

# PROFITEST | PV

## Peak Power Measuring Instrument and Curve Tracer for PV Modules and Strings (Measurement at Capacitive Load)

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4/11.13

- Generator voltage up to 1000 V DC, current up to 20 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 momentary measured values to STC
- Patented calculation process for evaluating PV generators without knowledge of the manufacturer's specifications.
- Patented calculation process for determining the generator's internal series resistance 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 disconnecter (1000 V/32 A DC) for all-pole disconnection of the measuring instrument from the PV generator
- Calibrated irradiation sensor per IEC/EN 60904-2 with integrated Pt1000 temperature sensor
- Integrated customer database with bidirectional data exchange
- Integrated module database with bidirectional data exchange
- Software for graphic visualization, evaluation and report generation with integrated database



### Applications

The PROFITEST PV allows for the measurement of characteristic I-U curves, as well as individual photovoltaic modules and 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 only one measurement and without entering module data”**, which are then indicated at a high-resolution color graphic touch-screen which is 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 peak 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.

### Features

- Internal data memory for up to several thousand measurements
- Acquired characteristic I-U curve is highly accurate thanks to steady measurement at the capacitive load
- Displayed (calculated) values: peak power  $P_{PK}$ , internal series resistance  $R_S$ , internal parallel resistance  $R_P$ , instantaneous values:  $U_{pmax}$ ,  $I_{pmax}$ ,  $P_{max}$ ,  $U_{OC}$ ,  $I_{SC}$ , FF,  $T_{mod}$ ,  $T_{ref}$ ,  $E_{TRMS}$

- Power and temperature measurement via four-conductor cable for error-free results
- 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. As a rule, measurement data cannot be transmitted continuously with solutions based on radio transmission, and thus only a snapshot is provided. However, irradiation typically changes by up to several hundred  $W/m^2$  even in the millisecond range.
- Continuous display of momentary irradiation and temperature provides information regarding measuring conditions.
- Universal input allows for use with commercially available irradiation reference sensors, assuring trouble-free on-site use of adapted sensors and sensor replacement.
- Operation of the PROFITEST PV via a PC with direct import of results (e.g. for continuous measurement)
- External power pack with broad-range input for charging the batteries, and for continuous operation of the measuring instrument
- Open interfaces allow for operation of the instrument in special applications as well
- High level of intrinsic safety thanks to included load disconnecter (1000 V / 32 A DC)

## Peak Power Measuring Instrument and Curve Tracer for PV Modules and Strings (Measurement at Capacitive Load)

Regulations and standard in accordance with which the test instrument is manufactured and tested:

IEC 61010-1/EN 61010-1/ VDE 0411-1	Safety requirements for electrical equipment for measurement, control and laboratory use – General requirements
EN 60529 VDE 0470, part 1	Test instruments and test procedures Degrees of protection provided by enclosures (IP code)
DIN EN 61326-1 VDE 0843-20-1	Electrical equipment for measurement, control and laboratory use – EMC requirements – Part 1: General requirements

Regulations and Standards for Use of the Test Instrument

IEC 62446 VDE 0126-23	Grid connected photovoltaic systems – Minimum requirements for system documentation, commissioning tests and inspection
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### Characteristic Values

Standard Measuring Ranges			
Voltage [V]	Current [A]	Temperature	Irradiation
25, 100, 500, 1000	2, 5, 10, 20	-40 to +100 °C with Pt1000	0 to 1300 W/m <sup>2</sup> (standard sensor)

The measuring ranges can be combined with each other. The measuring instrument automatically selects the ideal measuring range.

### Computer Unit

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 saved at the device permanently (flash memory)

### Measuring Unit

Sampling rate	Max. 100 kHz,
Resolution	0.01 to 0.25 V, 0.005 to 0.001 A (depending on selected measuring range)
Measuring accuracy	Better than 1%

#### 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 measurement.

- 4-conductor measurement cable to the generator 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)
- Commercially available reference sensors such as the ISET-Sensor® can be connected via interference-free cable connection
- Connection is only permissible to direct voltage sources with current limiting (e.g. photovoltaic generators)

### Sensor Connection Pin Allocations

Temperature (external): 4 pin female chassis socket, Lumberg KVF40  
 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 KVF81 (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) –

### Ambient Conditions

Accuracy	0 to + 40 °C
Operation	0 to + 40 °C
Storage	-10 to + 85 °C (without batteries)
Relative humidity	
Operation	10 to 90% (non-condensing), no condensation allowed
Storage	5 to 95% no condensation allowed

