

Product Review Column from QST Magazine

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ICOM IC-706MKIIG HF/VHF/UHF Transceiver

The AOR AR7000B Wide Range Communications Receiver

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Product Review

Edited by Joe Bottiglieri, AA1GW • Assistant Technical Editor

ICOM IC-706MKIIG HF/VHF/UHF Transceiver

By Rick Lindquist, N1RL
Senior News Editor

Recently I was scanning the automobile ads—a vain exercise in wishful thinking—when I spotted a writeup for the latest model of my current vehicle. Some of the features of the 1999 model were *exactly* the ones I'd often wished my car possessed. My vehicle was the first of its line, however.

This got me thinking about the time I bought my first 2-meter all-mode transceiver back when I was active on the satellites. It was a fine little transceiver, and I only recently parted company with it. But I never quite got over the fact that not six months after I'd bought my latest and greatest radio, the manufacturer came out with a new and improved version that incorporated all the features I'd come to wish that my rig had.

By now it should come as no surprise that I own an “original” IC-706 transceiver. We “original” owners have become greener with envy with each incarnation of the IC-706 line. Some have happily “traded up.” Since the “original” debuted in 1995 to the oohs and aahs of the Amateur Radio community, ICOM has continued to up the ante (but not the price) almost each succeeding year, almost like model years in the auto industry. But while the Amateur Radio industry is not like the auto industry, ICOM has distinguished itself in recent years by trumping its own aces and by correcting in subsequent models shortcomings that we have revealed during the course of our product reviews.

Getting yet another look at this hugely popular model gave us the opportunity to dig a bit more deeply into the basic unit, and to see how the various enhancements over the subsequent two models have made the IC-706 a better radio.

So, it is trade-in time again? Let's see what the IC-706MKIIG brings to the table.

What's New, pussycat?

The *primary* new features of the MKIIG are the addition of the 70-cm band, the inclusion of DSP, and more power—50 W—on 2 meters (history buffs will recall the original '706 put out 10 W on 2, the MKII 20 W). Yes, there are some other features that some users will consider significant or important, but for most folks, these are the big three. We'll get to the others in due course. They are largely incremental improvements, however.

DSP was an approximately \$150 option in the initial MKII. Now, it's standard. If for nothing other than competitive reasons, this was a wise move on ICOM's part. We



recently praised the Yaesu FT-100 for having superb DSP features—including the ability to digitally tailor your transmit audio on SSB—something you won't find on the MKIIG. The DSP features on the IC-706MKIIG are not quite as rich, but they are competent as far as they go.

The DSP menu offers two primary features: noise reduction and an autonotch filter to zap heterodynes while operating SSB. The IC-706MKIIG lets you adjust the level of noise reduction you prefer. While overall noise reduction was measured in the vicinity of 10 dB, as with the FT-100 we found a bit of rolloff at the high end plus a substantial amount of frequency ripple. With the NR cranked up full tilt boogie on SSB, the digital processing noise becomes much more apparent—even annoying at times. But, it might very well be far less

annoying than the noise you're trying to reduce, so it's one of those trade-offs.

One characteristic where the DSP in the '706 excels is the autonotch. Lab measurements revealed a notch depth for a single tone at greater than 50 dB. This is considerably better than the 20 dB notch depth on the FT-100.

Something new for FM-lovers: The MKIIG lets you set the “automatic” splits for repeater operation for HF, 50, 144 and 430 MHz, a real plus for repeater users. These settings are part of the initial set mode menu. This split is the one you'll get when you press the **DUP** button in FM mode. The IC-706MKIIG “knows” the split direction too, depending upon the band segment.

The MKIIG also includes tone scan capability—something that's optional in the nearest competitor, the FT-100. The Instruction Manual is a little unclear on this, but you have to be in repeater mode and have **TON** enabled.

The SWR Graph mode is a new and potentially useful feature that generates a little graphic representation of your SWR over a selectable range of HF or 6-meter frequencies. The menu lets you set the number of sample points to graph (3, 5, 7 or 9) and the step size between each point (10, 50, 100 or 500 kHz). The resulting “graph” is a set of vertical bars. The number of bars corre-

Bottom Line

With the addition of yet another band (70 cm), more power on 2 meters and the incremental improvements made with each new version of this popular transceiver, perhaps the '706 has reached its zenith. There's not much left to improve.

Table 1

ICOM IC-706MKIIG, serial number 01674

Manufacturer's Claimed Specifications

Frequency coverage: Receive, 0.03-200, 400-470 MHz; transmit, 1.8-2, 3.5-4, 7-7.3, 10.1-10.15, 14-14.35, 18.068-18.168, 21-21.45, 24.89-24.99, 28-29.7, 50-54, 144-148, 430-450 MHz.

Power requirement: Receive, 2.0 A; transmit, 20 A.

Modes of operation: SSB, CW, AM, FM, AFSK, WFM (WFM receive only).

Receiver

SSB/CW sensitivity, bandwidth not specified, 10 dB S/N: 1.8-30 MHz, <0.15 μ V; 50-54 MHz, <0.12 μ V; 144-148, 430-450 MHz, <0.11 μ V.

AM sensitivity, 10 dB S/N: 0.3-1.8 MHz, <13 μ V; 1.8-30 MHz, <2 μ V; 50-54, 144-148, 430-450 MHz, <1 μ V.

