



# Thermal Imaging Camera eT450C

## User Manual



Version 1.1. Revised 3/21/2020.  
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## Table of Contents

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Important Notes, Safety Considerations and Disclaimer	
– Please Read .....	1
Introduction .....	5
Overview .....	6
Instrument Description.....	7
Main User Elements.....	7
LCD Display .....	9
Keypad .....	10
How to Use Your Thermal Imaging Camera .....	11
Operating Instructions.....	11
Menu Description .....	14
Image Alignment .....	14
Images .....	14
Color Palette .....	16
Emissivity.....	17
Settings .....	20
Battery Charging.....	28
Cleaning Instructions .....	29
Lens Maintenance.....	29
Specifications.....	30

Thank you for purchasing the ennoLogic® Thermal Imaging Camera eT450C. This camera allows you to see and measure heat radiating from objects. The heat of objects in the frame of the camera is measured and temperatures are converted to different colors to display the heat distribution in the frame as a visible image. In the default color palette, temperatures are assigned shades from cold to hot across the color spectrum as purple, blue, green, yellow, red and white, with purple being coldest and white being hottest.

All objects emit some level of infrared radiation. This camera measures temperature by sensing infrared radiation, which is outside the visible light spectrum, and making it visible as an image.

In this manual you will find detailed operating instructions and descriptions of each of the advanced features of the ennoLogic thermal imaging camera eT450C.

## **Important Notes, Safety Considerations and Disclaimer – Please Read**

To avoid personal injury or damage to yourself, others, or the instrument, please read the following information carefully before use.



- Do not attempt to disassemble or take apart the camera in any way as doing so could damage precision components. Should you have any problems with your instrument please contact [support@ennologic.com](mailto:support@ennologic.com).

- To avoid damaging the lens/sensor of the thermal imaging camera do not allow it to come into close proximity with any strong heat source.
- When the camera is on, you may hear clicking noises every few seconds. This is part of the camera's normal operation.
- If the camera enclosure becomes damaged, discontinue its use.
- Should the camera spark, smoke or emit a burnt odor power it off right away and stop using it.
- Do not make any modifications to the USB cable or USB power adapter to avoid the risk of short circuits and fires.
- Do not attempt to remove the built-in Lithium battery. Tampering with the battery may result in dangerous leakage or explosion.
- Unplug the power adapter when it's not in use or when the battery has been fully charged. Do not leave the camera connected to the charger when the battery is fully charged. Leaving the adapter plugged in for a long time or the camera connected for a long time may lead to overheating, deformation or fire.
- Only plug the power adapter into its designated power outlet. Be sure the specifications on the adapter match your local outlet specifications in order to avoid the risk of overheating of the equipment, electric shock, fire, chemical leakage inside the battery, explosion and other serious potential consequences.

- If the power adapter or its cable are damaged, discontinue use immediately.
- To avoid damage and/or electric shock, always plug and unplug the USB cable and power adapter by holding the connector and not the wire.
- Avoid any contact of the camera with water. Should water or any other liquid come in contact with the camera, wipe it dry immediately. If water or any other liquid gets inside the camera, power it off at once and stop using it.
- Keep the power adapter and USB cable connectors clean and dust and moisture free to avoid the potential risks of short circuit and fire.
- Use only the provided USB power adapter to charge the camera's battery. Use of other power supply accessories may cause overheating, electric shock, fire, battery leakage, explosion and other serious consequences.
- To avoid damage of the enclosure do not clean the camera with any abrasives or solvents, including but not limited to isopropyl alcohol.
- Parts of the camera may get hot after long periods of charging. Please handle with caution.
- To avoid water condensation inside the camera do not carry the camera from very hot to very cold or very cold to very hot environments without first placing the camera inside its carrying case or a plastic bag. Leave it in the case or bag until it reaches the new temperature. If the

camera has developed water condensation inside, power it off immediately to avoid damage. Let the camera dry completely before using it again.

- The camera can be damaged by any strong impact including dropping it.
- Long-time storage and regular charging: Should you need to store the camera for a long time, choose a cool and dry environment, and periodically charge the battery. This will extend the life of the built-in Lithium-Ion battery.

