Product Reviews

August 2023

MFJ-1898 Portable HF 6-Meter Antenna

ICOM IC-T10 Dual-Band Handheld Transceiver

Pascal Villeneuve, VA2PV, va2pv@arrl.org

Product Review

Yaesu FT-710 AESS MF/HF and 6-Meter Transceiver

Reviewed by Mark Wilson, K1RO
k1ro@arrl.net

The FT-710 is Yaesu's newest and least expensive software-defined radio (SDR) transceiver. Unlike the higher-priced FT**DX**10 and FT**DX**101D/MP, it's a direct-sampling SDR rather than a hybrid design with roofing filters. The FT-710 covers 160 through 6 meters, with a 100 W transmitter, excellent receiver performance, and a wide range of useful features including a high-resolution, 4.3-inch TFT color touchscreen.

The shipping box includes the FT-710, an SP-40 external speaker and hardware to mount the speaker to the side of the radio, a dc power cable, an SSM-75E hand microphone, a spare fuse, and a printed operation manual. The Acoustic Enhanced Speaker System (AESS) and SP-40 speaker offer surprisingly good-sounding audio from a small package. The radio requires a 13.8 V dc power source at about 20 A. See Table 1 for more details.

Initial Setup

As with all modern radios, it's a good idea to check the firmware version in your new FT-710 and see if a later version is available from Yaesu's website. An SD memory card slot on the left side of the FT-710 is used for firmware updates, storing received audio files and transmitted voice messages, saving radio settings and memory contents, and saving screen captures from the display. You'll need to provide an SD card, and the card must be formatted in the radio before use.

Although the FT-710 is highly customizable through menu settings, the default settings are fine for getting started on the air right away. Menu labels are self-explanatory, but the well-illustrated manual goes into quite a bit of detail about the various settings and choices.

The rear panel connections include an SO-239 antenna jack and four-pin power jack (see Figure 1). The FT-710 can be programmed to automatically tune an accessory like the ATAS-120A multi-band auto-tuning mobile antenna when connected to the SO-239 antenna jack. The **EXT SPKR** jack is for the SP-40 external speaker. The **KEY** connector works with the internal CW keyer or with an external keyer (menu selectable). This jack requires a stereo 3.5-millimeter plug, with the tip used for external keying devices. The 3.5-millimeter **REM/ALC** jack can be used with the optional FH-2 remote keypad or for automatic level control (ALC) connection with an external power amplifier.

The eight-pin mini-DIN **TUNER/LINEAR** jack has several menu-selectable functions. It can be used with Yaesu's optional FC-40 automatic antenna tuner, for transmit-receive (TR) switching with an external linear amplifier, or as an additional computer-aided transceiver terminal. Band data for controlling external filters, antenna switches, or other devices is available at this jack as well.

Amplifier switching is relay-based, and quiet clicking is audible when this function is selected for the **TUNER/LINEAR** jack. The **QSK DELAY** menu sets the time be-

Bottom Line

Although it's Yaesu's least expensive SDR, the FT-710 AESS offers features and performance rivaling more expensive radios. With 160- to 6-meter all-mode coverage, it could be the centerpiece of many home or portable stations.

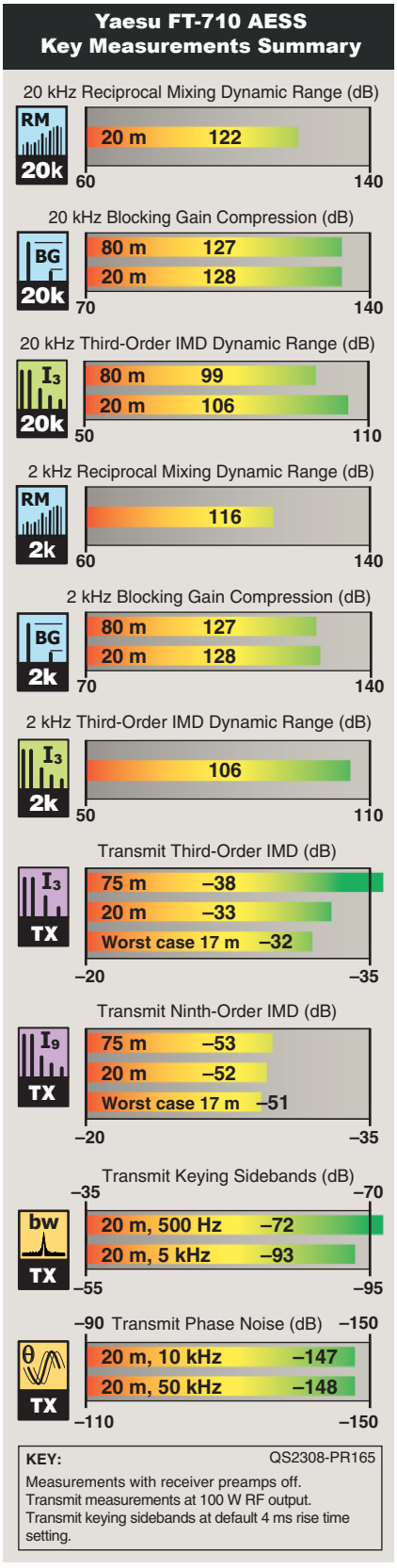


Table 1
Yaesu FT-710 AESS, serial number 2K030972, SP-40 External Speaker, serial number 2K003
Main Firmware – V01-09, Display – V01-07, SDR – V01-04

Manufacturer's Specifications

Frequency coverage: Receive, 0.030 – 75 MHz; transmit, 1.8 – 54 MHz (amateur bands only).

Power requirements: 13.8 V ±15%; receive, 1.8 A with no signal, 2.2 A with signal present; transmit, 21 A at 100 W RF output.

Modes of operation: SSB, CW, AM, FM, FM-N (FM narrow).

Measured in the ARRL Lab

Receive and transmit, as specified. Five CW and five SSB memory channels programmed for 60-meter operation.

At 13.8 V dc: receive, max. brightness, max. volume, no signal, 1.4 A; transmit, 18.2 A (typical) at 100 W RF output; 6.0 A at 5 W output. No change in RF output at minimum specified supply voltage.

As specified.

Receiver

SSB/CW sensitivity, 10 dB (S+N)/N, 2.4 kHz filter, preamp 2 on:
0.16 µV (1.8 – 30 MHz);
0.125 µV (50 – 54 MHz).

