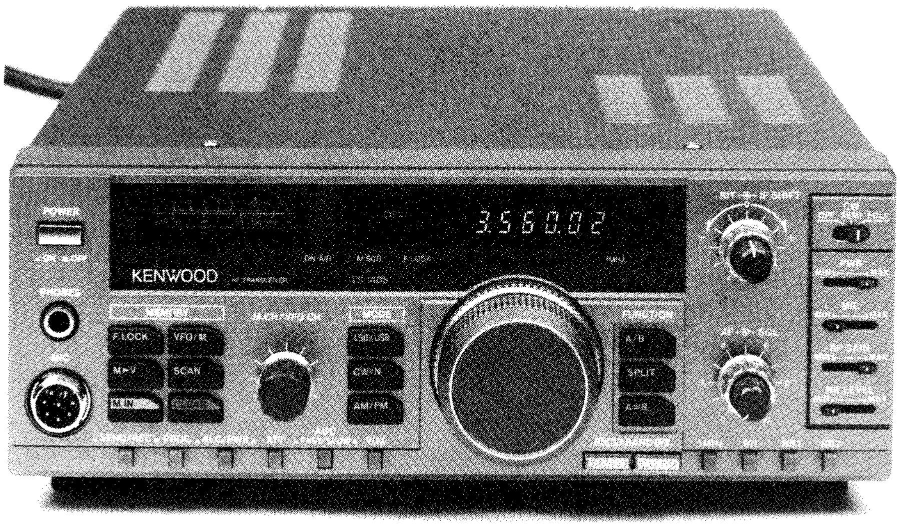
Product Review

Conducted By Mark Wilson, AA2Z
Senior Assistant Technical Editor

Kenwood TS-140S 160- to 10-Meter Transceiver

Reviewed by Larry Wolfgang, WA3VIL



Kenwood's newest 160-10 meter radio is intended to appeal to those who want a full-featured transceiver, but with a lower price than the top-of-the-line rigs. This transceiver comes with plenty of bells and whistles, so don't get the mistaken impression that it's a bare-bones rig. In fact, the TS-140S has most of the features we've come to expect in a modern transceiver.

Two digital VFOs (really tunable memories, as Dave Newkirk explained in *QST*[1]), 31 memory channels, two noise blankers, RIT, IF shift, a switchable 20-dB attenuator and the ability to receive any frequency from 50 kHz to 35 MHz are just a few of the special features built into this rig. There are even several versatile scanning features. The transmitting section includes full- or semi-break-in CW, PTT or VOX operation, a speech processor and split-frequency operation using memory channels or both VFOs. A battery backup maintains all memories and operating parameters when power is disconnected from the radio. The TS-140S is capable of operating on USB, LSB, CW, AM and FM.

The TS-140S doesn't talk to you, like some rigs do, but it can send Morse code to tell you its operating mode. When you change modes, the radio sends a single Morse letter to indicate which mode you have selected (U for USB, L for LSB, C for CW, N for CW with the narrow filter, A for AM and F for FM). There are some conditions that even cause a word or two of Morse code to be sent to you. For example, if the microprocessor is reset for some reason, the '140S sends RESET. If you attempt to locate an empty memory channel and all channels have something stored in them, the transceiver sends FULL, and if you try to locate a channel with something in it but there is no information in any memory, the radio sends EMPTY.

An external power supply, capable of producing 13.8 V at 20 A, is required. We used the optional Kenwood PS-430 power supply for the review. Kenwood specifies a supply voltage range of 12 to 16 V dc. We tested the '140 at several supply voltages and found that it worked fine down to about 11.5 V dc. Power output was down by about 10 W with a 12-V supply, but otherwise everything operated normally. This transceiver would be a good choice for someone contemplating mobile or battery operation.

[1]D. Newkirk, "View: DigiVFO," Technical Correspondence, *QST*, Sep 1987, p 43.

