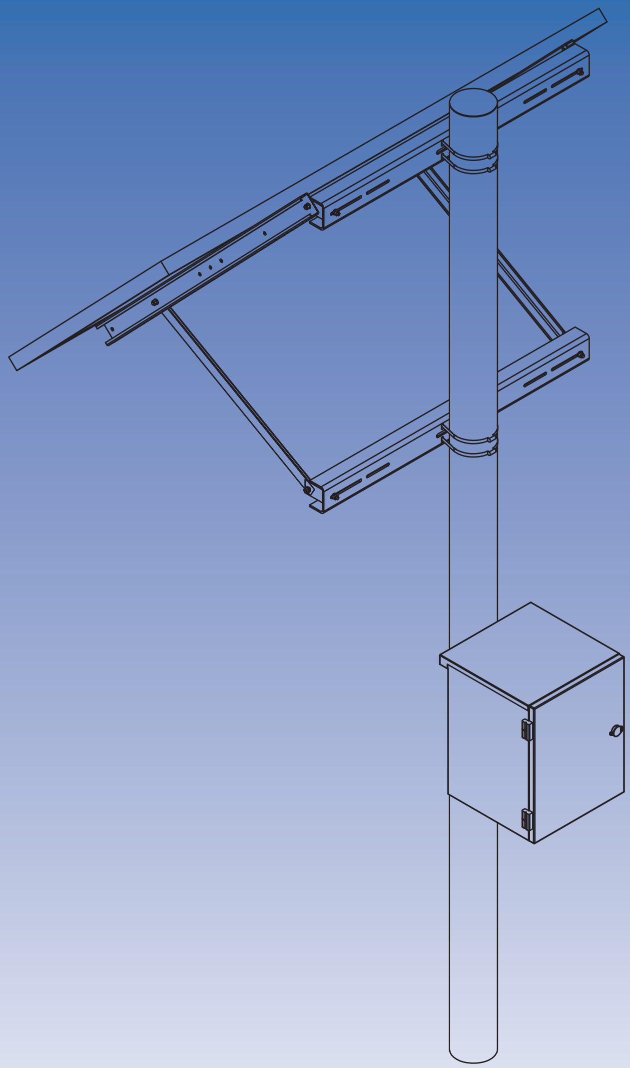

Installation, Operation & Maintenance Manual

SunWize® Power & Battery Power Ready System

SunWize
Age of Power Autonomy

Manual # PM296038

www.sunwizepower.com

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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 & Battery 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 INTRODUCTION TO SUNWIZE® POWER & BATTERY POWER READY SYSTEMS

Congratulations on your purchase of the SunWize® Power & Battery Power Ready System. This fully integrated system combines innovative technologies to provide you with a reliable stand-alone electrical power source. The system is a self-contained power supply using sunlight to generate electricity at 12, 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 system consists of:

- A photovoltaic (PV) module or array on a side-of-pole (SOP) mount , top-of-pole (TOP), roof-ground mount (RGM), or skid
- Aluminum enclosure
  - Key lockable, pole mounted, with filtered ventilation
    OR
  - Pad lockable, pole mounted
    OR
  - Pad lockable, ground mounted, chest style
- Solar charge controller
- Low voltage load disconnect
- Load distribution blocks
- DC surge protection

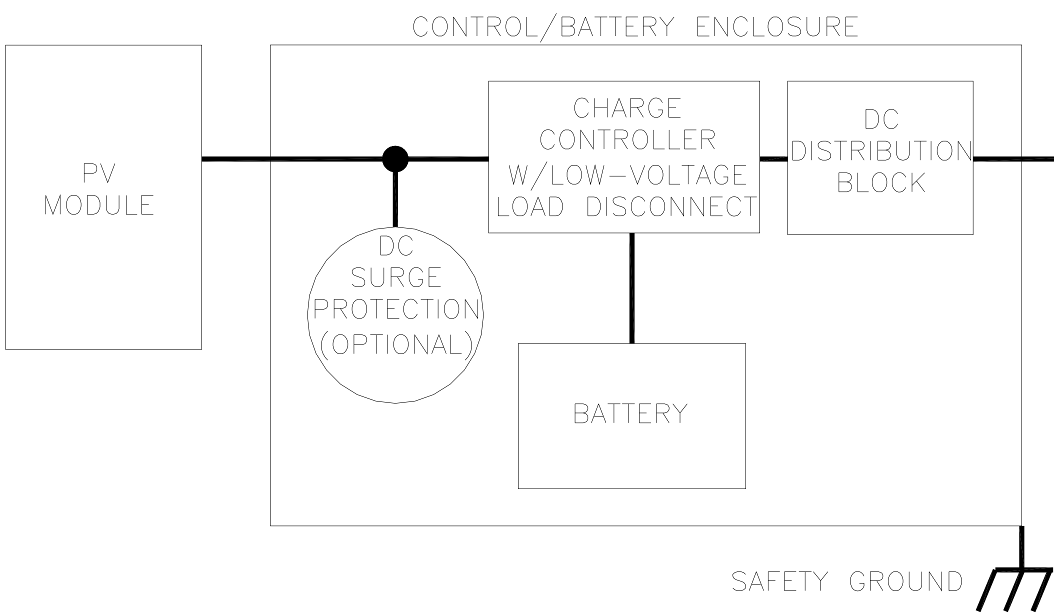

FIGURE 1: SYSTEM ONE LINE DIAGRAM (TYPICAL)

The PV array converts the sunlight into electrical current that charges the sealed batteries mounted in the enclosure. The enclosure also contains the charge controller, which 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 pole mounted aluminum enclosure comes in two types: the M-series and the premium F-series (features a tamper-resistant mounting system and filtered vents), and. The T-series, pad mounted, chest enclosures feature a continuous air gap to prevent gas buildup.

