FLUKE ®

TiR
Thermal Imager

Users Manual

Introduction

The Fluke Ti9, Ti10, Ti25, TiRx, TiR, and TiR1 Thermal Imagers (hereafter "the Imager") are handheld imaging cameras used for predictive maintenance, equipment troubleshooting, and verification. All these Imagers produce thermal and visual images on a 640 X 480 display. Thermal and visual images are displayed on the Imager LCD and can be saved to an SD Memory card. Transferring images to a PC is accomplished by removing the SD memory card and connecting it to a PC through the included card reader. SmartView$^{\rightarrow}$ software is included for image analysis and report generation from these saved images.

Thermal and visual images can be presented simultaneously as a full thermal image or as a Picture-In-Picture (PIP) image. The thermal image temperature range starts at -20 °C, and goes up to +100 °C for the TiRx, TiR and TiR1, +250 °C for the Ti9 and Ti10 and +350 °C for the Ti25. The thermal image can be displayed using any one of a number of color palettes, depending on the model.

Imager power is supplied by a rechargeable Nickel Metal-Hydride battery. For Imagers that support IR-Fusion$^{\rightarrow}$, a full visual image (640 X 480) can be displayed and stored with each IR image.

In addition to the features mentioned above, the Ti25 and TiR1 provide voice recording for annotating saved images.

The Fluke Ti9 and TiRx Thermal Imagers have the same basic specifications and operation as the Ti10 and TiR imagers, respectively, but without IR-Fusion$^{\rightarrow}$ or visible image capabilities. They operate in full-time thermal image mode. Both the Ti9 and TiRx Thermal Imagers can be upgraded to a Ti10 or TiR, respectively, to include the IR-Fusion$^{\rightarrow}$ and visible image features. Please contact Fluke or your local Fluke representative for more information and pricing for this upgrade.

Note

Not all models are available in all areas.

How to Contact Fluke

To contact Fluke, call one of the following telephone numbers:

- USA: 1-800-760-4523
- Canada: 1-800-36-FLUKE (1-800-363-5853)
- Europe: +31 402-675-200
- Japan: +81-3-3434-0181
- Singapore: +65-738-5655
- Anywhere in the world: +1-425-446-5500

Or, visit Fluke's website at www.fluke.com.

To register your product, visit http://register.fluke.com.

To view, print, or download the latest manual supplement, visit http://us.fluke.com/usen/support/manuals.

Safety Information

Use the Imager only as specified in this manual. See Table 1 for a list of symbols used on the Imager and in this manual.

A **Warning** identifies hazardous conditions and actions that could cause bodily harm or death.

A **Caution** identifies conditions and actions that could damage the Imager or cause permanent loss of data.

W **Warning**

To prevent personal injury:

- **Carefully read all instructions.**

- **See emissivity information for actual temperatures. Reflective objects result in lower than actual temperature measurements. These objects pose a burn hazard.**

- **Use the product only as specified, or the protection supplied by the product can be compromised.**

- **Batteries contain hazardous chemicals that can cause burns or explode. If exposure to chemicals occurs, clean with water and get medical aid.**

Table 1. Symbols

Symbol	Description	Symbol	Description
E	Battery condition.	b	Battery charging.
P	Conforms to requirements of European Union and European Free Trade Association.	W	Important information. See manual.
A	Imager connected to battery charger.	e	Audio recording associated with the displayed image.
O	On Off Symbol	f	Imager in sleep mode or audio paused.
~	Do not dispose of this product as unsorted municipal waste. Go to Fluke's website for recycling information.		

Charging the Battery

Before using the Imager for the first time, charge the battery for at least two hours. The Imager's battery condition is displayed in the upper-left corner of the display. When the last segment of the battery icon extinguishes, the Imager will shut down and will require recharging before operating again. To charge the Imager's battery:

W **Caution**

To avoid damage to the Imager, remove it from the DC car charger before starting or jump starting the vehicle.

Ensure the Imager is near room temperature before connecting it to the charger. See the charging temperature specification. Do not charge the Imager in hot or cold places. Charging in extreme temperatures reduces the battery pack's ability to hold a charge.

