Yaesu FTM-350R Dual Band FM Transceiver

Key Measurements Summary

Receiver Sensitivity (12dB SINAD, µV)
0.25 — 0.2 — 0.1
0.2 0.18

Receiver 3rd-Order Dynamic Range (dB)
60 — 81@10 MHz — 90
64@10 MHz 92@10 MHz**

Receiver 3rd-Order Dynamic Range (dB)
40 — 65@20 kHz* — 70
58@20 kHz* 63@20 kHz*

Adjacent Channel Rejection (dB)
50 — 56 — 90
59 63

IF Rejection (dB)
60 — 134 — 135
109 129

Image Rejection (dB)
60 — 67 — 120
65 98

Audio Output (W)
1 — 3.3 — 4

PR054

Key:
** Off Scale
* Measurement noise limited at value shown.
2 M   1.25 M
70 cm

Reviewed by Howard Robins, W1HSR
Contributing Editor

The FTM-350R is one of the more feature rich dual band radios I have had the occasion to use. I will elaborate on the features in this review. However, it is worth mentioning up front that this dual band rig also operates in the amateur 222 MHz band with 1 W of output power. It has APRS — Automatic Packet Reporting System — built-in, too.[1]

Separated Front Panel and Main Radio Unit

The FTM-350R has a separated front panel (control head) that is connected by umbilical to the main radio unit. RJ-11 and RJ-45 connectors are used for mic and umbilical connections. Note that the front panel cannot be attached to the main unit. The included mounting bracket for the front panel is an L bracket with a suction cup on the bottom. This leaves much room for improvisation.

[1]APRS is a program developed by Bob Bruninga, WB4APR. For more information, see **www.aprs.org**.

The front panel has a larger than usual display with brightness, color (eight choices) and contrast adjustable in the menu system. The panel is split into left and right half radios with mirrored controls on each half. Each half has a VOLUME control and a TUNING knob. The left side is dominant in that its tuning knob doubles as selector dial while working with the menus.

There are three buttons on each side of the display and five more under the display. The functions of many of these buttons change depending upon Smart Function mode. The eleventh button is the POWER/LOCK button. While a mic is included in the box and the rig is optionally Bluetooth capable, there is also a mic built into the front panel and the top button on the right serves as PTT. There are two built-in speakers, so external speakers are optional.

The main radio unit weighs in at just over 3.5 pounds. There are connectors for the umbilical and mic (yes, a second mic connector) on one side panel, and RF, data, line-in, and external speakers on the opposite side panel. Of course the fused power cord is also on this end of the main unit. There is a third speaker built into the main radio unit. From
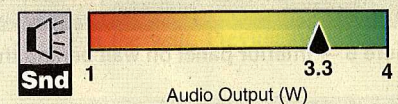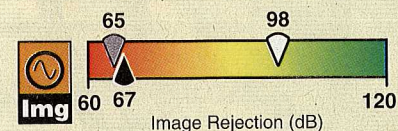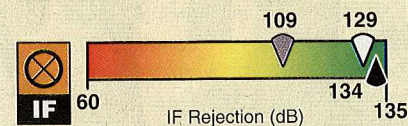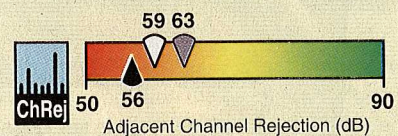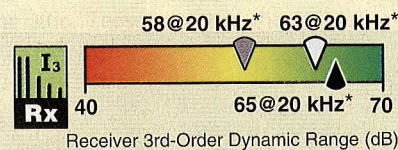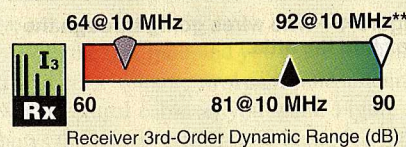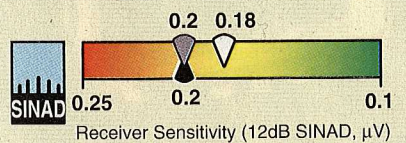
Bottom Line

The FTM-350R is a top-of-the-line mobile FM transceiver with well thought out controls. It offers some unusual features such as 222 MHz transmit and a stereo FM broadcast receiver, as well as options such as APRS and Bluetooth connectivity.

