



TC-5100

HI PHYSIX
testing & calibration laboratory

HI PHYSIX LABORATORY INDIA PVT. LTD

B-32/1/2, MIDC, Ranjangaon, Pune, Maharashtra

info@hiphysix.com, infohplindia@gmail.com

Phone : 02138 - 232901, 232902, 232903


CIN : U74120DL2009PTC194754

Mobile 1 : +91 7768005400


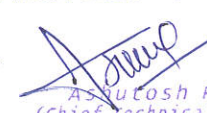
Mobile 2 : +91 7768005411

Mobile 3 : +91 7768005422

TEST REPORT IEC 61701: 2011 Salt mist corrosion testing of photovoltaic (PV) modules	
ULR-TC510021000001160F Discipline.....: Group.....:	Electronics Testing Miscellaneous Products
Report Number.....:	HPLI/Test/2108025601
Date of Issue	10/11/2021
Total no. of pages.....:	17
Manufacturer's Name.....:	VISAKA INDUSTRIES LIMITED (ATUM DIVISION)
Address.....:	Survey No 95 & 96, Adjacent to Kukkadam Railway Station, Kukkadam Post, Gajalapur, Madugulapally, Nalgonda-508207, Telangana, India.
Name of test laboratory.....:	HI PHYSIX LABORATORY INDIA PVT. LTD.
Address of laboratory.....:	B-32/1/2, MIDC, RANJANGAON, PUNE, MAHARASHTRA - 412220
<u>Test Specification</u> Standard.....:	IEC 61701: 2011 (Severity 6)
Test Procedure	Compliance Report
Non- Standard Test Method.....:	N/A
Test Report Form No.....:	IEC 61701: 2011/HPLI_PV
Test Report Form(s) Originator.....:	Hi Physix Laboratory India Pvt. Ltd., Pune
Test Report Form	Dated 11-2018
Test item Description	Crystalline silicon terrestrial photovoltaic (PV) modules. (Mono-crystalline)
Trade Mark.....:	ATUM
Model / Type reference	VIL-375AM (Representative model) 72 Cells: VIL-370AM, VIL-370M, VIL-375M, VIL-320P, VIL-325P, VIL-330P & VIL-335P (Series Models) 60 Cells: VIL-250P, VIL-255P, VIL-260P, VIL-265P & VIL-270P (Series Models)
Ratings.....:	See copy of marking plate on page no. 4


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 Ashutosh Pathak
 (Chief Technical Manager)



Testing procedure and testing location:		
<input checked="" type="checkbox"/> Testing Laboratory:		
Testing location/ address	Hi Physix Laboratory India Private Limited B-32/1/2 M.I.D.C, Ranjangaon Pune Maharashtra -412220	
Tested by (name + signature)..... :	Praveen Kumar Mishra (Testing Engineer)	
Approved by (name + signature) :	Ashutosh Pathak (Chief Technical Manager)	 HI PHYSIX LABORATORY INDIA PVT. LTD. Ashutosh Pathak (Chief Technical Manager)



Summary of testing:	
Tests performed (name of test and test clause): IEC 61701: 2011, Severity 6	Testing location: Hi Physix Laboratory India Private Limited. B-32/1/2 M.I.D.C, Ranjangaon Pune Maharashtra - 412220.
Preconditioning	
MST 01 Visual Inspection (Initial and Final)	
10.2 Maximum power determination (Initial and Final)	
MST 16 Dielectric withstand test (Initial and Final)	
10.15 Wet leakage current test (Initial and Final)	
MST 13 Ground continuity test (Initial and Final)	
Salt mist test according to IEC 60068-2-52, Severity 6	
Bypass diode functionality test	


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Copy of marking plate on the backside of the Module: (Representative Model)

VISAKA INDUSTRIES LIMITED (ATUM DIVISION)

Model No : VIL-375AM


Serial No 
VIL120212952017
VIL-375AM, Y.of Mfg.:2021, Nominal Wp:24V-375±2%

Power Max, Pmax	-	375.86 ± 2%W
Max System Voltage DC	-	1500V
Voltage at Pmp, Vmp	-	40.68V
Open Circuit Voltage, Voc	-	49.43V
Current at Pmp, Imp	-	9.23A
Short Circuit Current, Isc	-	9.70A

Fuse Rating 14A, Safety Class-II

Field wiring: copper only 12AWG wires insulated for a min of 90°C.

