

Ample Power Company

Troubleshooting the Smart Alternator Regulator, V3

Introduction

Most installations that fail to operate from the start are due to some wiring problem or an incompatible alternator. Read the ERROR INDICATOR section below to determine if the regulator identified an error. Then proceed to the Troubleshooting Steps section to isolate and remedy the problem. If the problem cannot be remedied then assistance is needed.

Getting Assistance

Free online support is available.

ERROR INDICATOR

An ERROR INDICATOR is provided that indicates errors that have been detected by the regulator. Errors are indicated by flash codes ...so many seconds on and so many seconds off. Under normal conditions, the ERROR INDICATOR is off. Seven abnormal conditions are reported by flashing the light at various rates as shown in Table 1, below.

Table 1 ERROR INDICATOR Codes:

Error	Seconds On	Seconds Off
Voltage Runaway	6	3
Field Short Circuit Detect	3	6
No Battery Sense	3	1
Cannot Turn Off Field Output	1	1
Battery Over Temperature	3	3
Abnormal Temperature Sensor	6	6
Cannot Turn On Field Output	1	3
Missing GROUND connection	6	0.5

NOTE: The ERROR INDICATOR comes on when the regulator is first powered up. This tests the LAMP to verify that the ERROR INDICATOR, error lamps and/or alarms operate.

Description of ERROR INDICATOR Codes

Battery Voltage Runaway: The voltage runaway condition is raised when the battery voltage exceeds (by 0.5 volt) the desired voltage determined by the regulator. The ERROR INDICATOR will turn on for 6 seconds and off for 3 seconds. This can be caused by other charger sources that do not follow the regulator's charge sequence (such as shore power battery chargers), in which case it is best to turn the other charge sources off while the regulator is running.

Field Short Circuit Detect: When the regulator detects the field current going out of the FIELD terminal exceeds the

factory value, the regulator signals the error condition. The regulator will attempt to power down the FIELD terminal and repeatedly attempt to restore power to the FIELD terminal. Activation of this error may indicate a partially shorted field winding within the alternator.

No Battery Sense: When the regulator does not sense the battery voltage, it can not regulate. After a short delay, the regulator will shut down and display an error code of 3 seconds on and 1 second off.

Cannot Turn Off the Field Output: When the regulator cannot turn off the field output, the alternator charges at its maximum rate. Obviously, this can destroy batteries if not corrected. The signal for this condition is easy to determine since it is 1 second on and 1 second off. There are two causes for this error: one, a shorted driver in the regulator, that is, the driver no longer goes off when commanded; and two, the FLD wire is not connected to the alternator's Field, which is more likely to be the case.

Abnormal Temperature Sensor: This condition will shut down the regulator indicated by an error code of 6 seconds on and 6 seconds off. There are two possible causes for this: one, a shorted or reverse wired temperature sensor; or two, a temperature less than -103 F / -75 C detected.

Battery Over Temperature: If temperature sensing is utilized, an over temperature condition may arise if the battery temperature should exceed 140° F, (60° C), signaled by an error code of 3 seconds on and 3 seconds off. In this case, the regulator will shut down after a short delay period.

Cannot Turn On the Field Output: When the regulator cannot turn on the field output, it turns off the output drivers and delays for about one minute before attempting to regulate again. It will display an error code of 1 second on and 3 seconds off. The regulator will repeat this procedure indefinitely. There are three main causes for this: one, if there is no power supplied to the power input (B+); two, if the alternator field is shorted to ground; and three, if the field wire is shorted to ground by rubbing through insulation or loosening from the field terminal. The engine should be shut off and the problem solved.

Missing GROUND connection: This error can occur when the GROUND connection is missing or poor.

Take Some Measurements

Fill in Table 2 completely. Fill in Column A first, Column B second, and Column C last. These measurements can catch 99% of all wiring errors if done meticulously. Leave the checkbox empty until you have gone through the analysis in Table 3.

Connect the negative probe of a digital voltmeter to only the battery negative. Use a separate long jumper wire if necessary, but do not use any other wires in the system. Connect the positive to the locations listed in Table 2.

