Product Review and Short Takes from *QST* Magazine

November 2009
Product Reviews:

ICOM IC-7600 HF and 6 meter transceiver

Update to FlexRadio Flex-3000 Product Review.

Short Takes:

Depiction Emergency Management Software

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PRODUCT REVIEW

ICOM IC-7600 HF and 6 Meter Transceiver

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Already widely known as the "PROIV," ICOM's IC-7600 HF+50 MHz transceiver is an apparent and worthy successor to the extremely popular IC-756PROIII.[1] Whatever ICOM's designation, the IC-7600 is a terrific performer with a fine complement of useful tools for DXing and contesting! Granted, the IC-7600 is not *totally* new and different with respect to the older PROIII and the more recent IC-7700 and IC-7800 transceivers.[2] This review will include some comparisons, as appropriate, to the models with which it shares some DNA. Let's see how the IC-7600 stacks up.

A Stylish Makeover

On its face, the '7600 looks similar to its PRO series forbears, the most notable exception being a larger and improved LCD display (Figure 1). My wife liked the new display after comparing the PROIII and the '7600 side by side, so it *must* be better. The IC-7600 is essentially the same convenient size and weight as the PROIII with a similar front-panel layout. Some may mourn the replacement of the PROIII's moving-coil meter with an excellent digital emulation on the '7600's larger display. ICOM has a similar implementation on the IC-7700 and IC-7800, and all offer a choice of *faux* meter styles, too — standard (analog), edgewise and bar.

If you're already familiar with the PRO line, you'll feel right at home with the '7600. If you're a newcomer, you'll find the IC-7600 has a gentle learning curve. ICOM's plain-language menus are a major reason for this.

Wider is Better

Legends and icons on the 5.8 inch 400×240 pixel display feature clean, straight lines. For example, on the PROIII, the current operating mode appears in a stylized horizontal tube, sort of like a hot dog or a blimp. The MODE indicator on the IC-7600 is a smallish but very visible blue rectangle with white letters. The RIT/XIT readout is smaller than the PROIII's, and it's in a different display location that I never quite got used to (the RIT/XIT readout on the PROIII places larger numerals directly below the last three digits of the main frequency readout). As with the IC-7700, the IC-7600 offers only an "A" or a "B" display — one essentially an inverse of the other — plus three font choices — basic, italic and round. The basic and round styles are quite similar, but the round characters are a bit fatter.

After complaining about the limited viewing angle of the IC-7700's otherwise excellent display, we're pleased to note that the IC-7600 offers excellent horizontal and vertical visibility from just about any angle. The IC-7600 does *not* provide for connecting an external VGA video display, however.

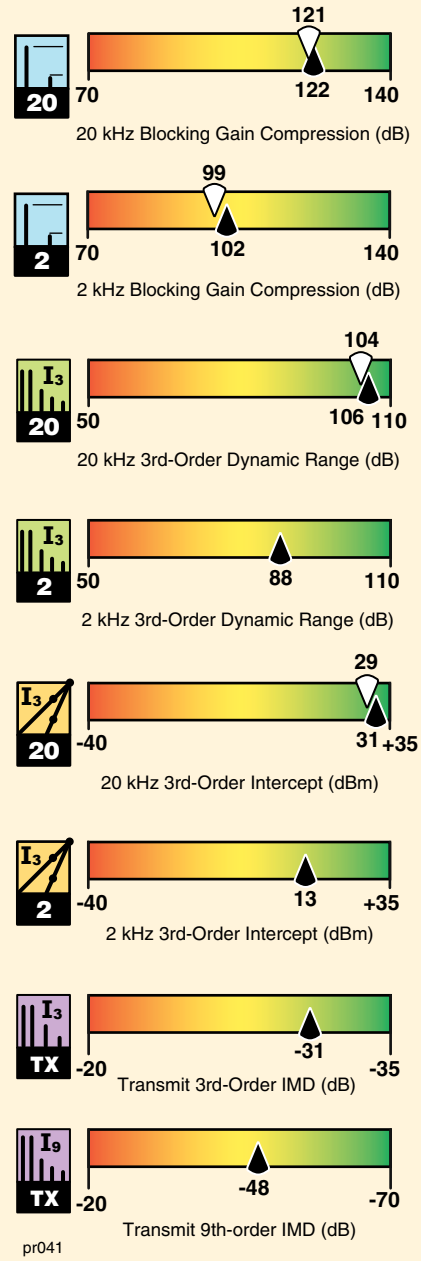
Cleaner Lines

Aside from its fabulous display, the '7600's uncluttered front-panel has a smooth,

[1]R. Lindquist, N1RL, "ICOM IC-756PROIII HF/6 Meter Transceiver," Product Review, *QST*, Mar 2005, pp 56-59. *QST* Product reviews are available on the Web at **www.arrl.org/members-only/prodrev/**.

[2]R. Lindquist, N1RL, "ICOM IC-7700 HF and 6 Meter Transceiver," Product Review, *QST*, Oct 2008, pp 41-47.

Key Measurements Summary



Bottom Line

The IC-7600 represents a superb synthesis of ICOM's popular PROIII and the IC-7700/7800 transceivers, both in style, features and capability. Another winner!

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semi-gloss surface that may be easier to clean than the PROIII's. The rest of the box closely resembles the PROIII's, but without the sunken front apron and with sharper, rather than rounded, features. The '7600's larger knobs — the hefty, clean-edged rubber-ringed tuning knob is like the one on the IC-7700 — ease their use.

The radio's bright-white control legends are larger and easier to read than those on the PROIII. While I do appreciate the PROIII's oversized red keypad numerals for entering a frequency, those on the '7600's keypad, though smaller, remain easy to read, and the keypad buttons are larger to start with. In addition, the "pointer" markings on the IC-7600's knobs are simple to see, and the rings on concentric controls contrast ever so slightly in hue and sheen. All knobs — even the *stem* controls — are fatter than the PROIII's. On the other hand, the stem controls are in a more congested location on the '7600 because of its larger display. The IC-7600 overcomes the absence of contrasting colors on knobs and front panel legends in part by employing variations in button styles and shapes.

