Product Review & Short Takes Columns from *QST* Magazine

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Product Reviews

Kenwood TM-D700A Dual-Band FM Mobile Transceiver

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Short Takes

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Kenwood TM-D700A Dual-Band FM Mobile Transceiver

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The TM-D700A—it's not your father's TH-D7A!

Last year, I reviewed Kenwood's TH-D7A dual-band FM hand-held transceiver (see *Product Review*, August 1999)—the first hand-held amateur transceiver to include a built in TNC. I was very impressed with what it had to offer, particularly to APRS users. When I first heard about the TM-D700A, my initial reaction was that it was probably just a TH-D7A in a mobile package. Well, it's marveling time again—Kenwood's TM-D700A dual-band mobile transceiver packs in even more features than its ground-breaking predecessor.

It's Two, Two—Two Radios in One

The TM-D700A includes all of the features that we've come to expect in a high-end dual-band FM mobile transceiver—and more. Highlights include 200 memory channels with 8-character alphanumeric memory naming capability; CTCSS and DCS encode, decode and tone scan; 10 nameable autodial memories; DTMF wireless remote control; extended receive frequency coverage; a spectrum display; extensive control from the microphone and cross band repeat—just to name a few. FM SSTV operation is even possible by connecting a single optional cable between the transceiver and Kenwood's VC-H1 Interactive Visual Communicator (see *Product Review*, December 1998).

Perhaps the most notable features however, are the built in 1200/9600-baud TNC and GPS receiver interconnect jack for APRS applications.

Having a TM-D700A is practically like owning two transceivers in a single enclosure. Both radios, "A" and "B," can transmit and receive on the 2-meter or 70-cm bands. In fact, both radios can transmit and receive on the *same* band, providing that one is in the voice mode and the other is in a data mode. (Voice transmission will however, interrupt or delay data transmission when operating in this configuration.)

Cross band data communications is also possible—very handy for digital satellite work. In this case, the transmitter of one radio is set up for data operation on the satellite uplink frequency and the receiver of the other radio is also set up for data operation on the satellite downlink frequency.

Two Boxes for the Price of One

The TM-D700A transceiver actually consists of two distinct components: a front panel and a main unit. The faceplate is not "detachable"—it is a completely separate part.

The 5.25×1.5×7.75-inch main unit contains the majority of the circuitry. It supports a single chassis mounted SO-239 antenna connector and two RJ style jacks—one for the microphone and another for the front panel's umbilical cord. A male DB-9 connector for computer connection, a female 6-pin mini DIN connector for an external TNC and a 2.5 mm jack for your GPS receiver are also provided. A pair of 3.5 mm jacks are available for connecting external speakers (you can use a single external speaker, independent speakers for radios A and B or combinations of the internal and external speakers by changing a menu setting). The built-in speaker, mounted inside the main unit, provides more than adequate audio even in the noisiest environments.

A short pair of power leads with a fuse on the positive side and terminated with a conventional T-type Molex power connector exits the back apron of the main unit. (This connector mates with one on a longer power cable that has fuses in both the positive and negative leads near the power source end.) The cooling fan is very quiet.

The front panel contains the radio controls and a large 3.75×1.25-inch dot-matrix LCD display. The default display setting shows black segments on an amber background, but a "reverse" mode is also available from a menu. Additional menu settings allow you to change the display intensity and contrast. An adjustable front panel bracket and a chassis-mounting bracket are provided. The display is easy to read over a wide range of lighting conditions and viewing angles.

The front panel's umbilical cord is over 9 feet long, providing considerable leeway for installation of the front panel and main unit in convenient locations in the car or shack. That leeway is somewhat limited—the main unit needs to be positioned within mike cord's length and ears' shot of the operator—the microphone connector and internal speaker are in the main unit. Trunk mount applications will require extension cables and an external speaker (or speakers).

Kenwood offers a solution. Their optional PG-4X extension cable kit contains 13-foot extensions for the microphone

Bottom Line

The TM-D700A is more than just a TH-D7A in a larger package. Kenwood's combination of top-of-the-line dual-band FM mobile transceiver features and enhanced digital, APRS and SSTV capabilities offer new dimensions in fixed and mobile amateur communications.

