# Product Review & Short Takes Columns from *QST* Magazine

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**Product Reviews**

# Yaesu FT-897 MF/HF/VHF/UHF All-Mode Transceiver

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Yaesu seems determined to build an MF through UHF transceiver for every operator. The FT-897 is tailored for campers and backpackers who want more power than the FT-817 provides.[1] I borrowed an FT-817 for a vacation to Pennsylvania last summer, and it was great fun. Yet I want a rig for mobile use too, and 5 W is not enough power to yield many contacts through mobile antennas. I had decided to buy an FT-100D last year, when I saw an ad for the FT-897—it looked like just the thing for me. I let the Product Review Editor know of my interest and was soon carrying home the FT-897.

I like the look of the rig. It's a little larger than the FT-817 ($3^3/_{16}$×$7^7/_8$×$10^5/_{16}$″ HWD), but it does pack a full 100 W for 160-6 meters (50 W for 2 meters and 20 W for 70 cm). It's solid, and its military styling looks very rugged. That handle on the side just shouts, "Let's go!"

The FT-897 offers some great operating features, too. The DSP section is versatile, offering band-pass filtering, general noise reduction, a notch filter and microphone equalization.

For strong-signal environments, it has a 10-dB front-end attenuator and IPO (intercept-point optimization), Yaesu's term for bypassing the preamplifier. Both functions are arranged to suit typical band conditions. For example, the attenuator and IPO are not available on the 144-MHz and 430-MHz bands. The manual suggests that "as long as the S-meter is moving on background noise, additional front-end gain is not necessary."

## User Interface

It's amazing how many functions are controlled by the four knobs, 15 buttons and one LCD (see Figure 1) on the front panel! Yaesu accomplishes this by having most controls perform more than one function. The basic process is similar to that of the FT-100D and FT-817. A momentary press of the [F] key activates the MEM/VFO CH knob to select one of 17 menus for the three multifunction keys immediately below the LCD. Many of the functions are linked to underlying menus that set a parameter related to the function.

Holding the [F] key down for one second enters the menu mode, where the MEM/VFO CH knob selects from 91 menus that govern much of the rig's operation, including the functions of some knobs and buttons.

Consider the CW keying setup. By default, the internal keyer is switched off to allow keying by an external keyer or straight key. To activate the internal keyer (which includes three memories), momentarily press [F] and turn MEM/VFO CH to select Multifunction Row j, which is indicated by MFj at the left of the meter bar. The labels SPOT, BK and KYR appear over multifunction keys [A], [B] and [C], respectively. A quick press of [C] activates the keyer, as indicated by the display change to [KYR]. Holding key [C] down for one second opens Menu 030 [CW SPEED] to set the keying speed. To save the change and exit the menu mode, press [F] again and hold it down for one second. This procedure takes far longer to describe than it does to execute. The functions of Multifunction Row q can be set by the user through Menus 65-67 (PG A, PG B, PG C).

There are LEDs to indicate battery status, CW tuning, transmit or busy channel status and DSP on/off. The CW tuning indicator blinks in cadence with a CW signal that is precisely centered in the IF passband. This may seem hokey, but it solves the problem of inaccurately tuned CW signals that disappear when you switch to a narrow filter. With this indicator, you can be assured that the signal will still be in the passband when you switch on that wonderful 60-Hz DSP filter. This is a blessing to CW operators.

The main dial has a nice feel. Tuning with this rig is a pleasure. In the VFO mode, the main dial can be set for coarse (10 Hz) or fine tuning (≈1 Hz). The MEM/VFO CH knob can be set to a different channel spacing for each mode. On SSB, I left it at the 2.5-kHz default. This means that I can rapidly tune across a band in 2.5-kHz steps, which are sufficiently close together to hear any SSB signal present. Once a signal is found, it can be accurately tuned with the main dial. A momentary press of the power key or the FST button on the hand mic selects coarse tuning on the dial and doubles the selected channel spacing (although the menu display for channel spacing remains unchanged). The V/M key toggles the frequency control between the VFO and memory systems.

The CLARifier knob adjusts both the RIT *and* the IF shift. Both are activated by a small unlabeled key to the knob's upper left. A quick press toggles the RIT, while holding it down for one second

**Bottom Line**

The FT-897 is a full-featured MF through UHF transceiver in a lightweight, rugged package that is well suited to traveling.

[1]R. Lindquist, N1RL, "Yaesu FT-817 Multiband Multimode Transceiver," Product Review, *QST*, Apr 2001, pp 75-80.

