



## Installation, Operation & Maintenance Manual



## SunWize<sup>®</sup> Power Station System

Manual #: PM291028  
August 18, 2014



**KEY TO SAFETY WARNING STATEMENTS****☠ DANGER ☠**

Failure to follow this warning may result in serious injury or death to humans.

**☞ CAUTION ☞**

Failure to follow this warning may result in damage to the system equipment.

**! NOTE !**

Failure to follow these instructions or information may prevent operation of the system.

**KEY TO COMMONLY USED ELECTRICAL TERMS**

AC:	Abbreviation for alternating current, typically used in grid applications.
Amp:	Common unit of measurement for electrical current.
Ammeter:	Instrument used to measure current.
Array:	Refers to the PV modules and all the associated wiring and mounting hardware.
AH:	Abbreviation for Amp-hour. Refers to battery capacity.
Converter:	Instrument used to convert power from AC:DC or DC:DC in a regulated manner.
DC:	Abbreviation for direct current, typically used in battery applications.
DOD:	Abbreviation for Depth of Discharge. Refers to a battery's state of dis-charge.
Earth:	Common term referring to the reference point for electrical equipment where it comes into contact with the soil, also referred to as Earth Ground.
Ground:	Common term referring to the electrical zero volt reference point.
Hz:	Abbreviation for hertz, unit of measurement for AC frequency. 60Hz equals 60 cycles per second.
Inverter:	Instrument used to convert power from DC:AC in a regulated manner.
Joule:	Common unit of measurement for electrical energy. Joules equals watts per second.
Ohm:	Common unit of measurement for electrical resistance.
LVD:	Abbreviation for Low Voltage Disconnect. A device in charge controllers that disconnects the load from the battery to protect from over discharge.
PF:	Abbreviation for power factor. Used to describe the quality of AC current in percentage.
PV:	Abbreviation for Photovoltaic. Refers to the solar module that generates power from sunlight in a SunWize® Power Ready System
Volts:	Common unit of measurement for electrical potential.
Voltmeter:	Instrument used to measure voltage.
Sine Wave:	Refers to the wave-form of AC power, measured in hertz (Hz).
SOV:	Abbreviation for Silicon Oxide Varistor. Used to protect electrical equipment from surges.
VA:	Common unit of measurement for AC Power. VA equals Volts x Amps x Power Factor.
Vpc:	Abbreviation for volts per cell, used to describe the individual battery cell voltage. A 12V battery has 6, 2V cells
Watt:	Common unit of measurement for DC Power. Watts equals Volts x Amps.
Wattmeter:	Instrument used to measure power.

**IT IS THE OWNER'S RESPONSIBILITY TO ABIDE BY APPLICABLE NATIONAL AND LOCAL CODES WHEN INSTALLING THIS SYSTEM.**

**1.0 INTRODUCTION TO SUNWIZE® POWER STATION SYSTEMS**

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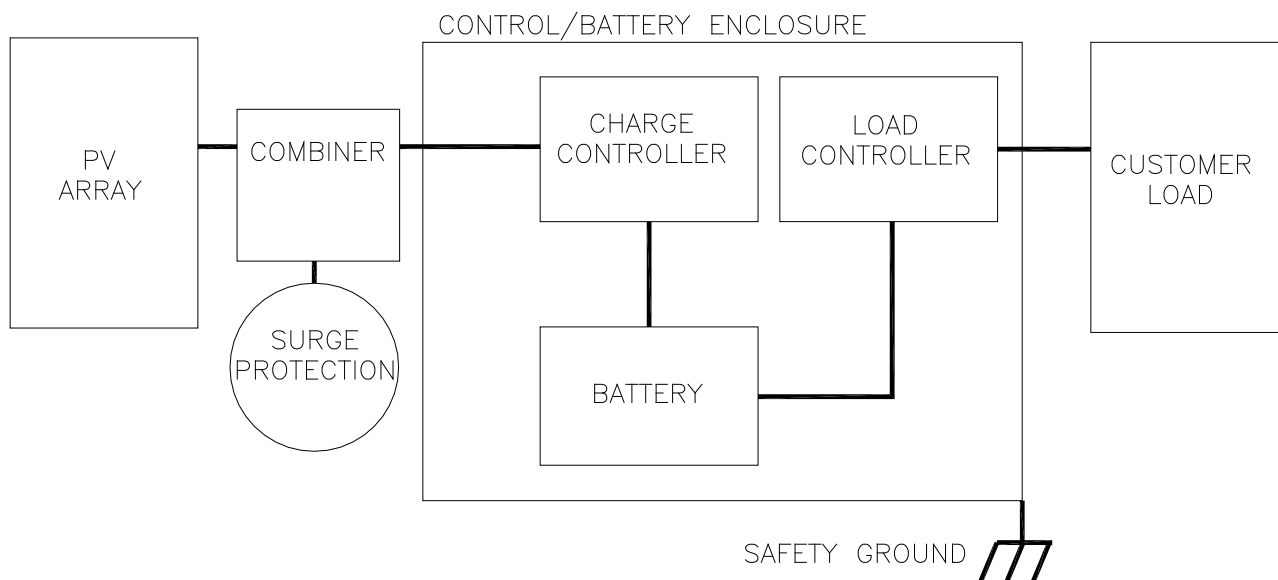


Congratulations on your purchase of the SUNWIZE POWER STATION SYSTEM®. This fully integrated system combines innovative technologies to provide you with a reliable stand-alone electrical power source. The POWER STATION SYSTEM is a self-contained power supply using sunlight to generate electricity at 24 or 48 volts DC. It is pre-assembled and ready to use. Because the system is powered by clean, quiet solar energy, you'll also enjoy independence from the utility electrical grid, as well as the reliability and satisfaction that comes with owning and operating an environmentally friendly renewable power source.

The POWER STATION SYSTEM® comes in two versions, stand-alone and hybrid.

A stand-alone system comes with the following components standard:

- A photovoltaic (PV) module or array on a galvanized steel, ground mounted structure
- Key lockable, battery enclosure
- Solar charge controller
- Low voltage load disconnect
- Load distribution blocks
- DC surge protection

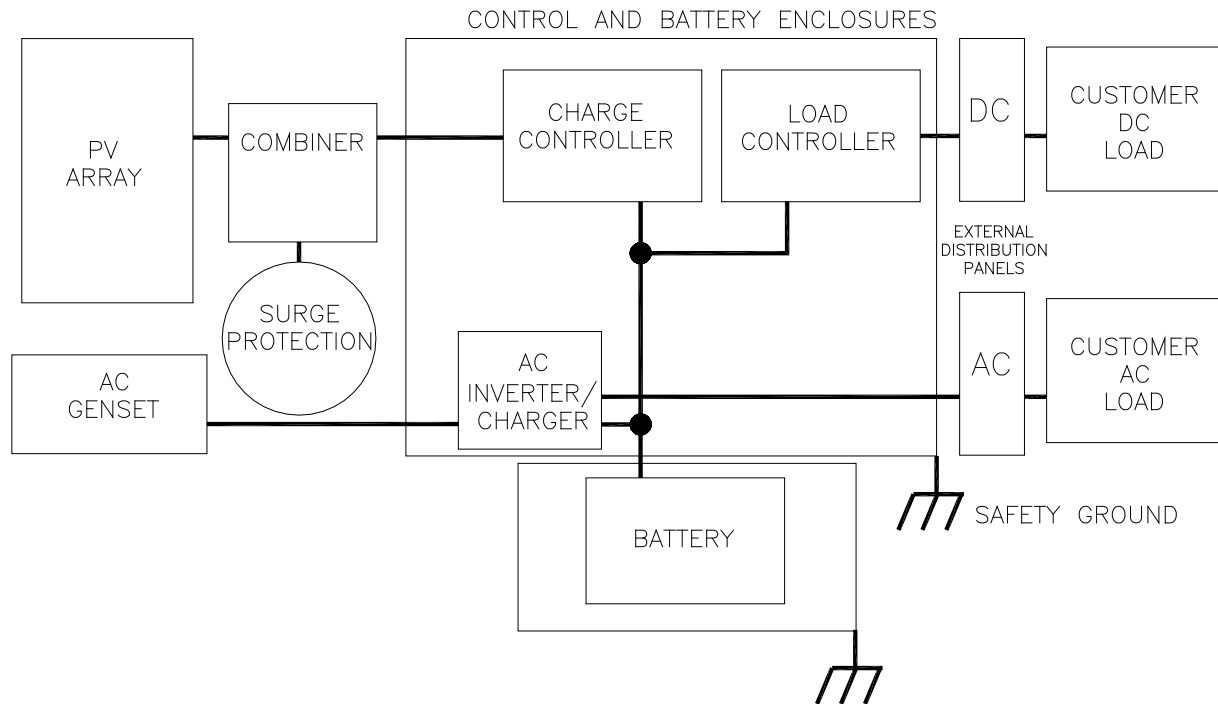


**FIGURE 1A: SYSTEM ONE LINE DIAGRAM STANDALONE (TYPICAL)**

A hybrid-system comes with the following components standard:

- Same as the stand-alone with additions of:
- AC inverter/charger with integral AC controls
- Engine genset





**FIGURE 1B: SYSTEM ONE LINE DIAGRAM AC HYBRID (TYPICAL)**

The PV array converts the sunlight into electrical current which charges the sealed batteries. The charge controller regulates battery charging by limiting the upper voltage level of the battery and limiting the lower voltage level of the battery by disconnecting the load. The equipment is protected by either circuit breakers or fuses. The front opening door enclosures feature tamper-resistant mounting system and filtered vents. Chest enclosures feature a continuous air gap to prevent gas buildup. (SEE SECTION 8.0 for additional system features provided by the controller and other electronic equipment.)

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## **1.1 COMPONENT IDENTIFICATION**

### **1.1.1 SOLAR ARRAY**

The solar array is comprised of the photo voltaic (PV) modules mounted onto panel rails. The modules are pre-wired and factory tested for correct system configuration. All fasteners are factory tightened to specification where applicable.

### **1.1.2 BATTERY BANK**

The system battery bank consists of sealed VRLA batteries of either GEL or AGM construction. Batteries are pre-installed, but left un-wired for safe transportation.

### **1.1.3 DC CONTROL PANEL**

The DC control panel provides all of the system DC charge controls to enable seamless operation between the solar electric array and the DC battery bank. Energy use is controlled using the DC low voltage disconnect. The DC low voltage disconnect removes the battery from the DC load should the battery bank become severely discharged due to lack of sun. All of the main DC disconnects circuit breakers are located on the DC control panel.

### **1.1.4 PV COMBINER BOX**

The aluminum combiner boxes contain all of the circuit breakers and bus bars necessary to wire the PV modules into a full system array. The breakers allow isolation and protection to each individual string of modules. This prevents an entire system failure should a problem with a single module or module string occur. Transient protection is also housed inside the enclosure.

### **1.1.5 OPTIONAL AC CONTROL PANEL**

The AC control panel provides all of the system charge controls to enable seamless operation between the AC power source and the DC battery bank. It also provides utility grade AC power for operating AC loads. All of the main AC disconnect circuit breakers are located on the AC control panel.

### **1.1.6 OPTIONAL AC ENGINE GENSET**

The engine genset is used where alternative power is required to supplement the solar array. The genset is controlled via the AC control panel and operates only when required.



## 2.0 INSTALLATION EQUIPMENT

### 2.1.1 CUSTOMER SUPPLIED TOOL LIST

- Wide, medium, and narrow flat head and Phillips screwdrivers
- Socket driver set and open end wrenches (3/8" – 1-3/4")
- Magnetic compass
- Tape measure
- Grease pencil, chalk, scribe or other marker
- Digital multi-meter
- Digital clamp on Ammeter (optional)

### 2.1.2 CUSTOMER SUPPLIED PARTS LIST

Item	Description	Comments
1	Load wire	18 – 6 AWG (0.8 – 13.0mm)
2	Load Conduit	1/2" - 1" KO provided
3	Equipment grounding	14-2 AWG Lug provided, ground per local electrical code
4	Array structure anchor bolts	3/4" dia. (8 per mount typ)
5	Battery enclosure anchor bolts	1/2" dia. (4 per enclosure) (chest style only)
6	Pad lock	1/2" dia hole provided (chest style only)

## 2.2 SUNWIZE SUPPLIED PARTS LIST

Refer to the wiring diagram enclosed for the specifics of your system.

Item	Description
1	Pre-assembled, pre-wired PV modules and mounts
2	Pre-assembled control/battery enclosure(s) with control panel
3	Control/battery enclosure mounting brackets with hardware
4	Batteries
5	Battery cables
6	Optional nylon wire ties
7	Optional spare controller load fuse
8	Optional enclosure keys (premium enclosures only)
9	SunWize® Installation & Operation Manual
10	Controller OEM manual

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### 3.0 MECHANICAL INSTALLATION INSTRUCTIONS

#### **DANGER**

Photovoltaic (PV) modules generate electricity when exposed to light. Modules pose a shock hazard and risk of serious injury or death if instructions and safety precautions are not followed carefully. Cover the glass faces of the modules with opaque material while working on the system to stop the production of electricity. Avoid touching the module terminals and isolate wire ends until all connections are made. Always observe proper polarities when making electrical connections to the modules, batteries, and controller.

#### **CAUTION**

The back-side of modules is susceptible to damage. Avoid dropping tools or other items on them.

Prior to commencing assembly and installation:

- Thoroughly read and follow all safety precautions and instructions to insure proper operation of the SUNWIZE POWER STATION SYSTEM.
- Gather the items identified in the TOOL LIST in Section 2.1 and the PARTS LIST in Section 2.2.

### 3.1 PV ARRAY SITE LOCATION

- For optimum performance in the Northern Hemisphere, the PV array should face true south (true NORTH in the Southern Hemisphere). Determine true south by using a magnetic compass corrected for local magnetic declination (SEE APPENDIX A for details).
- The PV array should be located so that there are no shadows or shading falling upon the face of the array from 8AM – 5PM. Even partial shading could reduce the array output to 0%.
- Determine the desired tilt angle of the array by using an atlas to determine the latitude of the installation location (SEE APPENDIX A for details).
- The module tilt angle is measured from horizontal, thus a panel that is lying parallel to the earth's surface is said to be at 0° tilt, a panel that is perpendicular to the earth surface is said to be at 90° tilt.

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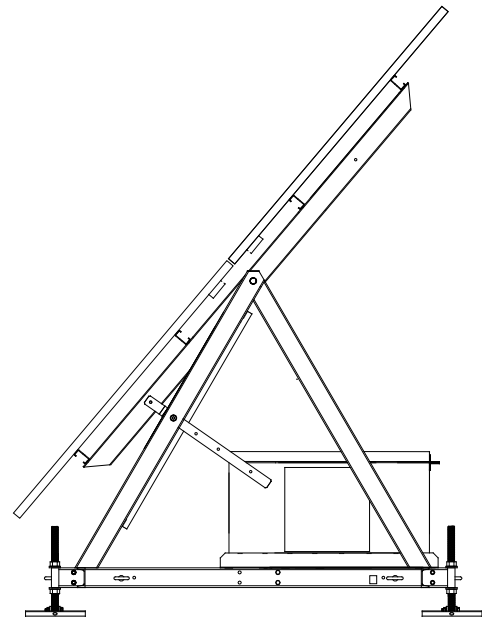
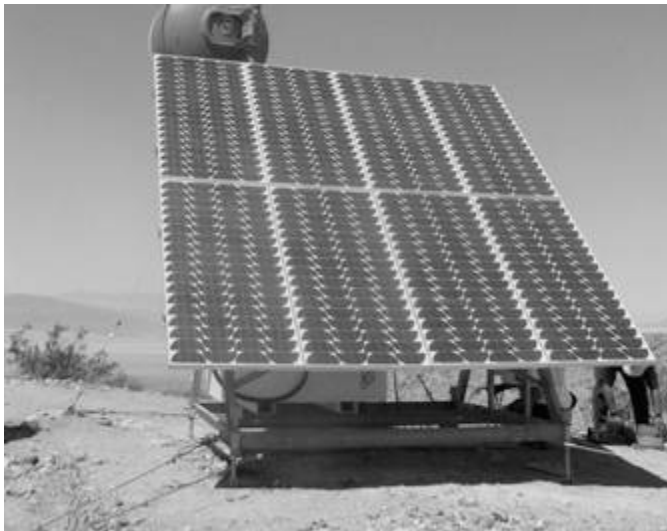
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### 3.2.1 PV ARRAY SITE PREPARATION – S01 - S02 Mount (Ballasted or earth anchored)

- S structures are intended for use where minimal site excavation is desired. The system is designed to be self supporting on uneven terrain (up to 12" end to end pitch).
- Remove loose debris and level the site to within the +/- 12" end to end pitch.
- Standard, if using earth anchoring, locate a minimum of 8 appropriate anchor points around the system (2 front, 2 rear, 2 ea. side). Anchors should each withstand a minimum of 1000lbs of uplift force.
- Optional, if self ballasting, locate 3 tons of appropriate local fill material to use as ballast such as gravel or rock. If using loose fill such as sand, contain the fill in an appropriate material such as burlap sand bags.



