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Icom IC-7300 HF and 6 Meter Transceiver

Icom's software defined radio (SDR) in a box with knobs.

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Calling a piece of technology a "game-changer" is to invoke a cliché of the highest order, but it's difficult to avoid when discussing the Icom IC-7300. A game-changer is usually defined as a product that has the potential to disrupt a market. When a game-changer appears on the scene, competitors are challenged, buying preferences change, and the market veers off in a new direction (the introduction of the Apple iPhone is a classic example).

The game-changing aspect of the IC-7300 is not the fact that it is a software defined radio (SDR). Hams have been exposed to SDR technology for more than a decade, and *QST* has reviewed several highly competent SDRs from other manufacturers. Instead, what makes the IC-7300 disruptive is that it offers the performance and flexibility of SDR with a touchscreen in a user-friendly package that is unlike any other — and it does this at a price point that is guaranteed to be attractive to a large segment of the amateur community. It's similar in concept and price point to Icom's previous generation IC-7410, but offers more features and better performance in many areas.[1]

SDR with Knobs

For those who may be unfamiliar with the technology, a software defined radio takes the analog signal arriving at the antenna input and "samples" it at an extremely high rate, effectively converting the analog signal into a stream of digital information. Once a signal has been converted to data, it can be processed by software in ways that are not possible — or at least practical — with analog technology. Any form of modulation can be decoded, noise can be removed (or greatly suppressed), and extraordinarily sharp filters can be applied to the result.

To transmit, the process is essentially reversed. Software massages the desired signal, which is then converted to analog and amplified.

In the early days of Amateur Radio SDR, a receiver board performed quadrature mixing on the incoming RF signal, creating in-phase (I) and quadrature (Q) analog

[1]R. Lindquist, WW3DE, "Icom IC-7410 HF and 6 Meter Transceiver," Product Review, *QST*, Oct 2011, pp 49 – 54.

Bottom Line

Icom's IC-7300 is a 160 – 6 meter, 100 W, software defined radio (SDR) in a conventional package. Aimed at the "entry level" segment of the market, it offers a wide range of features and excellent performance often found in higher-priced transceivers.

Figure 1 — The IC-7300's rear panel has connections for a CW paddle for the internal keyer or external key/keyer; an external speaker; ALC and TR switching for an amplifier; remote control via the optional *RS-BA1* software or an Icom CI-V device; a USB port for radio control and digital mode operation; an ACC socket for connecting a TNC or PC for digital modes, and a jack for connection to any of Icom's accessory antenna tuners or tuned antennas.