One minor unintended consequence of the front-panel rearrangement: The TRANSMIT, TUNER and MONITOR buttons are in a horizontal line on the left-hand side of the panel, above the AF GAIN control. On several occasions when I wasn't paying close-enough attention, I hit the TRANSMIT button instead of the neighboring TUNER button, which has a status LED. The MP-W and MP-R scratchpad memory buttons also can blend in with their neighbors, so you have to pay closer attention to ensure you're not pressing the adjacent *hard* memory buttons. On the PROIII, the scratchpad memory keys are not only larger and off by themselves, but are in a contrasting light gray.

Some additional visibility issues are worth a mention. The right-pointing arrows on the seven multi-function keys lining the left hand side of the display blend into the background, especially in soft light; these are not filled in with a contrasting color to make them easier to distinguish one from the other, much less to see them at all in low light. In a similar vein, legends on the six LCD function keys just below the display can be difficult to tell apart.

Just below the LCD function keys are six mode switches. In addition to the FILTER and EXIT/SET keys, the '7600 offers individual mode keys for SSB, CW, RTTY/PSK and AM/FM. As a PROIII user, I appreciated *not* having to share the CW mode with the RTTY key. Unbundling the CW key also means you can quickly swap from CW to CW-R when flipping your tuning direction, as I often do during search-and-pounce (S&P) contest operation.

The UP ∆ and DOWN ∇ buttons for memory scrolling are positioned right next to the main tuning knob, making them more obvious and handy. Depending upon how ham-handed (get it?) you are, their placement may make the tuning knob more vulnerable to the inadvertent jog when using them. I didn't have any problems in this regard.

I was pleased to find a feature on the '7600 that announces signal strength reading, frequency and mode in an agreeable female voice. It's possible to deactivate the S meter and mode components. This is standard equipment on the IC-7700 too. The '7600 back panel looks about as you would expect and is shown in Figure 2.

How Much Would You Pay . . .?

As the late TV huckster Billy Mays might have hollered in another life, "How many times have you been embarrassed by transmitting on top of the DX when you *thought* you were in split? Well, worry no more!" The IC-7600's mother of all SPLIT indicators makes it really difficult *not* to know when you're working split. The nearly 1-inch-long LED indicator along the top edge of the display looks like a mini-fluorescent lamp. An on-screen SPLIT legend of contrasting shade accompanies the bright light. ICOM also has placed the TX, RX and DUAL WATCH LEDs above the display where they belong; display icons reiterate the status of these functions.

In a similar "isn't that *amazing*!" vein, the IC-7600 lets you type in desired text for CW and digital memories using a USB (universal serial bus) keyboard. This is a vast improvement over having to "dial" in the memory contents one character at a time using the main tuning knob, although it's a bit of a hybrid system. To enter letters, you still must press the upper-case or lower-case TEXT button on the transceiver's display while in edit mode. In like fashion, to enter numbers you still must press the 123 button. Pressing SHIFT on the keyboard doesn't work.

Shape Shifting

ICOM has imbued the IC-7600 with top-notch DSP IF filters, but the implementation is not without some minor wrinkles. Basic IF filter selection is essentially identical to the PROIII's setup with the exception of AM. On the IC-7600, you can set the AM passband between 200 Hz (!) and 10 kHz in 200 Hz steps for a total of 50 discrete filter pass-band widths plus full dual pass-band tuning. On the PROIII, the IF filter passband choices for AM are fixed at 9, 6 or 3 kHz, with a simple IF (ie, single pass-band) shift available. For FM the IC-7600 offers three fixed passband choices, 15, 10 and 7 kHz, just as on the PROIII.

To select a basic filter shape (sharp or soft) requires going to the FILTER menu, rather than to the DSP menu as on the PROIII. If you pick SHARP or SOFT on the FILTER menu, that shape setting applies to all three available filter bandwidth settings. The FILTER SHAPE SET menu lets you configure filter shapes for SSB/SSB-D (data) and CW that are independent of the shape setting on the FILTER menu, but within strict limitations that favor CW or AFSK modes only.

Here's the thing: You can separately set CW filters 500 Hz or narrower and 600 Hz or wider to default automatically either to soft or sharp. On SSB-D (for AFSK), it's possible to have the radio default automatically to soft or sharp when the filter setting is greater than 600 Hz. The same is possible for SSB, although whichever shape you set becomes the default for any *practical* SSB filter. It would be far more useful for typical SSB operation if, for example, you could set the filter shape to default automatically to sharp when the filter setting is less than 2 kHz or so, not 600 Hz. In any case, it's just a couple of button presses to change the filter shape to whichever setting you want.

Diddles

While the PROIII can decode RTTY on its display and transmit RTTY from memories without the use of a PC, the IC-7600 offers full transmit and receive capability in RTTY and PSK31. Just plug a USB keyboard into the radio, bring up the DECODE screen for the relevant mode and you're ready to roll, digitally speaking. Unfortunately this capability doesn't extend to CW.

The DECODE screens for RTTY and PSK31 feature helpful, but diminutive, waterfall displays for finding and tuning signals. The PSK31 screen includes a tiny, ever-changing phase readout to lend further assistance, plus AFC and NET; the RTTY tuning indicator is in the upper right hand corner of the main display. This was the simplest and easiest RTTY and PSK31 experience I've ever had (well, at least since reviewing the IC-7700)!

The PSK31 and RTTY waterfall displays cover 1195 to 1805 kHz (610 Hz) with the center at 1500 (there's a choice of 1000, 1500 and 2000 Hz in both digital modes) — quite a bit less real estate than you'll find on a PC screen with *DigiPan* or similar software. While using narrow filter settings you must tune manually from waterfall to waterfall; otherwise, you won't always see them, just hear them. For RTTY, the waterfall display covers 1905 to 2515 (also 610 Hz) with a twin-peak waveform that lets you tune signals with precision. It's possible to adjust and read out the THRESHOLD.

Text appearing on the screen — red for transmitted text and green for received — is quite small, as is the "window space" available. Pressing the WIDE button gives you more on-screen elbow room, but if you've enabled the mini spectrum scope (the only one available in digital modes), it yields to the larger text window. In addition, lines of text don't always break appropriately, so you need to pay closer attention. Copy on the IC-7600's decoder screen seemed compa-

rable to what I was seeing via the *MMTTY* engine on my PC's display.

