



IR CAMERA

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Abstract

This SOP shall go over the structures of a thermal camera and the functions it can perform. For problems involving thermodynamics, an IR thermal camera would be extremely helpful in capturing data to determine temperature, heat flow between objects, etc.



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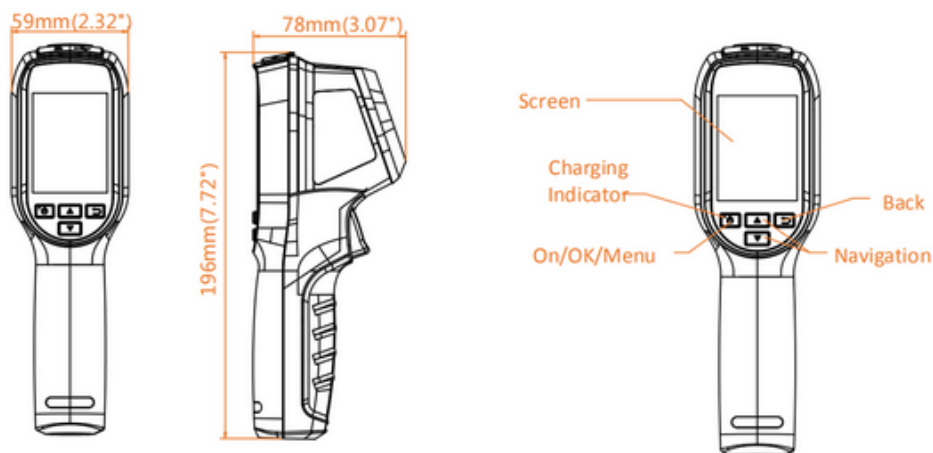
1 How does an IR camera work?

All objects emit infrared energy, known as a heat signature. An infrared camera (also known as a thermal imager) detects and measures the infrared energy of objects. The camera converts that infrared data into an electronic image that shows the apparent surface temperature of the object being measured. Some other information about an IR camera is listed below: [1]

- Contains an optical system that focuses infrared energy onto a special detector chip.
- Special detector chip contains thousands of detector pixels arranged in a grid, each pixel in the sensor array reacts to the infrared energy focused on it and produces an electronic signal.
- The signal from each pixel is applied to a mathematical calculation to create a colour map.
- It is easier to correlate areas in the infrared image with a standard digital image as well.

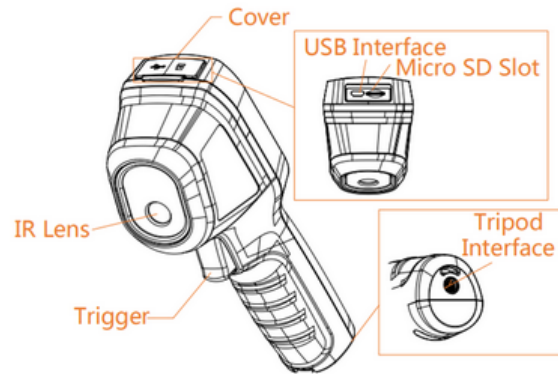
2 Structure and Basic Functions

The IR camera at the lab is HIKMICRO B20 256 x 192 IR Resolution Thermal Camera. The dimensions and interfaces of the camera are shown in the pictures below: [2]



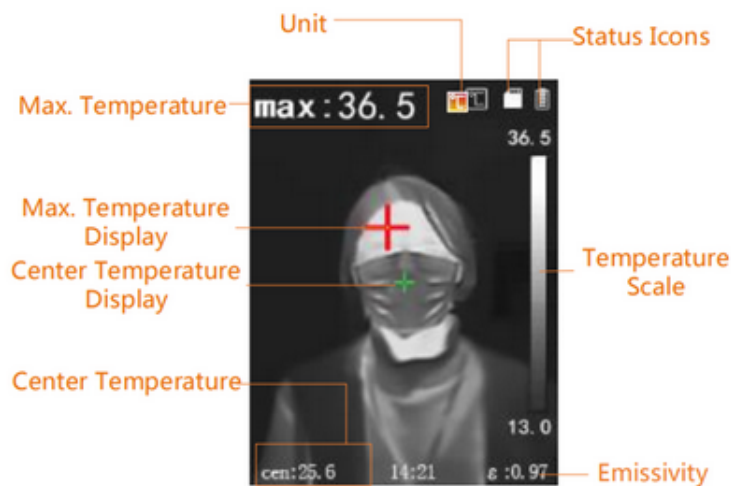
- On/Ok/Menu: turn power on/off, display menu and confirm operation.
- Back: exit the menu or return to previous menu.
- Navigation: click the up and down buttons to select parameters.
- Charging indicator: LED indicator is red when the device is charging. The LED indicator is green when the device is fully charged.
- USB interface: charge the battery and export snapshots with the USB cable.
- Trigger: pull the trigger to capture snapshots.

1. To charge the device, open the top cover and connect the USB interface and the power adaptor with USB cable.
2. To capture snapshots: pull the trigger in the live view interface. There will be a freeze. Press On/Ok/Menu button to save the picture, press back.
3. To export file: connect the handheld thermography camera to PC with USB cable.



