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Today's Charging Systems

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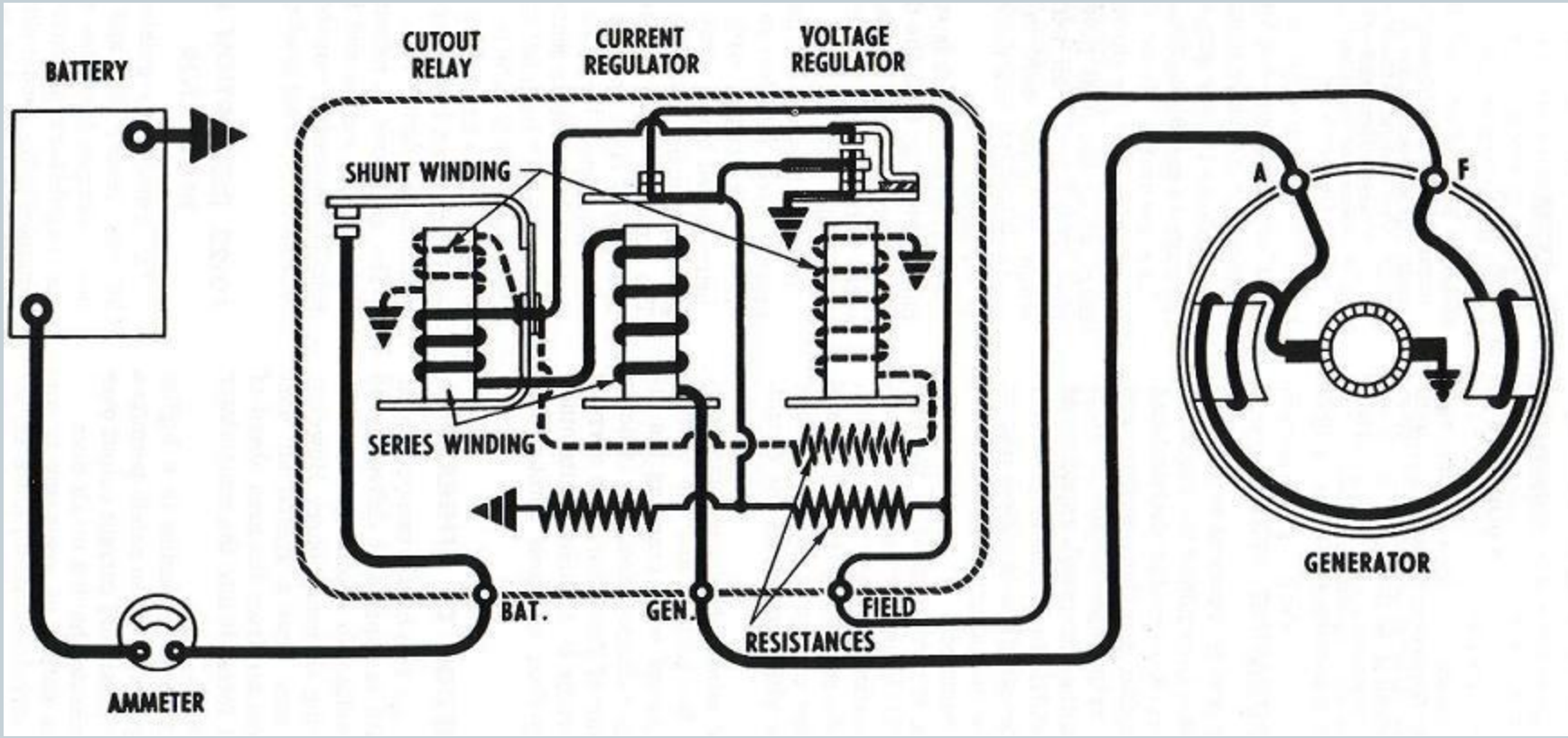
Today's Charging Systems

BY: OMAR TRINIDAD

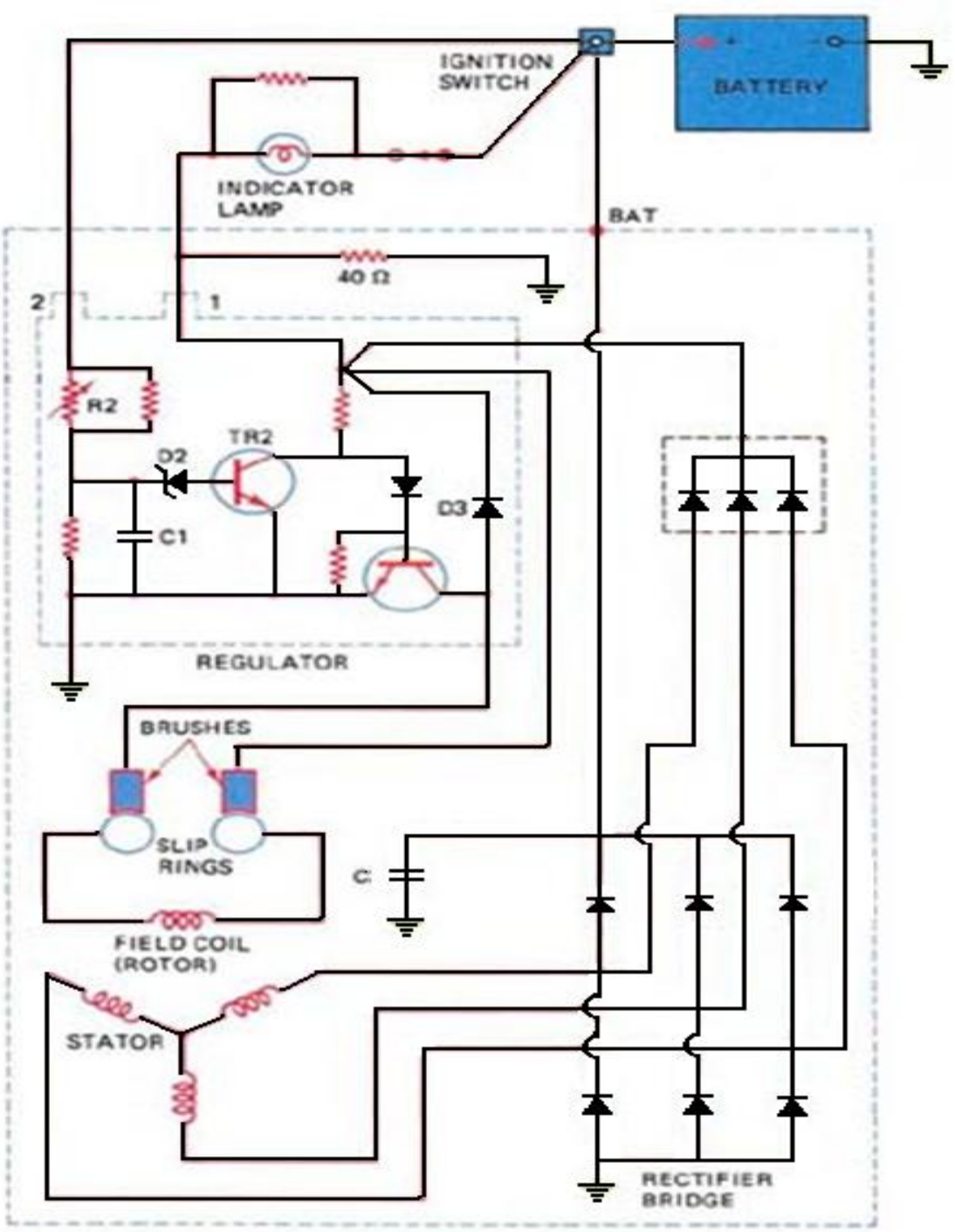
History

- Generator (Mechanically Regulated)



History

- GM-SI Alternator
- Electronically Regulated
- Temp Control



Charging Systems

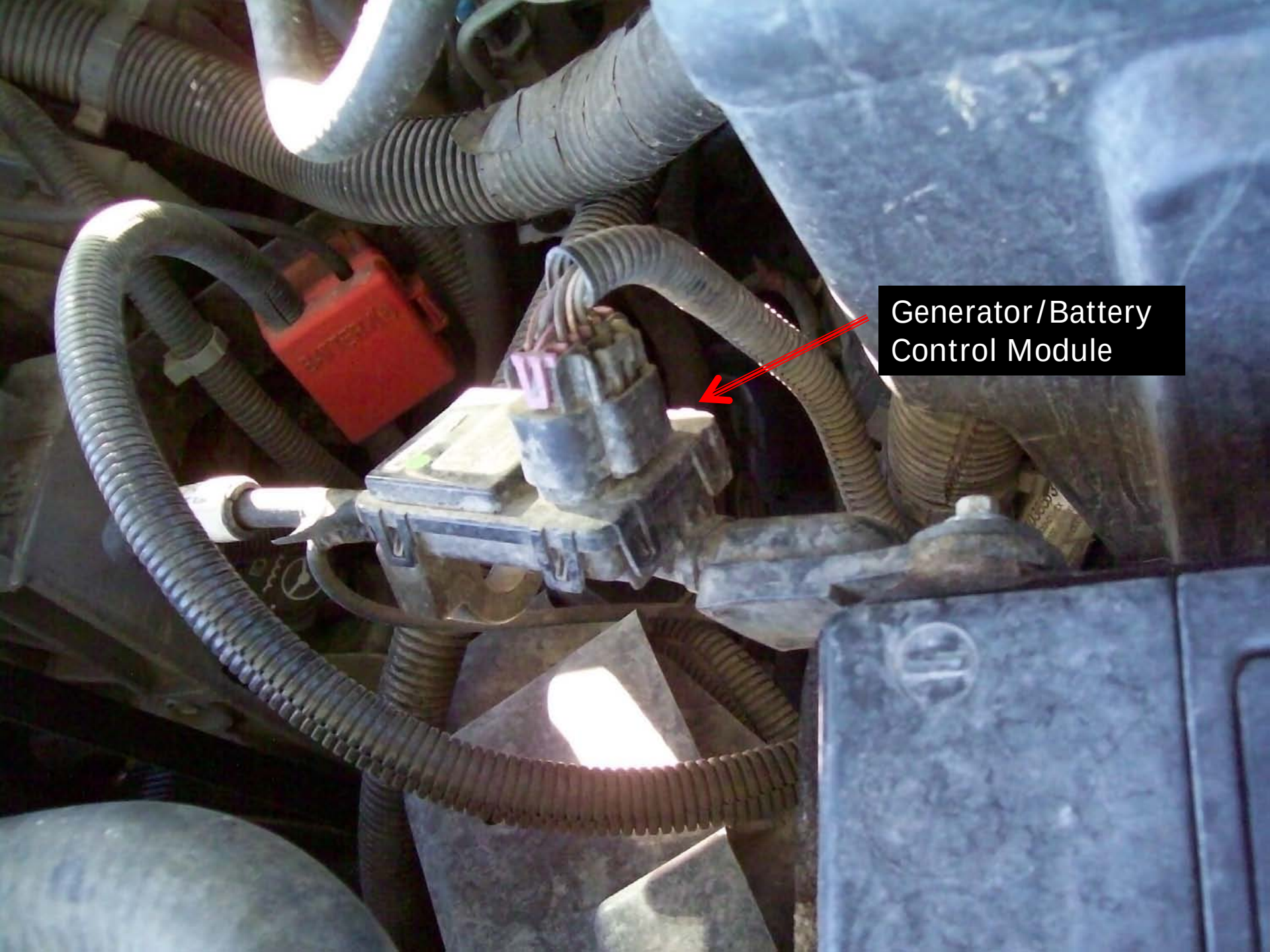
- 05-08 Chevy Suburban
- 01 Dodge Durango
- Honda & Acura

05-06 Chevy Suburban

- Generator/Battery Control Module
- 9 Modes
- Pulse Width Modulated
- Improves:
  - Alternator Effectiveness
  - Improve Battery Life
  - Improve Fuel Economy

Charging System

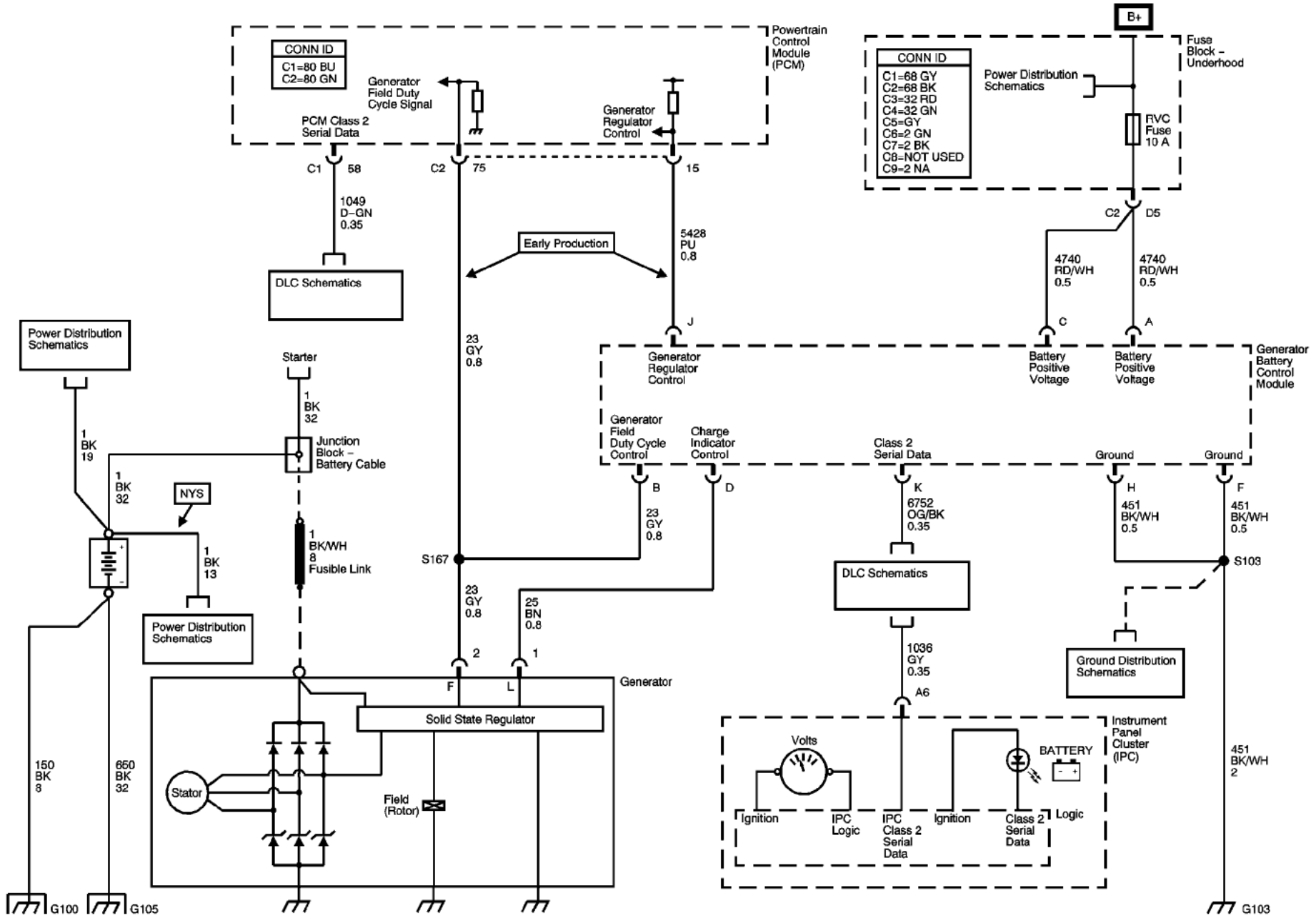
- Electrical Power Management System
  - Monitors Battery Voltage and Condition
  - Adjusts Regulated Voltage
  - Performs diagnostics and MIL
- Generator Battery Control Module
  - Communicates with the PCM and BCM
  - Controls generator field circuit
  - Monitors generator field duty cycle and battery voltage
  - 13.8 V Default
  - Negative Battery Cable


