

CQ REVIEWS:

A Trio of Accessories For the Kenwood TS-850S HF Transceiver

BY JOHN J. SCHULTZ*, W4FA

Kenwood seems to have made an all-out design effort with the TS-850S transceiver concept. As was mentioned in the review article on the TS-850S,¹ although the transceiver does carry over some features from other Kenwood transceivers, it is definitely a new, stand-alone design.

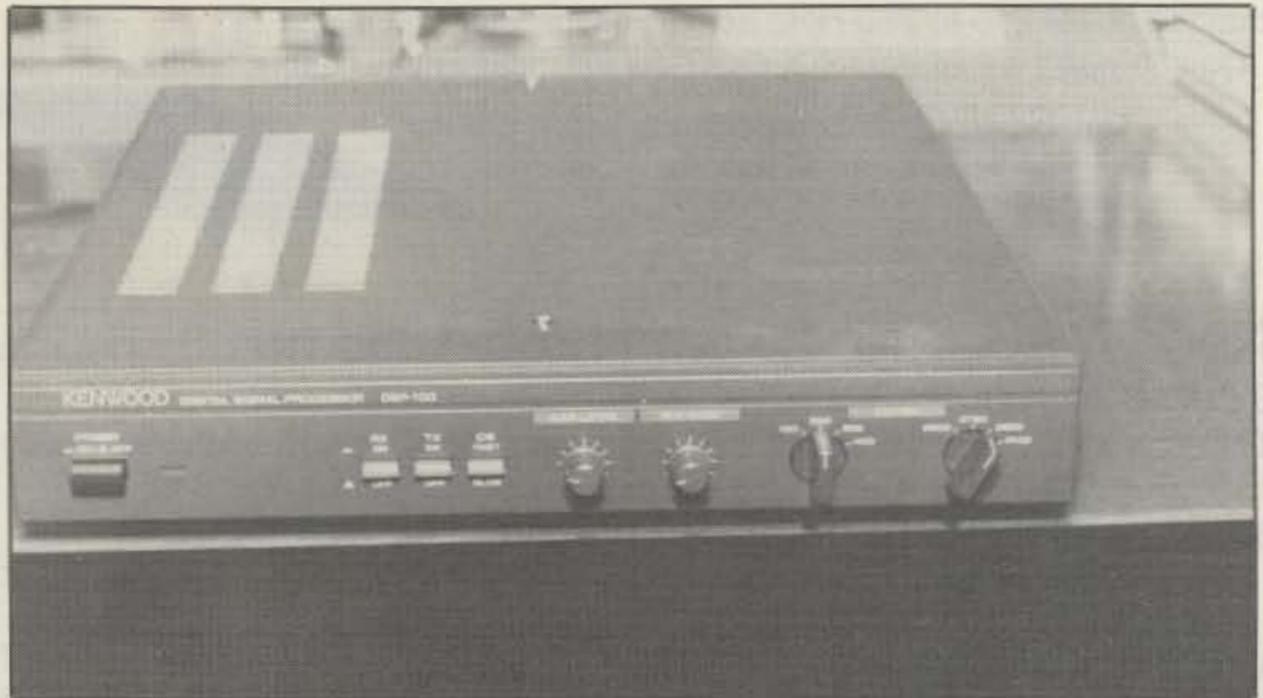
Kenwood has gone a step further, introducing some unique accessories for the TS-850S. At the moment, it would appear that the accessory items to be described were designed solely for use with the TS-850S, since they can immediately be interconnected and used with that transceiver. However, I suspect they probably also will interface with future Kenwood HF transceiver designs.

The three accessory items to be described are the DSP-100 Digital Signal Processor, the AT-300 Remote Automatic Antenna Tuner, and the DRU-2 Digital Recording Unit. These certainly are not all of the accessory items available for the TS-850S, but I thought they had something unique about them and/or represented items that would most interest Kenwood equipment users.

The DSP-100 Digital Signal Processor

Kenwood first introduced digital signal processing as a built-in feature on the TS-950SD and as an option for the TS-950S. Anyone who has heard digital processing in use on one of those Kenwood transceivers knows that the processing produces a distinctive difference. It's not a super quantum step, but there is no denying that the "crisp and clean" audio provided by digital processing catches one's attention and makes SSB, especially, sound great.

Digital processing of voice signals is not new, by the way. I've lost my file copy of the article, but way back in the 1960s, when *CQ* was still being published in 6" x



Front view of the DSP-100. It's not quite as large as it appears in some advertisements. An extremely good feature of the DSP-100 is that all the frequently used controls are "up front."

