USER MANUAL

Solar Irradiance Meter

MODEL PV78

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1 Introduction

Thank you for your purchase of the FLIR PV78 Solar Irradiance Meter.

The PV78 is designed for solar site surveys, panel installation, and maintenance of photovoltaic systems. It measures solar irradiation (in watts per square meter) as required by the IEC 62446-1 Electrical Safety of PV Installations standard.

Measure temperature by placing the meter directly on the panel or by connecting the supplied external probe for continuous measurements. The PV78 includes a compass to locate the predominant direction and a tilt function to determine the inclination of a roof or panel.

With Bluetooth® FLIR METERLiNK technology, you can connect to the METERLiNK® app on mobile devices, for instantaneous documentation, reporting, and sharing of results from the field.

Features include the following:

- Light irradiance sensor measures light intensity in watts per meter squared.
- Embedded sensor or external probe measures temperature in °C and °F.
- Internal sensors measure inclination angle and compass direction.
- Large HTN (high twisted nematic) high contrast display can be read in direct sunlight.
- Six hour data logger with adjustable time stamp, records 360 readings.
- Data log file sharing, using the METERLiNK application.
- Data Hold function freezes the displayed readings.
- Simple calibration for compass heading and inclination angle.
- Battery operated with automatic power off (APO).
- Includes PV78 meter, external temperature probe, battery, printed Quick Start guide, and carry pouch.

2 Safety

2.1 Safety Warnings and Cautions

WARNING

- Read, understand, and follow all safety information and operating instructions in this manual before using this meter.
- Do not use this meter if it appears damaged or is operating abnormally. If in doubt, contact customer support.
- Use this meter only as described in this user manual, using the meter for other uses will void the warranty.
- Comply with all applicable local and national safety codes.
- Do not expose this meter to extremes in temperature and relative humidity.

CAUTION

- When using the compass function, keep mobile phones, and other devices with magnetic properties, away from the meter.
- Calibrate the meter often, especially if it has not been used for long periods, and after it has been exposed to a strong magnetic field.

2.2 FCC Compliance

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

1. Reorient or relocate the receiving antenna.
2. Increase the separation between the equipment and receiver.
3. Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
4. Consult the dealer or an experienced radio/TV technician for help.

WARNING

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

3 Product Description

3.1 Meter (Front)

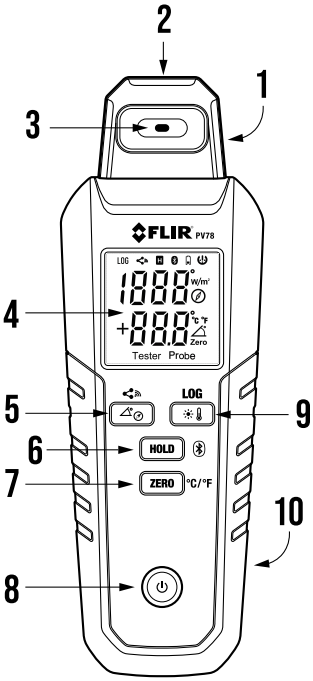

Figure 3.1 Front view of meter. See descriptions below.

1. Embedded temperature sensor (back).
2. External temperature probe jack.
3. Irradiance sensor.
4. Multifunction display.
5. Inclination/compass and data transmit button.
6. Data Hold and Bluetooth button.
7. Inclination zero and temperature units button.
8. Power ON/OFF button.
9. Irradiance/temperature and data log button.
10. Battery compartment and tripod mount on back.

3.2 Meter (Back)

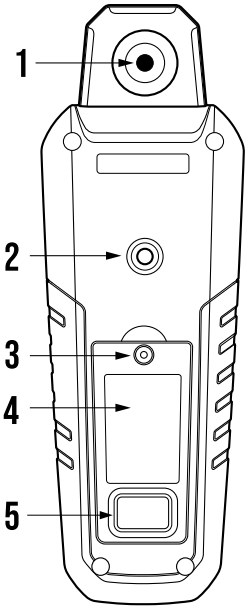

Figure 3.2 Rear view of meter. See descriptions below.

