FLEXWAVE

Product Catalogue

High Efficient PV Energy Harvesting Solution

Shaping a Smarter, Sustainable World Powered by the Sun.

APICTA Asia Pacific ICT Alliance AWARDS

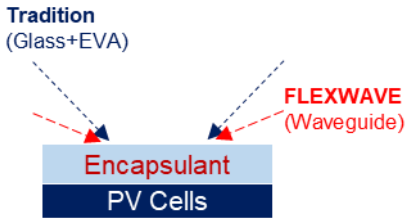
Member of

WORLD ALLIANCE *for* EFFICIENT SOLUTIONS by SOLARIMPULSE FOUNDATION

Advantages

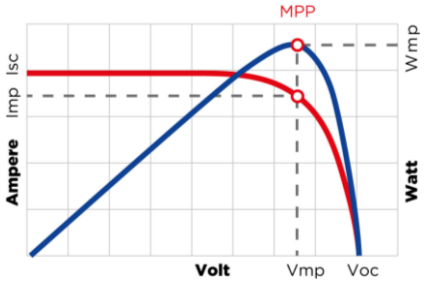
Waveguide Encapsulation

- Thanks to the waveguide technology, FLEXWAVE gives the PV module a talent of collecting diffusing light, which helps PV can absorb more photon and produce >**25%** more power.



Optimized Power Manager

- **Up to 95%** efficiency from PV to battery of the optimized MPPT solar charger, which can provide a 30% better performance than the tradition solution.
- Available lowest power 50μW.



We Produce 75% More Power!

Power Density × **Charging Efficiency** = **Performance**

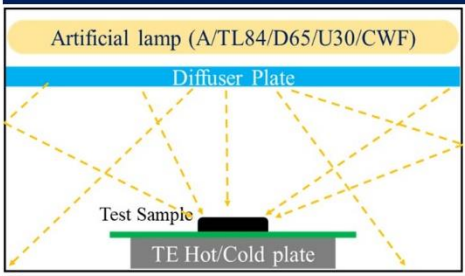
Item	Power Density	Charging Efficiency	Performance	Difference
Tradition	1	Avg. 68%	0.68	-
FLEXWAVE	1.4	Avg. 85%	1.19	***+75%***
Note	• Power density = generated energy per unit area. • Charging efficiency = stored energy from PV to storage units (battery or capacity).			

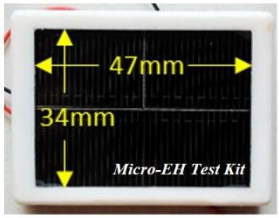
Allows 176° Wide-angle collection

Submission accepted by EU PVSEC 2023

FLEXWAVE

Performance Evaluation of AR Encapsulated Mono-Si PV Module under Indoor Lighting Simulator by Using RTOS Method

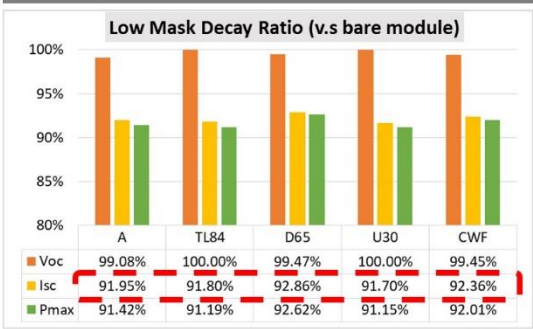




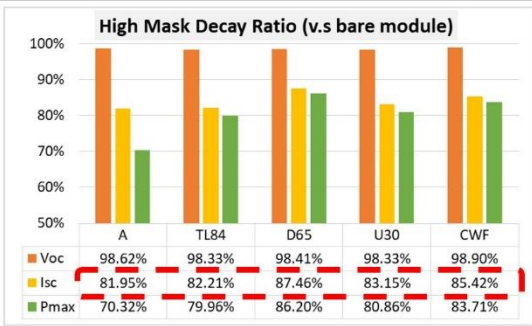
Using different height masks to evaluate the contribution of scattering rays under the diffusing condition of Indoor Lighting Simulator.

