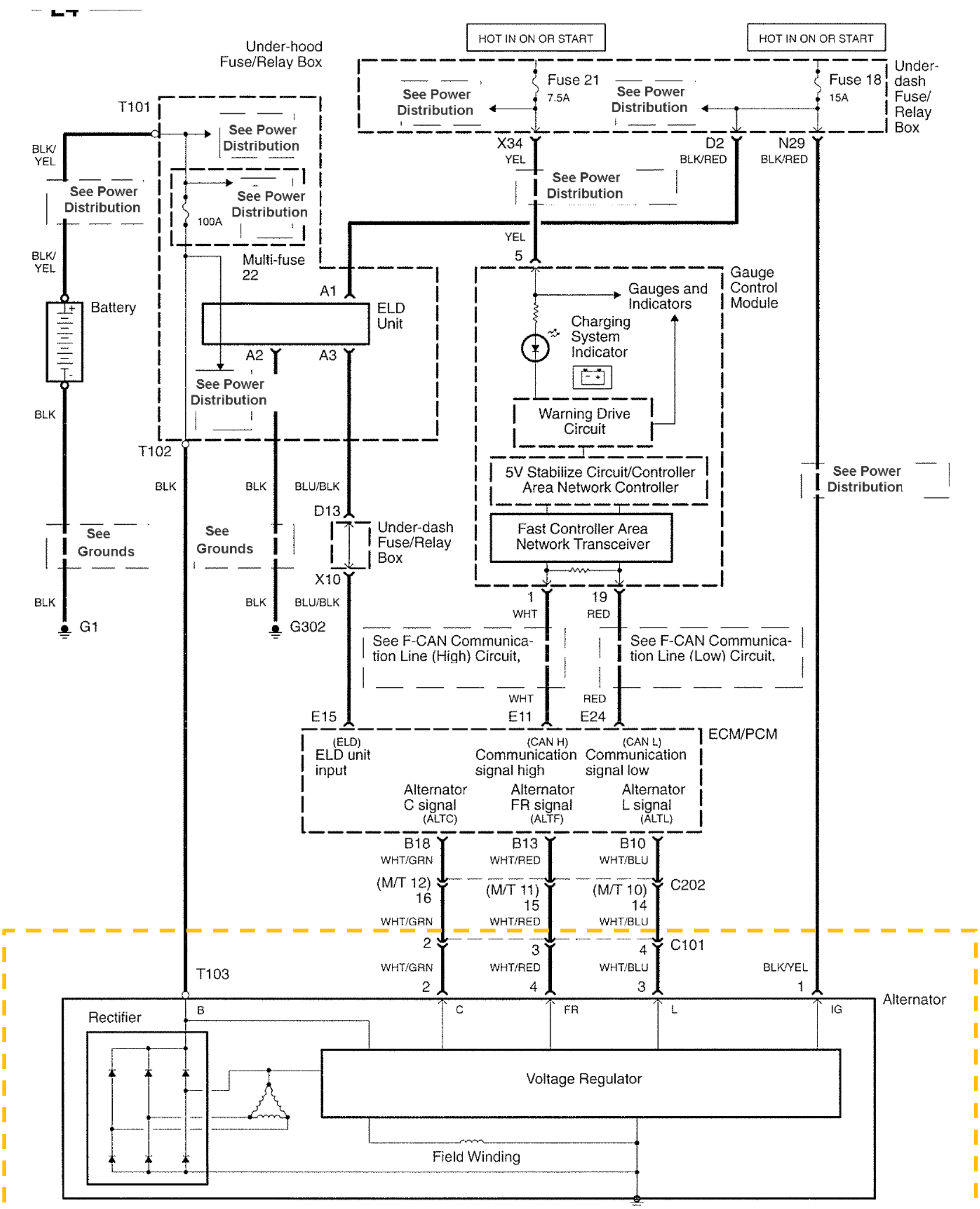
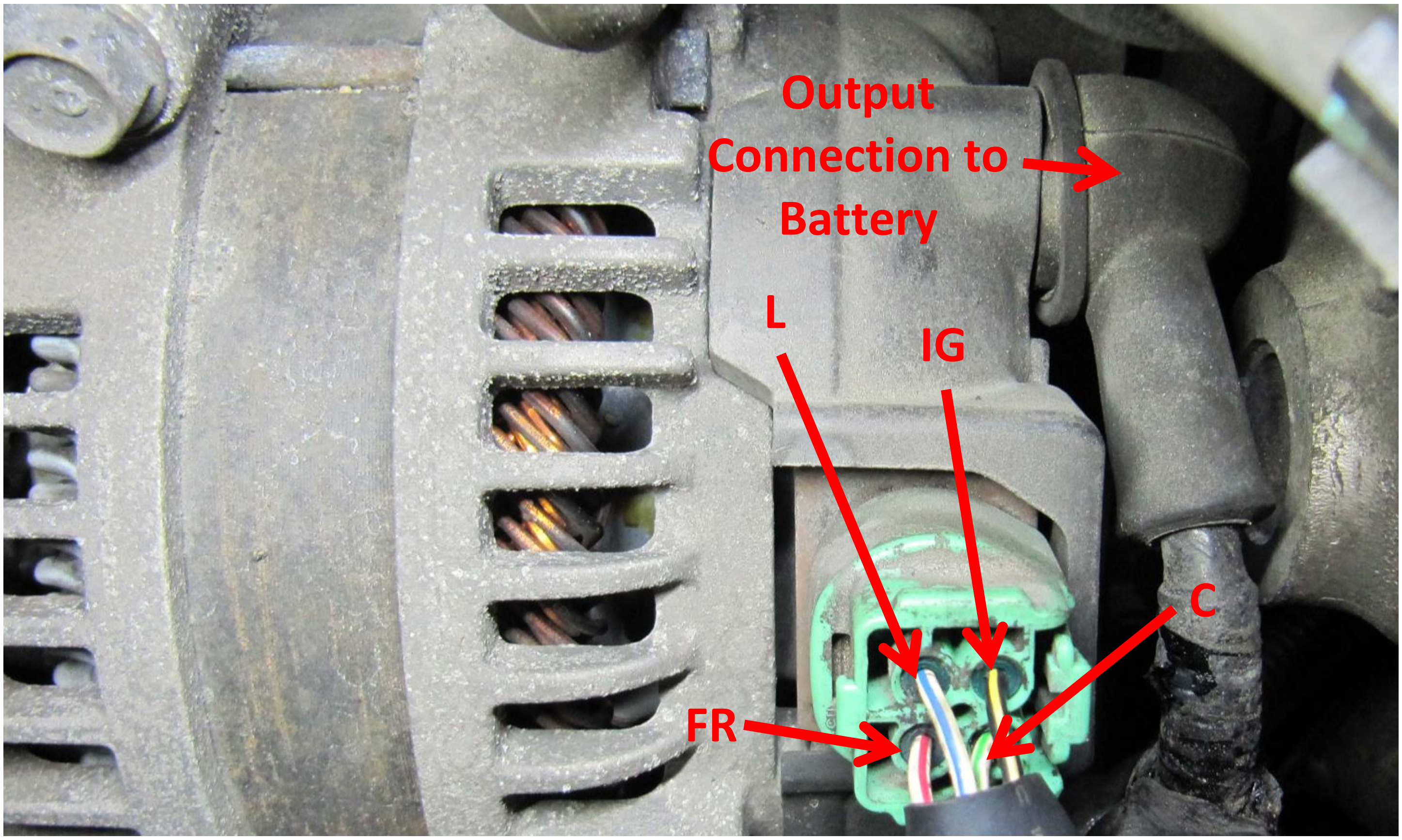
2007 4CYL Accord 2.4L
Alternator Signals and Known-Good Waveforms





