



Equipment Review

Reviewed by:

Ron Cook VK3AFW
Lew Whitbourn VK2ZIP

IC-2GAT and IC-4GAT TRANSCEIVERS

Icom seem to have stolen a lead over their competitors in the field of hand-held amateur transceivers with this pair. A quick glance at their features shows why. These two rigs are almost identical twins; the IC-2GAT is for use on two metres FM and the IC-4GAT is for 70 centimetres FM. Unless otherwise stated, comments in this article refer to both units.

FEATURES AT A GLANCE

- ★ Small, compact FM transceiver with seven watts output on two metres and six watts on 70 centimetres.
- ★ Splash resistant case with rubber gaskets to prevent water entering the case.
- ★ 20 memory channels plus one call channel. Stores all information required to work any repeater.
- ★ Power saver. If there is no received signal for 30 seconds the current drain is reduced to one quarter of the normal receiver current.
- ★ Programmable frequency scan and memory scan, including the ability to skip selected channels.
- ★ Squelch open button (Squelch monitor function) to allow monitoring of weak signals without disturbing the normal squelch setting.
- ★ Pocket beep function: operated by reception of sub-audible tones (optional).

TECHNICAL DETAILS

FREQUENCY COVERAGE

IC-2GAT — 144-148 MHz.

IC-4GAT — 430-440 MHz.

TUNING STEPS: 5, 10, 15, 20 or 25 kHz.

POWER SUPPLY: 5.5 to 16.0 volts.

CURRENT DRAIN:

(at 13.2 volts DC) for the IC-2GAT receiver — power saver — 10 mA typical. Maximum audio — 250 mA.

transmitter — High — 7 (6) watts out — 1.8 amps. Low — one watt out — 0.9 amps.

RECEIVER DETAILS:

Double conversion superheterodyne with 16.9 MHz (21.8 MHz for IC-4GAT) first IF and 455 kHz second IF.

SENSITIVITY:

0.25 μ V for 12 dB SINAD. Audio output 400 mW at 10 percent THD into an eight ohm load.

SIZE:

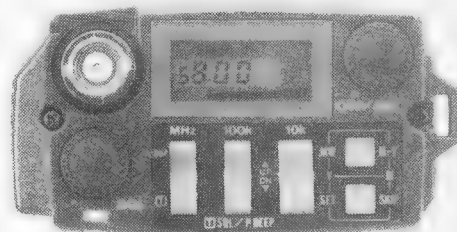
With BP-70 battery pack, 65 x 151 x 35 millimetres, weight 500 grams.

ACCESSORIES SUPPLIED:

Battery pack BP-70, charger BC-18, flexible antenna with BNC connector, hand strap and clip, belt clip and rain proof caps.

CONTROLS AND INDICATORS

With a small unit equipped with so many features, either very small controls must be used or each control must perform several functions. Icom have opted for the latter approach, fitting a *Function* button on the side panel. Pressing this at the same time as another button causes the second function to be executed. The controls are briefly listed and described in the following paragraphs.



TOP PANEL

There are two rotary controls, one for the volume/on-off function, the other for the squelch. A LED indicates when the transmitter is on. A BNC connector is provided for the antenna connection. Three rocker type switches allow selection of the operating frequencies in 1, 0.1 and 0.01 MHz steps. When pushed in one direction the frequency increases and when pushed in the other direction, the frequency decrease. Duplex and tone functions can be actuated through the alternative function mode for these switches. Two push buttons allow frequencies to be written to, or recalled from, memory, VFO/memory mode selection and memory skip operation.

A comprehensive LCD display gives the operating frequency in five digits (the hundreds of MHz are not shown); it also indicates duplex (+/-) or simplex operation, and memory channel number. A most useful feature is the provision of a wedge shaped bargraph display of RF output power level or received signal strength. Tone and squelch monitor operation are indicated by the characters "T" and "SQL". "SKIP" indicates memory skip operation and "LOW" denotes low power transmission setting is on. Unfortunately, no indication of the battery state is given. As the receiver will operate at voltages down to under five volts, reverse charging of some cells can occur in rechargeable battery packs giving 8.4 or 13.2 volts when charged.

