Product Reviews

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PreppComm MMX Multiband Morse Code Transceiver

Icom AH-730 Automatic Antenna Tuner

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Product Review

PreppComm MMX Multiband Morse Code Transceiver

Reviewed by Paul Danzer, N1II
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This 11-ounce CW unit might be considered a Swiss Army knife for both your shack and portable operations. There are several versions available; the reviewed one is the full-up unit consisting of a memory keyer with both key input and included keyboard input. The code reader has automatic speed measurement and will also capture incoming call letters. You can choose to use your home rig with the keyer portion or with the internal transceiver. Several configurations are available; you can purchase the MMX with a single-band transceiver, a dual-band version, or the tri-band (80-, 40-, and 20-meter) unit. You can see the band modules inside the MMX in Figure 1.

The 3.5-inch color touchscreen can display 10 lines of outgoing characters and incoming characters in addition to showing control commands and status. The keyer includes most of the features of standalone keyers with both programmability and recognition of a set of common pro-signs (such as AR, SK, BK, and others).

In Table 1, you will find the manufacturer's specifications with the Lab test results for this unit. There are a few things you should know before you plug it in and turn it on. First, there is no final amplifier protection, so attach a dummy load or matched antenna before you apply power. In addition, with the automatic call sign recognition (including your own), you might save a bit of frustration by skimming through the shorter of the two supplied instruction PDFs and then watching the first five brief videos supplied online. Once you get an idea of the automatic features, automatic code recognition, and steps to make a QSO, you can start at the beginning and turn on the unit.

Bottom Line

The PreppComm MMX is a great compact Morse code decoder/encoder that can be used either with a key or with the included keyboard. It offers a wide range of possibilities; you can use it as a standalone HF CW QRP transceiver (up to three bands) or use it to operate CW in your station with another transceiver.

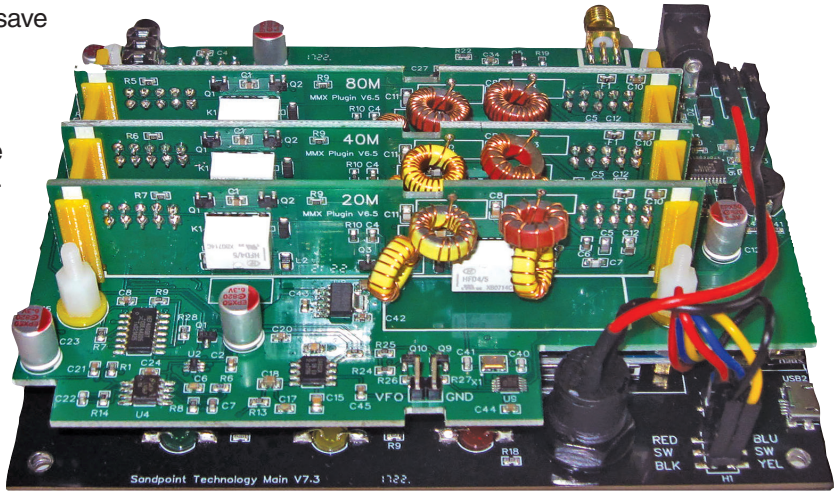
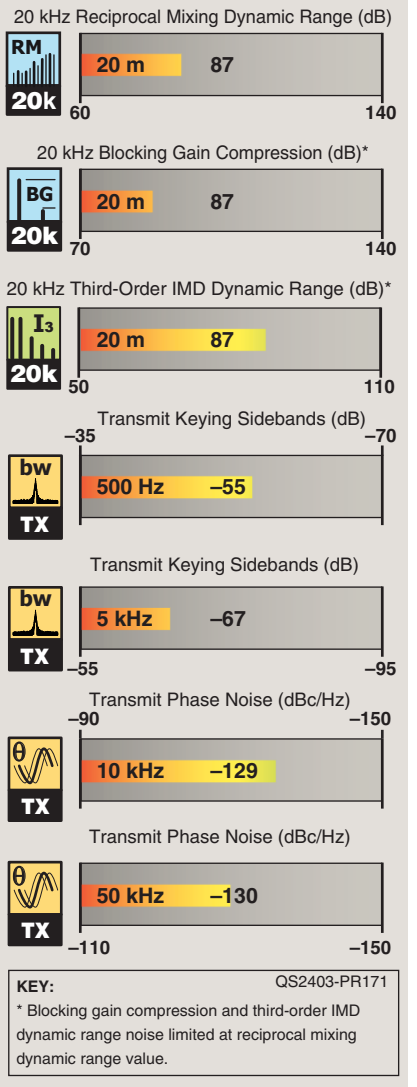


Figure 1 — Internal view of the PreppComm MMX, showing the three band modules (80, 40, and 20 meters).

