THE ICOM IC-910 TRANSCEIVER

Chris Lorek, G4HCL*, looks at Icom's new Multimode VHF / UHF Transceiver

ICOM HAS A solid history in VHF and UHF SSB transceivers. There can't be many 'old hand' hill-top 2m DXers who haven't either used, or known of, the IC-202 2m SSB transportable rig, used also by many as an IF for transverting to other frequencies, including the microwave bands.

The 'traditional' way of getting a DX-capable station on 2m or 70cm has indeed usually been via the transverter route. I still use an HF rig with 6m, 2m, 70cm and 23cm transverters, even though I also have a self-contained satellite-capable 'do everything from 160m to 70cm' multimode base station in my shack, which doesn't have the overall performance of the former system. So it was with great interest that I accepted Icom's latest 2m / 70cm multimode base transceiver, complete with its fitted 23cm option, to test for *RadCom* readers.

BANDS

THE IC-901H covers 144 - 146MHz and 430 - 440MHz on USB, LSB, and FM with switchable 12.5kHz (FMN) and 25kHz (FM) channel spacing. The transmit power output is specified as 100W on 2m and 75W on 70cm, with a variable power reduction facility down to 5W. An optional UX-910 module can be internally fitted to add 1240 - 1300MHz (23cm) coverage with a 1 - 10W transmit power output range. Any two bands can be used at any one time.

FRONT PANEL

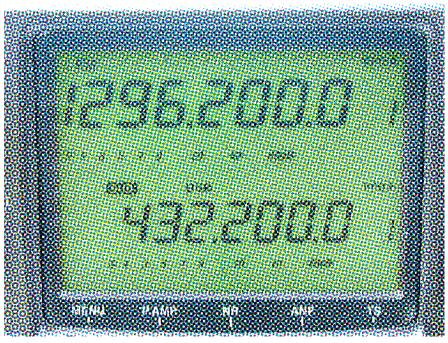
THE FRONT PANEL is well laid out with an uncluttered array of controls. A large backlit LCD is used to display the operating frequency etc along with a separate bargraph S-meter for each displayed operating band. This bargraph can also be used as a simple band scope, which visually sweeps either side of your tuned frequency and indicates detected signals along the bars.

Concentric to the separate volume control for each band is a combined RF gain and squelch outer knob. This uses the same method of control as on some other Icom transceivers, where from clockwise up to the 12 o'clock position it's an RF gain control with open squelch, and 12 o'clock onwards is maximum RF gain but with an increasing squelch level. Below these, two tiny knobs are fitted for mic gain and transmit RF power setting. An audio speech compressor can be switched in for SSB transmit, together with a VOX (Voice Operated Transmission) facility on both SSB and FM. Semi break-in is available on CW. A receive attenuator can be switched in on each band, this being continuously adjustable from 0 to 100% of the maximum attenuation, independently on each band, via the transceiver's 'set' mode. As many DX and satellite operators - to whom the IC-910 is aimed - will be using a mast-head receive preamp, a front-panel control is again available to switch this in and out.

Further buttons below the main display are fitted for a switchable SSB noise blanker, slow or fast AGC, selectable fast or slow VFO tuning steps, and a VFO 'dial lock'. SSB / CW can be pre-set to be tuned in 1, 10, 50 and 100Hz steps, FM on 0.1, 5, 6.25, 10, 12.5, 20, 25 and 100kHz steps, using the large tuning knob which has a brake tension adjustment which you can set as you like. For FM a switchable AFC (Automatic Frequency Control) is available, and a green 'busy' (squelch open) LED next to each volume / RF gain knob can act as a simple centre-tuning indicator, the LED flashing when an off-centre signal is received. The RIT control can shift the receive frequency by up to ±1kHz on SSB / CW and ±5kHz on FM, with double this shift on 23cm. To reduce the level of adjacent-frequency signals, an IF shift lets you move the receive passband up or down by up to 1.2kHz. The IF Shift and RIT controls can also act as a sub-band tuning control, by changing the sub-band operating frequency continuously at a variable speed. An internal keyer is fitted for CW with variable speed and keying weight, and you can alter the CW sidetone and pitch to your liking.

VFOs AND MEMORIES

TWO VFOs, A and B, are available on each operation band, together with five quick-access 'memo pads' to store and recall frequencies and operating modes. A further 'call' channel and 99 extra memory channels are also available for each band, each storing the frequency and operating mode together with offset and tone frequencies if programmed. Another six memory channels are fitted to store lower and upper scan edge frequencies, which the IC-910 can automatically search between to find activity. Up / Down buttons are provided for memory channel change and the programmed memory channels can also be automatically scanned for activity, the scan halting when the receive squelch opens. For FM, as well as a front panel press-button 1750Hz toneburst for repeater access, CTCSS (sub-tone) encode and decode is available either for repeater access or for quiet channel monitoring. A CTCSS Scan is available, which can cycle through the available tones while you're monitoring a re-



Close-up of main display screen.

