MICRO-EPSILON

Operating Instructions

thermoIMAGER TM-BR20AR-TIM

Ambient temperature reference source

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1 General Notes

To avoid a damage of the special coating, please do not touch the radiation surface with sharp or spiky objects.

Read the manual carefully before the initial start-up. The producer reserves the right to change the herein described specifications in case of technical advance of the product.

1.1 Intended Use

- The combination of a thermoIMAGER infrared camera and the thermoIMAGER TM-BR20AR-TIM reference source is a technical measuring device which enables thermographic detection of increased body temperature.
  The system is not a medical diagnostic instrument, medical device or accessory to a medical device. Only a medical examination and diagnosis can provide a reliable positive or negative statement about a possible disease.

- The system must only be operated within the limits specified in the technical data, see Chap. 2.

- The system must be used in such a way that no persons are endangered or machines and other material goods are damaged in the event of malfunction or total failure of the system.

- Take additional precautions for safety and damage prevention in case of safety-related applications.

1.2 Unpacking, Included in Delivery

- TM-BR20AR-TIM radiator
- Mounting bracket
- 20 m cable with PIF connector
- Operating Instructions

2 Technical Data

2.1 Short Description

The thermoIMAGER TM-BR20AR-TIM reference source is a compact and robust reference source suitable for referencing thermal imaging cameras. It contains 2 main components:

- Radiation surface
- Temperature probe (16-bit digital temperature sensor with 0.1 °C accuracy)

The radiation surface is made of aluminum with a special thermal conductivity and has shaped grooves.

The radiator corresponds to the ambient temperature and is floating with it. For referencing the thermal imaging camera, this temperature is measured and transferred to the process interface of the thermoIMAGER.

2.2 TM-BR20AR-TIM

Dedicated temperature range	18 °C – 33 °C
Emissivity	0.95 ± 0.02 (for 8-14 µm)
Temperature probe (integrated)	Digital 16-bit temperature sensor
Accuracy of temperature probe	± 0.1 °C (25…50 °C), drift: 0.0073 °C
Accuracy of TIM QVGA-HD with TM-BR20AR-TIM (T_{Amb} 18 °C…33 °C)	± 0.5 °C (T_{Obj} 30…40 °C)
Interface	5-pin connector fitting to PIF connector of TIM QVGA-HD cameras
Dimensions	20 cm x 20 cm x 5.8 cm
Weight (with mounting bracket/ without cable)	2.5 kg
Material	Radiation surface: anodized aluminum Back: stainless steel

