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Alinco DX-77T MF/HF Transceiver

Autek Research RF5 VHF Analyst

Product Review

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Alinco DX-77T MF/HF Transceiver

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With improvements in propagation on the HF bands over the last few months, stories of wide-open bands and easy DX are rapidly spreading. If you're a newcomer looking to join the fun without cleaning out the bank account, upgrading from "hollow state," or are just considering a new or second HF radio for your shack (or at that second QTH in the woods), the Alinco DX-77T may be just the ticket. Here's an economical HF box in the $1000 price category that won't take up a lot of space on the operating desk but still has plenty to offer.

Already known for its VHF and UHF products, Alinco entered the HF market in 1995 with the release of the DX-70T. This compact HF-plus-6 meters transceiver proved to be a popular choice for mobile, home station, and portable operation. A subsequent model, the DX-70TH, offered 100 W on 6 meters. With the introduction of the DX-77T, Alinco now adds a somewhat larger HF-only transceiver to their lineup.

What's it Got?

The DX-77T is a 100 W output SSB, CW, FM and 40 W AM transceiver that covers 160 through 10 meters and includes 0.5 to 30 MHz general-coverage receiving capability. It features dual VFOs, split operation, 100 memory channels, band stacking registers, a speech processor, IF shift, multiple scan options, computer controllability, and a front-facing speaker. But wait! A built-in CW keyer, 500Hz CW filter, and menu selectable CTCSS encode for 10-meter FM repeater operation also are all standard features (in the US version). In comparison, setting CTCSS tones in the DX-70T required setting DIP switches, and the earlier radio had no CW keyer.

While Alinco has managed to pack in some very nice capabilities, they've also kept the front panel surprisingly simple and functional, with just a few large buttons and knobs and bold, bright labels. Physically larger than the current crop of subcompact base/mobile type HF transceivers on the market the DX-77T is a more convenient size for desktop or portable operation. Many users will welcome the generous dimensions. You could almost operate this radio with oven mitts on!

Although it's on the small side, the busy LCD display offers good contrast and easy readability. Backlighting is adjustable to five brightness levels (or off altogether). In addition to the operating frequency, the window displays icons for mode, noise blanker, AGC slow or fast (AGC cannot be disabled), memory number, VFO A and B, split, narrow CW filter, CTCSS tone state, RIT offset and low power. A four-section readout indicates the state of the two-stage attenuator/normal/or 10-dB preamplifier RF gain level. An LCD bargraph-type S meter indicates relative power output on transmit.

Up Front

The front panel sports 14 buttons and four knobs, with one concentric control. The all-mode **SQUELCH** and **AF GAIN** controls are huge by today's standards, almost $^5/_8$ inch in diameter! The **RIT** and **IF** shift knobs are a concentric pair, mounted in the upper right corner. Center detents in their travel indicate zero settings, with RIT adjustable to approximately ±1.0 kHz. The RIT function is always available—there's no way to clear it or turn it off. Some users might find this a disadvantage.

BOTTOM LINE

A $1000-class desktop radio, the DX-77T is easy to use and a moderately good performer with some nice features you wouldn't typically expect at this price.

The large main tuning knob spins smoothly (some users thought a little *too* easily, however), is lightly weighted, and includes a finger dimple. The tuning rate is fixed at 2 kHz per knob revolution for SSB/CW and 10 kHz per revolution for FM/AM. A **DIAL LOCK** button is located to the lower right of the main knob. For large changes in frequency, the **SELECT** button used in conjunction with the front panel **UP** and **DOWN** buttons allows stepping through the band registers and memory channels, or frequency changes in 1 MHz or 100 kHz steps. Smaller mode-related step sizes are selectable in the set mode. A small front-facing speaker sends the audio in the right direction, a very nice arrangement. A jack for an 8-pin microphone connection and 3.5-mm jacks for an external key or paddles, an external speaker, and headphones are mounted along the bottom of the speaker grille.

The **POWER ON/OFF** switch is a large yellow push button located in the top left corner. Side-by-side green and red LEDs just to the left of the display window indicate transmit or receive, with the green LED showing received signal, and the red showing transmit, with increasing brightness on ALC peaks. Four large, black, rectangular buttons form a vertical row to the left of the main tuning knob. Side-by-side white and light green legends above each button indicate their primary and sec-