Using submenus on the DECODE screens, it's possible to save RTTY or PSK31 memories on a USB compatible medium, such as a flash drive (you can also save voice memories this way, but not CW). The RTTY and PSK31 memories are separate.

Contesting in RTTY and CW with the '7600 (using a computer logger and RTTY engine) was lots of fun, especially given the exceptional receiver. In these higher duty cycle modes — especially RTTY — the radio got quite warm to the touch, although the on-screen temperature gauge remained well within the normal range. The cooling fan is barely noticeable.

Magic Decoder Button

ICOM's APF (audio peak filter) skipped radio generations. First appearing (in a somewhat different implementation) on ICOM's original IC-756, APF turned up again on the IC-7800 and IC-7700 transceivers. Its incarnation on the IC-7600 includes a new twist. The TPF (twin-peak filter) for RTTY, an RTTY FIL menu selection on the PROIII, has been promoted to the front panel APF/TPF button on the IC-7600. More on that feature in a bit.

Pressing the APF/TPF button in CW imposes one of three mini audio-peaking filters — 80, 160 or 320 Hz or NAR, MID and WIDE — atop whatever DSP IF filter settings are in play. To hear much of a difference, the IF filter must be set to a passband that's significantly greater than the APF setting. For example, you might use the 80 Hz setting when you've got the IF filter set to, say, 150 Hz. When you press the button, the current setting appears briefly on screen, although you can disable this. You can choose either a "soft" or "sharp" APF shape via a menu.

On CW the effect of the APF is not especially dramatic when you've already selected a narrow IF filter, but it does help further quell background noise. The noise reduction processor (NR), readily at hand, can do the heavy lifting in that department, although the APF seems to boost signal-to-noise ratio. It's at its best when you're using, say, a 500 or 800 Hz IF DSP filter and need a little more help.

For RTTY, the TPF is exceptionally effective. Pressing the APF/TPF button in RTTY mode alters the radio's AF response by punching up the mark and space frequencies, 2125 and 2295 Hz. During the July North American QSO Party RTTY event, the TPF brought "S-nuttin'" signals (as we called the weak ones while I was growing up in Northern New Jersey) right out of the mud so they'd print. The '7600 lets you use the TPF in tandem with any of the three IF filter bandwidths (plus soft or sharp contour) you've set up in advance, and you can take full advantage of the dual-passband IF shift (PBT) feature. On the PROIII with the RTTY tuning meter enabled, you can choose just one of five possible IF bandwidths for RTTY, you're restricted to a single-passband IF shift and switching away from the RTTY filter setting disables the TPF.

The radio's NOTCH operates in a somewhat similar fashion to the APF/TPF, although the manual notch is adjustable via a front-panel control. You can pick from NAR, MID or WIDE notch filters. As with the APF/TPF feature, enabling the notch by pressing

Table 1

ICOM IC-7600, serial number 0201165

Manufacturer's Specifications	Measured in the ARRL Lab
Frequency coverage: Receive, 0.03-60 MHz; transmit, 1.8-2.0, 3.5-4, 5.3305, 5.3465, 5.3665, 5.3715, 5.4035, 7-7.3, 10.1-10.15, 14-14.35, 18.068-18.168, 21-21.45, 24.89-24.99, 28-29.7, 50-54 MHz.	Receive, as specified; transmit, as specified.
Power requirement: 13.8 ±15% V dc; receive, 3.5 A (max audio); transmit, 23 A (100 W out).	13.8 V dc; receive 2.4 A (max audio); transmit, 18 A (100 W out). Operation confirmed at 11.7 V (83 W output).
Modes of operation: SSB, CW, AM, FM, RTTY, PSK.	As specified.
Receiver	**Receiver Dynamic Testing**
SSB/CW sensitivity: 2.4 kHz bandwidth, 10 dB S/N: 0.1-29.99 MHz, 0.15 µV; 50-54 MHz, 0.12 µV.	Noise floor (MDS), 500 Hz bandwidth: *Preamp* / *off* / *1* / *2* 0.137 MHz / –124 / –126 / –129 dBm 0.505 MHz / –130 / –138 / –141 dBm 1.0 MHz / –130 / –138 / –141 dBm 3.5 MHz / –131 / –139 / –141 dBm 14 MHz / –131 / –139 / –141 dBm 50 MHz / –132 / –141 / –143 dBm
Noise figure: Not specified.	14 MHz, preamp off/1/2: 16/8/6 dB
AM sensitivity: 6 kHz bandwidth, 10 dB S/N: 0.1-1.799 MHz, 6.3 µV; 1.8-30 MHz, 2 µV; 50-54 MHz, 1.6 µV.	10 dB (S+N)/N, 1-kHz, 30% modulation: *Preamp* / *off* / *1* / *2* 1.0 MHz / 1.70 / 0.65 / 0.55 µV 3.8 MHz / 1.50 / 0.59 / 0.50 µV 50 MHz / 1.60 / 0.62 / 0.54 µV
FM sensitivity: 15 kHz bandwidth, 12 dB SINAD: 28-30 MHz, 0.5 µV; 50-54 MHz, 0.3 µV.	For 12 dB SINAD: *Preamp* / *off* / *1* / *2* 29 MHz / 1.05 / 0.38 / 0.29 µV 52 MHz / 0.62 / 0.24 / 0.22 µV
Spectral display sensitivity, preamp off/1/2: Not specified.	–105/–116/–121 dBm.
Blocking gain compression: Not specified.	Gain compression, 500 Hz bandwidth* *20 kHz offset* / *Preamp off/1/2* / *5/2 kHz offset* / *Preamp off* 3.5 MHz / 121/122/117 dB / 111/99 dB 14 MHz / 122/123/120 dB / 113/102 dB 50 MHz / 119/121/120 dB / 105/98 dB
Reciprocal mixing (500 Hz BW): Not specified.	20/5/2 kHz offset: –105/–91/–82 dBc.