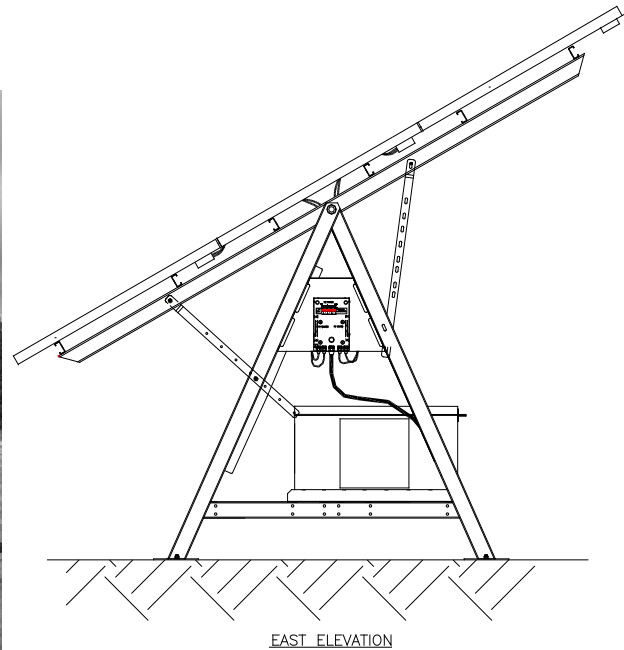
EAST ELEVATION

**FIGURE 2A: S-SIZE STRUCTURE ILLUSTRATION**



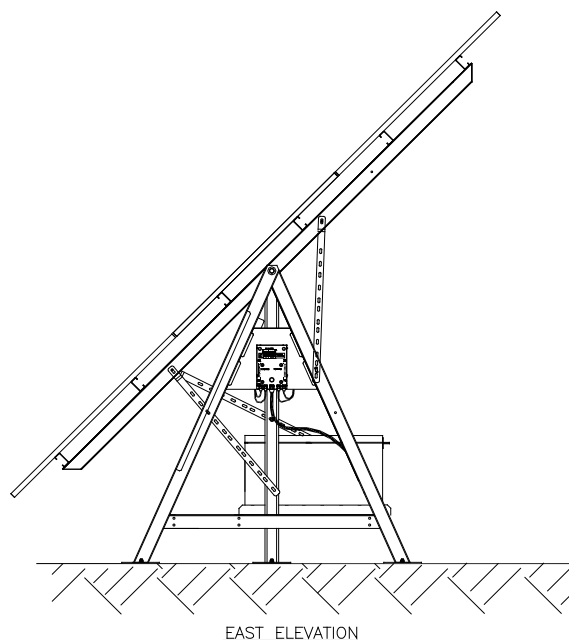
### 3.3.1 PV ARRAY SITE PREPARATION – M01 - M02 / L01 - L02 Mount (Concrete anchored)

- M / L structures are intended for use where site excavation is allowable with heavy equipment, and is intended for permanent anchoring onto level concrete surface.
- The foundation for the array can be any of the following options:
  - Poured reinforced concrete slab
  - Poured reinforced concrete footing piers
- All concrete is to be engineered to meet ASTM requirements for local soil conditions. Surface should be level and free of cracks or voids.
- All footings are to be on firm compacted soil a minimum of 6" below frost line.
- Fasteners are to be stainless steel, 3/4" diameter suitable for self anchoring into concrete surfaces.
- System to be designed for a minimum uplift force of 40,000lbs for M systems, 52,000lbs for L systems.



**FIGURE 2B: M-SIZE STRUCTURE ILLUSTRATION**





**FIGURE 2C: L-SIZE STRUCTURE ILLUSTRATION**



### 3.4.1 PV ARRAY STRUCTURE INSTALLATION – S01 - S02 Mount

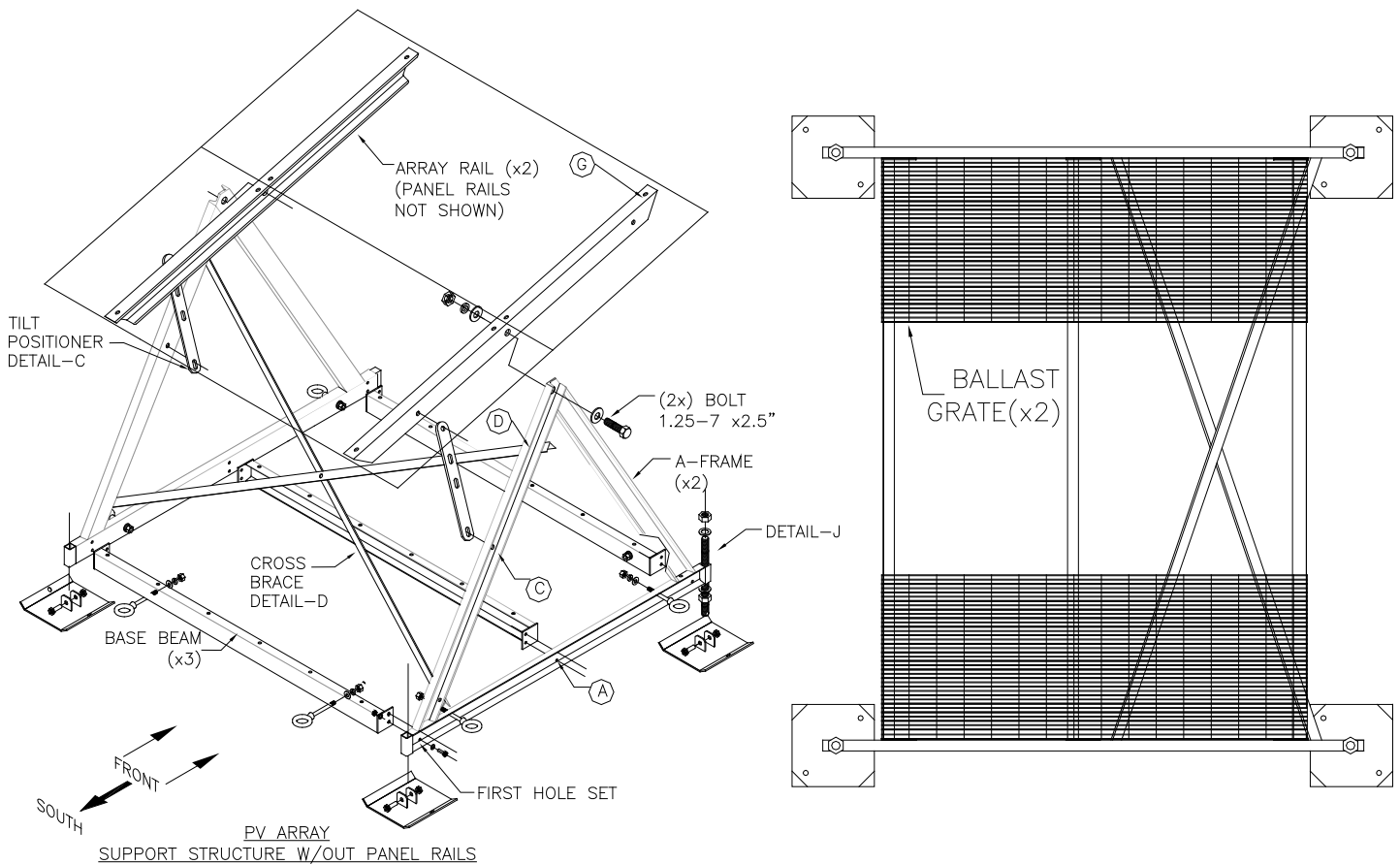
- The PV arrays (up to 2) are shipped with modules pre-assembled onto the panel rails, with module(s) pre-wired using ½" flexible liquid tight conduit and 10 AWG wire between modules. The conduit and wire that connect the array from the combiner box to the control enclosure may be larger.
- The Array Structure is shipped dis-assembled for ease of transportation. The structure assembly consists of (SEE FIGURE 3A):
  - A-frame to support the base-ends of the structure (x2)
  - Base beams (x3)
  - X-braces to stabilize the A-frame (x2)
  - Array rails to support the PV Panels at the desired tilt angle (x2)
  - Tilt positioner arms for adjusting the angle of the array (x2)
  - Leveling leg assemblies (x4)
  - Optional rear skid for supporting battery or control enclosures (x1)
  - Optional ballast screen (x2)
- Fasten the two A-frames to the three base beams using the 1/2" Galvanized hardware provided. Note the pre-drilled hole patterns should correspond to the combiner box or the AC Distribution enclosure. The PV combiner box frame should be on the EAST side of the array. Tighten the 1/2" hardware using a 3/4" wrench to 45-47 Ft. Lbs.
- Install the four leveling leg assemblies onto the A-frames. Adjust the leg positions so the system measures level.
- Attach the two X-braces to the SOUTH side of the structure using the provided 3/8" SS hardware provided. The hardware can be left hand tightened until the end of the assembly process.
- Attach the two array rails using the 1-1/4" hardware provided. Level the array rails so they are perpendicular to the ground. Tighten the hardware using a 1-3/4" wrench to 200-240 Ft. Lbs.
- Temporarily support the array rails from the NORTH side to prevent the array from tilting. Use 2x4 lumber (not provided) or alternate bracing material.
- For earth anchoring, install two earth anchors (not provided) minimum per side of the array. For each earth anchor, attach a 3/16" steel guy wire (not provided) to one of the eight guy bolts provided. Tension the guy lines prior to completion.
- For ballasting, install the 2 ballast screens using the 3/8" hardware provided. Locate the screens as shown in FIGURE 3A, one at the EAST end, one at the WEST end.
- Add ballasting material to support the system prior to adding the modules.

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**FIGURE 3A: S-SIZE STRUCTURE INSTALLATION DETAILS**



### 3.4.2 PV ARRAY PANELS INSTALLATION – S01 - S02 Mount

- Mount the first panel rail to the NORTH side of the array using the 3/8" SS hardware provided. Align the bolt holes on the panel rail with the bolt holes on the array rail. Insure the J-Box wiring is facing EAST towards the combiner box. Tighten the hardware using a 9/16" wrench to 18-20 Ft. Lbs.
- Mount the second panel rail to the SOUTH side of the array using the 3/8" SS hardware provided. Align the bolt holes on the panel rail with the bolt holes on the array rail. Insure the J-Box wiring is facing EAST towards the combiner box. Tighten the hardware using a 9/16" wrench to 18-20 Ft. Lbs.
- Attach the two tilt positioner braces to the SOUTH side of the array rail using the 1/2" hardware provided.
- Loosen the Array rail bolt and use the temporary braces to support the array. Tilt the array SOUTH to the desired tilt angle (SEE APPENDIX A for details).
- Secure the two tilt positioner braces to the A-frame using the 1/2" hardware provided.
- Tighten the 1/2" hardware using a 3/4" wrench to 45-47 Ft. Lbs. Tighten the 1-1/4" hardware using a 1-3/4" wrench to 200-240 Ft. Lbs.

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### 3.5.1 PV ARRAY STRUCTURE INSTALLATION – M01 - M02 / L01 – L02 Mount

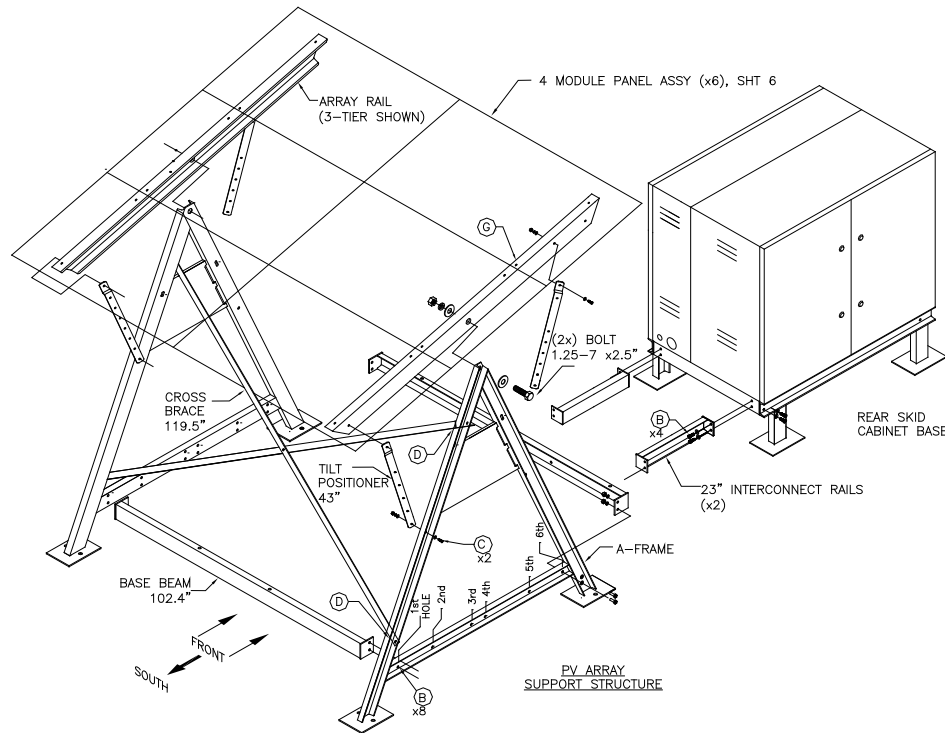
- The PV array (up to 6) are shipped with modules pre-assembled onto the panel rails, with module(s) pre-wired using flexible liquid tight conduit and 10 AWG wire between modules. The conduit and wire that connect the array to the control enclosure may be larger.
- The Array Structure is shipped dis-assembled for ease of transportation. The structure assembly consists of (SEE FIGURES 3B and 3C):
  - A-frame to support the base-ends of the structure (x2)
  - I-frame to support center span (x1) (L-systems only)
  - Base beams (x2)
  - X-braces to stabilize the A-frame (x2)
  - Array rails to support the PV Panels at the desired tilt angle (x2 for M, x3 for L)
  - Tilt positioner arms for adjusting the angle of the array (x4 for M, x5 for L)
  - Splice plates (x6)
  - Optional rear skid for supporting battery or control enclosures (x1 for M, x2 for L)
  - Optional rear skid interconnect channels (x2 for M)
- Mount the two A-frames to the prepared pad using 3/4" hardware (not provided). The Combiner box frame should be on the EAST side of the array.
- Fasten the two A-frames to the two base beams using the 1/2" Galvanized hardware provided. Ensure the base beams are located properly to allow the mounting of the battery enclosures provided. Tighten the 1/2" hardware using a 3/4" wrench to 45-47 Ft. Lbs.
- Attach the two X-braces to the SOUTH side of the structure using the provided 3/8" SS hardware provided. The hardware can be left hand tightened until the end of the assembly process.
- Attach the two array rails using the 1-1/4" hardware provided. Level the array rails so they are perpendicular to the ground. Tighten the hardware using a 1-3/4" wrench to 200-240 Ft. Lbs.
- Temporarily support the array rails from the NORTH side to prevent the array from tilting. Use 2x4 lumber (not provided) or alternate bracing material.
- For systems with rear skids (M02 / L02): mount the skid onto the prepared pad. Insure the skid is oriented to allow the skid interconnect beam to be connected to the base beams between the A-frames. Secure to the prepared pad using 3/4" hardware (not provided).
- Install the interconnect rails between the rear skid and the base beams using the 1/2" hardware provided. Tighten all hardware using a 3/4" wrench to 45-47 Ft Lbs.

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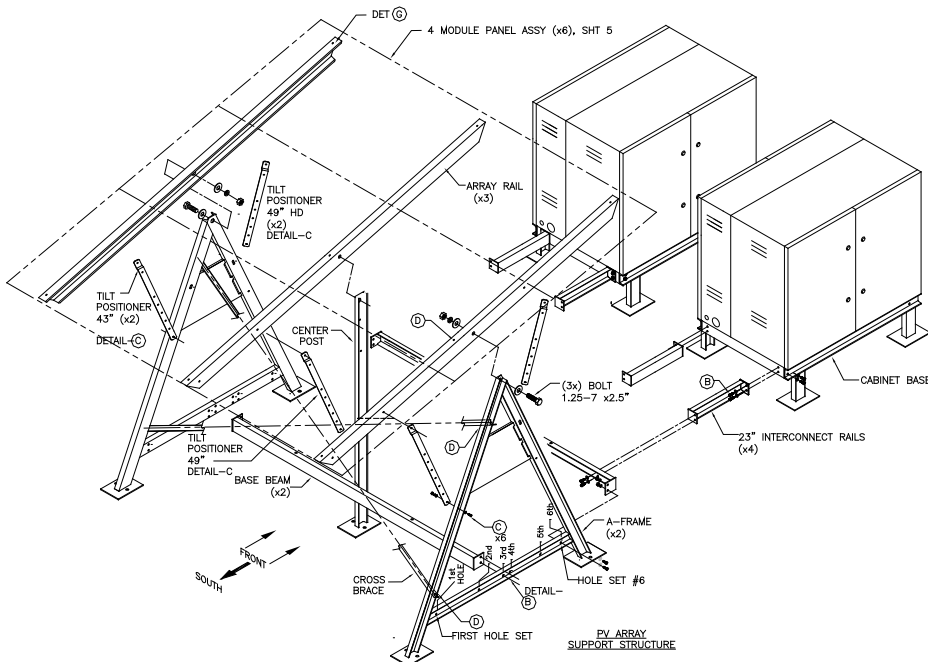
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**FIGURE 3B: M-SIZE STRUCTURE INSTALLATION DETAILS**



**FIGURE 3C: L-SIZE STRUCTURE INSTALLATION DETAILS**



### 3.5.2 PV ARRAY PANELS INSTALLATION – M01 - M02 / L01 – L02 Mount

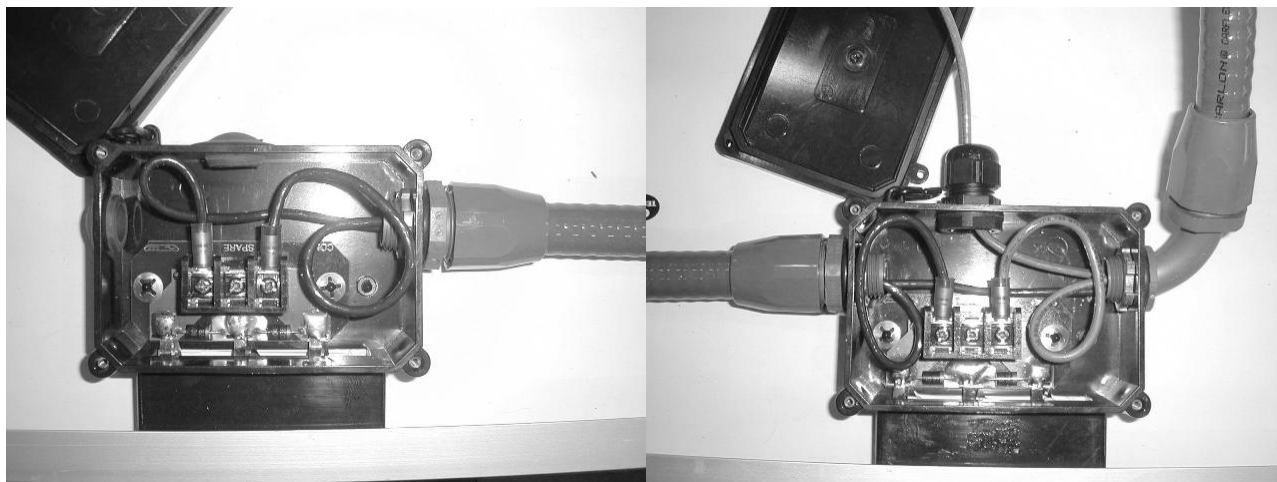
- Segregate the PV array panels based on the direction of the output wiring harness. When J-boxes are oriented in the same position, half of the PV panels will have the output harness exiting from the left side, half will have output harness exiting from the right side (SEE FIGURE 4A-B).
- Insert two splice plates into the first PV array assembly panel rail to be installed so the splices will be at the mid-span of the structure.
- Attach the first PV array panel rail to the Array rail using the 3/8" SS hardware provided at the NORTH WEST corner so the output wiring harness exits at the mid-span. The J-box of the PV modules should be oriented towards the bottom of the structure:
  - For M-structures, temporarily support the panel rail at the mid span (SEE FIGURE 4C).
  - For L-structures, the panel rails should be supported at the mid-span by the center I-frame Array rail.
- Attach the second PV array panel rail to the Array rail using the 3/8" SS hardware provided at the NORTH EAST corner so the output wiring harness exits at the mid-span
- Adjust the splice plates so they overlap between the two opposing PV array assembly panel rails. Attach them to the rails using the 3/8" SS hardware provided.
- For L-structures, attach the last hole position at the Mid-span / splice to the Array rail supported by the I-Frame using the 3/8" hardware provided.
- Repeat this process for the remaining rows. When complete, tighten all 3/8" hardware using a 9/16" wrench to 18-20 Ft Lbs. Apply thread locking compound to all 3/8" hardware (provided).
- Loosen the Array rail bolt and use the temporary braces to support the array. Tilt the array SOUTH to the desired tilt angle (SEE APPENDIX A for details).
- Secure the tilt positioner braces to the A-frame using the 1/2" hardware provided.
- For M-structures, secure four positioner braces.
- For L-structures, secure five positioner braces.
- Tighten the 1/2" hardware using a 3/4" wrench to 45-47 Ft. Lbs.
- Tighten the 1-1/4" hardware using a 1-3/4" wrench to 200-240 Ft. Lbs.

