

When turning on the transceiver, there is a sometimes painful pop in the headphones. This malady is not uncommon with radios of such simple design. Barring a redesign of the audio stages, you can simply plug in your headphones *after* power is applied.

Summary

This compact rig easily fits into a suit-

case, backpack or nearly anywhere on the operating bench. Although it's in the barebones category of amateur equipment, it's a good performer. The Backpacker II starts with a proven, popular design and adds some intelligent and worthwhile improvements. With an average antenna, above average patience and persistence, and the desire to try

something different, plenty of enjoyable contacts, even DX, are possible with this little radio.

Manufacturer: Tejas RF Technology, PO Box 720331, Houston, TX 77272-0331, tel 713-879-9300, fax 713-879-9494. Manufacturer's suggested retail price: Backpacker II kit, \$160; component kits for additional bands, \$10 each.

SGC Inc Model SG-230 "Smartuner" Automatic Antenna Tuner

Reviewed by Jeff Bauer, WA1MBK

Way back when I was in technical school, there was a man who put forth the proposition that you could tune an antenna, but you couldn't tune a fish. Or was that tuna fish? Anyway, that was back in 1969, or so... a time when there was a *lot* of strange preaching going on. Bell-bottom pants were hip, hip-huggers often ripped, and Woodstock was an event—not one of Charles Schulz's Peanuts characters.

It was also before Al LaPlaca, W2WW (then K2DKK), and Lew McCoy, W1ICP, had graced the pages of *QST* with the "Ultimate Transmatch"—the most popular antenna matching device to hit the Amateur Radio scene since the famous Johnson Kilowatt Matchbox tuners.

Yet by today's standards, even the Ultimate Transmatch is a dated unit that is sometimes cumbersome to use. Some 20 years later, we revel in the luxury of automatic, remote-control, microprocessor-based technology in every aspect of our lives. Cars have computers, kilowatt audio systems and electronic *everything*. Kitchen toasters have *memories*. Coffee makers and ovens can be programmed. Will it ever end? Probably not.

Here we review the SGC Model SG-230 Smartuner, a modern successor to the Ultimate Transmatch. It's an outboard microprocessor-controlled antenna tuner for radios in the 150-watt class. Its main application is for end-fed, unbalanced antennas such as random wires or whips. The manual recommends a radiator at least $\frac{1}{4}$ wavelength long, and shows a number of mobile, marine and fixed-station applications. Hook a random wire to the output terminal, apply at least 10 watts of RF, and the Smartuner automatically finds the best match.

Description

The Smartuner is literally and figuratively the proverbial "black box" many of us read *about while studying for our licenses*. The enclosure is made of ABS plastic, which is rugged and provides all-weather protection for the internal circuitry.

Inside is a virtual grab-bag of high-tech digital circuitry and some perhaps more-familiar RF and analog components. A shock-mount option is available for "military applications," as is 24-volt operation. The stock unit runs on 12 volts and should be fine for

everything other than the most torturous amateur installations.

The Tuner Circuit

Stripped of its computer brain, the Smartuner turns out to be a regular antenna tuner after all. What a surprise! The circuit configuration can be configured as a classic pi network or a series L network (the computer figures out which is needed to match a given antenna). Six input capacitors, eight inductors and five output capacitors are switched in or out of the tuner circuit by relays. There are no knobs, turns counters or band switches to deal with.

Depending upon the configuration of the various relays, capacitors and inductors, up to "about a half-million different pi or L con-

