Industrial production of high efficient ZEBRA IBC cells and modules

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Introduction of SPIC Solar

国家电投太阳能公司简介

PART 01

Introduction SPIC Group

- State Power Investment Corporation Limited (SPIC) is one of the five major power generation groups in China
- Largest solar power generation enterprise in the world
- No. 293 among the Fortune Global 500 in 2021
- SPIC has a total installed capacity of 187 GW, including 85 GW of thermal power, 24 GW of hydropower, 8 GW of nuclear power, 35 GW of solar power and 35 GW of wind power, with clean energy accounting for 58.7% of the total.

- Qinghai Huanghe Hydropower Development Co., Ltd. Xining Solar Power Branch (SPIC Solar) is a fully owned subsidiary of SPIC
- SPIC Solar has an annual production capacity of 1100 MW cells, 625MW modules and 120 million silicon wafers
- Series production of PERC, n-type TOPCon and n-type IBC solar cells
- 200 MW n-type IBC cell and module line is located in Xining city, Qinghai province, northwest China, commissioned at the end of 2019.

n-type IBC Production Xining

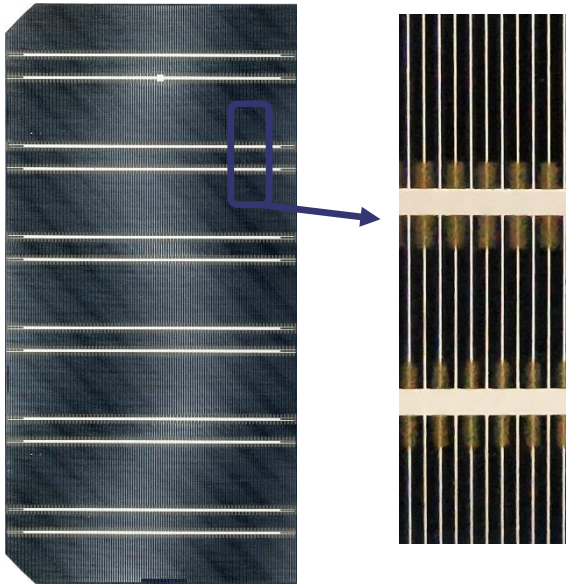
Basic of the cell and manufacturing

电池制造基础介绍

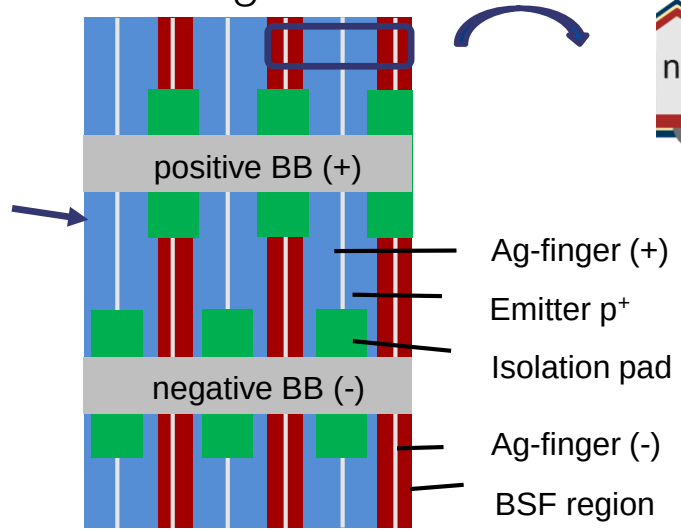
PART 02

The stripes of the ZEBRA

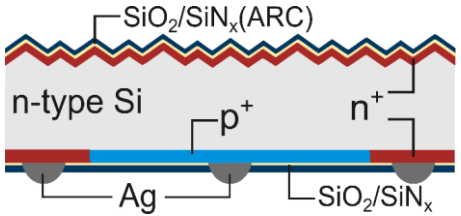
Photo of rear side



Schematic drawing



Drawing cross section



The stripes are p+ and n+ doped regions of optimum width

Lean manufacturing process

PERC process steps

- SDE and Texture
- POCl3 Diffusion
- PSG and Etching
- PECVD Rear side
- PECVD Front side
- Laser LCO
- Screen printing

