

ICOM IC-703 HF Transceiver

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We should establish one thing about the IC-703 right up front. Yes, operating a 10-W radio can be a very satisfying experience. Almost invariably, after we review an HF offering that produces less than 50 W output, we receive correspondence asking whether low-wattage signals really get out. As any QRP enthusiast will tell you, the answer is an enthusiastic yes. Whether one operates low power in order to minimize RF exposure or simply for the challenge of doing more with less, an effective antenna will allow the operator to be heard. As ARRL Laboratory Manager and resident QRP guru Ed Hare, W1RFI, says, "Ten watts is a lot of power."

And 10 W is exactly the lot of power that one gets when operating the IC-703. The radio looks and acts very much like the higher-power ICOM IC-706MkIIIG, reviewed in the July 1999 issue of *QST*. It differs from the MkIIIG in two important respects. The first is its output power; the second is that it lacks VHF and UHF capability. Due to a printing error on the boxes and on the manuals, there is an indication that the '703 has 6-meter capability. This is not the case, and ICOM makes that clear right up front with a note attached to the box. Six meters is available on the recently released IC-703 Plus, however.

QRP Ready to Go

So what has ICOM included in the '703 in order to make up for the 90 W and three bands it gives up? Quite a bit, actually. Foremost is the standard internal automatic antenna tuner, pictured in Figure 4. I was able to connect the IC-703 directly to the G5RV I have creatively supported on my apartment building's balcony and operate on all bands (except 160 and 30 meters, which are not typically compatible with a G5RV) at the touch of a button. The automatic tuner was put through its paces in the ARRL Lab, using the same methodology used in our January roundup of external antenna tuners. Our criteria for determining whether a match was obtained was whether the SWR indicated on the rig's bar graph meter was 1.5:1 or less, resulting in no output power reduction. While ICOM recommends that



the unmatched antenna should have an SWR of less than 3:1, the internal tuner successfully match loads up to an 8:1 SWR on all bands tested (160, 80, 20, and 10 meters). At an SWR of 10:1, no match was found, and the tuner turned itself off.

Conveniently, the first time the IC-703's tuner matches a particular frequency pair, the tuner settings are memorized. When the user returns to the frequency and the internal tuner is enabled, the proper settings spring to life. The can be overridden after an antenna change either by clearing the tuner memories or forcing the internal tuner to match again.

This feature should be of interest to portable station enthusiasts who seek a complete station in one lightweight box. No external antenna tuners need be carried; an antenna, a power source, and the '703 are all that such an operator will need to go out and have fun. The added weight of the tuner is more than offset by the removal of the 100-W power amplifier and VHF/UHF modules from the old MkIIIG. Even though the two models

have the same dimensions, the '703 weighs in 4.3 pounds, down more than a pound from the latest '706 model.

The '703 is friendlier on batteries than the '706MkIIIG was found to be. The power requirement in Table 1 indicates that less than 3 A is drawn when transmitting at the full 10-W capacity. On the receiver side, typical current draw at maximum audio was 0.58 A, and fell to 0.32 A when power saving options were utilized. This efficiency allows smaller battery packs to be used. In fact, I enjoyed several hours of operation using a very lightweight, rechargeable, 9.6-V battery pack. For portable operation enthusiasts, the IC-703's compact and lightweight stature is very attractive.

Some Things Stay the Same

But you would expect a radio that looks exactly like the '706MkIIIG to behave very much like the '706MkIIIG. And in most ways, the '703 does. Back in 1999, we complimented the performance of the DSP included standard on the MkIIIG. The same DSP functions, an automatic notch filter and a noise blanker, have found their way into the '703. The ARRL Lab measured a very impressive single-tone noise reduction of 65 dB for the autonotch filter; this measurement is one of the best ever measured in our Lab.

Something that did not change from the MkIIIG is the availability of 1200 and 9600 baud packet operation, and United States users should be aware of this and

Bottom Line

The IC-703 looks a lot like the IC-706MkIIIG, but trades a capable internal antenna tuner for some bands and 90 W of power. The result is a radio that will turn the heads of low-power and portable operators who yearn for features galore in a lightweight box.

