SMA E-Panel installation manual

Dual Master shown

Model MNE250SMA

The MidNite Solar SMA E-Panel is designed for single & multiple inverter installations.
Use this installation manual to aid in installation. The installation of electrical systems such as this fall under the guidelines of the NEC in the USA. Canadian electrical codes have jurisdiction in Canada. These instructions are not intended to be used in lieu of these local and federal codes, but rather are used as specific to this product. You may need to consult with a professional solar installer or electrical inspector when in doubt on code specific questions and system installation issues. Even though the E-Panel incorporates and simplifies numerous separate electrical circuits into one enclosure, an inverter system such as this is still a very sophisticated and somewhat complicated electrical system.

This Manual contains information for MidNite Solar SMA E-Panel Model Numbers:

Masters:

MNE250SMA-AC-SINGLE	**Single - AC Coupled**
MNE250SMA-OG-SINGLE	**Single – Off Grid**
MNE250SMA-OG/AC DM	**Master – Dual Off Grid**
MNE250SMA-QUAD MASTER	**Master – Quad System AC Coupled / Off Grid**
MNE250SMA-3PH MASTER	**Master - 3 Phase**

Slaves:

MNE250SMA-Slave	**Slave (right hand unit) for dual, 3PH and Quads**

Backplate

MNESMAXW-SHORT BP	**Short back plate for inverter and E-Panel**

Symbols used in this manual:

Caution: Indicates a condition where injury or damage may occur if instructions are not followed.

Danger: Indicates a condition where injury or death may occur if instructions are not followed.

Symboles utilisez dans ce manuel:

Attention: Indiqué un risque des blessures graves ou du dommage si on ne suit pas des instructions dans ce manuel.

Danger: Indiqué un risque des blessures graves ou du mort si on ne suit pas des instructions dans ce manuel.

IMPORTANT SAFETY INSTRUCTIONS

SAVE THESE INSTRUCTIONS - These instructions contain important safety and operating instructions for the MidNite SMA E-Panel.

If you do not fully understand any of the concepts, terminology, or hazards outlined in these instructions, please refer installation to a qualified dealer, electrician or installer. These instructions are not meant to be a complete explanation of a renewable energy system.

GENERAL PRECAUTIONS

If service or repair should become necessary, contact MidNite Solar Inc. Improper servicing may result in a risk of shock, fire or explosion. To reduce these risks, disconnect all wiring before attempting any maintenance or cleaning. Turning off the inverter will not reduce these risks. Solar modules produce power when exposed to light. When it is not possible to disconnect the power coming from the Photovoltaics by an external means such as a combiner, cover the modules with an opaque material before servicing any connected equipment.

Do not work alone. Someone should be in the range of your voice or close enough to come to your aid when you work with or near Batteries.

Remove rings, bracelets, necklaces, watches etc. when working with photovoltaic modules or other electrical equipment. Power from an illuminated photovoltaic array makes a very effective arc welder with dire consequences if one of the welded pieces is on your person.

All installations must comply with national and local electrical codes. Professional installation is recommended. Wiring must be done in accordance with the National Electrical Code ANSI/NFPA 70. Use Class 1 wiring methods for field wiring connections to terminals of a Class 2 circuit. Use only 14-1/0 gauge AWM wire. Select the wire gauge used based on the protection provided by the circuit breakers/fuses.

MidNite products are not intended for use in connection with Life Support Systems. MidNite Solar makes no warranty or representation in connection with their products for such uses.

Disclaimer
Every effort is made to ensure the completeness and accuracy of all technical reference material, still, unless specifically agreed to in writing, MidNite Solar Inc.
(a) Makes no warranty as to the accuracy, sufficiency or suitability of any technical or other information provided in its manuals or other documentation.
(b) Assumes no responsibility or liability for loss or damage whether direct, indirect, consequential or incidental, which might arise out of use of such information. The use of any such information will be entirely at the user's risk.

If service or repair of the E-Panel should become necessary, contact MidNite Solar Inc. For other parts of the system refer to the manual included with that equipment and contact the manufacturer for support. Improper servicing may result in a risk of shock, fire or explosion. To reduce these risks, disconnect all wiring before attempting any maintenance or cleaning. Turning off the inverter will not reduce these risks. Solar modules produce power when exposed to light. When it is not possible to disconnect the power coming from the Photovoltaics by an external means such as a combiner, cover the modules with an opaque material before servicing any connected equipment.

INSTRUCTIONS DE SECURITÉ IMPORTANTES

CONSERVER CES INSTRUCTIONS

1. Avant l'utilisez cet appareil lis et comprends toutes les instructions et avertissements.

2. Si vous ne comprenez pas l'une des concepts ou des instructions contenu dans cette manuel consulter un agent spécialisé.

3. Si des réparations sont nécessaires contactez MidNite Solar pour plus des informations. Danger de choc électrique et de risque de brulure. Rien à dépanner à l'intérieure du cette appareil. Ne pas ouvrir le couver. Pour toute réparation ou service d'entretien, consulter un agent spécialisé. Il y'a peut-être plusieurs sources d'alimentation dans cette system. Débrancher toutes les interrupteurs avant toute d'entretien où nettoyage.

4. Ne travaillez pas seul. Quelqu'un devrait toujours être à proximité pour aider en cas d'une situation d'urgence.

5. Retirer bagues, bracelets, colliers, montres, et quelles choses comme ça. Il y'a risque des blessures graves s'il y'a un court-circuit. Cela pourrait ruiner votre journée entière.

6. Le câblage doit être fait en conformité avec le National Electrical Code ANSI / NFPA 70. Utiliser des méthodes de câblage de catégorie 1 pour les connexions de câblage sur .des terminaux d'un circuit de classe 2. Utilisez uniquement des fils de AWM de calibre 14-1/0. Sélectionnez le type de câble utilisé sur la base de la protection prévue par les disjoncteurs / fusibles.

Table of Contents

Model Number Descriptions 2
Warning Symbols 2
Warnings 3,4
Component locator 7
Mounting System to the wall 8
Dimensional drawings 13
Wiring 15
Installing Conduit between E-Panels 16
AC Coupled Systems description 19
Wiring Diagrams 20
Quad Master 22
Off Grid Single 20
Off Grid Dual 24
Three Phase 26
Tightening torque for electrical connections 29, 40
Classic Charge Controller with arc fault detection 31
Charge Controller hookup 29
DCGFP Ground Fault 32
Battery Combiner 33
Whiz Bang Jr. 34
MNX240 AutoFormer 34
MNBDM Battery Disconnect Module 37
MNBirdHouse Remote Shutoff. 38
New NEC Requirements 39
Appendix. 40
E-Panel descriptions. 41
Slave unit 46
Exchanging bus bars. 47

All E-Panels:

4	9-565-1	1" Grommets
1	9-314-1	2" Grommet
9	6-032-1	1/4-20 Bolts 4 to mount the e-panel, 5 extra to mount the inverter
2	6-010-2	2 M6 Screws and other hardware for mounting inverter to backplate
1	10-234-1	Manual

Dual System:

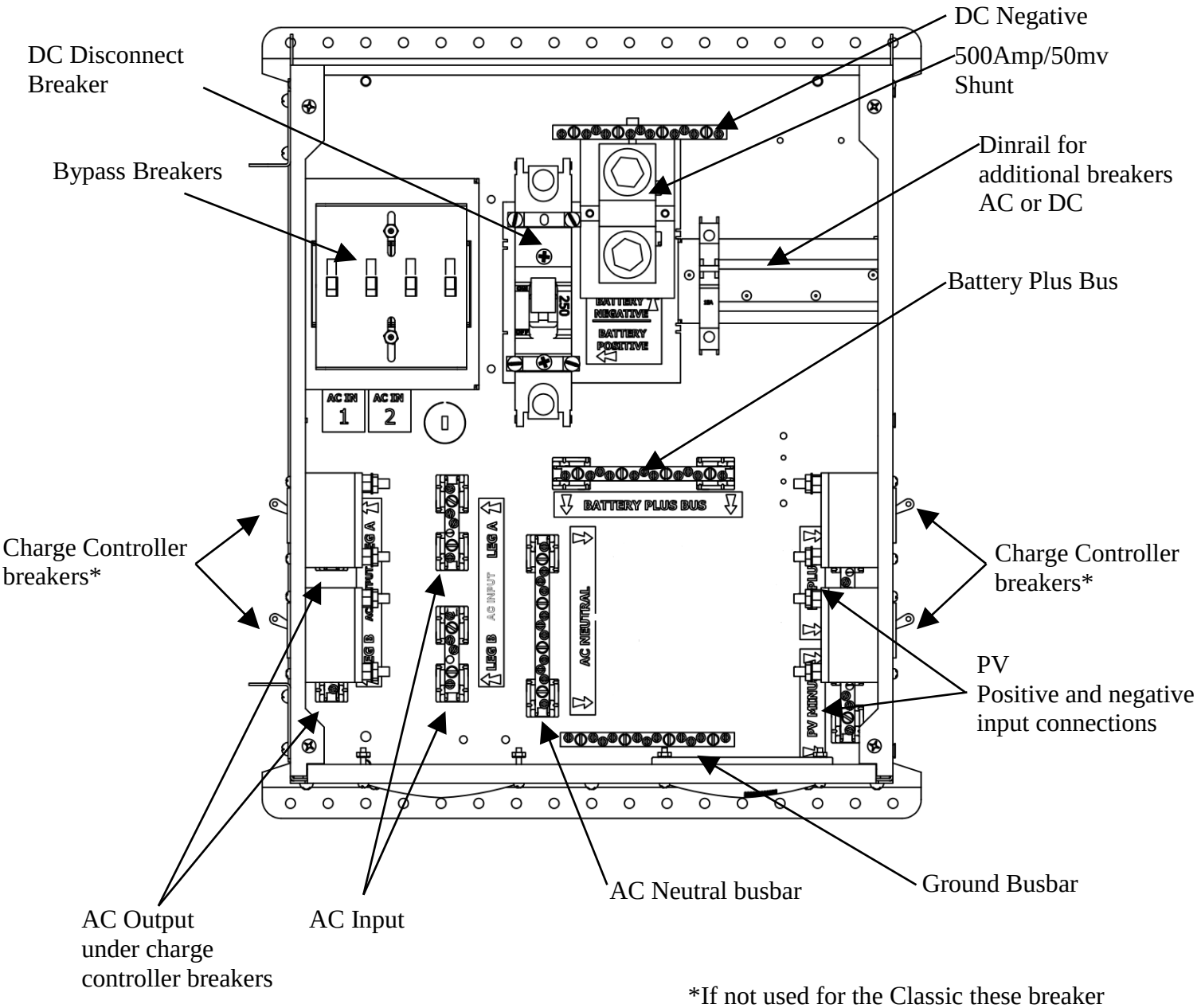
8	9-565-1	1" Grommets
2	9-314-1	2" Grommet
18	6-032-1	1/4-20 Bolts 4 to mount the e-panel, 5 extra to mount the inverter
4	6-010-2	2 M6 Screws and other hardware for mounting inverter to backplate
2	9-489-1	10.5" Conduit
4	9-490-1	Conduit terminal adaptors
4	9-235-1	Conduit lock nuts
4	9-236-1	Conduit bushings
4	Additional connecting wires	
1	10-234-1	Manual

Slave Unit:

4	9-565-1	1" Grommets
1	9-314-1	2" Grommet
9	6-032-1	1/4-20 Bolts 4 to mount the e-panel, 5 extra to mount the inverter
2	6-010-2	2 M6 Screws and other hardware for mounting inverter to backplate
4	5-015-1	Insulator, Black
4	5-015-6	Insulator, Blue
2	5-097-1	Insulator cover Black
4	6-037-1	Taptite screws

3 Phase and quad Units:

2	Conduit sets for 3 phase
3	Conduit sets for quads
2	Required connecting wire sets for 3 phase
3	Required connecting wire sets for quads



*If not used for the Classic these breaker locations are available for extra load breakers.

E-Panel Component location

Not all components installed on all models.

Mounting the SMA E-Panel to the wall:

This section describes the general instructions for installing components to the wall or other mounting surface. When you have completed this section then refer to the appropriate section for your model for specific instructions on wiring and wiring diagrams.

Pre-Wired systems start on Page 13.

Note: The SMA E-Panel system should only be installed with the backplate. Failure to use the backplate can result in poor alignment of system components resulting in a less reliable and non-code compliant installation.

Tools Required:
Long #2 Phillips Screwdriver
Medium slotted Screwdriver
Torque Screwdriver for electrical connections
9/16" Wrench
Large Allen wrench for inverter DC connections
Drill for pilot holes if required

Be sure to comply with all local and national code requirements including National Electrical Code, ANSI/NFPA 70. Use Class 1 wiring methods for field wiring connections to terminals of a Class 2 circuit. Select the wire gauge used based on the protection provided by the circuit breakers/fuses.

The SMA E-Panel is a type 1 enclosure suitable for installation in an indoor location protected from rain / snow etc.

When installing the system make sure to observe NEC maximum height requirements.

The system when complete will be quite heavy. Ensure that the wall can handle the weight of the system and use appropriate fasteners. Have help when positioning and mounting system components to the wall.

Mise en garde! Cet appareil est assez lourd. S'assurer que le mur peut supporter le système. C'est nécessaire d'avoir assistance pour installer le système.

High voltage is present throughout the system. Disconnect all sources of power and exercise extreme caution when working with, on or around this equipment.

Attention: Il y a haute tension partout. Débrancher toutes les sources d'alimentation et faire attention autour de le système. Lire aussi le manuel de l'inverter pour plus des informations.

Install the backplate MNESMA short BP to the selected surface using a minimum of four 5/16 lag bolts with a minimum length of 2".
The inverter should be installed before the E-Panel. Use ¼-20 bolts to attach the inverter mounting bracket, E-Panel and MNX240 (if so equipped) to the backplate. The MNX240 requires the tall backplate.

Left: MNSMA Short BP Backplate

Typical backplate installation, shown mounted on wall with the inverter mounting bracket installed (inverter mounting bracket supplied with inverter).

CAUTION: The inverter is ***extremely*** heavy. Use extreme caution when lifting the inverter. Refer to the inverter manual for safe and proper inverter installation instructions. Make sure the wall or other mounting surface can support the weight.

Encore, cet appareil est ***tellement*** lourd, sauvegarder vous-même.

Mounting the SMA E-Panel to the wall cont.:

Install the inverter mounting bracket before mounting the backplate to the wall. Use ¼-20 bolts and flat washers. Pressed in nuts are provided on the backplate.

Ensure that the inverter bracket is centered and is resting on the mounting screws (down on the screws and not slid up).

Mounting on back of inverter

The inverter rests on the tab of the inverter mounting bracket.

Caution!!
The inverter is *very* heavy. Have strong persons assist you.

Attention!!
L'inverter est *très* lourd. Avez des gens très forts vous assister.

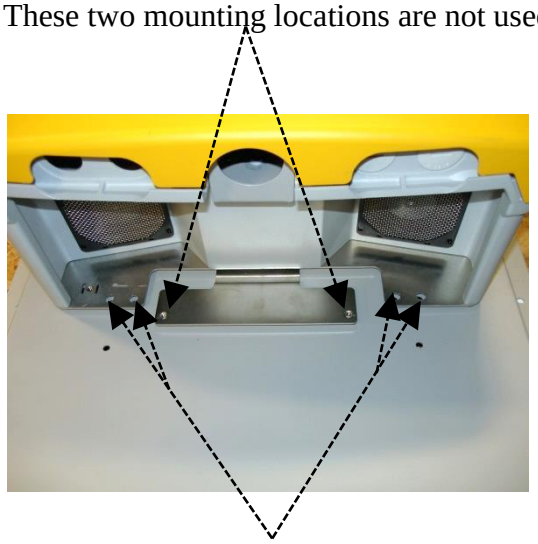
Backplate mounted to wall

Inverter mounting bracket mounted to backplate

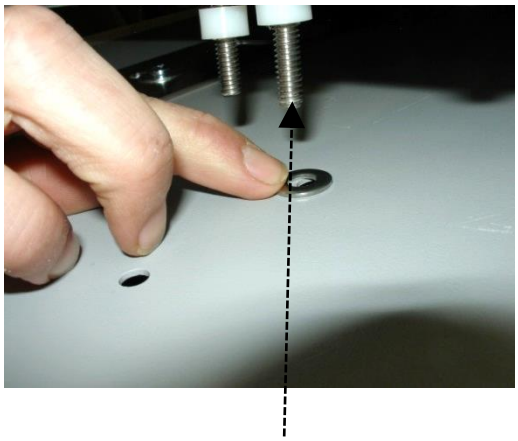
Secure inverter to bracket with the M6x10 screws provided.
Left and right sides.
Cover with fan grills provided.
The grills are marked left and right.

Mounting the SMA E-Panel to the wall cont.:

These two mounting locations are not used



Inverter lower mounting screw locations.



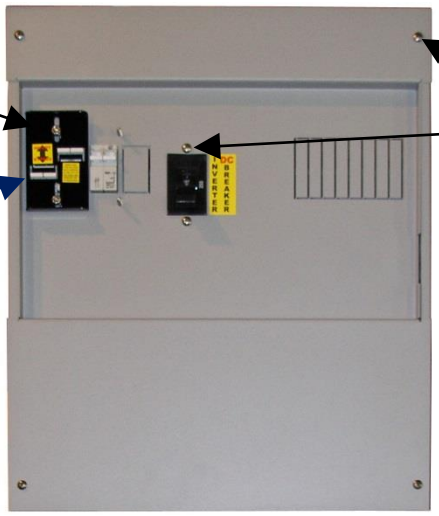
The inverter is spaced away from the back plate at the four lower mounting screws.

