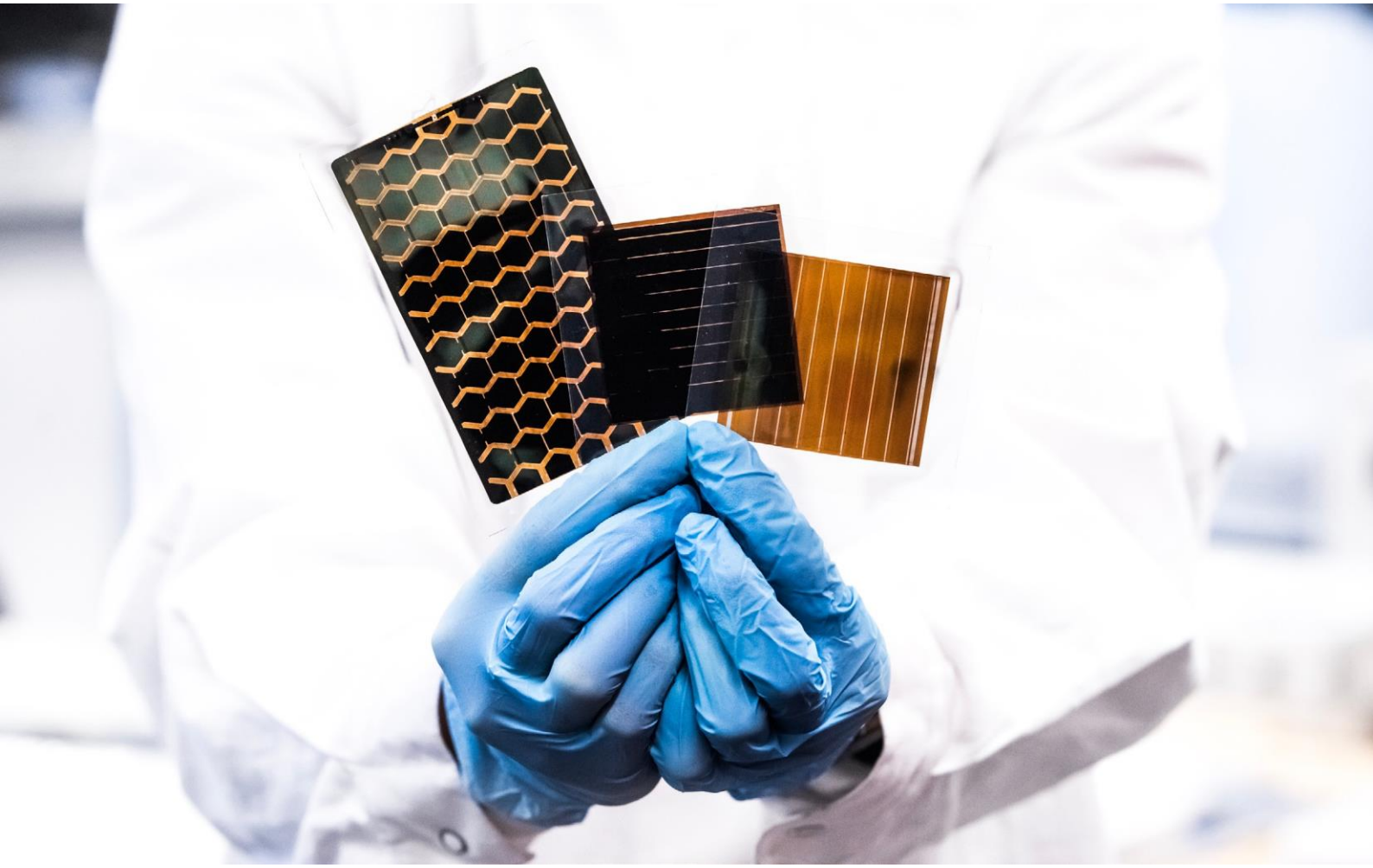
PRODUCT CATALOG

PEROVSKITE PV MODULES FOR IOT DEVICES AND CONSUMER ELECTRONIC DEVICES

THE BEST AND MOST EXCITING SOLAR TECHNOLOGY



Latest update: December 20th, 2024

SAULE TECHNOLOGIES

BUSINESS DEVELOPMENT & TECHNOLOGY CENTER
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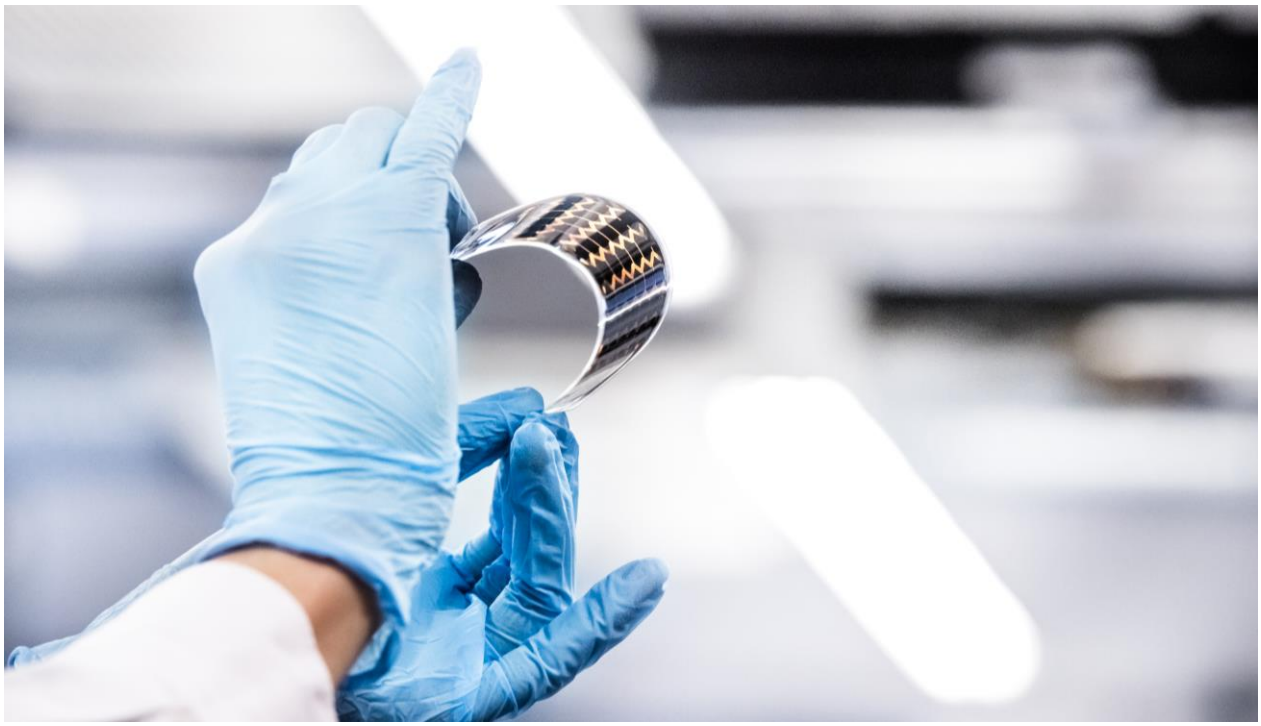
PRODUCT OVERVIEW

Our PV module is inkjet-printed, ultra-thin, and flexible, based on perovskites.
It's the latest and most exciting solar technology.



Fully printed on thin, flexible foil
Our solar cells are manufactured entirely by printing. This intuitive method, now performed with high-tech equipment, is the foundation of our success.

Flexible & low-weight
Perovskite solar cells can be thinner than a millimeter! Printed on thin and flexible PET foils, our cells have an impressive weight to power ratio.

A cleaner environment & eco-friendly processing
Processing in ambient air, with processes under 120 degrees Celsius. The carbon footprint can be up to 20x lower than that of silicon solar cells.

