

November 2023

**EXAMPLE 5.4KW solar array (500 Watt load) 600 AH Lithium battery
Solar Installation instructions**

Table of Contents

1	Requirements	2
2	Solution components	2
2.1	Solar panels	2
2.2	Solar array.....	4
2.3	MPPT Solar Controller.....	4
2.4	Equipment and Battery Cabinet	5
2.5	Combiner Box.....	6
2.6	Batteries.....	7
3	Detail of installation.....	8
3.1	Handling and Installing Solar Rack	8
3.2	Tools required	8
3.3	Solar array components identification	9
3.4	Solar array details.....	9
3.4.1	Foundation screws and bracket	9
3.4.2	Front and back legs	9
3.4.3	Tilt beam	9
3.4.4	Rail	10
3.4.5	End-Clamp.....	10
3.4.6	Mid-Clamp.....	10
3.5	Mounting brackets detail.....	11
3.6	Installation of solar panels using mid clamp and end clamp kits	12
3.7	Installation of tilt beam	13
3.8	Installation of rail	13
3.9	Wiring between photovoltaic modules	15
3.10	Combiner Box.....	15
3.11	Wiring schematic	16
3.12	Surge Arrestor installation.....	16
3.13	Combiner box / MPPT Controller / Batteries connections	16
3.14	Equipment & Battery cabinet specifications.....	17
3.15	Battery installation	18
3.16	Recommended battery parameters of controller.....	21
3.17	RS485 Monitoring and configuration software	22
3.18	SNMP Monitoring software	22
3.19	Cable protection	23
3.20	Battery cabinet free-cooling fans.....	23
3.21	Surge Arrestors and Grounding	24
3.22	Solar panel grounding connections	25
3.23	BOQ.....	26

1 Requirements

500 Watt/48V load work 24 hours every day, 2.5 days battery autonomy, DOD=100% Lithium
Tilt 15°, Azimuth 0°
5400 Watt Solar Array, total 4 strings, each string has 3 pcs ESM450-MH in series, 48V600Ah battery bank

2 Solution components

2.1 Solar panels

12 x ESM450-MH (450W/34.7V) Polycrystalline panels

SOLAR MODULE

**Mono with half-cut 7
inch 120 cells (430~455W)**


120 Cells


430-455W
Power output range


21.02%
Maximum efficiency


0 / +5W
Power output tolerance

-  The most flexible solution for any rooftop condition and orientation
-  Sand blowing test, salt mist test and ammonia test passed to endure harsh environments
-  Selected encapsulating material and stringent production process control ensure the product is highly PID resistant and small trails free
-  Optimized system performance due to module level current sorting
-  Special cutting and soldering technology leads to low hotspot risk
-  Highly transparent self-cleaning glass brings additional yield and easy maintenance

Comprehensive Products and System Certificates

- Complies with IEC61215, IEC61730, and IEC61701 standards.
- ISO9001: Quality Management System
- ISO14001: Environmental Management System
- German TUV NORD certification.
- German VDE certification.
- UL certification.





















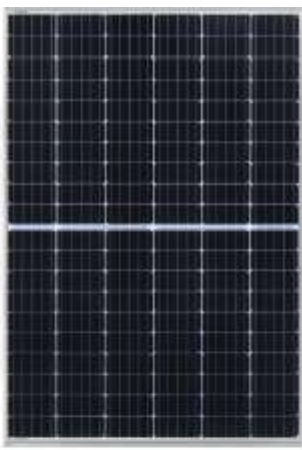
WE MAKE SOLAR ENERGY MORE EFFICIENT AND SIMPLE!

 High module conversion efficiency through half-cut, PERC, 182mm high efficiency cell and 11 multi busbar.

 Easy installation and handling for various applications.

 Entire module certified to withstand high wind loads (2400Pa) and snow loads (5400Pa).

 ISO9001, ISO14001, OHSAS18001



 10 years material and workmanship guarantee

95% power output guarantee for 5 years
90% power output guarantee for 10 years
80% power output guarantee for 25 years

EverExceed will not accept responsibility for damage caused to other equipment.

Contact EverExceed to receive our latest product information





Electrical Characteristics

Model	ESM-430MH	ESM-435MH	ESM-440MH	ESM-445MH	ESM-450MH	ESM-455MH
Type of Cell	Monocrystalline silicon					
Cell Size	182x91mm					
Module Efficiency	19.86%	20.09%	20.33%	20.56%	20.79%	21.02%
Cell Configuration	120(6x20)					
Size of module	1909x1134x35mm					
Weight per piece	23.9kg					
Maximum power (Pmp)	430W	435W	440W	445W	450W	455W
Maximum power voltage (Vmp)	33.89V	30.09V	34.28V	34.48V	34.67V	34.87V
Maximum power current (Imp)	12.69A	12.77A	12.84A	12.91A	12.98A	13.05A
Open circuit voltage (Voc)	40.65V	40.80V	40.95V	41.10V	41.25V	41.40V
Short circuit current (Isc)	13.59A	13.67A	13.74A	13.82A	13.89A	13.97A
Power Tolerance	0→5W					

Operation Characteristics

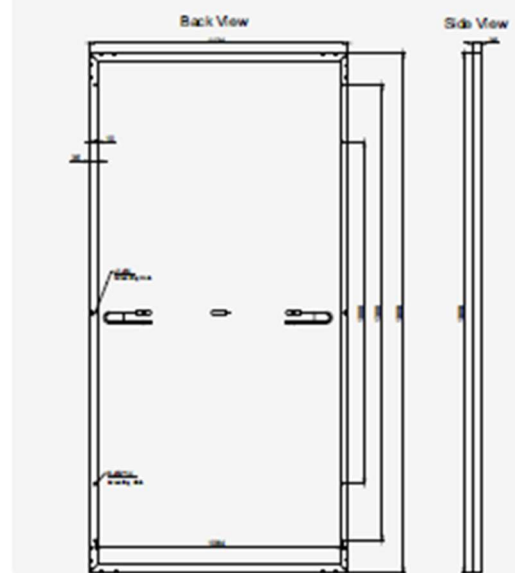
Maximum system voltage	1500VDC
Temperature coefficients of Isc	0.046%/°C
Temperature coefficients of Voc	-0.276%/°C
Temperature coefficients of Pm	-0.350%/°C
NOCT	45°C±2°C
Operating temperature range	-40°C→+85°C
Surface maximum load capacity	60m/s (200kg/m²)
Series fuse rating	25A

Mechanical Characteristics

Junction box type	IP68 rated
Connectors and cables type	MC4 / 4mm²
Length of cables	300mm ± 5mm
Frame (material, corners, etc.)	Anodized aluminum alloy
Glass	High transmissivity low-iron 3.2mm toughened glass



Dimension



2.2 Solar array

1 x 12-Panel structure as per below.



