Product Review Column from *QST* Magazine

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J.W. Miller Automatic Antenna Tuner Auto-Trak Model AT2500

Kenwood TS-130S HF SSB Transceiver

Shure 444D Controlled-Magnetic Fixed-Station Microphone

Product Review

Conducted By Paul K. Pagel,* N1FB

Kenwood TS-130S HF SSB Transceiver

Conventional wisdom has it that filmmakers often follow a successful movie with a sequel having much the same cast, roughly the same plot and none of the spontaneity that made the original popular. Usually, such imitations are dubbed by the critics as "Son of . . ." movies. The TS-130S could easily be tagged as "The Son of the TS-120S,"[1] but the TS-130S is in no way an inferior copy of the original. Kenwood has kept the solid foundation of the TS-120S and added features that greatly enhance its performance.

Refinements

Perhaps the most obvious change is in terms of frequency coverage: The '130 deletes the 15-MHz band and adds the new WARC bands.[2] For the time being, the only significance this has is that the operator will use the 10-MHz WWV signal for time and frequency reference instead of the 15-MHz signal. Factory-installed diodes prevent accidental transmission on the WARC bands before they become available for use. The owner's manual has instructions for removing each diode to enable transmission on a particular band. If the operator desires to simultaneously enable transmission on all three bands, he merely removes one jumper. Either way, it is a relatively minor procedure that the average amateur can perform in a few minutes.

In terms of flexibility, the most advantageous feature added to the '130 is the provision for optional filters and the means to switch them. Like the '120S, the user can add either the 500-Hz (YK-88C) or the 270-Hz (YK-88CN) filter for cw operation. The user can also choose to add the 1.8-kHz ssb filter (YK-88SN) to use as an alternative to the built-in 2.4-kHz ssb filter. With the '120, the cw filter was selected automatically when the rig was placed in the cw mode. Not so with the '130! A push-button switch located on the front panel allows the operator to choose between narrow and wide filters. In the WIDE position, the '130 automatically selects the 2.4-kHz ssb filter regardless of the setting of the MODE switch. Switching to the NARROW position causes the '130 to select either the optional cw or ssb filter, depending on the setting of the MODE switch. The receiver will be disabled if the NARROW position is selected without the corresponding filter installed. I used this feature to get a rough idea of the isolation of the ports on the filters. If the ports were not isolated, there would be a great deal of leakage of signals around the filters, defeating their purpose. This would be indicated by being able to hear signals in the NARROW position with no filter installed. I found that the only signals I could hear were the ones that had been "pegging" the S meter. My personal opinion is that the isolation is good enough that the filters are not compromised.

The table of specifications shows the noise floor to be −138 dBm at 80 m. This is more sensitivity than could ever likely be needed on this band; in fact, it contributes to the likelihood that the receiver will suffer from front-end overload in the presence of strong signals. Kenwood has added a 20-dB attenuator to the '130 that can be selected with another push-button switch located on the front panel. By using the attenuator and judiciously adjusting the RF GAIN control, the operator can avoid the problems associated with the front-end overload.

Another handy addition to the '130 is the built-in speech processor. As with most speech processors, results were not always predictable. On-the-air tests indicated that at times the processed signal was more effective than the unprocessed signal. At other times, the unprocessed signal seemed to do better. Presumably, varying band conditions, degrees and types of interference, and perhaps "black magic" account for the apparent inconsistencies. Nonetheless, having the processor available at the press of a conveniently located button gives the operator one more weapon for crashing the pileups.

