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ICOM IC-2GAT Hand-Held 2-Meter FM Transceiver

Conducted By James W. Healy, NJ2L
Assistant Technical Editor

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Reviewed by Brian Battles, WA1YUA

The IC-2GAT is the biggest sibling—both physically and functionally—in ICOM's line of 2-meter hand-held transceivers. It's a hefty 7-watt radio with plenty of features and sturdy construction. The IC-2GAT is one of a sub-family of ICOM hand-helds that includes the IC-4GAT for 440 MHz, the IC-12GAT for 1.2 GHz, and IC-32AT, which covers the 144- and 440-MHz bands. These rigs are ICOM's hand-held "muscle machines." Although ICOM's latest 2-meter hand-held, the IC-2SAT, is flashier, the '2GAT, introduced around May 1988, shouldn't be ignored. It has unusually high power output, allowing effective use in mobile, portable *and* base-station situations—something few rigs can claim.

Controls and Operation

Here's another of those radios that *seems* tricky to operate, but is easy to handle once you've played with it for a little while. The rig's front panel sports a 16-button DTMF pad with small rubber buttons, and three separate buttons marked **CALL** (user-preset memory frequency), **H/L** (high/low RF power output), and **MONI** (for checking activity on a repeater-input frequency). On the left-hand side is the **FUNC**tion button, which modifies the operation of several other controls, a large **PTT** button, and a small bar that controls the display lamp.

Mounted on top of the rig, facing upward, are the liquid-crystal display (LCD), power/**VOL** and **SQ**ue**L**ch knobs and a BNC antenna connector. The LCD shows the frequency (10-MHz through 10-kHz digits and a 5-kHz annunciator), memory channel number, status of the lock function, transmit offset (+, – or simplex), **SKIP** (to indicate if you have disabled a particular memory channel), and readouts to indicate the status of the tone squelch and power. A 7-segment, bar-graph received-signal-strength meter rounds out the display.

Three multipurpose, momentary-contact rocker switches just below the display (**MHz**, **100k**, and **10k**) make frequency and function changes. The **FUNC**tion key modifies the operation of these rocker switches. For instance, holding **FUNC** down while depressing the **10k** rocker initiates upward or downward scanning, running through the memories while the rig is in memory mode, or scanning across the covered receive frequencies when in VFO mode. The radio receives from 138 to 174 MHz, and you can define the upper and lower scanning-frequency limits within this range. This essential feature lets you avoid stopping on continuously busy frequencies, such as those used by local NOAA weather broadcasts. When scanning, the rig stops on any received carrier and remains for 15 seconds before continuing. When a carrier drops, the radio waits 2 seconds before resuming scanning. The scan can be halted at any time by pushing any button or switch on the rig (except the display-lamp bar).

Two small square buttons share the top of the rig, to the right of the display. The button labeled **WR** lets you enter the contents of a memory channel from the VFO, or vice-versa. The other, **V/M**, lets you switch between the memory and VFO functions, and puts the rig in Set mode (used for selecting memory channels to be skipped during scanning, and for several other functions) when pressed while the **FUNC**tion button is held. The **H/L** push button, when used with the **FUNC**tion button, prevents any inadvertent adjustments to the radio (except AF gain and squelch). The IC-2GAT's other features include selectable PL tones, power saver (more on this later), and a CTCSS encoder (you have to purchase the optional UT-40 tone squelch decoder to use this function on receive).

Everything about the ICOM IC-2GAT feels solid and rugged. I have to admit that I don't always treat my hand-held radios as gently as I should, and my IC-2GAT has gotten bounced around and moved from one location to another without special care. The radio has held up well to many months of not-too-dainty handling and operating, nothing rattles, and everything still works fine.

Several accessory items are supplied with the IC-2GAT. These include a wrist strap, belt hook, protective rubber cap for the antenna connector, a short, flexible antenna and a battery charger. The IC-2GAT also comes with a complete schematic and a 27-page instruction manual. The manual is profusely illustrated with line drawings that show what does what, and makes it easy to understand most of the rig's features. There are a couple of features that ICOM doesn't tell you much about, however, even though you're shown how to set them. The manual shows how to set the power-saver function, for instance, but the documentation doesn't tell you exactly what it *does*. ICOM's advertising literature is actually more valuable in this case! According to an ICOM ad, when the power saver is enabled, the IC-2GAT draws only 6 mA from its battery after sitting squelched for 30 seconds with no activity on the receive frequency. You can't use the power saver during packet-radio or AMTOR operation, because the current drain is reduced by decreasing the duty cycle of the receiver to less than 100%, so data transmissions may not be received properly.

