

A Club Project — Automatic Mobile Power Control

Avoid power-up transients on your mobile rig.

Jim Cook, W8WKE

I live in a large senior mobile home and recreational vehicle park in South Texas. We have a very active radio club in the winter months that meets every Friday morning. Several of our members are new to ham radio and received their license after they retired. Many of them have no experience in radio or electronics but are interested in learning.

Most years the club picks a construction project to work on together. Several years ago, I designed and built a circuit to turn on my mobile APRS (automatic position reporting system) equipment when I started the car and turn it off when I shut off the car. This will work with a radio connected directly to the battery or a cigarette lighter outlet that is on all of the



time. A total of 15 members decided to build similar units as a group project.

They decided they wanted to have an off delay of several minutes so they could finish a contact or get another APRS message sent before the equipment turned off. They also wanted a bypass switch so they could use their radio with the engine stopped. I redesigned the circuit to meet these requirements. The circuit is based on the change in voltage from about 12.6 V when the engine is

off to about 13.8 V while the engine is running. We set all of the units to turn on at about 13.2 V.

I ordered all of the parts, except the circuit board and power lead connectors, for 15 units from All Electronics and I was very pleased

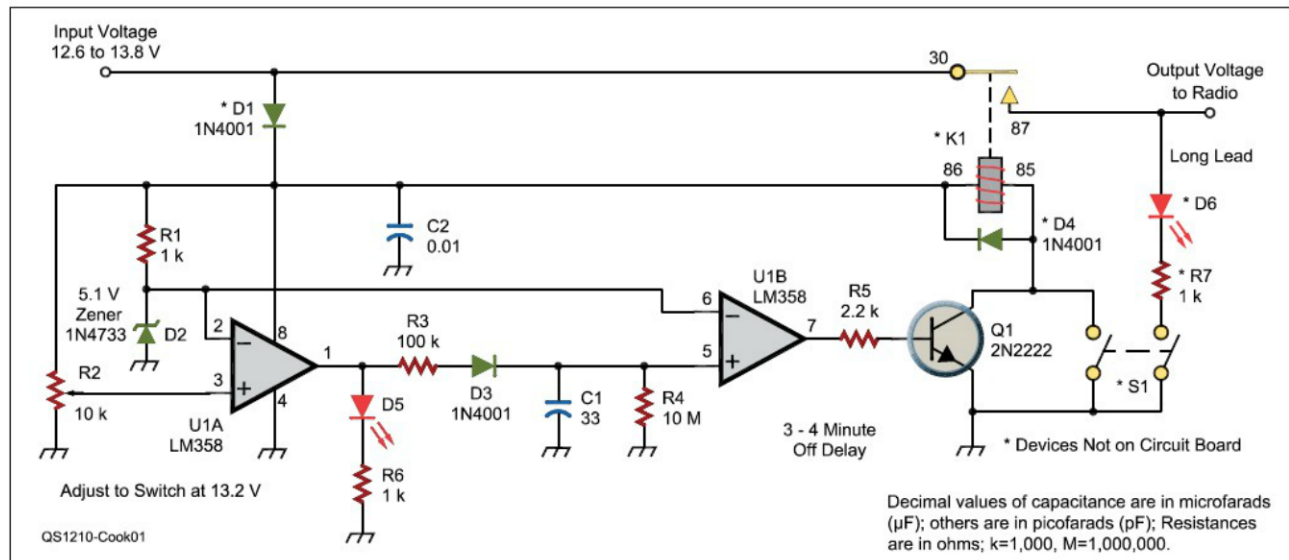


Figure 1 — Schematic diagram and parts list of automatic power controller. Parts with stock numbers are from All Electronics at www.allelectronics.com.

C1 — 33 μF, 35 V capacitor (All Electronics 33R25). [A capacitor with less leakage will improve timing accuracy. — Ed.]
 C2 — 0.01 μF disc ceramic capacitor (All Electronics 103D50).
 D1, D3, D4 — 1N4001 diode (All Electronics 1N4001).
 D2 — 1N4733 5.1 V Zener diode (All Electronics 1N4733).
 D5, D6 — LED (red) (All Electronics LED-1).
 K1 — Relay SPDT, 12 V, 30 A (All Electronics RLY-351).