The '120 did not always display the correct frequency on the digital readout when beyond the edges of the specified band. This minor annoyance has been alleviated in the '30. For instance, if you are listening to WWV on 10 MHz and move the VFO 100 Hz below the WWV signal, the digital display will switch from 10.000.0 to 9.999.9. For the average amateur this is probably of little importance; however, one of my primary on-the-air activities is participating in Army MARS nets, which are

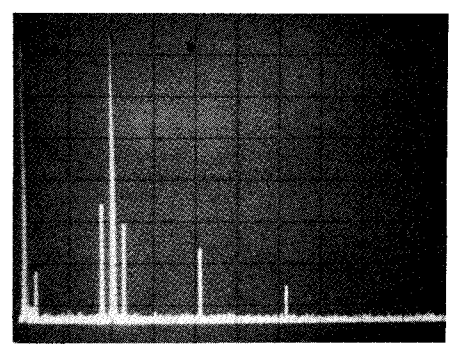


Fig. 1 — Worst-case spectral photograph of the TS-130S transmitter output on 14 MHz at 100-watts output. Vertical divisions are 10 dB each; horizontal, 10 MHz. Close-in spurs are down approximately 45 and 50 dB, respectively. The second harmonic is down about 55 dB. The TS-130S meets current FCC requirements for spectral purity.

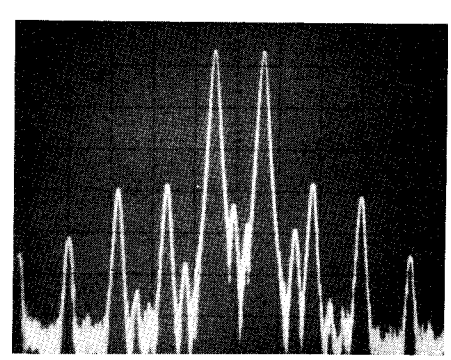


Fig. 2 — This photo represents 20-meter two-tone testing of the TS-130S at 100-watts PEP output. Each vertical division is 10 dB; horizontal, 1 kHz. Third-order products are about 38 dB down from the PEP output level.

[1]P. K. Pagel, "Product Review," *QST*, February 1980, p. 38.
[2]R. L. Baldwin, "It Seems to Us . . ." *QST*, January 1980, p. 9.

*Assistant Technical Editor

located just above and below the amateur bands. It is certainly convenient to "dial up" the given frequency of a net with no guesswork or mental gymnastics. As with the '120, the analog dial would be adequate (temporarily) should a problem develop with the digital readout.

On the '120, the operator used the MODE switch to select between cw, usb and lsb. The markings on the '130 MODE switch read: CW SSB REV. Diode switching selects the "normal" sideband for any given band when the switch is in the SSB position. If the operator desires to operate on the other sideband, he switches to the REV (reverse) position. This feature is hardly earthshaking, but it does facilitate rapid band changes.

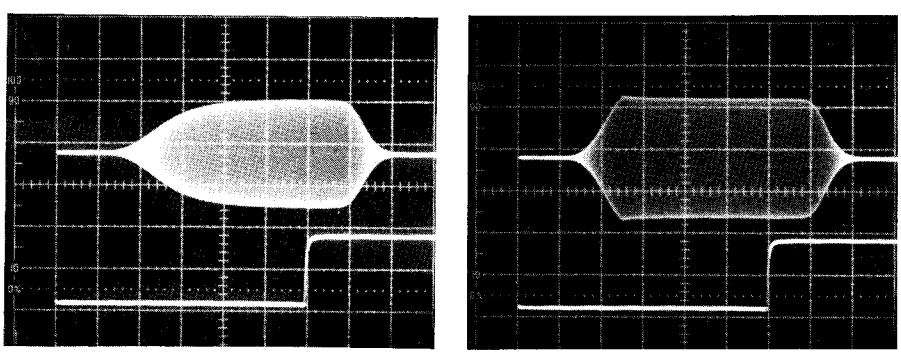
Kenwood TS-130S Transceiver Serial No. 1020547

Manufacturer's Claimed Specifications	*Measured in ARRL Lab*
Frequency coverage: 80-10 m, WARC bands included.	As specified plus approximately 70 kHz beyond upper and lower band edges.
Modes of operation: Ssb/cw.	As specified.
Readout: Analog and digital; 6-digit, fluorescent blue digital display.	0.25 inch (6.4 mm) digits.
Resolution: Analog, 1 kHz; digital, 100 Hz.	As specified.
Kilohertz per turn of knob: Not specified.	25.
Backlash: Not specified.	Nil.
RIT range: ±2 kHz.	±2 kHz.
Receiver attenuator: 20 dB.	As specified.
S-meter sensitivity (μV/S9): Not specified.	80 m, 100; 40 m, 100; 30 m, 100; 20 m, 100; 17 m, 100; 15 m, 102; 12 m, 102; 10 m, 100.
DB/S unit: Not specified.	From S1 to S9, 6 dB; from S9 to +30 dB, linear; above +30 dB, nonlinear.
Receiver sensitivity: 0.25 μV for 10 dB S + N/N.	Receiver dynamics measured with optional YK-88C i-f filter installed.

