

22074 Test Report:

Light and Elevated Temperature Induced Degradation Testing on M390-D1FB Modules Produced by Mitrex

Report Number: 22074-PR-E-001
Report Date: 2022-12-15
Test Period: 2022-02-07 to 2022-12-09
Project ID: 21060 (CFV), 000477 (Customer PO)
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Project Summary

CFV Labs conducted Light and Elevated Temperature Induced Degradation (LETID) testing on three **M390-D1FB** modules produced by **Mitrex** per IEC TS 63342:2022.

The modules were subjected to performance measurements and electroluminescence Imaging (EL) prior to, in between and after stress testing. Stress testing consisted of 24 hours of B-O CID Stabilization followed by 162 hours of LETID stress (one bypassed stress testing as the control).

The average change in STC Pmp [W] for the LETID test modules from initial to B-O CID and then from B-O CID to LETID testing was measured to be -0.13% and -0.02% respectively. The change in STC Pmp [W] for the control module from Initial to LETID testing was measured to be $+0.67\%$. The modules were determined to *not be* LETID sensitive. The modules passed all visual inspections.

Project Test Flow

The figure below shows the overall test flow for this project.

Incoming Inspection	A_LeTID	Z_Control
All samples	22074-001, 22074-002	22074-003
@Initial	@A_Initial	@Z_Initial
Incoming Inspection	MQT 06.1 Performance at STC	MQT 06.1 Performance at STC
MQT 01 Visual Inspection	@A_B-O_CID	@Z_LeTID
EL Imaging 1.0x Isc	BO CID Preconditioning (Isc-Initial, 25 C, 24 hr)	MQT 06.1 Performance at STC
	MQT 06.1 Performance at STC (Between 4 and 24 hrs after B-O CID)	
	MQT 01 Visual Inspection	
	EL Imaging 1.0x Isc	
	@A_LeTID	
	LeTID (75 C, 2 x (Isc_Initial - Imp-Initial), 162 hrs Intervals (max of three))	
	MQT 01 Visual Inspection	
	MQT 06.1 Performance at STC (Between 4 and 24 hrs after LETID)	
	EL Imaging 1.0x Isc	

Test Flow Assignment

The modules utilized for this testing were supplied by the customer after they were inspected and sampled by PI Berlin for CFV Labs. The report, *CFV21080 Mitrex sample witness report 20220121_R2*, was provided separately to the customer.

These modules were free of obvious defects under visual inspection and electroluminescence imaging. The test flow assignment for each of the modules is provided in the table below. The modules were subjected to the test legs in the order listed.

Module ID	Serial Number	Test Leg(s)	Notes
22074-001	MIT21A04827	Incoming Inspection, A_LETID	-
22074-002	MIT22A00009	Incoming Inspection, A_LETID	-
22074-003	MIT21A04872	Incoming Inspection, Z_Control	-

Sample Information

Sample Dimensions

Module Manufacturer	Module Type	Length [m]	Width [m]	Thickness [mm]
Mitrex	M390-D1FB	2.03	0.99	40

Sample Nameplate Values

Module Type	Isc [A]	Voc [V]	Imp [A]	Vmp [V]	Pmp [W]	Max Sys Volt [V]	Fuse Rating [A]
M390-D1FB	9.76	47.3	9.29	42.07	390	1000	20

Sample Type Images

Module (M390-D1FB)



Results: Test Leg – Incoming Inspection

An incoming inspection report is provided separately to the customer. No issues were observed during the incoming inspection.

Results: Test Leg – A_LETID

Results for both the positive (pos) and negative (neg) polarity tests are presented in this section.

Summary of Results – Performance at STC and Safety Testing

The tables below show the Performance at STC, Visual Inspection, and safety testing results per module. When required, more detail is provided in the section referenced in the “Notes” field.

