

Project No. **C-CA-1612-GTC-015**

TEST REPORT : EXTENDED TESTING TC1000,TC1200 SAMPLES FROM GTC-011 (1500 VSYSTMAX)

Report Date: 4/3/2017**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

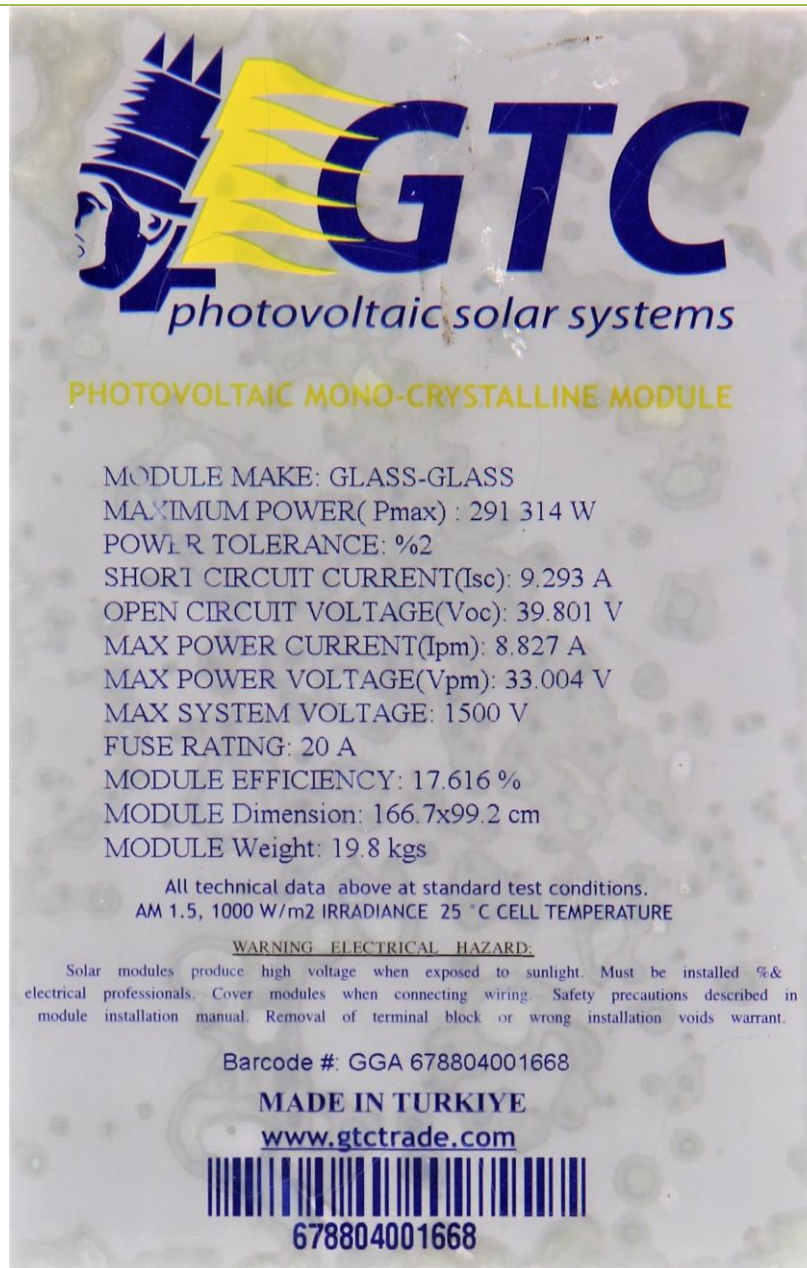
Test Site	Company	Renewable Energy Test Center (RETC,LLC) 46457 Landing Parkway, Fremont CA 94538
	Contact Person	Zen Villanueva Quality Director O: 510-226-1635 – F: 510-952-4351 Email: zenniav@retc-ca.com

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):		2/8/2017 – 3/31/2017
Issuance Date:		4/3/2017

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.

