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May 2005

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PRODUCT REVIEW

Yaesu FT-8800R Dual-Band FM Transceiver

Reviewed by Joe Carcia, NJ1Q
W1AW Station Manager

Whenever I get a radio for review, I try to find out what would be different about this particular rig. Is it a dual-bander or tri-bander? What might set this radio apart from the rig the average ham would want to buy? What's different between this dual-bander and the Yaesu FT-7800R dual-bander we reviewed last year, and is still in Yaesu's line up?[1]

On first glance one may feel that this radio might have something up its sleeve. Well, yes and no. Although it is very similar to many of its predecessors, this radio is also capable of full-duplex and cross-band operation. It can also be set up as an emergency repeater. This is something to consider—especially for those who gear themselves up for emergency communications.

Right Out of the Box

As with most radios of this type, it may end up in a mobile, as well as a base station, setting. Its relatively small size, approximately 6×2×7 inches, allows for ease in setting it up in either venue. For the duration of this review, it spent its time in my shack, except when I was actually testing it mobile. Like most mobile-oriented radios, the '8800R comes prepackaged with a mounting bracket and complete hardware. If you want to remote mount the body of the transceiver, this can be accomplished with the optional YSK-8900 separation kit. Although the remote head can be removed, it's still operable using the 3 inch pigtail supplied to connect the body and the head.

When I tried to remove the head, I found I had to depress the latch, located on the left side of the radio, and also slide the head to the left. It was a little difficult at first, but something a user would probably get used to in short order. Figure 1 shows the radio separated into its pieces.

The front panel display head is broken down into the *left* and *right* hand controls and switches, with each side controlling the usual functions for one band. This is really *two* radios in one box and as such, it needs to have separate controls for each. For normal single band operation, the BAND button on one side or the other is depressed to select operation on that band. The amber display is 3/4 inch high by 3 inches wide with clear, easy to read alphanumeric characters. The display's brightness can be changed through a menu setting.

Not counting the dial knobs, 15 non-illuminated buttons grace the front panel. When background lighting was low, I found I had a difficult time seeing the buttons. The fact that they were small exacerbated the problem. Figure 2 gives an indication of the control sizes.

On the *left* band side, going counter clockwise, you have the *left* dial knob and under that the *left* volume and squelch controls. Next to them are buttons, 1 through 3 for the *hyper* memories. Along the bottom are the buttons that control power level (LOW, MID1, MID2 or HIGH), VFO/MEMORY, HOME (favorite channel) and SCAN.

The SET button (used to control menus) separates the buttons used for the each band. There are similarly named buttons (as used for the *left* band side) with the exception of the two dial knobs. The upper *right* hand knob controls the *right* band, with the lower knob controlling the power, volume and squelch. The hyper memory buttons (4 through 6) are to the left of the control knobs.

On either side of the radio, the plastic (non-rubber coated) DIAL, VOLUME and SQUELCH controls are close to each other. I found that I would sometimes disturb the setting of the knob adjacent to the control I was using due to their proximity. This may take some getting used to.

On the rear of the radio, see Figure 3, looking left to right you'll find a single chassis-mounted antenna connector (a UHF-type SO-239) for both bands.[2] Next to that you have cooling fins, and the chassis-mounted cooling fan. Next to the fan are a few more fins and the power line pigtail that terminates in a two-pin T-type locking power plug. Under the power plug there is a miniature six-pin DIN used for 1200/9600 baud packet (depending on which pin you use). Finally, there is the 1/8 inch jack for an external speaker. The internal speaker fires out the top of the radio.

The FT-8800R has receive capability from 108 to 520 and 700 to 999.995 MHz (cellular blocked). The modes of operation are FM and AM (receive only). The receive mode selection is automatic, but you can change this via a menu setting if you wish.

The '8800R transmits from 144 to 148 MHz and 430 to 450 MHz. There are four power levels: 50, 20, 10 and 5 W on 2 meters, and 35, 20, 10 and 5 W on 70

Bottom Line

The Yaesu FT-8800R provides a solid 2 meter and 70 cm FM mobile capability in a convenient package with some important extra features that position it a notch above many other dual-banders.

[1] J. Carcia, "Product Review—The Yaesu FT-7800R Dual-Band FM Transceiver," *QST*, Apr 2004, pp 78-81.

[2] An inexpensive diplexer can be employed if you wish to use a separate antenna for each band. See Dec 2004 *QST*, pp 63-67.