Inverter lower mounting screws installed

Mounting the SMA E-Panel to the wall cont.:

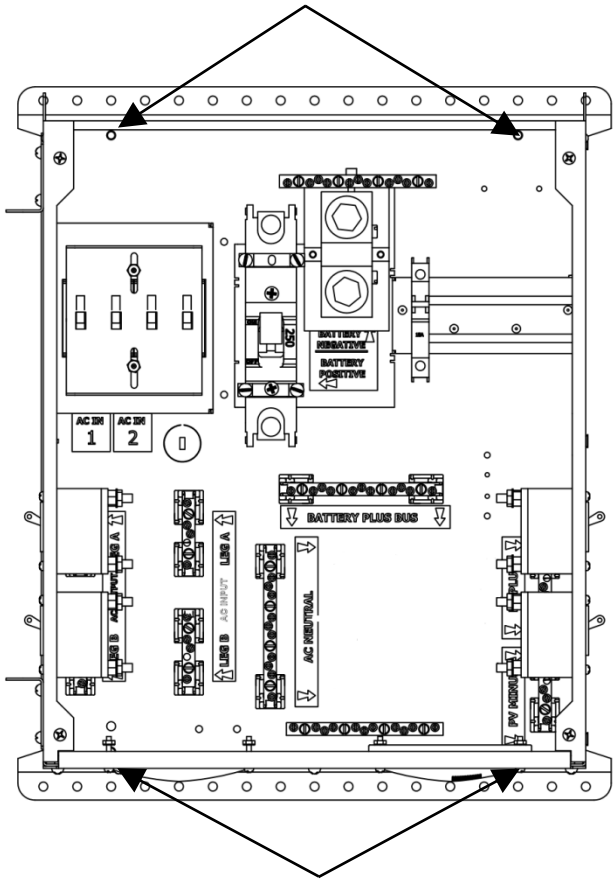
Slider

When reinstalling the deadfront ensure that the breaker handles are protruding through the slider as shown.



Remove the deadfront (metal front cover) by removing the screws in the four corners and the two on the DC disconnect breaker.

E-Panel mounting holes



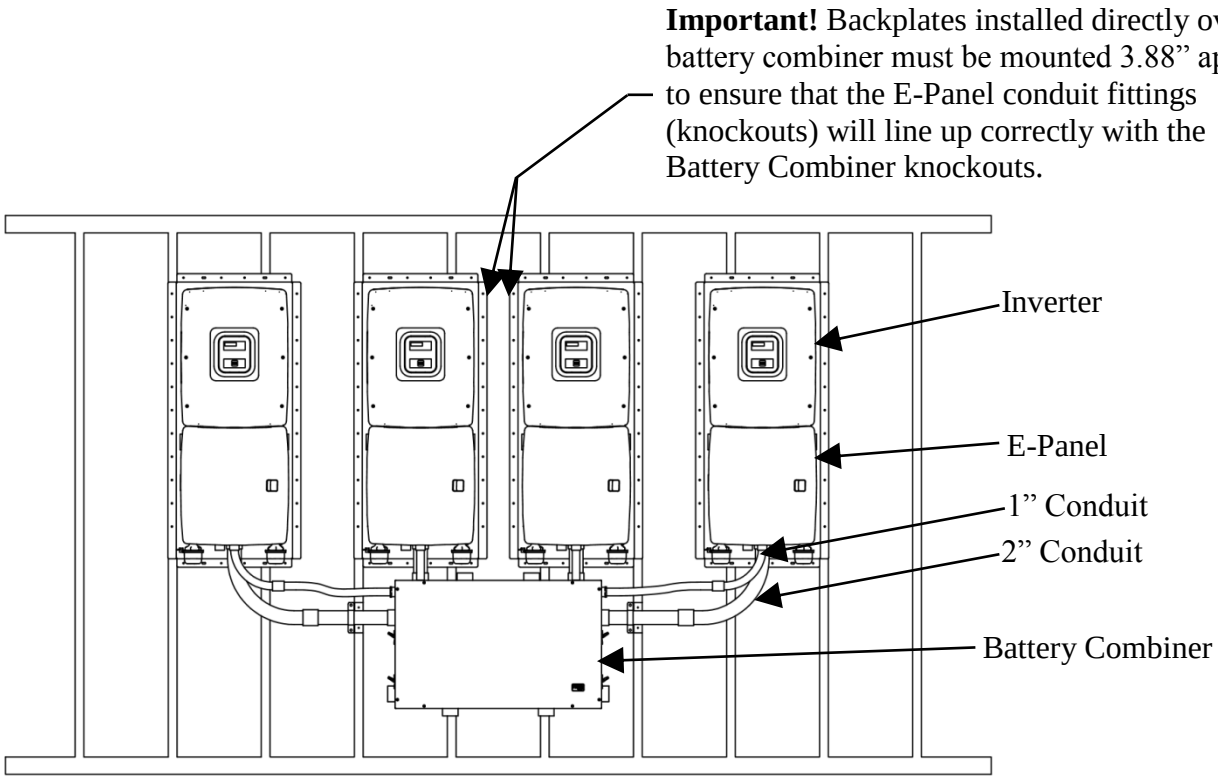
E-Panel mounting holes.

Place the E-Panel below the inverter and line up the E-Panel mounting holes with the holes in the backplate. Attach the E-Panel to the backplate with ¼-20 bolts. Pressed in nuts are provided on the backplate.

Plastic cover installation:

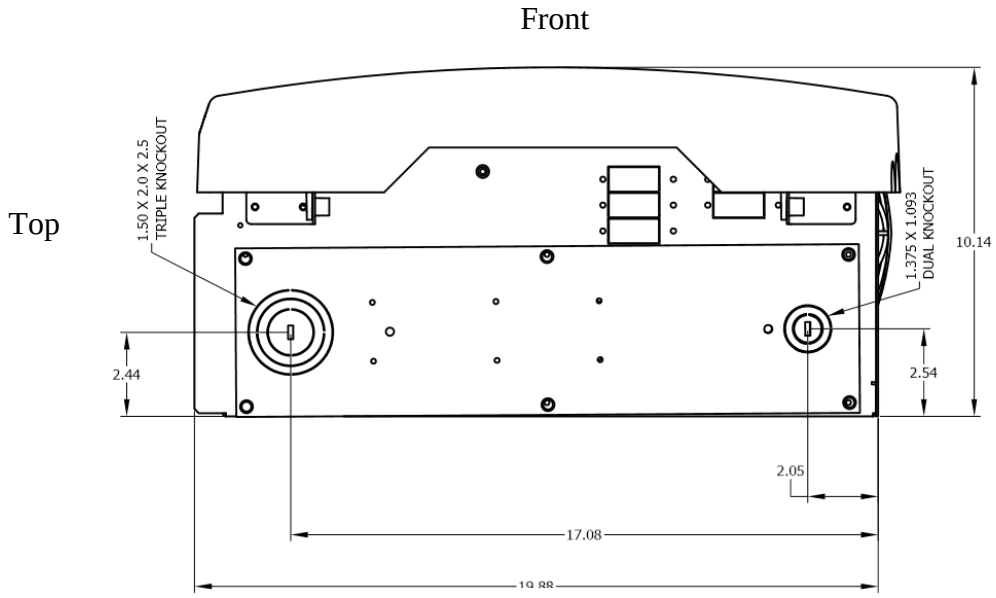
To install the cover line up both molded in hinge pins with the cover mounting brackets and slide down into position.

Mounting the SMA E-Panel to the wall continued:

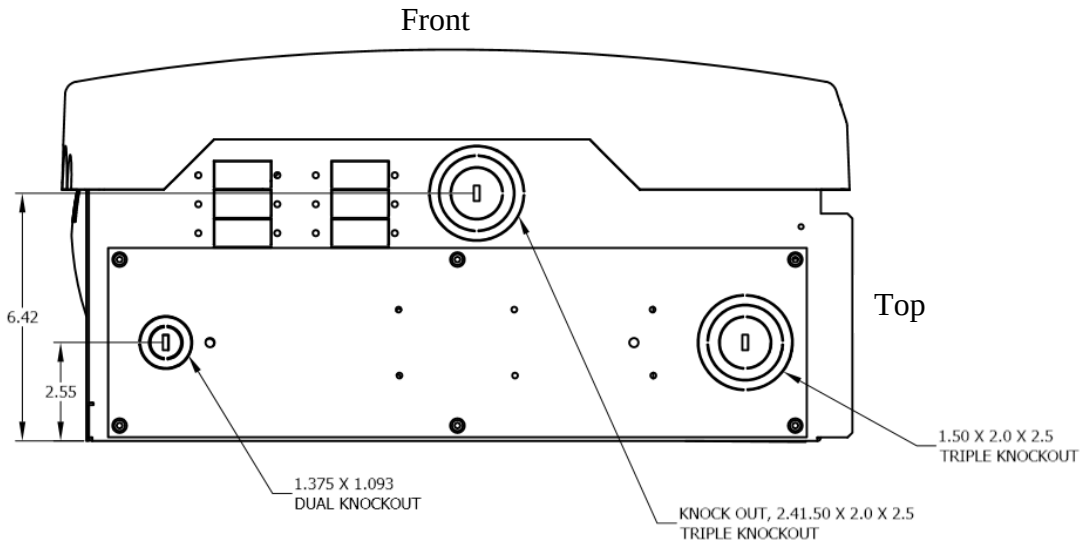


Above: Quad system with Battery Combiner.
Studs are shown for reference and are at 16” centers. If mounting on plywood use ¾” material.
Use a minimum of eight 1/4” screws per backplate.

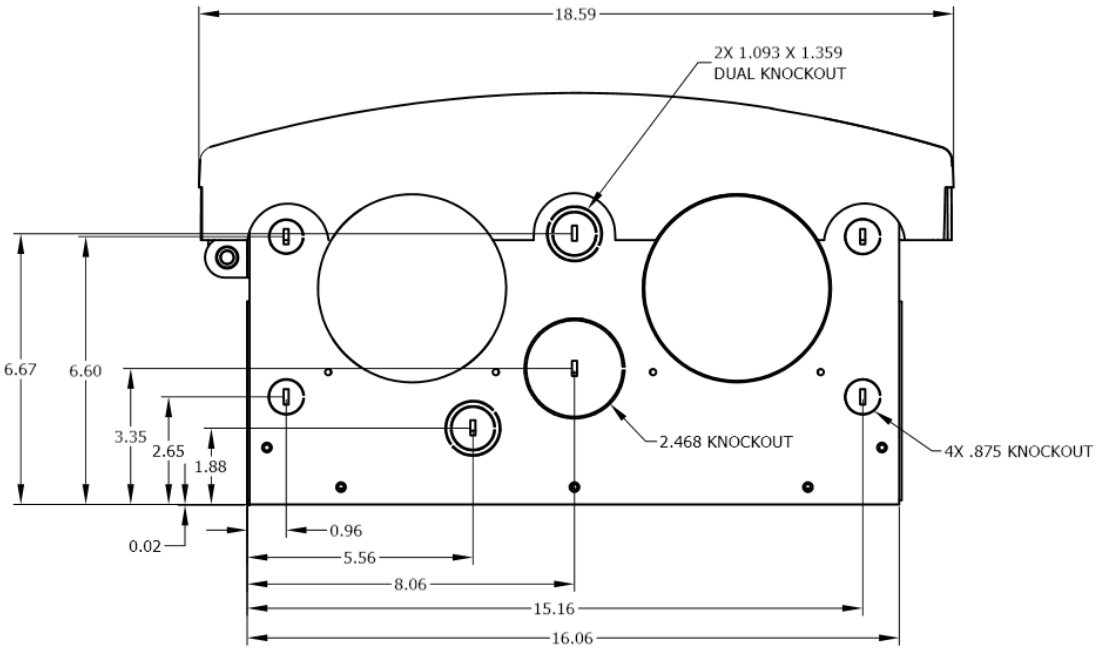
Pre-Wired Systems: Systems are available pre-assembled / pre-wired. It is not necessary to disassemble systems to mount them on the wall. One way to install a pre-Wired system is to find where the bottom of the backplate will be when installed and securely screw a 2x4 to the wall with the top just at where the backplate will be. Place the bottom of the backplate on the 2x4 and have two people tip it up into place and secure the backplate to the wall with a minimum of 8 ¼” screws at least 2” long.



Left Side knockout location



Right Side knockout location



Bottom knockout location

System wiring

The SMA E-Panel is a complex system and should be wired by a qualified electrician.

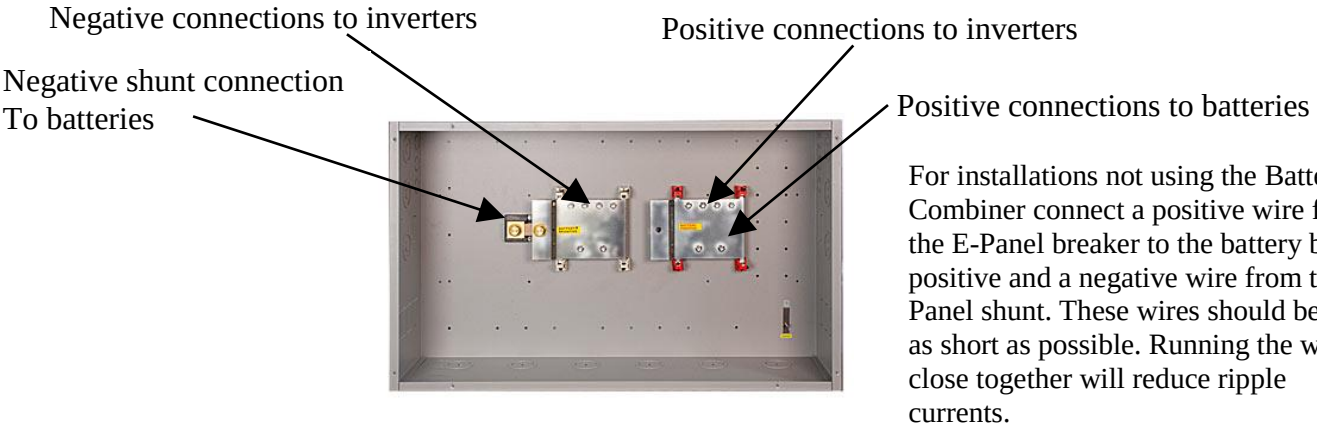
Danger: Hazardous voltages are present throughout the system. All power must be removed before attempting any wiring or maintenance of the system.

Danger: Il y a haute tension partout dans le système entière. Débrancher toutes les sources d'alimentation avant faisant des connections ou l'entretien.

The following pages contain wiring diagrams for many configurations. Follow the appropriate one for your installation such as on or off grid, AC Coupled or three phase. The diagrams below also cover single, dual and quad systems with up to 7 Classic Charge Controllers. Components sold separately. If you are unsure of any aspect of the installation contact a licensed electrician or MidNite Solar at 360.403.7207.

DC Wiring:

If using the optional Battery Combiner run 4/0 wire from the battery breaker to the positive connection in the Battery Combiner and 4/0 wire from the E-Panel shunt. It is acceptable to use black wire if the ends are clearly marked red or white as appropriate. Use copper wire of adequate gauge (Determined by breaker size) rated for a minimum of 75°C. Always use approved conduit and fittings.
Use 4/0 wire for a 250 Amp battery breaker and 2/0 for a 175 Amp battery breaker.



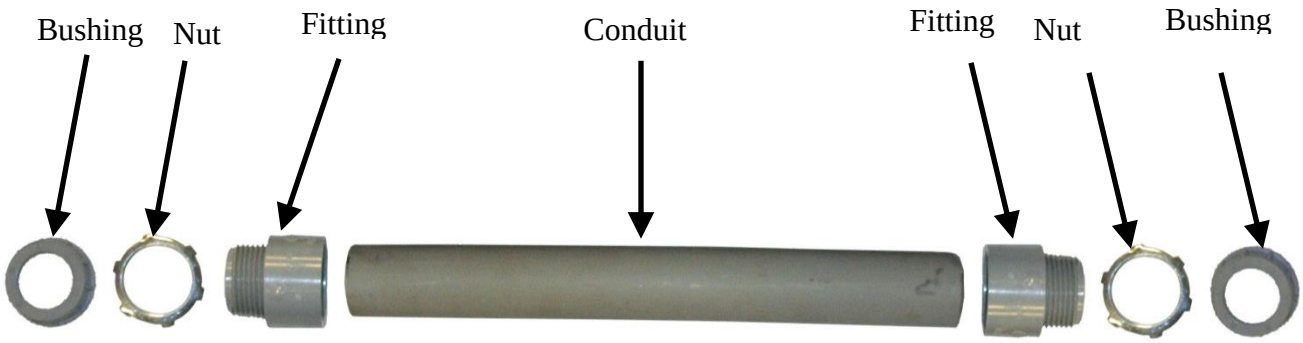
For installations not using the Battery Combiner connect a positive wire from the E-Panel breaker to the battery bank positive and a negative wire from the E-Panel shunt. These wires should be kept as short as possible. Running the wires close together will reduce ripple currents.

