

The Icom IC-9100 – The all round transceiver

Michael Coleman VK3KH and Peter Freeman VK3PF



Front view of the IC-9100.

Early in 2009, news began to filter out that Icom were planning a new radio that would pack more on board than anything they had previously offered. This radio was rumoured to be a multi mode HF/VHF/SHF radio that would combine many of the features of the IC-746pro (IC-7400) and the IC-910H, into one “box”. As with all good stories, the truth never got in the way of speculation. Of course, on-line blogs (including our own VK Logger) and YouTube videos all helped build the hype.

More than two years later the new radio has reached Australia, and your reviewers were excited when offered the opportunity to assess the radio. The radio arrived from Icom, plus the UX-9100 23 cm module and UT-121 D-STAR module were sent as well. They were not installed, as we had requested the opportunity to install them ourselves, and see how easy this was. The radio is double boxed for transportation, but we quickly managed to get it out of the box to have a look at it.

So, what is on offer?

The Icom IC-9100 is a multi band multi mode radio that offers:

- 1.8 MHz to 1300 MHz in one transceiver
- 100 W on 1.8 to 144 MHz, 75 W on 432 MHz and 10 W on 1296 MHz

- Independent dual receivers
- Modes including SSB, AM, FM, RTTY, D-STAR DV
- Satellite Mode operation
- High stability TXCO
- Two antenna connectors for HF and 50 MHz bands, with an automatic antenna selector and antenna tuner, and one each for 144 MHz, 430 MHz and 1.2 GHz* are included in the IC-9100 (*when the optional 1.2 GHz module is installed)
- USB connectivity
- Improved DSP filtering.

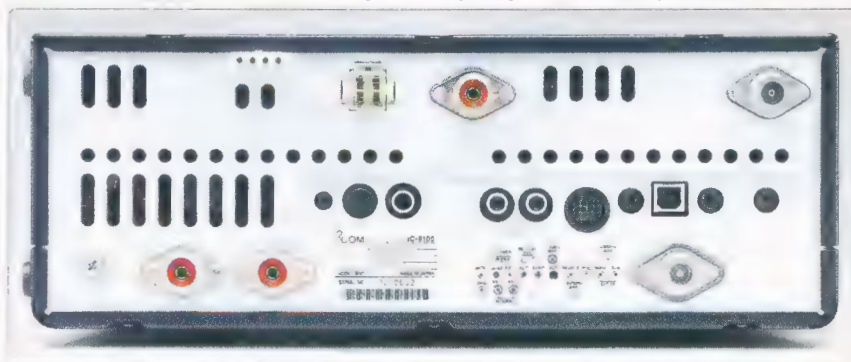
Transceiver design overview

This offering from Icom is a medium-sized base station transceiver requiring a 13.8 V DC power supply. It is reasonably heavy, at 11 kg.

In commercially available amateur transceivers, the heart of performance is usually that of the receiver. In the case of the IC-9100, there are two receivers – Main and Sub. Both use double conversion superheterodyne layout before feeding the IF signal to either the Main or Sub IF and DSP systems. The audio outputs from the DSP systems are then fed to a common audio system. If you have installed the UX-9100 23 cm module, a triple conversion system is used.

The final IF for both Main and Sub bands is 36 kHz, each feeding directly to similar DSP units for all signal processing functions. This includes noise reduction, channel filtering, notch filters, pass band tuning and noise blanking. Optional

View of the rear panel, with clean layout and plenty of interface options.



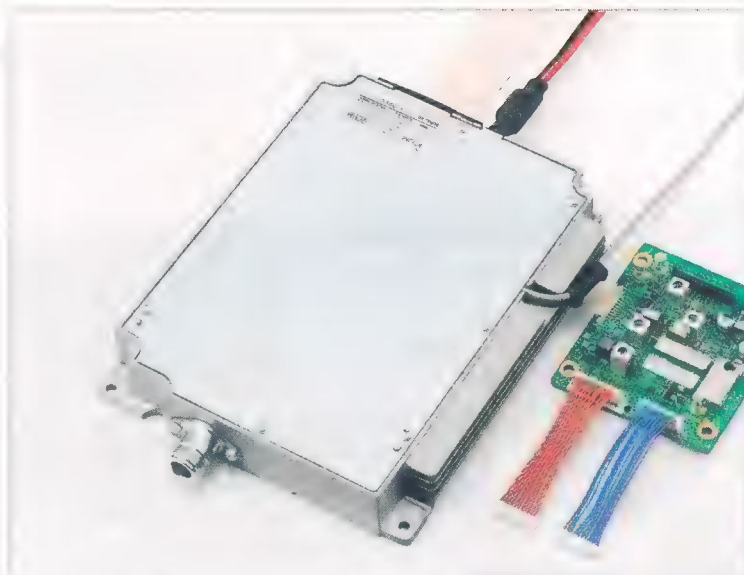
roofing filters (6 kHz and 3 kHz) are optional extras available for the HF/50 MHz.

