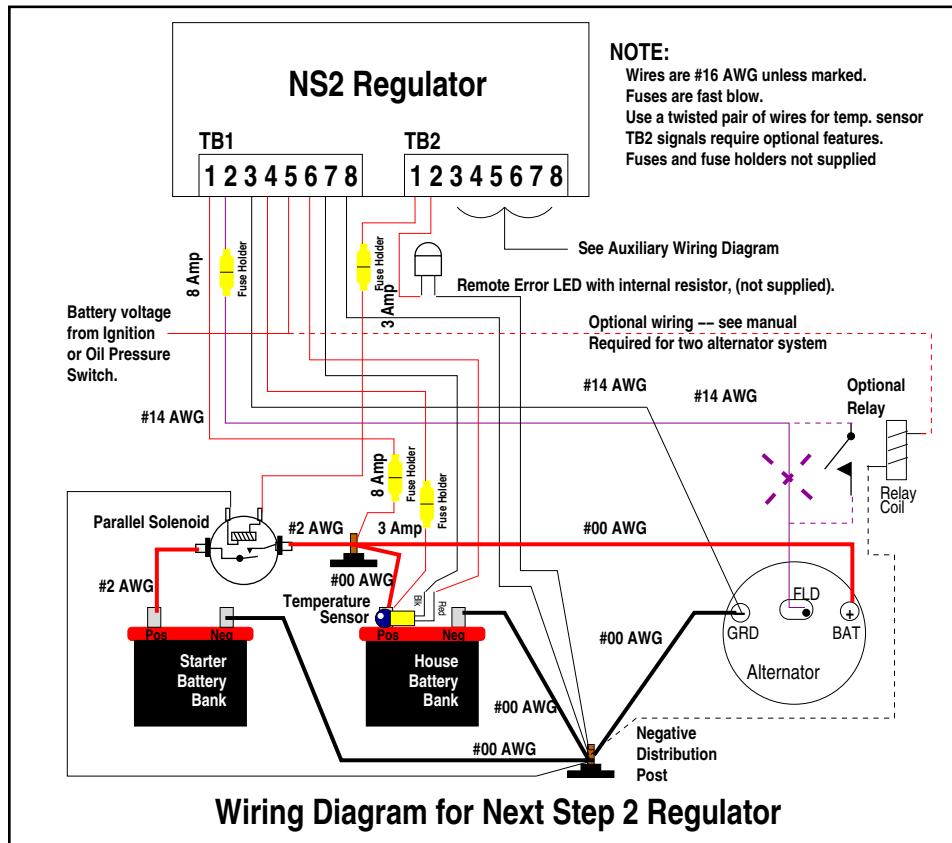


# Next Step 2 Alternator Regulator

## Installation and Operating Instructions

12, 24 Volt Models

June 12, 2009



### Introduction

This document covers the Next Step 2, NS2, alternator regulators. The Next Step 2 Regulators are produced in just one voltage model:

- For 12 and 24 Volt systems, #NS2-12/24

### WARNING!

The adjustment potentiometers can be set as necessary for the system voltage. That is, the pots can be set as appropriate for 12 Volt systems, or they can be set for 24V systems.

However, if you install a regulator in a 12 Volt system and then adjust the setpoints without reading how, you may end up with damaged batteries. Obviously a 12 Volt bank will not stand being charged as a 24 Volt bank.

### BE SURE TO READ THE ADJUSTMENT PROCEDURE!

### Other Relevant Documents

The data sheet for the NS2 contains ordering information and should be read prior to reading this manual. A copy can be printed from this URL: Next Step 2 Alternator Regulator Data Sheet, (<http://www.amplepower.com/products/ns2/index.html>).

The *Next Step 2 Factory Installed Options Manual* covers the Factory Installed Options and is shipped with the NS2 when they are installed. It can also be downloaded from [www.amplepower.com](http://www.amplepower.com).

### Mounting the Regulator

The regulator is protected against ambient humidity, but must be mounted in a dry area free of moisture, dust and other environmental insults. The regulator will operate in temperatures to 70°C (158°F).

### Wiring Diagram

The wiring diagram above is the only way to wire the NS2 Regulator. Do not wire in any other way, such as combining ground wires or battery positive wires. Use fuses where shown. Failure to do so may result in fire.