Circuit Highlights

The TS-140 uses intermediate frequencies of 40.055 MHz and 455 kHz. The first and second receiver mixer stages use 2SK125 junction FETs to ensure good dynamic range. The transmit circuit uses an IC balanced modulator and a 3SK122 dual-gate FET as the second mixer. The operating frequency is controlled by a microprocessor and a phase-locked-loop (PLL) circuit that includes four loops. A 36-MHz reference oscillator provides the reference signal for all other frequencies generated in the transceiver. This frequency-control technique provides 10-Hz tuning steps and an IF-shift feature that helps eliminate interference.

Six units make up the basic parts of the TS-140. A brief description of each unit shows how they work together in the radio.

- The *Control unit* includes the microprocessor, 36-MHz reference oscillator and four phase-locked loops for frequency control.
- A microphone amplifier and the speech processor make up the *Switch unit.*
- The *Signal unit* contains most of the transmit and receive circuitry, such as signal amplifiers, mixers, detectors, modulators, filters and transmit/receive switching. There is a 2.2-kHz filter for SSB and "wide CW." A 6-kHz filter is used on AM and there is a 12-kHz filter for FM. The review '140 came with the optional YK-455C-1 500-Hz CW crystal filter. All of these filters have a center frequency of 455 kHz, which means they operate at the second IF.

The optional filter was easy to install and the six-step instructions proved completely adequate. The filter plugs into the *Signal unit* PC board, which is the bottom circuit board. The top layer of circuit boards is on a hinged subchassis that simply folds out of the way, allowing easy access, but you do need to be careful not to pinch any wires as you close it. (The instructions include a warning to be careful about this.) A 250-Hz filter is available for those who want an even narrower CW filter. One or the other of these filters can be used in the TS-140.

- The transmitted RF is amplified as it passes through a three-stage final amplifier section in the *Final unit*. The first stage uses a single 2SC1971 transistor as a predrive amplifier. The second stage uses a pair of 2SC2509 transistors, and the final power amplifier includes a pair of 2SC2879 transistors.
- The *Filter unit* removes unwanted spurious high-frequency signals from the transmitter output.
- The *Display unit* includes a fluorescent display tube, LED indicators for various functions and a dc-to-dc converter for powering the display tube. The *Display unit* also includes switching circuits and controls, such as those for the noise blankers, attenuator, AGC, metering, RF and microphone gains and output-power control.

Operating Controls

The front panel of the TS-140 is carefully laid out, and most hams who have had some experience with a modern transceiver should have no trouble figuring out the basic operating controls. In fact, you should be able to get this radio to do some pretty fancy stuff just by reading the labels