Generator/Battery
Control Module

Powertrain Control Module

- Inputs:
  - Intake Air Temperature
  - Fuel Grams Per Second
  - Throttle Position
  - Engine Coolant Temperature
  - Ambient Air Temperature

Charging – except L18 or NYS



Charging Modes

- 9 Charging Modes
- Based on PCM Parameters and Battery Condition
- Controlled by the Generator/Battery Control Module
- Pulse Width Modulated at 126 Hz +/- 5%
- Duty cycle limited to 5-99%
- 100% Duty cycle with communication problems

Charging Modes

- Charge Mode
- Fuel Economy Mode
- Voltage Reduction Mode
- Start Up Mode
- Headlamp Mode
- Battery Sulfation Protection Mode
- Windshield Wiper Voltage Boost Mode
- Fuel Pump Voltage Boost Mode
- De-Ice Voltage Boost Mode

Charge Mode

- Baseline
- At least one condition met:
  - Cooling fans are on high speed
  - Rear defogger is ON.
  - Battery state is less than 80%
  - The battery current is not between -8 and 15 amps
  - Ambient air temperature less than 32◦ F
  - DTC B1516 is set (battery current sensor out of range)
- Output voltage: 13.9-15.5V
  - Based on battery temperature

Fuel Economy Mode

- All of the conditions are met:
  - Ambient air temperature is greater than 32◦ F
  - Battery Current is less than 15 amperes
  - 80% state of charge
  - Rear defoggers turned OFF
  - Cooling fans are on low speed or OFF.
- Output voltage: 13V

Voltage Reduction Mode

- Ambient air temperature is above 32◦ F
- Battery current is less than 2 amperes
- Generator field cycle is less than 99%
- Rear defoggers OFF
- Cooling fans low speed or OFF
- Output voltage: 12.9V

Other Modes

- Start-Up Mode
  - Charges at 14.5 V for 30 seconds after start-up
- Headlamp Mode
  - Charges at 14.5V when the low or high beams are ON
- Battery Sulfation Mode
  - If charging voltage is less than 13.2 V for 45 minutes
  - Charge Mode for 3 minutes
- Windshield Wiper Voltage Boost Mode
  - Charges at 14.5V after the wipers have been on for 8 seconds

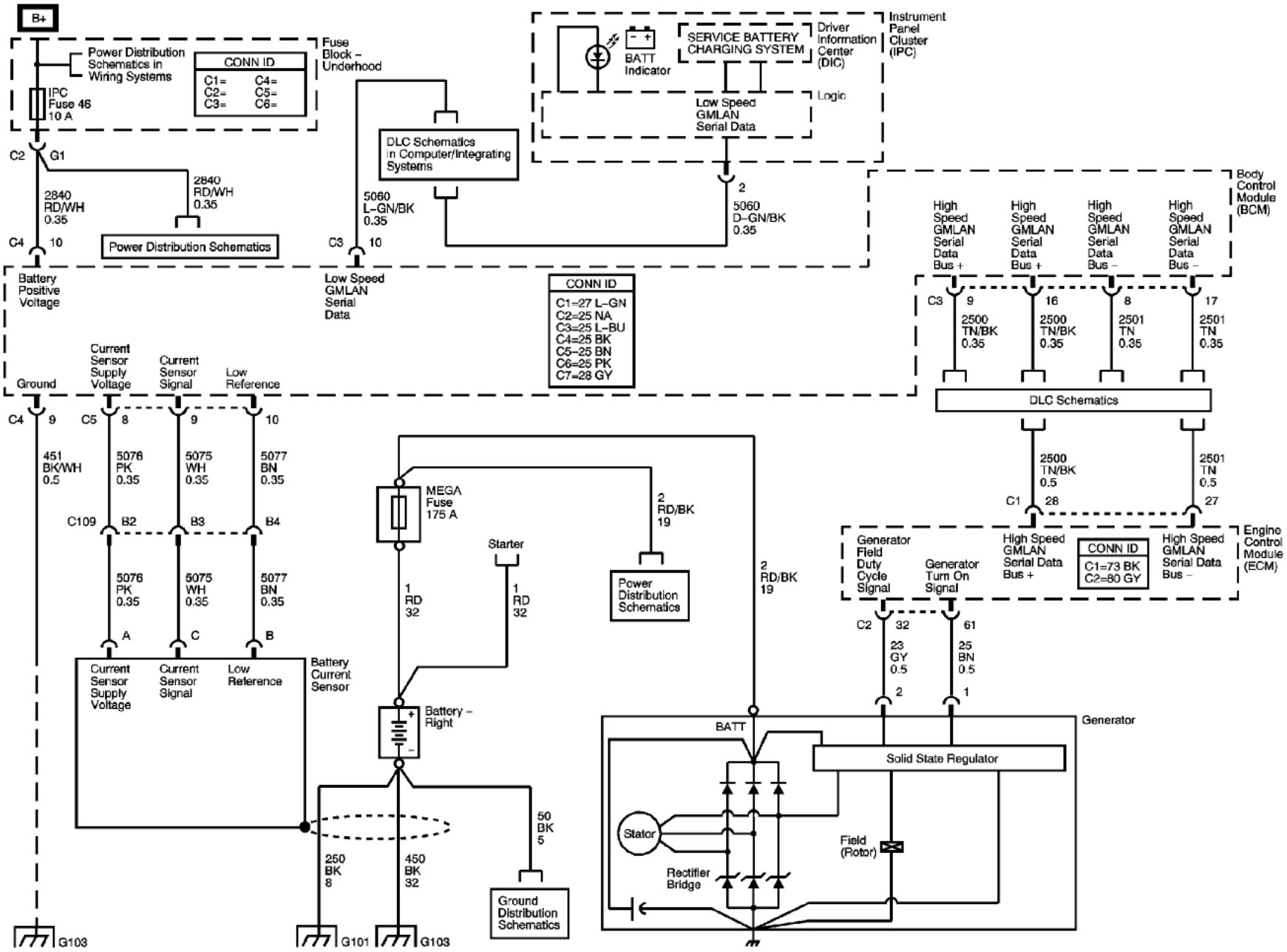
Other Modes

- Fuel Pump Voltage Boost Mode
  - If fuel flow is greater than 21K grams/second and the TPS is greater than 90%
  - Change from Fuel Economy or Voltage reduction Mode to Charging at 13.4V
  - If fuel flow is less than 5K grams/ second the charging system will go back to Charge, Fuel Economy, or Voltage Reduction Mode.
- De-Ice Voltage Boost Mode
  - If ambient air temperature is less than 28.4 ◦F and the ECT is less than 167 ◦F
  - Will enter into Charge Mode 13.9-15.5V

Newer Models

- PCM controls generator field circuit
- BCM monitors Battery Current Sensor
- 6 Charging Modes
  - Charge Mode
  - Voltage Reduction Mode
  - Fuel Economy Mode
  - Battery Sulfation Mode
  - Start Up Mode
  - Headlamp Mode

Charging

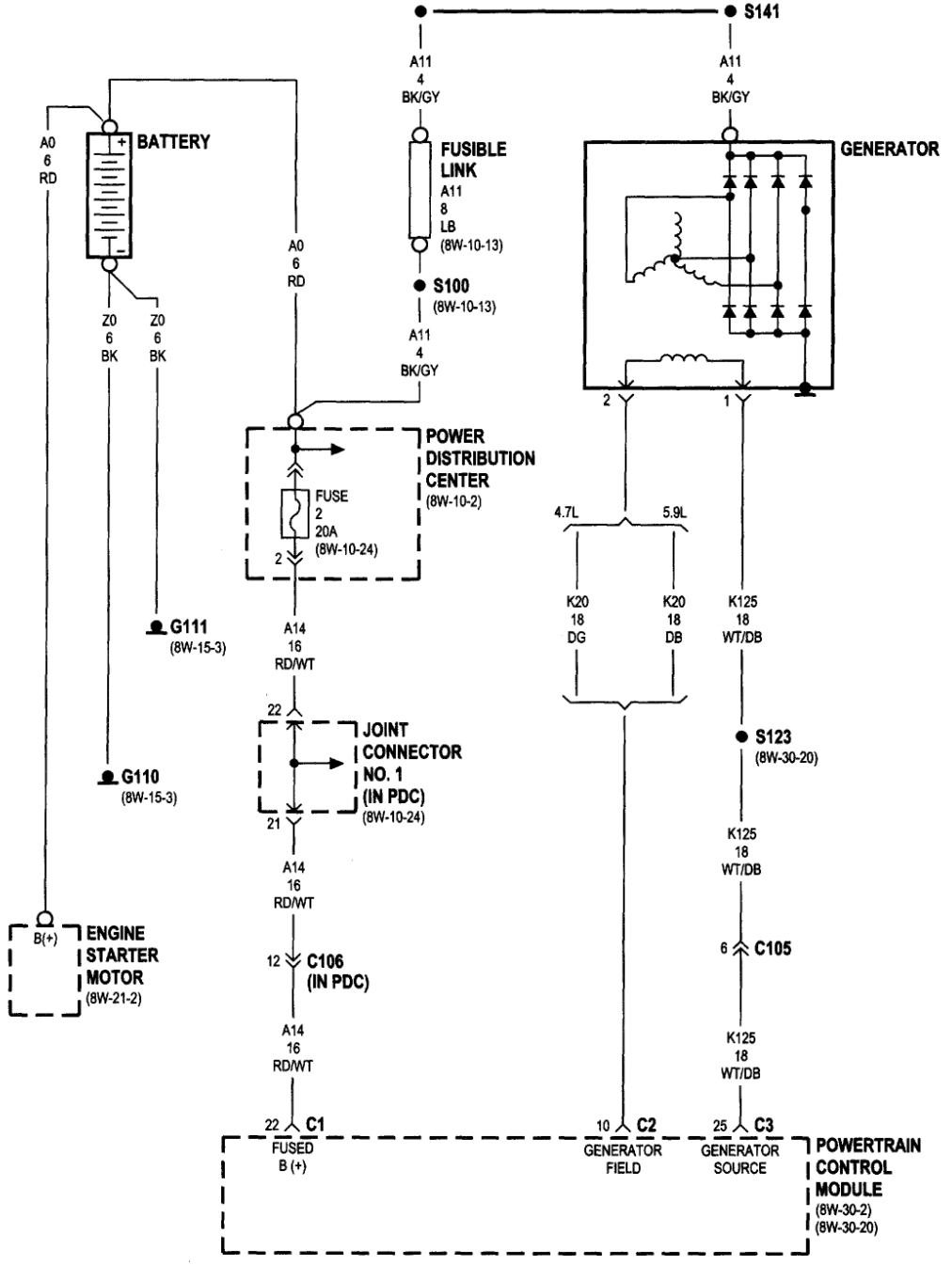

B+
Power Distribution Schematics in Wiring Systems
IPC Fuse 46 10 A
CONN ID
C1= C4=
C2= C5=
C3= C6=
Fuse Block – Underhood
C2
G1
2840 RD/WH 0.35
2840 RD/WH 0.35
C4
10
Power Distribution Schematics
DLC Schematics in Computer/Integrating Systems
5060 L–GN/BK 0.35
C3
10
BATT Indicator
SERVICE BATTERY CHARGING SYSTEM
Driver Information Center (DIC)
Instrument Panel Cluster (IPC)
Logic
Low Speed GMLAN Serial Data
2
5060 D–GN/BK 0.35
Body Control Module (BCM)
High Speed GMLAN Serial Data Bus +
High Speed GMLAN Serial Data Bus +
High Speed GMLAN Serial Data Bus –
High Speed GMLAN Serial Data Bus –
C3
9
16
8
17
2500 TN/BK 0.35
2500 TN/BK 0.35
2501 TN 0.35
2501 TN 0.35
DLC Schematics
2500 TN/BK 0.5
2501 TN 0.5
C1
28
27
Battery Positive Voltage
Low Speed GMLAN Serial Data
CONN ID
C1=27 L–GN
C2=25 NA
C3=25 L–BU
C4=25 BK
C5=25 BN
C6=25 PK
C7=28 GY
Ground
Current Sensor Supply Voltage
Current Sensor Signal
Low Reference
C4
9
C5
8
9
10
451 BK/WH 0.5
5076 PK 0.35
5075 WH 0.35
5077 BN 0.35
C109
B2
B3
B4
5076 PK 0.35
5075 WH 0.35
5077 BN 0.35
A
C
B
Current Sensor Supply Voltage
Current Sensor Signal
Low Reference
Battery Current Sensor
MEGA Fuse 175 A
2 RD/BK 19
Starter
1 RD 32
1 RD 32
Power Distribution Schematics
2 RD/BK 19
Battery – Right
250 BK 8
450 BK 32
50 BK 5
Ground Distribution Schematics
G103
G101
G103
Generator Field Duty Cycle Signal
Generator Turn On Signal
High Speed GMLAN Serial Data Bus +
CONN ID
C1=73 BK
C2=80 GY
High Speed GMLAN Serial Data Bus –
Engine Control Module (ECM)
C2
32
61
23 GY 0.5
25 BN 0.5
2
1
BATT
Generator
Solid State Regulator
Stator
Field (Rotor)
Rectifier Bridge

