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The Electrical Road Map

By Robert Greene

Diagnosing today's vehicles is no easy task. It is hard enough to keep up with new features and vehicle control systems; making it harder to diagnose and repair the vehicle. Diagnosing modern electrical systems without a schematic is much like driving in a big city for the first time without a road map. A lost driver will eventually arrive at the destination the same way that a technician will eventually repair the vehicle, however, if the correct path is used, the destination will be reached much faster and less time will be lost. Since time is a nonrenewable resource, the technician must be as efficient as possible. Lost shop time equals lost dollars for the shop and often lost dollars for the technician. This article is intended to encourage the use of proper wiring schematics and further develop the diagnostic strategy, minimizing the wrong turns in the diagnostic path and help devise a methodology behind the diagnosis.

The technician efficiency productivity multiplier:

Training + Technical Resources + Tools = Increased quality and quantity of repairs.

- Training is very important. Every year vehicles change and keeping up with new vehicle systems is critical. All vehicle systems eventually become old systems and need repair. Refresher courses are also important, basic skills are the foundation of automotive knowledge and even the most experienced and knowledgeable technicians should receive refresher courses.
- Technical resources such as wiring schematics, technical service bulletins and shop manuals enable the technician to resolve technical issues with the use of the manufacture's knowledge base.
- Tools have a much wider definition than just sockets and wrenches. Knowledge and resources are more important than a massive collection of hand tools.

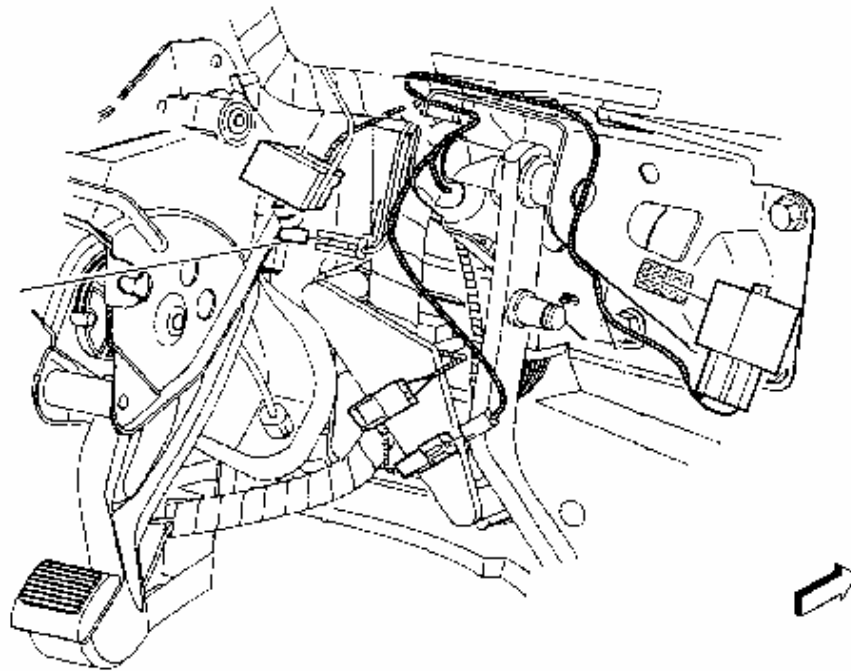
Having a schematic from the vehicle manufacturer is a luxury for an automotive technician. The cost and effort needed to obtain factory schematics often discourage technicians and shop owners. The time and money spent on technical resources is an investment. It is a good practice to get factory schematics for the common vehicles that are in the shop on a regular basis. There is no need to own every schematic, just the ones needed for day-to-day operation.

Aftermarket schematics vs. factory OEM schematics

- Aftermarket schematics are offered from several companies, who offer a monthly service at a competitive price. These schematics work well when repairing a vehicle once or twice, when purchasing the factory schematic would cost too much for the repair of a few vehicles.
- Factory OEM schematics originate from the design team who built the vehicle. These schematics offer the most accurate wire color, connector pin out and component location. Highly recommended whenever possible.

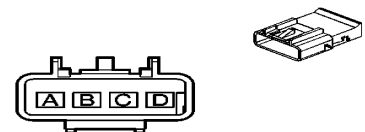
Harness layout and routing

- A good schematic will do more than just show the wires in an electrical circuit it will also show the location of the harness and connectors.



Connector pin out (connector view)

- Once the circuit has been identified and the connector is located, it is important to know the pin location from within the connector. The connector pin location is used to confirm that the correct wire is being tested and that the harness was not pinned incorrectly. A connector view feature is an indication of a quality wire schematic.



Symbols and icons

- Every schematic will have symbols and icons that may vary from one schematic to another. Learning the common (generic) icons is a skill often developed by experienced technicians. Learning the icons associated with the schematic will ease the diagnostic procedure. The more familiar the schematic, the easier the technician can learn the vehicle and decrease the time required to diagnose most electrical faults.

