

Testing Procedure for Universal Solar Pump Controller (USPC)

USPC must be tested in two principle modes:

1. As an offgrid solar pump controller: the testing should be as per MNRE specifications and Test procedure.
2. As a controller to operate motorized farm equipment: The testing should be as described below.

To test the USPC in the second mode the test centres must have standard actual mode suitable for 4 loading modes. The input to the USPC must be from a solar PV simulator using the hot and cold profiles issued by MNRE. Following tests may be performed on USPC driving the agrarian load like Atta Chakki, Chaff Cutter and Deep Freezer under test. The USPC must be able to operate these motors of the attached agrarian load, so that they deliver the rated torque and are able to also operate till 150% of the rated torque for 30 seconds.

S.No .	Test Performed	Expected result	Test Lab Observation	Remarks
1	Application description on screen and selection of applications	LCD screen provided on controller need to shows various applications which can be selected by keypad using up-down and enter key		
3	Mode operation of applications (Automatic: through keypad or remote / Manual: control switches)	Universal Solar Agriculture controller should come with multiple outputs which can be permanently connected to the application by selecting appropriate options for example following applications should automatically started by USPC by appropriate mean such as keypad or remote for selection. (i) Water Pumping (ii) Chaff Cutter (iii) Deep fridge/ Cold Storage (iv) Atta Chakki Manual changeover is not allowed.		
4	Application Specific output (Application specific software)	USPC should have inbuilt individual application specific software to run the agrarian applications other than pumps and output of the controller should be suitable for above mentioned applications	-	

5	Input PV voltage range Minimum – Voc at STC Nominal – Voc at STC Maximum – Voc at STC				
6	USPC Efficiency measurement in Hot and cold profile should be measured as per BS EN 50530/IEC 62891	Efficiency of the UPSC at minimum..... VOC			
		Load %	Charge controller eff (%)	Power tracking Efficiency (%)	Overall charge controller efficiency (%)
10					
25					
50					
75					
100					
		Efficiency of the UPSC at Nominal VOC			
10					
25					
50					
75					
100					
		Efficiency of the UPSC at 90 % of Max VOC			
10					
25					
50					
75					
100					
		Dynamic MPPT Efficiency			
Hot Profile					
Cold Profile					
7	Ripple and distortion at output on full load	Should below 5 % after 25 % loading condition			
8	Measurement of Output voltage waveform	Three phase output with up to 440 V rms pure Sine Wave to be measured at least 4 times between 300W/m2 irradiance and maximum irradiance as per the irradiance profile.		CF value should be provided by lab for voltage and current	
9	Operation at different output from array with all four load types (Array wattage as per MNRE model:	AboveWatt DC output Should not stop functioning at any load condition. Observation should be recorded.		Power value should be recorded by the lab with all agrarian load	Motor current should be recorded (for torque behavior) It must be almost constant

	<p>Example 4800 Wp array)</p> <p>At 40% Power</p> <p>At 50% Power</p> <p>At 75% Power</p> <p>At 100% Power</p>		supported by USPC	irrespective of available DC power from array (motor running condition). This is for Impact loading condition (such as Chaff cutter) current variation need to be recorded by laboratory.
10	<p>Operation at different output from array with all four load types (Array wattage as MNRE model: Example 4800 Wp array)</p> <p>At 10 % Power</p> <p>At 25 % Power</p> <p>At 30 % Power</p>	<p>USPC need to run all the agrarian load in variable frequency at the lower irradiance value</p> <p>The load may be increased beyond 150% of rated torque to determine at what level the motor is stalling and stopping and it must trigger 'torque overload' alert. If it goes beyond 150% of the motor rated torque the USPC must trip indicating an 'overload tripping'.</p>	Motor current should be recorded (for torque behavior) as it is a function of V/F ratio controlled by USPC	
11	Total circuit protection observation	<ul style="list-style-type: none"> • Soft Startup, • low radiation protection, • overload protection, • Open circuit protection • Reverse polarity protection 		

Expected output of individual applications must be specify as per their power rating and SPV capacity, such as:

1. kg/hour grinding of atta chakki, and granularity.
2. Volumetric Iceing of cold storage in x hours.
3. Output in terms of kg/hours for a specific capacity grass-cutter.
4. Output must be quantify in terms of rate of volume or weight as above for any other applications.

For Reference

Indian Standards on Renewable Energy notified by BIS

Solar Photovoltaics Systems and Components

Sl. No.	Product	Indian Standard Number	Title of Indian Standard
1.	Crystalline Silicon Terrestrial Photovoltaic (PV) Modules (Si wafer based)	IS 14286 : 2010	Crystalline Silicon Terrestrial Photovoltaic (PV) Modules - Design Qualification and Type Approval
2.	Thin-Film Terrestrial Photovoltaic (PV) Modules (a-Si, CiGs and CdTe)	IS 16077 : 2013	Thin-Film Terrestrial Photovoltaic (PV) Modules - Design Qualification and Type Approval
3.	PV Module (Si wafer and Thin film)	IS/IEC 61730 (Part 1) : 2004 IS/IEC 61730 (Part 2) : 2004	Photovoltaic (PV) Module Safety Qualification Part 1 Requirements for Construction Photovoltaic (PV) Module Safety Qualification Part 2 Requirements for Testing
4.	Power Inverter for use in photovoltaic power system	IS 16221 (Part 2) :2015	Safety of Power Converters for Use in Photovoltaic Power Systems Part 2- Particular Requirements for Inverters.
5.	Utility -Interconnected Photovoltaic inverters with islanding prevention measures	IS 16169: 2014	Test Procedure of Islanding Prevention Measures for Utility-Interconnected Photovoltaic Inverters
6.	Storage battery	IS 16270	Secondary Cells and Batteries for Solar Photovoltaic Application General-Requirements and Methods of Test

Solar Thermal Systems

S. No	Product	Indian Standard Number	Title of Indian Standard
1	Solar Flat Plate Collector	IS 12933(Part1):2003	Solar Flat Plate Collector - Specification Part 1 Requirements (Second Revision)
		IS 12933(Part 2):2003	Solar Flat Plate Collector - Specification Part 2 Components (Second Revision)

		IS 12933(Part 3):2003	Solar Flat Plate Collector - Specification Part 3 Measuring Instruments (First Revision)
		IS 12933(Part 5):2003	Solar Flat Plate Collector - Specification Part 5 Test Methods (Second Revision)
		IS 16368: 2015	Test Procedure for Thermosiphon Type Domestic Solar Hot Water Heating System
2	All Glass Evacuated Tubes Solar Collector	IS 16542 : 2016	Direct Insertion Type Storage Water Tank for All Glass Evacuated Tubes Solar Collector – Specification
		IS 16543 : 2016	All Glass Evacuated Solar Collector Tubes – Specification
		IS 16544 : 2016	All Glass Evacuated Tubes Solar Water Heating System
3	Concentrated Solar Thermal	IS 16648 (Part 1) :2017	Concentrated Solar Thermal - Specification Part 3 Parabolic Through Concentrator
		IS 16648 (Part 2) :2017	Concentrated Solar Thermal - Specification Part 2 Scheffler Concentrator
		IS16648(Part 3):2017	Concentrated Solar Thermal - Specification Part 3 Parabolic Trough Concentrator
		IS16648 (Part 4) :2017	Concentrated Solar Thermal Specification Part 4 Non-Imaging Concentrator
		IS16648(Part 5):2017	Concentrated Solar Thermal - Specification Part 5 Test Methods