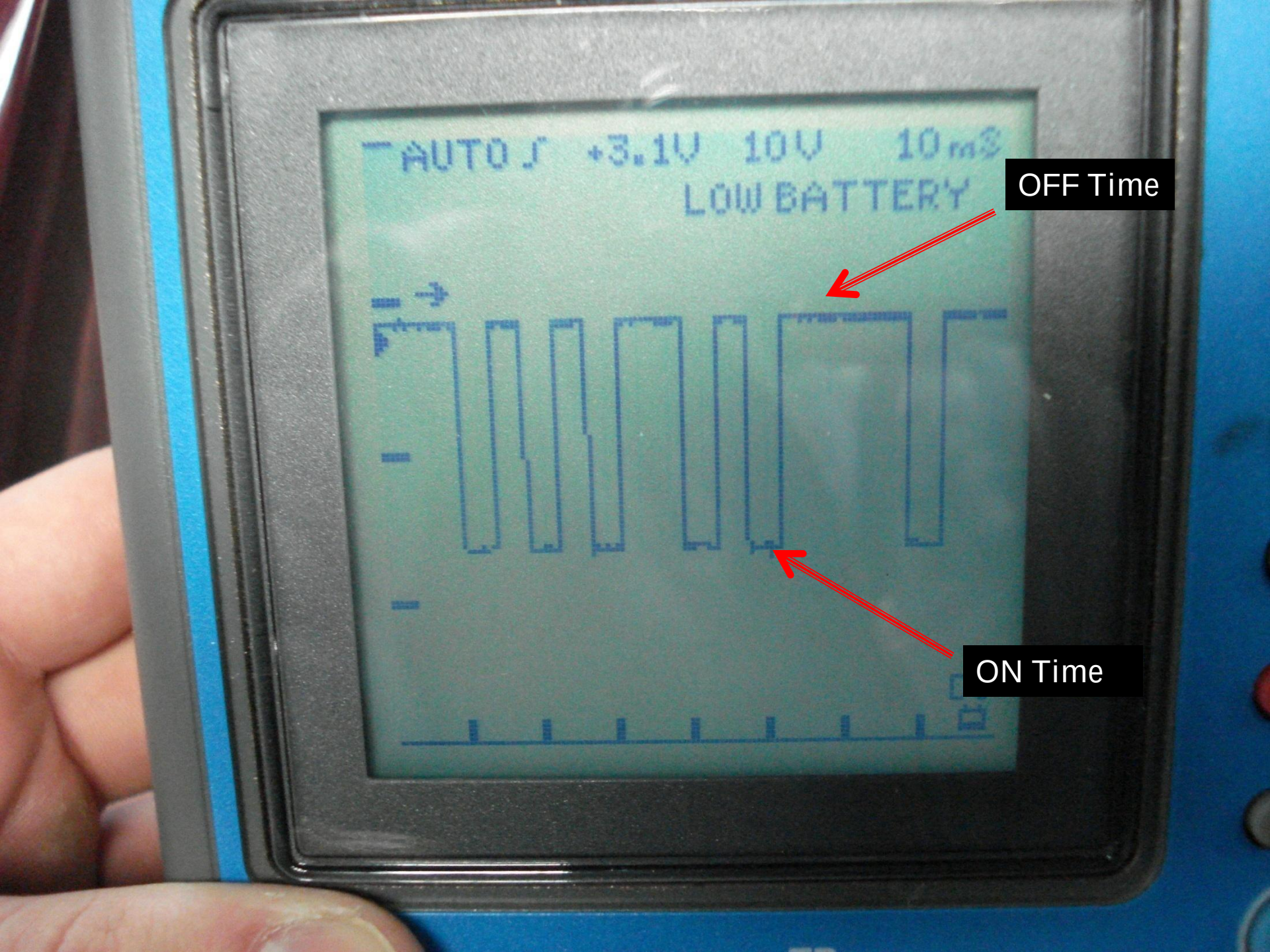
01 Dodge Durango

- PCM controlled
- Battery Temperature Sensor

98-02

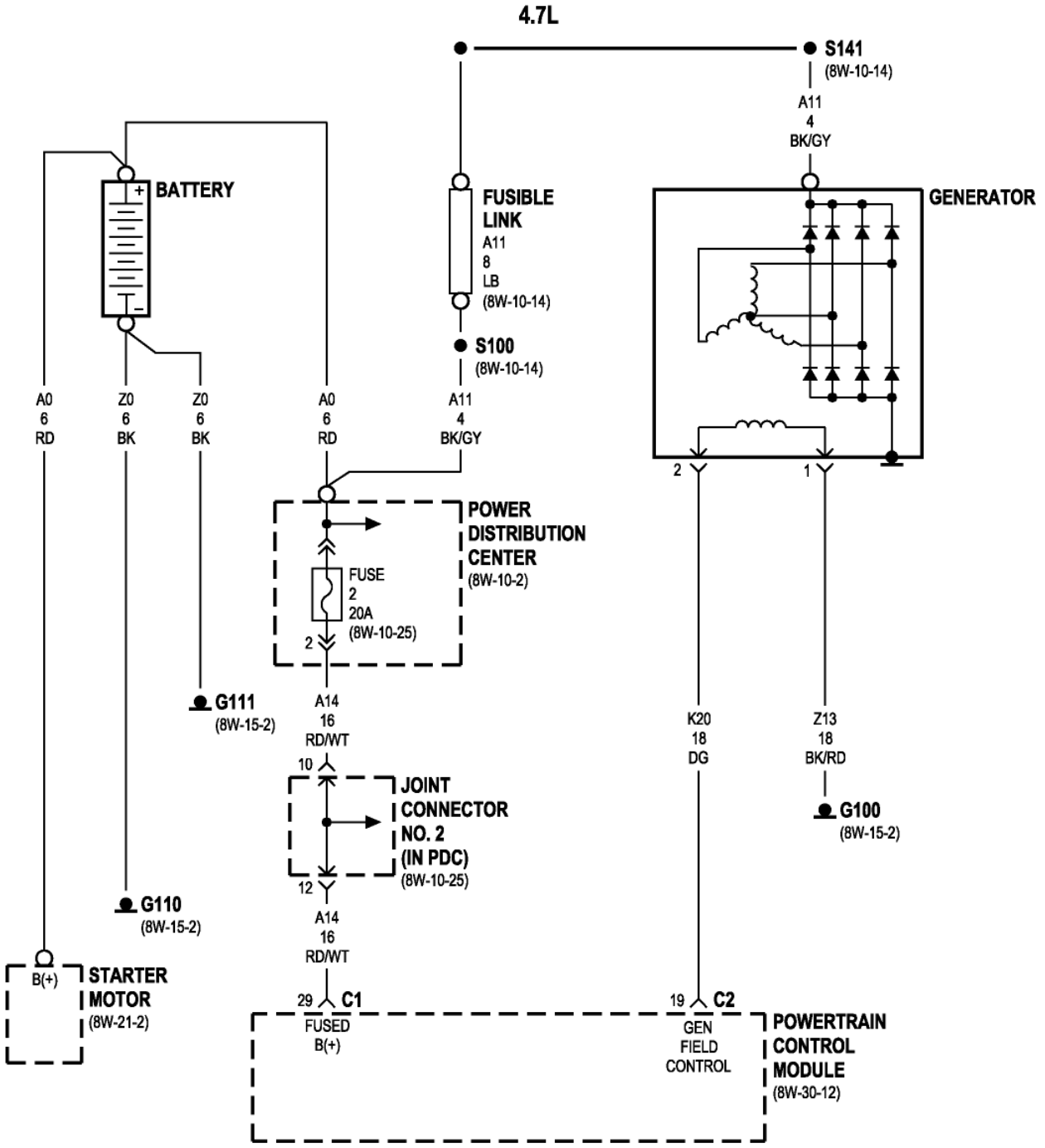
- Ground Controlled

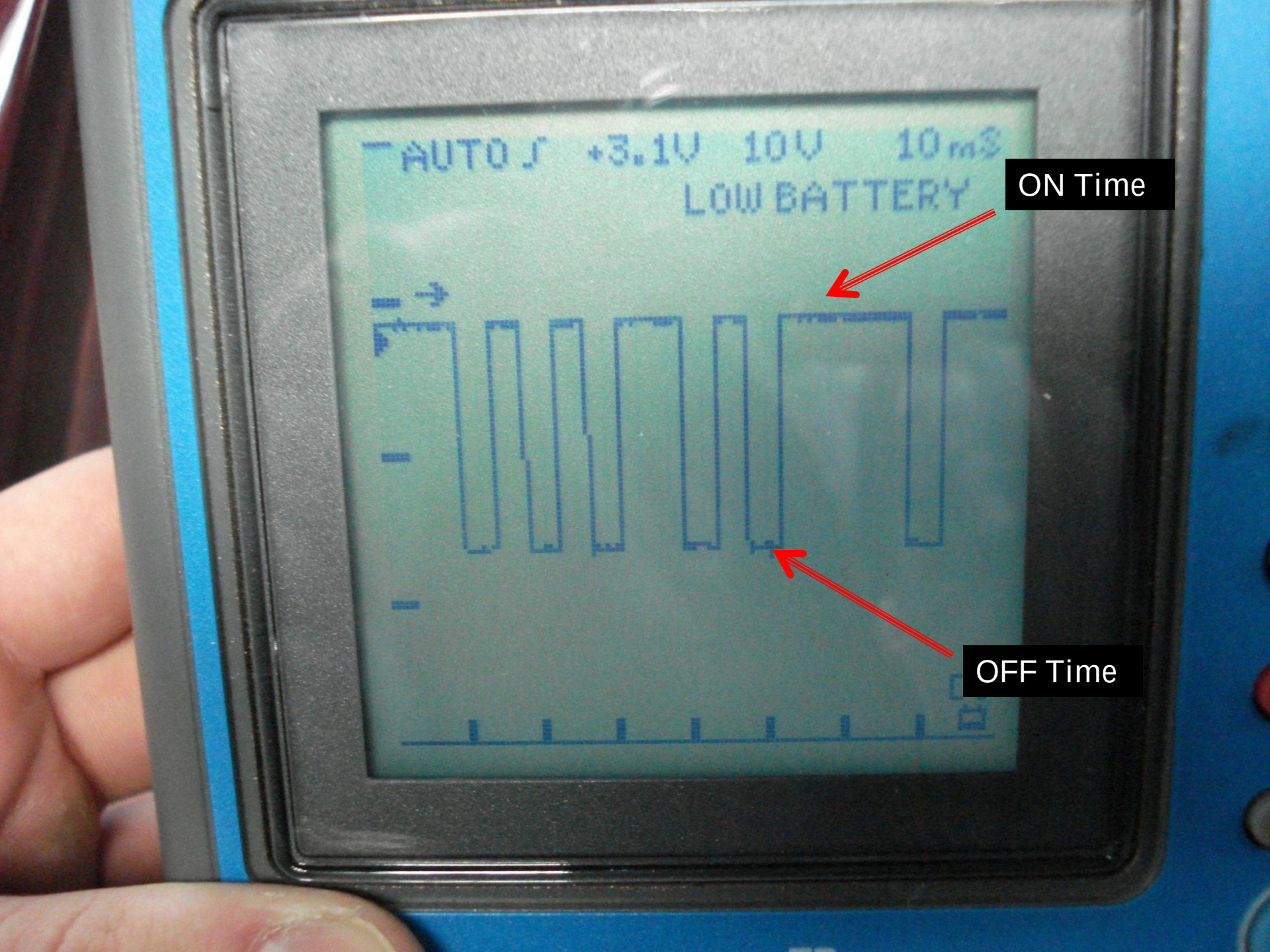



AUTO ∫ +3.1V 10V 10mS
LOW BATTERY
OFF Time
ON Time

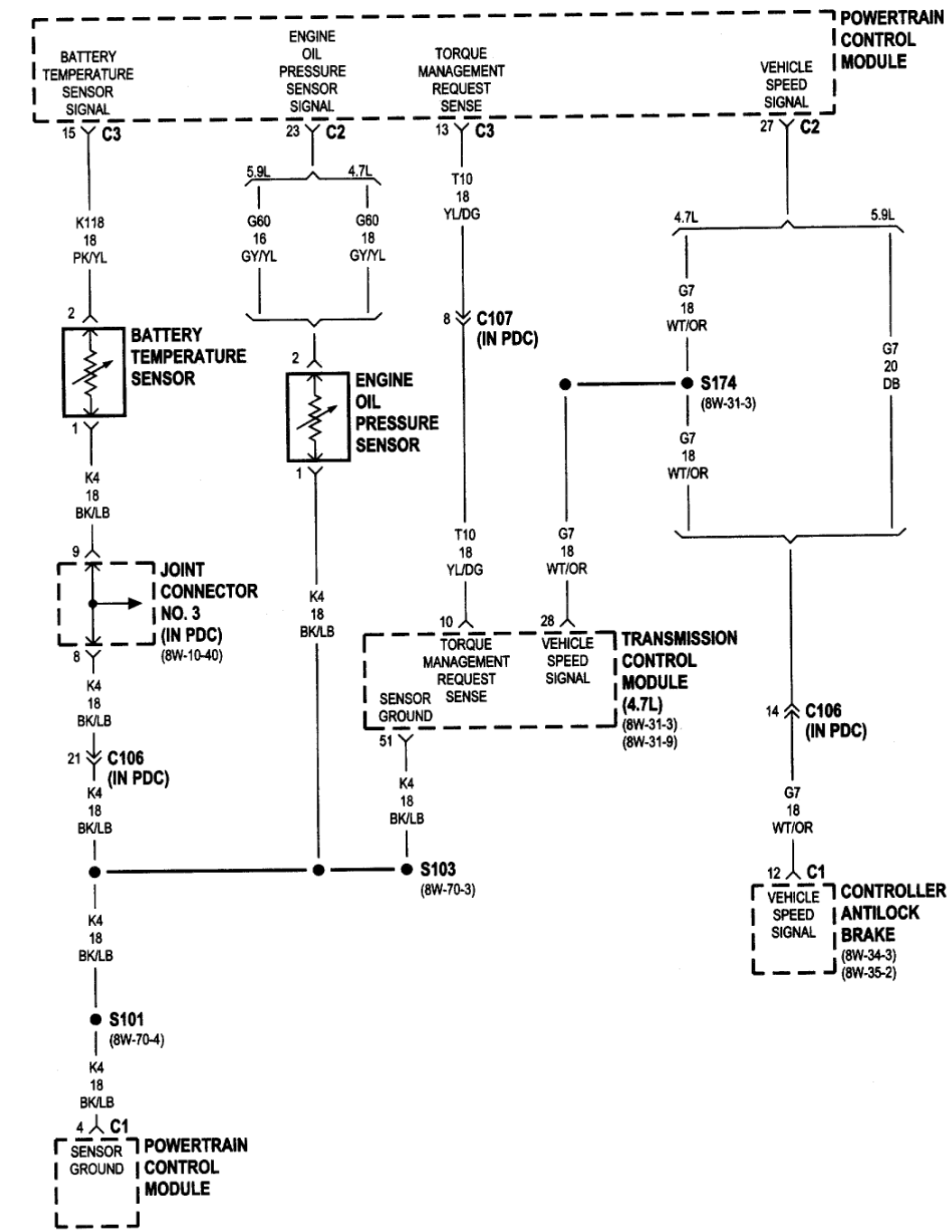
03-08

- Power-side Controlled

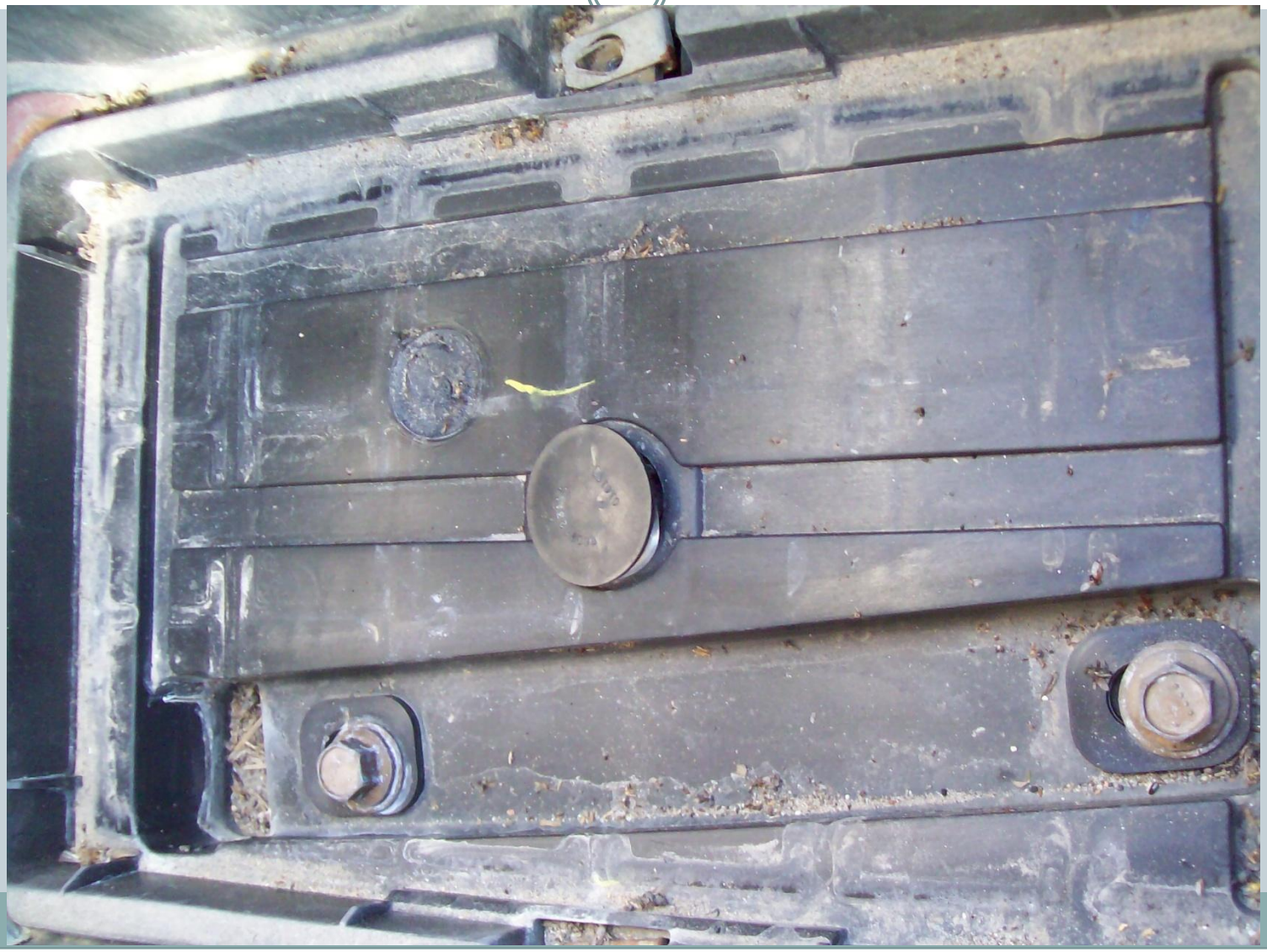



AUTO ∫ +3.1V 10V 10mS
LOW BATTERY
ON Time
OFF Time

Battery Temp



Battery Tray



Battery Temperature Sensor

- Input to the PCM
- PCM Controls Charging Voltage
- Colder Higher Charge
- Warmer Lower Charge
- Thermistor
- Increases Resistance as Temperature Decreases

Temperature/Charging

- 100 F 13.70V
- 90 F 13.77V
- 80 F 13.83V
- 70 F 13.96V
- 60 F 14.10V
- 50 F 14.22V
- 40 ◦F 14.34V
- 30 ◦F 14.40V
- 20 ◦F 14.51V
- 6 ◦F 14.70V
- -7 ◦F 14.76V
- Default
  - 89.6 F 13.84V

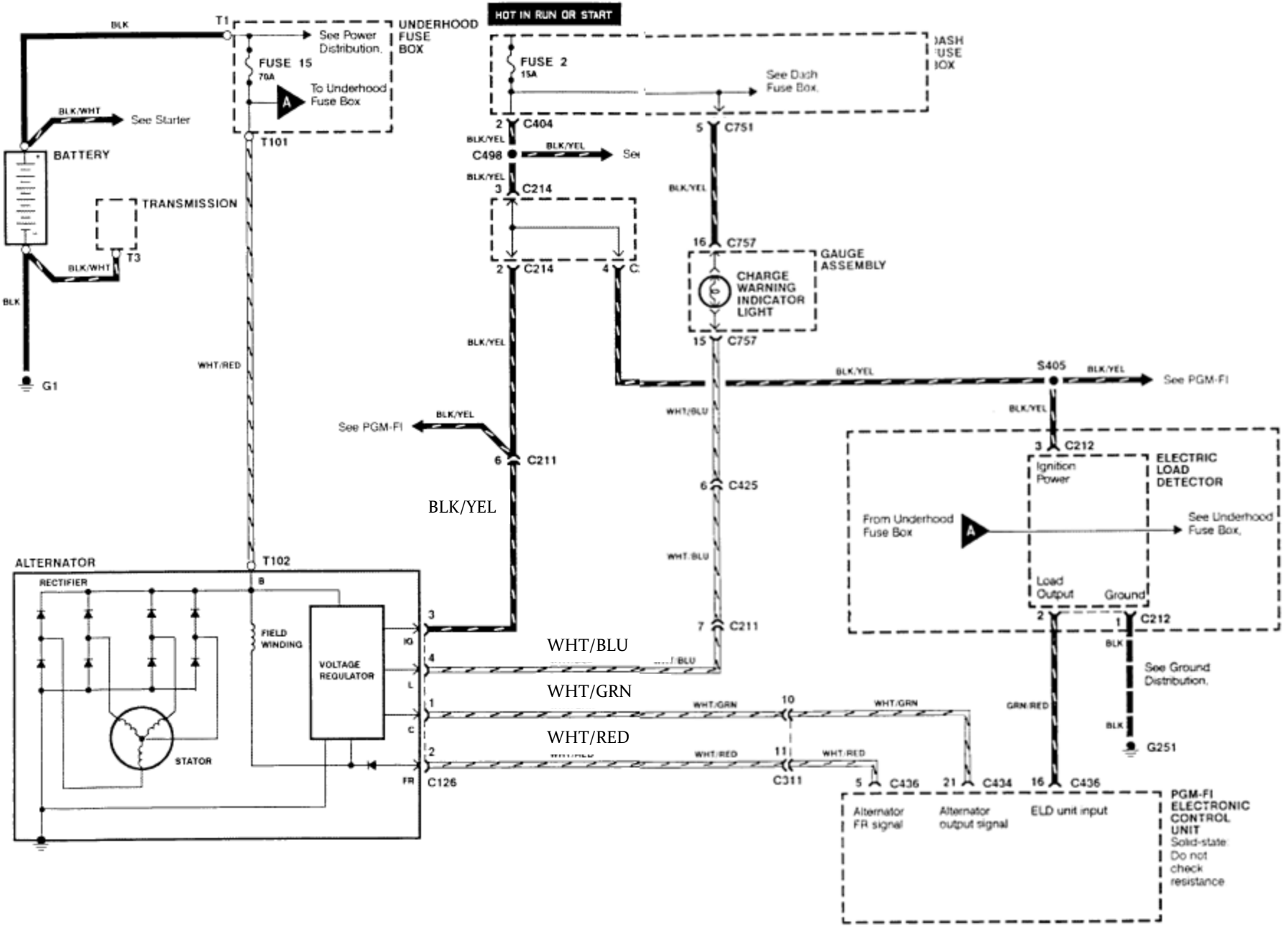
DTC Battery Sensor Shorted

DTC Battery Sensor Open

Honda's Charging System

- Two Charging Modes
  - PWM Regulated
  - Electric Load Detector
- Improves Fuel Economy