Table 1

Kenwood TS-140S 160-10 Meter Transceiver, Serial no. 8101427

Manufacturer's Claimed Specifications	*Measured in the ARRL Lab*
Frequency coverage: Receiver, 500 kHz to 30 MHz; transmitter, 160-10 meter ham bands.	Receiver: 50 kHz to 34.9999 MHz. Transmit frequencies (in MHz): 1.600-1.9999, 3.000-3.9999, 6.500-7.4999, 10.000-10.4999, 13.500-14.9999, 18.000-18.9999, 20.500-21.4999, 24.000-24.9999 and 27.500-29.9999.
Modes of operation: USB, LSB, CW, AM and FM.	As specified.
Frequency display: 7-digit blue fluorescent.	As specified.
Frequency resolution: 10 Hz or 100 Hz, operator selectable	As specified.
Power requirements: 12 to 16 V dc (13.8 V nominal) at 1.5 A on receive and 20 A on transmit.	13.8 V at 17 A at 100 W output.
Transmitter	*Transmitter Dynamic Testing*
Transmitter output power: SSB: 110 W PEP on 160 meters; 100 W PEP on 80-12 meters; 95 W PEP on 10 meters; CW: 100 W on 160-12 meters; 95 W on 10 meters; AM: 40 W PEP on all bands; FM: 50 W on 10 meters.	SSB output power varied from a high of 134 W PEP on 20 m to 118 W on 10 m. CW output ranged from 112 W on 40 m to 100 W on 10 m. FM output power measured 52 W on 10 m. The unit will transmit FM on all amateur bands. AM carrier power measured in excess of 100 W on all bands, but the power control should be used to reduce power as specified.
Spurious signal and harmonic suppression: Greater than 40 dB below peak power output.	See Fig 1.
Third-order intermodulation distortion products: Not specified.	See Fig 2.
CW keying waveform: Not specified.	See Fig 3.
Transmit-receive turnaround time (PTT release to 90% audio output with an S9 signal): Not specified.	27 ms.
Receiver	*Receiver Dynamic Testing*
Receiver sensitivity: SSB and CW: (2.2 kHz (bandwidth) less than 3.98 μV for 10 dB S + N/N from 0.5-1.62 MHz; less than 0.25 μV for 10 dB S + N/N from 1.62-30 MHz.	Minimum discernible signal (noise floor), with 500-Hz filter: 1.0 MHz: −118 dBm; 3.5 MHz: −137 dBm; 14 MHz: −137 dBm
AM: (6.0 kHz bandwidth) less than 39.8 μV for 10 dB S + N/N from 0.5-1.62 MHz; less than 2.5 μV for 10 dB S + N/N from 1.62-30 MHz.	1.0 MHz: −107 dBm; 3.8 MHz: −117 dBm; 14 MHz: −117 dBm (Test signal 30% modulated with a 1-kHz tone.)
FM: (12 kHz bandwidth) Less than 0.35 μV for 12 dB SINAD from 1.5-30 MHz.	0.3 μV for 12 dB SINAD at 29 MHz.
Receiver dynamic range: Not specified.	Blocking dynamic range†: 3.5 MHz: 115 dB; 14 MHz: 114 dB. Two-tone, third-order intermodulation distortion dynamic range†: 3.5 MHz: 92 dB; 14 MHz: 91 dB. Third-order input intercept†: 3.5 MHz: 1.0 dBm; 14 MHz: −0.5 dBm
S-meter sensitivity (μV for S9 reading): Not specified.	260 at 1.0 MHz; 29 at 3.5 MHz; 28 at 14 MHz
Squelch sensitivity: FM, Less than 0.32 μV.	0.25 μV min, 1 μV max at 29 MHz.
Receiver audio output: 1.5 W at 8 ohms with less than 10% total harmonic distortion (THD).	2.05 W at 10% THD.
Color: Gray.	
Size (height, width, depth): 4-7/32 × 11-1/16 × 12 in.	
Weight: 13.4 lb (not including the power supply).	

†Blocking dynamic range measurements were made at the ARRL Lab standard signal spacing of 20 kHz. Two-tone, third-order IMD dynamic range measurements were made at 30-kHz signal spacing instead of the ARRL Lab standard of 20 kHz because these tests were phase-noise limited at closer signal spacings. The third-order input intercept was calculated using the two-tone, third-order IMD dynamic range measurements made at 30-kHz signal spacing.

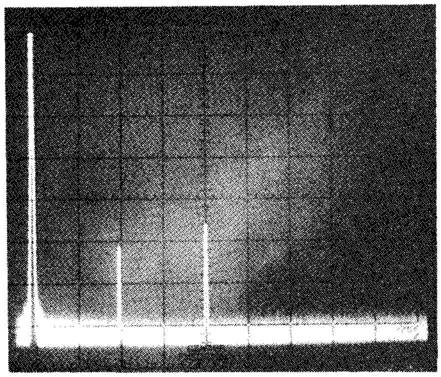


Fig 1—Worst-case spectral display of the Kenwood TS-140S. Horizontal divisions are each 5 MHz; vertical divisions are each 10 dB. Output power is approximately 110 W at 10.15 MHz. All harmonics and spurious emissions are at least 46 dB below peak fundamental output. The TS-140S complies with current FCC specifications for spectral purity.

