FLIR MODEL DM285

Imaging Multimeter with IGM™ and Bluetooth®
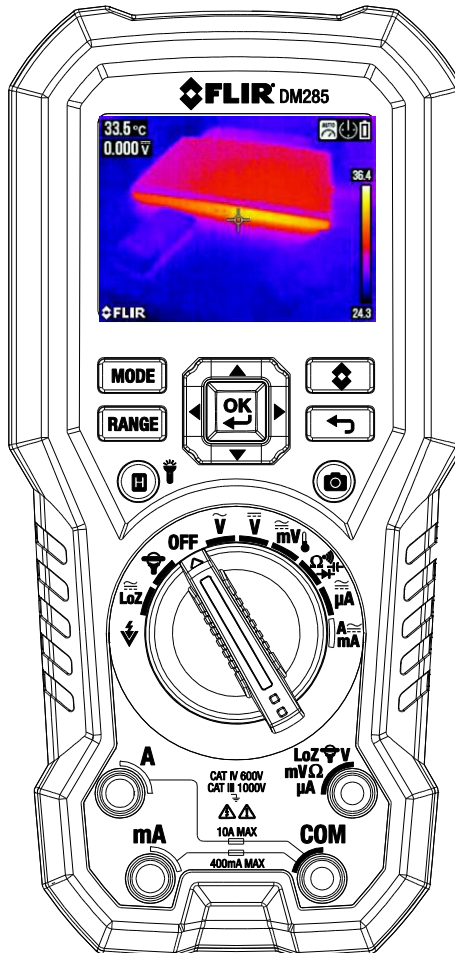
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1. Advisories

1.1 Copyright

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1.2 Quality Assurance

The Quality Management System under which these products are developed and manufactured has been certified in accordance with the ISO 9001 standard.

FLIR Systems is committed to a policy of continuous development; therefore, we reserve the right to make changes and improvements on any of the products without prior notice.

1.3 Documentation

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As with most electronic products, this equipment must be disposed of in an environmentally friendly way, and in accordance with existing regulations for electronic waste.

Please contact your FLIR Systems representative for more details.

# 2. Safety

Safety Notes

- Before operating the device, you must read, understand, and follow all instructions, dangers, warnings, cautions, and notes.
- FLIR Systems reserves the right to discontinue models, parts or accessories, and other items, or to change specifications at any time without prior notice.
- Remove the batteries if the device is not to be used for an extended period of time.

⚠ **Warning Statements**

- Do not operate the device if you do not have the correct knowledge. Incorrect operation of the device can cause damage, shock, injury or death to persons.
- Do not start a measuring procedure before you have set the function switch to the correct position. Failure to do so can cause damage to the instrument and can cause injury to persons.
- Do not change to the resistance mode when measuring voltage. This can cause damage to the instrument and can cause injury to persons.
- Do not measure the current on a circuit when the voltage increases to more than 1000 V. This can cause damage to the instrument and can cause injury to persons.
- You must disconnect the test leads from the circuit under test before you change the range. Failure to observe this warning can damage the instrument and cause bodily injury.
- Do not replace the batteries before you remove the test leads. This can cause damage to the instrument and can cause injury to persons.
- Do not use the device if the test leads and/or the device show signs of damage. Injury to persons can occur.
- Be careful performing measurements if the voltages are > 25 VAC rms or 35 VDC. There is a risk of shock from these voltages. Injury to persons can occur.
- Do not do diode, resistance or continuity tests before you have removed the power from capacitors and other devices under test. Injury to persons can occur.
- Be careful when performing voltage checks on electrical outlets. These checks are difficult because of the uncertainty of the connection to the recessed electrical contacts. You must not rely solely on this device when determining if the terminals are not "live". There is a risk of electrical shock. Injury to person can occur.
- Do not touch expired/damaged batteries without gloves. Injury to persons can occur.
- Do not cause a short circuit of the batteries. This can cause damage to the instrument and can cause injury to persons.
- Do not put the batteries into a fire. Injury to persons can occur.
- Use extreme caution when the laser pointer is on.
- Do not point the beam toward anyone's eye or allow the beam to strike the eye from a reflective surface.
- Do not use the laser near explosive gases or in other potentially explosive areas.
- Refer to the CAUTION statement label (shown below) for critical safety information.
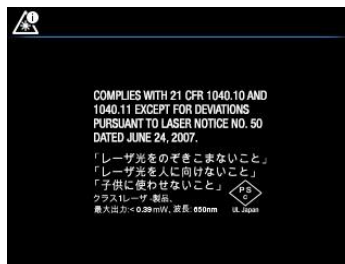
Cautions

Do not use the device in a manner not specified by the manufacturer. This can cause damage to the protection provided.

⚠	This symbol, adjacent to another symbol or terminal, indicates that the user must refer to the user manual for further information.
⚡	This symbol, adjacent to a terminal, indicates that, under normal use, hazardous voltages may be present.
⊡	Double insulation.

c(UL)us
LISTED   UL listing is not an indication or a verification of the accuracy of the meter

3. Introduction

Thank you for selecting the FLIR DM285 True RMS Digital MultiMeter with IGM^{TM} (Infrared Guide Measurement) and Bluetooth®. The DM285 can measure voltage up to 1000V AC/DC and includes Low-Z (low impedance), VFD (low pass filter), and Smart/Classic Diode modes. This device is shipped fully tested and calibrated and, with proper use, will provide years of reliable service.

3.1 Key Features

- 6000 count 2.8" digital TFT display with bargraph

- Built-in IGM^{TM} Infrared imager (120x160 pixel) with laser pointer and crosshair targeting

- Capture fully radiometric thermal images where a temperature measurement is saved for each display pixel

- Bluetooth® connectivity

- Measures Voltage, Current (A, mA, µA), Frequency, Resistance/Continuity, Diode (Classic and Smart modes), Capacitance, and Temperature

- Built-in non-contact voltage detector (NCV)

- Customizable via easy-to-use menu system

- Datalogger stores up to 40,000 readings in 10 sets

- Gallery mode for displaying stored screen shots and data log sets

- Automatic and Manual ranging

- Input over-voltage warning

- MIN-MAX-AVG memory

- PEAK MIN and PEAK MAX for ACA and ACV measurements

- Flex Clamp direct input

- On-screen programming menu navigation

- Variable-frequency drive VFD mode (low-pass filter)

- Low-Z (low impedance) mode

- Relative mode

- Data Hold and Auto Hold

- Auto Power OFF

- Safety Category Rating: CAT IV-600V, CAT III-1000V.

- Equipped with batteries, test leads, alligator clips, test lead storage/holder attachment, Type-K thermocouple, and Quick Start booklet.

4. Meter Description and Reference Guide

4.1 Front and Back Meter Descriptions

Fig. 4-1 Front View

1. Work Light and NCV detector area

2. LCD Display

3. Navigation/OK Buttons

4. MODE Button

5. RANGE Button

6. Data Hold/Work Light Button

7. Rotary Function Switch

8. Positive (+) Probe Input Jack for **A** (Current)

9. Positive (+) Probe Input Jack for **mA** (Current)

10. COM (-) Probe Input Jack

11. Positive (+) Probe Input Jack for all inputs except **A** and **mA**

12. Display Save Button

13. Cancel/Return Button

14. IGM^{TM} Button

15. Test Lead holder attachment mounts

16. Thermal Imaging lens

17. Tripod mount (test lead holder attaches here also)

18. Tilt Stand/Battery compartment

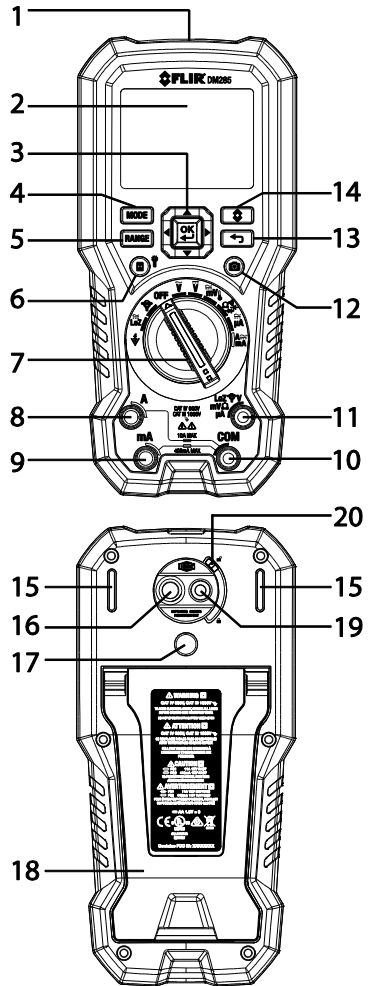19. Laser pointer lens

20. Lens cover slide control

Fig. 4-2 Rear View

4.2 Function Switch Positions

⚡▽ (non-contact symbol)	Detect AC voltage through the non-contact sensor at the top of the meter
≅ LoZ	Measure voltage through the probe inputs with a low-impedance load positioned across the inputs that stabilizes the measurement.
OFF	Meter is switched OFF and in full power-saving mode.
(clamp symbol)	FLEX Direct: Auxiliary channel for use with optional Flexible Current clamp or standard clamp adaptors when > 600A measurements are required. In this mode, the meter will display true rms ACA measurements from the connected device. Frequency (Hz) can be displayed by pressing the MODE button.
$\widetilde{\mathbf{V}}$	Measure AC voltage (V) through the probe inputs.
$\overline{\overline{\mathbf{V}}}$	Measure DC voltage (V) through the probe inputs.
≅ mV	Measure low voltage (mV) through the probe inputs. Use the MODE button to select AC/DC voltage.
(thermometer symbol)	Measure temperature through the probe inputs using a thermocouple adaptor. Use the MODE button to select Temperature (see Section 6.2.2, Thermal Settings Menu, to select °C or °F unit of measure).
Ω•))✦⊣⊢	Measure resistance, continuity, capacitance, or diode through the probe inputs. Use the MODE button to select the desired function.
≅ µA	Measure µA current through the probe inputs. Use the MODE button to select AC or DC.
A≅ mA	Measure current through the probe inputs (A or mA). Use the MODE button to select AC or DC.

