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ICOM IC-705

Ameritron ADL-2500 Dry Dummy Load

MFJ-264 Dry Dummy Load

Palstar DL1500 Dry Dummy Load

Product Review

Icom IC-705 HF/VHF/UHF Multimode Portable Transceiver



Reviewed by Steve Ford, WB8IMY
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There's no question that portable operating is on the rise. Award programs, such as Summits on the Air (SOTA), Parks on the Air (POTA), and Worldwide Flora and Fauna (WWFF), have fueled a substantial increase in activity. Even on weekdays, it's common to find mini pileups on the bands as portable operators, or *activators*, set up stations in parks and on mountaintops.

Restrictions imposed by the COVID-19 pandemic haven't dampened enthusiasm. After all, it is relatively easy to take transceivers to parks and summits without running afoul of social distancing rules. You just connect your gear, deploy an antenna, and get on the air. When *chasers* — operators trying to make con-

tacts with you — become aware of your presence, you can suddenly find yourself sorting through a mob of callers. Improving conditions on the HF bands bode well for low-power stations. Solar Cycle 25 is under way. In the coming months and years, conditions will only get better on 15, 12, and 10 meters.

Bottom Line

The Icom IC-705 is an extremely versatile low-power portable transceiver that covers 160 through 6 meters, 2 meters, and 70 centimeters with a wide variety of analog and digital modes. The radio offers a wealth of features typically found on larger desktop transceivers, and receiver and transmitter performance are excellent.

With the debut of the IC-705, Icom seems to be positioning itself to take advantage of the portable operating surge. In a compact 2¼-pound package that you can carry in one hand, Icom has created a transceiver capable of operating on all HF bands, plus VHF and UHF, in any mode you're likely to need — including D-STAR digital voice.

The IC-705 offers 5 W output when powered by its internal battery, and 10 W when using an external 13.8 V dc supply. The battery supplied with the '705 is a 7.4 V/1,880 mAh Lithium-ion pack. An optional 3,150 mAh battery is available as well.

Although the IC-705 is being marketed as a portable transceiver, it's worth noting that this radio is perfectly fine as a home station transceiver, if you're using it with an effective antenna system. Outside of my POTA activity (see the sidebar, "Parks On The Air with the IC-705"), I used the IC-705 at home with an HF dipole antenna and a VHF/UHF ground plane. Neither are gain antennas, yet I enjoyed surprising success, particularly with CW and digital modes.

SDR — With a Twist

At first glance, the IC-705 looks like a miniaturized version of the popular IC-7300 transceiver. The touchscreen is prominent, as it is in the IC-7300, and the front-panel layout is similar in appearance. However, the comparison largely ends there.

While the IC-705 is a software-defined radio (SDR), it implements this technology in a manner that is a departure from the IC-7300. Like the IC-7300, the IC-705 samples incoming signals as close as possible to the antenna input and converts them to digital information for processing. But unlike the IC-7300, the IC-705 is tasked with covering a much greater frequency range.

While it is certainly possible to do direct-sampling at UHF and beyond these days, such a high-performance direct-sampling design would add considerable cost to the radio, not to mention the additional power requirements. So, above 25 MHz, the IC-705 operates as a superheterodyne radio, converting the higher-frequency signals to lower frequencies before subjecting them to digital sampling. This approach keeps costs in line while still offering acceptable performance.

Parks on the Air with the IC-705

Steve Ford, WB8IMY

If you've never heard of the Parks on the Air (POTA) program, you're missing one of the most enjoyable — and popular — amateur radio activities available today. See the website at parksontheair.com.

The objective of POTA is simple: operate from one of the thousands of eligible state, provincial, or federal/national parks scattered throughout the world, or stay home and become a "chaser," logging contacts with park activators. There are many POTA awards available, and you'll find that activity is surprisingly strong. There is an active POTA Facebook group as well.

I'm relatively new to POTA and had never activated a park before — until I got my hands on the Icom IC-705. A quick look at the POTA website revealed that Wharton Brook State Park in North Haven, Connecticut, was just a few miles away.

I made a 20-meter vertical antenna using a telescoping fiberglass mast, a tripod support, and a network of 10 radial wires. For this review, we had also ordered the Icom LC-192 backpack, which is a convenient way to take the IC-705 and accessories on the road.

At the park, it took less than 10 minutes to deploy the antenna and put the IC-705 on the air. It was a chilly November day, so I operated from inside my car, using the IC-705 with its battery. With 5 W to a vertical antenna, it took a few CQs to get some SSB contacts, but I had good reports all around. Things picked up after I saw myself listed on the POTA website spotting page.

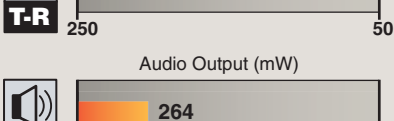
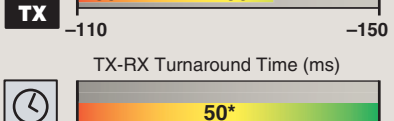
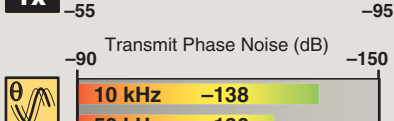
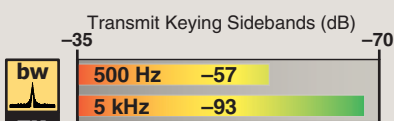
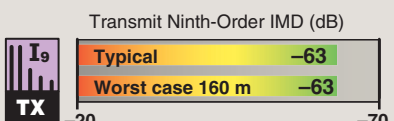
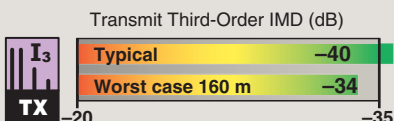
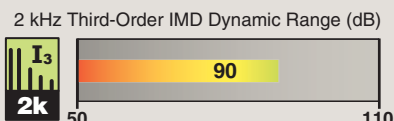
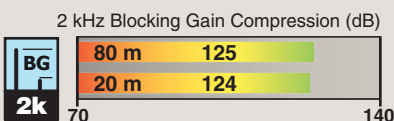
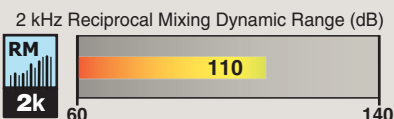
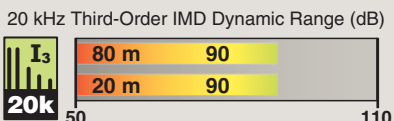
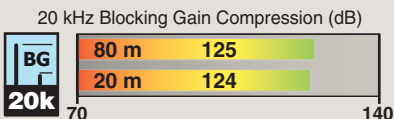
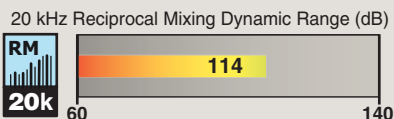
At the end of an hour full of calls and exchanges, the IC-705 battery was still going strong. According to the front-panel battery indicator, it had hardly been depleted at all. I estimate the battery could have easily lasted 2 hours, if not longer. This is in keeping with other reports I've heard about the IC-705's battery life. Of course, if I had been using a high-duty-cycle mode, such as FT8, it would likely be less.