SIDE PANELS

The function change button, PTT lever switch, light (for LCD display) button and battery pack release button are fitted on the left side panel.

Sockets for external microphone and speaker are on the right side panel. Sockets for the charger and external power supply are on the side panels.

FRONT PANEL

The loud speaker and microphone are behind this. Along side them are the Call, High/Low and Moni (Squelch monitor) buttons. In the duplex mode the Moni button allows monitoring the repeater input frequency. Beneath is an alphanumeric keyboard with 16 buttons which is used exclusively for DTMF audio tone transmission.

INSTRUCTION MANUAL

As with most modern instruction manuals, the one provided with this unit is well laid out with copious diagrams to aid the owner. It is necessary to read the manual to be able to access all the functions.



ON-AIR

The small size and light weight make this a delight to carry around. The sensitivity was found to be excellent and the higher power certainly cured the problem of being noisy into out-of-town repeaters.

A most appreciated function was the received signal strength indicator. No more experimenting to find the best position to get back into the repeater. No need to press the button to see if you are getting in either as a strong received signal indication is sufficient to ensure that you will get in.

Also, the ability to use the hand-held from the car battery without requiring a pre-regulator is a bonus. One of the reviewers has had a small box containing a pre-regulator, battery charger and PA to allow use of his hand-held in the car for extended periods. The extra box and associated cables are a nuisance that can now be done without. Of course, you will need to purchase the AD-12 external power adaptor which slides on in place of the battery pack. The extra power available when operating from the car is also very useful.

The recovered audio is of good quality and sufficient for most applications. In some vehicles, a larger speaker may be required for mobile operation, but in most the available level from the in-built speaker will be adequate.

ACKNOWLEDGEMENT

The review equipment for the section of the review was kindly made available by Icom Australia. Inquiries should be directed to Icom or their authorised agents.

FURTHER THOUGHTS ON THE IC-2GAT by Lew Whitbourn VK2ZIP

I have extensively used quite a number of synthesised hand-held radios: Icom's IC-2 thumb-wheel tunable model, their IC-02 microprocessor controlled radio, Yaesu's FT-203, 207 and 209, as well as Kenwood's TR-2400 and TR-260, and/or UHF versions of all these. I have not yet used any of the super-tiny multi-function radios that have recently appeared on the market, such as the IC- μ 2A, FT-23 and TH-25, so I cannot compare the IC-2GAT with any of those. However, the IC-2GAT is the best hand-held radio that I have ever used and it is certainly one that I would like to own. Nevertheless, there is always room for improvement. In the following sections I draw attention to areas in which the IC-2GAT excels and to others in which it could be even better.

FEATURES

It is good to see that Icom have, at last, decided to give us their top-of-the-line VHF hand-held, with sub-audible tone encoder and DTMF facilities included. (There are versions of the IC-2GAT without these). The emergence of a DTMF controlled digital voice bulletin board in Sydney is an indication of future trends. DTMF has many possibilities, with decoder chips readily available at Tandy Store for around \$24.95 these days. Also I find sub-audible tone and encode/decode to be the most widely accepted and least obtrusive of selective calling systems. A very interesting option is a sub-audible tone decoder with 'tone-beep' operation, allowing the radio to be used effectively as a pager.

OPERATION

Icom have achieved a very large number of functions with a relatively small number of keys. The trick is to have "modes" of operation: The VFO, MEMORY and SET modes are the main ones. Most keys have different uses in the

different modes and then there is a "function" key which gives a second function to most keys in most modes. You can toggle between the VFO and MEMORY MODES by pressing the V/M button and get into the SET mode from the VFO mode by pressing FUNCTION + V/M. This may sound complicated but I very quickly found it very user friendly. Operation is largely menu driven, especially in the SET mode, which is used to set sub-audible tone (from 38 standard frequencies), repeater offset, tuning step, scan limits and power saver ON/OFF. There is one other "official" mode, the CALL channel mode which you can toggle in and out of with the CALL button.

