

 **IO-Link**



# Pyrometer

## *CellaTemp PX 21/31/36*

**Content**

1	General .....	4
1.1	Information about the manual .....	4
1.2	Explanation of the symbols .....	4
1.3	Liability and Warranty .....	4
1.4	Copyright .....	5
2	Safety .....	5
2.1	Intended use .....	5
2.2	User's responsibility .....	5
2.3	Safety requirements .....	5
2.4	Laser Radiation Hazard .....	6
3	Shipping, packaging and disposal .....	7
3.1	Inspection after shipping .....	7
3.2	Packging .....	7
3.3	Disposal of the old devices .....	7
4	Theory of Non-Contact Temperature Measurements .....	8
4.1	Advantages of Non-Contact Temperature Measurement .....	8
4.2	Measurements at Black Bodies (Cavity Radiators) .....	8
4.3	Measurements of Real Radiators .....	9
4.4	Measurements errors .....	9
5	Ways to determine emissivity .....	10
6	Function .....	10
7	Installation .....	11
7.1	Assembly .....	11
7.2	Assembly fibre optic cable .....	11
7.3	Aiming the pyrometer .....	12
7.4	Focussing .....	12
8	Electrical connection .....	14
9	Setup .....	15
10	Shielding and Grounding .....	16
11	Operating control and display .....	17
11.1	Processing of measuring signals .....	18
11.2	Analogue output .....	18
11.3	Switching threshold OUT 1 .....	19
11.4	Output signal .....	19
11.5	Switch on delay .....	19
11.6	Switch off delay .....	19

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11.7	Hysteresis function .....	20
11.8	Window function .....	21
11.9	Switching output OUT 2 .....	22
11.10	Damping function .....	22
11.11	Peak hold function .....	23
11.12	ATD function .....	23
11.13	IO-Link .....	27
12	Menu .....	27
12.1	Analogouge output Ao .....	27
12.2	Switching output OUT 1 .....	28
12.3	Switching output OUT 2 .....	29
12.4	Spectral channel .....	30
12.5	Advanced Features .....	31
13	Menu explanation .....	32
13.1	Analogue output .....	32
13.2	OUT 1 (d1) .....	32
13.3	OUT 2 (d2) .....	33
13.4	Spectral channel (S) .....	33
13.5	Advanced Features (EF) .....	36
14	Parameterizing .....	36
14.1	Setting parameters – general information .....	36
15	Error indications .....	38
16	Service functions .....	38
16.1	Reset all parameters to factory settings .....	38
16.2	Simulate a desired temperature .....	39
17	Maintenace .....	39
17.1	Cleaning the pyrometer lens .....	39
17.2	Replacing the protective screen .....	40
18	Models .....	40
19	Field of view .....	41
20	General technical data .....	42
21	Device-specific technical data .....	44
23	Accessories .....	47
24	Default settings .....	47
25	Copyright .....	47

## 1 General

### 1.1 Information about the 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. It is imperative to comply with the safety instructions and the accident protection regulations valid for the area of application!

### 1.2 Explanation of the symbols

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

#### **ATTENTION**

This symbol points out guidelines. If you do not observe them, the device might be damaged, malfunctioning or even fail to operate.


#### **CAUTION**

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

- ▶ Action  
This symbol instructs the operator to take action.
- > Reaction, result  
This symbol indicates the result of the action taken.

### 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.

-  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.

## 1.4 Copyright

This Operating Manual should be treated as confidential. It is solely intended for the 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.

## 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 use as described in this manual. Operational safety can only be ensured when the instrument is used for its intended purpose.



The use of the pyrometer for any other purpose beyond what is specified in this manual is prohibited. 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 operates at low voltage (18 – 34 V DC). The power supply unit must conform to directive EN 50178, SELV, PELV.

## 2.4 Laser Radiation Hazard

### Laser radiation can be harmful to the eyes!

The CellaTemp PX with laser 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 2 minutes.
- Never look directly into the laser beam path
- Do not leave the instrument unattended when the laser is activated.
- Do not point the laser beam at any person
- During pyrometer installation and alignment, make sure to avoid the possibility of laser reflections caused by reflective surfaces.
- All currently valid laser safety standards must be observed.

### 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.

### 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).





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.

## 3 Shipping, packaging and disposal

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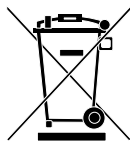
### 3.1 Inspection after shipping

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 the shipper or 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.

### 3.2 Packaging

The packages used are made of carefully selected, environmentally compatible materials and are thus recyclable. Please ensure that they are disposed of in an ecologically sound manner.

### 3.3 Disposal of the old devices



Old electrical and electronic devices frequently still contain valuable materials. These devices can be returned for disposal to the manufacturer or they must be disposed properly by the user.

For the improper disposal of the device by the user, the company KELLER HCW is not responsible.

## 4 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  $\mu\text{m}$ . Radiation pyrometers detect infrared radiation for non-contact temperature measurement.

### 4.1 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.

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

MS: 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.

### 4.3 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 pyrometer. The spectral emissivity coefficient of a body does not represent an exact material constant, but is also largely dependent on the surface properties (→ Ways to determine emissivity).

### 4.4 Measurements errors

The cause of measurement errors in the use of pyrometers is often an incorrectly determined or wrong emissivity. Another source of error is the reflected „background radiation“. If the measurement object has a low emissivity and there are hotter objects in the surrounding area, measurement results can be affected. These objects then have to be shaded. This effect is particularly to be observed in the measurement of a colder object within a hot oven.

## 5 Ways to determine emissivity

Technical literature or operating manuals often contain data on the emissivity of various materials. This information should be used with caution, however. It is important to know for which temperature and which wavelength the emissivity value is applicable. Furthermore, the stated emissivity values were obtained under ideal conditions. In actual practice, the total emissivity of the target object will vary, depending on the amount of extraneous radiation transmitted through the object from the background or reflected onto the object from the foreground. The emissivity can be determined using one of the following methods:

### Contact measurements

Measure the temperature with a contact thermocouple and measure the surface temperature with a pyrometer. Adjust the emissivity coefficient on the pyrometer until both devices show the same temperature. When measuring with the thermocouple, make sure to have good thermal contact and low heat dissipation.

