Renewable Energy Test Center
46457 Landing Parkway
Fremont, CA 94538

Project No. **C-CA-1611-GTC-012 Rev1**

TEST REPORT : EXTENDED CHAMBER TEST DH4000 TO DH6000 (CONT. OF GTC-011)

Report Date: 4/5/2017

Tested Product Configuration

Product	Description	Model Number	Qty
Module	60 Cell Mono Si Module	GTC-GG1H-295W	3

Client	**Company**	**Gıda Tekstil Cihaz Dış Ticaret Ltd.** Organize Sanayi Bölgesi 11.Cadde No:2 02040 Merkez/Adıyaman Turkey
	Contact Person	**Cigdem Besen** Phone: +90 216-370-5216 **Email:** cbesen@gtctrade.com **Nicolas Faivre** Phone: +90 216-370-5208 **Email:** nfaivre@gtctrade.com

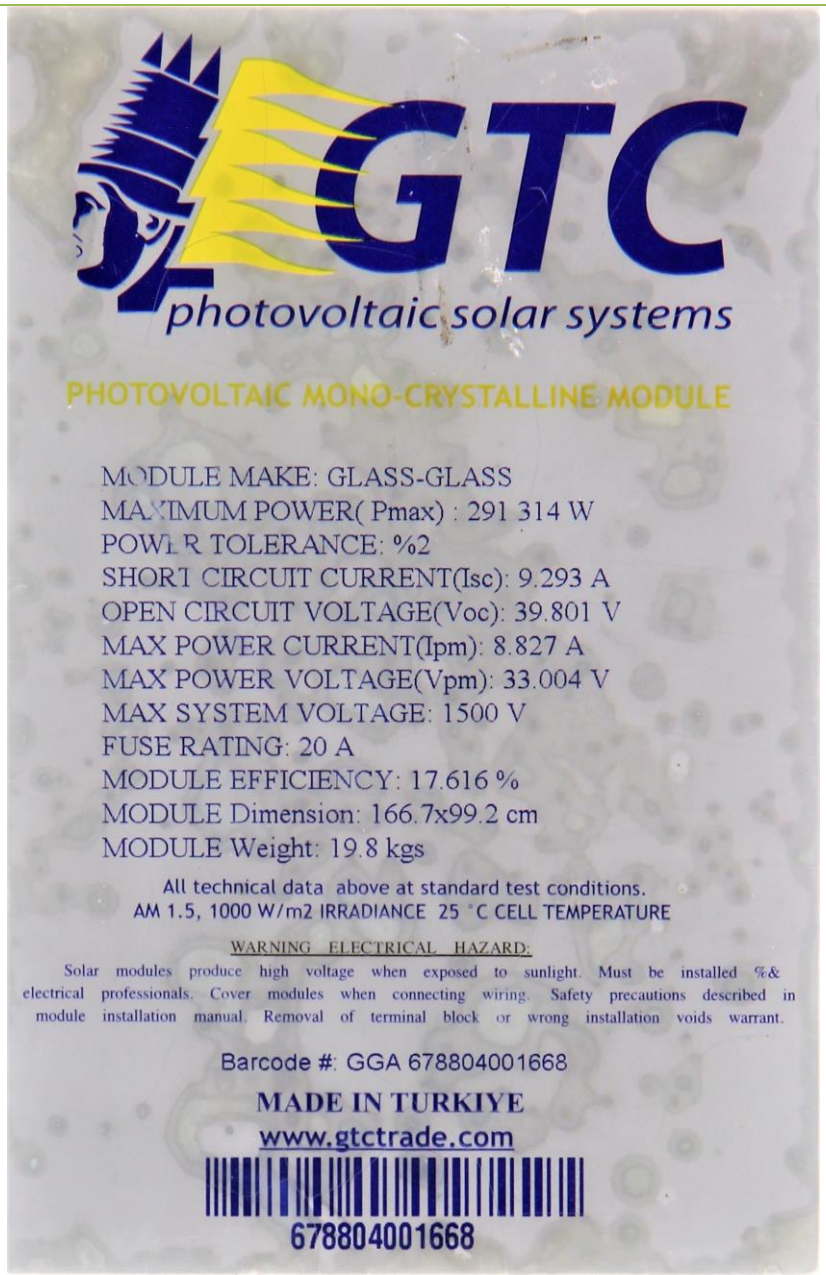
Test Site	**Company**	**Renewable Energy Test Center (RETC,LLC)** 46457 Landing Parkway, Fremont CA 94538
	Contact Person	**Zen Villanueva** Quality Director O: 510-226-1635 – F: 510-952-4351 **Email**: zenniav@retc-ca.com