1. Embedded temperature sensor.
2. Tripod mount.
3. Battery compartment screw.
4. Battery compartment cover.
5. Scratch protection base.

3.3 Control Buttons

	Power ON/OFF button
	Short press to switch the meter ON/OFF.
	To disable APO, with the meter ON, long press this button (the APO icon will switch OFF).
	Irradiance, Temperature, and Data Log button.
	Short press to access the irradiance and temperature mode. This is the default mode of operation.
	Long press to start data logging (short press to stop data logging).
	Inclination angle, Compass, and Transmit button.
	Short press to access inclination and compass mode.
	With Bluetooth enabled, long press to share data log file with mobile device.
	Data Hold and Bluetooth button.
	Short press to freeze/unfreeze readings.
	Long press to start/stop Bluetooth communication.
	Inclination angle zero calibration and Temperature unit button.
	Short press to change the temperature unit of measure.
	To use the inclination angle zero function, you must first set the meter face up on a level surface, press the Inclination button, and then short press the Zero button.

3.4 Display

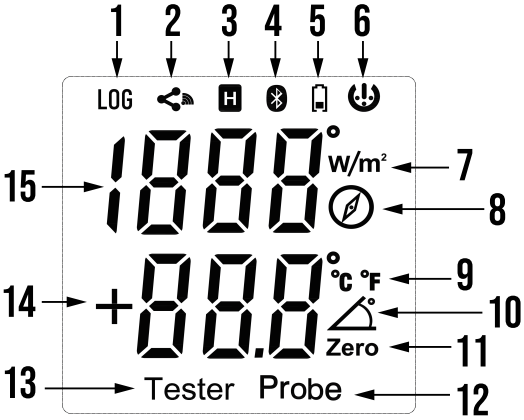

Figure 3.3 Meter display. See descriptions below.

1. Data logger is recording.
2. Data log file is transmitting.
3. Data Hold is active.
4. Bluetooth is active.
5. Battery is low.
6. APO is enabled.
7. Unit of measure for Irradiance.
8. Compass heading is displayed.
9. Unit of measure for Temperature.
10. Inclination angle is displayed.
11. Zero calibration is active.
12. External probe is connected.
13. Embedded sensor in use.
14. Inclination or Temperature reading.
15. Irradiance or Compass reading.

3.5 External Probe

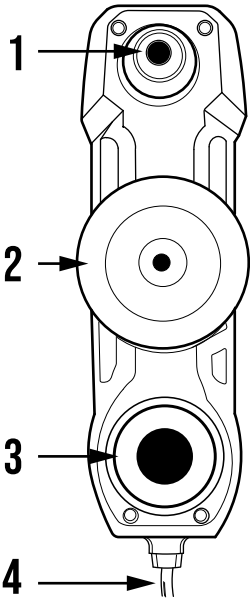

Figure 3.4 External temperature probe. See descriptions below.

1. Temperature sensor.
2. Suction cup to affix probe to panel.
3. Attachment base with scratch protection ring.
4. Meter connecting cable.

4 Battery Power

The meter is powered by one 9 V alkaline battery. The battery compartment is located on the back of the meter, secured by one screw.

Short press the power button to switch the meter ON or OFF. When battery power is low, the battery icon will appear on the top of the display. Replace the battery as explained in the Maintenance section.

4.1 Automatic Power OFF (APO)

To conserve battery energy, the meter automatically switches OFF after 30 minutes of inactivity.

To defeat APO, with the meter ON, long press the power button. The APO icon, on the upper right corner of the display, will switch OFF. Long press the power button again to enable APO, the icon will appear again. Note that APO is the default mode of operation and will switch ON each time the meter's power is cycled.

APO is automatically disabled when the data logger is active.

5 Irradiance Measurements

Irradiance is a measure of light intensity in units of W/m^2 (watts per meter squared).