9" format, I did an article on a commercial device that would digitally process analog voice signals. I thought at that time, and I think the promise is still there, that narrow-band SSB would be the wave of the future. I wrote that article simply to provide food for thought. The commercial device I described "digitized" an analog voice signal so the digital signal stream could be processed by encryption devices.

The DSP-100 certainly has no relation to encryption schemes, but the idea is there that once an analog signal is "digitized," it can be processed, formed, etc., in *controllable* ways that are not possible if one attempts to deal directly with the analog signal. Even relatively slow "on-off" signals, such as CW, can benefit from digital processing, since the relatively fuzzy off-on-off transitions can be controlled precisely.

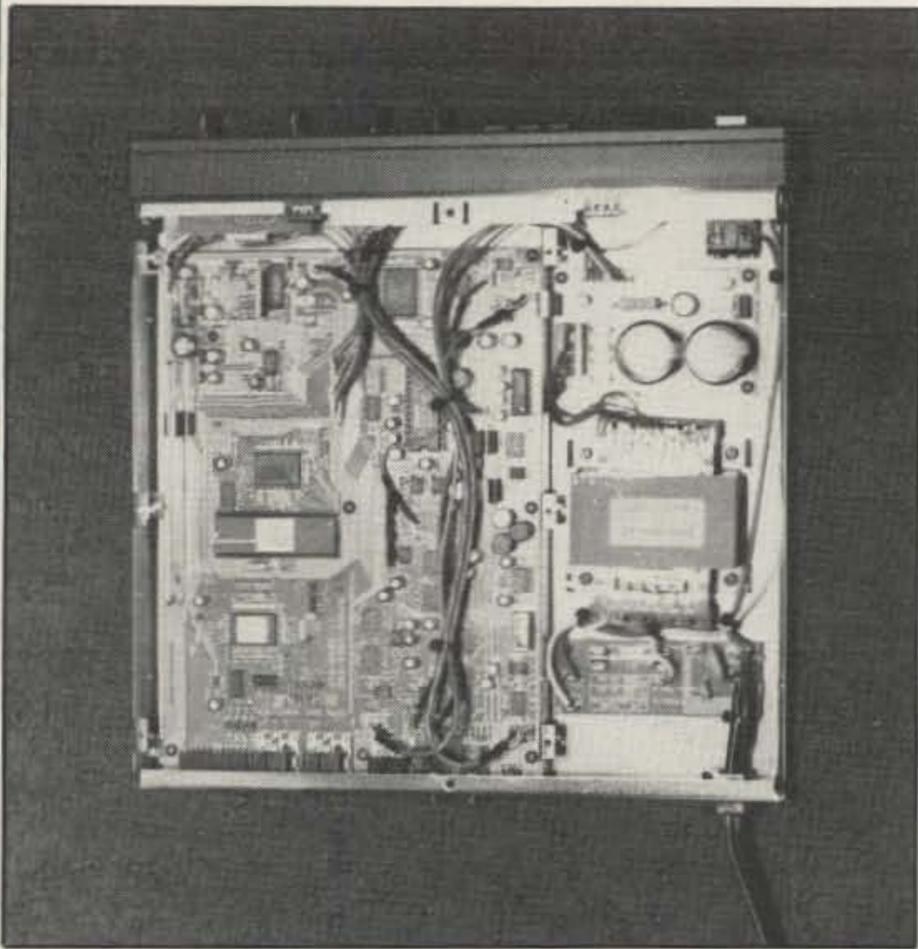
Some Kenwood advertisements show the DSP-100 sitting on top of a TS-850S. The size of the DSP-100 is somewhat exaggerated because of the angle of the photography. In reality the DSP-100 sits very neatly on top of a TS-850S and measures only 1 1/8 inches in height, excluding

the small mounting feet.