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## **Introduction**

Infrared thermal imaging technology has revolutionized detection and diagnosis, troubleshooting and many other aspects of modern industry and life. From fire and rescue, fire prevention, energy industries, manufacturing, metallurgy, to transportation, automotive industries, HVAC, home inspection, food production, national defense and many more, thermal imaging has become an indispensable time and money saving tool. Its non-contact high-speed performance allows for instant detection and diagnosis of problems in operating machinery with no need to power down or interrupt operation.

Application examples include:

- Search and rescue, such as finding lost or missing people in remote areas
- Fire and rescue, particularly finding people in burning buildings
- Inspection of power equipment, transmission lines, and transformers
- Identifying hidden potential fire hazards such as wiring in walls
- Locating and analyzing points of heat/cold loss and leaks in heating and cooling systems
- Diagnosing and analyzing train engine problems
- Night security monitoring
- Locating and troubleshooting mechanical and electrical failures in manufacturing equipment



- Repairing car and truck engines as well as farm equipment
- Checking heat distribution in ovens and furnaces
- Diagnosing hot spots on electronic circuit boards and in electronics manufacturing

## Overview

This infrared thermal imaging camera combines surface temperature measurements with real-time thermal imaging. It also provides real-time visible imaging overlaid with the thermal image for increased differentiation and better visualization of the heat emission of the target object.

Where an infrared thermometer can only measure one point at a time, the thermal imaging camera provides an instant thermal snapshot of the entire field of view. This saves time by making it easy to identify potential problems at a glance. Use the center point cursor to quickly pinpoint any target object and measure its temperature. In addition, the hottest and coldest spots in the thermal image are shown with cursors and their temperatures displayed.

Pulling the trigger button stores the currently displayed image in internal memory, and images can later be uploaded via USB or WiFi to a computer or mobile device, making it easy to include saved images in documents and reports. Images can also be streamed live via WiFi to a computer or mobile device.

The portable size and powerful feature set make this camera the ideal choice for demanding applications such as electronics manufacturing, monitoring oil and gas

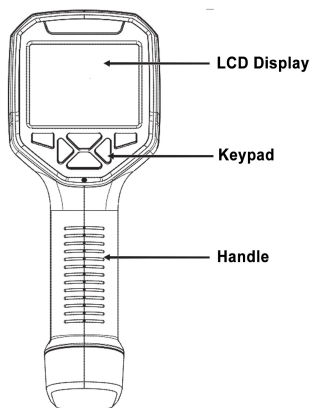
installations, HVAC troubleshooting and analysis, industrial inspections, and many other tasks.

Examples of these features in addition to those listed above include adjustable emissivity for increased measurement accuracy, five user-selectable color palettes, adjustable opacity of visible and thermal image, and adjustable alignment of overlaid visible and thermal images.

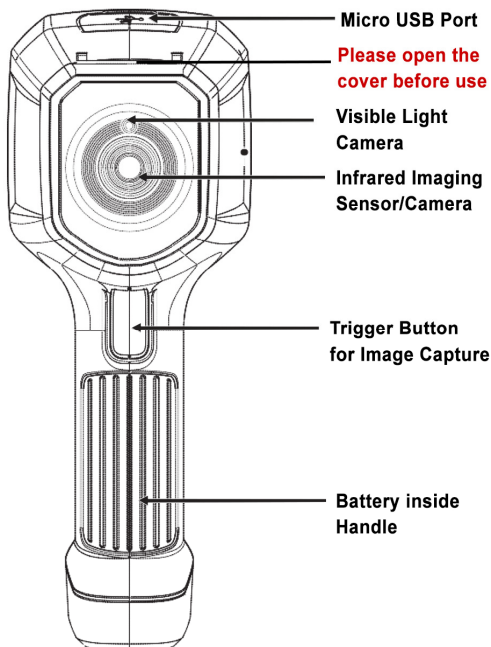
## Instrument Description

### Main User Elements

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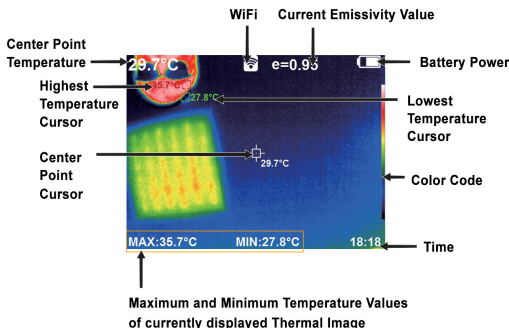


**Figure 1**



**Figure 2**

## LCD Display



**Color code:** displays the currently selected color palette from hottest to coldest, top to bottom.

**Center point temperature cursor:** this white cursor is always located in the center of the screen and its corresponding temperature is displayed in the top left corner.

