

# Technical and Commercial Proposal for a 0.5 MW Solar Power System

Prepared for: Ethanol Factory, Lamu

Prepared by: Eng. Julius Gitonga

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Validity Period: 90 Days

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## 1. Executive Summary

### *Project Overview*

This proposal outlines the design, implementation, and commercial terms for a 0.621 MW AC Grid-tied solar power system for an ethanol factory in Lamu. The system will utilize high-efficiency industry standard equipment, including 1,080 solar panels, and five 100 kW string inverters 0.5 MW AC. The system will be battery ready for future addition of a battery storage.

### *Key System Features*

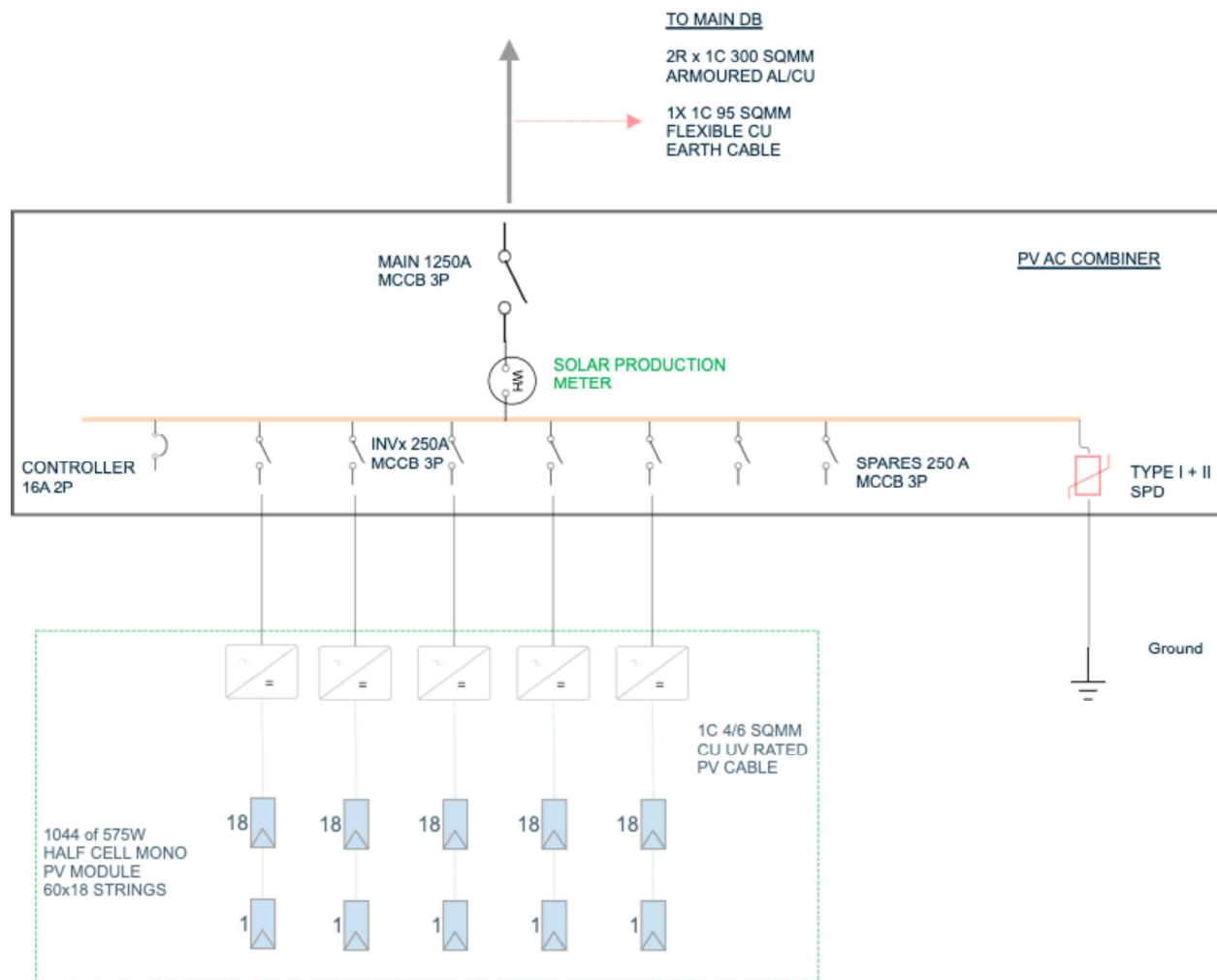
- Solar Capacity: 0.621 MW (1,080 x 575W panels)
- Inverters: 5x 100 kW Sungrow/ Huawei string inverters (0.5 MW AC)
- Mounting System: Fixed ground mount
- Cabling: 300mm<sup>2</sup> copper AC/ Al cables (100m per phase)
- Monitoring: Advanced monitoring system with a weather station

