Product Review Column from *QST* Magazine

August 1988

Heathkit SA-2550 Remote Antenna Matcher

Reviewed by Doug DeMaw, W1FB

"I wish I had a motor-driven remote variable capacitor for SWR adjustments at the antenna feed point." Is this a thought that has entered your mind? If so, the answer to your musing may lie in the Heathkit® SA-2550 remote matcher. I had fun building and testing this kit, and it works nicely for remote control of the effective antenna length, or for matching the feed line to certain types of antennas.

The SA-2550 has three modules. Two of them—a plug-in wall transformer and control box—are used in the ham shack. The third module, designed for mounting at the antenna feed point, is a metal box that contains a 500-pF transmitting-size variable capacitor that is operated by means of a reversible low speed dc motor. The control box has a center-off toggle switch. Moving the lever in one direction causes clockwise rotation of the motor. Moving the switch lever in the opposite direction (from OFF) results in counterclockwise rotation.

Heath engineers recommend that the remote assembly be mounted at the feed point of dipole and vertical antennas to permit adjusting the SWR within a given amateur band. Examples of these applications are shown in the assembly manual. More on this later.

Matcher Circuit

Fig 1 shows the three circuits that comprise the SA-2550 and how they connect to one another. (I redrew the circuit to conform to *QST* style. Its designators do not conform to those in the Heath assembly manual.) Although a three-wire primary circuit is used, I am disappointed to find no fuse in the system (safety first!). Installation of a primary fuse for T1 is impractical, owing to the structure of the plug-in transformer.

Ac voltage from T1 is rectified by D1 and D2 to provide plus and minus voltages for the motor, M. S1 is used to route plus or minus voltage to M for changing the direction of the armature.

You will notice in Fig 1 that there is no earth ground for this system. The chassis ground for the control box and remote unit is part of the transmission line. I see no reason why the chassis of the control box can't be grounded in the shack. I did this, and it did not disturb the performance of the system. But, there should not be an earth ground connected to the case of the remote box, since chassis ground for that assembly is, in some instances, common to part of the antenna.

Blocking capacitors (two) are used at J3 to isolate the system from dc ground via J3. This prevents a short-circuit on the dc supply line in the control circuit. RF chokes (three) are used to prevent RF energy from following unwanted paths within the system. You can see that the circuitry is simple. This makes the SA-2550 easy to construct and check out.

You must provide a two-wire control cable, plus the 50-ohm coaxial cable that connects the transmitter and control box, and the control box to the remote unit. The SA-2550 is for use from 1.8 through 30 MHz. Power-handling capability is specified at 1500 W PEP SSB and CW when the SWR is less than 3:1.

Applications

The instruction manual contains a section on applications. Included are a number of drawings that show the matcher as part of various antenna systems. I do not agree with some of the antenna theory presented in the manual, and a few of the suggested applications leave something to be desired. This does not mean that the SA-2550 is not a good and useful unit, though. It has a number of possibilities that are not mentioned in the manual. I will cover some of them here.

Figs 2A and 2B show recommended applications that are illustrated in the Heath manual. Heath engineers recommend that you make the antenna 5 to 15 percent longer than is dictated by the formulas 234/f(MHz) or 468/f(MHz) for finding the approximate radiator length in feet. You can get the impression that there is no need to first ensure a proper system match to 50-ohm line. Therefore, I must assume that the Heath illustrations are based on a 50-ohm match *before* the SA-2550 is introduced to the antenna system. I think it is vital that the system be prematched to 50 ohms.