Key Measurements Summary

Icom IC-7300 HF and 6 Meter Transceiver

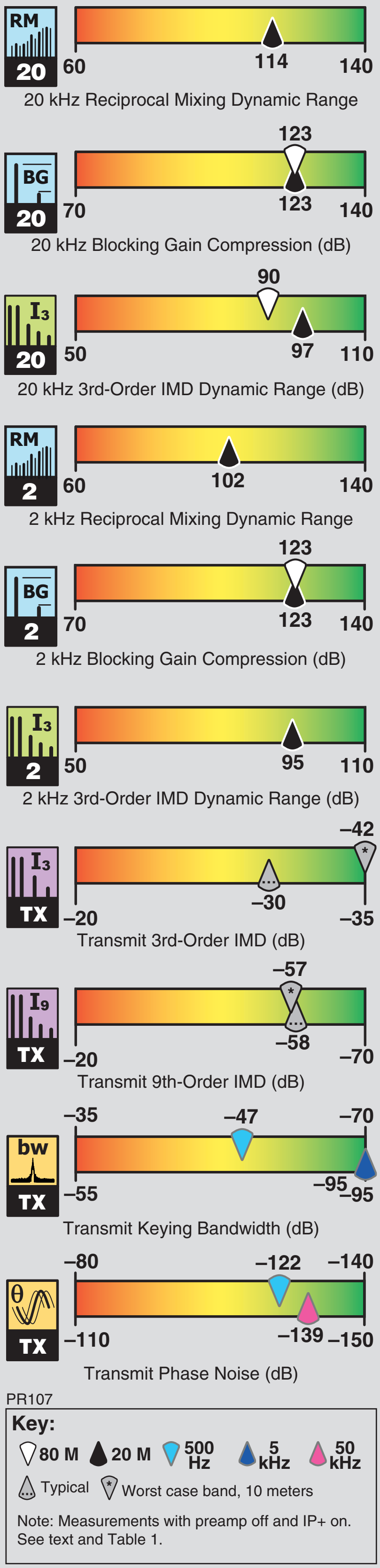

Table 1
Icom IC-7300, serial number 02001161

Manufacturer's Specifications	Measured in the ARRL Lab
Frequency coverage: Receive, 0.03 – 74 MHz; transmit, 160 – 6 meter amateur bands.	Receive and transmit, as specified; (5.255 – 5.405 MHz, 60 meters).
Power requirement: Receive, 0.9 A (standby), 1.25 A (maximum audio); transmit, 21 A at maximum power output at 13.8 V dc ±15 %.	At 13.8 V dc: Receive, 1.05 A (maximum volume); transmit, 18.5 A (typical); 5 mA (power off).
Modes of operation: SSB, CW, AM, FM, RTTY.	As specified.
Receiver	**Receiver Dynamic Testing**
CW sensitivity, <0.16 µV (1.8 – 29.999 MHz, preamp 1 on), <0.13 µV (50 MHz preamp 1 on), <0.16 µV (70 MHz, preamp 1 on).	Noise floor (MDS), 500 Hz bandwidth: *With IP+ (Dither) Off (See text)* *Preamp — Off — 1 — 2* 0.137 MHz — –85 — –83 — –82 dBm 0.475 MHz — –96 — –116 — –118 dBm 1.0 MHz — –114 — –123 — –125 dBm 3.5 MHz — –133 — –141 — –143 dBm 14 MHz — –133 — –141 — –143 dBm 28 MHz — –132 — –141 — –143 dBm 50 MHz — –130 — –139 — –141 dBm *With IP+ (Dither) On (See text)* 3.5 MHz — –123 — –135 — –139 dBm 14 MHz — –124 — –136 — –140 dBm 28 MHz — –122 — –135 — –138 dBm
Noise figure: Not specified.	14 MHz, IP+ off, preamp off/1/2: 14/6/4 dB; 50 MHz, 17/8/6 dB.
AM sensitivity: 10 dB S/N, <12.6 µV (0.5 –1.8 MHz preamp 1 on); <2.0 µV (1.8 – 29.999 MHz, preamp 1 on); <1.0 µV (50 and 70 MHz preamp 2 on).	10 dB (S+N)/N, 1-kHz, 30% modulation, 9 kHz bandwidth: *Preamp — Off — 1 — 2* 1.0 MHz — 12.20 — 4.16 — 3.71 µV 3.8 MHz — 1.64 — 0.61 — 0.56 µV 29 MHz — 1.82 — 0.66 — 0.58 µV 50.4 MHz — 2.19 — 0.76 — 0.66 µV
FM sensitivity: 12 dB SINAD, <0.5 µV (28 –29.990 MHz, preamp 1 on), 0.25 µV (50 and 70 MHz, preamp 2 on).	12 dB SINAD, 15 kHz bandwidth: *Preamp — Off — 1 — 2* 29 MHz — 0.50 — 0.17 — 0.16 µV 52 MHz — 0.62 — 0.21 — 0.17 µV
Spectral sensitivity: Not specified.	Preamp off/1/2: –100/–114/–118 dBm.
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 — 123/118/116 dB — 123/123 dB 14 MHz — 123/118/116 dB — 123/123 dB 50 MHz — 122/118/116 dB — 122/122 dB
Reciprocal mixing dynamic range: Not specified.	14 MHz, 20/5/2 kHz offset: preamp off, IP+ off: 114/107/101 dB; preamp off, IP+ on, 114/108/102 dB.

ARRL Lab Two-Tone IMD Testing (500 Hz bandwidth)

Band (Preamp/IP+)	*Spacing*	*Measured IMD Level*	*Measured Input Level*‡	*IMD DR*
3.5 MHz (off/off)	20 kHz	–133 dBm	–53 dBm	80 dB
		–97 dBm	–16 dBm	
3.5 MHz (off/on)	20 kHz	–123 dBm	–33 dBm	90 dB
		–97 dBm	–16 dBm	
14 MHz (off/off)	20 kHz	–133 dBm	–56 dBm	77 dB
		–97 dBm	–16 dBm	
14 MHz (two/on)	20 kHz	–140 dBm	–38 dBm	102 dB
		–97 dBm	–38 dBm	
14 MHz (off/off)	5 kHz	–133 dBm	–56 dBm	77 dB
		–97 dBm	–16 dBm	
14 MHz (two/on)	5 kHz	–140 dBm	–40 dBm	100 dB
		–97 dBm	–39 dBm	
14 MHz (off/off)	2 kHz	–133 dBm	–56 dBm	77 dB
		–97 dBm	–21 dBm	
14 MHz (off/on)	2 kHz	–124 dBm	–29 dBm	95 dB
		–97 dBm	–21 dBm	