	80 M	*20 M*
Noise floor (MDS) dBm:	−138	−138
Blocking DR (dB):	109	110
Two-tone, third-order IMD DR (dB):	79	78
Third-order input intercept (dBm):	−19.5	−21

Audio power output (8 ohm load): 1.5 W.	As specified.
Power consumption: Receive, 9.66 W; transmit, 248.4 W.	Not measured.
Transmitter rf power output: Not specified.	80-12 m, greater than 100 W; 10 m, greater than 90 W.
Spurious suppression: Better than 40 dB.	45 dB.
Harmonic suppression: Better than 40 dB.	Approx. −55 dB on 20 m (worst case).
Carrier suppression: Better than 40 dB.	As specified.
Third-order IMD: Not specified.	Approximately −38 dB (see photo).
Key-down time limitation: Not specified.	See text discussion of built-in protective circuitry.
Frequency stability: Within 1 kHz during the first hour after 1 minute of warm-up; within 100 Hz during any 30-minute period after warmup.	−110 Hz after 10 minutes, −337 Hz after 1 hour. (Measured with transmitter operating at 20-W output into 50-ohm load.)

Size (HWD) 3.8 × 9.6 × 11.7 inches (94 × 241 × 293 mm).
Weight: 12.4 lb (5.6 kg).
Color: Gold brown/gray.



(A) (B)

Fig. 3 — The keyed cw waveform of the TS-130S. At A, the carrier level control was adjusted so that the alc meter barely deflected upscale. The waveform is "soft and mushy." At B, the carrier level control was fully advanced. The alc meter was "pegged," yet the waveform remained relatively soft, indicating that it is difficult to overdrive the TS-130S. The best waveform was obtained by adjusting the carrier level control to the point that resulted in the alc meter reading being in the upper limit of the alc zone. Horizontal divisions are 5 ms each. As with the '120, roughly 7 ms after key up, the wave starts to decay. No key clicks were discernible. Because of the delay, the weighting may be a little heavy — that is probably unnoticeable below 40 to 50 wpm.

Constants

Most of the basic parameters of the '120 have not been changed in the '130. The '130 has the built-in VOX controls located on the top cover of the rig. This presents no problem for fixed or mobile use. The optional MB-100 mobile bracket is designed such that the operator should have no trouble reaching the VOX controls while the rig is installed in it, should that be necessary. I found the built-in noise blanker to be quite effective in taking out ignition noises from nearby automobiles.

The TS-130S is delightfully simple to operate. The transmitter is broadbanded, so tune-up is limited to selecting the appropriate band, picking a frequency and choosing the appropriate mode. Because the finals are solid-state, Kenwood has taken precautions to protect them from conditions that might lead to their destruction. A large and quite effective heat sink is attached to the finals. In fact, the heat sink on the finals is larger than the heat sink on the companion PS-30 power supply. A very quiet fan is mounted on the heat sink of the '130. Normally the fan is off; when the temperature of the heat sink rises above a predetermined level, the fan is switched on automatically. For the first couple of months that I used the rig, the fan did not come on. I had begun to suspect that it might be defective. During the lab tests we locked the transmitter on at full output power (into a dummy load, of course). The heat sink warmed up rapidly, and the fan did come on. It is an extremely quiet, but effective, fan.

The '130 has built-in circuitry that protects it from high VSWR levels. The circuitry senses the high VSWR and automatically reduces the drive level. At my station, one of the antennas failed in the midst of a QSO. The operator at the other end reported a sudden drop in my signal level. I checked the SWR and found that it was well above 5:1. I tested the '130 on a dummy load and found that the unit performed normally. The protective circuitry had passed the acid test!

