Product Review and Short Takes from *QST* Magazine

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Product Reviews:

ICOM IC-92AD Dual Band Handheld Transceiver

Short Takes:

MFJ-927 Remote Automatic Antenna Tuner

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PRODUCT REVIEW

ICOM IC-92AD Dual Band Handheld Transceiver

Reviewed by Gary Pearce, KN4AQ
ARRL Contributing Author

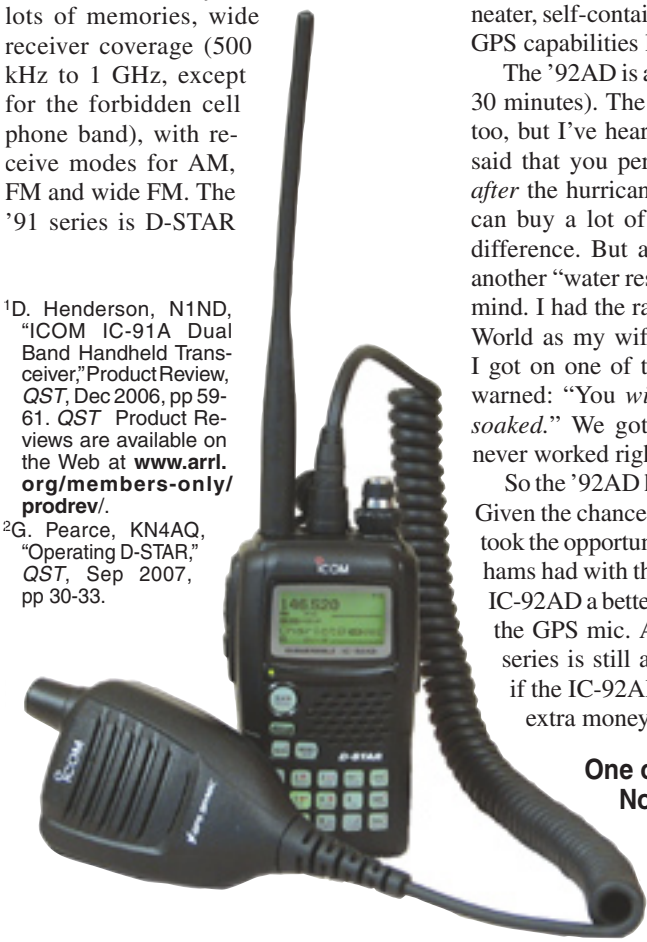
The IC-92AD came along pretty quickly as an addition to the IC-91AD, ICOM's flagship dual-display, D-STAR capable VHF-UHF handheld. The two models are so similar in form and function that you may wonder why there *is* an IC-92AD, and what justifies its higher price. I'll try to explain that. And since Dan Henderson, N1ND, reviewed the '91A model (without D-STAR) in December 2006 *QST*, I'll look at the digital capabilities of both the IC-91AD and IC-92AD.[1] For more general information on D-STAR, see my article "Operating D-STAR" in September 2007 *QST*.[2]

Both the IC-91AD and IC-92AD are very full featured dual band (144 and 440 MHz) FM handhelds. They have lots of memories, wide receiver coverage (500 kHz to 1 GHz, except for the forbidden cell phone band), with receive modes for AM, FM and wide FM. The '91 series is D-STAR optional. The '92AD is available only with D-STAR built in.

The IC-92AD exists to make emergency responders happy. It does that by having an optional GPS equipped speaker-mic. With that mic, in D-STAR digital mode, the radio can transmit the operator's position with every voice transmission as part of the data stream. And it can be set to beacon a position report at adjustable intervals, similar to APRS. If you have a second GPS equipped '92AD, or a GPS equipped ICOM IC-2820H mobile, you can use that information to show a compass bearing and distance between the radios, right on the radio's display — "He's 2.8 miles that-a-way" (Figure 1). Other D-STAR radio models can display the received coordinates numerically. The IC-91AD can be connected to an external GPS, so the '92AD with the GPS mic just makes a neater, self-contained package. More on the GPS capabilities later in the article.

The '92AD is also submersible (1 meter, 30 minutes). The Emcomm guys like that, too, but I've heard a few hams scoff. One said that you perform emergency service *after* the hurricane, not during it, and you can buy a lot of umbrellas for the price difference. But an experience I had with another "water resistant" handheld came to mind. I had the radio on my belt at Disney World as my wife Cyndi, KD4ACW, and I got on one of those water rides. A sign warned: "You *will* get wet. You *may* get *soaked*." We got soaked. That radio has never worked right since.

So the '92AD has a couple of exclusives. Given the chance for a do-over, ICOM also took the opportunity to address a few issues hams had with the '91 series and made the IC-92AD a better package, with or without the GPS mic. As this is written, the '91 series is still available. You can decide if the IC-92AD's updates are worth the extra money.