The theory of operation is that if you make the radiator longer than the resonant length, X_L (inductive reactance) will result. C1, the motor-adjusted variable capacitor in the remote box, presents X_C (capacitive reactance) in series with the X_L. C1 is adjusted until the X_C cancels the X_L. This brings the match back to the desired 50 ohms. In theory, this method permits you to cover all of an amateur band by elimi-

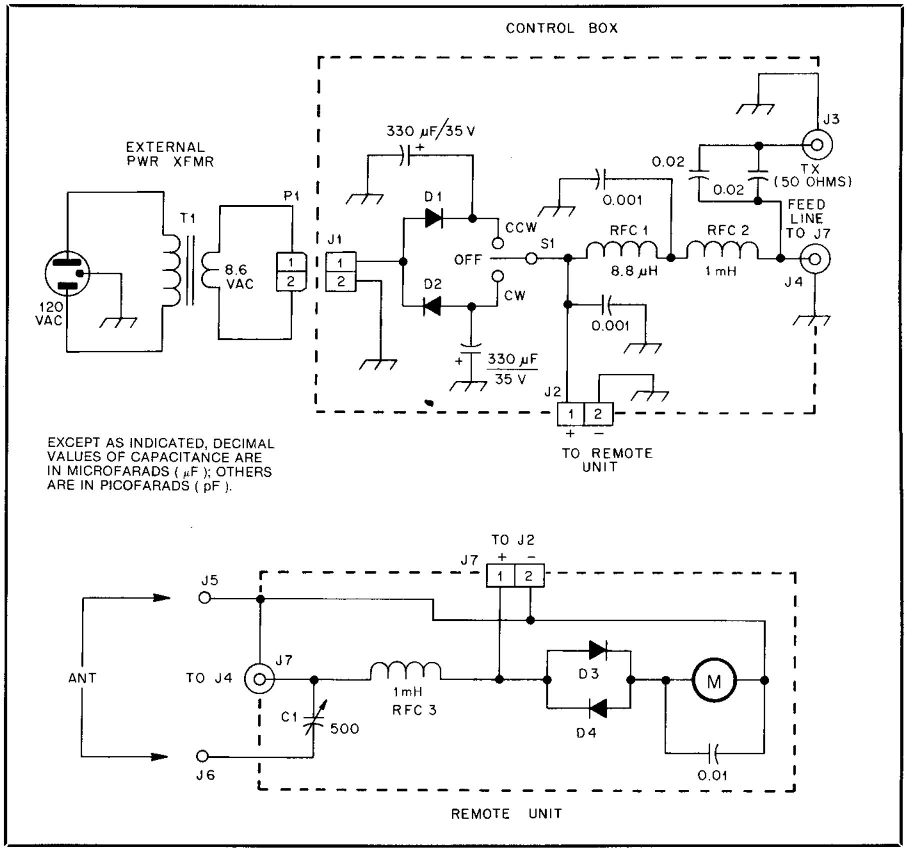


Fig 1—Schematic diagram of the SA-2550 control circuit. Part designators have been changed to conform to *QST* style and differ from those shown in the assembly manual. See text for circuit description.