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## Table 1
## Yaesu FT-897, serial number 2N120204

| Manufacturer's Claimed Specifications | Measured in the ARRL Lab | | |
|---|---|---|---|
| Frequency coverage: Receive—0.1-56, 76-108, 118-164, 420-470 MHz; transmit—1.8-2, 3.5-4, 7-7.3, 10.1-10.15, 14-14.35, 18.068-18.168, 21-21.45, 24.89-24.99, 28-29.7, 50-54, 144-148, 430-450 MHz. | Receive[1] and transmit, as specified. | | |
| Power requirement: Receive, 1.0 A; transmit, 22 A (100 W output). | Receive, 0.9 A; transmit, 15 A. Tested at 13.8 V. | | |
| Modes of operation: SSB, CW, AM, FM. | As specified. | | |
| ***Receiver*** | ***Receiver Dynamic Testing*** | | |
| SSB/CW sensitivity, bandwidth not specified, 10 dB S/N: 1.8-30 MHz, <0.2 µV; 50-54 MHz, <0.13 µV; 144-148, 430-450 MHz, <0.13 µV. | Noise floor (MDS), 500 Hz filter: | | |
| | | *Preamp off* | *Preamp on* |
| | 1.0 MHz | –129 dBm | –134 dBm |
| | 3.5 MHz | –132 dBm | –137 dBm |
| | 14 MHz | –133 dBm | –137 dBm |
| | 50 MHz | –138 dBm | –142 dBm |
| | 144 MHz | see note 2 | –140 dBm |
| | 432 MHz | see note 2 | –139 dBm |
| AM sensitivity, 10 dB S/N: 0.1-1.8 MHz, <32 µV; 1.8-30 MHz, <2 µV; 50-54 MHz, <1 µV; 144-148, 430-450 MHz, not specified. | 10 dB (S+N)/N, 1-kHz tone, 30% modulation: | | |
| | | *Preamp off* | *Preamp on* |
| | 1.0 MHz | 1.8 µV | 0.86 µV |
| | 3.8 MHz | 1.3 µV | 0.69 µV |
| | 50 MHz | 0.83 µV | 0.43 µV |
| | 120 MHz | see note 2 | 0.40 µV |
| | 144 MHz | see note 2 | 0.46 µV |
| | 432 MHz | see note 2 | 0.47 µV |
| FM sensitivity, 12 dB SINAD: 28-30 MHz, <0.5 µV; 50-54, 144-148, 430-450 MHz, <0.2 µV. | For 12 dB SINAD: | | |
| | | *Preamp off* | *Preamp on* |
| | 29 MHz | 0.43 µV | 0.26 µV |
| | 52 MHz | 0.28 µV | 0.17 µV |
| | 146 MHz | see note 2 | 0.20 µV |
| | 440 MHz | see note 2 | 0.21 µV |
| Blocking dynamic range: Not specified. | Blocking dynamic range, 500 Hz filter: | | |
| | Spacing | 20 kHz | 5 kHz |
| | | *Preamp off/on* | *Preamp off/on* |
| | 3.5 MHz | 111/109 dB | 99/102 dB |
| | 14 MHz | 109/106 dB | 96*/89* dB |
| | 50 MHz | 114*/92* dB | 104/84* dB |
| | 144 MHz | note 2/102* dB | note 2/81* dB |
| | 432 MHz | note 2/99* dB | note 2/79* dB |
| Two-tone, third-order IMD dynamic range: Not specified. | Two-tone, third-order IMD dynamic range, 500 Hz filter: | | |
| | Spacing | 20 kHz | 5 kHz |
| | | *Preamp off/on* | *Preamp off/on* |
| | 3.5 MHz | 91/90 dB | 68/67 dB |
| | 14 MHz | 89/86 dB | 67/65 dB |
| | 50 MHz | 89/85 dB | 68/65 dB |
| | 144 MHz | note 2/85 dB | note 2/64 dB |
| | 432 MHz | note 2/82 dB | note 2/63 dB |
| Third-order intercept: Not specified. | Spacing | 20 kHz | 5 kHz |
| | | *Preamp off/on* | *Preamp off/on* |
| | 3.5 MHz | +5.6/–1.9 dBm | –21/–29 dBm |
| | 14 MHz | +1.3/–6.7 dBm | –24/–32 dBm |
| | 50 MHz | –3.5/–12 dBm | –29/–39 dBm |
| | 144 MHz | note 2/–12 dBm | note 2/–40 dBm |
| | 432 MHz | note 2/–11 dBm | note 2/–38 dBm |
| Second-order intercept: Not specified. | Preamp off, +67 dBm; preamp on, +62 dBm. | | |

toggles IF shift. I found both facilities helpful in tuning. While the RIT and IF-shift functions can *act* simultaneously, the status of each is indicated by the same area of the display, so you can only see the status of one.

Several rear-panel connections are chassis mounted, so they are recessed slightly into the chassis (3/8″ diameter × 3/16″ deep for ACC, KEY and EXT SPKR; ½″ diameter × 5/16″ deep for CAT/LINEAR and DATA). This provides a little strain relief for the connectors, but requires that connectors fit inside the recesses. I normally use a 1/4″ stereo phone plug on my paddle and keep a 1/4:1/8 adapter on hand for smaller jacks. The adapter would not fit into the recess, so I wired a 1/8″ stereo-plug pigtail in parallel with the 1/4″ plug.

The back panel has a CAT connector, but that is also used to control an external power amplifier or automatic tuner.

