Educator II
Power Supply Kit

HEP KIT by MOTOROLA

Assembly and Operation Manual

KEY FEATURES

- Designed specifically for the Educator II.
- Regulated 5.0 ± 5% volts d.c. output @ 1.0 amps.
- 60 Hz real time clock available (approximately 5.1V peak-to-peak).
- Complete kit — all parts, cabinet and construction manual.
- Easy, one evening construction.

5-Volt Regulated Power Supply

You are about to build a most useful power supply. It is designed to provide a regulated source of 5-volts DC, up to 1 ampere. Typically, a 5-volt supply is one of the first items that an experimenter requires. 5-volts is the standard source for almost all TTL circuitry and most other transistorized and IC circuits can be powered from such a source.

We've supplied you with all the parts you'll need to build this kit — Including solder (use only the resin-core "radio" type. If for any reason you need more than we have supplied).

And, of course you'll need some standard tools . . . a pair of wire cutters/ strippers, long-nose pliers, a screwdriver, and a soldering iron will do the job.

Let's talk about the soldering iron a little. It does the vital job of melting solder around an electrical connection. Use the right size and type. A 20-30 watt unit with a small pencil-type tip is the best for this type of work.

Never soldered before? Well, now is the time to learn. It is very important to all electronic circuits — and really it's quite simple. A little practice will help you do it right.

There are three basic rules:

1. **Use enough heat.** That's a function of the size (wattage) of the soldering iron and how long you hold it on the connection.
2. **Use the right soldering iron.** We've already told you the right type of "iron" (20-30 watt, with small, pencil-type tip).
3. **Use the right solder.** Use only resin-core "radio" type. *NEVER USE ACID-CORE* or "plumber's" type.

Now — how to make a connection.
It's easy as 1 — 2 — 3 — 4!

1. Join bare metal to bare metal. Make solid mechanical connections and keep leads as short as possible.
2. Melt a fresh coat of solder over the tip of the iron (this is called "tinning the iron"). This makes it easier for heat to be transferred from the iron to the connection.
3. Press the tip of the hot iron against the connection to be soldered.

4. Keep the iron there and add solder between the connection and tip of the iron. Use enough solder to flow over all wires in the connection. Remove the iron and let the connection cool.

If you accidentally move wires before the connection cools, just reheat it with your iron.

Always check your connections when done. The finished connection should have a smooth metallic finish. The best connections will have a bright shine and the solder will have formed a neat, even coating around all leads and parts in the connection. If you can move a lead end in the connection, it needs to be reheated (sometimes you might even want to add a *little* solder).

Look out for — too much solder (flows down over a terminal to the chassis or even between adjacent leads or terminals) — too little heat (connection will have a dull, flaky appearance, or solder forms into a ball, instead of spreading).

You can remove excessive solder with the hot tip of your iron (or use a special desoldering tool). Dull, flaky connections can be reheated with the iron.

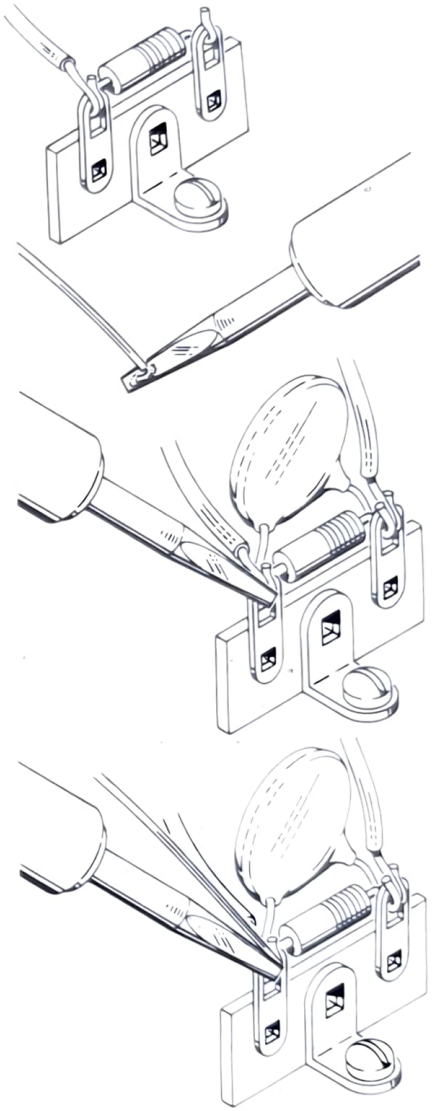
OK, got that? Try a few experimental connections with some spare wires, terminals, PC boards, etc.

1 **MECHANICAL CONNECTION**

2 **TINNING THE IRON**

3 **APPLYING HEAT**

4 **ADDING SOLDER**



MOUNTING PARTS ON THE CHASSIS

REFER TO FIGURE 1.

