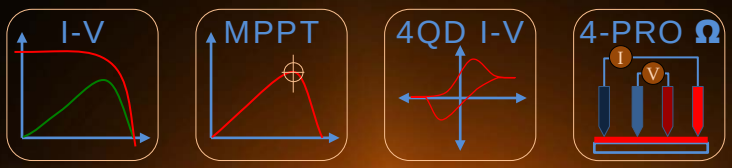
PV Power Analyzer

Type VK-PA-100

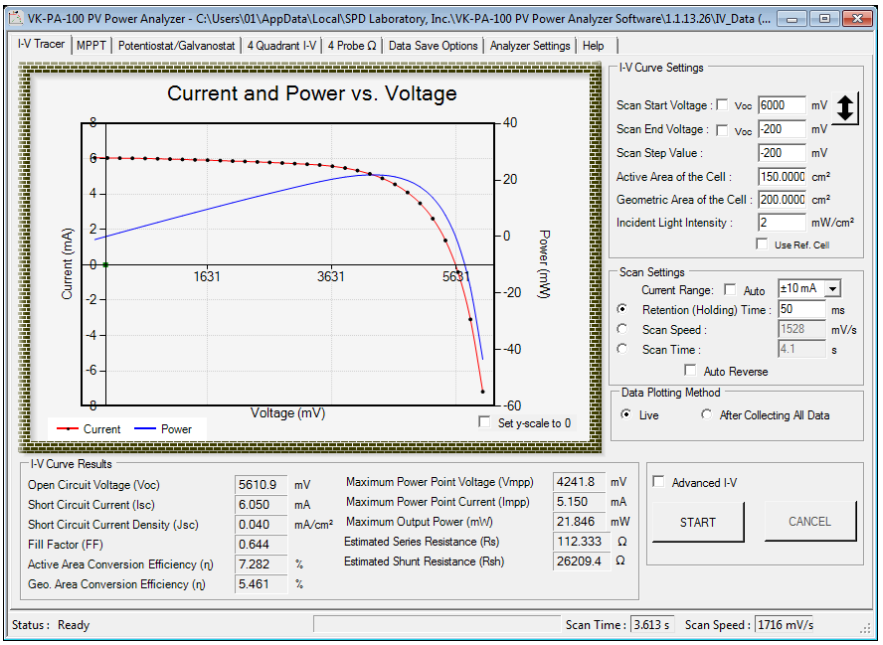
One Instrument for 5 Different Laboratory Applications:

- Solar cell I-V characterization (V_{oc}, J_{sc}, FF, η, R_s, R_{sh})
- Maximum Power Point Tracking with P_{max} & Efficiency vs. time plot
- Four quadrant I-V analysis (Dark I-V, Stepwise Cyclic Voltammetry)
- Four probe resistance measurements (Sheet resistance, Resistivity)
- Use as a potentiostat or Galvanostat



Specifications

Measurement Range	Voltage: ±10 V Current: 1 A (3 A Pulse) with 5½-digits resolution
Measuring Technique	Digital Source/Measure
Inputs	Front: 4 probes for PV device Back: 4 wire connector for reference cell (light intensity measurement)
A/D Converters	16 Bit (2 independent ADCs for V & I measurements)
User Interface and data collecting	Computer software is provided for control of all the functions and data logging. Measurement data can be saved as a text file and directly plotted on ®Microsoft Excel graph. (Windows based PC required)
Communication	Bluetooth
Power Requirement	100 – 240 VAC (50-60 Hz)
Electrical standard	CE RoHS compliant
Dimensions, Weight	93 mm x 210 mm x 350 mm, 2.5 kg



Features of Solar Cell I-V Tracer

User selectable START, END and STEP voltages. Plots current and power vs. voltage curves. Calculated results include V_{oc}, I_{sc}, J_{sc}, P_{max}, V_{mpp}, I_{mpp}, FF, R_s, R_{SH}, $\eta_{activeA}$, and η_{geoA}. User can set the desired scan speed, scan time, or holding time. Advanced I-V option allows initial, middle, and end point holding times. I vs. t transient plot for all data points and/or under a selected fixed voltage.