Fig. 4-3 Function Switch
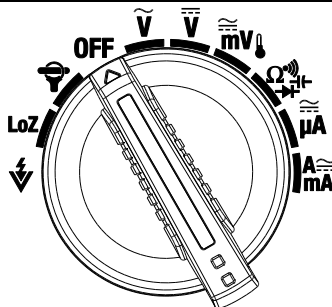
4.3 Function Buttons and Navigation Pad

MODE	Use to select a sub-function of the primary function. See Section 4.3.1, *MODE Button Operation*, for details
RANGE	From Auto range mode, short press to select Manual range mode. From Manual range mode, short press to change the range (scale). Long press to return to the Auto range mode
◆	Short press to open/close the Thermal Imager with IGM™ (Infrared Guided Measurement)
(OK arrow keypad)	OK button with arrow keypad allows you to confirm settings, navigate the menu system, and otherwise control the DM285 features and functions
↰	Press to exit modes or return from a menu screen (no function in normal mode)
H 🔦	Short press to enter the Hold mode (display hold or auto hold as selected in the General Settings Menu (see Section 6.2.5, *General Settings Menu* and Section 7, *General Settings*). Long press to enable/disable the work light
📷	Display Save button. Short press to capture a fully radiometric thermal image or DMM screenshot. Images are saved to the device's file system accessible in Gallery mode. The thermal imager must be fully initialized (indicated by display of IR temperature measurement) before radiometric data can be captured

4.3.1 MODE Button Operation

Rotary Switch Position and Description		Sequence of operations
⚡	Non-contact voltage detector	No operation
LoZ	Low impedance	ACV > DCV > Frequency
🔦	Clamp adaptor	ACA < > Frequency
$\widetilde{\mathbf{V}}$	AC Voltage	ACV < > Frequency
$\overline{\overline{\mathbf{V}}}$	DC Voltage	No operation
mV 🌡	Milli-volts / Temperature	ACmV > DCmV > Frequency > ºC/ºF
Ω))) ⊣⊢	Resistance/Continuity/Capacitance/Diode	Resistance > Continuity > Capacitance > Diode
µA	AC/DC micro-amperes	ACµA < > DCµA
A mA	AC/DC amps or milli-amps	ACA > DCA > Frequency ACmA > DCmA > Frequency

4.3.2 OK Button/Navigation Pad Operation

There are five (5) buttons arranged in a square that make up the Navigation pad, as shown in Figure 4-4.

Fig. 4-4 Navigation Pad

OK button (center) Access the main menu and select/change menu options

LEFT/RIGHT buttons: Navigate the menu system

UP/DOWN buttons: Navigate the menu system

4.4 Status Bar Display Icons

The Status Bar is located at the top of the display.

Fig. 4-5 Status Bar Display Icons

- L to R, row 1: Flex clamp icon/range, Laser, Relative, Continuity, Diode, VFD, LoZ, Work light, Bluetooth®, APO, Battery status
- L to R, row 2: Datalogger, Data Hold, Auto Hold, Auto Range.
- Additional display symbols are shown in the next section.

4.5 Other Display Icons

⚠	Sensed voltage is > 30 V (AC or DC)
	Left: Non-contact Voltage detector icon (high sensitivity 80~1000V range) Right: Non-contact Voltage detector icon (low sensitivity 160~1000V range)
	Non-contact Voltage detector display alert when voltage is detected
↑ ↓ ↕	MAX (maximum), MIN (minimum), AVG (average) reading value displayed
↑ ↓	PEAK MAX and PEAK MIN value displayed
0000	Primary display (large digits)
0000	Secondary display (smaller digits)
ε	Emissivity setting
∼	AC current or voltage
▬	DC current or voltage
∣∣∣∣∣∣∣∣∣∣	Bar Graph Measurement Indicator
▶	Bar Graph OL (overload) Indicator

5. Meter Power

5.1 Powering the Meter

1. Set the function switch to any position to switch on the meter.

2. If the battery indicator 🔋 shows that the battery voltage is low, if one of the Low Battery screens appears (Fig. 5-1), or if the meter does not power on, replace the three (3) 'AA' batteries. See Section 13.2, *Battery Replacement*. If using the Model TA04 charging system, please recharge the rechargeable battery.
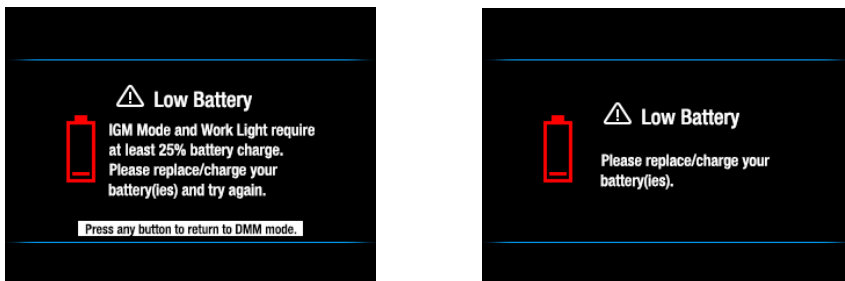
FIG. 5-1 Low Battery Alerts

5.2 Auto Power OFF (APO)

The meter enters sleep mode after a programmable period of inactivity, to customize this setting please see Section 7.1.2, *APO (Auto Power OFF)*. The default time-out is 10 minutes. The time can be set to 1, 2, 5, or 10 minutes (select OFF to disable the APO). Twenty (20) seconds prior to entering APO mode, the meter beeps; at this point, press any button or turn the Rotary Switch to reset the APO timer.

5.3 Battery Type Selection

The user must enter the battery type (Lithium or Alkaline) in the General Settings menu before use. This allows the meter to display battery status as accurately as possible. Refer to Section 7.1.10, *Battery Selection*.

6. Menu System

6.1 Using the Menu System

- Press **OK** to open the main menu, shown below:

Fig. 6-1 Main Menu

- Use the **Navigation Pad** left/right arrows to highlight an icon. From left to right the icons are *Image Mode, Imager Settings, Gallery (for viewing thermal images and data logs), Advanced Menu, and General Settings.*
- Press **OK** to open a menu or to set an option ON or OFF. When an option is ON a blue dot will appear next its icon. In some cases, use the navigation arrows to select an option.
- Use the Return ⏎ button to exit menu levels and to return to the normal display mode.
- The mode of the meter dictates what icons are available for use.

6.2 Main Menu Options

6.2.1 Image Mode Menu

This Image mode icon ▣ is only available in the thermal imaging mode. The Image mode has two options:

▣ **Image + DMM** mode (default): Display will show DMM data on the thermal images while in the thermal imaging mode.

▢ **Image-only** mode: Display shows thermal images only in the thermal imaging mode.

Press **OK** on the Image mode icon to open the menu and use the arrow buttons to select the desired option.

6.2.2 Thermal Settings Menu

Press **OK** at the Thermal Settings icon ⵌ to access the following options: *Color Palette, Emissivity, Laser pointer ON/OFF, and Cross hairs ON/OFF* shown top to bottom in **Fig. 6-2** below. Refer to Section 8.3, *Thermal Settings Menu (Color Palette, Emissivity, Laser Pointer, and Crosshairs)* for detailed information.
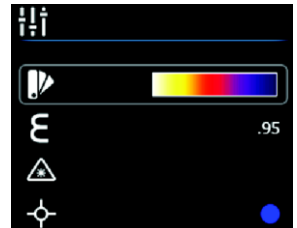
Fig. 6-2 Thermal Settings Menu

6.2.3 Gallery Mode

In Gallery ▶ mode, view stored thermal images and logged readings.

- Press **OK** at the Gallery ▶ icon. The display will show rows of stored thermal images (100 max.)on the lower area of the display and data logs (up to 10 sets with 40,000 readings max.) on the upper area.
- Use the up/down arrows to step between image and reading log areas.
- Use the left/right arrows to scroll through data logs or images.
- Press **OK** to open a reading log or a thermal image.
- Press **OK** again on a thermal image to bring up icons that will permit you to delete the image, transmit the images via Bluetooth®, and to resize the image to full screen.
- Press **OK** again on a data log set to bring up icons that will permit you to delete the log or to transmit the log via Bluetooth®.
- For More detailed information, see Section 7.1.11, *Delete all Datalogger Readings*, Section 7.1.12, *Delete all Stored Thermal Images*, Section 8.5, *Thermal Image Capture*, and Section 10, *Datalogger*

6.2.4 Advanced Functions Menu

Press **OK** at the Advanced Functions menu icon ⋮≣ to access the functions listed below. Highlight a function using the arrow buttons and then press **OK** to activate it. Refer to the dedicated section for each as listed below for detailed information:

- VFIP VFD (low pass filter), see Section 9.7, *VFD (Low Pass Filter)*
- ✛ MAX-MIN-AVG Readings, see Section 9.8, *MAX-MIN-AVG mode*
- (**P**) Peak mode, see Section 9.9, *Peak mode*
- △ Relative mode, see Section 9.10, *Relative mode*
- Datalogger, see Section 10, *Datalogger*

6.2.5 General Settings Menu

1. Press **OK** to open the main menu.
2. Press **OK** at the Settings icon ✿ to access the options.
3. See next section for detailed information on the General Settings mode.

7. General Settings

7.1 General Settings Navigation

Under General Settings, the user can customize a variety of features.
1. Press **OK** to open the Main Menu
2. Scroll to the Settings ⚙ icon and press **OK** to open the Settings menu (see Fig. 7-1)
3. Press **OK** on a menu item and customize the item per the sections below
4. Use the ⬑ button to exit screens and to return to the normal mode
5. A blue dot next to an option indicates that an option is ON

Fig. 7-1 General Settings Menu

7.1.1 Diode SMART/CLASSIC

✈ Press **OK** to toggle SMART/CLASSIC diode modes. see Section 9.15, *Classic Diode*, and Section 9.16, *Smart Diode*. Use the **OK** button to choose the desired setting.

7.1.2 APO (Auto Power OFF)

⏻ Press **OK** to open the sub-menu. Scroll to OFF, 1, 2, 5, or 10 minutes for the Auto Power OFF timer and press OK to select. Press ⬑ to exit the menu.

7.1.3 Temperature units select ºC/ºF

🌡 Press **OK** to toggle the temperature units ºC and ºF.

7.1.4 Datalogger Sample Rate

📊 Press **OK** to access the selector. Use the arrow buttons to select the desired datalogger sampling rate from 1 ~ 99 seconds. Press **OK** to confirm.

7.1.5 Real-time Clock

🕐 Press **OK** to open the date/time setting screen. Use the arrow buttons to scroll through the date and time fields and to select the current date and time. Press **OK** to confirm.

7.1.6 Auto Hold / Data Hold

AUTO H Auto hold: Use the **OK** button to toggle ON (blue dot) and OFF. For more information, see Section 9.5, *Data Hold and Auto Hold*.

7.1.7 Coarse Resolution

Coarse Resolution (*C.r.* ON/OFF) allows the user to reduce the resolution to remove distracting, quickly changing least significant digits. Use the **OK** button to toggle ON (blue dot) and OFF. This function is for Voltage function only. The range and resolution for the Voltage function will be adjusted as follows when Coarse Resolution is enabled:

- o 600.0mV → 600mV
- o 6.000V → 6.00V
- o 60.00V → 60.0V
- o 600.0V → 600V
- o 1000V → 1000V
- o Default: OFF

7.1.8 Bluetooth® ON/OFF

Press **OK** to toggle Bluetooth® ON/OFF (default is ON). See Section 11, *Bluetooth®*

7.1.9 Button-press tone ON/OFF

Press **OK** to toggle the button-press tone ON/OFF

7.1.10 Battery type selection

Press **OK** to select Alkaline or Lithium AA batteries in use.

7.1.11 Language selection

Press **OK** to open the menu. Scroll to the desired language and press **OK**. Press ⬅ to exit

7.1.12 Delete all Datalogger readings

Press **OK** to delete all datalogger records. The meter will ask for confirmation.