Joel R. Hallas, W1ZR ♦ Assistant Technical Editor ♦ w1zr@arrl.org

Table 1
Yaesu FT-8800R, Serial Number 4K260159

Manufacturer's Specifications	Measured in ARRL Lab
Frequency coverage: Receive, 108-520, 700-999.99 MHz (cell blocked); transmit,144-148, 430-450 MHz.	Receive and transmit, as specified.
Power requirement: Receive, 0.5 A (squelched); transmit, 8.5 A (high power).	Receive, 0.34 A; transmit, 7.1 A. Tested at 13.8 V.
Modes of operation: FM, AM (receive only).	As specified.
Receiver	**Receiver Dynamic Testing**
AM sensitivity: Not specified.	AM, 10 dB S+N/N, 120 MHz, 0.6 μV.
FM sensitivity, 12 dB SINAD: 0.2 μV.	For 12 dB SINAD, 144, 0.18 μV; 222 MHz, 0.22 μV; 430 MHz, 0.18 μV.
FM adjacent channel rejection: Not specified.	20 kHz channel spacing: 146 MHz, 55 dB; 440 MHz, 59 dB.
FM two-tone, third-order IMD dynamic range: Not specified.	20 kHz spacing: 146 MHz, 55 dB*; 440 MHz, 59 dB*; 10 MHz spacing: 146 MHz, 94 dB; 440 MHz, 79 dB.
FM two-tone, second-order IMD dynamic range: Not specified.	82 dB.
S-meter sensitivity: Not specified.	Max indication: 146 MHz, 6.3 μV; 440 MHz, 6.9 μV.
Squelch sensitivity: 0.16 μV.	At threshold: 146, 0.06 μV; 440 MHz, 0.07 μV.
Receiver audio output: 2 W at 5% THD into 8 Ω.	2.2 W at 5% THD into 8 Ω.
Spurious and image rejection: Not specified.	First IF rejection, 146 MHz, >135 dB; 440 MHz, >135 dB; Image rejection, 146 MHz, 135 dB; 440 MHz, 68 dB.
Transmitter	**Transmitter Dynamic Testing**
Power output (H/M1/M2/L): 144 MHz: 50/20/10/5 W; 430 MHz: 35/20/10/5 W.	146 MHz, 53/19/9.3/4.3 W; 440 MHz, 34/19/9.8/4.8 W.
Spurious-signal and harmonic suppression: 60 dB.	VHF, 65 dB; UHF, 67 dB. Meets FCC requirements.
Transmit-receive turnaround time (PTT release to 50% audio output): Not specified.	S9 signal, 146 MHz, 190 ms; 440 MHz, 220 ms.
Receive-transmit turnaround time (tx delay): Not specified.	146 MHz, 120 ms; 440 MHz, 130 ms.
Bit-error rate (BER), 9600-baud: Not specified.	146 MHz: Receiver BER at 12 dB SINAD, 8.8×10^{-4}; at 16 dB SINAD, 3.0×10^{-5}; at –50 dBm, $<1.0\times10^{-5}$; transmitter: BER at 12 dB SINAD, 7.0×10^{-3}; at 12-dB SINAD + 30 dB, 2.1×10^{-4}. 440 MHz: Receiver BER at 12 dB SINAD, 8.7×10^{-4}; at 16 dB SINAD, 5.6×10^{-5}; at –50 dBm, $<1.0\times10^{-5}$; transmitter: BER at 12 dB SINAD, 3.7×10^{-3}; at 12 dB SINAD + 30 dB, $<1.0\times10^{-5}$.

Size (height, width, depth): 1.6"×5.5"×6.6"; weight: 2.2 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.

cm. These are indicated on the display as HIGH, MID1, MID2 and LOW, respectively.

Power is Applied!

When the power switch (on the right band volume control) is depressed, the dc supply voltage is displayed on the right display half, and then the last frequency in use. The left band comes up with whichever band was last in use on that side. Prior to my receiving this radio, I reset the CPU. (Note that the manual says to depress the SET button *momentarily*. And when they say momentarily, they mean it!) When this procedure is completed, the radio defaults with the 70 cm band on the right side (and makes it the operating band) and 2 meters on the left. I depressed the left band button to shift to 2 meters. (I could have used the right band, but I would have needed to change bands manually.) The automatic repeater shift (ARS) defaults to ON, so it was a simple matter to tune to my favorite repeater. As it turned out, I initially had to go to simplex mode to find someone to talk with. (My thanks to the mobile station passing through Connecticut at the time!) His signal was a bit weak. I did hear him report that my signal sounded good. His audio was clear. The 2 inch, 2 W rated speaker did a good job of reproducing it.

I was finally able to make some repeater contacts after I figured out how to set the CTCSS tones. Audio reports from hams on both 2 meter and 70 cm repeaters were good.

For this review, I really wanted to operate a little packet. I didn't have a terminal node controller (TNC) to handle the 9600 baud that this radio can support, so I was relegated to 1200 baud. I sacrificed an old PS/2 mouse to get a six pin DIN cable. [If you don't have extra mice running around, consider the CT-39A accessory packet cable.—*Ed.*] Thankfully, the pins I needed had wires attached to them. I wired up the DIN plug to my MFJ-1278 TNC, and made a couple of connections into the local Flexnet and Packet Cluster nodes. It worked like a charm. The audio levels were just right. I didn't experience any unusual *packet retry* activity. This told me the TNC had no problem dealing with the receive audio level. The packet nodes apparently didn't have any problems with the transmit audio levels either, since communication was solid both ways.

As mentioned above, although the '8800 was used primarily in the shack, it did spend some time in my truck and even accompanied me on a weekend stint to the shore. Despite road and truck noise, the rig performed as expected. I was able to hear stations easily, and they didn't hear any problems with my audio.

While operating from the truck, I found that the mounting angle had a critical impact on how easy it was to view the display. With the capability to remotely mount the control head, this issue can be easily eliminated. Proper mounting of the transceiver body must be taken into consideration if for no other reason than for heat dissipation.

I found that the 10 W (MID2) level was just right for most of my operation on either band. At that power level, the heat

Figure 1—The Yaesu FT-8800R with front panel removed from the radio body along with supplied microphone.

Figure 2—A view of the size of the FT-8800R buttons compared to a US quarter.

Figure 3—Rear view of the FT-8800R. Note the single antenna connector for both bands.

sink got just a bit warm after a few long winded conversations. When I tried 20 W (MID1) for a while, I noticed it got a bit warmer as I would have expected.

The cooling fan should take care of any additional heat buildup. The cooling fan starts right up at the beginning of each transmission, and will continue to run for about 30 seconds, depending on how much heat there is. The fan is thermostatically controlled and there is no provision for manual control.

The Standard Functions—Plus the Bells and Whistles!

The FT-8800R includes the usual features found in most of today's mobile FM transceivers: automatic power off (APO), time-out-timer (TOT), automatic repeater shift (ARS), channel skip, priority channel scanning (often called "dual watch"), regular band scanning, and so on. There are also 47 menu settings. The tuning step size is selectable from 5, 10, 12.5, 15, 20, 25 and 50 kHz for either band. The scanning function can be accomplished by setting band scan limits, scanning just the memory channels or scanning an entire band. There are two scan resume limits—TIME, which means the scan will halt on a signal and hold for 5 seconds; and BUSY, which means the scan will hold until the received carrier drops. This radio also provides a "smart search." This function allows one to scan a band or segment for local activity and store repeater information in up to 25 temporary memories.

CTCSS encode and decode functions are built into the FT-8800R. Also included are digital coded squelch (DCS) encoding and decoding, DTMF tones and pocket beep (similar to paging). If the repeater you use has an autopatch, then the DTMF autodialer function allows you to memorize up to 16 different telephone numbers or repeater control sequences, each up to 16 digits in length.