FM sensitivity, 12 dB SINAD: 28-30 MHz, <0.5 μ V; 50-54 MHz, <0.25 μ V; 144-148, 430-450 MHz, <0.18 μ V.

Blocking dynamic range: Not specified.

Two-tone, third-order IMD dynamic range: Not specified.

Third-order intercept: Not specified.

Second-order intercept: Not specified.

Measured in the ARRL Lab

Receive, as specified; transmit 1.8-2, 3.5-4.1, 6.9-7.5, 9.9-10.5, 13.9-14.5, 17.9-18.5, 20.9-21.5, 24.4-25.1, 28-30, 50-54, 144-148, 430-450 MHz.

Receive, 1.4 A; transmit, 21 A. Tested at 13.8 V. As specified.

Receiver Dynamic Testing

Noise floor (mds), 500-Hz filter:

	Preamp off	Preamp on
1.0 MHz	-124 dBm	-130 dBm
3.5 MHz	-137 dBm	-142 dBm
14 MHz	-136 dBm	-142 dBm
50 MHz	-139 dBm	-142 dBm
144 MHz	-138 dBm	-142 dBm
432 MHz	-138 dBm	-143 dBm

10 dB (S+N)/N, 1-kHz tone, 30% modulation:

	Preamp off	Preamp on
1.0 MHz	3.3 μ V	1.7 μ V
3.8 MHz	0.68 μ V	0.44 μ V
50 MHz	0.25 μ V	0.21 μ V
120 MHz	0.91 μ V	0.39 μ V
144 MHz	0.68 μ V	0.39 μ V
432 MHz	0.67 μ V	0.37 μ V

For 12 dB SINAD:

	Preamp off	Preamp on
29 MHz	0.39 μ V	0.20 μ V
52 MHz	0.25 μ V	0.17 μ V
146 MHz	0.29 μ V	0.16 μ V
440 MHz	0.29 μ V	0.16 μ V

Blocking dynamic range, 500-Hz filter:

	Preamp off	Preamp on
3.5 MHz	125 dB	118 dB
14 MHz	122 dB*	120 dB*
50 MHz	116 dB*	112 dB*
144 MHz	111 dB*	101 dB*
432 MHz	109 dB*	106 dB*

Two-tone, third-order IMD dynamic range, 500-Hz filter:

	Preamp off	Preamp on
3.5 MHz	89 dB	87 dB
14 MHz	89 dB	86 dB
50 MHz	89 dB	82 dB
144 MHz	88 dB*	83 dB
432 MHz	85 dB	82 dB

	Preamp off	Preamp on
3.5 MHz	-3.4 dBm	-13 dBm
14 MHz	-1.3 dBm	-11 dBm
50 MHz	-4.9 dBm	-15 dBm
144 MHz	-3.0 dBm	-16 dBm
432 MHz	-8.7 dBm	-18 dBm

Preamp off, +36.4 dBm; preamp on, +38.5 dBm.

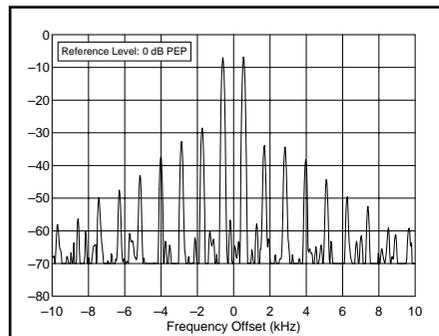


Figure 1—Worst-case HF spectral display of the IC-706MKIIG transmitter during two-tone intermodulation distortion (IMD) testing. The worst-case third-order product is approximately 30 dB below PEP output, and the worst-case fifth-order product is down approximately 33 dB. The transceiver was being operated at 100 W PEP output at 21.25 MHz.

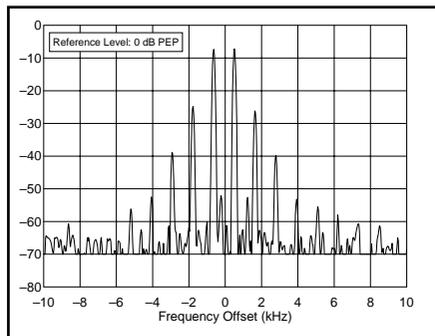


Figure 2—Worst-case VHF/UHF spectral display of the IC-706MKIIG transmitter during two-tone intermodulation distortion (IMD) testing. The worst-case third-order product is approximately 25 dB below PEP output, and the worst-case fifth-order product is down approximately 40 dB. The transceiver was being operated at 50 W PEP output at 144.2 MHz.

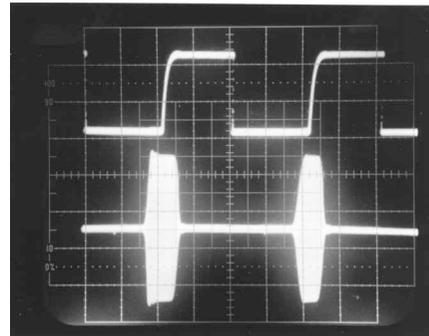


Figure 3—CW keying waveform for the IC-706MKIIG showing the first two dits in full-break-in (QSK) mode using external keying. Equivalent keying speed is approximately 60 wpm. The upper trace is the actual key closure; the lower trace is the RF envelope. Horizontal divisions are 10 ms. The transceiver was being operated at 100 W output at 14.2 MHz. Note the considerable shortening of both dits.