ARRL Lab Two-Tone IMD Testing*

Band/Preamp	*Spacing*	*Input Level*	*Measured IMD Level*	*Measured IMD DR*	*Calculated IP3*
3.5 MHz/Off	20 kHz	–27 dBm	–131 dBm	104 dB	+25 dBm
		–13 dBm	–97 dBm		+29 dBm
14 MHz/Off	20 kHz	–25 dBm	–131 dBm	106 dB	+28 dBm
		–12 dBm	–97 dBm		+31 dBm
		0 dBm	–61 dBm		+31 dBm
14 MHz/One	20 kHz	–33 dBm	–139 dBm	106 dB	+28 dBm
		–20 dBm	–97 dBm		+19 dBm
14 MHz/Two	20 kHz	–39 dBm	–141 dBm	102 dB	+12 dBm
		–24 dBm	–97 dBm		+13 dBm
14 MHz/Off	5 kHz	–37 dBm	–131 dBm	94 dB	+10 dBm
		–20 dBm	–97 dBm		+19 dBm
		0 dBm	–50 dBm		+25 dBm
14 MHz/Off	2 kHz	–43 dBm	–131 dBm	88 dB	+1 dBm
		–24 dBm	–97 dBm		+13 dBm
		0 dBm	–31 dBm		+16 dBm
50 MHz/Off	20 kHz	–29 dBm	–132 dBm	103 dB	+23 dBm
		–15 dBm	–97 dBm		+26 dBm

Receiver	Receiver Dynamic Testing
Second-order intercept: Not specified.	Preamp off/1/2, +63/+63/+59 dBm.
DSP noise reduction: Not specified.	Variable, 15 dB maximum.
Notch filter depth: Not specified.	Manual notch: 75 dB; auto notch: 57 dB; attack time: 37 ms.**
FM two-tone, third-order IMD dynamic range: Not specified.	20 kHz offset, both preamps on: 29 MHz, 72 dB†; 52 MHz, 72 dB†. 10 MHz channel spacing: 52 MHz, 110 dB.
S-meter sensitivity: Not specified.	S9 signal at 14.2 MHz: preamp off, 79.4 µV; preamp 1, 33.5 µV; preamp 2, 16.4 µV.
Squelch sensitivity: SSB, CW, RTTY, 3.2 µV; FM, 0.3 µV.	At threshold, both preamps on: SSB, 1.2 µV; FM, 29 MHz, 0.13 µV; 52 MHz, 0.12 µV.
Receiver audio output: >2 W into 8 Ω at 10% THD.	2.13 W at 10% THD into 8 Ω. THD at 1 V RMS, 0.25%.
IF/audio response: Not specified.	Range at –6 dB points (bandwidth):‡ CW (500 Hz): 336-803 Hz (476 Hz); Equivalent Rectangular BW: 486 Hz; USB (2.4 kHz): 228-2735 Hz (2507 Hz); LSB (2.4 kHz): 228-2725 Hz (2497 Hz); AM (10 kHz): 130-4600 Hz (8940 Hz); AM (6 kHz): 130-3150 Hz (6040 Hz)
Spurious and image rejection: HF and 50 MHz, (except IF rejection on 50 MHz): >70 dB.	First IF rejection, 14 MHz, 108 dB; 50 MHz, 84 dB. Image rejection, 14 MHz, 121 dB; 50 MHz, 118 dB.

Transmitter	Transmitter Dynamic Testing
Power output: HF and 50 MHz: SSB, CW, RTTY, PSK, FM, 2-100 W; AM, 1-30 W.	HF: CW, SSB, RTTY, PSK, FM, typically 1.2-105 W; AM, 0.7-32 W. 50 MHz: CW, SSB, RTTY, PSK, FM, 1-100 W; AM, 0.5-29 W.
Spurious-signal and harmonic suppression: >50 dB on HF, >63 dB on 50 MHz.	HF, 70 dB; 50 MHz, more than 70 dB. Meets FCC requirements.
SSB carrier suppression: >40 dB.	>70 dB.
Undesired sideband suppression: >55 dB.	>70 dB.
Third-order intermodulation distortion (IMD) products: Not specified.	3rd/5th/7th/9th order (worst case band): HF: –31/–35/–41/–48 dB; 50 MHz: –31/–34/–45/–55 dB.
CW keyer speed range: Not specified.	6 to 48 WPM.
CW keying characteristics: Not specified.	See Figures 3 and 4.
Transmit-receive turnaround time (PTT release to 50% audio output): Not specified.	S9 signal, 16 ms.
Receive-transmit turnaround time (tx delay): Not specified.	SSB, 21 ms; FM, 11 ms. Unit is suitable for use on AMTOR.
Composite transmitted noise: Not specified.	See Figure 5.

Size (height, width, depth): 4.6 × 13.4 × 11 inches; weight, 22 pounds.

Price: $3999.

*Receiver testing was performed with the bandwidth set to 500 Hz and 3 kHz roofing filter. ARRL Product Review testing now includes two-tone IMD results at several signal levels. Two-Tone, 3rd-Order Dynamic Range figures comparable to previous reviews are shown on the first line in each group. The IP3 column is the calculated third-order intercept point. Second-order intercept points were determined using –97 dBm reference.

**Single beat note. Reduces two beat notes by 45 dB with attack time of 106 ms.

†Measurement was noise-limited at the value indicated.

‡Default values, sharp setting. Bandwidth is variable; smooth setting is available. CW bandwidth varies with PBT and pitch control settings.

the button briefly flashes the current notch setting on screen, although you can disable this too. In addition to the manual notch, an automatic notch is available in SSB and AM mode. It's extremely effective against multiple heterodynes, although as broadcasters migrate from the amateur bands, these are becoming less of an issue.

The IC-7600's digital noise blanker not only lets you set NB level but NB depth and width. This feature is helpful for pulse-type noise, such as ignition interference, and it seems to generate less crud than many less-capable noise blankers impose. I was able to use the NB in conjunction with the noise-reduction feature to substantially reduce noise that included impulse spikes apparently emanating from a nearby solar panel installation. Very aggressive/extreme settings like these can add considerable distortion to desired signals, however.

Time Warp?

