Product Review

Conducted By Paul K. Pagel*, N1FB

Kenwood TS-180S Transceiver

"Bells, whistles and features galore." That's the slogan this writer would assign to the TS-180S hf-band transceiver if a catch phrase were necessary. But the rig shouldn't need promotional gimmickry in order for the manufacturer to sell it: The Kenwood name has long been of high repute among buyers of hf-band equipment. The TS-180S appears to reflect the quality that Kenwood owners appreciate.

But what about these bells and whistles? Well, let's examine the features that are offered. First, the unit covers from 1.8 to 29.7 MHz in six bands. WWV is available (receive only), plus auxiliary band positions for operation from 2.0 to 15 MHz (any 500-kHz segment thereof), 18.0 to 18.5 MHz and 25.0 to 25.5 MHz.

This new transceiver is completely solid state in circuit design. It contains 145 bipolar transistors, 21 FETs, 33 ICs and 213 diodes. A substantially greater number of semiconductor devices are contained in the rig if the digital frequency control (DFC) module is included as an accessory. The dc input power to the transmitter section is 200 watts PEP on ssb, 160 watts peak on cw and 100 watts on fsk. The ssb and cw modes are derated to 160 and 140 watts, respectively, for 10-meter operation.

The i-f selectivity is 2.4 kHz at the −6 dB points of the response curve and is 4.2 kHz at the −60 dB points. A cw filter (YK-88C) is available as an option. It has a bandwidth of 500 Hz and 1.5 kHz at the −6 and −60 dB points of the curve. A second ssb-bandwidth i-f filter (YK-88S) can be added as an option at the output end of the i-f amplifier strip. This will greatly reduce the wide-band noise in the receiver while improving the skirt selectivity of the i-f system. The i-f strip is common to the transmitting and receiving modes. Therefore, the use of the second ssb filter enhances the characteristics of the ssb signal when speech compression is used. In other words, the additional filter helps to keep the transmitted signal narrow by virtue of improved skirt selectivity.

There are no tuning controls for the solid-state PA stage. To move from one band to another it is necessary only to adjust the band switch and peak the drive (the drive control serves also for peaking the receiver front end). The PA transistors are each rated at 250 watts. They are SRF1714s, and are made for Kenwood by Motorola. An SWR shut-down circuit is included in the design. It begins to shut off the drive to the final amplifier when a SWR of 3:1 occurs. Additionally, if the case temperature of the PA transistors rises to an unsafe level the drive is reduced automatically.

Notable is the fact that this transceiver is capable of covering the new WARC-79 allocated bands. The TS-180S internal VFO covers more than 50 kHz above and below each band, for MARS and other applications.

The transceiver is a single-conversion type. A PLL type of local oscillator is employed. Only one crystal is used in that system. The net result is a reduction in possible spurious responses, plus an improvement in frequency stability over that which is attainable with other types of local oscillators.

The manufacturer rates the frequency stability at ±1 kHz during the first hour of operation, after 1 minute of initial warm-up. Thereafter, the drift is not supposed to exceed 100 Hz during any 30-minute period after warm-up. These claims appear to have been made for the purpose of allowing a wide latitude of possible drift; the review unit was much better than the published specifications

The Kenwood TS-180S is shown here with its companion power supply. This transceiver is capable of covering the new WARC bands.

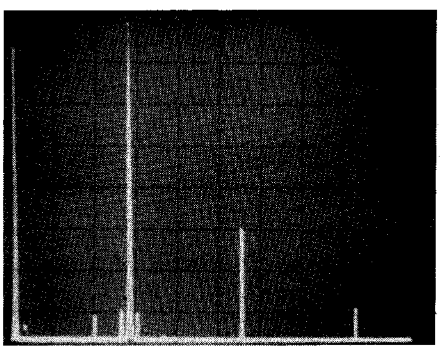


Fig. 1 — Worst-case spectral display of the transceiver at rated dc input power as observed at 28 MHz. Vertical divisions are 10 dB each. Horizontal divisions are 10 MHz each. The spurious products close to the carrier frequency are 70 dB down with respect to the operating frequency. Other spurs are down at least 50 dB.

