Product Reviews

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Icom ID-50A Dual-Band FM/Digital Handheld Transceiver

Product Review

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Bottom Line
The Icom ID-50A is a versatile transceiver. Exploring this unit is the best part of the fun, which is discovering what it can really do.

In the ID-50A, Icom offers a less expensive version of their popular ID-52A handheld. Unlike the ID-52A, the ID-50A does not include Bluetooth wireless connectivity. While the ID-50A is like the ID-52A in that it includes two separate receivers, the ID-50A restricts you to simultaneously monitoring either two FM signals or an FM and a D-STAR signal — you cannot receive two D-STAR signals at the same time. The ID-50A also lacks the ID-52A's colorful display and the ability to view received images in the display.

All that said, however, the ID-50A has much to offer in the same 2.3 × 4.4 × 1.2-inch, 11-ounce package.

Lots to Hear

The ID-50A has impressive receive capability, with coverage from 137 to 174 MHz, as well as from 375 to 479 MHz. This encompasses two amateur bands, along with considerable range above and below the bands. If you're interested in eavesdropping on aviation, the ID-50A offers AM between 108 and 136.99 MHz. The transceiver even includes FM broadcast reception from 88 to 108 MHz.

When it comes to digital operating, the ID-50A provides D-STAR functionality on 2 meters and 70 centimeters. You can enjoy local simplex or repeater contacts, or chat internationally through gateway-equipped repeaters and stand-alone hotspots.

The front speaker offers decent quality with about 750 mW maximum audio output. There is also a microphone/headset jack.

Out of the Box and All Around

The ID-50A arrives ready to go with a 1880 mAh battery pack (BP-272), a belt clip, and a detachable hand strap. The package includes a flexible helical antenna, better known as a "rubber duck." The antenna screws into a female SMA jack. The SMA gender is worth keeping in mind in case you want to purchase an adapter to connect the ID-50A to an external antenna.

The printed owner's manual is comprehensive, despite being called a basic manual. It even includes a D-STAR operating tutorial. Even so, the ID-50A has so many features it is a good idea to go to **www.icomamerica.com** and download the advanced manual.

The ID-50A is designed to interface with computers and various mobile devices, so to take full advantage of this capability you'll need a USB-C cable. You can use the cable to access a microSD memory card, program the ID-50A's memories, and even set up a D-STAR hotspot. The USB cable can also be used to charge the ID-50A from a computer or a typical USB "wall wart" power supply. Some amateur dealers include the USB-C cable in their packages, so be sure to check the details carefully. I encountered a few dealers that also offered wall chargers.

The case is ruggedly built and has a hefty feel overall. You immediately notice that the various ports are protected with tight-fitting rubber caps. That's a hint that the ID-50A is rated for IPX7 waterproofing, which means that it can withstand immersion in up to 3 feet of water for 30 minutes.

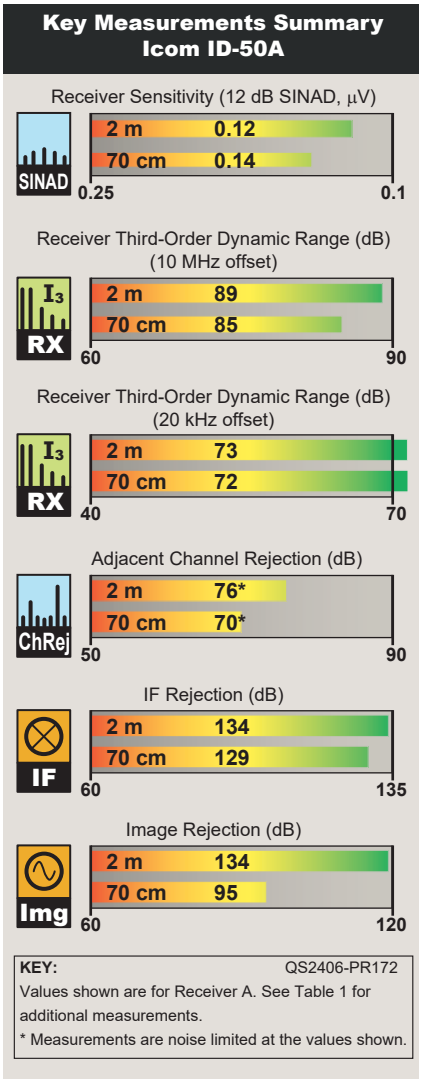

Table 1
Icom ID-50A, serial number 15001102
Firmware version: 1.03

Manufacturer's Specifications	Measured in the ARRL Lab
General	
Operating modes: FM/FM-N, AM/AM-N*, DV (GMSK), FM broadcast band (WFM).	As specified.
Power requirements: 10 – 16 V dc external supply; 7.4 V dc with specified Icom battery pack; 5.5 V dc with specified Icom battery pack.	As specified.
Current drain (at 7.4 V dc): Transmit (at 5 W): ≤2.5 A.	Measured at 13.8 V dc†, 146 MHz; High, 1.40 A; Med, 1.05 A; Low1, 0.72 A; Low2, 0.59 A; S-Low, 0.42 A. Measured at 13.8 V dc, 440 MHz; High, 1.84 A; Med, 1.30 A; Low1, 0.90 A; Low2, 0.68 A; S-Low, 0.42 A. Current drain from internal battery not measured.
Receive (max audio output, 8 Ω load): FM/FM-N, <400 mA. Digital voice (DV), <450 mA.	Measured at 13.8 V dc, 146 MHz and 440 MHz: S-9 modulated signal, lights on, one receiver on, 0.39 A. No signal, lights on, both receivers on, 0.41 A.
Receiver	
Receive frequency coverage: A band, 108 – 174 MHz, 375 – 479 MHz; B band, 137 – 174 MHz, 375 – 479 MHz; FM broadcast band, 88 – 108 MHz.	As specified. As specified. As specified.
Receiver sensitivity: A band FM/FM-N, 12 dB SINAD: 137 – 148 MHz: <0.18 µV; 148 – 174 MHz: <0.32 µV; 375 – 399.995 MHz: <0.5 µV; 400 – 475 MHz: <0.32 µV.	146 MHz, A band: FM, –125 dBm (0.12 µV); 146 MHz, A band: FM-N, –126 dBm (0.11 µV); 162.4 MHz, A and B band: FM, –123 dBm, (0.15 µV); 440 MHz, A and B band: FM, –124 dBm (0.14 µV); 440 MHz, A and B band: FM-N, –125 dBm (0.13 µV).
A band AM, 10 dB S/N: 108 – 142 MHz: <1 µV.	120 MHz, A band: –112 dBm (0.54 µV).
B band, FM/FM-N, 12 dB SINAD: 137 – 148 MHz: <0.18 µV; 148 – 174 MHz: <0.32 µV; 375 – 399.995 MHz: <0.5 µV; 400 – 479 MHz: <0.32 µV.	As measured for A band on 146 MHz and 440 MHz.
FM broadcast band (WFM), 12 dB SINAD: 88 – 108 MHz: <1 µV.	100 MHz, –112 dBm (0.59 µV).

