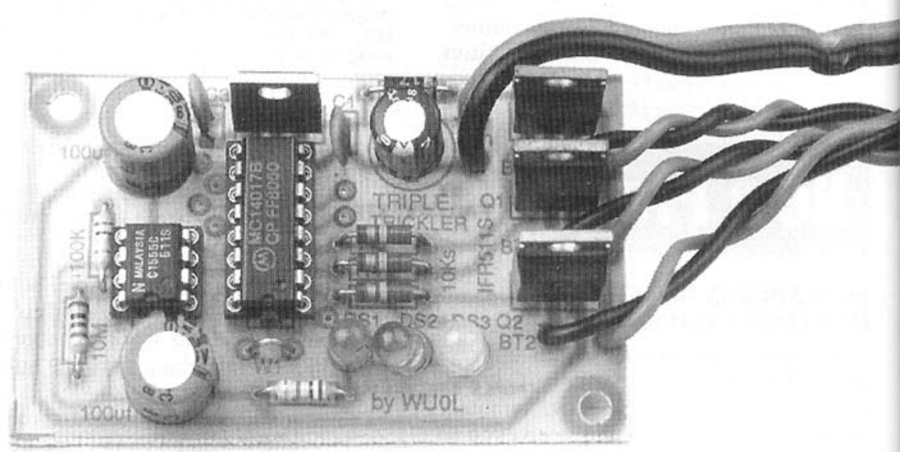
By Mark L. Meyer, WUØL

The Triple Trickler

A few dollars, a bit of spare time and you'll have an easy way to keep your batteries in top shape!



Have you ever had a hassle keeping your RV and portable-operation batteries charged? Do you have trouble remembering to fire up the trickle charger and then move it from battery to battery? That's the predicament I found myself in for the past several years. I have a large, deep-cycle lead-acid battery for my camping and Field Day radio operations, one more for the pop-up camper, and a smaller motorcycle battery that I also use for portable operations. After suffering a premature failure of one of my batteries (which I attributed to letting it become discharged over a long period of time), I decided to automate my trickle charging. Now, I just plug in a wall charger, hook up the batteries and forget about them for months at a time!

Triple Trickler Circuit

Figure 1 is a schematic of the circuit I developed to continuously cycle a single dc source from one battery to the other to keep each battery up to snuff. The system consists of a power source (in my case, a dc-output wall transformer or "wall wart"), the controller (the Trickler) and the batteries to be charged. The controller continuously switches the dc power source from one battery to the next.

The controller can be built to handle up to 10 batteries, but remember: Each battery shares an equal amount of charger time. This means that if the system is set up to service three batteries, each one gets charged *one-third* of the time. A 10-battery system allows each battery to be charged only one-tenth of the time. This may not be enough to keep the batteries fully charged.

In Figure 1, a CD4017 decade counter (U3) counts the clock pulses fed to it. Initially, the first digit (pin 3) is high. On receiving the next clock pulse, the second digit (pin 2) goes high and pin 3 goes low. On the next pulse, the third digit (pin 4) goes high, and so on, until all 10 digits are counted, then the process repeats. By using a jumper connected to U3 pin 15, the count can be controlled to set the restarting point. The other end of the jumper is connected to the U3 pin (7, 10, 1, 5, 6, 9, or 11) representing the digit that is *one higher* than the number of batteries to be charged. For three batteries, I wanted the count to go to three, so the jumper is shown connected to the fourth digit, pin 7. (Four batteries require connection to U3 pin 10, and so on, with pin 11 representing the highest number, 11, for use with 10 batteries.

The clock pulse to U3 is provided by the output of U2, a 555 timer. U2's output frequency is set by the time constant determined by the values of R1 and C5. With R1 at 10 MΩ and C5 at 100 μF as shown, U3 provides an output pulse approximately every 13 minutes. This means U3 will sequence to the next digit every 13 minutes, and a complete cycle of three digits takes 39 minutes before starting over. Larger values for R1 and/or C5 will increase the length of time for each output. Electrolytic capacitors, such as C5, have a wide tolerance, so depending on the actual value of C5, the timing could vary considerably from the specified 13 minutes, but it is not at all critical.