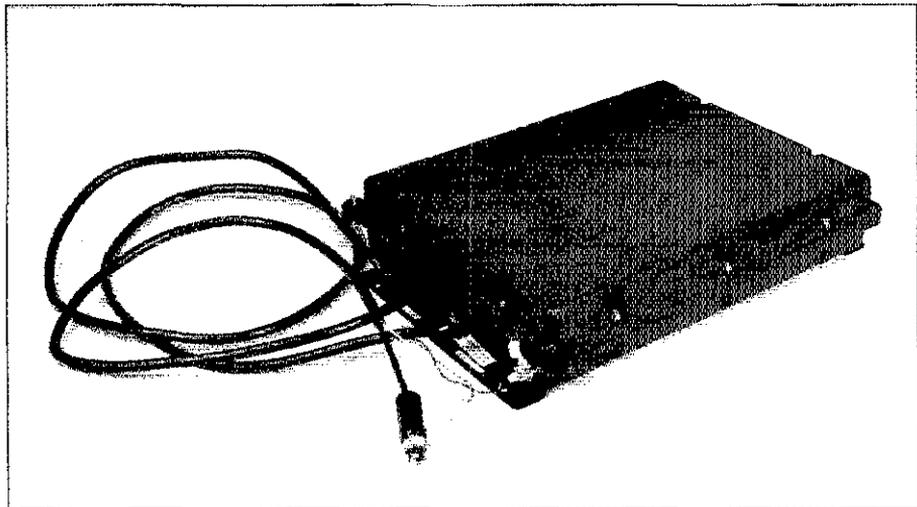
figurations" are provided, so states the manual. I didn't bother to draw out and count the various individual component configurations and do the math to verify the number. Let's just say there are a lot of combinations!

How it Works

Using the Smartuner couldn't be simpler. Simply talk into your mike or key a CW carrier. The reflected power measured in the tuner's directional coupler is shunted across terminating resistors and rectified by diodes. The rectified voltages (dc) are fed to a resistive voltage divider, and on to a voltage comparator, which sends digital data to the CPU, the tuner's computer brain. A phase detector circuit tells the CPU whether the load (antenna) impedance presented is capacitive or inductive; more CPU data in.

An MC146805E2 CMOS microprocessor comprises the tuner's brain. Sensor, comparator and detector data provides the CPU with information the built-in software needs to choose the correct combination of capacitors and inductors to achieve a 1:1 SWR (or close to it). Then the antenna is matched. According to the manual, this process typically takes two seconds or less, and the microprocessor will stop hunting if it can't find a match in 20 seconds (time to check the antenna...).

When the tuning procedure is complete,



The SGC-230 Smartuner is the proverbial black box. The cable carries wires for RF input and dc power, and for connecting a remote LED the lights when the tuner finds a match.

The Bottom Line

SGC's Smartuner applies modern microprocessor technology to a classic problem and comes up a winner. Although it's a bit pricey, the SGC-230 will match a variety of random-length radiators and is a good choice for mobile, marine or "stealth" home antenna systems.

the CPU creates a table in nonvolatile memory that stores tuner settings and frequency information. This becomes important for the SGC's tune-up algorithm: The more frequencies tuned, the more frequencies the SG-230 remembers and the faster it can tune up in the future. Retuning time is specified at 10 *milliseconds*, and although we didn't measure this specification, it's *fast*.

The Manual

The manual for the SG-230 is a lot more than I expected for an antenna tuner. It's a well-produced document with nine chapters: general information, specifications, a parts list, antenna types, typical installations, general parameters, installation procedures, electrical check-out and a general description. There are plenty of figures (more than 14!) that clarify almost any type of installation you could encounter.

Operation

Using the SG-230 couldn't be much easier. Simply attach an antenna and a decent RF ground to the tuner, connect the supplied coax to your transceiver, wire up the optional remote tune indicator LED, apply 13.8 V dc and apply RF. The SG-230 senses the RF, figures the SWR and goes through the process of reducing the SWR to match your rig's 50-ohm output to whatever impedance the attached radiator may present. Relays click and before you know it, the remote-tune LED is lit and you're ready to make QSOs.

At least 10 watts of RF is required for the Smartuner's sensing circuitry to function properly. This can be a problem with some solid-state transceivers that have sensitive circuitry to reduce output power in case of high SWR. The transmitter may not put out 10 watts until the Smartuner finds a reasonable match. This was problematic when using my Kenwood TS-440S on SSB: At times, the tuner didn't seem to sense any RF coming down the line. Switching the '440 to CW and sending a few dits kicked the SG-230 into gear. The manual shows how to modify the Smartuner so that its sensing circuitry responds to signals of 6 W or 3 W. I didn't try this during the review.