The FT-8800R supports the auto range transponder system (ARTS). This allows two or more parties to verify whether they're within range of each other. As stated in the manual, this can come in handy during search-and-rescue situations in which parties need to be in close proximity to each other. When ARTS is activated, the radio will transmit a tone with DCS codes at regular intervals. If the sending radio doesn't receive a reply signal from a similarly programmed rig, the user is notified of this. If the reply isn't received, the radio beeps and displays the message OUT.RNG indicating that the far station is out of range. ARTS is adaptable by menus to select polling time or to input a CW identifier.

You can "clone" the programmed information from one FT-8800R into another. This function is performed via the six-pin packet connectors using a user constructed cloning cable (instructions are included in the manual) and firmware internal to the radio(s). I did not see any indication that the radio could be programmed externally using a PC.

So How is it to Program?

I found that programming the radio or memories was a bit *interesting* at first. There are definite differences between holding down a key momentarily as opposed to half a second! On occasion, I found I missed a programming step because I held a button down a bit too long (or too short). But all this comes with practice. So much so that at one point I didn't even need the manual, at least to set the PL. Once you get the hang of it, it's pretty straightforward.

As an example, say you want to program

in your favorite repeater. You first set the frequency using the microphone UP and DOWN buttons or the DIAL in VFO mode. Press and hold the SET key for 1/2 second until a memory number blinks on the display for the band you're using. Then use either the DIAL or mic UP or DOWN buttons to select a channel. When this is done, press the SET button again to store the information. If you need to store CTCSS tones or other parameters, these should be set while the radio is still in VFO mode.

Memory channels can be assigned alphanumeric tags, so you'll know right away which memory channel is which. You can assign up to a six-character alphanumeric title to a memory channel while still in the memory programming stages. You get your choice of a selection of letters, numbers and symbols.

Many Memories

Each band has its own set of memory channels, including 512 standard memory channels, five home channels, 10 sets of band-edge memories, 10 memory banks and 6 *hyper memory* channels. The hyper memory channels are directly accessible via the front display panel buttons.

Other Cool Things!

The FT-8800R works quite well as a full-featured crossband repeater. As a test, I set up the '8800R to receive on 70 cm and transmit on 2 meters. With my FT-90R mobile radio set up on the FT-8800R 70 cm input frequency, I was able to key up the '8800R and monitored my transmission on my 2 meter handheld. There's little doubt that it would function just fine if called upon in emergency or portable work situations. [Some amateurs regularly use this setup at their home station to extend the range of a 70 cm handheld to allow communicating through a 2 meter repeater while walking their dog, for example.—*Ed.*]

This is a full-duplex, crossband 2 meter and 70 cm FM transceiver with independent volume controls. Obviously, my next test would have been to work through the AO-51 satellite (Echo)! Unfortunately, the only times I would have been able to do so was when Echo was operating using modes other than Mode JA (2 meter uplink/70 cm downlink). Disappointed, yes. But at least one should be able to do so. I've worked mobile stations on AO-51 from W1AW so it's certainly feasible with the FT-8800R.

Yaesu put some thought into the possibility of hams using the FT-8800R for FM transponder satellite operation. They included a way to switch between inverted and non-inverted satellites using the *band link* feature.

Also included is a function called *audio mute*. As stated in the manual, the audio level of the receive only band can be reduced automatically upon reception of a signal on the main band or if you transmit on the main band during dual-receive.

And Now, the Microphone

The microphone that comes with the radio is the Yaesu DTMF MH-48. The keypad allows for direct frequency entry. The coiled microphone cable extends about 5 feet and terminates in an RJ-45 plug that connects to a jack on the right side of the removable front panel, a plus if operating with the front panel separated. The buttons can be backlit with the toggle switch on the side of the microphone. There is a microphone LOCK switch that is located above a LAMP (backlight) switch. The PTT switch makes up almost half the other side of the microphone. The other buttons (P1, P2, P3 and P4) are not marked per se, since they are user programmable. If you opt to use a different Yaesu microphone you will need to change the mic setting in the menu system.

Easy to Read Manual

I found the 68 page manual easy to read. You start with the table of contents, then general instructions, radio specifications, antennas and safety and then a few pages devoted to installation. Next comes basic operating. The manual continues with the general functions, and then leads the user into the more advanced features. The last pages are devoted to menu functions. (How to program these functions is described throughout the manual, depending on the desired function.) If a user takes the time to read the manual, there should be little difficulty in either operating or programming the FT-8800R. And yes, your guide to understanding the terms used in the manual, the *R.F. Radio* cartoon character hints are there to assist!

The Overall Appeal

This is a good radio. Although I couldn't work any satellites through it, due to my schedule, I'm glad that I at least had the capability to do so. The fact that there are features that allow it to be used for emergency or special purpose situations (full duplex, crossband repeater, ARTS) and that you can operate packet with it, are certainly pluses. Oh yes—it works real well as a regular radio, too! It has the functions the average ham would find useful, and a few others as well.

Manufacturer: Vertex Standard, 10900 Walker St, Cypress, CA 90630; tel 714-827-7600; **www.vxstdusa.com**. Price: $365.99; YSK-8900 Remote Separation Kit, $59.99; CT39A packet cable, $11.99.

A Look at Some High-End Antenna Analyzers

Reviewed by Joel R. Hallas, W1ZR
Assistant Technical Editor

Almost a dozen years ago,[3] Mike Gruber, W1MG, reviewed the MFJ-207 and -249 Antenna Analyzers in this space. Those models are still available in MFJ's line, but they have added some new models as well. In addition, three other manufacturers have joined in to offer products in the same general category. In this issue, we will review the Autek VA1, the Kuranishi Instuments BR-210, the MFJ-269B and the Palstar ZM-30.

Mike did a good job of describing the functions of the earlier units so I will focus on the features of each and highlight the differences between the units here. The earlier article is available on the ARRL

Bottom Line

An antenna analyzer can be a real help in any project that includes antenna or transmission line trimming or data gathering. One of these models may have just what you're looking for!