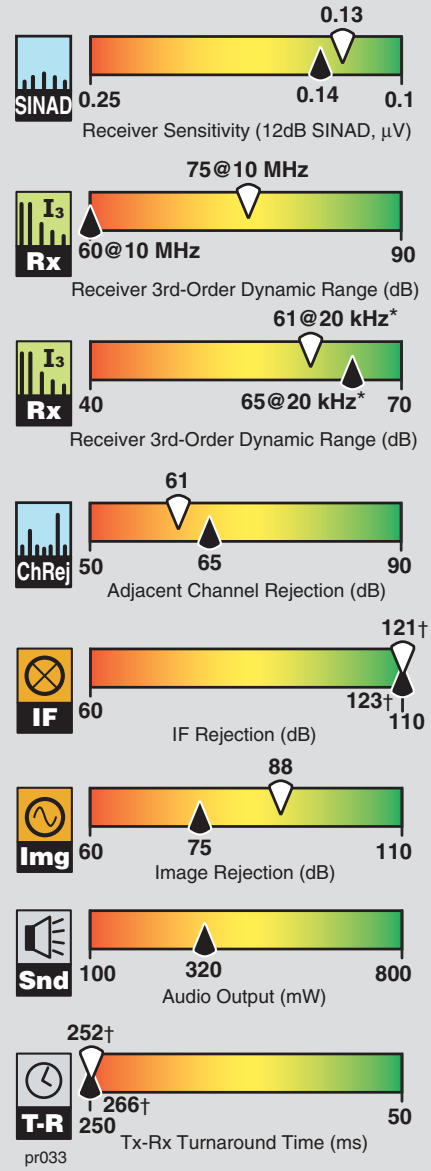
One of These Things is Not Like the Other

Most reviewers like to see how much they can make a radio do before they crack the manual.

[1]D. Henderson, N1ND, "ICOM IC-91A Dual Band Handheld Transceiver," Product Review, *QST*, Dec 2006, pp 59-61. *QST* Product Reviews are available on the Web at **www.arrl.org/members-only/prodrev/**.

[2]G. Pearce, KN4AQ, "Operating D-STAR," *QST*, Sep 2007, pp 30-33.

Key Measurements Summary



Key:
† Off Scale
*Measurement noise limited at value shown.
2 M
70 cm

See **www.arrl.org/members-only/prodrev**, "A New Look For Product Review."

Bottom Line

The IC-92AD is a very capable radio for analog and D-STAR digital VHF/UHF operation. It's expensive compared to analog-only dual-banders, and you'll need to spend some time learning the digital features. In return, D-STAR offers many capabilities not available in the analog world. If you're into emcomm or search and rescue, check out the HM-175GPS speaker/mic with a built-in GPS receiver.

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Can they turn it on, set a frequency, offset and tone, then key up a repeater and make a contact all without help? With the complexity of radios these days, that's not a given. Since I already had an IC-91AD, and the '92AD is very similar, my challenge was more like the "Game of Seven Differences" or the *Sesame Street* tune quoted in the heading for this paragraph. I went hunting for the changes. Most of the time, when I found one my reaction was, "Yes, that's better."

The very first thing I noticed was the VOLUME control, the outer ring on the dual-control shaft on the top of the radio. It rotates too easily on the '91AD, so it's easy to bump too loud or soft. The IC-92AD's control is stiffer and has detents, so it stays in place.

Ah, the humble VOLUME control. Today's diminutive dual display radios have a problem: not enough real estate on top for two VOLUME controls. One knob does double-duty, controlling both bands. That forces a choice. Do you control both bands at once? Do you only control the "Main" band? Each choice is a compromise. The '91AD and '92AD let you select either method, with options in the SET menu. The '92AD has another SET menu option labeled DIAL REPLACE. I saw that while playing the seven differences game, but didn't know what it meant until I read the manual. It lets you swap the functions of the center and ring knobs on that top shaft. This radio is nothing if not choices. Another example: Scan delays are adjustable from 2 to 20 seconds.

The DIAL REPLACE mystery prompts me to mention that the display has a fine-grain dot matrix that permits lots of real English words in the various menus (see Figure 2). DIAL REPLACE may have stumped me, but SET MODE, SCAN, DUP/TONE, DISPLAY and SOUNDS are all pretty intuitive, at least if you speak basic ICOM. I can never remember some of the more obscure abbreviations of earlier radio menus — what does 100 DT mean on my IC-W32A? And if you forget your reading glasses, the font size can be adjusted between large and small.

My next observation was that the mic connector wasn't the usual two-pin affair. It's a round, multi-pin connector, covered with a heavy rubber cap. That connector is needed for the GPS/mic, and also handles all other data and programming connections to the radio. If you have an ICOM mic from an older radio, you can get an adapter cable. The rubber cap is a little hard to put in place once popped off. It's obviously there to maintain submersibility. The rubber plug covering the dc power connector is heavy duty, too.

Physically, the '92AD is a little taller than the '91AD, and maybe a hair wider and thicker. Even so, several hams who held it said they liked the feel of the newer model. Another change is the belt clip. The IC-91AD has a very stiff, single-piece steel clip. The '92AD has a lever with a hook at the bottom that I find easier to clip to my belt single-handed.

