

2022

**EXAMPLE 17.34KW solar array (2.5KW load) 6000 AH battery backup
Solar Installation instructions**

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1 Requirements

2500W/48V load work 24 hours every day, 4 days battery autonomy, DOD=80%

Tilt 15°, Azimuth 0°

17340W Solar Array, total 17 strings, each string has 3 pcs ESM340-156 in series. 48V6000Ah battery

2 Solution components

2.1 Solar panels

51 x ESM340-156 (340W/37.6V) Polycrystalline panels

340 Watt

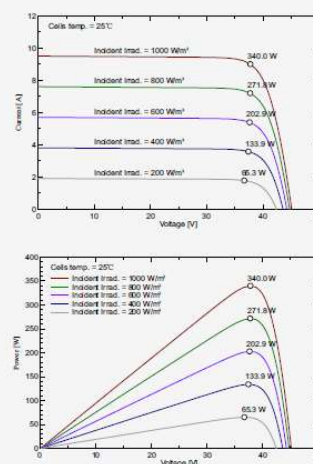
Electrical Characteristics

Type of Cell	Polycrystalline silicon
Cell Size(mm)	156x156mm
Module Efficiency	17.52%
Cell Configuration	72(6x12)
Size of module (mm)	1956x992x35mm
Weight per piece (Kg)	21 Kg
Maximum power (Wp)	340W
Maximum power voltage (V)	37.6V
Maximum power current (A)	9.04A
Open circuit voltage (V)	45.1V
Short circuit current (A)	9.51A
Tolerance of Pmax	0→+5W

Standard Operating Conditions

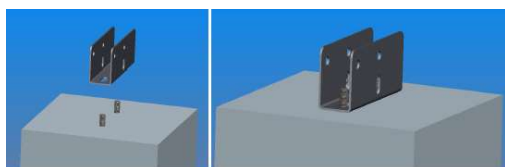
Maximum system voltage (V)	1000V
Temperature coefficients of Isc (%)	0.053%/°C
Temperature coefficients of Voc (%)	-0.33%/°C
Temperature coefficients of Pm (%)	-0.42%/°C
NOCT(°C)	45°C±2°C
Temperature range	-40°C to +85°C
Surface maximum load capacity	60m/s (200kg/sq.m)
Series fuse rating	15A

Characteristics (Module I-V Graph 340W)



STC: Irradiance 1000W/m², Module temperature 25°C, AM1.5 spectrum.

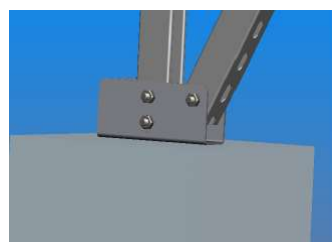
2.2 Solar array components



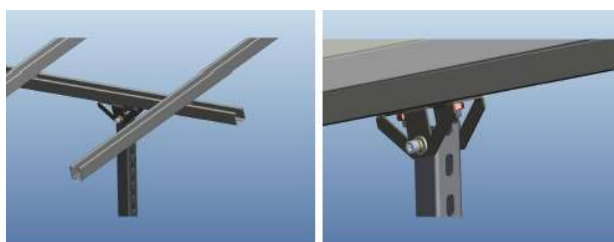
U-bolt fixing in foundation



Front & Rear leg fixings into foundations



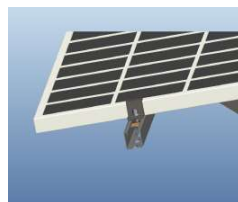
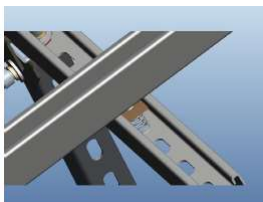
Tilt beam fixing



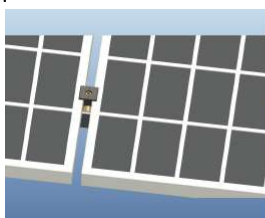
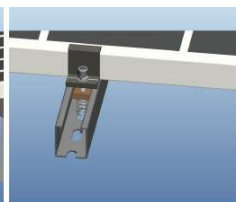
Connecting tilt beam and leg



Connecting rail & tilt beam



Using end-clamp to connect rail & PV

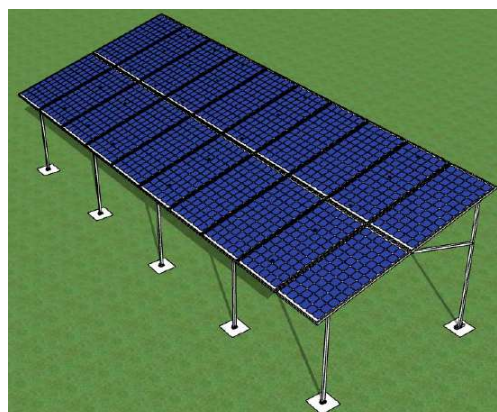
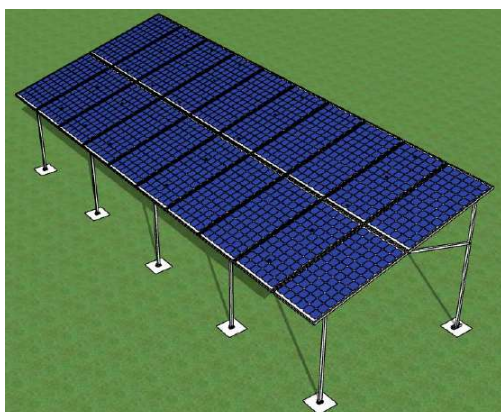


Using mid-clamp to connect rail & PV

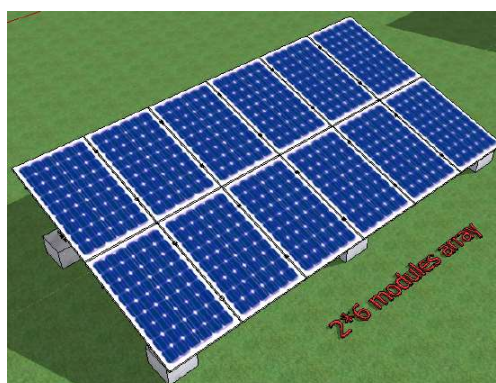
2.3 Solar array structure

2 x 20-Panel structures as per below.

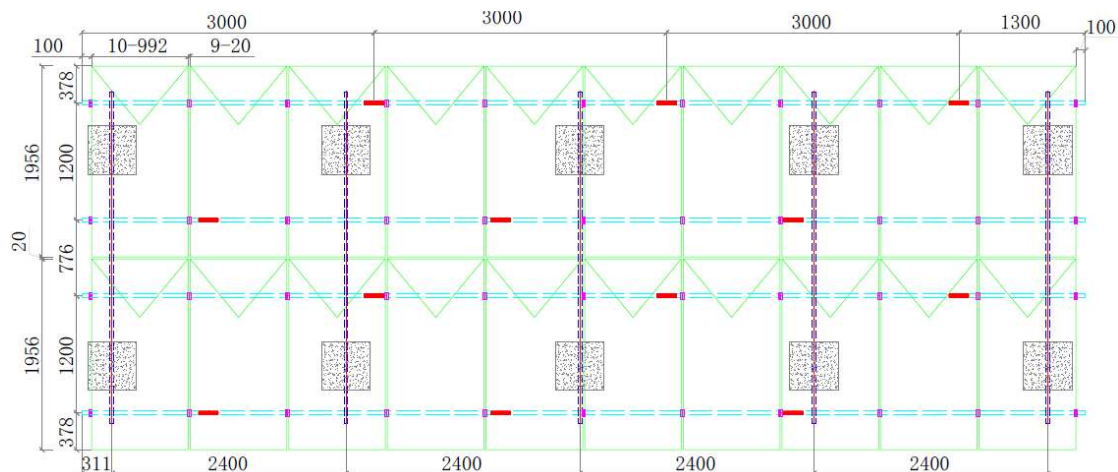
(Note that second structure only has 19 panels – please see details further in document)



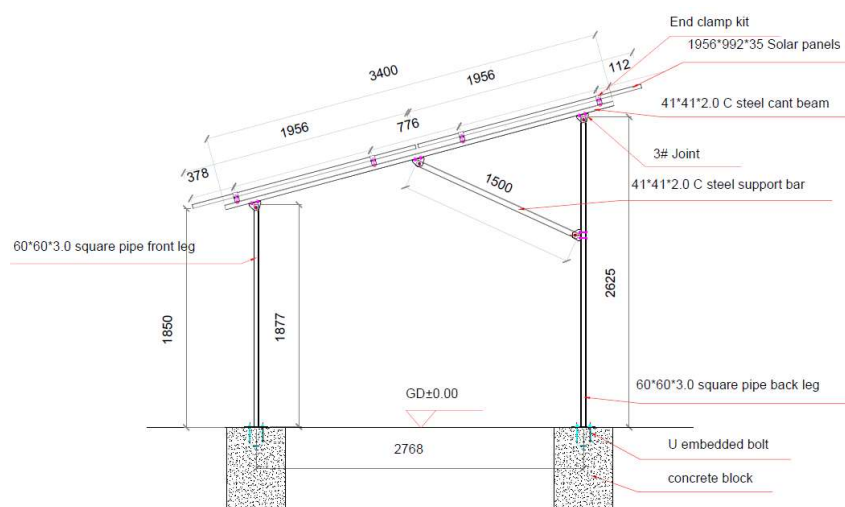
1 x 12-Panel structures as per below.



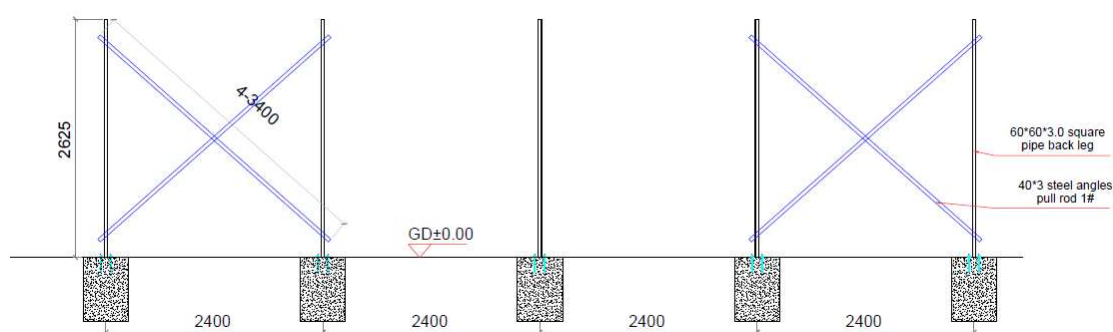
2.4 Each 20-panel structure as per drawing below



PV array elevation



Side elevation



Rear elevation showing sideways stabilisers

Total of 2 of the above arrays (one containing 20 PV panels and the other containing 19 PV panels)(total 39 panels)

2.6 MPPT Solar Controller

4 x TP100 High Conversion Efficiency MPPT Solar Controllers



2.7 MPPT Controller configuring & monitoring software download

The PC software to configure & monitor the MPPT Controllers may be downloaded from ..