Manufacturer's Claimed Specifications

FM adjacent channel rejection: Not specified.

FM two-tone, third-order IMD dynamic range: Not specified.

S-meter sensitivity: Not specified.

Squelch sensitivity: SSB, <5.6 μ V; FM, <0.3 μ V.

Receiver audio output: 2.0 W at 10% THD into 8 Ω .

IF/audio response: Not specified.

Spurious and image rejection: 1.8-30 MHz, 70 dB;
50-54 MHz, image rejection, 65 dB, IF rejection unspecified;
144-148, 430-450 MHz, IF and image rejection, 65 dB.

Transmitter

Power output: HF & 50 MHz: SSB, CW, FM, 100 W
AM, 40 W (high); 144 MHz, 50 W (high);
AM, 20 W (high); 430 MHz, 20 W (high);
AM, 8 W (high).

Spurious-signal and harmonic suppression: \geq 50 dB
on HF; \geq 60 dB on VHF & UHF.

SSB carrier suppression: \geq 40 dB.

Undesired sideband suppression: \geq 50 dB.

Third-order intermodulation distortion (IMD) products: Not specified.

CW keyer speed range: Not specified.

CW keying characteristics: Not specified.

Transmit-receive turn-around time (PTT release to 50%
audio output): Not specified.

Receive-transmit turn-around time (tx delay): Not specified.

Composite transmitted noise: Not specified.

Bit-error rate (BER), 9600-baud: Not specified.

Size (HWD): 2.3 \times 6.6 \times 7.9 inches; weight, 5.4 pounds.

Note: Unless otherwise noted, all dynamic range measurements are taken at the ARRL Lab standard spacing of 20 kHz.

*Measurement was noise-limited at the value indicated.

Third-order intercept points were determined using S5 reference.

Measured in the ARRL Lab

20 kHz channel spacing, preamp on: 29 MHz, 66 dB; 52 MHz,
64 dB; 146 MHz, 70 dB; 440 MHz, 71 dB.

20 kHz channel spacing, preamp on: 29 MHz, 66 dB*; 52 MHz,
64 dB*; 146 MHz, 70 dB*; 440 MHz, 75 dB; 10 MHz channel
spacing, preamp on: 52 MHz, 91 dB; 146 MHz, 78 dB;
440 MHz, 80 dB.

S9 signal at 14.2 MHz: preamp off, 34 μ V; preamp on, 11 μ V;
52 MHz, preamp off, 14 μ V; preamp on, 6.6 μ V; 146 MHz,
preamp off, 18 μ V, preamp on, 4.1 μ V; 432 MHz,
preamp off, 17 μ V, preamp on, 5.7 μ V.

At threshold, preamp on: SSB, 14 MHz, 1.4 μ V; FM, 29 MHz, 0.11 μ V;
52 MHz, 0.06 μ V; 146 MHz, 0.06 μ V; 440 MHz, 0.06 μ V.

2.1 W at 10% THD into 8 Ω .

Range at -6dB points, (bandwidth):

CW-N (500 Hz filter): 200-1000 Hz (800 Hz);

CW-W: 182-3077 Hz (2895 Hz); USB-W: 182-3077 Hz (2895 Hz);

LSB-W: 182-2667 Hz (2485 Hz); AM: 275-2860 Hz (2585 Hz).

First IF rejection, 14 MHz, 120 dB; 50 MHz, 54 dB; 144 MHz, 64 dB;
432 MHz, 108 dB; image rejection, 14 MHz, 112 dB; 50 MHz, 121 dB;
144 MHz, 71 dB; 432 MHz, 80 dB.

Transmitter Dynamic Testing

HF & 50 MHz: CW, SSB, FM, typically 103 W high, <1 W low;

AM typically 29 W high, <1 W low; 144 MHz: CW, SSB,

FM, typically 53 W high, <1 W low; AM, typically 19 W high,

<1 W low; 430 MHz: CW, SSB, FM, typically 20 W high,

<1 W low; AM, typically 6 W high, <1 W low.

HF, 53 dB; 50 MHz, 67 dB; 144 MHz, 61 dB; 430 MHz, 68 dB.

Meets FCC requirements for spectral purity.

As specified. >59 dB.

As specified. >64 dB.

See Figure 1.

6 to 50 WPM.

See Figure 3.

S9 signal, 21 ms.

SSB, 20 ms; FM, 210 ms. Unit is suitable for use on AMTOR.

See Figures 4 and 5.

146 MHz: Receiver: BER at 12-dB SINAD, 2.2×10^{-3} ; BER at
16 dB SINAD, 4.6×10^{-5} ; BER at -50 dBm, $<1.0 \times 10^{-5}$;
transmitter: BER at 12-dB SINAD, 4.6×10^{-3} ; BER at 12-dB
SINAD + 30 dB, 2.1×10^{-4} .

440 MHz: Receiver: BER at 12-dB SINAD, 2.3×10^{-3} ; BER at
16 dB SINAD, 8.4×10^{-5} ; BER at -50 dBm, $<1.0 \times 10^{-5}$;
transmitter: BER at 12-dB SINAD, 2.8×10^{-3} ; BER at 12-dB
SINAD + 30 dB, 1.9×10^{-4} .

Expanded Product Review Report Available

The ARRL Laboratory offers a detailed test result report on the ICOM IC-706MKIIG that gives in-depth, technical data on the transceiver's performance. Request the *IC-706MKIIG Test Result Report* from the ARRL Technical Department, 860-594-0278; e-mail mlevesque@arrl.org. Members can see this on-line on our Members Only Web site.

