

BUILD A POWER CONTROLLER FOR AUTOMOTIVE ACCESSORIES

ADDING ACCESSORIES TO A CAR OR truck was once a simple chore. Just run some heavy wire from the car battery to the load, through the fire wall to the dashboard, and connect the wires in series with a fuse and a toggle switch and the job was complete. With that huge, high-current switch mounted on a bracket strapped to the dashboard, a flip of the wrist would activate the new accessory and testify to the owner's expertise and initiative.

But a plain old toggle switch hanging from the dashboard doesn't cut it anymore; it presents a tacky, unprofessional appearance in today's motor vehicles. Besides looking bad, an old-fashioned lever switch could make you look bad, too. If you were to leave the power on when the ignition key is off, you could kill the battery.

You can personalize your dashboard and avoid those toggle-switch headaches with our simple pushbutton power controller for high-current accessories. When you're finished, you'll have a "smart" switch that blends in with the existing dashboard controls. An LED can also be installed to indicate the power state.

The motor vehicle power controller is specially designed for under-the-hood mounting. It is designed to switch a high current when it receives a positive-going pulse from a momentary switch. It could also be controlled by a specialized device like a remote control radio receiver. Pulses from a 555 timer IC could

Add that custom touch to your automotive accessories with our power-controller module.

DAVID J. SWEENEY

be used to trigger the power controller to flash warning lights.

For pushbutton use, only a thin control wire runs to the dashboard, which helps make mounting easy. As shown in Figure 1, a small switch, with an LED power indicator, controls power to a load, which could be lights, a siren, a winch solenoid, or any other device that draws up to 10 amps. A fuse, which should be mounted as close to the battery as possible, protects the switched power. Pressing the dashboard-mounted switch once activates a relay that supplies power to

the load; pressing the switch a second time disconnects power from the load.

The author designed the power controller for a pair of quartz halogen lights that he added to his car. The power controller delivers the 8 amps required for the fog lights, and it's controlled from a tiny pushbutton blended into the dashboard, as shown in Fig. 2.

The power controller operates only with the ignition on. Therefore, if the driver doesn't remember to turn off the lights, the controller will. That way you won't find a dead battery the next time you go to drive the car.

Circuitry

Figure 3 shows the



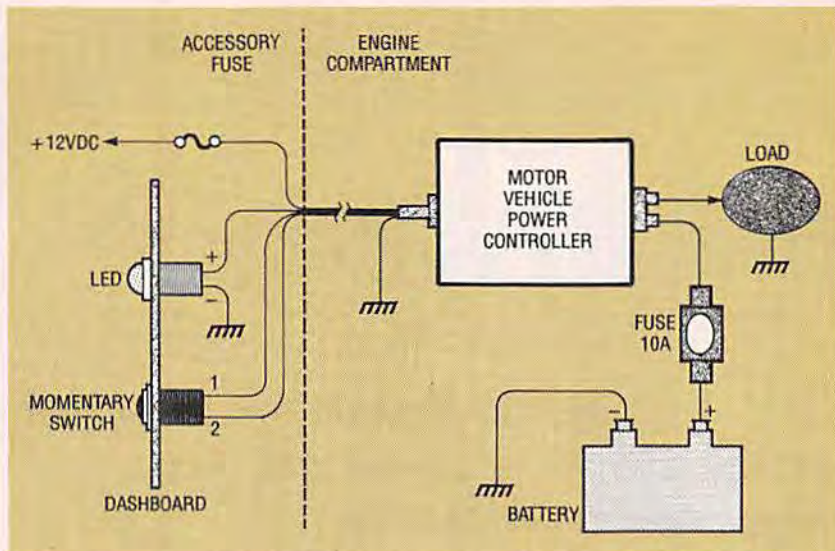
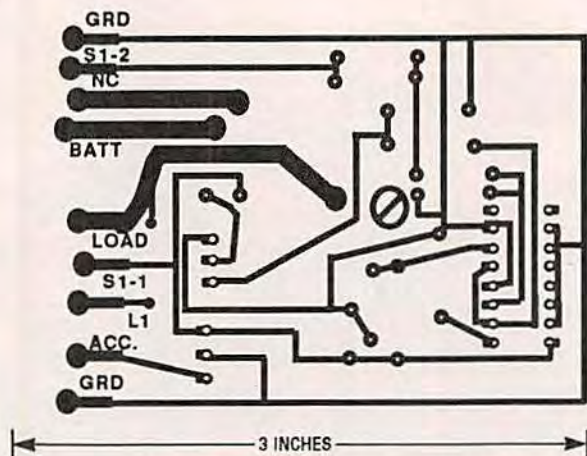


FIG. 1—THE POWER CONTROLLER lets a small pushbutton control power to a load that draws up to 10 amps.



FIG. 2—THE AUTHOR DESIGNED the power controller for a pair of quartz halogen lights that he added to his car. The lights are controlled from a tiny pushbutton switch blended into the dashboard.