Features of Maximum Power Point Tracking (MPPT) Function

Analyzer acts like the best load for the cell to extract maximum power point (MPP) and keep tracking MPP continuously. Plots P_{max} ,V_{mpp} , I_{mpp} and Efficiency vs. time curves and also display current/power vs. voltage plots.

Features of Potentiostat/Galvanostat Function

Plot the voltage, current vs. time under a given fixed output voltage or fixed current. User can directly measure the open circuit voltage, and short circuit current of the cell. Programmable electro deposit function.

Features of Full Range I-V Function

User selectable START, END, STEP voltages and SCAN SPEED (mV/s). Plot current vs. voltage curve for given number of voltage sweep cycles in potentiostat mode. Can be used in 3 electrodes liquid cell with reference electrode.

Four Probes Resistance Measurement

Three special functions included to easily measure **sheet resistance**, **resistivity**, and **resistance**. Geometric correction factors are automatically calculated according to size and measuring probe location on the sample which are entered as parameters. Measurement range 2.0×10^{-3} to 5.0×10^{6} Ω .

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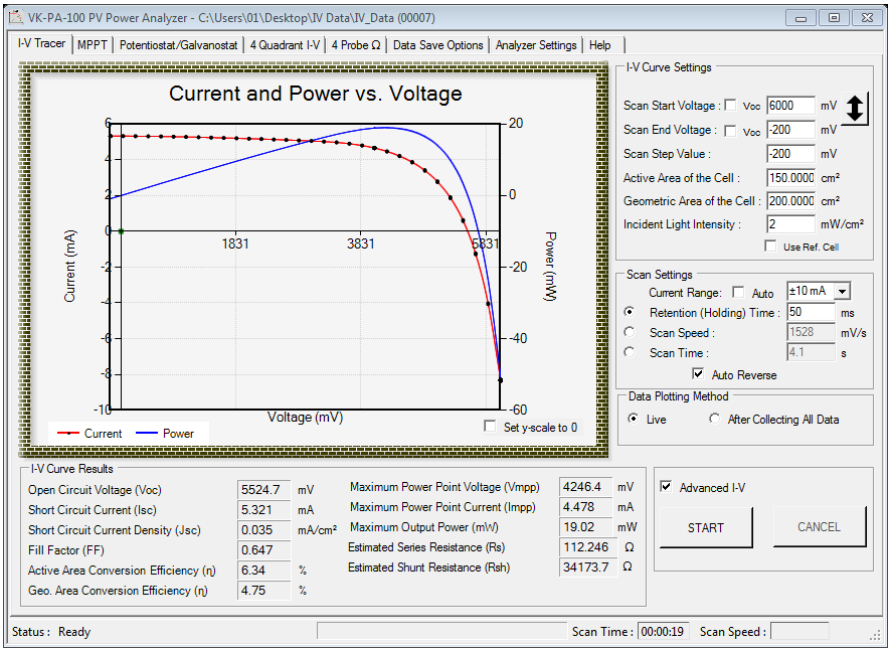
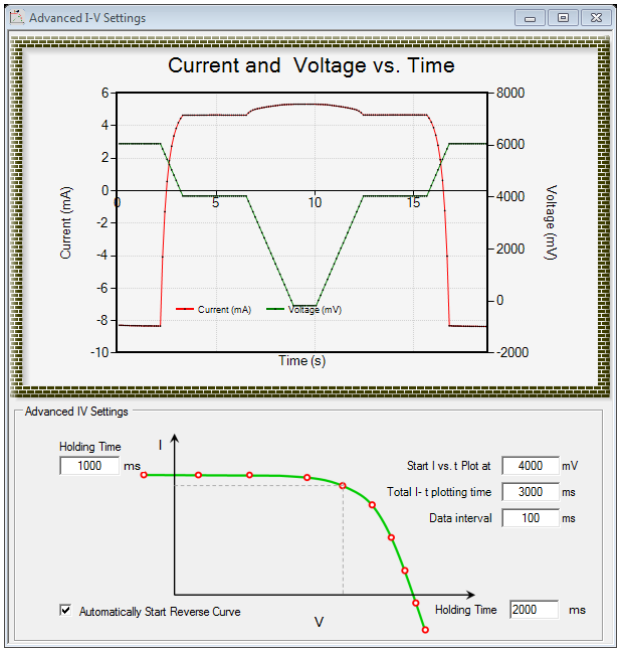
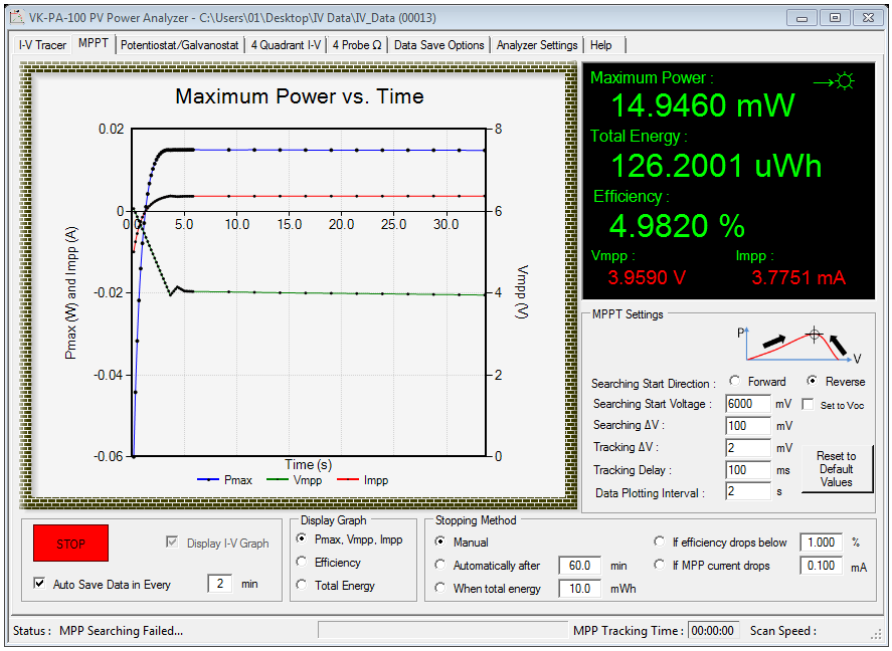
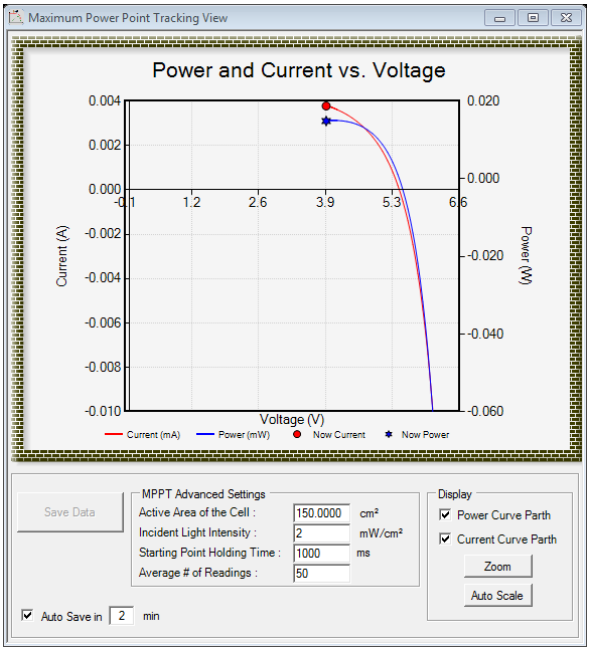
All the graphs and data can be saved in a Microsoft Excel Workbook.





"Advanced IV Setup" allows user to change various settings such as "start" point holding time, "end" point holding time, current vs. time plot for each data point, and /or at given fixed voltage in the middle of I-V curve tracing.