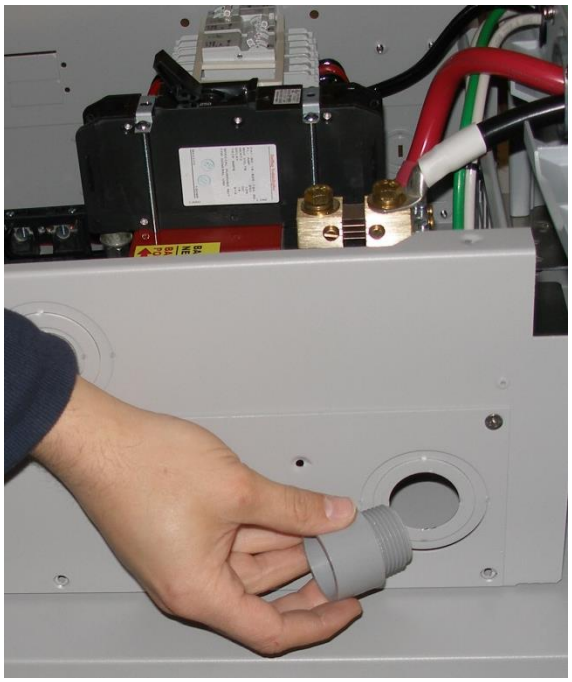
AC Wiring:

This varies greatly depending on your system configuration. The following wiring diagrams show on and off grid, with and without a generator, AC coupled and three phase systems. Please pay special attention to the information on AC coupled systems. Use appropriate conduit and fittings for a safe, reliable, code compliant system.
Slave units are shipped with red mounting blocks and covers for AC in and AC out installed. Black and blue mounting blocks and covers are included. Should you desire to change the mounting blocks and covers to match the desired wire color (L1 Black, L2 Red and L3 Blue) Simply pull the cover off, press the retaining tab on the mounting block to release the terminal block and remove the terminal block. There is a Phillips screw in each mounting block. Remove and retain the screw. Using the new color reverse the process to reinstall. Note: Use caution when tightening the screws. The chassis can be stripped if the screws are over-tightened. Should this occur then use a slightly longer #10 screw and a #10 nut from behind.
A single neutral to ground bond is required on all systems per NEC. Note that in a power back up system on a utility connected home, a bonding wire would not be installed in the E-Panel as it would already be bonded at the service entrance. On off-grid installations that employ a sub panel circuit breaker box, you can make this neutral to ground bond in the sub-panel. It is technically better to make this bond closest to the source of power (the E-Panel), but many electrical inspectors will be looking for it in the sub-panel box. It will work just fine in either location, just make sure you have adequate conductor sizes between the E-Panel and the sub-panel

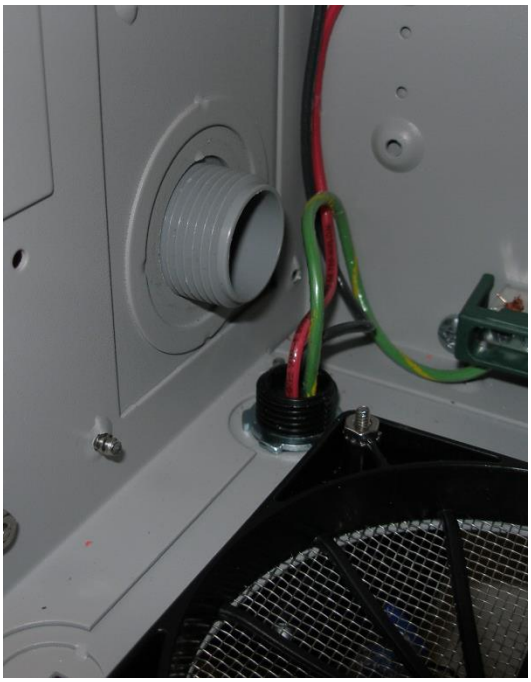
INSTALLING CONDUIT BETWEEN E-PANELS:

Conduit and fitting parts





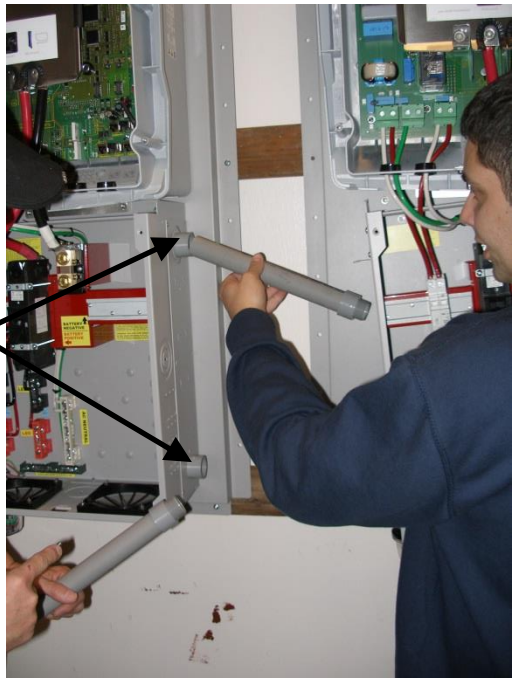
With one inverter installed, remove the top and bottom knockouts (see image next page) that face the other E-Panel and push one of the fittings from the outside through the knockout opening into the E-Panel.



Inside the E-Panel, secure the fitting with one of the nuts and a bushing

These instructions are for installing the supplied conduits and fittings in a system with a Battery Combiner.

Knockouts Removed

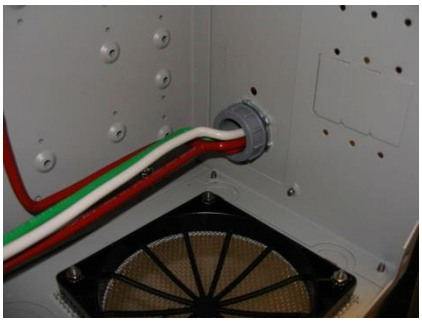


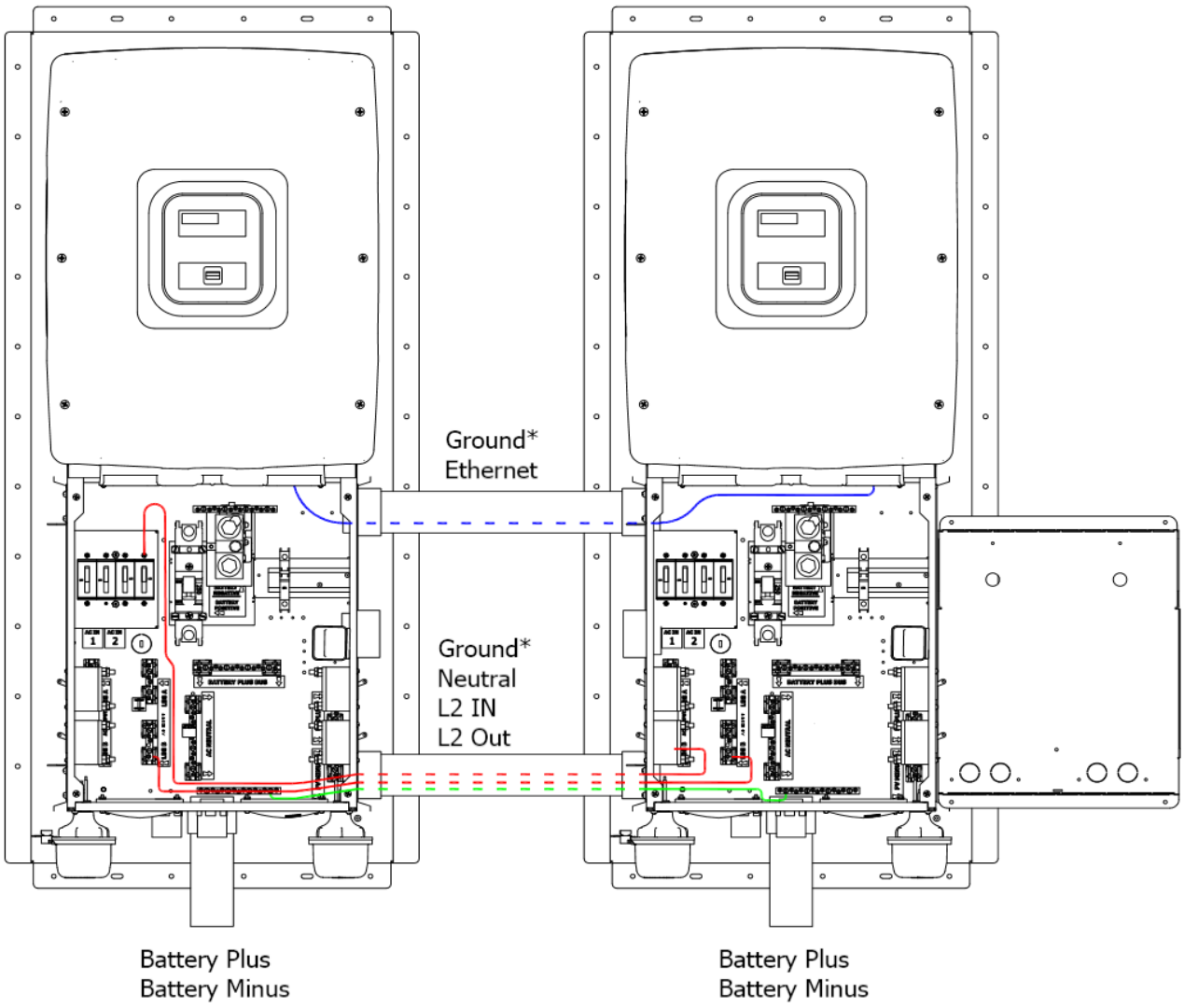
Place a fitting on one side of a conduit and insert the other end of the conduit into one of the fittings installed in the previous step.

Remove the facing knockouts on the second inverter. Move the second E-Panel into place. Secure the E-Panel to the wall then, secure the conduits with a nut and bushing.

Make sure to use the bushing. It is there to protect the wiring.

Conduit installed and ready for wiring





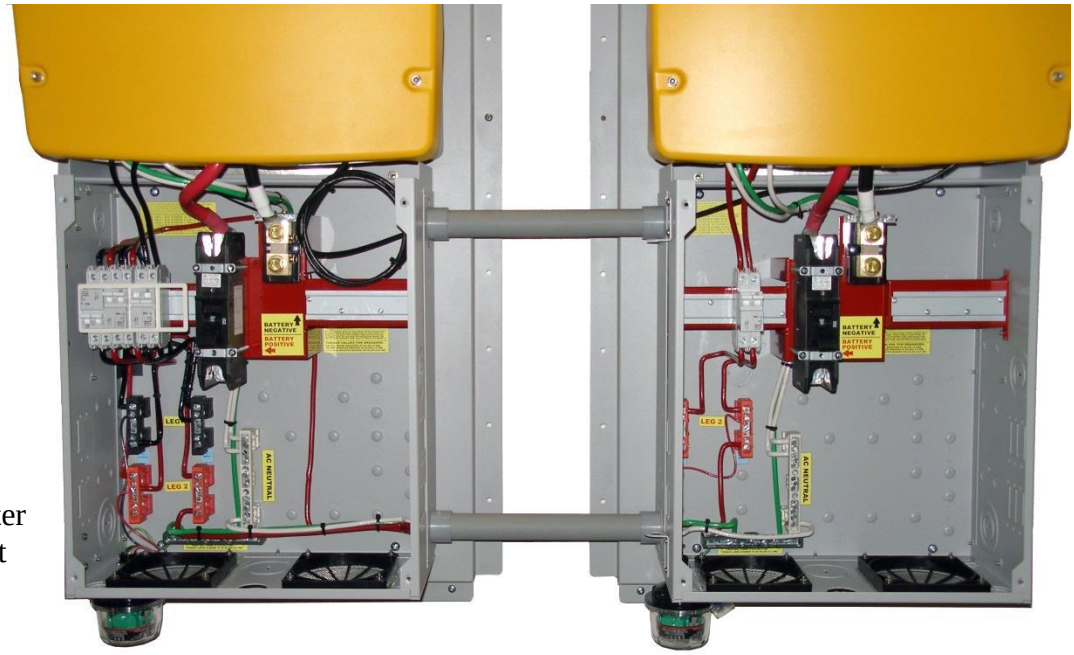
Typical wire routing between E-Panels.

Refer to the appropriate wiring diagram for your system.
In the example above L2OUT goes from the transfer breakers on the master to the L2OUT busbar on the slave unit, L2IN goes from the L2IN busbar on the master unit to the L2IN busbar on the Slave unit, all in the lower conduit. The ground can be in either conduit as is convenient. The inverter communication cable is routed through the upper conduit.

*Ground wire may be routed through either conduit.
Power and communication wiring should be kept separate.

Installing conduit between Inverters continued.

Master unit



Slave unit

Inverter wiring and wiring between E-Panels complete. Ready for AC/DC in and out connections.

AC Coupled Systems.

AC coupling allows a grid-tie system to also provide backup power during an outage. Grid tied systems are required to stop sending power to the grid immediately upon a power failure. This is for the safety of the linespersons effecting repairs as well as others who may encounter downed lines. Most inverters shut down completely at this point leaving you in the dark while your array or turbine are producing unused power.

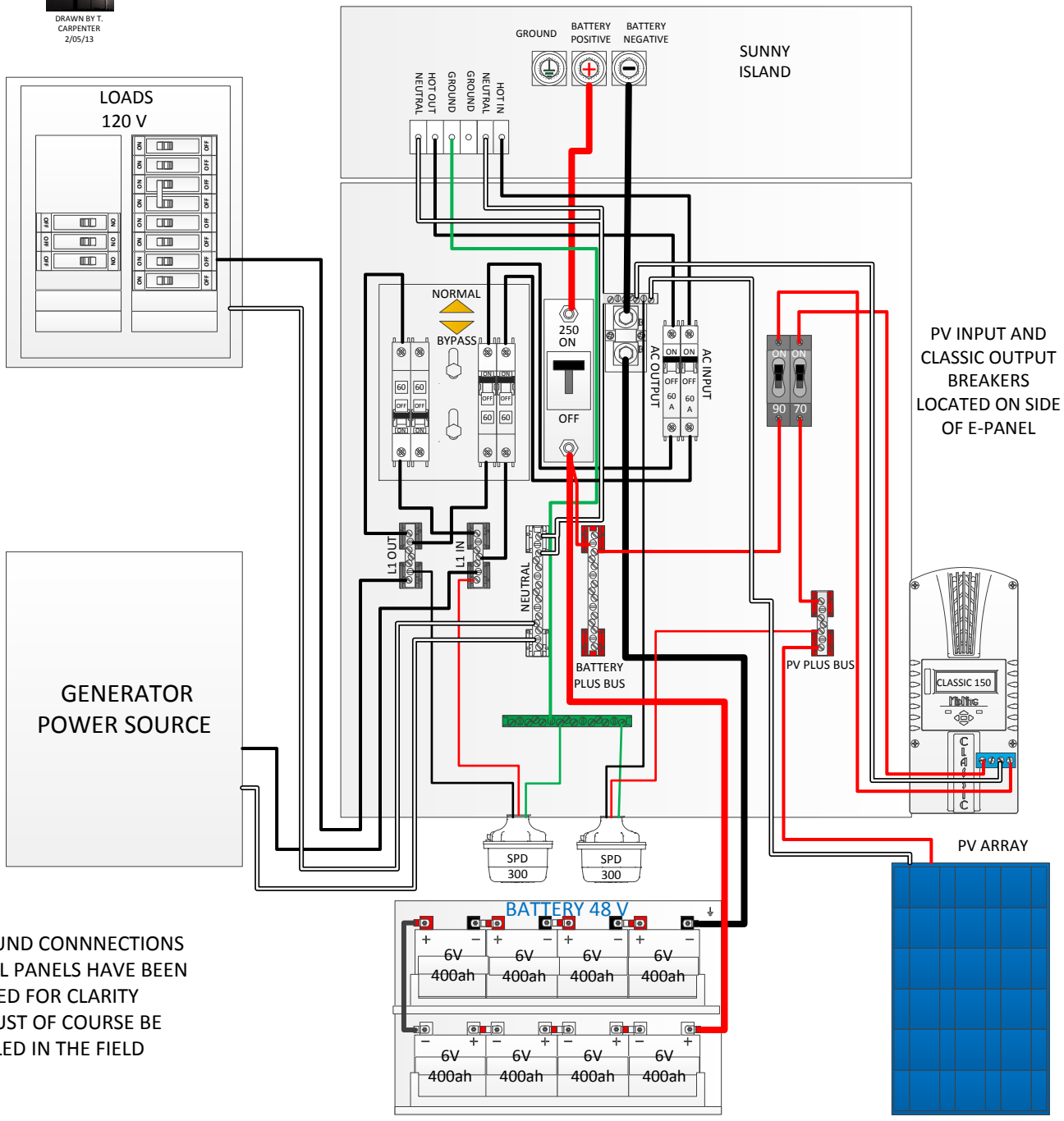
In an AC Coupled system when the power fails the inverter is disconnected from the grid but continues to supply power to the critical loads panel. The array or turbine continue to send their power to the batteries for charging or running loads. The SMA Inverter used in this system is particularly adept at this form of coupling giving you the best of both worlds of grid-tie and power backup.

Generator hookup to a standalone system vs. an AC coupled system.

- **Off Grid** the generator goes to the AC input on the inverter.
- **Utility connected non grid tie system** the generator and inverter go to a switch (Not included) so that the inverter is fed by the grid or the generator. This may be automatically or manually switched depending on the system.
- **AC coupled grid tied single system** the generator then goes through the normally open contacts of a relay (sold separately) and then to the inverter.
- **Off Grid** the generator goes to the AC input on the inverter.
- **Utility connected non grid tie system** the generator and inverter go to a switch (Not included) so that the inverter is fed by the grid or the generator. This may be automatically or manually switched depending on the system.
- **AC coupled grid tied single system** the generator then goes through the normally open contacts of a relay (sold separately) and then to the inverter.