The two receivers are completely independent, allowing simultaneous reception on any two bands at a given time – but note that all the HF bands and 6 metres count as “one band”: You can listen to 50 MHz and any one of the higher bands at the same time, but not to 28 MHz and 50 MHz at the same time. It is therefore unlikely that this is the radio for a hard-core HF operator wanting to monitor more than one band in a single radio. However, the transceiver does perform extremely well as a general transceiver and will suit many operators interested in VHF and above. For each of the Main and Sub bands, you have the choice of two VFOs, allowing rapid change between frequencies and split operation on the main channel. On the HF/50 MHz band, the receiver tunes 30 kHz to 60 MHz, making a useful general coverage receiver.

As one might expect from a modern transceiver, there are many available programmable memories – 99 per band, giving you 396 memories if you have the UX-1200 module installed. In addition, there are 6 scan edge channels per band (18 or 24), 1 call channel per band (3 or 4) and 20 channels for satellite operations.

With the dual receivers, full duplex operation between the Main and Sub bands is a breeze, together with full tracking satellite operation. Add the UT-121 and you have access to all the Digital Voice (DV) D-STAR modes on 2 m, 70 cm and 23 cm bands.

A useful inclusion is an auto antenna tuning unit for HF/50 MHz operations. It will cope with a VSWR of up to 1:3 on all the HF bands and 1:2.5 on 6 m. The transceiver will record in memory the tuner settings for each



The UX-9100 23 cm module and its IF board.

frequency range, in 100 kHz steps. For a broader matching range, the IC-9100 can interface with other tuners, such as the AH-4 tuner which will match a 7 m whip or long wire antenna on the bands 80 m and above.

There are many other interface options accessible from the back panel, including external amplifiers, GPS receiver and a USB port.

Those interested in further details can examine the product brochure or download the 202 page operation manual (42 MB) from the internet prior to committing your funds. Included with the radio are a set of circuit diagrams in addition to the operating manual.

The radio in operation

The IC-9100 is a modern looking radio with all black cabinet and knobs. The white lettering on this background made it very easy to read the control labelling. It looks right at home in the shack, and for a radio with so much packed in, takes up minimal shelf space.

The front panel features a large LCD multifunctional display that is easy to read. It shows frequencies on both receivers, the mode in operation, a multi function bar meter, and access to the menu functions.

The manual for this radio, however, is daunting. Two hundred and two pages of necessary reading, especially if you are plan to get the

most out of your new radio. A Quick Guide, either in the front of the manual or as a separate document would make getting it on air easier. It would seem obvious that a radio with so much in it would need a big set of driving instructions! 50 pages are dedicated to the intricacies of D-STAR operations, which can be somewhat daunting for a newcomer.

On the other hand, VK3PF had no problem in exploring the basic operation of the IC-9100, as the radio

controls for band changing and other simple operations are similar to the IC-910H. Of course, a more detailed exploration of any radio will require one to explore the manual as well.

After connecting 13.8 volts and an HF 80 metre/40 metre dipole, it was time to finally tune the HF bands. This was about 11 pm at night and both 80 and 40 metres had no activity. A scan of 20 metres, however, quickly showed that it was open to Europe and the first station encountered was LZ1MS. He was a strong 5/8 (on the 80/40 dipole). The audio from the IC-9100 was really nice and a number of VKs working him gave similar reports to what was being heard.

Engaging the dual receivers and putting on headphones, it was great to be able to listen to two different bands, one in each ear. You can adjust the volumes individually, and if you want to concentrate on one band, disabling the second receiver gives you one band in both ears. Nice!