### Using a reference emissivity coefficient

Apply matte black colour to a part of the surface to be measured. This part has an emissivity of 94 %. At first, measure the temperature of the coloured part. Then make a comparative measurement right next to the coloured part and adjust the emissivity on the pyrometer until it displays the previous measurement reading again.

## 6 Function

The pyrometer detects the radiated infrared radiation of objects without contact and converts them into an electrical switching signal and an analogue output signal.

## 7 Installation

### 7.1 Assembly basic unit

The basic unit should be mounted where it is not unnecessarily exposed smoke, heat or vapour.

#### **ATTENTION**

At ambient temperature  $> 65^{\circ}\text{C}$ , the basic unit must be cooled or protected against radiation by shielding plate.

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### 7.2 Assembly fibre optic cable

One end of the optical fibre has a nameplate 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.

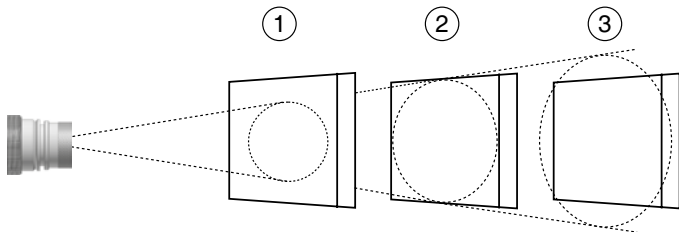
The serial number of the measuring head should also correspond to the pyrometer.

#### **ATTENTION**

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

### 7.3 Aiming the pyrometer

Point the measuring head at the object to be measured. If possible, the pyrometer should be installed at an angle of  $90^\circ$  to the object to be measured. The angle should not be less than  $45^\circ$  from the vertical. The spot must be completely filled by the measured object.



1	Best - Target larger than the spot size
2	Good - Target equal to spot size
3	Incorrect - Target smaller than spot size



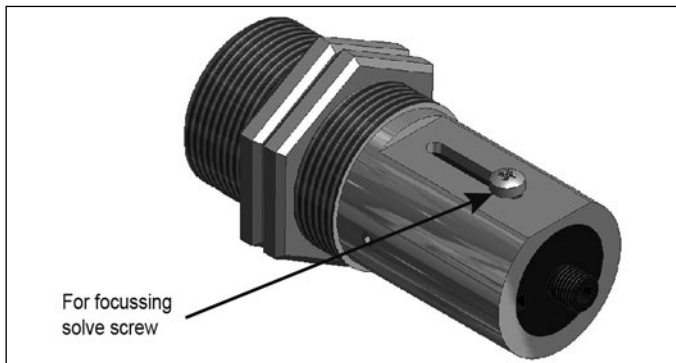
Contamination of lens can lead to measure measurement errors. Therefore, always make sure that the lens is clean. The pyrometer field of view must remain unobstructed. Any interferences from objects must be avoid.

### 7.4 Focussing

The pyrometers have a laser that can be activated to align the sensing head to the target spot. To activate the laser, press the MODE button in the real panel for 2 seconds.

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.



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The activated laser pilot light can influence the measured temperature. This influence will vary, depending on the instrument model and the temperature.

To protect the laser against overload, an over temperature is provided. At temperatures above 60 °C, the laser switches of an can no longer be activated. To check, whether the laser is activated, the parameter LED lights up.

In normal operation, the laser is switch off. After activation, the laser switch of again after 2 – 15 minutes. The operator must be familiar with the pyrometer and above safety guidelines.



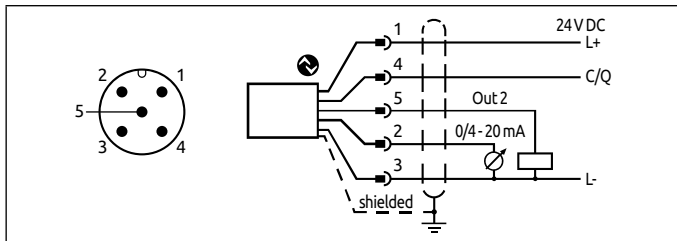
Information on the laser output can be found in chapter 2.4

## 8 Electrical connection

### ⚠ ATTENTION

- The pyrometer may only be installed by a skilled, qualified electrician. Do not connect the instrument while the voltage supply source is turned on. Please observe international safety regulations at all times.
- The pyrometer is supplied with low voltage 24V DC. The power supply unit must conform to directive EN50178, SELV, PELV.

- ▶ Switch to neutral and verify absence of voltage
- ▶ Connect the instrument according to the following schematic:



Pin 1	BN (brown)	L+ (Power supply 24V DC)
Pin 4	BK (black)	Open Collector switching output; $I_{max} = 150 \text{ mA}$ or IO-Link OUT 1
Pin 5	GY (grey)	Open Collector switching output; $I_{max} = 150 \text{ mA}$ OUT2
Pin 2	WH (white)	Analogue output; 0/4 - 20mA
Pin 3	BU (blue)	L- (GND)



The pyrometer must be protected against high voltage and strong electro-magnetic fields. Use a shielded cable, connecting it via connector casing to the device housing.



Use a flyback diode when switching inductive loads.

## 9 Setup

For non-contact temperature measurement, the pyrometer uses the intensity of the infrared radiation. In order to obtain accurate measurement results, the respective emissivity of the measurement object must be set on the pyrometer (→ emissivity determination).

An incorrectly set emissivity leads to measurement errors during temperature measurement. After the supply voltage has been switched on for the first time, the emissivity must first be set. The emissivity is set as follows:

- ▶ Press [ $\Delta$  or v]
- > >The value of the selected emissivity is displayed, for example [ 1000 ]
- ▶ Press [ $\Delta$  or v] until the desired emissivity will show
- ▶ Press [Enter] or wait for 3 seconds
- > The current temperature value is displayed and the new emissivity coefficient is stored.



