

■ Equipment Review

ICOM IC-706 All Mode HF, 6 m and 2 m Transceiver

Reviewed by Ron Fisher VK3OM



The small HM-103 microphone makes the IC-706 look even smaller than it really is.

If you think the title description looks interesting, just wait until you have read the whole story on this incredible piece of equipment.

Let's say you are looking for a new transceiver; what would you want it to do? Well, naturally, it would have to cover all the HF amateur bands. Oh, and why not include six metres? You would want 100 watts output on all of these bands for good measure. Having gone this far how about including two metres as well? I have to admit this is all pushing the bounds of possibility too far, or is it?

The new ICOM IC-706 will do all of this and more in a package about the same size as a ten-year-old two metre transceiver. Just imagine all of this (and more as you will later see), wrapped up in a package 167 mm wide, 58 mm high and 200 mm deep and weighing just 2.5 kg.

IC-706 Features and Facilities

I guess everyone will want to compare the IC-706 with the Kenwood TS-50S which has now been with us for two and a half years (doesn't time fly!). In round figures the IC-706 is 4/5ths the size of the TS-50S. It's also 0.4 kg lighter in weight. The two most significant differences are the extended frequency coverage and the removable front panel on the ICOM.

The extended frequency coverage is remarkable in several ways. First, of course, is the coverage of both the six and two metre amateur bands. This is not an optional extra which you have to purchase and plug in — both bands are built in as standard equipment. However, the extended frequency coverage goes even further with continuous receive coverage from 30 kHz to 200 MHz.

This will enable you to tune in the activity from your local air port, have a listen to the local fire brigade and, if the bands are really dead, relax to some music from the FM broadcast band. ICOM have included a wide FM selectivity position to allow this to happen.

Getting back to the amateur side of things, let's see what facilities you get and, believe me, you get plenty. With only five knobs and fourteen buttons on the front panel, ICOM had to come up with a way to control the numerous functions they have included in this transceiver. This has been achieved in two very unique ways. First, the incredible menu system to allow the operator to cycle through the various options; and second, the alphanumeric dot matrix LCD that tells you exactly what is happening. There are something like forty three functions that can be set and controlled via the menu setup. In addition to this, there are another twenty four parameters that can be set-up in the initial "switch-on mode". These are the set and forget items, such as display back lighting, scan speed, control beep on/off, etc.

Cooling is very important in a 100 watt transceiver of this size and ICOM have chosen to have the cooling fan run continuously while the transceiver is in receive mode, and increase in speed when in transmit mode. I found the fan noise slightly annoying when the transceiver was used in a quiet room but, if the rig was used mobile, this would not be an issue.

The tuning system is typical ICOM. Two VFOs, and 102 tunable memories made up of 99 normal memories, two scan edge setting points and one call channel. You can also give your memories a name, such as identifying a two metre repeater with its location. The keen CW operator has been well catered for with a built-in electronic keyer, and CW reverse mode so you can flip from USB to LSB to help reduce interference. Also, the receive CW pitch can be adjusted over a 600 Hz range from 300 to 900 Hz.

There is also a selection of CW filters available as options with 500 and 250 Hz bandwidth available. There are also two optional SSB filters available with a narrow

bandwidth of 1.9 kHz and a wide bandwidth of 2.8 kHz. I would very much like to try the latter. One slight problem with the optional filters is that the transceiver has only space for one extra filter. You will need to choose carefully.

ICOM HM-103 Microphone

The HM-103 is supplied as standard with the IC-706. It is a new design and certainly looks very smart. The curly cord easily extends to over a metre in length and is terminated in an eight pin plastic miniature connector. The internal element is an electret and, in fact, the circuit appears to be very similar to the earlier HM-12. The up/down buttons are on the top of the microphone rather than on the top edges of the HM-12. I found it difficult to get my fingers on these buttons due to their proximity to the metal "hang up" bracket.

If you want to use a standard ICOM microphone with your IC-706, an optional adaptor lead is available that connects from the eight pin metal to the eight pin plastic connector.

