

Icom IC-7200

Peter Hart looks at this new HF & 50MHz transceiver



The Icom IC-7200 is a rugged-looking radio that should give years of dependable service.

NEW KID ON THE BLOCK. The IC-7200 is the latest radio from Icom. First seen in the UK at the recent RSGB HF Convention, it is billed as an entry-class transceiver but it is certainly not short on essential features. As a midi-sized radio with rugged looks and rugged construction, it is equally suited to outdoor use and travel as well as normal operation from home. Although not waterproof, it has a measure of protection against the weather using techniques that Icom has developed for their range of marine radios.

BASIC FUNCTIONS. The IC-7200 is a 12V operated radio measuring 241 x 281 x 84mm (W x D x H) and weighs about 5.5kg. The receiver tunes continuously from 30kHz to 60MHz. The transmitter is enabled only within the amateur allocations appropriate to each country area, with 100W maximum output power on all bands. 5MHz transmit frequencies are not enabled as received out of the box in the UK but Icom agents can enable these channels on request. SSB, CW, AM and RTTY modes are provided but FM is not. A scroll button selects modes and a long press gives alternative (opposite sideband) modes on SSB, CW and RTTY. Modes can be inhibited for simplified operation if desired. RTTY uses a digital FSK transmit interface to an external terminal unit. For AFSK audio tones, a data mode on SSB may be enabled via the set-up menu, rather less convenient if you need to switch frequently between voice and data modes. More on data modes further in this review.

The front panel contains three dual

concentric rotary controls and a chunky tuning knob. Most of the functions of the radio are accessed by pushbuttons, which in most cases are multifunction and are dependent on whether a short or long press is given. Microphone and headphone jacks are mounted on the front with a CW key jack on the rear and unusually a front panel-mounted speaker is fitted. At 40mm diameter, this is very small but gives surprisingly good results with good bass and quite high volume levels although there are some rattles. From the audio point of view, the front panel is really the best place to mount the speaker but panel area for the operating controls is at a premium and they usually take priority.

A long push on many of the pushbutton selected features accesses a set-up level or a sub-selection function. In addition, a further 52 items are customisable via the set mode scrolling menus. Some 11 of the more commonly accessed items are grouped into the quick set-mode needing a single key access and the remainder into the standard set-mode needing double key access. The last accessed set-mode item is returned first on reselection so, for example, switching data mode on and off if you use voice and data modes frequently is not so tedious as might first be thought. Overall, access to the functions is well thought out given the constraints on front panel area and the necessary number of controls.

The display uses an amber backlit LCD panel with excellent brightness and visibility and a wide viewing angle. It is a monochrome display showing frequency and all the usual functions with a bar-graph meter and shows

everything that is really necessary. Voice readout of frequency, mode and S-meter reading is provided as standard at the touch of a button.

The rear panel carries a simple set of interface connectors. There is a single antenna socket (two would be more convenient for HF and 6m) and no separate receive antenna socket. A 13-pin accessory socket (plug supplied) provides general interfacing to linears, automatic ATUs, FSK and AFSK signals for data terminal units and has band data available. Two phono sockets provide T/R control and ALC for general amplifier switching but with 16V maximum open circuit on the T/R switching line an isolating relay is necessary for many older style valve linears. A separate socket for control of the AH-4 automatic ATU is provided and a CI-V remote interface for PC control via a level converter.

One interesting new feature is the provision of a USB port. This can be used to provide full PC control as an alternative to the CI-V interface. Also via the associated built-in codec, the USB port transfers receive and transmit audio to and from the PC without the need for a sound card. This can simplify operation on data modes, and with appropriate software in the PC can be used for transmitting contest voice message stores and recording virtually an unlimited amount of receiver audio.

The radio is provided with an HM-36 hand microphone and an instruction manual that runs to 100 pages and is thorough and well written. It includes a set of circuit diagrams and remote control commands.

RADIO DESIGN AND ARCHITECTURE.

The receiver in the IC-7200 adopts a triple superhet architecture with a first IF of 64.455MHz, a second IF of 455kHz and a third IF of 15.625kHz that directly feeds the DSP for all further signal processing. The first mixer uses a quad arrangement of FETs and 10 diode-switched bandpass filters cover the tuning range of the receiver. A 15kHz wide roofing filter is fitted at the first IF, a 6kHz wide filter at the second IF and all remaining filtering, demodulation, noise reduction, audio processing, AGC and transmit signal generation is performed by the DSP. The DSP is a 400MHz unit with 24 bit A/D and D/A converters. The AGC circuitry employs two loops, one within the DSP following the channel filtering and the other acting on the earlier IFs to prevent overload of the A/D and DSP circuits.