**Highest temperature cursor:** this red cursor always appears at the hottest spot of the displayed thermal image. Its corresponding temperature is displayed in the bottom left corner.

**Lowest temperature cursor:** this green cursor always appears at the coldest spot of the displayed thermal image. Its corresponding temperature is displayed at the bottom, in the center.

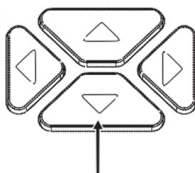
## Keypad

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**On/Off / Menu Button**



**Select / Enter Button**



**Navigation Buttons: Up, Down, Left and Right**

## How to Use Your Thermal Imaging Camera

### Operating Instructions

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#### Powering the Camera On and Off

Press and hold the “⏻ / MENU” button **for more than 3 seconds** to turn the Thermal Imaging Camera on or off. This relatively long press time is designed to prevent accidental powering on or off of the camera. This is particularly important if the user has chosen to disable auto shutdown, in which case an accidental powering on of the camera could result in a drained battery.

Please note that there will be no indication on the screen during the long-press of the power button. Hold the power button **for at least 3 seconds or until the boot image appears** on the screen. Conversely, when powering the camera down, long-press the power button **for at least 3 seconds or until the power off counter appears** on the screen.

#### LCD Display

After turning on the power you will see the boot screen and progress bar for a few seconds. Then the camera will be live.

#### Note:

If the camera has been moved between extreme hot or cold environments you may need to allow the camera to adjust

to the current ambient temperature before use. In general, prevent the camera from being exposed to extreme temperatures (see specifications table at the end of this manual).

### **Adjusting opacity between infrared thermal image and visible image**

This camera allows you to see thermal and visible images at the same time making it easier to see clearly what is in the camera's field of view.

There are 5 opacity settings (0%, 25%, 50%, 75% and 100%) to display the thermal image with varying intensity on top of the visible image.

This makes it easier to interpret the thermal image, provides more detailed information and improves analysis of heat distribution.

To adjust the opacity press the "◀" or "▶" button.

### **Image capture**

Press the red trigger button on the handle to capture the current image and save it in internal memory. When the image has been successfully captured, the screen will display the prompt "Store photo?" with the preselected answer "Yes". If you want to save the captured image simply press the trigger button again. Or you may press the "SELECT/ENTER" button to confirm.

If you don't want to save the image use the "▶" button to select "No" and press the "SELECT/ENTER" button. If you change your mind, press the "◀" button to go back to the

“Yes” selection, then press the “SELECT/ENTER” button. Please note that pressing the trigger button will always save the image regardless of the currently chosen “Yes” or “No” selection.

### **Show & Hide Max Min and Time On-Screen Display**

To hide the maximum temperature, minimum temperature and time display at the bottom of the screen during normal operation, press the “▲” button. To show it again press this button again.

### **Image Upload via USB**

Saved images can be uploaded to a computer via USB. Open the protective cover for the Micro USB port on the top of the camera (see Figure 2). Then use the included USB cable to connect the camera to your computer. Your computer will initialize and install a driver for the new device. Then you will be able to browse the camera images and copy & save them to your computer.




Supported operating systems include: Windows XP, Windows 7, Windows 8, Windows 10 and Apple.

Make sure to use a high quality USB data cable in the event you have misplaced the included cable.

When disconnecting the camera from your computer make sure to use the “Safely Remove Hardware” option before unplugging the USB cable to avoid file system damage and other potential problems.