Receiver Dynamic Testing

Noise floor (MDS), 500 Hz bandwidth:

Preamp	*Off dBm/µV*	*P1 dBm/µV*	*P2 dBm/µV*
0.137 MHz	–85/12.0	–95/3.8	–94/4.4
0.475 MHz	–108/0.90	–117/0.30	–125/0.13
1.0 MHz	–112/0.57	–121/0.19	–129/0.08
3.5 MHz	–126/0.11	–135/0.04	–141/0.02
14 MHz	–127/0.10	–136/0.04	–142/0.02
50 MHz	–129/0.08	–139/0.02	–142/0.02
70 MHz	–125/0.13	–135/0.04	–138/0.03

Noise figure: Not specified.

Preamp off/1/2: 14 MHz, 20/11/5 dB; 50 MHz; 18/8/5 dB.

AM sensitivity: 6 kHz BW, 10 dB (S+N/N), 30% modulation, 400 Hz tone:
6.3 µV (0.5 – 1.8 MHz, preamp off);
2 µV (1.8 – 30 MHz, preamp 2 on);
1 µV (50 – 54 MHz, preamp 2 on).

10 dB (S+N)/N, 1-kHz tone, 30% modulation, 6 kHz BW:

Preamp	*Off dBm/µV*	*P1 dBm/µV*	*P2 dBm/µV*
1.02 MHz	–81/19.7	–91/6.5	–99/2.6
3.88 MHz	–95/4.0	–104/1.4	–111/0.64
50.4 MHz	–98/2.7	–108/0.88	–110/0.68
70 MHz	–95/4.1	–105/1.3	–108/0.92

FM sensitivity: 12 dB SINAD, 12 kHz BW, 3.5 kHz deviation, preamp 2 on:
0.25 µV (28 – 30 MHz);
0.20 µV (50 – 54 MHz).

For 12 dB SINAD, 3 kHz deviation, 12 kHz BW:

Preamp	*Off dBm/µV*	*P1 dBm/µV*	*P2 dBm/µV*
29 MHz	–105/1.20	–115/0.42	–121/0.20
52 MHz	–108/0.90	–118/0.29	–120/0.22
70 MHz	–105/1.33	–114/0.43	–117/0.31

Spectral display sensitivity: Not specified.

Preamp off/P1/P2 (default sensitivity): waterfall, –106/–113/–125 dBm; 3DSS, –108/–117/–128 dBm.

Blocking gain compression dynamic range: Not specified.

Blocking gain compression dynamic range, 500 Hz BW:*

Preamp	*20 kHz offset Off/P1/P2*	*5/2 kHz offset Preamp off*
3.5 MHz	127/127/122	127/127 dB
14 MHz	128/128/122	128/128 dB
50 MHz	125/126/117	125/125 dB

Reciprocal mixing dynamic range: Not specified.

3.5 MHz, 20/5/2 kHz offset: (preamp off) 118/114/113 dB; 14 MHz, 20/5/2 kHz offset: (preamp off) 120/117/116 dB; 50 MHz, 20/5/2 kHz offset: (preamp off) 118/115/111 dB.

Two-Tone Intermodulation Distortion (IMD) Testing (500 Hz bandwidth)

Band/Preamp	*Spacing*	*Measured IMD Level*	*Measured Input Level*	*IMD DR*
3.5 MHz/Off	20 kHz	–126 dBm	–27 dBm	99 dB
14 MHz/Off	20 kHz	–127 dBm	–21 dBm	106 dB
14 MHz/P1	20 kHz	–136 dBm	–29 dBm	107 dB
14 MHz/P2	20 kHz	–142 dBm	–37 dBm	105 dB
14 MHz/Off	5 kHz	–127 dBm	–21 dBm	106 dB
14 MHz/Off	2 kHz	–127 dBm	–21 dBm	106 dB
50 MHz/Off	20 kHz	–129 dBm	–29 dBm	100 dB
50 MHz/P2	20 kHZ	–142 dBm	–45 dBm	97 dB

Manufacturer's Specifications Receiver	Measured in the ARRL Lab Receiver Dynamic Testing
FM adjacent channel rejection: Not specified.	P1 on: 29 MHz, 89 dB*; 52 MHz, 85 dB.*
FM two-tone third-order IMD dynamic range: Not specified.	20 kHz offset, P1 on 29 MHz, 85 dB; 52 MHz, 85 dB; 10 MHz offset, P1 on 29 MHz, 105 dB.
DSP noise reduction: Not specified.	Best case: DNR level 3: 11.5 dB @ S-7 input.
Notch filter depth: Not specified.	Adjustable manual notch, 0.2 to >70 dB.
S-meter sensitivity: Not specified.	S-9 signal, preamp off/P1/P2: 14 MHz, 86.0/29.8/8.31 µV; 50 MHz, 87.0/28.5/8.12 µV.
Squelch sensitivity: Not specified.	At threshold, FM, P1 on 29 MHz, 0.25 µV; 52 MHz, 0.19 µV; 14 MHz SSB, P1 on 5.88 µV.
Receive bandwidth: Not specified.	Range at –6 dB points:† CW (500 Hz BW), 448 – 949 Hz; SSB (3 kHz BW), 108 – 2894 Hz; AM (4 kHz BW), 73 – 4136 Hz.
Audio output: 2.5 W into 4 Ω at 10% THD.	As specified. THD 0.20% at 1 V_{RMS}.
Receive processing delay time: SSB mode. Not specified.	25 ms.

Transmitter	Transmitter Dynamic Testing
Power output: 5 to 100 W (AM, 5 to 25 W).	As specified.
Spurious-signal and harmonic suppression: ≥50 dB (HF); ≥63 dB (50 MHz).	HF, >70 dB typical; worst case, 62 dB (30 m); 50 MHz, 73 dB. Complies with FCC emission standards.
Third-order IMD products: Not specified.	3rd/5th/7th/9th order, 100 W PEP: 3.5 MHz (–38/–38/–44/–53 dB); 14 MHz (–33/–37/–42/–52 dB); 50 MHz (–32/–41/–48/–54 dB); worst case, 17 m (–32/–36/–41/–51 dB); at 50 W PEP RF output: 14 MHz (–34/–40/–51/–52 dB); 50 MHz (–40/–43/–55/–55 dB).
CW keyer speed range: Not specified.	4 to 60 WPM, iambic mode A, B, Y, semiautomatic (bug).
CW keying characteristics: Not specified.	See Figures A and B.
Transmit-receive turnaround time (PTT release to 50% audio output): Not specified.	S-9 signal, AGC fast, SSB: 33 ms; AGC fast, CW, full break-in: 64 ms.
Receive-transmit turnaround time (TX delay): Not specified.	SSB, 21 ms; FM, 21 ms (29 MHz), 20 ms (52 MHz).
Transmit phase noise: Not specified.	See Figure C.
Amplifier key line closure to RF output: Not specified.	15 ms.