1.1 Component Identification

1.1.1 Solar Array

The solar array is comprised of the photovoltaic (PV) modules mounted onto the supporting mounts. The modules are pre-wired and factory tested for correct output voltage configuration. All bolts are factory tightened to specification where applicable.

1.1.2 Battery Bank

The system battery bank consists of sealed VRLA-Pb batteries of either gel electrolyte (GEL) or absorbent glass mat (AGM) construction. Batteries are left separate for ease of installation in pole-mounted enclosures. Batteries are pre-installed in chest enclosures, but left un-wired for safe transportation.

1.1.3 DC Controller Panel

The DC control panel provides all 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 LVD. The DC LVD removes the battery from the DC load should the battery bank become severely discharged due to lack of sun. All of the main disconnect circuit breakers are housed on the DC control panel.

1.1.4 Optional 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. Combiner boxes are only used where 3 or more strings are required.

2 INSTALLATION EQUIPMENT

2.1 Customer Supplied Tool List

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

2.1.1 Customer Supplied Parts List

Item	Description	Comments
1	Load wire	18 – 6 AWG (0.8 – 13.0mm)
2	Load Conduit	½" KO provided
3	Equipment grounding	14-2 AWG Lug provided, ground per local electrical code
4	Array mount anchor bolts	1/2" dia. (4 per mount) (ground mounted only)
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)
7	Galvanized steel pole	2"-8" SCH 40

2.1.2 Supplied Parts List

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

Item	Description
1	Pre-wired PV modules
2	PV array mount
3	Pre-assembled control/battery enclosure with control panel
4	Control/battery enclosure mounting brackets with hardware
5	Batteries
6	Battery cables
7	Optional nylon wire ties
8	Spare controller load fuse (if needed)
9	Pole mounting hardware (band clamps or U-bolt)
10	Enclosure keys (premium F-series enclosures only)
11	SunWize® Power & Battery Installation & Operation Manual
12	Controller OEM manual

3 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 backsides of modules are susceptible to damage. Avoid dropping tools or other items on them.

! NOTE !

Each rack is optimized for specific pole diameter ranges, for standard round SCH40 steel poles. Ensure that the pole used matches the optimal range and geometry for the racking equipment provided. Failure to do so may cause mounts to detach from the pole.

Prior to commencing assembly and installation:

- Thoroughly read and follow all safety precautions and instructions to insure proper operation of the system.
- Gather the items identified in the TOOL LIST in Section 2.1 and the PARTS LIST in Section 2.1.1.

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^o tilt, a panel that is perpendicular to the earth surface is said to be at 90^o tilt.

3.2 Control/Battery Enclosure Installation – (SOP) Side-Of-Pole

☠ DANGER ☠

The control/battery enclosure may weigh up to 50 lbs. and individual batteries may weigh up to 170 lbs. each. Use caution to avoid injury when lifting and securing the enclosure. Do not remove auxiliary support for the enclosure before completing installation of all mounting hardware.

! NOTE !

The enclosure may be mounted on a pole, wall, or other surface adequate to support its weight.

- 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.

3.2.1 F-series Enclosures

- F-series enclosures come with mounting brackets that can accommodate 2 – 8" U-bolts or band clamps. For large diameter poles, custom cut pipe banding up to 1" wide 10 – 36" in length may be used.
- Install the upper mounting bracket at the desired height of the enclosure using band clamps or by using U-bolts (user supplied or available upon request). For typical applications, place the bracket 52 - 72" from the ground.
- Install the lower mounting bracket. The bracket spacing should be measured from the upper bracket as follows:
    - For WF2 or WF4 battery enclosure: CL = 23" [584.2]
    - For F1 or F2 battery enclosure: CL = 12 7/8" [327]
    - For F4 battery enclosure: CL = 24 1/8" [612]
- Hang the enclosure without batteries on the upper mounting bracket as depicted in FIGURE 2A.
- Attach the lower bracket to the enclosure using the 5/16" hardware provided. Tighten bolts using a 1/2" wrench to 10-12 ft. lbs. torque.
- Check alignment of all assembled parts and tighten all bolted connections.
- Install the battery(s) per the wiring diagram. Do not wire them at this point.