All these discoveries came while the radio was addressing its "A" side. I tried to switch to the "B" side. Couldn't do it. ICOM swapped the functions of three main front panel buttons, but my fingers had muscle

Table 1
ICOM IC-92AD, serial number 0201019

Manufacturer's Specifications	*Measured in ARRL Lab*
Frequency coverage: Receive, 0.495-999.990 MHz (cell blocked); transmit, 144-148, 420-450 MHz.	Receive and transmit, as specified.
Modes: FM, AM (receive only), WFM (receive only), DV.	As specified
Power requirements: 10-16 V dc or specified battery pack.† Receive, 150 mA at rated output (single watch, FM), 38 mA (single watch FM power save), 220 mA (dual watch, FM/DV) with 7.4 volt battery pack. Transmit, 2.1 A (high power, 440 MHz), 0.4 A (lowest power, 144 MHz).	Receive (max vol, no signal), 180 mA; transmit (hi/med/low/s-low, with 8.2 V measured battery voltage), 144 MHz: 1.75/1.24/0.6/0.35 A; 440 MHz: 1.98/1.37/0.67/0.36 A.
Receiver	***Receiver Dynamic Testing***
AM Sensitivity: 10 dB S/N, 0.5-5 MHz, 1.3 μV, 5-30 MHz, 0.56 μV, 118-137 MHz, 0.5 μV, 222-247 MHz, 0.79 μV, 247-330 MHz, 1.0 μV.	10 dB S+N/N, 1-kHz tone, 30% mod: 1, 3.9 MHz, 0.5 μV; 14, 53 MHz, 0.34 μV; 120, 146, 440 MHz, 0.42 μV.
FM sensitivity: 12 dB SINAD, 1.6-30 MHz, 0.4 μV, 30-118 MHz, 0.25 μV, 118-174 MHz, 0.14 μV, 174-350, 470-600 MHz, 0.32 μV, 350-470 MHz, 0.16 μV, 600-999 MHz, 0.56 μV; WFM, 76-108 MHz, 1 μV, 175-222 MHz, 1.8 μV; 470-770 MHz, 2.5 μV.	For 12 dB SINAD, 29 MHz, 0.13 μV; 52 MHz, 0.17 μV; 146 MHz, 0.13 μV; 222 MHz, 0.24 μV; 440 MHz, 0.14 μV; 902 MHz, 0.26 μV; WFM, 100 MHz, 0.97 μV.
FM two-tone, third-order IMD dynamic range: Not specified.	20 kHz offset: 29 MHz, 60 dB*; 52 MHz, 59 dB; 146 MHz, 61 dB*, 222 MHz, 63 dB*; 440 MHz, 65 dB*; 902 MHz, 65 dB. 10 MHz offset: 146 MHz, 75 dB; 440 MHz, 60 dB.
FM two-tone, second-order IMD dynamic range: Not specified.	146 MHz, 62 dB.
FM adjacent-channel rejection: Not specified.	20 kHz offset: 29 MHz, 60 dB; 52 MHz, 57 dB; 146 MHz, 61 dB; 222 MHz, 60 dB; 440 MHz, 65 dB; 902 MHz, 54 dB.
Spurious response: VHF, 60 dB; UHF, 50 dB.	IF rejection, 52 MHz, 22 dB; 146 MHz, 121 dB; 440 MHz, 123 dB; 902 MHz, 110 dB; Image rejection, 52 MHz, 79 dB; 146 MHz, 88 dB; 440 MHz, 75 dB; 902 MHz, 2 dB.
Squelch sensitivity: Not specified.	At threshold, VHF, 0.1 μV; UHF, 0.13 μV.
Audio output: 200 mW at 10% THD into 8 Ω.	320 mW at 10% THD into 8 Ω.
Transmitter	***Transmitter Dynamic Testing***
Power output: VHF and UHF, 5.0/2.5/0.5/0.1 W.	With battery pack or external 13.8 V dc, VHF, 5.3/2.8/0.5 /0.1 W; UHF, 5.0/2.8/0.5/0.06 W;
Spurious signal and harmonic suppression: 60 dB	VHF, 66 dB; UHF, >70 dB. Meets FCC requirements.
Transmit-receive turnaround time (PTT release to 50% of full audio output): Not specified.	Squelch on, S9 signal, VHF, 252 ms, UHF, 266 ms.
Receive-transmit turnaround time ("tx delay"): Not specified.	VHF, 74 ms; UHF, 77 ms.
Size (height, width, depth): 4.4 × 2.3 × 1.3 inches; weight, 11.5 ounces.	
Price: IC-92AD, $580; HM-175GPS speaker/mic, $350; RS-92 software and cable, $70.	

†BP-256 battery pack (7.4 V, 1620 mAh Li-ion) and BC-167 wall charger (approx 6 hour recharge time) supplied. Available options: Replacement BP-256, $75. BC-177 desktop drop-in rapid charger (2.5 hours), $60; BP-257 battery case (2 AA cells, TX power limited to 100 mW), $30; CP-12L ($36) and CP-19R ($44) cigarette lighter cables; OPC-254L external power cable, $14.
*Measurement was noise limited at the value shown.

memory from the '91AD. Reading the labels on the '92AD solved my problem, still without resorting to the manual.

After reaching the B side, I tried DV (Digital Voice) mode to key up the local D-STAR repeater. The '91AD and '92AD do digital only on the B side of the radio (they do analog on both sides). I programmed the key call sign fields needed for local repeater use (see Figure 3; this procedure is described in more detail later). But I got nothing. Stock-from-ICOM D-STAR repeaters don't have hang-time or a courtesy beep, so it can be hard to tell if you've keyed it up. I was listening on my ID-800H base station, so I'd hear myself — and I didn't.