Using the IC-2GAT

For almost a year, my IC-2GAT has served as my portable, mobile and home-station rig and has performed extremely well. Used in various mobile installations, the rig easily brings up most area repeaters. At home, it makes packet radio and checking into VHF traffic nets a pleasure.

As can be expected of a high-power rig, battery life isn't exceptional. ICOM rates the supplied BP-70 battery pack at 13.2 V dc and 270 mAh, and I'd say it's good for about 25-30 typical transmissions at full power output (7-plus watts), and perhaps 40-50 transmissions at low power (1 watt). The supplied BC-16U wall charger brings the

Table 1

ICOM Battery Packs for the IC-2GAT

ICOM part no.	*BP-2*	*BP-3*	*BP-5/5A*	*BP-7*	*BP-8*	*BP-70*
Voltage	7.2	8.4	10.8	13.2	8.4	13.2
Capacity (mAh)	450	270	450	450	800	270
Est. operating time (hours)†	3.8	2.0	2.4	2.5	5.9	1.5

†Assumed duty cycle: standby, 8 min; transmit, 1 min; receive, 1 min.

Table 2

ICOM IC-2GAT 2-Meter FM Hand-Held Transceiver, Serial no. 09914

Manufacturer's Claimed Specifications	***Measured in the ARRL Lab***
Frequency coverage: Receiver, 138-174 MHz; transmitter, 140-150 MHz.	As specified.
Mode of operation: FM.	As specified.
Current requirement: Maximum audio output, 250 mA; transmit low power, 0.9 A; transmit high power, 1.8 A	Minimum audio output, 37 mA; maximum audio output, 158 mA; transmit low power 0.51 A; transmit high power, 1.6 A.
Transmitter	*Transmitter Dynamic Testing*
Power output: Low, approx 1 W; high, 7 W (with BP-7 or BP-70 battery pack).	Low, 0.98 W; high 8.28 W.
Spurious signal and harmonic suppression: Better than 60 dB.	See Fig 1.
Transmit-receive turnaround (PTT release to 90% of full audio output): Not specified.	S1 signal, 74 ms, S9 signal, 74 ms.
Receiver	*Receiver Dynamic Testing*
Receiver sensitivity: Better than 0.25 μV for 12 dB SINAD.	0.135 μV (−124.5 dBm) for 12 dB SINAD; 0.135 μV (−124.5 dBm) for 10 dB quieting; 0.28 μV (−118.5 dBm) for 20 dB quieting.
Two-tone third-order IMD dynamic range: Not specified	Offsets from 146.000 MHz: +15 kHz, 68.5 dB; −15 kHz, 72.5 dB; +20 kHz, 74.5 dB; −20 kHz, 70.5 dB; +400 kHz, 72.5 dB; +600 kHz, 72.5 dB.
Adjacent-channel selectivity: Not specified.	Offsets from 146.000 MHz: +15 kHz, 37 dB; −15 kHz, 55.5 dB; +20 kHz, 62 dB; −20 kHz, 64.5 dB.
Squelch sensitivity: Not specified.	Minimum, 0.07 μV; maximum, 0.18 μV.
Receiver audio output: More than 400 mW at 10% distortion (8-Ω load).	690 mW at 10% total harmonic distortion (THD) with an 8-Ω load.
Other	
Frequency display: 4-digit backlit LCD.	
Size (H × W × D): 6.625 × 2.375 × 1.19 inches with BP-7 battery pack; weight (with BP-70), 1.1 lb. Color: Black.	

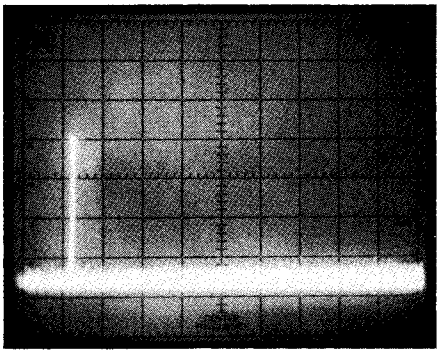

Fig 1—Worst-case spectral display of the ICOM IC-2GAT. Horizontal divisions are each 100 MHz; vertical divisions are each 10 dB. Output power is approximately 8.3 W at 146 MHz. The fundamental has been notched by approximately 30 dB to prevent spectrum-analyzer overload. All harmonics and spurious emissions are at least 62 dB below peak fundamental output. The IC-2GAT complies with current FCC specifications for spectral purity.

battery back from dead to fully charged overnight. Higher-capacity battery packs are available from ICOM and from other vendors; see Table 1.