1. Plug the ac input of the battery charger into an ac wall outlet.
2. Plug the battery charger's dc output into the Imagers ac adapter socket..

While the battery is charging, the battery icon appears as A while the Imager is operating. With the Imager off, b appears in the display while connected to the battery charger.

Keep the Imager attached to the charger until the battery condition icon indicates a full charge. With the Imager off, the battery charge icon will have four full bars. With the Imager on, turn the Imager off to view the battery condition icon. Removing the Imager from the charger before a full charge is indicated will deprive the battery of a full charge and thus shorten the run time.

Turning the Imager On and Off

To turn the Imager on or off, press the center softkey (2) for two seconds.

Features and Controls
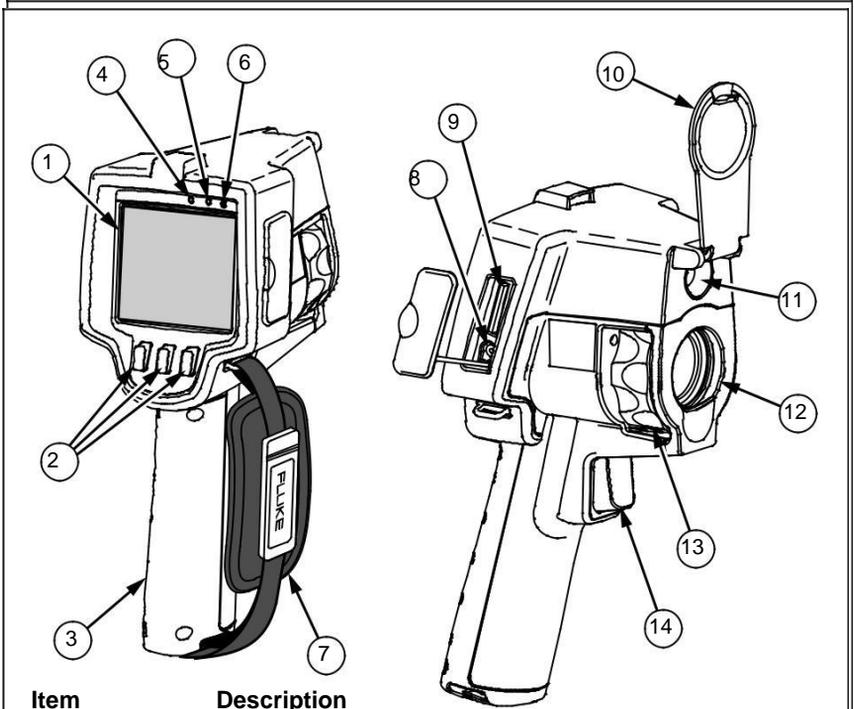
Item	Description
1	LCD Display
2	Function Softkeys (F1, F2, and F3)
3	Battery Cover
4	Speaker
5	Microphone
6	Auto backlight sensor
7	Hand strap
8	AC adapter/charger input terminal
9	SD memory card compartment
10	Retractable Lens Cover
11	Visual camera (Ti10, Ti25, TiR, TiR1 only)
12	Thermal (IR) camera
13	Focus control
14	Trigger

Using the Menu

The menus, coupled with the three softkeys (c, a, and d), provide access for setting features (date, time, language, units, backlight and spot temperatures), thermal image display, and saving and viewing stored images.

To bring up the menu, press a. The text above each function softkey (c, a, and d) corresponds to that softkey throughout all menu screens.

Press a to open and cycle through the menus.

The menu will disappear several seconds after the last press of a softkey.

Changing the Displayed Language

To change the display to present information in another language:

1. Press a until the F1 softkey label reads **Language**.

2. Press the softkey labeled **Language**.

3. Press the softkey labeled **Up** or **Down** to move the cursor to the desired language.

4. Press the softkey labeled **Back/Done** to set the units.

Setting the Imager Clock

The Imager has an internal real-time clock that holds the date and time of day.