Table 1
Alinco DX-77T, serial number T000528

Manufacturer's Claimed Specifications	*Measured in the ARRL Lab*
Frequency coverage: Receive, 0.5 to 30 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 MHz.	As specified.
Size (height, width, depth): 3.9×9.7×10.5 inches; weight, 8.4 pounds.	
Power requirement: Receive, 1.1 A (max); transmit, 20 A (max).	Receive, 0.8 A; transmit, 16 A. Tested at 13.8 V.
Modes of operation: SSB, CW, AM, FM, WBFM.	As specified.
Receiver	*Receiver Dynamic Testing*
SSB/CW sensitivity, bandwidth not specified: 0.5-1.8 MHz, –107 dBm; 1.8-30 MHz, –119 dBm.	Minimum discernible signal (noise floor), 500 Hz filter: *Preamp off* / *Preamp on* 1.0 MHz: –127 dBm / –129 dBm 3.5 MHz: –132 dBm / –140 dBm 14 MHz: –130 dBm / –136 dBm
AM sensitivity, 10 dB S/N: 0.5-1.8 MHz, 10 μV; 1.8-30 MHz, 2 μV.	10 dB (S+N)/N, 1-kHz tone, 30fi modulation: *Preamp off* / *Preamp on* 1.0 MHz: 3.2 μV / 1.9 μV 3.8 MHz: 1.4 μV / 0.6 μV
FM sensitivity, 12 dB SINAD: 0.5 μV.	For 12 dB SINAD: *Preamp off* / *Preamp on* 29 MHz: 0.7 μV / 0.2 μV
Blocking dynamic range: Not specified.	Blocking dynamic range, 500 Hz filter: *Preamp off* / *Preamp on* 3.5 MHz: 109 dB* / 110 dB* 14 MHz: 111 dB* / 112 dB*
Two-tone, third-order IMD dynamic range: Not specified.	Two-tone, third-order IMD dynamic range, 500 Hz filter: *Preamp off* / *Preamp on* 3.5 MHz: 92 dB* / 93 dB* 14 MHz: 94 dB* / 95 dB*
Third-order intercept: Not specified.	*Preamp off* / *Preamp on*† 3.5 MHz: +12.6 dBm / +4.5 dBm 14 MHz: +17.3 dBm / +9.5 dBm
Second-order intercept: Not specified.	Preamp off, +53 dBm; preamp on, +51.5 dBm.
FM adjacent channel rejection: Not specified.	29 MHz: 60 dB, at 20 kHz channel spacing, preamp on.
FM two-tone, third-order IMD dynamic range: Not specified.	29 MHz: 63 dB* at 20 kHz channel spacing, preamp on.
S-meter sensitivity: Not specified.	S9 signal at 14.2 MHz: preamp off, 36 μV; preamp on, 16 μV.
Squelch sensitivity: Not specified.	At threshold, preamp on: SSB, 14 MHz, 1.0 μV; FM, 29 MHz, 0.1 μV.
Receiver audio output: 2 W at 10% THD into 8 Ω.	2.1 W at 10% THD into 8 Ω.
IF/audio response: Not specified.	Range at –6dB points, (bandwidth): CW-N (500 Hz filter): 525-1027 Hz (500 Hz); CW-W: 150- 2288 Hz (2138 Hz); USB-W: 216-2977 Hz (2761 Hz); LSB-W: 186-2834 Hz (2648 Hz); AM: 146-2894 Hz (2748 Hz).
Spurious and image rejection: 70 dB.	First IF rejection, 114 dB; image rejection, 104 dB.
Transmitter	*Transmitter Dynamic Testing*
Power output: SSB, CW, FM: 100 W high, ≈10 W low; AM, 40 W high, ≈4 W low.	CW, SSB, FM, typically 106 W high, 11 W low; AM, typically 42 W high, 6 W low.
Spurious-signal and harmonic suppression: 50 dB (45 dB on 30 M).	52 dB. Meets FCC requirements for spectral purity for equipment in its power output class and frequency range.
SSB carrier suppression: 40 dB.	As specified.
Undesired sideband suppression: 50 dB.	As specified. >60 dB.
Third-order intermodulation distortion (IMD) products: Not specified.	See Figure 1.
CW keyer speed range: Not specified.	6 to 49 WPM.
CW keying characteristics: Not specified.	See Figure 2.
Transmit-receive turn-around time (PTT release to 50 % audio output): Not specified.	S9 signal, 19 ms.
Receive-transmit turn-around time (tx delay): Not specified.	SSB, 20 ms; FM, 8 ms. Unit is suitable for use on AMTOR.
Composite transmitted noise: Not specified.	See Figure 3.

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

∗Measurement was noise-limited at the value indicated.
†Third-order intercept was determined using S5 reference.

ondary functions. The top button in this row serves as a function button, allowing access to the secondary functions and the set mode. The lower three buttons control various memory, VFO and scan features. There's a second set of six buttons in two horizontal rows to the right of the main tuning knob. The top row contains single function buttons for **SELECT**, **MODE**, and **TUNE** (for use with an external automatic tuner). The second row are dual function buttons: **RF/FILTER** for RF gain level and CW filter, **NB/AGC** for noise blanker and automatic gain control fast or slow and **H/L/TONE** for power output level and CTCSS tone. All ten buttons also provide access to set mode controls, including the speech processor, display brightness, automatic LSB/USB selection, transmit inhibit, the step size of the **UP/DOWN** buttons, and several additional settings related to CW keyer and scan operations. A one page "Controls Quick Reference" table in the manual gives a description of the functions performed by each of these ten buttons in their primary, secondary and set mode applications. New users will definitely want to photocopy this chart and keep it handy. The only part about using this radio that can be confusing—at least at first—is that

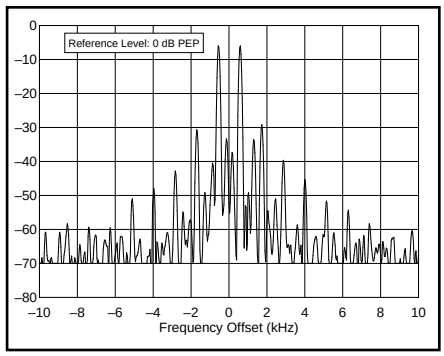


Figure 1—Worst-case spectral display of the Alinco DX-77T transmitter during two-tone intermodulation distortion (IMD) testing. The worse-case third-order product is approximately 30 dB below PEP output, and the worse-case fifth-order product is approximately 41 dB down. The transceiver was being operated at 100 W output at 21.250 MHz.