"MPP tracking" function shows the power, current, voltage and efficiency curves from the starting point of the MPP tracking so that user can see how it reach to maximum power point from different starting points and directions. It is continuously plot the conversion efficiency vs. tme curve.

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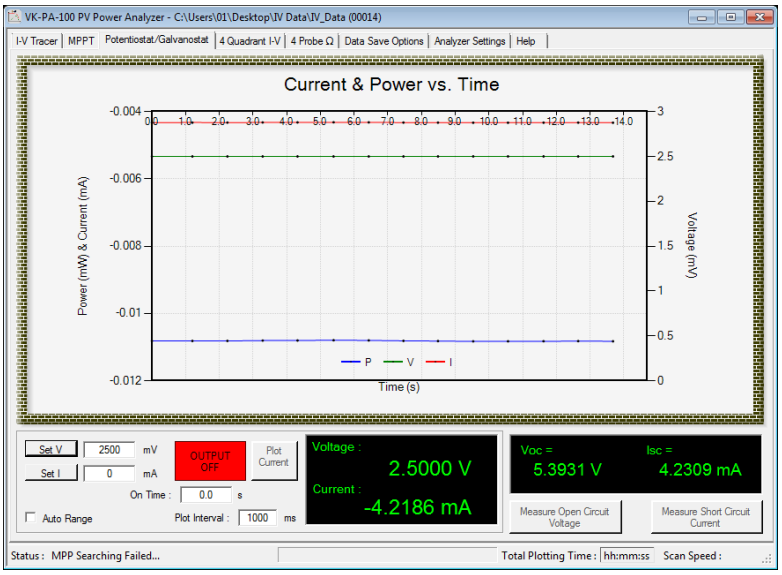
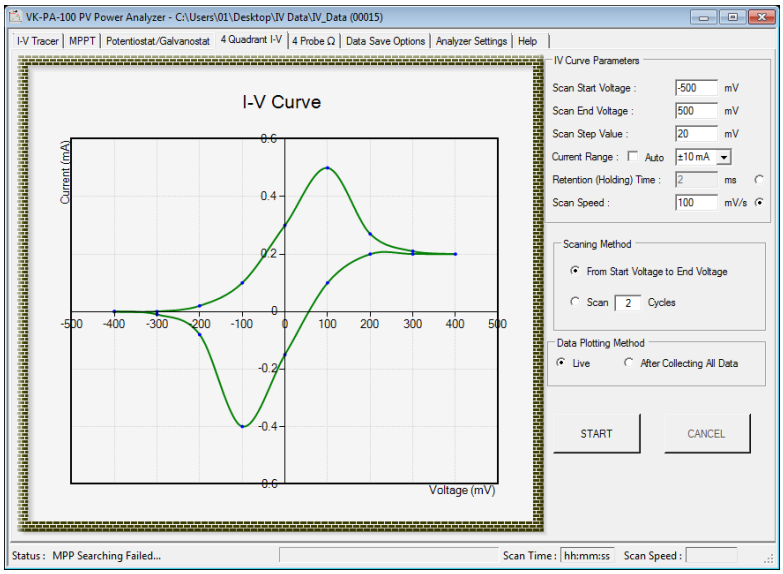
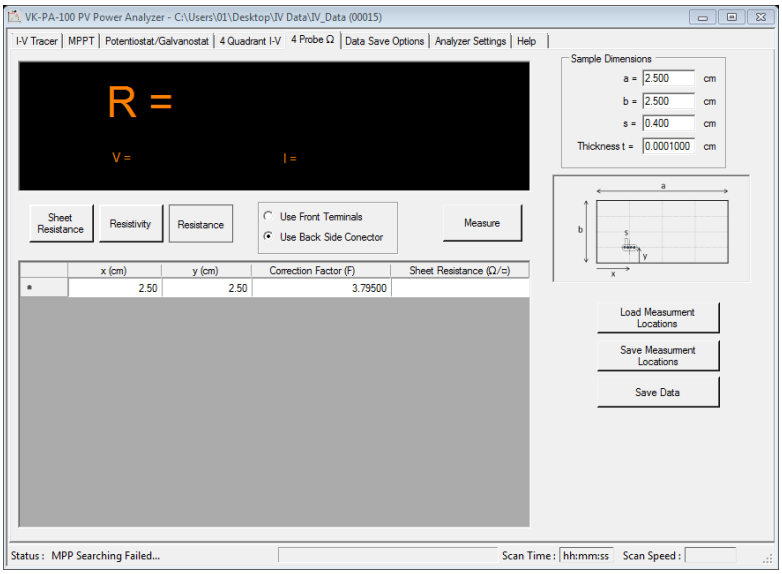


