

Product Review Column from *QST* Magazine

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Kenwood AT-250 Automatic Antenna Tuner

Kenwood TS-680S 160- to 6-Meter Transceiver

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Kenwood TS-680S 160- to 6-Meter Transceiver

Reviewed by Bart J. Jahnke, KB9NM

The Kenwood TS-680S is a full-featured, compact transceiver that covers 6 meters as well as the usual 160- to 10-meter bands. On 160 through 10 meters, the '680S is virtually identical in features, operation and performance to the Kenwood TS-140S.¹ In this review, I'll highlight the differences between the two transceivers and talk about features found on the '680S that are not found on the '140S.

Aside from frequency coverage, there are two noticeable differences between the TS-680S and TS-140S: The '680S does not include a built-in VOX, but it does have a 10- and 6-meter preamplifier.

If you want VOX operation with your '680S, you'll need to purchase an optional Kenwood VOX-4 unit. The VOX-4 is an external accessory that is easily connected to the transceiver by placing it between the microphone and the transceiver's front-panel MIC jack. The VOX-4, which supports the regular lineup of VOX controls such as VOX GAIN, ANTI VOX and DELAY TIME, also includes a built-in audio speech processor with its own OUTPUT control. The TS-680S has an internal speech processor, though, so use of the processor in the VOX-4 is not necessary.

Part of the reason why there is no built-in VOX is the receive preamp that operates from 21.5 to 60 MHz. This preamp works on 12, 10 and 6 meters, as well as the broadcast bands in between. The RF AMP switch replaces the VOX switch found on the '140S's front panel. Lab testing indicates that this preamp improves the receiver noise floor by about 4 dB. In on-the-air tests, the preamp helped pull the weak ones out of the noise.

Receiver

The receiver in the TS-680S is essentially the same as in the '140S. The big differences are the 10- and 6-meter preamplifier, and frequency coverage. In addition to the receiver features in the TS-140S (which covers 100 kHz to 35 MHz), the TS-680S has extra receiver coverage from 45 MHz to 60 MHz. You might ask, "What can this little extra coverage do for me?" Being able to listen to much of the spectrum between the 10- and 6-meter bands is especially useful if you're interested in working 6-meter band openings. You can follow the maximum usable frequency (MUF) of F-layer propagation or E-skip openings as it climbs above



10 meters by listening to the many public service frequencies within this range. Another feature I liked is that the '680S can receive the European TV carriers around 48.240 and 48.250 MHz. Most 6-meter transceivers cannot tune below 50.0 MHz, but this transceiver can—allowing you to use European TV carriers as propagation beacons.

In general, the '680S has a good receiver. I found, however (as did the TS-140S reviewer), that stations whose signals were stronger than S9 sometimes introduced blocking problems in the receiver. Weaker stations are difficult to hear when the nearby strong station transmits. This effect is noticeable on 6 meters as well as on the other bands. Use of the internal 20-dB attenuator helped, but only if the desired signal was strong enough to remain usable after attenuation.

The review transceiver was equipped with the optional 500-Hz CW filter. Audio is harsh in the NARROW CW mode—so much so that, for signals near the noise, switching in the narrow filter may barely improve readability over that achievable in the wide CW mode (using the SSB filter). CW signals are not pleasant to listen to for extended periods with the narrow filter switched in.

Overall, general-coverage performance of the TS-680S receiver is good. AM selectivity is wide, however, and it would be nice if Kenwood offered a good 4-kHz-wide crystal filter for those wishing to use the '680S for serious AM listening. The manual specs AM selectivity as 6 kHz at -6 dB and 18 kHz at -50 dB. This is too wide for comfortable reception in crowded

shortwave broadcast bands, where 5-kHz channel spacing is standard. In the AM mode, 5-kHz heterodynes are routinely audible in the shortwave broadcast bands, and the -50 dB spec is insufficient insurance against strong adjacent-channel interference, even from stations two channels (10 kHz) away. Selection of the SSB-bandwidth filter during rectification detection is not possible with the '680S. Assuming that an incoming full- or reduced-carrier AM signal is tuned as closely to carrier zero beat as allowed by the '680S's 10-Hz tuning steps, good AM reception (albeit with communications-quality demodulated audio) can be achieved when the rig is set to its USB or LSB mode.

