Product Review & Short Takes Columns from *QST* Magazine

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Product Reviews

ICOM IC-756PROII HF/6-Meter Transceiver
Yaesu FTV-1000 6-Meter Transverter

Short Takes

UI-View

ICOM IC-756PROII HF/6-Meter Transceiver

By Rick Lindquist, N1RL
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With the IC-756PROII, ICOM likely has come the closest of any manufacturer in providing the sort of performance demanding operators expect in a radio that relies largely on digital signal processing (DSP) for its ultimate selectivity.

To review very quickly for those of you who are tuning in late, the IC-756PROII covers the HF bands and 6 meters, plus it offers general coverage receive that begins down in the nether regions of the spectrum (30 kHz) and extends up to the VHF range (60 MHz). It transmits and receives SSB, CW, AM and FM, and it can even decode RTTY and directly display the text.

Of course, we liked the original PRO very much, so we had to wonder if those Roman numerals really added much. Personally, I tend to stay away from those Roman numeral movie sequels, but that doesn't necessarily apply to ham radio gear.

"The best just got better," ICOM's ads proclaim. With our focus on performance, the degree to which that claim is true about the IC-756PROII is our chief task at hand. While it may not be readily apparent from the Lab numbers alone, the PROII *does* represent a level of improvement over its predecessor. It hears and sounds better, and it does so without some of the annoying idiosyncrasies of the original PRO.

So Soon?

Indeed, it seems like just yesterday that we'd reviewed the IC-756PRO. Well, aging is a funny thing, I guess; your sense of time gets all compressed. It was June 2000 when the PRO "Product Review" appeared in *QST*. While that's a technological eternity, it's not, after all, very long in the greater scheme of things.

With the PROII coming out a year or so later, the more cynical might wonder if there was something *wrong* with the original PRO that ICOM needed to fix, hence the PROII. Or did technology just leapfrog ahead, and ICOM now is taking advantage with this updated model? Manufacturers might balk, but, cynics aside, these are valid questions that prospective buyers of transceivers in this price class have a right and a responsibility to ask.

True Story

You probably knew you were going to get a story at some point, so here it is. The first piece of new ham gear I ever bought was a 2-meter all-mode transceiver. At the time (this goes back about 20 years), I was very much into working Mode A on the early OSCAR and RS satellites, and the modified Tecraft (remember that little outfit?), crystal-controlled, tube-type transmitter I'd modified for CW satellite use just wasn't cutting it anymore (imagine that).

So, I scanned the catalogs, asked around and finally settled on a Kenwood TR-9000. Over vigorous spously protest, I plunked down about $450 for that little gem—a good chunk of cash in the early 1980s—and that unit continued to serve me well for the next 15 years, when I finally parted with it. But it always just galled the *heck* out of me that, within six or eight months after I'd bought the TR-9000, Kenwood came out with the TR-9130, which had a vastly more readable fluorescent display (the 9000's red LEDs were wicked hard, if not altogether impossible, to read in sunlight), plus more memories, among other things I'd wished the TR-9000 had when I'd bought mine. There were other new niceties, too, and the price was about the same.

Arrgh! If only I'd waited!

We can't speak for them, of course, but a few owners of the original PRO might well be saying the same thing to themselves right about now. ICOM says the PROII includes "improvements and features that you requested most." The changes are more than mere software upgrades and, no, you can't upgrade your PRO to a PROII.

As we've said in the past, ICOM is perhaps the only ham radio equipment manufacturer to routinely build on its past successes. Witness the three iterations of the extremely popular IC-706, which is now up to its MkIIG model and still going strong. Each model is better and more feature-filled than its predecessor. This is an admirable trend. Let's see how it worked out in the case of the latest IC-756 model.

A 3G Radio

Taking a cue from the wireless telecommunications industry, we'd have to call the PROII a "third-generation"—or "3G"—radio. The original IC-756 was a very capable, yet more conventional, transceiver that showed up in 1996 (see *QST* "Product Review," May 1997).

Like most other transceivers in its price class, it continued the trend to rely on conventional crystal or mechanical filters to enhance selectivity in the intermediate-frequency stages. But, as we pointed out in our review of the original PRO, the die had been cast with the debut of the

Bottom Line

With subtle but significant improvements, ICOM has nudged this latest incarnation of the '756—the IC-756PROII—even closer to Nirvana.

Joe Bottiglieri, AA1GW □ Assistant Technical Editor

Kenwood TS-870, which relied on then-state-of-the-art DSP.

Coming up with a flawless DSP design has become a search for the Holy Grail of sorts among manufacturers—although some seem to favor designs that meld conventional and DSP IF filtering systems, as Yaesu's MARK-V FT-1000MP does. Not only do DSP-based filters eliminate the need and expense of optional crystal or mechanical filters, but they also enhance flexibility. With the PROII's DSP, you don't just have a couple or three hard-and-fast choices for narrow filters, you've got more than 50 (by ICOM's count). Then there are the notch filters and digital noise reduction to sweeten the pot. We should point out, however, in the interests of accuracy that the PRO and the PROII use *crystal* filters in the signal path, not *ceramic*, as we'd incorrectly stated in our earlier PRO review. We're not quite to the point that we're ready to do away with crystal filters altogether.

We appear to be inching forward to that fabled day in the future when we'll "upgrade" our totally software-defined radios via the Internet.

Changes at the Cellular Level

ICOM says it went back to the drawing board to effect considerable changes from the original PRO to the new PROII at what we might call the cellular level. All of these changes seem to be aimed at reducing distortion in various places along the signal path. To wit (according to ICOM):

- The front-end bandpass filters have been completely redesigned to improve the second and third-order intercept numbers (more on what this means in a bit).
- PIN diodes have been improved to further reduce front-end distortion.
- The first mixer has been reworked for improved sensitivity and intermodulation distortion characteristics.
- "Preamp 1" now is a push-pull design, which reduces second-order IMD.
- The third mixer was redesigned for lower distortion using fast analog switches. (ICOM says that, because the DSP does the narrow-band filtering after the mixer, the third mixer becomes more critical in DSP receiver designs.)

A *More* Delightful Display

Everyone loved the display on the original PRO, and they adored the one on the PROII just as ardently. While ICOM touts the PROII's display as being "higher quality," putting a PRO and a PROII side-by-side revealed distinctions without much of a difference. For all intents and purposes, these were identical twins—clear and crisp and easily readable at wide angles from either side. To the naked eye, we noticed only that the large font used to read out the frequency was composed of vertical lines in the PROII rather than the tiny dots in the original PRO's display.

The *real big* difference is that you can do more with the display on the PROII. There's a greater choice of display backgrounds, and, as with the earlier model, there is a choice of seven fonts for the frequency readout and other on-screen legends.