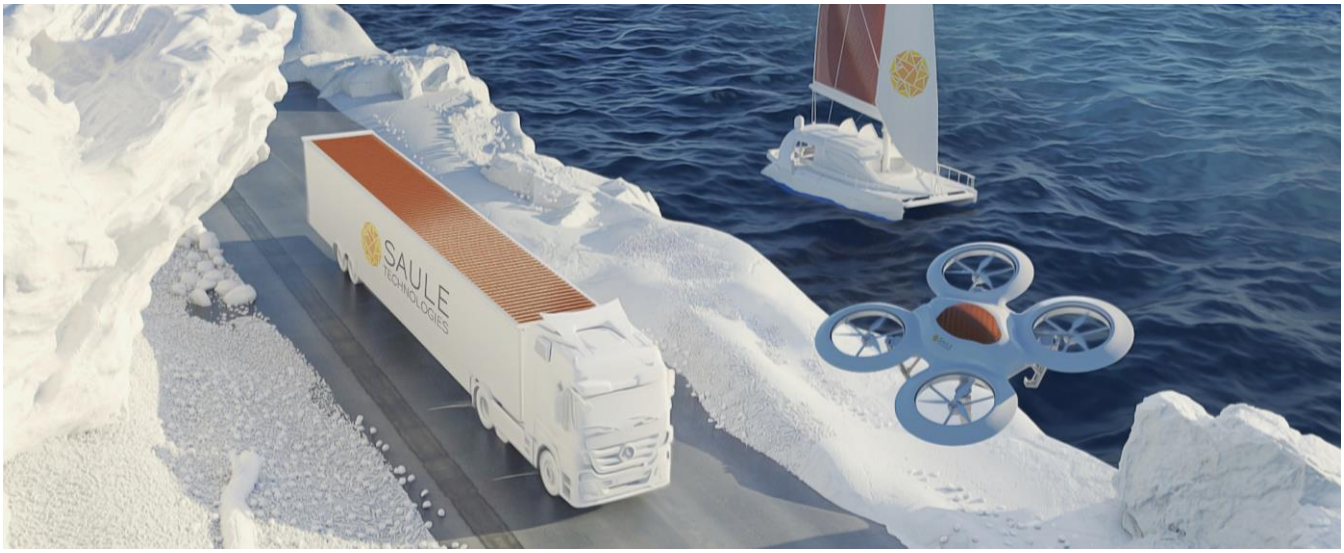
Great performance indoors & outdoors
Perovskite is one of the most versatile solar cell type, operating efficiently in the widest range of the light spectrum. No need anymore to choose between great performance outdoors and the possibility to charge in artificial light.

Various shapes, patterns & colors
Printing production technologies allow freedom of shape and easy pattern scaling. Perovskite solar cells can be material-engineered to have different colors and transparency levels.

High level of design adaptability
Printing technologies are very agile and great for scaling at a relatively low cost.

Higher efficiency & fast development
Perovskites have excellent light absorption properties resulting in high efficiency of the solar cells. This translates to a high power to cost ratio.

POSSIBLE APPLICATIONS



Smart Home
Power sensors and home automation.

Machine to machine
Wireless communication in retail and industrial environments.

Low power consumer electronics
Reduce charging frequency of wireless speakers, headphones, etc.

Asset tracking
Always know the location of your valuable items.

Industry 4.0
Automate machinery for improved processes.

Smart agriculture
Get more data on the environment for better harvests.

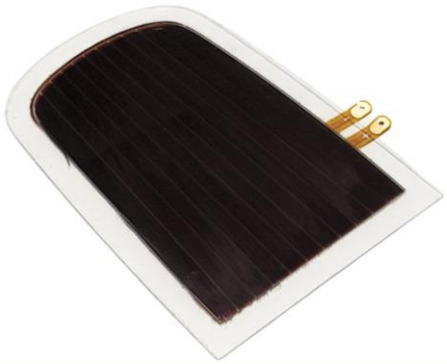
Labeling
Display and update information.

Health monitoring
Take care of yourself and your beloved ones.

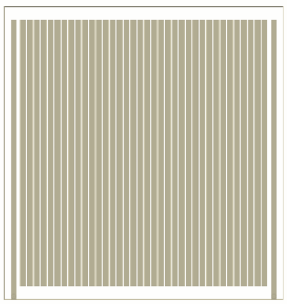
CUSTOM SHAPES AND PATTERNS

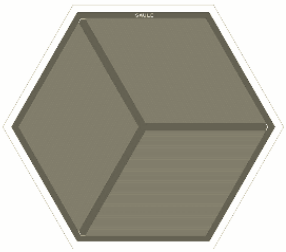
SHAPES

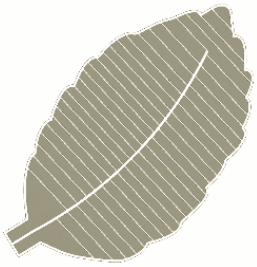
Advanced printing and laser cutting technology allows us to produce perovskite modules in many different shapes, from the regular ones such as rectangular, circular, polygonal etc. to custom shapes.

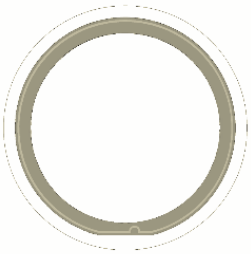


SHAPE EXAMPLES





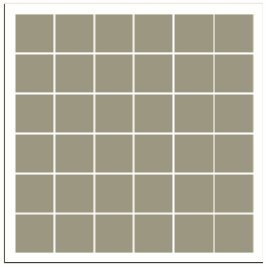


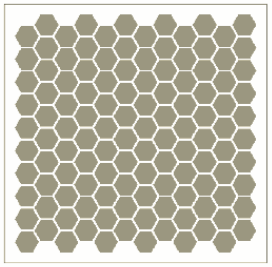


PATTERNS

Perovskite modules by default are provided with rectangular pattern of the solar cells, however our technology allows us to produce modules with the custom patterns. The modules contain organic semiconducting materials but are inedible. Use care if solder-pads are mechanically modified such as bending or cutting.