Manufacturer's Specifications		Measured in the ARRL Lab		
14 MHz (one/off)	2 kHz	–141 dBm –97 dBm	–63 dBm –34 dBm	78 dB
14 MHz (one/on)	2 kHz	–136 dBm –97 dBm	–36 dBm –34 dBm	100 dB
14 MHz (two/off)	2 kHz	–143 dBm –97 dBm	–64 dBm –34 dBm	79 dB
14 MHz (two/on)	2 kHz	–140 dBm –97 dBm	–40 dBm –39 dBm	100 dB
50 MHz (off/off)	20 kHz	–130 dBm –97 dBm	–41 dBm –15 dBm	89 dB
50 MHz (two/on)	20 kHz	–139 dBm –97 dBm	–41 dBm –30 dBm	98 dB

Manufacturer's Specifications	Measured in the ARRL Lab
Second-order intercept point: Not specified.	Preamp off/1/2:‡ 14 MHz, +69/+45/+41 dBm; 21 MHz, +65/+67/+67 dBm; 50 MHz, +71/+71/+71 dBm.
DSP noise reduction: Not specified.	15 dB (maximum).
Audio Output: >2.5 W into 8 Ω at 10% THD.	At 10% THD, 2.4 W into 8 Ω. THD at 1 V_{RMS}, 0.2%.
FM adjacent channel rejection: Not specified	29 MHz, 82 dB; 52 MHz, 79 dB.
FM two-tone third order dynamic range: Not specified.	20 kHz spacing, 29 MHz, 82 dB*; 52 MHz, 79 dB.* 10 MHz spacing, 29 MHz, 97 dB; 52 MHz, 99 dB.
Squelch sensitivity: SSB, 5.6 µV, FM, <1 µV.	At threshold: 1.58 µV 14 MHz (SSB, preamp off); 0.08 µV (29 MHz, p2 on).
Notch filter depth: Not specified.	Manual notch, 52 dB; auto-notch, 52 dB (45 dB two tones). Attack time, 198 ms (single tone), 2080 ms (two tones).
S-meter sensitivity: Not specified.	S-9 signal, (preamp off/1/2): 14 MHz, 70.7/31.2/18.8 µV; 50 MHz, 78.4/37.5/24.5 µV.
Audio filter response: Not specified.	Range at –6 dB points:** CW (500 Hz): 342 – 860 Hz (518 Hz); Equivalent Rectangular BW: 514 Hz; USB (2.4 kHz): 234 – 2632 Hz (2398 Hz); LSB (2.4 kHz): 250 – 2656 Hz (2406 Hz); AM (9 kHz), 166 – 4477 Hz (8622 Hz).

Transmitter	Transmitter Dynamic Testing
Power output: 2 – 100 W; 1 – 25 W (AM).	HF, 0.7 – 104 W typical; 50 MHz, 0.5 – 97 W. 70 W typical at minimum specified dc voltage input.
Spurious-signal and harmonic suppression: >50 dB (1.8 – 28 MHz); >63 dB (50 MHz).	HF, typically 64 dB, 57 dB (worst case 160 m), 50 MHz, 76 dB.
SSB carrier suppression: >50 dB.	>70 dB.
Undesired sideband suppression: >50 dB.	>70 dB.
Third-order intermodulation distortion (IMD)	3rd/5th/7th/9th order, 100 W PEP: HF, –42/–38/–46/–57 dB (typical) –30/–37/–44/–58 dB (worst case, 10 m); 50 MHz, –26/–37/–39/–44 dB (100 W); 50 MHz, –33/–37/–44/–62 dB (80 W)
CW keyer speed range: Not specified.	6 to 48 WPM, iambic mode B.
CW keying characteristics: Not specified.	See Figures 2 and 3.
Transmit-receive turn-around time (PTT release to 50% audio output): Not specified.	S-9 signal, AGC fast, 15 ms. QSK transmit to receive time, 35 ms.
Receive-transmit turn-around time (tx delay): Not specified.	SSB, 14. ms; FM, 15 ms (29 MHz and 52 MHz).
Composite transmitted noise: Not specified.	See Figure 4.

