BENNING PV 2 Tester and Characteristic Curve Meter Instruction Manual

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Curve Meter Instruction Manual

BENNING Short Instructions BENNING PV 2

Contents

1. Important information

 Before using the BENNING PV 2 please read the detailed operating manual (**http://tms.benning.de/pv2**) carefully.
The BENNING PV 2 should only be used by suitably trained personnel in accordance with the device specification described.
Before measuring, assess the conditions at the measuring point. If there is a risk of injury, use personal protective equipment.

 The connection to the PV generator is made exclusively in accordance with the connection figure of the operating manual.
Disconnect not required tests leads from the BENNING PV 2.

 Before the measurement disconnected the PV array from the PV inverter!
The PV string under test must not exceed the maximum open-circuit voltage of 1000 V, the maximum short-circuit current of 15 A and the maximum DC power (P = Uoc x Isc) of 10 kW.
The measurements are to be carried out on the individual PV string!
It must be ensured that all switching devices and isolating devices are open and that all PV strings are isolated from each other.
Only test a single PV string, never test multiple strings and beware of parallel connections! High levels of capacitance within the circuit under test can cause high currents to flow and may damage the test instrument.
Non-observance will result in damage to the BENNING PV 2!

 Disconnect the BENNING PV 2 from the test sample directly after the test.

 Do not touch the measuring probes! During insulating resistance measurements, high electric currents might be applied to the measuring probes.

 Do not touch any metal parts of the test object during measurement.

 The PV generator must be isolated from the electric power supply!
Neither the positive nor the negative pole of the PV generator must be earthed!

 Via the 4 mm test leads, voltage measurements on mains supply circuits are possible. Via the 4 mm test sockets, the BENNING PV 2 must be used only in electric circuits of overvoltage category III with max. 300 V AC/DC for phase-to-earth measurements. For this please disconnect the PV 2 PV measuring leads from the PV test sockets before measuring.

Before starting the unit, always check it for signs of damage. Do not use a damaged BENNING PV 2!

Only use measuring leads, which are supplied with the BENNING PV 2.

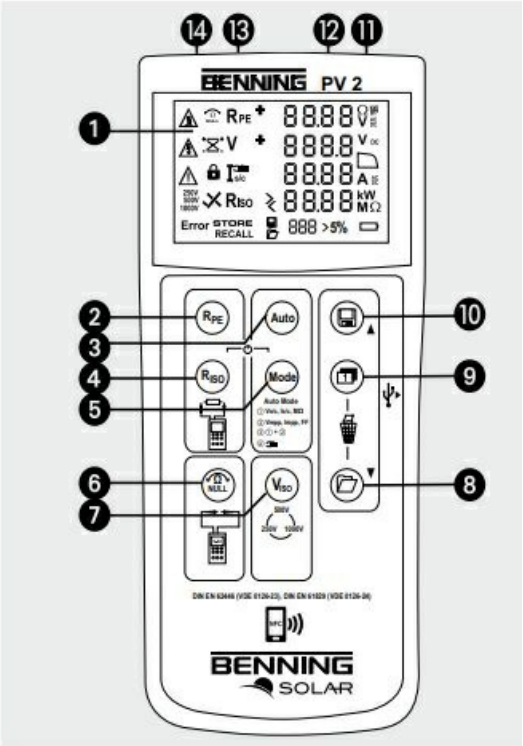
The BENNING PV 2 is intended for making measurements under dry ambient conditions only.

2. Switching the device ON/OFF

Press the R_{ISO}-key 4 and the Mode-key 5 simultaneously to switch the device ON or OFF. Without pressing a key, the device switches OFF automatically after approx. 1 minute (APO, Auto Power-Off). The switch-off time can be set within a range from 1
min. to 10 min. (see operating manual on **http://tms.benning.de/pv2**).

