

Type VK-PA-300

For I-V Tracing, Maximum Power Point Tracking, & Cyclic Voltammetry The Measuring Range (up to $\pm 12V$, up to $\pm 4A$)



Specifications	
Measurement Range (For details see page 4)	Voltage: ±12 V Current: ±2A (±4 A Pulse) with 5½-digits resolution
Measuring Technique	Digital Source Meter Type
Inputs	Front: 4 probes for PV devise
A/D Converters	24 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 (.csv or .txt) and directly plotted on [®] Microsoft Excel graph. (Windows based PC required)
Communication	Bluetooth
Power Requirement	100 VAC (50-60 Hz) 230 VAC (50-60 Hz)
Dimensions, Weight	260 mm(W) x 350 mm(D) x 133 mm(H) , 6 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_{scr} , 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. Programmed Continuous IV" function allow user to take series of IV curves on given time intervals.

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 current vs. time under a given constant voltage or constant current. User can directly measure the open circuit voltage, and short circuit current of the cell.

Features Cyclic Voltammetry (CV)

Allows user to get both three electrode and two electrode CV plots for given voltage range, scan speed and number of cycles. This function mimics the analog triangle wave of voltage without digital voltage steps.

SPD Laboratory, Inc.

2-35-1 Johoku, Hamamatsu, 432-8011, JAPAN Tel: +81-53-474-7901 Fax: +81-53-401-7080 Email: ing@spd-lab.com