I use a separate speaker/mike much of the time; it's very convenient for mobile use and when operating the rig at my home station, as it isn't very practical or comfortable to hold a hand-held while it's connected to a coax feed line. More importantly, if you try to hold the rig in your hand while transmitting on high power for any length of time, the radio's cast-metal back panel, which serves as a heat sink for the output transistor, becomes very hot (as in "Yowch!"). I can't hold the rig comfortably in my hand after about a half hour of chitchat while running it off my car's 13.8-V dc electrical system.

Received-audio quality is impressive. The audio amplifier is rated at nearly half a watt (and puts out more than that), and the radio has a good-size speaker. Reports on my transmitted audio quality are consistently good.

To operate the radio directly from a dc source, such as an automobile's cigarette-lighter receptacle or an ac-operated 13.8-V dc power supply, you need a special ICOM adapter (model AD-12). The adapter slips onto the bottom of the radio in place of the battery pack, and makes a compact (and much lighter-than-normal) package. In your auto, you can use the ICOM CP-11 filtered cable for operating or charging, or the CP-1 unfiltered charging-only cable.

The factory-supplied BP-70 battery pack can be charged directly from a car's dc accessory circuit, with a BC-35 or BC-36 desktop charger, or by the supplied BC-16 wall-cube charger. ICOM recommends that you do not operate the rig while a battery is in place and charging. If you want to operate the IC-2GAT mobile, you must use a battery or the dc adapter.

On packet radio, the rig requires no TNC-parameter adjustments (TX delay, etc) to accommodate the rapid switching needed for packet operation. (If you plan to use the IC-2GAT for packet, you'll need to put a capacitor and resistor into the PTT circuit, as described in most TNC manuals. See the Product Review of the ICOM IC-μ2AT in May 1987 *QST* for a suitable circuit.)

I find that the ICOM IC-2GAT's topside LCD location makes viewing the display convenient when the radio is clipped to my belt. Some who want to use the radio exclusively for mobile operation may prefer a front-panel display, but I discovered that the rig can be clipped onto one of the car's visors using the belt clip, and affords a "heads-up" view of the display, AF gain, tuning, and squelch controls, making it comfortable and safe to operate (with a speaker/mike, that is) while driving. Careful, though: The IC-2GAT is a rather heavy rig with a battery attached, and a loose visor hinge may allow the visor and radio to flip down.

The IC-2GAT is great if you need maximum hand-held power, operating ease, ruggedness, and a reasonable price for the level of flexibility and sophistication it offers. Nowadays, dual-band hand-helds are also becoming more common and less expensive, but if all you need is 2-meter FM, the IC-2GAT is an excellent choice. I'm glad I own one.

Price class: IC-2GAT (with BP-70), $380; BP-7, $80; BP-70, $70; AD-12 dc adapter, $25. Manufacturer: ICOM America, Inc, 2380 116 Ave NE, Bellevue, WA 98004, tel 206-454-7619.

SOLICITATION FOR PRODUCT REVIEW EQUIPMENT BIDS

[In order to present the most objective reviews, ARRL purchases equipment off the shelf from Amateur Radio dealers. ARRL receives no remuneration from anyone involved with the sale or manufacture of items presented in the Product Review or New Products columns.—*Ed.*]

The ARRL-purchased Product Review equipment listed below is for sale to the highest bidder. Prices quoted are minimum acceptable bids, and are discounted from the purchase prices.

Yaesu FT-736R VHF/UHF transceiver with optional 50, 220 and 1296-MHz modules, internal keyer, CW filter, dc cable and hand-held microphone (see Product Review, May 1990 *QST*). Sold as a package only. Minimum bid: $1800.

Sealed bids must be submitted by mail and must be postmarked on or before June 27, 1990. Bids postmarked after the closing date will not be considered. Bids will be opened seven days after the closing postmark date. In the case of equal high bids, the high bid bearing the earliest postmark will be declared the successful bidder.

In your bid, please clearly identify the item you are bidding on, using the manufacturer's name, model number, or other identification number, if specified. Each item requires a separate bid and envelope. Shipping charges will be paid by the successful bidder, FOB Newington. The successful bidder will be advised by mail. No other notifications will be made, and no information will be given to anyone regarding final price or identity of the successful bidder.

Please send bids to Bob Boucher, Product Review Bids, ARRL, 225 Main St, Newington, CT 06111. QST

New Books

THE LASER COOKBOOK: 88 PRACTICAL PROJECTS

By Gordon McComb. Published by TAB books, PO Box 40, Blue Ridge Summit, PA 17214. First edition, 1989. Softcover, 7.5 × 9.5 inches, 404 pages, $18.95 (plus shipping and state sales tax, if any).