SMA SUNNY ISLAND OFF GRID SYSTEM WITH SINGLE CLASSIC CHARGE CONTROLLER

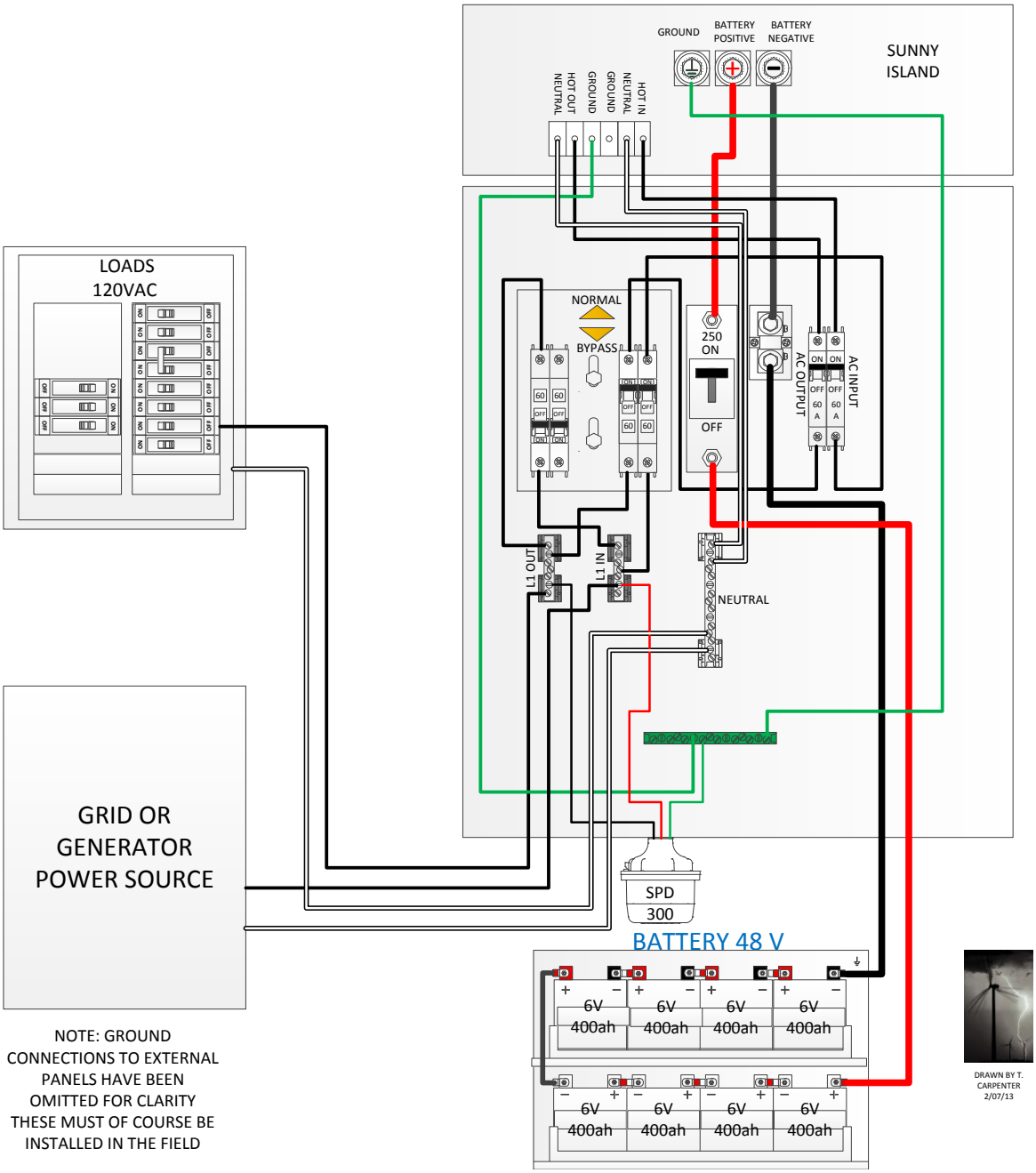
DRAWN BY T. CARPENTER 2/05/13



NOTE: GROUND CONNNECTIONS TO EXTERNAL PANELS HAVE BEEN OMITTED FOR CLARITY THESE MUST OF COURSE BE INSTALLED IN THE FIELD

Typical complete off grid system with one MNE250SMA-OG and one Classic charge controller. Parts sold separately.

SMA SUNNY ISLAND OFF GRID HYBRID
BATTERY / GENERATOR OR GRID CONNECTED UPS SYSTEM

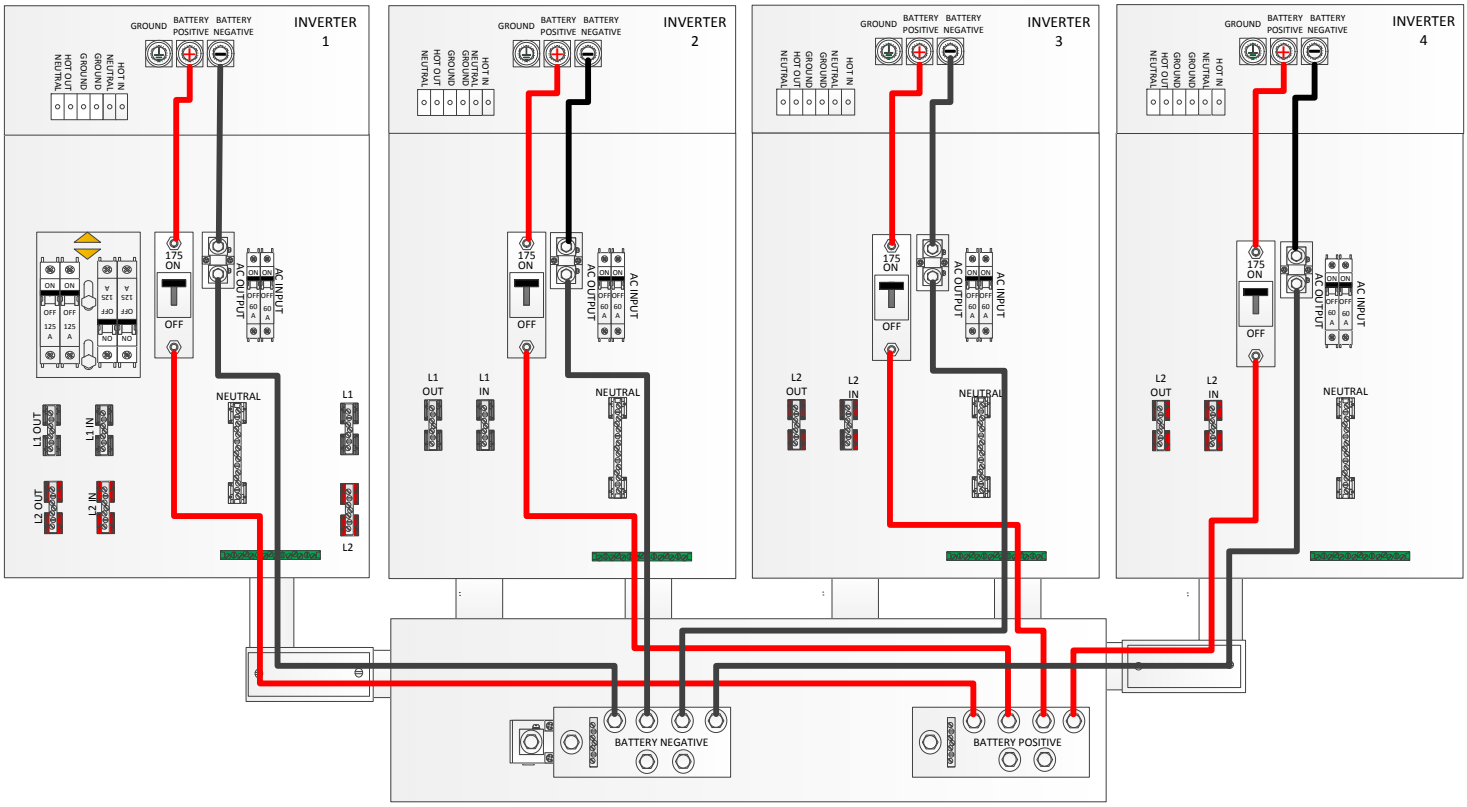


NOTE: GROUND CONNECTIONS TO EXTERNAL PANELS HAVE BEEN OMITTED FOR CLARITY THESE MUST OF COURSE BE INSTALLED IN THE FIELD

Typical UPS system. MNE250SMA-AC. Works with grid or generator.
Parts sold separately.

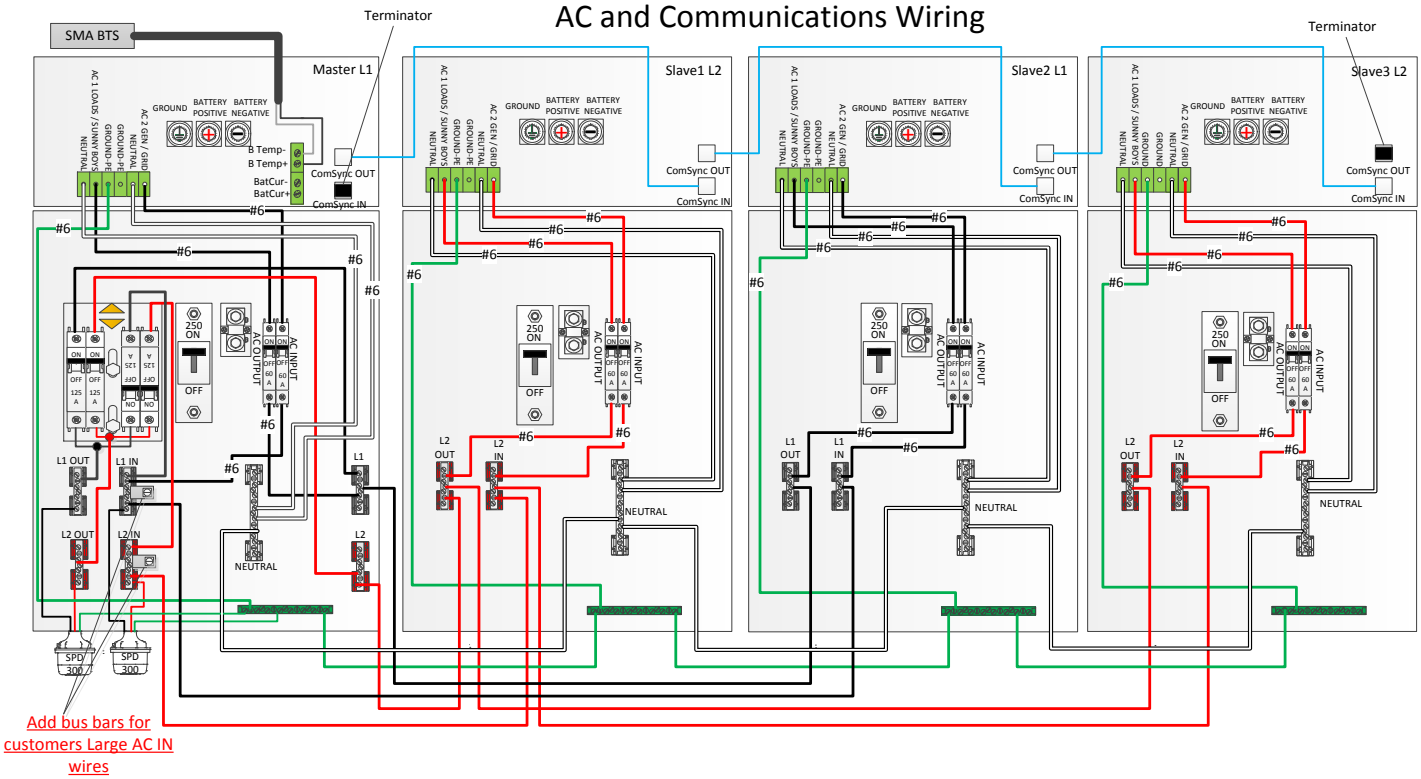
DRAWN BY T. CARPENTER 1/3/12

SMA QUAD STACK WITH BATTERY COMBINER / DISTRIBUTION BOX DC WIRING



Typical complete quad stack system. MNE250SMA-QUAD-MSTR and MNE250SMA-SLAVEs DC wiring shown here. Parts sold separately.

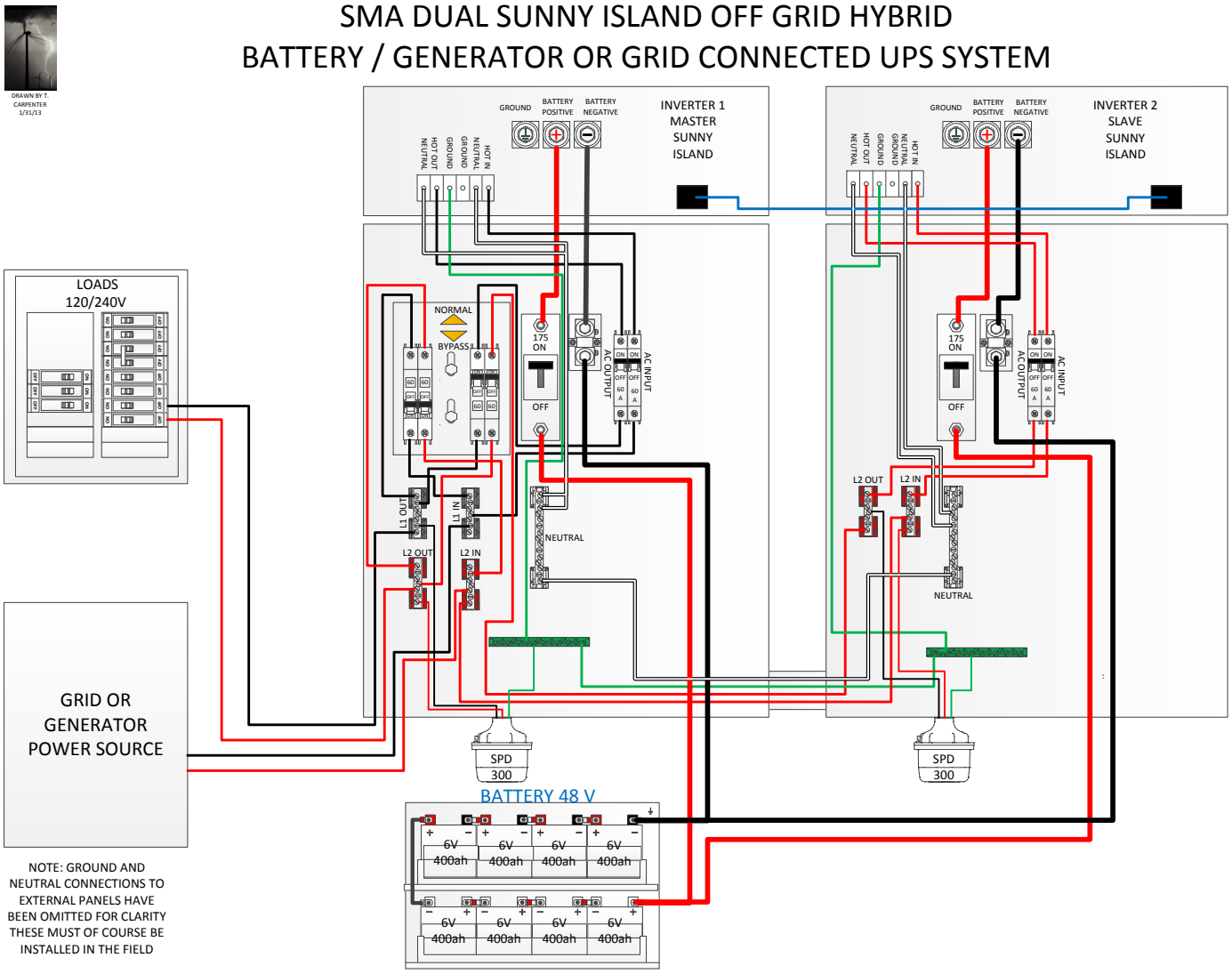
MNSI6048-QUAD REVE 12/17/15
AC and Communications Wiring



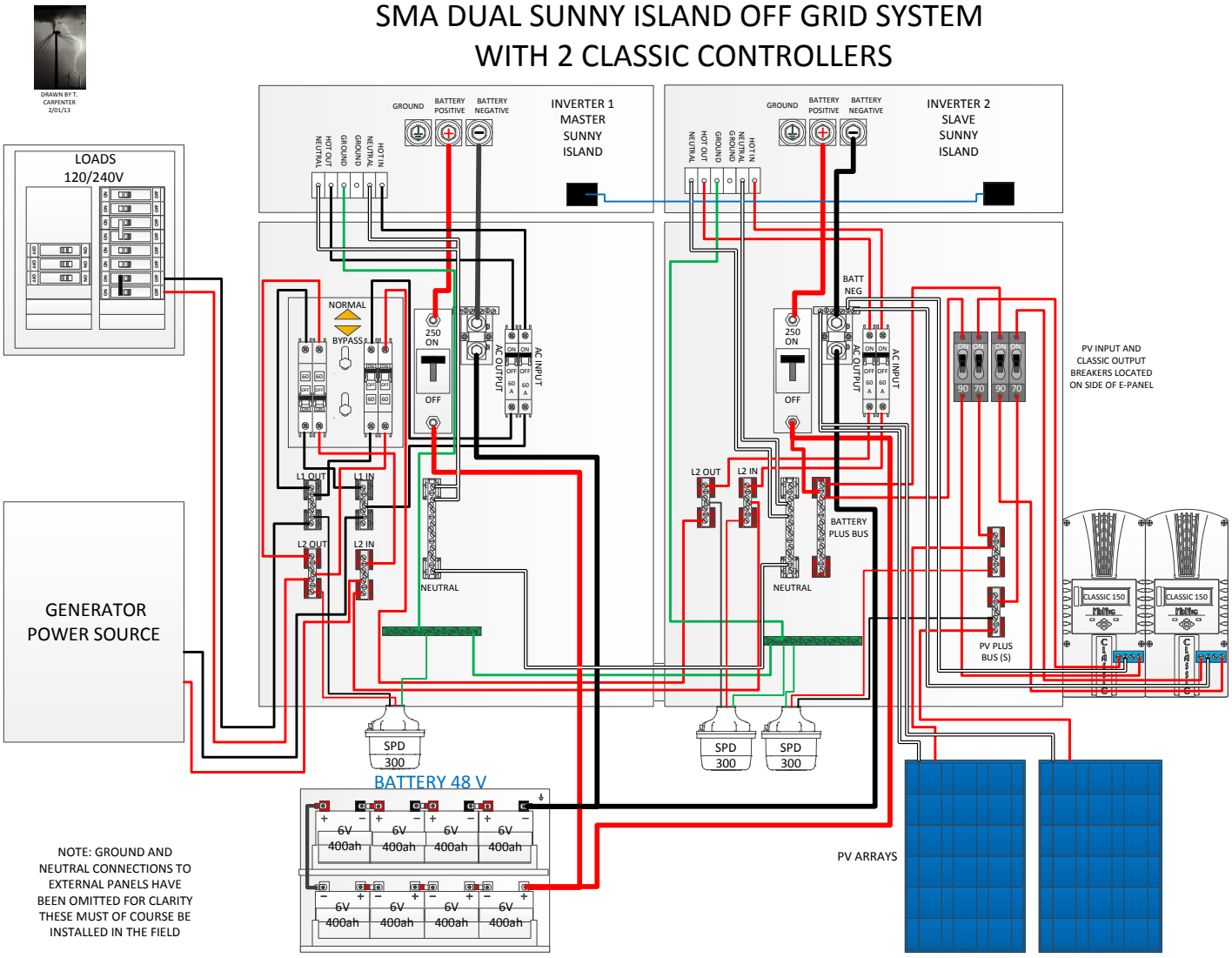
ALL AC WIRING IS #2 UNLESS MARKED OTHERWISE.