Table 1: Technical Data of TM-BR20AR-TIM

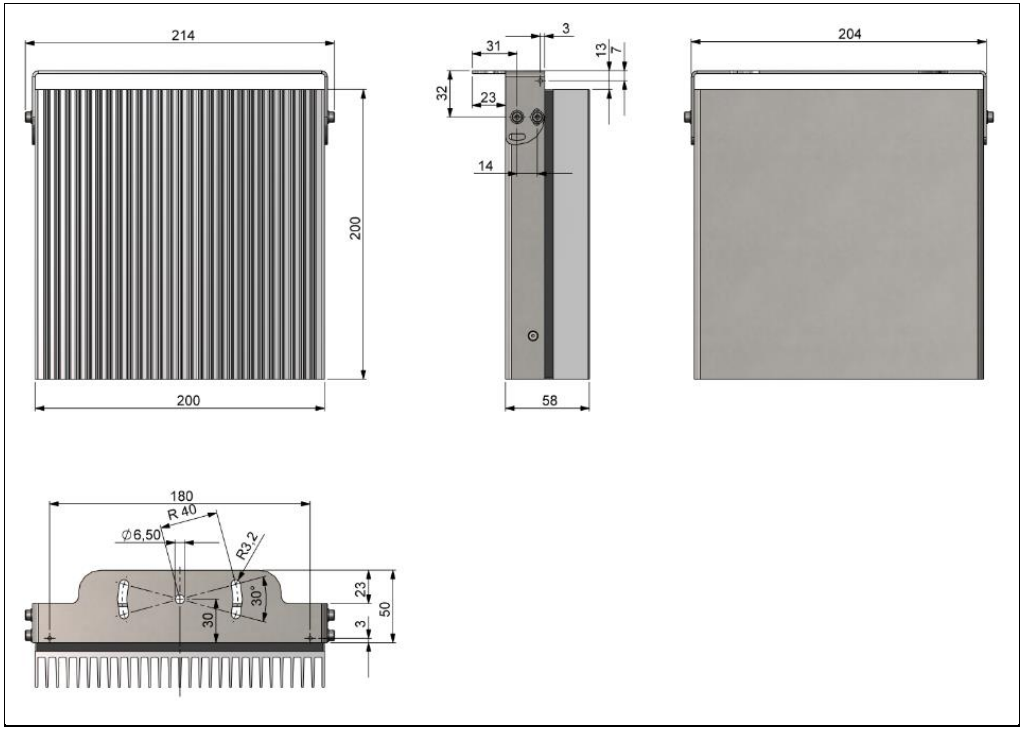

Figure 1: Dimensions [mm], ceiling mounting

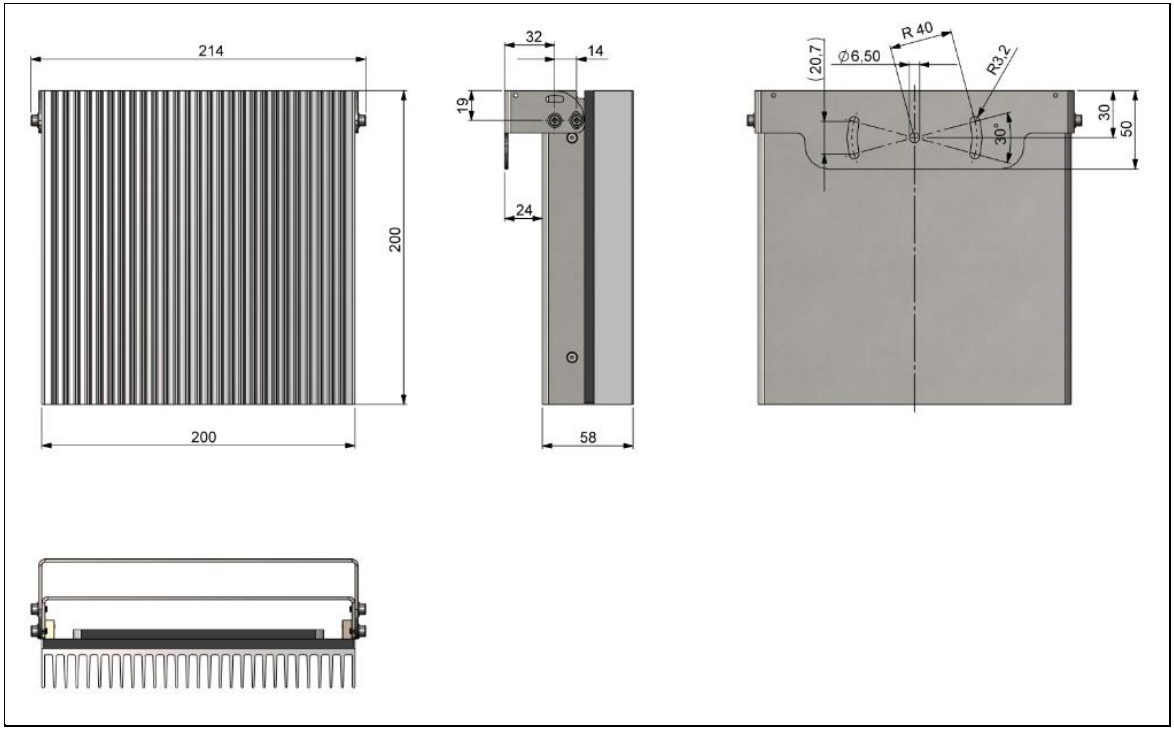

Figure 2: Dimensions [mm], wall mounting

3 Installation

3.1 Hardware Installation

A possible configuration of the TM-BR20AR-TIM is shown in **Figure 4**. The TIM QVGA-HD-T100 camera is connected via USB to the computer. The included 20 m cable has to be connected to the PIF connector on the camera back side (see **Figure 3**). There is no power supply necessary for the TM-BR20AR-TIM.