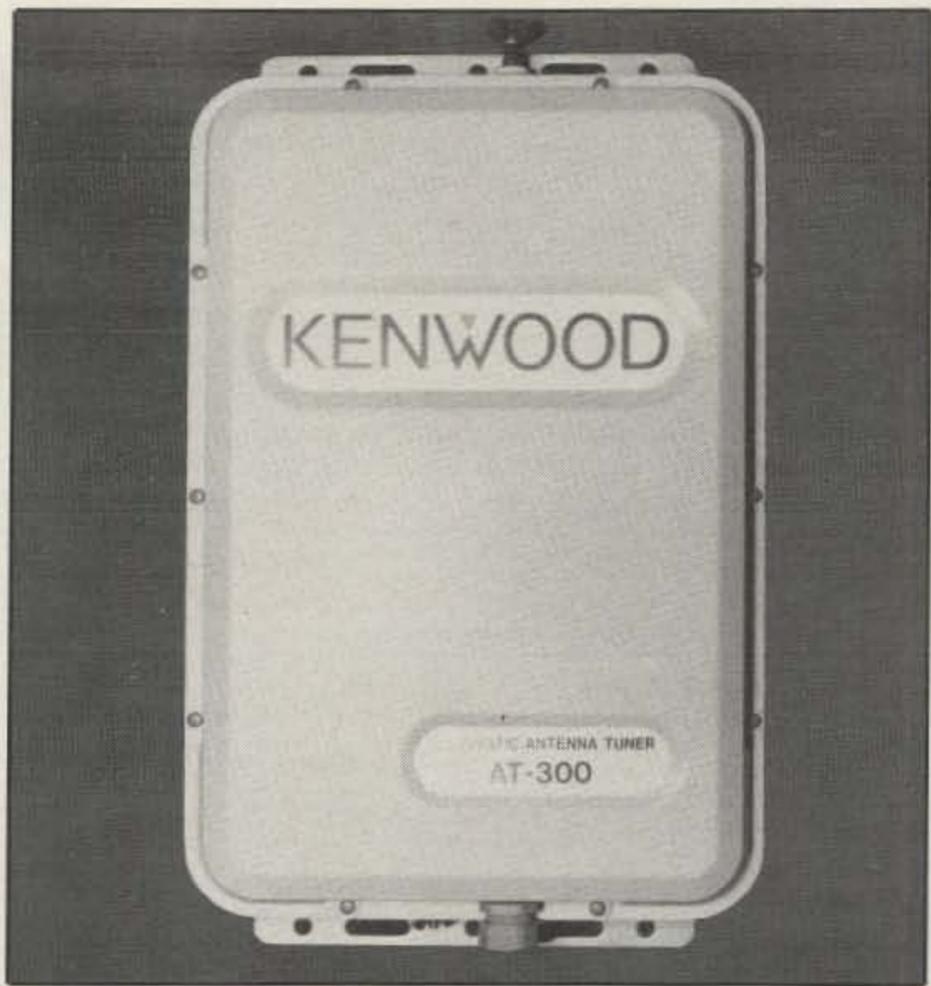
The circuitry used in the DSP-100 is basically similar to that used in the DSP-10 for the TS-950S. The circuitry revolves around a great many standard and custom ICs. There's not too much to be seen from a schematic of the unit, except to be impressed by the extensive circuitry involved, so I'll skip over that detail, although I feel rather sad doing so. As an electronics engineer myself, I couldn't help but be very impressed by the array of 44 ICs, 29 transistors, and almost countless passive components used in the DSP-100. Although the core circuitry of the DSP-100 does appear to duplicate that of the DSP-10, the DSP-100 is not simply a repackaged DSP-10. The DSP-10 had three PC boards, whereas the DSP-100's main processing circuitry is all on one large PC board. There are also numerous differences regarding the external controls.

Well, what does the DSP-100 really do in practical terms? It can digitally process the transmit and/or receive signal at the 36.891 MHz IF and is operative in the SSB, CW, AM, FSK, and FM modes. On

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Looking inside the DSP-100. Some shield covers have been temporarily removed. One large PC board contains the processor circuitry with a vast number of ICs and surface-mounted R/C/transistor components, while a separate AC power supply section is off to the side.



The AT-300 is housed in a sturdy, weatherproof plastic enclosure. Metal end brackets allow the tuner to be mounted on a flat surface or on a mast. A complete set of mounting hardware, 50 feet of control cable, and a neon RF tester come with the unit.

SSB transmit, unwanted sideband and carrier suppression is enhanced (to almost -60 dB), and the transmit audio passband can be tailored using the front-panel controls. A low-frequency cutoff of 100, 200, 300, or 400 Hz can be selected as well as a separate high-frequency cutoff of 2600, 2750, 2900, or 3100 Hz. Due to the digital processing, the filter slopes are quite sharp. If the 200 Hz low-frequency cutoff is chosen, for instance, the response will be down at least 12 dB at 100 Hz. Almost regardless of the microphone being used and in conjunction with the processor/high-boost features in the TS-850S, the transmit audio can be tailored from a very sharp sound to penetrate pile-ups to a softer response for prolonged ragchews on 75 meters. However, I would hasten to add that the evaluation of the sound of transmitted audio is a "very subjective" affair. Some stations will report that digital processing makes little difference, while others will report a distinct improvement in "clearness and crispness" using the digital processing.

