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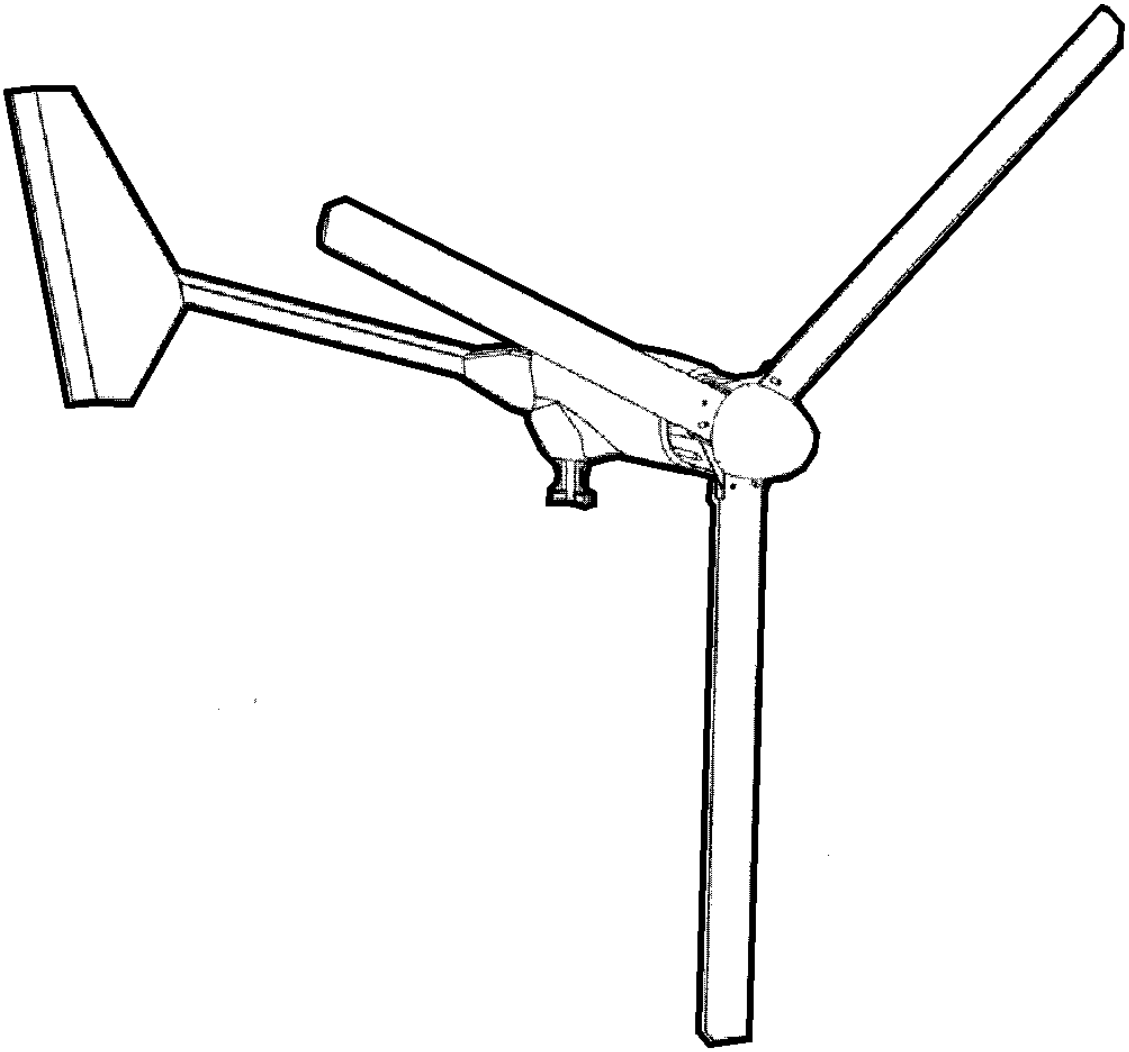
# BWC EXCEL 1

# 48 VDC

Battery Charging System
Owner's Manual

EXCEL 1 Wind Turbine



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# BWC EXCEL 1 Wind Turbine
# 48V System
# OWNER'S MANUAL

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# 1. Overview

The BWC EXCEL 1-48 wind turbine system is a state-of-the-art small generator designed to charge batteries and supply electrical loads in a 48 VDC power system. When used in conjunction with a suitable sine wave DC-AC inverter and a 48 VDC battery bank the EXCEL 1-48 can also be connected to the power grid.

The EXCEL 1-48 turbine consists of an 8.2', 75 lb wind turbine rated at 1,000 watts, and the Midnite Solar Classic controller.

The EXCEL 1-48 wind turbine features superior low-wind-speed performance, very high system efficiency, and low noise.

The BWC EXCEL 1-48 is offered with the optional guyed tubular Tilt Tower, which comes in heights from 60' to 100'. The Tilt Tower is shown in **Figure 1**. For installation procedures on this tower, please refer to the "BWC EXCEL 1 Tilt Tower Installation Manual". This manual is available on-line at http://www.bergey.com, from BWC dealers, and from BWC directly.

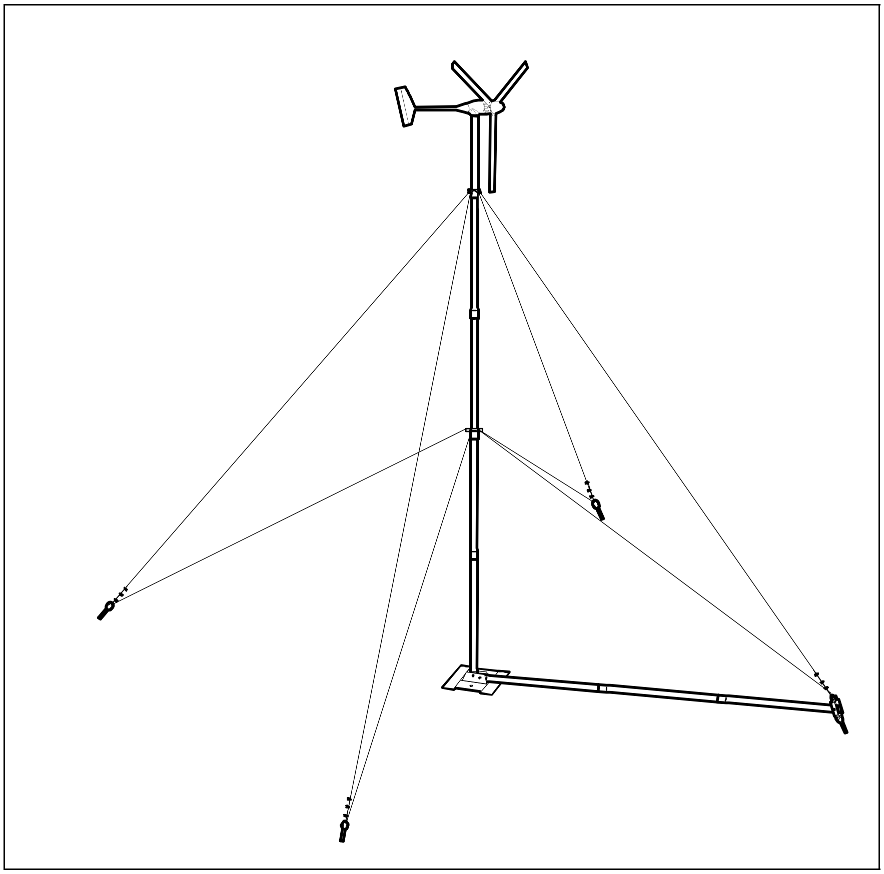


**Figure 1: EXCEL 1 with 60' Tilt Tower**

# 2. Cautions and Warnings

This manual contains important information on the installation of your BWC EXCEL 1 wind turbine and charge controller. **We strongly recommend that you read and follow the instructions contained in this manual.**

At several points in the manual items of special interest or significant impact are highlighted by one of the following notices.

| Warning |
| --- |
| Hazards or unsafe practices that could cause personal injury or death. |

| Caution |
| --- |
| Hazards or unsafe practices that could cause product damage. |

| Note |
| --- |
| Significant points of interest |

# 3. Identification

Each BWC EXCEL 1-48 wind turbine has a serial number decal located on the tower mount. The Serial Number is also written on the box that the turbine came in.  We recommend writing it here as well:

BWC EXCEL 1-48 Serial Number :________________________

# 4. System Description

**EXCEL 1 Wind Turbine Components**

The major components of the EXCEL 1 wind turbine are shown in **Figure 2**.

**A. Blades / Rotor System**

The rotor system consists of three fiberglass blades. Acting like aircraft wings, the blades convert the energy of the wind into rotational forces that can drive a generator. The airfoil on the EXCEL 1 is the new SH3045 developed specifically for the EXCEL 1 by Bergey Windpower. The fiberglass blades are exceptionally strong because they are densely packed with glass reinforcing fibers that run the full length of the blade. The rotor has three blades because three blades will run much smoother than rotors with two blades.

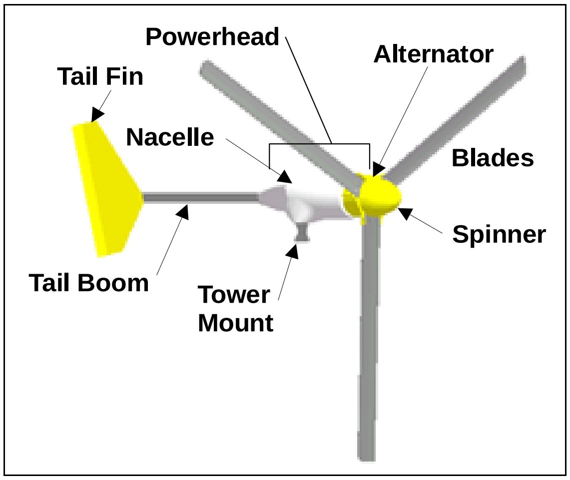



**Figure 2: Major Components of the EXCEL 1 Wind Turbine**

**B. Alternator**

The alternator converts the rotational energy of the rotor into electricity. The alternator utilizes permanent magnets and has an inverted configuration in that the outside housing (magnet can) rotates, while the internal windings and central shaft are stationary. The alternator was specially designed for the EXCEL 1 and produces power at low speeds, eliminating the need for a speed-increasing gearbox.

The output from the alternator is three-phase alternating current (AC), but it is rectified to direct current to charge the battery bank. Since it uses permanent magnets, the alternator is generating voltage whenever the rotor is turning.

| Warning |
| --- |
| The output wiring of the BWC EXCEL 1-48 presents a low voltage shock hazard whenever the rotor is turning. Caution must be exercised at all times to avoid electrical shock. |

**C. Nacelle**
The nacelle is the fiberglass housing around the main body of the machine. It contains the main structural "backbone" of the turbine (called the mainframe), the slip-ring assembly, the yaw bearings, and the tower mount. The yaw bearings allow the wind turbine to freely pivot around the top of the tower so that the rotor will face into the wind.

The slip-ring assembly is the electrical connection between the moving (as it orients with the wind direction) wind turbine and the fixed tower wiring. The slip-rings and yaw bearings are located just above the tower mount. The tower mount attaches the EXCEL 1 turbine to the top of the tower.

**D. Tail Assembly and AutoFurl® Operation**

The tail assembly, composed of a tail boom and the tail fin, keeps the powerhead (and, therefore, the rotor) aligned into the wind at wind speeds below approximately 12.5 m/s (28 mph). At about 12.5 m/s the AutoFurl® action (see **Figure 3**) turns the rotor away from the wind to limit its speed. The tail appears to fold, but in reality the tail stays stationary, as the powerhead turns sideways to the wind. The rotor does not, however, furl completely sideways. This allows the turbine to continue to produce power in high winds. When the high winds subside the AutoFurl® system automatically restores the turbine to the normal straight position.

**E. MidNite Solar Classic**

The MidNite Solar Classic charge controller is used to charge the batteries. The owner's manual for the Classic is included in the **Appendix**.

# 5. SYSTEM OPERATION

### A. Normal Operation

The rotor of the BWC EXCEL 1 should begin to rotate when the wind speed reaches approximately 3 m/s (7 mph). (For the first several weeks of operation, however, the start-up wind speed will be higher because the bearing seals have not worn-in.) Battery charging should commence shortly after the rotor spins up to speed. Once turning, the rotor will continue to turn in lower wind speeds, down to approximately 2.5 m/s (6 mph).

| Note |
|---|
| All operational wind speeds given assume steady winds, sea-level altitude and moderate temperatures. Hot weather, high altitude, turbulence, and gusting winds will reduce system performance. |

The rotor speed will increase with increasing wind speed and the system will provide a higher output. This output increases rapidly because the energy available in the wind varies as the third power (cube) of the wind speed. For example, if the wind speed doubles from 5 m/s (11.2 mph) to 10 m/s (22.4 m/s), the energy in the wind increases by a factor of eight ($2^3 = 2 \times 2 \times 2 = 8$). One result of this relationship is that there is very little energy available in light winds. For the average site, winds in the range of 5.5 – 9 m/s (12 – 20 mph) will provide most of the system's annual energy production.

### B. High Winds - AutoFurl

During periods of high wind speeds the AutoFurl system will automatically protect the wind turbine. When furled, the power output of the turbine will be significantly reduced. In winds between 13 m/s (29 mph) and 18 m/s (40 mph) it is normal for the turbine to repeatedly furl, unfurl and then furl again. In winds above 18 m/s (40 mph) the turbine should remain continuously furled.

AutoFurl is a simple and elegant method of providing high wind speed protection. The AutoFurl system is based on aerodynamic forces on the rotor, gravity, and the carefully engineered geometry of the wind turbine. As shown in **Figure 3**, the aerodynamic forces acting on the blades cause a thrust force pushing back on the rotor. This force increases with increasing wind speeds.

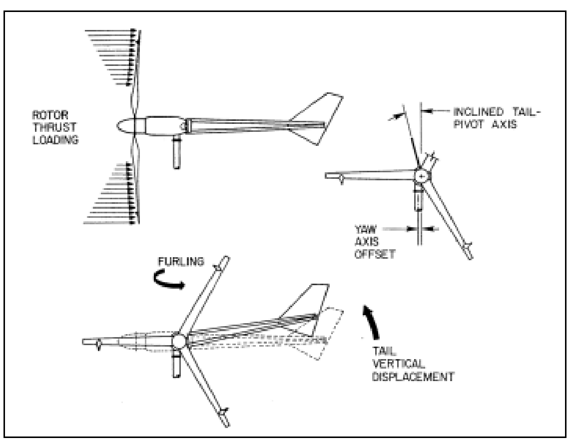



**Figure 3: AutoFurl**

The thrust force acts through the centerline of the rotor, which is offset from the centerline of the tower pivot axis (yaw axis). Therefore, the thrust force on the rotor is always trying to push the rotor over to the side, away from the wind.

But the rotor is kept facing into the wind at speeds up to ~ 12.5 m/s (28 mph) by the wind turbine's tail assembly. The tail, in turn, is kept straight by its own weight because its pivot at the back of the nacelle is inclined. So the weight of the tail holds it against a rubber bumper and the tail holds the rotor into the wind.

The geometries in the systems are carefully balanced so that at ~ 12.5 m/s (28 mph) the rotor force acting on the yaw-offset is large enough to overcome the preset force holding the tail straight. At this point the rotor will start turning away from the wind or furling. The tail stays aligned with the wind direction. The speed of furling depends on the severity of the wind gusts and whether the wind turbine stays furled depends on the wind speed.

As the wind turbine furls the geometry of the tail pivot causes the tail to lift slightly. When the high winds subside the weight of the tail assembly returns the whole turbine to the straight position. The AutoFurl system works whether the turbine is loaded or unloaded.

The AutoFurl system is completely passive, so it is very reliable and since there are no wear points, like in a mechanical brake system, it is very robust. AutoFurl was used in the very first wind system produced by Bergey Windpower in 1980 and in every unit produced since. AutoFurl is an important element of our success.

There is one situation in the field, however, that we have found can disrupt the operation of AutoFurl. If the wind turbine is installed on a sharp hill or next to a cliff so that the wind can come up through the rotor on an incline (e.g., from below; as opposed to horizontally) we know that this will affect furling and can produce higher peak outputs. We strongly recommend avoiding this situation.

| Caution |
|---|
| Do not install the EXCEL 1 wind turbine near cliffs or precipices or on sharp hills such that the wind does not travel horizontally through the rotor. |

# 6. Turbine Installation

Appendix 1 is an Installation Planning Guide. It provides recommendations on tower heights and locations, electrical components, and wiring. **Please read the Appendix page on "How to Avoid the 6 Most Common Mistakes when Installing an EXCEL 1".**

**Tower Mounting:** The EXCEL 1 wind turbine is attached to its tower by a three-sided, six fastener casting, shown in **Figure 4**, that is designed to fit inside a tube with an inner diameter of 108 mm (4.25 in). (Note: EXCEL 1's shipped prior to September 2003 were built to fit a tube with an 85 mm (3.35 in) inner diameter.)

If you are using the BWC Tilt Tower then the EXCEL 1 will bolt directly in place. If you are mounting the EXCEL 1 to a different type of tower then you will need to ensure that the tower meets the requirements for EXCEL 1 towers (see Appendix) and that it has a proper adapter fitting for attaching the EXCEL 1 tower mount casting (also defined in the Appendix).

Once you have the proper mounting arrangement you can proceed with assembly of the wind turbine. The fasteners on the EXCEL 1 are all metric.

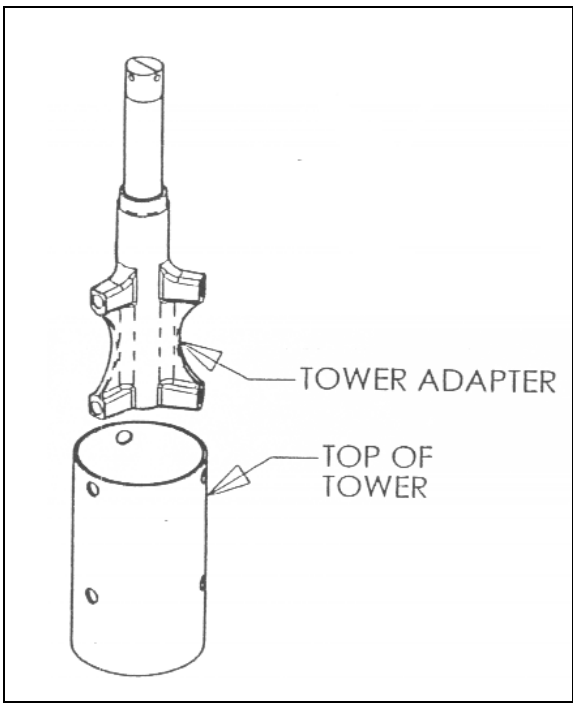



**Figure 4: Tower Mounting for the EXCEL 1**

**Tilt-up Type Towers:** If you have a tilting tower, such as the BWC Tilt Tower, the following procedure is recommended:

Tools Required:

- 17 mm box end wrench
- 17 mm socket and ~ 300 mm (12") ratchet drive
- 8 mm socket or wrench
- pliers
- crimpers for wiring terminals (U-shaped crimp preferred over straight crimp)
- thread locking compound (like Loctite 242)
- tape measure, 12 ft.

Procedure:

**Step 1:**
With the tower tilted down, place the powerhead of the wind turbine near the top end of the tower.

The tower wiring is connected to the EXCEL 1 wind turbine at the slip-ring using two small screws and ring terminals crimped to the two conductors. BWC does not supply these ring terminals. Cut the outer insulation on the wire back about 60 mm (2.5 in). Strip the insulation off the outer 12 mm (1/2 in) of each conductor and crimp on the appropriate ring terminals. Attach the two power conductors to the slip-ring assembly with the screws provided. The polarities of the connections are marked. If your conductors are color-coded we recommend making note of the colors connected to positive and negative leads.

| Caution |
| --- |
| Do not use the box lugs supplied for the charge controller connections instead of ring terminals. The box lugs could short circuit against the tower tube and damage the alternator. |

| Caution |
| --- |
| Be very careful with the washers on the slip-ring terminals. DO NOT let them fall into the alternator. If they do, you must disassemble the alternator and remove them before completing the installation. |

The slip ring assembly is not designed to support the weight of the down-tower wire. A strain relieving installation is required, as shown in **Figure 5**. If possible put a loop in each wire to wrap around the wire ties. Use the two nylon cable ties provided to secure the tower wiring to the tower adapter casting. After completing the connections, pull on the tower wire to make sure that it is secure before mounting the wind turbine on the tower.

**Step 2:**
Raise the tower about 3' off the ground to provide room to assemble the EXCEL 1 turbine. We recommend fashioning a temporary support stand to hold the tower up during turbine assembly.

**Step 3:**
Mount the wind turbine tower adapter to the top of the tower using six M10-1.5 x 20mm bolts and six washers. We require applying Loctite 242 (Thread Locking Compound) to the threads prior to installation to reduce the likelihood of loosening due to vibration. Use a torque wrench to achieve the proper fastener torque on the tower mounting bolts. The required torque is **45 ft-lbs**.

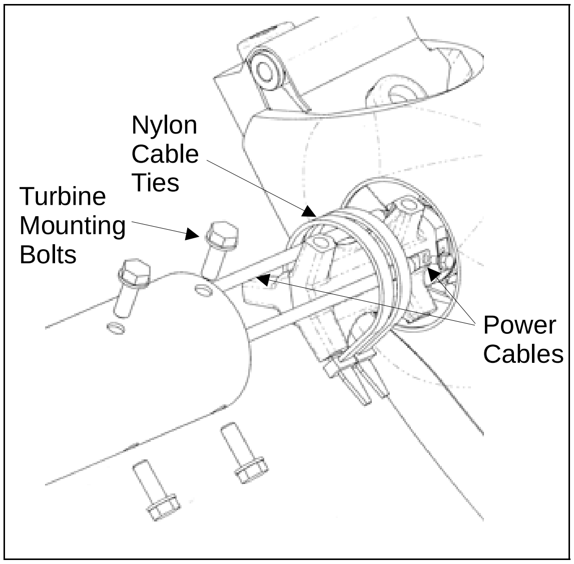



**Figure 5: Turbine Mounting**

**Step 4:**
Complete the turbine wiring to the charge controller before adding the blades. This is recommended so that you can test the DC polarity of the wiring by spinning the alternator by hand. It is very important that the polarity [positive (+) and negative (-)] is correct when the turbine is connected to the charge controller. The best way to ensure this is to complete the wiring and then test the polarity with a Volt-Ohm-Meter or the polarity checker built into the charge controller. **Do not use the polarity checker on the charge controller circuit board with blades on and the turbine turning under wind power because the voltage will be too high for the polarity check circuitry.**

To connect the battery leads, first connect the battery negative (-) wire to the terminal marked "BAT –". With the battery positive wire touch the pad marked "POLARITY CHECK", if red LED (D80) lights, the connections are backward, double check everything to find the cause. The green LED (D70) should come on, if it does leave the wire in contact with the "POLARITY CHECK" pad for 5 seconds to charge all capacitors and avoid a spark when making the battery connection. Quickly connect the battery positive wire to the terminal marked "BAT +". The system will not operate correctly and could be damaged if the polarity is reversed.

**Step 5:**
Bolt the tail fin to the tail boom using the eight M5 bolts and washers provided, as shown in **Figure 6**. We recommend applying Loctite to the bolt threads prior to assembly.

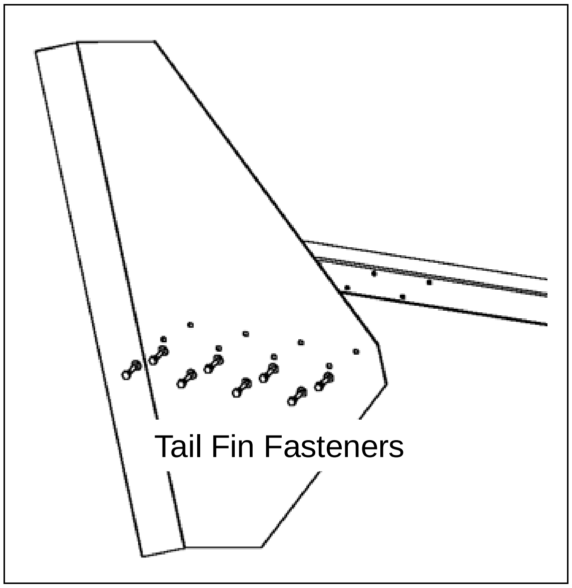



**Figure 6: Tail Fin Attachment**

**Step 6:**
Place the tail boom on the rear of the turbine powerhead and insert the 12 mm (1/2") tail pivot pin from the top. If the parts are aligned properly the pin should insert easily. Do not use a hammer to pound the pin in place, as this may cause scoring of the bronze bushings. Secure the tail pivot pin with two flat washers and cotter pins, as shown in **Figure 9**. Note: Failure to properly install and secure both cotter pins will lead to loss of the tail boom. Let the tail hang down so the turbine head turns part way up for easier blade assembly.

**Step 7:**
Turn the EXCEL1 powerhead so that the alternator is facing up. Attach the blades as shown in **Figure 7** using the M10 hardware provided. Insert bolts and start all three blade nuts. Then, partially tighten the nuts in the order shown in **Figure 8**. We recommend bolting one blade up solidly and leaving the other two somewhat loose while you check the tip-to-tip blade distance. We recommend checking, and adjusting as necessary, the blade tip spacing to ensure that the blade tips are equally spaced. This step will help make the wind turbine as smooth running as possible, which will maximize the operating life of the bearings and reduce vibration related noise. The blade tip-to-tip distances should not differ by more than 1/2" for smooth operation. Finally, torque the nuts (in order shown in **Figure 8**) to **45 ft-lbs** each. Loctite is not necessary on the blade fasteners because the nylon locking nuts provide adequate locking.

**NOTE:** For EXCEL 1's shipped after September 2003, all of the blade bolts are the same length.

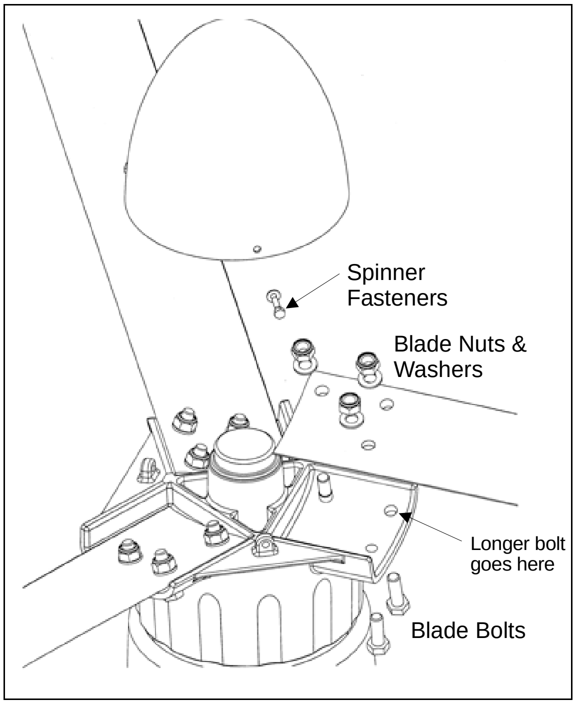



**Figure 7: Blade and Spinner Fasteners**

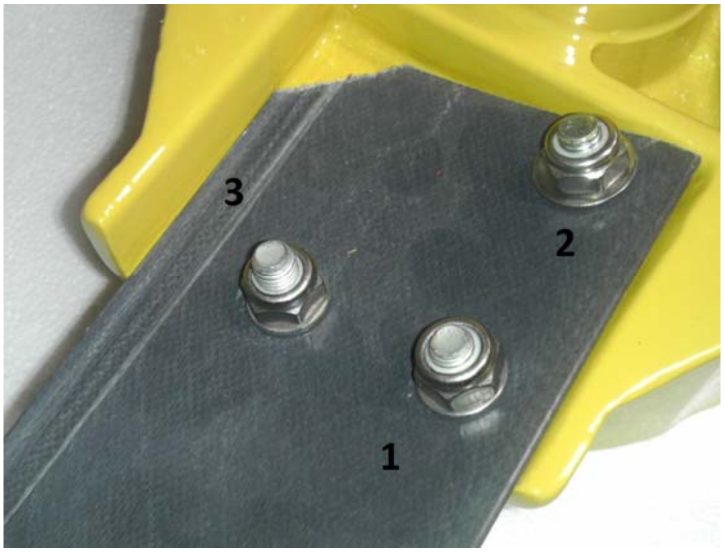



**Figure 8: Nut Tightening Order**

**Step 8:**
Attach the spinner (nose cone) using the three M5 bolts and washers provided, as shown in Figure 7. We recommend applying Loctite to the bolt threads prior to assembly.

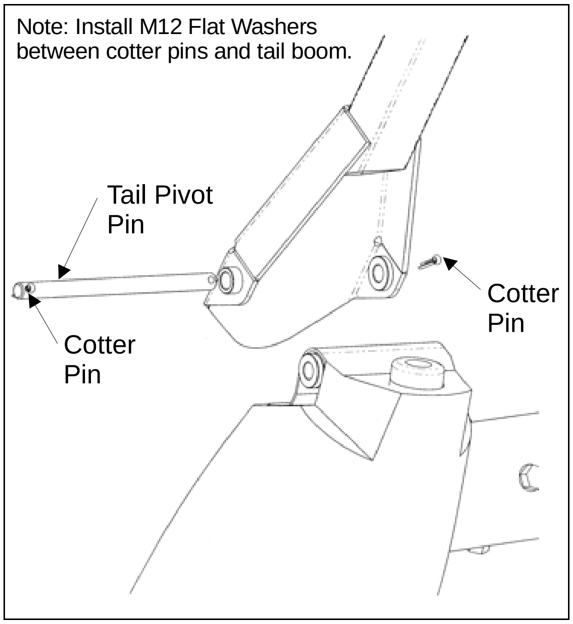



**Figure 9: Tail Boom Attachment**

**Step 9:**
Check the EXCEL 1 wind turbine carefully to make sure that the installation is complete. We recommend the following checklist:

- ❑ Blade fasteners are secure and properly torqued
- ❑ Blade tips are evenly spaced
- ❑ Spinner is secure
- ❑ Tail fin is secure
- ❑ Tail pivot pin is locked in place with both cotter pins.
- ❑ Tower adapter bolts are secure
- ❑ Wiring polarity is tested and marked

**Step 10:**
Dynamically brake the EXCEL 1's alternator by either of two methods: 1) using the Stop Mode function of the charge controller, if you already have the turbine and battery bank connected to the charge controller, or 2) connecting the positive (+) and negative (-) output leads together. The resulting short-circuit will keep the rotor from spinning during tower raising. DO NOT raise the wind turbine without first stopping the rotor from turning.

**Step 11:**
Raise the tower following the procedures outlined by the tower supplier. **Please make safety your top priority.**

**Non-tilting Towers:** On a non-tilting tower, such as a fixed guyed tower or a self-supporting pole type tower, there are two general approaches that can be used: 1) assemble the tower and turbine together on the ground and then use a light-duty crane to set the tower in place, or 2) erect the tower and then lift the wind turbine to the top with either a light-duty crane or a gin-pole.

A gin-pole, in this case, is a tower assembly tool that attaches to the tower and provides an arm with a pulley so that parts can be hoisted above the top of the tower. Gin-poles are used by professional tower erectors and we do not recommend their use by non-professionals. We know of at least one homeowner who died approximately fifteen years ago while improperly using a gin-pole to install a small wind turbine (though not a Bergey turbine).

Wherever possible we strongly recommend assembling the tower and turbine on the ground. In this case please follow the general procedure for turbine assembly provided in the preceding section. When raising the tower you must lift the tower, not the EXCEL 1 wind turbine. The EXCEL 1 cannot support the weight of the tower.

For customers installing a BWC EXCEL 1 on an existing fixed tower we recommend that you use a crane to lower the tower so that you can attach the turbine on the ground. Alternatively, we recommend you use a bucket-truck, like the type used by utility linemen. Check with local sign companies because they often offer bucket-truck services at reasonable hourly rates. If neither of these approaches is possible then we recommend that you engage the services of professional wind turbine or tower erectors to install your wind turbine.

# 7. Charge Controller Installation

**A. Electrical System**
The general electrical configuration for BWC EXCEL 1 installations will typically involve AC (alternating current) converting to DC (direct current) power, and they will be used through a connection to the Midnight Classic charge controller to charge 48 volt batteries.

The charge controller has a limited current carrying capacity so we recommend that you use a DC Source Center whenever you have multiple EXCEL 1 wind turbines. DC Source Centers are available from Bergey Windpower and from other sources.

Additional Design Guidance:

1. If you have multiple EXCEL 1 turbines and charge controllers, do not connect more than one wind turbine to one charge controller.
2. Connect multiple charge controllers to a DC Source Center via the charge controllers' battery terminals.
3. Do not connect the charge controller to another controller that could disconnect the charge controller from the batteries. The charge controller should not be disconnected from the battery when there is input from the wind turbine.
4. Do not connect the charge controller to the batteries through diodes

**B. Location**
The charge controller must be installed indoors and should be located relatively close to the battery bank. Do not install the charge controller outdoors; it is not waterproof.

**C. Mounting**
The charge controller needs to be mounted vertically to a wall, or other support structure, so that air can pass unobstructed through the passive cooling channel behind the enclosure. We recommend setting the height of the readout at eye level if possible so that the system status will be easiest to read.

The enclosure dimensions and mounting layout for the charge controller are shown in Error! Reference source not found.. The charge controller should be mounted with four M4 (0.157" dia.) screws. We recommend the following procedure:

Tools Required:
- Pencil
- Carpenters level
- Drill with ~ 2 mm or 0.09" dia. drill bit
- (4) M4, 1/8", or 5/32" screws
- Screwdriver

Procedure:

**Step 1:**
Mark the mounting hole locations using the charge controller enclosure as the template. Use a carpenters level to check the levelness of the enclosure before marking the holes.

**Step 2:**
Drill small (~ 2.5 mm or 0.1 in diameter) pilot holes for the mounting screws.

**Step 3:**

Screw the top two mounting fasteners into the wall until ~ 6 mm (1/4") of the shank extends out from the wall.

**Step 4:**
Remove the charge controller cover and place the charge controller enclosure on the two upper mounting fasteners. Slide the enclosure down such that the fasteners are placed at the top of the inverted "T-slots".

**Step 5:**
Install the bottom two mounting fasteners, and then tighten the top two fasteners.

## D. Wiring

All wiring should conform to the National Electric Code or other governing local electrical code. The use of electrical conduit for wiring between components is highly recommended. If you have any connections with dissimilar metals (aluminum to copper) they should be coated with an anti-oxidation compound to prevent galvanic corrosion. All loads should be protected by fuses or circuit breakers to avoid hazards from accidental short circuits.

The wind turbine tower must be well grounded and a good quality lightning surge arrestor, connected to a good quality earth ground, should be installed on the wiring from the wind turbine. We recommend a Delta LA302DC arrestor installed into the third (from the left) rear entrance hole of the enclosure. This tucks the arrestor neatly behind the enclosure. The arrestor leads are connected to the wind turbine terminals.

The charge controller does not have a built in ground, all circuits are floating, such that either the positive or the negative can be grounded. Some inverter manufacturers recommend grounding and some electrical codes require it. If you do ground the charge controller, please conform to local practices for grounding either the positive or negative bus.

All negative leads are connected together on the charge controller circuit board, so grounding the battery negative lead, will ground the turbine negative, the PV negative, and the dump load negative as well. This is the preferred grounding method; the enclosure should also be grounded, by bolting a box lug to it in a convenient location.

## E. Charge Controller Connections

We recommend the electrical connections be made in accordance with the charge controller owner's manual, which is attached in the **Appendix**. Please ensure that the wires do not pull on, or flex, the circuit board.

The EXCEL 1 wind turbine system is now ready to operate. We recommend that you verify that the EXCEL 1 is producing power by putting the charge controller in Watt Display mode. In all but the lightest of winds, you should see indication of varying wattage coming from the wind turbine.

# 8. Inspections and Maintenance

The BWC EXCEL 1 installation should be inspected after 30 days and then again 180 days after installation. Following these two inspections the installation should be inspected every two years and after any particularly severe weather. In corrosive marine environments more frequent inspections are recommended. Inspections should be done on days when the wind is below 7 m/s (16 mph).

Check List for Inspections

1. Inspect each of the anchor points. Ensure that all hardware is secure and the guy wires are properly tensioned. Check to ensure that no strands are broken.