There is also, what I call, an "unofficial" mode, the SCAN mode. When the radio is scanning, most keys serve only to stop the scan, so that is a different mode of operation of the keys.

MEMORIES AND SCANNING

All 20 memories can store individual offsets, sub-audible tones, scan skip status and tone beep status. There are two separate memories for scan limits and there is a separate call channel memory. This is all great. In memory mode the radio can scan all the memories or skip any designated channels. In VFO mode it will scan between the scan limits set up in the SET mode. I like all this too, but I think it could have been done better.

To start scanning, press FUNCTION and the 10 kHz up or down keys. When scanning, the radio looks for, and stops on, a busy channel. Scan resumes after two seconds of inactivity on that channel or after 15 seconds, regardless of activity. This is an unusual mode of scanning, quite different than that used by Icom in their IC-02, and not particularly to my liking. If you want to stop on a particular busy channel, pressing almost any key suffices, which is fine. However, if you want to scan-on you must either wait 15 seconds (which can seem like forever on some channels) or stop the scan then restart, which takes two hands. It is alright the first time, but it gets you down after a while! It would have been possible in scan mode for Icom to designate keys for pause, resume and stop, rather than all stop. This would be a great improvement. Whist I am making a wish-list, the feature I have always hoped for is a scan between limits where some or all memories can be used to define channels (or sub-bands) to be skipped. *Go to it Icom!*

I did notice one interesting peculiarity with band scanning. If the current VFO frequency is not between the defined scan limits, A and B (which are set up in the SET mode as described earlier), the radio first scans to one or other of the scan limits before starting a cyclic scan between the two limits. This is quite puzzling at first. You can have scan limits at, say 146 and 147 MHz. If you happen to be at 147.5 MHz and press function and 10 kHz up, the radio first scans down from 147.5 MHz to 146 MHz! It is not a problem once you know about it, but I wonder whether this is a software bug or whether Icom have some reason for programming this behaviour?

RECEIVER

I measured the receiver sensitivity to be 0.15 μ V for 12 dB of quieting (and 0.25 μ V for 20 dB) from 144 to 148 MHz, which is exceptionally good. The receiver showed no signs of distress when connected to a base aerial, a half-wave 13 metres above ground level, less than 10 kilometres from, and line-of-sight to, the taller buildings of Sydney on which many commercial VHF and UHF services are located. Note also

that the American version of the IC-2GAT receives from 138 to 174 MHz. (The only difference is a diode or two in the microprocessor initialisation matrix). For such a broadband receiver the performance described above is outstanding. Icom have achieved this performance by using four varicap-tuned tracking filters in the receiver front-end. The DC tuning voltage is derived from the VCO voltage of the PLL frequency synthesiser. The same system is used in Yaesu's FT-23, which can receive up to about 163 MHz.

Tight squelch opens at 0.1 μ V or a little less. The LCD signal strength indicator has seven bars, which correspond to the following ranges of signal strength: 0.1 - 2.0, 2.0 - 2.3, 2.3 - 2.7, 2.7 - 3.0, 3.0 - 3.4, 3.4 - 3.7 μ V, and from 3.7 μ V upwards. These ranges correspond to 26, 1.2, 1.4, 0.9, 1.1 and 0.7 dB respectively for the first six steps. This is hardly the ideal response, but any S-meter is better than none.

Measured current drain on receive was 40 mA at 10 volts, with the receiver squelched, rising to 70 mA unsquelched at moderate audio level. The power saver comes in after 30 seconds of inactivity and has a 0.6 second cycle time. The current then drops to about 11.5 mA (the needle of my multi-meter was dancing between 10 and 13 mA). The power saver does not operate during scanning. You are, in fact, never aware of its presence but you would become aware of the very low current drain if you were monitoring a single channel for long periods. According to Icom, the only reasons for ever turning it off would be for reception of various data modes.