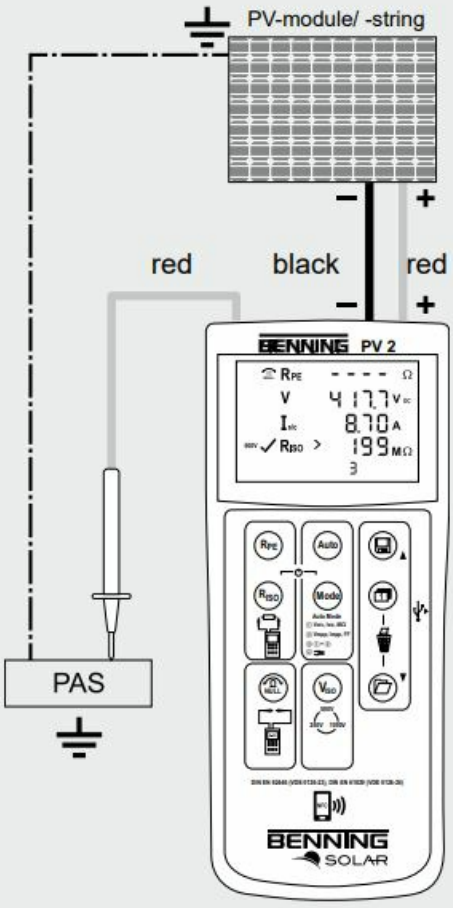
3. Device description

1. **LC Display**
2. R_{PE} **key,** protective conductor test
3. Auto**-key**, automatic test procedure
4. R_{ISO}**-key**, insulation test (2-pin)
5. Mode**-key**, selecting the test procedures
6. NULL**-key**, null balance of the measuring line
7. V_{ISO}**-key**, selecting the ISO testing voltage
8. **-key**, calling measured values
9. **-key**, switch-over of LC display
10. **-Taste**, storing measured values
11. **+ PV test socket (red)**
12. **– PV test socket (black)**
13. **– 4 mm test socket (black)**
14. **+ 4 mm test socket (red)**



4. AUTO measurement of the PV generator

1. Carefully read and understand all safety notes under point 1. “Important information”.
2. Connect the BENNING PV 2 to the PV generator as shown, by means of the enclosed PV measuring leads and the red 4 mm test lead.
3. The open-circuit voltage (Vo/c) is automatically displayed.
4. In case of reversed polarity of the DC voltage, the symbol ⁺⨯⁺ is displayed ❶ and the measurement will be blocked.
5. Press the Mode-key ❺ to select the desired test procedure (modes ① - ④):
   ① Measuring Vo/c, Is/c and MΩ
   ② Measuring the I-V characteristic with Vmpp, Impp and FF (filling factor)
   ③ Measuring ① + ②
   ④ Measuring via AC/DC current clamp
6. Press the V_{ISO}-key ❼ to select an ISO testing voltage of 250 V, 500 V or 1.000 V.
7. Press the Auto-key ❸ to start the test procedure.
8. As soon as the test procedure is completed, “Store?” will be indicated on the LC display ❶.
9. Press the 💾-key ❿ to store the measured values.



⚠⚠

Uoc x Isc ≤ 10 kW
Max.: Isc = 15 A, Uoc = 1000 V,
P = 10 kW

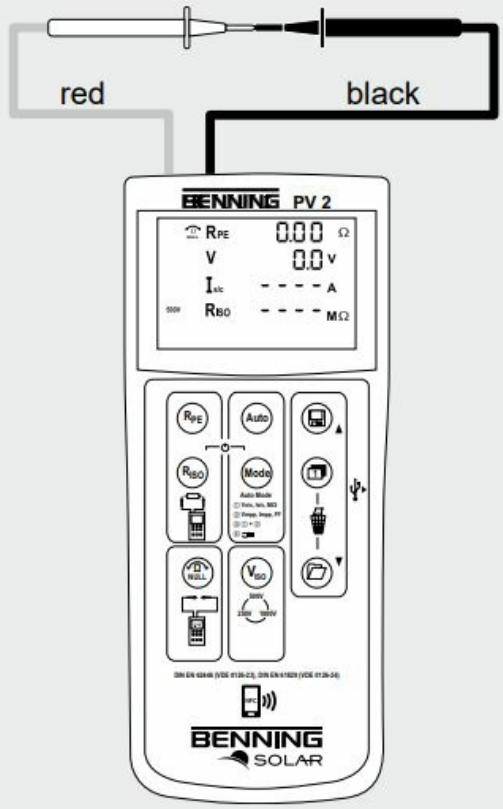
Disconnect all poles of the PV array from the inverter before testing!

Only test a single PV string, never test multiple strings and beware of parallel connections!
High levels of capacitance within the circuit under test can cause high currents to flow and may damage the test instrument.
The PV generator may not contain any power optimisers!