## Menu Description

Press the red “ / MENU” button and the menu appears in the bottom left. The menu items are “Image alignment”, “Images”, “Color palette”, “Emissivity” and “Settings”. Use the “ ” and “ ” buttons to select the menu item of your choice. Then press the “SELECT/ENTER” button to navigate to that menu item.

### Image Alignment

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


This function allows for the alignment of the visible and thermal images. This allows you to compensate for the parallax between the visible and infrared cameras.

Press the “ / MENU” button to enter the main menu, and select “ Image alignment”. Press the “SELECT/ENTER” button to enter the image alignment mode. Press the navigation buttons (up, down, left and right) to shift the visible image in relation to the thermal image. Press the “SELECT/ENTER” button to exit this mode. (Note: If no navigations buttons are pressed within 6 seconds the camera will exit this mode and revert to normal operation).

### Images

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#### View Images

Press the “ / MENU” button to enter the main menu, and select “ Images”. Then press the “ ” button to display the list of images.

Press the “▲” or “▼” button to choose an image. Then press the “SELECT/ENTER” button to view the selected image.

To browse all the images, press the “◀” button to view the previous image, and press the “▶” button to view the next image.

Press the “SELECT/ENTER”



button to return to the list of images. Press the “⏏ /MENU” button to exit this mode.

## Delete Images

While viewing an image, press the “▲” button. The screen will display the prompt “Delete photo?” with the preselected answer “Yes”. If you want to delete the image press the “SELECT/ENTER” button to confirm.

If you don't want to delete the image use the “▶” button to select “No” and press “SELECT/ENTER”.

When all images have been deleted, “No Image” will be displayed. Press the “SELECT/ENTER” button to return to the list of images. Press the “⏏ /MENU” button to exit this mode.

## Color Palette

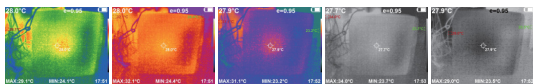
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### Description

Use this menu item to change the pseudo-color display of the thermal image. There are five palette options to choose from: rainbow spectrum, iron oxide red, cool color, white heat, and black heat. These palettes work best with high thermal contrast and offer good color contrast between high and low temperatures.







Some palettes are better suited for specific applications and should be chosen as needed. Choosing the right color palette will enhance the display of details of the target object. Color palettes such as rainbow spectrum, iron oxide red and cool color are recommended for high heat contrast and provide good contrast between high temperatures and low temperatures. The white heat and black heat palettes apply an even linear gray scale distribution between hot and cold temperatures.

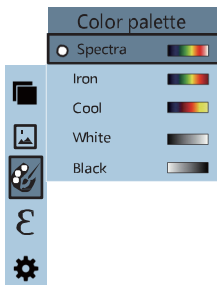
The following images show the same object with the five different color palettes applied:



*From left to right: Rainbow spectrum, Iron oxide red, Cool color, White heat, Black heat*

## Selecting and Applying a Color Palette

Press the “/MENU” button to enter the main menu and select “ Color palette”. Then press the “” button to display the list of palettes. Press the “” or “” buttons to select a color palette. Then press the “SELECT/ENTER” button. Press the “/MENU” button to apply the selected palette and exit the menu.



## Emissivity

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### Description

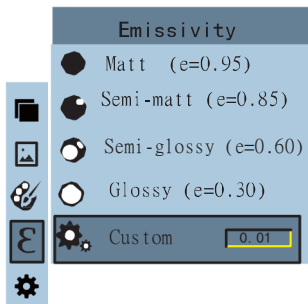
Emissivity of a material is the ability of its surface to emit thermal radiation. More accurately, it is the ratio of the energy radiated from a material's surface to that radiated from a perfect emitter (black body) at the same temperature and under the same conditions. The emissivity of a surface depends on the material and on the nature of its surface. For instance, a polished metal surface has a lower emissivity than an oxidized metal surface.

Since this thermal imaging camera calculates the surface temperature of objects by sensing their emitted thermal radiation it is important to take emissivity into account. A

polished metal object will emit less thermal radiation than an object with a flat black finish at the same temperature, and thus appear colder. The temperature displayed by the camera for the polished metal object would therefore be inaccurate, unless the camera's emissivity setting is adjusted to match the emissivity of the object.