Those wishing to tape record received-signal audio from the TS-680S can make use of the fixed-level audio output available at pins 3 (DATA OUTPUT) and 4 (GND) on the rear-panel 13-pin DIN ACC 2 jack. The 680S's AGC is so flat—with the rig's RF GAIN control fully advanced—that the associated tape recorder need not have automatic-record-level control to cope with fading.

6-Meter Transmit and Receive

The TS-680S's transmitter section is similar to that in the TS-140S, except for 50 MHz. On 160 through 10 meters, RF from the second mixer passes through a low-pass filter, four discrete stages of amplification (to about 100 W) and another low-pass filter on its way to the antenna. On 6 meters, RF from the second mixer passes through a band-pass filter, two discrete stages of low-level amplification, and

¹L. Wolfgang, "Kenwood TS-140S 160- to 10-Meter Transceiver," *QST*, Jun 1988, p 42.

Table 1

Kenwood TS-680S 160- to 6-Meter Transceiver, Serial no. 8111053

Manufacturer's Claimed Specifications

Frequency coverage: Receiver, 500 kHz to 30 MHz and 50 to 54 MHz; transmitter, 1.8 to 2.0, 3.5 to 4.0, 7.0 to 7.3, 10.1 to 10.15, 14.0 to 14.35, 18.068 to 18.168, 21.0 to 21.45, 24.89 to 24.99, 28.0 to 29.7, 50.0 to 54.0 MHz

Modes of operation: USB, LSB, CW, FM, AM.

Frequency display: 7-digit blue fluorescent.

Frequency resolution: 100 Hz or 10 Hz, operator selectable.

Power requirement: 12 to 16 V dc (13.8 V nominal) at 1.5 A on receive and 20 A on transmit.

Transmitter

Transmitter output power: SSB and CW: 100 W on 160 to 15 meters, 95 W on 10 meters, 10 W on 6 meters. AM: 40 W on 160 to 10 meters, 4 W on 6 meters. FM: 50 W on 10 meters, 10 W on 6 meters

Spurious signal and harmonic suppression: Greater than 40 dB below peak power output on 1.9 to 30 MHz; greater than 60 dB on 50 to 54 MHz.

Third-order intermodulation distortion products: Not specified.

CW keying waveform: Not specified.

Transmit-receive turnaround time (PTT release to 90% audio output with an S9 signal): Not specified.

Receiver

Receiver sensitivity: SSB and CW—(2.2 kHz bandwidth, for 10 dB [S + N]/N) less than 3.98 μ V from 0.5 to 1.62 MHz; less than 0.25 μ V from 1.62 to 21.5 MHz; less than 0.18 μ V from 21.5 to 30 MHz (preamp on); less than 0.16 μ V from 50 to 54 MHz (preamp on).

Measured in the ARRL Lab

Receiver: 0.1 to 35 MHz and 45 to 60 MHz; transmitter 1.6 to 1.99999, 3.0 to 3.99999, 6.5 to 7.49999, 10.0 to 10.49999, 13.5 to 14.99999, 18.0 to 18.99999, 20.5 to 21.49999, 24.0 to 24.99999, 27.5 to 29.99999, 50.0 to 53.99999 MHz.

As specified.

As specified.

13.8 V at 17.5 A at 100 W output.

Transmitter Dynamic Testing

SSB: 160 m, 103 W; 80 to 10 m, 108 to 112 W; 6 m, 11 W. CW: 160 m, 92 W; 80 to 12 m, 96 to 101 W; 10 m, 95 W; 6 m, 11 W. FM output power measured 47 W on 10 m and 10.5 W on 6 m. The unit will transmit FM on 160-6 meters. AM carrier power measured in excess of 100 W on 160-10 m (11.5 W on 6 m), but the power control should be used to reduce power as specified.