Others may appreciate the record/play feature more than I did. This feature, which lets you record off-the-air audio and then play it back, on or off the air, did not improve much with the jump from one model to the next. It could be convenient when helping someone adjust their audio or compare antennas, but you'll have to figure out how it works first. The manual's description of this feature is difficult to comprehend, and using it is far from intuitive.

The IC-7600 provides separate front-panel REC and PLAY buttons. It records continuously, so it can replay the 15 seconds of audio that you heard *before* you pushed the REC button. There's no on-screen indication that you're in record mode (the PROIII has a blinking on-screen REC indicator). At the default setting, the radio will play back up to 15 seconds per "cut." The VOICE menu indicates the frequency and recording date of each cut.

You and Me and Rain on the Roof

The inclusion of selectable roofing filters several years ago marked a sea change in Amateur Radio transceiver design. As with many of its peers, the PROIII did not have this feature — it used a single 15 kHz wide roofing filter. The implementation on the IC-7600 is essentially identical to that of the IC-7700, with a choice of three crystal band-pass roofing filters at 15, 6 and 3 kHz in the first IF.

ARRL Lab Test Engineer Bob Allison, WB1GCM, suggests thinking of a roofing filter as "a first line of defense against any adjacent strong signals, especially multiple signals." The roofing filter follows the first mixer, and it has the effect of reducing the passband of the first IF, he explains.

On the IC-7600 you can impose a roofing filter bandwidth setting of 15 kHz, 6 kHz or 3 kHz on any DSP IF filter setting. Allison says being able to insert a narrower roofing filter helps to reduce overloading in the IF amplifier and mixers that follow; the DSP IF filtering takes over to help with the rest. So, the narrower roofing filter does not determine the receiver's *ultimate* IF bandwidth but will enhance dynamic range since all but the *strongest* adjacent signals are attenuated before hitting the receiver's first IF.

"This is very desirable for CW, SSB and digital modes," Allison asserts. He allows, however, that no roofing filter is completely

Figure 1 — The IC-7600's display packs in a lot of information and is readable from a variety of viewing angles.

Figure 2 — The rear panel of the IC-7600 includes all the usual connectivity as well as the new USB jack for control and audio signals.

impervious. "I guess all roofs leak if it rains hard enough," he quips.

From a practical standpoint, there's a significant difference in noise — especially on an active band — when you switch from a 15 kHz to a 3 kHz roofing filter. The difference between 6 kHz and 3 kHz is hardly discernable under most circumstances, although the IC-7600 is already a very quiet receiver. [The difference is most dramatic during crowded conditions with many strong stations, such as during contests or DX pileups — *Ed.*]

We measured the two-tone third-order IMD dynamic range of the PROIII on 14 MHz at 5 kHz spacing, preamp off, at 77 dB — good in 2005 but modest by today's standards (the ARRL Lab did not routinely make a 2 kHz measurement back then). In the intervening years, other receiver designs have upped the ante. The '7600's big brother, the IC-7700, came in at 99 dB under the same conditions — more than 20 dB better — and at 87 dB at 2 kHz spacing.

Now comes the IC-7600. The ARRL Lab measured the receiver's two-tone third-order IMD dynamic range on 14 MHz, 5 kHz spacing, preamp off, at 94 dB — nearly within measurement error or unit-to-unit variation of the IC-7700's 99 dB. At the 2 kHz spacing, preamp off, it was 88 dB. All told, this performance is *substantially* superior to the PROIII's.

Control Freak

Although the Amateur Radio world has lagged a bit in keeping up with personal computer technology, USB ports have become commonplace over the past few years. The IC-7600 has a front-panel USB A port and a rear-apron USB B port. Connecting a USB cable between the B port and your computer's A port (or USB hub) not only avails PC control of the transceiver but a two-way baseband audio signal path — *very* slick!

For ICOM users, USB connectivity obviates the need to purchase a CI-V level converter for another $130 or so. There's still a CI-V REMOTE jack on the radio's rear apron, however, to enable transceiver operation with another ICOM CI-V equipped transceiver or receiver. For command and control purposes, you can select either CI-V or ASCII code output from the USB serial connection.

Getting up and running with USB port control is not just plug and play, however. You first must download a USB driver from the ICOM Web site. Installing this on my PC was not quite as straightforward as I'd hoped, but this may have had more to do with my unfamiliarity with *Windows Vista* — the operating system on the ham shack laptop.

I also had to download the latest version of *N1MM Logger*, so I had an IC-7600 driver. Curiously, turning the radio off while leaving the PC on routinely caused my computer to change the COM port assignment. I kept IC-7600 parameters in both of the COM ports *N1MM Logger* looked for.

Initially I ran into a brick wall when trying to get my *N1MM Logger* voice files to play via the USB connection while retaining the ability to use the mic and VOX — something that's easy to do with the PROIII, which lacks USB connectivity. To modulate the IC-7600 via the USB, you either can play audio files from your PC via the USB or use the microphone and VOX, but you cannot do both at the same time *unless* your logger's IC-7600 driver includes the correct commands. (The menu also offers MIC,ACC for either as well as just ACC choices; it's also possible to send audio to the IC-7600 via pin 4 of the ACC 1 jack on the rear apron.)

According to ICOM, "Switching between those inputs can be done using a set of our new CI-V commands through the same USB port." The ICOM representative recounted how he was able to toggle those inputs "with no problems at all" using a command testing program.

I'm not sure about the "no problems" part. A semblance of success came only after fiddling with menu settings, entering lengthy macro strings in *N1MM Logger* and reading the help file and the IC-7600 *Instruction Manual*. The end result was an unwieldy CAT command string that — most times — convinced the radio to switch to USB audio input before playing a .wav file, then switch back to MIC audio input when it was done. Given the macro execution delay involved, it's unclear if this fix would work in the heat of a fast-paced contest. This appears to be more of a software issue than a radio issue, and the ICOM rep expressed confidence that drivers in later logging software versions would improve switching capability.

The ACC menu includes provisions to adjust the USB audio input level as well as to enable a squelch (either on or open) for audio output from the radio via the USB connection. It can take a bit of tweaking to balance the various audio levels between the radio and the PC, especially if you're planning to use your logger's voice memories rather than the very nice ones in the radio. The ACC menu also offers three separate selections to modulate for AFSK via the USB connection.

