

CQ REVIEWS:

The Kenwood TS-870S Transceiver

BY LEW McCOY*, W1ICP

Many times in my career I have been called upon to review new equipment. Often the units I am asked to review fit into the same category (such as transceivers), and in that case they have similar "bells and whistles." To be very honest, most of the major manufacturers have excellent units, and it frequently is difficult to separate outstanding features. In the case of the new Kenwood TS-870S transceiver, however, this is not the case. To my way of thinking, digital signal processing (DSP) has finally arrived with this new transceiver.

First Impressions

The first TS-870S I received was from a very early production run, and consequently I did not get a manual. Like any amateur radio operator, I was anxious to try the unit, so I did what I'm sure no other amateur has ever done: I turned it on without having read the manual. After all, how could I go wrong if I only listened to the receiver?

I turned up the audio and figured out how to switch the unit to 20 meters. At first I did not hear any background band noise. I started to tune and wham! An S9 signal popped up, and he was loud and strong. When I tuned away, the band sounded extremely quiet. Finally I started to tweak a few of the knobs that control the digital filtering, and that was when I really got a surprise. The display of the receiver showed that tweaking one filter knob resulted in the bandwidth of one portion of the filter going from 6000 cycles down to 1400 cycles. I then set the control at 2100 cycles, as I cal-

*Technical Editor, CQ, 1500 W. Idaho St., Silver City, NM 88061



The Kenwood TS-870S transceiver.

culated this would be a good bandwidth for SSB reception. As I tuned between signals, I noted the band was quiet. Obviously, the filter was reducing random noise appreciably. It was apparent to me that the digital filtering produced exceptional skirt selectivity. The stated rating is 60 dB on the skirts, and such certainly was the case.

CW Filtering

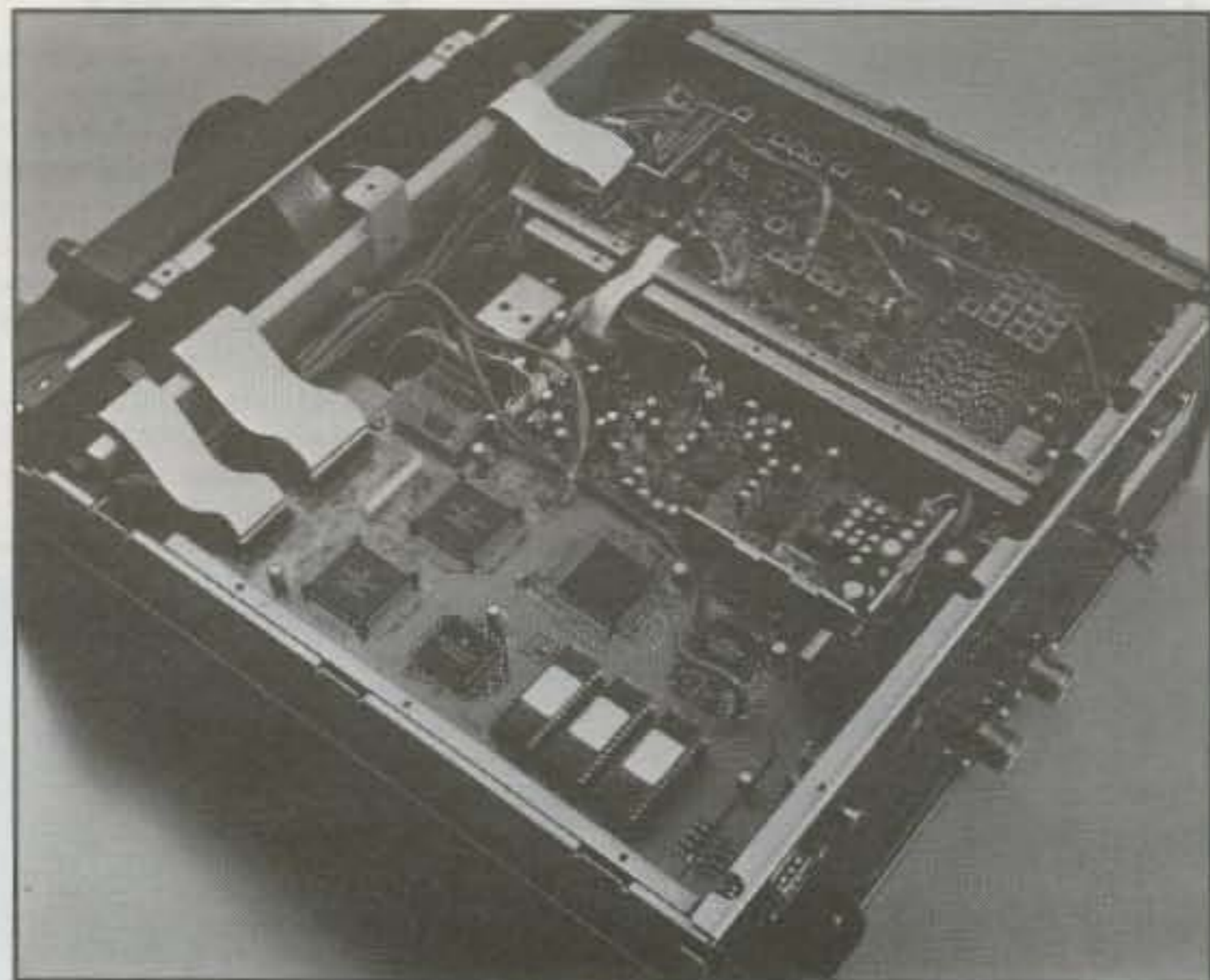
My next step was to test the CW filtering. However, before describing that, let me give you just a little history on the subject.

