 13.1      | Calibration/scaling via CellaView   | 44        |
| 13.2      | Calibration/scaling via terminal connection   | 44        |
| <b>14</b> | <b>Shielding and Grounding</b>  | <b>46</b> |
| 14.1      | Potential equalisation  | 46        |
| <b>15</b> | <b>Connectivity Examples</b>  | <b>48</b> |
| 15.1      | Connection to VK 02/A Cable   | 48        |
| <b>16</b> | <b>Theory of Non-Contact Temperature Measurements</b>   | <b>49</b> |
| 16.1      | Advantages of Non-Contact Temperature Measurement   | 49        |
| 16.2      | Measurements at Black Bodies (Cavity Radiators)   | 49        |
| 16.3      | Measurements of Real Radiators  | 50        |
| 16.4      | Emissivity Coefficient Table PA 21 – PA 36  | 51        |
| <b>17</b> | <b>Maintenance</b>  | <b>52</b> |
| 17.1      | Cleaning the pyrometer lens   | 52        |
| <b>18</b> | <b>Technical Data PA 21</b>   | <b>53</b> |
| 18.1      | Field of View Diagrams for PA 21  | 54        |
| 18.1.1    | PA 21 AF 11 (Standard lens PA 41.01 M30)  | 54        |
| 18.1.2    | PA 21 AF 21 (Standard lens PA 41.05 M16)  | 55        |
| 18.1.3    | PA 21 AF 22 (Close up lens PZ 41.18 M16)  | 55        |
| <b>19</b> | <b>Technical Data PA 31</b>   | <b>56</b> |
| 19.1      | Field of View Diagrams for PA 31  | 57        |
| 19.1.1    | PA 31 AF 11 (Standard lens PA 41.01 M30)  | 57        |
| 19.1.2    | PA 31 AF 21 (Standard lens PA 41.05 M16)  | 58        |
| 19.1.3    | PA 31 AF 22 (Close up lens PZ 41.18 M16)  | 58        |
| <b>20</b> | <b>Technical Data PA 36</b>   | <b>59</b> |
| 20.1      | Field of View Diagrams for PA 36  | 60        |
| 20.1.1    | PA 36 AF 11 (Standard lens PA 41.01 M30)  | 60        |
| 20.1.2    | PA 36 AF 21 (Standard lens PA 41.05 M16)  | 61        |
| 20.1.3    | PA 36 AF 22 (Close up lens PZ 41.18 M16)  | 61        |
| <b>21</b> | <b>Dimensions</b>   | <b>62</b> |
| 21.1      | Electronic part   | 62        |
| 21.2      | Fibre optic head M 30   | 62        |
| 21.3      | Fibre optic head M 16   | 63        |
| 21.4      | Special optic head  | 63        |
| <b>22</b> | <b>Transmission values of protective glasses</b>  | <b>64</b> |
| <b>23</b> | <b>Accessories</b>  | <b>65</b> |
| 23.1      | Mounting bracket PS 11/U  | 65        |

- 23.2 Cable VK 02/A.....66
- 24 Glossary .....67**
- 25 Shipping, Packaging and Disposal .....68**
  - 25.1 Inspecting your shipment.....68
  - 25.2 Packaging .....68
  - 25.3 Disposal of used apparatus .....68
- 26 Copyright.....69**
- 27 Default settings .....70**
  - 27.1 Temperature measurement via spectral channel 1 (configuration layer:  
c 0 0 !).....70
  - 27.2 Configuration I/O (configuration layer: c 0 ! 0).....71
  - 27.3 General Functions (configuration layer: c 0 ! !).....72



# 1 Miscellaneous

## 1.1 Information about this manual

The purpose of the Operating Manual is to provide the user with all necessary information to be able to install the pyrometer and any necessary accessories.

Before starting installation, be sure to read and understand this entire manual, in particular the chapter on safety! The instructions contained in this manual, especially those concerning safety, as well as site-specific regulations governing UV radiation must be complied with at all times!

## 1.2 Explanation of symbols

Important safety-related references in this manual are marked with a symbol.



### CAUTION!

This symbol indicates important information which, if neglected, might result in pyrometer damage, malfunction or breakdown.



### NOTE !

This symbol points out guidelines which should be followed for efficient and trouble-free operation.

## 1.3 Liability and Warranty

All information compiled in this manual is in accordance with applicable regulations. The statements made are based on state-of-the-art technology and reflect our extensive knowledge and many years of experience.



### NOTE !

*Always carefully read this Operating Manual before beginning any work on or with the instrument, especially prior to installation and initial setup! The Manufacturer shall not be held liable for any damages or malfunctions arising from a disregard of the warnings and instructions contained herein.*

This Operating Manual must be retained for future use. Please ensure that all persons who wish to operate the instrument have access to this manual.

## 1.4 Copyright

This Operating Manual should be treated as confidential. It is solely intended for use by persons involved with the instrument. This manual may not be made available to a third party without prior Manufacturer's consent. Please contact the Manufacturer if the need should arise.



### NOTE !

*The data, texts, charts, drawings, images or other representations contained in this manual are copyright-protected and furthermore, subject to intellectual property rights. Violators will be prosecuted. Unauthorised use and copyright infringement will be subject to penalty by law.*

Reproductions of any kind, in whole or in part, as well as the exploitation or disclosure of this manual's content without the explicit written approval of the Manufacturer are expressly prohibited by law. Violations shall be subject to compensation claims by the Manufacturer. The right to claim additional indemnities remains reserved.

## 2 Safety

This chapter outlines all important safety aspects to be considered for optimum employee protection and to ensure safe and reliable operations.

### 2.1 Intended use

The pyrometer is solely intended for non-contact measurement of temperatures as described in this manual. Any other use is not intended. Operational safety can only be ensured when the instrument is used for its intended purpose.



### CAUTION !

**It is prohibited to use the pyrometer for any other purpose beyond what is specified in this manual. Using the instrument in any other manner will be considered as improper.**

The manufacturer is only liable for damage that occurs during correct use. The prerequisite for any liability, however, is that the cause of the damage is due to a defective product and the defect in the product was caused by the manufacturer.



## 2.2 User's responsibility

The pyrometer may only be used when it is in perfect working condition.

## 2.3 Safety requirements

The instrument works with an operating voltage of 24 VDC. The voltage required for operation must be supplied by a separate power supply. This power supply unit must conform to directive DIN IEC 61010.

## 2.4 Electromagnetic Compatibility

The devices comply with the essential safety requirements of the Electromagnetic Compatibility Directive 2014/30/EU (EMC Act).

When connecting a power supply unit, make sure that it also conforms to these standards. Radio interference may arise if the pyrometer is interconnected with such peripheral devices which have not been properly interference-suppressed. This may necessitate additional interference suppression measures.

## 2.5 Quality Management Certification

The KELLER HCW Quality Management System meets the DIN EN ISO 9001 standards for design, production, repairs and service for non-contact infrared temperature measuring equipment.



## 2.1 Environmental Management

Sustainable environmental management is more important than ever. KELLER HCW's corporate environmental management system complies with DIN EN 14001/50001 standards.



### 3 General Description

The CellaTemp PA Series provides efficient, microprocessor-controlled pyrometers for non-contact temperature measurements. The pyrometers with fibre optics are preferably used for high ambient temperatures up to 250 °C without cooling or in areas with limited access.

The spectral pyrometers PA 21, PA 31 and PA 36 are used for temperature measurements from 300 °C to 2000 °C, 600 – 2500 °C respectively 650 °C to 3000 °C. Their applications cover large segments of the iron and steel producing industry and the metal, glass, ceramics and chemical industries.

The instruments have rugged stainless steel housings which make them ideal for use in hostile industrial environments. PA pyrometers are splash water proof according to IP65 (DIN 40050)

In addition to the focusable optic, the devices have a laser spot light for alignment of the sensor on the target.

The adjustable emissivity factor makes it easy to adapt the pyrometer to the specific radiation characteristics of the particular material measured.

All pyrometers of the PA series have two analogue current outputs; each is switchable from 0 - 20 mA to 4 - 20 mA.

The output currents are linear to the measured temperature. The required temperature range can be set at the pyrometer.

When ambient temperatures are higher than the admissible working temperature, the output current is > 20.5 mA.

CellaTemp PA also features an analogue voltage input which can be used as an alternative to current output 2. The emissivity factor or a correction for reflected ambient temperature can be controlled using this voltage input.

Two serial interfaces (USB and RS485) are available. They enable the user to change all operating parameters such as emissivity setting, temperature range, smoothing function or output current range during running operations.

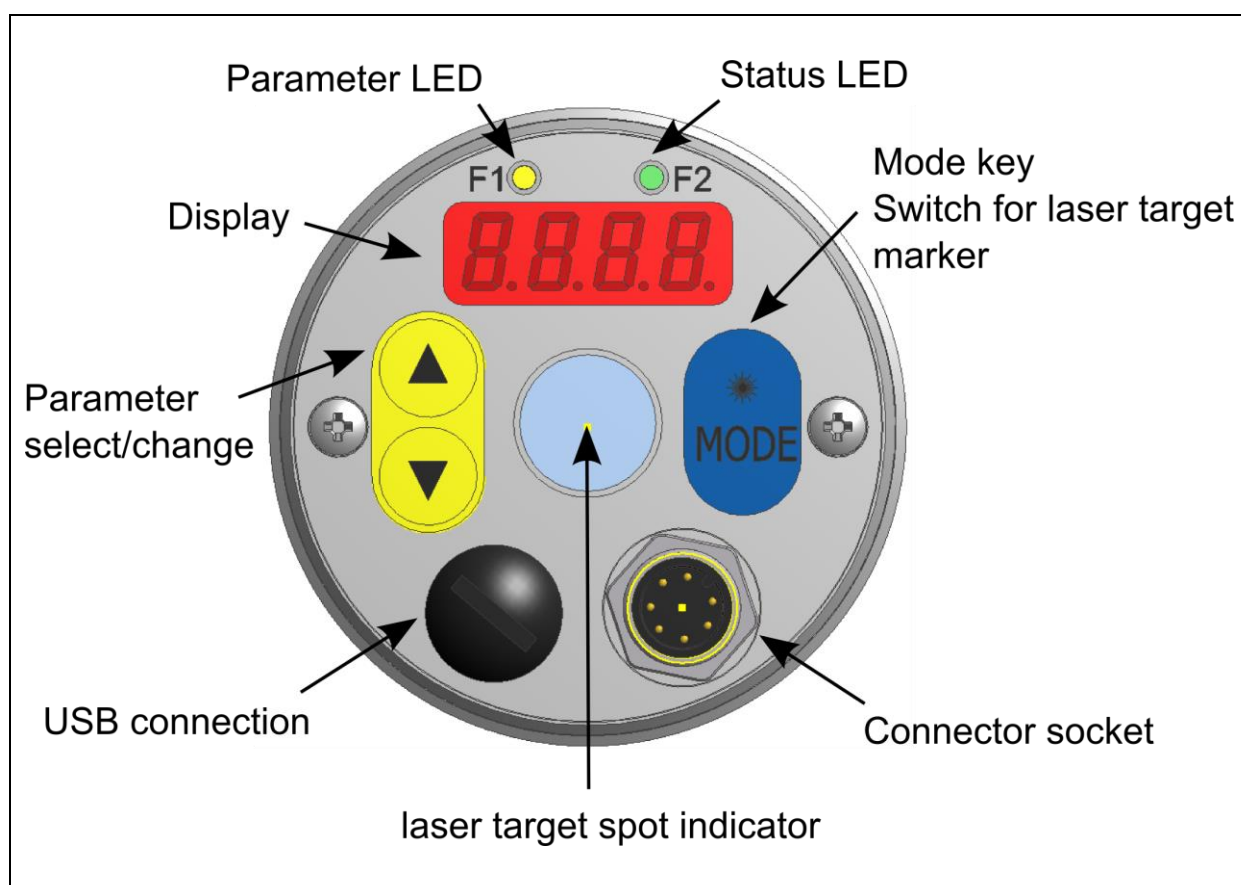
CellaTemp PA allows for continuous temperature data output in a user-configured cycle time.

### 3.1 Integrated Digital Display

#### Operating Controls and Display

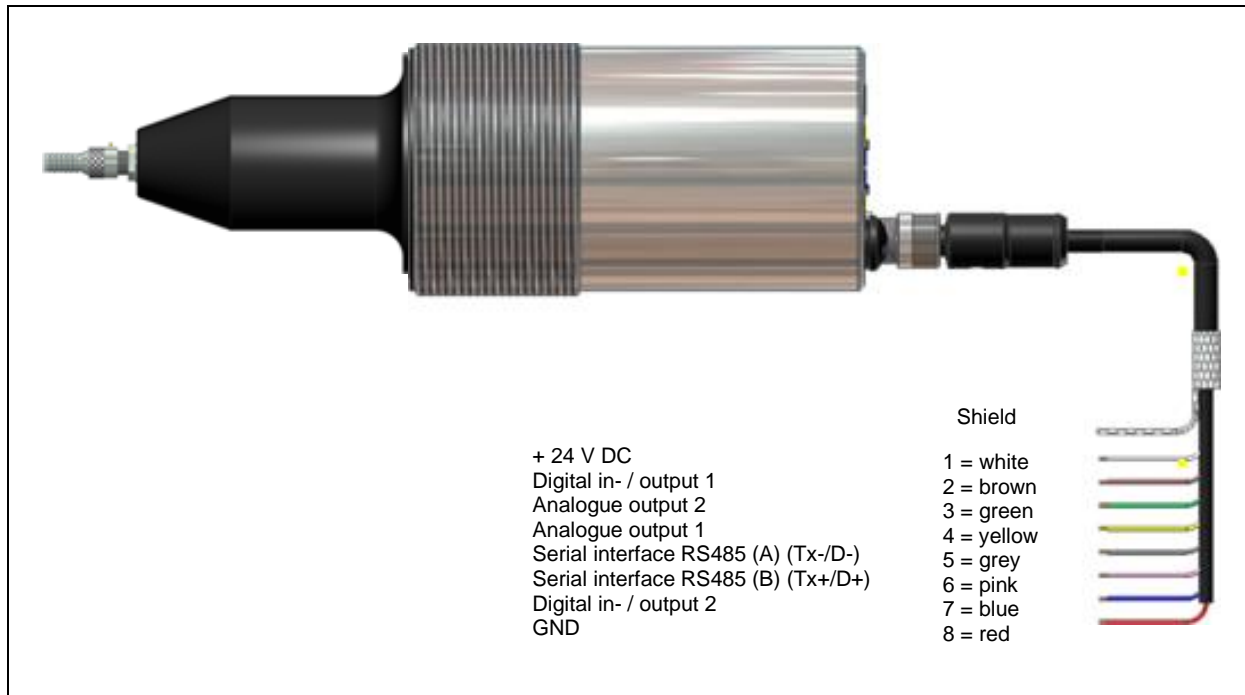
The rear panel of the CellaTemp PA has a 4-digit display and 3 push-buttons. The display shows the current temperature or, during configuration using the push-buttons, the display will show the corresponding parameter.

Whenever the display shows a parameter, the F1 Parameter LED (yellow) will light up. The function of the F2 Status LED (green) is user-configurable. In its initial state when supplied to the customer the F2 LED indicates current status for the switch able output Do1 as ready for operation.



## 4 Quick Reference Guide

### 4.1 PA Connector Pin Assignment



#### CAUTION!

*The pyrometer housing is connected to the signal ground via a 0.1 $\mu$  F/50V capacitor. Isolate any unused wires in order to avoid the display of erroneous data.*

### 4.2 Assembly fibre optic cable

One end of the optical fibre has a name plate showing the serial number of the corresponding basic pyrometer. This is the end which must be screwed onto the pyrometer. For proper connection, the arrow on the name plate of the fibre optic cable and the arrow on the pyrometer should point toward each other. The serial number of the measuring head should also correspond to the pyrometer.

#### General Remarks:

The fibre optic cable must not be exposed to tensile load and must not be twisted. The minimum bending radius is 125 mm.

### Power Requirement 24 V DC

The instrument works with an operating voltage of 24 V DC. The voltage required for operation must be supplied by a separate power supply. This power supply unit must conform to directive DIN IEC 61010.

The supply voltage is  $\leq 135$  mA for standard design,  $\leq 150$  mA with laser-powered pilot light. CellaTemp PA is equipped with inverse polarity protection. The output currents and voltages share one ground connection via pin 8 of the connector.

A self-test is performed when the instrument is switched on. The display will briefly indicate the software version and after that the emissivity setting. When the self-test is completed the pyrometer is ready for operation and the display will show the current temperature reading.



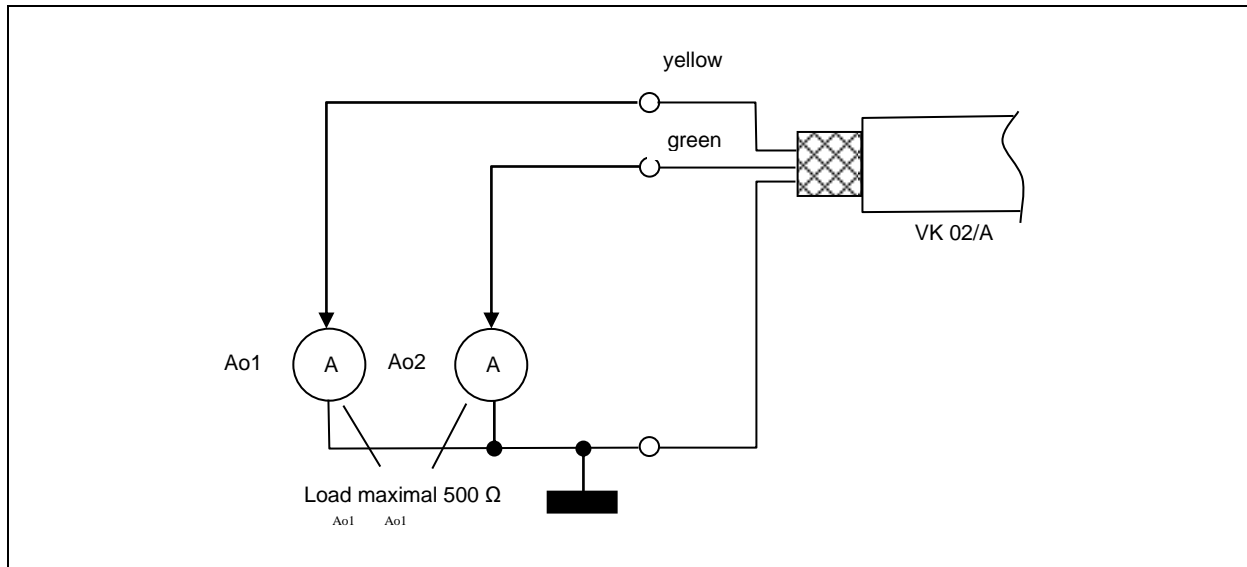
#### NOTE !

In order to achieve a high degree of measurement accuracy and repeatability it is important to allow the pyrometer time to warm up. Turn the power supply on about 10 minutes before starting. We recommend that you protect the feed line to the pyrometer against short circuit by using a 250 mA micro fuse.

### 4.3 Current Outputs 0/4 - 20mA

CellaTemp PA features two current outputs. Both of these outputs are active current sources which supply linear output current. The user can select between two scales: either 0 - 20 mA or 4 - 20 mA. Maximum load is 500  $\Omega$ .

**The two current outputs are factory preset to 4 - 20 mA !**

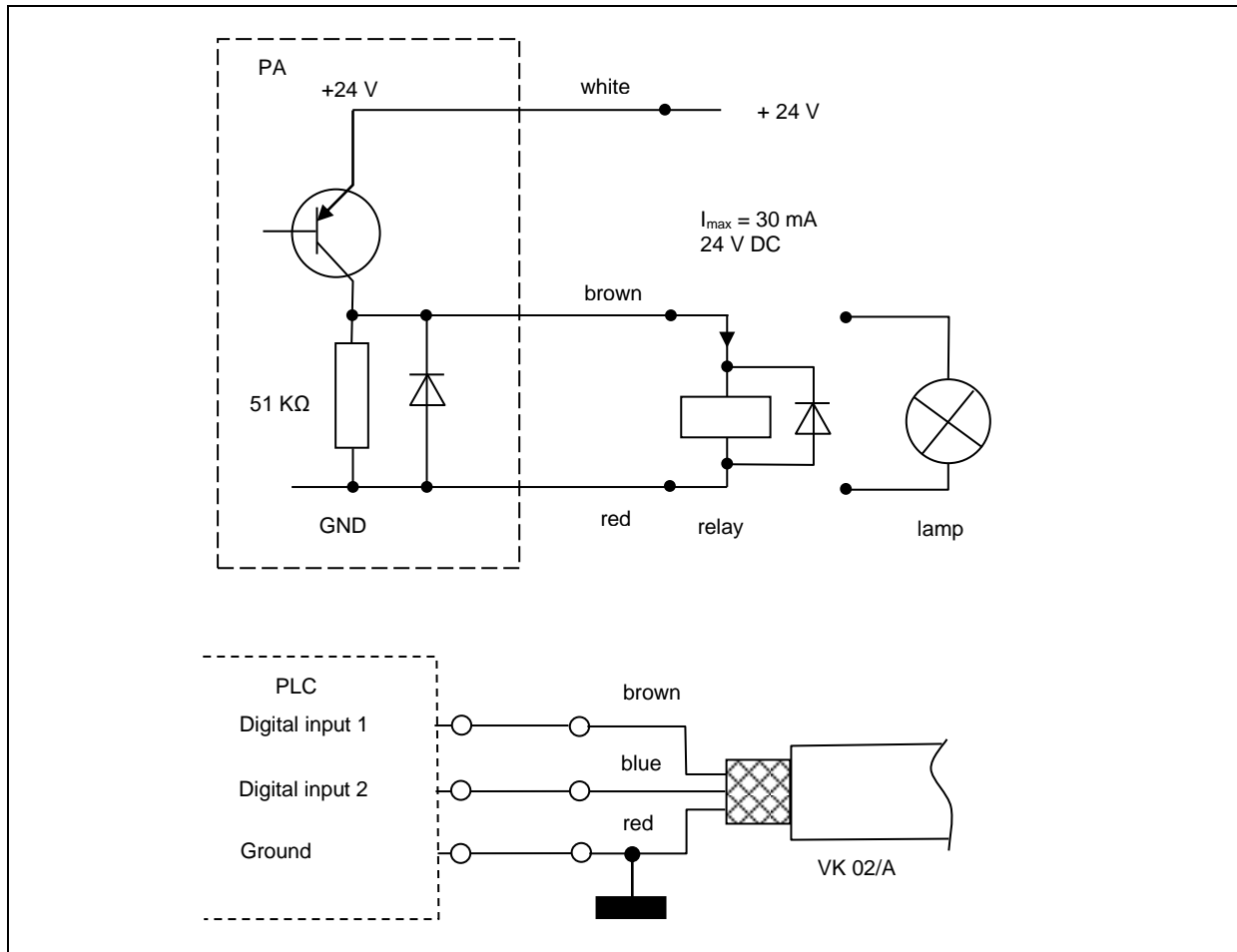


For all pyrometers of the PA series the current outputs are short-circuit-proof and share one ground connection via pin 8 of the connector. Each current output can be individually scaled and can be set either at the display or via interface.

When only one current output is required, Output 1 should be selected (Pin 4)

#### 4.4 Switching output

All pyrometers of the PA Series feature two switching outputs which can be configured as digital outputs or digital inputs. The open collector outputs allow for a voltage of +24 V DC. For signal processing a pull-down resistor can be applied to the ground connection of the supply voltage. The maximum current of each open collector output is 30 mA.



See Chapter 7.2.2 for more information configuration.

## 5 Getting Started

### 5.1 General installation tips

Install the pyrometer in a location where it will not be unnecessarily exposed to smoke, ambient heat or water vapour.