<https://www.dropbox.com/sh/a0v038g7pmkatox/AAB1WUYjWWsC2N5YAK9bflaha?dl=0>

In this folder you will find the following files to download and install

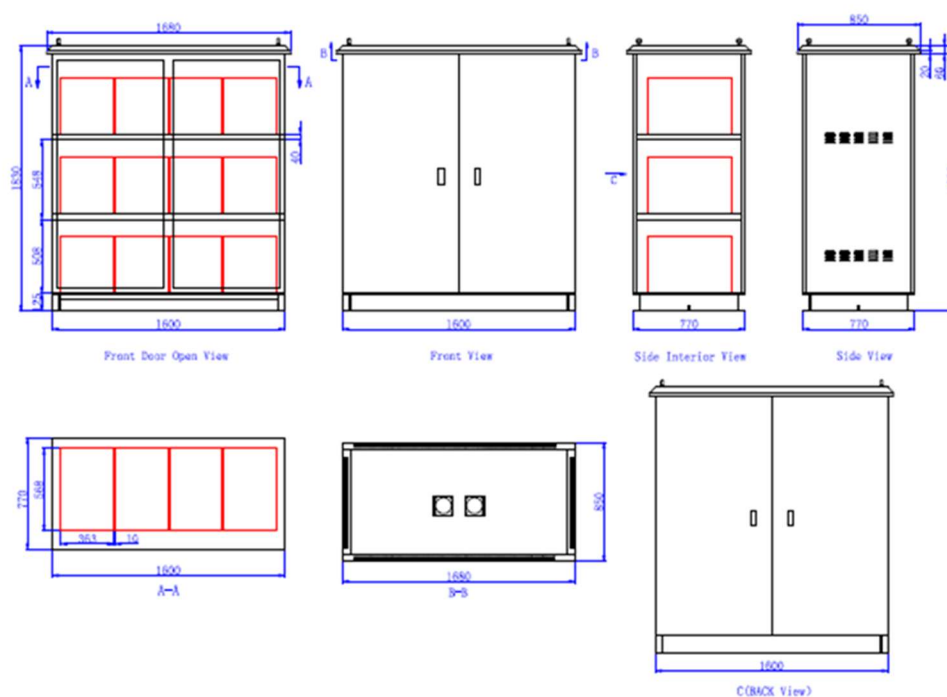
1. install_SolarMonitor_CS_Windows1.0.5.zip
This is the file to unzip and install to enable to configure & monitor the MPPT Controllers
2. CH341-W7.exe
This is the driver file for the USB / RS485 cable supplied to connect to the MPPT Controllers.
3. MastMinder MPPT Solar Charge Controller User's Manual - V2.0 rev A.pdf
This is the User Manual document for the Charge Controller. Please read this manual.
Note that the Charge Controllers will automatically detect 48 volt settings when connected and that default battery type charging settings can be used.

2.8 Battery Cabinet

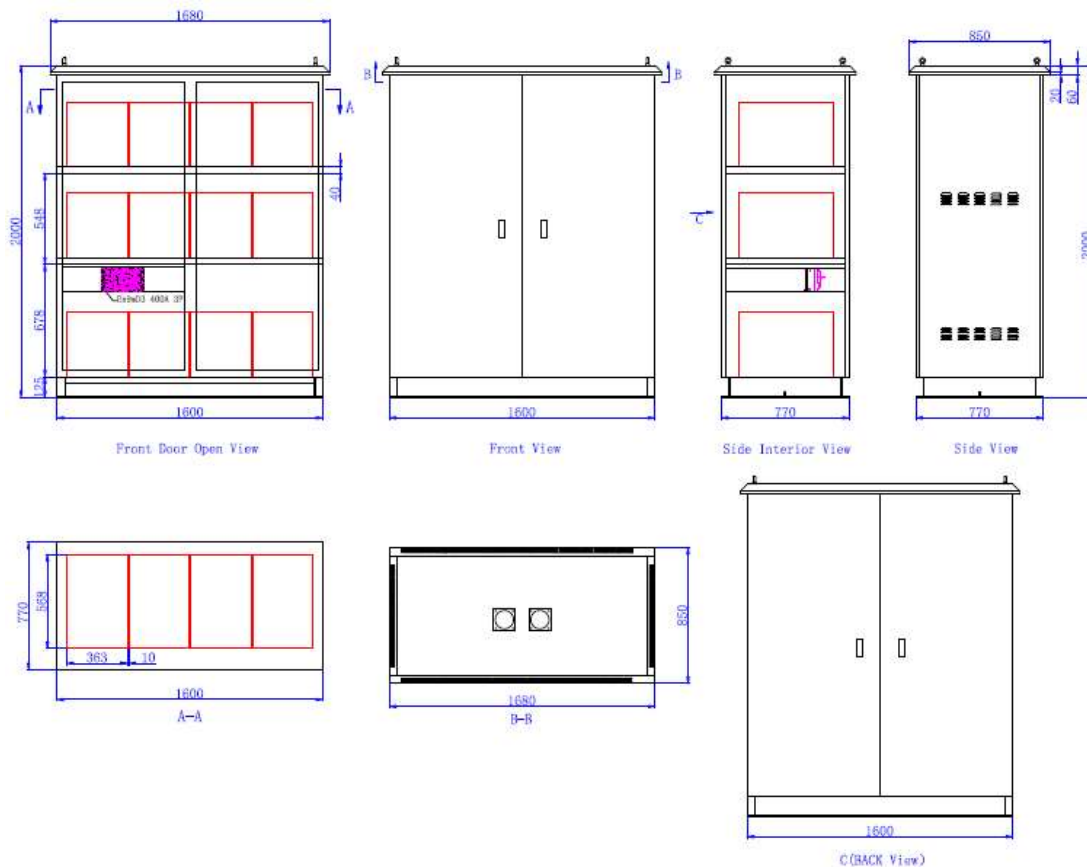
Total of 4 Battery Cabinets, 2 with 400 Amp Breakers installed and 2 without.

2 x Battery Cabinet without 400 Amp Breakers.

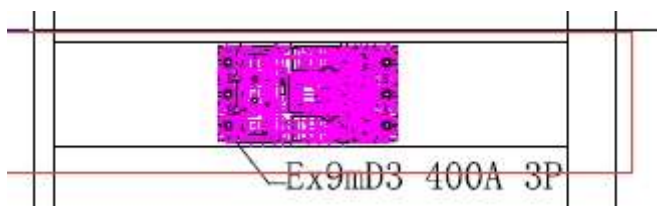
Battery Quantity:12PCS



2 x Battery Cabinet with 400 Amp Breakers. (Shown as colored purple below)



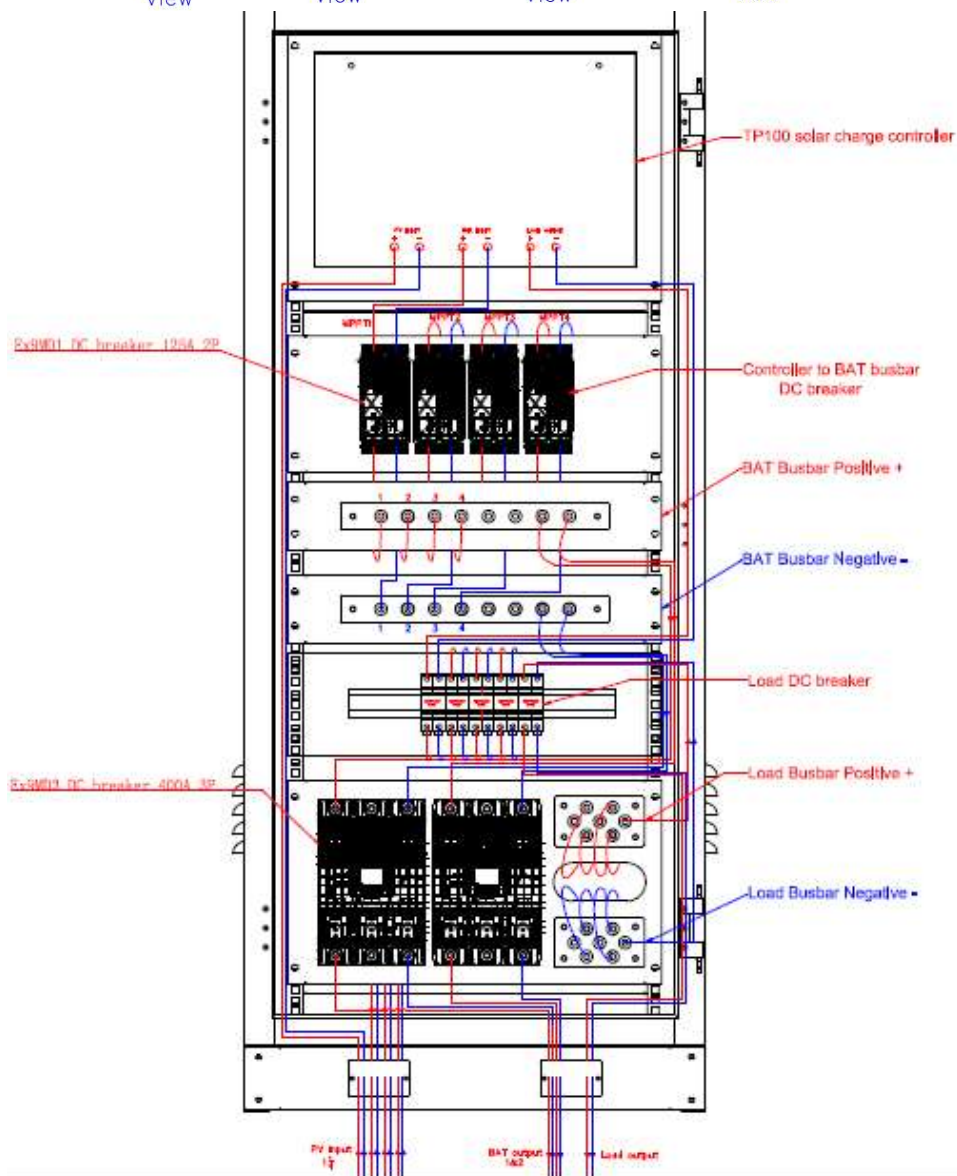
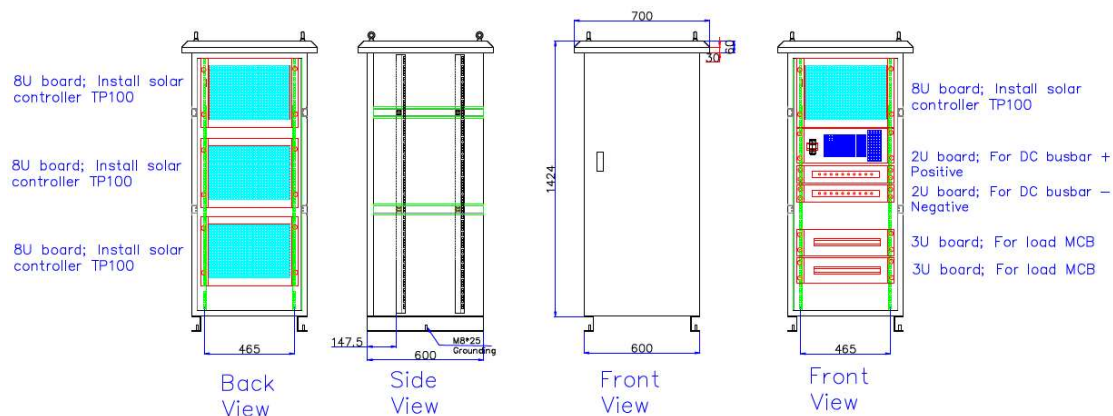
The 400 Amp Battery Breakers are packed separately from the cabinets and need to be installed into the cabinets by the system installer.