My introduction to POTA set the hook. Radios such as the IC-705 make this type of operating a joy. If you've become bored with your amateur radio routine, I encourage you to head outdoors and give portable operation a try.



The Icom LC-192 backpack was very convenient for carrying the IC-705 and my other station supplies during a quick Parks on the Air activation at Wharton Brook State Park in North Haven, Connecticut.

Icom-705 (HF) Key Measurements Summary



KEY: QS2102-PR150
Measurements with preamp off
*SSB mode, AGC Fast

Table 1

Icom IC-705, serial number 12003734, v. 1.11

Manufacturer's Specifications

Frequency coverage: Receive, 0.030 – 200, 400 – 470 MHz. Transmit, 1.8 – 2.0, 3.5 – 4.0, 5.255 – 5.405, 7.0 – 7.3, 10.1 – 10.15, 14.0 – 14.35, 18.068 – 18.168, 21.0 – 21.450, 24.89 – 24.99, 28.0 – 29.7, 50 – 54, 144 – 148, 430 – 450 MHz.

Power consumption: Receive, 0.5 A (max audio); transmit, 3 A (10 W) at 13.8 V dc. Battery power (using specified battery pack): receive, 0.8 A (max audio); transmit, 2.5 A.

Modes of operation: SSB, CW, AM, FM, WFM (receive only), RTTY, Data, DV.

Receiver

CW sensitivity, 10 dB S+N/N: 0.2 μ V (1.8 – 29.995 MHz, preamp 1 on); 0.15 μ V (50 – 54 MHz, preamp 2 on); 0.11 μ V (144/430 MHz, preamp on).

Noise figure: Not specified.

AM sensitivity, 10 dB S+N/N: <13 μ V (0.5 – 1.8 MHz), <2.0 μ V (1.8 – 29.995 MHz), <1.0 μ V (50 MHz, 108 – 137 MHz, 144, 430 MHz).

FM sensitivity, 10 dB S+S/N: <0.5 μ V (28 – 29.7 MHz, <0.15 μ V (50 MHz), <0.11 μ V (144/430 MHz).

Blocking gain compression dynamic range: Not specified.

Reciprocal mixing dynamic range: Not specified.

ARRL Lab Two-Tone IMD Testing — See Table 2.

Second-order intercept point: Not specified.

Measured in the ARRL Lab

Receive and transmit, as specified.

With 13.8 V dc external power: Receive, 512 mA (max. brightness, max. volume, no signal), 446 mA (backlights off). Transmit, 0.6 A at minimum RF output, 2.45 A (typical) at 10 W RF. Battery power: Receive, 431 mA (300 mA with screen saver). Transmit, 2 A at 5 W RF output at 8.3 V dc (full charge).

As specified.

Receiver Dynamic Testing

Noise floor (MDS), 500 Hz bandwidth:

Preamp	Off	P1	P2
0.137 MHz	-128	-135	-137 dBm
0.475 MHz	-128	-137	-139 dBm
1.0 MHz	-128	-137	-139 dBm
3.5 MHz	-129	-138	-140 dBm
14 MHz	-129	-139	-141 dBm
50 MHz	-128	-138	-140 dBm
Preamp	Off	On	
144 MHz	-133	-144 dBm	
432 MHz	-130	-144 dBm	

Preamp off/1/2: 14 MHz, 18/9/6 dB; 50 MHz; 19/9/7 dB. Preamp off/on: 144 MHz, 19/3 dB; 432 MHz, 17/3 dB.

10 dB (S+N)/N, 1 kHz tone, 30% modulation, 9 kHz bandwidth:

Preamp	Off	P1	P2
1.02 MHz	3.09	1.06	0.97 μ V
3.88 MHz	2.75	0.92	0.78 μ V
29.0 MHz	4.07	1.24	1.06 μ V
50.4 MHz	3.54	1.12	0.89 μ V
Preamp	Off	On	
120 MHz	2.72	0.55 μ V	
144.4 MHz	2.04	0.54 μ V	
432 MHz	3.06	0.63 μ V	

For 12 dB SINAD, 3 kHz deviation, 15 kHz bandwidth:

Preamp	Off	P1	P2
29 MHz	0.99	0.31	0.26 μ V
52 MHz	0.85	0.29	0.22 μ V
Preamp	Off	On	
100 MHz	1.58	0.46 μ V (WFM)	
146 MHz	0.50	0.13 μ V	
162 MHz	0.66	0.16 μ V	
440 MHz	0.76	0.15 μ V	

Blocking gain compression dynamic range, 500 Hz bandwidth:

	20 kHz offset	5/2 kHz offset
Preamp off/1/2	Preamp off	Preamp off
3.5 MHz	125/121/118	125/125 dB
14 MHz	124/121/119	124/124 dB
50 MHz	124/121/119	124/124 dB
144 MHz	122/114	122/122 dB
432 MHz	124/118	124/124 dB

14 MHz, 20/5/2 kHz offset: 114/112/110 dB.

Preamp off/P1/P2:

14 MHz, +59/+59/+59 dBm;
21 MHz, +51/+51/+51 dBm;
50 MHz, +67/+49/+37 dBm.

Preamp off/on:

144 MHz, +27/+16 dBm;
432 MHz, +93/+93 dBm.

Manufacturer's Specifications

DSP noise reduction: Not specified.