Hardware and Software Recommendation:

- Computer with OS Windows 7 or higher
- TIM QVGA-HD-T100 camera and TIM Connect Software Version 3.9.3063.0 or higher

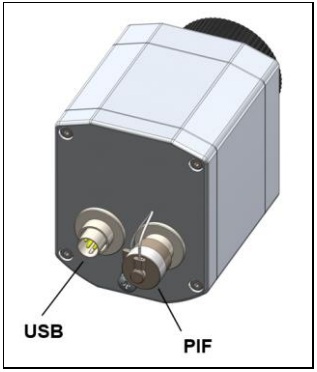

Figure 3: Connection

Note:

- The camera must be focused
- Consider the minimum distance of the selected optics
- The reference source must not be obscured by other objects

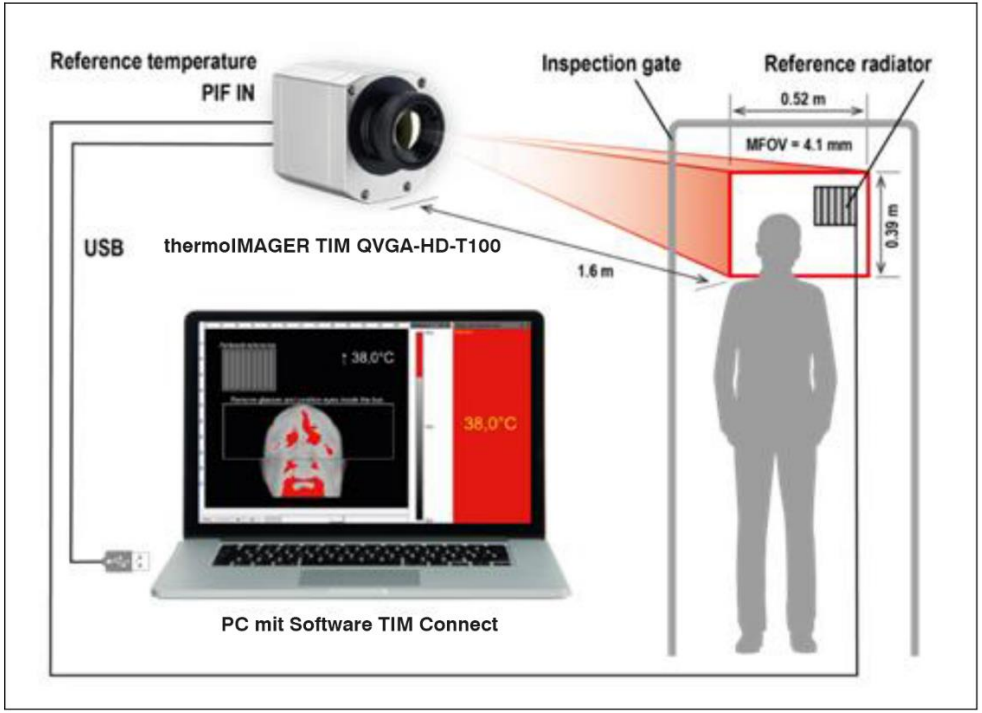

Figure 4: System overview with TIM QVGA-HD-T100 camera

The TM-BR20AR-TIM radiator can be mounted either on a ceiling or on a wall. An advantage of the radiator is its size. This means that it can be set up at almost any distance from the camera and the object to be measured. It is only important that the reference measuring area has a minimum size of 8x8 pixels and that the radiator is within the field of view of the camera. The ambient temperature for the radiator should be the same as that of the person to be measured. Installation close to a window or an air conditioning system should be avoided, as the air flow can have an effect on the measurement.