Note that there are two terminal blocks on the regulator, TB1 and TB2. TB1 is always present, however, TB2 is only present when one or more options are chosen.

The wiring diagram shows an **OPTIONAL RELAY** and associated wiring. The relay and wiring is only necessary when an *Alternator Driver* is used for a second alternator. The relay only engages

if the main ignition is on, preventing field current from flowing in the main alternator if the engine is not being operated. Optional wiring is shown with dashed lines. Note the large dashed **X** through the field wire. It denotes that the field wire is interrupted at the **X** and re-wired through the relay.

## TB1 Signal Names and Functions

- **Pin 1, B<sup>+</sup>, (required)** ... The source of power for the alternator field current and regulator logic circuits which stay activated to provide the battery combiner function on the parallel solenoid output. Amperage draw on this wire is rated at 8 Amps(12V) or 5 Amps(24V) maximum, enough for a single alternator.
- **Pin 2, FIELD, (required)** ... the wire driven positive to activate the alternator.
- **Pin 3, ALT GND, (required)** ... the return line for the field current. Amperage draw on this wire is rated at 8 Amps maximum.
- **Pin 4, BAT.VOLTS, (required)** ... the sense wire for battery voltage. Any erroneous voltage drop in this wire from the battery can cause overcharge.
- **Pin 5, ON/OFF, (required)** ... a positive voltage that turns on the field output regulator. Typically it is connected to the ignition switch or oil pressure switch. **NOTE: On gasoline engines DO NOT connect at the spark coil ... connect at the ignition switch.**
- **Pin 6, T+ (RED), (optional)** ... positive side of the temperature sensor. Voltage at T+ (RED) is 2.98V at @ 25°C (77°F), and varies plus and minus with temperature at the rate of 0.01V per degree C.
- **Pin 7, T- (BLK), (optional)** ... ground side of the temperature sensor which is supplied with the regulator.
- **Pin 8 GROUND, (required – connect this wire first)** ... the reference ground for the regulator. All battery voltages are referenced to this wire.

## TB2 Signal Names and Functions, Optional

- **Pin 1, PARALLEL, (optional)** ... a positive output signal that is asserted after 30 seconds and when the regulator detects that the house battery is being charged.. Maximum load is 0.5 Amps. This signal is active at all times to implement the *Battery Combiner* function. The output signal matches system voltage so always use a solenoid rated for battery voltage ... for instance, 24 for a 24V battery bank.
- **Pin 2, Error, (optional)** ... a positive output signal that provides troubleshooting information identical to the Red Error LED ... see the Error Indicator section. Maximum current permitted from this output is 0.5 Amps.
- **Pin 3, ON/OFF, Engine 2, (optional)** ... a positive input voltage that turns on the optional Alternator Driver output for the second alternator. Typically it is connected to the ignition switch or oil pressure switch of the second engine.
- **Pin 4, Reg-Drv-2-Y, (optional)** ... drive signal Y to the Alternator Driver.
- **Pin 5, Reg-Drv-2-Z, (optional)** ... drive signal Z to the Alternator Driver.
- **Pin 6 GROUND, (optional)** ... ground for the serial port.
- **Pin 7, RX, (optional)** ... serial port receive input
- **Pin 8, TX, (optional)** ... serial port transmit

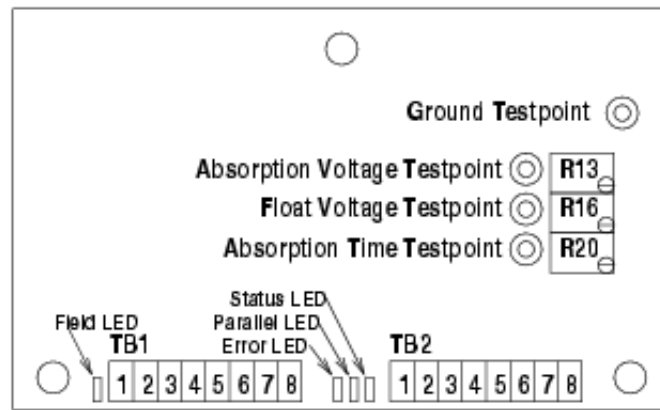
## Voltage Setpoints

Suggested battery voltage set-points are specified for 12, and 24 Volt systems. One model covers both 12 and 24 Volts. Only the 12/24 Volt values are given in this manual.