Notch filter depth: 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.

IF/audio response: Not specified.

Receiver audio output: 200 mW into 8 Ω .

Receive signal processing delay time:
Not specified.

Transmitter

Power output with external 13.8 V dc supply:
0.1 – 10 W (AM, 0.025 – 2.5 W). With
battery: 0.1 – 5 W (AM, 0.025 – 1.25 W).

Spurious-signal and harmonic suppression:
HF, >50 dB; 50, 144, 430 MHz, >60 dB.

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

CW keyer speed range: Not specified.

CW keying characteristics: Not specified.

Transmit phase noise: Not specified.

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

Receive-transmit turnaround time (TX delay):
Not specified.

Size (height, width, depth, with protrusions): 3.3 × 8.0 × 4.0 inches.

Weight, 2.55 pounds with battery; 2.3 pounds without battery.

Second-order intercept points were determined using S-5 reference.

*Measurement was noise at the value indicated.

†Default values; bandwidth is adjustable via DSP.

Measured in the ARRL Lab

12 dB.

Auto notch: 60 dB, single tone; 30 dB,
two tones. Attack time: 100 ms single
tone; 3 seconds, two tones.

Preamp 2 on: 29 and 52 MHz, 79 dB;
Preamp on: 144 MHz, 77 dB;
432 MHz, 69 dB.

20 kHz offset: Preamp 2 on, 29 MHz,
72 dB; 52 MHz, 73 dB. Preamp on,
144 MHz, 72 dB; 432 MHz, 69 dB.*
10 MHz offset: preamp 2 on, 29 MHz,
95 dB; 52 MHz, 87 dB. Preamp on:
144 MHz, 87 dB; 432 MHz, 81 dB.

S-9 signal, preamp off/P1/P2:

14 MHz, 52.4/15.8/9.3 μ V;

50 MHz, 53.7/15.8/9.8 μ V;

144 MHz, 14.1/3.4 μ V;

432 MHz, 18.4/3.3 μ V.

Scaling, 3 dB/S-unit.

At threshold/max level, preamp 2 on:

FM, 29 MHz, 0.18 μ V/10.6 mV;

52 MHz, 0.18 μ V/11.0 mV.

SSB, 14 MHz, 6.38 μ V/105 mV.

At threshold/max level, preamp on:

FM, 144 MHz, 0.10 μ V/3.93 mV;

432 MHz, 0.11 μ V/4.31 mV.

Range at -6 dB points:†

CW (500 Hz BW): 330 – 882 Hz;

Equivalent Rectangular BW: 514 Hz;

SSB (2.4 kHz BW): 330 – 2882 Hz;

AM (9 kHz BW): 360 – 4575 Hz.

264 mW into 8 Ω at 10% THD.

THD at 1 V_{RMS}, 0.3%.

15 ms.

Transmitter Dynamic Testing

As specified.

HF, typically >70 dB (55 dB worst case,
30 meters); 50 MHz, 78 dB; 144 MHz,
68 dB; 432 MHz, 65 dB. Meets FCC
requirements.

3rd/5th/7th/9th order, 10 W PEP:

-40/-49/-57/-63 dB (HF typical)

-34/-53/-56/-63 dB (worst case, 160 m)

-37/-47/-57/-66 dB (50 MHz)

-33/-44/-57/-64 dB (144 MHz);

-37/-45/-56/-63 dB (432 MHz).

6 to 48 WPM. Iambic mode B.

See Figures A and B.

See Figure C.

S-9 signal, AGC fast, SSB: 50 ms;

CW full break-in, 68 ms.

SSB, 79 ms; FM, 14 ms.

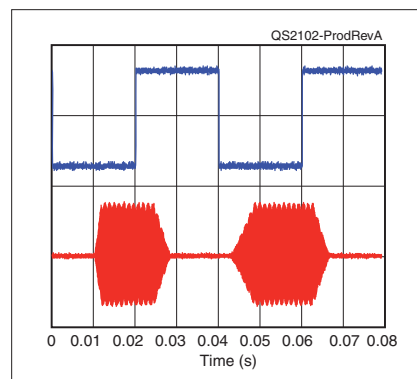


Figure A — The CW keying waveform for the Icom IC-705, showing the first two dits in full-break-in (QSK) mode using external keying. Equivalent keying speed is 60 WPM. The upper trace is the actual key closure; the lower trace is the RF envelope. (Note that the first key closure starts at the left edge of the figure.) Horizontal divisions are 10 milliseconds. The transceiver was being operated at 10 W output on the 14 MHz band.

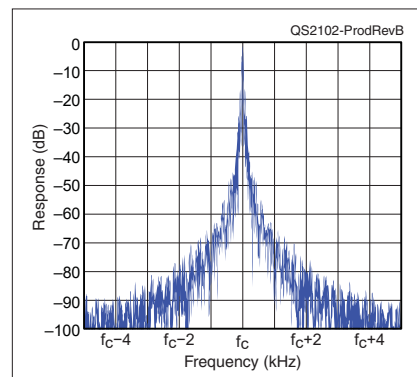


Figure B — A spectral display of the Icom IC-705 transmitter during keying sideband testing. Equivalent keying speed is 60 WPM using external keying. Spectrum analyzer resolution bandwidth is 10 Hz, and the sweep time is 30 seconds. The transmitter was being operated at 10 W PEP output on the 14 MHz band, and this plot shows the transmitter output ± 5 kHz from the carrier. The reference level is 0 dBc, and the vertical scale is in dB.

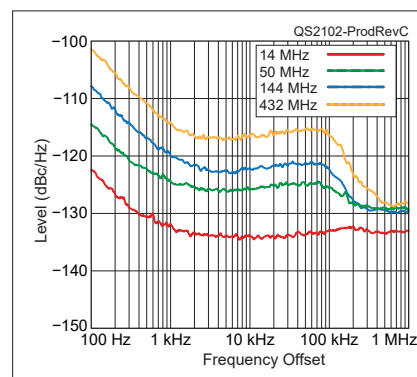


Figure C — A spectral display of the Icom IC-705 transmitter output during phase-noise testing. Power output is 10 W on the 14 MHz band (red trace), 50 MHz band (green trace), 144 MHz band (blue trace), and 432 MHz band (yellow trace). The carrier, off the left edge of the plot, is not shown. This plot shows composite transmitted noise 100 Hz to 1 MHz from the carrier. The reference level is -100 dBc/Hz, and the vertical scale is 10 dB per division.