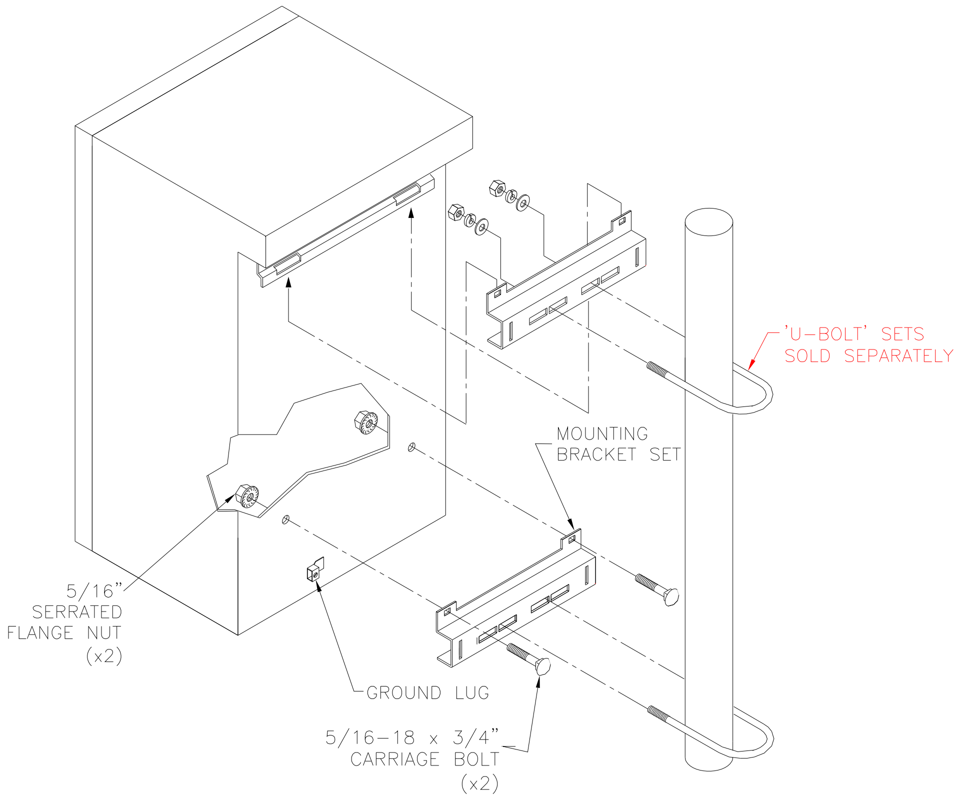

FIGURE 2A: WF / F-STYLE CONTROL/BATTERY ENCLOSURE POLE MOUNTED INSTALLATION

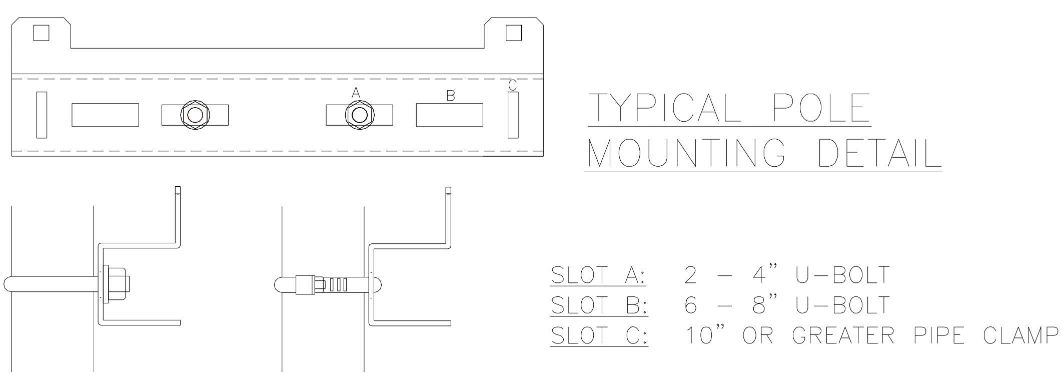

FIGURE 2B: WF / F-STYLE CONTROL/BATTERY ENCLOSURE POLE MOUNTED INSTALLATION

3.2.2 M-series Enclosures

- M-series enclosures can accommodate 2 – 8” U-bolts.
- Hang the enclosure without batteries at the desired height using U-bolts (user supplied or available upon request) as depicted in FIGURE 3. For typical applications, place the top of the enclosure 52 - 72” from the ground. Tighten bolts using a 1/2” wrench to 10-12 ft. lbs. torque..
- Check alignment of all assembled parts and tighten all bolted connections.
- Install the battery(s) per the wiring diagram. Do not wire them at this point.