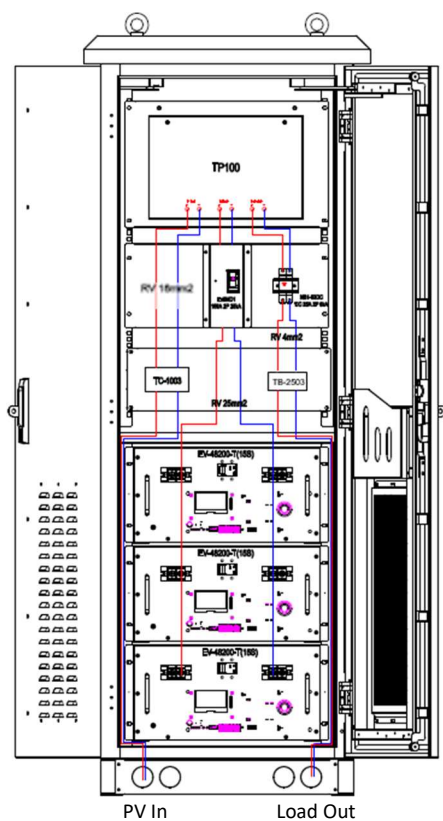
2.3 MPPT Solar Controller

1 x TP100 High Conversion Efficiency MPPT Solar Controller

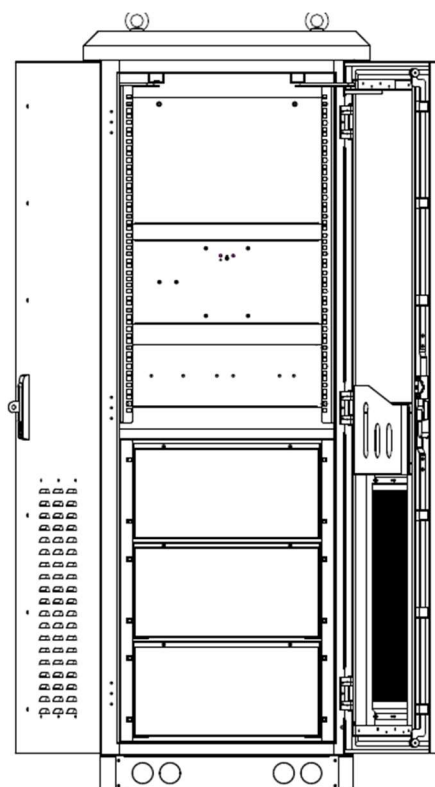


2.4 Equipment and Battery Cabinet

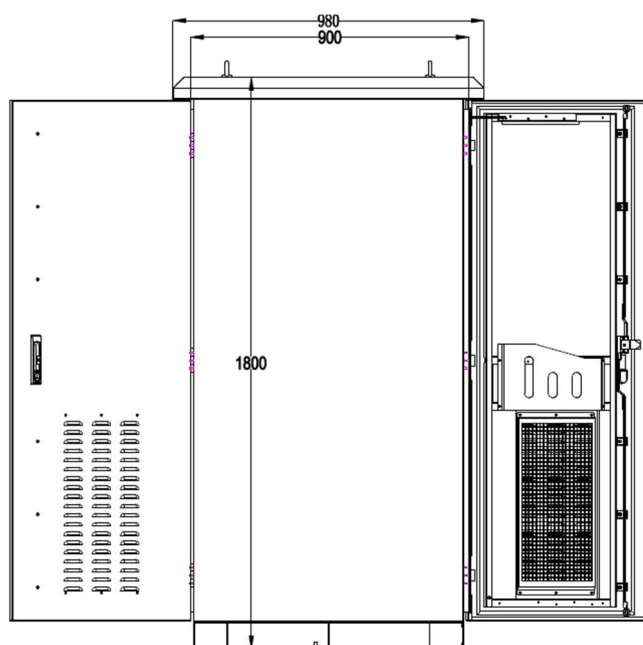
1 x Equipment and Battery Cabinet combined



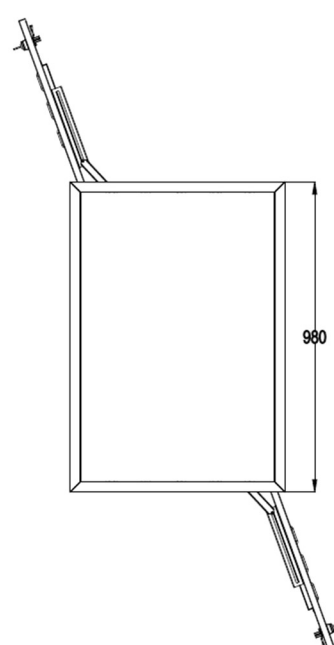
Front



Rear



Front



Top

2.5 Combiner Box

1 x Combiner Box (SCB6 – 6 In / 1 Out)



- ✧ Equipped with PV dedicated arrestor
- ✧ With function of arrestor failure alarm
- ✧ RS485 communication port (optional)
- ✧ The polarity reverse protection(optional)
- ✧ High voltage miniature circuit breaker control output



Combiner box

Internal Surge Arrestor

Technical Specification

Specification		Model	SCB3	SCB4	SCB5	SCB6	SCB8	SCB10
Input	Voltage Range (VDC)		0~500V					
	PV Array Input Sting No.		3	4	5	6	8	10
	Rated Current (A) of Each Circuit		10					
	Positive and negative fuse		15A(Optional circuit breaker)					
	Anti-reverse diode		Optional					
Output	Voltage Range (VDC)		0~500V					
	Output No.		1					
	Max. Voltage Fall		300mV					
	Max. Current (A)		30	40	50	60	80	100
	Breaker		Yes					
Others	Protection Level		IP65					
	Arrester Index		It can endure 20KA surge strike at the 8/20us					
	Insulation Resistance		Under the 15℃~35℃ temperature environment, insulation resistance between input or output circuit and ground ≥2MΩ.					
	Insulation Intensity		After removing the arrester, it can endure the AC 50Hz/1500V/60s without the phenomenon of breakdown and flashover between input or output circuit and ground, and the leakage current <30mA.					
	Safety		Breaker handle is short enough to prevent the operator from touching the electrified body and breaker operating handle during the operation.					
	SPD Protection		Yes					
	Dimension (LxWxH)		400*300*160mm			420*560*170mm		
Working Environment	Weight (KG)		8.5	9	9.5	10	15	15
	Radiation Shield		Antiultraviolet					
	Salt Spray Shield		Salt Spray Proofing					
	Mildew Shield		2 Grades					
	Relative Humidity		≤95% (Non Condensation)					
	Work Temperature		-30℃~70℃					
	Cooling Way		Natural Cooling					

2.6 Batteries

3 x 200 Ah 48 volt Lithium batteries



Specifications

Nominal Characteristics	
Battery Model	LV-48200-B1
Nominal Voltage	48.0 V
Nominal Capacity	200 Ah
Nominal Energy	9600 Wh
Electrical Characteristics	
Recommended Charging Voltage	54.0-54.7 V
Floating Charging Voltage	51.5-52.0 V
Recommended Charging Current	50 – 100 A
Maximum Discharging Current	100 A
Discharging Cut-off Voltage	40.5 V
Working Voltage Range	40.5-54.7 V
Operating Conditions	
Cycle Life	≥3000 Cycles @ 100% DOD
Roundtrip Efficiency	≥98%
Operating Charge Temperature	0°C to +50°C
Operating Discharge Temperature	-20°C to +60°C
Storage Temperature	-20°C to +60°C
Mechanical Characteristics	
Length x Width x Height	483 x 630 x 222 mm
Weight	85 Kg
Terminal	M6
Optional Functionality	
Remote Monitoring	SNMP

3 Detail of installation

Safety and Installer Responsibilities



INSTALLATION OF THIS PRODUCT IS TO BE PERFORMED ONLY BY PROFESSIONALLY TRAINED INSTALLERS. Any attempt by an unqualified person to install this product could result in death or serious injury.



WARNING: indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury. This symbol is not used for hazards relating to property damage unless there is also a risk of personal injury to this level.



CAUTION: indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to draw attention to unsafe practices that may cause damage to property.

3.1 Handling and Installing Solar Rack

It is critically important to observe standard safety practices when installing Solar Racking Components;

- Stop work during stormy weather as Solar modules can be blown in high winds;
- Never step or sit on the glass surface of a solar module. The glass may break, resulting in shock or bodily injury;
- Do not throw or roughly handle any Solar Racking components;
- Do not bring Solar Racking Components into contact with sharp or heavy objects;
- Do not modify Solar Racking components in any way without authorization;
- Products should be installed and maintained by qualified personnel. Keep unauthorized personnel away from solar modules;
- It is the installer's responsibility to verify the integrity of the structure to which Solar Racking is fixed. Roofs or structures with rotten/rusted bearers, undersized bearers, excessively spaced bearers or any other unsuitable substructure cannot be used with Solar Racking Installation or such structures could result in death or serious injury and will void the warranty

3.2 Tools required

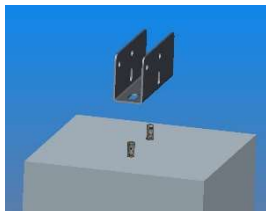
	
6mm metric Allen Key or 6mm hexagonal driver bit.	Drill or impact driver for driving roof material fixings.
	
