# ASTORIOS

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## PRODUCT CATALOGUE

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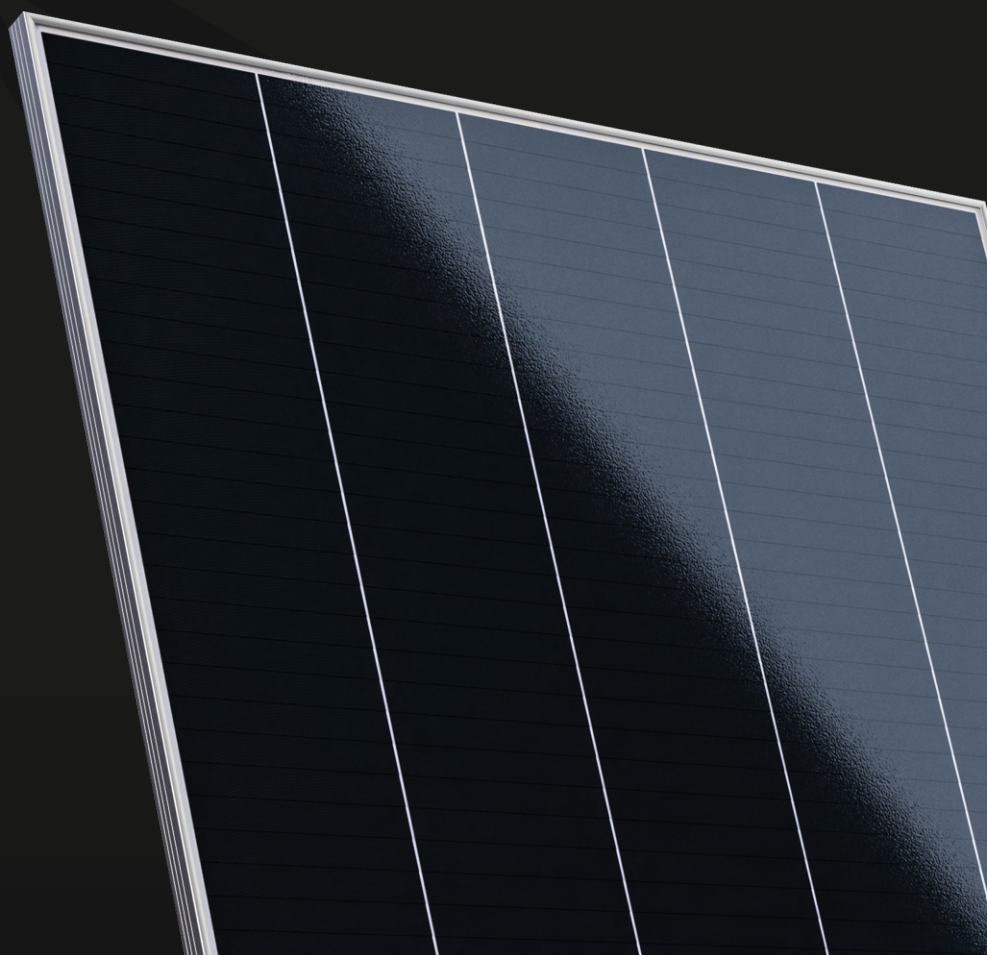


# It all starts with the right cell and ends with ASTORIOS solar panel

## Our Mission

We believe that the most meaningful progress comes from precision, collaboration, and long-term thinking. Through thoughtful use of advanced technology and careful attention to evolving global needs, we contribute to shaping a more connected and efficient energy landscape — one designed to endure. ASTORIOS – delivering future-ready solar solutions that stand the test of time.

## Our Vision

Rooted in experience and a culture of continuous improvement, we look ahead with a focus on practical innovation. Every step we take is guided by the belief that solar energy can do more — for people, for environment, and for the future it powers.

## About Us

ASTORIOS Holding Inc. operates across borders, time zones, and requirements. Headquartered in the U.S. with manufacturing and EPC branches in multiple countries, we supply solar modules and BESS for projects that don't fit into simple categories — and aren't meant to.

The catalogue is broad. The output is consistent. From rooftops to utility scale, through harsh climates and remote grids, our products are built to adapt without compromise, and to deliver without noise. Materials are selected with care, processes are fully automated by design, and each specification is engineered to precise thresholds. The result is no uncertainty in the field — and clarity at every stage.

Every component is there for a reason — selected, tested, and integrated to operate seamlessly together and at peak performance , not just exist together. The result is a product that reflects the purpose it was built for.

We work with people who seek solutions, who approach complexity with clarity, who understand that longevity is engineered, not assumed. The partners we choose, the vendors we trust, the standards we hold — none of it is accidental. Because reliability doesn't happen on its own.

What we make isn't meant to impress. It's meant to endure.

# TOPCon PV MODULES

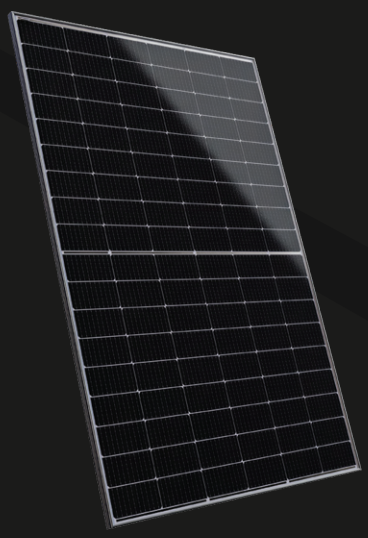
Experience the cutting-edge performance of ASTORIOS's N-Type Tunnel Oxide Passivated Contact (TOPCon) PV modules, setting new standards in efficiency, stability and effordability within the solar industry.

Our TOPCon PV modules boast a remarkable 23.14% maximum module efficiency, making them a highly competitive choice among advanced solar technologies with lower balance of system (BOS) cost, requiring less space and installation effort. TOPCon technology is an efficient choice for a variety of applications with numerous other advantages over conventional solar panel solutions.

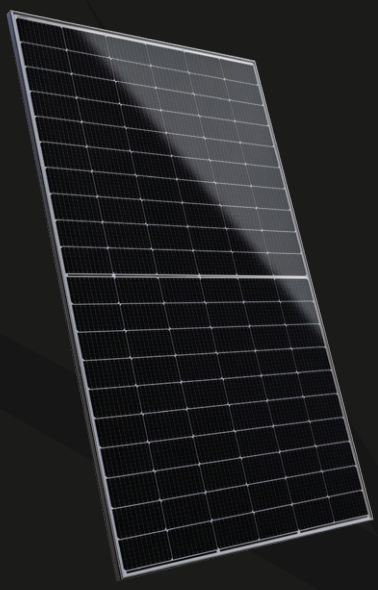
The high-performance capabilities of our N-Type TOPCon PV modules make them an attractive investment for both residential and commercial applications. They are especially well-suited for projects requiring maximum energy generation within limited space constraints.

N-Type TOPCon cells benefit from a unique layer structure that offers superior performance leading to increased efficiency, minimal power loses, and resistance to high temperature, designed to withstand extreme weather conditions, offering reliable performance even in the most challenging environments. These characteristics result in the elimination of potential-induced degradation (PID) and light-induced degradation (LID).

Exceptional longevity and durability are hallmarks of our N-Type TOPCon technology, ensuring that our modules continue to perform optimally over time, providing long-lasting performance and reliability.

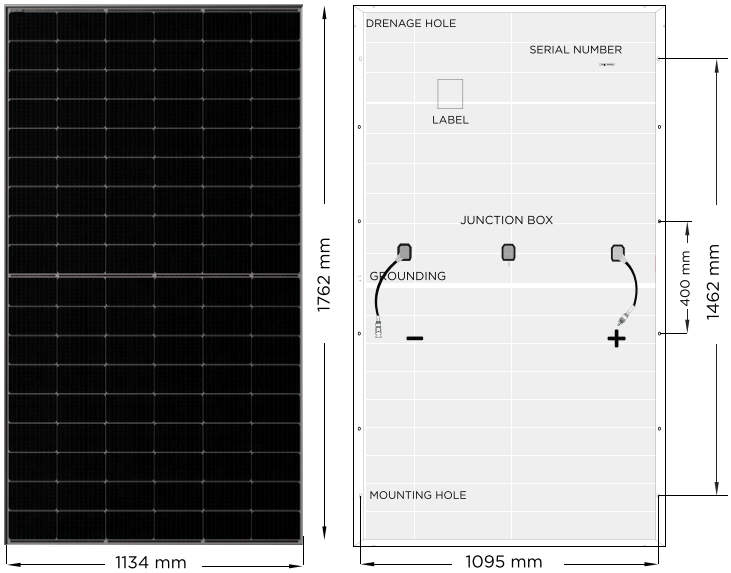


ASTR **108HCND/10** Series
**450-460 Wp**



ASTR **120HCND/10** Series
**495-505 Wp**

ASTR **144HCND/10** Series
**580-590 Wp**




# ASTORIOS

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# PHOTOVOLTAIC MODULE

**HIGH EFFICIENCY**
**TOPCON N-TYPE BIFACIAL CELLS**
ULTRA BLACK, DOUBLE GLASS

ASTR **108HCND/10** Series **445-455 Wp**

**455 Wp**
MAXIMUM POWER OUTPUT

**22.77%**
MAXIMUM MODULE EFFICIENCY

## MATERIAL CHARACTERISTICS

| | |
|---|---|
| Dimensions | 1762 × 1134 × 30 mm |
| Weight | 24.6kg |
| Number of cells | 108 pcs (6x18) |
| Glass front/rear | 2mm, High transparency, AR coated |
| Cell layout | Mono-crystalline, N-type, Bifacial (94x182.2 mm) |
| Frame | Black Color, Anodized aluminum alloy |
| Junction box | IP68 Rated, 3 bypass diodes |
| Connector type | Staubli MC4-Evo 2 / MC4 (Original) |
| Cable | 4 $mm^2$, 300 mm |