Additional process steps for ZEBRA

- PECVD rear (masking)
- Alkaline SDE
- BBr3 Diffusion
- BSG etching

Only 4 additional production steps, (Laser is used in different way)

Proven equipment base

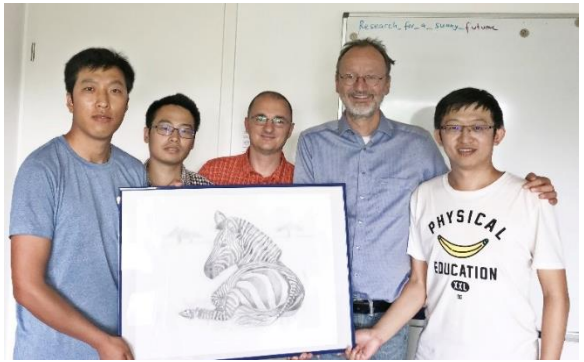
All additional steps can be performed standard equipment, proven in mass production

PECVD tubes
Diffusion furnace
Batch etching
No AlOx needed!

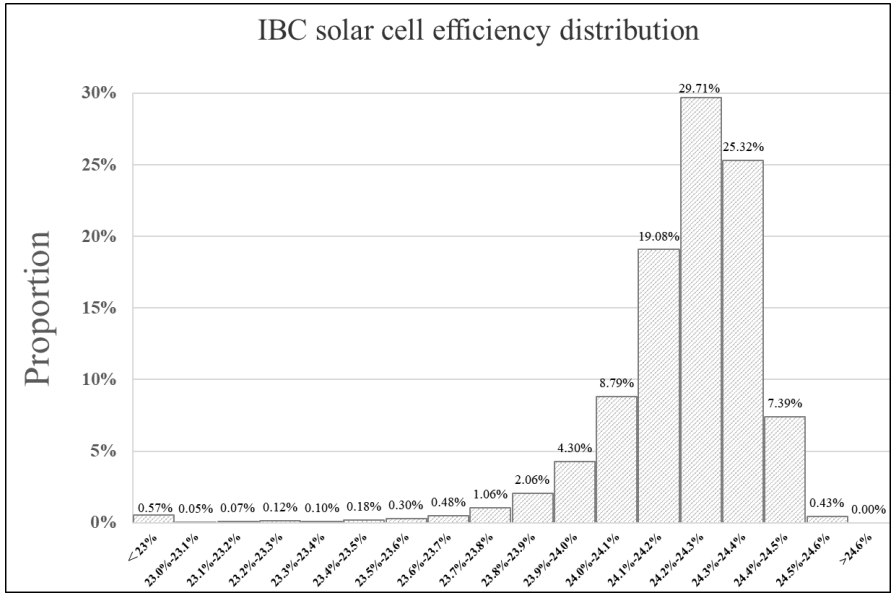
Ramp-up of ZEBRA IBC production line

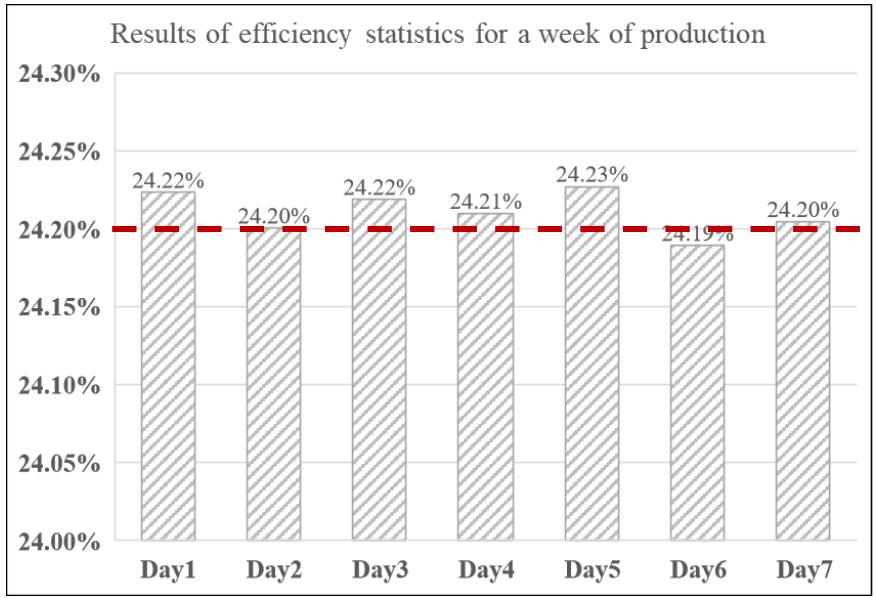
Production line for ZEBRA IBC solar cells was ramped up from Q4-2019 to Q1-2020 by a team of process experts from SPIC and ISC Konstanz

1st mass production of IBC cells in China