To compensate for environmental influences, it may be useful to have an emissivity of > 100 %. A setting of 110 % is possible.

### ATTENTION

An incorrectly set emissivity coefficient leads to wrong temperature readings.

## 10 Shielding and Grounding

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 equipotential bonding line.

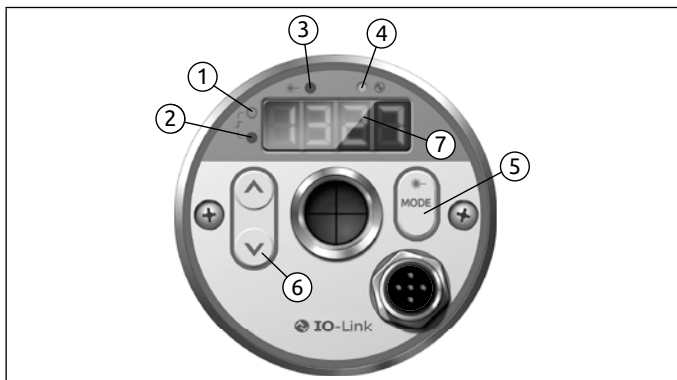
To avoid an equalising current, the pyrometer can be mounted electrically insulated. The shielding must be connected to the plant's earthing system.

### **ATTENTION**

If the pyrometer is installed without an insulator and without potential equalisation, the interference voltage may not exceed 32V.



## 11 Operating control and display



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### 1 to 4: Indicator-LEDs

- LED 1 = Switching state of switching output OUT1
- LED 2 = Switching state of switching output OUT2
- LED 3 = Laser pilot light active
- LED 4 = IO-Link Communication

### 5: Control key [MODE]

- Selection of parameters
- Reading the set values
- Confirmation of parameter values

### 6: Control key [▲] and [▼]

- Selection of parameters
- Activation of emissivity quick adjustment
- Confirmation of parameter values

### 7: Alphanumeric display, 4-digit

- Indicates temperature value
- Indicates parameter and configuration
- Display of errors

## 11.1 Processing of measuring signals

The pyrometer disposes of an IO-Link interface.

The generated three output signals correspond to the parameterization:

- Out 1: Switching output/ IO-Link
  - Switch signal: threshold value temperature / status signal
- Out 2: Switching output
  - Switch signal: threshold for temperature / status signal
- Analogue output: 0/4 -20 mA
  - Analogue output for temperature

## 11.2 Analogue output

The pyrometer converts the measuring signal into a temperature proportional analogue signal of 0/4 – 20 mA. The maximum load is 500 Ohm.

[R<sub>0F</sub>] Changeover 0 -20 mA or 4 -20 mA

[R<sub>0SP</sub>] defines at which measured value the output signal is 0/4 mA.

[R<sub>0EP</sub>] defines at which measured value the output signal is 20 mA.

Maximum measuring range		Measuring range scaled	
1	initial value of the measuring range	3	Analogue start point
2	final value of the measuring range	4	Analogue end point

### 11.3 Switching threshold OUT 1

OUT1 changes its switching status when the configured upper or lower thresholds  $[d\ I.S.P.]$ ,  $[d\ I.r.P.]$  are exceeded. Source  $d\ I.S$  specifies the signal that is output at OUT1.

- Spectral channel  $[d\ I.] \rightarrow [d\ I.S] = L\ I$

First, the switching point  $[d\ I.S.P.]$  is set in °C and °F and then the reset point  $[d\ I.r.P.]$ . When changing  $[d\ I.S.P.]$ , the  $[d\ I.r.P.]$  also changes so that the difference remains the same. If the  $[d\ I.S.P.]$  is reduced to such an extent that the distance can no longer be maintained (as the  $[d\ I.r.P.]$  would otherwise move below its minimum), the  $[d\ I.r.P.]$  is increased to its minimum. If  $[d\ I.S.P.]$  is subsequently increased again,  $[d\ I.r.P.]$  is also increased again immediately. The minimum distance between  $[d\ I.S.P.]$  and  $[d\ I.r.P.]$  is 1 K.

### 11.4 Output signal

The following output functions can be selected:

- Normally open contact  $[d\ I.] \rightarrow [d\ I.F.n] = h.n.o$  hysteresis function, normally open or rather  $F.n.o$  window function, normally open
- Normally closed contact  $[d\ I.] \rightarrow [d\ I.F.n] = h.n.c$  hysteresis function, normally open or rather  $F.n.c$  windows function, normally open

### 11.5 Switch on delay

Once the sensor has detected a temperature which exceeds the switching threshold  $[d\ I.S.P.]$  the time delay  $[d\ I.d.S]$  starts running. When this delay period has elapsed, the output OUT 1 activates switching. This status is sustained until the lower threshold  $[d\ I.r.P.]$  is violated. If this occurs before the time delay has elapsed, the delay will reset. This function can be used, for example, to suppress spurious impulse signals at the output.

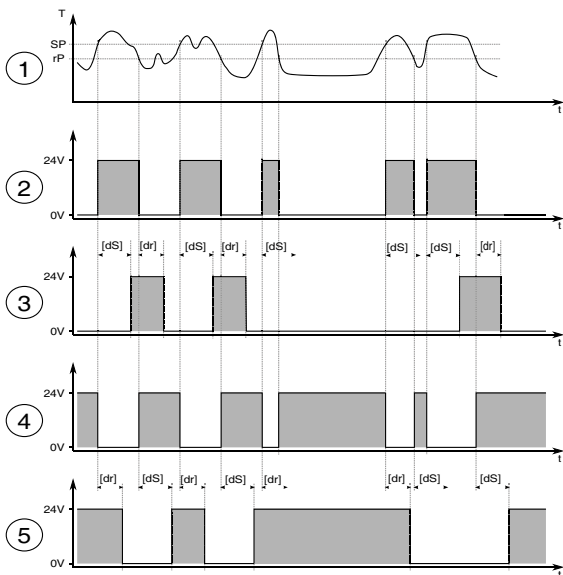
- Switching on delay:  $[d\ I.] \rightarrow [d\ I.d.S] = 0...10\ sec.$

### 11.6 Switch off delay

To make sure the output is correctly identified, e.g. by downstream control system, the output can be lengthened.