A false reading (too low) will be displayed when the pyrometer lens is dirty. Therefore, always ensure that the lens is clean.

The pyrometer's optical path must remain unobstructed. Any interference or obstacle may lead to measurement errors.

### 5.2 Pyrometer Alignment to Target

**For accurate temperature measurement, it is essential that the pyrometer is correctly aimed and focused at the target object. Make sure that the optical path is not obscured because this would most likely impair accuracy.**

A laser spot light, which can be switched on and off by means of a mode-button for 2 s on the rear side of the pyrometer, serves as a sighting aid. It will automatically switch off after configured time.

For focal adjustment loosen the shown socket screw (hexagon socket screw DIN 916) with a wrench (DIN 911) and shift the internal body of the tube towards the lens tube.

Due to the O-ring sealing between the internal body of the tube and the lens tube the focal adjustment must be carried out very slowly so that the air pressure in the space between lens and internal body of the tube can be equalised.

Focus the sensing head until the spot light is shown as a sharp round laser spot in the target area. In bright daylight or in an excessively lit environment it is recommendable to dim the area around the target.



#### NOTE !

For pyrometers featuring an integrated laser spot light, the light may, when activated, influence the instrument's temperature reading. This influence will vary, depending on the instrument model and the temperature. To ensure an accurate and reliable temperature reading, the laser spot light will automatically deactivate after approximately 1 – 15 minutes. The time is adjustable. The laser is not to be activated during normal operation; its purpose is only to facilitate pyrometer alignment and focussing.



## 5.3 Safety instructions and precautions

The user must be familiar with following safety instructions.

### 5.3.1 Laser Radiation Hazard

#### **Laser radiation can be harmful to the eye!**

CellaTemp PA operates with a class 2 red light laser. Direct prolonged viewing of a laser beam can injure the retina. Therefore, the following safety precautions must be strictly observed, otherwise the laser may not be operated!

- Only use the laser to align and focus the pyrometer. Deactivate the laser immediately afterwards. Alternatively, the laser will automatically switch off after 1 - 15 minutes.
- Never look directly into the laser beam path.
- Do not leave the instrument unattended when the laser is activated. Deactivate the laser immediately afterwards.
- Do not point the laser beam at any person.
- During pyrometer installation and alignment, make sure to avoid the possibility of laser light reflections caused by reflective surfaces.
- All currently valid laser safety standards must be observed.

### 5.3.2 Laser Power

The laser operates at a wavelength of 630 - 680 nm (visible red light). The emitted power of the laser beam at the lens opening is max. 1.0 mW. Under normal operating conditions, the emitted radiation does not present a danger to human skin. This laser product is classified according to laser class 2, EN60825-1, IEC60825-1.

### 5.3.3 Laser Warning Label

The black and yellow laser warning label is affixed next to nameplate of the instrument. An arrow indicates the laser emission path (lens opening).



Fig. 5.2 Laser warning label affixed to the pyrometer

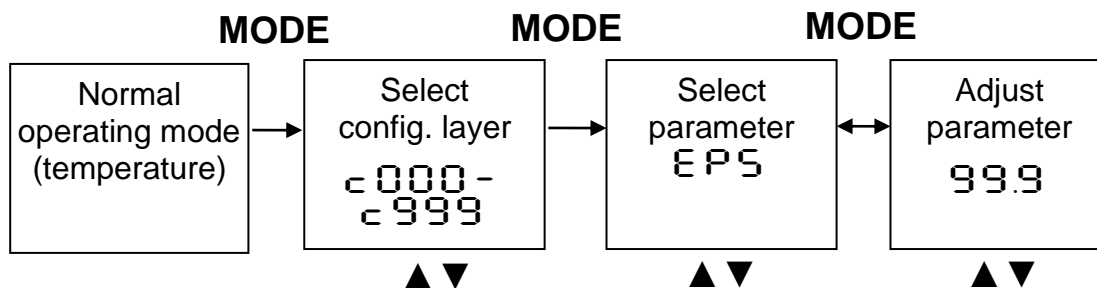
### 5.3.4 Laser warning label must be visible!

If the pyrometer is installed within a machine or equipment in such a way that the instrument's warning label is visibly blocked, additional laser warning labels (not included in scope of delivery) must be affixed to the equipment or accessory in immediate vicinity to the laser beam emission path opening.

## 5.4 Setting parameters at the pyrometer (basic configuration)

Use the buttons ▲ ▼ and the „MODE" button on the rear panel to access and configure parameters. With these buttons you can view and adjust all settings required for operating the pyrometer. (See Chap. 3.1).

Menu structure:



1. Press the MODE button while in normal operating mode to switch to "configuration layer" mode.
2. Use ▲ ▼ to select the configuration layer for the parameter you wish to set.
3. Press MODE to confirm. Press ▲ ▼ to select the particular parameter.
4. Press MODE to confirm. Press ▲ ▼ to adjust the parameter value.
5. Press MODE again to end. Press ▲ ▼ to select `END/SAVE`.
6. Now use MODE to either apply the changes you have made to the settings [`SAVE`] or to close without saving these changes [`END`]. After that, the display panel will resume showing the temperature reading.

The following parameters are important for initial set-up prior to first-time operation. See Chapter 6 for a comprehensive list of all adjustable parameters.

| Parameter | configuration layer | Explanation   |
|-----------|---------------------|---|
| EPS.1     | c 00 1              | Emissivity spectral channel 1 (Chapter 5.5)                                     |
| Ao 1.~    | c 0 10              | Lower limit of temperature span analogue output Ao1 (Chapter 5.6)               |
| Ao 1.~    | c 0 10              | Upper limit of temperature span analogue output Ao1(Chapter 5.6)                |
| Ao 1.4    | c 0 10              | Hardware configuration of the analogue output 0-20 mA, 4-20 mA (Chapter 5.6)    |
| Ao 1.t    | c 100               | Temperature measurement simulation to verify signal transmission. (Chapter 5.7) |



**NOTE !**

Key lock may have been activated at the terminal. When selecting the configuration layer, you will be prompted to enter an access code with P 0 0 0 . To obtain full access to parameter settings, enter P 1 0 0 otherwise you will only be able to view parameters but not change them.

### 5.5 Setting Emissivity

A pyrometer measures temperature by detecting the radiant energy emitted from an object’s surface in the form of electromagnetic waves. The temperature reading not only depends on the intensity of the object’s thermal radiation (how hot the object is), but also on the material’s particular surface characteristics and thus its specific ability to emit thermal energy. This is called emissivity. To obtain an accurate temperature reading, it is imperative that the pyrometer be adjusted for this emissivity prior to measurement.

Set the emissivity correction at configuration layer c 0 0 1. See the Emissivity Coefficient Table in Chapter 12 to select the proper emissivity factor for your application. We recommend that you first perform a comparison temperature measurement with another device to determine the correct emissivity factor for the task.

**NOTE !**

During normal operating mode, emissivity can be set at the pyrometer using the ▲▼ buttons. When simultaneously pressing the MODE key, the display shows the current measuring temperature while the emissivity coefficient continues to be adjusted in the background. This is an easy way to determine the emissivity when the object temperature is known. The modified values are directly adopted.

**CAUTION!**

**Once you have configured the emissivity parameter, the pyrometer will maintain this specific setting. The pyrometer will always operate with this value unless you change the setting.**

## 5.6 Output current range

For the pyrometer's two analogue current outputs, select the current loop scale – (0 - 20 or 4 – 20 mA)—which matches that of the downstream signal processing equipment (PLC, display device, controller, etc.). At the pyrometer and at the controller, set the upper and lower limits of the temperature range and the current loop output signal. Access this setting using configuration layer  $\llcorner \square \text{!} \square$  .

## 5.7 Simulated current signal for functional testing

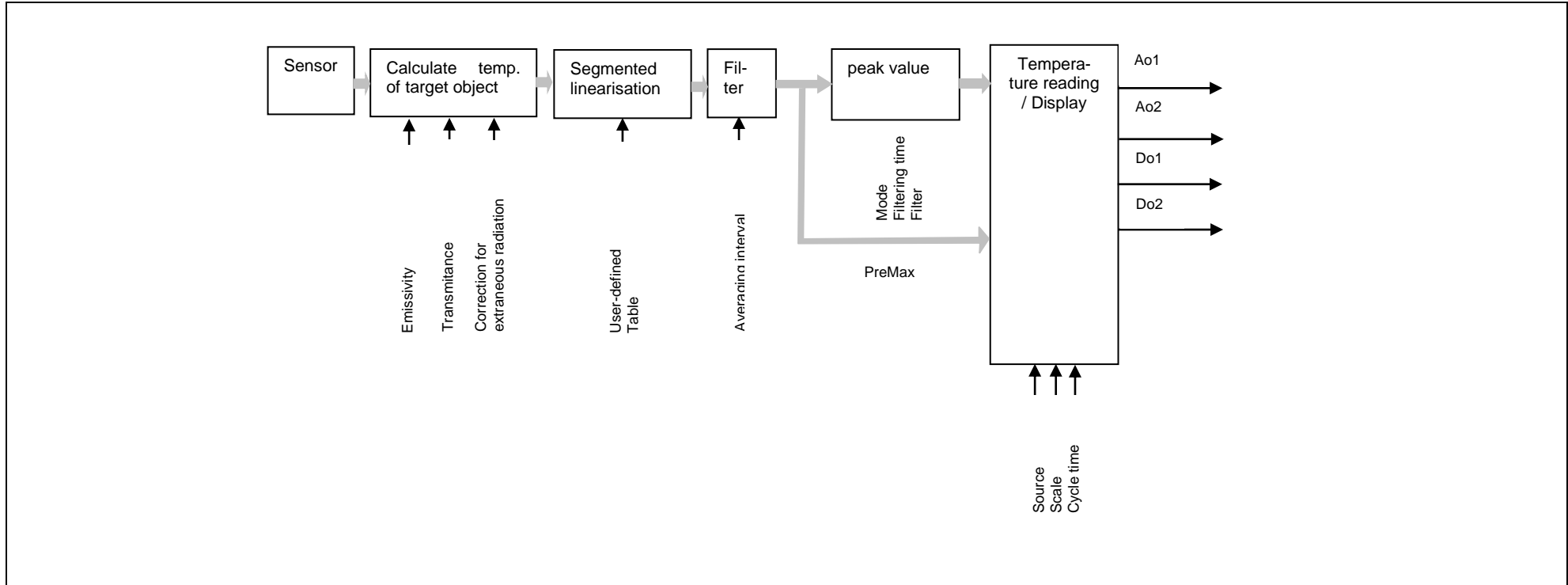
After initial installation, you should perform a function test to verify that temperature data is correctly transmitted to the controller. To do so, use the push-buttons on the pyrometer rear panel to simulate a temperature reading, which is applied as an output current signal scaled to the selected current range. The appropriate parameter can be accessed via configuration layer  $\llcorner \text{!} \square \square$  .

If the pyrometer is set up correctly, the downstream controller should indicate the values you have entered (only within the scaled range). If there is a discrepancy, please check the current range scale or the cable connection.

When you have completed the function test, exit by pressing "E 5  $\llcorner$ " and return to normal operating mode.

## 6 Functioning of the pyrometer

### 6.1 Internal signal processing



## 7 Configuration and Setup

### 7.1 Signal Conditioning

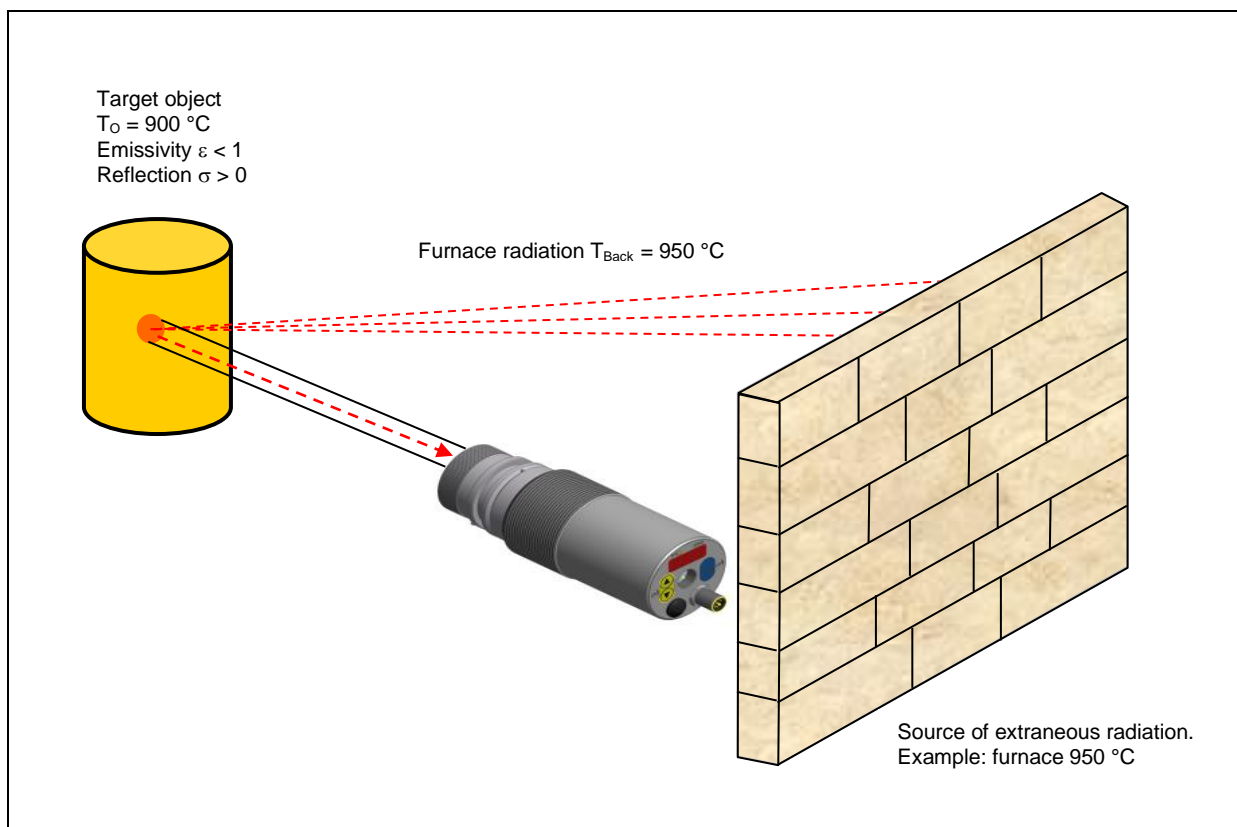
#### 7.1.1 Emissivity and Transmittance

Besides the emissivity correction (mentioned in Chapter 5.5), a pyrometer must be adjusted for the transmission properties of any supplementary lens and/or protective window screwed onto the pyrometer. Set the pyrometer for the specific transmission factor (a percentage value) which is indicated either in the products' data sheet or on the lens itself. This is parameter **TRU.1** and can be accessed at configuration layer **0001**. If you are not using any auxiliary lens or protective window, set the parameter to 100.0. A Listing of the transmission values of the used glasses you find in chapter transmission values of protective glasses.

#### 7.1.2 Ambient Temperature Compensation

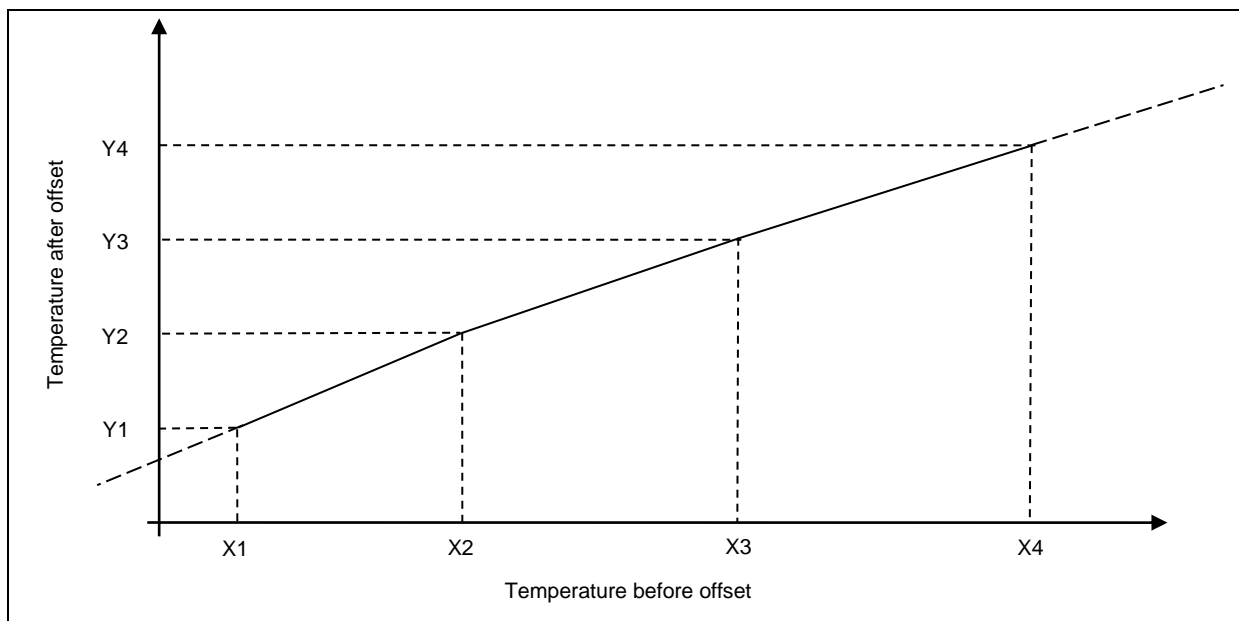
Under normal conditions, CellaTemp PA should produce highly accurate temperature readings once you have set the emissivity and transmittance factors. Certain conditions, however, will require that you make an additional correction. Object surfaces which have very low emissivity will reflect thermal radiation from their surroundings. If your target object is in surroundings which are hotter than the target itself, and the infrared radiation coming from extraneous sources reflects off of the object, the sensor will collect this additional energy. To ensure that the measurement is not distorted and that temperature readings are completely accurate, you should activate „Ambient temperature compensation“ (switch on **0001/6Ac.1**)

Now enter the temperature value of the ambient source of radiation and its influence as a percentage. You will have to determine these variables first.



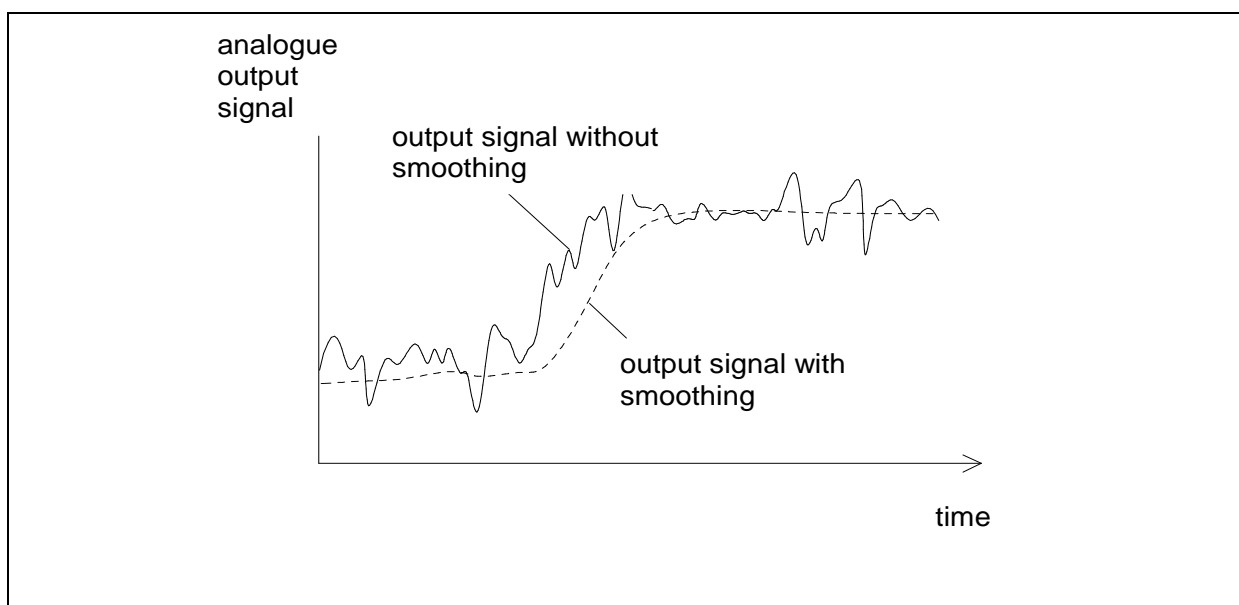
### 7.1.3 Temperature offset using linear interpolation

When necessary, CellaTemp PA allows you to program an offset for the temperature reading reported. The offset correction can be configured individually with a minimum of 2 and a maximum of 10 interpolating points (X/Y nodes). This information is stored in a user-defined temperature-indexed lookup table and used for signal conditioning. For values lower than the 1st node and higher than the last node, the first and last linear segments are extrapolated. Enter the nodes in ascending order. Use the rear panel display to access this function via `c 00 ! / L n. !`.



### 7.1.4 Signal Smoothing Filter

When the target object's temperature is erratic, it makes sense to smooth these temperature fluctuations in order to stabilize the signal. The greater the time constant  $t_{98}$ , (user definable), the lower the effect of these fluctuations on the yielded temperature reading. The pyrometer's response time is proportional to the time constant. Set signal smoothing via parameter  $\epsilon 00 1 / F 1 L 1$ .





### 7.1.5 Min/Max Data

CellaTemp PA features data memory to store minimum and maximum (peak) temperature readings. This feature can be configured in one of the following modes:

- Memory off
- Store minimum value (single)
- Store maximum value (single)
- Store double max. value for cyclical processes
- ATD function (Only available in pyrometer with ATD function)

Select and activate one of these memory modes for Spectral Channel 1 (L1) and configure as described below. The calculated temperature value can be shown on the rear panel display and/or transmitted to the current output for further processing.

#### ***Min/Max Memory***

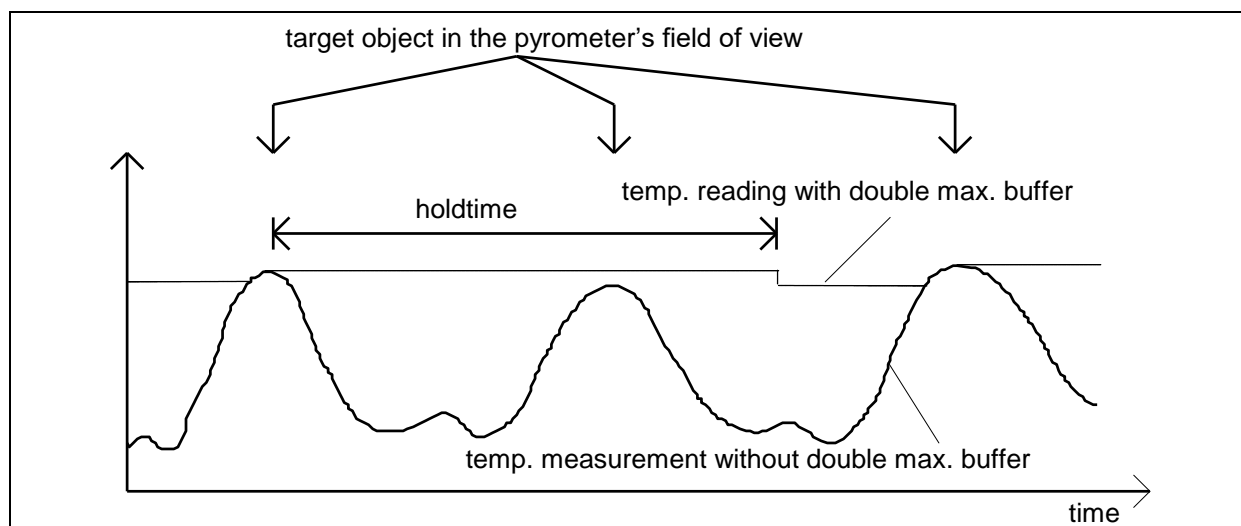
In this mode—also called peak picker—the pyrometer determines the highest or lowest temperature reading and keep the temperature reading. As an option, one of the switching inputs can be configured to reset the min/max memory and to define the smoothing filter setting.

