

indeed an older version and an updated copy was supplied. The new information now matches the schematic exactly.

Conclusions

DEM is still a leader in the high performance transverter market. I was particularly gratified by the extent to which DEM makes transverter integration a surprisingly easy task. I was also impressed with the careful RF design and the extensive filtering in this unit, which helped to reduce the amount

of interference from the many out-of-band signals at my location. Finally, the capability of having enough power to drive most big amplifiers without recourse to an intermediate amplifier is a real step forward. For someone like me going the transverter route, this unit would fit the ticket.

There was no huge E-skip opening while I was checking this transverter such as occurred while I was reviewing a different transverter last year, but conditions during the September VHF contest were better than

any in the last four years. Furthermore, while I was giving a talk in the Pacific Northwest on October 1 and 2, the East Coast enjoyed their best tropo opening in the past few years. So I look forward to testing more transverters in the future, as having one around seems to help propagation!

Manufacturer: Down East Microwave, 954 Rte 519, Frenchtown, NJ 08825; tel 908-996-3584; www.downeastmicrowave.com. Price: 144-28HP, \$589; 144-28, 25 W version, \$395; kits also available.

Array Solutions PowerMaster Wattmeter

*Reviewed by Mark Wilson, K1RO
Product Review Editor*

It's been more than 30 years since I put together my first ham station. It was a pretty simple station by today's standards—a Hammarlund HQ-180 receiver, Globe Chief transmitter, TR relay and a hand key. Once I had the basic equipment in hand, the experienced guys in the local radio club strongly suggested that I get an SWR/power meter as soon as possible. "You'll need it to prune your dipole," they said, "and to be sure the 807s in that old transmitter are really working." So I got a wattmeter and I've had at least one in my shack ever since.

Of course Amateur Radio has changed quite a bit. Transceivers and amplifiers and antenna tuners often have power/SWR meters built in. Transceivers don't have to be tuned up any more, and autotuners find the best match. We now have antenna analyzers to prune our antennas, and they give us more useful information about antennas and feed lines than our SWR meters ever did.

Even with the advances in equipment, a standalone wattmeter is still one of the most useful station accessories you can own. It provides independent verification of your transmitter power and SWR and may be more accurate than the built-in meters. Even if your transmitter or amplifier has a built-in power or SWR function, it may be shared with other metering functions and not available full time.

Hooking it Up

The Array Solutions PowerMaster con-



Table 2
Array Solutions PowerMaster Wattmeter, serial number 0143

Frequency Range	1.5-30, 50-54 MHz
Power Range	1-3005 W
Power Requirement	12-15 V dc, 600 mA
PEP Measurement	Active†

Actual Forward Power Frequency (MHz)	Indicated Peak Power (W)			
	2	14	28	50
5 W CW	5	5	5	4
5 W 50%	5	5	5	5
100 W CW	105	105	105	100
100 W 50%	105	105	105	101
100 W Two-Tone	—	97	—	—
1 kW CW	1010	970	950	‡
1 kW 50%	1040	1020	990	‡
1 kW Two-Tone	—	1005	—	—

SWR Accuracy

1:1 SWR	1:1	1:1	1:1	1:1
2:1 SWR	2:1	2:1	2:1	2:1
Insertion Loss (dB)	<0.1	<0.1	<0.1	<0.1

Notes

All data agrees with tolerances of both lab instruments and unit under test, see text.
 †For PEP monitoring, "Active" indicates that a circuit requiring external power is used.
 ‡An amplifier for 6 meters was not available at the time of testing.
 —Not measured.

Bottom Line

The Array Solutions PowerMaster is an accurate, expandable RF power meter that blurs the line between station accessory and precision test equipment.



Figure 3—The PowerMaster display and directional coupler are packaged separately.

sists of two boxes (see Figure 3). Micro-processor control circuitry and a large bright blue fluorescent display are housed in an attractive black box measuring about 3.5x8.25x4.25 inches. The directional coupler is in a separate box about 2.75 inches square and 6.5 inches long. Our coupler had SO-239 connectors, but you can order one with type N or 7/16 DIN connectors at extra cost.

Frequency coverage is 1.5-30 and 50-54 MHz with the standard coupler. The unit displays power from 1 to 3005 W in 1 W increments. A 10 kW version is also available. SWR is displayed to two decimal places from 1 to 99, but there's no SWR display if forward power is less than 5 W.

The 25 page instruction manual is easy to follow and well illustrated. Basic setup is pretty much like any other wattmeter. Connect the directional coupler close to your transmitter or amplifier antenna jack and connect the antenna feed line. Place the display unit wherever it's convenient and visible and connect it to a good quality 12 to 15 V, 600 mA supply. The display and coupler are connected with a shielded 6 foot cable that has 1/4 inch stereo phone plugs on each end. If you need a longer cable, it's no problem as long as you use a good quality shielded cable.