The PROII now provides eight possible display backgrounds, labeled A through H. In summary, there's a black background with white, yellow, light blue or green legends, a white background with dark blue legends, a dark blue background with white legends, a seascape with white legends or a cityscape (is it Tokyo, and, if so, can we get one with Godzilla?) with white legends.

Performance: Are We There Yet?

Creature comforts in a transceiver cer-

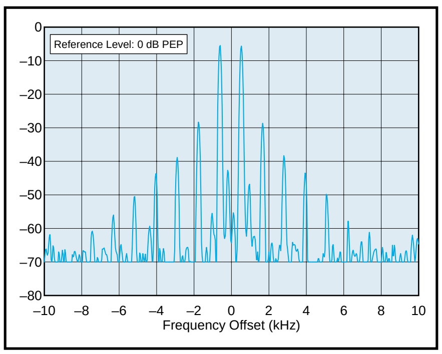


Figure 1—Worst-case spectral display of the IC-756PROII transmitter during two-tone intermodulation distortion (IMD) testing on HF. The worst-case third-order product is approximately 30 dB below PEP output, and the worst-case fifth-order is approximately 40 dB down. The transmitter was being operated at 100 W output at 28.35 MHz.

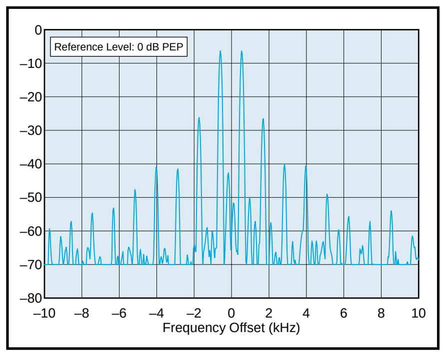


Figure 2—Spectral display of the IC-756PROII transmitter during two-tone intermodulation distortion (IMD) testing on 6 meters. The third-order product is approximately 28 dB below PEP output, and the fifth-order is approximately 42 dB down. The transmitter was being operated at 100 W output at 50.2 MHz.

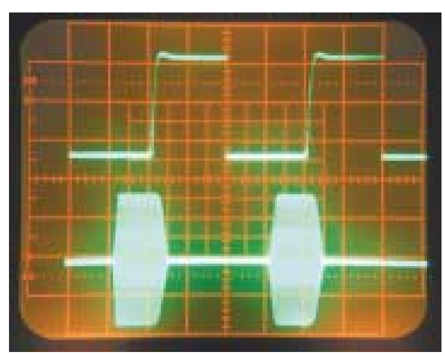


Figure 3—CW keying waveform for the IC-756PROII showing the first two dits in full-break-in (QSK) mode. The equivalent keying speed is 60 WPM. The upper trace is the actual key closure; the lower trace is the RF envelope. Horizontal divisions are 10 ms. The transceiver was being operated at 100 W output at 14.2 MHz. Note that both dits are somewhat shortened. Only the first dit is shortened in semi-break-in mode.

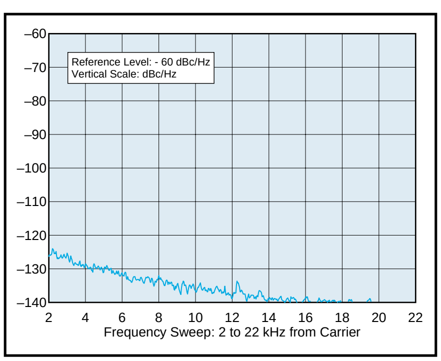


Figure 4—Worst-case tested HF spectral display of the IC-756PROII transmitter output during composite-noise testing at 14 MHz. Power output is 100 W. The carrier, off the left edge of the plot, is not shown. This plot shows composite transmitted noise 2 to 22 kHz from the carrier.

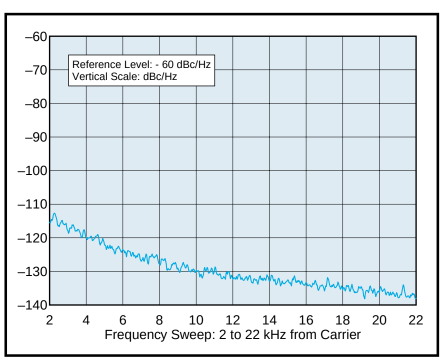


Figure 5—Spectral display of the IC-756PROII transmitter output during composite-noise testing at 50.2 MHz. Power output is 100 W. The carrier, off the left edge of the plot, is not shown. This plot shows composite transmitted noise 2 to 22 kHz from the carrier.

Table 1
ICOM IC-756PROII, serial number 01164

Manufacturer's Claimed Specifications	*Measured in the ARRL Lab*
Frequency coverage: Receive, 0.03-60 MHz; transmit, 1.8-2, 3.5-4, 7-7.3,10.1-10.15, 14-14.35,18.068-18.168, 21-21.45, 24.89-24.99, 28-29.7, 50-54 MHz.	Receive, as specified[1]; transmit, as specified.
Power requirement: Receive, 3.5 A; transmit, 23 A (maximum).	Receive, 3.2 A; transmit, 21 A. Tested at 13.8 V.
Modes of operation: SSB, CW, AM, FM, FSK, AFSK.	As specified.

Receiver	*Receiver Dynamic Testing*
SSB/CW sensitivity, bandwidth not specified, 10 dB S/N: 1.8-30 MHz (preamp 1 on), <0.16 µV; 50-54 MHz (preamp 2 on), <0.13 µV.	Noise Floor (MDS), 500 Hz filter: (see below)

Noise Floor (MDS), 500 Hz filter:

	Preamp off	*Preamp one*	*Preamp two*
1.0 MHz	–121 dBm	N/A	N/A
3.5 MHz	–132 dBm	–140 dBm	–143 dBm
14 MHz	–131 dBm	–139 dBm	–141 dBm
50 MHz	–125 dBm	–136 dBm	–139 dBm

AM sensitivity, 10 dB S/N: 0.5-1.8 MHz, <13 µV; 1.8-30 MHz (preamp 1 on), <2 µV; 50-54 MHz, <1 µV.

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

	Preamp off	*Preamp one*	*Preamp two*
1.0 MHz	5.0 µV	N/A	N/A
3.8 MHz	1.6 µV	0.7 µV	0.46 µV
50 MHz	3.6 µV	1.2 µV	0.65 µV

FM sensitivity, 12 dB SINAD: 28-30 MHz (preamp 1 on), <0.5 µV; 50-54 MHz (preamp 2 on), <0.32 µV.