Mounting bracket above where 400 Amp Battery Breaker to be attached.

2.9 Equipment Cabinet

1 x Equipment Cabinet



2.10 Combiner Box

4 x Combiner Boxes (SCB5 – 5 In / 1 Out)



Combiner box

- ✧ 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



Internal Surge Arrester

Technical Specification

Specification		Model	SCB3	SCB4	SCB5	SCB6	SCB8	SCB10
Input	Voltage Range (VDC)		0~500V					
	PV Array Input String 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					

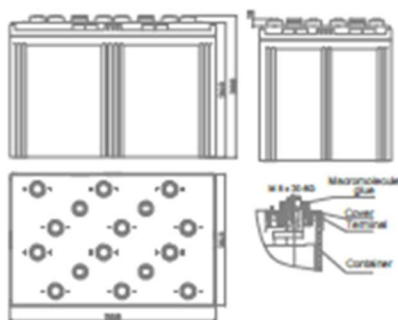
2.11 Batteries

48 x 3000 Ah 2 volt batteries



**HIGH
PERFORMANCE**

**VALVE REGULATED LEAD ACID
2V FLAT PASTED PLATE
BATTERY**



Innovative Features

- ◆ Valve Regulated Lead Acid (V.R.L.A.) design
- ◆ Fully tank formed plates
- ◆ Never needs addition of water
- ◆ Spill-proof and leak-proof
- ◆ Proprietary Fixed Orifice Plate Pasting technology applying active materials on both sides of the grid for consistent cell-to-cell performance, higher capacity and uniform grid protection.
- ◆ Operates at a low internal pressure
- ◆ For use in vertical or horizontal position
- ◆ Each cell has a low pressure safety release venting system
- ◆ Standard: Reinforced ABS (UL 94HB) container and cover.
Optional: Flame-retardant reinforced ABS container and cover compliant with U.L.94 V-0 with an Oxygen limiting index of greater than 28%
- ◆ Nano-Carbon enhanced active material to maximize cycle performance and PSoC operation
- ◆ Low calcium Lead/Tin alloy plates for efficient gas recombination for long life in both cycling and float applications

Performance Specifications

Normal Voltage	2V
Capacity	3000 Ah @ 10hr to 1.80V per cell @ 20°C (68°F)
Dimension	Length x Width x Height x Total Height: 568 x 363 x 369 x 388 (mm)
Weight	Approx. 172 kg (378 lbs)
Internal Resistance	Approx. 0.12 mΩ
Short Circuit Current	24200 A
Self Discharge @ 25°C (77°F)	No more than 3% after 30 days storage
Applicable Operating Temperature Range	-40°C~70°C (40°F~158°F)
Ideal Operating Temperature Range	20°C~30°C (68°F~86°F)
Maximum Charge Current	600 A
Charging Voltage @ 25°C (77°F)	Float: 2.23V, Temps coefficient -3 mV/°C Cycle: 2.30V
Contain Materials	ABS
Terminal Type	F-M8
Capacity Affected by Temperature	105% @ 40°C 85% @ 0°C 60% @ -20°C

Constant Current Discharge Characteristics - Watts Per Cell @ 20°C (68°F)											
Final VPC	1.5hr	2hr	3hr	4hr	5hr	6hr	8hr	10hr	12hr	20hr	24hr
1.85	2359	1969	1471	1152	950	839	682	564	481	394	265
1.80	2482	2074	1550	1214	1011	885	719	595	507	415	279
1.75	2657	2139	1601	1255	1045	915	744	616	525	430	289

Constant Power Discharge Characteristics - Amperes Per Cell @ 20°C (68°F)											
Final VPC	1.5hr	2hr	3hr	4hr	5hr	6hr	8hr	10hr	12hr	20hr	24hr
1.85	1226	1019	755	587	487	425	343	283	241	148	132
1.80	1300	1081	801	623	518	450	364	300	255	157	139
1.75	1356	1127	835	649	538	470	380	313	266	164	145

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

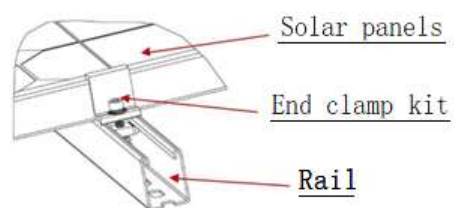
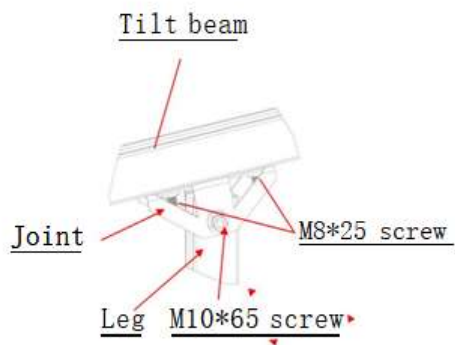
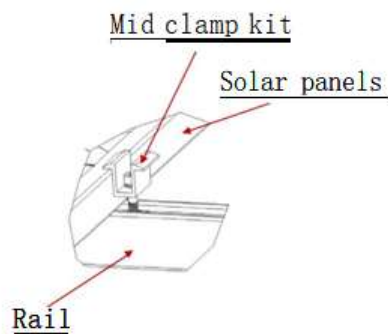
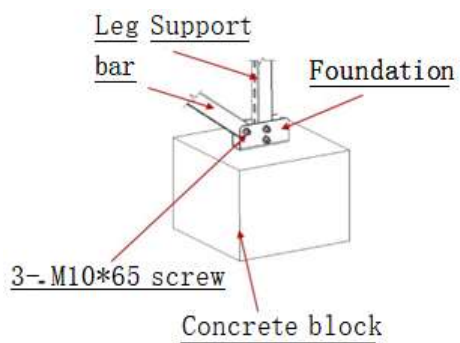
	
6mm metric Allen Key or 6mm hexagonal driver bit.	Drill or impact driver for driving roof material fixings.
	
Measuring tape	Chalk Line Reel
	
Glove	Helmet

3.3 Solar array components identification

Components Picture	Description
	Front Leg
	Back Leg
	Support Bar
	Tilt Beam
	Rail
	Foundation

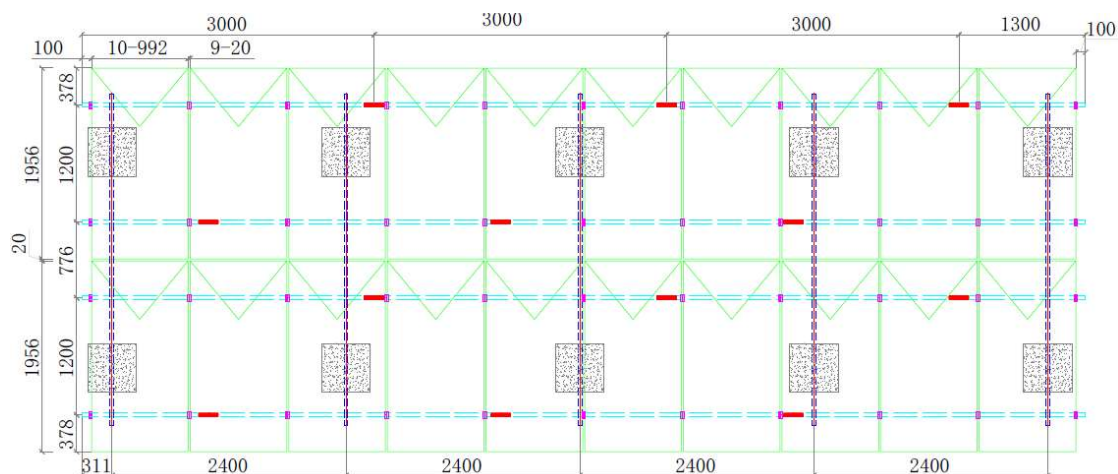
	Joint
	connect bolts for rail and tilt beam
	40 Mid Clamps Kits
	40 End Clamp Kits
	U-Ground bolt

3.4 Mounting brackets detail

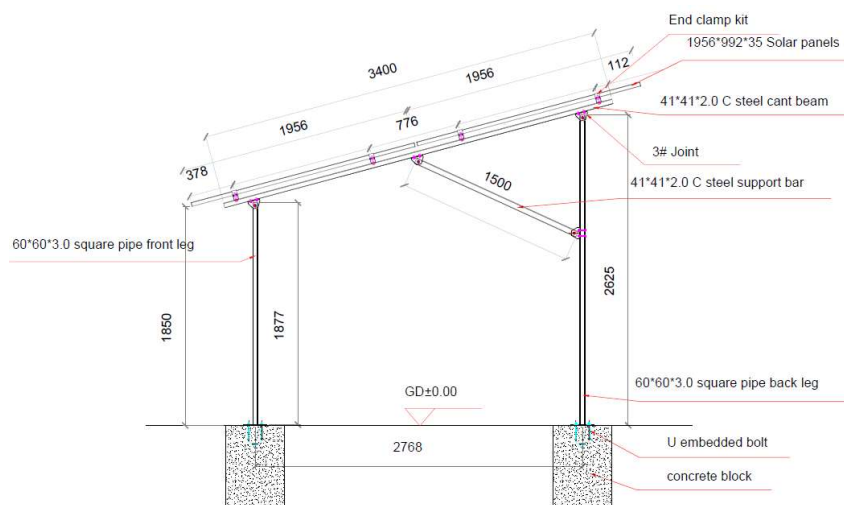


3.5 Layout of PV structures

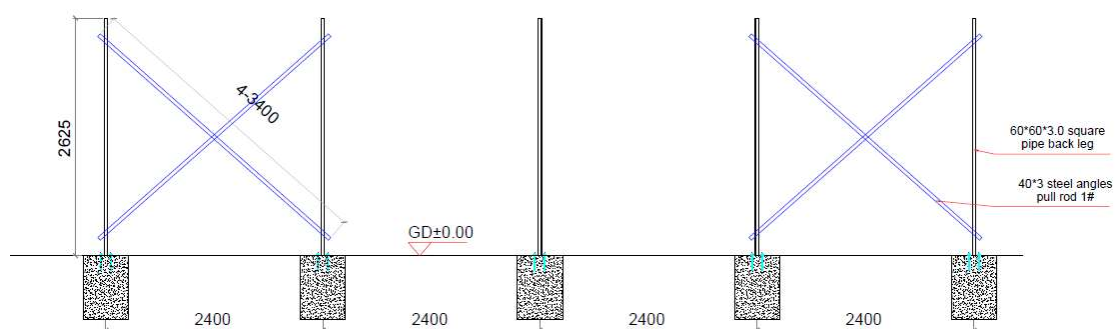
20 panel structure (2 of these)