[3]M. Gruber, "Product Review—MFJ-249 and MFJ-207 SWR Analyzers," *QST*, Nov 1993, pp 75-77.

Table 2

ARRL Laboratory Test Results of Four Antenna Analysers

AUTEK VA1 VECTOR ANTENNA ANALYST

Manufacturer's Specifications	*Measured in the ARRL Lab*
Frequency range: 0.5-32 MHz.	0.44-34 MHz.
Impedance range: 0-1000 Ω.	Wider than 5-1000 Ω.
Impedance accuracy: 20-200 Ω, typically 3-4%.	See Table 3.
Warm-up drift: Not specified.	0.42% in 15 min.
Output power: Not specified.	0.75 mW (50 Ω).
Power requirements: 80 mA (max), 9-12 V dc	70 mA max; measured at 9 V dc.

Size (height, width, depth): 4.1"×2.6"×1.5"; weight, 8 ounces.

KURANISHI BR-210 STANDING WAVE ANALYZER, SERIAL NUMBER 001478

Manufacturer's Specifications	*Measured in the ARRL Lab*
Frequency range: 1.8-170 MHz.	1.5-172 MHz.
Impedance range: 12.5-300 Ω.	As specified.
Warm-up drift: Not specified.	0.1% in 15 min.
Output power: Not specified.	0.5 mW (50 Ω).
Power requirements: 160 mA, 8-12 V dc.	320 mA max,* measured at 12 V dc.

Size (height, width, depth): 7.0"×3.1"×1.8"; weight: 2.0 pounds (with batteries).

MFJ 269 HF/VHF/UHF SWR ANALYZER

Manufacturer's Specifications	*Measured in the ARRL Lab*
Frequency range: 1.8-170, 415-470 MHz.	1.8-175, 415-470 MHz.
Impedance range: Not specified.	>6-400 Ω.
Warm-up drift: Not specified.	0.03% in 15 min.
Output power: 20 mW (50 Ω).	3.5 mW (50 Ω).
Power requirements: 150 mA (HF/VHF), 250 mA (UHF), 11-18 V dc.	HF/VHF: 160 mA; UHF: 290 mA; measured at 13.8 V dc.

Size (height, width, depth): 6.8"×4.1"×2.4"; weight, not specified.

PALSTAR ZM-30 DIGITAL ANTENNA Z BRIDGE

Manufacturer's Specifications	*Measured in the ARRL Lab*
Frequency range: 1-30 MHz	As specified.**
Impedance range: 5-600 Ω.	As specified.
SWR range: 1.0-9.9	As specified.
Warm-up drift: Not specified.	0% in 15 min; Freq accuracy: 6 ppm.
Stability: 50 ppm.	
Output power (50 Ω): 10 mW.	1.0 mW (50 Ω).
Power requirements: 200 mA, 9-16 V dc.	210 mA, measured at 13.8 V dc.

Size (height, width, depth): 5.8"×3.6"×2.1"; weight, not specified.

*All button lamps on.

**Tunes 0-30 MHz. Usable down to about 0.1 MHz.

members' Web site at **www.arrl.org/members-only/prodrev/** and is worth reading if you are not familiar with these handy devices.

A quick summary of the reasons why these are an improvement over just measuring SWR with the SWR meter in your transmitter or antenna tuner might be in order if you don't want to reread the earlier article. First, this device allows operation across the spectrum, not just on amateur bands. Second, the power used is minuscule, avoiding unnecessary interference. Third, much more information is available from these units than just SWR. See below to find out the nature of the information, it's different for each model. In addition, they all can also serve as signal generators, and one can even be used as a frequency counter.

Our Test Approach

We tested each unit in the ARRL Lab using some of the same calibrated loads that we use to test antenna tuners. In addition, we added in some samples of complex (reactive) loads. For each load we note the actual value and measured value at a representative set of frequencies. The results are shown in Table 2.

In Alphabetical Order:

AUTEK RESEARCH VA1 VECTOR RX ANTENNA ANALYST

This is the smallest and lightest of the group. It is also one of two units (see the ZM-30 below) that includes the capability to determine if the reactive component of the measured impedance is capacitive or inductive. This unit can make a whole bunch of different measurements selected by button switches in a 4 × 4 array adjacent to the single function display. To use, you connect the load to be measured to the UHF connector on top of the unit, push the FREQ button and tune to the desired frequency, then push two buttons to select the desired measurement from the matrix. Once you select a column of the matrix, a single button is all that is needed to select other measurement parameters in the same row. This is convenient since the parameters are grouped in a logical way—for example, the first column contains buttons for SWR, R_s and X_s (the series equivalent resistance and reactance), the data most likely to be taken. It is also possible to have the measurements cycle between two (or more) parameters. This can be useful if you want to make a series of SWR measurements at multiple frequencies, for example.

In addition to taking basic measurements, the VA1 also performs a number of calculations on the data. Available results are inductance or capacitance values (and you can tell which it is), for complex impedances—magnitude and phase angle of impedance—cable loss determination, based on SWR measurement of open or shorted cable—parallel equiva-

lent resistance and reactance (in addition to the commonly available series values), frequency at which the cable is 1/4 λ long—antenna impedance, calculated based on measurement at end of cable. While all these could be calculated off-line with a spreadsheet or calculator, it is handy to be able to determine the derived values right on the display.

Another handy feature is to be able to change the Z_0 of the line being measured from the usual 50 Ω to 25, 50, 52, 54, 73, 75, 93, 95, 112, 150, 300 or 450 Ω. Again, results could be adjusted off line, but having this capability is a real plus, in my opinion.

In use I found two limitations compared to the other units we looked at. First, the frequency adjustment is rather course. The frequency is selected in bands of about a 2:1 range; for example 2.4 to 4.8 MHz, 15 to 32 MHz and the TUNE knob covers the range in just half a turn. a FINE knob is also provided. The fine knob covers about 10% of the range at the high end and 2% at the low end of a range. Depending on the frequency range, tuning can be quite touchy if you need to take data at a particular frequency. The second limitation is that you can only read one value at a time. It would be nice to be able to watch the frequency change as you look for variation in SWR, for example. The unit will allow you to set it to alternate between the readings, but I found that a bit cumbersome.