Emissivity of a material surface is difficult to estimate since it depends on its texture, color, and temperature. A good default setting is  $\epsilon=0.95$ . The emissivity of this camera can be adjusted from 0.01 to 1.00. In addition, there are 4 preset emissivity settings provided to make it easy to use the camera in common measurement situations: Matte (0.95), Semi-matte (0.85), Semi-glossy (0.60), and Glossy (0.30).

### Setting the Emissivity



Press the “ $\varnothing$  / MENU” button to enter the main menu and select “ $\epsilon$  Emissivity” and press the “▶” button to enter the emissivity list.

Press the “▲” or “▼” buttons to select either one of the preset emissivities or choose “Custom” to enter your own value. Then press the “SELECT/ENTER” button to confirm your selection. Press the “⏏ / MENU” button to apply the setting and exit the menu.

When choosing “Custom”, press the “SELECT/ENTER” button to enter edit mode. A cursor will appear in the numeric value field. Press the “◀” / “▶” buttons to select the digit to be changed, press the “▲” “▼” buttons to change the value. After the desired emissivity value has been entered, press “SELECT/ENTER” to confirm. Then press the “⏏ / MENU” button to apply the new value and exit the menu.




Below is a simple table of emissivity values of common materials. The table provided here should only be used as a guideline. For a comprehensive emissivity table please visit: <https://ennologic.com/ultimate-emissivity-table/>

Material	Emissivity
Aluminum Foil	0.04
Asphalt	0.93
Bitumen	0.90-0.98
Black Body, matte	1.00
Brick, red	0.75 - 0.93
Ceramic	0.90-0.94
Chrome, polished	0.05
Concrete	0.85 - 0.94
Copper, polished	0.02 - 0.05

Galvanized Pipe	0.46
Glass	0.92 - 0.95
Granite	0.45
Gypsum	0.85-0.95
Ice	0.97
Iron, polished	0.14 - 0.38
Iron, rusted red	0.61
Marble, white	0.95
Mortar	0.87
Paper, white	0.68
Plastic	0.84 - 0.95
Quartz Glass	0.93
Rubber, black	0.95
Sand	0.90
Skin, human	0.98
Snow	0.80
Soil	0.92 - 0.95
Steel, oxidized	0.75
Steel, polished	0.07
Tape, electrical, black	0.97
Textile	0.87 - 0.98
Tile	0.97
Water	0.95 - 0.98
Wood	0.86 - 0.90









## Settings

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Press the “/MENU” button to select “ Settings” in the main menu. Press the “ ” button to enter the list of

available settings. Use the “▲” or “▼” buttons to select the setting you wish to adjust.

The table below gives an overview of the available settings and their possible values.

Settings		
 Auto shutdown ▶	Auto shutdown	5min, 20min, none
 Intensity ▶	Intensity	Low, Medium, High
 Language ▶	Language	English, Chinese, Italian, German
 Unit ▶	Temp. Unit	Celsius, Fahrenheit
 Time format ▶	Time Format	24 hour AM/PM
 Set time ▶	Set time	Year, Month, Day, Hour, Minute, Second
 Spot ▶	Spot	Off On
 WiFi ▶	WiFi	Off On



## **Auto Shutdown**

After selecting "☰ Auto shutdown", press the "▶" button to enter the auto shutdown setting list. The choices are No Shutdown, 5 minutes and 20 minutes. If "NO" is selected, auto shutdown will be disabled.

## **Intensity (Brightness)**

After selecting "☼ Intensity", press the "▶" button to enter the intensity setting list. The intensity (display brightness) can be set to Low, Medium or High.

## **Language**

After selecting "🌐 Language", press the "▶" button to enter the languages list. Available languages are: English, Chinese, Italian, German.

## **Unit (Temperature)**

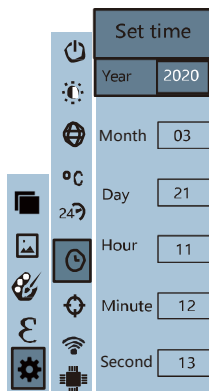
After selecting "°C Unit", press the "▶" button to enter the list of temperature units. Select either Celsius or Fahrenheit.