Table 1
PreppComm MMX Multiband Morse Code Transceiver, serial number M-1250

Manufacturer's Specifications	Measured in the ARRL Lab
Frequency coverage: receive, 2.45 – 5.6 MHz, 4.9 – 10.22 MHz, 9.8 – 20.9 MHz; transmit, 3.5 – 4.0 MHz, 7 – 7.3 MHz, 14 – 14.35 MHz.	As specified.
Power requirement: 12 – 16 V dc; transmit, 380 – 430 mA; receive, 80 – 120 mA.	At 13.8 V dc: transmit, 408 mA; receive, 112 mA (no signal, max. volume, backlight on), 72 mA (backlight off).
Modes of operation: CW, transmit and receive. AM and SSB, receive only.	As specified.
Receiver	**Receiver Dynamic Testing**
CW sensitivity: noise floor (MDS), better than –118 dBm / 0.03 µV.	–119.1 dBm / 0.28 µV.
Blocking gain compression dynamic range: Not specified.	Noise limited at RMDR value.
Reciprocal mixing dynamic range (RMDR): Not specified.	14 MHz, 20 kHz offset: 87 dB.
Two-tone, third-order IMD dynamic range.	Noise limited at RMDR value.
Transmitter	**Transmitter Dynamic Testing**
Power output: 80 m 2 W, 40 m 3 W, 20 m 1.5 W @ 13.8 V dc.	At 13.8 V dc, 80 m 2.3 W, 40 m 4.7 W, 20 m 1.4 W.
Spurious and harmonic suppression: Not specified.	All bands >53 dBc; meets the FCC limits for spurious emissions.
CW keyer range: up to 60 WPM.	As specified.
CW keying characteristics: Not specified.	See Figures A and B.
Transmit phase noise: Not specified.	See Figure C.
Size (height, width, depth): 1.3 (without lid) or 2.25 (with lid) x 5.2 x 3.8 inches.	
Weight: 11 ounces with lid.	

PreppComm MMX Multiband Morse Code Transceiver Key Measurements Summary



KEY: QS2403-PR171

* Blocking gain compression and third-order IMD dynamic range noise limited at reciprocal mixing dynamic range value.

What's in the Package?

The main unit includes a protective cover, which can also be used as a stand. There is also a small envelope containing a wiping cloth for the LCD screen and a power connector. The connector has on one end a barrel plug, which is the size that is used on many QRP and small instrument power supply cord ends. The other side has a polarity-marked pair of spring connector terminals that can be used at the end of a power cord. Several other accessories and packages are listed on the PreppComm web page (**www.preppcomm.com/products/mmx-multiband-morse-code-transceiver**).

There is no obvious instruction material in the carton, but there is a USB-terminated keyboard, slightly smaller than most standard keyboards. Included in the keyboard box is an information sheet that lists two websites. The first one (**www.preppcomm.com/pages/document-library**) brings up the MMX Product Data Sheet, the MMX Morse Code Transceiver Quick Start Guide, and the MMX Morse Code Transceiver Reference Manual. The second link (**www.youtube.com/@preppcomm**) brings up a set of instructional videos. There are a total of eight instructional videos plus a number of user-contributed videos.

Making Connections

All external connections are made through jacks on the rear and left side panels. On the rear, starting near the right side of the unit, is the 3.5-millimeter headphone jack that will drive a standard set of headphones. Toward the other end of the rear panel is the RF output jack, which mates with an SMA connector. The rest of my QRP equipment uses BNC connectors, so I bought a set of 12 BNC-to-SMA connectors with all possible combinations of male/female polarities. If

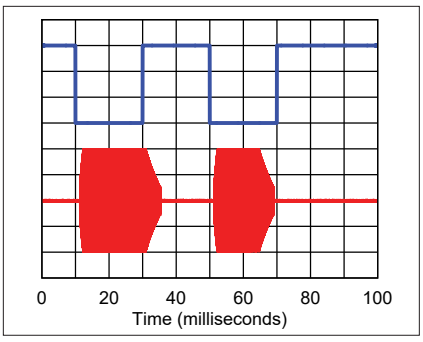


Figure A — CW keying waveform for the MMX showing the first two dits using external keying. Equivalent keying speed is 60 WPM. The upper trace is the key closure; the lower trace is the RF envelope. Horizontal divisions are 10 ms. The transceiver was being operated at 2 W output on the 14 MHz band. The first-dit rise time is 0.8 ms; the fall time is 4 ms. The second-dit rise time is 0.8 ms; the fall time is 4 ms. The first dit on delay is 1.5 ms; the off delay is 3.6 ms. The second dit on delay is 1.5 ms; the off delay is 2.6 ms.

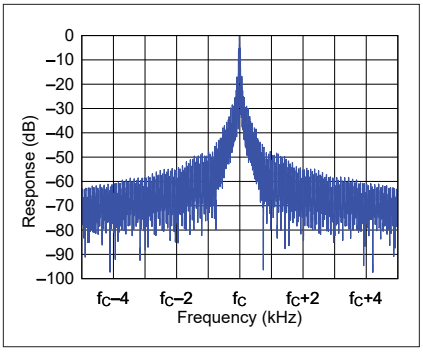


Figure B — Spectral display of the PreppComm MMX transmitter during keying sideband testing. Equivalent keying speed is 60 WPM using external keying. Spectrum analyzer resolution bandwidth is 10 Hz, and the sweep time is 30 seconds. The transmitter was being operated at 2 W PEP output on the 14 MHz band, and this plot shows the transmitter output ±5 kHz from the carrier. The reference level is 0 dBc, and the vertical scale is 10 dB per division.

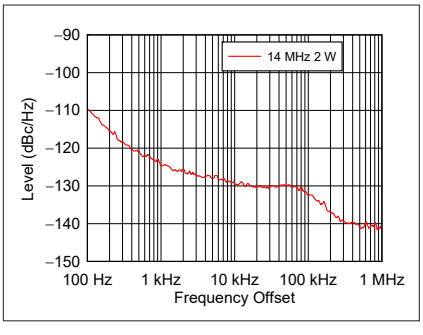


Figure C — Spectral display of the PreppComm MMX transmitter output during phase-noise testing. Power output is 2 W on the 14 MHz band. The carrier, off the left edge of the plot, is not shown. This plot shows phase noise 100 Hz to 1 MHz from the carrier. The reference level is –90 dBc/Hz, and the vertical scale is 10 dB per division.

you are not going to use the internal transceiver, the SMA female connector on the unit is not needed. Finally, the barrel power socket is toward the left edge.

On the left side of the case are three more jacks. The first is a standard USB socket for the keyboard, the next is a 3.5-millimeter audio connector labeled **AUDIO IN**, and the last is another audio connector labeled **KEY IN/OUT**.

