DATA SHEET
3-447-274-03
1/12.24

GOSSEN METRAWATT
GMC-INSTRUMENTS GROUP

PROFITEST PV 1540

PEAK POWER MEASURING INSTRUMENT AND CHARACTERISTIC CURVE TRACER FOR PHOTOVOLTAIC SYSTEMS WITH AUTO-RANGING UP TO 1500 V / 40 A

- PV module voltages up to 1500 V DC, currents up to 40 A DC
- Measurement of short-circuit current I_{SC}, open-circuit voltage U_{OC}, instantaneous peak power of a solar cell P_{max}, internal series resistance R_S and internal parallel resistance R_P
- Automatic conversion of instantaneous measured values to STC
- Patented calculation process for evaluating PV modules without knowledge of the manufacturer's specifications
- Patented calculation process for determining internal series resistance of the PV module based solely on a measured characteristic I-U curve
- Separate measurement of temperatures at the irradiation sensor and the back of the module for increased measuring accuracy
- High level of intrinsic safety thanks to included load disconnector (1000 V / 32 A_{DC}) for all-pole disconnection of the measuring instrument from the PV module
- Calibrated irradiation sensor in accordance with IEC/EN 60904-2 with integrated Pt1000 temperature sensor
- Integrated customer and module databases with bidirectional data exchange
- Visualization and evaluation software

APPLICATIONS

The PROFITEST PV 1540 facilitates the measurement of characteristic I-U curves for individual photovoltaic modules as well as photovoltaic strings.

With the help of a patented process, the instrument is capable of ascertaining peak power, internal series resistance and internal parallel resistance directly on-site with just a single measurement and without entering module data, which are then displayed at a high resolution color graphic touchscreen that's suitable for use in sunlight.

Troubleshooting in PV systems, as well as documentation of system quality, are executed quickly and economically during initial start-up and subsequent testing without a long learning curve. This simple yet decisive test assures safety for the customer and eliminates consequential costs for the installer.

Measured peak power can, for example, also be used in order to determine performance ratio.

Beyond this, acquired characteristic curves make it possible to draw further conclusions regarding the electrical characteristics of the measured module or string. And thus the instrument is also suitable for R&D.

INCLUDED FEATURES

Measurement of:

- Short-circuit current I_{SC}
- Open-circuit voltage U_{OC}
- Instantaneous peak power of a solar cell P_{max}
- Series resistance R_S
- Internal parallel resistance R_p

Calculation of:

- Peak power P_{Pk}
- Series resistance R_S
- Internal parallel resistance R_p
- Instantaneous values: U_{pmax}, I_{pmax}, P_{max}, U_{OC}, I_{SC}, FF, T_{mod}, T_{ref}, E_{RMS}

PRODUCT FEATURES

- 4-wire measurement cable to the PV module prevents systematic voltage measuring errors
- Calibrated irradiation sensor in accordance with IEC/EN 60904-2 with integrated Pt1000 temperature sensor
- 1500 V / 40 A_{DC} load disconnector included
- External power pack with broad-range input for charging the batteries, and for continuous operation of the measuring instrument
- Internal data memory for up to several thousand measurements
- Continuous display of momentary irradiation and temperature provides information regarding measuring conditions

DESCRIPTION OF FEATURES

PRECISE MEASUREMENTS

Sensors for irradiation and temperature are integrated by means of analog technology with a rugged data transmission line. As a result, irradiation can always be measured in real-time, and irradiation fluctuations are reliably detected within the millisecond range.

Power and temperature measurement via 4-wire cable for error-free results

Acquired characteristic I-U curve is highly accurate thanks to steady measurement at the capacitive load.

FLEXIBLE USE

A universal input permits use with commercially available irradiation reference sensors, assuring trouble-free on-site use of adapted sensors and sensor replacement.

Open interfaces permit operation of the instrument in special applications as well.

The PROFITEST PV 1540 can be operated either via a PC with direct transfer of measurement results (e.g. for long-term measurements) or directly at the instrument using the control unit.