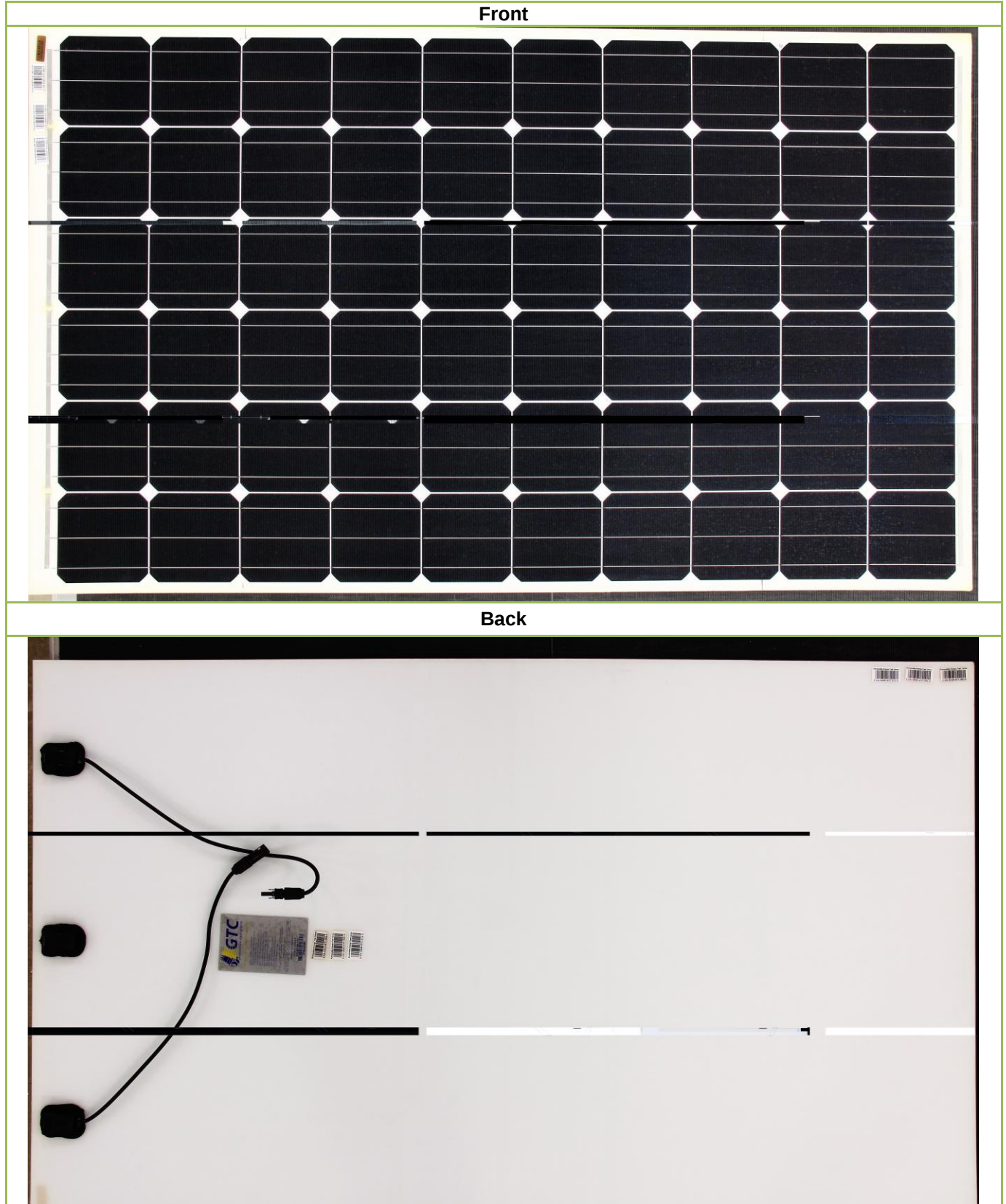
1. Product Information

1.1. Module Label Rating



Label Artwork later updated to reflect 295W

1.2. Module Visual



2. Test Flow

Tests performed on samples based on IEC 61215

GTC-011

Test Clause	Test Performed	A	B	C
10.11	Thermal Cycle 200 (cum 1000)		✓	✓
ENG	Electroluminescence		✓	✓
10.1	Visual Inspection		✓	✓
10.2	Maximum Power Determination	✓	✓	✓
MST17	Wet Leakage		✓	✓
10.11	Thermal Cycle 200 (cum 1200)		✓	✓
ENG	Electroluminescence		✓	✓
10.1	Visual Inspection		✓	✓
10.2	Maximum Power Determination	✓	✓	✓
MST17	Wet Leakage		✓	✓

✓: Denotes Test Completed

3. Sample Allocation

RETC SN	Predecessor RETC ID	Vendor SN	Model Number
GTC-015-A	GTC-011-A	678804001661	GTC-GG1H-295W
GTC-015-B	GTC-011-D	678804001662	GTC-GG1H-295W
GTC-015-C	GTC-011-E	678804001667	GTC-GG1H-295W

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4. Test Results

4.1. Electroluminescence

**GTC-015-B
TC1000**



TC1200



**GTC-015-C
TC1000**



TC1200



4.2. Visual Inspection

RETC SN	Sequence (Post)	Overall Visual Inspection Remarks
GTC-015-B	TC1000	No major visual defects observed
	TC1200	No major visual defects observed
GTC-015-C	TC1000	No major visual defects observed
	TC1200	No major visual defects observed