Table 2

Icom IC-705, ARRL Lab Two-Tone IMD Testing (500 Hz bandwidth)

Band/Preamp	Spacing	Measured IMD Level	Measured Input Level	IMD DR
3.5 MHz/Off	20 kHz	-129 dBm -97 dBm	-39 dBm -15 dBm	90 dB
14 MHz/Off	20 kHz	-129 dBm -97 dBm	-39 dBm -15 dB	90 dB
14 MHz/P1	20 kHz	-139 dBm -97 dBm	-51 dBm -26 dBm	88 dB
14 MHz/P2	20 kHz	-141 dBm -97 dBm	-54 dBm -30 dBm	87 dB
14 MHz/Off	5 kHz	-129 dBm -97 dBm	-39 dBm -15 dBm	90 dB
14 MHz/Off	2 kHz	-129 dBm -97 dBm	-39 dBm -15 dBm	90 dB
50 MHz/Off	20 kHz	-128 dBm -97 dBm	-41 dBm -27 dBm	87 dB
50 MHz/P2	20 kHz	-140 dBm -97 dBm	-56 dBm -37 dBm	84 dB
144 MHz/Off	20 kHz	-128 dBm -97 dBm	-45 dBm -31 dBm	83 dB
144 MHz/On	20 kHz	-144 dBm -97 dBm	-63 dBm -43 dBm	81 dB
432 MHz/Off	20 kHz	-130 dBm -97 dBm	-36 dBm -15 dBm	94 dB
432 MHz/On	20 kHz	-144 dBm -97 dBm	-50 dBm -38 dBm	94 dB

Ins and Outs

If you require more evidence that Icom designed this transceiver with portable operating in mind, notice that the various input and output connections are found on the sides of the enclosure (see Figure 1). This arrangement allows the radio to lie flat, although it can also stand on edge. There is even a threaded hole on the bottom edge that will allow the '705 to be attached to a tripod.

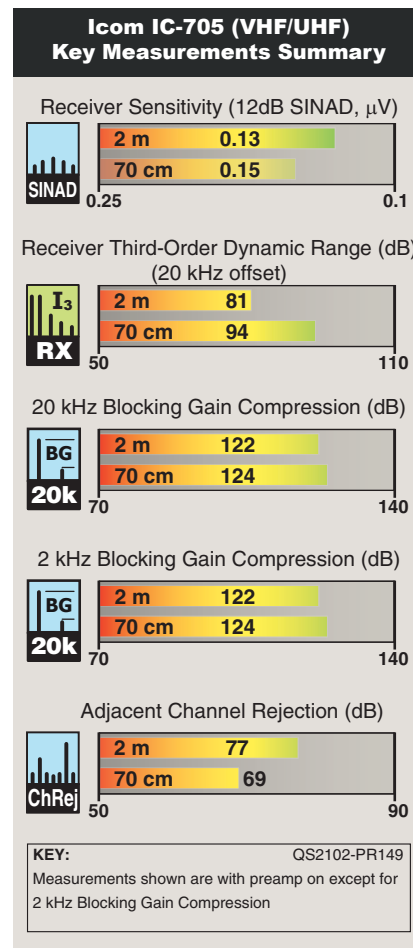
There is a micro-USB port for computer communication (more about this later). The IC-705 battery can also be charged through this port, if you desire. I connected it to one of my heftier USB power modules and noticed that it took about 3 hours to fully charge an exhausted battery in this fashion. When using the dc power cable and an external 13.8 V dc supply, I had a full charge in about 2 hours. The battery pack simply snaps into the back of the transceiver.

There are two ports for the supplied handheld speaker/microphone.

One is a 3.5-millimeter jack for the speaker and the other is 2.5 millimeters for the mic. The 3.5 millimeter jack doubles as the port for connecting headphones or ear buds. There is a jack for your CW key or paddle (with an internal electronic memory keyer available), and a BNC jack for the antenna. While most hams would use the BNC to attach a coaxial cable, you could also connect one of the venerable "rubber duck" antennas to this port for a quick bit of VHF/UHF operating on the fly.

There are two additional ports for attaching external gear. One is intended for an antenna tuner control line and the other is a stereo 3.5-millimeter jack for transmit-receive (TR) relay and an automatic level control (ALC) line for use with an external RF amplifier.

Looking at the front of the radio, the color display is the star attraction,



and it can be adjusted to various levels of brightness. At maximum brightness, I had no difficulty reading it in full sunlight. To preserve battery power, the screen is set to switch off after a certain amount of time with no operator activity. The display reappears the instant you touch one of the controls, press the microphone push-to-talk switch, or operate the CW key. The display timer is adjustable, or it can be disabled entirely.

As with the IC-7300 and other modern Icom transceivers, this is a responsive touchscreen through which I ended up controlling most of the radio's functions. In particular, the waterfall panadapter display mode is impressive (see Figure 2). Once you become accustomed to using it, you can choose signals on the panadapter with single taps of your fingers.



Figure 1 — Connectors for the antenna, microphone, CW key, and other accessories are located on the IC-705 side panels. Rubber caps help keep dust and moisture out when the connectors are not in use. The battery snaps into the back of the case.



Figure 2 — The IC-705 spectrum panadapter display, showing activity on 20 meters.

If you prefer mechanical controls, the IC-705 has those on offer as well, and they are arranged to make access as easy as possible. The VFO knob has a pleasant, solid feel — so much so that I often defaulted to it rather than the touchscreen when changing frequencies.

VLF to UHF Reception

The IC-705 offers all-mode reception throughout a range from 30 kHz to 199.99 MHz, and from 400 to 470 MHz. With this extensive range, the IC-705 can provide hours of listening pleasure when you aren't making contacts. The transceiver's front-panel speaker has reasonably good fidelity, despite its small size.

I enjoyed using the IC-705 as a portable shortwave listening receiver and found it to be every bit the match for serious radios, thanks in large part to the '705's flexible filtering options and noise-reduction functions. Sometimes I'd just attach a telescoping whip antenna and put the radio wherever I wanted it at that moment — such as at the side of my desk while working on a

kit project. It's worth noting that the IC-705 offers monaural FM broadcast reception from 88 to 108 MHz.

