

Radio Fun in the Sun

Here's a complete solar-powered QRP station for your operating pleasure.

Dave Evison W7DE
153 Park Avenue
Palo Alto CA 94306
[w7de@aol.com]

I've become a full-fledged tree hugger, energy miser, and recycler. I suspect it has something to do with the aging process and my own diminishing physical resources. I feel it happening to me, and see it happening to our little planet.

Now this attitude is spilling over into my amateur radio hobby. I want to be out in the woods, energy independent, and still play with my homebrew stations. In addition, I'm no longer interested in re-inventing the wheel, or plunking down big bucks to buy ready-made radios. So I began pawing through back issues of *73 Amateur Radio Today* to recycle some great ideas and circuits for building myself a portable, self-sufficient QRP

station. And I struck gold: the Ten-Tec QRP transceiver kit was purchased and assembled based upon an excellent review in *73*; the Desert Storm solar panel was selected because of a long-running advertisement in *73*; the expanded-scale voltmeter was a clever idea published by a fellow ham in *73*; and the simple charge controller was borrowed from a previous article of mine, also appearing in *73*.

The purpose of this article is not to encourage a cloning, but to share the delight of building a portable, solar-powered QRP station. The emphasis is upon building and incorporating simple amateur radio station accessories, based upon your own ingenuity and resources. The station depicted in the photos reveals that I'm from the school of form follows function. In my own case, since I have very few woodworking and metal forming tools, I used scrap lumber to build the case, a number of small pieces of two-sided PC board for mounting the various accessories, and a lot of screws to hold everything together. As chaotic as the little station appears, it works wonderfully! It is a complete station (including station monitoring equipment),

and when I get the urge to play radio in the woods, everything I need is connected to a couple of carrying handles!

My station was evolutionary in its formation. It began with only the transceiver and a battery fastened to a board with a handle. Then, one after another, came the rest of the bells and whistles. It was a lot of fun! I'd dream up the need for an additional station accessory, build it up on a scrap of PC board, then screw it onto the wooden case. Although this approach may reflect poorly on foresight, in its final form, the accessories are symbiotic—not parasitic.

The following notes and associated drawings describe the subassemblies



Photo A. W7DE's solar QRP station is handsome as well as functional.

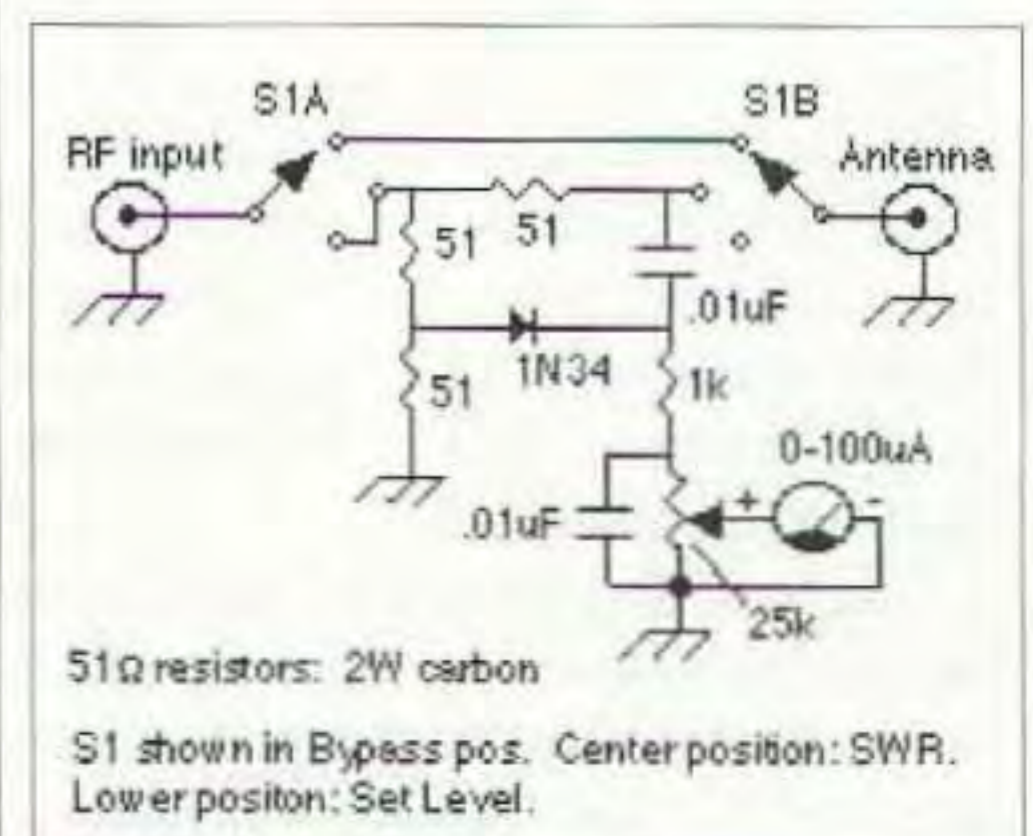


Fig. 1. QRP SWR meter schematic.