- ☐ Mount the two terminals strips inside the chassis-box where shown. Fasten with **small** screws, lockwashers and nuts.
- ☐ Mount the Fuse Holder with a **small** screw, lockwasher and nut.
- ☐ Mount S-1 Power Switch with two **small** screws, lockwashers and nuts. Position so the two terminals are up (blank space down).
- ☐ Locate the Transistor. It is a flat plastic package with three leads and the number S5028 on it. Study the part and you'll see one side has exposed bare metal — this side must be down against the chassis.
- ☐ Mount the Transistor (Q-1) as shown in Figure 2 — with the leads going into the **lower** holes of TS-2 terminals 1, 2, and 3:
  - E goes to terminal 1
  - C goes to terminal 2
  - B goes to terminal 3

  Secure Q-1 to the chassis with a **small** screw, compression washer, mica insulator and nut. **Be sure you place the mica insulator between chassis and bare metal side of Q-1.**
- ☐ Position T-1 Power Transformer inside the chassis with the black wires to your left. Mount with two large screws, lockwashers and nuts.

Be sure the screws and nuts are tightly secured. We'll wait till later to mount some other parts (it's easier to add wires without those parts).

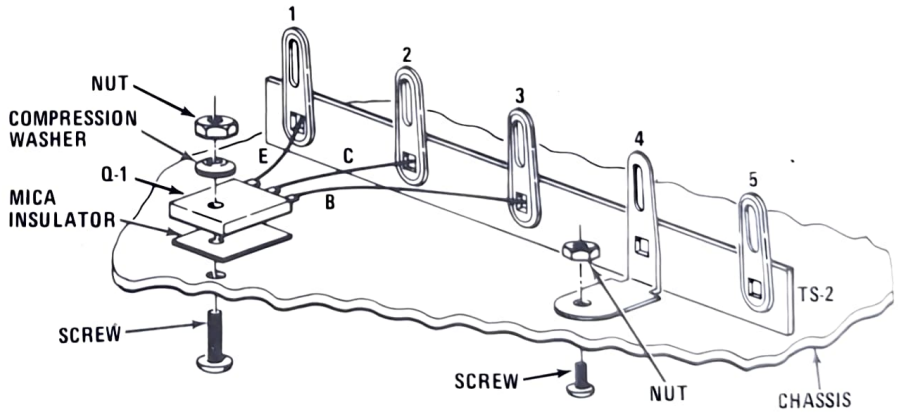


FIGURE 2

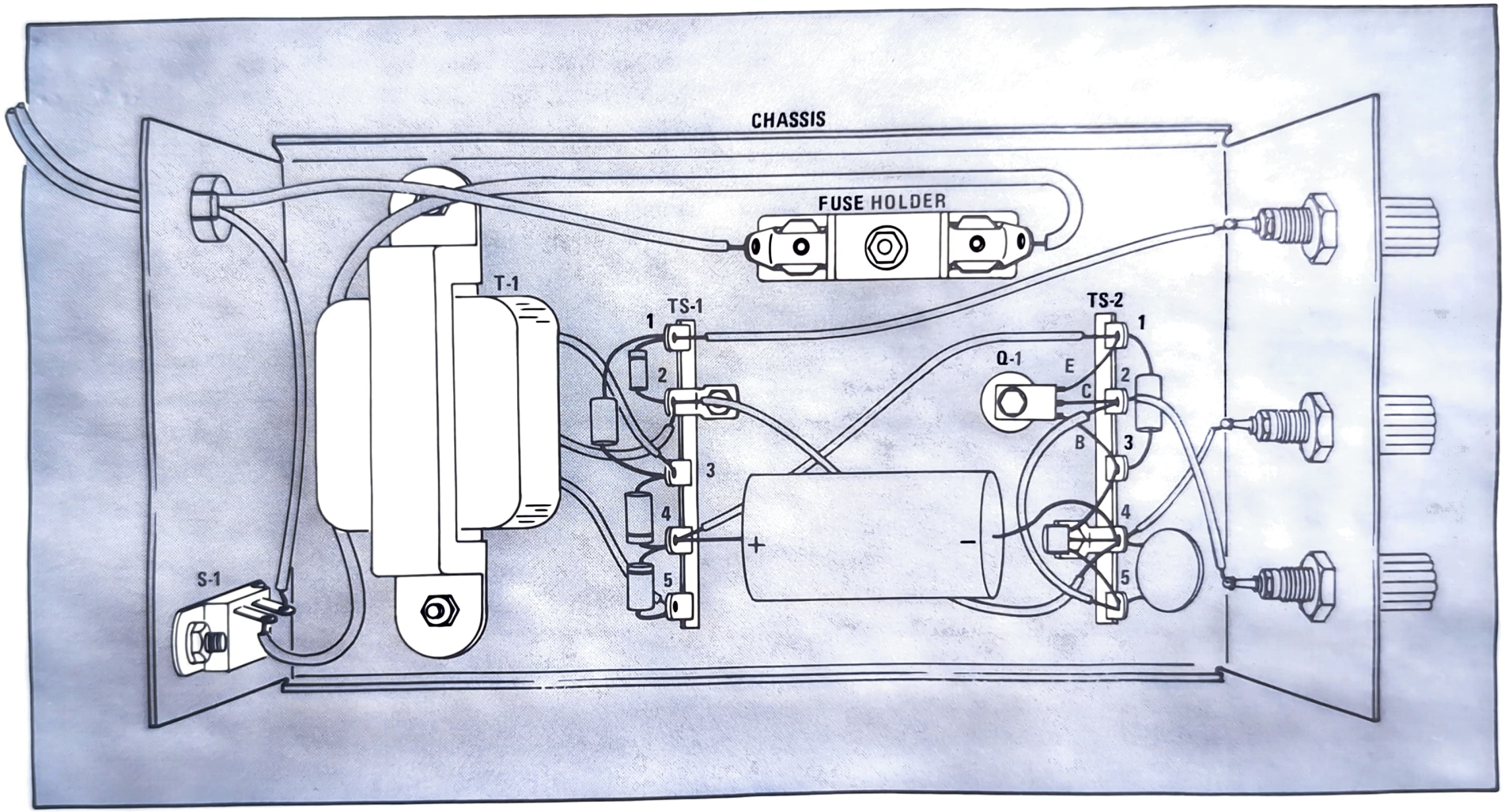


FIGURE 1

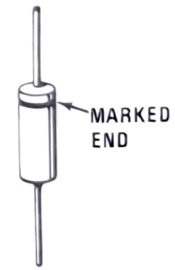
ADDING THE WIRING

REFER TO FIGURE 3.

NOTE: We will not have you solder wires and connections until all are in place; this way you can solder all at once, and know you've got it all. Of course, if you prefer, when you see all connections to a terminal are complete, you can solder it (that's up to you).