7.1.13 Delete all Stored Thermal Images

Press **OK** to delete all saved thermal images. The meter will ask for confirmation.

7.1.14 View HELP Screen

Press OK to view FLIR support contact information.

7.1.15 Viewing meter component information

Press **OK** to view meter component firmware version information and Laser data:

Meter firmware version

Lepton® camera interface firmware version

Bluetooth® firmware version

Laser data

8. Thermal Imaging

8.1 Thermal Imager Basics

In the Thermal Imaging mode, the user can measure a targeted surface's temperature by detecting the energy emitted by the surface under test. Color variations reflect temperature variations. See Section 12.3, *Infrared Energy and Thermal Imaging Overview* for in-depth information. The laser pointer and display cross hairs assist in targeting.

Press the IGM button to open the Thermal Imager. In **Fig 8-1** the meter is set to color palette IRON. Select other palettes in the Thermal Settings Menu (refer to Section 8.3, *Thermal Settings Menu*).

Fig. 8-1 Thermal Image Example
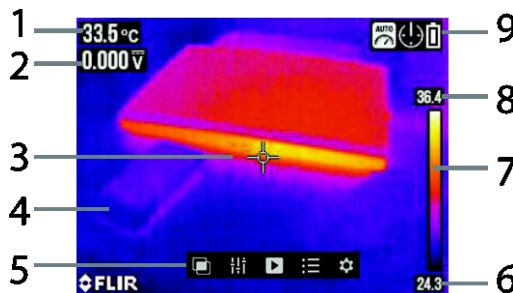
1. **IR Temperature measurement** represents the temperature of the spot sensed. Note that while the imager initializes, dashes will display.
2. MultiMeter **Measurement**
3. **Cross hairs** for targeting spots
4. **Thermal image** (120 x 160 pixels)
5. **Main Menu** (Press OK to open this menu)
6. **Lowest reading** measured in the current frame
7. **Thermal scale** shows the range of colors for the thermal image. The lighter the color, the warmer the temperature; the darker the color, the cooler the temperature.
8. **Highest reading** measured in the current frame.
9. **Status Icon Bar** (see Section 4.4, *Status Bar Display Icons* for definitions)

8.2 Thermal Imager Operation

To customize the Thermal Imager, refer to Section 8.3, *Thermal Settings Menu*. For basic operation, follow these steps:

1. Set the function switch to any position.

2. Press the **IGM** button ⬦ to switch the Thermal Imager ON. Point the thermal imaging lens (back of meter) toward an area to test.

3. The display will show the temperature in the upper left hand corner of the targeted area.

4. In the Thermal Imaging mode, use the laser pointer and display cross hairs for targeting. These can be switched ON or OFF in the Thermal Settings Menu.

5. In the Thermal Imaging mode, the meter continues to operate normally as a MultiMeter. In the Thermal Imaging mode, view electrical measurements and functions on the left side of the display. If desired, the meter can be set to image-only mode in the Image Mode menu, see Section 8.4, *Image Mode Menu*.

6. The Distance to Spot ratio for the imager is 30:1 meaning that the measurement spot is 30 times smaller than the distance from meter to spot (at a distance of 30", the meter 'sees' a target spot of 1"). **See Fig. 8-2.**

7. The thermal imager's resolution is 120 x 160 pixels and its FOV (Field of View) is 50 degrees (top view) by 38.6 degrees (side view) see **Fig. 8-3 (a) and (b).**
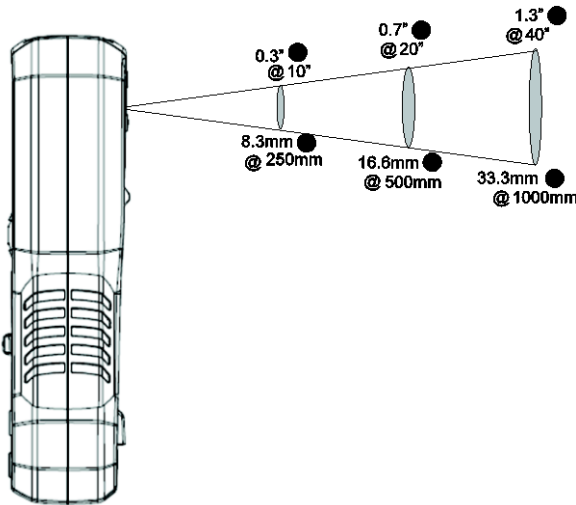
Fig. 8-2 Distance-to-Spot ratio 30:1
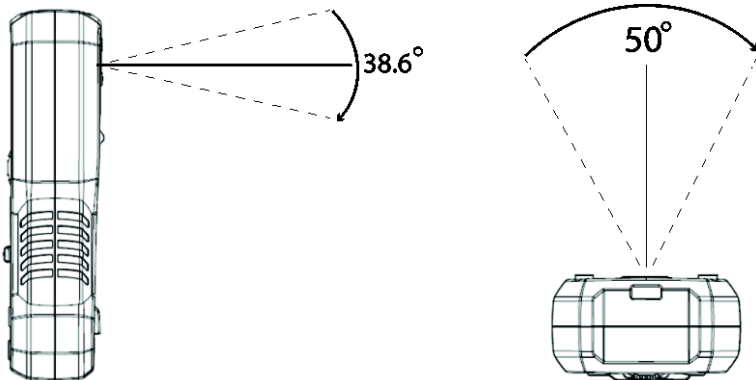
Fig. 8-3 (a) Field of View – side view   **Fig. 8-3 (b)** Field of View - top view

8.3 Thermal Settings Menu (Color Palette, Emissivity, Laser Pointer, Crosshairs)

1. Press **OK** to open the main menu
2. Scroll to the Thermal Settings ⚙ icon and press **OK**
3. Refer to the Thermal Settings screenshot and details below
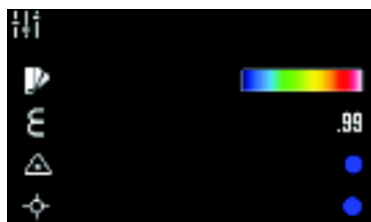
Fig. 8.4 Thermal Settings Menu

Icon	Description	Use
🎨	Color Palette	Press **OK** to step through the display color palettes (Iron, Rainbow, or Gray).
Ɛ	Emissivity	Press **OK** and then use up/down arrows to scroll to a preset (0.95, 0.85, 0.75, or 0.65) or to the fine-tuning icon Ɛ. To fine tune, press **OK** at the fine-tuning icon and use the arrow buttons to set the value, press **OK** to confirm. The range is 0.10 to 0.99 in 0.01 steps.
🔺	Laser pointer	Press **OK** to toggle the laser pointer ON (blue circle) or OFF
✛	Cross hairs	Press **OK** to switch the cross hairs ON or OFF

8.4 Image Mode Menu

The Image Mode menu 🖵 allows you to select:

Image + DMM mode 🖵 where you can view DMM data superimposed on the thermal images or:

Image-only mode 🖵 where DMM measurements are removed from the thermal images

8.5 Thermal Image Capture

Short press the Display Save button 📷 to store a displayed thermal image (or DMM screen) to the meter's internal memory. Up to 100 images can be stored. Saved thermal images are fully radiometric (each pixel includes temperature measurement data). Note that the imager must be fully initialized (indicated by display of IR temperature measurement instead of dashes) before radiometric data can be captured. To view radiometric data within captured thermal images, copy the images to a PC and view using *FLIR Tools*.

To view stored images:
1. Press **OK** to open the Main Menu
2. Press **OK** at the Gallery ▶ icon
3. Use the left/right arrow buttons to scroll through the images (note that the datalogging records are located here also, on the upper display area)
4. Press **OK** to open a selected image
5. Press **OK** to open a menu permitting recycling of image, full-screen sizing, and transmission of image via Bluetooth®
6. Use the RETURN 🔄 button to exit screens and to return to the normal operating mode

8.6 Thermal Image Freeze (Data Hold)

In Data Hold mode, the displayed reading or thermal image is frozen. To enter/exit Data Hold mode, press the **H** (hold) button. In Hold mode, the 🅗 indicator appears.

8.7 Using the Multimeter in the IGM™ mode

The Multimeter can be used as described in <u>Section 9, *Multimeter Operation*</u> while the IGM™ mode is active. Multimeter readings, status bar icons, and operational modes such as PEAK, RELATIVE, and MIN-MAX-AVG can be viewed directly on top of the thermal image when **IMAGE + DMM** mode is selected in the Image Mode menu (see <u>Section 6.2.1, *Image Mode Menu*</u>).

9. MultiMeter Operation

> **Caution**: Before operating the device, you must read, understand, and follow all instructions, dangers, warnings, cautions, and notes.
> **Caution**: When the meter is not in use, the function switch should be set to the OFF position.
> **Caution**: When connecting the probe leads to the device under test, connect the COM (negative) lead before connecting the positive lead. When removing the probe leads, remove the positive lead before removing the COM (negative) lead.

9.1 Auto/Manual Range Mode

In Auto range mode, the meter automatically selects the most appropriate measurement scale. In Manual range mode, the desired range (scale) can be adjusted by the user.

Auto range mode is the default mode of operation. When a new function is selected with the function switch, the starting mode is Auto range and the 🔲 indicator is displayed.

1. To enter Manual range mode, short press the RANGE button. To change the range, press the RANGE button repeatedly until the desired range is displayed.
2. To return to the Auto range mode, long press the RANGE button until the Auto Range 🔲 indicator is again displayed.

9.2 Probe Connection Alert

For voltage or current measurements (except µA), with the tests leads incorrectly connected to the meter (or not connected at all), one of the error displays shown below will appear:
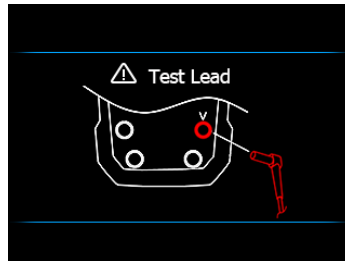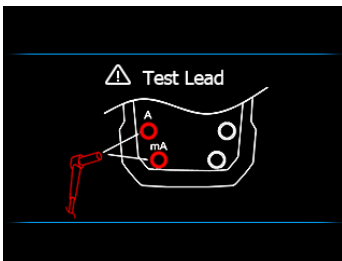
9.3 Test Lead Holder Accessory

If desired, connect the supplied Test Lead Holder to the rear of the meter. The Test Lead Holder connects to the back of the meter (to items 1 and 5 as shown in Fig. 4-2 in Section 4, *Meter Description and Reference Guide*)**.**

9.4 Out of Range Warning (OL)

If the input is over/under the full-scale range in Manual range mode, or if the signal has exceeded the maximum/minimum input in Auto range mode, 'OL' is displayed.

9.5 Data Hold and Auto Hold

The meter has two HOLD modes: classic Data Hold and Auto Hold. To select Data Hold or Auto Hold as the default, please use the General Settings menu (see Section 6.2.5, *General Settings Menu* and Section 7, *General Settings)*. Refer to the paragraphs below for instructions on using the Hold modes.

