The Peter Hart Review

KENWOOD TS-50S

MOBILE HF TRANSCEIVER

IN MOST CASES, when a new transceiver is launched, it is based on a previous design but with improvements in performance, features or styling. Every once in a while, something really different is unveiled and the new TS-50S HF transceiver from Kenwood falls into this category. There are now many small HF transceivers around which can be used at home or in the car but the TS-50S has been designed primarily for mobile operation. It is smaller than anything else on the market today, yet has all the usual features together with ergonomics tailored to meet the requirements of the mobile operator. Although small, it still delivers the standard 100 watt RF output. Small size is of crucial importance in a mobile rig as anyone who has attempted to install a transceiver into the average car will confirm.

I was pleased to have the opportunity of reviewing the first TS-50S to be seen in the UK.

The TS-50S is shown above with the optional AT-50 Auto ATU underneath.

PRINCIPAL FEATURES

THE MOST STRIKING feature about the TS-50S is its size. Measuring only 179mm (W) by 60mm (H) by 233mm (D), it has a front panel area less than half that of other so-called compact radios such as the TS-450, FT-890 etc. It is also light, weighing only 2.9kg, which is an important consideration for mounting in places such as under the front facia of a car.

The TS-50S is a 12 volt transceiver combining the usual general coverage receiver tuning 30kHz to 30MHz together with a 100W transmitter limited to the exact amateur allocations. Local variants are sold to suit US, mainland Europe and other market areas, differing only in the Tx coverage on 160, 80 or 40m.

The radio covers SSB, CW, AM and FM modes. SSB can be set to select, automatically, LSB below 9.5MHz and USB above or to allow the user to select the sideband.

Up/Down buttons select amateur bands or, alternatively, 500kHz/1MHz steps for receiver general coverage. Each band store returns the last used frequency, mode and front-end setting on each band. The rotary tuning knob functions in a rather different way to normal. The basic resolution is 100 steps per revolution of the knob but the step size is directly related to the speed at which the knob is turned. Many radios employ a single speed-up feature but the TS-50S gradually increases the step size from 5Hz at very low speeds up to 200Hz at high speeds. On FM, these tuning rates are ten times higher.

Fuzzy logic control is used in the tuning control circuitry. This is a relatively new technique developed to handle efficiently logic situations which are not a clear cut yes/no or 1/0 but include an element of 'in-between'. It is interesting to note that the frequency to which the radio is tuned need not be a direct multiple of the minimum step size of 5Hz but can be set to within 1Hz by suitably moving the tuning knob up and down at different speeds. Interesting to note maybe but not particularly useful!

More rapid frequency changes are achieved by using the UP/DWN buttons on the microphone. These step in 10kHz increments by default or may be programmed to step in smaller increments down to 10Hz. Using AM mode in the MW broadcast band, 9kHz step size can be automatically selected. The microphone UP/DWN buttons can be used to select channels in memory channel mode or menu items in menu set-up mode.

100 battery backed memory channels are provided storing receive and transmit frequencies, mode, filter bandwidth, front-end setting, AGC and tone frequency. Channel 99 is also used to store program scan start and end frequencies. Memory transfer functions are incorporated including memory scroll to preview the contents without changing the receive frequency. Memory channels may be protected to prevent accidental overwriting or deletion - useful in 'button-fumbling' mobile operation. There is a quick select mode giving access only to the empty channels or only to the channels where data is stored.

Scanning may be performed between programmed limits, across all memory channels or across groups of 10 channels. Scanning may be set to stop or dwell on signal present and the scan speed is adjustable.

The usual twin A/B VFOs are provided and, in split frequency operation, the transmit frequency may be monitored and set via a single touch key on the microphone. This is the Kenwood TF-SET function which is included on all their current radios. It is particularly useful for finding and netting onto the working channel in a split frequency DX pile-up.