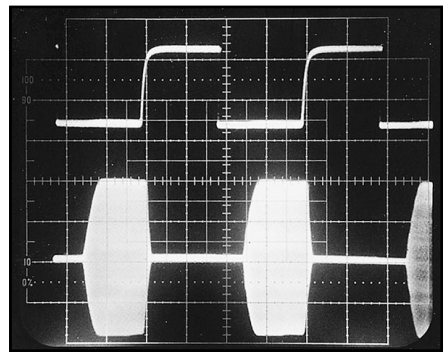


Figure 2—The default CW keying waveform for the Alinco DX-77T showing the first two dits in full-break-in (QSK) mode using external keying. The equivalent keying speed is 60 wpm. The upper trace is the actual key closure; the lower trace is the RF envelope. Horizontal divisions are 10 ms. The transceiver was being operated at 100 W output at 14.2 MHz. This is excellent keying. The waveform was nearly identical using semi-break-in mode with the "auto" delay feature.

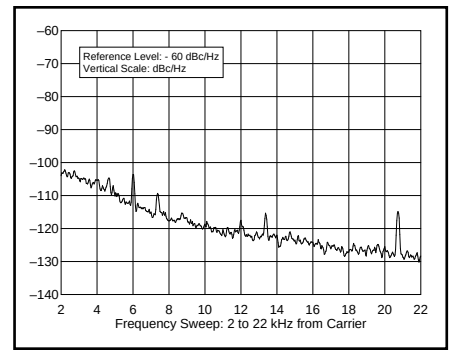


Figure 3—Worst-case tested spectral display of the Alinco DX-77T transmitter output during composite-noise testing. Power output is 100 W at 3.5 MHz. The carrier, off the left edge of the plot, is not shown. This plot shows composite transmitted noise 2 to 22 kHz from the carrier.

you won't find the set mode functions all in one place. Once you enter set mode, you'll have to push different buttons to access different "menu" items. There's a certain logic to it, however, and after a while, you will remember which settings reside behind which buttons on the front panel.

To the Rear!

The back panel has jacks for connection of the required external 13.8 V dc, 20A power supply, an SO-239 antenna connection, and an attachment point for station ground. RCA (phono) jacks for amplifier relay and ALC controls, a five-conductor connector for control of an external automatic antenna tuner, and a 3.5 mm **REMOTE** jack for the optional Alinco ERW-4 computer-control interface also are included. This **REMOTE** jack allows memory cloning between two DX-77Ts. Simply connect the two radios with a length of cable with stereo 3.5-mm plugs on either end and activate the clone feature.

Alinco says memory programming and remote control are on the horizon for the DX-77T. The software has not yet been developed, however. The control is via a serial port connection directly from the computer's COM port to the stereo **REMOTE** jack on the rear panel (Alinco supplies the ERW-4 cable as an option). With suitable software, a user will be able to set and control most of the radio's features including transmit and receive frequencies, output power, scanning start and stop, priority, split, mode, RF gain, AGC speed, noise blanker, CTCSS encoder, tune mode, filter, and various menu functions. The transceiver can report out its S meter reading, PTT status, squelch status, RIT status, memory channel information, split mode, and VFO or memory mode.

Attachment of equipment for operating the digital modes (RTTY, PACTOR, AMTOR, etc.) is via the front panel microphone connector. Alinco thoughtfully includes fixed-level audio at this connector for easy hookup. The manual includes a microphone wiring diagram. Two holes for mounting bracket hardware are on each side of the cabinet, although no mobile mounting bracket is currently available from Alinco.

On the Air!

Operating the DX-77T is fairly simple. A few seconds spent looking over the front panel and a quick glance at the aforementioned "Quick Reference" table should be enough to get most operators up and running. Once you have a feel for the interaction between the **SELECT** and **UP**/**DOWN** buttons, moving between frequencies, bands, or memory channels is easy. Major controls on this transceiver are very conveniently located, especially for right handers.

Voice operation is a simple matter of selecting the mode with a few presses of the **MODE** button (the DX-77T steps through its modes), tuning to the desired frequency, setting the volume and squelch levels, and away you go! Power output level is limited to two levels: high power is 100 W output; low power is 10 W output (an internal switch allows switching these to 50 W and 5 W respectively).

The microphone gain level is factory set. Those needing to make adjustments for their individual voice characteristics will find the location of and adjustment procedures for an internal mike gain control in the manual's maintenance chapter, but this probably will not be necessary. Our reviewers reported very good to excellent transmit audio reports with the included mobile microphone at the factory gain setting. While this radio has an audio-level speech processor, it does not have VOX.