Test Conditions

Irradiance [W/m ²]	Temperature [°C]
1000.0	25.0

Estimated Measurement Uncertainty

Technology	Isc	Voc	Imp	Vmp	Pmp
Si, Bifacial (k=2)	± 1.6 %	± 0.75 %	± 2.1 %	± 1.3 %	± 2.2 %

Module: 22074-001

Reference	Isc (A)	Voc (V)	Imp (A)	Vmp (V)	Pmp (W)	ΔPmp (%)	Visual Inspection
Initial	9.894	49.18	9.398	40.35	379.19	+0.05	pass
B-O CID	9.890	49.19	9.380	40.40	379.01	-	pass
LETID	9.896	49.18	9.391	40.38	379.21	+0.05	pass

Module: 22074-002

Reference	Isc (A)	Voc (V)	Imp (A)	Vmp (V)	Pmp (W)	ΔPmp (%)	Visual Inspection
Initial	9.890	49.09	9.392	40.27	378.18	+0.21	pass
B-O CID	9.887	49.04	9.391	40.19	377.40	-	pass
LETID	9.904	49.02	9.395	40.14	377.09	-0.08	pass

Performance at STC – Change from Stabilized

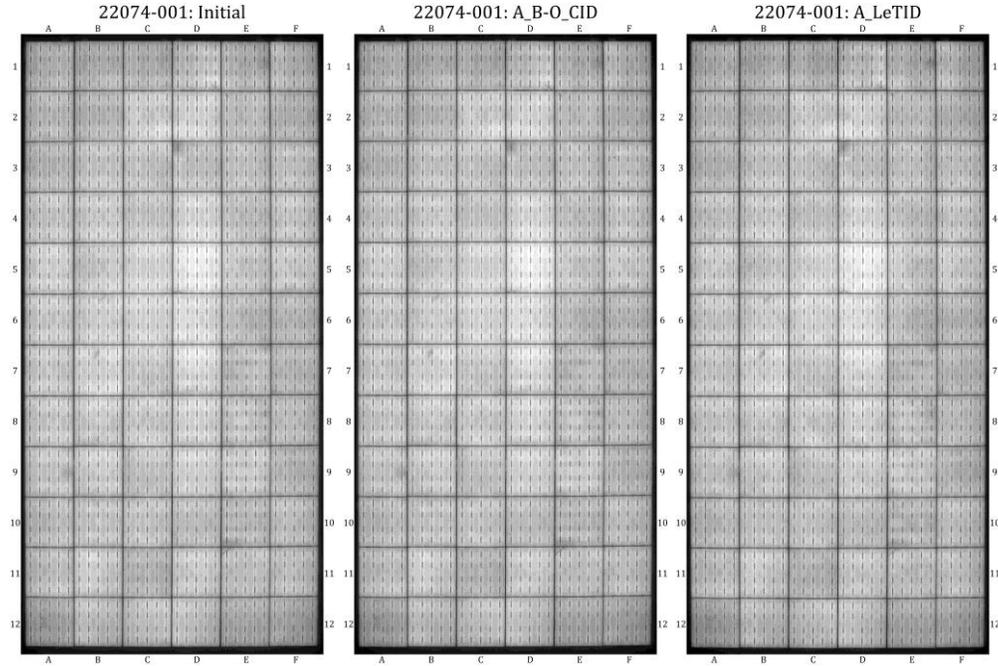
Module ID	Reference	Δ Isc [%]	Δ Voc [%]	Δ Imp [%]	Δ Vmp [%]	Δ Pmp [%]
22074-001	Initial	+0.04	-0.02	+0.19	-0.14	+0.05
	A_B-O_CID	+0.00	+0.00	+0.00	+0.00	+0.00
	A_LETID	+0.06	-0.02	+0.12	-0.07	+0.05
22074-002	Initial	+0.03	+0.10	+0.01	+0.20	+0.21
	A_B-O_CID	+0.00	+0.00	+0.00	+0.00	+0.00
	A_LETID	+0.18	-0.03	+0.04	-0.12	-0.08