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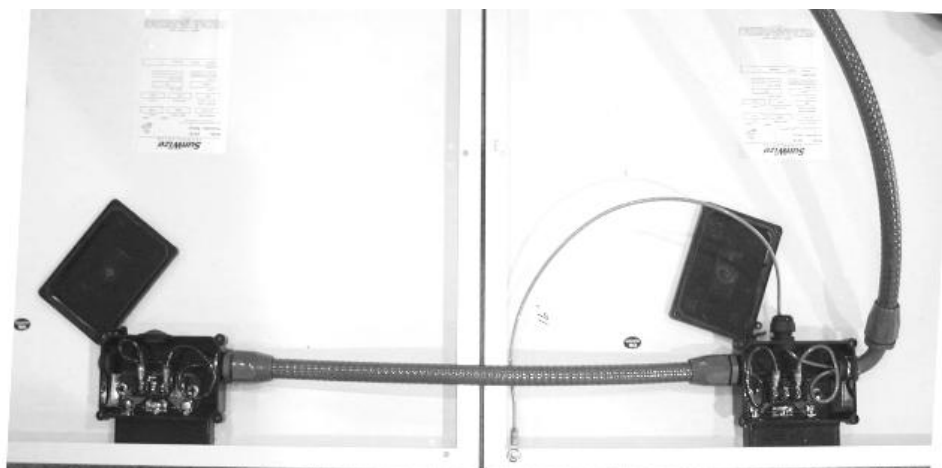
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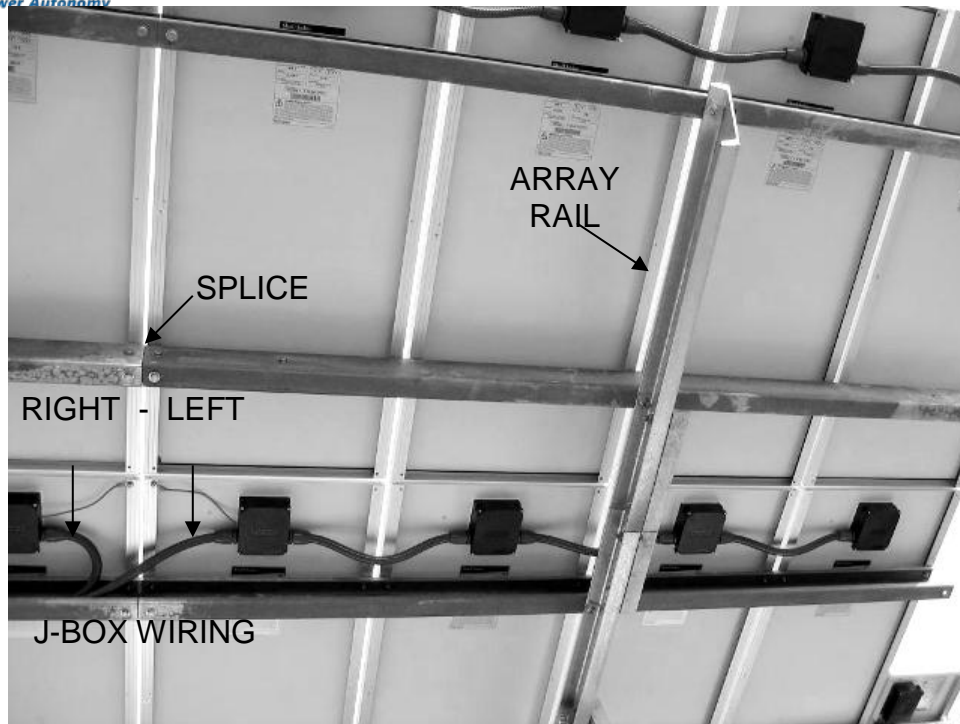


**FIGURE 4A: J-BOX WIRING DETAIL, LEFT SIDE WIRING SHOWN UPSIDE DOWN**

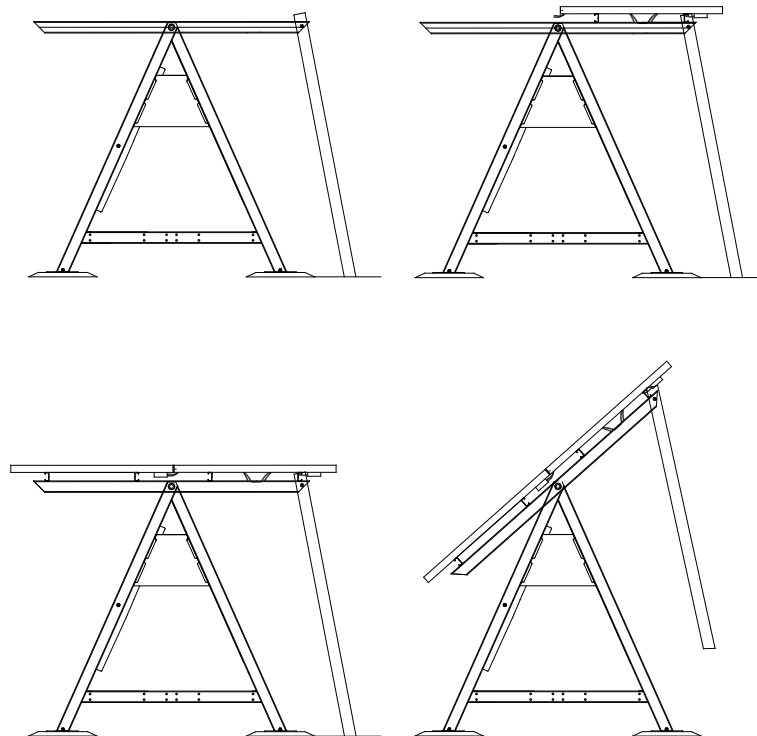


**FIGURE 4B: MODULE INTERCONNECT WIRING DETAIL, LEFT SIDE WIRING SHOWN UPSIDE DOWN**





**FIGURE 4C: SPLICE INSTALLATION DETAILS**



**FIGURE 4D: PANEL RAIL TEMPORARY SUPPORT ILLUSTRATION**



### 3.6 BATTERY ENCLOSURE INSTALLATION

#### ☠ **DANGER** ☠

The battery enclosure may weigh up to 250 lbs. and individual 12V batteries may weigh up to 130 lbs. , 2V batteries may weigh up to 1000 lbs each. Use caution to avoid injury when lifting and securing the enclosure.

#### **! NOTE !**

The preferred location for installation of the enclosure is in the shade of the PV array or in another shaded location. This will help minimize high temperature excursions of the batteries and extend battery life.

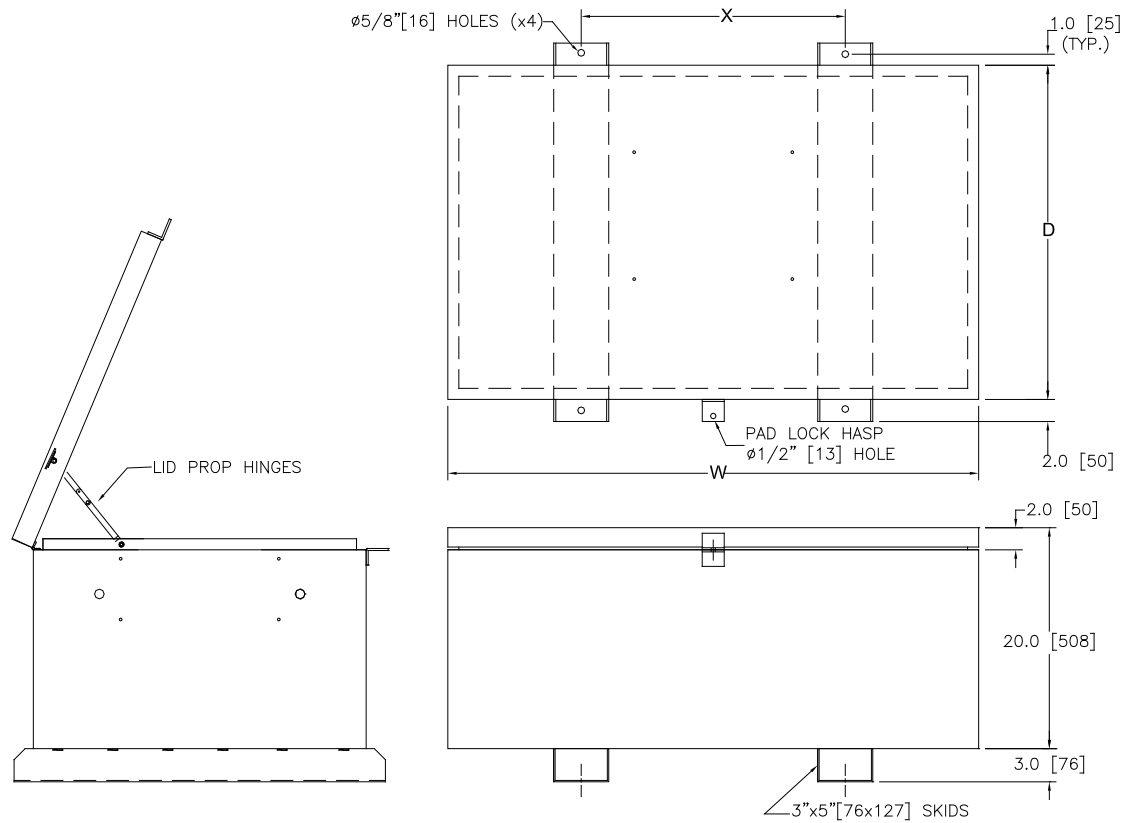
#### 3.6.1 BATTERY ENCLOSURE INSTALLATION – T-style chest enclosure

- Verify the enclosure size provided matches the mounting hole alignment on the base beam.
- Mount the enclosure onto the base beams.
- For S-systems, center the enclosure between the A-frames
- For M or L-systems, mount a single enclosure towards the EAST A-frame to allow the shortest wire run from the combiner to the enclosure. If two enclosures are provided, mount the second enclosure toward the WEST A-frame. Secure using the ½" hardware provided. Tighten using a 3/4" wrench to 45-47 Ft Lbs.



**FIGURE 5A: T–STYLE CONTROL/BATTERY ENCLOSURE**





**FIGURE 5B: T-STYLE CONTROL/BATTERY ENCLOSURE**

Model	Battery Capacity		Weight lbs (kg)	Dimensions					
	4D	8D		W		X		D	
				IN	mm	IN	mm	IN	mm
T-6X4D	6	4	100 (45)	48.25	1225.55	24.00	609.6	30.25	768.35
T-8X4D	8	6	125 (57)	48.25	1225.55	24.00	609.6	40.25	1022.35
T-8X8D	8	8	150 (57)	48.25	1225.55	24.00	609.6	46.00	1168.4

**TABLE 1: T-STYLE CONTROL/BATTERY ENCLOSURE**



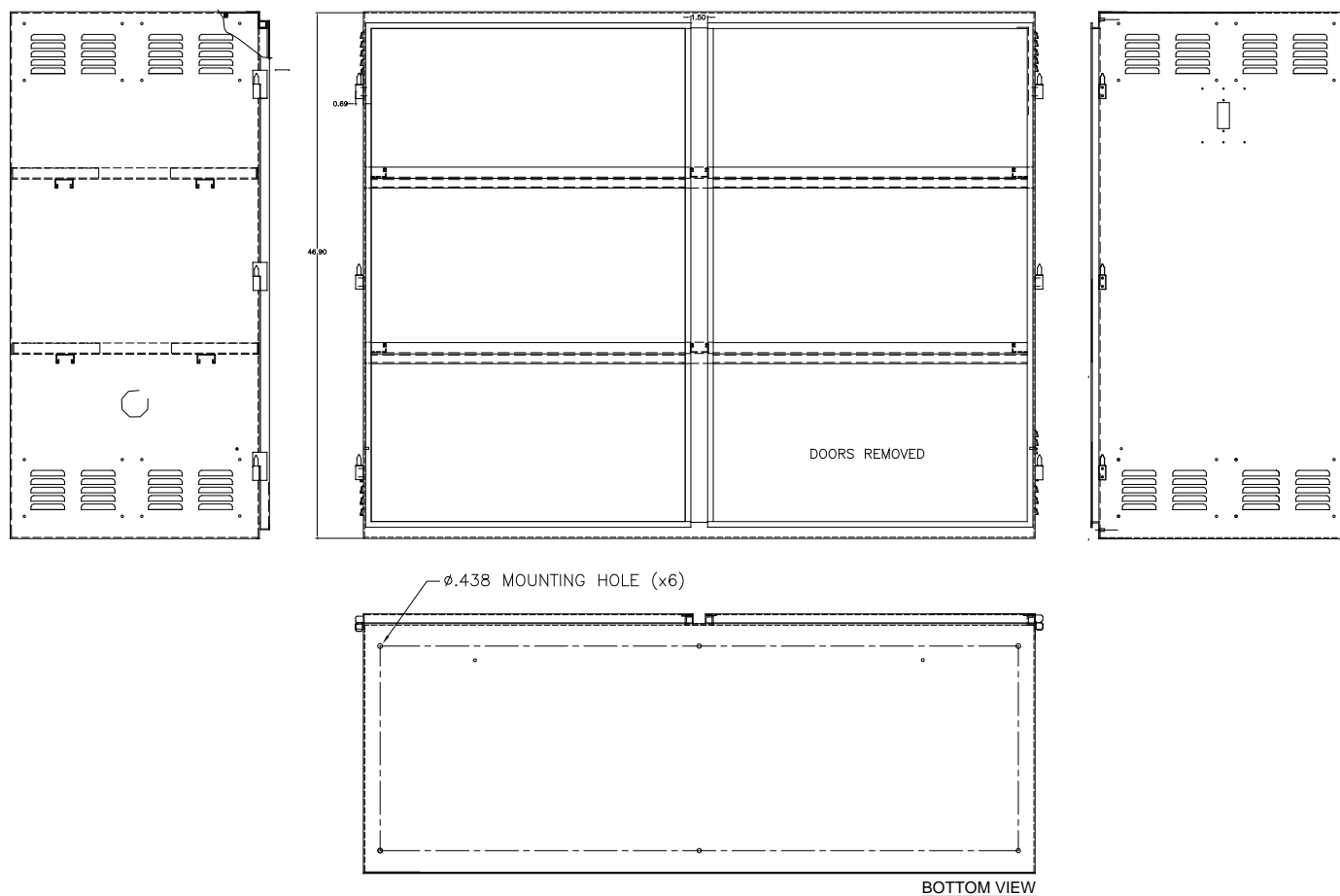
### 3.6.2 BATTERY ENCLOSURE INSTALLATION – (PSF12-12, PSF2-12) F-style enclosure

- The enclosures come pre-mounted to the rear skid. Each enclosure will have the batteries pre-installed and braced for shipment, but not wired.
- Mount the enclosure / skid onto the prepared surface per SECTION 3.4 and 3.5. Secure using 3/4" hardware (not provided). Ensure the enclosure is level in all directions (shim as necessary).