## TEMPERATURE PARAMETERS

| | |
|---|---|
| Temperature Coefficient of Pmax | -0.30 % / °C |
| Temperature Coefficient of Voc | -0.25 % / °C |
| Temperature Coefficient of Isc | +0.046 % / °C |
| Operating Temperature | - 40°C to + 85°C |
| Normal Operating Cell Temperature (NOCT) | 44±2°C |

## MAXIMUM RATINGS

| | |
|---|---|
| Max. System Voltage | 1500V DC - (H) |
| Max. Series Fuse Rating | 25A |
| Uplift load (wind) | 2400 Pa* |
| Downforce (snow) | 5400 Pa* |
| Hail Resistance | 25mm ice-ball with velocity of 23m/s |

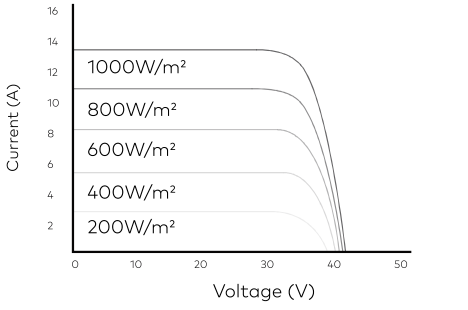
*For more information please refer to Instruction Manual

## PACKAGING INFORMATION

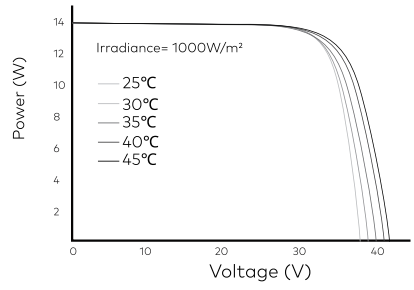
| | |
|---|---|
| One pallet quantity | 36 Pcs / 909kg / 1790x1130x1247mm |
| 40 ft HC/HQ container | 936 Pcs / 36 Pallets |

| MODULE TYPE 108HCND/10 | 445 Wp | | 450 Wp | | 455 Wp | |
|---|---|---|---|---|---|---|
| **ELECTRICAL CHARACTERISTICS** | **STC** | NMOT | **STC** | NMOT | **STC** | NMOT |
| Maximum power (Pmax/Wp) | **445** | 339 | **450** | 343 | **455** | 347 |
| Open circuit voltage (Voc / V) | **39.76** | 37.83 | **40.03** | 38.08 | **40.29** | 38.35 |
| Short circuit current (Isc / A) | **13.87** | 11.20 | **13.92** | 11.24 | **13.97** | 11.28 |
| Maximum power voltage (Vmp / V) | **33.59** | 31.39 | **33.76** | 31.59 | **33.93** | 31.76 |
| Maximum power current (Imp / A) | **13.25** | 10.80 | **13.33** | 10.86 | **13.41** | 10.93 |
| Module efficiency at STC (ηm / %) | **22.27** | | **22.52** | | **22.77** | |
| Power tolerance (Pmax) | | | **0~+3%** | | | |
| **NMOT:** Irradiance 800 W/m2, ambient temperature 20°C, wind speed 1 m/s / **STC:** Irradiance of 1000 W/m2, spectrum AM 1.5, a module temperature of 25°C | | | | | | |
| **BIFACIAL OUTPUT: BACKSIDE POWER GAIN** | **10%** | **20%** | **10%** | **20%** | **10%** | **20%** |
| Pmax (Wp) | 489.5 | 534 | 495 | 540 | 500.5 | 546 |
| Module efficiency (%) | **24.5** | **26.72** | **24.77** | **27.02** | **25.05** | **27.32** |

I-V Curve at Different Temperature (455 W)

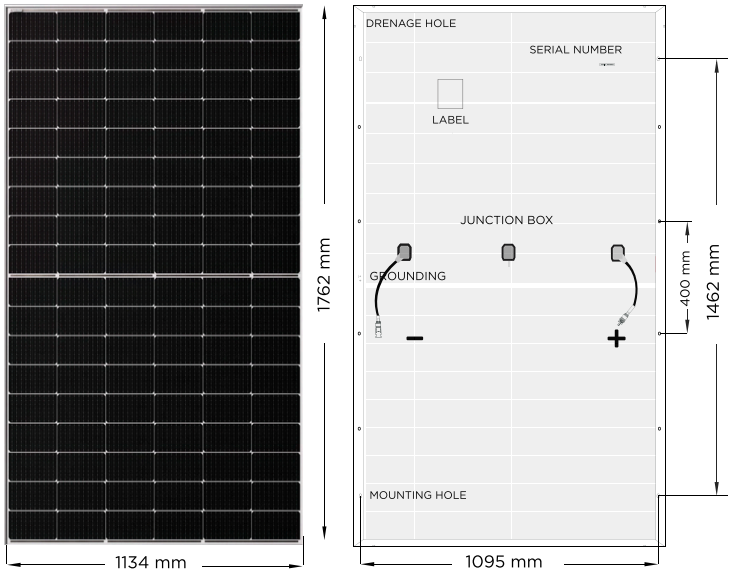



P-V Curve




**30 YEARS**
Performance Guarantee

**20 YEARS**
Product Warranty

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# PHOTOVOLTAIC MODULE

**HIGH EFFICIENCY**
**TOPCON N-TYPE BIFACIAL CELLS**
BLACK FRAME, DOUBLE GLASS

ASTR **108HCND/10** Series **445-455Wp**

**455 Wp**
MAXIMUM POWER OUTPUT

**22.77%**
MAXIMUM MODULE EFFICIENCY

## MATERIAL CHARACTERISTICS

| | |
|---|---|
| Dimensions | 1762 × 1134 × 30 mm |
| Weight | 24.6kg |
| Number of cells | 108 pcs (6x18) |
| Glass front/rear | 2mm, High transparency, AR coated |
| Cell layout | Mono-crystalline, N-type, Bifacial (94x182.2 mm) |
| Frame | Black frame, Anodized aluminum alloy |
| Junction box | IP68 Rated, 3 bypass diodes |
| Connector type | Staubli MC4-Evo 2 / MC4 (Original) |
| Cable | 4 $mm^2$, 300 mm |

## PACKAGING INFORMATION

| | |
|---|---|
| One pallet quantity | 36 Pcs / 909kg / 1790x1130x1247mm |
| 40 ft HC/HQ container | 936 Pcs / 36 Pallets |

## TEMPERATURE PARAMETERS

| | |
|---|---|
| Temperature Coefficient of Pmax | -0.30 % / °C |
| Temperature Coefficient of Voc | -0.25 % / °C |
| Temperature Coefficient of Isc | +0.046 % / °C |
| Operating Temperature | - 40°C to + 85°C |
| Normal Operating Cell Temperature (NOCT) | 44±2°C |

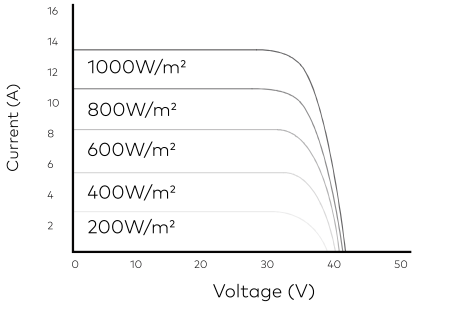
## MAXIMUM RATINGS

| | |
|---|---|
| Max. System Voltage | 1500V DC - (H) |
| Max. Series Fuse Rating | 25A |
| Uplift load (wind) | 2400 Pa* |
| Downforce (snow) | 5400 Pa* |
| Hail Resistance | 25mm ice-ball with velocity of 23m/s |

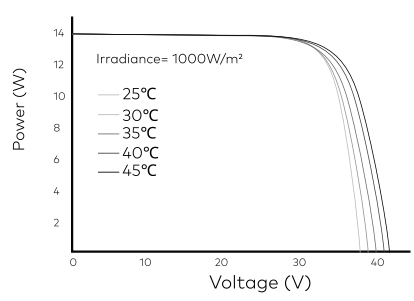
*For more information please refer to Instruction Manual

| MODULE TYPE 108HCND/10 | 445 Wp | | 450 Wp | | 455 Wp | |
|---|---|---|---|---|---|---|
| **ELECTRICAL CHARACTERISTICS** | **STC** | NMOT | **STC** | NMOT | **STC** | NMOT |
| Maximum power (Pmax/Wp) | **445** | 339 | **450** | 343 | **455** | 347 |
| Open circuit voltage (Voc / V) | **39.89** | 37.91 | **40.14** | 38.16 | **40.39** | 38.43 |
| Short circuit current (Isc / A) | **13.84** | 11.17 | **13.89** | 11.21 | **13.94** | 11.25 |
| Maximum power voltage (Vmp / V) | **33.69** | 31.48 | **33.89** | 31.68 | **34.04** | 31.85 |
| Maximum power current (Imp / A) | **13.21** | 10.77 | **13.29** | 10.83 | **13.37** | 10.90 |
| Module efficiency at STC (ηm / %) | **22.27** | | **22.52** | | **22.77** | |
| Power tolerance (Pmax) | | | **0~+3%** | | | |
| **NMOT:** Irradiance 800 W/m2, ambient temperature 20°C, wind speed 1 m/s / **STC:** Irradiance of 1000 W/m2, spectrum AM 1.5, a module temperature of 25°C | | | | | | |
| **BIFACIAL OUTPUT: BACKSIDE POWER GAIN** | **10%** | **20%** | **10%** | **20%** | **10%** | **20%** |
| Pmax (Wp) | 489.5 | 534 | 495 | 540 | 500.5 | 546 |
| Module efficiency (%) | **24.5** | **26.72** | **24.77** | **27.02** | **25.05** | **27.32** |

I-V Curve at Different Temperature (450 W)

