KENWOOD BUDGET HF BOX

If you wanted to get going on HF a few months ago, you had the choice of several rigs. If your eyes gazed longingly at the latest commercial equipments you had little choice below the £1000 mark, and the newly licensed amateur would either have to start saving hard or pay a visit to his friendly local bank manager! It has long been said that amateur radio is increasingly becoming a cheque book hobby, but lately there has been a trend on VHF towards *less* expensive rigs, could the same now be happening on HF?

Kenwood seem to be reacting to high quipment costs with their new HF rig. But does cost-cutting mean corner-cutting too? Chris Lorek, G4HCL, finds out.

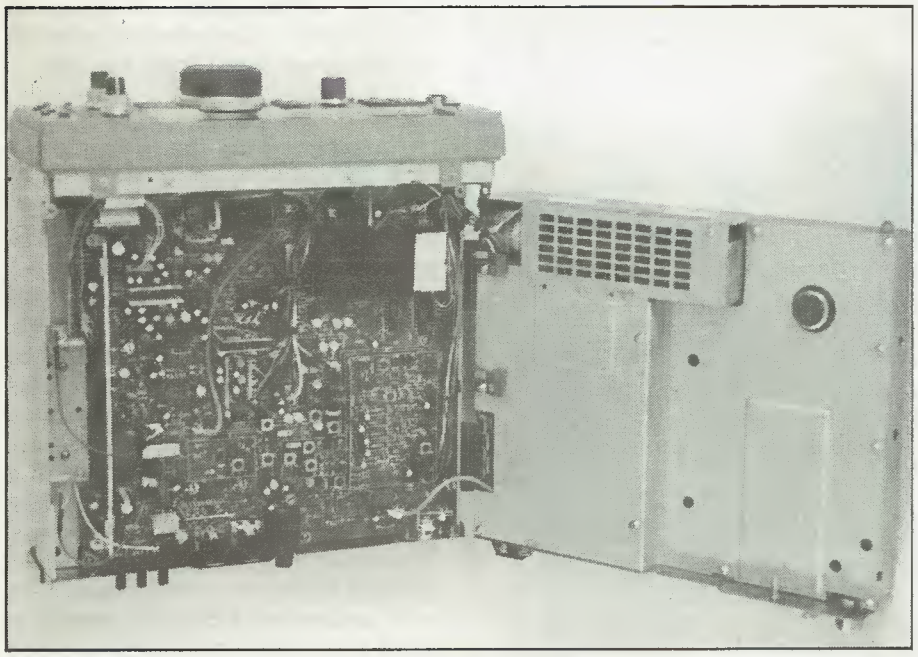
The Kenwood TS140S has just been introduced at a selling price of £862, making it cheaper than its predecessors while still offering similar features, but does this mean corners have been cut? A glance at the front panel shows a less cluttered array of knobs and switches than usual, but don't let this fool you, the set actually has many more features than it would seem, including a novel built-in morse code indicator system that tells you what's happening, and an optional computer control interface for the whizz-kids who let their fingers do the talking.

Features

The set covers all HF amateur bands from 160m to 10m (including the WARC 30, 17 and 12m bands) on transmit, coupled with general coverage receive operation specified over 500kHz — 30MHz, although the actual tuning range is a very wide 50kHz — 35MHz. USB, LSB, CW, FM and AM modes of operation are catered for, with each mode change being accompanied by a short morse code identification corresponding to the first letter of mode selected. The transmitter output power is specified at 110W PEP for SSB, 100W CW, 50W FM and 40W AM with a slight reduction on 10m, the set operating from a 13.8V DC supply and drawing 20A maximum on transmit with 1.5A nominal on receive. The TS-680S adds transceive coverage of 50-54MHz with 10W transmit power.