Receive audio reports were mixed. The included speaker is considerably smaller than the front-panel grille would suggest. Most reviewers felt that with the internal speaker, the audio was somewhat tinny-sounding. Predictably, using a larger external speaker helped quite a bit. Alinco located the external speaker jack on the front panel. While this may be convenient in some situations, for most station arrangements the rear panel would be a better site for this jack. Maybe an additional jack on the back would provide the ultimate solution.

We had complained some about the effectiveness of the noise blanker in the DX-70T. Apparently, Alinco listened and made the noise blanker in the DX-77T pretty aggressive. It works quite well on a variety of pulse-type interference—such as ignition noise—but it can impart some distortion to received signals under certain band or noise conditions. Overall, though, it will be an acceptable tradeoff for most users, we believe.

Several features on this transceiver make the DX-77T a good choice for the CW operator. For starters, one of the most desirable CW options, a 500-Hz CW filter, already is installed! We peeked inside and were pleased to find a real crystal filter, too, not a ceramic job like the one in the DX-70T. You can opt to receive CW signals on either side of zero beat—CWU or CWL. This can help fight interference that might be on one side or the other of the station you're trying to copy. You can zero beat a CW signal either by matching its tone in the CWU and CWL modes, or by a feature that allows matching the received signal's pitch to that of the CW sidetone. Using the set mode, it's possible to set the sidetone pitch anywhere between 400 Hz and 1000 Hz in 50 Hz increments.

The **IF** shift control allows minor changes in the position of the IF filter's passband—always an excellent feature for digging out weak signals under crowded band conditions.

Radios in this price class typically don't include built-in CW keyers, so it was a pleasant surprise to find one in the DX-77T. Nice going, Alinco! The keyer in this radio will generate code at between 6 and 50 words per minute, and it can operate fully automatic (iambic) as well as semi-automatic (bug

style). Operation with a straight key, of course, is also possible. Whether you are connecting a straight key or a set of paddles, you must use a stereo type plug in the key jack. Pay close attention to the paddle wiring arrangement. The dot-and-dash connections are opposite to those found as the default settings on radios from other manufacturers (ie, Kenwood, ICOM, and Yaesu), and you can't change this via the menu, as some radios let you do for "left-hand" and "right-hand" paddles.

Transmit-receive switching for CW can be set to operate full-break-in, semi-break-in (adjustable to seven different delay times), or auto break-in, which will automatically adjust the delay time for the keying speed being used.

The DX-77T was a pleasure to use on CW. With its wide range of interference-fighting capabilities, built-in electronic keyer, and smooth, multi-adjustable QSK, it earned high marks from our reviewers. Entry-class radios with built-in CW features like these could potentially put a dent in the sales of computer-generated CW practice programs!

Shortwave and AM broadcast performance also was quite decent. You can select an 8 or 2.7-kHz AM filter bandwidth, and AM tuning step sizes of 1.0, 2.5, 5.0, 9.0 or 10 kHz for the front panel or microphone **UP**/**DOWN** buttons, and scan modes make cruising for new stations easy. With the radio's 100 memory channels, you can program lots of these and still have plenty left for your 10-meter FM repeaters and other favorite ham frequencies.

A few words on our Lab testing results (see Table 1): The DX-77T stacked up pretty nicely with other transceivers in the same general price category. Dynamic range is always an important consideration. The higher the numbers, the better the receiver's ability to hear a desired signal without being adversely affected by strong, neighboring signals (usually exhibited by AGC pumping). In this instance, the DX-77T's two-tone, third-order IMD dynamic range numbers showed up in the low to mid 90s—several dB better than we measured in the ICOM 706MkII (see "Product Review," *QST*, Jan 1998), the Ten-Tec Scout (see "Product Review," *QST*, Dec 1993), or the Kenwood TS-50S (see "Product Review," *QST*, Sep 1993). In the IC-706MkII and the DX-77T, however, the level of measurement was limited by the transceiver's phase noise, although the worst-case phase noise on the DX-77T was still an improvement over what we observed on our IC-706MkII.

The DX-77T's receiver is not quite as sensitive as the ICOM or the Kenwood, however, and this results in third-order intercept calculations well into the positive numbers, preamp off or on.

Just a DX-70T in a New Box?

We had first suspected the DX-77T was just a DX-70T in a desktop box. The familiar display window and the same integrated PA-heatsink/rear panel as those on the DX-70 fueled speculation that Alinco had just stripped off 6 meters and repackaged their previous HF offering. Inquiring minds want to know!

A quick trip across the parking lot to liberate a DX-70T from one of W1AW's guest operating positions, and it was back to the lab for a closer internal investigation. A few minutes with a screwdriver revealed the truth. While it seems these radios share some of the PA components and the LCD display, none of the internal boards was common to both transceivers. Those who do choose to take a look inside will be amazed at the amount of unused space in the DX-77T cabinet!

Modern RF engineering techniques and miniaturized components have distilled the amount of actual volume necessary to support the long list of capabilities this transceiver provides to an unbelievably small level. A telephone answering machine of just a few years ago would contain twice the volume of electronics! Lab types gathered round and proposed various opinions on how best to occupy the vacant areas of its internal cavity (battery packs for portable QRP operation, home brew auto antenna tuners, switching power supplies, transverters, etc).