For 12 dB SINAD:

	Preamp off	*Preamp one*	*Preamp two*
29 MHz	0.72 µV	0.33 µV	0.21 µV
52 MHz	1.2 µV	0.43 µV	0.28 µV

Blocking dynamic range: Not specified.

Blocking dynamic range, 500-Hz filter:

Spacing	*20 kHz Preamp off/one/two*	*5 kHz Preamp off/one/two*
3.5 MHz	119/118/113 dB	102/100/95 dB
14 MHz	118/116/111 dB	100/97/94 dB
50 MHz	116/117/115 dB	99/99/96 dB

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

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

Spacing	*20 kHz Preamp off/one/two*	*5 kHz Preamp off/one/two*
3.5 MHz	98/97/92 dB	77/77/73 dB
14 MHz	97/95/91 dB	76/75/72 dB
50 MHz	94/94/90 dB	74/74/73 dB

Third-order intercept: Not specified.

Spacing	20 kHz *Preamp off/one/two*	5 kHz *Preamp off/one/two*
3.5 MHz	+17.1/+8.2/–4.3 dBm	–18.9/–27.8/–35.8 dBm
14 MHz	+20.2/+10.2/–4.1 dBm	–18.8/–28.8/–35.5 dBm
50 MHz	+14.4/+6.1/–4.2 dBm	–15.6/–25.5/–31.2 dBm

Second-order intercept: Not specified.	Preamp off/one/two, +75/+71/+59 dBm.
FM adjacent channel rejection: Not specified.	20 kHz channel spacing, both preamps on: 29 MHz, 77 dB; 52 MHz, 77 dB.

tainly are welcome, but for most amateurs, it's all about performance, and ICOM says it's upped the ante in the PROII. Among other things, ICOM claims that its newest all-DSP-filter radio offers improved third-order intercept (this has to do with dynamic range and a receiver's ability to let you hear weak signals in the presence of strong ones), as well as better sensitivity without having to hit the PREAMP button, selectable IF filter "shape" and enhanced DSP noise reduction.

ICOM says it's completely redesigned the noise blanker, and the PROII offers an adjustable noise blanker level (not just an on/off button), improved band scope noise floor and better audio fidelity.

When the first radios with digital filters came onto the market, one of my colleagues opined that we were still years away from the day that any software-defined filters would be capable of replacing crystal or mechanical filters. At that point, DSP "boxes"—outboard accessories that offered DSP filters at baseband audio—still were popular. Although earlier iterations of this technology—inboard and outboard—may have fallen short of the benchmark set by conventional IF filters, many users were willing to sacrifice some performance for the flexible user-friendly DSP filters.

DSP designs are getting better, though, and the days of the tradeoff and the compromise may well be in the past. With more than one "DSP" transceiver (including the original PRO) now on the market, it's easier to make comparisons to quantify the state of the art in this regard.

Learning to Love the Numbers

Deciding what radio to buy—helping you to do that as an informed consumer is what "Product Review" is all about—is a little bit like falling in love. A lot of

Receiver	Receiver Dynamic Testing
FM two-tone, third-order IMD dynamic range: Not specified.	20 kHz channel spacing, both preamps on: 29 MHz, 77 dB*; 52 MHz, 77 dB*. 10 MHz channel spacing: 52 MHz, 92 dB.
S-meter sensitivity: Not specified.	S9 signal at 14.2 MHz: preamp off, 53 µV; preamp one, 19 µV; preamp two, 7.9 µV; 50 MHz, preamp off, 73 µV; preamp one, 26 µV; preamp two, 13 µV.
Squelch sensitivity: SSB, CW, RTTY, <5.6 µV; FM, <1 µV.	At threshold, preamp on: SSB, 3.8 µV; FM, 29 MHz, 0.31 µV; 52 MHz, 0.25 µV.
Receiver audio output: 2 W into 8 Ω at 10% THD.	2.2 W at 10% THD into 8 Ω.
IF/audio response: Not specified.	Range at –6 dB points, (bandwidth):[2] CW-N (500-Hz filter): 466-982 Hz (516 Hz); CW-W: 348-1679 Hz (1331 Hz); USB-W: 235-2725 Hz (2490 Hz); LSB-W: 232-2716 Hz (2484 Hz); AM: 94-2786 Hz (2692 Hz).
Spurious and image rejection: HF & 50 MHz, (except IF rejection on 50 MHz): 70 dB.	First IF rejection, 14 MHz, 94 dB; 50 MHz, 83 dB; image rejection, 14 MHz, 110 dB; 50 MHz, 110 dB.
Transmitter	**Transmitter Dynamic Testing**
Power output: HF & 50 MHz: SSB, CW, FM, 100 W (high), 5 W (low); AM, 40 W (high), 5 W (low).	HF: CW, SSB, FM, typically 115 W high, <1 W low; AM, typically 39 W high, <1 W low; 50 MHz: CW, SSB, FM, typically 108 W high, <1 W low; AM, typically 38 W high, <1 W low.
Spurious-signal and harmonic suppression: ≥50 dB on HF, ≥60 dB on 50 MHz.	HF, 57 dB; 50 MHz, 62 dB. Meets FCC requirements for spectral purity.
SSB carrier suppression: ≥40 dB.	As specified. >65 dB.
Undesired sideband suppression: ≥55 dB.	As specified. >65 dB.
Third-order intermodulation distortion (IMD) products: Not specified.	See Figures 1 and 2.
CW keyer speed range: Not specified.	6 to 48 WPM.
CW keying characteristics: Not specified.	See Figure 3.
Transmit-receive turn-around time (PTT release to 50% audio output): Not specified.	S9 signal, 23 ms.
Receive-transmit turn-around time (tx delay): Not specified.	SSB, 20 ms; FM, 11 ms. Unit is suitable for use on AMTOR.
Composite transmitted noise: Not specified.	See Figures 4 and 5.

Size (HWD): 4.4×13.4×11.2 inches; weight, 21.1 pounds.

Note: Unless otherwise noted, all dynamic range measurements are taken at the ARRL Lab standard spacing of 20 kHz.

Third-order intercept points were determined using S5 reference.

*Measurement was noise-limited at the value indicated.

[1]Sensitivity degrades below 150 kHz and above 58 MHz.

[2]All measurements were taken at the "sharp" filter setting. SSB measured in the 2.4 kHz filter setting. CW bandwidth varies with the PBT and Pitch control settings.

subjective factors can attract an adoring amateur public to a given transceiver—fancy or innovative display, nice knobs, a quality "look and feel," even the color and texture of the cabinet (remember those two-tone green Heathkit boxes?). Starting with its dazzling TFT display, the PROII has its share of these.

