



Technical Report No.: 64.290.21.30259.01

Date: 2021-04-30

Client: Name: Trina Solar Co., Ltd.
Address: No. 2 TianHe Road, Trina PV Industrial Park, New District, 213031
Changzhou City, Jiangsu Province, PEOPLE'S REPUBLIC OF CHINA
contact person: Mr. Zhao Zhangang

Manufacturing place: Manufacturer's name: Trina Solar Co., Ltd.
Address: No. 2 TianHe Road, Trina PV Industrial Park, New District, 213031
Changzhou City, Jiangsu Province, PEOPLE'S REPUBLIC OF CHINA
Factory's name: Trina Solar Co., Ltd.
Address: No. 2 TianHe Road, Trina PV Industrial Park, New District, 213031
Changzhou City, Jiangsu Province, PEOPLE'S REPUBLIC OF CHINA

Test subject: Product: Mono Crystalline Silicon Photovoltaic (PV) Module(s)
Type: TSM-655DE21, TSM-650DEG21C.20

Test specification: IEC 61215-2:2016:
Visual inspection (MQT 01)
Maximum power determination (MQT 02)
Insulation test (MQT 03)
Wet leakage current test (MQT 15)
Hail test (MQT 17)
Initial stabilization (MQT 19.1)

Purpose of examination: Test according to the test specification of Client's requirement.

Test result: This report is only for test result, without verdict, see item 3 of this report for details.

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1 Description of the test subject

1.1 Function

Manufacturer's specification for intended use:

The PV modules are assembly of components that produce and supply electricity by the conversion of solar energy.

1.2 Consideration of the foreseeable

- Not applicable
- Covered through the applied standard
- Covered by the following comment
- Covered by attached risk analysis

1.3 Technical Data

Type of PV module	TSM-655DE21	TSM-650DEG21C.20
Rated Maximum Power [W]	655	650
Open-Circuit Voltage [V]	45.5	45.5
Short-Circuit Current [A]	18.48	18.35
Dimension (L x W x H) [mm]	2384 x 1303 x 35	2384 x 1303 x 35
Thickness of superstrate [mm]	3.2	2.0
Thickness of substrate (for glass) [mm]	-	2.0
Maximum System Voltage [V]	1500	1500

2 Order

2.1 Date of Purchase Order, Customer's Reference

5468493, 2021-03-24

2.2 Receipt of Test Sample, Condition, Location

Received 2 pcs samples TSM-655DE21 and 2 pcs samples TSM-650DEG21C.20 in Changzhou.

2.3 Date of Testing

2021-04-13 ~ 2021-04-19

2.4 Location of Testing

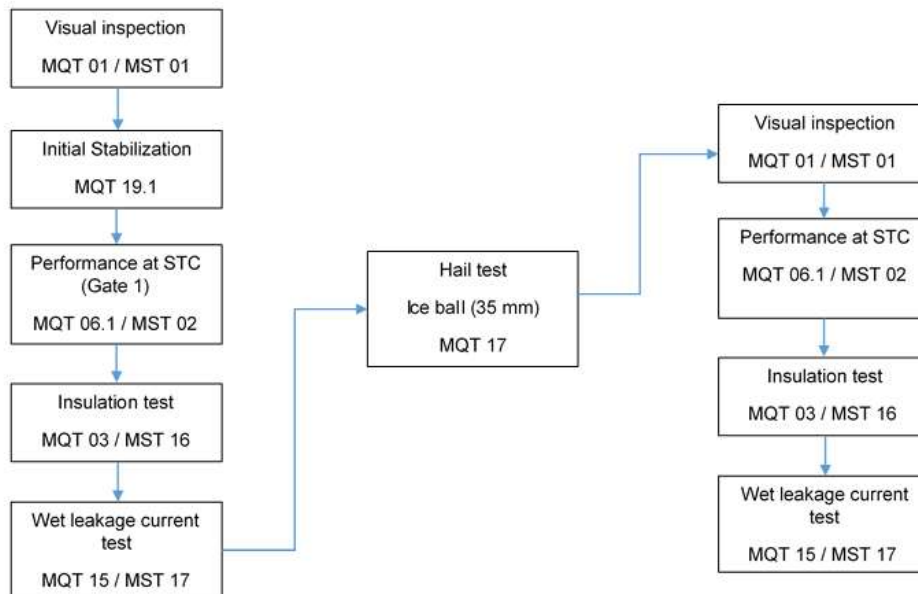
Changzhou HuaYang Inspection and Testing Technology Co., Ltd.