IC-706 Remote Front Panel

Push the lock button on the left hand side and the front panel slides off. There are no messy connectors to unplug. Amazing as it might seem, there are only eight connections between the front panel and the main transceiver and these mate automatically when the front panel is fitted to the main chassis.

IC-706 on the Air

This is one transceiver where you definitely need to read the instruction book fully before you start to operate.

With many of the controls tied up in the menu system, learning to access them can only be sorted out by digesting the manual first. However, back to the beginning. The DC power connector is a now-standard six pin plastic connector so there are no problems here. The supplied microphone (an electret) is terminated in an eight pin telephone type plastic connector which can be plugged into either the front panel or into the rear panel of the transceiver main chassis. Two SO-239 coax connectors provide a separate

connector for HF plus six metres, and also for two metres as a dedicated outlet. For receive, the two-metre antenna connector covers from 60 to 200 MHz.

One of the nice features on the IC-706 is the ability to convert the squelch control into an RF gain control on SSB and CW. This is one of the features that can be set up in the initial "power-up" selection. In practice I found it to be a little tricky to use. Maximum RF gain occurs at the 12 o'clock position. At the same position the squelch should be just on. So if you advance the RF gain a little too far and then switch to AM you might find the receiver dead, and wonder why!

Tuning around, the receiver handles extremely well. The tuning control feels first rate. The finger hole actually rotates within the knob on its own bearing. You won't wear out your finger tip tuning quickly up the band. A small lever on the right side of the knob adjusts the tension from free spinning to firm with the action remaining smooth either way. Two tuning rates are selectable with the TS button and these give either 200 Hz per knob revolution in 1 Hz steps, or 2 kHz per revolution in 100 Hz

steps. You can also choose a 1 kHz stepping rate for quickly moving up or down the band. In addition to all of this, you can choose different stepping rates for different modes. For example, I set it up for 25 kHz steps for the two metre band and 9 kHz steps for the standard AM broadcast band.

Band changing is also arranged via the TS button in either one MHz steps or from one amateur band to the next. This was not always an easy procedure. It took one push of the TS button to get into the band change mode and then, after selecting the required band, two pushes of the button to get back into the normal tuning mode. At home on the bench this might not be any trouble but if you are mobile you might need some practice. I actually found the easiest way to change bands was to put them into memory, select your band with the up/down button on the microphone and tune to your required frequency from there. Talking about memories, you have one hundred and two to play with. Enough to enter your favourite amateur frequencies including all the two metre repeater and simplex channels, plus a few AM and FM broadcast stations.



The detachable front panel disconnected from the IC-706.

Received audio quality from the internal speaker was very restricted. However a reasonable external unit made a very marked difference. ICOM produce several excellent speakers to match the IC-706 and I suggest you look at one of these.

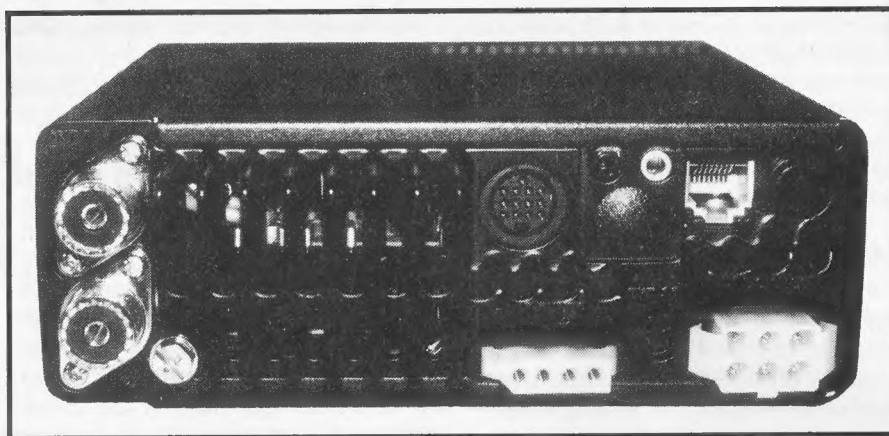
A single push-button operates the receiver pre-amplifier and attenuator. A small LED shows green with the pre-amp in and red with the attenuator in. I found that the use of the pre-amp was essential most of the time. The only time I could comfortably dispense with it was on 80 metres at night when signals were very strong. I found no use for the attenuator at all.