Performed by:	**Manny Siason** Director of Engineering and Operations	
Reviewed by:	**Cherif Kedir** Sr. VP of Engineering & Operations	
Date of Receipt of Samples:		10/27/2015
Date of Testing (Start/End):		12/30/2016 – 2/24/2017
Issuance Date:		Original: 3/06/2017 Rev 1: 4/5/2017

This report shall not be reproduced except in full. The results were obtained by following standard laboratory procedures and per the international standards listed in the test plan. The results in this report are only representative of the samples as received by RETC.

1. Product Information

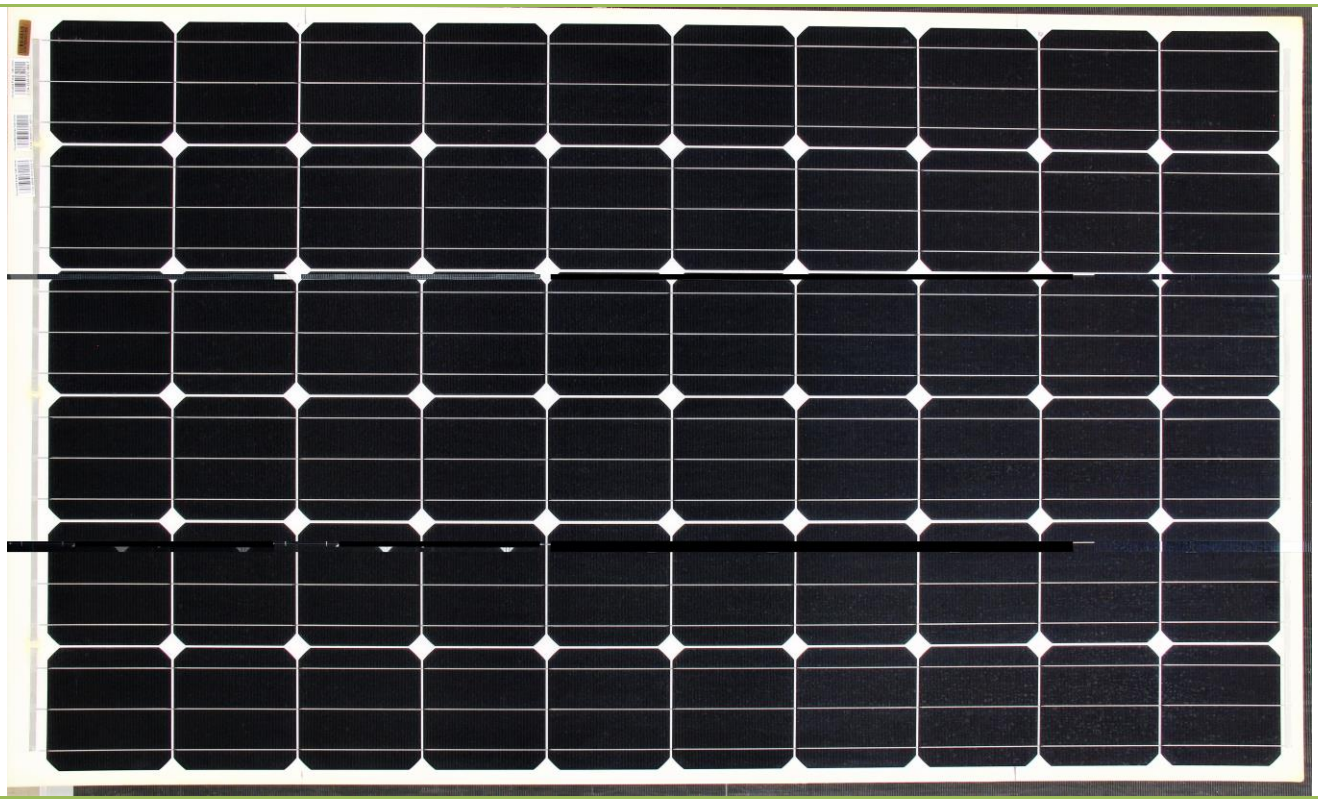
1.1. Module Label Rating



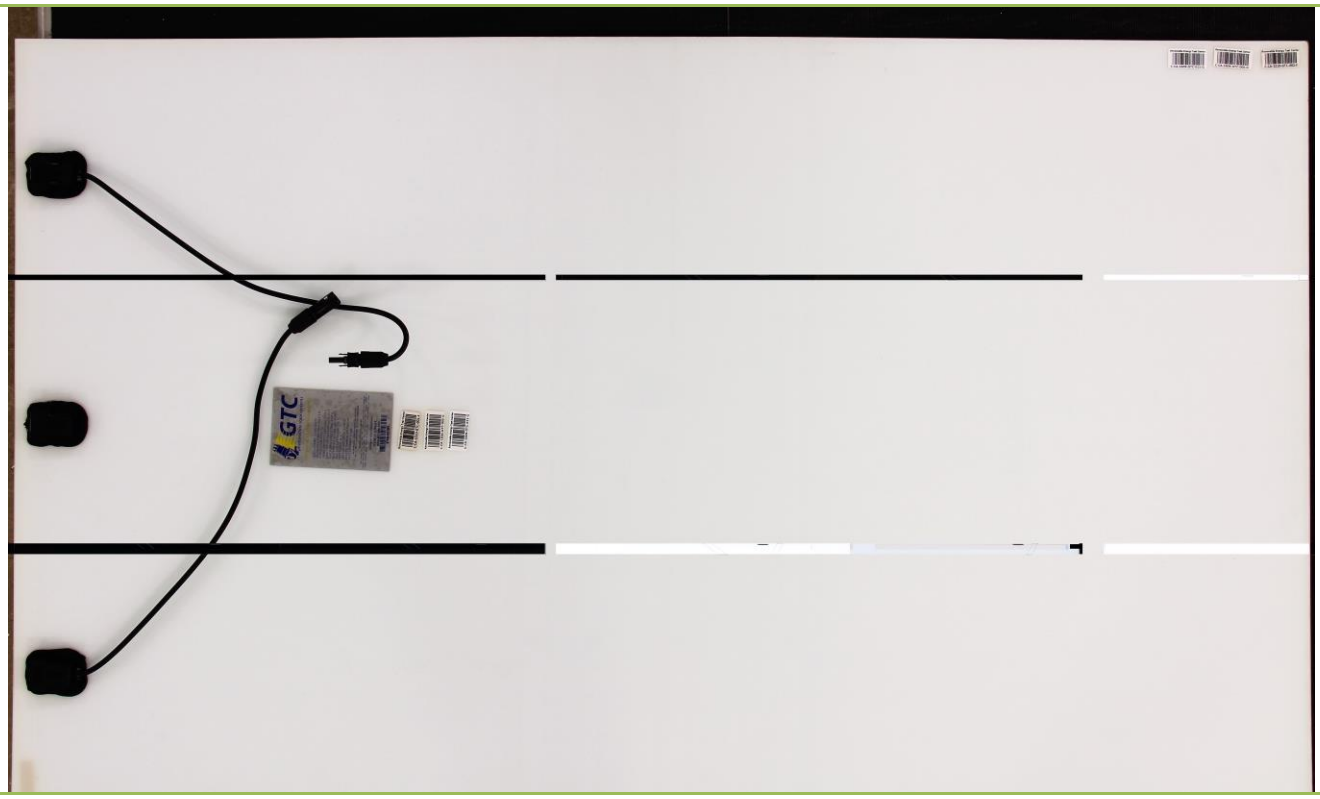
Label Artwork later updated to reflect 295W

