

Icom IC-705

multiband multimode portable QRP transceiver

Introduction

The IC-705 is Icom's latest addition to its range of direct-digital SDR transceivers. Building on the success of the popular IC-7300 HF and IC-9700 VHF/UHF designs, this new radio covers bands from LF to 430MHz with all-mode operation including D-Star, broadcast FM and aircraft AM. Aimed at the portable and QRP market, it is a small unit with an integral battery pack, ideal for hill-topping SOTA operations and other easy-to-carry activities. Similar in style to the Elecraft KX2 and KX3, it delivers 10W maximum output or 5W from batteries and like all Icom radios is so packed with functions and features that it is difficult to imagine what else could be added. It includes a multicolour touchscreen display, a built-in GPS receiver, Bluetooth and WLAN for Wi-Fi connectivity and remote operation.

Basic functions

The IC-705 is a compact portable measuring 200mm (w) x 83.5mm (h) x 82mm (d) and weighs about 1.1kg. The receiver tunes from 30kHz to 200MHz and 400 to 470MHz. The transmitter is enabled in the amateur bands except 70MHz, which is receive only. 60m transmit coverage extends continuously from 5.255MHz to 5.405MHz but as there is no dedicated band selector for 60m, it is probably quickest to access via the memory functions.

The usual modes, SSB, CW, RTTY, AM and FM are provided, with reverse sidebands selectable on SSB, CW and RTTY and with AFSK data on SSB, FM and AM. Various D-Star modes are also provided.

The radio can be powered either from an integral battery pack or from an external supply (13.8V nominal). The BP-272 7.4V lithium-ion battery is provided with the radio and clips on to the back. This is rated at 1880mAh but a higher capacity 3150mAh battery is also available (BP-307). The battery is charged whenever the radio is connected to an external supply and also when connected via USB to an appropriate charger or computer. Alternatively, the battery pack can be removed and charged separately using an external charger such as the Icom BC-202.

The radio is provided with a paper manual covering the basic functions and an advanced manual is available on the Icom website. The basic manual runs to about 90 pages and covers the essential items for initial setup and basic operation. The advanced manual is over 200



PHOTO 1: The front panel of the IC-705 is dominated by the large, clear LCD touchscreen.

pages in length and covers, as its name suggests, the more advanced features such as GPS and D-Star, remote operation, functions related to the SD card and recording. Both manuals are excellent, well written, very detailed and thorough, with plenty of graphical illustrations and step-by-step instructions.

A speaker/microphone and DC power cable are provided with the radio. The power cable is not the usual red and black twin, but instead black and black with a thin white tracer for the positive. Observe polarity carefully and make sure you do not connect it the wrong way round.

The HM-243 microphone supplied also contains a small speaker and four pushbuttons. These buttons can be assigned separately to a variety of functions. There is a growing range of accessories becoming available for the IC-705. These include a multifunction backpack for outdoor activities, a desktop support stand, external ATU and a compact lightweight loop antenna. The backpack supports the radio well in a suitable operating position with plenty of compartments for carrying antennas and accessories. On its own, the radio does not sit very well for comfortable operating on a desktop and a support stand (seen on this month's front cover photo) is a great help.

Radio design and architecture

Direct digital sampling is used for both the receive and transmit signal paths up to a frequency of 25MHz. Above that, mixing is used as described in the following paragraphs. All frequencies are generated from a high stability TCXO reference oscillator that achieves 0.5ppm stability.

In the receiver front end, incoming receive signals follow one of three paths depending on

frequency. HF and low VHF signals (to 75MHz) pass through the transmitter low pass output filters, then one of nine band filters and a dual-level receiver preamplifier. The upper VHF signals (to 200MHz) and the UHF band signals adopt separate filtering and separate preamplifiers. Following filtering and amplification, signals below 25MHz pass directly to the analogue to digital converter (ADC); signals above 25MHz are mixed to an IF at 38.85MHz before passing to the ADC. The IF filter bandwidth is 1MHz, to accommodate the spectrum scope at maximum span. The RF signal is then sampled by the A/D converter and passed in parallel digital format to a fast field-programmable gate array (FPGA), which extracts a slice of input signal by a process of down-conversion decimation and passes the result to a digital signal processor (DSP) device for all further processing.