OK, she's sweet as honey, but is her daddy rich? The subjective stuff is just one side of the coin. It's the objective numbers that result from rigorous and standardized testing in the ARRL Lab than can separate wheat from chaff in terms of manufacturer's representations and stark reality. Quite frankly, the margin of measurable improvement from the PRO to the PROII is rather narrow.

We've included some numbers for competitors' radios in the same price class. If you're curious about the specific transceivers and can't guess, you can look these up in past reviews; we would rather not inject the issue of brand names in this particular discussion, however, so we'll stick to the numbers themselves.

Let's cut to the chase. Please turn to Table 1 and follow along in your books as we learn several words and concepts you might not be familiar with.

SSB/CW Sensitivity

ICOM says it's beefed up the transceiver's sensitivity, so you won't need to be hitting that PREAMP button when the weak one comes along. The problem with adding stages of amplification is, of course, that you risk adding distortion, so more is not always better when it comes to "preamps." ICOM seems to be reasoning that the primary RF-amplification circuitry ought to be sufficient for most situations.

On our original PRO, we measured the SSB/CW sensitivity or noise floor (what the Lab calls "minimum discernible signal" or MDS) on 14 MHz, preamp off, at –128 dBm. Indeed, our PROII came in a bit better, at –131 dBm, and a second unit we checked tested at –132 dBm.

Recent comparable offerings from competitors came it at –127 dBm and –129 dBm in the MDS department at 14 MHz, preamp off.

Dynamic Range

The most demanding DXers and contesters tend to gravitate toward transceivers that offer superior dynamic range, rather than sensitivity, however. Something known as "two-tone, third-order IMD dynamic range" is an objective measure of the receiver's ability to let you discern (copy) a weak signal in the midst of stronger—even much stronger—signals. On a practical level, the difference here can be finding and working that rare one with the puny signal or going without because you couldn't "pull him out."

Now, eyes forward and repeat after me: "If you can't hear 'em, you can't work 'em!"

As regular readers of this column are aware, this past summer we began testing and publishing two-tone, third-order IMD dynamic range numbers at spacings of both 20 kHz—our standard for many years—and at 5 kHz. The latter measurement is closer to real-world QRM. It's also well inside the typical 15-kHz front-end "roofing filter."

At the 20-kHz spacing, our original PRO came in at 95 dB on 14 MHz, preamp off. We weren't publishing a 5-kHz number when we reviewed the original PRO, so we measured the one ICOM donated to W1AW. It came in at 80 dB on 14 MHz, preamp off.

By comparison, our PROII measured at 97 dB and 76 dB respectively. We checked another unit provided by ICOM and we measured 100 dB at the 20-kHz spacing.

The competition, you ask? The most recent comparable unit with DSP filtering tested at both spacings came in at 94 dB and 69 dB, respectively. Another competitor's current transceiver offering in the same price class that uses crystal/mechanical filters and DSP topped 100 dB at 20-kHz spacing and 76 dB at 5-kHz spacing.

Third-Order Intercept

The bottom line statistic for many manufacturers and prospective buyers is something called "third-order intercept" or IP_3. ICOM claims an IP_3 improvement for the PROII over its predecessor. This number is calculated on the basis of the MDS (or some higher signal level) and the two-tone, third-order IMD dynamic range figures we just discussed. The more the third-order intercept is in the positive range, the better.

Sticking with 14-MHz, preamp off, numbers, our PRO's IP_3 worked out to be +15.4 dBm. Our PROII came in at +20.2 dBm, while a second unit tested at +17 dBm and a third, provided by ICOM, tested at +21 dBm (we also measured 100 dB dynamic range on this unit).

IF/Audio Response

The characteristics of the IF "strip" and the audio amplifier stages by and large determine how a receiver sounds, assuming that whatever you're using to listen with—speaker or headphones—are up to the task of handling the delivered audio. Good "communications-quality" audio for amateur SSB work typically has a bandwidth in the vicinity of 2.4 kHz or so. Depending on what happens inside the radio, the resulting audio within such a passband can range from rich and full to overly bright, tinny or muddy. Digital filters of the sort the PROII employs allow the user to customize response, within design limits, among the various extremes.

Since ICOM claims "improved audio fidelity" as one of the PROII's selling points, we were a bit perplexed to discover that SSB audio with the 2.4 kHz filter engaged in the default "sharp" filter position sounded identical to our ears as that from the earlier PRO (we'll say more about the "sharp" vs "soft" filters in just a bit). The audio sounded clean; it just was not perceptibly better.

This was borne out by our Lab numbers (see Table 1), which show the USB "wide" response curve or range, measured at the –6-dB points, starting at 235 Hz on the "bass" end and ending at 2725 Hz on the "treble" side—a total audio bandwidth of 2490 Hz—pretty close to what it should be according to the filter setting. For all intents and purposes, this was identical to the audio response curve we'd measured with our original PRO, and it left us pondering ICOM's definition of "improved audio fidelity."

Widening the SSB filter to a full 3.0 kHz yielded "richer" audio, as expected—with the low end now rolling off at around 100 Hz and the high end at around 3010 Hz, or 2910 Hz of audio bandwidth. These are the kinds of things that flexible DSP filters let you do.

The good news here for ICOM is that while the PROII's "default" audio is no better or worse than the original PRO's, it does appear to top that of two competing transceivers we reviewed in recent months. We'd measured the "SSB-wide" audio passband for one DSP-based transceiver at a rather constricted 1911 Hz (the low end rolled off at around 450 Hz on that unit), and at a somewhat better 2157 Hz on another transceiver that employs conventional filtering (the low-end response was slightly better, and there was more high end). These measurements also were made at the 2.4-kHz filter settings on the respective radios.

Going by our Lab numbers, the PROII's audio response curve for classic AM mode does not appear to be nearly as good as the original PRO's, but this number is a bit deceptive. Keep in mind that our measurement was at the rather narrow 3.0 kHz bandwidth, and PROII's measured AM bandwidth of 2692 Hz is much more in line with what one should expect from a 3.0-kHz filter than the broader 3363 Hz we'd measured on the original PRO. The narrower passband in the PROII comes largely at the expense of high-end response, which will mean slightly muddier-sounding AM audio in the narrow filter position. The PRO and PROII offer AM filters at 6.0 and 9.0 kHz too.

The PRO and the PROII both measured a substantial 2.2 W at 10% total harmonic distortion into an 8-Ω load.

Killing Me Softly

A significant change in the DSP filtering is that you can select (via the menu) whether you want "sharp" or "soft" filter skirts for SSB or CW. These choices will impact the audio response curve. The PROII offers a graphical representation of the filter curves. In the sharp position, the filter curves are flat at the top and break at nearly right angles at the top of the slope. In the soft position, the filter curves are rounded at the top, something like a sine wave—sort of the kinder, gentler version of DSP.

