Product Review and Short Takes from *QST* Magazine

June, 2006
Product Reviews:

Short Takes:

PRODUCT REVIEW

Yaesu FT-1802M 2 Meter FM Transceiver

Reviewed by Rose-Anne Lawrence, KB1DMW, ARRL Club Assistant

It's pretty exciting to have a radio delivered to your desk to review and test, even though you know you'll be returning it in a few weeks. In this case, it was the Yaesu FT-1802M, a 2 meter FM transceiver that packs 50 W on transmit, extended 136-174 MHz receive coverage, and a wide range of standard features into a rugged package.

Learning the Radio

I found the FT-1802M easy to unpack from the secure box. Included were the microphone, power cord, mounting bracket, spare fuse and paperwork. I was immediately struck by its compact size and light weight. As a member of my local ARES Rapid Mobile Team and a past ARRL Emergency Coordinator, I immediately thought about what a great portable suitcase radio it would make for drills and emergency communications. It would be handy to carry along in the field to public service duty such as operating as a net control for a parade or a fixed checkpoint at a bike race.

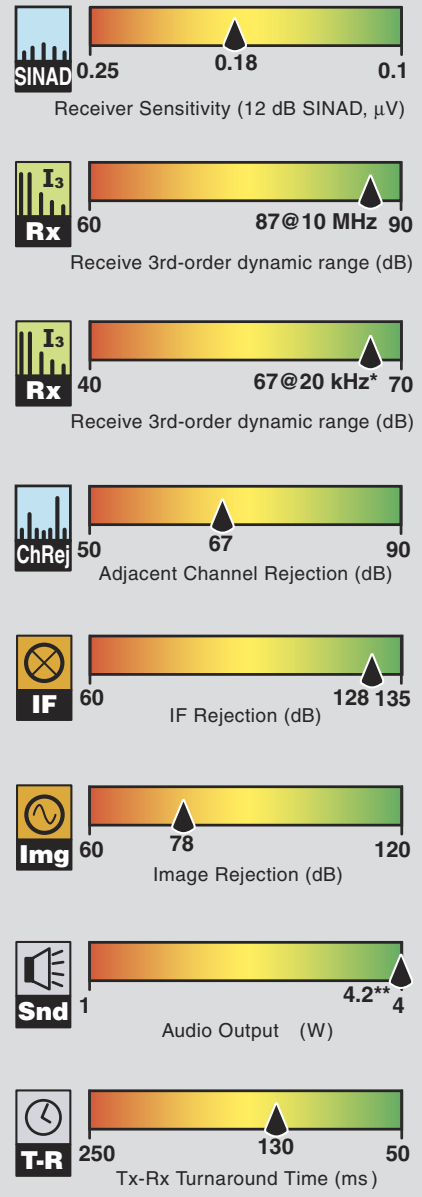
My next step after admiring the radio was to sit down and carefully read the operating manual and familiarize myself with the radio's features. The manual highly recommends this, too. The booklet has 86 pages and covers installation, basic operation, advanced operation, memory programming, scanning and other important topics. The easy-to-read outline format and clearly drawn numbered diagrams with lines pointing to the knobs and keys made it simple to follow. The back of the manual has 14 pages with details of the various SET MODE (menu) options.

Memories and Scanning

The proof would be in the first task of programming local repeater channels into the radio. It was not complicated at all with keypad frequency entry through the microphone. You could also use the tuning dial to select your favorite repeaters.

There are 200 regular memory channels, and each can store frequency, repeater shift (including nonstandard splits), CTCSS/DCS tones and transmit power level. The memory channels can be arranged into eight "banks" to make them easier to find. You can assign a memory channel to more than one bank. For example, a local repeater may be included

Key Measurements Summary



pr011

Key:
Receiver measurements with preamp on.
* Noise limited at value shown.
** Off Scale

Bottom Line

The FT-1802M is a rugged, compact 2 meter FM transceiver that offers a lot of features and is a good value.

Mark J. Wilson, K1RO ♦ Product Review Editor ♦ k1ro@arrl.org

in a bank with machines that you use during the morning commute, and it may also be in a bank with frequencies used during ARES drills or public service work. The memory channels may be displayed with either the channel frequency or a personalized alphanumeric label of up to six characters for easier recognition.

The "home channel" memory, which provides instant recall of a frequently used repeater frequency, was handy. There are also 10 sets of band-edge memories for scanning all frequencies within a defined range.

You can set up the '1802M to scan one or more selected memory banks, or you can create a preferred scan list to allow scanning only of selected memories. In the "dual watch" mode, the radio periodically checks a single selected priority channel while you're operating on or monitoring another frequency.

Other Features

A feature that immediately caught my eye was the 10 NOAA weather broadcast channels. This would be a selling point for me, since I'm the type of person who likes to check the weather forecast every morning. It's useful during ARES drills and emergency activations as well, to keep tabs on changing conditions.

Another convenient travel feature and a big plus is "Smart Search," a special bank of up to 31 memories that can change based on local activity. It sweeps the band, automatically loading frequencies where activity is found.

The microphone was comfortable to hold and use. Its keypad can be used for direct frequency entry or direct numeric recall of memory channels, as well as control of a number of radio functions. There are four user programmable "soft keys" labeled P1 to P4 that allow quick access to often-used features of your choice. The mic keypad also works for generating DTMF for an autopatch or for repeater control functions. You can store DTMF strings up to 16 characters in nine autodialer memories.