On transmit the process operates in reverse. The DSP generates the transmit signal in the digital domain, which is up-converted in the FPGA to the desired output frequency (if it is below 25MHz), then converted to analogue format by the D/A converter. For frequencies above 25MHz the same mixer is used as in the receiver to generate the higher frequencies. A wideband low level and power amplifier chain follows, covering all bands from 1.8 to 432MHz in a single path.

The radio is housed in a plastic case that divides in two to reveal the well-screened circuit boards mounted on a substantial framework. As the radio includes built-in antennas for GPS, WLAN and Bluetooth, a plastic case is most suitable. All controls are mounted on the front (or the top, depending how it is used). The battery is at the rear and all I/O connections are on the

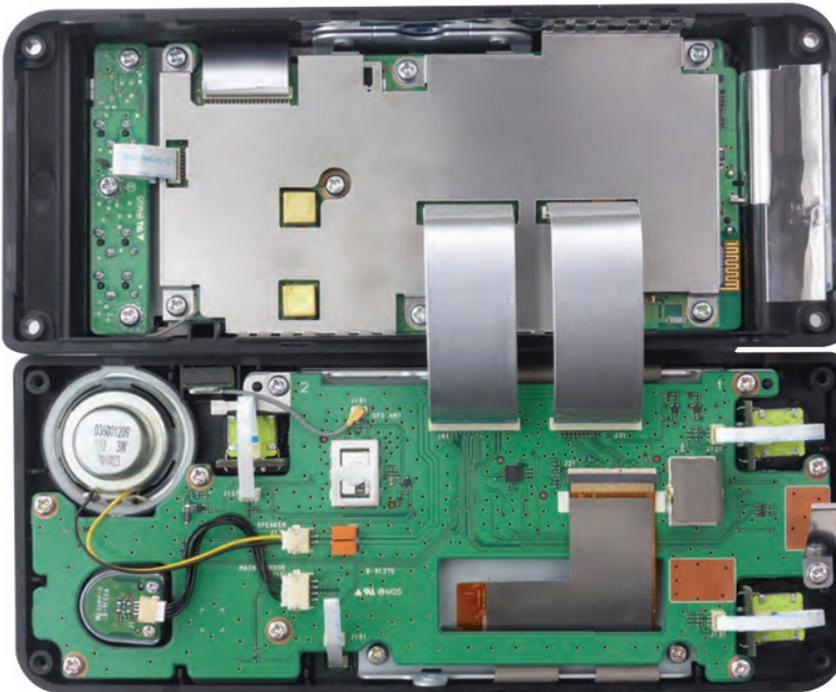


PHOTO 2: Opening the case reveals a sleek design. The lower board handles the display and controls. The RF section (above) fills the back of the case with just two ribbon cables between the two boards.

two end panels. The connectors have rubber caps for protection. A built-in speaker, 35mm in diameter, is mounted on the front panel and a smaller speaker, just 25mm diameter, is fitted into the microphone.

Controls and connections

Operation of the radio centres on the touchscreen display and the associated buttons and controls, which are very similar to the IC-7300 and IC-9700. The high resolution multicolour display is the same size as that used on these other radios and is particularly clear and bright, retaining readability well under bright lighting and during outdoor operations. Band, mode, filter selection, meter selection and VFO/memory functions are all selected by touching the appropriate areas on the display, which brings up a list of selectable options. Five hardware buttons along the bottom of the display select top-level functions via the MENU key or the main receiver parameters via the FUNCTION key. Other dedicated buttons on the front panel provide fast access to important receive and transmit functions.

Tuning is very smooth and easy using the 37mm diameter rotary control. Tuning is in 10Hz or 1Hz steps at 4kHz or 400Hz per knob revolution, with auto speed-up on fast tuning. A quarter-rate is also selectable on CW and data modes. A higher rate for faster navigation is also selectable, with a variety of mode-dependant step sizes. AF/RF gain combined with squelch and twin passband tuning (Twin PBT) are given separate rotary controls on the front panel. The

MULTI rotary control sets adjustable functions such as transmit power level and mic gain.

A very comprehensive Set mode allows tailoring of an enormous number of functions. These are all accessed via the touchscreen display, with nested menu items. Many are set using MULTI or the rotary tuning knob. A keyboard is displayed when alphanumeric data needs to be entered. This can be in either a full QWERTY or a 10-key format and makes data entry very straightforward. A bargraph style meter shows signal strength and various selectable transmit functions. Simultaneous display of multiple transmit functions can also be selected.