Three outputs of U3 turn on an IRF511 MOSFET (Q1, Q2 or Q3) that completes the charging circuit for each battery by providing a connection to ground. An LED (DS1, DS2 and DS3) on each of the three outputs of U3 provides a visual indication of the charging sequence. MOSFET devices have a very low turn-on resistance. Therefore, very little heat is generated by Q1 through Q3. My power supply will charge the battery at up to 500 mA when first connected to a low battery. At this rate, the tab on an IRF511 does not even get warm to the touch and no heat sinking is necessary. At higher charge rates, it may be wise to heat-sink these devices if any sign of heating is detected. The IFR511 is rated at 3 A continuous duty.

U1 provides a constant 12 V to U2 and U3. Its main function is to protect U2 and U3 from voltages exceeding their ratings because the open-circuit power supply or wall transformer output voltage may exceed the 16 V rating of U2 and U3. D1 prevents the batteries from back-feeding the circuit if the power supply is disconnected. D1 is a Schottky diode. A Schottky is chosen to keep the forward voltage drop low. If your power supply provides plenty of voltage, an ordinary rectifier diode can be substituted. The wall charger I use has a rated output of 15 V dc at 400 mA.

Construction

The circuit can be built in most any fashion. A PC board is available,[1] but you can use perf board, too. During assembly, take

[1]A PC board for this project is available from FAR Circuits, 18N640 Field Ct, Dundee, IL 60118-9269, tel 847-836-9148 (voice and fax). Price: $4 plus $1.50 shipping for up to four boards. Visa and MasterCard accepted with a $3 service charge. (Visit the FAR Circuit's Web site at **http://www.cl.ais.net/farcir/** to see a catalog of other available PC boards.—*Ed.*)

