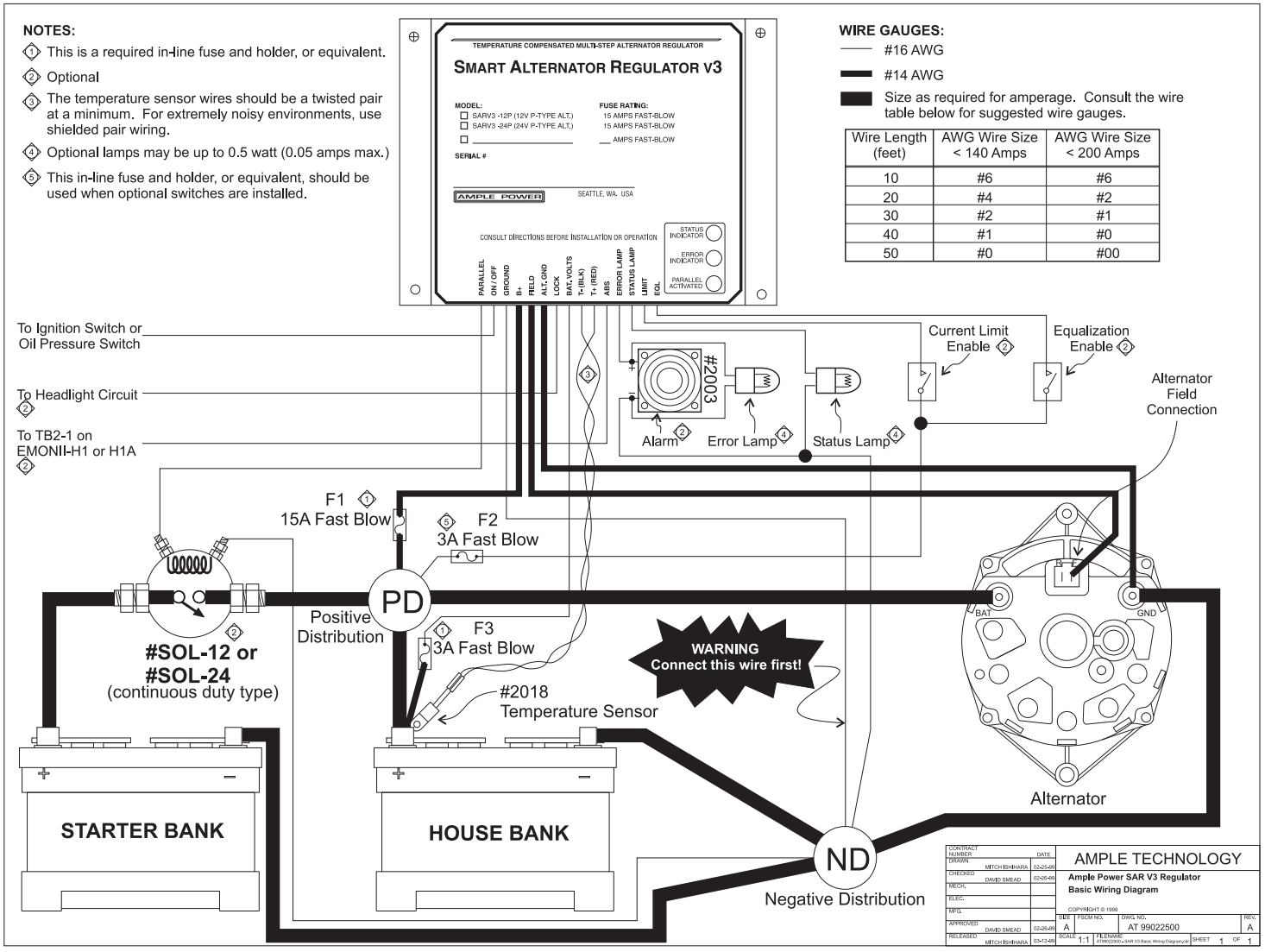
Smart Alternator Regulator^{tm} V3

Installation and Operating Instructions

Ample Power Models SARV3-12P and SARV3-24P February 1, 2017



Mounting the Regulator

The regulator is protected against ambient humidity, but must be mounted in a dry location free of moisture, dust, and other environmental insults. The regulator will operate in temperatures to 60°C (140°F).