FOIL PATTERN for the power controller.

schematic for the power controller. The controller is powered from the vehicle's accessory

switch, so the load can receive power only when the ignition key is in the "on" or "accessory"

position. Relay RY1 does the high-current switching (up to 10 amps), and its coil requires only 38 milliamps.

When you turn on the ignition switch in your car and press S1, capacitor C3 charges, causing pin 2 of IC1 (we only use half of a CD4013 dual flip-flop) to toggle high. The high output from pin 2 of IC1 is applied to the gate of FET transistor Q1, which in turn energizes relay RY1. The relay connects the load (up to 10 amps) to the car battery. After C3 discharges, a subsequent high from S1 will toggle the flip-flop again, opening RY1's contacts. Capacitor C2 resets the flip-flop to ensure that pin 2 is low and that the load is disconnected when the accessory voltage is first applied. FET transistor Q1 can easily drive an extra relay in parallel with RY1,

PARTS LIST

All resistors are 1/4-watt, 5%.

R1—10,000 ohms

R2—3300 ohms

R3—1000 ohms

R4—2200 ohms

R5—1500 ohms

R6—10,000 ohms

R7—2.2 megohms

Capacitors

C1—0.1 μ F, ceramic

C2—0.02 μ F, ceramic

C3—0.3 μ F, ceramic

Semiconductors

IC1—CD4013 dual flip-flop IC2—

LM7812 12-volt regulator

Q1—IRF511 field-effect transistor (FET)

D1—1N914 diode

LED1—light-emitting diode (choose color to match existing lighting on dashboard)

Other components

S1—momentary SPST pushbutton switch (choose one that closely matches existing switches on dashboard)

F1—10-amp fuse

SO1—5-pin DIN socket

PL1—5-pin DIN plug

RY1—12-volt, 10-amp relay (Radio Shack part number 275-248, or equivalent)

Miscellaneous: PC board, 10-amp terminal strip, inline fuse holder, aluminum plate, encapsulating material, wire, solder, etc.

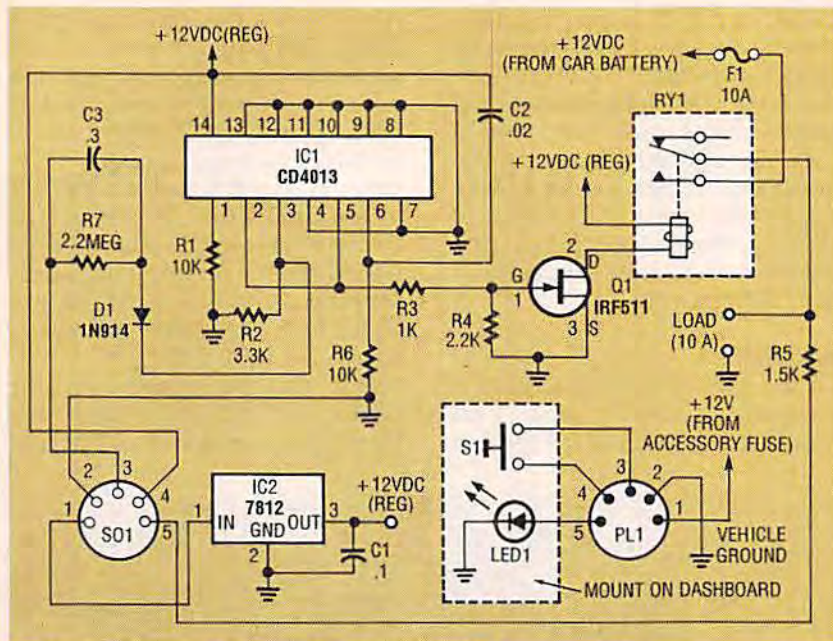


FIG. 3—POWER-CONTROLLER SCHEMATIC. Because the power controller is powered from the vehicle's accessory switch, the load can receive power only when the ignition key is on.

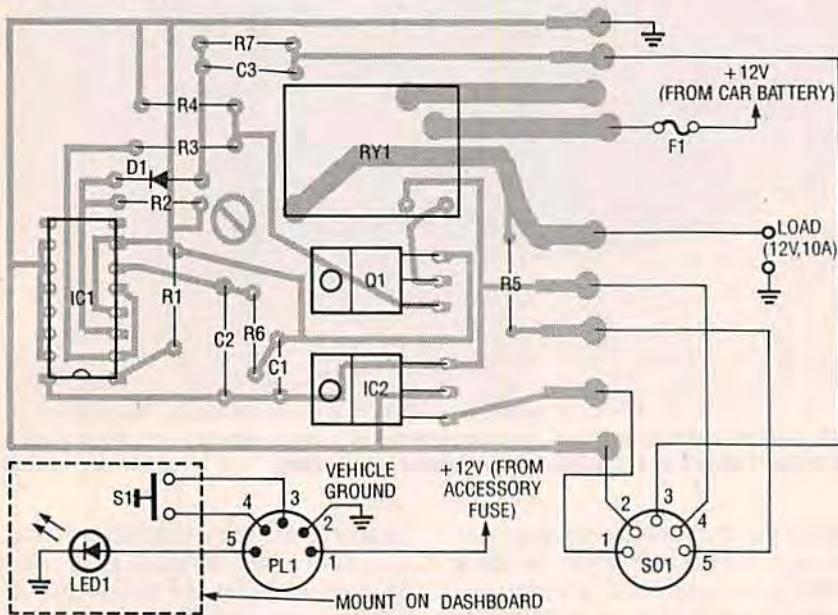


FIG. 4—ALL OF THE PARTS mount on a single-sided PC board for which we've provided the foil pattern.

in case you want to control a second 10-amp load. (Do not connect two 10-amp loads to one relay.)