Another feature carried over from the '120 that is quite useful is the IF SHIFT, which moves the i-f crystal filter center frequency ±1 kHz. This allows the operator to adjust the tone or eliminate interference. At the beginning of one of my cw QSOs, there was relatively little activity on the band, and I was using the ssb filter. As the ragchew progressed, additional stations appeared nearby. I switched to the 500-Hz cw filter, which removed the distraction. Then, suddenly, a very loud station came on top of the station I was working and began calling CQ. I decided to try taking him out with the IF SHIFT. It worked like a champ: I could tell he was still there, but he was so far down the slope that the station I was working was once again armchair copy. I was impressed.

The '130 has a built-in, 25-kHz crystal calibrator that can be adjusted to WWV. It also has provisions for installation of four crystals for fixed frequencies of operation. The S meter also doubles as an indicator for transmit conditions. On transmit, the meter can read either collector current or alc (automatic limiting control). The alc meter

reading is most useful in adjusting the microphone gain control for ssb operation. In the ARRL lab, we found that the best cw waveform could be obtained by setting the carrier level control so that the alc meter rested at the upper boundary of the alc zone (see photo).

A wide variety of accessories for the TS-130S are available in addition to the PS-30 power supply and MB-100 mobile bracket already mentioned. These include VFO-120 external VFO and the DFC-230 digital frequency controller. A DIN socket on the rear panel provides the means for controlling an external amplifier.

The only glitch noticed during several months of operation occurred one evening shortly after KB1O and I checked into a MARS net. I looked up at the rig and noticed that smoke was streaming out the air vent on the top. In a flash, I turned the rig off and unplugged it. I removed the top and bottom covers and looked for visible signs of damage — none. I reconnected the power supply and turned the unit on. Like a hawk, I watched for the first sign of smoke to pinpoint its source. I waited . . . and waited . . . and waited some more. Nothing. I connected a dummy load and tested the transmitter. Everything seemed normal. So I put it on the air and got excellent signal reports. Still no sign of smoke. For several weeks I operated the '130 with the top and bottom covers removed. There was never a recurrence of the smoke. I've found nothing abnormal in the unit's operation. I concluded that a small varmint had crawled into the innards and met an untimely end.

If I had a complaint it would not be about the rig at all, but about the documentation that goes with it. The owner's manual provides clear text and detailed pictorial drawings that indicate how to connect the TS-130S to various options and environments. It has a block diagram and schematic diagrams of the various boards, and one large diagram of the whole radio. Here the '130 falls short of the '120; its manual at least had an abbreviated description of the circuit. Kenwood does sell an optional service manual. If this radio were destined for the CB market or another service where no technical expertise is expected of the operator, then I think they would be justified in limiting the owner's manual to the information contained in this one. That is not the nature of the amateur market, though. I think that Kenwood and the other manufacturers who do not automatically provide good technical documentation of their equipment are doing a disservice to the amateur population and the Amateur Radio Service in general.

As with the '120, the '130 seems to have been designed with the mobile operator in mind. Over the years, mobile rigs have often implied compromise. The TS-130S is not the top of the Kenwood line in terms of receiver performance (see the receiver figures of the TS-830[3]). But the difference in performance is balanced by the added versatility. The TS-130S is convenient, easy to operate and ideal for mobile installations. The TS-130V, a low-power version with most of the features of the TS-130S, is available for the QRP enthusiast. Additional information about the TS-130S may be obtained from Trio-Kenwood Communications, Inc., 1111 West Walnut St., Compton, CA 90220. Price class for the TS-130S is $750. — *Peter O'Dell, KB1N*

[3]P. K. Pagel, "Product Review," *QST*, May 1981, p. 38.

J. W. MILLER AUTOMATIC ANTENNA TUNER AUTO-TRAK MODEL AT2500

☐ The moment I saw the AT2500 in operation I recognized that it was going to be a challenge to describe. The input and output capacitor knobs turning as if by magic, without a hand guiding them, surely implied a high degree of complexity and sophistication. It was not a disappointment. The past few months have been spent observing the operation of the tuner with a variety of loads, power levels and modes of operation at W1SE.