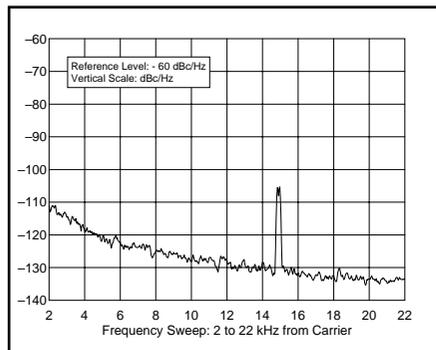


Figure 4—Worst-case HF spectral display of the IC-706MKIIG transmitter output during composite-noise testing. Power output is 100 W at 14.02 MHz. The carrier, off the left edge of the plot, is not shown. This plot shows composite transmitted noise 2 to 22 kHz from the carrier.

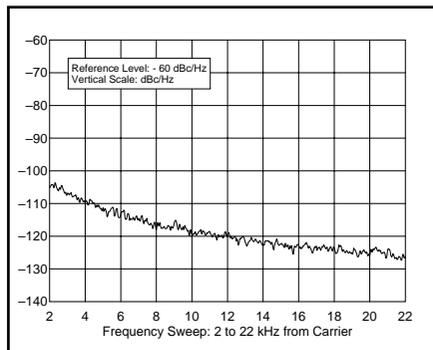


Figure 5—Worst-case VHF/UHF spectral display of the IC-706MKIIG transmitter output during composite-noise testing. Power output is 20 W at 432.02 MHz. The carrier, off the left edge of the plot, is not shown. This plot shows composite transmitted noise 2 to 22 kHz from the carrier.

sponds to the number of sample points, the height of each bar indicates the SWR at that point. This is a very neat feature—especially if you're trying to figure out where your antenna system is going wrong.

What Got Better?

One of the nice little touches on this transceiver is how the IF bandwidth icon pops up in the menu keys area as soon as you touch the **IF SHIFT** knob. The bandwidth narrows appropriately if you switch in a narrow filter too.

Another nice touch is the backlit buttons. Even the **P.AMP/ATT**, **RIT/SUB** and **TUNER/CALL** buttons are visible in darkness. When not activated, they emit a dull, orange glow.

An annoying and potentially damaging problem that we'd spotted in the earlier models in the IC-706 line appears to have been eliminated for the most part in the MKIIG. In

the earlier incarnations, if you cut back the power—say to match the required input for an amplifier—the transmitter still would put out a very brief “spike” of up to full output power when the transmitter was first keyed that lasted until the ALC took hold and reined in the output to the desired level. Some users reported that amplifiers sometimes would kick off as a result. ICOM apparently was listening. The leading-edge spike on the MKIIG is much less prominent and should not cause the same sorts of problems.

Déjà vu

The IC-706MKIIG continues the worthy tradition of being an easy-to-use and (almost as important) easy-to-mount subcompact radio.

As with all the previous '706s, this version's control buttons and knobs are logically positioned and adequately spaced and sized for convenient operation. The tuning speed automatically increases with faster knob rotation and a well-designed knob spinner and a drag adjustment lever is provided.

The built-in speaker in the last two iterations actually sounds pretty decent. The thermostatic control for the cooling fan, also added with the MKII model, was a welcome improvement—especially for fixed-station operation.

ICOM offers a nice selection of optional IF filters. Two slots are available (up from one in the original '706), and the plug-in sockets make the filters easy to install or swap out.

Unlike the competition, the radios in the '706 series only require a single quick-release separation cable for remote mounting of the control head. The head includes a connection point for the mike, and a switch on the back of the front panel allows you to use the “phones” jack for either headphones or an external speaker. This is a real convenience if you intend to use the radio in multiple applications.

Two notable weak points present in both of the earlier units, unfortunately, have also remained unchanged in the G.

From the advent of the IC-706 series, one of the things we'd complained about was fact that turning on the noise blanker can impart a lot of crackling artifacts, especially on a busy band or in the presence of nearby strong signals. Yes, it does work to eliminate pulse noise—I checked it out on the engine noise of passing vessels while operating marine mobile one weekend, and it worked just fine. Only when the band started to fill up a bit later did I start hearing the characteristic crackling noise—and realize I'd left the NB on.

The AGC is another thing that's the same across the entire model line. It can be fast or slow (no display indication means it's in the slow mode), but not off. For my tastes, the fast AGC is too fast for comfortable SSB listening, and I wasn't crazy about it for CW either. My tendency was to leave the AGC in the slow mode at all times. The AGC is accessible via the main menu.

Multiple Menus

First-time users of the IC-706MKIIG (or

of any of the '706 lineage, for that matter) will encounter a bit of a learning curve getting used to all the menus. The IC-706MKIIG has not one, not two, but four menus; unfortunately, the *Instruction Manual* does not cover all of them in the same place. Let's take a look at the layers of menus.

First, there's the “M” menu—a primary menu set that includes four sets of three choices apiece. These have not changed from the previous model. Successive quick presses of the **DISP** button get you to the “S” menu and the “G” menu. The S menu includes the Memo Pad, the Scan Func, the B.S.R. (band-stacking registers), and the D.S.P. functions. The G menu includes the *Band Scope*, an SWR Graph mode, a TX Freq readout mode, and a Memory Name mode.

