

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

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

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!

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 Instruments 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



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 equivalent



Table 2
ARRL Laboratory Test Results of Four Antenna Analyzers

AUTEK VA1 VECTOR ANTENNA ANALYST

Manufacturer's Specifications

Frequency range: 0.5-32 MHz.
Impedance range: 0-1000 Ω .
Impedance accuracy: 20-200 Ω , typically 3-4%.
Warm-up drift: Not specified.
Output power: Not specified.
Power requirements: 80 mA (max), 9-12 V dc
Size (height, width, depth): 4.1"×2.6"×1.5"; weight, 8 ounces.

Measured in the ARRL Lab

0.44-34 MHz.
Wider than 5-1000 Ω .
See Table 3.
0.42% in 15 min.
0.75 mW (50 Ω).
70 mA max; measured at 9 V dc.

KURANISHI BR-210 STANDING WAVE ANALYZER, SERIAL NUMBER 001478

Manufacturer's Specifications

Frequency range: 1.8-170 MHz.
Impedance range: 12.5-300 Ω .
Warm-up drift: Not specified.
Output power: Not specified.
Power requirements: 160 mA, 8-12 V dc.
Size (height, width, depth): 7.0"×3.1"×1.8"; weight: 2.0 pounds (with batteries).

Measured in the ARRL Lab

1.5-172 MHz.
As specified.
0.1% in 15 min.
0.5 mW (50 Ω).
320 mA max,* measured at 12 V dc.

MFJ 269 HF/VHF/UHF SWR ANALYZER

Manufacturer's Specifications

Frequency range: 1.8-170, 415-470 MHz.
Impedance range: Not specified.
Warm-up drift: Not specified.
Output power: 20 mW (50 Ω).
Power requirements: 150 mA (HF/VHF), 250 mA (UHF), 11-18 V dc.
Size (height, width, depth): 6.8"×4.1"×2.4"; weight, not specified.

Measured in the ARRL Lab

1.8-175, 415-470 MHz.
>6-400 Ω .
0.03% in 15 min.
3.5 mW (50 Ω).
HF/VHF: 160 mA; UHF: 290 mA;
measured at 13.8 V dc.

PALSTAR ZM-30 DIGITAL ANTENNA Z BRIDGE

Manufacturer's Specifications

Frequency range: 1-30 MHz
Impedance range: 5-600 Ω .
SWR range: 1.0-9.9
Warm-up drift: Not specified.
Stability: 50 ppm.
Output power (50 Ω): 10 mW.
Power requirements: 200 mA, 9-16 V dc.
Size (height, width, depth): 5.8"×3.6"×2.1"; weight, not specified.

Measured in the ARRL Lab

As specified.**
As specified.
As specified.
0% in 15 min; Freq accuracy: 6 ppm.
1.0 mW (50 Ω).
210 mA, measured at 13.8 V dc.

*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 op-

eration 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.