Note:
The red 4 mm measuring lead is required for the insulation resistance measurement.

5. Null balance of the measuring leads, resistance (RPE)

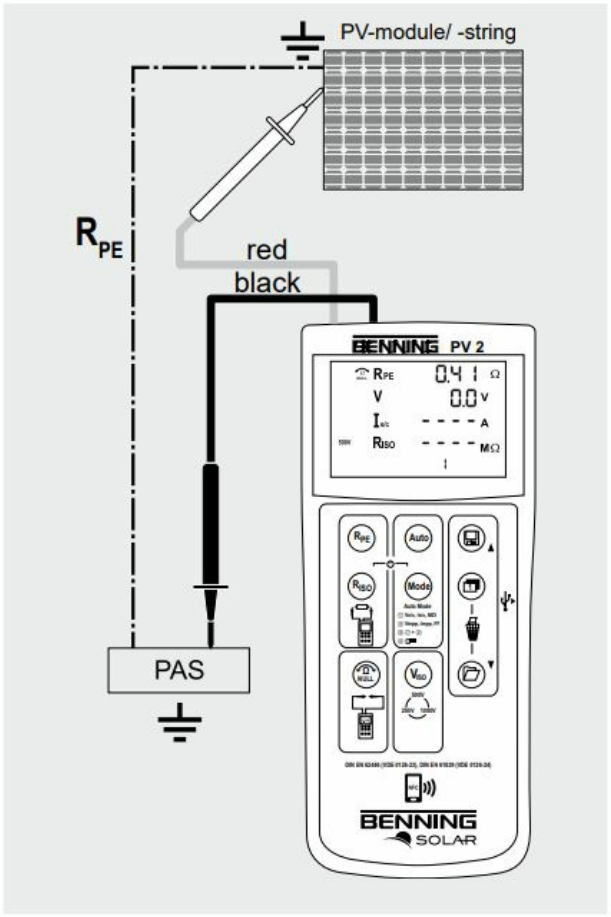
1. Connect the measuring leads to the red and black 4 mm test sockets of the BENNING PV 2.
2. Short-circuit the probe tips via the alligator clips.
3. Press and hold the NULL-key ❻ until an acoustic signal sounds and the NULL-symbol is displayed ❶.
4. The Null-value is stored when unit is switched off.
5. To disable, press NULL-key ❻ until the NULL-symbol is removed from LC display ❶.



Note:
Max. measuring lead resistance:
10 Ohm

6. Protective conductor resistance (RPE)

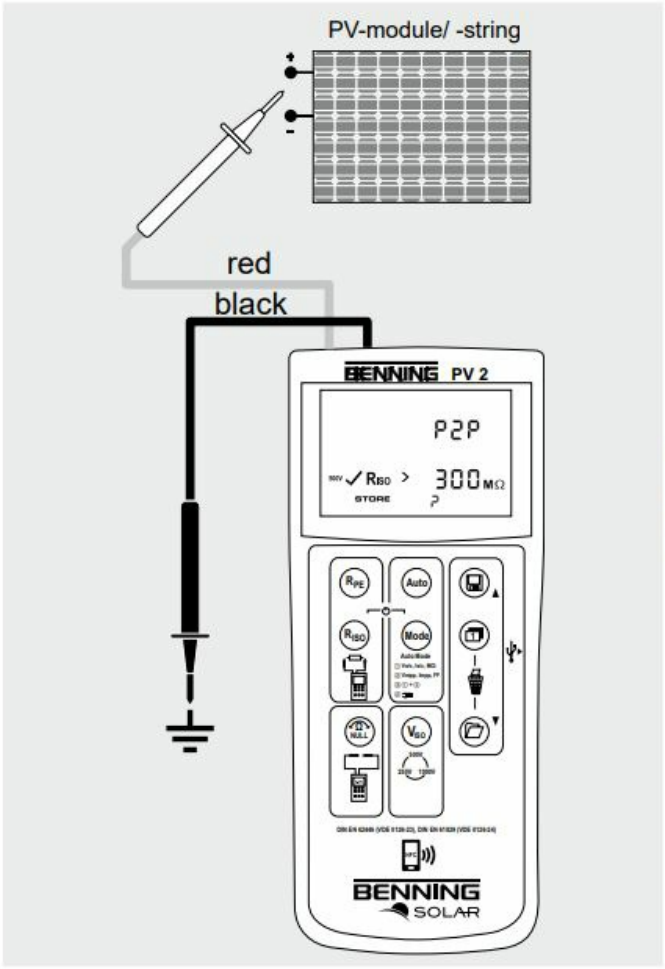
1. Connect the 4 mm measuring leads as shown.
2. To make a single measurement (2 sec.), press and release the R_{PE}-key ❷.
3. To make a continuous measurement, press and hold the R_{PE}-key ❷ until the symbol 🔒 is displayed ❶ continuously.
4. Press the R_{PE}-key ❷ to terminate the continuous measurement.
5. Press the 💾-key ❿ to store the measured values.