### VFO System

The radio has two VFOs, A and B. The A and B VFO information is stored for

| Receiver | Receiver Dynamic Testing |
|---|---|
| FM adjacent channel rejection: Not specified. | 20 kHz channel spacing, preamp on: 29 MHz, 66 dB; 52 MHz, 65 dB; 146 MHz, 65 dB; 440 MHz, 68 dB. |
| FM two-tone, third-order IMD dynamic range: Not specified. | 20 kHz channel spacing, preamp on: 29 MHz, 65 dB; 52 MHz, 63 dB; 146 MHz, 62 dB; 440 MHz, 62 dB; 10 MHz channel spacing, preamp on: 52 MHz, 89 dB; 146 MHz, 90 dB; 440 MHz, 99 dB. |
| S-meter sensitivity: Not specified. | S9 signal at 14.2 MHz: preamp off, 16 µV; preamp on, 5.7 µV; 52 MHz, preamp off, 7.1 µV; preamp on, 2.5 µV; 146 MHz, preamp on, 2.2 µV; 432 MHz, preamp on, 2.3 µV. |
| Squelch sensitivity: SSB, 1.8-30 MHz, <2.5 µV; 50-54 MHz, <1 µV; 144-148, 420-450 MHz, <0.5 µV; FM, 28-30 MHz, <0.32 µV; 50-54, 144-148, 430-450 MHz, <0.16 µV. | At threshold, preamp on: SSB, 14 MHz, 1.6 µV; FM, 29 MHz, 0.16 µV; 52 MHz, 0.1 µV; 146 MHz, 0.09 µV; 440 MHz, 0.12 µV. |
| Receiver audio output: 2.5 W at 10% THD into 4 Ω. | 4.2 W at 10% THD into 4 Ω. |
| IF/audio response: Not specified. | Range at –6 dB points (bandwidth):<br>CW (500 Hz filter): 385-971 Hz (586 Hz)<br>USB: 250-2563 Hz (2313 Hz)<br>LSB: 420-2588 Hz (2168 Hz)<br>AM: 124-2379 Hz (2255 Hz). |
| IF rejection: 60 dB; image rejection, 1.8-30, 50-54 MHz, 70 dB; 144-148, 430-450 MHz, 60 dB. | First IF rejection, 14 MHz, 124 dB; 50 MHz, 96 dB; 144 MHz, 122 dB; 432 MHz, 123 dB; image rejection, 14 MHz, 90 dB; 50 MHz, 86 dB; 144 MHz, 96 dB; 432 MHz, 77 dB. |

| Transmitter | Transmitter Dynamic Testing |
|---|---|
| Power output: HF and 50 MHz: SSB, CW, FM, 100 W, AM, 25 W (carrier); 144 MHz, SSB, CW, FM, 50 W, AM, 12.5 W (carrier); 430 MHz, SSB, CW, FM, 20 W, AM, 5 W (carrier). | HF and 50 MHz: CW, SSB, FM, typically 102 W high, 3 W low; AM, typically 20 W high, <1 W low; 144 MHz: CW, SSB, FM, typically 50 W high, 4 W low; AM, typically 13 W high, <1 W low; 430 MHz: CW, SSB, FM, typically 19 W high, 1 W low; AM, typically 5 W high, <1 W low. |
| Spurious-signal and harmonic suppression: ≥50 dB on HF; ≥60 dB on VHF and UHF. | HF, 53 dB; 50 MHz, 63 dB; 144 MHz, 64 dB; 430 MHz, 61 dB. Meets FCC requirements for spectral purity. |
| SSB carrier suppression: >40 dB. | 60 dB. |
| Undesired sideband suppression: >50 dB. | 53 dB. |
| Third-order intermodulation distortion (IMD) products: Not specified. | See Figures 1 and 2. |
| CW keyer speed range: Not specified. | 4 to 57 WPM. |
| CW keying characteristics: Not specified. | See Figure 3. |
| Transmit-receive turnaround time (PTT release to 50% audio output): Not specified. | S9 signal, 6 ms. |
| Receive-transmit turnaround time (tx delay): Not specified. | SSB, 21 ms; FM, 15 ms. Unit is suitable for use on AMTOR. |
| Composite transmitted noise: Not specified. | See Figures 4 and 5. |
| Bit-error rate (BER), 9600-baud: Not specified. | 146 MHz: Receiver—BER at 12-dB SINAD, $1.7\times10^{-3}$; BER at 16 dB SINAD, $7.0\times10^{-5}$; BER at –50 dBm, $<1.0\times10^{-5}$; transmitter—BER at 12-dB SINAD, $1.0\times10^{-3}$; BER at 12-dB SINAD + 30 dB, $<1.0\times10^{-5}$.<br>440 MHz: Receiver—BER at 12-dB SINAD, $2.3\times10^{-3}$; BER at 16 dB SINAD, $8.0\times10^{-5}$; BER at –50 dBm, $<1.0\times10^{-5}$; transmitter—BER at 12-dB SINAD, $8.0\times10^{-4}$; BER at 12-dB SINAD + 30 dB, $<1.0\times10^{-5}$. |

Size (height, width, depth): 3.2×7.9×10.3 inches; weight, 8.6 pounds.

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.

[1] Receive sensitivity is reduced below 350 kHz.