3 Main Configurations

3.1 Temperature



1. In the live view interface, press on/ok/menu button to show the menu bar.
2. Press navigation buttons to select the desired setting bar.
3. Press menu button to go to the setting interface.
 - a. Emissivity: emissivity for different materials, set emissivity as effectiveness in emitting energy as thermal radiation. (the common emissivity values are listed below) [3]

Material	Emissivity*	Material	Emissivity*
Aluminum, polished	0.05	Iron, wrought, polished	0.28
Aluminum, rough surface	0.07	Lacquer, Bakelite	0.93
Aluminum, strongly oxidized	0.25	Lacquer, black, dull	0.97
Asbestos board	0.96	Lacquer, black, shiny	0.87
Asbestos fabric	0.78	Lacquer, white	0.87
Asbestos paper	0.94	Lampblack	0.96
Asbestos slate	0.96	Lead, gray	0.28
Brass, dull, tarnished	0.22	Lead, oxidized	0.63
Brass, polished	0.03	Lead, red, powdered	0.93
Brick, common	0.85	Lead, shiny	0.08
Brick, glazed, rough	0.85	Mercury, pure	0.10
Brick, refractory, rough	0.94	Nickel, on cast iron	0.05
Bronze, porous, rough	0.55	Nickel, pure polished	0.05
Bronze, polished	0.10	Paint, silver finish**	0.31
Carbon, purified	0.80	Paint, oil, average	0.94
Cast iron, rough casting	0.81	Paper, black, shiny	0.90
Cast iron, polished	0.21	Paper, black, dull	0.94
Charcoal, powdered	0.96	Paper, white	0.90
Chromium, polished	0.10	Platinum, pure, polished	0.08
Clay, fired	0.91	Porcelain, glazed	0.92
Concrete	0.54	Quartz	0.93
Copper, polished	0.01	Rubber	0.93
Copper, commercial burnished	0.07	Shellac, black, dull	0.91
Copper, oxidized	0.65	Shellac, black, shiny	0.82
Copper, oxidized to black	0.88	Snow	0.80
Electrical tape, black plastic	0.95	Steel, galvanized	0.28
Enamel **	0.90	Steel, oxidized strongly	0.88
Formica	0.93	Steel, rolled freshly	0.24
Frozen soil	0.93	Steel, rough surface	0.96
Glass	0.92	Steel, rusty red	0.69
Glass, frosted	0.96	Steel, sheet, nickelplated	0.11
Gold, polished	0.02	Steel, sheet, rolled	0.56
Ice	0.97	Tar paper	0.92
Iron, hot rolled	0.77	Tin, burnished	0.05
Iron, oxidized	0.74	Tungsten	0.05
Iron, sheet galvanized, burnished	0.23	Water	0.98
Iron, sheet, galvanized, oxidized	0.28	Zinc, sheet	0.20
Iron, shiny, etched	0.16		

*Emissivities of almost all materials are measured at 0 °C but do not differ significantly at room temperature.

**Paint, silver finish is measured at 25 °C and Paint, enamel at 27 °C

- b. Distance (m/feet): set the straight-line distance between the target and the device. (recommended thermometry distance is 0.2 m to 2 m with target size 80 x 80 nm)
 - c. Rule: select centre spot and cold spot to show the centre temperature and minimum temperature in the live view interface.
4. Press the navigation buttons to select desired parameter, press menu button to enable it.
 5. If necessary, press navigation button to increase/decrease the setting values, hold navigation buttons to change the value quickly.
 6. Press the back button to save and exit.

3.2 Palette

Display different temperature colours, analyze image by different palette colours.

1. In the live view interface, press menu button to show the menu bar.
2. Press navigation buttons to select Palette.
3. Press on/off/ok button to select palette mode and the live view interface displays the according palette colour.
4. Press back button to save and exit .

3.3 Temperature Alarm

If the device detects temperature that is higher than threshold, there will be light flash and alarm sounds.

1. Press menu button to show the menu bar.
2. Press navigation button to select Temperature Alarm.
3. Press menu and press navigation buttons to increase or decrease alarm temperature threshold.
4. Press save button to exit.

If the palette is set as Above Alarm, when the detected temperature is higher than the set alarm temperature, the target is coloured in the live view interface. Other parameters, such as temperature measurement range, unit, palettes and so on, can be configured as steps above.

REFERENCES

- [1] How infrared cameras work. <https://www.fluke.com/en-ca/learn/blog/thermal-imaging/how-infrared-cameras-work#:~:text=All%20objects%20emit%20infrared%20energy,of%20the%20object%20being%20measured.>
- [2] Baseline thermographic handheld camera user manual. <https://www.hikvision.com/content/dam/hikvision/products.>
- [3] Emissivity values of common materials. [https://www.bergeng.com/mm5/downloads/fluke/Emissivity-Values-of-Common-Materials-Chart.pdf.](https://www.bergeng.com/mm5/downloads/fluke/Emissivity-Values-of-Common-Materials-Chart.pdf)