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a menu, you can enable the control head speakers, main unit speaker, all speakers or no speakers. Another menu allows you to tailor the audio a bit by enhancing the high or low tones in several steps.

Three helpful documents are included in the package: *Operating Manual* (52 pages), *APRS Manual* (35 pages), and two pages of diagrams depicting the installation of optional accessories, connections, and settings. Installation instructions for the optional accessories were weak or nonexistent — the diagrams were a lifesaver.

System Organization

This rig has so many features that I really did not get too far on my own before cracking open the manual. There are Set Mode menus, Smart Function keys, and Special Function Mode to configure the various installed features. It takes a little experience to know where to go to adjust settings. However, I must say that given the considerable suite of features, the keys and menus are very well thought out. After only a few minutes to get acquainted with them, making adjustments becomes fairly intuitive. A lot of consideration had to go into designing a system with so many features and options to make them reasonably manageable.

Too often I find that ergonomics and user-friendliness are left out of the equation. What good is a feature-rich radio if you can never figure out how to program it? I have a "simple" 2 meter radio that has such cryptic stenciling on the buttons that I need to refer to the manual to make simple changes, such as switching from memory to VFO or changing power level. Yaesu did a great job with this radio.

The three buttons to the left of the display are FWD, BCK and SET. Pressing the FWD or BCK buttons scrolls through several page displays: Main radio — Navigation — Clock — Barometer/Altitude — GPS. Which pages are included in this scheme is user settable.

Pressing the SET button brings you to the menu groups. Once there, turning the left TUNING knob indexes or scrolls from one group to the next; pressing the knob selects and opens the group. Turning the knob indexes into the list of options within the group; pressing the knob selects the option for setting. Rotating the knob scrolls through the available choices for setting the option. The groups are: Audio, TX/RX, Display, Memory, APRS/PKT, Scan, System, Navi, Timer/Clock, Signaling and Option. So, most of the settings for this rig are implemented using the same buttons and procedures.

The five buttons below the display are called Smart Function Keys. Their functions change with the push of the F key, which is