As an alternative to shaping the transmit audio, the front-panel filter controls can be used to shape the audio on SSB receive and the transmit audio will continue to be influenced by the processor/high-boost features in the TS-850S. The RX and TX switches on the front panel of the DSP-100 determine if the unit tailors the receive or transmit audio.

For CW transmit operation the DSP-

100 can be used to set the carrier level and the rise and decay times of the CW waveform. A front-panel control sets the carrier level and a front-panel switch selects slow or fast rise/decay times. Normally the slow/fast times would be 4 and 2 ms, respectively. However, they can be changed to 8 and 6 ms, respectively, by means of a rear-panel DIP switch. The 8 ms time is too long for full break-in operation, but some operators may prefer it for soft keying. On CW receive the front-panel filter controls can be used, if desired, to influence the audio passband. On FM and FSK the DSP-100 generates a carrier which can be set by the carrier-level control. On AM the DSP-100 takes over the functions of the carrier-level and microphone-gain controls on the TS-850S.

The DSP-100 does have a rear-panel SSB output level adjustment, and there is even a two-tone signal generator built into the DSP-100. Normally you would not need to make any adjustment. But if you wanted to perform a sort of "system" alignment now and then, the possibility is there. The rear-panel DIP switch can be used to alter a wide variety of operating parameters. Table I presents a listing. Some rather interesting possibilities are present, such as being able to generate a DSB instead of an SSB signal and being able to modify the generated waveform for packet radio.

I found the DSP-100 to be a far more versatile unit to use than the DSP-10 as-

sociated with the TS-950S, although the signal enhancement provided by both units is basically the same. The fact that the DSP-100 has almost all of its operating controls "up front" allows the user to try out or modify adjustments very easily. As with the DSP-10 for the TS-950S, the DSP-100 for the TS-850S is an accessory that I would think would appeal to those amateurs who enjoy trying to fine tailor their CW or voice transmit quality.

The AT-300 Remote Antenna Tuner

The AT-300 is a *remote* automatic antenna tuner that can be controlled by a TS-850S. The tuner can be used in a mobile situation to resonate a short 9 foot whip or in a portable/stationary situation to resonate a wire-type antenna. The tuner is connected to the transceiver by a four-conductor control cable *and* a coaxial line for the RF connection. The tuner can, in theory at least, be mounted at any distance from the transceiver, although in a practical situation you would have to watch that the voltage drop in the control cable does not become excessive. The attenuation introduced by the coaxial line is likely to be less of a problem, assuming a good low-loss cable is used, since the line is operating at, or very near to, a 1:1 SWR.

Table II presents the specifications for

DIP Switch Setting

Switch No.	Position (ON/OFF)	Description		
1	LPF In/Out	Turns the LPF (Low Pass Filter) on or off. This filter determines the high-cut frequency for transmit and receive.		
2	FSK/PSK	Determines the type of waveform generated in the FSK mode.		
3	SSB/DSB	Allows a double sideband, suppressed carrier to be generated during SSB operation when turned ON.		
4	Carrier Suppression notch filter In/Out	Controls the carriers suppression notch filter during transmit operations.		
5	CW waveform Rise-Decay time select FAST/SLOW	Selects the desired CW waveform characteristics. ON FAST: 2 mS, SLOW: 4 mS OFF FAST: 6 mS, SLOW: 8 mS		
6, 7	FILTER switch transmit/receive selection.			
	Switch No.6	Switch No.7	The LPF/HPF switches on the front panel are controlled by the FILTER switch during transmit or receive. It is also possible to fix the filter of transmit or receive at the 100 Hz Low-cut and 3100 Hz High-cut bandwidth.	
	ON	ON		Front switches control RX and TX
	ON	OFF		Fixed during RX.
	OFF	ON		Fixed during TX.
OFF	OFF	Controlled by transceiver.		
8	Receive HPF control	Controls the receiver HPF that determines the low frequency cutoff point.		
9	Transmit HPF control	Controls the transmit HPF that determines the low frequency cutoff point.		
10	Remote Control	Usually turned on. Allows DSP-100 to control frequency response.		

