Electrical Road Maps

A Look At Automotive Wiring Diagrams

You wouldn't go into a strange town and drive around aimlessly until you found the right street. You'd stop at a service station and buy yourself a road map.

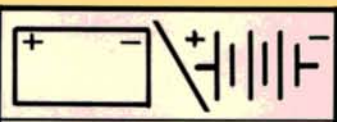
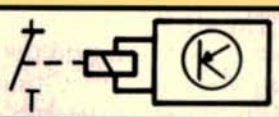
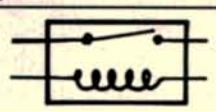
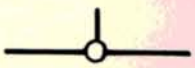
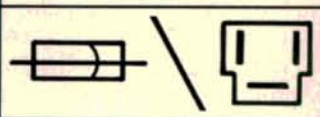
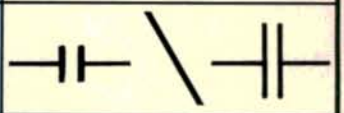
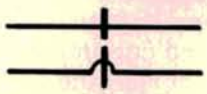
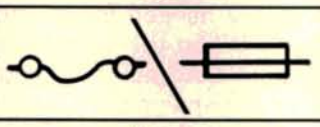
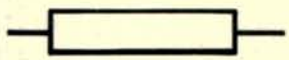
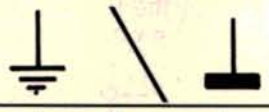
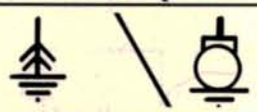
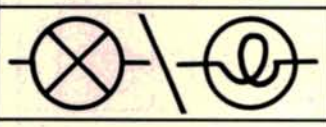
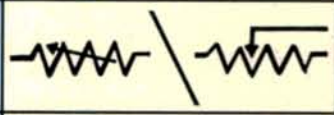
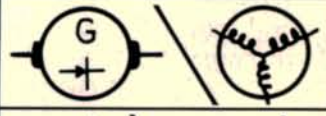
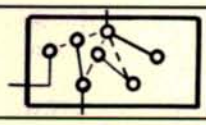
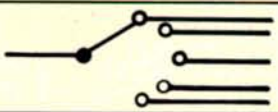
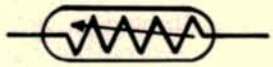
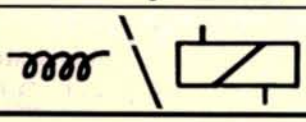
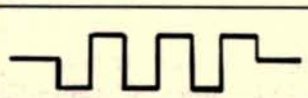
The same logic applies to finding your way around automotive electrical systems. You buy yourself a book with a schematic layout so you can find all those electrical highways and sidestreets. There's a little more to using that wiring diagram, however, than there is to using a road map. You'll have to learn some new symbols and signs or risk getting lost.

Most symbols used in schematics are universal. Except for minor differences in artist's renderings, you can learn a basic set of these symbols and apply them to many vehicles. And even when minor variations exist, the similarities among slightly different renderings will be great enough for you to recognize them.

The following chart lists commonly used symbols found in wiring diagrams. We repeat, please view them as generic representations of fairly standard symbols. We can't possibly include every possible variation, and certainly can't be responsible for each draftsman's artistic license.

With this symbol starter set and a little practice with the layouts and labels used on specific applications, you'll be reading and interpreting wiring diagrams in no time.

Always be sure you check the introductory material that should accompany any good diagram for a key defining the specific symbols used.

Some Commonly Found Symbols and What They Mean			
Battery		Solid State Relay	
Motor		Electro-Mechanical Relay	
Mechanical Connection		Wire Connectors	
Soldered Connection		Condenser	
Unconnected Wires Crossing		Horn	
Fuse		Resistor	
Ground		Fusible Link	
Wire End Connected To Ground		Transistor	
Bulb		Ignition Coil	
Diode		Light Emitting Diode	
Single Contact Switch Closed		Variable Resistor	
Single Contact Switch Open		Alternator	
Ignition Switch		Mechanically Operated Switch	
Multiple Contact Switch		Thermister	
Relay Holding Coil		Heating Element	

Getting From Here to There

The wiring in the car is the road system used by current as it travels to the car's electrical consumers. Wire sizes will vary from the tiny backroads wire feeding the radio speakers, to the super-highway cables at the battery.

Wires need to be thicker as current loads increase, just as highways are wider in high traffic areas. Wires must be big enough to carry all the traffic (current) at rush hour without overheating.

Wires will also be distinguished from one another by color, by position in multiple connectors, and by geographic location.