**FIGURE 6A: PSF12-12 CONTROL/BATTERY ENCLOSURE**

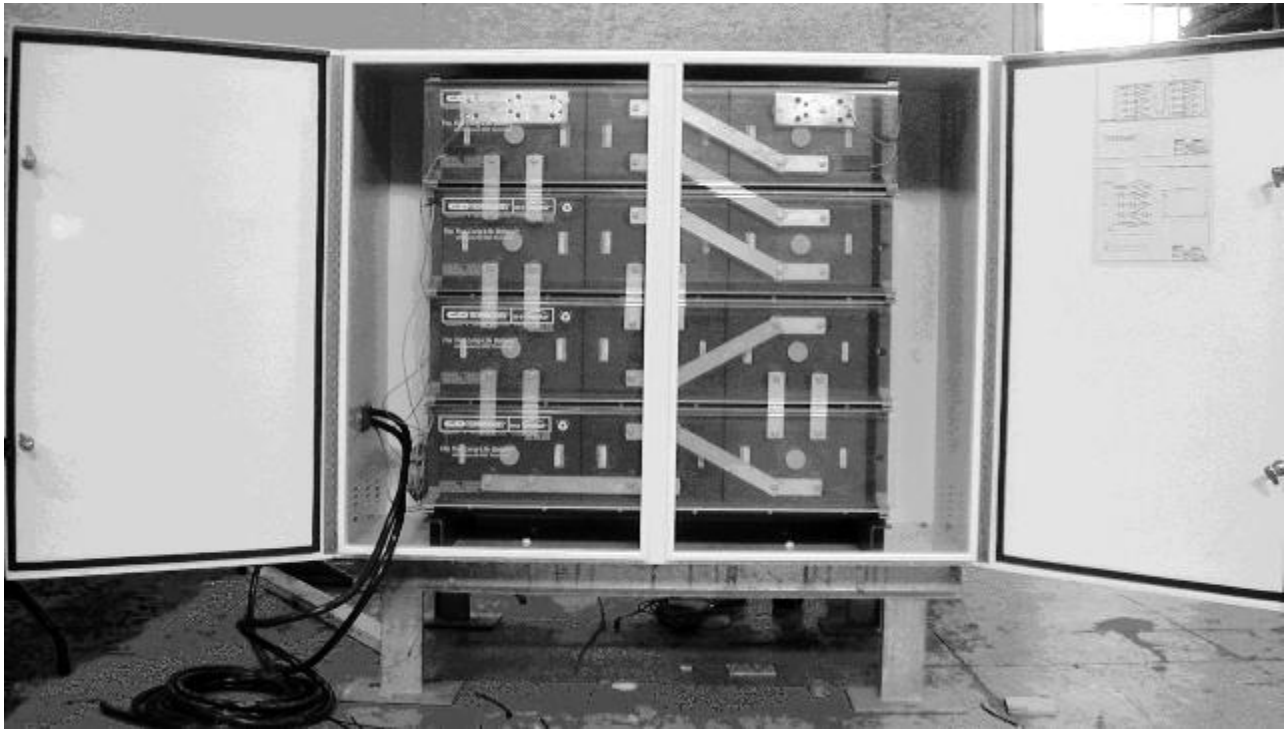



**FIGURE 6B PSF12-12 BATTERY ENCLOSURE**

Model	Battery Capacity		Weight lbs (kg)	Dimensions					
	4D	8D		W		H		D	
				IN	mm	IN	mm	IN	mm
PSF12-12	12	12	250 (114)	60.0	1524	47.0	1194	22.25	565

**TABLE 2: PSF12-12 BATTERY ENCLOSURE**

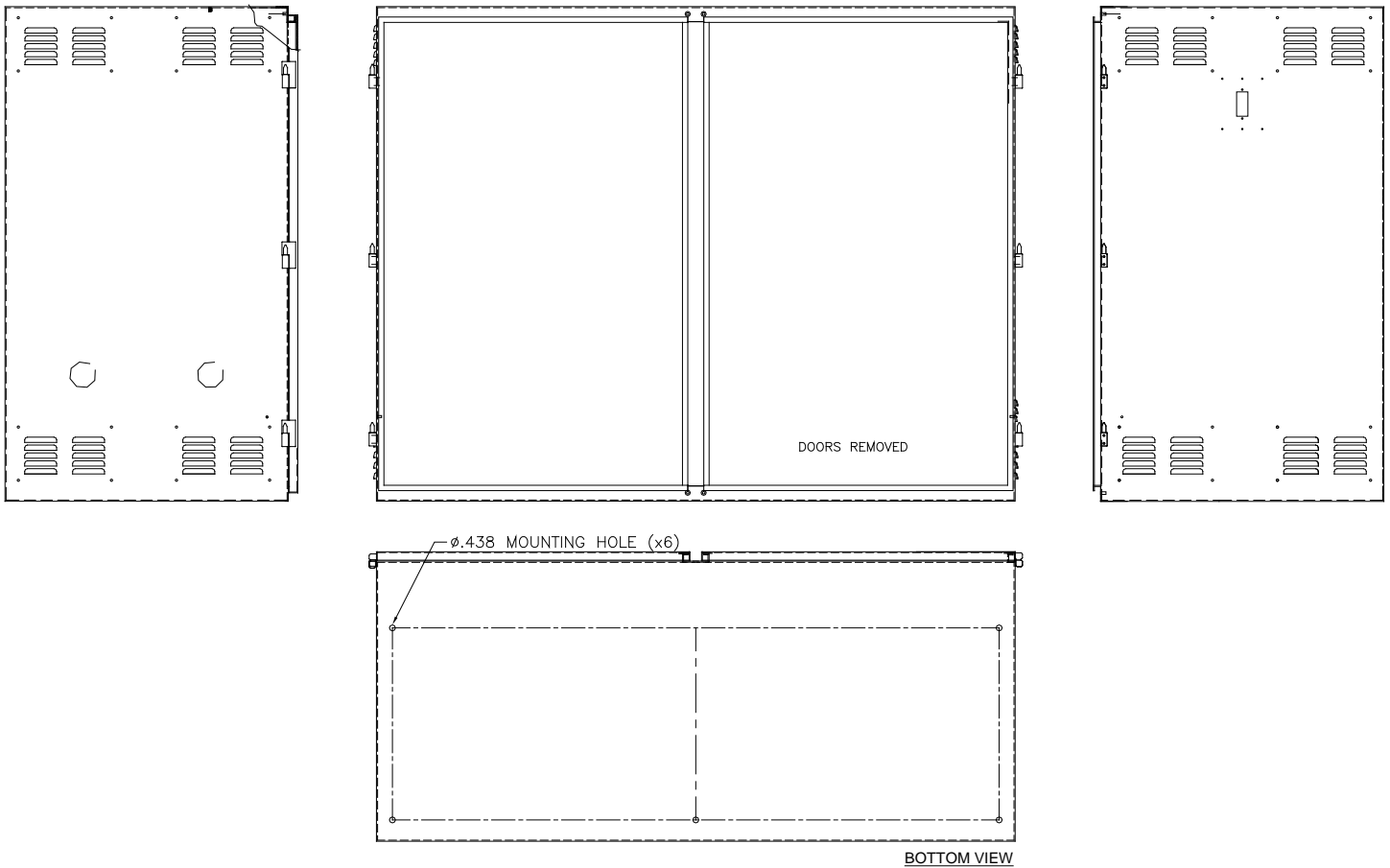




**FIGURE 7A: PSF2-12 BATTERY ENCLOSURE**

- Mount the 2V cell battery rack base to the enclosure using 5/8" hardware provided. Insure the rack is level in all directions. Shim as necessary. Tighten all hardware using a 15/16" wrench to 70-80 Ft. Lbs.
- Follow the manufacturers' installation recommendations for lifting, mounting and fastening the individual rack tiers to each other.





**FIGURE 7B: PSF2-12 BATTERY ENCLOSURE**

Model	Battery Capacity	Weight	Dimensions					
	2V CELLS 2200AH MAX	lbs (kg)	W		H		D	
			IN	mm	IN	mm	IN	mm
PSF2-12	12	250 (114)	60.0	1524	47.0	1194	22.25	565

**TABLE 3: PSF2-12–STYLE BATTERY ENCLOSURE**



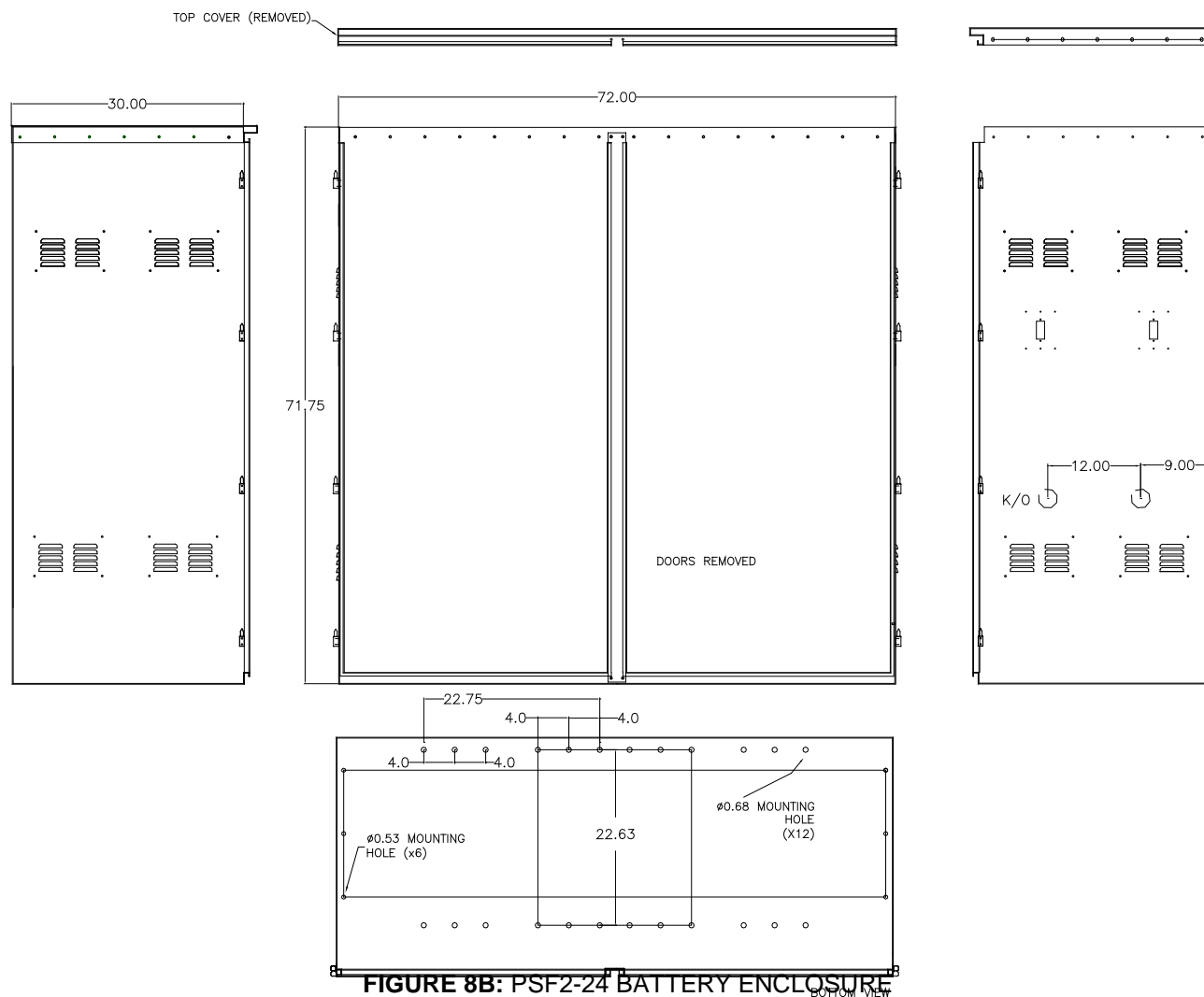
### 3.6.3 BATTERY ENCLOSURE INSTALLATION – (PSF2-24) F-style enclosure

- The enclosures come pre-mounted to the rear skid but without batteries due to the size and weight of the entire assembly.
- Mount the enclosure / skid onto the prepared surface per SECTION 3.4 and 3.5. Secure using 3/4" hardware (not provided). Ensure the enclosure is level in all directions (shim as necessary).
- Install battery rack 1 of 2 into the left side of the enclosure. Follow the battery manufacturers recommended lifting methods for the battery provided. Attach the battery bank using 5/8" hardware provided.
- Install battery rack 2 of 2 into the left side of the enclosure. Follow the battery manufacturers recommended lifting methods for the battery provided. Attach the battery bank using 5/8" hardware provided. Tighten all hardware using a 15/16" wrench to 70-80 Ft. Lbs.
- Secure the enclosure top using the 1/4" hardware provided. Tighten all hardware using a 7/16" wrench to 5 – 6 Ft. Lbs.



**FIGURE 8A: PSF2-24 BATTERY ENCLOSURE**





Model	Battery Capacity	Weight	Dimensions					
	2V CELLS Up to 2200AH	lbs (kg)	W		H		D	
			IN	mm	IN	mm	IN	mm
PSF2-24	24	350 (159)	72.0	1829	71.75	1823	32.0	813

**TABLE 4: PSF2-24 BATTERY ENCLOSURE**



### 3.7 CONTROL ENCLOSURE INSTALLATION

#### ⚠ **DANGER** ⚠

The control enclosure installation may weigh up to 400 lbs. Use caution to avoid injury when lifting and securing the enclosure.

#### **! NOTE !**

The preferred location for installation of the enclosure is in the shade of the PV array or in another shaded location. This will help minimize high temperature excursions of the batteries and extend battery life.

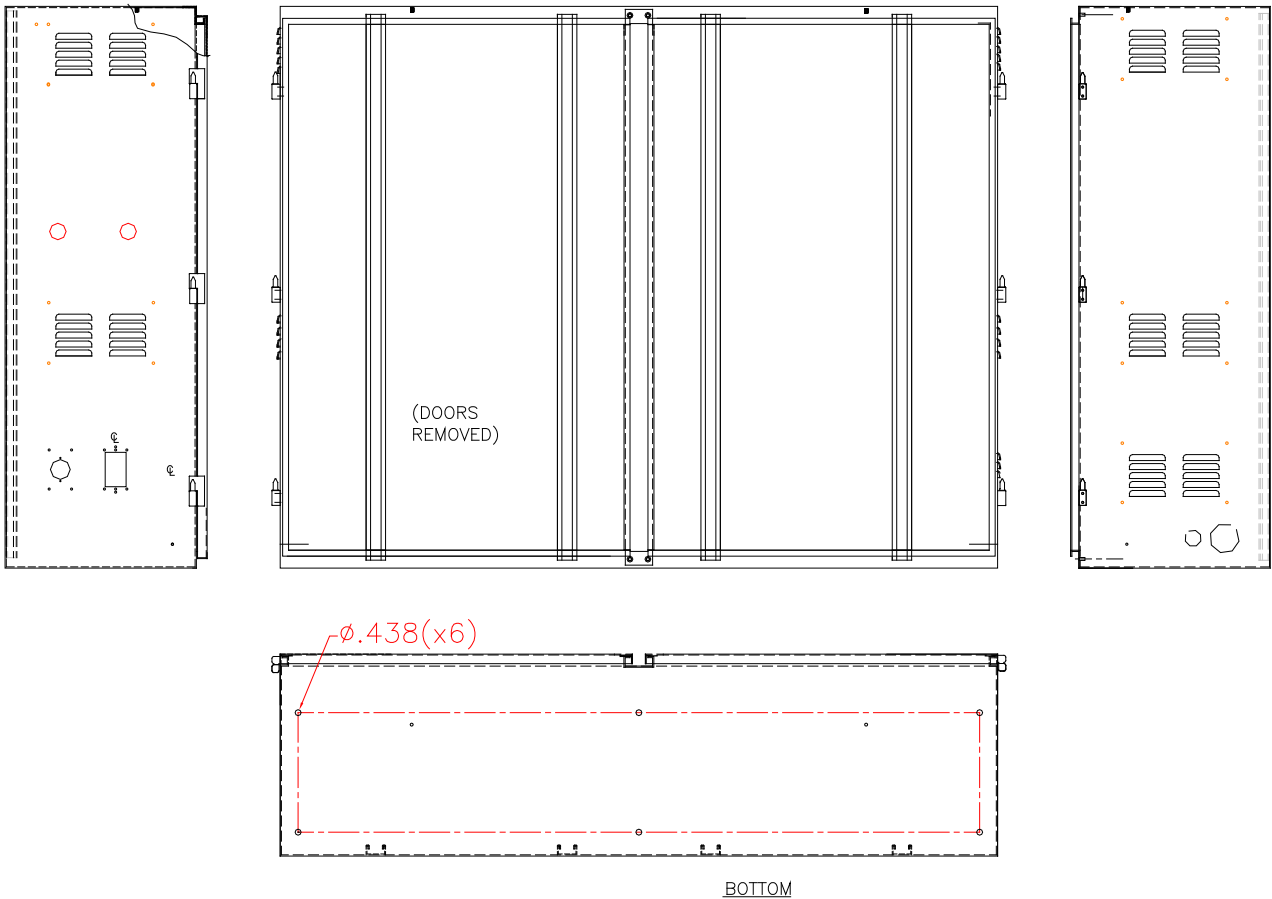
#### 3.7.1 CONTROL ENCLOSURE INSTALLATION – (PSF-L) F-style enclosure

- The enclosures come pre-mounted to the rear skid. Each enclosure will have the electronics pre-installed and braced for shipment.
- Mount the enclosure / skid onto the prepared surface per SECTION 3.4 and 3.5. Secure using 3/4" hardware (not provided)



**FIGURE 9A PSF-L CONTROL ENCLOSURE**





**FIGURE 9B: PSFL CONTROL ENCLOSURE**

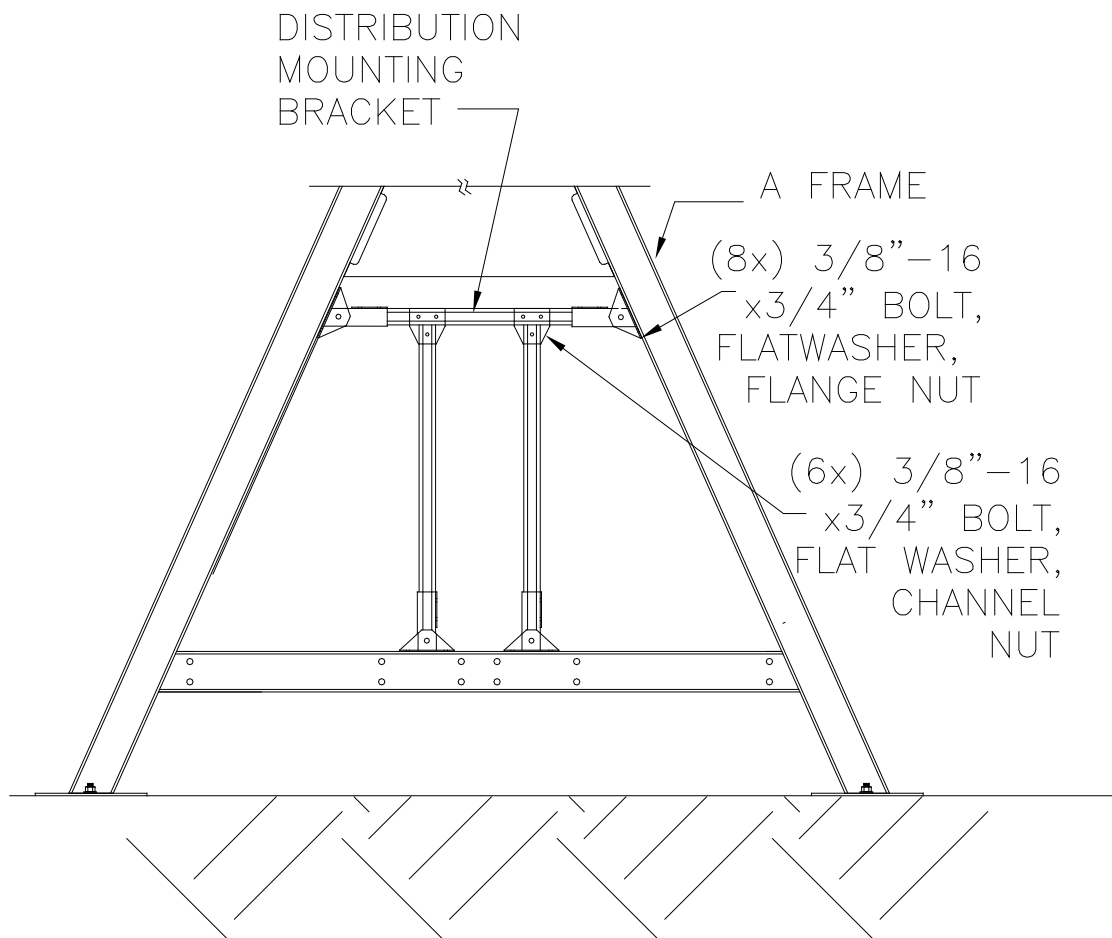
Model	Inverter Capacity kW	Weight lbs (kg)	Dimensions					
			W		H		D	
			IN	mm	IN	mm	IN	mm
PSF-L	12	150 (68)	60.0	1524	47.0	1194	16.0	406

**TABLE 5: PSFL CONTROL ENCLOSURE**



### 3.7.2 CONTROL ENCLOSURE INSTALLATION – (WF2 / WF4) F-style enclosure

- The system A-frame comes with a channel assembly pre-mounted.
- Mount the enclosure upper bracket to the channel assembly using 3/8" hardware provided. Tighten using a 9/16" wrench to 18-20 Ft. Lbs.
- Mount the enclosure lower bracket 27" on center from the upper bracket to the channel assembly using 3/8" hardware provided. Tighten using a 9/16" wrench to 18-20 Ft. Lbs.
- Hang the enclosure on the upper bracket. Attach the lower bracket to the enclosure using the 5/16" hardware provided. Tighten using a 1/2" wrench to 10-12 Ft. Lbs.