RECEIVER AUDIO

Received audio from the IC-2GAT was excellent. In fact, better than I have heard from a hand-held for some time. The trend with microprocessor controlled hand-helds has been to use smaller and smaller speakers in order to squeeze in all the other features. Icom have finally reversed the trend. There is plenty of audio output and it sounds good through the internal speaker. The audio level is actually acceptable in a not-too-noisy vehicle. This pleasant surprise is reflected in the specifications of the radio: 400 mW output into 8 Ω (at 10 percent distortion) for a total transmitter current of 250 mA. As usual with Icom, you can get the audio out. There is the standard Icom pair of speaker/microphone sockets on the right-hand side of the radio.

For comparison, the IC-2 had 300 mW of audio (at 140 mA) and the IC-02 was rated at 500 mW audio (also at 140 mA). The audio from the IC-2 was quite good and that from the IC-02 was awful, and certainly did not sound like 500 mW even through an external speaker. Readers suffering from this may be pleased to know that the audio quality can be improved dramatically by changing a capacitor in the audio frequency de-emphasis circuit, C117, from 0.22 μ F to 0.05 μ F. I am grateful to Bob Morrow WB6GTM, for this information. The same cure works for the IC-04. Make sure you get the right capacitor though, C118 is connected to C117, is right alongside it and is also 0.22 μ F!

TRANSMITTER

Icom state that typical powers with the BP-70 (11 cells: 13.2 volts at 270 mAh) and BP-3 (seven cells: 8.4 volts at 270 mAh) battery packs and seven watts and 3.5 watts respectively. I measured corresponding powers of 7.5 and 3.9 watts with freshly charged packs. Working through all the figures in the handbook I deduced that the current drains powers and overall

efficiencies for the BP-3, BP-70 and BP-5 (nine cells: 10.8 volts at 450 mAh) are:

	P (W)	I (mA)	Efficiency (%)
BP-3	3.5	1350	34
BP-5	5	1500	32
BP-7	7	1800	30

The efficiency is fairly constant. On low power the IC-2GAT seems to give about one watt (I measured 0.9 watt for both BP-3 and BP-70 packs) for any battery pack, at a current drain of about 0.9 amps or an efficiency that varies from 13 percent for the BP-3 to eight percent for the BP-70.

It is interesting to compare this performance with that of earlier Icom hand-helds. The IC-2 gave a guaranteed power of 1.5 watts with a BP-3 (8.4 volts) for a current drain of 600 mA, with a corresponding overall efficiency of 30 percent. The IC-02 gave three watts with a BP-3 for a current drain of 1.05 amps, yielding an efficiency of 34 percent. However, well tuned IC-2s gave 2 to 2.5 watts for about the same current drain, or overall efficiencies up to about 50 percent. I suspect that the difference is that the IC-2 used discrete devices whereas the IC-02 and IC-2G use broadband high power chips for RF power generation.

BATTERY PACKS

You need at least two battery packs with a radio like the IC-2GAT and Icom offer a wide variety to choose from:

TYPE	CELLS	VOLTAGE	CAPACITY (mAh)	LENGTH (mm)
BP-2	6	7.2	450	39
BP-3	7	8.4	270	39
BP-5	9	10.8	450	56
BP-5A	9	10.8	450	80
BP-7	11	13.2	450	80
BP-8	7	8.4	800	80
BP-70	11	13.2	270	61

The capacities quoted here are from the handbook supplied with the radio and some are a little higher than quoted by Icom elsewhere. For instance, the BP-3 is usually rated at 250 mAh and the BP-2, BP-5, BP-5A and BP-7 at 425 mAh. I measured the capacity of the BP-70 supplied with the radio to be 280 mAh at a discharge current of 40 mA.

Although the BP-70 is about 20 millimetres longer than the BP-3 supplied with most earlier Icom hand-helds, the shorter body of the IC-2GAT more than compensates for this with the result that, with the BP-70 it is still about 10 millimetres shorter than the IC-2 or IC-02 with a BP-3. To my eye the IC-2GAT looks about the right size with the BP-70 and the BP-3 makes it look short. However, I am not keen on drawing 1.8 amps from 11 270 mAh cells in series — some are bound to end up reverse polarity (and probably short circuited) eventually. My choice for a second battery pack would be the BP-5, which will still give about five watts and has 450 mAh capacity.