### *Client Benefits*

- Cost Savings: Significant reduction in energy costs through solar power generation.
- Sustainability: Reduced carbon footprint and alignment with green energy goals.
- Low Maintenance: High-quality equipment with minimal maintenance requirements.

## 2. Technical Solution

Below is a single line diagram showing the connection of the solar system from the PV module on the field to the AC output of the AC combiner box feeding to the Main factory distribution board. Please note that the Main DB should be designed with a provision for a solar feed in breaker with a capacity not less than 1250 A.



- a) Solar Panels. Data sheet will be attached in the Appendix section of this document
  - Model: Jinko 575 W Mono PERC
  - Quantity: 1080 units translating to 621 kWp DC
  - Efficiency: >21.5%
- b) Inverters. The data sheet of the inverters will be attached in the Appendix section of this document
  - Model: Huawei SUN2000-100KTL

- Quantity: 5 units translating to 500 kW AC
- Output: 100 kW per unit
- c) Mounting System
  - Type: Fixed ground mount
  - Material: Galvanized steel
- d) Cables
  - DC Cables: 4-6mm<sup>2</sup>
  - AC Cables: 10mm<sup>2</sup> - 240mm<sup>2</sup>
- e) Electrical Components
  - AC Combiner Boxes: 12- Inverter Inputs, surge-protected
  - Circuit Breakers: 415V AC, 250A AC and 1250 AC
  - Disconnect Switches: 415V AC, 1250A AC
  - Grounding System: Copper-bonded rods with an underground earthing grid
- f) Monitoring System. Data sheet will be attached in the Appendix section of this document.
  - Model: Huawei FusionSolar Smart Monitoring System
  - Features: Real-time performance tracking, fault detection, weather integration

#### *Performance Expectations*

- Annual Energy Production: ~667 MWh
- System Efficiency: > 95%

### **3. Quality Assurance**

#### *Applicable Standards*

- IEC 61215: Solar panel performance standards
- IEC 62109: Inverter safety standards
- ISO 9001: Quality management

#### *Quality Control Measures*

- Pre-Shipment Inspection: All equipment tested before dispatch

- On-Site Inspection: Daily quality checks during installation

## 4. Commercial Terms

Below is a BOQ with the unit price and total amount for each item line required to build the complete grid tied solar system.