Wiring Diagram

The wiring diagram above is the only way to wire the Smart Regulator. Do not wire it in any other way, such as combining ground wires or battery positive wires. For safety purposes, always use fuses where shown.

NOTE: For those familiar with earlier regulators such as the SAR-V2 or Next Step Regulators, note that all inputs and outputs on the SAR-V3 are active on a positive signal. That means the PARALLEL solenoid, the ERROR LAMP and the STATUS LAMP are wired to their respective devices with the other end of the device returned to **Negative Distribution**. All inputs at the terminal block are activated when they are connected to battery voltage. Leave unused *optional* terminals unconnected.

Signal Names and Functions

Battery voltage set-points are specified for each voltage system, 12 or 24 volts, as 12 / 24 volts, respectively.

- **PARALLEL**, (*optional*) . . . an output that has a positive voltage when the regulator detects that the house battery is being charged. The maximum load is 1.5 Amps.
- **ON / OFF**, (***required***) . . . an input that that turns the alternator field circuits of the regulator on when battery voltage is applied. Typically it is connected to the ignition switch. Typical draw is 0.003 Amps.
  NOTE: On gasoline engines DO NOT connect at the spark coil . . . connect at the ignition switch.
- **GROUND**, (***required – connect this wire first***) . . . the reference ground for the regulator. All battery voltages are referenced to this connection.
- **B$^+$**, (***required***) . . . the power input source for the alternator

field current, PARALLEL, ERROR LAMP, and STATUS LAMP. Amperage draw on this wire is rated at 15 Amps maximum. To completely deactivate the regulator, a suitable switch (not shown) can be inserted into this line.

- **FIELD**, (***required***) . . . an output that is driven positive by the regulator to make the alternator charge. Voltage at this point depends on how much current the alternator should produce and varies from zero to battery voltage.

- **ALT.GND**, (***required***) . . . the return line for field current. **NOTE: Do not jumper this wire to the GROUND tab.**

- **LOCK**, (*optional*) . . . an input, when connected to battery voltage, that *locks* the regulator set-point at the battery gassing voltage. Used to prevent higher voltages when halogen lights are used. Refer to the LOCK Input section for the operating description.

- **BAT.VOLTS**, (***required***) . . . the sense wire for battery voltage. Any erroneous voltage drop in this wire from the battery can cause overcharge.

- **T- (BLK)**, (*recommended*) . . . ground side of the temperature sensor, which is supplied with the regulator.

- **T+ (RED)**, (*recommended*) . . . 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. Some battery manufacturers require temperature sensing of the battery for warranty purposes. Under all cases except for temporary troubleshooting, we recommend using the temperature sensor at all times.

- **ABS**, (*optional*) . . . a positive voltage applied at ABS will lock the regulator at the absorption set-point. This is typically used with the Ample Power Energy Monitor/Controller. Refer to the ABS Input section for the operating description.

- **ERROR LAMP**, (*optional*) . . . an output that has a positive voltage blink rate identical to the red Error Indicator. Refer to the Error Indicator section. Maximum current permitted from this output is 0.05 Amps.

- **STATUS LAMP**, (*optional*) . . . an output that has a positive voltage blink rate identical to the green Status Indicator. Refer to the Status Indicator section. Maximum current permitted from this output is 0.05 Amps.

- **LIMIT**, (*optional*) . . . an input that activates the regulator's duty-cycle current limiting when battery voltage is applied to this connection. This duty-cycle current limit is adjusted with potentiometer R11 (Refer to Figure 2). Refer to the Current Limiting section for the operating description.

