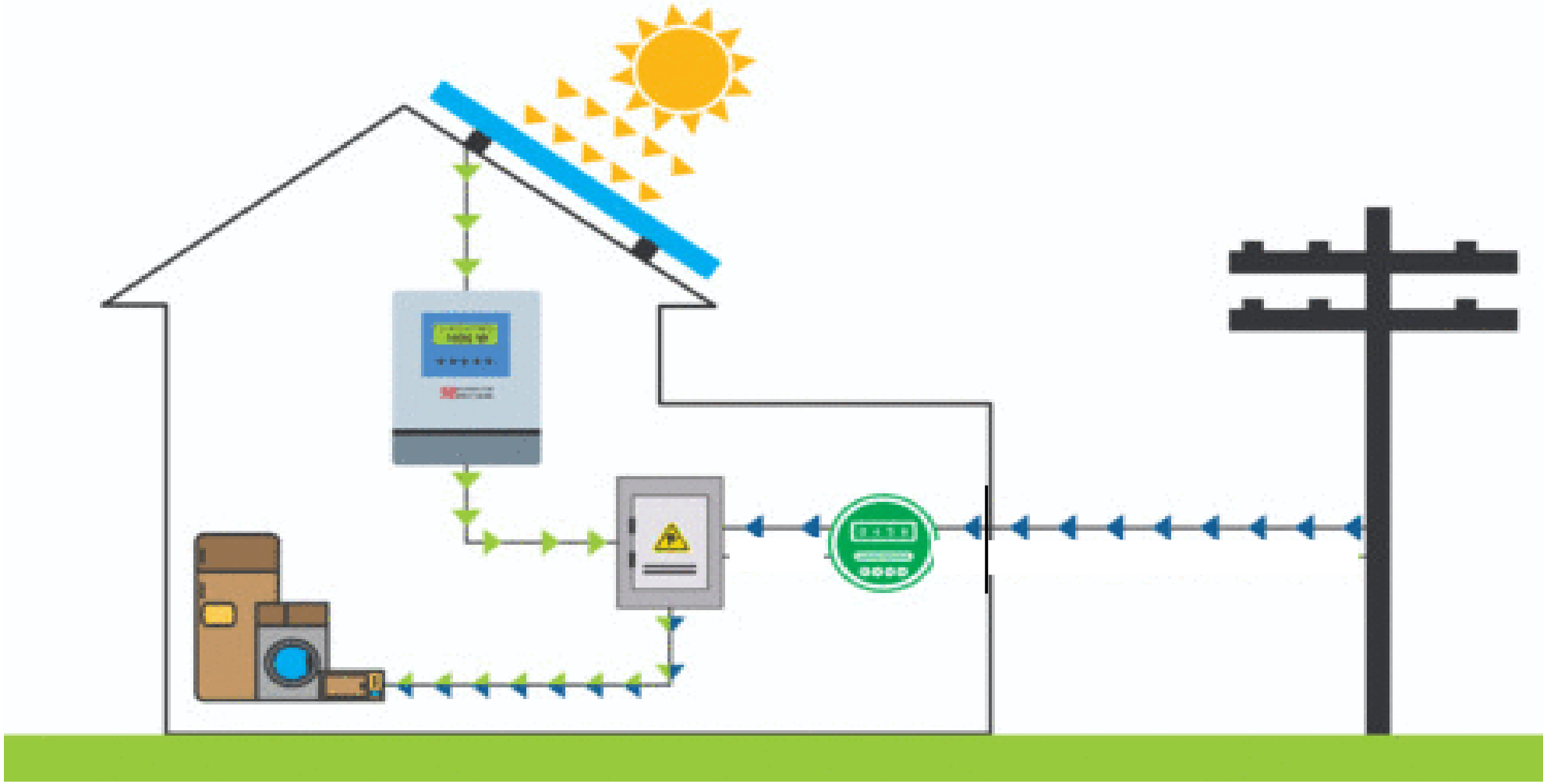
PSEC Turnover Presentation Reference

Table of Contents

On-Grid Solar PV System

The slide provides information on how solar energy is converted into electricity for consumption.