ZEBRA IBC in mass production





	C	Isc(A)	FF(%)	Eta(%)
average	0.700	11.83	80.15	24.21
Best cell	0.704	11.86	80.64	24.60

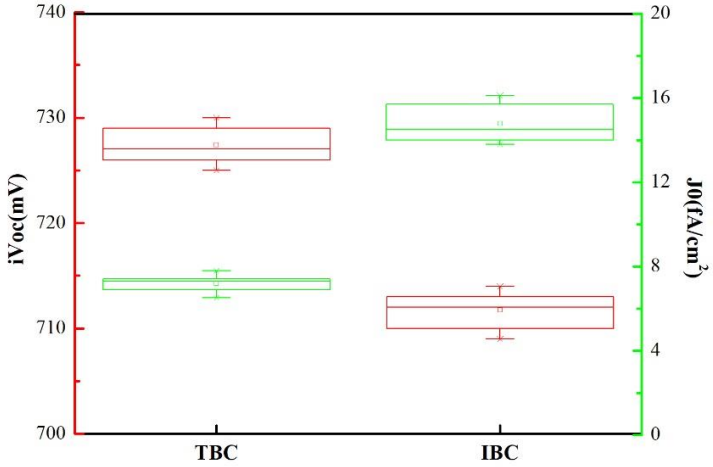
IV data for a week of production, 4/2022

TOPCon contacts + IBC cell = TBC cell

We work on the integration of passivating contacts into a cost effective process flow for mass manufacturing.

Cell precursor

Group	Anneal	Lifetime(μs)	iVoc(mV)	J0(fA/cm^2)
IBC	Y	2845	712	14.5
TBC	Y	4124	**727**	7.4



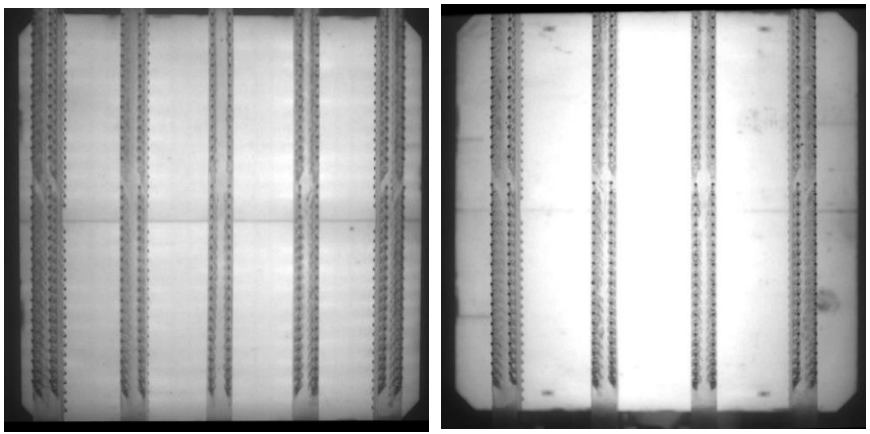
TOPCon contacts + IBC cell = TBC cell

We work on the integration of passivating contacts into a cost effective process flow for mass manufacturing.