Table I- DSP-100 DIP Switch listing.

the AT-300. Taking a look at Table II and the photograph of the AT-300, one can obtain some feel for the physical size and makeup of the unit. It is definitely a rugged unit that is meant to be used indoors or outdoors and operate over extreme temperature ranges. Note particularly from Table II the range of antenna lengths the AT-300 will accommodate when "working" those lengths against ground (a vehicle ground, radials, or some form of earth ground). A quite wide range of lengths can be accommodated, but of course the efficiency of the antenna system will be pretty much in direct relationship to the length of the antenna used. Random-length wire antennas always tend to be tricky to judge with regard to performance, but the old adage "the higher and the longer the better" certainly holds true for almost any installation.

As can be noted from Table II, the tune-up time can be as low as 1/2 second for frequencies which have been programmed as pre-tuned! Of course, 1/2 second is far faster than you can select a frequency on a transceiver. The reason for the fast response time is that the AT-300, unlike most automatic tuners built into transceivers, does not use any motor-driven variable capacitors. There would appear to be something like 500K + LC combinations which can be formed, although I'll hedge a bit about the validity of my math.

Using relay-switched LC components adds quite a bit to the size of the tuner, but it provides extreme reliability, especially for mobile or outdoor tuner installations. I also like it from the viewpoint of serviceability. If a LC or relay component should fail, there is at least some possibility that you can field service or at least jury-rig a temporary repair fairly easily.

The large band of inductors and relays can be seen in the photograph of the AT-300 with the top cover removed. The fixed capacitors grouped around the relays are a bit harder to discern, but they are quite accessible. Extensive shielding is used around various of the ICs for the control circuitry.

Used with a TS-850S, you only have to press a "tune" switch on the TS-850S, and the AT-300 will tune and the tuner setting will be stored. If a low SWR situation cannot be found, a warning tone will sound after about 20 seconds to indicate that a different antenna length or grounding connection is necessary. Kenwood goes through a lot of detail in the AT-300 manual to explain that random-length wire antennas worked against ground at times can introduce various sorts of feedback problems, RF burns if touched at high-voltage points, etc. In fact, they even supply a small neon tube tester with the AT-300 so you can check if a transceiver's enclosure has become "hot"

Frequency range	1.8 MHz to 29.7 MHz
Power Supply requirement	13.8 VDC \pm 15% Negative Ground max. 2 A (supplied from radiotelephone)
Power Capability	150W PEP (100W continuous)
Operating temperature	-20 °C to +60 °C (-4 °F to +140 °F)
Input Impedance	50 Ω
VSWR	Less than 1.5
Tuning Power	8~15 W
Antenna Required	12 to 23 m(39 to 75 feet); 1.8 to 29.7 MHz 2.7m(9 feet)whip; 3.5 to 29.7 MHz
Tuneup Time	Within 2 to 15 sec (Within 0.5 sec on pre-tuned frequencies)
Dimensions	W258 x H425 x D90 [mm] (10-5/32" x 16-23/32" x 3-17/32")
Weight	3.0 kg (6.6 lbs)