[2] IPO not available above 56 MHz.

each band, so the dual VFOs can serve as two dedicated memories for each band. A simple application of this might be leaving all VFOs A in CW subbands and leaving all VFOs B in the voice subbands. A complex application would be satellite operation, with A and B on different bands. The two VFOs may be on different modes. For split operation, the radio transmits on VFO A and receives on VFO B. You can also store separate transmit and receive frequencies in a single memory.

### Memory System

The FT-897 memory system includes the Quick Memory Bank (QMB), 200 regular memories, Home-channel memories and Smart Search memories. The Quick Memory Bank quickly stores the operating information for one frequency. To recall the frequency, you must use Multifunction Row c. Once recalled, the QMB frequency can be tuned and stored in a normal memory.

Regular memories can store single or split frequencies. They can be labeled

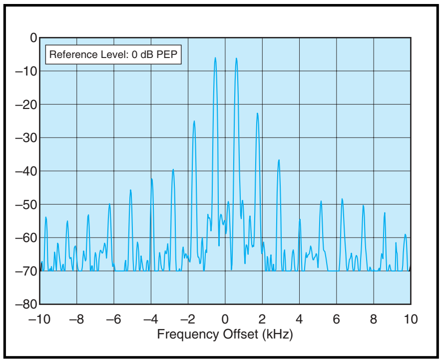



**Figure 1—Worst-case spectral display of the FT-897 transmitter during two-tone intermodulation distortion (IMD) testing on HF. The worst-case third-order product is approximately 23 dB below PEP output, and the worst-case fifth-order product is approximately 37 dB down. The transmitter was being operated at 100 W output at 28.350 MHz.**

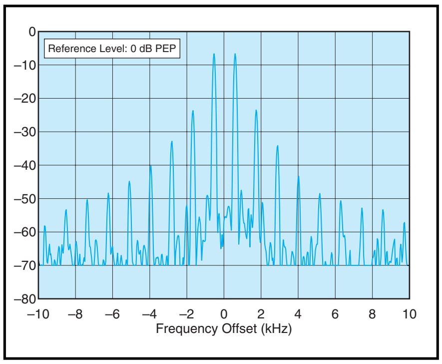



**Figure 2—Worst-case spectral display of the FT-897 transmitter during two-tone intermodulation distortion (IMD) testing on VHF. The worst-case third-order product is approximately 24 dB below PEP output, and the worst-case fifth-order product is approximately 33 dB down. The transmitter was being operated at 50 W output at 144.200 MHz.**

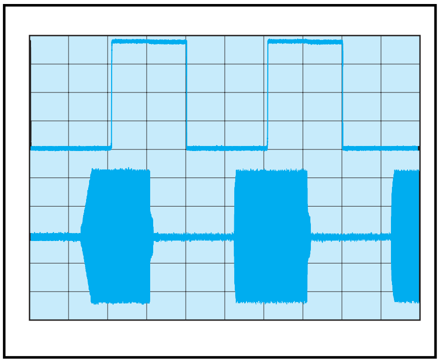


**Figure 3—CW keying waveform for the FT-897 showing the first two dits in full-break-in (QSK) mode. The equivalent keying speed is 60 WPM. The upper trace is the actual key closure; the lower trace is the RF envelope. Horizontal divisions are 10 ms. The transmitter was being operated at 100 W output at 14.2 MHz.**

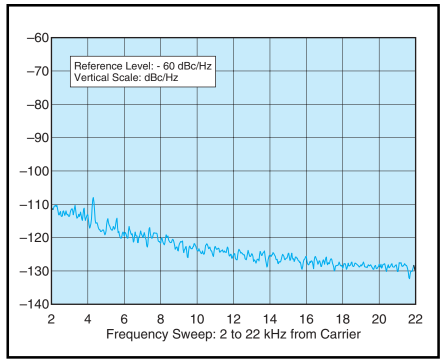



**Figure 4—Worst case spectral display of the FT-897 transmitter during HF composite-noise testing at 14.020 MHz. Power output is 100 W. The carrier, off the left edge of the plot, is not shown. The plot shows composite transmitted noise 2 to 22 kHz from the carrier.**

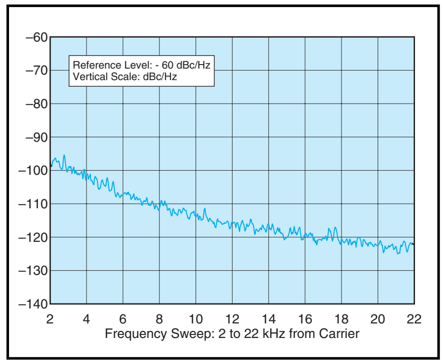



**Figure 5— Worst case spectral display of the FT-897 transmitter during UHF composite-noise testing at 432.020 MHz. Power output is 20 W. The carrier, off the left edge of the plot, is not shown. The plot shows composite transmitted noise 2 to 22 kHz from the carrier.**

with alphanumeric tags and hidden from memory scans. Memories can be grouped to simplify their management.