No.8 Lanxiang Rd, Wujin Economic Development Zone, Changzhou, Jiangsu, China

2.5 Points of Non-compliance or Exceptions of the Test Procedure

None

3 Test Results



Note: testing sequence according to IEC 61215-2:2016.

3.1	TABLE: Module test assignment	
Sample no.	Model/Type	Module serial No.
1	TSM-655DE21	A02201200400076
2	TSM-655DE21	A02201200400075
3	TSM-650DEG21C.20	A02210100100258
4	TSM-650DEG21C.20	A02210100100257

Supplementary information: The test samples were provided by Trina Solar Co., Ltd.

3.2 Initial	TABLE: Visual inspection (Initial)	—
Test Date [YYYY-MM-DD]	2021-04-13	—
Sample #	Nature and position of initial findings – comments or attach photos	—
1	No major visual defects	P
2	No major visual defects	P
3	No major visual defects	P
4	No major visual defects	P

Supplementary information: N/A

3.3	TABLE: Maximum power determination	—
Test Date [YYYY-MM-DD] start/end	2021-04-13	—
Radiant Source.....	<input checked="" type="checkbox"/> Solar simulator <input type="checkbox"/> Natural Sunlight	—
Module temperature [°C]	Corrected to 25	—
Irradiance [W/m ²]	Corrected to 1000	—



Sides of Modules.....:			<input checked="" type="checkbox"/> Front	<input type="checkbox"/> Rear	—	
Sample No.	Voc [V]	Isc [A]	Vmp [V]	Imp [A]	Pmp [W]	FF[%]
1	45.2	17.85	38.0	17.11	650.0	80.5
2	45.4	17.85	38.2	17.11	653.7	80.7
3	45.4	17.91	38.0	17.15	651.5	80.0
4	45.5	17.92	38.0	17.14	651.8	80.0
Sides of Modules.....:			<input type="checkbox"/> Front	<input checked="" type="checkbox"/> Rear	—	
Sample No.	Voc [V]	Isc [A]	Vmp [V]	Imp [A]	Pmp [W]	FF[%]
3	44.9	12.92	38.6	12.04	464.2	80.0
4	44.9	12.95	38.5	12.11	465.7	80.1
Supplementary information: N/A						

3.4	TABLE 02.2: MQT 19.1 ini: Initial Stabilization procedure						—
Light exposure method.....:			<input checked="" type="checkbox"/> Simulator	<input type="checkbox"/> Natural sunlight			
Abbreviation: Regarding light source “S” for Solar simulator and “N” for Natural sunlight							
Stabilization criterion x per IEC 61215-1-x			IEC 61215-1-1				
Sides of Modules.....:			<input checked="" type="checkbox"/> Front	<input type="checkbox"/> Rear			
Sample #	1	Test Date (YYYY-MM-DD) start/end			2021-04-14 / 2021-04-16		
Test cycle	Integrated irradiation (kWh/m ²)	Irradiance (W/m ²)	Module temperature (°C)	Resistive load	P _{max} (W) at the end of cycle	(P _{max} - P _{min}) / P _{average} (%)	Stable (Yes/No)
Initial	—	—	—	—	650.0	—	—
1	5.0	800 - 1000	50 ± 10	Yes	649.2	—	—
2	5.0	800 - 1000	50 ± 10	Yes	648.3	0.27	Yes
Sample #	2	Test Date (YYYY-MM-DD) start/end			2021-04-14 / 2021-04-16		
Test cycle	Integrated irradiation (kWh/m ²)	Irradiance (W/m ²)	Module temperature (°C)	Resistive load	P _{max} (W) at the end of cycle	(P _{max} - P _{min}) / P _{average} (%)	Stable (Yes/No)
Initial	—	—	—	—	653.7	—	—
1	5.0	800 - 1000	50 ± 10	Yes	652.5	—	—
2	5.0	800 - 1000	50 ± 10	Yes	651.4	0.37	Yes
Sample #	3	Test Date (YYYY-MM-DD) start/end			2021-04-14 / 2021-04-16		
Test cycle	Integrated irradiation (kWh/m ²)	Irradiance (W/m ²)	Module temperature (°C)	Resistive load	P _{max} (W) at the end of cycle	(P _{max} - P _{min}) / P _{average} (%)	Stable (Yes/No)
Initial	—	—	—	—	651.5	—	—