There are a lot of DV settings, but I was pretty sure things were right. I looked harder at the main display and noticed the tiny legend SLO in the corner. Hmmm. SLO. Slow? Something prompted me to push (and hold) the output power button. The legend changed to LOW. Okay, it's the power indicator. Another push brought MID, and another brought… a blank spot (for HIGH).

The 2.5 W Sweet Spot

The IC-92AD has four power levels — 100 mW (SLO), 500 mW, 2.5 W and 5 W. The '91AD has just the 500 mW and 5 W levels. The new radio's extra power levels address two complaints about the IC-91AD: battery life and heat. On longer transmissions at 5 W, both radios get pretty hot and uncomfortable to hold. They should. They're dissipating about 4 W, the same as one of those old, big Christmas tree light bulbs. Try wrapping your hand around one of *them* for a minute! The manual warns you about it (the radio's heat, not the Christmas light). Both radios use lithium-ion batteries that seem to give other handhelds nearly indefinite life, but the '91AD appears to chew up its battery quickly.

The IC-92AD has a somewhat higher capacity battery and marginally lower current drain. The big advantage for battery life is that 2.5 W MID power setting. It's just 3 dB down from 5 W and not very noticeable in FM (a slightly noisy signal will get a little noisier). It's not noticeable at all in DV, where signals stay "full quieting" until they're almost gone, unless you're right at that minimum signal threshold. At 2.5 W, current drain drops significantly (see Table 1). The radio gets warm, but not hot, with long transmissions. The batteries for the '91AD and '92AD are slightly different sizes so, alas, they can't share batteries or drop-in chargers.

I was successful in keying up the repeater once I raised power. My call sign and the short message I'd programmed with my name and the radio model number scrolled across my base station display. D-STAR digital sends that information with each transmission, right along with your voice.

I kept the IC-92AD turned on from 7 AM to near midnight several times, with a few short ragchews at 2.5 W, a little more listening, but mostly squelched receive. It had enough juice left for a finger-frying test of the adjustable time-out timer (set for three minutes) at 5 W before the battery indicator dropped the first of its two bars. Switching down to 2.5 W brought that bar back for many more minutes of transmitting. I never managed to kill the battery. I plugged in the charger and ticked off another little upgrade: a big CHARGING indicator on the display. The '91AD just flashes the tiny battery icon when charging.

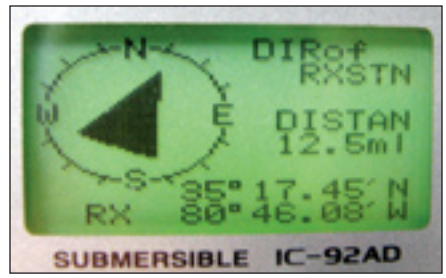


Figure 1 — The GPS compass display shows that the last reported position of the received station is 12.5 miles North-Northeast, and gives the exact latitude and longitude. As this radio moves, the direction and distance to the last received report is continuously updated.

Figure 2 — The large display and fine dot-matrix pattern allow longer words, many in something like real English.

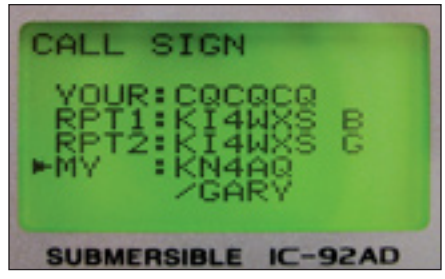


Figure 3 — These four key call sign fields (YOUR, RPT1, RPT2 and MY) are the heart of D-STAR repeater operation and routing through the Internet.

Figure 4 — The display shows many of the memory channel parameters on one screen.

Audio Reports and Memories

On the air, I asked for audio reports in both analog and digital. The first analog report was "very natural — sounds like you." But other reports weren't so flattering, especially when I offered a comparison with the '91AD and my IC-2820H mobile. The '91AD had better fidelity, with more lows and highs. The '2820H rolled off the low end and was very sharp, giving it marks for "most readable." The '92AD seemed somewhat restricted, right in the middle of the vocal spectrum. I've heard a couple of other IC-92ADs on the air, and they sounded okay to me.

I've made recordings of all three radios, in both analog and digital mode, recorded directly from the speaker jack of my ID-800H into my computer line input. You can judge for yourself by listening to the audio file, available for download from the ARRLWeb binaries page.[3]

The receive audio was reasonable for a handheld. I've seen complaints that the volume isn't loud enough, but I could hear it just fine in a car with open windows at highway speeds. I don't know what more you could ask.

Next it was time to fill up some memories with local repeaters. ICOM offers optional software and an interface cable for this, but it didn't come with the review radio so I did it manually. The big display makes this easy. It presents your options for naming and storing the memory all on the same screen (Figure 4). Tone settings are buried in another menu. And remember when turning tone on and off was simple? Now pressing the TONE button brings an endless series of options. Here's a secret: hold the TONE button and turn the top knob to move quickly forward *and backward* through the options.