For many years now in most HF transceivers, the frequency synthesiser unit, which provides the first local oscillator signal, has commonly used a combination of a single loop PLL with a DDS chip reference. This gives a good compromise between low phase noise, low level spurs, small step size with fast settling, simplicity and low cost. DDS technology has advanced over the years and the latest devices now give excellent performance well into the VHF region. The synthesiser in the IC-7200, which covers 64.485 – 124.455MHz, uses one of these later generation DDS chips, the Analog Devices AD9951, on its own without the PLL. This simplifies the overall structure and is, I believe, the first transceiver from the main Japanese suppliers to adopt this approach. The DDS operates at half frequency with a doubler and harmonic filtering. A built-in 0.5ppm TCXO reference ensures excellent frequency accuracy and stability.

The radio is very solidly constructed using a substantial diecast frame on which the circuit boards are mounted in recessed sections. The boards have metal shields and rubber gasket seals to prevent the ingress of moisture. The diecast frame provides an integral heatsink blown by two internal and very quiet miniature fans. The frame also incorporates the rear panel with side extensions, giving protection to the rear connectors and allows the unit to stand vertically when not in use. The two-part case and front panel look metallic but are in fact plastic and a bail stand angles the panel for ease of use. Front facing handles may be fitted to provide added protection during transit.

RECEIVE FEATURES. Individual buttons select the bands but not in the usual way. This had me reaching for the manual when I first wanted to change bands. Band changes are second level functions on the multifunction keypad, and band selection must be preceded by a long press of the band key. A short press of the band key accesses direct numeric frequency input via the keypad, so some care is needed. Only one last-used frequency/mode combination is stored for each band; there is no multiple band stack register.

The radio is fitted with a 45mm diameter tuning drive with a nice feel and flywheel action but only 150 steps per knob revolution. Normal tuning is 10Hz per step but 1Hz per step can be selected for fine

tuning. A faster tuning rate programmable in steps between 100Hz and 10kHz can also be selected. Auto speed-up increases the tuning rate on fast sustained tuning but this can be disabled. The radio can also be tuned from the microphone or the frequency entered directly through the numeric keypad.

The normal A/B twin VFOs are provided with split operation and quicksplit for equalising the VFOs. Monitoring and tuning the transmit frequency during split frequency operation may be done by a push and hold button press (XFC function). This is similar to the Yaesu TXW function. RIT is available (up to ± 10 kHz with a lot of knob winding) but no

bandwidths are immediately available for each mode, selectable by a simple push of a front panel key, from the available menu of bandwidths. In addition, two filter profiles are selectable on CW and SSB modes, a sharp profile with a flat passband and a soft profile with a more rounded passband. Twin passband tuning is also provided, which enables the filter sides to be both independently moved and narrowed. A manual notch filter is provided with three different width settings and an auto-notch on SSB and AM modes. On RTTY mode, a twin peak filter can be enabled with sharp peaks on the 2125/2295Hz tones. This is not available for shifts other than 170Hz or on the AFSK data modes on SSB, which uses an audio passband centred on 1500Hz.

TRANSMIT FEATURES. The transmitter contains a 100W power amplifier. Power is adjustable down to less than 2W from the quick set menu with different settings possible on HF and 6m. There is no provision for a built-in ATU but a tuner button provides control of Icom external ATUs AT-180 and AH-4. The bargraph panel meter can be switched to read RF power output, ALC level or antenna VSWR.

Audio modulation input may be selected from the microphone socket, the accessory socket or both, or via the USB port. Separate selections for voice operation or data operation may be set via the menu. VOX is provided on SSB and AM voice modes but only if the microphone

socket is used for audio input. A speech compressor is also provided on SSB. There is no adjustment of the transmit audio bandwidth or audio monitor facility.

On CW, there is the usual provision for full and semi break-in and a keyer. The keyer is adjustable for weighting and speed over the range from 6 to 60wpm and accommodates different paddle types including the microphone up/down keys. There are no memory stores.

