

## ALTERNATORS and Quirky Volvo Electronics

Technology is the bane and joy of vehicle operation/management systems. Let's begin. The XC90's alternator failed. I replaced it with a non-Bosch low cost rebuilt unit, which tested at 14.5-7 volts. Days later the DIM display advised the charging system had failed and the red battery symbol illuminated.



Turning off and restarting the motor returned the alternator to a charging state. Checking the wire connections and the voltage to the field coils and alternator output verified all was good.

I asked Mr. Google if these phenomena had occurred on other Volvos elsewhere. And it had. One shop purchased, returned and installed 5 rebuilt alternators in a customer car before settling on a \$500+ Bosch rebuilt. DIY-ers reported similar experiences. The shop theorized a communication failure between the ECU's and the alternator's voltage regulator was the source of the problem. An interesting theory in that Volvo alternators are not connected to the CAN bus communication system. Truth is that the Bosch voltage regulator has a higher steady state threshold than generic voltage regulators in less expensive rebuilt units.

Curious, I installed a new battery in the XC90 to eliminate the possibility of a random battery failure plus a digital voltmeter (\$8 eBay) to monitor the charging voltage as I drove.



Sure'nuf, each time the charging system failure warning appeared, the alternator output was 13.8 volts. Cutting the engine and restarting returned the output to 14.+ volts. The nominal voltage of a fully charged 12 volt battery is 12.6 volts. So, the alternator had not failed, but continued to push current into the battery. The ECU's message was erroneous.

At the next occurrence, as an experiment, I drove 20+ miles to observe the effect of a 13.8 volt condition. The motor continued to operate normally, the battery did not discharge and all electrical systems functioned perfectly.

The alternator had not failed. It continued to push current into the battery and the warning message was false. The voltage regulator was doing its job.

I observed that the charging system failure warning message would occur within 5-10 minutes following a cold start. If triggered, a single restart erased the message and restored the charging voltage to 13.9+ volts.

What's the lesson?

- 1) A cost effective rebuilt alternator is acceptable and good value. Install it with a digital voltmeter to verify operation.
- 2) The Volvo rebuilt alternator minimum charge threshold is 13.8 volts.
- 3) The Volvo ECU's minimum acceptable charge voltage is >13.8 volts, at 13.8 the ECU triggers a no-charge failure message. The Bosch voltage regulator's minimum charge voltage is likely >13.9 volts.

To avoid customer "call-back" a shop must install a \$500+ Bosch rebuilt or implement one of these DIY options.

- 1) Install the cost effective rebuilt alternator and a digital voltmeter.
- 2) Purchase the low cost rebuilt unit and swap the Bosch voltage regulator from the old unit to the new unit, but using the brushes from the new unit. (Old unit likely failed because brushes failed or became contaminated with oil/grease/grime or bearings failed.)
- 3) Purchase a rebuild kit with bearings and brushes and rebuild the original Bosch alternator using the original voltage regulator or a new Bosch regulator.

Ten thousand miles later, the XC90's ECU "learned" 13.8 volts is satisfactory and no longer triggers a charging system failure warning. The alternator "learned" to produce voltage greater than 13.9 and as much as 14.5 volts. Is there really AI in these systems? Wouldn't surprise me!

Most people have no idea or care to know what goes on beneath the hood or how the electro mechanical systems operate, much less their parameters. Yet a charging system failure warning message sends them into anaphylactic shock and to the shop, but not a Low Coolant message.

I have empathy for the mechanic who replaced 5 "defective" alternators; a money losing proposition for the shop and the parts house.

This story demonstrates why complex vehicles require real gauges and operators who know how to read them. A voltmeter allows an operator to verify whether the charging system has failed or not. Oddly, Volvo engineers included a dual system for the engine temperature; the ECU will display a low coolant warning message when coolant is lost and a temperature gauge. You'd think they'd have done the same with the equally critical electric power system.

BTW, there is a difference between a driver and an operator. A driver points the vehicle while an operator steers while monitoring road conditions and electro mechanical system performance.



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For other tips, check out the Blue Ridge Chapter website.  
<http://blueridgevolvonc.org/>