Item No.	Description	Specifications	Quantity	Unit	Unit Price (USD)	Total Price (USD)	Warranty
<b>1</b>	<b>Solar Panels</b>						
1.1	Jinko/ JA Solar Modules	Monocrystalline N-type TOPCon, 575W, >21.5% efficiency	1,080	Units	\$150.00	\$162,000.00	30yr performance, 12yr product
<b>2</b>	<b>Inverters</b>						
2.1	Huawei SUN2000-100KTL-H1	String inverter, 100kW, AI-powered optimization	5	Units	\$6,800.00	\$34,000.00	10yr standard
<b>3</b>	<b>Battery Storage</b>						
3.1	LUNA2000-215KWH-2H1	LiFePO4, 215kWh modules	0	Units	\$68,000.00	\$0.00	10yr or 6000 cycles
<b>4</b>	<b>Mounting Structure</b>						
4.1	Fixed Ground Mounting	Hot-dipped galvanized steel, 150km/h wind rating	1,000	Sets	\$55.00	\$55,000.00	15yr structural
<b>5</b>	<b>Cables</b>						
5.1	DC Cables	4mm <sup>2</sup> – 6mm <sup>2</sup> , UV-resistant, solar-rated	10,000	Meters	\$2.50	\$25,000.00	5yr
5.2	AC Cables	10mm <sup>2</sup> or larger	5,000	Meters	\$5.00	\$25,000.00	5yr
<b>6</b>	<b>Electrical Components AC - Combiner Box</b>						
6.1	MC4 Connectors	Standard solar connectors	500	Pairs	\$3.50	\$1,750.00	5yr
6.2	Combiner Boxes	10-Inverters Combiner box	1	Units	\$5,500.00	\$5,500.00	5yr
6.3	Surge Protection Devices	AC and DC protection	5	Units	\$500.00	\$2,500.00	2yr
6.4	Circuit Breakers	System capacity rated	12	Units	\$650.00	\$7,800.00	2yr
6.5	Disconnect Switches	Maintenance isolation	2	Units	\$800.00	\$1,600.00	2yr
6.6	Earthing and Grounding Kit	Complete with rods, clamps, copper cables	1	Set	\$15,000.00	\$15,000.00	10yr
<b>7</b>	<b>Monitoring System</b>						
7.1	Huawei SmartLogger 1000A	System controller, remote monitoring	1	Set	\$15,000.00	\$15,000.00	5yr
7.2	Weather Station	Irradiation, wind speed, temperature sensors	1	Set	\$5,000.00	\$5,000.00	2yr
<b>8</b>	<b>Installation Equipment</b>						
8.1	Tools and Safety Gear	Complete installation toolkit and PPE	1	Set	\$7,000.00	\$7,000.00	N/A
8.2	System Design	System sizing design and planning	1		\$25,000.00	\$25,000.00	
8.3	System Installation	Installation Labor + Associated logistics	1		\$65,000.00	\$65,000.00	
8.4	System testing and commissioning	System testing and commissioning	1		\$10,000.00	\$10,000.00	
<b>Total Equipment Cost =</b>						<b>\$462,150.00</b>	

## Return on Investment (ROI) Analysis for a 621 kWp Grid-Tied Solar System

### Assumptions & Key Parameters:

- System Size: 621 kWp
- Sun Hours (Lamu, Kenya): 4.2 hours/day
- System Efficiency: 82%
- Grid Electricity Tariff: \$0.2 per kWh
- Estimated System Cost: \$462,150
- Annual Maintenance Cost: 1% of system cost (~\$4,600/year)
- System Lifetime: 25 years
- Operating Days: 6 days per week (313 days per year)

### Annual Solar Energy Generation:

Since the system runs **6 days per week**, the total operating days per year are:

$$6 * 52.18 = 313 \text{ days in a year}$$

Now, using the energy generation formula:

$$\text{Annual Energy (kWh)} = \text{System Size (kWp)} * \frac{\text{Sun Hours}}{\text{day}} * \text{Operating Days} * \text{Efficiency}$$

$$\text{Annual Energy (kWh)} = 621 * 4.2 * 313 * 0.82 = 667,080 \text{ kWh per year}$$

Cost Savings from Solar:

- **Annual Electricity Cost Savings:**

$$668,080 * 0.2 \frac{\text{USD}}{\text{kWh}} = 133,616 \text{ USD per year}$$

- **Total Savings Over 25 Years (before degradation):**

$$133,616 \times 25 = 3.3 \text{ million USD}$$

#### ***Payback Period Calculation:***

- System Cost: \$462,150
- Annual Savings: \$133,616
- Payback Period = System Cost / Annual Savings

$$\frac{\$462,150}{\$133,616} = 3.5 \text{ years}$$

#### ***Return on Investment (ROI):***

$$\text{ROI (\%)} = \frac{(\text{Total Savings Over 25 Years} - \text{System Cost})}{\text{System Cost}} * 100$$

$$\frac{\$3,340,400 - \$462,150}{\$462,150} * 100 = 622\% \text{ over 25 years}$$

### *Payment Terms*

Breakdown of the Payment terms in % and USD		
Description	Percentage (%)	Amount (USD)
Advance payment with PO:	60%	\$277,290.00
On delivery to the site:	20%	\$92,430.00
On Commissioning:	15%	\$69,322.50
6 Months after commissioning:	5%	\$23,107.50
<b>Total =</b>	100 %	\$462,150.00

### *Delivery Schedule*

- Order to Delivery: 2-3 weeks
- Installation Period: 3-4 weeks
- Commissioning: 1 weeks
- Total Project Duration: 6-10 weeks

### **Notes:**

- I. All prices are in USD and exclusive of VAT/taxes
- II. Warranty periods start from date of commissioning
- III. Technical support included for first year of operation

## **5. Conclusion**

This proposal provides a comprehensive solution for your 600 kWp Grid tied solar power system, ensuring high performance, reliability, and cost-effectiveness. We look forward to collaborating with you on this project.