#### ***Double Maximum Memory with hold time***

It might often be desirable to determine the peak temperature during a defined time period, for example when the objects to be measured move past the pyrometer, resulting in temperature readings which would appear to be cyclical. In this mode, the displayed temperature reading will not drop between targeted objects. The peak temperature reading will be held for a preset time period.

Configure a hold time between 0.01 to 999 sec. either from your PC terminal or using the pyrometer's rear panel buttons. The maximum temperature sampled during the defined hold time will be saved. This value is transmitted to the signal output. In mid-sequence-- after 50% lapse of the hold time—a second internal peak picker starts. When the hold time has expired, the output signal decreases to the value of the second peak temperature (if it turned out being lower than the first peak). It makes sense to choose a hold time which is approximately 1 ½ times as long as the cycle of the moving targets. This ensures that a temperature measurement gap is avoided and temperature changes are detected quickly.

As an option, one of the switching inputs can be configured to reset the min/max memory and to define the smoothing filter setting.



### Automatic temperature detection (ATD) function \*

This function serves to automatically detect the temperature during manufacturing processes with discontinuous or intermittent material flow. First, define the sampling time and the upper and lower temperature limits. These limits or thresholds define the temperature range within which you wish to detect the temperature. It is also possible to determine the average temperature value over the course of multiple measuring cycles.

The start of a measuring cycle is determined automatically and is dependent on the following variables.

|                            |   |
|----------------------------|---|
| <b>Limit 1 (L 1. 1)</b>    | Before beginning the measurement, the temperature reading must have been lower than Limit 1 at least once.<br>If Autoreset (A.R. S.E. = ON) the limit 1 will be ignored |
| <b>Limit 2 (L 1. 2)</b>    | Limit 2 must be exceeded at least for the duration of the time delay (t DEL).   |
| <b>Time Delay (t DEL):</b> | See above   |

When the conditions are fulfilled, the sampling time will begin. (t RC t).

|                               |   |
|-------------------------------|---|
| <b>Sampling time (t RC t)</b> | During the sampling time the temperature is detected and stored as a temperature value. |
|-------------------------------|---|



**NOTE !**

If the parameter  $t_{RC} = 0$  the algorithm of the ATD function will detect automatically the end of the discontinuous process. At the parameter  $t_{RC}$  is shown "auto" instead of the time.

The configuration of the Normal Display Mode (ANO) determines which temperature value is saved during sampling

|                           |   |
|---------------------------|---|
| <b>Display mode (ANO)</b> | „t=0“ displays the lower temperature range limit during the measurement. „t=HLD“ indicates the previous temperature reading during the current measurement. |
|---------------------------|---|

As an option, the green Status LED can light up or the digital output can be used to indicate sampling.

When the sampling time has ended, an average value is calculated for recorded measuring cycles. The temperature reading is weighted with the previously saved average value and added.

|                                  |  |
|----------------------------------|--|
| <b>Weighted average (F - Pr)</b> | Factor for average weighting. If you choose 100%, averaging will be off. |
|----------------------------------|--|

The smaller you set the F - Pr factor, the stronger the weighting will be.

When the averaging function is activated (F - Pr < 100%) a plausibility check will be performed. The difference in temperature between the current reading and the previously stored average is established. If the difference is higher than the plausibility threshold  $t_{SP}$ , the transmitted data will be „0“ and the average value will remain unchanged.

|  |  |
|--|--|
| <b>Plausibility (<math>t_{SP-}</math>)</b> | Threshold for plausibility check: lower limit which is acceptable for a valid measurement. |
|--|--|

|  |  |
|--|--|
| <b>Plausibility (<math>t_{SP+}</math>)</b> | Threshold for plausibility check: upper limit which is acceptable for a valid measurement. |
|--|--|

When sampling is completed, the average temperature value or „0“ will be output. At the same time, an impulse is generated which can be used for the digital outputs. Enter  $\square \cdot t_{r \cdot i}$  as the source and set the hold time to 0.5 s.

A cut-off interval (time lag) begins after the sampling time has ended. This cut-off interval must expire before the next measurement can start with the cycle starting conditions described above.

|  |   |
|--|---|
| <b>Cut-off interval</b><br>( $t_{off}$ ) | The interval between one completed sampling and the start of a new sampling.. |
|--|---|

If a measuring cycle does not start during the period  $t_{off}$ , the saved average will be deleted and reinitialized when the next cycle begins.

|                              |  |
|------------------------------|--|
| <b>Timeout</b> ( $t_{out}$ ) | Time cycle for deleting average value (in minutes) |
|------------------------------|--|

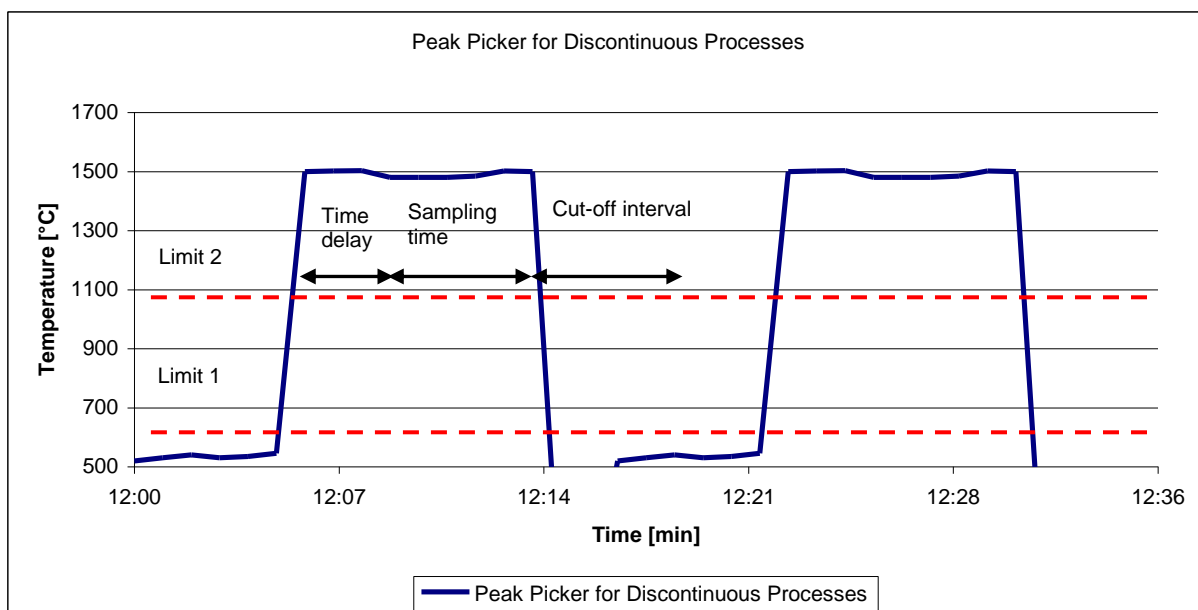
Activate auto reset for the ATD function to run cyclically. Limit 1 will then be ignored. Measurement continues when the Limit 2 is exceeded for the period configured with  $t_{ER}$ .

|                                |                   |
|--------------------------------|-------------------|
| <b>Auto reset</b> ( $R_{SE}$ ) | Auto reset on/off |
|--------------------------------|-------------------|

If, during the measurement, the temperature reading falls below Limit 2, the measurement will be dismissed.

|   |        |
|---|--------|
| <b>Set Li2 check on tAct</b> ( $c_{L2}$ ) | on/off |
|---|--------|

\* Only available with ATD function



## 7.2 I/O Configuration

### 7.2.1 Selectable current output range

You will need to define the current loop scale and define a source for an analogue output signal. For a spectral pyrometer the analogue output Ao1 is set to

- Spectral channel 1

**In the normal operating mode, the selected source for Ao1 will be the current object temperature.**

The second analogue output Ao2 offers additional the following option:

- Spectral channel 1 temperature before Min/Max memory
- Internal device temperature

Configure the scale of each of the two analogue outputs separately. Define the temperature span by adjusting the upper and lower limits of the measuring range. Select either 0 – 20 mA or 4 – 20 mA as the current output range. The temperature to current conversion is linear.

The desired current output range of either 0 – 20 mA or 4 – 20 mA can be configured as an absolute setting. Alternatively, the current range can be coupled to the specific voltages of Switching Output 1 or 2.

- 0 V -> 0 - 20 mA
- 24 V -> 4 - 20 mA

Make these settings in configuration layer  $\epsilon \square \square$  with parameters  $R_{\square 1.5}$ ,  $R_{\square 1.}$ ,  $R_{\square 1.}$  and  $R_{\square 1.4}$  for analogue output 1, and in the same manner for analogue output 2.

#### Configuration example PA 21:

Ao1: temperature reading of spectral channel 1  
300 - 2000 °C  $\equiv$  4 - 20 mA

Ao2: internal device temperature  
0 - 100 °C  $\equiv$  4 - 20 mA

It is also possible to configure analogue output 2 with a sub-range which covers a portion of the temperature span assigned to analogue output 1:

### Configuration example PA 21:

Ao1: temperature reading of spectral channel 1  
300 - 2000 °C  $\equiv$  4 - 20 mA

Ao2: temperature reading of spectral channel 1  
1000 - 1500 °C  $\equiv$  4 - 20 mA

## 7.2.2 Digital outputs

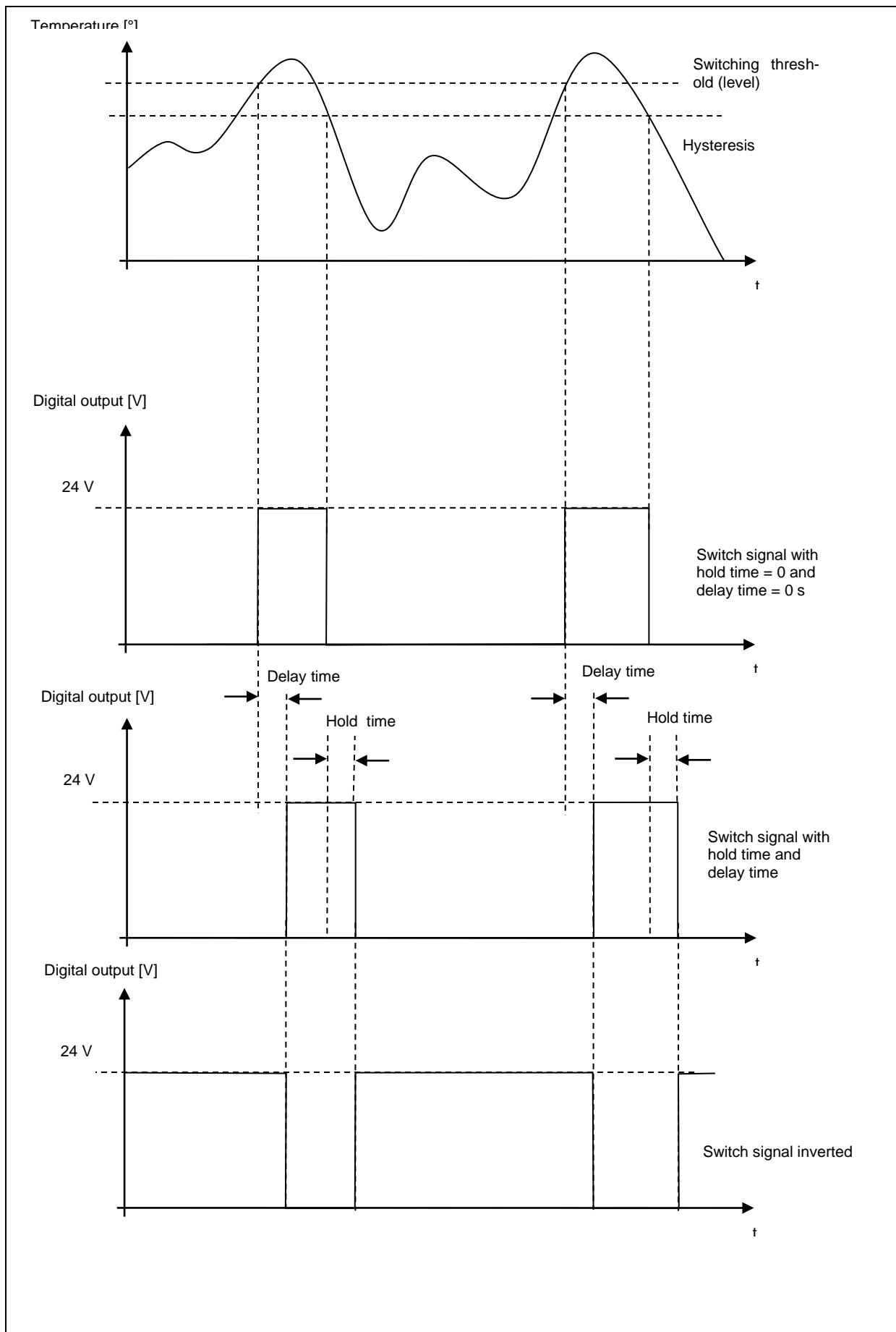
One of the following functions can be assigned to each of the digital outputs:

- **Deactivate** (This is required when you want to use the digital output as digital input).
- **Status LED** lights up to indicate that the temperature reading of spectral channel 1 lies within the pyrometers available temperature range.
- **Limit switch** with adjustable signal threshold, relating to spectral channel 1, min/max of spectral channel 1, or inner device temperature as the signal source.
- **Limit switch** with adjustable signal threshold:
  - Spectral channel 1
  - Min/Max spectral channel 1
  - Device temperature
- **Status Signal ATD** function.
  - Triggered by ATD function spectral channel 1 at the end of the measuring time
  - ATD function spectral channel 1 indicate the measuring time

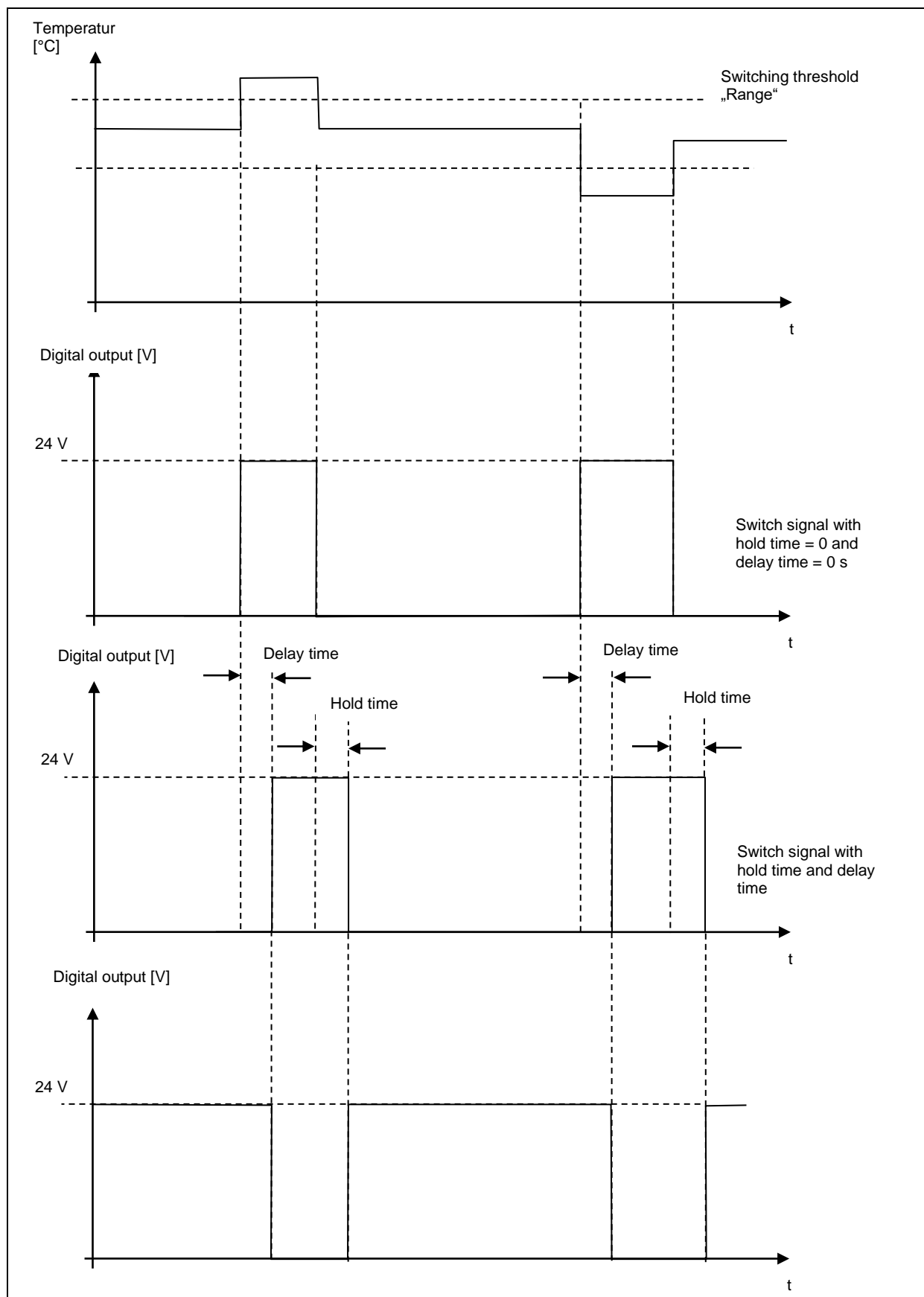
When the digital output is to be used as a limit switch, you can configure the following parameters:

- Signal source
- Signal function and direction
- Limit and hysteresis at function „level“
- Lower / upper limit at function = “Range”
- Delay time
- Hold time

### 7.2.3 Function „Level“



## 7.2.4 Function „Range“





### 7.2.5 Digital inputs

If you want to use the digital output as an input, you must first manually deactivate the digital output and configure the following parameters:

- Select a current output range (either 0 – 20 mA or 4 – 20 mA) for Ao1/Ao2
- Delete the temperature readings in Min/Max or DoubleMax
- Define whether the laser will be event-triggered.

### 7.2.6 Analogue input for emissivity correction or ambient temperature compensation

When desired, current output 2 (Pin 3) can function as a voltage input. Target object emissivity can be configured from another remote device. Alternatively, the input signal can be used to define the temperature of reflected radiation from surroundings for the ambient temperature compensation function.

First, manually deactivate current output 2. Then select one of these two correction functions at configuration layer  $\llcorner \square \square$  using parameter  $\text{R } \cdot \text{F } \square$ .

When this is activated, it will not be possible to configure the emissivity setting or the ambient temperature compensation using the rear panel buttons, nor will it be possible to change the settings from a PC. The pyrometer display will alternate between showing the currently used value and showing  $\text{E H E}$  to indicate that these parameters were set from an external source.

Define the upper and lower voltage values using parameter  $\text{R } \cdot \text{U}$ . Set the input variables using parameter  $\text{R } \cdot \text{V}$ .

Example for setting emissivity:

$\text{R } \cdot \text{U } 1 = 0 \text{ V}$

$\text{R } \cdot \text{U } 2 = 10 \text{ V}$

$\text{R } \cdot \text{V } 1 = 0$  (Epsilon 0 %)

$\text{R } \cdot \text{V } 2 = 100$  (Epsilon 100 %)

Example for configuring the ambient temperature compensation function:

$\text{R } \cdot \text{U } 1 = 2 \text{ V}$

$\text{R } \cdot \text{U } 2 = 10 \text{ V}$

$\text{R } \cdot \text{V } 1 = 700$  (temperature 700 °C)

$\text{R } \cdot \text{V } 2 = 1200$  (temperature 1200 °C)

## 7.3 General functions (configuration layer $\llcorner \text{0 1 1}$ )

### 7.3.1 Green Status LED

You can assign specific functions to the LED:

- LED is continuously lit to indicate 24 V operating voltage
- LED indicates status of switching output 1
- LED indicates status of switching output 2
- LED indicates ATD function in progress

Set the function using parameter  $\text{LE d 5}$ .

### 7.3.2 Activate Laser

To activate the built-in laser, there are several ways in which it can be activated. Configure parameter  $\text{P 1 L 0}$  with the particular method you have selected:

- Activate using button on rear panel
- Permanently off
- Edge-triggered: based on signal input (0 -> 24V transition)



NOTE !

Do not attempt to operate the laser continuously. The built-in laser is not designed for continuous use. When the user-defined laser auto-shutoff time is reached (maximum programmable duration = 15 minutes) the laser will automatically switch off. When the ambient temperature exceeds 55°C the laser will automatically deactivate

## 7.4 Simulate current signals for analogue output Ao1 and Ao2 (configuration layer: $\llcorner \text{1 0 0}$ )

CellaTemp PA features a function to simulate a temperature reading. This is especially useful after initial setup to verify that temperature data is correctly transmitted to the controller. Use the push-buttons on the pyrometer rear panel to simulate a temperature reading, which is applied as an output current signal scaled to the selected current range. The appropriate parameter can be accessed via configuration layer  $\llcorner \text{1 0 0}$ . If the pyrometer is set up correctly, the downstream controller should indicate the values you have entered (only within the scaled range). If there is a discrepancy, please check the current range scale or the cable connection. When you have completed the function test, exit by pressing " $\text{E 5 \llcorner}$ " and return to normal operating mode.

## 8 Setting Parameters at the device

In addition to the configuration possibilities described in Chapter 7, many parameters can be adjusted at the rear panel using push buttons. These settings can be accessed via configuration layers.

### 8.1 Configuration layers

The configuration layers are structured as follows:

- `c 00 1` Temperature measurement via spectral channel 1
- `c 0 10` I/O Configuration
- `c 0 11` General functions
- `c 020` Display temperature readings
- `c 100` Simulated current signal for outputs Ao1 and Ao2

The following chart lists all parameters. Certain parameters will be suppressed at the rear panel display if the prerequisite function is deactivated. For example: the smoothing time cannot be configured when signal smoothing is not activated.

