

SPECIFICATION OF SOLAR CELL TESTER

A. Purpose: This equipment is to be used for testing of mono and multi crystalline silicon solar cells under standard testing conditions. The equipment shall be interfaced with a computer through a user friendly software compatible with MS Windows XP for testing of the solar cells, storage, retrieval and printing of I-V curve data.

B. Functional Specification:

Sl. No.	Item	Specification
1.	Cell testing	Halogen or xenon lamp fixed on the top and solar cell placed on a copper chuck with vacuum holding at the bottom.
2.	Light Source	Halogen or pulsed xenon light source closely matching the solar spectrum.
3.	Uniformity of Illumination	+ / - 4 % (or better) over entire test area (*). (156mm x 156mm) (max.) (*) It means that if the set value of simulated irradiance level is taken as 100 (m W / sq. cm), the actual measured value of irradiance any where over entire test area should be within the range of 96 to 104 (m W / sq. cm).
4.	Solar cell coupling (Reference cell)	A single crystal solar cell or single crystal solar cell pyranometer should be coupled to the electronic circuitry to monitor illumination intensity.
5.	Electronic load	An electronic load with power source and sink
6.	Data Acquisition	Data acquisition for plotting of I-V curve and data measurement
7.	Parameter measurements	Range: a) Voltage :0- 1V b) Current : 0-10 A
8.	Resolution	a) Voltage: 0.001V b) Current: 0.01A
9.	I-V curve	Typical plotting time: 1 to 2 minutes (or less)
10.	Parameters to be measured and /or to be computed:	a) Open-circuit voltage b) Short-circuit current

10. Contd.		c) Load current and Power at fixed voltage d) Peak Power e) Current and Voltage at Peak Power f) Fill factor g) Cell efficiency h) Cell temperature and corrected temperature. i) Date and time of measurement j) Solar Insolation (simulated irradiation level W / m^2 or $m W / cm^2$)
11.	Temperature compensation	The cell temperature is measured during the testing to allow temperature compensation of Voc, Isc and Peak Power.
12.	Export of I-V data	The software package should store all the data in Micro Soft Excel for further analysis.
13.	Operating Systems	MS Windows XP.
14.	Test jig Note: 1) Suitable vacuum pump for holding solar cell should be supplied along with the equipment. 2) Suitable water chiller should be supplied along with the equipment. A maximum of 30 cells are to be tested in a day. 3) If electronic / Peltier cooling is provided or if single flash Xenon Light is used then water chiller is not required. 4) Suitable air compressor should be supplied along with the equipment if pneumatic controls are used as compressed air supply line is not available in the Laboratory. 5) Separate Teflon Alignment jigs for cells of different sizes may be provided if necessary.	a. Vacuum copper plate with provision for chilled water cooling b. Alignment jig for 50mm x 50mm, 125mm x 125mm, & 156mm x 156mm size solar cells as per sketch enclosed. In case of 156mm sq. size cell the centre to centre spacing between contact bars is 78 mm. c. Probe assembly with adjustable width (spacing) for front contact and back contact with copper chuck. d. Gold plated spring returnable pins e. Pneumatic for Up/Down movement, Vacuum generator, flow controller, Filter & regulator f. Pedestal mounting unit with forced exhaust g. Measurement using remote Kelvin probes.

15.	Temperature controller Note: Temperature controller not required if single flash Xenon Light is used provided cell temperature measurement is done and used for the computation of I – V data at 25 °C.	PID based Temperature controller consisting of a. PID temperature controller b. RTD sensor c. Chilled water valve
16.	Intensity controller	Lamp intensity closed loop control system (with reference cell intensity feedback) consisting of a. Halogen / Xenon lamp with reflector b. PID Controller with SSR. Note: Phase control mode to be used for lamps
17.	Personal Computer	PC Intel Original Pentium Core 2 Duo mother board with Intel chipset, 2GHz, 160GB HDD, 1GB RAM and 17” TFT monitor (or better) (warranty for 1 year)
18.	Laser Printer	A4 size laser printer of reputed make for printing of I-V characteristics (warranty for 1 year)
19.	UPS	500 VA of reputed make such as APC/SOCOMECLIBERT.
20.	Test bench	Approx. 39”*84” with PC fitting provision. Size to be mentioned.
21.	Spares	Spares for trouble free operation of the equipment for a period of two years shall be listed and included along with the equipment. Additional spares may be quoted separately as Option 1.

C. Power Input :

1. The complete system should be designed for use with 220 - 240 V A.C.(1 phase) or 415 V + / - 25 V A.C. (3 phase) with a mains frequency of $50 \pm 1\%$ Hz.