IG = Keyed battery power supplied to the voltage regulator. Should be equal to battery voltage when Key is in the ON position and when engine is running.

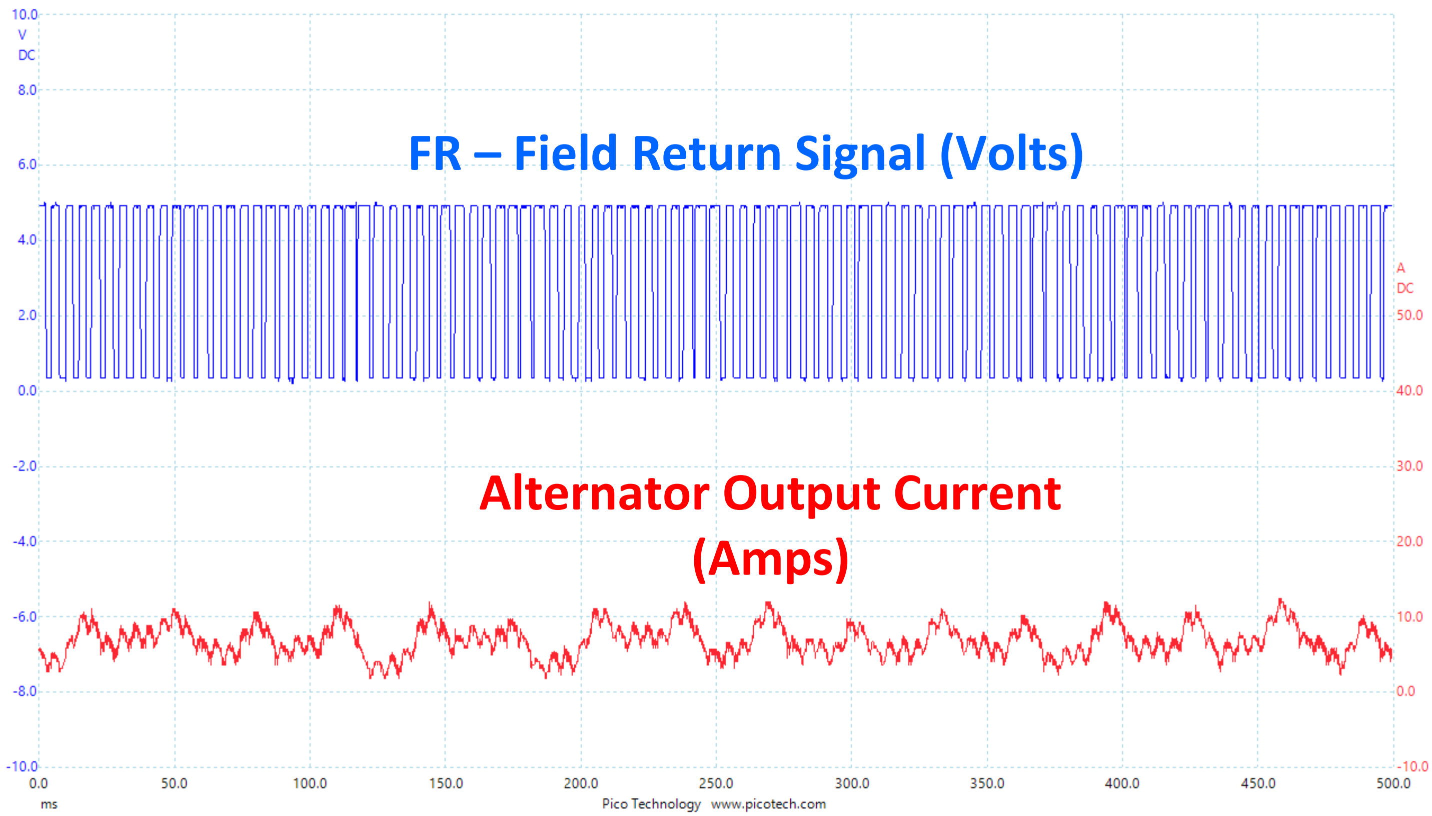
L = Lamp signal – When the alternator/voltage regulator detects a problem (no charging) the alternator forces this line to a low voltage. When the PCM sees a low voltage on this line, it lights the Charging System Indicator on the dash. With Key On Engine Off, the voltage on L should be low (near zero). With the engine running, the voltage should be at the battery voltage (if there is no fault condition in the alternator).