Kenwood TS-180S HF Transceiver

Claimed Specifications

Frequency coverage: 160 to 10 meters, plus WWV and the three WARC-79 bands (see text).
Modes: Ssb, cw and fsk.
Power (dc input): 100 to 200 watts (see text).
Power requirements: 13.8 V dc (nom.) at 20 A (transmit). Can be obtained from PS-30 ac power supply.
Receiver sensitivity: 0.25 μV S + N/N, 10 dB or greater.
Audio output: Greater than 2 watts with less than 10% distortion — 4-Ω load.
Mic impedance: 500 Ω to 50,000 Ω.
Weight: 25 lbs (11.5 kg).
Size (HWD): 5-1/4 × 12-13/16 × 11-5/16 inches (133 × 325 × 287 mm).
Price class: $1150.
Manufacturer: Trio-Kenwood Corp., 111 West Walnut St., Compton, CA 90220.

*Asst. Technical Editor, *QST*

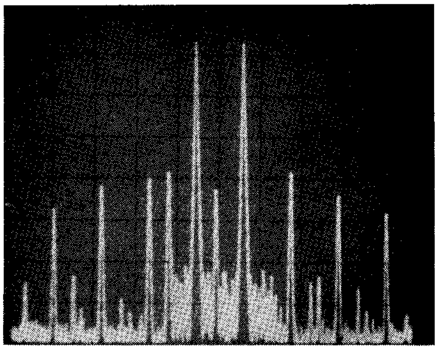


Fig. 2 — Output display of the '180S during a full-power 14-MHz two-tone test. Each vertical division is 10 dB and each horizontal division is 1 kHz. The third-order distortion products are down 38 dB from the PEP level.

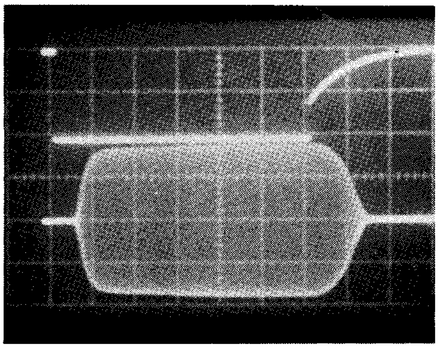


Fig. 3 — The keyed cw waveform of the Kenwood TS-180S. The horizontal divisions are each 5 ms. The upper waveform displays the actual key-down time. Such a smooth waveform should not have any clicks.

suggested. During a period of 1 hour after initial warm-up (1 minute) the maximum frequency change on 20 meters was 40 Hz.

The spectral output of the transmitter is shown in Fig. 1. It complies nicely with the FCC regulations. The 3rd- and 5th-order IMD products from the transmitter are shown in the spectrograph in Fig. 2. The distortion level is low, thereby ensuring a clean signal if the transmitter is operated in accordance with the manufacturer's instructions.

Fig. 3 shows the waveform during cw keying. On-the-air reports indicated that the TS-180S produced a clickless note that was neither "too hard" nor "too soft." Most of the solicited comments came back as, "the rig sounds excellent." Similar reports were received during ssb operation, with and without the speech processor activated. But, as is the case with all processed speech, the so-called "naturalness" of one's voice is degraded noticeably.

The usual testing ground this reviewer uses for receivers was utilized during the practical analysis of the '180S — just two blocks from the W1AW "onslaught" on 80 through 10 meters. The W1AW 10-, 15-, 20- and 40-meter beams are boresighted on the writer's QTH (at the 1-kW power level). No desensitization or cross-modulation effects were noted on any band, except when the W1FB triband Yagi was pointed toward W1AW. It then became necessary to use 20 dB of receiver front-end attenuation to clean up the weaker signals being received. It was noted during these tests (and simulated later by means of two signal generators) that the PIN diode attenuator in the TS-180S actually made the cross-modulation effects on weak signals worse than with no attenuation at all. The two-step PIN diode attenuator used in the '180S is shown schematically in Fig. 4. It is unlikely that this phenomenon would be experienced in normal amateur environments. Laboratory tests of the receiver dynamic range (based on test methods described by Hayward in July 1975 *QST*) revealed that the MDS is −139 dBm, the blocking commences at −114 dB and the IMD is 83 dB on 20 meters. For 80 meter operation the numbers are, respectively, −139 dBm, 112 dB, and 82 dB. These figures result in input intercept figures of −14.5 dBm on 20 meters and −16 dBm on 80 meters. The 500-Hz cw filter was used during these tests.