PATTERNS EXAMPLES





TEXTURES

Texture T0

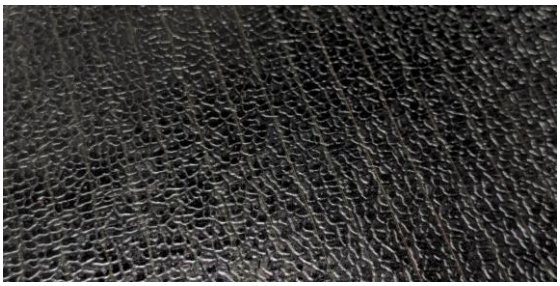
Module with a regular protective layer, without additional texture. The cells are clearly visible.
Reference performance.

Texture T3

Silver finish imitating sandblasted glass.
Use temperature: from 0°C to +80°C.
80% of reference performance.

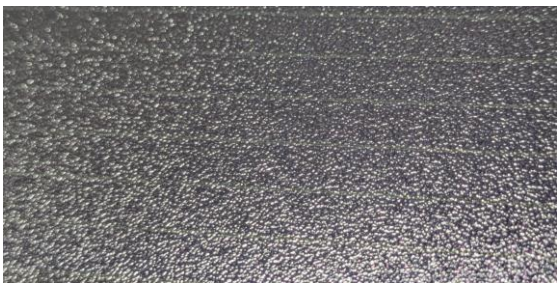
Texture T1

Matte surface finish with a fine sand structure.
Use temperature: from -30°C to +50°C.
98-99% of reference performance.



Texture T4

Porous finish imitating leather.
Use temperature: from -40°C to +82°C.
98-99% of reference performance.



Texture T2

Scratch-resistant finish with a fine sand structure.
Use temperature: from 0°C to +100°C.
98-99% of reference performance.

Texture T5

Smooth white finish.
Use temperature: from 0°C to +80°C.
80% of reference performance.

GENERAL INFORMATION

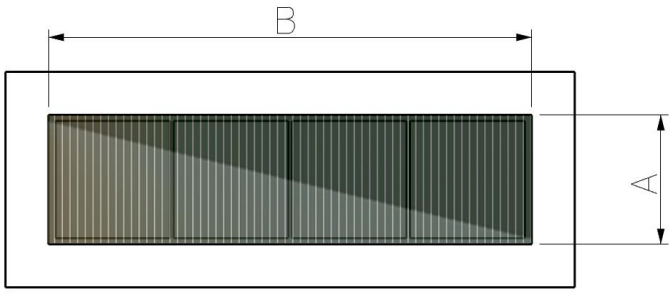


Fig. 1. Product Code and Module Dimensions.

Indoor IoT Application

Perovskite Photovoltaics

Number of Electrical Cells
- 3 (cells)
- 4 (cells)
- 8 (cells)

Texture Symbol
- T0
- T1
- T2
- T3
- T4
- T5

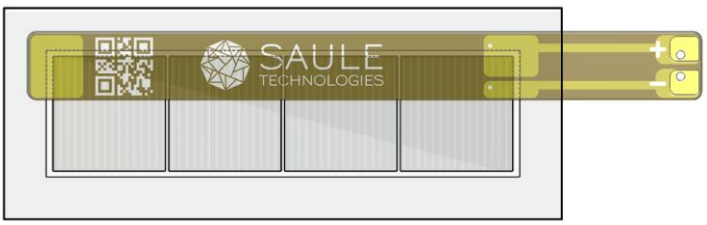
PPV.IOT_R1_AAxBB_C_TX_NN

Shape & Version
- R - rectangle
- C - C-shape
- D - D-shape

Power output
Power in µW, for 500 lux.

Module Aperture Area: Width(A) x Length(B)
Width (A) is measured along the cells.
Length (B) is measured across the cells.
The module has a 5 mm wide frame on each side.
The actual module size is 1 cm larger than aperture area.

Each module is supplied with a flexible PCB that can be customized.