If you would rather use a different mic, say for fixed station use, Yaesu thoughtfully provides a menu choice for MIC GAIN to allow an owner to set the optimum audio gain level for the microphone in use.

The LAMP switch turns the microphone keypad illumination on or off — essential for nighttime operation. Press the UP/DWN button on top to scroll the operating frequency up or down or select memory channels. Various aspects of the keys and knobs may be locked out to prevent frequency change or inadvertent transmission.

Back again to one of my favorite features. Press the microphone's P4 button to recall weather broadcast channels. Turn the dial knob to select the desired station or check the other channels for activity by scanning. Press the PTT switch to exit to normal operation. In the event of a storm or hurricane, NOAA sends a weather alert accompanied by a 1050 Hz tone and subsequent weather report on one of the NOAA weather channels. If an alert tone is received, operation will lock onto the weather broadcast station issuing the alert. When the alert tone is received, press the PTT button to disarm the alarm momentarily, and the severe weather message will be audible from the speaker.

For those of you who spend time traveling and are looking to upgrade your license by passing your 5 WPM code test, there is a CW training feature. It sends random Morse code in five character groups via the speaker to help you improve proficiency. Choices include letters, numbers or mixed groups, and the characters being sent scroll across the '1802M's display. The speed is adjustable.

There is a security feature that minimizes unauthorized use of your radio. When the password feature is activated, it will ask for a four-digit password when the radio is first turned on. If the wrong password is entered, the microprocessor will shut down the radio.

There are four available power levels with a push of the LOW(A/N) switch so you can use the right amount for your operating situation. Choices are 5, 10, 25 or 50 W. There's an adjustable time-out timer that turns off the transmitter after a set period (the default is

Table 1
Yaesu FT-1802M, serial number 5N030461

Manufacturer's Specifications	Measured in the ARRL Lab
Frequency coverage: Receive, 136-174 MHz; transmit, 144-148 MHz.	Receive and transmit, as specified.
Power requirement: Receive, 0.7 A; transmit, 10 A (high power).	Receive, 0.6 A; transmit, 8 A. Tested at 13.8 V.
Modes of operation: FM.	As specified.
Receiver	***Receiver Dynamic Testing***
Sensitivity, 12 dB SINAD: 0.2 μV.	For 12 dB SINAD: 146 MHz, 0.18 μV.
Two-tone, third-order IMD dynamic range: Not specified.	20 kHz offset: 146 MHz, 67 dB.* 10 MHz offset: 146 MHz, 87 dB.
Two-tone, second-order IMD dynamic range: Not specified.	146 MHz, 81 dB.
Adjacent channel rejection: Not specified.	20 kHz offset: 146 MHz, 67 dB.
Spurious and image rejection: 70 dB.	First IF rejection, 146 MHz, 128 dB; image rejection, 146 MHz, 78 dB.
S-meter sensitivity: Not specified.	Max indication: 5.1 μV.
Squelch sensitivity: Not specified.	At threshold: 0.06 μV.
Receiver audio output: 3 W at 10% THD into 4 Ω.	4.2 W at 10% THD into 4 Ω.
Transmitter	***Transmitter Dynamic Testing***
Power output (H/M/ML/L): 50/25/10/5 W (approx).	51 / 24 / 9 / 4 W.
Spurious-signal and harmonic suppression: ≥60 dB	68 dB. Meets FCC requirements.
Transmit-receive turnaround time (PTT release to 50% audio output): Not specified.	S9 signal, 130 ms.
Receive-transmit turnaround time (tx delay): Not specified.	77 ms.
Size (height, width, depth): 1.6×5.5×5.7 inches; weight, 2.6 pounds.	

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 indicated.

3 minutes). There's also an automatic power off feature that completely turns off the '1802M after a selected period of inactivity. This is helpful for conserving battery power.

You can operate 1200 baud packet with the FT-1802M by hooking a TNC up to the modular mic jack and speaker jack. The radio is compatible with Yaesu's WIRES-II (Wide-Coverage Internet Repeater Enhancement System) network. The manual also includes a section on using it with other Internet link systems that use DTMF tones for access.

On the Air

I participate in local nets that include friends who are familiar with my voice and usual signal quality. When participating in the nets with the FT-1802M, my signal was described as "crisp and clear." Receiving was the same. One great feature is the '1802M's audio output. The Lab measured 4 W, more than enough for noisy mobile or portable situations.

The large display has orange backlighting and was clear and easy to read for mobile operation in my car. It can be dimmed manually if it's too bright for you. The buttons below the display are illuminated, too, making the radio easy to use at night.

I took the FT-1802M to a local license class organized by my coworker, Mary Hobart, K1MMH. I demonstrated the radio to the students and checked into the Newington Amateur Radio League net using a mag-mount antenna near the window. It was as clear as ever. The students were very interested in the radio and had questions about what it could do. With its simple programming and easy-to-read visual display, it would be a great entry-level radio.

In summary, there is a lot of value packed into this fine radio for the price. The conveniently sized FT-1802M would nicely integrate into a home station. The easy-to-read display, handy controls and potent receiver audio make it a good mobile in the car. You could also count on it as a rugged workhorse for emergency operations out in the field.