- Switch off delay:  $[d\ I.] \rightarrow [d\ I.d.r] = 0...10\ sec.$

## 11.7 Hysteresis function



T = temperature

rP = reset point

t = time

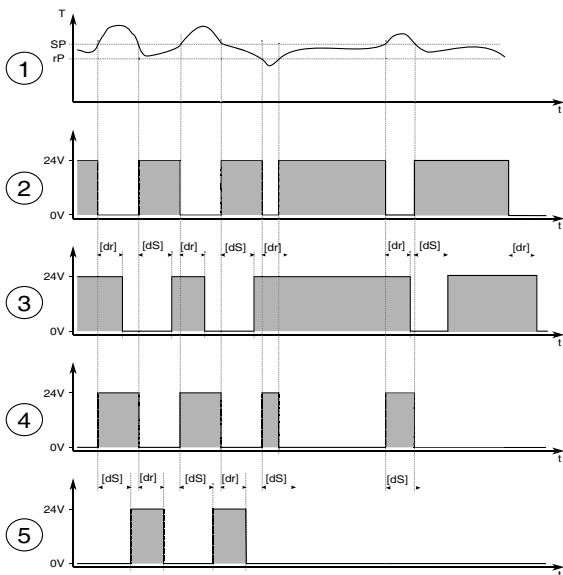
dS = switch on delay

SP = set point

dR = switch off delay

1	Temperature
2	Switch signal <b>h<sub>no</sub></b>
3	Switch signal <b>h<sub>no</sub></b> with switch on delay and switch off delay
4	Switch signal <b>h<sub>nc</sub></b>
5	Switch signal <b>h<sub>nc</sub></b> with switch on delay and switch off delay

## 11.8 Window function



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$T$  = temperature       $rP$  = lower limit value  
 $t$  = time               $dS$  = switch on delay  
 $SP$  = upper limit value     $dR$  = switch off delay

1	Temperature
2	Switch signal $F_{no}$
3	Switch signal $F_{no}$ with switch on delay and switch off delay
4	Switch signal $F_{nc}$
5	Switch signal $F_{nc}$ with switch on delay and switch off delay



The switching thresholds of the window function have a hysteresis of 0.25% of the measuring range.

## 11.9 Switching output OUT 2

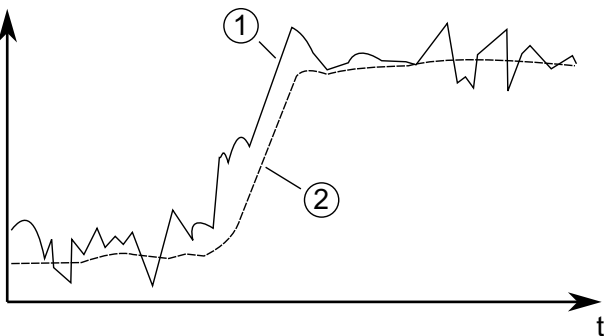
OUT2 changes its switching state according to the adjusted function. The functions and parameters are the same as OUT 1.

### 11.10 Damping function

When the target object's temperature is erratic, the damping function smoothens these temperature fluctuations in order to stabilize the measuring signal. The greater the time constant  $[S] \rightarrow [SF, L]$ , the lower the effect of fluctuations on the yielded temperature reading.

$A_o$

[mA]



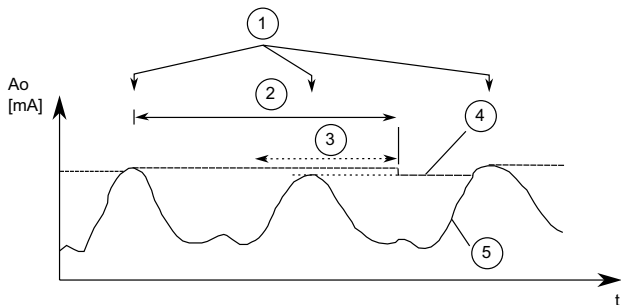
1	Output signal without smoothing function
2	Output signal with smoothing function

### 11.11 Peak hold function

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.

The hold time [S] → [SPHd] → [t . nE] can be set from 0.1 to 999.9 sec. The maximum temperatures sampled during the defined hold time will be saved. It make sense to choose a hold time which is approximate 1.5 time as long as cycle of the moving targets. This avoids temperature drops. Any changes are recognised at once.

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1	Measuring object in front of the pyrometer
2	Hold time
3	Second internal hold time
4	Measuring reading with peak hold function
5	Measuring reading without peak hold function

### 11.12 ATD function

This function is used to automatically measure the temperature of a discontinuously running process. For example, it can be used to determine the temperature of bolts passing the pyrometer acyclically and which have a variable length.

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

<b>Limit 1 (L1)</b>	Before beginning the measurement, the temperature reading must have been lower than Limit 1 at least once. If Autoreset (A.RST=ON) the limit 1 will be ignored
<b>Limit 2 (L2)</b>	Limit 2 must be exceeded at least for the duration of <b>time delay (T.DEL)</b> .
<b>Time delay (T.DEL)</b>	See above

When the conditions are fulfilled, the sampling time can begin. (T.ACT).

<b>Sampling time (T.ACT)</b>	During the sampling time the temperature is detected and stored as a temperature value.
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If the parameter T.ACT= 0 automatically the end of the discontinuous process is detected. At the parameter T.ACT instead of the time „auto“ is displayed.

The parameter (ANO) defines the temperature emitted during the measuring time.

<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.
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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 TSP, the transmitted data will be „0“ and the average value will remain unchanged.

<b>Plausibility (FRL)</b>	Threshold for plausibility check: lower limit which is acceptable for a valid measurement.
<b>Plausibility (FS)</b>	Threshold for plausibility check: upper limit which is acceptable for a valid measurement.

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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 M.TR.1 as source and set the hold time to 0.5 sec.

