

TECHNICAL NOTE - FEVER SCREENING SYSTEMS

Viral epidemics like the current **coronavirus / COVID-19** create a worldwide demand for infrared cameras able to screen for a fever condition in humans.

The PI 400i uses a 382 x 288 sensor to produce a thermal image with over 100,000 pixels.

PI 400i with T010 range (-4...212 °F)

The PI 400 is sold with a certificate of calibration validating measurement made against traceable 95°F temperature reference source

The basis for the effectiveness of thermal cameras as a screening tool lies in the correlation of outside skin surface temperature with internal or core body temperature.



PI 400i T010

Areas for fever screening

The **PI 400i** is extremely **sensitive** and capable of displaying temperature differences in increments as subtle as 0.04 °C. This sensitivity makes it easy to identify subjects in a group that are above the average temperature. The **PIX Connect software** can apply a color overlay indicating any area in the scene that is over a pre-set temperature threshold.

The practice of capturing data on a group of subjects exposed to the same ambient conditions and alarming on significant deviations from this average temperature may offer the best results for effectively screening for a fever condition.

Although crowd screening is possible, international standards associations (ISO/TR 13154) and IEC 80601-2-59 recommend against crowd scanning in favor of serial scanning one individual at a time to maximize the accuracy of the measurement at the **Medial Canthus (tear duct)** area on the face. This approach also provides the setting necessary to remove glasses to gather data on the hottest spot on the face.

The PI 400i captures and displays a unique thermal image 27 times a second so one or two seconds is plenty of time for the camera to capture and determine the hottest spot on the face provided the subject offers a clear line of site to the tear duct area and is within the focus range of the camera (typically 25" to 30" with the 29° lens).



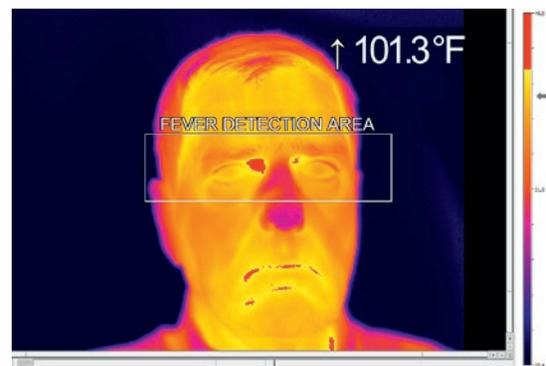
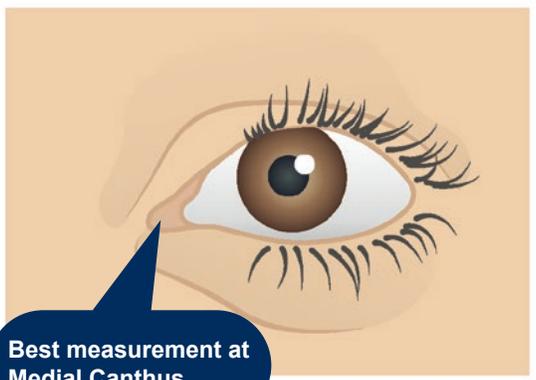
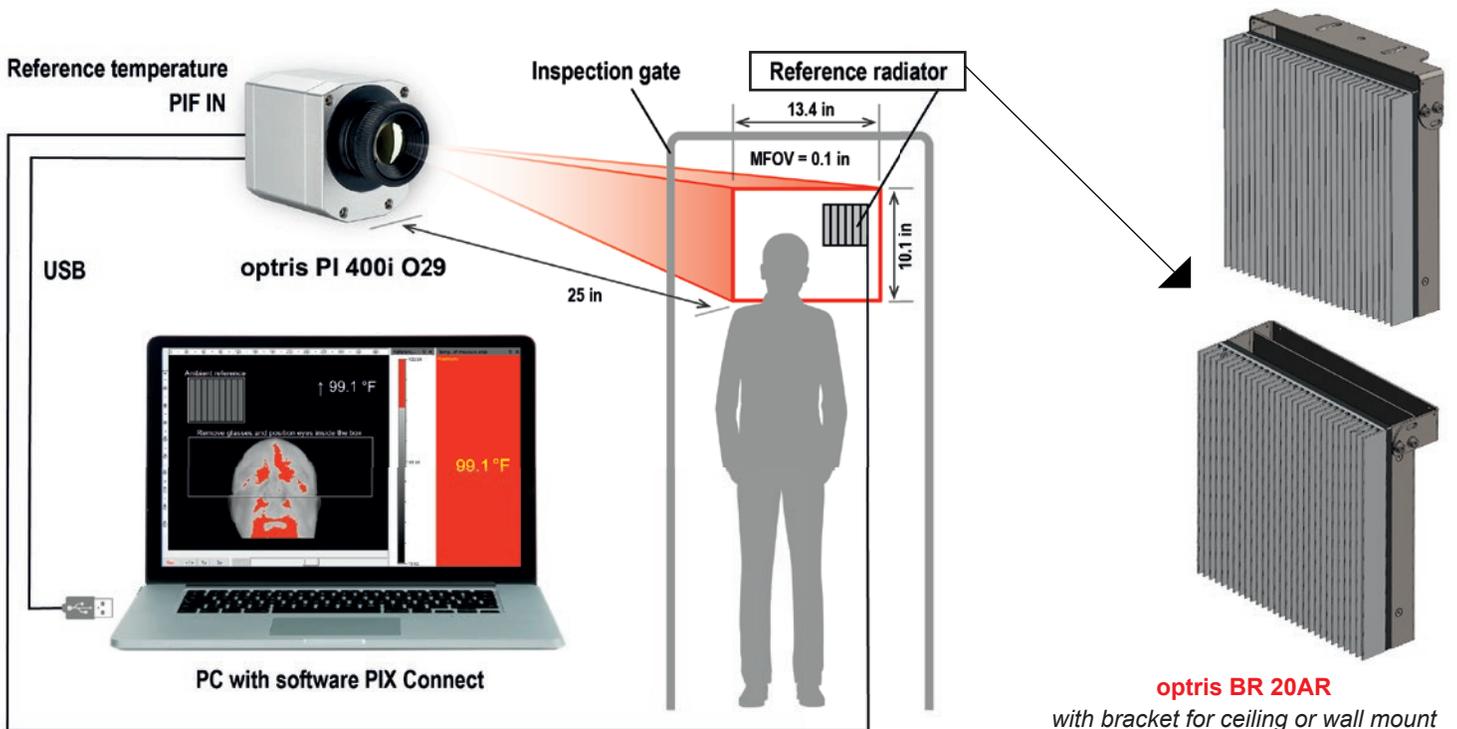
Absolute temperature measurement accuracy