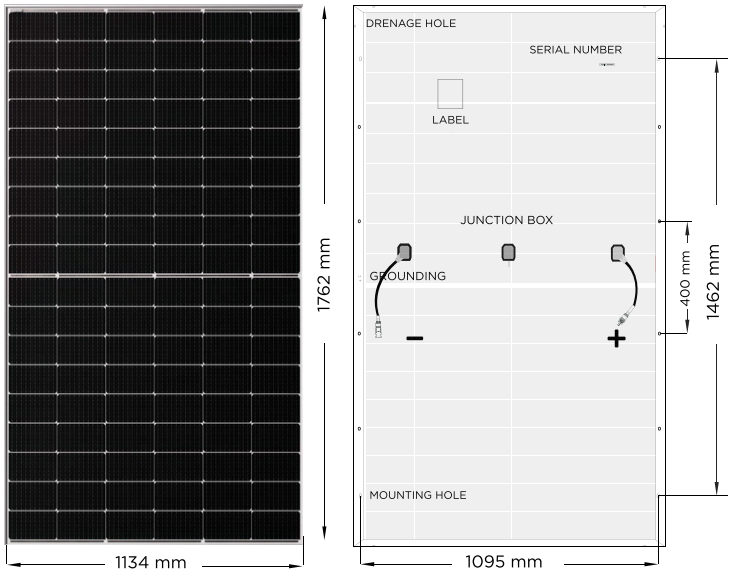



P-V Curve




**30 YEARS**
Performance Guarantee

**20 YEARS**
Product Warranty

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# PHOTOVOLTAIC MODULE

**HIGH EFFICIENCY**
**TOPCON N-TYPE BIFACIAL CELLS**
SILVER FRAME, DOUBLE GLASS

ASTR **108HCND/10** Series **450-460 Wp**

**460 Wp**
MAXIMUM POWER OUTPUT

**23.02%**
MAXIMUM MODULE EFFICIENCY

## MATERIAL CHARACTERISTICS

| | |
|---|---|
| Dimensions | 1762 × 1134 × 30 mm |
| Weight | 24.6kg |
| Number of cells | 108 pcs (6x18) |
| Glass front/rear | 2mm, High transparency, AR coated |
| Cell layout | Mono-crystalline, N-type, Bifacial (94x182.2 mm) |
| Frame | Silver Color, Anodized aluminum alloy |
| Junction box | IP68 Rated, 3 bypass diodes |
| Connector type | Staubli MC4-Evo 2 / MC4 (Original) |
| Cable | 4 $mm^2$, 300 mm |

## PACKAGING INFORMATION

| | |
|---|---|
| One pallet quantity | 36 Pcs / 909 kg / 1790x1130x1247 mm |
| 40 ft HC/HQ container | 936 Pcs / 36 Pallets |

## TEMPERATURE PARAMETERS

| | |
|---|---|
| Temperature Coefficient of Pmax | -0.30 % / °C |
| Temperature Coefficient of Voc | -0.25 % / °C |
| Temperature Coefficient of Isc | +0.046 % / °C |
| Operating Temperature | - 40°C to + 85°C |
| Normal Operating Cell Temperature (NOCT) | 44±2°C |

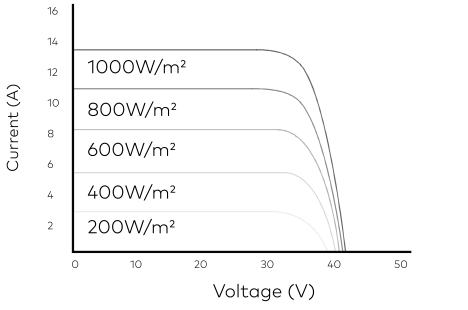
## MAXIMUM RATINGS

| | |
|---|---|
| Max. System Voltage | 1500V DC - (H) |
| Max. Series Fuse Rating | 25A |
| Uplift load (wind) | 2400 Pa* |
| Downforce (snow) | 5400 Pa* |
| Hail Resistance | 25mm ice-ball with velocity of 23m/s |

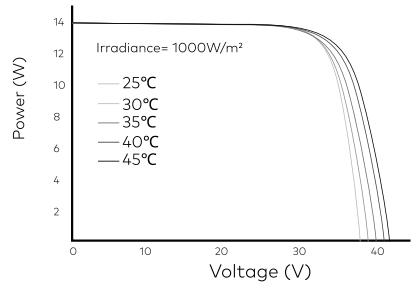
*For more information please refer to Instruction Manual

| MODULE TYPE 108HCND/10 | 450 Wp | | 455 Wp | | 460 Wp | |
|---|---|---|---|---|---|---|
| **ELECTRICAL CHARACTERISTICS** | **STC** | NMOT | **STC** | NMOT | **STC** | NMOT |
| Maximum power (Pmax/Wp) | **450** | 343 | **455** | 347 | **460** | 351 |
| Open circuit voltage (Voc / V) | **39.93** | 38.03 | **40.19** | 38.28 | **40.44** | 38.54 |
| Short circuit current (Isc / A) | **13.96** | 11.27 | **14.01** | 11.31 | **14.06** | 11.35 |
| Maximum power voltage (Vmp / V) | **33.69** | 31.51 | **33.86** | 31.69 | **34.03** | 31.87 |
| Maximum power current (Imp / A) | **13.36** | 10.89 | **13.44** | 10.95 | **13.52** | 11.02 |
| Module efficiency at STC (ηm / %) | **22.52** | | **22.77** | | **23.02** | |
| Power tolerance (Pmax) | | | **0~+3%** | | | |
| **NMOT:** Irradiance 800 W/m2, ambient temperature 20°C, wind speed 1 m/s / **STC:** Irradiance of 1000 W/m2, spectrum AM 1.5, a module temperature of 25°C | | | | | | |
| **BIFACIAL OUTPUT: BACKSIDE POWER GAIN** | **10%** | **20%** | **10%** | **20%** | **10%** | **20%** |
| Pmax (Wp) | 495 | 540 | 500.5 | 546 | 506 | 552 |
| Module efficiency (%) | **24.77** | **27.02** | **25.05** | **27.32** | **25.32** | **27.62** |

I-V Curve at Different Temperature (455 W)

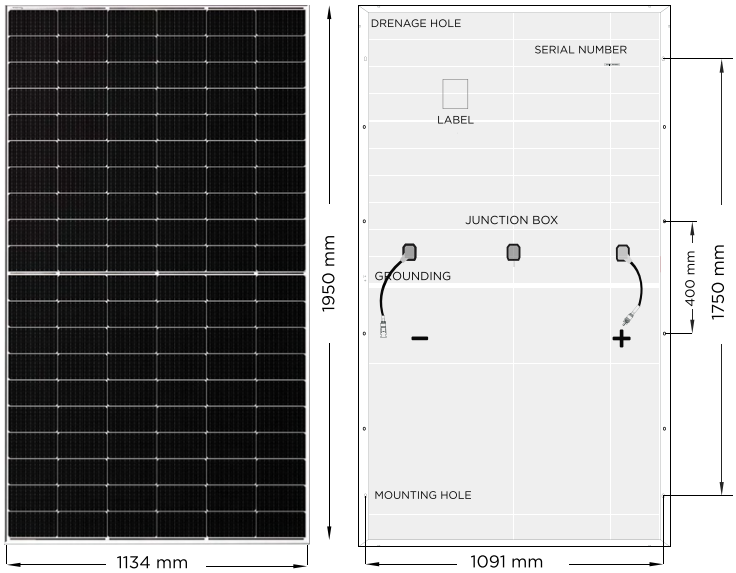



P-V Curve




**30 YEARS**
Performance Guarantee

**20 YEARS**
Product Warranty

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# PHOTOVOLTAIC MODULE

**HIGH EFFICIENCY**
**TOPCON N-TYPE BIFACIAL CELLS**
SILVER FRAME, DOUBLE GLASS

ASTR **120HCND/10** Series **495-505 Wp**

**505 Wp**
MAXIMUM POWER OUTPUT

**22.83%**
MAXIMUM MODULE EFFICIENCY

## MATERIAL CHARACTERISTICS

| | |
|---|---|
| Dimensions | 1950 × 1134 × 30 mm |
| Weight | 27 kg |
| Number of cells | 120 pcs (6x20) |
| Glass front/rear | 2mm, High transparency, AR coated |
| Cell layout | Bifacial, Half Cut N-Type (94x182 mm) |
| Frame | Silver frame, anodized aluminum alloy |
| Junction box | IP68 Rated, 3 bypass diodes |
| Connector type | Staubli MC4-Evo 2 / MC4 (Original) |
| Cable | 4 $mm^2$, 300 mm |

## PACKAGING INFORMATION

| | |
|---|---|
| One pallet quantity | 36 Pcs / 1010kg / 1985x1120x1247mm |
| 40 ft HC/HQ container | 864 Pcs / 36 Pallets |

## TEMPERATURE PARAMETERS

| | |
|---|---|
| Temperature Coefficient of Pmax | -0.30 % / °C |
| Temperature Coefficient of Voc | -0.25 % / °C |
| Temperature Coefficient of Isc | +0.046 % / °C |
| Operating Temperature | - 40°C to + 85°C |
| Normal Operating Cell Temperature (NOCT) | 44±2°C |

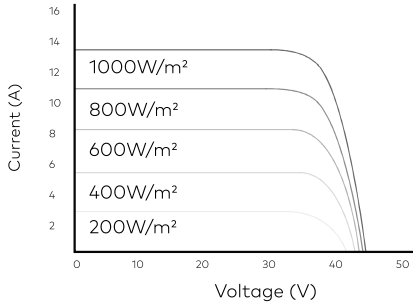
## MAXIMUM RATINGS

| | |
|---|---|
| Max. System Voltage | 1500V |
| Max. Series Fuse Rating | 25A |
| Uplift load (wind) | 2400 Pa* |
| Downforce (snow) | 5400 Pa* |
| Hail Resistance | 25mm ice-ball with velocity of 23m/s |