Manufacturer: Vertex Standard, 10900 Walker St, Cypress, CA 90630; tel 714-827-7600; **www.vxstdusa.com**. *Price:* $150.

RICK LINDQUIST, N1RL

The author found that the compact FT-1802M made a good addition to her ARES portable station. Everything fits in a padded briefcase, ready to grab and go for a drill or emergency ARES activation.

Ten-Tec/TAPR 6000 Vector Network Analyzer

Reviewed by Michael Tracy, KC1SX
ARRL Lab Test Engineer

Many ham radio operators like to experiment with homebuilt and kit projects or modify commercial equipment for enhanced operation. As part of that exploration, various types of test equipment aid in troubleshooting circuits, testing their functionality and making measurements of performance.

Most hams are familiar with digital multimeters (DMMs) that provide measurements of voltage, resistance and current. Some models also measure passive component values — inductance or capacitance, for example. Oscilloscopes monitor time-varying voltage over a wide range of frequencies. Spectrum analyzers make relative and absolute measurements of power levels at various frequencies. Antenna analyzers measure SWR and impedance versus frequency for antennas and also for circuits with impedances close to the nominal imped-

Bottom Line

The Ten-Tec/TAPR model 6000 vector network analyzer is a multifunction instrument that provides extensive test capabilities at a price on par with an entry level HF transceiver.

ance of the analyzer. Most of these devices are at least familiar to experimenters even if we don't own all of them.

Vector Network Analyzer? What's That?

A bit more exotic and less well known device is the *vector network analyzer* (VNA). VNAs are multipurpose instruments used to measure passive (and sometimes active) circuits as a whole rather than as individual pieces. They measure transmission and reflection responses, which can be used to determine input and output impedance versus frequency, circuit insertion loss (or gain) and phase shift from input to output.

The measurements of the transmission and reflection responses for all of the ports of a circuit network are collectively known as *scattering parameters*, an expression that stems from a type of circuit study known as "black box" analysis. In black box analysis, the general idea is that we assume we don't know what the circuit ("network") consists of and we try to determine as much as we can about its performance without investigating individual components.

In effect, we assume the whole circuit is enclosed in a sealed box that we cannot see into, with only connections to the input and output exiting the box for us to access. Each group of connections to the circuit network is called a *port*. The most common circuit arrangements are considered to be either a one-port network (such as an antenna, which only has an input from an electrical point of view) or a two-port network (such as a bandpass filter, which has one input and one output). Of course many other network arrangements are possible. A hybrid combiner, for example, is a three port network. But a great deal of work can be done just by analyzing one- and two-port arrangements.

Scattering parameters (usually called *S-parameters*) are named with subscripts that refer to the measurement port and the reference port. For example, the forward response (such as the insertion loss versus frequency of a bandpass filter) would be indicated by an S_{21} measurement — showing what the level on port 2 is relative to the signal input on port 1. A measurement of the input impedance of a network would be S_{11} — that is, port 1 measured relative to itself. S_{22} means the same thing on the output of a two-port network.

A vector network analyzer, then, makes complex (vector) circuit (network) measurements (analyzer), reporting the results in S-parameter form. Since S-parameters are complex, they have two values — either resistance and reactance for impedance measurements, or magnitude and phase for throughput measurements. A complete characterization of a circuit with a single input and output (two-port network) can be obtained using only four S-parameters: S_{11}, S_{21}, S_{22} and S_{12}. A more complete description of two-port S-parameter measurements can be found in the *ARRL UHF/Microwave Experimenter's Manual* or on the Wikipedia Web site (**wikipedia.org**).

From Project to Product

The model 6000 VNA was designed by TAPR members Tom McDermott, N5EG, and Karl Ireland. It was originally featured as a project article in our experimenter's magazine *QEX*.[1] It's now offered as a complete unit (with a couple of updates from TAPR), and built and sold under license by Ten-Tec.

The VNA hardware is in a compact black box measuring 1.2 × 4.2 × 6.2 inches (height, width, depth without connectors) and weighing 15 ounces. The front panel sports two SMA connectors labeled RECEIVE and TRANSMIT and the back panel has a third SMA labeled EXT REF. The back panel also has a typical dc coaxial connector for POWER and a USB jack for connection to the computer. There are no displays of any kind — not even a POWER ON LED. But displays would be superfluous since the software displays everything and will politely inform you that the VNA is not available if you forget to supply power to it first.

The model 6000 is not actually a VNA in the traditional sense, but is in fact a transmission-reflection test set. The model 6000 measures S_{11} and S_{21} on a two port circuit, but to measure S_{12} and S_{22} you merely have to reverse the connections. In a traditional VNA there would be two sets of transmission-reflection measurement circuits, so swapping would not be necessary.

In addition to the instrument itself, the package also includes a CD with the software, several printed pages of instructions, an ac adaptor, two lengths of coax with SMA connectors on each end, two fixed attenuators (10 dB and 30 dB), a 50 Ω termination, a shorted termination and a barrel connector. These items are necessary for the calibration procedure as well as being useful for testing.