Size (height, width, depth, including protrusions): 3.1 × 9.4 × 9.7 inches.

Weight: 9.92 pounds.

"Preamp off" measurements are with the Intercept Point Optimization (IPO) setting.
*Measurement was noise limited at values indicated.
†Default values; bandwidth is adjustable via DSP.

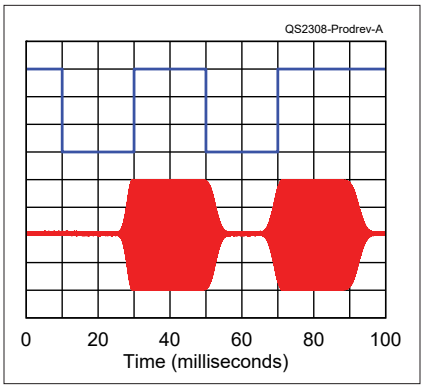


Figure A — CW keying waveform for the Yaesu FT-710 showing the first two dits using external keying. Equivalent keying speed is 60 WPM. The upper trace is the key closure; the lower trace is the RF envelope. Horizontal divisions are 10 ms. The transceiver was being operated at 100 W output on the 14 MHz band, using QSK set to 15 ms. The first-dit rise time is 2.5 ms; the fall time is 3.9 ms. The second-dit rise time is 3.6 ms; the fall time is 4.7 ms. The first-dit on delay is 18 ms; the off delay is 22.7 ms. The second-dit on delay is 18.8 ms; the off delay is 22.6 ms.

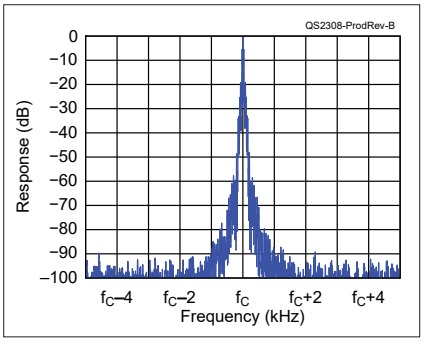


Figure B — The spectral display of the Yaesu FT-710 transmitter during keying sideband testing. Equivalent keying speed is 60 WPM using external keying and the default rise time setting. Spectrum analyzer resolution bandwidth is 10 Hz, and the sweep time is 30 seconds. The transmitter was being operated at 100 W PEP output on the 14 MHz band, and this plot shows the transmitter output ±5 kHz from the carrier. The reference level is 0 dBc, and the vertical scale is in dB.

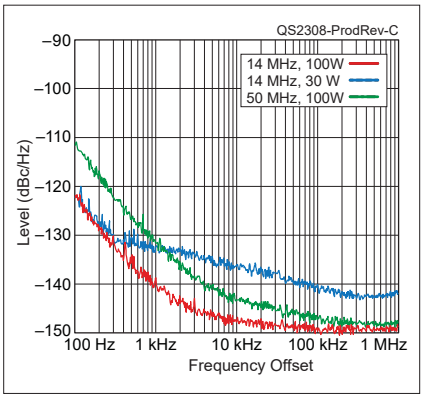


Figure C — The spectral display of the Yaesu FT-710 transmitter output during phase-noise testing. Power output is 100 W on the 14 MHz band (red trace), 30 W on the 14 MHz band (blue trace), and 100 W on the 50 MHz band (green trace). The carrier, off the left edge of the plot, is not shown. This plot shows phase noise 100 Hz to 1 MHz from the carrier. The reference level is –90 dBc/Hz, and the vertical scale is 10 dB per division.

Lab Notes: Yaesu FT-710 AESS MF/HF and 6-Meter Transceiver

The Lab testing of the FT-710 started out well, but I quickly noticed there was a problem. Some of the receiver dynamic range measurements did not meet the manufacturer's specifications. (This was surprising, because the Lab had tested a prototype receiver sent to us by Yaesu, and it had passed receiver specs with flying colors.) After we discussed the issue with Yaesu, they asked us to send our unit to them for evaluation. Yaesu discovered there were defective components in the SDR unit. Yaesu replaced the SDR unit in our radio and promptly shipped it back to us. The measurements performed on the repaired radio yielded results that were much better, easily meeting the manufacturer's specification. The sensitivity and dynamic range are very good, especially for a transceiver at this price point.

Transmit IMD is also very good at 100 W and, as expected, gets better as you reduce output power. This is important to operators who will be driving an amplifier with the FT-710.

Those of you who are familiar with Yaesu transceivers of late may notice that the CW rise/fall-time setting options, which Yaesu calls "CW Wave Shape" in the menu of the FT-710, are now 2, 3, and 4 ms, as opposed to the 4, 6, and 8 ms of some prior Yaesu rigs. When the Lab measured the rise and fall times, the measured times were much faster than the menu settings showed. The new times in the latest version of Yaesu's firmware (which you should, of course, download to your radio!) reflect more closely the actual rise times. The bottom line here is that you should leave the default setting of 4 ms, which produces a nice waveform without objectionable key clicks. Yaesu even warns in the operating manual (page 87 in the current version) that changing from the default setting may cause key clicks.

The very good transmit and receive performance, combined with the plethora of ways in which you can customize the 3DSS display to visually see those signals down in the weeds, should make this a great radio for newer hams to start using and grow into, as well as more experienced hams who appreciate and regularly use some of its more advanced features. — *George Spatta, W1GKS, ARRL Lab Manager*

tween when the amplifier control switches and RF output appears at the FT-710 antenna jack. This delay allows time for amplifier relay contacts to settle before the radio starts to transmit, preventing damage from hot switching. Although the menu name suggests that this setting is for full break-in (QSK) CW operation, the manual clearly states that the delay is effective for all modes.

A six-pin mini-DIN **RTTY/DATA** jack can be used with an external digital mode data controller or sound card for digital modes. Connections for fixed-level receiver audio output, frequency shift keying (FSK) RTTY, audio input for sound card modes, and PTT control are available.

A fan in the center of the rear panel keeps the radio cool. In my station, the fan came on after about 15 minutes of receive-only operation, and it stayed on much of the time after that. The fan speed seemed to stay constant whether I was transmitting heavily or just receiving. In a quiet room, the fan noise seems loud, but I didn't find it bothersome with other equipment running and the radio volume turned up to listen to signals.