On the left side of the case (when facing front) you find the push-to-talk button, a squelch-disabling monitor button, and the power on/off button. You can capture tiny BMP images of the ID-50A screen by enabling the capture function and briefly tapping the power button.

And speaking of capturing images, immediately below the power button resides the port for a microSD memory card. Icom doesn't supply a memory card with the ID-50A, but they are available from many retail outlets. I happened to have a 32 GB card on hand, and it worked perfectly. The card is used to store images sent or received via D-STAR, as well as repeater lists, frequency memories, GPS logs, audio recordings, and more. By accessing the appropriate menu setting, the ID-50A's memory card can function like an external hard drive whenever you plug the radio's USB cable into your computer.

FM two-tone, third-order IMD dynamic range: Not specified.	A band, 20 kHz offset: 146 MHz: FM, 73 dB; FM-N, 74 dB; 440 MHz: FM, 69 dB;‡ FM-N, 71 dB.‡ A band, 10 MHz offset: 146 MHz: FM, 90 dB; FM-N, 85 dB; 440 MHz: FM, 77 dB; FM-N, 78 dB. B band, 20 kHz offset: 146 MHz: FM, 75 dB; FM-N, 76 dB; 440 MHz: FM, 69 dB;‡ FN-N, 71 dB.‡ B band, FM, 10 MHz offset: 146 MHz: FM, 84 dB; FM-N, 85 dB; 440 MHz: FM, 73 dB; FM-N, 74 dB.
FM two-tone, second-order IMD dynamic range: Not specified.	A and B band, FM: 146 MHz: 55.2/90.82 MHz test tones, 86 dB; 440 MHz: 146.02/300 MHz test tones, 106 dB.
Adjacent-channel rejection: FM: ≥55 dB; FM-N, DV: ≥50 dB.	A and B band, FM, 20 kHz offset;‡ 146 MHz, 76 dB; 440 MHz, 69 dB. A and B band, FM-N, 20 kHz offset; 146 MHz, 76 dB, 445 MHz, 71 dB.
IF rejection: Not specified.	A and B band, FM: 146 MHz, >134 dB; 440 MHz, 129 dB.
Image rejection: Not specified.	A and B band: 146 MHz, >134 dB; 440 MHz, 95 dB.
Squelch sensitivity: Not specified.	A and B band: 146 MHz, 0.33 µV (min), 1.1 µV (max); 440 MHz, 0.27 µV (min), 0.99 µV (max).
S-meter sensitivity: Not specified.	A and B band, all-bar indication: 146 MHz, 1.60 µV; 440 MHz, 1.50 µV.
Audio output into 8 Ω: Internal speaker: 0.75 W at 10% THD. External speaker: 0.2 W at 10% THD.	Not measured. As specified.
Transmitter	
Power output at 7.4 V dc: High, 5 W; Mid, 2.5 W; Low2, 1 W. Low1, 0.5 W; S-Low, 0.1 W.	Battery power (8.4 V dc) or 13.8 V dc external power:** 146 MHz: Hi, 5.09 W; Med, 2.60 W; Low2, 1.01 W; Low1, 0.53 W; S-Slow, 0.13. 440 MHz: Hi, 4.94 W; Med, 2.46 W; Low2, 0.99 W; Low1, 0.5 W; S-Low, 0.11 W.
Spurious signal and harmonic suppression: <–60 dBc (High/Mid); <–13 dBm (Low2, Low1, S-Low).	Meets FCC requirements: 146 MHz: <–70 dBc; 440 MHz: <–68 dBc.
Transmit-receive turnaround time (PTT release to 50% of full audio output): Not specified.	Band A and B, squelch on, S-9 signal: 144 MHz: 90 ms; 440 MHz: 90 ms.
Receive-transmit turnaround time (TX delay): Not specified.	Band A and B: 146 MHz: 59 ms; 440 MHz: 59 ms.

Size (height, width, depth): 2.3 × 4.4 × 1.2 inches (with BP-272 battery, not including belt clip).

Weight: 10.6 ounces (including battery pack and antenna).

*Receive only from 108 MHz to 143.995 MHz.
†External voltage specified as 10 V dc –16 V dc.
‡Measurements phase-noise limited at values shown.
**Power output did not vary significantly with external voltage from 10 V dc to 16 V dc, or with use of a fully charged internal battery.

In addition to the SMA antenna jack atop the ID-50A, you have a Global Positioning System (GPS) antenna and two concentric knobs. The top knob is used for several functions such as frequency control, and the bottom knob adjusts the audio level.

There are two more rubber caps on the right-hand side. The top cap protects the external microphone/headset jacks. The bottom cap covers an external dc power port and a USB-C port.

On the front of the ID-50A you have a sizable monochrome display screen. Below the screen there are six convenient pushbuttons surrounding a multi-directional switch. Pressing the side, top, and bottom edges of the switch moves you between menus and submenus, among other things. At the center is a pushbutton to make selections (analogous to the **ENTER** key on a computer keyboard).