The camera is focused on the person to be measured. If the radiator is at a great distance from the object, it may also be out of focus in the image. This has no effect on the measurement, as it is an ambient radiator that is in the same ambient temperature as the object. The person or persons to be measured must be within the depth of field (DOF) range of the camera (**Figure 5**).

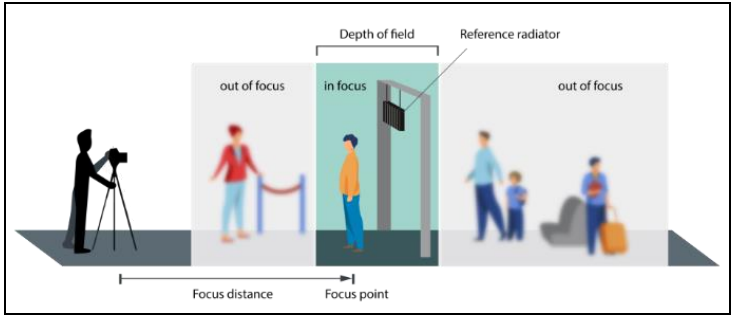

Figure 5: Depth of Field (DOV)

For optimal temperature measurement of the skin, the area of the medial canthus is recommended (**Figure 6**). At this point there is a very good correlation to the body core temperature.

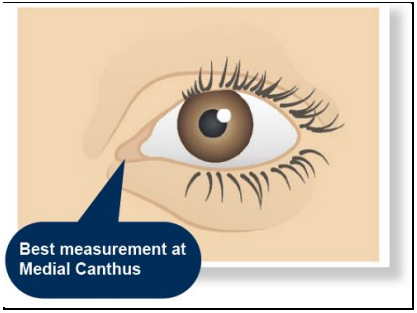

Figure 6: Medial canthus

In **Figure 7** the face of a person was measured with an infrared camera. The medial canthus is highlighted in red. In this example the temperature of 35.1 °C is significantly higher than the average temperature of the face (T=33.7 °C).

Figure 7: IR image – Medial canthus

The temperature distribution in the face is in this example between 31 °C and 35.1 °C (**Figure 8**). The size of the canthus is approximately assumed to be 15 x 15 mm.

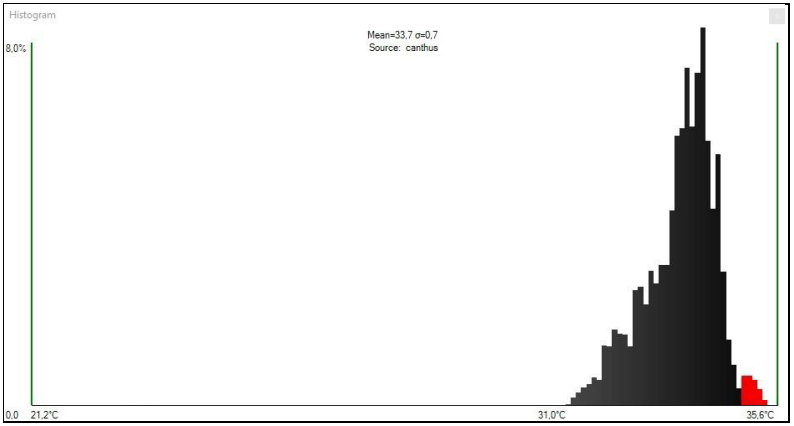

Figure 8: Temperature distribution face

To achieve the minimum temperature accuracy requirement, there must be at least 3 x 3 pixels within the Canthus region (15 x 15 mm).

The following tables show the DOF ranges and the number of pixels in the canthus for the different available optics depending on the distance.