## **Time Format**


After selecting "24h 🕒 Time format", press the "▶" button to enter the time format list. Select either "24 hour" or "AM/PM".

## Set Time

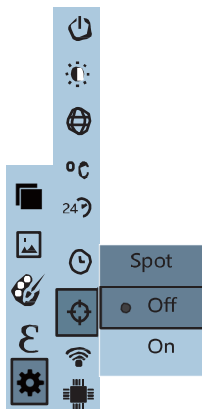
After selecting “🕒 Set time”, press the “▶” button to enter the set time list. Use the “▲” or “▼” buttons to select Year, Month, Day, Hour, Minute or Second. Press “SELECT/ENTER” to enter the edit mode. Press the “◀” / “▶” buttons to select the digit to be changed, press the “▲” / “▼” buttons to change the value. After the desired value has been entered, press “SELECT/ENTER” to confirm. Then press the “⏻ / MENU” button to apply the new date and time and exit the menu.




## Enable/Disable Highest & Lowest Temperature Cursor

After selecting “ Spot” press the “▶” button to make your selection to enable or disable the Highest & Lowest Temperature cursors.

Press “▲” / “▼” to select “Off” or “On”. Press “SELECT/ENTER” to confirm the selection. Then press the “⏻ / MENU” button to apply the new selection and exit the menu.



## WiFi

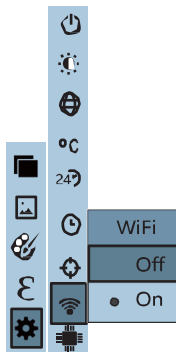
After selecting “ WiFi”, press the “▶” button to make your selection to enable or disable WiFi.

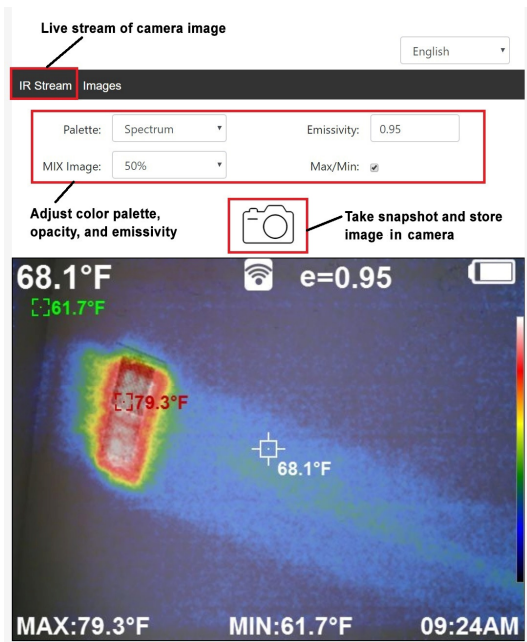
Press “▲” / “▼” to select “Off” or “On”. Press “SELECT/ENTER” to confirm the selection. Then press the “⏻ / MENU” button to apply the new selection and exit the menu.

After enabling WiFi, use a computer or mobile device to search for WiFi networks. The network name of the camera is “Thermal-xxxx” (xxxx are the last four digits of the MAC). Connect to the camera with your computer or mobile device.

Then open a web browser and access the camera through the IP address 192.168.230.1 (type <http://192.168.230.1/> into your browser’s address bar). You will see a live streaming image of the camera display.

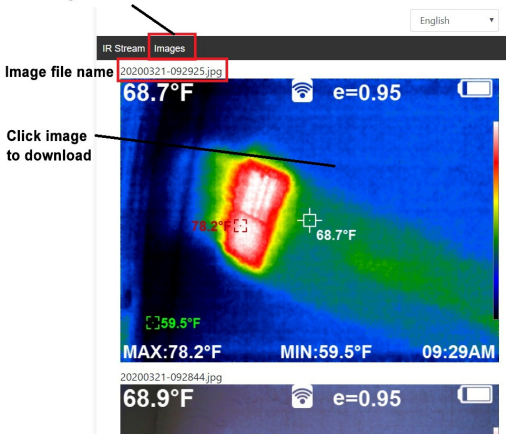
In the “IR Stream” mode, you can change the color palette, select thermal/visible opacity, change the emissivity, language, and enable the maximum/minimum temperature display at the bottom of the screen. Clicking on the camera icon on your browser screen will capture the camera image and store it in the camera.