Table 2 Your Voltage Measurements:

Row	Signal	Connected	Column A Ign. Off	Column B Ign. On	Column C Ign. and Running
1	PARALLEL				
2	ON/OFF				
3	GROUND				
4	B+				
5	FIELD				
6	ALT.GND				
7	LOCK				
8	BAT.VOLTS				
9	T- (BLK)				
10	T+ (RED)				
11	ABS				
12	ERROR LAMP				
13	STATUS LAMP				
14	LIMIT				
15	EQL				
n/a	House Battery +				

Row	Signal	Column A Ign. Off	Column B Ign. On	Column C Ign. and Running
1	PARALLEL	Note 1	Note 1	Note 1
2	ON/OFF	Note 2	Note 2	Note 2
3	GROUND	Note 3	Note 3	Note 3
4	B+	Note 4	Note 4	Note 4
5	FIELD	Note 5	Note 5	Note 5
6	ALT.GND	Note 6	Note 6	Note 6
7	LOCK	Note 7	Note 7	Note 7
8	BAT.VOLTS	Note 8	Note 8	Note 8
9	T- (BLK)	Note 9	Note 9	Note 9
10	T+ (RED)	Note 10	Note 10	Note 10
11	ABS	Note 11	Note 11	Note 11
12	ERROR LAMP	Note 12	Note 12	Note 12
13	STATUS LAMP	Note 13	Note 13	Note 13
14	LIMIT	Note 14	Note 14	Note 14
15	EQL	Note 15	Note 15	Note 15
n/a	House Battery +			

Analysis

- Note 1, Column A: If you have a parallel solenoid connected, the voltage should be 0 Volts. With a solenoid not connected to this pin, some internal leakage may cause the voltage to be up to 0.2 Volts.
- Note 1, Column B: Same as NOTE 1, Column A if the yellow LED is off. If the yellow LED is on, indicating that the solenoid should be activated, the voltmeter will show positive, and a voltage that is at most 0.75 Volts less than Row 4, B +.
- Note 1, Column C: Same as Note 1, Column B.
- Note 2, Column A:
- Note 2, Column B:
- Note 2, Column C:
-
-
-
-
-
-

Analyze the Results

Table 3, below, contains general information about valid results. Refer to the sub-sections following the table for the descriptions of problems. Check the valid values here in Table 3 against your measurements in Table 2. Place a check in the box provided if the value is valid.

Table 3 Valid Voltage Measurements:

PARALLEL 0.00V if de-activated.
 Up to 0.5 V less than Row 4, Col. A if activated. 0.00V if de-activated.
 Up to 0.5 V less than Row 4, Col. B if activated. 0.00V if de-activated.
 Up to 0.5 V less than Row 4, Col. C if activated. Row 2 ON/OFF 0.00 V Same value as Row 16, Col. B and up to 35 V Same value as Row 16, Col. C and up to 35 V Row 3 GROUND 0.00 V 0.00 V to +0.05 V 0.00 V to +0.05 V Row 4 B+ Same value as Row 16, Col. A Same value as Row 16, Col. B Same value as Row 16, Col. C Row 5 FIELD 0.00 V Up to 1.5 V less than Row 16, Col. B Anywhere between 0.00 V and a little less than Row 16, Col. C. Row 6 ALT.GND 0.00 V 0.00 V 0.05 V 0.00 V 0.05 V Row 7 LOCK Activated: Battery Voltage

Not Activated: 0.00 V Activated: Battery Voltage

Not Activated: 0.00 V Activated: Battery Voltage

Not Activated: 0.00 V Row 8 BAT.VOLTS Same value as Row 16, Col. A Same value as Row 16, Col. B Same value as Row 16, Col. C Row 9 T- (BLK) Same value as Row 3, Col. A Same value as Row 3, Col. B Same value as Row 3, Col. C Row 10 T+ (RED) 0.00 V Sensor Connected:

2.98 V @ 77 F / 25 C 0.01V for every 1.8 F / 1 C

Sensor Not Connected:

4.7 V 0.2 V Sensor Connected:

2.98 V @ 77 F / 25 C 0.01V for every 1.8 F / 1 C

Sensor Not Connected:

4.7 V 0.2 V Row 11 ABS Activated: Battery Voltage

Not Activated: Same value as Row 3, Col. A Activated: Battery Voltage

Not Activated: Same value as Row 3, Col. B Activated: Battery Voltage

Not Activated: Same value as Row 3, Col. B Row 12 ER-ROR LAMP 0.00V if de-activated.

Up to 0.5 V less than Row 4, Col. A if activated. 0.00V if de-activated.

Up to 0.5 V less than Row 4, Col. B if activated. 0.00V if de-activated.