The RIT clarifier (no transmit XIT) operates over the range +/- 1.1kHz in 10Hz steps or +/-2.2kHz in 20Hz steps and this control also doubles as scan speed. There is no RF gain control but the front end is switchable between full sensitivity and AIP (Advanced Intercept Point). The result is improved signal handling at the expense of reduced sensitivity. A 20dB input attenuator may also be selected. IF filter bandwidths of 2.4kHz are selected on SSB, 6kHz on AM and 2.4kHz on CW, unless the optional narrow CW filter has been fitted for 500Hz bandwidth. The 2.4kHz filter setting can also be selected for AM. An IF shift control is provided for SSB and CW and on CW, reverse sideband can be selected if heavy interference is experienced within the normal (upper) sideband. However, this is not quick to select, and involves delving into the set-up menus which rather negates the value of this facility.

Noise blanker is optimised for short pulse interference such as ignition noise. Fast or slow AGC is pre-settable for each mode from the set-up menu. Default settings are slow on SSB and AM and fast on CW. The pitch on CW is adjustable between 400Hz and 1000Hz in steps of 50Hz with a default of 800Hz.

Transmitter power is switchable to 100, 50 or 10W output and there is a miniature internal fan for cooling the finned heatsink. Two switchable transmitter audio gain settings suit a variety of 600Ω impedance microphones. If these settings are unsuitable there is an internal adjustment for microphone gain. There is no speech processor or VOX but audio frequency response is adjustable by shifting the carrier point –100 to +200Hz. On CW full break-in can be selected or semi break-in with a selection of return to receive delays between 100mS and 1.8S. CTCSS is included for use with some 10 meter FM repeaters.

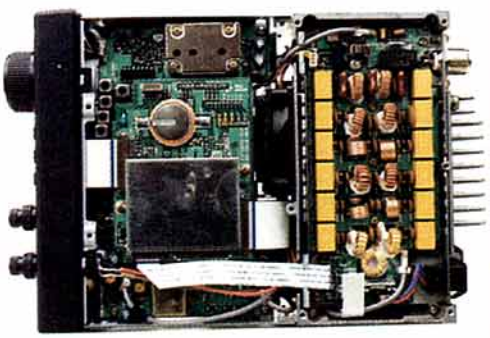
A liquid crystal display is used with adjustable back lighting, indicating frequency to 100Hz resolution, RIT offset, memory channel selected, S meter bar graph display and a host of status messages. The meter display may be set to include a peak hold.

The radio is provided with the MC-47 microphone. This includes the normal up/down buttons and also four additional programmable function keys. 27 different functions may be assigned to these function keys, for example transmit power, mode select, TF-set, band change etc. One function enables the RIT display to indicate 10Hz and 1Hz resolution digits for the main frequency display!

Two set-up menus are provided which enable some 41 functions to be tailored to individual preferences. These include step sizes, scan parameters, CW pitch and delay characteristics, beep and alarm messages to name just a few. Automatic power off may be selected whereby the radio is turned off if no control is operated for three hours.

The TS-50S is directly compatible with two auto ATUs. The AT-50 is housed in a matching style case and the AT-300 is intended to be mounted remote at the base of the antenna. Both ATUs are auto-sensed from the TS-50S and are fully controlled from the radio. The AT-50 was provided with the review unit. The tuning time is typically less than three seconds but can be up to thirty seconds on the initial tune. If the tuning does not finish within 30 to 45 seconds then an alarm lights on the AT-50 and warning beeps sound from the TS-50S radio. The settings for each amateur band are stored in EEPROM which eliminates the need for a backup battery.

The TS-50S provides switching for a linear



TS-50S with bottom cover removed.

KENWOOD TS-50S MEASURED PERFORMANCE

RECEIVER MEASUREMENTS

FREQUENCY	SENSITIVITY SSB 10dBs+n:n NOR	AIP	INPUT FOR S9 NOR	AIP
1.8MHz	0.13μV (-125dBm)	0.32μV (-117dBm)	28μV	89μV
3.5MHz	0.11μV (-126dBm)	0.28μV (-118dBm)	25μV	89μV
7MHz	0.11μV (-126dBm)	0.25μV (-119dBm)	22μV	79μV
10MHz	0.11μV (-126dBm)	0.28μV (-118dBm)	24μV	79μV
14MHz	0.11μV (-126dBm)	0.28μV (-118dBm)	25μV	84μV
18MHz	0.11μV (-126dBm)	0.25μV (-119dBm)	21μV	79μV
21MHz	0.11μV (-126dBm)	0.25μV (-119dBm)	21μV	75μV
24MHz	0.13μV (-125dBm)	0.25μV (-119dBm)	24μV	75μV
28MHz	0.13μV (-125dBm)	0.25μV (-119dBm)	25μV	75μV