### **Contact Information:**

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## Appendix

### SUN2000-100KTL-M1 Smart PV Controller



#### Smart

Smart I-V Curve Diagnosis supported



#### Efficient

Max. efficiency 98.8%



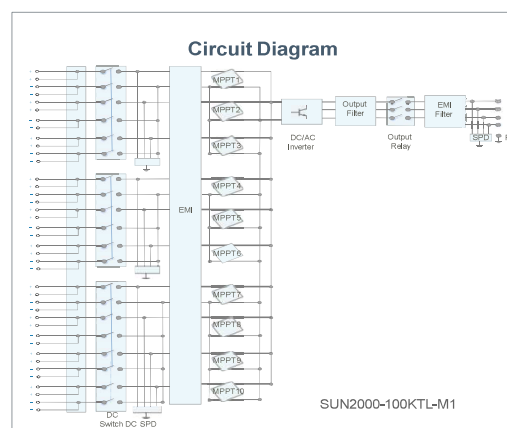
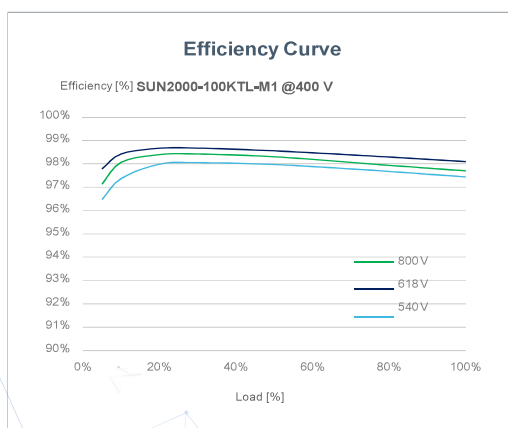
#### Safe

Fuse free design



#### Reliable

Type II surge arresters for DC & AC



SUN2000-100KTL-M1  
**Technical Specification**

Technical Specification	SUN2000-100KTL-M1
<b>Efficiency</b>	
Max. Efficiency	98.8%
European Efficiency	98.6%
<b>Input</b>	
Max. Input Voltage	1,100 V
Max. Current per MPPT	26 A
Max. Short Circuit Current per MPPT	40 A
Start Voltage	200 V
MPPT Operating Voltage Range	200 V ~ 1,000 V
Rated Input Voltage	600 V
Number of Inputs	20
Number of MPP Trackers	10
<b>Output</b>	
Rated AC Active Power	100,000 W
Rated AC Apparent power	100,000 VA
Max. AC Apparent Power	110,000 VA
Max. AC Active Power (cosφ=1)	110,000 W
Rated Output Voltage	400 V, 3W + PE
Rated AC Grid Frequency	50 Hz / 60 Hz
Rated Output Current	144.4 A
Max. Output Current	160.4 A
Adjustable Power Factor Range	0.8 LG ... 0.8 LD
Max. Total Harmonic Distortion	<3%
<b>Protection</b>	
Input-side Disconnection Device	Yes
Anti-islanding Protection	Yes
AC Overcurrent Protection	Yes
DC Reverse-polarity Protection	Yes
PV-array String Fault Monitoring	Yes
DC Surge Arrester	Type II
AC Surge Arrester	Type II
DC Insulation Resistance Detection	Yes
Residual Current Monitoring Unit	Yes
<b>Communication</b>	
Display	LED Indicators, Bluetooth/WLAN + APP
RS485	Yes
USB	Yes
MBUS	Yes (isolation transformer required)
<b>General Data</b>	
Dimensions (W x H x D)	1,035 x 700 x 365mm (40.7 x 27.6x 14.4 inch)
Weight (with mounting plate)	90 kg (187.4 lb.)
Operating Temperature Range	-25°C ~ 60°C (-13°F ~ 140°F)
Cooling Method	Smart Air Cooling
Max. Operating Altitude	4,000 m (13,123 ft.)
Relative Humidity	0 ~ 100%
DC Connector	Staubli MC4
AC Connector	Waterproof Connector + OT/DT Terminal
Protection Degree	IP66
Topology	Transformerless
Nighttime Power Consumption	≤ 3.5 W
Country of Manufacture	China
<b>Standard Compliance (more available upon request)</b>	
Safety	EN/IEC 62109-1, EN/IEC 62109-2, IEC 62116
Grid Connection Standards	AS/NZS 4777.2 2020