Table 1
ICOM IC-703, serial number 1801133

Manufacturer's Claimed Specifications

Frequency coverage: Receive, 0.03-30 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 MHz.

Power requirement: Receive, 0.45 A (max audio); transmit, 3.0 A (10 W output).

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

Receiver

SSB/CW sensitivity, bandwidth not specified, 10 dB S/N: 1.8-30 MHz, <0.16 μ V.

AM sensitivity, 10 dB S/N: 0.5-1.8 MHz, <13 μ V; 1.8-30 MHz, <2 μ V.

FM sensitivity, 12 dB SINAD: 28-30 MHz, <0.5 μ V.

Blocking dynamic range: Not specified.

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

Third-order intercept: Not specified.

Measured in the ARRL Lab

Receive¹ and transmit, as specified.

Receive, 0.58 A;² transmit, 2.5 A. Tested at 13.8 V.

As specified.

Receiver Dynamic Testing

Noise floor (MDS), 500 Hz filter:

	<i>Preamp off</i>	<i>Preamp on</i>
1.0 MHz	-121 dBm	-129 dBm
3.5 MHz	-133 dBm	-141 dBm
14 MHz	-131 dBm	-141 dBm

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

	<i>Preamp off</i>	<i>Preamp on</i>
1.0 MHz	6.5 μ V	2.34 μ V
3.8 MHz	1.5 μ V	0.537 μ V

For 12 dB SINAD:

	<i>Preamp off</i>	<i>Preamp on</i>
29 MHz	0.537 μ V	0.193 μ V

Blocking dynamic range, 500 Hz filter:

	<i>Preamp off/on</i>	<i>Preamp off/on</i>
Spacing	20 kHz	5 kHz
3.5 MHz	127*/127 dB	95/95 dB
14 MHz	121*/122* dB	95/95 dB

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

	<i>Preamp off/on</i>	<i>Preamp off/on</i>
Spacing	20 kHz	5 kHz
3.5 MHz	93/93 dB	78/77 dB
14 MHz	89/91 dB	76/76 dB
Spacing	20 kHz	5 kHz
	<i>Preamp off/on</i>	<i>Preamp off/on</i>
3.5 MHz	+12/+1.8 dBm	-14/-21 dBm
14 MHz	+11/+1.9 dBm	-14/-21 dBm

avoid using this function in most instances. Of the bands found on the '703, 1200 baud packet operation is only permitted in the United States on 10 meters [97.307(f)(4)]. What's more, 9600-baud operation is not permitted at all on HF; users interested in that speed must wait for the 6-meter capability of the '703 Plus [97.307(f)(5)].

Nevertheless, the IC-703 earns high marks for ease of operation and ergonomics, just as the MkIIG did. The controls are identically positioned, with the large VFO knob on the right of the large display, and separate AF and M-CH controls to its left. Backlighting enhances the visibility of the buttons in the dark, and the various menu options are easily toggled by a MENU and three F keys. The control panel is detachable from the radio, allowing for operation from a distance limited only by the length of the remote cable.

Overall, ICOM has added a tuner to the MkIIG in exchange for VHF/UHF capability and some wattage. What remains in the IC-703 is a lightweight station with modest power but all the bells and whistles of the MkIIG. These qualities may be attractive to those who have always been interested in portable, low-power operation but have wanted more features.

Comparing the Numbers

Testing in the ARRL lab indicates that the '703 offers slight improvements over the MkIIG in receiver performance. The results are spelled out in Table 1. Let's take a closer look at how the '703 stacks up to the '706 family.

Receiver sensitivity for SSB and CW signals was down slightly, but not significantly from the MkIIG. AM sensitivity was significantly degraded from the MkIIG,

rising from 0.68 to 1.5 μ V on 3.8 MHz with the preamp off. However, all sensitivity measurements fell well within ICOM's stated specifications, and an argument can be made that an overly sensitive radio during crowded conditions can be a hindrance. With the '703, I cleanly heard all that I wanted to hear.

