National Institute of Solar Energy

(Formerly known as Solar Energy Centre)

(An autonomous Institute of Ministry of New & Renewable Energy)

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2014-2015

TEST REPORT ON
SOLAR PUMP CONTROLLER- 3 HP

Sample ID No.	:	**104/2014**
Model	:	**iACQUA-220/3**
Sl. No.	:	**001/07/14**
Manufactured by:		**KISAN SOLAR**
Submitted by	:	**KISAN SOLAR** **A/2, ATULYA BHAVAN, NEXT TO C.E.R.C, S.G. HIGHWAY** **THALTEJ, AHMEDABAD-380054, GUJRAT, INDIA**

NOTE

This is a test report on measurements carried out on the Solar Pump Controller for solar water pumping applications (sample Id no. **104/2014**) submitted at National Institute of Solar Energy (NISE). The Solar Pump Controller is tested as per the user specifications. The data reported in this TEST REPORT is valid at the time and under the stipulated conditions of measurement. The test results reported are applicable to this Solar Pump Controller only and do not apply to other PCUs even though declared to be identical. The data contents in this report do not constitute a qualification test certificate. NISE does not accept any liability for any consequences including commercial or otherwise arising out of the utilization of the information contained in this report.

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Sample ID No. : 104/2014
Manufactured by: KISAN SOLAR
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A/2, ATULYA BHAVAN, NEXT TO C.E.RC, S.G. HIGWAY
THALTEJ, AHMEDABAD-380054, GUJRAT, INDIA

S.No.	Test performed as per NMRE Specifications	Claims of Manufacturer	NISE's Observations	Remarks
1.	**Input voltage**	220-310V		Maximum Voc allowed at inverter input is 310Vdc
	Inverter Minimum rated voltage		(190) 220	
	Inverter Nominal voltage		270	
	90%of Inverter's maximum input voltage		310	
2.	Ripple and Distortion	-	Tested with PV Array Simulator	Given in Tables on page no. 3
3.	Insulation Resistance test	-	826MΩ @ 1000V applied for 1 minutes	
4.	Output Voltage (Sine wave)	Three Phase, 230V AC pure Sine wave	Sine wave	Given in annexure -1
5.	Inductive load	-	Tested with Shakti 3 H.P. Pump	
6.	Low irradiation mode protection	Provided	Observed	satisfactory
7.	Dry run protection	Provided	Observed	Satisfactory
8.	Reverse polarity protection	Provided	Observed	Satisfactory
9.	Short Ckt protection	Provided	Observed	Satisfactory
10.	Open Ckt Protection	Provided	Observed	Satisfactory
11.	Data logging	Provided	Observed	Satisfactory
12.	**Efficiency Tests of the Controller at Nominal Voltage (270V) and motor's Duty Point @18mtr head**			
	At 25%of input power	**To be measured**	93.54%	
	At 50%of input power		93.99%	
	At 75%of input power		94.25%	
	At 100%of input power		94.24%	
13.	**Average MPPT tracking efficiency (%) @ duty point of motor**		99.77%	
14.	**Rated Output efficiency**	**To be measured**	94.22%	
15.	**Max. PV energy to water Efficiency (%)**	18 meter	43.55%	
		20 meter	46.03%	