Joe Bottiglieri, AA1GW ♦ Assistant Technical Editor

Table 1

Kenwood TM-D700A, serial number 10800015

Manufacturer's Claimed Specifications	***Measured in the ARRL Lab***
Frequency coverage: Receive and transmit, 144-148 MHz, 438-450 MHz.[1]	Receive, 118-524, 800-1300 MHz[2]; transmit, 144-148 MHz, 430-450 MHz.
Power requirement: Receive, 1 A; transmit, 11.5 A (high power).	Receive, 0.8 A; transmit, 8.1 A. Tested at 13.8 V.
Modes of operation: FM, FSK.	FM, FSK, AM (AM receive only).
Receiver	*Receiver Dynamic Testing*
FM sensitivity, 12 dB SINAD: <0.16 μV; sub-band (in VHF/VHF or UHF/UHF mode), <0.25 μV.	For 12 dB SINAD, VHF, 0.13 μV; UHF, 0.15 μV.
AM sensitivity: Not specified.	10 dB (S+N)/N, 1-kHz tone, 30% modulation: 0.9 μV.
FM adjacent channel rejection: Not specified.	20 kHz channel spacing, preamp on: VHF, 72 dB; UHF, 73 dB.
FM two-tone, third-order IMD dynamic range: Not specified.	20 kHz channel spacing, preamp on: VHF, 72 dB*; UHF, 73 dB*; 10 MHz channel spacing, preamp on: VHF MHz, 81 dB; UHF, 84 dB.
S-meter sensitivity: Not specified.	S9 signal: VHF, 3.4 μV; UHF, 4.7 μV.
Squelch sensitivity: <0.1 μV.	At threshold: VHF, 0.07 μV; UHF, 0.12 μV.
Receiver audio output: 2.0 W at 5% THD into 8 Ω.	2.5 W at 4% THD into 8 Ω.
Spurious and image rejection: Not specified.	First IF rejection, VHF, 102 dB; UHF, >130 dB; image rejection, VHF, 75 dB; UHF, 51 dB.
Transmitter	*Transmitter Dynamic Testing*
Power output (H/M//L): VHF, 50 / 10 / 5 W; UHF, 35 / 10 / 5 W.	VHF, 47 / 10 / 4.0 W; UHF, 35 W / 13 W / 5.3 W.
Spurious-signal and harmonic suppression: ≥60 dB.	VHF, 72 dB; UHF, 70 dB. Meets FCC requirements for spectral purity.
Transmit-receive turn-around time (PTT release to 50% audio output): Not specified.	S9 signal, VHF, 104 ms; UHF, 90 ms.
Receive-transmit turn-around time (tx delay): Not specified.	VHF, 58 ms; UHF, 55 ms.
Bit-error rate (BER), 9600-baud: Not specified.	146 MHz: Receiver: BER at 12-dB SINAD, 8.3×10^{-4}; BER at 16 dB SINAD, 2.4×10^{-5}; BER at –50 dBm, $<1.0\times10^{-5}$; transmitter: BER at 12-dB SINAD, 1.2×10^{-3}; BER at 12-dB SINAD + 30 dB, $<1.0\times10^{-5}$. 440 MHz: Receiver: BER at 12-dB SINAD, 6.5×10^{-4}; BER at 16 dB SINAD, 3.0×10^{-5}; BER at –50 dBm, $<1.0\times10^{-5}$; transmitter: BER at 12-dB SINAD, 8.6×10^{-4}; BER at 12-dB SINAD + 30 dB, $<1.0\times10^{-5}$.

Size (hwd): main unit, 2.4×5.5×7.7 inches; front panel, 2.4×5.5×1.3 inches; weight, main unit, 2.6 lb, front panel, 0.4 lbs.

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

*Measurement was noise-limited at the value shown.

[1]Band A receive range is approximately 136-200, 118-136 MHz (sub), 200-300 MHz (sub), 300-400 MHz (sub), 400-470 MHz (sub). Band B receive range is approximately 400-524 MHz, 136-175 MHz (sub), 300-400 MHz (sub), 800-1300 MHz (sub, see note 2).

[2]Receive range excludes 824-849, 869-894, 914-934 and 1213-1229 MHz. Sensitivity at 222 MHz was measured at 0.18 μV. Poor sensitivity (3-25 μV) was measured between 250-350 and 510-524 MHz. Reduced sensitivity (approximately 1 μV) was measured above 800 MHz.

An expanded test result report for this transceiver is available on the ARRL Members-Only Web site. Printed copies are also available for those without Web access.

cable and the front panel's umbilical cord. The kit also includes a third dual 13-foot cable for connecting up to two external speakers and a 19.5-foot dc power cable. A second PG-4X cabling kit can be connected in series to provide an even more remote installation. While these multi-wire extension cable kits allow for lots of flexibility for installing the various radio components, add your GPS receiver cable to the fray and the potential for a rat's nest escalates!

Controls, Buttons and Menus

The front panel sports five multi-function rotary controls and twelve multi-function buttons.

The largest control is the main tuning knob. It selects the operating frequencies in the "VFO" mode, the memory channels in the "memory recall" mode, or the menu selections in the "menu" mode. Pressing this knob toggles between 1 MHz and normal tuning steps and user-selectable incremental tuning steps when in the VFO mode.

Radios A and B each have separate concentric squelch and volume controls. Pressing a particular volume control causes that radio to be "selected." Adjustments or features you access with the other controls or buttons then effect only the "selected" radio.

With the exception of the **PWR** button, all the buttons surrounding the front panel have multiple functions. "Soft" labels for these appear in the LCD display above or beside each button. The assignments change depending on which mode is currently selected or whether the **F**unction button had been pressed. There are menu options that allow a considerable amount of flexibility for tailoring the available buttons to your particular operating preferences.