Tone of Voice

A lot of audio tailoring is available for transmit and receive — much more than on the PROIII. You can set a receiver audio high-pass (100-2000 Hz) and low-pass (500-2400) filters in steps for SSB, AM and FM modes. Alternatively, you can make separate TREBLE and BASS settings. For CW and digital modes, you can only set high-pass and low-pass limits. Using this feature on SSB can help to roll off unwanted noise without impairing readability. On the transmit side, you not only can set transmission passbands for WIDE, MID and NAR, but adjust TREBLE and BASS settings for voice modes. After very little tweaking I got uniformly good audio reports while using the IC-7600 with my Heil boom set.

The speech compressor/transmit bandwidth feature has become a bit more complicated to use than it is on the PROIII, although that radio's toggle/press-and-hold system can try your patience. The IC-7600 diverts you away from the front panel to a menu to set both compression level — a front-panel control on the PROIII — and transmit bandwidth preference. Pressing and holding the COMP button accesses this COMP/TBW menu, where you

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can select a NAR, MID or WIDE transmit bandwidth preference for the COMP ON and the COMP OFF conditions. (Setting the passband parameters for NAR, MID or WIDE is done via the SET/LEVEL menu, as it is on the PROIII.) The menu includes bar-style compression and ALC level meters for getting the adjustment right on target.

I found even the maximum MONITOR level setting too low to be useful. The monitor's output level also depends upon the setting of the AF control (as on the PROIII), and this can lead to wildly divergent audio levels when switching back to receive.

Scoping Things Out

The spectrum scope is very flexible, much more so than the PROIII's, and the *Instruction Manual* spends eight pages explaining the ins and outs of this feature. In the CENTER mode, the '7600 offers span choices of ±2.5, 5, 10, 25, 50, 100 and 250 kHz. In the FIXED mode, it displays the entire band (or a customized setting), excepting 10 and 6 meters. The more spectrum you're trying to view the more jagged the sweep.

It's possible to display markers for your transmitting, receiving and dual watch frequencies. A number of spectrum scope parameters, including waveform colors and sweep speeds, are menu-settable. You can pick a SLOW, MID or FAST sweep speed for each span selection. I found the narrower span options — 2.5 and 5 kHz — in CENTER mode especially useful while contesting in CW to determine precisely what was going on both sides of my run frequency.

Jots and Tittles

■ Unlike the IC-7700, the '7600 has a main receiver and a sub-receiver. The radio's *Dual Watch* function lets you listen to two signals in the same band at the same time [but combined in a single audio channel, unlike a full sub-receiver function — *Ed.*] — the DX station's transmit and listening frequencies, for example. Some prospective '7700 buyers considered the unit's lack of a sub-receiver as a deal breaker.

■ The IC-7600 "boots up" nearly instantly — no waiting!

■ It's possible to update the radio's firmware via the Internet. The procedure for doing so is essentially identical to the one we described in our IC-7700 review.

■ You must fashion your own external keypad for *direct* (ie, non-menu) access to the voice, CW or digital memories. Alternatively, you can access the voice and CW memories via the USB keyboard using the F1-F4 keys.

■ The radio's AUTO TUNE feature for CW and AM is convenient and useful, especially for the pitch-challenged. Sometimes it was unable to lock on the signal — perhaps because of fading — and would return to where it started (it only tries for two seconds). If you press AUTO TUNE with the RIT on, it changes the RIT frequency, not that of the main dial. This makes sense, I suppose, but the *Instruction Manual* doesn't mention it.

■ When turned rapidly, the main VFO tuning rate will automatically accelerate at AUTO or SLOW rates, or you can disable this feature off altogether.

■ The AGC menu lets you customize the fast, mid and slow parameters for all modes but FM. It does not appear possible to turn off the AGC in FM mode.

■ The '7600 can engage preamps and other features on the AM Standard Broadcast Band (530-1710 kHz) and below (ie, MW and LW). This is a sensitive BC band receiver! I could hear New York City AM stations in Delaware at mid-day.

■ Accessing transmit memories for phone modes remains confusing and awkward. You shouldn't have to consult the *Instruction Manual* simply to record a voice clip. There simply are too many menu screens, and the radio mixes memories for off-the-air recording (VOICE MEMORY) with the transmit memories you'd use in a contest.

■ The '7600's speaker is up-firing and sounds quite good, although setting an accessory (or a second radio!) atop the IC-7600 could muffle the audio.

■ The rear-panel SEND control jack for TR switching a linear amplifier or other accessory offers improved voltage and current-handling capabilities from those of the PROIII. ICOM says the TR control voltage must be less than 16 V dc at 0.5 A with the mechanical relay or 250 V ac at 0.2 A with solid-state switching (a menu selection).

■ ICOM's CAT command set for the IC-7600 still does not include any means to control, clear or even read the value of the RIT/XIT. These are features some ICOM watchers had hoped would appear in the IC-7600's command set. The command set does include instructions to turn the RIT/XIT "quick clear" feature on or off and read its status, however.

■ The RIT/XIT tuning rate is way too leisurely for my taste — about 0.1 kHz per turn on CW, identical to the PROIII's. I'd prefer it to be coarser to minimize twisting.

■ While in CW mode, a readout under the FILTER sub-menu displays the precise CW pitch frequency, eliminating any guesswork.

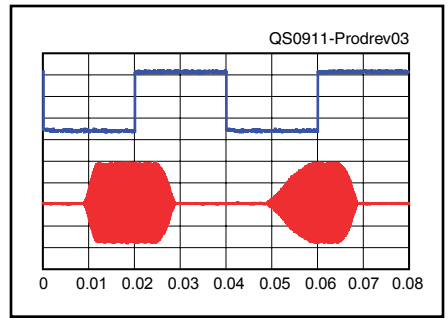

Figure 3 — CW keying waveform for the IC-7600 showing the first two dits in full-break-in (QSK) mode using external keying. Equivalent keying speed is 60 WPM. The upper trace is the actual key closure; the lower trace is the RF envelope. (Note that the first key closure starts at the left edge of the figure.) Horizontal divisions are 10 ms. The transceiver was being operated at 100 W output on the 14 MHz band.

