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ICOM IC-820H VHF/UHF Multimode Transceiver

Azden AZ-61 6-meter FM Hand-Held Transceiver

Dunestar Model 600 Multiband Bandpass Filter

Conducted by Mark Wilson, AA2Z
Editor, *QST*

ICOM IC-820H VHF/UHF Multimode Transceiver

Reviewed by Steve Ford, WB8IMY
Assistant Managing Editor

The ICOM IC-820H is a dual-band 144/430 MHz multimode transceiver designed primarily for home-station use. In addition to the usual FM, CW and SSB modes, the IC-820H offers advanced packet features and some special satellite capabilities.

The IC-820H is impressive right out of the box. It's tiny, as multimode transceivers go. The 820H fits easily on even the smallest desktops. Weighing only 11 pounds, the 820H is almost a featherweight. I should mention, however, that the 820H does not have an internal power supply. You'll have to provide a source of 13.8 V dc at a maximum of 16 A, either from your own power supply or one of the companion ICOM units (the PS-55 or PS-30).

The front-panel layout is clean and easy to comprehend. Unlike other multimode transceivers, you're not faced with a plethora of buttons sufficient to make an airline pilot blush. Instead, the 820H provides the minimum number of controls to get the job done. In addition, a bright amber LCD display gives you all the information you need. Getting the rig on the air was so straightforward that I was able to work the local 2-meter repeater in minutes without resorting to the well-written manual.

Some buttons operate more than one function, which can be a little confusing at times. If you have experience with modern VHF/UHF mobile transceivers or H-Ts, you'll pick up the technique right away. Otherwise, some reading is in order. The front-panel controls also provide access to the 820H's 116 memories. There are 50 regular memories, along with one call and two *scan-edge* memories for each band. (When you're doing a programmed scan, the scan function sweeps between the frequencies stored in the scan-edge memories.) The 820H also provides 10 satellite memories.

There was only one sour note at the start of the review process. As I unpacked the radio, something seemed to be missing: the microphone. Did I lose it in the box? No, it simply wasn't there. To my dismay I quickly discovered that a microphone is *not* standard issue with the IC-820H. Considering the hefty price tag this radio carries, you'd think ICOM would at least include a hand-held mike. Fortunately, I own an ICOM HF transceiver and I quickly confirmed that its microphone worked with the 820H. (As this review went to press, I was advised by Chris Lougee, N7TJM, ICOM Amateur Division manager, that the possibility of including a microphone in the IC-820H was under review.)

You can use a computer to control the IC-820H if you purchase the optional CT-17 level converter, or a similar unit from other sources. I didn't have the CT-17 or the necessary software, so this function was not tested.

Dual-Band Duplex

The IC-820H achieves full-duplex operation through the use of *Main* and *Sub* bands. The rig offers two VFOs for each band. By pressing a single button, you can assign 70 cm to the Main band and 2 meters to the Sub, or vice versa. You can set the VFOs to tune in several steps, from 100 Hz to 100 kHz, in the FM mode. When operating SSB or CW, the tuning steps are 1, 10, 50 or 100 Hz. There is an RIT control, but it operates only on the Main band.

Separate **VOLUME** and **SQUELCH** controls allow you to adjust the Main and Sub audio levels to suit your needs. If you're wearing headphones, you can hear the Main band in one ear and the Sub in the other. (An internal switch allows you to mix or separate the audio channels.) Separate Main/Sub external speaker jacks are provided on the rear panel, so you can achieve the same effect without headphones.

You can transmit on the Main band while receiving on the Sub band. However, you cannot *transmit* on the Sub band. This limitation caused a problem with the 9600-bit/s PACSATs, as you'll see later.

Satellite Operation

Although the 820H boasts satellite ability, my impression is that this feature was designed as an afterthought. This is not to say that the IC-820H is a poor performer—far from it. But if you're planning to use the radio for satellite operating, you should be aware of a few quirks.

James Miller, G3RUH, was one of the first hams to evaluate an IC-820H. His review was published in the July 1994 issue of *Satellite Operator* and elsewhere. In many cases, my comments parallel his, so you'll see G3RUH referenced occasionally in this review.

In the **SATELLITE** mode, the Main and Sub band frequencies track each other, either normal or reverse. This is a terrific feature when you've working the SSB/CW transponders on satellites such as OSCAR 13 and OSCAR 20. Once you set up the dual VFO functions, a change of frequency on the Main (transmit) band causes a corresponding change on the Sub band. If you're searching through the transponder passband looking for contacts, this feature takes much of the pain out of satellite tuning.

However, once you've started a conversation, you'll need to change the transmit frequency while keeping the receive frequency the same, or vice versa, to compensate for Doppler shift. You can "untrack" the Main and Sub bands, but the procedure is clumsy to say the least! You must press and hold a button on the front panel *while adjusting the VFO knob*. I tried this first on an OSCAR 20 pass and the effect was maddening—so much so that I abandoned the **SATELLITE** mode altogether and used the "normal" mode. Yes, I lost the automatic tracking function, but it was *much* easier to adjust for Doppler shift. Of course, awkwardness is in the eye of the beholder. While I dislike this aspect of the 820H, others may see it as a convenience.