Option:
40 m measuring leads BENNING TA 5
part no. 044039

7. Insulating resistance (RISO, 2-pin)

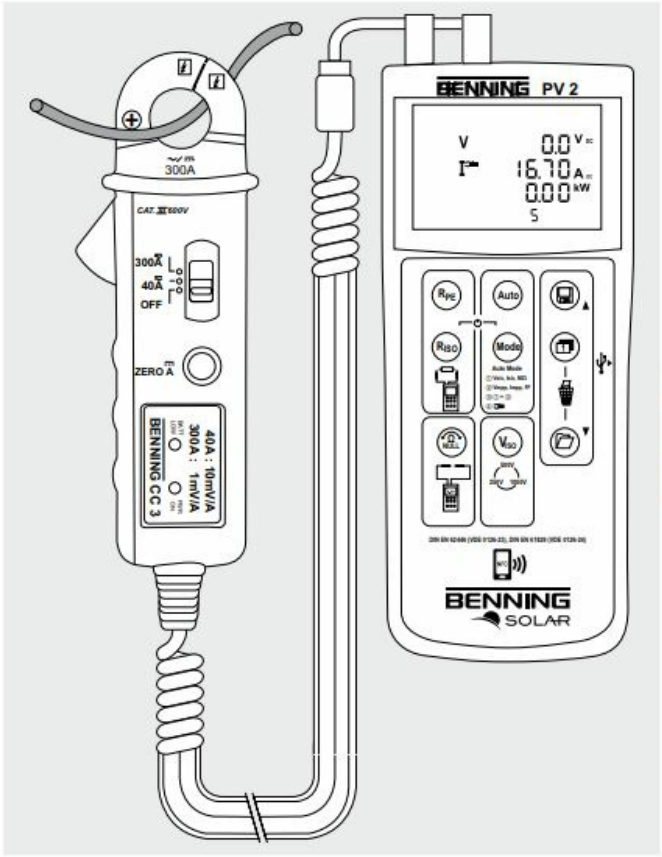
1. Connect the 4 mm measuring leads as shown in the figure.
2. Press the V_{ISO}-key ❼ to select an ISO testing voltage of 250 V, 500 V or 1.000 V.
3. For single measurement (2 sec.), press and release the R_{ISO}-key ❹.
   For continuous measurement, press and hold the R_{ISO}-key ❹ for several seconds until the 🔒 symbol is shown on the LC display ❶.
4. Press the R_{ISO}-key ❹ to terminate the continuous measurement.
5. Press the 💾-key ❿ to store the measured values.