lent resistance and reactance (in addition to the commonly available series values), frequency at which the cable is $1/4 \lambda$ 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 coarse. 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-j1 Ω (1.0:1)	51 Ω (1.0:1)	48±j0 Ω (1.0:1)	53+j0 Ω (1.0:1)	
	14 MHz	51-j1 Ω (1.0:1)	51 Ω (1.0:1)	48±j0 Ω (1.0:1)	52+j0 Ω (1.0:1)	
	28 MHz	58-j3 Ω (1.1:1)	50 Ω (1.0:1)	48±j0 Ω (1.0:1)	53+j0 Ω (1.0:1)	
	50 MHz	—	50 Ω (1.0:1)	48±j0 Ω (1.0:1)	—	
	144 MHz ^f	—	50 Ω (1.0:1)	48±j1 Ω (1.0:1)	—	
	432 MHz ^f	—	—	(1.1:1) ^c	—	
5.0 Ω (10:1 SWR)	3.5 MHz	5-j1 Ω (9.9:1)	<12.5 Ω (>6:1)	4±j2 Ω (12:1)	3+j2 Ω (>10:1)	5+j0 Ω
	14 MHz	6+j0 Ω (8.3:1)	<12.5 Ω (>6:1)	5±j0 Ω (9.3:1)	3+j2 Ω (>10:1)	5+j1 Ω
	28 MHz	5-j2 Ω (9.9:1)	<12.5 Ω (>6:1)	4±j3 Ω (12:1)	3-j4 Ω (>10:1)	5+j1 Ω
	50 MHz	—	<12.5 Ω (>6:1)	4±j5 Ω (12:1)	—	5+j2 Ω
25 Ω (2:1 SWR)	3.5 MHz	25-j1 Ω (2.0:1)	26 Ω (1.7:1)	23±j5 Ω (2.1:1)	24+j0 Ω	25+j0 Ω (2.0:1)
	14 MHz	25-j0 Ω (2.0:1)	27 Ω (1.8:1)	24±j2 Ω (2.0:1)	24+j0 Ω (2.0:1)	25+j0 Ω
	28 MHz	23+j0 Ω (2.2:1)	27 Ω (1.8:1)	23±j5 Ω (2.1:1)	25+j0 Ω (1.9:1)	25+j1 Ω
	50 MHz	—	27 Ω (1.8:1)	24±j6 Ω (2.1:1)	—	25+j1 Ω
100 Ω (2:1 SWR)	3.5 MHz	100-j0 Ω (2.0:1)	100 Ω (2.0:1)	99±j17 Ω (2.0:1)	108+j0 Ω	102-j1 Ω (2.0:1)
	14 MHz	97+j5 Ω (1.9:1)	100 Ω (2.0:1)	97±j10 Ω (2.0:1)	106+j0 Ω (2.0:1)	102-j5 Ω
	28 MHz	84+j0 Ω (1.7:1)	100 Ω (2.0:1)	95±j23 Ω (2.0:1)	102+j0 Ω (1.9:1)	101-j9 Ω
	50 MHz	—	100 Ω (2.0:1)	87±j32 Ω (2.0:1)	—	99-j15 Ω
200 Ω (4:1 SWR)	3.5 MHz	195-j16 Ω (3.9:1)	200 Ω (4.0:1)	185±j68 Ω (4.1:1)	210+j0 Ω (4.0:1)	200-j7 Ω
	14 MHz	170-j1 Ω (3.4:1)	200 Ω (4.0:1)	183±j0 Ω (3.8:1)	205+j0 Ω (3.9:1)	195-j20 Ω
	28 MHz	147-j3 Ω (2.9:1)	190 Ω (4.0:1)	156±j86 Ω (4.0:1)	173+j56 Ω (3.9:1)	189-j37 Ω
	50 MHz	—	190 Ω (4.0:1)	115±j98 Ω (3.9:1)	—	175-j60 Ω
1000 Ω (20:1 SWR)	3.5 MHz	900-j46 Ω (18:1)	>400 Ω (>6:1)	661±j743 Ω (27:1)	>600 Ω (>10:1)	978-j139 Ω
	14 MHz	590-j380 Ω (17:1)	>400 Ω (>6:1)	555±j368 Ω (19:1)	>600 Ω (>10:1)	781-j405 Ω
	28 MHz	420-j11 Ω (8.4:1)	>400 Ω (>6:1)	130±j409 Ω (25:1)	104-j449 Ω (>10:1)	502-j487 Ω
	50 MHz	—	>400 Ω (>6:1)	56±j258 Ω (24:1)	—	248-j417 Ω
50-j50 Ω (2.62:1 SWR)	3.5 MHz	50-j47 Ω (2.5:1)	80 Ω (2.3:1)	46±j47 Ω (2.5:1)	49-j47 Ω (2.5:1)	50-j46 Ω
	14 MHz	39-j41 Ω (2.5:1)	85 Ω (2.5:1)	63±j53 Ω (2.6:1)	44-j50 Ω (2.8:1)	48-j53 Ω
	28 MHz	55-j27 Ω (2.5:1)	80 Ω (1.7:1)	43±j45 Ω (2.3:1)	43-j43 Ω (2.6:1)	51-j48 Ω
50+j50 Ω (2.62:1 SWR)	3.5 MHz	54+j55 Ω (2.8:1)	80 Ω (2.4:1)	50±j51 Ω (2.6:1)	55+j50 Ω (2.6:1)	52+j50 Ω
	14 MHz	53+j54 Ω (2.7:1)	80 Ω (2.3:1)	60 ±j42 Ω (2.4:1)	60-j51 Ω (2.5:1)	55+j49 Ω
	28 MHz	52+j34 Ω (1.9:1)	80 Ω (2.3:1)	54±j50 Ω (2.6:1)	67+j53 Ω (2.5:1)	50+j49 Ω

^aMagnitude of Z indication only, neither R nor X is reported. Readings are approximate as this model only has an analog scale.

^bNo reactance sign is provided, only magnitude.

^cOnly SWR is reported on 432 MHz range.

^dThe SWR loads constructed in the ARRL Lab were measured on an HP-8753C Network Analyzer by ARRL Technical Advisor John Grebenkemper, KI6WX.

^eAn HP-11593A precision termination was used for the 50 Ω tests. This termination has a low SWR from dc through the UHF range.

^fThe 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	$\pm X^*$	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 $1/4 \lambda$ 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.

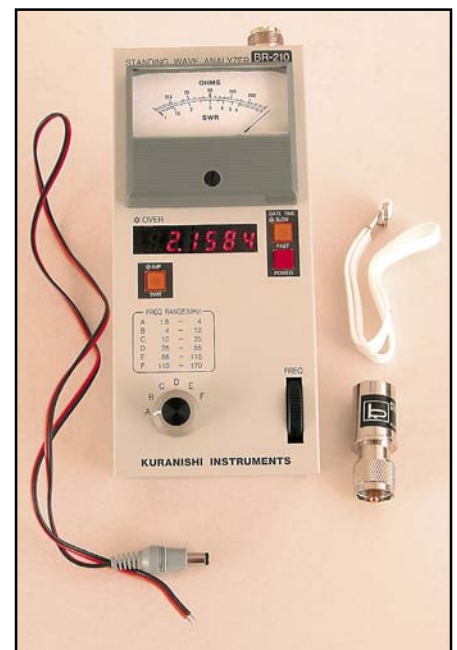
The '269 operates on 10 internal AA size batteries or an external 12 V dc supply. A wall wart type power supply is offered as an option. By setting an internal switch, the '269 can run from NiCd batteries and recharge them from the external supply. For this function either the optional MFJ supply must 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 need 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 $\pm 2 V_{p-p}$, 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.