SSB and CW satellite operating through OSCAR 20 was enjoyable. Once I got used to the dual-VFO tracking, I could consistently make contacts through the bird—

The Bottom Line

The IC-820H offers plenty of features for hams looking to sample the varied and interesting 144- and 430-MHz VHF/UHF activities waiting beyond the local repeater—including SSB, CW, packet and satellites.

Table 1
ICOM IC-820H VHF/UHF Multimode Transceiver, serial no. 01333

Manufacturer's Claimed Specifications	*Measured in the ARRL Lab*
Frequency coverage: 144-148 and 430-450 MHz.	As specified.
Modes of operation: LSB, USB, CW, FM.	As specified.
Power requirement: 13.8-V dc, ±15%; 2.5 A max on receive, 16 A on transmit.	At 13.8-V dc: 1.3 A on receive (no signal, max volume); 11 A max on transmit.
Receiver	*Receiver Dynamic Testing*
SSB/CW receiver sensitivity (bandwidth not specified): 0.11 μV for 10 dB S/N (–126 dBm).	Minimum discernible signal (noise floor) with 500-Hz IF filter: 146 MHz, –145 dBm; 440 MHz, –143 dBm.
FM receiver sensitivity: 0.18 μV for 12 dB SINAD.	At 146 MHz: 0.14 μV for 12 dB SINAD; at 440 MHz, 0.17 μV for 12 dB SINAD.
Blocking dynamic range: Not specified.	Blocking dynamic range with 500-Hz IF filter:* 146 MHz, 104 dB; 440 MHz, 111 dB.
Two-tone, third-order IMD dynamic range: Not specified.	Two-tone, third-order IMD dynamic range with 500-Hz IF filter:* 146 MHz, 85 dB; 440 MHz, 81 dB.
Third-order input intercept: Not specified.	146 MHz, –17 dBm; 440 MHz, –22 dBm.
FM adjacent channel rejection: Not specified.	At 20-kHz channel spacing: 146 MHz, 64 dB; 440 MHz, 71 dB.
FM two-tone, third-order IMD dynamic range: Not specified.	20 kHz offset from 146 MHz, 80 dB; 10 MHz offset from 146 MHz, 88 dB; 20 kHz offset from 440 MHz, 72 dB.
S-meter sensitivity: Not specified.	S9 signal at 146 and 440 MHz: 4 μV.
Squelch sensitivity: At threshold, SSB/CW, <1μV; FM, <0.1 μV.	At threshold: FM, 0.06 μV; SSB/CW, 0.4 μV.
Receiver audio output: More than 2 W into 8 Ω at 10% distortion.	2.9 W into 8 Ω at 10% THD.
IF/audio response: Not specified.	At –6 dB: CW-N, 446-1007 Hz (561 Hz); CW-W, 366-2762 Hz (2396 Hz); USB, 181-2563 Hz (2382 Hz); LSB, 422-2805 Hz (2383 Hz).
Image rejection: More than 60 dB.	146 MHz, ≥78 dB; 440 MHz, ≥86 dB.
IF rejection: Not specified.	≥94 dB.
Transmitter	*Transmitter Dynamic Testing*
Power output: 144 MHz, high: FM/CW, 45 W; SSB, 35 W. 430 MHz, high: FM/CW, 40 W; SSB, 30 W. Low power: 6 W on all bands and modes.	146 MHz, high: FM/CW, 45 W; SSB, 36 W. 440 MHz, high: FM/CW, 38 W; SSB, 31 W. Low power: typically 4 W.
Spurious-signal and harmonic suppression: Better than –60 dB.	As specified. Meets FCC specifications for equipment in its power output class and frequency range.
SSB carrier suppression: More than 40 dB.	>55 dB.
Undesired sideband suppression: More than 40 dB.	>55 dB.
Third-order intermodulation distortion products: Not specified.	See Figure 1.
CW keying characteristics: Not specified.	See Figure 2.
Transmit-receive turnaround time (PTT release to 50% audio output): Not specified.	S9 signal, 38 ms.
Composite transmitted noise: Not specified	See Figure 3.
Size (height, width, depth): 3.7×9.5×9.4 inches; weight, 11 pounds.	

*Dynamic-range measurements were made at the ARRL Lab standard signal spacing of 20 kHz. Blocking dynamic range measurements were noise limited at the values shown. AGC could not be disabled.

even with only 35 W on the uplink.

FM

Remembering that you can only transmit from the Main band, FM operating is as simple as pushing the **M/S** button to select 2 meters or 70 cm, then pushing **FM/RPT** to toggle the FM mode. When you tune through a repeater subband, the 820H automatically selects the correct transmitter-offset frequency. Of course, you can change the offset at will, or program nonstandard offsets. I found the IC-820H completely flexible when it comes to repeater operating.

If the optional UT-50 module is installed, the 820H can display the frequencies of CTCSS tones on received signals. This is convenient when you want to access a repeater that's using CTCSS, but you don't know the correct tone frequency. CTCSS *encoding* is standard in the 820H.

DTMF (*touchtone*) generation requires the HM-14 microphone. Because my old ICOM mike was not equipped with a keypad, I didn't have an opportunity to test this function. (There's that missing microphone problem again!)