- Consistent in Most Honda and Acura

Honda Accord 1990



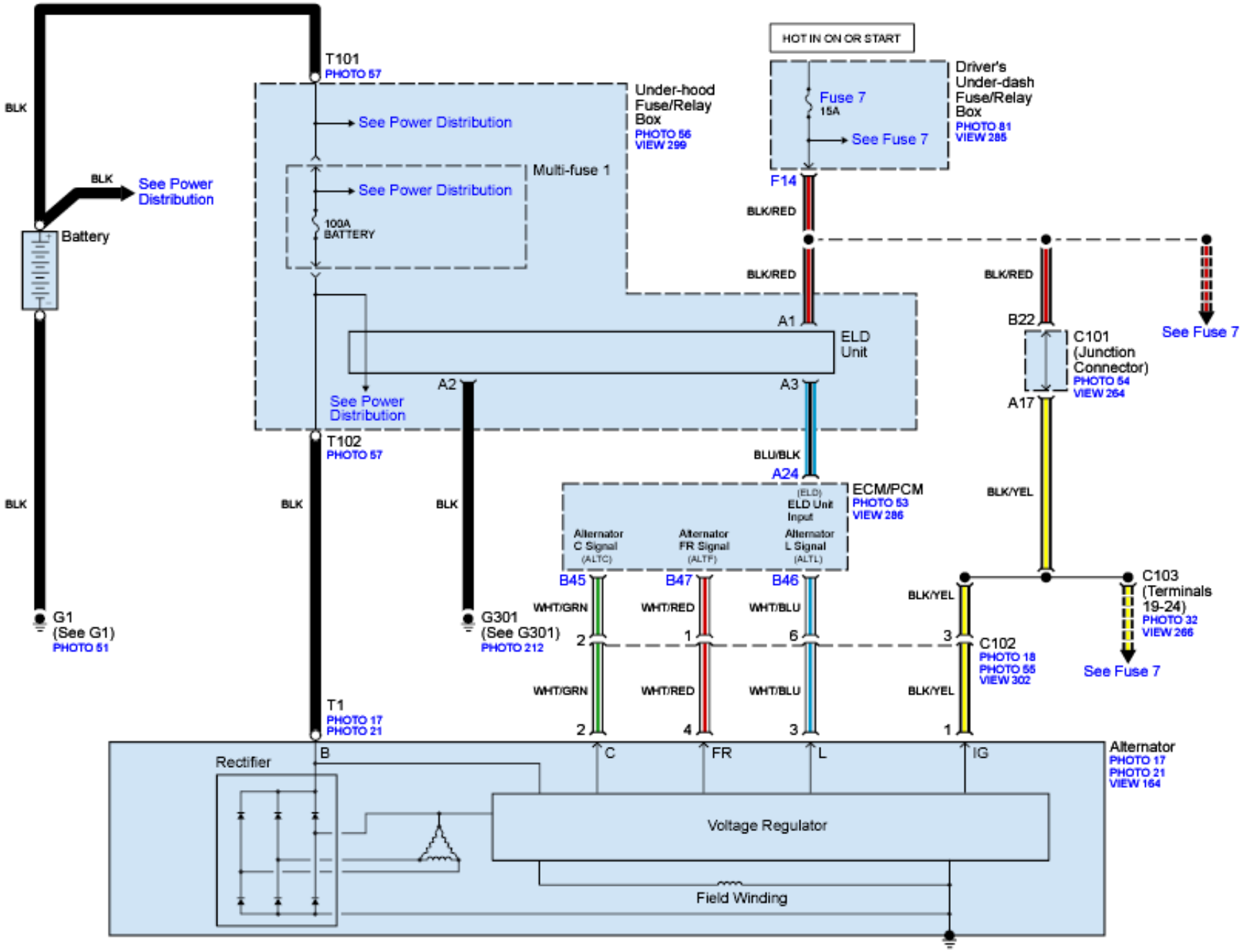
BLK/YEL

WHT/BLU

WHT/GRN

WHT/RED

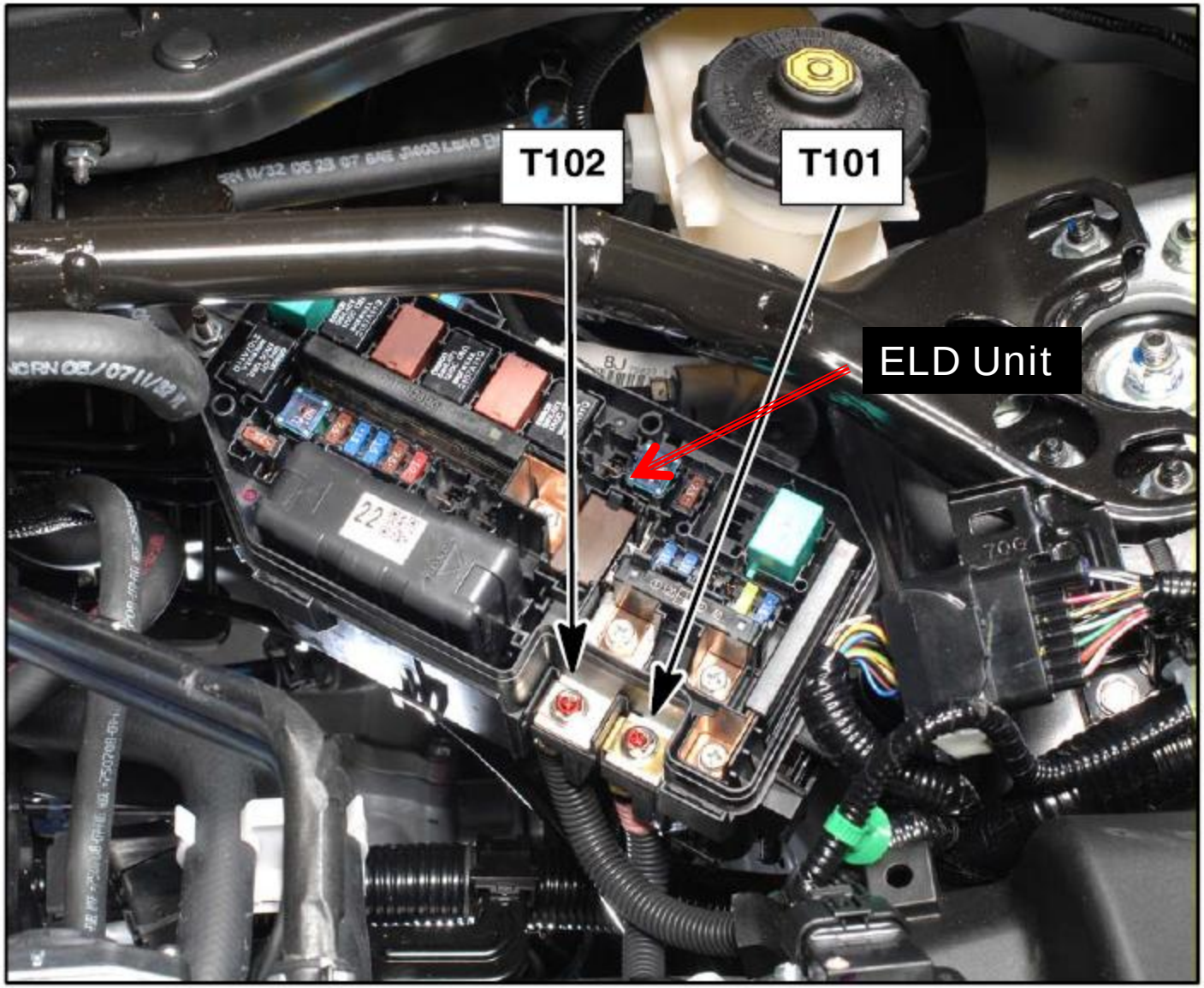
2008 Honda Accord


HOT IN ON OR START
T101
PHOTO 57
Under-hood Fuse/Relay Box
PHOTO 56
VIEW 299
See Power Distribution
Multi-fuse 1
See Power Distribution
100A BATTERY
BLK
See Power Distribution
Battery
Driver's Under-dash Fuse/Relay Box
PHOTO 81
VIEW 285
Fuse 7
15A
See Fuse 7
F14
BLK/RED
BLK/RED
A1
ELD Unit
A2
A3
See Power Distribution
T102
PHOTO 57
BLU/BLK
A24
ECM/PCM
PHOTO 53
VIEW 286
(ELD) ELD Unit Input
Alternator C Signal (ALTC)
Alternator FR Signal (ALTF)
Alternator L Signal (ALTL)
B45
B47
B46
WHT/GRN
WHT/RED
WHT/BLU
2
1
6
BLK
BLK
BLK
G1
(See G1)
PHOTO 51
G301
(See G301)
PHOTO 212
T1
PHOTO 17
PHOTO 21
B22
C101
(Junction Connector)
PHOTO 54
VIEW 264
A17
BLK/RED
BLK/YEL
See Fuse 7
C103
(Terminals 19-24)
PHOTO 32
VIEW 266
See Fuse 7
BLK/YEL
3
C102
PHOTO 18
PHOTO 55
VIEW 302
WHT/GRN
WHT/RED
WHT/BLU
BLK/YEL
2
4
3
1
Rectifier
B
C
FR
L
IG
Alternator
PHOTO 17
PHOTO 21
VIEW 164
Voltage Regulator
Field Winding