AGC action was very good. Either fast or slow decay times can be selected via the menu system. The slow setting gave about two seconds decay time from S9 which seemed just about right. I tried the noise blanker (again selected via the menu) and found it to be quite effective against car ignition noise but it had very little effect on power line noise. It didn't appear to introduce any noticeable cross modulation.

The IF shift was effective in reducing the effect of interference and you can even get a graphical representation of its position on the main display.

Talking of graphic displays, the IC-706 even includes a sort of spectrum analyser display. It's an interesting idea but I found it too small to be of much practical use; however, it does give an idea of the facilities packed into the transceiver.

Now over to the transmit side. Firstly, let's look at the facilities provided. Three metering scales can be selected, again via the menu system. These are power output, ALC and SWR. Other menu selectable or adjustable parameters are power output, microphone gain control, audio processor on/off and the SSB carrier point control. This last feature allows the audio band pass to be moved up or down relative to the filter and so increase or decrease the high or low frequency response by +/- 200 Hz. In theory this is an excellent idea, but in practice the audio bandwidth is so narrow that it's really not possible to set the response



The rear panel of the IC-706. Note the separate SO-239 sockets, one for 160 to 6 m, and the other for 2 m.

to a point that produces really good quality.

On air reports on SSB were conflicting. Many amateurs thought the quality sounded OK, and many suggested it sounded very restricted and of poor quality. I took the transceiver to a friend to put it on-air and listened to it myself. I have to admit the audio was not to my taste. The conflicting reports caused me to devise a method of measuring the overall audio response (see test results later).

IC-706 on Test

I carried out the usual series of tests on the IC-706 plus a new one which I will come to later.

First I checked the power output on transmit and the current drain on each band through to two metres. Maximum output in CW mode was:

BAND	POWER OUT
160	107 watts
80	107 watts
40	105 watts
30	105 watts
20	102 watts
17	100 watts
15	100 watts
13	100 watts
10	97 watts
6	80 watts
2	8.5 watts

Power output on HF and 6 metres is continuously variable up to the maximum from a low of three watts. On two metres the minimum power output is one watt. PEP power output was slightly in excess of the above figures.

Current drain was measured at 18 amps with 102 watts output on 20 metres, and at 3 amps with 8.5 watts output on 2 metres. On AM transmit on HF, power output was 40 watts and I found that 80% modulation was the maximum attainable. With the output power reduced to 25 watts, 100% modulation could be achieved.

I then carried out tests to estimate the transmitter intermodulation distortion. As I have mentioned before, I do not have access to a spectrum analyser so the figures obtained are estimated on a comparative basis with a transceiver with known figures of distortion. The tests were carried out on 14 MHz with normal speech modulation. The IC-706 produced a figure of -22 dB which is about average for a 12 volt powered transmitter.

Now to a new test which I intend to carry out on all HF transceivers in future. In this case the test was prompted by the conflicting reports I received on the transmitted audio quality. I therefore decided to actually measure the SSB audio frequency response. This was done by feeding an audio oscillator into the microphone input and then measuring the resultant RF power output, which was then converted into relative dB. The output power was kept at around the 10 watt level so that ALC action would not affect the result. Also, the audio compression was switched out. The published curve tells the story but, in basis, the response shows a sharp bass cut below 600 Hz, with 500 Hz being the -6 dB point and 400 Hz being -12 dB.

The response above 1 kHz is rather uneven with a 6 dB difference between 1.2 and 1.5 kHz and the upper -6 dB point being at 2.5 kHz. All of this shows why the audio reports mainly indicated a lack of lows. Of course, it's fair to say that many prefer their audio to sound this way.

I did the same test on an ICOM IC-735 and found that the low frequency response was even more restricted with a much sharper cut off below 600 Hz. Of course, this does not take into account the response of the microphone which might well change the overall curve to some extent. I have since checked the response of quite a few other transceivers and it's quite amazing to see the vast differences between different makes and models.

Both carrier and sideband suppression were excellent, each being in excess of -60 dB down.