Measuring tape	Chalk Line Reel
	
Glove	Helmet

3.3 Solar array components identification

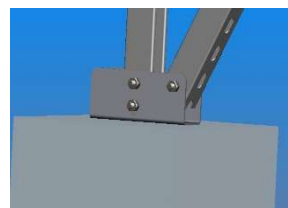
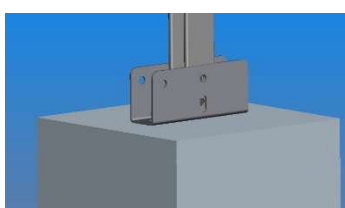
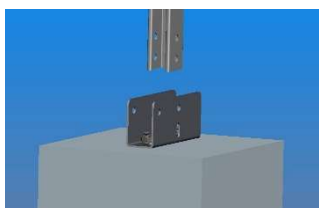
	Foundation			
	Joint			
	Connect bolts for rail and tilt beam			
	Mid Clamp Kits			
	End Clamp Kits			
	U-Ground bolt			
	Rail connector			

3.4 Solar array details

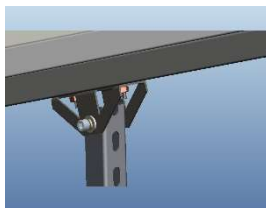
3.4.1 Foundation screws and bracket



3.4.2 Front and back legs

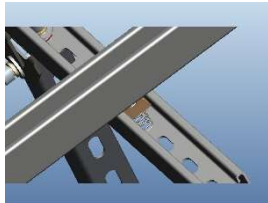


3.4.3 Tilt beam



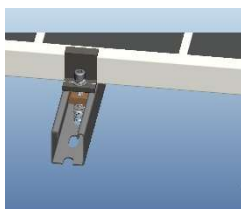
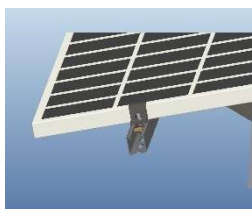
Use joint connect for Tilt beam and leg

3.4.4 Rail



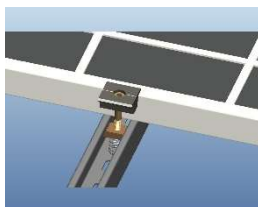
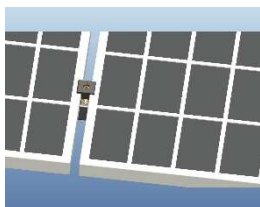
Use nut to connect Rail and Tilt beam (nut without spring)

3.4.5 End-Clamp



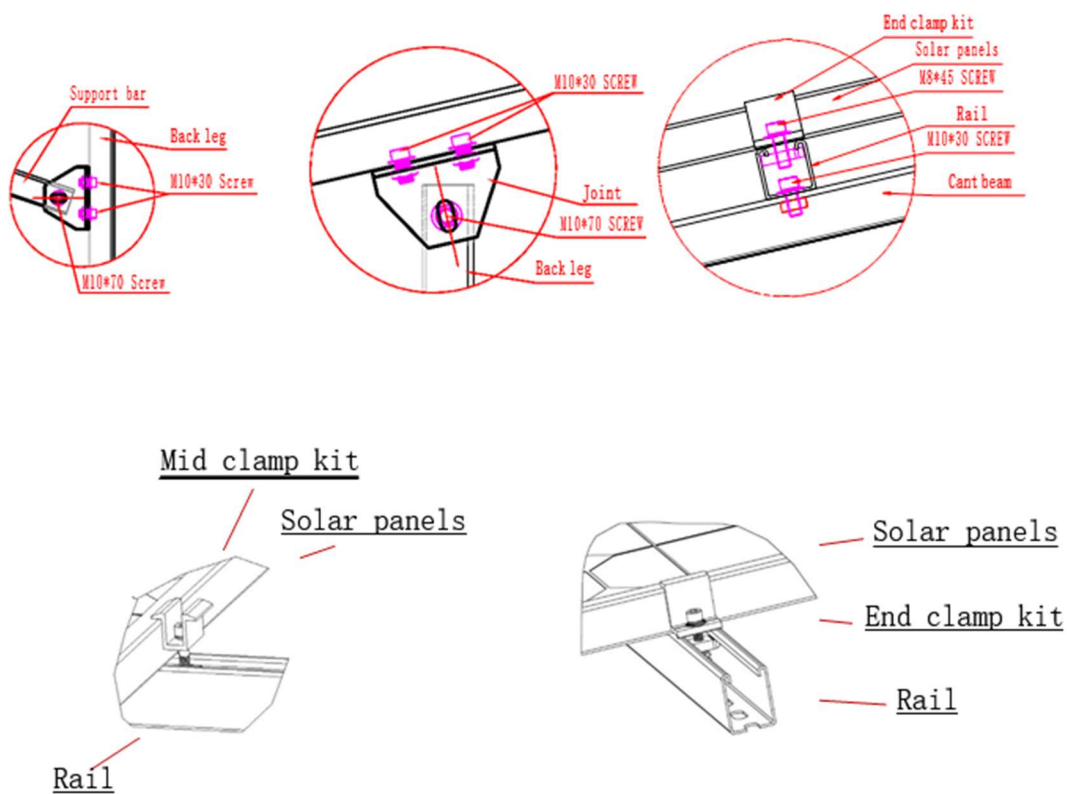
Use End-Clamp to connect Rail and PV

3.4.6 Mid-Clamp

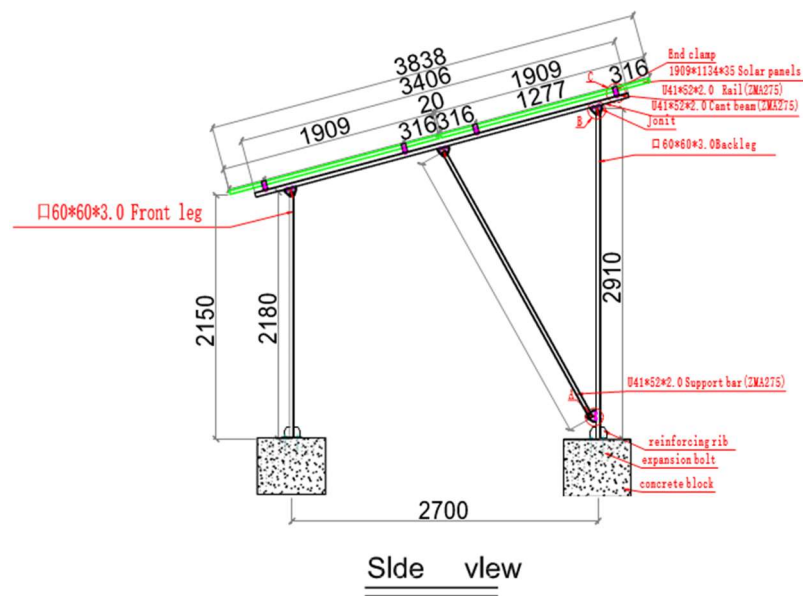
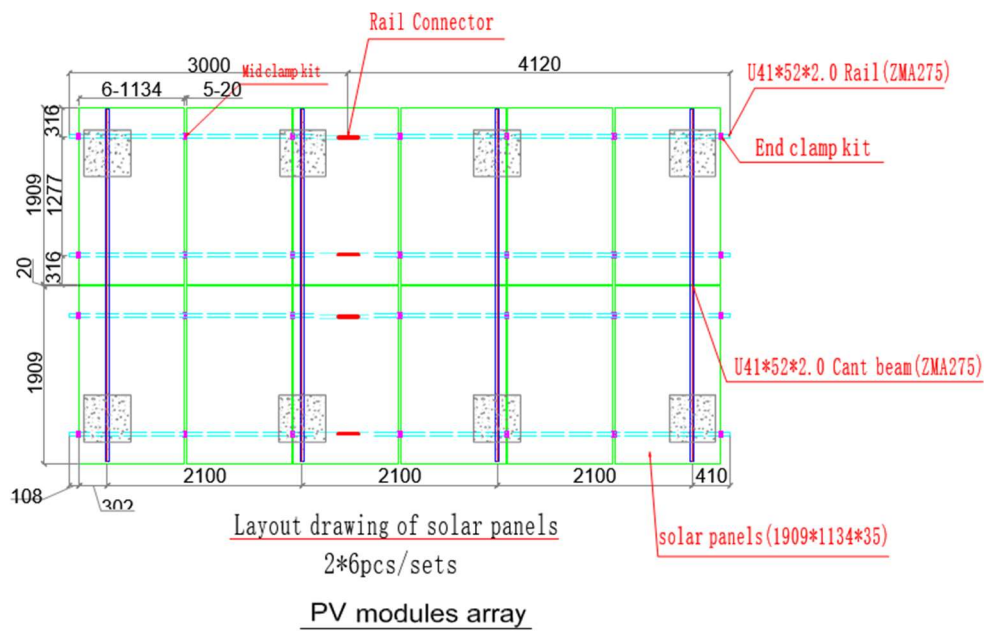