The suggested setpoint values are not specific to any battery type. Consult your battery manufacturer to determine the optimum set-points for their batteries. Adjust absorption time so that the batteries are fully charged just prior to when the regulator trips to float.

Setpoint	12V	24V
Absorption	14.40	28.80
Float	13.60	26.20

## Parts Locations



### Part Placement, Next Step 2

The outline above shows the location of parts relevant to adjusting the NS2 setpoints and also shows the location of the LED indicators. The testpoints hold a typical multimeter probe. There is a ground testpoint for the black lead, and three testpoints for the red lead. Test points are adjacent to the potentiometer used to vary the voltage at the test point.

## Status Indicator

The green LED shows at which set-point the regulator is presently operating. Status is shown by flashing the green LED with On and Off time in seconds as shown below.

**Table 1. Green Status LED**

Status	On	Off
On/Off Inputs, Off	3	3
Bulk Charge	2	1
Absorption Charge	1	1
Step to Float	1	6
Float Charge	2	2
Equalization Charge	6	6

## Error Indicator

Abnormal conditions are reported with the Red LED, and the external lamp/alarm, if wired. Errors are identified by On and Off times of the Red LED as shown below.

**Table 2. Red Error LED**

Error	On	Off
Bat. Volts disconnected	3	1
Over/Under Temperature	3	3
Voltage Runaway	6	3
Bad Temperature Sensor	6	6
Float setpoint higher than absorption	Continuous	n/a

## Parallel Indicator

The parallel indicator illuminates when the parallel output is activated. A connected solenoid should be closed anytime the parallel LED is on. The *Battery Combiner* option is required.

## Field Indicator

The field indicator is active whenever the field drive is active. The field output goes on and off to control alternator output. The field LED does change brightness somewhat depending on how high alternator current is.

## Voltage Setpoint Adjustments

Adjustments are easily made using a voltmeter. The regulator doesn't need to be regulating while adjustments are made so leave the engine off.

Begin adjustment by setting the meter to read voltage at a scale which will accommodate 3.3 Volts. Put the negative meter lead in the ground test point ... see the figure above.

Put the positive meter lead in a selected test point for absorption or float voltage. For the 12/24 Volt model, adjust the associated potentiometer until the voltmeter reads exactly one-tenth of the desired battery voltage ... for instance 1.440 for a desired absorption voltage of 14.40 Volts.

Repeat for the other voltage setpoint. The potentiometers are 20 turns and have a clutch to prevent damage if turned beyond the limit.

Adjusting the regulator while observing battery voltage is risky and can only be done accurately with the temperature sensor *disconnected*. Normally, adjustments should be made as described above.

**DO NOT MEASURE BATTERY VOLTAGE WITH THE ENGINE RUNNING AND ADJUST THE POT EXPECTING AN INSTANTANEOUS CHANGE IN BATTERY VOLTAGE. ALWAYS MEASURE THE TESTPOINT VOLTAGE TO MAKE SURE THE POT IS SET APPROPRIATELY. FAILURE TO OBSERVE THIS WARNING MAY CAUSE YOUR BATTERIES TO BE OVERCHARGED AND POSSIBLY EXPLODE.**

## Absorption Time Adjustment

How long the regulator stays in absorption state is set by measuring the voltage on the *Absorption Time* testpoint. Voltage is translated to minutes of absorption time by multiplying the voltage by 100. That is, a reading of 1 Volt will provide an absorption time of 100 minutes.

## What You Should See

When the regulator is first connected to B+, the red LED will glow for approximately 5 seconds before extinguishing. The alternator should slowly start to charge after the red LED goes off. Then the green LED will start to flash status information. For example: 2 seconds on, 1 second off, (bulk charge). The green LED connected to the *field* output will illuminate and vary somewhat in intensity depending on the average field voltage level.

The regulator will not stay in bulk charge mode long if the batteries are full, or the alternator can produce more than the batteries will accept.

The regulator cannot drive the battery voltage to any specific level if the alternator is not capable of producing enough current to satisfy battery acceptance capability, which varies with state-of-charge.

Alternators don't produce maximum output unless they are rotating at 6000 to 7000 RPM, so don't expect high current unless the alternator is rotating fast. If the batteries won't accept high current, then the voltage will quickly rise to the absorption setpoint and hold at that voltage. The regulator hasn't skipped the bulk charge step, just moved through it rapidly because the batteries don't accept much current.