Light Source \ I-V	Voc (V)	Isc (μA)	Pmax (μW)	PCE (%)
A	2.18	4971.4	8173.2	59.47
TL84	1.80	533.9	635.7	20.94
D65	1.89	798.5	1024.8	8.12
U30	1.80	509.9	609.2	20.06
CWF	1.81	538.3	648.3	21.35

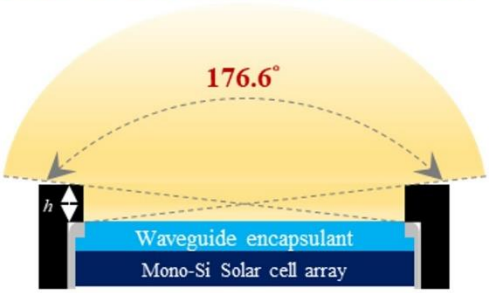
※ The results were tested by the Photovoltaics Calibration Laboratory of ITRI.

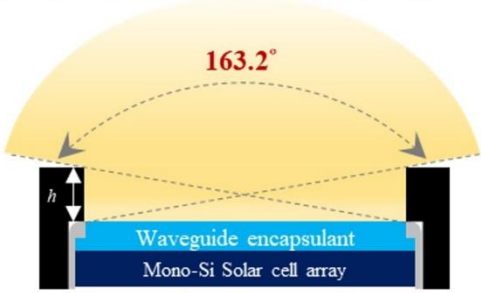


The contribution of 88.3-90° incidence blocked by low mask is about 8%.



The contribution of 81.6-90° incidence blocked by high mask is about 16%.





Certificated Efficiency

工業技術研究院
Industrial Technology Research Institute

Report No. : 11307C02814-1-1-04

Calibrated Results and Descriptions

I. Calibrated Results

1. Description of Calibrated Device

Sample #	11307C02814-1
Device ID	TOPCon based Energy Harvester – No. 10
Device Size	10 cm × 10 cm (Active area: 97.50 cm^2)
Device Material	mono-Si TOPCon with waveguide encapsulation

World Record!

2. Data of Calibrated Results

2.1 I-V Curve Characteristics

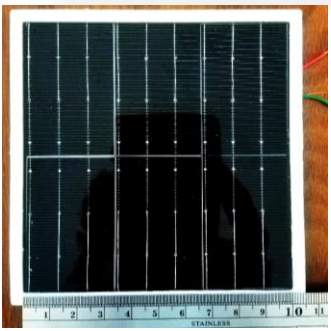
CIE TL84 standard illuminant under 1000 lx and 25 ℃							
Open-Circuit Voltage	V_{oc}	=	(	3057	±	45	) mV
Short-Circuit Current	I_{sc}	=	(	1.94	±	0.060	) mA
Maximum Power	P_{max}	=	(	4.44	±	0.16	) mW
Supplementary information:							
Current at Max. Power Point	I_{mpp}	=		1.78			mA
Voltage at Max. Power Point	V_{mpp}	=		2490			mV
Irradiance for Lighting	E	=		0.19			mW/cm^2
Efficiency	η	=		23.97			%
Current Density	J_{sc}	=		0.02			mA/cm^2
Power Density	Pd	=		0.046			mW/cm^2

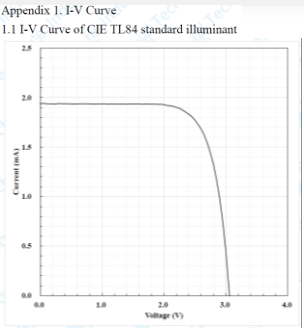
* Supplementary information:

Current Density = Short-Circuit Current / Active area

Power Density = Maximum Power / Active area

Efficiency = Power Density / Irradiance for Lighting





Conditions	Photon Energy (mW/cm^2)
1 Sun	100
Cloudy	50
Rainy	10
1000 lux T5 lamp	0.19

The micro-concentrating behavior of waveguide encapsulation enables mono-Si to maintain its performance even under extremely low-light conditions.

The waveguide PV module was made by 24.6% TOPCon mono-Si solar cells.

Standard Products

Arc-Solar Box

The Iron-man Suit design for outdoor IoTs.

Meet *Carbon Negative* in 1 Month under sunshine!

SolarImpulse Foundation

#beyond 1000 solutions

Flood Alarm	Water quality	Smart Agri.
Leakage sensing	**Mini Gateway**	Wildfire sensing
Railway sensing	Bridge sensing	TH sensing

ANALYST'S CHOICE
global sources

etc.

