The Brat Solar Charge Controller
Quick Start Guide

This quick start guide is for Beta units only.
Not all features of released units are available in Beta units.
More details are available within this guide.

Features

- PWM charge controller gives excellent value
- Works as a load controller / Charge controller
- Conformal coated circuit board for harsh environments
- 15 Lighting/Load control modes with High and Low Voltage Disconnect
- Load circuit can be paralleled with the PV input to Increase charging power
- Three stage charging
- Clear rainproof enclosure with included liquid tight strain reliefs
- Manual and Auto EQ
- Solar Clock Mode turns The Brat into a solar clock
- Dead battery charging
- Short Circuit and overthermal protection and de-rating

MidNite Solar
17722 - 67th Ave NE
Arlington, Wa 98223
www.midnitesolar.com

IMPORTANT SAFETY INSTRUCTIONS

SAVE THESE INSTRUCTIONS - These instructions contain important safety and operating instructions for The BRAT Charge Controller MODEL NUMBER MNBRAT.

If you do not fully understand any of the concepts, terminology, or hazards outlined in these instructions, please refer installation to a qualified dealer, electrician or installer. These instructions are not meant to be a complete explanation of a renewable energy system. All installations must comply with national and local electrical codes. Professional installation is recommended.

GENERAL PRECAUTIONS:
WORKING WITH OR IN THE VICINITY OF A LEAD ACID BATTERY, SEALED OR VENTED IS DANGEROUS. VENTED BATTERIES GENERATE EXPLOSIVE GASES DURING NORMAL OPERATION. FOR THIS REASON, IT IS VERY IMPORTANT THAT BEFORE SERVICING EQUIPMENT IN THE VICINITY OF LEAD-ACID BATTERIES YOU REVIEW AND FOLLOW THESE INSTRUCTIONS CAREFULLY.

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

Do Not expose to rain or snow. Never attempt to charge a frozen battery. Do not smoke around batteries.

When it is necessary to remove a battery, make sure that the battery bank disconnect breaker is in the off position and that the PV breakers, grid breakers and any other sources of power to the inverter are in the off position. Then remove the negative terminal from the battery first.

To reduce risk of battery explosion follow these instructions and those published by the battery manufacturer as well as the manufacturer of any additional equipment used in the vicinity of the batteries.
Avoid producing sparks in the vicinity of the batteries when using vented batteries. Provide ventilation to clear the area of explosive gases. Sealed AGM and Gel batteries do not under normal conditions create explosive gases. Refer to the battery manufacturer's documentation. Be especially cautious when using metal tools. Dropping a metal tool onto batteries can short circuit them. The resulting spark can lead to personal injury or damage to the equipment. Provide ventilation to outdoors from the battery compartment when installing vented batteries such as golf cart T-105 batteries. The addition of a spill tray is also a good idea.

Clean all battery terminals. Very high currents are drawn from the batteries; even a small amount of electrical resistance can result in overheating, poor performance, premature failure or even fire.
Have plenty of fresh water and soap nearby in case battery acid contacts skin, clothing or eyes. Wear complete eye and clothing protection. Always avoid touching eyes while working near batteries. If battery acid or battery terminal corrosion contacts skin or clothing, wash immediately with soap and water. If acid enters the eyes, immediately flood with cool running water for at least 15 minutes and get medical attention immediately. Baking soda neutralizes battery acid electrolyte. Keep a supply near the batteries

Do not work alone. Someone should be in the range of your voice or close enough to come to your aid when you work with or near electrical equipment.
Remove rings, bracelets, necklaces, watches etc. when working with batteries, photovoltaic modules or other electrical equipment. Power from an illuminated photovoltaic array makes a very effective arc welder with dire consequences if one of the welded pieces is on your person.

To reduce the risk of injury, connect only deep cycle lead acid type rechargeable batteries. Other types of batteries may leak or burst, causing personal injury or damage.