Years ago (back in the 1960s) I worked at the ARRL in the Technical Department. Byron Goodman, W1DX, was one of my bosses, and he had become interested in the "limits" of selectivity. He built up a multiple IF (interme-

diated frequency) strip to test selectivity. He kept making his receiver setup more and more selective, until he reached a point where a signal had so much "ringing" that it was no longer good copy. That point was 180 cycles. It was shortly after that when the commercial receiver people set 200-cycle filters as the maximum standard. Such filters were never standard equipment, but always cost a bundle as an add-on. Just ask any Collins equipment users. That brings us to digital signal techniques.

I switched the TS-870S to CW and started to listen to CW signals. The digital filter could be adjusted to a setting of 50 cycles! I found two fairly strong signals that were almost on exactly the same frequency. I then went to careful tuning and found that I could easily separate both signals—and I do mean easily.

There are two tuning rates. The slowest is



← The TS-870S with the bottom cover removed.

Rear view of the Kenwood TS-870S. ↓



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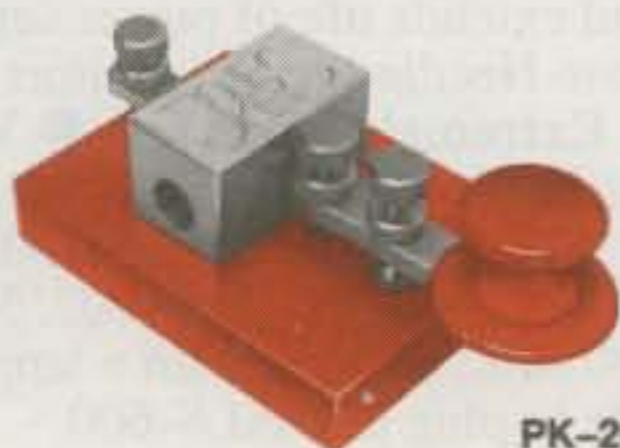
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MENU CONFIGURATION