Operating environment: Indoor / -20 °C to 40 °C / 0-85 % RH.
Different operating conditions may affect lifetime.
Storage conditions: Indoor / -20 °C to 40 °C / 0-85 % RH / in the dark

This PV module shall not be connected to other PV modules or other power sources unless the combination provides protection from reverse current and overvoltage protection.

MEASURING PROCEDURE AT SAULE

The procedure described below can be a reference for additional testing of R&D modules. In case of achieving very different values with your measuring procedures and routines, it is recommended to apply this procedure to confirm the results.

Modules fabricated by Saule S.A. were characterized first in STC (Standard Test Conditions), then under low-light (500 lux illumination).

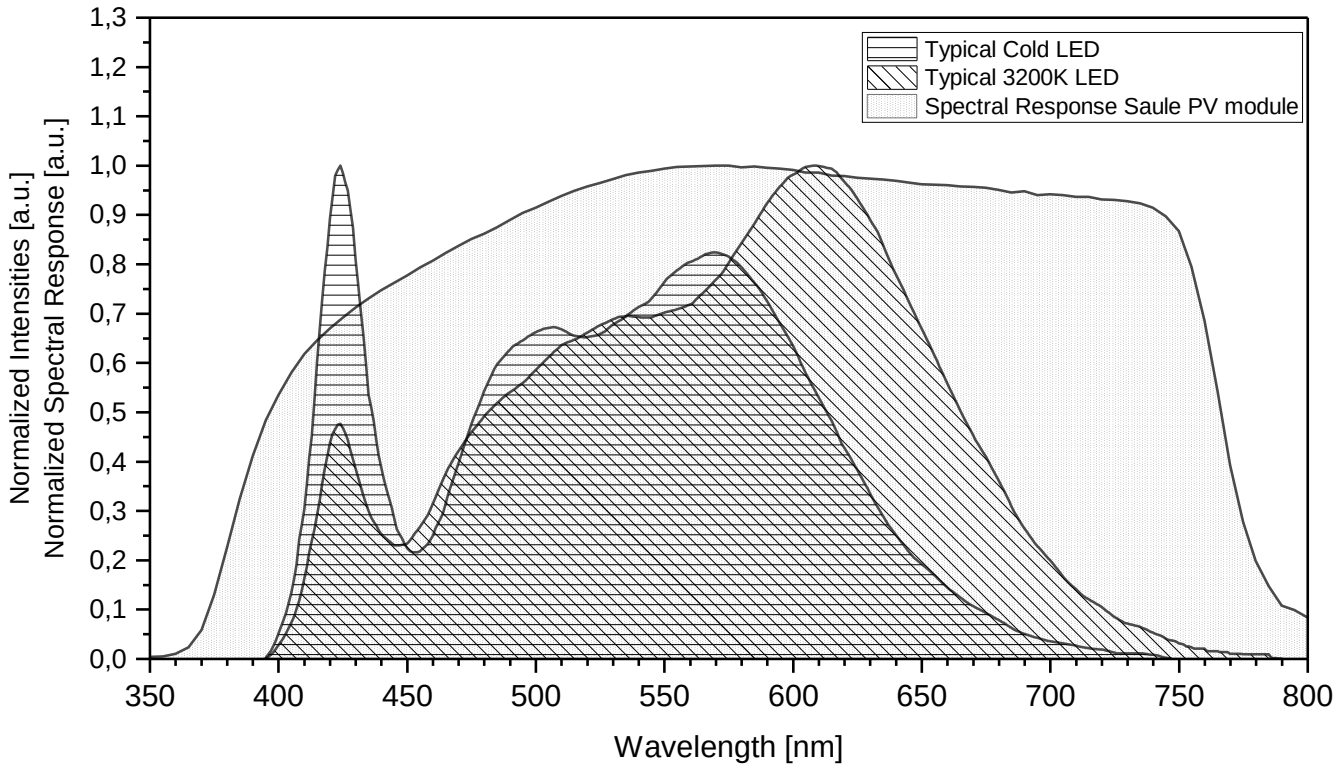
All specified shapes, patterns, values and dimensions are subject to change by Saule S.A.

Low-light measurement (500 lux)

Light source:	3200 K LED diode, DO NOT USE PWM for light intensity calibration
Lux-meter was used for LED light intensity modulation.	
Voltage range	-0.2 V – 1.2 * V_{OC}
Scan rate	1.5 V/s

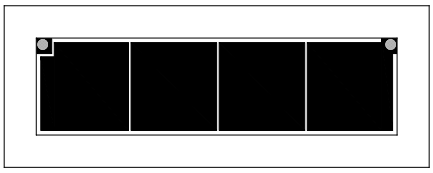
The sequence of I-V measurements

Light reversed I-V (from 1.2 * V_{OC} to -0.2 V)
Steady-state set the V_{MPP} and measure the current in time for 30 s (calculate P_{MAX}).