But wait, there's more: press and hold the **DISP** button and you get to the “Q” or “Quick Set” menu, which sets a variety of mode-related functions in addition to power output. There are some changes in this menu set, owing to the fact that ICOM has shifted some settings that were manual adjustments on the MKII are now menu adjustments on the MKIIG. The **VOX GAIN** and **ANTI VOX** used to be little trimpot adjustments on the side of the transceiver. Putting them into the Quick Set menu is a giant step toward greater convenience. The only trimpots on the side of the radio now are **COMPRESSION GAIN** and the **BEEP/SIDE** Tone adjustments.

To top it all off, the 706 series provides what's called an “Initial Set” menu. The Initial Set menu in the MKIIG contains 37 choices as opposed to 28 in the MKII, so there are some changes in the Initial Set menu from the previous model. One possibly convenient setting—it's the first one in this set of adjustments—is called Mode Select. It lets you inhibit the selection of unneeded modes. This eliminates the admittedly minor annoyance of having to step through, say, RTTY, when switching modes when you have no intention of operating RTTY.

Since the buttons now are backlit on the MKIIG, the Initial Set menu provides a way to set the backlighting at either the HI or LO brightness level.

The MKIIG is 9600 bps capable; you set the packet speed—1200 bps or 9600 bps—via the Initial Set menu. In the 9600 bps setting, the signal from the TNC passes through an internal limiter to maintain bandwidth. This brings up another new item from the previous model. The MKIIG has a new 6-pin mini-DIN **DATA** jack on the rear apron for packet connections to a TNC for either 1200 bps or 9600 bps operation.

Something that's really handy for FM repeater ops is that the Initial Set menu on the MKIIG also lets you select a DUP offset— ± 9.999 MHz—to set the standard repeater split on HF, 50, 144 and 430 MHz. You still can set a standard split that you then can retrieve at the push of a menu function button.

Once enabled via the Initial Set menu, the DUP offset makes available the one-touch repeater function. As it suggests, it

allows you to set repeater operation with the push of one switch.

Something new on the MKIIG, the auto repeater function, also is enabled via the Initial Set menu. This automatically activates the repeater settings (duplex direction and tone encoder on or off) when the operating frequency is within a repeater subband. This means, for example, that the duplex direction automatically will be + if you're in the 147 MHz range of 2 meters and within the repeater subband.

The upside of the individual menus is that not all items are in one big menu and, as a result, are more accessible. The downside is that all menu items are not in one big menu. It can be difficult to remember which menu function is where, and the groupings are not always intuitive. In addition to other information, the convenient *Operating Guide* that accompanies the manual includes a Menu Switch Flow Chart that certainly is a step in the right direction to simplifying matters.

Let's do the Numbers

In performance terms, did anything important change between the MKII and the MKIIG? SSB and CW sensitivity numbers are about the same across the board—HF and VHF. The 70-cm band falls into the same ballpark as well. Blocking dynamic range was slightly better—as much as 12 dB better and not noise-limited on 3.5 MHz this time.

Two-tone, third-order IMD dynamic range measurements were ever so slightly better than the previous model—and only noise-limited on 144 MHz this time, not on all bands. There was one difference. On the MKII we looked at early last year, third-order intercept had been in the positive numbers (preamp off) on 3.5 and 14 MHz. All third-order intercept numbers were negative on our MKIIG.

AM sensitivity appeared to be significantly improved on the MKIIG we tested. On 3.5 MHz, it went from 1.0 μ V to 0.68 μ V. In the aircraft band, it went from 2.0 μ V to 0.91 μ V. FM sensitivity numbers between the MKII and the MKIIG were comparable on 50 and 144 MHz and slightly better on 10 meters.

CW Keying

In the two earlier IC-706 models, we'd noted some limitations on the CW keying, especially when transmitting at speeds in excess of around 30 WPM using full-break-in, with or without the internal CW keyer. Our Lab measurements (see Figure 3) backed up the on-air reports we'd received of clipped characters. Dits were all shortened with high-speed keying. In the semi-break-in mode, only the first dit was shortened.

The on-air reports I received from my CW connoisseurs on 40 meters were not especially flattering of the IC-706MKIIG while using full-break-in and the internal keyer at or above 30 WPM or so. By the way, the IC-706MKIIG menu reads out CW

sending speed using the actual number (or a rough approximation) of words per minute. On the FT-100, you have to guess, since the number is only a relative indicator of sending speed.

Compared to the Competition

The IC-706MKIIG seemed to appear in response to the Yaesu FT-100, the first radio of the subcompact genre to offer the 70-cm band and announced at Dayton Hamvention 1998. Their features and street prices are similar, but there are some differences that go beyond the merely cosmetic. Whether these will matter to you depends a lot on how you plan to use the radio. We'd strongly suggest you take a close look at the product review for the Yaesu FT-100 (see

"Product Review," *QST*, Jun 1999) as well as our earlier reviews of the IC-706 (see "Product Review," *QST*, Mar 1996) and the IC-706MKII (see "Product Review," *QST*, Jan 1998). Pay especially close attention to the numbers in the respective technical data tables from our ARRL Lab testing.

Some of the things we like on the IC-706MKII side: a single remoting cable that snaps to the faceplate and to the radio body; dual microphone connections; bulk-head-type SO-239 antenna jacks; and a relatively quiet cooling fan.