1. Switch the meter ON.
2. The meter powers up in the Irradiance/Temperature mode. Press the Irradiance button LOG to return to this mode from other modes.
3. Place the meter on the surface of the solar panel, face up. Use electrical tape to adhere the meter to the surface if necessary.
4. The irradiance sensor on the front (top) of the meter measures the light irradiance. The measurement is shown on the upper display digits. Do not block the sensor's view of the light source.

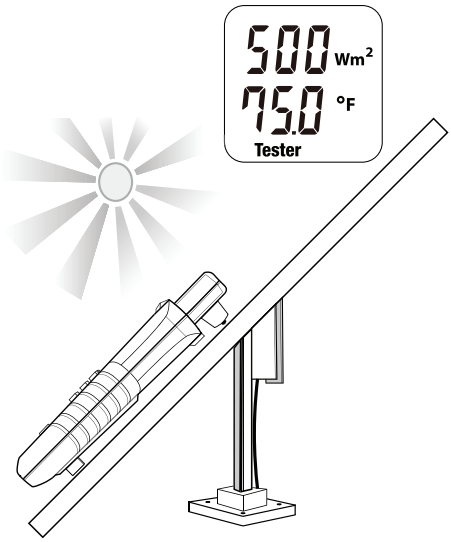

Figure 5.1 Irradiance measurements.

6 Temperature Measurements

The meter measures the solar panel's surface temperature in degrees C or F using the embedded temperature sensor or the external temperature probe (supplied).

6.1 Embedded Temperature Sensor

1. Switch the meter ON.
2. The meter powers up in the Irradiance/Temperature mode. Press the Irradiance/Temperature LOG button to return to this mode from other modes.
3. Place the meter against the solar panel, ensuring that the temperature sensor is making firm contact with the surface of the panel. Use electrical tape to adhere the meter to the surface if necessary.
4. The embedded temperature sensor on the back of the meter (top) senses the temperature. The temperature measurement is shown on the lower display digits. Short press the °C/°F button to toggle the units.

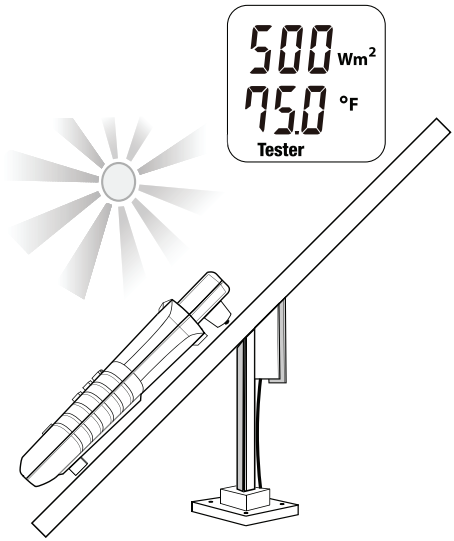

Figure 6.1 Surface temperature measurements using the embedded temperature sensor.

6.2 External Temperature Probe

1. Switch the meter ON.
2. The meter powers up in the Irradiance/Temperature mode. Press the Irradiance/Temperature LOG button to return to this mode from other modes.
3. Connect the external probe to the meter, as shown in Fig. 6.2.
4. The display will show ‘Probe’.
5. Use the probe’s suction cup to affix the meter to the back of the panel, as shown in the Fig. 6.3. Ensure that the temperature sensor is firmly touching the surface.
6. The temperature measurement is shown on the lower display digits. Short press the °C/°F button to toggle the units.

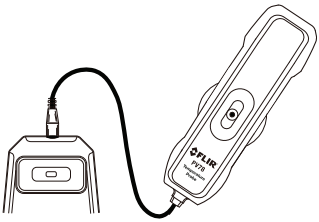

Figure 6.2 Connecting the external temperature probe to the meter.

Figure 6.3 Temperature measurements using the external probe.

7 Inclination Angle

7.1 Calibrate (Zero) the Inclination Angle

Before measuring the tilt angle of a solar panel, zero the inclination display as described below.