There are four "Home" memories, one each for HF, 6 meters, 2 meters and 70 cm. Each can hold frequency, mode, CTCSS, DCS and repeater-shift data as appropriate.

The Smart Search operation has a bank of 50 memories that hold results between searches. The Programmable Memory Scan function uses another five memory pairs (M-P1L/M-P1U through M-P5L/M-P5U).

## Battery and AC Power Systems

The provision for battery operation is one of the most attractive features of this radio. Removing the bottom cover reveals a compartment for two batteries or a 120-V ac switching power supply. Unfortunately, neither was available with the test radio, so information about them is taken from the operating manual.

The radio can hold two FNB-78 (13.2 V, 4.5 Ah) battery packs. Each should power the radio for about four hours of reception. Recharging also takes about four hours. The charger can charge one battery at a time and requires the operator to make charging-cable connections. The charger is simply a dc-dc converter that supplies 16.5 V from a user-supplied 12-V or 24-V source. The list price for two batteries and a charger is $360. (I've seen them on the Web for about $300.)

The ac power supply has its own switch. The manual instructs users to use both power switches in a specific sequence to operate the radio.

## A Look at the Numbers

An early unit of the FT-897 tested by the ARRL Lab did not exhibit a consistent dynamic range measurement, and transmit IMD performance was not good, even after a suggested alignment procedure. Yaesu attributes the failure of the alignment procedure to the absence of an "unrelated" design change in our early unit. This design change—a simple replacement of two resistors—was made early in production.

Subsequent units, representative of those currently on the market, performed quite well on the ARRL Lab bench—particularly well for a 100 W radio that retails for under $1000 without optional filters. Test results (with the optional YF-122C 500 Hz CW filter installed) are detailed in Table 1 and Figures 1 through 5.

The two-tone, third-order IMD dynamic range comes in at about 90 dB at 20 kHz signal spacing and the preamp off. When the spacing drops to 5 kHz, the IMD DR measurement drops to around 67 dB. Compare this 5 kHz measurement to Yaesu's other recent 100 W radio with a handle, the high-end and much heavier FT-1000 MP Mark V Field, and you will find similar performance. For a radio of its price class, the FT-897 does a very nice job of pulling out the weak ones in the presence of strong ones.

## Manual Disappointments

When I first received the'897, I thought it was broken. Although I set the dial tuning to fine and the SSB channel spacing to 2.5 kHz, the dial would only advance in 10-Hz and 5-kHz steps, respectively. I was very worried about this until I learned on the Web that it's an undocumented feature.

Based on this and some function descriptions that confused me, I think the manual needs more proofreading, explanations of how functions work and more detail about how to operate them. One section explains how to use the fold-down feet, but the FT-897 does not have fold-down feet. It has a bail, as shown on drawings throughout the manual.

The manual also needs an image of the LCD showing all icons and their meaning. For example, there's a small animation of a running person at the right of the meter scale. It took me a long time to find that the icon indicates the fast tuning rate. It's replaced by a key symbol when the dial lock is active. Both of the symbols are described in updated versions of the manual, Yaesu says.

Although memory grouping is a feature of the radio, I found no mention in the manual of how to group memories or how to use them.

In addition to basic operating instructions, the manual gives rules of thumb and tips. Some of these are very helpful.

### Miscellaneous Features

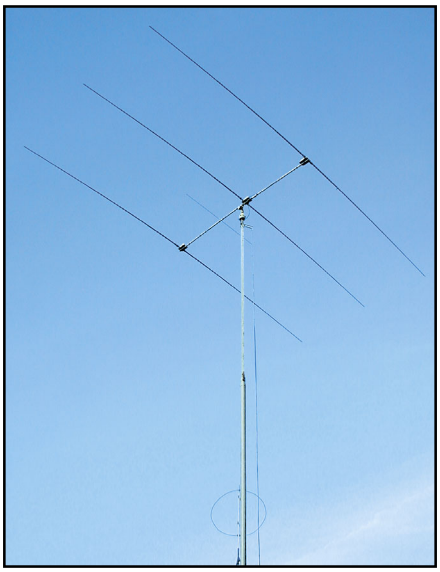
- The Dual Watch feature periodically switches the receiver from the frequency/mode of one squelched VFO to that of the other VFO.
- Priority Channel scanning functions much like Dual Watch. Memory channel M-001 is periodically checked, while you listen to a VFO or another memory channel.
- CW Training provides CW receiving practice via the sidetone with five-letter random groups of either letters or letters and numbers.
- The Beacon Feature lets you automatically send the Beacon Text 1 repeatedly at intervals up to 255 seconds.
- The '897 LCD backlight can be different colors to reflect the status of many radio parameters: ARTS status, band, memory group, VFO/Memory/home/QMB status or the meter indication.
- The auto-range transponder system (ARTS) uses DCS signaling to determine when another ARTS-equipped station is within range.
- The Spectrum Monitor function lets you view activity on frequencies above and below the tuned receive frequency. The receiver audio and S-meter are disabled while the Spectrum Monitor is operating.
- Smart Search scans the current band and stores active frequencies in temporary memories.
- The transverter function allows the user to set the display frequency to any arbitrary frequency up to 99,999 MHz. When using the '897 to drive a transverter, one can tune to a beacon or known frequency standard, set the display to that frequency, and proceed.