Click “Images” on your browser to see the images stored on the camera. Click on any image to download it to your computer or mobile device. Click on “IR Stream” to return to the live stream of the camera.


**View images stored on camera**



Please note that any operation in your web browser will not reset the auto shutdown clock of the camera, only a button press on the camera will do that. Using the camera only through the browser may result in an unexpected shutdown of the camera when no camera buttons are pressed. You may want to disable auto shutdown when doing extended work via WiFi.

## Battery Charging

**Use the USB data cable to charge the built-in Lithium-Ion battery:**

- The camera has a built-in rechargeable 26650 lithium battery.
- The battery charge level is always displayed in the top right of the screen. When the battery is low, the battery symbol will show “  ”. Make sure to charge it right away by connecting the camera to the included USB power adapter and cable through the Micro USB port in the top of the camera.
- After the battery has been fully recharged disconnect the USB cable from the charger and unplug the USB charger from the outlet.

**Note: If the battery is allowed to get very low the camera may exhibit unexpected abnormal behavior. For that reason, make sure to recharge the camera in time before the battery is completely empty.**

**For optimal performance and to extend the life of the Lithium-Ion battery please follow these important instructions:**

- Do not leave the battery on the charger for more than 24 hours.

- Make sure to charge the battery for at least two hours every three months.
- Do attempt battery charging in extremely cold environments.

## **Cleaning Instructions**

Use a damp cloth with or without mild soap to wipe the exterior of the camera enclosure. Never use any abrasives or solvents, including isopropyl alcohol! To clean the lens and/or the display screen use only professional optical cleaning cloths.

## **Lens Maintenance**

### **To prevent damage to the infrared lens:**

- The infrared lens has a sensitive anti-reflective coating. Clean with caution and very little pressure to avoid damage.
- Use professional lens cleaning solutions and professional optical cloth only. You may also use gentle compressed air or an ion gun to remove loose particles.
- To clean the lens, slightly moisten the optical cleaning cloth with a professional lens cleaning solution. Apply very gentle pressure in a circular motion to clean the lens. Repeat this step if necessary with a clean cloth.



## Specifications

<b>Display</b>	3.5-inch TFT display
<b>Infrared image resolution</b>	320×240
<b>Visible image resolution</b>	300,000 pixels
<b>LCD resolution</b>	640×480
<b>Field angle</b>	56°×42°
<b>Thermal sensitivity</b>	0.07°C
<b>Frame rate of thermal images</b>	9 frames per second
<b>Focus mode</b>	Fixed
<b>Wavelength coverage</b>	8-14μm
<b>Emissivity</b>	Adjustable (0.01 to 1.00)
<b>Color palette</b>	Rainbow, iron oxide red, cool color, white heat, black heat
<b>Temperature range</b>	-20°C~450°C (-4°F~842°F)
<b>Measurement accuracy</b>	≤100°C ±2°C; 100—300°C ±2%; ≥300°C ±3%; ≥400°C ±10%
<b>Storage capacity</b>	Built-in 8GB (Actually available 6.6GB)
<b>File format</b>	JPG
<b>USB</b>	Micro USB 2.0
<b>Power supply</b>	Built-in rechargeable 26650 Lithium-Ion battery

<b>Operating Time (Battery Life)</b>	~4 hours (less with WiFi enabled)
<b>Settings</b>	Auto shutdown, intensity, language, temp. unit, time format, date & time, high&low temperature cursors, Wifi
<b>Language</b>	English, Chinese, Italian, German
<b>Auto Shutdown</b>	Selectable: 5 minutes, 20 minutes, No auto shutdown (disabled)
<b>Operating temperature</b>	32°F to 113°F (0°C to 45°C)
<b>Storage temperature</b>	-4°F to 140°F (-20°C to 60°C)
<b>Relative humidity</b>	< 85%RH
<b>Size</b>	10"x4.5"x4" (254mm×115mm×100mm)
<b>Weight</b>	590g (1.3lbs)



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