Pleasantly surprising was the IC-703's dynamic range performance. Across the board, the '703 outperforms the '706 line in both blocking and two-tone, third-order IMD dynamic range at the ARRL standard test spacing of 20 kHz. In the four years that have passed since the MkIIG's arrival on the market, the ARRL Lab has begun dynamic range testing at 5-kHz spacing, and the '703 performs credibly at the new test.

Finally, third-order intercept numbers were uniformly positive at 20-kHz spacing on the '703, an improvement over the

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: SSB, 1.8-30 MHz, <5.6 μV ;
 FM, 28-30 MHz, <0.32 μV .
 Receiver audio output: 1.0 W at 10% THD into 8 Ω .
 IF/audio response: Not specified.

IF and image rejection, 70 dB.

Transmitter

Power output: SSB, CW, FM, 10 W high, 0.1 W low;
 AM (carrier), 4 W high, 0.1 W low.
 Spurious-signal and harmonic suppression: <50 dB
 SSB carrier suppression: >40 dB.
 Undesired sideband suppression: >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.
 Size (height, width, depth): 2.3x6.6x7.9 inches; weight, 4.3 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.

¹Receive sensitivity is reduced below 250 kHz.

²With all power saving options enabled, 320 mA.

Preamp off, +56 dBm; preamp on, +47 dBm.
 20 kHz channel spacing, preamp on: 29 MHz, 67 dB.
 20 kHz channel spacing, preamp on: 29 MHz, 73 dB.
 S9 signal at 14.2 MHz: preamp off, 40.7 μV ; preamp on, 15.1 μV .
 At threshold, preamp on: SSB, 14 MHz, 4.51 μV ;
 FM, 29 MHz, 0.186 μV .
 1.3 W at 10% THD into 8 Ω .
 Range at -6 dB points, (bandwidth):
 CW (500 Hz filter): 326-870 Hz (544 Hz)
 USB: 414-2920 Hz (2506 Hz)
 LSB: 85-2532 Hz (2447 Hz)
 AM: 36-3310 Hz (3274 Hz).

First IF rejection, 116 dB; image rejection, 121 dB.

Transmitter Dynamic Testing

CW, SSB, FM, typically 9 W high, <0.1 W low;
 AM, typically 2.9 W high, <0.1 W low.
 54 dB. Meets FCC requirements for spectral purity.
 58 dB.
 70 dB.
 See Figure 1.
 6 to 52 WPM.
 See Figure 2.
 S9 signal, 20 ms. Unit is suitable for use on AMTOR.
 SSB, 40 ms; FM, 16 ms.
 See Figure 3.

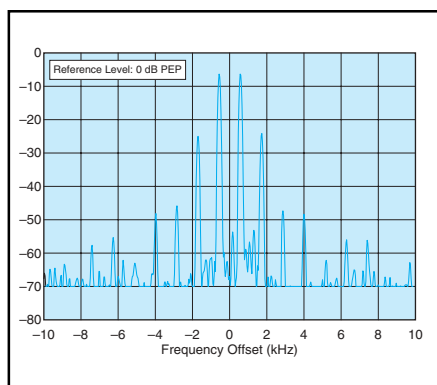


Figure 1—Worst-case spectral display of the IC-703 transmitter during two-tone intermodulation distortion (IMD) testing. The worst-case third-order product is approximately 24 dB below PEP output, and the worst-case fifth-order product is down approximately 46 dB. The transmitter was being operated at 10 W PEP output at 7.25 MHz.