Connectors on the two end panels include a 2.5mm barrel DC power socket, a grounding screw and a single BNC antenna socket for all bands. A stereo 3.5mm jack is used for external speaker or headphones and a 4-pole 2.5mm jack is provided to connect the microphone. I was curious how four wires could connect a microphone insert, PTT switch and four pushbuttons as well as providing a bias supply for an electret insert. On investigation, one pin is the ground and a second pin connects to the microphone through a DC blocking capacitor. This pin is shunted to ground via a 33kΩ resistor when the PTT is operated. The four pushbuttons connect to the third pin and place different resistance values to ground when pressed. The fourth pin is the electret microphone bias supply. So it *can* be done!

Three further 3.5mm stereo jacks provide a CW key jack, SEND and ALC for an external linear amplifier, and control for an external antenna

tuner (ATU). There is no internal tuner in the IC-705 and the Icom AH-705 external tuner was not yet available at the time of this review. The CW key jack accommodates paddles and straight keys and also allows connection to an external (homebrew) 8-key keypad. The keypad operates in similar fashion to the microphone pushbuttons by placing different resistance values to ground. Both key and keypad can be connected at the same time. The SEND/ALC jack provides a ground-on-transmit line and if this line is externally grounded, it keys the PTT. There is a slot for microSD and microSDHC cards up to 32GB for saving data and audio. A micro USB connector provides for remote interfacing with external audio lines when the USB driver has been installed.

Receiver features

Most receive functions are essentially the same as other current Icom radios. A single receiver is implemented with twin VFOs allowing split operation with the ability to easily check and tune the transmit frequency via transmit frequency check (XFC). Receive incremental tuning (RIT), transmit incremental tuning (XIT), pitch control and auto-tuning on CW are all provided. Band selection via the touchscreen buttons allows three separate frequencies to be stored per band (band stacking register). Frequencies can also be keyed in directly.

Memory mode operation has been expanded and enhanced and provides up to 100 groups, with the ability to store 100 channels in each group (up to a total limit of 500 channels). In addition, there are two call channels in each of the 2m and 70cm bands and 25 scan edge stores. Memory channels and groups can be assigned names up to 16 characters in length, which is quick and easy with the on-screen keyboard. A separate quick-access memo pad stack for 5 or 10 stores is also included. A host of scanning functions are also provided.

Filtering functions are very comprehensive, as with all Icom radios. There are three preset IF filter bandwidth settings for each mode (from a menu of over 40 different bandwidths) with both sharp and soft passband shapes available. Twin passband tuning (PBT) allows either side of the filter passband to be shifted independently, shifting or narrowing the overall shape to assist in combating adjacent channel interference. A manual notch filter operates at IF inside the AGC loop and hence prevents desensitisation with strong carriers. It has excellent depth with wide, medium or narrow width settings. A separate auto-tuning notch filter operating at audio removes multiple tones effectively but does

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FIGURE 1: The menu selection screen.



FIGURE 2: GPS display, showing location data.



FIGURE 3: Antenna SWR graph.

not prevent strong carriers from desensitising the receiver.

A noise reduction system reduces background noise and improves readability in certain situations. A separate noise blanker eliminates pulse-type noise from car ignition systems. Both systems are adjustable. Three separate AGC time constants are selectable from a menu of 13 different values (0.1 to 6s) and are set separately for all modes except FM. The AGC can also be switched off. The IC-705 does not provide a switchable IP+ function (as used on the IC-7300 and IC-9700) to reduce low level intermodulation products).

The receiver audio response can be tailored independently for each mode with respect to bass and treble or high-pass and low-pass roll-offs. There is no CW audio peak filter but, on RTTY, a sharp twin peak filter is provided.

RTTY

A built-in Baudot decoder for standard 45-baud RTTY signals displays four lines in 'normal' mode or eight in 'expanded' mode. The displayed typeface is proportionally spaced, so the number of characters per line varies, typically around 30 to 40. An audio spectrum and waterfall display is provided for tuning purposes and there are a host of user setups and options, all easy to access. There is no provision for connecting a keyboard for sending but there are eight message stores, each holding up to 70 characters for pre-programmed transmit messages. These are accessed and stored in a similar fashion to the CW message stores. Rx and Tx messages can be time-stamped and saved to your SD card.