Place the meter, face up, on a level surface. Short press the Inclination angle button to access the inclination mode, and then short press the Zero button. After a few seconds, the inclination angle (lower digits) will read zero degrees.

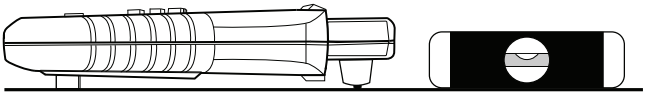

Figure 7.1 Ensure a level surface when performing a zero degree calibration.

7.2 Inclination Angle Measurements

The PV78 has an internal inclination sensor that measures the solar panel's tilt angle in degrees.

Place the meter, face up, on the surface of the panel, and secure with electrical tape, if necessary.

Press the Inclination angle button, to access the Inclination mode, and read the angle measurement on the lower digits.

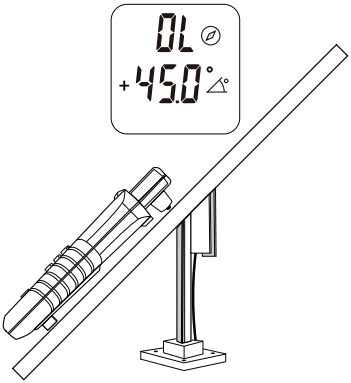

Figure 7.2 Inclination angle measurements.

8 Compass Heading

8.1 Compass Considerations

The PV78 has an internal compass that senses geomagnetic north for reference orientation. If the meter is placed near metallic objects, the sensor will become disoriented. Take compass readings at least 6.6 ft. (2 m) away from metal objects including solar panels, metal roofs, reinforced concrete surfaces, and electronic equipment.

Note that if the meter's inclination angle is < 20 degrees, the meter will likely be affected by metallic objects, and the compass sensor will be adversely affected.

Calibrate and use the meter as described in the next sections.

8.2 Compass Heading Procedure

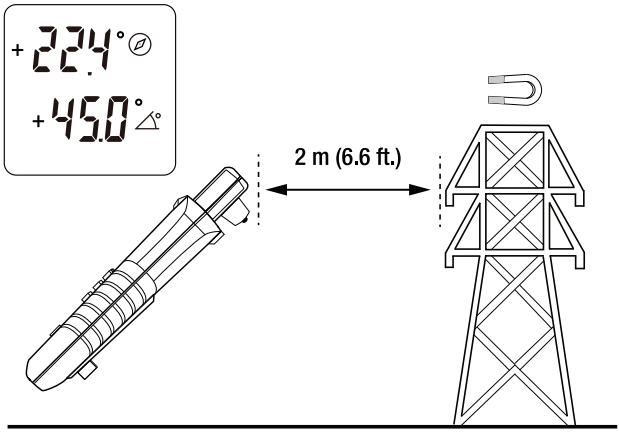

Figure 8.1 Checking compass heading. Keep meter at least 2 m from metallic objects.

Perform compass measurements at least 6.6 ft. (2 m) away from metallic objects, on a horizontal surface (at an angle > 20 degrees). Point the meter tip in the same direction that the solar panel faces.

Press the Compass button to access the mode, and read the compass heading on the upper display digits.

8.3 Compass Calibration

Calibrate the meter often, especially if it has not been used recently or if it is being used in a new location.

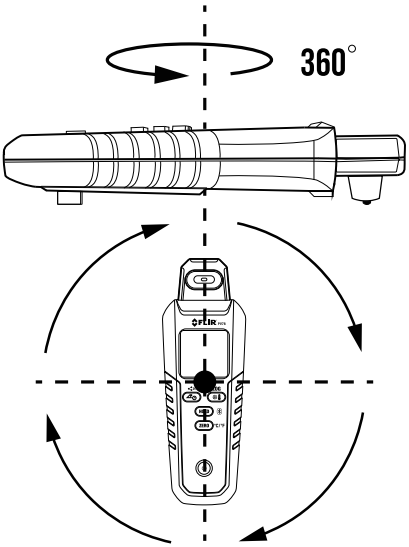

Figure 8.2 Slowly rotate the meter 360 degrees on a horizontal plane for at least one minute, with more than six rotations.