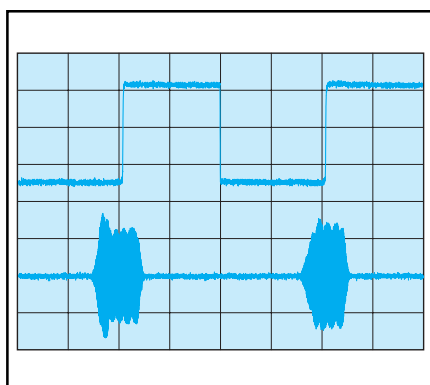


Figure 2—CW keying waveform for the IC-703 showing the first two dits in full-break-in (QSK) mode using external keying. Equivalent keying speed is approximately 60 wpm. The upper trace is the actual key closure; the lower trace is the RF envelope. Horizontal divisions are 10 ms. The transmitter was being operated at 10 W output at 14.2 MHz. Note the considerable shortening of both dits.

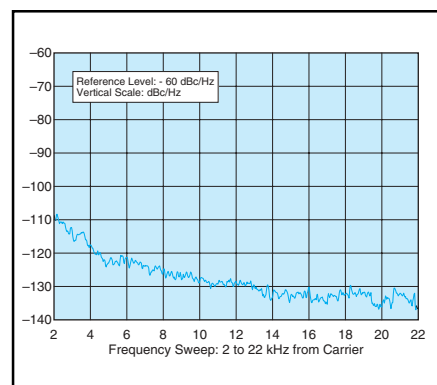


Figure 3—Worst-case spectral display of the IC-703 transmitter output during composite-noise testing. Power output is 10 W at 14.02 MHz. The carrier, off the left edge of the plot, is not shown. This plot shows composite transmitted noise 2 to 22 kHz from the carrier.