Components

- Alternator
- Electric Load Detector (ELD)
- Powertrain Control Module (PCM)
- Ignition Switch
- Battery
- Indicator Lamp
- Wiring harness and connections

2008 Civic SI



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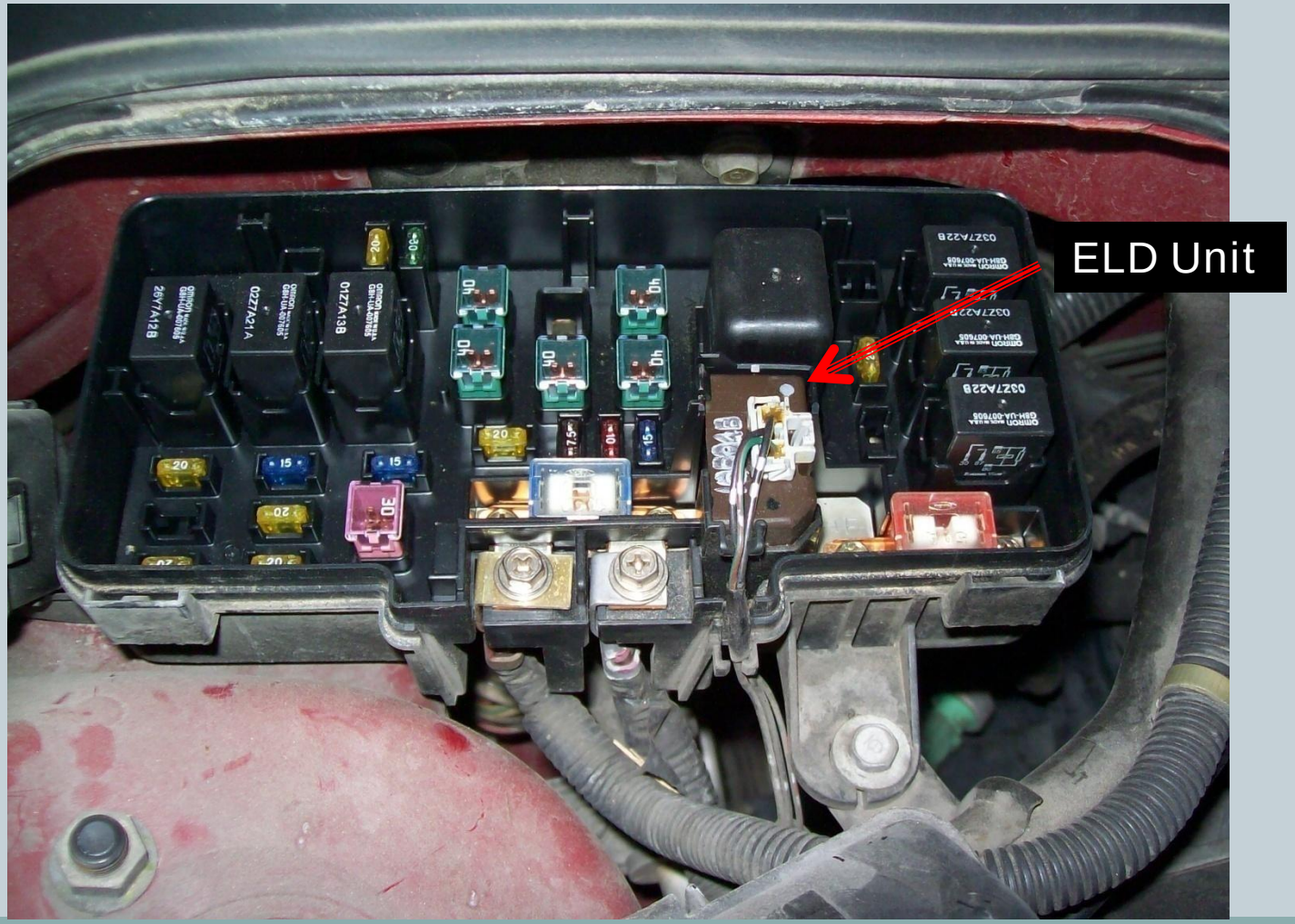
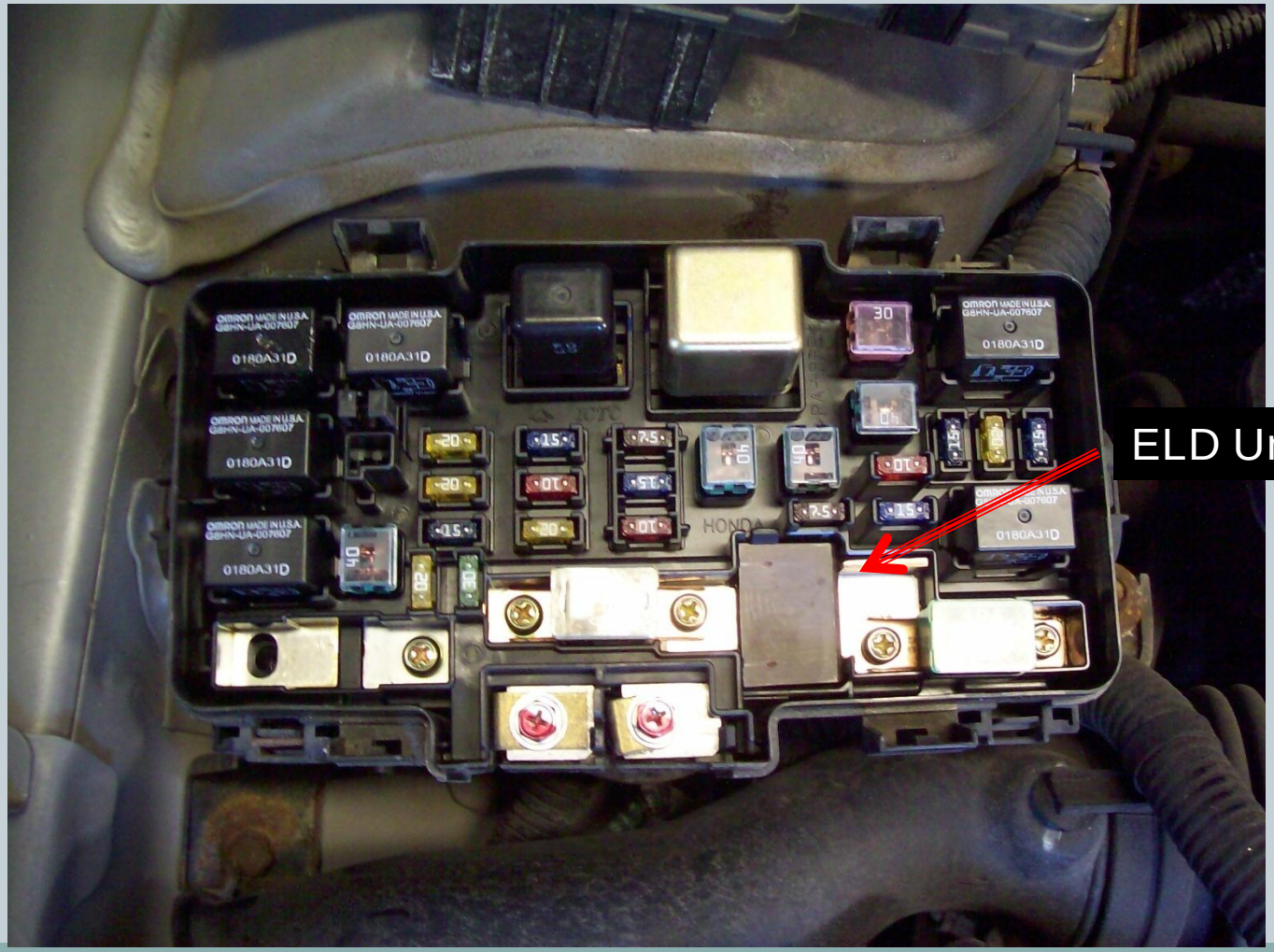
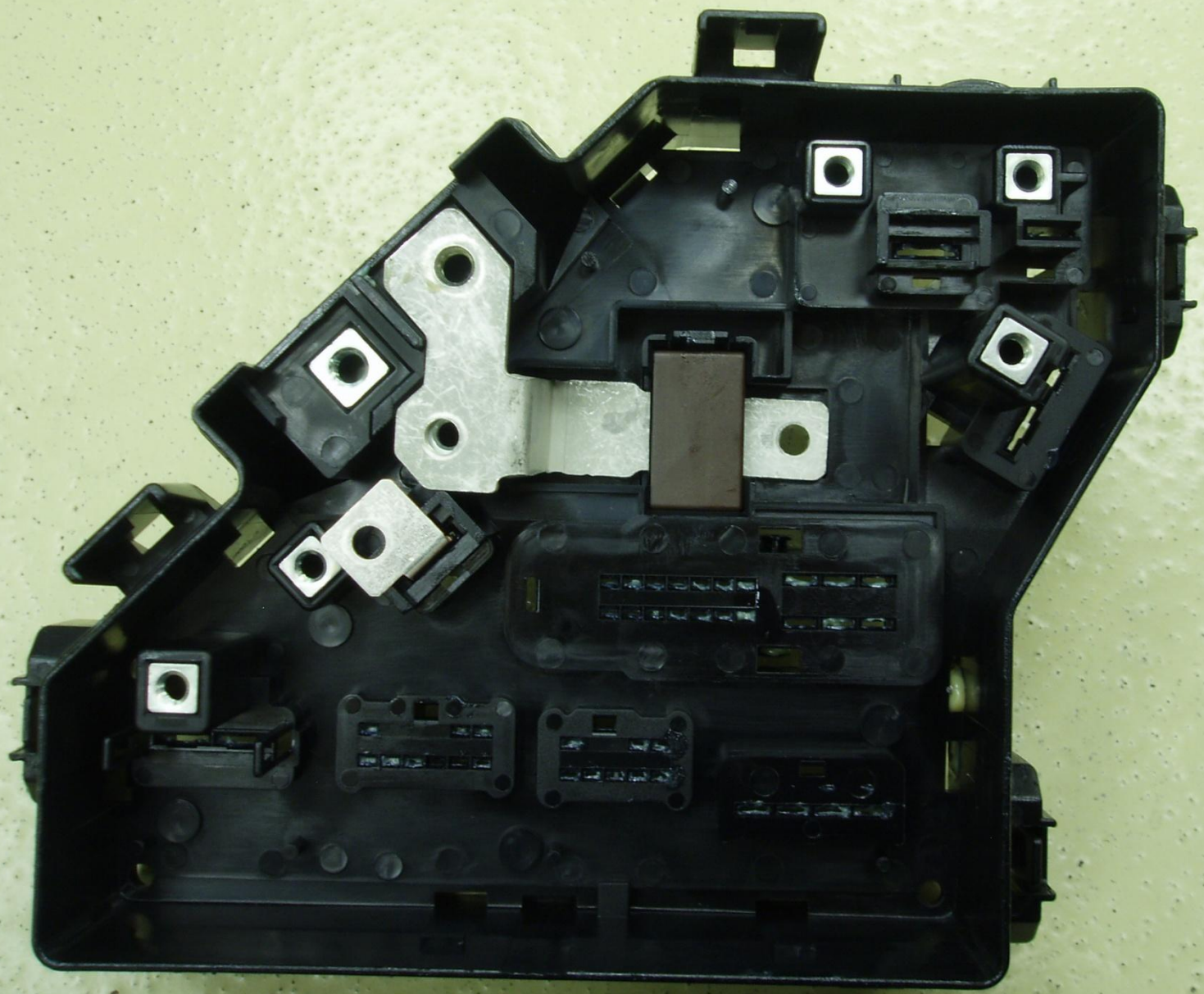
1999 Honda Accord