Size (height, width, depth, including protrusions): 4.0 × 9.4 × 10.7 inches. Weight, 9.3 lbs.
Price: $1500.

†Blocking occurs at ADC overload threshold. Blocking level is same for IP+ on or off.
‡There was no intercept of the IMD input signal and receiver IMD at the S5 (–97 dBm) level. Figures are at threshold of ADC overload or spurious receiver response. Second-order intercept points were determined using S5 reference.
*Measurement was noise limited at the value indicated.
**Default values; bandwidth is adjustable.

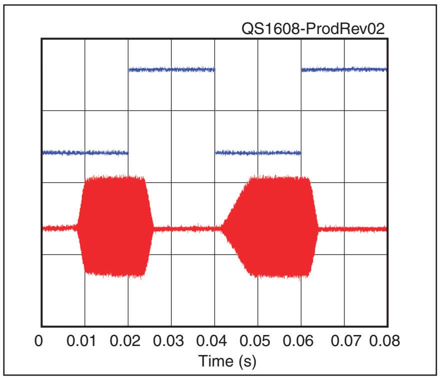

Figure 2 — CW keying waveform for the Icom IC-7300 showing the first two dits using external keying. Equivalent keying speed is 60 WPM. The upper trace is the actual key closure; the lower trace is the RF envelope. (Note that the first key closure starts at the left edge of the figure.) Horizontal divisions are 10 ms. The transceiver was being operated at 100 W output on the 14 MHz band.

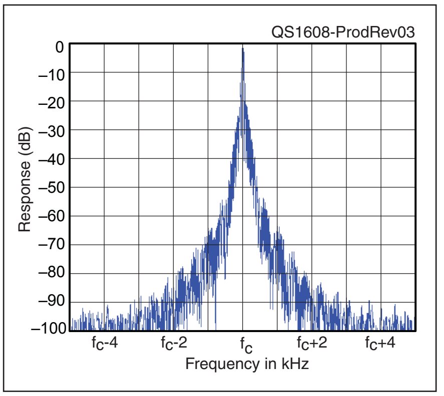

Figure 3 — Spectral display of the Icom IC-7300 transmitter during keying sideband testing. Equivalent keying speed is 60 WPM using external keying. Spectrum analyzer resolution bandwidth is 10 Hz, and the sweep time is 30 seconds. The transmitter was being operated at 100 W PEP output on the 14 MHz band, and this plot shows the transmitter output ±5 kHz from the carrier. The reference level is 0 dBc, and the vertical scale is 10 dB/division.

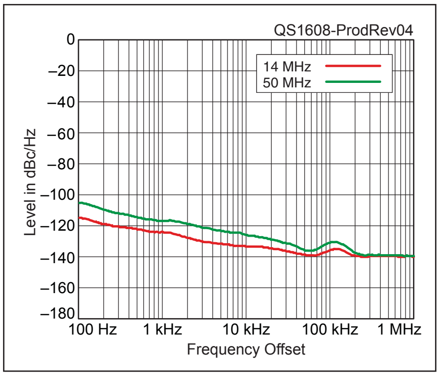

Figure 4 — Spectral display of the Icom IC-7300 transmitter output during phase noise testing. Power output is 100 W on the 14 MHz band (red trace) and 50 MHz band (green trace). The carrier, off the left edge of the plot, is not shown. This plot shows composite transmitted noise 100 Hz to 1 MHz from the carrier. The reference level is 0 dBc, and the vertical scale is in dBc/Hz.

baseband signals. This IQ baseband signal was converted to digital information by a computer sound card, and software was used to demodulate the received signal. As technology improved, the signal mixing and IQ digital conversion stages were combined in a single box, and the resulting data was streamed to the computer for processing, typically over a USB connection.

Today, most software defined transceivers do not rely on outboard computers for processing; all conversion and processing takes place within dedicated circuitry that functions as a complete transceiver. The computer merely functions as an interface between the transceiver and its human operator.