MEASUREMENTS. The full set of measurements is given in the table. The sensitivity is excellent across the HF tuning range. Below 1.6MHz an attenuator is inserted and sensitivity drops sharply below 100kHz. At 136kHz it is about $3\mu\text{V}$ for 10dB S+N:N. The S-meter bars dwell for about 8dB at S9 and above and about 2dB below S9 and are similar on all modes. The quoted S-meter calibration figures are the median values at each level. IF rejection was greater than 100dB but first IF image rejection was

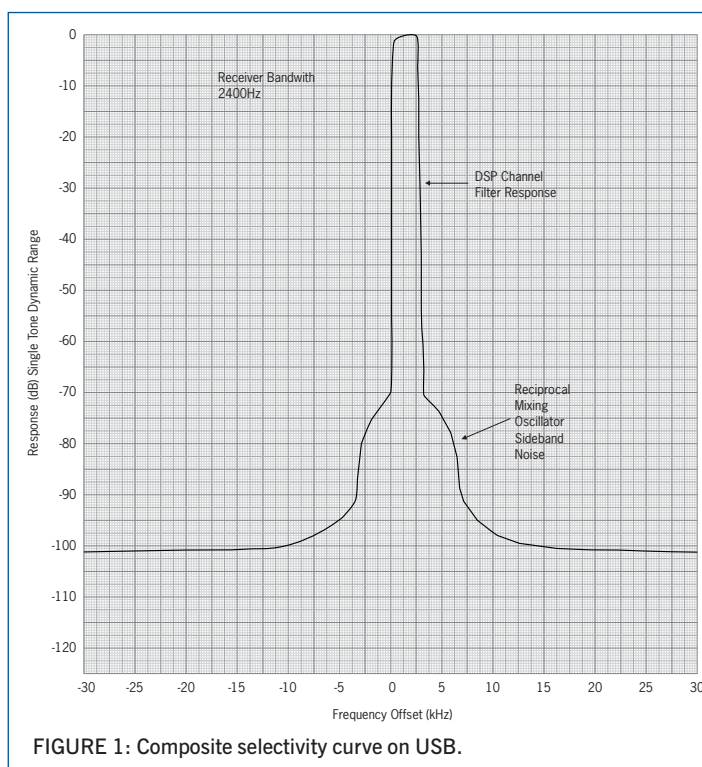


FIGURE 1: Composite selectivity curve on USB.

transmit XIT. There are 199 regular memory channels that store frequency, mode and IF filter bandwidth setting but no fancy features such as labelling or quick access stacks. Scanning between two programmable frequency limits or across the stored memory channels is also provided.

A switchable front-end preamplifier and a switchable attenuator allows the receiver to be optimised for weak or strong signals and a combined RF gain control and squelch is also provided. The AGC can be switched between fast and slow settings or turned off. A noise blanker is provided for pulse-type noise and is fully adjustable for level and pulse width. Digital noise reduction is also included with adjustable level setting.

The same comprehensive set of IF channel filters as fitted in the Icom top-end radios is also included in the IC-7200 with 41 different passband widths on SSB and CW (50-3600Hz), 32 passband widths on RTTY (50-2700Hz) and 40 passband widths on AM (200Hz-8kHz). Three separate



The USB port is a most welcome addition to the usual array of rear panel connectivity.



Opening the top cover reveals the main PCB and substantial fan-blown heatsink.

rather poor at little over 60dB. Rejection of the second IF image at 910kHz above the on-tune frequency was around 90dB. Other spurious responses, which can be a problem with DDS synthesisers, were generally at a low level of around -90dB or better, which is quite a good result. The AGC performance was generally clean and with no 'attack hole' as seen on some DSP based radios.

Third order intercept and dynamic range figures were very good for a radio in this price bracket, holding quite well close-in. Reciprocal mixing results are not as good as I was expecting from a straight DDS synthesiser, average to poor close-in and further out it plateaus at quite a high level. Reciprocal mixing noise is even seen on adjacent bands at this plateau level where the bands share a common input filter. The phase noise benefits of a DDS synthesiser are not really being achieved with this radio. Second order intermodulation with signals on other bands was fairly poor; I suspect the front-end bandpass filters are not particularly sharp. The IF filter measurements show a superb performance with possibly the narrowest skirts I have measured on any radio. These figures are even better than the IC-7700, suggesting Icom have been optimising their filtering software. Figure 1 shows the composite selectivity curve. As with most Icom radios, the inband intermodulation performance was exceptionally good.

On transmit, distortion products on SSB were fairly good for a 12V operated power amplifier, except on 24MHz. A VOGAD circuit is incorporated into the transmit audio. This is a long time constant AGC, making level setting less critical and preventing gross distortion from overdrive. The processor



Underneath the bottom cover are the PA board, output low pass filters and front end filters.

added minimal extra distortion. AM transmit was clean with low distortion. CW rise and fall times were 2 to 4ms with negligible delay or character shortening under semi break-in keying. With full break-in at 40wpm the characters were slightly shortened.