*PO Box 400, Eastleigh, Hants SO53 4ZF.

ceived FM signal and show you which, if any, sub-tone is being used. Split-frequency transmit / receive using VFOs A and B can be swtched in, and fixed TX / RX offsets can be programmed on each band for repeater use.

BAND OPERATION

TWO RECEIVER sections and a single transmit section are used within the transceiver, with two bands, the 'Main' and 'Sub', being used at any one time. So, you can have 2m and 70cm, 70cm and 23cm, or 2m and 23cm in use. Full-duplex cross-band transceive is available, with transmit capability on the Main band (although the Sub band is the TX band in 'Satellite' mode). Dual-band simultaneous receive operation is possible on the two selected bands, although it's not possible to set the Main and Sub bands to the same frequency range for twin-frequency receive operation.

CIRCUITRY

SSB RECEIVE ON 2m uses a single-conversion superhet with IFs of 10.85MHz and 10.95MHz for the main and sub bands respectively. 70cm SSB uses a double-conversion superhet with a 1st IF of 71.25MHz (Main) and 71.35MHz (Sub), the second IF being 10.85 (Main) and 10.95MHz (Sub). 23cm also uses double conversion, but with a higher first IF of 243.95MHz for both Main and Sub bands, again with a second IF of 10.85MHZ (Main) and 10.95MHz (Sub). In all cases. FM receive adds a further down conversion to a final IF of 455kHz.

The transmit power amplifier uses separate PAs for 2m and 70cm each using two bipolar transistors in parallel, 2SC5125 types on 2m and 2SC3102 types on 70cm, as the final high-power stage.

The 23cm PA uses an M57762-02 block PA module, with a mechanical transmit / receive relay for low loss. An internal fan comes into operation when needed to keep the transmit power amplifier circuitry cool.

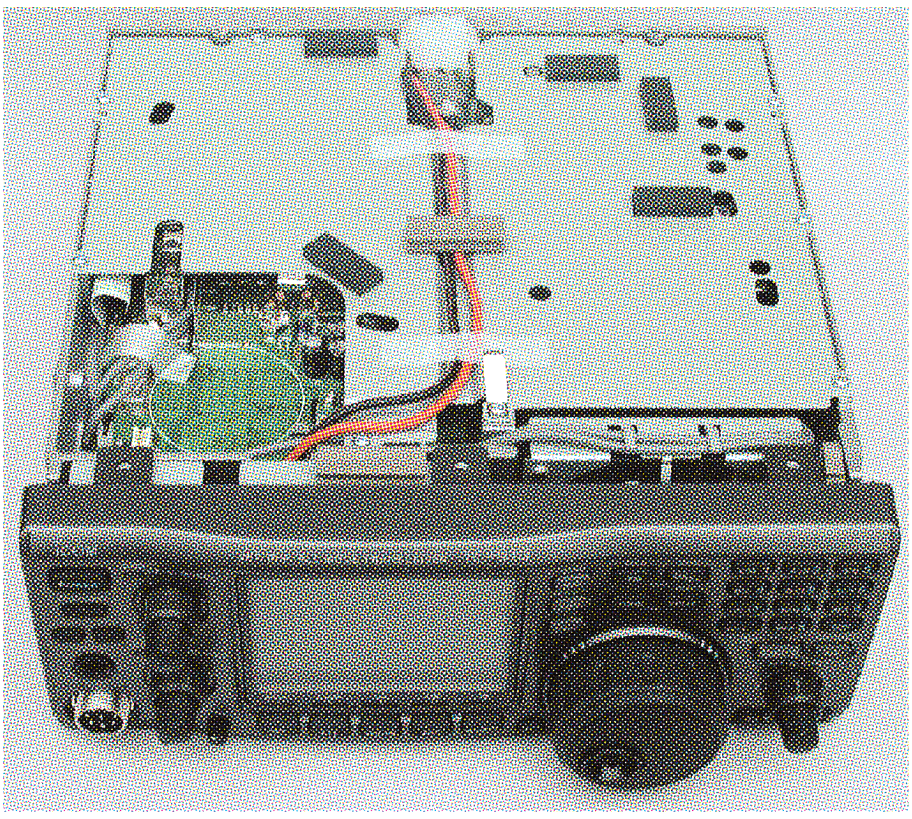
CONNECTIONS

ALONG WITH THE front panel microphone and earphone sockets, separate rear panel connectors are fitted for external Main and Sub band speakers, separate 6-pin mini DIN data sockets for the Main and Sub bands for packet TNC etc interconnection, and a separate antenna connector for each band - two (for 2m and 70cm) as standard, with an additional socket if the 23cm option is fitted.