1. Switch the meter ON.
2. Press and hold the Compass button .
3. While holding , press the power button . The numbers ‘444 444’ will appear.
4. Release all buttons, the numbers ‘444 444’ will disappear.
5. Short press the HOLD button (the numbers ‘444 444’ will appear again).
6. Place the meter on a horizontal plane, away from metallic objects.
7. Slowly rotate the meter 360 degrees, at a uniform speed. The number of rotations should be greater than six, and the rotation duration should be at least one minute.
8. Short press the Inclination button to complete the calibration.
9. If the calibration fails or if the steps are not followed correctly, switch the meter OFF and repeat the procedure.

9 Data Logger

9.1 Data Logger Overview

The data logger records one reading ‘set’ per minute, for up to six hours, for a total of 360 readings. One reading set consists of one Irradiance and one Temperature measurement.

Data log files are stored in the meter’s internal memory and are intended to be shared with mobile devices using the free METERLiNK app, as explained in Section 9.3, below. The user can view one reading on the app per minute (default), one reading every 10 minutes, one reading per hour, etc. by setting the time stamp option, as explained in Section 9.4, below.

Each time the data logger is stopped and started, the saved data log file is overwritten, since the PV78 does not support pause and resume logging.

The APO function is disabled while the data logger is running, and the data logger will not start if the battery power is low.

9.2 Data Logging Procedure

1. Long press the **LOG** button to begin recording, the **LOG** icon will appear at the top of the display.
2. The meter is now recording. All buttons, except the **LOG** button, will be inoperable while recording.
3. Short press the **LOG** button to stop recording, the **LOG** icon will switch OFF. The logging will automatically stop after six hours.
4. To record again (erasing the existing log file), repeat these steps. To share the file with a mobile device, continue to the next section.

9.3 Sharing a Data Log File with a Mobile Device

NOTE: Data log files can only be shared from the irradiance/temperature mode of operation. If you attempt to share files from the compass/inclination mode, the display will shown an error (ERR).

1. Download the METERLiNK application from the App Store® (iOS®) or Google Play™ (Android™).
2. Long press the Bluetooth button HOLD on the PV78, the Bluetooth icon will flash on the display.
3. Open METERLiNK on your mobile device. The app will recognize the PV78 and begin showing real-time readings. Instructions for general use are provided in the application.
4. To share a file, long press the PV78 Transmit button. The transmit icon will flash on the PV78 display.
5. The sharing progress is shown on the upper digits (1, 25, 50, 75, 100%).
6. When complete, the display will show **100%**, and the meter will exit the transmit mode (icon will stop flashing).
7. Long press the Bluetooth button HOLD to end communication.
8. If Bluetooth is not activated prior to sharing, if there is no data log file, or if the meter is in the compass/inclination mode, the display will show **Err** when attempting transmission.

9.4 Changing the Data Log Time Stamp

The default time stamp is one minute, meaning that when the data log file is viewed on the mobile device, one reading will be shown for every minute of data logging.

To change the time stamp, in order to view readings over a longer time interval, follow the steps below. Note that the time stamp will revert to the default setting (one reading per minute) each time the meter is switched OFF.

1. Long press the HOLD and ZERO buttons until the display shows ‘00’ on the upper digits (representing the hours) and ‘00’ on the lower digits (representing the minutes).
2. The flashing digit is ready to be changed. Use the HOLD button to increase a value and the ZERO button to decrease. Use the LOG button to step to the right, and use the Transmit button to step to the left.
3. Long press the HOLD and ZERO buttons to confirm the setting and exit.
4. Now when a data log session is recorded, and shared with a mobile device, the readings will be listed at the time interval set in this procedure.