On SSB, the difference is a bit more noticeable to the ear, and we were able to quantify this in the Lab in terms of how it affects audio response. In the USB mode with a 2.4-kHz filter enabled, the soft filter rolled off the audio at both the high and low ends—yielding a passband that started at 283 Hz and didn't roll off until 2456 Hz at the top—a total of 2173 Hz. That's more than 300 Hz narrower than the sharp mode—mostly as a result of high-end rolloff. As a result, it seems like there's less distortion and less background noise with the soft filter engaged, and, in general, the soft filter setting sounded better in the presence of atmospheric noise.

On CW, the soft filter exhibits much less ringing, especially at narrower bandwidths—although overall there's not much discernible difference on CW between the sharp and soft settings. The graphical representation of the filter curve indicates that the filter's skirts broaden in the soft mode in CW. In terms of measurable filter bandwidth, with a 500-Hz filter setting in the sharp mode, it's 516 Hz—pretty close! With the same filter in the soft mode, it's 541 Hz.

For those who use or listen in the AM mode, the sharp filter sounded a bit better than the soft filter. This would make sense, since the soft filter would similarly constrict the audio passband, and AM listeners typically like as much as they can get.

A Different Breed

Because some of the odd things we'd noticed in the original PRO only manifest themselves when the band we were using was really busy, we put the PROII though its paces in one SSB contest and two CW contests. A couple of things became clear: (1) the PROII comes through in a competitive environment and (2) it's a breed apart from the more conventional (ie, non-DSP) transceiver and you'll need to work with it a bit to learn how to achieve optimum results.

We alluded to the fact that ICOM has punched up the receiver's sensitivity. In fact, outside of FM use, I can't recall needing to turn on the preamp. Nine times out of ten, it did just fine without.

Arguably, the two most valuable features are the twin passband tuning and the manual notch control. The twin PBT is an obvious choice, since it lets you adjust your bandpass on the fly (high and low) as well as shift it to avoid interference (and displays the results on the screen). As for the notch, I've found on conventional transceivers that an IF notch (as opposed to most DSP-based notching system) can be a valuable asset to manually "shape" the IF filtering to help cut noise and pull out especially faint signals. This seemed to work even more superbly with the manual notch on the PROII.

The noise reduction often can accomplish the same thing, but a lot of operators don't care for the digital artifacts that some NR systems can impart.

ICOM Hears Us

We'd observed on the original PRO some distortion on stronger signals, with signals being further degraded with the preamps switched in. CW signals sounded "flutey" or a little rough. Loud CW and some SSB signals sometimes sounded as though they were on the verge of overloading the receiver or being clipped. Speculation was that this might have resulted from the inability of the analog-to-digital converter to track the input signal in a linear fashion, possibly as a result of AGC delays. Additionally, the original PRO would introduce pops on the "make" of each CW element. Keeping gain down or using noise reduction helped.

We're not exactly sure what ICOM did, but these idiosyncrasies are barely noticeable in the PROII. It's a much more delightful receiver to listen to. As with the PRO, the thing that seems to help most is simply engaging the 6-dB attenuator. By and large, the PROII is plenty "hot" already, and reducing the gain a bit can make all the difference.

In the original PRO, several operators noticed that, at some wider filter settings and with a band filled with signals, the radio generated a low-level rumble. The more signals in the bandpass, the more rumble. With no signals, the rumble disappeared. This was especially noticeable on CW and when using headphones that have good low-frequency response. ICOM said it got very few complaints about this but addressed it anyway by making some changes in the audio amplifier stages. They apparently worked, because the rumble was not detectable on the PROII—even during a contest.

We'd griped that when you're running the built-in digital voice recorder, you could not bring up the band scope at the same time—something you may want to be doing during a contest. The DVR in the PROII now can be controlled remotely—as we'd suggested in our earlier review—while the band scope or other menu is up on the display.

You also can control the memory keyer the same way.

Incremental Improvements

- The better-looking, brighter, easier-to-read analog meter is an unheralded improvement. The PRO meter has a jaundiced cast to it. The PROII meter has white markings and brighter backlighting. (The PROII also provides more steps for backlight dimming.)
- It's now possible to store digital and voice mode filter settings independently.
- It's no longer possible to inadvertently engage the speech processor in digital data modes, assuming you select the data mode. The *Instruction Manual* is not real detailed in this regard, but you'll know you're there when you see the "-D" appear after the mode in the display. You press and hold the AM/FM or SSB mode button to get into the data mode. A quick press returns you to speech mode.
- You can activate $^1/_4$ tuning (fine tuning) in the digital mode.
- There are two menu modes for clearing the RIT. You can set the RIT either to clear at a single button press or to clear only when the button is pressed and held, lest it be cleared accidentally.
- The noise reduction is a big help. It works very well and even helps on noisy FM signals. ICOM says that it's improved the NR function to reduce noise without degrading the signal.
- We of the failing-eyesight generation applaud ICOM for also improving the labeling on the PROII's keypad. The larger, bolder red digits are much easier to read than the boxed, small teal-colored ones on the original PRO.
- ICOM has changed the color of the function buttons that line the lefthand side of the display. The new ones are black, not gray, and now have little red arrows pointing toward the screen function displays they're associated with.
- ICOM improved the sensitivity of the PROII's band scope. It's now about 5 dB (nearly two ICOM S units) hotter, which means that signals that might not have showed up on the PRO band scope are visible on the newer model's screen.

What More Could We Ask For?

ICOM has been so accommodating in updating and enhancing the PRO that we're reluctant to suggest they might have left anything out, for fear that we be considered ingrates. But I think most users will concur that the cooling fan—as was the case with the PRO—is still *waaaay* too loud. It makes so much noise that you can hear it while using headphones.

In addition, the SSB monitor is a bit muddy-sounding, and some kind of "tune" button would be nice too.

But the big thing ICOM didn't do is include 2 meters on the PROII. Frankly, I've never understood the logic of including both 6 and 2 meters on the IC-746—one of my personal favorite ICOM radios that's soon to get the "PRO" treatment—and *not* including it on the higher-priced, better-featured unit. With 2-meter capability, the PROII would be approaching Nirvana—at least in ham radio terms.

We'd concluded our review of the original IC-756PRO by suggesting that all but the most particular operator would enjoy owning one. Given the subtle but significant improvements ICOM's managed to make in the PROII, we'd have to amend that statement to say that ICOM, with the IC-756PROII, has minimized the need for further improvements—and satisfied just about everyone but the crystal-filters-are-forever and heavy-metal AM crowds.

So, just when *are* they coming out with *Halloween X*, anyway?