PV array elevation



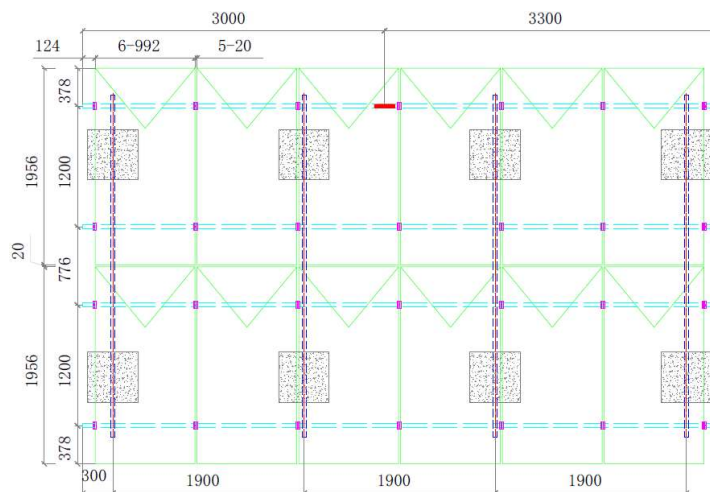
Side elevation



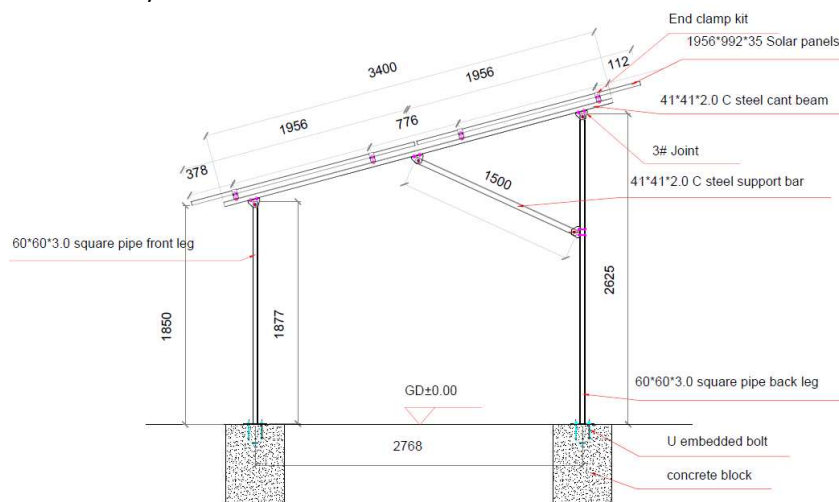
Rear elevation showing sideways stabilisers

Total of 2 of the above arrays (one containing 20 PV panels and the other containing 19 PV panels)(total 39 panels)

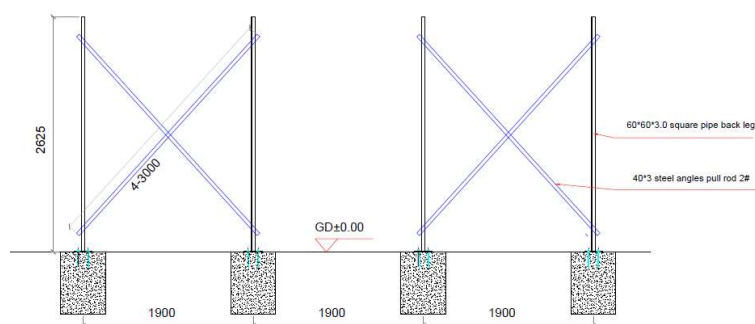
12 panel structure (one of these)



PV array elevation



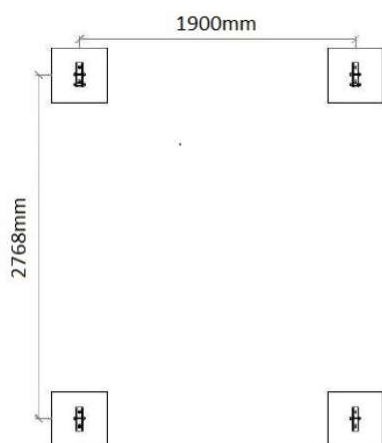
Side elevation



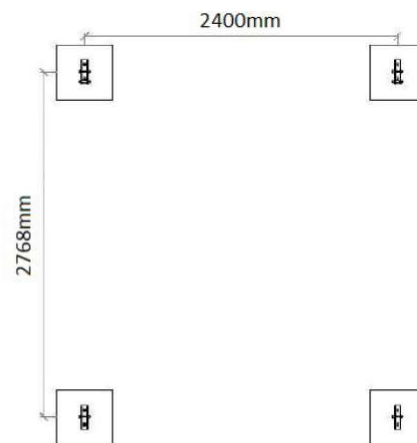
Rear elevation showing sideways stabilisers

Total of 1 of the above arrays (containing 12 PV panels)(total 12 panels)

3.6 Layout of foundations



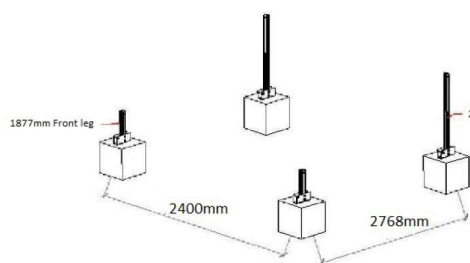
2x6 Structure Top View



2x10 Structure Top View

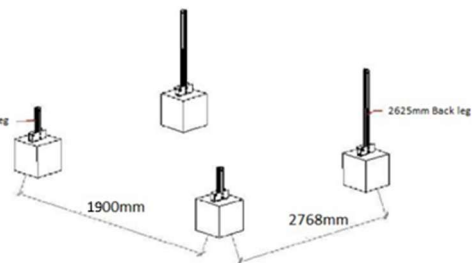
3.7 Installation of legs (front and back)