Wiring methods used shall be in accordance with the Canadian Electrical Code, Part I.
Wiring must be done in accordance with the National Electrical Code Article 690 ANSI/NFPA 70. Use Class 1 wiring methods for field wiring connections to terminals of a Class 2 circuit. Use only 14-10 gauge AWM wire. Select the wire gauge used based on the protection provided by the circuit breakers/fuses. Overcurrent protection must be installed as part of the system installation. Refer to the wiring diagrams provided in this manual for breaker/fuse/GFDI sizes and model numbers.

WARNING: This unit is not provided with a GFDI device. This inverter or charge controller must be used with an external GFDI device as required by the Article 690 of the National Electrical Code for the installation location.

Use of attachments or accessories not approved by MidNite Solar could result in damage or injury.
Before making any connections verify that the circuit breakers are in the off position including the inverter breaker. Double check all wiring before applying power.

INSTRUCTIONS DE SÉCURITÉ IMPORTANTES

CONSERVER CES INSTRUCTIONS - CES INSTRUCTIONS CONTIENNENT DES INFORMATIONS IMPORTANTES POUR UTILISER LE MIDNITE SOLAR THE BRAT CHARGE CONTROLLER (RÉGULATEUR DE CHARGE) MODEL NUMBERS MNBRAT, EN TOUTE SÉCURITÉ.

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

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

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

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

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

Cette appareil n'avoir pas un détecteur des fautes de terre. C'est nécessaire de emploi la protection contre des fautes de terre a l'extérieure de cette appareil en conformité avec le National Electrical Code.

Les méthodes de câblage utilisés doivent être conformes au Code canadien de l'électricité, Partie I.

Le câblage doit être fait en conformité avec le National Electrical Code Article 690 ANSI / NFPA 70. Utiliser des méthodes de câblage de catégorie 1 pour les connexions de câblage sur .des terminaux d'un circuit de classe 2. Utilisez uniquement des fils de AWM de calibre 14-1/0. Sélectionnez le type de câble utilisé sur la base de la protection prévue par les disjoncteurs / fusibles.

Table of Contents

Symbols used in this manual

Ground Symbol
Indicates an earth ground connection.

Changes from the previous version of this manual (REV P1) 1-9-15

Updated Feature Summary.
Replaced all photos to show new PCB and labels.
Updated text for switches.
Updated text for L.E.D. indications.
Added Overvoltage protection.
Added Note: Disconnect PV before Battery.
General text updates