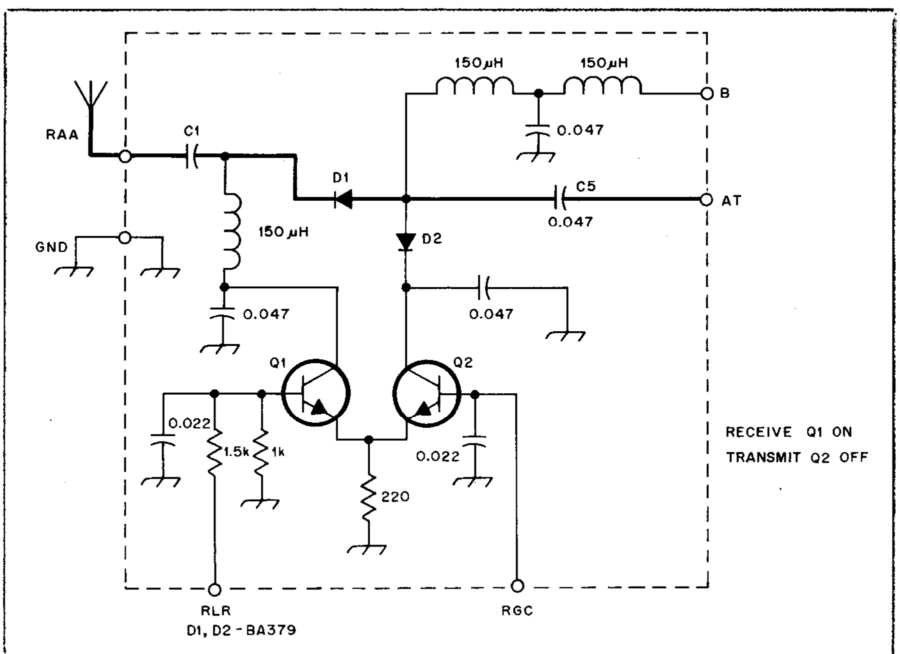


Fig. 4 — Schematic diagram of the PIN-diode rf attenuator (see text).

Other Features

The DFC module mentioned earlier in this report permits digital frequency control with four tunable memories. These memories can be used during the transmit or receive periods. Split-frequency operation can be effected by using the internal VFO and the memories, or by using an outboard VFO (VFO-180) and the memories. Frequencies from the TS-180S VFO, the outboard VFO or the "fixed channel" can be stored in the memories. Also, frequencies can be transferred between the memories. A unique feature is the memory-shift paddle on the front panel. It enables the operator to tune the memories up or down in 20-Hz steps without disturbing the initial frequencies which have been stored in the memories.

Among the access ports on the rear apron of the unit are I-F OUTPUTS 1 and 2. These are used for observing waveforms from within the circuit. There is an XVTR jack for use when attaching transverters. The ACSY (accessory) terminal permits the connection of linear amplifiers and other outboard gear. A jack is available to allow connection of an outboard receiver to the receive-antenna line in the '180S. An RTTY jack is also located on the rear of the transceiver for use during FSK operation.

In addition to the two i-f filters already mentioned as accessories, the operator can obtain the PS-30 ac power supply for fixed-station use. An SP-180 external speaker with selectable audio filters is available also. The VFO-180 and DF-180 units were discussed earlier in this report.

Instruction Manual

The TS-180S instruction manual is nicely written in clear English narrative. Detailed information is given concerning the installation of the transceiver and its accessories. A section of the manual is set aside for an explanation of how the various circuits function. This should be useful during trouble-shooting exercises. A trouble-shooting chart is provided in one section of the manual. There is even a three-page treatment of mobile operation. It provides all of the basic details for installation, antenna mounting and tune-up, plus noise reduction. Kenwood seems to have gotten away from the sometimes nebulous and confusing instruction-book passages of yesteryear. The translation from Japanese to English is excellent in this booklet. — *Doug DeMaw, W1FB*