1.2. Module Visual

Front



Back



2. Test Flow

Tests performed on samples based on IEC 61215

GTC-011

Test Clause	Test Performed	A	B	C
IEC 61215 10.13	Damp Heat 1000 (cum 5000)		✓	✓
ENG	Electroluminescence		✓	✓
IEC 61215	Visual Inspection		✓	✓
IEC 61215 10.2	Maximum Power Determination	✓	✓	✓
IEC 61215 MST17	Wet Leakage Current Test		✓	✓
IEC 61215 10.13	Damp Heat 1000 (cum 6000)		✓	✓
ENG	Electroluminescence		✓	✓
IEC 61215	Visual Inspection		✓	✓
IEC 61215 10.2	Maximum Power Determination	✓	✓	✓
IEC 61215 MST17	Wet Leakage Current Test		✓	✓

✓: Denotes Test Completed

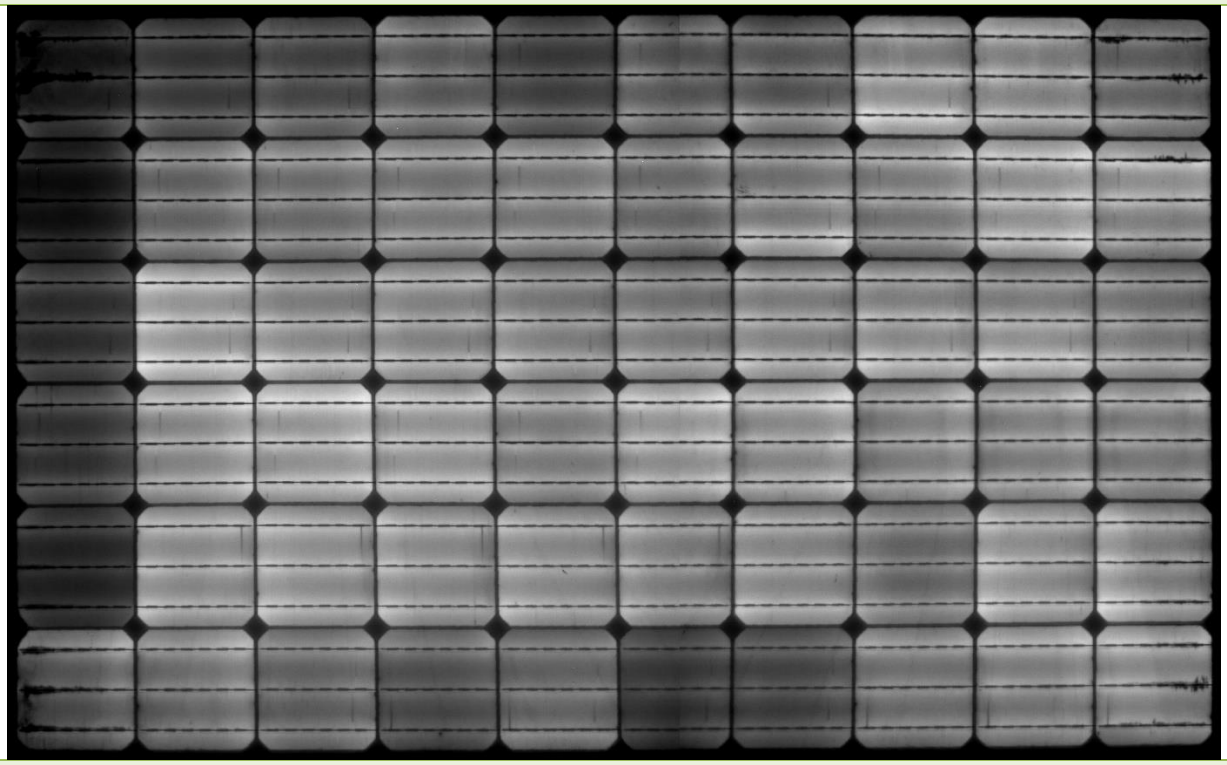
3. Sample Allocation

RETC ID	Predecessor RETC ID	Vendor SN	Model
GTC-012-A	**GTC-011-A**	678804001661	GTC-GG1H-295W
GTC-012-B	**GTC-011-F**	678804001648	GTC-GG1H-295W
GTC-012-C	**GTC-011-G**	678804001668	GTC-GG1H-295W