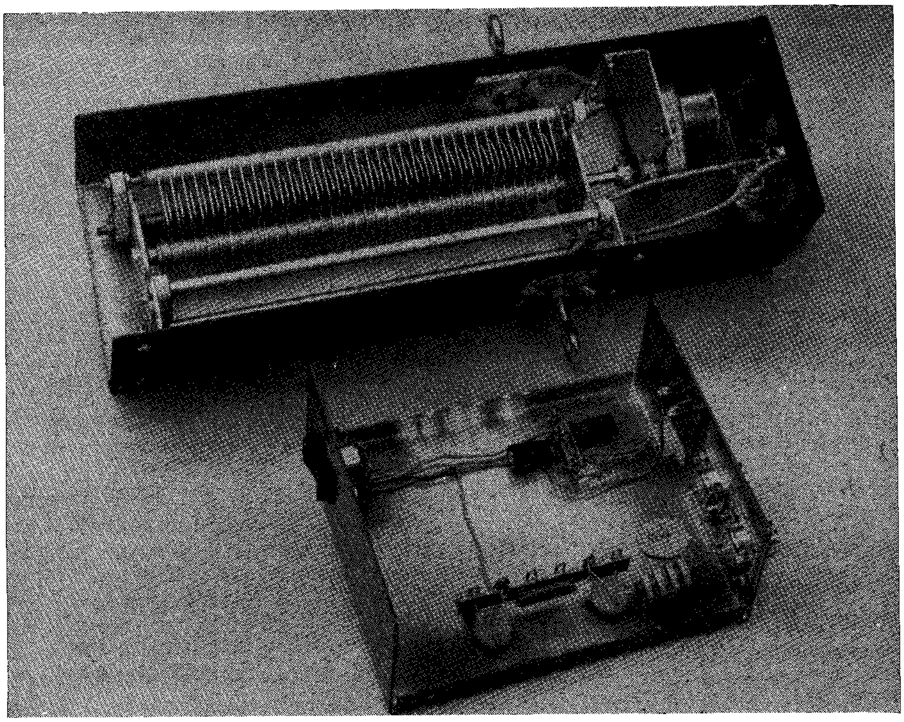


Table 1

Heath Model SA-2550 Remote Antenna Matcher

Manufacturer's Claimed Specifications

Operating frequency range: 1.8 to 30 MHz.

Input impedance: 50 ohms.

Input power capability: 1.5 kW (CW and SSB) at less than 3:1 SWR.

Dimensions (height, width, depth): control box, 2-9/16 × 5-1/2 × 6-15/16 inches; remote unit, 16-15/16 × 8-1/2 × 3-13/16 inches.

Weight: control box, 1 lb; remote unit, 5.6 lbs.

nating unwanted X_L and providing a resistive termination for the feed line.

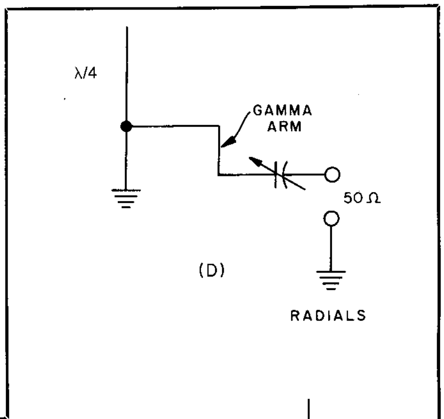
Example A of Fig 2 shows how this may be done with a vertical antenna. Antenna B shows Heath's suggestion for using the matcher with a dipole or inverted-V antenna. Note that only one half of the dipole is tuned via C1. In other words, one half of the antenna remains reactive by virtue of the increased length. (Example C shows the correct way to deal with this situation: *Two* capacitors are required to cancel the X_L in a dipole—one in each dipole wire. In any event, the matcher must be used with antennas that are ¼ wavelength long, or odd multiples of ¼ wavelength. It is not suitable for use with ½-wavelength end-fed antennas, or with antennas that are multiples of a half wavelength long.

Figs 2D and 2E illustrate excellent applications for the SA-2550 that are not mentioned in the Heath manual. Example D shows how you can use the matcher as a gamma-match capacitor on a shunt-fed vertical. C1 has sufficient capacitance to serve this need from 80 through 10 meters. For use on 160 meters, you may need to place a fixed-value transmitting capacitor in parallel with C1. Normally, a match on 160 meters requires less than 1500 pF. C1 can be adjusted remotely to help maintain a low SWR from one end of a band to the other.

An inverted L (popular on 160 and 80 meters) may be made somewhat longer than usual (Fig 2E). This permits the use of C1 for adjusting the SWR for a low value across a given amateur band. T1 is shown as a matching transformer that provides an SWR of 1:1 for 50-ohm line. (The impedance of the inverted L is on the order of 15 to 30 ohms, depending on the ground system and other factors.) You may prefer to use an LC matching network in place of T1.

Finally, Fig 2F shows how a radiator may be made shorter than ¼ wavelength for use with the SA-2550. A small loading inductor increases the electrical length of the radiator to create inductive reactance. C1 of the SA-2550 cancels the inductive reactance at the operating frequency.