20 panel array is 2400mm width



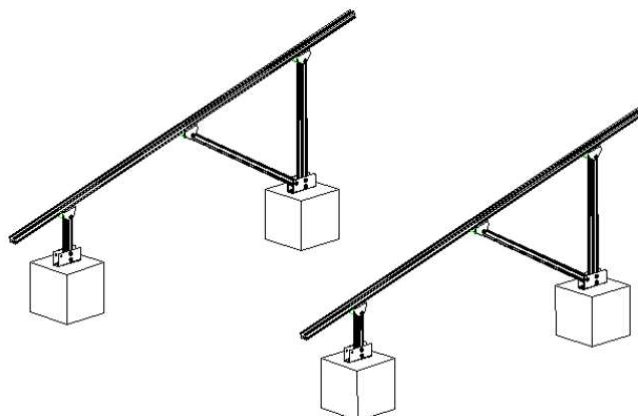
Side view

12 panel array is 1900mm width

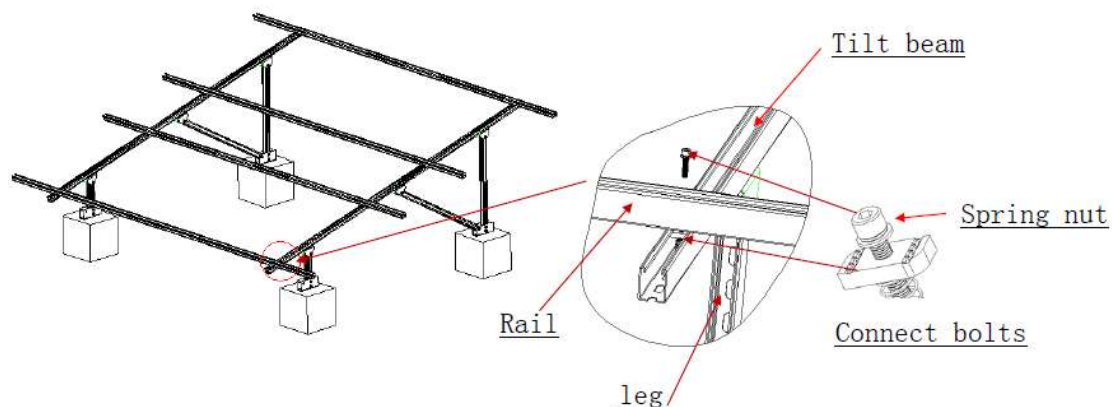


Side view

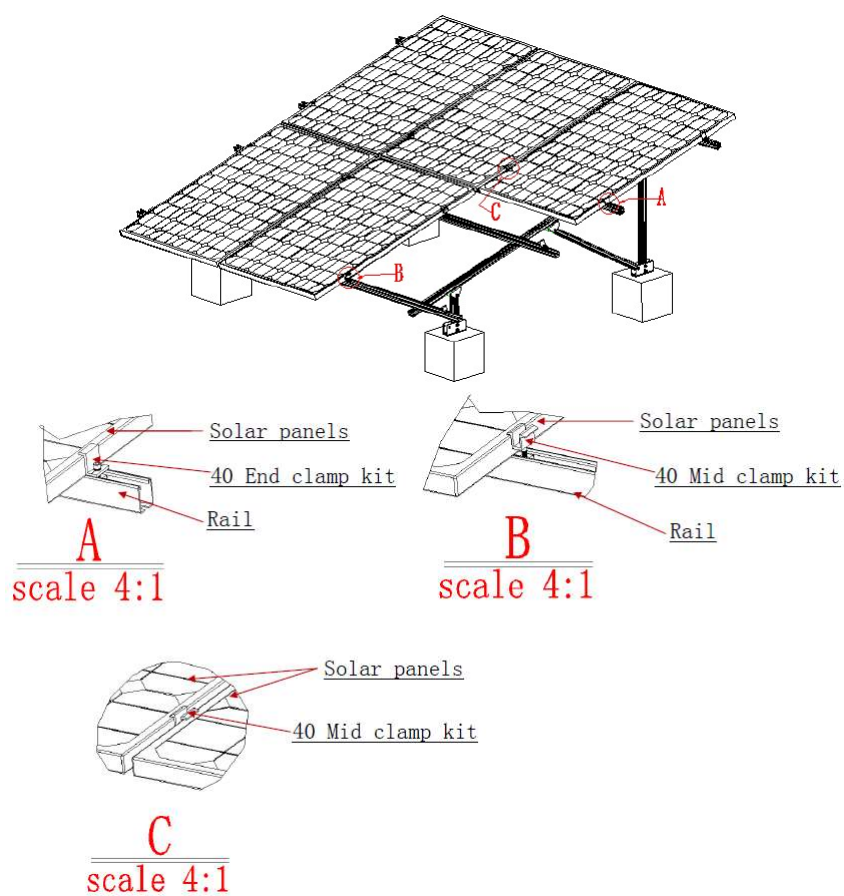
3.8 Installation of tilt beam



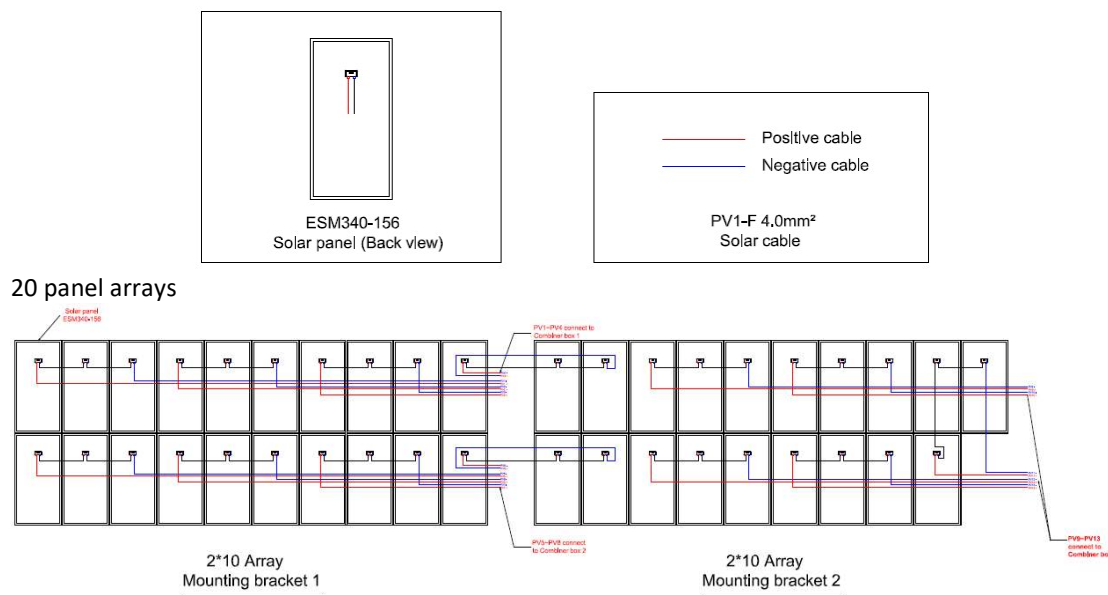
3.9 Installation of rail



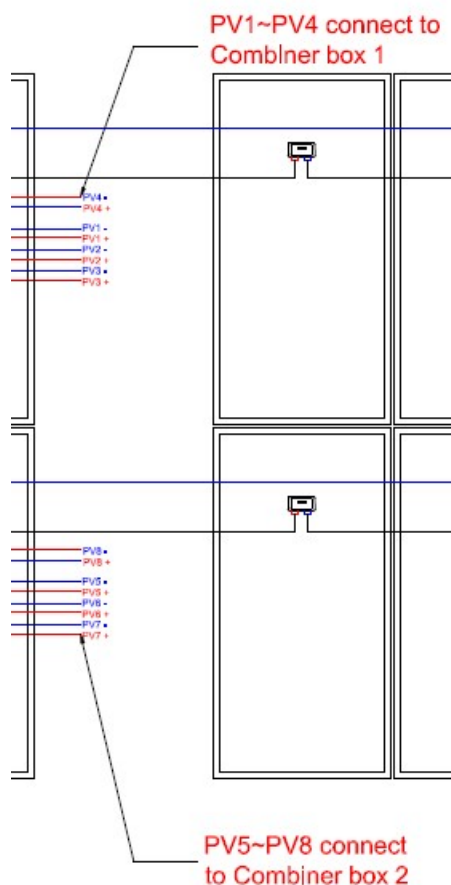
3.10 Installation of solar panels using mid clamp and end clamp kits



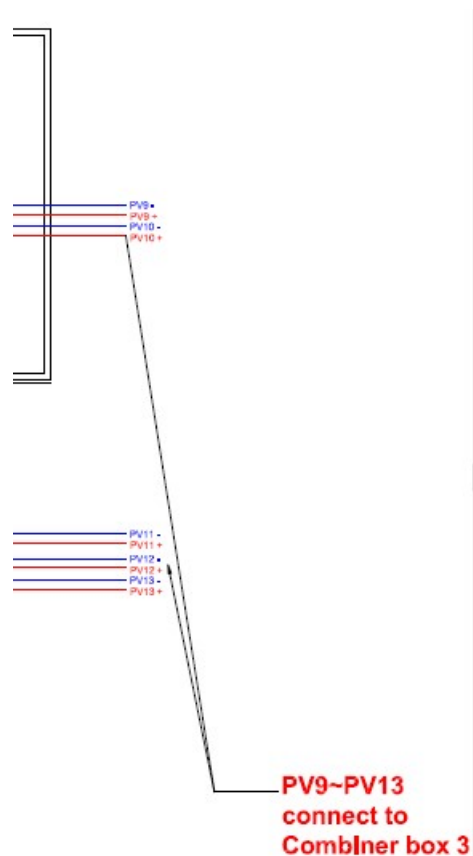
3.11 Wiring between photovoltaic modules



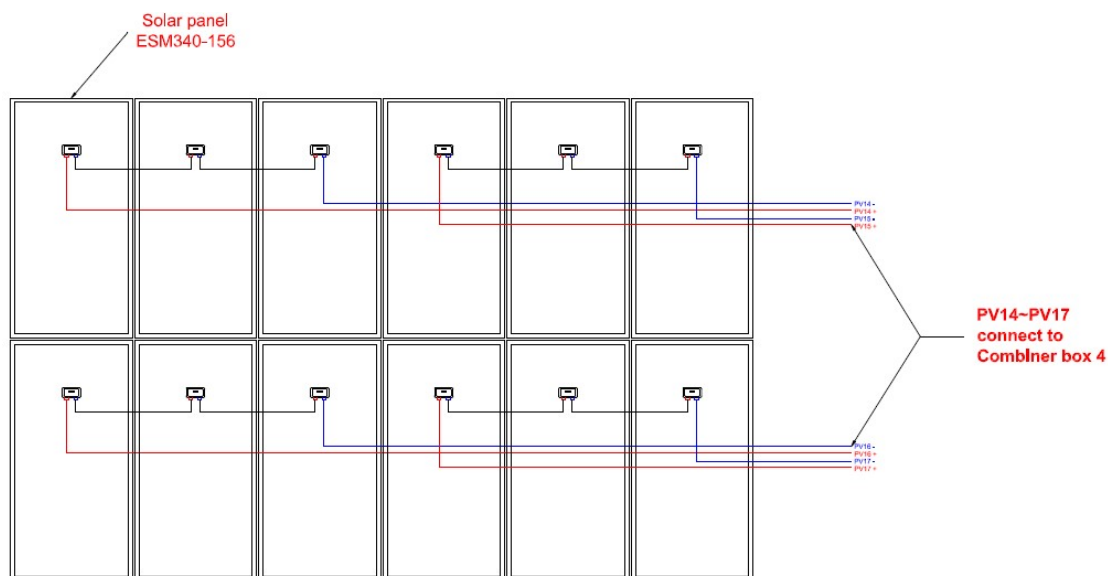
Detail view of above



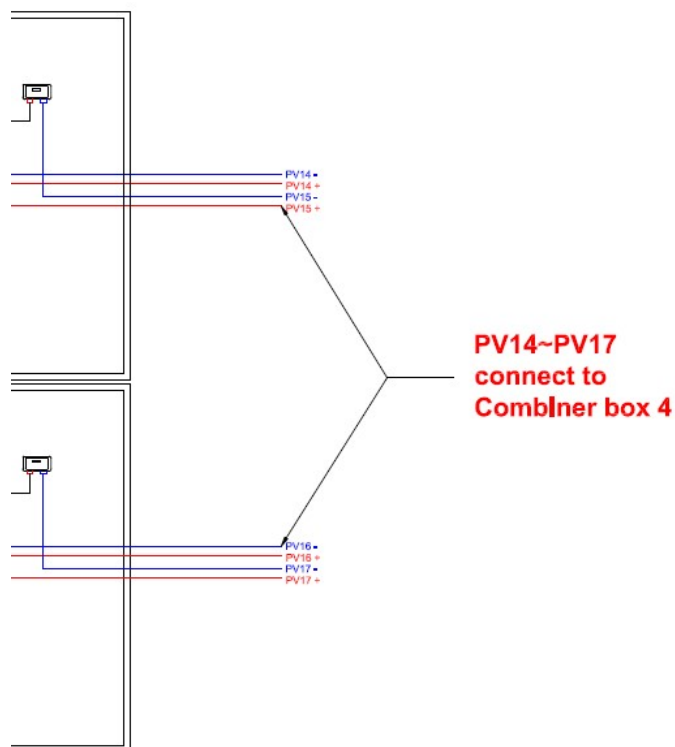
Detail view of above



12 panel array



Detail view of above



PV1 to PV4 connected with combiner box 1
 PV5 to PV8 connected with combiner box 2
 PV9 to PV13 connected with combiner box 3
 PV14 to PV17 connected with combiner box 4
 Combiner box SCB5, 5 IN 1 OUT , 4 Set

3.12 Combiner Box

There are 4 Combiner Boxes and each Combiner Box can accept up to 5 PV Strings.

Connect 4 PV Strings (PV1 to PV4 to Combiner Box 1).

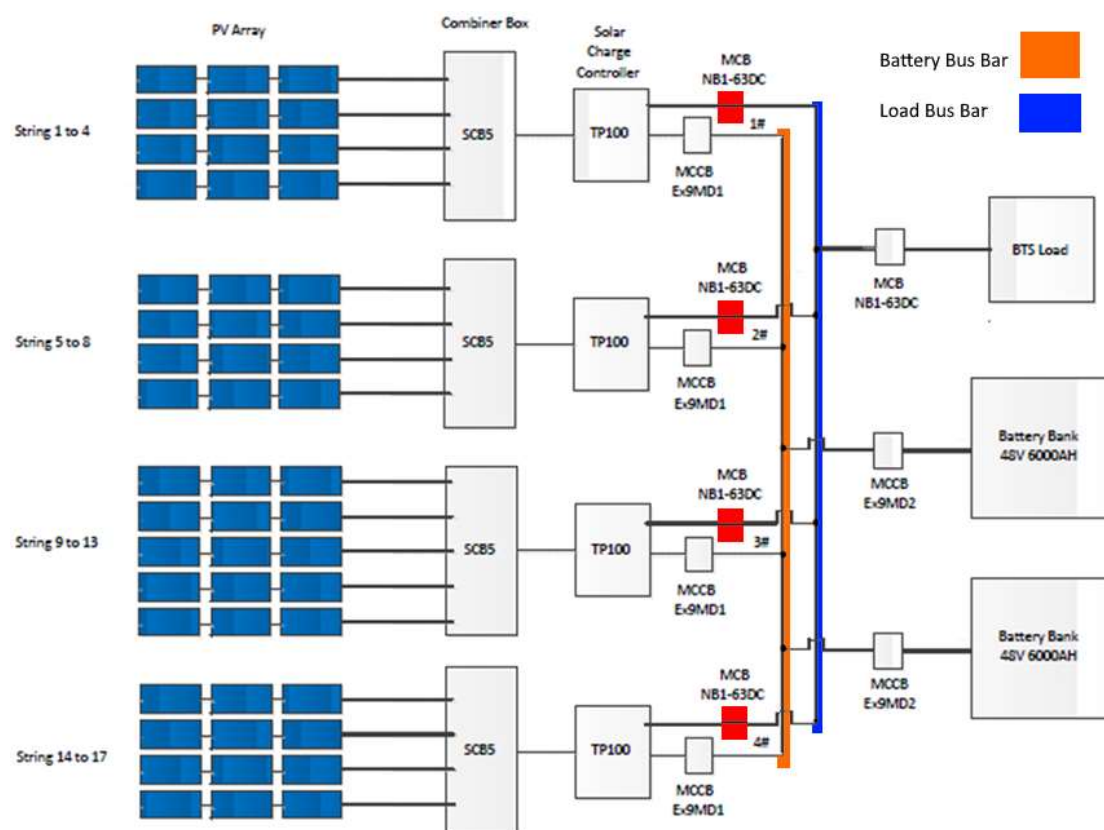
Connect 4 PV Strings (PV5 to PV8 to Combiner Box 2).