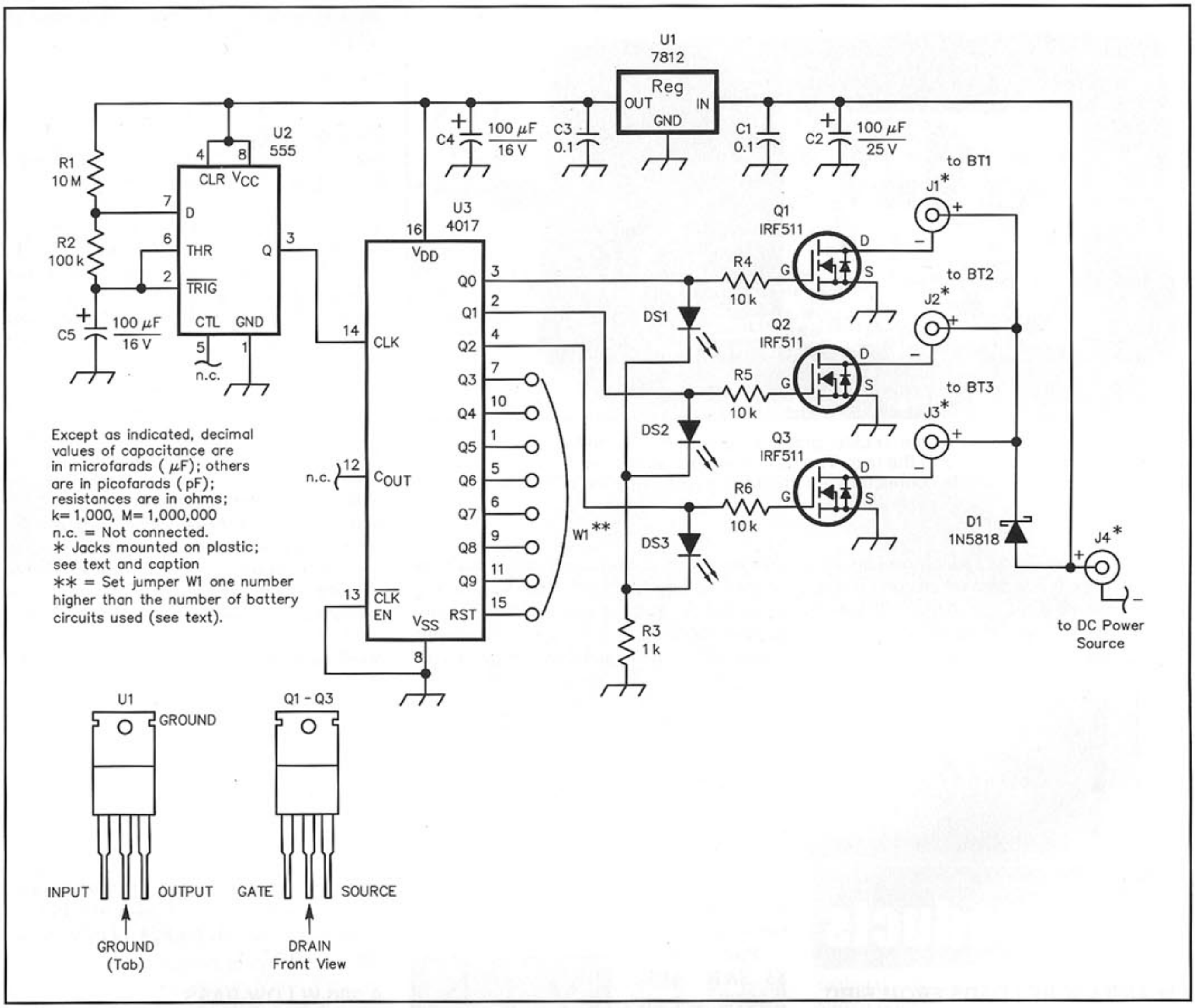


Figure 1—Schematic of the Triple Trickler circuit. J1 through J3 are insulated from ground by mounting them in a plastic box. Mating plugs connect Q1 through Q3 to their respective batteries. Part numbers in parentheses are Mouser; equivalent parts can be substituted (Mouser Electronics, 2401 Hwy 287 N, Mansfield, TX 76062, tel 800-346-6873, 817-483-4422; fax 817-483-0931 e-mail **sales@ mouser.com**; **http://www.mouser.com**). Unless otherwise specified, resistors are 1/4 W, 5% tolerance carbon-composition or film units.

C2—100 µF, 25 V (#539-SKR25V100)
C4, C5—100 µF, 16 V (#539-SKR16V100)
D1—1N5818, 1-A Schottky diode (#583-FM5818)
DS1-DS3—Small red LED (#512-MV57774C)
J1-J4—Dc power jacks, 2.5 mm ID, 5.5 mm OD (#163-4025); do not use jacks equipped with internal, normally closed switches.
P1-P4—Mating plugs (not shown) for J1-J4 (#172-4201). These plugs have pre-attached 72 inch long wires.
Q1-Q3—Power MOSFET (#333-IRF511)
U1—7812, 12 V, 1 A positive regulator (#511-L7812CP)
U2—555 timer (#511-NE555N)
U3—4017 decade counter (#511-4017BM)
Misc: enclosure (Radio Shack 270-223; see text); dc panel-mount jacks; mating dc cable plugs; hardware; wall transformer.

the usual precautions to protect Q1 through Q3 and U3 from static discharges.

The controller can be mounted in a plastic case commonly available from Radio Shack or other electronic parts suppliers. I used a plastic box with external dimensions of approximately 2×3×6 inches (HWD); it provides more than ample room. Coaxial power jacks and connectors attach the wall transformer to the controller and the controller to the batteries. Using a plastic enclosure ensures J1 through J3 are isolated from ground.