Menu No.	Menu Item	Function	Selections	Default	Page Ref.
00	MENU.A/B	Menu A or B selection	A/B	A	24
01	AUT/MAN	AGC mode: Manual (OFF), Automatic (ON)	OFF/ON	OFF	44
02	AGC SSB	Automatic AGC release time for SSB mode • 1 (Slow) → 20 (Fast)	OFF, 1 ~ 20	7	44
03	AGC CW	Automatic AGC release time for CW mode • 1 (Slow) → 20 (Fast)	OFF, 1 ~ 20	12	44
04	AGC FSK	Automatic AGC release time for FSK mode • 1 (Slow) → 20 (Fast)	OFF, 1 ~ 20	14	44
05	AGC AM	Automatic AGC release time for AM mode • 1 (Slow) → 20 (Fast)	OFF, 1 ~ 20	5	44
06	AF.AGC	AF AGC release time for FM and AM modes • 0: Slow, 1: Med, 2: Fast	0/ 1/ 2	1	44
07	AF.AGC.LV	AF AGC level for FM and AM modes • 0: OFF, 1: Min, 2: Med, 3: High, 4: Max	0/ 1/ 2/ 3/ 4	1	44
08	RX AT	Auto Tuner active while receiving	OFF/ON	OFF	49
09	P HOLD	Peak Hold for multifunction meter	OFF/ON	ON	22
10	Δ FREQ	TX/RX frequency difference for split operation	OFF/ON	OFF	43
11	AIP.GAIN	S-meter correction for AIP (excluding FM/AM)	OFF/ON	OFF	10, 53
12	FM.S-MET	S-meter correction for FM mode	OFF/ON	ON	38
13	LINE.ENH	Line Enhance function	OFF/ON	ON	53
14	LINE.ENH	Line Enhance response time • 0 (Fast) → 4 (Slow)	0/ 1/ 2/ 3/ 4	4	52
15	SPAC	SPAC time	2/ 5/ 10/ 17 ms	17 ms	53
16	SP.BEAT	Beat Cancel response time • 0 (Fast) → 4 (Slow)	0/ 1/ 2/ 3/ 4	2	52
17	SP.NOTCH	Auto Notch response time • 0 (Fast) → 4 (Slow)	0/ 1/ 2/ 3/ 4	2	52
18	TRACK	Adaptive filtering	OFF/ON	ON	52
19	PKT.FIL	Filter bandwidth for digital operation <i>Note: While operating in SSB mode, the following is displayed in each case:</i> 1200: P.FIL.WID 300: P.FIL.NAR P: P.FIL.PSK <i>Note: For SSB and AM modes, LOWWIDTH and HISHIFT controls are enabled, and the filter bandwidth is displayed, only when "OFF" is selected.</i>	OFF/ 1200/ 300/ P	OFF	41
20	PKT.IN	AF input level for Digital operation (MCP/TNC TX) • 0: 100 mV, 1: 30 mV, 2: 10 mV	0/ 1/ 2	2	41
21	PKT.OUT	AF output level for Digital operation (MCP/TNC RX) • 0 (minimum level) → 9 (maximum level)	0 ~ 9	4	41
22	MIC AGC	Microphone AGC release time • 0: Slow, 1: Med, 2: Fast	0/ 1/ 2	1	47
23	CW RISE	CW rise and decay times	2/ 4/ 6/ 8 ms	4 ms	31
24	PITCH	CW RX pitch/ TX sidetone frequency	400/ 450/ 500/ 550/ 600/ 650/ 700/ 750/ 800/ 850/ 900/ 950/ 1000 Hz	800 Hz	30
25	PROC.LOW	Speech Processor low-frequency response	-6, -3, 0, +3, +6 dB	-3 dB	23, 46
26	PROC.HI	Speech Processor high-frequency response	-6, -3, 0, +3, +6 dB	+3 dB	23, 46
27	TX INH	TX Inhibit	OFF/ON	OFF	45

Fig. 1- This is a page from the manual showing some of the MENU functions.

1000 cycles per revolution, which is adequate to separate signals with the filters in the sharpest position. The fastest rate is 10 kHz per revolution. I also might add here that we have had DSP for some time now, but most of it has been done at audio. This processing on the TS-870S takes place in the intermediate frequency (the IF). Needless to say, I am very impressed.