An UP/DOWN, LEFT/RIGHT "rocker switch" is embedded in the keypad for navigation through the menus. That fine-grain display lets you name your memory channels with eight characters, including upper and lower case text, numbers and lots of special characters. With the radio set for single-band display, it shows both the

[3]www.arrl.org/files/qst-binaries.

frequency and your memory name. In dual-display, you choose one or the other.

Programming is easy, but with 800 memory channels on the A side, 400 more on the B side (the A and B sides are separate — they don't share memory channels), and 24 more scan-limit pairs on each side, it's going to take some time. Memory channels are especially useful for D-STAR, which I'll explain in a minute. So the software is a good investment.

There is no "national simplex channel" for D-STAR, as 146.52 MHz is for FM voice. The D-STAR community is discussing the options, and the leading contender is 145.67, but that is used for conventional packet in some areas. The UHF discussion hasn't even gotten that far.

Back to memory programming — the BANK NAME doesn't refer to the financial institution from which you obtained a loan to buy the radio (if you loaded it up with the GPS mic, software, cables, a rapid charger and extra battery, you crossed the $1000 mark a while ago). With that many memories, you need a second level of management. Both the '91AD and '92AD have 26 memory "banks," labeled A through Z. Each bank holds 100 channels. You can cherry-pick individual memory channels and place them in banks. When you select a bank, you're limiting the radio to the 100 or fewer memories in that bank for scanning or manual tuning.

Figure 5 — The HM-175GPS speaker/mic includes a GPS receiver, making a self-contained package. It's big, as shown here with a more conventional speaker/mic.

Let's Do Digital

Now I'm going to tax your ability to absorb new stuff. The details of D-STAR programming aren't easy to grasp at first. I interviewed several of the hams at the leading edge of D-STAR for my video documentary *Digital Voice for Amateur Radio*.[4] I asked each of them to demonstrate how to program a radio for the various D-STAR functions. Doing this off the cuff, each of my experts made a mistake in one detail or another. What chance do we mere mortals have?

Let's all take a deep breath and give it a try. I'm only going to touch the basics. This is a review, not an instruction manual. But I am planning on producing a short, new video that concentrates on D-STAR radio programming. The one will be free, hosted on YouTube, and it should be ready by the time this review is printed. Check my Web site **www.ARVideoNews.com**.

To describe programming, I'm going to shift perspective and write mostly in the first-person — *I* do something with *my* call sign. That's because the nomenclature of ICOM's programming is from that perspective. My call is KN4AQ. Your call is… well, you know what your call is.

Here's the key — D-STAR operation is based on call signs. There are four call sign "fields" in every D-STAR radio. What I put in those fields controls where my signal is heard.

The '91AD and '92AD present these four fields together on one screen labeled CALL SIGN (see Figure 3). The bottom field, MY, gets my call sign, KN4AQ, as long as I'm using the radio. If I hand the radio to my wife, she switches it to KD4ACW.

The top field, YOUR, is where I put your call sign if I want to talk to you. For routine, local operation on repeaters or simplex, that field holds CQCQCQ, but there are circumstances in which I'd put your individual call sign. One example is *call sign squelch*. You can tell your D-STAR radio that you only want to hear transmissions directed specifically to you — a very personal squelch control. So to open your speaker, I put your call sign in the YOUR field. Neat trick.

If you'll bear with me, I'll push that YOUR example a little further. D-STAR is a network of repeaters, linked by the Internet through Gateways — *Linux* based computers running at the repeater sites. The Gateway keeps a list of all the users who have keyed up the repeater recently, and the list is shared with other Gateways. That's part of what MYCALL is for. So if I plug your call in to my radio's YOUR field, my local repeater plays another game — a D-STAR version of *Where's Waldo?* It looks at its list to see what repeater, anywhere on the network, anywhere in the world, you keyed up last. Then it instantly routes my transmission to that repeater. I can also put a specific *repeater's* call sign in the YOUR field to "manually" route my transmission to that repeater. In that case, I'd need to precede the call sign with a "/" that says "this is a repeater call." And I'd need to include the *port letter*, which I'll explain next.

The middle two fields shown in Figure 3 are RPT1 and RPT2. RPT1 is almost always the call sign of the local repeater. In this example, it's KI4WXS in Charlotte. But notice the "B" hanging out there on the end. That's the port letter. ICOM has D-STAR repeaters for 144, 440 and 1200 MHz, and many installations have all three bands. They all share a single call sign. Since transmissions are routed by call sign, I need to enter the extra letter to specify which repeater I want my signal to reach. The convention is A for 1200 MHz, B for 440 MHz and C for 144 MHz.

The RPT2 field in Figure 3 shows KI4WXS G. The G stands for "Gateway." The current recommendation is that I leave the Gateway call sign in RPT2 pretty much all the time. When D-STAR first arrived, ICOM said to set that to "Not Use" if you weren't going to actually use the Gateway. You'll see that in the manual. That's changed, primarily to support use of a device called the DV Dongle, which lets hams access D-STAR repeaters from their home computers over the Internet. Dongle users (get over it, that's the name) can only hear stations that have the Gateway addressed in RPT2.

