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 contacts 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.

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.

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.

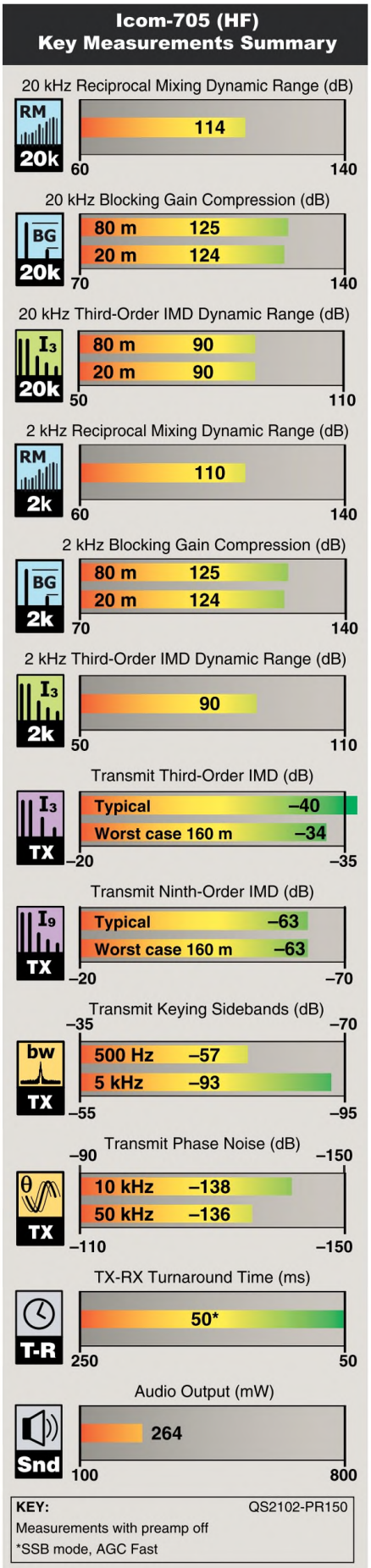


Table 1
Icom IC-705, serial number 12003734, v. 1.11

Manufacturer's Specifications	Measured in the ARRL Lab
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.	Receive and transmit, as specified.
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.	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).
Modes of operation: SSB, CW, AM, FM, WFM (receive only), RTTY, Data, DV.	As specified.
Receiver	**Receiver Dynamic Testing**
CW sensitivity, 10 dB S+N/N: 0.2 µV (1.8 – 29.995 MHz, preamp 1 on); 0.15 µV (50 – 54 MHz, preamp 2 on); 0.11 µV (144/430 MHz, preamp on).	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
Noise figure: Not specified.	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.
AM sensitivity, 10 dB S+N/N: <13 µV (0.5 – 1.8 MHz), <2.0 µV (1.8 – 29.995 MHz), <1.0 µV (50 MHz, 108 – 137 MHz, 144, 430 MHz).	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 µV 3.88 MHz 2.75 0.92 0.78 µV 29.0 MHz 4.07 1.24 1.06 µV 50.4 MHz 3.54 1.12 0.89 µV *Preamp Off On* 120 MHz 2.72 0.55 µV 144.4 MHz 2.04 0.54 µV 432 MHz 3.06 0.63 µV
FM sensitivity, 10 dB S+S/N: <0.5 µV (28 – 29.7 MHz, <0.15 µV (50 MHz), <0.11 µV (144/430 MHz).	For 12 dB SINAD, 3 kHz deviation, 15 kHz bandwidth: *Preamp Off P1 P2* 29 MHz 0.99 0.31 0.26 µV 52 MHz 0.85 0.29 0.22 µV *Preamp Off On* 100 MHz 1.58 0.46 µV (WFM) 146 MHz 0.50 0.13 µV 162 MHz 0.66 0.16 µV 440 MHz 0.76 0.15 µV
Blocking gain compression dynamic range: Not specified.	Blocking gain compression dynamic range, 500 Hz bandwidth: *20 kHz offset Preamp off/1/2 — 5/2 kHz offset 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
Reciprocal mixing dynamic range: Not specified.	14 MHz, 20/5/2 kHz offset: 114/112/110 dB.
ARRL Lab Two-Tone IMD Testing — See Table 2.	
Second-order intercept point: Not specified.	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	Measured in the ARRL Lab
DSP noise reduction: Not specified.	12 dB.
Notch filter depth: Not specified.	Auto notch: 60 dB, single tone; 30 dB, two tones. Attack time: 100 ms single tone; 3 seconds, two tones.
FM adjacent channel rejection: Not specified.	Preamp 2 on: 29 and 52 MHz, 79 dB; Preamp on: 144 MHz, 77 dB; 432 MHz, 69 dB.
FM two-tone, third-order IMD dynamic range: Not specified.	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-meter sensitivity: Not specified.	S-9 signal, preamp off/P1/P2: 14 MHz, 52.4/15.8/9.3 µV; 50 MHz, 53.7/15.8/9.8 µV; 144 MHz, 14.1/3.4 µV; 432 MHz, 18.4/3.3 µV. Scaling, 3 dB/S-unit.
Squelch sensitivity: Not specified.	At threshold/max level, preamp 2 on: FM, 29 MHz, 0.18 µV/10.6 mV; 52 MHz, 0.18 µV/11.0 mV. SSB,14 MHz, 6.38 µV/105 mV. At threshold/max level, preamp on: FM, 144 MHz, 0.10 µV/3.93 mV; 432 MHz, 0.11 µV/4.31mV.
IF/audio response: Not specified.	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.
Receiver audio output: 200 mW into 8 Ω.	264 mW into 8 Ω at 10% THD. THD at 1 V_{RMS}, 0.3%.
Receive signal processing delay time: Not specified.	15 ms.
Transmitter	**Transmitter Dynamic Testing**
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).	As specified.
Spurious-signal and harmonic suppression: HF, >50 dB; 50, 144, 430 MHz, >60 dB.	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.
Third-order intermodulation distortion (IMD) products: Not specified.	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).
CW keyer speed range: Not specified.	6 to 48 WPM. Iambic mode B.
CW keying characteristics: Not specified.	See Figures A and B.
Transmit phase noise: Not specified.	See Figure C.
Transmit-receive turnaround time (PTT release to 50% audio output): Not specified.	S-9 signal, AGC fast, SSB: 50 ms; CW full break-in, 68 ms.
Receive-transmit turnaround time (TX delay): Not specified.	SSB, 79 ms; FM, 14 ms.

