

# Product Review Column from *QST* Magazine

May 1984

Heathkit Antenna, Model HN-31A

Yaesu Electronics Corp FT-726R VHF/UHF Transceiver

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## Yaesu Electronics Corp. FT-726R VHF/UHF Transceiver

If you made a "wish list" of features you wanted in a rig for the bands at 6 meters and above, chances are good that Yaesu's newest multimode VHF/UHF offering would fulfill many of your desires. The FT-726R — a high-performance, multiband rig about the size of many modern HF transceivers — ushers in a new era for the serious VHFer.

### Multiband Capability

One prime consideration on my wish list is multiband capability. Although multimode rigs for 50, 144 and 432 MHz abound, it would be great to have everything in one tidy package. The cost of separate rigs for each band really adds up at \$400 to \$900 a crack, and separate rigs (perhaps with outboard power supplies) take up a lot of table space. Besides, those HF guys get as many as nine bands in one box, so why not us?

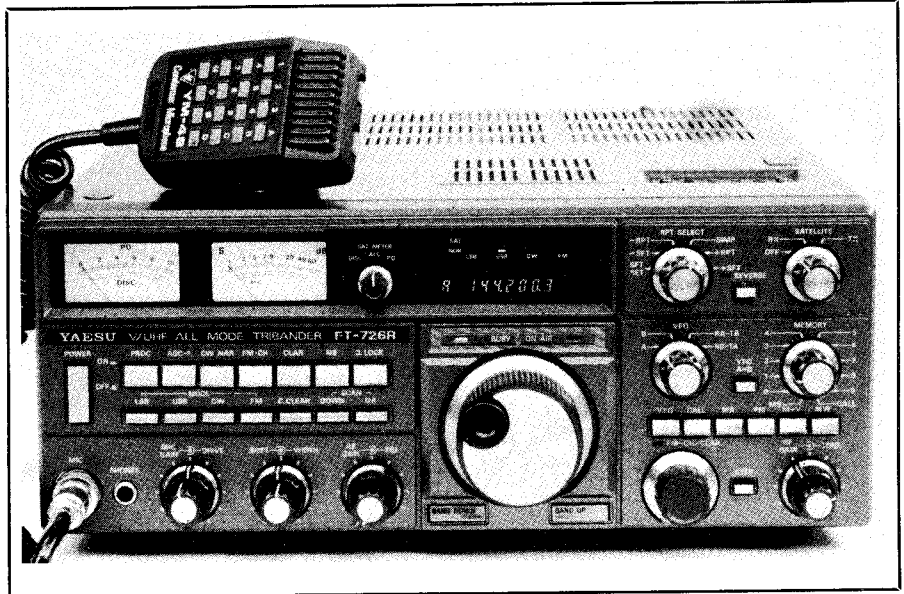
The FT-726R operates on the three most popular VHF/UHF bands worldwide — 6 meters, 2 meters and 70 cm. Two-meter coverage comes standard with the rig (the exact coverage depends on which parts of the band are permitted for use in your part of the world). Optional modules for 6 meters and 70 cm are available for far less than the cost of separate rigs for those bands.

Basically, the '726 can be thought of as a 10-MHz IF unit with separate transverter modules for each band. The main unit houses the power supply, the VFO, the 10-MHz transmit and receive section, and the audio and display sections, which are common to all bands. Each band module contains the RF circuitry for that band, a PLL, a power amplifier and appropriate switching circuitry. An 8-bit microprocessor-based controller keeps everything running smoothly. With this arrangement, the FT-726 can conceivably be expanded to include other VHF/UHF bands.

The review transceiver was supplied with the 50-54 MHz and 430-440 MHz modules. Up to three modules may be installed in the FT-726 at any time. Module installation is a snap. Just remove the top and bottom covers, place the module in one of the vacant positions, and bolt it in place with five screws. Wiring is even easier — Yaesu provides three multiconductor ribbon cables that run from the back of each module to the audio board. Each cable has a different number of conductors, and the path they follow is short and straight, so there is little chance of a wiring error.

### Features

Looking at the front panel, you might well think that the FT-726R is a state-of-the-art HF rig. Yaesu's VHF/UHF flagship includes IF SHIFT and WIDTH controls, separate AF GAIN and RF GAIN controls, selectable AGC, a CLARIFIER (RIT) knob, a noise blanker, a switch to place an optional 600-Hz CW filter in the 455-kHz IF, separate MIC GAIN (for SSB) and DRIVE (for CW



### Yaesu Electronics Corp. FT-726R VHF/UHF Transceiver, Serial No. 3K070227

#### Manufacturer's Claimed Specifications

Frequency Coverage: 50-53.99998 MHz (optional); 144-147.99998 MHz; 430-439.99998 MHz (optional); 440-449.99998 MHz (optional).