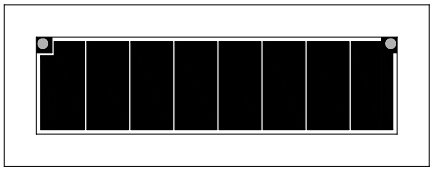


MODULE DESIGN

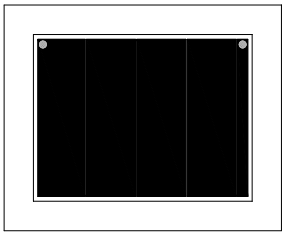
PPV.IOT_R1_15x56.2_4



PPV.IOT_ R1_ 15x56.2_8

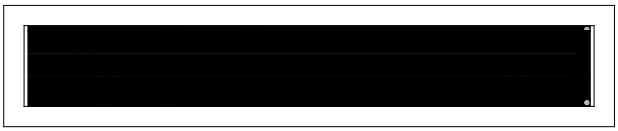


PPV.IOT_ R1_ 24.3x32.1_4

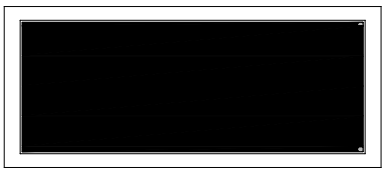


PPV.IOT_ R1_ 25x40.3_4

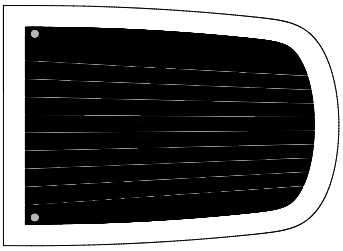
PPV.IOT_ R1_ 140x20_3



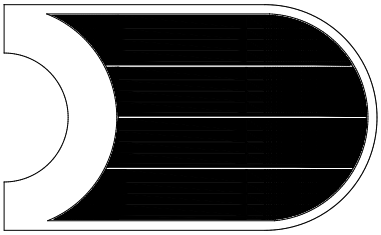
PPV.IOT_ R1_ 109x41.3_4



PPV.IOT_D1_67.1x45.2_9



PPV.IOT_C1_148x95_4



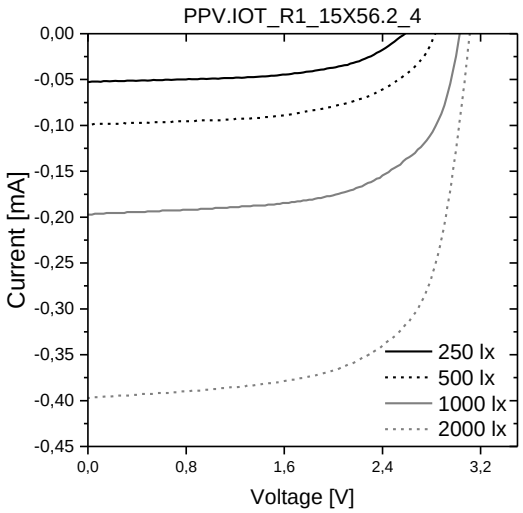
STANDARD SIZE [mm] & TECHNICAL DATA

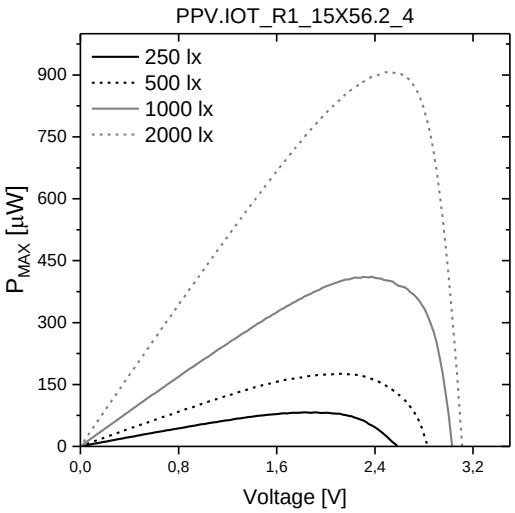
measured under specified conditions (500 lx, 3200 K)