- **EQL**, (*optional*) . . . an input that activates either the regulator's equalization mode **or** a second duty-cycle current limit, depending on the internal jumper P1. This input is activated when battery voltage is applied to EQL. The duty-cycle current limit is adjusted with potentiometer R12 (Refer to Figure 2). Refer to the Equalization section for the operating description.

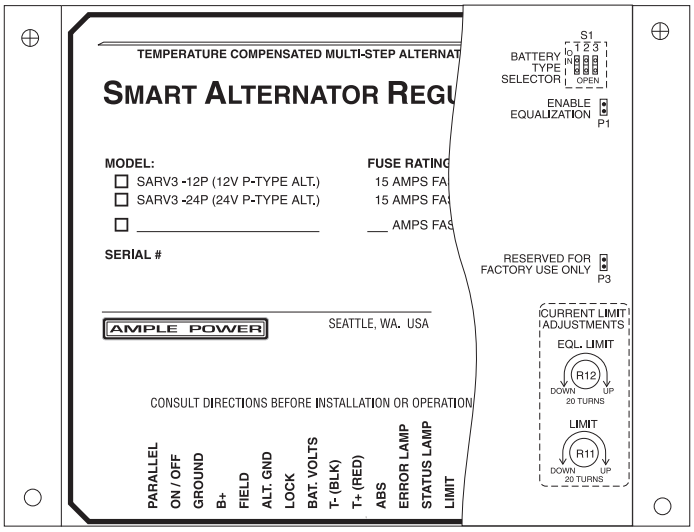


Figure 2. Internal Settings Locations

Status Indicator

The green Status Indicator and the external STATUS LAMP, if wired, shows the charging state of the regulator. Status is shown by flashing the green Status Indicator with On and Off times in seconds as shown in Table 1 below.

Table 1. Green Status Indicator

Status	On	Off
ON/OFF Input Off	3	3
Bulk Charge	2	1
Gas Charge	6	1
Absorption Charge	1	1
Step to Float	1	6
Float Charge	2	2
Gas Lock	3	1
ABS Hold	1	3
Equalization Charge	6	6

Error Indicator

The red Error Indicator and the external ERROR LAMP, if wired, reports abnormal conditions. Errors are identified by On and Off times of the red Error Indicator as shown in Table 2 below. They are listed in the order that errors are displayed if there are multiple errors. All errors, except the last one, attempt to shut off the field drivers until the error condition subsides.

Note: The last error can also be a warning that voltage getting to the regulator on the B^+ input is insufficient to fully drive the field output.

Table 2. Red Error Indicator

Error	On	Off
Voltage Runaway	6	3
Field Short Circuit	3	6
Bat. Volts disconnected	3	1
Can't turn field off	1	1
Bad Temperature Sensor	6	6
Over Temperature	3	3
Can't turn field on	1	3
Missing GROUND connection	6	0.5

Voltage and Absorption Time Set-points

The voltage and the time of the absorption cycle are controlled by the internal dip-switch, S1. Refer to Figure 2 for the location of S1. Select a charge profile by setting the battery type switches on S1 according to the following table.

Table 3. Battery Type Selection

Battery Type	Sw 1	Sw 2	Sw 3
Thick Plate Liquid	Off	Off	Off
Medium Plate Liquid	On	Off	Off
East Penn Gel	Off	On	Off
AGM	On	On	Off
Optima	Off	Off	On
Exide Gel	On	Off	On
Johnson Control Gel	Off	On	On
Ample Power Gel	On	On	On

What You Should See

The regulator is on whenever power is present at B+. Without voltage at the ON / OFF input, the regulator is simply controlling the parallel solenoid, and will close the solenoid whenever the voltage on BAT.VOLTS indicates that the main battery is being charged.

When the regulator is first turned on via B+, the red Error Indicator will glow for 5 - 8 seconds before extinguishing. Then the green Status Indicator will then start to flash the charge status.