Control Module Measurements

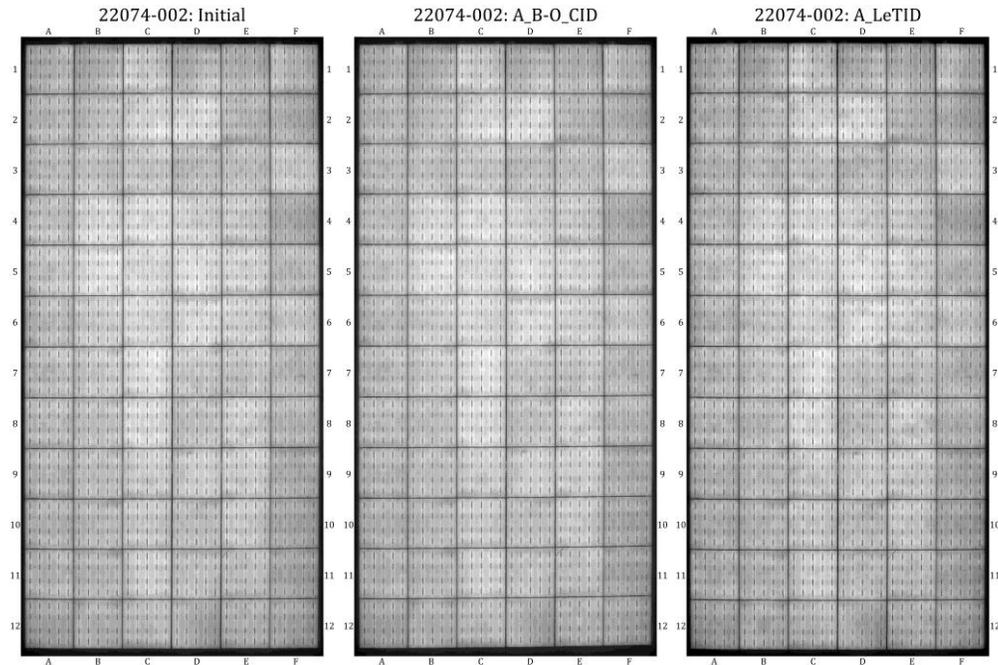
Module ID	Reference	Isc (A)	Voc (V)	Imp (A)	Vmp (V)	Pmp (W)
22074-003	Initial	9.901	49.04	9.389	40.31	378.50
	A_LETID	9.915	49.10	9.416	40.47	381.05

Electroluminescence Imaging

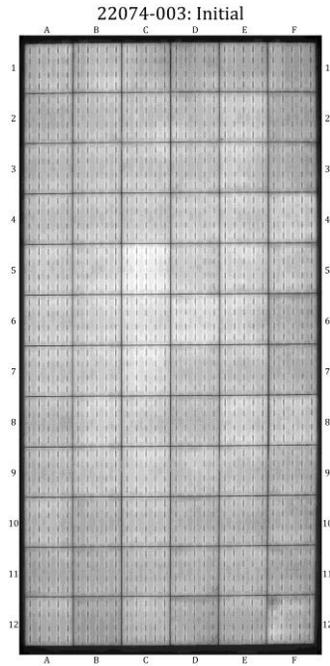
Module 22074-001



Module 22074-002



Module 22074-003 (Control)



Light and Elevated Temperature Induced Degradation

Module	Reference	Hour Count	Applied Current [A]	Temp [°C]	Vmp - Initial [V]	Vmp - Min [V]	Vmp - Final [V]
22074-001	A_LETID	163	0.988	75	37.93	37.78	37.92
22074-002	A_LETID	163	1.002	75	38.18	38.04	38.10

A module is deemed to be LETID sensitive if the following inequality is *not* met:

$$P_{final\ n} \geq 0.97 * P_{BO\ n} * \left(1 - \frac{r[\%]}{100}\right)$$

Where *r* is CFV's k = 2 repeatability of the measurement (0.5 %). Both modules tested *met* the inequality, so they were found to *not* be LETID sensitive.

Procedures

The procedures for the testing contained in this report are summarized in the following table.

Test Name	Standard / Procedure	CFV Accreditation
Incoming Inspection	CFV	NA
Visual Inspection	IEC 61215-2:2016 MQT 01	ISO 17025
Electroluminescence Imaging	IEC TS 60904-13:2018	ISO 17025
B-O CID	IEC TS 63342:2022 § 6.5	ISO 17025
Light and Elevated Temperature Induced Degradation (LETID)	IEC TS 63342:2022	ISO 17025

Equipment Calibration Information

Equipment and Calibration information is available upon request.

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