Setting the Date

To set the date:

1. Press a until **Date** appears over the F1 softkey.

2. Press the softkey labeled **Date**.

The date can be displayed in one of two formats: **MM/DD/YY** or **DD/MM/YY**.

3. Press the softkey labeled with the desired date format.

4. Press the softkey labeled **Up** (c) or **Down** (d) to adjust the selected date element.

5. Press the softkey labeled **Next** to move to the next date element.

6. Press the softkey labeled **Done** when finished.

Setting the Time

To set the time:

1. Press a until **Time** appears over the F3 softkey.

2. Press the softkey labeled **Time**.

The Imager will display time in two different formats: 24 hour or 12 hour.

3. Press the softkey labeled with the desired format.

4. Press the softkey labeled **Up** (c) or **Down** (d) to adjust the selected time element.

5. Press the softkey labeled **Next** to move to the next time element.

6. Press softkey labeled **Done** when finished.

The 12 hour format has a selection for setting whether the time is AM or PM.

Focusing and Capturing an Image

Point the Imager at the object or area of interest, focus by turning the focus control until the image displayed on the LCD is as clear as possible, and then press and release the trigger. The Imager displays the captured image and a menu. The TiR, menu allows image storage. The TiR1 menu allows image storage, image setting adjustments, and recording of audio annotations. To cancel image storage and return to live viewing, press and release the trigger.

> *Minimum focus distance for thermal (IR) camera is 15 cm (approx. 6 inches). Minimum focus distance for visible (visual) light camera is 46 cm (approx. 18 inches). IR-Fusion$^{\rightarrow}$ and visible light images are unavailable on the Ti9 or TiRx Thermal Imagers.*

> *The Imager can save the image as a simple picture or as a radiometric image that allows further temperature analysis. To change the saved image format, see the "Setting File Format" section later in this manual.*

> *When IR-Fusion$^{\rightarrow}$ is enabled, adjusting the IR focus control will align the IR and visible light images on the LCD display. When the IR image is properly focused, the images should be almost perfectly aligned. This functionality provides an easy method to get a good focus on the IR image. Because of image parallax and minimum focus specifications, the minimum distance for an aligned IR-Fusion$^{\rightarrow}$ image is approximately 46 cm (18 inches). (IR-Fusion$^{\rightarrow}$ and visible light images are not available on the Ti9 or TiRx Thermal Imagers.)*

Pressing the softkey labeled **Settings** allows modification of image characteristics such as palette, picture-in-picture, and range. Refer to the appropriate setting section for operational details.

Saving Imager Data

The Imager saves displayed data on an SD card placed into the camera. See the "Changing the SD Card" section for inserting and ejecting an SD card. The file format set on the Imager determines how the measured information is stored on the SD card. To store Imager data:

1. Point camera at the area of interest and pull the trigger to capture an image. This will freeze the image in the display and bring up the Image Capture menu.

2. Press the softkey labeled **Store**. If the SD card is in the Imager and there is enough room left on the card, the information is stored.

Adjusting the Thermal Image

The Imager uses different colors or shades of gray to display the temperature gradient of the area within the Imager's field of view. There are two adjustments for changing how the Imager displays the image: Palette and Range.

Selecting a Palette

The palette menu provides different thermal viewing patterns. Grayscale, Blue-Red, High Contrast, and Ironbow are available in all four Imagers. The TiR1 and Ti25 add Amber and Hot Metal to the list. To select a palette:

1. Press a until **Palette** appears over c.
2. Press the softkey labeled **Palette** to display the available palette options.
3. Press the softkey labeled **Up** or **Down** to move between the palette options.
4. Press the softkey labeled **Back/Done** to set the Imager to the selected palette.

Setting the Range

Viewing temperature (level and span) is set either automatically or manually. To set the range, do the following:

1. Press a until **Range** appears over d.
2. Press the softkey labeled **Range**.
3. Press the softkey labeled **Manual** to set the Imager to manual ranging and press the softkey labeled **Auto** to select auto ranging.

Fast Auto/Manual Range Toggle (Ti10, Ti25, TiR, TiR1)

When NOT in a menu mode, press F1 for ½ second to toggle between Auto Range and Manual Range.