Connect 5 PV Strings (PV9 to PV13 to Combiner Box 3).

Connect 4 PV Strings (PV14 to PV17 to Combiner Box 4).



3.13 Wiring schematic



Note:

- 4 pieces of TP100 are connected in parallel to charge a 6000 AH Battery Bank consisting of 2 strings of 3000 AH each, consisting of 2 Battery Cabinets to make each string. Each TP100 has an isolating MCB and a final further isolating MCB to each Battery string.
- 4 pieces of TP100 are connected in parallel to supply the telecom load via an isolating MCB on each TP100 controller and then a final load MCB to the load.
- 4 strings of PV solar panels of 3 panels per string are connected to each TP100 controller via a Combiner box. Note that one of the Combiner boxes has 5 strings connected.

3.14 Surge Arrestor installation

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

3.15 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.

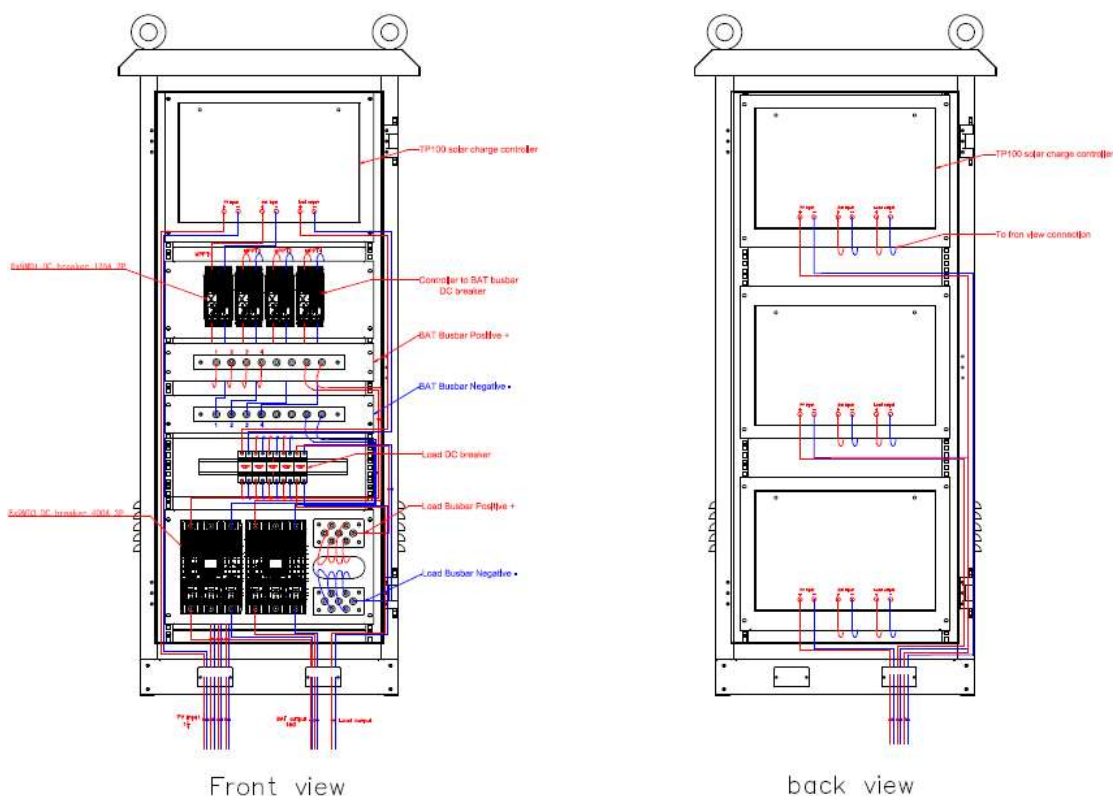
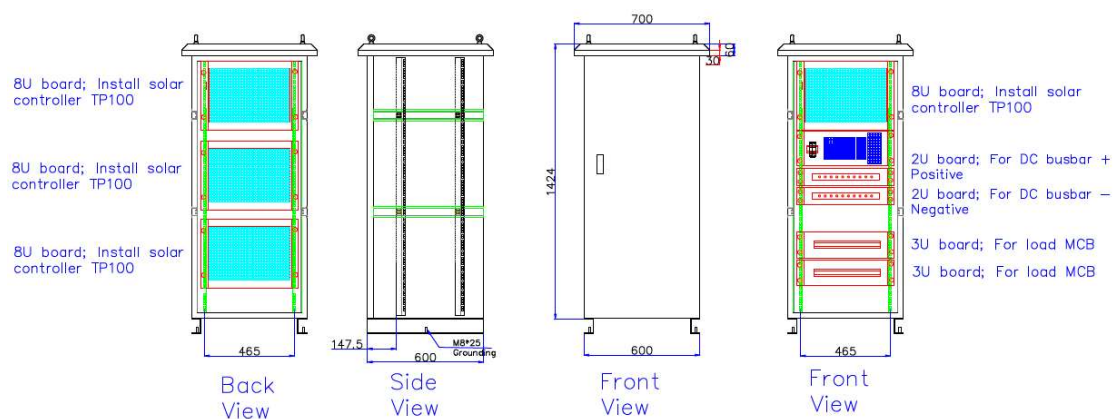
There is an MCB in each Combiner Box.

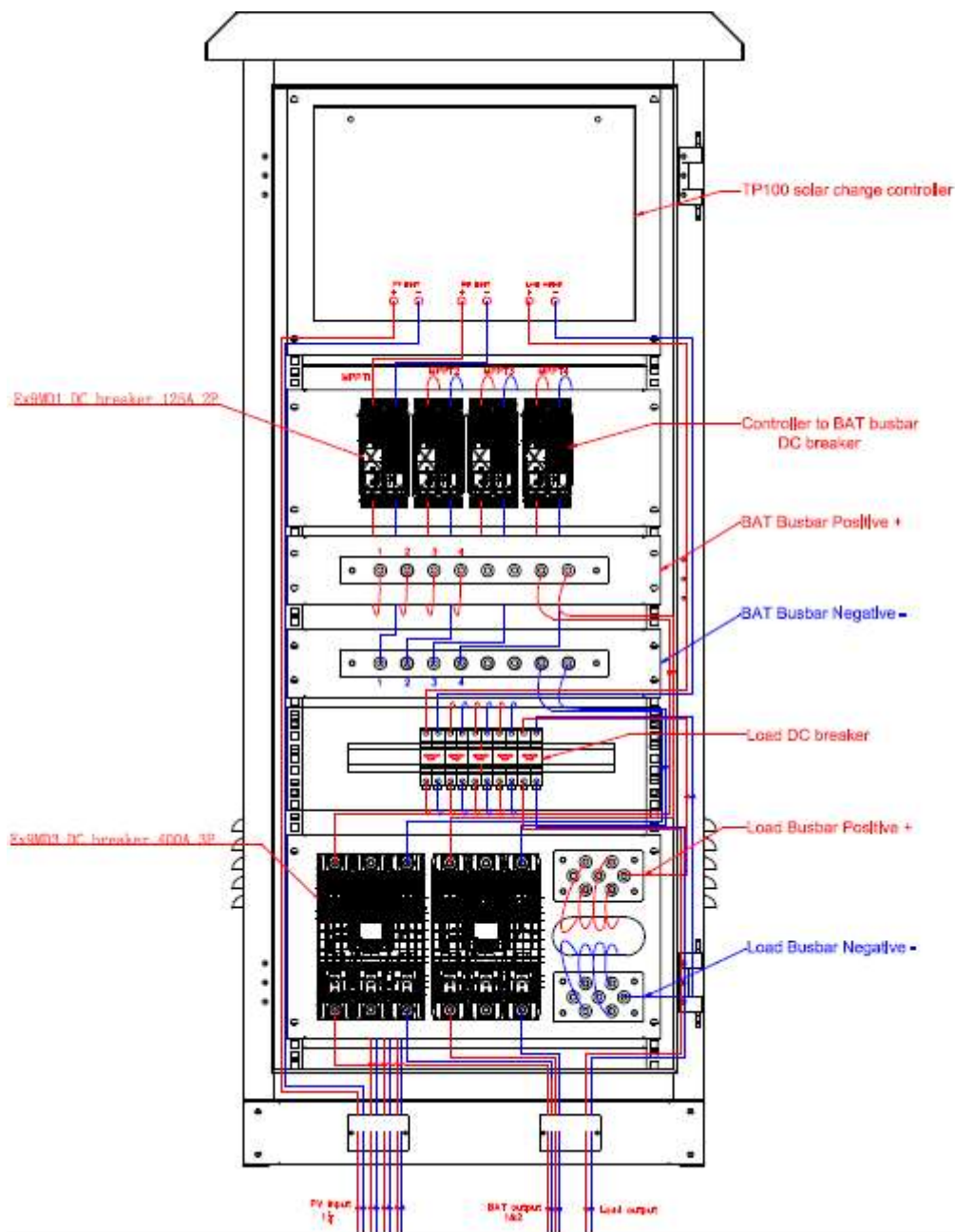
This may also be used manually for maintenance purposes.

Note that a Surge Arrestor is also situated inside each Combiner box.

- 2) Connect Combiner box 1 to MPPT Controller 1 using ZR-YJV 2*10mm² cable provided.
- 3) Connect Combiner box 2 to MPPT Controller 2 using ZR-YJV 2*10mm² cable provided.
- 4) Connect Combiner box 3 to MPPT Controller 3 using ZR-YJV 2*10mm² cable provided.
- 5) Connect Combiner box 4 to MPPT Controller 4 using ZR-YJV 2*10mm² cable provided.
- 6) Connect MPPT Controller 1 (Battery input/output) via MCB1 (Ex9MD1) (125 Amp) and onwards to the Battery DC BUS using ZR-YJV 2*25mm² cable provided.
- 7) Connect MPPT Controller 2 (Battery input/output) via MCB1 (Ex9MD1) (125 Amp) and onwards to the Battery DC BUS using ZR-YJV 2*25mm² cable provided.
- 8) Connect MPPT Controller 3 (Battery input/output) via MCB1 (Ex9MD1) (125 Amp) and onwards to the Battery DC BUS using ZR-YJV 2*25mm² cable provided.
- 9) Connect MPPT Controller 4 (Battery input/output) via MCB1 (Ex9MD1) (125 Amp) and onwards to the Battery DC BUS using ZR-YJV 2*25mm² cable provided.
- 10) Connect the Battery Bank Positive+ / Negative- from the Battery Cabinet 1 (String 1) to the Battery DC BUS+ / BUS- bars using BVR 1*120mm² Red & Black cable provided via MCB2 (Ex9MD2) (400 Amp).
- 11) Connect the Battery Bank Positive+ / Negative- from the Battery Cabinet 3 (String 2) to the Battery DC BUS+ / BUS- bars using BVR 1*120mm² Red & Black cable provided via MCB2 (Ex9MD2) (400 Amp).
- 12) Connect MPPT Controller 1 (Load output) Positive+ / Negative- via MCB NB1 63DC (63A 2P 10KA) and onwards to the Load DC BUS using ZR-YJV 2*25mm² cable provided.
- 13) Connect MPPT Controller 2 (Load output) Positive+ / Negative- via MCB NB1 63DC (63A 2P 10KA) and onwards to the Load DC BUS using ZR-YJV 2*25mm² cable provided.
- 14) Connect MPPT Controller 3 (Load output) Positive+ / Negative- via MCB NB1 63DC (63A 2P 10KA) and onwards to the Load DC BUS using ZR-YJV 2*25mm² cable provided.
- 15) Connect MPPT Controller 4 (Load output) Positive+ / Negative- via MCB NB1 63DC (63A 2P 10KA) and onwards to the Load DC BUS using ZR-YJV 2*25mm² cable provided.
- 16) Connect the Load Output Positive+ / Negative- from the Load DC BUS to the final load MCB NB1 63DC (63A 2P 10KA) and onwards to the actual load.