THE OPTOELECTRONICS 8010 FREQUENCY COUNTER

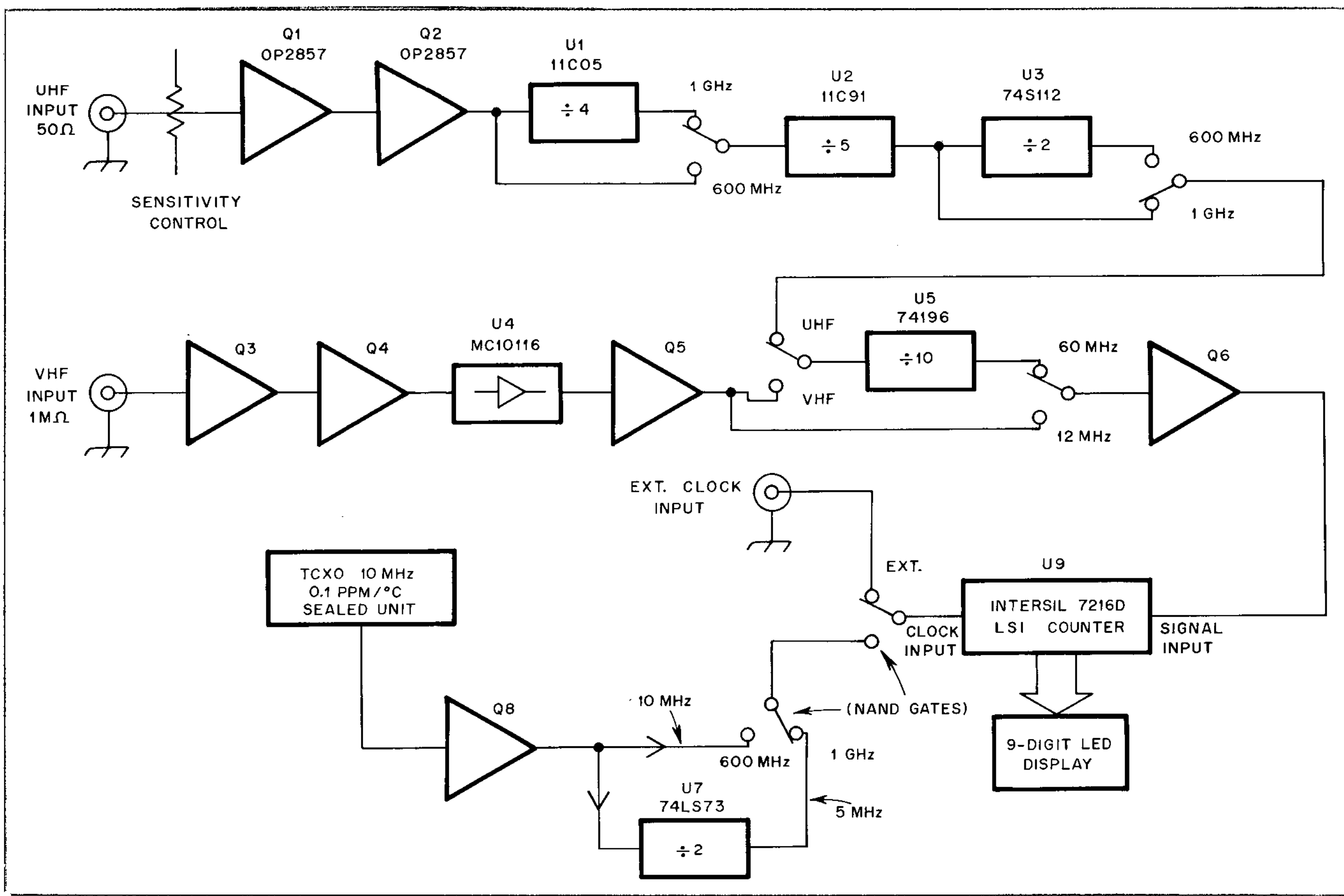
Optoelectronics Inc., Ft. Lauderdale, FL, manufactures a variety of modern digital measurement instruments. A very interesting member of their product line is the model 8010, a 1-GHz frequency counter. The 8010 is available in three versions differing in their maximum frequency range and time-base stability. The basic 8010 is supplied with a 1-ppm, 10-MHz crystal time base, while the model 8010.1 has a precision time base with a stability of 0.1 ppm over the 20° to 40° Celsius temperature range.

For those who find the 1-GHz maximum frequency a limitation, specially selected and tested model 8010.1 counters are available with a guaranteed upper frequency limit of 1.3 GHz. These are designated as model 8010.1-13. All models are supplied with three test probes, telescopic pick-up antenna, 117-V ac wall-plug transformer and a 17-page owner's manual. Extra-cost options include a NiCad battery pack and charger for mounting inside the 8010 and a vinyl carrying case. The unit supplied for review was a model 8010.1-13 with the vinyl case.

The 8010's black anodized-aluminum case provides an attractive appearance and good rf shielding. When placed close to a general coverage receiver, harmonics of the 10-MHz time-base oscillator could be detected but were at very low levels. Use of a nearby 1-kW transmitter had no effect on the counter operation when shielded test leads were used. The pick-up antenna on the counter allowed measurement of a transceiver output frequency even while operating into a Heath Cantenna dummy load. A flip-up stand holds the counter at an angle suitable for viewing from most working positions. This and the size of the unit allow for very convenient use on the test bench.

