

1. Technical specification of the Spectral Response (SR)/External Quantum Efficiency (EQE) and Internal Quantum Efficiency (IQE) Measurement System

Sl. No.	Technical specification of Spectral Response (SR)/External Quantum Efficiency (EQE) Measurement System and Internal Quantum Efficiency (IQE)
1	Complete system shall be capable to obtain SR/EQE and IQE of III-IV Triple, Four Junction, capable to do measurement beyond four junctions in future by including additional biasing, Si, CIGS and other type of Solar Cells.
2	High output monochromatic light source with wavelength range 300-1800 nm is required
3	Monochromatic light source shall be highly stable with temporal variation in intensity variation less than 1% within 48 hours
4	Appropriate Light bias source with suitable filters shall be provided to carry out the measurement of component junction cell of a Triple and Four junction solar cell. The provision shall be provided to incorporate additional biasing sources to carry out the measurement for more than four junction Solar cells in future
5	It shall be capable to perform the continuous measurement for Triple and Four Junction Solar Cell without any manual switch
6	It shall be capable to measure the SR/ EQE of the component junction cell of a Triple and Four junction solar cell separately by applying an appropriate light bias
7	It shall be capable of doing IQE measurement. Switching between IQE and EQE mode should be easy without any need of attaching any physical part. The system should allow measurement of EQE and IQE for same place (i.e no need to move the sample)
8	The system shall have capacity to measure and store the EQE as well as IQE Vs wavelength data for full wave length range in txt/spread sheet.
9	Reference detectors Si and Ge shall be provided
10	The monochromatic probe with optical chopper shall be provided with scanning step variable between 0.1 to 50 nm
11	Lock-in amplifier with complete electronics to detect the photocurrent generated by the solar cell shall be provided- Vendor to provide the complete details
12	Chopper system to generate the reference signal for Lock-in amplifier shall be provided-Vendor to provide the complete details
13	System shall be supplied with sample stage which can accommodate up to 10cmx10 cm Wafer samples for measurements
14	Sample stage (Chuck) shall be with vacuum control provision to hold the solar cell of size 10cmx10cm and be made of copper with gold coating

15	Micro-positioner with electrically isolated contact probes shall be provided for electrical contacts.
16	Customized temperature-controlled chuck shall be provided which can be connected with existing bath circulators
17	Provisions shall be available to measure the temperature of the solar cell sample stage
18	Controller hardware shall be installed in a latest system with latest windows operating system
19	Software control through USB interface preferred Software should be able to perform following operations:
(a)	Absolute light intensity calibration
(b)	Spectral responsivity & External quantum efficiency (EQE) measurement
(c)	Automatic short-circuit current calculation for single wavelength
(d)	Auto and immediate device short-circuit density current calculation for AM0
(e)	Mismatch factor calculation
(f)	Data collection and analysis function
(g)	Raw data also shall be available optionally and TXT data saved
20	The software shall have sufficient back up to install in an alternate system in case of hardware/software crash. The software support (in case of any issues) shall be long term.
21	Provide the complete list and details of all parts/units of the SR/EQE and IQE system.
22	References and catalogues of the system offered shall be provided
23	The supplier should demonstrate the capabilities of equipment for test and evaluation prior to Shipment and after installation at URSC/ISITE by supplier
(a)	Supplier will demonstrate the capabilities of the equipment at Pre-Delivery time after PO release (as a Pre-Dispatch inspection). This will be carried out by the supplier at their premises. The standard/reference set of cells available with the supplier will be used to demonstrate the capabilities of system. The supplier shall provide the IQE and EQE data in the electronic form (pdf / excel form). The data will be assessed by the Solar Panel Division and based upon data acceptance (on successful demonstration of system performance) despatch clearance will be given within T0+one month (T0= intimation through email by vendor for pre-delivery inspection). No intimation from URSC is required for site readiness post-dispatch clearance.