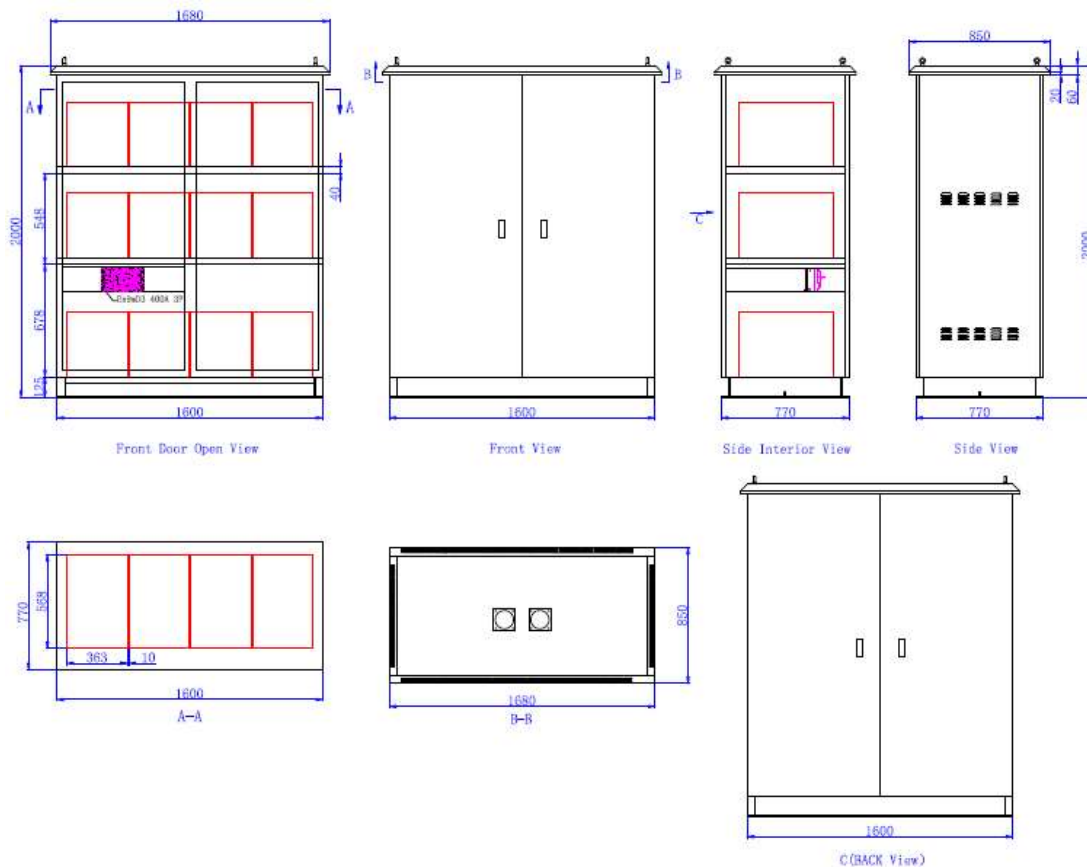
3.16 Equipment cabinet specifications



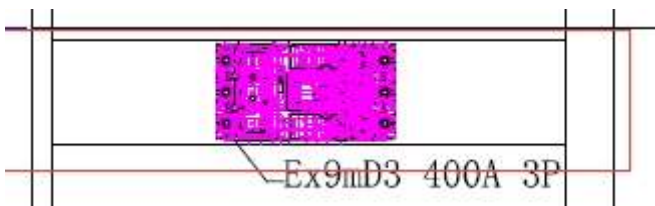


Similar drawing enlarged to show detail

2 x Battery Cabinet with 400 Amp Breakers. (Shown as colored purple below)

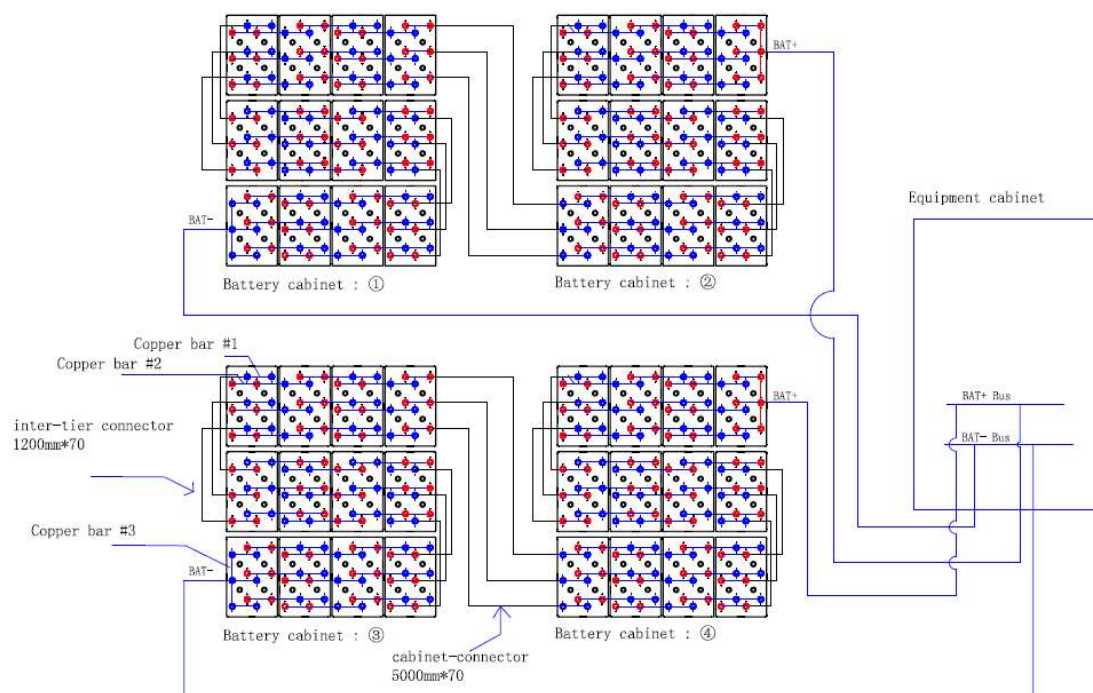


The 400 Amp Battery Breakers are packed separately from the cabinets and need to be installed into the cabinets by the system installer.

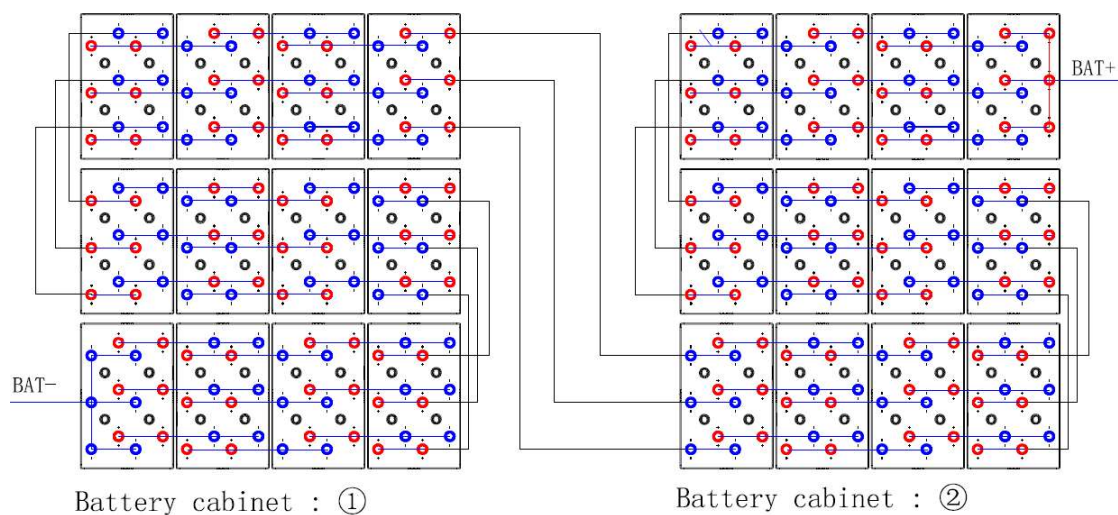


Mounting bracket above where 400 Amp Battery Breaker to be attached.

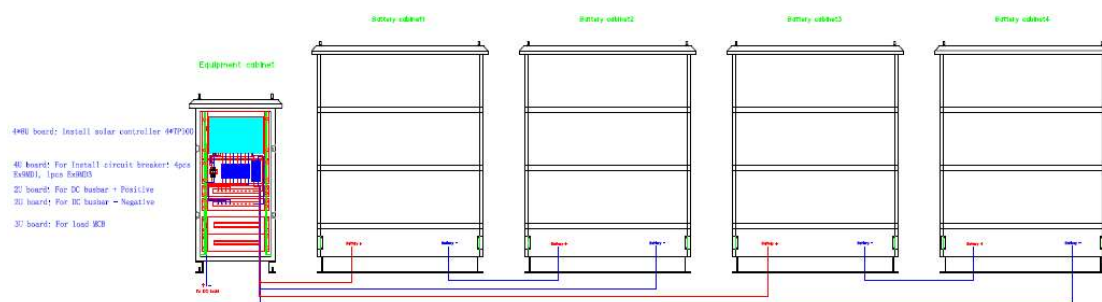
3.19 Battery connections



3.20 Battery connections (Detail for clarity)



3.21 Equipment cabinet and Battery cabinet inter-connections



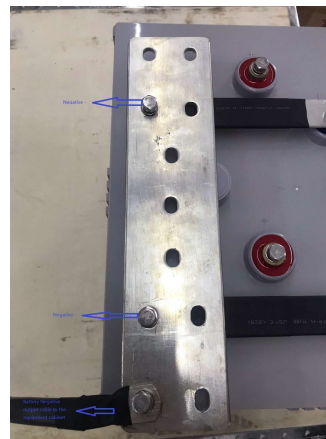
Network cabinet & Battery cabinet connection

Note: Battery cabinet to the Equipment cabinet cable need to same length.