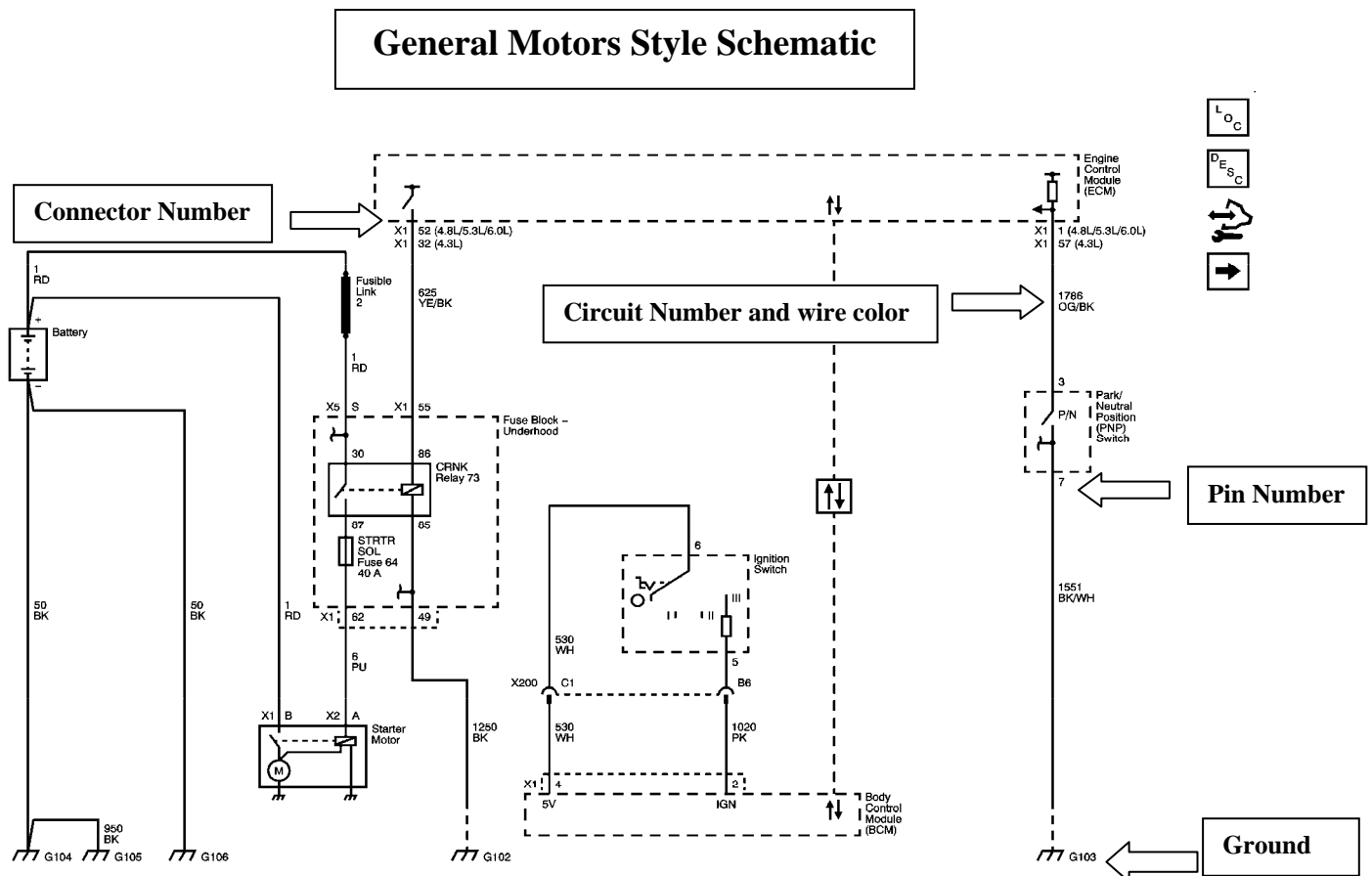
BN	Brown
BU	Blue
GN	Green
GY	Gray
LG	Light green
OG	Orange
RD	Red
VT	Violet
WH	White
YE	Yellow

Wire color abbreviations

- The ability to look at a schematic and identify the wire color is critical to locating the circuit on the vehicle.
- There is no “across the board standard” for wire color abbreviations. Some schematics might recognize a Pink wire as PK and other schematics may just use K. Some commonly used wire abbreviations are shown.

Different schematic styles.

- Every vehicle manufacturer has a different schematic format. Below are two common OEM schematics with examples.