O18, 382 x 288 px

Distance [m]	Field of view: HFOV [m]	Pixel inside canthus (15x15 mm)	Depth of field: DOF [m] for 3x3 px
1.5	0.5	12 x 12	0.7
3.0	1.0	6 x 6	3.0
6.0	2.0	3 x 3	34.0

O29, 382 x 288 px

Distance [m]	Field of view: HFOV [m]	Pixel inside canthus (15x15 mm)	Depth of field: DOF [m] for 3x3 px
1.0	0.5	12 x 12	0.5
2.0	2.0	6 x 6	3.0
4.0	4.0	3 x 3	infinite

O53, 382 x 288 px

Distance [m]	Field of view: HFOV [m]	Pixel inside canthus (15x15 mm)	Depth of field: DOF [m] for 3x3 px
0.5	0.5	14 x 14	0.5
1.0	1.0	7 x 7	5.0
2.0	2.0	3 x 3	infinite

The following table shows the recommended installation area.

Lens	Recommended working range for screening [m] (Distance Camera - Person)		Recommended working range for reference [m] (Distance Camera - BR20)	
	min	max	min	max
O18	3	6	3	20
O29	2	4	2	18
O53	1.0	2	1	11

The O18 or O29 optics are recommended for temperature measurement by individual screening at the medial canthus. At least 3x3 pixels are required in the canthus area and the optimal FOV width is 1 m.

3.2 Software Configuration

After having connected your Hardware, you can start with the configuration in the TIM Connect software. To do this, go to the **Referencing** tab under **Tools** and **Configuration**. Under **Reference temperature** and **Source**, select **External probe**.

Now select under **Compare with measuring area** the measuring area that should correspond to the reference area. This measuring area must be located in the reference source. The remaining options do not require further adjustments.

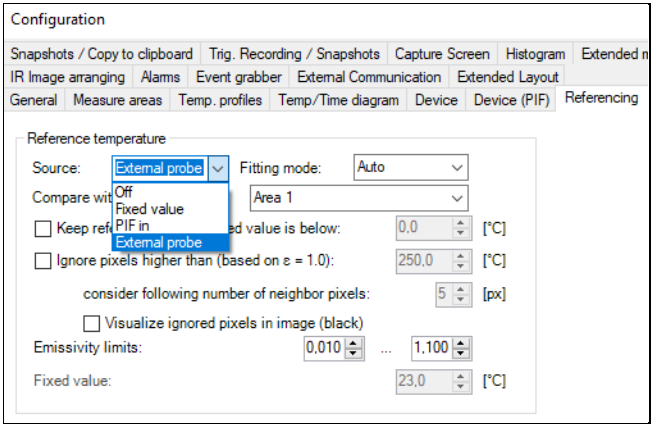

Figure 9: Configuration in TIM Connect software

The software already contains a predefined layout called "Fever Inspection with Ref". You can load this layout under Tools and Load layout and use it as a presetting.

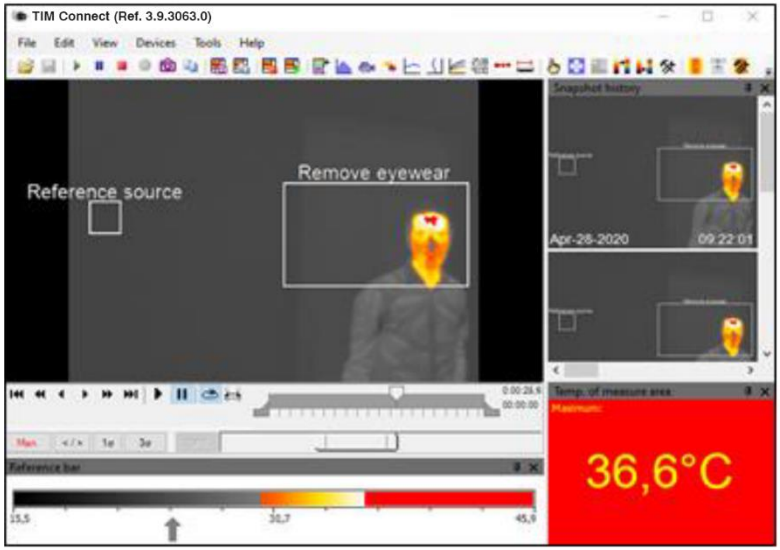

Figure 10: Example layout in TIM Connect – Fever Inspection with Ref

To make a correct temperature measurement on the human face make sure that glasses of the persons are removed and that the eyes are inside the measuring area.