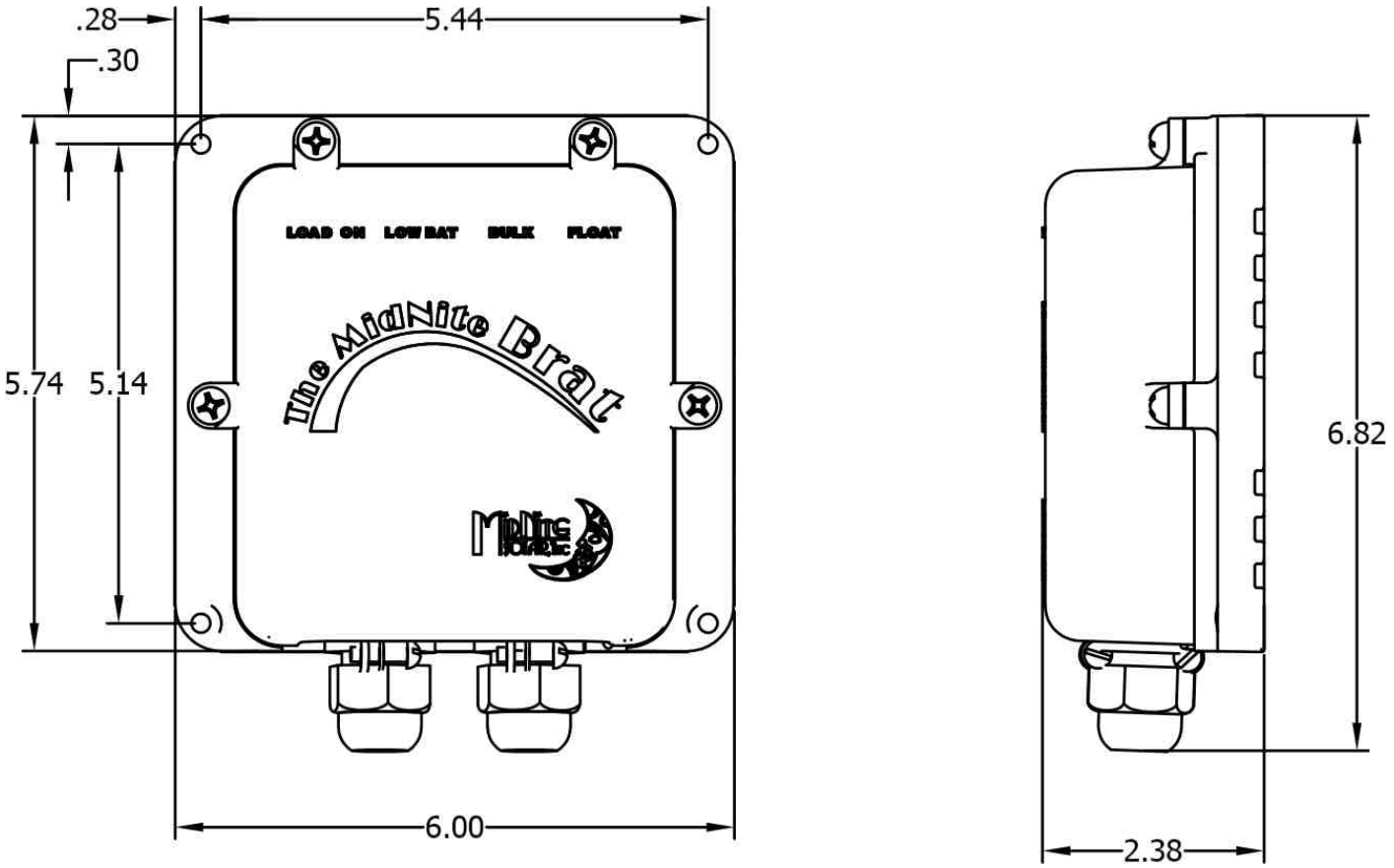
Mounting The Brat:

The Brat features rainproof construction allowing great flexibility in installation.