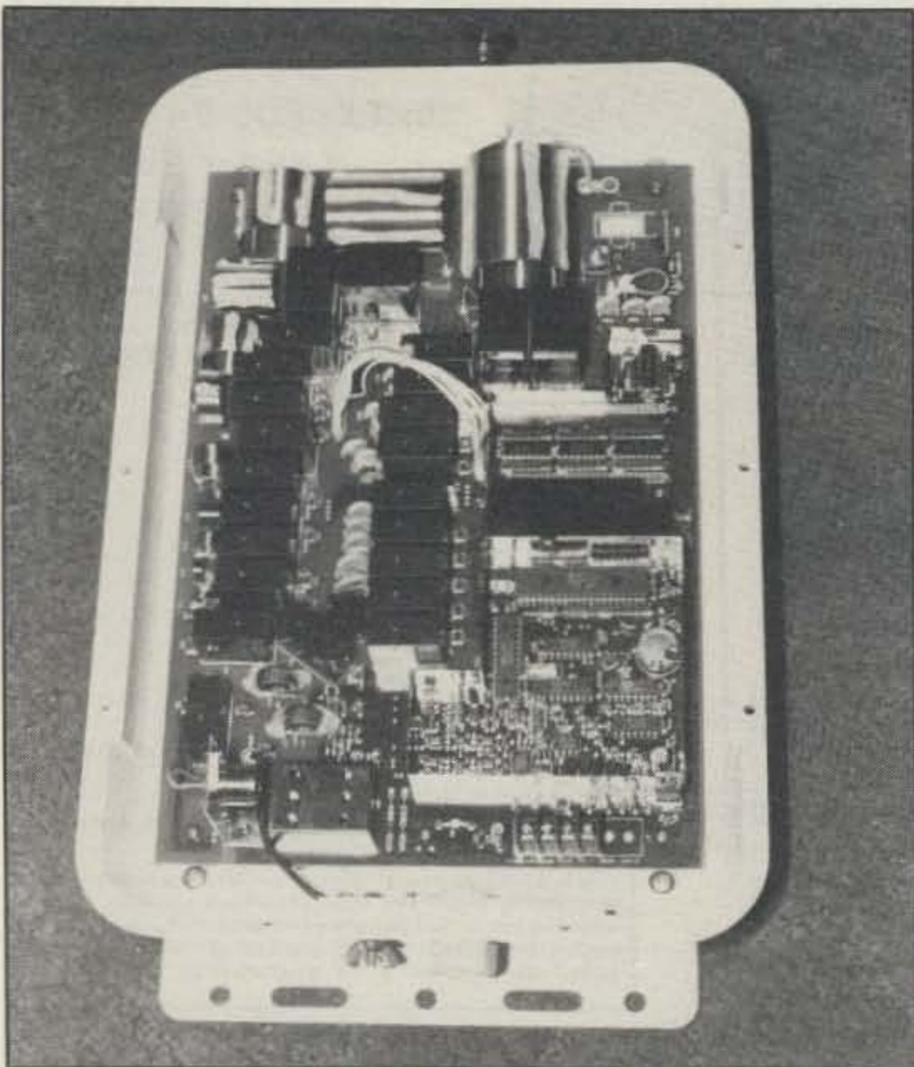
Table II- AT-300 specifications.

from stray RF! I never used it, but it's a nice touch.

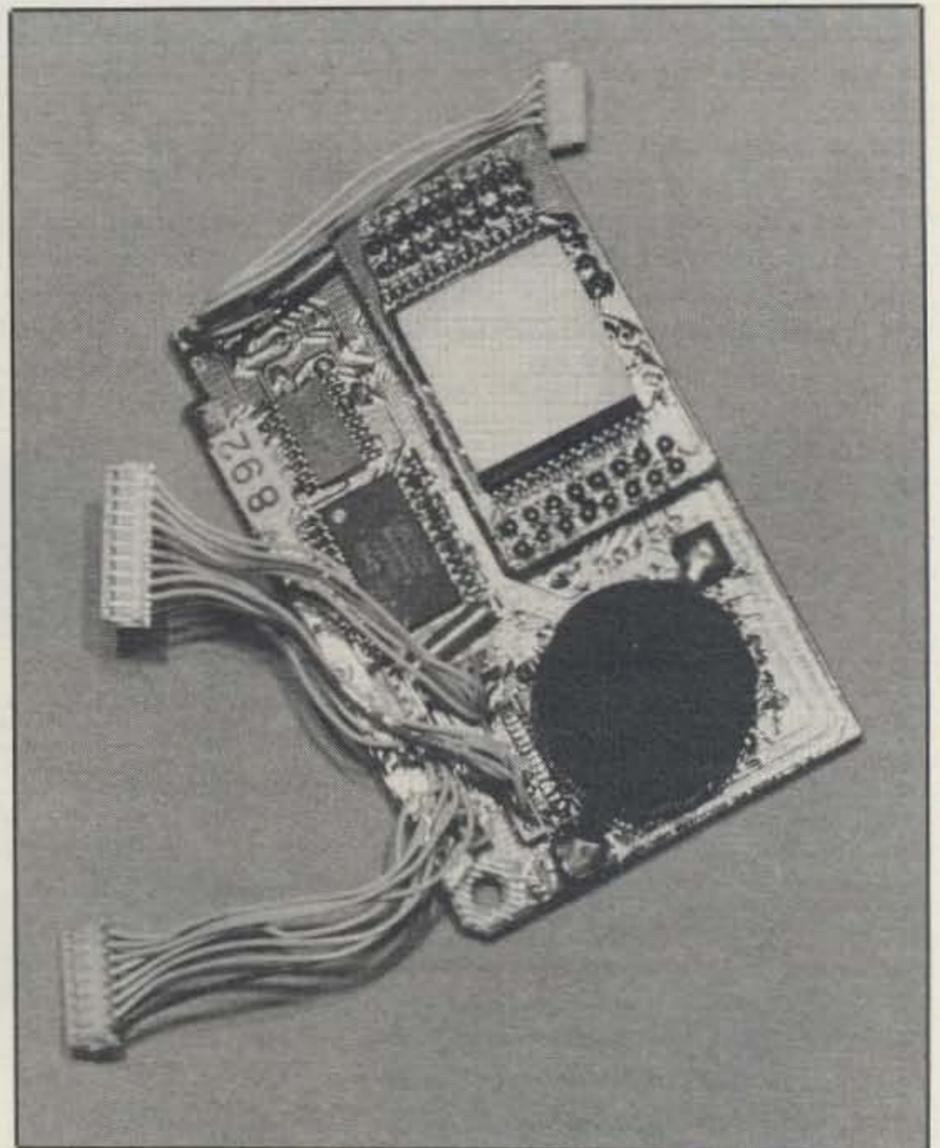
Using the AT-300 initially is a bit of fun. You can hear all of the relays very lightly chattering as all those LC combinations are tried, and then there is silence. I tried the AT-300 with some random-length wire antennas worked against a cold-water-pipe ground and never encountered any problems with stray RF. The ground lead to the water pipe was of #12 wire and only a few feet long.