The 12 page VA1 manual is quite complete. In addition to clearly describing the operation of the controls and display, it does a good job describing the functions provided and also indicates potential applications in working with antennas and transmission lines.

The VA1 is powered by a single 9 V alkaline radio battery (not supplied) with a projected life of 6 to 12 hours. There is no direct provision for the use of an external power source. The manufacturer does identify some after-market sources of 9 V battery eliminators that can be used. The unit comes with four precision resistors for calibration use as well clips and wire to make clip leads for connecting to non-coax loads, such as the resistors or balanced line.

Manufacturer: Autek Research, PO Box 7556, Wesley Chapel, FL 33544; tel 813-994-2199, **www.autekresearch.com**. Price: $199.95.

MFJ-269

MFJ has added to the features of their earlier top-of-the line unit, the MFJ-259, by including a UHF range—from 415 to 470 MHz, covering 70 cm with some overlap. The '259 is still available as an MFJ-259B for $260 and has most of the features except for the 70 cm coverage and a

Table 3

Impedance and SWR Measurements of Test Samples Compared to Laboratory Reference

Load	*Frequency*	*Autek VA1*	*Kuranishi BR-210*[a]	*MFJ-269*[b]	*Palstar ZM-30*	*HP-8753C (Reference)*[d]
50 Ω[e] (1:1 SWR)	3.5 MHz	52–*j*1 Ω (1.0:1)	51 Ω (1.0:1)	48±*j*0 Ω (1.0:1)	53+*j*0 Ω (1.0:1)	
	14 MHz	51–*j*1 Ω (1.0:1)	51 Ω (1.0:1)	48±*j*0 Ω (1.0:1)	52+*j*0 Ω (1.0:1)	
	28 MHz	58–*j*3 Ω (1.1:1)	50 Ω (1.0:1)	48±*j*0 Ω (1.0:1)	53+*j*0 Ω (1.0:1)	
	50 MHz	–	50 Ω (1.0:1)	48±*j*0 Ω (1.0:1)	–	
	144 MHz[f]	–	50 Ω (1.0:1)	48±*j*1 Ω (1.0:1)	–	
	432 MHz[f]	–	–	(1.1:1)[c]	–	
5.0 Ω (10:1 SWR)	3.5 MHz	5–*j*1 Ω (9.9:1)	<12.5 Ω (>6:1)	4±*j*2 Ω (12:1)	3+*j*2 Ω (>10:1)	5+*j*0 Ω
	14 MHz	6+*j*0 Ω (8.3:1)	<12.5 Ω (>6:1)	5±*j*0 Ω (9.3:1)	3+*j*2 Ω (>10:1)	5+*j*1 Ω
	28 MHz	5–*j*2 Ω (9.9:1)	<12.5 Ω (>6:1)	4±*j*3 Ω (12:1)	3–*j*4 Ω (>10:1)	5+*j*1 Ω
	50 MHz	–	<12.5 Ω (>6:1)	4±*j*5 Ω (12:1)	–	5+*j*2 Ω
25 Ω (2:1 SWR)	3.5 MHz	25–*j*1 Ω (2.0:1)	26 Ω (1.7:1)	23±*j*5 Ω (2.1:1)	24+*j*0 Ω	25+*j*0 Ω (2.0:1)
	14 MHz	25–*j*0 Ω (2.0:1)	27 Ω (1.8:1)	24±*j*2 Ω (2.0:1)	24+*j*0 Ω (2.0:1)	25+*j*0 Ω
	28 MHz	23+*j*0 Ω (2.2:1)	27 Ω (1.8:1)	23±*j*5 Ω (2.1:1)	25+*j*0 Ω (1.9:1)	25+*j*1 Ω
	50 MHz	–	27 Ω (1.8:1)	24±*j*6 Ω (2.1:1)	–	25+*j*1 Ω
100 Ω (2:1 SWR)	3.5 MHz	100–*j*0 Ω (2.0:1)	100 Ω (2.0:1)	99±*j*17 Ω (2.0:1)	108+*j*0 Ω	102–*j*1 Ω (2.0:1)
	14 MHz	97+*j*5 Ω (1.9:1)	100 Ω (2.0:1)	97±*j*10 Ω (2.0:1)	106+*j*0 Ω (2.0:1)	102–*j*5 Ω
	28 MHz	84+*j*0 Ω (1.7:1)	100 Ω (2.0:1)	95±*j*23 Ω (2.0:1)	102+*j*0 Ω (1.9:1)	101–*j*9 Ω
	50 MHz	–	100 Ω (2.0:1)	87±*j*32 Ω (2.0:1)	–	99–*j*15 Ω
200 Ω (4:1 SWR)	3.5 MHz	195–*j*16 Ω (3.9:1)	200 Ω (4.0:1)	185±*j*68 Ω (4.1:1)	210+*j*0 Ω (4.0:1)	200–*j*7 Ω
	14 MHz	170–*j*1 Ω (3.4:1)	200 Ω (4.0:1)	183±*j*0 Ω (3.8:1)	205+*j*0 Ω (3.9:1)	195–*j*20 Ω
	28 MHz	147–*j*3 Ω (2.9:1)	190 Ω (4.0:1)	156±*j*86 Ω (4.0:1)	173+*j*56 Ω (3.9:1)	189–*j*37 Ω
	50 MHz	–	190 Ω (4.0:1)	115±*j*98 Ω (3.9:1)	–	175–*j*60 Ω
1000 Ω (20:1 SWR)	3.5 MHz	900–*j*46 Ω (18:1)	>400 Ω (>6:1)	661±*j*743 Ω (27:1)	>600 Ω (>10:1)	978–*j*139 Ω
	14 MHz	590–*j*380 Ω (17:1)	>400 Ω (>6:1)	555±*j*368 Ω (19:1)	>600 Ω (>10:1)	781–*j*405 Ω
	28 MHz	420–*j*11 Ω (8.4:1)	>400 Ω (>6:1)	130±*j*409 Ω (25:1)	104–*j*449 Ω (>10:1)	502–*j*487 Ω
	50 MHz	–	>400 Ω (>6:1)	56±*j*258 Ω (24:1)	–	248–*j*417 Ω
50–*j*50 Ω (2.62:1 SWR)	3.5 MHz	50–*j*47 Ω (2.5:1)	80 Ω (2.3:1)	46±*j*47 Ω (2.5:1)	49–*j*47 Ω (2.5:1)	50–*j*46 Ω
	14 MHz	39–*j*41 Ω (2.5:1)	85 Ω (2.5:1)	63±*j*53 Ω (2.6:1)	44–*j*50 Ω (2.8:1)	48–*j*53 Ω
	28 MHz	55–*j*27 Ω (2.5:1)	80 Ω (1.7:1)	43±*j*45 Ω (2.3:1)	43–*j*43 Ω (2.6:1)	51–*j*48 Ω
50+*j*50 Ω (2.62:1 SWR)	3.5 MHz	54+*j*55 Ω (2.8:1)	80 Ω (2.4:1)	50±*j*51 Ω (2.6:1)	55+*j*50 Ω (2.6:1)	52+*j*50 Ω
	14 MHz	53+*j*54 Ω (2.7:1)	80 Ω (2.3:1)	60 ±*j*42 Ω (2.4:1)	60–*j*51 Ω (2.5:1)	55+*j*49 Ω
	28 MHz	52+*j*34 Ω (1.9:1)	80 Ω (2.3:1)	54±*j*50 Ω (2.6:1)	67+*j*53 Ω (2.5:1)	50+*j*49 Ω