Transmit features

The transmit power output is adjustable in steps down to 0W from 10W when operating from an external supply or down from 5W when using the internal battery. The power output can be set separately for HF, 50MHz, 144MHz and 430MHz. Functions for SSB include the usual speech compressor, voice operated switch (VOX) and a transmission monitor. The audio transmit filter bandwidth may be set to wide, mid or narrow. In addition, the bass and treble responses can be cut or enhanced separately for each voice mode, in a similar fashion to the receive audio.

On CW there is the usual provision for full and

semi break-in. The keying envelope rise and fall times are adjustable between 2 and 8ms and an additional delay is selectable to accommodate slow-switching linear amplifiers. Different delays may be set for HF, 50, 144 and 430MHz.

A full CW message keyer is incorporated, with adjustable weighting and a variety of keying paddle arrangements. Eight memories will each store up to 70 characters, with a provision to send automatically incrementing serial numbers and auto-repeat after a time delay. The message stores are programmed in text via the touchscreen keyboard display and may be sent either from display buttons or via an external (homebrew) keypad connected to the key socket.

FM mode includes repeater split frequency operation, CTCSS access and tone squelch. Duplex offsets are stored separately for each band and are programmable over wide limits.

Spectrum and scope displays

One of the key features that SDR brings to a radio at relatively low cost is the high performance, real-time spectrum scope display. This operates simultaneously with normal receiver operation. Two displays are provided: a spectrum of the signals for the band currently selected and an audio scope showing the waveform and spectrum of the receiver or transmitter audio. Both spectrums can show an associated waterfall display. Various combinations of spectrum and audio display are possible in expanded or in mini-scope mode used in conjunction with other displays such as the RTTY decoder. The displays have excellent resolution.

The spectrum display has two modes of operation. Centre mode displays the spectrum on either side of the on-tune frequency, with spans selectable from $\pm 2.5\text{kHz}$ to $\pm 500\text{kHz}$. Fixed mode displays the spectrum between two fixed points; three fixed edge bands can be set for each amateur band. In both modes there are a number of settings that select sweep speed, colours, VFO markers, peak hold, averaging, reference level etc. The displayed vertical range is 80dB.

One of the features of the spectrum display is touchscreen tuning. When the spectrum area or the waterfall area is touched, either with a finger or a stylus, the frequency span immediately adjacent to the touched area is zoomed. A second touch will precisely tune the radio to the wanted

frequency. Zooming greatly improves the accuracy of tuning by this method.

D-Star and GPS

The IC-705 is equipped for D-Star operation with DV digital voice and DR repeater mode operation. The radio contains a memory store for repeater data, with a capacity of 2500. It comes preloaded with the worldwide repeater data list current at the time that the radio is manufactured (2146 repeaters in the review radio) and updates can be downloaded from the Icom website. Short messages up to 20 characters in length can be directly input in DV mode, with five message stores available. Data communication and DV fast data can also be used and other functions such as digital squelch, break-in, Enhanced Monitor Request (EMR) are all provided. Direct access to the external gateway is also provided.

The radio also includes a GPS receiver and has an integral antenna. The GPS function displays latitude, longitude, altitude and speed and calculates the Maidenhead grid square. The data is transmitted along with voice messages in DV mode for a host of different uses such as distance and bearing to a station being worked, repeater searches based on distance, tracking the path taken by a mobile station and much more. A sky view constellation map of satellites visible at any particular time can also be shown. Over 80 pages of the manual is devoted to D-Star topics; a further 46 pages cover GPS.

Auxiliary features

The IC-705 includes a digital voice recorder for transmitting messages such as CQ calls. These are stored only on the microSD card, which must be in place for this facility to function. Eight channels are available, each with 90 seconds recording time. These can be tagged with labels up to 16 characters long for easy identification on the display screen. Messages can also be set to repeat after a time delay. Messages are sent from the display buttons or from an external keypad in a similar fashion to the CW and RTTY stores.

As well as providing message stores on transmit, the voice recorder can also store the receive and transmit audio. Files are automatically named and placed in folders together with time and date, frequency, mode etc. The recording time is limited only by the amount of available



PHOTO 3: Seen here on the left side panel are the antenna socket, grounding screw, speaker/mic and microSD card sockets. The right side panel contains the DC in jack and sockets for the ATU, linear interface, key and micro USB.

memory on the SD card. Individual files are limited to 2GB in length but new files are created automatically if necessary. Audio is stored as .WAV files at a data rate of 128kbps, so a 2GB file corresponds to around 35 hours of recording time. The recorded audio can be transferred to a PC or played back on the radio.