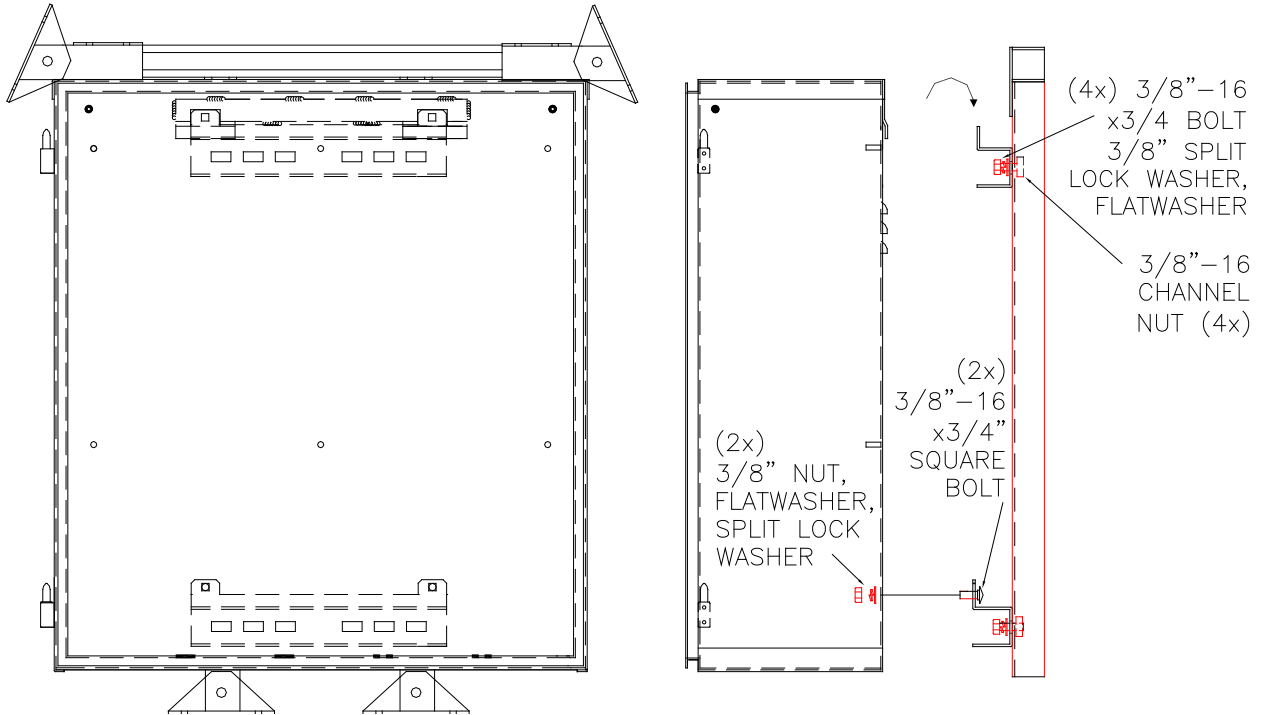
**FIGURE 10A: WF2 / WF4 CONTROL ENCLOSURE MOUNTING FRAME**

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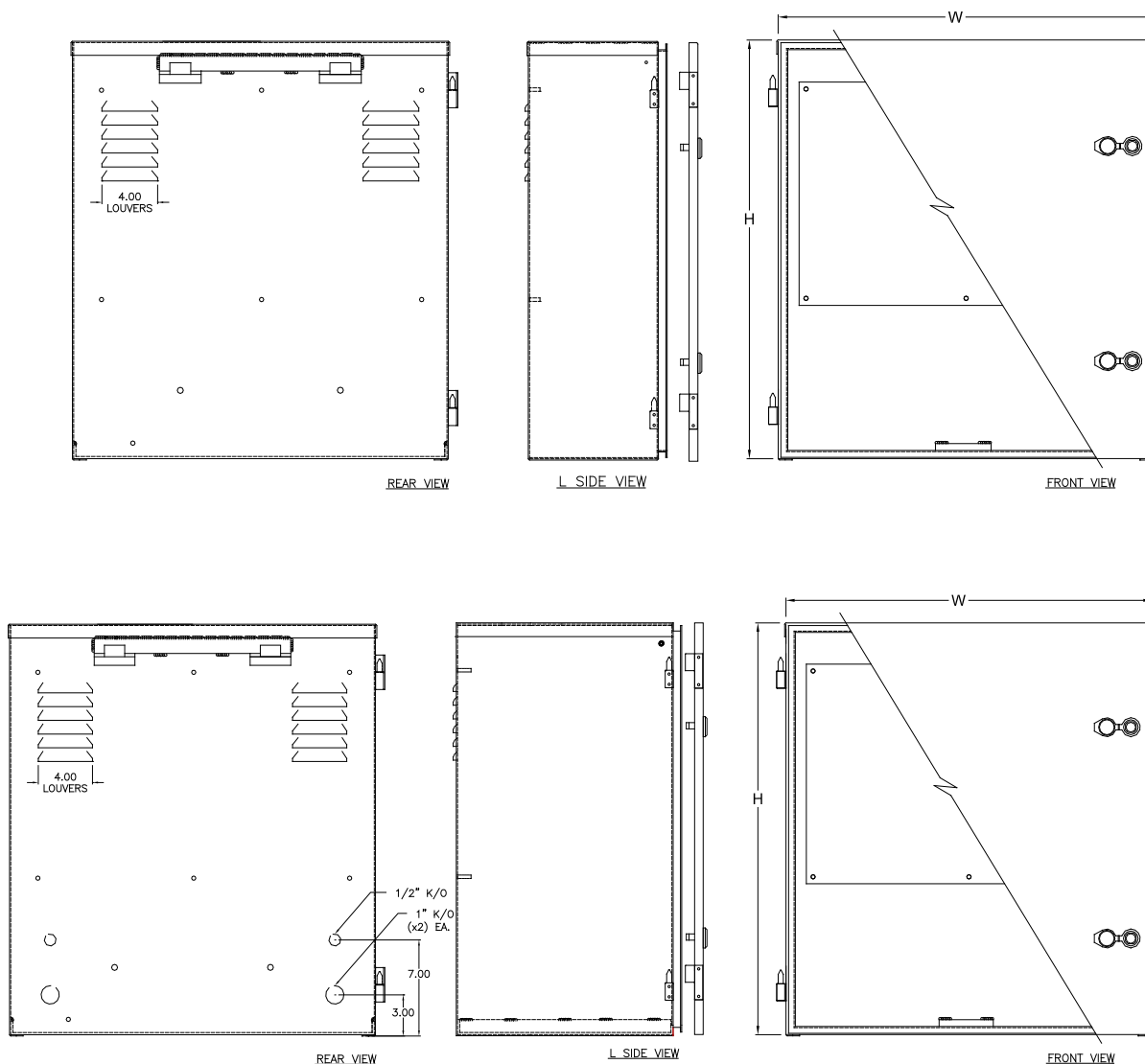
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**FIGURE 10B: WF2 / WF4 CONTROL ENCLOSURE MOUNTING**




**FIGURE 10C: WF2 / WF4 CONTROL ENCLOSURE**

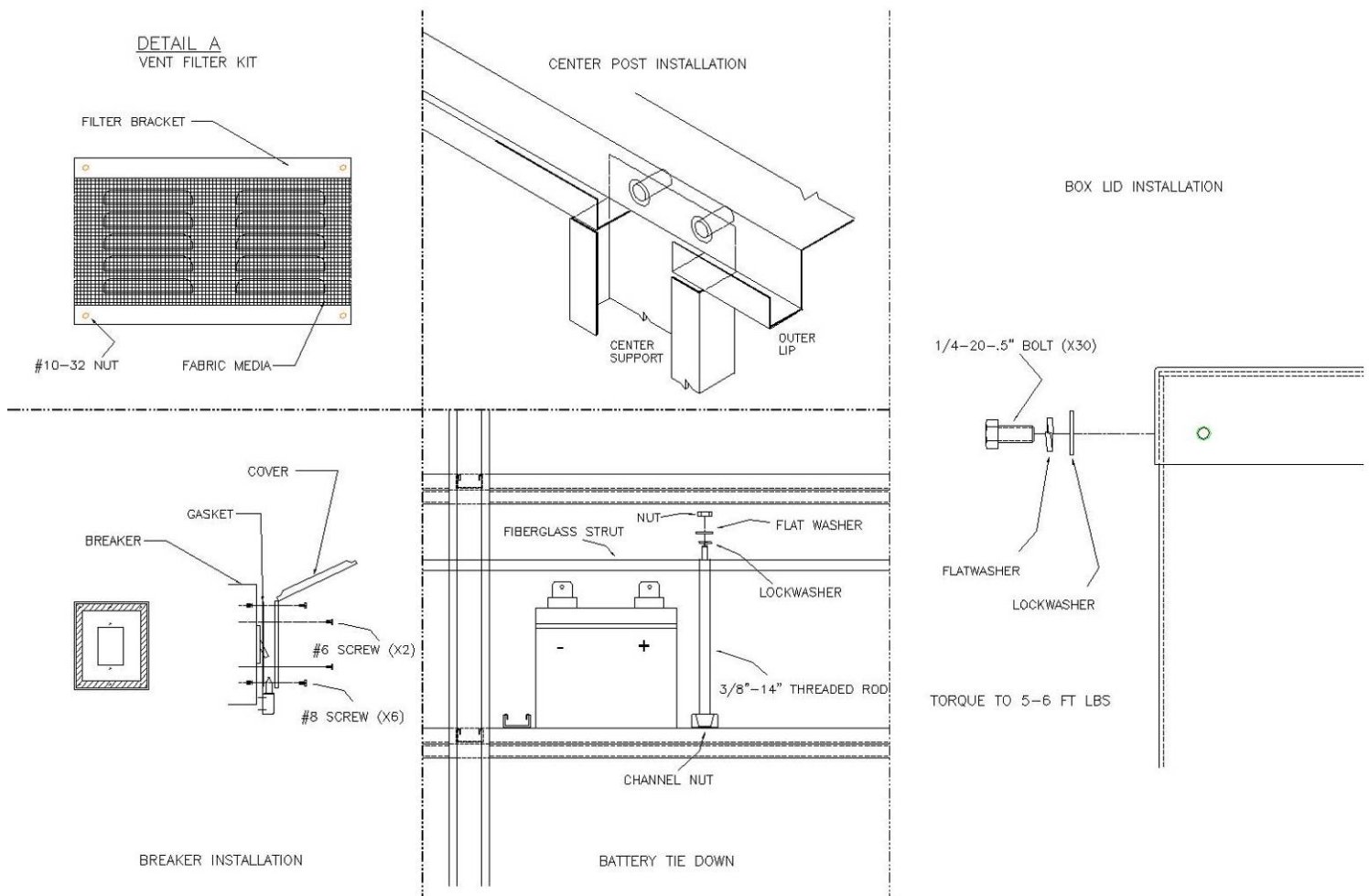
Model	Inverter Capacity	Weight	Dimensions					
	kW	lbs (kg)	W		H		D	
			IN	mm	IN	mm	IN	mm
WF2	1.0	20 (9.1)	27.0	686	30.0	762	9.35	238
WF4	1.0	35 (15.9)	27.0	686	30.0	762	16.0	406

**TABLE 6: WF2 / WF4 CONTROL ENCLOSURE**



### 3.7.3 ENCLOSURE ACCESSORY DETAILS

- For all enclosures with vents, install the vent filters using the #10 hardware and brackets provided (1 kit per vent).
- For all battery enclosures (PSF2-12, PSF2-24, PSF12-12), install the circuit breaker and weather proof cover using the hardware provided (1 kit per breaker).
- For all enclosures with a removable center post (PSF-L, PSF2-12, PSF2-24), install the enclosure center post using the 1/4" hardware provided (1 per enclosure).
- For PSF12-12 enclosures, install the battery tie down struts using the fiberglass strut and 3/8" galv rod and hardware kits (1 kit per shelf).

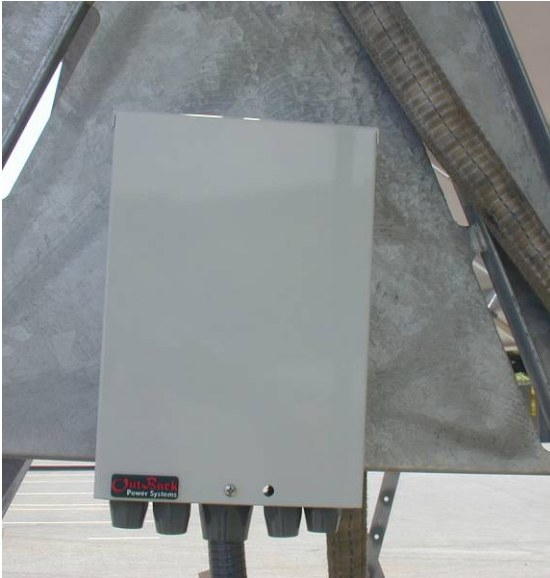


**FIGURE 10D: ENCLOSURE DETAILS**



### 3.8 PV COMBINER BOX INSTALLATION

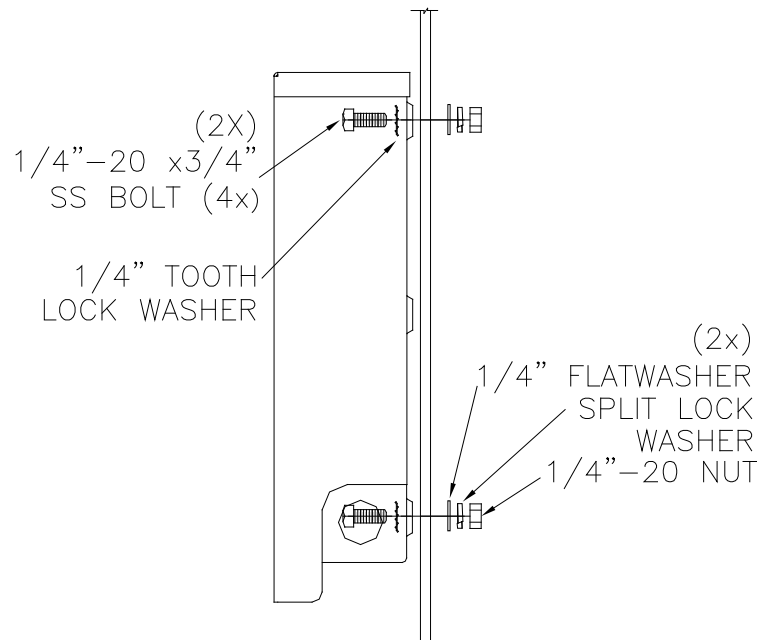
- Mount the PV combiner box to the EAST side A-frame using 1/4" hardware provided. Tighten hardware using 7/16" wrench to 5-6 Ft. lbs.



**FIGURE11A:** PV COMBINER M/L FRAME



**FIGURE11B:** PV COMBINER S FRAME



**FIGURE 11C:** PV COMBINER M/L AND S FRAME MOUNTING

### 3.9 ENGINE GENSET INSTALLATION



- The engine genset comes pre-mounted on a skid with a removable housing.
- Remove the housing to access the lift points on the genset. Hoist the genset onto the prepared concrete surface. Fasten using concrete anchors (Not provided).
- Install the removable housing.
- Each engine genset comes with a 10W solar module kit used to maintain the 12V starter battery state of health. Install the 10W module to the A-frame West side bottom row using the 3/8" hardware provided.



**FIGURE 12: 10W PV MODULE FOR GENSET STARTER BATTERY**



## 4.0 ELECTRICAL INSTALLATION INSTRUCTIONS

### **DANGER**

Batteries can explode or severely burn if the terminals are shorted to the opposite polarity. Exercise extreme care when handling batteries. Use insulated tools when practical.

### **CAUTION**

Per NEC A.690, a single point system ground is required. It is recommended that the Battery negative (-) terminal be tied to the equipment chassis at the time of installation.

### **! NOTE !**

Refer to the wiring diagram on the inside door of the control/battery enclosure of your system for actual wiring configuration of the system.

## 4.1 WIRING OVERVIEW

- The system wiring will vary depending on the enclosure configuration.
- For systems with T-style enclosures and 12V batteries, the system DC control panel are co-located with the batteries.
- For all other systems, the DC control panel is mounted in the dedicated control enclosure.

## 4.2 GROUND WIRING

- Verify all components are installed per the wiring diagrams in APPENDIX D.
- Verify all circuit breakers are set to the **OFF (OPEN)** position.
- Install the equipment grounding conductor (not provided) to the control and battery enclosure(s) ground lugs located outside the enclosure. Use wire rated for outdoor use per local codes and sized per NEC A.690.
- Verify system neutral bonding on the AC side is per local code. Verify system negative bond on the DC side is per local code.