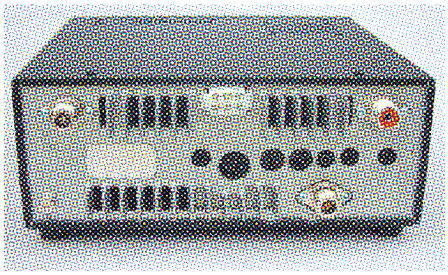
A further 8-pin accessory socket lets you connect a common data terminal / TNC, and this socket provides a handy 13.8V output to power your TNC as well as an ALC input for use with an external power amplifier.

There's a stereo jack for either a straight or paddle Morse key, and a CI-V remote control connector is fitted for you to control remotely the radio from your PC; you'll need an optional CT-17 external interface or similar in line between the radio and PC for this.

The transceiver measures 241W x 94H x 239Dmm and weighs 4.5kg, the UX-910 23cm module adding a further 850g. It's



IC-910 with top cover removed.



Rear panel connections on the IC-910.

powered from an external 13.8V DC supply which you'll need to provide, the maximum current requirement being stated at 23.0A at maximum transmit power.

ACCESSORIES

THE TRANSCEIVER comes with a fist microphone, a fused high-current DC lead (fairly short at 1m), spare fuses and an 83-page user instruction manual together with circuit diagrams. Optional accessories include narrow CW filters for main and sub bands, a high-stability crystal unit, external speaker, desk mic, the 23cm band unit (which was fitted to the review sample), CI-V level converter for PC control, voice synthesiser unit to announce the operating frequency, mode etc, mobile mounting bracket, a carrying handle, and weather-proof preamps for 2m, 70cm and 23cm. Finally, an optional internally-fitted UT-106 DSP unit adds audio-based DSP (Digital Signal Processing) to the receive side. You can select automatic noise reduction for weak-signal work, and an automatic notch filter which will notch out audio beat tones etc even if they're varying in frequency.

ON THE AIR

TO REPLICATE A variety of situations, for the on-air tests I used the IC-910H with two different roof-top mounted 2m / 70cm / 23cm collinear antennas as well as a telescopic tower-mounted azi / ele steerable array comprising a 23cm loop Yagi plus 2m / 70cm switched vertical / horizontal / circular crossed Yagis.

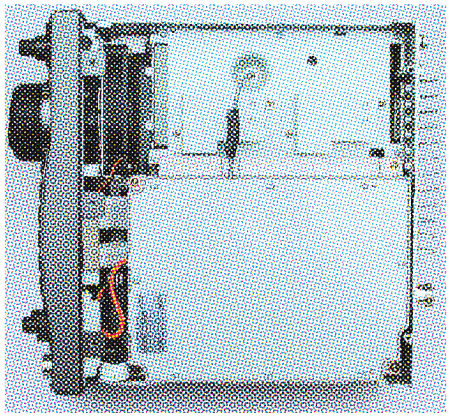
When generally tuning around, I appreciated the 'memo pad' channels which stored the various frequencies I'd manually tuned to on a first-in, first out basis with a single button press each time. This way, I could have an initial tune, find out what's happening, and cycle back quickly to see if the contact was finishing or whatever. Five of these memo pads are the default, although I could increase them to 10 in the 'set' mode; the higher number could be useful during busy periods such as a contest weekend.

As the Main band is used for transmit in normal operation, I found it handy to be able to use this while tuning or scanning around on the 'sub' band, also being able to keep a continuous ear open for activity on, say, 23cm while I was chatting away on one of

the other bands. I appreciated the programmable band search, and often left the transceiver in this mode, searching two bands simultaneously, while I was doing other things in the shack. Try as I might, I found the combined RF gain and squelch control difficult to get used to. Fortunately, Icom had already pre-empted this and allow, via the 'set' mode, for this to act instead just as a squelch control on FM and just an RF gain control on SSB / CW, which I preferred. I found a handy facility was a memory channel 'mode scan', where I could scan just those channels programmed with USB frequencies, or those with FM frequencies - quite useful! Overall I was very pleased with the general operating capabilities, especially the smooth tuning, my only regret was that I couldn't have all three bands active at the same time!