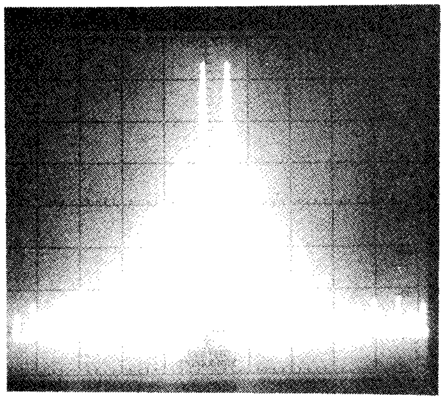


Fig 2—Spectral display of the Kenwood TS-140S during two-tone intermodulation distortion (IMD) testing. Third-order products are approximately 30 dB below PEP output, and fifth-order products are approximately 42 dB down. Vertical divisions are each 10 dB; horizontal divisions are each 2 kHz. The transceiver was being operated at 110 W PEP output on 14 MHz.

on the push buttons, slide controls and knobs on the front panel. A glance at the photo reveals plenty of knobs and buttons, but not so many that you will be overwhelmed by them. In fact, compared to some of the larger rigs available today, you might wonder how a rig could have so many features with so few controls! What isn't immediately obvious is that some of the controls serve more than one purpose. For example, the RIT knob also controls the scan speed when you use one of the radio's scan modes. The small knob labeled M.CH/VFO CH steps through the 31 memory channels in the memory mode. In the VFO mode, however, this knob tunes the '140S in 10-kHz steps.

I won't describe the operation and layout of each front-panel control. Most of the labels are self-explanatory. I'll describe some of the hidden features and those that may be less obvious, however.

The F.LOCK button prevents you from accidentally changing the operating frequency of the transceiver. M > V means "move the memory frequency into the VFO," while the M.IN button stores the VFO frequency in the selected memory channel.

Several transceiver functions can be changed by holding down one of several buttons at the same time the transceiver is "powered up." The CLEAR button changes between 10-Hz and 100-Hz tuning steps. (This also changes the resolution of the frequency display from 10 to 100 Hz.) Holding the RIT button in when you turn the power on selects 10- or 20-Hz RIT steps. The CW/N control also switches the mode announcements between beep tones and Morse code, and holding the F.LOCK button when you turn power on changes the audible alarm announcements between Morse code and beep tones.

If the 1MHz button is pressed, an LED lights next to the 1MHz marking on the display panel. When this LED is lit, pushing the BAND UP or DOWN buttons changes the operating frequency in 1-MHz steps. You can select 500-kHz steps instead of 1-MHz steps for this frequency-changing feature by holding the 1MHz button in when you turn the radio on. When this LED isn't lit, the BAND UP and DOWN buttons change the operating frequency one ham band at a time.

Holding the AM/FM button in when you turn on the power selects either 9- or 10-kHz tuning steps for the AM broadcast band from 535 to 1605 kHz. It took me a while to figure this one out. To use those tuning steps you must turn the M.CH/VFO CH knob, although I couldn't find any reference to this in the instruction manual. In the AM mode, the main tuning knob changes the frequency in 100-Hz steps even if you have selected 10-Hz tuning steps for the VFOs.

There are so many ways to change the operating frequency of this transceiver that it's hard to even list them all. The main tuning knob is the most obvious way, of course. You can select tuning steps of 10 Hz or 100 Hz, as already mentioned. Either of these steps results in a tuning rate of 10 kHz per knob revolution in the SSB and CW modes (50 kHz per revolution in the AM and FM modes).

If you turn the knob faster than about three revolutions per second, the tuning rate goes into overdrive, though. The tuning rate depends on how fast you turn the knob at this point. I could easily spin the knob fast enough to make the 10-kHz digits fly by, which means you can change frequency by a few hundred kilohertz with little effort. (It's probably easier to turn the M.CH/VFO CH knob, but I nearly always grabbed the main tuning knob by instinct and gave it a spin.)

The hand-held microphone that comes with the '140S is equipped with a pair of buttons marked UP and DOWN. These change the operating frequency one step at a time. (The size of the step corresponds to the main tuning knob frequency step.)

Instruction Manual

Although most hams will have no trouble figuring out how to make the radio work just by reading the front-panel controls, they will definitely need the instruction manual to get full benefit of the TS-140's capabilities. This 43-page booklet includes a complete listing of the transceiver's specifications, along with directions for unpacking the unit and getting it ready to operate.

Five pages in the manual describe the basic operation of the front-panel controls, and two more pages describe the rear-panel connections and controls. There are about three pages listing specific examples of receiver operation, and another three pages dedicated to transmitter operation. Numerous drawings, charts and graphs illustrate these details.