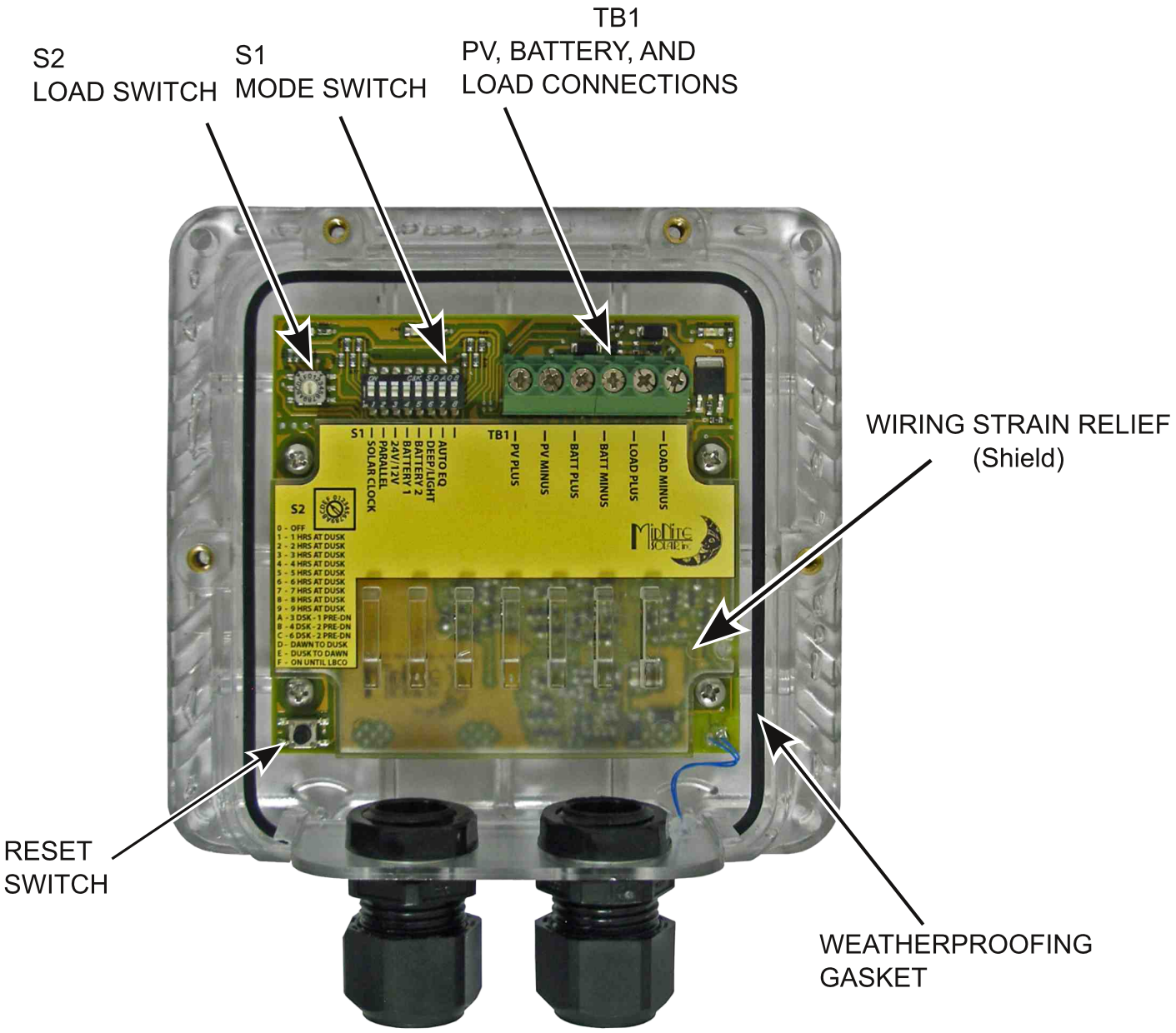
Things to consider when selecting a location for the Brat:
- Length of wire runs/power losses - Longer wires mean heavier gauge wire and greater power loss.
- Environment - The brat's weatherproof construction gives great flexibility, but if it is installed in a very warm location power output may be reduced.
- Visibility of indicator LEDs - The Brat should be mounted where the status LEDs are readily visible.

When you have selected a suitable mounting location, simply attach to the selected area with appropriate screws (not included). #8 hardware should be enough to secure the Brat.

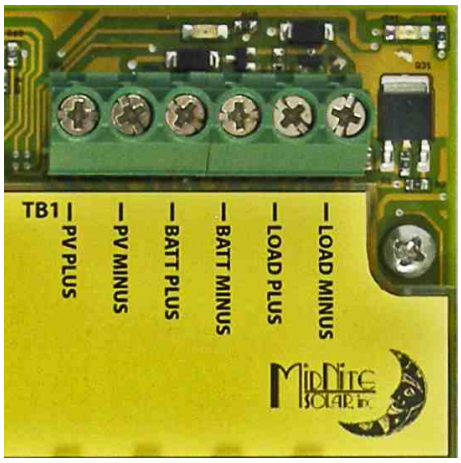
The Brat's weatherproof design even allows "nail it to a tree" installations.