The electrical parameters are within -0%/ ± 2% of the Indicated nominal power under STC (Irradiance of 1000W/Sqm; AM - 1.5 Spectrum at Cell Temp of 25°C).



All instructions should be read and understood before attempting to install, operate and maintain the module. Contact with electrically active part of the module such as terminals can result in burns, sparks and lethal shock irrespective of the module is connected or disconnected. Modules produce electricity when sunlight or other sources illuminate the front face. The Voltage from a single module is not considered a shock hazard but when modules are connected in series, voltages add -up, consequently, a module array can produce high voltages and current, which constitute an increased hazard and could cause serious injury or death. When installing comply with all national and local safety and building codes.

Manufactured By: **MADE IN INDIA**
VISAKA INDUSTRIES LIMITED (ATUM DIVISION)
FACTORY ADDRESS: Survey No 95 & 96, Adjacent to Kukkadam Railway station, Kukkadam Post, Gajalapur, Madugulapally, Nalgonda - 508207, Telangana, INDIA.

Copy of marking laminated inside the glass:

ATUM
by **VISAKA**


VIL120212952017
VIL-375AM, Y.of Mfg.:2021, Nominal Wp:24V-375±2%

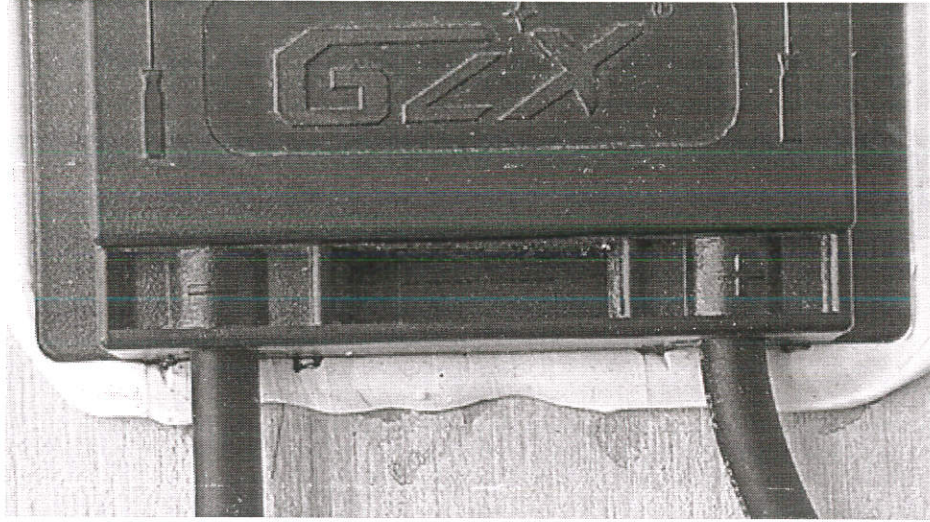
(All serial No. mentioned on page No: 6)

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Polarity of terminals or leads:



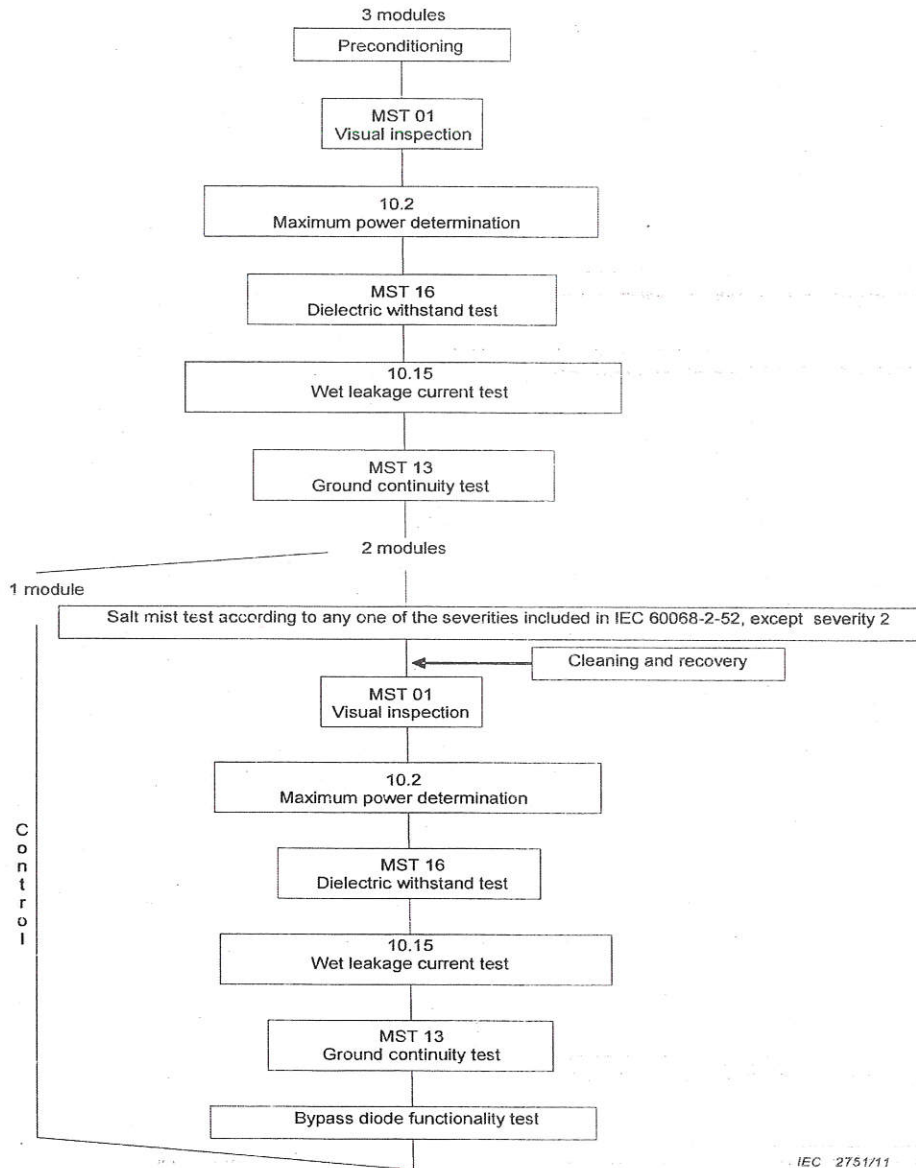
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Test item particulars:	Crystalline silicon terrestrial photovoltaic (PV) modules. (Mono-crystalline)	
Accessories and detachable parts included in the evaluation	N/A	
Options included	N/A	
Abbreviations used in the report:		
DH – Damp Heat	Vmp – Maximum power voltage	
Imp – Maximum power current	Voc – Open circuit voltage	
Isc - Short circuit current	FF – Fill Factor	
Pmp – Maximum power	STC – Standard Test Conditions	
Possible test case verdicts:		
- test case does not apply to the test object	N/A	
- test object does meet the requirement	Pass (P)	
- test object does not meet the requirement.....	Fail (F)	
- Date(s) of performance of tests.....	06/09/2021 to 08/11/2021	
- Receipt Number.....	21080256	
- Date of Deposit.....	19/08/2021	
General remarks:		
The test results presented in this report relate only to the object tested. This report shall not be reproduced, except in full, without the written approval of the Issuing testing laboratory. The Management System is maintained in accordance with IS/ISO/IEC 17025:2017 and testing Standards/Instruments are traceable to National / International Standards. "(see Enclosure #)" refers to additional information appended to the report. "(see appended table)" refers to a table appended to the report. Throughout this report a point is used as the decimal separator.		
Module group assignment:		
Sample #	Sample Group ID	Sample No. & S/N
VIL-375AM	1	1 & VIL120212952017 (72 cells Mono Crystalline)
	2	2 & VIL120212952014 (72 cells Mono Crystalline)
	3	3 & VIL120212952011 (72 cells Mono Crystalline)
Remark: All tests has been carried out on model: VIL-375AM of 72 cells package. Family models mentioned in this Test Report based on the manufacturer declaration only. Bill of material is same for all family models as per declaration provided by the manufacturer.		