[a]Magnitude of Z indication only, neither R nor X is reported. Readings are approximate as this model only has an analog scale.
[b]No reactance sign is provided, only magnitude.
[c]Only SWR is reported on 432 MHz range.
[d]The SWR loads constructed in the ARRL Lab were measured on an HP-8753C Network Analyzer by ARRL Technical Advisor John Grebenkemper, KI6WX.
[e]An HP-11593A precision termination was used for the 50 Ω tests. This termination has a low SWR from dc through the UHF range.
[f]The impedance of test loads other than 50 Ω are not accurate above 50 MHz.

Table 4

Antenna Analyzer Feature Comparison

Model	*Frequency Range*	*SWR*	*Z*	*R*	*X*	*±X**	*Freq Digits*	*Counter***	*Calculations*	*Price*
Autek VA1	0.44-34 MHz	15	Y	Y	Y	Y	4	N	Y	$199.95
MFJ-269	1.8-170, 415-470	31	Y	Y	Y	N	5	Y	Y	$359.95
BR-210	1.8-170 MHz	6	Y	N	N	N	5/6	N	N	$429.99
ZM-30	1-30 MHz	10	Y	Y	Y	Y	6/7	N	Y	$349.00

*Ability to determine sign of reactance.
**Frequency counter available for use independent of other analyzer functions.

few different analysis options. In addition, MFJ offers a number of lower priced units with reduced, but possibly sufficient, features depending on your requirements.

The '269 does have features! The '269 includes a built-in frequency counter, signal generator and impedance measurement system. The '269 has a VHF/UHF oriented Type N connector for load attachment. MFJ also provides a Type N to SO-239 connector adapter for the more common coax connections on HF and VHF. While the generator and counter are clearly designed with the antenna measurement function in mind, they can be used independently for receiver calibration or general measurement purposes. The generator output level is the highest of the group providing an advantage if measuring in heavy RF environments. A big plus for this MFJ unit is that all major results are visible at the same time. The two-line LCD display (in impedance measurement mode) simultaneously shows the frequency, R and X values and SWR. Analog meters also show the SWR and magnitude of impedance at the same time. While the digital readout provides more precision, the analog meter can be handy when tuning to find frequency of minimum SWR, or to adjust an antenna element length, for example.

The '269 covers the widest frequency range and the tuning is reasonably easy to set. Each band covers about a 2.5:1 frequency range and the knob covers this in three turns. There is no separate fine tuning, but I was able to adjust to any frequency I wanted without difficulty.

The '269 covers about the same set of derived functions discussed for the Autek unit, some with slight twists. For example, instead of determining the ¼ λ frequency, it can compute the "distance to a short or open" based on the same information. It also adds a few useful pieces of data, especially *reflection coefficient* and *return loss*. These "advanced modes" provide the requested output while still displaying frequency and SWR on the top line of the display. The analog meters still provide their output in advanced mode as well. Showing six pieces of information at the same time is a real plus.

The '269 will also calculate capacitance or inductance from its reactance measurement. Be careful, though—it can't tell which it is, so a given reactance can be converted to either a capacitance or inductance value, but obviously only one is right! If you are measuring a capacitor or inductor, you will know which calculation to make. If you are measuring an unknown load consisting of multiple parts—an antenna and a transmission line, for example—it won't always be easy to tell. The use of a small value capacitive or inductive reactance, compared to the measured reactance, in series with the load should be able to tell you which side you are on.

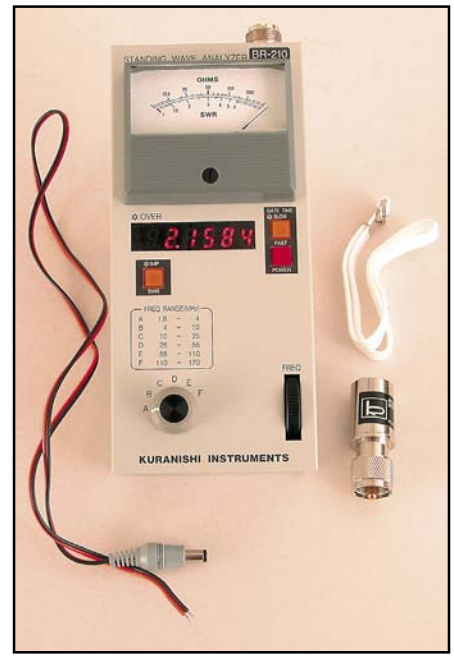
A well written 38 page manual thoroughly describes the operation of the unit and provides examples of applications.