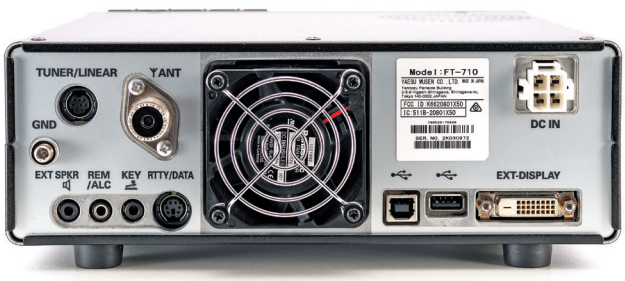


Figure 1 — The FT-710 rear panel.

Next to the fan are USB-B and USB-A jacks. The USB-B connector is for connection to your station PC, and the USB-A connector can be used with a keyboard or mouse to select items on the display or enter characters. The mouse cursor speed is adjustable, and I found using a mouse to be more accurate than my fingertip for selecting signals on the touchscreen spectrum display.

After installing the USB driver (available at **www.yaesu.com**), connect the radio to your PC with a standard USB-A to USB-B cable, and apply power to the radio. In your PC's **DEVICE MANAGER** screen, look under **PORTS (COM & LPT)** for **SILICON LABS DUAL CP2105 USB TO UART BRIDGE**. There will be two new virtual COM ports with COM port numbers, one "standard" and the other "enhanced." You'll use these COM port numbers when configuring logging, digital mode, and other software.

The **EXT DISPLAY** jack is a DVI-digital (DVI-D) connector for using an external monitor to show the contents of the FT-710 display. It looked good on my older

20-inch wide-screen computer monitor using the 800 × 600 pixel setting. Note that current-generation monitors tend to have HDMI and/or DisplayPort interfaces instead of DVI-D. You can easily find online a DVI-D-to-HDMI adapter.

Receiver and Transmitter Settings

Receiver bandwidth filtering is adjustable for each mode, with a menu-settable narrow filter available with a press of the **NAR** button. Additional interference mitigation is available through use of the **IF SHIFT**, **NOTCH**, **CONTOUR**, and audio peak filter (**APF**) settings along with the digital notch filter (**DNF**) for automatically attacking AM broadcast carriers and other steady tones.

The FT-710 offers adjustable DSP noise reduction (**DNR**) and noise blanker (**NB**) features. **DNR** has 15 possible settings, but with early versions of the firmware I heard distortion and watery-sounding audio at settings greater than 3. A firmware update in late March 2023 greatly improved **DNR** operation, eliminating the watery sound in settings 1 to 7. Higher settings offer increased noise reduction that's very effective, but with varying degrees of the watery sound. Audio quality at the higher settings can be improved to some degree by lowering the RF gain and/or adjusting the **CONTOUR** filter shape.

You can tailor receiver audio separately for each mode with adjustable bass/mid/treble settings and low- and high-frequency cutoff filters. While listening with the speaker, there is very little audio output until the **AF GAIN** control reaches the nine o'clock position, and then volume suddenly increases. Listening with headphones, there is an audible pop as you start to increase volume, but there is more control at low audio levels.

The AESS feature blends the audio from the FT-710's internal top-facing speaker with audio from the SP-40 mounted on the side of the radio. You can adjust the balance between the two speakers using the AESS setting and the function knob. The internal speaker on its own has plenty of range, and the SP-40 seems to add more depth to the mid range. I didn't hear the "three-dimensional acoustical effect" described in the manual, but I thought that the two speakers working together sounded good.

Transmitter power is adjustable in 1 W steps. The minimum power output is 5 W, and from a menu you can set the maximum power output separately for HF, 6 meters, and AM mode.

The internal antenna tuner is rated for loads from 16.7 to 150 Ω (3:1 SWR) on 1.8 to 30 MHz, and 25 to 100 Ω on 6 meters. I had no trouble matching my antennas, which have an SWR of 2.5:1 or less across the bands. Antenna tuner settings are memorized, so tuning is nearly instantaneous after the initial tune.

Touchscreen and Settings

The 4.3-inch color touchscreen on the left side of the front panel shows all sorts of useful information (see Figure 2). Brightness, contrast, colors, and screen-saver options are available in the menus. The meter in the upper left corner looks and acts like a traditional analog meter. The default meter scales are transmit power and receive signal strength. Touch the meter area on the screen to change the lower scale to monitor compression level, ALC, drain voltage, drain current, or SWR.

To the right of the meter are displays of frequency and mode for the two VFOs. Below the VFO B information is a display showing signals in the receive filter passband. The graphic changes with adjustments to the filter bandwidth, shift, notch filter, or contour filter controls.

Pressing the function (**FUNC**) knob brings up a screen to access many of the radio's settings (see Figure 3). Touching the label for a parameter such as **RF POWER** or **CW SPEED** allows adjustment by rotating the **FUNC** knob, and that parameter remains adjustable after you return the screen to normal operation. Touching any of the **SETTING** labels across the bottom of the screen brings up another menu screen with more options. While experimenting with different settings, I found it helpful that default values are indicated in bold type in the manual and in a different color on the screen.

For the most part, menu functions are obvious from the labels, and the operation manual does a good job

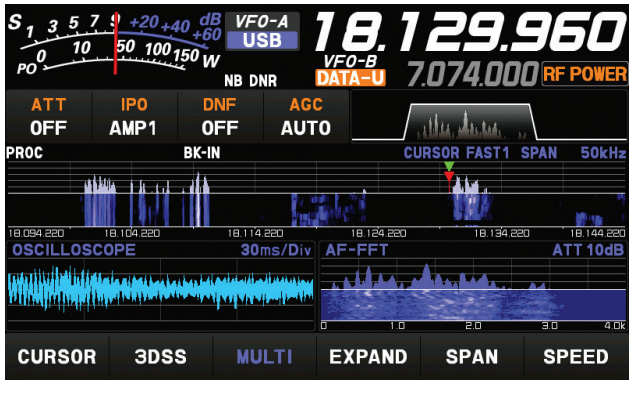


Figure 2 — The FT-710's high-resolution 4.3-inch touchscreen packs a lot of information into a small space.

Figure 3 — Pressing the **FUNC** knob brings up a screen to access many of the radio's settings. Touch one of the onscreen labels, and rotating the **FUNC** knob adjusts that function even after the screen returns to normal operation. In this case, **RF POWER** is selected. The blue **SETTING** labels at the bottom bring up additional menus for parameters that are adjusted infrequently.