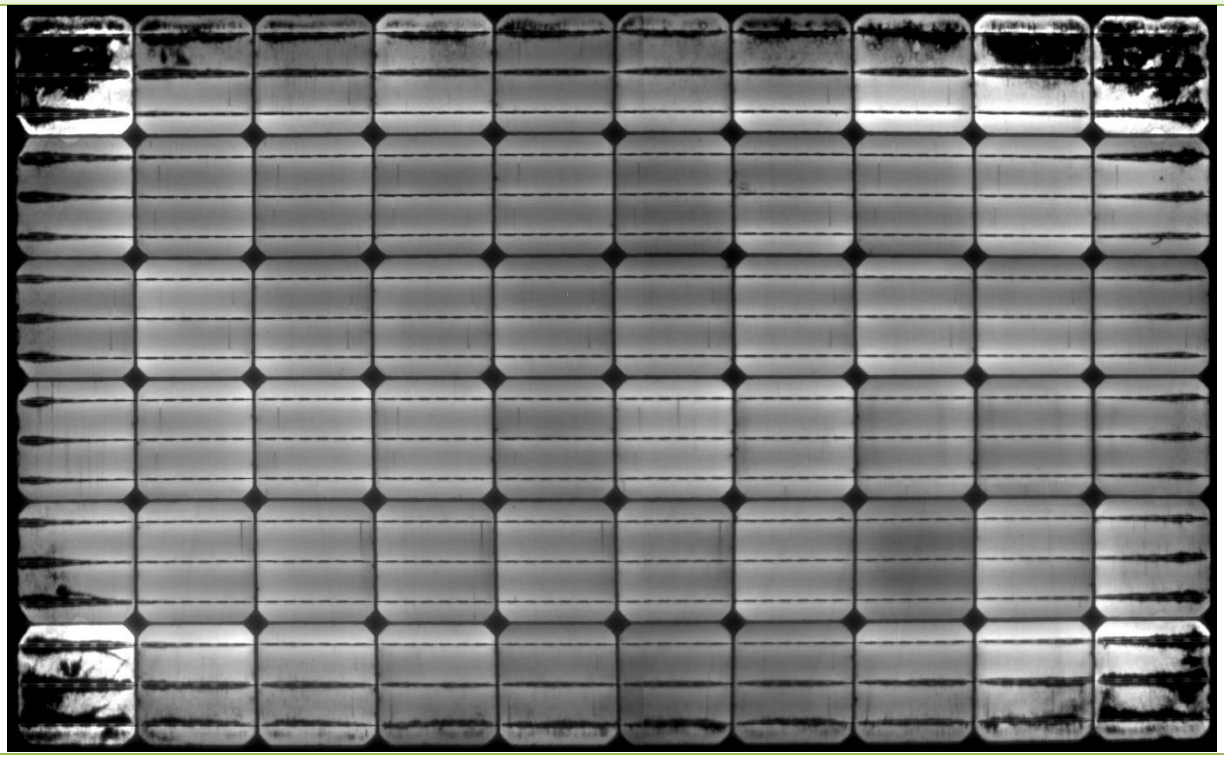
4. Test Results

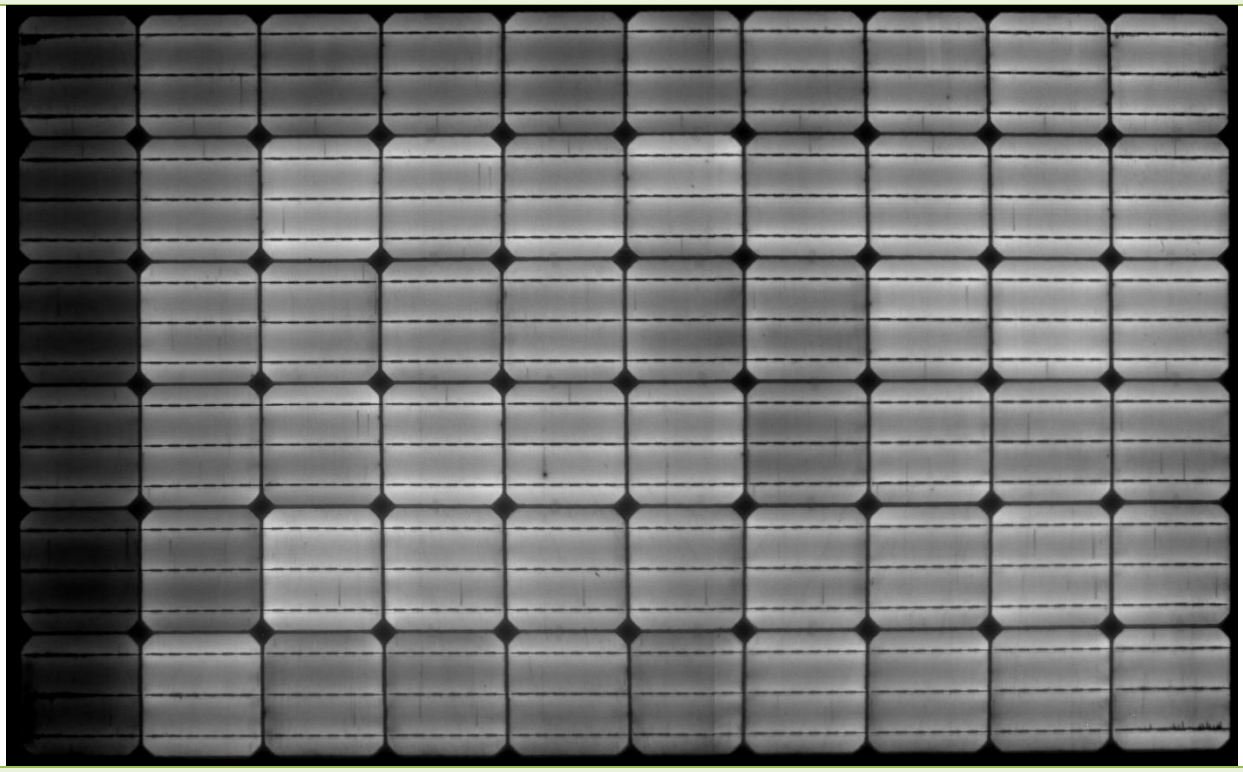