## 4.3 PV ARRAY WIRING

- Verify all charge control components are installed per the wiring diagrams provided with the system.
- Verify all circuit breakers on the control panel are set to the **OFF (OPEN)** position. Verify all fuses on the control/battery enclosure are removed.
- Route each array 1/2" conduit and wiring to the combiner box. Secure the conduit to either the PV panel frame or the mounting surface using wire ties or other restraining hardware (not provided) to prevent

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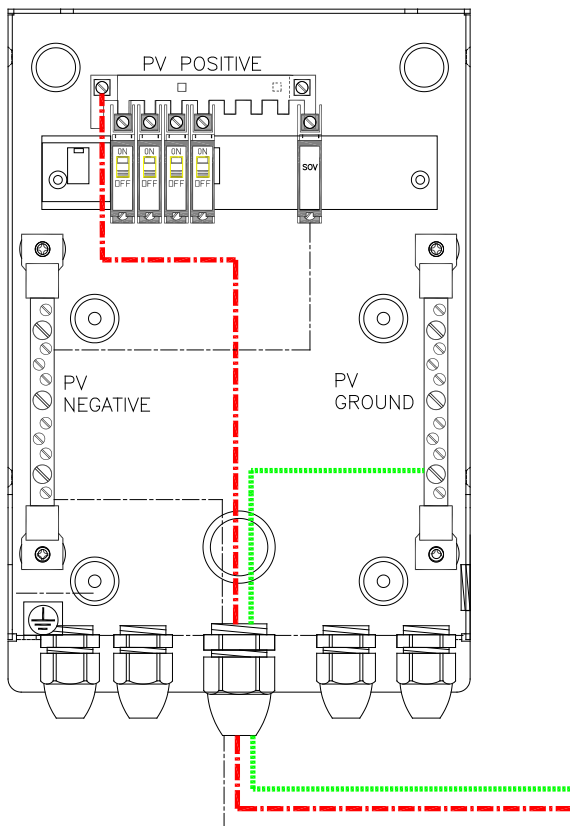
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damage during severe weather conditions. Install the liquid tight fitting to the enclosure using the 1/2" knock outs provided.

- Inside the combiner, connect the **RED PV(+)** wire to the combiner disconnect breakers. Each PV array string wire has a breaker dedicated to it. Connect the **BLK (PV-)** wire to the combiner **PV(-)** terminal block. Connect the **GRN PV(GND)** wire to the combiner **PV(GND)** terminal block.
- Route the output conduit from the combiner to the DC control panel.



**FIGURE 13: PV COMBINER WIRING**

- For systems with a genset, route the 10W starter battery maintenance module wiring from the genset battery to the solar module on the array structure. Attach the **RED BAT(+)** wires together using the male/female .25" spade faston connectors provided, Attach the **BLK BAT(-)** wires together using the male/female .25" spade fastons connectors provided.
- Shrink sleeve the connectors to prevent corrosion using the sleeve material provided.



#### 4.4 BATTERY WIRING

- For systems with 12V Batteries

- Wire the batteries per the system wiring diagram prints provided (APPENDIX D).

For 24V systems:

- Each pair of 12V batteries are in series and form one string. Ensure the jumper connects the **BLK** jumper from **BAT 1 NEGATIVE(-)** terminal to the **BAT 2 POSITIVE(+)** terminal. This pattern repeats for each additional series string.
- Each series string must be connected in parallel to complete the bank wiring. Ensure the parallel jumpers connect the **RED** jumper from **BAT 1 POSITIVE(+)** terminal to the **BAT 3 POSITIVE(+)** terminal and the **BLK** jumper from **BAT 2 NEGATIVE(-)** terminal to the **BAT 4 NEGATIVE(-)** terminal. Repeat this pattern for each additional parallel pair. A system can accommodate from one to four battery strings.

For 48V systems:

- Each quadruple set of 12V batteries are in series and form one string. Ensure the jumpers connect the **BLK** jumper from **BAT 1 NEGATIVE(-)** terminal to the **BAT 2 POSITIVE(+)** terminal, **BAT 2 NEGATIVE(-)** terminal to the **BAT 3 POSITIVE(+)** terminal, **BAT 3 NEGATIVE(-)** terminal to the **BAT 4 POSITIVE(+)** terminal.. This pattern repeats for each additional series string.
- Each series string must be connected in parallel to complete the bank wiring. Ensure the parallel jumpers connect the **RED** jumper from **BAT 1 POSITIVE(+)** terminal to the **BAT 5 POSITIVE(+)** terminal and the **BLK** jumper from **BAT 4 NEGATIVE(-)** terminal to the **BAT 8 NEGATIVE(-)** terminal. Repeat this pattern for each additional parallel pair. A system can accommodate from one to four battery strings.

- For systems with 2V Batteries

- Wire the batteries per the system wiring diagram prints provided (APPENDIX D).

For 24V systems:

- Each set of 12, 2V batteries are in series and form one string. Ensure the jumpers connect the **BLK** jumper from **BAT 1 NEGATIVE(-)** terminal to the **BAT 2 POSITIVE(+)** terminal. This pattern repeats eleven times per series string.
- Each series string must be connected in parallel to complete the bank wiring. Ensure the parallel jumpers connect the **RED** jumper from **BANK 1 POSITIVE(+)** terminal to the **BANK 2 POSITIVE(+)** terminal and the **BLK** jumper from **BANK 1 NEGATIVE(-)** terminal to the **BANK 2 NEGATIVE(-)** terminal. Repeat this pattern for each additional parallel pair. A system can accommodate from one to four battery strings.

For 48V systems:

- Each set of 24, 2V batteries are in series and form one string. Ensure the jumpers connect the **BLK** jumper from **BAT 1 NEGATIVE(-)** terminal to the **BAT 2 POSITIVE(+)** terminal. This pattern repeats twenty-three times per series string.
- Each series string must be connected in parallel to complete the bank wiring. Ensure the parallel jumpers connect the **RED** jumper from **BANK 1 POSITIVE(+)** terminal to the **BANK 2 POSITIVE(+)** terminal and the **BLK** jumper from **BANK 1 NEGATIVE(-)** terminal to the **BANK 2 NEGATIVE(-)** terminal. Repeat this pattern for each additional parallel pair. A system can accommodate from one to four battery strings.

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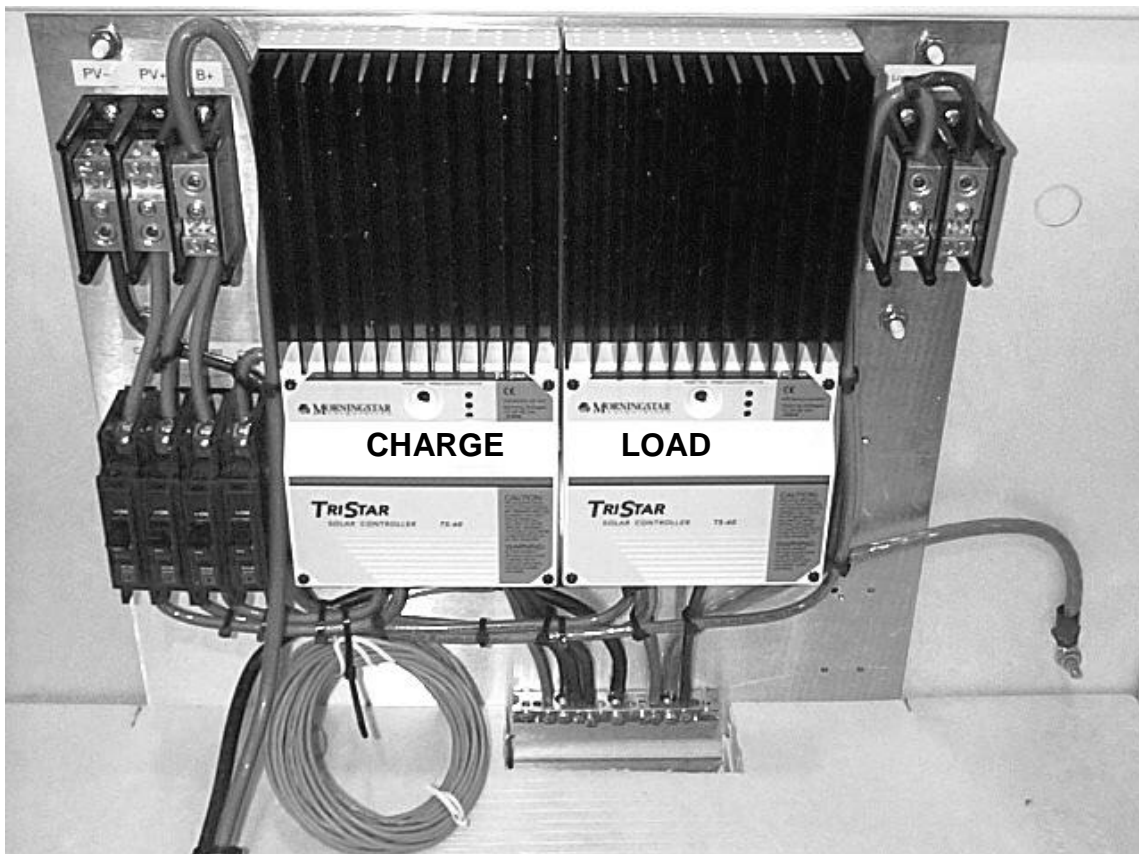
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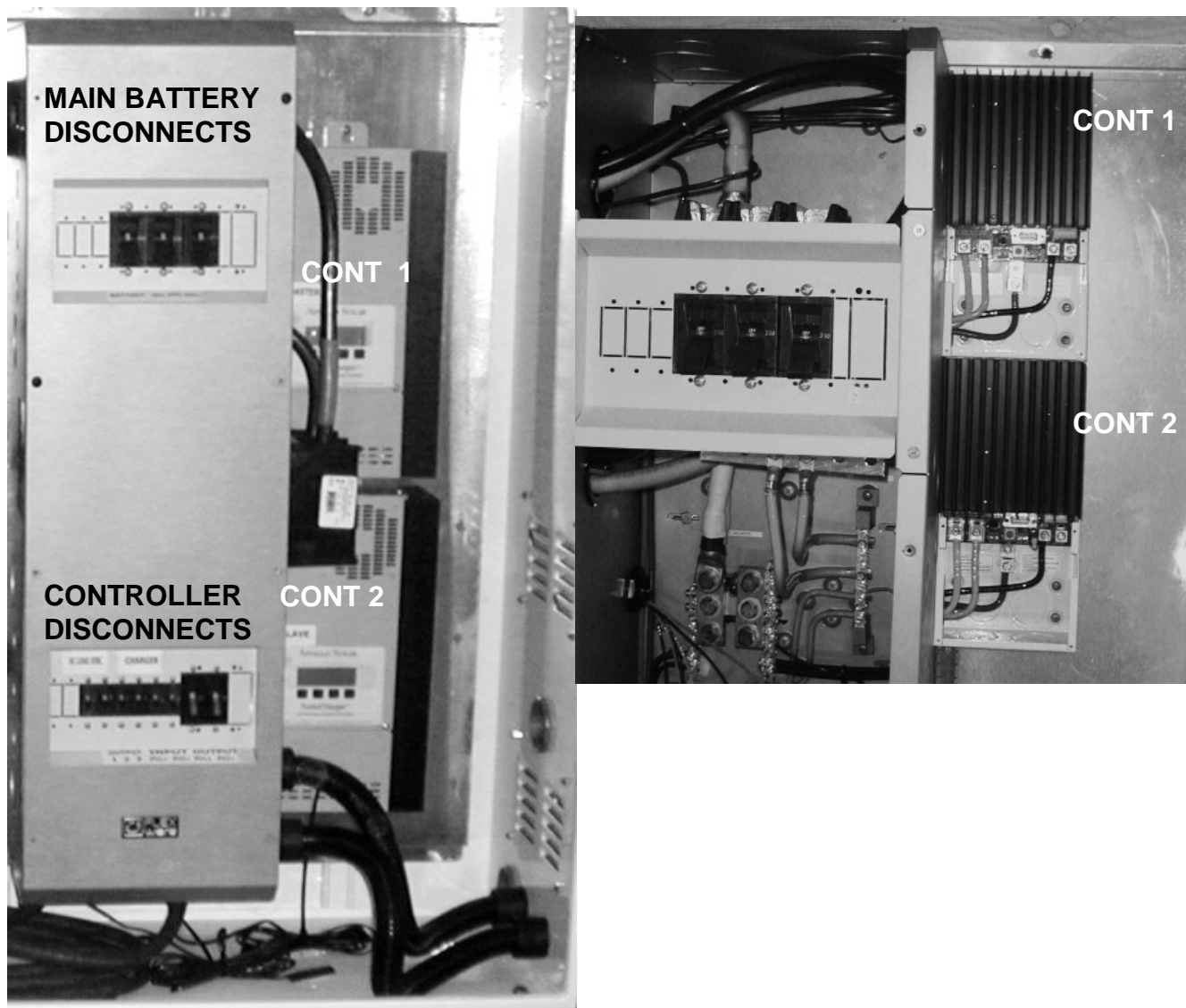
#### 4.5 DC CONTROL PANEL WIRING

- Wire the DC control panel per the system wiring diagram prints provided (APPENDIX D).
- For T-enclosures with 12V batteries,
- On the DC control panel, connect the **RED PV(+)** wire from the PV combiner box to the **PV(+)** terminal block. Connect the **BLK (PV-)** wire PV combiner box to the **DC NEGATIVE (-)** terminal block. Connect the **GRN PV(GND)** wire to the **PV(GND)** terminal block.
- On the DC control panel, connect the controller **RED BAT(+)** wire terminal to the battery bank **POSITIVE (+)** terminal. Connect the controller **BLK BAT(-)** wire terminal to the battery bank **NEGATIVE (-)** terminal.
- For all other systems,
- On the DC control panel connect the **RED PV(+)** wire to the **PV(+) INPUT BREAKER**. Connect the **BLK (PV-)** wire to the **PV(-)** terminal block. Connect the **GRN PV(GND)** wire to the **PV(GND)** terminal block.
- On the DC control panel, connect the **RED BAT(+)** wire from the battery enclosure **B(+) DISCONNECT** to the control panel **B(+) DISCONNECT**. Connect the **BLK BAT(-)** wire terminal from to the battery bank **NEGATIVE (-)** terminal to the control panel **DC NEGATIVE (-) terminal block**.



**FIGURE 14A: DC CONTROL PANEL WIRING TYPICAL IN T AND WF2/4-STYLE ENCL**



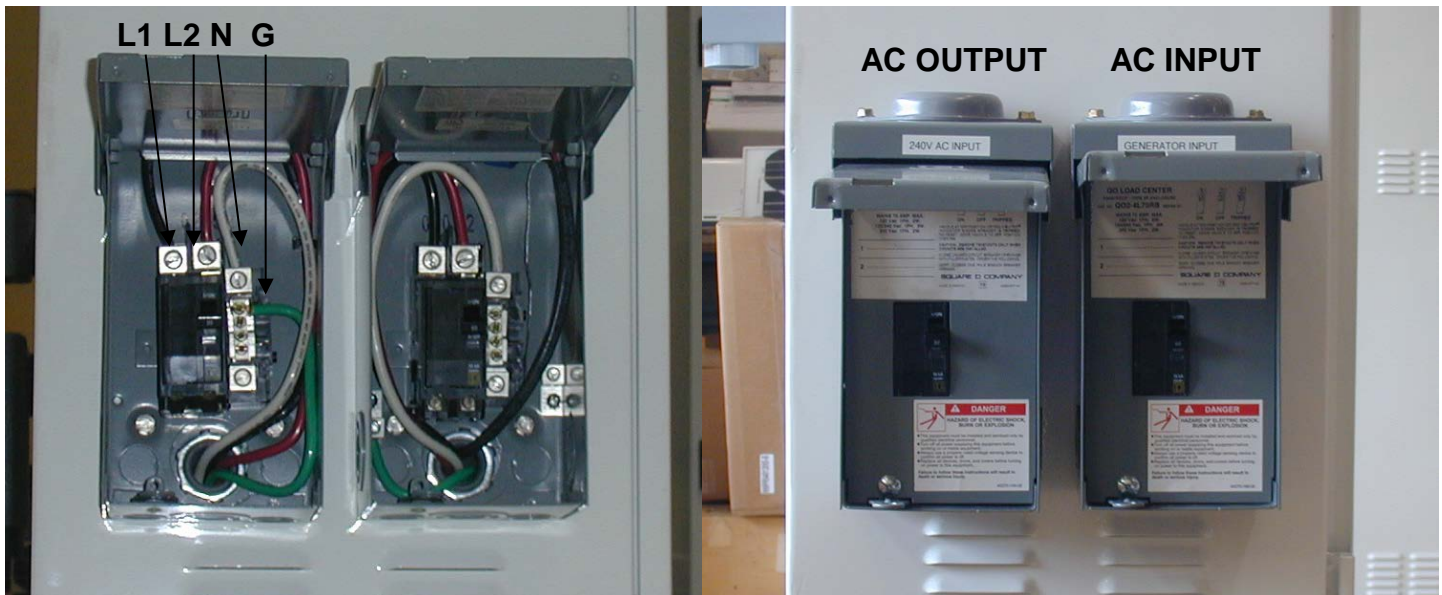


**FIGURE 14B:** DC CONTROL PANEL WIRING TYPICAL IN F-STYLE PSF-L ENCL



#### 4.6 AC CONTROL PANEL WIRING

- Wire the AC control panel per the system wiring diagram prints provided (APPENDIX D).
- Route the **BLK L1 AC** Mains wire from the left engine genset or alternate utility source to the **AC INPUT** disconnect **L1** position.
- Route the **RED L2 AC** Mains wire from the left engine genset or alternate utility source to the **AC INPUT** disconnect **L2** position.
- Route the **WHT NEU** AC Mains wire from the left engine genset or alternate utility source to the **AC INPUT** disconnect **NEU** position.
- Route the **GRN GND** AC Mains wire from the left engine genset or alternate utility source to the **AC INPUT** disconnect **GND** position. *System Neutral-Ground bond should be done here.*
- If engine genset is remote start, attach the two **RED RST** wires together using wire nuts provided. Attach the two **BLK RST** wires together using wire nuts provided
- Route the **BLK L1 AC** Load wire from the right customer load equipment to the **AC OUTPUT** disconnect **L1** position.
- Route the **RED L2 AC** Load wire from the right customer load equipment to the **AC OUTPUT** disconnect **L2** position.
- Route the **WHT NEU** Load wire from the right customer load equipment to the **AC OUTPUT** disconnect **NEU** position.
- Route the **GRN GND** Load wire from the right customer load equipment to the **AC OUTPUT** disconnect **GND** position.



