

TUV Rheinland (India) Pvt. Ltd.
Product Safety & Quality

Test Report

Photovoltaic module Testing

TÜV Report No. ULR: TC568819400000583F

Bangalore, December 2019



Certificate No. TC- 5688

Test report no.: <i>Prüfbericht - Nr.:</i>		ULR: TC568819400000583F	
Client (Customer no. and address): <i>Auftraggeber</i> <i>(Kunden-Nr. u. Adresse):</i>		410949 Renewsys India Pvt Ltd. Division: Hyderabad Fab City (SEZ), Plot No.6, #114/P, Srinagar Village, Maheswaram Mandal, Rangareddy 501359 INDIA	
Test item: <i>Gegenstand der Prüfung:</i>		Photovoltaic (PV) Module(s)	Date of receipt: <i>Eingangsdatum:</i> 29.11.2019
Module type designation: <i>Modultypen-Bezeichnung:</i>		DESERV 3M6-330	
Order no.: <i>Auftragsnummer:</i>		166158258	
Testing location: <i>Prüfart:</i>		TUV Rheinland(India) Pvt.Ltd 27/B,Electronic city, Phase I, Bangalore-560 100,India Tel: +91 80 46498000	
Test specification: <i>Prüfgrundlage:</i>		IEC 61853-1:2011 <i>Photovoltaic (PV) module performance testing and energy rating.</i> <i>Part 1: Irradiance and temperature performance measurements and power rating</i>	
Test result: <i>Prüfergebnis:</i>		Results enclosed	
compiled by / erstellt:		reviewed by / kontrolliert:	
26-12-2019 Prashanth G S./Asst. Manager		26-12-2019 K. Ganesh Kamath / Manager	
Date <i>Datum</i>	Title/Name <i>Titel/Name</i>	Date <i>Datum</i>	Title/Name <i>Titel/Name</i>
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Address/es of the manufacturing site/s:

Name / Description:	Renewsys India Pvt Ltd, Division: Hyderabad
Street:	Fab City (SEZ), Plot No.6, #114/P, Srinagar Village
Postcode / City:	Maheswaram Mandal, Rangareddy 501359
Country:	India
Type of production:	Solar Photovoltaic Modules
Inspection report no:	NA

Summary of testing:

According to the inquiry of the customer, for testing as per IEC 61853-1, *Photovoltaic (PV) module performance testing and energy rating – Part 1: Irradiance and temperature performance measurements and power rating* on PV module type **DESERV 3M6-330**, the results are incorporated in this report no: **ULR: TC568819400000583F**. The above listed module type have passed all tests of the IEC 61215:2005 standard before testing as per IEC 61853-1.

Pass criteria:

1. The values of STC power measured after preconditioning fall within the power range specified by the manufacturer of this product. (results enclosed)
2. After generating the matrix of parameters, the modules are remeasured at STC to verify that the performance is stable. (results enclosed)

All presented results are only valid for the exact tested module type and design (cell type, encapsulation material, glass type)

Summary of test locations:

All tests were performed at TUV Rheinland (India) Pvt Ltd, Bangalore.

Summary of deviations from the standard:

- NA

General product information:

PV module type reference.....:	DESERV 3M6-330
Nominal maximum power ($P_{\max}$)	330 W (0-4.99W)
Nominal open circuit voltage at (V_{oc})	46.24 V
Nominal short circuit current at (I_{sc})	9.30 A
Nominal maximum power voltage ($V_{\max}$)	37.62 V
Nominal maximum power current ($I_{\max}$).....:	8.78 A
<u>Product Safety Ratings</u>	-
Maximum system voltage.....:	1000 V

Test procedure:

- ☐ Random sampling from production
☒ Prototype submitted by client

Test performed with a solar simulator.

In order to minimize the errors related to translations/interpolations, we used the irradiance-specific temperature coefficients as per IEC 60891:2009, and the temperature and irradiance conditions during the tests were maintained very close (within ± 1 °C and 10 W/m²) to the reporting conditions of 15, 25, NOCT, 50 and 75 °C and 100, 200, 400, 500, 600, 800, 1000, and 1100 W/m².