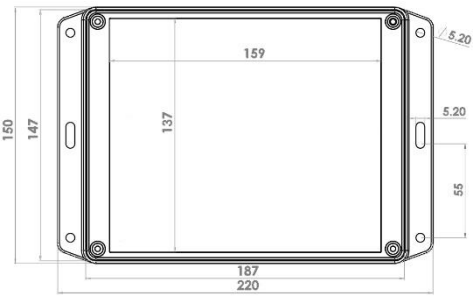
CE RoHS IP67

Model Name	Arc-solar Box	Arc-Solar Box P
Size (LxWxH)	195 x 88 x 40/55 mm	220 x 150 x 75/55 mm
PV	P_{max}= 1.35W V_{oc}=2.6V and I_{sc}= 640mA	P_{max}= 3.18W V_{oc}=3.98V and I_{sc}= 1,050mA
Electrical Specifications	Embedded MPPT charger for single rechargeable battery with adjustable charging voltage. (Standard = 4.2V) Battery Health Level Control : Output off @ V_{bat}=2.8V, and restart @ V_{bat}=3.4V <u>Output Voltage:</u> Standard - V_{bat}, 5V (max. 1A) Optional – 3.3V, 9V (max. 450mA), 12V (max. 300mA) Connector: Molex/JST 1.25mm pitch	
Daily Power[a]	Sunny : 5,500 mWh (3.7V / 1,350mAh) Cloudy : 450 mWh (3.7V / 120 mAh)	Sunny : 12,000 mWh (3.7V / 3,240mAh) Cloudy : 1,000 mWh (3.7V / 270 mAh)
CO_2 Reduce[b]	35.14 kg / year	84.36 kg / year

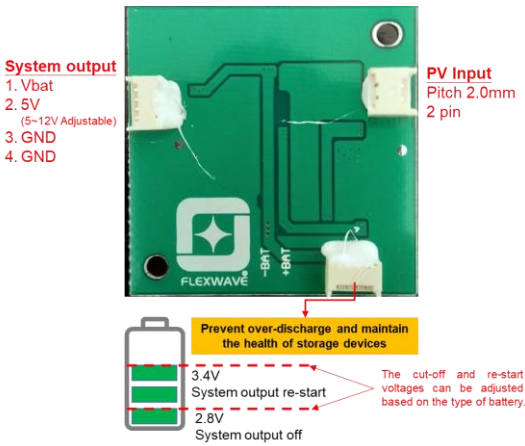
a: The daily power was measured at Hsinchu, TW, the data will be different under various condition. The sun intensity of a Sunny day is 1,000W/m^2, a Cloudy day is around 100W/m^2.
b: Energy harvester can reduce the replacement of battery, and the carbon footprint of one AA Alkaline battery (3,000mWh; 1.5V/2,000mAh) is 0.107kg.

Arc-Solar Box

Arc-Solar Box P



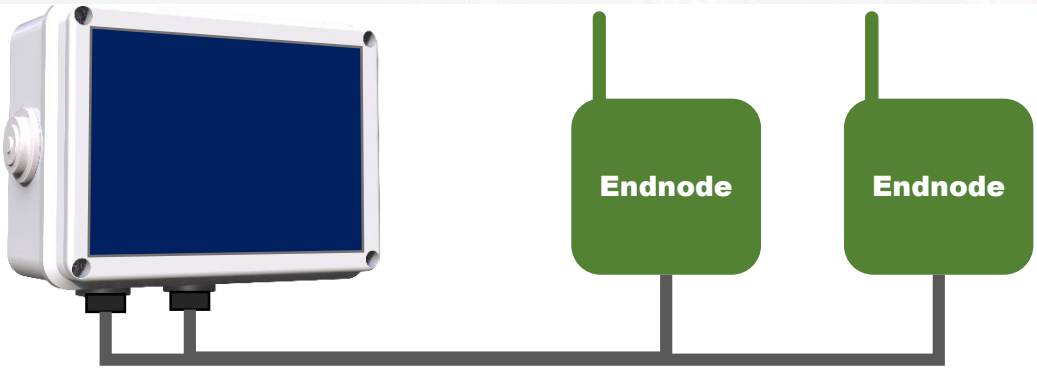
Well-defined Power Manager, Just Plug and Play!



Watch the instant charging records of Arc-Solar Box → *Link here*!