ON THE AIR PERFORMANCE. I took the opportunity to check out the radio during the recent CQWW SSB and CW contests. The receiver coped very well with crowded conditions and no real strong signal problems were encountered. The receiver was clean with a quiet background and very sensitive on the higher bands. On AM broadcast the quality was excellent and although the sensitivity dropped at LF the receiver was again very clean. The audio quality from the front panel speaker was good on speech but there were resonances and rattles on tones and on CW. As always, headphone quality is so much better.

The filters generally functioned well but narrow CW bandwidths in sharp mode tended to ring or blur the sound more than expected and the soft mode seemed better. The manual IF notch was very effective. Icom claim 70dB depth and, being before the AGC detection point, full sensitivity is retained with strong carriers. The auto-notch also functioned well and was very fast to operate although strong carriers capture the AGC. The noise reduction system also seemed fairly effective.

On transmit, I had good audio quality reports on SSB and the CW break-in characteristic was clean and trouble free although the changeover relays were a little noisy on full break-in. I had some problems with RF breakthrough into the headphone leads on 20m when beaming at the house.

This could be cured by wrapping the headphone leads through a ferrite ring but could be a potential problem area.

Once I had overcome my initial dislike of the two-button band change, I found the overall ergonomics really quite good. It is an easy radio to use but I found the buttons needed a good push and must be pressed square-on as many sit in a slight recess in the front panel. The tuning drive is good but I generally prefer more steps per revolution. However, the change tuning speed button is easily accessed from the tuning hand and with 100Hz set for the higher tuning rate a good compromise on tuning the bands is achieved. The display is bright, unambiguous and easy to read.

To connect the radio to a computer via a USB cable, you first need to install a driver on the PC. Suitable drivers for Windows XP, 2000 and Vista can be downloaded from the Icom Japan support website and full instructions are given in the manual and on the website. I installed drivers on two PCs and had RTTY running using MMTTY in LSB data mode with no problem. It's a pity that VOX doesn't function on data modes: I had to route the PTT line via a serial port. Suitable software could enable this via the USB port.

CONCLUSIONS. The IC-7200 is far more than just an entry-level radio. It is a good performer and has all the features and functions necessary for effective use on all HF modes at home or out in the field. Possible RF breakthrough might be a problem in high RF environments and with a linear. Priced less than £800 it represents good value and will appeal as an excellent all-round radio for general use on HF and 50MHz. My thanks to Icom (UK) Ltd for the loan of the radio.

ICOM IC-7200 MEASURED PERFORMANCE

RECEIVER MEASUREMENTS

FREQUENCY	-----SENSITIVITY SSB 10dBs+n:n-----		-----INPUT FOR S9I-----		S-READING (7MHz)	-----INPUT LEVEL USB-----	
	PREAMP OFF	PREAMP ON	PREAMP OFF	PREAMP ON		PREAMP OFF	PREAMP ON
1.8MHz	0.35µV (-116dBm)	0.1µV (-127dBm)	110µV	25µV	S1	6.3µV	1.3µV
3.5MHz	0.32µV (-117dBm)	0.1µV (-127dBm)	100µV	22µV	S3	11µV	2.5µV
7MHz	0.28µV (-118dBm)	0.09µV (-128dBm)	100µV	22µV	S5	21µV	4.5µV
10MHz	0.28µV (-118dBm)	0.09µV (-128dBm)	100µV	22µV	S7	40µV	8.5µV
14MHz	0.28µV (-118dBm)	0.1µV (-127dBm)	100µV	22µV	S9	100µV	22µV
18MHz	0.28µV (-118dBm)	0.1µV (-127dBm)	100µV	22µV	S9+20	800µV	180µV
21MHz	0.28µV (-118dBm)	0.1µV (-127dBm)	100µV	21µV	S9+40	6.5mV	1.4mV
24MHz	0.32µV (-117dBm)	0.1µV (-127dBm)	110µV	25µV	S9+60	35mV	8mV
28MHz	0.35µV (-116dBm)	0.11µV (-126dBm)	120µV	25µV			
50MHz	0.18µV (-122dBm)	0.09µV (-128dBm)	56µV	16µV			

AM sensitivity (28MHz) preamp on: 0.56µV for 10dB S+N:N at 30% mod depth.

AGC threshold preamp on: 0.8µV.

100dB above AGC threshold for <1dB audio output increase.

AGC attack time: 1-2ms.

AGC decay time: 100-400ms (fast) 0.5-3s (slow).

Max audio into 8Ω: 1.7W at 1% distortion, 2.1W at 10% distortion.