Web: http://www.spdlab.com/English/VK-PA-300.html



PV Power Analyzer

VK-PA-300

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



		U ,
$\left(\frac{HR_s}{n_1}\right) - 1 - I_{s2} \left[e^{\frac{q}{kT}}\right]$	$\left(\frac{V+IR_s}{n_2}\right)$	$-1\left]-\frac{V+R_s}{R_{sh}}\right]$
Calculated Result		
	From Fitting	From IV-Curve
09 Maximum Power Point V (Vmpp) -	211.40 mV	200.60 mV
10	0.4000	200.00
Maximum Power Point I (Impp) :	2.1898 mA	2.3409 mA
Maximum Output Power (Pmax) :	462.90 uW	469.60 uW
Shunt Resistance (Rsh) :	85.929 Ω	103.76 Ω
Series Resistance (Rs) :	13.431 Ω	39.859 Ω
51	$\frac{r+IR_{s}}{n_{1}} - 1 - I_{s2} \left[e^{\frac{q}{kT}} \right]$	$\frac{r+IR_{s}}{n_{1}} - 1 - I_{s2} \left[e^{\frac{q}{kT} \left(\frac{V+IR_{s}}{n_{2}} \right)} - 1 \right] - I_{s2} \left[e^{\frac{q}{kT} \left(\frac{V+IR_{s}}{n_{2}} \right)} - 1 \right] - I_{s2} \left[e^{\frac{q}{kT} \left(\frac{V+IR_{s}}{n_{2}} \right)} - 1 \right] - I_{s2} \left[e^{\frac{q}{kT} \left(\frac{V+IR_{s}}{n_{2}} \right)} - 1 \right] - I_{s2} \left[e^{\frac{q}{kT} \left(\frac{V+IR_{s}}{n_{2}} \right)} - 1 \right] - I_{s2} \left[e^{\frac{q}{kT} \left(\frac{V+IR_{s}}{n_{2}} \right)} - 1 \right] - I_{s2} \left[e^{\frac{q}{kT} \left(\frac{V+IR_{s}}{n_{2}} \right)} - 1 \right] - I_{s2} \left[e^{\frac{q}{kT} \left(\frac{V+IR_{s}}{n_{2}} \right)} - 1 \right] - I_{s2} \left[e^{\frac{q}{kT} \left(\frac{V+IR_{s}}{n_{2}} \right)} - 1 \right] - I_{s2} \left[e^{\frac{q}{kT} \left(\frac{V+IR_{s}}{n_{2}} \right)} - 1 \right] - I_{s2} \left[e^{\frac{q}{kT} \left(\frac{V+IR_{s}}{n_{2}} \right)} - 1 \right] - I_{s2} \left[e^{\frac{q}{kT} \left(\frac{V+IR_{s}}{n_{2}} \right)} - 1 \right] - I_{s2} \left[e^{\frac{q}{kT} \left(\frac{V+IR_{s}}{n_{2}} \right)} - 1 \right] - I_{s2} \left[e^{\frac{q}{kT} \left(\frac{V+IR_{s}}{n_{2}} \right)} - 1 \right] - I_{s2} \left[e^{\frac{q}{kT} \left(\frac{V+IR_{s}}{n_{2}} \right)} - 1 \right] - I_{s2} \left[e^{\frac{q}{kT} \left(\frac{V+IR_{s}}{n_{2}} \right)} - 1 \right] - I_{s2} \left[e^{\frac{q}{kT} \left(\frac{V+IR_{s}}{n_{2}} \right)} - 1 \right] - I_{s2} \left[e^{\frac{q}{kT} \left(\frac{V+IR_{s}}{n_{2}} \right)} - 1 \right] - I_{s2} \left[e^{\frac{q}{kT} \left(\frac{V+IR_{s}}{n_{2}} \right)} - 1 \right] - I_{s2} \left[e^{\frac{q}{kT} \left(\frac{V+IR_{s}}{n_{2}} \right)} - 1 \right] - I_{s2} \left[e^{\frac{q}{kT} \left(\frac{V+IR_{s}}{n_{2}} \right)} - 1 \right] - I_{s2} \left[e^{\frac{q}{kT} \left(\frac{V+IR_{s}}{n_{2}} \right)} - 1 \right] - I_{s2} \left[e^{\frac{q}{kT} \left(\frac{V+IR_{s}}{n_{2}} \right)} - 1 \right] - I_{s2} \left[e^{\frac{q}{kT} \left(\frac{V+IR_{s}}{n_{2}} \right)} - 1 \right] - I_{s2} \left[e^{\frac{q}{kT} \left(\frac{V+IR_{s}}{n_{2}} \right)} - 1 \right] - I_{s2} \left[e^{\frac{q}{kT} \left(\frac{V+IR_{s}}{n_{2}} \right)} - 1 \right] - I_{s2} \left[e^{\frac{q}{kT} \left(\frac{V+IR_{s}}{n_{2}} \right]} - 1 \right] - I_{s2} \left[e^{\frac{q}{kT} \left(\frac{V+IR_{s}}{n_{2}} \right)} - 1 \right] - I_{s2} \left[e^{\frac{q}{kT} \left(\frac{V+IR_{s}}{n_{2}} \right)} - 1 \right] - I_{s2} \left[e^{\frac{q}{kT} \left(\frac{V+IR_{s}}{n_{2}} \right]} - 1 \right] - I_{s2} \left[e^{\frac{q}{kT} \left(\frac{V+IR_{s}}{n_{2}} \right]} - 1 \right] - I_{s2} \left[e^{\frac{q}{kT} \left(\frac{V+IR_{s}}{n_{2}} \right]} - 1 \right] - I_{s2} \left[e^{\frac{q}{kT} \left(\frac{V+IR_{s}}{n_{2}} \right]} - 1 \right] - I_{s2} \left[e^{\frac{q}{kT} \left(\frac{V+IR_{s}}{n_{2}} \right]} - 1 \right] - I_{s2} \left[e^{\frac{q}{kT} \left(\frac{V+IR_{s}}{n_{2}} \right]} - 1 \right] - I_{s2} \left[e^{\frac{q}{kT} \left($

I-V curve fitting function automatically fit the I-V data with two diode model and calculate various parameter.



"Programmed Continuous IV" function allow user to take series of IV curves on given time intervals. User can also determine the cell keeping condition during I-V measurements. Data can be save in a single Excel file or separate files.



PV Power Analyzer

VK-PA-300



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"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.