The instructions guide you through the software installation (*Windows* only; a *Linux* version is under development) and hardware connection. The operation manual and schematic are included on the CD as PDF files (they may also be downloaded from **radio.tentec.com/Amateur/vna**). The installation also requires the Microsoft .NET framework version 1.1 *redistributable.* This software is included on the CD, but the instructions suggest downloading the latest version of 1.1 from the Web. Note that version 2.0 will *not* work, but you can have both versions installed on your system if you need 2.0 for another application. The CD also includes the free Adobe *Acrobat Reader* software, versions 6.0 and 7.0 for those who might need it.

Capabilities and Features

Professional vector network analyzers run in the thousands (or tens of thousands)

[1]T. McDermott and K. Ireland, "A Low-Cost 100 MHz Vector Network Analyzer with USB Interface," *QEX*, Jul/Aug 2004, pp 3-14.

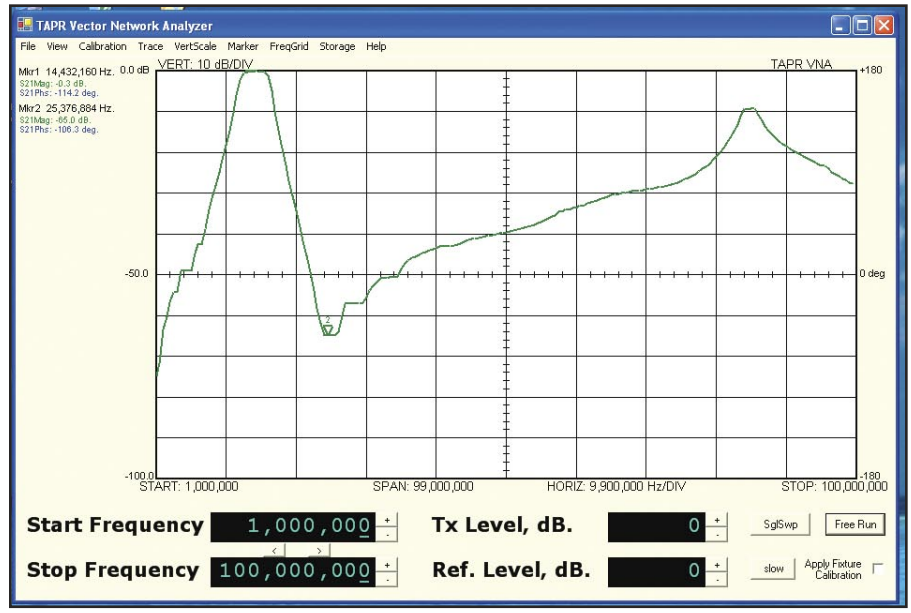


Figure 1 — Response of a 20 meter bandpass filter over the range of 1 to 100 MHz as measured with the Ten-Tec/TAPR model 6000 VNA. Vertical divisions are 10 dB. Insertion loss is 0.3 dB at 14.4 MHz, and stop band attenuation is 65 dB at 25 MHz (in the notch near the second harmonic frequency).

of dollars, even on the used market. At $655, the Ten-Tec/TAPR model 6000 VNA is much more affordably priced but has some limitations. The dynamic range is limited to about 75 dB, compared to 90 to 100 dB for the high priced versions. The 6000's basic resolution is 0.1 dB for amplitude measurements, and the phase resolution measurement is 1 degree. Its frequency range is 200 kHz to 120 MHz, but accuracy is degraded below 1 MHz and above 100 MHz. The phase detectors are accurate only down to about 20 dB above the noise floor; thus the phase component of an S_{21} measurement with more than about 60 dB attenuation is not valid.

The 56 page instruction manual is split into seven sections and four appendices. The sections are Overview, Software Installation, Detector Calibration, Fixture Calibration, VNA Software Menu, Controls and Example Measurement. The appendices give an overview of S-parameters, calibration details, software installation and a discussion of group delay and aperture. The manual is well written and organized and is easy to understand. It covers the background of the design, the instrument limitations, measurement ranges and calibration standards. The manual steps through the detector calibration process, discusses fixture calibration, measurement technique and the details of the software menus.

The software includes rectangular, polar and time domain reflection (TDR) views. The rectangular display mode shows the magnitude and phase of S_{11} and S_{21}, plus the S_{21} group delay, S_{11} magnitude as SWR, and the raw calibration data of S_{21} "through." (A "through" calibration run is made without the device to be tested, but with any cables, adapters or other devices in place.) You can choose a number of these items for simultaneous display, but having more than two or three selected can lead to a confusing display.

The polar display mode resembles a Smith Chart. S_{11} is always indicated with additional options of tracking error compensation (E_P), source mismatch error compensation (E_S), directivity error compensation (E_D) and raw calibration data for S_{11}.

The TDR mode displays the real part of the inverse *Fast Fourier Transform* (FFT) of a reflection measurement, and is useful when making measurements on transmission lines. The vertical scale menu has options for magnitude resolution (10, 5, 2 or 1 dB), SWR (11:1, 6:1, 3:1, or 2:1), group delay (100 picoseconds/div to 100 microseconds/div) and group delay aperture (1, 4, 16, or 64).

On the rectangular display, the right side scale is selectable with options of phase, SWR and delay. The polar display can be zoomed up to a factor of 2.5. Both the rectangular and polar displays offer up to five measurement markers, which indicate their parametric values according to the display format selected.