The linearity of the module and test setup meets the requirements as per IEC 60904-10

Description of similarity (differences) between the applied model and the previously tested model: NA

Table 1: Module group assignment

Sample no.	Client serial number
A001034291-020	R1000048182023793
A001034291-016	R1000026192532944
A001034291-018	R1000026192532854
A001034291-017	R1000026192532948

Table 2: Constructional characteristics

Components	Model/Type	Manufacturer		
Junction Box	PV- ZH011-3	Sunter		
JB Sealant	HT906Z	Hutian		
Frame Sealant	HT906Z	Hutian		
Frame	40x35- 1mm Wall thickness	Haihong		
EVA (FRONT)	Conserv A 360.2 14 FC	RenewSys		
EVA (BACK)	Conserv A 360.2 14 FC	RenewSys		
Backsheet	RenewSys A 190WN	RenewSys		
Glass	1950 x 983 x 3.2mm, ARC glass	Xinyi		
Bus bar	SnPb	Telison		
Flux	952-S	Kester		
Cell	RESERV 625	RenewSys		
Module parameters				
Module dimensions (L x W x T) in mm	Cell technology	Number of cells	Number of bus bars	Cell area in cm ²
1960 X 985 X 40	Poly	72	5	245.71

Table 3: Marking requirements

Parameters	Verdict
Name, monogram or symbol of the manufacturer	P
Type or model number	P
Serial number	P
Polarity of terminals or leads (colour coding is permissible)	P
Nominal and minimum values of maximum output power at STC after preconditioning, as specified by the manufacturer for the product type (see Clause 5).	P
The date and place of manufacture shall be marked on the module or be traceable from the serial number.	P
Supplementary information: None	

Table 4: Visual inspection

Test date [DD/MM/YYYY]	26.09.2019	—
Sample no.	Nature and position of initial findings	—
A001034291-020	No major visual defects found	P
A001034291-016	No major visual defects found	P
A001034291-018	No major visual defects found	P
A001034291-017	No major visual defects found	P
Supplementary information: Visual inspection performed as per IEC 61215 clause 7		

Table 5: Maximum power determination after preconditioning

Test date [DD/MM/YYYY]:	26.09.2019 to 27.09.2019								
Module temperature [°C] .	Corrected to 25								
Irradiance [W/m²]:	1000								
Sample no.	P _{max} [W]	V _{max} [V]	I _{max} [A]	V _{oc} [V]	I _{sc} [A]	FF [%]	M.efficacy in [%]	Rsh in ohms	Rs in ohms
A001034291-020	334.76	38.04	8.800	46.79	9.340	76.60	17.30	458.15	0.573
A001034291-016	333.90	37.75	8.845	45.95	9.370	77.56	17.21	260.40	0.488
A001034291-018	330.66	37.71	8.760	45.81	9.226	78.00	16.99	402.12	0.492
A001034291-017	330.71	37.72	8.768	45.90	9.283	77.62	17.04	165.48	0.494
Supplementary information: Preconditioning done as per IEC 61215 clause 5									

Table 6: Comparison of measured power with name plate of the module after preconditioning

Test date [DD/MM/YYYY]:	04.12.2019 to 06.12.2019		
Sample no.	Power measured at STC after preconditioning in [W]	Power on name plate	-
A001034291-020	334.76	330 W (0-4.99W)	P
A001034291-016	333.90		P
A001034291-018	330.66		P
A001034291-017	330.71		P
Supplementary information: None			