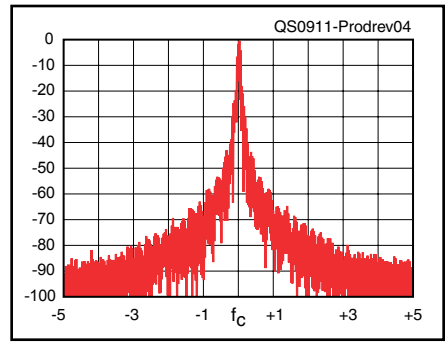

Figure 4 — Spectral display of the IC-7600 transmitter during keying sideband testing. Equivalent keying speed is 60 WPM using external keying. Spectrum analyzer resolution bandwidth is 10 Hz, and the sweep time is 30 seconds. The transmitter was being operated at 100 W PEP output on the 14 MHz band, and this plot shows the transmitter output ±5 kHz from the carrier. The reference level is 0 dBc, and the vertical scale is in dB.

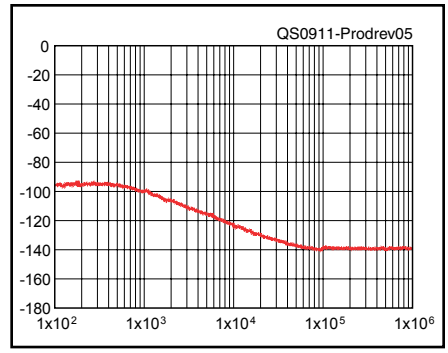

Figure 5 — Spectral display of the IC-7600 transmitter output during composite-noise testing. Power output is 100 W on the 14 MHz band. The carrier, off the left edge of the plot, is not shown. This plot shows composite transmitted noise 100 Hz to 1 MHz from the carrier. The reference level is 0 dBc, and the vertical scale is in dB.

My Take

While the jury still may be out as to whether the IC-7600 qualifies as a top-tier transceiver, its frills, feature set and performance alone make it a must-see for serious contesters and DXers, if not for discerning casual operators.

Manufacturer: ICOM America, 2380 116th Ave NE, Bellevue, WA 98004; tel 800-872-4266, fax 425-454-1509, **www.icomamerica.com**.

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Update to FlexRadio FLEX-3000 Product Review

In the Product Review for the FLEX-3000 [October 2009, pp 45-51], in Table 1 we reported values for "Second Order Dynamic Range," instead of our usual "Second Order Intercept." While this is valid data, it is not a figure that members are used to seeing. The corresponding second order intercept is +69 dBm with the preamp off and +21 dBm with the preamp on. Further testing proved the figure with the preamp on to be rather poor and lower than we've seen at the Lab for other radios. Upon consulting FlexRadio Systems, they acknowledged the problem and came up with a modification to the radio hardware and software to improve the second order intercept with the preamp on. We received and tested an updated FLEX-3000 at the ARRL Laboratory shortly afterward. Results for the updated radio are shown in Table 2.

Notice that there are now two preamplification levels, instead of the one level in the original design. Both of the new preamp settings have improved second order dynamic range, resulting in higher second order intercept figures. Third order IMD dynamic range also improved considerably with the new preamp modifications.

In the original review, we also reported the reciprocal mixing as "better than 112 dBc." This is the case with AGC on at certain settings. To get a better understanding of how noise from adjacent signals affect the noise floor, we have provided before and after data with the AGC off

FlexRadio Systems has informed us that all FLEX-3000s shipped beginning in September include the preamp modifications. To determine if your FLEX-3000 incorporates the IP2 upgrade, check to see if the TRX board hardware revision is revision G or higher. Open *PowerSDR* and click on SETUP/GENERAL/HARDWARE CONFIG/. Look at the last letter of the TRX serial number. If it is Rev G or later, it indicates the IP2 improvement is in place. Contact FlexRadio if you have an earlier version and you desire to receive this upgrade. It will be provided at no cost.

The provided software contained everything needed to easily upgrade to Power SDR v.1.18.3. The folks at FlexRadio graciously worked with the ARRL Lab to improve their product. It was a pleasure working with them. — *Bob Allison, WB1GCM, ARRL Test Engineer*

Table 2

FlexRadio FLEX-3000, serial number 3109-0286

Test results before and after modification.

Noise floor (MDS), 500 Hz bandwidth:

	Preamp off	*Preamp 1*	*Preamp 2*
14 MHz, before:	–120 dBm	–135 dBm	n/a
14 MHz, after:	–121 dBm	–126 dBm	–135 dBm
Noise figure, before:	27 dB	12 dB	n/a
Noise figure, after:	27 dB	21 dB	12 dB

Blocking gain compression:

Gain compression, 500 Hz bandwidth:

	20 kHz offset	*5/2 kHz offset*
	Preamp off/on	*Preamp off*
14 MHz, before	112/105 dB	112/112 dB
	Preamp off/1/2	*Preamp off*
14 MHz, after	113/111/114 dB	113/113 dB

Reciprocal mixing, 14 MHz

	20/5/2 kHz offset
Before, AGC on:	Better than 112 dBc
Before, AGC off:	91/90/89 dBc
After, AGC off:	91/91/91 dBc