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NOTE 1 Preconditioning and tests 10.2 and 10.15 are taken from IEC 61215. Tests MST 01, MST 13 and MST 16 are taken from IEC 61730-2.

NOTE 2 The control module should be used as a check every time the test modules are measured to evaluate the effect of the salt mist test.

Figure 1 – Salt mist corrosion testing sequence for crystalline silicon PV modules

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TABLES

Visual Inspection (Initial) (MST01)

TABLE: Visual inspection (Initial)		P
Test Date [DD/MM/YYYY].....:	10/09/2021	—
Sample #	Nature and position of initial findings – comments or attach photos	—
1	No visual defects observed	P
2	No visual defects observed	P
3	No visual defects observed	P
Supplementary information: Nil		

Maximum power determination (Initial) (10.2)

TABLE: Maximum power determination (Initial)							P
Test Date [DD/MM/YYYY].....:	10/09/2021						—
Module temperature [°C].....:	25						—
Irradiance [W/m ²].....:	1000						—
Sample #	Voc [V]	Vmp [V]	Isc [A]	Imp [A]	Pmp [W]	FF [%]	
1	48.475	39.147	10.05	9.630	376.986	77.37	
2	48.351	39.028	10.07	9.649	376.581	77.35	
3	48.281	38.934	10.11	9.676	376.725	77.21	
Supplementary information: Temperature corrected to 25°C and Irradiance corrected to 1000 W/m ²							

Dielectric withstand test (Initial) (MST 16)

TABLE: Dielectric Withstand Test - MST 16 (Initial)				P
Test Date [DD/MM/YYYY].....:	10/09/2021			—
	Maximum system voltage [V _{DC}].....:	1500V		—
	Test voltage applied V _{TEST} [V _{DC}].....:	2 minutes of 1500V and 1 minute of 8000V		—
	Module area A [m ²].....:	2.07		—
Sample No.	Dielectric breakdown	Insulation resistance at V _{TEST} [MΩ]	Insulation resistance x A [MΩ·m ²]	
1	<input checked="" type="checkbox"/>	1250	40	P
2	<input checked="" type="checkbox"/>	1310	40	P
3	<input checked="" type="checkbox"/>	1290	40	P
Supplementary information: <input checked="" type="checkbox"/> Means No Dielectric breakdown, Minimum requirement according to the standard is 40 MΩ·m ² .				

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Wet leakage current test (Initial) (10.15)

TABLE: Wet leakage current test (Initial)				P
Test Date [DD/MM/YYYY]		10/09/2021		—
Test Voltage applied [V].....		1500V		—
Solution resistivity [Ω cm].....		< 3,500 Ω cm at 22 \pm 3°C	2460	—
Surface tension [Nm^{-1}].....		< 0.03 Nm^{-1} at 22 \pm 3°C	0.023	—
Solution temperature [°C]		24°C		—
Sample #	Measured [$\text{M}\Omega$]	Limit [$\text{M}\Omega$]		Result
1	961	19.32		P
2	924	19.32		P
3	990	19.32		P
Supplementary information: Size of module 2.07 [m^2], Minimum requirement according to the standard is 40 $\text{M}\Omega\text{-m}^2$.				

Ground continuity test (Initial) (MST 13)

TABLE: Ground Continuity Test - MST 13 (Initial)				P
Test Date [DD/MM/YYYY]		10/09/2021		—
Maximum system voltage [V_{DC}]		1500V		—
Current applied [A]		75 A		—
Location of designated grounding point		Right corner of frames		—
Location of second contacting point		Left corner of frames		—
Sample No.	Voltage [V_{DC}]	Resistance [Ω]		
1	0.10	0.001		P
2	0.10	0.001		P
3	0.10	0.001		P
Supplementary information: Nil				

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Performance of salt mist corrosion test (Severity 6)

Test Date [DD/MM/YYYY].....:	13/09/2021 to 08/11/2021	—
NaCl concentration.....:	5%	—
Course of cycle	Test method 6 of IEC 60068-2-52 used	—
Duration.....:	8 cycles = 56 Days (one cycle = 7days)	—
Sample No.	---	—
2	---	P
3	---	P
Supplementary information: Nil		