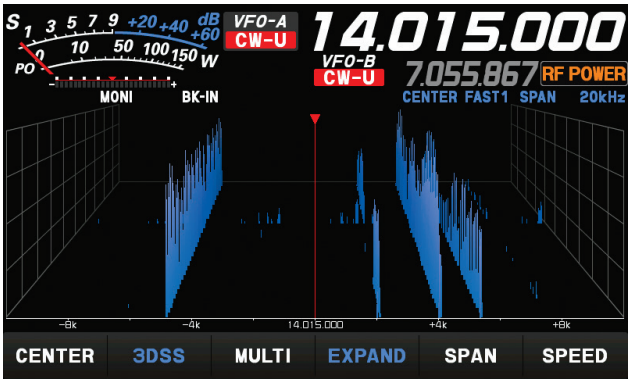


Figure 4 — The **3DSS** setting changes the spectrum scope to a three-dimensional view with signals marching off the back of the screen over time. A standard waterfall display is available when the 3D view is deactivated.

of explaining what each one does. It didn't take long to become comfortable navigating the menu system, settings, and controls. I did notice that some pop-up screens disappear after about 3 to 5 seconds if you don't make a selection.

Like the FT**DX**10 and FT**DX**101D/MP, the FT-710's band scope can show a traditional panadapter/waterfall display, add inset displays of the received audio with both oscilloscope (time versus amplitude) and spectrum analyzer views, or switch to the 3DSS three-dimensional view (shown in Figure 4) with time marching out the back of the screen. Frequency span, sweep speed, sensitivity, colors, and other parameters are adjustable.

The cursor in the spectrum display shows the tuned frequency. In addition to using the tuning knob, you can tune to signals in the display by touching the screen or by using a mouse if you have one connected to the FT-710's rear panel USB port. In **CENTER** mode, the cursor (received frequency) is fixed at the center of the screen, and the waterfall moves left or right as you tune. In this mode, signals shown in the waterfall skew as the waterfall moves. In **CURSOR** mode, the waterfall is static and the cursor moves as you tune. When the cursor reaches the left or right side of the screen, the waterfall scrolls to keep up. In **FIXED** mode, the selected frequency range in the waterfall doesn't move when the cursor reaches the side of the screen. Icons light up to indicate that you have tuned outside the fixed range.

The spectrum display would benefit from averaging capability. Signal peaks come and go very quickly. With averaging, weaker signals would slowly grow out of the noise at the bottom of the screen, making them easier to find.

Voice Operation

The FT-710 offers SSB, AM, and FM voice operation. Extensive customization of the transmitted audio characteristics is possible using a three-band parametric equalizer. Separate equalizer settings can be stored for use with the speech processor off or on, making it easy to switch between mellow audio for conversation or punchy audio for DXing or contesting. On-air reports indicated that the FT-710 sounded good when used with either the supplied hand microphone or my INRAD W1 headset.

On SSB, the transmit filter bandwidth menu offers several options, ranging from 400 – 2600 Hz to 50 – 3050 Hz. The default setting of 50 – 3050 Hz worked just fine for me. Separate transmit bandwidth settings are available for AM and data modes.

With the current solar cycle progressing, 10 meters has been hot, and that's sparked renewed interest in 10-meter FM at the high end of the band. The FT-710 is ready for FM operation on 10 or 6 meters, either simplex or on repeaters using the **RPT SHIFT** feature to set a repeater offset. CTCSS tone encoding and decoding are available for repeater access.

You can record up to five voice messages for transmission. Maximum recording time is 90 seconds per message, and messages are stored on the SD card. Record and playback functions can be controlled from the touchscreen or from the optional FH-2 external keypad. You can also record received audio, up to a maximum of 16 hours per file, using the SD card for storage. File selection and playback options are handled from the touchscreen, if you want to listen to recordings using the FT-710. I didn't see mention of a way to play back recorded audio on the air. Recordings are standard

.wav files, so I was able to copy them from the SD card and play them on my desktop computer. This is a great way to document memorable QSOs.

CW Operation

The FT-710 supports semi break-in CW operation with adjustable delay or full break-in CW (QSK). TR switching is relay based, so you can hear relay clicking but it's very quiet. Typical of relay-based TR systems, I found that QSK worked well up to 20 WPM or so. Above that speed I could not really hear received audio between characters.

The built-in CW keyer offers iambic modes A and B, a bug mode that generates dots only (dashes sent manually), and a couple of other modes described in the manual. Keyer speed can be adjusted from 4 to 60 WPM, weight is adjustable, and dot/dash paddle polarity can be switched from a menu. There are five CW message memories with up to 50 characters each, and memories can include incremental serial numbers for contests.

CW pitch is adjustable, and there are several useful tuning aids. Press the **ZIN/SPOT** switch with a signal in the passband, and the radio automatically tunes the received signal to the correct pitch. Alternatively, you can press and hold that switch to generate a tone that corresponds to the pitch of your transmitted signal, then tune your receiver until the tone of the received signal matches. A tuning offset indicator (a row of dots below the meter on the display) gives a visual indication of the pitch of the received signal, and you can also see the received signal in the onscreen passband display.

Digital Modes

For digital mode operation, you can connect an external computer to the FT-710 through the USB port and use the radio's internal sound card for FT8, FT4, PSK, MSK144, AFSK RTTY, SSTV, or any other sound card modes. The FT-710 does not have built-in RTTY, PSK, or CW decoders and transmit message memories like the FT**DX**10.

Setup couldn't be simpler. After installing the USB driver, install a USB cable between the radio and the computer. When power is applied to the radio, **USB AUDIO DEVICE** shows up as a sound device on the computer. I selected that device for receive and transmit audio in the *WSJT-X* **SETTINGS** menu. The sound card modes use the FT-710's **DATA-U** mode. Touching the onscreen **PRESET** button configures the radio for FT8 operation.

Final Thoughts

I really enjoyed using the FT-710. I found the controls to be logically placed and easy to access, and adjusting key settings didn't require a deep dive into a cryptic menu system. Although the radio is highly customizable, the default settings were a fine starting point as I explored the effects of various settings. The FT-710's receiver holds up well with strong signals on a packed band, with various filters and other interference-fighting features available as needed. In terms of price versus performance and features, the FT-710 offers a lot of value.

Manufacturer: Yaesu USA, 6125 Phyllis Dr., Cypress, CA 90630, **www.yaesu.com**. Price: $1,150.

Icom IC-T10 Dual-Band Handheld Transceiver

Reviewed by Rick Palm, K1CE
k1ce@arrl.net

The Icom IC-T10 is a compact dual-band FM handheld transceiver that covers the 2-meter and 70-centimeter bands, one band at a time. It also covers the FM broadcast band 88 – 108 MHz (receive only), the National Weather Service weather broadcast channels, and extended frequencies 136 – 174 MHz and 400 – 479 MHz with transmit-only on the amateur bands.