Receiver Tests

As usual the first test was to check the S meter calibration. It is not a meter as such, but a series of bars on the LCD. It's always difficult to get an actual calibration as each bar section "hangs on" for a large spread in the input signal. Anyhow, here is how I measured it at 14.2 MHz:

S1	1.2 μV
S3	1.4 μV
S5	1.6 μV
S7	3.0 μV
S9	8.0 μV
S9 + 20 dB	23 μV
S9 + 40 dB	160 μV
S9 + 60 dB	1400 μV

This test was done with the pre-amp on. The pre-amp has a gain of 20 dB and the attenuator has a loss of 20 dB. Receiver sensitivity was checked and found to agree exactly with the specification which is 0.16 μV for 10 dB S/N on SSB with the preamp on; 0.3 μV for 12 dB SINAD on FM measured on 146 MHz.

Sensitivity was very even right across the entire HF range but a bit lumpy from 30 MHz up to the maximum of 200 MHz. However for general listening it was quite good enough.

Received frequency response on SSB measured quite a bit wider for receive compared to the transmit figures. The -6 dB point at the low end was 250 Hz with the top end point being the same as transmit at -6 dB at 2.5 kHz. This was actually measured at audio so indicates that ICOM have not used too much audio top cut filtering. The response for AM reception was also very satisfactory with the following results:

Frequency	Response
100 Hz	-12 dB
200 Hz	-6 dB
400 Hz	-2 dB
600 Hz	-0.5dB
800 Hz	0 dB
1 kHz	0 dB
1.5 kHz	-0.5 dB
2.0 kHz	-2 dB
2.5 kHz	-4 dB
3.0 kHz	-6 dB
3.5 kHz	-10 dB
4.0 kHz	-12 dB

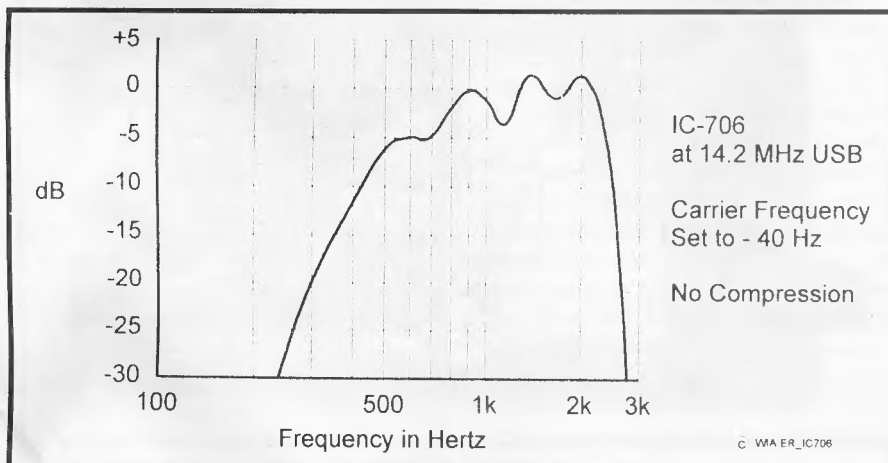
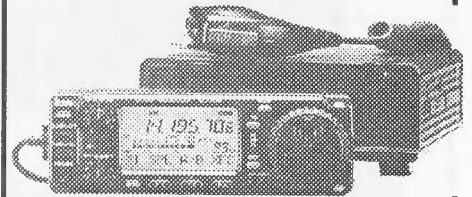


Figure 1 — A plot of the transmitted audio response of the IC-706, operating USB on 14.2 MHz with the carrier frequency set to -40 Hz.

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this ICOM IC-706
Txcvr worth \$2478

HF + 50 + 144 MHz

ALL MODES

100 W HF-6m/10 W 2m
Home/portable/mobile

WHO'S ELIGIBLE?