Initial Explorations

After a long press on the power button, the ID-50A sprang to life with a beep. Without even glancing at the manual, I was able to switch bands, modes, and frequencies right away.

But without the manual's guidance, any exploration is likely to be shallow. So, I dug into the booklet, as well as the downloaded advanced documentation, and was astonished at the sheer number of features. This is not to say that the ID-50A is difficult to navigate, but doing some patient reading pays major dividends.

The first item I checked was the RF power setting. There are five power levels available: 5, 2.5, 1, 0.5, and 0.1 W. I found that 0.5 W was adequate for nearby repeaters, and it resulted in considerable operating time when the battery was fully charged.

The manual also informed me about the ID-50A's copious memories. There are 500 frequency memories, and an additional 500 memory channels just to store FM broadcast frequencies (who listens to that many stations?). The radio allocated 300 memories to store GPS data and a whopping 2,500 memory slots for its repeater database.

The repeater memories come preprogrammed with an impressive list of FM and D-STAR repeaters. You can update the list, which I did after I noticed that a popular local FM repeater was missing for whatever reason. I downloaded a more recent list from **www.dstarinfo.com/RepeaterDownloads.aspx**, saved the file to the microSD card, put the card into the ID-50A, and imported the updated information. Icom also offers repeater lists on their website. Thanks to the built-in GPS receiver, the ID-50A also has the ability to use the Near Me repeater function of the DR mode for D-STAR and FM repeaters.

Many radios include speech assistance these days, and just like with their previous model, Icom took an additional step with the ID-50A. Through the menu system you can turn on the speech annunciator and select which information you want to hear spoken aloud, such as frequencies only. In addition — and I thought this was very cool — you can have the speech function announce letters individually, such as "A, B, C," or announce them phonetically ("Alfa, Bravo, Charlie").

On the Air

I spent the first several minutes listening to the AM aviation band. Even with just the rubber duck antenna, reception was quite clear. I live in an area with a lot of air traffic, so it didn't take long to find plenty of chatter.

And, of course, I had to try FM broadcast reception. Once again, the clarity and sensitivity were impressive. The ID-50A only receives in monoaural, but with a single speaker that doesn't matter.

I noticed a small flashing symbol along the top of the screen. That turned out to be the GPS status indicator, and it flashes until the receiver acquires enough satellite signals to determine your position. Even within my aluminum-sided home, the ID-50A's GPS received enough signals that it established a fix in less than 60 seconds.

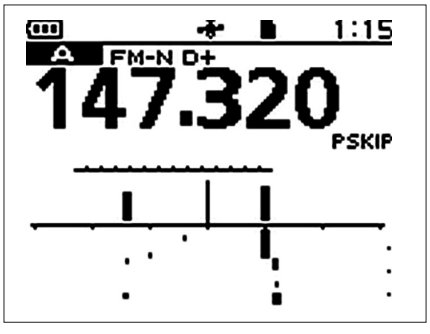

Figure 1 — The ID-50A's band scope display.

Cruising through the amateur bands was a pleasure with the ID-50A. Reception seemed excellent, and I also received good transmit audio reports through several FM repeaters. I configured the display to show 2 meters as the top, main band and 70 centimeters as the secondary band. It is easy, however, to flip this arrangement as you wish, or display only a single band.

The band scope feature made it easy to spot activity. Even though the scope's waterfall display is strictly monochrome, I found it highly intuitive to interpret. When I saw an indication of a signal, I simply spun the frequency selection knob to move the cursor to the mark, and I heard the result (see Figure 1).

Speaking of listening, because the ID-50A sports two independent receivers, the dual watch function is particularly slick. This is true dual watch, with both receivers monitored simultaneously. Unlike the dual watch functionality you find in other radios, there is no clicking or popping as the radio bounces from one receiver to another. In the ID-50A, dual watch is as seamless as it gets.

Programming with *CS-50*

While I found the menu system relatively useful for memory programming, this task is far easier to accomplish with Icom's free *CS-50* software for Windows. With the USB cable connecting the ID-50A to my computer, the *CS-50* software established a virtual COM port and quickly located the radio. I was then able to read everything from the ID-50A, modify whatever items I desired (or add new information), and finally write everything back to the radio (see Figure 2). You'll find the *CS-50* application on Icom's website.

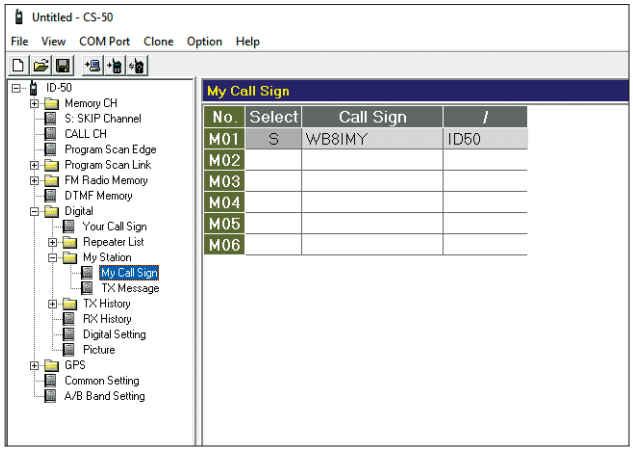

Figure 2 — Programming the ID-50A was a snap with Icom's *CS-50* software.

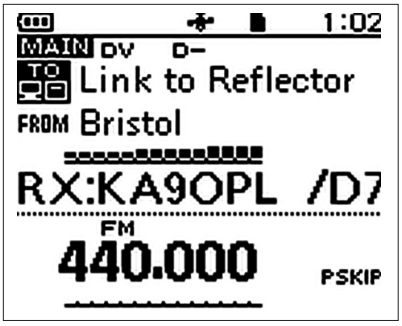

Figure 3 — Connecting to a nearby D-STAR repeater and linking to a reflector.