The “Fever Inspection with Ref” layout consists of two measuring areas. The first measuring area is the so-called "reference source", which must be placed on the TM-BR20AR-TIM radiator. It is important to cover a large area as possible, but not the edges (see **Figure 11**). The minimum size should be at least 8 x 8 pixels. The second measuring area ("Remove eyewear") must be positioned so that the human face is captured. The emissivity of the "reference source" does not have to be taken into account further, as the ambient temperature is equal to the reference source temperature. This can remain set at ε = 1. The emissivity of the object (here the human skin) should be set at ε = 0.98.

The window **Temp. of measure area** displays the current maximum temperature value. As soon as this reaches the alarm value, the color changes to red. This ensures that the alarm case is clearly visible. In this case the threshold value is set to 36 °C. The threshold value of the alarm must be adjusted for different conditions.

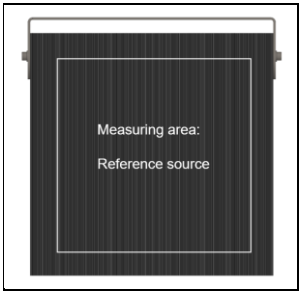

Figure 11: Position of Reference source

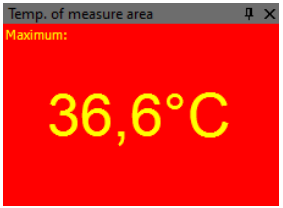

Figure 12: Temp. of eeasure area

In the **snapshot history**, all alarm cases are stored and can be analyzed more precisely. A snapshot is taken for each alarm condition. For this purpose, *Snapshot on alarm* selection must be activated under Alarm configuration in the Alarms tab.

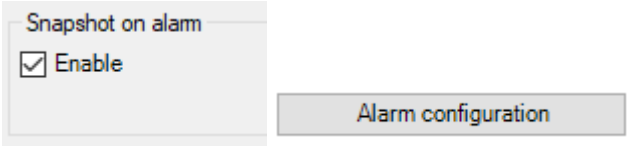

Figure 13: Configuration – Snapshot on alarm

Figure 14: Snapshot history

The **reference bar** shows the scaling of temperature within the color palette. The threshold value can be changed directly here.

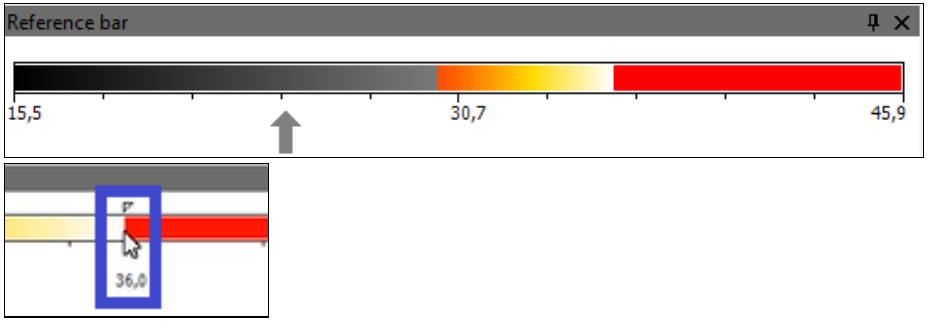

Figure 15: Reference bar

The settings for the different color palettes can be found in the configuration under the **Measuring colors** tab. Several color palettes can be defined here. In this layout the color palette *Gray* was used to achieve a good contrast to the critical areas. Between a temperature of 30 - 36 °C the color palette *Iron Hi* is used. This illustrates the "normal" body temperature. And all values that are higher than 36 °C are indicated by the color red. In this way, critical points can be clearly highlighted.

By activating *Bind threshold to high alarm of main measure area*, this threshold is equated with the alarm condition.