9.5.1 Data Hold Mode

In Data Hold mode, the primary meter display freezes the last reading. To enter/exit Data Hold mode, short press the ▯ (hold) button. In Hold mode, the ▯ indicator appears.

9.5.2 Auto Hold Mode

In Auto hold mode, the secondary display freezes the last reading and the ▯ icon appears. The real-time reading appears on the primary display.

The held reading will not change unless the difference between the held reading and any new reading is > 50 digits.

The Auto hold function will capture a reading if the reading is > 1% full scale (trigger level) for Voltage, Current, and Capacitance. For Resistance, Diode, and Temperature the trigger is active as long as OL (over range).

To enter/exit Auto hold mode, short press the ▯ (hold) button.

9.6 Status Bar and Menu Icons

The Status Bar is located at the top of the display.
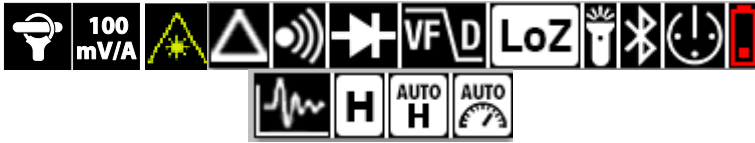
- L to R, row 1: Flex clamp icon/range, Laser, Relative, Continuity, Diode, VFD, LoZ, Work light, Bluetooth®, APO, Battery status
- L to R, row 2: Datalogger, Data Hold, Auto Hold, Auto Range.

There are 5 main options in the Menu bar. See Section 6, *Menu System*.

- o Image Mode (available in IGM^{TM} mode only)
- o Thermal Settings (available in IGM^{TM} mode only)
- o Gallery Mode (view stored screenshots and data logs)
- o Advanced Features Menu
- o General Settings
- Use the Left / Right buttons to move the cursor.
- Press the **OK** button to select an option.
- Up / Down buttons are not used for Menu bar operation.
- If an option is disabled (grayed) it is not available for the currently active mode.

9.7 VFD (Low Pass Filter)

VFD eliminates high-frequency noise from AC current/voltage measurements using a low-pass filter. Access VFD through the Advanced Menu; see Section 6.2.4, *Advanced Functions menu*.
1. Press **OK** at the VFD icon ; the blue dot next to the icon and the VFD display icon will appear
2. De-select the VFD mode by pressing **OK** again at the VFD icon.

9.8 MAX-MIN-AVG mode

Access MAX-MIN-AVG mode ⬦ through the Advanced Menu; see <u>Section 6.2.4,</u> <u>*Advanced Functions menu*</u>. Press **OK** on this icon to begin recording and viewing the highest, lowest, and average readings.

1. A blue dot appears next to the icon when you select this mode.
2. The highest reading will be shown next to the MAX icon ⬆
3. The lowest reading will be shown next to the MIN icon ⬇
4. The average reading will be shown next to the AVG icon ⬍
5. Press OK at this icon ⬦ in the Advanced Menu to exit this mode.

9.9 Peak Mode (AC Current and Voltage Measurements only)

Access Peak mode (**P**) through the Advanced Menu; see <u>Section 6.2.4, *Advanced*</u> <u>*Functions menu*</u>. In Peak mode, the meter captures and displays the positive and negative ACA or ACV peak values. The Peak display values change only when higher/lower values are registered.

1. Press **OK** to show the Peak Max ⬆ and Peak Min ⬇ readings on the display.
2. Press **OK** to switch this mode OFF.

9.10 Relative mode

Access Relative mode (△) through the Advanced Menu; see <u>Section 6.2.4, *Advanced*</u> <u>*Functions menu*</u>. Press **OK** on this icon to capture a reference reading which to compare subsequent measurements.

1. A blue dot appears next to the icon when you select this mode.
2. The reference value will be displayed next to the Relative icon.
3. The primary display will show the difference between the measured value and the stored reference.
4. Press **OK** at this icon to switch the Relative mode OFF.

9.11 Voltage and Frequency Measurements

1. Set the function switch to one of the following positions:
   - $\overline{\overline{\mathbf{V}}}$ (VDC) or $\widetilde{\mathbf{V}}$ (VAC) for high voltage measurements.
   - $\overset{\approx}{\mathbf{mV}}$ (milli-volts) for low voltage measurements (use MODE to select AC or DC).
   - $\overset{\approx}{\mathbf{LoZ}}$ for voltage measurements using the meter's low input impedance mode. The **LoZ** indicator will be displayed (use MODE to select AC or DC).
2. Insert the black probe lead into the negative COM terminal and the red probe lead into the positive terminal.
3. For **mV** and **LoZ** measurements use the $\boxed{\text{MODE}}$ button to select AC or DC measurement:
   - The $\sim$ indicator will be displayed for AC measurements.
   - The $\overline{\overline{}}$ indicator will be displayed for DC measurements.
4. Connect the probe leads in parallel to the part under test.
5. Read the voltage value on the display.
6. The Frequency (Hz) of the measured voltage is shown on the smaller, secondary display digits above the primary voltage reading. Press the $\boxed{\text{MODE}}$ button to view only the Frequency reading.
7. Refer to Section 6.2.4, *Advanced Functions Menu*, for details on VFD, MIN-MAX-AVG, Peak, and Relative modes of operation.
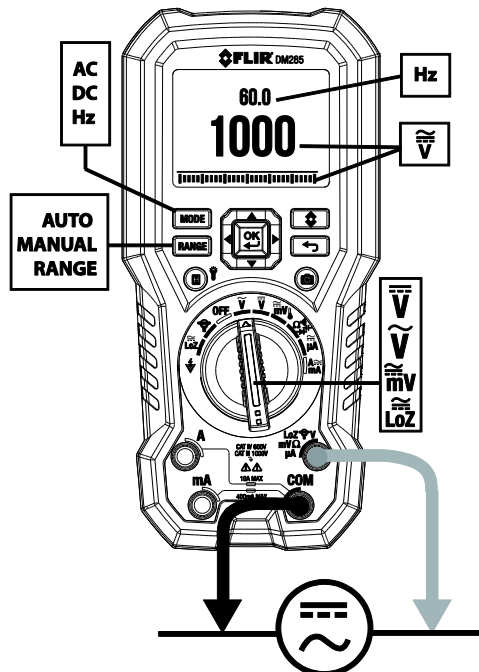
Fig. 9-1 Voltage and Frequency Measurements

9.12 Non-Contact Voltage Detector

1. Set the function switch to the NCV ⚡ position. See **Fig. 9-2**.
2. Be sure to remove the test leads from the meter when doing NCV tests.
3. Use the RANGE button to choose High (80~1000V) or Low (160~1000V) Sensitivity range (see the sensitivity icons in **Fig. 9-2**).
4. Position the top of the meter close to a source of voltage or electromagnetic field.
5. When the meter detects a voltage or electromagnetic field it emits a continuous tone and the displayed NCV icon will turn red in color and blink.
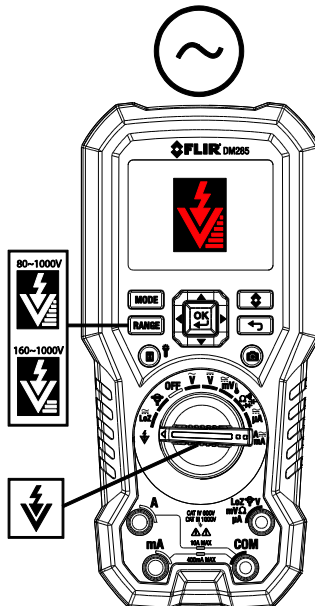
Fig. 9-2 Non-Contact Voltage Detector

9.13 Resistance Measurements

Warning: Do not perform diode, resistance or continuity tests before removing power from capacitors and other devices under test during a measurement. Injury to persons can occur.

1. Refer to **Fig. 9-3**. Set the function switch to the $\Omega_{\rightarrow\vdash}^{\cdot))}$ position.
2. Use MODE to step to the Ω display if necessary.
3. Insert the black probe lead into the negative COM terminal and the red probe lead into the positive Ω terminal.
4. Touch the tips of the probe across the circuit or component under test.
5. Read the resistance value on the display.
6. Refer to Section 6.2.4, *Advanced Functions Menu*, for details on MIN-MAX-AVG and Relative modes of operation.
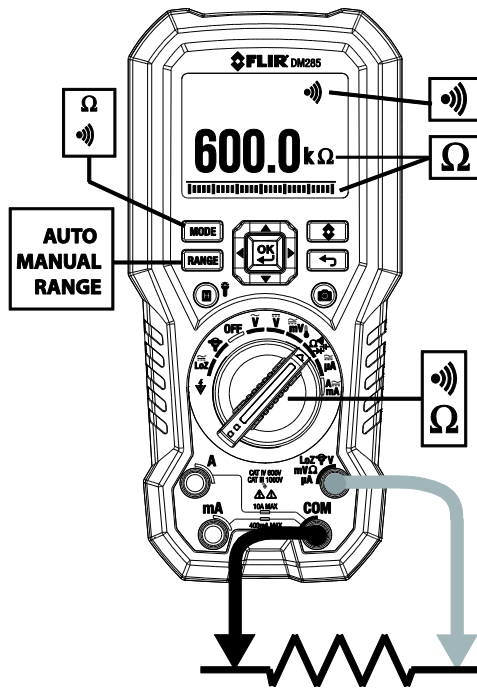
Fig. 9-3 Resistance and Continuity Measurements

9.14 Continuity Test

Warning: Do not perform diode, resistance or continuity tests before removing the power from capacitors and other devices under test during a measurement. Injury to persons can occur.

1. Refer to **Fig. 9-3**. Set the function switch to the Ω position.
2. Use the $\boxed{\text{MODE}}$ button to select continuity. The •)) indicator will be displayed.
3. Insert the black probe lead into the negative COM terminal and the red probe lead into the positive terminal.
4. Touch the tips of the probe across the circuit or component under test.
5. If the resistance is < 20Ω the meter beeps. If the resistance is > 200Ω the meter will not beep. > 20Ω but < 200Ω the beeping will stop at an unspecified point.

9.15 Classic Diode Test

Warning: Do not perform diode tests before removing the power to the diode or other devices under test during a measurement. Injury to persons can occur.