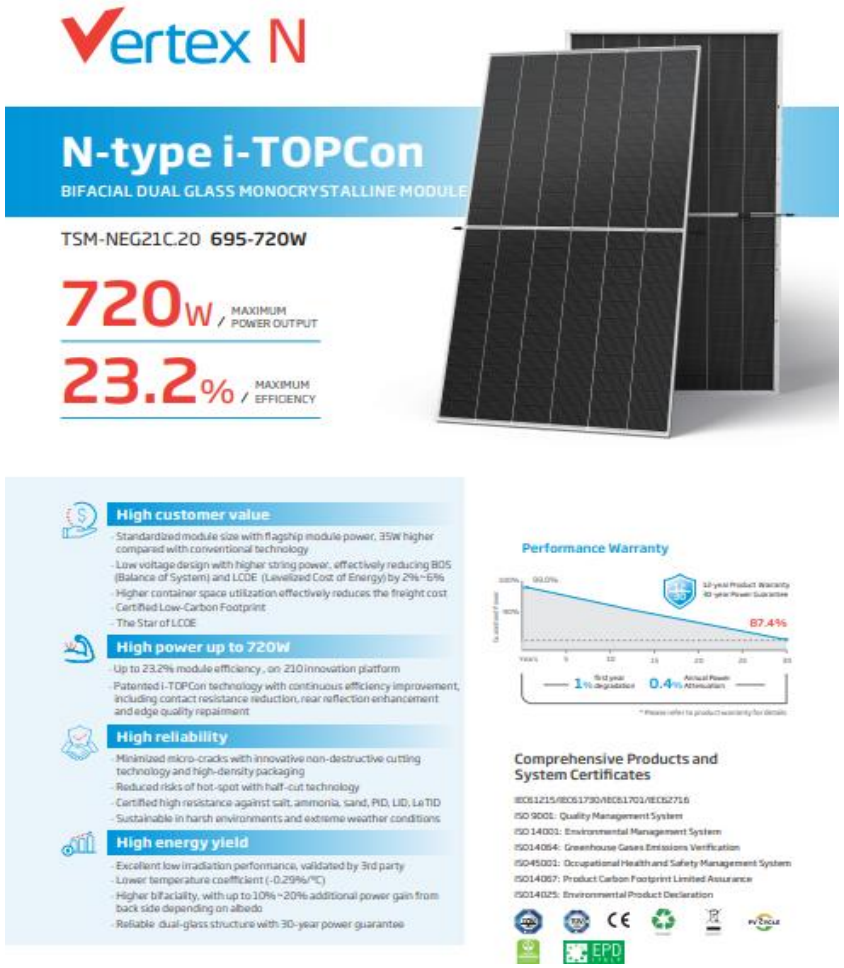
System Overview

The following provides a description and specification of solar modules and related components. It shows the technical specification of the PV module and inverter that is installed in the manufacturing plant.

System Overview	
System Size	**28.4 kWp**
Inverters	SUN2000-8K-LC0 **3 units**
Module Quantity	Trina Solar TSM-NEG21C.20 695-720W **40 pcs**

Main Components – Solar Module

Following slide provides description and specification about solar module and related components. It shows technical specification of PV module and inverter that will be installed on the manufacturing plant.



ELECTRICAL DATA (STC & NOCT & BNPI)

Testing Condition	STC	NOCT	BNPI	STC	NOCT	BNPI	STC	NOCT	BNPI	STC	NOCT	BNPI	STC	NOCT	BNPI	STC	NOCT	BNPI
Peak Power Watts-PMAX(Wp)*	695	531	770	700	534	776	705	540	781	710	543	787	715	547	792	720	551	798
Power Selection (W)**										0~+5								
Maximum Power Voltage-VMPP (V)	40.3	37.9	40.3	40.5	38.0	40.5	40.7	38.3	40.7	40.9	38.5	40.9	41.1	38.7	41.1	41.3	38.8	41.3
Maximum Power Current-IMPP (A)	17.25	14.00	19.11	17.29	14.04	19.15	17.33	14.08	19.19	17.36	14.12	19.23	17.40	14.14	19.28	17.44	14.19	19.32
Open Circuit Voltage-VOC (V)	48.3	45.9	48.3	48.6	46.1	48.6	48.8	46.3	48.8	49.0	46.5	49.0	49.2	46.7	49.2	49.4	46.9	49.4
Short Circuit Current-ISC (A)	18.28	14.72	20.25	18.32	14.76	20.30	18.36	14.80	20.34	18.40	14.83	20.39	18.44	14.86	20.43	18.49	14.90	20.49
Module Efficiency ηm (%)		22.4			22.5			22.7			22.9			23.0			23.2	

STC: Irradiance 1000W/m2, Cell Temperature 25℃, Air Mass AM1.5. NOCT: Irradiance at 800W/m², Ambient Temperature 20℃, Wind Speed 1m/s. BNPI: Irradiance: front 1000W/m², rear 135W/m², Temperature 25℃, Air Mass AM1.5
*Measuring tolerance: ±3%. **Power selection up to: +3%.

Electrical characteristics with different power bin (reference to 5% & 10% backside power gain)

Backside Power Gain	5%	10%	5%	10%	5%	10%	5%	10%	5%	10%	5%	10%
Peak Power Watts-PMAX(Wp)*	730	765	735	770	740	776	746	781	751	787	756	792
Maximum Power Voltage-VMPP (V)	40.3	40.3	40.5	40.5	40.7	40.7	40.9	40.9	41.1	41.1	41.3	41.3
Maximum Power Current-IMPP (A)	18.11	18.98	18.15	19.02	18.20	19.06	18.23	19.10	18.27	19.14	18.31	19.18
Open Circuit Voltage-VOC (V)	48.3	48.3	48.6	48.6	48.8	48.8	49.0	49.0	49.2	49.2	49.4	49.4
Short Circuit Current-ISC (A)	19.19	20.11	19.24	20.15	19.28	20.20	19.32	20.24	19.36	20.28	19.41	20.34

Power Bifaciality:80±5%.

TEMPERATURE RATINGS

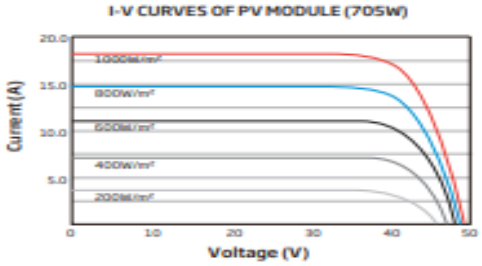
NOCT(Nominal Operating Cell Temperature)	43℃ (±2℃)
Temperature Coefficient of PMAX	- 0.29% /℃
Temperature Coefficient of Voc	- 0.24% /℃
Temperature Coefficient of Isc	0.04% /℃

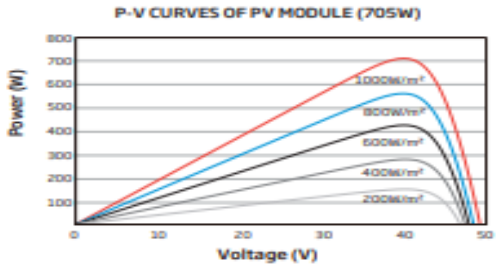
Due to different testing methods, the actual performances might differ from the declared specifications.