Not Just Another Wattmeter

With most other wattmeters, you would be finished with the setup and ready to check

your power and SWR. At this point you could do that with the PowerMaster, but you'd be missing out on several useful features.

The PowerMaster doesn't have an on/off switch. Apply dc power and the display cycles through a short startup sequence, shows the firmware version number, and is ready for operation. If you're not transmitting, the display will dim after 2 minutes and the unit will shut off after 10. Apply RF and it turns right back on. There's no RF power range switch either. Apply 5 W or 1500 W and the PowerMaster knows what to do.

Pressing MENU steps you through various parameters that can be changed by pressing the MODE SELECT button. During normal operation, the top line of the display shows VSWR (for example, V 1.67) and forward power (for example, 115 W). The bottom line is a bar graph that follows peak power with four menu selectable ranges from 50/250/1250 W to 400/2000/3000 W. Another menu selects between display of forward power only or "net power" (forward power minus reverse power).

Three of the four modes simply adjust peak reading response time. F (fast) holds peak power for 0.2 second, M (medium) is 1 second and S (slow) is 2 seconds. In the V mode, the bar graph displays SWR rather than peak power. This is really useful when you're adjusting an antenna tuner and looking for minimum SWR.

The PowerMaster includes several alarm functions that flash LEDs on the front panel

and activate relays you can connect to external equipment via the POWER MONITOR ALARM, PTT IN and PTT OUT jacks on the rear panel. The POWER MONITOR ALARM jack can be used to activate an audible or visible alarm, while the PTT jacks can be used to interrupt the amplifier key line or apply an ALC voltage to shut the amplifier down in case of a problem.

Various menus allow you to set alarm trip points for high SWR, high power or low power and choose whether an alarm condition activates the alarm relays or just flashes a warning on the LEDs. The alarms are a nice touch that can help protect your expensive power amplifier in case of a serious antenna or feed system malfunction.

Software

After you've had a chance to try the options and menus on the display unit, it's worth booting up your computer and checking out the *PowerMaster Lite* software CD-ROM. After installation you can set up the communications parameters with the software's PROGRAM SETTINGS menu, but in my case it worked perfectly with the default settings. The PowerMaster display unit connects to a serial port on your computer with a standard DB9 cable. (If you don't have a serial port, there's information about USB-to-serial adapters on the Array Solutions Web site).

From the METER SETTINGS menu (Figure 4), you can set any of the parameters that you can set from the display unit's front panel. The software is actually a bit more convenient because you can see all the parameters at once. You can also program the software and display unit to show your call sign or a name up to 16 characters. This would be especially useful if you have several wattmeters in your station and want to know at a glance which is which. You can also quickly access menus for some commonly used functions by right-clicking on the meter face.

Figure 5 shows the *PowerMaster Lite* display during normal operation. It includes bar graphs and numerical displays for forward and reflected power as well as a numerical display for SWR. The MODE buttons (fast,



Figure 4—You can adjust a number of parameters and download firmware updates using the *PowerMaster Lite* software's METER SETUP screen.



Figure 5—During normal operation the software displays both bar graphs and numerical readings for forward power (50 W) and reflected power (0 W) and a numerical reading for SWR (1.04:1). In this case, the forward power is displayed in red because the low power alarm has tripped.