#### 8.1.1 Temperature measurement via spectral channel 1 (configuration layer: `c 00 1`)

| Parameter            | Function                                      | Explanation  |
|----------------------|---|--|
| <code>EPS. 1</code>  | Emissivity factor L1                          | See Chap. 7.1.1  |
| <code>tAU. 1</code>  | Transmission factor L1                        | See Chap. 7.1.1  |
| <code>bAc. 1</code>  | Ambient temperature compensation              | See Chap. 7.1.2  |
| <code>bAc t</code>   | Temperature of ambient source of radiation    |  |
| <code>bAc %</code>   | Influence of ambient IR radiation             | The reflected thermal radiation from the surroundings as a portion of the total IR radiation collected by the sensor in %  |
| <code>L in. 1</code> | Temperature offset using linear interpolation | <code>oFF</code> off<br><code>n - 10</code> : number of nodes used   |
| <code>L. H 1</code>  | node x 1..10                                  | Signal input (initial value) node n  |
| <code>L. Y 1</code>  | node y 1..10                                  | Signal output (resulting value) node n   |
| <code>F .L. 1</code> | Smoothing filter                              | <code>oFF</code> smoothing not activated<br><code>o n</code> simple smoothing  |
| <code>F .L t</code>  | Smoothing time                                | time t98 in sec. for simple smoothing  |
| <code>nEn. 1</code>  | Min/Max memory                                | <code>oFF</code> off<br><code>n in</code> lowest (min.) temperature, single<br><code>n RH</code> highest (max.) temperature, single<br><code>dbl n</code> double maximum |

|       |                                     |  |
|-------|-------------------------------------|--|
|       |                                     | ATD function in process  |
| HELT  | Hold time for Min/Max               | Hold time in sec.  |
| FILN  | Smoothing filter for min/max *      | OFF Off<br>ON On   |
| FILT  | Smoothing time*                     | Time t98 in sec.   |
| CLR N | external delete for Min/Max memory* | OFF no external deletion<br>EXT 1 delete when 0-24V for switching output 1<br>EXT 2 delete when 0-24V for switching output 1 |
| EDEL  | time delay**                        | For ATD function, see Chap. 7.1.5  |
| ERCT  | meas. time active**                 | For ATD function, see Chap. 7.1.5  |
| EDIS  | cut-off interval**                  | For ATD function, see Chap. 7.1.5  |
| EOUT  | timeout**                           | For ATD function, see Chap. 7.1.5  |
| L1    | Limit 1**                           | For ATD function, see Chap. 7.1.5  |
| L2    | Limit 2**                           | For ATD function, see Chap. 7.1.5  |
| F-P   | Average weighting**                 | For ATD function, see Chap. 7.1.5  |
| ESP-  | Threshold plausibility**            | For ATD function, see Chap. 7.1.5  |
| ESP-  | Threshold plausibility**            | For ATD function, see Chap. 7.1.5  |
| ANO   | Mode of display**                   | EQ show lower limit of temp. range during running measurement<br>HLD Hold previous temp. reading during running measurement  |
| ARST  | Autoreset**                         | For ATD function, see Chap 7.1.5   |
| CHL2  | Set Li2 check on ERCT **            | For ATD function, see Chap 7.1.5   |
| SAVE  | Save                                | Save changes / exit menu   |
| ESC   | Escape                              | Discard changes / exit menu  |

\* Only available with Min/Max and Double Max modes

\*\* Only available with ATD function



**NOTE !**

L1 stands for Lambda 1, meaning the temperature reading from spectral channel 1

### 8.1.2 Configuration I/O (configuration layer: $\llcorner \square \square \square$ )

| Parameter | Function                             | Explanation   |
|-----------|--------------------------------------|---|
| Ao1.5     | Ao1 select source                    | $\llcorner \square$ Spectral channel 1<br>(the selected temp. reading source will be shown on the display)  |
| Ao1.-     | Ao1 define lower limit of temp. span |   |
| Ao1.-     | Ao1 define upper limit of temp. span |   |
| Ao1.4     | Ao1 0/4 - 20mA                       | $\square - 20$ 0-20mA<br>$4 - 20$ 4-20mA<br>$\text{EH}\text{E}\text{.}\text{1}$ digital input 1: 0V=0-20mA 24V=4-20mA<br>$\text{EH}\text{E}\text{.}\text{2}$ digital input 2: 0V=0-20mA 24V=4-20mA  |
| Ao2.      | Analogausgang 2                      | $\square \text{FF}$ Off<br>$\square \text{ON}$ on   |
| Ao2.5     | Ao2 select source                    | $\llcorner \square$ Spectral channel 1<br>$\llcorner \square \text{P}\text{r}$ Lambda 1 without peak picker<br>$\text{E}\text{U}$ internal device temperature   |
| Ao2.-     | Ao2 define lower limit of temp. span |   |
| Ao2.-     | Ao2 define upper limit of temp. span |   |
| Ao2.4     | Ao2 0 / 4 - 20mA                     | $\square - 20$ 0-20mA<br>$4 - 20$ 4-20mA<br>$\text{EH}\text{E}\text{.}\text{1}$ Switch. input 1: 0V=0-20mA 24V=4-20mA<br>$\text{EH}\text{E}\text{.}\text{2}$ Switch. input 2: 0V=0-20mA 24V=4-20mA  |
| do1.      | Switching output 1                   | $\square \text{FF}$ Off<br>$\square \text{ON}$ On   |
| do1.5     | Do1 select source                    | $\text{r}\text{d}\text{y}$ Status LED indicates 'ready'<br>$\llcorner \square$ Lambda 1<br>$\llcorner \square \text{P}\text{r}$ Lambda 1 without peak picker<br>$\text{E}\text{U}$ Internal device temperature<br>$\text{R}\text{E}\text{r}$ Triggered by ATD function Lambda 1*<br>$\text{R}\text{R}\text{c}$ Measuring time ATD Lambda 1* |
| do1.F     | Do1 function                         | $\llcorner \square \llcorner$ Switch direction "Level" (output activ if limit excess)<br>$\llcorner \square \llcorner -$ Switch direction "Level" / output inverted<br>$\text{r}\text{r}\text{E}$ Switch direction "Range" (output activ if limit excess)<br>$\text{r}\text{r}\text{E} -$ Switch direction "Range" / output inverted        |
| do1.t     | Do1 switching threshold              | Switching threshold<br>(only available at function "Level")   |
| do1.h     | Do1 signal threshold                 | Hysteresis +/- relative to signal threshold<br>(only available at function "Level")   |
| do1.-     | Do1 lower limit of range             | Lower limit of range for switch signal<br>(only available function "Range")   |
| do1.-     | Do1 upper limit of range             | Upper limit of range for switch signal<br>(only available function "Range")   |
| do1.L     | Do1 delay time                       | See Chap. 7.2.2   |
| do1.H     | Do1 Hold time                        | See Chap. 7.2.2   |
| do2.      | Switching output 2                   | $\square \text{FF}$ Off<br>$\square \text{ON}$ on   |

|       |   |  |
|-------|---|--|
| do2S  | Do2 select source                           | <ul style="list-style-type: none"> <li>LED Status LED indicates 'ready'</li> <li>L1 Lambda 1</li> <li>L1P Lambda 1 without peak picker</li> <li>ET Internal device temperature</li> <li>ATD Triggred by ATD function Lambda 1*</li> <li>Measuring time ATD Lamda 1*</li> </ul>                               |
| do2F  | Do2 function                                | <ul style="list-style-type: none"> <li>Level Switch direction "Level" (output activ if limit excess)</li> <li>Level- Switch direction "Level" / output inverted</li> <li>Range Switch direction "Range" (output activ if limit excess)</li> <li>Range- Switch direction "Range" / output inverted</li> </ul> |
| do2t  | Do 2 switching threshold                    | Switching threshold<br>(only available at function "Level")  |
| do2h  | Do2 signal threshold                        | Hysteresis +/- relative to signal threshold<br>(only available at function "Level")  |
| do2-  | Do2 lower limit of range                    | Lower limit of range for switch signal<br>(only available function "Range")  |
| do2.  | Do2 upper limit of range                    | Upper limit of range for switch signal<br>(only available function "Range")  |
| do2L  | Do2 delay time                              | See Chap. 7.2.2  |
| do2H  | Do2 Hold time                               | See Chap. 7.2.2  |
| A .Fn | Analogue input function                     | <ul style="list-style-type: none"> <li>OFF Analogue input deactivated</li> <li>EPS Emissivity for Lambda 1 via analogue input</li> <li>Temp. ambient radiation via analogue input</li> </ul>   |
| A .U1 | Analogue in upper and lower voltage values  | Define lower limit of voltage for input voltage (0 - 10V)  |
| A .U2 | Analogue in upper and lower voltage values  | Define upper limit of voltage for input voltage (0 - 10V)  |
| A .u1 | Analogue in upper and lower input variables | Input of lower voltage value<br>(example 80% for emissivity)   |
| A .u2 | Analogue in upper and lower input variables | Input of upper voltage value<br>(example 100% for emissivity)  |
| SAVE  | Save  | Save changes / exit menu   |
| ESC   | Escape                                      | Discard changes / exit menu  |

\* Only available with ATD function



**NOTE !**

Ao1 and Ao2 stand for Analogue Output 1 and Analogue Output 2  
 Do1 and Do2 stand for Switching Output 1 and Switching Output 2  
 Ain stands for Analogue Input

### 8.1.3 General Functions (configuration layer: **c 0 1 1**)

| Parameter | Function                              | Explanation  |
|-----------|---------------------------------------|--|
| L E d 6   | Green status LED                      | <ul style="list-style-type: none"> <li>o n LED indicates 24V</li> <li>d o 1 LED indicates digital output 1</li> <li>d o 2 LED indicates digital output 2</li> <li>t R c 1 LED indicates running measurement in mode for ADT function*</li> </ul> |
| P i L o . | Activate laser                        | <ul style="list-style-type: none"> <li>i n t keypress</li> <li>o F F laser disabled</li> <li>t d i 1 edge-triggered, switching input 1</li> <li>t d i 2 edge-triggered, switching input 2</li> </ul>   |
| P i L t   | Laser ON-time                         | i - 15: select auto laser shut-off in minutes  |
| t E r n . | Assign Interface                      | <ul style="list-style-type: none"> <li>o F F non-terminal mode</li> <li>U S B terminal mode at USB interface</li> <li>r S 485 Terminal mode at RS485 (Halbduplex)</li> </ul>   |
| A S t r . | Automatic temperature data output     | <ul style="list-style-type: none"> <li>o F F automatic temp. data output is off.</li> <li>o n temp. data output at PC terminal</li> </ul>  |
| A c y c . | Cycle for automatic temp. data output | Select cycle time in s   |
| A d d r . | Device address                        | Enter address of device for non-terminal mode  |
| d i s p . | Display panel                         | <ul style="list-style-type: none"> <li>"o n" the display panel indicates "on"</li> <li>i R 1 indicate temperature of source Ao1</li> </ul>   |
| U n i t   | temperature scale                     | <ul style="list-style-type: none"> <li>o C degrees Celsius</li> <li>o F degrees Fahrenheit</li> </ul>  |
| S A v e   | Save                                  | Save changes / exit menu   |
| E S c     | Escape                                | Discard changes / exit menu  |

\* only available for models with ATD function

### 8.1.4 Displayed temperature readings (Configuration layer: **c 0 2 0**)

| Parameter   | Function                            | Explanation   |
|-------------|-------------------------------------|---|
| L 1 .       | Temp. reading Lambda1               | Shows current temperature reading for L1                      |
| L 1 P r .   | Reading Lambda1 without peak picker | Shows current temperature reading for L1 prior to peak picker |
| t . i n t . | Internal temperature                | Current internal temp. of device                              |
| A i n       | Initial value at analogue input     | Current value of analogue input when activated                |
| E S c       | Escape                              | Exit menu   |

### 8.1.5 Simulated current signal for outputs Ao1 and Ao2 (configuration layer: $\llcorner$ 100)

| Parameter | Function                                   | Explanation  |
|-----------|--|--|
| Ao1.      | Current output 1                           | Enter a value in milliampere to simulate a current signal for Ao1                            |
| Ao1t      | Current output 1 incl. scaled temperature  | Enter a temperature value to simulate a temperature reading for Ao1 (based on linear scale). |
| Ao2.      | Current output 2*                          | Enter a value in milliampere to simulate a current signal for Ao2                            |
| Ao2t      | Current output 2 incl. scaled temperature* | Enter a temperature value to simulate a temperature reading for Ao2 (based on linear scale). |
| Esc       | Escape                                     | Exit menu  |

\* Function only available when Current Output 2 is activated.

## 9 CellaView software

The CellaView software displays, evaluates and stores the temperature readings of your pyrometer.

Download the CellaView software here:

[www.keller.de/its/](http://www.keller.de/its/)

## 10 Installation of the USB driver

The PA pyrometer can be addressed via a special driver. On systems with Windows 7, 8 or 10 the driver installs a virtual COM interface which allows access to the serial port of the pyrometer.

Use the link below to download the driver

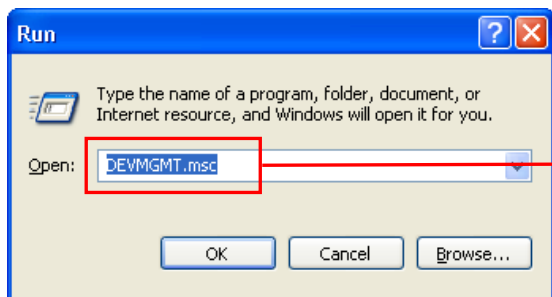
[www.prolific.com.tw](http://www.prolific.com.tw) (PL2303 Prolific Driverinstaller.zip v1.x.x)

Alternatively, the USB driver can be downloaded from our website in the CellaView download area.

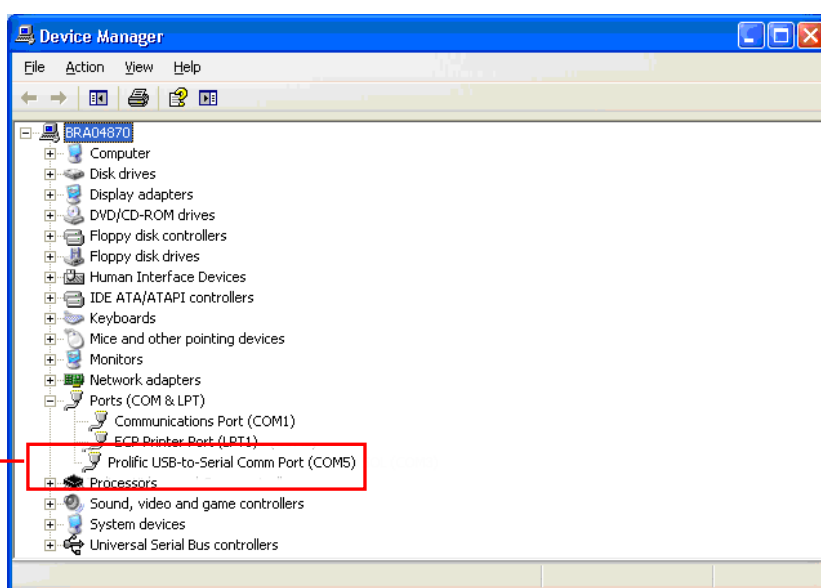
Install the driver and connect the pyrometer to the PC (USB cable is included in the scope of delivery). Windows will recognise the new hardware. Windows automatically assigns a virtual COM port. To determine the COM port number assigned to the adapter, check the Device Manager as follows:



First, open the Run dialog box by using the Windows key + R key combination. Then enter the command “devgmt.msc.”



and click OK to open the Device Manager. Then click



Ports (COM and LPT). You will see a listing of ports and should now be able to see which COM Port the PA USB connection assigned to. The PA USB connection will be indicated as a USB-to-Serial Comm Port. In this example, COM Port 5 has been assigned to the adapter. You will need to select this particular COM Port in the software settings.

## 11 How to operate the pyrometer with the CellaView software

It is not necessary to change settings when using the CellaView software. The CellaView software both works via USB and RS485 interface. The interface can be operated either as a point-to-point connection to connect a device or as a bus to connect up to 31 pyrometers.

### 11.1 CellaView via USB point-to-point connection

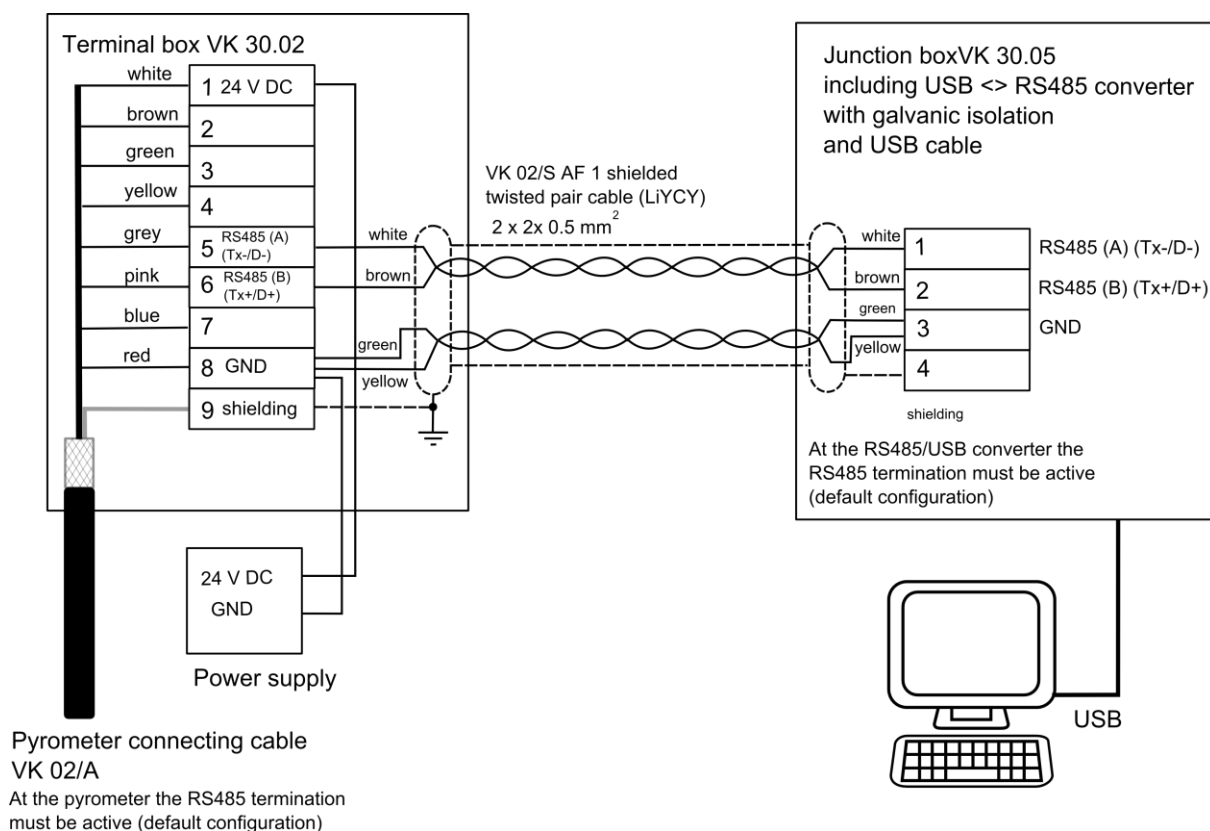
- Install the USB driver
- Connect the pyrometer to the PC
- Start CellaView
- Select the correct COM port or use the CellaView search function.

For more information on how to work with CellaView read the separate CellaView manual.

### 11.2 CellaView via RS485 point-to-point connection

A USB/RS485 converter is needed when working with the RS485 interface. The pyrometer can be directly connected if the PC has an integrated RS485 Interface board. The distance between pyrometer and PC can be up to 1200 m.

In order to prevent reflections on the RS485 connection, it is absolutely necessary to terminate the connection at the pyrometer and at the converter. The termination is integrated in the PA pyrometer and is active when delivered from the factory.



Moreover, use a converter with galvanic isolation (e.g. W&T 38211) to avoid problems with ground loops.



**Caution !**

If the supply voltage or current output are conducted via this cable, then make sure to consider the voltage drop if the cable length is greater than 100 m.

- Disconnect the pyrometer from any voltage source
- Install all required electric connections
- Connect the converter with the PC
- Install the converter according to instructions
- Connect the voltage supply for the pyrometer
- Start CellaView
- Select the correct COM port or use the CellaView search function.

For more information on how to work with CellaView read the separate CellaView manual.

**11.3 CellaView via RS485 bus connection**

The RS485 two-wire bus consists of the bus cable itself with a maximum length of 1200 m. The participants are connected to this cable via a branch line with a length of 5 m max.

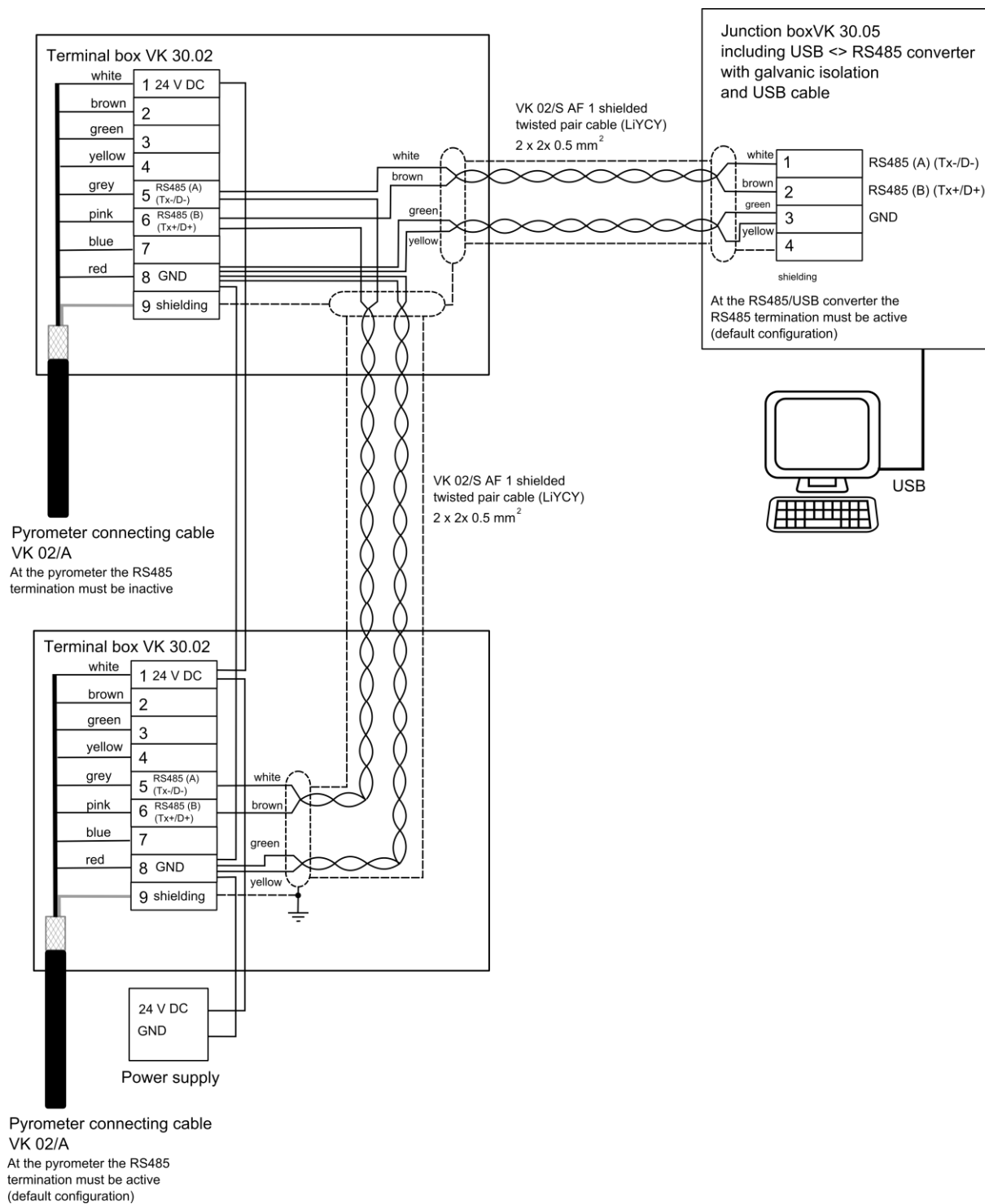
Up to 31 pyrometers can be connected to the RS485 bus. CellaView controls the communication on the bus and prompts allocated pyrometers to send or to receive data. Each participant will be addressed by a unique address. Configure this address during setup of each pyrometer using the keyboard.

**Configuration layer: c 0 ! !**

|       |                |   |
|-------|----------------|---|
| Addr. | Device address | Enter address of device for protocol mode |
|-------|----------------|---|

A USB/RS485 converter is needed when working with the RS485 interface. The pyrometer can be directly connected if the PC has an integrated RS485 Interface board.