MAXIMUM RATINGS

Operational Temperature	-40~+85℃
Maximum System Voltage	1500V DC (IEC)
	1500V DC (UL)
Max Series Fuse Rating	35A

CURVES OF PV MODULE





UNION SOLAR BY PHINMA SOLAR

Main Components – Inverter

Following slide provides description and specification about solar module and related components. It shows technical specification of PV module and inverter that will be installed on the manufacturing plant.

Technical Specification	SUN2000-8K-LC0	SUN2000-10K-LC0
Efficiency		
Max. efficiency	98.1%	
European weighted efficiency	97.5%	
Input (PV)		
Recommended max. PV power [1]	12,000 Wp	15,000 Wp
Max. input voltage	600 V	
Startup voltage	50 V	
MPPT operating voltage range	40 ~ 560 V	
Rated input voltage	360 V	
Max. input current per MPPT	16 A	
Max. short-circuit current	20 A	
Max. number of inputs	3	
Number of MPP trackers	3	
Input (DC Battery)		
Compatible battery	LUNA2000-5/10/15-S0	
Operating voltage range	350 ~ 560 Vdc	
Max. operating current	25 A	
Max. charge power	8,000 W	10,000 W
Max. discharge power	8,000 W	10,000 W
Output (On Grid)		
Grid connection	Single-phase	
Rated output power	8,000 W	10,000 W
Max. apparent power	8,800 VA	10,000 VA
Rated output voltage	220 Vac / 230 Vac / 240 Vac, L / N + PE	
Max. output current	40.0 A	45.5 A
Rated AC grid frequency	50 Hz/60 Hz	
Adjustable power factor	0.8 leading ... 0.8 lagging	
Max. total harmonic distortion	≤ 3%	
Backup power output	Yes (via SmartGuard-63A-S0)	
Features & Protection		
Anti-islanding protection	Yes	
DC reverse polarity protection	Yes	
Insulation monitoring	Yes	
DC surge protection	Yes, compatible with TYPE II protection class according to EN/IEC 61643-11	
AC surge protection	Yes, compatible with TYPE II protection class according to EN/IEC 61643-11	
Residual current monitoring unit	Yes	
AC overcurrent protection	Yes	
AC short-circuit protection	Yes	
AC overvoltage protection	Yes	
Over-heat protection	Yes	
Arc fault protection	Yes	
Battery charging from grid	Yes	

Main Components – Rapid Shutdown

TS4-A-2F

Module-level PV Rapid Shutdown for two modules

The TS4-A-2F (Fire Safety) is the advanced add-on rapid shutdown solution that brings smart module functionality to standard PV modules for higher reliability. Ensure safety by upgrading existing PV systems or by adding safety features to new installations.

The TS4-A-2F complies with NEC 2017 & 2020 690.12 Rapid Shutdown specifications when installed with the Tigo RSS Transmitter or an inverter with built-in Tigo certified transmitter.

Electrical Data	15A	25A
Maximum input voltage (per input)	80V	
Operating voltage range[1]	16 - 80V	
Maximum input current (Isc)	N/A	25A per input
Maximum input current (Imp)	15A per input	20A per input
Maximum wattage (total)	1000W (500W per input)	1400W (700W per input)

[1]Maximum output voltage of the TS4 is dependent on the PV module voltage. Refer to PV modules nameplate.

Connections	
Module Conductor lengths[2]	0.12/1.2/1.3m, options available[2]
String Conductor lengths	2.2/2.4m, options available[2]
Connectors[2]	MC4, EVO2, options available[2]

[2]Contact sales for additional connector and conductor length options. MOQ may apply.

General Data		
Operating temperature range	-30°C to +80°C (-22°F to +176°F)	
Storage temperature range	-40°C to +85°C (-40°F to +185°F)	
Recommended fuse rating	20A	30A
Outdoor rating	IP68	
Maximum altitude	3000m	
Efficiency	99.9%	
Communication	PLC	
Rapid Shutdown UL Listed (NEC 2017 & 2020 690.12)	Yes	
Rapid Shutdown Time Limit	30 secs or less[3]	
Conductor AWG Range	10-12 AWG	
PVRSE Controlled Conductors	≤30 Vdc, ≤240VA, ≤8A[3]	

[3]Limits are based on NEC 690.12 rapid shutdown requirements.

Main Components – Rapid Shutdown

As stated on PEC 2017, 6.90.2.6:

PV System circuits on or in buildings shall include a rapid shutdown function to reduce shock hazards for emergency responders in accordance with

A. Controlled conductors.

- Requirements for controlled conductors shall apply to PV circuits supplied by the PV system.

B. Controlled Limits.

- The use of the term *array boundary* in this section is defined as 305mm from the array in all locations.
- Outside the array boundary- controlled conductors located outside the boundary of more than 1000mm from the point of entry inside a building shall be limited to no more than 30Vdc within 30 secs of rapid shutdown initiation. The voltage shall be measured between any two conductors and between any conductor and ground.