When we tell you to use wire, cut it to length and *carefully* remove about ¼" of insulation from the end(s) to be connected.

- ☑ Cut a 4¼" piece of wire from the length supplied. Connect one end to terminal 2 of TS-1. Connect the other end to terminal 4 of TS-2.
- ☑ Cut another 4¼" length of wire. Connect one end to terminal 4 of TS-1. Connect the other end to terminal 1 of TS-2.
- ☑ Cut a 1¾" length of wire. Connect one end to terminal 2 of TS-2. Connect the other end to terminal 5 of TS-2.
- ☑ Carefully cut one Black Transformer lead to 2½" and remove ¼" of insulation. Connect to the lower terminal of S-1.
- ☑ Carefully cut the other Black Transformer lead to 6" and remove ¼" of insulation. Connect to terminal 2 of the Fuse Holder.
- ☑ Cut the remaining 3 leads of the Transformer to 3" and remove ¼" of insulation from the ends. Connect these wires as follows:
  Yellow to terminal 2 of TS-1.
  Either Green to terminal 3 of TS-1.
  Remaining Green to terminal 5 of TS-1.
- ☑ R-1 is a 100 ohm resistor with brown, brown, brown and silver color bands. Cut each lead to about ¾". Connect one lead to 1 of TS-1 and the other to 3 of TS-1.
- ☑ R-2 is a 33 ohm resistor with orange, orange, black and silver color bands. Cut each lead to about ¾". Connect one lead to 1 of TS-2 and the other to 3 of TS-2.
- ☑ D-1 and D-2 are silicon power diodes and are marked R0 050. They each have a band around one end; this is the cathode and must be positioned as shown. Cut each lead to about ¾".



- ☑ Connect D-1 between 4 and 5 of TS-1 with the cathode (banded end) to terminal 4.
- ☑ Connect D-2 between 3 and 4 of TS-1 with the cathode (banded end) to terminal 4.