The frequency grid menu selects the number of intervals for the frequency sweep, with options of 100, 200, 400 and 1020. More points give finer frequency displays but slower acquisition of measurement data. The storage menu allows storing the current measurements into memory. The three options are store, recall and display storage. A common use of this function is to make a measurement and store the data to compare against a new measurement. Note that the markers are not attached to the stored data.

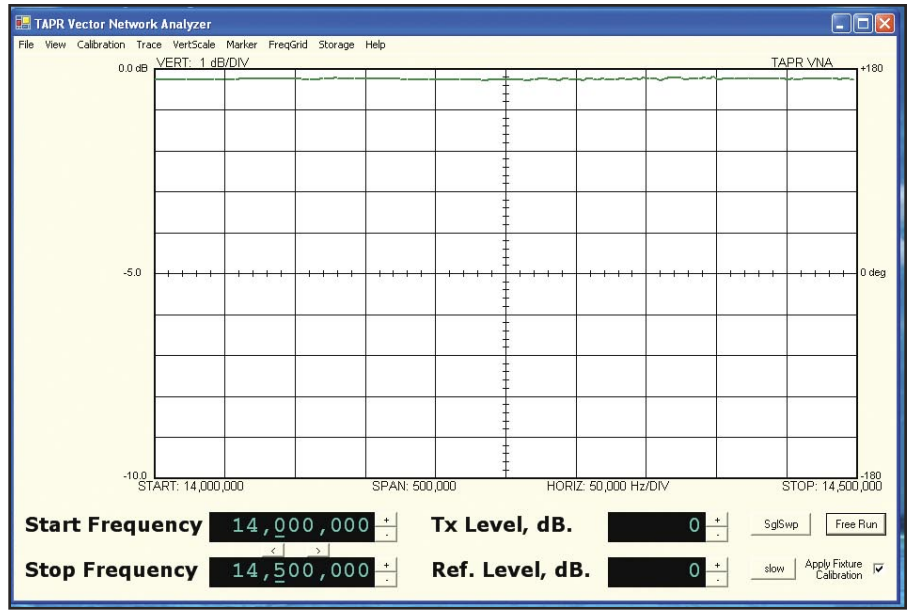


Figure 2 — Here's a closer look at insertion loss within the pass band of the filter. The model 6000 VNA is now measuring the response from 14 to 14.5 MHz, and vertical divisions are 1 dB.

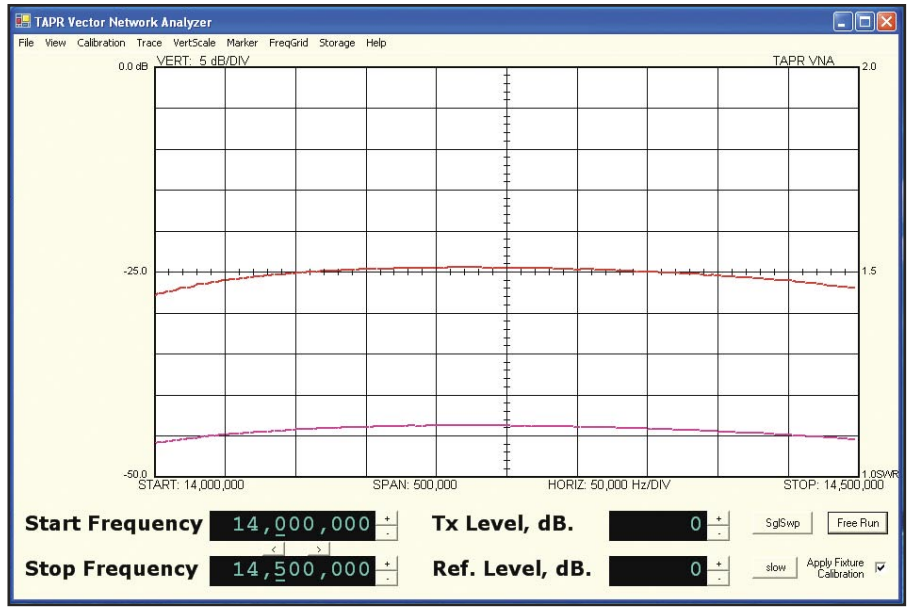


Figure 3 — Here's a look at the bandpass filter's input reflection coefficient. The model 6000 VNA is again looking at 14 to 14.5 MHz, and vertical divisions are 5 dB. The red trace near the center shows return loss, while the pink trace near the bottom shows SWR.

Putting the VNA to Work

In addition to measuring circuits, the VNA is useful for measuring antennas systems, filters, low-gain amplifiers, attenuators, mixers (with proper termination), impedance matching networks, attenuator pads, transmission lines and dozens of other RF devices and function blocks. The model 6000 VNA can also be used as a time-domain reflectometer, a function that will find

conductor breaks, shorts and other faults in multiconductor cables. More information on VNA applications can be found in the Agilent Application Note #5965-7917E: *Network Analyzer Basics*. It's available for download via the Application Notes and Technical papers section of the Agilent Web site, **www.agilent.com**.

Figure 1 shows a measurement of a 20 meter bandpass filter that has been optimized for second harmonic attenuation. Ed Wetherhold, W3NQN, described the design in February 1999 *QST*. The horizontal scale shows 1 MHz to 100 MHz with 9.9 MHz per division. Vertical divisions are 10 dB. A measurement marker (the marker icon is off the graph here) shows an insertion loss of 0.3 dB at 14.4 MHz. A second marker at 25 MHz shows a stop band attenuation of 65 dB near the second harmonic frequency.