When operating in SSB mode, LSB or USB is automatically selected as you switch from the LF to the HF bands in accordance with normal amateur practice, the changeover occurred at 9.5MHz. A VOX facility (Voice-operated Tx switching) is fitted with VOX gain, delay and anti-vox controls on the rear. On the TS-680S a switchable receive preamp operating on 6m and 10m is fitted in place of the VOX. For the CW addicts, full break-in keying may be selected as well as semi break-in, and an optional narrow CW filter may be fitted and independently selected as required, in place of the 2.2kHz SSB filter normally used, by pressing a front panel button. Separate filters are provided for AM (6kHz bandwidth) and FM (12kHz bandwidth) which are automatically switched in as appropriate for the mode selected. For noise-free monitoring on 10m, a variable squelch is fitted that operates in the FM mode. Two digital VFOs are provided, these tune in 10Hz steps on SSB and CW, and 100Hz steps on AM and FM, the VFOs may be used independently or for split frequency Tx/Rx operation.

Your operating frequency may be varied by using the large VFO tuning knob or by microphone mounted up/down buttons, and an adjacent 'VFO CH' click-step knob provides 10kHz steps for fast frequency shifts or channelised operation. A switchable RIT (Receiver Incremental Tuning) with a ±1.2kHz range is provided to cope with drifting stations after establishment of QSO, an indication of the offset and direction being shown on the set's main display. To suit different uses such as base station, mobile or whatever, the tuning knob 'stiffness' may be varied by a friction adjustment around its outer perimeter, and to prevent accidental QSYs a frequency 'lock' button is provided on the front panel. Band changes are made by using a pair of large up/down buttons next to the tuning knob, these step either between amateur bands or in 1MHz steps for general coverage receive as required.



Top view of the TS-140.

QRM Rejection

As the HF bands become more and more crowded, the performance of a receiver depends not so much as to how sensitive it is, but on how it stands up to rejecting stronger unwanted signals. These may be either from a stronger signal on a closely adjacent frequency where selectivity is important, from a number of stronger signals either within the frequency band or indeed from an adjacent broadcast band all mixing together in the first stages of your receiver, where strong signal handling comes in, or indeed from other man-made interference such as next door's chainsaw or a little further afield from over-the-horizon radar such as the American 'Pave Paws' system.

With all this in mind, as well as employing careful circuit design, Kenwood have provided the usual QRM fighting circuits such as a 20dB front-end attenuator and slow/fast switchable AGC (Automatic Gain Control) coupled with a manual RF gain slider control, together with an IF shift that moves the crystal filter passband either side of the tuned frequency. A dual-mode noise blanker is also provided, one mode for pulse suppression such as ignition interference, the other for longer pulse widths such as radar, a variable threshold level control gives you a degree of control to prevent the wanted signal deteriorating. As a 'fighting back' measure, a built-in speech processor may be switched in to give your SSB (or even AM) transmit signal more punch. A variable power output slider control lets you continuously reduce your transmit power down from 100W to around 10W for when things aren't tough going or for those who enjoy a challenge.

Multiple Memories

A total of 30 memory channels are provided in 3 blocks of 10 each, selected by the rotary 'M.CH/VFO CH' knob. Apart from allowing you to quickly recall Radio Tirana's frequency for easy bed-time listening a couple of useful features are provided. Memory channels 1-10 may store frequency and mode, and memory channels 11-20 may store split Tx/Rx frequencies as well as the operating mode. A push of the 'M>VFO' button then allows you to transfer the memory channel information into the operating VFO(s) as required if you wish to tune around for other activity.

Memory channels 21-30 however are designated as 'Programmable Band Markers,' these store an upper and lower frequency limit as well as a programmed mode of operation. Once selected, you may QSY or change mode as you wish within the frequency limits you have programmed by a twist of the main tuning knob, the memory channel storing the last tuned frequency and mode in each case. As such, they may be used to store amateur or broadcast band frequency limits together with appropriate modes of operation.