So, while it was clear that the DX-77T has borrowed freely from its older sibling, it's not really the same radio when you look under the hood. Also, as we've pointed out, it offers some features the DX-70T does not. In addition, it provides a rich computer-control interface that was not available on the DX-70T.

Read All About It

The *Instruction Manual* is excellent—an improvement from earlier Alinco books, and generating comments from the reviewers like "maybe Alinco's best yet" and "obviously written by hams." It's easy to follow and includes lots of illustrations. A well-organized table of contents, a "How to Use this Manual" page with a black page-edge tab arrangement for quickly locating specific topics, and a complete index make locating desired information a snap. Most of the sections on major operating parameters include a short introduction and explanation of the particular topic, plus step-by-step examples to help you along. This is a real boon to beginners.

In addition to clear, concise instructions for operating the transceiver, the manual includes several "tutorials" that give tips to optimize performance in the radio's various modes. Newcomers also will find these a welcome addition to the traditional manual fare. A maintenance chapter describes the location and adjustment of the internal controls for microphone gain, the 100 W/50 W maximum output switch, and CW sidetone and key activation "beep" volume. The frequency calibration procedure appears as well.

Connection diagrams for Alinco's optional EDX-1 manual or EDX-2 automatic antenna tuner also are shown, as well as wiring instructions for Kenwood's AT-300 and ICOM's AH-3 tuner units! A complete—though somewhat difficult to read—schematic is included. While you will find some typographical errors in the manual, they are very minor and don't distract from the content.

Consensus

The overall impression of those who got to play with the Alinco DX-77T was that it's a terrific "first steps" radio or a fine second radio. Indeed, some may find it a great "main" radio. It's less adaptable to mobile use than some of the other offerings already on the market, but it's not very large nor very heavy, so it's good choice for portable use.

The inclusion of a CW keyer and a decent narrow CW filter plus speech processing (even though it's at audio) make this a slightly better than just the plain-vanilla starter boxes available just a few years ago.

Some users felt that including a built-in ac power supply would make the DX-77T a killer product—sort of the latter-day equivalent of the Heath HW-16.

With the long list of features already included in the DX-77T, first-time buyers may be curious as to what additional capabilities they would find in the next step up. Several other manufacturers offer mid-level radios for an added investment of $400 to $600. These may include items such as built-in automatic antenna tuners, digital signal processing (DSP), SWR metering, CW message memories, voice operated transmit (VOX), remotable faceplates, and additional IF filtering capabilities. In addition, manufacturers will usually include a few interesting extended features that may be unique to their products. While these certainly may be desirable, none classifies as an absolute necessity for effective communications.

We also were pleased to report that everything worked the first time on our DX-77T, and that we did not encounter any situations where our unit failed to meet its published specifications or where it was seriously on the hairy edge of not meeting them. This increases our confidence in Alinco's ability to turn out a radio that you won't have to send back to the factory when it doesn't work as advertised. Other manufacturers should take notice.

Thanks to Dan Miller, K3UFG, Rick Lindquist, N1RL, and Mike Tracy, KC1SX, and Ed Hare, W1RFI of the ARRL Lab for their contributions to this review.

Manufacturer: Alinco USA, 438 Amapola Ave, Suite 130, Torrance, CA 90501; tel 310-618-8616; fax 310-618-8758; **http://www.alinco.com.** Manufacturer's suggested retail price, DX-77T transceiver, $1059; EMS-14 desk microphone, $113; ERW-4 computer interface cable, $27; Alinco DM-340MVT power supply, $199.

Autek Research RF5 VHF Analyst

Reviewed by Mike Gruber, W1DG
ARRL Technical Advisor

What can only be described as a long late spring afternoon of gripping tension finally concluded as my wife, Debbie, drove up the driveway. Years of coaxing and persuasion had finally paid off. My wife had taken her first Amateur Radio exam, and she was beaming with that special infectious pride that comes only with accomplishment! Later that week, the FCC granted her N1YYB. So began the saga!

Debbie's initial contacts were on simplex. Later that spring, however, she surprised me by showing up on the local repeater one morning as I was on my way to work. "W1DG, this is N1YYB calling," she declared with utmost confidence. Her first repeater contact! That was the good news. The bad news was that our basement was completely flooded (every silver lining has a cloud).

As Debbie gained experience, antennas began sprouting from each of the family vehicles, and 2-meter radios began to proliferate. Complaints about "repeater hogs" and the like soon followed. Yes, I had created a monster! I soon began to realize I needed a way to properly tune all those antennas. True, the radios all *seemed* to be working at maximum rated output, but the desire to optimize performance kept gnawing at me.

Why Tune?

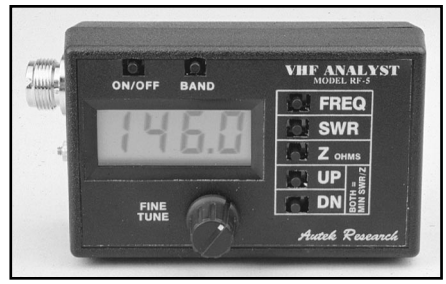
The effect of SWR is to *increase* the existing loss in a transmission line. Since line loss tends to increase with frequency, things can be quite different on 2 meters than on HF. True, most mobile installations require only relatively short transmission lines, but these lines are typically smaller diameter and more flexible than the premium cable I might otherwise select for non-mobile VHF use. The convenience of the smaller-diameter line often has its price in terms of loss, aggravated by SWR. If it's severe enough, a mismatch can even cause a transmitter to fold back its output power.