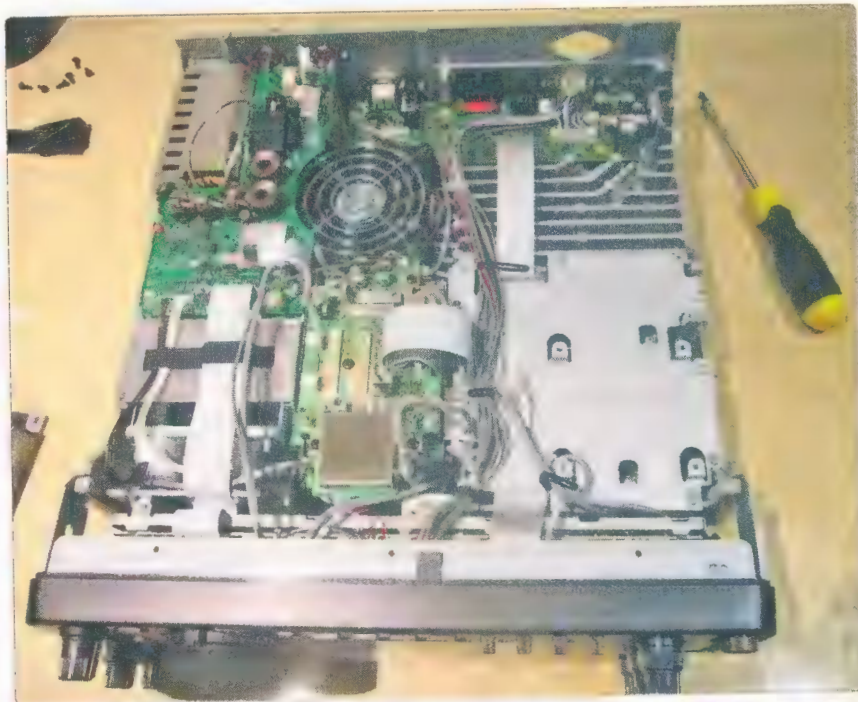
As 144 MHz was on the second receiver, it was time to look for local beacons. The VK5RSE two metre beacon at Mt Gambier was 549, a distance of over 380 km. A listen with the “usual” radio on the same antenna produced a 539 report. The audio on the IC-9100 was also more natural.

Over the next few weeks, contacts were carried out across all the bands. The noisy 3.5 MHz and 7 MHz band really showed off the improvements in the DSP on this radio. By selecting and adjusting the right filter the DSP made a big difference. It was able to pull an unreadable signal out of the S9 noise, and there seemed to be less "ring" than with the DSP on predecessor radios like the IC-7400.

Transmit audio reports were always very positive, and the default setting on the Compressor produced surprising compliments. Often compression circuits can produce an overdriven sound, but the Icom seemed to be able to produce noticeable punch without any apparent side effects. You can always get in to the radio's copious menus and adjust the audio till it overdrives, if that is what you want!

One noticeable feature was the excellent receive audio quality. The sound from the in-built speaker was clearly "rich" from the start. During later exploration of the receiver performance, the standard settings were used to feed the Spectran audio DSP software package. Listening to a weak distant 2 m beacon, it was clear that the receiver audio passband was very flat in its response, with very fast roll off at the edge of the passband – demonstrating the excellent performance of the DSP system in the receiver. Of course, one can adjust the receive passband characteristics via the DSP controls.

It should also be noted that strong signal performance was also excellent. Whilst listening to the VK3RED beacon on 144.436 MHz at about 10 dB above the noise, we heard clear key clicks from the VK3RGI beacon on 144.434 MHz. The keying on VK3RGI could be better, and VK3RGI was at least 60 dB stronger than VK3RED. We were pleasantly surprised – the receiver performed very well using the default settings, considering the characteristics of VK3RGI with its much stronger signal only 2 kHz away. If we had wished, we could have significantly reduced the



Bottom view of the IC-9100, ready for the installation of the 23 cm unit.

VK3RGI signal using some of the many DSP controls in the IC-9100.

As previously mentioned, the 1200 MHz module was supplied separately. We asked for it this way, as it would allow a look inside, and an opportunity to see how easy the install was. Inspection inside the unit showed extensive diecast aluminium used in the chassis for heat dissipation, plus a large fan over the Power Amp section. The only time the fan was noticed was whilst using FM on two metres.

Installation was really straight forward, and the instructions were adequate to ensure everything went smoothly. Install time was 25 minutes, although it was delayed a little as we took some photos which we have included in this report.