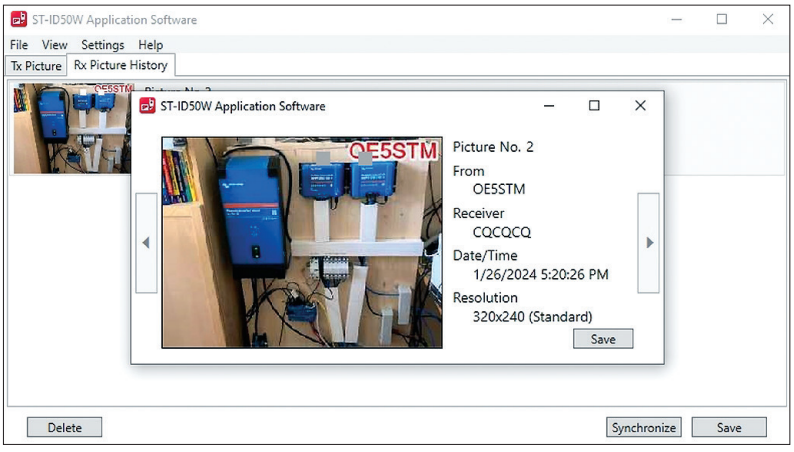

Figure 4 — An image received from OE5STM.

D-STAR

Thanks to the well-written tutorial, operating D-STAR with the ID-50A was a breeze. Within minutes I accessed a repeater, used its gateway to reach a D-STAR reflector (a kind of group chat room) in Indiana, and enjoyed a contact with a fellow near Indianapolis (see Figure 3).

It is important to note that to operate D-STAR you must first add your call sign to the ID-50A's memory. Also, if you intend to access D-STAR gateways, you'll need to register accordingly. The manual tells you how to go about doing this.

Exploring the various D-STAR functions introduced me to one of the most clever features of the ID-50A: the searchable repeater list. When you are in D-STAR mode, it takes just a couple of button clicks to reach the repeater list menu. Thanks to the GPS module, the ID-50A knows your location. So, you can choose to list the nearest D-STAR repeaters. Select a repeater, and the radio automatically configures itself for the proper frequency. It will work this magic for FM repeaters, too.

Imagine taking the ID-50A on a trip. When you reach your destination, you merely switch on the radio, wait for the GPS receiver to achieve a position lock, and then select the nearest repeaters. Operating on the road doesn't get much easier than that.

I'm lucky to have several D-STAR repeaters close to my location, but if you don't, the ID-50A can be used in *terminal mode* to allow you to access the entire D-STAR network via your computer and the internet. If you and your friends have D-STAR-capable transceivers, the ID-50A can also be pressed into service as a hotspot to allow everyone to connect to the network wirelessly. Both of these functions require software that is available for free from Icom.

I would be remiss if I didn't mention the ID-50A's picture-sharing ability. Although it won't display colorful images in the way they appear on an ID-52 screen, you can still capture transmitted images from another station, save them automatically to the microSD card, and then view them on your computer with Icom's free picture utility software, the *ST-ID50W* for Windows PCs. (If you have an Android device, there is also an Icom app, the *ST-ID50A*, that makes image swapping much easier.)

Through a local repeater I accessed reflector REF096D in Austria. Austrian amateurs often use this reflector to exchange images. Sure enough, within about 10 minutes the ID-50A suddenly began beeping. I looked at the screen and saw the RX box that informed me that I was receiving image data. When the transmission finished, I rushed to my PC, grabbed the file with *ST-ID50A*, and was treated to a photo sent by Timm Schneider, OE5STM (see Figure 4). Naturally, I loaded an image of my own to the memory card and sent it to the reflector.

Conclusion

A few printed pages can't describe all the features of the ID-50A, but part of the fun is exploring such a versatile transceiver just to see what it can really do. As D-STAR handhelds go, the ID-50A is considered entry level, at a price of about $200 less than its upscale cousin.

Manufacturer: Icom America, 12421 Willows Rd. NE, Kirkland, WA 98034, **www.icomamerica.com**. Price: $399.95.

GQ Electronics EMF-390 Multi-Field, Multi-Function EMF Meter and RF Spectrum Power Analyzer

Reviewed by John Leonardelli, VE3IPS
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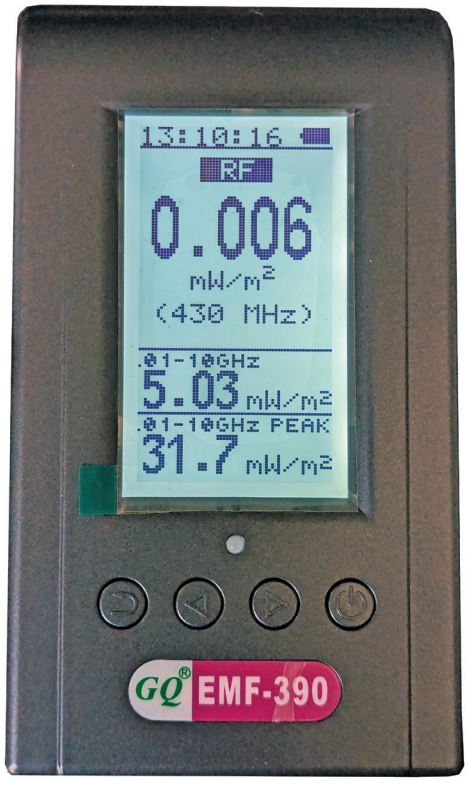


In this review, we'll delve into the key features of the EMF-390 and discuss its applicability in testing the RF levels in the context of amateur radio operations. It identifies RF sources quickly using sensitive sensors. The RF Radiation mode and RF Spectrum Analyzer mode apply themselves to amateur radio as well. However, bear in mind that this device is not designed as an RF spectrum analyzer but as a multipurpose, relative-level RF, EMF, and ELF meter. The meter can assist in identifying common EMF/RF sources of power line, Wi-Fi, cell phone, microwave, and commercial broadcast towers. Also, this is not laboratory-grade equipment; the manufacturer doesn't provide any certification of accuracy or calibration, but it can be a fun tool to have around, at least to have an idea of the relative RF field. (See the Lab Notes for more information about the accuracy, or general lack thereof, of this instrument.)