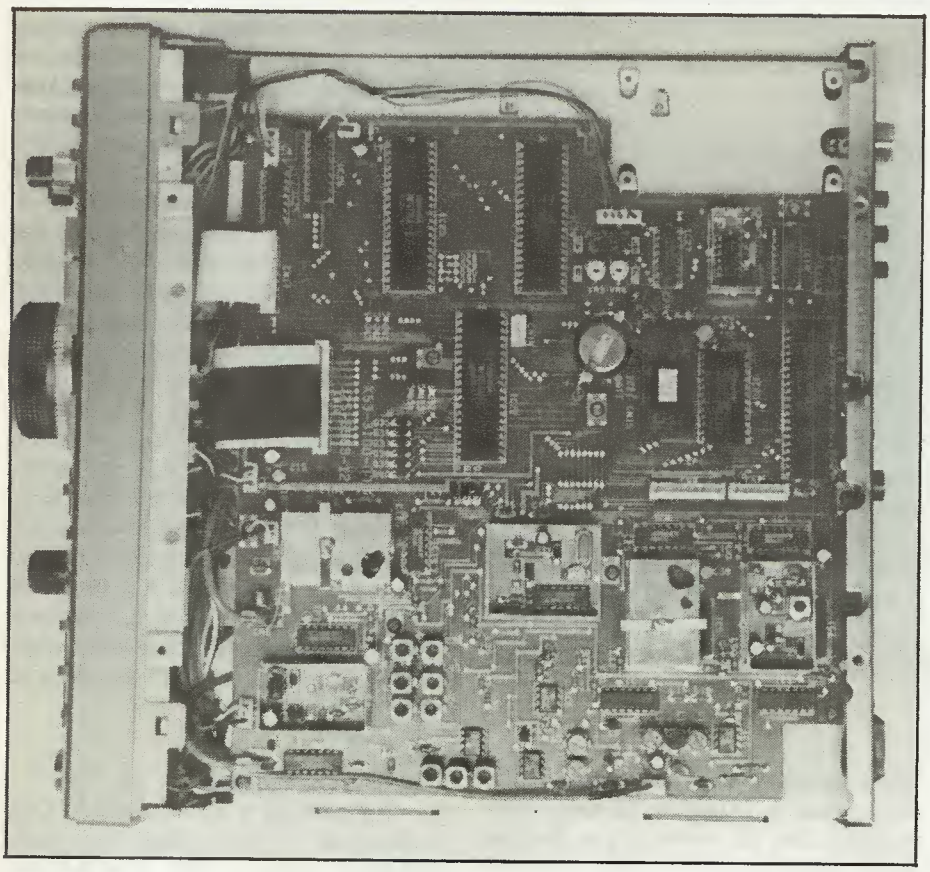
Memory channels may be sequentially scanned, the RIT knob allowing you to alter the scanning speed and hence the amount of time spent sampling each channel, any of the channels may be locked out of scan mode if desired. A programmable band scan is also available, this normally searching between the limits programmed in memory channel 30. If this channel is empty, then the entire range from 50kHz to 35MHz is searched, or if the scan is initiated outside these limits then the channel 30 range is excluded. Again the RIT knob may be used to alter the scan rate.

Dah Dit Dah

As well as a short audible CW indication of the mode selected, several other CW messages emanate from the set's speaker, apart from those received off air. For instance, if memory scan is initiated while all memory channels are either vacant or locked out of scan then a 'Check Memory' message in CW is produced, similar indications of 'Full' or 'Empty' are given when checking memories with the '1MHz' step switch selected. Other indications such as 'Reset' and 'Unlock' are given as alarm indications. All the above may be changed to simple bleep tones in case CW sends you round the twist!

Interfaces

A large fluorescent display shows the operating frequency to a resolution of 10Hz or 100Hz as desired, together with LED indicators displaying the operational mode and VFO. A backlit analogue meter shows receive signal strength and selectable indications of the relative output power or ALC level on transmit. Round the back of the set are four accessory sockets providing a multiplicity of functions. The ACC2 connector is designed for RTTY/AMTOR/Packet controllers, providing receive audio output at a fixed 300mV level, squelch control output, Tx AF input, and Tx key lines



Underside of the new Kenwood.