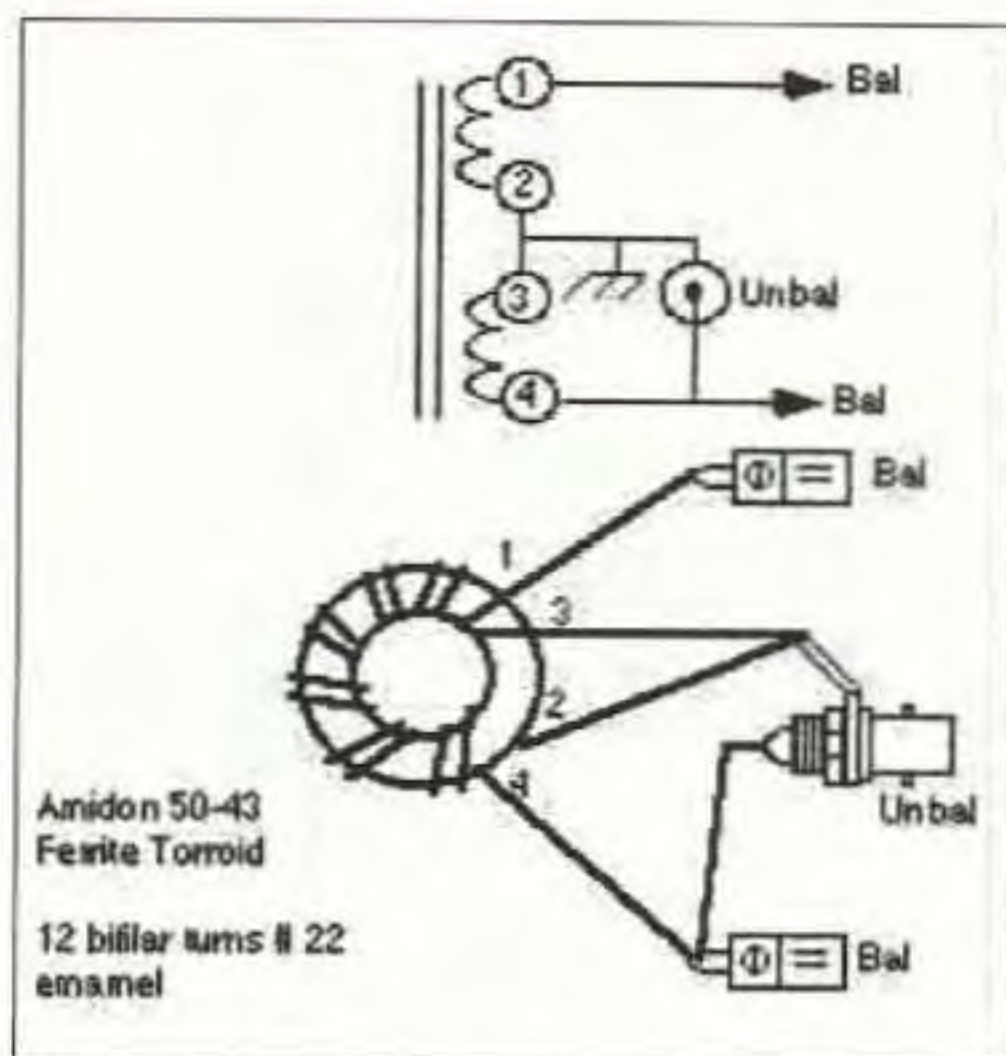


Fig. 2. QRP 4:1 balun schematic and pictorial.

that now cling to the wooden case of my portable QRP station. Some of them are essential, some of them might come in handy, and only one is original—but all of them are useful and fun to build. No detailed physical construction guidance is supplied in this article. It's assumed that doing things your own way is the radio amateur way!

About the transceiver: Although I used the Ten-Tec 1340 QRP kit, there are other terrific kits available (including the bulletproof little NorCal 40A, from Wilderness Radio).

About the battery: Gel-cell batteries are rugged—and they don't leak electrolyte! Don't skimp on the battery by buying a surplus battery—buy a new one. A 4.5 Ah battery will be sufficient for a QRP rig. In the afternoon sun, the solar panel delivers enough power to operate my rig with the key down and still charge the battery. Three hours of nighttime operation will still leave the battery with about 66% of full charge.