See Fig 1.

See Fig 2.

See Fig 3.

25 ms.

Receiver Dynamic Testing

Minimum discernible signal (noise floor), with 500-Hz filter:

1.0 MHz: -119.5 dBm

3.5 MHz: -139.5 dBm

14 MHz: -140.0 dBm

Preamp off:

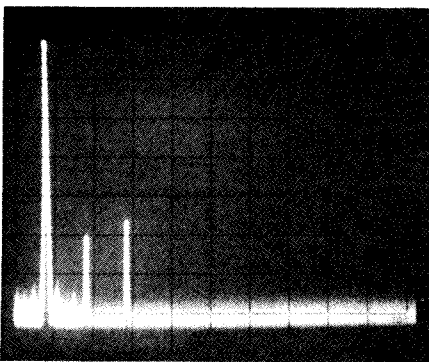
29 MHz: -137.0 dBm

50 MHz: -137.5 dBm

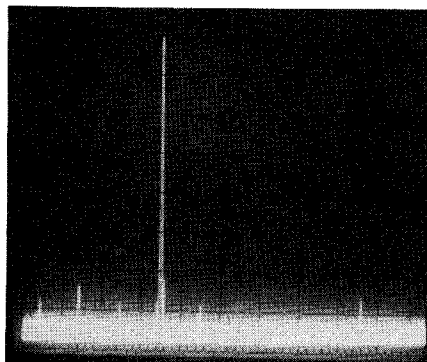
Preamp on:

29 MHz: -141 dBm

50 MHz: -141.5 dBm



(A)



(B)

Fig 1—Worst-case spectral display of the Kenwood TS-680S. Horizontal divisions are each 10 MHz; vertical divisions are each 10 dB. In the photo at A, output power is approximately 98 W at 10.15 MHz. All harmonics and spurious emissions are at least 45 dB below peak fundamental output. In the photo at B, output power is 10 W at 50.2 MHz. All harmonics and spurious emissions are at least 64 dB below peak fundamental output. The TS-680S complies with current FCC specifications for spectral purity.

the final amplifying stage—a hybrid power module capable of producing 10 watts output. The output of the power module is low-pass-filtered before going to the antenna. On receive, the 6-meter signal passes through low-pass and high-pass filters, and then (with receive RF amp on) is amplified by a low-noise 2SK125 FET.

The sunspot cycle is on its upswing now, and more and more amateurs are getting on 6 meters and enjoying E-skip, meteor-scatter, auroral and transequatorial propagation. The '680S offers the opportunity to try 6-meter operation without having to purchase another transceiver in addition to your HF transceiver. During this past May and June, 6 meters was open almost every evening to some part of the US. There were several openings to the Caribbean islands and even a couple of European openings to boot! It was fun to have the ability to participate in these openings.

Manufacturer's Claimed Specifications

AM: (6.0 kHz bandwidth, for 10 dB [S + N]/N) less than 39.8 μ V from 0.5 to 1.62 MHz; less than 2.5 μ V from 1.62 to 21.5 MHz; less than 1.78 μ V from 21.5 to 30 MHz (preamp on); less than 1.58 μ V from 50 to 54 MHz (preamp on).

FM: (12 kHz bandwidth) Less than 0.18 μ V for 12 dB SINAD from 21.5 to 54 MHz.

Receiver dynamic range: Not specified.

S-meter sensitivity (μ V for S9 reading): Not specified.

Squelch sensitivity: FM, less than 0.32 μ V.

Receiver audio output: 1.5 W at 8 ohms with less than 10% total harmonic distortion (THD).

Color: Gray.

Size (height, width, depth): 4-7/32 \times 11-1/16 \times 12 inches.

Weight: 13.4 lbs (not including the power supply).