(one of which disables the microphone). ACC3 provides an interconnection to the optional AT-250 automatic aerial tuner, and a further 'Remote' socket provides for external linear amplifier Tx/Rx switching, a PTT footswitch, and a speaker audio output.

For the computer-control buffs, an optional computer interface may be fitted with the ACC1 socket connecting to the outside world, but the manual states that you'll have to write your own computer program! The set comes supplied with 7 and 13 pin DIN plugs to suit the accessory connectors, a heavy duty DC cable fused in each lead with a spare fuse provided, and an instruction manual giving operating details together with circuit and block diagrams. The set measures 281mm(W) × 107mm(H) × 305mm(D) and weighs 6.1kg.

Technicalities

The set is constructed on a metal chassis with a 'hinge-open' arrangement where after removing the covers the set literally opens up like a book, to expose all the innards in their glory, this of course makes access for servicing very easy. On receive, the aerial signals pass through the appropriately selected low and high pass filters, broadcast band and IF traps, then into the balanced FET mixer without an RF amplifier being used (although switchable ones operating on 10m and 6m are fitted to the TS680 model, not tested here). This enables the best possible blocking and intermodulation performance to be obtained without degradation by due to the gain of the RF stage.

A first IF of 40.055kHz is used, a monolithic crystal filter being used here to obtain roofing selectivity. Individually switched filters are used for SSB, AM and FM, together with the optional CW filter, at the 455kHz IF. A quad-loop synthesiser controlled by a single reference oscillator provides the local oscillator signals common to receive and transmit. On transmit the DSB signal is generated at 455kHz, filtered to obtain the required sideband, amplified and mixed to 40.055MHz, filtered and mixed again with the VCO signal to achieve the final RF frequency. On FM, the first mixer oscillator is directly modulated. A pair of 2SC2879 PA transistors provide the 100W output level from the set.

On The Air

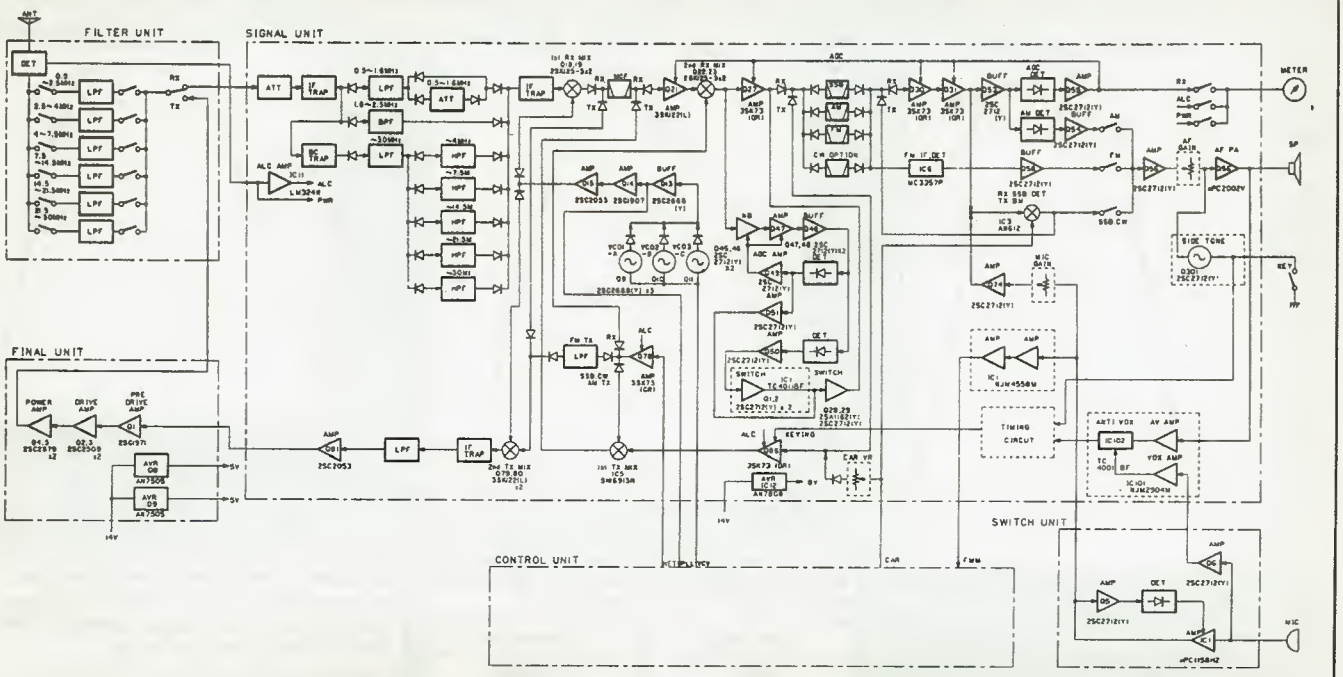
After coupling the set up to my 25A DC power supply unit and HF aerial system, I busied myself tuning around the bands to get a general 'feel' of the set, and I must say I was pleasantly surprised to find the set was quite versatile despite its 'simple' control appearance. I found the programmable band memories very useful, in fact after programming my favourite amateur band segments and modes, together with a couple of broadcast bands, I used these memories in preference to the band change switch for normal use. This way switching from one amateur band to another always placed me in the portion I required, rather than the set just changing the MHz digit as appropriate and requiring yours truly to perform a QSY job each time.