Modes of operation: USB, LSB, FM, CW.  
kHz/turn of knob: 10 or 100, switchable.  
Frequency display: 7 digit.

Frequency resolution: 100 Hz.  
Backlash: Not specified.  
S-meter sensitivity ( $\mu\text{V}$  for S 9 reading): Not specified.  
Transmitter power input: 20 W on 50 MHz; 30 W on 144 and 432 MHz. 10-W output on all bands.

Harmonic suppression: Not specified.  
Spurious suppression: Better than 60 dB.  
Third-order IMD: Not specified.  
Receiver sensitivity: CW/SSB — less than 0.15  $\mu\text{V}$  for 10 dB S + N/N; FM — less than 0.25  $\mu\text{V}$  for 12 dB SINAD.

Squelch sensitivity: Not specified.

Receiver audio output @ 10% THD: 1.5 W min.  
Color: Two-tone gray.  
Size (HWD): 5.1 x 13.1 x 12.4 in (129 x 334 x 315 mm).  
Weight: 24 lb (11 kg) without optional modules.

#### Measured in ARRL Lab

50-53.99998 MHz; 143.5-148.499998 MHz and 430-439.99998 MHz (optional) modules installed in review unit.

As specified.  
As specified.  
Blue fluorescent, 1/4-in-high digits.  
As specified.  
Nil.

50 MHz: 19; 144 MHz: 16; 432 MHz: 2.7.

Power output: 50 MHz, 12 W; 144 MHz, 11 W; 432 MHz, 12 W.

Better than 70 dB.  
Better than 70 dB.  
-30 dB worst case.

Receiver dynamics measured with optional 600-Hz CW filter installed.

	6 m	2 m	70 cm
Noise floor (MDS) dBm:	-141	-140	-138
Blocking DR (dB):	121.5	116.5	107
Two-tone, 3rd-order IMD DR (dB):	86	90.5	80
Third-order intercept (dBm):	-12	-4.25	-18
Receiver quieting ( $\mu\text{V}$ for 12 dB SINAD):	0.16	0.18	0.14

Min. 0.053  $\mu\text{V}$ ;  
max. 0.55  $\mu\text{V}$   
2.2 W.

\*Assistant Technical Editor

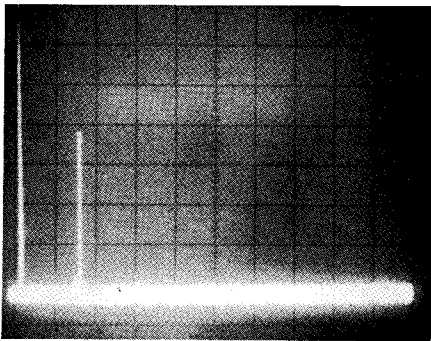


Fig. 1 — Worst-case spectral display of the Yaesu FT-726R. Vertical divisions are each 10 dB; horizontal divisions are each 100 MHz. Output power is approximately 10 W on 2 meters. The fundamental has been reduced in amplitude approximately 32 dB by means of notch cavities to prevent analyzer overload. All harmonics and spurious emissions are at least 70 dB below peak fundamental output. The FT-726R complies with current FCC spectral purity specifications.

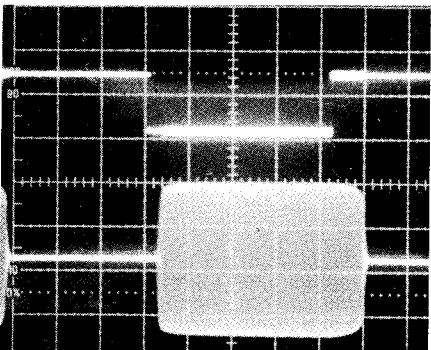
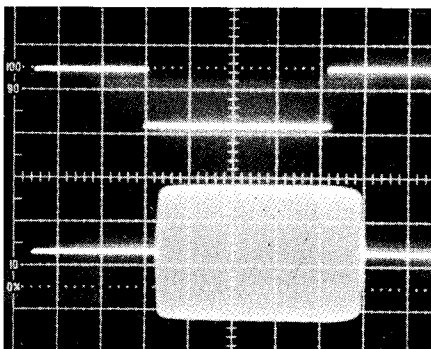
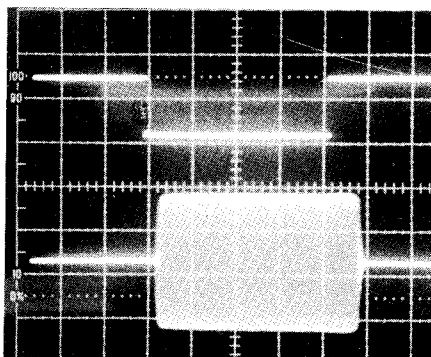


Fig. 3 — From top to bottom, CW keying waveforms of the FT-726R on 50, 144 and 432 MHz. Upper trace is actual key closure; lower trace is the RF envelope. Each horizontal division is 5 ms.