Product Code	P_{MAX} [µW]*	V_{OC} [V]**	V_{MPP} [V]**	I_{SC} [mA]**	Outer dimension [mm x mm]	Weight [g]
PPV.IOT_R1_15x56.2_4_T0_170	170	2.8	2.1	110	25x66.2	0.75
PPV.IOT_R1_15x56.2_8_T0_170	170	5.6	4.2	53	25x66.2	0.75
PPV.IOT_R1_24.3x32.1_4_T0_155	155	2.8	2.1	96	42.1x34.3	0.6
PPV.IOT_R1_25x40.3_4_T0_200	200	2.8	2.1	150	51.7x36.4	1.1
PPV.IOT_R1_140x20_3_T0_560	560	2.1	1.6	419	150x30	3.2
PPV.IOT_R1_109x41.3_4_T0_900	900	2.8	2.1	590	51.3x119	4.2
PPV.IOT_D1_67.1x45.2_9_T0_700	700	6.3	4.7	110	55.2x77.1	2.4
PPV.IOT_C1_148x95_4_T0_2160	2160	2.8	2.1	1150	105x158	9.7

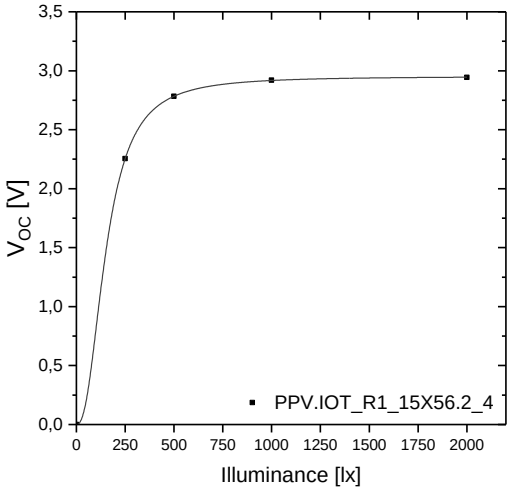
*minimum performance
**typical value

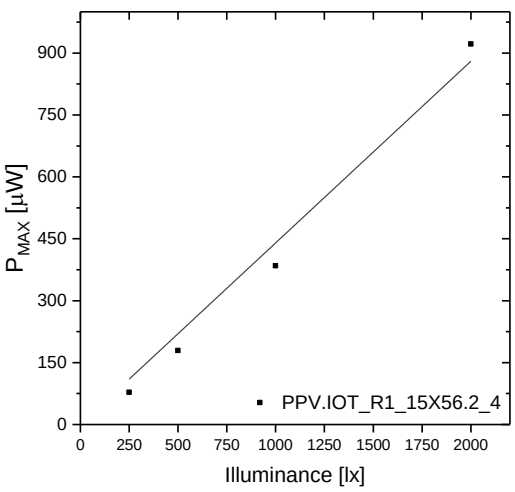
PPV.IOT_R1_15X56.2_4 MODULE DATA





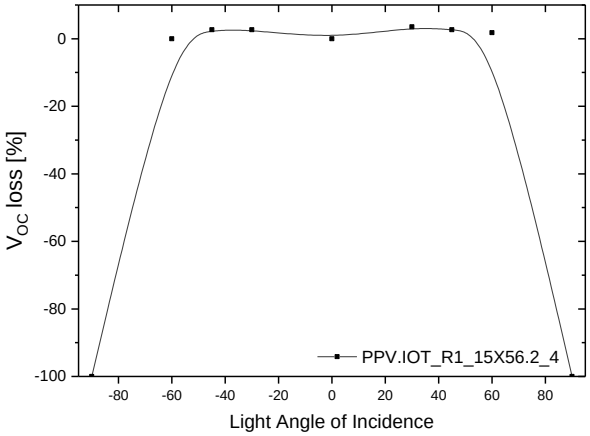
ILLUMINANCE

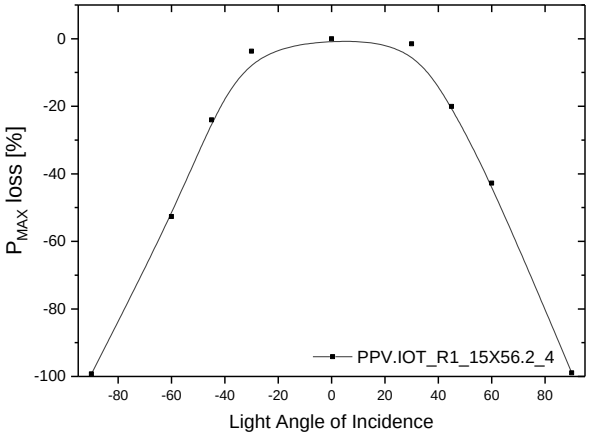




LIGHT ANGLE OF INCIDENCE

measured under conditions specified (500 lx, 3200 K)





SAFETY INFORMATION

In order to ensure safe product operation and best product performance, customer or OEM have to comply with the provided handling recommendations. Non-compliance with the given instructions or improper handling of the product can result in damaging the device or pose a threat to health and life of the user.