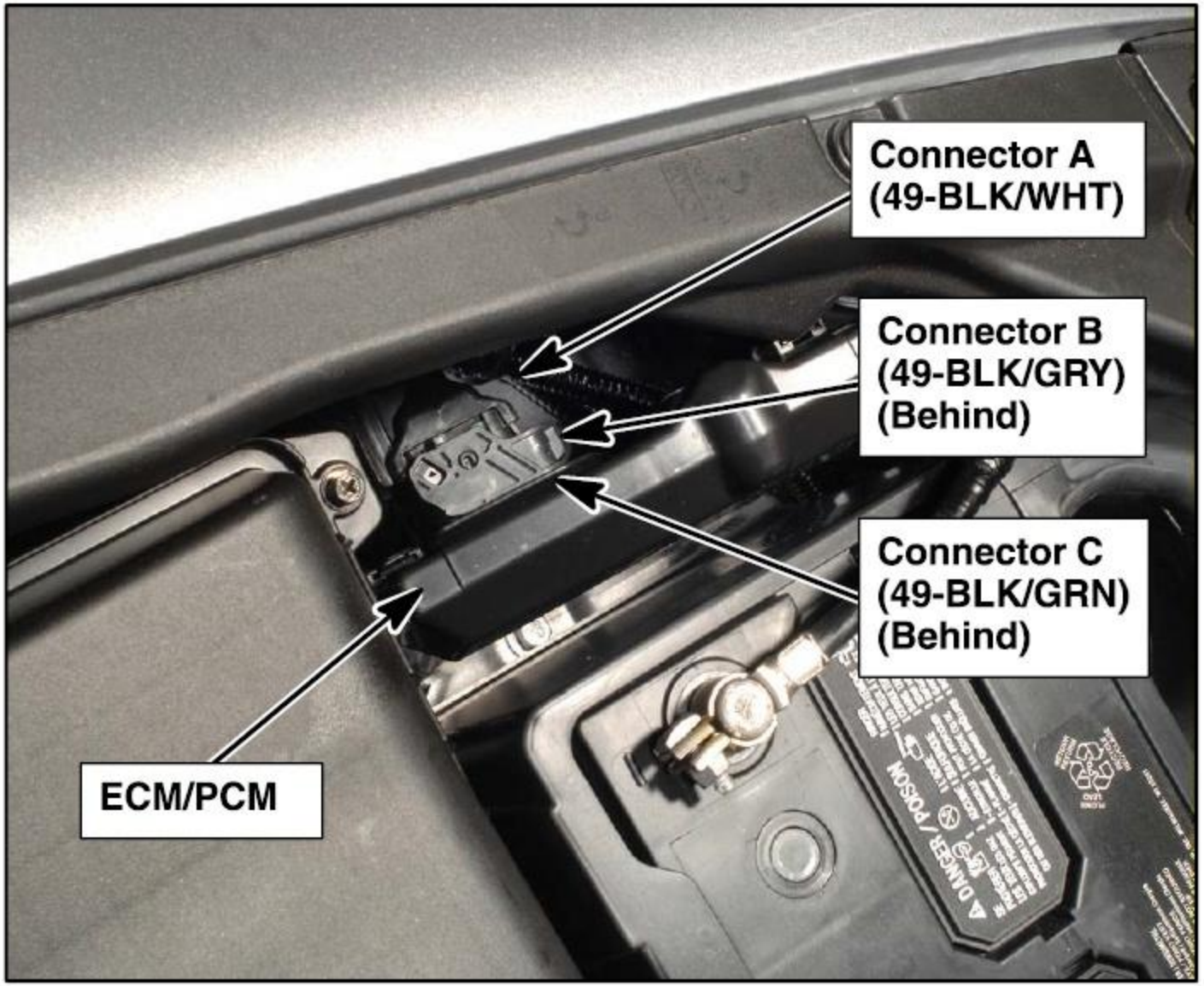


2000 Honda Civic



2004 Acura RSX





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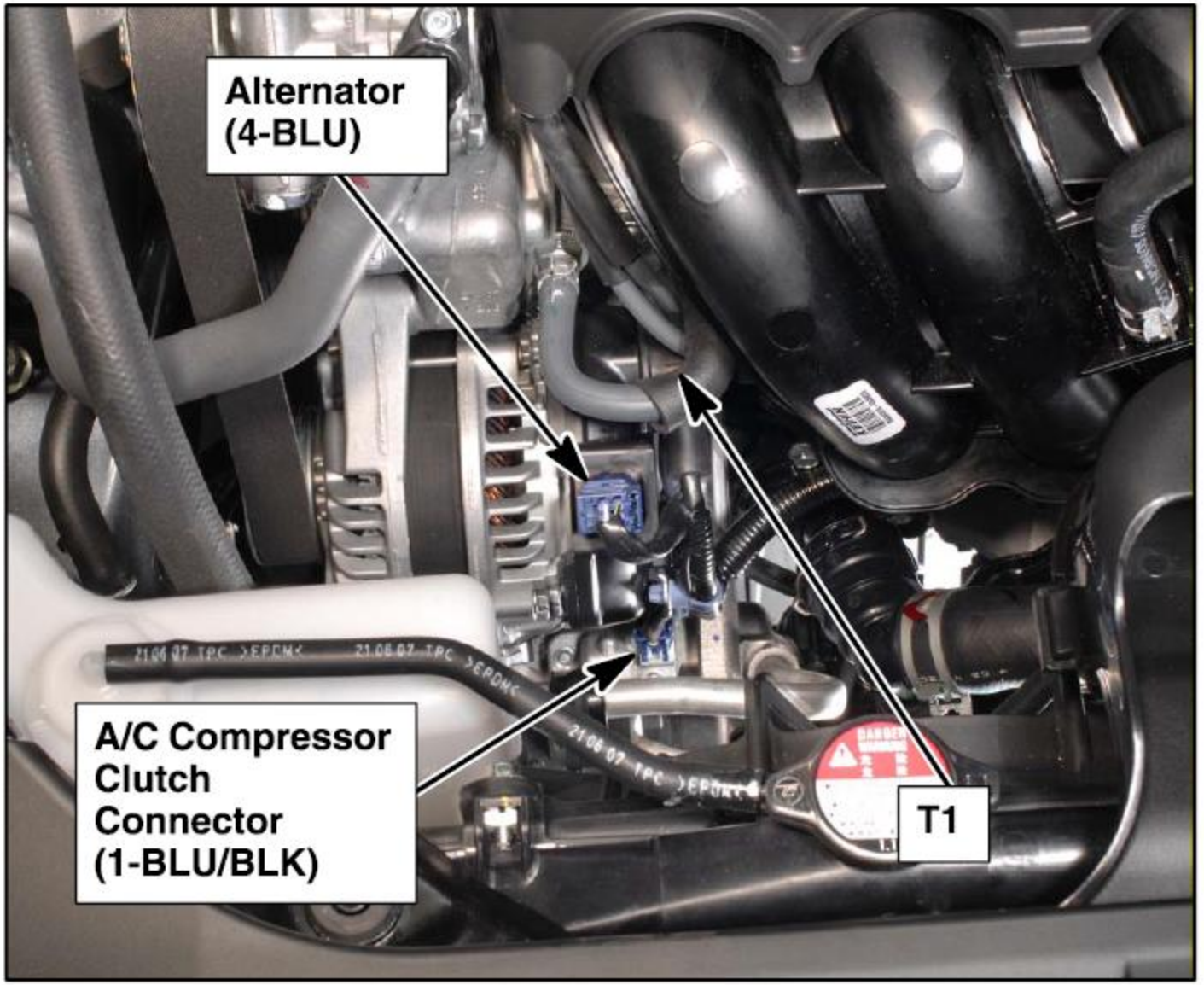

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Connector Terminal Views

164. Alternator

– BLU

– Front of Engine

L4:

– On Starter Sub-harness

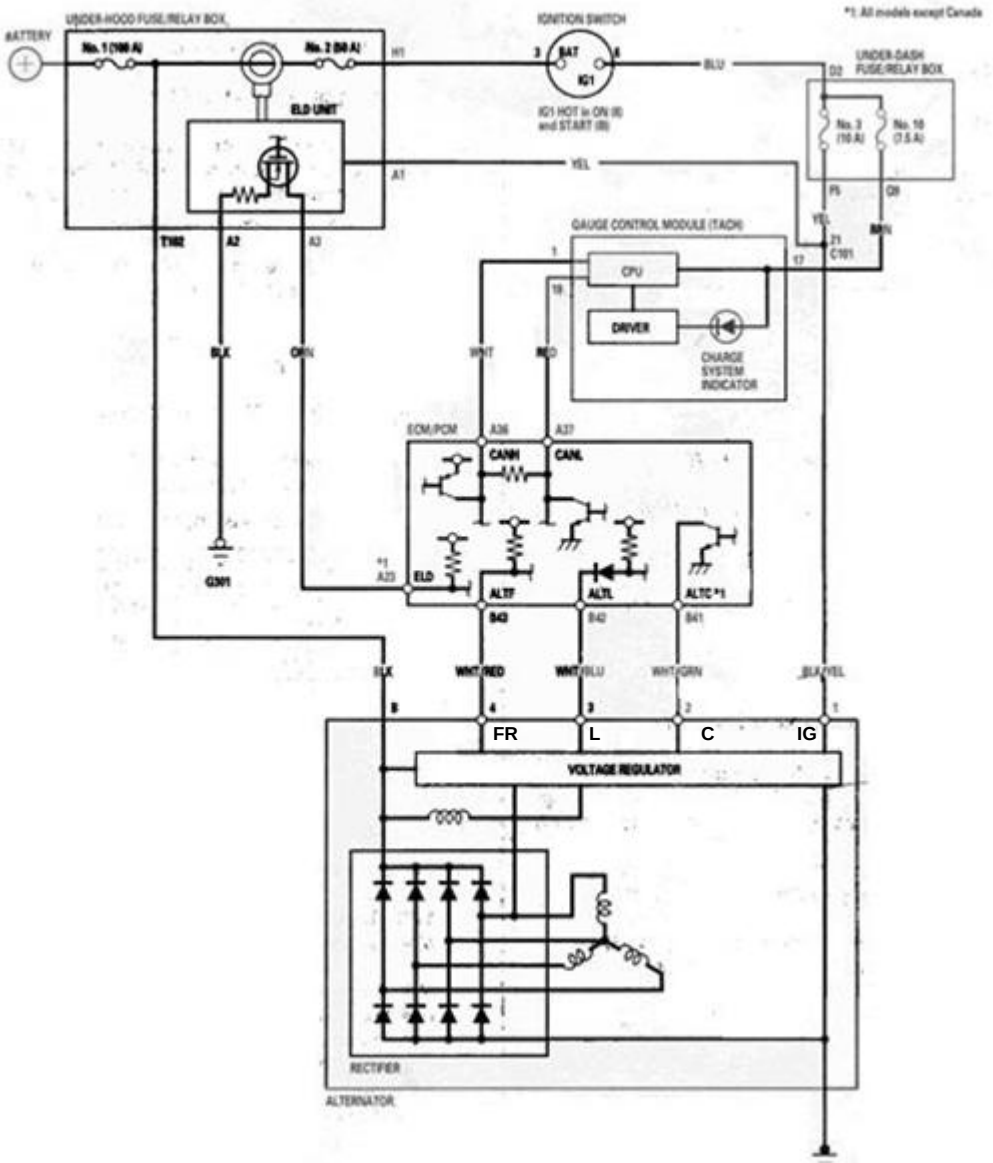
1. BLK/YEL (Fuse 7 – Driver's)
2. WHT/GRN (ALTC)
3. WHT/BLU (ALTL)
4. WHT/RED (ALTF)

V6:

– On Engine Wire Harness

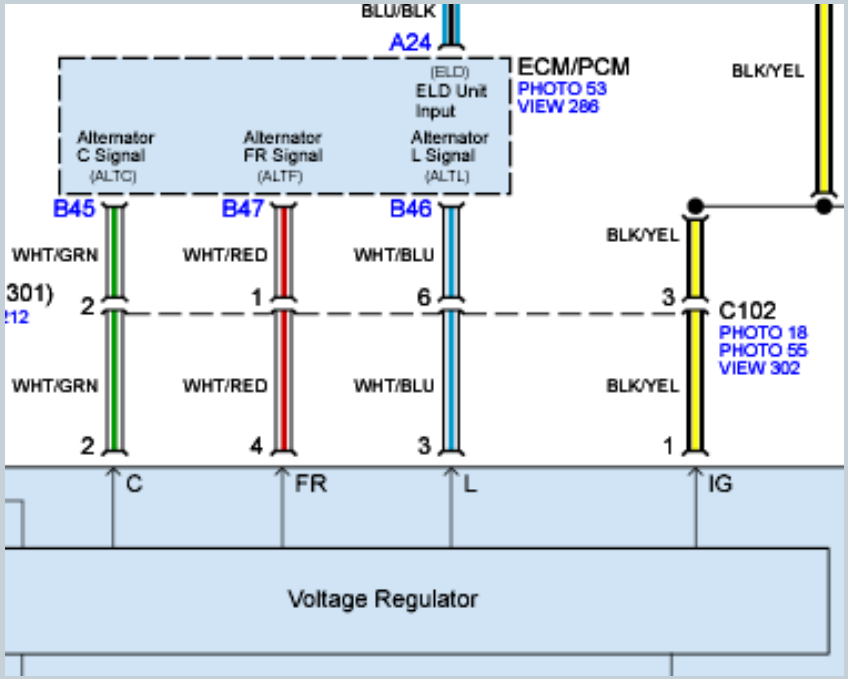
1. BLK/YEL (Fuse 7 – Driver's)
2. WHT/GRN (ALTC)
3. WHT/BLU (ALTL)
4. WHT/RED (ALTF)

Circuit Diagram



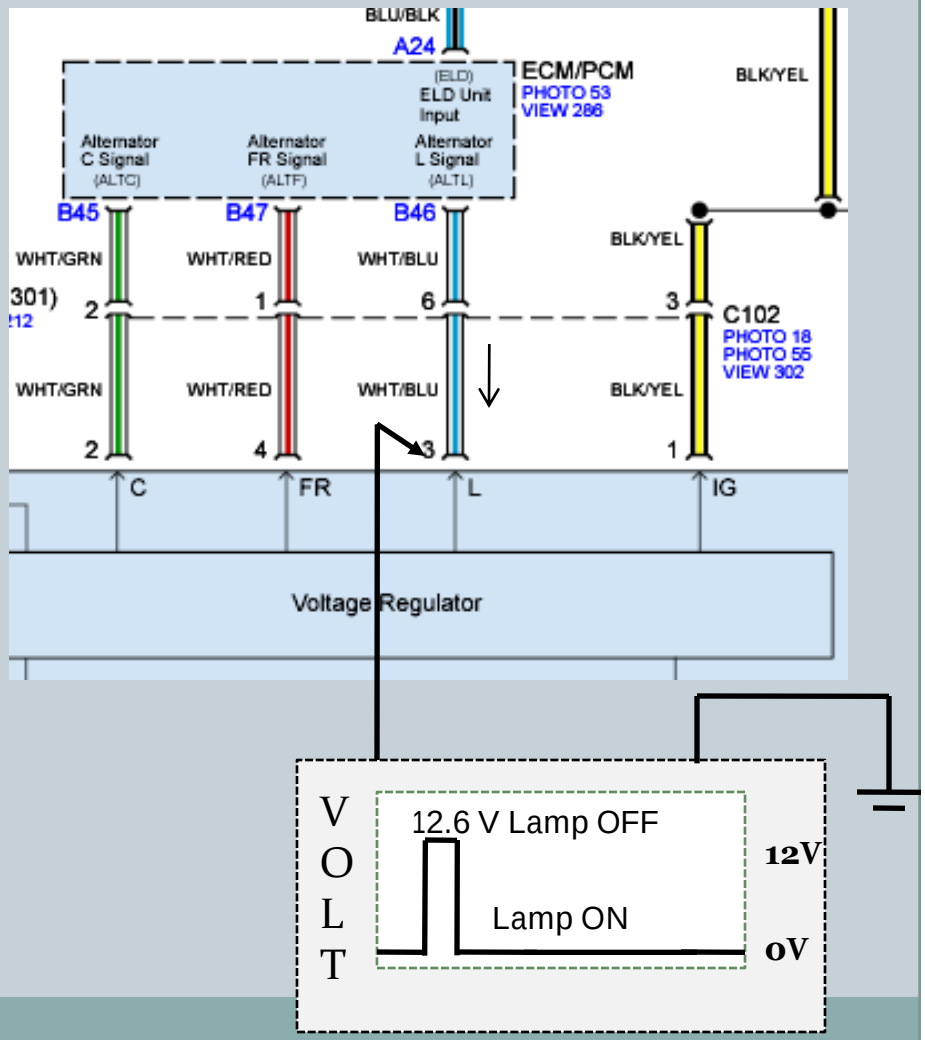
Terminals

- **L**-Indicator Lamp Circuit
- **IG**- Powers the Voltage Regulator
- **C**- Controls Charging Voltage (14.5 or 12.5)
- **FR**- Input to the PCM