COMPUTER SECTION

- Miniature industrial PC, real-time clock, no moving mechanical parts such as hard disks, fans etc.
- A/D sampling rate: max. 100 kHz, resolution: 12-bit
- Measuring accuracy for characteristic I-U curve better than 1%, peak power ±5%
- Data from several thousand measurements are automatically stored to the device permanently.

MEASURING SECTION

Parameter	Value
Sampling rate	Max. 100 kHz
Resolution	0.01 V … 0.25 V, 0.005 A … 0.001 A (depending on selected measuring range)
Measuring accuracy	Better than 1% (as of 10 W)
Ascertainment of Peak Power	
Tolerance	±5%
Reproducibility	±2%

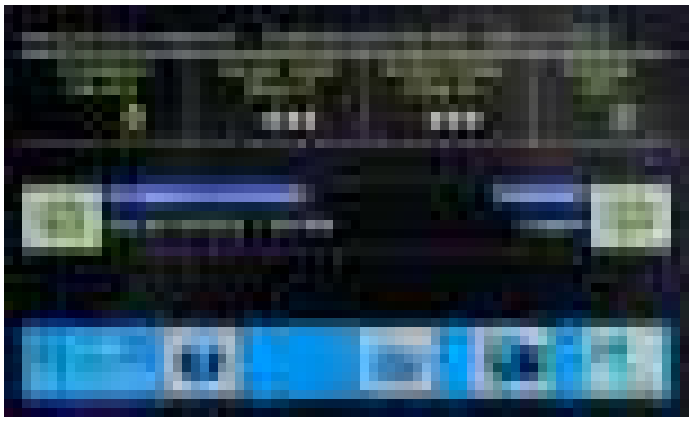
Measurement duration for separate measurement of individual modules: > 20 ms (approx. 100 pairs of measured values), and thus the capacitive characteristics of the device under test have no influence on the measurement.

- 4-wire measurement cable to the PV module prevents systematic voltage measuring errors.
- Irradiation reference sensor (Phox) with integrated Pt1000 temperature sensor
- Supplementary measurement of temperature at the back of the module is possible (a second Pt100 input is provided).

DATA INTERFACE

Interface	Function
Mains	External power pack: connection via barrel plug, 5.5 × 2.1 mm
Temperature	Connection for temperature sensor ■ Instruments with 2 measuring inputs: external Pt100 for acquiring temperature at the back of the module ■ Other instruments: external Pt100 for measuring temperature at the back of the reference cell
Irradiation	Connection for irradiation reference sensor (Phox) – the Pt100/Pt1000 reference sensor and the measured irradiation value are combined into a single 8-pin plug.
4-wire measurement	Measurement input (voltage measurement)
Current input	Power input (for current measurement)
PC	Connection to the PC via USB cable

DISPLAY

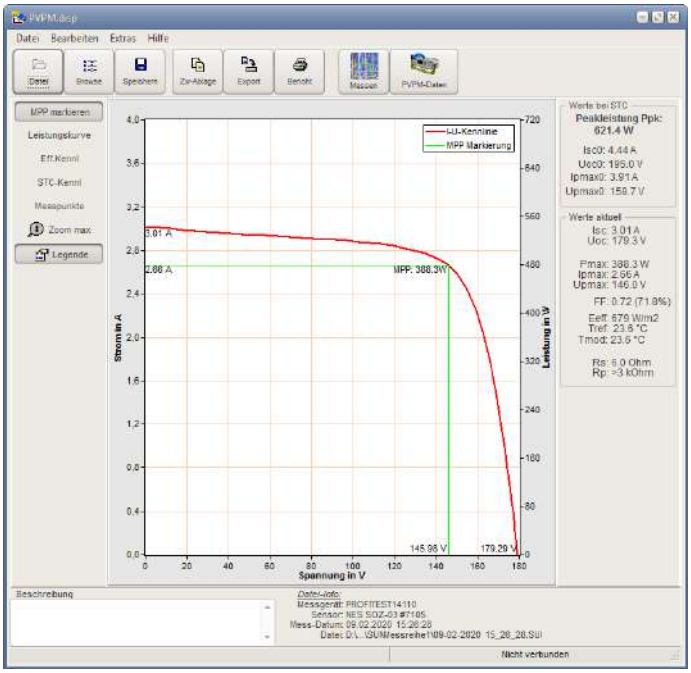


- Color LCD with LED backlight
- Resolution: 480 × 272 pixels
- Suitable for use in sunlight