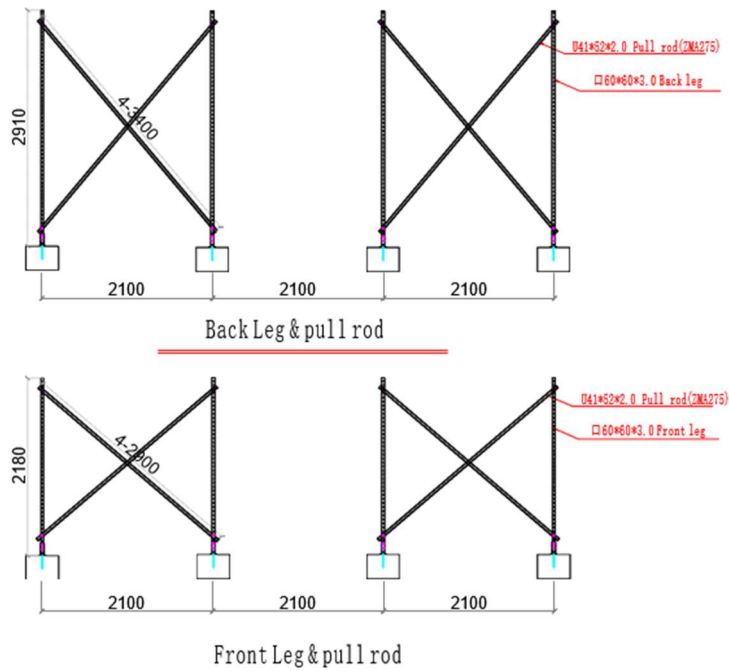
Use Mid-Clamp to connect Rail and PV

3.5 Mounting brackets detail



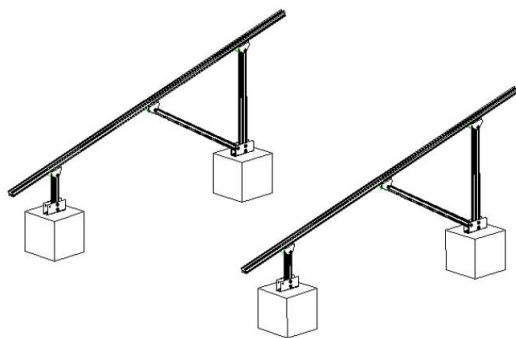
3.6 Installation of solar panels using mid clamp and end clamp kits



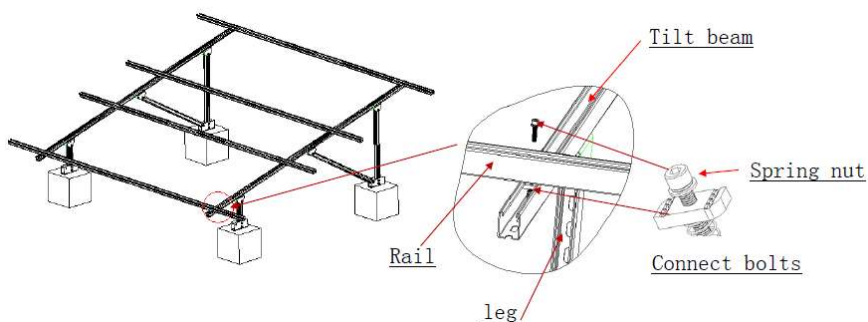


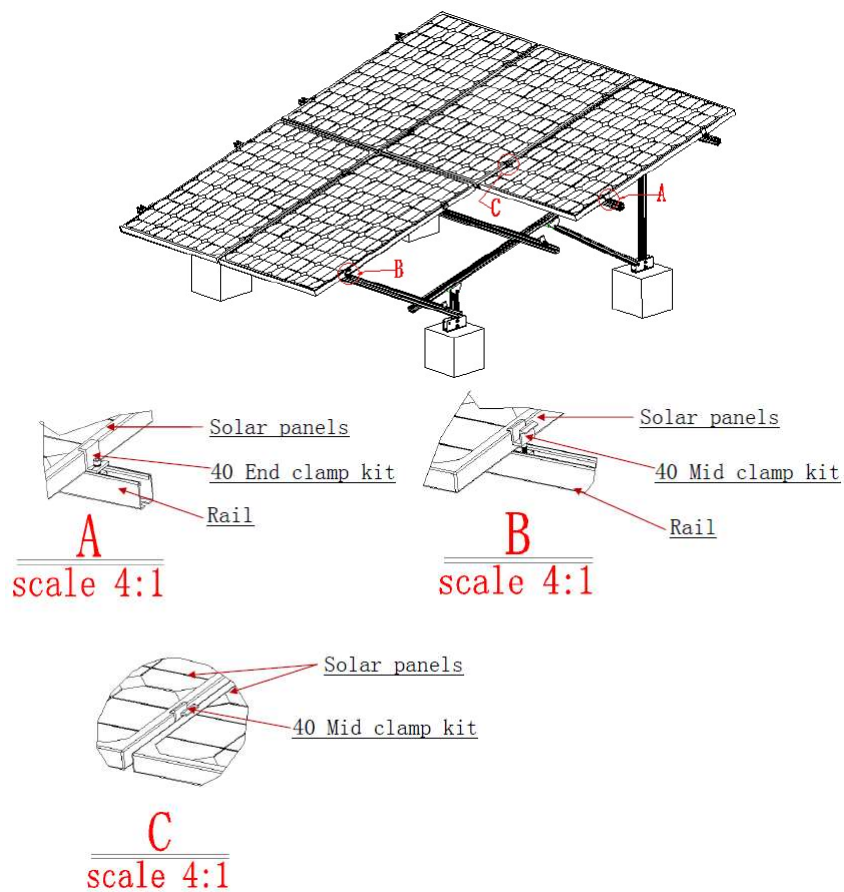
Rear elevation showing sideways stabilisers
Total of 1 of the above arrays containing 12 PV panels