The Basics

So what are some of the basics of the transceiver? It measures 4.75"H x 13"W x 13"D. Power requirement is 13.8 volts at 23 amps, and must be supplied. The display is arranged so that all information is visible, either during operation or via switches.

The S-meter has the unusual feature of show-

ing the filter passband width in the form of a rainbow arc. The wider the passband, the larger the arc. In the 50-cycles position mentioned earlier, the arc consists of only three bars. While receiving, you have the bar-type S meter. This also is unusual in that as the signal being received shifts up and down, as in sideband reception, a single bar segment is left visible at the peak of signal strength. It is easy to tell the other operator you are working exactly what his received signal peak is. While transmitting, the meter serves as a calibrated power meter plus an ALC meter, an SWR meter, or a speech-processor compression meter. A PEAK Hold function which holds each reading for about 2.5 seconds can be activated. Also while transmitting, a calibrated power reading and ALC reading are available. In addition, either SWR or speech compression is shown.

I don't ever recall seeing for any transceiver as complete an operating manual as is provided with this unit. The book is 98 pages in length with large, clear print, and is extremely detailed. If anything, this transceiver is not a piece of equipment you will understand completely in one reading of the manual. True, you can get it on the air in about an hour, but from there you must be prepared to spend several hours reading the manual to obtain a good grasp of all the functions. Think I'm kidding? Let's discuss the MENU features.

The Menu

This transceiver is menu driven. Fig. 1 is the first page of the menu information from the manual. You press a panel button, and the transceiver goes into the MENU mode. There are 68 different menu functions that can be programmed. I also have included a page from the manual (fig. 2), which shows the cross reference for menu functions. For example, under CW you can program the rise and fall decay times, the RX pitch, and the TX sidetone. I mentioned the PEAK Hold function, under DISPLAY. This can be set according to your needs.

I could go on and on, but there are pages and pages in the manual describing these functions. We obviously have entered a new world of transceivers. I might add that this DSP world is here to stay.

Back To The Basics

Getting back to the basics, the transceiver covers receive range 100 kHz through 30 MHz. Amateur band coverage is 160 through 10 meters. Modes include SSB, CW AM, FM, and FSK. There are four (!) IF stages—the first at 73.05 MHz, second at 8.83 MHz, third at 455 kHz, and fourth at 11.3 kHz. I'll be the first to admit I don't understand that fourth IF, but I couldn't find details in the manual. I assume that this low an IF was or is used in some way to handle the DSP functions, because the DSP is done at IF and not audio. In the radio, FM has double conversion, while all other modes have quadruple conversion. As if this isn't enough, getting back to the manual, fig. 2 is a page showing how to customize the transmit signal. You can "sharpen" your signal as you desire. Pretty neat, don't you think?

More On Filter Tuning

This is a kind of "jump around" review, so bear with me. Getting back to the filter tuning, which is done in the IF, we have a BEAT CANCEL switch, which when turned on, will knock someone who is tuning up near your desired station out of the passband. Nice!