An LM7812 12-volt DC regulator (IC2) provides a stable voltage to run the circuitry, regardless of fluctuations in the vehicle's power. Capacitor C1 provides decoupling for RY1.

Construction

All of the parts for the power controller should be easy to find

at most electronics supply houses. The electronic components are mounted on a single-sided printed circuit board as shown in Fig. 4. We've provided the foil pattern for the PC board in case you want to make your own. Otherwise, use point-to-point wiring and perforated construction board. Be sure that the gauge of the wire you use for the load connections can handle 10 amps.

A DIN socket (SO1) provides

the low-current external connections to S1, LED1, accessory power, and ground. A matching DIN plug (PL1) plugs into SO1 to make those connections. (The load's power and ground connections should be separate from the DIN connector). The DIN connector also makes it easier to change a power-controller module in case of failure,

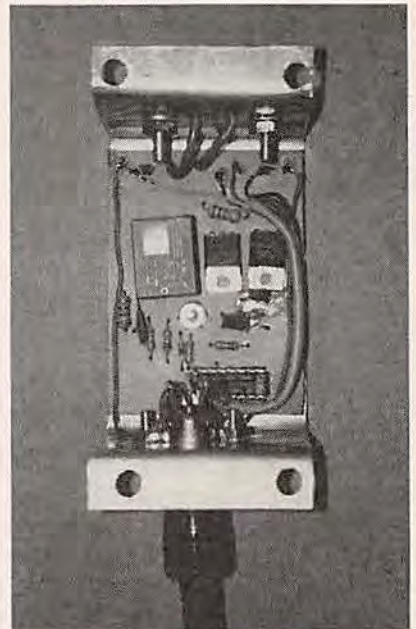


FIG. 5—THE POWER-CONTROLLER board is mounted on a 0.064-inch aluminum plate bent into a U-shaped frame. The DIN socket and the terminal strip are mounted on the sides of the U-bracket.

without having to disconnect any wiring. If you don't have a 5-pin DIN connector, you can use 4-conductor phone wire to connect the module to power, ground, LED1, and S1. If you do that, you must ground the LED to the dashboard or any chassis ground as shown in Fig. 1. A terminal strip provides the connections from the load to the relay contacts.

To make the power controller as durable as possible in a car's engine compartment, the circuit board was mounted on a 0.064-inch aluminum plate bent into a U-shaped frame, as shown in Fig. 5. The DIN socket and the terminal strip were mounted on the sides of the U-bracket. The entire circuit was then encapsulated in a clear plastic resin block (the product is called Casting Resin) as

shown in Fig. 6. Encapsulation is not necessary, but it helps the circuit withstand the vibration, humidity, and temperature extremes found under the hood of a car. You should make sure the power controller works before encapsulating it. After encapsulation, the unit becomes "disposable" if it fails because it can't be repaired.

Installation

After you've encapsulated a working module, you can mount it in your car. Find a

ty. If there's no removable plug in the fire wall, try to snake the new wires through an opening where existing wires already pass through. It's often helpful to poke a coat-hanger wire through the fire wall and to use a hook bent on the end of the hanger to pull the wires through in much the same manner as an electrician uses a fish tape to snake electrical wires through walls.

Next connect power from the load to the controller, and then from the controller to the car



FIG. 6—THE ENTIRE CIRCUIT is encapsulated in a clear plastic resin block help it withstand vibration, humidity, and temperature extremes.

place for the module somewhere under the hood away from a high heat source. (For example, avoid the exhaust-manifold side of the engine.) Route the control wire through the fire wall and connect it to the switch and LED indicator, which you should mount in the driver's compartment. Be sure to drill the mounting holes slowly in plastic.

Snaking wires through a fire wall can be difficult. Sometimes there's a plastic plug that can be removed to gain access to the interior of the car from the engine compartment. Be sure to weatherproof such openings after the power controller is installed so your car won't be draf-

battery. After checking all the connections, install fuse F1. You should now be ready to sit behind the wheel, turn on the ignition, and operate the load that is connected to the power controller.

You can expand the design of the controller to incorporate two relays, both powered by Q1, or to connect something to the normally-closed (NC) side of RY1. However, building an additional power controller might be just as easy. Once you get used to the convenience of our motor-vehicle power controller, you could end up adding a number of custom pushbutton-controlled accessories to your automobile.