About the SWR meter: A sensitive

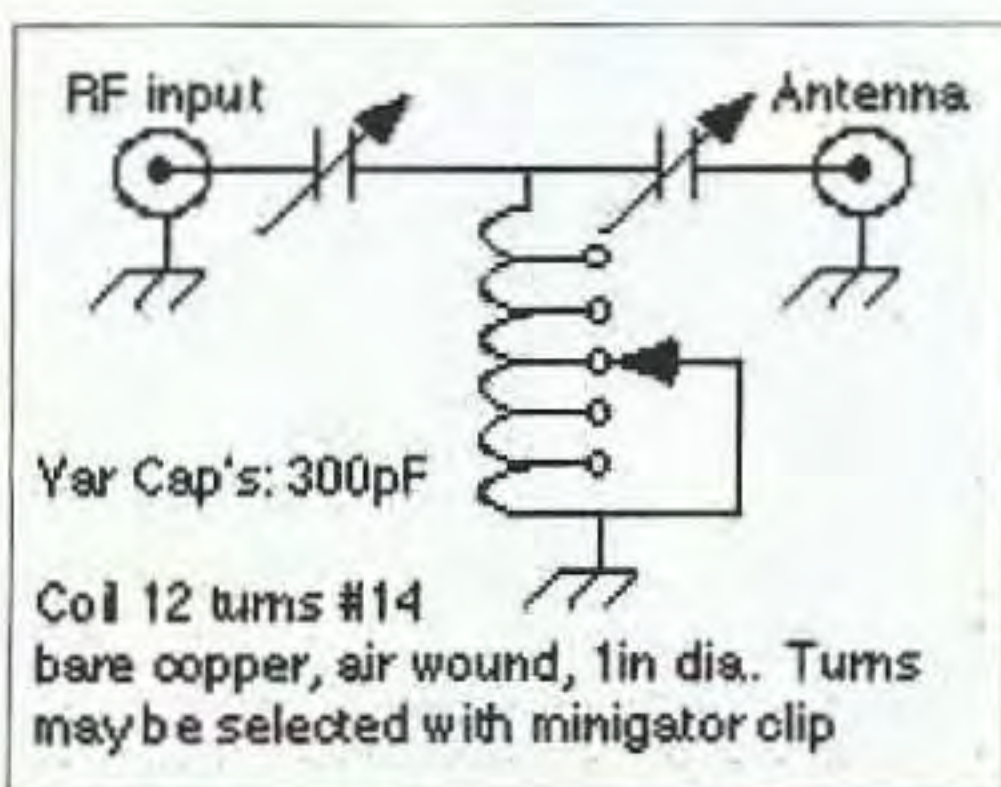


Fig. 3. Antenna tuner schematic.

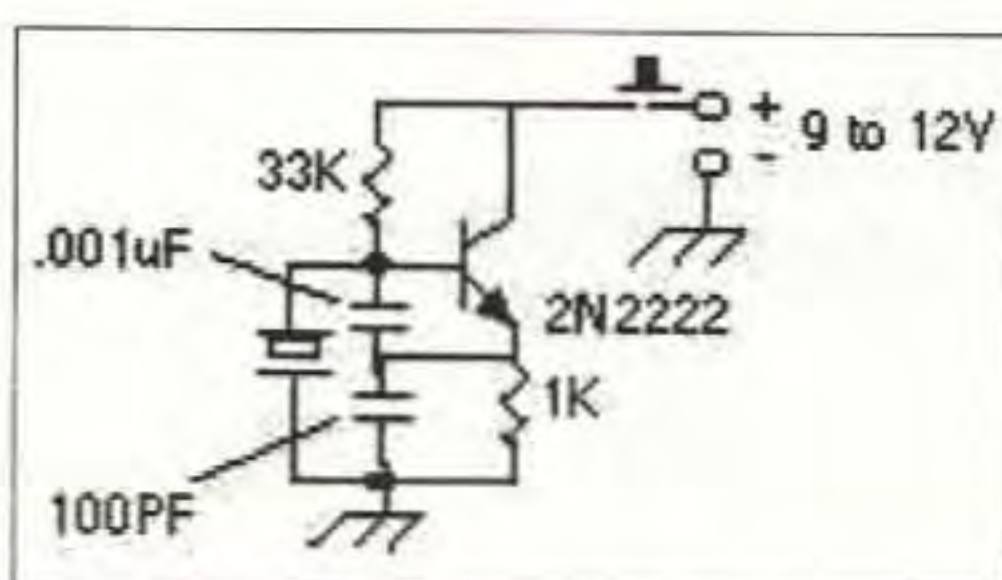


Fig. 4. Signal generator schematic.

SWR meter is an excellent accessory, and it is used together with the antenna tuner. In addition to monitoring the SWR during tuneup, the set level control of the SWR meter can be calibrated to indicate where the sensitivity pot is set for normal RF output from the integrated rig. Therefore, it can double as a relative wattmeter. The schematic appears in Fig. 1.

About the tuner: Camping sites vary dramatically, especially when it comes to finding antenna supports. Therefore, compromises are necessary, and antenna