2. Stop the alternator by clicking the mode selector button to place the charge controller into Stop Mode. Once the rotor is stopped, climb or lower the tower. Always use proper safety belts and lanyards when climbing.

| Warning |
|---|
| Only qualified personnel with proper safety equipment should climb the tower. Never climb the tower when the rotor is turning. |

3. Inspect the blades for:

   A. Condition of the leading edge, particularly out near the tip.

   B. Tip damage.

4. Remove the spinner. Check the torque on the blade nuts; the torque value is 45 ft-lbs. Check the front bearing cover for seal integrity and grease loss. Check the alternator bearings for lack of play, a tiny amount of play is acceptable and normal, if it appears excessive, pop the front bearing cover off. This will expose the bearing adjustment nut. Remove the cotter pin and tighten the nut to just snug. **DO NOT USE A WRENCH**, if the cotter pin will go through one of the two holes in the alternator shaft then push it through, if not **BACK THE NUT OFF (CCW)** until a cotter pin will go through. Replace the front bearing cover. Reattach the spinner and check that it is secure.

5. Check the screws holding the nacelle rubber bumpers and tail fin in place.

6. Check the cotter pins on the tail pivot pin.

7. Check the torque on the tower mounting bolts; the recommended value is 45 ft-lbs.

8. Check for cracks or loose hardware on the tail boom and fin.

9. While descending the tower or before raising it, inspect the following:

   A. Check that the tower wiring is properly secure.

   B. Check all tower fasteners.
   C. Look for any cracks in the tower structure.
   D. Check the condition of the guy wire attachments.

10. Check the connection on all ground rods and hardware.

11. Inspect the surge arrestor(s). Replace if there are signs of damage.

12. Restart the turbine.

13. Listen to the sound of the machine as it speeds up. No mechanical sounds, such as a "clunking" or "banging," should be heard. Also watch for any new or significant vibration. Some “growling” from the alternator is normal. The turbine operation should be smooth.

14. Inspect the wire run, particularly all electrical connections.

15. Check condition of all wiring connections into and out of the charge controller.

## Preventive Maintenance

The Bergey EXCEL 1 turbine and tower should be inspected 30 days after installation, and then again 180 days after installation.

Following these two inspections the installation should be inspected every two years and after any particularly severe weather. Inspections should be done on days when the wind is below 16 mph.

**Check List for Inspections**

1. Inspect the blades for:
   A. Cracks outboard of the hub pad, in the blade pultrusion itself. Cracks in the molded hub pad are normal after a few weeks of operation and will not affect the strength or reliability of the blade.
   B. Leading or trailing edge damage.
   C. Condition of the paint.

2. Check the torque on the blade nuts; the recommended value is 45 ft-lbs. Check the bearings for seal integrity and grease loss.

3. Inspect the mainframe for cracks.

4. Check for cracks or loose hardware on the tail boom, bushings, and fin.

5. Check the tail pivot pin and particularly its fasteners.

6. Check the connection on all ground rods and hardware.

7. Remove the alternator shorting connection. Check the disconnect switch.

8. Inspect the wire run, particularly all electrical connections.

9. Check condition of all wiring connections into and out of the charge controller.

We recommend that the bearings be re-packed (re-greased) every 8-12 years. There are four tapered roller bearings, two for the alternator and two for the tower adapter. They are all the same size (Timken L44643/L44610), except for the lower yaw bearing on EXCEL 1’s shipped after September 2003. There are two bearing seals and we recommend that these seals be replaced when the bearings are re-packed.

The strength of the blades, particularly at the root (inner) end, may degrade over time due to flexure and UV degradation of the fiberglass material. The symptom of degradation is a reduction in blade stiffness fore-and-aft. The blades have to become very flexible in the fore-aft direction before there is any risk of tower strikes during severe weather. We recommend that you check blade stiffness about every 10 years and replace the blades if they become extremely flexible.

## Charge Controller Fuses

The charge controller has four fuses. If you blow (fail) one or more of these fuses you may replace them using the following specifications and parts identifiers (P/N means part number):

Battery Fuse: 90-amps; Buss P/N JJN-90 or Little Fuse P/N JLLN-90

Turbine Fuse: 70-amp or 75-amp; special order because of the L-shaped mounting tabs, but you can use a Buss P/N JJN-70 or Little Fuse JLLN-70 by also installing 2 x M6 brass nuts per post (before placing the new fuse) to accommodate the straight tabs on the stock fuse.

Dump Load Fuse: 60-amp or 63-amp; Buss P/N JJN-60L or JJN-60, or Little Fuse JLLN-60, using 2 x M6 brass nuts per post as described for the Turbine Fuse.

# 9. Trouble-Shooting Problems

The following guide can be used to pinpoint the cause of operational problems with the BWC EXCEL 1 wind turbine and the charge controller. For problems or symptoms not found in the following listing, please contact the Service Department at Bergey Windpower Co. at:

Tel: 405-364-4212
Fax: 405 364-2078
e-mail: service@bergey.com

| Problem | Cause(s) | Diagnosis | Remedy |
|---|---|---|---|
| **Battery voltage gets too high.** | Charge controller regulating voltage set too high | Excessive battery gassing. Use voltmeter to check battery cell voltages or hydrometer to check the specific gravity – compare to battery manufacturers recommendations. | Adjust battery regulation voltage as on page 9 |
| **Batteries do not reach full state of charge.** | Charge controller regulating voltage set too low. | Use hydrometer to check the specific gravity of the battery cells. Compare with battery manufacturer's recommendation. | Adjust battery regulation voltage as on page 9 |
| | Loads are too large. | Remove largest load. If battery bank reaches higher state of charge, then the system is overloaded. | Consult with BWC about possible remedies. |

| Problem | Cause(s) | Diagnosis | Remedy |
|---|---|---|---|
| **Rotor turns, but the system doesn't charge the batteries.** | Blown Turbine fuse | Check voltage across fuse with turbine spinning, should be near zero volts DC. | Replace fuse |
| | Blown output fuse | Reading on charge controller erratic, dump load light stays on, check battery fuse with multimeter | Replace 90A battery fuse on charge controller circuit board. Check battery connections. |
| | Power transistor failure. | Turbine voltage is above 10 VDC and Turbine light is on, but no current is being delivered. | Return complete charge controller to BWC for repair. |
| | Turbine rectifier failure, possible damaged stator winding | Check voltage from the turbine. | Replace rectifier assembly, or stator |
| **Rotor is unbalanced, causing the turbine to move slightly back and forth as it spins.** | Blade tips not evenly spaced. | Check tip-to-tip distances with a tape measure. They should be within 6.5 mm (¼"). | Loosening one blade at a time, adjust the tip spacing to bring distances within specifications. |
| | Ice build-up on blades. | Visual inspection. Severe icing is very obvious. | Take no action. Do not stand under machine. The ice will be shed when there is sufficient sun and wind. |
| **Wind is higher than 16 mph, but rotor will not turn, or turns slowly** | Short in power leads. | Check connections first. Isolate power leads. Use VOM to check for short circuit. | Repair short circuit. |
| | Power transistor or MOV (varistor) failure. | Disconnect turbine from charge controller. Turbine should start. Disconnect turbine and check with diode meter. Should read ~ "1 V" in one direction and "OL" in the other direction. | Return complete charge controller to BWC for repair. Replace rectifier. |

| Problem | Cause(s) | Diagnosis | Remedy |
|---|---|---|---|
| **PV is not on, even though sun is shining.** | Dump load at 97% capacity or higher<br>PV hooked up backwards.<br>PV fuse blown. | Turn on additional loads to pull down battery voltage. See if PV turns on.<br>Check polarity.<br>Check fuse with VOM. | Normal operation.<br>Reverse leads.<br>Replace fuse. |
| **Dump load does not work.** | Fuse blown.<br>Voltage below regulation. | Check fuse with VOM.<br>Check battery bank voltage with VOM. If it is below regulation voltage ("TEST1" x 10) the dump load should not be coming on. | Check resistance of dump load, should be no less than 1/2 ohm. Replace fuse.<br>Normal operation. |
| **Dump load comes on during automatic generator charge, preventing the batteries from taking a bulk charge** | Dump load set to come on at 28.1 Volts, Inverter set to bulk charge batteries at a higher voltage | During charge, battery voltage limited to 28.1 V, Extra Load LED lit | Manually put charge controller in Equalize Mode<br>Contact BWC for help |

# Appendix

**Installation Planning**

The location and height of the tower for the BWC EXCEL 1 wind system will be important factors in determining the overall performance of the system. Average wind speed is influenced by many things and may vary considerably within a relatively small region, particularly in complex terrain. Site and tower choice, however, are often limited by such factors as zoning restrictions, property size, proximity to neighbors, customer preferences, and wiring costs. All of these factors should be taken into consideration in choosing the best tower site and height.

**A. Legal Restrictions and Good Neighbor Relations**

One of the first steps in planning an installation is to determine the legal status of the proposed wind turbine installation in the community in which it will be installed. In most cities and some counties an installation will be subject to zoning laws and building codes. Some neighborhoods have protective covenants that limit the types of home improvements. In areas requiring permits the installation must be planned weeks to months in advance to allow time for applications to be processed and, if necessary, hearings to be held.

The quickest way to determine the local codes and requirements is to call or visit the office of the building inspector. Few cities have specific regulations dealing with wind turbines, but most will have height restrictions, building code requirements, and a formal process for obtaining a building permit. The most common problem encountered in the United States is a height restriction of 35', particularly in residentially zoned areas.

The 30' Tilt Tower meets the 35 ft restriction, but it does so at some loss in performance. If you need or want to go higher than the zoning height restriction you must apply for a variance. A variance is essentially permission to break a rule and it is granted following a public hearing before a Planning Board. Obtaining a variance is a major undertaking, costing $200-5,000 and taking several months, so it is important to establish whether it will be necessary as soon as possible.

Bergey Windpower Co. has experience in working with customers and BWC dealers in variance hearings and we offer advice and assistance to those who request it.

Generally, in order to obtain a building permit you will be required to submit a plot plan and fill out an application. A plot plan is a map, drawn to scale, of your property showing the boundaries, dwelling(s) and other structures, major topographic features, easements, and, most importantly, the location and height of the proposed wind turbine tower. Often you will be required to submit plans for the tower and information on the wind turbine. In some cases you will also be required to submit a structural analysis of the tower to show that it is in compliance with the building code. Sometimes a registered Professional Engineer (PE) must sign this analysis and occasionally the PE must be licensed in the State where the unit will be installed.

Bergey Windpower Co. has engineering analyses, PE-Certified, for most towers it offers and copies of these analyses are available to our customers. Noise data is occasionally required and will soon be available for the EXCEL 1 from Bergey Windpower Co.

If your property size is several acres or more then the turbine will likely be so far from the nearest neighbor's house that they will not be bothered. It is, none the less, strongly recommended that you contact your nearest neighbors well in advance of any construction to let them know that you are installing a wind turbine. This is doubly good advice if your property size is less than several acres or you have to obtain a variance for a building permit. Good neighbor relations boil down to treating your neighbors the same way you would like to be treated and showing respect for their views. An example of what not to do is to put the turbine on your property line so that it is closer to a neighbor's house than to your own and not give those neighbors any advance notice of your intentions.

In general, we do not recommend that a BWC EXCEL 1 be installed on property of less than one-half acre in size. We say this because the impact of a wind turbine on the neighbors in such a "tight" area is significant and the potential for disputes is too great.
If you have questions about procedures, requirements, or tactics, please contact us. Since so few wind systems have been installed and communities are generally unfamiliar with them, you may face some obstacles in gaining permission to install a unit. We appreciate the pioneering spirit and resolve demonstrated by our customers and we stand ready to help out in any way that we can.

**B. Towers**

The smooth flow of the wind over the land is interrupted by obstructions and topographical variations. These interruptions bring about two important phenomena: **wind shear** and **turbulence**. Wind shear describes the fact that close to the ground the wind is slowed down by friction and the influence of obstacles. Thus, wind speed is low close to the ground and increases with increasing height above the ground. Wind shear is more pronounced over rough terrain and less pronounced over smooth terrain. Turbulence is essentially rough air caused by the wind passing over obstructions such as trees, buildings, or terrain features. Turbulent air reduces energy output and puts greater strain on the wind turbine.

The effects of both wind shear and turbulence diminish with height and can be largely overcome simply by putting the machine sufficiently high above the ground. Taller towers usually will provide better economics because the power in the wind increases as the cube of the wind velocity ($P = V^3$; e.g., a 26% increase in wind speed doubles the energy output). A small increase in average wind speed will result in a large increase in long-term energy output.

Table 2 shows the influence that tower height can have on annual energy output for the BWC EXCEL 1 wind turbine under typical DOE Class 2 inland site conditions with a shear exponent of 0.20. Wind speed may increase more radically with tower height in hilly or wooded areas. In flat open areas, power production will increase less significantly with tower height.

The BWC EXCEL 1 wind turbine must be placed on a tower that is tall enough to give the rotor proper exposure to the wind. Putting a wind turbine on a tower that is too short is like installing a solar system in the shade. As a "rule-of-thumb" the BWC EXCEL 1 should be 9 m (30 ft) above obstacles within 50 m (160 ft), particularly in the prevailing wind direction. So, the minimum recommended tower height is 9 m (30 ft.). For most situations, a tower of at least 18 m (60 ft.) is recommended for this unit.

**Table 1: Variation in wind speed and expected relative energy output with tower height**

| Tower Height (meters) | Average Wind Speed (m/s) | Relative Energy Production |
|---|---|---|
| 9 m | 4.8 | 100% |
| 13 m | 5.2 | 121% |
| 19 m | 5.6 | 147% |
| 25 m | 5.9 | 165% |
| 32 m | 6.2 | 186% |

We do not recommend mounting the BWC EXCEL 1 to a home and we suggest caution if installing one on a larger, more substantial, building. Our concerns are 1) the forces on the turbine and mounting system are substantial and homes are not designed structurally for them, 2) the air flow around and over a home or building is complex and can cause considerable turbulence, and 3) the wind turbine will cause vibrations that will be amplified through the home's structure.

BWC offers a guyed-tubular tilt-up tower, the Tilt Tower, for the EXCEL 1 in heights form 9 m (30 ft) to 32 m (104 ft). The Tilt Tower is cost-effective and is designed to be installable by non-experts. The installation of these towers is covered in the BWC EXCEL 1 Tilt Tower Installation Manual. BWC is working to expand the range of tower options, including self-supporting towers that do not require guy wires.

Customers can also supply their own towers. These towers have to meet certain criteria for strength and blade clearance (see Appendix), and a mounting adapter for the EXCEL 1 wind turbine will need to be designed and fabricated. Customer supplied towers are not covered by the BWC warranty and any damage to the EXCEL 1 wind turbine resulting from a customer supplied tower is excluded from the turbine warranty coverage.

**C. Location**

The size and layout of the installation site may limit the tower location, height, or type. More often than not, however, there are several potential sites. In choosing the best one, the following factors should be considered:

1. The proximity of the proposed site to dwellings.

As noted before, it is a good idea for you to consult with neighbors about the installation before proceeding. The rotor system and alternator do produce a certain amount of sound. This is a low-level whirring sound that usually can not be heard indoors. From a noise standpoint, the further the wind turbine is from a house the better. <u>In general, we recommend that the turbine be installed at least 60' from the house</u>. Most often the tower is installed 60' – 160' from the owner's house. Never choose a site that is closer to a neighbor's home than to your own.

2. The local elevation at the tower site.

Since system performance improves with increased wind turbine elevation it is sometimes best to site the tower on a hill or ridge to gain extra height. If, as is often the case however, the hill or ridge is a considerable distance (more than 330') from the house the additional wiring costs may more than offset the performance gain to be realized. It is often less expensive to avoid the hill and simply chose a taller tower installed closer to the house.

3. The length of the wire run.

While is possible to install wire runs (the wiring between the wind turbine and the wind turbine electronics) of 650' or more, the costs for long wire runs, particularly if they are buried, can be prohibitive. The longer the wire run, the larger and more expensive the wire that is required to conduct the electricity with acceptable losses. <u>As a general rule, wire runs over 330') if buried or 650' if installed overhead should be avoided because of their high costs.</u> On the BWC EXCEL 1 it is not possible to use transformers to increase the wire run voltage because the wire run is direct current (DC). Transformers only work with alternating current (AC).

4. General convenience.

Often the most compelling consideration for locating the wind turbine tower is the space where it will not interfere with vehicle traffic, fence lines, crops, gardens, septic system lateral lines, power poles, etc. Since the wind turbine installation is semi-permanent, your future plans for the property should also be taken into consideration. When using a Tilt Tower you should consider the extra space needed for the tower when it is tilted down.

5. Safety

The BWC EXCEL 1 should never be installed close to a power line. We recommend that the tower be at least 1 ½ times the height of the tower from any power line including any overhead service line bringing power to your home.

| Warning |
| --- |
| The wind turbine towers are typically made of metal, which readily conducts electricity. If any part of the wind turbine or tower makes contact with power lines there is a risk of electrocution. |

We also recommend that any guy wire anchors be kept away from roads or paths used by vehicles.

**D. Wiring**

The basic electrical schematic for the BWC EXCEL 1 battery charging system is shown in Error! Reference source not found..

The wind turbine alternator produces 3-phase AC, which is rectified into DC in the controller. A three (3)-conductor wire is needed between the wind turbine and the charge controller. The charge controller has a fuse for the wind turbine input, so a fused-disconnect switch is not required at the base of the tower (as is recommended for the other BWC wind turbines).

We recommend that the tower wiring be with SO cord. The SO cord's neoprene jacket will provide good abrasion resistance. For ground runs we recommend THHN wire buried inside plastic conduit rated for electrical service. A suitable watertight junction box should be installed at the base of the tower to enclose the wire connections between the tower and underground wiring.

In some cases it will be possible to provide direct point-to-point wiring between the EXCEL 1 wind turbine and the charge controller. For this purpose we recommend 3-conductor VNTC (Vinyl Nylon Tray Cable), which is suitable for outdoor and direct-burial applications. For rocky soils, or runs underneath roadways, we recommend that the underground wire run be installed in conduit. If a wiring junction is made at the base of the tower then a watertight junction box should be installed for the connections.

The recommended wire sizes for the 48 VDC EXCEL 1 wind turbine are shown in Table 3. The listed distances include the height of the tower.

Maximum Current: 60 amps

| Caution |
| --- |
| Installing wire sizes larger than those recommended will increase the maximum current produced by the turbine. |

**Table 2: Recommended Wire Sizes for the EXCEL 1**

| WIRE SIZE | | DISTANCE FROM TURBINE TO CHARGE CONTROLLER | |
|---|---|---|---|
| MM^2 | AWG | METERS | FEET |
| 10 | 8 AWG | 0 - 35 | 0 - 116 |
| 16 | 6 AWG | 36 - 56 | 117 - 183 |
| 25 | 4 AWG | 57 - 89 | 184 - 292 |
| 30 | 3 AWG | 90 - 112 | 293 - 368 |
| 35 | 2 AWG | 113 - 141 | 369 - 464 |
| 50 | 1 AWG | 142 - 178 | 465 - 585 |
| 55 | 1/0 AWG | 179 - 225 | 586 - 739 |
| 70 | 2/0 AWG | 226 - 287 | 740 - 940 |
| 95 | 3/0 AWG | 288 - 361 | 941 - 1185 |
| 120 | 4/0 AWG | 362 - 455 | 1186 - 1494 |

Note: These wire sizes have been engineered to provide optimum rotor loading for the BWC EXCEL 1/48 wind turbine. Deviation from these recommendations can result in decreased performance from your machine and / or unnecessary additional wire-run costs. The use of a wire gage one size larger than the recommended size is recommended if aluminum wire is used.

Before assembling the wind turbine the tower wiring must be in place, though not necessarily permanently affixed. We recommend that you leave at least 30 cm (12 in) of free wire at the top of the tower for making the electrical connections to the wind turbine.

### E. Other System Components

A complete remote power system will include other electrical components such as a solar array (optional), a battery bank (required), a dump load (optional), and an inverter (optional). These components are sometimes called the “balance of system” or BOS equipment.

The wind turbine and the other BOS equipment are electrically connected in a “DC-bus” architecture, as shown in **Figure 4**. The DC-bus architecture is robust and very flexible, allowing endless options for multiple and differing components. The unifying feature is that all of these components are electrically connected to the positive (+) and negative (-) DC bus, so they all experience the same DC voltage. The DC voltage of the system is largely determined by the state of charge of the battery bank and to a lesser, but still significant, extent by the charging or discharging rates (the rate at which DC current, or amps, is being created or consumed).

Charging components, such as wind turbines, solar arrays, and inverter/chargers (powered by a back-up generator or the power grid), can be added to a DC-bus system with separate charge regulators and these regulators can operate completely autonomously (e.g., they do not need to communicate with each other or be coordinated using a central system controller). The separate charge regulators, whether there is just one or if there are a dozen, will respond to the DC-bus voltage and control their generators charging current.

When putting together or adding to a DC-bus remote power system there are a few pitfalls to avoid if possible:

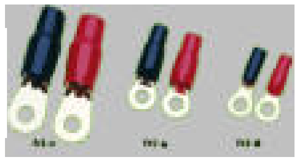
- Battery banks that are too small, so that battery voltage swings too much with high charging or discharging currents.
- Multiple charge regulators set to the same voltage, so that there is one big step in charging current rather than several smaller ones.
- Setting high voltage regulation points too low so that the batteries don’t get fully charged

- Setting the low voltage disconnect (typically part of the inverter) too high so that the battery bank capacity is underutilized

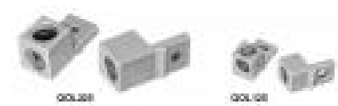
## How to Avoid the 6 Most Common Mistakes When Installing an EXCEL 1

1. **DO NOT use the charge controller box lugs to connect wiring to the turbine**. There is not enough space for them, so they will rub the tower and eventually develop a short circuit. Use crimp-type ring lugs.

**Use These**



**Not These**



2. **DO use the built-in polarity checker when connecting the battery leads to the charge controller**. Connect either battery lead to the Neg. (-) battery terminal on the charge controller, and then touch the other lead to the Polarity Test Point. A green LED is good, a red LED shows that the polarity is reversed. Do Not connect your test wire to the Pos. (+) terminal. Use the same procedure when connecting PV to the charge controller. Please note that the Neg. (-) Battery terminal is on the LEFT side, while the Turb. Neg. (-) terminal is in the RIGHT side.
3. **DO NOT install a circuit breaker between the charge controller and the battery bank.** Using a circuit breaker on the output of the charge controller can allow the charge controller to be open-circuited under high output condition, which can damage the system. If you are using a Trace Power Panel, Do Not connect the wind turbine to the PV Array Disconnects in the DC Disconnect Box. Do connect the charge controller to the “top” of one of the Battery Disconnects (Pos.) and the Grounding Block (Neg.).
4. **DO NOT install the wind turbine close to a steep slope or cliff.** If the wind can blow up at an angle as it hits the wind turbine the furling will be hampered and the turbine will experience excessive loads and vibration. This is most important from the prevailing wind direction. Try to keep the tower at least two tower heights back from steep slopes.
5. **DO use thimbles on all guy wires and position the lower malleable clip close to the thimble so that the guy wire “captures” the thimble securely.** Not using thimbles or not securing them can lead to guy failure and tower collapse. Thimbles are not required on knuckle-end anchors, such as double-eye and triple-eye anchors.
6. **DO follow the recommended wire sizes for your wire run from the wind turbine to the charge controller.** With the EXCEL 1 oversizing the wire is a bad thing because it will cause excessively high currents during high winds. Normally, over sizing wire is a good thing – but not in this case.

EXCEL 1 SPECIFICATIONS

TURBINE:

| | | |
|---|---|---|
| • ROTOR DIAMETER | 2.5 M | 8.2 FT |
| • OVERALL LENGTH | 2.1 M | 6.9 FT |
| • TURBINE WEIGHT | 34 KG | 75 LB |
| • TURBINE THRUST | 890 N | 200 LB |
| • RATED POWER | | 1,000 W |
| • RATED WINDSPEED | 11 M/S | 24.6 MPH |
| • RATED ROTOR SPEED | | 490 RPM |
| • START-UP WINDSPEED | 3 M/S | 6.7 MPH |
| • CUT-IN WINDSPEED | 2.5 M/S | 5.6 MPH |
| • FURLING WINDSPEED | 13 M/S | 29 MPH |
| • MAX DESIGN WINDSPEED | 54 M/S | 120 MPH |
| • MAX RUNNING CURRENT | 60 AMPS | |
| • MAX SHORT CIRCUIT CURRENT | 120 AMPS | |

WIRE SIZING RECOMMENDATIONS:

| | | |
|---|---|---|
| • BATTERY TO CONTROLLER | 25 MM^2 | 4 AWG |
| • DUMP LOAD | 16 MM^2 | 6 AWG |
| • PV PANEL (MINIMUM) | 10 MM^2 | 8 AWG |
| • TURBINE TO CHARGE CONTROLLER | SEE TABLE BELOW | |

| WIRE SIZE | | DISTANCE FROM TURBINE TO CHARGE CONTROLLER | |
|---|---|---|---|
| MM^2 | AWG | METERS | FEET |
| 10 | 8 AWG | 0 - 35 | 0 - 116 |
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| 50 | 1 AWG | 142 - 178 | 465 - 585 |
| 55 | 1/0 AWG | 179 - 225 | 586 - 739 |
| 70 | 2/0 AWG | 226 - 287 | 740 - 940 |
| 95 | 3/0 AWG | 288 - 361 | 941 - 1185 |
| 120 | 4/0 AWG | 362 - 455 | 1186 - 1494 |

BASIC TOWER REQUIREMENTS
For the BWC EXCEL 1 Wind Turbine

**Customer supplied towers for the BWC EXCEL 1 Wind Turbine should meet the following minimum requirements:**

**Tower Height:** 9 m (30 ft) minimum, though we recommend 18 m (60 ft) or higher

**Design Wind Speed:** 54 m/s (120 mph)

**Turbine Weight:** 34 kgs (75 lbs)

**Maximum Turbine Thrust Load:** 890 N (200 lbs) @ 54 m/s (120 mph)

**Blade Clearance:** Top 1.1 m (44 in) of the tower must not exceed 12.7 cm (5 in) radius from the tower center line

**Dynamics:** Not considered due to variable rotor speed

**Stiffness:** Tower top should not deflect more than 15 cm (6 in) @ 54 m/s (120 mph)

**Turbine Mounting:** Cylindrical, 108 mm (4.25 in) Outside Dia. See attached drawing

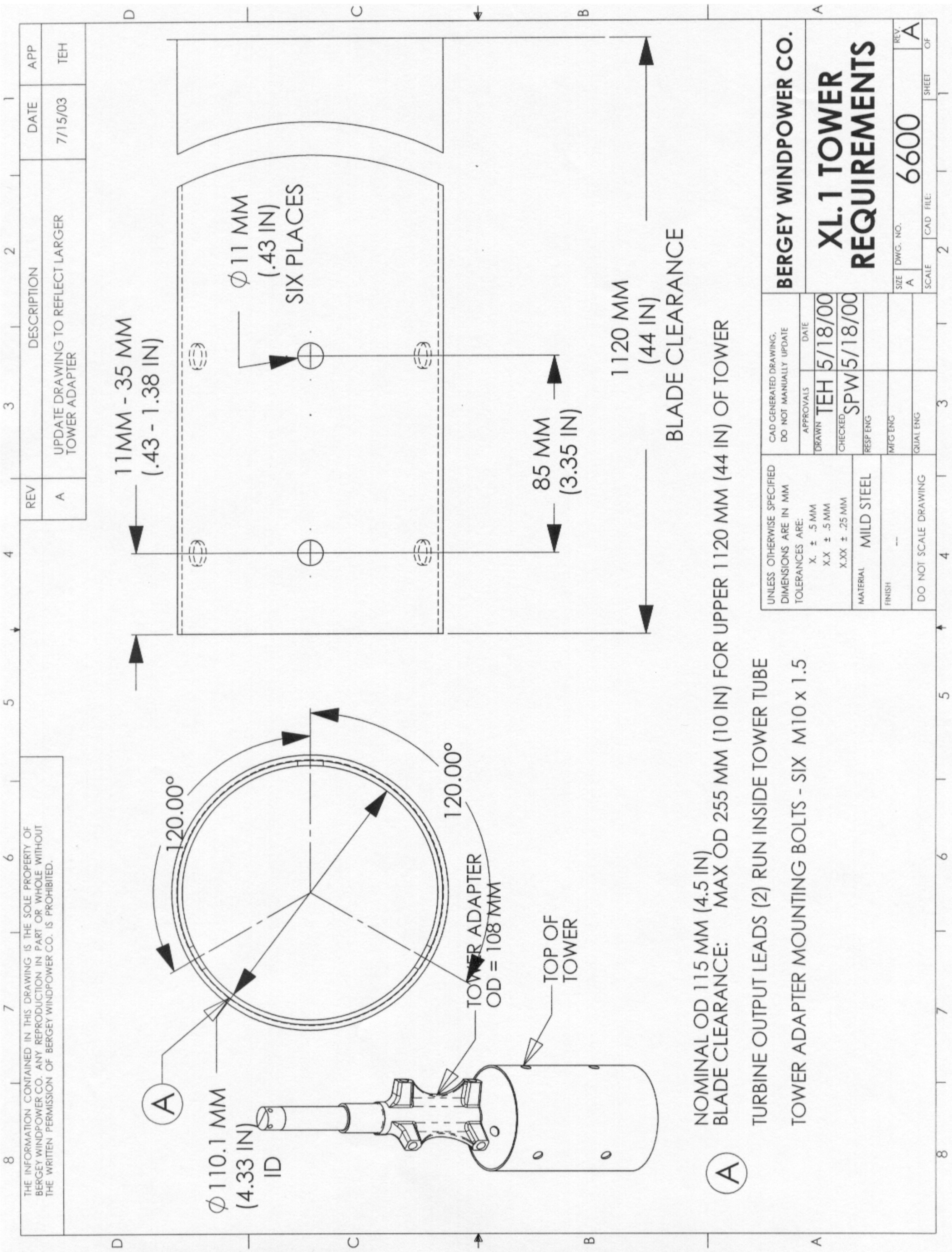
**Tower Climbing:** On non-tilting towers, provisions must be made to allow the tower to be climbed for inspections and possible maintenance. Climbing pegs should be removable if they do not meet the blade clearance requirement. On lattice-type towers, we recommend the use of horizontal laterals to facilitate climbing. We recommend the use of anti-fall devices for towers requiring climbing.

**Materials:** We recommend low-carbon steel towers, with careful attention given to weld quality. Stress risers and brittle materials must be avoided because of the possibility of fatigue and cracking. We do not recommend aluminum be used due to the risk of cracking. Fasteners should be U.S. Grade 2 or Grade 5 or equivalent.

**Finish:** We recommend hot-dip galvanizing after fabrication

**Pipe / Tubing Sizes:** The following standard steel tubing sections have ID and OD dimensions that are compatible with the BWC EXCEL 1 (shipped after Sept. 2003):

4.5 in. OD, 0.095 in. wall thickness
4 in. pipe, 0.120 in. wall thickness
120 mm OD, 5.0 mm wall thickness
120 mm OD, 2.5 mm wall thickness


THE INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF BERGEY WINDPOWER CO. ANY REPRODUCTION IN PART OR WHOLE WITHOUT THE WRITTEN PERMISSION OF BERGEY WINDPOWER CO. IS PROHIBITED.
REV | DESCRIPTION | DATE | APP
A | UPDATE DRAWING TO REFLECT LARGER TOWER ADAPTER | 7/15/03 | TEH
Ø110.1 MM (4.33 IN) ID
120.00°
120.00°
TOWER ADAPTER OD = 108 MM
TOP OF TOWER
11MM - 35 MM (.43 - 1.38 IN)
Ø11 MM (.43 IN) SIX PLACES
85 MM (3.35 IN)
1120 MM (44 IN) BLADE CLEARANCE
A NOMINAL OD 115 MM (4.5 IN)
BLADE CLEARANCE: MAX OD 255 MM (10 IN) FOR UPPER 1120 MM (44 IN) OF TOWER
TURBINE OUTPUT LEADS (2) RUN INSIDE TOWER TUBE
TOWER ADAPTER MOUNTING BOLTS - SIX M10 x 1.5
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN MM TOLERANCES ARE: X. ± .5 MM X.X ± .5 MM X.XX ± .25 MM
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BERGEY WINDPOWER CO.
XL.1 TOWER REQUIREMENTS
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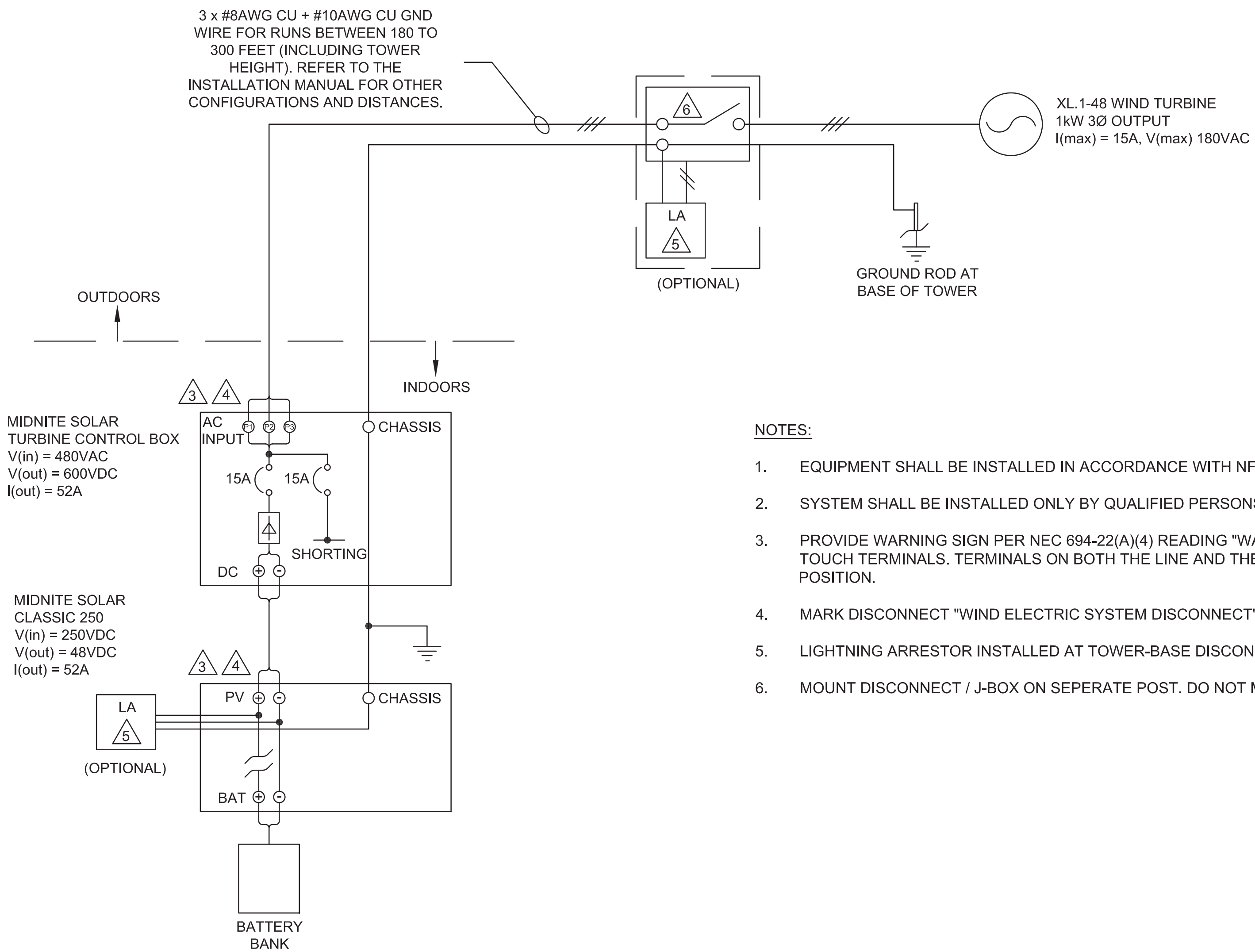


NOTES:

1. EQUIPMENT SHALL BE INSTALLED IN ACCORDANCE WITH NFPA 70 NEC ARTICLE 694.
2. SYSTEM SHALL BE INSTALLED ONLY BY QUALIFIED PERSONS PER NEC 705-6.
3. PROVIDE WARNING SIGN PER NEC 694-22(A)(4) READING "WARNING. ELECTRIC SHOCK HAZARD. DO NOT TOUCH TERMINALS. TERMINALS ON BOTH THE LINE AND THE LOAD SIDE MAY BE ENERGIZED IN THE OPEN POSITION.
4. MARK DISCONNECT "WIND ELECTRIC SYSTEM DISCONNECT" PER NEC 694.22(C)(2).
5. LIGHTNING ARRESTOR INSTALLED AT TOWER-BASE DISCONNECT SWITCH OR POWERCENTER.
6. MOUNT DISCONNECT / J-BOX ON SEPERATE POST. DO NOT MOUNT TO THE TOWER.