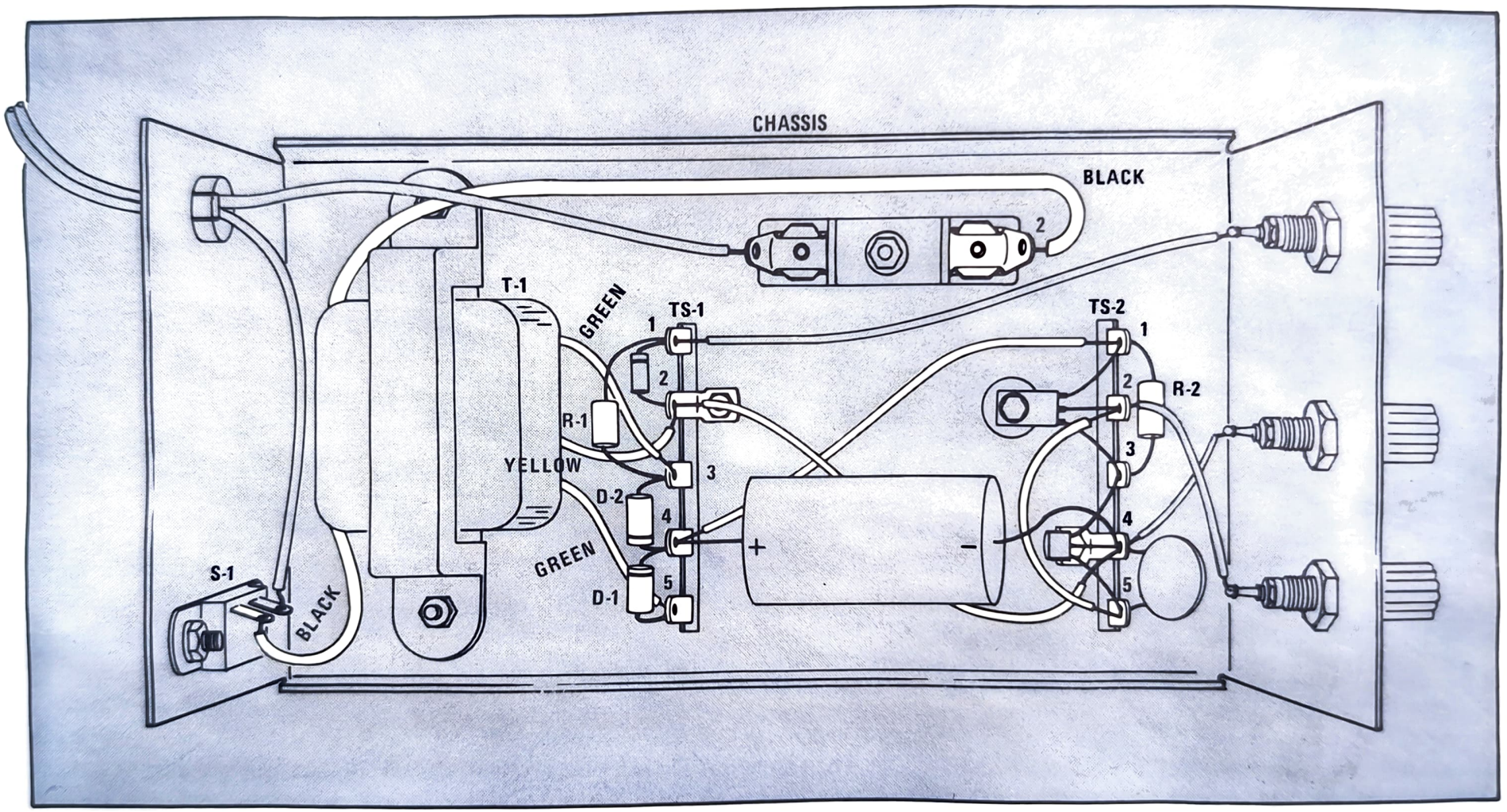
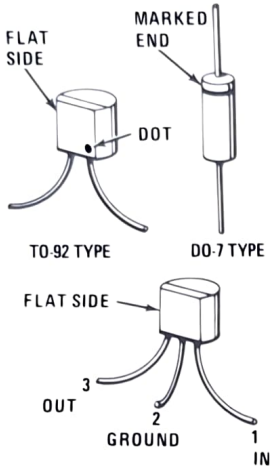

CHASSIS
BLACK
2
T-1
GREEN
TS-1
1
2
R-1
YELLOW
3
D-2
4
GREEN
D-1
5
S-1
BLACK
+
–
TS-2
1
2
R-2
3
4
5

FIGURE 3

ADDING MORE WIRING

REFER TO FIGURE 4.



- [ ] D-3 is a zener diode and may be one of two case styles shown. It will be marked Z0211. Connect the lead from the marked end (dot or band) to 1 of TS-1. Connect the other lead to 2 of TS-1.
- [ ] IC-1 will be marked HEPC6142P. It will look like this. Carefully identify each lead (1 = IN, 2 = OUT, 3 = GROUND). Position IC-1 as illustrated in Figure 4 and connect IN lead to 3 of TS-2; connect GROUND lead to 4 of TS-2; connect OUT lead to 5 of TS-2.
- [ ] C-1 is a 5000 μF, 15-volt electrolytic capacitor. The body has + and/or — markings on it. Position so the + end is toward the Transformer. Cut each lead to about 1″ and connect the lead from the + end to 4 of TS-1. Connect the other lead (− end) to 4 of TS-2.
- [ ] C-2 is a 0.1 μF capacitor. Cut its leads to about ¾″. Connect between 4 and 5 of TS-2.
- [ ] Mount the Binding Posts as shown in Figure 5. The Black one in the center, Red next to C-2 and Green next to the Fuse Holder.