Figure 2 shows a closer look at insertion loss within the passband of the filter. The frequency is stepped over a narrower range and the vertical scale is expanded to show the response more clearly. This time the frequency range is 14 to 14.5 MHz with 50 kHz per division. Vertical divisions are 1 dB. The filter response is very flat within the passband.

Figure 3 shows the input reflection coefficient — the return loss with the filter terminated in 50 Ω at its input. The frequency range is again 14 to 14.5 MHz, and vertical divisions are 5 dB. The return loss (red trace near the center, with the scale shown on the left side of the graph) is better than 24 dB across the range. The SWR (pink trace near the bottom, with the scale shown on the right side of the graph) is a maximum of about 1.1:1.

While these types of measurements could also be made with other equipment, the VNA provide a faster and simpler measurement setup, and there is also a benefit in that the VNA can compensate for "fixture" effects (loss and impedance of cables and connectors). The result is that the measurement is a more accurate representation of the device or circuit being measured.

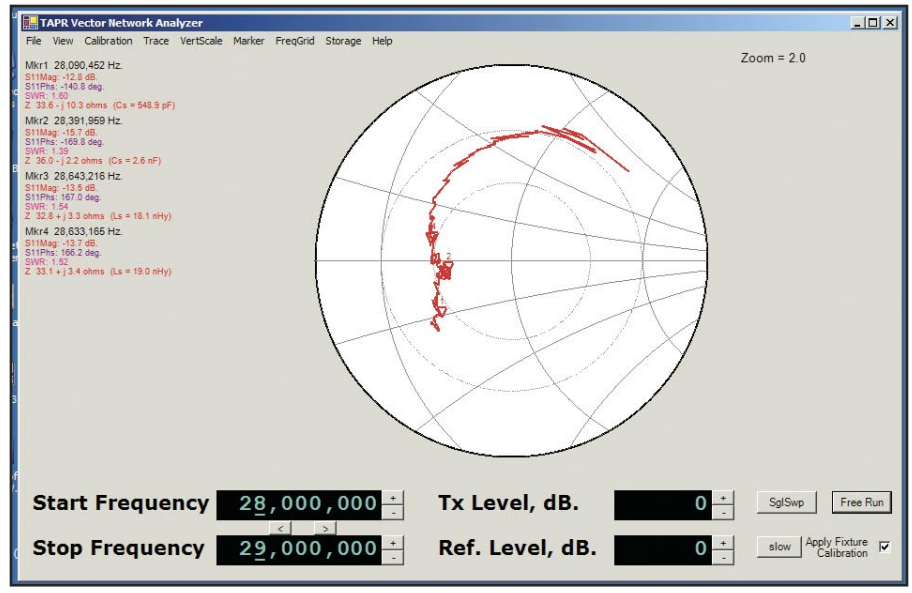


Figure 4 — The polar display mode shows test results in a Smith Chart format. The model 6000 VNA is testing a 10 meter beam over the frequency range of 28 to 29 MHz. There are four frequency markers and the values for impedance and SWR are shown to the left of the plot.

Figure 4 shows a return-loss measurement of a coax-fed 10 meter beam using the polar (Smith Chart format) display mode. Note the marker values showing SWR for several different frequency points.

Although most folks tend to think of vector network analyzers as esoteric test instruments, the availability of a compact, affordable version with USB interface control changes that picture completely. Coupled with a laptop PC and a 5 V power source for the VNA itself, the system also becomes highly portable, a feature not commonly found in the typical laboratory VNA. While the included power adapter can supply up to 2 A output, the unit only draws about 300 mA at idle. Powering it from batteries with a low-dropout regulator should work quite well. With its many diverse applications, this instrument would be a most welcome addition to any well-equipped ham shack.

Manufacturer: Ten-Tec, Inc, 1185 Dolly Parton Pkwy, Sevierville, TN 37862; tel 800-833-7373; **radio.tentec.com**. *Price*: $655.

Heil Pro Set Quiet Phone Noise Canceling Headset

Reviewed by Dave Patton, NN1N
ARRL Field & Educational Services Manager

There are a few accessories in a ham shack with the status of "must have." Headsets and CW paddles achieve that level of necessity for me.

Headsets, or *cans* as they are known from the old days, serve a few vital functions in today's shack. First and foremost, they allow the operator to optimally hear the audio from the receiver. That's particularly important when signals are weak or buried in interference. The cans will also reduce the noise that would be heard by anyone else nearby if you were using a speaker. This feature is especially popular with other family members!

A headset with a boom mic helps reduce the clutter on the desktop by removing the need for a desk mic. If your shack is like mine, it's already crowded enough with radios, computers, antenna switches, wattmeters and so forth. And, finally, a headset provides an easy way to listen to and monitor your transmit audio without creating a feedback loop between a speaker and microphone.

Bottom Line

Heil's comfortable Pro Set Quiet Phone adds noise reduction to the popular Pro Set headset. The noise canceling headphones help reduce fatigue and make operating more pleasant.

Take a Great Headset...