SSB/CW

SSB and CW operation is just as easy as FM. The rig provides a maximum RF output of 35 W on 2 meters and 30 W on 70 cm. (Minimum output levels are 6 W for both bands.) On 2 meters I'm limited to an omnidirectional antenna at home, but the power was more than sufficient to make contacts over about a 75-mile radius. On 70 cm I managed to dig out several contacts using my attic beam antenna.

An outboard amplifier and receive preamplifier would have expanded my terrestrial range considerably. External amplifiers available from a number of companies can be used with the 820H. There is no way to easily vary the RF output, though, so you need to select an amplifier that requires a compatible drive level.

The IC-820H also works with a number of receive preamps. There is a front-panel button that you can use to switch the preamp in or out of the line. It accomplishes this by switching 10-V on either the VHF or UHF antenna lines rather than a through a separate contact closure. Although this feature is convenient, some operators would prefer to switch the preamp with a separate contact closure. You can do this via the **SEND** output on the rear-panel accessory socket.

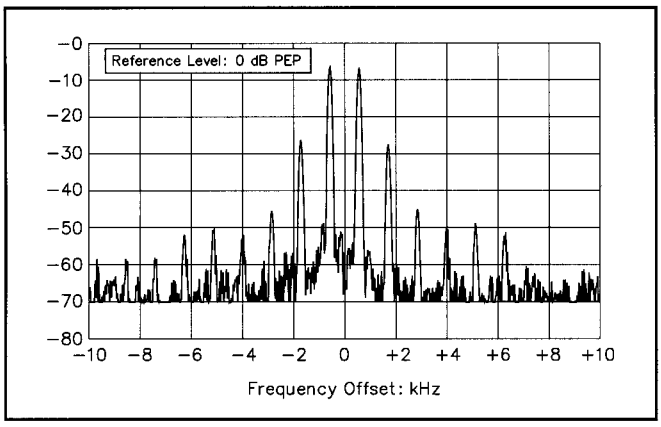


Figure 1—Worst-case spectral display of the ICOM IC-820H transmitter during two-tone intermodulation distortion (IMD) testing. Worst-case third-order product is approximately 27 dB below PEP output, and the fifth-order product is approximately 45 dB down. The transceiver was being operated at 35 W PEP output at 146 MHz.

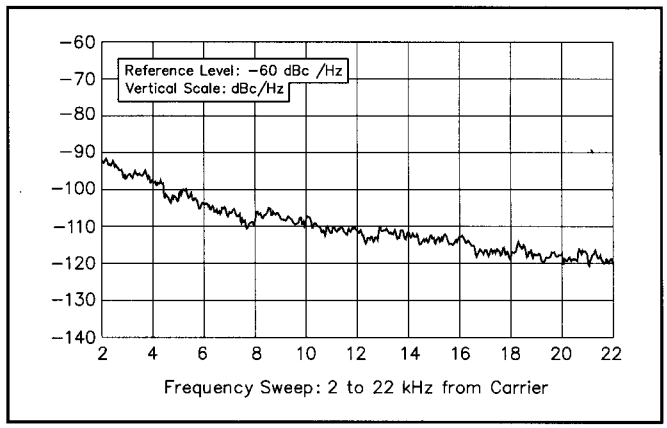
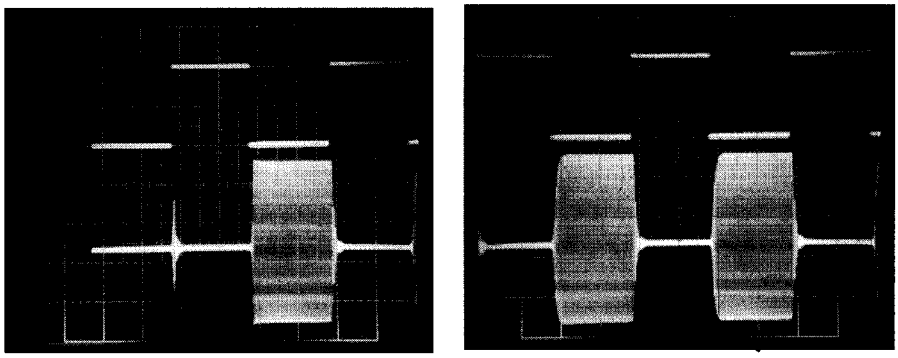


Figure 3—Spectral display of the ICOM IC-820H transmitter output during composite-noise testing. Power output is 45 W at 146 MHz. The carrier, off the left edge of the plot, is not shown. This plot shows composite transmitted noise 2 to 22 kHz from the carrier.



(A) (B)

Figure 2—CW keying waveform for the ICOM IC-820H in the semi-break-in mode. 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 44 W output at 146 MHz. The photo at A shows extreme shortening of the first transmitted character during semi-break-in operation; the photo at B shows the CW waveform with the radio locked in transmit.

The 820H's noise blanker is quite effective. I suffer from frequent pulse-type noise generated by my oil-fired furnace. The noise blanker worked wonders on this annoying signal, making SSB and CW operation much more pleasant. The AGC switch (fast or slow) is located in the same row as the noise blanker. The only disappointment for either function is that you can only control them when you're using the Main band. (AGC in the Sub band is selected automatically.)