3.7 Installation of tilt beam

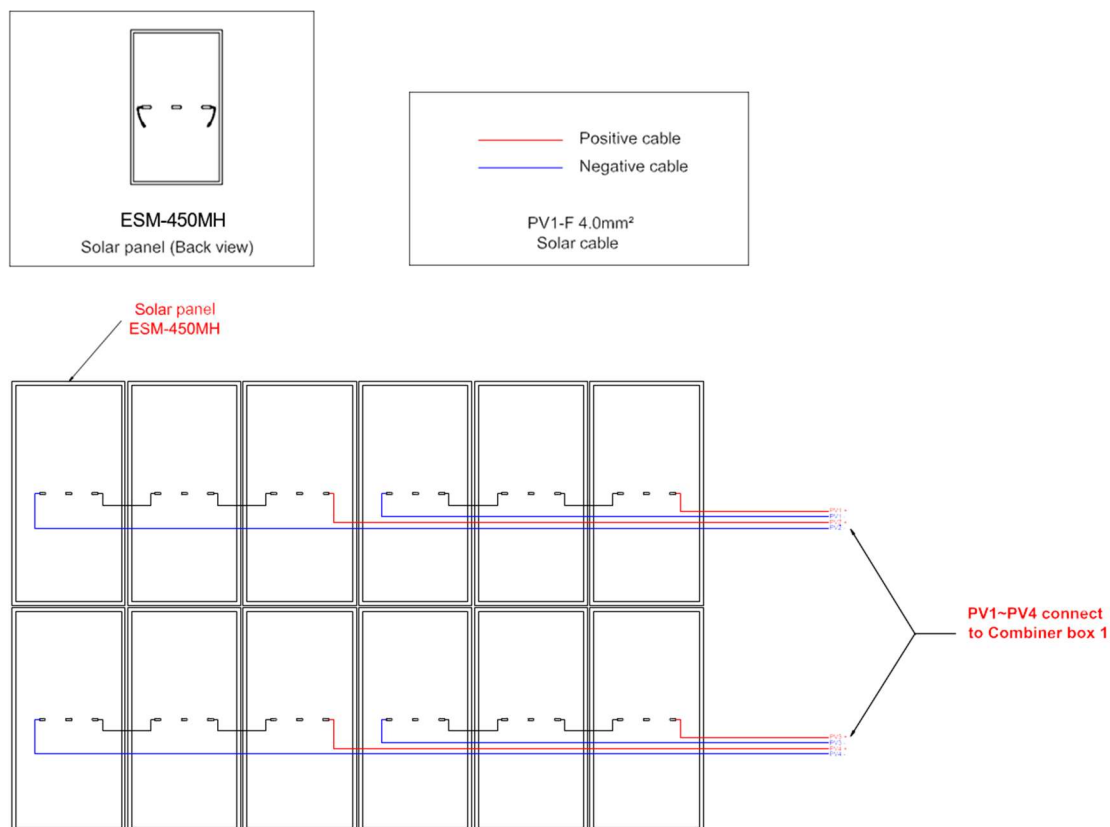


3.8 Installation of rail





3.9 Wiring between photovoltaic modules

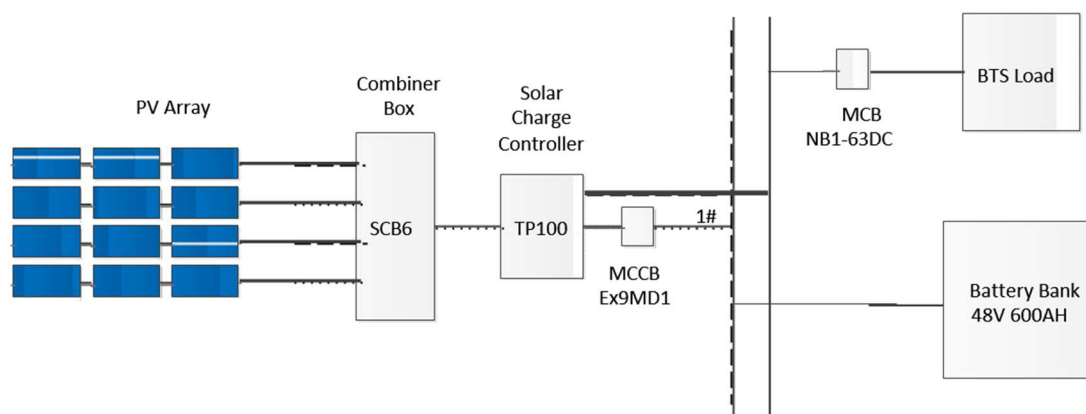


3.10 Combiner Box

There is 1 Combiner Box and it can accept up to 6 PV Strings.
Connect 4 PV Strings (PV1 to PV4 to Combiner Box 1).



3.11 Wiring schematic



3.12 Surge Arrestor installation

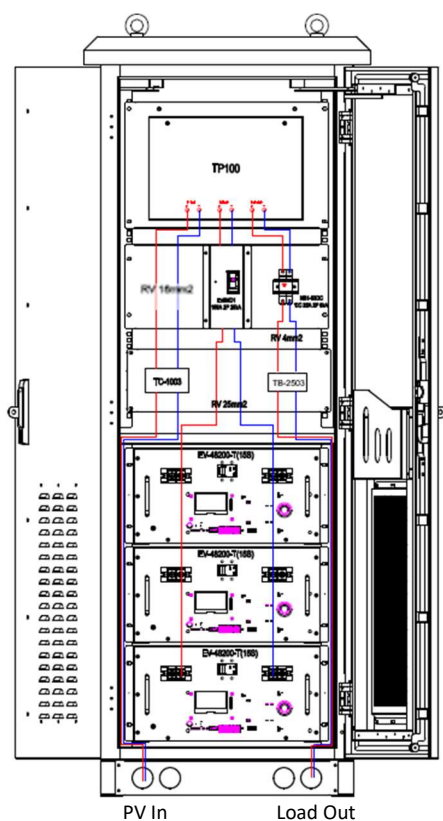
A Surge Arrestor is already provided integrated inside each Combiner Box. It is essential that this is well grounded.

3.13 Combiner box / MPPT Controller / Batteries connections

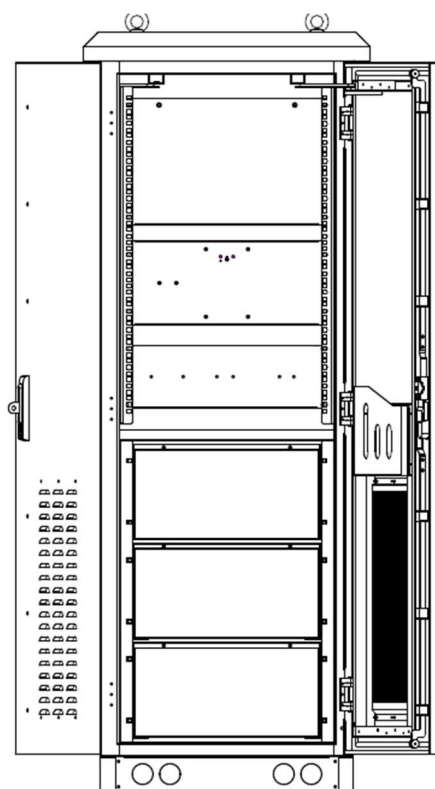
- 1) Note that the Circuit Breaker (MCB) to isolate the PV Array from the MPPT Controller is situated inside the Combiner box and accessed by opening the front door of the Combiner box.
There is an MCB in the Combiner Box.
This may also be used manually for maintenance purposes.
Note that a Surge Arrestor is also situated inside each Combiner box.
- 2) Connect Combiner box (SCB6) to MPPT Controller (TP100) via Terminal TC-1003 using RV 16mm² cable Red & black cable provided.
- 3) Connect MPPT Controller (TP100) (Battery input/output) via MCCB (Ex9MD1) and onwards using RV 25mm² cable Red & black cable provided.
- 4) Connect the Battery Bank to the MCCB (Ex9MD1) using RV 25mm² cable Red & black provided.
- 5) Connect the Load Output from MPPT Controller (TP100) (DC output) to load MCB NB1-63DC (25A 2P 6KA) via Terminal TB-503.