Q1 — 2N2222 transistor (All Electronics PN2222A).
 R1, R6, R7 — 1 kΩ, ¼ W resistor (All Electronics 291-1 K).
 R2 — 10 kΩ, variable, 10 turn potentiometer (All Electronics RTP-10 K).
 R3 — 100 kΩ, ¼ W resistor (All Electronics 291-100 K).
 R4 — 10 M Ω, ¼ W resistor (All Electronics 291-10M).

R5 — 2.2 kΩ, ¼ W resistor (All Electronics 291-2.2 K).
 S1 — DPDT switch (All Electronics STS-92).
 U1 — LM358 dual op amp (All Electronics LM358).
 Circuit board (RadioShack 276-159).
 IC socket, 8-pin (All Electronics HRICS-8).
 LED two piece mount clip (All Electronics HLED-4).
 Project box 4.7 x 2.6 x 1.55 inches (All Electronics 1591-CSB K).

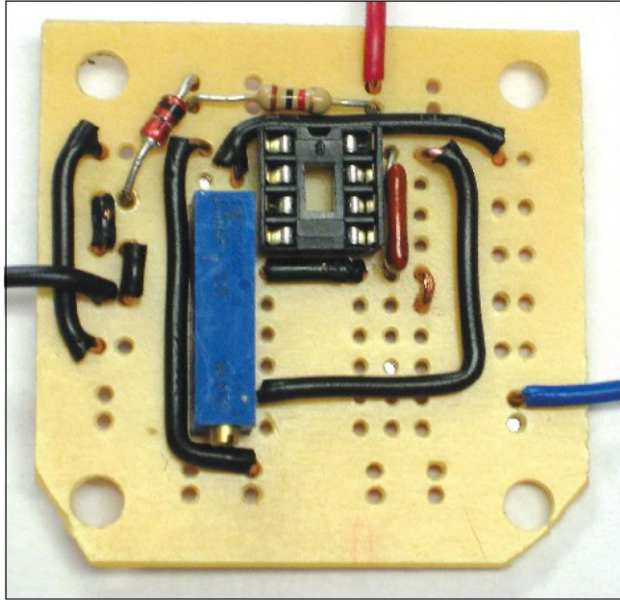


Figure 2 — All of the jumpers and the parts needed for the first test.

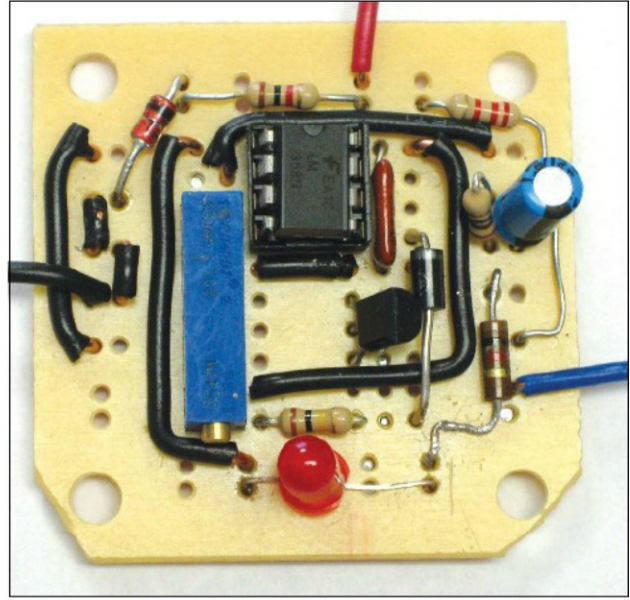


Figure 3 — The rest of the parts mounted on the circuit board ready for testing before mounting in the handy box.

with the way they handled my order. Their website is very easy to use and I was able to get some quantity discounts on many parts. The parts were delivered in about 3 days, all sorted and in plastic bags with the part number and description on a label.

The circuit boards were purchased from RadioShack. I like this circuit board for construction projects because it has large pads for soldering. Many of the hams in our club had never soldered before this project. There are two boards connected together in a package so we split them apart and only used one section for this project.

The total cost per unit including power connectors and mounting hardware was about \$20.

Circuit Description

The circuit and its parts list are shown in Figure 1. Diode D1 is used to protect the circuit from reversed polarity power being connected to the input. The capacitor C2 is for RF bypass to minimize RF interference.

U1A and U1B are op amps used as comparators. The LM358 has two op amps in an 8 pin dual inline package (DIP) that are designed to operate on a single polarity power supply.

Resistor R1 and diode D2 supply the reference voltage needed for the op amps. Resistor R2 is adjusted so that U1A turns on at about 13.2 V. Light emitting diode D5 and resistor R6 are used to make it easy to tell when U1A turns on when adjusting R2.

