



**PVPM | 1000CX** (1000V, 20Adc)  
**1000CX40** (1000V, 40Adc)

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

The PVPM 1000CX / 1000CX40 enables the measurement of the I-V-curve of photovoltaic modules as well as of strings or arrays. 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 installation site of the PV system. Calculation results and the diagram can be displayed on the internal colour TFT-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 patented procedure [2], which was developed by Professor Wagner at the University of Applied Sciences Dortmund, 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. That is why the PVPM 1000CX / 1000CX40 is suitable as an instrument in research and for development purposes as well.

**The Device**

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



- ✓ everlasting and waterproof plastic housing
- ✓ 32 bit miniature industrial PC
- ✓ internal battery power supply including charge controller
- ✓ external power pack 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 selectable time intervals

**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 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/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 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 plastic housing, watertight, crushproof, and dust proof (IP67), 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, exhaust 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 leads avoids systematic errors in voltage measurement  
 Measuring period single measurement 0.02 - 2 seconds (100 pairs of measured values)  
 Irradiation reference sensor (Phox) with integrated Pt1000 temperature sensor  
 Optional additional measurement of the back surface temperature of the module under test  
 Other commercially available irradiance reference sensors (i.e. ISET® sensor) can be used

Measuring Ranges	Voltage dc	Current dc	Temperature	Irradiance
PVPM1000CX	25 / 100 / 500 / 1000 V	2 / 5 / 10 / 20 A	-40°C - +120°C	0 - 1300 W/m <sup>2</sup>
PVPM1000CX40	25 / 100 / 500 / 1000 V	2 / 5 / 10 / 40 A	with Pt1000	(Standard Sensor)

The measuring ranges can be combined among each other

The measuring instrument automatically selects an optimal measuring range

The device must be used only for the test of current limited dc sources (photovoltaic generators)

### Display

Daylight-suited colour-TFT display with 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

### Voltage Supply

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

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

Continuous measurement possible during mains operation

### Dimensions

Width: 40.6cm, height: 17.5cm, depth: 33cm, weight: about 7.7kg

### Operating Conditions

	Temperature	Dampness
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
- Battery supply, external power supply for battery charging and line operation
- 4-wire-lead (10 meters, other on request)
- 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
- Printed Users Manual
- External Santon Security Switch 1000V / 32 or 40A, disconnects all wires between PVPM and generator
- Aluminium case for leads and sensors

### Optionally available

- Software for MS Windows for the automatic generation of test reports (PVPMreport)
- 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: [www.pv-e.de](http://www.pv-e.de))