Table 7: Averaging of three test modules

Irrad [W/m ²]	Temp. [°C]	Sample no.	P _{max} [W]	V _{max} [V]	I _{max} [A]	V _{oc} [V]	I _{sc} [A]	FF [%]	M.Eff [%]
1100	75	A001034291-016	298.89	30.86	9.686	39.43	10.523	72.04	14.00
		A001034291-018	295.14	30.72	9.606	39.24	10.439	72.05	13.83
		A001034291-017	297.03	30.85	9.629	39.39	10.474	71.99	13.92
		Average	297.02	30.81	9.640	39.35	10.479	72.03	13.92
	50	A001034291-016	334.35	34.37	9.728	42.83	10.441	74.78	15.66
		A001034291-018	330.40	34.15	9.675	42.65	10.334	74.96	15.48
		A001034291-017	331.93	34.34	9.666	42.80	10.362	74.85	15.55
		Average	332.23	34.29	9.690	42.76	10.379	74.86	15.56
	25	A001034291-016	366.87	37.70	9.731	45.18	10.309	78.77	17.19
		A001034291-018	362.21	37.66	9.619	45.12	10.154	79.06	16.97
		A001034291-017	363.78	37.76	9.635	45.17	10.220	78.80	17.04
		Average	364.29	37.70	9.662	45.16	10.228	78.88	17.07
1000	75	A001034291-016	271.23	30.76	8.818	39.18	9.569	72.35	13.98
		A001034291-018	267.60	30.59	8.747	38.96	9.483	72.43	13.79
		A001034291-017	269.37	30.75	8.760	39.13	9.526	72.27	13.88
		Average	269.40	30.70	8.775	39.09	9.526	72.35	13.88
	50	A001034291-016	303.63	34.31	8.850	42.60	9.490	75.11	15.65
		A001034291-018	300.09	34.05	8.813	42.43	9.383	75.39	15.47
		A001034291-017	301.43	34.29	8.789	42.57	9.420	75.18	15.53
		Average	301.72	34.22	8.817	42.53	9.431	75.23	15.55
	25	A001034291-016	333.90	37.75	8.845	45.95	9.370	77.56	17.21
		A001034291-018	330.66	37.71	8.760	45.81	9.226	78.00	16.99
		A001034291-017	330.71	37.72	8.768	45.90	9.283	77.62	17.04
		Average	331.76	37.73	8.791	45.88	9.293	77.73	17.08
	15	A001034291-016	346.39	39.33	8.808	47.33	9.322	78.50	17.85
		A001034291-018	342.53	39.18	8.742	47.25	9.178	78.99	17.65
		A001034291-017	343.21	39.18	8.760	47.30	9.241	78.52	17.69
		Average	344.04	39.23	8.770	47.29	9.247	78.67	17.73

Table 7: Averaging of three test modules (continued)

