FSEC Photovoltaic Module Characterization Facility (PVMCF) Testing Fee Schedule
(Effective September 30, 2025)

The FSEC PVMCF has a comprehensive suite of characterization and analysis tools to study performance, durability, and reliability in fine detail. If you are interested in having PV modules measured at the PVMCF, please select from the measurements and analyses below and contact us at PVmodule@fsec.ucf.edu for a quote. **This step must be completed prior** to invoicing and signing the measurement agreement.

Important: **Reception and Processing fees** are added to the final quote unless they are already bundled within a measurement package. The **Standard Package for analysis** is added to the final quote unless otherwise specified by the client.

Definition of terms

- "**EL**" refers to electroluminescence.
- "**Standard EL**" refers to EL images obtained at 10% nameplate I_{SC} and at 100% nameplate I_{SC}.
- "**EL sweep**" refers to EL images obtained at the following percentages of nameplate I_{SC}: 1%, 5%, 10%, 40%, 70%, and 100%. Analyzing these images gives dark *I-V* curves for each cell non-destructively.
- "***I-V***" refers to illuminated current-voltage data obtained by flash testing unless specified as "dark *I-V*" or "p-*I-V*."
- "**Dark *I-V***" refers to current-voltage data obtained by applying bias in a dark room.
- "**Suns-V_{OC}**" refers to open-circuit voltage versus light intensity measurements. The Sinton FMT-350 measures both *I-V* and suns-V_{OC} simultaneously; the Spire cannot obtain suns-V_{OC} data.
- "**p-*I-V***" refers to pseudo-*I-V* which is obtained from suns-V_{OC} data.
- "**UVF imaging**" refers to ultraviolet fluorescence imaging in which UV light is shone onto a PV module and the fluorescent response is imaged.
- "**IR thermography**" refers to infrared thermography imaging after applying a bias of 1I_{SC} for 5 minutes unless otherwise specified by the client.
- "**Reception and Processing**" refers to any labor and resources for: receiving the modules, visual inspection upon reception, assigning modules unique identifiers for measurements, and obtaining visual images for each module.

Discounts and Surcharges	Percentage Discount/Surcharge of Total
Discounts are calculated by taking the sum of the percentages and applying them to the total.	
Measure a total of 10 or more modules, OR	-15%
Measure a total of 100 or more modules	-50%
Bifacial modules (if both sides are being measured)	+75%

PV Module Testing	Amount/Module
Package Deals	
Standard Package	$~~625~~ 600
• Reception and Processing • *I-V* flash test • Standard EL imaging	
Advanced Package	$~~1550~~ 1500
• Reception and Processing • *I-V* flash test • EL sweep • Dark *I-V* test • UVF imaging • IR thermography imaging • PL imaging	
Mechanical Loading IEC61215 Sequence (setup fee not included)	$~~1550~~ 1500

• Reception and Processing
• One of the following:
  ○ 1000 cycles of $\pm$1000 Pa, OR
  ○ One cycle of 2400 Pa, OR
  ○ One cycle of 5400 Pa
• Flash test and standard EL imaging performed at beginning and end of load sequence
• Request quote for custom tests	

Individual Measurements

Reception and Processing (**applied to all measurement agreements**)	$25
Sinton FMT-350 Flash Test	$300
Dark *I-V* Test	$100
EL Imaging	
Standard	$300
EL Sweep	$450
UVF Imaging	$75
IR Thermography Imaging	$300
High-Resolution Closeup EL/PL scan	$300 for either EL or PL
LoadSpot Mechanical Test	
Test Time Per Hour	$250/hour
Flash testing at Each Step	$200
Standard EL Imaging at Each Step	$200
EL Sweep at Each Step (Replaces Standard EL Imaging)	$300
Dark *I-V* at Each Step	$50