Antenna SWR can be plotted graphically against frequency, which can be useful to check antenna performance over a band. The measuring step is selectable from 10 to 500kHz and the number of steps from 3 to 13.

Connectivity is taken to a new level with this radio. The built-in 24-hour clock and calendar can be synchronised by internet network time protocol (NTP) server or by GPS. A Bluetooth interface provides a cable-free connection to suitable headsets such as the Icom VS-3; an Android tablet or phone can be connected by Bluetooth with application firmware from the Icom website. This can be used for extended D-Star functions. Wi-Fi connectivity operates only at 2.4GHz and provides a wireless local area network (WLAN) connection to a home network or the internet. Remote control is possible using the optional RS-BA1 remote control software. Firmware upgrades can be downloaded from the Icom website and are installed via the microSD card.

Measurements

The full set of measurements is given in the table. Generally, these were quite similar to the IC-7300. The receiver sensitivity is excellent and fairly flat across the whole tuning range down to below 100kHz. The S-meter is very linear and represents just under 3dB per S-unit. 38.85MHz IF breakthrough was about 60dB down on 28 and 50MHz but over 100dB down on 144 and 432MHz. The AGC attack time was clean with a slight hole but no overshoot. Decay times are broadly according to set values.

The strong signal performance is limited by ADC overload. With the preamplifier off, this

occurs with single input signals at about -7dBm , which sets the blocking limit of the receiver. An overload indicator on the display (OVF) indicates when this point is reached. This limit applies to signals more than 10kHz away. With close-in signals the front end AGC operates, reducing input to the ADC. If overload occurs, just turn down the RF gain control or switch in the front end attenuator.

Direct sampling receivers respond to multiple strong signals in a totally different way from conventional analogue receivers. Low-level intermodulation products appear out of the noise floor with quite small input signals, but do not increase significantly until much closer to the overload limit. These low-level products can be an issue on quiet bands such as 50 and 144MHz when multiple big signals are around, but are generally masked by background noise on the lower bands. The IC-7300 and IC-7610 implement IP+ as a switchable function, an algorithm that removes these low-level products. The IC-705 does not provide IP+ as a selectable function, but it seems less prone to suffering from these low-level products so maybe some element of IP+ is included in the processing. However, the overall intermodulation-limited dynamic range of the IC-705 is somewhat less than the other two radios.

Intermodulation figures are independent of signal spacing down to very close spacing and in-band products are also extremely good. Audio noise and distortion was low.

The reciprocal mixing phase noise figures are very good, and similar to the IC-7300. This allowed the IF filter skirts to be measured down to a level of about -80dB with relative ease and showed similar tight skirts to other recent Icom radios.

On transmit, the results are generally good. The power output was well up to specification and fully controllable down to 0W. CW rise and fall characteristics are reasonable, distortion negligible on semi break-in but with slightly shortened characters on full break-in at higher speeds. There was no first-character shortening or overshoot at lower power levels. The adjustable delay for linear amplifier switching gives the expected results on key-down but timing on key-up is very short in full break-in mode, which may be a problem with some fast amplifiers. This is similar to the IC-7300, but was corrected in the IC-7610. SSB intermodulation products are very reasonable for a 12V radio, tolerant of audio overdrive, with an apparent VOGAD action; the compressor does not add significant distortion.

The transmit noise output at full power is better than most radios on the bands and unlike the IC-7300 does not degrade at lower power levels. It is similar across most bands but degrades on 28MHz and above, the bands that are mixed from an IF.

The current consumption on receive measured about 200mA from the external supply below 25MHz and up to 240mA on 144 and 432MHz.

With the screen saver active, the current was about 30mA less. On 10W transmit the current increased to about 2A.

On-the-air performance

The layout of the controls and access to the features and functions via the Menu and Function keys is virtually the same as the other recent Icom radios, so familiarity with one ensures you will be at home with the others. I was very impressed with how well the radio performed and how easy it was to use. The controls are most intuitive. Functions are accessed and perform much as you would expect. The touchscreen display is very responsive and undemanding even with large fingers and is crisp and clear. Touch tuning from the spectrum display worked well and the zoom feature generally ensured that the frequency was fairly accurately set. The ergonomics are good but for desktop use a stand, even a makeshift one, is essential. The MBF-705 is ideal but others are also available.