Along with all the primary multi-function controls and buttons, there is a menu hierarchy that allows you to control additional operating parameters. Pressing the **MNU** button accesses the main menu. Navigation through the various selections and choices

is accomplished by using **OK**, **BACK** and arrow buttons and/or the main tuning knob.

The menu contains 88 selections controlling an incredible variety of operations. For example, if you wish to monitor AM activity in the 118 MHz band, you would press the **MNU** button, then press the arrow button to display the "RADIO (1)" menu. Press the **OK** button; then press the arrow buttons to display the "TX/RX (3)" submenu. Press the **OK** button; then press the arrow buttons to bring up the "FM/AM MODE" sub-sub-menu. Press the **OK** button; then press the arrow buttons to select the desired mode (FM or AM). Press the **OK** button to select "AM," then press the **MNU** button to exit the menu mode. While this may seem a bit complicated, once you get a feel for the general arrangement, it really becomes quite easy.

Some of the menu items—memory naming for example—require that you input alphanumeric data into the radio. There are two ways of performing this task: via the 16-key microphone keypad or via the front panel tuning control.

The ten number keys (**0** through **9**) on the microphone keypad are also labeled with two or three letters. You can use these keys to enter the number or one of the letters in lower or upper case. For example, each time you press the key labeled **4GHI**, you are offered the following selections in sequential order: g, h, i, 4, G, H and I. When you bring up the desired character, you press the microphone's **D** key to enter it. A variety of punctuation signs and symbols are available by pressing the # key.

Alternatively, you can also use the front panel tuning control to scroll through all the choices. When you locate the character or symbol you want, you press the **OK** button to select it and the right arrow button to move on to the next character. Once you are finished inputting the desired information you save it by pressing the **OK** button once again.

In my opinion, using the main tuning knob for alphanumeric entry is much easier than using the microphone keypad. The knob allows you to scroll through all the choices very quickly. Once you get a feel for programming characters with that control, you will probably prefer it to the microphone keys as a means of entering alphanumerics.

Good News for Scanner Buffs

Radio A and radio B each have expanded receive frequency coverage. The specific ranges covered by each are different. The overall receive range is approximately 118 to 524 MHz and 800 to 1300 MHz. See Table 1 for details.

There's a bevy of scanning modes—and these complement this wide receive frequency coverage nicely. Scanner enthusiasts will be very pleased.

"VFO scan" checks all the frequencies on a selected band. "Memory scan" examines every programmed memory channel. "Group scan" looks at a group of 20 memory channels—memory channels 21 to 40 for example.

"Program scan" peruses a specified range of frequencies between preset limits—144.910 to 145.090 MHz for example. "MHz scan" looks at the 1-MHz segment of the band where the radio is currently tuned. "Call/VFO scan" monitors the calling channel of the selected band and the current VFO frequency on that band. "Call/memory scan" monitors the call channel on the selected band and a selected memory channel.

"Visual scan" provides a graphic representation of the activity on the frequencies surrounding the current operating frequency. You can select 31, 61, 91 or 181 frequency channels to visually scan. For example, if you select 61 channels, 30 channels above and below your current operating frequency as well as your current operating frequency are scanned. Vertical bars whose height is dependent on signal strength indicate the active channels. The main tuning knob can be used to move the visual scan cursor on the horizontal axis of the graph to investigate active frequencies. The operating frequency that the cursor represents is displayed in the visual scan window. A **SET** button allows you to reset the current cursor position as the center frequency of the visual scan.

Visual scan is a great tool, but I ran into difficulty when using it initially. Visual scan will *not* work when the radio is in the TNC packet or TNC APRS modes, but this important bit of information is not in the manual. And as Murphy would have it, I tried using visual scan for the first time when the radio was in the TNC APRS mode. After a frustrating 20 minutes, I finally guessed the source of my problem and switched out of the TNC mode. The visual scan then worked as advertised.

On to the Main Attraction—APRS!

As with the TH-D7A, the big selling feature for this radio is its built-in TNC and APRS capabilities. With that combination, the TM-D700A is a self-contained APRS station with practically all the necessities. The only significant item you'll probably want to add is a GPS receiver. While for fixed station operation, the GPS receiver isn't necessary, for most mobile APRS applications I consider a GPS receiver to be a necessity.

Unlike the TH-D7A, the TM-D700A can serve as an APRS digipeater. It can take on as many as four "aliases" (alternative tactical station identifications that are used in place of a station call sign). The instruction manual briefly mentions the *four*-alias capability, then goes on to explains how to program *one* alias—leaving you in the dark as to how to program the other three!