Up to 0.5 V less than Row 4, Col. C if activated. Row 13 STATUS LAMP 0.00V if de-activated.

Up to 0.5 V less than Row 4, Col. A if activated. 0.00V if de-activated.

Up to 0.5 V less than Row 4, Col. B if activated. 0.00V if de-activated.

Up to 0.5 V less than Row 4, Col. C if activated. Row 14 LIMIT Activated: Battery Voltage

Not Activated: Same value as Row 3, Col. A Activated: Battery Voltage

Not Activated: Same value as Row 3, Col. B Activated: Battery Voltage

Not Activated: Same value as Row 3, Col. B Row 15 EQL Activated: Battery Voltage

Not Activated: Same value as Row 3, Col. A Activated: Battery Voltage

Not Activated: Same value as Row 3, Col. B Activated: Battery Voltage

Not Activated: Same value as Row 3, Col. B Row 16 House Battery + Any voltage that is within the range of your batteries. Any voltage that is within the range of your batteries. Any voltage that is within the range of your batteries.

Next Check the Alternator Wiring

To operate properly, the regulator must be connected exactly as shown by the wiring diagram. Remove the in-line fuse to the regulator's B+ tab. Test the alternator in place by momentarily connecting the field terminal to the battery positive, after first having removed the quick disconnect terminal to the regulator. The alternator should charge at its maximum output. Do not full field the alternator for more than a few seconds. If no charging is detected, then turn off the engine. Temporarily connect the regulator's end of the field wire to the battery positive for P-Type or ground for N-Type. Measure the voltage on the battery. Unplug the field wire from the alternator end. Measure the voltage on the field wire at the alternator end. The voltage should correspond to the voltage on the battery. If there is no voltage then the wire is open-circuit. Check the connector and wire. Also give the connectors a tug to check that they are properly crimped. If everything checks out fine then reinsert the regulator's in-line fuses and proceed below.

Voltages Seem Consistently High or Low

If the temperature sensor is connected, you could be seeing the effect of the temperature compensation. If the voltage between house battery negative and the GROUND terminal on the regulator is more than a few millivolts (say 50 mv) then, there may be a problem with the GROUND wire and/or connection.

Float Voltage Seems High

If the temperature sensor is connected, you could be seeing the effect of the temperature compensation. If the regulator just tripped to float, the batteries may be retaining a residual charge. Simply turn on a small load (about 10 amps such as the engine blower and cabin lights) and the regulator should start regulating.

Tachometer Drive Problems (Oscillates)

Some tachometers operate from a terminal on the alternator. The alternator signal is a half sine wave where its frequency is related to the engine RPM. The magnitude of the tachometer signal is dependent on the amount of current in the alternator field. Output current is also proportional to the field current, resulting in a conflict when field current needs to be low to regulate properly.

When the batteries are fully charged (especially gel batteries), little field current is necessary to maintain the float voltage at a proper level. Under these conditions, the regulator reduces field current to a level consistent with the output demand, so that the batteries will not be overcharged. The regulator is designed to be kind to the batteries first, and kind to the tachometer second. While special software in the regulator attempts to both regulate and still supply enough field current to keep the tachometer operating, the tachome-

ter may still become erratic or even stop. This situation can be avoided by turning on a minimum load of a few Amps such as the running lights. This will load the alternator and result in more field current. (Be sure to turn off the load when it is no longer needed.)

At the end of the absorption cycle the alternator steps down to the float voltage over approximately 5 minutes. The tachometer may "pulse" at the time of the step about every 30 seconds. Do not be alarmed by this, as it is normal after the absorption stage. The minimum load mentioned above will alleviate any tachometer instabilities.

This can also happen when there is improper grounding of the alternator and/or wiring of the regulator's B+ and GROUND connections. Check that everything is physically wired as specified.

Fuses Blow

If any of the fuses are blown, then there is a short-circuit somewhere and it should be found and corrected. If the fuse on the regulator blows twice in a row when the engine is not running, then remove all connections to the regulator except the GROUND and the B+. If the fuse blows again, then the regulator is damaged. If the fuse does not blow then proceed. In the following steps, if the fuse blows then the regulator may be damaged. In this order connect ON/OFF, BAT.VOLTS, and FIELD. If the fuse only blows when the regulator is properly wired and the field connection is made, then check to make sure that there is a resistance (of 1.2 Ohms or greater) between the field wire and the alternator ground wire, GND.