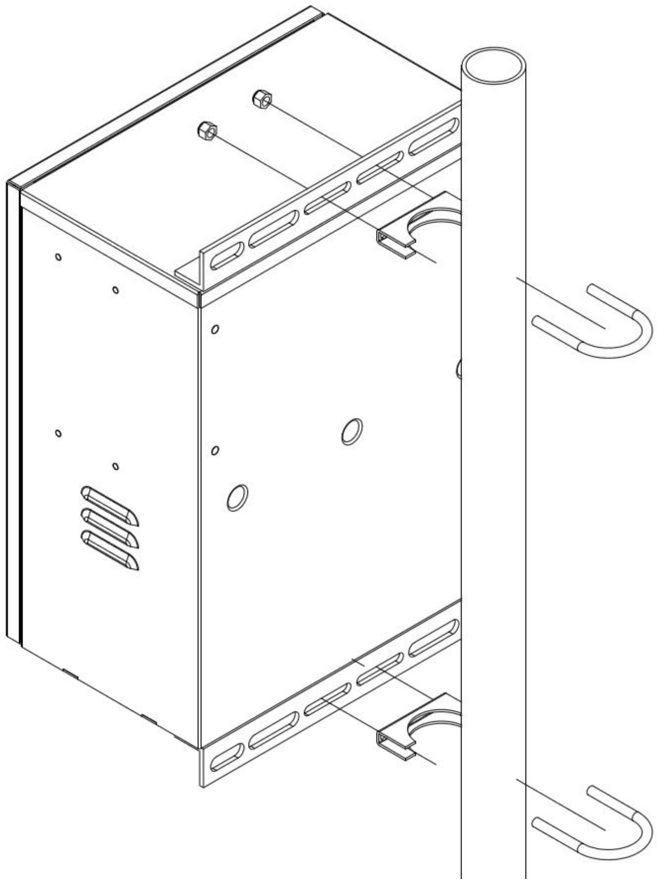

FIGURE 3: M-STYLE CONTROL/BATTERY ENCLOSURE POLE MOUNTED INSTALLATION

3.3 Control/Battery Enclosure Installation – (RGM) Roof / Ground

☠ DANGER ☠

The control/battery enclosure may weigh up to 175 lbs. and individual batteries may weigh up to 170 lbs. each. Use caution to avoid injury when lifting and securing the enclosure.

- 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.
- Install the base mounting pads at the desired location using appropriate concrete fastening hardware.
- Check alignment of all assembled parts and tighten all bolted connections.
- Install the battery(s) per the wiring diagram. Do not wire them at this point.

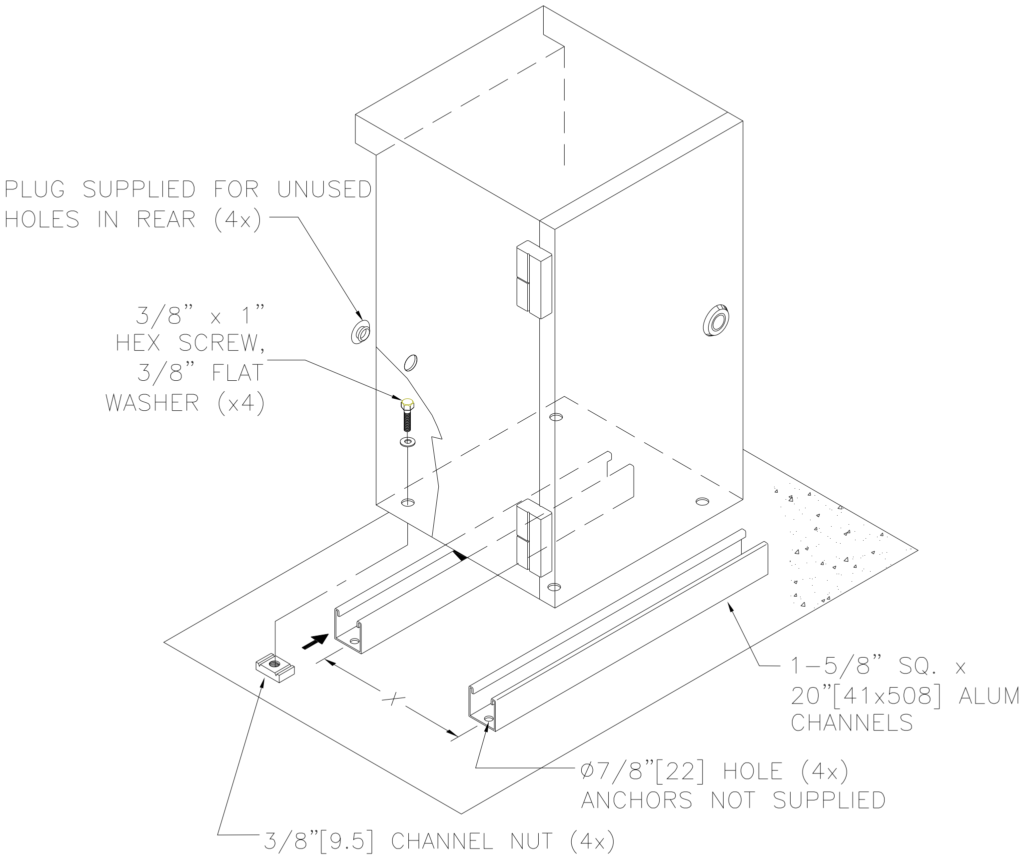

FIGURE 4A: WF / F-STYLE CONTROL/BATTERY ENCLOSURE PAD MOUNTED INSTALLATION

Model	Battery Capacity	Weight	Dimensions					
	GROUP 31	lbs. (kg)	H		X		D	
			in	mm	in	mm	in	mm
F1	1	25 (11)	16	406.4	7.375	187.3	10	254.0
F2	2	30 (14)	16	406.4	12.375	314.3	15	381.0
F4	4	40 (18)	16	406.4	12.375	314.3	15	381.0
WF2	2	40 (18)	27	685.8	7.375	187.3	10	254.0
WF4	4	50 (14)	27	685.8	12.375	314.3	15	381.0