Table 1
Yaesu FTM-350R, serial number 9M010140

Manufacturer's Specifications	Measured in the ARRL Lab
Frequency coverage: Receive, 0.5-1.8 MHz (AM), 76-108 MHz (WFM), 108-137 MHz (AM), 137-174 MHz (FM), 174-222 MHz (WFM), 222-250 MHz, (FM), 300-336 MHz (AM), 336-470 MHz (FM), 470-800 MHz (WFM), 800-999.99 MHz (FM, USA version cellular blocked); transmit, 144-148, 223-225 (USA only), 430-450 MHz.	Receive, As specified, except 0.5-1.71 MHz (AM). 800 MHz and up, 800-868.990, 894.010-911.990, 943.510-956.990, 988.510-988.510-999.990 MHz (FM); transmit, as specified.
Modes: FM, AM receive (specified frequencies).	As specified.
Power requirements: Receive, 500 mA; transmit, 10 A on 144 and 430 MHz (50 W output) at 13.8 V dc.	At 13.8 V dc: Receive, 960 mA (max vol, max lights, no signal, both receivers), 300 mA standby, min lights). Transmit, 146 MHz, 9.1, 5.8, 3.1 A (hi, med, low), 440 MHz, 10.5, 6.2, 3.4 A (hi, med, low).
Minimum operating voltage: Not specified.	9 V dc (5, 17, 30 W output typical).
Receiver	**Receiver Dynamic Testing†**
Sensitivity: (10 dB S+N/N) 0.5-1.7 MHz, 5 µV; 108-137 MHz, 0.8 µV; 300-336 MHz, 0.8 µV (12 dB SINAD) 76-108 MHz, 2 µV; 137-150 MHz, 0.2 µV; 150-174 MHz, 0.25 µV; 174-222 MHz, 1 µV; 336-420 MHz, 0.25 µV; 420-470 MHz, 0.2 µV; 470-800 MHz, 5 µV; 800-900 MHz, 0.4 µV; 900-1000 MHz, 0.8 µV.	For 12 dB SINAD, 146 MHz, 0.18 µV; 223 MHz, 0.2 µV; 440 MHz, 0.2 µV; 902 MHz, 0.38 µV; 100 MHz, 0.7 µV. For 10 dB S+N/N, 1 MHz, 0.47 µV; 120 MHz, 0.7 µV; 340 MHz, 0.7 µV.
FM two-tone, third-order IMD dynamic range: Not specified.	20 kHz offset*: 146 MHz, 63 dB; 223 MHz 58 dB; 440 MHz, 65 dB, 902 MHz, 64 dB. 10 MHz offset: 146 MHz, 92 dB; 223 MHz, 64 dB, 440 MHz, 81 dB, 902 MHz, 70 dB.
FM two-tone, second-order IMD dynamic range: Not specified.	146 MHz, 91 dB; 223 MHz, 93 dB; 440 MHz, 108 dB; 902 MHz, 76 dB.
Adjacent-channel rejection: Not specified.	20 kHz offset, 146 MHz, 59 dB; 223 MHz, 63 dB; 440 MHz, 56 dB; 902 MHz, 48 dB.
Spurious response: Not specified.	IF rejection, 146 MHz, 129 dB; 223 MHz, 109 dB; 440 MHz, >134 dB; 902 MHz, 125 dB. Image rejection, 146 MHz, 98 dB; 223 MHz, 65 dB; 440 MHz 67 dB; 902 MHz, –3 dB.
Squelch sensitivity: 0.16 µV (144/430 MHz).	At threshold, 146 MHz, 0.1 µV, 0.25 µV (max); 223 MHz, 0.1 µV, 0.27 µV (max); 440 MHz, 0.12 µV, 0.29 µV (max).
S meter sensitivity: not specified.	At full scale, 146 MHz, 5.3 µV; 223 MHz, 3.8 µV; 440 MHz, 6.1 µV.
Audio output: 4 W at 10% THD into 4 Ω (external speaker).	3.3 W at 10% THD into 4 Ω. THD at 1 V RMS, 1.5%.
Transmitter	**Transmitter Dynamic Testing**
Power output: 50, 20, 5 W (hi, med, low) at 13.8 V dc ±15%.	146 MHz, 53, 20, 5 W (hi/med/low); 223 MHz, 1 W (fixed); 440 MHz, as specified.
Spurious signal and harmonic suppression: >60 dB.	>70 dB. Meets FCC requirements.
Transmit-receive turnaround time (PTT release to 50% of full audio output): Not specified.	Squelch on, S9 signal: 70 ms.
Receive-transmit turnaround time ("tx delay"): Not specified.	146 MHz, 134 ms; 223 MHz, 130 ms; 440 MHz, 115 ms.

Size (height, width, depth): Control panel, 2.6 × 6.2 × 1.3" (not including knobs and connectors); rear chassis, 1.8 × 5.5 × 5.9". Weight, 4.6 lbs (panel, chassis and connection cable).

Price: FTM-350R, $550; FGPS-2 GPS unit, $80; CT-133 GPS cable, $70; CT-136 GPS adapter, $30; BH-1A Bluetooth stereo headset, $90; BU-1 Bluetooth adapter, $70; FEP-4 earphone for BH-1A, $20; CAB-1 charger sleeve for BH-1A, $10; FVS-2 voice guide unit, $35; CT-140 packet cable, $55; ADMS-350 *Windows* programming software and cable, $50.

†"Left Side" and "Right Side" receivers measured identically.
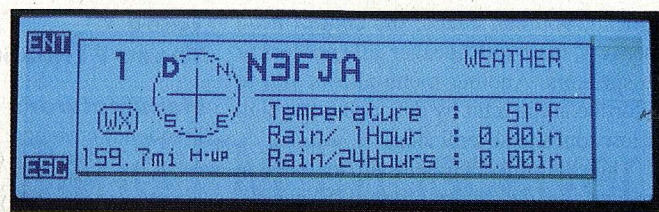*20 kHz offset measurements were noise limited at the values indicated.