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1	5.0	800 - 1000	50 ± 10	Yes	650.6	—	—
2	5.0	800 - 1000	50 ± 10	Yes	649.7	0.28	Yes
Sample #	4	Test Date (YYYY-MM-DD) start/end			2021-04-14 / 2021-04-16		
Test cycle	Integrated irradiation (kWh/m ²)	Irradiance (W/m ²)	Module temperature (°C)	Resistive load	P _{max} (W) at the end of cycle	P _{max} - P _{min} / P _{average} (%)	Stable (Yes/No)
Initial	—	—	—	—	651.8	—	—
1	5.0	800 - 1000	50 ± 10	Yes	649.5	—	—
2	5.0	800 - 1000	50 ± 10	Yes	648.2	0.55	Yes
Supplementary information: N/A							

Equivalent irradiance (W/m ²)..... :				1000 + φ.G _R			
Sides of Modules..... :				<input checked="" type="checkbox"/> Front		<input type="checkbox"/> Rear	
Sample #	3	Test Date (YYYY-MM-DD) start/end			2021-04-14 / 2021-04-16		
Test cycle	Integrated irradiation (kWh/m ²)	Irradiance (W/m ²)	Module temperature (°C)	Resistive load	P _{max} (W) at the end of cycle	(P _{max} - P _{min}) / P _{average} (%)	Stable (Yes/No)
Initial	—	—	—	—	714.5	—	—
1	5.0	800 - 1000	50 ± 10	Yes	712.6	—	—
2	5.0	800 - 1000	50 ± 10	Yes	711.8	0.39	Yes
Sample #	4	Test Date (YYYY-MM-DD) start/end			2021-04-14 / 2021-04-16		
Test cycle	Integrated irradiation (kWh/m ²)	Irradiance (W/m ²)	Module temperature (°C)	Resistive load	P _{max} (W) at the end of cycle	P _{max} - P _{min} / P _{average} (%)	Stable (Yes/No)
Initial	—	—	—	—	713.6	—	—
1	5.0	800 - 1000	50 ± 10	Yes	712.0	—	—
2	5.0	800 - 1000	50 ± 10	Yes	709.7	0.54	Yes
Supplementary information: φ = Min (φ _{ISC} , φ _{Pmax}); G _R = 135 W/m ² .							

3.5	TABLE: Maximum power determination (after Initial Stabilization)						—
Test Date [YYYY-MM-DD] start/end				2021-04-16		—	
Radiant Source.....				<input checked="" type="checkbox"/> Solar simulator		<input type="checkbox"/> Natural Sunlight	
Module temperature [°C]				Corrected to 25			
Sides of Modules.....				<input checked="" type="checkbox"/> Front		<input type="checkbox"/> Rear	
Sample No.	Voc [V]	Isc [A]	Vmp [V]	Imp [A]	Pmp [W]	FF[%]	
1	45.2	17.85	37.9	17.09	648.3	80.3	
2	45.3	17.87	38.0	17.14	651.4	80.4	

3	45.4	17.86	38.1	17.06	649.7	80.0
4	45.4	17.83	38.1	17.03	648.2	80.0
Sides of Modules.....:			<input type="checkbox"/> Front <input checked="" type="checkbox"/> Rear		—	
Sample No.	Voc [V]	Isc [A]	Vmp [V]	Imp [A]	Pmp [W]	FF[%]
3	44.9	12.83	38.5	11.98	460.9	80.0
4	44.9	12.89	38.4	12.05	463.2	80.1
Equivalent irradiance (W/m ²).....:			1000 + ϕ .G _R		—	
Sides of Modules.....:			<input checked="" type="checkbox"/> Front <input type="checkbox"/> Rear		—	
Sample No.	Voc [V]	Isc [A]	Vmp [V]	Imp [A]	Pmp [W]	FF[%]
3	45.6	19.64	37.9	18.77	711.8	79.5
4	45.6	19.61	37.9	18.71	709.7	79.4
Supplementary information: $\phi = \text{Min}(\phi_{\text{Isc}}, \phi_{\text{Pmax}})$; G _R = 135 W/m ² .						