Irrad [W/m ²]	Temp. [°C]	Sample no.	P _{max} [W]	V _{max} [V]	I _{max} [A]	V _{oc} [V]	I _{sc} [A]	FF [%]	M.Eff [%]
800	75	A001034291-016	216.47	30.72	7.047	38.68	7.651	73.14	13.95
		A001034291-018	213.54	30.50	7.002	38.46	7.579	73.27	13.76
		A001034291-017	214.92	30.71	6.998	38.62	7.612	73.10	13.84
		Average	214.98	30.64	7.016	38.59	7.614	73.17	13.85
	50	A001034291-016	242.64	34.28	7.078	42.14	7.575	76.02	15.63
		A001034291-018	239.72	34.15	7.019	41.96	7.497	76.21	15.44
		A001034291-017	240.66	34.06	7.024	42.10	7.524	75.98	15.50
		Average	241.01	34.15	7.040	42.06	7.532	76.07	15.52
	47	A001034291-016	245.60	34.69	7.080	42.52	7.579	76.20	15.82
		A001034291-018	242.64	34.47	7.040	42.35	7.496	76.43	15.63
		A001034291-017	243.57	34.68	7.023	42.50	7.510	76.32	15.69
		Average	243.94	34.61	7.048	42.46	7.528	76.32	15.71
	25	A001034291-016	267.15	37.84	7.061	45.56	7.487	78.32	17.21
		A001034291-018	263.75	37.70	6.995	45.42	7.372	78.78	16.99
		A001034291-017	264.33	37.71	7.010	45.49	7.416	78.35	17.03
		Average	265.08	37.75	7.022	45.49	7.425	78.48	17.08
	15	A001034291-016	276.72	39.28	7.044	46.88	7.451	79.22	17.83
		A001034291-018	273.51	39.15	6.985	46.79	7.339	79.65	17.62
		A001034291-017	274.07	39.26	6.980	46.85	7.386	79.20	17.66
		Average	274.77	39.23	7.003	46.84	7.392	79.36	17.70
600	75	A001034291-016	160.86	30.61	5.255	37.98	5.733	73.87	13.82
		A001034291-018	158.79	30.38	5.226	37.78	5.679	74.01	13.64
		A001034291-017	159.86	30.50	5.241	37.98	5.699	73.85	13.73
		Average	159.84	30.50	5.241	37.91	5.704	73.91	13.73
	50	A001034291-016	180.54	34.13	5.290	41.49	5.686	76.53	15.51
		A001034291-018	178.42	33.91	5.262	41.31	5.616	76.90	15.33
		A001034291-017	179.16	34.12	5.251	41.46	5.636	76.66	15.39
		Average	179.38	34.05	5.268	41.42	5.646	76.70	15.41
	25	A001034291-016	199.31	37.66	5.293	44.95	5.615	78.96	17.12
		A001034291-018	196.61	37.52	5.240	44.81	5.527	79.38	16.89
		A001034291-017	197.27	37.64	5.241	44.94	5.559	78.96	16.94
		Average	197.73	37.61	5.258	44.90	5.567	79.10	16.98
	15	A001034291-016	206.43	39.08	5.282	46.30	5.585	79.82	17.73
		A001034291-018	203.97	38.96	5.236	46.20	5.505	80.20	17.52
		A001034291-017	204.38	39.06	5.232	46.27	5.539	79.74	17.55
		Average	204.93	39.03	5.250	46.26	5.543	79.92	17.60

Table 7: Averaging of three test modules (continued)

Irrad [W/m ²]	Temp. [°C]	Sample no.	P _{max} [W]	V _{max} [V]	I _{max} [A]	V _{oc} [V]	I _{sc} [A]	FF [%]	M.Eff [%]
500	15	A001034291-016	171.27	38.97	4.395	44.94	4.649	81.96	17.65
		A001034291-018	169.09	38.86	4.352	44.91	4.580	82.20	17.43
		A001034291-017	169.41	39.05	4.338	44.94	4.608	81.81	17.46
		Average	169.92	38.96	4.361	44.93	4.613	81.99	17.51
400	50	A001034291-016	119.34	33.68	3.543	40.62	3.808	77.16	15.38
		A001034291-018	117.91	33.54	3.515	40.43	3.764	77.47	15.19
		A001034291-017	118.37	33.68	3.515	40.59	3.779	77.16	15.25
		Average	118.54	33.63	3.524	40.55	3.784	77.26	15.27
	25	A001034291-016	132.34	37.32	3.546	44.13	3.769	79.56	17.05
		A001034291-018	130.49	37.19	3.509	43.99	3.710	79.97	16.81
		A001034291-017	130.94	37.31	3.510	44.11	3.730	79.58	16.87
		Average	131.26	37.27	3.522	44.08	3.736	79.70	16.91
	15	A001034291-016	137.27	38.68	3.549	45.52	3.752	80.37	17.69
		A001034291-018	135.67	38.67	3.508	45.42	3.696	80.82	17.48
		A001034291-017	135.90	38.67	3.515	45.49	3.715	80.41	17.51
		Average	136.28	38.67	3.524	45.48	3.721	80.53	17.56
200	25	A001034291-016	63.97	36.33	1.761	42.71	1.884	79.51	16.48
		A001034291-018	63.07	36.14	1.745	42.56	1.855	79.86	16.25
		A001034291-017	63.15	36.32	1.739	42.67	1.865	79.35	16.27
		Average	63.40	36.26	1.748	42.65	1.868	79.57	16.33
	15	A001034291-016	66.62	37.79	1.763	44.14	1.875	80.47	17.17
		A001034291-018	65.74	37.78	1.740	44.03	1.848	80.77	16.94
		A001034291-017	65.80	37.79	1.741	44.11	1.860	80.21	16.95
		Average	66.05	37.78	1.748	44.10	1.861	80.48	17.02
100	25	A001034291-016	30.67	35.16	0.872	41.32	0.940	78.99	15.81
		A001034291-018	30.22	34.88	0.866	41.16	0.927	79.21	15.57
		A001034291-017	30.17	35.17	0.858	41.27	0.932	78.44	15.55
		Average	30.35	35.07	0.866	41.25	0.933	78.88	15.64
	15	A001034291-016	32.10	36.72	0.874	42.80	0.940	79.79	16.54
		A001034291-018	31.69	36.53	0.868	42.68	0.927	80.07	16.33
		A001034291-017	31.60	36.63	0.863	42.75	0.932	79.34	16.29
		Average	31.80	36.63	0.868	42.74	0.933	79.73	16.39