CW and SSB

With portable hamming being the IC-705's most important application, it makes sense to find it well equipped for both CW and SSB operation.

The IC-705 is supplied with a small handheld speaker/microphone that includes programmable buttons for easier control when your hands are otherwise full and you're making contacts at fast clip. According to reports I received, the audio quality was quite good, even when I engaged the speech processor. And when you're operating outdoors, it's nice to have a speaker closer to your face.

There are voice memories at your disposal, and they're invaluable when you are doing a park or summit activation, or a contest. After recording your various voice messages, you can send each one with just a tap on the touchscreen button. You can even set a memory to automatically repeat, such as when calling CQ. This requires a longer push on the screen button to start the auto-repeat mode and the amount of listening time between transmissions is adjustable. If you're out in the field running just 5 W on SSB, having your CQs automatically repeat is very convenient, because it may take several calls before someone finally hears you. When you squeeze the microphone's push-to-talk switch to respond, auto-repeat disengages.

Message memories and repeating functions are available for CW as well (see Figure 3). With many portable operators using CW, these can be a godsend. Manual CW is flawless with the IC-705. I used it with a set of paddles as well as a straight key, and both were as smooth as proverbial silk. The radio features semi break-in as well as full break-in (QSK). The transmit-



Figure 3 — CW memories make park or summit operating much easier.

receive switching uses a relay, and clicking is audible, but not really noticeable if you're sending while listening to the sidetone.

Like the IC-7300, the IC-705 features a versatile audio recorder. With a microSD memory card installed, the '705 will create audio files each time you start recording (you can start recording received audio almost immediately through the front-panel **QUICK** menu). Each audio file is labeled with the date, time, frequency, and operating mode. You can replay the files through the radio or load them into another device.

HF Digital

Another similarity between the IC-705 and the IC-7300 is the functionality available through its USB port for HF digital operating and computer-aided transceiver (CAT) control. If you enjoy digital operating with modes such as FT8, the IC-705 makes this as easy as possible — no external interfaces or sound devices required.

You'll need to provide your own micro-USB cable to connect the transceiver to your computer, but as the manual warns, don't connect the IC-705 straightaway; there are two Windows COM port drivers that must be installed on your computer first. (At the time of this writing, Icom offered only Windows drivers.) You must download the driver installation package from the Icom support site, extract the files, and then run the setup application, choosing either 32 or 64 bit.

I initially tried using an older laptop but discovered the Icom drivers were incompatible with its Windows 8.1 operating system. This may have been due to an issue with the old laptop's configuration. On my Windows 10 desktop PC, there wasn't a problem.

The drivers create two separate COM ports, and you'll need to open the Windows Device Manager to see which numbers Windows has assigned to them. One is for Icom CI-V computer-aided transceiver (CAT) control and the other port is used for other applica-

Lab Notes: Icom IC-705

Bob Allison, WB1GCM

The Icom IC-705 has plenty of dynamic range for use in the field or a home station. At 14 MHz, with the pre-amp off and 2 kHz signal spacing, its lowest dynamic range is 90 dB (two-tone, third-order IMD). This performance is *very good*. Blocking dynamic range (BDR) and reciprocal mixing dynamic range (RMDR) were quite good as well, at 124 and 110 dB, respectively.

The only potential performance issue may surface while operating on the 2-meter band, where second-order products may occur if the offending signals are strong enough. (A second-order product is a "phantom" signal that appears when the sum of the frequencies of the interfering signals equals the tuned frequency. For example, 100 MHz + 44 MHz signals create a phantom signal at 144 MHz.) All transceivers can experience unwanted signals, and that is why amateur radio receiving equipment includes an attenuator function. Use it, if needed, to reduce unwanted effects, though you will rarely need it with the IC-705.

Transmit performance is very good. Even the worst-case transmit intermodulation distortion (IMD) products are better than the typical transmitter IMD products we see in the Lab.

This is an important point to make, because some amateurs will undoubtedly want to use an RF amplifier with the IC-705. It is always best to use a transceiver with lower transmit IMD figures than the IMD figures of the amplifier being driven.

Transmit phase noise is very low on the HF bands and is quite acceptable on 6 and 2 meters. Transmit phase noise is higher on 70 centimeters, but it drops noticeably at 100 kHz, or more, away from the transmitted signal. This may be okay for low power, but perhaps not if used with a high-power RF amplifier when signals are strong. Transmit phase noise is more noticeable on VHF and UHF frequencies, where receiver noise floors are lowest. The CW keying characteristics of the IC-705 are excellent. All in all, the IC-705 is a good neighbor to stations operating nearby on the dial.

tions, such as streaming GPS information to your computer.

I had a blast using the IC-705 with *WSJT-X* software and the FT8 and FT4 modes. However, when this review was written, the latest version of *WSJT-X* didn't include the '705 in its list of CAT-controllable transceivers. The workaround is to go into the IC-705's CI-V menus and change the CI-V address from the default (A4h) to 94h. Once you've done that, select the IC-7300 configuration from the *WSJT-X* menu, and choose 9600 baud as the signaling rate. (I found that the IC-705 does not allow you to change its CI-V signaling rate; it appears to be fixed at 9600 baud.)

I checked FT8 results using PSKReporter while running 5 W to my dipole antenna on 20 meters and saw reception reports from across the US. I was also able to snag a few FT8 contacts on 6 meters with just 5 W to the same antenna.

If your HF digital interests include RTTY, you'll be interested to know that the IC-705 has the ability to send and receive RTTY without the need for an external computer, and it does this quite well with its extremely sharp mark/space "twin peaks" filtering. I used it to copy W1AW RTTY bulletin transmissions, along with the occasional random RTTY signal. I ran the popular *MMTTY* RTTY software simultaneously on my station computer and noticed that the IC-705's RTTY decoder matched it character for character. To send RTTY without an external computer, you'll need to preprogram the RTTY macro memories. Because most RTTY activity these days is confined to contests and DX operating where exchanges are preformatted anyway, this isn't a serious limitation.

Although slow-scan TV (SSTV) isn't the best mode for low-power work, I had to give it a try. I loaded up the *MMSSTV* software, configured it to communicate with the '705, and then sent an SSTV CQ. My 5 W 20-meter signal was rather noisy at KD9DD in Illinois, but my CQ image was viewable (see Figure 4).