3.14 Equipment & Battery cabinet specifications

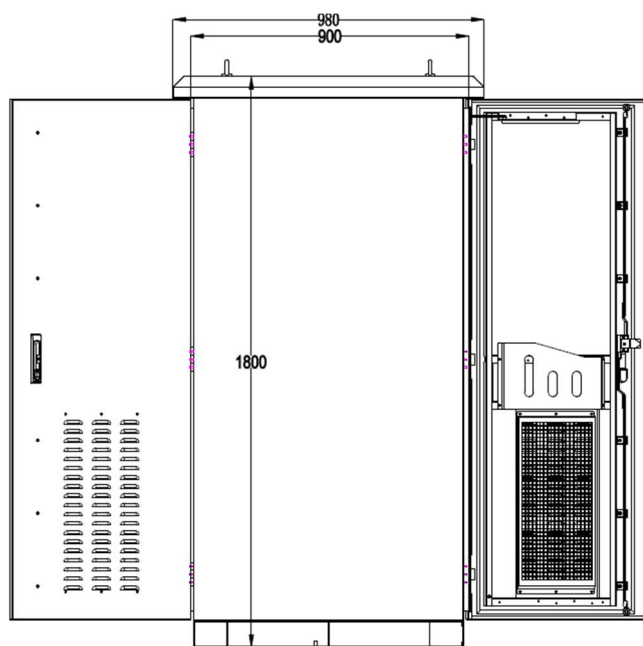
1 x Equipment and Battery Cabinet combined



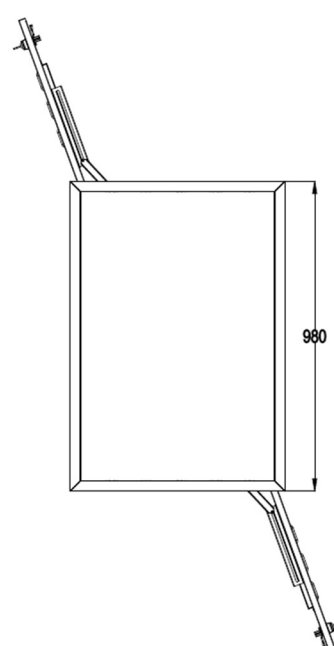
Front



Rear



Front



Top

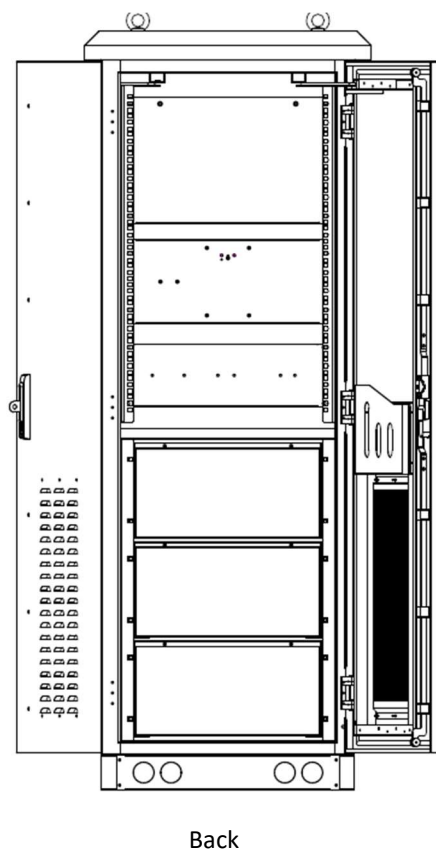
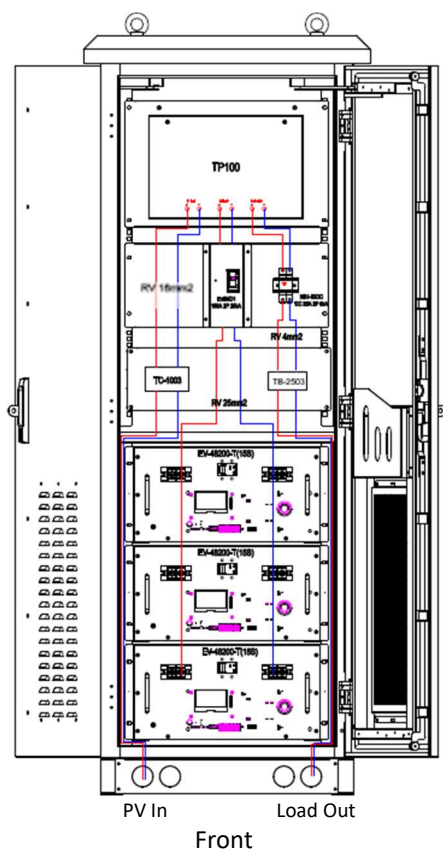
3.15 Battery installation

1. Perform this installation in conjunction with referencing and fully understanding the “MastMinder User manual - Regular Lithium_Battery_V3.7A_20230720.pdf”.
2. Before physically installing, please check the appearance of each battery including its voltage and display for any damage or faults.
3. Install the batteries into the cabinets using the M6 screws and snap nuts as supplied.
4. Connect the fan power cables to the busbar.
5. For this 500-Watt installation it uses 3 batteries (600 AH) in parallel, as per the drawing below. Set the dip switches on the front of each battery to the binary number 1 to 3 to identify each battery in the group (see User Manual for details).
6. Similarly, set the top rightmost dip switch on the number 1 battery of the group ON to identify this battery as the Master of the Group of 3. It will also be the battery where we set the IP Address for remote access for SNMP data extraction (see User Manual for details). Also where we make local PC / RS485 access to the Group of batteries.
7. Similarly, still referencing the batteries into the group of 3 as per the drawing below, connect the parallel RS485 communication cable using standard RJ45 connectors to connect all the batteries within each group (see User Manual for details).
Starting from battery number 1, connect the right-hand RS485 RJ45 to the left-hand RJ45 in battery number 2, then connect the right-hand RS485 RJ45 of battery number 2 to the left-hand RJ45 in battery number 3.
(Use 400mm standard network cable) (These cables are provided in the installation kit).
8. With each battery MCB in the Off (Open) position then physically connect the DC positive & negative cables between each battery and the relative busbars.
The length of the power cables from each battery to the busbar must be the same, to ensure a balance of voltages and currents between batteries.
9. Connect the monitoring software using the PC / USB-RS485 converter to the left-hand RS485 RJ45 on battery number 1 and set the IP address of the battery as detailed in the manual Annex6. (MastMinder User manual - Regular Lithium Battery_V3.7A_20230720.pdf)
10. There are no software settings that need to be made in the batteries other than setting the IP Address as above to facilitate SNMP access.
11. The RS485 monitoring and control software provided is to be used solely for monitoring purposes other than setting the IP Addresses. This software may also be used with the instructions of MastMinder to make updates, otherwise none is necessary.
(There is a separate User Manual document for the RS485 monitoring & control software).
(There is also a download link for the RS485 monitoring & control software provided in the annex to this document)
12. Similarly, the SNMP access is simply for remote monitoring.
13. There is also configuration data below for the TP100 MPPT charge controller, outlining the parameters required to charge a 15-cell Lithium battery with a nominal voltage of 48.0 volts).
14. When all is installed and checked then to make the system operational then turn on the MCB on each of the batteries.

These 600 AH solar storage sites consist of the following configuration.

- Each site consists of 1 fan cooled equipment / battery cabinet.
- Each cabinet contains 3 x 200 AH 48.0 Volt Lithium modules, all connected in parallel.

Layout (as below)



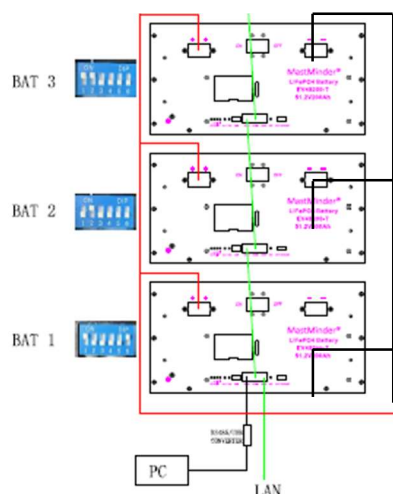
Logical wiring layout and connections.

There are fundamentally two sets of cables connecting all the batteries together as follows.