Detailed information about how to adjust your antenna for use with the remote matcher is provided in the instruction booklet, so I will not repeat it here. There are many potential uses for the SA-2550. For example, how about using C1 in combina-



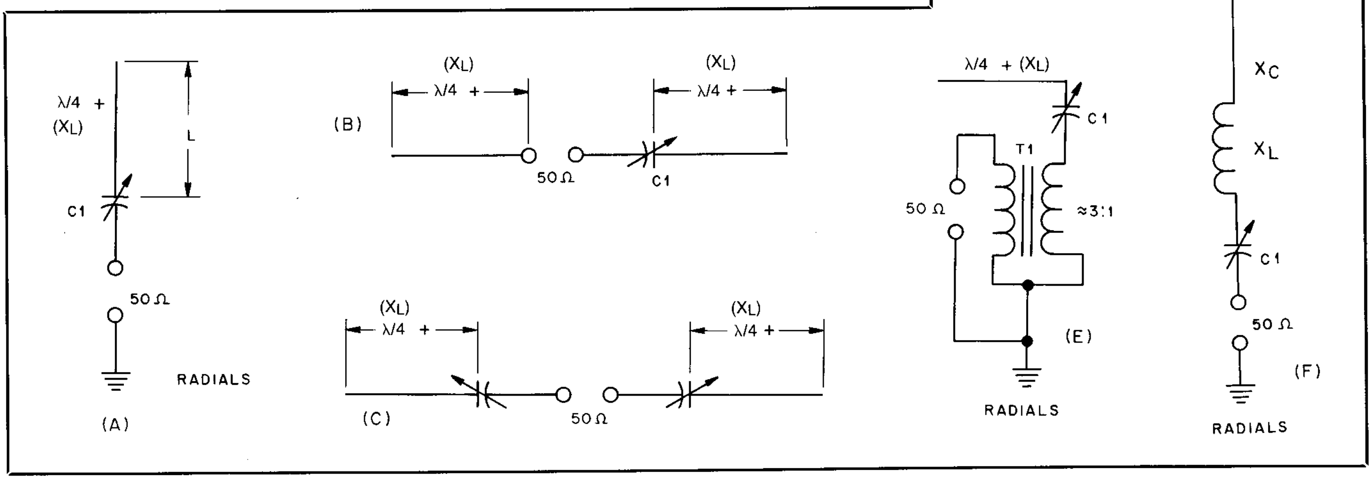


Fig 2—These examples show some situations in which the SA-2550 may be used for remote antenna matching. These systems are discussed in the text.

tion with a suitable inductance to form a remotely tuned L network for antenna matching? The coil can be housed near the remote box in a weatherproof container. A remote relay can be added for changing coil taps.

Possible Improvements

In its present form, the SA-2550 provides no visible indication of the position of C1 of Fig 1. C1 is set at midrange when installed at the antenna feed point. Tuning is done while observing the SWR from within your ham shack. Perhaps the next model may include a sensor circuit that will enable you to observe the degree settings of C1. This would make quick adjustment when changing bands or frequencies within a band more convenient. An accessory kit might be offered to permit the system to be used as an L network.

Assembly Notes

Assembly time should be on the order of 5 to 6 hours if you are familiar with kit construction. The most detailed part of the job is assembly of the large variable capacitor, but this is fun! There are very few wires to cut and solder, so you should not be bored by having to measure and trim numerous wires. The step-by-step assembly instructions are clearly written in considerable detail. The pictorial assembly drawings are excellent.

I consider the SA-2550 a quality unit that has many potential uses for remote adjustment of antennas. It may be the solution to one or more of your antenna problems. My tests were done with antennas configured as shown in Figs 2D and 2E, and I had good results.

Manufacturer: Heath Company, PO Box 1288, Benton Harbor, MI 49022, tel 800-253-0570. Price class: $120.

CREATIVE DESIGN CLP5130-1 VHF/UHF LOG-PERIODIC ANTENNA

Reviewed by Bart Jahnke, KB9NM

Over the past 50 years, log-periodic antennas have seen much service on the bands below 50 MHz. Although some amateurs have constructed home-brew log antennas for VHF/UHF bands, commercially made log-periodic VHF/UHF ham antennas are rare. Recently, however, Japanese antenna manufacturers have brought log-periodic antennas back into the limelight—and US importers have decided to share these products with consumers.

Creative Design Co (Create) manufactures three versions of a VHF/UHF log-periodic antenna for the US market. All three models are similar, differing primarily in the frequency ranges covered. The antenna reviewed here, the CLP5130-1, covers 50 to 1300 MHz. The CLP5130-2 covers 105 to 1300 MHz, while the CLP5130-3 works from 90 to 220 MHz.