I had several pleasant QSO's on the amateur bands, both on SSB and using AMTOR and Packet modes with the set coupled up to my KAM unit. As a microphone is not supplied with the set, a quick wiring job was performed to couple my usual desk and fist mics up. In asking for audio reports, little difference was noted between the TS-140S and my usual 'top performance' equipment, although reports received when using the speech processor were a little indifferent from stations who were receiving me at a reasonable strength.

Testing the set on AMTOR, at least with the European and American stations heard over the review period, showed it to be adequately fast in its Tx/Rx changeover without further modifications being required. I appreciated the accessory Tx keying line that muted the microphone on transmit, using this for data communications means that you don't need to remember to unplug the mic each time for fear of corruption. This was a limitation with the TS-440S (reviewed *HRT Aug '86*) so maybe someone out there in the land of the rising sun did their homework!

Around The Bands

Around the amateur bands I



TS-140 circuit diagram.

found the receiver to be very 'quiet,' not through lack of sensitivity but due to the absence of all the burbly 'rumbles' one often hears on the LF bands, such as 40m, at night on less-than-perfect receivers caused by internal mixing products. I found that by switching the attenuator in provided no discernible improvement apart from giving my ears the occasional rest, showing the front end was not being driven into non-linearity through overloading. On my 160m/80m/40m trap dipole at least (over 200ft long in all) I encountered no blocking problems from the many high-powered broadcast stations to be found on the bands. I did however note a 'glitch' in tuning through 50kHz steps in the frequency ranges, in the presence of strong AM broadcasters this would often bring about a sudden decrease in sensitivity as the S-meter deflected almost fully for an instant whilst tuning. This is due to the now common multi-loop synthesiser approach being employed in many sets, the 'glitch' occurring as one sub-loop takes over from the other, but nevertheless I still found it annoying.

Laboratory Tests

The receiver sensitivity results on SSB did rather surprise me as I would have expected a slightly deafer set due to the absence of an RF amplifier stage, The AM sensitivity was a little poorer but still acceptable in view of the power ratrace that occurs on the HF broadcast bands. Of note though was the extremely good strong signal performance measured, so good in fact that I believe the set is in a class of its own at this price level.