Description

The radio comes with the BP-280 battery pack, a rubber duck antenna (FA-S270C), a belt clip, a desktop rapid charger (BC-213), and an ac adapter. The antenna connector is an SMA type (50 ohms). It is a small radio (see Table 2 for more details).

While holding down the monitor key (below the PTT), the large dial knob on top of the radio can be rotated to adjust the squelch level. Hold down the monitor key to briefly open the squelch. Just below the monitor knob

is the "programmable key." Out of the box, the key is pushed to enter the 1 MHz step selection mode for fast tuning. Hold the key down to enter the tuning step item in the set mode, and set the tuning step from 5 kHz up through 200 kHz.

On the top panel, the large, tall knob is the control dial. In the VFO mode, it is rotated to select the operating frequency (based on the tuning step selected, as described above). In memory mode, it is rotated to select the memory channel. In the set mode, it's rotated to select an option. In the character entry mode, it's rotated to select an alphanumeric character when naming a repeater. The smaller knob just to the right of the control dial is the volume/power knob; rotate it to the right to turn on the radio, and continue to rotate it for increased audio volume output.

On the right side panel is an external microphone/speaker jack, which has a removable cover protection; this needs to be kept on or with the optional external microphone attached to meet the IP67 requirements for dust-tight and waterproof protection.

Function Display

On the front panel, the function/frequency screen is basic but complete. It shows the operating frequency/memory with the alphanumeric programmed name, and features like the battery capacity, duplex, tone, VOX, automatic power off, key lock, memory channels, and more.

The signal RF bar meter displays the relative strength of the incoming signal, and the relative RF output of the radio on transmit. An operating mode icon is displayed for FM, and **FMN** for FM narrowband operation. Power icons are displayed — **L** for low power, **M** for medium power, and no icon is displayed when the radio is in high-power mode.

Bottom Line

The Icom IC-T10 is a small dual-band handheld transceiver that is solidly built, well designed, and easy to use right out of the box.

The battery is charged by the included BC-213 drop-in charger cradle, and a spare battery pack can be charged in the cradle without the radio.

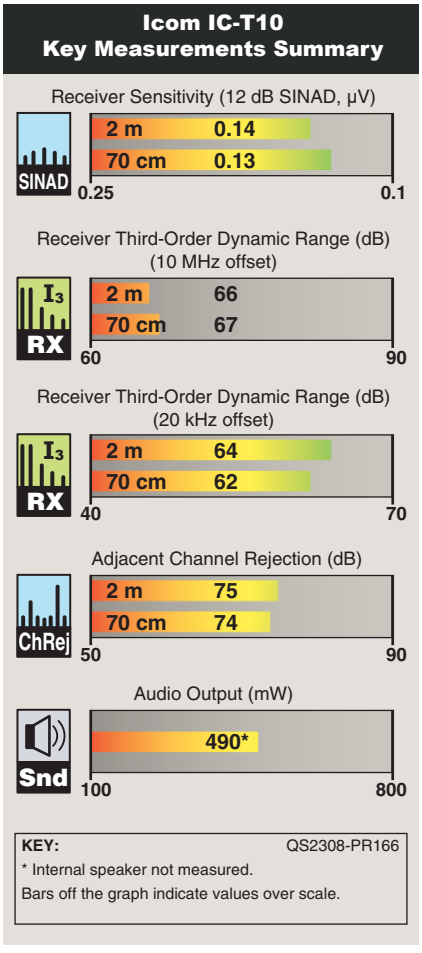
There are four frequency selection modes: VFO, memory, call channel, and weather channel. In VFO mode, the operating frequency can be selected by rotating the dial knob. In memory mode, a memory channel that has been programmed by the user can be selected. In call channel mode, the operator can recall the two most often used frequencies programmed by the user. Note that the **BAND** button is pushed to toggle between the two call channels. The weather channel mode is selected to monitor channels of NOAA weather broadcasts.

To select the operating band, first select the VFO mode, then push the **BAND** button repeatedly to select the VHF band, the UHF band, and the FM broadcast radio band.

Set the operating frequency using the keypad numbers or by turning the top panel **DIAL** button while in VFO mode. RF power output can be set to approximately 5 W (high), 2.5 W (mid), or 0.5 W (low) by repeatedly pushing the **H/M/L** button on the front panel (it is indicated on the bottom of the display screen). To lock down the operating frequency, hold down the **SET/KEY** icon button.

The home channel — selection of the most often used frequency for VHF and UHF — is accomplished by pushing the simple, tiny **HOME** button on the top panel between the volume knob and the dial knob, and cycling through them by repeatedly pushing the **BAND** button. The frequencies are stored by selecting the frequency and then holding down the **HOME** button until a beep sounds.

To set function values, push the **SET** button. Once the SET function is displayed, push the **SET** button repeatedly to toggle between functions. For example, to set a repeater tone, push the **SET** button, and then push it again repeatedly until the **TONE** function appears. Rotate the dial knob one click to turn it on. Then push the **SET** button one more time to select the repeater tone frequency. Rotate the dial knob to select and set the desired tone frequency. Other frequently used standard SET items include duplex reverse, tuning step, priority scan, tone scan, etc. Several initial SET mode items program the radio for basic "set and forget" settings.



Programming Memory Channels

Programming memory channels is straightforward. The radio has room for 210 memory channels — 200 six-character alphanumeric memories, two call channels, three pairs of scan edge memories, and two home channels. To program a memory channel, go in VFO mode and select the frequency, the tone function if needed, and the offset if not automatically set. Then, push and hold down the **S.MW** button until you hear two short beeps sound, and then **MR** and the channel number will blink on the screen. Rotate the dial to scroll to the desired memory channel number, and then push and hold down the **S.MW** key until two more short beeps sound and the memory is stored.