Now, if you think about it, you've got the potential for a lot of call sign programming. as you route your signal to specific hams around the world. Fortunately, the memory channels store the YOUR, RPT1 and RPT2 fields along with the usual frequency, offset, tone and mode. So for every combination of local repeater, distant repeater, and friend's call sign, you use a memory channel. You'll need to get creative in naming those channels.

By the way, to use a Gateway, you have to be registered. That's done locally, through

[4]S.Ford,WB8IMY, "ShortTakes — Amateur Radio Video News," *QST*, August 2008, p 64.

your repeater's *Gateway Administrator*. You'll be able to track him or her down through **dstarusers.org**.

There is news on the Gateway front. Until recently, we've all said that you can't "link" repeaters in D-STAR in the same way as IRLP and Echolink — all network communication was between individuals. Now you can, two different ways. ICOM's G2 Gateway software now permits connections between as many as 10 individual repeaters. The Administrator sets up the conference and users must put a conference name in the YOUR field. And the third-party *Dplus* program lets the Administrator connect the repeater to a conference server. Users don't have to do anything special. Everyone on all the conferenced repeaters hears everyone else.

That wasn't so hard, was it? We've still got to cover two more features, and that GPS microphone.

Figure 6 — My position, course and speed, as reported on FindU.com, courtesy of the *Dplus* program running on the Charlotte D-STAR Gateway.

Turn Up the Volume!

The last two features I'll describe are the Break-In and Emergency modes, common to the '91AD and '92AD handhelds, and the ID-800H and IC-2820H mobiles.

These transmit modes allow you to be heard by D-STAR stations who are using any of the various forms of selective squelch (call sign squelch, which I described earlier, and Digital Code Squelch (DCS), which is similar to analog's CTCSS). Just turn on BREAK-IN with a keypad button on the IC-91AD, or in a menu on the '92AD, and everyone on the channel hears you, regardless of their squelch settings.

Emergency mode is even cooler.

What do you do when a conversation on the radio interrupts something you're doing — a phone call, writing an article on your computer, sleeping…? You turn the volume down. And there it sits until you remember to turn it up again. If I activate EMERGENCY MODE (again, keypad on the '91AD, menu on the '92AD), I can reach into your radio and turn your volume back up!

I felt a little strange as I experimented with this, almost like I was dialing 911 just to see if it worked. Only problem was, it didn't work! I tried all four of my D-STAR radios. I turned their volume down, then transmitted to them with a radio in EMR. They stayed quiet. The manual was just as silent, referring to "the specified volume level" without telling me how to specify that level (or even who specifies it, because apparently it isn't me). I experimented, and only after receiving an EMR transmission with my volume up once was I able to then hear them with my volume down. After that, EMR worked every time. Try this before you rely on it!

GPS on D-STAR

The IC-92AD's GPS speaker-mic (HM-175GPS) shown in Figure 5 comes with built-in sticker shock. We're not used to paying $350 or more for a speaker/mic, but of course this one has a GPS receiver and it plugs conveniently into the radio with no adapter or power cables.

The mic is large and heavy for a handheld. It'll tug hard at the collar of your shirt if you clip it there. And GPS is its only trick. There are no up/down buttons or volume control. You might expect some extras for the price, but this mic is designed for emergency responders in the field, so KISS applies. It has one illuminated yellow button to turn the GPS on and off. That button lights up while the GPS is acquiring satellite signals and blinks when it has a lock. Under open sky, it took about a minute to lock. It took longer but did get a lock indoors in some single-story, wood-frame buildings.

I turned to the manual (for the first time!) before trying to use the GPS function. I understood the instructions up to the point of telling me to plug in the mic. Then it lost me under the heading "Sentence formatter setting." While ICOM's manuals are usually above average, they all fall short in explaining general D-STAR operation. Without some prior knowledge, they leave you hanging.

I gleaned enough from the manual to let me poke around the menus and get the GPS functions turned on in both the '92AD handheld and my IC-2820 mobile. It turns out that you need very little from the manual to get GPS data to flow between these radios and show up on the compass display that shows the direction and distance between radios (see Figure 1). And that was very cool. I was following Ken, KC4YOZ, up to the Charlotte D-STAR repeater site, and we got far enough apart that I could read his bearing and distance.

If GPS has you thinking APRS, I'll warn you that D-STAR data is not "on-air" compatible with AX.25 packet data. They're both digital, but the similarity ends there. The '91AD and '92AD *do* have D-STAR's "low speed" data capability. A 1200 bps data "signal" rides along with every voice transmission. You need a computer and another optional cable to use it — there's no access to this data via the radio's controls or display. There are several third-party programs already available for using this data stream for text messages and small file transfers, and more on the way. Again, this data is not AX.25 packet compatible.

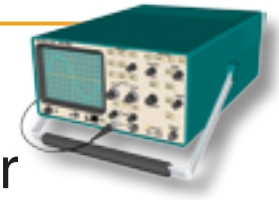
There is a bridge between D-STAR and the APRS networks. A third-party application called *Dplus* runs on the Gateway. It can pick off your GPS data and forward it to the APRS network via the Internet. Your location shows up on APRS displays, and on Internet sites like Find-U (see Figure 6). The manual falls short here. I was successful using instructions supplied by Ken, KC4YOZ. I suggest contacting your local D-STAR experts.