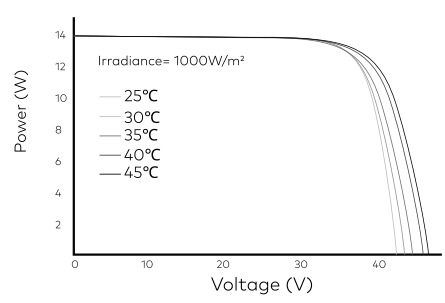
*For more information please refer to Instruction Manual

| MODULE TYPE 120HCND/10 | 495 Wp | | 500 Wp | | 505 Wp | |
|---|---|---|---|---|---|---|
| **ELECTRICAL CHARACTERISTICS** | **STC** | NMOT | **STC** | NMOT | **STC** | NMOT |
| Maximum power (Pmax/Wp) | **495** | 378 | **500** | 382 | **505** | 385 |
| Open circuit voltage (Voc / V) | **44.42** | 42.30 | **44.62** | 42.56 | **44.82** | 42.87 |
| Short circuit current (Isc / A) | **13.87** | 11.20 | **13.93** | 11.24 | **13.99** | 11.29 |
| Maximum power voltage (Vmp / V) | **36.97** | 34.65 | **37.18** | 34.86 | **37.38** | 34.98 |
| Maximum power current (Imp / A) | **13.39** | 10.91 | **13.45** | 10.96 | **13.51** | 11.01 |
| Module efficiency at STC (ηm / %) | **22.38** | | **22.61** | | **22.83** | |
| Power tolerance (Pmax) | | | **0~+3%** | | | |
| **NMOT:** Irradiance 800 W/m2, ambient temperature 20°C, wind speed 1 m/s / **STC:** Irradiance of 1000 W/m2, spectrum AM 1.5, a module temperature of 25°C | | | | | | |
| **BIFACIAL OUTPUT: BACKSIDE POWER GAIN** | **10%** | **20%** | **10%** | **20%** | **10%** | **20%** |
| Pmax (Wp) | 544.5 | 594 | 550 | 600 | 555.5 | 606 |
| Module efficiency (%) | **24.62** | **26.86** | **24.87** | **27.13** | **25.12** | **27.40** |

I-V Curve at Different Temperature (500 W)

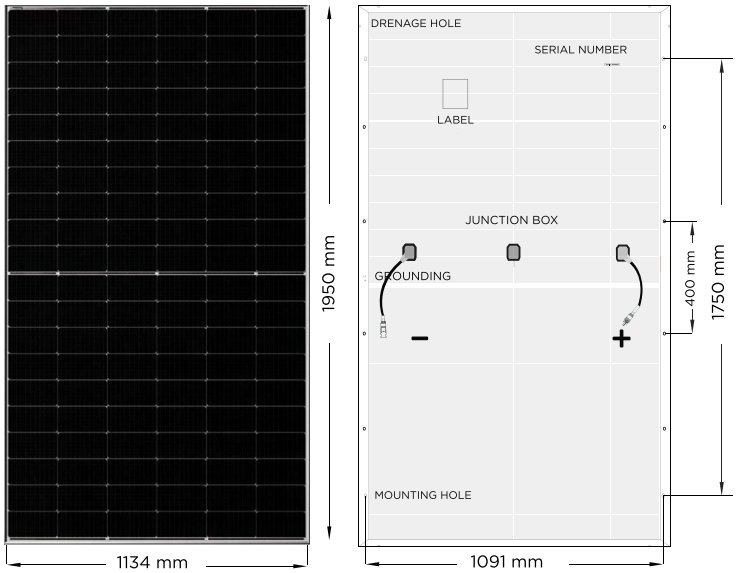



P-V Curve




**30 YEARS**
Performance Guarantee

**20 YEARS**
Product Warranty

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# PHOTOVOLTAIC MODULE

**HIGH EFFICIENCY**
**TOPCON N-TYPE BIFACIAL CELLS**
ULTRA BLACK, DOUBLE GLASS

ASTR **120HCND/10** Series **490-500 Wp**

**500 Wp**
MAXIMUM POWER OUTPUT

**22.61%**
MAXIMUM MODULE EFFICIENCY

## MATERIAL CHARACTERISTICS

| | |
|---|---|
| Dimensions | 1950 × 1134 × 30 mm |
| Weight | 27 kg |
| Number of cells | 120 pcs (6x20) |
| Glass front/rear | 2mm, High transparency, AR coated |
| Cell layout | Bifacial, Half Cut N-Type (94x182 mm) |
| Frame | Black frame, anodized aluminum alloy |
| Junction box | IP68 Rated, 3 bypass diodes |
| Connector type | Staubli MC4-Evo 2 / MC4 (Original) |
| Cable | 4 $mm^2$, 300 mm |

## PACKAGING INFORMATION

| | |
|---|---|
| One pallet quantity | 36 Pcs / 1010kg / 1985x1120x1247mm |
| 40 ft HC/HQ container | 864 Pcs / 36 Pallets |

## TEMPERATURE PARAMETERS

| | |
|---|---|
| Temperature Coefficient of Pmax | -0.30 % / °C |
| Temperature Coefficient of Voc | -0.25 % / °C |
| Temperature Coefficient of Isc | +0.046 % / °C |
| Operating Temperature | - 40°C to + 85°C |
| Normal Operating Cell Temperature (NOCT) | 44±2°C |

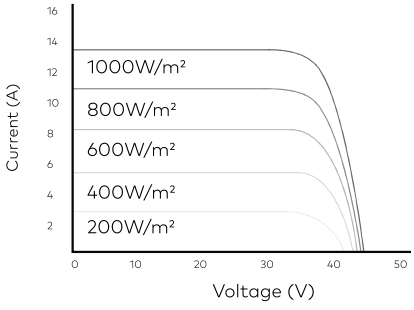
## MAXIMUM RATINGS

| | |
|---|---|
| Max. System Voltage | 1500V |
| Max. Series Fuse Rating | 25A |
| Uplift load (wind) | 2400 Pa* |
| Downforce (snow) | 5400 Pa* |
| Hail Resistance | 25mm ice-ball with velocity of 23m/s |

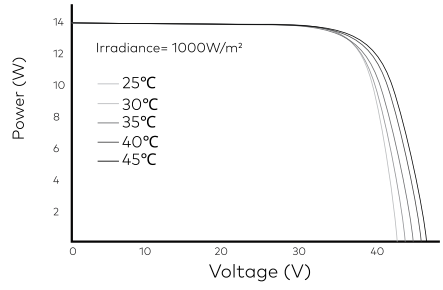
*For more information please refer to Instruction Manual

| MODULE TYPE 120HCND/10 | 490 Wp | | 495 Wp | | 500 Wp | |
|---|---|---|---|---|---|---|
| **ELECTRICAL CHARACTERISTICS** | **STC** | NMOT | **STC** | NMOT | **STC** | NMOT |
| Maximum power (Pmax/Wp) | **490** | 374 | **495** | 378 | **500** | 382 |
| Open circuit voltage (Voc / V) | **44.29** | 42.27 | **44.54** | 42.51 | **44.78** | 42.75 |
| Short circuit current (Isc / A) | **13.80** | 11.14 | **13.85** | 11.18 | **13.90** | 11.22 |
| Maximum power voltage (Vmp / V) | **36.80** | 34.36 | **37.03** | 34.60 | **37.21** | 34.77 |
| Maximum power current (Imp / A) | **13.32** | 10.86 | **13.37** | 10.90 | **13.44** | 10.96 |
| Module efficiency at STC (ηm / %) | **22.16** | | **22.38** | | **22.61** | |
| Power tolerance (Pmax) | | | **0~+3%** | | | |
| **NMOT:** Irradiance 800 W/m2, ambient temperature 20°C, wind speed 1 m/s / **STC:** Irradiance of 1000 W/m2, spectrum AM 1.5, a module temperature of 25°C | | | | | | |
| **BIFACIAL OUTPUT: BACKSIDE POWER GAIN** | **10%** | **20%** | **10%** | **20%** | **10%** | **20%** |
| Pmax (Wp) | 539 | 588 | 544.5 | 594 | 550 | 600 |
| Module efficiency (%) | **24.37** | **26.59** | **24.62** | **26.86** | **24.87** | **27.13** |

I-V Curve at Different Temperature (495 W)

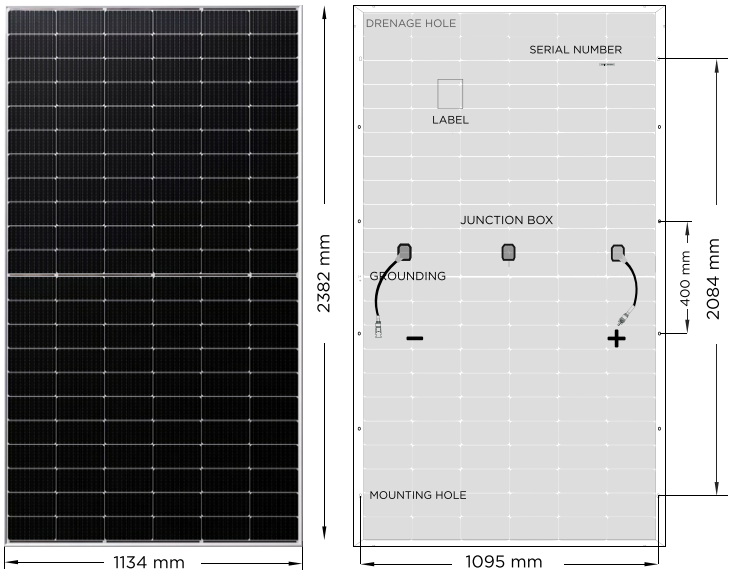



P-V Curve




**30 YEARS**
Performance Guarantee

**20 YEARS**
Product Warranty

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# PHOTOVOLTAIC MODULE

**HIGH EFFICIENCY**
**TOPCON N-TYPE BIFACIAL CELLS**
SILVER FRAME, DOUBLE GLASS

ASTR **132HCND/10** Series **615-625 Wp**

**625 Wp**
MAXIMUM POWER OUTPUT

**23.14%**
MAXIMUM MODULE EFFICIENCY

## MATERIAL CHARACTERISTICS

| | |
|---|---|
| Dimensions | 2382 × 1134 × 30 mm |
| Weight | 33.6kg |
| Number of cells | 132 pcs (6x22) |
| Glass | 2mm, High transparency, AR coated |
| Cell layout | Bifacial, Half Cut N-Type (105x182 mm) |
| Frame | Silver frame, anodized aluminum alloy |
| Junction box | IP68 Rated, 3 bypass diodes |
| Connector type | Staubli MC4-Evo 2 / MC4 (Original) |
| Cable | 4 $mm^2$, 300 mm |