FR = Field Return signal. This signal provides information from the alternator to the PCM to indicate how hard the alternator is working (what percentage of capacity it is operating at). This signal is a 5V square wave output from the alternator that is low when the field/rotor winding (armature) is energized (current being driven through it). The more time the FR is low, the harder the alternator is working (the more output current). If the FR is continuously low, then the alternator is at its highest output. If the FR is continuously high, then the alternator is very lightly loaded. If you monitor the AVERAGE voltage on this pin with a multi-meter, it should vary from about 5V when the alternator is operating at 0% of its capacity to about 0.36V when the alternator is working at 100% of its capacity.

C = Alternator Control signal From PCM to Alternator – The voltage regulator in the alternator has two modes. If the control wire is high (~8V) then the alternator is placed in high output mode and maintains ~14.5V output. If the control wire is low (near 0V) then the alternator is placed in a low “maintenance” mode and maintains ~12.5V output. The low output mode is only commanded when a set of conditions is met (engine up to temperature, under a certain amount of electrical load, certain speeds, etc.) to increase efficiency. I never saw the PCM command “Low” mode when the engine was at idle, but “Low Output” mode was commanded during driving conditions. Under normal idle conditions, this pin should be at ~8V (I measured 7.6V typically). It should go low (near zero) when “Low Output Mode” is commanded.

Case 1 - Running at Idle, No loads Turned On

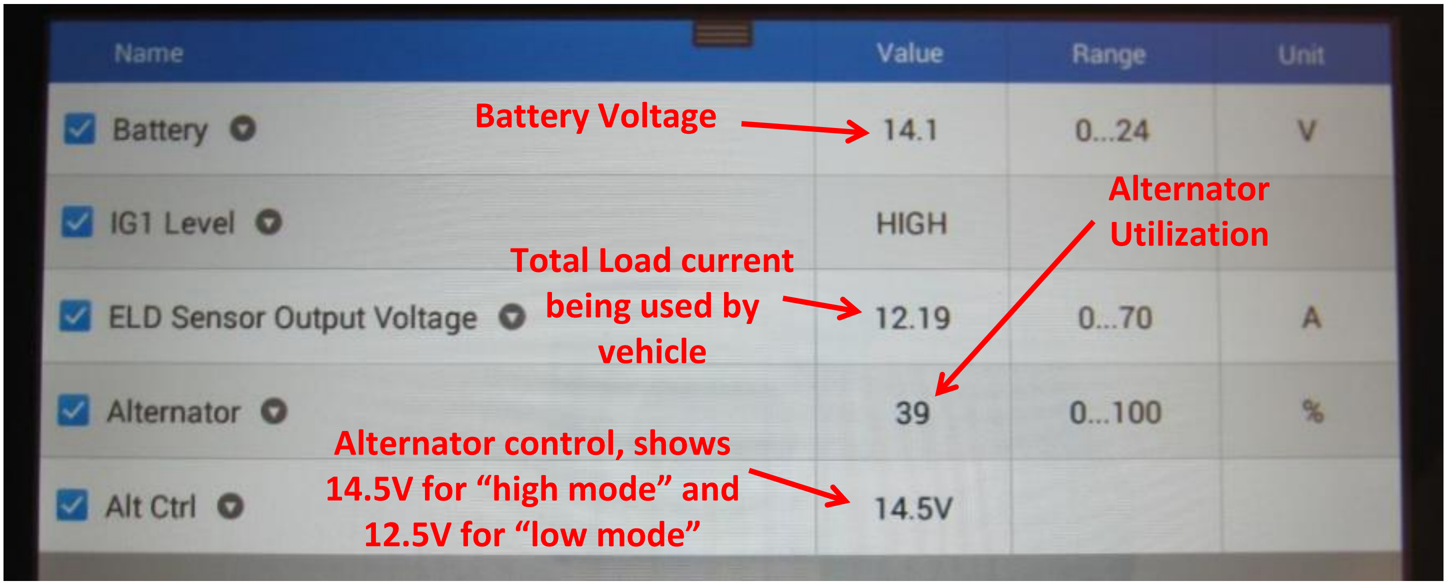
In this case, since the electrical load is low, the alternator output current is only about 7Amps average and the FR signal is low for only a relatively small fraction of time:



The average alternator output current is ~6.9Amps and the Duty Cycle (percentage of time that the FR signal is High) is 67%. This means that the FR signal is low (Alternator Field Current Turned ON) for 33% of the time (100%-67%=33%). Consequently, the alternator is working at 33% capacity in this case. Of course, the alternator output current is based on two factors: (a) the field current – as indicated by the FR signal and (b) engine/alternator speed. In other words, having the field on for 30% of the time at 3000RPM is going to produce a lot more output current than having the field on for 30% of the time when at idle (700 RPM or whatever).

Channel	Name	Value	Min	Max	Average	σ	Capture Count	Span
A	Duty Cycle	66.67 %	66.67 %	66.67 %	66.67 %	0.000 %	1	Whole trace
B	DC Average	6.896 A	6.896 A	6.896 A	6.896 A	0 A	1	Whole trace

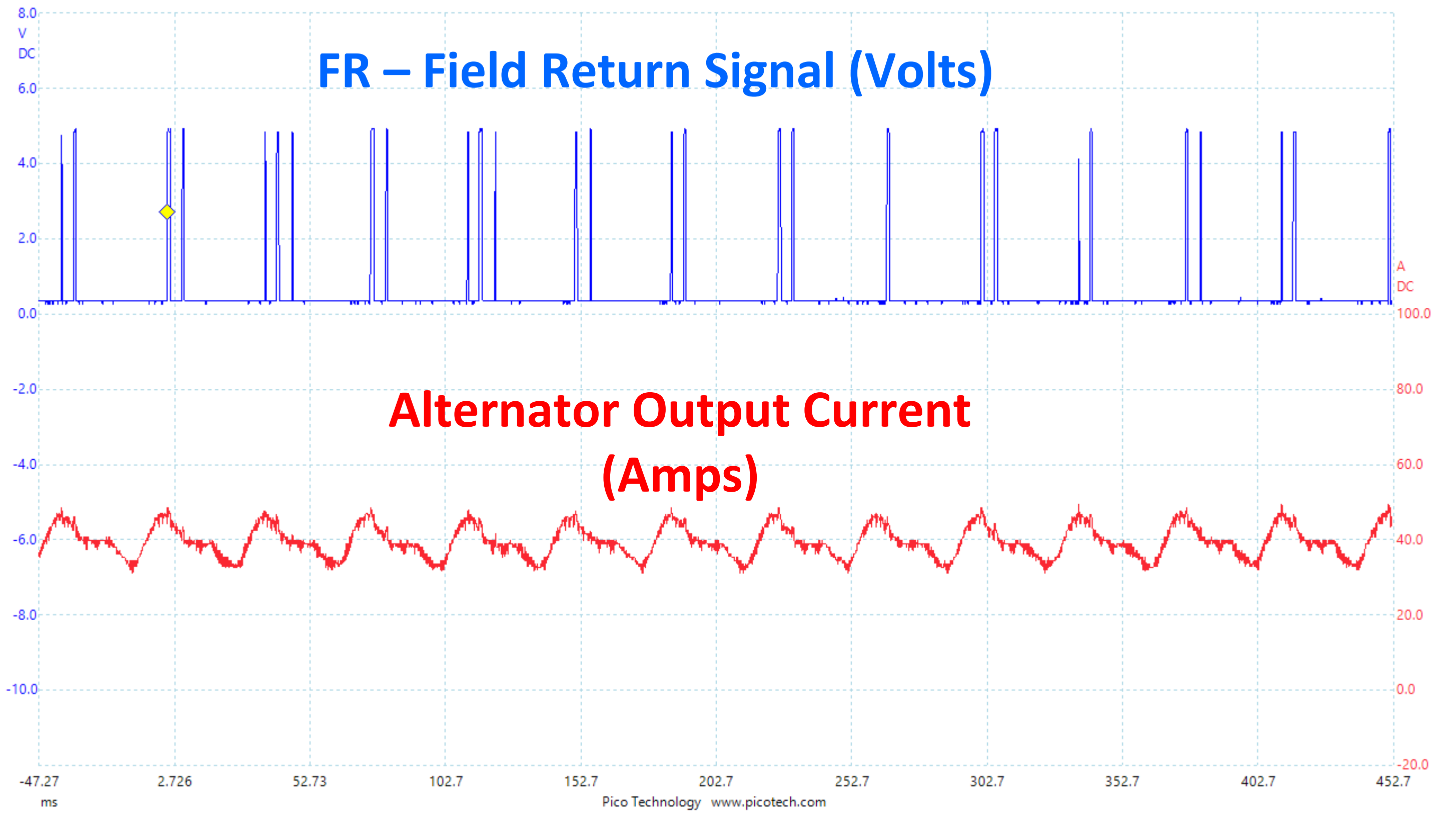
Under the same light load conditions, the scan tool shows reports 39% alternator utilization which is in rough agreement with the calculation above. The scan tool also shows a total electrical load of 12A being used by the vehicle:



If you don't have a scope, you can still monitor the alternator output using a multi-meter to measure the AVERAGE voltage on the FR line. For the light load case, I measured an average of 3.3V as shown below. Since 5V would be 0% alternator utilization and 0V would be 100% capacity, you can calculate the % alternator load as (1-3.3V/5V)*100% = 34%, which is in pretty good agreement with the value from the scope above.

Case 2 - Running at Idle, Heavy Load (AC, Blower, Rear Defrost, Headlights)

In this case, with a very heavy electrical load, the alternator is working at very high capacity. This is indicated by the fact that the FR is low most of the time (energizing the field in the armature) and the average alternator output current is about 40Amps.



The average alternator current is now 39.5Amps and the FR signal is high only 4.5% of the time, so it is low 95.5% of the time, indicating that the alternator is working at 95.5% of its full capacity.

Channel	Name	Value	Min	Max	Average	σ	Capture Count	Span
A	Duty Cycle	4.545 %	4.545 %	4.545 %	4.545 %	0.000 %	1	Whole trace
B	DC Average	39.53 A	39.53 A	39.53 A	39.53 A	0 A	1	Whole trace

For the same high load conditions, the ECU reports 93% utilization of the alternator as shown below. Note also that the battery voltage has dropped from 14.1V to 13.8V due to the high load and the ELD (Electronic Load Detector) shows 70A load current being used versus the 12A it showed under light load conditions.

Name	Value	Range	Unit
Battery	13.8	0...24	V
IG1 Level	HIGH		
ELD Sensor Output Voltage	68.82	0...70	A
Alternator	93	0...100	%
Alt Ctrl	14.5V		

Using a multi-meter to measure the average FR voltage shows 0.645V which corresponds to (1-0.645V/5V)*100% = 87%. But we can actually improve this measurement by noting that the FR signal actually doesn't go from 5V to 0V but rather from 5V to about 0.36V. So a more precise conversion that accounts for this is (1-(0.645-0.36)/(5-0.36))*100% = 94% which is in quite good agreement with the value calculated by the scope waveform and the value reported by the scan tool.