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 (T)</b>	The interval between one completed sampling and the start of a new sampling.
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If a measuring cycle does not start during the period T.OUT, the saved average will be deleted and reinitialized when the next cycle begins.

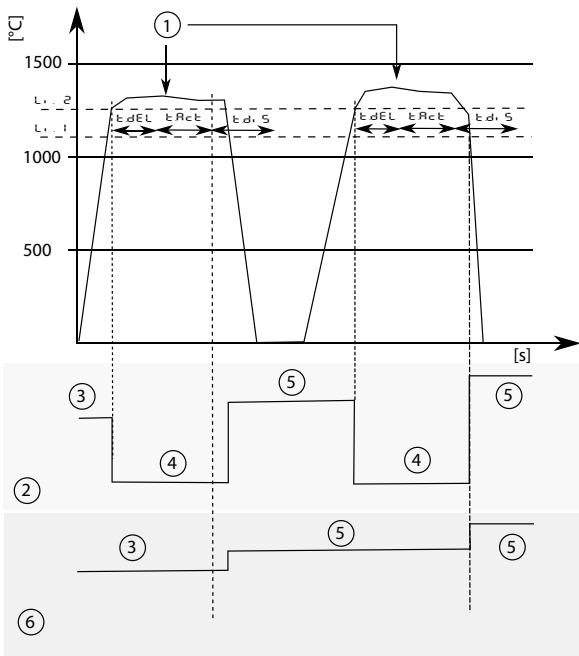
<b>Timeout (TOUT)</b>	Timeout for mean function (in minutes)
-----------------------	--

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.DEL.

<b>Auto reset (TRES)</b>	Auto reset on/off
--------------------------	-------------------

The parameter Set Li2 checks on T.ACT checks, whether the value falls below threshold 2 during the measuring time. If the value falls below the threshold, the measurement is rejected. The display shows „---“.

<b>Set Li2 check on tAct (L2)</b>	on/off
-----------------------------------	--------



$L_2$  = limit 2

$L_1$  = limit 1

$t_{dEL}$  = time delay

$t_{Rct}$  = sampling time

$t_{d,S}$  = cut-off interval

1	Measuring object in front of the pyrometer
2	Temperature output $t_{Rno} = \text{OFF}$
3	Previous reading
4	Lower limit of temperature range
5	New reading
6	Temperature output $t_{Rno} = \text{HOLD}$

## 11.13 IO-Link

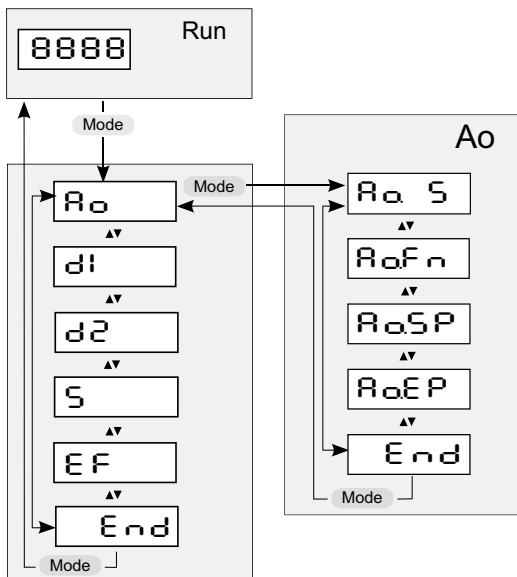
This device has an IO-Link communication interface, which requires an IO-Link-capable module (IO-Link master) for operation. The IO-Link interface allows direct access to process and diagnostic data and offers the possibility to parameterize the device during operation. The IODDs required for configuring the IO-Link device as well as detailed information on process data set-up, diagnostic functions and parameter addresses are available in the download area at [www.keller.de/its](http://www.keller.de/its).

For IO-Link operation a 3-wire cable port Class A (Type A) must be used.