(b)	Supplier will demonstrate the capabilities of the equipment after installation at URSC/ISITE. Solar Cells (Triple junction, Four Junction, Si, GaAs and other type of Solar Cells) will be provided by the Solar Panel Division. Collected IQE and EQE data will be assessed by the Solar Panel Division to give the final clearance.
24	The location of delivery is URSC/ISTE stores
25	The supplier shall provide guarantee of operation of equipment at least for one year from the date of installation at URSC/ISITE
26	Delivery date will be maximum 12 months from PO Release

2. Spectral Response (SR)/External Quantum Efficiency (EQE) and Internal Quantum Efficiency (IQE) Measurement System

Sl no.	Description	Requirements
1	Monochromator Light Source	
	(i) Lamp	Highly stable Xe lamp with power supply Vendor to specify- Appropriate wattage of the lamp
	(ii) Spectral range	300-1800 nm
	(iii) Provision of Lamp Adjustment	Preferable
	(iv) Temporal Deviation	Less than 1% within 48 hours
	(v) Focal Length	110 mm or more
	(vi) Resolution	less than 0.5 nm
	(vii) Variable Scanning interval	0.5 nm - 50 nm
	(viii) Light spot size	0.5 mmx0.5mm or better
	(ix) Light spot size variation	Required Vendor to provide details
	(x) Light spot size variation range	Minimum size-0.5 mmx0.5mm Maximum Size- Vendor to specify
2	Light Bias source for triple junction solar cell	
	(i) Bias Source	Appropriate as per Triple and Four Junction Solar Cell measurement Vendor to provide details
	(ii) Mechanism of Transport of bias light to sample	Vendor to provide details

	(iii)	Uniformity	$\pm 1\%$ over 1 cm^2
	(iv)	Filters	Appropriate as per Triple and Four Junction Solar Cell measurement Vendor to provide details
3	Reference Detector		
	(i)	Si Detector range	300-1100 nm
	(ii)	Ge Detector range	800-1800 nm
4	Internal Quantum Efficiency Measurement Module		
	(i)	Integrating Sphere diameter	2" or larger
	(ii)	Mounting	Mounted in such a way it is switchable between EQE and IQE modes without need of physically removing or attaching the integrating sphere.
	(iii)	Spectral Range	300 – 1800nm
	(iv)	Measurement Repeatability	$\geq \pm 99\%$
	(v)	Beam Direction for measurement	Vertically downwards (same as EQE)
	(vi)	Function	1. Measurement of Reflectivity & IQE 2. Should allow EQE & IQE measurement at same point 3. Samples should not touch integrating sphere while measurement to avoid any surface damage
	(vii)	Calibration	Standard reflectivity white reference sample with traceable report
5	Sample Mount		
	(i)	Sample Holding Mechanism	Vacuum chuck stage which can accommodate upto $10 \text{ cm} \times 10 \text{ cm}$ Wafer samples
	(ii)	Vacuum pump	Not required
	(iii)	Temperature control	Sample stage shall be capable to connect with available bath circulators, required PORTs shall be provided for water / fluid circulation
	(iv)	Material	Chuck stage shall be made of copper with

		gold coating
6	Control Hardware	Controller hardware shall be installed in a latest system with latest windows operating system and capability of 8GB RAM (minimum), 64-bit OS & 1Tera byte hard disk for storage.

3. General requirements to install the system: Vendor shall specify the general requirement for installation of the equipment.

Sl no.	General Requirements
1	All the Hardware shall be of 230V±10, 50 HZ single phase (Indian supply).
2	The supplier is responsible for installation, commissioning and training of the system.
3	Supplier may quote separately for the essential spare parts
4	URSC will have the rights to procure the full system or only spare parts without assigning any reason.
5	Supplier shall specify the maintenance and share the procedure document of optics in the system
	Failure and diagnostics
6	The system shall have the diagnostic software, so that it indicates error message if any problem in the system.
7	Supplier shall supply Trouble shooting manual and detailed circuit diagram of the offered system.
8	The unit shall have a minimum of 12 months of warranty from the date of installation and commissioning.
9	The vendor shall optionally quote for post AMC of the system year wise.
10	The vendor shall be responsible for demonstration of all specifications of the system
11	Provision to store/ back up the data and facility to print shall be provided.
12	Vendor shall provide the Acceptance Test plan at vendors end and after installation at URSC.

13	All documents shall be in English language only.
14	The vendor shall carry out the packing of the entire system and to take care of shipment through AIR/SEA/ROAD. Supply Shall be at airport, Bangalore
15	Proper humidity and shock indicators shall be provided to take care of problems during transportation.
16	Vendor shall provide the details of customers to whom similar equipment is supplied
17	Vendor shall list all deliverables. The description/name of each item offered shall be specified in the blank price bid table.