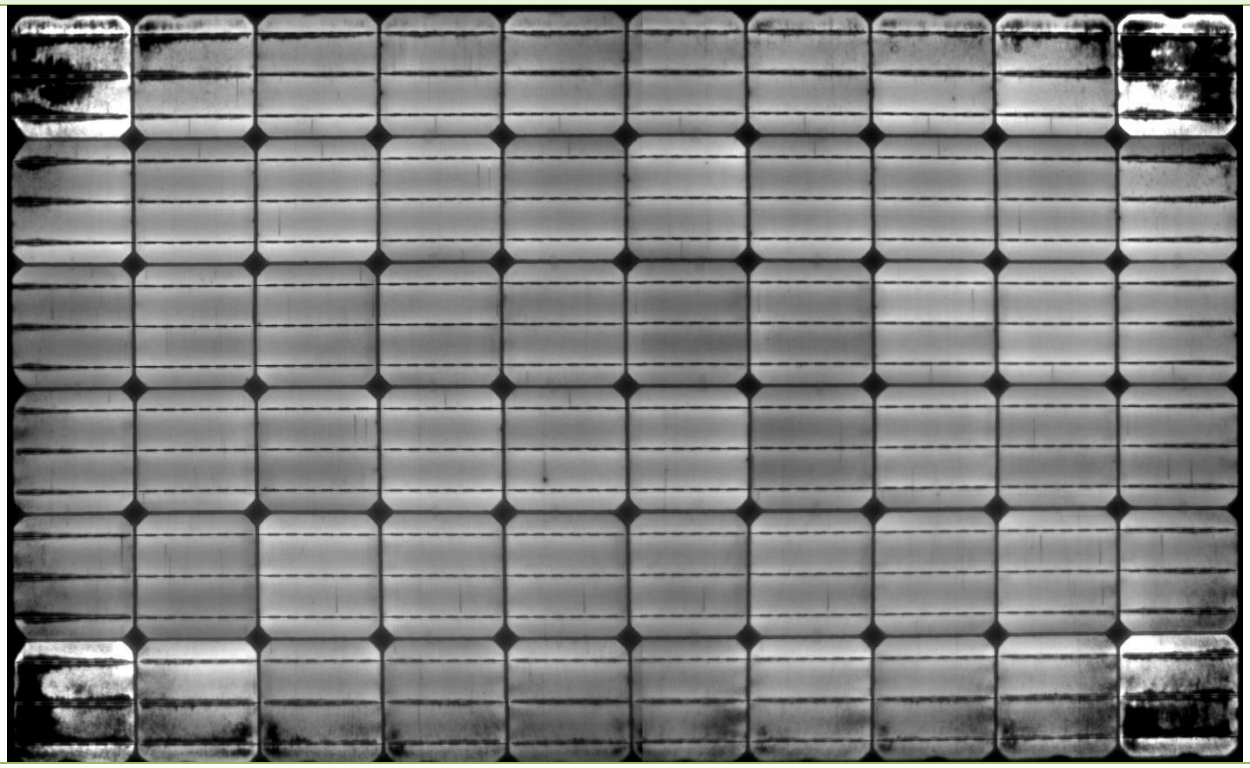
4.1. Electroluminescence