The Pro Set Quiet Phone is the latest in a growing line of Amateur Radio headsets from Bob Heil's Fairview Heights, Illinois, company. I currently own five Heil headsets, including the BM-10 lightweight set, a couple of Pro Sets, a Pro Set Plus, and now these noise cancellers.

I have found each type of headset to have some benefits that the others do not, but had settled on the Pro Set as my favorite variety. The Pro Set is lightweight and comfortable, and mine have held up well over the years. The flexible padded headphone band is adjustable, and you can even bend it a bit to

adjust the pressure on your head. Earphones fit over the ears, helping to block external noises. A recent addition is washable cloth covers for the ear pads.

The mic is mounted on a flexible boom that can be bent and twisted to any position. When I'm operating CW, I can swivel it up and out of the way. Three mic elements are available — the HC-5 full range element, the HC-4 tailored for DXing and contesting, and the iC that works best with earlier ICOM radios. There's a lot of information about these various elements and even some audio samples on Heil's Web site. The review unit has the HC-4 element.

The Pro Set cable terminates in a ¼ inch stereo plug for the headphones and a ⅛ inch phone plug for the microphone. You'll need one (or more) of the Heil AD-1 series adapters to fit your radio (or radios). Adapters are available for the popular 8-pin mic jacks on current transceivers, as well as the 4-pin jacks on older transceivers, modular jacks and even the classic 3/16 inch Collins phone jacks. The AD-1 adapters also have a ¼ inch jack for external PTT control from a foot switch, hand switch or other device.

...and Make it Better

The Quiet Phone is essentially the same as the Pro Set with the addition of a small box in the line that goes to the radio's headphone output. The box holds the noise canceling circuitry and two AAA batteries for power. It also has a momentary contact PTT switch that can be connected to the AD-1 adapter. Rounding out the package is a foam windscreen for the microphone and zippered vinyl carrying bag to store everything.

The Quiet Phone uses active noise cancellation. There are small microphones in the ear pieces that pick up noise in the area around the wearer and feeds it to a differential amplifier in the box in the headphone line. The circuitry then generates signals that cancel out the noise. The result is that the user hears the receiver audio in a quiet background. Heil specifies ambient noise reduction of 15 dB, with the 3 dB point at 400 Hz. They certainly do work.

The regular Pro Set series includes a small switch on the outside of the left earpiece that reverses the phase of the receiver audio. The Quiet Phone has a PHASE REV IN/OUT switch on the noise canceller box. When switched in, it does give the user a "different perspective" on what he is hearing. Occasionally when I tried it while listening to a pileup it allowed me to hear different signals. It is an interesting tool that can also relieve some of the fatigue experienced during long stints of operating.

Creature Comforts

The Quiet Phone is very comfortable — as I expected since it's based on the Pro

Set. The ear pieces cover my ears completely and I have no problem with the earpiece contacting my eyeglass stems, which sometimes becomes a painful problem with other headphones. During long contests I tend to change headsets a few times so as not to hurt my ears, but with the Pro Sets I've been able to operate a full contest without changing to something else.

I also own a set of Bose Quiet Comfort 2 (QC2) noise canceling headphones. I have had some experience with using these in contests recently, and they really saved the day in one case where I operated a CW contest in a room that also had the air conditioning system's blower motor. Using noise canceling headphones I find that I usually turn the radio's audio volume down. That helps lessen my fatigue levels thanks to having a quieter overall environment in which to operate. The Bose headphones work tremendously well for noise reduction, but of course they aren't optimized for Amateur Radio and have no boom mic. I was curious to see hear how well the Heil Quiet Phone stacked up.

The long and short of it is that the Heil Quiet Phone stacked up nicely. The noise reductions achieved by both the Heil and the Bose were quite similar, and both were very effective. *Warning* — the Quiet Phone is effective enough that it is very easy for your spouse, friends, family members or pets to sneak up on you and startle you to the point of panic! In full-concentration contest mode, I find it useful to have a mirror sitting near the computer monitor so I can tell when my wife enters the shack.

The Bose headset gives me the feeling of "pressurizing" my head. I'm not sure why that is, but the noise canceling with them can be so complete, that the sensation of pressure is noticeable. Using the Heil set, I did not notice this sensation of pressure, yet the noise canceling was nearly identical. Perhaps it's because the Heil ear pads fit around the ear a bit more loosely than do the Bose QC2 ear cups. I much preferred using the Heil set at this point.

One thing to note, and this goes into the category of "minor annoyance," is that I found that the cable to the radio and circuitry/battery box was always in the way. Like most of us, I have a keyboard on my desk for logging purposes, and the box seemed to get hung up on the keyboard while limiting my ability to move my head and body freely. The Bose has its noise canceling circuitry and battery holder built into the earpiece. The simple solution for the Heil is to use a simple audio extension cable from an audio store or RadioShack.

Of course having the utility of a boom mic attached to these phones is a great thing, and the customary excellent Heil microphone elements adds to the package. With the Quiet Phone you really do get a great piece of equipment that has been fine-tuned over the years, is designed with Amateur Radio in mind, and costs quite a bit less than the Bose QC2s.

Both the Heil and Bose require batteries — not a big deal if you have a bunch of them ready to go. The Heil uses a pair of AAA batteries.

The Quiet Set's batteries will probably last for an entire 48 hour contest — my batteries were still going strong after 15 hours straight. Others have reported more than 40 hours of operation.