The IC-7300 takes the next step by eliminating the computer interface completely and substituting knobs, buttons, and a highly responsive touchscreen. As a result, if you are comfortable operating a conventional transceiver, you can operate an IC-7300 just as easily. You'll find buttons and knobs that are entirely familiar. Best of all, the complicated menu systems found in other transceivers have been greatly streamlined in the IC-7300 through the use of the touchscreen. Navigation is as simple as tapping your finger on a screen icon or "button."

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Some amateurs may miss the ability to directly tap into the IQ stream (the IC-7300 does not offer an IQ output), but the IC-7300 is clearly designed to appeal to a different audience. The hams who embrace the IC-7300 are those who desire the performance of an SDR, yet are put off by the need to have a computer or some other interfacing device between them and the radio.

The Basics

The IC-7300 is a 100 W output, 160 through 6 meter transceiver capable of operating SSB, CW, FM, AM, and digital modes. The chassis is compact at 9.4 inches wide, 3.7 inches high, and 9.4 inches deep. It is somewhat light at only 9.3 pounds, of interest for portable operation as well as home station use. All of the knobs and buttons have a high-quality feel.

The transceiver comes with a handheld microphone and a printed "basic" manual. An accompanying CD-ROM contains a much more detailed manual and a complete set of schematic diagrams.

Looking over the schematics, it's obvious that the IC-7300 wastes no time getting from analog to digital. Received signals are filtered, amplified, and then sent to an analog-to-digital converter (ADC). Then they are fed to an FPGA (field programmable gate array) for conversion and processing. All of this is transparent to the user, though...if you sat down in front of an IC-7300 without knowing about its architecture, you'd never guess that you were looking at an SDR.

The "No Manual Test"

When a transceiver makes the claim of being "user friendly," that's my cue to perform the No Manual Test. I simply leave the manual in the box and attempt to set up and operate the radio without any assistance other than my own experience.

It took less than 5 minutes to plug in the dc power cord (the radio draws 21 A maximum) and connect the coaxial cable from my antenna to the IC-7300's single SO-239 port. That antenna port is used for all bands from 160 through 6 meters, and also 4 meters — 70 MHz — in other markets. There's no provision for a separate receiving antenna such as a Beverage for the low bands.

The rear panel (see Figure 1) also has connections for a CW paddle for the internal keyer or external key/keyer, an external speaker, digital mode interfaces, and other accessories. I pressed the POWER button and the large touchscreen came to life with a frequency display and a bright spectrum scope and waterfall. The audio and RF gain knobs operated as expected, as did the passband tuning.

I noticed the TUNER button and assumed that it operated the built-in antenna tuner. I held it down for about a second and was rewarded with rapid clicking noises as the tuner went to work. A few seconds later, the IC-7300 had tuned to a flat 1:1 SWR.

You can't miss the large VFO knob, so I gave it a spin across the signal peaks appearing in the spectrum scope. Being in the SSB mode at the time, I marveled at how good the received audio sounded.

But how would I change bands? There were no mechanical band buttons to be found, so I knew I had to resort to the touchscreen. Being on 20 meters, I tapped my index finger on "14" on the frequency display. Sure enough, an array of band-button icons appeared. I tapped on "7" and was immediately transported to 40 meters. Through this exercise, I also discovered that tapping on various portions of the frequency display also effectively altered the tuning rate of the VFO. Direct frequency entry is also possible through the same window.

I plugged in the microphone, and within a couple of minutes I found a fellow calling CQ. I answered and received an outstanding signal report (he remarked that my audio sounded particularly good). The elapsed time from power application to conversation was less than 10 minutes. The IC-7300 had passed the No Manual Test with high marks.

Of course, you will probably want to peruse the full version (PDF format) of the manual at some point to look a bit deeper into what the IC-7300 can do. The manual is well organized and well written, with illustrations and helpful hints throughout. The manual is also available for download from Icom's website.

On the Air in Depth

The SDR aspects of the IC-7300 become apparent as you spend more time listening to signals and using the various features. The sensitivity and selectivity of the radio never failed to impress. Even in crowded conditions, the IC-7300 clearly outperformed my older analog transceiver.

The manual warns that the IC-7300 could distort in the presence of very strong signals. The receiver is indeed very "hot" — so hot that I found myself turning off the dual preamps and even switching in the attenuator on occasion. Receiver sensitivity without the preamps is adequate virtually all of the time.