Front-panel switches select one of four gate times from 0.1 to 10 seconds and frequency ranges of 12, 60 or 600 MHz, or 1 GHz. When the 1-GHz range is used, the selected gate time is doubled. This is because the time-base frequency is reduced from 10 to 5 MHz, thus maintaining the same 10-Hz maximum resolution on both the 600-MHz and 1-GHz ranges. Using the 12-MHz range and a gate time of 10

The Optoelectronics 8010 frequency counter and accessories. The probes, antenna and carrying case are optional. A wall transformer is supplied with the counter for ac operation.



Block diagram of the 8010.13 frequency counter. The switching shown is simplified to make the general signal flow more apparent. A complete diagram is provided in the owner's manual.

seconds yields the greatest resolution, 0.1 Hz. Two more front-panel push buttons allow selection of an external time-base signal and a "display hold" function. The hold function inhibits the display update for easier reading of a fluctuating count or retains the most-recent reading after removing the input signal. Two BNC connectors serve as signal inputs to the separate vhf and uhf front ends. Input A, a 50-ohm input, is used with the 600-MHz and 1-GHz ranges. When the 12- or 60-MHz ranges are used, the high-impedance B input must be used. This does not force you to use the HI Z input for all measurements below 60 MHz, as both the 600-MHz and 1-GHz ranges have a specified minimum frequency of 25 MHz. During lab tests, the 600-MHz range was found to function well to below 10 MHz. The only remaining front-panel control is the combination power switch and sensitivity control. The sensitivity control affects only the 50-ohm B input. It was noted that this input is sensitive to input signal level. Using the variable sensitivity control allows a wide range of signal levels to be measured. No variable control is needed with the HI Z A input, as it handles a wide range of signal levels without need for adjustment. On the front panel are nine 7-segment LED displays and two LED indicator lights. One LED indicates that an external time-base signal has been selected and the other shows when the counting period is completed.

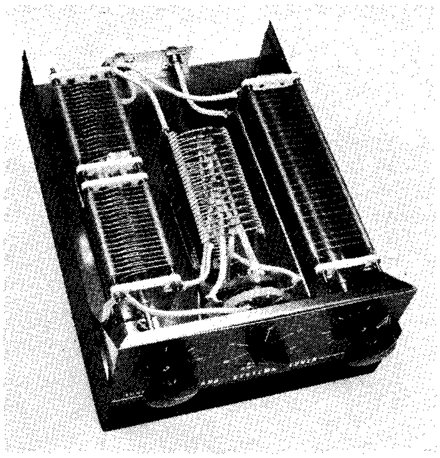
The external clock input, a BNC connector, also serves as a clock output making available the internal 10-MHz time-base signal. This connector, along with the power connector is located on the rear panel. Also provided on the rear of the case are the display test and battery charge/operate switches. Access to the TCXO frequency trimmer is made through a small hole in the rear panel.

Examination of printed circuit board reveals that considerable attention has been paid the input stages; this is necessary to insure good sensitivity over the wide frequency range of the counter. The low-frequency B input has a JFET first stage, two bipolar stages and an ECL triple line driver, Q3 through Q5 and U4 of Fig. 1, to provide amplification and waveform shaping. To maintain the input to the 7216D LSI counter below its maximum frequency, an additional divide-by-10 operation is performed by U5 on the 60-MHz range. The high-frequency input A has a two-stage bipolar amplifier using two SOE (stripline-opposed emitter) packaged transistors. As shown in Fig. 1, these are followed by the frequency prescaler composed of U1 through U3, providing division by 10 on the 600-MHz range and by 20 on the 1-GHz range. The actual counting, latching and display multiplexing functions are performed by a single 28-pin IC, the Intersil 7216D. Use of LSI circuits such as this results in great reductions in size, power consumption and cost over that possible using random logic.

Sensitivity checks made using a calibrated 500-MHz signal generator showed that the 8010 was within specifications on all frequency ranges. No sensitivity tests were made above 500 MHz because there was no suitable signal generator, but the output frequency of a 1296-MHz transceiver with a nominal 1-watt output was easily measured after a 40-dB attenuator was placed in the line.