If you run out of batteries, no problem! Just turn the switch off and the Quiet Phone works like a regular Pro Set. Rechargeable batteries are a good investment if you'll use the set a lot.

I truly enjoyed using the Heil Pro Set Quiet Phone headset and find its utility to be well worth the price. Unless your shack is inside an igloo, isolated from any blower noise or other manmade noise, you will definitely find how much these headsets can do to reduce fatigue and introduce the pleasure of quieter operation.

Manufacturer: Heil Sound Ltd, 5800 North Illinois, Fairview Heights, IL 62208; tel 618-257-3000; **www.heilsound.com**. *Price:* Pro Set Quiet Phone with HC-4 element (model PSQP-4) or HC-5 element (PSQP-5), $225; AD-1 series adapters, $20 each. PSQP-IC (with ICOM element and adapter), $242.

Kill-A-Watt Electric Usage Monitor

Electricity is the lifeblood of Amateur Radio, but it comes at a cost no matter how you generate it.

Most of us take electric power for granted. We tap 120 V ac from our wall outlets and feed it to our station power supplies, which convert it to 12 V dc for our radios. Since we depend so much on the good graces of the electric company to provide this critical resource, it is a good idea to keep a close watch on the quality of the power we receive, and the cost.

The Kill-A-Watt by P3 International is a device that allows you to measure ac voltage, frequency, active power, RMS current, apparent power and the power factor ($PF=W/V_{rms}\ A_{rms}$). Best of all, the Kill-A-Watt will calculate the *cost* of the power you are consuming!

The Kill-A-Watt measures 5 inches in length × 2.25 inches wide and 1.5 inches thick, not counting the prongs. The bottom front panel contains an electric plug receptacle and the bottom rear has a typical three prong (grounded) plug.

Using the Kill-A-Watt

The Kill-A-Watt is about as simple to unpack and install as you can imagine. It arrives in clear plastic bubblepack with a single-page instruction sheet printed on one of the thinnest paper stocks I've seen in recent memory. (Translation: Be careful unpacking the Kill-A-Watt. The instructions are easy to tear or misplace.)

Like most gadget freaks, my initial impulse was to rip away the packaging and run to the nearest wall outlet to see what happened. I plugged in the Kill-A-Watt and it sprang to life, counting up the time in minutes on its 2 inch LCD display. (When the display reaches 99 minutes, it begins counting in hours.)

Pushing the front-panel buttons allowed me to step through the various measurement displays. Yes, my power company was delivering rock-stable 60 Hz ac. Good for them. The ac voltage fluctuated between 120 and 118 V as appliances and other devices turned on and off. Maybe it is time to upgrade my service.

The next step was to conduct a genuine test with the Kill-A-Watt. My first test was performed on the most critical appliance in my household—the coffee maker. (Well, at least it was convenient and easy to get to.) I allowed the Kill-A-Watt to maintain its vigil of the coffee maker for a week. At the end of 7 days, it was time to gather the results.

Dialing for Dollars (or Cents)

When I first plugged in the Kill-A-Watt and pressed the all-important red kWh button, the display read 0.00. This was the cumulative energy consumption since power was first applied to the unit. Pressing the button again gave me the cumulative time, which at that point was also zero.

A week later I toggled the red button again.

Cumulative Power Consumption: 2.11 kWh

Cumulative Time: 168 hours

My local power company bills me an average of 8 cents per kilowatt-hour. This charge is stated on every electric bill. So, at the end of the test period, the Kill-A-Watt declared that I had spent 17 cents (8 × 2.11) to operate the precious coffee maker for one week, or 68 cents per month. That's fair, especially considering how important the brown elixir can be to my survival.

In subsequent tests, I discovered that operating my radios costs a mere 50 cents per month. The station computer, however, sucks down a surprising amount of money since it is on most of the time. As in many households, my "station computer" is also the family computer.

The big money sinks are the washing machine and refrigerator, as you would guess. I'll be curious to see how much power the window air conditioners use over the summer. Large appliances usually come with stickers that indicate their kWh power consumption, but it is interesting to compare the estimates with real-world usage. If you're like me, you'll be measuring every electrical device in your home. It's too bad that there isn't a 220 V version of the Kill-A-Watt.

Pros and Cons

I have only a couple of brickbats for the Kill-A-Watt. The device is powered entirely from the ac wall outlet, so when you remove the Kill-A-Watt, your cumulative data vanishes. It isn't stored in memory. This means that you must take your readings *in situ*, which may entail crawling behind a desk with pen in hand and a flashlight in your mouth. The characters on the LCD display are difficult to see at a distance and the display is not illuminated. You could solve the problem by plugging the Kill-A-Watt into an extension cord and moving the meter to a more convenient location, but this wouldn't be ideal for long-term monitoring.

That said, the Kill-A-Watt is a highly useful product and a potential money saver. In ham applications, the Kill-A-Watt would be great for monitoring portable 120 V ac power systems such as generators or ac inverters connected to solar-charged battery banks. At a $40 average street price, the Kill-A-Watt is hard to beat.

Manufacturer: P3 International, 132 Nassau St, New York, NY 10038-2400; tel 212-346-7979; **www.p3international.com**. *Suggested list price $49.95. Available at many hardware outlets and home centers.*

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