How these connectors are used depends on your decision to use the internal transceiver or only the keyer-related functions and your home rig. Both the Quick Start Guide and the full Reference Manual will give you the information you need. The only unusual connections are made through the **KEY IN/OUT** jack. The sleeve of the stereo plug needed is used for a ground shield. For **KEY OUT**, the tip is used; for **KEY IN**, the ring is used. These have separate functions depending on the selection of the internal transceiver or the external rig, with a warning not to try to use the same cable for both functions.

Make the Unit Yours

There is a start-up procedure you go through the first time you turn on the unit. As mentioned before, connect either a matched antenna or a dummy load before connecting the power. It may be easy to accidentally transmit, and this can damage the internal transmitter.

The connections for the unit and initial turn-on procedure are given in detail in the Quick Start Guide, for using either the internal transceiver or the external rig.

The initial turn-on brings up a splash screen followed by the main screen. You are instructed to press the **MENU** button — but first you have to find the button! Hint: there is no button, but this is a touchscreen. Toward the lower right corner of the screen, there is an area with the label **MENU**. All buttons in the printed material are pressable areas on the LCD screen. Note that pressing a button in the middle of a sequence may not elicit an immediate response. If you press it in the middle of a sequence, a response (often a change of the button's color) will not occur until the current sequence is finished.

Pressing the **MENU** button at this point brings up the main menu (see Figure 2), from which you select **LOCAL STATION SETUP**. A press on this legend brings up a set of questions and windows to enter information.

The first entry is your call sign. This is followed by your name, QTH, rig type, antenna type, and license level. This last entry will limit the frequency band edges that the internal transmitter will tune to. Finally, there is a **FINISH** button.

At this point you will be instructing the unit to be set to either the internal transceiver or an external rig. The frequency button (one line up from the bottom of the main screen, toward the right) cycles between selection of one of the three bands — if you have a tri-band unit — and **EXTERNAL**. The selection of **EXTERNAL** shuts off the transceiver and prepares the unit to use an external rig.

Now, you may want to go back to the main menu to measure your typing speed. A full explanation of this function is given in the Reference Manual (page 23). It allows the unit to set your output text as readable

Figure 2 — The PreppComm MMX main menu has six choices, including the internal HELP system.

words. If you manually set the output Morse code text rate faster than you can type, often the transmission will be disconnected individual letters, not words. This makes it very difficult for the person (or machine) at the other end to understand what you are sending.

The typing speed test (see Figure 3) sets the output code speed to match but not overrun your typing speed. If you desire, you can manually enter any speed you want.

It's Almost Time to Get on the Air

Knowing that the MMX will provide a keyboard for Morse code output and Morse code in to printed text display, the MMX has, in its basic organization, a number of automation features to both initiate and respond to a QSO in almost a hands-off mode. The Quick Start Guide has a one-step-at-a-time set of instructions, divided into receiving and transmitting. If you set the frequency to the **EXTERNAL** mode, you can practice

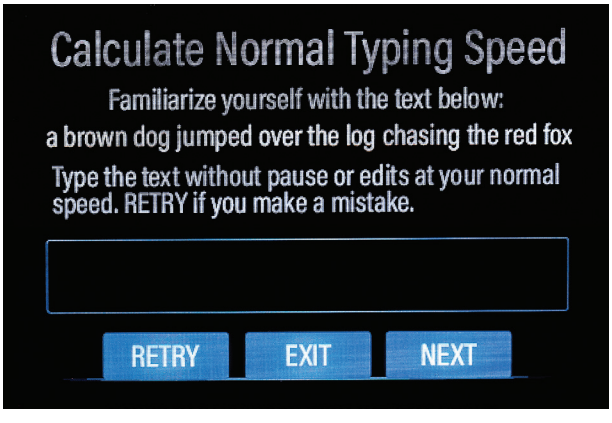


Figure 3 — The PreppComm MMX output code speed is set to the limit, found as a result of this typing speed measurement.

the transmit commands without radiating. Alternatively, you can leave the transmitter set to a band and use a dummy load.

Transmitter Commands

The **CALL** button is on the main screen. After selecting the default transmission speed (by pressing the space bar), the transmitter sends out a sequence of several repetitions of CQ followed by your call sign twice. This will continue indefinitely until you press the **CALL** button again. Then the current sequence will end, followed by a "K."

You can manually enter the call sign letters of a station you wish to call by pressing the **CCS** button. Then press **CALL**, and a calling sequence will be transmitted. Suppose WA1WTB answers. To call him back, press the **NO CCS** button, and press **CALL** again. You will transmit his call sign a few times followed by "DE" and your call sign. This sequence will be repeated until you press **CALL** again. Then the current sequence will continue to its end, and it will add "KN" to finish the call.

The Quick Start Guide steps you through four basic transmission functions or sequences: general call, directed call, answer-validate, and answer. Going through the example in the guide will lead you to the idea of canned QSO starts (initiation) and manual finishes. You probably will want to practice these sequences before you go live on the air. If you wish, you can customize each of these sequences using the Rig Programming Language (RPL). The RPL is discussed in detail, with examples, at the end of the Reference Manual.

Receiver Commands

There is an extensive set of receiver commands, including receiver incremental tuning, frequency selection, volume, frequency memories, and others. A small picture of the keyboard can be found in the Quick Start Guide, and a larger version is in the Reference Manual. The pictures have the various keyboard receive-related keys with text callouts, and you will probably want to print out a hard copy as a guide when you begin to operate.