In Conclusion

The IC-92AD is a very capable, complete radio for analog and digital VHF/UHF operation. The only significant downsides I found are the mediocre transmit audio, the price and the complexity (you'll need some local help to get the most out if this radio). If you're into emcomm or search and rescue, the GPS mic is a great addition.

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

SHORT TAKES



MFJ-927 Remote Automatic Antenna Tuner

Last spring I was harangued into doing a long-postponed home renovation. My ham station was moved to a room more rightfully called an "office" while my teen daughter staked her claim to larger, more dignified quarters. The point of mentioning this is that the move provided an outstanding excuse to revamp my HF antenna system. After all, I had to run more coaxial cable to the office area so I might as well redo the antenna, too. (It made sense to me at the time.)

I strung a 140-foot inverted-V wire antenna through the trees and fed it in the center with 450-Ω ladder line. I didn't want to bring the ladder line all the way into the house — not when I had a nice 100-foot length of low-loss coax to do the job instead. So, for all-band operation with my shiny new antenna, I needed a remote automatic antenna tuner at the outdoor transition between the ladder line and the coax. With a remote tuner I could potentially use the dipole on every band. Yes, the SWR on the "antenna side" of the tuner would be sky high at times, but with ultra-low-loss ladder line between the tuner and the antenna, it would be of little consequence. The tuner would provide a 50-Ω match for the new coax back to the radio and all would be right with the world.

There are a number of remote antenna tuners on the market, but they tend to be expensive. In addition, many models require a separate control line, dc power line, or both. I wanted as few additional wires as possible; ideally *no wires* other than the coaxial feed line.

Enter the MFJ-927

The MFJ-927 is an automatic antenna tuner designed for remote installations. The '927 seemed attractive for my application because (1) it was affordable at $260 and (2) it required no additional wiring whatsoever.

The '927 is an RF-sensing antenna tuner, so control lines are not necessary. It senses the presence of RF on the feed line and starts tuning automatically. The MFJ-927 will begin tuning when it senses as little as 5 W output from the radio (the tuner is rated for a maximum of 200 W PEP). When you key your transceiver, the tuner's microprocessor rapidly switches through combinations of coils and capacitors as it searches for an acceptable impedance match. In my experience, the '927 found matches within about 10 seconds, often

An interior view of the MFJ-927 tuner.

less. Once a match is found for a particular frequency, the '927 stores the coil/capacitor configuration in memory. Unless you make a large change in frequency, chances are the tuner will not have to retune when you transmit again.

The MFJ-927 doesn't require a dc power line, either. It gets its dc power through the same feed line that supplies the RF. It works this bit of legerdemain through the use of a dc power inserter at your operating desk. You attach the coaxial feed line to one side of the inserter and another length of coax between the inserter and your radio. (Another line snakes from the inserter to the nearest 13.8 V dc power supply.) Thanks to a choke/capacitor circuit in the inserter, dc power travels down the coax to the tuner, but is blocked from going "backward" to your transceiver.

The remote tuner can go just about anywhere and installs in seconds. For your antenna the '927 offers two ports: an SO-239 connector for a coaxial fed antenna and a binding post for long-wire antennas. There is also a ground connection with a wing nut. I attached the ladder line between the random-wire post and the ground connection.

A Problem—and a Solution

At first the MFJ-927 worked quite well. I was able to tune my antenna to less than a 1.6:1 SWR on any frequency from 160 through 10 meters. Soon, however, I noticed that the MFJ-927 didn't seem to be storing the match configurations in its frequency memory.

I contacted MFJ and they responded immediately, suggesting that I initiate a microprocessor "self test." The procedure is described in the manual and involves removing the tuner from its case so you can access the internal switches and see the test LEDs. I ran the self test and the '927 "passed" as far as I could tell. When I put the tuner back into service, it worked perfectly! Perhaps by running the diagnostic I erased a glitch in the memory. MFJ sent a replacement tuner anyway and it performed flawlessly.

Conclusion

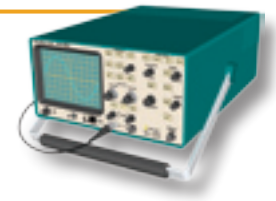
The MFJ-927 is an elegant solution to a vexing problem. It places automatic impedance matching at the antenna, and it achieves this without the hassle of having to install additional wiring. If you are going to install the '927 outdoors, I'd strongly recommend that you run a bead of silicone caulk around the case edges. It wouldn't hurt to cover the screw heads as well (you can easily remove the caulk later if necessary).

Regardless of where you install the '927, a common-made choke on the tuner end of the coax will help prevent RF from running down the cable and into your station.

Manufacturer: MFJ Enterprises, PO Box 494, Mississippi State, MS 39762; tel 800-647-1800; **www.mfjenterprises.com**. *$259.95.*

Steve Ford, WB8IMY ♦ *QST* Editor ♦ sford@arrl.org

SHORT TAKES



Byonics TinyTrak4 APRS Position Encoder

Most hams use the Automatic Position/Packet Reporting System, better known as *APRS*, as a means to track moving objects by radio. If you read the article by Bob Bruninga, WB4APR, elsewhere in this issue, you will see that the APRS network is capable of much more, including various forms of instant messaging, but tracking is by far the most popular application today.