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**BERGEY WINDPOWER**
**NORMAN, OKLAHOMA**



TITLE: XL.1 1kW 48VDC SYSTEM SINGLE LINE DIAGRAM

REVISION: 0
SCALE: 1=1
DRAWING NO.: XEC0805

# MidNite Solar Classic
# Owner's Manual


## This Manual covers models Classic 150, 200, 250 &250KS

The MidNite Solar Classic charge controller conforms to ***UL 1741, Safety for Inverters, Converters, Controllers and Interconnection System Equipment for Use With Distributed Energy Resources, Second Edition, May 7, 1999 with revisions through January 28, 2010 and CAN/CSA C22.2 No. 107.1: 2001/09/01 Ed: 3 (R2006)***

**Note: The Classic KS has not been evaluated by ETL.**



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# Scope

This Manual provides safety guidelines and installation information for the Classic charge controller. It does not provide brand specific information about photovoltaic panels, batteries etc.  Contact the manufacturer of other components in the system for relevant technical data.

# Introduction

The MidNite Classic charge controller is unique in its ability to be used for a great variety of DC input sources. The Classic is designed to regulate DC input from PV, Hydro, Wind and other DC sources..
The Classic 150, 200 and 250 are designed to work with 12, 24, 36, 48, 60 and 72 volt battery banks.
The Classic250KS is designed to charge up to a 120V nominal battery bank.
The Classic can be installed stand alone or as a multi-unit networked installation.

Standard features of the Classic charge controller include:
*3 input operating voltage ranges 150, 200 and 250 VDC
*Multiple DC input options (example Solar, Wind or Hydro)
*Wizard driven setup interface including voice and help screens
*Graphical display
*Previous 180 days of operational data logged
*Internet ready

This Manual covers ***Classic 150, Classic 200 Classic 250 and the Classic 250KS***. It covers the installation, wiring and use of the Classic charge controller.

**WARNING** Warnings signs identify conditions or practices that could result in personal injury or loss of life.

**CAUTION** Cautions identify conditions or practices that could result in damage to the unit or other equipment.

MIDNITE SOLAR CHARGE CONTROLLER INSTALLATION GUIDELINES AND SAFETY INSTRUCTIONS

This product is intended to be installed as part of a permanently grounded electrical system as shown in the system configuration sections. The following important restrictions apply *unless superseded by local or national codes*:

•The System's DC Negative conductor must not be bonded to earth ground. The Classic does this with its internal Ground Fault Protection circuitry.  The battery negative and ground are not bonded together directly but are connected together by the Classic’s internal GFP device. All negative conductor connections must be kept separate from the grounding conductor connections. The equipment ground terminal inside the Classic must be connected to Earth Ground for the internal DC-GFP to work. *Continue*

• With the exception of certain telecom applications, the Charge Controller should *never* be positive grounded.

• The Charge Controller equipment ground is marked with this symbol: ⏚
• If damaged or malfunctioning, the Charge Controller should only be disassembled and repaired by a qualified service center. Please contact your renewable energy dealer/installer for assistance. Incorrect reassembly risks malfunction, electric shock or fire.
• The Charge Controller is designed for indoor installation or installation inside a weatherproof enclosure. It must not be exposed to rain and should be installed out of direct sunlight.

**For routine, user-approved maintenance:**

• Turn off all circuit breakers, including those to the solar modules, batteries and related electrical connections before performing any maintenance.

**Standards and Requirements**

All installations must comply with national and local electrical codes; professional installation is recommended. The NEC in the USA requires a DC ground fault interrupter for all residential PV installations. NEC2011 requires an ARC FAULT detector on all charge controllers and inverters operating above 80VDC. Both of these devices are built into the Classic.

**DC and Battery-Related Installation Requirements:**

- ❖ All DC cables must meet local and national codes.
- ❖ Shut off all DC breakers before connecting any wiring.
- ❖ Torque all the Charge Controller's wire lugs and ground terminals to the specs found on page 19.
- ❖ Copper wiring must be rated at 75° C or higher.
- ❖ Keep cables close together (e.g., using a tie-wrap) as much as possible to reduce inductance.
- ❖ Ensure both cables pass through the same knockout and conduit to allow the inductive currents to cancel.
- ❖ DC battery over-current protection must be used as part of the installation on the input and output.
- ❖ Breakers between the battery and the Classic must meet UL489 standards.
- ❖ Breakers between the DC source and the Classic must meet UL1077 or UL489 standards.

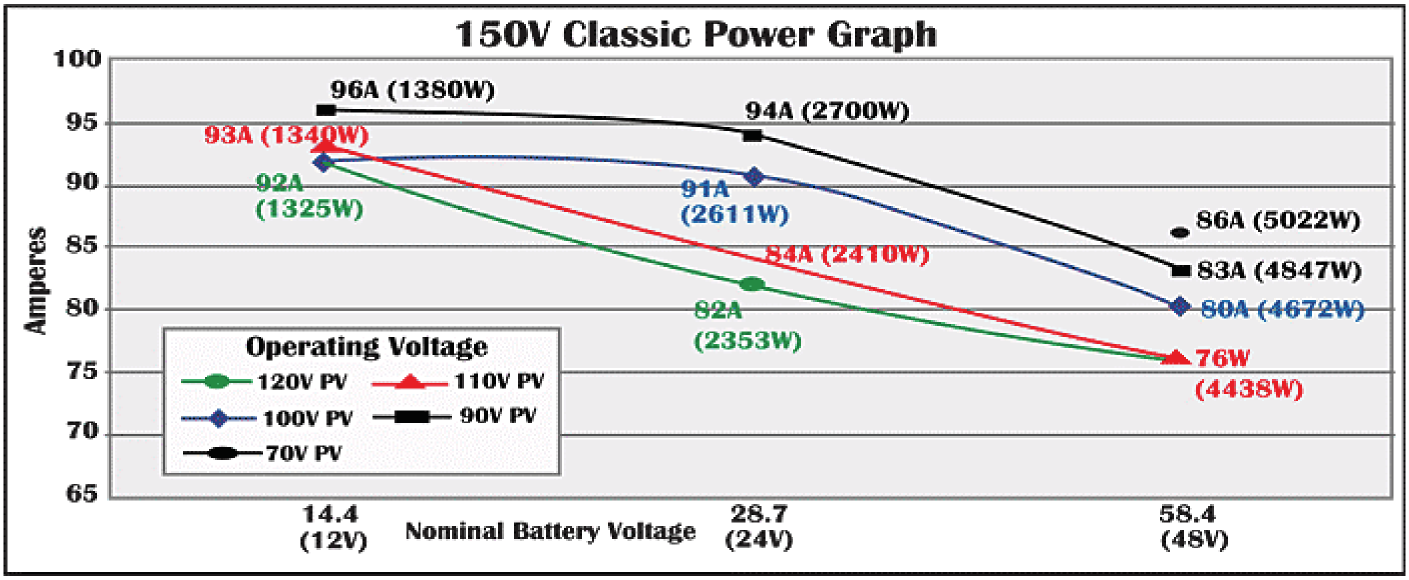
Design the battery enclosure to prevent accumulation of hydrogen gas at the top of the enclosure. Vent the battery compartment from the highest point to the outside. A sloped lid can also be used to direct the flow of hydrogen to the vent opening. Sealed (AGM, Gel etc) batteries do not normally require ventilation. Consult your battery manufacturer for details.

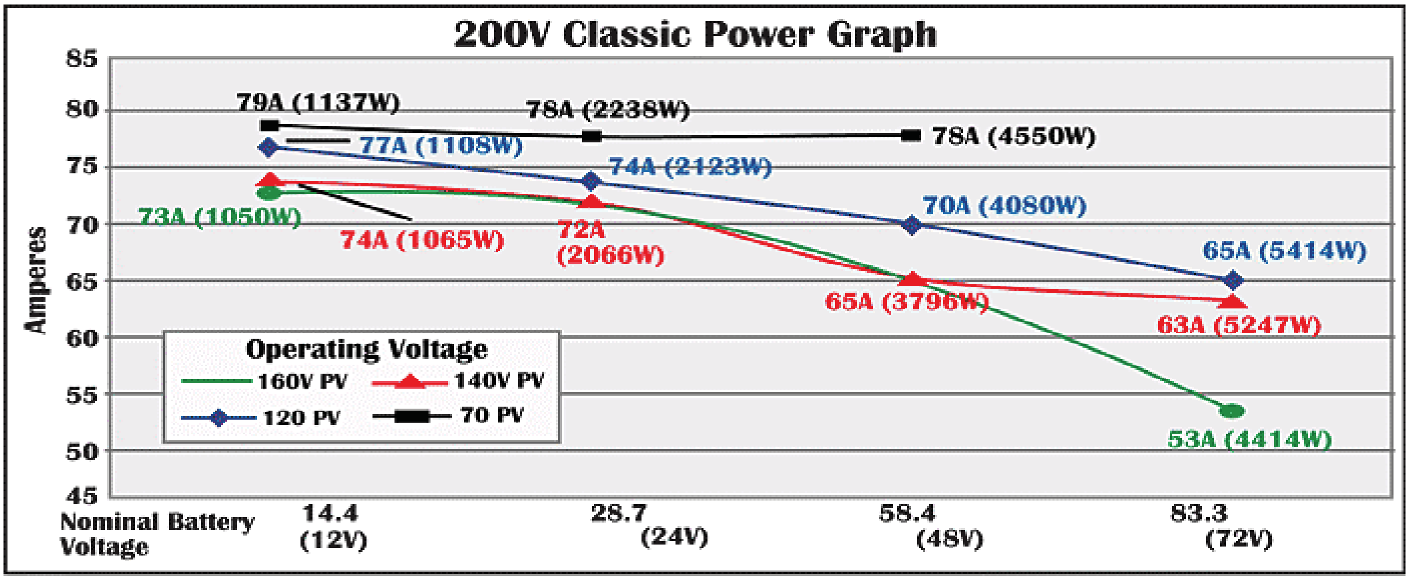
**WARNING: PERSONAL PRECAUTIONS DURING INSTALLATION**
**WARNING BATTERIES PRESENT RISK OF ELECTRICAL SHOCK, BURN FROM HIGH SHORT CIRCUIT CURRENT, FIRE OR EXPLOSION FROM VENTED GASES. FOLLOW PROPER PRECAUTIONS.**

- ❖ Someone should be within range of your voice to come to your aid if needed.
- ❖ Keep plenty of fresh water and soap nearby in case battery acid contacts skin, clothing, or eyes.
- ❖ Wear complete eye protection. Avoid touching eyes while working near batteries. Wash your hands with soap and warm water when done.

- ❖ If battery acid contacts skin or clothing, wash immediately with soap and water. If acid enters an eye, flood the eye with running cool water at once for at least 15 minutes and get medical attention immediately following.
- ❖ Baking soda neutralizes lead acid battery electrolyte. Keep a supply on hand in the area of the batteries.
- ❖ NEVER smoke or allow a spark or flame in vicinity of a battery or generator.
- ❖ Be cautious to reduce the risk of dropping a metal tool onto batteries. It could short the batteries or other electrical parts that can result in fire or explosion.
- ❖ Never wear metal items such as rings, bracelets, necklaces, and watches when working with a battery or other electrical circuits. A battery can produce a short circuit current high enough to weld a ring or the like to metal, causing severe burns.

## Classic Power Curves



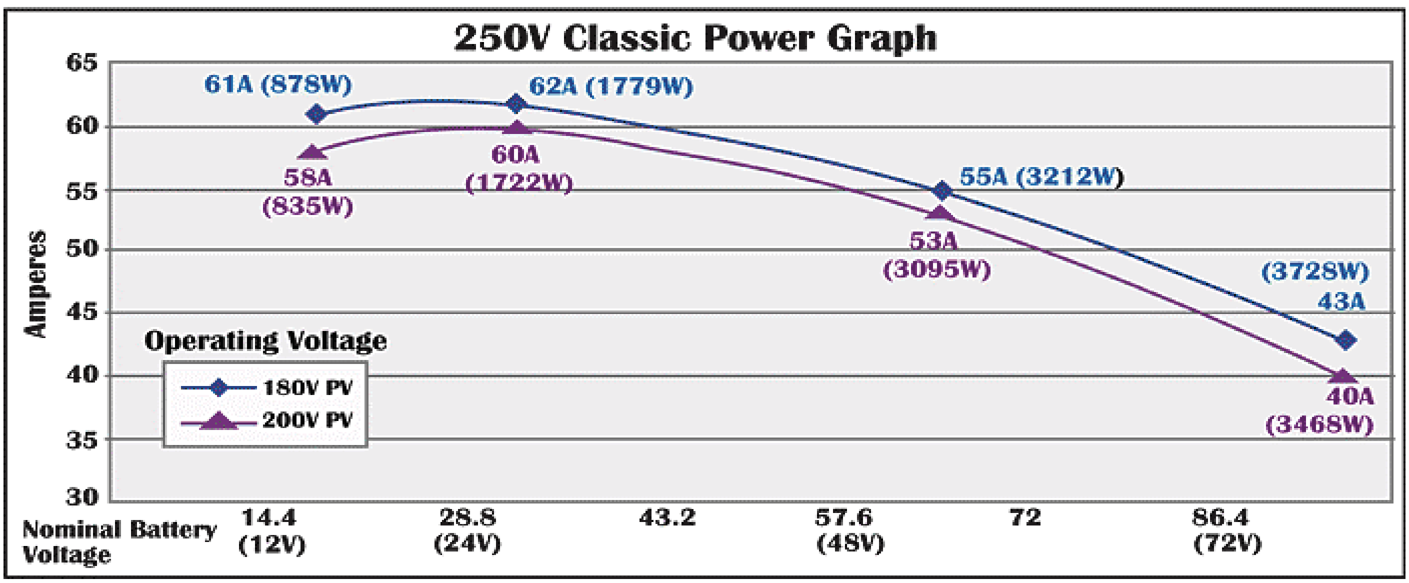
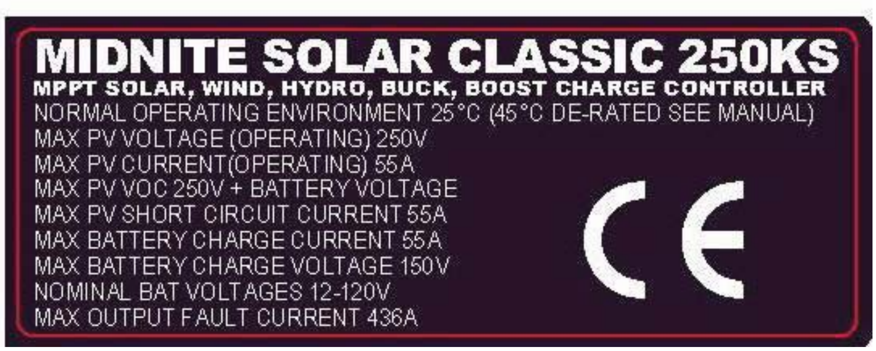



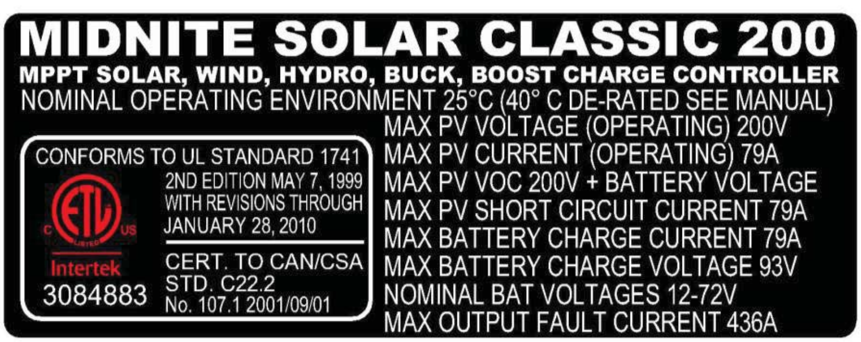
Figure 2.1

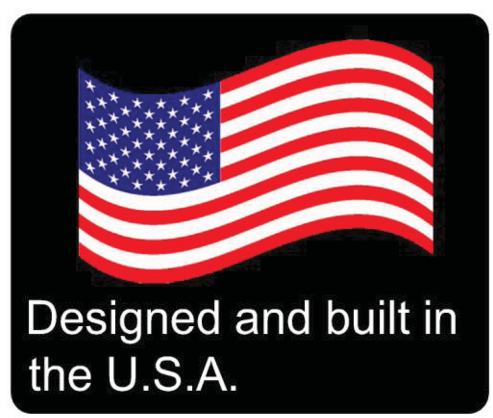
The graphs above represent the max power output for a given input for each Classic. Using and understanding these power graphs will help maximize Classic's output power and aid in selecting wire and breaker/disconnects. The built in set up wizard also helps select breakers and wire sizes. Notice that lower battery voltages and lower PV input voltages result in higher continuous output power. The PV voltages listed are for reference and are not intended to be the only PV voltages supported. The battery voltages listed show the most used battery bank configurations. Other voltages are also supported. The Classic battery voltage parameters are fully user adjustable.

**For example:** if you are using a Classic 250 and 48v battery bank, the maximum continuous output power based on 25 degree C ambient is 55 amps when using a PV array that yields a Maximum Power Voltage of 180 volts. The same set up using a bit higher voltage modules that result in a 200V Maximum Power voltage will result in only 53 amps. Although 55 to 53 amps is not a significant change, it does give you the idea that all things being equal, lower voltages are a bit more efficient.

Below are the labels present on the Classic.




## Unpacking the Classic

When you receive your Classic you will want to unpack it and make sure everything is there and in good shape. Refer to Figure 1.1. Included in the Classic package should be:

*Classic charge controller
*Battery temperature sensor
**Snap on upper vent cover
*Knock out covers 4 screened
**Knock out covers 4 solid
*User’s manual DVD, printed installation instructions

*1 ten foot custom USB cable

**Note. These items are optional email customerservice@midnitesolar.com for more information
If anything is missing or damaged please refer to Page 2 for details on contacting us.

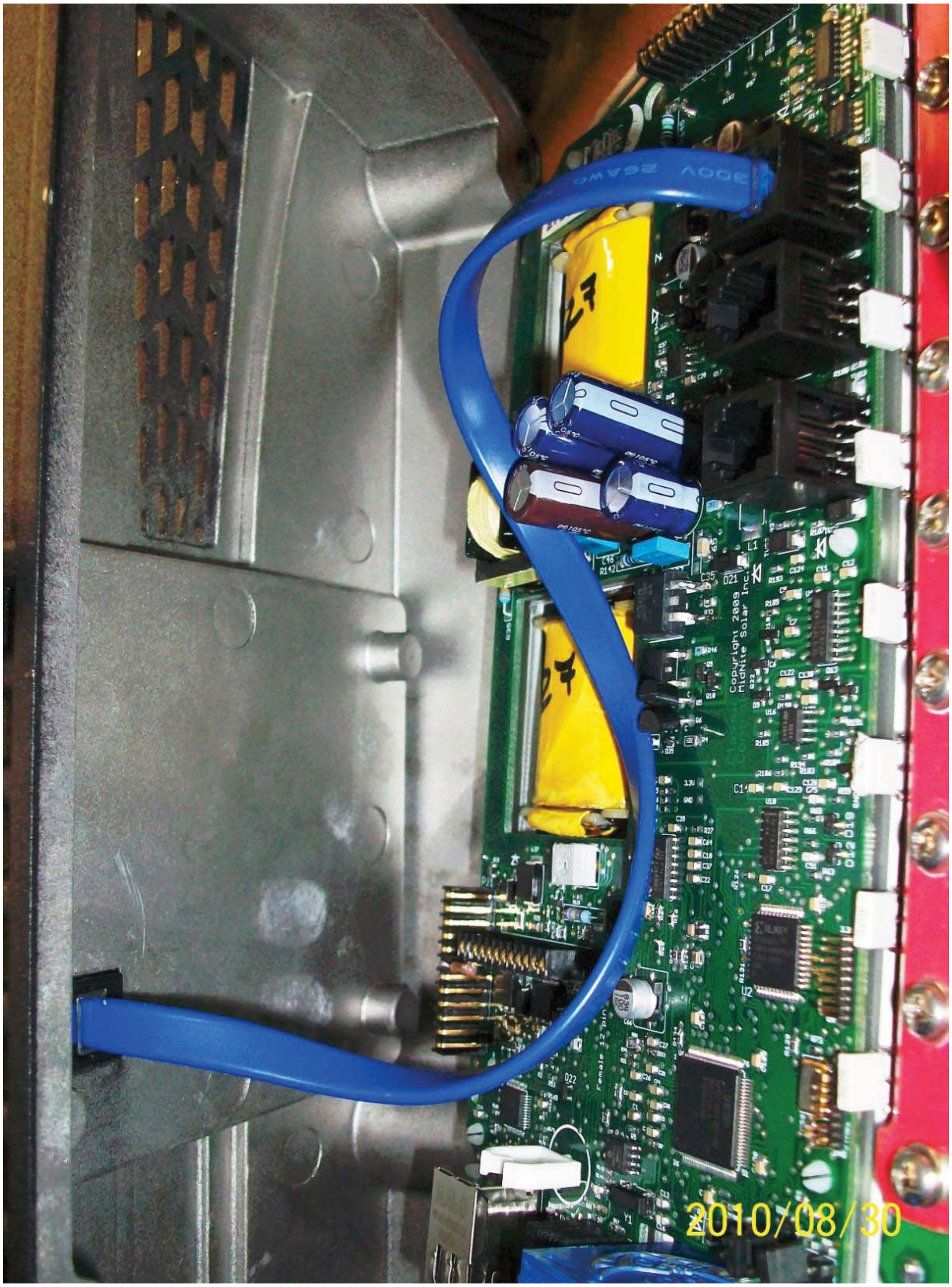
*Figure 1.1*


## Removing and installing the front cover on the Classic

Removing the front art deco cover is required to gain access to the wiring compartment.
**Be aware there is a cable connecting the cover to the electronics. Do not pull hard or fast as damage could occur.**

To remove the front cover of the Classic in preparation for installation, remove the 4 Phillips head screws with a #2 Phillips screwdriver. Lift the front half of the Classic casting off. You will need to unplug the display cable. It works the same as any phone cable.
To re-install the front cover of the Classic you will need to plug in the display cable and carefully route it around the components on the circuit board as you set the cover in place. See Figure 1.2 Do not force the cover if it does not seat into place easily stop and look for any cables or wires that may be interfering. With the cover seated in place install the four Phillips screws with a #2 Phillips screwdriver.

Figure 1.2




## Mounting the Classic

The following section covers typical mounting arrangements. If you require additional details that are not covered here please contact our technical support team. The Classic is designed to be directly mounted onto the MidNite Solar E-Panel. The Classic can also accommodate other installation methods as well. Mount in an upright position out of direct sunlight when possible. For your convenience the

Classic has four one inch knock outs that are pre cast. The Classic has mounting locations and conduit locations are similar to other brands of charge controllers to facilitate ease of upgrading older technologies.

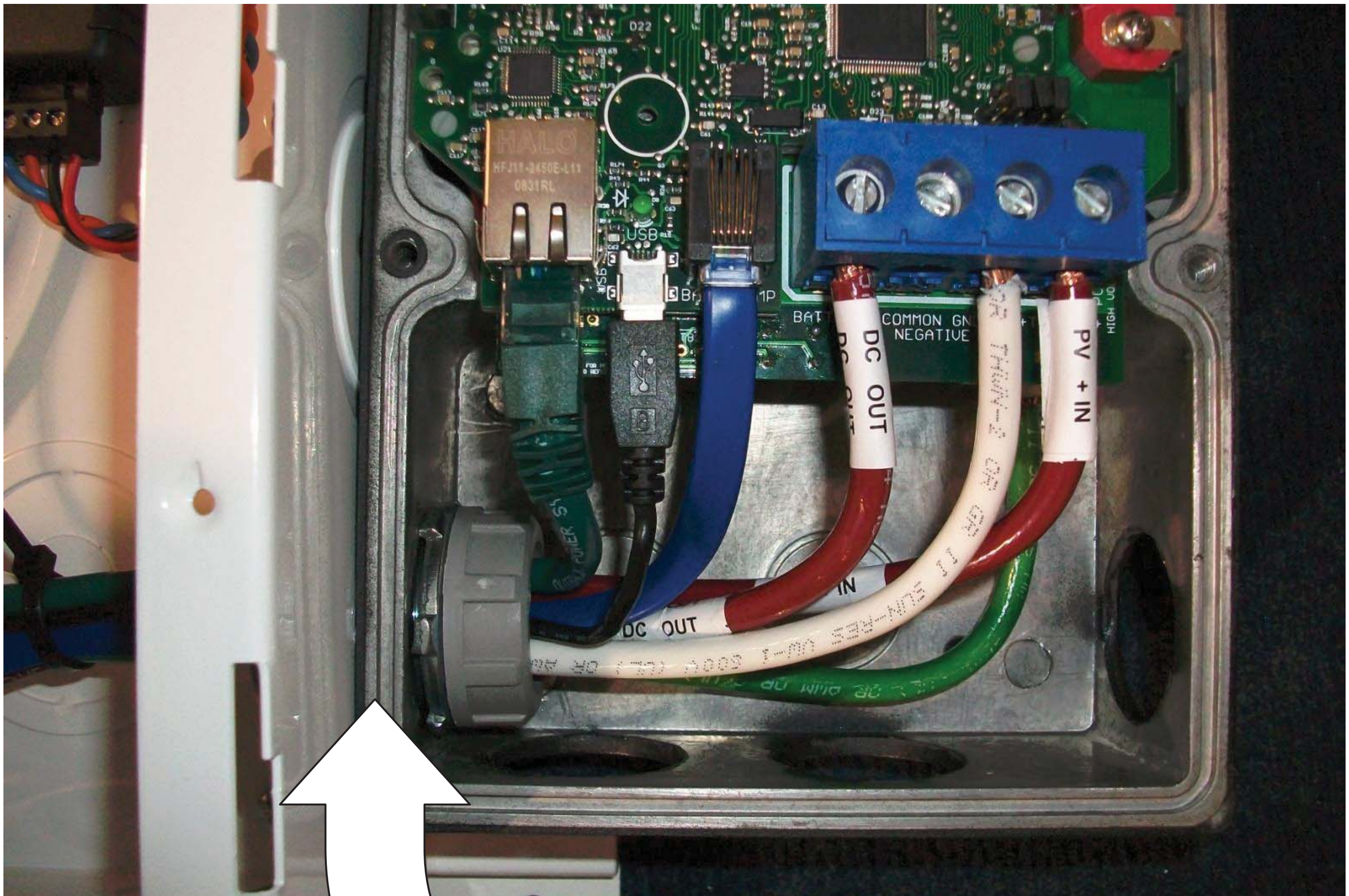
Mounting the Classic directly to the E Panel:
*Remove the front cover of the Classic.
*Install the mounting bracket on the E Panel and start the upper mounting screw into the bracket leaving it about half way out so you can hang the Classic on this screw.
*Install the 1 inch close nipple into the E Panel as shown in the E-Panel directions. The 1” close nipple, 3 locknuts and 2 plastic bushings are included with each E-Panel. One locknut acts as a spacer.
*Carefully hang the Classic on the screw in the bracket and slide it over the close nipple see figure 1.3.
*Install the lock nut and bushing on the close nipple and tighten the screw in the mounting bracket.
*Don't install the front cover until you complete the wiring of the Classic.

Figure 1.3A Charge controller bracket mounted to the E-Panel. The bracket comes with every E-Panel

Figure 1.3B Classic Mounted to side of E-Panel

Figure 1.3C Nipple, locknuts and bushings that come with every E-Panel

Figure 1.3D Classic mounted to the side of a MidNite Solar E-Panel



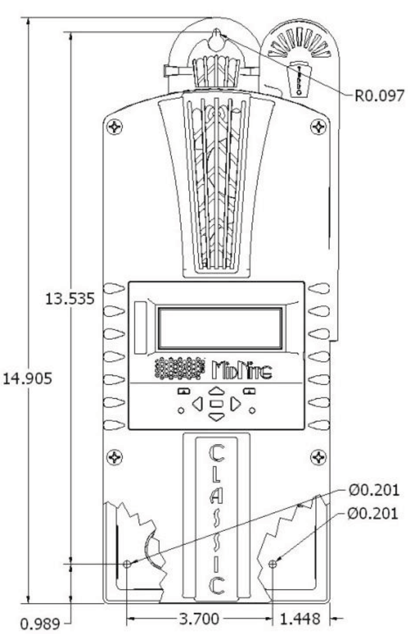

Install locknut here to act as a spacer.

## Alternative Mounting

To mount the Classic to a plywood surface use 1 1/2” wood screws in the top key hole slot hole and the holes in the wiring compartment. Taking care to make sure the Classic is Plumb and Level.

### Dimensions

See page 40 for more details.




## Sealed or Vented

The Classic has the ability to be sealed for protection from salt air or dust. It comes from the factory Vented. If you live in a dusty or salt air environment you may wish to seal the Classic. Sealing the Classic does not make the unit water resistant. To seal the Classic  install the solid plastic knock out covers into any unused knock outs and snap the upper vent cover onto the Classic as seen in the photo below. Note that the Classic will be slightly de-rated (puts out less power) by sealing it. Refer to the specifications page of the owner’s manual for the ratings in the sealed mode. To obtain the parts necessary to seal the Classic please contact our Technical Support Team. Refer to Figure 1.4 and 1.5

Figure 1.4

Figure 1.5


## Network Cable Routing and Installation Guidelines

The Classic uses a 4 conductor phone cable to communicate with other Classic's or other MidNite products. This cable is a standard 4 conductor phone cable and simply plugs into the jack on the Classic labeled slave. Plug the other end into the master jack on the second device. There is a plastic clamp located on the circuit board for routing the network cables above the USB jack so they stay tied down and out of the way. Refer to figure 1.7A and 1.7B

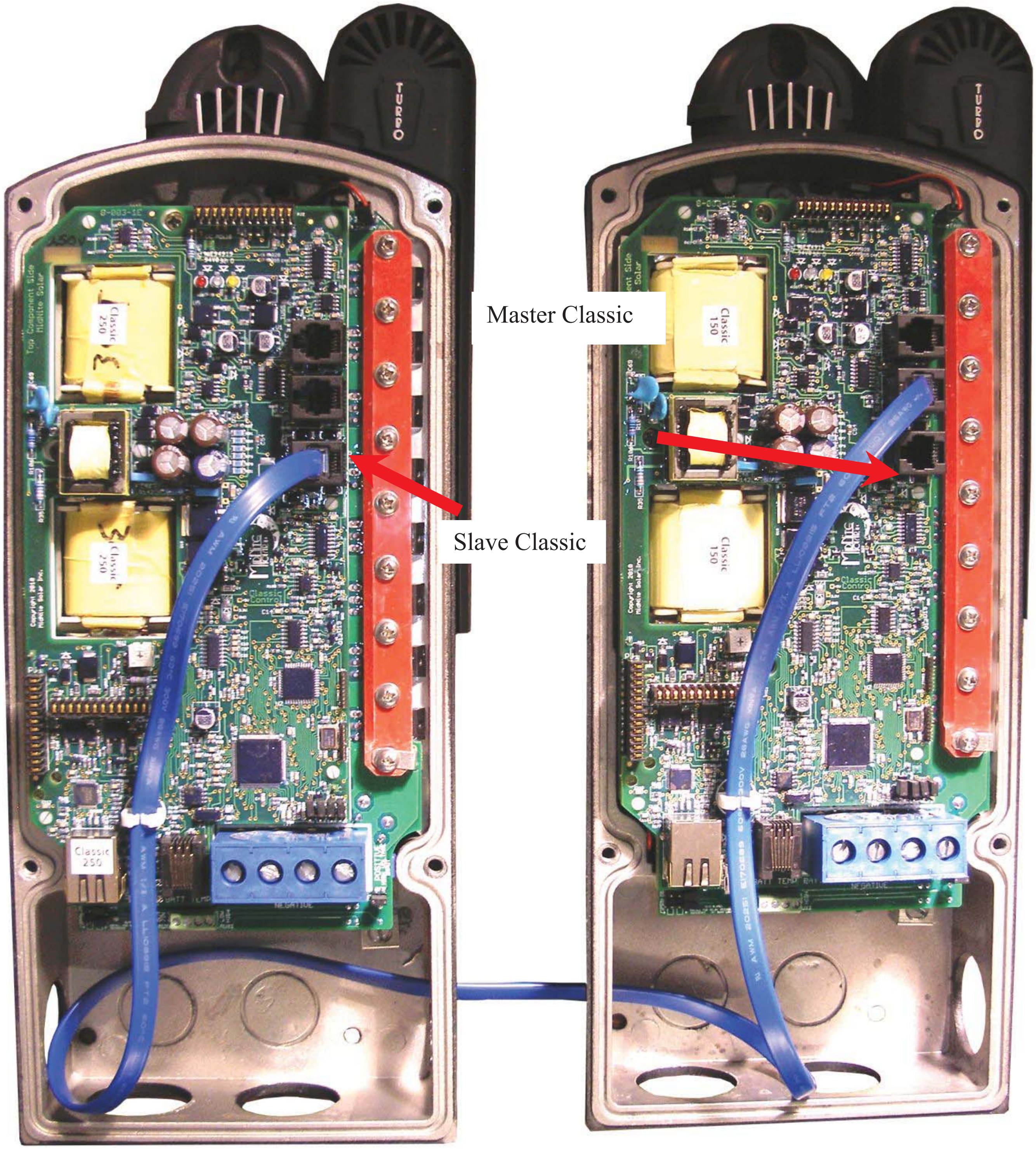



Figure 1.7A Master / Slave methods of hook up

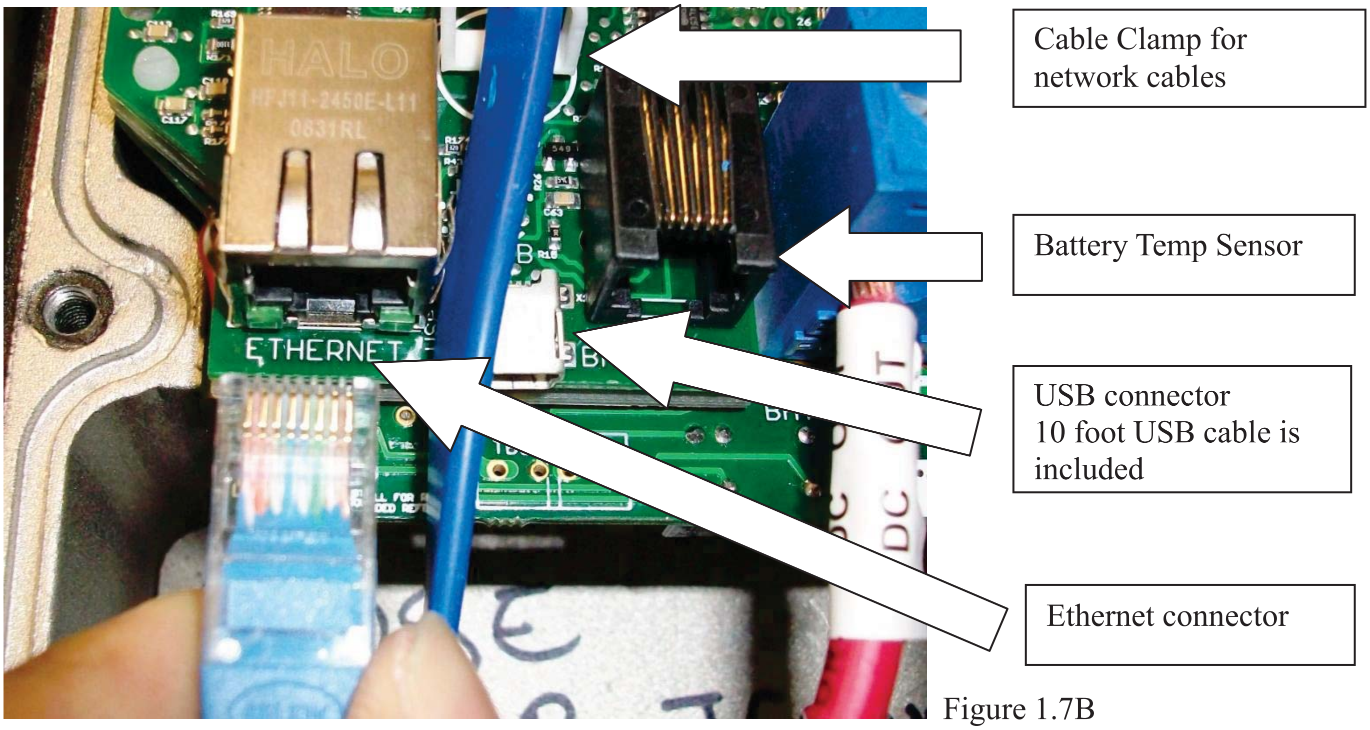


Figure 1.7B

## Battery Temperature Sensor Installation

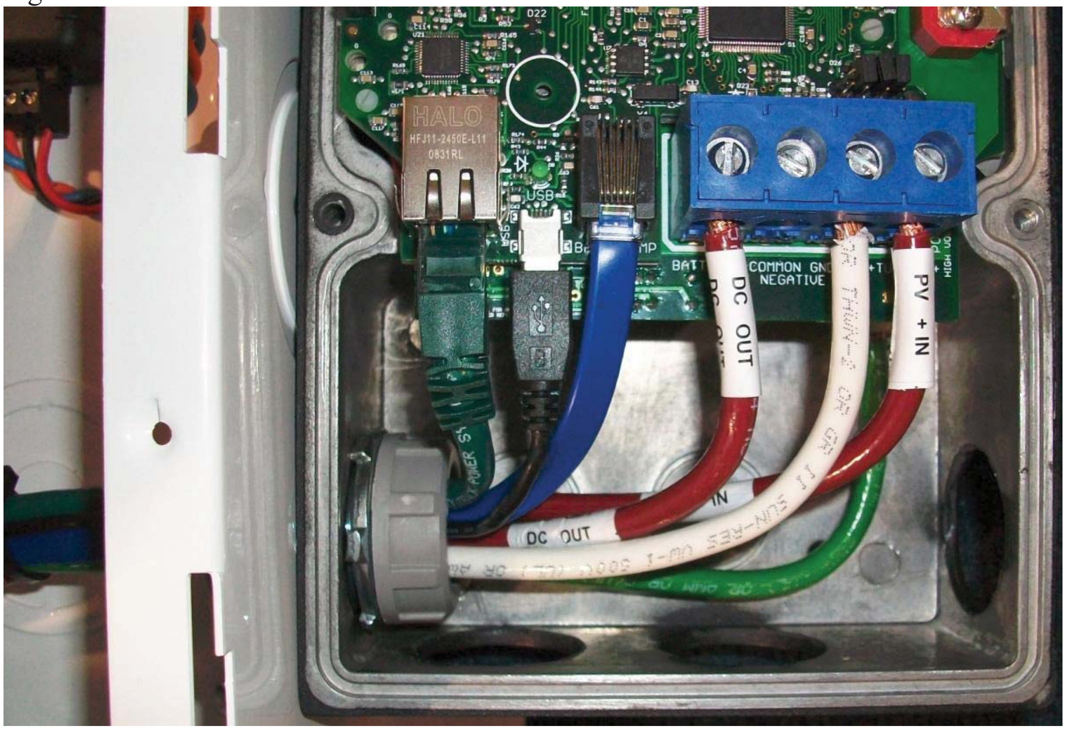
**CAUTION -** To reduce risk of injury, charge only deep-cycle lead acid, lead antimony, lead calcium, gel cell or absorbed glass mat type rechargeable batteries. Other types of batteries may burst, causing personal injury and damage. Never charge a frozen battery.