[†]Blocking dynamic range and two-tone, third-order IMD dynamic range measurements were made at the ARRL Lab standard signal spacing of 20 kHz.

Measured in the ARRL Lab

(6.0 kHz bandwidth, test signal 30% modulated with a 1-kHz tone.)

1.0 MHz: 2.4 μ V

3.8 MHz: 0.25 μ V

14 MHz: 0.25 μ V

Preamp off:

29 MHz: 0.28 μ V

50 MHz: 0.33 μ V

Preamp on:

50 MHz: 0.25 μ V

0.17 μ V for 12 dB SINAD at 29 MHz.

Blocking dynamic range[†]:

3.5 MHz: 108 dB

14 MHz: 106.5 dB

50 MHz: 106.5 dB (preamp off);

102.5 dB (preamp on).

Two-tone, third-order intermodulation distortion dynamic range[†]:

3.5 MHz: 92 dB

14 MHz: 95 dB

50 MHz: 88.5 dB (preamp off);

87.5 dB (preamp on).

Third-order input intercept[†]:

3.5 MHz: -1.5 dBm

14 MHz: 2.5 dBm

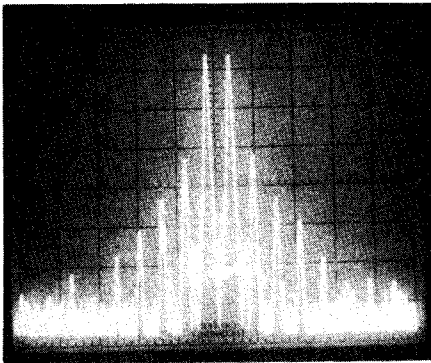
50 MHz: -4.75 dBm (preamp off);

-10.25 dBm (preamp on).

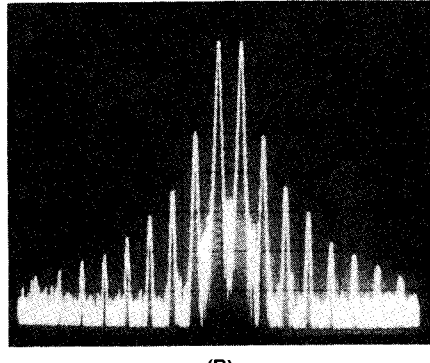
20 μ V at 14 MHz; 23 μ V at 50 MHz (preamp off).

0.15 μ V min, 0.4 μ V max at 29 MHz.

1.9 W at 10% THD.



(A)



(B)

Fig 2—Spectral display of the Kenwood TS-680S during two-tone intermodulation distortion (IMD) testing. Vertical divisions are each 10 dB; horizontal divisions are each 2 kHz. In the photo at A, the transceiver is being operated at 100 W PEP output on 14 MHz. Third-order products are approximately 32 dB below PEP output, and fifth-order products are approximately 43 dB down. In the photo at B, the transceiver is being operated at 10 W PEP output on 50 MHz. Third-order products are approximately 29 dB below PEP output, and fifth-order products are approximately 44 dB down.

The day I hooked my 6-meter antenna to the radio, I immediately thought that the receiver and my location were really good. I noticed some weak CW signals scattered

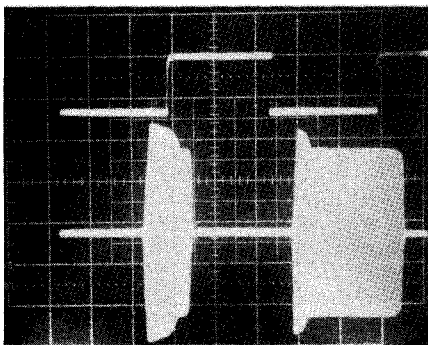
about the band—signals that I couldn't hear on my other 6-meter transceiver. It turned out that these were not actual stations, but spurious responses generated

in the receiver by strong local beacons. These responses were present only with the preamp on.