The memory capabilities of this radio are extremely versatile. There are more than four pages in the manual that explain how to program the memory channels and transfer information from the VFOs to memory, from memory to VFO and even from one memory channel to another. This can be a rather complicated process, and even after using the rig for several months, I found myself referring to the instruction manual to be sure I was using the right procedure for operating the memories.

All 31 memory channels can store a single operating frequency and mode. The first 10 channels store no more information than that. The next 10 memories can store separate transmit and receive frequencies, and modes, for split-frequency operation. The last 11 memory channels can store upper and lower frequency limits, allowing operation only within the limits you set. (For example, I set up a series of memories with the Novice bands as frequency limits for the Novice Roundup.) When you reach the end of the frequency range set by one of these memories, the '140S automatically jumps to the other frequency limit. This is a useful feature for contest operation. You could also store the band segments that you are permitted to use, based upon your license class, as a way to keep from accidentally wandering beyond the band edges.

The instruction manual also includes a brief circuit description, information about maintenance and adjustments, and a short troubleshooting section. There are several illustrations and an explanation of how to open the radio and fold out the subchassis to install accessories like the optional CW filter and the computer interface kit.

Computer interface kit? This accessory is mentioned several places in the manual. There is even a space for a 6-pin DIN connector that comes with this option. But nowhere in the manual could I find reference to what you can do with this interface!

The manual includes a listing of the many accessories available from Kenwood, such as power supplies, antenna matching networks, microphones and so on. The last few pages include some information about antennas and a section on installing the rig in a car.

This manual is well written, with clear, easy-to-understand instructions about how to operate the TS-140S. For detailed technical information, there is a separate service manual.

Receiver

The TS-140 receiver is packed with features. The IF SHIFT control is very helpful for reducing interference from a station that is close in frequency to the desired signal. The 20-dB attenuator can also help reduce interference from extremely strong signals. There are two noise blankers in this transceiver. The first noise blanker is intended for pulse noises, such as automotive ignition noise, and the second one is for longer-duration pulses like the over-the-horizon radar "woodpecker" noise. A slide control sets the noise blanker level. The noise blankers were effective against power-line noise, but I did not find any "woodpecker" signals to try them on.

It was fun to use the SCAN feature to have the radio tune various frequency ranges. When I was doing various chores around my shack, I could scan a ham band or a short-wave broadcast band for activity. There is a "scan hold" feature that can be turned on or off by holding the SCAN button when the power is turned on. The instruction manual mentions this feature in two places, but the feature isn't explained. I expected the rig to stop on a signal when this scan hold was enabled. It did not.

Memory channel 30 sets the program scan frequency limits. If you press the SCAN button and memory 30 is empty, the '140S automatically stores 50.0 kHz for the lower limit and 34.9999 MHz as the upper limit. You can store any frequency range that you want to scan in this memory channel. The frequency range is set by using VFO A to store one frequency and VFO B to store the other. Scanning starts with the frequency set by VFO A, so you can have the radio scan up or down in frequency depending on whether you set the upper or lower limit with VFO A. There is no way to reverse the scanning direction unless you reprogram memory channel 30.

Although the TS-140 receiver has excellent specifications, as shown in Table 1, I did notice a few problems. The blocking dynamic range, as measured in our lab tests, was better than 110 dB. In operation, however, I experienced blocking problems quite frequently. While listening to stations that had signal strengths of as much as S9 or stronger, the station might suddenly fade and almost disappear. I could usually find a signal of 40 dB or more over S9 within about 20 kHz of the station I was listening to when this happened. I would expect a signal this strong to block the receiver if it was within a few kilohertz of the desired signal, but it should have little effect 10 or 15 kHz away. This may be no more than a minor annoyance for casual operating when the bands aren't too crowded. Under contest conditions or on a busy weekend when 15 or 20 meters is open, it can be quite frustrating though.

A front-panel pushbutton selects the 20-dB attenuator. The attenuator helped solve the blocking problem sometimes. It wasn't always an effective way to solve the problem, though, because attenuating a weak desired signal makes it even weaker. Likewise, reducing the RF gain helped sometimes, but not always.