After some head scratching and experimentation, I figured out how to get all four programmed into the radio. Once in the menu, work your way down to the "UIDIGI" command (menu item 3-L), then enter each alias separated by a comma with no spaces (example: "alias1,alias2,alias3,alias4"). The total number of characters in each alias must not exceed 9. Note that aliases like WIDE and RELAY will work, but the TM-D700A cannot be programmed to function as a TRACE N-N or WIDE N-N APRS digipeater. The TM-D700A can be programmed to use TRACE N-N and WIDE N-N digipeaters in the path that it uses for relaying its packets.

Another enhanced feature is the ability to store *five* positions and *five* status texts (the TH-D7A only allows you to store one of each). The five-position status text capability is especially useful if you do not have a GPS receiver and want to report your changes in position. This would allow you to program a position for your home and another for work, then switch between the two as required. The five status texts are also useful for conveniently switching between status messages such as "Parked in my driveway," "En route to work," and "Parked in my company parking lot." Each status message can be up to 28 characters long (versus 20 with the TH-D7A).

A related new feature is the ability to control how often your status text is transmitted. You can program status to be transmitted with every transmitted APRS packet or you can limit it to a ratio between 1:2 and 1:8 (one status text transmission per X number of APRS packet transmissions). For example, if you select 1:4 your status is sent once in every four transmitted APRS packets. You could also set this parameter to 0, thereby disabling status text transmissions entirely.

Position ambiguity is another settings option with the TM-D700A. Rather than transmitting your "exact" latitude and longitude, you can make your reported position less specific by programming the TM-D700A to lop off the last 1 to 4 digits of your position. Thus, 41 degrees 37.80 minutes N and 72 degrees 56.71 minutes W in my backyard becomes a less precise 41 degrees N, 72 degrees W when the unit is set for "maximum ambiguity."

A new internal clock allows you to set the date and time that is displayed in the detailed received APRS data window and this will record precisely when an APRS packet was received.

You can view the actual raw packet data

received by switching to the packet monitor mode. A **HOLD/RESUME** button allows you to freeze this display in order to study its contents and then resume displaying the scrolling lines of packets. The arrow buttons allow scrolling up and down through as many as ten pages of received packets that the radio is capable of storing.

The messaging functions have some new capabilities, too. For starters, messages and bulletins can now be 69 characters in length (versus 45 in the TH-D7A). A 64-character automatic answer message can be stored in the TM-D700A to automatically respond to any received messages. This function is very useful for times when you cannot respond manually (tooling down the Interstate during rush hour for example).

You can also program the TM-D700A for message and bulletin "groups." This filters received messages and/or bulletins and displays only those messages or bulletins from the groups you specify. The TM-D700A stores the last 16 messages or bulletins received.

Position limit settings of from 10 to 2500 miles (or kilometers) allow you to filter packets from APRS stations beyond a selected limit. For example, if you set the limit to 50, all packets originating from beyond 50 miles will be ignored by the TM-D700A. (A menu setting allows you to display measurements in miles or kilometers and degrees Fahrenheit or Centigrade.)

The TM-D700A can be programmed to transmit APRS packets via the "manual" mode (after pressing the **F** button, then the **BCON** button on the front panel), via the "PTT" mode (on a press and release of the microphone PTT button) or via an "auto" mode. In the auto mode the radio transmits APRS packets automatically according to the setting of the transmit beacon rate parameter.

Kenwood added a 0.2-minute transmit beacon rate to the selectable rates provided in the TH-D7A (0.5, 1, 2, 3, 5, 10, 20 and 30 minutes). The 0.2-minute setting is handy for fast-moving APRS sources such as a Ferrari at Le Mans. The 30-minute rate is more appropriate for sedentary sources like my classic Oldsmobile—in *Le Driveway*.

Like the TH-D7A, any APRS icons can be used to identify your station, but the radio is only capable of displaying 15 of these. Since the TM-D700A can function as a digipeater, a displayable digipeater star icon has replaced the triangle icon found on the 'D7A. And, since the TM-D700A is more likely to be installed in a vehicle than carried by a jogger, a tractor-trailer icon replaces the jogger icon found on the H-T.

The TM-D700A stores information received from the last 40 APRS stations (just as with the TH-D7A). However, the TM-D700A can store and display more extensive information on each station.

When the TM-D700A receives a new APRS packet, it momentarily replaces the band operating frequency on the display with the call sign, SSID and a short string of data. This data varies depending on the type of APRS station that is being received.

For a mobile station, it typically displays its course and speed. A mobile station using the compressed APRS data format also provides its altitude. A mobile APRS station employing a TM-D700A, TH-D7A or a MIC-E also gives a position comment. A fixed APRS station typically displays its transmitting power, height above average terrain (HAAT), antenna gain and antenna directivity (or "OMNI" if it's using an omni-directional antenna). A fixed station using the compressed APRS data format can also display its transmit range and altitude. An APRS weather station might display its wind direction, wind speed, temperature and the recent rainfall amount. An APRS object displays its course, speed and the call sign of the station that placed the object in the APRS network.

