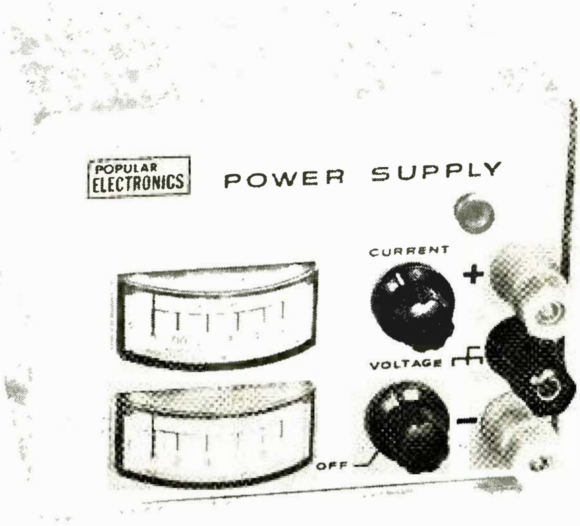


Experimenter's "Professional" Power Supply

- ADJUSTABLE 0-10 VOLTS
- ADJUSTABLE 0-500 mA
- SHORT-CIRCUIT-PROOF
- ALL FOR ABOUT $20

BY DON LANCASTER

LOOKING FOR a professional-quality low-voltage power supply? Here's one that puts out 0-10 volts at half an ampere or less, is fully regulated, and automatically protects both itself and your circuits from any possible damage. An adjustable current limiter sets the absolute maximum current that can possibly be delivered to the circuits—no high damaging currents are possible should an accidental short circuit or polarity reversal occur. The power supply can even run short-circuited overnight with no harm!

This power supply circuit (Fig. 1) is ideal for IC experiments, where you can easily set the 3.6 or 4.5 volts at the high-current levels you will need in multiple circuits. You'll also find it handy as a battery eliminator for transistor radio servicing, and a general replacement for "D" cells or similar batteries in bench experiments, and anywhere else you're working with transistor or IC circuitry.

The performance specs are very impressive: less than 1 millivolt of r.m.s. output ripple; regulation better than 300 millivolts, no load to full load. There are dual meters, one for voltage and one for current, with no confusion over what scale you are reading. Two controls are provided—one for adjusting voltage, the other to set the short-circuit current limit. And the split output terminal design gives you either a positive or negative case ground. All this in a three-pound 3″ x 4″ x 5″ package you can easily put together in several evenings for $15 to $30, depending upon how fancy you care to get.

Construction. The power supply will just fit in a 3″ x 4″ x 5″ metal box. Holes for the meters are cut with a nibbling tool. Color-coded five-way binding posts are used at the output, red for +, yellow for −, and black for the case. If you use *exactly* ¾″ mounting centers between the binding posts, you can use a standard double banana plug connector to your experimental projects. Line switch *S1* mounts on the rear of voltage-adjust potentiometer *R6*.

Although not essential, a small printed circuit board greatly simplifies the wiring and makes all the small parts easy to mount. The board should be laid out and drilled as shown in Fig. 2. Component layout and interconnections are shown in Fig. 3. Be very careful of all circuit and component polarities. The PC board mounts on the chassis spacers with four #6 screws.

To bleed the heat from *Q3*, use a Wakefield NC623K heat sink drilled to suit the 2N3766 unit specified, and an insulated