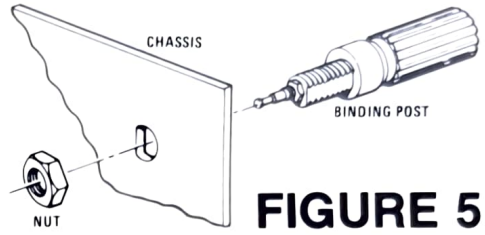


FIGURE 5

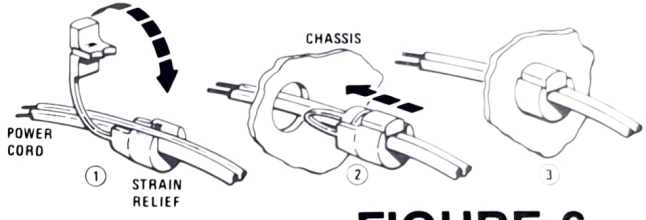


FIGURE 6

- [ ] Cut a 1½″ piece of wire. Connect between 4 of TS-2 and the Black binding post.
- [ ] Cut another 1½″ piece of wire. Connect between 2 of TS-2 and the Red binding post.
- [ ] Cut a 4½″ piece of wire. Connect one end to 1 of TS-1 and the other end to the Green binding post.
- [ ] Secure the Power Cord into the hole in the chassis behind the Transformer. Use the Strain Relief as shown in Figure 6. Let the ends of the wire extend about 4″ past the Strain Relief.
- [ ] Remove ¼″ of insulation from the ends of the Power Cord. Connect one end to terminal 1 of the Fuse Holder. Connect the other end to the upper terminal of S-1.

CHECKING YOUR WORK AND SOLDERING

Now is the time to check your work.

- ☑ Be sure you have made all connections as shown in Figures 3 and 4.
- ☑ Be sure you've got D-1, D-2 and D-3 in properly (leads from marked/banded ends as shown).
- ☑ Did you install C-1 with the + end toward TS-1?
- ☑ Did you mount IC-1 with the flat side of the package as shown in Figure 4? Any leads crossed?
- ☑ Any bare wire ends touching each other? Cut off excess lead and wire ends now.
- ☑ Everything look OK? Be sure it does before you solder (it's difficult to change connections after soldering).
- ☑ Solder each connection and be sure all lead ends are covered with a smooth (and thin) layer of bright, shiny solder. **Be sure you solder the leads of Q-1 in the bottom holes of TS-2,** terminals 1, 2 and 3. Check soldering again to be sure everything is OK.
- ☑ Snap the ½-amp fuse into the Fuse Holder. Set S-1 power switch down (OFF).
- ☐ Fasten the case top over the chassis with 4 self-tapping screws.
- ☑ Fasten the 4 rubber feet to the bottom of the chassis with self-tapping screws.
- ☐ Plug the power cord into a source of 120 volts, 60 Hz AC power.

You are ready to use the Power Supply.

OPERATING YOUR POWER SUPPLY

It is simple to use. Just connect leads between the binding posts and the equipment to be powered. Red is for +5 volts and Black is for common ground.

The Green binding post provides a convenient source of 60 Hz (Approx. 5.1V p-p square wave) to serve as a clock pulse, or other timing/calibration/level signal. As you work with digital circuitry, you'll soon find this to be a most handy feature.

Due to the circuit design, you cannot damage the power supply by an accidental short term short at the output terminals (the voltage will drop to zero and internal circuitry is self-limiting).

Study the Specifications provided to help you realize the capabilities and limitations of this Power Supply.