BASICALLY ALL WIRES FROM EACH INDIVIDUAL INVERTER WILL BE #6 AND ALL OTHERS ARE #2

Typical complete quad stack system. MNE250SMA-QUAD-MSTR and MNE250SMA-SLAVEs AC wiring shown here. Parts sold separately.



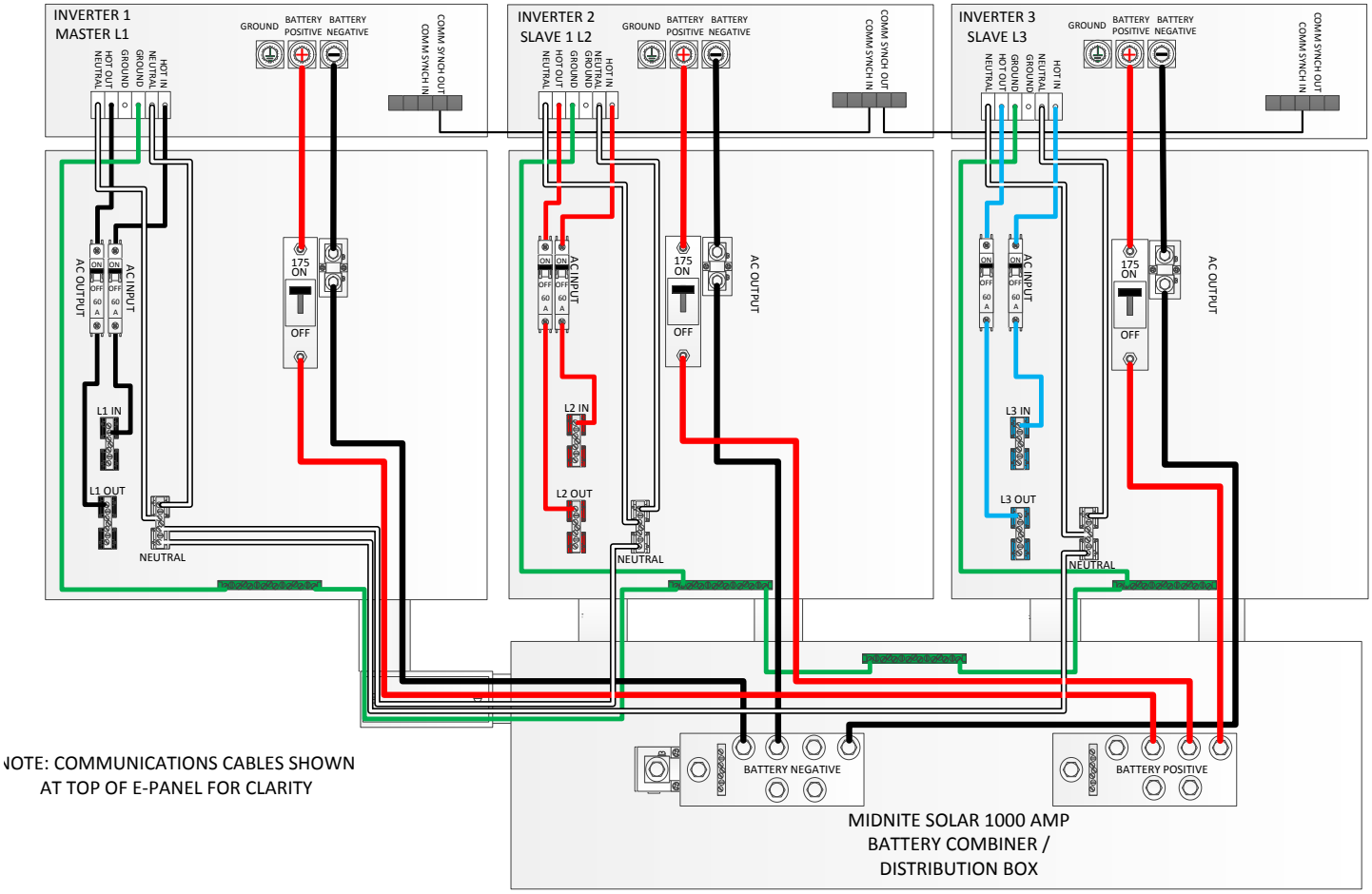
Typical complete dual system. Parts sold separately.



Typical complete off grid system with an MNE250SMA-OG/AC DM. an MNE250SMA-SLAVE and two Classic charge controllers. Parts sold separately.

DRAWN BY T. CARPENTER
02/18/13

SMA 3 PHASE WITH BATTERY COMBINER / DISTRIBUTION BOX NO BYPASS SWITCH

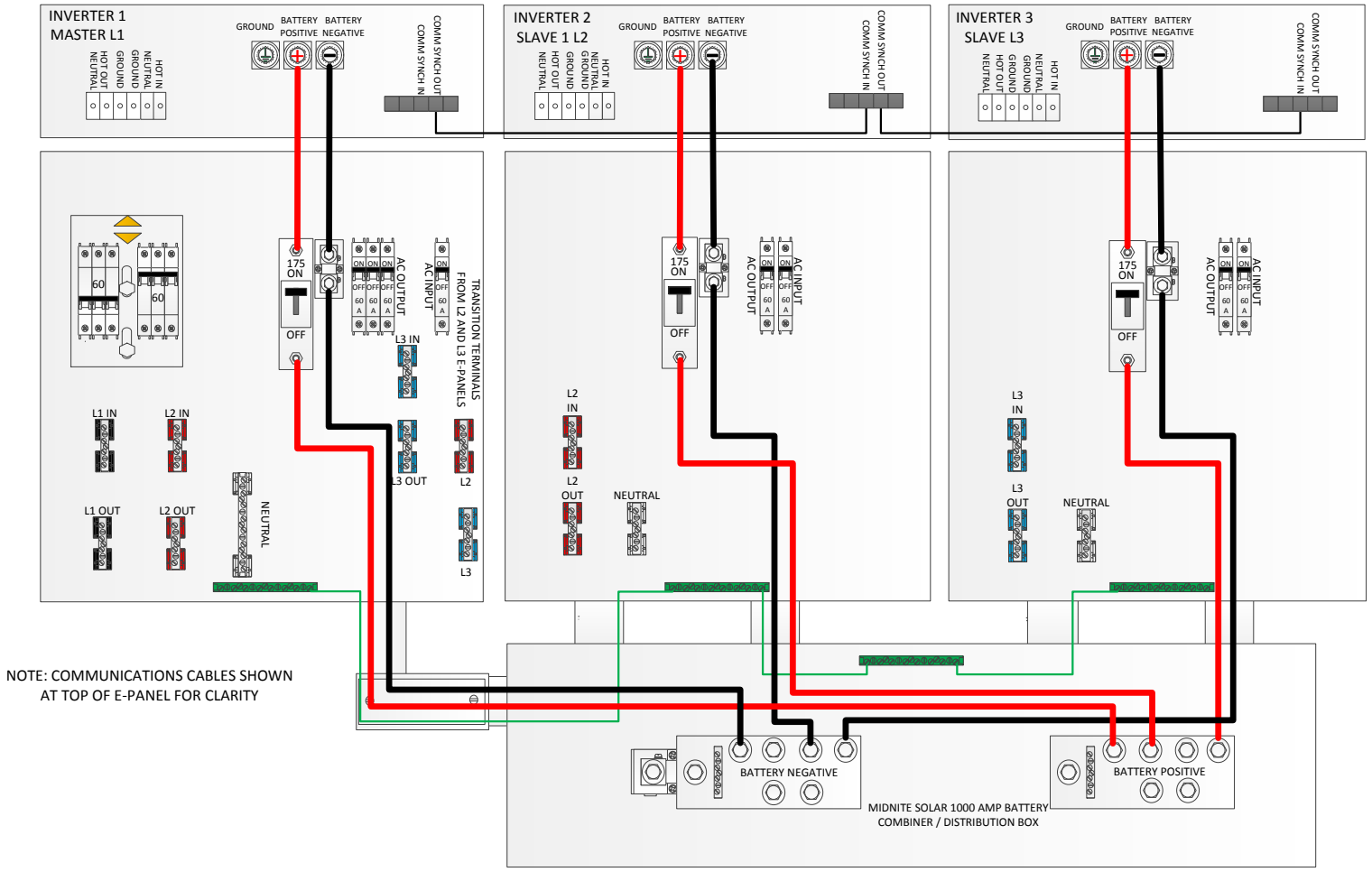


NOTE: COMMUNICATIONS CABLES SHOWN AT TOP OF E-PANEL FOR CLARITY

Typical complete three phase system with MNE250SMA-3PH Master, Two MNE250SMA-SLAVEs and a MidNite Battery Combiner. Parts sold separately.

DRAWN BY T. CARPENTER 02/05/13

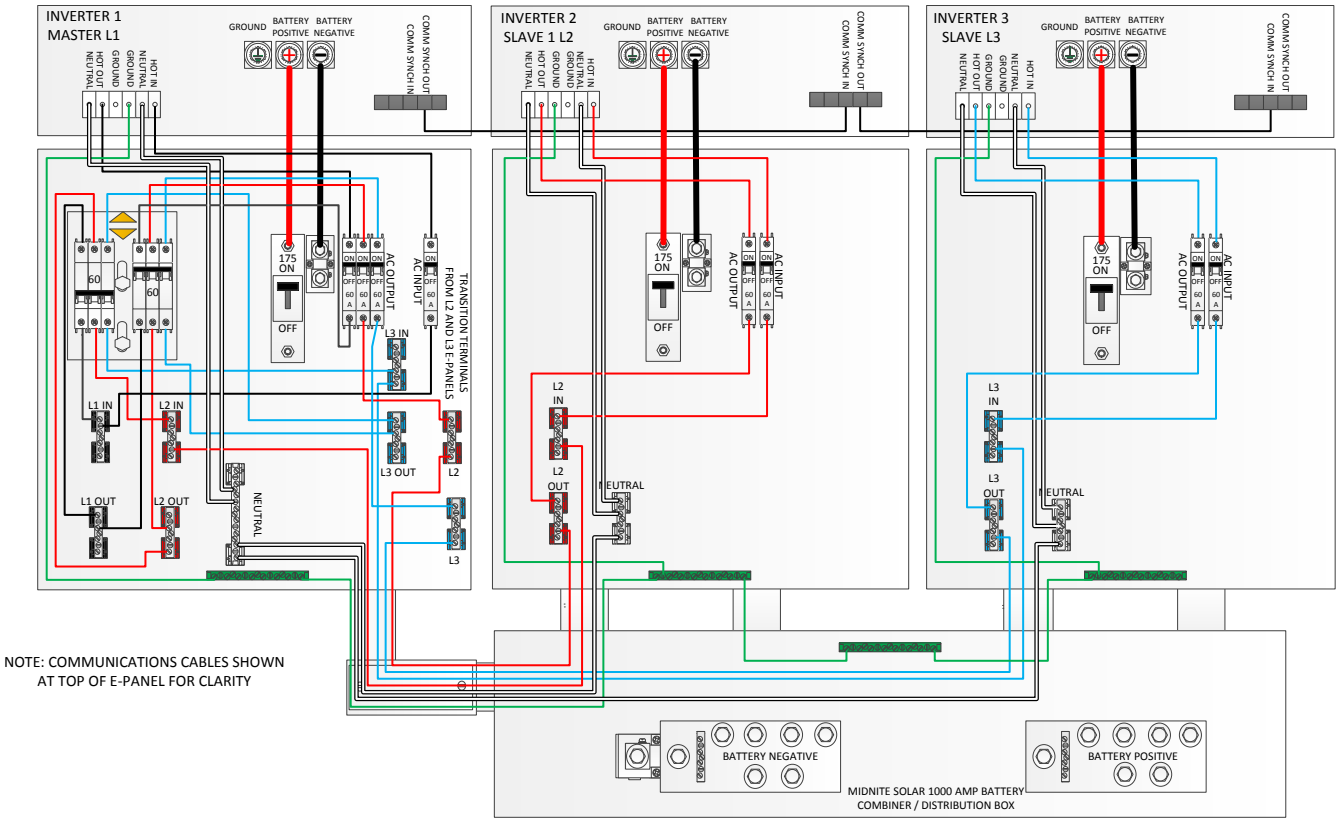
SMA 3 PHASE WITH BATTERY COMBINER / DISTRIBUTION BOX DC WIRING



Typical complete three phase system with MNE250SMA-3PH Master, Two MNE250SMA-SLAVEs and an MidNite Battery Combiner. Parts sold separately.

DRAWN BY T. CARPENTER
01/18/13

SMA 3 PHASE WITH BATTERY COMBINER / DISTRIBUTION BOX AC WIRING



Typical complete three phase system with MNE250SMA-3PH Master, Two MNE250SMA-SLAVEs and an MidNite Battery Combiner. Parts sold separately.

Torque for electrical connections on all E-Panels

Torque small busbar screws to 20-30 IN-LBS (2.3NM)
Torque large busbar screws to 45 IN-LBS (5.1 NM)
Torque Dinrail circuit breakers to 20 IN-LBS (2.3NM)
Torque battery disconnect breaker to 15 Ft-Lbs (20.4NM)

Classic Charge Controller - Optional accessory

The Classic MPPT Charge Controller helps you get the most from your power source as well as providing ground fault and arc fault protection.

A Quad system may have up to seven Classic Charge Controllers.

WARNING: Shock hazard. Disconnect the batteries and input power (PV, Hydro, Wind ETC.) before opening the Classic front cover.

Note: When two or more Classics are paralleled onto one DC Source a blocking diode must be used between each Classic and the input source to isolate each Classic from other ones.
The Classic should be wired by a qualified professional and needs to meet all applicable electrical codes. Always make sure all source and battery circuits are de-energized and wait 5 minutes before working on the wiring in the Classic. The Classic has 2 common (negative) terminals. Therefore, only one negative conductor is required to run from the E-Panel and terminate on either (or both) common negative terminal. The Positive DC source wire goes to the **PV+ Turbine+** screw. The Positive Battery DC wire goes to **battery +** terminal.
Torque the terminal screws to the specs below.