The IC-820H's other bells and whistles include a switchable RF attenuator. This is very handy for use with a too-hot preamplifier or microwave downconverter. A speech compressor can be switched in for weak-signal work and an IF shift control is available for Main band receive.

If you live in an area where CW VHF/UHF contesting runs hot and heavy, you may want to consider the optional 500-Hz IF filter. Experienced CW operators may carp at the fact that the break-in delay and sidetone controls are on the rear panel, but this didn't present a problem for me. In any event, most hams set these controls once and then forget them.

Terrestrial Packet

For packet operating I used the IC-820H with a Kantronics KPC-9612 TNC. If you confine yourself to 1200-bit/s packet, there is little you need to do except wire the TNC's radio cable to the 820H's accessory socket. If you want to merge into the high-speed lane at 9600 bit/s, you must remove the bottom cover of the radio and search for a small slide switch labeled **AMOD** and **PACT**. In the **PACT** position, Main band receive audio is tapped at the discriminator and transmit audio goes directly to the Main band varactor. (You lose the audio from the Sub band.) I wish ICOM had placed this switch on the front panel. It would make life with the IC-820H much easier.

Operation at 1200 bit/s was a breeze, as it is with most modern transceivers. The real surprise came when I switched to 9600 bit/s. I'm skeptical of the claims of many manufacturers when it comes to 9600-bit/s plug-and-play operation, but the IC-820H blew me away! It is one of the best 9600-bit/s packet rigs I've used to date.

With the exception of my noncalibrated hearing, I lack the test equipment to adjust deviation. That's critical when you're dealing with 9600-bit/s signals. So, in perfect violation of good engineering practice, I booted up my TCP/IP software and decided to give it a try anyway. To my astonishment, I connected immediately through the local 70-cm TCP/IP node at 9600 bit/s and began transferring mail. I tried the same thing with a station much farther away and was again rewarded with success. The IC-820H seemed remarkably tolerant of my seat-of-the-pants operation. It was difficult to wean myself and return to 1200-bit/s packet with my own radios! (ARRL Lab tests of the IC-820H's 9600-bit/s performance will appear in an upcoming issue of *QST*.)

Satellite Packet

The 1200-bit/s packet satellites require you to transmit a phase-shift keying (PSK) signal on FM and receive the PSK downlink on SSB. All packet satellites uplink on 2 meters and downlink on 70 cm, in the full-duplex mode.

To set up the IC-820H you must place the internal slide switch into the **AMOD** position. (Now you understand why I wish they'd mounted this switch on the front panel.) In the **AMOD** position, the SSB receive audio from the Sub band is available at the rear accessory jack, assuming that you've changed the position of yet another internal slide switch.

I used the IC-820H with OSCAR 16 and it performed well—with one exception. As any 1200-bit/s packet satellite operator will tell you, Doppler shift on the relatively narrow 70-cm downlink signal is wicked!

You can compensate by hand, but you'll be tweaking the VFO almost constantly. The solution is to allow the TNC to make the correction through the **UP/DOWN** frequency stepping available at the radio's microphone jack. With the IC-820H, however, the minimum up/down step is 100 Hz. A 100-Hz jump is too drastic for this type of operation; 10 Hz would have been much better. My PSK satellite TNC scrambled wildly to resynchronize with the downlink every time the 820H changed frequency. During each scramble I lost data and my throughput suffered accordingly.

When I tried the 9600-bit/s packet satellites, I hit the most serious snag of all. Remember that you must set the internal slide switch to the **PACT** position for 9600-bit/s operating. But wait a minute! When you place the switch in **PACT**, you lose the receive audio from the Sub band—your 70-cm FM downlink. Instead, you get the *Main* band audio—your *uplink* channel. This won't work.

No problem, you think. You'll just flip-flop the Main and Sub bands. You can transmit on 2 meters using the Sub band and receive the 70-cm downlink on the Main band. *Wrong.* You can't transmit from the Sub band, remember?

In other words, you're stuck. You can't use the IC-820H to operate the 9600-bit/s packet satellites—at least not without a modification. G3RUH's solution was to pick off the signal from the Sub band discriminator and make it available at the rear panel. He simply attached a small shielded cable to pin 9 of IC20, the Sub receiver discriminator chip. I tried the same approach and it worked beautifully. ICOM has adopted this modification "officially" for the IC-820H and will provide the necessary details upon request.

With the modification in place, I was able to successfully work OSCARs 23 and 25. Throughput was excellent, even with my less-than-optimum antenna system. Manual tracking for Doppler shift was a bit tricky at times, but manageable.

Conclusion

ICOM's IC-820H is a serious contender for hams anxious to explore VHF/UHF activities beyond the local repeater. It excels as a terrestrial radio for FM, SSB, CW or packet. Its 9600-bit/s performance is superb. With a simple modification, the 820H is also a good way to try the packet satellites. And it's a fine starter rig for those who want to work OSCAR 13, OSCAR 20 and so on. As G3RUH has stated, though, the ICOM IC-820H won't win the hearts of serious satellite operators.