Saule S.A. will not be held liable for any damages resulting from improper use or handling.

This product safety information should be read carefully before handling or usage.

SOLDERING INSTRUCTIONS

To solder the wires, use soldering station with temperature of 250 °C. Don't heat the module soldering point for more than 3 seconds

APPLICATIONS

Saule photovoltaic module must not be used in applications or in relation with equipment that supports - directly or indirectly - human health or life or with applications that can result in danger for people, animals or real value.

Saule photovoltaic modules are not suitable for use in mechanically or environmentally challenging environments including (but not limited to) environments with heavy vibrations, mechanical shocks, high humidity or in explosive atmosphere.

HANDLING AND USAGE

- ➔ Apply the precautions required for the handling of electrostatic sensitive devices. Static discharge can damage the solar module.
- ➔ Photovoltaic modules should not be exposed to rapid temperature changes shortly before or during operation.
- ➔ Condensation of moisture onto the module has to be avoided as it might damage the module.
- ➔ Do not modify or use the product beyond product specification. For details refer to the product user manual.
- ➔ Do not strongly bend or apply mechanical stress to the module. The maximum bending radius is 5 cm.
- ➔ Modules with solar cells can have sharp edges; housing design should account for that.
- ➔ We recommend wearing safety gloves during handling of modules with solar cells.
- ➔ Wrong cleaning of solar cells can damage them; we suggest cleaning with soft tissue and ethanol or isopropanol.

TERMS AND CONDITIONS FOR SAMPLE PRODUCT

Saule S.A. a Polish corporation with its seat in Wrocław, ul. Duńska 11, 54-427 Wrocław, POLAND ("SAULE") only agrees to provide sample products subject to these terms and conditions. Provision of any sample is expressly conditional on assent to these terms and conditions, which may not be modified.

By requesting a sample products, you agree as follows:

1. No Warranty. Due to storage conditions, sample products are only provided "AS-IS," and the recipient assumes all costs and risks associated with their use. The sample products are not necessarily subject to the same quality controls as products available for sale, and must not be considered fit for human consumption. The sample shall not be used in combination with any items, devices or materials anyhow. SAULE HEREBY DISCLAIMS ANY EXPRESS OR IMPLIED WARRANTY WITH RESPECT TO ALL SAMPLE PRODUCTS, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY OF THE SAMPLE PRODUCTS OR THEIR FITNESS FOR A PARTICULAR PURPOSE. SAULE WILL NOT BE LIABLE FOR DAMAGES ARISING OUT OF ANY USE OF ANY SAMPLE PRODUCT RECEIVED FROM SAULE.

2. Indemnification. The buyer shall use SAULE products only as a stand-alone technical device, and is liable for any damages arising from any other use of SAULE products. The buyer hereby indemnifies SAULE against any loss or liability resulting from use of SAULE products in any other type of application, and represents that it carries adequate insurance to cover any such loss or liability, including product liability and recall insurance.

3. Confidential Information. The manufacturing processes and formulations of SAULE products are confidential and proprietary to SAULE, as are the sources of raw materials used in their production. The recipient of any sample product shall not reverse engineer any such product, and shall not use SAULE product information for any reason other than testing the sample product's usefulness in one or more product applications.

4. Miscellaneous. Failure or delay of either party to exercise any right under this agreement is not a waiver of that right. These terms and conditions are severable, and if any are held invalid or unenforceable by an authority of competent jurisdiction, the remaining terms and conditions will remain valid and enforceable to the extent permitted by law. These terms and conditions is governed by the laws of Poland. In lack of conflict with any binding provisions of law, any disputes arising out of or related to this Agreement shall be finally settled under the Arbitration Rules of the Court of Arbitration at the Polish Chamber of Commerce in Warsaw in force on the date of commencement of the proceeding by an arbitrator or arbitrators appointed in accordance with the said Rules. The Parties shall be bound by any arbitration award rendered as a result of such arbitration as the final adjudication of any such controversy, claim or dispute.

CONTACT

If you are interested in the purchase of our IoT perovskite modules, please contact us:

b2b@sauletech.com