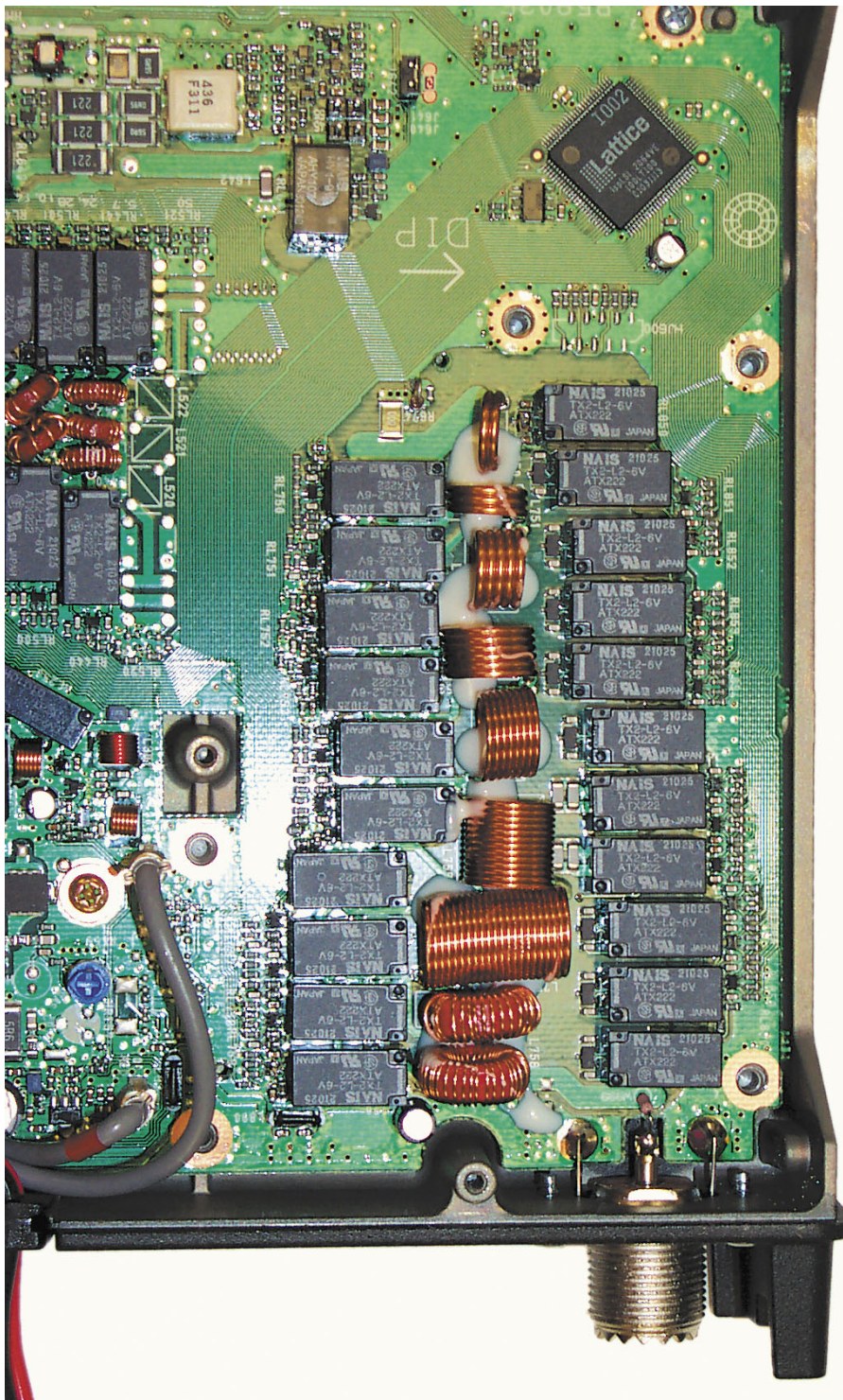


Figure 4—A peek inside the ICOM IC-703 with the bottom panel removed reveals the automatic antenna matching network that comes standard with the transceiver. This network successfully matched SWRs of up to 8:1 in the ARRL Lab.

MkIIIG's uniformly negative numbers. Only at the close spacing of 5 kHz does the IP3 fall into the negative numbers, -14 dB with the preamp off and -21 dB with it on.

The IC-703 outperforms its specification for IF and image rejection by a healthy margin. Overall, the '703's receiver performance is on par with its high-

powered cousins, and continues the trend of incremental improvements. The transmitter, however, shows relatively high third-order products during two-tone IMD testing (see Figure 1). The '703 performs about 6 dB worse than the MkIIIG here.

CW Keying and ALC

In the first two IC-706 models, we

noted some limitations on the CW keying, particularly in full-break-in mode. Dits were shortened in full-break-in keying at speeds of around 30 WPM or above. These shortened dits are once again evident in the IC-703 (see the keying waveform in Figure 2). The dits default to their normal weight in semi-break-in mode, however. High-speed CW operators may wish to take this into consideration.

Also, the leading-edge spike of the CW waveform on our unit of the IC-703 indicates a recurrence of a problem observed to an extent in the 706 series—the failure of the ALC to take hold until a short time into the transmission. While one is unlikely to drive an amplifier with the '703, some '706 users reported that the leading spike would fault amplifiers. The spike had been minimized in the MkIIIG, but was again prominent in our unit.

In fairness, our unit of the IC-703 was one of the first units sold in the United States. ICOM America Chief Engineer John Gibbs, KC7YXD, indicates that the leading spike was remedied prior to the recent release of the 6-meter capable IC-703 Plus, and that this fix has been incorporated into all but the first few IC-703 units sold in the United States. We plan to revisit the CW and ALC issues in a forthcoming review.

Good Bang for the Buck

ICOM has combined a no-nonsense HF transceiver patterned after its successful IC-706 series with a surprisingly capable antenna tuner in a lightweight, affordable package. As mentioned above, hams who are looking for a lightweight, low-power radio with a number of nice features will find the IC-703 worth a serious look. So will hams in close quarters, such as apartments or condominiums, where RF safety and susceptibility concerns must be considered. And in these tight economic times, the pricetag is attractive, particularly for a starter HF rig for a General class licensee.

For under \$700, ICOM has provided a nice little radio, patterned very much after the successful IC-706 series. It shares much of its older cousins' limitations, but includes and improves upon much of their features, even while shedding some bands and some power. For the low-power market and the low-price class, this is a commendable effort.

Manufacturer: ICOM America, 2380 116th Ave NE, Bellevue, WA 98004, tel 425-454-8155; fax 425-454-1509; www.icomamerica.com. Price: \$679.95.