3.6 Initial	Table: Insulation test (initial)				—
Test Date [YYYY-MM-DD].....:			2021-04-16		—
Test Voltage applied [V]			8000/1500		—
Sample #	Measured	Required	Dielectric breakdown		Result
	MΩ	MΩ	Yes (description)	No	
1	2000	12.9	—	No	P
2	2000	12.9	—	No	P
3	2000	12.9	—	No	P
4	2000	12.9	—	No	P
Supplementary information:					
1) Test was performed as Dielectric withstand test according IEC61215-2:2016.					
2) Size of module [m ²]: 3.11.					
3) The maximum measure range of the equipment is 2000 MΩ.					

3.7 Initial	TABLE: Wet leakage current test (Initial)			—
Test Date [YYYY-MM-DD].....:		2021-04-16		—
Test Voltage applied [V]		1500		—
Solution resistivity [Ω cm).....:		< 3500 Ω cm at 22 ± 2°C	< 3500	
Solution temperature [°C]		22 ± 2		
Sample #	Measured [MΩ]	Limit [MΩ]		Result
1	2000	12.9		P



2	2000	12.9	P
3	2000	12.9	P
4	2000	12.9	P
Supplementary information: 1) Size of module [m ²]: 3.11. 2) The maximum measure range of the equipment is 2000 MΩ.			

3.8	TABLE: MQT 17 - Hail impact test						—
Test Date [YYYY-MM-DD]	2021-04-16						—
Sample #	1						—
Ice ball size [mm]	1	2	3	4	5	6	—
	35.0	35.1	35.0	35.4	35.1	35.1	
	7	8	9	10	11	-	
Ice ball weight [g]	1	2	3	4	5	6	—
	20.4	20.3	20.5	20.4	20.6	20.7	
	7	8	9	10	11	-	
Ice ball velocity [m/s]	1	2	3	4	5	6	—
	27.1	27.4	26.4	27.0	27.5	27.3	
	7	8	9	10	11	-	
Ice ball velocity [m/s]	1	2	3	4	5	6	—
	26.8	27.6	27.2	27.1	27.9	-	
	7	8	9	10	11	-	
Number of impact locations	11						—
Supplementary information: N/A							
Sample #	3						—
Ice ball size [mm]	1	2	3	4	5	6	—
	34.5	35.4	35.5	35.1	34.9	35.2	
	7	8	9	10	11	/	
Ice ball weight [g]	1	2	3	4	5	6	—
	20.3	20.5	20.5	20.5	20.7	20.4	
	7	8	9	10	11	/	
Ice ball velocity [m/s]	1	2	3	4	5	6	—
	26.1	26.8	26.8	27.3	27.5	27.5	
	7	8	9	10	11	/	

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	28.0	27.8	26.7	26.7	27.6	/	
Number of impact locations	11						—
Supplementary information: N/A							

3.9 Final	TABLE: Visual inspection (Final)						—
Test Date [YYYY-MM-DD]	2021-04-19						—
Sample #	Nature and position of initial findings – comments or attach photos						—
1	No major visual defects						P
2	No major visual defects						P
3	No major visual defects						P
4	No major visual defects						P
Supplementary information: N/A							