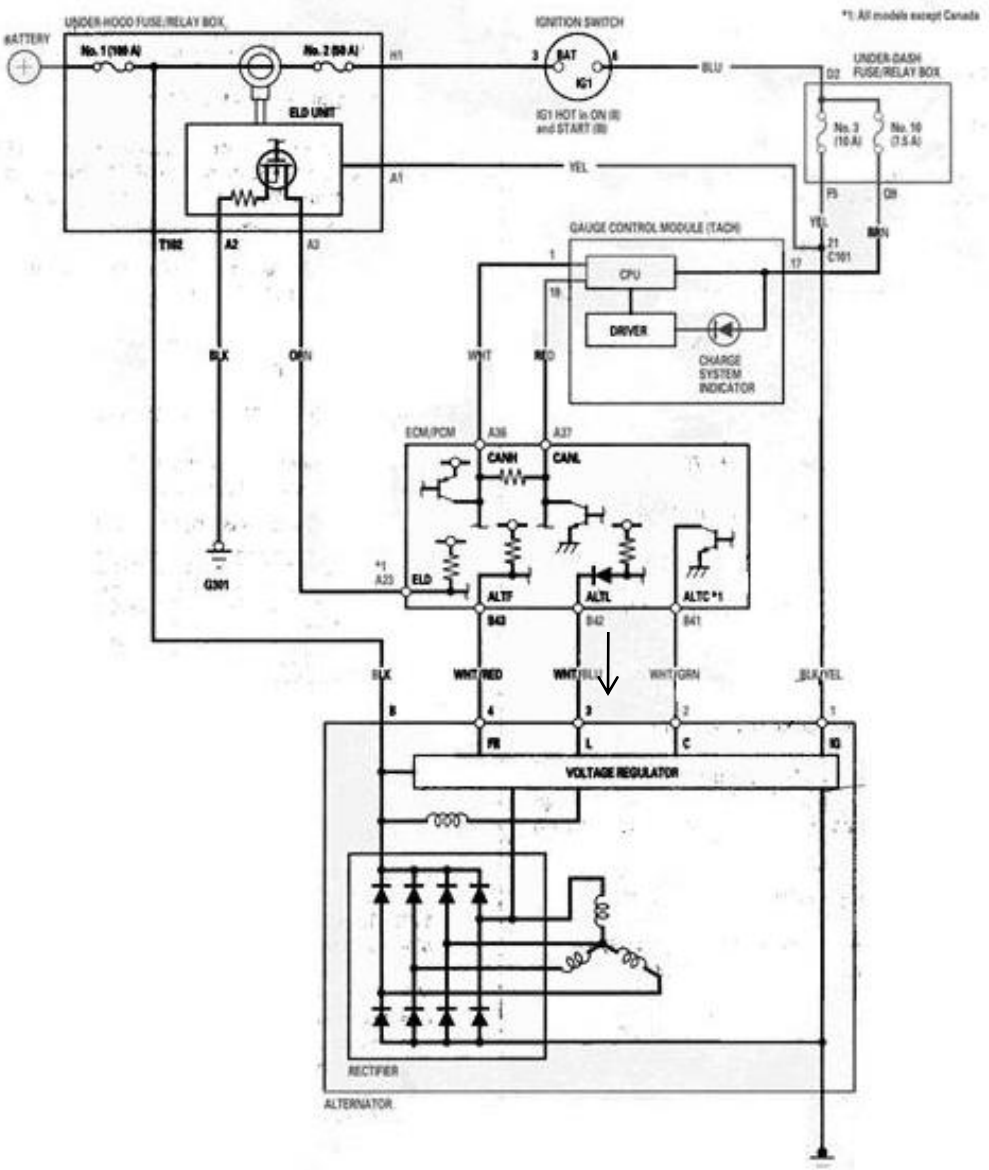


L- Terminal

- The PCM senses the voltage at the L terminal.
- The Voltage Regulator grounds the L terminal to turn the Lamp ON and sends charging voltage to the PCM to turn the Lamp OFF.
  - 0V (Grounded) Light ON
  - Source Voltage Light OFF

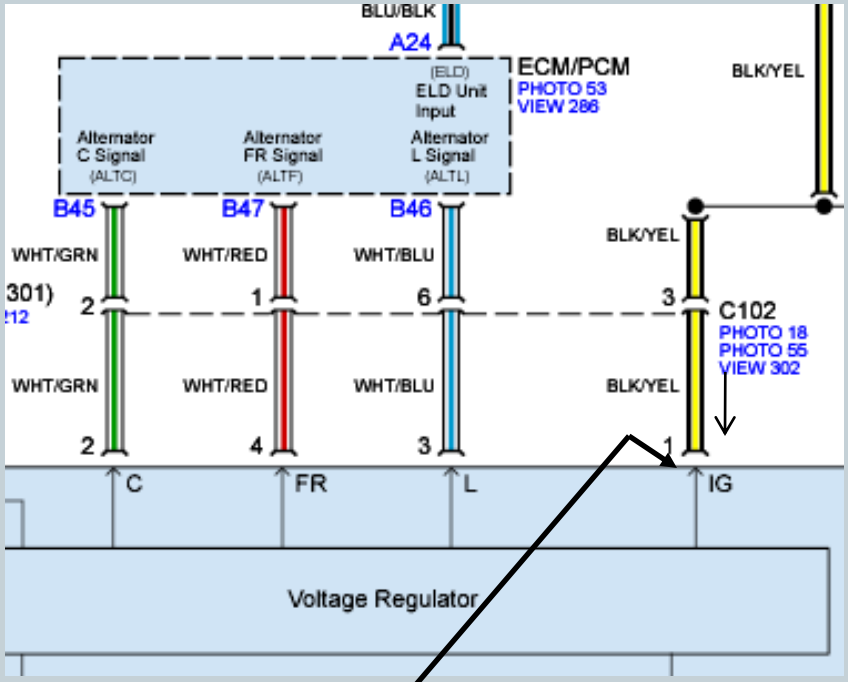


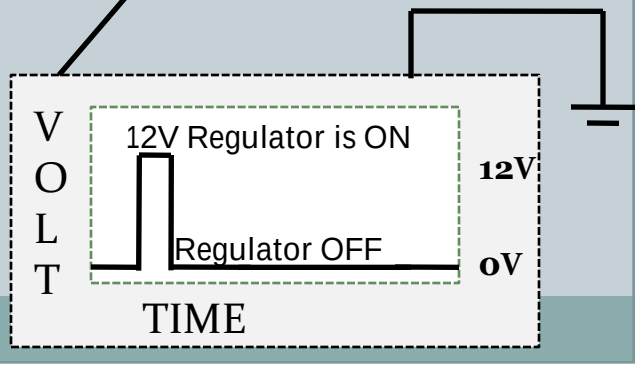
Circuit Diagram



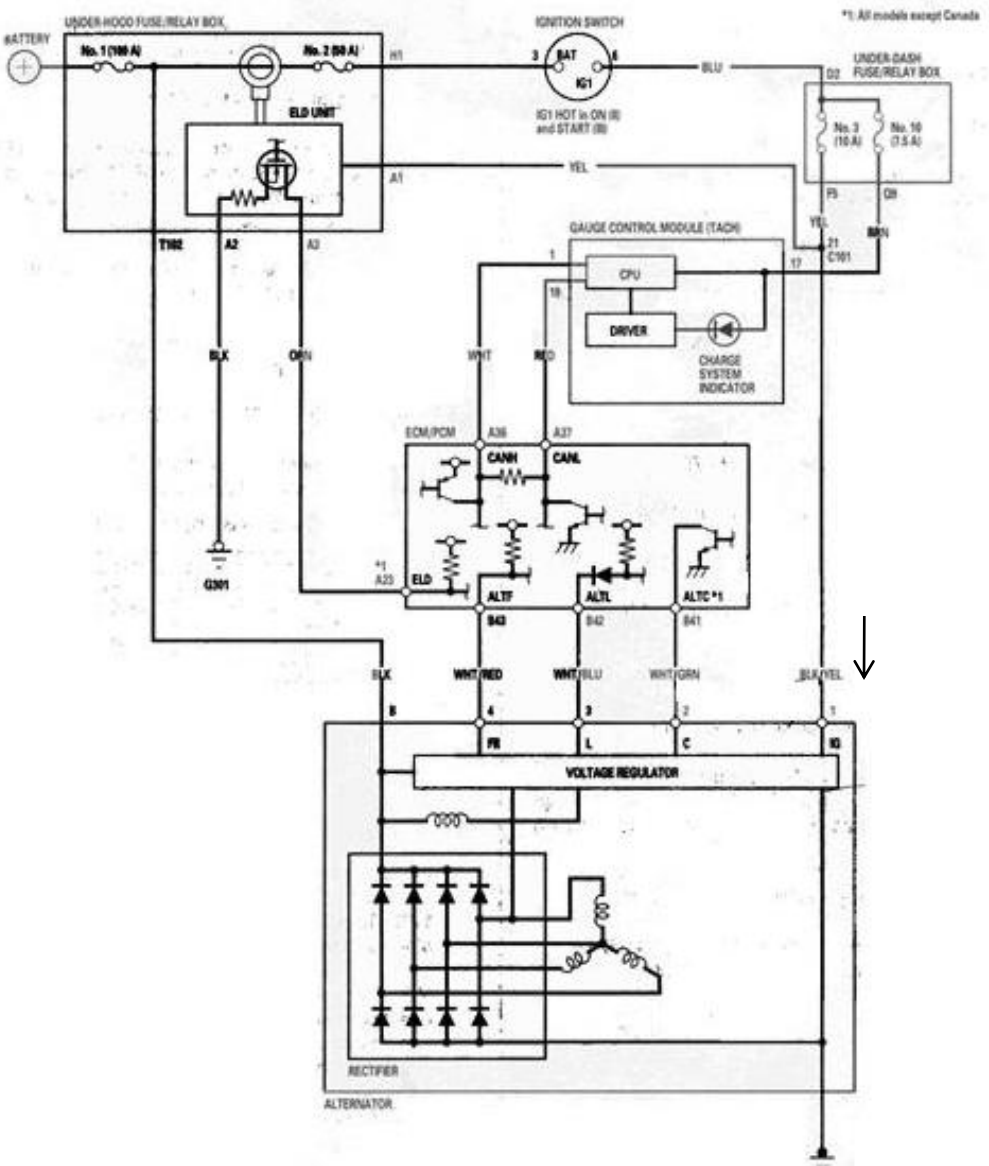
IG- Terminal

- The Ignition switch provides the voltage to the IG Terminal.
- 12V at the IG terminal will turn the Regulator ON.
- O V at the IG terminal will turn the Regulator OFF.
- With out this the charging system will not function.



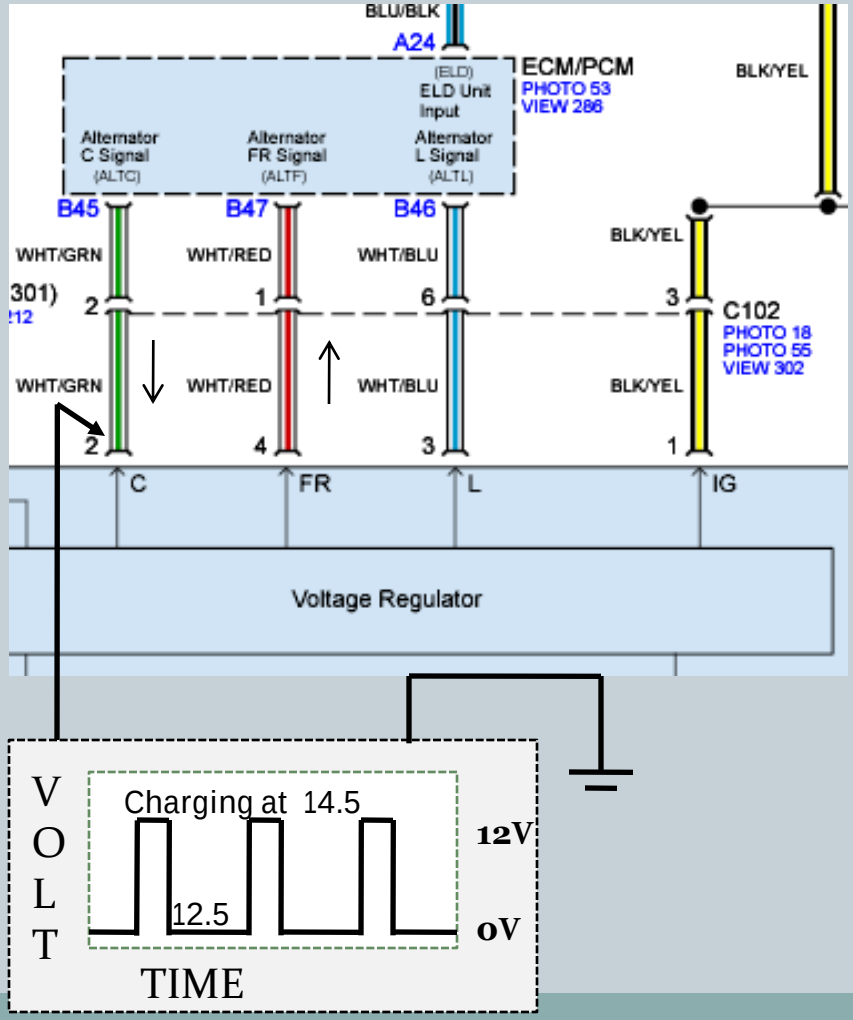


Circuit Diagram

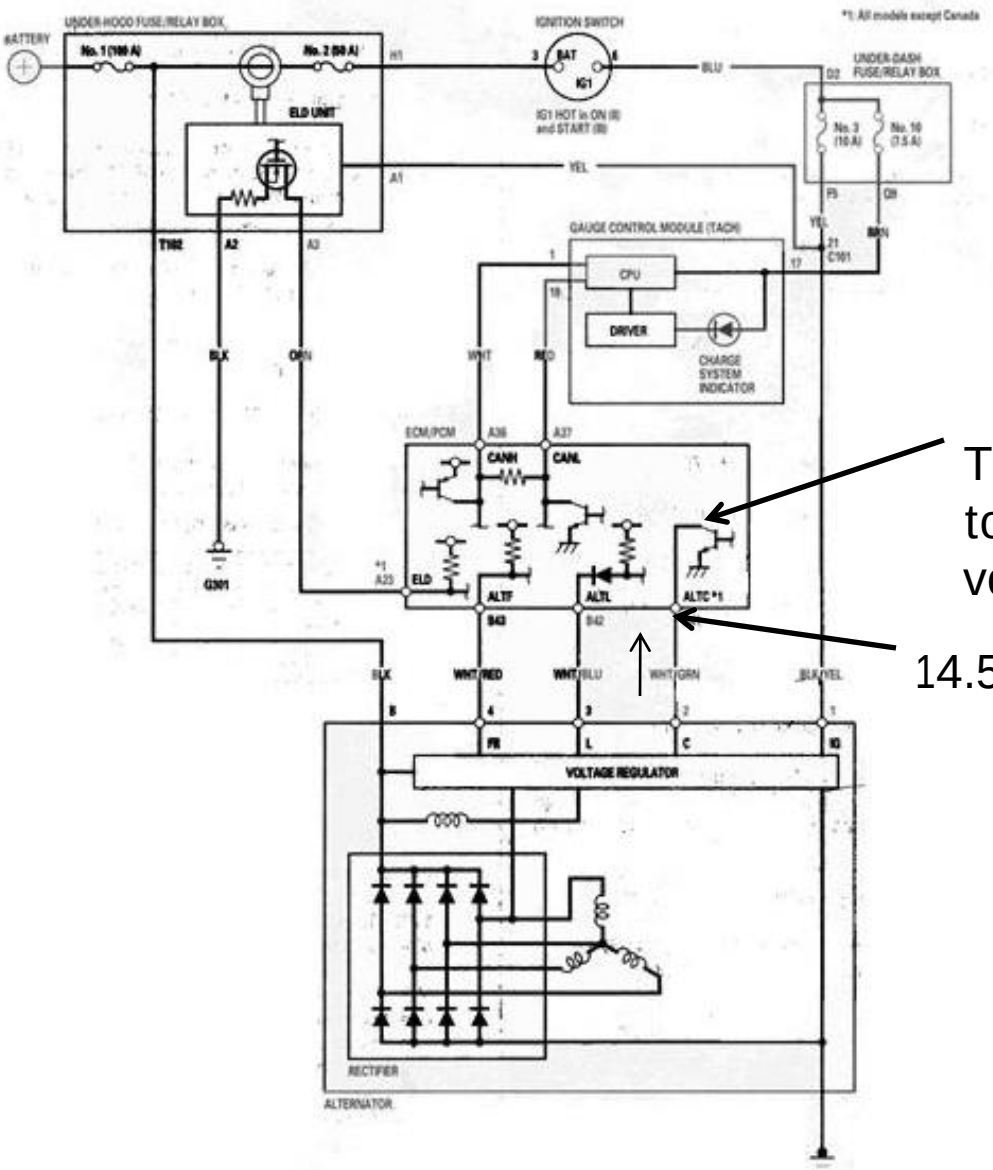


C-Terminal

- Informs the Voltage Regulator to charge at 12.5V or 14.5V.
- The Voltage Regulator sends source voltage to the PCM.
- The PCM toggles the source voltage to ground when the parameters are met.
- Charging voltages drops to 12.5V