The CLP5130-1 uses 25 elements on a 5-foot, 9-inch boom to cover all of the ham bands from 6 meters through 23 cm with

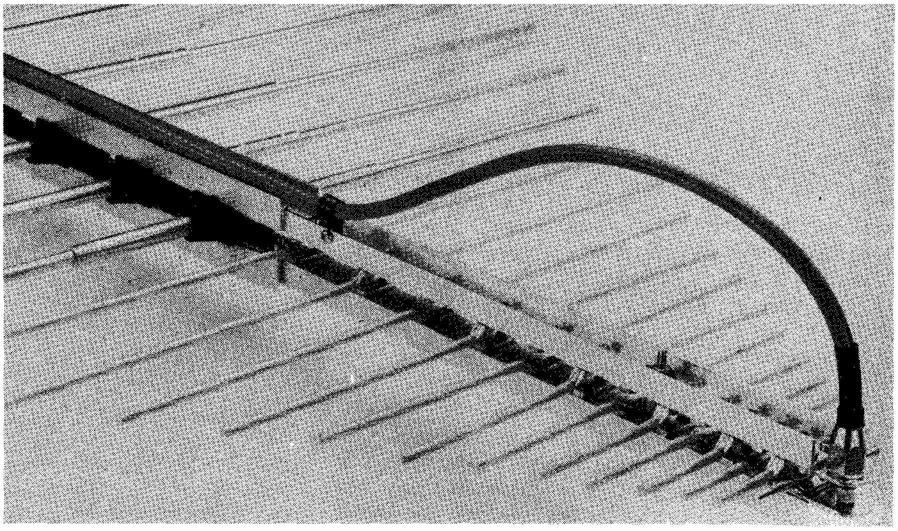


Table 2

Creative Design CLP5130-1 VHF/UHF Log-Periodic Antenna

Manufacturer's Claimed Specifications

Frequency range: 50 to 1300 MHz.
SWR: 2.0:1 or less.
Boom length: 5 feet, 9 inches.
Mast diameter: 1½ to 2 inches.
Maximum power capability: 500 W PEP.
Wind survival: 90 mi/h.
Weight: 11 lbs.

low SWR. Assembled, the antenna weighs only 11 pounds. The longest element measures 9 feet, 10 inches, and the antenna is UPS shippable. Create supplies a 4-foot coaxial cable with PL-259 connector to run from the feed point to the main feed line.

Construction

The boom of the CLP5130-1 is made from two pieces of aluminum channel stock. Elements are sandwiched between the two halves of the boom. The CLP5130-1 is supplied with a partially preconstructed front element assembly. Elements 2 through 13 are riveted so that they are properly positioned on the boom, although they are folded back almost parallel to the boom for shipping. All that's required to align these elements is to pivot them so that they are perpendicular to the boom, and use a 3 mm × 8 mm machine screw, washer and nut to lock each element in place.

Element number one is not part of the prefabricated front element assembly. This element is part of a bracket that also provides a mechanical connection for the feed line. I found it difficult to insert the machine screws into the tapped holes in element number one. I recommend that these holes be tapped to allow the use of no. 4-40 hardware if you have problems.

All of the remaining elements mount in black plastic insulators sandwiched between the boom halves. Sheet-metal screws hold the elements in the insulators and make electrical connection.

Construction took about three hours. All of the materials appear to be of good quality, and I had no problems except for fitting some of the screws as mentioned previously.

Installation

This antenna lends itself to horizontal or vertical installation. For additional weatherproofing in vertical installations, element caps (plugs) have been provided for the hollow elements (which point skyward) to prevent the accumulation of water.

I installed the CREATE CLP5130-1 log periodic on a 10-foot Radio Shack® mast in my backyard. (I'm an apartment-dweller ham who can't erect 200 feet of tower on the landlord's property.) The antenna was later raised to the rooftop—about 30 feet in the air.

In my installation, I decided to use a *good* low-loss feed line—Andrew ½-inch Superflex Heliax®. You need only one feed line, so it might as well be a good one so you get as much signal as possible to the antenna. Remember, this antenna isn't the high-gain variety—instead it's designed for broad bandwidth.