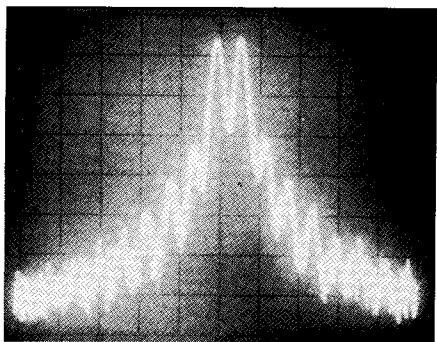


Fig. 2 — Spectral display of the FT-726R output during two-tone IMD testing. Third-order products are about 30 dB below PEP, and fifth-order products are approximately 42 dB down. Vertical divisions are each 10 dB; horizontal divisions are each 2 kHz. The transceiver was being operated at rated output power on the 6-meter band.

and FM) level controls, and a speech PROCESSOR switch.

For the low-end CW/SSB enthusiast, these features make the FT-726 a powerful tool. For example, the CW filter works very well. When the filter is used with the IF SHIFT and WIDTH controls, it is possible to dig a weak signal out of a pile of strong locals — a feature especially useful on the VHF bands where the locals are often orders of magnitude stronger than the DX. The noise blanker is effective against impulse noise from power lines and passing automobiles. The selectable AGC is useful, too. Many multimode VHF rigs have only one AGC setting with a very slow decay. For FM, this type of AGC is fine, but on CW and SSB it is very annoying when the AGC cannot track a rapidly fluttering signal, making for difficult copy.

As an FM transceiver, the '726 is a strong performer. In addition to SIMPLEX operation, standard plus and minus repeater offsets may be selected from the RPT SELECT switch. In the

review unit, the factory-programmed standard offsets are  $\pm 1$  MHz for 6 meters  $\pm 600$  kHz for 2 meters and  $\pm 5$  MHz for 70 cm. The REVERSE button allows instantaneous exchange of the transmit and receive frequencies. Nonstandard offsets may be programmed and stored in the SFT SET position.

Another feature of interest to the FM operator is the FM-CH selector. When this control is activated in the FM mode, it allows the user to tune up and down the band in 10-kHz increments (switch-selectable to 5-kHz increments). This feature makes tuning around the FM portion of the bands a breeze. With the main VFO knob, it can be work zeroing in on the desired frequency, and at 10 kHz per knob revolution, it seems to take forever to get from channel to channel. With the FM-CH control, however, the channels flash past, and once the desired frequency is reached, there is no additional tuning required. It's just like having a channelized FM-only rig.

FM operators will probably appreciate the

discriminator center-tuning meter and the standard tone-burst generator. A selectable continuous tone-coded squelch system (CTCSS) board is available as an option. The optional YM-48 hand-held microphone incorporates a tone pad.

The VFO and memory features on the '726 offer state-of-the-art flexibility. This rig contains two VFOs, which may be set up for in-band split-frequency operation or for crossband operation. When more than one band module is installed, the effect of having the VFOs set on different bands is like having two separate radios in one box. Eleven user-programmable memories are included. These memories store frequency and mode, and they may be used for a number of purposes. They can be used to store popular repeater frequencies, the calling frequencies for each band, or frequently used net or schedule frequencies. For example: MEMORY 1 might store 146.52-MHz FM; MEMORY 2 for 144.200-MHz SSB; MEMORY 3 for 432.100-MHz CW. Various controls allow switching among the memory channels, switching from memory to VFO and writing the frequency from the VFO into the memory.

Like many VHF rigs these days, the FT-726 has an elaborate scanning feature. It is possible to scan a band from top to bottom, a select portion of a band, or just the 11 preprogrammed memories. Through switches on the top panel, the scanning feature may be programmed to halt only on busy or clear channels, or when manually directed to halt by front-panel controls. In addition, the scanner may be set to halt momentarily (PAUSE), or to STOP.