OPERATION

- Menu driven via touch-screen directly at the instrument
- Operation and evaluation alternatively with Windows software
- Connection to the PC: USB mini-B socket to USB 2.0 cable

PV ANALYZER SOFTWARE



Software for visualization, evaluation and documentation of measured characteristic curve values with database

- Measured characteristic curve values are read in from the PROFITEST PV 1540
- Graphic representation of the characteristic I-U curve
  - With calculated MPP – maximum power point (P_{max})
  - In comparison with the characteristic power curve
  - In comparison with the TRMS curve
  - In comparison with the STC curve
  - Characteristic I-U curve with display of measuring points
- Representation of measured and calculated values under STC
- Overview of characteristic IU curves for a given test series in the browser window
- Export of measured values or results (e.g. as XLS file)
- Generation of a test report (e.g. as a PDF file)
- Online measurement – graphic representation of the characteristic curve and measured values (also suitable for continuous measurement)
- Access to the database and file management at the PROFITEST PV 1540
- Runs under Windows® 10 and Windows® 11

TECHNICAL DATA

Power Supply	Rechargeable lithium-ion battery:	11.25 V 8850 mAh 99.6 Wh Continuous operation: approx. 8 hr. Power consumption: approx. 40 W
	External power pack:	In 90 … 263 V_{AC} 47 … 63 Hz 60 W
Ambient Conditions	Operating temperature:	0 … +50 °C
	Storage temperature:	-10 … +85 °C
	Relative atmospheric humidity:	Max. 90%, no condensation allowed
	Elevation:	Max. 2000 m
Electrical Safety	Measuring category:	Cat III 1500 V_{DC}, max. 1500 V_{DC} between the inputs
	Pollution degree:	2
	Protection category:	II
Electromagnetic Compatibility (EMC)	Interference emission:	Conducted emission: EN 55011, group 1, class B EN 55032, class B
		Field strength: EN 55011, group 1, class A EN 55032, class BA
	Interference immunity:	EN 55011 EN55032 EN61326-1 EN61326-2-2 EN 61000-3-2 EN 61000-3-3 EN 61000-4-2 EN 61000-4-3 EN 61000-4-4 EN 61000-4-5 EN 61000-4-6 EN 61000-4-11
Mechanical Design	Protection:	Housing: IP67 per DIN EN 60529 / IEC 60529 (protection against ingress of solid foreign objects: dust-proof; protection against ingress of water: protected when immersed)
	Housing (W × H × D):	Approx. 410 × 328 × 175 mm
	Weight:	Approx. 9.5 kg
	Display:	Color LCD with LED backlight Resolution: 480 × 272 pixels Suitable for use in sunlight
Data Interfaces	USB:	USB mini-B socket, USB 2.0
Internal Memory	Flash memory in the instrument:	Space for 1000 measurements 50 module types can be exported to the PROFITEST PV 1540.
Computer Section	Miniature industrial PC:	A/D sampling rate: max. 100 kHz Resolution: 12-bit Measuring accuracy for characteristic I-U curve better than 1% Peak power: ±5%

RELEVANT STANDARDS

The instrument has been manufactured and tested in accordance with the following safety regulations:

DIN EN 60529 IEC 60529	Test instruments and test procedures Degrees of protection provided by enclosures (IP code)
DIN EN 61010-1 IEC 61010-1	Safety requirements for electrical equipment for measurement, control and laboratory use – Part 1: General requirements
DIN EN 61326-1 IEC 61326-1	Electrical equipment for measurement, control and laboratory use – EMC requirements – Part 1: General requirements
DIN EN 61326-2-1 IEC 61326-2-1	Electrical equipment for measurement, control and laboratory use – EMC requirements – Part 2-1: Particular requirements – Test configurations, operational conditions and performance criteria for sensitive test and measurement equipment for EMC unprotected applications

Regulations and standards for use of the instrument:

DIN EN 62446-1 IEC 62446-1	Photovoltaic (PV) systems – Requirements for testing, documentation and maintenance Part 1: Grid connected systems – Documentation, commissioning tests and inspection

CHARACTERISTIC VALUES

Measuring range	PROFITEST PV 1540
Voltage [V]	25, 100, 500, 1500
Current [A]	2, 5, 10, 40
Temperature [°C]	-40 °C … +120 °C with Pt1000
Irradiation	0 … 1300 W/m^2 (standard sensor)

SENSOR CONNECTION PIN ALLOCATIONS

Temperature (external): 4 pin female chassis socket, Lumberg KFV40

- Pin 1: current source + (~1 mA)
- Pin 2: Pt100 +
- Pin 3: Pt100 –
- Pin 4: current source - (~1 mA)

Irradiance: 8 pin female chassis socket, Lumberg KFV81 (plug: SV81)

- Pin 1: irradiance +
- Pin 2: Pt1000 (reference) +
- Pin 3: irradiance –
- Pin 4: current source + (~1 mA)
- Pin 5: current source – (~1 mA)
- Pin 6: unused (do not connect)
- Pin 7: unused (do not connect)
- Pin 8: Pt1000 (reference) –

SCOPE OF DELIVERY

Standard Scope of Delivery:

1	PROFITEST PV 1540 peak power measuring instrument
1	Shielded mini USB cable for connection to a PC
1	External power pack, 60 W
1	Irradiation reference sensor
1	External Pt100 temperature sensor for temperature at the back of the module or at the jumper plug
1	External safety disconnector between the 4-wire power measurement cable and the PROFITEST PV 1540
1	4-wire measurement cable, 10 m
1	Accessories case
1	PV analyzer software*
1	Test report
1	Calibration certificate

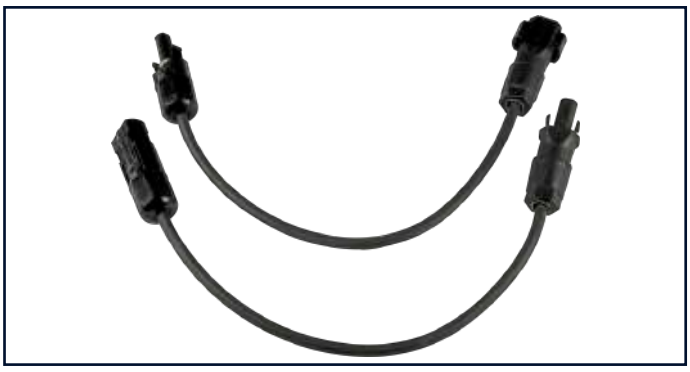
* Available for download

Available accessories ⇨ "Accessories" 🗎6.

OPTIONAL ACCESSORIES

SUNCLIX – MC4 PV ADAPTER SET (Z360H)

Solar connector cable, length: 300 mm, cross-section: 4 mm^2



ORDER INFORMATION

INSTRUMENTS

Type	Description	Article Number
PROFITEST PV 1540	Peak power measuring instrument and characteristic curve tracer for photovoltaic systems with auto-ranging up to 1500 V / 40 A.	M360G

ACCESSORIES

Type	Description	Article Number
SUNCLIX-MC4 PV Adapter Set	Solar connector cable, length: 300 mm, cross-section: 4 mm 2	Z360H

Further information is available:

- on the Internet at www.gossenmetrawatt.com
- in our Measuring Instruments and Testers catalog

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