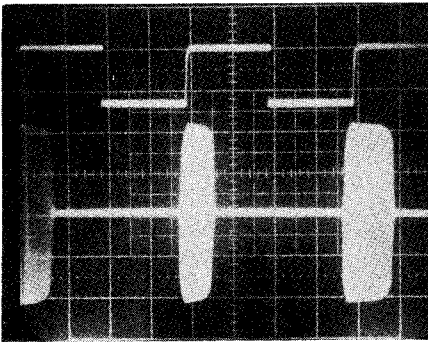
Computer Control

Another feature of the TS-140S and TS-680S is that many of the transceiver's functions can be computer controlled. There is little information on computer control in the instruction manual and the service manual, though. Here are some of the functions you can control with a computer: changing the two VFO frequencies; moving the VFO frequency up/down; choosing which memory channel (1-30) to recall; turning the RIT on/off, and changing the offset; changing the mode (SSB/CW/AM/FM); and enabling or disabling SCAN and SPLIT.

For computer control, you'll need to purchase two Kenwood accessories: the IF-10C interface kit and the IF-232C level translator. The IF-10C interface kit installs inside your transceiver and provides accessory jack ACC 1 on the rear panel. The IF-232C plugs into the IF-10C, and a cable from your computer's serial port plugs into the IF-232C. The IF-232C requires a source of 12 V dc.



(A)



(B)

Fig 3—CW keying waveform for the Kenwood TS-680S. The photo at A is with the TS-680S in the semi-break-in mode. The photo at B is with the TS-680S in the full-break-in (QSK) mode. In each photograph, the lower trace is the RF envelope; the upper trace is the actual key closure. Each horizontal division is 10 ms.

You'll also need a computer and appropriate software. I used a program called HAM.COM, written by Dan Diehlman, AE6G, with my TS-680S.² HAM.COM runs on IBM® PCs and compatibles, and it did a great job controlling the TS-680S.

Instruction Manual

As mentioned in the TS-140S review, the manual is an essential part of learning all of the operating features of the transceiver. This is especially true in the case of this transceiver, where a number of switches have more than one function. One drawback that I recognized early on is the lack of information on the 6-meter circuitry. In fact, I found it necessary to obtain the TS-140S/TS-680S service manual from Kenwood just to get a complete schematic for the TS-680S.

Reviewer Impression

The review transceiver was equipped

²HAM.COM is available from Dan Diehlman, AE6G, 5478 N Bond, Fresno, CA 93710, tel 209-439-5520.

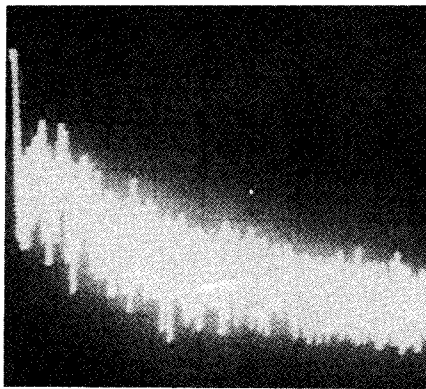


Fig 4—Spectral display of the Kenwood TS-680S transmitter output during phase-noise testing. Power output is 100 W at 14 MHz. Each vertical division is 10 dB; each horizontal division is 2 kHz. The scale on the spectrum analyzer on which this photo was taken is calibrated so that the log reference level (the top horizontal line on the scale in the photo) represents -60 dBc/Hz and the baseline is -140 dBc/Hz. Phase-noise levels between -60 and -140 dBc/Hz may be read directly from the photograph. The carrier, which would be at the left edge of the photograph, is not shown. This photograph shows phase noise at frequencies 2 to 20 kHz offset from the carrier.

with a Kenwood PS-430 power supply to provide the 13.8 V dc necessary to power the transceiver. A safety note: The fuse is in the neutral side of the ac line, and the power switch is in the hot side of the line. This wiring choice can result in a personal safety hazard if a primary-to-chassis short occurs in the power transformer with the power switch on and the power-supply chassis not grounded (either through a properly grounded three-wire line cord and ac outlet or through a wire from the power-supply chassis to the station ground).