After having used the 8010 both at home and at work in the ARRL lab for several weeks, I found it to be a very accurate, reliable and easy-to-use instrument. The three supplied test probes, offering high-impedance, low-pass and direct coupling were useful, and the pick-up antenna is convenient for checking transmitter frequency calibration. The vinyl carrying case is large enough to hold only the frequency counter; no room is provided for the test probes or wall transformer. The owner's manual provides complete specifications and operating instructions. A minor error was noted in the table of specifications in the manual. The high-impedance input is referred to as input A while the front-panel marking show it as input B. Also included in the manual are seven pages of information on correct frequency counting techniques, a bibliography of articles relating to frequency counting and a certificate of calibration. For anyone needing to make accurate, high-resolution frequency measurements at uhf, the Model 8010.1-13 should fill the bill very nicely. Price class: Model 8010.1-13, $495; CC-80 carrying case, $10; TA-100 telescoping antenna, $10; P100 1X-50 probe, $14; P101 low-pass probe, $17; P102 high-impedance probe, $17. — *George Collins, ADØW*

THE APOLLO TRANS-SYSTEMS TUNER 2000X-2



The Apollo Products 2000X-2 Trans-Systems Tuner. Interconnecting wiring is made with glass cloth-covered braid. The bracket at the rear of the unit supports the input and output coaxial connectors.

The circuit used in the Apollo Products 2000X-2 tuner is an adaptation of the original McCoy Ultimate Transmatch that appeared in *QST* some years ago.[1] A tapped coil has been substituted for the roller inductor as was done in a follow-up article.[2] Although the front panel doesn't show it, there actually is a 160-meter switch position at 6 o'clock where the lettering "band switch" appears. The tuner is designed primarily for use with coax-fed antennas. No feed-through insulator is provided for single-wire feed, nor is a balun or SWR meter included.

The "works" are housed in a black, clamshell cabinet with a contrasting wood-grain front panel. The enclosure is spacious and there is no crowding of components. This cabinet is also available separately for those wishing to use their own components in constructing an antenna-matching network.[3]

Since the review item was already wired, one could only "guesstimate" how long it would take to bring the '2000 from shipping carton to finished product. At most, three hours should be required. Should a factory-wired unit be purchased, some of the coil-tap positions may have to be altered to fit the individual antenna systems in use at your particular location. During use, it was found that the coil taps on the review model had not been well soldered and it was necessary to remake each connection.

Although it is not mentioned in the construction manual, indenting every other turn along the tapped quadrant of the coil when making the coil-tap connections, will make the job easier. The advertisement mentions the coil for the kit model has indented turns, but the factory-wired unit had no such provision; the indented turns of the coil in the unit shown in the photograph were made when resoldering the coil taps. When selecting the coil-tap positions, use those which provide the lowest SWR readings consistent with the use of the largest amount of capacitance for the two tuning capacitors. These settings will afford the greatest amount of harmonic attenuation. (Remember to turn the transmitter off when changing taps!)

It was felt that it would be easier to set the taps for the higher frequency bands (15 and 10 meters) if a coil with a lower pitch were used for that part of the matching unit inductor. At the higher frequencies, lead lengths come into play and become a substantial part of the network. The manner in which the coil is physically mounted also means the higher-frequency coil taps are the farthest from the band switch and they require the longest lead lengths. When making the coil connections, attempt to keep the tap leads as near the center of the coil as possible to prevent any possible arcing from the tap lead to another part of the coil.

Without a ground connection on the '2000, hand capacitance affected the SWR meter readings and adjustments made to the unit. Once the unit was grounded, no difficulties were encountered. (Good practice would dictate having all station equipment connected to a good, common ground in any case.)

The stand-off insulators for the coil and capacitors are made of PVC. While PVC may not always exhibit good dielectric qualities in certain applications, no problems were encountered with the test unit at the 1-kW dc and 2-kW PEP input levels. Measured insertion of the tuner while using a commercial 50-ohm load was less than 0.5 dB.

The impedance-matching range of the tuner will be somewhat limited by the initial setting of the coil taps; different antenna systems may require different coil-tap positions be used. Additionally, the setting of the band switch is not sacrosanct. Under certain circumstances one may find a tuner band-switch setting of, say, 40 meters would provide the required match on the 80-meter band when using fixed-tap positions.

The Trans-Systems Tuner 2000X-2 is available from Apollo Products, P. O. Box 245, Vaughnsville, OH 45893. Price class: $125 kit form, $145 wired and tested. — *Paul K. Pagel, N1FB*

[1]McCoy, "The Ultimate Transmatch," *QST*, July 1970.
[2]Myers, "The Rollerless Ultimate," *QST*, November 1973.
[3]The cabinet model is TM-5.