My goal was to optimize my $^5/_8$-wavelength 2-meter mobile antenna so I could hit a distant repeater. Besides, I just love experimenting with such things.

If only there was a VHF/UHF RF Analyst similar to the Autek RF1 (see "Product Review," *QST* May 1995). My prayers were soon answered by the RF5!

Features and Functions:

The Autek RF5 looks nearly identical to its HF cousin, the RF1. Both have a black plastic enclosure (4×2$^3/_8$ inches) that easily and conveniently fits in one hand (the RF5 weighs just under 8 ounces); both feature a 1$^{11}/_{16}$×$^5/_8$-inch LCD display window with $^1/_2$-inch high numerals. Directly below the RF5 display is a **FINE TUNE** knob. Above the case are two buttons, **ON/OFF** and **BAND**. The latter selects one of the three available bands. To the right of the display is a vertical row of five buttons to select display information: **FREQ**, **SWR**, and **Z OHMS**. The bottom two buttons, **UP** and **DN**, provide coarse frequency selection. An SO-239 connector and a ground terminal protrude from the left side of the RF5.



BOTTOM LINE

The Autek RF5 is a handy and reasonably accurate device that can serve a variety of testing and measurement functions at VHF and UHF frequencies. Accuracy suffers as you move higher in frequency, however.

With its large numerals, the display was easy to see under a variety of light conditions and angles, but it did fade a bit when the bottom of the RF5 was tilted away from me. Maximum contrast occurred when I tilted the top of the RF5 away from me.

A common 9 V battery powers the RF5, and battery replacement is real snap. The unit can be powered externally from a 9 V source, but the manual warns that it will not work properly at 12 V. At a nominal 50 mA current draw, the manual indicates the RF5 is good for 6 to 12 hours of typical intermittent use with a standard alkaline battery. An automatic shut-off feature turns off the unit after it's been idle for 15 or 20 minutes. This function can be disabled.

The nine-page instruction manual (actually a set of five sheets stapled in the upper left corner) not only covers operation and use of the RF5 but numerous measurement techniques and graphs for such things as line loss and characteristic impedance (more about these later). The manual is adequate, but it could benefit from some professional editing. Larger charts and graphs also would help.

Performance

Operating the RF5 is pretty intuitive. First, connect your feed line to the SO-239. Then, press the buttons as required to turn on the unit, select a frequency, and pick the meter display (either SWR or Z) that you want. It's really quite simple.

Typical operation starts by tapping the **ON/OFF** button. The display first flashes the firmware version (ours was 5.1) before automatically entering the frequency mode. The RF5 always initializes with the second lowest frequency band—conveniently, it's the one that covers 2 meters. If you need another band, press the **BAND** button. The unit features three "bands" that cover the following approximate frequency ranges: 35 to 86 MHz; 132 to 300 MHz; and 255 to 532 MHz. Note there is some overlap.

Say, for example, that you want to tune your antenna to 147.600 MHz (which just happens to be our local repeater input). To do this, you first select the correct band. The display indicates approximately 135 MHz with the **FINE TUNE** control centered. Use the **UP** and **DN** buttons to get within striking distance (in my case, it was 147.8 MHz after about 15 taps on the **UP** button, but holding the **UP** or **DN** button lets you change frequency more rapidly) From there, a slight adjustment of the **FINE TUNE** control puts you right on the money.

You now have a choice between measuring SWR or Z (in ohms) by tapping the appropriate button. Tapping **FREQ** will return you to the frequency mode. Pressing two or three of these buttons simultaneously causes the RF5 to cycle between the modes selected. This can be a handy feature for some types of measurements and awkward situations, such as when you're up on a tower. If all you desire is a typical SWR measurement at 147.600 MHz, simply tap the SWR button, and the display switches from frequency to SWR.

Other typical measurement possibilities include varying the frequency while in the SWR or Z mode. You can, for example, sweep through a range of frequencies to

Table 2—Autek Research RF5 VHF Analyst

Manufacturer's claimed specifications	*Measured in ARRL Lab*
Frequency range: Not specified.	Band 1, 34-85 MHz; Band 2, 133-300 MHz; Band 3, 255-531 MHz.
Impedance accuracy: At 50 MHz, better than 10% from 10 to 600 Ω; better than 5% from 30 to 400 Ω.	See Table 3.
SWR accuracy: Generally accurate to 10% below 3:1 and 15% up to 6:1.	See Table 4.
Power requirements: 6-12 V dc.	50 mA max with 9 V battery.

find the point of minimum SWR. Like most microprocessor-based instruments, the RF5 includes some neat features not normally found in non-microprocessor counterparts. In the case of the RF5, one such feature is the *Instant SWR Mode*—something that wasn't available on the RF1. This mode provides fast, easy scanning of an entire band for minimum SWR or impedance. All you have to do is select the appropriate band, then press both the **UP** and **DN** buttons. Within a few seconds, the frequency of minimum SWR (or minimum Z) appears. Only manual fine tuning is required. I found this to be a valuable feature, and it's one that's sure to please.