Once installation was complete, a pair of 36 element 23 cm Yagis were connected, and some country beacons were checked. The VK5SRE beacon was 519 at 380 km, and the Ballarat 23 cm beacon was 599 at about 100 km. The receiver definitely works well!

This radio also has a D-STAR DV option, although time did not allow this to be checked out.

The only real disappointment with this radio was the inability to set power output at different levels on

different bands. This was the same on the IC-746 series (IC-7400) and the IC-910H, and it is frustrating if you want to follow the radio with external power amplifiers that require different drive levels. In addition to this, the Power Output meter is only calibrated as a percentage of total output power, so if you want to run QRP at 10 W on 3.5 MHz, you set the power to 10% output.

Technology

Our hobby has become more diverse over recent years, as computer technology is embraced both in radio transceiver design and in operator's own lives. Computers and the internet have meant more operators have begun to explore how they can control their radios in ways never before possible. Also new modes, including the growing list of Digital modes, mean that amateur radio operators are finding many new means of making a QSO. The growing number of operators who now have made successful EME contacts on 2 metres using JT65b is a classic point in case.

The Icom IC-9100 incorporates this technology, and allows access to these new modes that more amateurs are exploring. It does this by incorporating a USB port



The location for the installation of the UX-9100.

for connecting your radio to your computer and the internet.

This brings up one minor issue. Frequency stability can be important for some of these weak signal digital modes. For most operators, the IC-9100 will probably be adequate for 2 m and 70 cm operations on digital modes.

Measurements on the 2 m band simulating JT65 operations (almost 50 seconds transmit time in each 2-minute period) showed a shift in frequency of only 5 Hz after each transmit period. One would therefore expect a shift of approximately 15 Hz on 70 cm and 45 Hz on 23 cm.

In the IC-9100, frequencies are generated from a single 30 MHz high stability oscillator driving the Direct Digital Synthesis units in the PLL unit. The system shows a period of drift during warm up, as do most transceivers. However, our measurements show good performance after this initial warm up period for most typical operations.

Some of us are keen to explore the limits of weak signal VHF and UHF performance using the digital modes and might seek to have better stability than the already excellent performance of this transceiver. I wonder if Icom might consider making available an optional module allowing the use of an external high quality frequency source (such as a 10 MHz source like a Rubidium oscillator or GPS-locked TCXO)? All that would be needed would be an adequate injection level (perhaps a buffer circuit) and a tripler and filter prior to injection of the 30 MHz at the appropriate place on the PLL unit. My guess is that there may be some

potential users out there willing to possibly void their warranty if they find that their requirements are not met by the existing PLL unit.

If you are looking for remote control, Icom have even covered this with optional RS-BA1 Remote Control Software, enabling the radio to be controlled from elsewhere in the house/shack, or anywhere in the world where you can access the internet. Also available is the CS-9100 cloning software package, which allows one to program settings, memory channels and set mode contents easily from a PC via the USB interface.

Summary

It is state of the art, it is nicely set out, and once you have learnt your way around the amazingly in-depth menus and controls you will be able to enjoy whichever part of our diverse hobby you personally want from it. Whether you are a lowbander, a HFer, a VHF/UHF FM operator, a weak signaller or an aspiring microwaver,

this radio will cover your needs. It will also allow you to go to other parts of our hobby you may not have previously explored.

At around \$4000 (without the 1200 MHz option, which costs approximately \$650) it will not be for everyone, but if you are looking for a base station radio that will cover all your normal operating requirements, incorporates the latest technology and gives you new frontiers to explore, then no other radio offers you what the Icom IC-9100 can offer you. Interestingly, one Australian retailer reports that 85% of purchasers were adding the 1200 MHz module and the D-STAR DV option (\$279). Covered by a five year warranty, Icom are confident that this radio will prove very reliable. Judging by the high level of take up, and the back orders for stock, it seems that many Australian amateurs have already made their decision.

We thank Icom Australia for the loan of the radio.

Band	FM	SSB	
144 MHz		0.08 mV MDS	-148 dBm MDS
432 MHz		0.08 mV MDS	-148 dBm MDS
1296 MHz		Not measured	Approx. -150 dBm MDS

Table 1: Receive sensitivity tests on the test transceiver on the bands 2 m and above, using a calibrated HP signal generator for 2 m and 70 cm. The figure for 23 cm is estimated from the second harmonic from the signal generator. These figures are excellent for these bands.

The UX-9100 module and IF board installed, ready for the radio bottom cover to be replaced.