Visual inspection after salt mist corrosion test (MST 01)

TABLE: Visual inspection		P
Test Date [DD/MM/YYYY].....:	08/11/2021	—
Sample #	Nature and position of initial findings – comments or attach photos	—
2	No visual defects observed	P
3	No visual defects observed	P
Supplementary information: Nil		

Maximum power determination after salt mist corrosion test (10.2)

TABLE: Maximum power determination							P
Test Date [DD/MM/YYYY]	08/11/2021						—
Module temperature [°C].....:	25						—
Irradiance [W/m ²].....:	1000						—
Sample #	Voc [V]	Vmp [V]	Isc [A]	Imp [A]	Pmp [W]	FF [%]	
2	48.098	38.793	9.931	9.513	369.038	77.26	
3	47.984	38.682	9.930	9.511	367.905	77.21	
Pmp degradation after this test [%]				2: -2.00	3: -2.34		P
Supplementary information: Temperature corrected to 25°C and Irradiance corrected to 1000 W/m ²							

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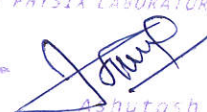


Dielectric withstand after salt mist corrosion test (MST 16)

TABLE: Dielectric Withstand Test - MST 16				P
Test Date [DD/MM/YYYY]		08/11/2021		—
Maximum system voltage [V _{DC}]		1500V		—
Test voltage applied V _{TEST} [V _{DC}]		2 minutes of 1500V and 1 minute of 8000V		—
Module area A [m ²]		2.07		—
Sample No.	Dielectric breakdown	Insulation resistance at V _{TEST} [MΩ]	Insulation resistance x A [MΩ·m ²]	—
2	<input checked="" type="checkbox"/>	1120	40	P
3	<input checked="" type="checkbox"/>	1080	40	P
Supplementary information: <input checked="" type="checkbox"/> Means No Dielectric breakdown, Minimum requirement according to the standard is 40 MΩ·m ² .				

Wet leakage current test after salt mist corrosion test (10.15)

TABLE: Wet leakage current test				P
Test Date [DD/MM/YYYY]		08/11/2021		—
Test Voltage applied [V].....		1500V		—
Solution resistivity [Ω cm).....		< 3,500 Ω cm at 22 ± 3°C	2490	—
Surface tension [Nm ⁻¹).....		< 0.03 Nm ⁻¹ at 22 ± 3°C	0.023	—
Solution temperature [°C]		24°C		—
Sample #	Measured [MΩ]	Limit [MΩ]	Result	—
2	810	19.32	P	
3	790	19.32	P	
Supplementary information: Size of module 2.07 [m ²], Minimum requirement according to the standard is 40MΩ·m ² .				

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Ground continuity test after salt mist corrosion test (MST 13)

TABLE: Ground Continuity Test - MST 13			P
Test Date [DD/MM/YYYY]	08/11/2021		—
Maximum system voltage [V _{DC}]	1500V		—
Current applied [A]	75 A		—
Location of designated grounding point	Right corner of frames		—
Location of second contacting point	Left corner of frames		—
Sample No.	Voltage [V _{DC}]	Resistance [Ω]	—
2	0.20	0.003	P
3	0.20	0.003	P
Supplementary information: Nil			

Bypass diode functional test after salt mist corrosion test

Test Date [DD/MM/YYYY].....	08/11/2021			—
Number of diodes in Junction box.....	3			
Sample No.	Diode 1	Diode 2	Diode 3	
2	P	P	P	
3	P	P	P	
Supplementary information: Nil				

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 (Chief Technical Manager)



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Test Report No.: HPLI/Test/2108025601


List of Annexes

Annex 1: List of measurement equipment

Annex 2: Statement of the estimated uncertainty of the test results

Annex 3: Enclosures

Annex 4: Bill of Material

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(Chief Technical Manager)