The Final Chapter?

Overall, this latest IC-706 incarnation is a competent transceiver for mobile or portable operation. The incremental improve-

ments in this version give rise to speculation that, with the MKIIG, ICOM has written the final chapter in this line of little transceivers. There's not much left to improve.

Manufacturer: ICOM America, 2380 116th Ave NE, Bellevue, WA 98004, tel 425-454-8155; fax: 425-454-1509; <http://www.icomamerica.com>. Manufacturer's suggested retail price: IC-706MKIIG, \$1680. Typical current street price, \$1390. MB-62 mobile mounting bracket, \$25; OPC-581 separation kit, \$60; MB-63 front panel mounting bracket, \$18; FL-100 500-Hz CW filter, \$133; FL-101 270-Hz CW filter, \$133; FL-103 2.8-kHz SSB filter, \$123; FL-223 1.9-kHz narrow SSB filter, \$105; FL-232 350-Hz RTTY/CW filter, \$113; CR-502 high-stability crystal unit, \$95; UT-102 voice synthesizer, \$74.

The AOR AR7000B Wide Range Communications Receiver

*Reviewed by Joe Bottiglieri, AA1GW
Assistant Technical Editor*

Of all the advances that we've seen in communications equipment over the last few decades, perhaps the most noticeable changes are in control and display technology. The AOR AR7000B wide range scanning receiver uses a 3.1-inch diagonally measured rectangular color LCD display—similar to those used in handheld television receivers—to provide a new level of flexibility in alphanumeric text and graphics display.

All front panel controls, with the exception of the main tuning dial, are push buttons. An infrared remote control is included, and allows duplicate control of nearly all of the front panel operations.

While the bright, busy, colorful display is certainly the first aspect of this unit that catches the eye, this receiver also sports an extensive list of capabilities and features that should attract the attention of those whose radio listening interests might range nearly anywhere between dc and daylight. (OK, so I'm exaggerating a bit—100 kHz to 2000 MHz, cellular blocked, of course.) Modes include WFM, FM, AM, CW, USB and LSB.

Getting Started

The programming scheme used in this radio is really quite unique—for a communications receiver that is... If your VCR has been flashing "12:00 PM" since the day you plugged it in, perhaps this is not the radio for you.

Several different menus and submenus are used to configure general operating parameters; to set the clocks and timers; to program the individual memories; to assign frequency limits for searches; to set upper and lower memory positions for programmed scans and to input alphanumeric tags. These appear on the screen in much the same format as the programming menus on most current VCRs and television sets. Each menu screen contains a list of related settings—move a cursor to the setting you wish to change and press the **ENTER** key. This gives

you access to a submenu, or puts you in position to input digits with the keypad. Some settings—mode and bandwidth for example—require stepping through a group of choices with the main tuning knob or the + and - buttons on the remote. Once you get a feel for it, it's really quite simple.

The receiver includes two separate VFOs and a memory mode. 100 channels in 15 banks provide plenty of storage for your favorite frequencies. Alphanumeric tagging, up to 7 characters (practically a necessity with 1,500 memories), lets you easily keep track of your stored information. Each memory/bank location retains the frequency, the memory name, the AGC setting, the mode and the IF bandwidth settings—and displays them all simultaneously (see Figure 6).

After tuning around a bit and catching some action in the VFO mode, it won't be long before you'll want to try programming

a few frequencies into the memories. Press and hold the **EDIT/7** key on the front panel to bring up the "Memory Function" menu (see Figure 7). Here you'll find menu items that let you edit or delete memories—or copy, move or swap memory information. The memory menu is only accessible using the front panel mounted **EDIT/7** key. This key is not included on the remote.

Search and Scan

In addition to the typical scan and search operations, the '7000B also includes eight search and eight scan *memories*.

Press and hold the **SEARCH/8** button and the "Program Search" menus appear. You use the main tuning dial or the + and - **TUNE** buttons on the remote to move between the search memories. You can program into each a search name (40 Mtrs for example), stop and start frequencies, scan direction, tuning step size, mode, bandwidth and scan pause duration. Hit the **RUN/BRK** key and a band scope display appears (see Figure 8). The receiver then searches the range, graphically displaying the relative signal strength and pausing on active frequencies. There's even a setting that can automatically store up to 100 active frequencies into your choice of memory banks.



Bottom Line

A combination of cutting-edge display technology and impressive spectrum agility make the AR7000B an attractive and versatile tool for the wide-range communications enthusiast.

Table 2**AOR AR7000B, serial number 050011****Manufacturer's Claimed Specifications**

Frequency coverage: Receive, 0.1-2000 MHz (cell blocked).

Power requirement: Receive, 1.5 A;

Modes of operation: SSB, CW, AM, FM, WFM.

ReceiverSSB/CW sensitivity, bandwidth not specified, 10 dB S/N: 0.1-0.7 MHz, <1.6 μ V; 0.7-20 MHz, <1.5 μ V; 20-1200 MHz, <0.5 μ V; 1200-2000 MHz, <2.0 μ VAM sensitivity, 10 dB S/N: 0.1-0.7 MHz, <4.2 μ V; 0.7-20 MHz, <3.5 μ V; 20-1200 MHz, <1.3 μ V; 1200-2000 MHz, <4.0 μ V.FM sensitivity, 12 dB SINAD: 0.1-0.7 MHz, <4.0 μ V; 0.7-20 MHz, <2.0 μ V; 20-1200 MHz, <0.56 μ V; 1200-2000 MHz, <1.6 μ V.