Overall Mounting Dimensions



Component Locator - No Scale



Wiring the Brat:

All wiring for the Brat is done through the six position terminal block (TB1) at the top of the printed circuit board. Input and output circuit breakers sized to protect the wiring should be used on the input and output. These provide circuit protection as well as a convenient means of disconnecting for service or maintenance. Typical breaker sizes by wire gauge:10 AWG - 30 Amp, 12 AWG - 20 Amp, 14 AWG 15 Amp.

Remove the front cover.

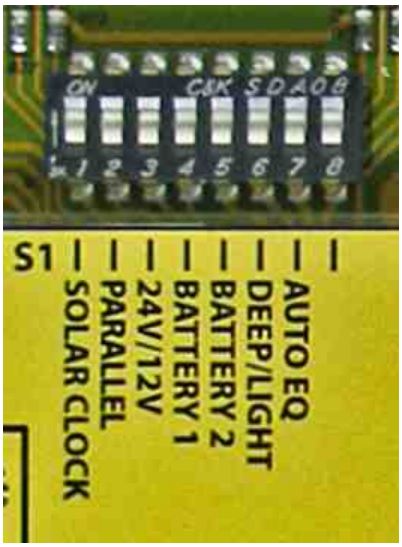
From left to right the connections are:

PV PLUS*	This connection comes from the solar panels or combiner.
PV MINUS*	This connection comes from the solar panels or combiner.
BATT PLUS	This connection comes from the Positive connection on the battery.
BATT MINUS	This connection comes from the Negative connection on the battery.
LOAD PLUS*	This connection goes out to the Positive connection of the load/lighting to be controlled by the Brat.
LOAD MINUS*	This connection goes out to the Negative connection of the load/lighting to be controlled by the Brat.

*For Parallel mode (30 Amp charging) the load section of the controller is *paralleled* to the PV inputs.

To do this run a red wire from **LOAD PLUS** on the Brat's terminal block to the incoming PV positive connection. **PV PLUS** and **LOAD PLUS** should both be connected to the positive PV input.
Next run a black wire from **LOAD MINUS** on the Brat's terminal block to the incoming PV negative connection. **PV MINUS** and **LOAD MINUS** should both be connected to the Negative PV input.

Setting up the Brat:



S1 - DIPSWITCH

ON

OFF

MODES:

The switch marked as **S1** is used for setting up the various modes of the Brat. Pushing the switch up turns it on and pushing it down turns it off.

For lighting / load settings see **S2** on the next page.

S1-1 Solar Clock -	When on, The Brat will adjust load control for seasonal solar changes (time).
S1-2 Parallel -	When on, the load circuit is used by the Brat to boost charging to 30 Amps.
S1-3 24V / 12V -	Push the switch up for 24V systems and down for 12V systems.
S1-4 Battery 1 -	Selects the type of system battery - See Below.
S1-5 Battery 2 -	Selects the type of system battery - See Below.
S1-6 Deep / Light -	Up allows load to discharge the batteries deeper. Down for normal / light.
S1-7 Auto EQ -	Slide the switch up to enable Auto EQ.
S1-8 Low EMI -	Slide switch down for lower PWM - Not implemented on Beta units.

S1-4 OFF and S1-5 Off	Sealed Profile #1 Bulk and Absorb 14.1, Float 13.7, Equalize NA*.
S1-4 OFF and S1-5 On	Sealed Profile #2 Bulk and Absorb 14.4, Float 13.5, Equalize NA*.
S1-4 On and S1-5 Off	Flooded Profile #1 Bulk and Absorb 14.4, Float 13.2, Equalize 15.5.
S1-4 On and S1-5 On	Flooded Profile #2 Bulk and Absorb 14.4, Float 13.7, Equalize 14.9.

* Equalization is disabled for sealed batteries.