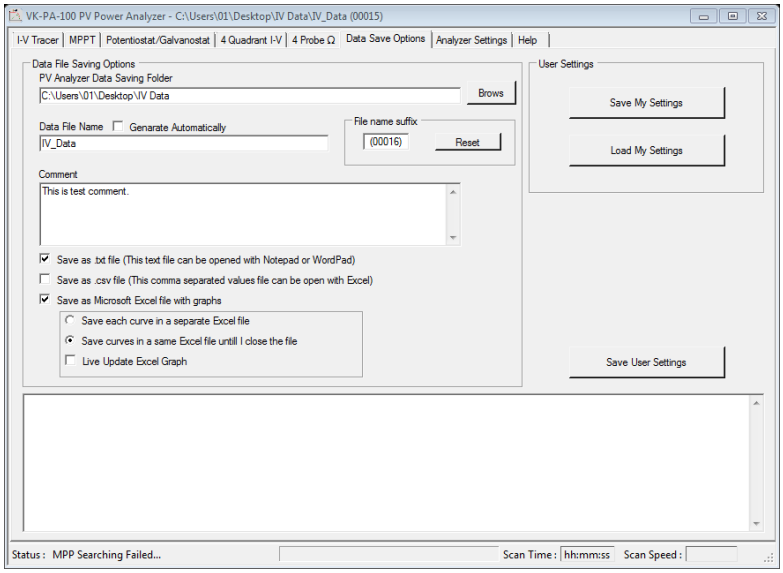
"Potentiostat/Galvanostat " tab allows user to use analyzer as Potentiostat or Galvanostat mode with given set voltage or set current value. Plotting V, I, and power also possible in this function. Programmable fix voltage or fix current On/Off timing function can use for electro deposition or lighting external laser diode with given on/off times and number of cycles.

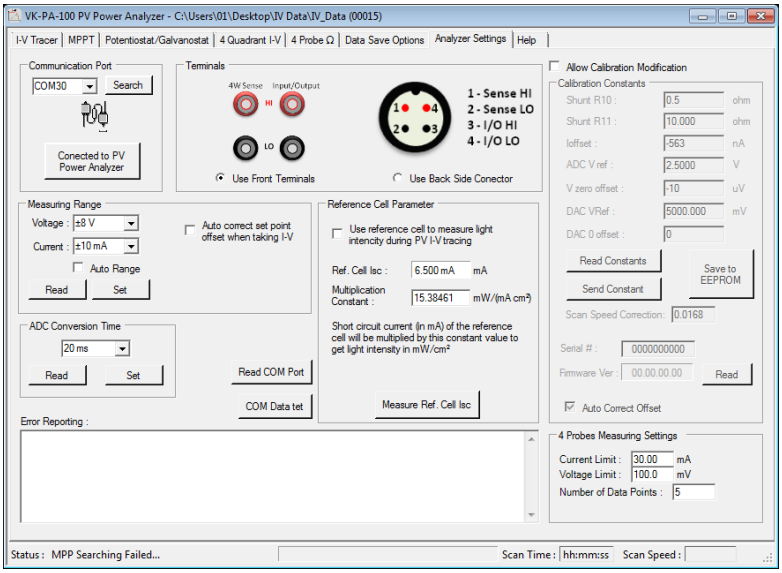




"4 Quadrant I-V" allows to plot Cyclic Voltammetry graphs.