Blocking dynamic range: Not specified.

Two-tone, third-order IMD dynamic range: Not specified.

Third-order intercept: Not specified.

Second-order intercept: Not specified.

FM adjacent channel rejection: Not specified.

FM two-tone, third-order IMD dynamic range: Not specified.

S-meter sensitivity: Not specified.

Squelch sensitivity: Not specified.

Receiver audio output: 1.0 W at 10% THD into 8 Ω .

IF/audio response: Not specified.

Spurious and image rejection: Not specified.

Size (HWD): 3.5x8.7x9.4 inches; weight, 7.7 pounds.

Note: Unless otherwise noted, all dynamic range measurements are taken at the ARRL Lab standard spacing of 20 kHz.

*Measurement was noise-limited at the value indicated.

Third-order intercept points were determined using noise-floor reference.

¹S-meter is color based, so "S9" figures were taken at the maximum limit of the green region.²The image rejection for these frequencies is outside of the ARRL Lab's measurement capabilities.**Measured in the ARRL Lab**

As specified.

Receive, 1.2 A. Tested at 13.8 V.

As specified.

Receiver Dynamic Testing

Noise floor (mds), 500 Hz filter:

1.0 MHz -127 dBm

3.5 MHz -129 dBm

14 MHz -131 dBm

50 MHz -137 dBm

144 MHz -135 dBm

432 MHz -140 dBm

10 dB (S+N)/N, 1-kHz tone,

30% modulation:

1.0 MHz 3.67 μ V3.8 MHz 3.16 μ V50 MHz 1.23 μ V120 MHz 1.33 μ V144 MHz 1.88 μ V432 MHz 0.676 μ V

For 12 dB SINAD (15 kHz bandwidth):

29 MHz 0.305 μ V52 MHz 0.489 μ V100 MHz 0.489 μ V146 MHz 0.402 μ V223 MHz 0.320 μ V440 MHz 0.214 μ V902 MHz 0.335 μ V1270 MHz 0.421 μ V

Blocking dynamic range, 500-Hz filter:

3.5 MHz 95 dB

14 MHz 98 dB

50 MHz 69 dB

144 MHz 67 dB

432 MHz 69 dB

Two-tone, third-order IMD dynamic range,

500-Hz filter:

3.5 MHz 78 dB

14 MHz 78 dB

50 MHz 80 dB*

144 MHz 102 dB*

432 MHz 98 dB

3.5 MHz -12 dBm

14 MHz -14 dBm

50 MHz -17 dBm

144 MHz +18 dBm

432 MHz +7.0 dBm

+51.4 dBm.

20 kHz channel spacing: 29 MHz, 44 dB;

52 MHz, 43 dB; 146 MHz, 46 dB;

440 MHz, 36 dB.

20 kHz channel spacing: 29 MHz, 44 dB*;

52 MHz, 43 dB*; 146 MHz, 46 dB*;

440 MHz, 36 dB*; 10 MHz channel

spacing: 52 MHz, 73 dB; 146 MHz,

91 dB; 440 MHz, 63 dB.

S9 signal¹ at 14.2 MHz: 242 μ V; 146 MHz,237 μ V.At threshold: SSB, 14 MHz, 2.5 μ V; FM,29 MHz, 0.45 μ V; 52 MHz, 1.0 μ V;146 MHz, 0.71 μ V; 440 MHz, 0.35 μ V.0.8 W at 10% THD into 8 Ω .

Range at -6dB points, (bandwidth):

CW-N (500-Hz filter): 526-1111 Hz (585 Hz);

USB-W: 222-2666 Hz (2444 Hz);

LSB-W: 222-2666 Hz (2444 Hz);

AM: 176-3317 Hz (3141 Hz).

First IF rejection, HF, 89 dB; VHF, 65 dB;

UHF, 48 dB; SHF, 71 dB; image rejection,

HF, 114 dB; VHF, UHF, SHF, N/A.²

Press and hold the **SCAN/9** key to access the "Program Scan" memories. Each contain settings to set up a memory channel scan between selected upper and lower memory channel limits. A setting in the memory menu allows you lock out specific memories from the scan modes. The scan speed in either search or scan is 20 channels per second.

One priority channel is also included. With the priority feature activated, the selected memory channel will be checked for activity at an adjustable time interval between 1 and 60 seconds.

Hook Ups

The rear panel includes a jack for 12 V dc in—an external ac power supply is provided. The antenna connector is a BNC type. There's an 8-pin DIN auxiliary socket, a female DB-9 jack for direct connection to your PC COM port for computer programming or control and a 3.5 mm external speaker jack. (You'll find a second 3.5 mm jack on the front panel for headphones.) The remaining items mounted here are two RCA type connectors—labeled "VIDEO" and "AUDIO," and a small slide switch marked "PAL/NTSC."

The 8-pin auxiliary socket contains connections for switching circuitry tied to squelch activity, a mute control point, a fixed level audio output, a 12V dc (10 mA) voltage source and ground.

The "VIDEO" and "AUDIO" jacks and the associated switch allow some interesting possibilities. You can connect the video output to TVs or VCRs that have auxiliary NTSC or PAL inputs (in the US, video equipment typically uses the NTSC format). The receiver's display will now appear on your TV. You can even connect the audio output of the '7000B to the audio input of your home electronics.