While this information is shown, you can press the **DETAIL** button to bring up additional details on the received station. The detailed received APRS data window displays the station's call sign, its SSID, the time the packet was received, the station type, the station icon, the latitude, the distance, the longitude, the grid square, a compass pointing to the station's approximate relative location, an exact compass direction and a longer string of data that varies depending on the station type. Pressing the **DATE** button changes the time the packet was received to the date the packet was received. Pressing the **MSG** button opens the message input window with the received station's call sign and SSID already inserted in the "Message To:" field. Arrow buttons allow you to scroll through the details of the 40 most recently received stations.

You can toggle the TM-D700A's GPS interface to use position data generated by a GPS receiver that is connected to the TM-D700A or you can manually input position information directly. The TM-D700A is compatible with GPS receivers that use the NMEA 0183 2.0 protocol. The Garmin GPS-II+ GPS receiver that I normally use with my 'D7A attached to the TM-D700A using the same cable and connector. (This cable and radio connector is included with the TM-D700A. You must provide the connector for the GPS receiver end of the cable.)

If your current GPS receiver supports $GPWPL sentence data input, it will accept position data from the TM-D700A and that data will be added to the GPS receiver's waypoint list. The waypoint is identified by the last six characters of the received station's call sign and SSID (WA1LOU-15 would become LOU-15 in the GPS receiver's list.) This data will also be displayed on the GPS receiver's map window if it supports that capability.

The TM-D700A has 15 preprogrammed MIC-E compatible messages or "position comments"—the TH-D7A only provides 8.

The internal TNC uses a command set that is very similar to those in most current standalone TNCs. It includes some additional commands, like KISS and DIGIPEAT, that were not available in the TH-D7A's command set.

On the Air and On the Road

To road test the TM-D700A, I decided to install it in my land barge (the Oldsmobile). I ran it in the APRS mode back and forth to work and hither and yon everyday for weeks. To monitor my daily treks, I ran *MacAPRS* on my computer at the home station.

The local WIDE APRS digipeater (WA1LOU-15) is in my backyard near the top of a 1000-foot mountain (which, incidentally, is pretty darn high for this part of the country!). On my trip to work, I drive down the mountain to about 200 feet above sea level and then proceed through a valley to my final destination at the "salt mine." When using my TH-D7A for mobile APRS, my tracks inevitably disappeared near the base of the mountain. The mountain creates an RF shadow that the 5 W output of my TH-D7A just could not overcome. When using that radio, I would have to clear the shadow of the hill before my tracks reappeared on my home station's APRS map. While road-testing the TM-D700A—with its hefty 50 W 2-meter transmitter—there was never a drop-out. My tracks were solid for the entire 19-mile trek to and from work.

I also ran the TM-D700A extensively from my home station in the following configurations:

Voice on 2 meters and 70 cm.

Plain vanilla packet with a dumb terminal program running on my computer using the TM-D700A's built-in TNC.

APRS with *MacAPRS* running on my computer interfaced to the TM-D700A's TNC.

DX Packet Cluster operation using the DX mode of the TM-D700A.

APRS using the APRS mode of the TM-D700A.

General monitoring of our local police frequency—453.150 MHz.

All of these applications ran smoothly without any gotcha's or other unwanted surprises. However, the last application resulted in an interesting surprise.

Monitoring 453.150 MHz proved to be a good test of the radio's UHF receiver capabilities. Besides hearing the local *gendarme* on that frequency, I also heard an-

other radio operation. The chatter from the mystery radio station indicated that it was coming from some kind of government housing authority. I assumed it had to be out of state—I doubted that another in-state radio service would be assigned the same frequency as our local police force.

The nearest state is Massachusetts and the nearest populated area in Massachusetts that would likely have a housing authority is the Springfield area. I started keeping track of the street names that were mentioned by the users. At one point, the intersection of X and Y streets was mentioned, so I ran Delorme *Street Atlas* on my computer, searched for that street intersection and, voilá, Springfield was indeed the source of the mystery radio transmissions.

Nice detective work, but more importantly it gave some indication of the radio's UHF sensitivity. Springfield is approximately 40 miles away from my radio shack as the RF flies and the signals emanating from the housing authority were S-9. But, there's more! Pushing the envelope, I started monitoring the Springfield housing authority while mobile and I was shocked how well I was able to hear that operation while traversing the hills and dales around town. This was very impressive!

For a weekend, I replaced the WA1LOU-15 APRS digipeater radio equipment with the TM-D700A using its built-in APRS software. None of the users noticed any difference in the digipeater's operation. (At least, no one complained and, as they say, "*No news is good news.*")

The TM-D700A may lack some state-of-the-art APRS digipeater protocol features like TRACE N-N and WIDE N-N, but it can still serve as a suitable APRS digipeater in a pinch.

The Ultimate Test

My wife has never been interested in any of my ham radio toys. When she saw the TM-D700A installed in my Oldsmobile, she thought it was actually "neat!" I believe that earning that response from her qualifies this radio as a major milestone in Amateur Radio equipment design!