*Manufacturer:* Vertex Standard USA, 10900 Walker St, Cypress, CA 90630; tel 714-827-7600; **www.vxstdusa.com**. Price: $954. Optional accessories: YF-122S 2.3 kHz SSB filter, $169.95; YF-122C 500 Hz CW filter, $169.95; TXCO-9 high stability reference oscillator, $99; FP-30 clamp-on power supply, $209.95; ATAS-120 automatic antenna tuner, $329.95.

# SteppIR 3-element Yagi Antenna

*By H. Ward Silver, NØAX*
QST *Contributing Editor*

At the 2001 Dayton Hamvention, the new SteppIR Yagi with its adjustable-length elements set tongues wagging amongst HF operators. Two years later, the antenna is selling to hams around the world and interest continues to grow. Does it really work? Is it reliable? Is it worth the price?



### Description of Antenna and Design

The SteppIR is available as a dipole, or as a 2-element or 3-element Yagi covering 14 through 50 MHz. The 3-element model was tested for this review, including the optional 6-meter element. The key to the design is that the antenna elements are adjustable in length. Each element is made from a pair of copper-beryllium strips inside telescoping fiberglass tubes. A microprocessor-based controller in the shack and a stepper motor for each element adjust how much the strips extend into the tubes. This allows the antenna to be adjusted for optimum performance at any frequency within its design range.

Figure 6 shows the internal construction of the motor/element spool housing with the metal tape feeding into the element tube coupling. The sprockets are driven by a stepper motor that pushes and pulls the metal tapes into and out of the fiberglass tubes. Machined nylon tracks guide the tape as it goes on and off the storage reels.

The driven element on each configuration is adjusted for approximately 22 Ω impedance. A 2:1 toroidal impedance transformer is contained in the driven element motor housing to match 50-Ω feed line.

**Bottom Line**

The SteppIR Yagi packs excellent performance into a mid-sized, three-element package. The antenna is well-suited for tight-quarters and moderate tower/rotator combinations.

Antenna modelers and manufacturers have traditionally struggled with the necessary compromises for Yagi designs. Fixed element lengths and placement on the boom make it difficult to come up with designs that have acceptable gain, front-to-back ratio and VSWR across the amateur bands.

The SteppIR, by allowing variable-length elements, allows some of the design compromises to be avoided. A narrow-band design with good VSWR, gain, and front-to-back ratio is now acceptable because the adjustable element lengths allow the design frequency to be shifted at will. In fact, the SteppIR controller is programmed with dozens of separate antenna configurations that cover 14 through 50 MHz.

The controller is operated manually by front-panel buttons. To move the antenna's center frequency, a BAND button can be pressed to cycle between the configurations stored for the band. Fine-tune buttons direct the controller to make 25-kHz adjustments that interpolate between the stored designs. Eighteen custom frequencies can also be stored.

The controller can be connected directly to a transceiver with a serial port, and the antenna will follow you around the bands auto-magically. The SteppIR data interface can also be used if a logging program is connected to the radio by using a Y-cable to acquire the radio's data. The controller ignores frequencies from outside the range of the antenna, so if you are on 15 meters and jump to 40 meters, the antenna configuration stays as-is for when you come back.

## Special Features

Because the SteppIR's elements are adjustable, it offers two unusual features: "180° Mode" and "Bi-Directional Mode." 180° Mode allows the operator to reverse the beam pattern so that it "points" in the opposite direction from the Normal Mode configuration. Because the three elements are spaced nearly equally, performance is approximately equivalent to Normal mode when the pattern is reversed. Bi-Directional Mode changes the reflector element to a director so that the antenna beams power in both directions at once—like a pair of 2-element beams.

If you like, you can make adjustments to the stored configurations or even store your own antenna designs. Adjusting the factory-default element lengths is useful if nearby antennas or conductors raise the SWR or if the antenna height is low. If you use an SWR analyzer, you can adjust the antenna in real time while watching the meter.

Retracting the elements for disassembly or protection is also easily done from the controller front panel. Since the elements are internal to the fiberglass tubes, it doesn't change the mechanical shape of the antenna.

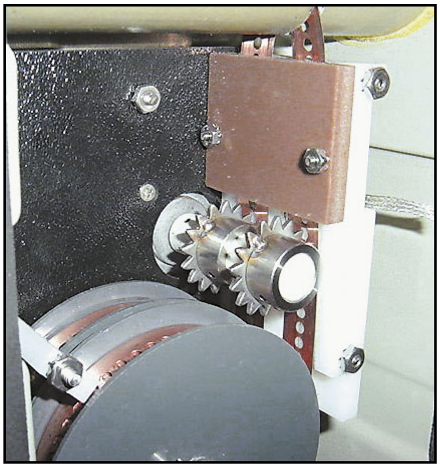


**Figure 6—The internal assembly of a SteppIR motor housing. You can see the motor drive sprockets, the copper-beryllium tape spools and the unwound tape feeding into the tube coupling.**


**Figure 7—The SteppIR controller and the Bird wattmeter used during testing.**

## Assembly Process and Instructions

The antenna I built and tested is a 3-element Yagi with the 6-meter fixed element, and a transceiver data interface. The antenna is mounted on a 55-foot crank-up mast with a HAM-IV rotator. The antenna is fed with 100 feet of RG-213/U.