**WARNING: RISK OF INJURY.** To reduce the risk of injury, charge only properly rated (such as 6 V 12 V and 24 V ) lead-acid (GEL, AGM, Flooded, or Nickel Cadmium) rechargeable batteries. Other battery types may burst, causing personal injury and damage.

**WARNING: Explosion hazard** during equalization, the battery generates explosive gases. Follow all the battery safety precautions listed in this guide. Ventilate the area around the battery using ventilators with brushless motors thoroughly and ensure that there are no sources of flame or sparks in the Vicinity.

The Classic comes with a Battery temperature sensor which plugs into the jack beside the DC Terminal connector labeled “Battery Temp”. Refer to Figure 1.8 Route the cable through the E-panel into the battery box. Pick a battery in the middle of the bank and about half way up the side of the battery thoroughly clean a spot off on the case. Then remove the protective tape from the sensor and adhere the temperature sensor to the battery. Some manufacturers use a double wall case on the battery. For mounting a temp sensor to them please refer to the battery manufacturer's recommended procedure.

Figure 1.8




Insert BTS to the jack labeled BATTERY TEMP on the control board.

Figure 1.9

## Chassis Grounding

In all installations the Classic chassis should be connected to ground. For systems with a battery breaker sized 60 amps and smaller 10 AWG (6 $mm^2$) copper is generally sufficient. For systems with a battery breaker sized 100 amps and smaller 8 AWG (10 $mm^2$) copper is required. For grounding conductor requirements on your specific installation please consult your local electrical code. The chassis grounding terminal is in the upper right corner of the electrical connection compartment see Figure 2.0

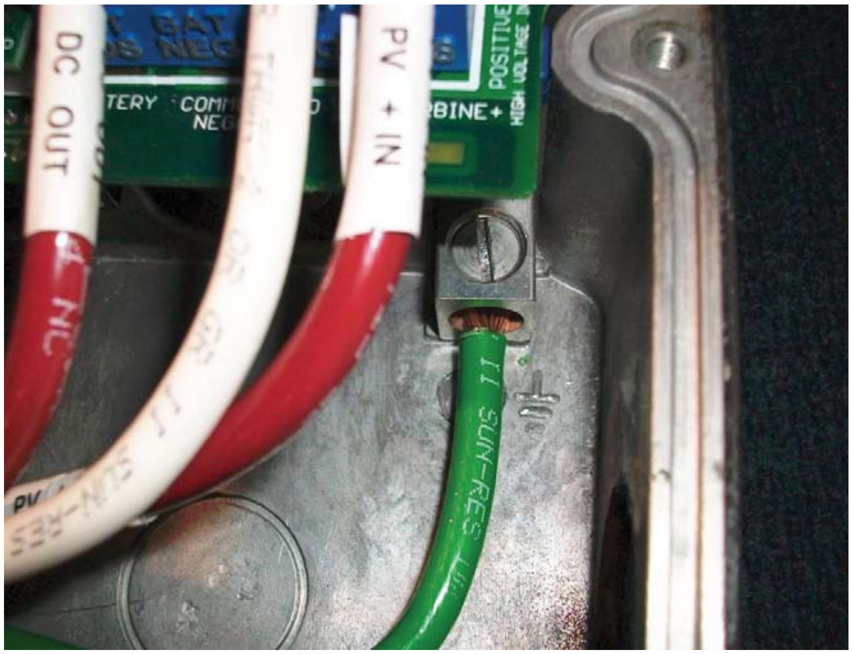



Figure 2.0

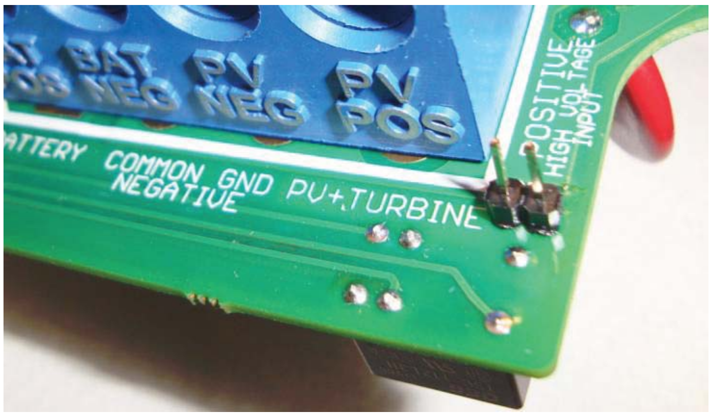
## DC System Grounding

The Classic charge controller is designed to work with Negative Ground, Positive Ground or Ungrounded power systems. In grounded systems, dc negative may be connected to ground either externally or by using the Classic's internal grounding jumper, shown on figure 2.1. The internal grounding jumper should only be installed when the Classic's GFP is enabled. In a system with multiple charge controllers the grounding jumper should be installed on every charge controller. In Positive ground or Ungrounded systems the GFP jumper must be removed. See Figure 2.1 Also note that with Positive ground there will be items still referenced to battery negative that can complete a short circuit of the battery bank. These items include but are not limited to the USB Cable and the Ethernet jack. Please contact Technical support for assistance on Positive ground systems.

# DC GFP (Ground Fault Protection)

The Classic has internal ground fault protection (GFP) built in. Since 2008 the NEC requires a DC-GFP on all PV systems in the USA. The built in DC-GFP eliminates the need to purchase and install an external DC-GFP. If the internal grounding jumper is installed in a Classic, the battery negative and DC source negative must not be connected to the system grounding conductor anywhere in the system. Grounding of these circuits will defeat the GFP function. In a network with multiple Classics, all Classics must have the internal grounding jumper installed and GFP enabled. The factory setting will make a DC negative to System Ground connection in the Classic charge controller. The GFP function will need to be disabled for Positive ground or an ungrounded DC system.

Figure 2.1




The Ground fault device is simple to understand and use. The Classic DC-GFP works a bit different than others. It detects a fault between battery/PV negative and earth ground just like the breaker DC-GFP system. The difference with the Classic is that it simply turns off when a ground fault is detected. This is different than disconnecting the PV plus circuit. This trick of turning off was first pioneered by another charge control company as an alternative to a $100 external circuit breaker assembly. The Classic's system consists of a PTC that is between the Negative and Ground internally in the Classic. A PTC is basically a type of resistor with a 1 ohm value that when loaded to three quarters of an amp will heat up and go to a very high resistance looking like an open circuit. One of the 3 Classic microprocessors watches the PTC and when it sees a high resistance it will disable the Classic. The ground fault device will then require a manual reset. The PTC is self-healing though so there are no fuses to change. This method meets the requirement for DC ground fault protection in the National Electric Code.

To disable the internal Ground Fault Protection function, the jumper labeled GFP needs to be removed, and the GFP function must be disabled in the TWEAKS menu. See section below for instructions.

To reset the internal GFP function after detection has occurred, fix the actual ground fault, then turn OFF the Classic and turn it back ON. Do this by turning the external battery breaker to OFF position and then to ON position.

# Disabling GFP

The GFP feature should only be disabled to operate the Classic in an ungrounded power system or in systems where GFP is not required.

- Press Main Menu
- Scroll to the right or left until TWEAKS is highlighted and press ENTER
- In TWEAKS press the right soft key to get to the MORE menu
- In MORE scroll until GFP is highlighted
- Use the up and down arrow keys to toggle between on and off
- Press ENTER to save

# Wiring the Classic

**WARNING: Shock hazard.** Disconnect the batteries and input power before opening the Classic front cover

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 the 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 neutral (negative) terminals. Therefore, only one neutral conductor is required to run from the E-Panel and terminate on either (or both) common neutral 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.

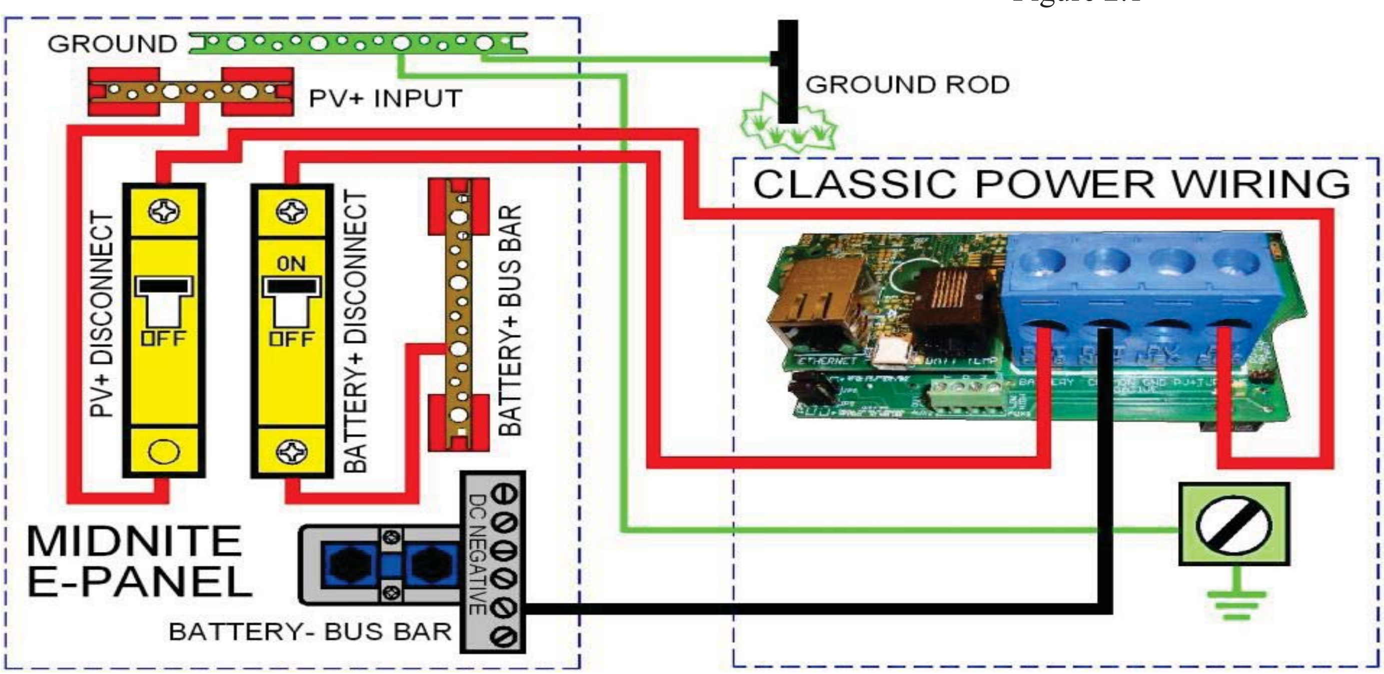
To connect the wiring to the Classic:

- ❖ Ensure the DC source and Battery are disconnected
- ❖ Connect a grounding conductor between the Classic and system ground
- ❖ Ensure the breaker between the battery and Classic meets UL489 standards.
- ❖ Ensure the breaker between the dc source and Classic meets UL1077 standards.
- ❖ Connect the DC source and Battery wire to the Classic
- ❖ Connect any communications cables or auxiliary input/output wires
- ❖ Torque terminal connector screws to the following specs

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 above. Torque to 40-50 inch pounds.

Figure 2.1



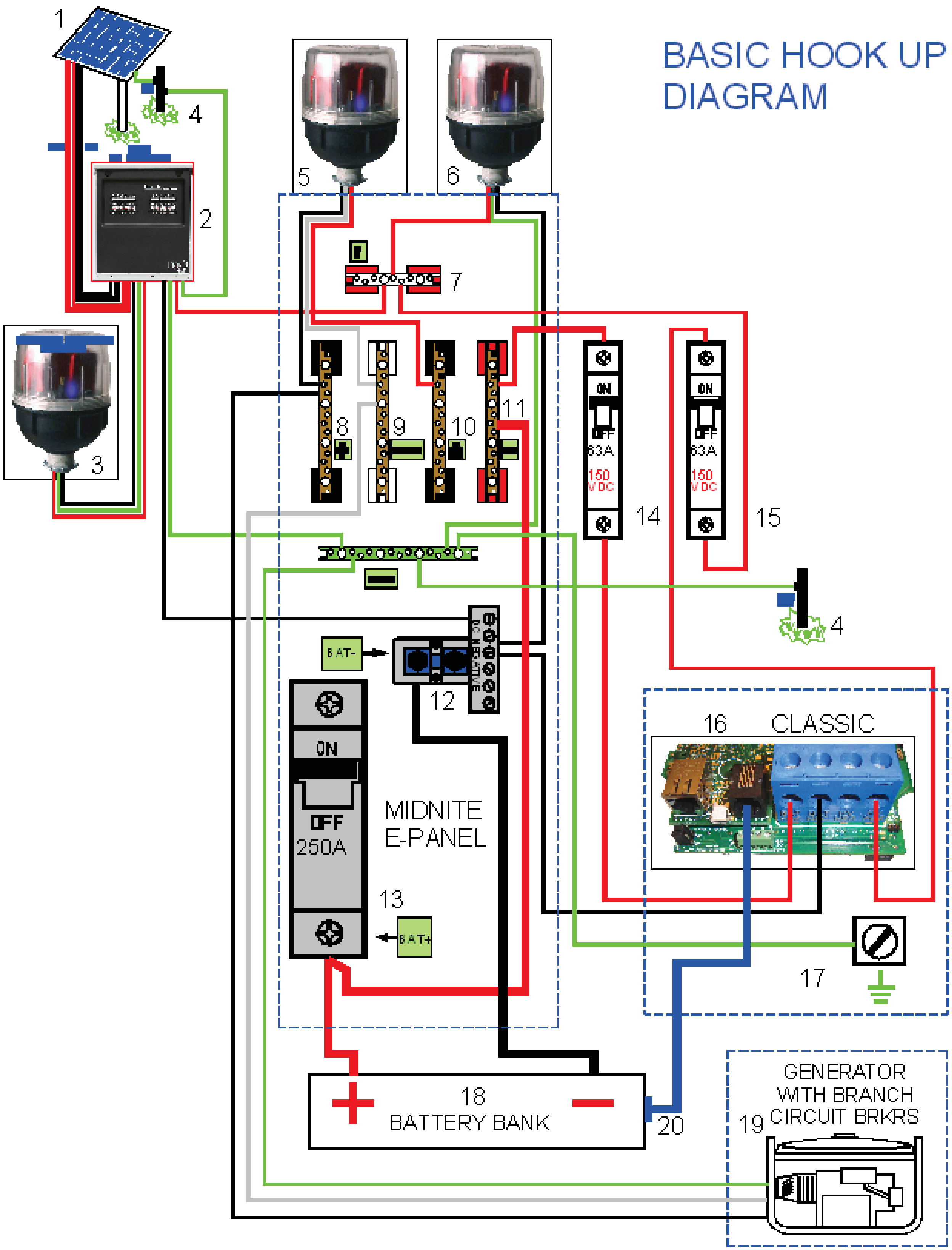

BASIC HOOK UP DIAGRAM
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
CLASSIC
17
18
BATTERY BANK
19
20
4
ON
OFF
63A
150 VDC
ON
OFF
63A
150 VDC
BAT-
BAT+
ON
OFF
250A
MIDNITE
E-PANEL
GENERATOR
WITH BRANCH
CIRCUIT BRKRS

Figure 2.2

## DC Terminal Connector

Figure 2.4

The Classic's DC terminal connector is located on the circuit board as shown in. The connector will take up to a #4 AWG. #4 AWG THHN when installed in the Classic and MidNite E-Panel is rated for over 100 amps and is therefore suitable for the highest power available from the Classic 150.

## Over Current Protection and Wire Size Requirements

The over current devices, wiring, and installation methods used must conform to all electrical codes applicable to the location of installation. Wiring needs to be protected with proper strain relief clamps and or conduit. See page 49 for a breaker and wire size chart.

The network cables, USB cable, BTS cable and auxiliary input/output cables should run in a different conduit to preserve their signal. When installing the Classic in a MidNite E-Panel, it is acceptable to run all wiring through the same knockout hole. It is legal to run signal and power wires together as long as all wiring is listed for the highest voltage to be encountered.

## Current Rating

The Classic limits the output current based on the model you have.

The Classic current ratings are:
Classic 150v - 96 amps maximum
Classic 200v - 79 amps maximum
Classic 250v - 62 amps maximum

## Temperature Current Limit

The Classic has a current limit component which interacts with the temperature of the charge controller. If the Classic is exposed to extremely hot ambient conditions the output current will be reduced automatically to keep the charge controller safe, if the orange LED comes on, on the MNGP it means that the Classic is in current limit mode. If you believe the Classic is not hot and the orange LED is on, most likely the current limit set point is too low. To check this follow steps bellow.

- Press Main Menu
- Highlight the CHARGE menu and press the Enter Button
- Scroll to LIMITS and press the Enter Button
- Press the right arrow key to highlight Out Amps column
- Use the up and down arrow keys to change the current limit then press the Enter Button to save this data

# Over Current Protection

The Classic must have over current protection to protect wiring from over current events. A means of disconnect must be installed on the DC in and DC out of the Classic. Consult your local codes to determine over current ratings. The breaker between the battery bank and the Classic must conform to UL489. The breaker between the DC source and the Classic must conform to UL1077 or UL489. The NEC requires 1.56 times short circuit current for PV over current protection. This is reduced to 1.25 times when using a breaker rated for continuous duty. All MidNite Solar breakers are hydraulic/magnetic and are rated for continuous duty. No de-rating is required for the output breaker when using MidNite Solar breakers.

PV in particular will be capable of producing more current than its name plate rating in extreme situations so the safe minimum wire size should be selected for the PV array maximum short circuit current. Please consult PV manufacturer for specifications. The US National Electrical Code requires 1.56 times the PV short circuit current for wire size on the PV input. Output wire size follows the NEC guidelines. Typical wire size for output is 6AWG for the Classic250 and 4AWG for the Classic200 and 150 but check all de-ratings for your wire type and installation method.

# Long Distance Wire Runs

The Classic offers some unique opportunities if you are faced with longer than normal wire runs between the DC source and the Classic. The Classic comes in 3 input voltage ranges letting you design a DC source at a higher voltage if it is beneficial. For example let's say you have a 300 ft run from a PV array to the Classic you could wire for an open circuit voltage close to 250vdc accounting for the coldest temperature you will encounter. This will allow you to run a smaller gauge wire than with a lower voltage charge controller. The efficiency of a high voltage Classic is less than the lower voltage versions, so you need to weigh the benefit. If this sounds too complicated use this rule of thumb in selecting the proper Classic. PV runs up to 100 feet, use the Classic 150. Runs up to 180 feet, use the Classic 200. Above 180 feet use the Classic 250.

If the wire size between the DC source and the Classic is larger than the Classic's DC terminal connector you can use a splicer block or similar connector to reduce down to #4 AWG close to the Classic. The MidNite E-Panels are supplied with a PV input busbar that accepts up to 1/0 wire.

## Connecting the Classic to the Clipper

Not Yet Available Please email customerservice@midnitesolar for status updates on the Clipper.

## Maximum and Minimum Wire Size

The Classic DC terminal connector will accept wire from #14-#4 AWG

## Commissioning the Classic

The Classic will enter into the setup wizard upon initial power up. If the Classic does not enter into the setup wizard or you want to enter the wizard at any time follow these steps to get into the setup wizard.

- Press the Main Menu button.
- Scroll Left or Right until Wizard is highlighted and press the Enter button.
- Follow the on screen instructions through to the end.

## Using the Classic Setup Screen's

The Classic setup wizard will walk you through the set up process. Below is a description of the steps.

| | |
|---|---|
| DO YOU WANT PASSWORD ENABLED?<br>PASWORD WILL BE 142<br>YES NO | Sets the password On Classic Settings |
| CONNECTED TO<br>CLASSIC 150 | Tells you which classic model it is |
| IS THIS A<br>GRID TIED SYSTEM<br>(BATTERY BACKUP)<br>YES NO | This menu will determine how to treat batteries differently. sealed batteries lower voltage for grid tied |
| TIME DATE<br>24:00:00 01/10/2010 | Set time and date, this is important because Classic will automatically know at what time to wake up and go to sleep mode (**Sunrise/sunset using Astronomical formulas**) |
| BATTERY CHEMISTRY<br>FLOODED LEAD ACID<br>ENTER | Sets up battery temp compensation and absolute maximum charge voltages regardless of temp |
| BATTERY BANK VOLTAGE<br>48 | Selects between different voltage configurations on the system, increments of 12 volts (12v, 24v, 36v, 48v, 60v, 72v) |

| | |
|---|---|
| DO YOU KNOW THE BATTERY BANK AMP HR<br>CAPACITY<br>YES NO | Helps set Absorption time and EQ defaults |
| WHAT IS THE VOLTAGE<br>OF AN INDIVIDUAL<br>BATTERY<br>6 | This is necessary for the set up software to help figure out battery capacity |
| SET CURRENT LIMIT<br>80<br>ENTER TO CONTINUE | Sets classic's max output current |
| CONTROLLER MODE<br>SOLAR WIND HYDRO<br>SCROLL < > TO SELECT<br>THEN PUSH ENTER | Selects classic's mode. This can be changed in the mode menu |
| STC<br>MODULE POWER<br>210 ^ WATTS | Photovoltaic module power rating |
| STC<br>VOC RATING<br>44.3^ VOLTS | Photovoltaic module voltage rating |
| STC<br>ISC RATING | Photovoltaic module current rating |

# Setting Nominal Battery voltage

Upon initialization the Classic will display battery
To set up the Classic to a preset battery voltages (e.g. 12v, 24v… 48v) follow the steps below.

- Press Main Menu
- Scroll to the left until Charge is highlighted and push the Enter button
- Highlight Volts and press the Enter button
- Press the Right soft key
- Scroll up and down to select the desirable battery voltage

# Battery Charge Stages and Meanings

## Bulk MPPT

This stage of the Classic means; that the Classic will be putting out as much current as it can trying to charge the batteries to the absorb voltage set point. This is also known as constant current mode.

## Absorb

This stage means that the Classic will maintain the absorb set point voltage until the batteries are charged or it reach Float stage. At this stage the classic is not putting out maximum current, as that would increase the battery voltage over the Absorb set point. This is also referred to as constant voltage mode.
The absorb time is proportional to the bulk time. (i.e. the time bulk takes to reach the absorb voltage.) The battery it's considered "full" at the end of the absorb charge cycle.

### Float

A *Float* cycle follows after the *Absorb* cycle is completed; *Float* is displayed on the screen. Battery voltage is held at the float voltage set point, float time can be changed by the user.

### Equalize

Equalization function has to be enabled by the user, refer to page 25. The intent of an equalization charge is to bring all battery cells to an equal voltage by a deliberate overcharge. The goal is to return each battery cell to its optimum condition through a series of voltage controlled chemical reactions inside the batteries.

## Adjusting Absorb, Equalize and Float Voltages

Setting the Classic up through the wizard will set Absorb, Float and EQ to the factory default set voltage to the specified battery type. (E.g. Flooded Lead, Gel...) These voltages are fully adjustable, just follow the steps below.

- ❖ Press Main Menu
- ❖ Scroll to the left until Charge is highlighted and push the Enter button
- ❖ Highlight Volts and press the Enter button
- ❖ Use left and right arrows keys to highlight the set point voltage to adjust
- ❖ Use up and down arrow keys to lower or raise the voltage
- ❖ Press the Enter button to save the new voltages.

## Battery Size and Chemistry

The Classic supports a variety of battery chemistries including; Flooded lead acid, sealed – AGM, gel cell and Nickel Cadmium. These different types of batteries have different charging parameters. These parameters are crucial for long- time battery life. Go through the WIZARD to select the battery type of your system. If you replace the batteries for a different type make sure you change the type on the WIZARD. That is the only place where the battery type can be changed.

## Battery Temperature Compensation

The Classic comes with a battery temperature sensor (BTS). This sensor raises or lowers charge voltage based on temperature. Connect BTS to the BATT TEMP jack. *(Refer to fig 1.7B and 1.9)* Battery temperature menu appears as **T-Comp** in the BATTERY MENU. In this menu you can change the voltage compensation as needed. If the BTS is disconnected or shorted the Classic will automatically use the default charge voltages non-compensated.

## Calibrating Battery and PV Voltage

To calibrate the Classic battery and PV voltage reading, you will need a Volt meter to check the actual battery bank voltage or input PV voltage. Using the volt meter measure the voltage on the DC terminal connector of the Classic (refer to Figure 2.4) compare this reading to the reading on the Status screen in the Classic,(press Status if not in this screen) to adjust the reading of the Classic to the one in the volt meter follow these steps:

- ❖ Press Main Menu, scroll to TWEAKS and press Enter
- ❖ Highlight VBatt and use the up and down arrow keys to match both of the readings
- ❖ Press the Enter button to save

Note. Use the description below to help complete the calibration of the Classic voltages.

TWEAKS screen


Figure 2.7

## Configuring DC Input Source

To select the Mode the Classic will run in, follow the steps below.

- Push the Main Menu button.
- Scroll left or right until Mode is highlighted and then push the Enter button.
- Scroll to the right and highlight the current Mode than use the up and down arrows to set the mode you want.
- Take note of the Right soft key most modes have some set points that can be adjusted.
- Press the Main Menu button until you get back to the Mode Menu
- Set the ON/OFF to ON and press Enter

The following Modes will appear in this order in the MODE Menu.

### Micro Hydro

This mode is intended for use with hydro systems but can be used with other sources as well. When the Classic first turns on after the input voltage goes above battery voltage, it will sweep from that open circuit voltage down to battery voltage, finding the maximum power point voltage (MPP V). Then return the input to that newly found voltage. After the original turn on sweep, the Classic will do mini sweeps at user adjustable time intervals. If the time interval is set to 0, the Classic will not do any mini sweeps but will stay on this first found MPP V until the user goes to the mode menu and turns it off and back on again.

Micro Hydro mode sweeps slightly slower than Solar mode and has 2 user adjustable settings. Sweep Interval is the time between mini-sweeps, in minutes, and sweeps around the present (i.e. the last found), MPP Voltage. The range of this sweep is determined by the Sweep Depth user adjustment and is expressed as a percentage of Watts that the sweep started from. For example, if in Micro Hydro mode, the Classic was outputting 1000 Watts and the Sweep Depth percentage was set for 20%, (200 Watts), the sweep will bring the input voltage DOWN until the output power drops down to 800 Watts, then will sweep UP in voltage until the power drops again down to 800 Watts and then go back to the newly found MPP Voltage, waiting for the next sweep.

This mode will NOT go to resting even when the input has been disconnected and will always stay awake so the turbine has the least chance of over-spinning.

### Solar

This is the default mode for PV systems and has a very fast sweep (typically1/2 second or less) that will re-sweep at user adjustable sweep intervals, unless the Classic finds that it needs to do a sweep on its own because of changing conditions. The timed sweep interval is user adjustable and is in units of minutes. SOLAR mode is typically best for PV systems, especially if there is partial shading at times during the day. The Classic will show a message of "PV SHADE" if it thinks the PV array is partially

shaded (if this feature is enabled).
SOLAR mode is best suited for shaded or un-shaded PV arrays that are at least one nominal voltage above the battery voltage. For severe partial shading or PV arrays with nominal voltage equal to battery voltage, you may also want to try Legacy P&O (Perturb and Observe) MPPT mode.

## Legacy P&O

Legacy P&O (Perturb and Observe) mode is a slow tracking mode similar to the Micro Hydro mode but with the difference that it is slightly faster and will shut off if the power source goes off.
It has 2 settings that are user adjustable. Sweep Interval is the time between mini-sweeps, in minutes, and sweeps around the present (i.e. the last found), MPP Voltage. The range of this sweep is determined by the Sweep Depth user adjustment and is expressed as a percentage of Watts that the sweep started from. For example, if in Legacy P&O mode, the Classic was outputting 500 Watts and the Sweep Depth percentage was set for 10%, (50 Watts), the sweep will bring the input voltage DOWN until the output power drops down to 450 Watts, then will sweep UP in voltage until the power drops again down to 450 Watts and then go back to the newly found MPP Voltage, waiting for the next sweep.
This mode is also useful for such items as DC generators or rectified ac alternators being driven by a fossil fuel engine. An Example would be a Lister diesel with an Other Power 3 phase alternator. The AC output would be rectified and run into a Classic set for legacy P&O.

NOTE ON HIGH VOLTAGE-HIGH POWER INPUT SOURCES... When using an unlimited power source, it is recommended that the input voltage not be much higher than 4 or 5 times the output (battery) voltage. i.e. Don't try to charge a 12V battery from an unlimited input power source sitting at, say, 200 Volts. The Classic is able to work with high power-high voltage sources but will usually require an input voltage dropping power resistor in series with the input voltage source. Please call a MidNite technical representative for advice on what size input resistor to add to the input for these special cases if you are unsure what to place in-line and we will try to help.

## Wind Track

This mode uses a power curve that is either built by the user or one of the pre-installed graphs. The power curve consists of 16 set points that consist of output amperage and input voltage, allowing the user to custom build a curve for their Wind turbine. Please refer to the Wind section of the manual for full details on programming the curve as well as our video that will help in understanding how to adjust these curves using the wind graph editor.

## Dynamic

This is typically used for PV (solar) input sources and tries to follow, on a slow dynamic basis, the changing conditions of the input source. This mode has one user adjustment which is a forced sweep perturb trigger interval for times when the input condition changes do not trigger a dynamic sweep. The interval is in units of minutes.

## U-Set VOC%

This is a fully manual mode based on a percentage of VOC. The Classic will sweep based on the user set time in minutes and then park at a user set % of the VOC the Classic found on that sweep. This mode is useful for testing or constant voltage sources.

The ON/OFF has to be set to OFF in order to change the operational mode. Scroll to the right to highlight the word ON or OFF and use the up and down keys to change it to OFF. Push the Enter button to save this change. Now you can scroll to the right and highlight the mode under Function. Scrolling up or down changes the modes. Once a mode is selected push the Enter button to save this change. Then you can use the right soft key to select “setup”. This would be where you will manually set up any parameters specific to the mode you selected.

## Configuring the Classic for Wind Input Source

### Wind

If you selected “Wind” you will need to select a power curve from the list of pre-loaded curves or build your own. To access the list of power curves follow the steps below.

- ❖ Push the Main Menu button.
- ❖ Scroll left or right until “Mode” is highlighted and push the Enter button.
- ❖ Set the status to OFF and then use the right soft key to select “Graph”.

Using the left soft key select “MEM”. Now you can scroll up and down through the menu and select from the curve that was designed for your turbine. Once you find the correct power curve use the right soft key to select “RECALL”. Now push the Enter button to save this power curve to the Classics memory.

There are also 9 memory spaces for you to save a custom power curve. To build custom power curves select a memory location between 1 and 9 and hit “RECALL”. Use the right and left arrow buttons to scroll through the 16 steps in the custom curve. On each step you can set the amperage by using the up and down buttons. When you have the power curve the way you want it select “MEM”. Use the up and down buttons to select a location 1 through 9 to save it in and select “SAVE”. Now push the Enter button to save it to the Classic's memory.

For more information consult the videos contained in this DVD as well as the MidNite Solar web site.
*Classic-Wind-Graph-Editor-1.mpg*

## Setting the Date and Time

To set the date and time manually on the Classic follow the steps below.

- ❖ Push the Main Menu button.
- ❖ Scroll left or right to highlight “TIME” and push the Enter button

Now scroll left or right to highlight the data you want to manually change. Use the up and down buttons to change the data. When you have all the data changed push the Enter button to save the changes.
The Classic includes a battery in the MNGP portion, to keep the time running even when the power is disconnected. To replace the battery refer to the Installation Manual

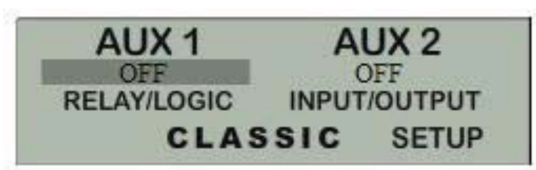
## Setting Longitude and Latitude

With the built in virtual map, you are able to select where you are in the world. For a more precise setting you can manually enter the longitude and latitude coordinates, geographic location is important because it helps determine when the Classic wakes up and when it goes to sleep. This setting tells the Classic when sunrise and sunset are to happen. The Classic will use this information on future features also. To set longitude and latitude coordinates you need to go thought the WIZARD that is the only way to gain access of this feature

## Configuring Auxiliary Input/Output

The Classic includes two auxiliary ports which can be configured to become inputs or outputs. These aux ports can be used as a secondary power supply to be used for accessories such as vent-fan, anemometer and generator starter or even and anemometer. The Aux output is limited to 200ma or less per channel. These aux ports if used correctly could extend the system life. Here is an explanation of how they work.