Figure 1 — Two examples of the FTM-350R display during APRS operation. (Left) Received positions include an icon, distance, relative location (D), speed and coordinates. (Right) Received weather beacon information can include temperature, precipitation and wind speed.

the lowest of the three buttons to the right of the display. There are four sets of functions with the optional Voice Guide Unit installed and APRS activated. Pressing and holding the F key brings up a fifth set of functions that control squelch type and tones.

A Special Function Mode is accessed by powering up while pressing the key to the left of the power key. In this mode you can reset the radio, reset APRS settings, setup cross-band repeat, control cloning, turn on Bluetooth pairing and so on.

Channel programming is equally simple. Each memory channel can store frequency, split/offset, tone, power level and alphanumeric label. I like the fact that the power level is included — it avoids accidentally using too much or too little power when changing channels, and results in less fumbling around while on the road. There are eight character positions for each alphanumeric entry. The large alphanumeric display is crisp and readable from several feet away. The frequency is also displayed in a smaller font. Each half of the radio has its own set of 500 programmable channels.

Yaesu's MH-48 microphone, which has four programmable P buttons, is included. These buttons can be set to most common functions such as TX power, repeater shift, reverse, scan or tone. There are also UP and DWN buttons that can be used to change channels or frequency in VFO mode. The alphanumeric keypad can be used for direct entry of numerical information, such as frequencies or pairing codes, and text for APRS text messages. The A, B and C buttons on the mic can be used to navigate the text message entry fields.

Built-in Features

Packet Radio and Automatic Packet Reporting System (APRS)

Yaesu, with the FTM-350R joins Kenwood in providing mobile APRS. The Set Mode, APRS group, provides one-stop shopping for all APRS parameters such as MYCALL, SSID, icon, Beacon rate, SmartBeaconing Path, and so on.[2] There are a number of interesting ways that beacons can be managed in this radio. In addition to

manual, auto and SmartBeaconing, there are Interval, Proportional, Decay, Slow Speed and Rate Limit controls available. *Proportional* cycles through a series of Path routes over a period of time. *Decay* extends the preset beacon interval when your vehicle is stopped for a period of time. Your beaconed position can be fixed or based on actual coordinates with the optional GPS receiver attached.

Received positions are displayed on the full screen and include icon, distance, a graphic display of relative location, speed and coordinates. Received weather beacon information is decoded and displayed quite clearly. See Figure 1 for some examples. With the Smart Function keys set for the APRS functions, pressing the S LIST button brings up a list of received beacons; turning the left tuning knob indexes through the list. Pressing that knob selects and opens the beacon info for reading.

Text messaging works in similar fashion. After I received a message that was sent as a bulletin, a little message icon appeared on the main screen. Pressing the MSG button brings up a list of messages and turning the left tuning knob scrolls through the list. Pressing that knob selects and opens the message for reading and reply.

Muting the APRS side of the radio (the side you select) is an option that makes it possible to not have to turn down the volume to avoid listening to packet clatter. You can also select options for alerting you when various types of beacons are received.

Alerting has been taken to another level with this radio. Some of us manually set up a 100 Hz tone to be transmitted with position beacons. Receivers are set up to open squelch when they are close enough to the transmitter to decode the tone. Hearing packet clatter alerts you to the fact that you are within sim-

[2]SmartBeaconing is an algorithm created by Tony Arnerich, KD7TA, and Steve Bragg, KA9MVA, of HamHUD for adjusting transmit rate based on speed and heading changes of the vehicle. See **www.hamhud.net** for more details on this algorithm.

[3]See *QST* Product Review, February 2008. Past *QST* reviews are available to ARRL members at **www.arrl.org/product-review**.

plex range of another station (digipeaters do not repeat the tone), which means you could make voice contact on the APRS frequency and move to a different frequency to have a conversation if desired. Kenwood made this a feature in the TM-D710 that could simply be turned on and off.[3]

Needless to say, this conventional 100 Hz tone arrangement could also be implemented on the FTM-350R. However, it seems Yaesu has adapted its proprietary alerting features (Enhanced Paging and Coded Squelch, EPCS — more on this later) to work with APRS. You can set up alerts when beacons and messages from specific stations are received, or for those received from any station meeting range criteria that you can set. With the Voice Guide Unit installed and MSG VOICE turned on (in the APRS/PKT Set group), call sign and message will be announced. There are filters that can be used to limit which beacons and messages will be announced. For example, it is possible to set up a filter so that only participants in a public service event are displayed.