1. The first is the DC positive and negative cables that connect all the batteries together in parallel then to the Ex9MD1 Breaker via the connector block.
There is nothing special about this other than one important factor that **ALL the cables must be the same length between the battery connections and the connector block.**
This is to ensure that all the batteries have the same resistance in parallel as Lithium batteries are much more sensitive to charging and discharging voltages.
2. The second is the RS485 cables that allows the BMS (Battery Management System) to communicate between the batteries.
For the RS485 communications, the batteries are in a group of 3 batteries within the cabinet, as per the diagram further below.
Each battery within the group of 3 are all connected in parallel via the RS485 ports on each battery.
The group of 3 will have 1 "Master" unit defined and 2 "Slave" units defined.
The "Master" unit will be the BMS that coordinates the BMS's in the other 2 units.
The "Master" unit is also the unit that will communicate externally to a lap-top or other monitoring system.
The external communication software running on a PC or other monitoring system will be communicating via the SNMP Port using a unique IP Address configured into the "Master" unit.
The "Master" and "Slave" units are defined individually by the dip switch settings on each unit and these are also shown further below and additionally in the User Manual.
So, as an overview, in this scenario of 3 batteries, we have the following setup-

1. A total of 3 batteries, all in parallel, in a total of one cabinet.
2. 1 group of 3 batteries in a cabinet, making 1 group in total
3. The group has one Master unit and 2 Slave units.
4. The group "Master" is configured with a unique IP Address for SNMP monitoring.
5. Therefore, the SNMP IP Address will view all the cell details of all 3 batteries within that group.
6. A total of 1 IP Address will need to be used to monitor all the individual cell details of all the 3 batteries.

Please refer to the drawing below to understand the wiring of both the DC Power cables and the RS485 communications between the modules.



Note that all the DC Positive and Negative power cables must be the same length to ensure that each battery has the same resistance to the Connectors.

The DC Positive and Negative power cables are shown by the Red & Black cables respectively in the above drawing.

Note also that this drawing shows the one group of 3 units connected separately by the RS485 cables. The RS485 cable is shown by the Green cables.

The “Master” unit will be BAT 1 at bottom.

This will also be the SNMP IP connection for monitoring purposes.

3.16 Recommended battery parameters of controller

If using the “Solarmate” App, then use the following –



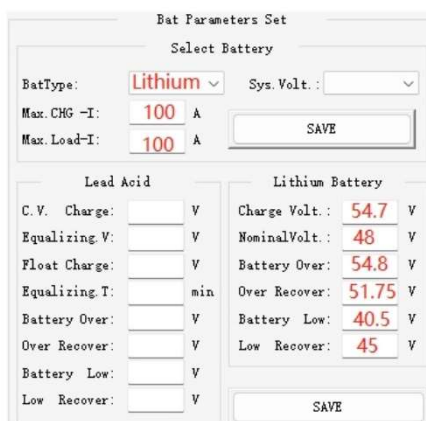
Li-ion battery setting	
Nominal voltage	48V
Saturation charging voltage	54.7V
Battery over voltage protection	54.8V
Battery over voltage recovery	51.75V
Battery cut-off voltage	40.5V
Battery cut-off reset voltage	45V
Current setting	
Max. discharge current	100A
Max. charge current	100A

Apply Close

Below is a link to download the “Solarmate” App.

https://www.dropbox.com/s/el4ax5h9ru2womn/install_SolarMate_CS_Windows.exe?dl=0

If using the “MpptSolarMonitor_N_V1.2” App, then use the following –



Bat Parameters Set

Select Battery

BatType: Lithium Sys. Volt.: []

Max. CHG -I: 100 A

Max. Load-I: 100 A

SAVE

Lead Acid		Lithium Battery	
C. V. Charge:	[] V	Charge Volt.:	54.7 V
Equalizing V:	[] V	Nominal Volt.:	48 V
Float Charge:	[] V	Battery Over:	54.8 V
Equalizing T:	[] min	Over Recover:	51.75 V
Battery Over:	[] V	Battery Low:	40.5 V
Over Recover:	[] V	Low Recover:	45 V
Battery Low:	[] V		
Low Recover:	[] V		

SAVE

Below is a link to download the “MpptSolarMonitor_N_V1.2” App.

<https://www.dropbox.com/scl/fo/6s14jazccl8f1c55a0umj/h?rlkey=9d1tyuki4tanhb2nawykuemdb&dl=0>

3.17 RS485 Monitoring and configuration software

To access the RS485 interface then use the USB to RS485 Converter and connector as provided below.

(10 sets of cables were provided with the shipment).

(5 sets in shipment 1 and 5 sets in shipment 2, in “accessories” boxes)



Below is a link to download the RS485 Monitoring software.

<https://www.dropbox.com/s/e25tnstkw006ek/RS485%20Monitor.zip?dl=0>

(Also refer to “MastMinder Lithium Battery RS485 Monitor User Manual May 2023.pdf”).

3.18 SNMP Monitoring software

To access the SNMP simply Browse to the IP Address you have set up in each Master unit.

(The SNMP IP Address would be set using the RS485 software above).

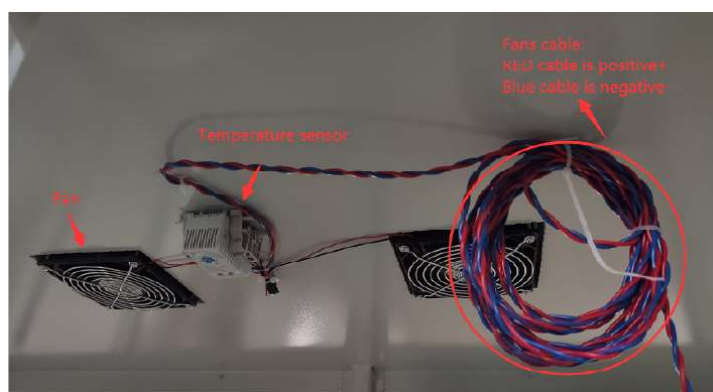
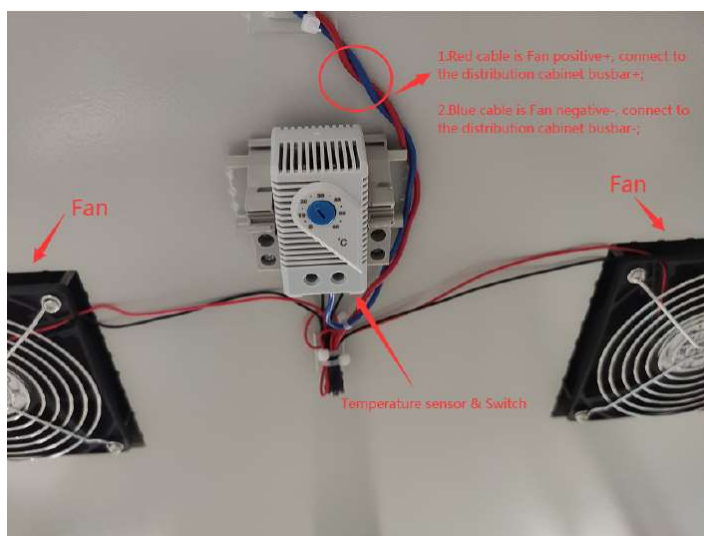
3.19 Cable protection

When passing cables between the cabinets or from cabinets to the PV arrays, then use the PVC Connectors and PVC Tube provided. This provides additional protection to the insulation on the cables against the chassis of the cabinets.

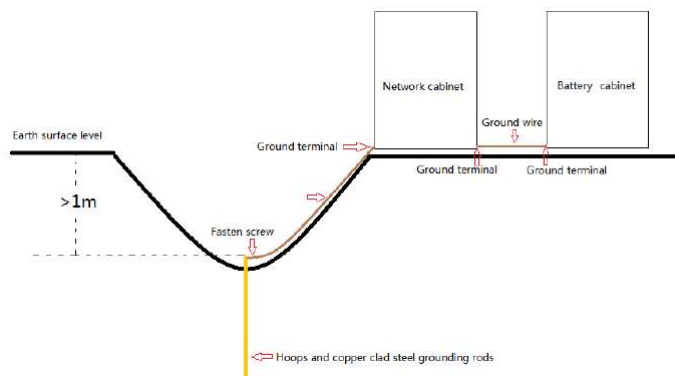


3.20 Battery cabinet free-cooling fans

Thermostatically controlled fans are installed in the Battery Cabinet.