Description

The GQ EMF-390 provides a three-axis top-mounted sensor that includes an electrical field and RF sensor. It also has the capability of providing real-time data logging to a computer. It has audio and visual alarms, and it can also be used for RF detection indoors and outdoors (though it is not waterproof).

The EMF-390 is equipped with a sensitive detector that can pick up even low-level RF signals. This feature is crucial for accurately assessing relative RF levels, especially in environments where weak signals may be present. Its ability to show various transmissions from a broad-spectrum perspective is also useful.

The meter includes a high-contrast black-and-white LCD screen display with a single LED indicator with four function buttons. The LCD display provides real-time readings. The interface is user-friendly, making it accessible for both beginner and experienced operators. The display offers multiple readings and is readable outdoors.

The device comes with a nice protective case, Radiation Safety reference card (with no certificate of accuracy), Quick Guide, and USB-C cable. The device is equipped with a USB port, used for data communication and for external power/charging of the internal rechargeable Li-ion 3.7 V dc battery. Battery life is estimated to be 24 hours before needing a charge. Using the external power source, continuous data monitoring is possible using the free *GQ EMF Pro* software, available for Windows and MacOS (see Figure 5).

Software, a USB driver, and an in-depth manual are available for download from their website. They also offer a demo software download that will allow you to experience the meter and use the menu items. I found this to be a great learning tool before reading the manual.

Bottom Line

The USA-designed GQ Electronics EMF-390 is an EMF/ELF diagnostic tool with a built-in RF spectrum analyzer. It offers real-time data logging and is capable of detecting a wide range of EMF sources up to 10 GHz. Because it is not calibrated, nor does it make any claims for accuracy, it cannot be used to assess the safety or compliance of any RF source.

Table 2
GQ Electronics EMF-390 Manufacturer's Specifications
(Not tested in the ARRL Lab)

Audible alarm	Beep/siren
Visual alarm	Green, red LED
Operating temperature and humidity	5 to 40 °C, below 80% relative humidity
Working voltage	3.6 – 3.7 V dc
Display	LCD dot matrix, backlight, 1.2 × 2.6 inches
Power consumption	25 mW to 125 mW (backlight-dependent)
Power	Supply 3.7 V dc Li-ion battery / USB power
Dimensions	5.25 × 3 × 1 inch
Weight	10 ounces
EMF (Electromagnetic Field)	
Triple axis (X, Y, Z) detectable low frequency	0.5 Hz to 150 kHz
Range	0.0 – ~500 mG
Resolution	0.1/1 mG
EF (Electric Field)	
Range	0 V/m to 1000 V/m
Resolution	1 V/m
RF Field (Radio Frequency Field)	
Detectable RF frequency	10 MHz to 10 GHz
RF Spectrum Power Analyzer	
Frequency band 1	50 MHz to 65 MHz
Frequency band 2	65 MHz to 76 MHz
Frequency band 3	76 MHz to 108 MHz
Frequency band 4	240 MHz to 1040 MHz
Frequency band 5	2.4 GHz to 2.5 GHz

Multi-Mode Measurement

The device offers multiple modes of measurement, allowing users to assess EMF levels in terms of electric field, magnetic field, and power density. This versatility is invaluable for amateur radio operators who need to evaluate different types of relative RF emissions. This device is not intended to be used to test RF equipment in the HF range.

Display Modes

There are six versatile display modes that provide an All-in-One mode, a Vertical mode, a Table mode, EMF graphs, an RF Browser, and RF Spectrum.

As the name suggests, the All-in-One mode shows multiple measurements on a single screen. The Vertical mode changes the display from horizontal to vertical. In this mode, you can toggle between reading EMF/EF and RF signals. The Table mode displays data in a table format showing frequency in MHz, dBm, and power. The EMF X-Y-Z sensor mode shows data from the past 45 seconds displayed in a graph format.

RF Browser shows the complete spectrum and total RF emissions (100 kHz to 10 GHz) on the display. It provides instant RF readings in a graph format. I noticed an interesting utility that estimates total data byte packets for digital RF signals. I am not sure what the best use case is for this. There is a power histogram measurement in graph format as well.

The RF Spectrum mode shows data based on selection of one of the five bands. I understand they are using band-pass filters for the individual bands. These bands do not cover the lower HF amateur bands, but they do cover 6 meters and up, but it doesn't cover the 1.25- and 2-meter amateur bands.

Using the navigation keys you can access the main menu, where you can set user options, display options (backlight, alarm settings, RF settings [sensitivity and scale power units]), and initial setup (time and date).

Audible and Visual Alarms

The device can be set to trigger alarms when certain predefined threshold levels are exceeded. This is an interesting feature, especially in situations when you need to identify relative RF levels. The display LED can change colors based on radiation severity. The display LED can change colors based on radiation severity.

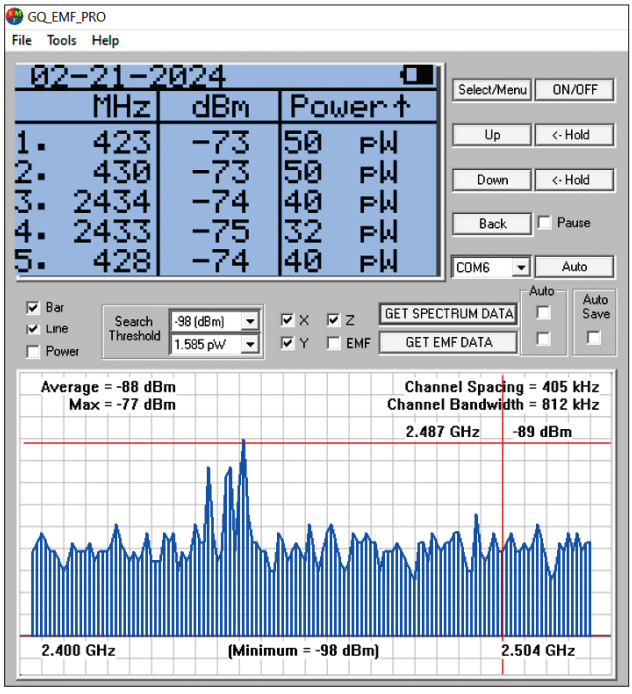


Figure 5 — The *GQ EMF Pro* software screen capture, which shows more information.