The left- and right-arrow keys in the lower right-hand corner of the keyboard are used to tune the receiver frequency; the arrow keys are also used for the steps of tuning (for example, the tuning rate change is controlled by the up and down arrows). The rate can be changed from 1 Hz to 100,000 Hz in steps of 10. If the steps are set to 100 kHz, this could be useful in tuning the band. If you are tuned past the band edges, or the sub-band your license permits, the green **ENABLED**

light will not go on, as a reminder that you cannot transmit on this frequency.

Two gain control keys adjust both the heard volume (period and comma) and the volume of the decoder (left and right angle brackets). The space bar controls the decoder response to lost lock. When the decoder loses lock due to a frequency change, QSB, QRM, or any other reason, it will keep trying to decode based on its previous activity. At this point, tell the automatic decode to drop the past history and start fresh. A press of the space bar tells the decoder to drop this continuation, start fresh, and look for a new lock. This step is necessary!

Because the internal transceiver is based on a direct conversion circuit, often a signal can be heard at the carrier frequency plus and minus the equivalent of a beat note. If you select the "wrong" signal, your receiver will be centered at twice the beat note from your transmitter. The guides provide a rule: to answer a call, move your receive frequency one step up. If the beat note now sounds lower, you are okay. If it sounds higher, press the **D** key and then move the frequency one step down. By using this rule, you will be on the correct sideband without having to do any mental gymnastics each time.

To copy a station with the automatic decode function, tune until the green **CW IN** light is blinking on the front panel. Then press the space bar to tell the decoder to start processing.

One other unusual receive control is the **ESC** key. This switches between the human-created CW (HCW) decoder mode and the computer-assisted Morse code texting system (CTX) decoder mode. HCW is the normal mode of operation. CTX is a specialized mode that runs only at 30 WPM. It was apparently designed for communication between two stations equipped with the MMX. It appears, though not tested, that using the RPL programming, two equipped stations can exchange a set of information automatically.

With Your Home Rig

If you choose, you can use your home rig with the MMX decoder and keyboard. This has the advantage of keeping the rig control functions you are familiar with — frequency, selectivity, power, and so on. To do this, press the frequency button on the front panel several times until it reads **EXTERNAL**, rather than a frequency. The **KEY OUT** jack is connected to the **KEY IN** jack of your rig and the audio from your rig split — half to a set of headphones and the other half (i.e., a parallel connection) to the **AUDIO IN** jack of the MMX. The keyboard is plugged into its normal jack on the MMX.

Warning: You must use the SSB filter rather than the CW filter on your rig. Otherwise, the 1300 Hz note may be out of the passband and not audible. In general, operation with the MMX is pretty much the same as with the internal transceiver.

A Few Other Notes

Usually, the MMX stores the settings and values you have picked and restores them through a shutdown/power-up sequence. In addition to the stored prosigns, you can store a set of frequencies in memory to be recalled when you want them.

There is no tune position directly with the MMX. You have several choices — you can send a number of the letter "T" in series or just use your external key. If you plug in a manual key, it has to be wired, as shown in the Reference Manual. A simple RPL code string to transmit a repeated "T" until you press the function key again can double as a tune command.

The RPL allows you to set many rig functions, including changing the supplied **CALL** and **ANS** microprograms for use in contests or for net operations. You can also use the RPL for storing fixed text messages.

Using the **KEY IN** jack, you can send code to the decoder. This code is seen as text on the screen and allows you to see how a station at the other end will see your output. Unfortunately, this does not allow you to plug a set of paddles directly into the jack. It might, however, be compatible with certain keyers that provide a voltage-free on/off set of contacts.

One further limit is the keyboard. Although the connector looks like a standard USB connector, most current keyboards will not work correctly with the MMX for historical (USB-related) reasons. This is detailed in the instructions.

On-the-Air Testing

Because the unit tested here included a transceiver, I devoted a few hours to seeing how it worked as a QRP radio. I made a few QSOs when the band had low activity. Although the receiver is a direct conversion design, there is no schematic provided, and performance suggested the direct conversion detector stage is preceded by an RF amplifier stage.

During high-activity periods here (Friday and Sunday evenings), performance in the presence of other close-by signals was not surprising — neither good nor bad. This is not a verification or measurement of the manufacturer's claimed receiver performance; it just means I enjoyed using the QRP rig as long as there was no 20 dB over S-9 signal close. This may not be a prob-

Lab Notes: PreppComm MMX Multiband Morse Code Transceiver

Because the PreppComm MMX is designed primarily for CW signals, you'll notice the lack of many of the usual receiver tests we perform in the ARRL Lab. This unit employs a selective decoder with a narrow 120 Hz wide filter, which allows the MMX to "hear" a CW tone while rejecting a lot of what may be around the tone. Because of this design, most of the audio-related receiver measurements we make on traditional receivers simply do not apply to the MMX. The ability to take this small unit into the field with a resonant antenna and make CW contacts without knowing the code comes with a bit of a compromise in sensitivity and CW wave shaping, but it is surely an interesting device to have with its unique set of features as a transceiver and code-learning tool. — *George Spatta, W1GKS, ARRL Laboratory Manager*

lem if you use this unit as a QRP with a portable antenna, but when connected to a home station antenna, it may be different. Fortunately, you have the option to use it differently in the station by connecting it to your main radio without using the internal transceiver.

Most of the on-the-air testing was spent learning how to effectively use the automatic call sign recognition and the built-in programming language. Although I needed quite a bit of time to learn the system and the programming language, the results can be summed up very quickly — it was fun!

Conclusion

The MMX makes a neat, low-size, low-weight package. Operating with the internal transceiver (12 V nominal, 16 V maximum), it draws slightly less than 450 mA, peak on transmit. Using the automation features requires a bit of practice, but the most basic steps for calling, recognizing a set of call letters, and answering are quick to learn. Many QRP operators have gotten used to choosing a sideband on receive, and with a signal above the noise level, it's not difficult to work with.