We bought the CT-140 data cable to see how this radio would work with a PC. This cable has an 8 pin mini-DIN plug that goes into the data port on the main radio unit. On the other end of this cable are a 9 pin female D connector for a PC serial port, and a 6 pin mini-DIN connector for an external TNC. There is no information in either manual on using the built-in TNC for anything other than APRS. You can select either GPS or packet to be outputted on the data port. There are TXD and RXD pins on the serial PC connector diagram, but no PTT.

I tested the packet cable using *HyperTerminal* and mapping software. The GPS GPRMC and GPGGA sentences are sent, and they did spill into *HyperTerminal* with their coordinates reflected on the mapping software. (GPRMC and GPGGA sentences are standard strings of data that contain latitude and longitude, speed, bearing, time and other information used by GPS systems.) I switched the data output to the packet mode and saw raw APRS data spill out. I tuned to a local packet node frequency and saw its ID beacon and some other packet data. I could not get a command prompt, so could

not exercise the internal TNC any further.

I am a bit surprised that the built-in TNC is set up for APRS only. While APRS is the dominant packet application these days, there are still some conventional packet nodes, BBS and Winlink 2K in use for emergency communications. If you want to use this radio for those purposes, you will have to add a fully functional external TNC to do so.

While I am mobile, I like to keep APRS running; which ties up one side of the radio. I wish APRS could be implemented to run in the background, perhaps as a third channel, so that both halves of a dual band radio could run in the foreground. Too much of the radio becomes dedicated to APRS the way it is implemented on *any* radio available today.

AF Dual

This feature lets you monitor an Amateur Radio frequency on the right side of the radio while listening to the *built-in* AM/FM broadcast radio on the left side. (The FM receiver is stereo and makes use of the two speakers in the control head.) There is also a LINE-IN connector that lets you attach your own MP3 player or other audio source. If a signal is received on the amateur frequency, audio switches to it and the other audio source will not be heard. I tested this with *muted* APRS operating on the right side. The FM broadcast station came in, uninterrupted except when beacons were transmitted. APRS functioned — received positions were displayed and periodic beacons were transmitted (right side set to main or active transmit side). The interruption only lasted for the short time it takes to transmit a beacon.

Band Scope

In VFO mode you are able to observe activity on ±22 or ±50 channels from your frequency. There is even a 10 dB attenuator that can be switched in or out if strong local signals are a problem.

Clock/Timer

One of the FWD/BCK pages displays the clock functions. The current date and time, count up, and count down timers are mode choices. Lap functions are optional selections. Average and maximum speed can be displayed instead of lap when the GPS is connected. One neat feature is that it plays a unique note on the hour, every hour. You can leave the clock page up if you want a large digital clock to look at, and it won't

Figure 2 — We ordered several of the many available accessories for our FTM-350R, including GPS, Bluetooth and Voice Guide. See text for details.

interfere with other radio functions. There are areas on the clock display that indicate what channels/frequencies the left and right sides are on.

Scan Modes

The FTM-350R has four scan modes: VFO, Memory, Programmable Memory Scan (PMS) and Priority Channel Scan (Dual Watch). VFO and Memory scan are just that. PMS — there are nine pairs of band limits (upper and lower frequencies) that can be programmed for scanning. Dual Watch — Priority memory channel 000 can be programmed to be checked for activity while operating in VFO or memory mode.

WX Alert Scan has become so commonplace that it does not warrant explanation, and there is none in the Operating Manual. This feature can be turned on and off in the Set Mode, TX/RX Group. In memory scan mode with just a few channels programmed, I observed that the 10 weather band frequencies were also being scanned. I noticed a brief stop in the scan and a full scale S-meter reading on one of the frequencies, but heard no audio. I assume that with this feature on, if the National Weather Service transmits the 1050 Hz alert tone, the FTM-350R will stop on that WX frequency and open squelch. There is no WX indication on the main radio display.