If there is a positive voltage on the ON / OFF input, then the alternator should start to charge after the red Error Indicator goes off. Thus, alternator charging can be controlled via the ON / OFF input.

NOTE: You may not see all the charge states if the batteries are full or nearly full when the regulator is turned on. If the regulator detects this condition it will skip the absorption state.

ABS Input

When battery voltage is applied to this input, the regulator is held at the absorption set-point. Removal of the input signal causes the regulator to begin stepping toward the float voltage. Step-to-float is an intermediate mode where the float set-point is approached in small steps over time. This is done in an attempt to maintain some alternator output and thus keep the tachometer alive.

LOCK Input

This input locks the regulator at the gassing set-point, which is half-way between the absorption and float set-points.

Removal of the signal toggles between stepping to float, or going to the absorption set-point. The first activation and then removal of the LOCK signal causes the regulator to step float. The next activation and then removal of the LOCK signal causes the regulator go to the absorption set-point, initializing the absorption timer. This cyclic behavior repeats. Thus, the LOCK input can be used to completely control the charge state at float, gas or absorption.

Input Priorities

The EQL signal overrides the LIMIT signal. The EQL overrides the ABS and LOCK signals. On the current release, the LOCK signal overrides the ABS signal. The LIMIT signal will limit current with either LOCK or ABS.

Current Limiting

Two 20-turn potentiometers with two input signals permit duty cycle current limiting at two independent set-points. Duty cycle current limiting is a mode where the percentage-of-time that the regulator is driving the field is set by the potentiometer. Current limiting is useful to reduce alternator output, and thus reduce horsepower requirements from the engine.

Two settings are available. The control inputs are LIMIT, and EQL. Note that the EQL input serves a dual function depending on whether an internal jumper, P1, is in place. See the Equalization section for more information.

For normal limiting on a small engine, assert the LIMIT input. The EQL input can be connected to the same switch that enables another load on the engine. For example, a clutch driven pump may require a further reduction in current, so wire the EQL input to the switch that activates the clutch for the water pump. The potentiometer for LIMIT is R11. R12 sets the current limit for the EQL input. Refer to Figure 2 for R11 and R12 locations.

NOTE: The EQL input is used here as a second current limit set-point. See the following section below for information to do equalization.

Equalization

Equalization is a process where the voltage on the battery is allowed to rise to a higher voltage, typically 16.2 / 32.4 Volts for most batteries, where the applied current is limited to 3 - 7% of the Ah capacity of the battery. The applied current must be set using R12.

The EQL input is used for a second current limit whenever the input signal is activated. To enter the actual equalization mode, the two pins of P1 must be first shorted with a jumper terminal or a switch connected to the two pins, refer to Figure 2. This changes the mode of the EQL input signal to regulate at the equalization voltage set-points as well as current limit. Then the EQL input should be momentarily activated for at least two seconds and then released. A second momentary action will terminate the equalization process. Equalization will terminate automatically whenever the ending voltage or time is achieved.

CAUTION: Equalization produces a higher voltage than some normal equipment can tolerate. Turn off equipment that will not tolerate an input of 17 / 34 Volts or more.

NOTE: The Smart Regulator does not permit equalization for the gel batteries but does permit equalization of absorbed glass matte batteries at an appropriate voltage.

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).

NOTE: Alternators not rated for continuous operation at high current and temperature may fail when driven by the regulator unless current is limited to a safe value.

Troubleshooting

First, look at the Signal Names and Functions section above and make sure that all required wires are in place and properly connected. We have found that 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 disable temperature compensation and prevent a faulty temperature sensor from affecting the system.

NOTE: With temperature sensing, a higher battery temperature will result in a lower battery voltage. Likewise, a lower battery temperature will result in a higher battery voltage.

Second, if the problem still exists, obtain a copy of the *SAR V3 Troubleshooting Guide* which is available from http://www.amplepower.com/trouble/index.html.

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.

Support

Support for the Smart Alternator Regulator is available at: http://www.amplepower.com/phpBB3.