Another pushbutton on the front panel selects FAST or SLOW AGC action. There is no way to turn off the receiver AGC. This isn't normally a problem, although there are times when it's helpful to be able to turn off the AGC.

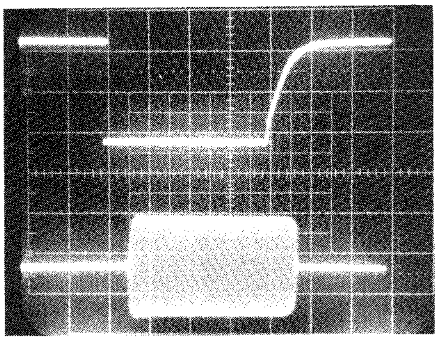
The frequency synthesizer makes a jump every 50 kHz. This took some getting used to because the receiver makes a small pop every time you tune through 50- or 100-kHz points. I think it is a little more noticeable than with some other PLL synthesized rigs I have used. Several times, I was fooled into thinking I was hearing a weak signal. The PLL jumps were most noticeable when I tried to tune a real signal on a frequency on or near a multiple of 50 kHz. Tuning across the PLL jump seemed to produce a large frequency change because of the extra little pop. Eventually I began to get used to this, and then it didn't bother me as much.

I scanned all of the Amateur Radio frequencies that the '140 covers and found only a few weak birdies. None of them are strong enough to move the S meter, and most of them were *very* weak and disappeared in the noise when I connected an antenna.

Transmitter

The TS-140 produces more than 100 watts of CW and SSB output power on all bands. The instruction manual tells you to reduce output power to 40 watts or less on AM, and to no more than 50 watts on packet radio, AMTOR or Baudot RTTY. While it's possible to make fine adjustments in power level, the slide potentiometer is very touchy, and that makes it difficult to set a specific power level.

Proper SSB operation requires that you set the meter to measure ALC and adjust the mic gain control so the needle doesn't move out of the ALC range on the meter face. When you turn on the built-in speech processor you should also be sure the meter needle doesn't swing above the ALC range. The mic gain control is another touchy slide potentiometer. I found that I had to keep this control set very close to minimum at all times.



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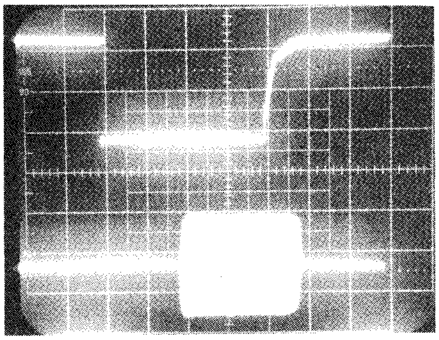
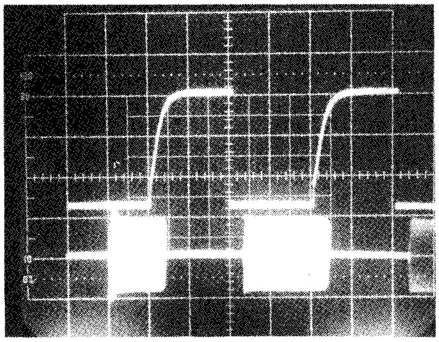


(B)



(C)

Fig 3—CW keying waveforms for the Kenwood TS-140S. The photo at A shows the keying waveform in the semi-break-in mode, and the photograph at B shows the keying waveform 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. The photo at C shows shortening of the first dot during semi-break-in operation. In this photograph, each horizontal division is 20 ms.

The speech processor is helpful for being heard under weak-signal conditions, but shouldn't be needed most of the time. There is no adjustment for the amount of processing, so you only need to be concerned with the mic gain level and the ALC meter reading.

Fig 1 shows the worst-case spectral output. The TS-140S easily meets FCC (and the manufacturer's) specifications for spurious emissions. Fig 2 shows the spectral output for a two-tone, third-order intermodulation distortion (IMD) test. The '140 can stand improvement here. Other rigs, including others in the Kenwood line, have IMD levels 6 dB or more lower (better) than the TS-140S.