Electrical performance (IBC vs. TBC)

Group	Eta	Isc	Voc	FF	Rs
IBC	24.21%	11.83	0.700	80.15	0.0027
TBC	**24.70%**	**11.72**	**0.719**	**80.43**	**0.0019**

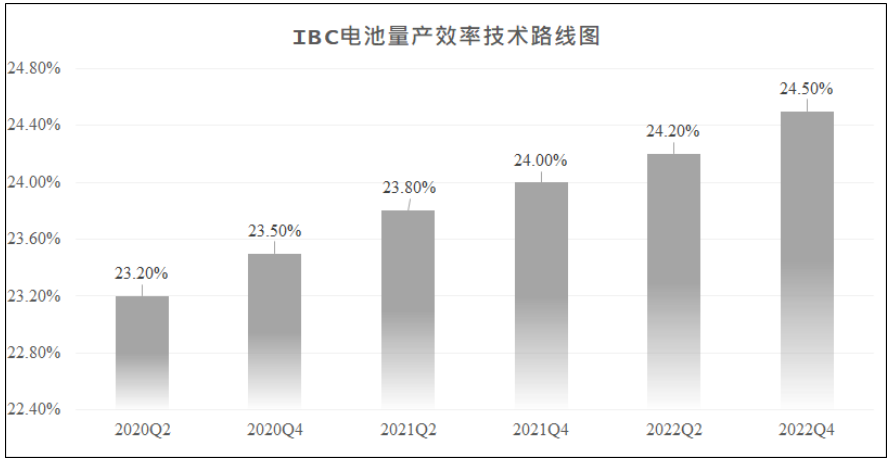
Electro luminescence

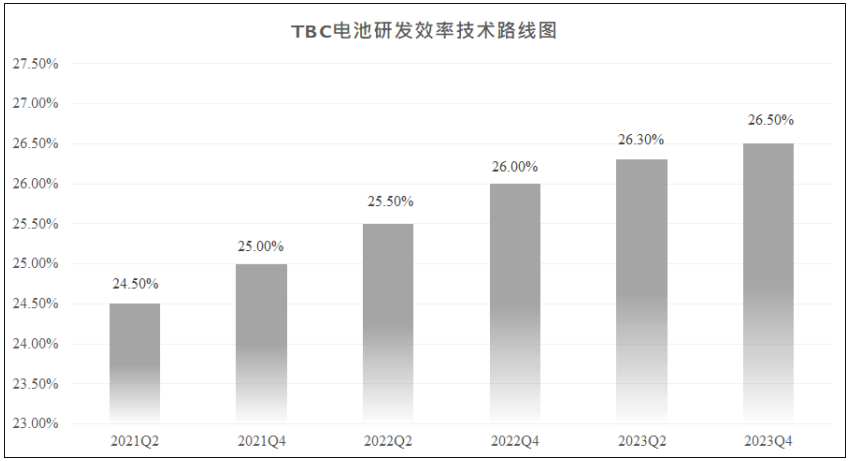


IBC **TBC**

Roadmap for cell efficiency

Improvement of IBC cell in production





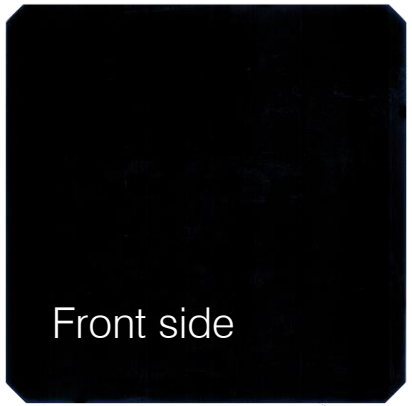
Switching to TBC cell, combining TOPCon passivating contacts and IBC technology allows to maintain steady improvement of efficiency