Manufacturer: ICOM America, 2380 116th Ave, Bellevue, WA 98004, tel 206-454-8155. Manufacturer's suggested retail prices: IC-820H transceiver, $1999; PS-55 power supply, $345; HM-14 hand-held microphone with DTMF keypad, $82; CT-17 level converter, $123; UT-50 CTCSS tone squelch unit, $68; FL-132 500-Hz IF filter, $96.

Azden AZ-61 6-Meter FM Hand-Held Transceiver

Reviewed by Steve Ford, WB8IMY
Assistant Managing Editor

Despite the fact that we're wallowing in the depths of a solar minimum, 6-meter activity appears to be on the rise. Codeless Technicians are the engines driving much of this band's new-found popularity. Many have grown weary of the overcrowding on 2 meters and want to explore new territory. The 6-meter band rewards the curious with coverage that's often superior to 2 meters, and occasional *sporadic E* openings that span hundreds of miles or more. If the current crop of 6-meter enthusiasts remains active for a few more years, they'll be astonished at the DX propagation they'll encounter. (Routine contacts into Europe, Africa and so on.)

Two modes enjoy the lion's share of activity on 6 meters: SSB and FM. The SSB operators usually chase exciting band openings on a variety of interesting modes, and many are heavily involved in contesting. FM operators enjoy local and regional contacts through repeaters. You'll also find them on several simplex frequencies, but mainly on 52.525 MHz. Contesting is not as popular on FM, but that's changing.

If you want the best of both worlds, a 6-meter *multimode* transceiver is ideal. It offers CW and SSB in addition to FM. But if SSB doesn't interest you, there is little reason to waste your money on a multimode when a 6-meter FM-only transceiver will do. Single-mode rigs are also easier to use.

The AZ-61

With the AZ-61, Azden brings the convenience of an H-T to the 6-meter FM world. The AZ-61 is patterned after the AZ-21A 2-meter hand-held and includes many of its features. The design is rugged, and Azden backs up the AZ-61's durability with a two-year warranty (unique in the amateur equipment market).

The Bottom Line

The AZ-61 is a dandy H-T for a band that can provide many interesting contacts, both local and—when the band is open—DX.

RF output is switchable from a hefty 5 W to only 500 mW. Considering that 6-meter repeaters are few and far between in many areas of the country, 5-W output is a necessity. Much of the H-T's bulk is comprised of a NiCd battery pack. The battery supplies up to 1.5 A when the AZ-61 is transmitting at the 5-W setting. The AZ-61 provides an automatic power-off (APO) mode to conserve battery power. When the APO is active, the radio will shut down after a preset time (10, 30, 60 or 120 minutes).

Because of the changeable nature of 6-meter propagation, your "local" coverage area can suddenly expand to hundreds of miles! In this situation it's possible for one station to key up several repeaters simultaneously on the same frequency. To reduce the headache potential, many 6-meter repeaters require you to send a subaudible *CTCSS* tone along with your primary signal. A repeater activates only when it receives the correct tone. It ignores all other signals on the input frequency.

The AZ-61 accommodates this arrangement with a flexible CTCSS encoder. You can select the tone frequency from the keyboard, or program it into any of the AZ-61's 40 memory channels. The AZ-61 also includes the ability to *decode* CTCSS

Table 2

Azden AZ-61 6-Meter FM Transceiver, serial no. 021225

Manufacturer's Specifications	*Measured in ARRL Lab*
Frequency coverage: Receive, 46-54 MHz; transmit, 50-54 MHz.	As specified.
Power requirements: 6.5-16 V dc; 150 mA max (receive); 1.5 A max (transmit).	At 13.8 V dc: 190 mA max (receive); 940 mA max (transmit).
Receiver	*Receiver Dynamic Testing*
Sensitivity: Better than 0.16 μV for 12 dB SINAD.	0.15 μV for 12 dB SINAD.
Two-tone, third-order IMD dynamic range: Not specified.	60 dB at 20-kHz spacing.
Adjacent-channel rejection: Not specified.	70 dB at 20-kHz spacing.
IF rejection: Not specified.	1st IF (16.9 MHz): 69 dB; 2nd IF (455 xkHz): >133 dB.
Image rejection: Not specified.	>50 dB.
Squelch sensitivity: 0.1 μV or less.	0.06 μV at threshold.
Audio output: ≥250 mW into 8 Ω at 10% distortion.	730 mW at 10% THD into 8 Ω.
Transmitter	*Transmitter Dynamic Testing*
Power output: High, 5 W; low, 0.5 W with external 13.8 V power source.	As specified.
Spurious signal and harmonic suppression: Equal to or better than 60 dB.	As specified. The AZ-61 meets FCC requirements for spectral purity for transmitters in its power class and frequency range.
Transmit-receive turnaround time (PTT release to 50% of full audio output): Not specified.	Squelch on or off, 240 ms.

Size (height, width, depth): 7.3×2.8×1.5 inches; weight, 1.2 pounds with BP-11 battery pack.

tones for paging. This is especially useful for emergency-response situations where whole groups of operators must be alerted at once.

A 16-button keypad on the front panel is the entry point for most programming functions. This same keypad is used for DTMF (*touchtone*) dialing when you're using an autopatch to place a telephone call through a repeater. The AZ-61 also decodes DTMF tones for paging and other applications.