- An internal, re-settable Positive Temperature Co-efficient (PTC) fuse protects the AUX internal components from overcurrent or a short circuit.
- AUX 1 consists of either RELAY or LOGIC operation depending on the user selection function.
- AUX 2 could be set to become an INPUT or OUTPUT. One at a time this port could be reading the state of a device connected and takes an action from there.




To configure the Classic's Aux ports:
- Push the Main Menu button
- Scroll left or right to highlight "AUX" and push the Enter button.

Scroll left or right to highlight the relay you wish to change. Push the right soft key labeled "SETUP". Scroll up or down to change the function of the relay. Select the right soft key to set the parameters of the function. When finished push the ENTER button to save the changes.

Main Aux Screen shows both Aux1 and Aux2 functions

Table 2.0

| | |
|---|---|
| Off - | Places output to Low state (0 Volts) |
| Auto - | Selects the assigned function to the Aux output or input |
| On - | Sets output for Low state (12 Volts or Relay On) |

The Following is a list of the Aux 1 and 2 functions with brief descriptions of their function.

# Aux 1

## Vent Fan Lo

This mode will turn Aux 1 off above the voltage set point you program. It allows you to run a vent fan for a battery bank based on battery voltage. There is a voltage set point that you set and Aux 1 will turn off when the battery reaches that set point. The voltage has to fall 2 tenths of a volt below the set point for 30 seconds before Aux 1 will turn back on.

## Vent Fan High

This mode will turn Aux 1 on above the voltage set point you program. It allows you to run a vent fan for a battery bank based on battery voltage. There is a voltage set point that you set and Aux 1 will turn on when the battery reaches that set point. The voltage has to fall 2 tenths of a volt below the set point for 30 seconds before Aux 1 will turn off.

## Float Low

This mode will turn Aux 1 off whenever the Classic is in Float. Aux 1 will stay off until the Classic falls 3 tenths of a volt below the float voltage set point.

## Float High

This mode will turn Aux 1 on whenever the Classic is in Float. Aux 1 will stay on until the Classic falls 3 tenths of a volt below the float voltage set point.

## Clipper Control

This mode was intended to control the MidNite Clipper. It will send out a PWM signal whenever the controller is unloading the turbine because the battery is full or close to it. There are no adjustment in this mode the Classic is preprogrammed with the best parameters to control turbine RPM.

## Day Light

This mode will turn Aux 1 on at sunrise and turn it off at sunset based on the PV input voltage.

## Nite Light

This mode will turn Aux 1 on at sunset and turn it off at sunrise based on the pv input voltage.

## Toggle Test

This mode will cycle Aux 1 for 1 second off and 1 second on repeatedly. This mode is mostly for testing purposes.

## Pv V on Low

This Mode will turn Aux 1 off above a user set voltage based on the input voltage to the Classic ( V High) and turn Aux 1 on when it hits a low voltage set point (V Low). It also allows you to set a delay time in seconds the Classic will wait before turning Aux 1 off after reaching the V High set point. It also allows you to set a hold time in seconds the Classic will wait before turning Aux 1 on after reaching the V Low set point. This mode can be useful for controlling a failsafe stopping system for Hydro or Wind.

## Pv V on High

This Mode will turn Aux 1 on above a user set voltage based on the input voltage to the Classic ( V High) and turn Aux 1 off when it hits a low voltage set point (V Low). It also allows you to set a delay time in seconds the Classic will wait before turning Aux 1 on after reaching the V High set point. It also allows you to set a hold time in seconds the Classic will wait before turning Aux 1 off after reaching the V Low set point. This mode can be useful for controlling a failsafe stopping system for Hydro or Wind.

## Opportunity Lo

This mode will turn Aux 1 off when the Classic gets within a certain range of the voltage set points for each charging stage (V High) and turn Aux 1 on when it gets to a low set point (V Low). These set points are user adjustable and will allow the Absorb, Float and EQ timers to continue to run. You will adjust these set points to negative numbers and the numbers are an offset from the voltage set point. For example a -.2 would turn Aux 1 off 2 tenths of a volt below your set points. This mode will allow you maximum diversion while maintaining your 3 stage charging. It also allows you to set a delay time in seconds the Classic will wait before turning Aux 1 off after reaching the V High set point. It also allows you to set a hold time in seconds the Classic will wait before turning Aux 1 on after reaching the V Low set point.

## Opportunity Hi

This mode will turn Aux 1 on when the Classic gets within a certain range of the voltage set points for each charging stage (V High) and turn Aux 1 off when it gets to a low set point (V Low). These set points are user adjustable and will allow the Absorb, Float and EQ timers to continue to run. You will adjust these set points to negative numbers and the numbers are an offset from the voltage set point. For example a -.2 would turn Aux 1 on 2 tenths of a volt below your set points. This mode will allow you maximum diversion while maintaining your 3 stage charging. It also allows you to set a delay time in seconds the Classic will wait before turning Aux 1 on after reaching the V High set point. It also allows you to set a hold time in seconds the Classic will wait before turning Aux 1 off after reaching the V Low set point.

## Low bat disc

This mode will turn Aux 1 off when it reaches a set point based on battery voltage (V High) and turn it on at another set point based on battery voltage (V Low). It also allows you to set a delay time in seconds the Classic will wait before turning Aux 1 off after reaching the V High set point. It also allows you to set a hold time in seconds the Classic will wait before turning Aux 1 on after reaching the V Low set point. This can be used with a NC relay when the battery gets to the set point the Classic will send 12vdc to the relay holding it open and disconnecting the load.

## Diversion

This mode will turn Aux 1 on when it reaches a set point based on battery voltage (V High) and turn it off at another set point based on battery voltage (V Low). It also allows you to set a delay time in seconds the Classic will wait before turning Aux 1 on after reaching the V High set point. It also allows you to set a hold time in seconds the Classic will wait before turning Aux 1 off after reaching the V Low set point.

# Aux 2

## Float Low

This mode will turn Aux 2 off whenever the Classic is in Float. Aux 2 will stay off until the Classic falls 3 tenths of a volt below the float voltage set point.

## Float High

This mode will turn Aux 2 on whenever the Classic is in Float. Aux 2 will stay on until the Classic falls 3 tenths of a volt below the float voltage set point.

## Day Light

This mode will turn on Aux 2 at sunrise and turn it off at sunset based on the PV input voltage.

## Nite Light

This mode will turn on Aux 2 at sunset and turn it off at sunrise based on the pv input voltage.

## Clipper Control

This mode was intended to control the MidNite Clipper. It will send out a PWM signal whenever the controller is unloading the turbine because the battery is full or close to it. There are no adjustment in this mode the Classic is preprogrammed with the best parameters to control turbine RPM.

## Pv V on Low

This mode is PWM based and is just reverse logic of Pv V High. It would be comparable to using the NC contacts of the relay used in Pv V High. It can be used that way with a solid state relay with NC contacts for a failsafe load.

## Pv V on High

This mode is PWM based and will PWM Aux 2 above a user set voltage (V High) based on the input voltage to the Classic and stop when it hits a low voltage set point (V Low).

## Toggle Test

This mode will cycle Aux 2 for 1 second off and 1 second on repeatedly. This mode is mostly for testing purposes.

## Opportunity Lo

This mode is PWM based and is just reverse logic of Opportunity Hi. It would be comparable to using the NC contacts of the relay used in Opportunity Hi. It can be used that way with a solid state relay and NC contacts to do diversion above a set voltage.

## Opportunity Hi

This mode is PWM based and will PWM Aux 2 when the Classic gets within a certain range of the voltage set points for each charging stage (V High) and stop when it gets to a low set point (V Low). These set points are user adjustable and will allow the Absorb, Float and EQ timers to continue to run. You will adjust these set points to negative numbers and the numbers are an offset from the voltage set point. For example a -.2 would turn Aux 2 on 2 tenths of a volt below your set points. This mode will allow you maximum diversion while maintaining your 3 stage charging.

## Diversion Lo

This mode is PWM based and is just reverse logic of Diversion Hi. It would be comparable to using the NC contacts of the relay used in Diversion Hi. It can be used that way with a solid state relay and NC contacts to do diversion above a set voltage.

## Diversion Hi

This mode is PWM based and will PWM Aux 2 at a set point based on battery voltage (V High) and stop it at another set point based on battery voltage (V Low).

# Aux 1 Function

OUTPUT = Relay or 12V/0V Signal jumper selectable

Aux 1 has the relay so Diversion functions must operate slowly

| | |
|---|---|
| VENT FAN LOW | Aux1 on below setpoint |
| VENT FAN HIGH | Aux1 on above setpoint |
| FLOAT LOW | Aux1 off when in Float |
| FLOAT HIGH | Aux1 on when in Float |
| CLIPPER CONTROL | PWM Control for Cipper |
| DAY LIGHT | Aux1 on at dawn off at dusk |
| NITE LIGHT | Aux1 on at dusk off at dawn |
| TOGGLE TEST | Aux1 cycled 1 sec interval |
| Pv V ON LOW | Aux1 on below Pv in setpoint |
| Pv V ON HIGH | Aux1 on above Pv in setpoint |
| OPPORTUNITY LO | Divrt based on chrg state lo |
| OPPURTUNITY HI | Divrt based on chrg state hi |
| LOW BAT DISC | Disc load based on bat volt |
| DIVERSION | Slow Diversion control |

## Aux 2 Function. Output/Input

OUTPUT = 12V/0V Signal

| | |
|---|---|
| FLOAT LOW | Aux2 off when in Float |
| FLOAT HIGH | Aux2 on when in Float |
| DAY LIGHT | Aux2 on at dawn off at dusk |
| NITE LIGHT | Aux2 on at dusk off at dawn |
| CLIPPER CONTROL | PWM Control for Clipper |
| Pv V ON LOW | PWM sig below Pv in setpoint |
| Pv V ON HIGH | PWM sig above Pv in setpoint |
| TOGGLE TEST | Aux2 cycled 1 sec interval |
| OPPORTUNITY LO | PWM divert rltv chg state lo |
| OPPORTUNITY HI | PWM divert rltv chg state hi |
| DIVERSION LO | PWM Divert on Bat voltage lo |
| DIVERSION HI | PWM Divert on bat voltage hi |

To set/ change threshold voltage as well as time do the following:

- When in the function you wish to use press the right soft button
- This will take you to the VOLTS menu here is where you set your threshold voltage
- Use the left and right arrow keys to navigate through the options
- Use the up and down arrow keys to raise or lower the threshold voltage
- To change the time press again the right soft button to get to the TIME menu
- In this menu do the same as you did in the VOLTS menu, until desired adjustments are made
- Press ENTER to save

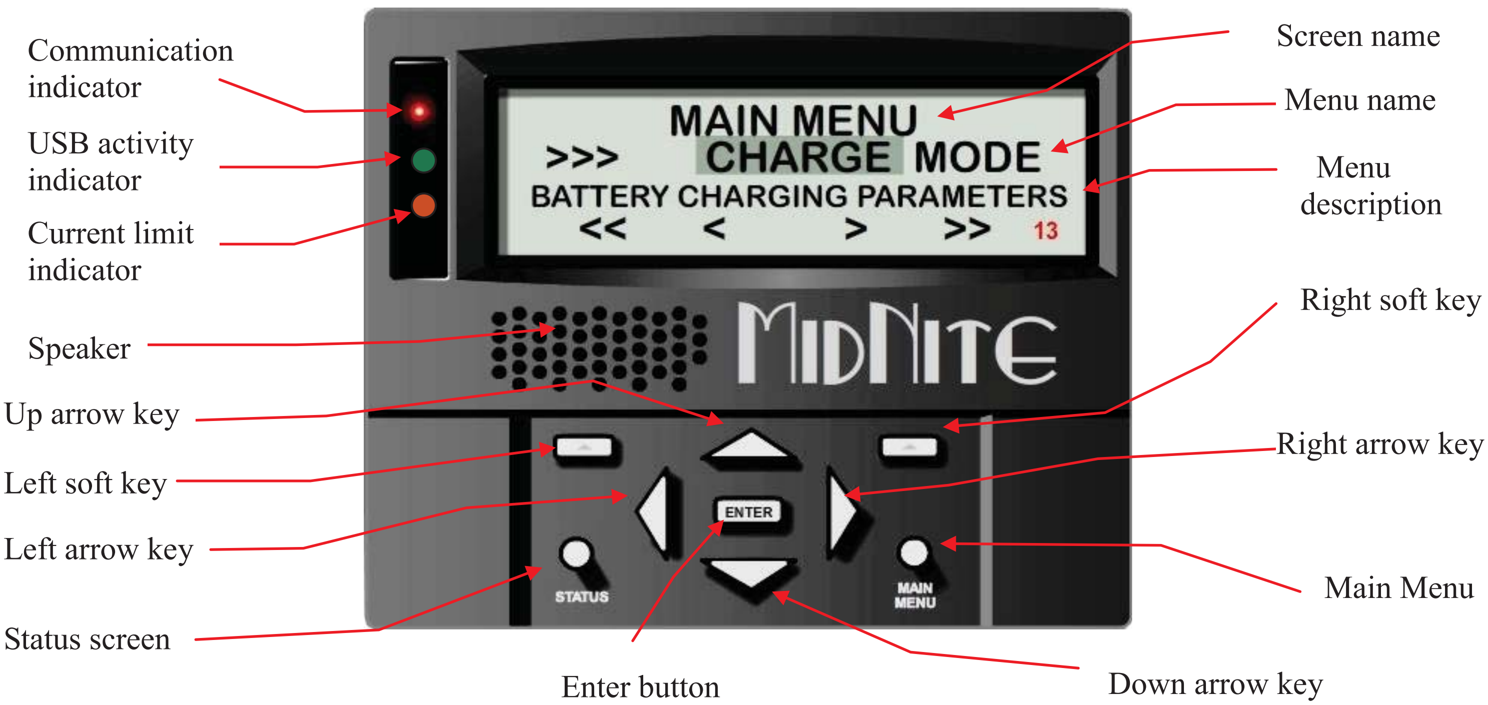
## Setting the MNGP features, Access the Version of software and Restore factory defaults

The Classic comes with an integrated “MidNite Graphics Panel” (MNGP), which is the primary interface to the Classic. Setting up contrast, backlight and volume its simple just follow the steps below.

- Push the Main Menu button.
- Scroll left or right to highlight “Misc” and push the Enter button.
- Use the left and right arrow keys to select the feature to set and press the Enter button
- Press the up and down buttons to adjust
- Press Enter to save

Use diagram below for MNGP reference. Figure 2.8

Figure 2.8




## Operating the Classic

Once the parameters have been set via the set up wizard or from manual set up, there are no further requirements to make the Classic function. It is all automatic.

## Navigating the Menu's

- Push MAIN MENU
- Push right and left buttons to see the different menus
- To return to the status screen push STATUS button

* To navigate from one end of the main menus to the other end push the top right and left buttons

When the Classic first turns on it will take you through the WIZARD setup. After all of these parameters are set **and saved**, you will be placed in the MAIN MENU screen with WIZARD highlighted. Below the name of the menu is a description of the menu. Pushing the left and right buttons will enable you to see all the main menus provided. Inside some of these main menus will be sub-menus to adjust the parameters of the selected feature.
Here is an overview of these menus:

<<WIZARD— CHARGE —MODE—AUX—MISC—LOGS—TWEAKS—TEMPS—NET>>

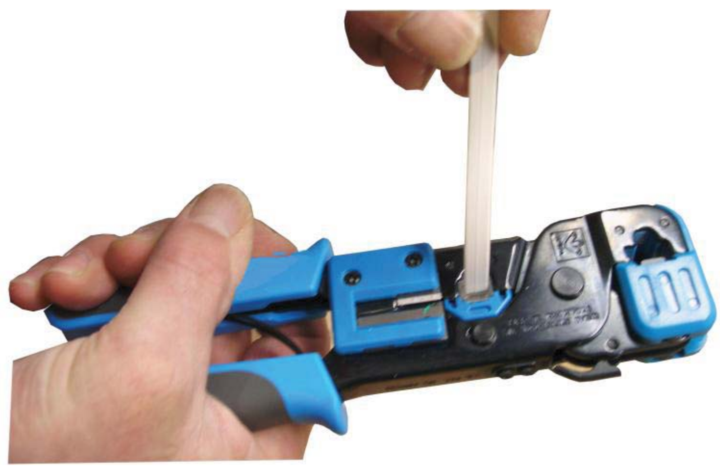
Below each of the menu names is a row with a description of the menu inside. To enter a menu, the name of the menu has to be highlighted. Pushing ENTER will show the submenus. The up and down arrow keys are enabled for easier navigation. Highlighting a sub menu and pushing ENTER will take you inside the submenu where you will be able to change the parameters of the unit. To get out of the submenus push MAIN MENU, this will take you out of the submenus one at a time every time you push it. See page 44 for entire Menu Map.

## Viewing Other MidNite Products on the Display

The Classic is able to view other products or Classics connected to the network. For example: the MidNite Solar Clipper. To view other products or Classics connected to the Classic network, go to the Status screen and press the UP and DOWN arrows to scroll between the addresses of the different items. The Classic is address 10 and labeled. CLASSIC

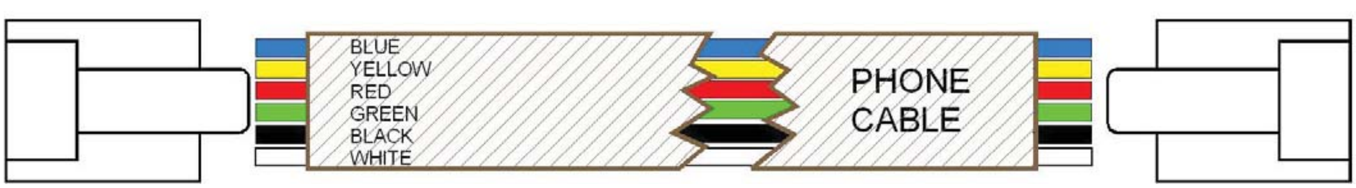
## Connecting Classic to Two MNGPs/Network cable

The Classic can be controlled with two MNGPs at the same time. This will help when the Classic is in a shop and there is a considerable distance between the Classic and the controlling point (office, inside house, garage etc.). Instead of going to the Classic to check status or to change a setting, the user can run a cable to the controlling point and see the Classic in a second MNGP. The cable is a six wire phone cable. Connect one side of the extension cable to the jack in the Classic labeled SLAVE/OUT and the other end to the second MNGP. Since the Classic transmits power and data signals through the phone cable to the MNGP the length of the cable is limited to 100ft.



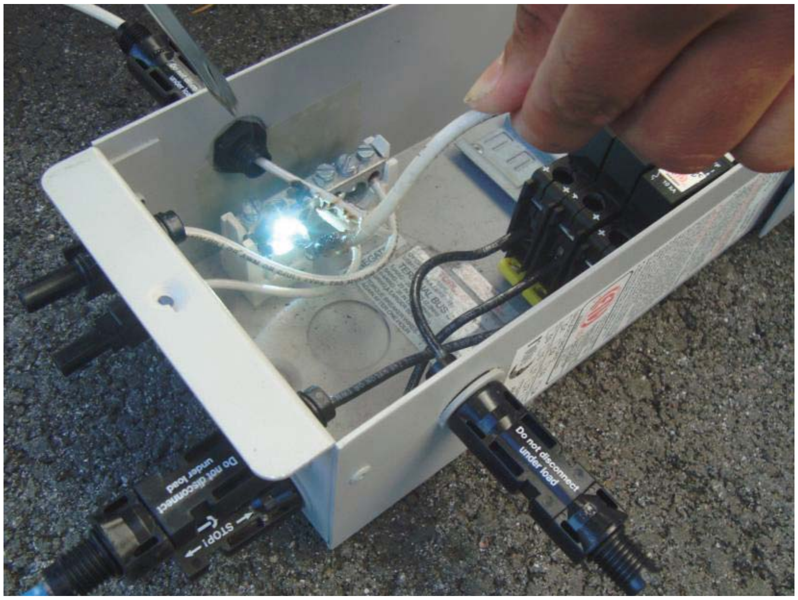
MidNite Solar only offers a 3ft as an optional accessory. If you are making your own cable be sure be sure to insert cable end all the way into the phone terminal to get a good contact. Use the phone crimping pliers to crimp both ends of the cable.

We recommend using flat phone cable for extension, just because it is easier to work with. Use the two pictures above as reference. Make sure the color and position of the wires are as shown in the diagram below. Use terminal connector tab as reference.



## Arc Fault

The Arc Fault Detector is a unique safety component included in every Classic, because safety is not an option, the engineers at MidNite take action as the 2011 NEC code requires. 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 arcing 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. When an arc is detected the Classic has to be manually cleared.




Resetting the Arc Fault Detector after detection has occurred: The First thing to do is find and fix the actual arcing wire, terminal, splice etc. The Classic needs to be powered down completely for 15 seconds and then powered back up. Do this by turning the DC source (PV, Wind or hydro etc.) breaker off. Then turn off the external battery breaker. Than simply turn the 2 breakers back on starting with the battery breaker.

The arc fault module has three adjustable parameters consisting of: MODE, TIME & SENSITVY
MODE: Is assigned as a 1 from factory default and it should stay that way unless instructed by MidNite Solar.

TIME: This sets the length of the arc the Classic has to monitor before tripping the Arc fault detection. This parameter is set to 4 from the factory.

SENSITIVITY: This parameter determines how sensitive the Arc fault detector will be 1 being the most sensitive and 15 the least. This parameter is set to 10 from the factory.

If you experience nuisance tripping you can raise the sensitivity one digit at a time. Follow the instructions below to make adjustments or disable Arc fault. As a last resort, you may disable Arc fault if your system cannot work with the arc fault detector.

To change the parameters of the Arc Fault, follow the steps below:

- ❖ Press Main Menu
- ❖ Scroll to the right or left until TWEAKS is highlighted and press ENTER
- ❖ In TWEAKS press the right soft key to get to the BITS menu
- ❖ In BITS press the right soft key to get to ARC ADJ
- ❖ In this menu use the left and right keys to select the feature to adjust
- ❖ Use the up and down arrow keys to change the parameters

In order for the Classic to read the new settings you must power cycle the Classic. Do this by turning the DC source (PV, Wind or hydro etc.) breaker off. Then turn off the external battery breaker. Than simply turn the 2 breakers back on starting with the battery breaker.

## View Faults and Warning's

The Classic has some helpful safety features including the GFP (Ground Fault Protection) and AFD (Arc Fault Detector). When one or more faults are detected the Classic will stop outputting power and display a fault message in the bottom right corner of the home screen (STATUS). To clear the fault refer to Page 19 and page 33; Arc Fault section.

## View Logged Data

The Classic can log the power produced by your system. Shown in Total kilo Watt hours (kWh), you can view daily logged data or accumulated throughout the life time of the Classic. Daily logged data is displayed in the bottom left corner of the Status screen; the daily logged data will get reset to 0 kWh every 24hrs. The total logged data is displayed in a menu screen called LOGS. Total logged data is an accumulation of all of the power that has been produced by the system; this data cannot be reset back to 0 kWh. To view total kWh produced by you system:

- Press Main Menu,
- Scroll to LOGS and
- Press the Enter button.

## Uploading New Firmware to the Classic

There is also an Ethernet method for updating software in the Classic itself (Ethernet for MNGP Remote coming soon).

## Updating Classic Firmware (Windows XP)

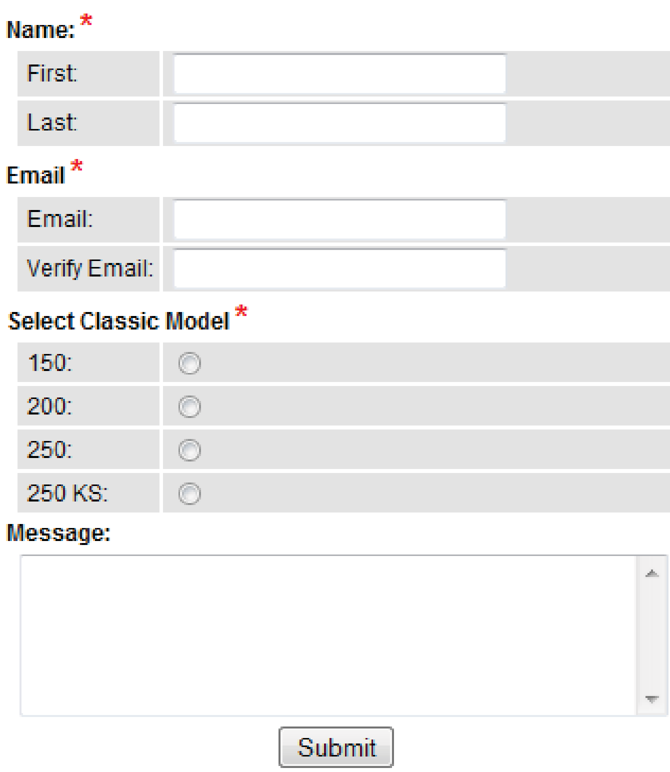
**Requirements:**

**PC with Windows XP**
**One available USB port**
**Internet Connection**

**WARNING ! The Classic's USB port is NOT isolated from battery negative. This is typically only an issue on positive ground systems or systems with a tripped ground fault protection device. Care must be taken that a computer connected to the Classic's USB port is either isolated from ground and the Classic's negative or that the computer's USB negative is common with the Classic's negative and ground.**

1. To retrieve the firmware, go to www.midnitesolar.com, then click on the link labeled “Firmware” in the top menu bar of the web site.


2. Fill out the registration form with the required fields and click Submit.




3. An email will be sent to you with a link to the firmware. Click the link to start the download.
**If the download does not start, copy the link, paste it in the URL address bar and then press enter.**

**MidNite Solar Firmware Download**

midni9@sadar.lunarpages.com

Sent: Fri 3/11/2011 5:57 PM

To: rob@midnitesolar.com; rob@midnitesolar.comrnFrom: info@midnitesolar.comrn

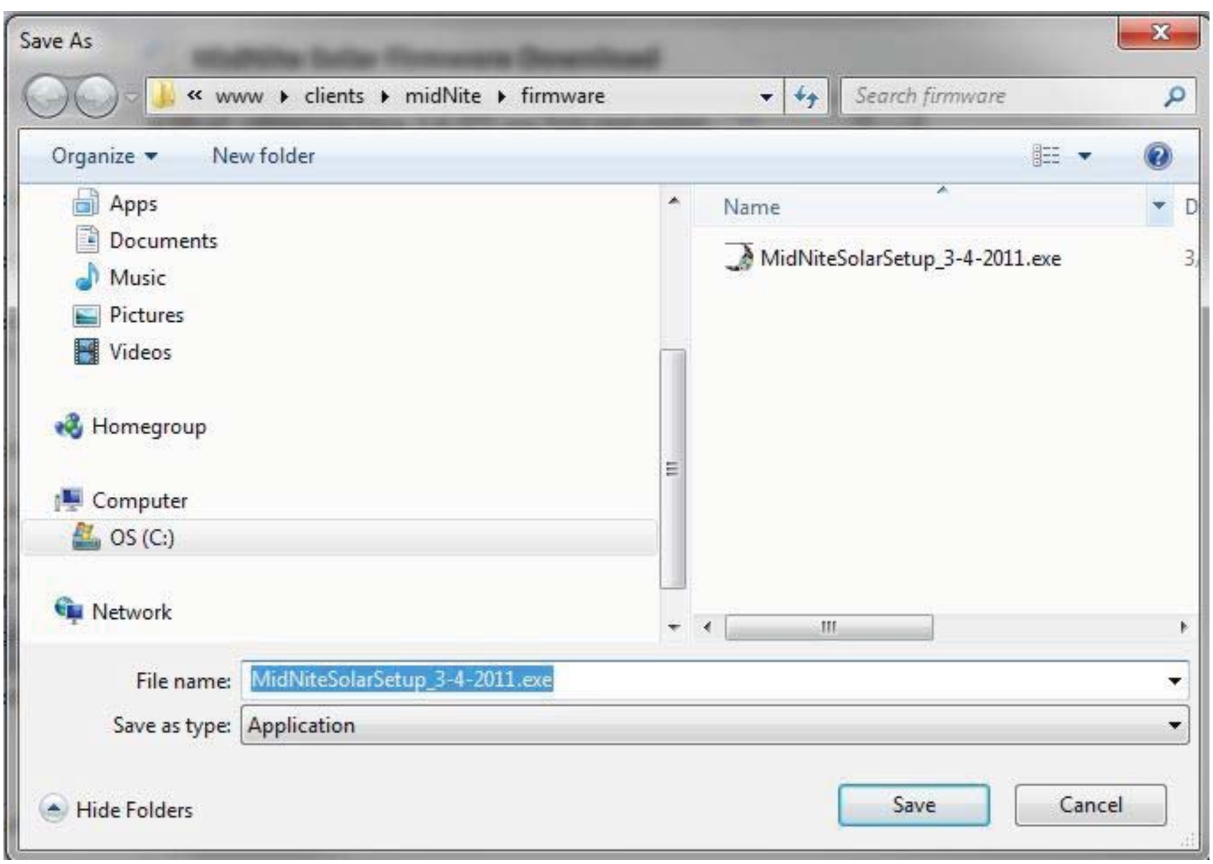
MidNite Solar Inc.
Ph. 360.403.7207
Fax 360.691.6862
17722 - 67th Ave NE
Arlington, WA 98223
www.midnitesolar.com

Click the link below to start the download.
http://www.midnitesolar.com/firmware/MidNiteSolarSetup_3-4-2011.exe

If the download does not start, copy the link, paste it in the URL address bar and then press enter.

Thank you!
MidNite Solar Inc.

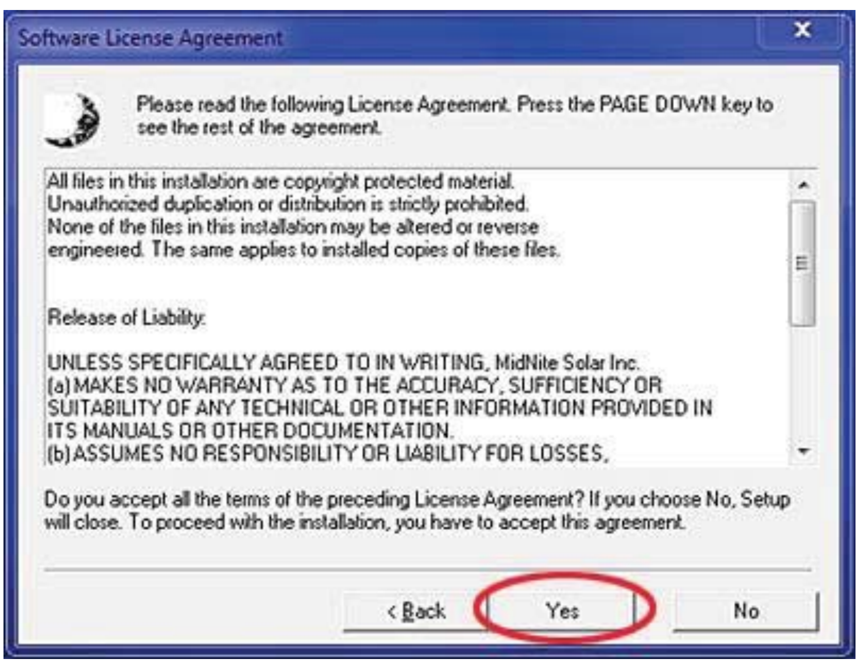
4. Select "Save" to save the file on your computer.



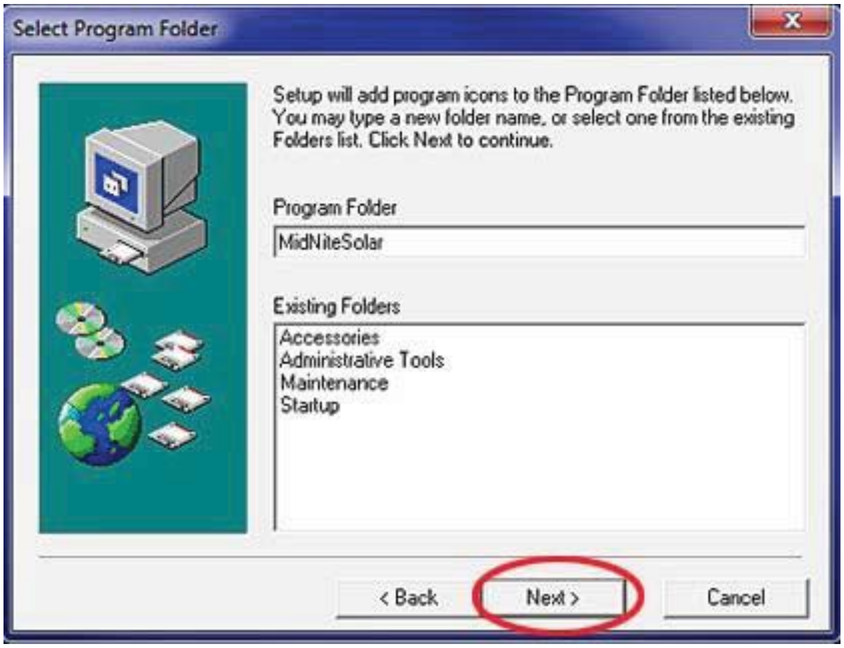
**If your antivirus sees the MidNite Update.exe as a threat, temporarily disable your antivirus. When the install is complete enable your antivirus.**

5. After saving the MidNiteSolarSetup_3-4-2011.exe file double click on it to start the installation.

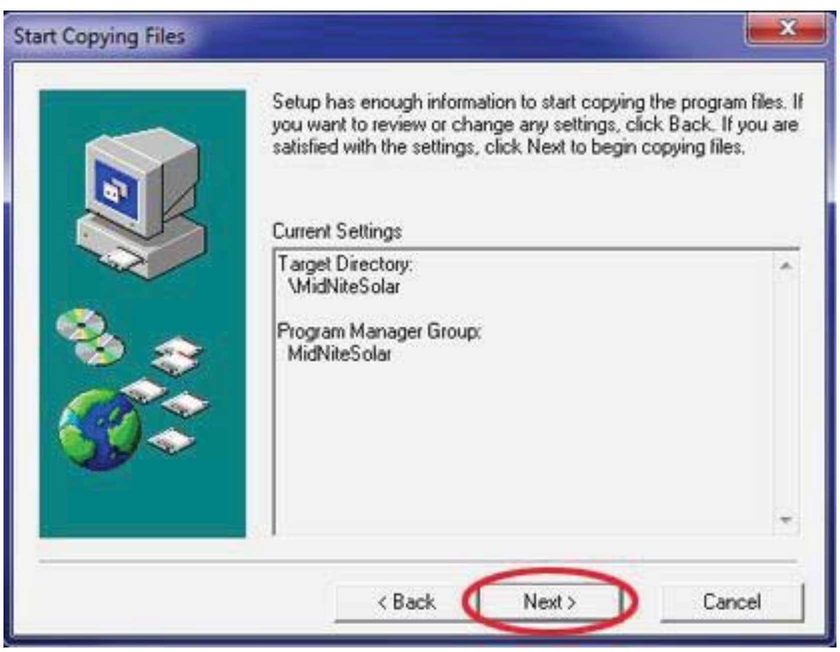

6. The Software License Agreement dialog box will appear. Click "Yes" to except the terms.




7. In the "Select Program Folder" dialog box make sure that MidNiteSolar is in the Program Folder field, and then click "Next".