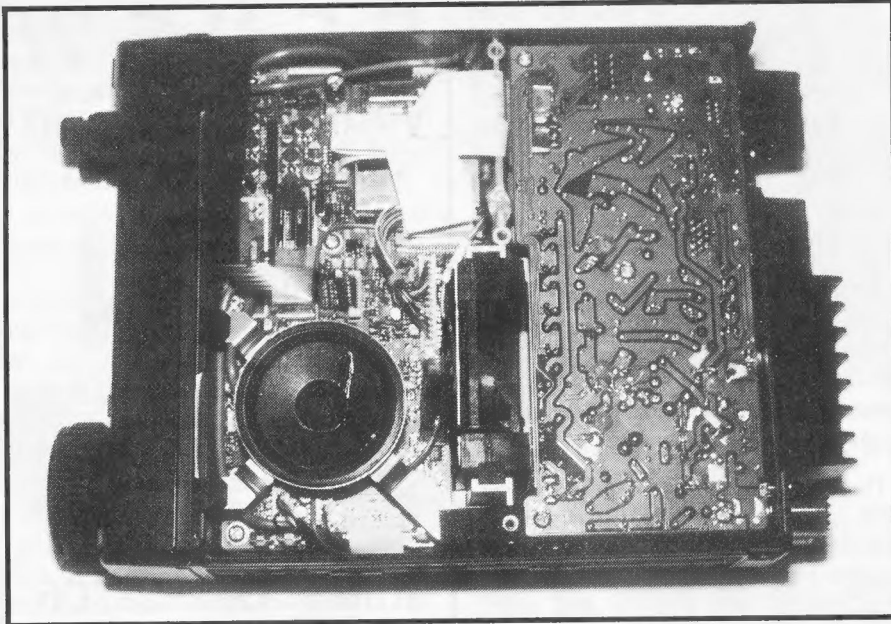
- current members who renew, or have already renewed, between 1/6/95 and 31/5/96
- persons who join, or have already joined, between 1/6/95 and 31/5/96
- current members who are on a 3-year membership
- life members
- all grades of membership

The IC-706 Txcvr prize, generously donated by Icom (Australia), will be awarded by way of a draw and the result published in July 1996.



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Further details are available from your Division, see contact details on p.3 of this issue.



Top view of the IC-706 with the cover removed, the centrally mounted cooling fan located just to the rear of the speaker.

While this may not be Hi-Fi standards, the quality on a reasonable external speaker sounds very acceptable. I had no way to measure the received frequency response on either wide or narrow band FM but, again, they both sounded very acceptable on my usual external speaker.

My final test was to check audio output and distortion. The external speaker output was terminated with either an 8 or 4 ohm load and audio power and distortion measured. The specification shows "more than 2.0 watts with an 8 ohm load". I measured a maximum output of 2.6 watts with 2.0 watts with 10% distortion. With a 4 ohm load connected there was a very useful increase to 4 watts maximum output.

Overall the tests indicated a very high standard of performance. Two aspects might be open to some criticism. Firstly, the SSB audio response. Reports showed that it was not always liked but then again many amateurs found it quite satisfactory. I have to admit that it is not to my taste, so check it out for yourself. By the way, the transmitted audio on FM is quite reasonable.

Secondly, the transmitter intermodulation distortion could be better, although it is about the same for other transceivers in its class, if that's any consolation.

IC-706 Instruction Manual

This has a total of 58 pages plus a separate menu operating sheet printed on heavy paper. If you intend to operate the IC-706 portable or mobile could I suggest you photo copy both sides of this sheet and pop them in the glove box.