The IC-7300 has an IP+ feature, which inserts a *dither signal* when you activate it. You could say this is somewhat like adding a strong signal off frequency, which has the clever effect of reducing the intermodulation distortion (IMD) products. The dither signal is noise and it raises the noise floor a bit. As shown in Table 1, the best possible measured performance is with IP+ and Preamp 1 on. However, as with other radios,

Lab Notes: Icom IC-7300

By Bob Allison, WB1GCM
Assistant Laboratory Manager

Starting with this review, the ARRL Lab will offer comments and observations about HF transceivers tested. The Icom IC-7300 uses an RF direct sampling system. Analog signals are picked up via the antenna and go through the appropriate band-pass filter. Then all incoming analog signals are digitized, processed, and manipulated by software and then converted back to analog audio for listening with the speaker or headphones. This is quite different from current traditional receiver architecture, in which the signal path stays analog until the digital signal processing stage is reached.

A key component of an RF direct sampling system is the analog-to-digital converter (ADC). The digitization of an analog signal is done in small steps. These steps are a type of non-linearity that forms intermodulation (IMD) products at low signal levels that can coherently add up.† To prevent this unwanted effect, a dither signal (random noise) is added. The result is an improved two-tone third-order intermodulation distortion dynamic range (3 IMD DR). The dither signal inside the IC-7300 can be turned on and off by using the IP+ key. With IP+ on, the sensitivity is reduced by the dither signal, but the overall 3 IMD DR is improved. Table 1 shows the minimum discernible signal level and the 3 IMD DR with and without the dither signal.

All ADCs have an input signal limit. If a high enough signal level is present at the antenna jack, the ADC can go into an overload state. The signal level at which the overload state is attained is known as the *ADC threshold*. At this signal level, the receiver is not usable. Fortunately, the ADC threshold is high in the IC-7300 — an in-passband signal does not overload, even at >10 dBm. No signal blocking appears until the ADC threshold level from an *adjacent* signal is reached.

The reciprocal mixing dynamic range (RMDR) and gain compression (blocking) dynamic range figures are very good. RMDR in particular shows the benefit of Icom's new synthesizer design. At 2 kHz spacing, it is nearly 25 dB better than the previous generation IC-7410. Note that these dynamic ranges are measured with the AGC off. With the AGC on, no blocking is observed, but the background noise *increases* as the ADC threshold level is approached with an adjacent signal 2 kHz away. Still, overall performance is excellent for an entry-level transceiver.

For decades, it's been generally accepted that an S-meter reading of S-9 corresponds to an input signal level of 50 µV (–73 dBm), and that each S unit represents a change of 6 dB (S-8 = –79 dBm, S-7 = –85 dBm, and so on). Our measurements indicate that some manufacturers do a good job of hitting the S-9/50 µV level, but many ARRL members have told me that they wish there were more uniformity with the rest of the S-meter scale. Unfortunately, in most transceivers the S-meter scale does not accurately report 6 dB/S unit. The Icom IC-7300 uses a 3 dB/S unit scale, for example. I hope that manufacturers will improve upon this by adding a dBm signal level scale for more accurate reports, and also make the meter read the same level with the preamp(s) on or off. Turning the preamp on does not magically add voltage at the antenna jack!

The transmitter of the IC-7300 is clean, with low phase noise and reasonable keying sidebands. On most HF bands, the transmit IMD third-order products are excellent, among the best we've tested in 13.8 V transceivers, but the fifth and seventh order products are on the high side. On 6 meters, all transmit IMD products are high at full RF power output. Reducing the RF output to 80 W PEP reduces odd order products considerably.

I did not see any power overshoot in CW mode but did find some in SSB mode. It happens very quickly, for less than 2 ms, and can only be seen on a scope with screen persistence. I tested the IC-7300 with an amplifier that has protection circuitry that is sensitive to overshoot. The amplifier's peak power meter does indicate a higher power on the first syllable — 1800 W — then it settles down to 1500 W. This very brief overshoot did not trip the amplifier's protection circuitry, and appears to be of no concern. Icom recommends operating the IC-7300 with the speech compressor off to minimize the probability of overshoot when using an external power amplifier.

A concern pointed out by a member is the appearance of RF output at the antenna jack for 3 ms, after the amplifier key line opens (confirmed in the ARRL Lab). If used during QSK (full break-in) CW operation with an amplifier with very fast PIN diode TR switching, it is possible that the amplifier could switch back to receive mode while RF is still flowing from the IC-7300. In such a case, hot-switching can cause key clicks.