1. If not already selected, choose CLASSIC Diode test mode in the General Settings menu (see Section 6.2.5, *General Settings Menu* and Section 7, *General Settings*).
2. Set the function switch to the diode $\Omega_{\text{))}}^{\text{))}}$ position. Use the MODE button to select the diode test function. The diode indicator ➤⊢ will be displayed.
3. Insert the black probe lead into the negative COM terminal and the red probe lead into the positive terminal.
4. Touch the tips of the probe across the diode or semiconductor junction under test in one polarity (direction) and then in the opposite polarity as shown in **Fig. 9-4**.
5. If the reading is between 0.400 and 0.800V in one direction and OL (overload) in the opposite direction, the component is good. If the measurement is 0V in both directions (shorted) or OL in both directions (open), the component is bad.
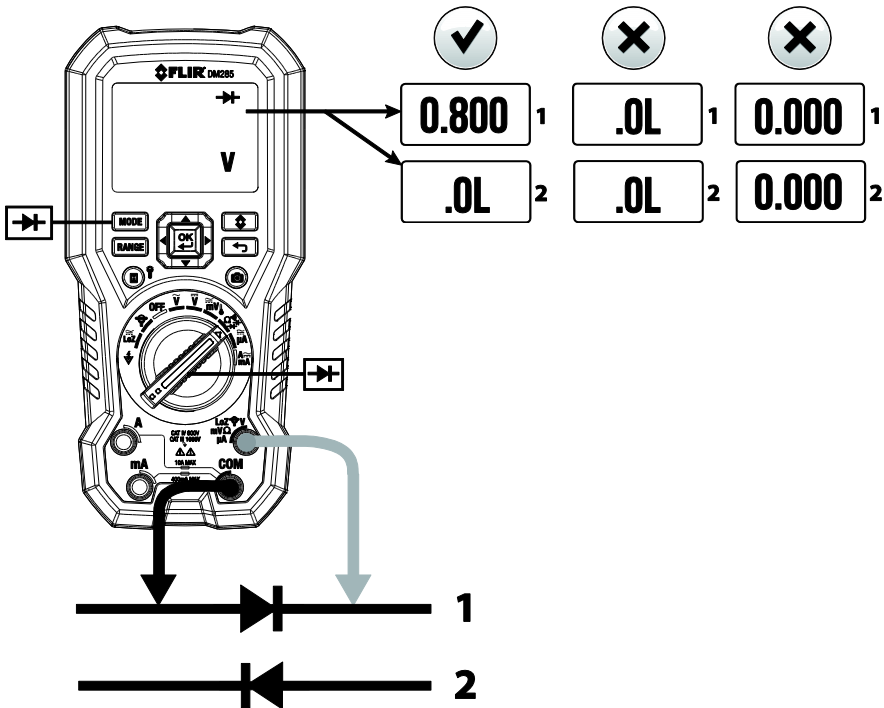
Fig. 9-4 Classic Diode Test

9.16 Smart Diode Test

Warning: Do not perform diode tests before removing the power from capacitors and other devices under test during a measurement. Injury to persons can occur.

1. If not already selected, choose SMART Diode test mode in the General Settings menu (see Section 6.2.5, *General Settings Menu* and Section 7, *General Settings*).
2. Set the function switch to the diode $\Omega_{\overset{\text{)))}}{\overset{\longrightarrow}{\longmapsto}}}$ position. Use the MODE button to select the diode test function. The diode indicator ➤⊢ will be displayed.
3. Insert the black probe lead into the negative COM terminal and the red probe lead into the positive Ω terminal.
4. Touch the tips of the probe across the diode or semiconductor junction under test.
5. If the reading is between ± 0.400 ~ 0.800V, the component is good; BAD or O.L displays indicate a defective component.

NOTES: In SMART Diode mode the meter checks diodes using an alternating test signal sent through the diode in both directions. This allows the user to check the diode without having to reverse polarity manually. The meter display will show ± 0.400 ~ 0.800V for a good diode, 'BAD' for a shorted diode, and 'O.L' for an opened diode. See **Fig. 9-5** below:

Fig. 9-5 SMART Diode Test
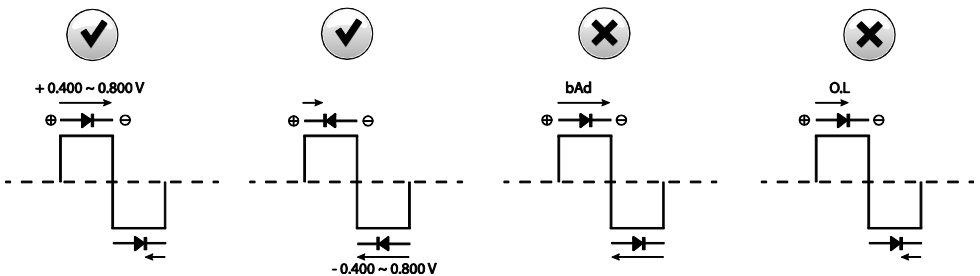
9.17 Capacitance Measurements

Warning: Do not perform capacitance tests before removing power to the capacitor or other devices under test during a measurement. Injury to persons can occur.

1. Set the function switch to the $\Omega^{\text{))}}_{\rightarrow}$ position.
2. Use the MODE button to select the capacitance measurement. The F (Farad) unit of measure will be displayed.
3. Insert the black probe lead into the negative COM terminal and the red probe lead into the positive terminal.
4. Touch the tips of the probe across the part under test.
5. Read the capacitance value on the display.
6. Refer to Section 6.2.4, *Advanced Functions Menu*, for details on MIN-MAX-AVG and Relative modes of operation.

Note: For very large capacitance values, it may take several minutes for the measurement to settle and the final reading to stabilize.
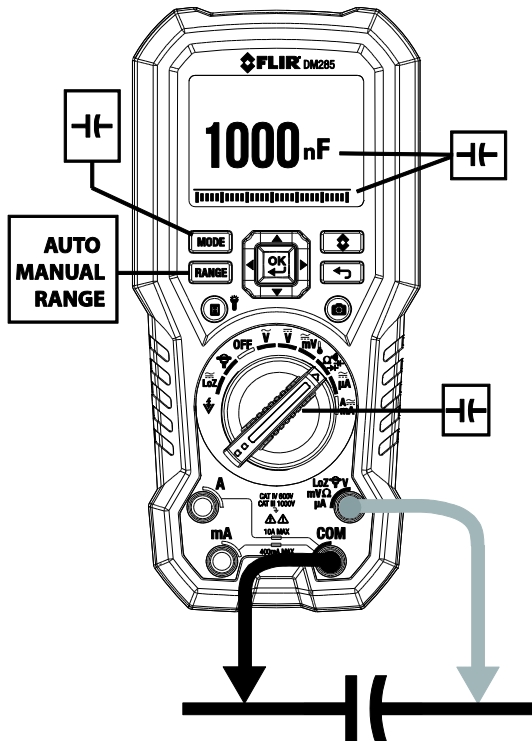
Fig. 9-6 Capacitance Measurements

9.18 Type K Temperature Measurements

1. Set the function to the Temperature 🌡 position.
2. Use the MODE button to select temperature measurement. The °F or °C unit will be displayed. To change from F to C or from C to F, please use the General Settings menu (see Section 6.2.5, *General Settings Menu* and Section 7, *General Settings*).
3. While observing the polarity, insert the thermocouple adapter into the negative COM terminal and the positive terminal.
4. Touch the tip of the thermocouple to the part under test. Keep the thermocouple tip on the part until the reading stabilizes.
5. Read the temperature value on the display.
6. To avoid electrical shock, disconnect the thermocouple adapter before turning the function switch to another position.
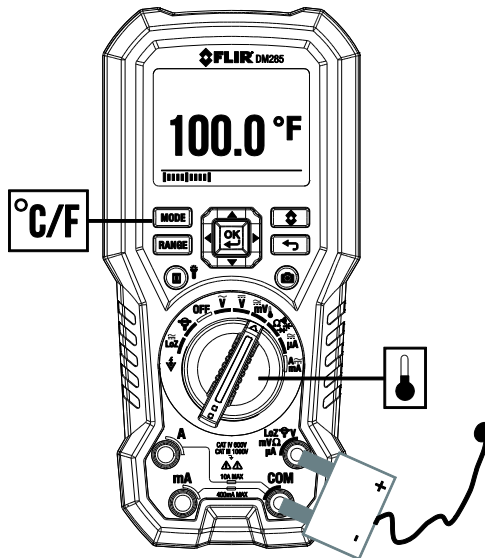
Fig. 9-7 Temperature Measurements

9.19 Current and Frequency Measurements (A, mA, μA)

For test lead current measurements, disconnect the part under test and connect the test leads in series with the part, see **Fig. 9-8**.

Fig. 9-8 Disconnected component

9.19.1 Test Lead Current Measurements (A, mA, and μA)

1. For test lead measurements (A, mA, and μA), set the function switch to the $\overset{A\approx}{mA}$ or $\overset{\approx}{\mu A}$ position.
2. Insert the black probe lead into the negative COM terminal and the red probe lead into one of the following positive terminals:
   - **A** for high current measurements.
   - **mA** for lower current measurements.
   - **μA** for micro-amp measurements
3. Use the MODE button to select AC or DC measurement.
   - The ∿ indicator will be displayed for AC measurements.
   - The ▬ indicator will be displayed for DC measurements.
4. Connect the probe leads in series with the part in accordance with **Fig. 9-8** and **Fig. 9-9** for 'A' measurements, **Fig. 9-10** for mA measurements, or **Fig. 9-11** for μA measurements.
5. Read the current and frequency values on the display. Frequency (Hz) is available only in the **A AC** and **mA AC** modes. Use the MODE to view the Frequency only.
6. Refer to Section 6.2.4, *Advanced Functions Menu*, for details on VFD, MIN-MAX-AVG, Peak, and Relative modes of operation.
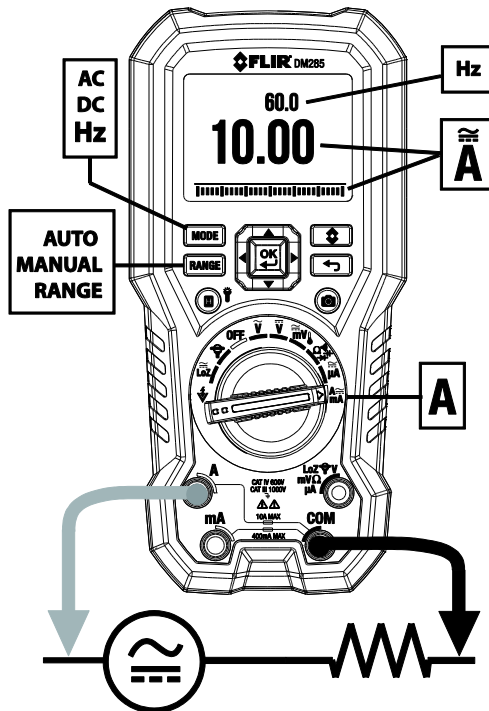
**Fig. 9-9** High Current 'A' Measurements
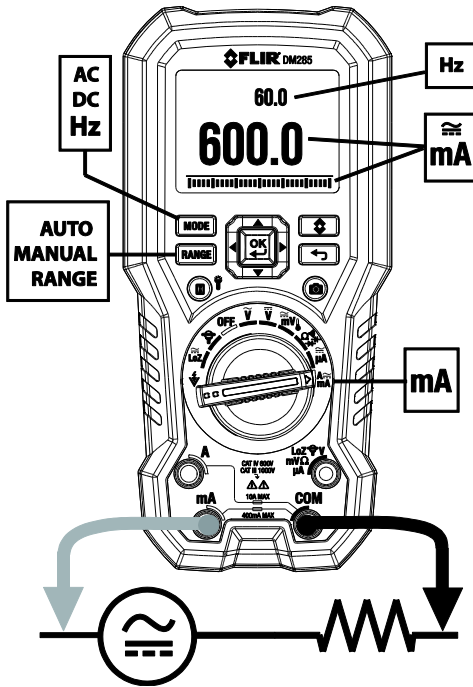
Fig. 9-10 mA Current Measurements
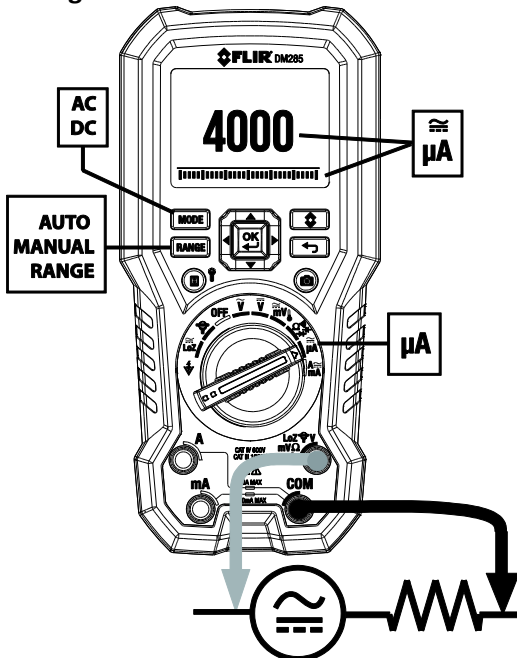
Fig. 9-11 uA Current Measurements