### Power Supply

Rechargeable batteries	Li-Ion-Accumulator, 11.25 V, 8850 mAh, 99.6 Wh (continuous operation: approx. 8 hr.)
Power consumption	Approx. 40 W
External power pack	In: 90 to 263 V AC, 47 to 63 Hz, 40 W, Out: 16 V DC

- UL approval
- Integrated charge controller for protection against overcharging and excessively depleting the batteries
- Charge level indication by means of LED on the housing (status display on the PROFITEST PV)

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## Display



Display Color LCD with LED backlight  
 Resolution 480 x 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 PC: USB, standard B socket
- USB cable: standard USB 2.0 cable

## Mechanical Design

Protection IP20  
 Dimensions W x H x D: 480 mm x 315 mm x226 mm  
 Weight Approx. 9,5 kg

## Interfaces

The PROFITEST PV is equipped with the following inputs and outputs (except for the jacks for the external power pack, all interfaces are located on the front panel, and are labeled):

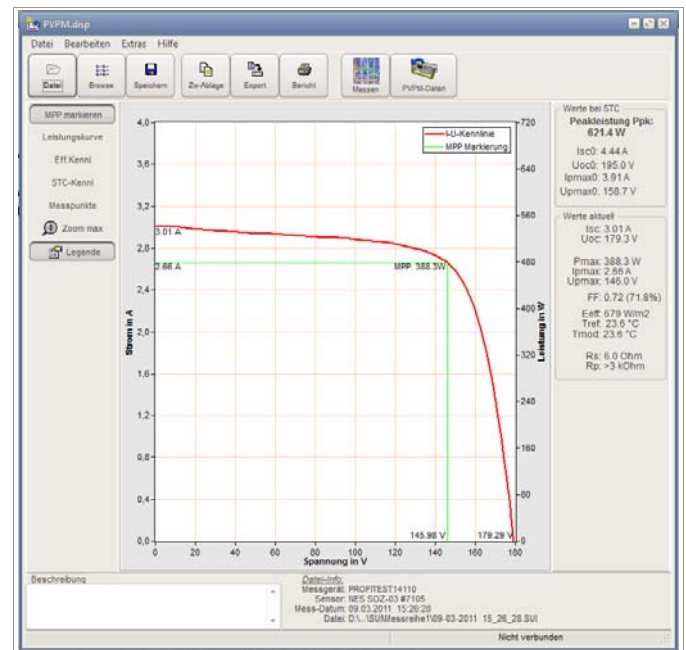
Interface	Function
Mains	External power pack: connection via jack plugs, 5,5 x 2,1 mm
Temperature	Connection for temperature sensor <ul style="list-style-type: none"> <li>• Instruments with 2 temperature measuring inputs: external Pt100 for acquiring temperature at the back of the module</li> <li>• Other instruments: external Pt100 or Pt1000 (depending on variant) for measuring temperature at the back of the reference cell</li> </ul>
Irradiation	Connection for irradiation reference sensor (Phox) <ul style="list-style-type: none"> <li>• The Pt100/Pt1000 reference sensor and the measured irradiation value are combined into a single 8-pin plug.</li> </ul>
4-wire measurement	Measurement input (voltage measurement)
Current input	Power input (for current measurement)
PC	Connection via USB cable

## PC Software Features

### PV Analyzer

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

- Measured characteristic curve values are read in from the PROFITEST PV
- Graphic representation of the characteristic I-U curve
  - With calculated MPP – maximum power point (Pmax)
  - 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 I-U curves for a given test series in browser window
- Export of measured values or results (e.g. XLS file)
- Generation of test reports (e.g. PDF file)
- Online measurement – graphic representation of the characteristic curve and measured values (also suitable for continuous measurement)
- Online access to the database and file management at the PROFITEST PV
- Compatible with MS Windows® NT, 2000, XP, Vista, 7



## Peak Power Measuring Instrument and Curve Tracer for PV Modules and Strings (Measurement at Capacitive Load)

### Included Accessories

#### Irradiation Reference Sensor (Z360C)

Calibrated monocrystalline irradiation sensor, integrated Pt1000 temperature sensor, with mounting and 10 m connector cable



#### Mounting of Irradiation Reference Sensor on a PV-Modul



#### External Pt100 Temperature Sensor, 10 m Long (Z360D)



#### External Safety Disconnecter (Z360B)

External load disconnecter (1000 V / 25 A) for all-pole disconnection of the measuring instrument from the PV generator



#### 4-Conductor Measurement Cable, 10 m Long (Z360A)

For connecting the load disconnecter and the PV generator



#### External Power Pack, 16 V DC, 2.5 A (Z360G)

For supplying power to the PROFITEST PV





# Peak Power Measuring Instrument and Curve Tracer for PV Modules and Strings (Measurement at Capacitive Load)

## PROFITEST PV Case System

For the test instrument



For accessories



## Optional Accessories

Trolley for PROFITEST PV Case System (Z502V)  
can only be used in combination with the accessory case (TOOLS)  
Carrying handle retracted