Manufacturer: ICOM America, 2380 116th Ave NE, Bellevue, WA 98004; 425-454-8155, fax 425-454-1509; **amateur@icomamerica.com**; **www.icomamerica.com**. Manufacturer's suggested list price: $3599.99. Typical current street price: $2980. Manufacturer's suggested list prices for selected optional accessories: UT-102 voice synthesizer unit: $74; CT-17 CT-V level converter (for computer control): $169.

Yaesu FTV-1000 6-Meter Transverter

Reviewed by Dave Patton, NT1N

Over the years I've developed a deep love for 6 meters, "The Magic Band."

My first experience on 6 was way back in my high school days when Frank Miller, K9HMB, let me give it a try from his station. I didn't have another opportunity to operate on the band until about 10 years later, when I borrowed a Kenwood TS-690 (an HF/6-meter rig) to take along on a small DXpedition to Saipan. While our operations were mainly focused on HF, we did manage to work a handful of JAs on 6. I was hooked.

In the mid-'90s I purchased a brand new JRC JST-245 HF/6-meter transceiver. Around that same time, several of the other radio manufacturers were also beginning to include 6-meter coverage as standard fare in a few of their mid-level HF transceivers (the Yaesu FT-920, the Kenwood TS-570S, the Alinco DX-70T and the ICOM IC-736 are some examples). More recently, 6-meter, 2-meter and 70-cm capabilities have been finding their way into relatively affordable transceivers. The tremendous popularity of this new breed of multiband/multimode radios has been partially responsible for a dramatic increase in the level of activity on 6. The tremendous 6-meter propagation that we've enjoyed lately certainly hasn't hurt either!

A Blast from the Past

Yaesu's original version of the FT-1000MP hit the market just before this "added bands" phenomenon really got rolling. During the recent reworking of the 'MP into the new MARK-V FT-1000MP version, Yaesu chose to take a more classic approach to adding 6-meter band coverage: they designed an optional external transverter, the FTV-1000. This unit is built specifically to pair up with the MARK-V FT-1000MP transceiver. The *Operating Manual* provides no information for connecting the transverter to any alternative transceivers—Yaesu or otherwise. (Yaesu recently released an optional cabling kit for connecting the FTV-1000 to the original version of the FT-1000MP. An FP-29 power supply would be required.)

Adding the FTV-1000 transverter will allow you get to take full advantage of the excellent receiver characteristics, flexible DSP and all of the other advanced features available in the MARK-V on the 6-meter band. The maximum RF output power of the transverter is 200 W in Class-AB or 50 W in Class-A mode.

There's no shortage of serious ham operators plying both the HF *and* 6-meter bands from the New England region. I was very anxious to see how an FTV-1000-equipped MARK-V FT-1000MP would hold up on 6 when the band was hopping.

Hooking Up

The FTV-1000 transverter package comes complete with all of the cabling necessary to lash it up to a MARK-V. DC power for both units is supplied by the FP-29 13.8-V/30-V switching power supply that comes with the MARK-V. The FP-29 is connected to the DC POWER IN jack on the back panel of the FTV-1000, and then a second cable—connected to the DC POWER OUT jack—provides power to the transceiver.

The radio and the transverter communicate via a BAND DATA cable. Low level RF drive (50 mV_{rms}) and ALC are handled through phono plug terminated cables. A coax jumper is used to carry the received signals—converted from 6 meters to 10 meters in the transverter—from the FTV-1000's TRANSCEIVER connector into the MARK-V's ANT A connector.

Setting up the system is very easy. The manual includes "Interconnections" diagrams for connecting the transverter to the transceiver alone or for integrating it into a high-power station that includes both the MARK-V and the VL-1000 HF/6-meter amplifier.

Bottom Line

The FTV-1000 transverter can transform a MARK-V FT-1000MP into a very capable HF/6-meter transceiver.

A Quick Tour of the Front Panel

The front panel of the transverter supports seven rocker switches. These control a 12-dB attenuator, IPO (intercept point optimization), preamp level (one or two), amplifier class (AB or A), band segment (50-52 MHz or 52-54 MHz), antenna selection and power.

An LED display window is located in the center of the panel. Eight LEDs positioned around its perimeter show the state of the various settings. In addition to these, there's a five-LED relative power output meter, warning lights for high SWR and excessive temperature, and fan and ALC indicators. The fan is temperature controlled.

Are You Ready to Rumble?

Once you've got everything hooked up and a 6-meter antenna connected to the transverter, to operate on 6, you set the MARK-V to the 10-meter band, disable the radio's front-end RF preamplifier (the associated "IPO" LED should show green), switch the ATT knob to the 0 position and select antenna "A."

The FTV-1000 transverts 6-meter signals to and from frequencies between 28 and 30 MHz. A menu setting (item #3-3) allows you to program the MARK-V to display the 6-meter frequencies directly, if so desired. While this is a nice feature, it takes a minute or so to set it up, and you've got to go back into the menu and disable it for typical HF operation. Since it doesn't affect actual operation, I often

Table 2
Yaesu FTV-1000, serial number 10040047

Manufacturer's Claimed Specifications	Measured in the ARRL Lab
Frequency coverage: Receive and transmit, 50-54 MHz.	Receive, 35-54 MHz; transmit, as specified.
Power requirement: Receive, 0.5 A, 13.8 V dc; transmit, 14.5 A, 30 V dc and 0.5 A, 13.8 V dc (200 W output).	As specified.
Receiver	***Receiver Dynamic Testing***
SSB/CW sensitivity: n/a.	Noise floor (MDS), 500-Hz filter:[1] *Preamp off* / *Preamp one* / *Preamp two* 50 MHz: –127 dBm / –136 dBm / –141 dBm
AM sensitivity, 10 dB S/N: n/a.	10 dB (S+N)/N, 1-kHz tone, 30% modulation:[1] *Preamp off* / *Preamp one* / *Preamp two* 53 MHz: 1.95 µV / 1.02 µV / 0.56 µV
FM sensitivity, 12 dB SINAD: 1.8-30 MHz, <0.5 µV.	For 12 dB SINAD:[1] *Preamp off* / *Preamp one* / *Preamp two* 52 MHz: 0.69 µV / 0.35 µV / 0.19 µV
Blocking dynamic range: Not specified.	Blocking dynamic range, 500-Hz filter:[1] *Preamp off* / *Preamp one* / *Preamp two* 50 MHz: 125 dB / 123 dB / 118 dB
Two-tone, third-order IMD dynamic range: Not specified.	Two-tone, third-order IMD dynamic range, 500-Hz filter:[1] *Preamp off* / *Preamp one* / *Preamp two* 50 MHz: 85 dB / 84 dB / 81 dB
Third-order intercept: Not specified.	*Preamp off* / *Preamp one* / *Preamp two* 50 MHz: +6.2 dBm / –6.1 dBm / –15.7 dBm
FM adjacent channel rejection: Not specified.	20 kHz channel spacing, both preamps on: 52 MHz, 80 dB.
FM two-tone, third-order IMD dynamic range: Not specified.	20 kHz channel spacing, both preamps on: 52 MHz, 62 dB.
IF and image rejection: n/a.	First IF rejection, 79 dB; image rejection, 142 dB.
Transmitter	***Transmitter Dynamic Testing***
Power output: 200 W.	CW, SSB, FM, typically 180 W high, < 1 W low.
Spurious-signal and harmonic suppression: 60 dB.	64 dB. Meets FCC requirements for spectral purity.
SSB carrier suppression: n/a	>75 dB.
Undesired sideband suppression: n/a	>80 dB.
Third-order intermodulation distortion (IMD) products: n/a.	See Figures 6 and 7.
Composite transmitted noise: Not specified.	See Figure 8.
Size (HWD): 5.4×9.6×13 inches; weight, 16.5 pounds.	