Tones

In addition to the usual CTCSS and DCS, Enhanced Paging and Code Squelch (a Yaesu proprietary system) is also incorporated into this radio. EPCS uses paging memory and tone pairs to accomplish selective calling. The receiver remains quiet until the stored tone pair is received with paging activated. A bell ringer can be assigned to sound when the tones are received.

Barometer/Altimeter

One of the available page displays is the barometer/altimeter, which uses the built-in sensor to determine barometric pressure. This pressure is shown numerically in the upper right side of the display and graphically on the left side. The graphical display is over a user changeable time scale from 2 to 24 hours. Altitude and position coordinates are also displayed on the right side when the optional GPS receiver is attached.

Cloning

With the Yaesu CT-135 or equivalent cable plugged into the data ports, memory contents and configuration data can be transferred from radio to radio. This feature is implemented in the Special Function Mode (accessed by powering up with the button to the left of the power button pushed). The data port is a standard 8 pin mini-DIN, so I suspect that fabricating a cable for this purpose should be fairly simple.

Optional Hardware Installation

We added most of the optional features (Figure 2), including the Bluetooth Adapter Unit (BU-1), Bluetooth Headset Charging Sleeve (CAB-1), GPS Antenna Unit (FGPS-2), GPS Adapter (CT-136), GPS Connection Cable (CT-133), and the Voice Guide Unit (FVS-2).

Installation of the Voice Guide Unit requires removing the lid from the main radio unit. Mating surface mounted connectors on the PC boards (PCB) made this a very simple installation. One word of caution, however; the speaker mounted on the lid has very short connecting wires that broke when the weight of the lid stressed the soldered connections. The other end of that wire has a pin connector that I could have pulled off the PCB, but I did not get the chance to do that.

The other devices are installed in or onto the front panel following an order of process. There are six screws on the back of the panel that must be removed. The panel has circuit boards on both halves, but the flat ribbon cable that ties them together is long enough to let you work. The Bluetooth BU-1 has a surface mount connector that mates with the panel's PCB (Figure 3). Once that is installed, the panel can be reassembled.

Two of the screws previously removed held a cover plate in place. The access port that was covered by this plate has a connectorless flat ribbon cable pigtail. That pigtail must be inserted into a connector on the

GPS connection cable. There was just enough room to manipulate the flat pigtail into the cable connector. This required care, as it was important to get the flat cable properly inserted without breaking it. The two screws from the cover plate are used to attach the GPS cable to the panel.

The Bluetooth headset charging sleeve is installed last, to avoid interference with the GPS cable. Removing an adhesive patch that covers the mounting spot for the charging sleeve reveals two tiny screw holes. The charging sleeve screws provide electrical and mounting connections for charging the headset battery. The good news is that everything worked when I reassembled the radio!

Optional Features

Bluetooth

After charging the Bluetooth headset, I tried to pair it with the radio, but failed. The headset was positioned behind the front panel. After several retries, I moved the headset to the front of the panel and pairing succeeded immediately. My assumption is that either the rear of the panel is shielded or the Bluetooth antenna in the front panel is focused forward.

I tested the Yaesu BH-1A Bluetooth headset over the air and got good audio reports. In fact if I did not mention that I was using Bluetooth, nobody would have known. You have the option of using a PTT button that is located on the earphone or using VOX. VOX sensitivity adjustment, an Option menu item, is either high or low, and with the flexible boom mic, it is possible to make it just right. I personally do not like to use VOX, but if you want totally hands free operating, this will give it to you. In Connecticut, and in many other states, hands free operation is required for driver cell phone use in a moving motor vehicle, so this could help avoid having to try to explain to police that this isn't a cell phone.