Annex 1: List of measurement equipment


Description	Identification #	Application
1. Visual inspection test setup	HPLI/U2/TEST/145	Visual inspection test
2. Large area steady state solar simulator with I-V Tracer	HPLI/U2/TEST/025	Maximum power determination, Bypass diode functionality test
3. DC High Voltage Tester	HPLI/U2/TEST/151	Dielectric Withstand Test
4. Insulation resistance tester	HPLI/U2/TEST/059	Insulation test and Wet leakage current test
5. Wet leakage test setup	HPLI/U2/TEST/202	Wet leakage current test
6. E.C.R test apparatus	HPLI/T-E/345(a)	Ground Continuity Test
7. Heating chamber	HPLI/U2/TEST/038	Bypass diode thermal test
8. Measuring tape	HPLI/U2/TEST/007	For dimension of PV modules.
9. Pyranometer	HPLI/U2/TEST/029	For preconditioning test
10. Salt Mist Chamber	HPLI/U2/TEST/039	Salt Mist exposure
11. Measuring tape	HPLI/U2/TEST/007	For dimension of PV modules.

Annex 2: Statement of the estimated uncertainty of the test results

The total measuring uncertainty of P_{mpp} is ±2.4%

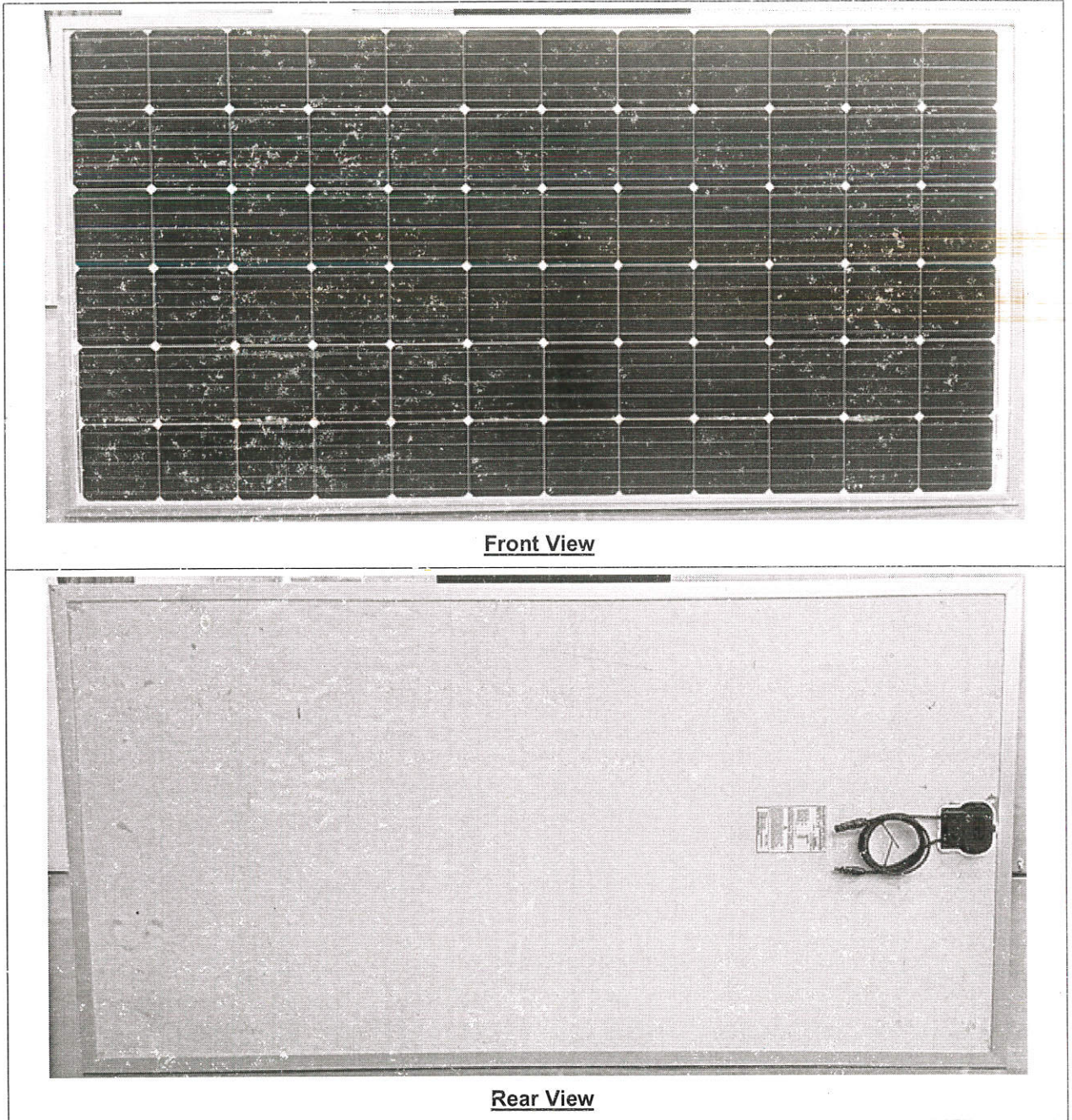
The total measuring uncertainty of I_{sc} is ±2%