The Instant SWR Mode does have some limitations. To save scan time, the RF5 only searches 120 frequencies across each band instead of the 240 available via the **UP** and **DN** buttons. This increases the possibility that a minimum frequency might be missed. Less smoothing of SWR and Z is also used. Nonetheless, I consistently obtained successful results using this feature.

A Word on Accuracy

Autek says the RF1 and the RF5 are the only analysts that measure *true* impedance, because they look at the current through the load as well as the voltage across the load. The company also points out that the RF5 uses 1% components in "critical areas" and high-quality microwave diodes in the RF head, plus digital correction. But, let's face it. One can only expect so much from an instrument in this price class. Autek says the unit should work pretty accurately at 50 MHz, and our ARRL Lab tests bore out that assertion. On higher frequencies, however, users will encounter greater errors in measuring impedance at, say, 440 MHz, where stray capacitance, lead length, and other factors can affect measurement accuracy. In fact, this was one of the factors that prevented us from making accurate impedance measurements with reactive loads on 2 meters and on 70 cm in the ARRL Lab (see Table 3). The RF5 can be used to determine the frequency of minimum impedance on the higher frequencies, however.

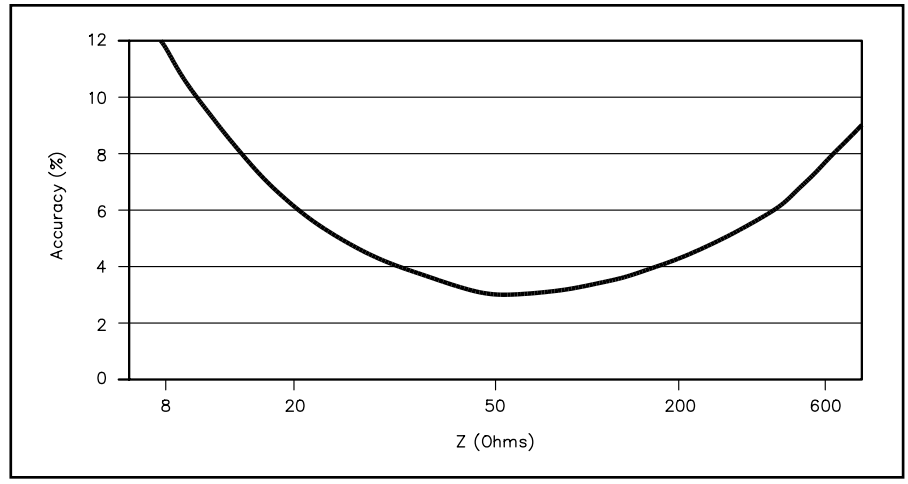


Figure 4—Here's a plot of impedance accuracy for the Autek RF5, as provided by the manufacturer. The plot shows the accuracy you can expect at 50 MHz with negligible lead length and an impedance below 100 Ω. At higher impedances, the meter's output capacitance makes the impedance appear smaller.

As Figure 4 shows, at 50 MHz, you can expect pretty reasonable impedance-measurement accuracy at 50 Ω. At higher impedances, the meter's output capacitance makes the impedance appear smaller. We found the RF5 to be pretty consistent on a 50-Ω termination up through 450 MHz, however (see Table 3).

Autek says the same holds true for SWR measurements on 2 meters and—especially—on 70 cm (see Table 4). As the manual points out, at frequencies of 440 MHz or higher, "any SWR less than 1.5 is usually considered good, and 2.0 is usually 'acceptable.'"

The bottom line is that in terms of impedance, the RF5 provides acceptable accuracy on the lower portions of its coverage range, but stray reactances must be taken into account in determining impedance at higher frequencies.

More than Meets the Eye

The RF5 manual also describes a plethora of other uses for this device—essentially, creative applications of standard SWR or impedance measurements. In addition to antenna length adjustments based on SWR, you'll find techniques for

• *Feed line loss measurements*: The RF5 manual offers two methods to determine cable loss. The first method, using SWR, seemed to offer consistent results. The second method, using a measured impedance, was found to be inaccurate in some cases. This method uses an equation that assumes low cable loss, so cables that have more than a few dB of loss might yield inaccurate results—despite the manufacturer's note in the manual that this method is the more accurate of the two. This method also involves the measurement of low impedances, but the RF5's accuracy degrades significantly below 20 Ω (see Figure 4), so this method appears to be a poor match for this instrument.

• *Total feed line loss at any SWR*: This procedure is similar to the feed line loss measurement, above. First, measure the SWR of the unterminated feed line, then measure the SWR at the transmitter end with the antenna connected. The manual provides a convenient graph to determine the percentage of power reaching the antenna using these two measurements.