S-READING (14MHz)	INPUT LEVEL SSB	FM
S1	0.7μV	0.4μV
S3	1.1μV	0.6μV
S5	2.2μV	0.8μV
S7	6.3μV	1.0μV
S9	25μV	1.3μV
S9+20	220μV	2.0μV
S9+40	2.2mV	3.2μV
S9+60	18mV	5.0μV

MODE	IF BANDWIDTH -6dB	-60dB
SSB,CW	2480Hz	5120Hz
AM	7550Hz	25.2kHz
FM	13.5kHz	18.4kHz

AM sensitivity (28MHz): 0.9μV for 10dBs+n:n at 30% mod depth

FM sensitivity (28MHz): 0.2μV for 12dB SINAD 3kHz pk deviation

AGC threshold: 0.35μV

100dB above AGC threshold for +1.5dB audio output

AGC attack time: 5-10ms

AGC decay time: 0.1-0.2s (fast), 2-3s (slow)

Max audio before clipping: 1.9W into 8Ω at 1% distortion

Inband intermodulation products: -26 to -37dB

	INTERMODULATION (50kHz Tone Spacing) NOR		AIP	
Frequency	3rd order intercept	2 tone dynamic range	3rd order intercept	2 tone dynamic range
1.8MHz	+5.5dBm	94dB	+6dBm	89dB
3.5MHz	+7.5dBm	96dB	+12.5dBm	94dB
7MHz	+8dBm	96dB	+13dBm	95dB
14MHz	+12dBm	99dB	+20dBm	99dB
21MHz	+10.5dBm	98dB	+24dBm	102dB
28MHz	+12dBm	98dB	+24dBm	102dB

TONE SPACING (7MHz BAND)	3rd ORDER INTERCEPT	2 TONE DYNAMIC RANGE
3kHz	-35dBm	67dB
5kHz	-33dBm	69dB
10kHz	-25dBm	74dB
15kHz	-17dBm	80dB
20kHz	-10dBm	84dB
30kHz	+2dBm	92dB

FREQUENCY OFFSET	RECIPROCAL MIXING FOR 3dB NOISE	BLOCKING NOR	AIP	TX NOISE IN 2.5kHz BANDWIDTH
3kHz	78dB	-32dBm	-20dBm	-74dBC
5kHz	84dB	-32dBm	-20dBm	-79dBC
10kHz	95dB	-32dBm	-20dBm	-85dBC
15kHz	blocking	-28dBm	-15dBm	-90dBC
20kHz	103dB	-22dBm	-8dBm	-93dBC
30kHz	104dB	-13dBm	-1dBm	-97dBC
50kHz	105dB	-7dBm	+6dBm	-99dBC
100kHz	112dB	-7dBm	+6dBm	-101dBC
200kHz	118dB	-7dBm	+6dBm	-103dBC

TRANSMITTER MEASUREMENTS

FREQUENCY	CW POWER OUTPUT	SSB(PEP) POWER OUTPUT	HARMONICS	INTERMODULATION PRODUCTS 3rd order	5th order
1.8MHz	115W	122W	-60dB	-24dB	-40dB
3.5MHz	112W	120W	-59dB	-24dB	-40dB
7MHz	110W	117W	-62dB	-20dB	-35dB
10MHz	110W	115W	-58dB	-21dB	-35dB
14MHz	110W	112W	-60dB	-16dB	-34dB
18MHz	110W	115W	-58dB	-21dB	-32dB
21MHz	110W	115W	-75dB	-21dB	-34dB
24MHz	109W	116W	-64dB	-26dB	-37dB
28MHz	108W	116W	-70dB	-24dB	-40dB

Carrier suppression: 60dBC. Sideband suppression: 70dBC at 1kHz. Transmitter noise: see table above. Transmitter AF response at -6dB: 220-2750Hz. Transmitter AF distortion: <1%. Microphone input sensitivity for full output: 4mV (low), 1.3mV (high). T/R switching speed (SSB): mute-TX 18ms, TX-mute 4ms, mute-RX 22ms, RX-mute 3mS. Power into load mismatch: 2:1 VSWR 53-75W, 3:1 VSWR 22-31W.