TABLE 1A: WF / F–STYLE CONTROL/BATTERY ENCLOSURE INSTALLATION PAD DETAILS

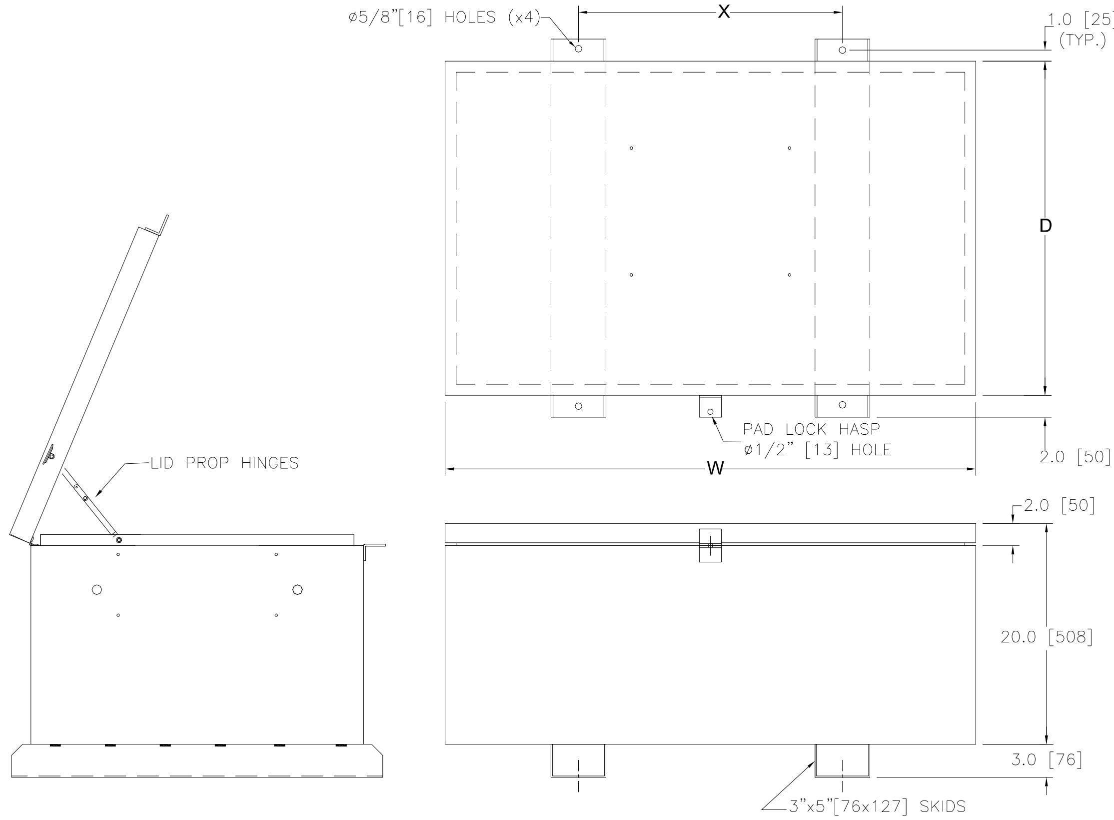

FIGURE 4B: T-STYLE CONTROL/BATTERY ENCLOSURE PAD MOUNTED INSTALLATION

Model	Battery Capacity		Weight	Dimensions					
	4D	8D	lbs. (kg)	W		X		D	
				IN	mm	IN	mm	IN	mm
T-2X8D	2	2	55 (25)	31.25	793.75	15.75	400.05	23.75	603.25
T-4X8D	4	4	75 (25)	48.25	1225.55	24.00	609.6	23.75	603.25
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 1B: T–STYLE CONTROL/BATTERY ENCLOSURE INSTALLATION PAD DETAILS