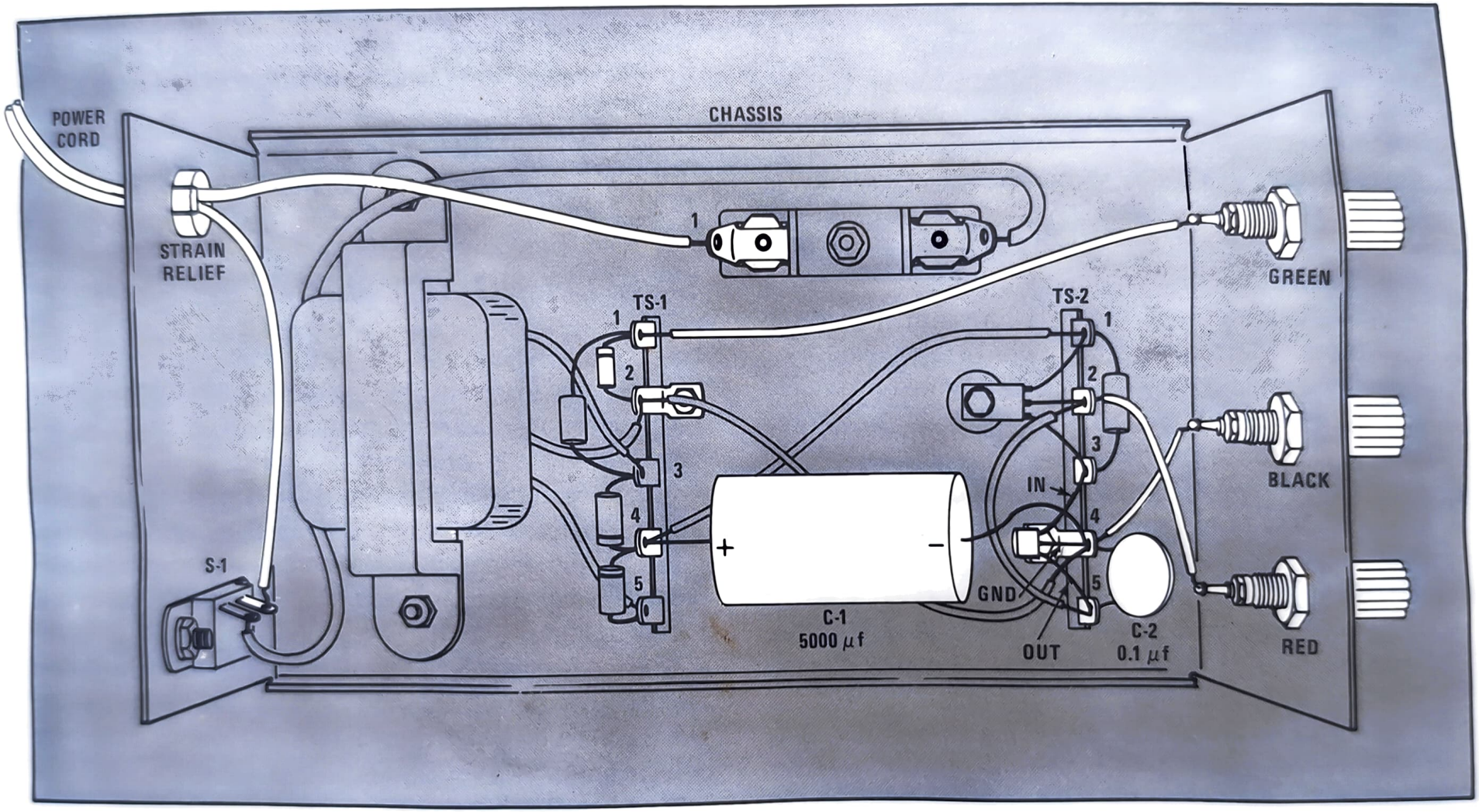

POWER CORD
CHASSIS
STRAIN RELIEF
1
TS-1
1
2
3
4
5
TS-2
1
2
3
4
5
IN
GND
OUT
GREEN
BLACK
RED
S-1
C-1
5000 µf
C-2
0.1 µf
+
−

FIGURE 4

CHECKING YOUR WORK AND SOLDERING

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- ☑ Did you mount IC-1 with the flat side of the package as shown in Figure 4? Any leads crossed?
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Study the Specifications provided to help you realize the capabilities and limitations of this Power Supply.

NOTE: Always be careful to make proper polarity connections when using the Power Supply. Certain equipment can be damaged by reverse voltage polarity. Connect a milliameter in series with the load to monitor current drain; in some circuits this can be most helpful.

CIRCUIT DESCRIPTION

The power supply is a very basic circuit and you'll find detailed descriptions of such circuits in almost any book on electronics. If you need details, we suggest you check your local public or technical school library.

120 volts, 60 Hz AC power is supplied to the primary of the power transformer T-1 through the power switch S-1 and protective fuse F-1. The secondary of T-1 provides 12.6 volts RMS across the green windings. D-1, D-2 and T-1 secondary are connected in a full-wave rectifier con- tion. C-1 functions as a ripple filter.

Q-1 is the series-pass transistor whose impedance is varied by the control of IC-1 voltage regulator. IC-1 senses the change in output voltage and compensates for this through the base of Q-1 and thus output is maintained constant under varying load conditions. C-2 is added to eliminate any switching spikes (or any tendency to oscillate). R-2 sets the base-bias for Q-1.

R-1 is the series-dropping resistor for zener diode D-3. This circuit provides the useful 60 Hz clock output signal at the green binding post.

TROUBLESHOOTING

Have trouble . . .? The most common problem with kits is not the parts — it's construction. *Here are the most* common faults:

1. Poor soldering
2. Poor soldering
3. Poor soldering

   Get the point?! Check all connections again. Have a friend look them over for you (a fresh pair of eyes may see what you overlook again and again).
4. Did you get the diodes in correctly? Check banded/ marked ends again.
5. How about the leads of Q-1?
6. Did you get IC-1 in backwards?
7. Any stray wire/ lead ends touching each other?
8. Any blobs of solder touching between adjacent terminals or to the chassis?
9. Fuse blown? Replace only with another of exact type and size (3AG, ½-amp, slow blow type).