Arc-Solar UPS

Build a Reservoir for your distributed devices



Model Name	UPS-Arc	UPS-Arc P
Size (LxWxH)	195x88x55 mm	220x150x75 mm
Electrical Specifications	Waveguide PV module with embedded MPPT charger and stable output voltage. Output Voltage: Standard - 5V (max. 1A) Optional – V_{bat}, 9V (max. 450mA), 12V (max. 300mA) Connector: Micro-USB/Type-C USB/M12 connector with IP67 rating or custom. Battery level control : Output off @ V_{bat}=2.8V, and restart @ V_{bat}=3.4V.	
Built-in batteries	10x18650 Li-ion rechargeable battery (34,000mAh @ 3.7V) with phase change material to reduce the heat accumulation.	36x18650 Li-ion rechargeable battery (122,400mAh @ 3.7V) with phase change material to reduce the heat accumulation.
Others	Suitable for the system with an avg. daily power consumption of 2,000-3,600 mWh/day under open sky.	Suitable for the system with an avg. daily power consumption of 4,000-7,000 mWh/day under open sky.

Solar-Navi

The World's Smallest Never-End GPS Tracker

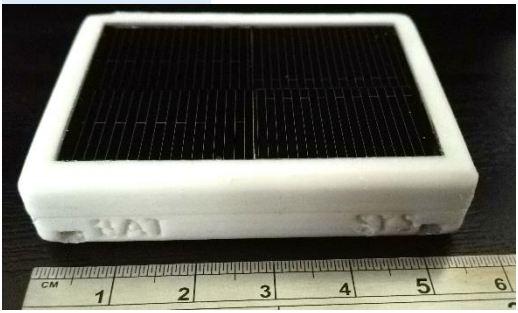
Specification			
L×W×H (mm)	58x48x26	**Weight (g)**	87
Communication	LTE Cat M1: 700 (Bd12, Bd13, Bd28, Bd85), 800 (Bd18, Bd19, Bd20, Bd26, Bd27), 850(Bd5), 900 (Bd8), AWS-3 (Bd66), AWS-1 (Bd4), 1800 (Bd3), 1900 (Bd2, Bd25), 2100 (Bd1)		
Working Condition	1. Position Accuracy = avg. 5m under open sky. 2. Logging interval=15 mins, 96 GPS positions/day. 3. Temperature: (-10) ~ 60℃		
Power System	1. PV: P_{max}=330mW, with embedded MPPT power manage system. 2. Battery capacity: 3.7V / 1,800mAh Li-ion rechargeable battery. 3. Battery health control: system off when $V_{bat} \leqq 3.0V$, and restart at 3.6V. 4. Remarkable battery lifetime with PV energy harvester. The daily power is ~1,100mWh (3.7V/297mAh) in a sunny, which can support the tracker for 2 days, and available for 12 days without sun irradiation.		
Optional	1. Motion alarm. 2. Smaller size for a longer logging interval.		
app	1. Available for iOS & Android. 2. Battery level monitoring.		

Solar Powered GNSS tracker with Cat. M communication and AGPS support.

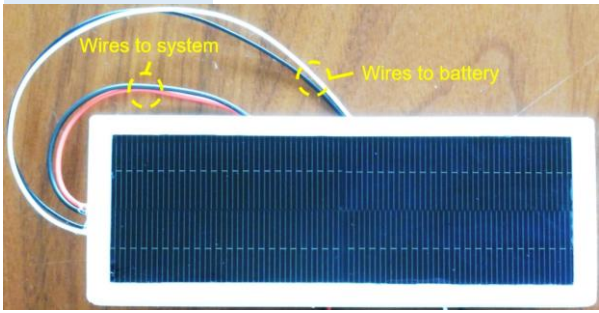
Micro-EH Test Kit

Quick Evaluation of Your Applications

Micro-EH 330



Micro-EH 880



Model Name	Micro-EH 330	Micro-EH 880
Size (LxWxH)	58x48x12 mm	130x48x12 mm
PV	P_{max} = 330mW V_{oc}=2.6V and I_{sc}= 169mA	P_{max} = 880mW V_{oc}=2.6V and I_{sc}= 450mA
Electrical Specifications	Embedded MPPT charger for single rechargeable battery with adjustable charging voltage. (Standard = 4.2V) Output Voltage: Standard - V_{bat} ; Optional – 5V (max. 1A) Battery level control: Output off @ V_{bat}=3.0V, and restart @ V_{bat}=3.6V. Connector: Molex/JST 1.25mm pitch	
Daily Power	**Outdoor**[a] Sunny: 1,100 mWh (3.7V / 297mAh) Cloudy : 105 mWh (3.7V / 28 mAh) **Indoor**[b] 8hrs under 800 lux T5 lamp : 1.9mWh (3.7V / 0.5mAh)	**Outdoor**[a] Sunny :2,850 mWh (3.7V / 770mAh) Cloudy : 280 mWh (3.7V / 28 mAh) **Indoor**[b] 8hrs under 800 lux T5 lamp : 4.9mWh (3.7V / 1.3mAh)