Table 2
Icom IC-T10, serial number 32001613, FCC ID# AFJ432800
Main Firmware – VAB-99-1311, Display – VA1-14, SDR – VA1-06

Manufacturer's Specifications	Measured in the ARRL Lab
Operating modes: FM/FM-N, FM broadcast band (WFM).	As specified.
Power requirements: 7.2 V dc with supplied Icom battery pack, 10 – 16 V dc with AD-149H external supply.	As specified.
Current drain (at 7.2 V dc): Transmit (at 5 W): <2.5 A.	Measured with fully charged battery at 8.3 V dc; 146 and 440 MHz: high, 1.8 A; med, 1.3 A; low, 0.6 A; current drain from battery not measured.
Receive (max audio output, 8 Ω load): FM/FM-N, <600 mA.	Measured with fully charged battery; 146 MHz and 440 MHz; no signal, lights on, 0.09 A; no signal, lights off, 0.06 A.
Receiver	
Frequency coverage* A band: 136 – 174 MHz; B band: 400 – 479 MHz; FM broadcast band: 88-108 MHz.	 As specified. As specified. As specified.
Sensitivity: band FM/FM-N, 12 dB SINAD: <0.18 µV / <–15 dB µV.	100 MHz: FM, –107 dBm (0.99 µV), (–0.1 dBµV); 146 MHz: FM, –124 dBm (0.14 µV), (–17 dBµV); 146 MHz: FM-N, –126 dBm (0.11 µV), (–19.2 dBµV); 162.4 MHz: FM, –124 dBm (0. 14 µV), (–17 dBµV); 440 MHz: FM, –125 dBm (0.13 µV), (–18 dBµV); 440 MHz: FM-N, –127 dBm (0. 10 µV), (–20 dBµV).
Adjacent-channel rejection: FM: >55 dB; FM-N: >50 dB.	FM, 20 kHz offset:† 146 MHz, 75 dB; 440 MHz, 74 dB; FM-N, 15 kHz offset: 146 MHz, 75 dB, 440 MHz, 75 dB.
FM two-tone, third-order IMD dynamic range: Not specified.	20 kHz offset: 146 MHz: FM, 64 dB; FM-N, 71 dB; 440 MHz: FM, 62 dB; FM-N, 71 dB; 10-MHz offset: 146 MHz: FM, 66 dB; FM-N, 66 dB; 440 MHz: FM, 67 dB; FM-N, 71 dB.
FM two-tone, second-order IMD dynamic range: Not specified.	FM: 146 MHz: 55.2/90.82 MHz test tones, 72 dB; 446 MHz: 146/300MHz test tones, 95 dB.
Squelch sensitivity: <–15 dBµV.	A and B band: 146 MHz, 0.25 µV (min), (–12 dBµV); 0.64 µV (max), (–4 dBµV); 440 MHz, 0.28 µV (min), (–11 dBµV), 0.70 µV (max), (–3 dBµV).
S-meter sensitivity: Not specified.	A band, 10-bar indication: 146 MHz, 1 µV; 440 MHz, 1 µV.
Audio output into 8 Ω: internal speaker: 1.5 W at 10% THD; external speaker: 0.45 W at 10% THD	 Not measured; 0.49 W at 10% THD; 0.40 W at 1% THD.
Transmitter	
Power output at 7.2 V dc: high, 5 W; mid, 2.5 W; low, 0.5 W.	Battery fully charged at 8.3 V dc:†† 146 MHz: high, 4.3 W; med, 2.15 W; low, 0.42 W; 440 MHz: high, 4.2 W; med, 2.0 W; low, 0.43 W.
Spurious-signal and harmonic suppression: <–60 dBc (high/mid); <–13 dBm (low)	Meets FCC requirements. 146 MHz: < –66 dBc; 440 MHz: –70 dBc.
Transmit-receive turnaround time (PTT (release to 50% of full audio output): Not specified.	Squelch on, S-9 signal: 144 MHz: 110 ms; 440 MHz: 112 ms.
Receive-transmit turnaround time (TX delay): (TX delay): Not specified.	146 MHz: 40 ms; 440 MHz: 40 ms.

Size (height, width, depth): 4.4 × 2.1 × 1.2 inches (excluding protrusions).
Weight: 9.8 ounces.
Antenna length: 7 inches.

*A and B band frequency coverage and specifications guaranteed only between 144 – 148 MHz and 430 – 450 MHz.
†Measurements phase-noise limited at values shown.
††Power output did not vary significantly with external voltage from 10 to 16 V dc, or with use of a slightly discharged internal battery.

To select a memory channel as the operating frequency, push the **V/M/C** key repeatedly until the memory mode comes up. Rotate the dial to select the desired channel.

Scanning

Scanning is simple to accomplish. Push the **V/M/C** key repeatedly to select the VFO mode or the memory mode, and then hold down the **H/M/L SCAN** button until the beep sounds to start the scan. When a signal is detected, the signal strength is displayed. Push either the **SCAN** or **V/M/C** button to stop the scan. Skip channels can also be programmed easily.

The priority scan function searches for a signal on the selected memory channel or call channel. While operating on a VFO mode frequency, the priority scan checks the selected memory or call channel every 5 seconds for activity. For example, if the operator is on a VHF mode frequency, but wants to keep an ear out for activity on 146.520 MHz (same band), activating the priority scan will allow for checking for any signals every 5 seconds. Select a channel to be scanned, then push the **SET** button, select **PRIO**, and you can turn **ON** or **BELL**. Then, push the **V/M/C** button to start the priority scan. Push it again to cancel the scanning.

Operating Impressions

Overall, the radio has an admittedly subjective quality feel to it. It's compact and goes easy in the hand. I enjoyed operating it. It would make a good addition to an ARES® EmComm operator's go-bag, with its included charging cradle. And speaking of going into the field for operations at a public event emergency tent or disaster area, it seems to be able to withstand harsh environmental conditions. The IC-T10 has an IP67 rating, which means complete protection against dust and airborne particles, but also waterproof up to 1 meter (39 inches).

Other field-expedient features include high-level loudspeaker audio and RF output. The promotional literature claims "a combination of a new speaker design and a 1500 mW audio amplifier" as the reason for the good audio output.

Interestingly, the radio covers the FM broadcast band, which might be handy when on a deployment and listening for media reports involving the potentially evolving disaster situation. The IC-T10 also has a weather alert function and is pre-programmed with NOAA weather alert channels.

At almost 70 years of age, I found it to be a bit challenging to read the characters on the necessarily small display screen and the function button labels just below the screen. A pair of readers helped. In the SET mode, there is a **LIGHT** function that can be turned on — the extra illumination helped me to read the screen and button labels that are also backlit.

The audio output from the speaker is indeed loud and undistorted. Audio quality reports from QSO partners were all good. I also listened to my transmitted audio and can confirm it is of good quality. I successfully programmed the home channel (selected by the small gray button on the top panel) with my often-used local repeater pair. A quick push of the button brings up the repeater frequency.

Setting operating parameters in the SET mode was easy to accomplish. It was easy and quick to turn on the repeater tone function and select/set the tone itself. There are two SET tables: the SET mode and the initial SET mode, which sets the "set and forget" basic functions such as the beep sound level, time-out timer, etc.