The AT-300 is an extremely solidly constructed unit, and I would estimate it could easily survive for years in harsh environments considering either temperature, moisture, dust, or vibration. I surely wish I could have had a unit like the AT-300 available as I roamed around the world and tried to operate from various QTHs. However, I sort of wonder why Kenwood didn't put a balun in the AT-300. It would have been extremely easy to incorporate one internally, but you can always use an external unit. Then you would have the additional flexibility of being able to use the tuner with outdoor wire-type delta loops or even, at the other extreme, with attic-mounted balanced antennas in situations where there isn't a good ground available.

By the way, I didn't test it out completely, but there seems to be no reason why the AT-300 cannot be used with transceivers other than the TS-850S as long as a control voltage can be supplied to the tuner and a temporary grounding action over a control cable to set the tuner into its tune-up mode. There are many situations in which the use of a remote tuner, such as the AT-300, will provide far better results than having "hot" RF lines from an antenna running into a shack.



Looking inside the AT-300 a large 8" x 12" PC board can be seen. Various internal shields were removed temporarily for clarity. Note how the eleven coils are neatly aligned at right angles to each other. It's not obvious, but there is a test push-button and "tune" LED so a "tune" sequence could be initiated right at the tuner for setup or test purposes.



The DRU-2 Digital Recording Unit which mounts inside the TS-850S. It provides very good CW/voice record/playback capabilities. An on-board lithium battery (the circular black area) provides memory retention.

The DRU-2 Digital Recording Unit

The original review article on the TS-850S contained a photograph showing a latch cover on top of the transceiver. The cover didn't expose any hidden controls, but was meant for one-time use so the DRU-2 option could be installed. The DRU-2 mounts in place by one holding screw and three cable connections which plug di-

rectly into the TS-850S. It's a very compact piece of technology with ICs mounted on top of ICs and a multitude of surface-mount components on the underside of the main PC board. The unit itself does not have any control adjustments. It has a replaceable 3 volt lithium battery, which might have to be renewed every few years for memory retention.

The DRU-2 will record and playback CW messages or voice signals in any voice mode. FSK is the only mode for

which it cannot be used. Three sets of keys marked **PLAY 1/REC 1**, **PLAY 2/REC 2**, and **PLAY 3/REC 3** on the front panel of the transceiver control the operation of the unit. The 1, 2, and 3 refer to three separate record/playback segments available for any combinations of CW/voice usage which have lengths of 8, 8, and 16 seconds, respectively. However, by means of the alternative function selection scheme described in the article on the TS-850S, the time length for any given segment can be doubled to provide maximum segment lengths of 16, 16, and 3 seconds, respectively. That's a lot of storage capability.

CW recording must be done using the keyer built into the TS-850S, while voice recording is done using the station microphone. A digital display will confirm the recording segment being used and count down the seconds left for recording! Recorded messages (CW or voice) can be played back for confirmation purposes without actually transmitting them. Actual transmission can be done using manual PTT or VOX. If VOX is used, the transceiver will, of course, revert to receive whenever a recorded message has ended regardless of whether the message filled a recording segment. If **PLAY 1**, **PLAY 2**, and **PLAY 3** are pressed in turn,

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all three recorded segments will be played back in succession for either continuous confirmation or transmitting purposes.