Eighteen pages of the 20-page instruction manual describe each circuit in explicit detail. The manual is extremely well organized, and includes schematic and circuit-board layouts with every component identified.

General Description

Two primary assemblies make up the AT2500. The main tuner assembly houses the rf components and two circuit boards, which contain circuitry to control the motor-driven capacitors. During operation the tuner band switch, lettered A through R, must be set to the correct band before automatic operation may begin. The capacitors may be operated manually, with or without the automatic feature disabled and for minor "touch-up" by those who just can't keep their hands off the knobs. This feature is handy should there ever be a control-circuit malfunction. Manual operation of the tuner is possible with the boards removed for repair or replacement. The impedance-matching circuit is a conventional T network.

The second assembly is the remote directional bridge coupler which, though separate, is connected to the main tuner assembly by means of a captive plug-in cable.

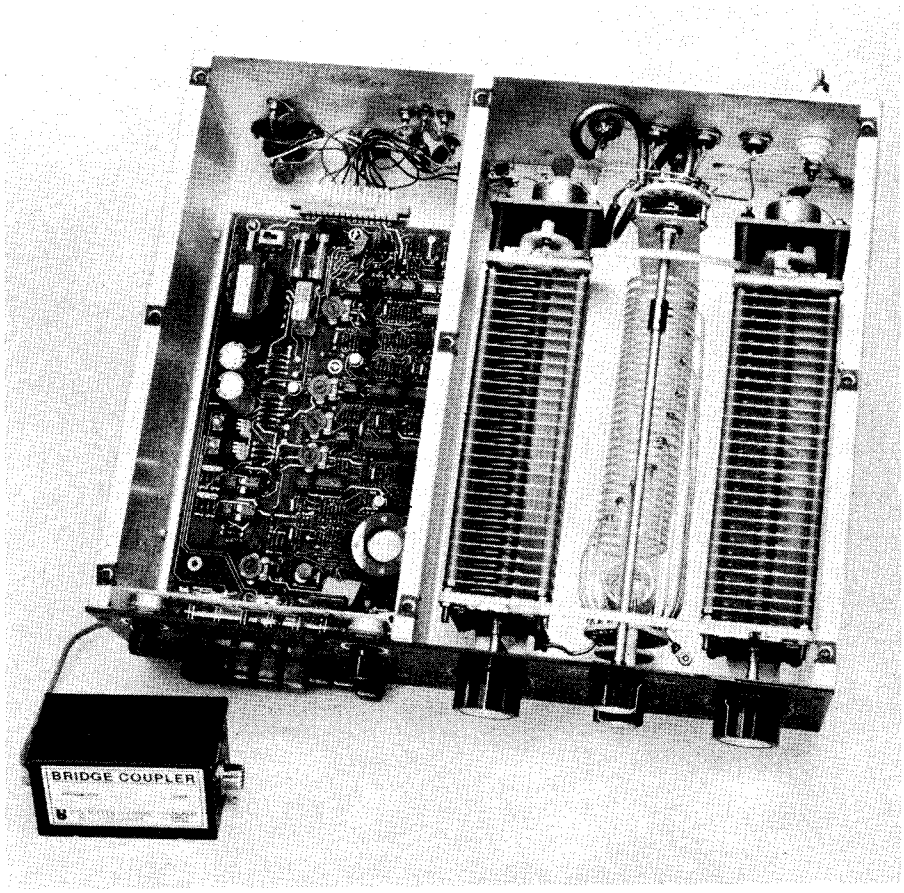
Circuitry

A very brief description of each circuit will provide the reader with an idea of what the AT2500 does. The remote directional bridge coupler is a separate package, designed to be inserted in the coax line at the output of the rf source, i.e., transmitter, transceiver or amplifier — the point in the feed line where it is most important to exhibit a low SWR. The bridge generates dc voltages that are proportional to the forward and reflected rf voltages present on the cable. Ultimately, these dc voltages are used to actuate the motors that drive the capacitors in the rf section.