As with any automatic decoder, the ability to correctly decode depends on a number of things, including the received signal strength, the accompanying noise and QRM, and the sending ability of the operators at the far end. I found the space bar (to tell the decoder it is off base and should try again) to be a handy feature that saves having to tune off or take other action to break the decoder from trying to stay on an undecipherable signal.

Manufacturer: PreppComm, 130 McGhee Rd., Ste. 220, Sandpoint, ID 83864, **www.preppcomm.com**. Price: Single-band version, $449; dual-band version, $499; triple-band version, $549.

Icom AH-730 Automatic Antenna Tuner

Reviewed by Mark Wilson, K1RO
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Icom's AH-730 automatic antenna tuner is designed for use with Icom transceivers that have a four-pin Molex **TUNER** jack on the rear panel. Compatible transceivers include the IC-718, IC-7100, IC-7300, and IC-7610 from the current lineup, as well as older radios such as the popular IC-746 and IC-756 series. It's a weatherproof remote tuner designed for use on 160 through 6 meters with a wire that's 23 feet or longer. You can use a wire or whip shorter than 23 feet with reduced frequency coverage, such as 40- through 6-meter operation, with Icom's AH-2B mobile antenna.

The AH-730 package includes the tuner, a 32.8-foot control cable, and hardware for several mounting options (see Figure 4). Power is supplied from the radio through the control cable.

New and Improved

The AH-730 replaces Icom's popular AH-4 automatic

Bottom Line

The Icom AH-730 is a weatherproof remote tuner designed for use with a wire that's 23 feet or longer or with Icom's AH-2B mobile antenna. It covers 160 through 6 meters and integrates seamlessly with compatible Icom transceivers.

Figure 4 — The AH-730 package includes a 32.8-foot control cable with connectors for the tuner and compatible Icom radios, along with stainless-steel hardware for a variety of mounting options.

tuner. Compared to the AH-4, the AH-730 has some important upgrades and improvements. The new model is specified for 1.8 through 50 MHz, adding 160-meter operation to the AH-4's range. The input power rating is 150 W PEP (100 W continuous), compared to 120 W PEP for the AH-4. The new tuner is about 2 inches wider and 4 inches longer than the old model, and it is noticeably heavier (5.5 pounds versus 2.6 pounds). Table 2 lists the AH-730 specifications.

Perhaps the most noticeable difference between the old and new models is that the feed-line and control cable connections are now external to the unit. Users had to open the AH-4 to connect the feed line and control cable and then reassemble the case. The control cable included with the AH-4 is 16.4 feet long — half the length of the cable that comes with the new model.

The AH-730 also has an IPX4 water resistance rating, which means that it is resistant to water splashes from any direction. It's okay to leave it out in the rain, but it should be installed where it won't be submerged.

The AH-730 has pigtails on the bottom of the case for the feed line and the control cable, making it quick and easy to set up the tuner and to disconnect cables for transport or storage. There's also a terminal with a wing nut on the bottom of the unit for attaching a ground wire or counterpoise, such as a radial system or vehicle body (see Figure 5).

On the top side of the tuner case (shown in Figure 6) is the output connection — an insulator with a

Table 2
Icom AH-730 Automatic Antenna Tuner

Manufacturer's Specifications	
Frequency range	1.8 – 54 MHz (>23-foot antenna)
Maximum input power	150 W PEP, 100 W continuous
Tuning power required	5 – 15 W
Tuning time	Average 2 – 3 seconds, maximum 15 seconds
Power supply requirement	13.8 V dc ±15%, <0.7 A (supplied by radio through control cable)
Tuning accuracy	Less than 2:1 VSWR except with antennas ½ λ or a multiple of ½ λ long
Number of tuned memories	45
Dimensions (height, width, depth)	3.1 × 9.1 × 13.4 inches
Weight	5.5 pounds
Compatible antennas	Long wire and vertical whip antennas

Figure 5 — Pigtails for the feed-line and control cable connections and a ground post are located on the bottom of the AH-730 enclosure.

Figure 6 — The top of the AH-730 enclosure has a post for attaching the antenna wire.

threaded post and another wing nut. Connect a suitable antenna wire or the Icom AH-2B mobile antenna here. Icom supplies a crimp-type ring terminal, flexible cap, and weatherproofing tape for this connection.

Using the AH-730

Mounting plates along the top and bottom edges of the enclosure allow several mounting options with the provided stainless-steel hardware. The enclosure can be mounted to a pole or mast with **U**-bolts and saddles, or attached to a board or metal plate with wood screws or machine screws and nuts (see Figure 7).

The tuner connects to the radio with the provided control cable and a user-supplied feed line (in my case, a 25-foot piece of RG-58 with PL-259s on each end). If the 32.8-foot control cable is not long enough for your installation, you can extend it with an identical cable that Icom offers separately (part number OPC-1465). A green wire at each end of the cable can be used for a ground connection between the tuner and the radio. The instructions say to make this connection if RF feedback occurs. For permanent installations, it's a good idea to waterproof the control cable and feed-line connections as well as the antenna wire connection on the top of the enclosure.

There are no indicators or controls on the AH-730. When it's plugged into the **TUNER** socket, the radio's internal tuner is disabled. Press and hold the front-panel **TUNER** button for a second or two to start tuning. When the standing wave ratio (SWR) is reduced to 2:1 or less, **TUNE** shows on the display and the antenna system is ready to use. Although it's always a good idea to make adjustments on a clear frequency, radiated power during the short tuning process is less than 300 mW, minimizing potential interference with other operators.