Fig 3A shows the CW keying waveform using the semi-break-in (VOX) position. Fig 3B shows the CW keying waveform in the full-break-in (QSK) position. Code elements are noticeably truncated during full-break-in operation, and you should adjust your keyer weighting for "normal" sounding on-the-air CW. Fig 3C shows two Morse code dots during semi-break-in operation; note that the first dot (or dash) is shortened a bit when you start to transmit. First dots are not shortened compared to other dots in the QSK mode.

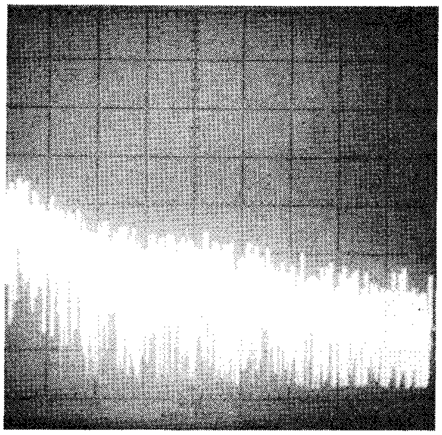
The specifications table lists TR turnaround times. I did not use the '140S on AMTOR, but it should be able to work that mode with no problems.

There are several adjustments you may have to make inside the radio. These adjustments, which involve removing the top and bottom cover and folding open the hinged subchassis, are explained in detail in the instruction manual. I found the CW sidetone level to be a bit weak to suit me. The sidetone level can be increased by adjusting a control inside the '140S. You can also adjust the level of the beep or CW mode and alarm announcements. The microphone sensitivity is set to maximum at the factory, which helps explain why the front-panel control had to be almost at minimum. You can decrease this sensitivity by adjusting an internal control. You can also adjust the modulation level for the rear-panel data communications input. I did not have to adjust that level to operate Baudot RTTY with my AEA CP-1 communications processor (CP). Other CPs may provide different signal levels to the radio, so it's nice to know you can make this adjustment if needed.

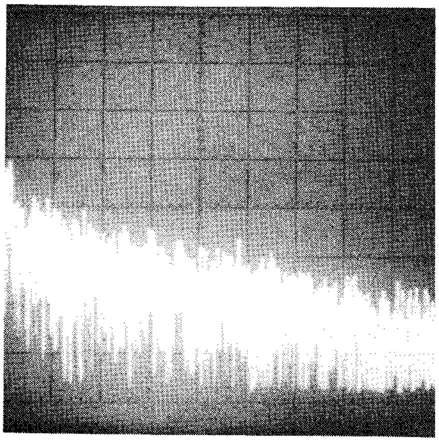
A thermostatically controlled fan cools the final amplifier transistors when they get too hot. This fan is very quiet, and it does not run often under normal operating conditions. In fact, I turned the transmitter on and held the key down (transmitting into my dummy antenna, of course) for almost a minute before the fan turned on, just to verify that it did work.

Split-frequency operation is easy with the '140S. Set the receive frequency in one VFO and the transmit frequency in the other. Then press the SPLIT button and watch for the word SPLIT to appear in the display. When you transmit, the radio automatically switches to the frequency and mode set in the other VFO. It's even possible to operate cross-band, cross-mode in this manner.

A back-panel connector provides ALC input and TR-control relay connections for use with an external power amplifier, as well as a line for an external PTT switch.



(A)



(B)

Fig 4—Spectral display of the Kenwood TS-140S transmitter output during phase-noise testing. Power output is 105 W at 3.5 MHz (A) and 14 MHz (B). Each vertical division is 10 dB; each horizontal division is 2 kHz. The scale on the spectrum analyzer on which these photos were taken is calibrated so that the log reference level (the top horizontal line on the scale in the photos) 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 photographs. The carrier, which would be at the left edge of the photographs, is not shown. These photographs show phase noise at frequencies 2 to 20 kHz offset from the carrier.

I did not use the '140S with an amplifier. There is also an accessory connector for use with the optional automatic antenna tuner unit. There is no provision for using the TS-140 with a VHF transverter.

The KEY jack accepts a standard ¼-inch-diameter phone plug. The dc open-circuit voltage at this jack is 5.5. Be sure to set your keyer for positive keying.