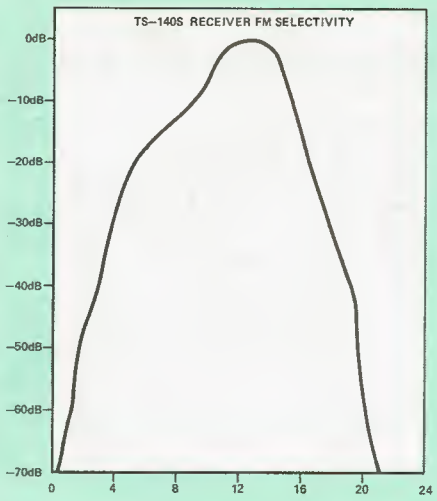
I tried very hard to find traces of reciprocal mixing from the synthesiser when measuring the selectivity of the set with my low-noise cavity tuned signal generators, and although I *did* find a slight increase in noise centred around 6kHz HF of the wanted signal frequency, I had to increase the unwanted signal fed through a hybrid combiner by over 80dB over the S3 level to show up on an adjacent S3 strength received SSB signal. To put this in 'real' terms, this would just start causing problems only when receiving a very weak signal (S4-S5) a few kHz away from a horrifically strong signal absolutely taking the S-meter off the scale (S9+70dB) approx.).

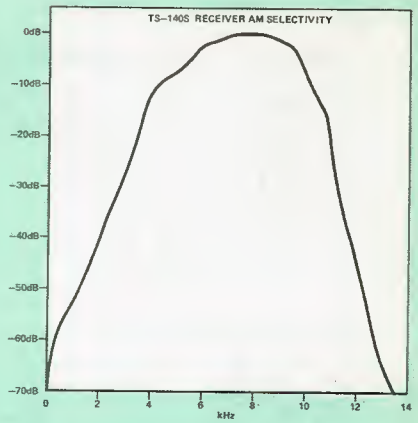
As a result the measured SSB selectivity did not artificially 'widen out,' however the AM and FM selectivities measured were a compromise I believe between price and performance. Totally adequate for the general listener, the 10% measured distortion is also certainly good enough amongst all the fading and processing encountered on most broadcast signals, and one must remember that it is an amateur band transceiver after all! In tuning across the entire 50kHz-35MHz with a 50ohm load connected to the aerial socket I found only six weak 'birdies,' none of which were strong enough to lift the S-meter, which is very good when you consider all the internally generated oscillator frequencies.

On Transmit

On transmit, the higher order narmonics were generally well filtered, I did notice a few spurii separated from the main carrier at intervals of ±3MHz on 40m, ±2.6MHz on 30m, and ±11MHz on 12m and 10m, which appear to be internal mixing products. The two-tone SSB IMD performance, that is the amount of 'spreading' of the signal due to non-linearities in the PA, was acceptable but not of the class of higher priced sets, often with PAs running from higher than 13.8V supply and hence achieving greater linearity for a given power output. The 'splatter' was lopsided on all the tests, changing the audio frequencies of the applied tones made little differences.

As data communication is becoming more and more popular,





LABORATORY RESULTS RECEIVER

Sensitivity: Input level in µV pd required to give 12dB SINAD

Freq. MHz	SSB/CW	AM	FM
1.8	0.164	2.40	—
3.5	0.123	2.12	—
7.0	0.110	1.96	—
10.05	0.123	2.23	—
14.0	0.108	1.98	—
18.0	0.114	2.09	—
21.0	0.126	2.18	—
24.5	0.168	2.53	—
28.5	0.136	2.26	0.286
29.5	0.141	2.33	0.290

Blocking: Measured as increase over 12dB SINAD level of interfering signal, unmodulated carrier (SSB/CW), causing 6dB degradation in 12dB SINAD on-channel signal.

Spacing	Level
±50kHz	107dB
±100kHz	113dB
±200kHz	117dB

Image Rejection: Increase in level of signal at the first IF image frequency, and the IF frequency itself, over level of on-channel signal to give identical 12dB SINAD signals.