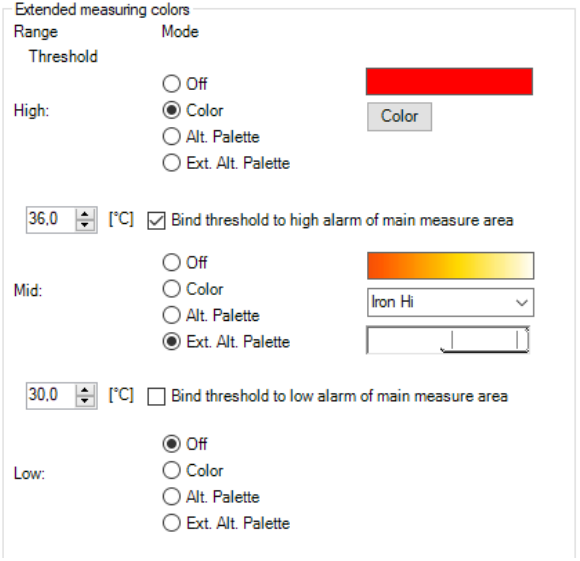

Figure 16: Configuration – Measuring colors

3.3 Optional Accessories

To be able to use the TM-BR20AR-TIM source and the PIF (standard or industrial PIF) with the camera simultaneously, a optional **PIF splitter** is available (**Part-No: TM-PIFSPCB2-TIM**).

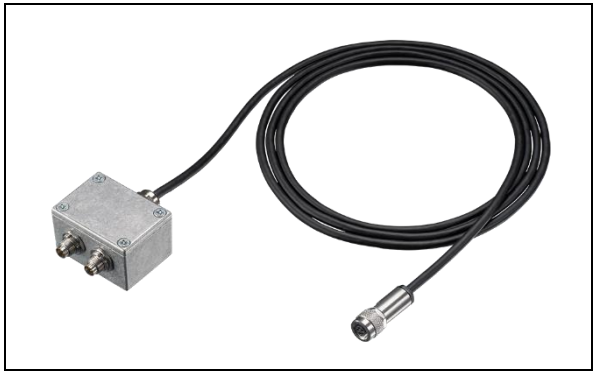

Figure 17: PIF Splitter

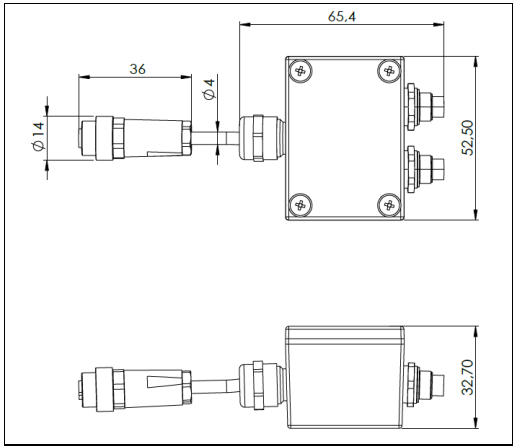

Figure 18: PIF Splitter – Dimensions [mm]

The splitter is only working for one TM-BR20AR-TIM and one PIF. The use of two PIFs at the same time is not possible. The connection to the splitter can be chosen freely.

4 Fever Detection

There are essentially two different methods for detecting possible persons for fever with a thermal imaging camera: **Individual screening** or **Crowd based screening**. The most suitable method depends on various factors (such as the installation location).

4.1 Crowd Based Screening

The IR camera is monitoring a crowd of people at once or sequential. Assuming that the majority of the measured maximum head temperature values are coming from healthy individuals the exceptions with an elevated body temperature can be easily detected.

4.2 Individual Screening

This method is mainly used at control gates or where crowd screening is not possible. The Medial Canthus (tear duct) provides the strongest correlation between outside skin temperature and core body temperature and is measured more precisely from a close distance. This method is also best for detecting low grade fevers.

4.3 Absolute Temperature Measurement Accuracy

Most IR cameras with 8 - 14 µm spectral response are specified with an accuracy of ±2 °C or 2 % of reading whichever is greater based on deployments in industrial environments in a wide variety of ambient conditions from 0 °C to +50 °C.