The total measuring uncertainty of V_{oc} is ±0.9%

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Annex 3: Enclosures (PHOTOGRAPHS OF PV MODULE UNDER TEST)



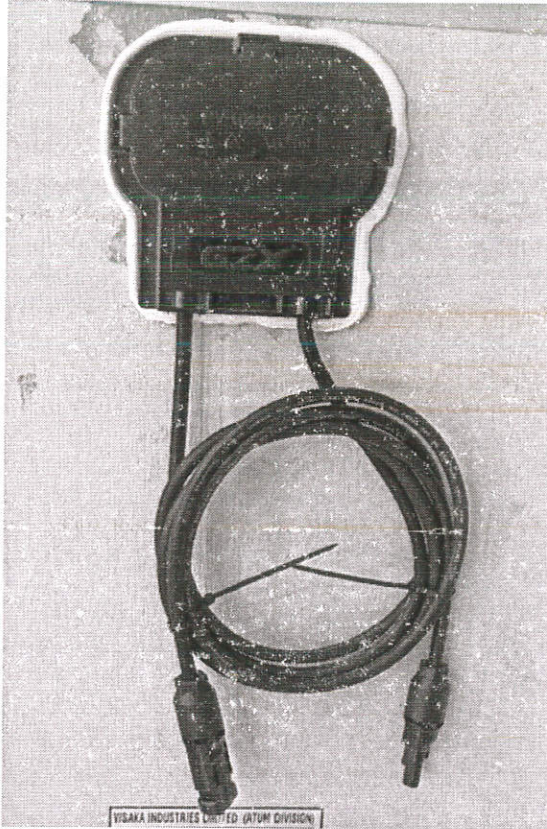
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[Signature]
Shilash Pathak
(Chief Technical Manager)



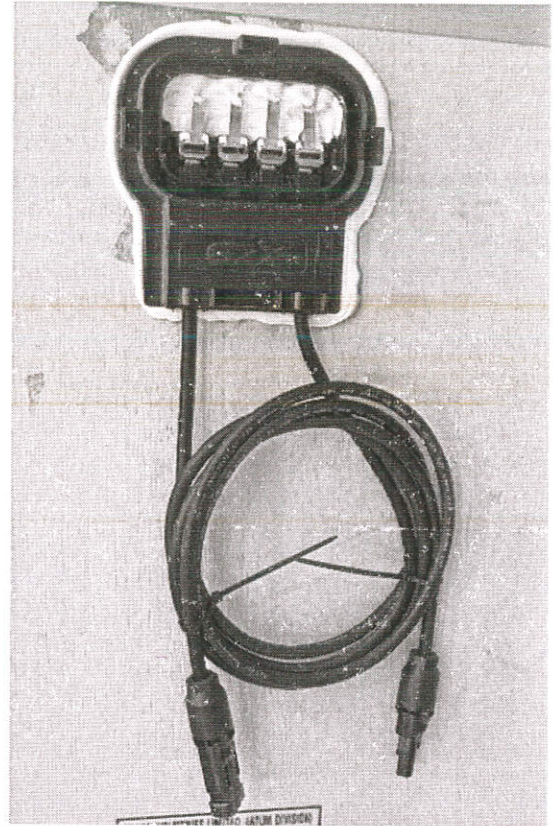
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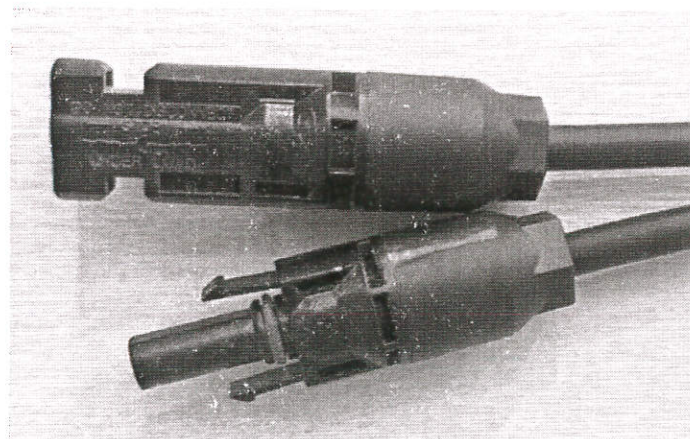
Test Report No.: HPLI/Test/2108025601