At the beginning of the transmission, there is an adjustable transmit delay for RF to start flowing after the key line closes. The delay is 6 ms with the default setting. If you use the IC-7300 with an amplifier, check the amplifier switching time. You will probably need to set the delay to 10 or 15 ms (or longer), to avoid hot-switching and subsequent damage to amplifier switching circuitry.

†See *QST*, February 2010, page 52 for more information.

it is best to leave the preamp off unless needed. For the weakest signals, I would turn off the IP+ for maximum sensitivity.

Speaking of noise, the IC-7300's noise blanker is a thing to behold. I've never experienced this level of noise blanker performance in a radio in this price class. All but the worst clicks and pops were completely eliminated. The noise reduction feature was equally impressive. It manages to greatly reduce background hiss and static without introducing excessive distortion of its own.

AGC is highly adjustable. FAST, MID, and SLOW settings are available with separate settings for SSB, CW/RTTY, and AM modes. Time constants are adjustable from 0.1 – 6 seconds for SSB and CW/RTTY, and up to 8 seconds for AM. FM is fixed at a 0.1 second FAST setting. At the default setting of 6 seconds, on SSB the AGC is very slow to recover in the presence of a strong signal. As noted in the manual, a faster setting works better when receiving weak signals if strong signals are also present. As with many current transceivers, any kind of impulse noise captures the AGC when the noise blanker is off.

As with all SDR rigs, you can adjust the filtering to whatever parameters you desire. In the IC-7300, this is accomplished through the touchscreen. Each operating mode provides three filter selections and

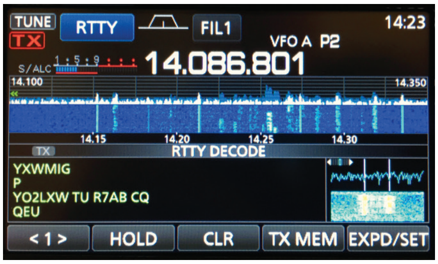

Figure 5 — The built-in RTTY decoder features a window on the lower right with a visual tuning aid — just line up the mark and space signals with the vertical bars. Up to four lines of decoded text are displayed at the lower left.

Figure 6 — The IC-7300's real-time spectrum scope shows both panadapter and waterfall displays. The frequency span is adjustable in several steps and can be set to show a fixed portion of the band or centered around the operating frequency.

Figure 7 — The SWR graphing function offers a visual indication of antenna system SWR over an adjustable frequency range.

you can change the bandwidths of each one, as well as the shape between "sharp" and "soft."

When operating CW, it was a pleasure to select a sharp 250 Hz filter and just slowly tune through crowded bands, listening to individual signals without a hint of ringing. When it comes to sending CW, earlier SDRs occasionally had latency issues (a lag between pressing the key and sending or receiving the CW), but none of this is present in the IC-7300. I quickly found that I could send CW every bit as well as I could with my analog rig. Break-in operation is selected by a front panel switch, either with full break-in (QSK) or an adjustable delay for semi break-in. Note that in QSK operation, the turnaround time is 35 ms, which is slower than, for example, the IC-7100, which is 29 ms. This limits QSK operation at higher speeds. The AUTO TUNE button can help you to tune in a CW signal to the proper pitch.

The IC-7300 includes a CW keyer with adjustable speed, weighting, and so forth. You can program up to eight memories to send your call sign, signal reports, contest exchanges, and other information. Once recorded, memories can be played back using buttons on the lower portion of the screen or with an external keypad. (Icom doesn't offer a keypad, but the manual shows the connections needed.) There's a similar "voice keyer" provision for recording and sending up to eight short voice messages.

Split frequency operation is similar to other Icom transceivers. With QUICK SPLIT enabled, simply press and hold the SPLIT button. The transceiver turns on the split function and sets VFO A and B to be equal. The VFO B frequency (which will be used for transmitting) is displayed near the bottom of the screen. Use the XFC button to set your transmit frequency, or to listen on the transmit frequency.

Audio can be tailored with the TONE CONTROL menu. Bass and treble are adjustable separately for each voice mode (SSB, AM, and FM), with separate adjustments for receive and transmit. Other adjustments include high-pass and low-pass filter cutoff frequencies for receive audio for each mode and transmit bandwidth for SSB.