8. The “Start Copying Files” dialog box will appear, click “Next”. Files will begin to install on your computer.



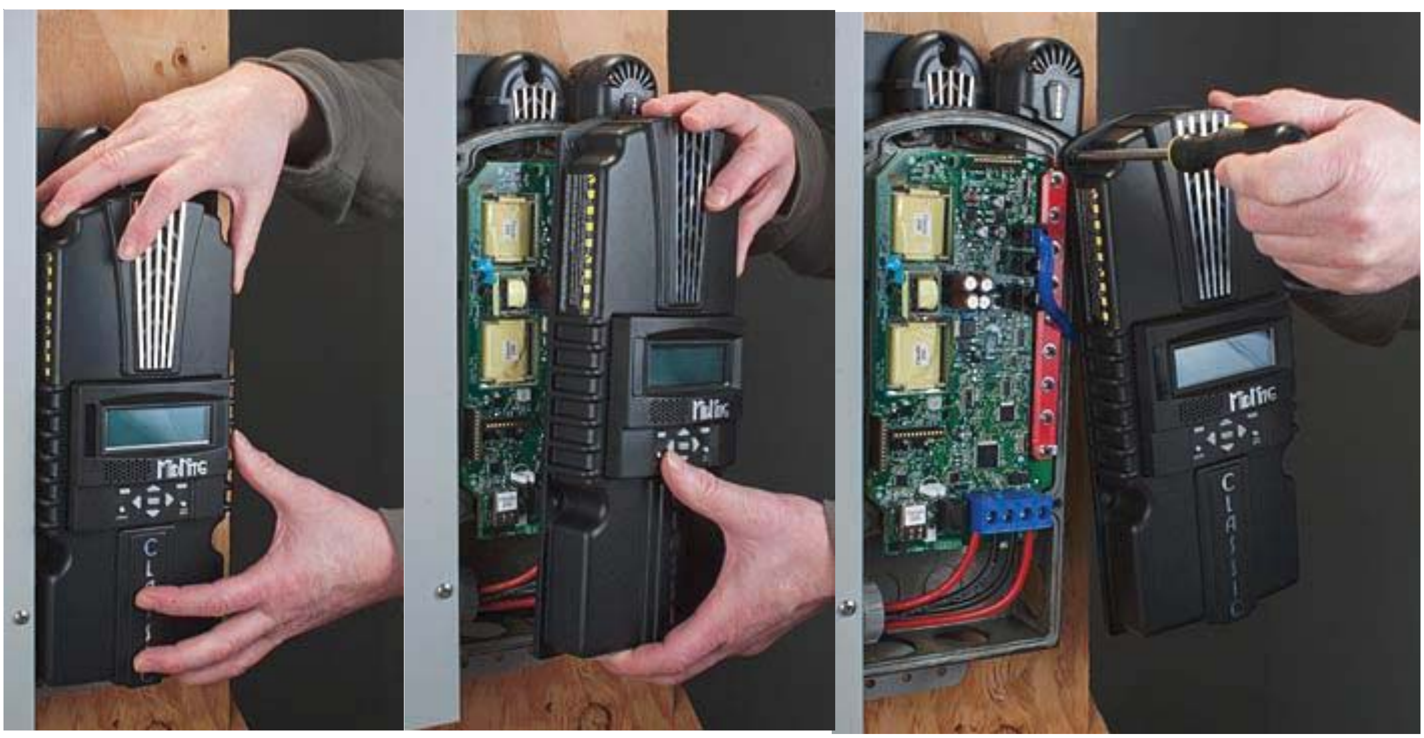

9. In the Setup Complete dialog box click “Finished”. A new MidNite Solar folder will be placed in your C:\ drive. We will refer to this folder in step 20. By default the “View Readme” check box is checked. If you don’t want to read the Readme file, uncheck this box before clicking the “Finish” button.


Prepare Classic charge controller for update.

10. Now go to your electrical panel and identify the input and output breakers for the Classic. Turn them off. Wait 3 minutes for the Classic to de-energize.

11. Remove the four screws holding the front cover of the Classic charge controller. **Do not let the front cover hang by the cable.**


12. Holding the front cover with one hand, place a screw in the top left hole of the front cover and screw it into the top right hole of the back casting.



13. Use the provided USB cable to connect the Classic to the PC. The smaller terminal connects to the USB port on the Classic. The USB port is located on the right side of the Ethernet Jack in the lower part of the Classic.

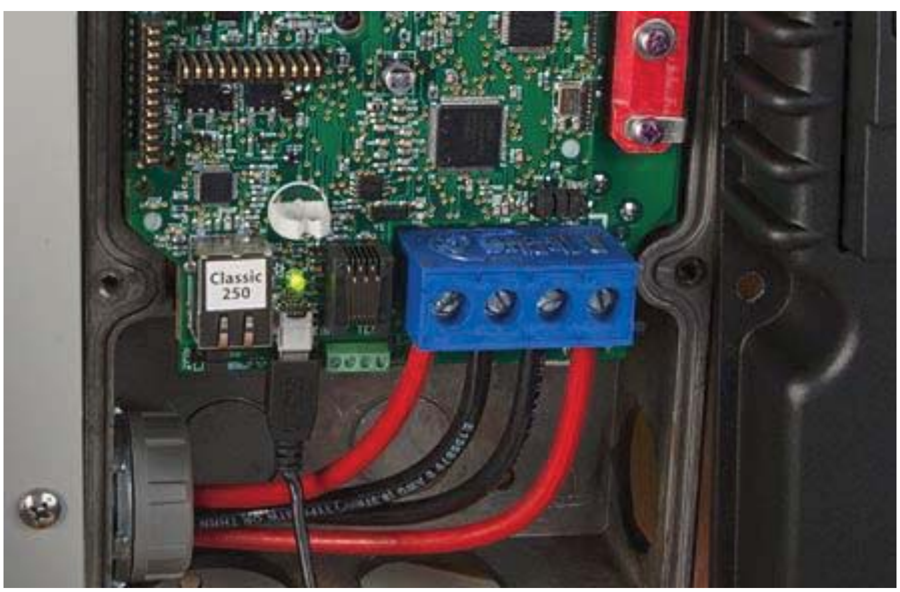
 

14. Connect the other end of the USB cable to an available port of the PC.

Install USB Classic driver

15. Go back to the electrical panel and turn on the battery breaker to the Classic.

16. The LED above the USB port on the Classic will light up and stay on.



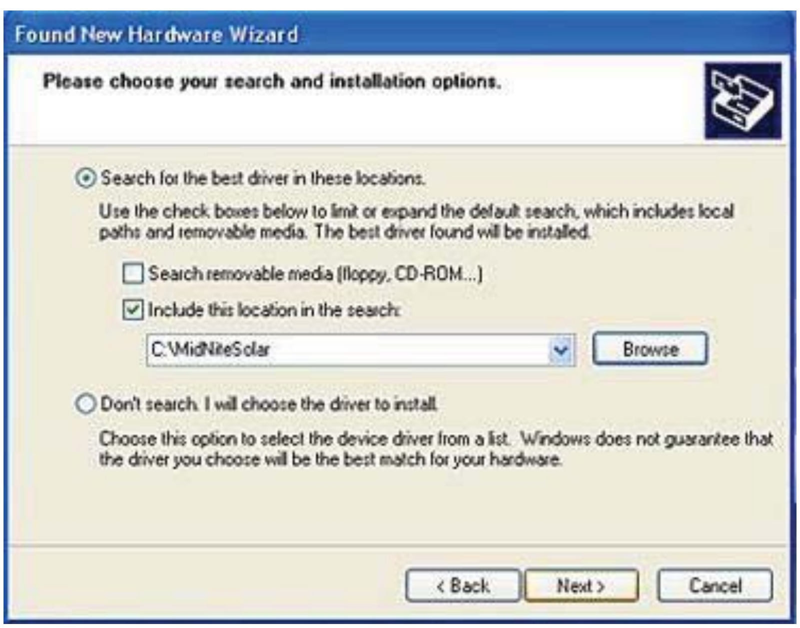
17. The computer will prompt with a "Found New Hardware" pop-up. Select "Not at this time" and press "Next".


18. A "New Found Hardware Wizard" dialog box will appear. Select "Install from a list or specific location (Advanced)" and click "Next".


19. Select "Search for the best driver in this location". Check the "Include this location in the search" checkbox and then click "Browse".

20. Browse to the MidNite Solar folder located on the C:\\ drive and click OK.


21. Click "Next".



22. In the Hardware Installation dialogue box click on “Continue Anyway”.


23. Click Finish to finish driver installation.


Changing Classics’ COM port

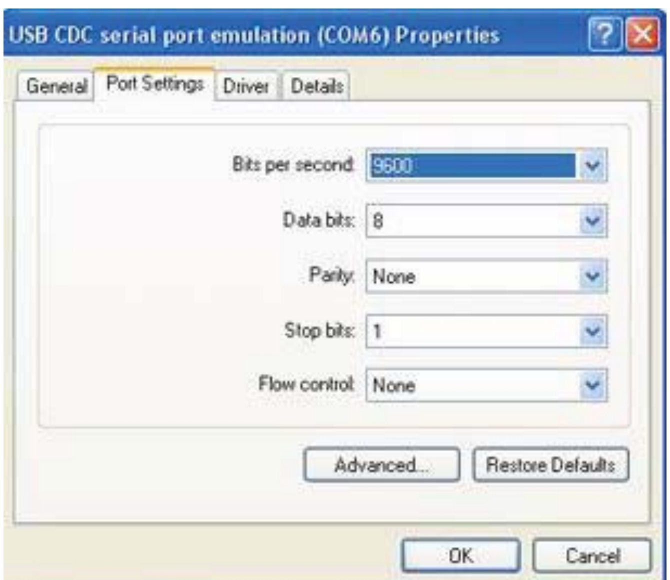
The Classic charge controller can only be recognized if it is set up for COM 8 on the PC; most likely you'll need to change the default COM number of the classic. Here is how:

24. On your computer go to the Control Panel and click on System.

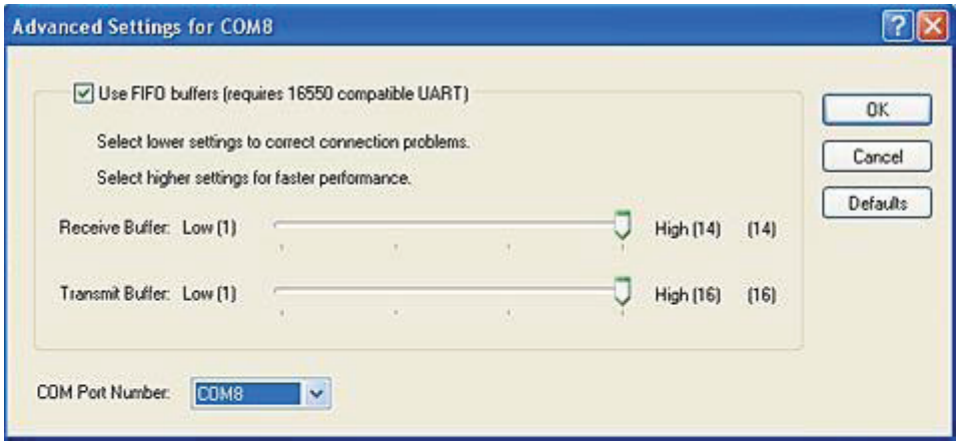

25. Select the tab labeled "Hardware" and click on "Device Manager".

26. In the Device Manager, expand the tree branch labeled “Ports (COM & LPT1)”. Right click on “USB CDC serial port emulation (COMxx)” and select “Properties”.


27. Select the tab labeled “Port Settings” and click on “Advanced”.



28. In the “COM Port” number drop down selection box, select “COM8” and press “OK” to exit that window.

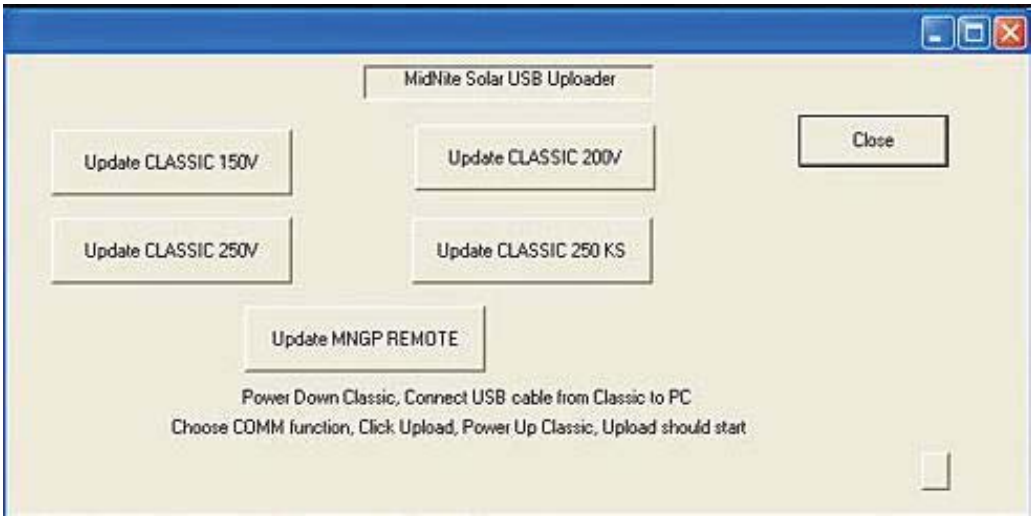



29. Click “OK” on the “USB CDC serial port emulation (COM8) Properties” to save changes. Now close the “Device Manager”, click “OK” on “System Properties” and then close the “Control Panel”.

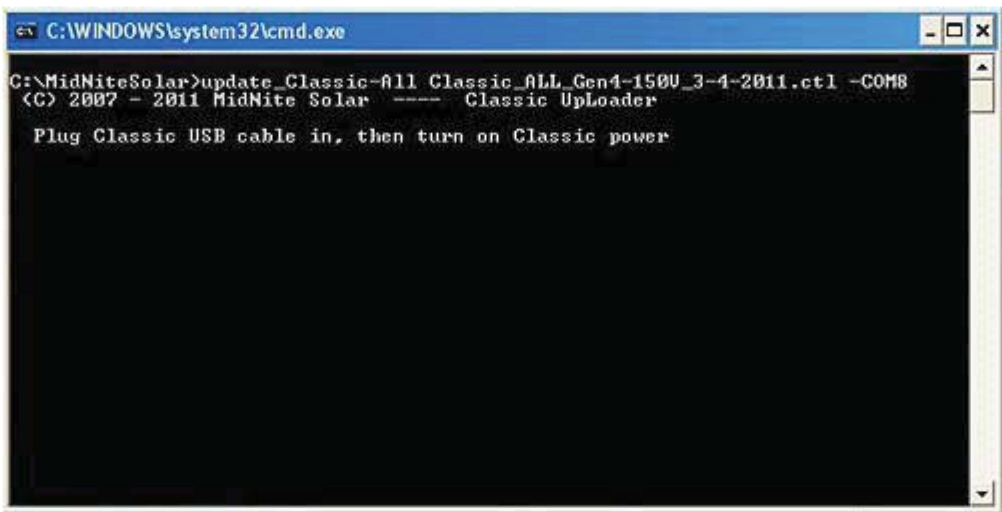
Uploading Classic Firmware

30. Turn OFF the battery breaker to the Classic on the electrical panel and open the “MidNite Update GUI”. The “MidNite Update GUI” can be found by clicking on the Start menu in the lower left portion of the monitor screen and then selecting “MidNite Update GUI”.


31. Click on the model (150, 200, and 250) of the Classic to be updated. A black window will appear and close automatically upon completion of the update.




32. Now turn ON the battery breaker to the Classic. The update should start automatically. Wait until the "update" goes to 100% then turn the battery breaker to the Classic OFF and then ON.




**Turning the breaker off and on resets the Classic so the new settings take effect.**

33. If MNGP (MidNite Graphics Panel) needs to be updated as well, turn OFF the battery breaker to the Classic. Click on the “MNGP” button on the “MidNite Update GUI” then turn ON the breaker.
34. Wait until the uploading percentage reaches 100% and then turn the battery breaker to the classic OFF and then ON. **Turning the breaker off and on resets the Classic so the new settings to take effect.** This now completes the firmware installation. The battery settings, saved graphs and LCD settings on the Classic will remain the same.

**Beware: If the Classic has been updated with a different model of Classic firmware than the factory default, the charge controller will display a “WRONG CODE” message on the bottom right corner of the Status screen and it will not turn ON.**

## Connecting the Classic to the Internet

## Networking

The Classic supports standard 10/100-base T Ethernet networks. For Gigabit networks you will need a common network switch that is capable of mixed mode operation. The Classic may also be placed on a, b, g, or n wireless networks by using a wireless network bridge device.
Depending on your network you may use one of the topographies detailed in Figures 5 – 5.3. Note that the switch may be self-contained or, in many cases, may already be integrated into your cable or DSL modem. Refer to Figure 1.7B for Ethernet connector location in the Classic.

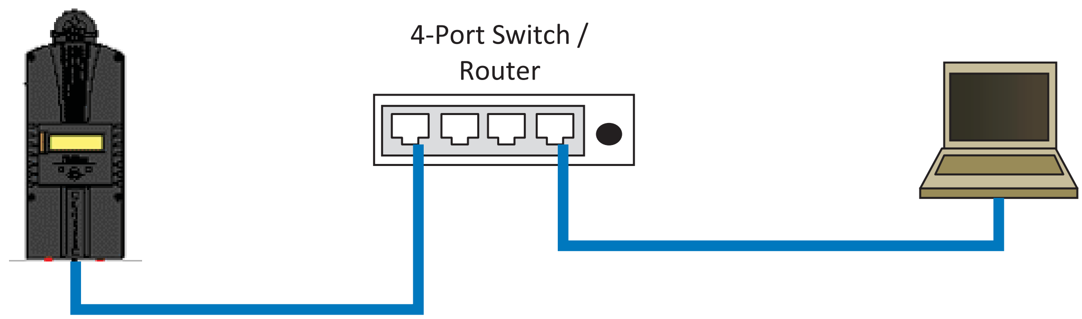



*Figure 5  Local network through switch. In some cases you may be able to connect Classic directly to your PC; however, this is not a recommended topography.*

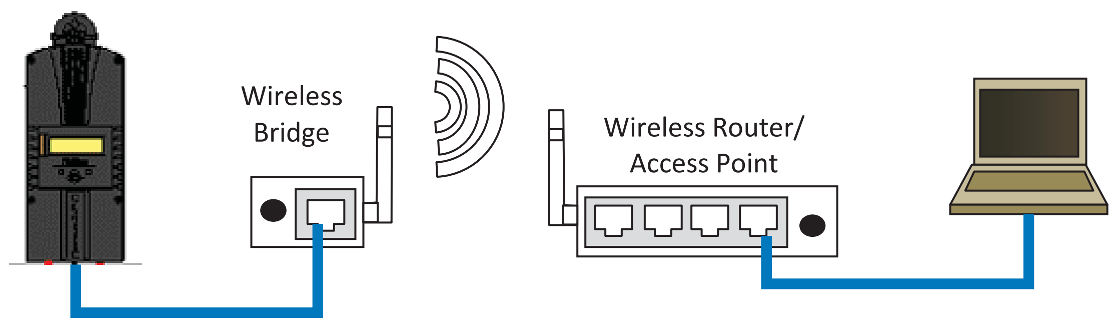



*Figure 5.1  Local network through wireless bridge.*

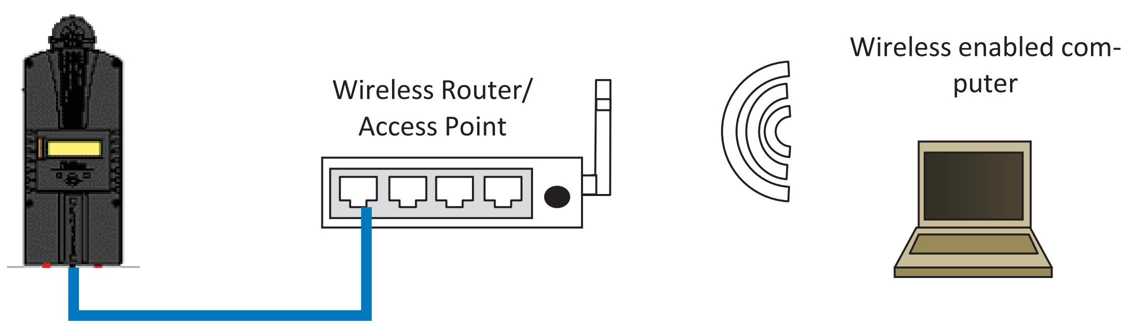



*Figure 5.2  Local wireless network*

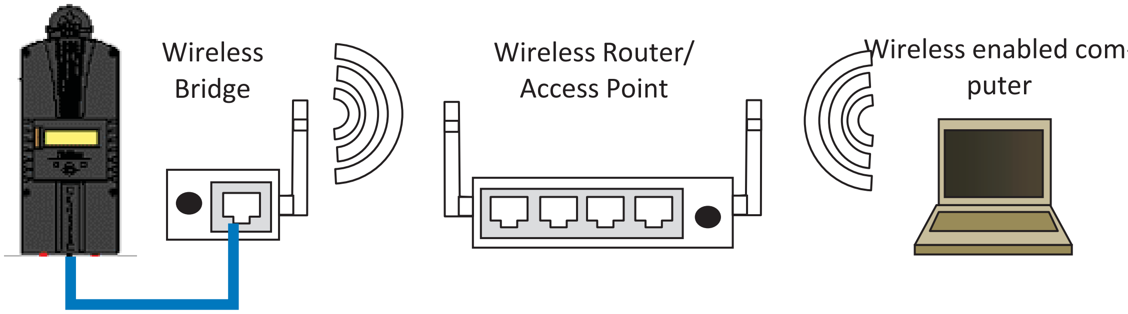



*Figure 5.3 Local wireless network through wireless bridge*

There are many different configurations possible when it comes to networking that are beyond the scope of this manual. The basic ones in the above figures should help get you going.

## Network Setup Through the MNGP

The Classic's Ethernet capabilities may be configured using the Network menu on the MNGP. From the main menu select "NET".
There are three screens that configure network settings. Table TBD decodes the descriptions from the MNGP's small screen.

| MNGP | Long-hand | Description |
|---|---|---|
| Mode | IP address configuration mode: DHCP/Static | The Classic supports both static and dynamically (DHCP) allocated IP addresses. If you are unsure which to choose try DHCP first. If you have trouble move to the troubleshooting section. |
| IP | IP Address | The Network address of the Classic |
| SN | Subnet | The Subnet or address class specifier |
| GW | Gateway Address | The address of the network's gateway device |
| D1 | Primary DNS Address | Primary Address lookup device |
| D2 | Secondary DNS Address | Secondary Address lookup device (optional) |
| Web Access | - | Enables or disables the Classic's online web service feature |
| MA | MAC Address | The hardware or Ethernet address of the Classic |
| DI | Device ID | The unique MidNite Solar address of the Classic |
| | | |

*Table 5.1 Net Menu Details*

## DHCP

The Classic supports Dynamic Host Configuration Protocol (DHCP) in which all networking settings are derived from a DHCP-enabled router. This is the simplest configuration method and recommended unless you explicitly need a statically allocated IP address for your Classic. In this mode all other settings are automatically configured and are read only (informational) with the exception of the Web Access feature.

- Press Main Menu
- Scroll to NET menu and press the Enter button
- Highlight and select DCHP

Please note that the Classic's DHCP protocol implementation usually takes a few seconds up to a minute to update the network settings. If the network settings do not update within a minute, please consult the troubleshooting section.

## Static IP

The Classic supports static IP address allocation. In this mode you can assign the Classic a specific IP address. This lets you set up things like port forwarding from your router or for networks with static IP allocations.

- Press Main Menu
- Scroll to **NET** menu and press the Enter button
- Highlight and select **STATIC**
- Using the left and right keys, navigate to the settings to change and use the up and down arrows to adjust the desired fields.
- Press the **COMMIT** softkey at any time to commit the settings to the Classic's Flash memory.

Please note that static settings span two menu screens. You may use the soft keys to navigate between the two menus. Pressing the **ENTER** key in either menu saves all settings to Flash memory.
For convenience when you manually set the device's IP address the Gateway and Primary DNS addresses follow the change. See the following sections for details on each of these fields.

### IP Address

This is the local network address of your Classic. It usually takes the form "192.169.0/1.x" or "10.0.0.x" depending on your networking equipment. You must be careful when selecting this address. If it does not match your network subnet then the classic will not be able to communicate with the network. If it is the same as another device on the network then collisions will occur causing both devices to act erratically. Check your router settings or ask your network administrator which local address to use. Also refer to the troubleshooting section for tips.

### Subnet

This refers to the class of local network you are using. This depends on your network hardware but most users should use "255.255.255.0" for this field.

### Gateway

This is the address of your router or modem – the device which is connected directly to the Internet proper. It will usually take the form 192.168.0/1.1 or 10.0.0.1 depending on your network configuration and hardware. Check your router settings or ask your network administrator which local address to use. Also refer to the troubleshooting section for tips.

### DNS 1 & 2

The DNS is the means by which human-readable internet addresses are resolved to actual IP addresses on the network. These values can usually be set identically to the gateway address depending on your network hardware. If your ISP provides you with specific DNS servers then use those addresses in these fields instead.
**Example 1**: Your gateway is a DSL modem with address 192.168.1.1. If your ISP has not given you explicit DNS servers to use then set the **D1** field to 192.168.1.1. **D2** can be ignored.
**Example 2**: Your gateway is a cable modem with address 10.0.0.1. Your ISP has specified primary and

secondary DNS server addresses of 11.22.33.44 and 11.22.33.55, respectively. Set the **D1** address to 11.22.33.44 and the **D2** address to 11.22.33.55.

## Web Access

MidNite Solar offers a free web service with which you can access your Classic from a web page from anywhere in the world simply by pointing your favorite web browser to
http://www.mymidnite.com
See the web section further on for instructions on how to create an account and use the web-based system. All communications between the Classic and MidNite Solar's server are encrypted using a strong session-based algorithm. To respect your privacy, however, it is required that you manually enable this feature if you'd like to use it.
In order to enable the web access feature:

- Press **Main Menu**
- Scroll to **NET** menu and press the Enter button
- using the soft keys, navigate to the **ADVANCED** menu (**NET→NEXT→ADVANCED**)
- The **Web Access** option should be highlighted.
- Use the up/down keys to now enable or disable the feature.

Note that the **Web Access** selection indicates the current setting of the feature: i.e. **ENABLED** means the feature is currently in operation.
Note also that you will need the values **MA** and **DI** handy in order to create an account on the MidNite Solar web site. This unique number pair identifies your particular classic to our server and helps to prevent malicious users from trying to access your Classic. The **DI** or Device Id is different than your Unit's Serial Number.

## Local Network

Note that your classic identifies itself by name to DHCP-enabled routers as "Classic". There is facility to change the name of a given classic via the local and web-based interfaces as well as using third-party MODBUS software packages.

### Advanced

The Classic advertises its address every 10 seconds using the UDP protocol on port (TBD). Advanced users and programmers may use this feature to identify Classics on their network.

## MODBUS (Preliminary)

## DISCLAIMER

There is not a convention on the write-ability of registers. You may write to any register in the system including registers THAT MAY DAMAGE OR DESTROY your Classic and attached equipment like battery banks. Please make sure that you understand what you are doing before attempting to change any settings (like battery voltage) using the raw MODBUS interface. MidNite Solar cannot take responsibility for any damage to your Classic in the event of misconfiguration.

Registers and bits marked RESERVED are not necessarily unimplemented. Great care must be taken not to overwrite these registers or bits to ensure proper operation of the Classic.

Wherever possible we have tried to indicate settings that may have an adverse effect on your system if set incorrectly.

If you need to configure your system, please consider using the MNGP's built in configuration wizard which will step you through the process.

## Conventions:

Register units are expressed using formulas to try to reduce the ambiguity surrounding converting from the raw bus formats and human-readable values. Due to the nature of the Classic's operation, there is not a uniform convention as far as data endianness so you may find some classes of values that follow a Most Significant Byte (MSB) first convention and others that use the Least Significant Byte (LSB) first convention.

Bits are numbered from 0-15 in the little-endian or LSB-0 notation. That is, the least significant bit is indexed by 0.
For Example, the number 43,981 is 0xABCD in hex is represented in binary as 1010101111001101.

The bit ordering is as shown in the following table:

| **15** | **14** | **13** | **12** | **11** | **10** | **9** | **8** | **7** | **6** | **5** | **4** | **3** | **2** | **1** | **0** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 1 |

So that the binary digit indexed by (0) is 1. (1) is 0, (6) is 1, and (10) is 0.

MODBUS registers are 16-bit (2-octet/byte) in size. When using values from the map to indicate conversion formulas the following convention is used to access different octets:

Note that when talking about bytes or octets, it is more convenient to describe them in hexadecimal (base 16) form than in decimal. Some values are expressed in bytes as it is a more compact way of dealing with certain classes of numbers (IP addresses, for example). We use the 'C' convention of referring to hexadecimal numbers by prefixing them with '0x'. So the decimal value 10 is represented by the hexadecimal value 0x0A.

A note on Read/Write: The Classic MODBUS does not strictly enforce the Read/Write accessibility of some registers. It is possible to write to some registers marked Read Only. This will usually have no effect on Classic operation, but in some cases you may corrupt a register from which you wanted to read data. In some cases the registers are reset internally as new values. Additionally, some counters are accessible directly. For example, the AbsorbTime (4139) timer is a "suggested" read only register; however, if your MODBUS application has reason to reset or adjust this register, there is nothing to prevent you from changing it however you please. Don't be surprised if your batteries pop in and out of Absorb stage unexpectedly, though!

Operators:
**Indexing**
[ ] square brackets around an address indicate the value of the register specified:

ex: [4116] indicates the value of the register at address 4116.

$[\ ]_{MSB}$ Square brackets followed by an $_{MSB}$ means to use the most-significant byte of the register.
ex: if the value at register 4116 is 0x04B1 (decimal 1201):
[4116] = 0x04B1,
then
$[4116]_{MSB}$ = 0x04

$[\ ]_{LSB}$ Square brackets followed by an $_{LSB}$ means to use the least-significant byte of the register.
ex: if the value at register 4116 is 0x04B1 (decimal 1201):
[4116] = 0x04B1,
then
$[4116]_{LSB}$ = 0xB1

( ) Parentheses refer to bits within the register.
For example: [4116](0) means "the 0th bit of the value in register 4116.
So if 4116 held the value 1 (0x0001 hex) then [4116](0) would be a 1. [4116](1…15) would all be 0s.

… Ellipses represent ranges of values or indices.
For example to refer to the first three bits of a register you may see:
[4116](0…3) which signifies the first three bits of the value of register 4116.
You may also see spans of registers as:
[4116…4120] which refer to registers 4116 to 4120 inclusive.

**Arithmetic**

| | |
|---|---|
| + | Add two numbers together |
| - | Subtract two numbers (or negate the value on the right) |
| / | Divide two numbers (integer implied) |
| * | Multiply two numbers (integer implied) |

**Logical**

<< x Binary shift left. Shift the value x binary digits to the left. This is equivalent to multiplying the decimal number by $2^x$. Ex:
[4116] = 0x0001
Then
[4116] << 1 = 0x0002.

>> x Binary shift right. Shift the value x binary digits to the right. This is equivalent to dividing the decimal number by $2^x$.

[4116] = 0x0002
Then
[4116] >> 1 = 0x0001.

| | | |
|---|---|
| \| | OR two numbers together (aligned to LSB) |
| & | AND two numbers together (aligned to LSB) |
| ^ | XOR two numbers together (aligned to LSB) |

**String**

| | |
|---|---|
| \|\| | Concatenate. |
| | [4116] = 0x4142. |
| | $[4116]_{MSB}$ \|\| $[4116]_{LSB}$ => 0x41 \|\| 0x42 => 'A' \|\|'B' => "AB" |

**Examples:**
Using the example of the Average PV Voltage register: dispavgVpv @ 4116
Suppose using a MODBUS scanner you retrieve the following (integer) value from the dispavgVpv register at address 4116:

**4116**: 1201

- The address itself: 4116
- Full 16-bit value at the address: [4116] = 1201 (0x04B1 hex)
- The top-most (MSB) octet of the register: $[4116]_{MSB}$ = 0x04 hex
- The bottom-most (LSB) octet of the register $[4116]_{LSB}$ = 0xB1 hex
- Applying the Conversion (**[4116] / 10) Volts:**
    - [4116] = 1201
    - 1201 / 10 = 120.1 Volts

**File Transfer and Function Execution modes:**

Coming soon *(next revision of this document)* will be information on how to use the MODBUS File Transfer and Function execution commands. File Transfer will be necessary, for instance, to transfer wind power curves to/from the Classic or logging and audio data to/from the Classic and/or MNGP.