I did not require optional the Boom Slide assembly fixture, which allows the antenna to be assembled on a tower or mast. The fixture would be very handy if sufficient assembly space was not available, but I used a portable workbench to hold a short piece of pipe on which I assembled the antenna.

Total assembly time was a little over three hours. Others report shorter times, but I was taking it slow to review the manual as well as get the antenna together. The antenna arrives in a carton a little over 5 feet long and with the various assemblies and hardware collections bagged or wrapped. Shipping weight of the antenna is about 50 pounds. The boom pieces are 48 inches long, so the antenna pieces should fit into a ski bag for transport.

No parts were missing or extra. Having assembled a number of Yagi antennas over the years, I was pleasantly surprised at the low number of parts. The hard part of the assembly—inside the motor housings, which are self-contained—is done by SteppIR.

Instead of a checklist of instructions, the instructions are part of a text description that provides some background and explanation. Personally, I would prefer that the text and specific instructions be separated, but the necessary information is all there. I recommend that the builder read through the entire process carefully and highlight significant procedures. Assembling this antenna is quite different from the usual plumber's-delight all-aluminum antenna.

The manual, currently under revision, includes useful color photographs that illustrate some of the more involved steps. There is a control cable for each motor housing, and these must be carefully dressed on the boom and around the boom-to-mast mounting plate. It helps to visualize how the cables and feed line will lie before taping them to the boom.

When the fiberglass tubes are completely extended, electrical tape and self-vulcanizing tape are used to seal the joints. SteppIR provides a premium brand of tape, and it's easy to wrap each joint with a clean-looking covering. If you haven't used the self-vulcanizing tape before (I hadn't on an antenna), it's not immediately

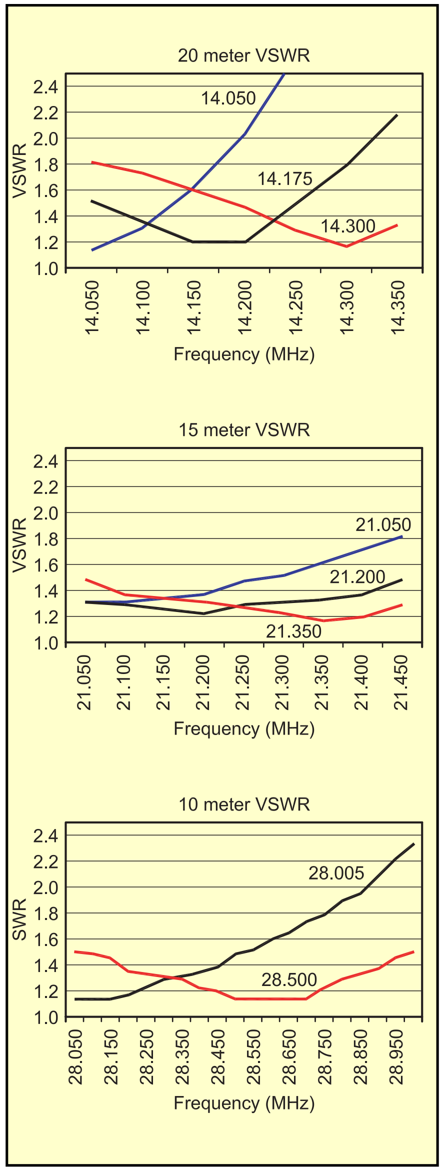



**Figure 8—SWR curves on 20, 15, and 10 meters for the SteppIR 3-element Yagi as assembled using the labeled factory default settings. VSWR on 12 meters was 1.1:1 across the band. VSWR on 17 meters was 1.4:1 at 18.100 MHz and was adjusted to 1.3:1 using the Modify function on the driven element.**

obvious how much to stretch the tape or how well it will self-adhere. You might want to get some of your own and practice, as it will be difficult to rewrap the joints once the antenna is in the air.

Getting the antenna onto the mast and rotator wasn't much of a problem, although one of the element tips had a disagreement with the roof that would likely have bent or broken an aluminum tube. There are some scratches on that tip, but it was undamaged. If any segment of the tubes is damaged, the entire telescoping assembly must be replaced—they cost $30 separately. The antenna was easy to lift into place with a gin pole and the job can be done single-handed.

## On the Air Performance

As of this writing, I've had the antenna up a little over three weeks and have several hundred contest QSOs (ARRL DX CW and SSB) in the log using the SteppIR. If there is a drawback at all, it's that using the 180° Mode and Bi-Directional Mode are so interesting that one tends to fiddle with them unnecessarily.

Figure 8 shows line graphs of VSWR versus frequency for several of the default antenna configurations. The graphs' legends show the frequency at which the configuration is optimized. Changing to 180° or Bi-Directional Mode raises SWR a small amount—not enough to consider retuning the antenna. Figure 7 shows the controller and my wattmeter.