a : The sun intensity of a Sunny day is 1,000W/m^2, a Cloudy day is around 100W/m^2.
b : The power intensity of 800 lux artificial lamp is about 1 W/m^2.

Efficient Solutions in both Indoor & Outdoor!

Design-in Solution

Harvest Photons in 3 steps!

1. Elucidate the electric specification of your device.

Including the power consumption and operating voltage.

2. Define the Energy Harvester.

Including the working condition of you device and available size of PV.

3. Design Confirmed and Kick-off.

The prototype will be started with the confirmed drawing.

Prototype Delivered in 8 weeks!

3D Printing

Build the first prototype with Flexwave's 3D printer (ABS).

Device-integrated Solution

Thermal-cured encapsulation.

Verification

Field tests and optimize.

ODM

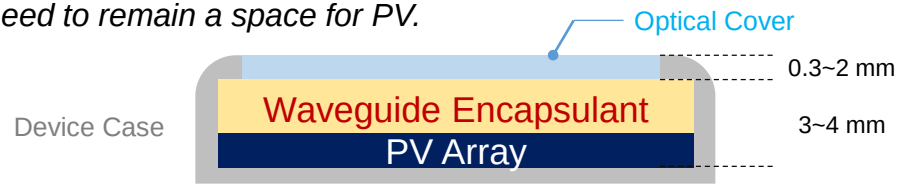
Go to mass production.

Fast-Track from 0 to 1 before mass production!

Ready Items for you

Select a set and Put in.

Just need to remain a space for PV.

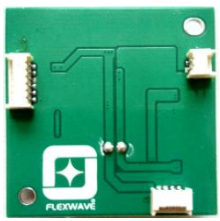


Waveguide PV Module

#	A	B	C	D	E	F	G
Array size	20x20 mm^2	39x54 mm^2	42.5x125 mm^2	62.5x117 mm^2	106x106 mm^2	122.7x 144.7 mm^2	296x296 mm^2
P_{max} @ 1 Sun	70 mW	330 mW	880 mW	1250 mW	2100 mW	3050 mW	16W

MPPT Power Manager

#	1	2	3	4	5
Model	SPUB102	SPUB103	SPUB203	SPAW302	SPUB251
Size	20x20 mm^2	20.07x20.95 mm^2	20.2x28.1 mm^2	40x40 mm^2	22x38 mm^2
PV Input Power	5μW – 500mW	15μW – 500mW		50mW – 5W	2W – 240W
MPPT Charger	Standard: 4.2V for Li-ion. Adjustable for Li-Fe, Ni-MH or supercaps.				Standard:12V. Adjustable for 4.2, 8.4, 24V
Output	Connect to battery.	• V_{bat} with max. output current of 200mA. • Battery level control: V_{bat} =3.0V off / 3.6V on.	• V_{bat}, 5/9/12V • Battery level control: V_{bat} =3.0V off / 3.6V on.	• V_{bat}, 5/9/12V • Battery level control: V_{bat} =2.8V off / 3.4V on.	Connect to battery.



Reference Design		
Operating Conditions	**Items**	**Applications**
Indoor	B1, B2, C1, C2, D1, D2, E1, E2, E3, F1, F2, F3	BLE, Sigfox, LoRa, Zigbee etc.
Window-side	A1, B1, B2, C1, C2, C3, D1, D2, D3, E2, E3, F2, F3	BLE, Sigfox, LoRa, Zigbee etc.
Outdoor	A1, B2, B3, C2, C3, C4, D2, D3, D4, E4, F4, G5	BLE, Sigfox, LoRa, Zigbee, NB-IoT, Cat M, 4G-LTE etc.

※Note※

1. The design should depend on the power consumption of system and the intensity of light.
2. The power intensity of artificial lamps will be difference due to the different spectrums even under a similar illumination.

It's Time To Decarbonize!

For More Information: www.flexwave.com.tw

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