NO and NC

Switches and relays will be shown as normally open (NO) or normally closed (NC). Normally open means that the switch or relay is open when it is at rest. It will remain open until energized.

Normally closed is just the opposite. Even at rest, the switch or relay will conduct current, completing a circuit *before* being energized. When energized, it opens and interrupts circuit continuity.

Swartze und Rot?

These are import cars. Some older diagrams listed color designations as abbreviations of foreign words. Newer diagrams list colors in English or in abbreviations of English words (Bl for black is one example). But what if you get an old diagram for a German car that uses Sw, for the German word *swartze*, which means black?

Here are some typical foreign word and letter designations that may help in a pinch.

ENGLISH	JAPANESE	GERMAN	SWEDISH
BLUE	L	Bl	Bl
BLACK	B	Sw	Sb
WHITE	W	Ws	W
RED	R	Ro	R
GREEN	G	Gn	Gn
YELLOW	Y	Ge	Y
BROWN	Br	Br	Br
GRAY	Gr	Gr	Gr

As you can see, most of the symbols are easily recognized. It's the exceptions that'll kill you, especially if someone brings you an older diagram. Also remember that most wires won't be one solid color. If we limited ourselves to solid colored insulation when we wired the car, we'd run out of colors long before we ran out of different circuits. So wires will usually be two colors; a base color with different colored bands or stripes.

The base, or main color will be given first, the striping color second. For example, a R/B wire is red with a thinner black band or stripe. A B/R wire is basically black with a thinner red band or stripe. This sounds like a small point, but it really can make a difference.

0.5 = cross-section wire size in MM^2 (although some will be given in American wire gauge sizes)

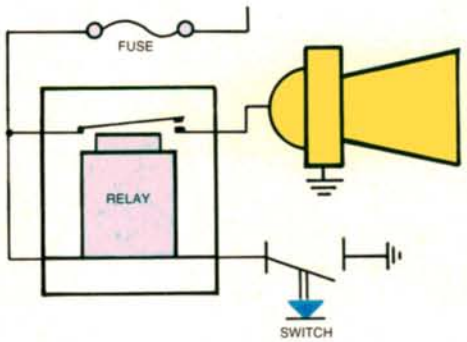
R = main color of insulation (red)

B = color of stripe or band (black)

BEEP BEEP

Here's an illustration showing one possible way to connect a horn. There are other ways to hook up this horn, but this example allows us to show a fuse protected current source, a switch (NO), a relay (NO), a consumer (the horn), and a ground. We have everything needed for a functioning circuit.

When the switch closes, the circuit through the relay holding coil is completed. The coil becomes an electro-magnet pulling the contact points closed, completing the flow of current to the horn. This horn is already grounded, so it beeps.



But what if it doesn't beep?

The diagram gives clues as to possible causes for a no-beep situation.

- **No Current.** A dead battery? An open circuit in any part of the wiring caused by a broken wire, a loose or high resistance connection, a burned fuse?
- **No Ground.** Loose or corroded ground connections?
- **Component Failure.** An internal open circuit in the horn itself, the switch, or the relay? Maybe there's something jammed in the relay preventing it from closing? What about high internal resistance?

On the next two pages we'll show you two close-up views of sample diagrams. Try to remember that no matter how many wires and symbols there are in a diagram, complex arrangements can be broken down into understandable bite-sized bits like the horn diagram. And even though more complex diagrams may present a greater number of wires, components, and connections to check, the same thought process applies.

Current Flow Diagrams

Here's an example of a Volkswagen style current flow diagram. The large block across the top is the fuse/relay panel. The numbered bar across the bottom is the chassis, or ground, completing the circuit to the battery.

We've circled several symbols and identified them as an aid to reading these diagrams. Also note the standardized numbering system for the fuse box feed wires allowing you to know at a glance which feed wires are hot, and *when* they are hot.

Occasionally, a wire in a given circuit will actually be continued in another current track. When this happens, a small box with a number inside will send you to the current track where the wire is continued. An example is included.

Circuit Designations
30 = Battery direct connection
15 = Hot with ignition on
50 = Hot when cranking
x = Hot with ignition on, loses power during crank
31 = Ground

Fuse Panel Terminal Designation

Fuse Number in Box and Amp Rating

Wire Size and Color (Dominant Color Given First)

Solid State Relay

Numbered Box Indicates Track on Which Wire Continues

T1 Indicates Single Terminal Connector (T2 a Double, and So On)

Multiple Connector

Component Symbol (Motor)