I found 9600 baud packet data to work perfectly with the transceiver, with none of the messy 'fiddling' I sometimes have to do for weak signal demodulation - top marks Icom. On FM speech, switching in the NFM mode gave me excellent rejection of even strong 12.5kHz-spaced FM signals. On both SSB and FM, all audio reports on my transmitted signal with the supplied fist mic were positive, and I found the high transmit power available on both 2m and 70cm was useful in getting my signal where I needed it. The rear panel ALC input would be handy for use with an external transmit amplifier, although most users would find the drive level on 2m and 70cm to be too high for most use. A quick initial adjustment of the front panel power control would be in order here. Only on 23cm did I sometimes switch in my 50W linear amplifier when needed, the 10W drive on 23cm being perfect for this. I did seem to encounter a slight degree of noise on even very strong local 23cm SSB received signals, less so on 2m and 70cm, but it did suggest to me that synthesiser phase noise could be creeping in here.

With my omni-directional antenna, or the beam pointed at a local PMR (Private Mobile Radio) site, I did occasionally come across the odd burst of receive intermodulation, where two off-frequency signals, in this case out of band, combine within the receiver to give a third unwanted signal. But this was never enough for me to miss out on a contact and I do admittedly live in an RF congested area. However, hill-top contest operators may need to take care.



IC-910 with bottom cover removed.

SATELLITE OPERATION

BOTH SATELLITE Mode B (70cm uplink, 2m downlink) and Mode J (2m uplink, 70cm downlink) can be used, and with the 23cm module fitted, satellite Mode L is added. Normal and reverse VFO tracking is available, depending whether you're using an inverting transponder or not. For example, with an inverting transponder, when you tune upwards in frequency on 2m you'll need to tune downwards, ie in the reverse direction, on 70cm. To save twisting multiple VFOs while you're trying to 'net', the IC-910 does it for you by automatically linking the VFO on each of your selected bands. The set usefully also has 10 satellite memory channels to memorise both uplink and downlink frequencies and operating modes so you don't need to re-initialise each time you switch satellites. This worked fine in 'real-time' use on the 'birds', and the useful sub-band tune facility let me manually correct for the different Doppler shifts between bands.

LAB TESTS

THE RECEIVE performance figures show the IC-910 to be adequately sensitive, the 23cm receive sensitivity being excellent, with reasonable if not outstanding unwanted strong-signal rejection all-round. The FM adjacent channel rejection was very good, although the SSB / CW skirt selectivity started to broaden out a little down below -50dB or so, possibly confirming the slight amount of phase noise I suspected from on-air tests. The close-in intermodulation rejection likewise appeared to be artificially improved by the noise masking the signal levels. On transmit, the harmonic levels were very adequately suppressed, the SSB transmit intermodulation quite reasonable for the type of PA in use, although some close-in noise was evident on the recorded 23cm plots.

PSU LIMITATION

I TESTED THE IC-910H using three different amateur-specification (non-Icom) power supplies, each capable of at least 30A output, and I had severe problems with one. Here, when transmitting on maximum power on 2m and occasionally on 70cm, even when into a dummy load, the indicated current on the front-panel PSU meter would slowly rise and the transmission became unstable, the transceiver eventually switching itself off. Transmitting at 25W or below was fine.

Investigation showed this to be RF fed via the DC cable back into the CE-marked PSU, which affected its operation and regulation. The mandatory standard for commercially-available amateur equipment, ETS 300 684, has an optional 'exclusion' in the required tests for short DC cables, eg less than 3m in length, where tests of such RF levels etc at the DC port need not be made. Could this explain the fairly short 1m DC cable supplied with the IC-910H? Mind you, a short cable is by far the best for reducing voltage drop!

CONCLUSIONS

ALTHOUGH I wouldn't term the IC-910H a hill-top contest grade transceiver, it should very adequately fulfil the needs of many VHF / UHF DXers and amateur radio satellite users, as well as being a powerful FM transceiver in its own right for speech, data, and *DXCluster* use. The facility of built-in remote masthead amplifier control will be a boon to many serious users, and the 23cm option is a welcome addition especially for mode L satellite enthusiasts as well as terrestrial and 'moonbounce' operators.

Our thanks to Icom UK, tel: 01227 741741, for the loan of the review transceiver. ♦

ICOM IC-910 LABORATORY RESULTS

All measurements carried out on 144.300MHz in USB mode, with attenuator disabled (default setting) and with set powered from stabilised 13.8V DC using supplied length of DC lead, unless otherwise stated.