Initiating Rapid Shutdown

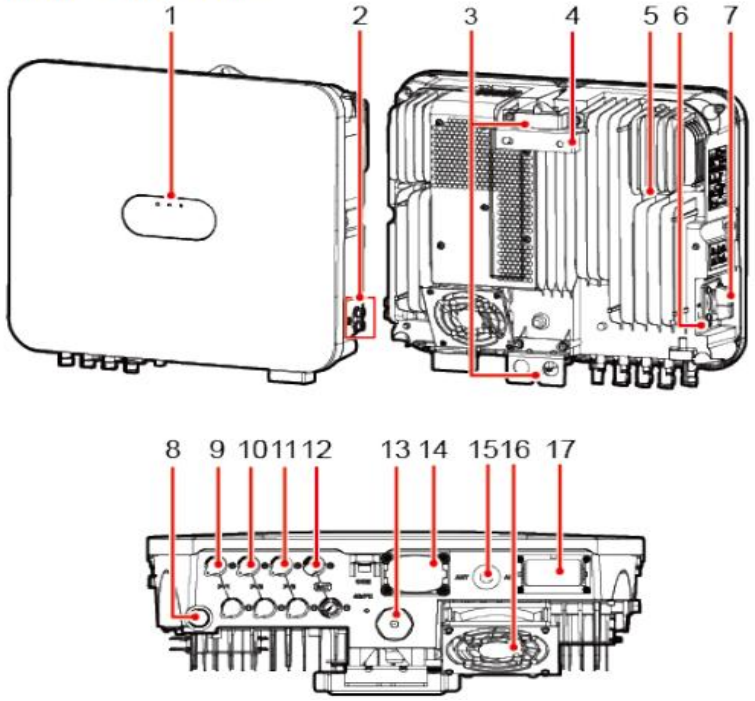
- Rapid Shutdown can be initiated by one of the following methods:
- The inverter AC breaker is turned OFF, or AC to the inverter is disconnected by another method (intentionally or as the result of a fault)
- The DC switch is turned OFF (applicable only to inverters with a DC safety Unit)

Inverter Operation

Provides details on the status of the inverter based on the indicators.

Appearance and Ports

Figure 2-6 Appearance



(1) LED indicators

(2) Ground screws

(3) Hanging kits

(4) Mounting bracket

(5) Heat sink

(6) DC switch locking screw hole[1]

(7) DC switch (DC SWITCH)

(8) Ventilation valve

(9) DC input terminal (PV1+/PV1-)

(10) DC input terminal (PV2+/PV2-)

(11) DC input terminal (PV3+/PV3-)

(12) Battery terminal (BAT+/BAT-)

(13) Smart Dongle port (4G/FE)

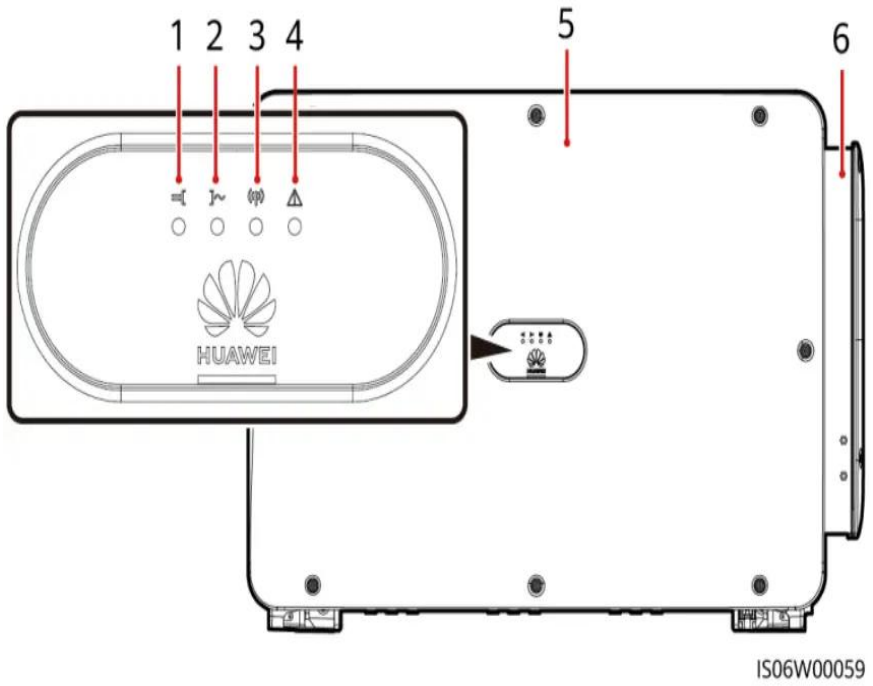
(14) Communications port (COM)

(15) Antenna port (ANT)

(16) Fan[2]

Inverter Operation

Provides details on the status of the inverter based on the indicators.



LED Indicator

The LED indicator on the front of the inverter indicates the working state of the inverter.

Category	Status		Description
Running indication 	**LED1**	**LED2**	–
	Steady green	Steady green	The inverter is running in grid-tied state.
	Blinking green slowly (on for 1s and off for 1s)	Off	The DC is on and the AC is off.
	Blinking green slowly (on for 1s and off for 1s)	Blinking green slowly (on for 1s and off for 1s)	Both the DC and AC are on, and the inverter is off-grid.
	Off	Blinking green slowly (on for 1s and off for 1s)	The DC is off and the AC is on.
	Steady yellow	Steady yellow	The inverter is running in off-grid state.
	Blinking yellow slowly	Off	The DC is on and the inverter has no output in off-grid state.
	Blinking yellow slowly	Blinking yellow slowly	The inverter is in off-grid overload state.
	Off	Off	Both the DC and AC are off.
	Blinking red fast (on for 0.2s and off for 0.2s)	–	There is a DC environmental alarm, such as **String Voltage High**, **String Reverse Connection**, or **Low Insulation Resistance**.
	–	Blinking red fast (on for 0.2s and off for 0.2s)	There is an AC environmental alarm, such as **Grid Undervoltage**, **Grid Overvoltage**, **Grid Overfrequency**, or **Grid Underfrequency**.
	Steady red	Steady red	A fault exists.