ZEBRA Solar Cells

ZEBRA太阳能电池

PART 03

ZEBRA IBC solar cells on M6 wafer

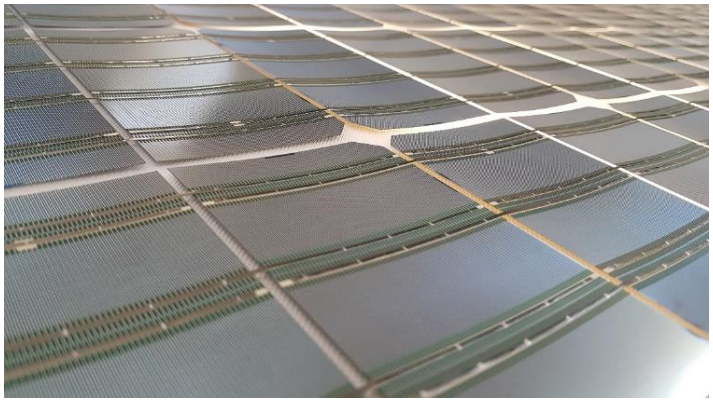


Two product versions are available

- 6 BB cells easy integration with (modified) standard equipment
- 9 BB cells with reduced consumption of metal pastes

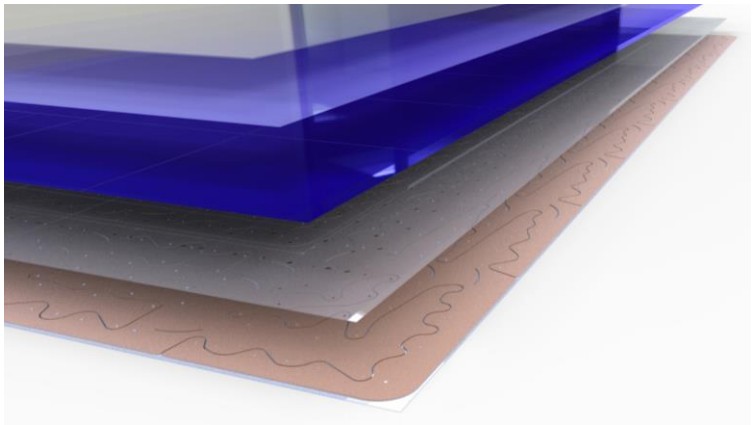
Options for Module Interconnection

Ribbon based soldering



- Standard ribbon and soldering
- Only adjustment of stringer required
- Use of half cells recommended

Conductive back sheet (CBS)



- Flexibility on module layout
- Pick-and-place process with low mechanical stress on cells

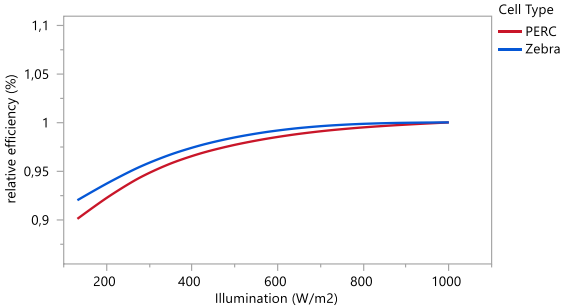
Further, processes can also be mixed:

- Ribbon in combination with adhesives or LT solder

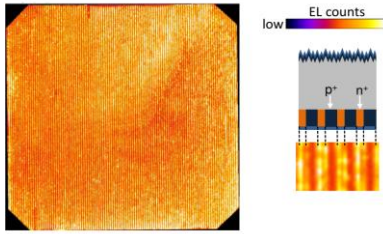
Cell features

- High conversion efficiency
- Low temperature coefficient
- Good low light performance
- Low break down voltage
- Distributed junction