9.19.2 FLEX Clamp Adaptor Current and Frequency Measurements

FLIR Flex Clamp Adaptors (Models TA72 and TA74, for example) and other clamp adaptors connect to the DM285 to display current measurements made by a clamp adaptor.

1. Turn the function dial to the 🍄 position.

2. Connect a Clamp adaptor as shown in **Fig. 9-12**.

3. Set the Range of the Flex Clamp Adaptor to match the range of the DM285.

4. Use the RANGE button to select the range of the DM285 (1, 10, 100 mv/A). The selected range appears on the upper left side of the DM285 display.

5. Operate the Flex Clamp per instructions provided with the Flex Clamp meter.

6. Read the current measured by the Flex Clamp on the DM285 LCD. The frequency also appears on the DM285's secondary display.
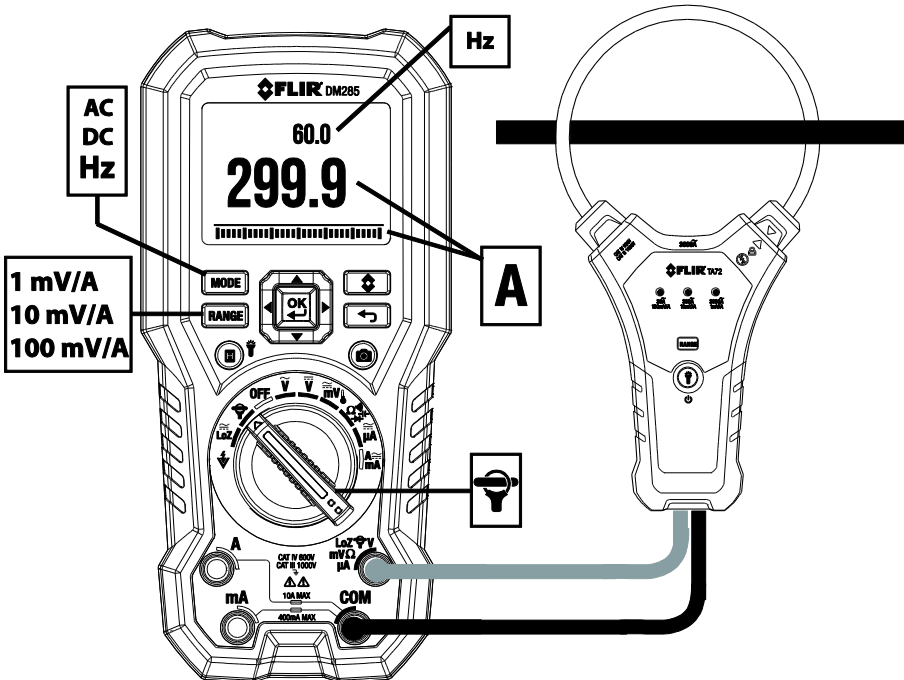
Fig. 9-12 FLEX Clamp Adaptor Application

10. Datalogger

Log up to 40,000 total readings over ten memory 'sets'. Each time the datalogger is started a new memory set is opened and the previous one is archived.

10.1 Start Datalogging

1. Press **OK** to access the main menu
2. Press **OK** at the Advanced Menu ▤ icon
3. Press **OK** at the datalogger icon ⩗ to begin storing readings at the sample rate selected in the General Settings menu, see Section 7.1.4, *Datalogger Sample Rate*. The datalogger display icon will appear while the logger is running

10.2 Stop Datalogging

1. Press **OK** to access the main menu
2. Press **OK** at the Advanced Menu ▤ icon
3. Press **OK** at the datalogger icon ⩗ to stop logging. The datalogger display icon will switch off

10.3 View Datalogger Sets

1. Press **OK** to access the Main menu
2. Press **OK** at the Gallery ▶ icon
3. Use the up arrow to move the cursor up to the log area of the display (the lower area is reserved for saved screenshot images). Scroll left/right to a data 'set' and press **OK** to open it. The list of recorded measurements for the set will appear.

10.4 Delete Datalogger Sets

1. With a datalog set open, press **OK**. Two icons will appear on the bottom of the display, one for transmitting data and one for deleting.
2. Scroll to the Trash icon and press **OK** to delete all of the readings in the selected set.
3. Delete data using the General Settings menu also, however using this method, all readings are deleted, not individual sets. See Section 6.2.5, *General Settings Menu* and Section 7, *General Settings*.

10.5 Transmit Datalogger Sets via Bluetooth®

Transmit data logs to a remote device running the FLIR Tools software suite. Refer to the next section (Bluetooth® Transmission) for more information.

1. With a datalog 'set' open, press **OK**. Two icons will appear on the bottom of the display (one for transmitting or one for deleting).
2. Scroll to the transmission icon and press **OK** to begin transmitting all of the readings in the selected set.
3. Note that a micro USB port is located in the battery compartment. When connected to a PC the DM285 operates in the same manner as an external storage medium where you can drag and drop data logs and images from the meter to a PC.

11. Bluetooth® Transmission

When connected to a remote device running the **FLIR Tools** software suite, the DM285 (using the **METERLiNK®** protocol) can:
- Send readings for live display on the remote device
- Send saved data log files to the remote device
- Send saved screen images (thermal and DMM) to the remote device

When connected to a remote FLIR camera that supports Bluetooth® BLE (Bluetooth® Low Energy), the DM285 can:
- Send meter readings for live display on the camera screen

Download the **FLIR Tools** software suite at the link below:

http://www1.flir.com/l/5392/2011-06-08/IUUE

1. Any Bluetooth® BLE device running FLIR Tools can find and connect to the meter.
2. When successful communication between the meter and a remote device or FLIR camera is established, the Bluetooth® icon 🗦 appears on the meter display.
3. Open the Main menu (by pressing **OK**) and use the Gallery mode ▶ to locate the stored images and data log sets. You can transmit Images and data log sets directly from the Gallery mode. For further information, refer to Section 6.2.3, *Gallery mode*. See additional information provided in Section 10, *Datalogger*.
4. Refer to the **FLIR Tools** help utility from within the software suite for detailed information and tutorials on using the **FLIR Tools** application.

Note: The Bluetooth® utility defaults to ON but can be disabled if desired in the General Settings menu (see Section 7, *General Settings*).

12. Appendices

12.1 Emissivity Factors for Common Materials

Material	Emissivity	Material	Emissivity
Asphalt	0.90 to 0.98	Cloth (black)	0.98
Concrete	0.94	Skin (human)	0.98
Cement	0.96	Leather	0.75 to 0.80
Sand	0.90	Charcoal (powder)	0.96
Soil	0.92 to 0.96	Lacquer	0.80 to 0.95
Water	0.92 to 0.96	Lacquer (matt)	0.97
Ice	0.96 to 0.98	Rubber (black)	0.94
Snow	0.83	Plastic	0.85 to 0.95
Glass	0.90 to 0.95	Timber	0.90
Ceramic	0.90 to 0.94	Paper	0.70 to 0.94
Marble	0.94	Chromium Oxides	0.81
Plaster	0.80 to 0.90	Copper Oxides	0.78
Mortar	0.89 to 0.91	Iron Oxides	0.78 to 0.82
Brick	0.93 to 0.96	Textiles	0.90

12.2 Non-Uniformity Correction

A non-uniformity correction (or NUC) is an image correction carried out by the camera software to compensate for different sensitivities of detector elements and other optical and geometrical disturbances[1].

The NUC is an automatic function that takes place periodically (approximately every 2-3 minutes) or whenever the inner core of the cameral detects a ±2°C temperature change.

1. Definition from the imminent international adoption of DIN 54190-3 (Non-destructive testing – Thermographic testing – Part 3: Terms and definitions).

12.3 Infrared Energy and Thermal Imaging Overview

A thermal imager generates an image based on temperature differences. In a thermal image, the hottest item in the scene appears as white and the coldest item as black. All other items are represented as a gray scale value between white and black. The DM285 also offers color images to simulate hot (lighter colors) and cold (darker colors) temperatures.

It may take some time to get used to the thermal imagery. Having a basic understanding of the differences between thermal and daylight cameras can help with getting the best performance from the DM285.

One difference between thermal and daylight cameras has to do with where the energy comes from to create an image. When viewing an image with an ordinary camera, there has to be some source of visible light (something hot, such as the sun or other lighting) that reflects off the objects in the scene to the camera. The same is true with human eyesight; the vast majority of what people see is based on reflected light energy. On the other hand, the thermal imager detects energy that is directly radiated from objects in the scene.

This is why hot objects such as parts on engines and exhaust pipes appear white, while the sky, puddles of water and other cold objects appear dark (or cool). Scenes with familiar objects will be easy to interpret with some experience.

Infrared energy is part of a complete range of radiation called the electromagnetic spectrum. The electromagnetic spectrum includes gamma rays, X-rays, ultraviolet, visible, infrared, microwaves (RADAR), and radio waves. The only difference is their wavelength or frequency. All of these forms of radiation travel at the speed of light. Infrared radiation lies between the visible and RADAR portions of the electromagnetic spectrum.

The primary source of infrared radiation is heat or thermal radiation. Any object that has a temperature radiates in the infrared portion of the electromagnetic spectrum. Even objects that are very cold, such as an ice cube, emit infrared. When an object is not quite hot enough to radiate visible light, it will emit most of its energy in the infrared. For example, hot charcoal may not give off light, but it does emit infrared radiation, which we feel as heat. The warmer the object, the more infrared radiation it emits.