Inband intermodulation products: better than -55dB.

FILTER	-----SHARP-----			-----SOFT-----		
	-----IF BANDWIDTH-----			-----IF BANDWIDTH-----		
	-6dB	-60dB	-70dB	-6dB	-60dB	-70dB
AM 6kHz	6110Hz	6594Hz	9140Hz	-	-	-
USB 2.4kHz	2502Hz	2897Hz	2983Hz	2601Hz	4065Hz	4323Hz
USB 1.8kHz	1922Hz	2376Hz	2486Hz	2129Hz	3475Hz	3809Hz
CW 500Hz	518Hz	594Hz	609Hz	517Hz	869Hz	946Hz
CW 250Hz	260Hz	297Hz	305Hz	260Hz	443Hz	486Hz

INTERMODULATION (50kHz TONE SPACING)
2400Hz BANDWIDTH USB

Frequency	-----PREAMP OFF-----		-----PREAMP ON-----	
	3rd order intercept	2 tone dynamic range	3rd order intercept	2 tone dynamic range
1.8MHz	+20dBm	97dB	+3.5dBm	94dB
3.5MHz	+21dBm	99dB	+3.5dBm	94dB
7MHz	+20dBm	99dB	+5.5dBm	96dB
14MHz	+18dBm	97dB	+5dBm	95dB
21MHz	+17dBm	97dB	+4dBm	94dB
28MHz	+20dBm	97dB	+7.5dBm	96dB
50MHz	+14dBm	97dB	+3dBm	94dB

FREQUENCY OFFSET	RECIPROCAL		
	MIXING FOR 3dB NOISE	BLOCKING PREAMP OFF	BLOCKING PREAMP ON
2kHz	75dB	noise limited	noise limited
3kHz	80dB	noise limited	noise limited
5kHz	93dB	noise limited	noise limited
10kHz	97dB	-6dBm	-18dBm
15kHz	98dB	+10dBm	-2dBm
20kHz	100dB	+11dBm	-1dBm
30kHz	101dB	+11dBm	-1dBm
50kHz	102dB	+11dBm	-1dBm
100kHz	102dB	+11dBm	-1dBm
200kHz	102dB	+11dBm	-1dBm

CLOSE-IN INTERMODULATION ON 3.5MHz BAND
2400Hz BANDWIDTH USB

Spacing	-----PREAMP OFF-----		-----PREAMP ON-----	
	3rd order intercept	2 tone dynamic range	3rd order intercept	2 tone dynamic range
3kHz	noise limited	noise limited	noise limited	noise limited
5kHz	noise limited	noise limited	noise limited	noise limited
7kHz	+1.5dBm	86dB	-13dBm	83dB
10kHz	+13.5dBm	94dB	+0.5dBm	92dB
15kHz	+18dBm	97dB	+3.5dBm	94dB
20kHz	+19.5dBm	98dB	+3.5dBm	94dB
30kHz	+21dBm	99dB	+3.5dBm	94dB
40kHz	+21dBm	99dB	+3.5dBm	94dB
50kHz	+21dBm	99dB	+3.5dBm	94dB

TRANSMITTER MEASUREMENTS

FREQUENCY	CW POWER OUTPUT	HARMONICS	INTERMODULATION -----PRODUCTS-----	
			3rd order	5th order
1.8MHz	114W	-66dB	-30dB	-41dB
3.5MHz	109W	-60dB	-36dB	-36dB
7MHz	106W	-67dB	-34dB	-36dB
10MHz	107W	-59dB	-35dB	-42dB
14MHz	107W	-60dB	-28dB	-43dB
18MHz	108W	-70dB	-36dB	-32dB
21MHz	108W	-66dB	-36dB	-32dB
24MHz	106W	-63dB	-22dB	-36dB
28MHz	107W	-80dB	-33dB	-34dB
50MHz	103W	-70dB	-29dB	-36dB

Intermodulation product levels are quoted with respect to PEP.

Carrier suppression: >70dB.

Sideband suppression: >70dB at 1kHz.

Transmitter AF bandwidth: 280 – 2715Hz at -3dB.

Transmitter AF distortion: much less than 1%.

Microphone input sensitivity: 6mV for full output.

Data T/R switch speed: mute-TX 12ms, TX-mute 4ms, mute-RX 30ms, RX-mute 2ms.

NOTE:

All signal input voltages given as PD across antenna terminal.

Unless stated otherwise, all measurements made on USB with receiver preamp switched out and with 2.4kHz bandwidth sharp filter selected.