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.

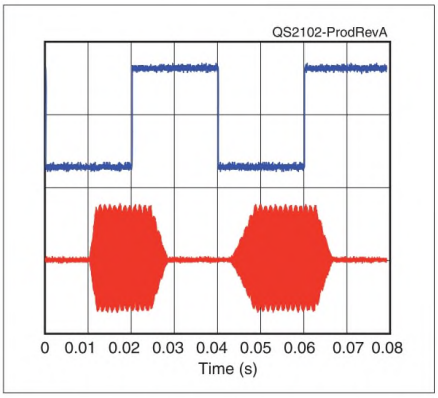


Figure A — The CW keying waveform for the Icom IC-705, showing the first two dits in full-break-in (QSK) mode using external keying. Equivalent keying speed is 60 WPM. The upper trace is the actual key closure; the lower trace is the RF envelope. (Note that the first key closure starts at the left edge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

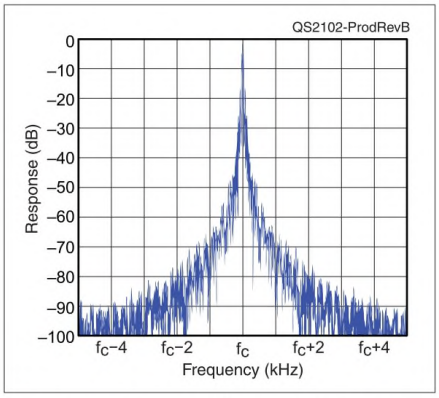


Figure B — A spectral display of the Icom IC-705 transmitter during keying sideband testing. Equivalent keying speed is 60 WPM using external keying. Spectrum analyzer resolution bandwidth is 10 Hz, and the sweep time is 30 seconds. The transmitter was being operated at 10 W PEP output on the 14 MHz 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.

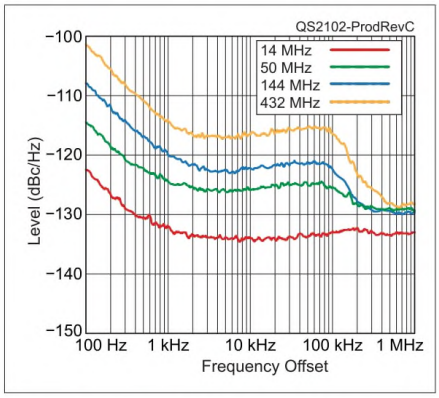
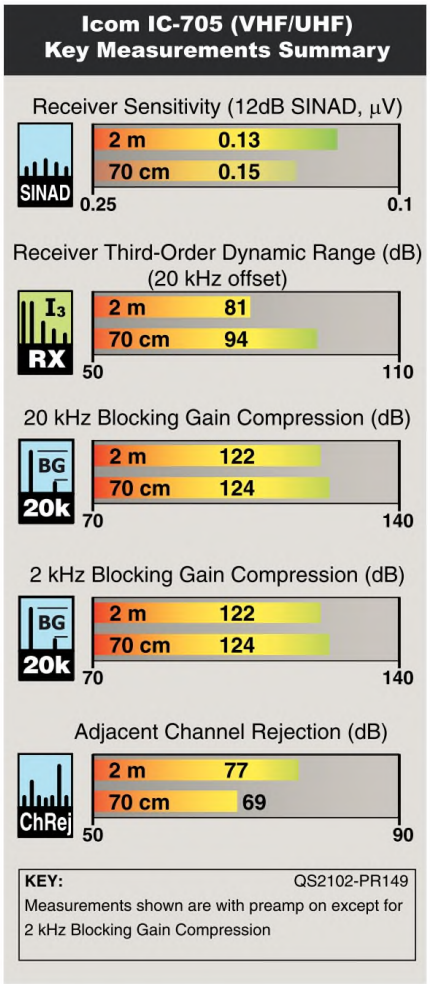


Figure C — A spectral display of the Icom IC-705 transmitter output during phase-noise testing. Power output is 10 W on the 14 MHz band (red trace), 50 MHz band (green trace), 144 MHz band (blue trace), and 432 MHz band (yellow trace). The carrier, off the left edge of the plot, is not shown. This plot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

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 preamp 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.