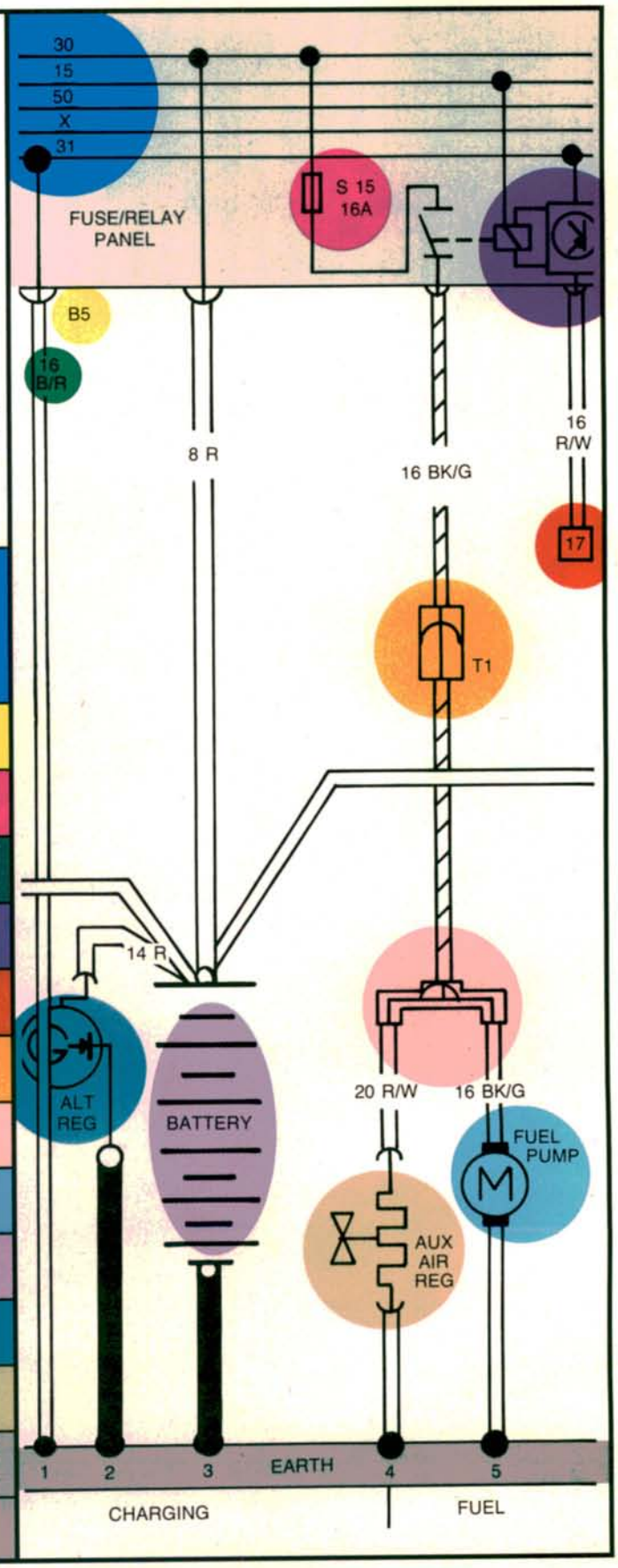
Component Specific Designation (Battery)

Single Line Indicates Internal Wiring

Heating Element Controlling a Valve

Current Track Numbers

All Wiring to Lower Bar is Ground



Another Sample

Here's a close-up of a little more traditional schematic. You'll note that unlike the current flow diagrams, grounds are indicated for each individual component. You may also note that even though the two styles of diagram take a different approach, there are many similarities in the layouts and symbols used.

The samples shown are admittedly simpler than some of the full-blown monsters required for today's increasingly complicated wiring systems. But the same principles will apply no matter how intricate things get. The more you use these maps the better you'll like them, not to mention you'll have a lot less chance of getting lost.

—By Ralph Birnbaum

Battery Symbol (Ground Shown to Chassis)

Fusible Link Located Near the Battery Protects Main Current Feed

Multi-position Switch (Ignition)

Fuse and Amp Rating—Located Near the Ignition Switch

Fuse In-line (Usually an Insulated Holder in the Wiring Harness)

Electro-mechanical Relay—Energizing the Winding Completes the Circuit by Closing Contact Points

In-line Connection—Direction of Arrows Indicates Male or Female Connector, Not Direction of Current Flow

Component Symbol (Motor) and Specific Designation (Starter)

Resistor for Heater Blower (Note That as Distance Current Must Pass Through Resistor Increases, Motor Speed Decreases

Multi-position Switch Controls Passage of Current Through Resistor to Ground

Simple On/Off Switch Controls Current Flow to Stop Light Bulbs

Bulb Symbols—In This Case Stop Light Bulbs

Ground