SPECIFICATIONS

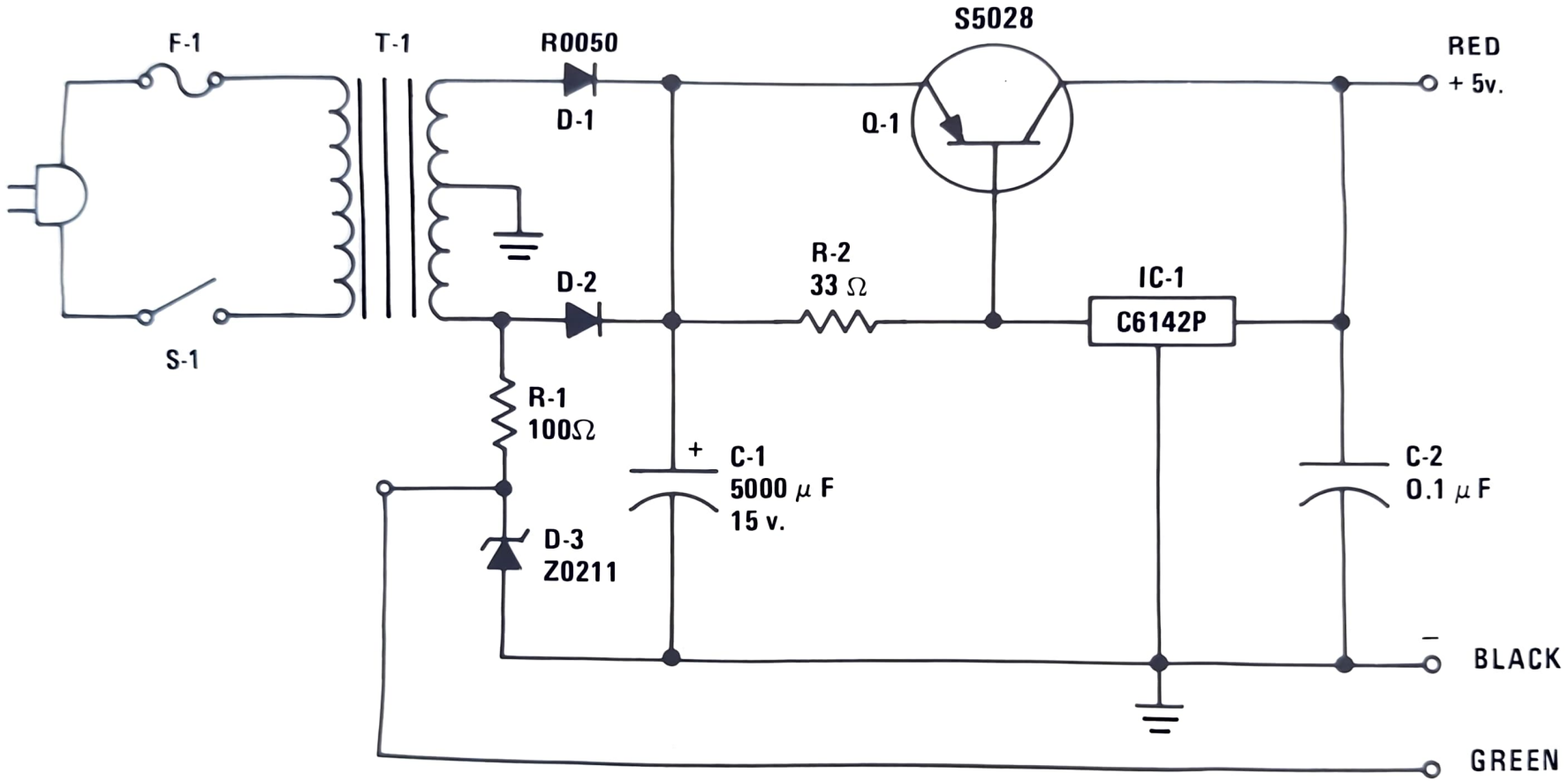
Output Voltage : 5 volts ± 6%
Output Current : 0-1000 milliamperes
Voltage Regulation : Less than 10 mV change no-load to full-load. Less than 10 mV change for input change of 100 to 130 VAC
Ripple : Less than 100 mV at full-load
Circuit Protection : Short Term (10 minutes) short circuit current limit (< 2.0 Amps)
Power Requirements : 110 to 130 Volts, 50/60 Hz 00 watts at full-load 00 watts at no-load