#### Satellite Operation

Perhaps the most intriguing option available for the FT-726R is the satellite IF unit. With this option and two of the RF modules installed, the FT-726R may be used for full-duplex crossband operation. The satellite unit includes a complete additional IF system, so the result is really full duplex.

Despite initial misgivings about the ease of duplex operation with one radio, full-duplex satellite operation proved to be straightforward. To set the '726 up for satellite work, simply tune one of the VFOs to the desired transmit band and frequency. Set the RPT SELECT switch to SIMPLEX. Tune the other VFO to the receive band and frequency. The receive and transmit bands must be different. Then, set the VFO selector to the appropriate split operation setting (RA-TB to receive on VFO A and transmit on VFO B, or vice versa.) Next, switch the SATELLITE selector to the RX position. Set up like this, the FT-726 will transmit on the frequency for which it was initially set. Spotting is accomplished by tuning the main tuning knob, which now controls only the receive VFO, until the downlink signal is heard. Alternatively, the SATELLITE selector could be set to the TX position. In this position, the receive frequency stays put and the tuning knob controls the transmitter.

During actual operation, the FT-726 proved to be just as easy to use as two separate rigs. We set the radio up in the W1AW satellite operating position one lunchtime to try working through OSCAR 10. We set one VFO on the 435-MHz uplink and the other on the 145-MHz downlink, and hit the key. Our signal was perfectly copyable, even when using the FT-726R barefoot. During this time, we tried bringing the transmit frequency to stations calling CQ and bringing the receiver frequency to our CQing frequency. The FT-726 works like separate rigs.

There is no switching noise or desense; just smooth, quiet, full-duplex operation.

### General Operation

The lab tests indicated that the receiver is "hot," and on-the-air operation confirmed that observation. Although not the equivalent of a system incorporating a high-performance receive converter with a GaAsFET front end and a good IF receiver using a clean crystal oscillator, the FT-726R is a step ahead of most other synthesized VHF multimode radios. Reciprocal mixing noise from the synthesizer is noticeable on stronger signals, but it is held to a tolerable level.

In addition to separate antenna connectors for each band module, Yaesu has thoughtfully provided separate amplifier key lines for each band as well. An operator active on more than one band can have separate amplifiers connected at all times without the hassle of external relays or relay switches.

The review '726 saw active duty during the ARRL 6- and 2-meter Fall Sprint contests, as well as during the ARRL January VHF Sweepstakes. Several operators used the rig; all commented that it is easy to use, the controls are in the right places and the receiver sounds good. Signal reports from other stations indicate that the audio quality is good and the CW signal is click free. Many of the operators who were asked for speech processor in/out comparison reports said that it added little, if anything, to the signal.

One glaring omission on the features list is VOX operation on SSB. The FT-726R incorporates semi-break-in operation on CW, however. There is also a rear-panel jack for an external PTT switch (e.g., a foot switch). My operating style does not require VOX operation on SSB, but it seems strange to find a rig with so many features that does not include this standard convenience.

Yaesu's newest VHF/UHF transceiver is certainly worth considering if you're in the market for a new rig. Even if you're only interested in 2 meters right now, the ability to add other bands at any time makes it an attractive box. If you like satellite operation, or would like to give it a try, take the time to see a '726 in action before spending those hard-earned dollars on separate radios.

Price class for the basic FT-726R with the 144-MHz module is \$900. Price class for the options: XF-455MC CW filter, \$60; 50-MHz-band module, \$200; 430-MHz-band module, \$300; satellite IF unit (SU), \$100; 440-MHz unit, \$250; HF module, \$225; 144-MHz module (as a separate unit), \$175; YM-48 hand-held microphone, \$70. Manufacturer: Yaesu Electronics Corp., 6851 Waltham Way, Paramount, CA 90723. — Mark Wilson, AA2Z

### HEATHKIT CANTENNA, MODEL HN-31A

□ No Amateur Radio station is complete without a dummy antenna (also called a dummy load). Eventually, we all have a need to test a transmitter off the air. A dummy load makes leisurely testing possible while keeping signal radiation to a minimum. This will please the FCC and your fellow hams. A dummy load is also useful when testing receivers. It resembles an antenna electrically, but it does not pick up external noise and signals like an antenna; that's a desirable feature in some tests.

Electrically, a dummy load is a resistor. Not just any resistor, it must have certain



characteristics. The resistance must equal the characteristic impedance of the system in which it is used; for most systems that is 50 ohms. Ideally, it should have pure resistance; that is, there should be no reactance. In the real world, that is not possible; inductance and capacitance are always present. Further, for transmitter tests, the load resistor must be capable of safely dissipating the transmitter output.