A higher accuracy can only be achieved by using a black body reference source. The source needs to be stable, have high emissivity and positioned in the scene proximate to the subject to be scanned.

The TM-BR20AR-TIM ambient referencing source can be combined with the TIM QVGA-HD-T100 camera. The black body is equipped with a 16 bit digital temperature sensor with ±0.1 °C accuracy. By integrating this highly accurate reference signal to TIM Connect software, the camera uncertainties can be reduced resulting from device adjustment, ambient temperature drift and short term stability down to a system accuracy of ±0.5 °C with a confidence interval of 95 %.

The real ability of an IR camera based screening system to detect subjects with fever lies more in the ability to discern which external face temperatures, as measured at the tear duct/ Medial Canthus, are significantly higher than those in a given population exposed to similar ambient temperature conditions.

4.4 Deployment of an IR Camera for Best Results

- Use a camera with a spatial resolution of 382 x 288 pixels or better and with a NETD of 80 mK or better.
- Select the right optics using the calculator. Check the Field of View (FOV) and Measurement Field of View (MFOV) which defines the smallest spot size that can be measured accurately.
- Set the emissivity for temperature measurement on human tissue to 0.98.
- Setting the temperature span for maximum contrast on face temperatures (typically from 23 °C to 40 °C) and applying color isotherms to highlight the hottest temperature on the human face makes it easy to see a subject with temperatures outside a normal range.
- The span and isotherm settings are depending on ambient temperature variations, so optimal setting is important. For differential thermography technique, measure tear duct temperatures of test subjects and set alarms for 1 ... 2 °C above that average temperature making sure to adjust if ambient temperatures change.
- The TIM Connect software can be set to alarm audibly when a temperature inside the area tool exceeds a customer set threshold. This can be combined with automatic snapshots. Customers should set their own alarm threshold based on their degree of sensitivity to false negatives and positives and advice of medical professionals.
- Use the pre-defined layouts that are provided with TIM Connect software for either crowd based or individual screening. The layouts can easily be adapted for local needs if necessary.

- The accuracy of the measurement can be increased to ±0.5 °C by using the optional TM-BR20AR-TIM ambient reference black body.
- Eyewear and sunglasses are opaque in the 8 - 14 µm infrared spectral range. Therefore they should be removed before the individual screening. Contact lenses need not be removed as these do not cover the tear duct.

4.5 Influences on External Skin Temperatures

- Medications including aspirin, acetaminophen/ paracetamol and ibuprofen or other antipyretics will reduce the human core and also skin temperature and make it impossible for screening a fever condition.
- The evaporative cooling effect from perspiration will decrease outside skin temperatures particularly when a subject is positioned below air flow vents. Subjects visibly perspiring will not deliver temperature measurements useful for fever screening with an IR camera or any remote infrared device.
- Vascular dilatation can occur after alcohol consumption increasing skin temperatures.
- High blood pressure, pregnancy and other physical conditions can also result in increased skin temperature.

- Influences from extremes in ambient temperature such as a long walk through a cold parking lot will impact measurements possibly masking a fever and reporting a false negative reading.

It is important to note that temperatures made on the outside of the body (even at the Medial Canthus) will not match core temperatures taken with a traditional oral thermometer.

5 Liability for Material Defects

All components of the device have been checked and tested for functionality at the factory. However, if defects occur despite our careful quality control, MICRO-EPSILON or your dealer must be notified immediately.

The liability for material defects is 12 months from delivery. Within this period, defective parts, except for wearing parts, will be repaired or replaced free of charge, if the device is returned to MICRO-EPSILON with shipping costs prepaid. Any damage that is caused by improper handling, the use of force or by repairs or modifications by third parties is not covered by the liability for material defects. Repairs are carried out exclusively by MICRO-EPSILON.

Further claims cannot be made. Claims arising from the purchase contract remain unaffected. In particular, MICRO-EPSILON shall not be liable for any consequential, special, indirect or incidental damage. In the interest of further development, MICRO-EPSILON reserves the right to make design changes without notification.

For translations into other languages, the German version shall prevail.

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