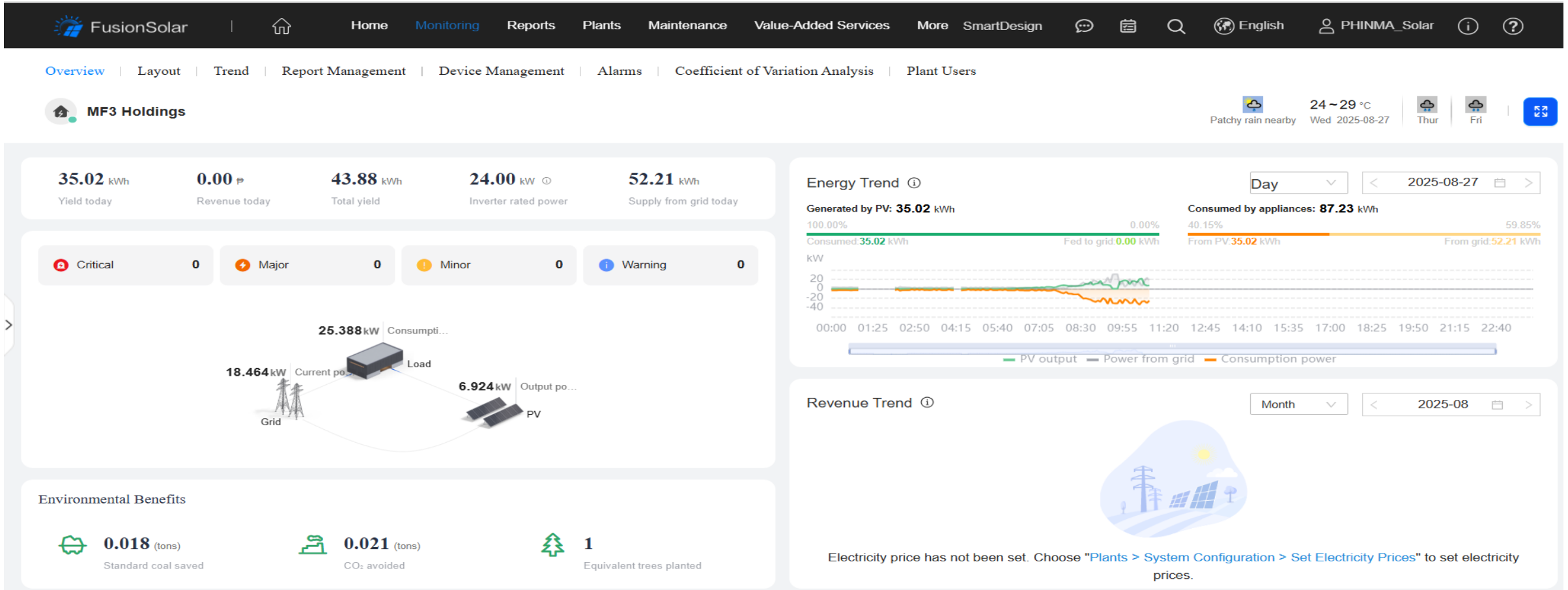
Category	Status			Description
Communication indication 	**LED3**			–
	Blinking green fast (on for 0.2s and then off for 0.2s)			Communication is in progress.
	Blinking green slowly (on for 1s and off for 1s)			A mobile phone is connected to the inverter.
	Off			There is no communication.
Device replacement indication	**LED1**	**LED2**	**LED3**	–
	Steady red	Steady red	Steady red	The inverter hardware is faulty and needs to be replaced.