## TEMPERATURE PARAMETERS

| | |
|---|---|
| Temperature Coefficient of Pmax | -0.30 % / °C |
| Temperature Coefficient of Voc | -0.25 % / °C |
| Temperature Coefficient of Isc | +0.046 % / °C |
| Operating Temperature | - 40°C to + 85°C |
| Normal Operating Cell Temperature (NOCT) | 44±2°C |

## MAXIMUM RATINGS

| | |
|---|---|
| Max. System Voltage | 1500V DC - (H) |
| Max. Series Fuse Rating | 30A |
| Uplift load (wind) | 2400 Pa* |
| Downforce (snow) | 5400 Pa* |
| Hail Resistance | 25mm ice-ball with velocity of 23m/s |

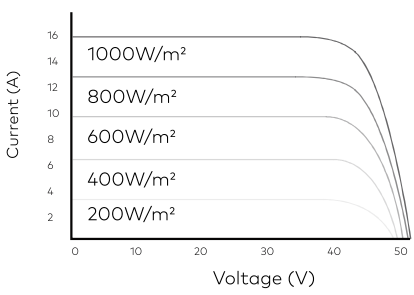
*For more information please refer to Instruction Manual

## PACKAGING INFORMATION

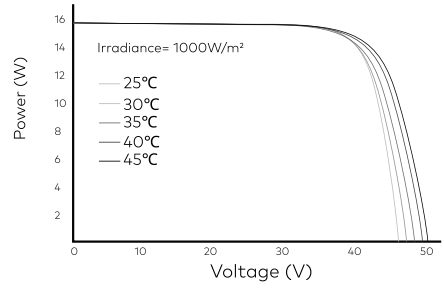
| | |
|---|---|
| One pallet quantity | 36 Pcs / 1228kg / 1160x1130x2535mm |
| 40 ft HC/HQ container | 720 Pcs / 36 Pallets |

| MODULE TYPE 132HCND/10 | 615 Wp | | 620 Wp | | 625 Wp | |
|---|---|---|---|---|---|---|
| **ELECTRICAL CHARACTERISTICS** | **STC** | NMOT | **STC** | NMOT | **STC** | NMOT |
| Maximum power (Pmax/Wp) | **615** | 469 | **620** | 472 | **625** | 476 |
| Open circuit voltage (Voc / V) | **48.90** | 46.49 | **49.10** | 46.70 | **49.30** | 47.09 |
| Short circuit current (Isc / A) | **15.93** | 12.84 | **15.95** | 12.86 | **15.97** | 12.88 |
| Maximum power voltage (Vmp / V) | **41.12** | 38.52 | **41.32** | 38.64 | **41.52** | 38.84 |
| Maximum power current (Imp / A) | **14.97** | 12.18 | **15.02** | 12.22 | **15.07** | 12.26 |
| Module efficiency at STC (ηm / %) | **22.77** | | **22.95** | | **23.14** | |
| Power tolerance (Pmax) | | | **0~+3%** | | | |
| **NMOT:** Irradiance 800 W/m2, ambient temperature 20°C, wind speed 1 m/s / **STC:** Irradiance of 1000 W/m2, spectrum AM 1.5, a module temperature of 25°C | | | | | | |
| **BIFACIAL OUTPUT: BACKSIDE POWER GAIN** | **10%** | **20%** | **10%** | **20%** | **10%** | **20%** |
| Pmax (Wp) | 676.5 | 738 | 682 | 744 | 687.5 | 750 |
| Module efficiency (%) | **25.04** | **27.32** | **25.25** | **27.54** | **25.45** | **27.76** |

I-V Curve at Different Temperature (620 W)

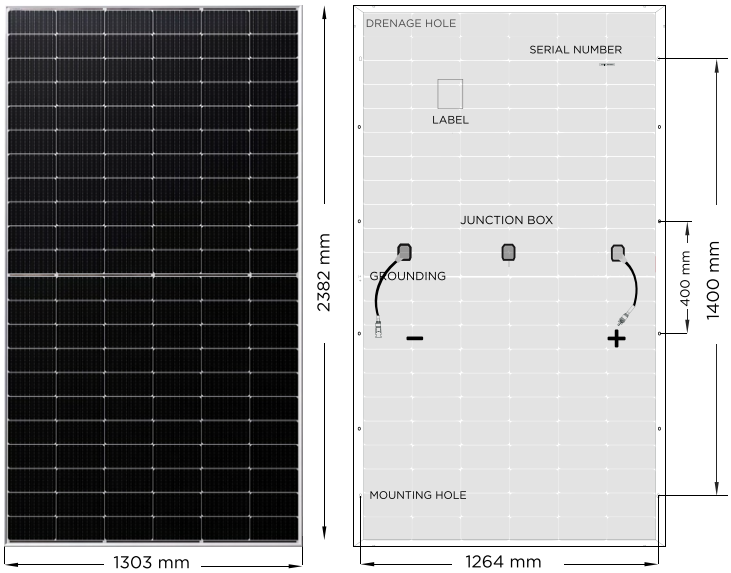



P-V Curve




**30 YEARS**
Performance Guarantee

**20 YEARS**
Product Warranty

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# PHOTOVOLTAIC MODULE

**HIGH EFFICIENCY**
**TOPCON N-TYPE BIFACIAL CELLS**
SILVER FRAME, DOUBLE GLASS

ASTR **132HCND/12** Series **700-710 Wp**

**710 Wp**
MAXIMUM POWER OUTPUT

**22.85%**
MAXIMUM MODULE EFFICIENCY

## MATERIAL CHARACTERISTICS

| | |
|---|---|
| Dimensions | 2384 × 1303 × 33 mm |
| Weight | 38kg |
| Number of cells | 132 pcs (6x22) |
| Glass front/back | 2mm, High transparency, AR coated |
| Cell layout | Bifacial, Half Cut N-Type (105x210 mm) |
| Frame | Silver frame, anodized aluminum alloy |
| Junction box | IP68 Rated, 3 bypass diodes |
| Connector type | Staubli MC4-Evo 2 / MC4 (Original) |
| Cable | 4 $mm^2$, 300 mm |

## PACKAGING INFORMATION

| | |
|---|---|
| One pallet quantity | 33 Pcs / 1272kg / 1330x1130x2535mm |
| 40 ft HC/HQ container | 594 Pcs / 33 Pallets |

## TEMPERATURE PARAMETERS

| | |
|---|---|
| Temperature Coefficient of Pmax | -0.30 % / °C |
| Temperature Coefficient of Voc | -0.25 % / °C |
| Temperature Coefficient of Isc | +0.004 % / °C |
| Operating Temperature | - 40°C to + 85°C |
| Normal Operating Cell Temperature (NOCT) | 44±2°C |

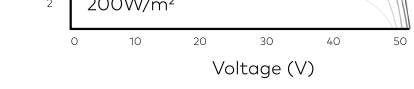
## MAXIMUM RATINGS

| | |
|---|---|
| Max. System Voltage | 1500V DC - (H) |
| Max. Series Fuse Rating | 30A |
| Uplift load (wind) | 2400 Pa* |
| Downforce (snow) | 5400 Pa* |
| Hail Resistance | 25mm ice-ball with velocity of 23m/s |

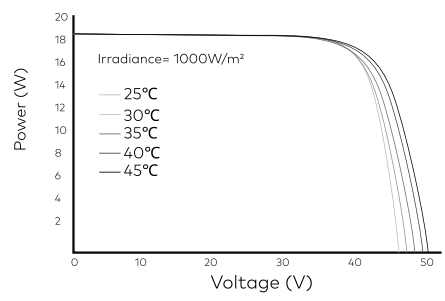
*For more information please refer to Instruction Manual

| MODULE TYPE 132HCND/12 | 700 Wp | | 705 Wp | | 710 Wp | |
|---|---|---|---|---|---|---|
| **ELECTRICAL CHARACTERISTICS** | **STC** | NMOT | **STC** | NMOT | **STC** | NMOT |
| Maximum power (Pmax/Wp) | **700** | 533 | **705** | 537 | **710** | 541 |
| Open circuit voltage (Voc / V) | **48.04** | 45.74 | **48.22** | 45.93 | **48.40** | 46.20 |
| Short circuit current (Isc / A) | **18.42** | 14.84 | **18.47** | 14.88 | **18.52** | 14.92 |
| Maximum power voltage (Vmp / V) | **40.45** | 37.95 | **40.65** | 38.14 | **40.85** | 38.34 |
| Maximum power current (Imp / A) | **17.31** | 14.05 | **17.35** | 14.08 | **17.39** | 14.11 |
| Module efficiency at STC (ηm / %) | **22.53** | | **22.69** | | **22.85** | |
| Power tolerance (Pmax) | | | **0~+3%** | | | |
| **NMOT:** Irradiance 800 W/m2, ambient temperature 20°C, wind speed 1 m/s / **STC:** Irradiance of 1000 W/m2, spectrum AM 1.5, a module temperature of 25°C | | | | | | |
| **BIFACIAL OUTPUT: BACKSIDE POWER GAIN** | **10%** | **20%** | **10%** | **20%** | **10%** | **20%** |
| Pmax (Wp) | 770 | 840 | 775.5 | 846 | 781 | 852 |
| Module efficiency (%) | **24.79** | **27.04** | **24.96** | **27.23** | **25.14** | **27.43** |

I-V Curve at Different Temperature (705 W)