Resistor R3 is used to limit the current while charging C1 and also provides some on delay to allow the car power system to settle down

before turning on the connected radio. Diode D3 prevents capacitor C1 from discharging through R3 and R6.

Capacitor C1 and Resistor R4 provide the off delay. Op amp U1B will be on when the voltage on pin 6 is higher than the voltage on pin 5. A 33 μ F capacitor and 10 M Ω resistor gives an off delay time of 3 to 4 minutes. The time will vary because of the tolerance of the capacitor and/or the resistor. If you want a different off delay time, change the value of the capacitor and/or the resistor, but I would not use a resistor any larger than 10 M Ω .

K1 is a 12 V, 30 A automotive relay. Resistor R5 and transistor Q1 are used to turn on K1 because the op amp does not have enough power to operate the relay directly. Diode D4 is used to dissipate the energy in the relay coil when the relay turns off.

Switch S1 is used to provide manual bypass to allow using the radio when the engine is off. Light emitting diode D6 is used to indicate manual mode.

Construction Details

Because of the inexperience of the group, I decided to have them build the circuit in sections and test each stage. We started by installing R1, R2, D2, C2, the IC socket and all of the jumpers (see Figure 2). We used a socket for the op amp to be able to easily replace it, in case of a wiring error, because unsoldering an 8 pin DIP is very difficult. Notice the orientation of the circuit board, the top and bottom are not the same. The best way to tell is to look at where the blue wire is connected. We clipped the corners so it would

fit in the handy box better.

Each unit was tested to be sure we had about 5 V on pins 2 and 6 on U1 and we could adjust the voltage on pin 3. We also checked to see that we had power to U1 on pin 8.

Next we installed D5, R6 and the op amp. We tested to see if D5 would go on and off as we adjusted R2. We left R2 adjusted so that D5 just turned off.

The rest of the components were mounted on the circuit board (see Figure 3) and an LED and 1 k Ω resistor temporarily connected from the positive side of the test power supply to the collector of Q1 (blue wire) so we could test the entire circuit board.

We left R2 adjusted so that D5 was off in the previous test. We adjusted R2 until D5 turned on and checked to see that our test LED came on a couple of seconds later. We adjusted R2 so that D5 turned off and checked to see if our test LED stayed on for 3-4 minutes.

We mounted D1 and D4 on the relay (see Figure 4) then mounted and wired the relay, D6, R7 and the switch. The circuit board was mounted (see Figure 5) using $\frac{1}{4}$ inch stand-offs and the red and blue wires connected to the relay. The black wire was connected to the power ground wire.

For the final test we used a variable voltage power supply set at 13.2 V connected to the input leads. A test LED and 1 k Ω resistor were connected to the output leads and R2 was adjusted so D5 just turns on. Then we made sure that D5 turned off when the voltage was set to 12.6 V and turned on

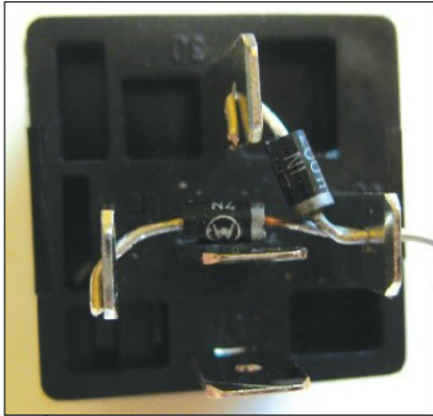
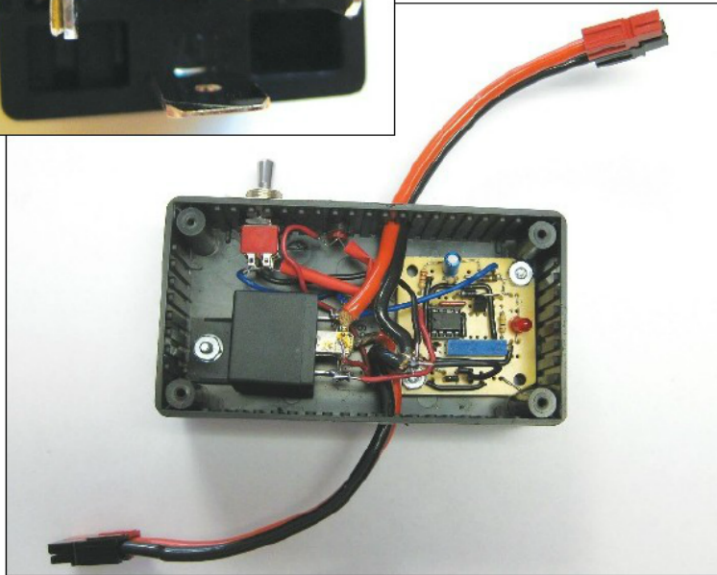


Figure 4 — D1 and D4 mounted on the relay.