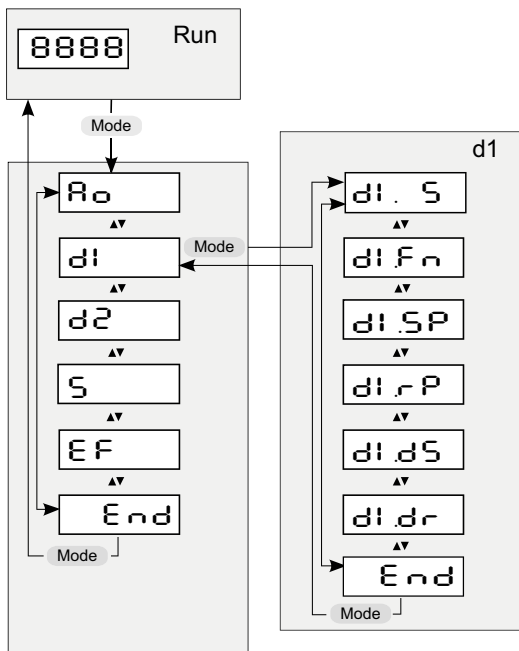
EN

## 12 Menu

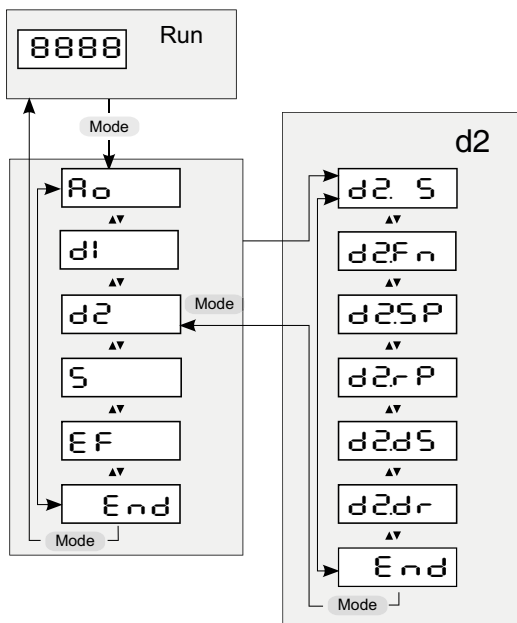
### 12.1 Analogue output Ao



## 12.2 Switching output OUT 1

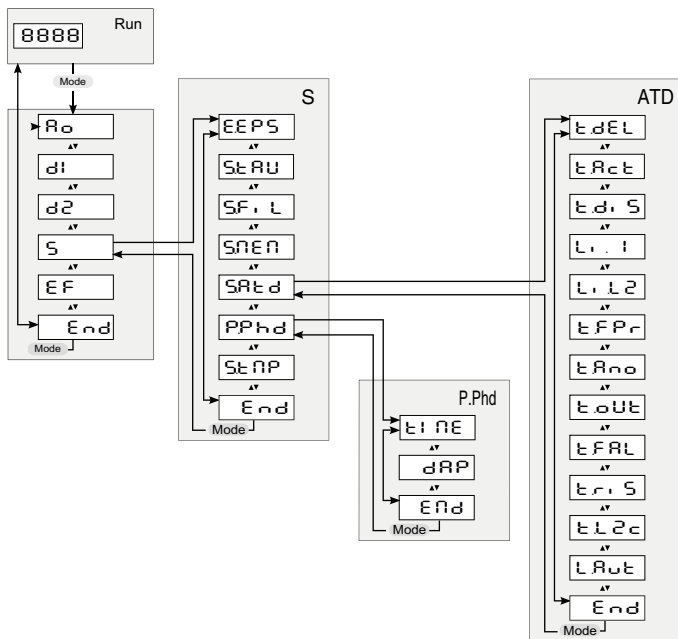


### 12.3 Switching output OUT 2



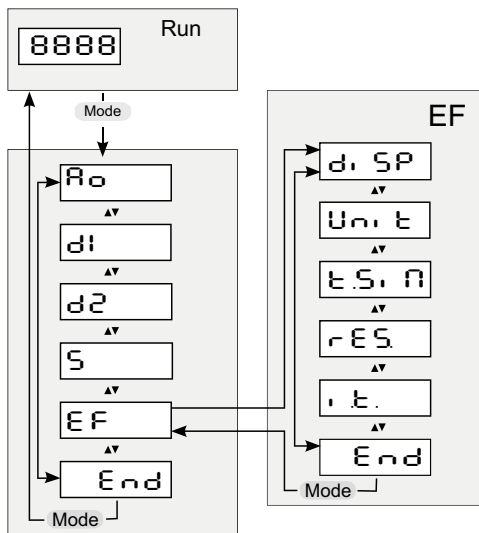
EN

## 12.4 Spectral channel



P.Ph'd	Peak Hold Function Submenu only available when Peak hold function is active
ATD	ADT Function Submenu only available when ATD function is active

## 12.5 Advanced Features



EN

## 13 Menu explanation

### 13.1 Analogue output

Parameter	Function	Comments
R <sub>o</sub> S	Select source	Λ, Lambda 1
R <sub>o</sub> F <sub>n</sub>	0/4 – 20 mA	0 – 20 mA 4 – 20 mA
R <sub>o</sub> S <sub>P</sub>	Define lower limit of temp. span	Analogue start value
R <sub>o</sub> E <sub>P</sub>	Define upper limit of temp. span	Analogue end value
E <sub>nd</sub>	End	Exit menu

### 13.2 OUT 1 (d<sub>i</sub>)

Parameter	Function	Comments
d <sub>i</sub> S	Select source	Λ, Lambda 1 E <sub>U</sub> Internal device temperature > 70 °C* R <sub>L</sub> I <sub>R</sub> ATD Trigger* R <sub>L</sub> I <sub>E</sub> ATD Tact*
d <sub>i</sub> F <sub>n</sub>	output function	h <sub>no</sub> hysteresis function normally open h <sub>nc</sub> hysteresis function normally closed F <sub>nc</sub> window function normally closed F <sub>no</sub> window function normally open
d <sub>i</sub> S <sub>P</sub>	Lower threshold	
d <sub>i</sub> r <sub>P</sub>	Upper threshold	
d <sub>i</sub> d <sub>S</sub>	Switch on delay	Value in sec (≤ 10 sec in steps of 0.1)
d <sub>i</sub> d <sub>r</sub>	Switch off delay	Value in sec (≤ 10 sec in steps of 0.1)
E <sub>nd</sub>	End	Exit menu

\* The source is a pure switching signal without the possibility of defining a switching threshold (switch-on/switch-off point).



## 13.3 OUT 2 (d2)

Parameter	Function	Comments
d2. S	Select source	L 1 Lambda 1 E U internal device temperature ALI A ATD Trigger ALI E ATD Tact
d2Fn	Output function	hno hysteresis function normally open hnc hysteresis function normally closed Fno window function normally open Fnc window function normally closed
d2SP	Lower threshold	
d2rP	Upper threshold	
d2dS	Switch on delay	Value in sec ( $\leq 10$ sec in steps of 0.1)
d2dr	Switch off delay	Value in sec ( $\leq 10$ sec in steps of 0.1)
End	End	Exit menu

EN

## 13.4 Spectral channel (S)

Parameter	Function	Comments
EPS	Emissivity	Correction of the radiation properties of the measured object (10...110%)
SEAU	Transmission factor	When using protection shields, the value of the transmission of the used disk can be entered here.
SFIL	Smoothing time	time $t_{98}$ in sec. for simple smoothing
SNE n	Memory function	OFF Off SPH d Peak-Hold function S. A E d ATD function

Parameter	Function	Comments
Start**	Opening of the lower menu level ATD Function**	
tdEL	Time delay	See chapter ATD function
tAct	Sampling time	
tDiS	Cut-off interval	
L. 1	Limit 1	
L. 2	Limit 2	
tFPr	Weighted average	
tRno	Display mode	
tOUT	Timeout	
tFAL	Threshold for plausibility check: lower limit	
tRiS	Threshold for plausibility check: upper limit	
tL2c	Check, whether threshold 2 is fallen below during the measuring time	See chapter ATD function
End	Closing of the lower menu level ATD Function	