The Wireless Connection

This is the era of wireless mobile devices, and the IC-705 is no exception. It includes Wi-Fi functionality as standard equipment. This means the IC-705 can connect to any 2.4 GHz wireless network and instantly become a remotely controllable transceiver.



Figure 4 — You can attach an external computer and operate slow-scan TV (SSTV) with the IC-705. KD9DD was 1,000 miles away in Illinois, but he was still able to view my noisy 5 W CQ image.

You set up the Wi-Fi connection in the IC-705 in the same way you would configure a tablet computer or smartphone. Using the touchscreen, you choose the network SSID, and then enter the password (see Figure 5). I was able to add the transceiver to my home network in less than a minute.

For operation away from home, Icom recommends a travel wireless router to use with the radio, as the IC-705 will not connect to a wireless network requiring secondary connection like you see in many hotels. You would use the travel router to connect to the hotel wireless network with the secondary information, then the radio would connect to the travel router.

With the IC-705 connected to Wi-Fi, it can be used for remote operating in almost any mode. At the time of this writing, the only remote-control software available for the '705 was the Icom *RS-BA1* package. I didn't have an opportunity to test the IC-705 with *RS-BA1*, but I'm aware of a few amateurs who are using it with this transceiver for long-distance remote access. It will be interesting to see what third-party software developers do with this feature in the months and years to come.

Another wireless asset that comes standard on the IC-705 is Bluetooth. This allows you to connect wireless headphones or a complete wireless microphone headset for hands-free operating. I didn't have a wireless headset available, but I was able to connect my Apple AirPods to the IC-705 for hands-free listening. Set-up was simple, and the result was impressive. Within my home, I was able to monitor the radio to a distance of about 30 feet; the range would be likely greater outdoors.

VHF/UHF

With its all-mode capability, the IC-705 does an excellent job as a portable or mobile alternative for exploring the world above 50 MHz. During this review, much of my VHF/UHF operating was analog FM, but I was fortunate to also have a couple of D-STAR digital repeat-

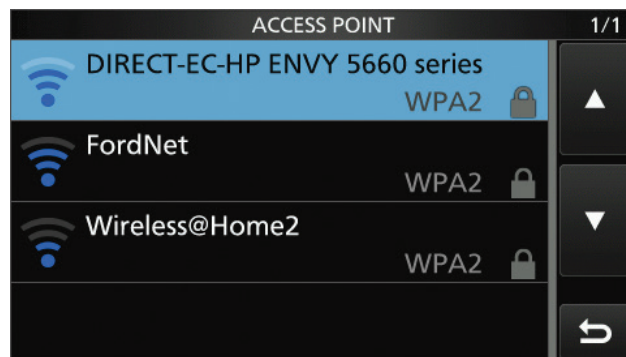


Figure 5 — You can connect the IC-705 to a wireless network for remote control via the internet. It's simply a matter of choosing the desired network and entering the password.

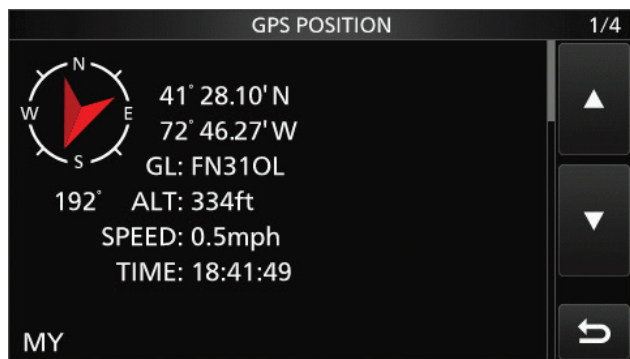


Figure 6 — The IC-705 has a sensitive internal GPS receiver.

ers nearby. If you've never tried D-STAR, you'll need to carefully follow the manual to configure the IC-705. Once I had it properly configured, accessing a D-STAR repeater was straightforward.

I found the audio quality of D-STAR to be quite good. In turn, I received good audio reports as well. In addition to local chats, I was able to enjoy several international conversations through internet-linked D-STAR reflectors.

In addition to swapping voice data during D-STAR transmissions, the IC-705 is capable of sending and receiving digital images via the DV data stream. This separate data channel is one of the cool aspects of D-STAR. It allows you to send other information — such as small images — to accompany your voice conversations.

The IC-705 is equipped with a sensitive Global Positioning System (GPS) receiver (see Figure 6), and you can use it to send position information using the D-STAR D-PRS format. This is similar to the Automatic Packet Reporting System (APRS), where positions of other stations can be displayed on the IC-705's screen. You can also use the GPS function to plot your course and position, and even store this information to the microSD card for later review (using *Google Earth*, for instance). This is a handy feature if you plan on taking the IC-705 on hiking expeditions.

I didn't try this, but with the right software it's possible to sync your PC clock to the IC-705's internal GPS time. This would be useful for portable operation using digital modes such as FT8 or FT4, where accurate timing is critical and syncing to an internet time server is not possible.

GPS is also used to help you determine which D-STAR repeaters are nearby. The IC-705 ships with the latest list of repeaters in its internal memory. A couple of screen taps is all it takes to bring up a list of machines and their distances from your location.

Select the nearest repeater, and the IC-705 configures itself automatically. The D-STAR list can be updated by downloading the latest version to your PC and transferring it to the '705 using the microSD card.

With its VHF/UHF SSB and CW capabilities, the IC-705 would be a worthy radio for contest roving, although you may want to consider adding an amplifier. The '705 also has potential for microwave operating when paired with a transverter. You can reduce the output to as little as 100 mW for compatibility with just about any transverter on the market.

Of course, a review wouldn't be complete without trying the IC-705 on amateur satellites. With 5 W to a small dual-band Yagi, I was able to make a few contacts through AMSAT-OSCAR 91, an FM repeater satellite. I used Icom's free *CS-705* programming software to set up some transmit/receive frequency memories prior to the satellite's arrival. The *CS-705* application does much more than program memories, though. You can use it to configure many aspects of the radio that you'd otherwise have to access through the menu system.