The DRU-2 has recording/playback segments of great enough length such that their use can be very varied for anything from short contest calls, to directional CQs, to general CQs, to sked calls, etc. I didn't try it, but I can well imagine that if the VOX delay is set short enough, the DRU-2 can be used to transmit a call very effectively while trying to crack a pile-up. All the operator would have to do is keep hitting the playback button at the appropriate time until his call was recognized by the DX station. Frankly, it sounds too automated to me, but I guess the capability is there.

As with most state-of-the-art digital recorders, I found the DRU-2 delivered an output which sounded somewhat quieter and crisper on playback than the original voice input signal. I liked the sound, but as I said before, the evaluation of the sound of audio tends to be very subjective. The DRU-2 is not set up to record receive audio, although I suspect there must be some way to modify it to do so. In any case, at its relatively modest price the DRU-2 option is quite interesting to consider both for its test capabilities if you like to more objectively evaluate your own CW or voice "sound" or for its use for a multitude of on-the-air applications.

Summary

These days there are so many accessory items available for transceivers that it becomes difficult to pick and choose. However, I think it's better to have that difficulty while manufacturers such as Kenwood maintain a bottom, basic price on a basically excellent transceiver such as the TS-850S. Accessory items, to my mind, fall either into the categories of those items which provide performance enhancement or those which enhance operating convenience. Some operators, for instance, might prefer to first spend their money on a desk microphone, such as the MC-85 for the TS-850S, as an operating convenience rather than on a performance-enhancement device such as the DSP-100. I think if you just take a look at your station setup and operating preferences, the logical addition of accessory items will fall into place. Of course, hopefully one purpose served by review articles such as this is to give operators a bit more insight into the functioning of various accessory items than is possible by a simple perusal of the advertising literature.

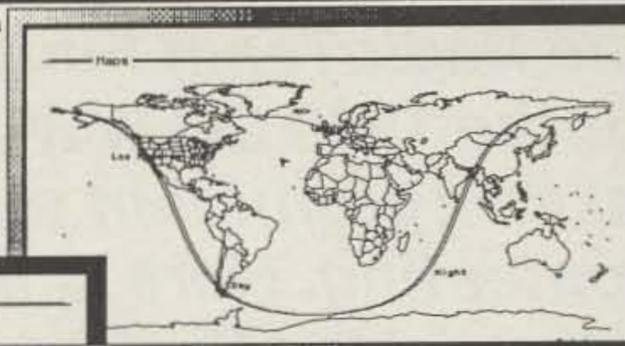
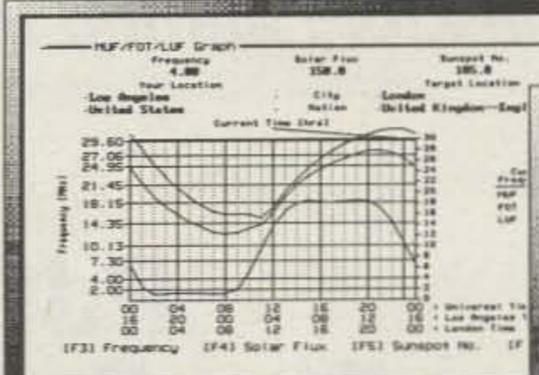
The TS-850S and its accessories are manufactured by Kenwood USA Corp., P.O. Box 22745, Long Beach, CA 90801-5745. The DSP-100 is priced at \$629.95; the AT-300 is \$589.95; and the DRU-2 is \$121.95.



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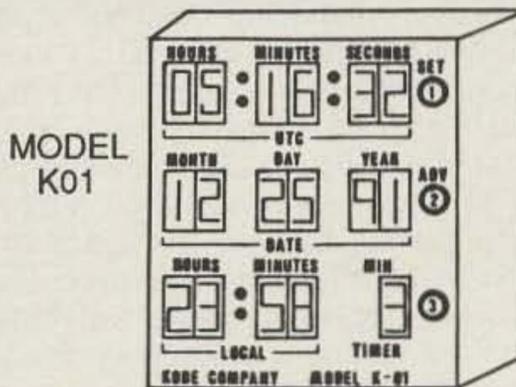
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