You easily can make yourself APRS "trackable" with little more than a 2-meter FM transceiver, a Global Positioning System (GPS) receiver and a packet radio modem called a Terminal Node Controller, or *TNC*. Within minutes after firing up your equipment, your fellow hams will be able to see an icon that represents your location on their computer-generated maps.

But if all you want to do is beacon your ever-changing position to the wider world, a TNC is overkill. Instead, you can use a simpler device to transform the GPS position information into packet radio data: a *position encoder*. A basic position encoder is dedicated to the task of creating data packets and translating them into audio tones for transmission by your radio. Unlike a TNC, a position encoder only transmits; it doesn't receive. If a position encoder "listens" at all, it is only to detect activity on the frequency to avoid generating unnecessary interference.

The Byonics TinyTrak4 is one such position encoder, but it is also more — quite a bit more.

A Software Defined Device

Straight out of the box, the TinyTrak4 is an empty vessel, so to speak. The function of the device depends upon the software you load into it. You can load the Byonics software and create an advanced APRS encoder that does nifty things such as sending new position beacons when you turn a corner at a certain angle. You can even set the beacon rate to automatically increase or decrease according to how fast you are moving.

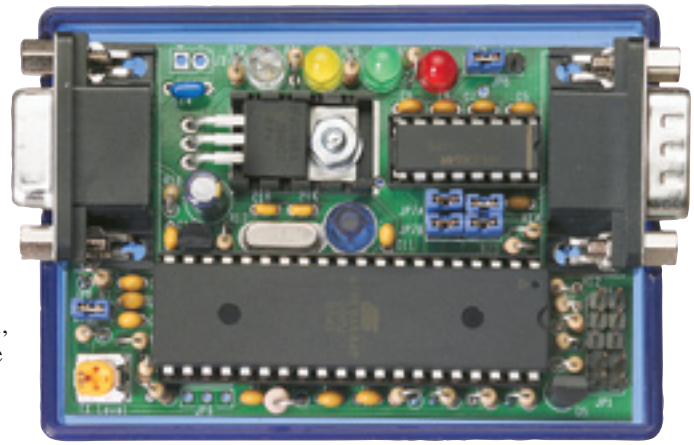
When you're ready to try something new, you can load the KISS software and turn the TinyTrak4 into a 2-way TNC that allows you to communicate on a packet network (APRS or otherwise) at 300, 1200 or 9600 baud. You can even load software that will allow the TinyTrak4 to decode DTMF (TouchTone) tones, or PSK31 transmissions.

In other words, the TinyTrak4 can become whatever you want it to be — it is just a matter of loading new instructions. The software offerings are constantly under development and the latest versions are available for free downloading on the Byonics Web site. When this review was written, the PSK31 decoding software was not yet ready, but I am particularly curious to give it a try.

Building and Testing the TinyTrak4

For this review we purchased the TinyTrak4 kit with its translucent blue case. (Built and tested units will be available soon.) The TinyTrak4 circuit board fits neatly into the case, creating a truly tiny 2 × 3 inch position encoder with DB-9 connectors at each end.

We also purchased a Byonics GPS2 receiver and a null modem adapter, which you must have to connect the TinyTrak4 to your computer for programming. Since my laptop lacked a serial port for the null modem adapter, I also had to purchase a USB-to-serial adapter.



An inside view of the TinyTrak4.

According to the instructions, it should take about an hour to build the TinyTrak4, but I required an hour and forty-five minutes. Perhaps I am just slower than normal. The components are all of the through-hole variety, but some are tiny nonetheless. A magnifying glass came in handy at times.

The "smoke test" was delightfully smoke free, but the four status LEDs were flashing in a strange left-to-right pattern. The instructions did not explain the meaning of the LED patterns, so I was left to assume the worst. Fortunately, there is an excellent TinyTrak group on Yahoo at **http://groups.yahoo.com/group/TinyTrak/**. I joined the group (it's free) and searched the messages. I quickly discovered that the TinyTrak4 ships pre-loaded with diagnostic software. Ah-hah! That explained the odd display; the TinyTrak4 was operating in diagnostic mode.

I loaded the proper firmware and was rewarded with a fully functioning position encoder — and LED activity that made sense. I immediately hooked up the Byonics GPS2 receiver and radio cable harness (also available from Byonics) to my handheld transceiver.

The TinyTrak4 worked like a champ, blasting my position data all over central Connecticut. Later I loaded the KISS TNC firmware and did a bit of two-way APRS using *UI-View* software, sending and receiving position data as well as a few text messages.

Flexible and Capable

The TinyTrak4 not only works well for APRS and other forms of packet networking, it has the potential to function in many other applications. The only caveat I can offer is that the documentation leaves a number of things unexplained, such as how to use the encoder configuration software, and this may be confusing to someone who is new to APRS in general and position encoders in particular. When in doubt, join the TinyTrak online group.

Manufacturer: Byonics, 8378 Granite Mountain Ln, Las Vegas, NV 89129; **www.byonics.com**. *TinyTrak4 kit and case: $65. Null modem adapter: $6. GPS2 receiver: $69. Radio/power cable: $19.* QST

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