Online Monitoring via FusionSolar

USING LAPTOP: https://sg5.fusionsolar.huawei.com/

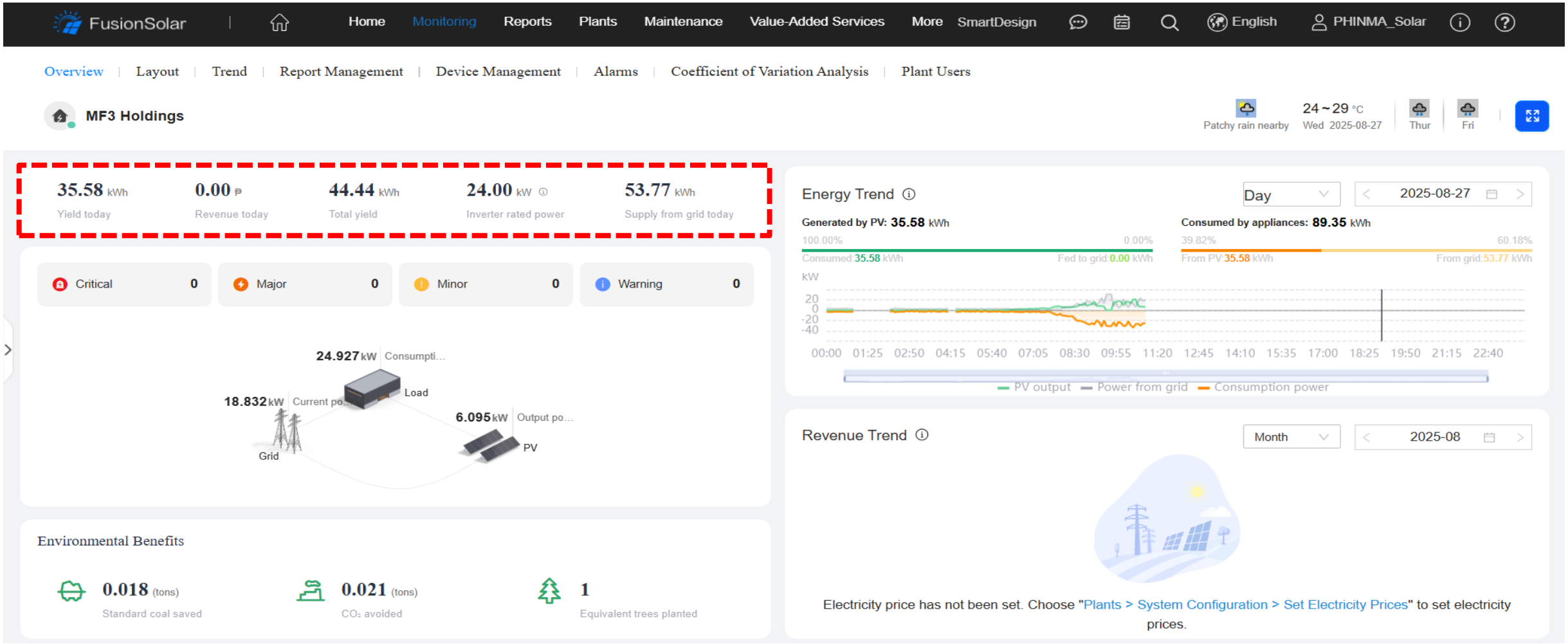
Online Monitoring via FusionSolar

2. Enter the username/email and password to access dashboard
https://sg5.fusionsolar.huawei.com/



Online Monitoring via FusionSolar

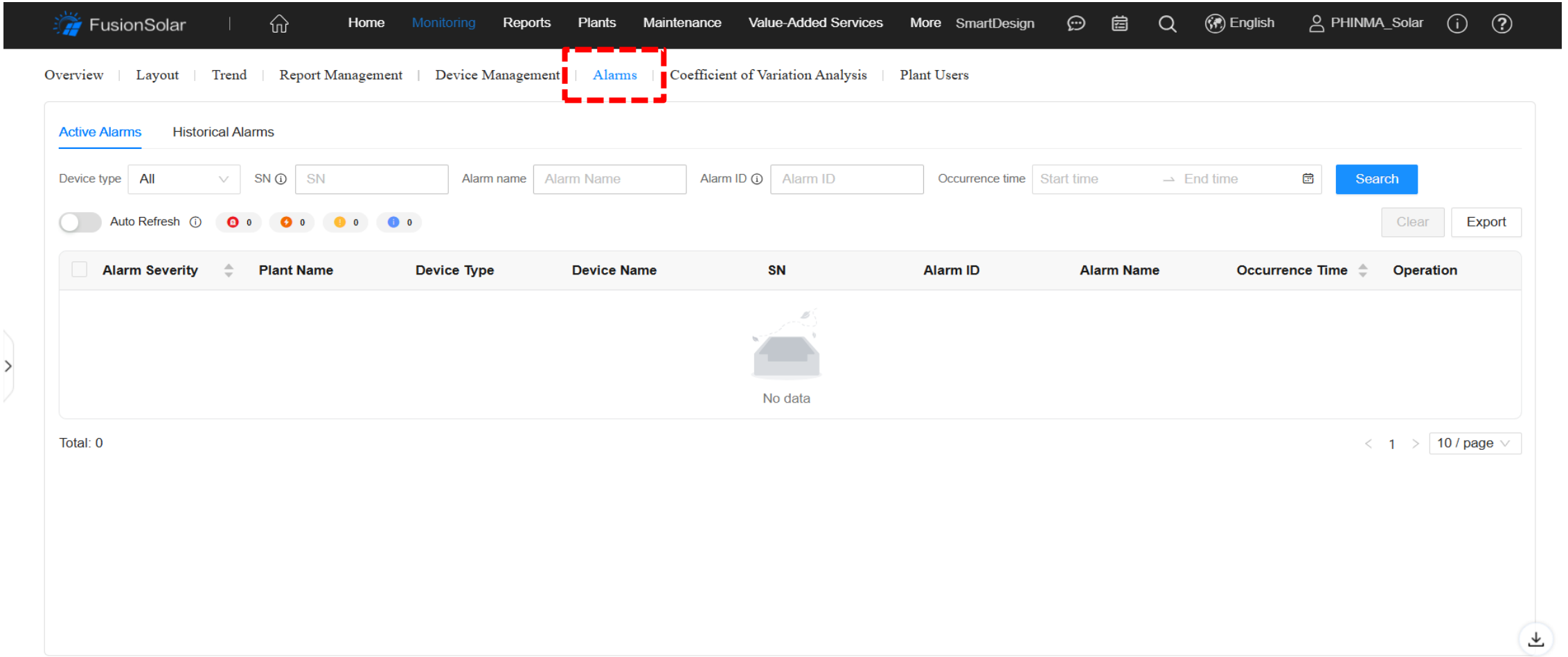
To see the energy yielded by the solar PV system