D. Other aspects:

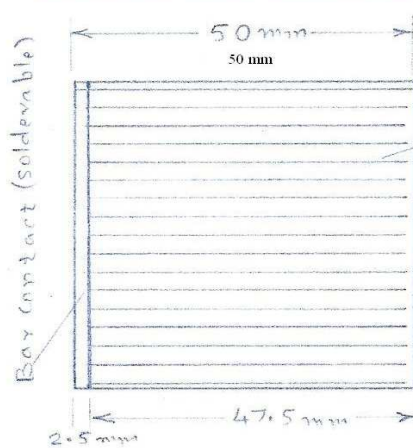
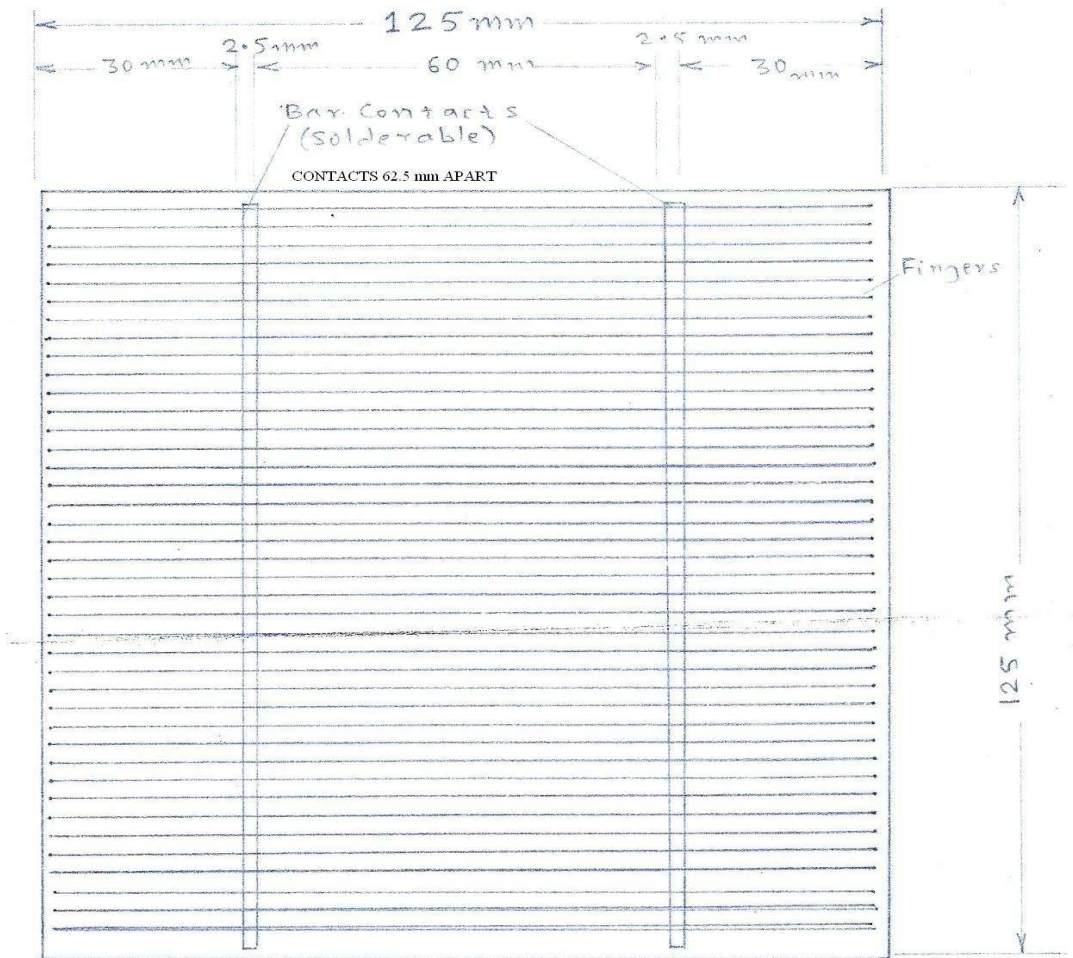
1. The vendor **should have supplied minimum two such equipments and the addresses of the customers with telephone numbers should be furnished.**
2. Should have agents in India to provide after sales service and maintenance.
3. The equipment should be Guaranteed for a period of **2 years** from the date of commissioning. During warranty period, if there is any repair to be carried out at

- the suppliers works, transportation cost of equipment / component besides repair / replacement charges, if any, should be borne by the supplier.
4. **Catalogue related to each and every item should be enclosed.**
 5. Dimensions of equipment, weight and space requirements to be given.
 6. **Pre-installation requirements should be furnished.**
 7. Installation & commissioning of the equipment to be carried out by supplier at site at Corporate R&D, BHEL, Hyderabad, India. Training to be provided at Corp. R&D, BHEL, Hyderabad.
 8. Commissioning charges, if any, to be indicated separately.
 9. Compliance statement of specification to be submitted along with the offer. Without compliance statement, the offer is liable to be rejected. All tender specifications to be compared with equipment offered line by line and documentary evidence must be enclosed by the supplier along with quotation.
 10. Two copies of operating manual to be provided along with the equipment.

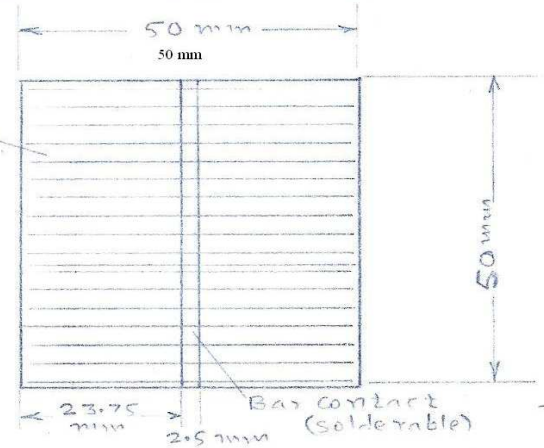
- A. After the system delivery to BHEL R & D, if the system is installed in existing R & D building and later if it has to be shifted to the new building (Center for Nanotechnology and Applications) this has to be done by the supplier and related expenses should be specified. The shifting will be within 9 months of initial installation**
- B. Delivery:** The equipment should be delivered within 3-4 months from the date of placement of purchase order
- Note: All covers should be clearly marked indicating the contents and should be SEALED.**

Typical solar cell contact location

(BHEL/RD/CNT/VP)



2.5 mm WIDE SINGLE BAR CONTACT



2.5 mm WIDE SINGLE BAR CONTACT IN CENTRE