I am the administrator of the HTAPRS Special Interest Group (*SIG*), which is an e-mail list devoted to the discussion of technology topics related to APRS—including the TM-D700A. The SIG is sponsored by TAPR. If you have questions concerning the operation of this transceiver, this list can provide a good source of information. You'll also discover how other owners are using the radio. You can subscribe to the HTAPRS SIG by visiting **http://www.tapr.org/tapr/html/sigf.html**. Select the "Join APRS HT" link.

Manufacturer: Kenwood Communications Corp, 2201 E Dominguez St, Long Beach, CA 90801; 310-639-5300; fax 310-537-8235; **http://www.kenwood.net**.

Manufacturer's suggested retail price, $780. Typical current street price, $660. PG-4X Extension Cable Kit, $70; VS-3 Voice Synthesizer Unit, $40.

ACOM 2000A HF Linear Amplifier

Reviewed by David Sumner, K1ZZ
Executive Vice President

It would be very easy to get used to having an ACOM 2000A in your shack. In fact, you might get so used to having it that you might forget it's there! Operation is almost that transparent.

The ACOM 2000A amplifier consists of a large, heavy, black box and a small, separate remote control unit (RCU) that's about half the size of an $8^1/_2 \times 11$ sheet of paper and about a half-inch thick. The main unit can be stowed in any out-of-the-way corner where there is adequate ventilation. In normal operation you never have to touch it or even see it, although the manufacturer recommends using the master power switch (the black box's only control) to turn the power off between operating sessions. What little operator interface is required is provided by the remote control unit, which can be as much as 10 feet away using the supplied cable.

The amplifier is shipped in two cartons—the transformer is boxed separately. The tubes come installed, but special supports are included to keep them from shifting during shipping. These, of course, must be removed prior to use. Two small screws through the back panel also temporarily secure the blower assembly and are likewise removed. The control head comes packed in a box nestled within the amplifier in the location where the transformer is installed.

The desired ac line voltage must be set before the transformer is installed. Rather than a terminal strip, the 2000A uses a PC-board with 9 metal posts arranged in a grid. Three movable shorting bars are positioned to allow a wide variety of supply line voltages from 100 to 240 volts. As with most HF amplifiers, the user must supply the appropriate plug for the power receptacle.

The complete assembly process takes less than an hour. As the finished main unit is quite heavy (79 lbs), it's a good idea to put the amp together in a location close to its final operating position.

Hooking up the amplifier is straightforward. For full-power operation, a source of approximately 240 V ac at 20 A is required. On the rear panel there's a grounding stud, one SO-239 coaxial connector for the input from the transceiver, and another for the output to the antenna or antenna switch. Three RCA phono jacks provide connections for **KEY IN**, **KEY OUT** and **ALC**. **KEY IN** is the usual "ground on transmit" control line that puts the amplifier into the line when your transceiver switches to transmit. **KEY OUT** allows you to inhibit the operation of the amplifier at times when you might want to, such as when you're switching antennas and you want to avoid inadvertently "hot switching." The manufacturer recommends against using the **ALC** connection—it's better to adjust the drive to the amplifier with the "RF power" control that is almost universally available on the front panel of HF transceivers these days—but it's there if your particular installation requires it. Finally, there are two DB-9 connectors, one for the cable to the RCU and the other for an RS-232 interface. The most common use for the RS-232 interface is to control the accessory ACOM

Bottom Line

The operation of the ACOM 2000A is so transparent that you might forget it's there. After initial set up and programming with it connected to your particular antenna system, the amplifier will sense your transmitting frequency and automatically tune itself for the band segment of interest.

Figure 2—The optional weatherproof 2000SW 10-position remote antenna switch and the corresponding 2000S automatic antenna selector control.

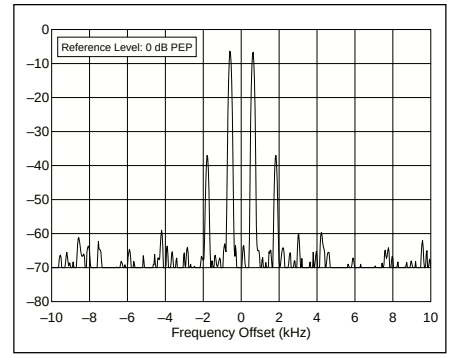

Figure 1—The spectral display of the ACOM 2000A during two-tone intermodulation distortion (IMD) testing on 14 MHz at 1500 W PEP output. The third-order product is approximately 37 dB below PEP output, and the fifth-order product is down approximately 60 dB.

Table 2

ACOM 2000A, serial number 990346

Manufacturer's Claimed Specifications	*Measured in ARRL Lab*
Frequency Range (US units): All amateur frequencies, 1.8 to 29.7 MHz.[1]	As specified.
Power output: 1500 W PEP, all modes and continuous or modulated carrier.[2]	As specified for SSB and CW.
Driving power required: 50 to 60 W.	As specified.
Input SWR: less than 1.3:1	As specified.
Output matching: up to 3:1 SWR (2:1 for 160 meters).	As specified.
Spurious signal and harmonic suppression: 50 dB below rated output or greater.	50 dB, worst case (3.5 MHz).
Intermodulation distortion (IMD): –35 dB.	See Figure 1.