UNION SOLAR BY PHINMA SOLAR

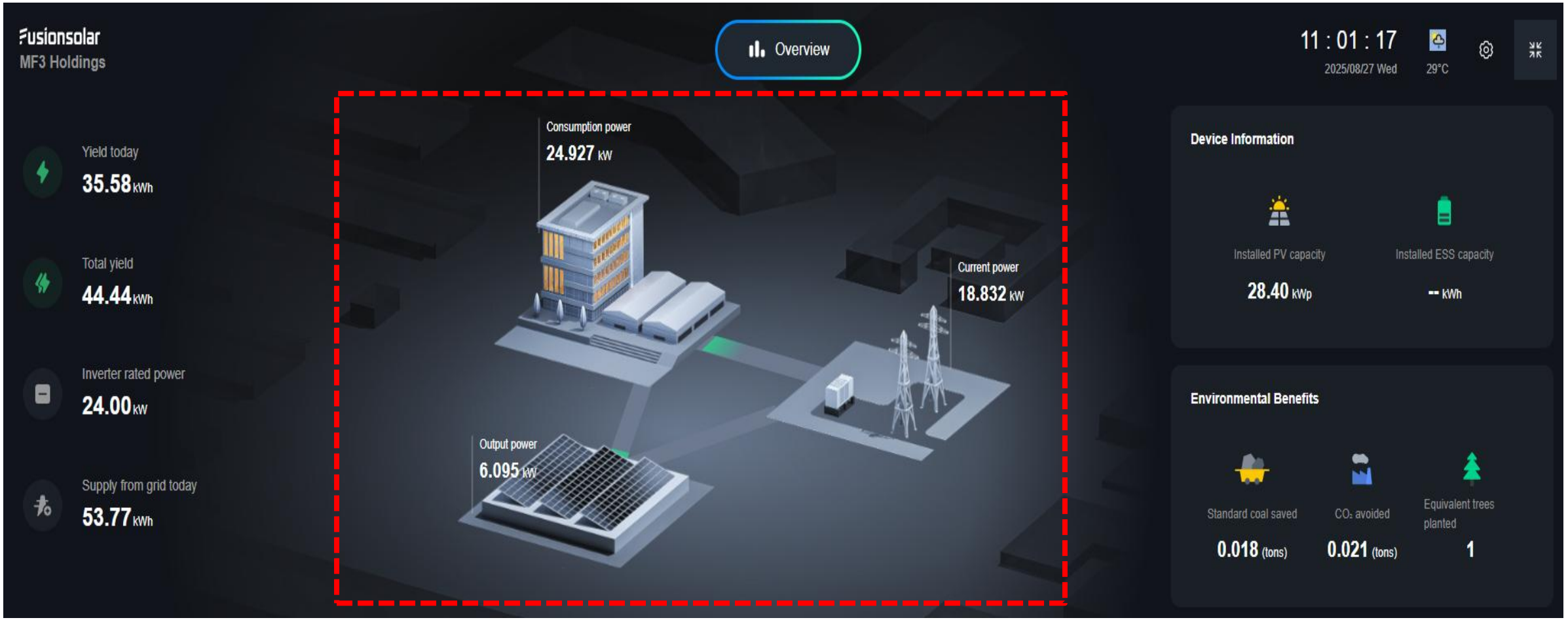
Online Monitoring via FusionSolar

To see if there are active/ running alarms:



Online Monitoring via FusionSolar

To see the active production (real-time)



Shutting down the Inverter for Troubleshooting:

- Step 1 Wear proper personal protective equipment (PPE).
- Step 2 If the solar inverter is not shut down due to a fault, send a shutdown command on the app or management system. If the solar inverter has shut down due to a fault, go to the next step.
- Step 3 Turn off the AC switch between the solar inverter and the power grid.
- Step 4 Measure the DC current of each PV input string using a clamp meter that is set to the DC position. If the current is less than or equal to 0.5 A, go to the next step. If the current is higher than 0.5 A, wait until the solar irradiance decreases and the PV string current decreases below 0.5 A at night, and then go to the next step.
- Step 5 Open the maintenance compartment door, install a support bar, and use a multimeter to measure the voltage between the AC terminal block and the ground. Ensure that the AC side of the solar inverter is disconnected.
- Step 6 Turn off all DC input switches of the solar inverter.
- Step 7 Wait for 15 minutes and troubleshoot or repair the inverter.

Shutdown Procedure

Quick Shutdown

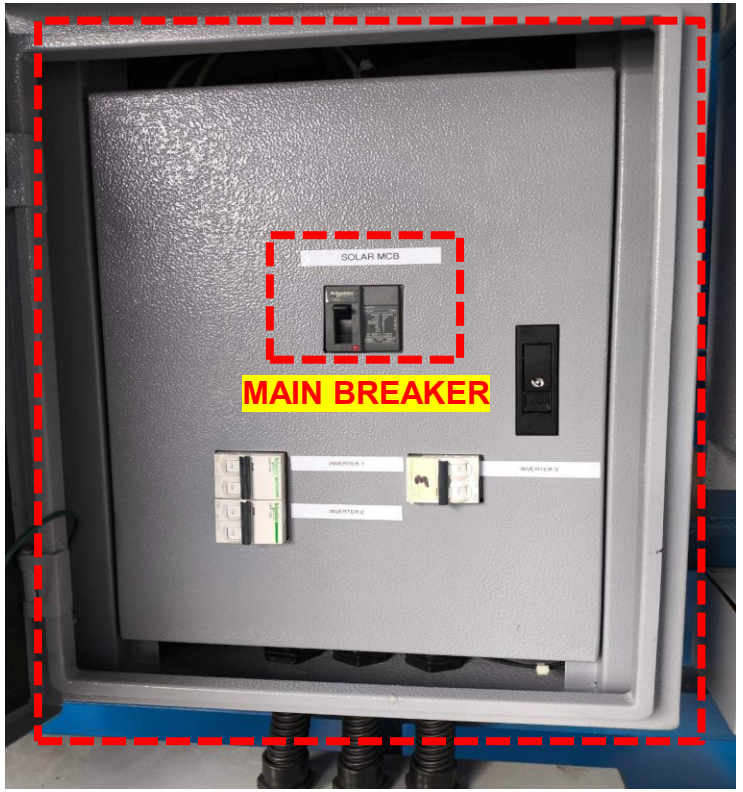
The PV system can perform a quick shutdown, reducing the output voltage of strings to below 30 V within 30 s.