Most IR cameras with 8-14 μm spectral response are specified with an accuracy of **3.6 °F or 2%** of reading whichever is greater based on deployments in industrial environments in a wide variety of ambient conditions from 32 °F to 122 °F.

Many IR cameras with microbolometer sensors are promoted today with accuracies of **+/-0.9 °F** or better. These accuracies cannot be achieved without the use of a **black body reference source**. The source needs to be stable, have high emissivity and positioned proximate to the subject to be scanned.

Our **BR 20AR** ambient referencing source fulfils these criteria and is equipped with a 16 bit digital temperature sensor with **+/- 0.18 °F** accuracy. By integrating this highly accurate reference signal to our **PIX Connect software**, we can reduce camera uncertainties resulting from device adjustment, ambient temperature drift and short term stability down to a system accuracy of **+/- 0.9 °F** 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.



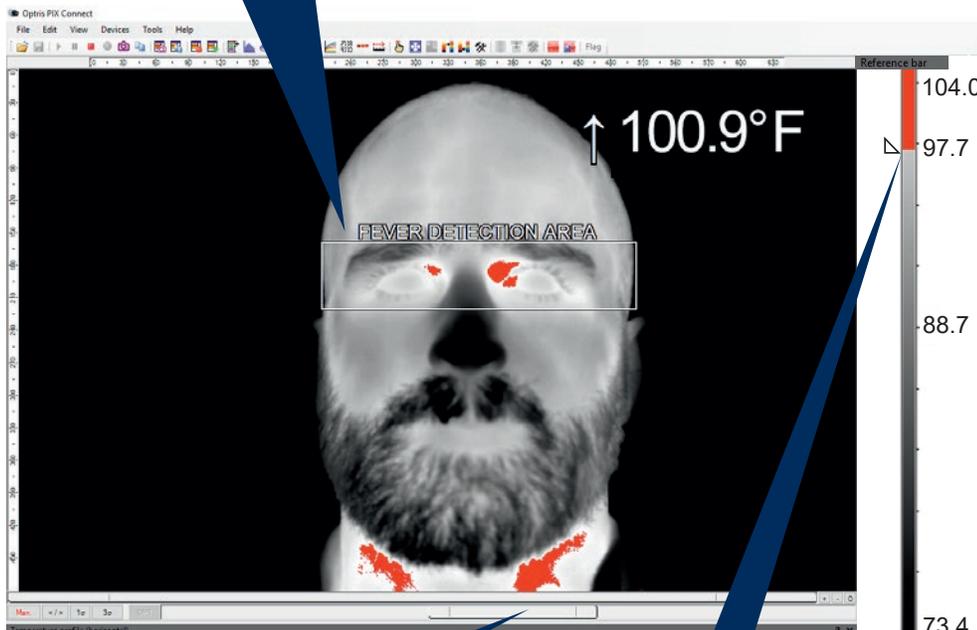
IR temperature measurement at the Medial Canthus for a close correlation to the core body temperature



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 Optris 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 **74 °F to 104 °F**) 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 ear duct temperatures of test subjects and set alarms for **2 °F to 3 °F** above that average temperature making sure to adjust if ambient temperatures change.
- The PIX 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 layout we provide with PIX Connect software for individual screening. The layout can easily be adapted for local needs if necessary.
- The accuracy of the measurement can be increased to +/- 0.9 °F by using the optional BR 20AR 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.

The measuring area is positioned at eye level for optimal results



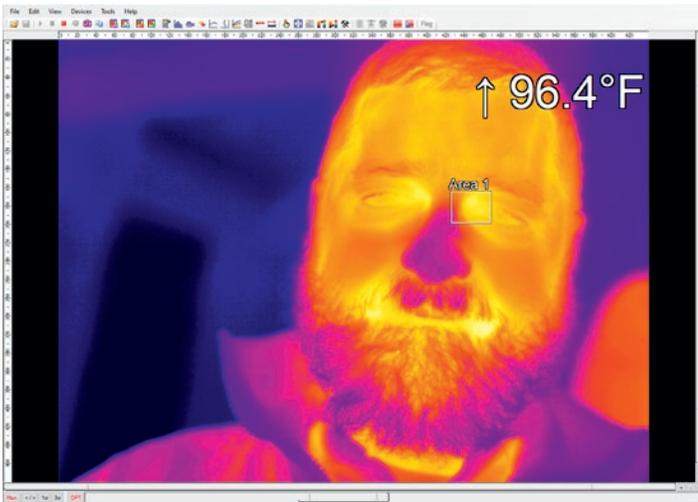
Temperature span and isotherm settings tuned

to highlight hottest face temperatures

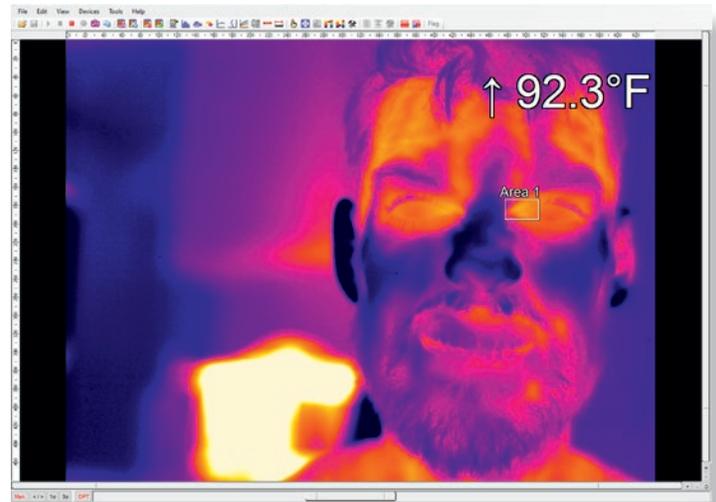
Influences on external skin temperatures

- 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.



Person coming from inside (exposed for 1 hour to an ambient of 69.8 °F)



Person coming from outside (exposed for 1 hour to an ambient of 42.8 °F)