Option:
40 m measuring leads BENNING TA 5
part no. 044039

8. AC/DC current measurement

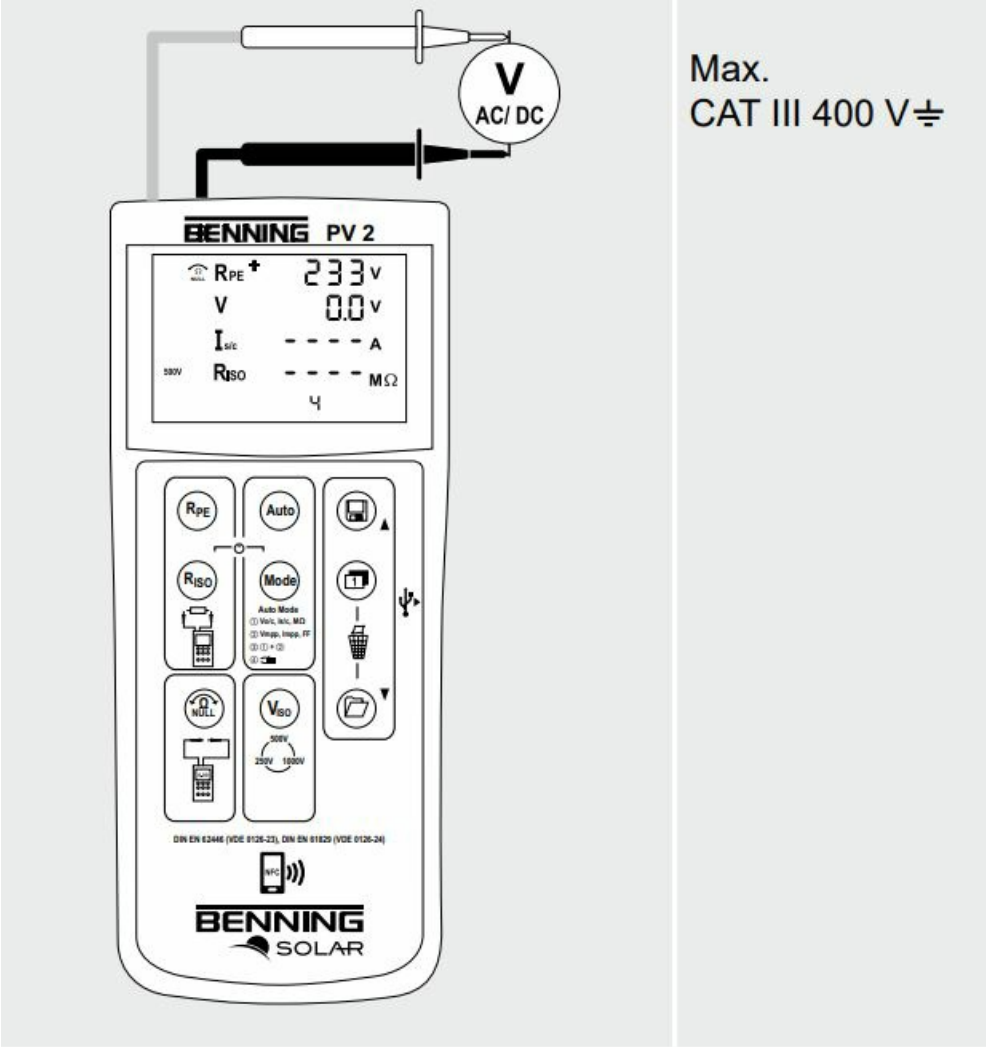
1. Disconnect all measuring leads from the BENNING PV 2.
2. Connect the BENNING CC 3 (option) current clamp adapter to the 4 mm test sockets.
3. Select the 40 A range on the BENNING CC 3.
4. Press the null balance key **(ZERO)** of the BENNING CC 3 for approx. 2 seconds.
5. Press the Mode-key ❺ to select the desired mode ④ of the BENNING PV 2. The symbol is shown on the LC display ❶.
6. The AC/DC current can be measured in single-wire live conductor.
7. Press the -key ❿ to store the measured values.



Option:
BENNING CC 3
part no. 044038

9. AC/DC voltage measurement

1. Disconnect the PV measuring leads from the BENNING PV 2.
2. Connect the red and black safety measuring lead as pictured.
3. The BENNING PV 2 automatically measures the AC/DC voltage at the measuring probes.
4. The polarity of the DC voltage is displayed by “+/-“. In case of AC voltage, “+/-“ will be displayed alternately.
5. Press the -key (**10)** to store the measured values.



10. Measured value memory (999 display screens)

-Store	Store all measurements currently on the LC display. In the RE-CALL mode, the measuring results are called in reverse order.
-Recall	Recall the stored measured values on the LC display. Press and hold to send the measured value memory to the USB port.
+	Clear all results from memory.
+Display	Switch-over of the LC display in the I-V characteristics mode from Vo/c, Is/c to Vmpp, Impp.

11. Downloading the measured value memory to the PC

1. Install the BENNING SOLAR data logger and driver from **http://tms.benning.de/pv2**.
2. Disconnect all measuring leads from the BENNING PV 2.
3. Connect the BENNING PV 2 to your PC by means of the USB connecting cable.
4. Start the PC software, select the COM port and click “Download”.
5. Switch on the BENNING PV 2, press the -key 8 and hold the -key 8 again for approx. 2 seconds to start the download.