Data Logging and Analysis Software

The EMF-390 has onboard flash memory and a real-time clock for data logging and saving. The data can be logged every second. The companion software, *GQ EMF Pro v3.67*, allows monitoring measurements on the computer screen and the ability to download historical data, which is provided as a standard .csv file for further in-depth analysis and visualization of the collected data.

Connection of the PC/Mac is via the USB port. It also has the ability to test specific frequency bands with front-end filtering and DSP algorithms being used. This helps the user to focus on the frequencies of interest and investigate and understand any radiation risks. You need to download and install the USB driver before connecting your meter.

If you wish to convert power density levels measured in mW/m^2 into mW/cm^2, the conversion is easily accomplished by dividing the displayed value by 10,000. Therefore, 39.2 mW/m^2 is equal to 0.00392 mW/cm^2, for example.

Applicability in Amateur Radio Testing

The EMF-390 is not well suited for amateur radio enthusiasts who are concerned about the potential health risks associated with prolonged exposure to RF radiation, as there's no accuracy certificate. In fact, the ARRL Lab used *EZNEC* antenna-modeling software to estimate the field strength near the inverted-**V** antenna end insulator (see Figure 8) owned by the author, and found that the measurements of this instrument underestimated the EMF readings by approximately 30 dB! This instrument should not be used for any RF-safety or RF-compliance measurements. (See the Lab Notes.)

Its portability lends itself to taking readings outside of the shack. By utilizing its comprehensive measurement capabilities, operators can obtain an indication of the relative levels of electromagnetic radiation emitted by their equipment and antennas.

The RF Browser and RF Spectrum modes will be of interest to us from a broad capture to help identify RF or noise sources.

Furthermore, the ability to record and analyze data over time enables users to identify trends and potentially adjust their setup. The inclusion of audible and visual alarms serves as an additional layer of information, alerting operators when RF levels are high.

My first test was to see what kind of RF was being emitted in my home. I used the All-in-One mode that shows the electric field, the relative RF field, and overall EMF. I was able to obtain a baseline of those emissions. It found and indicated signals from the 434 MHz ISM band that I discovered is my temperature sensor for my weather station (see the lead photo). It also indicated signals at 2.437 GHz, which is my Wi-Fi router on chan-

Figure 6 — The GQ EMF-390 showing Wi-Fi channel 1.

nel 6. I observed signal levels increasing as I got closer to the devices. I have another temperature sensor, which found that too, and I was surprised to see it was on 915 MHz, another ISM band.

I then started to look at the Wi-Fi band using the RF Browser mode, and it showed a sweep of this band. I was also able to pick up my neighbor's Wi-Fi router (see Figure 6 as an example). This mode will detect the RF across the broad radio spectrum from 10 MHz to 10 GHz. Keep in mind that this unit is not specifically designed for hams and that none of the band selection actually has the 2-meter band. In RF Browser mode it will detect the RF level, but the unit won't be able to tell you on which frequency.

I then used the RF Spectrum mode to validate various emissions across the five frequency bands, starting at 50 MHz. These bands are in the amateur VHF and above frequencies. I did look at my Wi-Fi router and was able to trigger an alarm that I set as I got closer.

You can set alerts, change the scale readings, and set sample hold times, as well as other advanced functions. I found that after an hour of taking readings, the battery was still at full charge, indicating that one can get several hours of use without any concern. It also offers a screenshot mode to save data, and the arrow keys can be used to navigate across one of the five bands (see Figure 7). There is a lot of information here, and reading the manual several times will allow you to take advantage of this unit.

I now plan to start a focused approach to capture RF noise emitters in my home, and utility power transformer locations. In conjunction with a small shortwave portable radio, I can listen to the RF hash and also see it on the EMF-390 display.

Real-World Application

Although it really can't be used to assess actual field strength or power density across its entire frequency range, especially for the purpose of assessing compliance with the RF-exposure rules, in my own experience, the EMF-390 has proven its worth during various operating scenarios. Whether assessing RF relative signals in my home station or during portable operations, my observation is that the EMF-390 is able to provide a reading. The ability to relocate antennas or adjust setups based on real-time data ensures a proactive approach to assessing RF present in an environment. I found this device very useful in making observations of signals in play. This is a welcome addition to my analog RF/EMF sensors.

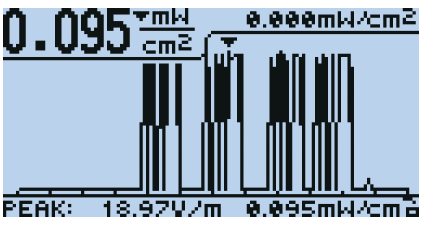


Figure 7 — Screenshot saved into the GQ EMF-390.

Figure 8 — The GQ EMF-390 measuring RF on 40 meters, and the "V V V" in CW is shown.

Improvements

Having a ¼-inch camera mount on the bottom and back panel would allow the unit to be mounted on a tripod. The ability to have specific or additional radio bands covering the amateur HF segments could also prove useful in the RF Spectrum mode. I did find the software a bit buggy, but I am sure with proper reporting of bugs that they can be resolved in future updates.

Conclusion

Although the EMF-390 can provide operators with a real-time estimation of RF exposure, there is no reference for its precision, so this is not necessarily a reliable tool for amateur radio operators seeking to assess and monitor the RF exposure levels.