In order to prevent reflections on the RS485 connection, it is absolutely necessary to terminate the bus system with termination network. The termination can be activated or deactivated by a DIP switch on the PA pyrometer. The termination is active when delivered from the factory. Moreover, use a converter with galvanic isolation (e.g. W&T 38211) to avoid problems with ground loops.



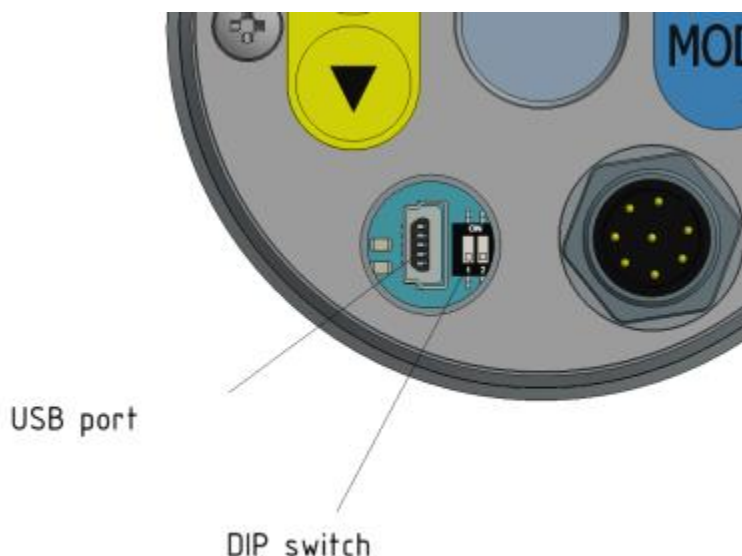
**Caution !**

All pyrometers must be connected to the same voltage supply. The maximum length of the branch lines to the pyrometer is 5 m.

- Disconnect the pyrometer from any voltage source
- Activate or deactivate the termination of the respective participant (see termination of RS485 bus)
- Install all required electric connections
- Connect the converter with the PC
- Install the converter according to instructions
- Connect the voltage supply for the pyrometers
- Adapt the addresses of the participants
- Start CellaView
- Select the correct COM port or use the CellaView search function.

#### 11.4 Termination of RS485 bus

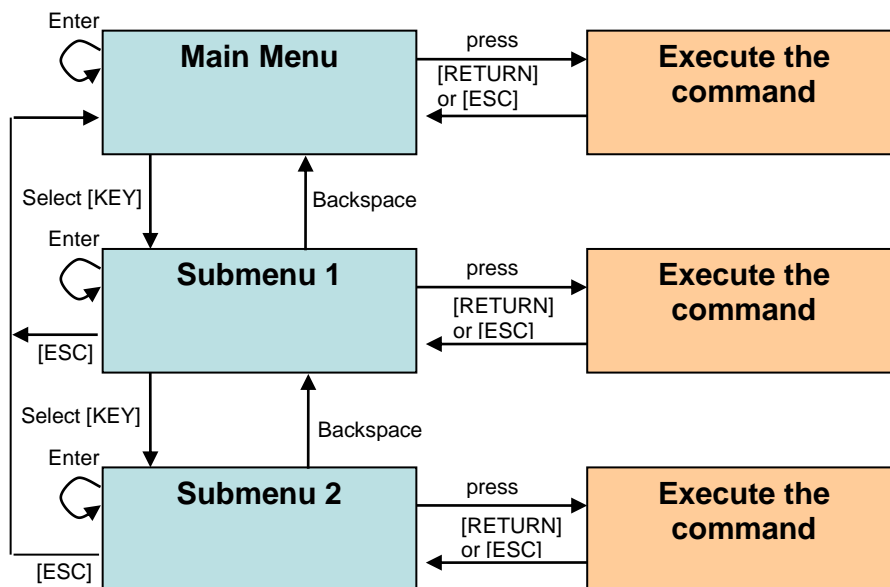
The terminal resistor of the pyrometer must be activated on the relevant bus end. For this purpose set the DIP switches to ON. Deactivate the termination with the remaining pyrometers.



## 12 Operation of the pyrometer via terminal program

By default, the pyrometer has fully integrated communications software to the point-to-point connection with a PC. As an alternative to the CellaView software, all parameters that are required for a measurement data acquisition or a general configuration of the pyrometer can be configured via a simple terminal connection using the terminal program.

Most key parameters are directly available in the main menu. Further functions are contained in submenus. Navigation within the menus is explained in the following graphics:



To set the pyrometer to the terminal mode, simultaneously hold down the **Ctrl key** and press the **E key** twice in rapid succession.

Direct commands have an assigned key. Example: E for emissivity (epsilon). Submenu settings are shown in brackets. Example: [LAMBDA 1]

### 12.1 Serial Data Transmission of Temperature Data

Transmission parameters for the serial interface:

57600 Baud / 8 data bits / odd parity / 1 stop bit / no handshake

Temperature format (one cycle):

| Byte | Negative Temperature | Positive Temperature | Temperature falls below measuring range | Temperature exceeds measuring range |
|------|----------------------|----------------------|---|-------------------------------------|
| 1    | Minus symbol "-"     | Space                | Space                                   | Space                               |
| 2    | Digit 1000           | Digit 1000           | Minus symbol "-"                        | Minus symbol "-"                    |
| 3    | Digit 100            | Digit 100            | "U"                                     | "O"                                 |
| 4    | Digit 10             | Digit 10             | "N"                                     | "V"                                 |
| 5    | Digit 1              | Digit 1              | "D"                                     | "E"                                 |
| 6    | Decimal point "."    | Decimal point "."    | "E"                                     | "R"                                 |
| 7    | Decimal place        | Decimal place        | "R"                                     | Space                               |
| 8    | Space                | Space                | Space                                   | Space                               |
| 9    | Unit "C" or "F"      | Unit "C" or "F"      | Minus symbol "-"                        | Minus symbol "-"                    |
| 10   | Space                | Space                | Space                                   | Space                               |
| 11   | Carriage Return      | Carriage Return      | Carriage Return                         | Carriage Return                     |



Please note:

All symbols are ASCII coded; preceding zeros will be included in the transmission

The cycle time in which the temperature reading is transmitted can be set at the PC terminal (minimum cycle duration is 0.1 second).

## 12.2 Terminal connection via USB

For communication through a terminal connection via USB set the parameter `⌘ E r ⌘` on the pyrometer to USB (default setting).

The parameter `⌘ E r ⌘` is available on configuration layer C011.

Parameter `⌘ E r ⌘` = USB

- Install the pyrometer's USB driver on the PC
- Connect the pyrometer with a USB cable to the PC
- Start a standard terminal program (e.g. Windows Hyperterminal or Putty)
- Select the correct COM port
- Set the interface parameters for the serial interface (see chapter transmission of measurement values)
- Open the connection

## 12.3 Terminal connection via RS485

For communication through a terminal connection via RS485 set the parameter `⌘ E r ⌘` on the pyrometer to `r 485`.

The parameter `⌘ E r ⌘` is available on configuration layer C011.

Parameter `⌘ E r ⌘` = r 485

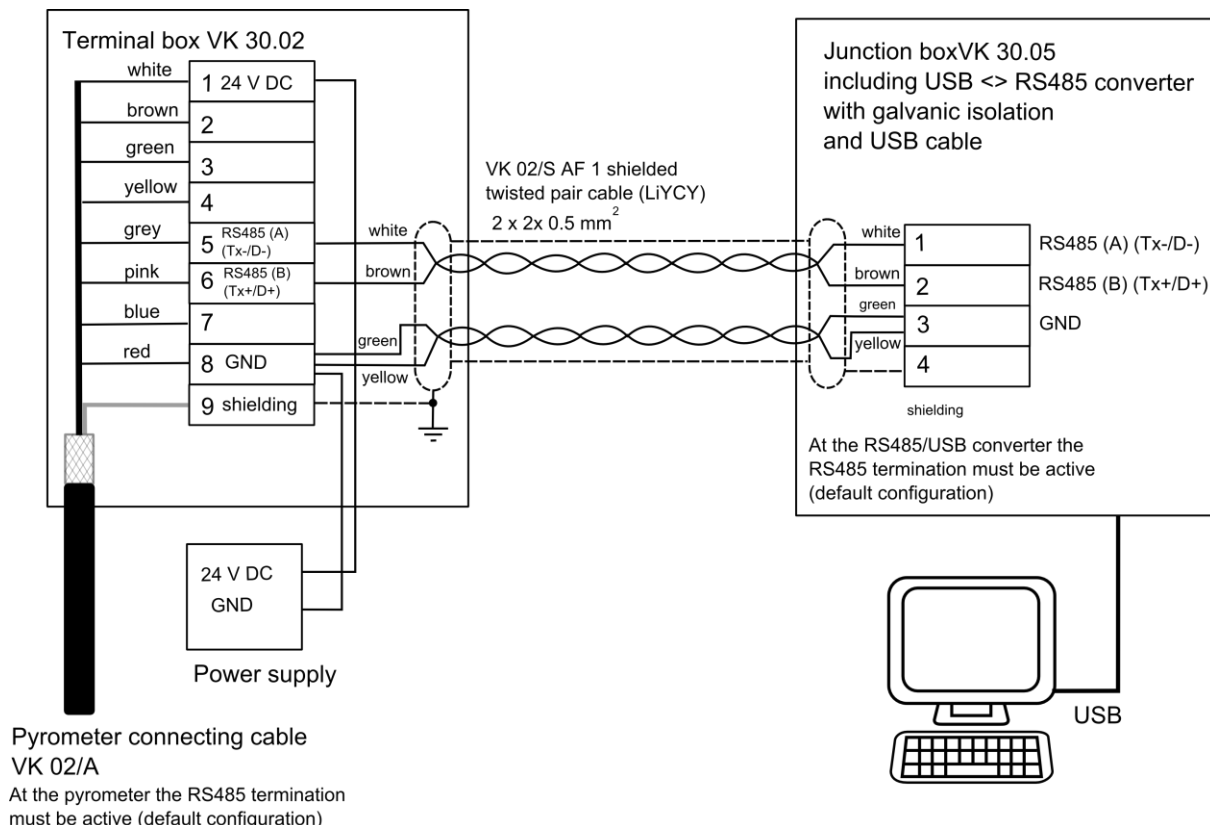


Caution !

When using a terminal connection via the RS485 interface, Cel-laView cannot be used via the RS485 interface any longer.

A USB/RS485 converter is needed when working with the RS485 interface. The distance between pyrometer and PC can be up to 1200 m.

In order to prevent reflections on the RS485 connection, it is absolutely necessary to terminate the connection at the pyrometer and at the converter. The termination is integrated in the PA pyrometer and is active when delivered from the factory.



Moreover, use a converter with galvanic isolation (e.g. W&T 38211) to avoid problems with ground loops.



**Caution !**

If the supply voltage or current output are conducted via this cable, then make sure to consider the voltage drop if the cable length is greater than 100 m.

- Disconnect the pyrometer from any voltage source
- Install all required electric connections
- Connect the converter with the PC
- Install the converter according to instructions.
- Connect the voltage supply for the pyrometer
- Change the parameter  $\epsilon \epsilon r \eta$  to  $r 485$
- Start a terminal program such as Hyperterminal

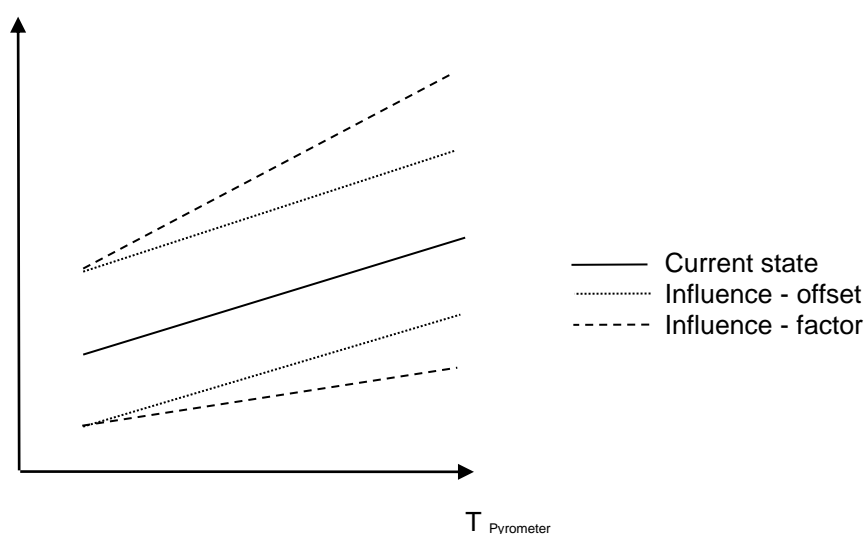


- Select the correct COM port
- Set the correct parameters for the serial interface (see chapter transmission of measurement values)
- Open the connection

### 13 User-defined calibration / scaling of the current output

If necessary, the pyrometer can be adjusted with a user-defined calibration function. The following drawing explains the effects for offset and factor.

$T_{\text{shall}}$



Caution:

**To recalibrate your CellaTemp PA, you will require a calibration furnace and a reference standard.**

In addition to a user-defined calibration, the user-defined range function can also be activated. With this function being active, scaling of the current output can be extended.



Please note:

The measuring accuracy is not defined when the scaling is outside the pyrometer range.

### 13.1 Calibration/scaling via CellaView

To use the user-defined calibration function, activate it first in expert mode.

- Start CellaView
- Open the menu Settings Extras -> Settings
- Select expert mode and activate editable calibration
- Close the menu
- Open the menu Pyrometer settings

The parameters can now be edited under the tab Spectral channel 1.

### 13.2 Calibration/scaling via terminal connection

If ever required, the CellaTemp PA can be recalibrated using the sub-menu Calibration. Press command „K“ and then enter the password „100“ to access the calibration menu.

The calibration menu opens.

```

-----
-----
Submenu CALIBRATION
-----
Name .... "Pyrometer PA Series"

1: [LAMBDA 1 CALIBRATION]
A: Reset settings to factory default
S: Set pyrometer name
Z: End Calibration-Mode
ESC: Back to MAIN-MENU
-----
>CALIBRATION >

-----
-----
Submenu LAMBDA 1
-----
L1 range .... 0.0 - 1000.0 C
L1 User calibration ..... off
L1 User def. offset +0.00000
L1 User def. factor +1.00000

A: Set L1 - extended-range
B: Set L1 User-Cal. On/Off
C: Set L1 User-Cal. Offset
D: Set L1 User-Cal. Factor
ESC: Back to MAIN-MENU
-----
>CALIBRATION >LAMBDA 1 >

```

You can reset all configurations you have made to your CellaTemp PA and restore the factory default settings using Command „A“. This also

applies to data acquisition parameters and input/output settings. Use keys "B", "C" and "D" for direct access to enable the adjustments. If you make a mistake while making the adjustments, simply enter offset=0.0 und factor=1.0, or set User Cal. to „off“.

Command "A" redefines the pyrometer's entire measuring range. This new temperature span may be smaller or larger than the range originally programmed by the manufacturer. When selecting a new temperature range for your CellaTemp PA, make absolutely sure that the temperature span you select is actually covered by the pyrometer model you have purchased. The only way to be certain is to perform measurement tests.

Press "S" to enter a short text to name the control point. View this text by selecting „Q“ in the Main Menu.

## 14 Shielding and Grounding

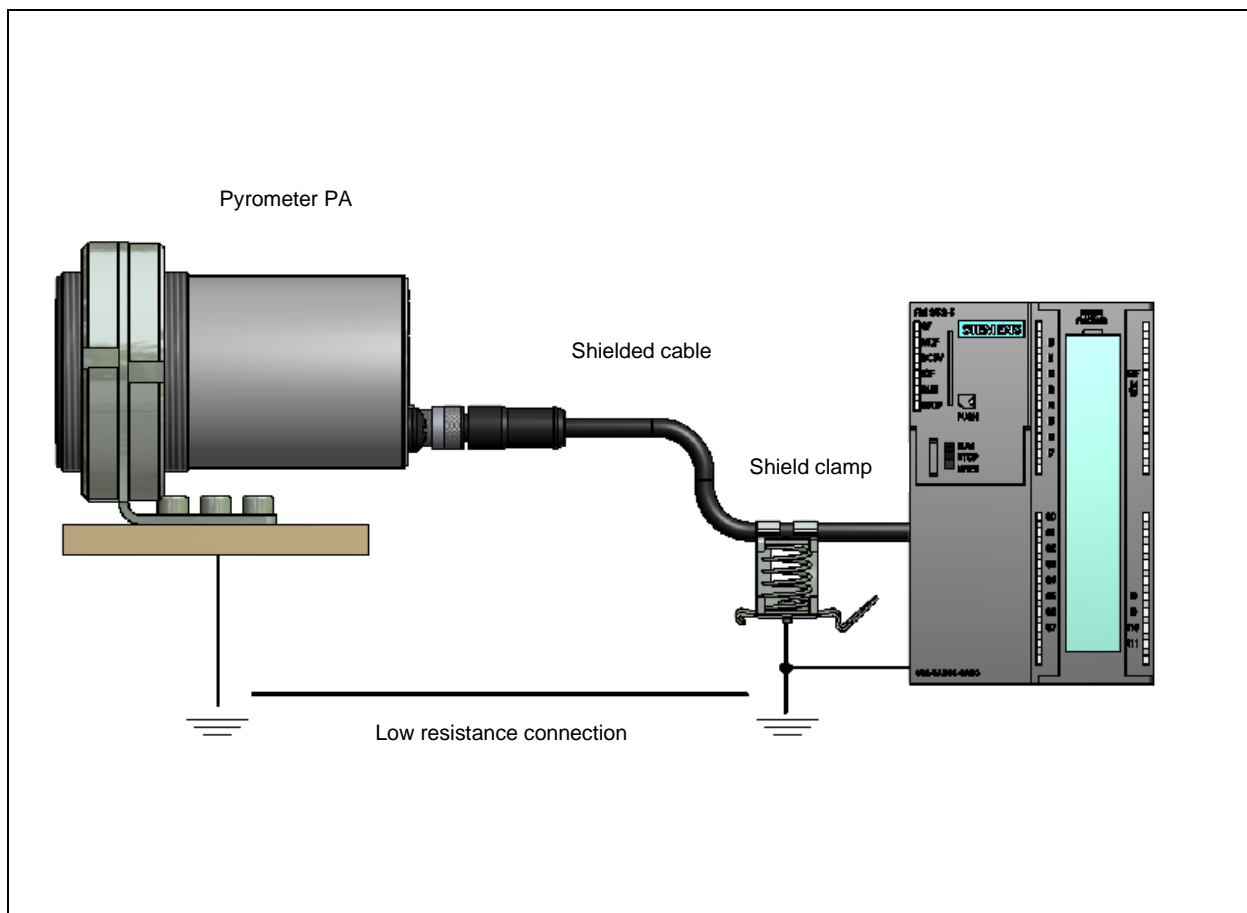
### 14.1 Potential equalisation



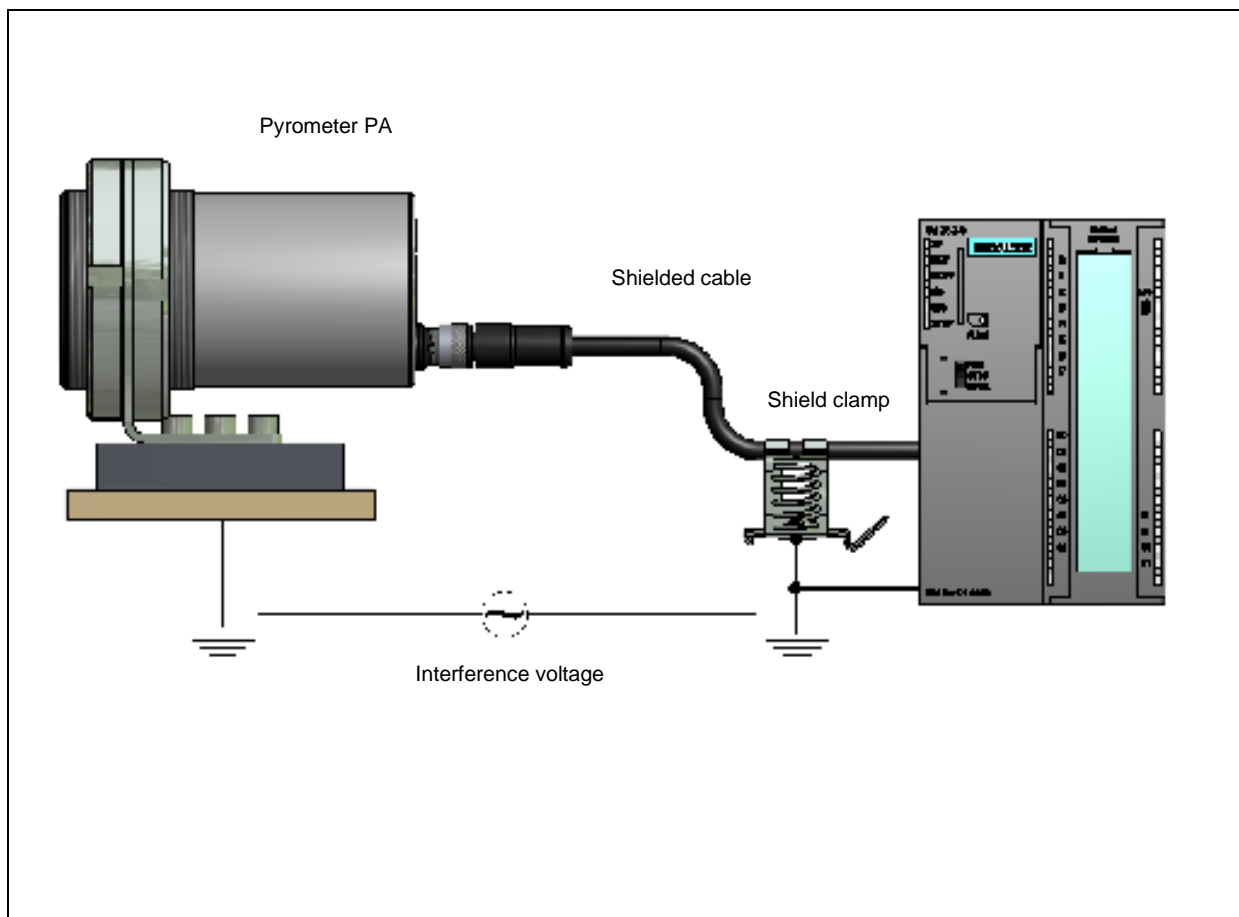
**Caution:**

All applicable laws and codes must be complied with at all times.

The pyrometer housing is connected to the shielding via the cable connector! Differences in ground potentials might cause an equalising current to flow between devices through a cable shielded at both ends.



In this case, be sure to install an additional potential equalisation line.



To avoid an equalising current, the pyrometer can be mounted electrically insulated. The shielding must be connected to the plant's earthing system.