Three stage charging:

Stage one, bulk charge -	The Brat sends all available power to the batteries until the bulk voltage setting is reached.
Stage two, Absorb charge-	The Brat holds the batteries at the absorb voltage for two hours as long as adequate power is available from the panels.
Stage Three, Float charge-	The brat holds the batteries at the float voltage as long as adequate power is available from the panels.
EQ and Auto EQ Charge-	The Brat holds the batteries at the EQ voltages listed above for two hours.

This is a form of controlled overcharge that allows the cells of the batteries to become more equally charged. Refer to your battery manufacturers recommendation for equalizing your batteries and expect to be adding water afterward.

Lighting Modes:

The Brat includes a lighting controller that can be used to turn lights or other loads on at sunset and after dawn for a specified period of time or until the battery is depleted to the depth of discharge (LBCO) setting.

The rotary switch marked as **S2** is used for setting the lighting controller.

S2 Rotary Switch

The rotary switch settings are as follows:

0 - Turns lighting controller off.
1 - Turns lights on for one hour at dusk.
2 - Turns lights on for two hours at dusk.
3 - Turns lights on for three hours at dusk.
4 - Turns lights on for four hours at dusk.
5 - Turns lights on for five hours at dusk.
6 - Turns lights on for six hours at dusk.
7 - Turns lights on for seven hours at dusk.
8 - Turns lights on for eight hours at dusk.
9 - Turns lights on for nine hours at dusk.
A - Turns lights on for three hours at dusk and one hour before dawn.
B - Turns lights on for four hours at dusk and two hours before dawn.
C - Turns lights on for six hours at dusk and two hours before dawn.
D - Turns lights on from dusk to dawn.
E - Turns lights on from dawn to dusk.
F - Turns lights on until Low Battery Cut Off **(LBCO).**

Test/Reset Manual EQ pushbutton

The pushbutton switch on the lower right corner of the board is used for:
1. Testing loads (Click).
2. Resetting displayed fault conditions (Hold).
3. Staring manual EQ (Hold).

1. To test loads connected to the Brat's controlled load output give the pushbutton a momentary push. Power will be available at the output for ten seconds. This is useful for verifying function of the connected loads. Note: load functions are only available when the brat is not set to parallel. See S1-2 on the page 6.

2. Resetting fault conditions: If a fault condition is present, pressing and holding the pushbutton will reset the fault condition. If the fault condition is still present the fault indication will return.

3. Manual EQ: If no fault condition is present, pressing and holding the pushbutton will manually start an EQ cycle.
One of three things will happen at this point.

1. All LEDs blink three times and the green LED remains on. This indicates an attempt to EQ a sealed battery.
2. The LEDs will blink once in succession from left to right to show that the EQ request is accepted and the green LED will blink during the EQ cycle.
3. If an EQ cycle has already been initiated the LEDs will blink once in succession from right to left to show that the EQ request is Cancelled and the green LED will return to its previous condition e.g.: on-Float.

NOTE: EQ is only available for flooded batteries. Attempting to start an EQ cycle with switch S1 (see page 6) set to any sealed battery setting will result in an error being displayed on the LEDs and the EQ cycle will not start.

NOTE: If the battery is disconnected while the PV input is active The Brat may continue to function. If this should occur the load output may lose regulation resulting in possible damage to connected loads.
Always disconnect the PV input before disconnecting the battery.

Error Codes

When an error occurs all LEDs will blink together three times and a code will be displayed.

These codes are shown on the LEDs as follows:

Attempt to EQ a Sealed Battery	Off	Off	Off	**On**
Reverse polarity Battery	Off	Off	**On**	Off
Reverse polarity PV	Off	Off	**On**	**On**
24 Volt Battery with Brat set to 12 V	Off	**On**	Off	Off
Parallel**	Off	**On**	Off	**On**
Switch set to an invalid setting while on	Off	**On**	**On**	Off

A note to nerds: The LEDs do indicate the binary number of the error.

** Indicates that the load circuit was not correctly wired for Parallel (30 Amp) charging. This is not checked on Beta units.