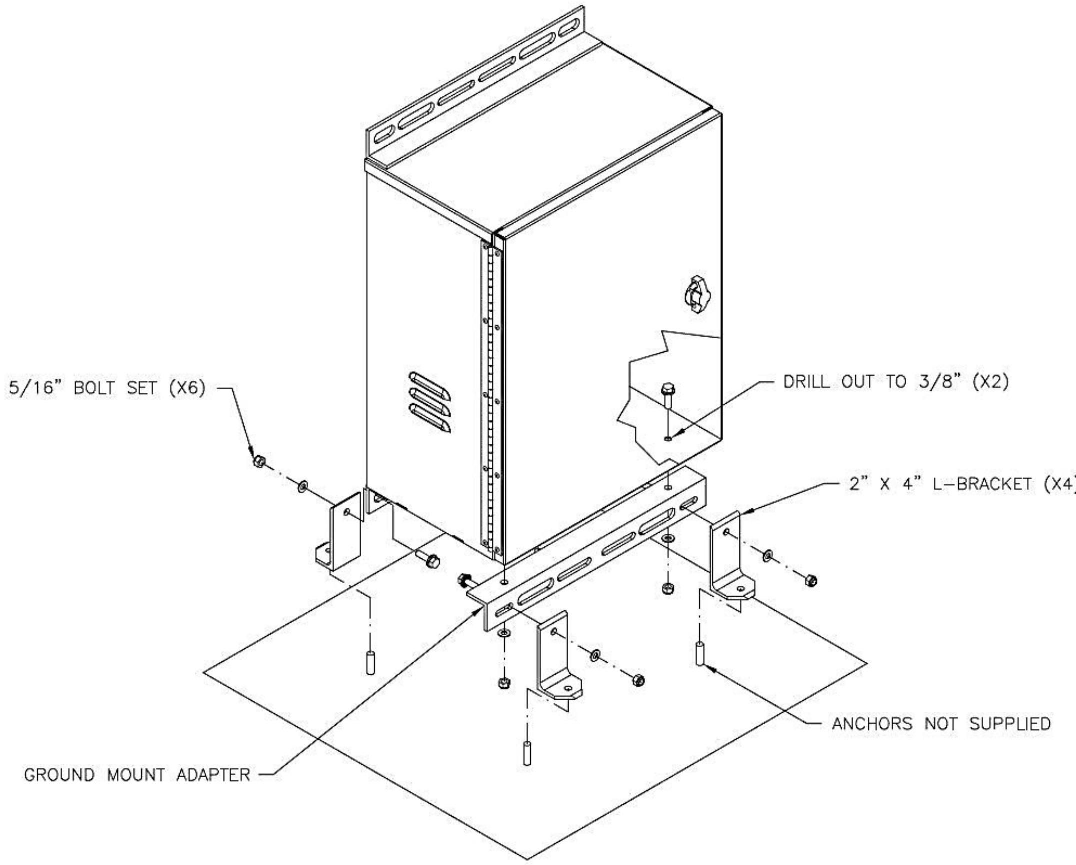

FIGURE 4C: M-STYLE CONTROL/BATTERY ENCLOSURE PAD MOUNTED INSTALLATION

4 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 Ground Wiring

- Verify all components are installed per the wiring diagrams in Appendix B.
- Verify all circuit breakers are set to the **OFF (OPEN)** position.
- Install the equipment-grounding conductor (not provided) to the control/battery enclosure and AC distribution enclosure ground lug. Use wire rated for outdoor use per local codes and sized per NEC A.690.
- Verify system neutral bonding is per local code.

4.2 PV Array Wiring

- Verify all charge control components are installed per the wiring diagrams provided with the system.
- Verify all circuit breakers in the control/battery enclosure are set to the **OFF (OPEN)** position. If provided, verify all fuses in the control/battery enclosure are removed.
- Install the equipment-grounding conductor to the control/battery enclosure ground lug, located on the outside of the enclosure. Use wire rated for outdoor use per local codes and sized per NEC A.690.
- For systems with a combiner box, route the output conduit from the combiner to the control/battery enclosure. Secure the conduit to either the PV panel frame or the mounting surface using wire ties or other restraining hardware (not provided) to prevent damage during severe weather conditions. Install the liquid tight fitting to the rear of the enclosure using the 1/2” knock out provided.
- Inside the control/battery enclosure, mate the PV array **PV(+)** wire to the controller **PV(+)** terminal block. Mate the PV array **PV(-)** wire to the controller **PV(-) or NEG** terminal block. Mate the PV array **GND** wire to the control panel **GND** bus bar.

- For system without a combiner box, route the output conduit from the PV panel to the control/battery enclosure. Secure the conduit to either the PV panel frame or the mounting surface using wire ties or other restraining hardware (not provided) to prevent damage during severe weather conditions. Install the liquid tight fitting to the rear of the enclosure using the 1/2” knock out provided.

- Inside the control/battery enclosure, mate the PV array **PV(+) FEMALE** connector to the controller **PV(+) MALE** connector. Mate the PV array **PV(-) FEMALE** connector to the controller **PV(-) MALE** connector. Mate the PV array **GND** wire to the control panel **GND** bus bar.

4.3 Battery Wiring

- Inside the control/battery enclosure, 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 12V systems:

- Each 12V battery is in parallel with the next. Ensure the battery parallel jumpers connect the **RED** jumper from **BAT 1 POSITIVE(+)** terminal to the **BAT 2 POSITIVE(+)** terminal and the **BLK** jumper from **BAT 1 NEGATIVE(-)** terminal to the **BAT 2 NEGATIVE(-)** terminal. This pattern repeats for each additional battery added. A system can accommodate from one to four batteries.

For 24V systems:

- Each pair of 12V batteries is in series and form one string. Ensure the series jumper connect 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 series jumper 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.