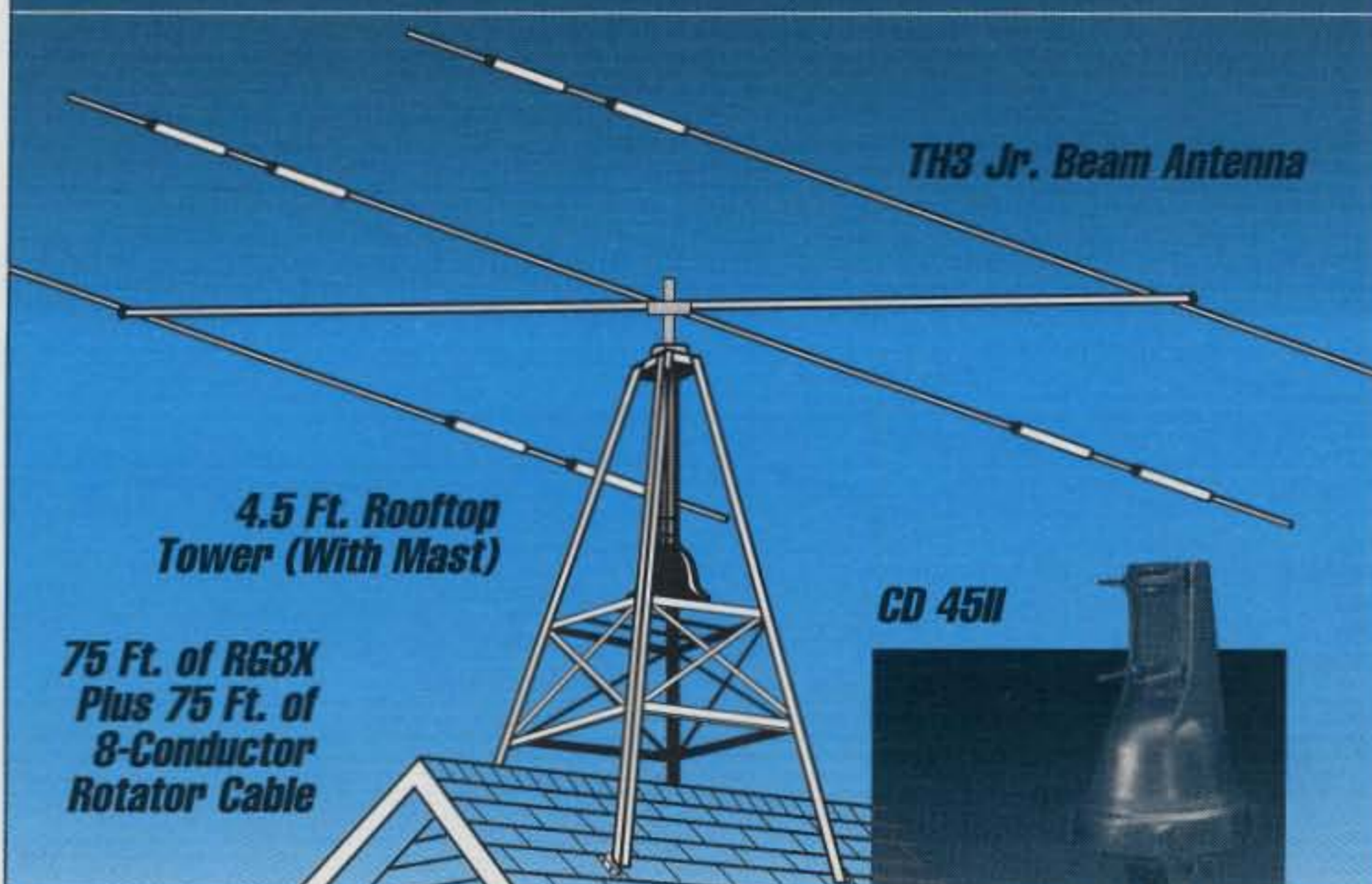
Next, we have AUTO NOTCH, which may or may not work better than the BEAT CANCEL for a given situation. You can change MENU No. 17 for response times for the AUTO NOTCH. As the manual instructs, experiment and listen. I did and I was amazed.

The RCP Computer Program

The manual also provides details for RS-232C computer connection, and Kenwood has software available. This software is called "The

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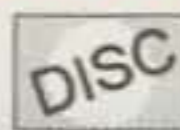
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CUSTOMIZING TRANSMIT SIGNAL CHARACTERISTICS (SSB/AM)

The quality of your transmitted signal is important regardless which on-the-air activity you pursue. However, it's easy to be casual and overlook this fact since you don't listen to your own signal. The following sub-sections provide information that will help you tailor your transmitted signal.

■ Changing Transmit Bandwidth

Transmit bandwidth is modified via Menu No. 29 (TX.WIDTH). The available selections include:

- 1800, 2000, 2300, 2600, and 3000 Hz

The default is 2300 Hz. Consult the Bandwidth/Bandshift Table for additional data. When the Speech Processor is switched ON, the bandwidth changes as shown in this table; however, displayed values do not change.