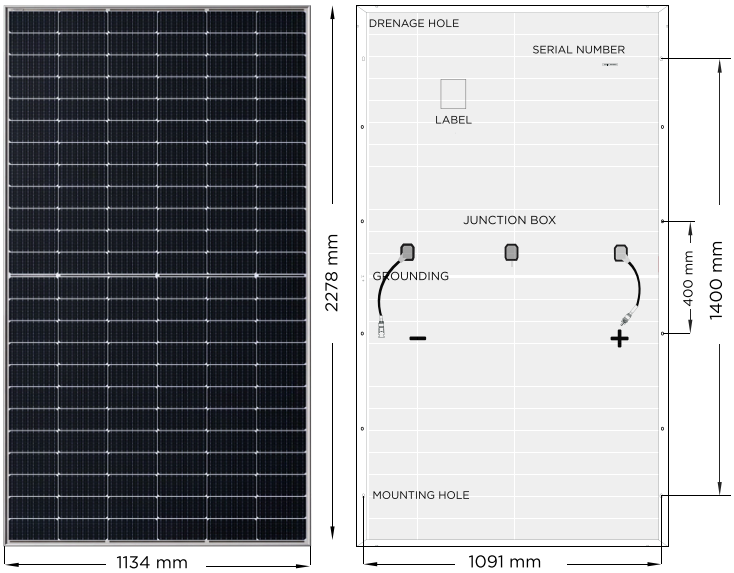



P-V Curve




**30 YEARS**
Performance Guarantee

**20 YEARS**
Product Warranty

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# PHOTOVOLTAIC MODULE

**HIGH EFFICIENCY**
**TOPCON N-TYPE BIFACIAL CELLS**
SILVER FRAME, DOUBLE GLASS

ASTR **144HCND/10** Series **580-590 Wp**

**590 Wp**
MAXIMUM POWER OUTPUT

**22.84%**
MAXIMUM MODULE EFFICIENCY

## MATERIAL CHARACTERISTICS

| | |
|---|---|
| Dimensions | 2278 × 1134 × 30 mm |
| Weight | 31kg |
| Number of cells | 144 pcs (6x24) |
| Glass front/rear | 2mm, High transparency, AR coated |
| Cell layout | Half Cut N-Type, Bifacial (91x182 mm) |
| Frame | Silver frame, anodized aluminum alloy |
| Junction box | IP68 Rated, 3 bypass diodes |
| Connector type | Staubli MC4-Evo 2 / MC4 (Original) |
| Cable | 4 $mm^2$, 300 mm |

## PACKAGING INFORMATION

| | |
|---|---|
| One pallet quantity | 36 Pcs / 1147kg / 2310x1120x1247mm |
| 40 ft HC/HQ container | 720 Pcs / 36 Pallets |

## TEMPERATURE PARAMETERS

| | |
|---|---|
| Temperature Coefficient of Pmax | -0.30 % / °C |
| Temperature Coefficient of Voc | -0.25 % / °C |
| Temperature Coefficient of Isc | +0.046 % / °C |
| Operating Temperature | - 40°C to + 85°C |
| Normal Operating Cell Temperature (NOCT) | 44±2°C |

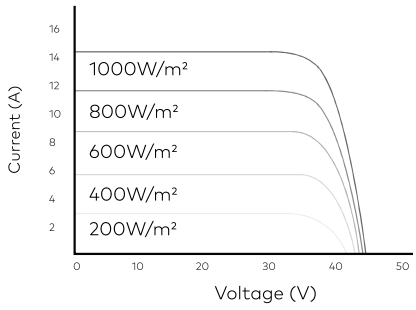
## MAXIMUM RATINGS

| | |
|---|---|
| Max. System Voltage | 1500V |
| Max. Series Fuse Rating | 25A |
| Uplift load (wind) | 2400 Pa* |
| Downforce (snow) | 5400 Pa* |
| Hail Resistance | 25mm ice-ball with velocity of 23m/s |

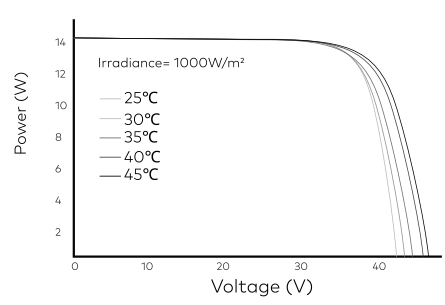
*For more information please refer to Instruction Manual

| MODULE TYPE 144HCND/10 | 580 Wp | | 585 Wp | | 590 Wp | |
|---|---|---|---|---|---|---|
| **ELECTRICAL CHARACTERISTICS** | **STC** | NMOT | **STC** | NMOT | **STC** | NMOT |
| Maximum power (Pmax/Wp) | **580** | 442 | **585** | 446 | **590** | 450 |
| Open circuit voltage (Voc / V) | **51.46** | 48.67 | **51.66** | 48.80 | **51.86** | 49.00 |
| Short circuit current (Isc / A) | **14.36** | 11.59 | **14.42** | 11.64 | **14.48** | 11.68 |
| Maximum power voltage (Vmp / V) | **42.84** | 40.07 | **43.05** | 40.29 | **43.26** | 40.50 |
| Maximum power current (Imp / A) | **13.54** | 11.03 | **13.59** | 11.07 | **13.64** | 11.11 |
| Module efficiency at STC (ηm / %) | **22.45** | | **22.64** | | **22.84** | |
| Power tolerance (Pmax) | | | **0~+3%** | | | |
| **NMOT:** Irradiance 800 W/m2, ambient temperature 20°C, wind speed 1 m/s / **STC:** Irradiance of 1000 W/m2, spectrum AM 1.5, a module temperature of 25°C | | | | | | |
| **BIFACIAL OUTPUT: BACKSIDE POWER GAIN** | **10%** | **20%** | **10%** | **20%** | **10%** | **20%** |
| Pmax (Wp) | 638 | 696 | 643.5 | 702 | 649 | 708 |
| Module efficiency (%) | **24.70** | **26.94** | **24.91** | **27.17** | **25.12** | **27.41** |

I-V Curve at Different Temperature (585 W)




P-V Curve




**30 YEARS**
Performance Guarantee

**20 YEARS**
Product Warranty

# ASTORIOS

# ABC PV MODULES

## All-back contact. N-type. Bifacial. Sleek and powerful.

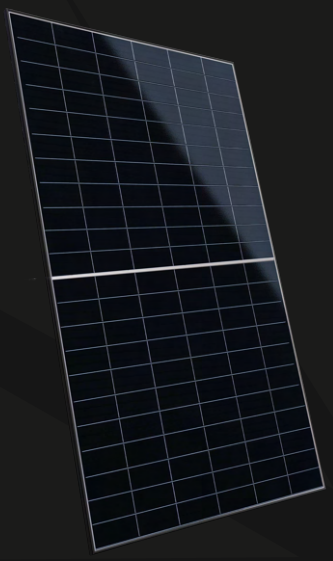
ASTORIOS ABC modules are engineered with advanced all-back contact (ABC) N-type bifacial cells that eliminate front-side metallization, resulting in a seamless surface that maximizes sunlight absorption and delivers outstanding visual uniformity. With all electrical pathways located on the rear of the cell, the design reduces shading loss and internal resistance, significantly improving energy output and overall module performance.

These modules benefit from the inherent advantages of N-type silicon, including minimal light-induced degradation (LID), strong thermal stability, and long-term power retention, making them ideal for installations where consistent high performance is critical. The double-glass structure not only enhances durability but also enables rear-side power generation, capturing reflected light to boost total energy yield throughout the day.

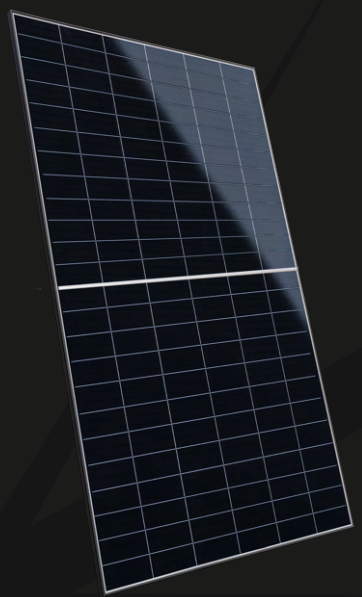
With a half-cell configuration and split-string layout, ABC modules offer improved tolerance to partial shading and lower hotspot risks. The use of high-purity materials and precision manufacturing ensures maximum resistance against potential-induced degradation (PID), while extensive environmental testing confirms reliability under extreme conditions such as high humidity, salt mist, ammonia exposure, and mechanical stress from wind or snow.

With power ratings of up to 670 Wp and module efficiencies reaching 24.80%, ABC modules represent the cutting edge of photovoltaic innovation. They are backed by a 30-year performance guarantee and a 20-year product warranty, making them the premium choice for residential, commercial, and utility-scale projects where both aesthetics and performance are paramount.