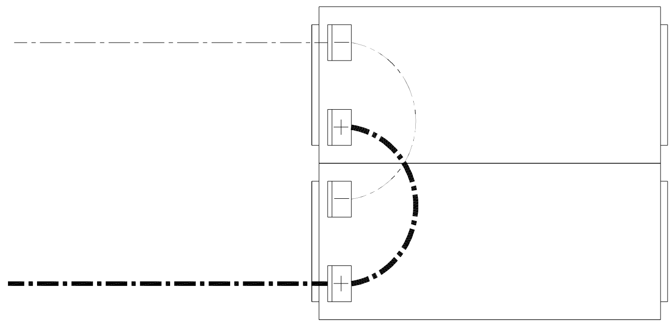

FIGURE 5A: 12V BATTERY WIRING DETAILS

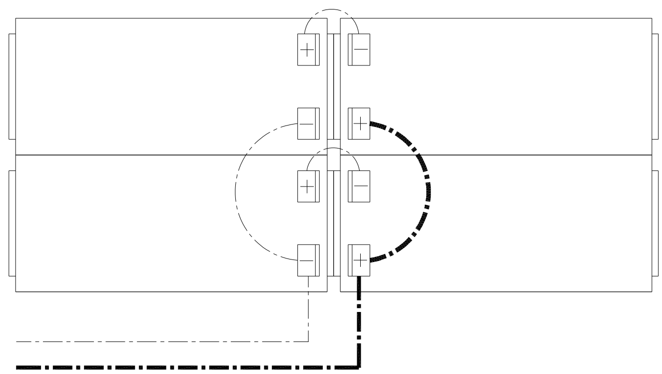

FIGURE 5B: 24V BATTERY WIRING DETAILS

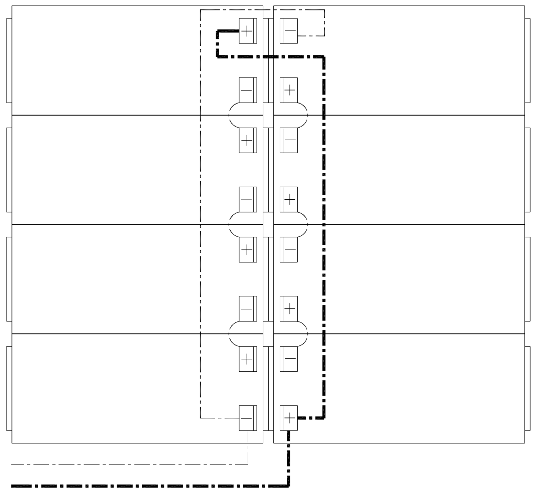

FIGURE 5C: 48V BATTERY WIRING DETAILS

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5 SYSTEM OPERATION

5.1 System Commissioning

- Verify the mechanical installation is complete per the Commissioning Checklist (Appendix B)

- 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 B) 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.

- For systems without a combiner box, under optimum overhead sunlight conditions, verify the PV array open circuit voltage (Voc) by measuring the voltage from the **PV(+)** to the **PV(-)** terminals inside the control enclosure. This should measure appx:

  21VDC for a 12V system
  42VDC for a 24V system
  84VDC for a 48V system

- Check the nameplate rating on the module or the wiring diagram included with the system for actual values.

- 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:

  12-13V for a 12V system
  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 charge control panel, set the **PV(+)** input breaker(s) to the **ON (CLOSED)** position.

- On the charge control panel, set the **BAT(+)** input breaker(s) to the **ON (CLOSED)** position.

- Verify the controller status LEDs illuminate per Charge Controller manual.

- On the charge control panel, verify the load voltage by measuring from the **LOAD(+)** terminals to the **LOAD(-)** terminal**.** This should measure the same as the battery bank voltage.

- Connect the user load at this point.

5.2 System Operation Summary

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 too high for too long (SEE Charge Controller manual 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.

- 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 50% state of charge (SOC) 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 the 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 16VDC (12V battery) and in summer it will typically be 13.5VDC (12V 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.

6 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 in Appendix C.

6.2 Troubleshooting Guide

- Refer to Charge Controller manual 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 cutoff voltage. If not, allow battery to fully charge
	Load overload or short circuit	Check the wire terminations for proper configuration
Breaker Trip or Fuse Blown	LVD trip repeatedly	Verify the load is not exceeding the system capability. Confirm that battery DOD cycles have not exceed normal end of life
	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

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® Power & Battery Customer Service at 1-866-827-6527.

6.3.1 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 12.8 / 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 voltage open circuit (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^{o}C.:

SOC	Voc	Vuc
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.

- If battery voltage climbs very rapidly under charge, then falls rapidly after removing charge, 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 approx 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 in winter. As a reference:

LOW	a clear sunny day at 7AM-9AM	(10-30% sun capacity)
MED	a clear sunny day at 9AM-11AM	(30-60% sun capacity)
HIGH	a clear sunny day at 11AM-1PM	(60-100% sun capacity)
MED	a clear sunny day at 1PM-3PM	(30-60% sun capacity)
LOW	a clear sunny day at 3PM-5PM	(10-30% sun capacity).

- In summer sky:

LOW	a clear sunny day at 7AM-9AM	(10-30% sun capacity)
MED	a clear sunny day at 9AM-11AM	(30-60% sun capacity)
HIGH	a clear sunny day at 11AM-2PM	(60-100% sun capacity)
MED	a clear sunny day at 2PM-5PM	(30-60% sun capacity)
LOW	a clear sunny day at 5PM-8PM	(10-30% sun capacity).

7 LIMITED WARRANTY

SunWize® Power & Battery ("SWPB") warrants the SunWize® Power & Battery Power Ready 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. SWPB 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 SWPB 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. SWPB makes no warranty against defects in materials and workmanship by component parts manufacturers, except to the extent provided below.

SunWize® Power & Battery 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® Power & Battery and be prepared to supply the following information:

- The date your SunWize® Power & Battery product was purchased.
- Product serial number.
- Description of the problem.
- Photos of the system performance indicators, such as status indicator lamps & meters
- Photos of solar array and photos of the solar access (horizon) to the south of the solar array, if the product includes a solar array

For most expedited service, please complete the customer service request on our website or call customer service directly. The form can be found at www.sunwizepower.com/customer-service

If we cannot correct the situation through phone consultation, we will provide you with the following information regarding shipping the product to SunWize® Power & Battery 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, SWPB will pay the return shipping charges to any destination within the United States.