Fast Auto Rescale (Ti10, Ti25, TiR, TiR1)

When in Manual Range and NOT in a menu mode, press F3 for ½ second to automatically rescale the level and span range for objects within the Imager's thermal field of view.

It powers up in the same Range mode, Auto or Manual, as when it powered down.
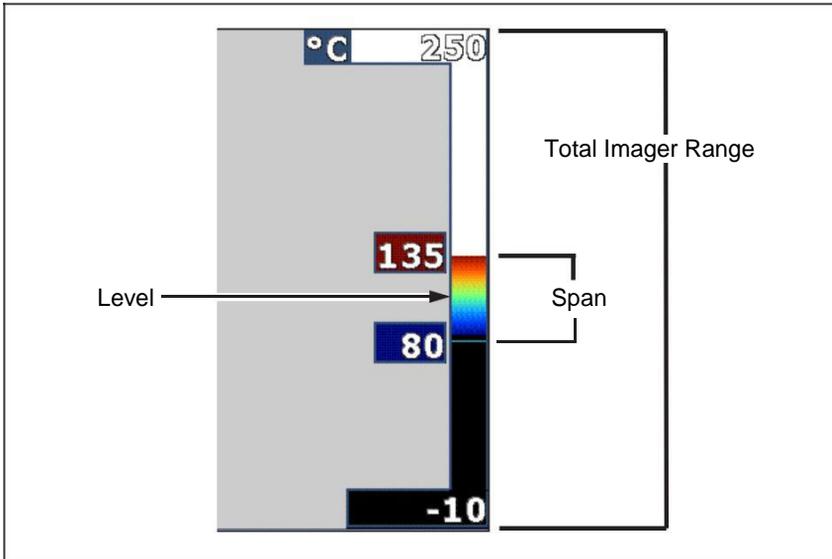
exj02.eps

Figure 1. Range and Span Settings

Setting the Level (Manual)

When put into manual ranging, the level setting adjusts the thermal span within the total temperature range of the Imager. See Figure 1. To set the level:

1. After entering the manual range mode (See the "Setting the Range" section above), press the softkey labeled **Level**.

2. Press the softkey labeled **Up** to move the temperature span to higher temperatures or **Down** to move the span to lower temperatures.

3. Press the softkey labeled **Done** to set the Imager's range level.

   The scale along the right side of the display indicates the range.

Setting the Temperature Span (Manual)

When put into manual ranging, the span setting adjusts the palette over a temperature range within the total range of the Imager. See Figure 1. To adjust the temperature span:

1. After entering the manual range mode (See the "Setting the Range" section above), press the softkey labeled **Span**.

2. Press the softkey labeled **Increase** to widen the temperature span or **Decrease** to narrow it.

3. Press the softkey labeled **Done** to set the Imager's range level.

Switching Between PIP and Full IR

The Imager can be set to display a full infrared image (Full IR) or an infrared image surrounded by a visual light image (Picture-in-Picture / PIP). To switch the r TiR Imagers between a full infrared display and Picture-In-Picture (PIP) display:

1. Press F2 until IR **Fusion** appears over F3d.

2. Press the softkey labeled **Up** or **Down** to toggle the display between **PIP** and **Full IR**.

3. Press the softkey labeled **Back/Done** when finished.

Reviewing and Deleting Stored Images

To view stored images on the SD card:

1. Press a until **Memory** appears over c.

2. Press the softkey labeled **Memory** to reveal the review menu.

3. Press the softkey labeled **Review**.

4. Press the softkey labeled **Up** to display the previous image or **Down** to display the next stored image.

To delete a single Image from the SD card:

1. Perform the steps under viewing stored images above to bring the desired image to the display.

2. Press the softkey labeled **Select**.

3. Press the softkey labeled **Delete**.

To delete all the images from the SD card:

1. Press a to activate the menu.
2. Press the softkey labeled **Memory**.
3. Press the softkey labeled **All Images**.

Changing the Temperature Units

The Imager will display temperature in Fahrenheit or Celsius. To change the temperature units:

1. Press a until **Units** is displayed over d.

2. Press the softkey labeled **Units**.

3. Press c for Celsius or d for Fahrenheit.

4. Press the softkey labeled **Back/Done** to set the language.

Making Accurate Temperature Measurements

All objects radiate infrared energy. The amount of energy radiated is based on two primary factors: the surface temperature of the object and the emissivity of the object's surface. The Imager detects the infrared energy from an object and uses this information to estimate the temperature of the object. Most of the objects measured such as painted metal, wood, water, skin, and cloth are very efficient at radiating energy and it is easy to get very accurate measurements. For surfaces that are efficient at radiating energy (high emissivity), the emissivity factor is estimated to be 95% (or 0.95). This estimate works for most purposes. This simplification does not work however, on shiny surfaces or unpainted metals. These materials are not efficient at radiating energy and are classified as having low emissivity. To accurately measure materials with a low emissivity, an emissivity correction is necessary. The easiest correction method is to set the Imager to the proper emissivity value so the Imager automatically calculates the correct surface temperature. If the Imager uses a fixed emissivity value (meaning that it is set to one value and the user cannot adjust it), then the Imager's measurement must be multiplied by a value found in a look up table to get a more accurate estimate of the actual temperature.

The TiR1 and Ti25 have the ability to set emissivity by directly entering a value or using a table of built-in values. The TiRx, TiR, Ti9, and Ti10 have emissivity that is permanently fixed at 0.95, which works well for most surfaces but can provide very inaccurate reading if used directly on a shiny metal surface.

A significant amount of information is available on emissivity. Further study of this topic is recommended to get the most accurate temperature measurements using the Imager.

Setting File Format

Data stored on the Imager's SD card can be saved in two different file formats: .bmp and .is2. This setting is saved and remains valid when the Imager is turned off and back on. It can always be changed prior to capturing images.

To change the file format:

1. Press a until **File Format** appears over softkey F3.

2. Press the softkey labeled **File Format**.

3. Press c to set the bitmap (.bmp) file format, or d to set the infrared storage (.is2) file format.

The bitmap format only saves the image shown on the Imager's display. The ".is2" format is a proprietary file format that saves the radiometric data, fusion blend, palette, visual image, screen settings, and voice recording to annotate the stored image.

Bitmap (.bmp) images can be transferred to a PC and used immediately in non-proprietary software and electronic documents. Images in ".is2" format can be transferred to a PC for further analysis and report generation through Fluke SmartView$^{\rightarrow}$ software or non-Fluke software that is available from specially approved software vendors. Visit the Fluke web site or contact Fluke to find out about currently available software options.

SmartView$^{\rightarrow}$ Software

SmartView$^{\rightarrow}$ software is supplied with the thermal imager. This software is specially designed for Fluke imagers and contains powerful functions to analyze images, organize data storage, and create professional reports.

SmartView$^{\rightarrow}$ allows audio annotations to be reviewed on a PC. SmartView$^{\rightarrow}$ can be used to export IR and visible images as JPEG, BMP, GIF, TIFF, WMF, EXIF, or EMF formatted files.

Changing the SD Card

To eject an SD card from the Imager, press in on the exposed edge of the SD card and then release. The card should pop partially out after releasing it. Carefully pull the card out of the slot.

The SD Card can be inserted and removed while the Imager is in operation.

To insert an SD card into the Imager, carefully slip the card into the slot with the card's label facing toward the LCD display. Push the card in until it catches.

Setting the Backlight

The backlight can be set to Auto-sensing or Full-Bright. To set the backlight:

1. Press a until **Backlight** appears over c.
2. Press the softkey labeled **Backlight**.
3. Press the softkey labeled **Auto** or **Full-Bright**.

To extend battery life, Auto-Sensing automatically adjusts backlight brightness based on ambient light levels.

Maintenance

The Imager supplies maintenance-free operation. However, some precautions should be followed to get the best and longest Imager performance.

Cleaning the Imager

Wipe the case with a damp cloth and a mild detergent. Do not use abrasives, isopropyl alcohol, or solvents to clean the case or lens/window.