"Advanced 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.



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

Power Analyzer

VK-PA-300 PV Power Analyzer C:\Users\01\Desktop\IV Data\IV_Dataxcv (000 × V Tracer MPPT POT/GAL Cyclic Voltammetry Data Save Options Analyzer Settings Help Set Voltage CV Curve Parameters Cyclic Voltammetry Curve rt Voltage Scan End Voltage mV otal No. of Data P 0.0004 10 mA 200 mV/s Scan Sneed 0.0002 No. of Cycles 100 ms 0 00 0 200 0 400 0 600 0 800 1 000 -0 200 12 -0.0002 1 ms * -0.0004 G Live C After Collecting Al Data Voltage (V START CANCEL Status: Ready Scan Time : 29.930 s Scan Speed : 200.5 mV/s

"Cyclic Voltammetry" allows user to get both three electrode and two electrode CV plots for given voltage range, scan speed and number of cycles.



"Data Save Option" tab allow user to specify results saving folder and file name prefix. User can save setting parameter also.

VK-PA-300 PV Power Analyzer Software			- 0
/ Tracer MPPT POT/GAL Cyclic Voltammetry Data Save Op	tions Analyzer Settings Help Cali	bration	
Communication Port Measuring Range	System Reset	F Enable Service Mode	
Votage: ±125V ···	Reset	V-ADC Viref : [2.4993 V I-ADC Viref : [2.4995 V R-ADC Viref : [2.4995 V	Rehnt R2 : 10.0110 Rehnt R3 : 999.00
Conected to PV Read Set	General Andree General	DAC Calibration Constants DAC Range 0.0ffs [Set 1 + 3.4. (Pulk + 0.0	t Ref. Vokage (V
ADC Conversion Time Timing Diagram		Set V • 20 V • 1	90 [4.903
Read Set Last VI Settings astVI Set Current. 10.0 MA 7.0	on (Holding) Time 95 ms 17.101 ms	V Range Zero Offset 20 V - 65 I Range Zero Offset 13 A (Pulse) - 63	Real Gain 0.25001 Real Gain 2
Set Voltage : 1000.0 mV Pe Comp. Voltage : 1000.0 mV Pe Mode : CV Read Read Am	nind + 25.000 ms ay Read COM Read Errors	Global Current Limit : 3 Positive Voltage Protection : 11 Negative Voltage Protection : -11	00 A Self 000 V Diagnosis 000 V Test
ror Reporting :		Read Write	Save to EEPRON
		Serial # 1220160002	Auto Correct Offset
		Firmware Ver. : 20.20.04.1	Show V_Shurt
		Firmware Ver.: 20.20.04.1 I V-PGA 0 Clear Full offset V-PGA 0 VO	Show V_Shurit Range Cus Range #fset V Offset

"Analyzer Settings" tab allows user to change specific parameters of the PV power analyzer.



VK-PA-300

"POT/GAL" Tab allows user to set constant voltage or current to the sample and measure and plot data. Also Voc and Isc of solar cells can be measured with single click.

If you face any problem while using this software, or If you found any bug or you have suggestion, comment or request					
Teit +81-53-47-7301 (office) Postal address: +81-90-2835-60728 (cell) Dr. Plyankarage. Viraj Vishwakantha Jayaweera Fax: +91-63-407-7000 Dr. Plyankarage. Viraj Vishwakantha Jayaweera E-mail: viraj@apditab.com Serior Scontability viraj@apditab.com 2-257. Johotuk. Nukh-ku. Skype Name: viraj@ayaweera Hamamatsu, 432-8011. Limo: and Vibor: Phone Number +81-90-3835-0788 Web: thir//viraijweerea phones.com thir//viraijweerea phones.com thir//viraijweerea phones.com	Postal address: Dr. Piyankarage. Viraj Vishwakantha Jayaweera Senicor Sciontist SPD Laboratory, Inc. 2-35-1. Johoku, Nakar-ku, Hamamatsu, 432 8011, JAPAN				
Suthware Version . 6.1.3.17					