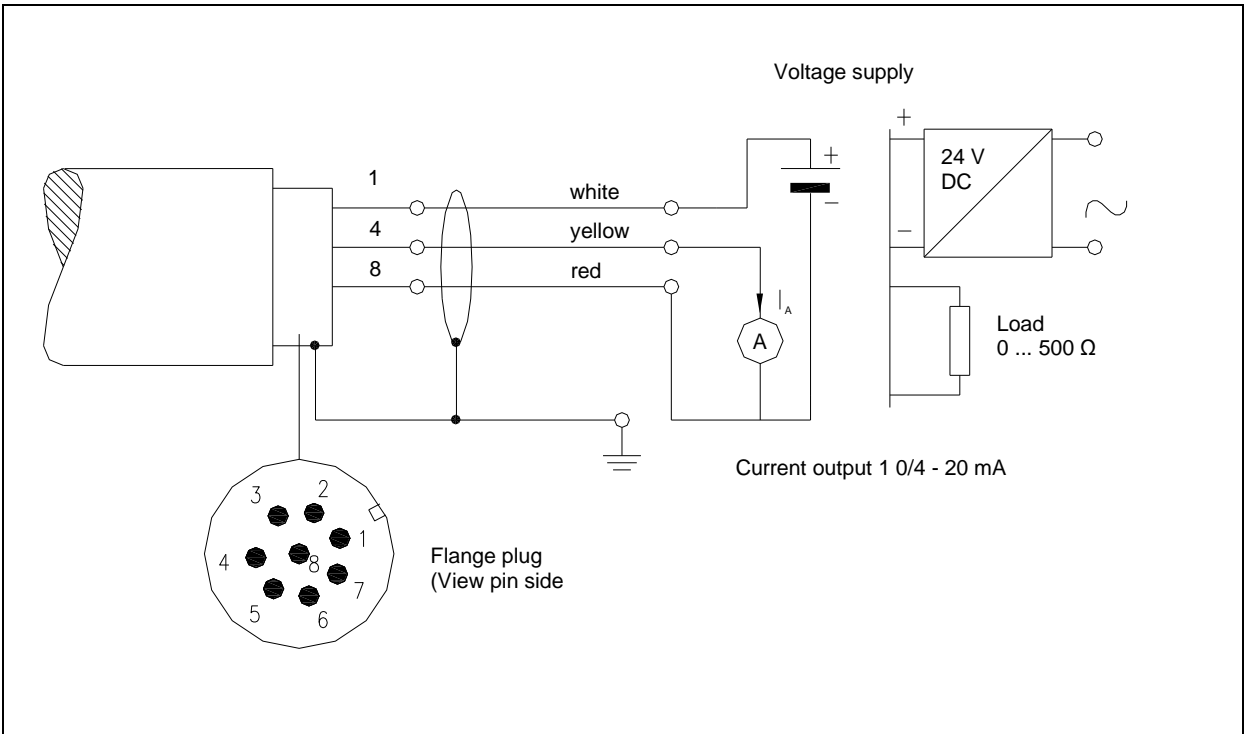


**Caution:**

If the pyrometer is installed without an insulator and without potential equalisation, the interference voltage may not exceed 48V.

# 15 Connectivity Examples

## 15.1 Connection to VK 02/A Cable



## 16 Theory of Non-Contact Temperature Measurements

All materials radiate thermal energy in all states of aggregation above absolute zero. This radiation is mainly caused by atomic or molecular oscillations. This temperature radiation is only a limited sector within the total electromagnetic radiation spectrum. It extends from the visible range starting at wavelengths of approx. 0.5  $\mu\text{m}$  to the infrared range with wavelengths of more than 40  $\mu\text{m}$ . The KELLER HCW PA radiation pyrometers detect infrared radiation for non-contact temperature measurement.

### 16.1 Advantages of Non-Contact Temperature Measurement

Non-contact temperature detection means cost-effective temperature measurement because this technique only requires a single investment in an instrument without any follow-up costs for consumables such as thermocouples. This method enables temperature detection of moving objects - quick temperature measurements within milliseconds - for example at automatic welding processes. Small objects with medium and high temperatures can also be easily and accurately measured. When measuring materials with low specific heat, a non-contact method does not induce heat loss which would distort the temperature reading (as is the case with contact temperature probes). Non-contact temperature detection is ideal with corrosive molten materials for which the use of thermocouples is hardly feasible. Last but not least it is also possible to measure the temperature of voltage-carrying objects.

### 16.2 Measurements at Black Bodies (Cavity Radiators)

A black body or a black radiator is used to calibrate radiation pyrometers. This black body is designed in a way that its radiation does not depend on material characteristics, but only on its temperature. A black body emits at any wavelength the maximum energy possible for the specific temperature. Real bodies do not have this ability. In other words, a black body completely absorbs the radiation without reflection or transmission losses. The spectral emissivity coefficient  $\varepsilon(\lambda)$  of a black body is equal to 1 or 100 %. The emissivity coefficient indicates the ratio of radiation of a real body (target) to the radiation of an ideal black body.

$$\varepsilon(\lambda) = \frac{M}{M_S}$$

$\varepsilon(\lambda)$ : Emissivity coefficient of the object's surface (targeted spot) at wavelength  $\lambda$

$M$ : radiant energy actually emitted by a real object

$M_S$ :: radiant energy emitted by a black body (perfect radiator)

Most burning, annealing and hardening furnaces emit a radiation of nearly '1' which corresponds to the conditions of a black body if the aperture through which the measurement is made is relatively small.

### **16.3 Measurements of Real Radiators**

Real radiation sources are characterized by the relation of the emitted radiation to the radiation of a black body with the same temperature. Measurements outside a furnace - which applies to all other self-contained targets - always show a reading which is too low. Considerable errors can occur at targets with reflecting, polished or bright surfaces, e.g. molten steel and metal without oxide layer and ceramic materials. Exact results can only be obtained when the emissivity coefficient is correctly adjusted on the PA pyrometer.

The spectral emissivity coefficient of a body does not represent an exact material constant, but is also largely dependent on the surface properties. For different materials the spectral emissivity coefficient  $\varepsilon$  for the spectral ranges  $\lambda = 1.1 - 1.7 \mu\text{m}$  (PA 21),  $\lambda = 0.8 - 1.1 \mu\text{m}$  (PA 31) and  $\lambda = 0.82 - 0.93 \mu\text{m}$  (PA 36) is shown in the following tables:



## 16.4 Emissivity Coefficient Table PA 21 – PA 36

List of emissivity coefficients of different materials in %

| CellaTemp                   | PA 21                   | PA 31/ PA 36            |
|-----------------------------|-------------------------|-------------------------|
| Wavelength $\lambda$        | 1.1 – 1.7 $\mu\text{m}$ | 0.8 – 1.1 $\mu\text{m}$ |
| "Black Body"                | 100                     | 100                     |
| Aluminium, polished         | 5                       | 15                      |
| Aluminium, blackened        | 10                      | 25                      |
| Asbestos cement             | 60                      | 70                      |
| Bronze, polished            | 1                       | 3                       |
| Bronze, blackened           | 15                      | 30                      |
| Chromium, polished          | 15                      | 30                      |
| Iron, heavily scaled        | 90                      | 95                      |
| Iron, rolling skin          | 75                      | 90                      |
| Iron, liquid                | 15                      | 30                      |
| Gold and silver             | 1                       | 2                       |
| Graphite, blackened         | 85                      | 90                      |
| Copper, oxidized            | 70                      | 90                      |
| Brass, oxidized (tarnished) | 50                      | 70                      |
| Nickel                      | 8                       | 20                      |
| Porcelain, glazed           | 50                      | 60                      |
| Porcelain, rough            | 75                      | 85                      |
| Soot                        | 90                      | 95                      |
| Fireclay                    | 40                      | 50                      |
| Slag                        | 80                      | 85                      |
| Pottery, glazed             | 85                      | 90                      |
| Bricks                      | 85                      | 90                      |
| Zinc                        | 40                      | 60                      |

## 17 Maintenance

### 17.1 Cleaning the pyrometer lens

A false temperature reading will be given when the lens is dirty. Therefore check the lens periodically and clean it, if necessary.

Dust can be removed by simply blowing it away or by using a soft brush. A special lens cleaning cloth is ideal, but any soft, clean, lint-free cloth will be suitable.

If the lens is quite dirty, use a very mild liquid detergent and rinse carefully with clear water while holding the pyrometer down. Apply as little pressure as possible to avoid scratching the lens.

Make sure to turn off the pyrometer prior to connecting or disconnecting the coupler connector (e.g. when cleaning). Failure to do so may result in damage to the instrument!



#### NOTE !

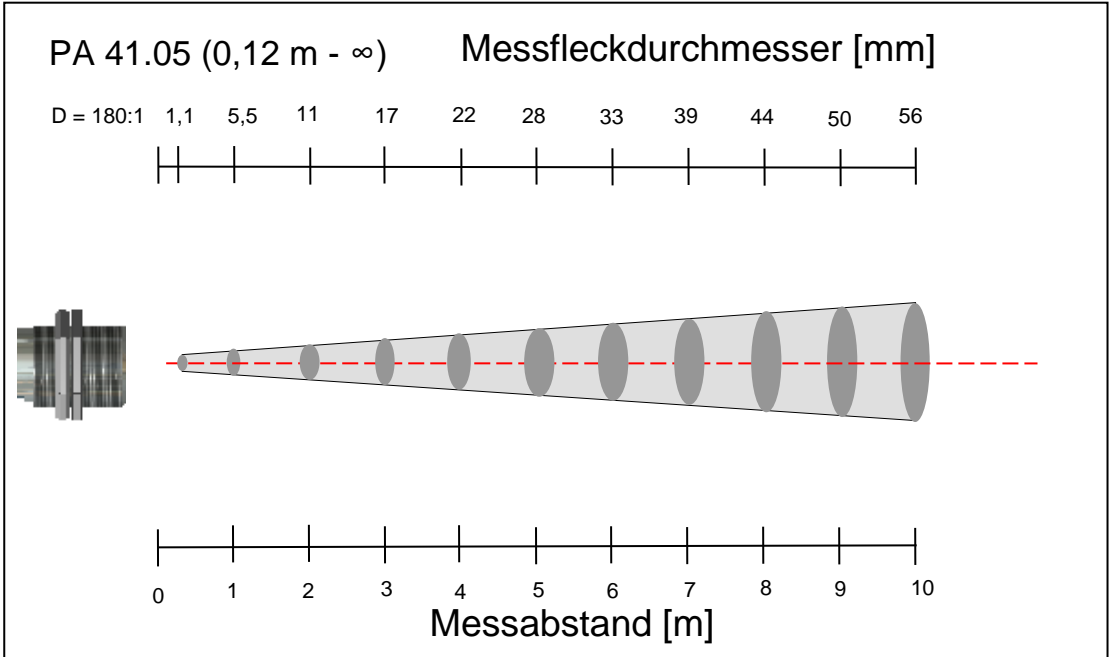
The pyrometer must be protected against high ambient temperatures, high air humidity, high voltage and strong electromagnetic fields. Never hold the lens directly into the sun.

## 18 Technical Data PA 21

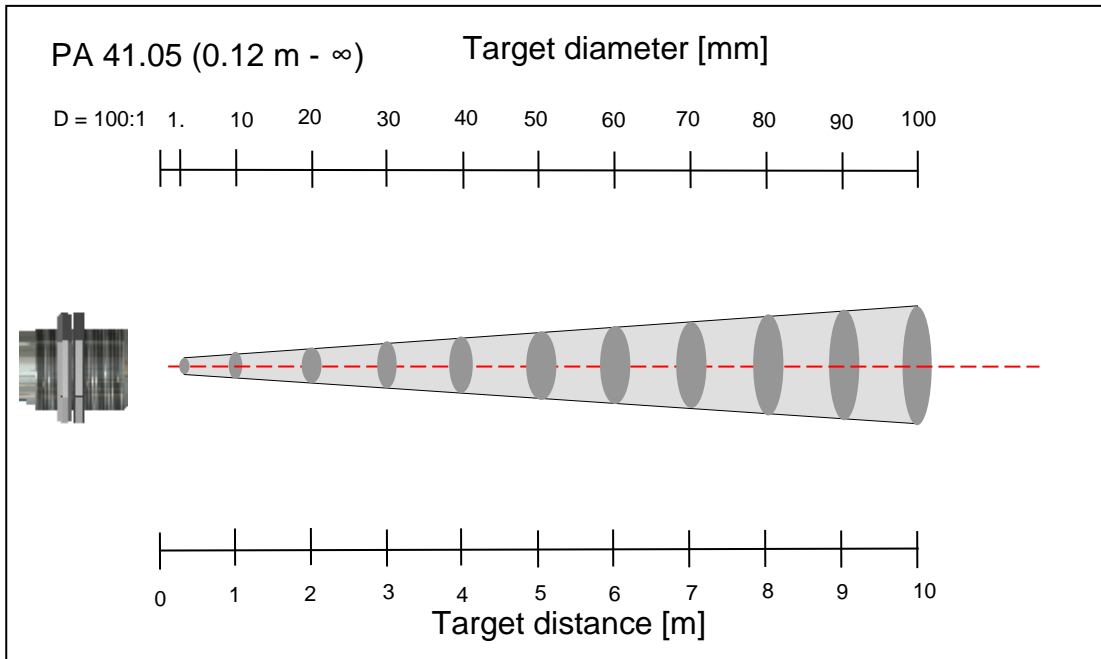
|  |  |   |
|--|--|---|
| <b>Measuring ranges:</b><br>300 ... 2000 °C  | <b>Repeatability:</b><br>2 K   | <b>Housing material:</b><br>Stainless steel   |
| <b>Sensors:</b><br>photo diode   | <b>Sighting device:</b><br>laser spot light  | <b>Mounting:</b><br>External thread M 65 x 2<br>length 40 mm  |
| <b>Spectral sensitivity:</b><br>1.1 - 1.7 µm   | <b>Ambient operating temperature:</b><br>sensor: - 20 ... 250 °C<br>fibre optic cable:- 20 ..85 °C<br>optional up to 250 °C<br>electronic: 0 ... 65 °C | <b>Weight:</b><br>Approx. 0.9 kg  |
| <b>Focussing range M 30:</b><br><b>Optic PA 41.01</b><br>0.2 m ... ∞ (standard lens)   |  | <b>Connection:</b><br>with 8-pin connector  |
| <b>Focussing range M 16:</b><br><b>Optic PZ 41.18</b><br>33 ... 45 mm (close-up lens)<br><b>Optik PA 41.05</b><br>0.12 m ... ∞ (standard lens) | <b>Indication of Overheating:</b><br>If the internal temperature of the pyrometer exceeds 80 °C the analogue output will show a value > 20.5 mA.       | <b>Protection:</b><br>IP 65 according to<br>DIN 40050<br>(with connector attached)  |
| <b>Distance to target-size ratio:</b><br>PA 41.01: 180:1 (0.2m-∞) M30<br>PA 41.05 100:1 (0.12 m-∞) M16<br>PZ 41.18: 50:1 (33-45 mm) M16        | <b>Storage temperature:</b><br>sensor: - 20 ... 250 °C fibre<br>optic cable:- 20 . 85 °C<br>optional up to 250 °C<br>electronic: -20 ... 70 °C         | <b>Adjustable parameters:</b><br><b>Analogue output 1 &amp; 2:</b><br>source/ scaling   |
| <b>Digital output:</b><br>Periodic output of measurement data with adjustable cycle time   | <b>Permissible humidity:</b><br>95% r.H. max.<br>(non-condensing)  | <b>Digital input output 1 &amp; 2:</b><br>source/ switch point  |
| <b>Analogue output 1 &amp; 2:</b><br>0(4) ... 20 mA linear,<br>switchable, scalable, output insulated from power supply (4...20 mA normally)   | <b>Temperature coefficient with reference to 23 °C:</b><br>0.25 K / K (for T < 500 °C)<br>0.05 % / K (for T ≥ 200 °C)<br>of measured value             | <b>Transmission factor</b><br><br><b>Compensation of background radiation</b>   |
| <b>Resistance:</b><br>max. 500 Ω   | <b>Interface:</b><br>USB / RS485 with integrated software to set parameters and transmit measurement data to a PC                                      | <b>Look-up table for temperature alignment</b><br><br><b>Emissivity ε:</b><br>10 - 110 %<br>increment size 0.1 %              |
| <b>Response time t<sub>98</sub>:</b><br>≤ 50 ms (T > 300 °C)<br>≤ 2 ms (T > 800 °C)  | <b>Analogue input:</b><br>0 - 10 V   | <b>Smoothing function t<sub>98</sub>:</b><br>0 - 999 sec  |
| <b>Resolution Analogue output:</b><br>0.2 K + 0.03 % of the adjusted span  | <b>Digital output:</b><br>2 Open collector outputs<br>24 V; ≤ 30 mA  | <b>Memory modes:</b><br>- Min./Max. (peak picker)<br>- Double maximum with adjustable hold time                               |
| <b>Resolution Display:</b><br>1 K  | <b>Digital input:</b><br>2 to 24 V   | <b>Optional accessories:</b><br>calibration certificate according to ISO 9001<br><br>calibration certificate according to DKD |
| <b>Resolution USB / RS 485:</b><br>0.1 K at terminal operation   | <b>Power supply requirements:</b><br>24 V DC +10% / -20%<br>current input ≤135 mA / ≤ 150 mA with switched on spotlight<br>Ripple: ≤ 200 mV            | large variety of mounting devices, digital displays, software, etc.   |
| <b>Measuring uncertainty:</b><br>0.75 % of reading<br>(at ε =1.0 and T <sub>A</sub> =23 °C)  | <b>Dimensions:</b><br>Ø 65 x 220 mm<br>(with connector attached)   |   |
| <b>Linearisation:</b><br>digital via microcontroller   |  |   |

**18.1 Field of View Diagrams for PA 21**

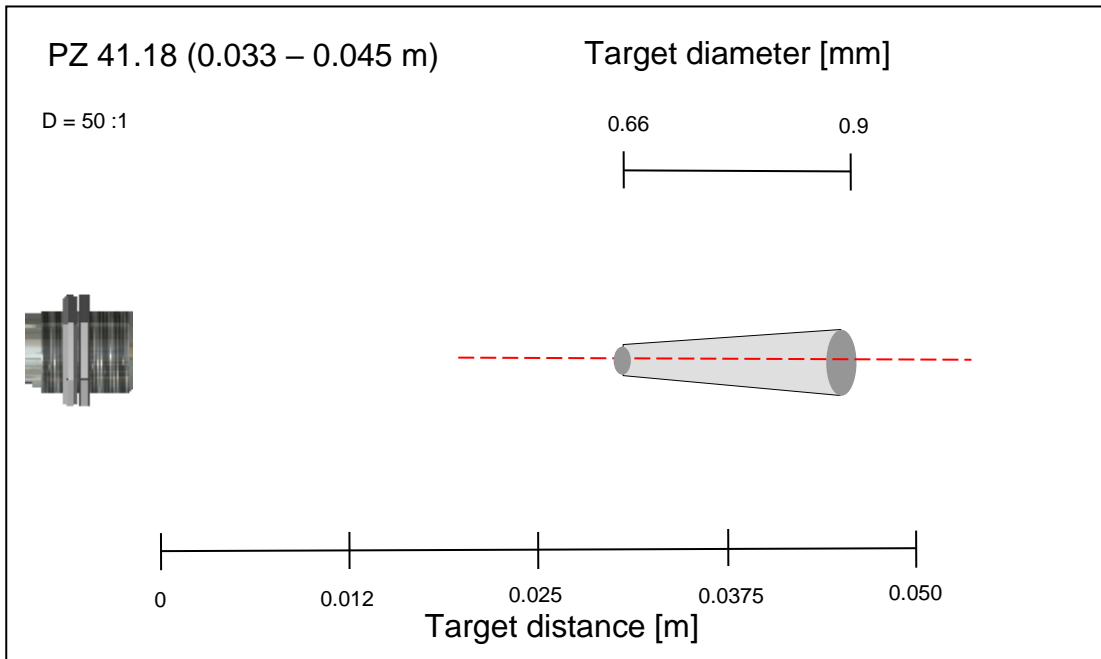
**18.1.1 PA 21 AF 11 (Standard lens PA 41.01 M30)**