I prefer hands free speaker phones and in-ear devices to something that hangs on my ear. I tested and found that standard Bluetooth devices will pair and work with the FTM-350R. My JVC HA-W700BT clip-on Bluetooth device, with Bose in-ear phones, paired with no problems. The phone button on the JVC clip worked as PTT. The received audio had great fidelity.
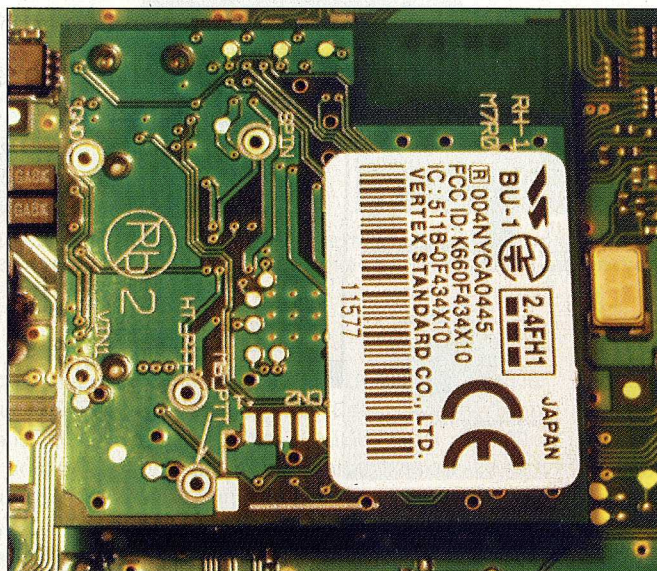
In a comparison test my transmit audio

Figure 3 — The BU-1 Bluetooth adapter is a small PC board that piggybacks on the control head. Accessory installation required attention to detail but wasn't difficult.

sounded better with the boom mic on the Yaesu BT headset. Surprisingly, the best transmit audio report came from the mic built into the front panel. While mic characteristics vary, this was a subjective test, and gain and position adjustments could modify perceived audio quality from any of the mics.

Navigation

Most typical GPS receivers are used for navigation and have detailed maps and much useful information for the traveler. This is a radio with an optional GPS receiver attached. When Navi is enabled as one of your display pages, pressing the FWD or BCK buttons will scroll to it. There are a total of 16 *point memories* in 4 four point groups. Latitude and longitude can be manually entered or stored in point memory from GPS positions. There is a graphical compass on the left side of the display. A D is located on the compass that represents the destination relative to your position. The object is to drive in the direction of the D to get to your destination. The right side of the display reflects the destination point information and distance to it.

If you could use this feature to navigate to received APRS position beacons it could be useful in certain public service operations. Unfortunately, I could not find any connection between the APRS and Navi features to make this happen.

Audio Playback

The optional Voice Guide Unit provides memory to record the last 30 seconds of received audio — *Last* mode — or up to five minutes total in eight variable length

memories — *Free* mode. The VGU also provides for the announcement of main band operating frequency when the operating band changes.

Closing Thoughts

I am pleased that Yaesu has added APRS to their suite of features. I am a bit disappointed that the GPS functionality is so integrated that it seems to require the use of a Yaesu proprietary GPS receiver, which precludes working with external map-based navigation systems. This could be considered an attribute, if you like this integrated approach, as it does not require an external system to be fully APRS functional. Everything is there, but users might wish for the map, graphics and other features such as turn-by-turn routing of navigation systems commonly available today. Of course the GPS position data could be outputted for manipulation by a laptop computer running mapping software.

The FTM-350R is a significant departure from typical dual band radios. It incorporates all the features hams expect and then some, yet ease of use could hardly be made better. Low power 222 MHz operation is a bonus. Mobile installation should be a snap given that the main radio unit can be hidden almost anywhere, even in the smallest of vehicles. Front panel mounting could require some creativity, but I find that always to be the case when they are detached. Having mic connectors and speakers on both the main unit and front panel is a big help. The optional Bluetooth features work well, allowing effortless hands-free operation.

As this review went to press, Yaesu announced an updated model — the FTM-350AR. Scheduled for shipping at the end of 2010, the new model features a redesigned, adjustable angle suction mount for the control head and new firmware. According to Yaesu, new features include GPS and waypoint data output in standard NMEA format, APRS operation in the background on a single band, additional voice alert functionality, reallocated button functions and use of the programmable button on the microphone for APRS functions. Current FTM-350R owners can get the new features via a firmware update (data cable required). Updated firmware and revised manuals are available on Yaesu's Web site.

Manufacturer: Vertex Standard, 10900 Walker St, Cypress, CA 90630; tel 714-827-7600; **www.yaesu.com**.