Primary power requirements: 90-132, 180-264 V ac (five user settable taps).

Size (hwd): 7.1×17.3×19.7 inches; weight, 79 lb.

An expanded test result report for this amplifier is available on the ARRL Members-Only Web site. Printed copies are also available for those without Web access.

[1]1.8-21.7 MHz. Frequencies above 21.7 MHz can be unblocked with proof of proper licensing.

[2]Optional auxiliary cooling fan recommended for extended high-duty-cycle operation.

2000S automatic antenna selector and 2000SW remote antenna switch; we'll have more to say about these accessories later.

When you turn the amplifier on (using the rocker switch on the front panel and the distinctive red **POWER ON/OFF** pushbutton on the RCU) the LCD display on the RCU comes to life and it beeps a cheery "TEST" in Morse code. The fan also turns on, although if you have a desktop PC running in the shack you may not notice it; it's quieter than many PCs. It takes 2½ minutes for the pair of 4CX800A tubes to warm up, during which time a countdown clock on the RCU tells you how many seconds you have to wait. A Morse "R" tells you when the amplifier is ready. Push **OPR/STB** to switch from Standby and you're ready to go. In addition to the LCD display the RCU has peak-reading LED bar displays showing forward and reflected power and individual LEDs to show when power is on and whether the amplifier is operational or in standby, and to warn of abnormal operation.

The first time you use the amplifier with a particular antenna or on a particular band segment (the amateur HF bands are divided into 40 different band segments ranging in width from 25 kHz in the 160-meter band to 300 kHz in the 10-meter band) you will have to run through a simple autotune procedure. Push **ENT** twice and the LCD display will tell you to apply 10-20 W of drive. The display will show you when the drive is within these limits. As soon as it is, the autotune circuitry will take over and a second or so later the message "AUTOTUNE COMPLETED PLEASE REMOVE DRIVE" will appear on the LCD. That's all there is to it! From that point on, the amplifier will automatically sense (from the first few milliseconds of drive you apply to the input) the operating frequency and will tune itself up for that band segment. Manual tuning is also possible, but it's unlikely you would ever need to resort to it in normal operating. The amplifier requires about 60 W of drive to deliver the full legal-limit output of 1500 W.

The amplifier can handle VSWRs of up to 3:1 on all bands except 160 meters, where the limit is 2:1. Should the characteristics of your antenna change drastically, either through failure of the antenna or feedline or because of temporary weather conditions such as icing, the amplifier will sense the change and will put itself in standby, displaying an appropriate error message. The same thing will happen if you apply too much drive or commit some other "cockpit error." While any high-power transmitter is worthy of the utmost care and respect, it would be very difficult to damage this amplifier through inadvertence.

The LCD display normally shows the temperature of the exhaust air, whether the amplifier is in Standby or Operate, the band segment and antenna (if the automatic antenna selector is installed) that are in use, and whether the amplifier is tuned to factory default or user-defined settings. There are 20 other operating parameters that can be measured and displayed, two at a time, by digital readout. You can check your power line voltage, plate voltage and current, antenna VSWR, drive power, and a host of others—even the power gain of the amplifier! Monitoring some of these parameters during CW or SSB operation isn't possible because they change too quickly, but a brief key-down test (into a dummy load, please!) will tell you what you need to know.

ACOM encourages amateurs who buy the 2000A also to pick up the 2000S automatic antenna selector and 2000SW 10-position remote antenna switch (see Figure 2). Once you have used them together it's easy to see why. The amplifier will automatically select the last antenna that was used in the band segment of operation. Changing bands becomes a matter of choosing your operating frequency on your transceiver, tapping your key or your microphone, and waiting for the second or so that it takes for the amplifier to sense the new operating frequency, tune itself to that frequency, and select the right antenna. Alternatively, you can use the computer interface to the 2000S and the switch will follow commands from the computer rather than from the amplifier. If you have more than one antenna per band you can select them (up to a maximum of 10) using the 2000S control box or your own switching system. If the antennas tune differently, don't worry—the amplifier will remember separate settings for up to 10 antennas per band segment!

It's difficult to describe the 2000A in

operation because there's so little involved. It's like having a 1.5-kW no-tune transceiver. I thought my manual switching system for selecting various monobanders was pretty good, but having the switching done automatically was a revelation. There's nothing more involved in changing from, say, 160 to 10 meters than there is in going from one frequency to another within the same band. The benefits for contesting and DXing are obvious, but even if your operating is more casual (and especially if it's intermittent and you have to remind yourself how things work every time you sit down to operate) it's a great convenience and will add to your operating enjoyment. My wife Linda, KA1ZD, often tells me that our station is configured differently every time she sits down to operate, which discourages her from doing so when I'm not around. If the ACOM 2000A/S/SW were permanent residents of our shack she wouldn't have to worry.