| Base Registers | | | | |
|---|---|---|---|---|
| **Address** | **R/W** | **Name** | **Conversion** | **Notes** |
| 4101 | R | UNIT_ID | PCB revision = $[4101]_{MSB}$<br>Unit Type = $[4101]_{LSB}$ | The PCB revision is a value between 0 and 255 indicating the hardware revision of the PC board.<br>The Unit Type is an integer value indicating the voltage category of the Classic See Table 4101-1. |
| 4102<br>4103 | R | UNIT_SW_DATE_RO | Year = [4102]<br>Month = $[4103]_{MSB}$<br>Day = $[4103]_{LSB}$ | Software Build date. |
| 4104<br>4105 | R | UNIT_SerialNumber | ([4105] << 16) + [4104] | The serial number of the unit as appears on the label. |
| 4106<br>4107<br>4108 | R | UNIT_MAC_AddressI | $[4108]_{MSB}$ **:** $[4108]_{LSB}$ **:**<br>$[4107]_{MSB}$ **:** $[4107]_{LSB}$ **:**<br>$[4106]_{MSB}$ **:** $[4106]_{LSB}$ | The unit's Ethernet MAC address. |
| 4109<br>4110 | R | UNIT_IP_Address | $[4110]_{MSB}$ . $[4110]_{LSB}$ .<br>$[4109]_{MSB}$ . $[4109]_{LSB}$ | The Unit's TCP/IP Address |
| 4111<br>4112 | R | UNIT_Device_ID | ([4112] << 16) + [4111] | The device ID of the unit. |
| 4113 | **RESERVED** (Do NOT Write) | | | |
| 4114 | R | RestartTimerms | [4114] Mili Seconds | Time after which the Classic can wake up. (countdown) |
| 4115 | R | dispavgVbatt | ([4115] / 10) Volts | Average Battery Voltage |
| 4116 | R | dispavgVpv | ([4116] / 10) Volts | Average PV terminal input Voltage |
| 4117 | R | IbattDisplaySi_mbus | ([4117] / 10) Amps | Average Battery Current |
| 4118 | R | kWhoursAdj | ([4118] / 10) kWh | Average Energy to the Battery This is reset once per day |
| 4119 | R | Watts | ([4119] / 10) Watts | Average Power to the Battery |
| 4120 | R | mbComboChrgStge | Charge Stage = $[4120]_{MSB}$<br>State = $[4120]_{LSB}$ | See Table 4120-1 for battery charge state.<br>See Table 4120-2 for State |
| 4121 | R | PvInputCurrent | ([4121] / 10) Amps | Average PV terminal input Current. |
| 4122 | R | VocLastMeasured | ([4122] / 10) Volts | Last measured open-circuit Voltage at the PV terminal input. |

| Address | R/W | Name | Conversion | Notes |
|---|---|---|---|---|
| 4123 | **RESERVED** | | | |
| 4124 | R | MatchPointShadow | [4124] | Instantaneous value of Wind curve being used. Values [1…16] |
| 4125 | R | AmpHours | ([4125] / 10) Amp Hour | Daily Amp Hours reset once per day |
| 4126<br>4127 | R | TotalkWhours | (([4127] << 16) + [4126]) kWh | Lifetime Energy Generation |
| 4128<br>4129 | R | TotalAmpHours | (([4129] << 16) + [4128]) Amp Hours | Lifetime Amp-Hour Generation |
| 4130<br>4131 | R | InfoFlagsBits | ([4131] << 16) + [4130] | See Table 4130-1 |
| 4132 | R | BATTtemperature | ([4132] / 10) °C/F | Temperature measured at the external Battery Temperature Sensor (if installed, else 25C) |
| 4133 | R | FETtemperature | ([4133] / 10) °C/F | Temperature of PWM FETs |
| 4134 | R | PCBTemperature | ([4134] / 10) °C/F | Temperature of the Classic Control (top) PCB |
| 4135 | | NiteMinutesNoPwr | [4135] minutes | Nighttime Check |
| 4136<br>4137 | **RESERVED** (Do NOT Write) | | | |
| 4138 | R | TimeMinutesFloatToday | [4138] minutes | Number of minutes that the Batteries have spent in float today. Reset next AM. |
| 4139 | R/W | AbsorbTime | [4139] seconds | Absorb Time Up/Down Counter |
| 4140 | R | DaysSinceLastFloat | [4140] days | Elapse days since battery was last in the Float stage |
| 4141 | R | PWM_ReadOnly | [4141] ( 0 to 1023) | Duty Cycle command of PWM signal. (NOT a Percent) |
| 4142 | R | SunRiseTodayMsrd | [4142] Minutes | Minutes since first wakeup today for solar modes |
| 4143 | R | Equalize Time | [4143] Seconds | Battery Stage Equalize Down Counter. Time remaining in Equalize Stage |
| 4144<br>4145<br>4146 | **RESERVED** (Do NOT Write) | | | |

| Address | R/W | Name | Conversion | Notes |
|---|---|---|---|---|
| 4147 | R | NoDoubleClickTimer | [4142] Seconds | Forced time space between manual MPPT sweeps. |
| 4148 | R/W | Battery output Current Limit | [4148] / 10) Amps | Battery Current Limit Amps (example: 23.4 A = 234) |
| 4149 | R/W | Absorb Set Point Voltage | ([4149] / 10) Volts | Battery Absorb Stage Set point Voltage (example: 28.3V = 283) |
| 4150 | R/W | Float Voltage Set Point | ( [4150] / 10) Volts | Battery Float Stage Set Point Voltage |
| 4151 | R/W | Equalize Voltage Set Point | ([4151] / 10) Volts | Battery Equalize Stage Set Point Voltage |
| 4152 | R | Sliding Current Limit | [4152] Amps | Sliding Current Limit (changes with V/Temp etc.) |
| 4153 | R/W | Minimum Absorb Time | [4153] seconds | Minimum time for Batteries to remain in Absorb Stage. |
| 4154 | R/W | Maximum Absorb Time | [4154] seconds | Maximum time for Batteries to remain in Absorb Stage. |
| 4155 | R/W | Maximum Battery Temperature Compensation Voltage | ([4155] / 10) Volts | Highest Charge Voltage is limited to this value when battery temp sensor installed |
| 4156 | R/W | Minimum Battery Temperature Compensation Voltage | ([4155] / 10) Volts | Lowest Charge Voltage is limited to this value when battery temp sensor installed |
| 4157 | R/W | Battery Temp Comp Value for each 2V cell | -([4157] / 10) mV/degree C/cell (0.5 mV steps) 0 to 10 mV per 2V cell | Absolute value of the Temperature Compensation Value in mV/°C /2V cell |
| 4158 | R/W | Battery Type | [4158] | Type of Batteries. See Table 4158-1 (unimplemented as of May 2011) |
| 4159 | **RESERVED** | | | |
| 4160<br>4161 | W | Force Flag Bits | ([4161] << 16) + [4160] | See Table 4160-1. |

| Address | R/W | Name | Conversion | Notes |
|---|---|---|---|---|
| 4162 | R/W | Equalize Time | [4162] Seconds | Initialize Time for Batteries to remain in Equalize Stage. |
| 4163 | R/W | Equalize Interval Days | [4163] Days | Number of days between Equalize Stages (Auto EQ) |
| 4164 | R/W | Mppt Mode (Solar, Wind, …………… etc) | [4164] (bit 0 = On/Off) | Maximum Power Point Mode. See Table 4164-1. |
| 4165 | R/W | Aux 1 and 2 Function | [4165] | Combined Aux 1&2 Functions + On/Off. See Table 4208 |
| 4166 | R/W | Aux1VoltsLoAbs | ([4166] /10) Volts | Aux 1 Absolute Low Threshold Voltage |
| 4167 | R/W | Aux1DelayT | [4167] Milli Seconds | Aux 1 Delay time before Asserting. |
| 4168 | R/W | Aux1HoldT | [4168] Milli Seconds | Aux 1 Hold time before De-asserting. |
| 4169 | R/W | Aux2PwmVwidth | ([4169] /10) Volts | Voltage range over which PWM operates. |
| 4170 | **RESERVED** | | | |
| 4171 | | | | |
| 4172 | R/W | Aux1VoltsHiAbs | ([4172] /10) Volts | Aux 1 Absolute High Voltage Threshold |
| 4173 | R/W | Aux2VoltsHiAbs | ([4173] /10) Volts | Aux 2 Absolute High Voltage Threshold |
| 4174 | R/W | Aux1VoltsLoRel (Relative to charge stage set point V) | ([4174] /10) Volts | Aux 1 Relative Lower Voltage Threshold (Charge Stage Rel) |
| 4175 | R/W | Aux1VoltsHiRel (Relative to charge stage set point V) | ([4175] /10) Volts | Aux 1 Relative Upper Voltage Threshold (Charge Stage Rel) |
| 4176 | R/W | Aux2VoltsLoRel (Relative to charge stage set point V) | ([4176] /10) Volts | Aux 2 Relative Lower Voltage Threshold (Charge Stage Rel) |
| 4177 | R/W | Aux2VoltsHiRel (Relative to charge stage set point V) | ([4177] /10) Volts | Aux 2 Relative Upper Voltage Threshold (Charge Stage Rel) |
| 4178 | R/W | Aux1VoltsLoPv (absolute) | ([4178] /10) Volts | Aux 1 Lower PV Voltage Threshold |

| Address | R/W | Name | Conversion | Notes |
| --- | --- | --- | --- | --- |
| 4179 | R/W | Aux1VoltsHiPv (absolute) | ([4179] /10) Volts | Aux 1 High PV Voltage Threshold |
| 4180 | **RESERVED** (Do NOT Write) | | | |
| 4181 | R/W | Aux2VoltsHiPv (absolute) | ([4181] /10) Volts | Aux 2 High PV Voltage Threshold |
| 4182 | **RESERVED** (Do NOT Write) | | | |
| 4183 | R/W | ArcFaultSenstvty | Time = [4183]<br>Sense = [4183] | Arc Fault Protection sensitivity response adjustments |
| 4184 | **RESERVED** (Do NOT Write) | | | |
| 4185 | | | | |
| 4186 | | | | |
| 4187 | R/W | Enable Flags bits | [4187] | See Table **4187-1** |
| 4188 | R/W | **RESERVED** | [4188] | **RESERVED**(Do NOT Write) |
| 4189 | R/W | Vbatt_Offset | ([4189] /10) | Battery Voltage Offset Tweak (Range Limited) (Signed) |
| 4190 | R/W | Vpv_Offset | ([4190] /10) | Input Voltage Offset Tweak (Range Limited) (Signed) |
| 4191 | R | VpvTargetRd | ([4191] /10) Volts | Input Target (V regulation) Voltage (Usually Vmpp) |
| 4192 | **RESERVED** (Do NOT Write) | | | |
| 4193 | | | | |
| 4194 | | | | |
| 4195 | | | | |
| 4196 | | | | |
| 4197 | R/W | LgcySweepIntervalSecs | [4197] Seconds | Legacy P&O, Hydro, Solar, U-Set Sweep Interval, Seconds<br>(Forcing Sweep resets timer) |
| 4198 | R/W | MinSwpVocPercentage | ([4198] / 100) % | Minimum sweep as a percentage of $V_{oc}$ **(Unused)** |
| 4199 | R/W | MaxSwpVocPercentage | ([4199] / 100)% | Maximum sweep as a percentage of $V_{oc}$ **(Unused)** |
| 4200 | R/W | SweepDepth | [4200] Watts % | Percent of last Mpp Watts |

| Address | R/W | Name | Conversion | Notes |
|---|---|---|---|---|
| 4201 | **RESERVED** (Do NOT Write) | | | |
| 4202 | R/W | ClipperCmdVolts | ([4202] /10) Volts | Variable Voltage command to Clipper or Aux in Clipper mode |
| 4203 | R/W | WindNumberOfPoles | [4203] poles | Number of turbine alternator poles (for RPM Calc) |
| 4204 | R/W | MppPercentVoc | [4204] 00 to 100 % | % of Voc for U-Set mode |
| 4205 | R/W | WindTableToUse | [4205] | **FUTURE** power curve select |
| 4206 | R/W | WindTableLearn | [4206] | **FUTURE** Wind Learn usage |
| 4207 | R/W | LEDmode | [4207] | See Table 4207-1 |
| 4208<br>4209 | **RESERVED** | | | |
| 4210<br>4211<br>4212<br>4213 | R/W | ID name | $[4210]_{MSB} \Vert [4210]_{LSB} \Vert$<br>$[4210]_{MSB} \Vert [4210]_{LSB} \Vert$<br>$[4210]_{MSB} \Vert [4210]_{LSB} \Vert$<br>$[4210]_{MSB} \Vert [4210]_{LSB} \Vert$ (End with 00 if less than 8 characters) | Unit Name. DHCP and MODBUS name. 8 character maximum ASCII. Takes place of MODBUS address in MNGP display if present (this needs some work) |
| 4214<br>4215 | W | CTIME0 | ([4215] << 16) + [4214] (possibly atomic op) | Consolidated Time Registers SEE Table 4214-1 |
| 4216<br>4217 | W | CTIME1 | ([4217] << 16) + [4216] (possibly atomic op) | Consolidated Time Registers SEE Table 4216-1 |
| 4218 | W | CTIME2 | [4218] | Consolidated Time Registers SEE Table 4218-1 |
| 4219 | R/W | BaudRateStopStartEtc | [4219] Baud rate, bps<br>(Not implemented as of May 2011) | MODBUS Serial Baud rate. Note that writing this register will immediately change the target unit's serial baud rate which may result in communication problems with other units in the system including the unit's MNGP. |
| 4220 | R/W | RemoteMenuMode | [4220] | Present Remote Menu sent from MNGP |
| 4221 | R/W | RemoteButtons | [4221] | Remote Buttons pressed from MNGP |
| 4222 | R/W | VbatOvrshootSenstvty | [4222] | Overshoot Sensitivity *(not implemented)* |
| 4223 | R/W | **RESERVED** | [4223] | **RESERVED** (Do NOT Write) |

| Address | R/W | Name | Conversion | Notes |
|---|---|---|---|---|
| 4224 | R/W | PreVoc | ([4224] /10) Volts | PV Terminal V before Relay |
| 4225 | | **RESERVED** (Do NOT Write) | | |
| 4226 | R/W | VauxA2Dinput | [4226] TBD | Aux 2 A to D input (TBD) |
| 4227 | | **RESERVED** (Do NOT Write) | | |
| 4228 | | | | |
| 4229 | | | | |
| 4230 | | | | |
| 4231 | R | VocRD | ([4231] /10) Volts | Last $V_{OC}$ reading |
| 4232 | | **RESERVED** (Do NOT Write) | | |
| 4233 | | | | |
| 4234 | | | | |
| 4235 | | | | |
| 4236 | R/W | AbsorbTime | [4236] seconds | Absorb Time Counter (DUP!) |
| 4237 | R/W | AntiClickSenstvty | [4237] | Best Left Alone |
| 4238 | | SiestaTime | [4238] seconds | Sleep timer |
| | | | | |
| 4239 | | SiestaAbortVocAdj | ([4239] / 10) Volts | Volts above last Voc reading to abort Siesta. |
| 4240<br>4241 | R | flagsRD | ([4241] << 16) + [4240] | Internal Flags See Table 4240-1 |
| 4242 | | **RESERVED** (Do NOT Write) | | |
| 4243 | | | | |
| 4244 | R | VbattRegSetPTmpComp | ([4244] / 10) Volts | Temperature compensated battery regulation target voltage |
| 4245 | R/W | VbattNominal | [4245] 12 * 1 thru 10<br>(120 Max for 250 KS) | Nominal Battery bank voltage (i.e. 12V, 24V, etc) |
| 4246 | R/W | EndingAmps | ([4246] /10) Amps | Goes to Float below this Batt I |
| 4247 | | EndingSoc | | |
| 4248 | | EndAmpSocMBaddress | | |
| 4249 | R/W | RebulkVolts | ([4249] /10) Volts | Rebulks if battery drops below this for > 90 Seconds |

| Address | R/W | Name | Conversion | Notes |
|---|---|---|---|---|
| 4250 | R | BattMonVolts | | |
| 4251 | R | BattMonSOC | | |
| 4252 | R | BattMonAmps | | |
| 4253 | R | BattMonAHefficiency | | |
| 4254<br>4255<br>4256 | | **RESERVED** (Do NOT Write) | | |
| 4257 | R/W | RebulkTimerSec | [4257] seconds | Rebulk interval timer. Cleared if Vbatt >= Rebulk V |
| 4258<br>4259<br>4260<br>4261<br>4262<br>4263 | | **RESERVED** (Do NOT Write) | | |
| 4264<br>4265 | | Voc_Qualify_Timer_1ms | (([4265] << 16) + [4264]) msec | Timer (msec) qualifying time till turn on valid (not 2 useful) |
| 4266 | R | MinVpvTurnOn | ([4266] / 10) Volts | Minimum Turn On Volts( Best Left Alone) Not too useful |
| 4267<br>4268<br>4269<br>4270<br>4271 | | **RESERVED** (Do NOT Write) | | |
| 4272 | R | RestartTimerms | [4271] Milli Seconds | Count Down Time until Wake<br><br>Allowed |
| 4273 | R | Ibatt | ([4272] /10) Amps | Battery Current, Unfiltered |
| 4274<br>4275 | | **RESERVED** (Do NOT Write) | | |
| 4276 | R | ReasonForResting | [4275] Reason number | Reason Classic went to Rest (See **Table 4275-1**) |
| 4277 | R | Output Vbatt | ([4376] / 10) Volts | Battery Voltage Unfiltered |

| | | | | |
|---|---|---|---|---|
| 4278<br>4279 | R | Input Vpv | ([4377] / 10) Volts | PV Voltage Unfiltered |
| **Address** | **R/W** | **Name** | **Conversion** | **Notes** |
| 4280 | | Typeint | ([4279] << 16) + [4278] | TBD |
| 4281 | **RESERVED** (Do NOT Write) | | | |
| 4282 | | | | |
| 4283 | | | | |
| | | | | |

**Table 4101-1 Device Type**

| Name | Value | Description |
|---|---|---|
| Classic150 | 150 | Classic 150 |
| Classic200 | 200 | Classic 200 |
| Classic250 | 250 | Classic 250 |
| Classic250 KS | 251 | Classic 250 with 120 V Battery bank capability (lower current than 250) |

**Table 4120-1 Battery Stage (UPPER Byte of mbComboChrgStge register)**

| Name | Value | Description |
|---|---|---|
| Resting | 0 | Off , No Power, Waiting for Power Source, Battery V over set point, etc. |
| Absorb | 3 | Regulating battery voltage at Equalize Set point |
| BulkMppt | 4 | Max Power Point Tracking until Absorb (Bulk Terminate) Voltage reached |
| Float | 5 | Battery is FULL and regulating battery voltage at Float Set point |
| FloatMppt | 6 | Max Power Point Tracking. Seeking Float set point Voltage |
| Equalize | 7 | Regulating battery voltage at Equalize Set point |
| HyperVoc | 10 | Input Voltage is above maximum Classic operating Voltage |
| EqMppt | 18 | Max Power Point Tracking. Seeking Equalize set point Voltage |

**Table 4120-2 Classic States (LOWER Byte of mbComboChrgStge register)**

| Name | Value | Description |
|---|---|---|
| Internal Resting state 0 | 0 | |
| Internal state 1 through 6 | 1,2,3,4,5, 6,7 | Internal state machine states |

**Table 4130-1 Info Flag Bits: READ ONLY**

| Flag | Value | Description |
|---|---|---|
| Classic Over Temperature | 0x00000001 | Classic Over Temperature if set |
| EEPROM error | 0x00000002 | Classic EEprom read/write found an error if set |
| **RESERVED** | 0x00000004 | **RESERVED** |
| Equalize In Progress | 0x00000008 | Equalize Charge stage Active if set |
| **RESERVED** | 0x00000010 | **RESERVED** |
| **RESERVED** | 0x00000020 | **RESERVED** |
| **RESERVED** | 0x00000040 | **RESERVED** |
| EQ MPPT | 0x00000080 | Battery V is less than EQ Voltage (EQ MPPT) |
| In V is Lower Than Out | 0x00000100 | Input Voltage (PV) is lower than Vbatt if set |
| Current Limit | 0x00000200 | User current limit or internal temperature current limt reached |
| HyperVoc | 0x00000400 | Hyper Voc PV input is between Vmax and Vmax+Vbatt |
| **RESERVED** | 0x00000800 | **RESERVED** |
| **RESERVED** | 0x00001000 | **RESERVED** |
| Battery Temp Sensor Installed | 0x00002000 | Battery temperature sensor installed if set |
| Aux1 State On | 0x00004000 | Aux 1 ON (aux 1 connector has V or relay closed) |
| Aux2 State On | 0x00008000 | Aux 2 ON (aux 2 connector has V present) |
| GroundFaultF | 0x00010000 | Ground Fault detected if set |
| DefCon4ErrF | 0x00020000 | FET Drive Error if set (lower priority than DefCon3) |
| ArcFaultF | 0x00040000 | Arc Fault occurred if set |
| NegBatCurrentF | 0x00080000 | Negative battery current if set |
| DefCon3ErrF | 0x00100000 | FET error (higher priority and DefCon 4) |
| XtraInfo2DsplayF | 0x00200000 | Extra info is available to display (Shading, etc) |
| PvPartialShadeF | 0x00400000 | Partial Shade detected during SOLAR sweep |
| WatchdogResetF | 0x00800000 | watchdog reset flag indicator (for debugging) |
| LowBatteryVF | 0x01000000 | VERY low battery) Vbatt is lower than 8.0 Volts |
| StackumperF | 0x02000000 | Stack Jumper is NOT installed if set |
| EqDoneF | 0x04000000 | EQ Finished. Resets when mode changed or new day |
| TempCompShortedF | 0x08000000 | Indication of shorted Temp Comp if set (all fans should come on if this is true) |
| LockJumperF | 0x10000000 | Lock Jumper is NOT installed if set |
| XtraJumperF | 0x20000000 | Extra Jumper is NOT installed if set |
| | | |

**Table 4158-1 Battery Type (not used yet as of May 2011)**

| Name | Value | Description |
|---|---|---|
| Flooded | 1 | Lead Acid (Flooded) |
| Gel | 2 | Lead Acid (Gel) |
| AGM | 3 | Lead Acid (AGM) |
| AGM2 | 4 | Lead Acid (AGM2) |
| Lithium | 5 | LiIon |
| Nicad | 6 | Nickel Cadmium |
| VRLA | 7 | AGM or AGM or AGM2 actually |
| AbsolyteIIP | 8 | TBD |
| User1 | 9 | TBD |

**Table 4160-1 ForceFlagsBits (*can write to low or high 16 bits independently if wanted*)**

| Name | Value | Description |
|---|---|---|
| **RESERVED** | 0x00000001 | **RESERVED** (Do NOT Set to 1) |
| ForceRstDailyKwHrsF | 0x00000002 | Reset Daily kWh count |
| ForceEEpromUpdateWriteF | 0x00000004 | Write all current settings to internal EEPROM |
| ForceEEpromInitReadF | 0x00000008 | Reset all values to EEPROM defaults (MAY not work yet) |
| ForceResetInfoFlags | 0x00000010 | Force ALL Info Flags to zero when set to 1 (Will reset info flags to 0) (or course some may pop back to 1 after resetting if applicable) |
| ForceFloatF | 0x00000020 | Force battery charge stage to Float |
| ForceBulkF | 0x00000040 | Force new Bulk/Absorb charge stage |
| ForceEqualizeF | 0x00000080 | Force new Equalize stage |
| ForceNiteF | 0x00000100 | Force a new night time |
| Force25HrDayF | 0x00000200 | Otherwise it's a 24 Hour day |
| ForcePandOsweepF | 0x00000400 | Force a Mini-Sweep for Legacy P&O mode |
| ForceSweepF | 0x00000800 | Force a Sweep ***(at least for U-Set)*** |
| **RESERVED** | 0x00001000 | **RESERVED**(Do NOT Set to 1) |
| ForceGetTimeF | 0x00002000 | Set time from MNGP Remote Modbus (CTIME) |
| **RESERVED** | 0x00004000 | **RESERVED**(Do NOT Set to 1) |
| **RESERVED** | 0x00008000 | **RESERVED**(Do NOT Set to 1) |
| **RESERVED** | 0x00010000 | **RESERVED**(Do NOT Set to 1) |
| **RESERVED** | 0x00020000 | **RESERVED**(Do NOT Set to 1) |
| **RESERVED** | 0x00040000 | **RESERVED**(Do NOT Set to 1) |
| **RESERVED** | 0x00080000 | **RESERVED**(Do NOT Set to 1) |
| **RESERVED** | 0x00100000 | **RESERVED**(Do NOT Set to 1) |
| **RESERVED** | 0x00200000 | **RESERVED**(Do NOT Set to 1) |
| **RESERVED** | 0x00400000 | **RESERVED**(Do NOT Set to 1) |
| ForceResetFaultsF | 0x00800000 | Just reset all of the faults |
| **RESERVED** | 0x01000000 | **RESERVED**(Do NOT Set to 1) |

**Table 4164-1 MPPT MODE†**

| ` | Value | Description |
|---|---|---|
| PV_Uset | 0x0001 | U-SET MPPT MODE (includes MPPT ENABLED (On) FLAG i.e. if 0x0000 MPPT mode is OFF) |
| DYNAMIC | 0x0003 | Slow Dynamic Solar Tracking (old Solar 1 O & P ) |
| Legacy P&O | 0x0009 | Legacy P & O sweep mode |
| SOLAR | 0x000B | Fast SOLAR track (old PV Learn mode) |
| MICRO HYDRO | 0x000D | Micro Hydro mode (similar to Legacy P&O) |
| WIND TRACK | 0x0005 | Wind Track Mode |
| WIND LEARN (future mode) | 0x0007 | Wind Learn Mode (not implemented as of May 2011) |
| PV COMBO 1 | 0x000F | PV COMBO 1 |
| **RESERVED** | 0x0011 | **RESERVED** |
| BOOST CHRG | 0x0013 | Boost Charge Mode (Lower to Higher Voltage, Unimplemented as of May 2011) |

*†Bit 0 is the ON/OFF (Enable/Disable) Table shows modes as ON*

***NOTE**: MPPT MODE will automatically revert to OFF during mode change*

**Table 4207-1 LED Mode**

| Name | Value | Description |
|---|---|---|
| All Off | 0 | No LED activity except on startup |
| Rick Mode | 1 | Minimal Activity: Remote Yellow LED indicates Current Limiting or FET Temperature Limit. |
| Blinky | 2 | All LEDs Active: Lightshow!<br>MNGP Red LED : MNGP->Classic MODBUS active |
| LED 1 | 3 | Status Mode:<br>MNGP Green LED = Battery Full (Float)<br>Classic Red LED = Aux 1 Active.<br>Classic Yellow LED = Aux 2 Active<br>Classic Blue LED = Unimplemented |
| LED 2 | 4 | Unimplemented |
| LED 3 | 5 | Unimplemented |

**Table 4240-1  Internal Flags bits (Read Only) (flagsRD)**

| Name | Value | Description |
|---|---|---|
| **RESERVED** | 0x00000001 | **RESERVED** |
| **RESERVED** | 0x00000002 | **RESERVED** |
| **RESERVED** | 0x00000004 | **RESERVED** |
| **RESERVED** | 0x00000008 | **RESERVED** |
| **RESERVED** | 0x00000010 | **RESERVED** |
| **RESERVED** | 0x00000020 | **RESERVED** |
| **RESERVED** | 0x00000040 | **RESERVED** |
| AbsorbTimeRunf | 0x00000080 | Bulk/Absorb Timer Counting is Enabled |
| EqTimeRunf | 0x00000100 | EQualize Timer Run flag |
| FloatTimeRunf | 0x00000200 | Float Time accumulate flag |
| kWhAccumRunf | 0x00000400 | kiloWatt-hour & Amp-Hour accumulate enabled |
| **RESERVED** | 0x00000800 | **RESERVED** |
| AbsorbCountUpf | 0x00001000 | Absorb Timer is counting UP if set |
| OK2WriteIVtables | 0x00004000 | OK to write WindPowerTableV[] & I[] |
| WindLowflag | 0x00008000 | Indicates that we turned off because of low power |
| SweepDwnEnabledf | 0x00010000 | Slowly Sweeping Down V input |
| LowLightflag | 0x00020000 | State 2 detected low light (May not be accurate) |
| **RESERVED** | 0x00040000 | **RESERVED** |
| **RESERVED** | 0x00080000 | **RESERVED** |
| **RESERVED** | 0x00100000 | **RESERVED** |
| SweepUpEnabledf | 0x00200000 | Slowly Sweeping UP V input |
| **RESERVED** | 0x00400000 | **RESERVED** |
| **RESERVED** | 0x00800000 | **RESERVED** |
| **RESERVED** | 0x01000000 | **RESERVED** |
| BattFull | 0x02000000 | Battery Full, Absorb complete, Float |
| **RESERVED** | 0x04000000 | **RESERVED** |
| EqCountUpf | 0x08000000 | EQ Timer is counting Up |
| **RESERVED** | 0x10000000 | **RESERVED** |
| **RESERVED** | 0x20000000 | **RESERVED** |
| **RESERVED** | 0x40000000 | **RESERVED** |
| **RESERVED** | 0x80000000 | **RESERVED** |

**AUX 1 and 2 modes**
**Extracted and encoded as combined in Aux12Function**

**Table 4165-1 AUX 1 Off – Auto – On** *(Extracted/Encoded as Aux12Function bits 6,7)*

| Name | Value | Description |
|---|---|---|
| Aux 1 Off | 0 | Aux 1 output is OFF (0 Volts) |
| Aux 1 Auto | 1 | Aux 1 operates as defined in Aux2Funtion |
| Aux 1 On | 2 | Aux 1 output is ON (~14 Volts) |
| Aux 1 Unimplemented | 3 | Unassigned at present |

Aux1OffAutoOn = (((Aux12Function & 0xc0) >> 6));

**Table 4165-2 AUX 2 Off – Auto – On** *(Extracted/Encoded as Aux12Function bits 14,15)*

| Name | Value | Description |
|---|---|---|
| Aux 2 Off | 0 | Aux 2 output is OFF (0 Volts) |
| Aux 2 Auto | 1 | Aux 2 operates as defined in Aux2Funtion |
| Aux 2 On | 2 | Aux 2 output is ON (~14 Volts) |
| Aux 2 Unimplemented | 3 | Unassigned at present |

Aux2OffAutoOn = ((Aux12FunctionS & 0xc000) >> 14);

**Table 4165-3 AUX 1 Function** ***(Extracted/Encoded as Aux12Function bits 0-5)***

| Name | Value | Description |
|---|---|---|
| DIVERSION SLW+ | 1 | Non-PWM On at Vbatt > Aux1VoltsHiAbs<br>Off at Vbatt < Aux1VoltsLoAbs (Active High) |
| DIVERSION SLW- | 2 | Same as DIVERSION SLW+ but Active Low |
| BAT DIV V REL+ | 3 | Non-PWM On at Vbatt > Aux1VoltsHiAbs<br>Off at Vbatt < Aux1VoltsLoAbs (Active High) |
| BAT DIV V REL- | 4 | Non-PWM On at Vbatt > Aux1VoltsHiAbs<br>Off at Vbatt < Aux1VoltsLoAbs (Active Low) |
| PV V TRIGGER + | 7 | Active High output if Vin exceeds Aux1VoltsHiPv |
| PV V TRIGGER - | 8 | Active Low output if Vin exceeds Aux1VoltsHiPv |
| MANUAL ON-OFF | 9 | MANUAL On/Off allowed using Off-Auto-On Selection |
| TOGGLE TEST | 13 | Out Once per second On-Off-On-Off automatic toggle |
| NITE LITE HIGH | 14 | Active High indicating Night Time. Inactive at Wakeup |
| NITE LITE LOW | 15 | Active Low indicating Night Time. Inactive at Wakeup |
| WIND CLIPPER | 16 | Output goes Active High when V input is above PV input V plus headroom voltage |

Aux1Function = Aux12Function & 0x3f;

**Table 4165-4 AUX 2 Function** ***(Extracted/Encoded as Aux12Function bits 8-13)***

| Name | Value | Description |
|---|---|---|
| DIVERT DGTL F+ | 0 | Digital Out PWM Battery Diversion (Active High) |
| DIVERT DGTL F- | 1 | Digital Out PWM Battery Diversion (Active Low) |
| BAT DIV V REL+ | 2 | Digital Out PWM Relative to Charge Stage Voltage Threshold Diversion (Use It Or Lose It) (Active High) |
| BAT DIV V REL- | 3 | Digital Out PWM Relative to Charge Stage Voltage Threshold Diversion (Use It Or Lose It) (Active Low) |
| TOGGLE TEST | 6 | Out Once per second On-Off-On-Off automatic toggle |
| PV IN TRIG + | 7 | Active High output if Vin exceeds Aux2VoltsHiPv |
| PV IN TRIG - | 8 | Active Low output if Vin exceeds Aux2VoltsHiPv |
| MANUAL ON-OFF | 9 | MANUAL On/Off allowed using Off-Auto-On Selection |
| WIND CLIPPER | 10 | PWM output Active High when V input is above PV input V plus headroom voltage |
| NITE LITE HIGH | 11 | Active High indicating Night Time. Inactive at Wakeup |
| NITE LITE LOW | 12 | Active Low indicating Night Time. Inactive at Wakeup |

Aux2Function = (Aux12FunctionS & 0x3f00) >> 8; (Digital/Analog Input/Output)

**Table 4187-1 EnableFlags bits [4187]**

| Name | Value | Description |
|---|---|---|
| GroundFaultEn | 0x0001 | **Ground Fault Protection Enabled when Set to 1** |
| ArcFaultEn | 0x0002 | **Arc Fault Protection Enabled when Set to 1** |
| **RESERVED** | 0x0004 | **RESERVED (Do NOT set this bit)** |
| PvPartialShadeEn | 0x0008 | **Partial Shade reporting Enabled when Set to 1** |
| **RESERVED** | 0x0010 | **RESERVED (Do NOT set this bit)** |
| DefCon3ErrEn | 0x0020 | DefCon3 Error reporting enabled if set to 1 |
| DefCon4ErrEn | 0x0040 | DefCon3 Error reporting enabled if set to 1 |
| PwmLowMaxFlag | 0x0080 | Low Max Enabled if Set to 1 (Low Vin - Vout) |
| **RESERVED** | 0x0100 | **RESERVED (Do NOT Set to 1)** |
| **RESERVED** | 0x0200 | **RESERVED (Do NOT Set to 1)** |
| BumpWindI | 0x0400 | When adjusting wind curve, automatically “bumps” adjacent current set points out of the way if set to 1 |
| DivrsnAbsEqTmrEn | 0x0800 | Enables Absorb & EQ timer counting when Aux functions are diverting if set to 1. |
| **RESERVED** | 0x1000 | **RESERVED (Do NOT Set to 1)** |
| **RESERVED** | 0x4000 | **RESERVED (Do NOT Set to 1)** |
| **RESERVED** | 0x8000 | **RESERVED (Do NOT Set to 1)** |

**Table 4214-1 Consolidated Time Registers 0 (write only to set Classic Time -- Normally, MNGP will set these registers from its battery backed RTC)**

| Name | Value | Description |
|---|---|---|
| BITS 5:0 | 0 to 59 | Seconds Seconds value in the range of 0 to 59 |
| BITS 5:0 | RESERVED | **RESERVED (Do NOT write ones to these bits)** |
| BITS 13:8 | 0 to 59 | Minutes value in the range of 0 to 59 |
| BITS 15:14 | RESERVED | **RESERVED (Do NOT write ones to these bits)** |
| BITS 20:16 | 0 to 23 | Hours value in the range of 0 to 23 |
| BITS 23:21 | RESERVED | **RESERVED (Do NOT write ones to these bits)** |
| BITS 36:24 | 0 to 6 | Day Of Week Day of week value in the range of 0 to 6 |
| BITS 31:27 | RESERVED | **RESERVED (Do NOT write ones to these bits)** |

**Table 4216-1 Consolidated Time Registers 1 (write only to set Classic Time -- Normally, MNGP will set these registers from its battery backed RTC)**

| Name | Value | Description |
|---|---|---|
| BITS 4:0 | 1 to 28, 29, 39, 31 | Day of month value in the range of 1 to 28, 29, 30, or 31(depending on the month and whether it is a leap year) |
| BITS 7:5 | RESERVED | **RESERVED (Do NOT write ones to these bits)** |
| BITS 11:8 | 1 to 12 | Month value in the range of 1 to 12 |
| BITS 15:12 | RESERVED | **RESERVED (Do NOT write ones to these bits)** |
| BITS 27:16 | 0 to 4095 | Year value in the range of 0 to 4095 |
| BITS 31:28 | RESERVED | **RESERVED (Do NOT write ones to these bits)** |

**Table 4218-1 Consolidated Time Register 2 (write only to set Classic Time -- Normally, MNGP will set these registers from its battery backed RTC)**

| Name | Value | Description |
|---|---|---|
| BITS 11:0 | 1 to 366 * | Day of year value in the range of 1 to 365<br>***** (366 for leap years) |
| BITS 31:12 | RESERVED | **RESERVED (Do NOT write ones to these bits)** |

**Table 4275-1 Reason For Resting**

| VALUE | REASON FOR RESTING |
|---|---|
| 1 | Anti-Click. Not enough power available (Wake Up) |
| 2 | Insane Ibatt Measurement (Wake Up) |
| 3 | Negative Current (load on PV input ?) (Wake Up) |
| 4 | PV Input Voltage lower than Battery V (Vreg state) |
| 5 | Too low of power out and Vbatt below set point for > 90 seconds |
| 6 | FET temperature too high (*always* shows up on boot up) (Cover is on maybe ?) |
| 7 | Ground Fault Detected |
| 8 | Arc Fault Detected |
| 9 | Too much negative current while operating |
| 10 | Battery is less than 8.0 Volts |
| 11 | PV input is available but V is rising too slowly. Low Light or bad connection |
| 12 | Voc has gone down from last Voc or low light. Re-check |
| 13 | Voc has gone up from last Voc enough to be suspicious. Re-check |
| 14 | Same as 11 |
| 15 | Same as 12 |
| 16 | Mppt MODE is OFF (Usually because user turned it off) |
| 17 | PV input is higher than operation range (too high for 150V Classic) |
| 18 | PV input is higher than operation range (too high for 200V Classic) |
| 19 | PV input is higher than operation range (too high for 250V or 250KS) |
| 25 | Battery Voltage too high of Overshoot (small battery or bad cable ?) |

The network registers are all Read/Write. You may write any values to these registers, however this may result in erratic operation in some instances.
To set A static IP address, be sure to clear the DHCP bit in register 20481 before writing the static values to the

| **Network** | | | |
|---|---|---|---|
| **Address** | **Name** | **Units** | **Description** |
| 20481 | IP Settings | [20481] | Network Settings Flags. See Table 20481-1 |
| 20482<br>20483 | IP Address | $[20483]_{MSB}$ . $[20483]_{LSB}$ .<br>$[20482]_{MSB}$ . $[20482]_{LSB}$ | The IP address of the Classic† |
| 20484<br>20485 | Gateway  Address | $[20485]_{MSB}$ . $[20485]_{LSB}$ .<br>$[20484]_{MSB}$ . $[20484]_{LSB}$ | Network Gateway Address. † |
| 20486<br>20487 | Subnet | $[20487]_{MSB}$ . $[20487]_{LSB}$ .<br>$[20486]_{MSB}$ . $[20486]_{LSB}$ | Network Subnet Mask† |
| 20488<br>20489 | DNS_1 | $[20489]_{MSB}$ . $[20489]_{LSB}$ .<br>$[20488]_{MSB}$ . $[20488]_{LSB}$ | Primary DNS Address† |
| 20490<br>20491 | DNS_2 | $[20491]_{MSB}$ . $[20491]_{LSB}$ .<br>$[20490]_{MSB}$ . $[20490]_{LSB}$ | Secondary/Alternate DNS Address† |
| † Read Only if the DHCP flag is set. To assign a static IP to the Classic, first clear the DHCP flag in the IP Settings Register (20481). | | | |

Table 20481-1

| **Name** | **Value** | **Description** |
|---|---|---|
| DHCP | 0x0001 | Set this bit to enable DHCP. |
| Web Access | 0x0002 | Set this bit to enable online access to your Classic through http://www.mymidnite.com |

The Version Registers are all Read Only. Writes to any of these registers will have no long-term effect.

| **Version** | | | |
|---|---|---|---|
| **Address** | **Name** | **units** | **Description** |
| 16385 | app_version | Major: [16385](15…12)<br>Minor: [16385](11…8)<br>Release: [16385](8..4) | Release version of the application code |
| 16386 | net_version, | Major: [16386](15…12)<br>Minor: [16386](11…8)<br>Release: [16386](8…4) | Release version of the communications stack |
| 16387<br>16388 | app_rev | ([16388] << 16) + [16387] | Build Revision of the application code |
| 16389<br>16390 | net_rev | ([16390] << 16) + [16389] | Build Revision of the communications code stack |