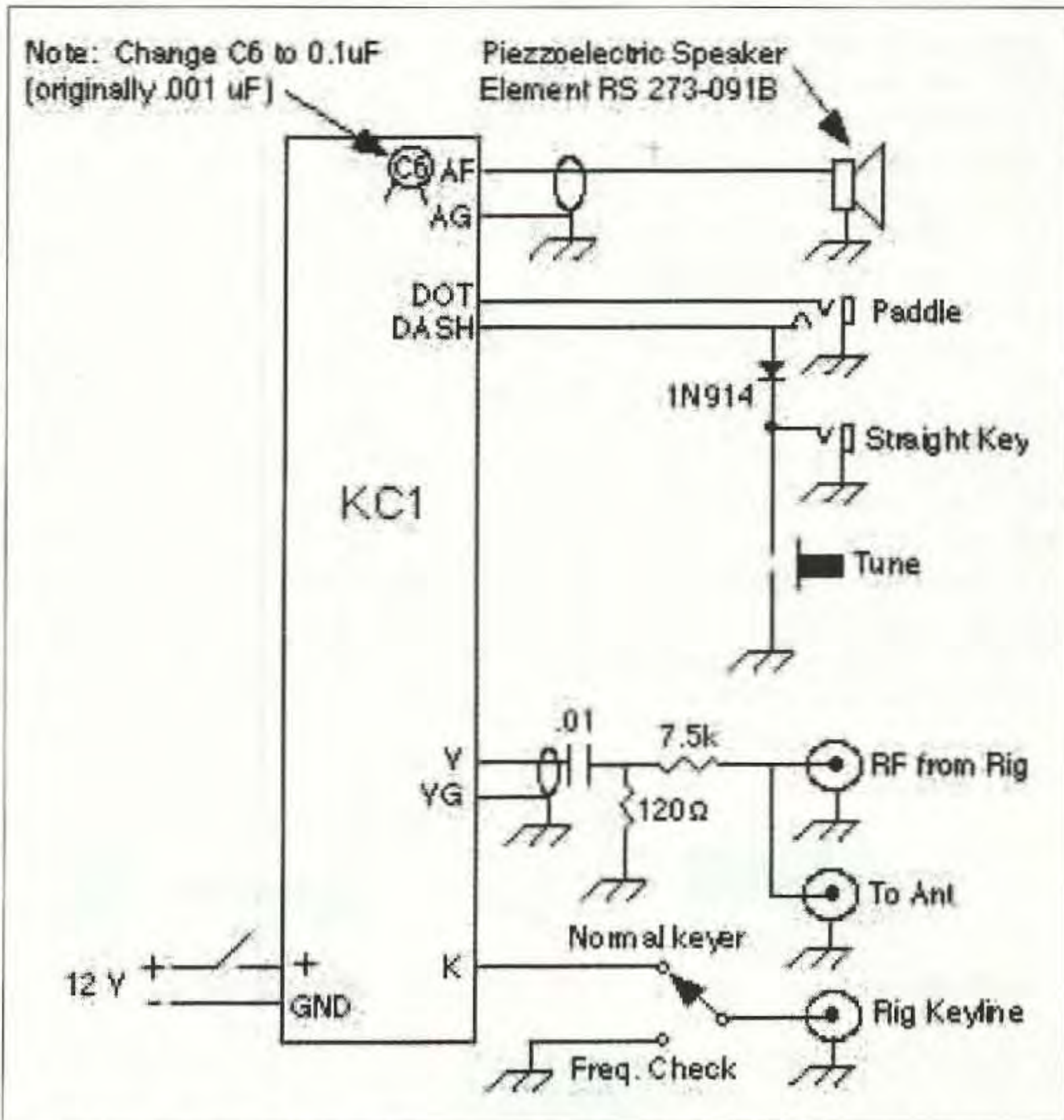


Fig. 5. Interface control panel schematic for Wilderness Radio KC1 keyer and frequency counter.

ELECTRONIC MILITARY SURPLUS
FAIR RADIO SALES

30 FT MAST KIT

AB-1244/GRC MAST KIT, twelve aluminum alloy on steel sections form sturdy, yet lightweight 30 foot 1.7" dia mast. Kit includes five each lower and upper sections, one ea lower and upper adapter sections, gin pole swivel base, four ea 36 and 42 ft guy ropes, four guy stakes, two guy rings plus 2.5 pound sledge hammer. Part of OE-254/ GRC antenna set; 30 lb sh. NEW, \$139.50

Electron Tubes, JAN-BOXED unused:

4CX300A Eimac, \$45	811A Cetron, \$25.00
4CX5000J Eimac, \$650	1625 Nat. Union, \$4.50
4D32 Raytheon, \$28	5998A Sylvania, \$9.95
6B4GA Sylvania, \$17	6336B Cetron, \$30
83 Sylvania, \$9.00	7360 ECG, \$15.00

Allow money for shipping on merchandise.

WEBSITE: fairradio.com
 E-MAIL: fairradio@wcoil.com
 PHONE: 419-227-6573 - FAX: 419-227-1313
 1016 E. Eureka - Box 1105 Lima, OH 45802
 VISA, MASTERCARD, DISCOVER accepted
 Write for latest Catalog - Address Dept. 73

CAPACITORS - MOTORS - RELAYS - POWER SUPPLIES - TEST EQUIPMENT
 Radios - Antennas - Roller Inductors - Transformers - Wire - Tubes

CIRCLE 75 ON READER SERVICE CARD

73 Ad Sales
 Call
1-800-677-8838

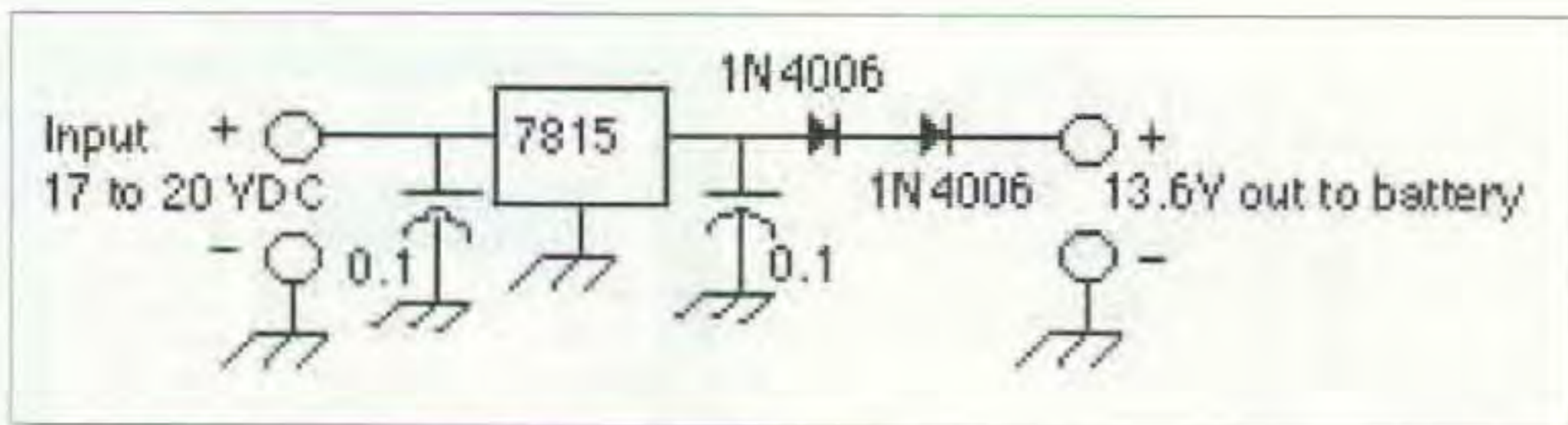


Fig. 6. Charge controller schematic.

tuning is generally required for maximum performance. A capacitor-capacitor tapped inductor tuner works great, and it can be constructed at very low cost.