NOTE: All signal input voltages given as PD across antenna terminal. Unless stated otherwise, all measurements made on SSB with the receiver preamp switched in (NOR) and operating from a 13.6V PSU. All two-tone transmitter intermodulation products quoted with respect to either originating tone.

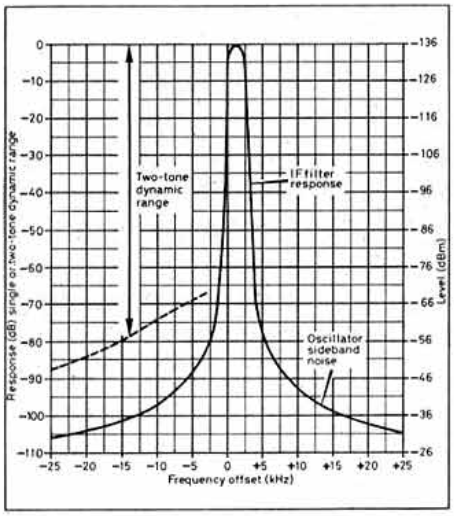


Fig 1: Dynamic range combined results.

and can be controlled from a computer via the IF-10D interface connector. This is perhaps a bit of an afterthought as it requires unsticking a patch on the bottom cover to gain access to a PCB connector.

Included with the TS-50S is a mobile mounting bracket and 60 page instruction manual. This is the usual well thought out and informative document. A set of circuit diagrams is included but no block diagram or technical description. A second manual in German and Italian languages was also supplied.

DESCRIPTION

SOME CRITICAL THOUGHT has obviously gone into the design of this transceiver. It provides all the features in a small unit and the front panel layout is kept simple to help the mobile operator. Indeed, the essential controls can be assigned to the microphone function keys to provide a basic operational mode entirely from the microphone.

In a radio of this size, the construction is naturally quite compact. There are several PCBs mounted in a pressed steel framework and miniature surface mount technology is used throughout. The rear half of the unit comprises the PA and filter sections housed in a substantial finned diecast assembly. A thin 6.5cm diameter speaker is mounted upward facing through the top of the case.

The receiver is double conversion on SSB, CW and AM with IFs of 73.045 and 10.695MHz. On FM, there is a third conversion to 455kHz. All the main selectivity is achieved at 10.695MHz. The receiver first mixer uses a quad balanced FET arrangement with a dual balanced FET in the second mixer. Two parallel FETs are used in the RF amplifier which is by-passed in the AIP position. The transmit signal is generated at 10.695MHz and then mixed via 73.045MHz to final frequency. The frequency synthesiser uses the now universal combination of DDS and PLL techniques to give small step size, smooth tuning characteristic and low spurious output levels. A single battery backed microcontroller is used and the lithium battery is easily accessible.

MEASUREMENTS

WERE MADE WITH THE TS-50S powered from a 13.6V PSU and are detailed in the table. Additional comments are as follows.

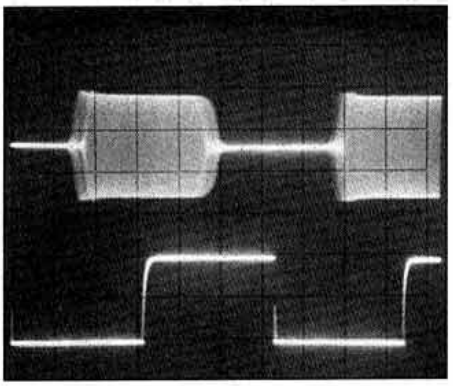


Fig 2: CW Keying waveform at 40WPM. Horizontal scale 10m/div.