Note: Unless otherwise noted, all dynamic range measurements are taken at the ARRL Lab standard spacing of 20 kHz.
Third-order intercept points were determined using S5 reference.
[1]Tested with MARK-V FT-1000MP.

didn't bother to take the time to enable it. It would be nice if the radio could sense when the transverter was turned on, and toggle this menu setting automatically.

The FTV-1000 has two antenna jacks that can be used in a couple of different ways. The ANTENNA switch on the front panel of the transverter can be set to NOR or ALT ("normal" or "alternative"). The most obvious arrangement is to connect 6-meter antennas to both jacks and then use the switch to select the desired antenna. The MARK-V also has two antenna jacks. When the transverter is connected, it might seem that the antenna A connector is tied up for transverter use only, making it unavailable for use with a second HF antenna—but that's not necessarily the case.

When the transverter is switched off, the connection defaults to the to the antenna that's connected to the NOR ANT jack on the back of the transverter. If you want to continue to use both antenna connectors on the MARK-V for HF applications, you can attach your second HF antenna to the transverter's NOR ANT jack and leave the front panel ANTENNA switch in the ALT position. When you turn the transverter on, the 6-meter antenna (connected to the ALT ANT jack) will be automatically selected. Power it off, and the HF antenna will be selected.

In the CW mode, the 6-meter RF output power is controlled by the RF PWR control on the MARK-V. For 200 W operation, you set the control to the point where all five LEDs on the output power meter on the transverter are lit. For 200 W SSB operation, you speak into the microphone and adjust the RF PWR control until all five LEDs are lit on voice

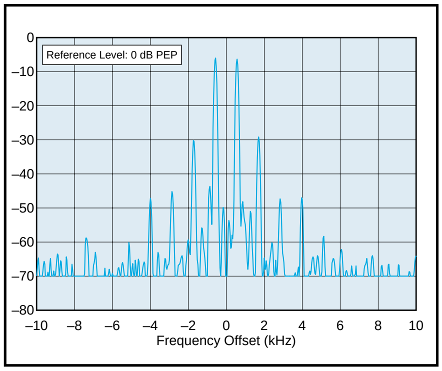


Figure 6—Spectral display of the FTV-1000 transverter's transmitter during two-tone intermodulation distortion (IMD) testing in Class-AB mode. The worst-case third-order product is approximately 30 dB below PEP output, and the worst-case fifth-order is approximately 46 dB down. The transmitter was being operated at 200 W output at 50.2 MHz.

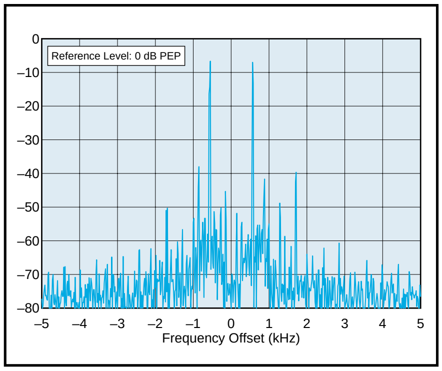


Figure 7—Spectral display of the FTV-1000 transverter's transmitter during two-tone intermodulation distortion (IMD) testing in Class-A mode. The third-order product is approximately 40 dB below PEP output, and the fifth-order is approximately 61 dB down. The transmitter was being operated at 50 W output at 50.2 MHz.

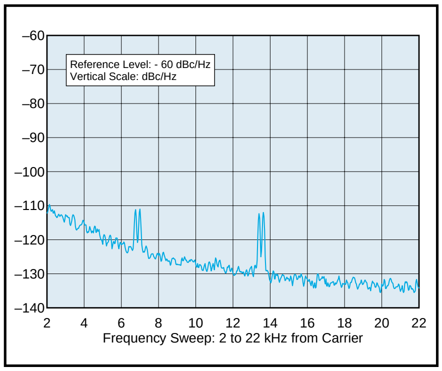


Figure 8—Worst-case spectral display of the FTV-1000 transverter's transmitter output during composite-noise testing in Class-AB mode. Power output is 200 W. The carrier, off the left edge of the plot, is not shown. This plot shows composite transmitted noise 2 to 22 kHz from the carrier.

peaks. Maximum output power in the AM mode is specified as 50 W. It's important to note that the transverter does not contain a built-in automatic antenna tuner. The FTV-1000 is designed to operate into loads that present an SWR no greater than 2.5:1.

If you want to put out a particularly clean SSB signal, you can switch the transverter into the Class-A mode (it's not necessary to select the Class-A setting on the MARK-V, as the low-level RF signal from the transceiver's transverter jack is already Class A). I have a homebrew 8877 amplifier that operates on very low levels of drive power, and I was really looking forward to trying it out in Class A. Unfortunately, the amp went up in flames a few days before I had the chance to hook it up to the FTV-1000. I do think the ability to operate in Class-A mode is a great feature for those of us who use low drive amplifiers.

Some Informal Comparisons

So how did it work? The thing works great! I set up a coax switch so that I could quickly swap my 7-element Yagi between my JST-245 and the MARK-V/FTV-1000. I aimed my antenna towards the W1RA beacon on Cape Cod.

After switching back and forth a few times, I convinced myself that there was something wrong with my '245! Listening on the MARK-V/FTV-1000, the beacon really seemed to jump up out of the noise. The S meter indication was approximately S7. When I switched the antenna over to the '245, the S meter only read about S2. (This was with the maximum amount of preamplification switched in on both radios.)