4.3. Maximum Power Determination

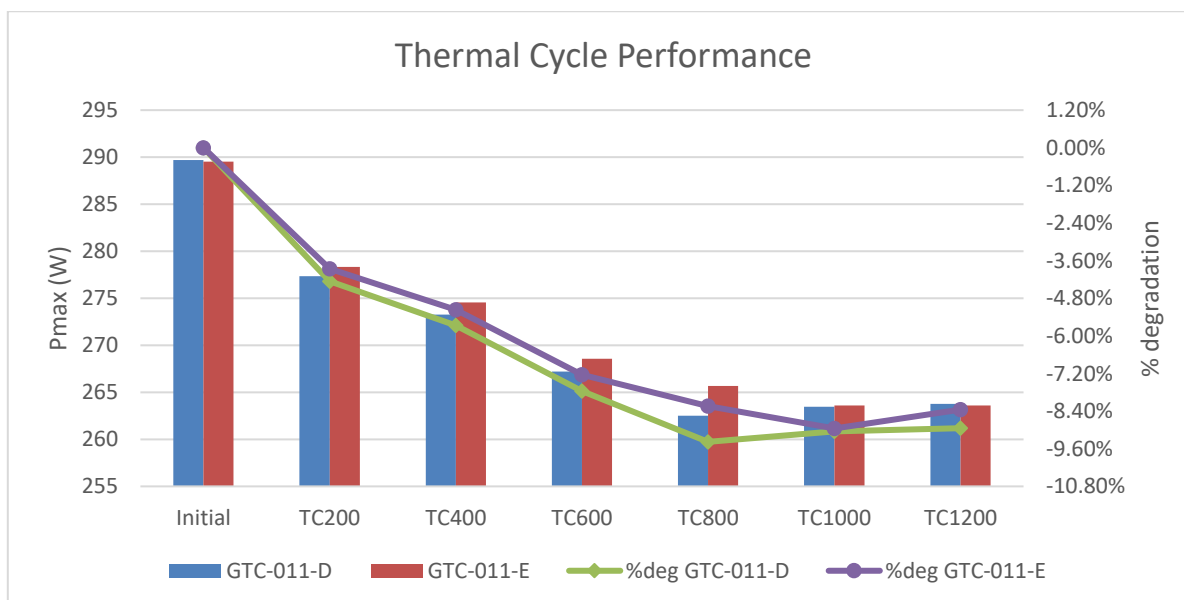
Note: Values are normalized to a control sample

SN	Sequence (Post)	Voc (V)	Vmp (V)	Isc (A)	Imp (A)	Pmax (W)	FF (%)	PT (°C)
GTC-011-A	Control	39.878	32.350	9.433	8.950	289.494	76.955	24.990
GTC-015-B	TC1000	39.688	30.863	9.419	8.531	263.47	70.478	25.352
	TC1200	39.746	30.945	9.419	8.53	263.77	70.459	25.08
GTC-015-C	TC1000	39.707	30.682	9.421	8.591	263.62	70.471	25.171
	TC1200	39.734	30.844	9.424	8.6	265.36	70.864	25.08

% Degradation

SN	Sequence (Post)	Voc	Vmp	Isc	Imp	Pmax	FF
GTC-015-B	TC1000	-0.56%	-4.63%	-0.41%	-4.68%	-9.05%	-8.17%
	TC1200	-0.41%	-4.37%	-0.41%	-4.69%	-8.95%	-8.19%
GTC-015-C	TC1000	-0.57%	-5.13%	-0.37%	-4.01%	-8.95%	-8.10%
	TC1200	-0.50%	-4.63%	-0.34%	-3.91%	-8.35%	-7.58%

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



1.1. Wet Insulation Test

Sample ID	Sequence (Post)	Applied Voltage (V)	Measured Current (μA)		Computed Resistance (MΩ)		Resistance Min. Limit (MΩ)	Remarks
			(+)	(-)	(+)	(-)		
GTC-015-B	TC1000	1500	0.5	0.6	3000	2500	24.24	P
	TC1200	1500	0.8	0.9	1875	1667	24.24	P
GTC-015-B	TC1000	1500	0.5	0.6	3000	2500	24.24	P
	TC1200	1500	0.7	0.8	2143	1875	24.24	P
Supplementary Information: Min Resistance Limit = $40/\text{area}(\text{m}^2) = 40/1.65 = 24.24$								

Annex 1: List of measurement equipment

Description	Identification #	Cal Due
Power Supply	MEP-CA-077-00	2/18/2018
Data Logger	MEP-CA-254-00	2/1/2018
Power Supply	MEP-CA-070-00	10/13/2017
Luxmeter	MEP-CA-335-00	09/21/2017
Luxmeter	MEP-CA-344-00	11/12/2017
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
Dielectric Withstand Tester	MEQ-CA-058-00	6/28/2017
Dielectric Withstand Tester	MEQ-CA-059-00	02/17/2018
Tensiometer	MEP-CA-016-00	09/12/2017
Conductivity Meter	MEP-CA-184-00	07/27/2017
Chamber 6	MEQ-CA-055-00	11/3/2017

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

Temperature measurements using thermocouples (ie chamber tests) are estimated to have a $\pm 1.31^{\circ}\text{C}$ uncertainty while the reported performance measurements are subject to $\pm 2.1\%$, $\pm 1.8\%$, $\pm 2.6\%$ 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 $k=2$