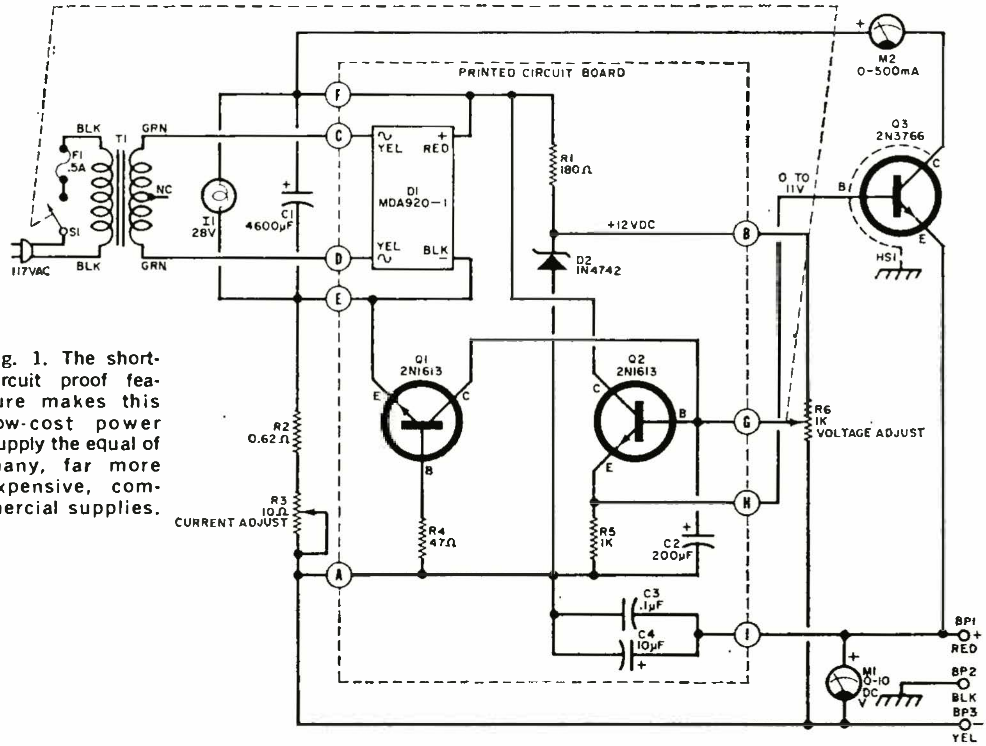


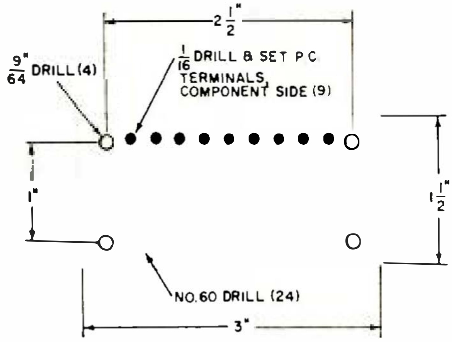
Fig. 1. The short-circuit proof feature makes this low-cost power supply the equal of many, far more expensive, commercial supplies.

PARTS LIST

BP1, BP2, BP3—5-way binding post, one red, one black, one yellow
C1—4600-μF, 15-volt computer-grade electrolytic capacitor (Sprague 462G015AA, or similar)
C2—200-μF, 15-volt electrolytic capacitor
C3—0.1-μF, 50-volt miniature disc ceramic capacitor
C4—10-μF, 15-volt electrolytic capacitor
D1—1.5-ampere, 50-volt, full-wave bridge rectifier (Motorola MDA930-1, or similar)
D2—12-volt, 1-watt zener diode (Motorola 1N4742, or similar)
F1—0.5-ampere fuse with holder
HS1—3" x 4 7/16" flat-finned heat sink (made from Wakefield NC623K—see text)
I1—28-volt, miniature pilot light assembly
M1—0-10 d.c. voltmeter, edgewise-type (Emico Model 13, or similar)
M2—0-500 d.c. milliammeter, edgewise-type (Emico Model 13 or similar)
PC1—1½" x 3" printed circuit board
Q1, Q2—2N1613 transistor
Q3—2N3766 transistor with mounting kit for TO-66 case
R1—180-ohm, ½-watt carbon resistor
R2—0.62-ohm, 1-watt carbon resistor
R3—10-ohm, 5-watt miniature wire-wound potentiometer (Mallory VW-10, or similar)
R4—47-ohm, ½-watt carbon resistor
R5—1000-ohm, ½-watt carbon resistor
R6—1000-ohm, ½-watt potentiometer (with s.p.s.t. switch S1)
S1—S.p.s.t. switch (on R6)
T1—12.6-volt, 2-ampere filament transformer (Allied Radio 54 D 1420 or similar)
1—3" x 4" x 5" enclosure (Bud CU-2105-A, or similar)
1—Hard anodized-aluminum dialplate, available from Reill's Photo Finishing, 4627 N. 11th St., Phoenix, Arizona 85014; in silver color for $2.75, red or copper for $3.25, postpaid in USA; stock #PSY-1 (optional)
Misc.—Insulated mounting kit and #6 hardware for Q3, line cord and strain relief, ¾" knobs (2), mounting clip for C1, ground strap for BP2, #10 nylon cup washers (4), TO-5 transistor pads (2), printed circuit terminals (9), solderless terminals (9), wire nut, #6 hardware, wire, solder, etc.

mounting kit. (As this heat sink is a $1.50 item, you might prefer to build your own with ⅛" aluminum or some other low-priced material.) Use silicone grease on *Q3*, and check to be certain the transistor is insulated from the heat sink proper. The heat sink mounts on the rear of the case with pop rivets or #6 hardware.