Reviewed by Bob Atkins, KA1GT

Way back in the mists of time (actually around 1917), Einstein postulated a process by which an excited atom could be made to emit a quantum of radiation, coherent (same phase and frequency) with a colliding quantum. This process was called *stimulated emission,* and remained a theoretical concept until 1954 when the maser (microwave amplification by stimulated emission of radiation) was developed. A few years later the optical maser, or laser (light amplification by stimulated emission of radiation) was first demonstrated.

Lasers are now very common; they are found in many homes (mostly in compact disc players) and most supermarkets (in check-out scanners). You can find lasers for sale at most ham radio flea markets for less than $100.

Basic principles of laser operation are covered in the first few chapters of this book, and a number of different types of lasers (including ruby, gas, excimer, chemical and semiconductor) are described. I'm glad that safety precautions that must be followed when working with lasers are also covered early in the book. A brief introduction to simple optics, including the basic properties of lenses, mirrors, prisms and filters, is given next, and includes advice on buying, cleaning and storing optics.

The lasers most commonly found on the surplus market are of the helium-neon (He-Ne) variety. McComb devotes a chapter to describing He-Ne lasers in detail. He covers both theory of operation and a number of practical hints on buying and testing used laser tubes. A second chapter is devoted to the construction of laser power supplies for use with both 12-V dc and 120-V ac input. Simple supplies, suitable for He-Ne lasers rated at less than 1 mW, as well as more complex, pulse-modulated supplies for higher-power lasers are covered, along with schematics and construction details. In contrast to the high-voltage, low-current supplies required for He-Ne lasers, many semiconductor lasers require low-voltage, high-current, pulse-type power supplies; these are also covered in some detail.

Much of the remainder of the book is devoted to experiments involving lasers (and a few LED projects), such as building an interferometer, making holograms, putting on laser-light shows, building a laser seismometer and using fiber optics. One chapter is devoted to free-space laser and LED communications, but the range of the equipment described is very limited, probably less than a mile.

For laser diodes, a pulse frequency modulator/demodulator scheme is described. Two He-Ne-laser-modulation schemes are also covered. Readers interested in developing a laser-communications system suitable for DX communication (more than 10 km) should note that there is no discussion of atmospheric propagation phenomena or high-sensitivity detectors, which are required for such work.

One chapter about which I have misgivings is entitled "Experimenting with Laser Weapons Systems." After a brief discussion of "star wars" laser weapons, McComb describes a project that involves the construction of an He-Ne laser pistol. This is basically a low-power laser with a battery-operated power supply built into a pistol housing. There is nothing wrong with building such a device, and in fact it can be quite useful as a laser pointer, as the author suggests. McComb also cautions against using the laser pistol in any laser-tag-type games, but an additional warning should be given about the hazards of using such a device in any public place. In fact, the same warning should be heeded by anyone using lasers *for any purpose.* The public at large is often frightened by lasers, which many regard as "death rays." There have been cases of police intervention when lasers have been used in an irresponsible manner in public places. Although there may be no real danger to the public, such incidents are only likely to make regulation more probable, and certainly do not improve the public perception of Amateur Radio when radio amateurs are involved.

Overall the book is quite error-free, but there are a few exceptions. For example, early in the book, gold mirrors are said to "provide the maximum amount of reflection at all visible wavelengths," whereas in fact gold is a poor reflector at the blue end of the spectrum (this accounts for its color). Gold's important optical attribute is that it is an excellent reflector in the infrared region. Also, on p 233, in a discussion of light propagating in glass, it is stated that "...the wavelength of light can't be altered (at least by ordinary refraction), that means that the frequency of light must be shifted..." In fact, when light propagates in a dense medium, such as glass, its velocity is reduced but its frequency remains constant. It is the wavelength, not the frequency, that changes from its free-space value. Overall, however, the errors are minor and do not detract from the practical utility of the book.

In summary, *The Laser Cookbook* provides the beginner with an excellent introduction to lasers. It is written on a level that is understandable by anyone with a basic knowledge of electronics, and certainly by anyone with an Amateur Radio license. The projects described are generally inexpensive, use readily available components, and are well described in the text with the aid of explanatory diagrams and schematics. A nice touch is the inclusion of several pages of suppliers of lasers, optics and related components, as well as a bibliography for those who want to go deeper into the subject. It does not provide all the information required to set up a laser-communications system suitable for amateur DX work, but that's not the purpose of this book. I recommend this book to anyone who wants to know how lasers work and who would like to get some hands-on experience with laser technology. QST