Freq. MHz	Image Rej.	IF Rej.
1.8	74.6dB	107.5 dB
3.5	78.6dB	112.0
7.0	81.8dB	117.7dB
10.05	108.9dB	121.8dB
14.0	90.5dB	111.3dB
18.0	80.4dB	94.8dB
21.0	77.2	93.6dB
24.5	71.0dB	88.7dB
28.5	73.7dB	89.9dB
29.5	73.2	89.5

AM Distortion: Measured at 1kHz audio freq, 100µV pd received signal

Mod tech	Distortion
30%	9.03%
60%	10.30%

S-Meter Linearity, (SSB/CW, 14.25MHz).

Indication	Sig Level	Rel. Level
S1	1.19µV pd	–22.7dB
S2	1.45µV pd	–21.0dB
S3	1.89µV pd	–18.7dB
S4	2.40µV pd	–16.6dB
S5	3.17µV pd	–14.2dB
S6	4.43µV pd	–11.3dB
S7	6.32µV pd	–8.2dB
S8	9.57µV pd	–4.6dB
S9	16.3µV pd	0dB ref
S9+20	0.134mV pd	+18.3dB
S9+40	0.924mV pd	+35.1dB
S9+60	5.24mV pd	+50.1dB

S-Meter S9 Level (SSB/CW)

Freq. MHz	Sig. Level
1.8	14.7µV pd
3.5	11.8µV pd
7.0	21.1µV pd
10.05	18.4µV pd
14.0	16.3µV pd
18.0	11.9µV pd
21.0	13.5µV pd
24.5	18.5µV pd
28.5	13.5µV pd
29.5	13.5µV pd

3rd Order Intermodulation Rejection: Increase over 12dB SINAD level of two interfering signals giving identical 12dB SINAD on-channel 3rd order intermodulation product (SSB/CW).

Spacing	Level
50/100kHz spacing	91.5dB
100/200kHz spacing	92.0dB

Transmitter

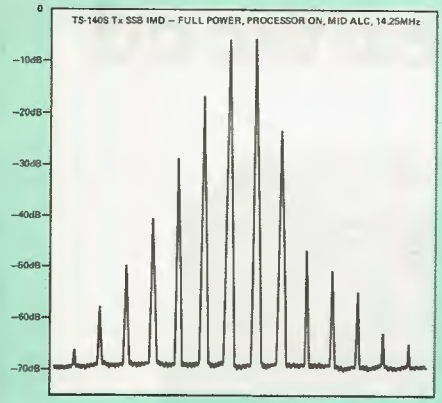
Operational Frequency Range
1.60-2.00MHz
3.00-4.00MHz
6.50-7.50MHz
10.00-10.50MHz
13.50-14.50MHz
18.00-19.00MHz
20.50-21.50MHz
24.00-25.00MHz
27.50-30.00MHz

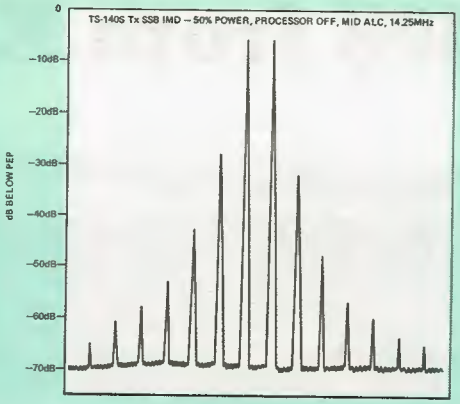
Max Tx Power

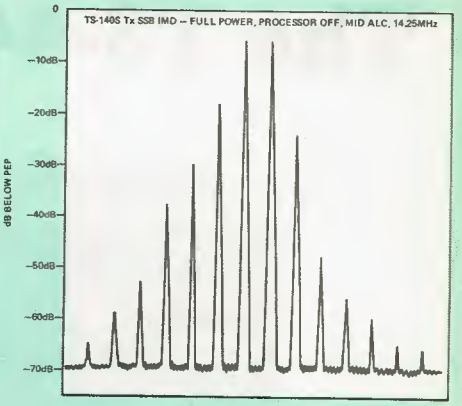
Freq MHz	SSB PEP	SW/AM	FM
1.8	113W	90W	47W
3.5	114W	91W	49W
7.0	114W	91W	49W
10.05	117W	93W	49W
14.0	112W	89W	48W
18.0	111W	88W	47W
21.0	108W	86W	46W
24.5	105W	83W	45W
28.5	101W	81W	43W
29.5	100W	80W	42W