However, the BP-70 battery supplied with the IC-2GAT has two good things going for it. At 61 millimetres long it is long enough to fit eight rechargeable penlight cells (AA size) which can be purchased quite reasonably in 500 mAh or even 600 mAh capacity and could be used to replace the original 270 mAh cells. Also the BP-70 has two sockets, one for a one millimetre DC coaxial jack for charging and the other for a two millimetre DC coaxial jack labelled 13.8 volts. At first I thought that the latter socket was to allow external power to the radio. You can even hear an internal relay click over when you plug a 13.8

volts source into the two millimetres socket. However, I discovered in the handbook (and verified) that both sockets are for charging and the relay clicks over when power is applied to either socket. When being charged, the BP-70 only lets enough current through to the radio for receiving. The relay must be responsible for this.

I cannot say any more about this strange behaviour because the circuit of the BP-70 is not supplied with the radio. Quoted charging time for the supplied BC-18 charger, which is a 12 volt 300 mA plug-pack, (17 volts open circuit), is nine hours, so the BP-70 must limit charging current to 45 mA. No time is quoted for charging through the 13.8 volt socket, but I wouldn't recommend using it for charging because 11 nicad cells will rise to about 15.4 volts when fully charged, so current regulation over the charge cycle would vary from difficult to impossible. Current regulation from the BC-18 would not be much better. However, the good thing about the BP-70 here is that, with two sockets and an internal relay included you could easily rewire it to allow external power to the radio through one socket and safe (ie externally regulated/monitored) charging through the other.

SUMMARY

Don't be put off by my fault-finding, I love the IC-2GAT. It has a very sensitive, well-behaved receiver, lovely audio and plenty of RF power it you want it. It has sub-audible encode (optional decode), DTMF and 20 full function memories. All the accessories for the IC-2 and IC-02 series radios still work with the IC-2GAT. The back-lit display is beautiful — I only wish you could leave it switched on for base and mobile use! My review unit was kindly supplied by Practronics, PO Box 47, Peakhurst, NSW, phone (02) 533 2753.



ABOUT THE AUTHOR:

LEW WHITBOURN VK2ZIP, was first licenced as VK2ZLB in 1975. While living in Melbourne and Canberra since then he has also had the call signs VK3ZSQ and VK1ZLW, respectively.

His work involves research on long-wavelength lasers and optical techniques (300 GHz to 30 000 GHz) and he has worked for several two to three year terms at a number of universities and laboratories throughout Australia and has also spent a period in France. Currently he works for the CSIRO Division of Exploration Geoscience, at North Ryde, New South Wales, on development of an airborne carbon dioxide laser system for active remote sensing of minerals.

Lew's main interest in amateur radio is in the design and construction of antennas, and analogous optical systems, which present a fascinating combination of mechanical and electrical constraints and are readily tested at VHF and UHF. He is also interested in propagation at these frequencies and in the technology of hand-held radios. He operates occasionally on the two metre, 70 centimetre and 477 MHz FM bands.

Other interests include sailing, French, computers and, as a matter of necessity, car maintenance!

IAN J TRUSCOTTS

ELECTRONIC WORLD

FOR ALL YOUR COMPONENT REQUIREMENTS

MAIL ORDERS WELCOME

AMATEURS REBUILD YOUR TRANSCEIVER NICAD PACKS OR LET US DO IT FOR YOU.

- * LARGE RANGE NICAD BATTERIES AVAILABLE
- * SPECIAL PACKS MADE-UP TO YOUR REQUIREMENTS
- * ICOM REPLACEMENT NICAD BATTERY PACKS

ALSO SEALED LEAD ACID AND GELL CELLS AVAILABLE.

SEND S.A.S.E. FOR FURTHER INFORMATION.

30 LACEY STREET
CROYDON 3136

Phone: (03) 723 3860
(03) 723 3094