I made provision in my unit to be able to charge a fourth battery (should I acquire one) by installing a fourth IRF511 (Q4) and associated circuitry (not shown in the schematic). Now, if I want to activate the fourth charging circuit, all I have to do is move the jumper from U3 pin 7 to U3 pin 10, and connect another jumper from U3 pin 7 to the junction of the added 10 kΩ resistor (R7) and LED (DS4).

Testing is easy. Using jumpers, connect a 100 kΩ resistor in parallel with R1. This decreases U1's timing cycle to 22 seconds. (This is done so you don't otherwise have to wait 13 minutes to check each clock pulse!) Apply power from your power supply and you should see one of the LEDs light up. In approximately 22 seconds, that LED should extinguish and the next LED light up, and so forth in a continuous cycle. Then connect the batteries. With your VOM in the ammeter mode, check that each battery is getting a charging current as its associated LED lights. Then, disconnect the temporarily added 100 kΩ resistor and the unit is ready for service.

If your power supply delivers more voltage than you need, insert one or more diodes in series with the lead to the control-

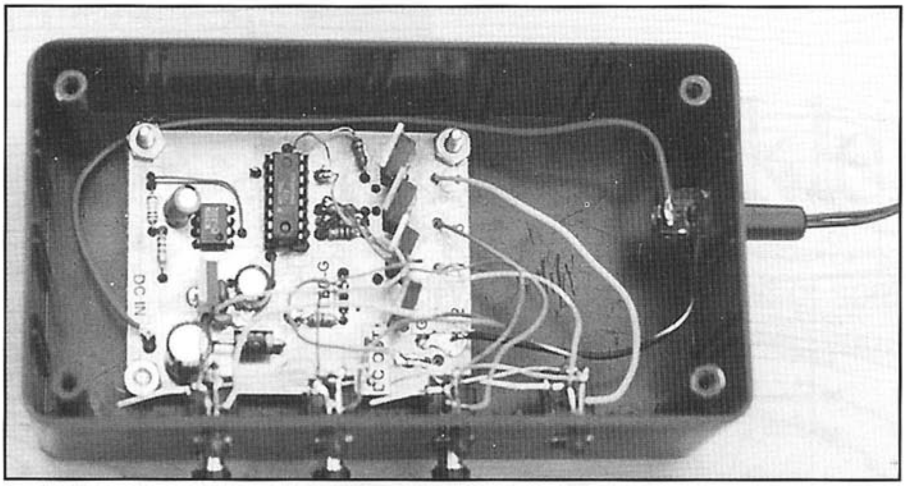


Figure 2—This inside view of the Trickler prototype shows the fourth MOSFET, LED and output connector mentioned in the text. The dc connectors on the front panel are those I had in my junk box; suitable connectors are identified in the parts list of Figure 1.

ler. Each silicon diode added provides approximately a 0.7 V drop when conducting in the forward direction. This will lower the charging current. When my batteries are in good shape, my 15 V dc wall charger charges them at about 300 mA, and their resting voltage is about 13.5 V, which is close to optimum. If you use a wall transformer, be sure it provides a *dc* output. Some wall transformers deliver *ac*. To use an ac-output transformer, you'll have to add a rectifier circuit.

Summary

Remember: This unit should be used only for *trickle* charging. When you discharge your batteries on a field expedition, first recharge them using your regular battery charger. (Also, you may want to top them off with your standard battery charger before major usage is contemplated.) In between, however, you can rest assured that your batteries are kept in good condition by connecting them to the Trickler. My unit has been in service several months now and it is a delight! I just connect it and forget it!

Mark L. Meyer, WUØL, was first licensed in 1965 as WNØNSY when he was a high-school senior. He homebrewed his first transmitter and has been homebrewing ever since. Mark graduated with a BSEE from South Dakota School of Mines and Technology in 1970, and has worked in hydroelectric power generation and transmission since then. Mark is currently involved in the operation of the high-voltage electric grid in the western United States. You can contact him at 14153 W First Dr, Golden, CO 80401, e-mail **wu0l@aol.com**. QST

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