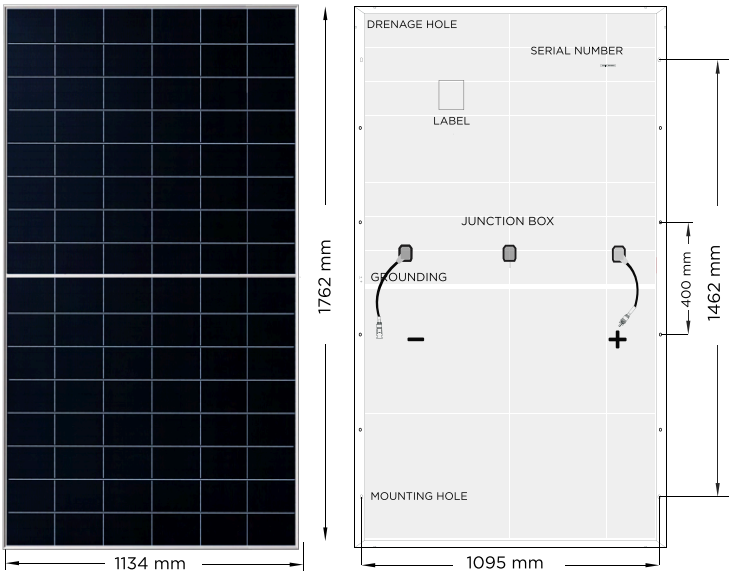
ASTR **96HCNBD/10**
Series **475-485 Wp**



ASTR **132HCNBD/10**
Series **650-660 Wp**



ASTR **144HCNBD/10**
Series **660-670 Wp**

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# PHOTOVOLTAIC MODULE

**BACK-CONTACT**
**N-ABC MONO BIFACIAL CELLS**
SILVER FRAME, DOUBLE GLASS

ASTR **96HCNBD/10** Series **475-485 Wp**

**485 Wp**
MAXIMUM POWER OUTPUT

**24.27%**
MAXIMUM MODULE EFFICIENCY

## MATERIAL CHARACTERISTICS

| | |
|---|---|
| Dimensions | 1762 × 1134 × 30 mm |
| Weight | 24.6kg |
| Number of cells | 96 pcs (105x182) |
| Glass | 2mm, High transparency, AR coated |
| Cell layout | Bifacial, N-ABC Mono |
| Frame | Silver frame, anodized aluminum alloy |
| Junction box | IP68 Rated, 3 bypass diodes |
| Connector type | Staubli MC4-Evo 2 / MC4 (Original) |
| Cable | 4 $mm^2$, 300 mm |

## PACKAGING INFORMATION

| | |
|---|---|
| One pallet quantity | 36 Pcs / 909kg / 1790x1130x1247mm |
| 40 ft HC/HQ container | 936 Pcs / 36 Pallets |

## TEMPERATURE PARAMETERS

| | |
|---|---|
| Temperature Coefficient of Pmax | -0.26 % / °C |
| Temperature Coefficient of Voc | -0.22 % / °C |
| Temperature Coefficient of Isc | +0.05 % / °C |
| Operating Temperature | - 40°C to + 85°C |
| Normal Operating Cell Temperature (NOCT) | 44±2°C |

## MAXIMUM RATINGS

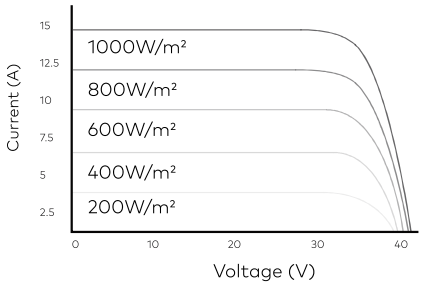
| | |
|---|---|
| Max. System Voltage | 1500V DC - (H) |
| Max. Series Fuse Rating | 30A |
| Uplift load (wind) | 2400 Pa* |
| Downforce (snow) | 5400 Pa* |
| Hail Resistance | 25mm ice-ball with velocity of 23m/s |

*For more information please refer to Instruction Manual

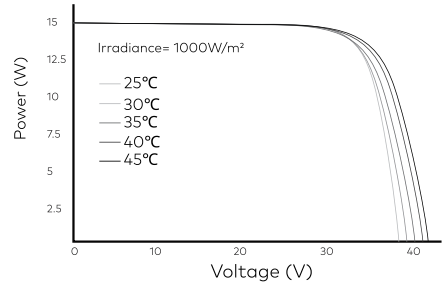
| MODULE TYPE 96HCNBD/10 | 475 Wp | | 480 Wp | | 485 Wp | |
|---|---|---|---|---|---|---|
| **ELECTRICAL CHARACTERISTICS** | **STC** | NMOT | **STC** | NMOT | **STC** | NMOT |
| Maximum power (Pmax/Wp) | **475** | 365 | **480** | 369 | **485** | 373 |
| Open circuit voltage (Voc / V) | **40.75** | 38.67 | **40.85** | 38.75 | **40.97** | 38.92 |
| Short circuit current (Isc / A) | **14.74** | 11.89 | **14.80** | 11.94 | **14.85** | 11.98 |
| Maximum power voltage (Vmp / V) | **34.15** | 32.23 | **34.24** | 32.33 | **34.38** | 32.47 |
| Maximum power current (Imp / A) | **13.91** | 11.33 | **14.02** | 11.42 | **14.11** | 11.49 |
| Module efficiency at STC (ηm / %) | **23.77** | | **24.02** | | **24.27** | |
| Power tolerance (Pmax) | | | **0~+3%** | | | |

**NMOT:** Irradiance 800 W/m2, ambient temperature 20°C, wind speed 1 m/s / **STC:** Irradiance of 1000 W/m2, spectrum AM 1.5, a module temperature of 25°C

I-V Curve at Different Temperature (480 W)

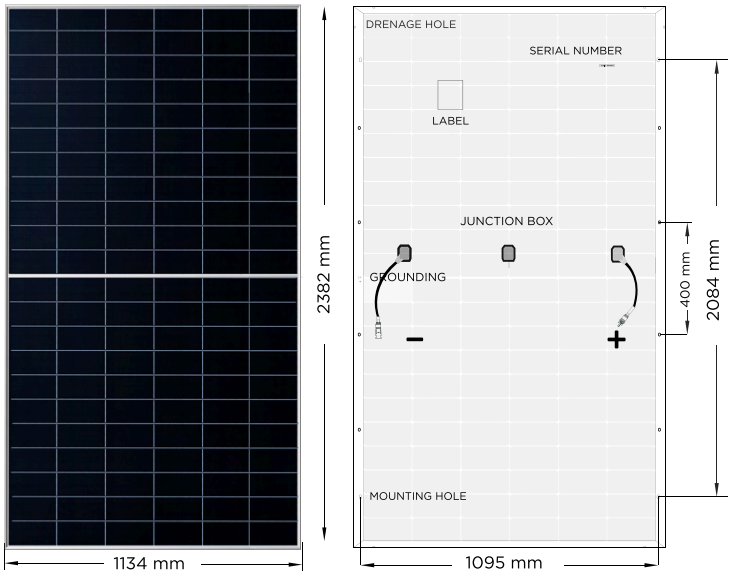



P-V Curve




**30 YEARS**
Performance Guarantee

**20 YEARS**
Product Warranty

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# PHOTOVOLTAIC MODULE

**BACK-CONTACT**
**N-ABC MONO BIFACIAL CELLS**
SILVER FRAME, DOUBLE GLASS

ASTR **132HCNBD/10** Series **650-660 Wp**

**660 Wp**
MAXIMUM POWER OUTPUT

**24.43%**
MAXIMUM MODULE EFFICIENCY

## MATERIAL CHARACTERISTICS

| | |
|---|---|
| Dimensions | 2382 × 1134 × 30 mm |
| Weight | 32.5kg |
| Number of cells | 132 pcs (105x182) |
| Glass | 2mm, High transparency, AR coated |
| Cell layout | Bifacial, N-ABC Mono |
| Frame | Silver frame, anodized aluminum alloy |
| Junction box | IP68 Rated, 3 bypass diodes |
| Connector type | Staubli MC4-Evo 2 / MC4 (Original) |
| Cable | 4 $mm^2$, 300 mm |

## PACKAGING INFORMATION

| | |
|---|---|
| One pallet quantity | 36 Pcs / 1190kg / 1160x1130x2535mm |
| 40 ft HC/HQ container | 720 Pcs / 36 Pallets |

## TEMPERATURE PARAMETERS

| | |
|---|---|
| Temperature Coefficient of Pmax | -0.26 % / °C |
| Temperature Coefficient of Voc | -0.22 % / °C |
| Temperature Coefficient of Isc | +0.05 % / °C |
| Operating Temperature | - 40°C to + 85°C |
| Normal Operating Cell Temperature (NOCT) | 44±2°C |

## MAXIMUM RATINGS

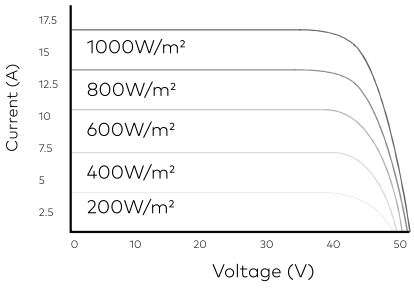
| | |
|---|---|
| Max. System Voltage | 1500V DC - (H) |
| Max. Series Fuse Rating | 30A |
| Uplift load (wind) | 2400 Pa* |
| Downforce (snow) | 5400 Pa* |
| Hail Resistance | 25mm ice-ball with velocity of 23m/s |

*For more information please refer to Instruction Manual

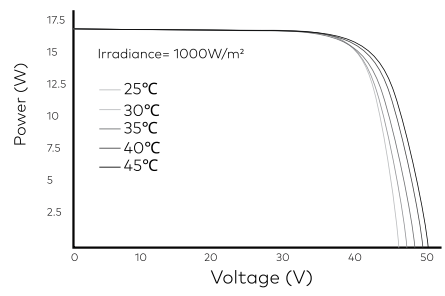
| MODULE TYPE 132HCNBD/10 | 650 Wp | | 655 Wp | | 660 Wp | |
|---|---|---|---|---|---|---|
| **ELECTRICAL CHARACTERISTICS** | **STC** | NMOT | **STC** | NMOT | **STC** | NMOT |
| Maximum power (Pmax/Wp) | **650** | 499 | **655** | 503 | **660** | 507 |
| Open circuit voltage (Voc / V) | **49.85** | 47.65 | **50.03** | 47.83 | **50.20** | 47.99 |
| Short circuit current (Isc / A) | **16.17** | 13.04 | **16.22** | 13.08 | **16.27** | 13.12 |
| Maximum power voltage (Vmp / V) | **42.74** | 40.35 | **42.90** | 40.51 | **43.06** | 40.67 |
| Maximum power current (Imp / A) | **15.21** | 12.37 | **15.27** | 12.42 | **15.33** | 12.47 |
| Module efficiency at STC (ηm / %) | **24.06** | | **24.25** | | **24.43** | |
| Power tolerance (Pmax) | | | **0~+3%** | | | |

**NMOT:** Irradiance 800 W/m2, ambient temperature 20°C, wind speed 1 m/s / **STC:** Irradiance of 1000 W/m2, spectrum AM 1.5, a module temperature of 25°C

I-V Curve at Different Temperature (655 W)