SUNWIZE® POWER & BATTERY 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, SWPB shall not be liable for any damages of any kind. SWPB 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 SWPB be liable for any incidental or consequential damage.

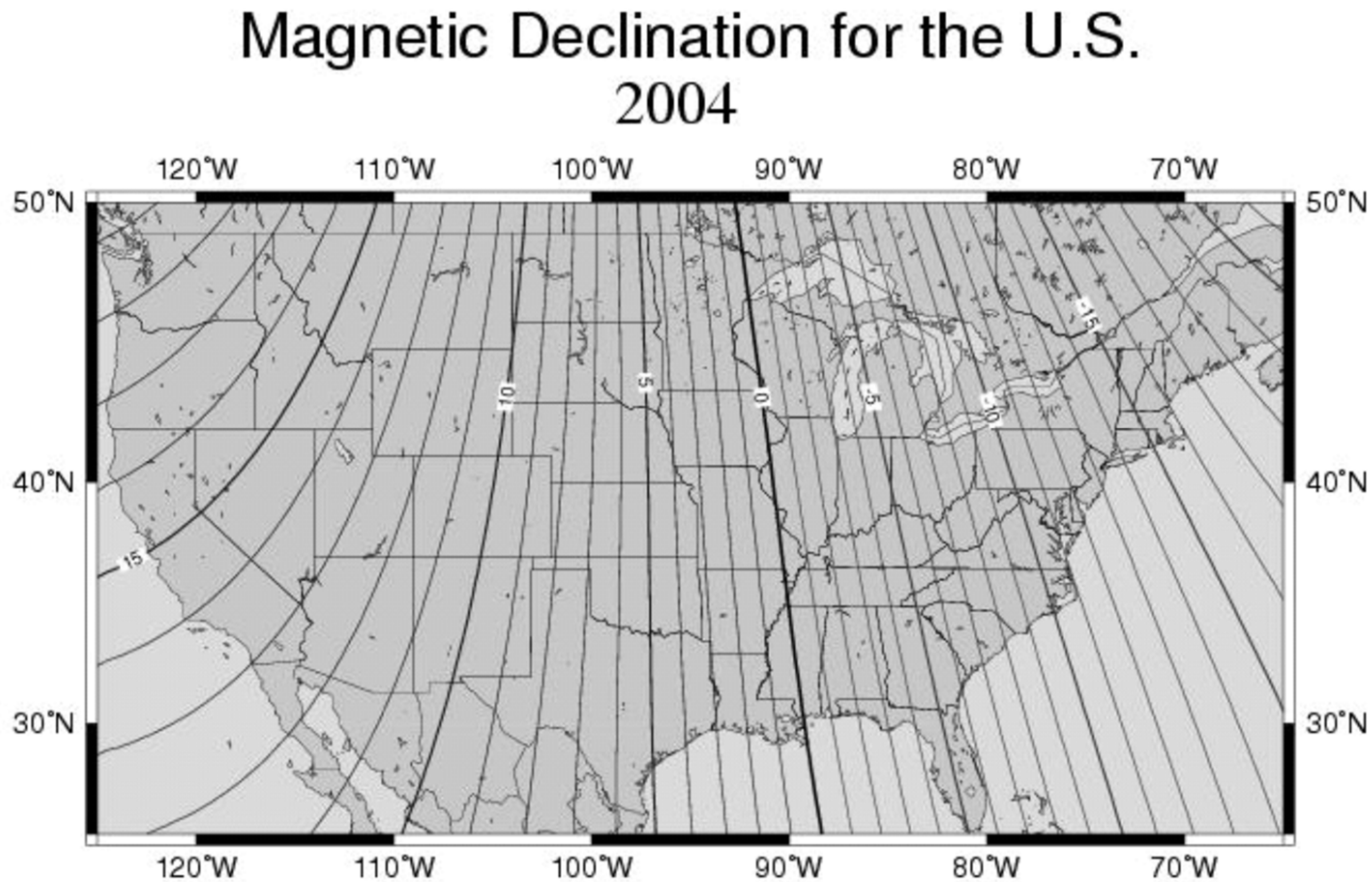
APPENDIX A CORRECTION FOR MAGNETIC DECLINATION AND ARRAY TILT

- 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 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 -11º; for Chicago, IL, -3º; and for Los Angeles, CA, +14º.
    - 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 180º + 11º = 191º 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 180º – 14º = 166º 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/ will calculate magnetic variation from an input of altitude, latitude and longitude.
- For optimum performance, your PV array should be 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 – 45 º	SET TO 60º
Latitude range between 40 – 25 º	+15 º
Latitude range between 25 – 15 º	+5 º
Latitude range between 10 – 0 º	SET TO 15º



- It is recommended that the array tilt be limited to 15° for a minimum angle and 60° for a maximum tilt angle.

FIGURE C1: MAGNETIC DECLINATION MAP NORTH AMERICA

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

APPENDIX B COMMISSIONING 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
3	Breakers in the OPEN (OFF) position	YES / NA

II. Electrical Inspection

System DC Voltage (circle) 12 24 48

A. Array

Array open circuit:

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. Charge Cont.

Battery open circuit:

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

C. 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

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

APPENDIX D SYSTEM DRAWINGS