If the tuner cannot find a tuning solution 2:1 or less within 15 seconds, the **TUNE** indicator goes out. In almost all cases, the AH-730 found a tuning solution within a couple of seconds, and the tuned SWR was close to 1:1. On the higher-frequency bands, I could make fairly large frequency excursions without retuning.

The tuner has memories to store the most recent 45 tuner settings, so tuning is nearly instantaneous when you press **TUNE** after returning to a previously used band segment. You do have to initiate the tuning procedure with each band change (it doesn't automatically follow the Icom radio), and the memories are stored only until power is turned off.

On the Air

I used the AH-730 with several different antennas. Originally, I was interested in the tuner for multiband portable operation with the Eagle One vertical antenna reviewed in the June 2023 issue of *QST*. As shown in Figure 8, I secured the AH-730 to the antenna's mounting pole using the supplied **U**-bolts and saddles. With the Eagle One antenna's 31-foot vertical element con-

Figure 7 — An option is to mount the enclosure using wood screws or bolts and nuts. Here is the AH-730 attached to one of my deck supports and feeding an 85-foot end-fed wire.

Table 3
Icom AH-730 Resistive Load and Loss Testing

VSWR/Impedance	160 M	80 M	40 M	20 M	10 M	6 M
10:1/5 Ω loss (%)	21%	29%	43%	47%	83%	NT
Tuned SWR	1.1	1.2	1.3	1.2	1.1	
8:1/6.25 Ω loss (%)	11%	18%	32%	32%	68%	NT
Tuned SWR	1.1	1.2	1.3	1.2	1.2	
4:1/12.5 Ω loss (%)	7%	11%	20%	25%	64%	NT
Tuned SWR	1.1	1.2	1.3	1.3	1.1	
2:1/25 Ω loss (%)	3%	5%	13%	19%	45%	NT
Tuned SWR	1.1	1.2	1.2	1.1	1.3	
1:1/50 Ω bypass loss (%)	0%	0%	2%	4%	4%	5%
Bypass VSWR	1.2	1.2	1.2	1.1	1.1	1.9
2:1/100 Ω loss (%)	6%	4%	11%	12%	44%	62%
Tuned SWR	1.1	1.2	1.2	1.2	1.3	1.6
4:1/200 Ω loss (%)	7%	6%	10%	17%	67%	69%
Tuned SWR	1.1	1.2	1.2	1.1	1.1	1.4
8:1/400 Ω loss (%)	4%	7%	11%	20%	69%	84%
Tuned SWR	1.1	1.2	1.2	1.2	1.2	1.3
10:1/500 Ω loss (%)	6%	8%	12%	22%	75%	89%
Tuned SWR	1.1	1.2	1.1	1.2	1.2	1.3

NT = No tuning solution found
All loss percentages accounted for % of reflected power at tuned SWR.

Lab Notes: Icom AH-730 Automatic Antenna Tuner

Sometimes you are forced to use a less-than-ideal antenna that is not resonant on the band(s) on which you wish to operate. These constraints will often cause the SWR of the antenna to be higher than one can safely operate their transmitter into. When operating into a compromised antenna with a high SWR, a good way to match it to the 50 Ω impedance of your transceiver is to use a remote automatic tuner like the AH-730 at the antenna feed point. This is the most efficient way to match to an antenna with a high SWR because the feed line is being operated near its 50 Ω impedance. (SWR-related cable losses can also be high when the antenna SWR is high even if your built-in tuner provides a 1:1 match at the rig.)

The ARRL Lab performs resistive tests on antenna tuners to determine if they can match a wide range of high and low impedances on the bands for which the unit is specified (see Table 3). This provides a data set that can be used to compare tuners. In real-world use, especially with random wire or other non-resonant antennas, the impedance is never purely resistive. In order to get a sense of how an antenna with reactance will tune, the Lab also tests a couple of scenarios with different magnitudes of reactance to simulate a 43-foot vertical antenna.

Phil Salas, AD5X, who has performed many antenna tuner tests for the ARRL Lab over the years, describes the precision test setup he built and test methods in "Antenna Tuner Loss Measurements" in the March/April 2021 issue of *QEX*. A perfect antenna tuner would take the RF power from a transmitter, transform the impedance seen at the antenna to 50 Ω, and then send the power to the antenna. Tuner designs can come close to this ideal, but to do so, they need large roller inductors and typically use large variable capacitors, which, of course, make for a large — and expensive — antenna tuner. A manually operated tuner can also be used at the station operating position, so it does not change the SWR on the feed line, which at a high SWR can have losses that exceed the losses expected with any tuner.

In practice, unfortunately due to real-world limitations of components, especially the quality factor of inductors, there is always some power loss through the tuner.

Manually operated antenna tuners typically have lower losses than automatic antenna tuners that switch in various values of fixed inductors and capacitors, but the convenience of being able to automatically match to a wide range of antennas often makes the increase in loss worth the trade-off.

Tuner losses are simply heat generated by the imperfect components used in the tuner. Surprisingly, this can result in an increased ability of the tuner to match a wider range of impedances (see Table 4). Tuners will see the highest RF currents and inductances from short antennas. The losses through the tuner will be higher while matching these types of antennas. (With the AH-730, the internal losses of the tuner allow the transmitter to tune into both an open [infinite impedance] load or a shorted [0 Ω of impedance] load.) Either condition would normally present an infinite SWR value to your transceiver's final amplifiers. This could be a "gotcha" in that you could potentially have an open or shorted antenna, but you would still see a match. The other way to look at this is that if, in fact, you did have either one of those conditions, the tuner would still create a match that would spare your transmitter from potential harm. However, keep in mind that if your tuner does find a match into an extremely high or low impedance, all your power will be dissipated within the tuner. In this case, you may damage the auto tuner if you transmit into it with full power. So, if you don't hear any signals either before or after a tune-up, you might want to check your antenna system before you start transmitting.