Infrared imaging devices produce an image of invisible infrared or "heat" radiation that is unseen by the human eye. There are no colors or "shades" of gray in infrared, only varying intensities of radiated energy. The infrared imager converts this energy into an image that we can interpret.

The **FLIR Infrared Training center** offers training (including online training) and certification in all aspects of thermography: http://www.infraredtraining.com/.

13. Maintenance

13.1 Cleaning and Storage

Wipe the housing with a damp cloth as needed. Use a high quality lens wipe to remove dirt or smudges from the meter lenses and display window. Please do not use abrasives or solvents to clean the meter housing, lenses, or display window.

If the meter is not to be used for an extended period, remove the batteries and store them separately.

13.2 Battery Replacement

The Battery symbol flashes with no 'bars' when the batteries have reached a critical level. The meter displays readings within specifications while the low battery indicator is on. The meter powers off before it displays an out of tolerance reading.

WARNING: To avoid electrical shock, disconnect the meter from any connected circuits, remove the test leads from the meter terminals, and set the function switch to the OFF position before attempting to replace the batteries.

---

1. Unscrew and remove the battery compartment cover.
2. Replace the four (4) standard AAA batteries, observing correct polarity.
3. If using the Model TA04 rechargeable lithium polymer battery system, please recharge the rechargeable battery.
4. Secure the battery compartment cover.

13.3 Fuse Replacement

The two fuses are accessed via the battery compartment. The fuses are rated:

- mA: 440 mA, 1000 V IR 10 kA fuse (Bussmann DMM-B-44/100).
- A: 11 A, 1000 V IR 20 kA fuse (Bussmann DMM-B-11A).
- Fuse kit PN: FS881, contains one of each fuse type.

13.4 Disposal of Electronic Waste

As with most electronic products, this equipment must be disposed of in an environmentally friendly way, and in accordance with existing regulations for electronic waste. Please contact your FLIR Systems representative for more details.

14. Specifications

14.1 General specifications

Maximum voltage:	1000 V DC or 1000 V AC RMS
Display Counts:	6000
Polarity Indication:	Automatic, positive implied, negative indicated
Over-range Indication:	OL
Measuring Rate:	3 samples per second
Power Requirements:	3 x 1.5 V AA alkaline/lithium batteries or optional Model TA04-KIT lithium polymer rechargeable battery system

Approximate battery life for thermal imager:

- 6 hours: Alkaline 'AA' Battery x 3
- 13 hours: Energizer L91 Lithium (Li/FeS$_2$) 'AA' Battery x 3
- 13 hours: Optional Rechargeable Battery: Li-Polymer; FLIR PN: TA04-KIT

Auto Power Off:	Default 10 minutes
Operating Temp/RH:	14°F to 86°F (-10°C to 30°C), < 85% RH
	86°F to 104°F (30°C to 40°C), < 75% RH
	104°F to 122°F (40°C to 50°C), <45% RH
Storage Temperature/RH:	-4°F to 140°F (-20°C to 60°C), 0-80% RH (without batteries)
Temperature Coefficient:	0.1 x (specified accuracy)/°C, < 64.4°F (18°C), > 82.4°F (28°C)
Operating Altitude:	6560' (2000m)
Calibration Cycle:	One year
Weight:	18.9 oz. (537g)
Dimensions:	(L x W x H) 7.9 x 3.7 x 1.9 in. (200 x 95 x 49mm)
Safety:	Complies with IEC 61010-1 CAT IV-600 V, CAT III-1000V

CAT	Application Field
I	Circuits not connected to mains.
II	Circuits directly connected to a low-voltage installation.
III	Building installation.
IV	Source of the low-voltage installation.

EMC: EN 61326-1
Pollution degree: 2
Drop protection: 9.8' (3m)

14.2 Thermal Imaging Specifications

IR Temperature Range	14 ~ 302°F (-10 ~150°C)
IR Temperature Resolution	0.1°F/C
Image Sensitivity	< or equal to 150mK (0.15°C)
IR Temperature Accuracy	3°C or 3% whichever is greater (> 77°F [25°C]) or 5°C (14~77°F [-10 to 25°C])
Emissivity	0.95 maximum (4 presets and a fine tuning feature)
Distance to Spot ratio	30:1
Response time	150ms
Spectral Response	8~14um
Scanning type	Continuous
Repeatability	0.5%
Image Detector	Lepton ®
Field of View (FOV)	120 x 160 pixels (38º x 50º)
Color Palettes	Iron, Rainbow, and Greyscale
Stored thermal image radiometry	Fully radiometric
Laser type	Class 1
Laser power	< 0.4mW

14.3 Electrical Specifications

Accuracy is given as ± (% of reading + counts of least significant digit) at 23°C ± 5°C, with relative humidity < 80%

Temperature coefficient: 0.1 * (Specified accuracy) / °C, < 18°C, > 28°C

AC Function notes:

- ACV and ACA are ac coupled, true RMS.
- For all AC functions, LCD displays 0 counts when the reading < 10 counts.
- For square waves, accuracy is unspecified.
- For non-sinusoidal waveforms, additional accuracy for Crest Factor (C.F.):
  - Add 1.0% for C.F. 1.0 to 2.0
  - Add 2.5% for C.F. 2.0 to 2.5
  - Add 4.0% for C.F. 2.5 to 3.0
- Max. Crest Factor of Input Signal:
  - 3.0 @ 3000 counts
  - 2.0 @ 4500 counts
  - 1.5 @ 6000 counts
- Frequency Response is specified for sine waveform.

DC Voltage

Range	OL Reading	Resolution	Accuracy
6.000V	6.600V	0.001V	
60.00V	66.00V	0.01V	
600.0V	660.0V	0.1V	±(0.09% + 2D)
1000V	1100V	1V	

Input Impedance: 10MΩ

Overload Protection: AC/DC 1000V

AC Voltage

Range	OL Reading	Resolution	Accuracy	Freq. Response
6.000V	6.600V	0.001V	±(1.0% + 3D)	45Hz ~ 500Hz
60.00V	66.00V	0.01V	±(1.0% + 3D)	45Hz ~ 1kHz
600.0V	660.0V	0.1V		
1000V	1100V	1V		

Input Impedance: 10MΩ (< 100pF)
Overload Protection: AC/DC 1000V

Lo-Z Voltage (Auto AC & DC Detection)

Range	OL Reading	Resolution	Accuracy
600.0V DC & AC	660.0V	0.1V	±(2.0% + 3D)
1000V DC & AC	1100V	1V	

Input Impedance: about 3kΩ
Frequency Response: 45 ~ 1kHz (Sine Wave)
Overload Protection: AC/DC 1000V

DC mV

Range	OL Reading	Resolution	Accuracy
600.0mV	660.0mV	0.1mV	±(0.5% + 2D)

Input Impedance: 10MΩ
Overload Protection: AC/DC 1000V

AC mV

Range	OL Reading	Resolution	Accuracy
600.0mV	660.0mV	0.1mV	±(1.0% + 3D)

Frequency Response: 45 ~ 1kHz (Sine Wave)
Input Impedance: 10MΩ
Overload Protection: AC/DC 1000V

DC Current

Range	OL Reading	Resolution	Accuracy
60.00mA	66.00mA	0.01mA	±(1.0% + 3D)
400.0mA	660.0mA	0.1mA	
6.000A	6.600A	0.001A	±(1.0% + 3D)

10.00A	20.00A	0.01A	

The accuracy of measurements > 10A is unspecified.

Maximum measurement time: > 5A for max. 3 minutes with at least 20-minute rest time.

> 10A for max.30 seconds with at least 10-minute rest time.

Overload Protection: AC/DC 11A for A terminal. AC/DC 660mA for mA terminal.

AC Current

Range	OL Reading	Resolution	Accuracy
60.00mA	66.00mA	0.01mA	±(1.5% + 3D)
400.0mA	660.0mA	0.1mA	
6.000A	6.600A	0.001A	±(1.5% + 3D)
10.00A	20.00A	0.01A	

Accuracy of readings > 10A is unspecified.

Maximum measurement time: > 5A for max. 3 minutes with at least 20-minute rest time.

> 10A for max. 30 seconds with at least 10-minute rest time.

Frequency Response: 45 ~ 1kHz (Sine Wave)

Overload Protection: AC/DC 11A for A terminal. AC/DC 660mA for mA terminal.

DC μA

Range	OL Reading	Resolution	Accuracy
400.0μA	440.0μA	0.1μA	±(1.0% + 3D)
4000μA	4400μA	1μA	

Input Impedance: approx. 2kΩ

Overload Protection: AC/DC 1000V

AC μA

Range	OL Reading	Resolution	Accuracy
400.0μA	440.0μA	0.1μA	±(1.0% + 3D)
4000μA	4400μA	1μA	

Input Impedance: approx. 2kΩ; Frequency Response: 45 ~ 1kHz (Sine Wave)

Overload Protection: AC/DC 1000V

Resistance

Range	OL Reading	Resolution	Accuracy
600.0Ω	660.0Ω	0.1Ω	±(0.9% + 5D)
6.000kΩ	6.600kΩ	0.001kΩ	±(0.9% + 2D)

60.00kΩ	66.00kΩ	0.00kΩ	±(0.9% + 2D)
600.0kΩ	660.0kΩ	0.1kΩ	±(0.9% + 2D)
6.000MΩ	6.600MΩ	0.001MΩ	±(0.9% + 2D)
50.00MΩ	55.00MΩ	0.01MΩ	±(3.0% + 5D)

Overload Protection: AC/DC 1000V

Continuity

Range	OL Reading	Resolution	Accuracy
600.0Ω	660.0Ω	0.1Ω	±(0.9% + 5D)

Continuity: Built-in beeper sounds when measured resistance is less than 20Ω and is off when measured resistance is more than 200Ω. Between 20Ω and 200Ω the beeper will stop at an unspecified point.

Continuity Indicator: 2KHz Tone Buzzer; Response Time of Buzzer: < 500μsec.