As you can see, the SWR curves, while not broadbanded, are not so sharp as to require frequent re-tuning as one prowls the bands. In fact, were SWR the only criteria for performance, one setting would suffice on all bands except 20 meters. Changing the configuration frequency affects forward gain much less than an S-unit (6 dB) except for extremely wide changes. Antenna tuning really comes into play in the front-to-back ratio. This can be observed by tuning in a station off the front of the beam and then activating 180° Mode. After the antenna changes direction, changing the configuration frequency causes much bigger changes in front-to-back than in forward gain.

Forward gain was about equivalent to a three-element monoband Yagi. Front-to-back (F/B) ratio, which depends on the signal's angle of arrival, was unexpectedly good. The best performance was on 20 meters, where F/B ranges from 2 to 7 S units. On the remaining HF bands, F/B ranges from 2 to 5 S units.

The 180° Mode can almost make a signal disappear in a couple of seconds. This was really handy when I was trying to switch between working JA and Caribbean stations. Because those two parts of the world were obviously having trouble hearing each other, the interference at my location was often fierce. Instead of wearing out my rotator swinging the beam back and forth, it was easy to switch directions and work the desired station in a few seconds. At its peak, the SteppIR's front-to-back ratio is exceptionally good.

A very useful technique is to put the SteppIR in Bi-Directional Mode while tuning across a band and then switch to the desired direction when a station is found. Often, I could work the station in Bi-Directional mode without changing—it's like having a stack of 2-element Yagis.

How long does switching directions take? When switching from Normal to 180° Mode, the longest delay I experienced was 3 seconds on 20 meters, when changing element lengths took the most steps. The worst case HF frequency change—from 14.050 to 29.9 MHz—took 14 seconds. Changing the antenna configuration does create a low noise level while the motors are running.

An "unintended consequence" of a variable-length element, several SteppIR owners have discovered that the antenna can act as a "tunable top-hat." Changing the frequency of the SteppIR will affect the tuning of a shunt-fed tower or wire antenna attached to the tower. Depending on your situation, this can be either a bonus or a problem, but those reporting the effect have generally been able to make good use of it.

I have been unable to really put the 6-meter portion of the antenna to much of a workout, as I've been unable to find any sporadic-E openings here in the dead of winter. I've checked out the antenna on some local repeaters and some mobile stations. It acts like a beam and hears a lot better than the discone antenna I was using previously.

## Operating Manual

Given the amount of electronics involved with the SteppIR, the operating manual is not thick and is written in a conversational style. Assembly covers 9 pages and the instructions for using the controller fill another 10 pages. Each operating mode is explained in detail, with the operating instructions mixed in with the text. This is a bit of a drawback for finding the instructions once you've read the manual. (You do read the manual, don't you?) It would probably be more user-friendly to bundle the descriptions together and keep the actual instructions in a step-by-step format.

Sections on the antenna's design and modeling which discuss the design philosophy and how it affects the antenna's operating characteristics. Schematics of the controller or motor assemblies are not provided.

## Reliability

I contacted SteppIR owners in hot, cold, windy and salty places. One in New Brunswick and another in North Carolina both had experienced rather severe ice and snow loading under windy conditions without any mechanical problems. Both reported little effect on the antenna's electrical performance even when coated with ice and sagging 3 to 4 feet at the tips.

Another owner used his SteppIR dipole in San Diego for a year without the tip sections of the fiberglass tubes installed. The element tapes extended into the open air and hung down below the antenna. The resulting salt and dust exposure did not seem to affect it. He's purchased another one for use in Texas. A separate Texas owner reports that the antenna "ignores ice." Two local owners here in Washington near salt water have not experienced any degradation after a wet year of installation near Puget Sound.

What has not been conclusively answered is the antenna's ability to withstand prolonged periods of strong wind and exposure to ultraviolet radiation. We'll have to wait for some time to have a good answer to those questions. However, the materials and construction appear to be properly rated for those environments.

## Summary

Every antenna has a few "I wishes" and here are mine. I wish the feed line connector were offset from the control cable on the center housing so it would be easier to tighten and waterproof. I wish there were a little more self-vulcanizing tape so that I had a little extra for a practice wrap. I wish the fiberglass tubes had a more positive lock so that you could be sure you had them fully extended (you can measure, though). I wish the designers could make it beam sideways, too!

The SteppIR is not a cheap antenna compared to other tribanders. Is it worth the cost? The SteppIR provides good performance out of its physical package. Particularly for someone with restricted space and tower/rotator capabilities or replacing an older tribander, the SteppIR should get a close look.

*Manufacturer*: SteppIR Antennas, 14135 233rd Pl SE, Issaquah, WA 98027; tel 877-885-8700 or 425-456-0200, fax 425-391-6031; **sales@steppir.com**; **www.steppir.com**. Manufacturer's suggested retail price: 3-element SteppIR Yagi, $1099; Transceiver interface kit, $60; BoomSlide assembly fixture, $70; extended warranty, $35/year.