Parameter	Function	Comments	
SPhd*	Opening of the lower menu level Peak-Hold Function*		
t <sub>NE</sub>	Hold time Peak-Hold function	Time in sec.	
	dRP	Damping	Damping
	End	Closing of lower menu level Peak-Hold Function	
StNP	Actual temperature reading	The display shows the actual temperature reading	
End	End	Exit menu	

\* Parameter and lower menu level can only be selected with active Peak-Hold Function

\*\* Parameter and lower menu level can only be selected with active ATD function

### 13.5 Advanced Features (EF)




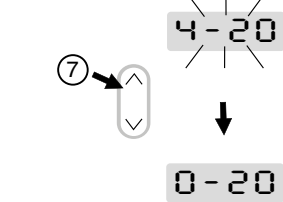

Parameter	Function	Comments
d. SP	Process value display	ON current temperature value OFF run is shown on the display
Unit	Temperature unit	Temperature displayed in °C or °F
ES. n	Temperature Simulation	A temperature can be simulated
RES	Factory settings	Reset to factory settings
End	End	Exit menu

## 14 Parameterizing

When you reset/adjust the operating parameters, the instrument remains in run mode. It continues to operate, using the current parameter settings, until you have finished configuring by pressing [MODE].

### 14.1 Setting parameters – general information

1	<b>Select main menu</b> ► Press [MODE] to access the main menu.	
2	► Press [^ oder v] until the required output function or advanced features is displayed.	
3	<b>Select parameter</b> ► Press [MODE].	
4	► Press [^ oder v] until the required parameter is displayed	

5	<b>Change parameter value</b> ▶ Press [MODE]. > Current parameter value is displayed.	
6	▶ Press [^ or v] for 2 second. > >Display flashes three times.	
7	▶ Press [^ or v] to change the parameter.   ▶ Hold key [^ or v]. > Numerical values scroll through rapidly.	
8	<b>Confirm parameter value</b> ▶ Press [MODE]. > The display indicates the parameter. The new value has been saved and will take effect.	
<b>Exit operating parameter layer</b> ▶ Wait 30 seconds or ▶ Press [^ or v] to change to the parameter <b>E n d</b> . Then press [MODE] to change to the functional menu. ▶ In the functional menu press [^ or v] to change to the parameter <b>E n d</b> , then press [MODE].		



If you press both keys [^ v] only briefly, you will exit the layer (ESC) function.

EN

## 15 Error indications

Overload switching output	Sc and flashing of LED Out 1/2
Overtemperature	Display off and the process value change with 0.5 Hz
Incorrect connection of supply voltage	The display is turned off
Supply voltage $\leq 16$ V	The display is turned off
Temperature below measuring range	The display shows UL
Temperature above measuring range	The display shows OL

## 16 Service functions

### 16.1 Reset all parameters to factory settings

▶	[r E S.] Select extended functions [E F ] in the menu
▶	Press [MODE]
>	RES is shown in the display
▶	Press the v key for 2 s
>	RES flashed for 2 s
▶	Release the key v key and press it again
>	---- is shown in the display
▶	Press [MODE] button
>	The current temperature is shown in the display

## 16.2 Simulate a desired temperature

▶	[ $\text{E}$ $\cdot$ $\text{S}$ $\cdot$ $\text{F}$ ] Select extended functions [ $\text{E}$ $\text{F}$ ]
▶	Press [MODE]
>	The display shows the previously set temperature
▶	Press the $\wedge$ key for 2 s
>	Temperature flashes 3 times
▶	Use the keys $\wedge$ $\vee$ to set the desired temperature, release the key
>	The display alternately shows $\text{E}$ $\cdot$ $\text{S}$ $\cdot$ $\text{F}$ and the temperature value
▶	Press MODE button
>	The display shows $\text{E}$ $\cdot$ $\text{S}$ $\cdot$ $\text{F}$ and the simulation is completed
<b>Exit operating parameter layer</b>	
▶	Wait 30 seconds
or	
▶	Press [ $\wedge$ or $\vee$ ] to change to the parameter End. Then press [MODE] to change to the functional menu.
▶	In the functional menu press [ $\wedge$ or $\vee$ ] to change to the parameter $\text{E}$ $\text{r}$ $\text{d}$ , then press [MODE].

EN

## 17 Maintenance

### 17.1 Cleaning the pyrometer lens

A soiled lens leads to wrong display of the measured value.

- ▶ Check the lens regularly and clean it, if required.
  - Remove dust by blowing or with a soft brush
  - Use clean, soft and lint-free cloths or those offered on the market for lens cleaning.
  - For heavier contamination, use washing-up liquid or liquid soap. Then carefully rinse with clear water. Hold the lens downwards.
  - Exert only little pressure on the lens during cleaning to avoid scratches.

## 17.2 Replacing the protective screen

To protect the pyrometer optics against contamination in harsh industrial environments, an additional protective screen is often used. A contamination of the protective screen also leads to a reduced indication of the measuring value.

- ▶ Check the protective screen regularly and clean it if necessary or replace it in case of damage.
  - Remove dust by blowing or with a soft brush.
  - Use clean, soft and lint-free cloths or those offered on the market for lens cleaning.
  - For heavier contamination, use washing-up liquid or liquid soap. Then carefully rinse with clear water. Hold the lens downwards.
  - Exert only little pressure on the lens during cleaning to avoid scratches.

### ATTENTION

Replacement of the protection glass only by authorized person. When removing the protective screen, always wear **protective glasses and -gloves**.

## 18 Models

Pyrometer		
Type	Temp. range	Application
PX 21	250 - 2000 °C	Metals, ceramics, molten glass
PX 31	500 - 2500 °C	Metals, ceramics at high temperatures
PX 36	650 - 3000 °C	Precise measurement of metals, semiconductors

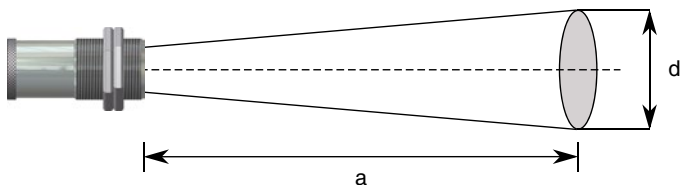


## 19 Field of view

With a pyrometer with focusable optics, the size of the measurement field is determined by the distance ratio  $D$ . The measurement field diameter  $d$  at the focal distance is defined by the formula:

$$d = \frac{a}{D}$$

EN



On our website you will find a measurement field calculator. Select the suitable pyrometer, enter the measuring distance and the length of the measurement field and you will get the suitable measurement field course and you can see the size of the measuring spot at the relevant distance.