All antenna tuners are compromises. What trade-offs are best for you? At first glance, a 50% loss through an antenna tuner being operated into an antenna that would have a high SWR might sound concerning, but a 50% loss is only half of an S-unit, so the convenience of having an automatic tuner and the ability to match a very wide range of antennas might be a good choice for most hams. If you need to get something on the air and have an antenna "just work," then the compromise of matching ability versus efficiency should be acceptable.
— *George Spatta, W1GKS, ARRL Laboratory Manager*

For details about the test fixtures and methods used by Phil Salas, AD5X, to test antenna tuners for the ARRL Lab, visit **www.arrl.org/qst-in-depth**.

Table 4
AH-730 Antenna Tuner Loss Measurements with Antenna Simulator Box

Rp	Cs	Rp/50	Sim. Ant.	Tuned SWR	RF In/Out	Ideal Loss	Actual Loss	Loss %
∞*	∞	50	50 Ω load	1.1	3.2/3.2	0 dB	0	0
15 Ω	36 pF	11.5 Ω	8 ft 40 m	1.8	3.3/.13	6.4 dB	14 dB	67%
20 Ω	91 pF	14.3 Ω	25 ft 80 m	1.3	3.3/.48	5.4 dB	8.4 dB	46%
25 Ω	130 pF	16.7 Ω	33 ft 80 m	1.3	3.3/.73	4.8 dB	6.6 dB	29%
40 Ω	200 pF	22.2 Ω	43 ft 80 m	1.3	3.3/1.2	3.6 dB	4.4 dB	13%
50 Ω	390 pF	25 Ω	90 ft 160 m	1.2	3.1/1.36	3 dB	3.6 dB	7%
50 Ω	560 pF	25 Ω	100 ft 160 m	1.1	3.1/1.4	3 dB	3.5 dB	7%

All loss percentages accounted for % of reflected power at tuned SWR.
*Loss of the antenna simulator box on 160 – 40 meters.

nected to the antenna terminal on top of the tuner, and my vehicle frame connected to the ground terminal, I was able to find a tuning solution on all ham bands from 1.8 to 50 MHz. I used this combination during several park activations and made contacts on 10 bands.

Figure 8 — The AH-730 package includes **U**-bolts for attaching the enclosure to a mast such as the support for the Eagle One vertical antenna on its trailer hitch mount.

At my home station, I used wood screws to mount the AH-730 on a piece of plywood attached to one of my deck supports. I ran an 85-foot wire from an insulator attached to my deck out to a tree at the back of my property. The wire is about 8 feet above the ground at the deck and 30 feet up at the far end. I also ran two 33-foot radials from the AH-730 ground lug. The AH-730 easily tuned this antenna on all bands from 160 through 6 meters.

I made hundreds of SSB, CW, and FT8/FT4 contacts with this simple wire and was impressed with how well it worked on all bands. For example, during the CW weekend of the CQ World Wide 160-Meter Contest, I operated for a few hours each evening and made nearly 300 contacts in 40 states/provinces and 12 DX countries. At the other end of the spectrum, I made 20 FT8 contacts in eight grids in the ARRL January VHF Contest on a flat 6-meter band.

I also have a 135-foot inverted-**V** dipole fed with balanced line that I normally use with a manual tuner in my station. The AH-730 had no difficulty tuning that antenna on all bands.

Final Thoughts

Icom's AH-730 remote auto tuner is a good choice for someone who wants to operate on multiple bands with a compatible Icom radio and simple antenna such as an end-fed wire, 43-foot vertical, or dipole fed with balanced line. It quickly found a tuning solution with the antennas I tried, and worked well enough to make a lot of contacts across the bands.

Manufacturer: Icom America, 12421 Willows Rd. NE, Kirkland, WA 98034, **www.icomamerica.com**. Price: $549.99.

Chelegance JNCRadio M-104 Four-Band HF Portable Antenna Kit

Reviewed by John Leonardelli, VE3IPS
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I have been searching for a lightweight HF multiband antenna that I can easily carry during air travel and fit into the side pocket of my backpack for portable use. After conducting some research, I came across the JNCRadio M-104 multiband antenna kit. It consists of a base-loaded vertical antenna with band coils for 40, 20, 15, and 10 meters, a base unit using the PL-259 format connector, a counterpoise ring terminal (for adding your own counterpoise), and a 3.94-foot (1.2-meter) telescopic whip. The power rating of 50 W PEP is perfect for my portable operations. Additionally, it includes a six-sided coupler to connect the whip directly to the antenna base without a coil. The assembly process is straightforward, with all components easily screwing together. I ordered mine from **www.chelegance.com**, and it arrived within 7 days with UPS shipping.

Chelegance was established a few years ago to address the need for cost-effective portable antennas and relevant amateur radio products, featuring designs from BG8BXM and BD8ABC. I noticed that the counterpoise wire is not included, but Jesse, BD7LLY, promptly responded to my inquiry and informed me that it is op-

Bottom Line

The Chelegance JNCRadio M-104 is a low-cost, compact, and lightweight HF portable antenna, making it the ideal antenna for travel when luggage weight and size are limited.

▲**Figure 9** — The JNCRadio M-104 on a Diamond K400 series bracket mobile mount.

▶**Figure 10** — The JNCRadio M-104 on a Comet mobile magnetic mount.

tional. They have observed many users utilizing this antenna for fixed mobile operations.

The overall construction of the antenna is excellent, and it comes in a compact plastic box measuring 7 × 4.3 × 1.2 inches (see the lead photo). Two primary features attracted me to this antenna: its small and lightweight design (weighing only 11 ounces) and its compatibility with a mobile mount (see Figures 9 and 10).