Its very unlikely that a regulator is to blame for slow charging. They either work or they don't. Failure to charge is generally the alternator, or electrical connections.

## Battery Temperature Sensing

For optimal battery life we recommend using the battery temperature sensor. The temperature sensor accessory is an external temperature probe that attaches to the battery. The NS2 will then compensate the charging voltages based on the temperature to provide the fastest charge while protecting the life of the battery. **Order Accessory:** Battery temperature sensor, #2018 or

Battery temperature sensor with 20 feet (6-m) twisted pair wire, #2018-WIRE

## Alternator Requirements

The alternator must be an externally regulated model with one brush connected to ground and the other brush fitted with a connection to make the *field* connection, (P-type). **Be advised that alternators not hot rated for continuous operation at high current and temperature may fail when driven by the regulator.**

An alternator can easily be tested by disconnecting the field wire from the regulator and then with another wire, connecting the alternator field terminal to battery voltage. Don't do this very long because the alternator will be producing maximum output for its RPM, and battery voltage may rise to unacceptable values.

## Troubleshooting

First, look at the Signal Names and Functions section above and make sure that all required wires are in place and properly connected. Moving a wire such as BAT.VOLTS or GROUND a few feet away from a good Battery Positive or Negative Distribution could result in undesirable regulation due to voltage spikes in the system. To help diagnose voltage set-points, remove the T+ (RED) connection to prevent a faulty temperature sensor from affecting the system. Second, if the problem still exists, obtain a copy of the *Next Step 2 Troubleshooting Guide* which is available from the following sources:

### Regulator Service Center

- the dealer who sold the regulator
- Web: <http://www.amplepower.com/support/>
- E-mail: [support@amplepower.com](mailto:support@amplepower.com)
- Phone: (206) 789-0827 or Fax: (206) 789-9003

The troubleshooting guide was designed to help isolate a majority of the installation problems. Fill out the Troubleshooting Guide to determine if all measurements meet the specified requirements.

Finally, if you are unable to remedy the problem, contact the regulator service center with the Next Step 2 Troubleshooting Guide completed for referencing.

## Factory Installed Options

The basic NS2 can be enhanced with several options which are:

- Two Alternator Option
- Battery Combiner Option
- Serial Port/Equalization Option

Refer to the *Next Step 2 Alternator Regulator* data sheet for ordering information of the factory installed options, factory installed options with accessories, and accessories.

Refer to the *Next Step 2 Factory Installed Options Manual* for additional information, including wiring instructions for these options.

Note: The extra circuitry for the factory installed options are built into the NS2 only at the factory.

The factory installed options are summarized below.

### Two Alternator Option

The NS2, without the *Two Alternator Option*, can only be used with a single alternator. The NS2 can be ordered with the capability to regulate two alternators on the same or different engines. One alternator is regulated from the NS2 itself. The second alternator is regulated via an Alternator Driver module which connects to the NS2. The connection between the Alternator Driver and NS2 is made using high speed communications over two wires. See pins 4 and 5 on TB2.

The NS2 uses low power signals to drive a second alternator via the Alternator Driver. In this case, the NS2 is mounted close to one al-

ternator while the second alternator, with the Alternator Driver can be mounted up to fifty feet, (15 meters) away. Signals between the NS2 and Alternator Driver are low level, rather than power signals. This is a much more reliable method of driving two alternators than direct coupling of field current which can result in electrical noise and high voltage transients caused from ringing on long wires.

### Battery Combiner Option

The *Battery Combiner* option includes circuits on the NS2 regulator and includes an external parallel solenoid to combine the Starter Battery Bank to the House Battery Bank when the NS2 detects the House Battery Bank is being charged.

### Serial Port/Equalization Option

With the serial port option a user can communicate with the NS2 using a personal computer. Communications with the NS2 requires a terminal emulator program such as HyperTerminal, and a user must understand a small subset of the Remote Access Protocol, RAP. A document covering the full RAP description can be downloaded from the Ample Power Website.

Use of the serial port enhances operation of the NS2 by allowing:

- view battery voltage and temperature;
- change charge setpoints from the computer;
- enable current limit and set its value;
- equalize batteries;

A cable is supplied with the #NS2SP-CABLE and has the appropriate DB-9 connector for hook-up to a computer. Not all computers have serial ports so a USB-to-serial adapter may be required.