"4 Probe Ohm" tab allows user to perform sheet resistance, resistivity, and resistance measurements.





"Data Save Options" tab has various options to save data files and graphs. All the graphs can be saved as fully formatted Excel workbooks.

"Analyzer Settings" allows to change various settings of the analyzer..

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VK-PA-100 Detailed Electrical Specifications

Measuring Technique	Digital Source Meter with 4 probes connection to DUT. Controlled by a microcontroller working at 32 MHz system clock speed.
Measuring Range	Voltage: ±10 V Current: ±1 A (3A Pulse)
Specifications of A/D Converters	Resolution: 16 Bit Integral Nonlinearity: ±0.0003% Utilize on-chip digital calibration to eliminate offset and gain errors. Data acquisition speed can be selected from 50Hz, 60 Hz, 250 Hz and 500Hz.
Built-in Voltage Reference Parameters	Output Voltage : 2.500 ± 0.001 V Output Voltage Drift : 3 ppm/°C (-40°C to +85°C) Output Noise : 100 nV/$Hz^{½}$
Voltage Measurements Resolution	5½-digit resolution

Measuring Range	Resolution
±30 mV	1.2 µV
±60 mV	2.4 µV
±125 mV	4.8 µV
±250 mV	9.5 µV
±500 mV	19 µV
±1 V	38 µV
±2 V	76 µV
±4 V	0.15 mV
±8 V	0.3 mV
±10 V	0.6 mV

Voltage Set Point Resolution	±1 mV (16 Bit)
Current Measurements Resolution	5½-digit resolution

Measuring Range	Resolution
±6 µA	2 pA
±12 µA	4 pA
±25 µA	9 pA
±50 µA	1.7 nA
±100 µA	3.5 nA
±200 µA	7 nA
±250 µA	10 nA
±500 µA	19 nA
±1 mA	38 nA
±2 mA	76 nA
±6 mA	227 nA
±12 mA	454 nA
±25 mA	908 nA
±50 mA	1.8 µA
±100 mA	3.6 µA
±200 mA	7.2 µA
±500 mA	19 µA
±1 A	38 µA
±2 A (Pulse only)	76 µA
±3 A (Pulse only)	152 µA

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Function	Description	Measurement /Results
I-V Tracer	1. Standard I-V curve tracing	Current vs. voltage plot of solar cell. User can set desired scan speed, scan time, or holding time at each data point. Calculate V_{oc}, I_{sc}, J_{sc}, P_{max}, V_{mpp}, I_{mpp}, FF, R_s, R_{SH}, $\eta_{activeA}$, and η_{geoA}.
	2. Advance I-V curve tracing	Current vs. time plot at start point, given middle point, and end point for given holding time. Calculate V_{oc}, I_{sc}, J_{sc}, P_{max}, V_{mpp}, I_{mpp}, FF, R_s, R_{SH}, $\eta_{activeA}$, and η_{geoA}.
MPPT	Maximum power point tracking (MPPT)	Automatically scan for maximum power point of the cell. Then track and maintain the cell at maximum power point (MPP) and plots P_{max} ,V_{mpp} , I_{mpp}, and Efficiency vs. time curves and also display current/power vs. voltage plots.
Potentiostat	Measure current (and voltage) at given fixed bias voltage	Maintains sample at a given voltage, then displays current. Plots the current vs. time under the selected bias voltage.
Galvanostat	Measure Voltage (and current) at given fixed bias current	Maintains sample at a given current, then displays voltage. Plots the Voltage vs. time under the selected bias current.
4-Qudrent I-V	Cyclic voltammetry (CV)	Current vs. voltage plots for given voltage range and scan speed. Can be used in 3 electrodes liquid cell with reference electrode.
4 Probe Ω	Four terminal resistance measurement	Measures sheet resistance, resistivity, or resistance using 4 probe technique.

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