The rear panel includes TR switching and ALC connections for using an external power amplifier. Transmit delay is adjustable in several steps up to 30 ms to allow amplifier relays to settle and avoid hot switching. The Lab did observe that RF output appears at the IC-7300's antenna jack for about 3 ms after the amplifier key line opens so hot-switching an amplifier is possible at the end of transmission during full break-in (QSK) operation if the amplifier uses fast switching (see the accompanying sidebar).

Once you have the IC-7300 configured to your liking, you can save the configuration to the SD memory card (the memory card is not included). In this way, you can store different configurations for different types of operating. The SD card will also store many other types of information, including received audio and transmit voice keyer audio.

Digital Modes

The IC-7300 offers a built-in RTTY decoder (see Figure 5). I tested this function, along with the "twin peaks" RTTY filtering, and it performed quite well. The text appears in a small window within the main display. The radio can also save the decoded text to the SD card for later review.

The RTTY feature includes transmit memories for various "canned" messages. These would be highly useful for DX hunting, especially in pileup situations. You could program your call and response, and simply tap the touchscreen to send.

For most digital operating generally, the IC-7300's USB connection is the way to go. Transmit and receive audio, and transmit/receive keying, are all handled smoothly over a single cable between the radio and your computer — no hardware interfaces required. You only need to keep in mind that the IC-7300 presents itself as a "sound device" (USB Audio CODEC), which you'll have to select in your software setup. For transmit/receive keying, the IC-7300 appears as a virtual serial COM port. To hunt down the assigned COM port number, I had to access Device Manager in *Windows 10* and open the list of ports. In my computer, the IC-7300's interface appeared as "Silicon Labs CP210x USB to UART Bridge" and had been assigned to COM 9 (the COM port number will likely be different in your computer). So, once I configured my software to use COM 9 for rig keying, all was right with the world. I operated the IC-7300 on several digital modes with ease — exactly as I would with a conventional transceiver.

With RTTY contesting in mind, I used the IC-7300's USB connection to handle receive audio and FSK keying with the popular *MMTTY* RTTY software and did a little searching and pouncing during the Alessandro Volta RTTY competition. Once again, the IC-7300 performed perfectly. Rich Donahue, KØPIR, has a video on YouTube at **https://youtu.be/ZCkiuzAMuZI** that shows you how to set up *MMTTY* for use with the IC-7300.

If you already own a digital interface, and prefer to continue using it instead, don't worry. The IC-7300 still offers a multi-pin accessory port on the rear panel to accommodate your interface connections.

About that Screen

I quickly learned to love the IC-7300's touchscreen. It is bright and easy to read, including the waterfall and spectrum scope (see Figure 6). Both scopes are adjustable and you can even zoom in for a closer look at individual signals, or select an additional display of the audio characteristics of the signal. (This was particularly helpful when sending PSK31. I could see the modulation characteristics of my transmit signal right there on the screen.) Tapping a signal on the scope tunes the transceiver to that frequency. Even passband tuning is rendered graphically. When you twist either of the passband tuning knobs, you see the result as an animated graphic that shows the effect of what you are doing.

While exploring the myriad features, I also ran across a very cool SWR graphing function that behaves like an antenna analyzer. You set your frequency parameters and then repeatedly press the TRANSMIT button. With each press, the SWR is measured and plotted on the graph (see Figure 7). This is a good time to mention that while the built-in antenna tuner is designed for mismatches that result in a maximum 3:1 SWR, it offers a so-called "Emergency Mode" that allows it to grapple with SWRs as high as 10:1, albeit at reduced RF output.

Overall, the screen was well suited to my needs, even with my aging vision, but if you want something bigger, Icom offers the optional $100 RS-BA1 remote control software. With this software you can control the transceiver and display the entire screen on your computer monitor. You can even control the IC-7300 remotely via the Internet.

Conclusion

So is the IC-7300 really a game-changer? In my opinion, it clearly meets the criteria. The IC-7300 takes the familiar ergonomic design of an analog transceiver and blends it seamlessly with software defined radio technology — all at a moderate price. I have a feeling that this approach to amateur transceiver design is likely to spread rapidly, even to lower-end models. Years from now we may look back at the IC-7300 and see its introduction as the moment when everything changed.

Manufacturer: Icom America, 12421 Willows Road NE, Kirkland, WA 98034; tel 800-872-4266; **www.icomamerica.com**.

See the Digital Edition of *QST* for a video overview of the Icom IC-7300 HF and 6 meter transceiver.