Junction box closed view



Junction box open view



Connector view

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(Chief Technical Manager)



Annex 4: Bill of Material		
Sr No.	Objective / part no.	Type/model/ Technical data
1	Bypass diode	Type: 30SQ045T, Schottky Barrier Reifier, Reverse Voltage 45 V, Forward Current 30 A, Manufactured by Ningbo Guangzhixing Photovoltaic Technology Co. Ltd.
2	Front Cover	Type: Low-iron Patterned AR, Antireflective coated textured tempered solar Glass, Manufactured by Borosil india pvt ltd.
3	Rear cover	Type: PRESERV A- 125WN 300WD, White, RTI Electrical (Temperature Rating, Tfilm*) - 140°C, RTI Mechanical (Strength) (Temperature rating, Tfilm*)-125°C, Manufactured by RENEWSYS INDIA PVT LTD. and Back substrate: (1980x990x10) mm, Manufactured by Visaka Industries Limited
4	Encapsulation material	Type: CONSERV P 360 14FC, Thickness:0.45mm, HWI-4, HAI-0, RTI Electrical- 50, TI Imp- 50, RTI Str- 50 Manufactured by RENEWSYS INDIA PVT LTD.
5	Frame parts	2018x1028x17mm, Manufactured by Sagar Asia Private Limited
6	Cell & string connector	Cell connector: 0.9x0.20 mm, String Connector: 5.0x0.3mm, Material: Base Cu > 99.95%, Coating Sn60%Pb40%, Manufactured by SUKRITI VIDYUTUDYOG PVT.LTD.
7	Junction box	PV-GZX 156V, IP67, 1500V DC, Rated Current -14A, Reverse Current: 30A, Manufactured by Ningbo Guangzhixing Photovoltaic Technology Co., Ltd
8	Cable	62930 IEC 131 - 1x4mm ² , DC1500V, Application Class-A, Protection Class-ii, Manufactured by Ningbo Guangzhixing Photovoltaic Technology Co., Ltd
9	Fluxing Agent	Type: 018S, No Clean Liquid Flux, Manufactured by Metal Chem
10	Soldering Material	1mm thickness wire, Tin/Lead: 60/40, Manufactured by Sri Bhavani Metals Pvt. Ltd
11	Connector	Type: PV- GZX 1500, DC 1500V, 30A, IP67, Manufactured by Ningbo Guangzhixing Photovoltaic Technology Co., Ltd
12	Adhesive for frame	type Seal 'N' flex® 1, Gray Colour, Manufactured by Bostik India Pvt Ltd.
13	Adhesive for junction box	type "Sikasil® AS-60", white. Rated HB, RTI=105°C. UL certified, Manufactured by SIKA SERVICES AG
14	Potting material	Type: 5299VV-S, Rated HB at min. 3.0 mm thick, HWI:1 HAI:0, RTI=105, CTI=0,UL certified, Manufactured by Shanghai Huitian new material Co., Ltd.
15	Solar Cell	MSPVLM2M5, ADANI SOLAR CELLS, Mono Perc, 156.75x156.75mm, Manufactured by Mundra Solar Pvt Ltd.

----- End of Test Report -----

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(Signature)
Ashutosh Pathak
(Chief Technical Manager)