RECEIVER MEASUREMENTS.

SENSITIVITY

A good sensitivity has been achieved which is important for mobile operation.

S-METER CALIBRATION

Performance is reasonable (except on FM) within the limits of the bargraph display.

SPURIOUS REJECTION

The receiver appears to be fairly clear of spurious responses. Rejection of all IF related signals was in excess of 85dB and first mixer image rejection in excess of 95dB. When connected to the AT-50 ATU some beat frequencies were audible, mostly outside of the amateur bands but the strongest were up to S8.

SELECTIVITY

The IF filter skirts are poor compared with most radios.

STRONG SIGNAL PERFORMANCE

The performance is quite reasonable where the intended use is for mobile operation. The front end dynamic range is excellent but the close-in dynamic range could be better and shows the rather wide response to the first IF filter. The reciprocal mixing performance is very reasonable (**Fig 1**).

Recently I have had a couple of letters from Germany highlighting a problem which is experienced there with most radios. Spurious signals, at 5kHz intervals, are found particularly on the 15m band due to intermodulation from broadcast stations in the 25/31m and 19/31m bands. I have never seen this problem myself, in the UK. DL1BU in his reviews in *CQ-DL* reports that this is due to second and third order intermodulation generated by the input filter switching diodes from widely spaced signals which are not protected by any filtering from the antenna. I have checked the TS-50S under these conditions at 21.1MHz (test signals 11.6 and 9.5MHz) and 14.3MHz (test signals 7.2 and 7.1MHz). Indeed there was quite a substantial response, at a level some 10dB worse (generator levels) than the normal 50kHz spacing intermodulation measurement levels. I will monitor this parameter in future reviews. This is primarily a concern with wideband antennas and definitely not a problem with mobile antennas.

TRANSMITTER MEASUREMENTS.

POWER OUTPUT

The table gives the figures in the highest power setting. The two lower settings gave about 55W and 10W respectively.

SSB PERFORMANCE

The PA intermodulation level is rather poor but did improve substantially at lower output powers.

CW KEYING PERFORMANCE

Fig 2 shows the CW keying envelope at 40WPM. This seems quite acceptable.

ON-THE-AIR PERFORMANCE

I COMPARED THE TS-50S with the main station rigs and also a brief try out in the car on my mobile G whip. As a mobile rig in the car, it performed well with good sensitivity and no real strong signal problems. On the main station antennas, it was generally necessary to switch to AIP on the LF bands and at times also to switch in the attenuator. The rather wide filter skirts and degraded close-in dynamic range made the radio somewhat noisier and more prone to overload problems than I would normally have expected. The noise blanker was most effective in reducing car ignition noise but on the larger main station antennas gave added overload problems.

At switch-on, the radio greets you with a 'Hello' on the display. Within constraints imposed by the size limitations, the ergonomics were very good but a finger indent for the main tuning knob would be a great help. I found the variable speed-up on the tuning rate to be an advantage over the fixed speed-up found on many radios.

The transmit audio quality was good and the CW reasonably clear of clicks. The rear heatsink could become quite hot with extensive transmit use and the radio should be mounted to provide good rear ventilation.

The AT-50 auto-ATU introduced a few spurious signals. Although the stronger ones were outside of the amateur bands, these were plainly audible on 15m and 20m when band conditions were quiet, and particularly so using small mobile whip antennas. There are, however, definite advantages in using such ATUs on mobile antennas to ensure that maximum power is transmitted away from the sharp resonant frequency of the antenna.

CONCLUSIONS

FOR A MOBILE RIG, the TS-50S is in a class of its own, being designed primarily for mobile operation. Being small and light, it is also attractive to take as hand luggage on holiday, a business trip or mini DXpedition but in this situation with larger antennas, the performance limitations of close-in dynamic range and filter skirt selectivity become more apparent. The current list price of the radio is £999.95 inc VAT and for the AT-50 ATU £299.95 inc VAT.

ACKNOWLEDGEMENTS

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Peter Hart, G3SJX