



PVPM 1540X (1500V, 40ADC, 60kW)

Peak Power Measuring Device and IV-Curve Tracer for Photovoltaic Generators

The PVPM 1540X is designed to measure the IV curve of utility-scale photovoltaic strings or arrays, even high capacity modules like bi-facial or PERC. Using patented methods, the instrument can measure and calculate the peak power P_{pk} , R_s and R_p directly at the installation site of the PV system. Calculation results and the IV curve can be displayed on the internal colour TFT display.

Peak power is the output of a PV module under standard test conditions (STC) [1]. Formerly, the very complex measurement of peak power was only possible in specially equipped laboratories. Using a patented method [2] developed by Professor Wagner at the University of Applied Sciences in Dortmund, Germany, the PVPM makes this measurement simple.

This allows the quality control of a PV system to be carried out quickly and economically. In practice, this simple and meaningful check provides peace of mind for both the customer and the installer. In



addition, the measured I-V curves allow further explanations of the electrical characteristics of the tested module or string. The PVPM 1540X is therefore also suitable as a research and development tool.

The Device

- ✓ precise I-V-curves due to capacitive load
- ✓ integrated module database
- ✓ integrated customers database
- ✓ easy touch screen operation
- ✓ high-contrast and highly dissolving colour TFT display
- ✓ self-contained mobile operation (no other equipment required)



- ✓ everlasting and waterproof plastic housing
- ✓ 32 bit miniature industrial PC
- ✓ internal Li-Ion battery power supply including charge controller
- ✓ external power adaptor with wide range input (world-wide use), charge & continuous operat.
- ✓ data transfer and further analysis of measured data on a PC (isolated USB connection)
- ✓ with PC: continuous measurements with adjustable time intervals

The Measurement

The PVPM automatically measures the IV-characteristic of the generator at a capacitive load. From the measured data it calculates the effective solar cell characteristic, P_{pk} and R_s . [2], [3]. The **IV-characteristic** can be shown directly on the bright TFT display. After the measurement the data are stored automatically in a non-volatile storage and so they are available also later (in the office) [4]. The device can store the data of several thousand measurements.

The following results are displayed:

- Permanent values:
Peak Power P_{pk}
Internal Series Resistance R_s
Internal Parallel Resistance R_p
- Current values, (depending on irradiation and temperature):
 V_{pmax} , I_{pmax} , P_{max}
 V_{oc} , I_{sc} , FF , T_{mod} , E_{eff}
- I-V-curve diagram

[1] IEC60904-3: STC= Irradiance 1000 W/m², Spectrum AM=1.5, Cell Temperature 25°C.

[2] Wagner A.: Peak Power and Internal Series Resistance Measurement under Natural Ambient Conditions. – EuroSun Copenhagen 2000.

[3] Bendel C., Wagner A.: Photovoltaic Measurement relevant to the Energy Yield. - WCPEC3 Osaka 2003

[4] Schulte K.M., Wagner A.: Die Effektive Solarzellenkennlinie. - Anwendung Teillast-Berechnung. Staffelstein 2002

Technical Data (subject to change)

Housing:

Sturdy, military grade PELI case, watertight, crushproof, and dust proof (IP67 when closed), easy-open, double-step latches, automatic pressure equalization valve, comfortable, rubber over-moulded handle, durable plastic foil front plate. All connectors accessible at the front plate.

Measurement and Evaluation Unit:

Industrial class PC, flash data storage 512MB (sufficient for several 1000 measurements)

No mechanically moved parts such as fixed disks, fan or similar

Sampling rate max. 100kHz, resolution 12Bit

Measuring accuracy for the I-V-characteristic better 1%, for the peak performance $\pm 5\%$

4-wire-measurement Kelvin leads avoids systematic errors in voltage measurement

Measuring period single measurement 0.02 - 2 seconds (100 pairs of measured values)

Irradiation reference sensor with integrated Pt1000 temperature sensor

Measurement of the back surface temperature of the module under test

Other commercially available irradiance reference sensors (i.e. from ISE Fraunhofer) can be used (see price list)

| Measuring Ranges | Voltage / VDC | Current / ADC | Temperature / °C | Irradiance / W/m ² |
|------------------|-----------------------|-----------------|-------------------------------|-------------------------------|
| PVPM1540X | 25 / 100 / 500 / 1500 | 2 / 5 / 10 / 40 | -40°C - +120°C with Pt1000 | 0 - 1300 (Standard Sensor) |

Maximum power: 48kWp assuming a fill factor of 80% of the modules under test.

Each voltage measuring range can be combined among each current range

The measuring instrument automatically selects an optimal measuring range

The device must be used only for the test of current limited, not grounded DC sources (photovoltaic generators)

Display

Daylight-readable colour TFT touch display, LED back-light, resolution 480 x 272 pixels, high contrast

Operation

Menu driven by touch function of the display directly at the device

Operation and analysis alternatively with MS-Windows® application, communication over isolated USB

Power Supply

Lithium-Ion battery 11.25V/8.8Ah/99.6Wh (continuous operation about 8h), flight approval

External power supply with wide range input 90-264Vac, 47-63Hz, UL-approved, power 40W

Internal automatic battery charge controller with overcharge protection

Display of the charge state by control LED at the front side of the housing

Continuous measurement can be taken during mains operation

Dimensions

Width: 40.6cm, height: 17.5cm, depth: 33cm, weight: about 8.5kg

Operating Conditions

| | Temperature | Humidity |
|-----------|---------------|-----------------------------|
| Operation | 0°C to 50°C | 10% to 90% (non-condensing) |
| Storage | -10°C to 85°C | 5% to 95% |

Scope of Supply

- Measuring instrument in sturdy plastic housing with carrying handle
- External power supply for charging and mains operation
- 4-wire-lead (10 meters, other on request) with MC4 connectors
- Calibrated irradiation sensor (monocrystalline) and integrated temperature sensor Pt1000 with lead
- USB cable for linking an evaluation PC
- Control software for MS Windows® XP, Vista, 7, 8, 8.1, 10, 11
- Printed Users Manual
- External Santon Security Switch 1500VDC, disconnects all wires between PVPM and generator
- Aluminium case for accessories (leads, sensors, tools)

Optionally available

- Individually adapted test leads and extension cables
- Calibrated irradiance reference Sensors for several module technologies

Warranty

We grant a warranty of 24 months starting from date of purchase on production and material defects as well as free updates of the evaluation software (download from Internet: <https://t1p.de/mqd7>)