## Multi-MPPT String Inverter for 1000 Vdc System



### HIGH YIELD

- 9 MPPTs with max. efficiency 98.7%
- Compatible with bifacial module
- Built-in PID recovery function

### LOW COST

- Compatible with Al and Cu AC cables
- DC 2 in 1 connection enabled
- Q at night function

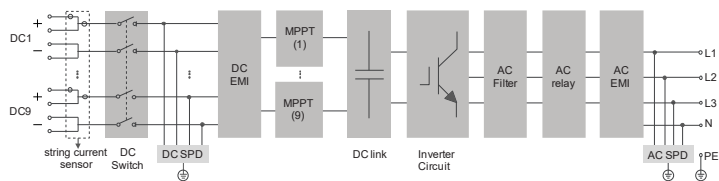
### SMART O&M

- Touch free commissioning and remote firmware upgrade
- Online IV curve scan and diagnosis\*
- Fuse free design with smart string current monitoring

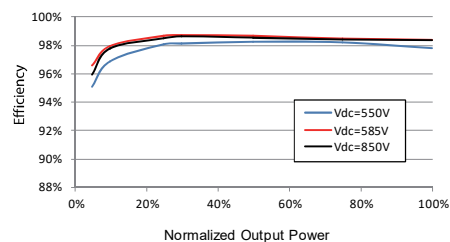
### PROVEN SAFETY

- IP66 and C5 protection
- Type II SPD for both DC and AC
- Compliant with global safety and grid code

### CIRCUIT DIAGRAM



### EFFICIENCY CURVE



Type designation	SG110CX
<b>Input (DC)</b>	
Max. PV input voltage	1100 V
Min. PV input voltage / Startup input voltage	200 V / 250 V
Nominal PV input voltage	585 V
MPP voltage range	200 – 1000 V
MPP voltage range for nominal power	550V – 850 V
No. of independent MPP inputs	9
Max. number of PV strings per MPPT	2
Max. PV input current	26 A * 9
Max. DC short-circuit current	40 A * 9
<b>Output (AC)</b>	
AC output power	110 kVA @ 45 °C / 100 kVA @ 50 °C
Max. AC output current	158.8 A
Nominal AC voltage	3 / N / PE, 400 V
AC voltage range	320 – 460 V
Nominal grid frequency / Grid frequency range	50 Hz / 45 – 55 Hz, 60 Hz / 55 – 65 Hz
THD	< 3 % (at nominal power)
DC current injection	< 0.5 % I <sub>n</sub>
Power factor at nominal power / Adjustable power factor	> 0.99 / 0.8 leading – 0.8 lagging
Feed-in phases / connection phases	3 / 3
<b>Efficiency</b>	
Max. efficiency	98.7 %
Euro. efficiency	98.5 %
<b>Protection</b>	
DC reverse connection protection	Yes
AC short circuit protection	Yes
Leakage current protection	Yes
Grid monitoring	Yes
Ground fault monitoring	Yes
DC switch	Yes (not available for Australia)
AC switch	No
PV String current monitoring	Yes
PID recovery function	Yes
Overvoltage protection	DC Type II / AC Type II
<b>General Data</b>	
Dimensions (W*H*D)	1051*660*362.5 mm
Weight	89 kg
Isolation method	Transformerless
Ingress protection rating	IP66
Night power consumption	< 2W
Operating ambient temperature range	-30 to 60 °C (> 50 °C derating)
Allowable relative humidity range (non-condensing)	0 – 100 %
Cooling method	Smart forced air cooling
Max. operating altitude	4000 m (> 3000 m derating)
Display	LED, Bluetooth+APP
Communication	RS485 / Optional: Wi-Fi, Ethernet
DC connection type	MC4 (Max. 6 mm <sup>2</sup> )
AC connection type	OT / DT terminal (Max. 240 mm <sup>2</sup> )
Compliance	IEC 62109, IEC 61727, IEC 62116, IEC 60068, IEC 61683, VDE-AR-N 4110:2018, VDE-AR-N 4120:2018, IEC 61000-6-3, EN 50549, AS/NZS 4777.2:2015, CEI 0-21, VDE 0126-1-1/A1 VFR 2014, UTE C15-712-1:2013, DEWA
Grid Support	Q at night function, LVRT, HVRT, active & reactive power control and power ramp rate control