About the 4:1 balun: The balun does not take up very much space, and it will allow you to use balanced feedlines. You will be able to use folded dipoles and other antennas using balanced lines—then you won't need to worry so much about poor grounding circumstances. Details are shown in Fig. 2.

And if miniature variable capacitors (the type used in transistor pocket radios) are used, the unit can be quite compact. There's nothing particularly critical about a tuner such as this; in fact, the uglier they are, the better they seem to work! Refer to Fig. 3.

About a signal source for checking the receiver section: This is another simple and useful addition. It will allow you to accomplish simple performance tests for sensitivity and frequency calibration. A simple one-transistor circuit is depicted in Fig. 4. No direct connection needs to be made to the transceiver. The little oscillator will put out enough RF to be readily detected. I chose to run the oscillator from a 9 volt battery. The battery will last for years. The crystal specified in the drawing is for 40 meter operation. The oscillator will accept crystals to 20 MHz.

About the keyer: If you're comfortable with a straight key, you simply don't need a keyer. In fact, you don't even need a key! One resourceful ham suggests recycling a computer keyboard switch for forming the dits and dahs. If you decide to use a paddle, there are several excellent amateur keyer kits available. I selected the Wilderness Radio keyer because of its very small size, low battery demands, integrated memory and frequency counter. This unit is designed to be built into the transceiver itself. However, I chose to build it as a stand-alone unit to allow me to substitute other transceivers. The stand-alone modifications to the Wilderness Radio keyer are depicted in Fig. 5.

About the charge controller: If you elect to charge the battery exclusively from the solar panel, you simply do not need the charge controller. In my case, I included the controller for wintertime operation in the Northwest. I use a salvaged 12 volt plug-in wall unit as the charging source. Although the little plug-in wall unit claims to deliver 12 volts at 300 mA, its unloaded terminal voltage is actually 19 volts. It is, of course, simply an unregulated supply, and its internal resistance drops its terminal voltage to approximately 12 volts when supplying 300 mA. This is ideal for use with the simple charge