Assembly. The various elements are assembled in the case in accordance with the layout selected. Figure 4 shows the author's unit before wiring. The printed board is mounted at the top, directly above the two meters, and the fuse holder is at the rear. The two potentiometers and three binding posts are also visible. The transformer (*T1*) and filter capaci-



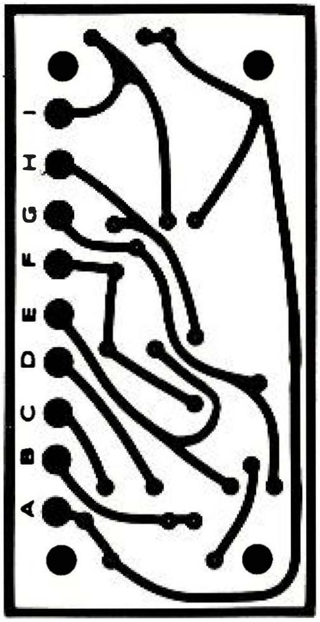


Fig. 2. Foil side of full-size PC board (right) is drilled as shown above and components mounted as shown in Fig. 3.

HOW IT WORKS

The power supply circuit uses full-wave, capacitor-filtered, 16-volt, unregulated d.c. generated by 12.6-volt, 2-ampere filament transformer *T1*, rectifier bridge module *D1*, and filter capacitor *C1*. Transistors *Q2* and *Q3*, and 12-volt zener diode *D2* make up a voltage regulator. Together *Q1* and *Q2* have a gain of around 10,000, effectively "amplifying" the filtering effect of capacitor *C2*. Voltage-adjust potentiometer *R6* across *D2* permits setting the output voltage smoothly from zero to 10 volts. A heat sink is required for *Q3* as it will dissipate about 16 watts in the short-circuit mode.

A silicon transistor needs 0.6 volt between base and emitter before it will conduct current. To get short-circuit protection, a 0.62-ohm current sensing resistor (*R2*) is placed in series with the output, and transistor *Q1* is connected across this resistor. As long as the current is less than 1 ampere, the voltage drop across *R2* is less than 0.6 volt, and *Q1* stays *off*. If too much current flows, *Q1* immediately turns *on*, and robs the zener diode of its supply voltage; the output voltage drops immediately, thus preventing any fault currents. A wire-wound control potentiometer (*R3*) connected in series with the 0.62-ohm resistor permits setting the maximum short-circuit current to be delivered to a load.

tor *C1* are mounted on the rear wall of the case. Long leads are used to interconnect these two components, and to wire *Q3* to the PC board.

Wiring should present no major problems. Use #18 wire on the high-current portions of the instrument—between the collector of *Q3* and meter *M2*, from *M2* to terminal F of the PC board, from the emitter of *Q3* to the red (+) binding post, and between the yellow (−) binding post and *R3*, *R3* to *R2* (*R3* can be soldered directly to *R2*), and *R2* to ter-

(*Continued on page* 105)

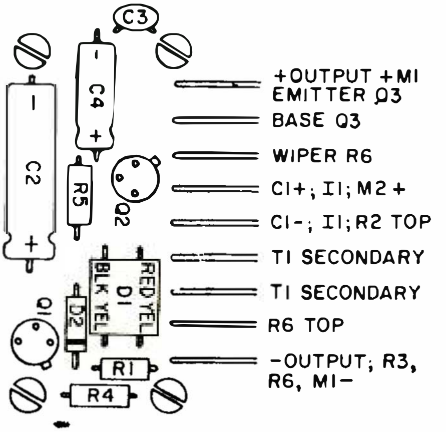


Fig. 3. Parts arrangement on component side of the printed board. Observe polarity of the capacitors.