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## 5.0 SYSTEM OPERATION

### 5.1 SYSTEM COMMISSIONING

- Verify the mechanical installation is complete per the Commissioning Checklist (Appendix C)
- Verify grounding continuity between all mechanical assemblies to the earth grounding bond. All resistive measurements should be below 0.5 ohms.
- Verify the electrical operation per the Commissioning Checklist (Appendix C) as follows:
- For systems with a combiner box, under optimum overhead sunlight conditions, verify the PV array open circuit voltage (Voc) by measuring the voltage from each individual combiner **PV(+)** breaker to the **PV(-) NEG** terminal block inside the combiner box enclosure.
- Check the name plate rating on the module or the wiring diagram included with the system for actual figures.
- Verify the battery bank voltage by measuring from either the **BAT(+)** terminal block to the **BAT(-)** terminal block or the **BANK POSITIVE(+)** to the **BANK NEGATIVE(-)**. This should measure appx:

**24–26V** for a 24V system

**48–52V** for a 48V system.

- Verify that polarity is positive for all measurements. If negative, reverse battery wiring to the system and repeat measurement.
- For systems with a combiner box, in the combiner box, set the **PV(+)** input breaker(s) to the **ON (CLOSED)** position.
- On the DC control panel, set the controller **PV(+)** input breaker(s) to the **ON (CLOSED)** position.
- On the DC control panel, set the controller **BAT(+)** input breaker(s) to the **ON (CLOSED)** position.
- Verify that the controller status LEDs illuminate per SECTION 8.

For systems with AC Control panel, continue the following steps

- On the DC control panel, set the inverter **BAT(+)** input breaker(s) to the **ON (CLOSED)** position.
- On the battery enclosure, set the **BAT Disconnect** to the **ON (CLOSED)** position.
- On the AC control panel, connect the **MATE** programmer to the **HUB PORT 1**.
- Verify that the inverter status LEDs illuminate per SECTION 8. Verify that the MATE LCD illuminates.
- On the AC control panel, set the inverter AC OUT breaker(s) to the **ON (CLOSED)** position.
- On the AC control panel, set the **NORMAL AC OUT** breaker(s) to the **ON (CLOSED)** position. Insure that the **BYPASS AC OUT** breakers are in the **OFF (OPEN)** position.
- On the AC control panel, set the **LOAD AC OUT** breaker(s) to the **ON (CLOSED)** position.

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- On the AC control enclosure, set the **UTILITY AC INPUT** disconnect to the **ON (CLOSED)** position.
- On the AC control enclosure, set the **LOAD AC OUTPUT** disconnect to the **ON (CLOSED)** position. Verify the voltage out measures:

**234 – 246VAC** from L1-L2  
**117 – 123VAC** from L1-N  
**117 – 123VAC** from L2-N

- User load is active at this point.

For systems with AC engine genset, continue the following steps

- Set the genset operation switch from the **OFF** position to the **STANDBY** position.
- Set the genset **AC DISCONNECT** to the **ON (CLOSED)** position.
- Insert the 5A fuse near 12V starter batter from the 10W maintenance charger.

## 5.2 SYSTEM OPERATION SUMMARY – STANDALONE SYSTEM

- Upon completion of the system, you can expect the following typical performance:
- When sunlight is available, the system will begin to charge. The amount of charging current available is dependent on the time of year and the position of the sun in the sky. This equates to low charging power in the morning, gradually increasing and reaching full potential during the mid-day, then gradually decreasing until the end of the day. It is typical to see both an increase in charging current and battery voltage throughout the day.
- The regulation of the charge is performed by the charge controller. It will prevent the battery voltage from climbing for too high for too long (SEE SECTION 8.0 for specific details).
- In the evening, the load is run strictly from battery. Throughout the evening the battery will discharge but remain at a safe operating level.
- The system battery is designed to carry the system through 5 continuous days (120 hrs) of no-sun availability. This allows the load to maintain operation without interruption through extended no-sun availability.
- The solar regulator will run for a nominal 8 -12HR charge cycle, and automatically terminate when the battery voltage reaches 2.35 VPC and is sustained for 1hr. It will then revert to float mode charging set for 2.23 VPC until the sun sets.
- Should the no-sun availability exceed this time period, the system will disconnect the load from the battery to prevent the battery from being too deeply discharged. This insures a longer battery life. This happens at about 80% depth of discharge (DOD)
- Upon return of sun availability, the system will recharge the battery and automatically connect the load. This does not happen immediately, as it must first allow the battery to reach a state of 50% depth of discharge (DOD) to insure the system does not cycle on and off repeatedly in a short time frame. This can take one or more days depending on time of year and size of the system.
- The system voltage will fluctuate throughout the year depending on outside air temperature. In cold weather the system voltage can rise to 62VDC (48V battery) and in summer it will typically be 54VDC

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(48V battery). The range varies with specific controller type and battery configuration, but is what can be typically expected. The load output will track the battery voltage.

### 5.3 SYSTEM OPERATION SUMMARY – HYBRID SYSTEM

- Upon completion of the system, you can expect the following typical performance:
- When sunlight is available, the system will begin to charge. The amount of charging current available is dependent on the time of year and the position of the sun in the sky. This equates to low charging power in the morning, gradually increasing and reaching full potential during the mid-day, then gradually decreasing until the end of the day. It is typical to see both an increase in charging current and battery voltage throughout the day.
- The regulation of the charge is performed by the charge controller. It will prevent the battery voltage from climbing for too high for too long (SEE SECTION 8.0 for specific details).
- In the evening, the load is run strictly from battery. Throughout the evening the battery will discharge but remain at a safe operating level.
- The system battery is designed to carry the system through 3 continuous days (72 hrs) of no-sun availability. This allows the load to maintain operation without interruption through extended no-sun availability.
- Should the battery state of charge fall due to sun availability, the engine genset will automatically start to re-charge the system. This happens at about 50% depth of discharge (DOD) at 2.091 VPC.
- The solar regulator will run for a nominal 8 -12HR charge cycle, and automatically terminate when the battery voltage reaches 2.35 VPC and is sustained for 1hr. It will then revert to float mode charging set for 2.23 VPC until the sun sets.
- The genset will run for a nominal 12HR charge cycle, and automatically terminate the engine genset when the battery voltage reaches 2.40 VPC and is sustained for 2hrs.
- Should the engine genset fail to operate, the system will disconnect the load from the battery to prevent the battery from being too deeply discharged. This insures a longer battery life. This happens at about 80% depth of discharge (DOD)
- Upon return of sun availability, the system will recharge the battery and automatically connect the load. This does not happen immediately, as it must first allow the battery to reach a state of 50% depth of discharge (DOD) to insure the system does not cycle on and off repeatedly in a short time frame. This can take one or more days depending on time of year and size of the system.
- The system voltage will fluctuate throughout the year depending on outside air temperature. In cold weather the system voltage can rise to 62VDC (48V battery) and in summer it will typically be 54VDC (48V battery). The range varies with specific controller type and battery configuration, but is what can be typically expected. The load output will track the battery voltage.

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## 6.0 SYSTEM MAINTENANCE

### 6.1 ANNUAL MAINTENANCE

- An annual inspection of the system is recommended and should consist of the following:
  - Visual inspection
  - Electrical inspection and test
  - Routine maintenance, troubleshooting and repair
- An inspection checklist is provided.

### 6.2 TROUBLESHOOTING GUIDE

- Refer to SECTION 8 LED INDICATIONS for definition of controller status and possible error codes

Problem	Probable Cause	Solution
No Charging Power	Overload Solar/Load	Verify the load is not exceeding the system capability
	High temperature disconnect	Allow the controller to cool down then verify operation continues
	Reverse Polarity	Re-configure the wiring terminations to restore operation
	Battery Select fault	Verify that the jumper settings are correct for the system configuration
	Solar module is shaded	Confirm that the solar module angle and direction are correct. Verify no shading
Load Disconnected	LVD trip on the load controller	Confirm battery voltage is above the LVD Cut-off voltage. If not, allow battery to fully charge
	Load overload or short circuit	Check the wire terminations for proper Configuration
	LVD trip repeatedly	Verify the load is not exceeding the system capability. Confirm that battery DOD cycles have not exceed normal end of life
Breaker Trip or Fuse Blown	Improper wiring	Confirm wiring is correct and terminals are not corroded. Confirm wire and terminal continuity using an ohm meter
	Short circuit	Confirm that the load end of the circuit breaker does not have a short circuit.
	Breaker damaged	Verify breaker continuity out of circuit with an ohm meter. Replace breaker if necessary

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### 6.3 TROUBLESHOOTING PROCEDURE

- Use the procedures below in conjunction with the Troubleshooting guide to determine if there is a problem with the system.
- In the event that you experience any difficulties with installation or operation of your system, please contact SunWize Customer Service at 1-800-81-SOLAR.

#### 6.3.1 DC LOAD/CONTROLLER TROUBLESHOOTING

- The load voltages can be measured at the designated terminal blocks.
  - If the battery voltage is present at the load blocks, then the load fuse and the load low voltage disconnect (LVD) can be assumed to be fully functional
  - If the battery voltage is above 25.6 / 51.2VDC with the PV array on in sunlight and the load is attached and active, the controller is actively charging.
  - No further troubleshooting of the controller is required

#### 6.3.2 BATTERY TROUBLESHOOTING

- Batteries can be measured for both open circuit voltage (Voc), and voltage under charge (Vuc). The Vuc is a simple method to measure voltage without disabling the system from charging or the load. The Voc is used when the battery end of life is in question, and a more accurate means of measurement is required.
- Batteries should be tested for end of service life whenever a particular system begins to fall in a SOC below 80% repeatedly or the system begins to LVD on a recurring basis. This may vary depending on load use, depth of discharge and temperature extremes, but can vary between 3 – 10 years.
- To measure for battery end of life, disconnect the battery from the system and charge with an appropriate 3-stage battery charger. After completion, allow battery to settle for 3 hours with no charge or load attached.
- Below is a table of Voc and Vuc vs. SOC at 25°C.

<b>SOC</b>	<b>Voc</b>	<b>Vuc</b>
100	12.8	14.2
80	12.6	12.91
60	12.3	12.60
40	12.0	12.25
20	11.8	11.81
0	<11.6	<11.81

- If an individual battery does not hold a voltage of at least 12.6VDC open circuit after a full charge and a 3 hour wait period under no load, you may have a damaged cell and require a battery replacement.



### 6.3.3 ARRAY TROUBLESHOOTING

- If the array is un-obstructed, un-shaded, at the correct tilt angle and in full light, (between 10am and 3pm), you can verify the module performance per the nameplate ratings for voltage open circuit (VOC) and short circuit current (ISC).
- Set the **PV(+)** breaker to **OPEN (OFF)** position.
- Using a volt meter, measure the VOC voltage between the **PV(+)** and **PV(-)** terminal blocks. It should measure within 5% of the nameplate rating in LOW to HIGH sunlight.
- Set the **PV(+)** breaker to **CLOSED (ON)** position.
- Using an ammeter rated for a maximum system ISC value, measure the charging current through the **PV(+)** conductor. It should measure appx 30% or less of nameplate rating in LOW sunlight, 60% or less of nameplate rating in MED sunlight, 60% or greater in HIGH sunlight.
- The degree of sunlight is based on cloud cover and height on the horizon for that time of day. As a reference:

HIGH	a clear sunny day at 11AM-1PM	(60-100% sun capacity),
MED	a clear sunny day at 9AM-11AM	(30-60% sun capacity)
LOW	a clear sunny day at 7AM-9AM	(10-30% sun capacity).

### 6.2.4 AC CONTROLS TROUBLESHOOTING

- Should the inverter fail to operate, refer to the inverter manual troubleshooting guide



## 7.0 LIMITED WARRANTY

SunWize® Technologies warrants the SunWize® Power Station System against defects in materials and workmanship described below under normal installation, application, use and service conditions, for a period of one year from date of original purchase. This warranty extends to the original retail purchaser ("Customer") only. SunWize will, at its sole discretion, either repair or replace the product if it becomes inoperable due to a defect in material or workmanship performed directly by SunWize during the one year period of this warranty. This warranty does not cover cosmetic damage, damage from accident, negligence, misuse, or acts of God, and is voided by failure of the Customer to install, operate or use the product in accordance with instructions and warnings contained in the Installation & Operation Manual and in component manufacturers' manuals supplied with the product, if any. SunWize makes no warranty against defects in materials and workmanship by component parts manufacturers, except to the extent provided below.

SunWize will pass through to the Customer any and all additional warranties provided by the manufacturer(s) of component parts as applicable, such as batteries, PV modules, controllers, inverters, pumps, or lights, subject to the terms and enforceability of such manufacturers' warranties.

In order to obtain warranty service, the Customer must contact SunWize and be prepared to supply the following information:

- Where and when your SunWize product was purchased.
- Your product serial number, if applicable.
- Description of the problem. If we cannot correct the situation through phone consultation, we will provide you with the following information regarding shipping the SunWize product to SunWize Technologies including:
  - Address for return of product
  - Preferred shipping method  
(the user is responsible for the shipping charges)
  - An RMA (return materials authorization) number to be prominently displayed on the return packaging.

Provided that the necessary repairs are covered under warranty, SunWize will pay the return shipping charges to any destination within the United States.

SUNWIZE MAKES NO OTHER WARRANTIES TO CUSTOMER, EXPRESS OR IMPLIED, AND HEREBY EXPRESSLY DISCLAIMS ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. Except as herein stated, SunWize shall not be liable for any damages of any kind. SunWize shall have no responsibility for damage to persons or property or other loss or injury resulting from a defect in the product or from improper installation or use. Under no circumstances will SunWize be liable for any incidental or consequential damage.

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## 8.0 EQUIPMENT SPECIFICATION



The SunWize controllers are configured for use with a sealed-type battery in accordance with manufacturer's recommendations. If a flooded lead-acid battery is substituted, the controller must be set to the flooded setting to provide for battery equalization charging.

### **! NOTE !**

The SunWize controllers optimally charge the battery to maximize performance. Note, that new batteries are received from the manufacturer approximately 90% formed and therefore require approximately 75 to 100 charging cycles before maximum capacity is reached.

When the battery breaker is first set to ON (CLOSED), the controller LEDs will remain off for approximately 2 seconds and may flash red before turning green. This is normal and is not indicative of a problem with the controller or the system.

### 8.1.1 CONTROLLER OPERATION – TriStar Controller (45 – 60A)

- Controllers carry the following certifications:  
CE/UL certified
- External temperature compensation optimizes the battery charging over temperature extremes.
- A Low Voltage Disconnect (LVD) protects the battery from over discharge. The controller automatically disconnects the load from the battery at 80% depth of discharge (DOD), and automatically re-connects at 50% DOD.
- The controller is factory configured for 24V or 48V operation.

### 8.1.2 LED INDICATION

- The LEDs transmit data in three categories of indication:
  - General Transitions
  - Battery or Load Status
  - Faults
- LED Display Key:
 

○ G	=	Green LED is illuminated
○ Y	=	Yellow LED is illuminated
○ R	=	Red LED is illuminated
○ G/Y	=	Green and Yellow are simultaneously illuminated
○ G/Y-R	=	Green and Yellow are simultaneously illuminated in sequence with Red
○ Slow	=	Blink rate at 1Hz (1 second on, 1 second off)
○ Fast	=	Blink rate at 3Hz (3 blinks per seconds on)
○ Normal	=	Blink rate at 1/2Hz (1/2 second on, 1/2 second off)

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- General transitions indicate as follows:
  - G/Y/R Blink 1x: Controller Start up
  - G/Y/R Blink 2x: Pushbutton Transitions charging under normal sunlight
  - G/Y/R Blink continuous: Battery service required
- Battery / Load Status indicates as follows:
- Charge Mode:
  - G Blink: PWM Absorption charge
  - G Fast Blink: Equalize charge
  - G Slow Blink: Float charge
- State of Charge:
  - G On: 80 – 95% SOC
  - G/Y On: 60 – 80% SOC
  - Y On: 35 – 60% SOC
  - Y/R On: 0 – 35% SOC
  - R On: Battery Discharging
- Fault Status indicates as follows:
  - G/Y/R simultaneous blink: Battery Select fault
  - R – Y in sequence: High temperature disconnect
  - R – G in sequence: High voltage disconnect
  - R/G – Y in sequence: Load overload or short circuit
  - R/Y – G in sequence: Overload Solar/Load
  - No LED: Reverse polarity – battery
  - R-Y-G in sequence: DIP switch fault
  - R/Y – G/Y in sequence: Temp or Voltage sense fault

### 8.1.3 CONTROLLER FACTORY SETTINGS

- The controller is factory configured for sealed Pb batteries.
- Equalization can be performed manually and is set for a safe level using sealed Pb batteries.
- Controllers come factory equipped standard with a remote temperature sensor for better charge control over temperature extremes.
- An optional LCD meter is available.

### 8.1.4 JUMPER SETTINGS

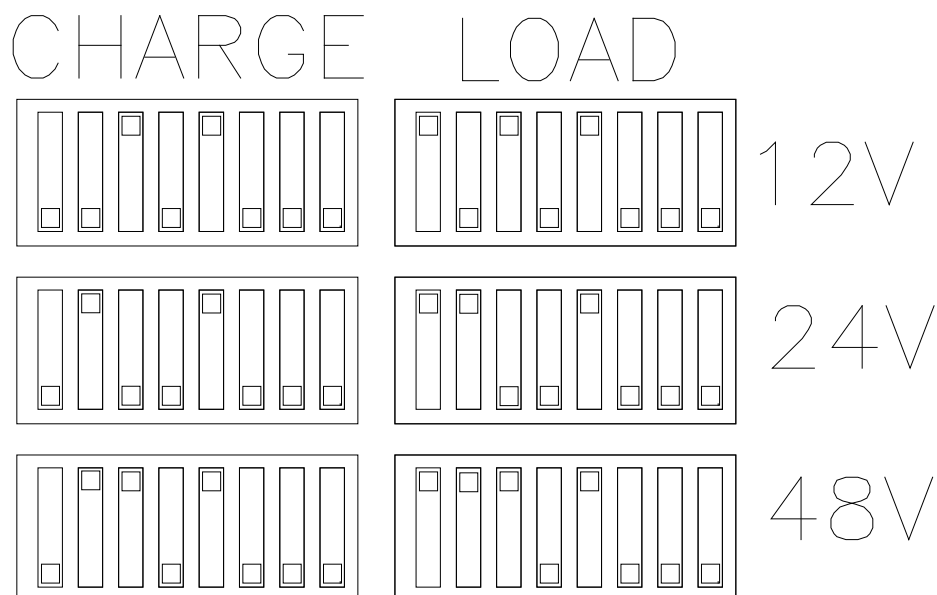
- The Sunwize®/TriStar controller can operate as either a charge controller or a load controller or a diversion controller. The controller can not operate in more than one mode of operation at a time. A typical POWER STATION SYSTEM® has both a charge controller and a load controller.
- The DIP switches located inside the controller are factory set at the time of test for the specific system requirement. These settings are illustrated in the drawings that accompany the system.