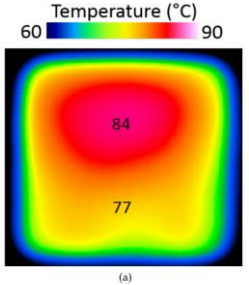
  Power is dissipate in reverse bias conditions over a larger area -> cells stay a lower temperature compared to cells with more localized breakdown -> lower risk for damaging encapsulant



Comparision of performance at low irradiation of 5 commercial ZEBRA IBC cells versus 5 commercial PERC cell from major manufacturer, ISC 2020



Reverse biased EL image (ReBEL) of cell operated at -7,7A. Magnification centre in small image



IR picture of mini module operated at -8,5A (pictures from PhD, Haifeng Chu, University Konstanz, 2019)

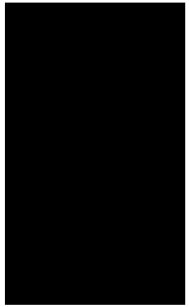
Modules

组件

PART 04

SPIC Andromeda 2.0 module series

Elegent Series **Mono/ Dual Glass Series**

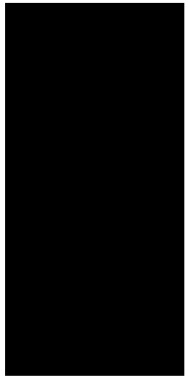


SPIC 120Half-Cell Black

- Mono-Glass :375/380/385W
- Dual-Glass:370/375/380W

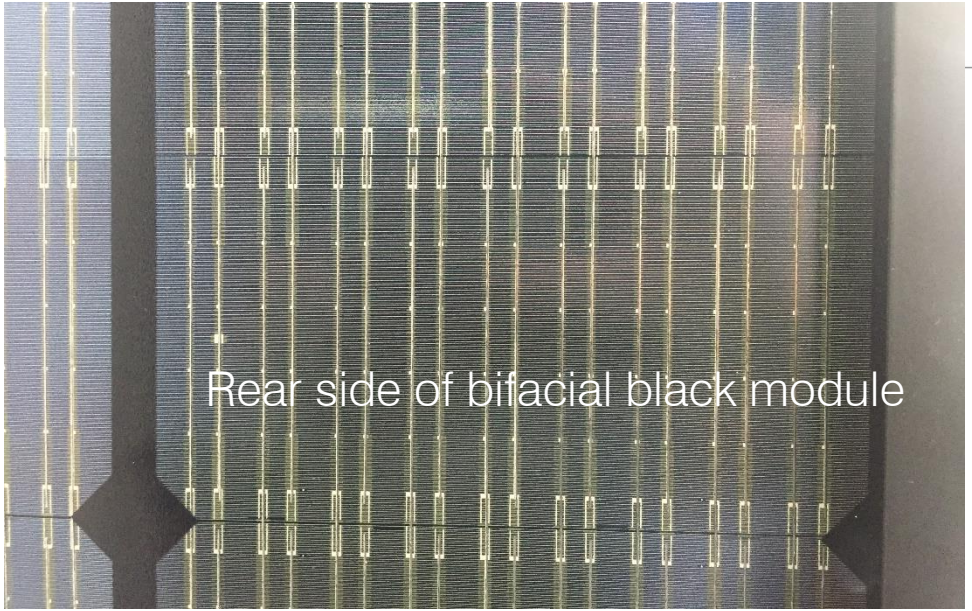
SPIC 132Haf-Cell Black

- Mono-Glass :415/420/425W
- Dual-Glass:410/415/420W



SPIC 144Half-Cell Black

- Mono-Glass :450/455/460W
- Dual-Glass:445/450/455W



- Dual Glass version is prepared for bifacial use
- Worldwide first bifacial IBC modules -> combining the best of all worlds!