The specifications call for a 23 to 80-foot antenna for operation on 160 meters, but I was able to tune a haphazardly strung 15-foot length of wire on that band. For frequencies above 3.3 MHz, as little as eight feet of antenna may be used, making a garden variety 102-inch CB whip antenna more than sufficient for multiband mobile use.

One point to remember is that the use of certain antenna lengths on some frequencies can cause extremely high RF voltages to appear at the feedpoint. SGC provides a high-voltage porcelain feed-through for connecting the tuner to the antenna, so care should be exercised in maintaining high-voltage insulation for the antenna lead-in wire. High-voltage anode wire from a defunct color TV set (or a TV repair shop) works fine. The center conductor from RG-213 coaxial cable is rated at 5000 volts and should suffice for most

Table 6

SGC SG-230 Smartuner 1.8 to 30 MHz Antenna Tuner, Serial no. 65815174

Manufacturer's Claimed Specifications

Frequency range: 1.8 to 30 MHz.

RF power input range: 10 to 150 W PEP.

Power requirement: 10-15 V dc (13.8 V typ), 900 mA.

Size (height, width, depth): 3 × 5 × 11 inches; weight, 8 lb.

Measured in the ARRL Lab

Tested on 160 through 10-meter amateur bands.

As specified.

At 13.8 V with no RF present, 470 ma; with RF present, 880 mA.

applications unless your radiator is *very* short.

We tried some 150-watt 10-minute key-down tests in the ARRL Lab on a variety of frequencies and with a variety of loads. Although the SGC-230 became slightly warm to the touch, we observed no problems or signs of stress. When SGC says 150 watts, they mean it.

The Finale

Readers may ask, "My rig already has an internal antenna tuner. Why would I want this one?" That's a fair question.

The internal antenna tuners in most transceivers can usually handle only a rather limited range of impedances. The SG-230 will tune a wider range of impedances, and it can be located *at or near the antenna*. This is important in providing the maximum transfer of power directly to the radiator.

Although expensive, the SC-230 is a wonderful unit for the serious mobile or marine operator who prefers to keep rolling instead of stopping to change band elements or coil taps when band hopping. The SG-230 would also be a welcome helper for the amateur interested in operating undercover HF in "stealth Mode" from an apartment or condo with a minimum of gadgetry to adjust.

Come to think of it, with this SG tuner, maybe you *can* tune a fish! Or is that *can tuna fish*?

Manufacturer: SGC, Inc. 13737 SE 26th St, Bellevue, WA 98005, tel 206-746-6310, fax 206-746-6384. Manufacturer's suggested retail price: \$595.

SOLICITATION FOR PRODUCT REVIEW EQUIPMENT BIDS

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only. Minimum bid: \$753.

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SSB Electronic SP-70 mast-mount 70-cm preamplifier (see Product Review, March 1993 *QST*). Minimum bid: \$100.

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In your bid, clearly identify the item you are bidding on, using the manufacturer's name and model number, or other identification number, if specified. Each item requires a separate bid and envelope. Shipping charges will be paid by ARRL. The successful bidder will be advised by mail. No other notifications will be made, and no information will be given to anyone other than successful bidders regarding final price or identity of the successful bidder. If you include a self-addressed, stamped postcard with your bid and you are not the high bidder on that item, we will return the postcard to you when the unit has been shipped to the successful bidder.

Please send bids to Bob Boucher, Product Review Bids, ARRL, 225 Main St, Newington, CT 06111-1494. 

Feedback

◇ There's a numerical error in a table in "A Unified Approach to the Design Of Crystal Ladder Filters," by Wes Hayward, W7ZO1, *QST*, May 1982. (This error is repeated in W1FB's *Design Notebook*.) In Table 1, *Normalized k and q Values for a Butterworth Response Without Predistortion*, contains an error. The table entry for N=4, k23 is given as 0.4512. This is wrong. It should be 0.5412. The correct number is given in Zverev's *Handbook of Filter Synthesis*, and I have confirmed this also from Table 3, Chapter 8, in *Reference Data for Radio Engineers*. —Dan Halbert, KB1RT