An SWR analog computer circuit automatically calculates the SWR as derived from the dc voltages developed by the bridge. The calculated SWR is in turn displayed on the front-panel SWR meter.

These same dc voltages also drive the power logarithmic amplifier to provide in excess of 60 dB of compression, enabling the front-panel power meter to read either 1 to 250 or 10 to 2500 watts on a single scale. Each range is selected by a panel switch.

As the motors turn the capacitors, the dc voltage developed by the bridge circuit is changing constantly. The slope detection circuit monitors these changes, and as a decending voltage begins to change, that is to increase, the particular motor operating at that moment is stopped, and the other motor is started. As the SWR is reduced, by alternate starting and



J. W. Miller Automatic Antenna Tuner Auto-track Model AT2500

Manufacturer's Claimed Specifications	*Measured in ARRL Lab*
Frequency range: 3.0 to 30 MHz.	As specified.
Power-handling capability: In excess of 2500 watts PEP.	Tested at 1 kW cw; 2 kW PEP ssb.
Impedance-matching range: 10 to 300 ohms, to 50 ohms resistive.	As specified.
Outputs: 3 coax-fed antennas, 1 random wire, 1 coax-fed antenna bypass.	
Type of network: Not specified.	CLC T network.
Insertion loss at 50 ohms: Not specified.	Immeasurable
Harmonic suppression capability: Not specified.	10 dB at 160, 40 and 10 meters.
Tune-up time: 15 seconds.	As specified.
Minimum tune-up power: 1 watt.	As specified.
Cabinet size (HWD): 5.25 × 17 × 4 inches (133 × 432 × 356 mm).	
Weight: 17 lb (7.7 kg).	As specified.
Power requirements: 115/220 V ac, 50-60 Hz; or 13.5 V dc.	As specified.

stopping of first one motor and then the other, the drive level to the motor(s) is reduced, slowing them, for a smooth stop without overshoot. When the SWR reaches a point lower than that selected by the TUNE SWR control, the electronic logic circuit issues a stop command to the motor drive circuit, which stops both motors.

In addition to controlling the motors, the logic control circuits perform four other functions; one of them, for example, will shut down an amplifier if an SWR is detected that is higher than that selected by the LINEAR ENABLE control. This could happen if operation was removed from one end of a band to the other. When the SWR is once again within the limit set, the amplifier will be turned on. Within one second from the time that a high SWR is detected, the AT2500 will begin a retune sequence. The retune sequence also may be ordered by the operator by means of the front-panel START switch.

A tune/load motor drive circuit drives the motor-control transistors. The motors are not permitted to operate simultaneously, and the sequencing logic information is provided to ports of a bilateral switch by separate flip-flops. Each flip-flop controls a separate LED on the front panel, which indicates when its companion motor has been actuated. The slope-detection circuit also provides "level" information that slows the motors as the desired SWR is approached.

A built-in, dual-mode power supply will operate from mains of 95-125/185-250 volts, 50-60 Hz. A power converter circuit permits operation from a dc source of 12-15 volts.

Operation With an Amplifier

The AT2500 features a relay-switched circuit for control of an external amplifier. The associated jacks on the rear apron of the tuner will accommodate an amplifier that requires either normally open or normally closed relay circuitry.

When the amplifier is interconnected to the tuner, the LINEAR switch is depressed, and the front-panel LINEAR ENABLE control is set to an SWR level of between 1.5 and 3 as determined by the operator. Whenever the SWR of the system exceeds this preset level, the amplifier is immediately switched out of the line and into a standby condition, thus protecting the amplifier from excessive SWR. The AT2500 was operated for a considerable period with a Heath SB-220. The automatic standby feature operated flawlessly whenever it was required. Input power was 2 kW PEP on ssb and 1 kW on cw.

