

PVPM | 2540C  
6020C  
1000C  
1000C40

## Peak Power Measuring Device and Curve Tracer for Photovoltaic Modules

The devices of type PVPM enable the measurement of the I-V-curve of photovoltaic modules as well as of strings. By a newly developed procedure the device can measure and calculate the peak power  $P_{pk}$ , the  $R_s$  and  $R_p$  directly at the place of assembly of the PV system. Calculation results and the diagram can be displayed on the internal LCD-display.

The peak power is the power of a module under Standard Test Conditions (STC) [1]. So far the very complex measurement of the peak power was possible only in particularly suited laboratories. By a new procedure [2], which was developed by Professor Wagner at the University of Applied Sciences Dortmund (patented), the measurement with the PVPM can easily be performed.

So the quality control of a PV system can be executed fast and economically. This simple and



meaningful check in practice serves the certainty of the customer and also that of the installer. Beyond that the measured I-V-curves permit further explanations about the electrical characteristics of the verified module or string. So the PVPM is suitable as well as an instrument in research as for development purposes.

### The Device

The PVPM is a mobile measuring device with integrated battery supply and charge controller in a durable metal housing. The device has its own industrial miniature PC and a high-contrast LCD display and thus its function is independent of other devices. However if desired a PC can be attached for data transfer and further analysis of

the measured values over a standard interface. The PVPM is operated comfortably over few keys and an on-screen menu. The functions are defined self-describing and the user is always led by the program. So no long training activities for the operating staff are necessary.

### The Measurement

The PVPM automatically measures the I-V-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 **I-V-characteristic** can be shown directly on the LCD display. After the measurement the data are stored automatically in a non-volatile storage and so are available also later (in the office) [4]. The device internally stores the data of several 1000 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:

$$V_{pmax}, I_{pmax}, P_{max}$$

$$V_{oc}, I_{sc}, FF, T_{mod}, E_{eff}$$

[1] IEC60904-3: STC= Irradiance 1000 W/m<sup>2</sup>, Spectrum AM=1.5, Cell Temperature 25°C.

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

# PVPM 2540C / 6020C / 1000C / 1000C40

## Technical Data (subject to change)

Construction with sturdy metal housing, adjustable carrying handle, durable plastic foil 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, exhaust or similar

Sampling rate max. 100kHz, resolution 12Bit

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

Four-wire-measurement leads avoids systematic errors in voltage measurement

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

Irradiation reference sensor (Phox) with integrated Pt100/Pt1000 temperature sensor

Optional additional measurement of the back surface temperature of the module under test

Other commercially available irradiance reference sensors can be used

Measuring Range	Voltage dc	Current dc	Temperature	Irradiance
PVPM2540C	25 / 50 / 100 / 250 V	2 / 5 / 10 / 40 A	-40°C - +120°C with Pt1000	0 - 1300 W/m <sup>2</sup> (Standard-Sensor)
PVPM6020C	25 / 100 / 300 / 600 V	2 / 5 / 10 / 20 A		
PVPM1000C	25 / 100 / 500 / 1000 V	2 / 5 / 10 / 20 A		
PVPM1000C40	25 / 100 / 500 / 1000 V	2 / 5 / 10 / 40 A		

The measuring ranges can be combined among each other.

The measuring instrument automatically selects an optimal measuring range.

### Display

Large daylight-capable LCD with LED backlight, resolution 256 x 128 pixels, monochrome

Representation black text on white background, thus high contrast

### Operation

Menu controlled by plastic foil keyboard directly at the device

Operation and analysis alternatively with MS-Windows® application, communication via RS232

### Voltage Supply

Lead Acid accumulator 12V/3.4Ah (continuous operation 3h), optionally 12V/7.2Ah

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

Internal automatic battery charge controller with overloading protection

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

### Dimensions

Width: 48cm, height: 16cm, depth: 35cm, weight: about 9.9kg (PVPM2540C), 10.9kg (PVPM1000C40)

### Operating Conditions

	Temperature	Dampness
Operation	0°C to 40°C	10% to 90% (non-condensing)
Storage	-10°C to 85°C	5% to 95%

### Scope of Supply

- Measuring instrument in sturdy metal housing with adjustable carrying handle
- Battery supply, external power supply for battery charging and line operation
- 4-wire-lead (10 meters, more on request)
- Standardised radiation sensor Phox and integrated temperature sensor Pt1000 with lead
- USB cable for linking an evaluation PC
- Control software for MS Windows® 2000, XP, Vista, 7
- Users Manual
- External Santon Security Switch 1000V / 32A
- Plastic case for leads and sensor

### Optionally available

- Software for MS Windows for the automatic generation of test reports
- Test lead with 15 or 25 m (other lengths on request)
- Housing optionally as 19" rack mounting cover.

### Warranty

We grant a warranty of 24 months starting from date of purchase on production and material defects as well as 12 months free updates of the firmware (download from Internet: [www.pv-e.de](http://www.pv-e.de))