■ Transmit Bandshift

Transmit bandshift is modified via Menu No. 30 (TX.SHIFT). The available selections include:

- 0, 100, 200, 300, 400, and 500 Hz

The default is 300 Hz. Consult the Bandwidth/Bandshift Table for additional data. When the Speech Processor is switched ON, the bandwidth changes as shown in this table; however, displayed values do not change.

■ Equalizing Transmit Audio

Press [TX EQ.] to toggle the transmit equalizer ON or OFF. To change transmit frequency characteristics, access Menu No. 31 (TX EQ.). The available selections include:

- High boost (H)
- Comb filter (C)
- Bass boost (B)

The default is High Boost.

■ Microphone AGC

While transmitting, Microphone AGC helps to prevent distortion due to overly high audio input. It is disabled while using CW or FSK.

Function	Menu No.	Selections	Default
Microphone AGC Release Time	22	0: Slow 1: Med 2: Fast	1: Med

BANDWIDTH/ BANDSHIFT TABLE

TX Bandshift Setting (Hz) (Menu No. 30)	TX Bandwidth Setting (kHz) (Menu No. 29)	Resulting Upper Cutoff Freq. (kHz)	Speech Processor	
			OFF	ON
0	1.8	1.8	200	1.6
	2.0	2.0		
	2.3	2.3		
	2.6	2.6		
	3.0	3.0		
100	1.8	1.9		1.7
	2.0	2.1		
	2.3	2.4		
	2.6	2.7		
	3.0	3.1		
200	1.8	2.0		1.8
	2.0	2.2		
	2.3	2.5		
	2.6	2.8		
	3.0	3.2		
300	1.8	2.1	300	1.8
	2.0	2.3		
	2.3	2.6		
	2.6	2.9		
	3.0	3.3		
400	1.8	2.2	400	1.8
	2.0	2.4		
	2.3	2.7		
	2.6	3.0		
	3.0	3.4		
500	1.8	2.3	500	1.8
	2.0	2.5		
	2.3	2.8		
	2.6	3.1		
	3.0	3.5		

Fig. 2— Also from the manual, this shows some of the adjustments for your transmitted signal.

Radio Control Program" (RCP). The system requirements are as follows: a 386/33 or higher computer, 3 MB of hard disk space, 4 MB of RAM, a Kenwood TS-870S transceiver, serial cable, DOS 5.0 or higher, and either Windows 3.1 or Windows 96.

The software has the following features: full-featured amateur radio CAD (computer-aided design) system, full set of radio assembly and layout tools, full Drag and Drop implementation, five sample radios, powerful RCP scripting language, Wizards for creating new custom controls, and on-line tutorial and documentation. All of the basic requirements for station operation are included for logging, timekeeping, etc. The software can control multiple transceivers; you contest guys think about that one!

Frankly, this review was done under some tight deadlines, and I did not have a chance to use the transceiver with software to its full potential. (However, I have no doubt whatsoever that it would work very well.) Suffice it to say, this setup with the transceiver and software brings amateur radio into a completely new era.

Conclusion

The transceiver has 100 memories, with SCAN, group or total, plus all the other functions you would normally expect in a first-class rig.

My conclusion should be obvious at this point. I consider the TS-870S to be a major milestone in the development of receivers and transmitters. It certainly will revolutionize our hobby. And I can see this being a very hot item with DXers and contesters. The selectivity characteristics alone make it stand out—in addition to the dual VFOs and weak signal reception capabilities—and the computer aspect certainly moves us into a different era in transceiver technology.

I could go on for pages and pages. I am sure you have many questions, but I'm sure Kenwood will fill you in through their advertising of the TS-870S.

The list price of the TS-870S is \$3199.95. It is manufactured by Kenwood Corp., P.O. Box 22745, 2201 E. Dominguez St., Long Beach, CA 90801-5745 (customer support/ brochures 310-639-5300).