Reporting and Analysis	Total Amount

Comprehensive Package Deals

Standard Package (**added by default unless otherwise stated by client**) $250

- Summary table and boxplots of measured *I-V* parameters.
- Summary of observations from EL images, visual images, and *I-V* data.
- *I-V* curve data and plots.
- p-*I-V* curves, and *I-V* overlayed with p-*I-V* curves.
- Cropped EL images of each module.
- *Bifacial testing also includes bifaciality calculations if both sides are measured.*
- *Mechanical load testing also includes plots of* I-V *parameters and GIFs of EL images with respect to loading conditions. E.g.,* I_{SC} *per 200 cycles of ±1000 Pa.* +$250

Advanced Package $1000

- *Everything in the Standard Package.*
- *I-V* performance loss rate analysis based on nameplate values as applicable.
- *I-V* parameters as a function of light intensity with plots.
- *I-V and* p-*I-V* data as a function of light intensity with plots.
- Effective lifetime versus carrier density data and plots.
- EL sweep analysis with series resistance and recombination mapped for each cell in the module[1] (EL sweep imaging required).
- EL image analysis with series resistance and recombination resolved across the module area[2].
- Cropped cells from module EL images.
- Machine learning defect detection of EL images[3].
- Enhanced and cropped UVF images.
- Basic statistics from IR thermography images.
- Dark *I-V* curve analysis.
- *Bifacial testing also includes bifaciality calculations if both sides are measured.*
- *Mechanical load testing also includes these analyses as a function of loading conditions.* +$1000

Custom Package

Select analysis techniques from below and request quote.

Sinton FMT-350

- Summary table and boxplots of measured *I-V* parameters.
- Plots of *I-V* curves, p-*I-V* curves, and *I-V* overlayed with p-*I-V* curves.
- *I-V and* p-*I-V* data as a function of light intensity with plots.
- *I-V* parameters as a function of light intensity with plots.
- Effective lifetime versus carrier density data with plots.
- *I-V* performance loss rate analysis based on nameplate values as applicable.
- *Mechanical load testing: I-V and* p-*I-V* performance and plots with respect to loading conditions.
- *Bifacial testing:* any of the above comparing between both sides of each module, including bifaciality calculations.

EL Imaging

- Summary of results.
- Module and cell cropping.
- GIFs of images.
- EL sweep analysis[1]: dark *I-V* curves for each cell in the module. Performance characteristics obtained from these curves are mapped onto an image to visualize cell performance. *Contact us for details on half-cell or shingled cell modules.*
- EL pixel resolved analysis[2]: series resistance and recombination saturation current are mapped on a pixel-by-pixel map of the module to visualize performance across the module and cell surfaces. *Contact us for details on half-cell or shingled cell modules.*
- Machine learning defect detection[3].
- *Mechanical load testing:* any of the above with respect to loading conditions.
- *Bifacial testing:* any of the above comparing between both sides of each module.

UVF Imaging

- Summary of results.
- Image enhancement and module cropping.

IR Thermography Imaging

- Summary of results.
- Basic statistics of module temperature.

Dark *I-V*

- Curve analysis.

Bibliography

[1] D. J. Colvin, E. J. Schneller, and K. O. Davis, "Cell dark current–voltage from non-calibrated module electroluminescence image analysis," *Solar Energy*, vol. 244, pp. 448–456, Sep. 2022, doi: 10.1016/j.solener.2022.08.043.
[2] M. Li, C. Weik, D. Colvin, and K. O. Davis, "Pixel-Level Series Resistance Analysis Using Electroluminescence Images: Understanding the Degradation Behavior of Photovoltaic Modules after Long-Term Field Exposure," SSRN, preprint, 2023. doi: 10.2139/ssrn.4367178.
[3] J. Fioresi, D.J. Colvin, *et al.*, "Automated Defect Detection and Localization in Photovoltaic Cells Using Semantic Segmentation of Electroluminescence Images," *IEEE J. Photovoltaics*, vol. 12, no. 1, pp. 53–61, Jan. 2022, doi: 10.1109/JPHOTOV.2021.3131059.