• *Finding a short or open in cable*: This technique requires you to look up or mea-

Table 3—
Impedance (Z) Measurement Accuracy: RF5 vs HP-8753/HP-4815A

Frequency (MHz)	*Load Z (Ω)*	*RF5 Z (Ω)*	*HP-8753 Z (Ω)*
52	5	6	7
	25	24	25
	50	50	49
	200	176	172
Frequency (MHz)	*Load Z (Ω)*	*RF5 Z (Ω)*	*HP-4815A Z (Ω)*
52	52+*j*25	60	58
	46–*j*42	62	64
80	50	52	n/a
146	50	53	n/a
222	50	56	n/a
275	50	62	n/a
420	50	54	n/a
440	50	57	n/a
530	50	86	n/a

Table 4—SWR accuracy of the Autek RF5

Load	*Freq (MHz)*	*Measured SWR*
25 Ω resistive (calculated SWR 2:1)	52	1.7:1
	146	1.6:1
	435	1.8:1
50 Ω resistive (calculated SWR 1:1)	52	1:1
	146	1:1
	435	1:1
100 Ω resistive (calculated SWR 2:1)	52	1.8:1
	146	1.9:1
	435	1.9:1

sure the velocity factor in an equivalent piece of cable. You then measure the frequency difference between impedance nulls and enter these data into an equation.

The RF5 also will permit you to determine the characteristic impedance and velocity factor of an unknown piece of coaxial cable, check the input and output impedance of baluns and other RF transformers, make 1/2 and 1/4-wavelength lines (eg, for phased arrays or for matching stubs), and measure trap impedance. You can even use the RF5 to tune an antenna tuner without transmitting, and it can fill in as a sine wave generator. In this last application, however, note that the RF5 VCOs, while shielded and buffered, are not synthesized and are noisy and subject to drift. These limitations—plus a lack of modulation capability, output level control, and 100 kHz resolution on VHF and UHF—tend to make me want to consider alternative signal generators. In a pinch, however, the RF5 may work.

The manual finishes up with discussions on accuracy, measurements above 300 MHz, determining R+*j*X, and a small table of cable data. There is quite a bit of info here.

In the Shack and Field

I made the first RF5 test run with my 3-element 6-meter beam and 50 feet of RG-8 mini coax. First, I connected the RF5 to the transmitter end of the feed line inside the shack and tried the Instant SWR Mode. I made several passes and found good consistency among them. The frequency ranged between 50.1 and 50.44 MHz, even with the relatively broad bandwidth of this antenna system.

Next, I checked the SWR at the target frequency of 50.4 MHz. It measured a nice 1.0—no surprise, since I had already tuned it using a conventional SWR meter. I had often thought about replacing that mini coax with something a bit heavier and less lossy; Now I had the opportunity to actually measure how bad it was. I grabbed a ladder from the garage and climbed onto the roof. With the antenna disconnected, I measured an SWR of 3.7 in the shack. A careful look at the graph in the manual revealed the loss to be about 2.3 dB—a bit higher than I had expected, and more incentive to change the cable. The bottom line here is that this technique would have been impossible using a conventional SWR instrument.

Next I tackled Debbie's mag mounted 5/8-wavelength 2-meter vertical. The Instant SWR Mode showed the resonant frequency to be around 144.0 MHz, a bit low for FM repeater work. The whip was already as far down as possible, so pruning was required. I removed about 3/4 inch and tried again. (I had about an inch of adjustment without cutting the antenna.) The resonant frequency came up about halfway to the target. Again I trimmed off about 3/4 inch. This time, the RF5 showed the SWR to be 1.0 at 147 MHz, with minimal or no variation between 146 and 148 MHz. This is where most of the local repeaters can be found, so decided to call it quits.

Wish List and Overall Impressions

Perhaps first and foremost on my wish list would be HF capability, with an ability to measure capacitance and inductance—sort of an RF1 and RF5 rolled into one. A protective case and a convenient strap or tether point for tower work would probably tie for second place. Rounding out my list would be a wall power cube and a better manual. Autek says most 9 V dc adapters work fine with the RF5 (the manual recommends two Radio Shack units). A carrying case will be available soon. During my time with the RF5, I came to regard it as indispensable for VHF and UHF antenna tuning. I like its quality, fit and finish, convenient size and affordable price.

The RF5 was just what the doctor ordered for the new Tech in our family. And I've already received two calls from friends wanting to stop by and "show" me their new 2-meter mobile antennas. Maybe one of them has a pump I can borrow for the basement.

Manufacturer: Autek Research, Box 8772, Madeira Beach, FL 33738; tel 813-886-9515. Manufacturer's suggested retail price, VHF Analyst Model RF5, $230.

SOLICITATION FOR PRODUCT REVIEW EQUIPMENT BIDS

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MFJ MFJ-1026 deluxe noise canceling signal enhancer with ac power cube (see "Product Review," April 1998 *QST*). Minimum bid: $94.

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In your bid, clearly identify the item you are bidding on, using the manufacturer's name and model number, or other identification number, if specified. Each item requires a separate bid and envelope. Shipping charges will be paid by ARRL. Please include a daytime telephone number. The successful bidder will be advised by telephone with a confirmation by mail. No other notifications will be made, and no information will be given to anyone other than successful bidders regarding final price or identity of the successful bidder. If you include a self-addressed, stamped postcard with your bid and you are not the high bidder on that item, we will return the postcard to you when the unit has been shipped to the successful bidder.

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