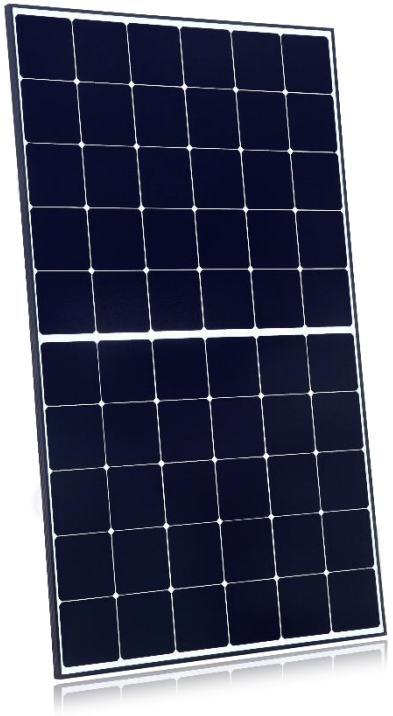
Superior Aesthetics

ANDROMEDA 2.0 385W

Elegant Series (Black)

FEATURES

- Up to 21.5% Module Efficiency
- All Black design
- IBC-No electrode to block sunlight
- N-Type cell has ZERO LID
- Excellent Temperature Coefficient
- Anti-PID
- Low mismatch loss
- Minimal power degradation (93% of initial after 25years)
- Double 25 Years Warranty



ANDROMEDA 2.0 390W

High Efficiency Series

FEATURES

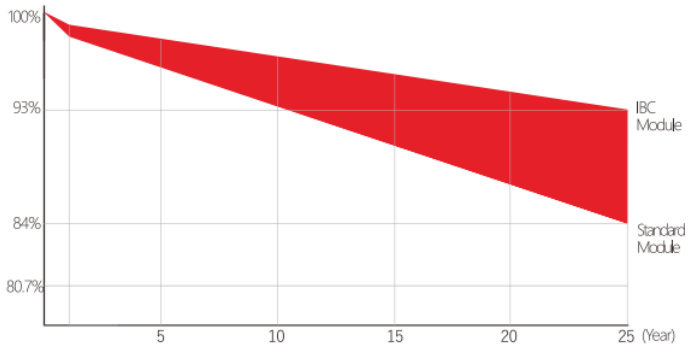
- Up to 22.0% Efficiency
- IBC-No electrode to block sunlight
- N-Type cell has ZERO LID
- Excellent Temperature Coefficient
- Anti-PID
- Low mismatch loss
- Minimal power degradation (93% of initial after 25years)
- Double 25 Years Warranty

TOP PERFORMER 2021 PVEL PV MODULE RELIABILITY SCORECARD

High Reliability and Warranty

- SPICs Andromeda modules were included in 2021 PQP test of PV-EL and achieved “Best performer” title in several categories of module reliability scorecard

- Compared to standard PERC modules a much lower degradation rate is guaranteed
  - < 1% first year degradation
  - -0.25%/a degradation 2nd – 25th year
  - > 93% power after 25 year



- SPIC give outstanding long performance warranty
  - 25 year glass-BS
  - 30 year glass-glass

New module types for special applications

ANDROMEDA
Flexible VIPV Series

32 cell - 190 W

60 cells - 360W

2.7 kg / 5.0 kg

FEATURES

- Up to 20.2% Efficiency
- Ultra Flexible and Weight reduced more than 70%
- Installation cost reduced about 50%
- IBC-No electrode to block sunlight
- N-Type cell has ZERO LID

ANDROMEDA 2.0
Dual-Glass BIPV Series

360W|365W

2 x 6mm toughened glass

FEATURES

- Excellent crack resistance
- Excellent sand and salt-mist resistance
- Noise insulation and less building
- With the IBC cell without grid line on the front, the appearance is elegant and beautiful
- Can be customized for various scenarios to meet diverse needs

Intersolar booth 2022

All module types are displayed at our booth A3.374 on Intersolar 2022

Contact:
jan.lossen@isc-konstanz.de;
miaolin@spic.com.cn

Installation examples

SPIC headquarters


Yan'an Cadre College


Daqing Base

AOK Munich


Baozhigu Conference Center

国家电投
SPIC

谢 谢

Thank you