\*: Only compatible with Sungrow logger and iSolarCloud



# Tiger Neo N-type 72HL4-(V) 555-575 Watt MONO-FACIAL MODULE

## N-Type

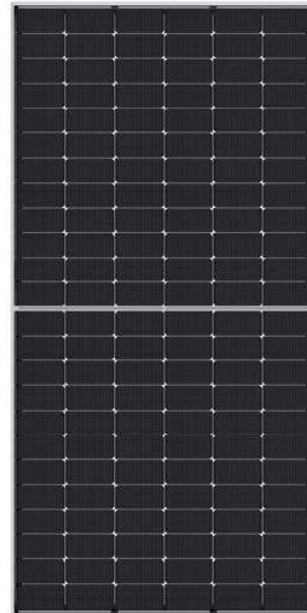
Positive power tolerance of 0~+3%

IEC61215(2016), IEC61730(2016)

ISO9001:2015: Quality Management System

ISO14001:2015: Environment Management System

ISO45001:2018  
Occupational health and safety management systems



## Key Features



### SMBB Technology

Better light trapping and current collection to improve module power output and reliability.



### PID Resistance

Excellent Anti-PID performance guarantee via optimized mass-production process and materials control.



### Durability Against Extreme Environmental Conditions

High salt mist and ammonia resistance.



### Hot 2.0 Technology

The N-type module with Hot 2.0 technology has better reliability and lower LID/LETID.



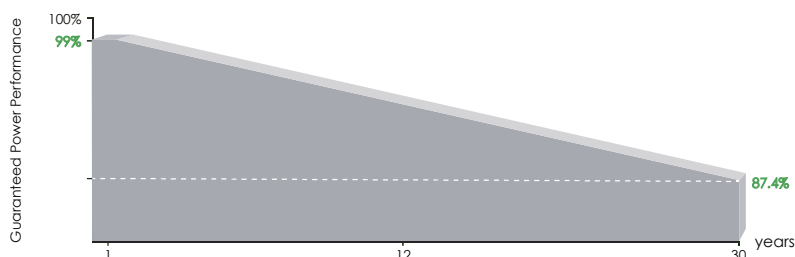
### Enhanced Mechanical Load

Certified to withstand: wind load (2400 Pascal) and snow load (5400 Pascal).