GTC-012-B
DH5000



DH6000



GTC-012-C **DH5000**

DH6000


4.2. Visual Inspection

RETC SN	Sequence (Post)	Overall Visual Inspection Remarks
GTC-012-B	DH5000	No major visual defects observed
	DH6000	 Delamination occurred.
GTC-012-C	DH5000	No major visual defects observed
	DH6000	 Delamination occurred.

4.3. Maximum Power Determination

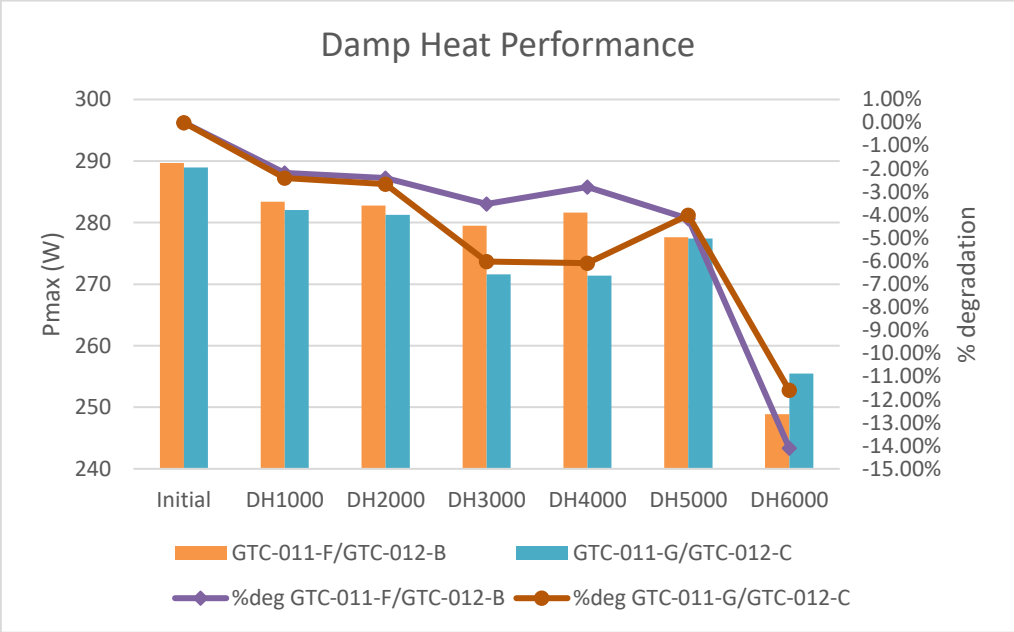
Note: Values are normalized to a control sample