Tables 8: Test matrix of module performance with respect to temperature and irradiance**Table 8.1: $P_{\max}$ [W] versus irradiance and temperature**

Irradiance	Spectrum	Module temperature				
		15 °C	25 °C	NOCT °C	50 °C	75 °C
1100 W/m ²	AM 1.5	NA	364.29	NA	332.23	297.02
1000 W/m ²	AM 1.5	344.04	331.76	NA	301.72	269.40
800 W/m ²	AM 1.5	274.77	265.08	243.94	241.01	214.98
600 W/m ²	AM 1.5	204.93	197.73	NA	179.38	159.84
500 W/m ²	AM 1.5	169.92	NA	NA	NA	NA
400 W/m ²	AM 1.5	136.28	131.26	NA	118.54	NA
200 W/m ²	AM 1.5	66.05	63.40	NA	NA	NA
100 W/m ²	AM 1.5	31.80	30.35	NA	NA	NA

Table 8.2: I_{sc} [A] versus irradiance and temperature

Irradiance	Spectrum	Module temperature				
		15 °C	25 °C	NOCT °C	50 °C	75 °C
1100 W/m ²	AM 1.5	NA	10.228	NA	10.379	10.479
1000 W/m ²	AM 1.5	9.247	9.293	NA	9.431	9.526
800 W/m ²	AM 1.5	7.392	7.425	7.528	7.532	7.614
600 W/m ²	AM 1.5	5.543	5.567	NA	5.646	5.704
500 W/m ²	AM 1.5	4.613	NA	NA	NA	NA
400 W/m ²	AM 1.5	3.721	3.736	NA	3.784	NA
200 W/m ²	AM 1.5	1.861	1.868	NA	NA	NA
100 W/m ²	AM 1.5	0.933	0.933	NA	NA	NA

Table 8.3: V_{oc} [V] versus irradiance and temperature

Irradiance	Spectrum	Module temperature				
		15 °C	25 °C	NOCT °C	50 °C	75 °C
1100 W/m ²	AM 1.5	NA	45.16	NA	42.76	39.35
1000 W/m ²	AM 1.5	47.29	45.88	NA	42.53	39.09
800 W/m ²	AM 1.5	46.84	45.49	42.46	42.06	38.59
600 W/m ²	AM 1.5	46.26	44.90	NA	41.42	37.91
500 W/m ²	AM 1.5	44.93	NA	NA	NA	NA
400 W/m ²	AM 1.5	45.48	44.08	NA	40.55	NA
200 W/m ²	AM 1.5	44.10	42.65	NA	NA	NA
100 W/m ²	AM 1.5	42.74	41.25	NA	NA	NA