**18.1.2 PA 21 AF 21 (Standard lens PA 41.05 M16)**



**18.1.3 PA 21 AF 22 (Close up lens PZ 41.18 M16)**

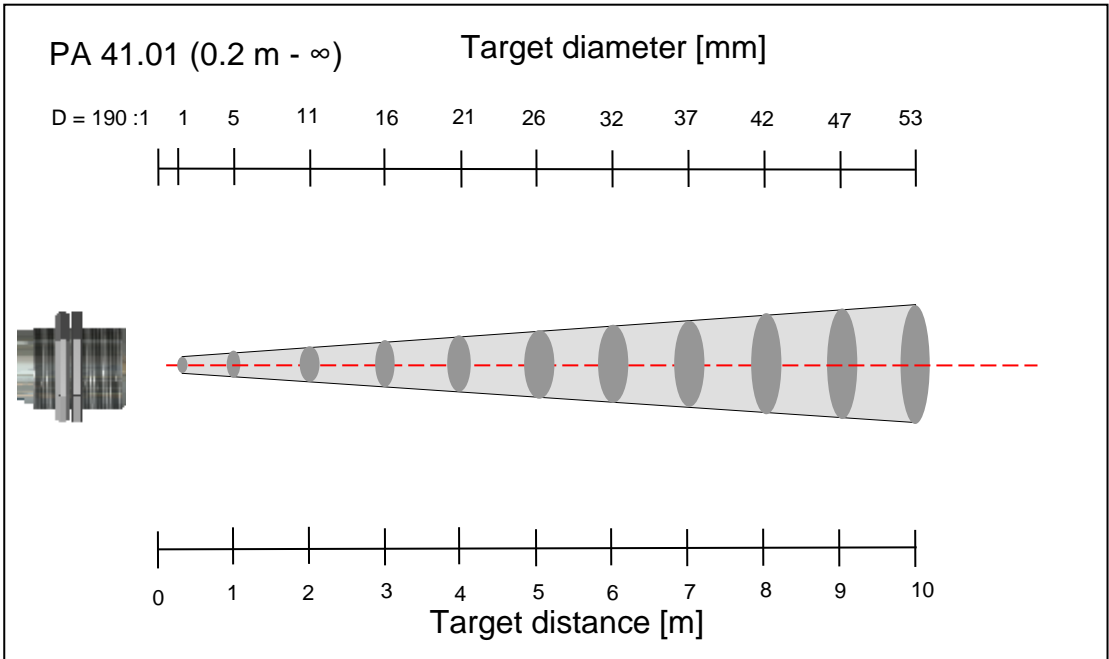


## 19 Technical Data PA 31

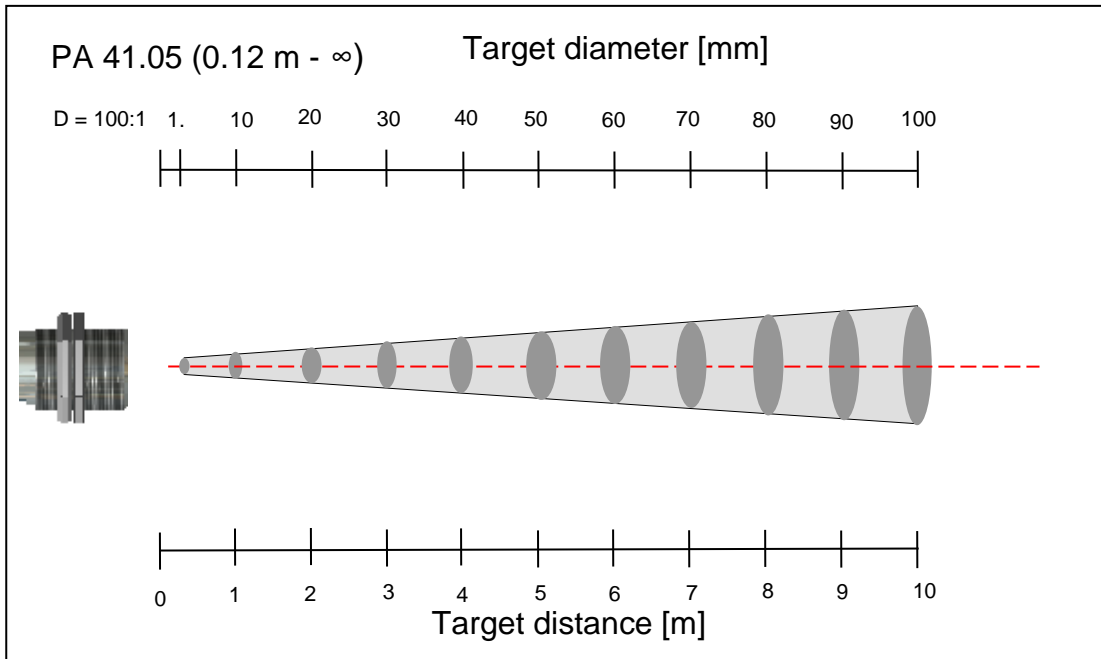
|  |  |  |
|--|--|--|
| <b>Measuring ranges:</b><br>550 ... 2500 °C  | <b>Repeatability:</b><br>2 K   | <b>Housing material:</b><br>Stainless steel  |
| <b>Sensors:</b><br>photo diode   | <b>Sighting device:</b><br>laser spot light  | <b>Mounting:</b><br>External thread M 65 x 2<br>length 40 mm   |
| <b>Spectral sensitivity:</b><br>0.78 - 1.06 µm   | <b>Ambient operating temperature:</b><br>sensor: - 20 ... 250 °C<br>fibre optic cable:- 20 ..85 °C<br>optional up to 250 °C<br>electronic: 0 ... 65 °C | <b>Weight:</b><br>Approx. 0.9 kg   |
| <b>Focussing range M 30:</b><br><b>Optic PA 41.01</b><br>0.4 m ... ∞ (standard lens)   |  | <b>Connection:</b><br>with 8-pin connector   |
| <b>Focussing range M 16:</b><br><b>Optic PZ 41.18</b><br>33 ... 45 mm (close-up lens)<br><b>Optik PA 41.05</b><br>0.12 m ... ∞ (standard lens) | <b>Indication of Overheating:</b><br>If the internal temperature of the pyrometer exceeds 80 °C the analogue output will show a value > 20.5 mA.       | <b>Protection:</b><br>IP 65 according to<br>DIN 40050<br>(with connector attached)   |
| <b>Distance to target-size ratio:</b><br>PZ41.31: 190:1 (0.4 m-∞) M30<br>PA41.05: 100:1 (0.12 m-∞) M16<br>PZ41.18: 50:1 (33-45 mm) M16         | <b>Storage temperature:</b><br>sensor: - 20 ... 250 °C fibre<br>optic cable:- 20 . 85 °C<br>optional up to 250 °C<br>electronic: -20 ... 70 °C         | <b>Adjustable parameters:</b><br><b>Analogue output 1 &amp; 2:</b><br>source/ scaling  |
| <b>Digital output:</b><br>Periodic output of measurement data with adjustable cycle time   | <b>Permissible humidity:</b><br>95% r.H. max.<br>(non-condensing)  | <b>Digital input output 1 &amp; 2:</b><br>source/ switch point   |
| <b>Analogue output 1 &amp; 2:</b><br>0(4) ... 20 mA linear,<br>switchable, scalable, output insulated from power supply (4...20 mA normally)   | <b>Temperature coefficient with reference to 23 °C:</b><br>0.05 K / K<br>of measured value   | <b>Transmission factor</b>   |
| <b>Resistance:</b><br>max. 500 Ω   | <b>Interface:</b><br>USB / RS485 with integrated software to set parameters and transmit measurement data to a PC                                      | <b>Compensation of background radiation</b>  |
| <b>Response time t<sub>98</sub>:</b><br>≤ 50 ms (T > 600 °C)<br>≤ 2 ms (T > 800 °C)  | <b>Analogue input:</b><br>0 - 10 V   | <b>Look-up table for temperature alignment</b>   |
| <b>Resolution Analogue output:</b><br>0.2 K + 0.03 % of the adjusted span  | <b>Digital output:</b><br>2 Open collector outputs<br>24 V; ≤ 30 mA  | <b>Emissivity ε:</b><br>10 - 110 %<br>increment size 0.1 %   |
| <b>Resolution Display:</b><br>1 K  | <b>Digital input:</b><br>2 to 24 V   | <b>Smoothing function t<sub>98</sub>:</b><br>0 - 999 sec   |
| <b>Resolution USB / RS 485:</b><br>0.1 K at terminal operation   | <b>Power supply requirements:</b><br>24 V DC +10% / -20%<br>current input ≤135 mA / ≤ 150 mA with switched on spotlight<br>Ripple: ≤ 200 mV            | <b>Memory modes:</b><br>- Min./Max. (peak picker)<br>- Double maximum with adjustable hold time  |
| <b>Measuring uncertainty:</b><br>0.75 % of reading<br>(at ε =1.0 and T <sub>A</sub> =23 °C)  | <b>Dimensions:</b><br>Ø 65 x 220 mm<br>(with connector attached)   | <b>Optional accessories:</b><br>calibration certificate according to ISO 9001<br><br>calibration certificate according to DKD<br><br>large variety of mounting devices, digital displays, software, etc. |
| <b>Linearisation:</b><br>digital via microcontroller   |  |  |

**19.1 Field of View Diagrams for PA 31**

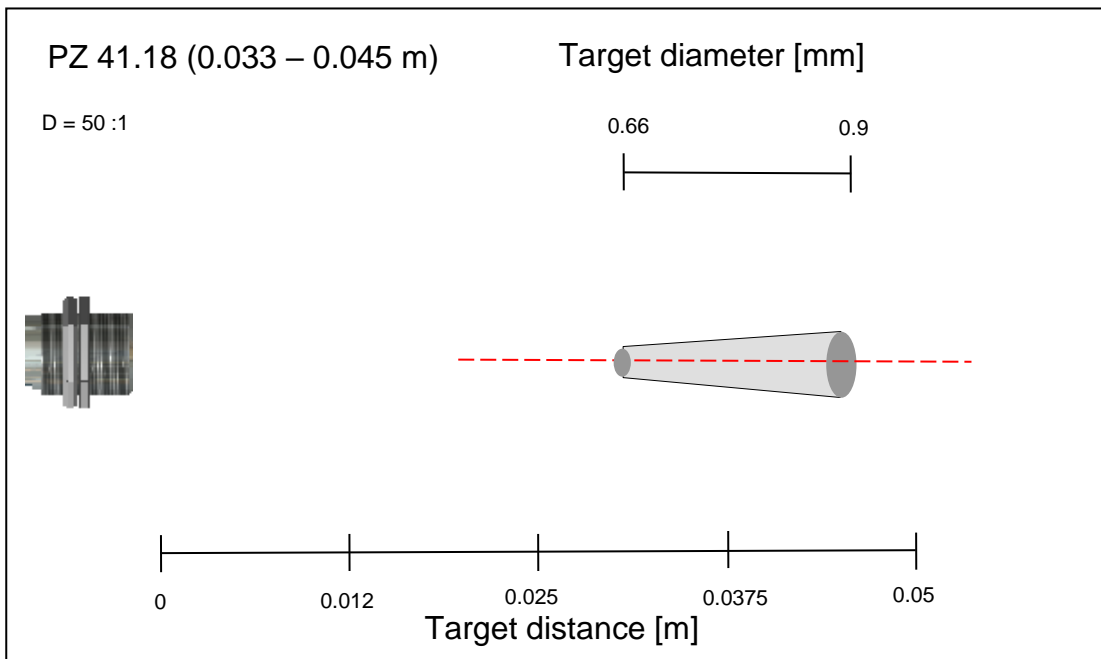
**19.1.1 PA 31 AF 11 (Standard lens PA 41.01 M30)**



**19.1.2 PA 31 AF 21 (Standard lens PA 41.05 M16)**



**19.1.3 PA 31 AF 22 (Close up lens PZ 41.18 M16)**





## 20 Technical Data PA 36

**Measuring ranges:**  
650 ... 3000 °C

**Sensors:**  
photo diode

**Spectral sensitivity:**  
0.82 - 0.93 µm

**Focussing range M 30:**  
**Optic PA 41.01**  
0.4 m ... ∞ (standard lens)

**Focussing range M 16:**  
**Optic PZ 41.18**  
33 ... 45 mm (close-up lens)  
**Optik PA 41.05**  
0.12 m ... ∞ (standard lens)

**Distance to target-size ratio:**  
PZ41.31: 190:1 (0.4 m-∞) M30  
PA41.05: 100:1 (0.12 m-∞) M16  
PZ41.18: 50:1 (33-45 mm) M16

**Digital output:**  
Periodic output of measurement data with adjustable cycle time

**Analogue output 1 & 2:**  
0(4) ... 20 mA linear, switchable, scalable, output insulated from power supply (4...20 mA normally)

**Resistance:**  
max. 500 Ω

**Response time  $t_{98}$ :**  
≤ 50 ms (T > 680 °C)  
≤ 2 ms (T > 900 °C)

**Resolution Analogue output:**  
0.2 K + 0.03 % of the adjusted span

**Resolution Display:**  
1 K

**Resolution USB / RS 485:**  
0.1 K at terminal operation

**Measuring uncertainty:**  
0.75 % of reading  
(at  $\epsilon = 1.0$  and  $T_A = 23$  °C)

**Linearisation:**  
digital via microcontroller

**Repeatability:**  
2 K

**Sighting device:**  
laser spot light

**Ambient operating temperature:**  
sensor: - 20 ... 250 °C  
fibre optic cable: - 20 ..85 °C  
optional up to 250 °C  
electronic: 0 ... 65 °C

**Indication of Overheating:**  
If the internal temperature of the pyrometer exceeds 80 °C the analogue output will show a value > 20.5 mA.

**Storage temperature:**  
sensor: - 20 ... 250 °C fibre optic cable: - 20 . 85 °C  
optional up to 250 °C  
electronic: -20 ... 70 °C

**Permissible humidity:**  
95% r.H. max.  
(non-condensing)

**Temperature coefficient with reference to 23 °C:**  
0.05 K / K  
of measured value

**Interface:**  
USB / RS485 with integrated software to set parameters and transmit measurement data to a PC

**Analogue input:**  
0 - 10 V

**Digital output:**  
2 Open collector outputs  
24 V; ≤ 30 mA

**Digital input:**  
2 to 24 V

**Power supply requirements:**  
24 V DC +10% / -20%  
current input ≤ 135 mA / ≤ 150 mA with switched on spotlight  
Ripple: ≤ 200 mV

**Dimensions:**  
Ø 65 x 220 mm  
(with connector attached)

**Housing material:**  
Stainless steel

**Mounting:**  
External thread M 65 x 2 length 40 mm

**Weight:**  
Approx. 0.9 kg

**Connection:**  
with 8-pin connector

**Protection:**  
IP 65 according to DIN 40050  
(with connector attached)

**Adjustable parameters:**

**Analogue output 1 & 2:**  
source/ scaling

**Digital input output 1 & 2:**  
source/ switch point

**Transmission factor**

**Compensation of background radiation**

**Look-up table for temperature alignment**

**Emissivity  $\epsilon$ :**  
10 - 110 %  
increment size 0.1 %

**Smoothing function  $t_{98}$ :**  
0 - 999 sec

**Memory modes:**  
- Min./Max. (peak picker)  
- Double maximum with adjustable hold time

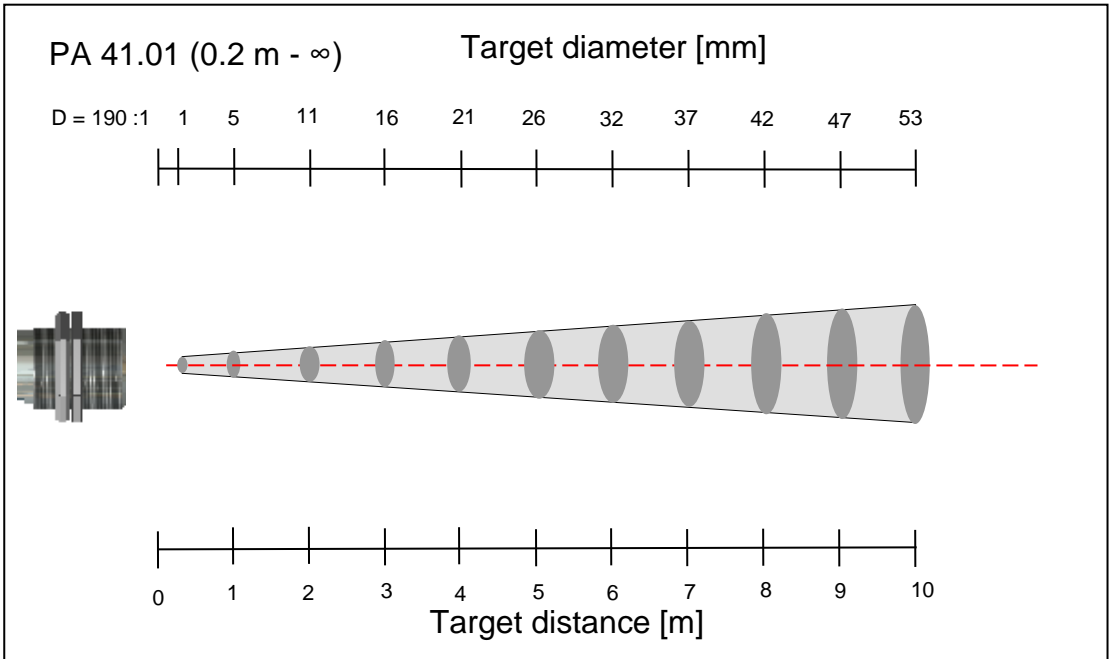
**Optional accessories:**  
calibration certificate according to ISO 9001

calibration certificate according to DKD

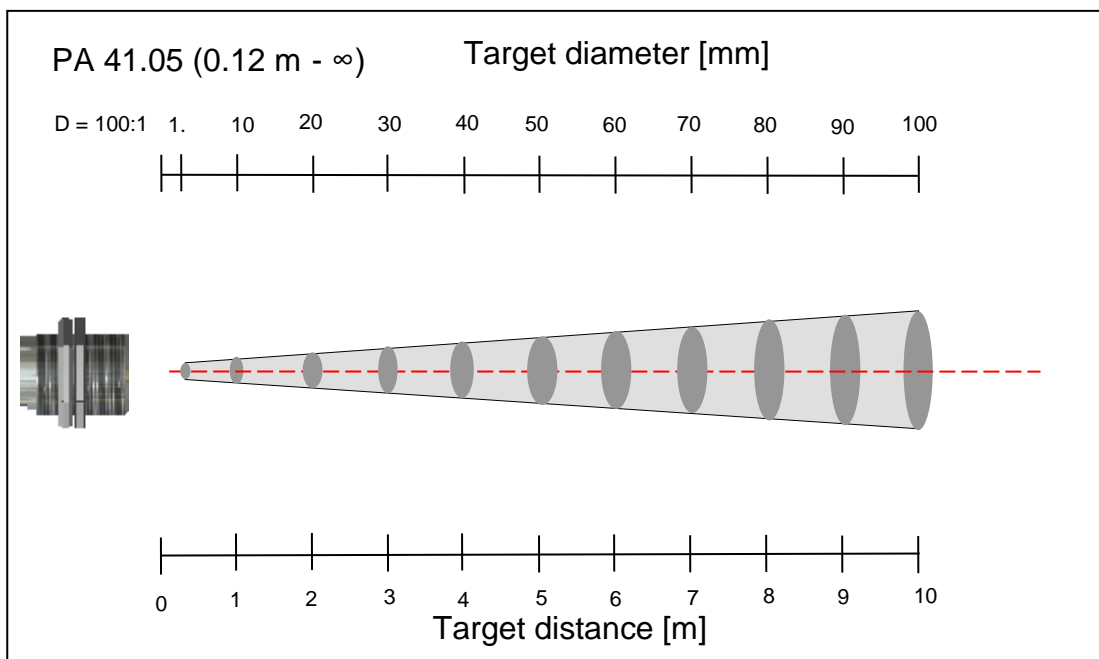
large variety of mounting devices, digital displays, software, etc.

**20.1 Field of View Diagrams for PA 36**

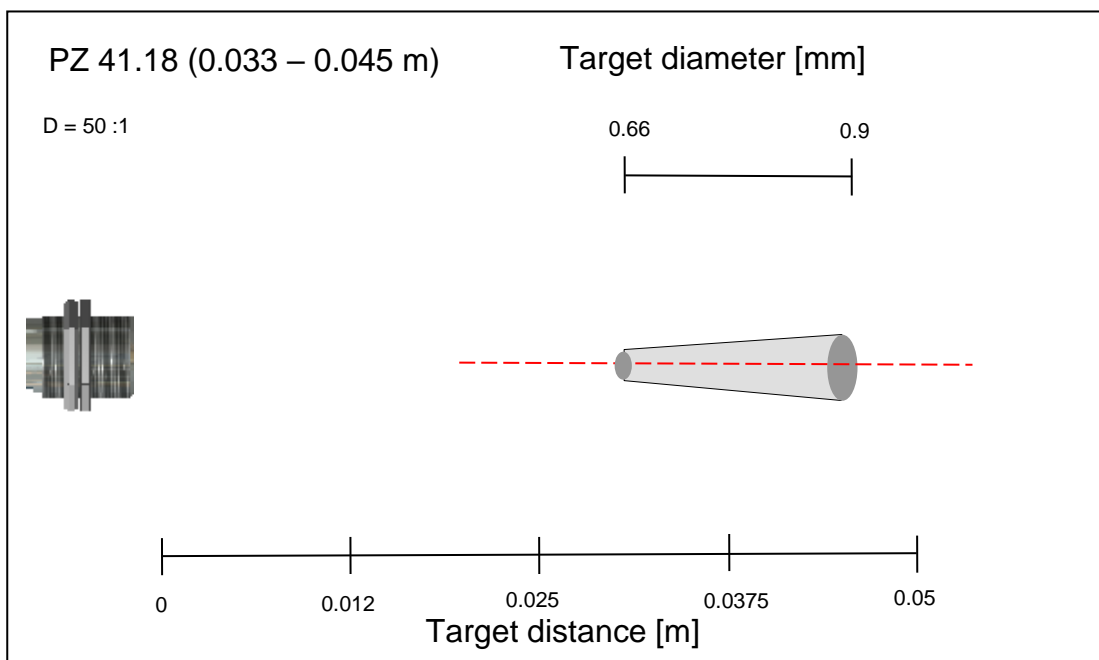
**20.1.1 PA 36 AF 11 (Standard lens PA 41.01 M30)**