The unit itself — as a user-friendly interface, with versatile measurement modes — seems highly sensitive, and advanced features make it a companion for every amateur radio enthusiast's tool kit. It would be nice if the unit covered all of the HF and VHF bands for amateur radio. I also found this meter was able to discover various RF emitters, like ISM band-based sensors, in your home.

Manufacturer: GQ Electronics LLC, 1001 SW Klickitat Way, Suite 110, Seattle, WA 98134, **www.gqelectronicsllc.com**. Price: $108.

Lab Notes: GQ Electronics EMF-390 Multi-Field, Multi-Function EMF Meter and RF Spectrum Power Analyzer

Although the text of the review makes it clear that this instrument cannot be used to accurately measure field strength, because the manufacturer's documentation makes reference to EMF exposure, the ARRL Lab took a closer look at this instrument and its accuracy, or, more correctly, its lack of accuracy.

The author of this review had initially hoped that this instrument could be used to perform the required RF-exposure calculation for his station. He was ultimately disappointed. He did a calculation of the needed compliance distances, using the ARRL RF Exposure Calculator found at **www.arrl.org/rf-exposure**. The calculator showed him that on 7 MHz, even at 1000 W of SSB, exposure to neighboring properties was under the limits (see Figure A).

So far, so good! He then used the instrument to make a measurement of the power density near the end of his inverted-**V** end insulator. The instrument gave a reading that was approximately 30 dB lower than the expected levels, based on the ARRL calculator.

This raised red flags, so I quickly got out my laptop and used my favorite RF tool for all things antenna-related — *EZNEC*. (*EZNEC* can now be downloaded free of charge at **www.eznec.com**.) The near-field calculator that is part of *EZNEC* showed results that reasonably closely agreed with the ARRL RF Exposure Calculator, with field strengths and near-field equivalent power density nowhere near the obviously low reading that the instrument provided.

Field strength and power density can be measured, but instruments capable of providing accurate results cost many thousands of dollars. There are many inexpensive "EMF" instruments in the marketplace, and the ARRL Lab does not know of a single instrument costing less than $1000 that is accurate enough to assess RF exposure. Although the FCC would permit amateurs to make measurements to assess RF exposure, this instrument will not fit the bill. Amateurs should use the ARRL RF Exposure Calculator, which gives "worst-case" results for all but very small antennas, such as 1-meter mag loops, or use a more accurate calculator, such as *EZNEC*, to ensure that their stations can be operated safely. — *Ed Hare, W1RFI, ARRL Lab Volunteer*

Figure A

RF Exposure Calculator

Parameters

- Power at Antenna: 1000 (watts)
- Mode duty cycle:
  Conversational SSB, no speech processing (mode duty cycle=20%)
- Transmit duty cycle: (time transmitting)
  You transmit for 5 minutes then receive for 10 minutes (and repeat).
- Antenna Gain (dBi): 2.15
- Operating Frequency (MHz): 7.0

☑ Include Effects of Ground Reflections

This calculator should not be used for antennas that are less than 20 cm (8 in) from a person.

Results for a controlled environment:

Maximum Allowed Power Density (mW/cm^2): 18.3673
Minimum Compliance Distance (feet): 1.8068
Minimum Compliance Distance (meters): 0.5507

For an uncontrolled environment:

Maximum Allowed Power Density (mW/cm^2): 3.6735
Minimum Compliance Distance (feet): 2.5551
Minimum Compliance Distance (meters): 0.7788

Technology >> Radio Technology Topics >> Safety >> RF Exposure >> RF Exposure Calculator

EXPLORE ARRL

Pacific Antenna Active Antenna Kit

Reviewed by Paul Danzer, N1II
n1ii@arrl.net

This kit consists of a broadband, untuned amplifier designed to be useful throughout the frequency range of 100 kHz to more than 200 MHz. It is built on a high-quality printed circuit board, measuring approximately 2.5 × 3.5 inches. A 38-inch telescoping antenna is included to be mounted on the board, and a single-ended wire can be either substituted or clipped to the telescoping antenna.

The schematic given in the instruction booklet (available online) shows the circuit consists of a single high-gain, wide-bandwidth N-channel JFET, followed by an NPN transistor configured as an emitter follower. Input, output, and interstage coupling are done with a capacitor, so there is no tuning in the circuit.

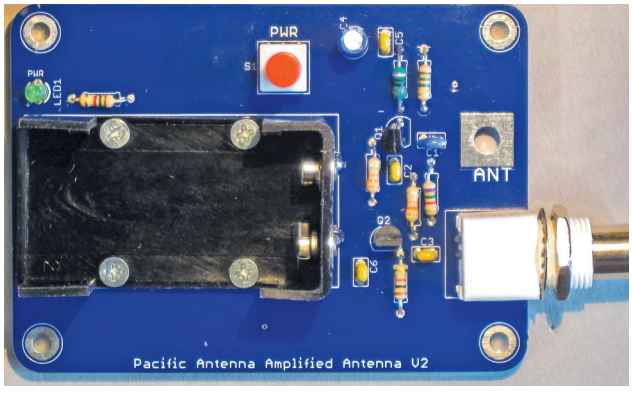
An on-board 9 V battery holder is included to power the circuit with a red-capped pushbutton on/off switch and miniature green LED to remind you when power is on. The only caution needed is a reminder: when connected to a transceiver or signal processing system, don't go key down, because it will result in a degree of destruction!

There are several uses for the unit. The first, and most obvious, is to make up (on reception only) for a longer antenna. It can also be used as the second antenna needed for a synthesized diversity pointing application for either canceling or lobe pointing. Several such units have been reviewed in *QST* in the last few years.

Kit Assembly

The entire kit consists of roughly 20 components and, as such, should not take very long to build. Figure 9 is a 200% enlargement of the bare board. Although the PC board has the component locations clearly marked, the markings disappear once you insert a part. The two-time magnified copy will come in handy if you want to find a particular part that has already been mounted.