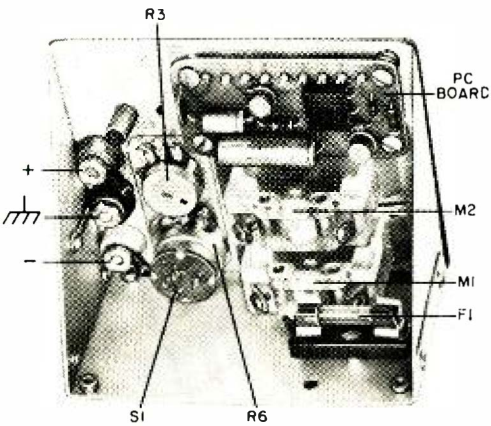
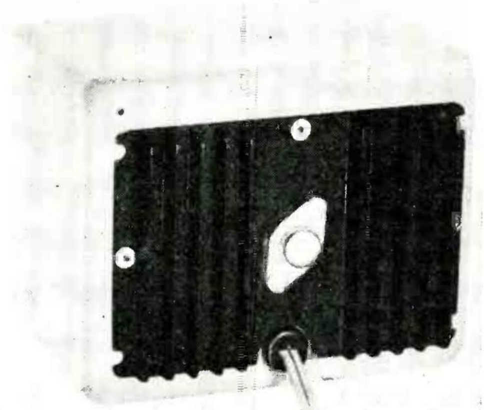


Fig. 4. Author's unit before wiring. Capacitor C1, transformer T1, and transistor Q1 are on rear cover.

point is moved, mentally, one or two places to the left (as the setting of the *Range* switch requires) and, when necessary (on the 1.5- and 15-volt ranges), the reading is multiplied by three. -30-

POWER SUPPLY

(*Continued from page* 73)



For good heat dissipation, mount transistor Q3 on a heat sink and bolt both to outside rear of cabinet.

minal E of the PC board. Four #10 nylon cup washers serve as feet.

Current Limiting. The current limit can be preset from 50 to 500 mA. Up to about three-quarters of the current limit, the power supply produces a constant-

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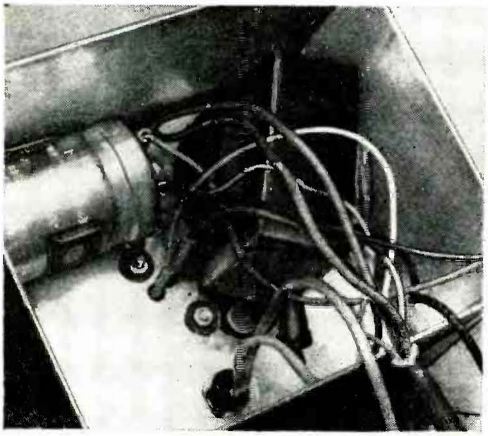

Use long leads when connecting transformer T1, capacitor C1, and power transistor Q3 in the circuit.

voltage output. When the predetermined critical current value is reached, the regulator automatically switches over from constant voltage to constant current. For instance, suppose your circuit takes 60 mA of current under normal conditions. You would simply set your current limit about double, say 120 mA.

As long as the circuit is working properly, you get constant voltage out of the supply. Should a polarity reversal or a fault occur, the supply will provide no more than 120 mA, even to a short circuit, thus automatically protecting both itself and your circuits from a careless mistake or an inadvertent wiring error. The response time to a fault is measured in microseconds—much faster than any fuse or circuit breaker could possibly respond. —30—

COLOR CODE QUIZ ANSWERS

(Quiz appears on page 70)

A **Axial Lead Resistor**
Value: 27,000 ohms Tolerance: ± 5%

B **Molded Tubular Paper Capacitor**
Value: 0.1 uF Tolerance: ± 30%
Voltage: 1200 volts

C **Molded Flat Mica Capacitor**
Value: 470 pF Tolerance: ± 10%
Code: JAN Class: C

D **Temperature-Compensated Tubular Ceramic Capacitor**
Value 8 pF Tolerance: ± 0.1 pF
Temp. Coef.: −75 PPM/°C

E **Mylar/Polyester Film Capacitor**
Value: 5600 pF

F **Radial Lead Resistor**
Value: 3.6 megohms Tolerance: ± 10%

G **Standoff Ceramic Capacitor**
Value: 68 pF Tolerance: ± 5%
Temp. Coef.: −220 PPM/°C

H **Ceramic Disc Capacitor**
Value: 720 pF Tolerance: ± 5%
Temp. Coef.: −150 PPM/°C

J **Molded Choke Coil**
Value: 1.5 uH Tolerance: ± 10%
Code: MIL

K **Button Silver Mica Capacitor**
Value: 391 pF Tolerance: ± 10%