SWR for the CLP5130-1 measures less than 2:1 on the 50, 144, 220, 432 and 903-MHz bands. I didn't try it on 1296 MHz.

While the antenna was still at the 10-foot level, I used it to operate in the ARRL 144-MHz Sprint contest. Activity levels seemed quite good and yielded over 40 contacts, with the farthest station being over 325 miles away. I must mention that this testing was not done from a mountaintop. In fact, it was done from nearly sea level, as my location is alongside the Connecticut River. Similar RF tests were made on the 50, 220 and 432-MHz bands with equally good reports and performance. I tried the antenna on 903 MHz and worked a few local stations, but its gain did not approach that of a single-band antenna designed for the band.

Six meters with the CLP5130-1 has been

fun. I've worked quite a few stations on sporadic E, and I've heard a number of early morning scatter signals as well.

I even had good luck using the log periodic as a 2-meter uplink antenna for RS-11. The wide beamwidth makes tracking the satellite a snap.

Although the CLP5130-1 is rated for 500 watts, I was limited to solid-state amplifiers and no more than 160 watts output. My measured SWR compared closely with the manufacturers specifications.

The CLP5130-1 allows me to be active on many VHF/UHF bands, yet it takes up a minimum amount of space. Although the gain and performance of this antenna can't compare to long-boom, monoband Yagis, I've made quite a few contacts with locals and with stations in faraway grid squares. In my apartment situation, where I can have but one antenna, it's ideal. If you're planning to install a VHF/UHF antenna for use with FM/repeaters, weak-signal SSB/CW or scanners (or even for television reception), the CLP5130-1 is worth serious consideration.

Distributor: Orion Hi-Tech, PO Box 8771, Calabasas, CA 91302, tel 800-255-7020. Price class: $239.

A & A ENGINEERING'S SMART BATTERY CHARGER

Reviewed by Paul K. Pagel, N1FB

□ A & A Engineering offers a modified version of Warren Dion's (N1BBH) Smart Battery Charger.[1] The kit (A & A no. 150) can be purchased in any of several versions for specific voltages and charge currents. If at some time you want to change the charger's voltage and current delivery, you can do so by making a couple of simple wiring changes and component substitutions; a table included with the documentation provides you with the necessary information. The Smart Battery Charger will deliver charging voltages of between 6 and 24 at currents up to 1 A. The standard output current is 500 mA; you simply add another shunt resistor to increase the output current level.

This charger is designed to be used with lead-acid or gelled-electrolyte batteries. The charger controls the bulk charging rate, tapers and limits the overcharge voltage and maintains the battery at the float level. (If these terms are unfamiliar to you, refer to the article referenced in note 1.) The Smart Battery Charger can be left connected to the battery indefinitely, and will not overcharge it.

The cabinet supplied is similar to one Radio Shack® model (RS 270-253). You have to do the cabinet work; no holes are predrilled or punched (except for those for the cabinet feet), and no panel labels are supplied. I recommend that the chassis work be done before mounting any of the components on the PC board. All drilling dimensions are given in decimal inches, as are drill sizes. So, unless you have drills sized that way (I have a numbered drill set), it's helpful to have a drill gauge that provides you with a cross reference.

If you drill the holes according to the template, everything will fit perfectly. Making the required chassis holes is a relatively simple task for all but the power on/off switch. The switch supplied is an illuminated, push-in, locking-tab rocker switch that requires a rectangular mounting hole. Making such a hole in a flat piece of aluminum is easy with the aid of a nibbling tool, but with the front and rear panels already formed, I found it difficult to use the nibbling tool. Eventually, I had to resort to using some flat files to make the hole reasonably symmetrical. Using a switch that mounts in a round hole is a much simpler approach and is less time consuming. Unless you really want the rectangular rocker switch, I suggest you substitute a toggle switch, and drill another round hole for a power indicator; the PC board has provisions for adding a power-on LED.

The cabinet is made of soft aluminum with a light-gray finish, and the top is made of steel painted in black-crackle. Because the body metal is soft, it's easy to work, but it's also easily bent if you're not careful. Proceed slowly when drilling holes and enlarging them.