3.10 Final	TABLE: Maximum power determination								—
Test Date [YYYY-MM-DD] start/end	#1 and #2: 2021-04-16; #3 and #4: 2021-04-19								—
Radiant Source.....	<input checked="" type="checkbox"/> Solar simulator <input type="checkbox"/> Natural Sunlight								—
Module temperature [°C]	Corrected to 25								—
Irradiance [W/m ²]	Corrected to 1000								—
Sides of Modules.....	<input checked="" type="checkbox"/> Front <input type="checkbox"/> Rear								—
Sample #	Isc [A]	Voc [V]	Imp [A]	Vmp [V]	Pmax [W]	FF [%]	Pmax [W] (Lab _GateNo.1)	Power Degradation [%]	Result
1	17.9	45.2	17.10	37.9	648.4	80.2	648.3	+0.02	—
2	17.9	45.3	17.10	38.0	649.8	80.2	651.4	-0.25	—
3	17.9	45.4	17.1	38.1	649.6	80.0	649.7	-0.02	—
4	17.8	45.4	17.0	38.0	645.9	79.9	648.2	-0.35	—
Sides of Modules.....									
<input type="checkbox"/> Front <input checked="" type="checkbox"/> Rear									
Sample #	Isc [A]	Voc [V]	Imp [A]	Vmp [V]	Pmax [W]	FF [%]	Pmax [W] (Lab _GateNo.1)	Power Degradation [%]	Result
3	12.84	44.9	11.989	38.5	461.0	80.0	460.9	+0.02	—
4	12.84	44.9	11.99	38.5	460.8	80.0	463.2	-0.52	—
Equivalent irradiance (W/m ²).....									
1000 + φ _R									
Sides of Modules.....									
<input checked="" type="checkbox"/> Front <input type="checkbox"/> Rear									

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Sample #	Isc [A]	Voc [V]	Imp [A]	Vmp [V]	Pmax [W]	FF [%]	Pmax [W] (Lab_GateNo.1)	Power Degradation [%]	Result
3	19.59	45.63	18.69	38.03	710.7	79.5	711.8	-0.15	—
4	19.57	45.59	18.68	37.93	708.7	79.4	709.7	-0.14	—

Supplementary information:
2) $\phi = \text{Min}(\phi_{\text{Isc}}, \phi_{\text{Pmax}})$; $G_R = 135 \text{ W/m}^2$.

3.11 Final Table: Insulation test (Final)					—
Test Date [YYYY-MM-DD]				2021-04-16	—
Test Voltage applied [V]				8000/1500	—
Sample #	Measured	Required	Dielectric breakdown		Result
—	MΩ	MΩ	Yes (description)		No
1	2000	12.9	—		No
2	2000	12.9	—		No
3	2000	12.9	—		No
4	2000	12.9	—		No

Supplementary information:
1) Test was performed as Dielectric withstand test according IEC61215-2:2016.
2) Size of module [m²]: 3.11.
3) The maximum measure range of the equipment is 2000 MΩ.

3.12 Final TABLE: Wet leakage current test (Final)					—
Test Date [YYYY-MM-DD].....				2021-04-16	—
Test Voltage applied [V]				1500	—
Solution resistivity [Ω cm).....			< 3500 Ω cm at 22 ± 2°C	< 3500	
Solution temperature [°C]				22 ± 2	
Sample #	Measured [MΩ]		Limit [MΩ]	Result	
1	2000		12.9	P	
2	2000		12.9	P	
3	2000		12.9	P	
4	2000		12.9	P	

Supplementary information:
1) Test was performed as Dielectric withstand test according IEC61215-2:2016.
2) Size of module [m²]: 3.11.
3) The maximum measure range of the equipment is 2000 MΩ.

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4 Remark

N/A

5 Documentation

N/A

6 Summary

This report is only for test result, without verdict.

**TÜV SÜD Certification and Testing (China) Co., Ltd. Guangzhou Branch
TÜV SÜD Group**

Tested by:

Tom Cai, Project Handler

Approved by:

Wavey Yang, Designated Reviewer





Annex 1: List of measurement equipment

Description	Identification no.	Application
Illumination photometer	HYJC-YS-070	Visual inspection
Module pulse simulator	HYJC-YS-021	Maximum power determination
Programmable control voltage insulation meter	HYJC-YS-155	Insulation test
Programmable control voltage insulation meter	HYJC-YS-155	Wet leakage current test
Conductance meter	HYJC-YS-171	Wet leakage current test
Hail tester	HYJC-YS-036	Hail test

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

Pmax measurement uncertainty: 2.12% (K=2);

Voc measurement uncertainty: 0.98% (K=2);

Isc measurement uncertainty: 2.26% (K=2).

--- End of Report ---