3.21 Surge Arrestors and Grounding

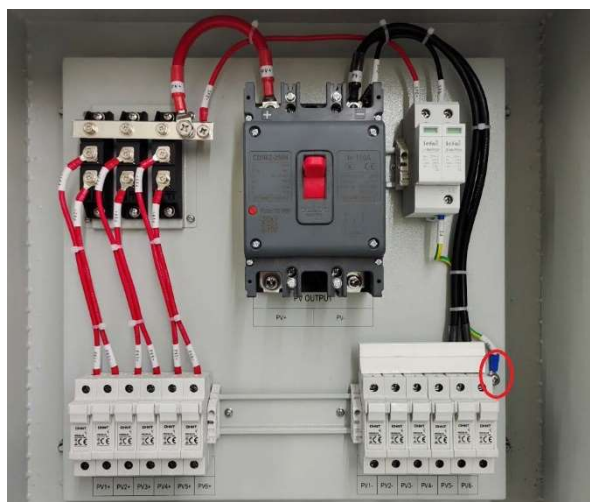


Note: Regarding the Ground terminal on outside of the Network Cabinet & Battery Cabinet. Take care to remove the protection tube before making connection.



Use 16mm² ground wire (yellow/green) to connect the Surge Arrestor Ground and Equipment Cabinet Ground terminals.

Note there are two Surge Arrestors, one in each Combiner Box.

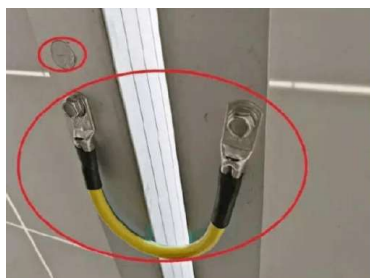


Note the Ground connection on the Surge Arrestor in bottom right hand corner of the Surge Arrestor.

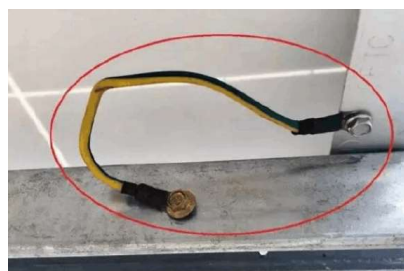
Connect the yellow / green grounding wire to the copper clad steel grounding rod provided or other good site grounding point.

3.22 Solar panel grounding connections

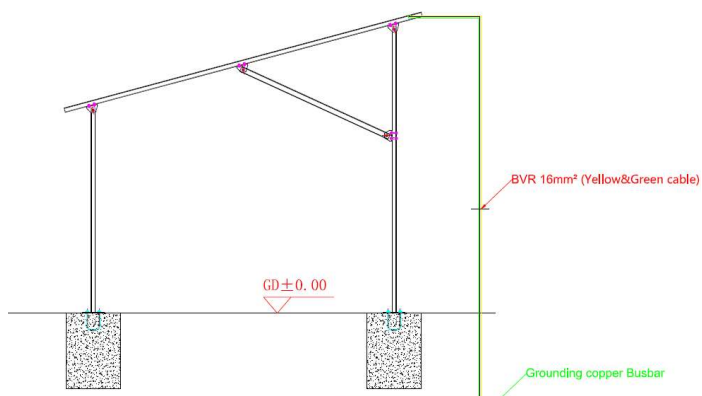
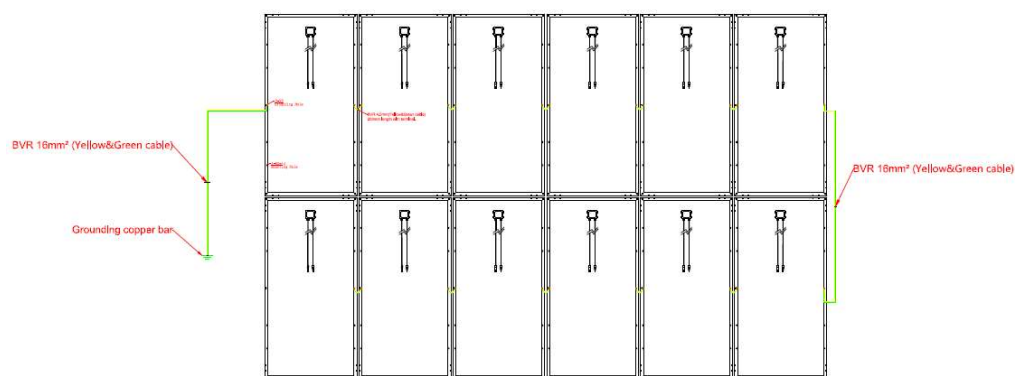
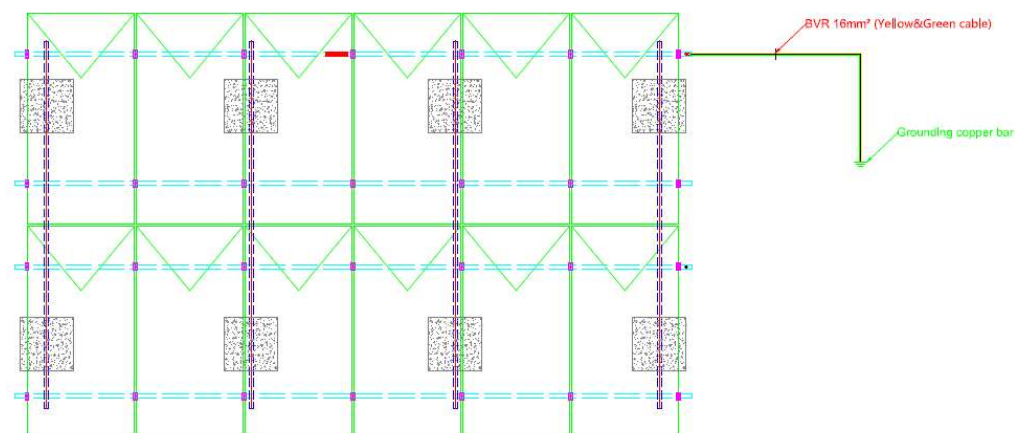
Please note that the PV Array and PV Modules are to be Grounded as per below.



Connect the ground wire between the solar panels



Connect the ground wire between the solar panel and the bracket



3.23 BOQ

No	Product	Specifications	Quantity	Unit
Main Part				
1	Solar panel	Mono 450Wp/34.67Vmp 41.25Voc 3S4P	12	pcs
2	Battery	48VDC 200Ah LiFePO4 regular lithium battery	3	pcs
3	Solar Controller	MPPT 100A 48VDC	1	pcs
4	Combiner box	6 in 1 out/ 500V	1	pcs
5	Mounting Bracket	Tilt10° , 12 pcs ESM-450MH, size 1909*1134*30mm, array 2*6, the array lowest point to ground 2150MM	1	set
6	Equipment Cabinet	Install 1pc TP100 solar charge controller, MCB , MCCB and battery (900*900*2100mm,IP55)	1	set
Accessories				
7	Load MCB	DC 25A 2P 6kA	1	pcs
8	Bat. MCCB	160A 2P 50kA 250VDC	1	pcs
9	PV MC4 Connector	1 in 1 out	5	pair
10	PV cable	H1Z2Z2-K 4mm2	200	m
14	DC cable	RV 16mm2	20	m
15		RV 4mm2	2	m
16		RV 25mm2	6	m
17	Ground wire	BVR 4.0mm ² , 200mm length, ϕ 5mm	15	pcs
18		BVR 6mm ²	30	m
19	Terminal	VE4012	20	pcs
20		SC16-8	5	pcs
21		C45-16	5	pcs
22		C45-25	5	pcs
23		SC25-8	10	pcs
24		RV5.5-6	10	pcs
26	Combination screw	M4*12	30	pcs
27	Nut	M4	30	pcs