I used the '680S with external power amplifiers that are not capable of QSK operation, so I found it necessary to change the setting of an internal switch to activate the external control relay. This adjustment was easy to make and required only 10 minutes, a screwdriver to remove the covers, and a brief overview of the circuit board to locate the switch.

After initial familiarization, I found the TS-680S easy to use with little need to continually refer to the manual. I did, however, need to refer to it when I decided to begin programming memories, especially in the case of 10- and 6-meter repeaters and their offsets.

I found, as did the reviewer of the TS-140S, that the lack of provision for transverter connection to the TS-680S is an inconvenience. As an active VHF operator, I need a good HF transceiver to use with transverters that have 28-MHz IFs. Although the TS-680S is small enough to

take mountaintopping for a VHF event, you may still need to bring another HF transceiver just to provide the 28-MHz IF for transverters for other bands.

Overall, I enjoyed using the TS-680S. The addition of 6 meters and the extended receiver coverage make this radio a welcome addition to my shack. HF plus 6 meters has never been more economical, and in one package to boot.

I would like to thank Dave Newkirk, AK7M, for using the review '680S and providing comments that were incorporated in this review.

Manufacturer: Kenwood USA Corporation, 2201 E Dominguez St, Long Beach, CA 90801-5745, tel 213-639-4200. Price class: TS-680S, \$1100; PS-430 power supply, \$195; YG-455C-1 CW filter, \$135; VOX-4 VOX unit, \$70; IF-10C computer interface, \$95; IF-232C level translator, \$95.

KENWOOD AT-250 AUTOMATIC ANTENNA TUNER

Reviewed by Bart J. Jahnke, KB9NM

The Kenwood AT-250 is an automatic antenna tuner that works with the TS-680S, TS-140S and other Kenwood transceivers. The tuner covers the 160- through 10-meter amateur bands and is capable of handling 100 W continuous input power.

It's easy to connect the AT-250 to a matching Kenwood transceiver. For the TS-680S, I simply had to place a good coaxial cable jumper between the tuner and radio and hook up the tuner control line to accessory jack number 3 on the rear of the transceiver. The last step (very important) is to connect the tuner's ground terminal to your station ground. The AT-250 can be powered from 120 V ac for home station use, or from 13.8 V dc for mobile or portable operation.

According to the instruction manual, the AT-250 is capable of matching loads from 20 to 150 ohms, or a 2.5:1 SWR (referenced to 50 ohms). Kenwood recommends that less than 50 W be used during tune-up procedures (to avoid problems caused by high voltages present when the match is not right). I ran as little as 5 W and found that the tuner worked very effectively.

The AT-250 is very easy to use. There is a front-panel BAND switch with positions for each amateur band. If you're using the tuner with an appropriate Kenwood transceiver (such as a TS-680S), though, you can set the BAND switch to AUTO and the tuner will switch automatically to the same band as the transceiver.

The tuner also has a built-in antenna switch, allowing front-panel selection of up to four antennas. In my application, I only needed to use one feed line because my HF antenna is a multi-band vertical. After you select the right antenna, tune-up is simple. Apply 50 W or less RF, wait a few seconds

New Products

COMMUNICATIONS SPECIALISTS CTCSS ENCODER/DECODER

□ Com Spec has introduced their TS-32P CTCSS encoder/decoder, which is a more versatile version of their popular TS-32 encoder/decoder. The TS-32P contains a 32-bit programmable memory that allows specifying any 32 tone frequencies from 15 to 255 Hz. Up to six tones can be accessed for multi-tone use. Tone recall is controlled by the 5-position DIP switch on the TS-32P circuit board. Manufacturer-claimed frequency accuracy is ± 0.01 Hz. The TS-32P can be programmed with a hand-held programmer at service shops, or it can be returned to the manufacturer for reprogramming without charge. The TS-32P is $1.25 \times 2 \times 0.4$ inches, and operates on 6 to 25 V dc. A one-year warranty covers the product. Price class: \$57.95. Available from Communications Specialists, 426 W Taft Ave, Orange, CA 92665-4296, tel 800-854-0547 or 714-998-3021.—*Rus Healy, NJ2L*