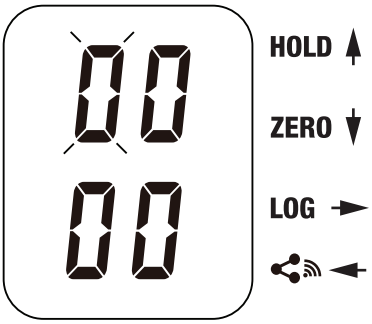

Figure 9.1 Time Stamp setting screen. Upper digits represent hours; lower digits represent minutes. The flashing digit is ready to be adjusted. Use the HOLD and ZERO buttons to change a digit value, and use the LOG and Transmit buttons to step right and left.

10 Maintenance

10.1 Battery Replacement

To replace the 9 V battery, remove the screw located on the back (centre) of the meter and remove the battery compartment cover.

Insert one (1) alkaline battery in the compartment, observing correct polarity.

 Do not dispose of used batteries or rechargeable batteries in household waste.

10.2 Cleaning and Storage

Before cleaning the meter, switch it OFF. Wipe the meter housing with a damp cloth, and mild detergent, as necessary. Do not use solvents or abrasives. To clean the irradiance sensor at the top of the meter, use a high quality lens cleaner and lint free swab.

Store the meter in a protective case, supplied pouch, or in the original packaging. Remove the battery and store separately when the meter is to be stored for longer than three months.

11 Specifications

11.1 General Specifications

Display	HTN (high twisted nematic) type
Measurement update rate	Three (3) samples per second
Power supply	9 V alkaline battery
Battery life	25 hours, typical, with Bluetooth and Data Logger OFF
Automatic Power OFF (APO)	After approximately 30 minutes of inactivity
Operating temperature	Meter: 14 to 122°F (–10 to 50°C) Probe: –22 to 212°F (–30 to 100°C)
Storage temperature	–4 to 140°F (–20 to 60°C)
Operating and storage humidity	< 80 % RH
Operating altitude	6560 ft. (2000 m)
Pollution degree	2
Dimensions	9.5 x 2.6 x 1.5 in. (240.5 x 67 x 38 mm)
Weight	10.6 oz. (300 g)
Certifications	CE, FCC, RCM
EMC compliance	EN61326-1/-2-2, EN300328, EN301489-1/-17, EN62479 FCC Part 15B/C
Ingress rating	IP40
Drop test	4.9 ft. (1.5 m)
Supplied equipment	PV78 meter, external temperature probe, battery, printed Quick Start guide, carry pouch

11.2 Measurement Specifications

Irradiance Measurements	
Measurement range	50 to 1400 W/m²
Resolution	1 W/m²
Accuracy	± 5%
Temperature Measurements	
Measurement range	meter: 14 to 122°F (–10 to 50°C) Probe: -22 to 212°F (–30 to 100°C)
Resolution	0.1°C 0.2°F (<100°F); 1°F (>100°F)
Accuracy	±2.7°F (1.5°C) from 14 to 167°F (–10 to 75°C) ±3.6°F (2.0°C) from –22 to 14°F (–30 to –10°C) ±4.5°F (2.5°C) from 167 to 212°F (75 to 100°C)
Inclination Angle Measurements	
Measurement range	-90° to +90°
Resolution	0.1°
Accuracy	±3°
Compass Measurements	
Measurement range	0 to 360°
Resolution	1°
Accuracy	±7°

11.3 Connectivity and Data Logging Specifications

Mobile connection type	Bluetooth BLE
Communications method	METERLiNK application
Bluetooth range	32.8 ft. (10 m)
Data logger interval	1 reading per minute (with adjustable time stamping)
Data logger timer	Data logger will run continuously for up to six (6) hours
Data logger internal file	File holds up to 360 reading sets (Irradiance and Temperature) for sharing with mobile device

12 Customer Support

Customer Support Telephone List	https://support.flir.com/contact
Repair, Calibration, and Technical Support	https://support.flir.com

13 Warranty

This product is protected by FLIR's Limited 3-Year Warranty. Visit www.flir.com/testwarranty to read the warranty document.

Website
http://www.flir.com

Customer support
http://support.flir.com

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