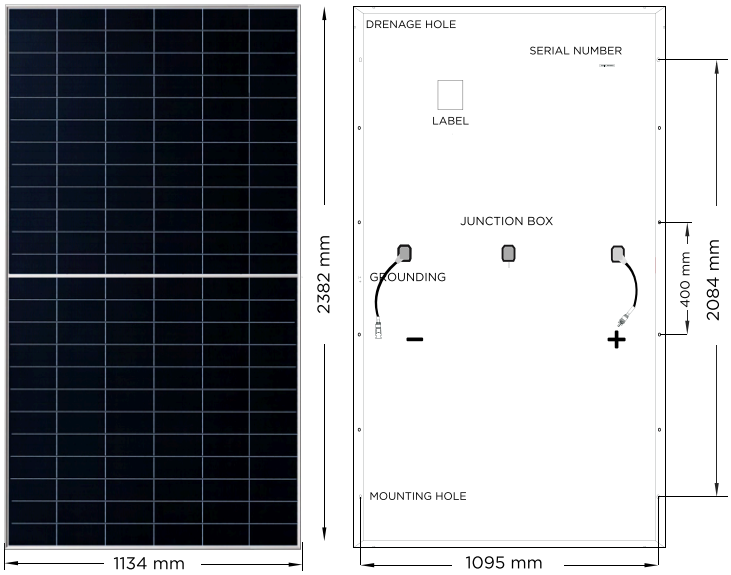



P-V Curve




**30 YEARS**
Performance Guarantee

**20 YEARS**
Product Warranty




ASTORIOS
per aspera ad astra

# PHOTOVOLTAIC MODULE

**BACK-CONTACT**
**N-ABC MONO BIFACIAL CELLS**
SILVER FRAME

ASTR **144HCNB/10** Series **660-670 Wp**

**670 Wp**
MAXIMUM POWER OUTPUT

**24.80%**
MAXIMUM MODULE EFFICIENCY

## MATERIAL CHARACTERISTICS

| | |
|---|---|
| Dimensions | 2382 × 1134 × 30 mm |
| Weight | 27.6kg |
| Number of cells | 144 pcs (96x182) |
| Glass | 3.2mm, High transparency, AR coated |
| Cell layout | Bifacial, N-ABC Mono |
| Frame | Silver frame, anodized aluminum alloy |
| Junction box | IP68 Rated, 3 bypass diodes |
| Connector type | Staubli MC4-Evo 2 / MC4 (Original) |
| Cable | 4 $mm^2$, 300 mm |

## PACKAGING INFORMATION

| | |
|---|---|
| One pallet quantity | 36 Pcs / 1034kg / 2410x1120x1247mm |
| 40 ft HC/HQ container | 576 Pcs / 36 Pallets |

## TEMPERATURE PARAMETERS

| | |
|---|---|
| Temperature Coefficient of Pmax | -0.26 % / °C |
| Temperature Coefficient of Voc | -0.22 % / °C |
| Temperature Coefficient of Isc | +0.05 % / °C |
| Operating Temperature | - 40°C to + 85°C |
| Normal Operating Cell Temperature (NOCT) | 44±2°C |

## MAXIMUM RATINGS

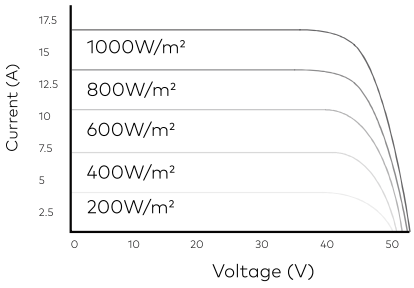
| | |
|---|---|
| Max. System Voltage | 1500V DC - (H) |
| Max. Series Fuse Rating | 30A |
| Uplift load (wind) | 2400 Pa* |
| Downforce (snow) | 5400 Pa* |
| Hail Resistance | 25mm ice-ball with velocity of 23m/s |

*For more information please refer to Instruction Manual

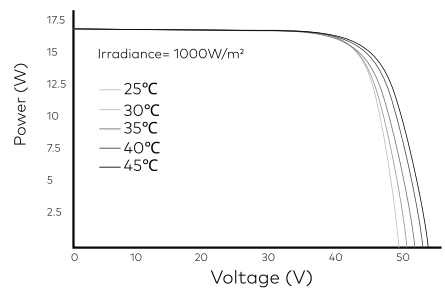
| MODULE TYPE 144HCNB/10 | 660 Wp | | 665 Wp | | 670 Wp | |
|---|---|---|---|---|---|---|
| **ELECTRICAL CHARACTERISTICS** | **STC** | NMOT | **STC** | NMOT | **STC** | NMOT |
| Maximum power (Pmax/Wp) | **660** | 507 | **665** | 511 | **670** | 515 |
| Open circuit voltage (Voc / V) | **54.10** | 51.72 | **54.23** | 51.86 | **54.36** | 51.92 |
| Short circuit current (Isc / A) | **15.27** | 12.32 | **15.34** | 12.37 | **15.41** | 12.43 |
| Maximum power voltage (Vmp / V) | **45.33** | 42.80 | **45.43** | 42.91 | **45.52** | 43.01 |
| Maximum power current (Imp / A) | **14.56** | 11.85 | **14.64** | 11.91 | **14.72** | 11.98 |
| Module efficiency at STC (ηm / %) | **24.43** | | **24.62** | | **24.80** | |
| Power tolerance (Pmax) | | | **0~+3%** | | | |

**NMOT:** Irradiance 800 W/m2, ambient temperature 20°C, wind speed 1 m/s / **STC:** Irradiance of 1000 W/m2, spectrum AM 1.5, a module temperature of 25°C

I-V Curve at Different Temperature (665 W)




P-V Curve




**30 YEARS**
Performance Guarantee

**20 YEARS**
Product Warranty

# COMMERCIAL & INDUSTRIAL BATTERY ENERGY STORAGE SYSTEMS

ASTORIOS delivers modular, scalable battery energy storage solutions engineered for commercial and industrial environments. Designed around flexibility, each BESS system supports a wide range of applications — from backup power and peak shaving to frequency regulation, load shifting, and demand response.

Available in cabinet, modular, or containerized formats (from 40 kW to multi-MW scale), our systems are built for easy deployment, fast integration, and smooth compatibility with energy infrastructure already in place. Whether the requirement is self-consumption, critical load support, or fuel cost reduction, every configuration is built to adapt.

Each BESS integrates $LiFePO_4$ chemistry for stability and service life, supported by a full stack of intelligent protections and control layers. Fire detection, active cooling, intrusion detection, and short-circuit prevention are built in — along with communication and monitoring systems that ensure full operational visibility.

Advanced Energy Management Systems (EMS) bring added precision, enabling energy coordination across sites, loads, and timeframes. With EMS, our systems handle high-complexity demands while maintaining peak performance and efficiency — without manual oversight.

ASTORIOS BESS solutions can incorporate optional components including:

- Human Machine Interface (HMI)
- Energy Management Systems (EMS)
- Backup power source integration (UPS, diesel generators)
- Power Conversion Systems (PCS)
- Static Transfer Switch (STS)
- State of Charge / Health monitoring
- CAN and RS485 compatibility
- Remote control and SCADA (Modbus, Ethernet)
- Cloud-based data monitoring
- Temperature and fault protection systems

**Each system is built to meet high-reliability thresholds under complex operating conditions. Longevity is designed in. Performance is expected. The rest is simply delivery.**


www.astorios.com

# CERTIFICATION

ASTORIOS technologies, processes, and production lines are certified by internationally recognized institutions. Every process, from raw material sourcing to final product assembly, is evaluated under established safety and management standards. Products are tested under environmental and mechanical stress to meet the industry's highest standards for long-term performance in variable, often harsh, conditions.

Certification procedures include third-party inspections of manufacturing sites and processes, components, and — most critically — products. These inspections also verify calibration protocols, testing systems, and automated quality control equipment — ensuring stability and compliance even as technologies evolve.

Our suppliers — whether for raw materials or components — must meet strict international quality benchmarks. Only materials that meet defined technical and compliance criteria are approved for integration into product.

## PV MODULES

Every ASTORIOS PV module passes through a multi-stage quality control process. Raw materials and components are inspected at intake. Soldering, EL (electro-luminescence), and optical tests using micro-shot cameras are conducted at critical stages to detect any visual or structural inconsistencies. Once laminated and assembled, modules undergo two separate electrical test phases — each verifying output, resistance, performance, along with overall conformity to quality specifications. Modules are sorted only after final visual and electrical clearance.

**Modules are approved for release only when they satisfy all technical, operational, structural, and visual quality requirements.**

UL 61730 – U.S. photovoltaic module design & safety

IEC 61215 / IEC 61730 – International design and safety standards

IEC 62804 – PID resistance

IEC 61701 – Salt mist resistance

IEC 62716 – Ammonia resistance

IEC 60068-2-68 – Sand and dust resistance

IC TS 62941:2016 – PV industry quality management

ISO 9001:2015 – Quality management

ISO 14001:2015 – Environmental management

ISO 45001:2018 – Health & safety management

ISO 50001:2011 – Energy management

CE Declaration – European conformity

## BATTERY ENERGY STORAGE SYSTEMS

ASTORIOS BESS platforms are built using Lithium Iron Phosphate ($LiFePO_4$, LFP) cells — selected for stability, safety, and cycle life. Casing materials are chosen for mechanical strength and long-term durability under variable operating conditions. Every product is certified to meet strict performance, safety, and management system standards across manufacturing, packaging, and control.

IEC 62119:2017 – Safe operation of lithium cells and batteries

IEC 62477 – PECs (power electric converter systems)

SPS-C KBIA-10104-03-7312 – Safety testing and performance compliance

EN IEC 61000-6-1:2019 – EMC immunity (residential/commercial/light-industrial)

EN IEC 61000-6-2:2019 – EMC immunity (same environments)

EN IEC 61000-6-3:2021 – EMC emission (residential/commercial/light-industrial)

EN IEC 61000-6-4:2019 – EMC emission (industrial)

ASTORIOS

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