The paint on my charger cabinet body flaked off easily. Once started, the paint lifted from the aluminum like the thinnest of tissue papers. Because of this, I stripped the finish and repainted the cabinet. (I briefly considered an alternative covering: Using adhesive-backed shelf paper. But I decided against that because of earlier bad experiences I'd had with that material. You must be careful when tightening nuts on panels covered with adhesive-backed paper, otherwise the paper twists and you wind up with a wrinkled panel.)

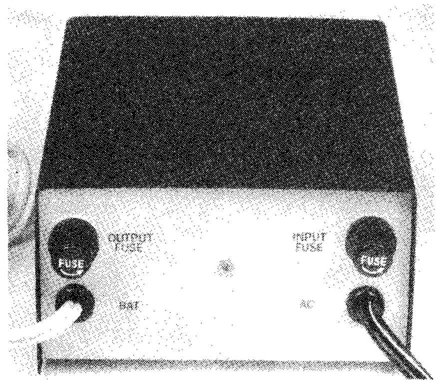
Documentation for the kit consists of two 8½- × 11-inch sheets of paper printed on both sides—not a Heathkit® construction manual by any means, but complete in every detail. If you're a novice builder, it's worthwhile to examine the instruction sheets and familiarize yourself with the components and their eventual placement before taking a drill or soldering iron in hand. When I first looked at the drilling template (none are full-size) for mounting the power transformer and PC board, I was under the impression that the transformer and PC board were supposed to be mounted across the width of the cabinet. That's not so, because the pass transistor (mounted on the PC board) needs to be attached to—but insulated from—the cabinet's rear panel, which acts as a heat sink.

While on the subject of the pass-transistor mounting, here's a tip: Before you solder the transistor to the PC board, temporarily mount the circuit board in place and check to make sure the hole in the transistor's mounting tab aligns with the screw hole in the cabinet's back panel. If you make the transistor leads too short, the mounting holes won't line up.

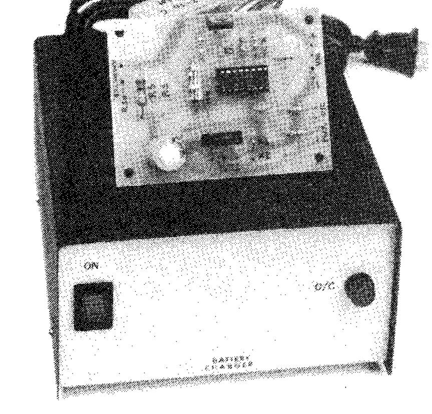
Stuffing the PC board is a snap. The board is high quality and well tinned, so solder flows readily onto it. To provide flexibility, the board is supplied with additional shunt-resistor mounting pads and three pairs of jumper pads. The choice of jumper positions, number of shunt resistors and the values of certain components are selected from notes and a table on one of the instruction sheets. This enables you to configure the charger to your output voltage and current requirements. The PC board has pads that can be used to connect an ammeter and/or voltmeter to the circuit.

I used rub-on transfers to identify the panel-mounted components. Then I sprayed the cabinet body with three coats of satin-finish polyurethane to protect the finish and panel labels.

The Smart Battery Charger is available from A & A Engineering, 2521 W La Palma, Unit K, Anaheim, CA 92801, tel 714-952-2114. The standard kit is a 12-V, 500-mA unit. Price: $49.50 each. For 6, 14 or 24-V chargers, add $1 and specify the charger voltage desired. Include $3.50 for shipping and handling.



The rear panel of the charger. The screw in the center of the cabinet is used to secure the pass transistor to the panel, which acts as a heat sink.



This photo shows the finished front panel, with the PC board and power transformer ready to be installed in the cabinet. I made the component, pad and jumper identifiers on the board with a permanent-ink marker—they're not on the A & A board.

[1] W. Dion, "A New Chip For Charging Gelled-Electrolyte Batteries," *QST*, Jun 1987, pp 26-29. See also Technical Correspondence, *QST*, Oct 1987, p 38.