Ford Style Schematic

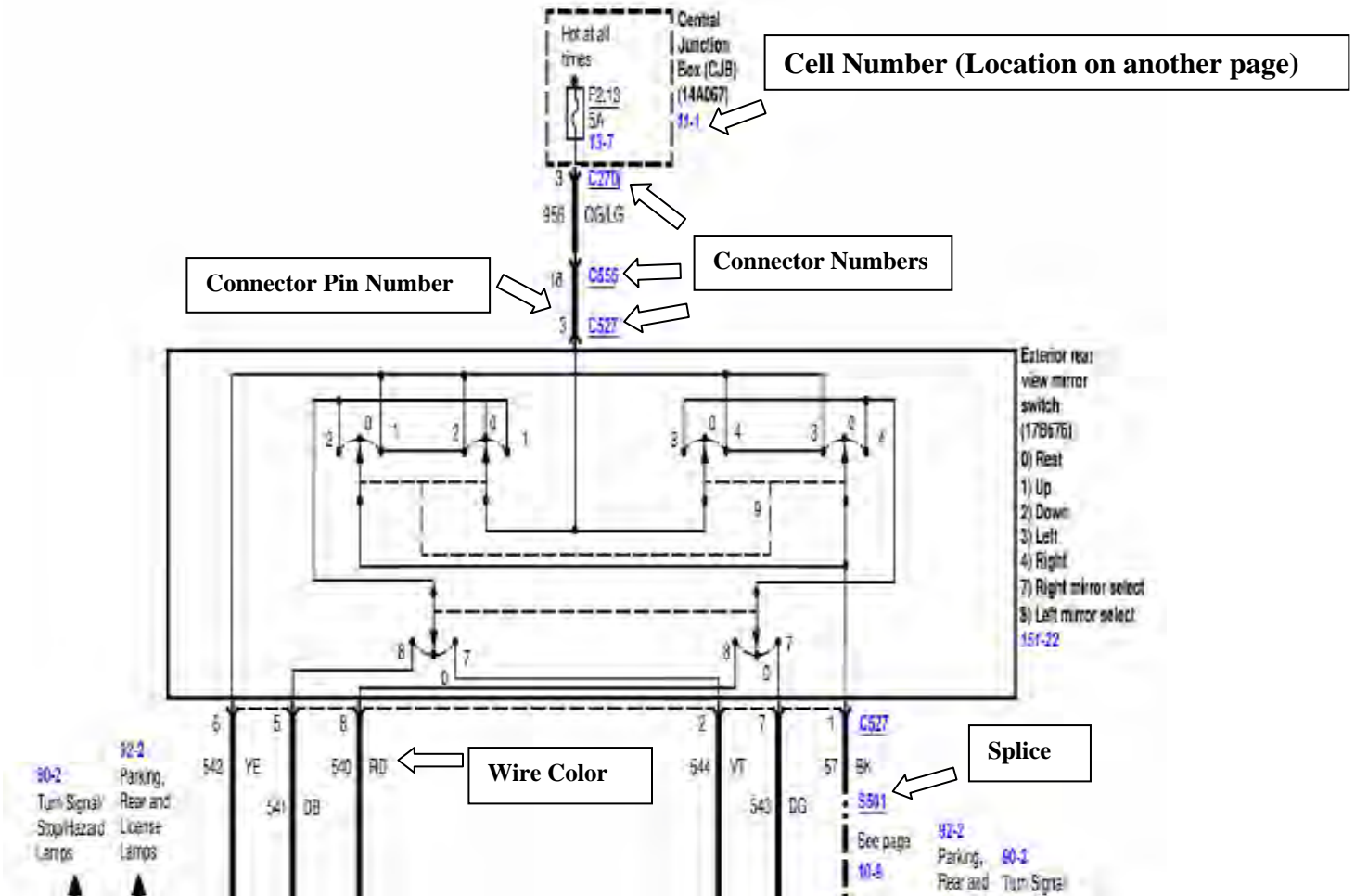
Cell Number (Location on another page)

Connector Pin Number

Connector Numbers

Wire Color

Splice



Tips for diagnosing an electrical system

- Looking at a schematic before looking at the vehicle can help identify other related systems to test.
- After verifying the vehicle fault, other systems should receive a function test to identify additional systems that may have a related or common link to the failure. Example: The customer complains that the vehicle running lamps do not illuminate. After a quick check of related systems, the technician finds that the dash and instrument cluster bulbs are also not illuminating. The technician reviews the schematic, a shared fuse is discovered and the first test point is now identified.
- When starting a diagnosis of an unfamiliar system, printing a copy of the schematic allows the technician to write notes and test results on the schematic. The ability to remember the results of the test can help prevent testing the same circuit twice and putting the diagnostic flow into a spin.

Split half testing and the diagnostic strategy

- Review the circuit and outline a test strategy before starting the diagnosis.
- Determine the acceptable DVOM reading before testing the circuit. Knowing what the meter should read will tell the technician if the test passes or fails.
- On large and complicated circuits, find a logical center point on the schematic to take a DVOM reading. The reading will split the circuit in half, eliminate the possibility of fault in half of the circuit, and prevent unnecessary tests. Continue to split half test the circuit until the fault is isolated and can be identified.

Do not get burned out

- Difficult faults to find can become mentally taxing on even the most patient technician. Often a technician will stop at the point of saturation and work on another vehicle. Upon return to the electrical system, often a fresh mind can resolve the issue faster. Good notes come in handy when returning to work on the vehicle.
- Electrical diagnosis is the hardest of automotive skills to master and takes time to develop. Some of the best electrical system technicians learned from many tough days and the lessons learned were not easy.