Table 8.4: $V_{\max}$ [V] versus irradiance and temperature

Irradiance	Spectrum	Module temperature				
		15 °C	25 °C	NOCT °C	50 °C	75 °C
1100 W/m ²	AM 1.5	NA	37.70	NA	34.29	30.81
1000 W/m ²	AM 1.5	39.23	37.73	NA	34.22	30.70
800 W/m ²	AM 1.5	39.23	37.75	34.61	103.03	30.64
600 W/m ²	AM 1.5	39.03	37.61	NA	34.05	30.50
500 W/m ²	AM 1.5	38.96	NA	NA	NA	NA
400 W/m ²	AM 1.5	38.67	37.27	NA	33.63	NA
200 W/m ²	AM 1.5	37.78	36.26	NA	NA	NA
100 W/m ²	AM 1.5	36.63	35.07	NA	NA	NA

Table 8.5: $I_{\max}$ [A] versus irradiance and temperature

Irradiance	Spectrum	Module temperature				
		15 °C	25 °C	NOCT °C	50 °C	75 °C
1100 W/m ²	AM 1.5	NA	9.662	NA	9.690	9.640
1000 W/m ²	AM 1.5	8.770	8.791	NA	8.817	8.775
800 W/m ²	AM 1.5	7.003	7.022	7.048	7.040	7.016
600 W/m ²	AM 1.5	5.250	5.258	NA	5.268	5.241
500 W/m ²	AM 1.5	4.361	NA	NA	NA	NA
400 W/m ²	AM 1.5	3.524	3.522	NA	3.524	NA
200 W/m ²	AM 1.5	1.748	1.748	NA	NA	NA
100 W/m ²	AM 1.5	0.868	0.866	NA	NA	NA

Table 9: Summary of reference power conditions (at AM 1,5)

Irrad [W/m ²]	Temp. [°C]	$P_{\max}$ [W]	$V_{\max}$ [V]	$I_{\max}$ [A]	V_{oc} [V]	I_{sc} [A]	FF [%]	M.Eff [%]
1000	25	331.76	37.73	8.791	45.88	9.293	77.73	17.08
800	NOCT	243.94	34.61	7.048	42.46	7.528	76.32	15.71
200	25	63.40	36.26	1.748	42.65	1.868	79.57	16.33
1000	75	269.40	30.70	8.775	39.09	9.526	72.35	13.88
500	15	169.92	38.96	4.361	44.93	4.613	81.99	17.51

Table 10: Maximum power determination after matrix generation

Test date [DD/MM/YYYY]:		04.12.2019 to 07.12.2019							
Module temperature [°C]:		Corrected to 25							
Irradiance [W/m²]:		1000							
Sample no.	P _{max} [W]	V _{max} [V]	I _{max} [A]	V _{oc} [V]	I _{sc} [A]	FF [%]	M.efficacy in [%]	Rsh in ohms	Rs in ohms
A001034291-020	334.11	38.00	8.790	46.80	9.320	76.60	17.30	478.36	0.584
A001034291-016	333.82	37.87	8.815	46.01	9.347	77.62	17.20	228.38	0.487
A001034291-018	331.26	37.72	8.782	45.92	9.251	77.98	17.07	480.18	0.490
A001034291-017	331.61	37.85	8.762	45.97	9.287	77.67	17.09	140.66	0.492
Supplementary information: None									

Table 11: Comparison of measured power with name plate of the module after matrix generation

Test date [DD/MM/YYYY]:	04.12.2019 to 07.12.2019		
Sample no.	Power measured at STC after matrix in [W]	Power on name plate	-
A001034291-020	334.11	330 W (0-4.99W)	P
A001034291-016	333.82		P
A001034291-018	331.26		P
A001034291-017	331.61		P
Supplementary information: None			

Table 12: Measurement of temperature coefficients

Test date [DD/MM/YYYY].....	04.12.2019 to 06.12.2019		
Ambient air temperature [°C]	25 ± 2		
Irradiance [W/m²]	1000		
Module temperature [°C] high/low	65 / 25		
Sample No.	α [%/K]	β [%/K]	γ [%/K]
A001034291-016	0.0547	-0.2938	-0.3685
A001034291-018	0.0596	-0.2973	-0.3705
A001034291-017	0.0549	-0.2937	-0.3625
Average	0.0564	-0.2949	-0.3671
Supplementary information: None			