Battery Care

To get the best performance from the Imager's Nickel-Metal Hydride (NiMH) battery, use the guidelines that follow.

W **Caution**

To avoid damage to the Imager, do not leave the camera exposed to a heat source or high-temperature environments, such as an unattended vehicle in the sun.

- Do not store the Imager on the charger for more than 24 hours as reduced battery life may result.
- Charge the Imager for a 2-hour minimum at least every six months to maximize battery life. Without use, the battery will self-discharge in approximately six months. Batteries stored for long periods may require two to ten charging cycles before it reaches full capacity.
- Always operate the Imager within the temperature range specified in the specifications labeled Temperature – Operating.

~ W **Caution**

Do not incinerate the Imager and/or battery. Go to Fluke's website for recycling information.

General Specifications

Temperature

    Operating.. -10 °C to 50 °C (14 °F to 122 °F)

    Storage... -20 °C to 50 °C (-4 °F to 122 °F)
                                 without batteries

    Charging... 0 °C to 40 °C (32 °F to 104 °F)

Relative Humidity .... 10 to 90 % non-condensing

Display.. 640 x 480 Color LCD, approx. 2" X 3"
                                   (Landscape orientation) with Backlight

Controls and Adjustments   (selectable Bright or Auto)

    User selectable temperature scale (°C/°F)

    Language selection

    Time/Date set

Software ....SmartView® full analysis and reporting
                                   software included

Power

    Battery ....Internal rechargeable battery pack

    Battery Life ....3 to 4 hours continuous use (assumes
                                   50 % brightness of LCD)

    Battery Charge Time ....2 hours full charge with ac adapter or
                                   dc car charger

    AC Operation/Charging ....AC adapter/charger (110 – 220 Vac,
                                   50/60 Hz). Charges battery while
                                   imager is operating. Universal ac
                                   mains adapters included.

    Power Saving ....Sleep Mode activated after 5 minutes
                                   of inactivity
                                   Automatic Power Off after 30 minutes
                                   of inactivity

Vibration ....2 G, IEC 68-2-29

Shock..25 G, IEC 68-2-6

Drop ....2 meter drop, all sides

Size (H x W x L) .... 10 in x 5 in x 6 in (25.4 cm x 12.7 cm x 15.2 cm)

Weight.. 1.1 kg (2.35 lb)

Enclosure Rating IP54

Warranty .... 2 years

Calibration Cycle .... 2 years (assumes normal operation and normal aging)

Detailed Specifications

Temperature Measurements

Temperature Range (not calibrated below -10 °C)…20 °C to +100 °C

    Accuracy ……………………………………………±5 °C or 5 % (whichever is greater)

    Measurement Modes .... Auto-Scaling and Manual Scaling

Imaging Performance

    Field of View .... 23 ° x 17 °

    Spatial Resolution (IFOV) .... 2.5 mRad

    Minimum Focus Distance

        Thermal Lens.. 15 cm (approx. 6 in)

        Visible (Visual) Light Lens .... 46 cm (approx. 18 in)

    Focus .... Manual

    Image Frequency... 9 Hz refresh rate

    Detector Type .... 160 X 120 Focal Plane Array, uncooled microbolometer

    Infrared Lens Type... 20 mm EFL, F/0.8 lens

    Thermal Sensitivity (NETD)………………………..≤0.1 °C at 30 °C (100 mK)

    Infrared Spectral Band....................................... 7.5 µm to 14 µm

    Visual Camera .... 640 x 480 resolution

Image Presentation

    Palettes   …………….............................Ironbow, Blue-Red, High Contrast, Grey

Image and Data Storage

    Storage Medium ....SD Memory Card (2 GB memory card will store at least 1200 fully radiometric (.is2) IR and linked visual images each with 60 seconds voice annotations or 3000 basic (.bmp) IR images)

    File Formats ....Non-Radiometric (.bmp) or Fully-Radiometric (.is2)

                  No analysis software required for Non-Radiometric (.bmp) files

    Export File Formats w/ SmartView[®] Software .....JPEG, JPG, JPE, JFIF, BMP, GIF, DIP, PNG, TIF, and TIFF

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