6. Open the measured value file in the CSV format via MS Excel®.

Note:
The optional PC software BENNING SOLAR Manager (part no. 050423) allows documentation according to DIN EN 62446 (VDE 0126-23) as well as representation of the I-V characteristic according to DIN EN 61829 (VDE 0126-24).

12. Radio connection to the BENNING SUN 2

The BENNING PV 2 is able to receive the measured values (insolation, PV module / ambient temperature and date / time stamp) of the optional BENNING SUN 2 (part no. 050420) via radio connection.
Typical radio range in open space: approx. 30 m

Coupling with BENNING SUN 2

1. Remove all electronic devices in direct vicinity
2. Switch the BENNING PV 2 and the BENNING SUN 2 off.
3. Press and hold the two ON/OFF keys of the BENNING SUN 2.
4. Press and simultaneously hold the R_{ISO}-key 4 and the Mode-key 5 of the BENNING PV 2.
5. The BENNING PV 2 indicates the successful coupling by means of an acoustic signal and by displaying the serial no. of the BENNING SUN 2
6. The “W/m2” symbol is shown on the LC display 1 of the BENNING PV 2.

Decoupling from BENNING SUN 2

1. Remove all electronic devices in direct vicinity.
2. Switch the BENNING PV 2 off.
3. Press and hold the R_{ISO}-key 4 and the Mode-key 5 of the BENNING PV 2 for approx. 10 seconds.
4. The BENNING PV 2 indicates the decoupling from the BENNING SUN 2 by means of an acoustic signal and by clearing the LC display.
5. The “RPE/Ω” symbol is shown on the LC display 1 of the BENNING PV 2.

Activating/deactivating the radio transmission of the BENNING SUN 2

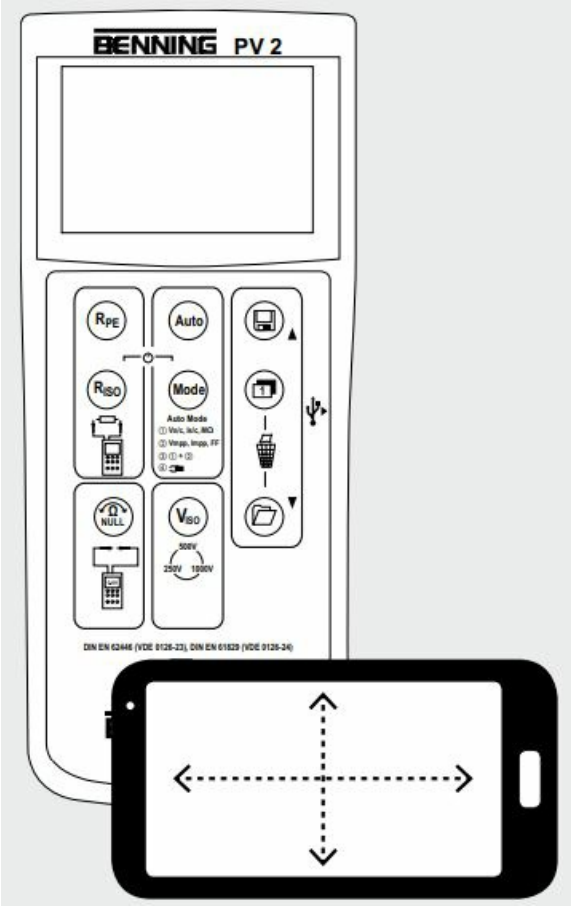
1. Couple the BENNING PV 2 with the BENNING SUN 2.
2. To activate/deactivate the radio transmission, press and hold the -key of the BENNING SUN 2 and simultaneously press the HOLD-key. A flashing triangle ▽ is shown on the LC display.
3. The BENNING PV 2 receives the measured values as soon as the insolation (W/m²) is shown on the LC display 1.
4. AUTO measurement (modes a – c) additional stores the temperature values and the date/time stamp of the BENNING SUN 2.
5. If the BENNING PV 2 is outside the radio range of the BENNING SUN 2, the “W/m2 ” on the LC display 1 starts flashing. Moreover, “_ _ _ _” is shown on the LC display, if the measured insolation value is outside the measuring range.

Note:
If the BENNING PV 2 does not receive any radio signal from the BENNING SUN 2, the display indications are stored with the date/time stamp of the BENNING PV 2.