Table 2

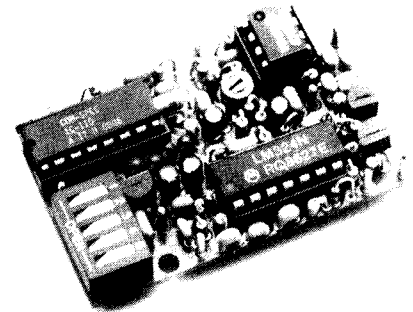
Kenwood AT-250 Automatic Antenna Tuner, Serial no. 7100135

Manufacturer's Claimed Specifications

Frequency range: All amateur bands from 1.8-29.7 MHz.
 Input impedance: 50 ohms unbalanced.
 Output impedance: 20-150 ohms unbalanced.
 Insertion loss: 0.8 dB or less.
 Pass-through power: 100 W.
 Minimum power for activation: 3 W.
 Power requirements: 120, 220 or 240 V ac at 15 W; or 12 to 16 V dc (13.8 V normal) at 600 mA.
 Size (height, width, depth): 3.8 x 6.9 x 10.1 inches.
 Weight: 9.2 lbs.
 Color: Gray.

Measured in the ARRL Lab

As specified
 As specified.
 Not measured.
 As specified.
 As specified.
 4 W.
 As specified.




ELECTRONIC SPECIALISTS LAP-TOP TRANSIENT SUPPRESSOR

□ Need an ultra-compact transient suppressor for your lap-top computer? Electronic Specialists has introduced two versions, the LTP-101 for ac power lines, and the LTP-102 for phone-line modems. Filtering included in the LTP-102 includes multielement spike suppression, and RF and balun noise filtering. Price class: LTP-101, \$64.95; LTP-102, \$45.95. Available from Electronic Specialists, Inc, 171 S Main St, Natick, MA 01760, tel 800-225-4876.—*Rus Healy, NJ2L*

as the capacitor motors whirl while the tuner finds a match, and you're ready to go.

A useful feature of this antenna tuner is its ability to run on 13.8 V dc. This is an added pleasure when you want to take your radio on the road. Typically, mobile antennas have a narrow SWR bandwidth,

and being able to have an automatic tuner in your car is handy when you can't take your eyes off the road.

Manufacturer: Kenwood USA Corporation, 2201 E Dominguez St, Long Beach, CA 90801-5745, tel 213-639-4200. Price class, \$400. 

Strays



CALL FOR QST TECHNICAL ARTICLES

□ Surface-mount devices (SMDs) that suit Amateur Radio applications are becoming more and more common—we have already seen SMDs used in digital voice recording and other exciting areas. What are you doing with SMDs? Have you found ways to make

handling and mounting them easier? Perhaps you've discovered an application for SMD technology in your station that makes conventional ICs obsolete—share your insights with QST readers! Other League members want to know what you're doing with SMDs. QST pays for feature articles. Not sure about how to write the article? No problem—for an author's guide, write or call the Technical Department at HQ. Send finished articles to Technical Editor, QST, American Radio Relay League, 225 Main St, Newington, CT 06111, tel 203-666-1541.

FATHER MORAN'S CENTRAL FLORIDA SCHEDULE CHANGED

□ Father Moran, S.J., 9N1MM, will speak on October 2, 1988 at 3:00 PM in the Commissioners' Auditorium of the Marion County Governmental Complex on SE Fort King St, Ocala, Florida. This is a change from the date and time reported in September QST. Father Moran will share his experiences of living and teaching in India and Nepal. The Silver Springs Radio Club, Inc, invites all interested amateurs and the general public to attend.