Operating Impressions

The 25 push-button controls are large enough and far enough apart for my clumsy fingers to push without hitting other buttons. Seldom during the review period did I hit the wrong button, even when I just reached without carefully watching where my finger was going.

I actually had the opportunity to operate two different TS-140S transceivers for this review. The first one was a radio that Kenwood engineers brought to ARRL Headquarters for evaluation. The Product Review unit arrived a few weeks later. Both '140s exhibited the receiver blocking that I mentioned earlier, but otherwise performed flawlessly.

I used a TS-140 during the November phone Sweepstakes, the ARRL 10-Meter Contest, the ARRL 160-Meter Contest and the Novice Roundup. On 160 meters, I used a 120-foot random-wire antenna with a homemade matching network. I wasn't able to obtain a good impedance match, and with an SWR of not much better than 3:1 the '140S automatically reduced output power. I was limited to about 15 to 20 watts on that band, but still managed to have fun and contact a few stations.

Received audio quality is excellent, and the transceiver has plenty of volume without distortion—even for a noisy environment. I also received good reports about the transmitted audio, including a couple of reports from people who could make a good comparison between my "live" voice and my "radio" voice.

I used both VOX and PTT on SSB. The VOX GAIN, DELAY and ANTIVOX controls are on the back panel, near the antenna connector and grounding screw. This makes them hard to see and even harder to reach to make adjustments. But once the controls are properly adjusted, there is little need to reset them. The one possible exception to this is the VOX DELAY control, which also sets the hold time for semi-break-in CW operation. I much prefer the full-break-in position for CW operation, so I didn't have the problem of readjusting the VOX DELAY.

ACCessory jack 2 (on the back panel) provides data and TR control lines for use with a CP for radioteletype or TNC for packet-radio operation. I connected the appropriate lines to my AEA CP-1 for RTTY operation. The interface provides tones to the microphone input lines. I set the '140S for LSB operation to use audio-frequency-shift keying. There is no direct FSK feature built in, but the TS-140 did a fine job using LSB in this manner.

Overall, this radio is a joy to operate. Its many features and convenient front-panel layout proved helpful for contest operation. The receiver blocking that I described earlier was at its worst during these contests, however. If you're setting up a station to use primarily for contesting, this may not be the rig you are looking for. For more casual operation, with an occasional contest-operating stint, it's a nice rig.

Manufacturer: Kenwood USA Corporation, 2201 Dominguez St, Long Beach, CA 90801-5745, tel 213-639-4200. Price class: TS-140S, $900; PS-430 power supply, $190; YK-455C-1 CW filter, $130.

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Please clearly identify the item you wish to bid on, using the manufacturer's name, model number, or other identification number if specified. Each item requires a separate bid and envelope. Shipping charges will be paid by the successful bidder, FOB Newington. The successful bidder will be advised by mail of the successful bid. No other notifications will be made, and no information will be given by telephone to anyone regarding final price or identity of the successful bidder.

Please send your bids to Kathy McGrath, Product Bids, ARRL, 225 Main St, Newington, CT 06111.

ICOM IC-375A 220-MHz multimode transceiver, s/n 01040 (see Product Review, Mar 1988 *QST*). Minimum bid $800.

RF Concepts RFC 2-23 2-meter power amplifier, s/n 2-0254 (see Product Review, Mar 1988 *QST*). Minimum bid $67.

RF Concepts RFC 3-22 220-MHz power amplifier, s/n 3-1016 (see Product Review, Mar 1988 *QST*). Minimum bid $67.

MFJ-931 artificial RF ground (see Product Review, Apr 1988 *QST*). Minimum bid $53.

Ameco PT-3 1.8-54 MHz preamplifier (see Product Review, Apr 1988 *QST*). Minimum bid $79.

RF Concepts RFC 3-312 220-MHz power amplifier, s/n 3-3012 (see Product Review, Apr 1988 *QST*). Minimum bid $158.

Ten-Tec Model 585 Paragon 160- to 10-meter transceiver, s/n 084 with Model 960 power supply and Model 285 500-Hz CW filter (sold as a package only; see Product Review, May 1988 *QST*). Minimum bid $1325.