The assembly instructions can be summed up in a single word: excellent! The nine pages begin with a brief description followed by a suggested list of tools needed. This is followed by a list of optional tools, including my favorite — a cookie sheet to build on, and it also keeps parts from jumping onto the floor. If you have a piece of carpeting or a mat in front of your workbench, you also know why this cookie sheet is a good idea.



A set of some general construction suggestions are listed. For anyone who is not too familiar with soldering techniques, a reference tutorial is included. Figure 10 illustrates an addition to this list. Look in the "Community" section of the suggested reference for the tutorial. The spacing between solder pads on the board is very tight in some places. So, it's better to use a very small soldering tip versus a typical one.

The manual proceeds to show each component in a small photograph, so take it step by step, as though you have an advisor looking over your shoulder. By comparing the part and the illustrations, you should have no doubt what component goes where.

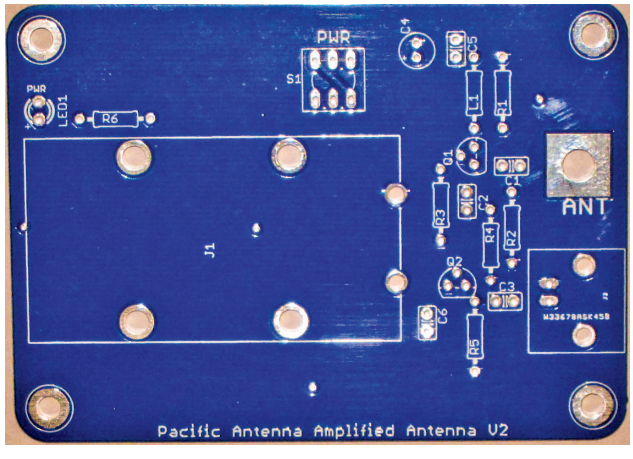


Figure 9 – A twice-magnified photocopy of the bare PC board layout.

Bottom Line

The Pacific Antenna Active Antenna Kit is a low-cost kit that's fun to build for beginners, and it can be useful for shortwave listeners.

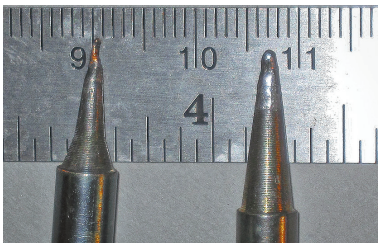


Figure 10 — The smaller tip was easier to use than the larger, standard tip in several places. The top scale numbers are centimeters; the smaller divisions are millimeters.

A Few Suggestions

Some components come with a bit of tape on the end of their leads. These are a result of being supplied to commercial users for automated insertion machines. Removing the tape can be tedious; it is unnecessary — the leads are all long enough so you can just cut off the taped end.

You may decide to insert a few components in a group and then reverse the board. Then you can solder these components at the same time without having to flip the board over and over. The next step is to cut off the excess leads, as they all poke up from the solder. As you do, keep count of the number of leads you clip. If you come up with an odd number, this means you forgot to solder or clip one lead — they are usually in pairs.

The Board

The board is an industry-standard two-sided printed circuit board with traces on the top and bottom. Here is where a very small soldering tip might come in handy. The soldering pads surrounding the component lead holes are very small and very narrow. Use a bit of caution, and try not to overheat and destroy any of the pad surface. In many cases, the holes themselves are just big enough to be able to insert the component lead.

The board coating between solder pads serves to help you if you are too generous with the amount of solder used. It is nonstick; if you accidentally bridge two points with solder, the coating allows you to melt the solder and wipe out the excess.

If, for some reason, you do have to unsolder a component, or you accidentally splash solder into a hole that should be used for another component, you may have difficulty cleaning out the hole. If you do have to clean out a hole, check for continuity from the hole to the next connecting point. If there isn't any continuity, use an external jumper.

Tests at HF and VHF

Two sets of tests were run at HF: one at 40 meters and one at 10 meters. There is no way to specifically describe the results as either good (helpful in hearing signals) or not helpful. When it is used, either with the included telescoping antenna or with a random wire extending the telescoping antenna, any signal may be raised as well as the noise. Whether this improved the readability of the signal or not is, to a good extent, in the mind (and ears) of the tester, and no specific answer can be given.

It was not possible to test the kit as a second antenna element for noise suppression or signal enhancements. However, previous product evaluation tests run here with several different diversity combiners, and a few antennas gave the same spread of results — sometimes yes, sometimes no, and most often cannot really tell.

For VHF, the test used a Yaesu VX-6, which had a 16-inch dual-band whip (145 and 430 MHz). The 162.55 MHz weather broadcast reception at my home is constant but marginal, and signal strength can be varied by changing the location slightly. With the Pacific Antenna unit connected in place of the 16-inch whip, the squelch break point had to be reset, thus showing that there was increased noise (and signal) using the active antenna instead of the usual whip.

Here, more than half the time, the signal readability was improved. Because there was equal gain in noise and signal, perhaps some could be related to the difference, depending on where the gain was applied with respect to where the bandwidth was limited in the narrow FM. No significant difference was seen when the mode was set to AM or wide FM.

One unexpected problem was found in this test with the VX-6. The output of the active antenna is a BNC connector. The VX-6 uses an SMA connector. Because I and many others, including companies advertising their products, are often unable to decide if a connector is male or female, my solution was to buy a set of SMA-to-BNC converting connectors of various polarities.

This kit is designed to allow for listening using a short (wavelength-wise) antenna in cases where a full-size antenna is not practical.

In Summary

Sometimes there was an increase in signal readability, and sometimes it was indecisive. The kit comes with a very good instruction manual and a low parts count, which is suitable for beginner and intermediate kit builders. Ultimately, its price and the fact that it's a fun kit to build make it worth the investment, and it can be handy for improving reception in certain situations.

Manufacturer: Pacific Antenna, P.O. Box 10301, Fayetteville, AR 72703, **www.qrpkits.com**. Price: $25.