The remote antenna switch can be located practically any distance from the shack and is designed to be weatherproof, so if you want to you can eliminate as many as nine coaxial cables coming into the shack. Depending on your own installation, the cost of the switch could easily be less than the cost of the cables it would replace.

Special thanks to Tod Olson, KØTO, for the loan of his brand new ACOM equipment. Tod let us use the gear for several months before he even had the opportunity to lay eyes on it!

Manufacturer: ACOM OOD, ul.3011-9, complex Lyulin, 1324 Sofia, Bulgaria; +359-2-251-164; fax +359-2-276-190; **acom@aster.net**. Manufacturer's US/Asia/Pacific sales and service division: ACOM International, Inc, 157 Horse Pond Rd, Sudbury, MA 01776; 978-440-7555; fax 978-440-9008; **info@acom-intl.com**; **http://www.hfpower.com/**.

Retail price: ACOM 2000A Amplifier, $5500; 2000SW Antenna Switch with 2000S Controller, $595.

Heil Sound Goldline Studio Microphone

By Dan Henderson, N1ND
Contest Branch Manager

Everyone has their own idea of the type of look they want for their personal station. Some go for the high tech style while others strive to achieve a nostalgic feel to the shack. While the engineering adage of "form follows function" certainly is a must, there is no reason why an equipment's "form" has to be unappealing, if it can still provide the "function" for which it was intended.

For those that say any microphone will do so long as it gets the job done, I would offer that at least in the case of the Heil Sound Goldline Studio Microphone, you have a product that gets results *and* is an attractive addition to your station appearance.

Rarely does any piece of radio equipment receive a more thorough workout than during a contest. The Heil Goldline was put through its paces recently at ARRL Headquarters station W1AW during the ARRL International DX Phone Contest. In preparation the microphone was set to the factory suggested settings for the Yaesu FT-1000 transceiver that was used during the event. The set-up procedure varies from radio to radio and can be a bit complicated, but was accomplished without much difficulty.

The model used for the test was the Goldline GM-5, which can be switched between the full range studio element and a Heil HC-5 element. I used the full range element for operation during the contest. Two other models are available. The GM-4 includes the full range studio element and HC-4 "DX Dream Machine" element while the Goldline Vintage includes a special low to high-impedance matching transformer designed for use with "vintage" gear to accompany the full range dynamic element.

Being accustomed to using a headset with microphone attached, it took a little time to get used to working with a boom microphone during the contest. But in short order it was easy to position the boom out of the line-of-site to the computer monitor and radio controls. After overdriving the microphone a couple of times, and with a bit of testing, it was also easy to find a position where the normal speaking voice was easily picked up and transmitted without distortion.

Using the boom type set-up produced a pleasant surprise. The mike on a tight fitting headset is often sensitive to normal twists and turns by the operator. This in turn can trigger the VOX circuitry. The easiest solution is to use a foot pedal. This contest was run entirely with VOX using the Heil Goldline and boom configuration. Setting the microphone to the side, and speaking in normal conversational tones allowed easy, reliable VOX operation.

After all is said and done, the real test is simple: how did I sound? I find two good ways to measure this. First, many QSOs included comments on the "good audio." Knowing how my southern drawl often affects how others hear me, I would chalk up "good audio" comments as a real plus. After all, if my audio was good enough to provoke comments, it must have been very good indeed.

The second simple test involved conversations with friends who know how I sound "in real life." Before the contest, and in several conversations with friends during and after the contest, it was common to hear "you sound like yourself" when asked about the quality of the audio. One old friend tuned across the conversation and dropped in to chat for a while, saying "I heard that voice and knew right away who it was."

Your choice of station accessories can be as important as the choice of transceivers and radio equipment. This is especially true of microphones. Don't let its sleek style and attractive appearance lull you into believing that the Heil Sound Goldline Studio Microphone is there just for show. With its 60 Hz-16 kHz response, including a +4 dB peak at 2 kHz, the Goldline offers excellent voice articulation. On phone your goal is to be *understood*—and the Goldline gives you a definite edge.

The Heil Sound Goldline and accessories including a boom with a shock mount, a foot switch and a microphone-to-transceiver cable.

Manufacturer: Heil Sound Ltd, 5800 North Illinois Ave, Fairview Heights, IL 62208; tel 618-257-3000; fax 618-257-3001; **http://www.heilsound.com/**. *Goldline GM-4 (full-range and DX Dream Machine HC-4) $139.99; Goldline GM-5 (full-range and HC-5), $139.99; Vintage Goldline, high impedance only for Collins, Drake, etc, $159.99; CC-1 connecting cable, $29.99; LX-1 balanced studio microphone boom, $94.99; SM-1 shock mount assembly, $50; FS-1 foot switch, $29.99.* QST