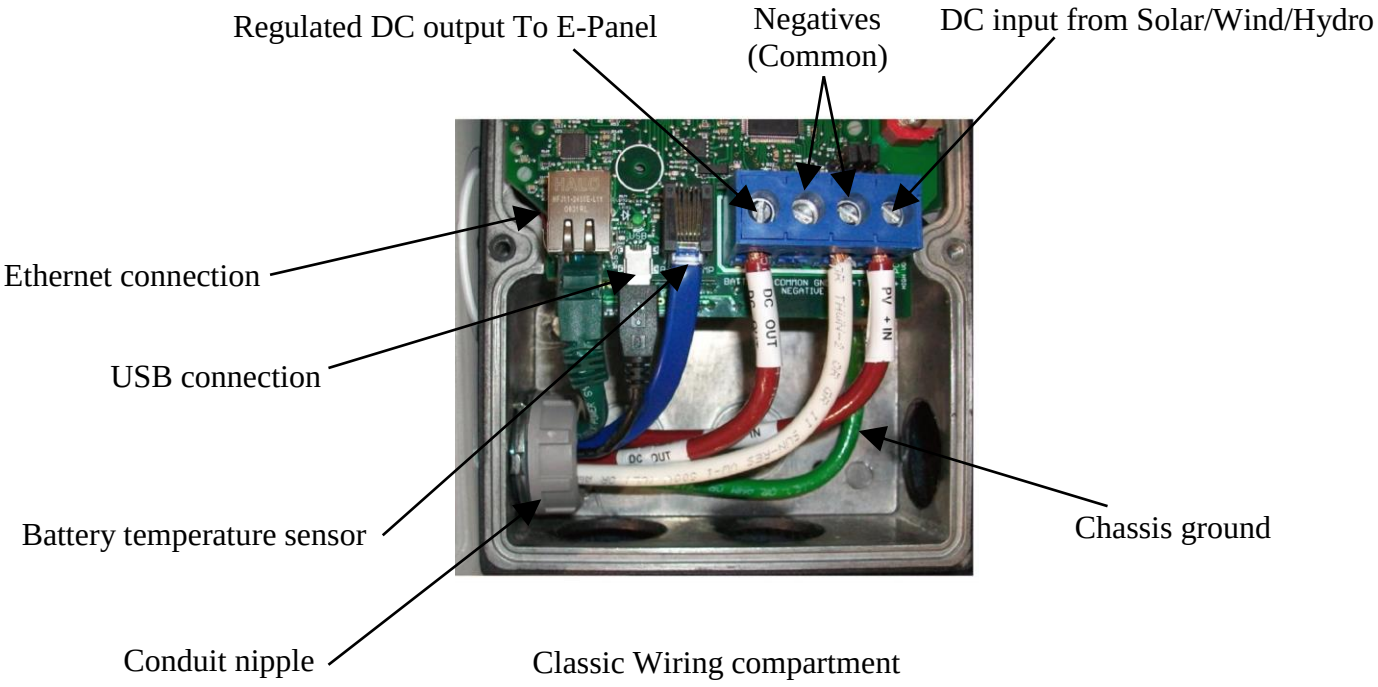
The Torque specs on the DC terminal connector (big blue terminal connector) are:

- Up to #10 AWG torque to 25-35 inch pounds.
- #8 AWG torque to 30-40 inch pounds.
- #6 AWG or larger torque to 40-50 inch pounds.

Installing and Wiring the Classic Charge Controller:

The MNCCP Dual Classic Mounting Plate (Sold separately) holds two Classics and is used with MidNite E-Panels.
The MNCCP Dual ships with the MNCCCK Close Nipple Kit and three 10 x 3/8 Flathead screws.
The three screws are for attaching the MNCCCP bracket to the E-Panel. A knockout is provided that lines up with the wire exit of the Classic.
The MNCCB-L and MNCCB-R each hold one charge controller. Specify MNCCB with an L for left and an R for mounting to the right of the E-Panel respectively. A conduit nipple is not supplied with the single bracket. Order the MNCCCK if the close nipple and locknuts and insulating bushing are required.

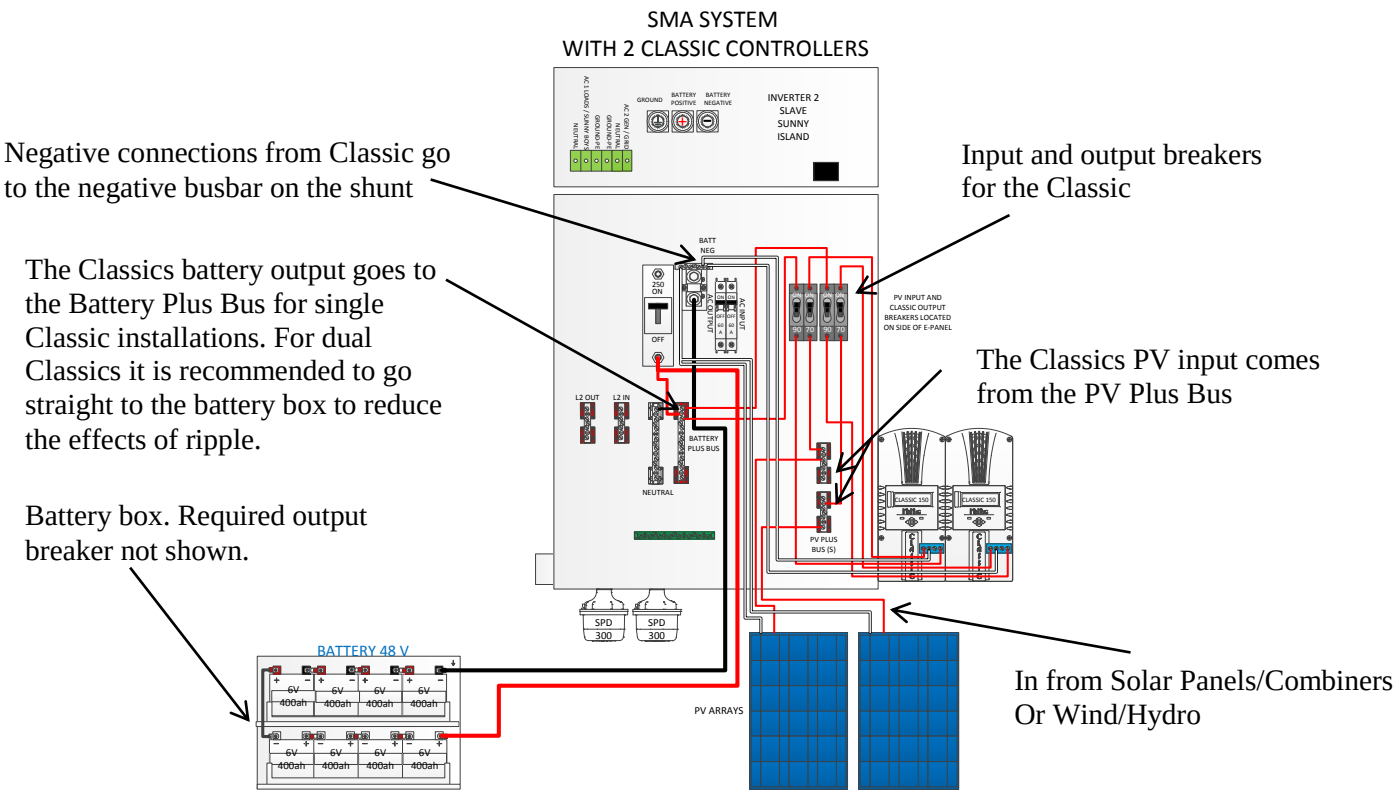
On the next page is the layout of the Classic wiring compartment.
Besides the DC in and out there may be network, USB, Aux and battery temp sensor wires. These wires should be run in a separate conduit when possible to reduce noise on the signal lines. They may use the same knockout as the other wires.



Above: Basic wiring connections to the Classic.
When selecting wire and breakers for the Classic (or any device) remember that the breakers are there to protect the wiring, not the equipment.

Refer to Appendix C for breaker and wire sizing or the Classic Charge Controller.

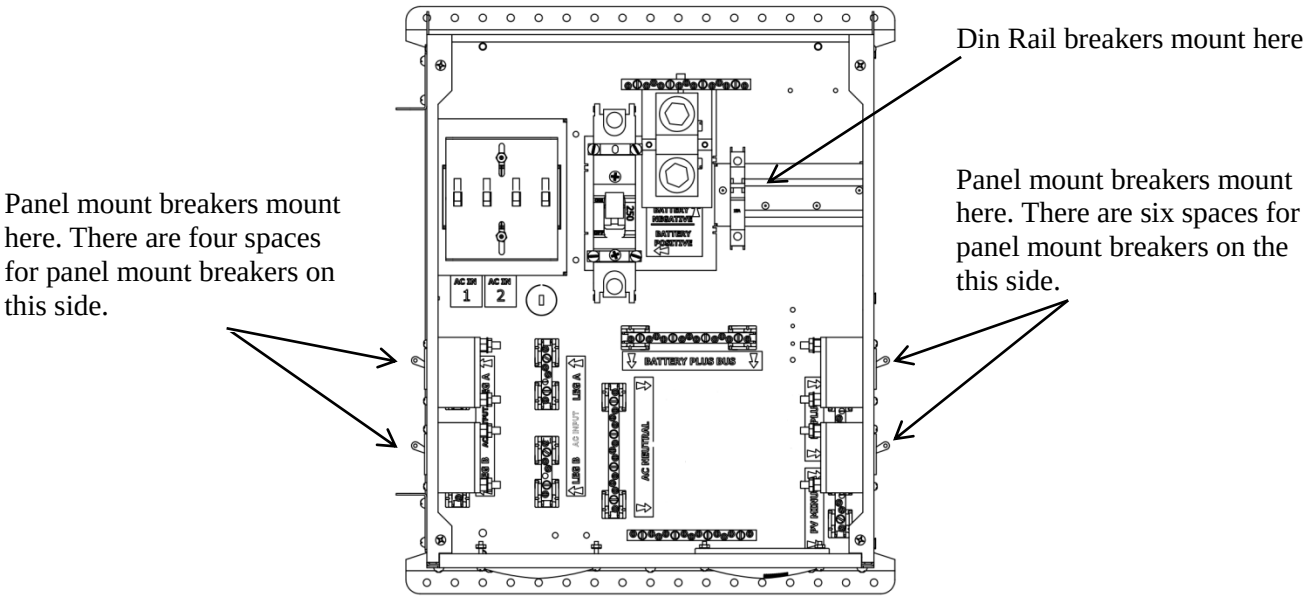
When two Classics are mounted on a dual bracket, the wires of the outer Classic pass through the inner Classic.

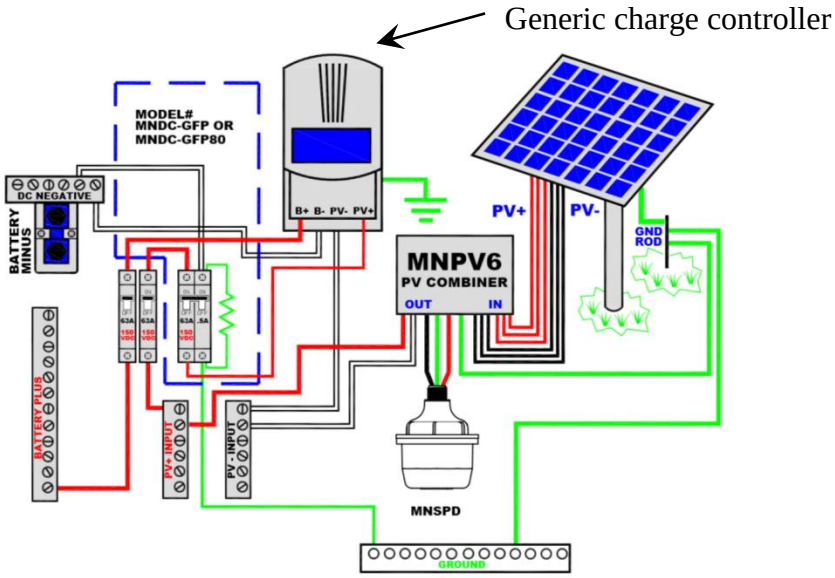


Above: a slave unit with two Classics. Other wiring removed to show charge controller wiring.

Each Classic requires an input and an output breaker. Breakers are available from MidNite Solar in Dinrail style up to 63 Amps / 150 Vdc and in panel mount up to 100 Amps / 300 Vdc.

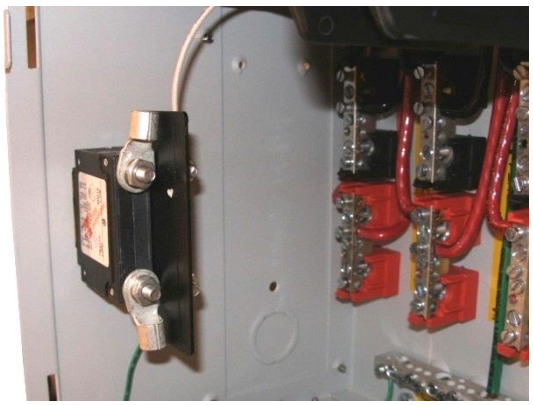
Either type of breakers can be easily used in the E-Panel.
Below: Breaker locations for charge controllers or general use are shown. Din Rail and panel mount.





Single DC-GFP Wiring.

The MidNite Solar Classic charge controller has the DC-GFP plus arc detection built in and does not require an external DC-GFP



80 amp panel mount DC-GFP ready for the high current wires.

63 amp din rail DC-GFP wired with a 63 amp PV disconnect and a 63 amp controller output breaker.

The DC-GFP device monitors current flowing between battery negative and earth ground and will trip when more than ½ amp is present. There should be no current flowing in this circuit under normal circumstances.

In the event your DC-GFP trips, it is usually on a new installation. One of two things is happening. 1: There is an actual ground fault in the wiring, or 2: there is an excess of current flowing through the large 63 or 80 amp breaker. Be sure to **check your wiring**! Refer to the wiring diagrams in these instructions.

The wiring diagrams show a PV disconnect breaker connected directly after the PV array + busbar and before the DC-GFP. It doesn't matter which order these two devices are connected. The DC-GFP can be connected to the Array plus output before the PV disconnect just as well.

Make sure that the polarity of all DC dinrail breakers is correct. MidNite Solar panel mount breakers are not polarity sensitive. The din rail mount breakers have a + sign at the bottom terminal. The + connection needs to be connected to the most positive point in the circuit.

The output of the PV charge controller also requires over-current protection. Most installations will use either a 63 amp din rail mount breaker (observe polarity) or an 80 to 100 amp panel mount breaker. Use a red 6AWG wire for the 63 amp breaker and 4AWG wire for an 80 or 100 amp breaker. The charge controller output breaker must be sized large enough for the expected output. You can always use a larger breaker and wire than the array output though. The breaker is there to protect the wire, not the controller, so you can use a 63 amp breaker even if the controller is not capable of outputting more than 30 amps.

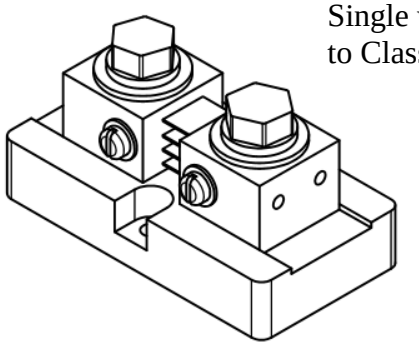
Classic Arc Fault Detector: If your system includes a Classic charge controller then Arc fault protection is provided for the system. The Arc Fault Detector is a unique safety component built into every Classic charge controller. Because safety is not an option, MidNite Solar responded to the 2011 NEC code requirements by adding arc fault detection as standard. The Classic is the first charge controller in the world to successfully stop a series arc. The Classic can detect an arc in less than 100mSec. From low power arcs to devastating high power arcing, the Classic will detect and shut down with an audible and visible alert to announce that there is a problem in the PV side of the system. A manual reset is required after clearing the fault. Refer to the Classic charge controller manual for more information.

Battery Combiner Optional accessory

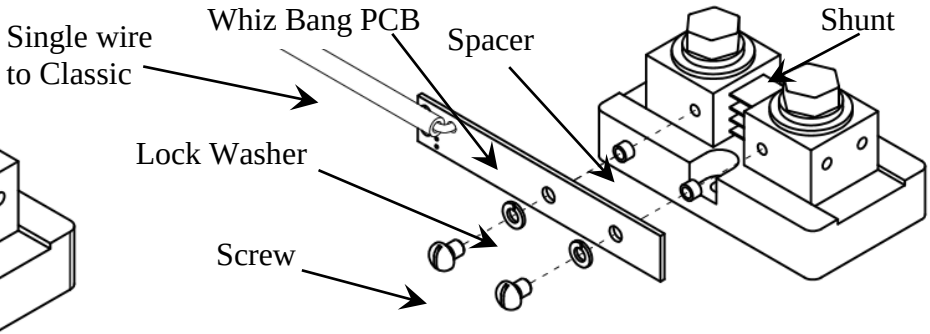
The MN Battery Combiner combines battery banks for use with up to 4 Classic Charge Controllers and provides a 1000 Amp / 100 mv shunt for precise current measurement.

Whiz Bang Jr. Optional Accessory

The Whiz Bang Jr. attaches to a 500 Amp / 50 mv shunt to send real time information to the Classic Charge Controller.
Installation is a simple one wire connection. The Classic can use this information along with its internal measurements to get a clearer picture of how much power is actually going into and out of the batteries.



Shunt before installing the Whiz Bang Jr.. Located in E-Panel. See component locater on page 11.



Whiz Bang Jr. installation sequence

To use the Whiz Bang Jr. Simply install the Whiz Bang PCB to the shunt as shown and connect the wire to the Classic AUX 2 input terminal block in the far left position.

MidNite Solar Battery Disconnect Module – MNBDM (Optional)

The Midnite Solar Battery Disconnect Module (MNBDM) is an optional circuit board which can be installed in most MidNite Solar E-Panels. It is used in conjunction with one or more MNBH Disconnect switches and MidNite Solar disconnecting combiners to remotely shutdown the system in emergencies. The MNBDM is controlled by the MNBH Birdhouse Disconnect switch and disconnects the main batteries from the system in a similar manner as the disconnecting combiner disconnects the PV array from the rest of the system. The trip signal for the MNBDMs and combiners is generated by the MNBH Disconnect Panel. Control signals are provided to the target devices via a ruggedized 600V CAT-5 cable, which connects all components in the system.