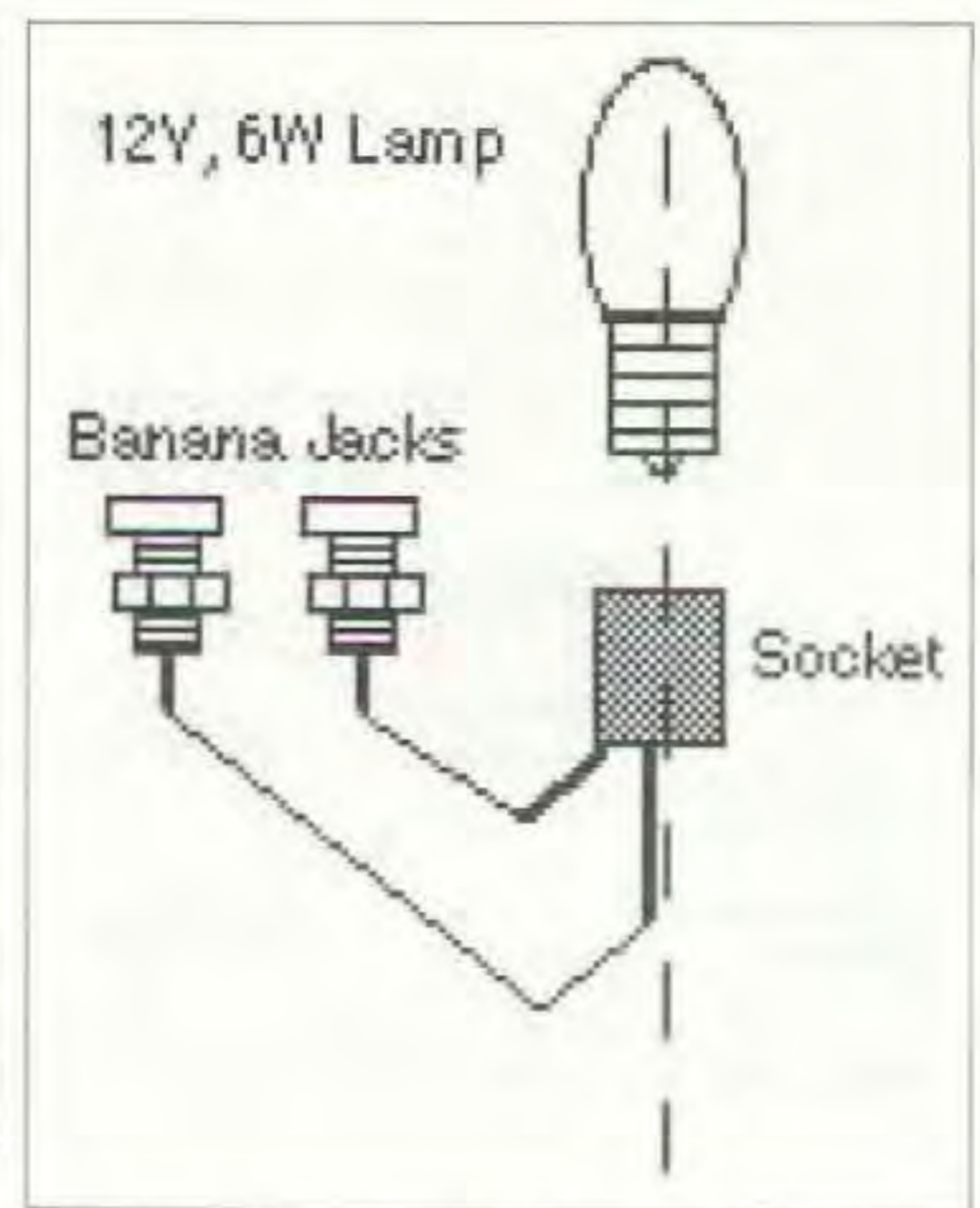


Fig. 8. Solar panel tester.

controller shown in Fig. 6. The charge controller functions by supplying a regulated 13.6 volts (the forward drop of the two diodes reduces the 15 volts from the 7815 to 13.6 volts). The battery charging rate decreases as the battery terminal voltage increases during charging. When the battery terminal voltage (surface charge) equals 13.6 volts, the charging process stops because there is no longer a potential difference between the charging source and the surface charge of the battery. Simple, straightforward, and it works perfectly.

About the dummy load: A simple dummy load fashioned from carbon-clay 2-watt resistors is a very useful addition. Of course, other combinations of resistance values may also be used to achieve 50 Ω and a power dissipation rating of 5 watts or greater. Refer to Fig. 7.

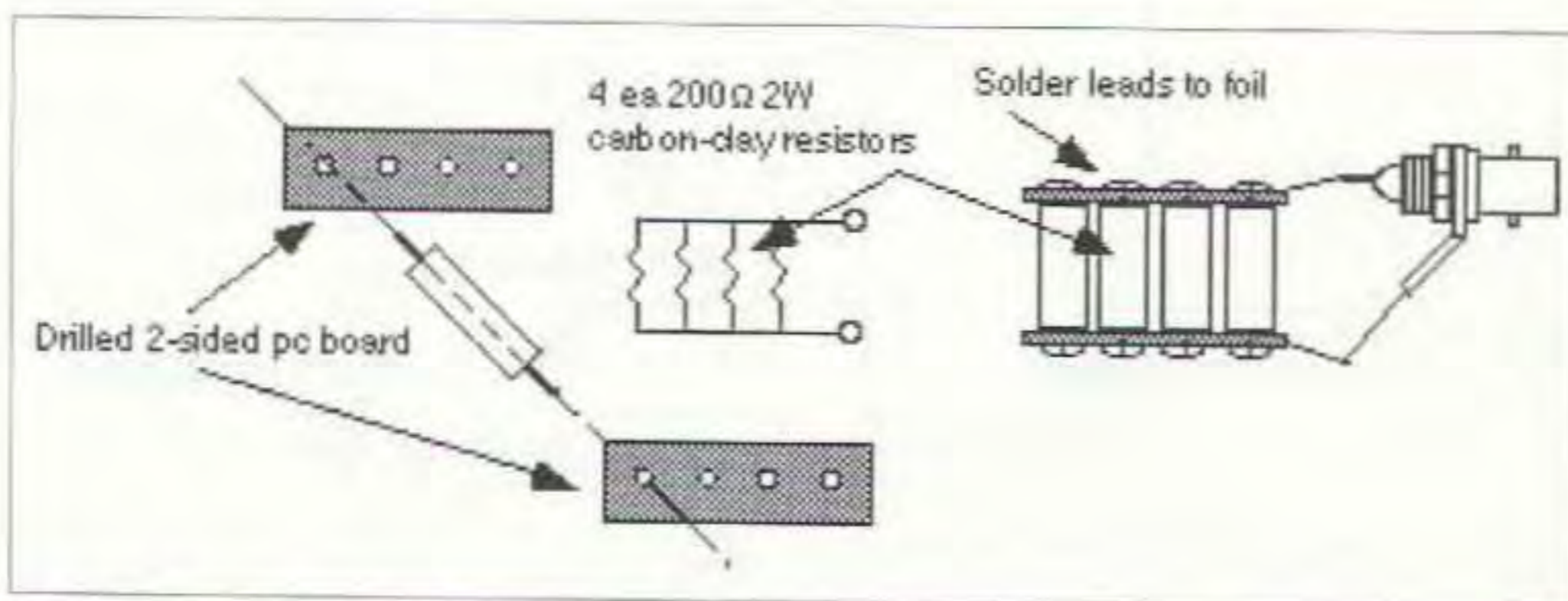


Fig. 7. 50 Ω dummy load.



Photo B. Front view of portable QRP station.