Out of the Box

When I opened the AZ-61's box, I thought someone had made a mistake. The manual was labeled "AZ-21A 144 MHz FM Transceiver." No, it wasn't a mistake. Rather than provide a separate manual for the AZ-61, you're told to use the AZ-21A documentation along with a photocopied addendum sheet. This is unfortunate because it adds another layer of confusion to the task of learning a new rig. It became particularly disconcerting when I tried to use features that were available on the AZ-21A, but *not* on the AZ-61. According to Azden, a new manual was in the works at presstime. The new manual will be sent free of charge to AZ-61 owners of record.

As I removed the radio from the packing material, I was pleased to discover that Azden included a charging stand with the AZ-61. The Azden engineers must have had my clumsiness in mind. Now I could charge an H-T upright without worrying about knocking it over every other minute. When I needed to use the rig, all I'd have to do is lift it from the stand. If you want to power the AZ-61 from a source other than its batteries, a coaxial dc power jack is available on the top of the radio.

At about 1.5 pounds, the AZ-61 felt as solid as a brick. I bounced it up and down in my hands and wondered what would happen if it slipped and headed for my feet. A belt clip is included, although I wouldn't advise attaching it to the waistband of a loose pair of shorts! After connecting the oversized flexible rubber antenna, I was ready to take it on the air.

On the Air

My first impulse was to switch on the AZ-61 and dial up 52.525 MHz. As I pushed the **VFO** up/down switches, I saw the digital display read 52.520 then 52.530 MHz. Wait a minute! You mean you can't step frequencies in 5-kHz increments? Yes, you can. However, the default setting for the AZ-61 is *10*-kHz steps. I had to enter the program mode and switch it to 5 kHz. Programming the AZ-61 is relatively easy. It's just a matter of stepping through the choices until you find the one you want to modify.

After listening for a hour or so, it became apparent that 52.525 MHz was little used in my area—at least by nearby hams. When I attached an improvised 6-meter outdoor dipole, however, I heard signals from as far as 70 miles away.

The AZ-61 offers extended receive capability down to about 46 MHz. While I was hooked up to the external antenna, I set the H-T to scan from 46 to 50 MHz. After 10 minutes of listening I heard several cordless telephone conversations and a few baby monitors—including our own. I programmed our baby monitor frequency into memory and took a walk with the AZ-61. I was astonished to discover that I could hear the signal from nearly three blocks away. This demonstration renewed my appreciation of how unsecure cordless telephones, baby monitors and similar devices can be. If the AZ-61 can eavesdrop over such a wide area, who else is listening?

According to *The ARRL Repeater Directory*, there was a 6-meter FM repeater not far from my home, and I was eager to give it a try. The input frequency was at 52.050 MHz and the output was at 53.050 MHz (a 1-MHz split). I set the AZ-61 on the output frequency and toggled the transmit offset to minus (–). When I keyed the H-T, I was surprised to see that it was transmitting on 52.550 MHz, only 500 kHz below 53.050 MHz. This was understandable, however, because the most recent ARRL band plan calls for a 500-kHz input/output split for 6-meter repeaters. Obviously, the AZ-61 was set up to conform to the band plan.

For many years, the band plan called for a 1-MHz split, and this arrangement is still in use in many areas. I didn't think this would present a problem. All I had to do was enter the program mode and readjust the offset for 1 MHz. *Wrong!* The 500-kHz split is *fixed* in the AZ-61. You can't change it. The only way I could access the repeater was to program the transmit and receive frequencies into one of the memory channels and select the duplex mode. This is another area where the manual (or lack thereof) falls short. Because of my impatience, I wasted time trying to program the H-T for a 1-MHz split *before* reading the footnote on the addendum sheet ("Offset width control not available.").

Once I had the frequencies programmed into memory, the rest was simple. I was able to access the repeater and eventually received several good signal reports. Finding people to talk to wasn't easy, though. In some areas of the country (southern California, for example), 6-meter FM has a sizable following. In New England, however, 6-meter FM is not terribly popular. I had to hunt for contacts during the morning and afternoon commutes.

Speaking of commuting, I had a number of opportunities to use the AZ-61 mobile. An H-T in an automobile with a rubber-duck antenna is always the worse-case scenario. My experience with the AZ-61 was no exception. I usually received poor reports unless I happened to be on a hilltop. An external 1/4 or 5/8-wavelength mobile antenna would have made a world of difference.

The lighted LCD display was handy

when operating mobile or portable. In addition, there is a push-button **LOCK** control to prevent you from changing frequencies or other settings by accident. A similar push button controls high/low RF output. I enjoyed having RF power control on a push button rather than on the keypad. It beats fumbling for the right keypad button in the dark. An optional speaker/microphone is available for the AZ-61 and I consider it a must for convenient mobile operating. If you plan to do a lot of 6-meter FM operating from your car, consider Azden's PCS-7500H 50-W mobile transceiver.

The AZ-61 really shined when I used it with my outdoor dipole antenna at home. Not only did I make several distant simplex contacts, I also took advantage of a couple of band openings. One Saturday morning I enjoyed several contacts through a repeater 300 miles away. Not bad for 5 W and a dipole!