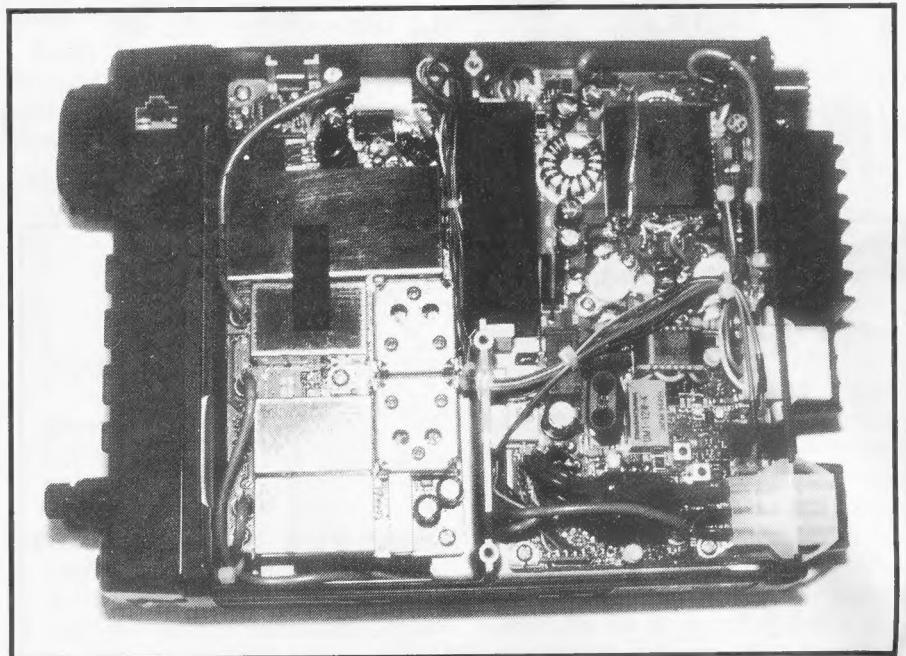
The book is presented in fourteen sections which include front panel

description, installation and connections, frequency setting, receive and transmit, memory and scan functions, set mode, maintenance and trouble shooting, and installation of the optional filters, voice synthesiser and high stability master oscillator.

Operational instructions for this extremely complex transceiver are very well covered with plenty of diagrams. Several adjustment points are shown on the two photos of the top and bottom circuit boards, but there is no description on how these should be set. Or, for that matter, no warning to keep clear if you are not sure what might happen. However, in general it is a well written book which covers everything an operator would need to know. Again, there is no technical description and not even a circuit diagram is supplied. I score the instruction manual seven out of ten.

IC-706 Conclusions

The IC-706 takes over where the famous Kenwood TS-50S left off. It provides many more facilities in a slightly smaller overall size. But with the remote front panel, the versatility has been increased a thousand times. Add to this one hundred watts on six metres, ten watts on two



Bottom view of the IC-706 with the cover removed. Note the microphone socket mounted on the bottom of the front panel below the tuning knob (top left in the photo).

metres and a full coverage receiver up to 200 MHz and you virtually have a complete amateur station in one very small box.

The list price of the IC-706 is \$2478.84, but Daycom presently has it on special for \$2400 even.

A matching antenna tuner will be available shortly for \$999.60 and I hope I will be able to report on this as soon as possible. Other accessories you might be interested in include a 500 Hz CW filter at \$152.88, and a 3.5 metre extension cable to make use of the remotable front panel will cost you \$76.44. There is also a matching power supply, a small switched-mode unit which is designed to go with, but not to match, the appearance of the IC-706. It is the PS-85 and will be priced at \$570.36. There are many other accessories to go with the IC-706 and your ICOM dealer has a full list available.

The review IC-706 was supplied by Daycom Communications Pty Ltd.

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■ Technical

Negative Resistance Revived

Lloyd Butler VK5BR takes a look at some interesting basic electronics*

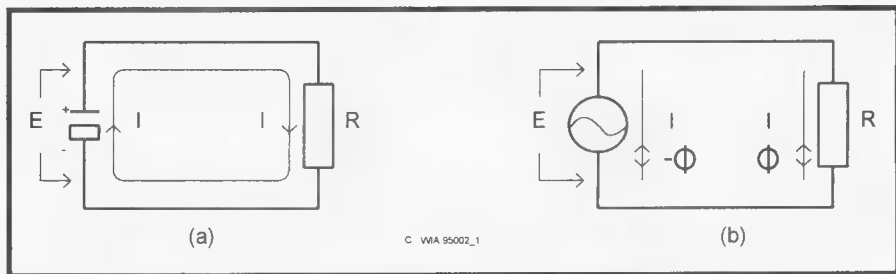


Figure 1 — Current and voltage relationships in generator and load.

Introduction

The concept of negative resistance

through resistance R is in phase with the applied AC voltage E. Current