"Help" shows contact information and Software Version.

elect Voltage Range +1.25 V +	Select Voltage Range 1+6 uA	- 1			
Start Calibration	and the set of the set				
Enter measured Correct Voltage (mV)		Enter measured Correct Current (mA)			
Set V1 :	Set I1 : 0.005824 mA	0.005709			
lead V1 :	Read I1 : 0.005856 mA				
iet V2	Set 12 0.006178 mA	-0.006306			
lead V2 :	Read 12 0.006169 mA				
let V3 :	Set 13 : 0.000818 mA	-0.000595			
lead V3 :	Read 13 0.000454 mA				
iet V4	Set 14 0.000505 mA	0.000756			
Read V4	Read I4 : 0.000532 mA	Set			
All voltage values must be enterd in mV units	All current values must be enterd in mA units				

If needed user can recalibrate VK-PA-300 with a standard meter. (Please request password to access to calibration menu)



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VK-PA-300	Detailed Ele	ctrical Specif	ications						
Measuring Technique			Digital Sou	rce Meter with	4 probes conne	ection to DUT.			
Measuring Range			Voltage: ±	Voltage: ±12 V Current: ±2 A Continuous 4 A (pulse)					
Specifications of A/D Converters			Resolution Utilize on-ι ADC integr μs.	Resolution: 24 Bit Utilize on-chip digital calibration to eliminate offset and gain errors. ADC integration time can be selected from 16 different values from 400 ms to 33.3 μs.					
Built-in Voltage Reference Parameters			Output Vo Output No	ltage : 2.500 ± ise : 100 nV/Hz	0.001 V Outpu	t Voltage Drift : 3	ppm/°C (-40°0	C to +85°C)	
	Voltage measu	Iring ranges ar	d reading (24-bit	t ADC) resolutio	on and voltage	setting (16-bit D	AC) resolutions	;	
Range	± 150 mV	± 300 mV	± 600 mV	±1V	± 2 V	±4 V	± 8 V	± 1 2V	
Reading Resolution	9 nV	19 nV	37 nV	74 nV	149 nV	298 nV	0.6 μV	1.2 μV	
Setting Resolution	9.5 μV	9.5 μV	19.1 μV	19.1 µV	38.1 μV	76.3 μV	153 μV	305 μV	
	Current measu	Iring ranges an	d reading (24-bit	t ADC) resolutio	on and current	setting (16-bit D	AC) resolutions	;	
Current Measuring Range		Currei	Current Reading Resolution (24-bit ADC)		Current Setting Resolution (16-bit DAC)				
	± 6 μΑ			0.8 pA			1 nA		
	± 12 μΑ			2 pA			1 nA		
± 25 μΑ				3.4 pA			1 nA		
± 50 μΑ			7 pA			1.7 nA			
	± 100 µA			13 pA			3.5 nA		
	± 200 μA			27 pA			7 nA		
	± 250 μA			37 pA			9 nA		
	± 500 μA			74 pA			19 nA		
	±1mA			148 pA			38 nA		
± 2 mA			295 pA			76 nA			
± 6 mA			887 pA			0.9 μΑ			
± 12 mA			1.8 nA			0.9 μA			
	± 25 mA			3.5 nA		0.9 μΑ			
± 50 mA				7.1 nA		1.8 μΑ			
± 100 mA				14 nA		3.6 μΑ			
	± 200 mA			28 nA		7.3 μΑ			
	± 500 mA			75 nA		19.1 μΑ			
	±1A			149 nA			38.1 µA		
	± 2 A			298 nA			76 µA		
± 5 A			0.6 μΑ		153 μΑ				

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2-35-1 Johoku, Hamamatsu, 432-8011, JAPAN Tel: +81-53-474-7901 Fax: +81-53-401-7080 Email: <u>inq@spd-lab.com</u> Web: <u>http://www.spdlab.com/English/VK-PA-300.html</u>