Much to the consternation of my spouse, I connected the audio and video jacks to the television in our living room—instant big screen receiver! While I couldn't get away with this arrangement long enough to run further tests, I'm confident that similar interconnection with our VCR would have resulted in a great system to capture frequency activity—such as the local public service traffic—for later review. Pop in a tape, set the VCR for LP, hit record and you're in business. Not only will you have a record of the radio communications—you'll also capture the full front panel display—frequency, signal strength, date/time, etc... Sitting there in my living room, remote control in hand, enjoying one of *my* favorite pastimes was tremendous fun. It didn't last long—I was soon once again banished to my basement shack.

If DX listening is your passion, you'll be happy to find that the AR7000B includes five separate clock/date displays. You can program in local and UTC time/date and still have space to set information for three distant locations. You can assign any three letter alphanumeric tag to identify the displayed time zone (EST, UTC, PST, for example). A



Figure 6—The display screen of the AR7000B showing the contents of memory channel 2 of bank 1. Graphic representations of the signal strength and volume level appear at the top of the screen. The selected squelch level is indicated in S units.

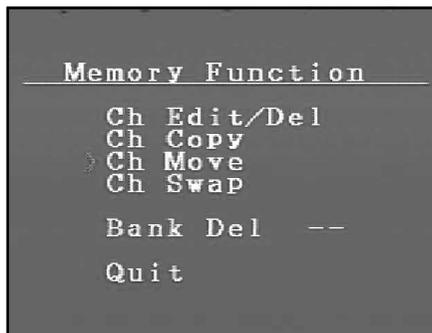


Figure 7—Most programming operations are carried out using a system of menus—does this arrangement look familiar?



Figure 8—The AR7000B band scope in the search mode. The band limits, search name (40 Mtrs in this example), mode, step size, bandwidth, sweep direction and pause duration can all be varied in a setup menu.

on the remote or the front panel cycles you through the selections.

Five receiver on/off timers are also available. These are programmable for both the time *and* date. Use these in conjunction with the squelch activated relay control and the fixed level audio output (accessible from the 8-pin auxiliary jack), and you can set up a tape recorder to capture scheduled communications. You could also use these timers and the audio/video outputs to tape with your VCR—just program identical stop/start times into both units.

Back to the Shack

The AR7000B is a triple conversion superhet with digital signal processing applied at the 10.7 MHz IF. This allows a wide range of DSP-based selectable filter bandwidths and an IF shift feature—both very handy for fighting off nearby interference. Fast and slow AGC settings are available, and there's a 10 dB attenuator included as well.

Tuning around in this wide a chunk of frequency spectrum is a blast. You can use the front panel tuning knob, the tune buttons on the remote, or enter frequencies into the VFOs directly on the front panel or the remote keypad. The main tuning knob rotation action is detented. I did run into some instances where the rebound of the switching action bounced the frequency back a step as I cranked. While this was a bit unusual, it was not a major annoyance—I did most of

my tuning with the remote control.

I started out on the lower end of the range tuning through the AM broadcast band. Although the AM sensitivity in this frequency range is greater than $3\mu\text{V}$ (see Table 2), there were still plenty of distant stations to explore between the big locals. I tuned past a weather report from Toronto, a talk show in Buffalo and finally settled on listening to a ballgame rebroadcast from an Ohio station. AM audio quality, even when using the built in top-firing speaker, is quite good—on both broadcast and shortwave AM.

Tuning up into the HF ham bands and listening in the SSB and CW modes revealed decent overall performance. While not quite up to the standards we've come to expect in radios designed specifically for the Amateur Radio market, this unit compares favorably with some of the other communications receivers we've looked at recently.

The ability to tune in 10-Hz steps, the wide variety of available DSP-based filters and the IF shift feature worked very well for casual HF listening. In the SSB modes, you can select digital filter bandwidths of 3, 2.5 or 2 kHz. For CW, you can choose from 5 bandwidths ranging from 800 Hz all the way down to 50 Hz. AM choices are 8, 6 and 3 kHz. Lab tests revealed two-tone, third-order IMD dynamic range in the HF bands in the high seventies—performance does suffer a bit under busy band conditions.

Moving up into the VHF region and beyond, the tremendous memory capacity, the

band scope and the automatic frequency storage system make it easy to find and collect interesting subjects for your listening library. Sorting through the accumulated frequencies, choosing which ones to keep or delete, assigning alphanumeric tags and deciding which bank to archive them in will keep you occupied for hours.

If your main listening interests center around local FM activity in this upper end of the frequency spectrum, you may be a bit disappointed the lack of CTCSS squelch.

Overall Impressions

The AR7000B lures you in with its pretty face and its user-friendly programming scheme. What true electronics buff could possibly resist the opportunity to connect yet another audio/video device to the home entertainment system and add one more remote to the ever-growing pile on the coffee table?

The AR7000B falls slightly short of the performance benchmarks set by some of the other tabletop receivers currently available in the AOR line. That said—it's likely that some may be willing to compromise a bit of performance for the unique display and control arrangement and the interesting interconnectivity options offered by this receiver.

Manufacturer: AOR USA, Inc, 20655 S Western Ave, Suite 112, Torrance, CA 90501; 310 787-8615; fax 310-787-8619; <http://www.aorusa.com>. Manufacturer's suggested list price, \$1460. Typical current street price, \$1150. 