Annex 1: Equipment used

Equipment	Equipment ID	Cal Due date
Pasan Sun Simulator-3b	50-2018-0188	01-09-2020
Reference Module	50-2012-0231	31-07-2020

Annex 2: Statement of the estimated uncertainty of the test verdicts and spectrum at test plane

- Electrical performance rating is outside the scope of IEC 61215:2005 qualification testing. The verdicts of performance rating are only related to the test samples that were subjected to the tests. They cannot be generalised to the modules from the series production.
 - Pmax measurement: 2.49% with a coverage factor k=2
 - Current measurement: 2.28% with a coverage factor k=2
 - Voltage measurement: 2.08% with a coverage factor k=2
 - Relative measurements were performed with a flash type solar simulator.
- The accuracy of measurement reproduction with the solar simulator is less than $\pm 1\%$.

Annex 3: Pictures of Test Samples


Fig.01: Front view of test sample



Fig. 02: Rear view of test sample



Fig. 03: Detail view of Junction Box

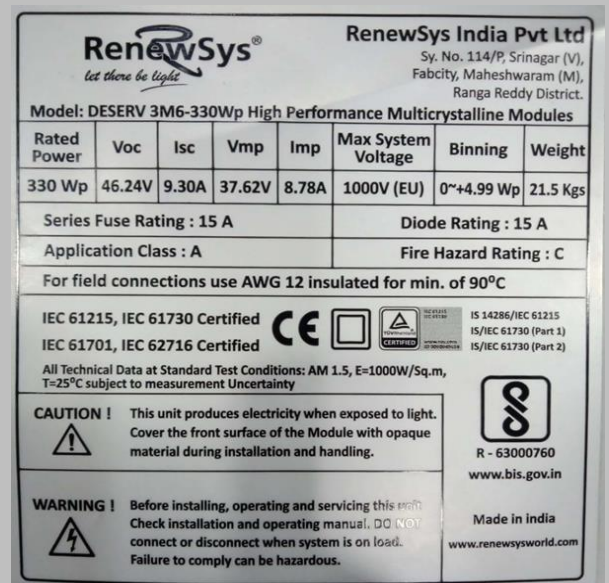


Fig. 04: Detail view of Type label

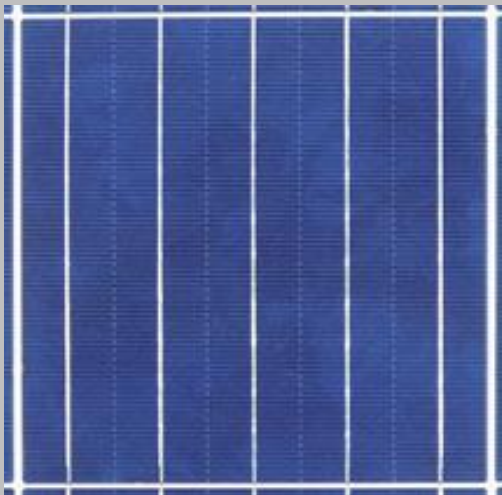


Fig. 05: Detail view of Solar cell



Fig. 06: Detail view of connector

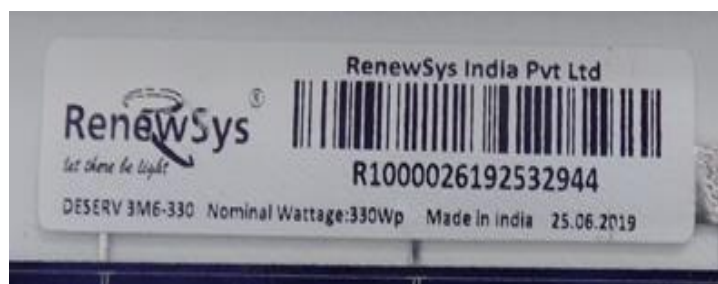


Fig. 07: Detail view of Solar cable



Fig. 08: Detail view of serial number

Annex 4: Serial numbers



-----END OF REPORT-----