- 1) There are 4 batteries connected in series per layer.
- 2) There are 3 layers connected in series per cabinet
- 3) Making 24 volts @ 3000 AH per cabinet
- 4) There are 2 cabinets in series per string
- 5) Note that there are three cables in parallel joining the cells between the cabinets
- 6) Making 48 volts @ 3000 AH per string
- 7) There are 2 strings of 2 cabinets in each string
- 8) Making a total of 48 volts @ 6000 AH
- 9) Total battery bank voltage is 48 volts.
- 10) Note that Battery Bank cables between each string and the Equipment cabinet must be of equal length to balance resistance between both battery strings.
- 11) Note that the power supply to the DC cooling fan is already connected when supplied.
- 12) There are 108 pieces of Copper Bar #2, shown as Blue Battery Interconnectors, as below.
(These have 4 holes)
- 13) There are 72 pieces of Copper Bar #1, shown as Black Battery Interconnectors, as below.
(These have 2 holes)
- 14) There are 4 pieces of Copper Bar #3, as shown as large with many holes.
(This is used for terminating the battery connection to a cable to the Equipment cabinet)
- 15) Note that the cables to the Equipment cabinet terminate to a 400 Amp Breaker for each string independently.



Blue Interconnectors



Black Interconnectors and large terminator copper bars

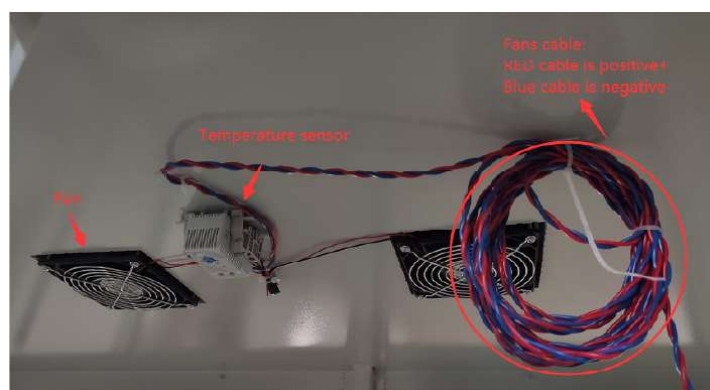
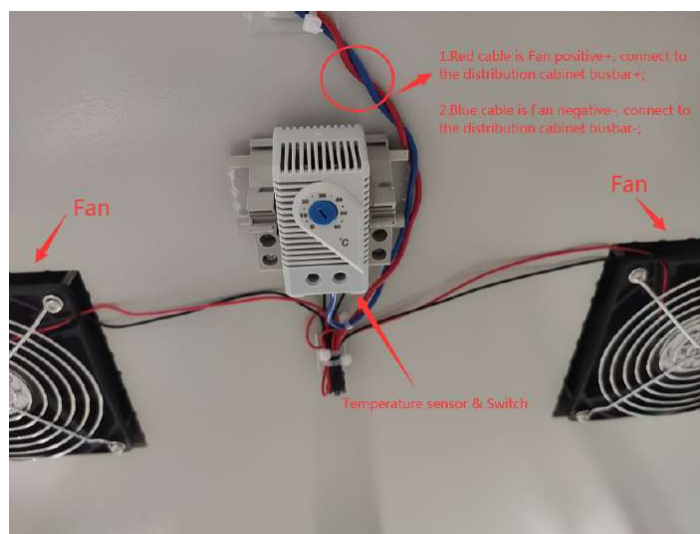
3.22 Cable protection

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.

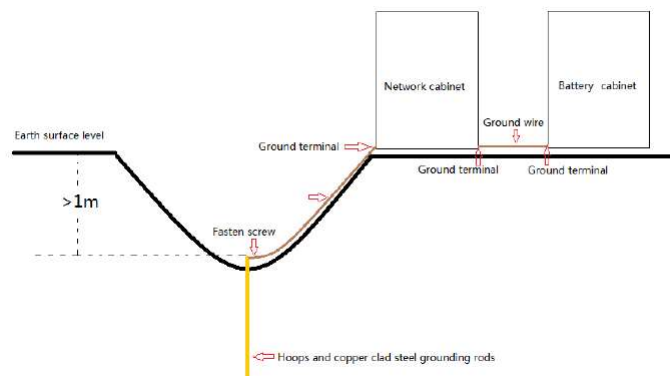


3.23 Battery cabinet free-cooling fans

Thermostatically controlled fans are installed in the Battery Cabinet.



3.24 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.

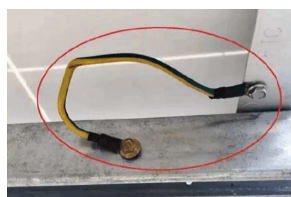
Connect the yellow / green grounding wire to the copper clad steel grounding rod provided or other good site grounding point.

3.25 Solar panel grounding connectors

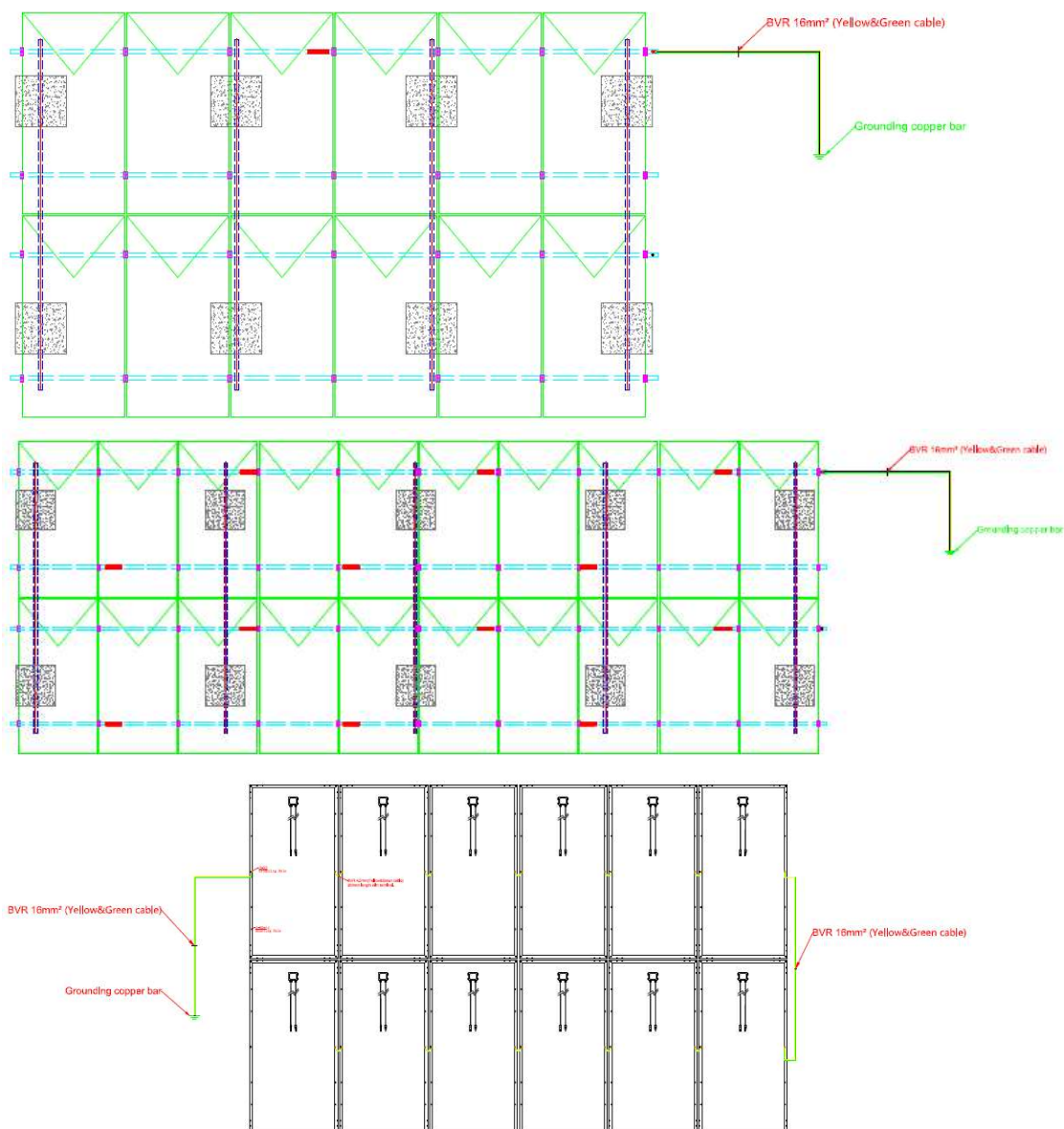
Please note that the PV Array and PV Modules are to be Grounded as per below with the supplied Grounding Tags

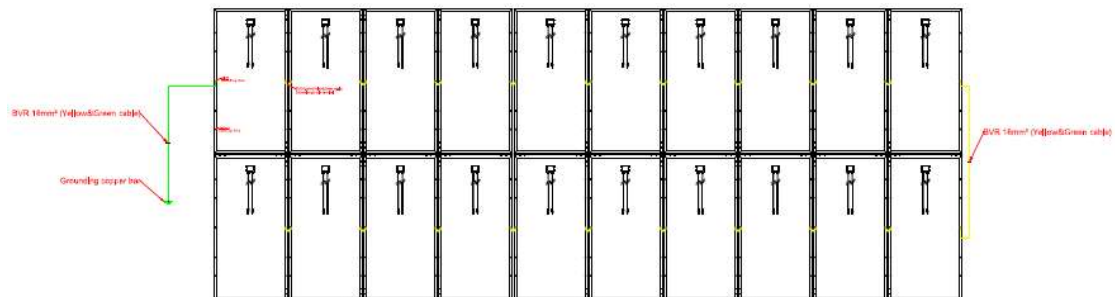


Connect the ground wire between the solar panels



Connect the ground wire between the solar panel and the bracket





4 BOQ

Product	Model	Specifications	QTY	Unit
Solar panel	ESM340-156	Poly 340Wp/37.6Vmp 45.1Voc	51	pcs
Battery	MR 2-3000 Max	2V/3000Ah	48	pcs
Solar Controller	TP100	48V/100A, with RS485 port & 5 meter temperature sensor	4	pcs
Mounting Bracket		tilt15°, 20 pcs ESM340-156, size 1957*992*40, array 2*10, the array lowest point to ground 1850MM	2	set
Mounting Bracket		tilt15°, 20 pcs ESM340-156, size 1957*992*40, array 2*10, the array lowest point to ground 1850MM	1	set
Equipment Cabinet			1	set
Battery Cabinet	EC-12-MR3000 Max-3T1L-02		2	sets
Battery Cabinet	EC-12-MR3000 Max-3T1L-01 (with MCB)		2	sets
DC Combine Box	SCB5	5 IN 1 OUT	4	pcs
Accessories				
PV MC4 Connector	MC4	1 in 1 out	22	pair
PV cable	PV1-F 1*4mm ²		250	m
DC cable	ZR-YJV-2*10mm ²		80	m
DC cable	ZR-YJV-2*25mm ²		20	m
DC load cable	ZR-BVR-16mm ²		20	m
DC cable	ZR-BVR-120mm ²		20	m
Ground wire	BVR 16mm ²		50	m
MCCB	Ex9MD1	125A 2P 25KA	4	pcs
MCCB	Ex9MD3	400A 3P 25kA	2	pcs
MCB	NB1-63DC	63A 2P 10KA	1	pcs
MCB	NB1-63DC	63A 2P 6KA	4	pcs
Cable	RVV 0.75mm ²		50	m
Terminal	SC120-10		20	pcs
	SC25-8		40	pcs
	OT16-8		20	pcs
	VE16-12		10	pcs