Communication Statistics are all Read/Write registers. You may write any value to these registers which will be incremented should the trigger for that counter occur. The most useful type of write may be to periodically reset the counters to zero. These are all lifetime counters and due to the number of MODBUS transactions may overflow to 0.

| **Communication Statistics** | | | |
|---|---|---|---|
| **Address** | **Name** | **units** | **Description** |
| **Master / In Bus Interface** | | | |
| 10001<br>10002 | rx_ok | ([10002] << 16) + [10001] | Number of correctly received packets |
| 10003<br>10004 | rx_crc_err | ([10004] << 16) + [10003] | Number of packets received with crc errors |
| 10005<br>10006 | requested_ok | ([10006] << 16) + [10005] | Number of transactions originating from this unit that completed successfully |
| 10007<br>10008 | requested_err | ([10008] << 16) + [10007] | Number of transactions originating from this unit that failed |
| 10009<br>10010 | forwarded | ([10010] << 16) + [10009] | Number of packets forwarded through this interface |
| 10011<br>10012 | broadcast | ([10012] << 16) + [10011] | Number of broadcast packets received |
| 10013<br>10014 | dropped_busy | ([10014] << 16) + (10013) | Number of packets dropped due to the interface being busy. |
| 10015<br>10016 | **RESERVED** | | |
| **Slave / Out bus interface** | | | |
| 10017<br>10018 | rx_ok | ([10018] << 16) + [10007] | Number of correctly received packets |
| 10019<br>10020 | rx_crc_err | ([10020] << 16) + [10020] | Number of packets received with crc errors |
| 10021<br>10022 | requested_ok | ([10022] << 16) + [10021] | Number of transactions originating from this unit that completed successfully |
| 10023<br>10024 | requested_err | ([10024] << 16) + [10023] | Number of transactions originating from this unit that failed |
| 10025<br>10026 | forwarded | ([10026] << 16) + [10025] | Number of packets forwarded through this interface |
| 10027<br>10028 | broadcast | ([10028] << 16) + [10027] | Number of broadcast packets received |
| 10029<br>10030 | dropped_busy | ([10030] << 16) + [10029] | Number of packets dropped due to the interface being busy. |
| 10031<br>10032 | **RESERVED** | | |

| | | | |
|---|---|---|---|
| **Communication Statistics**<br>**Remote bus interface** | | | |
| 10033<br>10034 | rx_ok | ([10034] << 16) +<br>[10033] | Number of correctly received packets |
| 10035<br>10036 | rx_crc_err | ([10036] << 16) +<br>[10035] | Number of packets received with crc errors |
| 10037<br>10038 | requested_ok | ([10038] << 16) +<br>[10037] | Number of transactions originating from this unit that completed successfully |
| 10039<br>10040 | requested_err | ([10040] << 16) +<br>[10039] | Number of transactions originating from this unit that failed |
| 10041<br>10042 | forwarded | ([10042] << 16) +<br>[10041] | Number of packets forwarded through this interface |
| 10043<br>10044 | broadcast | ([10044] << 16) +<br>[10043] | Number of broadcast packets received |
| 10045<br>10046 | dropped_busy | ([10046] << 16) +<br>[10045] | Number of packets dropped due to the interface being busy. |
| 10047<br>10048 | **RESERVED** | | |
| **TCP bus interface** | | | |
| 10049<br>10050 | rx_ok | ([10050] << 16) +<br>[10049] | Number of correctly received packets |
| 10051<br>10052 | rx_crc_err | ([10052] << 16) +<br>[10051] | Number of packets received with crc errors |
| 10053<br>10054 | requested_ok | ([10054] << 16) +<br>[10053] | Number of transactions originating from this unit that completed successfully |
| 10055<br>10056 | requested_err | ([10056] << 16) +<br>[10055] | Number of transactions originating from this unit that failed |
| 10057<br>10058 | forwarded | ([10058] << 16) +<br>[10057] | Number of packets forwarded through this interface |
| 10059<br>10060 | broadcast | ([10060] << 16) +<br>[10059] | Number of broadcast packets received |
| 10061<br>10062 | dropped_busy | ([10062] << 16) +<br>[10061] | Number of packets dropped due to the interface being busy. |
| 10063<br>10064 | **RESERVED** | | |

| Reserved | | | |
|---|---|---|---|
| **Address** | **Name** | **units** | **Description** |
| 61441-61442 | Reserved | | Reserved |
| | | | |

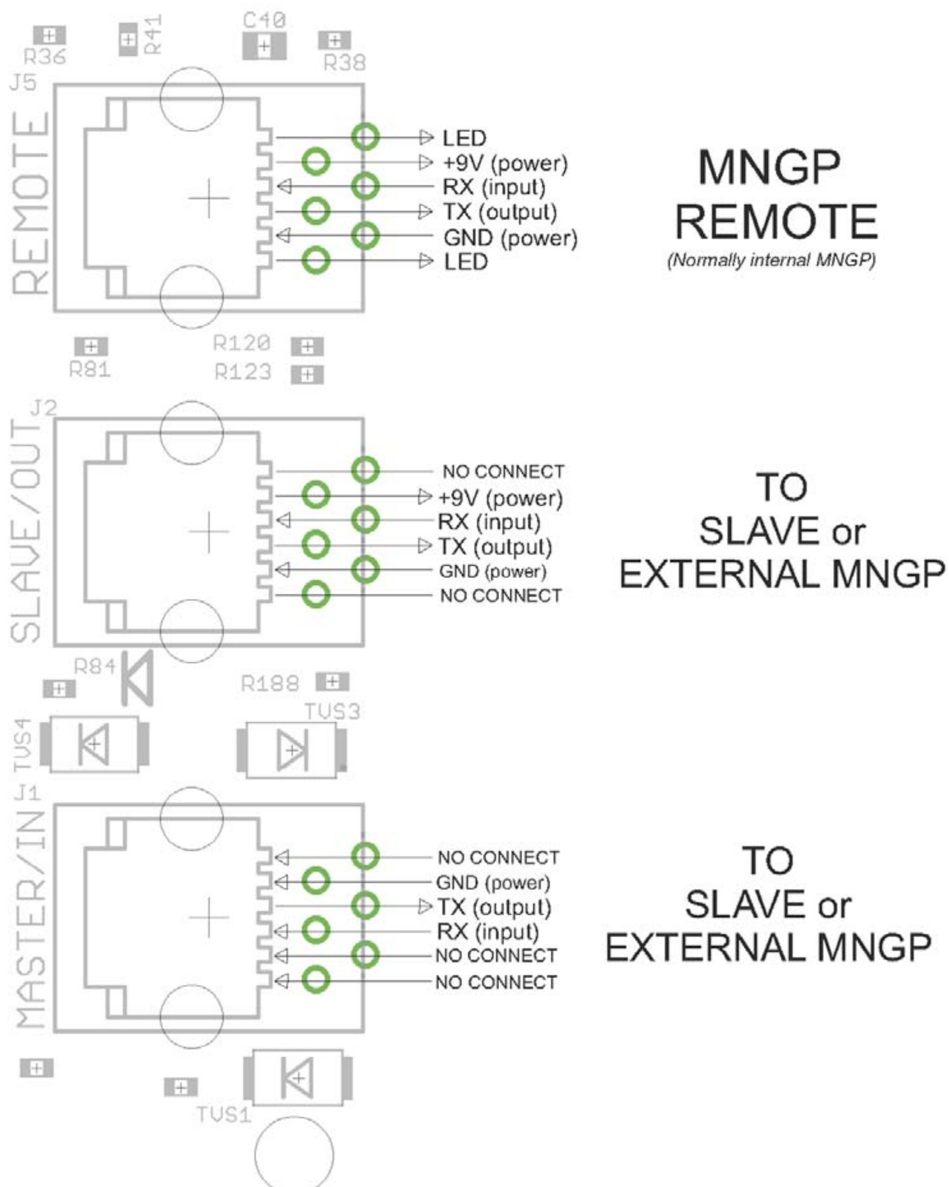



Figure 1. Classic RS-232 MODBUS RJ-11 PHONE JACK PINOUTS (Top View)

## Dealer Information Screen

For dealers' convenience the Classic has a display screen that can be modified to publicize the dealers' business information. This is helpful because the customer will know who to contact in case they want to report any problems regarding the product. This will also help to promote retailers' accessories that are compatible with the Classic. This screen is capable of 20 characters per row and four rows, for a total of 80 modifiable characters.
To modify this display screen, follow these steps:

- Press main menu
- Scroll to MISC and select it
- On the following screen, select MNGP and press enter
- On this screen select LOAD DEFAULTS press enter
- On the password select 365 and press enter
- Using the up and down keys will allow you to change the alphabet characters
- Now scroll left and right to go to the next character block
- Do this until your desired message is complete
- Press enter to save on the classic memory

## Positive Ground systems

When installing the Classic in a positive ground systems there are a few extra steps that need to be taken. The Ground fault jumper needs to be removed, and ground fault needs to be disabled in the menu. Refer to page 19 for instructions on doing this.

The overcurrent protection needs to be done a little different as well. The input and output breakers need to be double poles. Battery negative and positive conductor both need to be protected. Refer to *Classic Breaker Sizing.* Table 6.1

**IMPORTANT: Do not connect both, positive battery and positive PV input to ground. One or the other positive (normally battery +) but not both otherwise the Classic input and output will be shorted.**

## HyperVOC ™

HyperVOC is a unique feature the Classic has built in. HyperVOC refers to; when the DC Input Voltage raises above the maximum operating voltage (150V, 200V, 250V, depending on the Classic model). HyperVOC gives you the flexibility to go up to the maximum operating voltage PLUS the nominal battery voltage. For example, the Classic 150 has an input voltage rating of 150 operating volts, if the Classic 150 is connected to a 48 volt battery bank, the HyperVOC voltage limit will be: 150V + 48V a total of 198 Volts that the Classic can withstand without breaking. When the Classic input voltage rises above 150 volts it will switch off (stop outputting power). As long as the Classic is in HyperVOC mode, the microprocessor and all other functions like AUX will continue running. When the input voltage comes back down below 150v (or the rated operating voltage of the Classic, depending on model) the Classic will wake up and start charging again automatically. This could happen in a really cold morning with a system that has a Voltage Open Circuit (VOC) close to the maximum operating input voltage.
*Note 1.* A **HyperVOC** message will be displayed on the bottom right side of the Status screen.
*Note 2.* Max nominal battery voltage to be added is 48v

## HyperVOC ™ Origins

HyperVOC can be useful in overcoming an industry shortcoming in charging 48 volt battery's with standard panels. For example let's take a sample system with Solar World 165's that have a VOC of 44.1vdc. The industry has limited us to 2 of these panels in series making it hard to charge a 48vdc battery on hot summer days. With the Classic we designed in Hyper VOC to allow you to run 3 of these in series. 3 panels at 44.1vdc will give you a total VOC of 132.3vdc. When temperature compensated for cold climates to 125% gives you 165vdc. This is above the maximum safe limits for most controllers but falls well into the Hyper VOC range of the Classic. We do have to use Hyper VOC wisely though if we abuse it the Controller will never wake up in colder weather.

## Troubleshooting

# Technical information

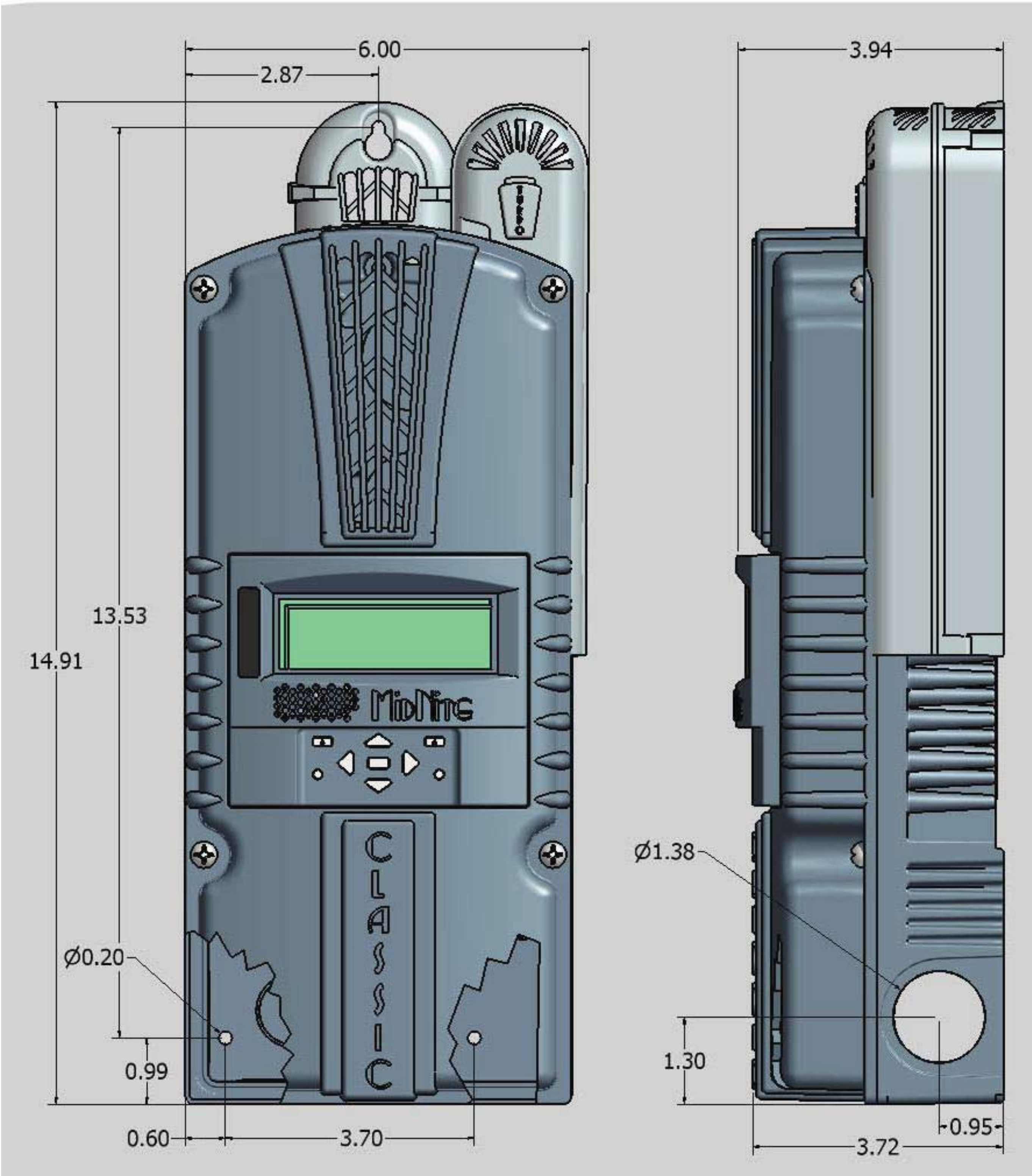
## Specifications Electrical

*Table 6.1*

| Model | Classic150 | Classic200 | Classic250 | Classic250KS |
|---|---|---|---|---|
| Operating Volts in | 150VDC | 200VDC | 250VDC | 250VDC |
| Max Hyper VOC | 150+battery | 200+battery | 250+battery | 250+battery |
| *Battery Charge Volts | 12-93 volts | 12-93 volts | 12-93 volts | 12-150 volts |
| **Absolute Current Output at 25°C | 96a at 12v battery<br>94a at 24v battery<br>83a at 48v battery | 74a at 12v battery<br>70a at 24v battery<br>65a at 48v battery | 60a at 12v battery<br>62a at 24v battery<br>55a at 48v battery | 40a at 120v battery |
| De-rate current at 40°C+ | 80 amperes | 66 amperes | 52 amperes | 33 amperes |
| Environment | -40c to 40c | | | |
| Dimensions of Classic | 14.87”X 5.95”X 4.00” 378mm X 151mm X 102mm | | | |
| Dimensions of Box | 19.00”X 8.50”X 5.70” 483mm X 216mm xX145mm | | | |
| Shipping Weight | 11.5 lb 4.9 kg | | | |

NOTE: Current output ratings were measured with 75% of the PV array’s VOC (Open Circuit Voltage)
*NOTE: Calculated by adding battery voltage to the maximum input operating voltage (48V battery max)
**NOTE: Measurement Accuracies: +- 0.12v, offset calibration adjustment maybe necessary

# Specifications Mechanical



## Default Battery charge set points

The table below describes the default preset voltages for the different nominal battery voltages. This means that if you set the Classic from the QUICK SET Menu (see page 25) to a different battery voltage the Classic will take the default voltage set points. Note. If you manually adjust the absorb float or equalize voltage set point, and then nominal battery voltage is changed to a different nominal voltage, (e.g. from 24v to 12v or to 48v etc.) manually adjustments may be required. See page 6 for further information

*Table 6.2*

| Battery Voltage | 12v | 24v | 36v | 48v | 60v | 72v |
|---|---|---|---|---|---|---|
| Bulk MPPT | 14.3v | 28.6v | 42.9v | 57.2v | 71.5v | 85.8v |
| Float | 13.6v | 27.2v | 40.8v | 54.4v | 68.0v | 81.6v |
| Equalize | 14.3 | 28.6v | 42.9v | 57.2v | 71.5v | 85.8v |

To adjust these voltage set point see page 25 of this manual.

## Optional accessories

Optional accessories for the Classic include:

Blank display for multiple Classic installations
MidNite network cables various Lengths.

## Regulatory Approval

The MidNite Solar Classic charge controller conforms to ***UL 1741, Safety for Inverters, Converters, Controllers and Interconnection System Equipment for Use With Distributed Energy Resources, Second Edition, May 7, 1999 with revisions through January 28, 2010 and CAN/CSA C22.2 No. 107.1: 2001/09/01 Ed: 3 (R2006)***

## Warranty

MidNite Solar's Classic comes with a standard 5 year warranty we will repair or replace the Classic at no charge to the consumer during this 5 year period

## End of Warranty tune up

MidNite Solar offers a industry first Tune up / Extended Warranty. 6 months prior to the end of the warranty period Customers can ship their Classic back to MidNite Solar with a check for $125 dollars and we will replace any wearable items like the fans and the capacitors and in general tune the Classic up. This will also extend the warranty by 2 additional years as well.

## Aux 1 and Aux 2 Graphs/Jumpers

Figure 3.0

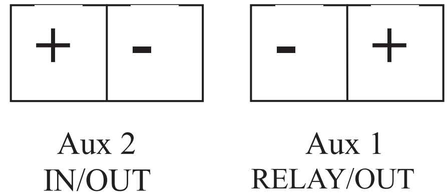



Figure 3.0 shows the two Aux port terminals, with their respective polarities. These terminals are located at the bottom of the power board below the battery temperature jack. Use a mini flat head screw driver to tighten the screws. The jumpers are described in the section below.

In order to select operation of Aux 1 between relay contact or 12v output JP6 and JP8 need to be configured accordingly following the instructions provided in this section.

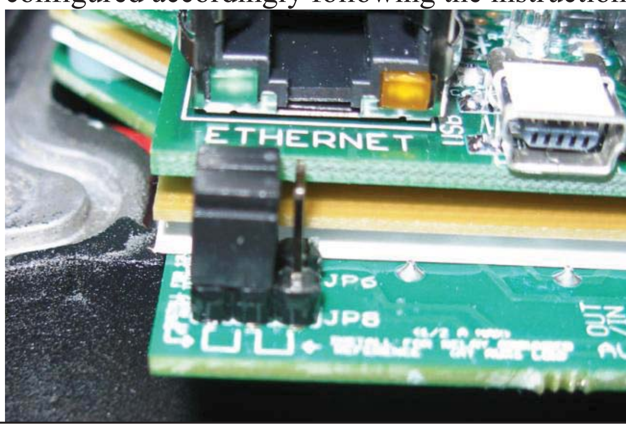



Figure 3.1
*JP6 and JP8 positioned to supply 12v out of the Aux 1 terminals*

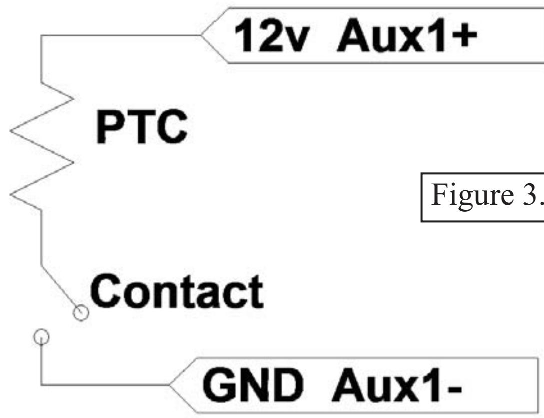
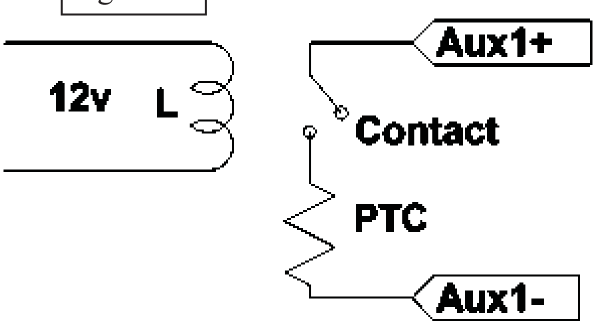



Figure 3.2

When Aux 1 is used to supply 12v out, JP6 and JP8 have to be in the position shown in Figure 3.1. The basic schematic of how this works is shown in Figure 3.2. The 12v out is more like 14.5v. The maximum current from Aux 1 should not exceed 200mA. The Aux 1 output can be set to operate at either Active High (12V) or Active Low (0V) when the Aux 1 function condition is true. For more information see Table 2.1, page 31.

Figure 3.3



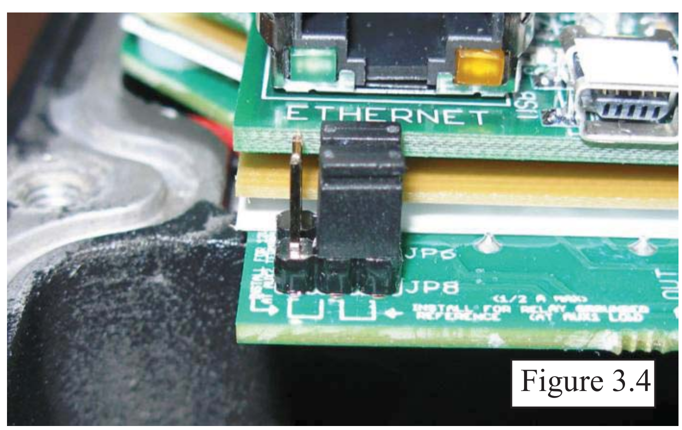




Figure 3.4

To configure Aux 1 to use the internal relay, JP6 and JP8 have to be in the position shown in Figure 3.4. This configuration is commonly known as "dry contact" because it does not provide 12v at the Aux1 terminals; it acts more like an isolated switch (to the ratings of the relay). The Aux 1 output can be set to operate at either normally open, (Active High) or normally closed (Active Low) when the Aux 1 function condition is true. For more information see Table 2.1, page 31. This is ideal for an Auto Gen Start.

## Aux 1 Voltage-Time Relation (Relay/12v)

Aux 1 Function Graph shows the relationship between voltage and time of AUX 1. (The axis labeled VOLTAGE could be battery, PV, wind input voltage, etc. depending on the function selected by the user) VHIGH is the upper voltage limit, as soon as the voltage reaches this limit the Delay time will then start, as soon as the Delay time expires AUX1 will change state and stay there until the voltage drops below VLOW set point, then another timer called Hold Time will start and when this expires the out put will go back to the original state.

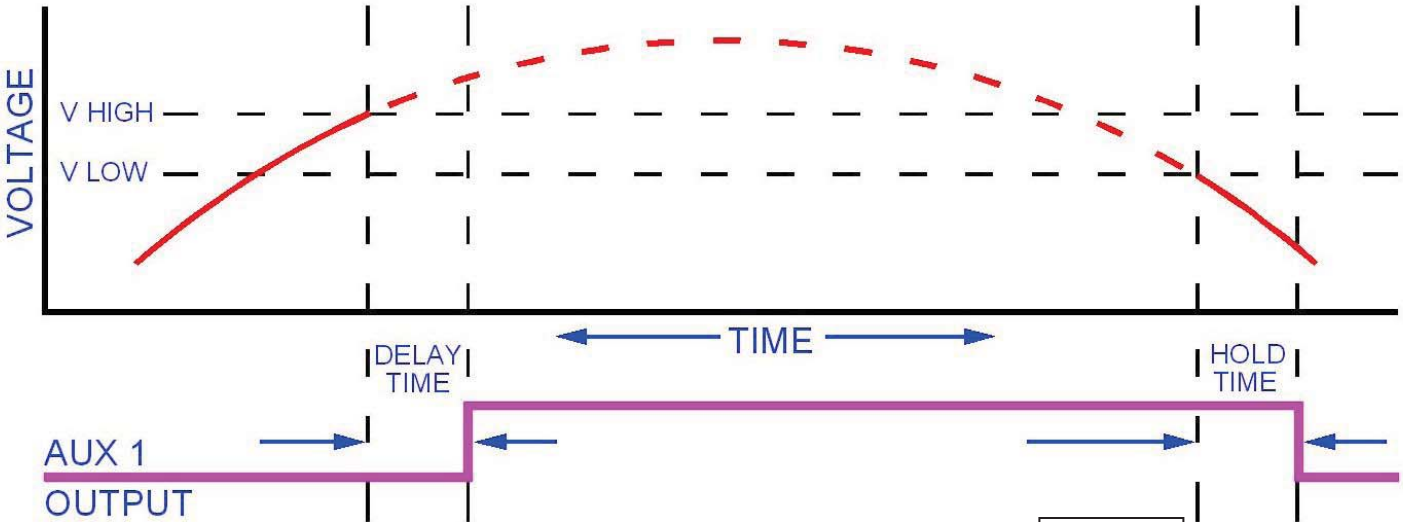



Figure 3.5

## Aux 2 Voltage-Time Relation (PWM)

The graph below describes the relation in Aux 2, between voltage and time. The difference in Aux 2 is the use of PWM running at a hundreds of Hz rate and is suitable for use with Solid State Relays (SSRs). The way this works is: user sets a desired threshold and a width voltage, this means that at the desired voltage (VOLTS), the aux will start to PWM and it has to go above or below the width to completely change states (from 0v to 12v, or from 12v to 0v depending on the user selection, active high or active low). This gives a much smoother transition. For more information see; *Configuring Auxiliary Input/Output*. Page 29

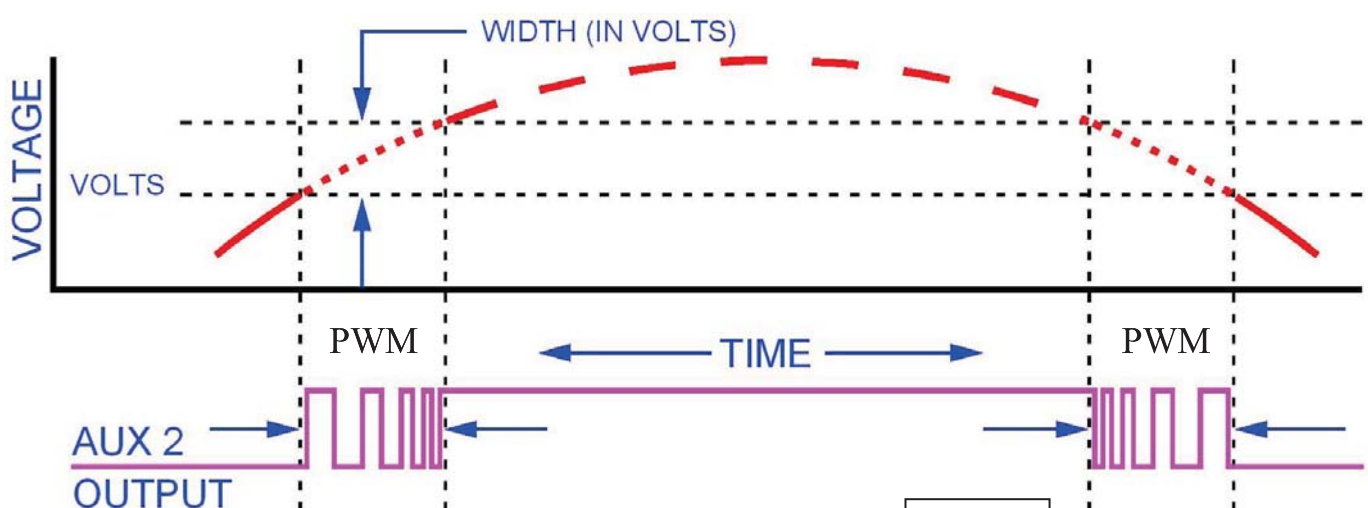



Figure 3.6

Table 6.1

# Classic Breaker sizing

| Model | Bat V | MPPT V (not VOC) | In/Out ratio | Max output A | Output brkr 150VDC | Wire size 310-17* | Max input A | Input breaker/wire with 125% factor** |
|---|---|---|---|---|---|---|---|---|
| Classic 150 | 12 | 70 | 5.83 | 96 | 100 | 4AWG | 16.46 | 30A /10AWG - 63A /6AWG 150V |
| Classic 150 | 24 | 70 | 2.92 | 94 | 100 | 4AWG | 32.19 | 50A/8AWG - 63A/ 6AWG 150V |
| Classic 150 | 48 | 70 | 1.45 | 86 | 90-100 | 4AWG | 59.31 | 80A/4AWG 150V |
| Classic 150 | 12 | 90 | 7.5 | 96 | 100 | 4AWG | 12.8 | 30A /10AWG - 63A /6AWG 150V |
| Classic 150 | 24 | 90 | 3.75 | 94 | 100 | 4AWG | 25.06 | 50A/8AWG - 63A/ 6AWG 150V |
| Classic 150 | 48 | 90 | 1.87 | 83 | 90-100 | 4AWG | 44.38 | 63A 150V |
| Classic 150 | 12 | 100 | 8.33 | 92 | 100 | 4AWG | 11.04 | 30A /10AWG - 63A /6AWG 150V |
| Classic 150 | 24 | 100 | 4.16 | 91 | 100 | 4AWG | 21.87 | 30A /10AWG - 63A /6AWG 150V |
| Classic 150 | 48 | 100 | 2.08 | 80 | 80-90 | 4AWG | 38.46 | 50A/8AWG - 63A/ 6AWG 150V |
| Classic 150 | 12 | 110 | 9.16 | 93 | 100 | 4AWG | 10.15 | 30A /10AWG - 63A /6AWG 150V |
| Classic 150 | 24 | 110 | 4.58 | 84 | 90-100 | 4AWG | 18.34 | 30A /10AWG - 63A /6AWG 150V |
| Classic 150 | 48 | 110 | 2.29 | 76 | 80-90 | 4AWG | 33.18 | 50A/8AWG - 63A/ 6AWG 150V |
| Classic 150 | 12 | 120 | 10 | 92 | 100 | 4AWG | 9.2 | 30A /10AWG - 63A /6AWG 150V |
| Classic 150 | 24 | 120 | 5 | 82 | 90-100 | 4AWG | 16.4 | 30A /10AWG - 63A /6AWG 150V |
| Classic 150 | 48 | 120 | 2.5 | 76 | 80-90 | 4AWG | 30.4 | 50A/8AWG - 63A/ 6AWG 150V |
| | | | | | | | | |
| Classic 200 | 12 | 70 | 5.83 | 79 | 80-90 | 4AWG | 13.55 | 30A/10AWG - 50A/6AWG or 8AWG 300V |
| Classic 200 | 24 | 70 | 2.91 | 78 | 80-90 | 4AWG | 26.8 | 50A/6AWG or 8AWG 300V |
| Classic 200 | 48 | 70 | 1.46 | 76 | 80-90 | 4AWG | 52.05 | 80A/4AWG 300V |
| Classic 200 | 12 | 120 | 10 | 77 | 80-90 | 4AWG | 7.7 | 30A/10AWG - 50A/6AWG or 8AWG 300V |
| Classic 200 | 24 | 120 | 5 | 74 | 80-90 | 4AWG | 14.8 | 30A/10AWG - 50A/6AWG or 8AWG 300V |
| Classic 200 | 48 | 120 | 2.5 | 70 | 70-80 | 4AWG | 28 | 50a/6AWG or 8AWG 300V |
| Classic 200 | 72 | 120 | 1.66 | 65 | 70-80 | 4AWG | 39.15 | 50a/6AWG or 8AWG 300V |
| Classic 200 | 12 | 140 | 11.66 | 74 | 80-90 | 4AWG | 6.34 | 30A/10AWG - 50A/6AWG or 8AWG 300V |
| Classic 200 | 24 | 140 | 5.83 | 72 | 80-90 | 4AWG | 12.34 | 30A/10AWG - 50A/6AWG or 8AWG 300V |
| Classic 200 | 48 | 140 | 2.92 | 65 | 70-80 | 4AWG | 22.26 | 50a/6AWG or 8AWG 300V |
| Classic 200 | 72 | 140 | 1.94 | 63 | 63-70 | 6AWG | 32.47 | 50A/6AWG or 8AWG 300V |
| Classic 200 | 12 | 160 | 13.33 | 73 | 80-90 | 4AWG | 5.47 | 30A/10AWG - 50A/6AWG or 8AWG 300V |
| Classic 200 | 24 | 160 | 6.66 | 72 | 80-90 | 4AWG | 10.81 | 30A/10AWG - 50A/6AWG or 8AWG 300V |
| Classic 200 | 48 | 160 | 3.33 | 65 | 70-80 | 4AWG | 19.52 | 30A/10AWG - 50A/6AWG or 8AWG 300V |
| Classic 200 | 72 | 160 | 2.22 | 53 | 60-63 | 6AWG | 23.87 | 50A/6AWG or 8AWG 300V |
| | | | | | | | | |
| Classic 250 | 12 | 180 | 15 | 61 | 63-70 | 6AWG | 4.06 | 30A/10AWG - 50A/6AWG or 8AWG 300V |
| Classic 250 | 24 | 180 | 7.5 | 62 | 63-70 | 6AWG | 8.26 | 30A/10AWG - 50A/6AWG or 8AWG 300V |
| Classic 250 | 48 | 180 | 3.75 | 55 | 60-83 | 6-4AWG | 14.66 | 30A/10AWG - 50A/6AWG or 8AWG 300V |
| Classic 250 | 72 | 180 | 2.5 | 43 | 50-63 | 6AWG | 17.2 | 30A/10AWG - 50A/6AWG or 8AWG 300V |
| Classic 250 | 12 | 200 | 16.6 | 58 | 60-70 | 6AWG | 3.49 | 30A/10AWG - 50A/6AWG or 8AWG 300V |
| Classic 250 | 24 | 200 | 8.33 | 60 | 60-70 | 6AWG | 7.2 | 30A/10AWG - 50A/6AWG or 8AWG 300V |
| Classic 250 | 48 | 200 | 4.16 | 53 | 60-63 | 6AWG | 12.74 | 30A/10AWG - 50A/6AWG or 8AWG 300V |
| Classic 250 | 72 | 200 | 2.77 | 40 | 40-63 | 8-6AWG | 14.44 | 30A/10AWG - 50A/6AWG or 8AWG 300V |

*NEC310-17 is the chart for single conductors in free air. This chart is conservatively based on this chart, 75C wire inside a MidNite E-Panel

** MidNite Solar breakers are all rated for 100% duty cycle and do not require 156% safety factor. * above also applies to input breaker and wire.

# CLASSIC MENU MAP

Apr 28, 2011

MidNite Solar Inc.

**Status Menu**

- Battery Status (Home screen)
- Input Status
- MoonScope
- About Classic

**Main Menu**

- Wizard
  - Solar
  - Wind
  - Hydro
- Charge
  - Volts
    - Quickset (Right Soft Key)
  - ChgTime
    - View (Right Soft Key)
  - T-Comp
    - View (Right Soft Key)
  - EQ
  - EndAmps
  - Limits
- Mode
  - Solar
    - Setup (Right Soft Key)
  - Wind Track
    - Graph (Right Soft Key)
  - Hydro
  - Slow Track
    - Setup (Right Soft Key)
  - U-Set VOC %
    - MPPV % (Right Soft Key)
- Aux
  - Aux 1
  - Aux 2
- Misc
  - Led-Mode
  - Time
  - Audio
    - Volume
    - Play
  - Display
    - Version
    - Backlight
    - Contrast
  - Comm
  - Dflts
    - Password
      - Dealer Message
- Logs
- Tweaks
  - More
    - Arc Adj
- Temps
- Net
  - Next
    - Advanced