RECEIVER

FM Adjacent Channel Selectivity
Measured on FM as increase over 12dB SINAD level of interfering signal with 400Hz modulation at 1.5kHz deviation, causing 6dB degradation in the 12dB SINAD on-channel signal.

	FMN	FM
+12.5kHz	60.3dB	29.6dB
-12.5kHz	60.2dB	31.6dB
+25kHz	68.5dB	67.7dB
-25kHz	68.3dB	68.6dB

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

10kHz spaced signals:	81.5dB
20kHz spaced signals:	83.2dB
50kHz spaced signals:	78.1dB
100kHz spaced signals:	77.1dB

S-Meter Linearity

Indication	Sig Level	Rel Level
S1	0.29µV pd	-18.8dB
S2	0.33µV pd	-17.7dB
S3	0.39µV pd	-16.3dB
S4	0.47µV pd	-14.6dB
S5	0.65µV pd	-11.8dB
S6	0.88µV pd	-9.2dB
S7	1.23µV pd	-6.3dB
S8	1.85µV pd	-2.7dB
S9	2.56µV pd	0dB ref
S9+20dB	20.9uV pd	+18.3dB
S9+40dB	153µV pd	+35.6dB
S9+60dB	902µV pd	+51.0dB

SSB / CW Selectivity

-3dB	1.89kHz
-6dB	2.34kHz
-20dB	2.81kHz
-40dB	3.43kHz
-60dB	4.45kHz

Blocking
Measured as increase over 12dB SINAD level of interfering signal, unmodulated carrier, causing 6dB degradation in 12dB SINAD on-channel signal.

±50kHz:	88.2dB
±100kHz:	94.0dB
±200kHz:	99.4dB

S-Meter S9 Level

Freq MHz	Sig Level
144.300:	2.56µV pd
433.200:	2.98µV pd
1296.200:	1.85µV pd

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

SSB / CW	
144.300MHz:	0.07µV pd
433.200MHz:	0.09µV pd
1296.200MHz:	0.08µV pd
FM	
145.500MHz:	0.16µV pd
433.500MHz:	0.16µV pd
1297.500MHz:	0.14µV pd

Image Rejection
Increase in level of signal at the first IF and second IF image frequencies, and the first and second IF, over level of on-channel signal, giving identical 12dB SINAD signal.

Freq MHz	1st Image Rej	1st IF Rej	2nd Image Rej	2nd IF Rej
144.300	88.8dB	96.4dB	-	-
433.200	86.4dB	98.0dB	94.5dB	94.2dB
1296.200	>100dB	>100dB	72.9dB	>100dB

TRANSMITTER

FM Deviation

	Peak	Toneburst
145.500MHz (FMN):	2.40kHz	1.65kHz
145.500MHz (FM):	5.09kHz	3.50kHz
433.500MHz (FMN):	2.37kHz	1.66kHz
433.500MHz (FM):	4.95kHz	3.46kHz
1297.500MHz:	5.10kHz	3.71kHz

Harmonics
Measured level of transmit harmonics up to 2GHz.

Freq	2nd	3rd	4th	5th	6th	7th
144.300	-78dBc	-72dBc	>-90dBc	>-90dBc	>-90dBc	>-90dBc
433.200	-87dBc	-71dBc	>-90dBc	-	-	-
1296.200	-	-	-	-	-	-

SSB IMD Performance
Measured with a two-tone AF signal, results given as dB below PEP level, measured at mid ALC with SSB processor off. Tabular figures refer to level of unwanted signal below (lower in frequency than) the wanted two-tone signal, and above (higher freq than) the two-tone TX signal.

	3rd	5th	7th	9th	11th Order
144.300MHz					
Below 2-tone sig:	-38dB	-56dB	-52dB	-58dB	-62dB
Above 2-tone sig:	-38dB	-53dB	-54dB	-56dB	-62dB
433.200MHz					
Below 2-tone sig:	-35dB	-43dB	-48dB	-52dB	-58dB
Above 2-tone sig:	-34dB	-41dB	-46dB	-52dB	-57dB
1296.200MHz					
Below 2-tone sig:	-29dB	-38dB	-42dB	-43dB	-44dB
Above 2-tone sig:	-29dB	-36dB	-41dB	-43dB	-45dB

TX Power and Current Consumption

Freq MHz	Max Power	Min Power
144.300:	101W/19.2A	2.23W/7.6A
433.200:	71W/21.8A	1.53W/7.0A
1296.200:	10.2W/4.7A	0.23W/2.6A

Frequency Accuracy

144.300MHz:	+182Hz
433.200MHz:	+104Hz
1296.200MHz:	-86Hz