SN	Sequence (Post)	Voc (V)	Vmp (V)	Isc (A)	Imp (A)	Pmax (W)	FF (%)	PT (°C)
GTC-011-A	Control	39.878	32.35	9.433	8.95	289.49	76.955	24.99
GTC-012-B	DH5000	39.6	31.937	9.181	8.691	277.63	76.359	24.99
	DH6000	38.972	30.459	9.067	8.171	248.853	70.421	24.811
GTC-012-C	DH5000	39.611	31.887	9.184	8.701	277.39	76.246	24.632
	DH6000	39.342	30.892	9.126	8.271	255.46	71.151	24.9

% Degradation

SN	Sequence (Post)	Voc %	Vmp %	Isc %	Imp %	Pmax %	FF %
GTC-012-B	DH5000	-0.51%	-1.34%	-2.71%	-2.89%	-4.17%	-1.00%
	DH6000	-2.09%	-5.90%	-3.92%	-8.70%	-14.10%	-8.69%
GTC-012-C	DH5000	-0.44%	-1.28%	-2.72%	-2.78%	-4.01%	-0.88%
	Dh6000	-1.12%	-4.36%	-3.34%	-7.59%	-11.60%	-7.51%

Note: Refer to combined report(s) GTC-011 for previous test results.



4.4. Wet Insulation Test

Sample ID	Sequence (Post)	Applied Voltage (V)	Measured Current (µA)		Computed Resistance (MΩ)		Resistance Min. Limit (MΩ)	Remarks
			(+)	(-)	(+)	(-)		
GTC-012-B	DH5000	1500	2.5	2.7	600	556	24.24	P
	DH6000	1500	4.4	4.6	341	326	24.24	P
GTC-012-C	DH5000	1500	3.4	8.5	441	176	24.24	P
	DH6000	1500	3.8	3.6	395	417	24.24	P
Supplementary Information: Min Resistance Limit = 40/area(m^2) = 40/1.65 = 24.24								

Annex 1: List of measurement equipment

Description	Identification #	Cal Due
Luxmeter	MEP-CA-335-00	09/21/2017
EL Camera	MEQ-CA-009-00	N/A
IV Tester	MEP-CA-318-00 MEP-CA-319-00 MEP-CA-320-00	08/17/2017
Conductivity Meter	MEP-CA-184-00	07/27/2017
Dielectric Withstand Tester	MEQ-CA-058-00	6/28/2017
Tensiometer	MEP-CA-016-00	08/12/2017
Oven Chamber 5	MEQ-CA-054-00	02/17/2018

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

Temperature measurements using thermocouples (ie chamber tests) are estimated to have a +/-1.31°C uncertainty while the reported performance measurements are subject to +/-2.1%, +/-1.8%, +/-2.6% uncertainty for voltage, current and power respectively to account for the random and systematic errors inherent to the calibration of reference materials, environment, human factor, etc.
Stated quantities represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of k=2