<https://www.keller.de/en/its/tools/field-of-view-calculator.htm>

## 20 General technical data

<b>Pyrometer</b>	
Analogue output	0(4) -20 mA linear according NAMUR 43, switchable, scalable load 500 $\Omega$
Switching output OUT1	PNP Open Collector outputs 24 V, $\leq 150$ mA switch point [ $^{\circ}$ C]/ return switch point [ $^{\circ}$ C], hysteresis $\geq 1$ K, on/switch-off delay, NC/ NO or IO-Link
Switching output OUT2	PNP Open Collector outputs 24 V, $\leq 150$ mA switch point [ $^{\circ}$ C]/ return switch point [ $^{\circ}$ C], hysteresis $\geq 1$ K, on/switch-off delay, NC/ NO
Ambient temperature	0 - 65 $^{\circ}$ C (basic unit) 0 - 250 $^{\circ}$ C (measuring head)
IO-Link revision	V1.1, download compatible to V1.01
SIO mode	yes, supported
Transmission rate	COM2 (38.400 Baud)
Storage temperature	-20 – 80 $^{\circ}$ C
Permissible humidity	95 % r.H. max. (non condensing)
Power supply	24 V DC +10 % / -20 % ripple $\leq 200$ mV
Current consumption	$\leq 150$ mA
Housing material	Stainless steel
Weight	Approx. 1 kg
Connectivity	5-pin connection M12 (A coded)
Protection	IP 65 according DIN 40050 with screwed plug

Configuration parameter	Emissivity $\epsilon$ 10 - 110 % Transmissions factor $\tau$ 10 - 100 % Smoothing function $t_{98}$ 0.1 – 999.9 s Peak hold function 0.1 – 999.9 s ATD function
Sighting device	Laser spot light
Dimensions	$\varnothing$ 65 x 187 mm (basic unit without plug) $\varnothing$ 30 x 67...86 mm (LWL measuring head M30) $\varnothing$ 16 x 33...39 mm (LWL measuring head M16)

**EN**

## 21 Device-specific technical data

<b>PX 21</b>	
Temperature range	250 - 2000 °C (Default setting analog output 300 - 2000 °C)
Sensor	Photodiode
Spectral sensitivity	1.1 - 1.7 µm
Focussing range	0.4 m - ∞ optic PA 41.01 M30 0.12 m - ∞ optic PA 41.05 M16 33 - 45 mm optic PZ 41.18 M16
Distance to target-size ration	180:1 (PA 41.01) 100:1 (PA 41.05) 50:1 (PZ 41.18)
Resolution current output	0.2 K + 0.03 % of selected range
Resolution temp. reading	1 K
Response time $t_{98}$	≤ 50 ms (T > 300 °C) ≤ 2 ms (T > 800 °C)
Measurement uncertainty	0,75 % of temperature reading, minimum 4 K (at $\epsilon = 1.0$ and $T_u = 23$ °C)
Repeatability	2 K
Temperature coefficient with reference to 23°C	≤ 0.25 K / K (T < 500 °C) ≤ 0.05 %/K (T ≥ 500 °C) of temp. reading / K

<b>PX 31</b>	
Temperature range	500 - 2500 °C
Sensor	Photodiode
Spectral sensitivity	0.78 - 1.06 $\mu\text{m}$
Focussing range	0.4 m - $\infty$ optic PA 41.01 M30 0.12 m - $\infty$ optic PA 41.05 M16 33 - 45 mm optic PZ 41.18 M16
Distance to target-size ration	190:1 (PA 41.01) 100:1 (PA 41.05) 50:1 (PZ 41.18)
Resolution current output	0.2 K + 0.03 % of selected range
Resolution temp. reading	1 K
Response time $t_{98}$	$\leq 50$ ms ( $T > 600$ °C) $\leq 2$ ms ( $T > 800$ °C)
Measurement uncertainty	0,75 % of temperature reading, minimum 4 K (at $\epsilon = 1.0$ and $T_u = 23$ °C)
Repeatability	2 K
Temperature coefficient with reference to 23°C	$\leq 0.05$ %/K

<b>PX 36</b>	
Temperature range	650 - 3000 °C (AF 2)
Sensor	Photodiode
Spectral sensitivity	0.82 - 0.93 $\mu\text{m}$
Focussing range	0.4 m - $\infty$ optic PA 41.01 M30 0.12 m - $\infty$ optic PA 41.05 M16 33 - 45 mm optic PZ 41.18 M16
Distance to target-size ration	190:1 (PA 41.01) 100:1 (PA 41.05) 50:1 (PZ 41.18)
Resolution current output	0.2 K + 0.03 % of selected range
Resolution temp. reading	1 K
Response time $t_{98}$	$\leq 50$ ms ( $T > 680$ °C) $\leq 2$ ms ( $T > 900$ °C)
Measurement uncertainty	0.75 % of measuring value (at $\epsilon = 1.0$ and $T_u = 23$ °C)
Repeatability	2 K
Temperature coefficient with reference to 23°C	$\leq 0.05$ %/K

## 22 Accessories

A range of mechanical and electrical accessories are available for mounting the pyrometers in industrial environments.

For the selection of the components use the following link:

<https://www.keller.de/en/its/pyrometers/accessories.htm>

## 23 Default settings

The default settings can be found in the description of the IODD. You can find it on our website [www.keller.de/en/its/mediacenter](http://www.keller.de/en/its/mediacenter).

## 24 Copyright

The licence information of the Open Source libraries used can be found in the media library on our website [www.keller.de/its](http://www.keller.de/its)

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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.

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