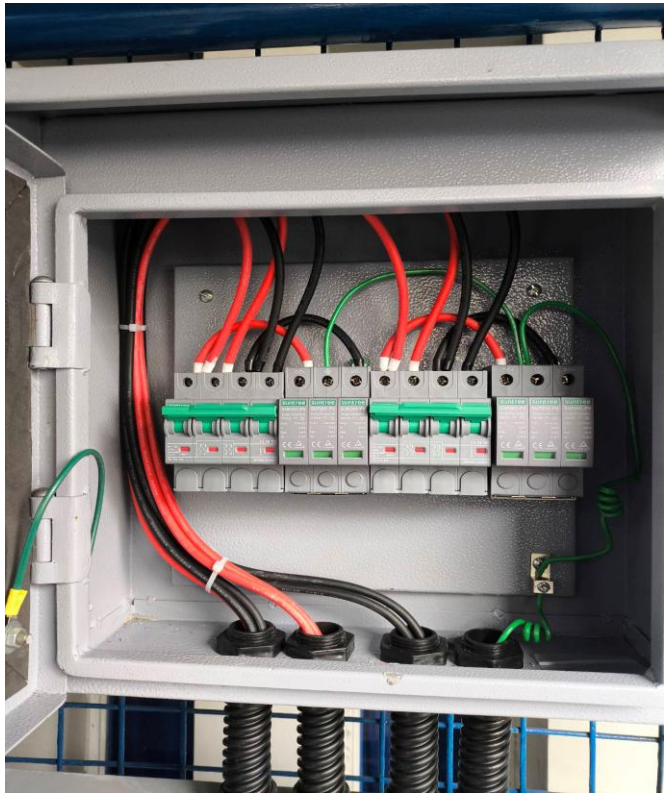
Triggering methods of quick shutdown:

- Method 1: Turn off the AC circuit breaker between the inverter and the grid.

Shutdown Procedure

2. Located above the inverter, open the AC COMBINER BOX and switch OFF the Main Circuit Breaker then the branch circuit breakers below.





AC COMBINER BOX

- Follow the abovementioned procedure in **REVERSE** when **RE-ENERGIZING** the system.

Shutdown Procedure

Shutting down of inverter/s is NOT required for the following activities/situations:

- In case of grid failure – inverters automatically cut off from the system until power from the grid is restored. This is the “anti-islanding” feature of the inverter, the purpose of which is to protect the electrician from electrical hazards as the PV system is still “live” and capable of feeding voltage into the grid
- During nighttime
- Cleaning of the solar PV panels
- Reading of data

Maintenance Warnings

- WARNING: Do not attempt to clean or come in contact with the surface of a solar module with broken glass. This could result in a dangerous electric shock.
- WARNING: Do not attempt to clean or come in contact with the surface of a solar module with broken glass. This could result in a dangerous electric shock.
- WARNING: Solar modules remain live during daylight hours, even when the DC isolator is off. Therefore, wiring etc. will still be energized even when the DC isolators are off. Hazardous voltages are present whenever solar panels are exposed to light.
- WARNING: The system should be shut down following the shutdown procedure before performing any maintenance.
- WARNING: Read and obey all warning signs before performing any maintenance
- CAUTION: Appropriate precautions must be taken when working at heights. Do not attempt to access the roof unless the precautions to prevent falling from heights are in place. PHINMA Solar recommends that only PHINMA Solar contact persons/certified electrician who have been trained to work at heights conduct all solar system maintenance at height.

Basic Maintenance

a) Build-up of dust or dirt on the module(s) upper part will result in a decreased energy output. Clean the module(s) preferably once per annum if possible (depending on site conditions) using a soft cloth, dry or damp, as necessary.

b) Never use abrasive material under any circumstances.

c) Examine the PV module(s) for signs of deterioration. Check all wiring for possible rodent damage, and weathering and that all connections are tight and corrosion free. Check electrical leakage to the ground.

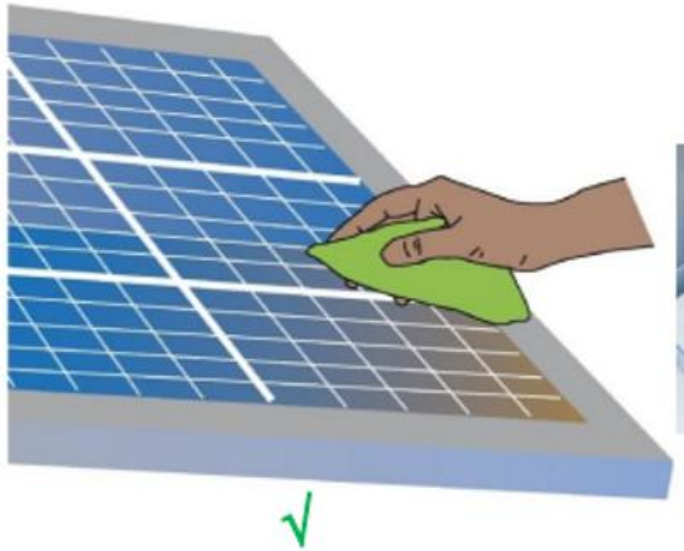
d) Check fixing screws and mounting brackets are tight, adjust and tighten as necessary.

e) Thermal scanning of termination and connectors.

f) Scheduling of preventive maintenance.

Basic Maintenance

1. Clean solar panel with soft cloth or soft mop and water anytime it is dirty. Do this when panels are cool and do not use soap/detergent for cleaning. Also do not step on the solar panel nor use pressure washers for cleaning.



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2. Trim trees that may create shade over the panels.
3. Clean inverter, DC and AC (Energy) box, and batteries when dusty with a dry soft cloth or soft hand dusting brush.
4. Do not touch module terminals with metal objects; otherwise, you can get an electric shock.
5. Check connections for loose contact/connections and tighten them.

Drone Shot Photos

END OF PRESENTATION