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Table No. 1: Efficiency test of solar pump controller at nominal parameters (270V) and various heads						
Head	**S.No.**	1	2	3	4	5
10 Meter	**Load (%)**	**10**	**25**	**50**	**75**	**100**
	DC Input Power (W)	241.68	638.68	1268.14	1905.60	2512.35
	Output Voltage R.M.S. Line-Line (V)	85.97	128.29	159.05	177.22	199.05
	Frequency	25.47	31.73	40.10	45.13	50.95
	Output power(W)	220.52	588.79	1189.76	1795.60	2367.33
	Output power factor	0.54	0.67	0.81	0.86	0.88
	Output V_{THD} (%)- V1/V2	52.68 / 40.77	29.98 / 30.22	14.52 /14.01	1.25 /1.86	1.47 /1.98
	Output I_{THD} (%) - I1/I2	50.7/ 63.87	37.27 / 37.39	16.76 /15.29	4.81 /6.11	4.47 /5.91
	Pump Controller Output Efficiency (%)	91.24	92.19	93.82	94.23	94.23
	Max. PV Energy to Water Efficiency (%)	36.60				
	Average MPPT tracking Efficiency (%)	99.76				
15 Meter	**DC Input Power (W)**	258.60	662.25	1266.08	1903.71	2514.00
	Output Voltage R.M.S	91.83	151.45	170.59	184.11	197.26
	Frequency	26.20	37.31	43.07	47.00	50.50
	Output power(W)	238.96	577.93	1179.26	1783.89	2360.10
	Output power factor	0.54	0.64	0.79	0.85	0.88
	Output V_{THD} (%)- V1/V2	42.97/ 32.67	18.37 /19.60	0.93 / 1.61	1.21 / 1.85	1.47 / 2.07
	Output I_{THD} (%) - I1/I2	39.38/ 54.95	10.32 /12.29	5.15 / 6.61	4.77 /6.24	4.43 / 5.85
	Pump Controller Output Efficiency (%)	92.40	93.38	93.77	94.18%	94.25%
	Max. PV Energy to Water Efficiency (%)	40.50				
	Average MPPT tracking Efficiency (%)	99.69				
18 Meter	**DC Input Power (W)**	-	715.01	1270.66	1901.25	2513.22
	Output Voltage R.M.S	-	132.64	176.58	188.79	201.01
	Frequency		32.78	44.42	48.04	51.31
	Output power(W)	-	668.84	1194.27	1791.89	2366.05
	Output power factor	-	0.70	0.78	0.85	0.88
	Output V_{THD} (%)- V1/V2	- -	25.95 /29.38	0.85/ 1.56	1.21/ 1.87	1.47/ 2.09
	Output I_{THD} (%) - I1/I2	- -	27.53/ 29.22	4.95/ 6.47	4.88/ 6.35	4.50/ 5.96
	Pump Controller Output Efficiency (%)	-	93.54%	93.99%	94.25%	94.24%
	Max. PV Energy to Water Efficiency (%)	43.55				
	Average MPPT tracking efficiency (%)	99.77				
20 Meter	**DC Input Power (W)**	-	-	1269.05	1894.77	2509.11
	Output Voltage R.M.S	-	-	183.62	192.41	202.47
	Frequency			46.25	49.04	51.75
	Output power(W)	-	-	1181.85	1788.94	2348.19
	Output power factor	-	-	0.77	0.85	0.88
	Output V_{THD} (%)- V1/V2	- -	- -	0.89/ 1.61	1.19/ 1.88	1.44/ 1.92
	Output I_{THD} (%) - I1/I2	- -	- -	5.03/ 6.77	4.83/ 6.47	4.47/ 5.99
	Pump Controller Output Efficiency (%)	-	-	94.03%	94.33%	94.21%
	Max. PV Energy to Water Efficiency (%)	46.03				
	Average MPPT tracking efficiency (%)	99.70				

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Table No. 2: Performance over specified voltage range and at various heads

Head	S.No.	1	2	5
10 Meter	Voltage Range	Minimum	Nominal	Maximum
	Input voltage (V)	220	270	310
	Threshold P_{PV} for start of water discharge (W)*	-	793	-
	Threshold P_{PV} for stop of water discharge (W)*	-	330	-
	Average MPPT tracking efficiency (%)	99.76	99.76	99.38
15 Meter	Voltage Range	Minimum	Nominal	Maximum
	Input voltage (V)	220	270	310
	Threshold P_{PV} for start of water discharge (W)*	-	920	-
	Threshold P_{PV} for stop of water discharge (W)*	-	552	-
	Average MPPT tracking efficiency (%)	99.69	99.69	99.66
18 Meter	Voltage Range	Minimum	Nominal	Maximum
	Input voltage (V)	220	270	310
	Threshold P_{PV} for start of water discharge (W)*	-	968	-
	Threshold P_{PV} for stop of water discharge (W)*	-	638	-
	Average MPPT tracking efficiency (%)	99.77	99.77	99.74
20 Meter	Voltage Range	Minimum	Nominal	Maximum
	Input voltage (V)	220	270	310
	Threshold P_{PV} for start of water discharge (W)*	-	989	-
	Threshold P_{PV} for stop of water discharge (W)*	-	777	-
	Average MPPT tracking efficiency (%)	99.75	99.70	99.78