The following day I hauled the '245 into the ARRL Lab and had them check its sensitivity. With its preamp on, it measured –136 dBm. The MARK-V/FTV-1000 with both preamps selected measured –141 dBm (see Table 2).

My '245 wasn't broken—the MARK-V/FTV-1000 combination is just considerably more sensitive. The preamps don't just raise the noise floor either. On the JST I hear lots of little blips and pops from the synthesizer when I tune the band. This isn't the case with the MARK-V/FTV-1000.

I was especially enamored with the 200-W MARK-V/FTV-1000 combination after using it to blast through some tremendous 6-meter pileups with relative ease, including E3ØNA's, and many Europeans'. The extra 3-dB advantage that it gained me over the typical 100-W radios I was up against in the pileups seemed to make a noticeable difference.

Top Shelf

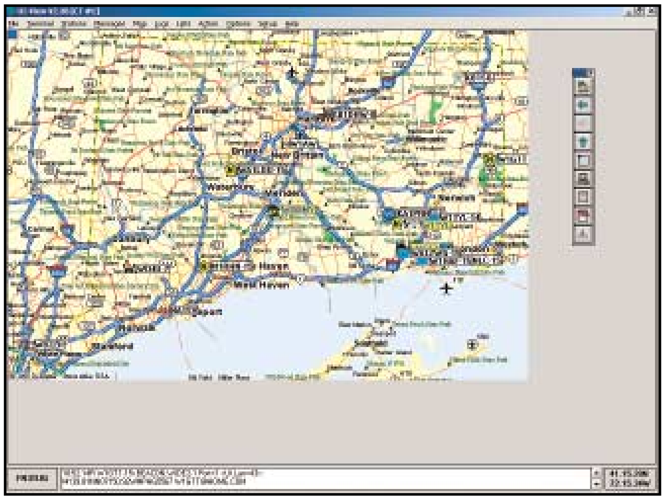
If you already own a Yaesu MARK-V FT-1000MP and want a terrific radio for 6 meters, you simply cannot go wrong with the FTV-1000. Add Yaesu's VL-1000 solid state amp, and you'll end up with a nicely integrated "plug and play" kW station for 6 meters and the HF bands.

If your main interest is 6 meters, and you don't already own a MARK-V, this combination is obviously a pricey way to go. If money is no object, though, it's certainly one of the nicer choices available.

Manufacturer: Yaesu USA, 17210 Edwards Rd, Cerritos, CA 90703; 562-404-2700; fax 562-404-1210; **www.yaesu.com**. Manufacturer's suggested list price: $1100. Typical current street price: $900. QST

SHORT TAKES

UI-View



It isn't often that you come across a piece of Amateur Radio software that is so easy and enjoyable to use. The user friendliness of *DigiPan* was largely responsible for igniting the PSK31 explosion. *UI-View* for *Windows* by Roger Barker, G4IDE, may do the same for APRS.

For those not familiar with the term, APRS is the Automatic Position Reporting System developed by Bob Bruninga, WB4APR. In its most basic form, APRS involves tracking radios that transmit data beacons. The beaconing stations use standard AX.25 packet, often at 1200 baud, to relay their latitude and longitude coordinates (many have Global Positioning System [GPS] receivers that provide accurate coordinates as their station positions change). At the receiving end, the APRS software decodes the beacon data and displays the positions as icons on a computer-generated map. As the stations move and beacon their new positions, the icons move.

During the last few years, APRS has become much more sophisticated than mere beacon tracking. APRS weather stations allow you to sample conditions at their locations. This is especially handy when severe weather strikes. "Information Kiosk" stations can be queried for various kinds of helpful data. Messages can be exchanged (some are routed through the Internet). There are APRS satellite relays such as the new PCSat…and the list goes on.

Introducing *UI-View*

What sets *UI-View* apart from other APRS applications is its versatility and ease of use. Like any complex piece of software, you should read the Help files before you begin hiking up the learning curve with *UI-View*. Even so, I found *UI-View* to be intuitive and easy to grasp.

You can start by downloading and installing the free version of *UI-View* that you'll find at **www.packetradio.org.uk/**. This version contains some basic maps, but nothing detailed—unless you happen to live in the UK. I discovered that the key to really getting the most out of *UI-View* is having a good set of local and regional map images—the kind that show details right down to street level if necessary. Many *UI-View* users capture and import maps from DeLorme's *Street Atlas* software (available for less than $30 at most retailers). You cannot zoom into map images with *UI-View*, so you need to import maps that provide the detail you need for the area you want to see. For example, there is a lot of APRS activity in Connecticut. If I used a map of New England only, the small area of the image set aside for Connecticut would quickly fill with APRS icons to the point where I couldn't separate one from the other. So, what I needed was a map of Connecticut by itself. Some users might even need maps of their hometowns for even greater "resolution." *UI-View* allows you to instantly switch from one map to another.

In Business

With the proper maps captured and loaded, I was ready to enjoy APRS with *UI-View*. You need a packet radio terminal node controller (TNC) to act as the radio "modem," and *UI-View* is set up to work with just about any TNC made. Rather than invest in a TNC, however, I opted to download the *AGWPE* software from **www.elcom.gr/sv2agw/index.html**. Created by George Rossopoulos, SV2AGW, *AGWPE* puts your computer sound card to work as a packet TNC—no external hardware required!

I installed and configured *AGWPE*, a task made easier by the fact that *UI-View* is also designed to recognize it. I tuned my FM transceiver to 144.39 MHz and within a few minutes the Connecticut map filled with APRS icons.

I clicked on a weather (WX) icon and *UI-View* obligingly opened a little window complete with the latest conditions at the station, along with a graphic showing wind direction. I clicked on the MESSAGES menu and saw a list of brief messages going back and forth among various stations. Other drop-down menus provided station lists, headings from my station and much more. After about 15 minutes I switched to the USA map and saw icons that had popped through Internet APRS gateways—such as a Weather Service special event operation in Oklahoma. When I wasn't paying attention to the monitor, I could listen to *UI-View* "announce" each new station over my computer speakers with a smooth British accent (presumably Roger's). This was fun!

Try *UI-View*

If you'd like to explore APRS, *UI-View* is one of the best software packages for the beginner as well as the advanced user. If you don't have a TNC to use with *UI-View*, try the *AGWPE* sound card software. And don't worry about owning a GPS receiver. This isn't necessary unless you intend to operate mobile.

The freeware version is bound to whet your appetite. After you've tried it, step up to the registered version, known as *UI-View32*, which offers more useful features. You can't go wrong for the $15 investment. *UI-View* will run on most PCs, even on 486DX2/66 systems running *Windows 95*.

Steve Ford, WB8IMY ▫ *QST* Editor