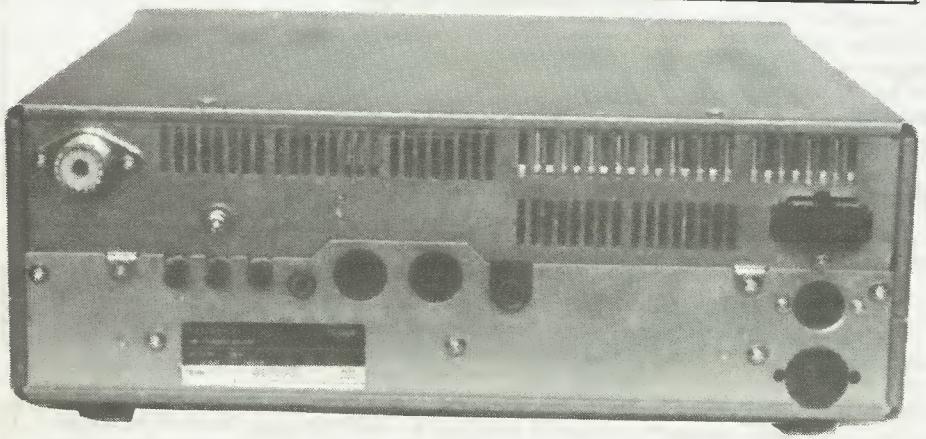
Harmonics/Spurii

Freq. MHz	2nd	3rd	4th	5th	Spurii
1.8	–63dBc	–56dBc	<–70dBc	<–70dBc	<–70dBc
3.5	–63dBc	–65dBc	<–70dBc	–63dBc	<–70dBc
7.0	–53dBc	–54dBc	<–70dBc	<–70dBc	–54dBc
10.05	–52dBc	–46dBc	<–70dBc	<–70dBc	<–70dBc
14.0	–52dBc	<–70dBc	<–70dBc	<–70dBc	–52dBc
18.0	–51dBc	<–70dBc	<–70dBc	<–70dBc	<–70dBc
21.0	–58dBc	<–70dBc	<–70dBc	<–70dBc	<–70dBc
24.5	–56dBc	<–70dBc	<–70dBc	<–70dBc	–51dBc
28.5	–57dBc	<–70dBc	<–70dBc	<–70dBc	–52dBc
29.5	–56dBc	<–70dBc	<–70dBc	<–70dBc	–49dBc









AMTOR users may be interested to note that I measured the Tx switching time at 11.5mS (Carrier), with full RF SSB single tone output occurring 21mS after the Tx key command. The Rx recovery time following full power transmit I measured as 24mS.

Conclusions

The set I believe is an excellent rig for the amateur HF bands at the price, its performance on receive exceeds many sets at over twice its cost. Kenwood never fail to surprise me with the standard of technical performance achieved from their latest equipments, and the TS-140S is no exception. The set is deceptively versatile, having several useful features of which the programmable band limits were my personal favourite. It is light and small enough to carry around with you for a spot of portable operation (but don't forget the power requirements!), and could certainly find a place in the odd mobile installation or two.

There is no transverter facility coupled with no apparent external ALC input for automatically switched output reduction, hence its suitability as a driver rig for transverting to other bands could be limited. Remember that a DC power supply capable of giving 20A is required, this must be budgeted for when considering purchase if you do not already have one.

My thanks go to Lowe Electronics Ltd for the loan of the review set.