Performance was excellent. Sensitivity and strong signal handling were good, extending well down into the lower frequency broadcast and timecode bands with a clean response and quiet background. The armoury of channel filters, notches, noise blanker and noise reduction system all performed extremely well. Although the internal speaker is only small, the audio quality and volume was remarkably good for its size. Even the quality from the speaker in the microphone was surprisingly effective.

Transmit operation was very well behaved. The audio quality seemed fairly well balanced with the HM-243 microphone supplied but did tend to boom a little and I set a small amount of bass cut. CW break-in was excellent with no clicks on transmit and very clean changeover to and from receive, with no clicks on the sidetone.

The spectrum scope, waterfall and audio screens were very effective and have high resolution. The RTTY decoder was also very effective and easy to use for rubber-stamp contacts. The GPS receiver seemed quite sensitive and I achieved a location fix indoors quite quickly, rather better than my TomTom satnav. I did not check out D-Star functions or Bluetooth but I downloaded the USB driver and had FT8 running easily on my PC using WSJT-X and with CIV and audio connected via USB.

Conclusions

The IC-705 is a great take-anywhere QRP radio, ideal for all outdoor activities and SOTA expeditions. Covering HF through to UHF bands with all-mode operation, a top-level performance and extensive remote connection capabilities, it is quite a remarkable piece of kit. Currently priced at around £1300, it is excellent value for money.

Icom IC-705 measured performance

Receiver measurements

Frequency	-----Sensitivity SSB 10dBs+n:n-----			-----Input for S9-----		
	Preamp off	Preamp 1	Preamp 2	Pre off	Preamp1	Preamp 2
1.8MHz	0.40µV (-115dBm)	0.13µV (-125dBm)	0.10µV (-127dBm)	45µV	14µV	8µV
3.5MHz	0.45µV (-114dBm)	0.13µV (-125dBm)	0.10µV (-127dBm)	45µV	14µV	8µV
7MHz	0.50µV (-113dBm)	0.14µV (-124dBm)	0.11µV (-126dBm)	50µV	16µV	9µV
10MHz	0.45µV (-114dBm)	0.14µV (-124dBm)	0.11µV (-126dBm)	50µV	16µV	9µV
14MHz	0.50µV (-113dBm)	0.16µV (-123dBm)	0.13µV (-125dBm)	50µV	16µV	10µV
18MHz	0.45µV (-114dBm)	0.14µV (-124dBm)	0.11µV (-126dBm)	50µV	14µV	8µV
21MHz	0.56µV (-112dBm)	0.16µV (-123dBm)	0.13µV (-125dBm)	56µV	16µV	10µV
24MHz	0.56µV (-112dBm)	0.16µV (-123dBm)	0.13µV (-125dBm)	56µV	16µV	10µV
28MHz	0.63µV (-111dBm)	0.18µV (-122dBm)	0.14µV (-124dBm)	56µV	14µV	9µV
50MHz	0.56µV (-112dBm)	0.16µV (-123dBm)	0.13µV (-125dBm)	56µV	16µV	10µV
144MHz	0.32µV (-117dBm)	0.08µV (-129dBm)		14µV	4µV	
432MHz	0.35µV (-116dBm)	0.09µV (-128dBm)		20µV	4µV	

Noise figure Preamp-2 50MHz: 8.7dB
 Noise figure Preamp-on 144MHz: 4.3dB
 Noise figure Preamp-on 432MHz: 5.0dB
 AGC threshold Preamp-1: 1.3µV
 100dB above AGC threshold for 2dB audio output increase

AGC attack time: 2ms
 AGC decay time: approx as specified
 Max audio into 8Ω: 0.25W at 10% distortion
 Inband intermodulation products: -55dB

S-reading (7MHz)	Input level USB	
	Pre off	Preamp 1
S1	4µV	1.3µV
S3	7µV	2.2µV
S5	14µV	4µV
S7	25µV	8µV
S9	50µV	16µV
S9+20	500µV	160µV
S9+40	5mV	1.4mV
S9+60	50mV	14mV