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**FIGURE 16: JUMPER SETTING**

Controller Model	TS-45	TS-60
Max load current @ 45° C	45A	60A
Max module current @ 45° C	45A	60A
Max wire gauge for terminals	35mm <sup>2</sup> (2 AWG)	
Weight	1.6 kg (3.5 lbs.)	
Dimensions	260.4 X 127 X 71 mm (10.25 X 5.00 X 2.80 in)	
Enclosure protection rating	IP 22 (NEMA 12)	
System Voltage	12V, 24V or 48V	
Operating Temperature	-40° C to +45° C	

**TABLE 7A: CONTROLLER SPECIFICATION**

Set Points	SOC algorithm	Battery Voltage	Volts/cell
LVD low voltage disconnect	SOC < 18%	11.5 Volts	1.92
LVDr reconnection of load after LVD	SOC > 50%	13.0 Volts	2.16
Constant Voltage charge	SOC > 80%	14.35 Volts	2.38
Equalization charge	SOC > 100%	14.40 Volts	2.40
Float charge	SOC > 100%	13.4	2.23
HVD solar high voltage disconnect)		14.6	2.53
HVDr reconnection of load after HVD		13.0	2.16
Temperature compensation		-5 mV/K°/Cell	--
Voltage values are doubled for 24 V systems, four times for 48V systems			

**TABLE 7B: CHARGING SET POINTS**

### 8.2.1 CONTROLLER OPERATION – Apollo Solar (80A/100A)

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- Controllers carry the following certifications:  
     CE/UL certified
- External temperature compensation optimizes the battery charging over temperature extremes.
- The controller is factory configured for 24V or 48V operation.

### 8.1.2 LCD INDICATION

- The LCD display can be used for:
  - Programming charge control set-points,
  - System diagnostics
  - Battery state of charge meter using trimetric patented technology.

### 8.2.3 CONTROLLER FACTORY SETTINGS

- The controller is factory configured for sealed Pb batteries.
- Equalization can be performed manually and is set for a safe level using sealed Pb batteries.
- Controllers come factory equipped standard with a remote temperature sensor for better charge control over temperature extremes.
- An optional LCD meter is available.

Controller Model	T80	100A
Max module current @ 45° C	80A	100A
Max wire gauge for terminals	35mm <sup>2</sup> (2 AWG)	
Weight	1.6 kg (3.5 lbs.)	
Dimensions	260.4 X 127 X 71 mm (10.25 X 5.00 X 2.80 in)	
Enclosure protection rating	IP 22 (NEMA 12)	
System Voltage	12V, 24V or 48V	
Operating Temperature	-40° C to +45° C	

**TABLE 8A: CONTROLLER SPECIFICATION**

Set Points	SOC algorithm	Battery Voltage	Volts/cell
Constant Voltage charge	SOC > 80%	14.15 Volts	2.36
Equalization charge	SOC > 100%	N/A	N/A
Float charge	SOC > 100%	13.5	2.25
MPPT Mode	Scan & Hold	30 Min Freq	
Temperature compensation		-4 to -5 mV/K°/Cell	--
Voltage values are doubled for 24 V systems, four times for 48V systems			

**TABLE 8B: CHARGING SET POINTS**



### 8.3.1 INVERTER OPERATION– Outback VFX Inverter

- The SunWize® /Outback inverter/charger is the alternate charging system for the batteries to supplement the solar as well as the AC load power source.
- Temperature compensation optimizes the battery charging over temperature extremes.
- The charger is configured for the battery bank voltage and is fully adjustable.
- The charger is activated automatically upon AC genset start, whenever the battery bank voltage falls below 2.10VPC, and charges the battery bank for 2 hour beyond the first detection of a total battery system voltage of 2.40VPC.
- The charger provides up-to 2.7kW worth of charging power from a 120/240VAC source per inverter / charger.
- The inverter can be programmed and controlled using the MATE (SEE Outback User Manual for Details). The mate plugs into the HUB, MATE 1 slot using the RJ-45 Ethernet cable provided.

### 8.3.2 LED INDICATION

- The LEDs transmit data in three categories of indication:
  - General Transitions
  - Battery or Load Status
  - Faults
- LED Display Key:
 

○ G	=	Green LED is illuminated
○ Y	=	Yellow LED is illuminated
○ R	=	Red LED is illuminated
○ Flashing	=	Blink rate at 3Hz (3 blinks per seconds on)
- Battery LED indicates as follows:
 

○ G	=	Battery Full (25V or higher)
○ Y	=	Battery low (23 – 25V)
○ R	=	Battery Low (23V or lower)
- Status LED indicates as follows:
- GREEN
 

○ Solid:	=	Inverter ON
○ Flashing:	=	Search Mode or Power Slave Mode
○ OFF:	=	Inverter OFF
- YELLOW
 

○ Solid:	=	AC Source is connected
○ Flashing:	=	AC Source is Live – waiting to connect
○ OFF:	=	No AC source present



- RED
  - Solid: = Error – SEE MATE FOR ERROR SCREEN MESSAGES
  - Flashing: = Warning – Non critical error SEE MATE FOR ERROR SCREEN MESSAGES
  - OFF: = No problems detected

Inverter Model	VFX3524	VFX3648
Max load power @ 25° C	3500 VA	3600 VA
Max charging current @ 25° C	100A	
Output voltage	120VAC @ 60HZ	
Weight	28.1 kg (62 lbs.)	
Dimensions	533 X 210 X 301.5 mm (21.00 X 8.25 X 11.87 in)	
Enclosure protection rating	IP 22 (NEMA 12)	
System Voltage	24V (21 – 32VDC)	48V (42 – 64VDC)
Operating Temperature	-20° C to +45° C	

**TABLE 9A: INVERTER SPECIFICATION**

Set Points		Battery Voltage	Volts/cell
LVD low voltage disconnect	SOC < 20%	22.2 Volts	1.85
LVDr reconnection of load after LVD	SOC > 40%	24.0 Volts	2.00
Absorption charge voltage	SOC > 80%	28.8 Volts	2.40
Absorption charge time		2 hrs	
Float charge voltage		27.0 Volts	2.25
Float charge time		0.0 hrs	
Equalization charge voltage	SOC > 100%	28.8 Volts	2.40
Equalization charge time		0.0 hrs	
AC Input current limit	20A AC		
AGS start voltage 24 hr	SOC < 70%	25.6 Volts	2.13
AGS start voltage 2 hr	SOC < 60%	25.4 Volts	2.12
AGS start voltage 2 min	SOC < 50%	25.2 Volts	2.10
AGS quiet time	NONE		
AGS Warm up	5 minutes		
AGS PORT	1		
AGS fault alert time	10 minutes		
Auto start genet upon load surge demand	NONE		
Auto start genet upon load surge demand delay	NONE		
Auto stop genet upon load surge demand	NONE		
Temperature compensation		-5 mV/K°/Cell	--
SOC Based on 120hr rate 24V, double values for 48VDC			

**TABLE 9B: CHARGING SET POINTS**


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## APPENDIX A CORRECTION FOR MAGNETIC DECLINATION AND ARRAY TILT

- For optimum performance, your PV array should face true south in the NORTHERN Hemisphere (and true NORTH in the Southern Hemisphere). However, when determining direction using a magnetic compass, indicated bearings will vary from true bearings because of the difference between the location of the true and magnetic NORTH poles. This angular difference varies with location on the globe and is called the “declination.” Values of declination for the contiguous United States and portions of Mexico, Canada, and the Caribbean are shown in the map below (note that values are changing very slowly—this effect is negligible for purposes of installing your PV array). In order to correct for magnetic declination when sighting your PV array, proceed as follows:
  - Locate your site on the map below. (Great accuracy is not critical).
  - Interpolate the value for magnetic declination in degrees based on the lines of constant declination (isogonic lines) shown above. For example, the declination for Washington, D.C., is approximately  $-11^{\circ}$ ; for Chicago, IL,  $-3^{\circ}$ ; and for Los Angeles, CA,  $+14^{\circ}$ .
  - Determine magnetic south at your site using a magnetic compass.
  - If the local declination found in step 2 is negative, *true* south is that number of degrees *added to magnetic south*. For example, at Washington, D.C., true south is the same as  $180^{\circ} + 11^{\circ} = 191^{\circ}$  indicated. If the local declination found in step 2 is positive, true south is that number of degrees *subtracted from magnetic south*. For example, at Los Angeles, true south is the same as  $180^{\circ} - 14^{\circ} = 166^{\circ}$  indicated.
  - Orient your array in the direction of true south (or NORTH if applicable) as determined above.
  - A declination chart for NORTH America is provided below for assistance in determining the appropriate correction for other sites. Other suggested resources include World Aeronautical Charts (WAC), the World Wide Web, local airports, or government agencies. The Internet site [www.ngdc.noaa.gov/cgi-bin/](http://www.ngdc.noaa.gov/cgi-bin/) will calculate magnetic variation from an input of altitude, latitude and longitude.
- For optimum performance, your PV array should set to a specific tilt angle. To determine the desired tilt angle of the array, use an atlas to determine the latitude of the installation location.

To determine what your latitude is:

- Locate your site on the map. (Great accuracy is not critical).
- Determine what latitude line closest intersects your region.
- Take this value and add the factor based on the table below. This will provide the optimum worst case performance with the minimum amount of annual adjustment, based on the winter months (Northern hemisphere).

Latitude range between $90 - 40^{\circ}$	SET TO $55^{\circ}$
Latitude range between $40 - 25^{\circ}$	$+15^{\circ}$
Latitude range between $25 - 10^{\circ}$	$+5^{\circ}$
Latitude range between $10 - 0^{\circ}$	SET TO $10^{\circ}$

- It is recommended that the array tilt be limited to  $10^{\circ}$  for a minimum angle and  $55^{\circ}$  for a maximum tilt angle.

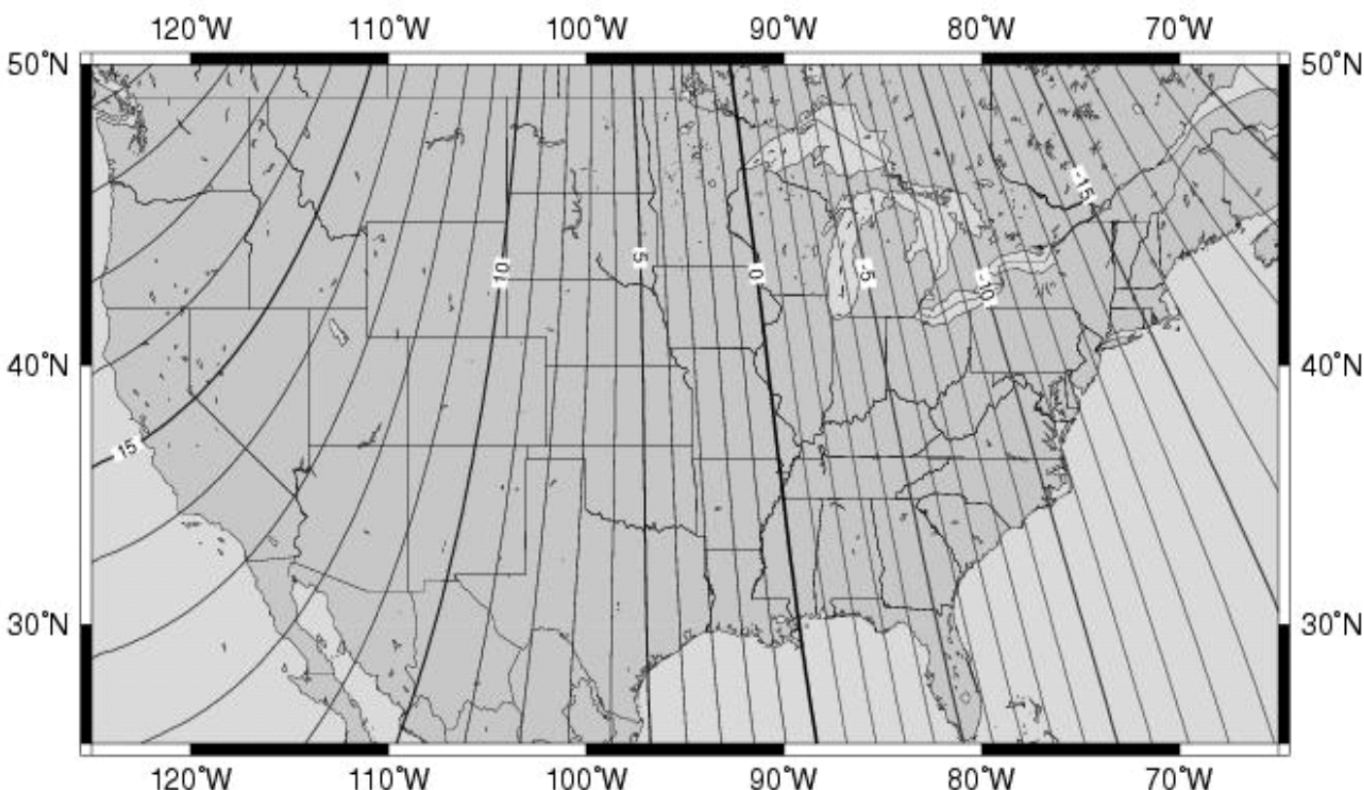
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## Magnetic Declination for the U.S. 2004



**FIGURE C1: MAGNETIC DECLINATION MAP NORTH AMERICA**

SITE INFORMATION	
CITY:	
STATE:	
LATITUDE:	
LONGITUDE:	
DECLINATION:	
TILT ANGLE:	



**APPENDIX B COMMISSIONING CHECKLIST**

Date:	<hr/>		
Model No.:	<hr/>		
Serial No.:	<hr/>		
Inspected By:	<hr/>		
		Approved by:	<hr/>

<b>I. Mechanical Inspection</b>			
<b>A. Array</b>			
1 Fitting(s) secure to J-Box			YES / NA
2 Fitting(s) secure to enclosure			YES / NA
3 Rack installation hardware tight			YES / NA
4 PV Module surface clean and free of debris			YES / NA
5 PV Module direction is south facing			YES / NA
6 PV Module tilt angle is at a _____ degree angle from horizontal			YES / NA
<b>B. Enclosure</b>			
1 Mounting fasteners tight			YES / NA
2 Ground lug fastened tightly, free of corrosion			YES / NA
<b>C. Charge Cont.</b>			
1 Wiring secure to terminals			YES / NA
2 SOV arrestor free of visual damage			YES / NA
3 Breakers in the OPEN (OFF) position			YES / NA
<b>II. Electrical Inspection</b>			
System DC Voltage (circle)	12	24	48
<b>A. Array</b>			
<b>Array open circuit:</b>			
1 PV array 1 output voltage(V)	_____ VDC	Sun %	NONE LOW MED HIGH
current(A)	_____ ADC		
2 PV array 2 output voltage(V)	_____ VDC	Sun %	NONE LOW MED HIGH
current(A)	_____ ADC		
3 PV array 3 output voltage(V)	_____ VDC	Sun %	NONE LOW MED HIGH
current(A)	_____ ADC		
4 PV array 4 output voltage(V)	_____ VDC	Sun %	NONE LOW MED HIGH
current(A)	_____ ADC		
5 Frame to ground continuity (< 0.5 ohm)			YES / NA
<b>B. Charge Cont.</b>			
<b>Battery open circuit:</b>			
1 System battery voltage(V):	VDC: _____	> 2.0Vpc	YES / NA
2 Load voltage(V)	VDC: _____	> 2.0Vpc	YES / NA
3 Backpanel to ground continuity (< 0.5 ohm)			YES / NA
4 Battery Neg (-) to ground continuity (< 0.5 ohm)			YES / NA
<b>C. Charge Cont.</b>			
1 PV Breakers in the CLOSED (ON) position			YES / NA
2 Battery Breakers in the CLOSED (ON) position			YES / NA
<b>System operating:</b>			
3 System battery voltage(V):	VDC: _____	> 2.1Vpc	YES / NA
4 Load voltage under charge meas:	VDC: _____	> 2.1Vpc	YES / NA



## APPENDIX C ANNUAL INSPECTION CHECKLIST

**Date:** \_\_\_\_\_  
**Model No.:** \_\_\_\_\_  
**Serial No.:** \_\_\_\_\_  
**Inspected By:** \_\_\_\_\_

**Approved by:** \_\_\_\_\_

## I. Mechanical Inspection

### A. Array

- |  |          |
|--|----------|
| 1 Fitting(s) secure to J-Box                                     | YES / NA |
| 2 Fitting(s) secure to enclosure                                 | YES / NA |
| 3 Rack installation hardware tight                               | YES / NA |
| 4 PV Module surface clean and free of debris                     | YES / NA |
| 5 PV Module direction is south facing                            | YES / NA |
| 6 PV Module tilt angle is at a _____degree angle from horizontal | YES / NA |

## B. Enclosure

- |  |          |
|--|----------|
| 1 Mounting fasteners tight                       | YES / NA |
| 2 Ground lug fastened tightly, free of corrosion | YES / NA |

### C. Charge Cont.

- |                                      |          |
|--------------------------------------|----------|
| 1 Wiring secure to terminals         | YES / NA |
| 2 SOV arrestor free of visual damage | YES / NA |

## II. Electrical Inspection

### A. Battery

- |  |    |    |    |          |
|--|----|----|----|----------|
| 1 System DC Voltage (circle)             | 12 | 24 | 48 |          |
| 2 PV breakers in the OPEN (OFF) position |    |    |    | YES / NA |

**Battery open circuit:**

BATTERY 1	_____	VDC	BATTERY 7	_____	VDC
BATTERY 2	_____	VDC	BATTERY 8	_____	VDC
BATTERY 3	_____	VDC	BATTERY 9	_____	VDC
BATTERY 4	_____	VDC	BATTERY 10	_____	VDC
BATTERY 5	_____	VDC	BATTERY 11	_____	VDC
BATTERY 6	_____	VDC	BATTERY 12	_____	VDC

Maximum Delta:

Highest Battery Voltage	_____	VDC	
Lowest Battery Voltage	=====	VDC	
Highest - Lowest Battery Voltage	=====	VDC	(<.05VDC)

## B. Charge Cont.

- |  |          |
|--|----------|
| 1 PV Breakers in the CLOSED (ON) position      | YES / NA |
| 2 Battery Breakers in the CLOSED (ON) position | YES / NA |

**System operateing:**

- |                                   |            |          |          |
|-----------------------------------|------------|----------|----------|
| 3 System battery voltage(V):      | VDC: _____ | > 2.1Vpc | YES / NA |
| 4 Load voltage under charge meas: | VDC: _____ | > 2.1Vpc | YES / NA |

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**APPENDIX D SYSTEM DRAWINGS**

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