ARRL Lab Two-Tone IMD Testing

	Band/Preamp	*Spacing*	*Input Level*	*Measured IMD Level*	*Measured IMD DR*	*Calculated IP3*
Before:	14 MHz/Off	20 kHz	–23 dBm	–120 dBm	97 dB	+26 dBm
			–14 dBm*	–97 dBm		+28 dBm
			0 dBm*	–13 dBm		+7 dBm
After:	14 MHz/Off	20 kHz	–22 dBm	–121 dBm	99 dB	+28 dBm
			–14 dBm*	–97 dBm		+28 dBm
			0 dBm*	–13 dBm		+7 dBm
Before:	14 MHz/On	20 kHz	–40 dBm	–135 dBm	95 dB	+8 dBm
			–37 dBm	–97 dBm		–7 dBm
After:	14 MHz/1	20 kHz	–27 dBm	–126 dBm	99 dB	+23 dBm
			–19 dBm*	–97 dBm		+20 dBm
After:	14 MHz/2	20 kHz	–36 dBm	–135 dBm	99 dB	+14 dBm
			–27 dBm	–97 dBm		+8 dBm
Before:	14 MHz/Off	5 kHz	–24 dBm	–120 dBm	96 dB	+24 dBm
			–15 dBm	–97 dBm		+26 dBm
			0 dBm*	–13 dBm		+7 dBm
After:	14 MHz/Off	5 kHz	–23 dBm	–121 dBm	98 dB	+26 dBm
			–14 dBm*	–97 dBm		+28 dBm
			0 dBm*	–14 dBm		+7 dBm
Before:	14 MHz/Off	2 kHz	–25 dBm	–120 dBm	95 dB	+23 dBm
			–15 dBm*	–97 dBm		+26 dBm
			0 dBm*	–13 dBm		+7 dBm
After:	14 MHz/Off	2 kHz	–26 dBm	–121 dBm	95 dB	+22 dBm
			–14 dBm*	–97 dBm		+26 dBm
			0 dBm*	–14 dBm		+7 dBm

Second-order Intercept, 14 MHz

	Preamp off	*Preamp 1*	*Preamp 2*
Before:	+69 dBm	+21 dBm	n/a
After:	+69 dBm	+55 dBm	+45 dBm

ADC clipping level (single tone)

	Preamp off	*Preamp 1*	*Preamp 2*
Before:	–8 dBm	–31 dBm	
After:	–7 dBm	–13 dBm	–21 dBm

*IMD level exceeds the threshold of ADC clipping. Single tone clipping reported above. Two tone clipping occurs at –13 dBm.

QST

SHORT TAKES

Depiction Emergency Management Software

By David Friedman, KE7GOY
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In the winter of 2008, the Snohomish County (Western Washington) Department of Emergency Management declared a widespread flood emergency. The organization I am involved with, MuttShack Animal Rescue and Response, was activated and I became its Disaster Response Director. There was a problem, though: I was in New Orleans on vacation, more than a thousand miles away. Despite the distance, I was still able to fulfill my role thanks to Amateur Radio, the Internet and a software application for *Windows* named *Depiction*.

Answering the "What If?" Questions

Depiction is designed with emergency management and planning in mind. It allows everyday users to build interactive and simulated scenarios by integrating freely-available data with their own custom input. By incorporating information about personnel, resources, and other assets in-place, *Depiction* gives you the ability to modify reality, so to speak, by altering rules and behaviors and seeing the results. "What if the water changes direction or my mobile communications van needs a new route? If I need to move radio operators to locations and still know their assets? If this arterial were blocked, how would I get my team to the hospital?"

Depiction let me plot all of my resources on a dynamic map to get an instant perspective on events. This data can come in a variety of formats, such as publicly available data on repeater locations, JPEG images and area maps, or user-generated text or *Excel* files that contain lists and locations of Amateur Radio operators, ARES/RACES volunteers, SKYWARN observers and other critical volunteers (including a summary of their operating capabilities). *Depiction* placed me on the scene, at least in a virtual sense.

While an Internet connection is needed to download certain data, *Depiction* also works offline with saved data. *Depiction* can download and integrate maps, elevation plots, weather data, "fly over" imagery, situation reports, damage assessments and volunteer movement (from the Automatic Packet/Position Reporting System [APRS]). Then, once critical data has been uploaded, you can take your computer offline and use it in the field as a replacement for unwieldy binders. Best of all, unlike a static paper map, you can position or move resources or objects anywhere within *Depiction* to provide increased situational awareness.

Depiction in Action

Soon after MuttShack was activated for the flooding event, I was able to create a "depiction" of the activity centered on the specific locations. The software quickly aggregated data from the MuttShack volunteer database, ARES/RACES lists, shelters, hospitals, EOC/IC locations and more. Instead of being pushpins on a single image, the volunteers appeared as "elements" in the graphic depiction. The volunteer elements, for instance, have properties that distinguish them on the basis of not only their locations, but also skill sets, credentials, training and equipment – information that is crucial in decision-making related to their deployment. *Depiction* also allowed integration of information from the field via text e-mails that I received from a variety of sources.

Information from the incident command came in via phone and radio relay. This, in conjunction with updated maps from the County DEM, helped me observe the current extent of the event. Talking to my liaison, I was able to locate potential options for staging areas for personnel and animals, as well as shelters. *Depiction's* controls allowed me to zoom in and out of the emergency areas, view multiple layers of information in separate windows, visually distinguish the volunteers based on their skill sets using color-coded mapping and get an overview of the surrounding terrains and crucial evacuation routes.

As I received updates on the resources from the scene, I made recommendations to the Animal Rescue Liaison on the assignment of specific tasks to the volunteers based on their proximity to resources. Based on the reports from the field, I was able to continually update the locations of the volunteers as well as the locations and status of resources. In addition, I was able to respond to emerging conditions on the ground by using the simulation elements of *Depiction* to introduce road barriers and determine alternate transportation routes, and convey them to the teams.

Evolving Software

The makers of *Depiction* are increasingly aware of its potential for use in the Amateur Radio community. They have recently released an add-on that lets users view APRS data and are actively soliciting feedback for further customizations. Trial versions of *Depiction* can be downloaded from their Web site and the full product can be purchased for less than $200.

Manufacturer: Depiction, Inc, tel 425-297-1950; **www.depiction.com**. *$199. APRS Add-On: $19.95. Community volunteer discounts. Minimum system requirements: Microsoft* Windows XP *with Service Pack 2 (SP2) or* Windows Vista*; 400 MHz Pentium Processor (1 GHz recommended); 512 MB RAM, or 1 GB when running on* Vista *(1 GB recommended); up to 570 MB hard drive space (includes up to 500 MB for* .NET *frameworks); minimum display setting of 800 × 600, 16-bit high color (32-bit true color recommended).* QST

Depiction **displaying information during the winter 2008 storms and flooding in Western Washington. Note how it indicates Red Cross shelters, Amateur Radio operator resources, NOAA weather radar and more.**

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