Power and Circuit Breaker Connections

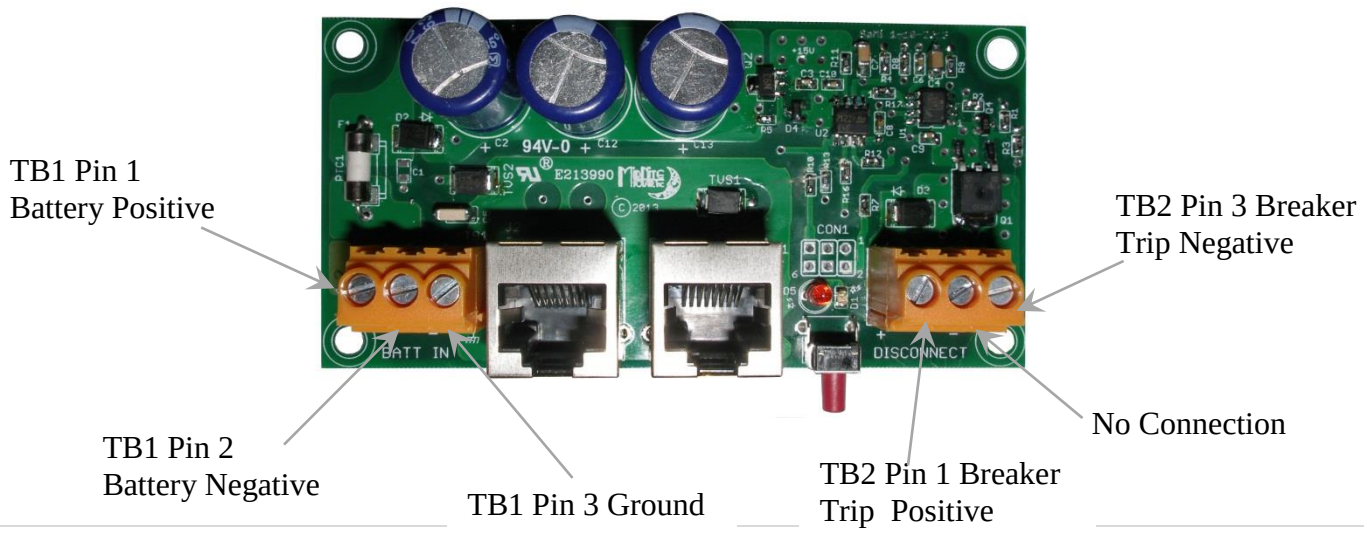
The MNBDM is powered from the main batteries and has terminals for connection to the E-Panel remote trip circuit breaker, other MNBDMs, the disconnecting combiners and the MNBH Disconnect Panel.
Electrical connections: First, Connect the battery negative to TB1 pin2 (-) then connect the switched battery positive (after the battery breaker) to TB1 pin 1 (+). The MNBDM has onboard overcurrent protection but a circuit breaker should be used to protect the wiring. The chassis ground connects to TB1 pin 3 (GND symbol).
Connect the red remote trip wire from the remote trip circuit breaker to TB2 pin 1 (+) and the black to TB2 pin 3 (-). Leave TB2 pin 2 open (middle).

System Connections

There can be up to four MNBDMs in the system. All system components are connected together with CAT-5 cable which plugs into the two RJ-45 (Ethernet-style) connectors, J1 and J2. There is no difference between the two connectors. A typical BirdHouse installation consists of one MNBH Disconnect switch, one MNBDM and one disconnecting combiner would use one of the RJ-45 jacks for connection to the MNBH switch and the other for connection to the combiner. Connect one to the MNBH Disconnect switch, or to another MNBDM that connects to the MNBH Disconnect switch. Connect the other to any downstream MNBDM units or combiners.

Operation

The MNBH Disconnect Panel must be energized and connected to an MNBDM before closing the battery circuit breaker on the E-Panel. If you attempt to close the breaker without the MNBH on and the cable installed, the MNBDM will detect a problem and trip the breaker within about 5 - 7 seconds. This is a fail-safe feature that requires the system to be intact and working before energizing.
If the cable is properly installed the power will remain on and the system is now ready for operation. The MNBDM LED will briefly blink (off) three times when power is first applied. This is normal and indicates that the board is working properly. The system may be tested by pressing the button on the MNBH Disconnect Panel, but doing that will trip every combiner and MNBDM in the system. To avoid this, a small test button is located on the front edge of the MNBDM board. Pressing the test button only trips the one breaker in that panel. Note that there is 2 second delay after pressing the button before the breaker trips.



MNBirdhouse Emergency shut-off

MNBirdhouse Optional accessory

• Located at ground level, the Birdhouse provides a safe means to disconnect high voltage PV arrays from MidNite Disconnecting and Arc Fault combiners

• Hard wired connection gives positive feedback that the Disconnect on the roof has actually been thrown. Connection is via 600/1000v Cat 5 USE-2 cable

• Up to four separate means of power including battery backup insures that the disconnect will be tripped when the button is pushed

• Voice and L.E.D. confirm level of safety (day or night) to the person pushing the button

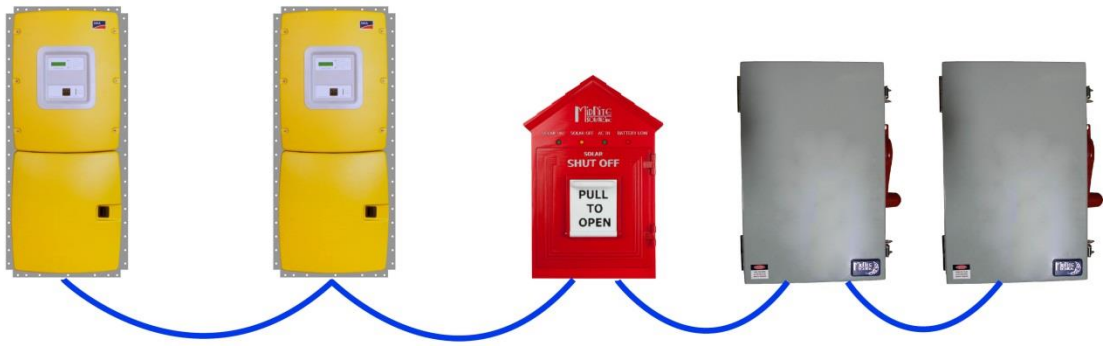
• Nema 3R UV resistant enclosure

• Able to disconnect multiple PV Disco Arcfault Combiners

• Firefighter Approved

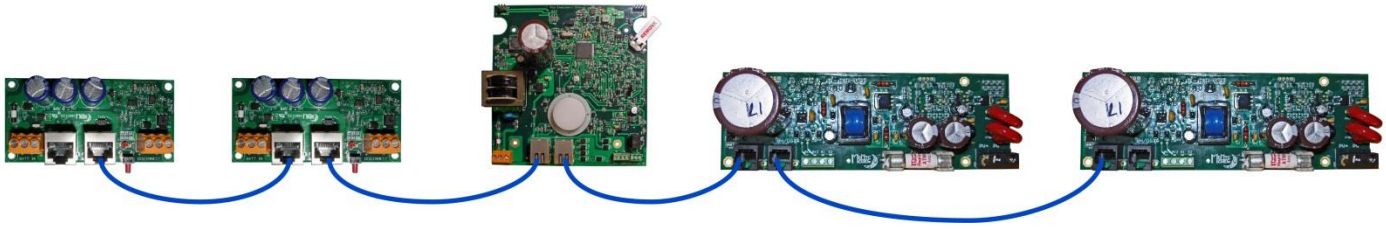
• 600V Cat 5 USE-2 90° cable available from Midnite Solar

System connections for the MNBDM and Birdhouse (sold separately)



SMA E-Panel SMA E-Panel Birdhouse Disco Combiner Disco Combiner

System connections for the MNBDM at the circuit board level.



Below are some of the new requirements for NEC 2014.
In short, there is a requirement for a "Rapid Shutdown". This is accomplished nicely with the MidNite Solar Birdhouse, Disco Combiners and MNBDM Battery Disconnect Module (located in the E-Panel).

Where there is more than one source of power this is even more critical. Consider a system with solar panels and battery backup. There is the high voltage of up to 600 volts from the panels and the 120/240 volts in the building AC Supply. When the main breaker is thrown to disconnect AC, the inverter will do as intended and maintain voltage in the building. The 600 Volts from the panels, the 120/240 VAC and battery voltage are all still present. Thus, throwing the mains did not remove any power at all.

The MidNite Solar Birdhouse, Disco Combiners and MNBDM Battery Disconnect Module work together to remove power from the solar panels and disconnect DC from the batteries to the inverter removing all backup power. All with the push of a single button.

690.12 Rapid Shutdown of PV Systems on Buildings.
PV system circuits installed on or in buildings shall include a rapid shutdown function that controls specific conductors in accordance with **690.12**(A) through (D).
(A) Requirements for controlled conductors apply only to PV system conductors of more than 1.5 meters (5 feet) in length inside a building, or more than 3 meters (10 feet) from a PV array.
(B) Controlled conductors shall be limited to no more than 30 volts and 240VA within 10 seconds of rapid shutdown initiation. Voltage and power shall be measured between any two conductors and between any conductor and ground.
(C) The rapid shutdown initiation methods shall be labeled in accordance with **690.56**(B).
(D) Equipment that performs the rapid shutdown shall be listed and identified.

The following comment is one of many resulting from a consensus process established among three groups of stakeholders: 1) CMP4 Firefighter Safety Task Group, 2) the SEIA Codes and Standards Working Group, and 3) the PV Industry Forum.

9. ROP 4-325 (accepted) introduces a distance of 1.5m (5 feet) to disconnection means of indoor battery-backup wiring. This distance is recognized as an acceptably short conduit length that allows for best practices in workmanship, and can be applied to PV wires entering a building in addition to conductors in and out of inverters and conductors coming out of a battery.

Appendix A

Wire size based on breaker size @75°C.

Breaker Size	AWG Wire Size	Wire Size mm^2
10 Amp	16 AWG	1.31 mm^2
15 Amp	14 AWG	2.08 mm^2
20 Amp	12 AWG	3.31 mm^2
30 Amp	10 AWG	5.26 mm^2
40 Amp	8 AWG	8.36 mm^2
50 Amp	8 AWG	8.36 mm^2
60 Amp	6 AWG	13.3 mm^2
70 Amp	4 AWG	21.1 mm^2
80 Amp	4 AWG	21.1 mm^2
90 Amp	2 AWG	33.6 mm^2
100 Amp	2 AWG	33.6 mm^2
125 Amp	1/0 AWG	53.5 mm^2
175 Amp	2/0 AWG	67.4 mm^2
250 Amp	4/0 AWG	107 mm^2

Appendix B

Classic Breaker and wire sizing chart

Model	Battery Voltage	MPPT Voltage	In/out Ratio	Output Amps	0utput Breaker	Wire Gauge	Input Amps	Input Breaker / Wire size
Classic 150	48	70	1.45	86	90-100	4AWG	59.31	80A/4AWG 150V
Classic 150	48	90	1.87	83	90-100	4AWG	44.38	63A 150V
Classic 150	48	100	2.08	80	80-90	4AWG	38.46	50A/8AWG - 63A/ 6AWG 150V
Classic 150	48	110	2.29	76	80-90	4AWG	33.18	50A/8AWG-63A/6AWG 150V
Classic 150	48	120	2.5	76	80-90	4AWG	30.4	50A/8AWG-63A/6AWG 150V
Classic 200	48	70	1.46	76	80-90	4AWG	52.05	80A/4AWG 300V
Classic 200	48	120	2.5	70	70-80	4AWG	28	50A/6AWG or 8AWG 300V
Classic 200	48	140	2.92	65	70-80	4AWG	22.26	50A/6AWG or 8AWG 300V
Classic 200	48	160	3.33	65	70-80	4AWG	19.52	30A110AWG-50A/6AWG or 8AWG300V
Classic 250	48	180	3.75	55	60-83	6-4AWG	14.66	30A/10AWG - 50A/6AWG or 8AWG 300V
Classic 250	48	200	4.16	53	60-63	6AWG	12.74	30A/10AWG-50A/6AWG or 8AWG300V

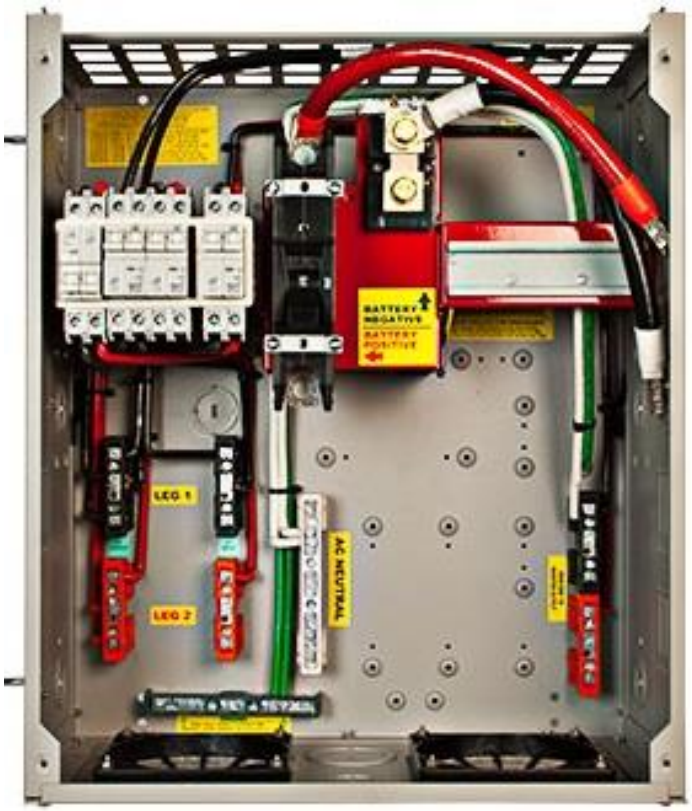
Appendix C

Torque for electrical connections on all E-Panels

Torque small busbar screws to 20-30 IN-LBS (2.3NM)
Torque large busbar screws to 45 IN-LBS (5.1 NM)
Torque Dinrail circuit breakers to 20 IN-LBS (2.3NM)
Torque battery disconnect breaker to 15 Ft-Lbs. (20.4NM)

Appendix D E-Panel descriptions

MNE250SMA-AC-SINGLE
Master E-Panel in a single Sunny Island AC Coupled system. (SunnyBoy inverter required)



The master includes the input/output bypass system along with separate AC input and output breakers. This E-Panel is used in conjunction with a Sunny Island inverter as part of an AC Coupled system. Comes with a 250 Amp battery disconnect breaker and inverter cables. Pre-wired with AC input and output wiring.

RS485 boards are required when AC Coupling to SunnyBoy inverters if 3 stage charging is desired. One RS485 board goes into the Sunny Island inverter and each SunnyBoy Inverter. AC Coupling to the SunnyBoy grid-tie inverter is possible without RS485 boards. The Sunny Island grid-tie inverter will frequency shift based on battery voltage to knock the grid-tie inverter off line. SunnyBoy inverters can switch between off-grid and grid-tie mode automatically when RS485 boards are used. To program this feature you must use either a SMA service cable (USBPBS) or SMA web box (SUNNYWEBBOXU).

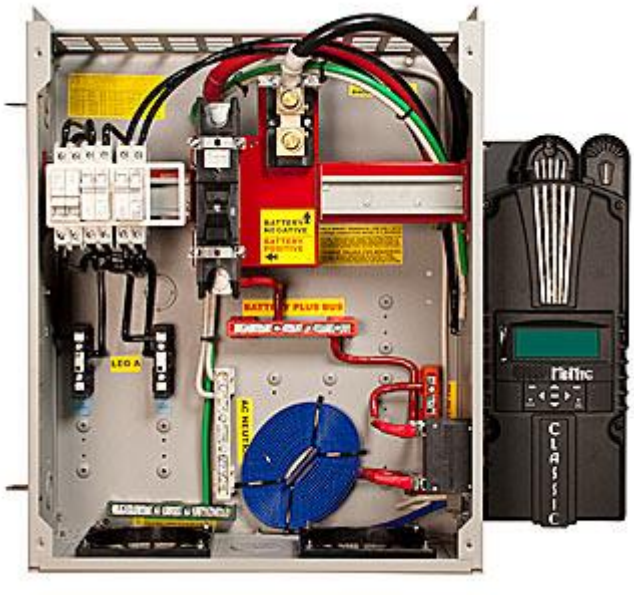
The backed up critical loads panel always has 120/240 available. 60A is available on leg 1 & and 30A on leg 2 in the critical loads panel. Comes standard with one MNSPD-300 for leg 1 in and out.

Recommended Options:

- MNSPD-300 - Surge protection for leg 2 AC IN and OUT
- MNBE-D Battery Enclosure - Holds eight Concorde 3050T AGM batteries. Steel indoor enclosure.
- MNXFLEX4/0-W60" - 60 inch 4/0 Black UL Listed Cobra X-Flex battery cable with tin plated lugs and glue filled White heat shrink.
- MNXFLEX4/0-R60" - 60 inch 4/0 Black UL Listed Cobra X-Flex battery cable with tin plated lugs and glue filled Red heat shrink.

Description: The MNE250SMA-AC-SINGLE master includes the Manual input/output bypass system along with separate AC input and output breakers. This E-Panel can be used in conjunction with a Sunny Island inverter as part of an AC Coupled system. Comes with a 250 battery disconnect breaker and inverter cables. Pre-wired with AC input and output wiring. Box Size 25"L x 23"W x 14"D Weight 40 lbs.

MNE250SMA-OG Single
Master E-Panel in a Single 6KW Sunny Island inverter system. The system is for off-grid, battery backup grid tie or battery backup.