13. Representing the I-V characteristic via the “BENNING PV Link” app

Requirements: NFC-enabled Android device
The app allows the user to represent and to compare the measured I-V characteristic and the power characteristic with the nominal module data of the manufacturer under STC conditions.
Please read the detailed operating manual of the BENNING PV 2 and of the “BENNING PV Link” first (**http://tms.benning.de/pv2**).

1. The NFC chip required for this functionality is located under the NFC logo on the top of the BENNING PV 2 housing.
2. Upon completion of each test procedure (modes b + c) as well as after calling a storage location via the -key 8 and pressing the -key 9, the I-V characteristic is written to the NFC chip.
3. The I-V characteristic can be read and represented via an Android device with NFC functionality.



14. Measuring ranges and limiting values

Function	Range
R_{PE}/V	0.05 Ω - 199 Ω/30 V - 440 V AC/DC
R_{ISO} (2-pin)	0.05 MΩ - 300 MΩ
Vo/c	5 V - 1000 V DC
Is/c	0.5 A - 15 A DC
R_{ISO} (AUTO measurement)	0.2 MΩ - 200 MΩ
I	0.1 A - 40 A AC/DC
ISO test voltage	**Limiting value of insulating resistance**
250 V	0.5 MΩ
500 V/ 1000 V	1.0 MΩ

15. Setting the date and time

1. Turn off the BENNING PV 2.
2. Press and hold the 🗁-key ❽ and then press simultaneously the R_{ISO}-key ❹ and the Mode-key ❺ of BENNING PV 2.
3. The date format and time format is shown as follows:
   MM.DD = month (1-12). Day (1-31)
   YYYY = year
   HH.mm = hours (0-23).minutes (0-59)
   SS = seconds (0-59)
4. Press the R_{PE}-key ❷ to select a date field and time field
5. A blinking field shows that this field can be set.
6. With the 🖫-key ❿ and the 🗁-key ❽, the value increases or decreases. With each change, the second field is set to zero.
7. Turn off the device to save the setting.

Note:
If the BENNING PV 2 has established a radio connection to the BENNING SUN 2, the date/ time of the BENNING PV 2 will be synchronized automatically after 10 seconds to the date/ time of the BENNING SUN 2, if the device detects a deviation of more than 1 minute. BENNING SUN 2 (master) → BENNING PV 2 (slave).

16. Error codes

Error code	Remedy
FUSE	The internal fuse has blown. Refer to chapter 9.5 in the operating instructions for details.
HOt	The electronic components of the BENNING PV 2 have reached the maximum admissible temperature. Disconnect the BENNING PV 2 from the object to be measured and let it cool down.
H iSC H iCu	The DC short-circuit current or the capacitive inrush current has the maximum value of 15 A. The measurement has been stopped.
H iOC	The DC open circuit voltage has exceeded the maximum value of 1000 V. The measurement has been stopped.
> 10.00 kW H iPr	The DC power has exceeded the maximum value of 10 kW. Measurement has been cancelled.
d IS- CONN ECt	Immediately disconnect the BENNING PV 2 from the PV generator!
do nOt USE Er 12	Please return the BENNING PV 2 to an authorized service center, see chapter 9.6 „Calibration“ for the address.
HOtF	
FEt	
rL 1,2,3 or 4	
Er 1,2 Etc.	
CAL	
FAIL STORE	Storage has failed. Please store the measured values again to the next storage location available.
nFC FAIL STORE	Storage to the NFC chip has failed. Please remove the NFC-enabled device from the BENNING PV 2.

Other error codes see detailed user guide (**http://tms.benning.de/pv2**).

17. Optional accessories

PC software BENNING SOLAR Manager (part no. 050423)
Temperature sensor with suction cup for BENNING SUN 2 (part no. 050424)
PV module holder for BENNING SUN 2 (part no. 050425)
Current clamp adapters BENNING CC 3 (part no. 044038)
Measuring lead BENNING TA 5, length 40 m (part no. 044039)

Documents / Resources

	**BENNING PV 2 Tester and Characteristic Curve Meter** [pdf] Instruction Manual PV 2, PV 2 Tester and Characteristic Curve Meter, Tester and Characteristic Curve Meter, Characteristic Curve Meter, Curve Meter, Meter

References

- tms.benning.de/
- User Manual