Carrying handle extended



## Peak Power Measuring Instrument and Curve Tracer for PV Modules and Strings (Measurement at Capacitive Load)

Extension cable for Pt100 (Z360E)



PV Adapter Set MC3-MC4 (Z360K)



Extension cable for Referenz-Sensor (Z360F)



PV Adapter Set SUNCLIX-MC4 (Z360H)

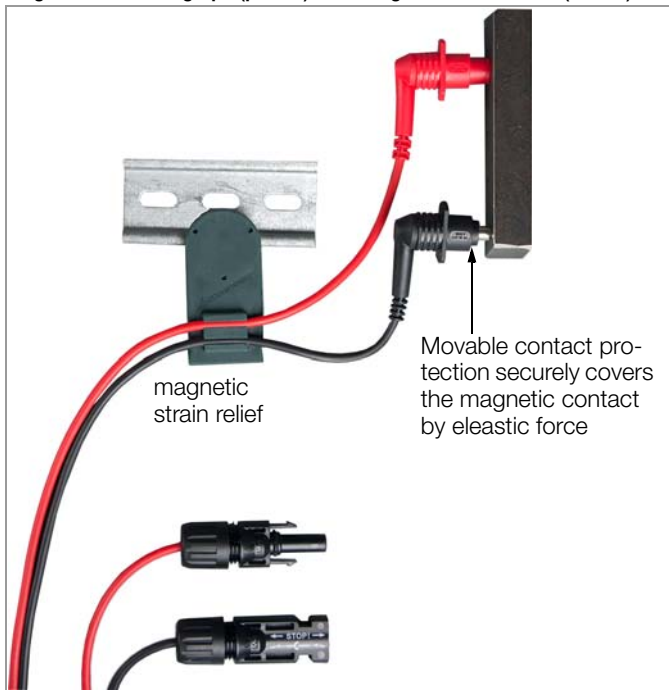


PV Adapter Set TYCO-MC4 (Z360J)



# Peak Power Measuring Instrument and Curve Tracer for PV Modules and Strings (Measurement at Capacitive Load)

Magnetic measuring tips (patent) with magnetic strain relief (Z502Y)



## Order Information

Description	Type	Article Number
Peak power measuring instrument and curve tracer for PV modules and strings (measurement at capacitive load) including accessories	PROFITEST PV	M360A
Trolley for case system	Trolley	Z502V
4-wire-Power-Measurement-Cable (Set) for PROFITEST PV, 2 x 10 m	4-wire-Measurement-Cable 10 m	Z360A
4-wire-Power-Measurement-Cable (Set) for PROFITEST PV, 2 x 25 m	4-wire-Measurement-Cable 25 m	Z360L
External Safety Disconnecter (4-pin) 1.000 V DC / 32 A DC, SANTON X-TYPE in housing IP65, Multi Contact MC – Safety lab plugs / -sockets 4 mm	External Safety Disconnecter	Z360B
Irradiation Reference Sensor with integrated Pt100 temperature sensor, 10 m	Irradiation Reference Sensor	Z360C
Surface probe for temperature Pt100, stainless steel housing, IP54, temperature range -30 °C until +150 °C, Accuracy class DIN 1/3 B, 4-conductor measurement cable, 10 m	PV-Surface probe Pt100	Z360D
Extension cable for external surface probe Pt100, 10 m for PROFITEST PV	Extension cable for Pt100	Z360E
Extension cable for Reference sensor with integrated temperature sensor Pt 1000, 10 m for PROFITEST PV	Extension cable for Reference sensor	Z360F
Charger for Profitest PV, wide range input 90-264 V AC, output 16 V DC (Mascot)	Charger for PROFITEST PV	Z360G
Solar connection cable, length 300 mm, diameter 4 mm <sup>2</sup>	PV Adapter Set MC3-MC4	Z360K
Solar connection cable, length 300 mm, diameter 4 mm <sup>2</sup>	PV Adapter Set SUNCLIX-MC4	Z360H
Solar connection cable, length 300 mm, diameter 4 mm <sup>2</sup>	PV Adapter Set TYCO-MC4	Z360J
2 magnetic measuring tips with contact protection – Set with magnetic holder 5,5 mm in diameter insulated with <b>MC4 plug</b> (for Photovoltaic Tester), CAT III 1.000 V / 4 A, temperature between -10 °C and 60 °C, under standard conditions and flat-head screws holding force 1.200 g vertical to contact area	Set 2 – Magnetic Measuring Tips	Z502Y

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