Figure 5 — The finished unit mounted in a handy box ready for the final adjustment.



when the voltage was set to 13.8 V. We made sure our test LED turned on when the voltage was above 13.2 V. We then set the voltage at 12.6 V and confirmed that our test LED stayed on for 3 to 4 minutes.

If a variable voltage power supply is not available the unit can be tested and adjusted with a fixed 13.8 V power supply. Temporarily connect a 1N4001 or equivalent silicon diode in series with the power supply positive terminal and connect it to the unit. Because of the 0.7 V drop in the diode, the input voltage will be about 13.1 V. Adjust R2 until D5 just turns on. Then the unit needs to be tested in a

vehicle to be sure it is off when the engine is not running and turns on when the engine is running. Then turn off the engine and confirm that the test LED stays on for 3-4 minutes.

Testing the circuit in stages made trouble shooting much easier. We found cold solder joints, solder bridges, missing jumpers, missing parts and misconnected parts. We were able to fix all of the problems and did not destroy any parts.

A special thanks to Ron Maeder, KC2JGP, for working out the details for mounting all of the parts in a handy box. He built various jigs

so he could drill all of the holes the same in all boxes. He brought his drill press to one of our meetings and drilled all of the holes.

We meet in a computer room that has an overhead projector and screen. I took pictures of the prototype circuit board as each part was installed and showed them on the screen during construction. We set up several soldering stations, since not everyone had soldering equipment. The prototype also got passed around to help with parts placement. We discovered that lighted headband magnifiers are a great help for our age group!

Everyone seemed to enjoy the project and they are looking forward to a new project next season.

ARRL member Jim Cook, W8WKE's first receiver was a foxhole radio using a razor blade for a detector, built from plans in a *Boy's Life* magazine while he was in junior high school. He was first licensed as a novice, WN8WKE, in 1955 and now holds an Amateur Extra class license. He received a FCC First Class Commercial General Radiotelephone license in 1962 and received a BS in Engineering Technology with an electronics major from Western Michigan University in 1963. Jim was a licensed professional engineer in Ohio for several years. Jim started work as an electrical engineer with the Delco Products Division of General Motors in Dayton, Ohio in 1963 and retired in January 1999.

Jim and his wife Sharon, KC8TFN, are enjoying retirement in the Fun N Sun seniors' RV/mobile home park in south Texas. He is an active member of the park radio club. Jim enjoys designing and building homebrew projects. He has been operating PSK31 since 2001 and this is now his favorite mode.

You can reach Jim at 1400 Zillock Rd, Lot U3, San Benito, TX 78586 or at w8wke@arri.net.

For updates to this article, see the QST Feedback page at www.arri.org/feedback.



Feedback

- In "The Evolution of DX Spotting" [Oct 2012, pp 71-72] the author noted that he used the work "splitter" when he meant "skimmer" when describing certain terminology related to the Reverse Beacon Network.
- In "The Uncooperative Tree" [Sep 2012, p 30-32] the value of the inductors in Figure 2 should have been shown as 33 μ H.

- In "Power Carts for Scouts and Field Operations" [Sep 2012, pp 36-40] switch S3 in Figure 6, shown as a DPDT center-off switch, could be a SPDT center-off unit instead.
- In "A Digital Interface for Fldigi" [Aug 2012, pp 36-38] Figure 1 shows the connectivity of the output pins of U2 in error. Pin 4 should go to MIC GROUND, pin 5 should go to PTT and pin 6 should be left unconnected. The miniature audio isolation

transformers, T1-T3, are no longer listed by RadioShack. Rick, WA6NUT, suggests the Triad TY-145P as a suitable replacement. It is available from the usual suppliers, including Jameco (www.jameco.com) and Mouser (www.mouser.com).

- In "My Tuner Tuned My Antenna — But Now It Doesn't!" [Aug 2012, p 47] the caption to Figure 1 should say TLW TUNER output, not EZNEC TUNER output.