The '269 operates on 10 internal AA size batteries or an external 12 V dc supply. A wall wart type power supply is offered as an option. By setting an internal switch, the '269 can run from NiCd batteries and recharge them from the external supply. For this function either the optional MFJ supply must be used, or an external supply providing 14-19 V is necessary. A 12 V supply will not charge the batteries. An additional function provided is *power saver mode*. Selecting this mode turns off the display and reduces power consumption by about 90% if you haven't changed anything for three minutes. A poke at the MODE or GATE button will revive it, right where you last left it. A LOW BATTERY indication is also provided.

Manufacturer: MFJ Enterprises, Inc, 300 Industrial Park Rd, Starkville, MS 39759; tel 800-647-1800; **www.mfjenterprises.com**. Price: MFJ-269, $359.95; MFJ-259B, $259.95; MFJ-1312D ac supply, $14.95; MFJ-731 tunable filter, $89.95; MFJ-762 step attenuator, $69.95.

KURANISHI INSTRUMENTS BR-210 STANDING WAVE ANALYZER

This analyzer appears to be a nicely made unit that has a more limited range of measurements available than the other units we looked at. It covers a wide frequency range in 2.5:1 bands and has a smooth thumb wheel providing for precisely adjustable tuning with about five turns to cover each range. The frequency is read out with a choice of two time bases, one reading to five digits and the other to six. The five digit position is easy to tune to, while the six digits requires very slow and careful movement to take



advantage of the available precision because of the delay between counts of the frequency counter.

The frequency is the only value shown on the LCD display. The other measurements are provided on a 2.5 inch meter that can read either SWR or impedance. Unlike the other units, this device only provides the impedance magnitude, not the vector components. The meter shows SWR values to 6:1 with some space above that point, but no additional numbers. The impedance scale is calibrated to 200 Ω in an easy to read geometric scale.

The instruction "manual" consists of four sheets of very rough translation into almost English. Fortunately, the operation of this unit is quite straightforward and most users should needed little coaching. A sample sentence that had us scratching our heads: "This machine works normally if '50 Ω' and '1:1' are directed respectively through the frequency is changed with the frequency cooking stove switch and the FREQ dial." There are some illustrations of applications included and they are fairly straightforward.

It seems clear that this unit is designed particularly for antenna and matching system adjustment and the taking of SWR data, and for those purposes the measurement data is likely enough for most users. One could also determine capacitor and inductor values by adjusting the frequency to obtain an on-scale impedance reading and calculating off line.

Manufacturer: Kuranishi Instruments, Japan. US distributor: NCG Co, 1275 N Grove St, Anaheim, CA 92806; tel 800-962-2611; **www.cometantenna.com** Price $429.99.

PALSTAR ZM-30 DIGITAL ANTENNA Z BRIDGE

The ZM-30 from Palstar is a brand new unit and has some unique features. This is an MF/HF only analyzer. It is the only unit that is completely digital, including the VFO, a DDS processor-based signal generator. Unlike the other units that have tuning rates that vary with frequency range, this unit can be set to change frequency down to less than 100 Hz per revolution at the smallest step size, (10 Hz steps) or up to 15 MHz per revolution at the highest—a very convenient arrangement.

While measuring impedance, one of its four modes, it shows four data elements on its LCD screen: frequency (to 10 Hz resolution), SWR, and real and imaginary parts of the impedance—*with* the sign of the reactance. There is a price to this, however. It determines the sign by shifting the frequency and noting the direction of change in reactance. This takes a short, but noticeable time, so changing frequency needs to be accomplished slowly for the display to keep up. As noted on Table 2, at one of our sample frequencies, with one of the complex loads, it computed the sign in error. The manufacturer was unable to resolve this before publication, so some caution should be used in taking these results at face value. The ZM-30 has a battery saving auto shut-off feature after 15 minutes.

The other three modes are inductance, capacitance and VFO. In the first two, you can make the measurements at any frequency you select, and I found quite a variation over frequency with some components in my junk box, which is good to know. The VFO mode is designed to put out an accurate frequency reference for calibration use, or actual transmitter or receiver frequency control. The fixed output is specified at ±2 V_{p-p}, or +10 dBm.

Other unique features of this unit include the ability to download software updates from the Palstar Web site through the serial connector on the unit and the ability to automatically scan across a selected frequency range, looking for a match. A successful search will be indicated on the display, or an audible alarm can be invoked.

I found the ZM-30 quite easy to work with and believe it will be a real contender for those who want a unit for HF only use. The ability to upgrade the software in the field naturally makes me think of features I'd like to see in future releases—one would be to have a choice in impedance mode as to whether the ZM-30 would calculate the sign of the reactance. It would be handy to be able to change frequency more quickly and then go back and spot check for sign as needed.

The ZM-30 is quite well equipped. It is provided with an ac adapter, a double-male BNC adapter and three BNC reference loads as well as a BNC terminated balun for measuring balanced feed line systems. If your antenna systems terminate in a PL-259 rather than a BNC connector, you will need to get an adapter such as the RadioShack 278-120. The descriptive and well written manual runs to 16 pages including calibration and download instructions as well as operation and applications.

Manufacturer: Palstar Inc, 9676 N Looney Rd, PO Box 1136, Piqua, OH 45356; tel 937-773-6255; fax 937-773-8003; **www.palstar.com**. Price: $349.

In Summary

Any of these analyzers could be a worthwhile addition to an Amateur Radio station, or RF laboratory for that matter. They all provide useful functionality but all have different features and specifications, so you'll want to compare your requirements carefully to the specifications and features. Some of the key parameters are described in Table 4. QST

Going Once, Going Twice...

In order to present the most objective reviews, ARRL purchases equipment off the shelf from dealers. ARRL receives no remuneration from anyone involved with the sale or manufacture of items presented in the Product Review, Short Takes or New Products columns—*Ed.*

The ARRL-purchased equipment listed below is for sale to the highest bidder. Prices quoted on the Web page are the minimum acceptable bids, and are discounted from the purchase prices. All equipment is sold without warranty except as noted.