Summary

As useful and as interesting a piece of equipment as the AT2500 may be, it is not for everyone. For example, it does not cover 160 meters, has no provision for bypassing an antenna *through* the tuner and has a limited matching range (10 to 300 ohms output, to 50 ohms resistive input). The BY-PASS position of the antenna selector switch selects one antenna which may be bypassed *around* the tuner. However, this antenna may not then be selected to be used *with* the tuner. This choice is made when the feed line is connected to the rear-panel connector. Some increase in the matching range of the tuner was obtained by connecting a 4:1 balun at the output of one coax connector. An internal balun is not included. At W1SE this output was used with an 80/40-meter, open-wire-fed doublet antenna. A 50-ohm impedance was seen by the transceiver, and the antenna loaded well on both bands. Similarly, when a random wire is connected to the appropriate connector on the rear panel, the length of the wire must be selected so that the impedance presented to the tuner is within the range of the tuner.

It would appear that the greatest utility of the AT2500 would be in making fast changes from one end of a band to another, or from one band to another, when narrow-bandwidth antennas are employed. Contesters will love this tuner; the manufacturer must have had them in mind.

When the tuner senses a change in SWR, as for example following a large frequency excursion within a band, and when the antenna exhibits a relatively narrow bandwidth, an ssb signal will not permit the tuner to retune properly. The operator must switch to a continuous-carrier mode such as TUNE or CW. Then, in one second, the AT2500 will commence a retune sequence. The tune-up time is approximately 15 seconds, providing the proper position has been set on the manually selected band switch. The audible alarm will advise the operator of the higher than desired SWR, and in effect tell him to apply steady carrier for the retune sequence. As soon as the retune sequence commences the amplifier is disabled.

The AT2500 is the first antenna tuner of its kind to be manufactured in this country for amateur use. The manufacturer is to be complimented on the quality of the components used, the development of the design, its usefulness to the contester and the superb operating manual that describes everything one could ever wish to know about the AT2500.

The AT2500 is manufactured by the J. W. Miller Division of Bell Industries, 19070 Reyes Ave., Compton, CA 90224. Price class: $670. — *Lee Aurick, W1SE*

SHURE 444D CONTROLLED-MAGNETIC FIXED-STATION MICROPHONE

☐ Over the years products for the amateur market come and go. Only a few are of such high quality and universal appeal that they endure more than a season or two. The Shure 444 series of microphones has been around as long as I can remember. In fact, I've owned and used a 444 since the early '70s. The 444D is a worthy successor to the line.

As in the earlier models a slide switch in the base permits the user the option of using the microphone in either a PTT or a VOX mode. If the VOX mode is chosen, the PTT bar must be depressed and locked in place. The 444D has another slide switch on the bottom that allows the operator to choose between a high-impedance output and a low-impedance output to suit the transmitter audio-input impedance. This feature simplifies things for those moving from tube-type to solid-state radios.

One of the more innovative features of the 444D is not even a part of the microphone — it is the literature that comes with the microphone! When I purchased a new microphone or a new radio in the past, I played the game of getting out the schematic diagram of the radio and matching it with the schematic diagram of the microphone. The most tedious job was deciding which color wire goes to which pin. The 444D comes with an "Amateur Radio wiring guide" which gives hookup data including pin numbers and wire colors for equipment made by 19 different manufacturers. With the guide, attaching the microphone to the plug for the TS-130 took all of five minutes from start to finish — no strain, no pain. Other manufacturers should give some consideration to providing their customers with this kind of documentation! The guide even tells the user whether to set the slide switch for high or low impedance.

The 444D is housed in an ARMO-DUR (plastic) case that is impervious to rust and corrosion. Rubber feet keep the microphone from "walking about" the operating position. The height is adjustable from 9-19/64 to 11-51/64 in. (236 to 300 mm). The microphone comes equipped with a coiled cord; a straight cord is an option. Another option provides for monitor/transmit switching, which is most often used in signal-coded, two-way commercial circuits.

On-the-air reports indicate that the tonal qualities of the signal produced using this microphone are equal to those of my earlier-version 444. My overall opinion is that Shure has taken a very good product and made it even better. Price class: $56. Additional information may be obtained from Shure Microphones and Electronic Components, 222 Hartrey Ave., Evanston, IL 60204. — *Peter O'Dell, KB1N*