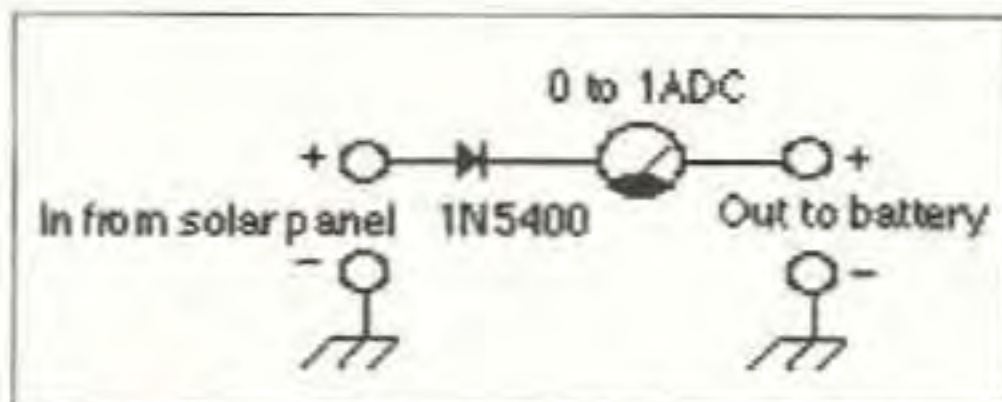


Fig. 9. Solar panel interface schematic.

About the solar panel tester: This is merely a 12 volt, 6 watt incandescent lamp. You simply connect the solar panel to the lamp and adjust the angle and position of the panel for maximum brightness of the lamp. Once this adjustment is made, transfer the solar cell connector to the battery. This is a super-handy accessory—actually a necessity! Refer to Fig. 8.

About the solar panel interface: Well, you have to have someplace to plug the solar panel into, and a place to install the series diode. It is also useful to include an ammeter to monitor the charging current. Using banana jacks and plugs is recommended for connecting the solar panel to the station. Two-circuit, 1/4-inch phone plugs and jacks are not recommended, because the tip electrode of the plug shorts out momentarily while inserting it into the jack. Refer to Fig. 9.

About the solar panel: The Desert Storm solar panels are available from Antennas West. These are very compact and rugged units. They are not cheap, but well worth the money.

There are two very important requirements for using the Desert Storm unit: First, a series diode between the positive lead of the solar panel and the

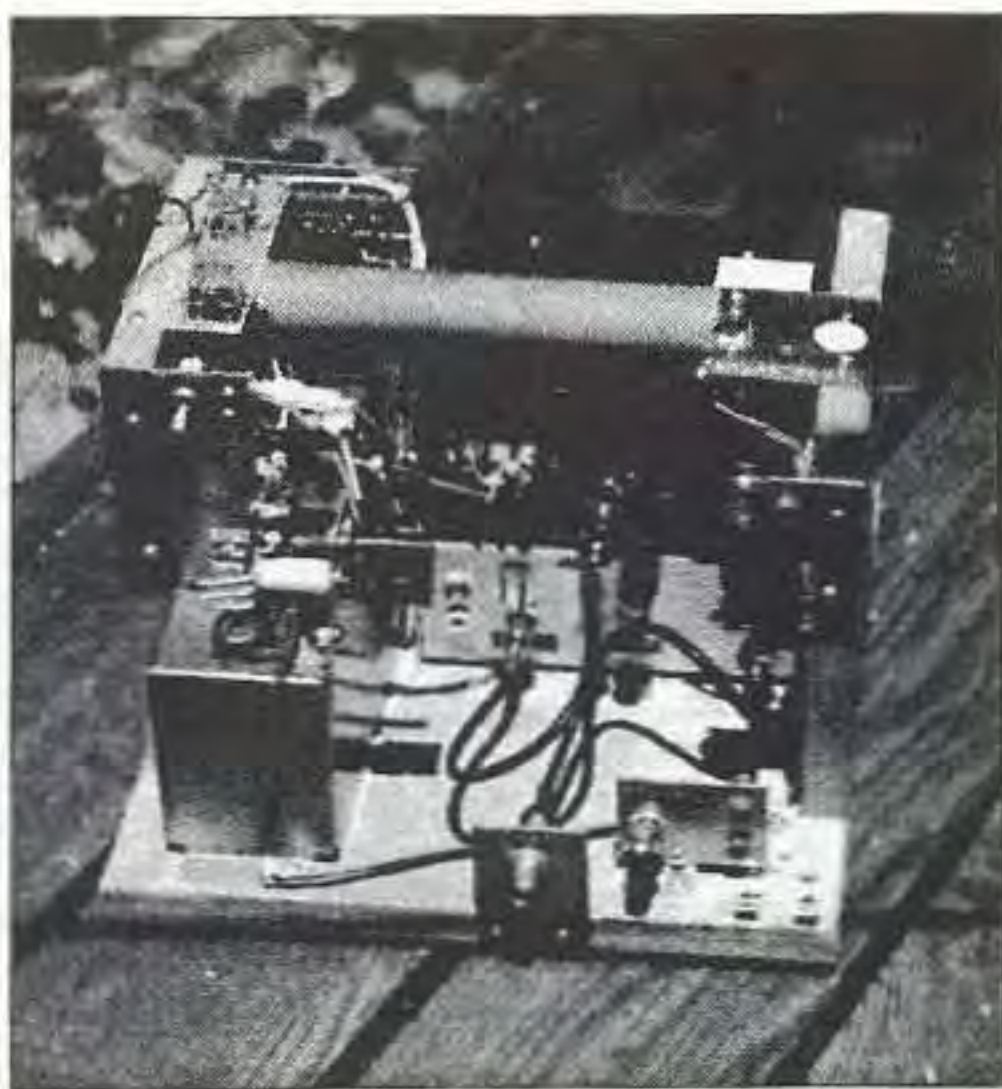


Photo C. Rear view.

battery must be used (a Radio Shack diode, #276-1141, will do the job); and second, the panel must be adjusted periodically to track the Sun and maximize power output. Using the 6 watt incandescent lamp really speeds up the positioning process. Notice the small, collapsible aluminum stand; it allows you to securely position the solar panel. The stand was purchased at an art supply store. The Desert Storm solar panel was my first serious experience using solar energy for amateur radio. It's a very exciting experience to work another amateur station hundreds (and even thousands) of miles away, and know that you're using the ultimate power source—the Sun!