The Heathkit HN-31 Cantenna has been around for a good many years. I have had one in my shack for about as long as I can remember. About a dozen years ago, an HN-31 was a fixture in the truck and at the bench I used in the two-way FM service business. For many of us, the name Cantenna is synonymous with dummy load.

### A New Model

One immediately notices that the HN-31A is different. Gone is the small rectangular box with an SO-239 connector at one end and a phono jack at the other. The SO-239 is still there, now center-mounted and positioned vertically on the lid. The identification label is no longer painted on the can — a bright, three-color stick-on label is provided. Inside, the only noticeable change is the connector mounting. The result is that the connection between the SO-239 and the load resistor is more direct in the '31A.

There is one significant change in the electrical specifications. The '31A is rated for an SWR of less than 1.5 up to 450 MHz. (In the '31, the 1.5 SWR frequency is specified as 300 MHz, and for an SWR of 2, it is 400 MHz.) Fig. 4 shows SWR curves for an HN-31, an HN-31A and a Bird model 82 dummy load. Amateur bands between 50 and 450 MHz are identified so that you can

make your own comparisons easily. As you can see, the models I tested in the ARRL lab readily surpassed their rated performance. There is a "bump" in the SWR curve for each of the Heath Cantennas. In the '31A, the bump is well removed from any amateur band and, for that reason, should not be a problem.

SWR below 30 MHz is better than 1.07 for the '31A. That compares to 1.1 or better for the '31, and better than 1.02 for the Bird '82. (At 1.8 MHz, the Bird '82 has an SWR of better than 1.006.) Certainly, the HN-31A is more than adequate for Amateur Radio use — at 450 MHz, the SWR was better for the '31A than for the Bird '82!

The '31 had a built-in peak RF voltage detector. The loss of that feature is a small price to pay for the improved SWR performance of the '31A. Chances are, most would never use that feature anyway, especially if there is a wattmeter in the shack.

The power-handling capability of the '31A remains the same as for the '31. When power is applied to the Cantenna, the 50-ohm resistor element absorbs the power and converts it into heat. The heat is dissipated into a liquid bath that surrounds the resistor element. If that liquid is transformer oil, the load can handle a kilowatt for up to 10 minutes of intermittent operation. [Some transformer oil contains PCBs, a suspected carcinogen. Handle all transformer oil carefully. — Ed.] Mineral oil may be easier for you to locate (Heath does not supply the liquid coolant); it will limit you to one minute at 1 kW, however. Below the 400-W level, mineral oil will work as well as transformer oil. You may be able to get transformer oil through your local power utility. Mineral oil is available at most drug stores. The Cantenna holds 1 gallon (3.79 liters) of coolant.

### Final Words

I calculated SWR from return-loss measurements made in the ARRL lab while using a spectrum analyzer, tracking generator and a directional coupler rated to over 1 GHz. After making those measurements, I decided to replace the SO-239 with a type-N chassis connector. It didn't make any significant change in the SWR curve, but it does make it easier to use with my 70-cm station and its N connectors.

A dummy load should be part of every station. The HN-31A is available from Heath Company, Benton Harbor, MI 49022. Price class: \$25. — Chuck Hutchinson, K8CH

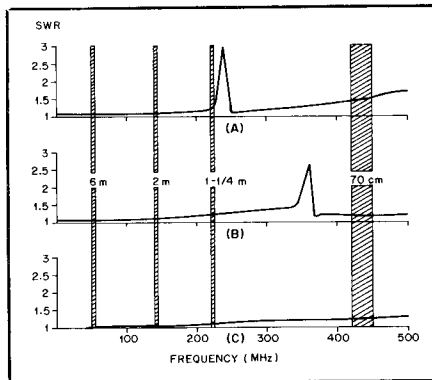


Fig. 4 — SWR curves for the Heath HN-31 shown at A, HN-31A at B and Bird model 82 at C.

## Strays

I would like to get in touch with...

□ other radio amateurs interested in exchanging RTTY/CW software and hardware ideas for the Timex-Sinclair T/S-1000 computer. John Dowlan, W3HU, 8341 Boyce St., Spring Hill, FL 33526.

□ anyone who has developed an interface for a Timex Sinclair 1000 computer and Amateur Radio. Charles Hudson, KA2NWP, 44 Nelson Ave., Cooperstown, NY 13326.

□ anyone who has successfully interfaced the Radio Shack Color Computer II with a Ten-Tec Argosy transceiver for RTTY and CW. Mark Callahan, KA1IGC, 8 Pondview Rd., Norfolk, MA 02056.