I didn't attempt to use the IC-705 to communicate through any of the SSB/CW linear-transponder satellites. It is possible to use the IC-705 with these satellites, at least in theory, but the transceiver doesn't operate full duplex, so you'd be unable to hear yourself on the downlink and adjust your frequency to compensate for the Doppler effect. Even so, it may still be possible to use the '705 with these satellites if you keep your transmissions very short to minimize the effects of drifting.

A Compact Contender

With its all-encompassing list of features, the Icom IC-705 will offer fierce competition to other portable transceivers. The only thing the IC-705 lacks is a built-in antenna tuner. For those who don't use resonant antennas, this could be an issue, although Icom has announced the AH-705, a tiny companion antenna tuner for the IC-705, which had not been released at press time.

Several well-illustrated manuals for the IC-705 are available for download from Icom's website and are well worth a look for more information about what this radio can do.

Manufacturer: Icom America, 12421 Willows Rd. NE, Kirkland, WA 98034; www.icomamerica.com. **Price:** \$1,300. Replacement BP-272 7.4 V/1,880 mAh battery pack, \$100. BP-307 7.4 V/3,150 mAh battery pack, \$130.

Three High-Power Dry Dummy Loads

Reviewed by Mark Wilson, K1RO
k1ro@arrrl.org

A 50 Ω dummy load (sometimes called a dummy antenna) is a great addition to any station for testing equipment or learning how to adjust an amplifier, antenna tuner, or vintage transmitter without transmitting a signal on the air. Years ago, the typical dummy load was a messy affair, consisting of a high-power resistor in a mineral oil bath. This review features three modern dry dummy loads that are lightweight, air cooled, and capable of briefly handling the 1,500 W legal limit. These loads use noninductive ceramic resistors that maintain their resistance over a wide temperature range.

Bob Allison, WB1GCM, tested each load in the ARRL Lab with high- and low-power levels on the 20-meter band. The high-power test was with 1,350 W, the maximum available in the Lab at the time of testing. The Lab also performed swept return loss measurements on each load to check the match to 50 Ω over the specified frequency range, and plots showing those measurements are included here. Additional return loss plots with greater detail for 0 – 30 MHz are available from www.arrrl.org/qst-in-depth.

Ameritron ADL-2500

The Ameritron ADL-2500, shown in Figure 7, is rated to handle up to 2,500 W over a frequency range of dc to 54 MHz. The case has an SO-239 connector for connecting the station transceiver and/or amplifier on one side, and a 2.1-millimeter jack for 12 V dc power from the station power supply or a wall cube on the other. Power is required for the internal fan, which must be used at high-power levels (the manual doesn't define "high"). The fan runs at a single speed and turns on 12 V dc is applied. There's no **ON/OFF** switch.

The ADL-2500 uses four large power resistors, which are shipped in individual cardboard tubes to prevent damage. The resistors must be installed before use — remove the screws holding the case together and carefully press the resistors into fuse clips. It's a snug fit, and the manual cautions that the resistors are fragile.

According to a chart in the manual, the ADL-2500 can handle 2,500 W for 60 seconds, 1,500 W for 70 seconds, and 300 W indefinitely. The duty cycle is specified at 10% with the fan enabled. In other words, if you transmit into it for 1 minute, let it cool for 10 minutes.



Figure 7 — The Ameritron ADL-2500 power-handling chart and specifications are printed on the top of the case.

Table 3

Ameritron ADL-2500

Frequency range: dc – 54 MHz.

Power rating: 2,500 W maximum (10% duty cycle). Per chart in manual: 1,500 W for 70 seconds, 300 W continuous. Internal fan must be used for high power levels.

Cooling: Internal 12 V dc fan; current consumption 200 mA.

Impedance: 50 Ω .

SWR: Less than 1.3:1 at 30 MHz. See Figure 8.

Size (height, width, depth): 3.8 × 8.5 × 9.2 inches.

Weight: 4.1 pounds.

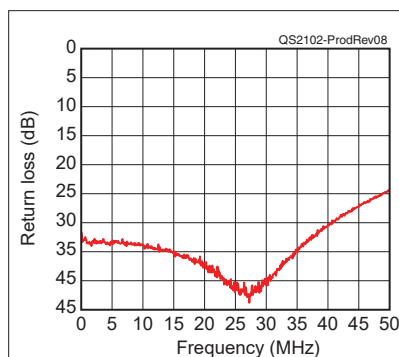


Figure 8 — The swept return loss of the Ameritron ADL-2500 over the range of 0 to 50 MHz. A return loss of 30 dB is the equivalent of an SWR of 1.065:1, 20 dB is an SWR of 1.22:1, and 10 dB is 1.93:1.

The power-handling chart and other specifications are also printed on the case for easy reference.

With 300 W applied for 10 minutes, SWR started at 1.09:1 and was 1.14:1 after 10 minutes. After cool-off, we applied 1,350 W for 80 seconds. The built-in fan

was powered up during these tests, and there were no sign of stress, only warm air blowing out the vents. The fan is not quiet, but the noise seems typical for a 3-inch fan blade in a metal case. We also tried 100 W for 10 minutes without running the fan. The case reached 110 °F, just warm to the touch, with no issues.

Figure 8 shows the swept return loss measured at the SO-239 jack on the rear of the ADL-2500 over the range of 0 to 50 MHz. Return loss ranges from about 34 dB (SWR = 1.04:1) at 160 meters to greater than 40 dB (SWR = 1.02:1) at 10 meters. At 6 meters, return loss is about 25 dB (SWR = 1.12:1).

Manufacturer: Ameritron, an MFJ company, 116 Willow Rd., Starkville, MS 39759; www.mfjenterprises.com. Price: \$250.

MFJ-264

The MFJ-264 (see Figure 9) uses a single, large power resistor and is rated to handle up to 1,500 W over a frequency range of dc to 650 MHz. An SO-239 is used for connecting the station transceiver and/or amplifier, and cooling is passive (no fan). This load is shipped assembled and ready to use.

Like the ADL-2500, the MFJ-264 manual includes a chart showing maximum transmit power versus time, and this chart is also printed on the case. According to the chart, the MFJ-264 can handle 1,500 W for 10 seconds and 100 W for 10 minutes. The duty cycle is not specified, but the manual says to let the load cool down for 10 to 20 times the load usage (indicating a duty cycle of 5% to 10%). So, if you transmit into it for 10 seconds, let it cool down for 100 to 200 seconds (several minutes).