Conclusion

The AZ-61 was a pleasure to use, although my initial experience would have been more fun if I'd had the new manual. The radio performed well in all applications: mobile, portable and home. If you're going to explore FM simplex or work distant repeaters from your car, you'll need a power amplifier to boost the AZ-61's output to 50 W or more. An amplifier is also a good idea for home use, although you can realize the same gain by installing a beam antenna.

What surprised me most about 6-meter FM is how much fun it is. Chasing signals with the AZ-61 reminded me of 2-meter FM in the early 70s: low activity, but plenty of fascinating contacts.

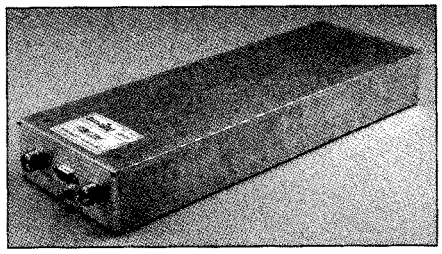
Manufacturer: Azden Corporation, 147 New Hyde Park Rd, Franklin Square, NY 11010, tel 516-328-7501. Manufacturer's suggested retail price: $379.

Dunestar Model 600 Multiband Bandpass Filter

Reviewed by R. Dean Straw, N6BV
Senior Assistant Technical Editor

The Dunestar 600 bandpass filter is an in-line filter that operates on both transmit and receive. Its primary application is reducing interference between stations operating in close proximity, at Field Day or a multitransmitter contest site. The Dunestar 600 covers 160 through 10 meters (excluding 30, 17 and 12 meters) and is rated at 200 W. Band switching is accomplished by applying 12 V dc to the appropriate pin on a DB9 connector, or by grounding the appropriate pin. You can select either option (ground-to-switch or 12 V-to-switch) with an internal jumper. An internal relay automatically bypasses the filter if you remove power or do not specifically select a band. This feature allows operation on 30, 17 and 12 meters or listening outside the ham bands without rerouting coaxial cables. The manual shows a number of possible switching configurations.

During the October 1994 CQ World-Wide Phone DX Contest, I used the Dunestar 600 in my single operator, all band, unassisted contest effort. My station consists of two ICOM IC-765 transceivers feeding separate power amplifiers. One radio is used primarily for CQing and the other for tuning for multipliers on other bands. I used a Band Decoder made by Top Ten Devices[1] to switch the filter to the correct band automatically, using data available from a jack on the IC-765's rear panel. Late in the contest, when fatigue sets in, I'm never quite sure which of the two radios I'm listening to—a problem no bandpass filter is going to solve! But not having to switch transmitter filters manually is a good step in the right direction. The highest compliment I can pay the Dunestar 600 and Top Ten Band Decoder is that they never reminded me they were in



the circuit—they just did their jobs quietly and efficiently!

My antenna system consists of eight antennas, all on a single 120-foot-high Rohn 45 tower.[2] I like to think I have one of the more efficient single-tower contesting setups around, with four stacked tribanders on 20 through 10 meters, a five-element 10-meter monoband Yagi, a three-element 40-meter Yagi and a full-sized 80-meter quad—gain on all HF contesting bands!

One drawback to using a single-tower system with two active stations is that the transmitting antenna for one station will always be physically close to the other station's receiving antenna. I eliminate fundamental overload by using simple double-tuned bandpass filters in the receivers' antenna input lines. I manually select these receiver filters, which are part of the switchbox controlling the Beverage receiving antennas. (Someday I'll automate that function too.)

However, modern no-tune solid-state transmitters also generate wideband white noise. Although it is usually suppressed well in excess of 100 dB compared to the desired fundamental signal, this wideband noise is often strong enough to affect nearby receivers, even on different frequency bands. The second receiver is affected only when it is used on a frequency lower than the cutoff frequency of the transmitter output low-pass filter, which is used only to suppress harmonics. For example, when the main transmitter is on 21 MHz, a nearby 14-MHz receiver would hear wideband noise passing through the transmitter's output low-pass filter, typically designed to cut off above 30 MHz.

Efficient external high-power bandpass filtering with a filter such as the Dunestar 600 can save the day. Since the band-pass filter must be able to withstand the full exciter power (up to about 200 W for some transceivers), the loss in the filters must be engineered to be very low, yet the attenuation to spurious energy on adjacent amateur bands should be better than about 30 to 40 dB, to ensure that wideband noise is suppressed adequately.

Band-pass filters like the Dunestar 600 can also help protect the receiver in the main transceiver from fundamental overload whenever a very close transmitter is activated on another HF band. (By the way, I can't help wondering why transceiver manufacturers themselves don't incorporate better band-pass filtering in their radios at the medium-power-level stages, after the low-level gain stages, especially for so-called "contest-grade" radios. *Sigh.*) The second-order IMD problem noted by Ulrich Rohde in a recent series of *QST* articles[3] can also be helped by such extra selectivity before the receiver front end.

One unexpected benefit of using the Dunestar 600 between the transceiver and my AL-1200 linear amplifier was that it "smoothed out" the input SWR of the amplifier on 20 meters enough to allow the transceiver to deliver full power into the amp without having to resort to using the internal antenna tuner, as I had to do previously.

[1]Top Ten Devices, 143 Camp Council Rd, Phoenixville, PA 19460; tel 610-935-2684. Price class: $100.