Overload Protection: AC/DC 1000V

Diode

Range	OL Reading	Resolution	Typical Reading
1.500V	1.550V	0.001V	0.400 ~ 0.800V

Open Circuit Voltage: Approx. 1.8V; Overload Protection: AC/DC 1000V

Frequency

Range	OL Reading	Resolution	Accuracy
100.00Hz	100.00Hz	0.01Hz	
1000.0Hz	1000.0Hz	0.1Hz	
10.000kHz	10.000kHz	0.001kHz	±(0.1% + 2D)
100.00kHz	100.00kHz	0.01kHz	

ACV - Minimum Sensitivity (including LoZ ACV):

Range	5Hz ~ 1kHz	1kHz ~ 10kHz	>10kHz
600.0mV	60mV	100mV	Unspecified
6.000V	0.6V	6V	Unspecified
60.00V	6V	10V	Unspecified
600.0V	60V	100V	Unspecified
1000V	600V	Unspecified	Unspecified

ACA - Minimum Sensitivity:

Range	5Hz ~ 10kHz	>10kHz
60.00mA	10mA	Unspecified
600.0mA	60mA	Unspecified
6.000A	2A	Unspecified
10.00A	2A	Unspecified

FLEX Clamp Adaptor Current - Minimum Sensitivity:

Range	5Hz ~ 10kHz	>10kHz
30.00A	3.00A (0.300V)	Unspecified
300.0A	30.0A (0.300V)	Unspecified
3000A	300A (0.300V)	Unspecified

Minimum Frequency: 5Hz

Overload Protection: AC/DC 1000V

Capacitance

Range	OL Reading	Resolution	Accuracy
1000nF	1100nF	1nF	±(1.9% + 5D)
10.00μF	11.00μF	0.01μF	±(1.9% + 2D)
100.0μF	110.0μF	0.1μF	
1.000mF	1.100mF	0.001mF	
10.00mF	11.00mF	0.01mF	

Overload Protection: AC/DC 1000V

Flex Current

Range	OL Reading	Resolution	Accuracy
30.00A	33.00A	0.01A	±(1.0% + 3D)
300.0A	330.0A	0.1A	
3000A	3300A	1A	

Accuracy does not include the accuracy of the Flexible Clamp Meter.

Frequency Response: 45 ~ 1kHz (Sine Wave)

Overload Protection: AC/DC 1000V

Type-K Temperature

Range	OL Reading	Resolution	Accuracy (DMM)	Accuracy (IGM)
-40.0°C to 400.0°C	≤ -44.0°C, ≥ 440.0°C	0.1°C	± (1% + 3°C)	± (1% + 5°C)
-40.0°F to 752.0°F	≤ -44.0°F, ≥ 824.0°F	0.1°F	± (1% + 5.4°F)	± (1% + 9°F)

The accuracy applies with a 30-minute warmup time and is unspecified when the Work Light is ON.

Accuracy does not include the accuracy of the thermocouple probe.

Accuracy specification assumes surrounding temperature stable to ±1 °C. For surrounding temperature changes of ± 2 °C, rated accuracy applies after 2 hours.

Overload Protection: AC/DC 1000V.

NCV (Non-Contact Voltage Detector)

Voltage Range (High Sensitivity): 80V to 1000V

Voltage Range (Low Sensitivity): 160V to 1000V

Peak Max and Peak Min Hold

For ACV, AC mV, ACA, ACmA, AC µA, and Flex Current modes (unavailable for LoZ mode)

Specified accuracy ± 150 digits for < 6000 counts

Specified accuracy ± 250 digits for >/= 6000 counts

VFD (Low Pass Filter)

For ACV, AC mV, ACA, ACmA, AC µA, and Flex Current modes (unavailable for LoZ mode)

Specified accuracy is for 45Hz ~ 65Hz

Specified accuracy ± 4% for 65Hz ~ 400Hz

Accuracy is unspecified for > 400Hz

Cut-off Frequency: 800Hz (± 100Hz)

Work Light

Color Temperature: 4000-5000°K
Beam Angle: ± 20°
Light Output: 70 lumens, minimum
Power: 0.5 Watt RMS

15. Technical Support

Main Website	http://www.flir.com/test
Technical Support Website	http://support.flir.com
Technical support Email	TMSupport@flir.com
Service/Repair Support Email	Repair@flir.com
Support Telephone number	+1 855-499-3662 option 3 (toll-free)

16. *Warranties*

16.1 FLIR Test & Measurement Imaging Product 10-year/10-year Warranty

Congratulations! You (the "Purchaser") are now the owner of a world-class FLIR Imaging Test and Measurement product. A qualifying FLIR Imaging Test and Measurement product (the "Product") purchased either directly from FLIR Commercial Systems Inc. and affiliates (FLIR) or from an authorized FLIR distributor that Purchaser registers on-line with FLIR is eligible for coverage under FLIR's industry-leading 10-10 Limited Warranty, subject to the terms and conditions in this document. This warranty only applies to purchases of Qualifying Products (see below) purchased after September 2015 and only to the original Purchaser of the Product.

PLEASE READ THIS DOCUMENT CAREFULLY; IT CONTAINS IMPORTANT INFORMATION ABOUT THE PRODUCTS THAT QUALIFY FOR COVERAGE UNDER THE 10-10 LIMITED WARRANTY, PURCHASER'S OBLIGATIONS, HOW TO ACTIVATE THE WARRANTY, WARRANTY COVERAGE, AND OTHER IMPORTANT TERMS, CONDITIONS, EXCLUSIONS AND DISCLAIMERS.
1. PRODUCT REGISTRATION. To qualify for FLIR's 10-10 Limited Warranty, the Purchaser must fully register the Product directly with FLIR on-line at www.flir.com WITHIN Sixty (60) DAYS of the date the Product was purchased by the first retail customer (the "Purchase Date"). PRODUCTS THAT ARE NOT REGISTERED ON-LINE WITHIN Sixty (60) DAYS OF THE PURCHASE DATE OR PRODUCTS WHICH DO NOT QUALIFY FOR THE 10-10 WARRANTY WILL HAVE A LIMITED ONE YEAR WARRANTY FROM THE DATE OF PURCHASE.
2. QUALIFYING PRODUCTS. Upon registration, a list of thermal Imaging Test and Measurement Products that qualify for coverage under FLIR's 10-10 Warranty can be found at www.flir.com/testwarranty
3. WARRANTY PERIODS. The 10-10 Limited Warranty has two separate periods of warranty coverage (the "Warranty Period"), depending on the Imaging Test and Measurement Product part:

Product components are warranted for a period of ten (10) years from the Purchase Date;

Thermal imaging sensor is warranted for a period of ten (10) years from the Purchase Date.

Any Product that is repaired or replaced under warranty is covered under this 10-10 Limited Warranty for one hundred eighty days (180) days from the date of return shipment by FLIR or for the remaining duration of the applicable Warranty Period, whichever is longer.

4. LIMITED WARRANTY. In accordance with the terms and conditions of this 10-10 Limited Warranty, and except as excluded or disclaimed in this document, FLIR warrants, from the Purchase Date, that all fully registered Products will conform to FLIR's published Product specifications and be free from defects in materials and workmanship during the applicable Warranty Period. PURCHASER'S SOLE AND EXCLUSIVE REMEDY UNDER THIS WARRANTY, AT FLIR'S SOLE DISCRETION, IS THE REPAIR OR REPLACEMENT OF DEFECTIVE PRODUCTS IN A MANNER, AND BY A SERVICE CENTER, AUTHORIZED BY FLIR. IF THIS REMEDY IS ADJUDICATED TO BE INSUFFICIENT, FLIR SHALL REFUND PURCHASER'S PAID PURCHASE PRICE AND HAVE NO OTHER OBLIGATION OR LIABILITY TO BUYER WHATSOEVER.
5. WARRANTY EXCLUSIONS AND DISCLAIMERS. FLIR MAKES NO OTHER WARRANTY OF ANY KIND WITH RESPECT TO THE PRODUCTS. ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE (EVEN IF PURCHASER HAS NOTIFIED FLIR OF ITS INTENDED USE FOR THE PRODUCTS), AND NON-INFRINGEMENT ARE EXPRESSLY EXCLUDED FROM THIS AGREEMENT.
THIS WARRANTY EXPRESSLY EXCLUDES ROUTINE PRODUCT MAINTENANCE, AND SOFTWARE UPDATES. FLIR FURTHER EXPRESSLY DISCLAIMS ANY WARRANTY COVERAGE WHERE THE ALLEGED NONCONFORMITY IS DUE TO NORMAL WEAR AND TEAR OTHER THAN SENSORS, ALTERATION, MODIFICATION, REPAIR, ATTEMPTED REPAIR, IMPROPER USE, IMPROPER MAINTENANCE, NEGLECT, ABUSE, IMPROPER STORAGE, FAILURE TO FOLLOW ANY PRODUCT INSTRUCTIONS, DAMAGE (WHETHER CAUSED BY ACCIDENT OR OTHERWISE), OR ANY OTHER IMPROPER CARE OR HANDING OF THE PRODUCTS CAUSED BY ANYONE OTHER THAN FLIR OR FLIR'S EXPRESSLY AUTHORIZED DESIGNEE.

THIS DOCUMENT CONTAINS THE ENTIRE WARRANTY AGREEMENT BETWEEN PURCHASER AND FLIR AND SUPERSEDES ALL PRIOR WARRANTY NEGOTIATIONS, AGREEMENTS, PROMISES AND UNDERSTANDINGS BETWEEN PURCHASER AND FLIR. THIS WARRANTY MAY NOT BE ALTERED WITHOUT THE EXPRESS WRITTEN CONSENT OF FLIR.

6. WARRANTY RETURN, REPAIR AND REPLACEMENT. To be eligible for warranty repair or replacement, Purchaser must notify FLIR within thirty (30) days of discovering of any apparent defect in materials or workmanship. Before Purchaser may return a Product for warranty service or repair, Purchaser must first obtain a returned material authorization (RMA) number from FLIR. To obtain the RMA number Owner must provide an original proof of purchase. For additional information, to notify FLIR of an apparent defect in materials or workmanship, or to request an RMA number, visit www.flir.com. Purchaser is solely responsible for complying with all RMA instructions provided by FLIR including but not limited to adequately packaging the Product for shipment to FLIR and for all packaging and shipping costs. FLIR will pay for returning to Purchaser any Product that FLIR repairs or replaces under warranty.

FLIR reserves the right to determine, in its sole discretion, whether a returned Product is covered under warranty. If FLIR determines that any returned Product is not covered under warranty or is otherwise excluded from warranty coverage, FLIR may charge Purchaser a reasonable handling fee and return the Product to Purchaser, at Purchaser's expense, or offer Purchaser the option of handling the Product as a non-warranty return. FLIR shall not be responsible for any data, images or other information that may be stored on the returned Product which was not included in the Product at the time of purchase. It is Purchaser's responsibility to save any and all data prior to returning the Product for warranty service.

7. NON-WARRANTY RETURN. Purchase may request that FLIR evaluate and service or repair a Product not covered under warranty, which FLIR may agree to do in its sole discretion. Before Purchaser returns a Product for non-warranty evaluation and repair, Purchaser must contact FLIR by visiting www.flir.com to request an evaluation and obtain an RMA. Purchaser is solely responsible for complying with all RMA instructions provided by FLIR including but not limited to adequately packaging the Product for shipment to FLIR and for all packaging and shipping costs. Upon receipt of an authorized non-warranty return, FLIR will evaluate the Product and contact Purchaser regarding the feasibility of and the costs and fees associated with Purchaser's request. Purchaser shall be responsible for the reasonable cost of FLIR's evaluation, for the cost of any repairs or services authorized by Purchaser, and for the cost of repackaging and returning the Product to Purchaser. Any non-warranty repair of a Product is warranted for one hundred eighty days (180) days from the date of return shipment by FLIR to be free from defects in materials and workmanship only, subject to all of the limitations, exclusions and disclaimers in this document.