With 100 W applied for 10 minutes, SWR started at 1.03:1, dropped to 1:1 after a minute and was 1.18:1 after 10 minutes. The case temperature reached 140 °F, measured in the center of the top panel. After the load cooled off, we applied 1,350 W applied for 10 seconds and did this several times with no issues. The instructions warn to never allow the resistor to get hot enough to glow red, and we observed no color change during testing.

Figure 10 shows the swept return loss measured at the SO-239 jack on the MFJ-264 over the range of 0 to 650 MHz. Return loss on the HF bands ranges from about 37 dB (SWR = 1.03:1) at 160 meters to about 30 dB (SWR = 1.07:1) at 10 meters. At 6 meters, return loss is about 25 dB (SWR = 1.12:1); at 2 meters, about 17 dB (SWR = 1.3:1), and at

Table 4
MFJ-264

Frequency range: 1 – 650 MHz.

Power rating: 1,500 W for less than 10 seconds, 100 W for 10 minutes (per chart in manual). Cool down period must be 10 to 20 times the load usage.

Cooling: Passive.

Impedance: 50 Ω.

SWR: Less than 1.3:1 up to 650 MHz. See Figure 10.

Size (height, width, depth): 3 × 3.2 × 8 inches. Weight: 1.3 pounds.



Figure 9 — The MFJ-264 power-handling chart is printed on the end of the case opposite the connector.

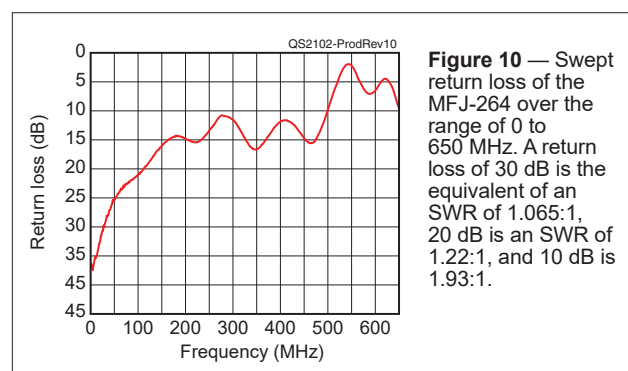


Figure 10 — Swept return loss of the MFJ-264 over the range of 0 to 650 MHz. A return loss of 30 dB is the equivalent of an SWR of 1.065:1, 20 dB is an SWR of 1.22:1, and 10 dB is 1.93:1.

70 centimeters, about 15 dB (SWR = 1.4:1). It's very usable through the 70-centimeter band, although we did not apply high power in the VHF/UHF range.

Manufacturer: MFJ, 300 Industrial Park Rd., Starkville, MS 39759; www.mfjenterprises.com. Price: \$90.

Palstar DL1500

The Palstar DL1500 (see Figure 11) is rated to handle up to 1,500 W over a frequency range of dc to 30 MHz, and lower power at higher frequencies (see Table 5). The case has an SO-239 connector for connecting the station transceiver and/or amplifier. Like the MFJ-264, the DL1500 uses a single, large power resistor and relies on passive cooling. It's shipped assembled and ready to use.

Like the other two loads, the DL1500 manual includes a chart showing maximum transmit power versus time. According to the chart, from 0 to 30 MHz the DL1500 can handle 1,500 W for 10 seconds, and 100 W for 10 minutes. The duty cycle is not specified.

With 100 W applied for 10 minutes, SWR started at 1.19:1, dropped to 1:1 after 7 minutes, and ended at 1.02:1. After this period, the case temperature reached 195 °F in the center of the top panel, so be careful handling it. After cool-down, we applied 1,350 W for 12 seconds and tried this several times. The case got hot once again, but not as hot as during the 100 W continuous test.

Figure 12 shows the swept return loss measured at the SO-239 jack on the DL1500 over the range of 0 to 450 MHz. Return loss on the HF bands is about 20 dB (SWR = 1.22:1) across the range. At 6 meters, return loss is about 18 dB (SWR = 1.28:1); at 2 meters, about 15 dB (SWR = 1.43:1), and at 70 centimeters, about 17 dB (SWR = 1.33:1). It's very usable through the 70-centimeter band, although we did not apply high power in the VHF/UHF range.

Manufacturer: Palstar, Inc., 9676 N. Looney Rd., Piqua, OH 45356; www.palstar.com. **Price:** \$200.

Table 5
Palstar DL1500

Frequency range: dc – 450 MHz.

Power rating: 0 – 30 MHz: 1,500 W for 10 seconds, 100 W for 10 minutes (per chart in manual). Maximum 1,000 W at 30 – 60 MHz; 750 W at 60 – 150 MHz; 350 – 500 W at 150 – 450 MHz.

Cooling: Passive.

Impedance: 54 Ω, ±5%.

SWR: Less than 1.3:1 dc – 100 MHz; less than 1.4:1, 100 – 500 MHz. See Figure 12.

Size (height, width, depth): 7.75 × 3.5 × 8 inches. Weight: 1.5 pounds.



Figure 11 — The Palstar DL1500. (The most recent production units have a gold-anodized case instead of the brushed aluminum shown here.)

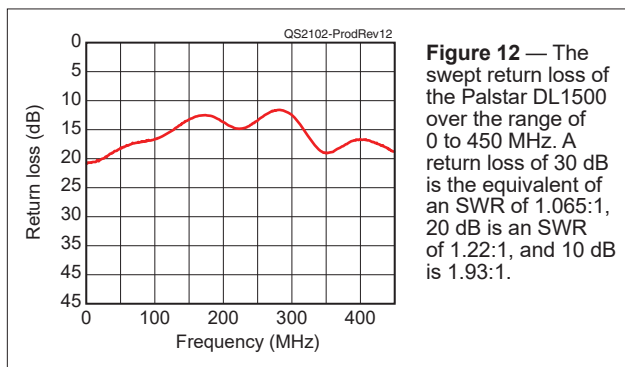


Figure 12 — The swept return loss of the Palstar DL1500 over the range of 0 to 450 MHz. A return loss of 30 dB is the equivalent of an SWR of 1.065:1, 20 dB is an SWR of 1.22:1, and 10 dB is 1.93:1.