Battery life is prolonged with the power save function and will give you up to 11 hours of operating time, enough for a long day on an incident command post or at a remote road rally checkpoint. There is an optional dc power supply pack, a battery eliminator style, and the AD-149H, which replaces the standard battery pack, and that can be used to connect the optional cigarette lighter-type dc power cables (CP-12L) or the OPC-254L cable to connect to a dc power supply. There is no battery tray option for AA batteries, like my Icom V80 handheld has. If a club owns multiple Icom IC-T10s to be used in emergencies or events, an optional charger for six units is also available (BC-214 with the BC-157S). For more information, you can download the product brochure along with the user manual and the advanced manual on the manufacturer's website (see **www.icomamerica.com/en/downloads**).

All scanning functions and modes worked well — the VFO scan scans all frequencies, or just the frequencies in one or the other band (2 meters versus 70 centimeters). The program scan scans one of three programmable sets of scan edge frequencies, and they worked well. Skip channels and frequencies can be programmed, too.

The CS-T10 programming software is available for free, but you will need to purchase the optional OPC-478UC/-1 USB programming cable.

Summary

The Icom IC-T10 is a small dual-band handheld transceiver that is solidly built, well designed, and easy to use right out of the box. You can be on the air in a matter of seconds. It has that quality Icom look and feel, which is important to me.

The display is necessarily small to allow for the larger loudspeaker, and it took me some time getting used to it. While it was a bit of a challenge to read in the indoor artificial light, in the sunlight I had no problem.

Manufacturer: Icom America, 12421 Willows Road NE, Kirkland, WA 98034, **www.icomamerica.com**. Price: $240.

MFJ-1898 Portable HF 6-Meter Antenna

Reviewed by Steve Ford, WB8IMY
wb8imy@arrl.net

The MFJ-1898 is just 20 inches in length when the whip is fully retracted.

The MFJ-1898 is a multiband 40- through 6-meter antenna designed for portable operating. The MFJ-1898 consists of a sizable loading coil at its base. The coil attaches to an 87-inch telescoping stainless-steel rod. When fully retracted, the MFJ-1898 is just 21.75 inches in length (see the lead photo). The whip unscrews from the coil, so you end up with two 11.5-inch sections for easy packing. When fully extended, the antenna reaches 103 inches.

The bottom of the loading coil terminates in a male ⅜ – 24 threaded section that will screw into any compatible mount. There are many suitable mobile and portable antenna mounts that will do the job nicely. For this review, I attached the MFJ-1898 to a mobile mount that was clamped to the luggage rack on my minivan.

The ground side of my mobile mount is electrically bonded to the vehicle chassis via a short wire. I mention this because every antenna needs a ground return of some kind to radiate at maximum efficiency. In my case, the ground return was provided by the vehicle chassis. When using the MFJ-1898 with a mobile mount attached to a tripod, I also achieved satisfactory results with five 10-foot radial wires secured to a ground connection on the mount. I simply laid the wires on the grass around the tripod, and I was good to go.

Adjusting the MFJ-1898

My first experience with the antenna took place during a Parks on the Air (POTA) operation not far from my home in Connecticut. Before heading out to the park, however, I attached the MFJ-1898 to my vehicle mount and used an antenna analyzer to help me adjust the loading coil.

The MFJ-1898 has a clever tuning mechanism that allows you to easily transition from one coil winding to the next. You loosen the holding ring at the bottom and then slide the assembly up or down as necessary to achieve the lowest SWR. The slider is clearly marked, somewhat like a ruler, so that you can make note of the positions that offer the best results at various frequencies (see Figure 5).

My results are shown in Table 3. The SWR "sweet spots" are found at lower coil positions as you move higher in frequency. On 10 and 6 meters, I had to bring the slider all the way to the bottom and then reduce the length of the telescoping whip by about 6 to 10 inches.

As you'd expect, the 2:1 SWR bandwidth on 40 meters was narrow at only about 50 kHz. On the other hand, bandwidths were increasingly broad on the higher bands. With the exception of 40 meters, I enjoyed SWRs of less than 2:1, often much less. If you happen

Bottom Line

The MFJ-1898 Portable HF 6-Meter Antenna is an impressive performer with its rugged mechanical design, for an affordable price. Every portable antenna strikes a compromise between size and efficiency, but the MFJ-1898 seems to make the most of it.

◀ **Figure 5** — The tuning section at the base of the antenna includes ruler-like markings for easy reference.

Figure 6 — Operating POTA with the MFJ-1898 attached to a mobile antenna mount.

to own a transceiver with a built-in antenna tuner, it should have no problem dealing with the higher SWRs you may encounter on 40 and 30 meters.

The MFJ-1898 is rated at 125 W PEP. That's fine for use with a 100 W SSB transceiver, but if you intend to operate a 100% duty cycle mode such as FT8 or RTTY, it is best to reduce your output.

POTA with the MFJ-1898

I picked a poor day to try a POTA activation. A geomagnetic storm was in progress, with the K index at 4 and rising (it would reach 7 before the end of the day). But then again, I reasoned that challenging conditions would really put the antenna to the test.

Table 3
MFJ-1898 Portable HF 6-Meter Antenna
Reviewer's SWR Measurements (not tested by the ARRL Lab)

Frequency (MHz)	SWR	Tuning Section Position
7.18	2:1	12.9
10.1	1.8	6.7
14.1	1.2	3.3
18.1	1.4	2.7
21.1	1.4	1.9
24.9	1.4	1.2
28.4	1.5	0 (shortened whip also)
50.125	1.3	0 (shortened whip also)

After parking and attaching the MFJ-1898 to the mount (see Figure 6), I began on 20-meter SSB running 100 W. I was astonished at the results. After a few calls, I had a small pileup going, with many stations giving me excellent reports. A fellow in Iowa said I was 5 dB over S-9, but with his triband Yagi at 75 feet, he was surely doing the heavy lifting.

I reduced the power, switched to FT8, and got impressive results on 20 meters. I had even better results on 15 and 10 meters, although the gathering storm made those efforts short-lived.

The MFJ-1898 didn't perform as well on 40 meters, but this is to be expected. The antenna is very short electrically, at 7 MHz, and its radiation efficiency suffers accordingly. Still, I made plenty of phone and FT8 contacts, more than I would have expected considering the conditions.

Impressive Overall

Every antenna of this type strikes a compromise between size and efficiency, but the MFJ-1898 seems to make the most of it. I was skeptical about how well the antenna would perform, but it easily exceeded my expectations. Combine the MFJ-1898's impressive performance with its rugged mechanical design at an affordable price, and you have the makings of a keeper.

Manufacturer: MFJ Enterprises, 300 Industrial Park Rd., Starkville, MS 39759, **www.mfjenterprises.com**. Price: $150.