* P_{PV} – the photovoltaic power

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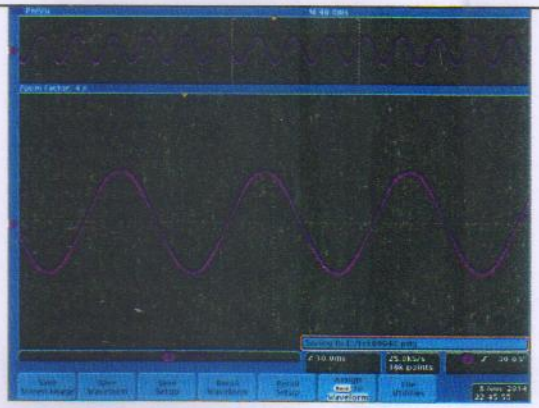
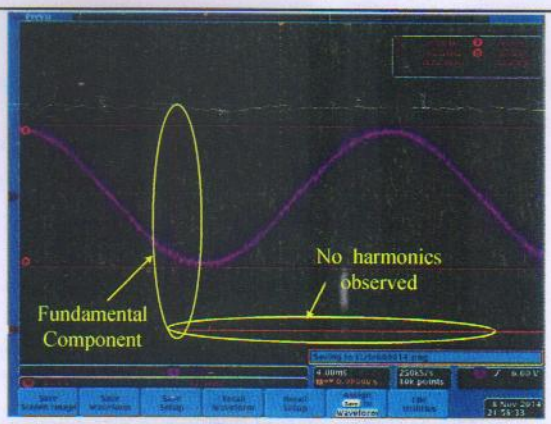
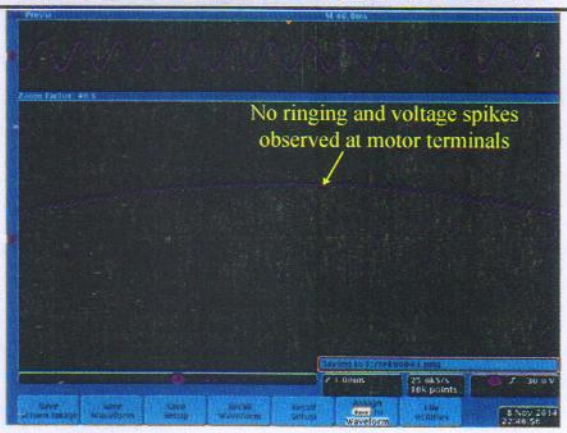
Note:

1. **The pump controller is tested using PV array simulator Ametek Make, Model No. ETS600X which can simulate different real field array conditions and the load is 3 Hp surface pump of Shakti Make, Model No. SOLAR SMB-SS-32-160.**

2. **It is observed that MPPT of Solar Pump Controller is operating at greater than 99.50%, which is remarkable and the performance of the pump with this controller is found to be optimum under the given conditions.**

3. **The PV array to water efficiency of the system using this controller is 46% at 20 meter head.**

Table No. 3: Instantaneous voltage performance for long motor cable			
S. No.	Description	Waveform recorded	Remark
1	Instantaneous line voltage at PCU terminals		Satisfactory
2	Instantaneous line voltage at motor terminals with 60 meter length of motor cable		No voltage spikes observed
3	Instantaneous line voltage at motor terminals with 60 meter length of motor cable (Zoomed version)		No ringing observed

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