Portability and On-the-Air Operations

I recently traveled to Boston for business, and because I would be there for a few days, I decided to bring my Yaesu FT-818 multiband radio for possible Parks on the Air field operations and chatting on the repeaters while on the move. It was crucial for me to have a compact antenna that I could discreetly deploy, as I always travel with carry-on luggage. Both the radio and the antenna fit easily into my Think Tank travel backpack, and I have never encountered any issues with airport security. However, the coils do catch the attention of the X-ray machine, so I always place my radio and antennas in the security bin for a quick and hassle-free inspection. Trust me, if you don't, security will conduct a physical inspection that can cause delays.

Because I rented a car, I was able to use a Diamond K400 mount that I had packed (don't forget the Allen key) along with the M-104 antenna for HF operations. I also brought a cigarette lighter cord for the radio, ensuring I was fully prepared. On a beautiful day, I drove down to the waterfront district of Boston to visit the USS *Constitution* and the Christopher Columbus Waterfront Park. I had also packed a small clamp bracket that I made using an SO-239 connector and a counterpoise wire for use at the park. I typically use either #26 Silky wire or a 33-foot rubberized test lead wire.

During my operation, I made a local contact on 40 meters and several contacts with stations in Texas on 20 meters. As expected with short HF antennas, I knew beforehand that I would need to adjust the length of the counterpoise wire to achieve a desirable SWR. I made adjustments incrementally, a few inches at a time, until the SWR was around 1.5:1.

It's worth noting that the telescopic whip itself is too lightweight to be used while driving on the interstate highway, so I utilized it only at roadside tourist rest stops. I made a quick rest stop on my way to Salem, New Hampshire, on Highway 93. It took me only 30 seconds to swap out a Larsen 2-meter mobile whip with the M-104 antenna and 20-meter band coil, and was on the air.

Table 5
Chelegance JNCRadio M-104 Four-Band HF Portable Antenna Kit

Manufacturer's Specifications (not tested by the ARRL Lab)	
Maximum SSB power input	50 W
Maximum digital power input	20 W
Band coverage	40, 20, 15, and 10 meters
Antenna impedance	50 Ω
Antenna connector	PL-259
Minimum antenna length	55.12 inches
Package dimensions	7.09 × 4.33 × 1.18 inches
Weight	11 ounces

While I could hear many European stations on 20 meters, I wasn't able to make successful contacts using just 5 W. However, I did manage to work a station in Kentucky with a 5 × 5 signal. Needless to say, I was extremely pleased with the performance of the antenna.

On a warm day, I decided to take a walk and set up the antenna with my Icom IC-705 at the local park to take some photos for this review. I used a small 3D-printed bracket for the antenna mount and adjusted the SWR by shortening the counterpoise wire while utilizing the Icom's built-in SWR meter (see Figure 11). During my operation, I heard N4SMS calling CQ from Schofield Middle School Radio Club, and I received him at 59 while he had me at 57 on 20 meters. With 10 meters becoming the Magic Band again, I also picked up several CW beacons on this band. Additionally, this antenna serves as a great shortwave listening antenna. Simply screw in the band coil, extend the whip, and enjoy tuning the bands. After several operating events, I have found that this antenna lives up to its promises, and its convenient size makes it a valuable addition to my radio kit. One of the features of the antenna that I appreciate the most is its telescopic whip, which can be fully extended and paired with the appropriate coil. It makes the setup easier than adjusting tap points and measuring the whip length.

I also deployed the antenna with a custom bracket mounted on the side of the Icom IC-703 backpack for a tabletop operation. The same scenario applied for the Icom IC-705, and I could adjust the SWR by changing the attached counterpoise length. With the radio antenna tuner, I was even able to use the 15-meter coil on the 17-meter band.

For the counterpoise, I made use of #26 Silky stranded wire, terminating it on the supplied spade lug. I coiled it up and stored it in a small ziplock plastic bag, which can also fit in the antenna kit's plastic box.

During my usage, I developed a quick and easy hack. I attached a 44-foot-long wire to the base mounting unit

Figure 11 — A 3D-printed bracket with an SO-239 connector with the M-104 antenna. It works as expected on the Icom IC-705.

(without coils or whips) using a washer and an M6 metric nut. I then tossed the wire into a 10-foot-tall tree, effectively enabling near vertical incidence skywave communications on 60 meters. I can also shorten the wire to 32 feet for 40 meters.

Additionally, I can use the antenna without the coil. By using the telescopic whip and the six-sided coupler, I can cover the 2-meter to 70-centimeter range. Additionally, if I attach a 5- to 6-inch wire with an alligator clip, I can even utilize it for 6-meter operations. This antenna proves to be highly versatile.

Furthermore, this antenna can be deployed on tabletops in homeowners association situations where antennas are a problem. By using a small camera tripod, an SO-239 bracket, and its counterpoise, I can be on the air. It is small and discreet, blending in seamlessly on top of a patio table. This setup is also ideal for FT8 users and other weak-signal digital modes as well.

Conclusion

Overall, this antenna is a valuable addition to my antenna collection. It can be used easily in portable and mobile configurations, and it has consistently demonstrated excellent radiating performance despite its compact size. I am highly satisfied with this investment, as it provides HF communications for the portable operator in a multiband antenna that can fit in a vest pocket.

Manufacturer: Chelegance JNCRadio, **www.chelegance.com**. Price: $70.

See *QST* in Depth for More!

Visit www.arrl.org/qst-in-depth for the following supplementary materials and updates:

✓ Test fixtures and methods used by Phil Salas, AD5X, to test antenna tuners for the ARRL Lab