Filter	-----IF bandwidth Sharp-----				-----IF bandwidth Soft-----			
	-6dB	-60dB	-70dB	-80dB	-6dB	-60dB	-70dB	-80dB
10kHz FM	11.9kHz	16.1kHz	16.5kHz	16.9kHz	-	-	-	-
6kHz AM	6.4kHz	10.4kHz	11.0kHz	11.6kHz	-	-	-	-
2.4kHz USB	2524Hz	3463Hz	3660Hz	3862Hz	2252Hz	3447Hz	3660Hz	3872Hz
500Hz CW	513Hz	661Hz	697Hz	739Hz	538Hz	771Hz	828Hz	894Hz
100Hz CW	107Hz	189Hz	210Hz	236Hz	110Hz	228Hz	248Hz	271Hz

Frequency	Intermodulation dynamic range 2.4kHz BW		Frequency offset	Reciprocal mixing dynamic range 500Hz BW, 7MHz	Reciprocal mixing dynamic range 500Hz BW, 21MHz
	Preamp off	Preamp 1			
1.8MHz	86dB	83dB	1kHz	107dB (-134dB/Hz)	not measured
3.5MHz	86dB	84dB	2kHz	108dB (-135dB/Hz)	104dB (-131dB/Hz)
7MHz	91dB	90dB	3kHz	109dB (-136dB/Hz)	108dB (-135dB/Hz)
14MHz	91dB	89dB	5kHz	111dB (-138dB/Hz)	109dB (-136dB/Hz)
21MHz	91dB	90dB	10kHz	113dB (-140dB/Hz)	111dB (-138dB/Hz)
28MHz	83dB	82dB	15kHz	115dB (-142dB/Hz)	113dB (-140dB/Hz)
50MHz	83dB	83dB	20kHz	117dB (-144dB/Hz)	115dB (-142dB/Hz)
144MHz	82dB	79dB	30kHz	119dB (-146dB/Hz)	115dB (-142dB/Hz)
			50kHz	121dB (-148dB/Hz)	116dB (-143dB/Hz)
			100kHz	overload limit	118dB (-145dB/Hz)
			150kHz	overload limit	119dB (-146dB/Hz)

Transmitter measurements

Frequency	CW power output	Intermodulation products wrt PEP			Frequency offset	Transmit noise 7MHz 10W CW O/P	Transmit noise 7MHz 0W SSB O/P
		Harmonics	3rd order	5th order			
1.8MHz	10.3W	-64dB	-35dB	-51dB	1kHz	-74dBm/Hz (-114dB/Hz)	-84dBm/Hz
3.5MHz	10.4W	-65dB	-39dB	-50dB	2kHz	-78dBm/Hz (-118dB/Hz)	-84dBm/Hz
7MHz	10.4W	-62dB	-42dB	-50dB	3kHz	-79dBm/Hz (-119dB/Hz)	-85dBm/Hz
10MHz	10.5W	-59dB	-40dB	-48dB	5kHz	-79dBm/Hz (-119dB/Hz)	-85dBm/Hz
14MHz	10.5W	-75dB	-42dB	-50dB	10kHz	-80dBm/Hz (-120dB/Hz)	-85dBm/Hz
18MHz	10.6W	-75dB	-48dB	-58dB	20kHz	-80dBm/Hz (-120dB/Hz)	-85dBm/Hz
21MHz	10.8W	-70dB	-40dB	-50dB	50kHz	-84dBm/Hz (-124dB/Hz)	-85dBm/Hz
24MHz	10.9W	-72dB	-38dB	-48dB	100kHz	-87dBm/Hz (-127dB/Hz)	-85dBm/Hz
28MHz	10.5W	-75dB	-38dB	-47dB	150kHz	-89dBm/Hz (-129dB/Hz)	-85dBm/Hz
50MHz	10.3W	-68dB	-35dB	-45dB			
144MHz	11.5W	-65dB	-32dB	-42dB			
432MHz	9.4W	-60dB	-34dB	-42dB			

Intermodulation product levels are quoted with respect to PEP.

Transmitter AF distortion: much less than 1%
 Microphone input sensitivity: 4mV for full output
 FM deviation: 4kHz (wide), 2kHz (narrow)

NOTE: All signal input voltages given as PD across antenna terminal. Unless stated otherwise, all measurements made on USB with receiver preamp switched out, 2.4kHz bandwidth Sharp filter selected.