POSITIVE QUALITY™  
Continuous Quality Assurance

## LINEAR PERFORMANCE WARRANTY

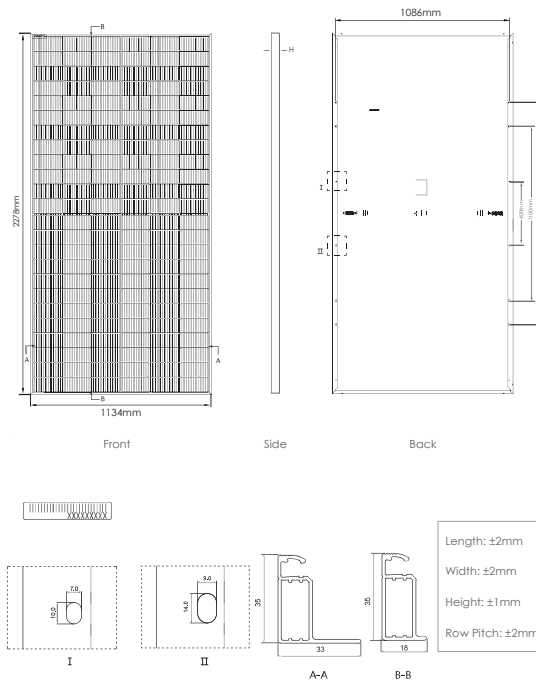


**12** Year Product Warranty

**30** Year Linear Power Warranty

**0.40%** Annual Degradation Over 30 years

## Engineering Drawings

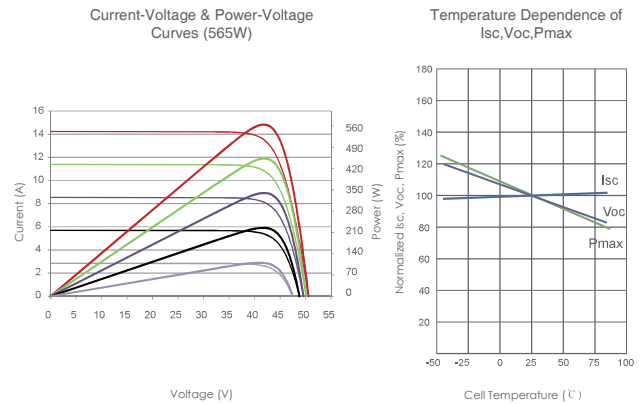


## Packaging Configuration

( Two pallets = One stack )

31pcs/pallets, 62pcs/stack, 620pcs/ 40'HQ Container

## Electrical Performance & Temperature Dependence



## Mechanical Characteristics

Cell Type	N type Mono-crystalline
No. of cells	144 (6×24)
Dimensions	2278×1134×35mm (89.69×44.65×1.38 inch)
Weight	28 kg (61.73 lbs)
Front Glass	3.2mm, Anti-Reflection Coating, High Transmission, Low Iron, Tempered Glass
Frame	Anodized Aluminium Alloy
Junction Box	IP68 Rated
Output Cables	TUV 1×4.0mm <sup>2</sup> (+): 400mm, (-): 200mm or Customized Length

## SPECIFICATIONS

Module Type	JKM555N-72HL4 JKM555N-72HL4-V		JKM560N-72HL4 JKM560N-72HL4-V		JKM565N-72HL4 JKM565N-72HL4-V		JKM570N-72HL4 JKM570N-72HL4-V		JKM575N-72HL4 JKM575N-72HL4-V	
	STC	NOCT	STC	NOCT	STC	NOCT	STC	NOCT	STC	NOCT
Maximum Power (Pmax)	555Wp	417Wp	560Wp	421Wp	565Wp	425Wp	570Wp	429Wp	575Wp	432Wp
Maximum Power Voltage (Vmp)	41.64V	39.12V	41.77V	39.25V	41.92V	39.38V	42.07V	39.51V	42.22V	39.60V
Maximum Power Current (Imp)	13.33A	10.67A	13.41A	10.73A	13.48A	10.79A	13.55A	10.85A	13.62A	10.92A
Open-circuit Voltage (Voc)	50.34V	47.82V	50.47V	47.94V	50.60V	48.06V	50.74V	48.20V	50.88V	48.33V
Short-circuit Current (Isc)	14.07A	11.36A	14.15A	11.42A	14.23A	11.49A	14.31A	11.55A	14.39A	11.62A
Module Efficiency STC (%)	21.48%		21.68%		21.87%		22.07%		22.26%	
Operating Temperature(°C)	-40°C~+85°C									
Maximum system voltage	1000/1500VDC (IEC)									
Maximum series fuse rating	25A									
Power tolerance	0~+3%									
Temperature coefficients of Pmax	-0.30%/°C									
Temperature coefficients of Voc	-0.25%/°C									
Temperature coefficients of Isc	0.046%/°C									
Nominal operating cell temperature (NOCT)	45±2°C									

\*STC: Irradiance 1000W/m<sup>2</sup>

Cell Temperature 25°C

AM=1.5

NOCT: Irradiance 800W/m<sup>2</sup>

Ambient Temperature 20°C

AM=1.5

Wind Speed 1m/s