[2]R. Dean Straw, N6BV/1, and Fred Hoppengarten, K1VR, "Stacking Tribanders: A Super Station—Sorta," *QST*, Feb 1994, pp 38-44.

[3]Ulrich L. Rohde, KA2WEU, "Key Components of Modern Receiver Design," Part 1 in *QST*, May 1994, pp 29-32; Part 2 in *QST*, June 1994, pp 27-31; Part 3 in *QST*, Jul 1994, pp 42-45.

Table 3
Dunestar Model 600 Multiband Bandpass Filter

Manufacturer's Claimed Specifications	*Measured in the ARRL Lab*
Frequency range: 160, 80, 40, 20, 15 and 10-meter amateur bands.	As specified.
Power requirement: 12 V dc, 100 mA max.	12 V dc at 84 mA. Unit switches at less than 8 V.
Insertion loss: Not specified.	At band center: 160 m, 1.1 dB; 80 m, 0.8 dB; 40 m, 0.5 dB; 20 m, 0.6 dB; 15/10 m, 0.7 dB.
Power rating: 200 W in intermittent operation.	As specified. See text.

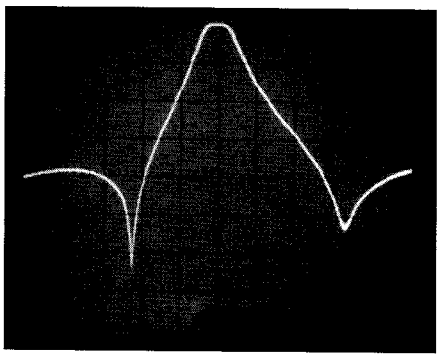


Figure 4—Dunestar 600 filter response, centered on the 20-meter band. Horizontal divisions are 2 MHz, and vertical divisions are 10 dB. The filter's center frequency is 14.205 MHz, and its –3 dB points are 13.375 and 15.079 MHz.

Lab Testing

We started this review with a Dunestar 505 band-pass filter, which covered 80 through 10 meters and was rated at 150 W. During testing, the unit failed on 10 meters during intermittent use at 100 W. We also heard reports of 10-meter failures from other contest operators. Lab investigation revealed that the 505's mica capacitors have insufficient current ratings for this service. We retrofitted our 505 with a series/parallel combination of capacitors to increase the current handling capability and solved the problem.

In discussing the situation with Dunestar, we learned that they had identified the problem and made the necessary design changes to solve it, but that they were getting ready to introduce a new, improved, model—the 600. Improvements in the 600 include the use of NP0 ceramic capacitors instead of mica (with multiple parallel capacitors where necessary) to improve current handling, air-core inductors instead of toroids, and a change in 10- and 15-meter components to improve the Q. The 600's cabinet is longer than the 505's to accommodate the larger air-core inductors.

Our 600 fared well in our power testing. According to the manual, the filter is rated for 200 W, but not at continuous duty. We performed several tests, with the test frequency set to mid-band and the filter output connected to a 50-Ω load. First, to mimic typical on-the-air contest operation, we tested it at 125 W at a 50% duty cycle for 10 minutes and observed no problems on any band. Next we increased power to 200 W and reduced the duty cycle to 20%. Again, no failures after 10 minutes, but the coils were warm to the touch on several bands. We then tried 200 W at 40% duty cycle for 10 minutes. This time, a capacitor failed in the 10-meter filter near the beginning of the test and in the 20-meter filter after 7 minutes. Dunestar promptly shipped replacement capacitors. Dunestar says that the 600 will handle 200 W, but is not intended for continuous duty at that power level. They mean it. The filter works just fine during typical SSB/CW operation at the usual 100 to 150-W power levels.

Consistent with its intended use in Field Day or contest stations, the filter response favors the CW part of the bands and, in the wider bands, the low end of the phone band. With a 50-Ω load connected to the output, the filter's SWR is 1:1 across the 40, 20 and 15-meter bands. On 160 meters, the SWR is about 1.3:1 at 1.8 and 1.9 MHz, but rises sharply to 5.7:1 at 2 MHz. On 80 meters, the SWR is 1:1 at 3.5 and 3.75 MHz, but rises sharply to 5.5:1 at the top of the band. And on 10 meters, it's 1.2:1 at 28 MHz, 1:1 at 28.8 MHz, and 3.6:1 at 29.7 MHz. Figure 4 shows the Dunestar 600's 20-meter filter response.

Conclusion

So, did I have any interference between the main and multiplier radios during the contest? None whatsoever, unless of course I tuned to a harmonic of the CQing transmitter. (On the SSB subbands this was not the same sort of problem as it is on CW. Besides, a band-pass filter at the transceiver output is not going to have much effect on the level of harmonics generated by the linear amplifier.)

Before using the Dunestar, I had heard loud switching transients in the second receiver when the CQing transceiver/linear first went on line. With the Dunestar 600 in the line, these loud clicks were gone. The Dunestar 600 does what it is advertised to do, and with the automatic bandswitching afforded by the Top Ten Devices Band Decoder, its operation is transparent.

Manufacturer: Dunestar Systems, PO Box 37, St. Helens, OR 97051; tel/fax 503-397-2918. Manufacturer's suggested retail price: $229.

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