LED indications

Blue LED (Far left)	On Solid = Load is on. Slow Blink = OCP Fault, Can attempt reset by pressing reset button.
Red LED (2nd Left)	On Solid = Load disconnected by Low Voltage Disconnect (Low Batt). Slow Blink = Battery too low to start loads (Very Low Batt). Rapid Blink = Battery Voltage too high - Not yet implemented, future feature.
Org LED (2nd Rt)	On Solid = Bulk Charging. Slow Blink = Absorb Charging. Rapid Blink = Bulk or Absorb, Output derated due to overheating.
Grn LED (right)	On Solid = Float Charging. Slow Blink = EQ cycle in progress. Rapid Blink = Float or EQ, Output derated due to overheating.

Troubleshooting

Problem	Possible Cause(s)	Solution
Batteries do not charge	Incorrect system Voltage selected	Set S1-3 to correct system voltage
	Not enough sunlight reaching the panels	Reposition panels, check for shading
	wiring error	Verify all connections

Ratings

Max PV Voltage in	60 Volts DC
Max Output	30 Amps DC Configurable as 20 Amps charge and 10 Amps load or as 30 Amps charge only.
Thermal Shutdown	85°C restarting at 55°C

MIDNITE SOLAR INC. LIMITED WARRANTY

MidNite Solar Power electronics, sheet metal enclosures and accessories

MidNite Solar Inc. warrants to the original customer that its products shall be free from defects in materials and workmanship. This warranty will be valid for a period of two (2) years for MNBRAT Charge Controllers.

At its option, MidNite Solar will repair or replace at no charge any MidNite product that proves to be defective within such warranty period. This warranty shall not apply if the MidNite Solar product has been damaged by unreasonable use, accident, negligence, service or modification by anyone other than MidNite Solar, or by any other causes unrelated to materials and workmanship. The original consumer purchaser must retain original purchase receipt for proof of purchase as a condition precedent to warranty coverage. To receive in-warranty service, the defective product must be received no later than two (2) weeks after the end of the warranty period. The product must be accompanied by proof of purchase and Return Authorization (RA) number issued by MidNite Solar.
For an RMA number contact MidNite Solar Inc., 17722 67th Ave NE, Arlington, WA 98223 (360) 403-7207.
Purchasers must prepay all delivery costs or shipping charges to return any defective MidNite Solar product under this warranty policy. Except for the warranty that the products are made in accordance with, the specifications therefore supplied or agreed to by customer:

MIDNITE SOLAR MAKES NO WARRANTY EXPRESSED OR IMPLIED, AND ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE WHICH EXCEEDS THE FOREGOING WARRANTY IS HEREBY DISCLAIMED BY MIDNITE SOLAR AND EXCLUDED FROM ANY AGREEMENT MADE BY ACCEPTANCE OF ANY ORDER PURSUANT TO THIS QUOTATION. MIDNITE SOLAR WILL NOT BE LIABLE FOR ANY CONSEQUENTIAL DAMAGES, LOSS OR EXPENSE ARISING IN CONNECTION WITH THE USE OF OR THE INABILITY TO USE ITS GOODS FOR ANY PURPOSE WHATSOEVER. MIDNITE SOLAR'S MAXIMUM LIABILITY SHALL NOT IN ANY CASE EXCEED THE CONTRACT PRICE FOR THE GOODS CLAIMED TO BE DEFECTIVE OR UNSUITABLE.

Products will be considered accepted by customer unless written notice to the contrary is given to MidNite Solar within ten (10) days of such delivery to customer. MIDNITE SOLAR is not responsible for loss or damage to products owned by customer and located on MIDNITE SOLAR'S premises caused by fire or other casualties beyond MIDNITE SOLAR's control. This warranty is in lieu of all other warranties expressed or implied.

MIDNITE SOLAR INC. 17722 67TH AVE NE ARLINGTON, WA 98223
Email: info@midnitesolar.com
PH: 360.403-7207 FAX: 360-691-6862

Midnite the Cat