### 20.1.2 PA 36 AF 21 (Standard lens PA 41.05 M16)

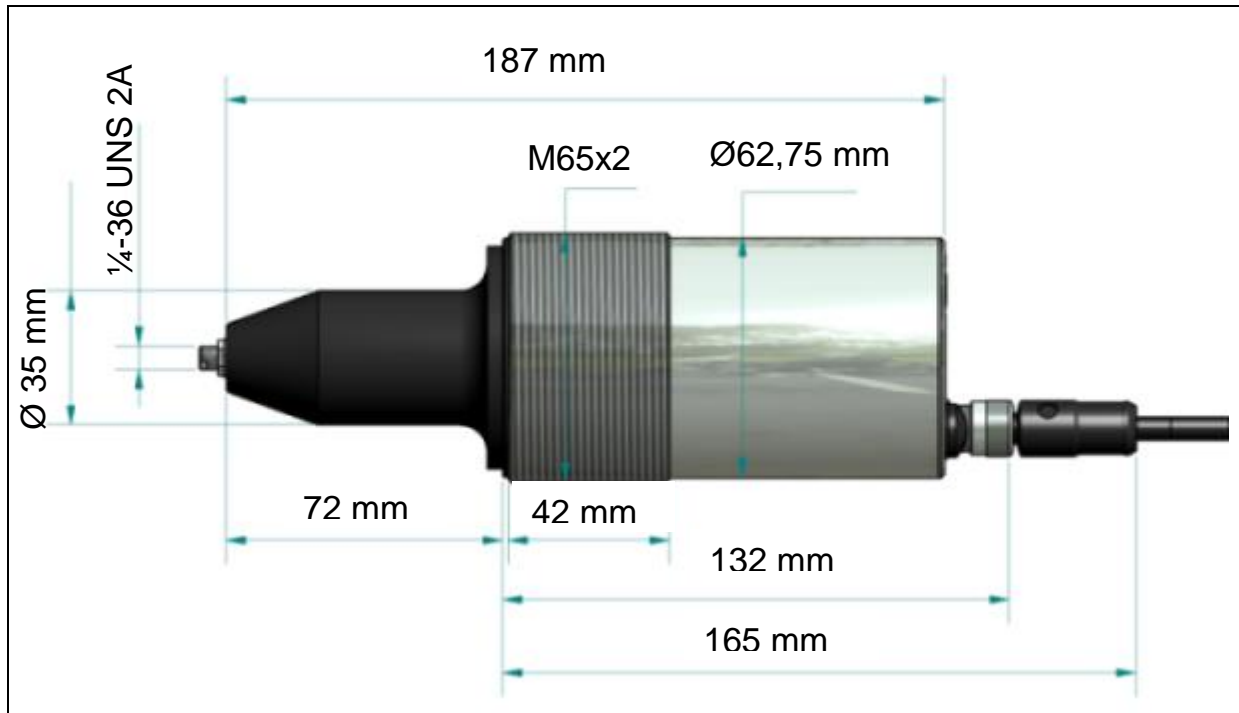


### 20.1.3 PA 36 AF 22 (Close up lens PZ 41.18 M16)

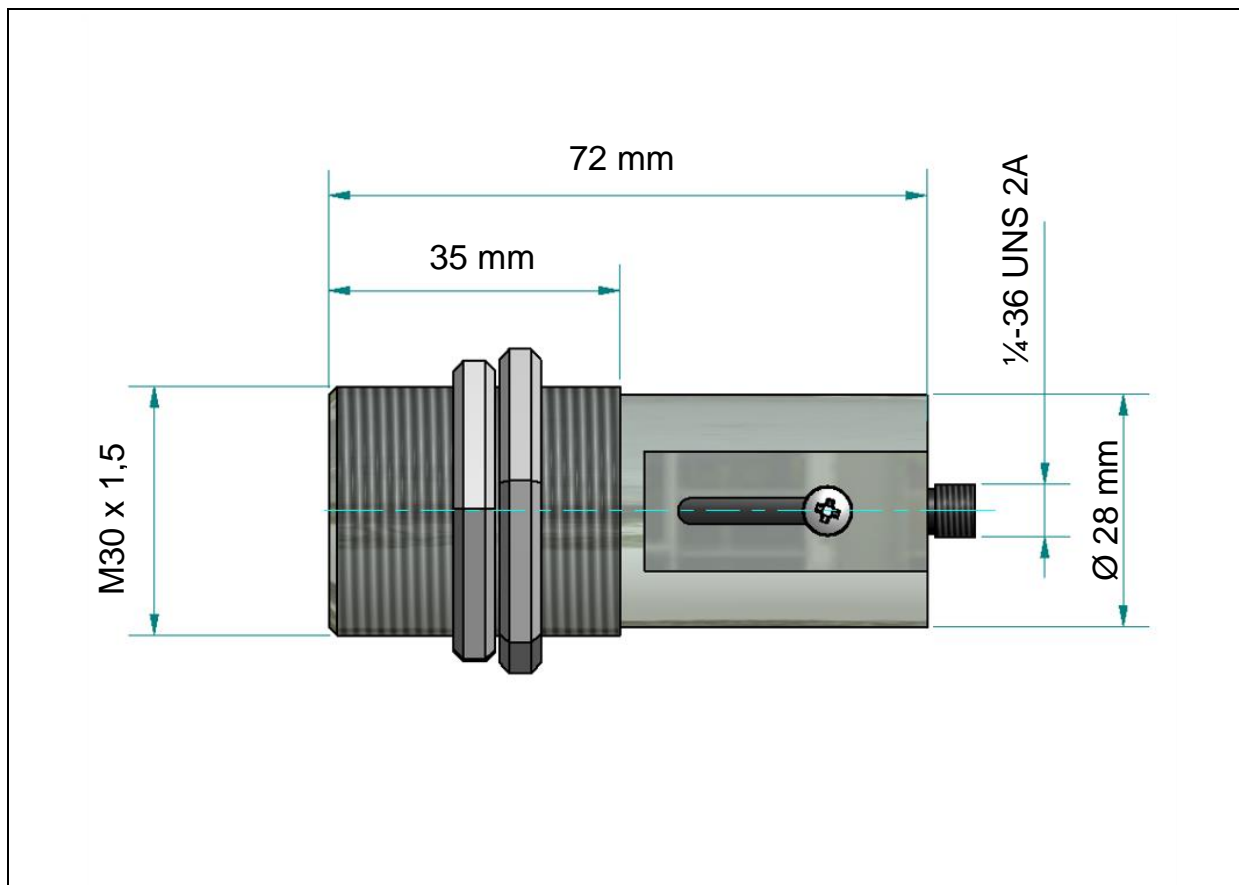


## 21 Dimensions

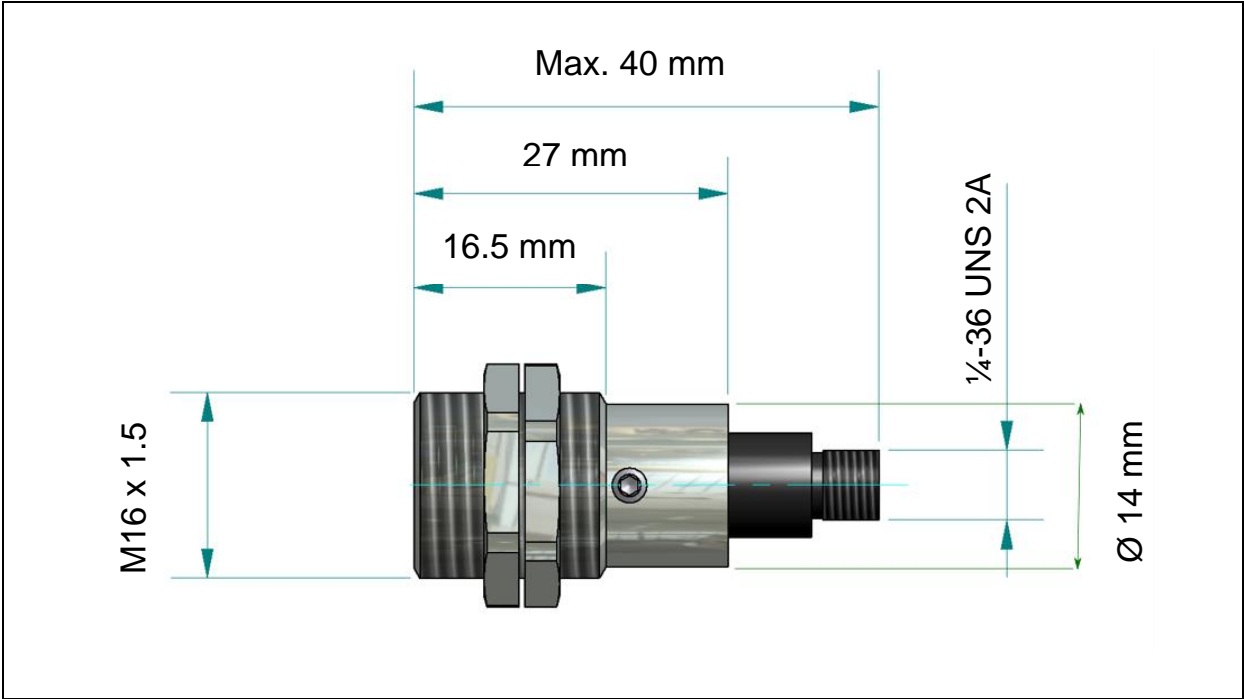
### 21.1 Electronic part



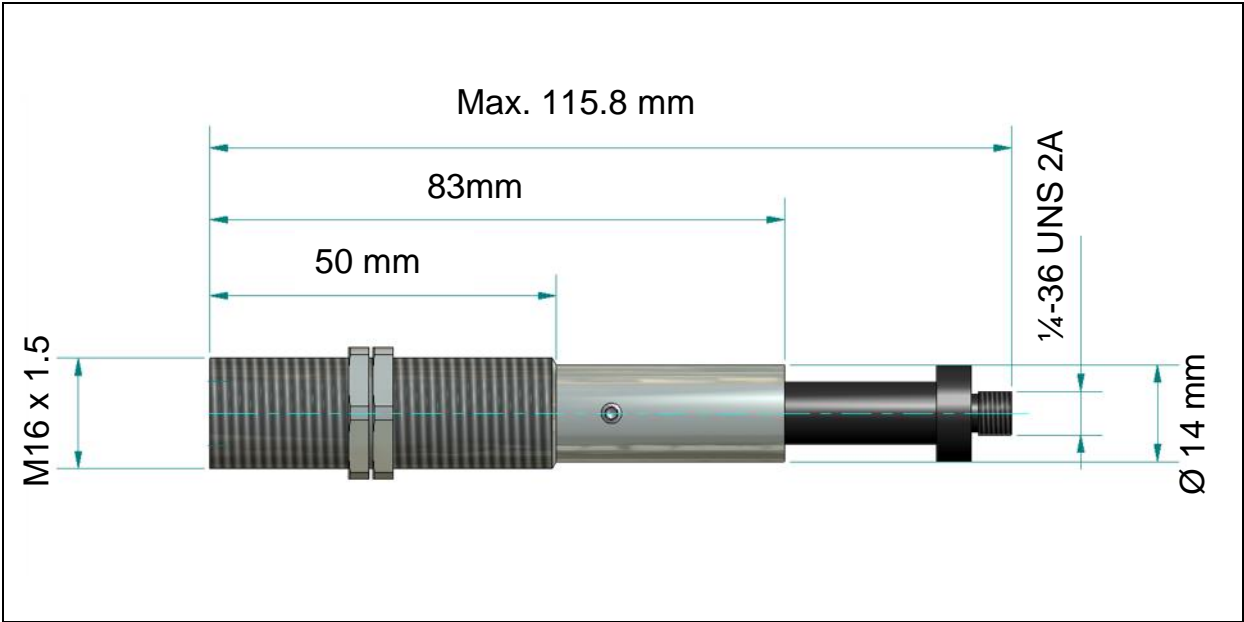
### 21.2 Fibre optic head M 30



**21.3 Fibre optic head M 16**



**21.4 Special optic head**



## 22 Transmission values of protective glasses

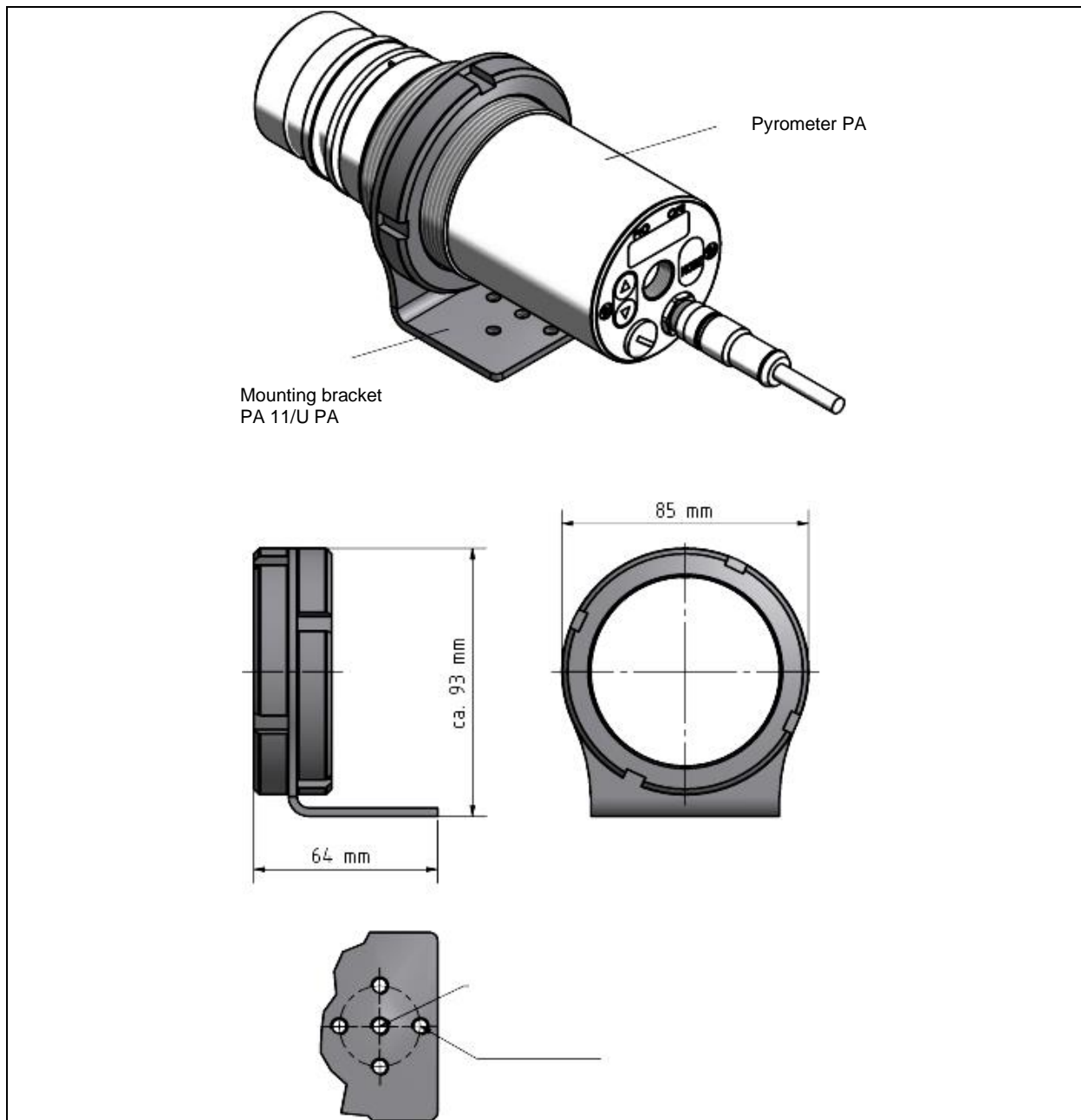
In the table you find the transmission values of the used protective glasses. In the column types you find the mechanical accessories in which the glasses are used.

| Article number | Description               | Transmission (reflexion) [%] |           |         |           |           |            | Used in followings types                           |
|----------------|---------------------------|------------------------------|-----------|---------|-----------|-----------|------------|--|
|                |                           | 0.85<br>µm                   | 1.4<br>µm | 2<br>µm | 3.9<br>µm | 4.7<br>µm | 8-14<br>µm |  |
| 1057687        | Quarz protective glass    | 94                           | 94        | 94      |           |           |            | PA 20/C  |
| 1077319        | Quarz protective glass    | 94                           | 94        | 94      |           |           |            | PZ 20/I AF 1<br>PZ 20/I AF 2<br>PZ 20/I AF 4       |
| 1008177        | Quarz protective glass    | 94                           | 94        | 94      |           |           |            | PA 20/I  |
| 1023961        | Sapphire protective glass | 87                           | 87        | 87      | 86        | 76        |            | PS 15/I AF 1<br>PS 15/I AF 2                       |
| 1021133        | Sapphire protective glass | 86                           | 86        | 87      | 86        | 76        |            | PA 15/I AF 1                                       |
| 1066877        | Sapphire protective glass | 86                           | 86        | 87      | 86        | 76        |            | PZ 15/I AF 2<br>PZ 15/I AF 3                       |
| 1048531        | Protective glass          | 92                           | 91        | 90      |           |           |            | PV 11  |
| 120314         | Protective glass          | 93                           | 92        | 90      |           |           |            | Serie CellaTemp<br>PA, PT, PZ                      |
| 1048533        | Protective glass          | 92                           | 91        | 90      |           |           |            | PZ 20/X AF 5                                       |
| 1045534        | Protective glass          | 92                           | 91        | 90      |           |           |            | PZ 20/X AF 6                                       |
| 295757         | Mirror                    | 95                           | 96        | 97      |           |           |            | PS 11/W  |
| 1021132        | ZnS protective glass      |                              |           |         |           |           | 71         | PA 10/I  |
| 515164         | ZnS protective glass      |                              |           |         |           |           | 71         | PZ 20/I AF 3                                       |
| 1057688        | ZnS protective glass      |                              |           |         |           |           | 71         | PA 10/C  |
| 119394         | ZnS protective glass      |                              |           |         |           |           | 71         | PS 11/D<br>PS 11/D AF 2<br>PS 11/S<br>PS 11/N AF 3 |
| 515089         | ZnS protective glass      |                              |           |         |           |           | 71         | PZ 10/I AF 1                                       |
| 515167         | ZnS protective glass      |                              |           |         |           |           | 71         | PZ 10/A F 4  |

## 23 Accessories

| Description  | Product Name | Article No. |
|--|--------------|-------------|
| Cable<br>length 5 m, 8 x 0.25 mm <sup>2</sup> , shielded | VK 02/A      | 101 3909    |
| Mounting bracket   | PA 11/U      | 100 9679    |
| Lock nut   | KM 13        | 513 854     |
| USB cable  | VK 11/D      | 100 9677    |

### 23.1 Mounting bracket PS 11/U



**23.2** Cable VK 02/A

Ident. - Nr. 101 3909

| Belegung<br><i>Configuration</i> | Pol<br><i>contacts</i> |
|----------------------------------|------------------------|
| weiß<br><i>white</i>             | an 1<br><i>at 1</i>    |
| braun<br><i>brown</i>            | an 2<br><i>at 2</i>    |
| grün<br><i>green</i>             | an 3<br><i>at 3</i>    |
| gelb<br><i>yellow</i>            | an 4<br><i>at 4</i>    |
| grau<br><i>grey</i>              | an 5<br><i>at 5</i>    |
| rosa<br><i>pink</i>              | an 6<br><i>at 6</i>    |
| blau<br><i>blue</i>              | an 7<br><i>at 7</i>    |
| rot<br><i>red</i>                | an 8<br><i>at 8</i>    |

Schirm durchgängig an Verschraubung  
*Shield constantly at screw connection*

8 polig  
*8 poles*

( Maßstab 3:1 )

Anschlussquerschnitt 0,25mm<sup>2</sup> (AWG 24)  
Schutzart IP68 / IP67 geschirmt  
Obere Grenztemperatur + 85°C  
Untere Grenztemperatur - 25°C

*Wire gauge 0,25mm<sup>2</sup> (AWG 24)  
Degree of protection IP68 / IP67 shielded  
Upper temperature + 85°C  
Lower temperature - 25°C*



## 24 Glossary

|                                      |   |
|--------------------------------------|---|
| <b>Autoprint</b>                     | After connecting the power supply, the pyrometer automatically begins transmitting measurement data via the serial interface.   |
| <b>Print cycle time</b>              | The cycle time for the temperature data output via the serial interface.  |
| <b>Distance to target size ratio</b> | Describes the ratio between the pyrometer-to-object distance and the target spot diameter.  |
| <b>Double Max-Memory</b>             | Brief temperature peaks will be held for an adjustable holding time.  |
| <b>Emissivity</b>                    | A measure of a material's ability to emit energy by radiation. The emissivity value is the ratio of energy radiated by a particular material's surface to energy emitted by an ideal radiator (black body) at the same temperature. A pyrometer's emissivity setting must be adjusted for the specific material to be measured. |
| <b>Switching outputs</b>             | The digital outputs can be used as digital inputs   |
| <b>Two-colour pyrometer</b>          | Detects infrared radiation at two different wavelengths at the same time. Based on that ratio, the pyrometer calculates the temperature value.  |
| <b>Spectral pyrometer</b>            | Detects infrared radiation at one particular wavelength and produces a temperature reading from that measurement.   |
|                                      |   |

## 25 Shipping, Packaging and Disposal

### 25.1 Inspecting your shipment

Unpack and inspect the entire shipment immediately upon receipt to make sure it is complete and undamaged.

If the container/package shows visible signs of damage, please refuse the shipment. If this is not possible, accept the shipment on the condition that the freight carrier's delivery record is noted with the extent of the damage in order to file a claim.

Should you discover a concealed loss or damage, report it to KELLER HCW and to the freight carrier immediately. If the period for filing claims has expired, you will no longer be able to make any claims for compensation of damage or loss.

### 25.2 Packaging

The packages used by KELLER HCW are made of carefully selected, environmentally compatible materials and are thus recyclable. We suggest you retain the packaging for possible future use; otherwise please ensure that they are disposed of in an ecologically sound manner.

### 25.3 Disposal of used apparatus

Used electrical and electronic equipment often contain valuable components. The owner/user may either return such an instrument to the manufacturer for disposal, or he must dispose of it himself in a professional and nonpolluting manner.

KELLER HCW will not be held accountable for any inappropriate disposal carried out by the user/owner of KELLER HCW instruments.



## 26 Copyright

Portions of avr-libc are Copyright (c) 1999-2007  
Keith Gudger,  
Bjoern Haase,  
Steinar Haugen,  
Peter Jansen,  
Reinhard Jessich,  
Magnus Johansson,  
Artur Lipowski,  
Marek Michalkiewicz,  
Colin O'Flynn,  
Bob Paddock,  
Reiner Patommel,  
Michael Rickman,  
Theodore A. Roth,  
Juergen Schilling,  
Philip Soeberg,  
Anatoly Sokolov,  
Nils Kristian Strom,  
Michael Stumpf,  
Stefan Swanepoel,  
Eric B. Weddington,  
Joerg Wunsch,  
Dmitry Xmelkov,  
The Regents of the University of California.  
All rights reserved.

Redistribution and use in source and binary forms, with or without modification, are permitted provided that the following conditions are met:

- \* Redistributions of source code must retain the above copyright notice, this list of conditions and the following disclaimer.
- \* Redistributions in binary form must reproduce the above copyright notice, this list of conditions and the following disclaimer in the documentation and/or other materials provided with the distribution.
- \* Neither the name of the copyright holders nor the names of contributors may be used to endorse or promote products derived from this software without specific prior written permission.

THIS SOFTWARE IS PROVIDED BY THE COPYRIGHT HOLDERS AND CONTRIBUTORS "AS IS" AND ANY EXPRESS OR IMPLIED WARRANTIES, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE DISCLAIMED. IN NO EVENT SHALL THE COPYRIGHT OWNER OR CONTRIBUTORS BE LIABLE FOR ANY DIRECT, INDIRECT, INCIDENTAL, SPECIAL, EXEMPLARY, OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT NOT LIMITED TO, PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES; LOSS OF USE, DATA, OR PROFITS; OR BUSINESS INTERRUPTION) HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN CONTRACT, STRICT LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY OUT OF THE USE OF THIS SOFTWARE, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGE.

## 27 Default settings

### 27.1 Temperature measurement via spectral channel 1 (configuration layer: c 00 i)

| Parameter | Function                                      | Default | User settings |
|-----------|---|---------|---------------|
| EPS.i     | Emissivity factor L1                          | 99.0%   |               |
| TRAU.i    | Transmission factor L1                        | 100 %   |               |
| bAc.i     | Ambient temperature compensation              | Off     |               |
| bAct      | Temperature of ambient source of radiation    | Off     |               |
| bAc!      | Influence of ambient IR radiation             | --      |               |
| Lin.i     | Temperature offset using linear interpolation | Off     |               |
| L.H.i     | node x 1..10                                  | --      |               |
| L.Y.i     | node y 1..10                                  | --      |               |
| FIL.i     | Smoothing filter                              | On      |               |
| FILt      | Smoothing time                                | 0.1 s   |               |
| MEM.i     | Min/Max memory                                | Off     |               |
| MEMt      | Hold time for Min/Max                         | --      |               |
| FILn      | Smoothing filter for min/max                  | --      |               |
| FILt      | Smoothing time                                | --      |               |
| CLrn      | external delete for Min/Max memory            | --      |               |
| tdEL      | time delay*                                   | --      |               |
| TRAct     | meas. time active*                            | --      |               |
| tdIS      | cut-off interval*                             | --      |               |
| toUt      | timeout*                                      | --      |               |
| L1.i      | Limit 1*                                      | --      |               |
| L2.i      | Limit 2*                                      | --      |               |
| F-Pr      | Average weighting*                            | --      |               |
| ESP_      | Threshold plausibility*                       | --      |               |
| ESP-      | Threshold plausibility*                       | --      |               |
| ANO       | Mode of display*                              | --      |               |
| ARSt      | Autoreset*                                    | --      |               |
| chL2      | Set Li2 check on TRAct*                       | --      |               |
| SAUE      | Save  | --      |               |
| ESc       | Escape  | --      |               |

\* Only available with ATD function

## 27.2 Configuration I/O (configuration layer: c 0 10)

| Parameter | Function                                    | Default               | User settings |
|-----------|---|-----------------------|---------------|
| Ao1S      | Ao1 select source                           | Lamda 1               |               |
| Ao1.      | Ao1 define lower limit of temp. span        | Measuring range begin |               |
| Ao1.      | Ao1 define upper limit of temp. span        | Measuring range end   |               |
| Ao14      | Ao1 0/4 - 20mA                              | 4 – 20 mA             |               |
| Ao2.      | Analogausgang 2                             | Off                   |               |
| Ao2S      | Ao2 select source                           | --                    |               |
| Ao2.      | Ao2 define lower limit of temp. span        | --                    |               |
| Ao2.      | Ao2 define upper limit of temp. span        | --                    |               |
| Ao24      | Ao2 0 / 4 - 20mA                            | --                    |               |
| do1.      | Switching output 1                          | On                    |               |
| do1S      | Do1 select source                           | Status Ready signal   |               |
| do1F      | Do1 function                                | Level/signal          |               |
| do1t      | Do 1 switching threshold                    | --                    |               |
| do1h      | Do1 signal threshold                        | --                    |               |
| do1.      | Do1 lower limit of range                    | --                    |               |
| do1.      | Do1 upper limit of range                    | --                    |               |
| do1L      | Do1 delay time                              | 0.00 s                |               |
| do1H      | Do1 Hold time                               | 0.00 s                |               |
| do2.      | Switching output 2                          | Off                   |               |
| do2S      | Do2 select source                           | --                    |               |
| do2F      | Do2 function                                | --                    |               |
| do2t      | Do 2 switching threshold                    | --                    |               |
| do2h      | Do2 signal threshold                        | --                    |               |
| do2.      | Do2 lower limit of range                    | --                    |               |
| do2.      | Do2 upper limit of range                    | --                    |               |
| do2L      | Do2 delay time                              | --                    |               |
| do2H      | Do2 Hold time                               | --                    |               |
| A.Fn      | Analogue input function                     | --                    |               |
| A.u1      | Analogue in upper and lower voltage values  | --                    |               |
| A.u2      | Analogue in upper and lower input variables | --                    |               |
| A.u1      | Analogue in upper and lower input variables | --                    |               |
| A.u2      | Analogue in upper and lower input variables | --                    |               |
| SAVE      | Save  |                       |               |
| ESC       | Escape                                      |                       |               |

### 27.3 General Functions (configuration layer: c 0 1 1)

| Parameter | Function                              | Default | User settings |
|-----------|---------------------------------------|---------|---------------|
| LEd6      | Green status LED                      | DO1     |               |
| P.Lo.     | Activate laser                        | INT     |               |
| P.Lt      | Laser ON-time                         | 2 min   |               |
| tErn.     | Assign Interface                      | USB     |               |
| A.Ste.    | Automatic temperature data output     | Off     |               |
| A.cyc.    | Cycle for automatic temp. data output | 0.1 s   |               |
| Addr.     | Device address                        | 001     |               |
| d.SP.     | Display panel                         | active  |               |
| Un.it     | temperature scale                     | Celsius |               |
| SAvE      | Save                                  |         |               |
| ESc       | Escape                                |         |               |