About the paddle: The Paddlette is a terrific little paddle, and I built one into my station. There are several paddle kits on the market, and they look very promising.

About the expanded voltmeter: This excellent item was discussed in the



Photo D. All packed up and ready for a little Radio Fun in the Sun!

“QRP” column by Mike Bryce WB8VGE, on page 70 of the June 1991 issue of 73. The expanded voltmeter will allow you to assess the

Continued on page 38

THE POCKET GENERATOR

5 Amp-Hr, Portable Gel-Cell and 110 VAC Inverter..... \$89.95 + \$10.50s&h

ONLY 3" x 3.5" x 4" & Very Light Weight (3.5 Lb.) Perfect for Laptops, Chargers, Boom Boxes, Cameras, etc.

- AC Wall Charger
- 50 Watt Continuous/80 Watt Peak DC to AC Inverter Measures Only 1.25" x 2.5" x 3.25"
- 110 VAC Outlet Modified Sine Wave
- Shoulder Strap and Soft Carrying Case
- 12 VDC Cigarette Lighter Outlet
- DC Charging Cord

THE POCKET STATION

Same as THE POCKET GENERATOR, But a Smaller, Lighter 3 OR 7 Amp-Hr Gel-Cell, Without the Inverter..... \$59.95 or \$69.95 +\$10.50s&h.



12 VDC to 110VAC INVERTERS

- Modified Sine Wave
- Great w/ The POWER STATION or MEGA STATION
- Overload, Thermal, & Undervoltage Protection

Model	Cont. Pwr	Peak Pwr	Price
PC140	140 Watts	250 Watts	\$34.95*
PC300	300 Watts	500 Watts	\$49.95*
PP500	500 Watts	800 Watts	\$99.95*
PP1000	1000 Watts	2000 Watts	\$219.95**
PP1500	1500 Watts	3000 Watts	\$324.95**
PP2500	2500 Watts	4000 Watts	\$549.95***
	*\$10.50s&h	**\$12.50s&h	***\$14.50s&h

CHARGE CONTROLLERS

- Flexcharge 12V x 7 Amp Controller.....\$59.95+\$8.50s&h
- Flexcharge 12V x 25 Amp Charge.....\$119.95+\$8.50s&h
- Charge Controllers for Multiple Battery Banks Also!

For Literature on Antennas, HT & Gel Batteries, Inverters, Power Supplies, Etc., Send a large SASE w/3 stamps

POWER STATION

- 12 Volt x 7 Amp/Hr Gel Cell Battery
- 12 Volt Cigarette Lighter Outlet
- 3, 6, & 9 Volt Output Jack
- Car & Wall Charger w/Auto Shutoff, Built-in Voltmeter
- 2 Hidden Terminals For Hardwiring Provide Up To 90 Amps (Short Circuit)



MEGA STATION

- 17 Amp/Hr Gel Cell w/Heavy Duty Jumper Cables Provide up to 300 Amps Short Circuit
- Cigarette Lighter Output
- Charge Indicator Meter
- Car & Wall Charger w/Auto Shutoff



SOLAR CELLS

All Wattage's & Sizes

- Rigid - 5, 11, 22, 32, 42, And 64 Watt Panels
- 5 Watt: \$105* 11 Watt: \$179**
- 22 Watt: \$219**
- 32 Watt: \$269*** 42 Watt: \$329***
- 64 Watt: 449****
- Flexible 5, 11 & 32 Watt Panels
- 5 Watt Flex: \$115* 11 Watt Flex: \$189** 32 Watt Flex: \$399***
- Reverse Blocking & By-Pass Diodes
- Silicon Alloy Deposited on Stainless Steel. No Glass to Break
- Triple Junction Silicon Cells
- *\$10.50s&h **\$12.50s&h ***\$16.50s&h ****\$18.00s&h



THE HAM CONTACT

P.O. Box 4025,
Westminster, CA 92684, Dept. Q
INFO 714-901-0573
FAX 714-901-0583
ORDERS 800-933-4264
E-Mail: N6YYO@SPRYNET.COM



VISIT OUR BRAND NEW WEBSITE:
WWW.HAMCONTACT.COM

Radio Fun in the Sun

continued from page 33

battery's state of charge as a function of terminal voltage. Another expanded voltmeter is discussed by Mike in his December 1991 "QRP" column on page 69. The December 1992 issue carries a complete feature article about an Expanded Scale Voltmeter.

Of course, this list is only the beginning: There are a myriad of simple—yet useful—station accessories just waiting to be included.

A portable, solar-powered QRP station, such as the one described in this article, can provide many hours of enjoyment while you build it, not to mention years of operating fun after. And,

of course, Ol' Sol will provide the operating power as well as those great spots for DX propagation.