Details of equipment offered and bidding instructions can be found on the ARRL members' Web page at **www.arrl.org/prauction**. The following items are available for bid in the May auction:

- ICOM IC-756ProIII HF/6 meter 100 W transceiver.
- Flex Radio SDR-1000 100 W software defined HF transceiver. Fully assembled with RF expansion chassis.
- Noise Cancellation Technologies Clear-Speech Line, line-level DSP processor.
- Alinco CJ-7T pocket sized VHF/UHF handheld transceiver.
- SGC MAC-200, 200 W auto antenna tuner and antenna control console.
- MFJ-991 Auto antenna tuner.
- West Mountain Radio CBA computerized battery analyzer with software.
- Comet CF-4160 HF to 2 M and 70 cm duplexer.

Weather Display

Reviewed by Stan Horzepa, WA1LOU
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Amateur Radio operators are a technical bunch and as a result, weather stations are another gizmo that are finding their way into more and more ham shacks. Among the APRS ham radio crowd, weather stations share a part of the ham radio RF.

With the proliferation of weather equipment in the ham radio world, we decided to check out a computer program called *Weather Display*, which bills itself as "*the* software to get the most from your weather station." My review of the software confirms that their claim is true.

I reviewed the *Windows* (Win95/98/2000/ME/XP/NT4) version of *Weather Display* (a *Linux* version is also available) on a laptop computer running *Windows 2000* and connected to a Peet Brothers Ultimeter 2100 weather station. In addition to Peet Brothers, the program supports weather stations from Dallas, Davis, Heathkit, La Crosse, Oregon Scientific, RadioShack, Texas Instruments and many others.

Getting Started

Weather Display is so easy to configure that I did not have to refer to any documentation to set up the software. All I did was use the program's setup wizards (select "Run a setup wizard" from the Setup menu). During the configuration, the setup wizards ask you to select units of measurement (US or metric), COM port information, your weather station model and its equipment information, weather station coordinates, program colors, graphing options, initial rainfall totals and any offsets required by weather station equipment.

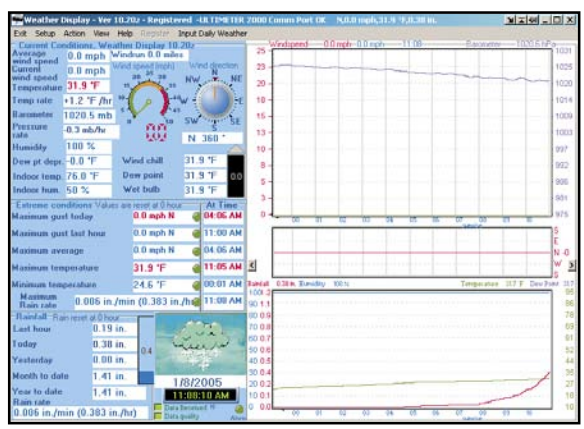
I used the default selections for most of the settings because I figured that I could go back and tweak the settings once I became more familiar with the software. Before running the wizards, make sure to determine your weather station's latitude and longitude (degrees, minutes, and seconds) and the weather station's height above sea level in meters, as you will have to input this information during the configuration.

Getting Connected

Connecting the computer and weather station was a simple 2-wire connection (weather station output and ground) from the Ultimeter 2100's serial port to a COM port on the laptop.

Initially, I selected the Ultimeter's 2100 "multiple output" mode to output data to the computer. The multiple output mode provides the weather data in three formats for the computer (the "data logger," "complete record" and "complete history" modes) and in a fourth format (the "packet mode").

I chose the multiple output mode because my APRS station's TNC was also connected to the 2100's serial port to transmit weather information into the local APRS network. Later, I did not need the "multiple output" mode because *Weather Display* can be optioned to output its own APRS packet data and pass it on to my APRS station's TNC via the second COM port of my laptop.



The main screen of *Weather Display* presents all the current weather data that a weather station can output (via a serial port connection).

In addition to outputting data for APRS packets, *Weather Display* may be optioned to output data to the Internet in various formats for various purposes. For example, you can option *Weather Display* to send weather data over the Internet to any variety of on-line weather entities like the Citizen's Weather Observer Program (CWOP; **www.wxqa.com/**). You can also build a Web site with *Weather Display* to display your weather station's data and option *Weather Display* to provide the weather data for that Web site. You can even add a Webcam to the system to display the weather outside your window in a window of your *Weather Display* Web site.

Getting Weather

The main window of *Weather Display* presents all the current weather data that your weather station has to show. The three left windowpanes display the current conditions, extreme conditions (today's high and lows) and rainfall information. There is also a graphic displaying what the software guesses how the weather looks outside your window. Clicking on any parameter in the extreme conditions windowpane displays a window showing additional high and low data information.

The right windowpanes of the main window display various weather parameters on an auto-scaling graph. On the fly, you can change the chunk of time that those graphs represent.

In addition to the main window, *Weather Display* provides a variety of other ways of displaying weather data by means of the Large Display, Weather Dials and Wind Dials windows. Large Display shows the current weather conditions using very large text (except for wind data which appears on dials). Weather Dials shows the current weather conditions using dials, virtual thermometers and graphs. Wind Dials is a subset of the Weather Dials display showing only the wind data.

Getting More

Weather Display has a huge list of features. Simply listing them here will fill this page; forget about describing them all.

This is an amazing piece of software that can do almost anything you want it to do. The problem is that the documentation is not as good as the software. Good thing that the software is easy to use, so you don't have to depend on the documentation to get things done. However, I encountered some bumps in the road that could have been avoided with better documentation. Note that there is a forum where issues about the software are worked out and the author of the software was quick to respond to an e-mail I sent him, so the documentation issue is far from being a maker or breaker when deciding whether to purchase *Weather Display*.

To see for yourself how good this software is, download a 30-day trial version of *Weather Display* from the software's Web site (**www.weather-display.com/**) and $70US will make your installation permanent. QST