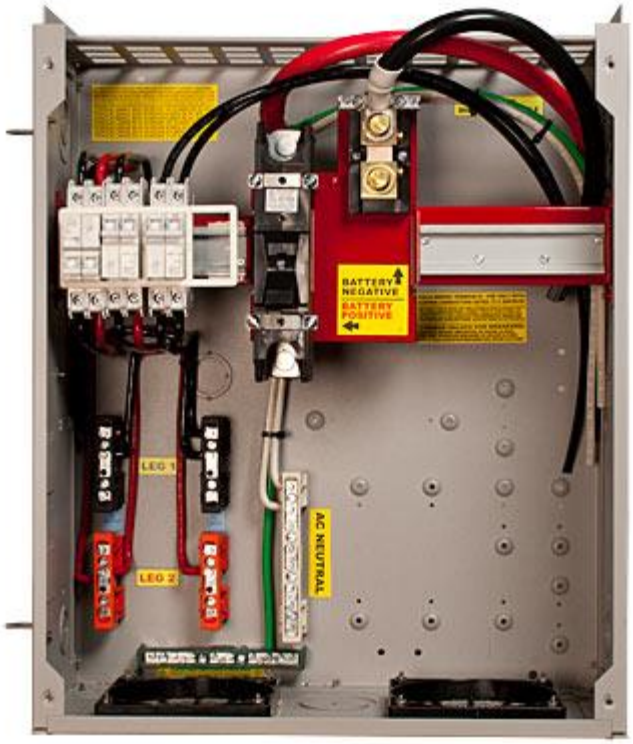
This E-Panel includes a 60 amp AC Output/Bypass system, separate AC input and output breakers for the Master inverter, 250 amp battery breaker with inverter cables, 500 amp/50mV shunt, battery negative busbar, AC input and output busbars, neutral and ground busbars, AC input and output wiring. All breakers are hydraulic-magnetic and rated for continuous duty. Space provided for 6 additional 1/2" wide din rail mount AC or DC breakers and up to ten 3/4" wide panel mount breakers. Knockouts located for battery cables, lightning protection and AC conduit connections.

Recommended options:

- MNESMA Short BP - Back Plate Highly recommended
- MNSPD-300 - One surge protection device works for AC input and AC output
- Classic Charge controller wiring for off-grid or battery backup grid tie installations.
- NOTE: Classic charge controllers are sold separately.
- MNBE-D Battery Enclosure - Holds eight Concorde 3050T AGM batteries. Steel indoor enclosure.
- MNXFLEX4/0-W60" - 60 inch 4/0 Black UL Listed Cobra X-Flex battery cable with tin plated lugs and glue filled White heat shrink.
- MNXFLEX4/0-R60" - 60 inch 4/0 Black UL Listed Cobra X-Flex battery cable with tin plated lugs and glue filled Red heat shrink.

Description:
Box Size 25"L x 23"W x 14"D
Weight 40 Lbs.

MNE250SMA-OG/AC DM
Master E-Panel for a dual off-grid, AC Coupled or battery backup 120/240 VAC Sunny Island inverter system



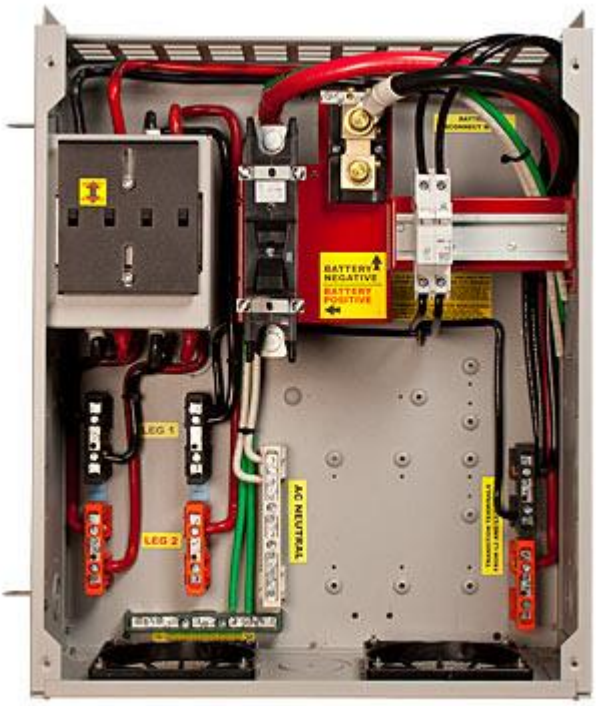
Comes with AC output/bypass assembly and independent AC input and output breakers, 500A/50mV shunt, neutral and AC IN and OUT terminal busbars, 250A battery breaker with inverter cables, AC wiring to inverter.

Recommended Options:

- MNESMA Short BP (short back plate)
- MNSPD-300 - Surge protection for AC In/Out
- NOTE: Classic charge controllers are sold separately.
- MNBE-D Battery Enclosure Holds eight Concorde 3050T AGM batteries. Steel indoor enclosure.
- MNXFLEX4/0-W60" - 60 inch 4/0 Black UL Listed Cobra X-Flex battery cable with tin plated lugs and glue filled White heat shrink.
- MNXFLEX4/0-R60" - 60 inch 4/0 Black UL Listed Cobra X-Flex battery cable with tin plated lugs and glue filled Red heat shrink.

Description:
Box Size 25"L x 23"W x 14"D
Weight 40 Lbs.

MNE250SMA-Quad Mstr



Master E-Panel for an 18-24KW quad Sunny Island inverter system. The quad system can be off-grid, AC coupled, battery backup grid tie or battery backup. Three Slave E-Panels and three additional Sunny Island inverters required.

This master E-Panel in a quad Sunny Island inverter system includes a 125 amp AC Output/Bypass system, separate AC input and output breakers for the Master inverter, 250 amp battery breaker with inverter cables, 500 amp/50mV shunt, battery negative busbar, AC input and Output busbars, neutral and ground busbars, AC input and output wiring, transition terminals to Slave E-Panels. All breakers are hydraulic-magnetic and rated for continuous duty. Space provided for 6 additional 1/2" wide din rail mount AC or DC breakers and up to ten 3/4" wide panel mount breakers.
Knockouts located for battery cables, lightning protection and AC conduit connections.

Recommended options:

- MNESMA Short BP - Back Plate (Highly recommended)
- MN-Battery Combiner 1000A - Combiner for battery connections for 4 inverters. (Highly recommended)
- MNSPD-300 - One surge protection device for AC inputs and one for AC outputs.
- Classic Charge controller wiring for off-grid or battery backup grid tie installations.
- Classic charge controllers are sold separately.
- MNBE-D Battery Enclosure - Holds eight Concorde 3050T AGM batteries. Steel indoor enclosure.
- MNXFLEX4/0-W60" - 60 inch 4/0 Black UL Listed Cobra X-Flex battery cable with tin plated lugs and glue filled White heat shrink.
- MNXFLEX4/0-R60" - 60 inch 4/0 Black UL Listed Cobra X-Flex battery cable with tin plated lugs and glue filled Red heat shrink.

Description:
Box Size 25"L x 23"W x 14"D
Weight 40 Lbs.

MNE250SMA-3PH Master
Master E-Panel in a 3 phase system. Two slaves are also required for 3 phase.

The 3 phase master includes the 3 phase input/output bypass system. This E-Panel can be used in conjunction with a Sunny Island inverter as part of a 3 phase off-grid, battery backup or AC Coupled system. Terminals are provided for hookup to leg 2 and leg 3 E-Panels. Comes with a 250Amp battery disconnect breaker and inverter cables. Pre-wired with AC input and output wiring for leg 1 (master) inverter. (Two slaves are also required for 3 phase.)

This E-Panel does not come with a relay board, RS485 (485USPD-NR) boards or MNSPD lightning protection. RS485 boards are required when AC Coupling to SunnyBoy inverters if 3 stage charging is desired. One RS485 board goes into the master inverter and each SunnyBoy Inverter. AC Coupling to a SunnyBoy or any other grid-tie inverter is possible without RS485 boards. The Sunny Island inverter will frequency shift based on battery voltage to knock the grid-tie inverter off line. SunnyBoy inverters can switch between off-grid and grid-tie mode automatically when RS485 boards are used. To program this feature you must use either SMA service cable (USBPBS) or SMA web box (SUNNYWEBBOXU).

Recommended Options:

- MN-Battery Combiner - 1000A combiner for up to 4 inverters. (Highly recommended)
- MNSPD-300 - Surge protection for each leg of 3 phase.
- MNESMA Short BP - Short back plate for mounting one Sunny Island and one SMA E-Panel.
- NOTE: Classic charge controllers are sold separately.
- MNBE-D Battery Enclosure - Holds eight Concorde 3050T AGM batteries. Steel indoor enclosure.
- MNXFLEX4/0-W60" - 60 inch 4/0 Black UL Listed Cobra X-Flex battery cable with tin plated lugs and glue filled White heat shrink.
- MNXFLEX4/0-R60" - 60 inch 4/0 Black UL Listed Cobra X-Flex battery cable with tin plated lugs and glue filled Red heat shrink.

Description: Box Size 25"L x 23"W x 14"D
Weight 40 Lbs.

MNE250SMA-SLAVE
Companion E-Panel for dual, triple and quad Sunny Island inverter systems. The Slave E-Panel is the same part number for all multiple SMA E-Panel systems regardless of off-grid, AC coupled, battery backup, 3 phase or quad.

This E-Panel does not include any AC Output/Bypass system. It does include separate AC input and output breakers for the slave inverter, 250 amp battery breaker with inverter cables, 500 amp/50mV shunt, battery negative busbar, AC input and Output busbars, neutral and ground busbars, AC input and output wiring. Comes with Red busbars installed. Additional black and blue insulators included for tailoring to suit the application. See instructions for replacing terminals blocks on page 45.All breakers are hydraulic-magnetic and rated for continuous duty. Space provided for 6 additional 1/2" wide din rail mount AC or DC breakers and up to ten 3/4" wide panel mount breakers. Mounting hole spaces for additional terminal busbars. Knockouts located for battery cables, lightning protection and AC conduit connections.

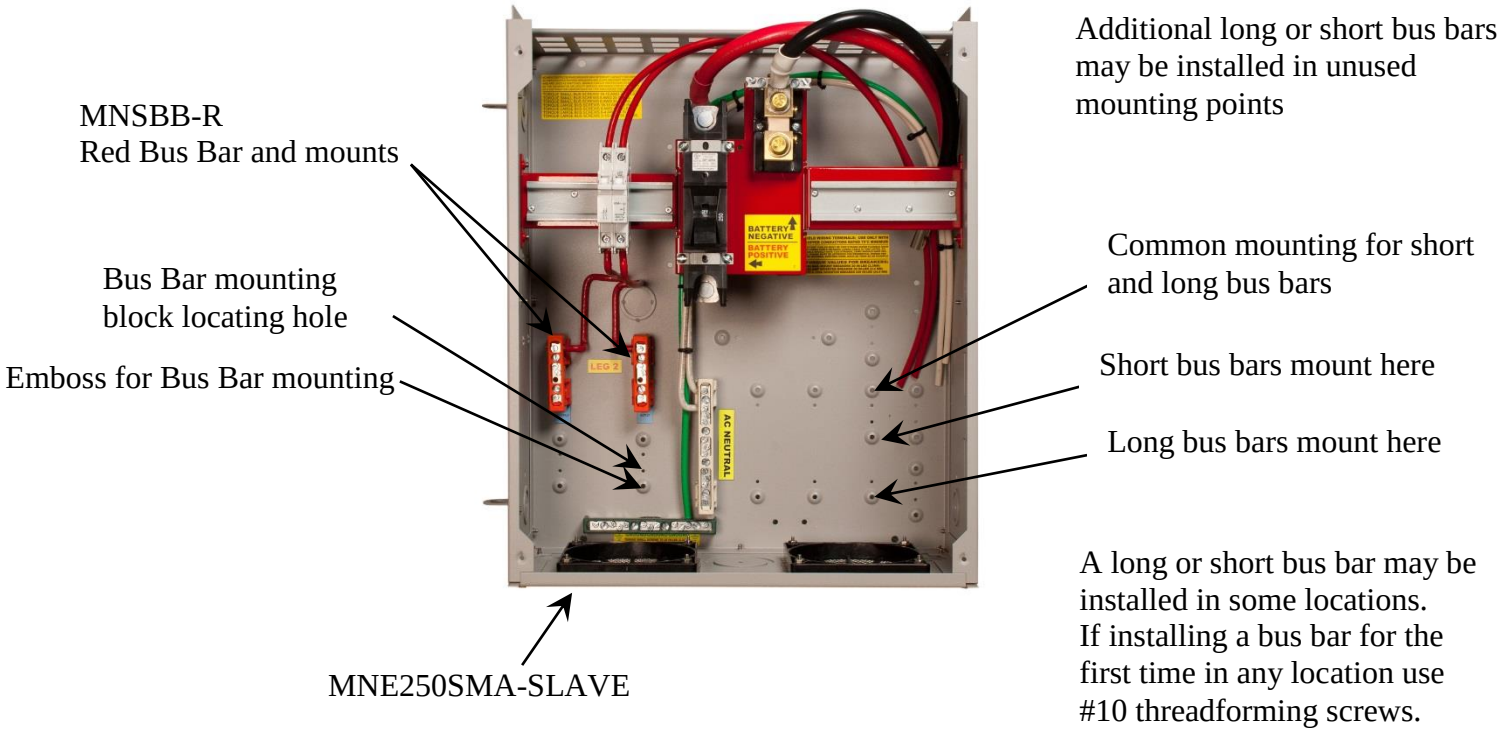
Recommended options:

- MNESMA Short BP - Back Plate (Highly recommended)
- MN-Battery Combiner 1000A - Combiner for battery connections for 4 inverters. (Highly recommended for triple or quad systems)
- MNSPD-300 - Surge protection device if not already included on Master E-Panel.
  Classic charge controllers are sold separately.
- MNBE-D Battery Enclosure - Holds eight Concorde 3050T AGM batteries. Steel indoor enclosure.
- MNXFLEX4/0-W60" - 60 inch 4/0 Black UL Listed Cobra X-Flex battery cable with tin plated lugs and glue filled White heat shrink.
- MNXFLEX4/0-R60" - 60 inch 4/0 Black UL Listed Cobra X-Flex battery cable with tin plated lugs and glue filled Red heat shrink.

Description:
Box Size 25"L x 23"W x 14"D
Weight 40 lbs.

Appendix E Exchanging Bus Bars

Slave units are shipped with red AC in and out wires as well as red bus bar mounts. It may be desired to change to another color to identify a different phase.



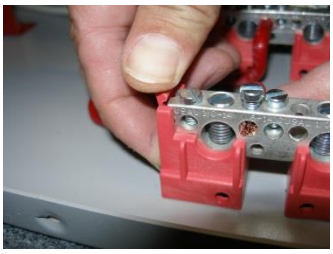
To exchange MNSBB Bus Bar mounts for another color.

First remove any wires that will be replaced with the new color.
Next, remove the plastic cover.
To remove the Bus Bar press back gently on the tab on the top of the mounting block and lift up on the bus bar. After the Bus Bar is removed then remove the screw in the mounting base and set aside. Repeat for the other mounting block.

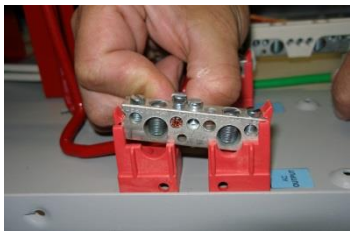
Place a mounting block of the new color in place of the previous colored ones. The mounting block has a small pin formed in the base that goes into the bus bar mounting block locating hole shown above.
The screws supplied with the original mounting blocks are of the threadforming type.
Important! If the screws are overtightened they may strip. If this should occur simply replace the screw with a 10-32 Panhead machine screw and nut.
Hint! Holding the mounting blocks apart and in a straight line while tightening them will make it easier to reinstall the terminal block.
Replace the snap on terminal block cover and install wires tightening them according to the torque chart in Appendix C on page 43.

Starting with a slave unit

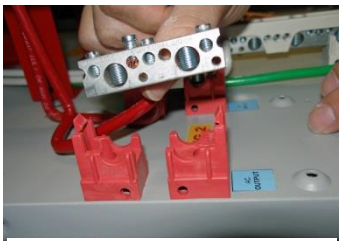
Remove cover by gently rocking



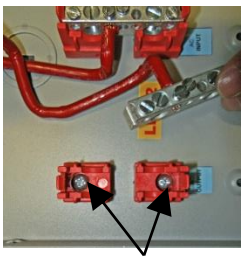
Gently pry back ear of mounting block and push up on terminal block from below



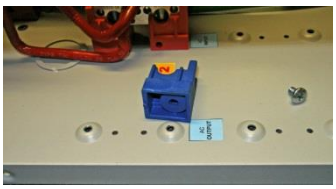
Finish removing the terminal block



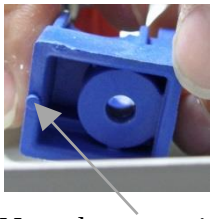
Terminal block is removed. Set aside



Remove screws in mounting blocks to remove mounting blocks. Set screws aside



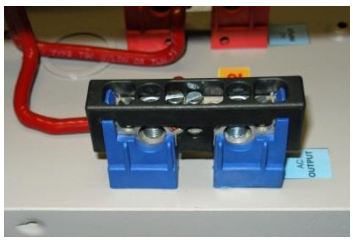
New mounting block



Note the mounting block locating pin

Position new mounting blocks as shown. Secure them with screws removed earlier*

Replace the Busbar and press into place



Replace wiring cover. Black cover shown here

Completed. Red wires replaced with blue and “LEG 2” Sticker replaced

*Important! If the screws are overtightened the threads in the chassis may strip. If this should occur simply replace the screw with a 10-32 Panhead machine screw and nut.