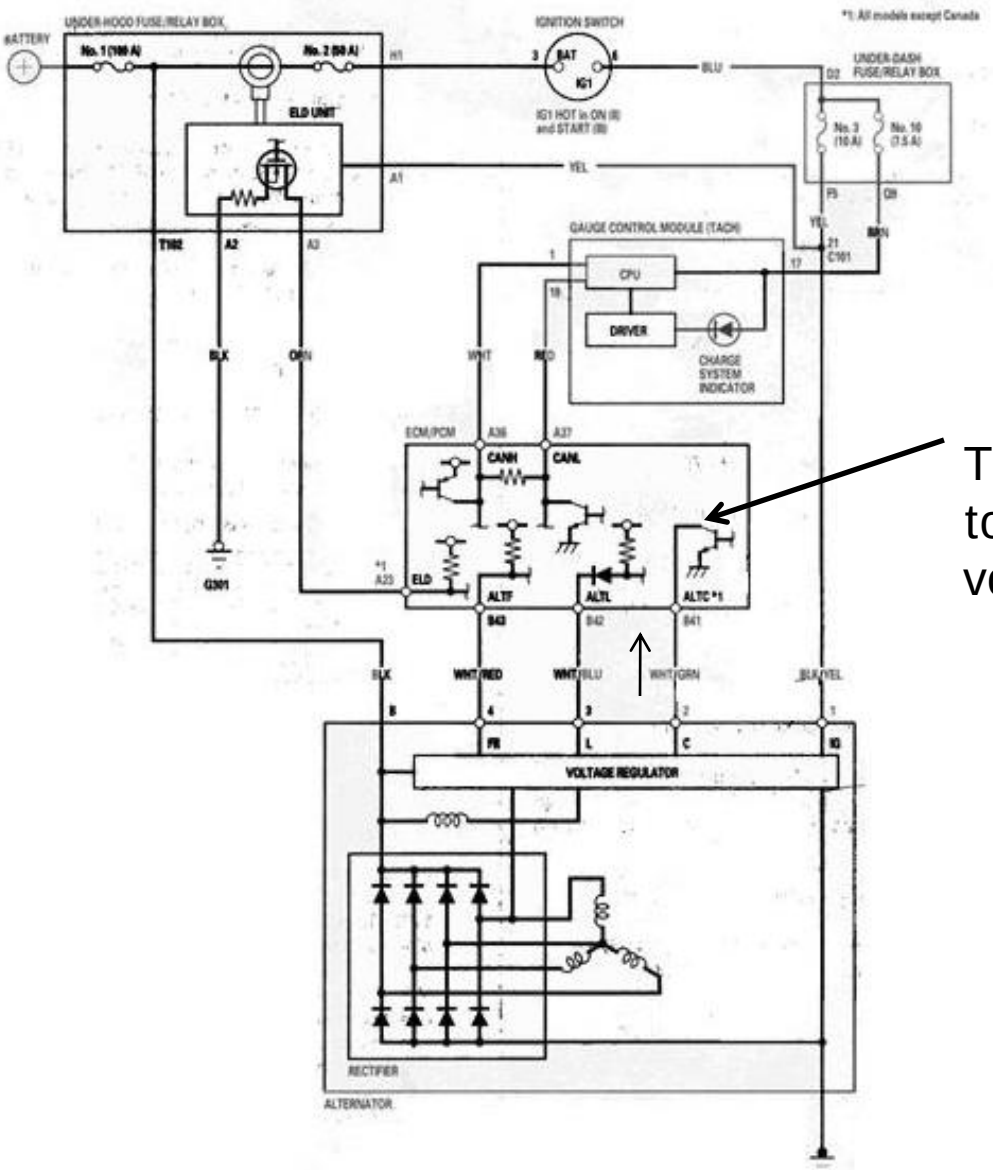
Circuit Diagram



This transistor toggles the voltage.

14.5V

Circuit Diagram



This transistor toggles the voltage.

PCM Inputs

- Throttle Position Sensor (TPS)
- Coolant Temperature Sensor (ECT)
- Intake Air Temperature Sensor (IAT)
- Starter Switch Signal
- TDC/ Crank Sensor
- Speed Sensor (VSS)
- Transmission Position
- Electric Load Detector (ELD)
- Air Conditioning Signal

Parameters to Charge at 12.5

- Vehicle is being Started (Starter Switch)

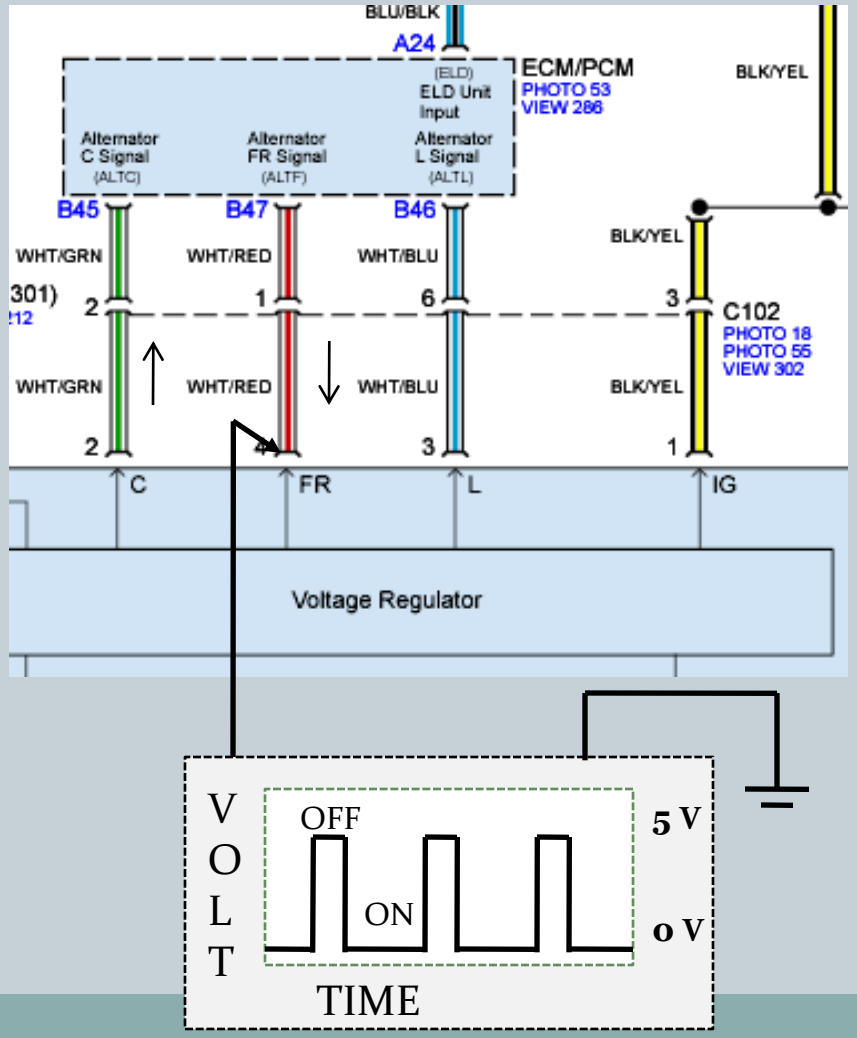
  OR
- Electrical Load below 13 Amps
- Vehicle Speed between 10-45 mph
- Engine Speed below 3,000 rpm
- Coolant Temperature above 167 F (75 C)
- A/C Switch Off
- Intake Air Temperature above 68 F (20 C)
- Not in Park
- Fuel Cut-Off is not Performed

From a Stop

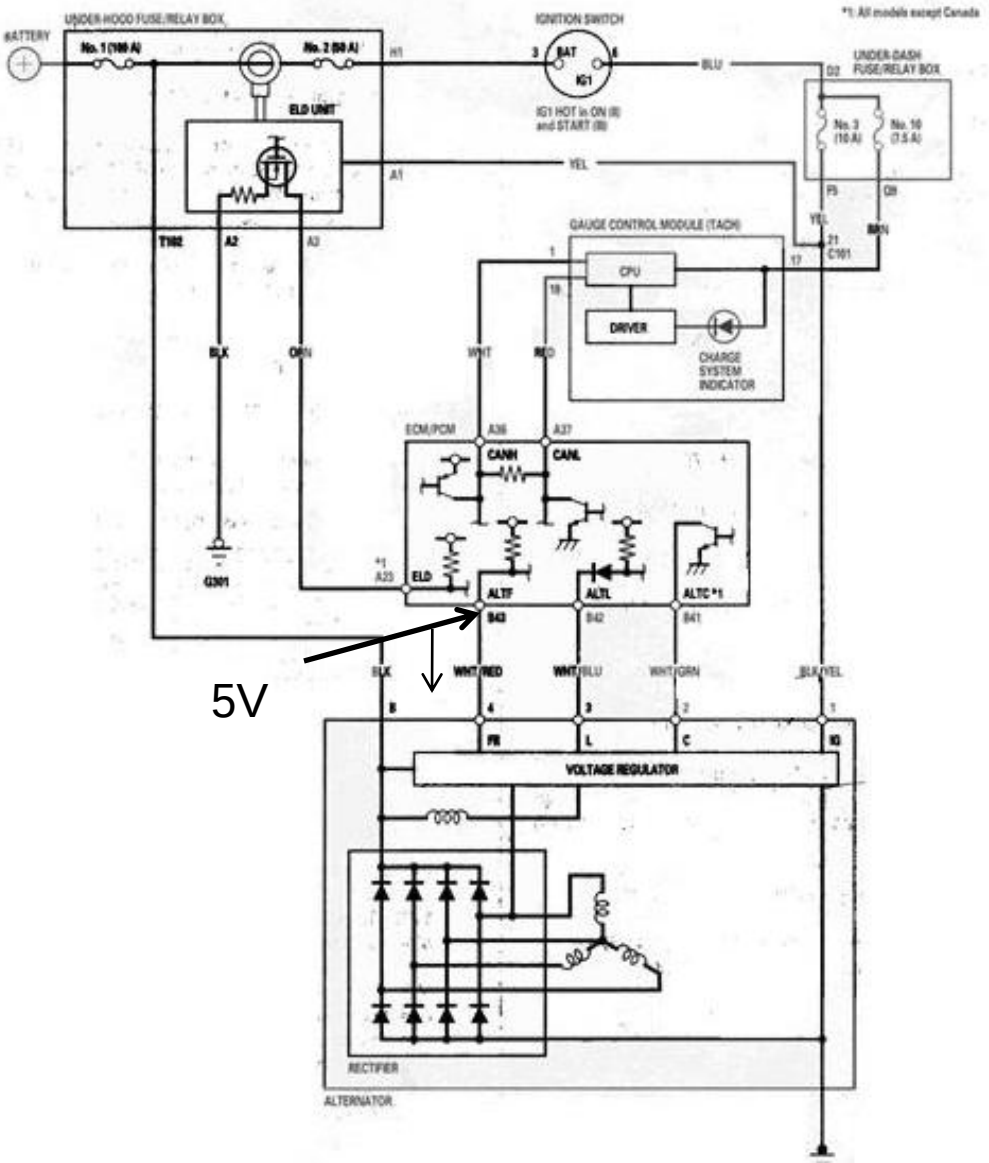
From 40-50 mph

FR-Terminal

- Is an Input to the PCM
- **PCM** sends 5V to the FR Terminal of the Alternator.
- The Voltage regulator toggles the 5V to ground based on the status of the Field Coil.

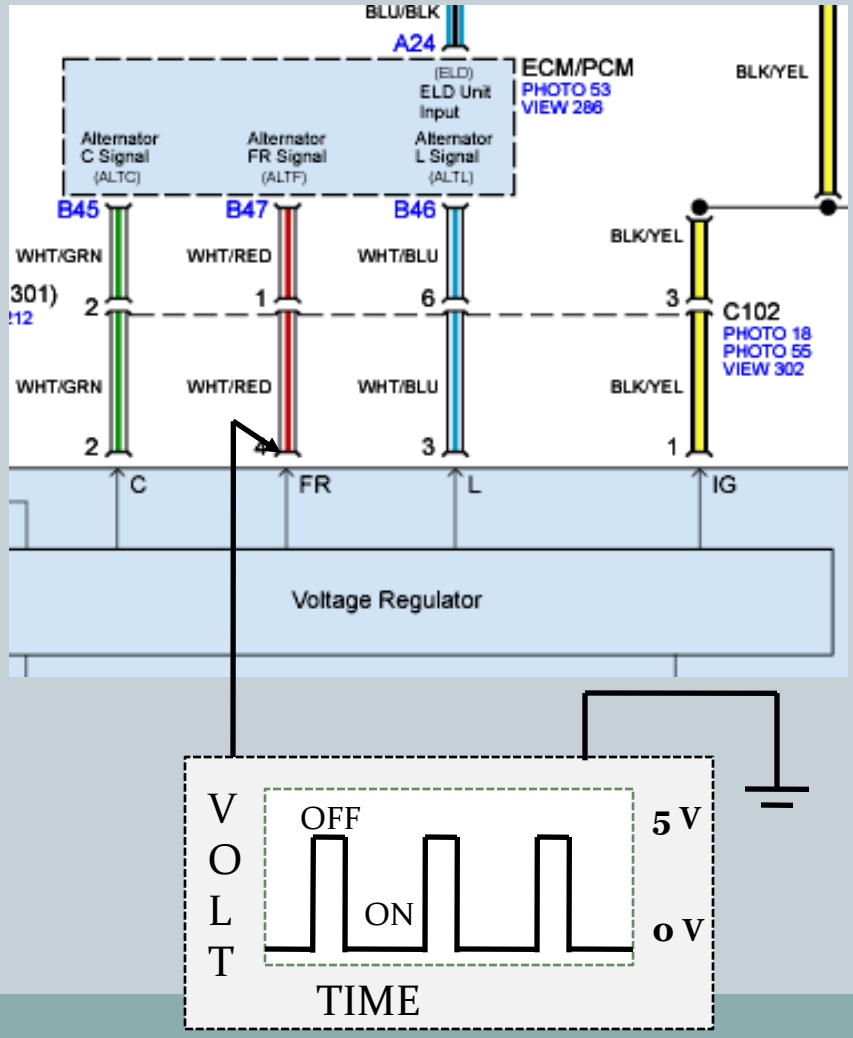


Circuit Diagram



FR-Terminal

- Field On- 5V is toggled to ground.
- Field Off- 5V ground is opened.



Common Problems

- Lights dimming
- Faulty Solder-points in the ELD
- Aftermarket Alternators
- DTC P1298 (electrical load detector circuit high voltage)

Today's Charging Systems

- Multimodal
- PCM Controlled
- Battery Temperature Sensor
- Electric Load Detector
- DTC

Reference

- Chevrolet
- Dodge
- American Honda Motor CO., Inc.
- SIUC Students and Faculty

Questions