PARTS LIST

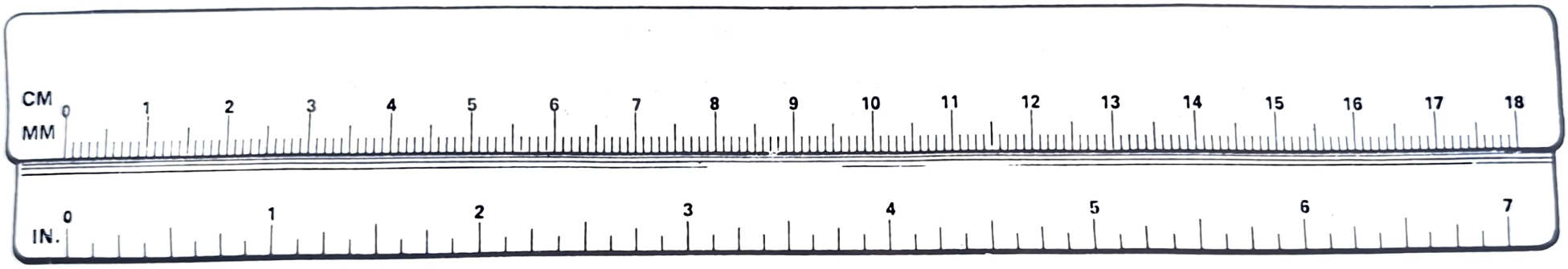
Symbol/Description	Part Number
ELECTRICAL	
C-1, 5000 μF, 15-volt electrolytic capacitor	.21BSH0003H-502
C-2, 0.1 μF, ceramic disc capacitor	.21BSH0002A-002
D-1, silicon diode, R0 050	.48ASH0050R-000
D-2, silicon diode, R0 050	.48ASH0050R-000
D-3, zener diode, Z0211 (5.1 volts)	48ASH0211Z-000
F-1, ½-amp, 3AG, s/ o blow fuse	.80ASH0002A-000
IC-1, 5-volt voltage regulator, HEPC6142P	.48ASH6142C-001
Q-1, power transistor, S5028	.48ASH50285-000
R-1, 100 ohm, ¼-watt, 10% resistor	.06ASH0001A-101
R-2, 33 ohm, ½-watt, 10% resistor	.06ASH0002A-330
S-1, power switch, SPST	.40ASH0003A-000
T-1, power transformer	.24BSH0001A-000
MISCELLANEOUS	
Binding post, Black	.29BSH002A-002
Binding post, Green	.29BSH002A-003
Binding post, Red	.29BSH002A-001
Case top	.16BSH0002A-001
Chassis	.16BSH0002A-002
Foot, rubber (4)	.77ASH0001A-000
Fuse holder	.09ASH0004A-001
Mica insulator for Q-1	—
Power cord	.30ASH0003A-000
Strain relief for power cord	.43ASH0001A-000
Wire, "	—

HARDWARE

Description	Quantity
Lockwashers, small (#4)	6
Lockwashers, large (#6)	2
Nuts, small (4-40, hex)	6
Nuts, large (6-32, hex)	2
Screws, small (4-40 x ⅜")	6
Screws, large (6-32 x ¼")	2
Screws, self-tapping (#4 x ⅜")	8
Washer, compression	1



SCHEMATIC DIAGRAM



RULER
(for measuring wires and leads)

LIMITED WARRANTY

Motorola Inc. warrants the "kit" to be free from defects in material and workmanship and that it will conform to applicable specifications. This warranty is for a period of ninety (90) days after the date the "kit" is delivered to the original consumer only.

In the event of a defect in material or workmanship and/or nonconformity with applicable specifications during the ninety (90) day period, Motorola Inc., at its option, will either replace or repair the "kits." "Kits" thought to be defective must be returned, by mail, to Motorola Inc., HEP/MRO Operations, 705 W. 22nd Street, Tempe, Arizona 85282, along with a check or money order in the amount of $10.00 payable to Motorola Inc. to cover handling and inspection. In the event inspection reveals that the "kit" is defective or nonconforming, then Motorola Inc. shall refund the $10.00. Return postage to the consumer shall be paid by Motorola Inc.

This warranty is void if:

(a) The "kit" has been used for other than its normal and customary purpose.
(b) The "kit" has been subject to misuse, accident, neglect or damage; or
(c) Solder, other than resin core, including but not limited to acid core solder or paste are used in the assembly of the "kit."

The implied warranties, which the law imposes on the sale of this product, are expressly limited to the terms of the limited warranty extended herein. Limitations on the period of an implied warranty are not permitted in some states in which event the limitation set forth may be inapplicable.

IN NO EVENT SHALL MOTOROLA INC. BE LIABLE FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES FOR NON-CONFORMITY, FAILURE OR DEFECT IN THE "KIT." Motorola Inc. disclaims such liability to the full extent permitted by law. Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation may not apply to you.

This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

Completion of the warranty registration card enclosed with the "kit" and mailing same to Motorola Inc. at the address set forth herein is mandatory in order to obtain coverage under this warranty.

Motorola HEP/MRO Operations • 705 West 22nd Street • Tempe, Arizona 85282 • (602) 244-3208