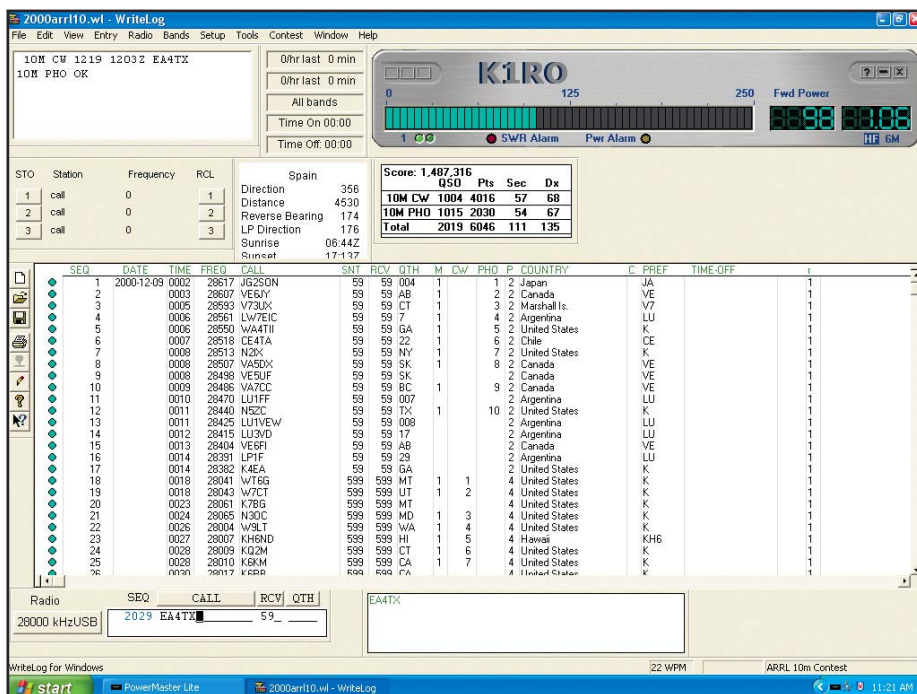


Figure 6—PowerMaster Lite also has a compact display mode that is convenient when you want to display power and SWR readings while using other software. In this case PowerMaster Lite occupies the upper right corner of a computer screen primarily dedicated to contest logging software.

medium, slow display update and VSWR) are along the right hand side. Clicking the VSWR button changes the screen to show a bar graph for SWR as well as numerical displays of forward power and SWR, much like the V mode on the display unit. Note that not all buttons are labeled on screen, but labels pop up when you run the mouse cursor over the button.

Double-click the onscreen meter face it changes to a compact display with a bar graph (forward power in blue, reflected in red), numerical displays of forward power and SWR, and indicators for the SWR and power alarms. As shown in Figure 6, you can keep the PowerMaster readings in sight even when you're concentrating on other things like entering information into a logging program.

Upgrades on Tap

The software also includes one of the PowerMaster's most powerful features—the ability to load new firmware into the display unit. Even though our PowerMaster had the latest firmware, I was curious to see how it worked. This process is relatively painless if you follow the directions in the manual. First, I went online and downloaded the firmware update ZIP file. Next I extracted and ran the enclosed file (*PM01002.exe*), which created the file that's actually used for the update (*PM01002.crh*). Next I went to the METER SETTINGS screen in *PowerMaster Lite* and clicked on UPDATES. This activated a wizard that took me through the steps necessary to download the firmware update to the display unit. The process probably sounds a

bit complicated, but it really only took a few minutes to do.

The ability to easily update the software and firmware means that your PowerMaster won't be frozen in time. You can add features and capabilities as they become available. Version 2.0 was introduced during the review period, and it added the high power alarm and power display (forward only or net) menus.

Accuracy

The PowerMaster's accuracy is specified at better than $\pm 5\%$, which is hard to achieve over a broad range of frequencies and power levels. Array Solutions spent some effort in learning about power measurement techniques and coupler design, and the results show it. Most wattmeters that we've tested do fine in the center of their frequency range but often fall off at the edges. Or they do fine at 1000 W but not 5 W. Or they have difficulty with PEP measurements. This one does well in all of the tests.

Array Solutions calibrates each coupler with a calibrated HP 436A microwattmeter and Bird attenuator, which is pretty much the same way we check power accuracy in the ARRL Lab (we use an HP 437B). Each coupler has a sticker with calibration settings for forward and reverse power for HF and 50 MHz. These numbers can range from +15% to -10% and are entered in the FORWARD POWER TRIM and REVERSE POWER TRIM menus or via the software. On our coupler, the trim settings were 0 for HF, +5 for 50 MHz forward and +8 for 50 MHz reverse. With the latest version of the *Powermaster Lite* soft-

ware, you can switch between stored HF and 50 MHz settings with a mouse click.

As shown in Table 2, the PowerMaster is quite accurate over a range of frequencies, power levels and signal types. The test signals include key down CW, CW at a 50% duty cycle (60 WPM dits) and two tone (PEP). The HP microwattmeters themselves are rated at $\pm 5\%$ accuracy, so any variations are well within measurement tolerances. During the PEP testing we discovered that the PowerMaster is more accurate for PEP measurements than the Bird 4381 computing wattmeter we normally use for comparison. The Bird's spec is $\pm 8\%$ of full scale for PEP measurements. The Lab used its HP microwattmeter and the 14 MHz 2-tone test fixture that we use to check amplifier IMD to verify the measurements. The PowerMaster was pretty much right on the money.

Array Solutions has announced the availability of couplers for VHF/UHF bands. That expandability, coupled with continuing improvements in firmware and software, makes the PowerMaster a great choice for many Amateur Radio stations. Its accuracy across a range of frequency and power ranges often reserved for lab equipment, not station accessories. The PowerMaster is FCC (A and B) and CE Mark certified, and is warranted for two years.

Manufacturer: Array Solutions, 350 Gloria Rd, Sunnyvale, TX 75182; tel 972-203-2008; e-mail sales@arraysolutions.com; www.arraysolutions.com. Price: \$400.

Going Once, Going Twice...

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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 January auction:

- Palstar ZM-30 Digital Antenna Z Bridge.
- C.A.T.S RD-1800 antenna rotator and controller.
- Diamond SX20C wattmeter.
- FlexRadio SDR-1000 transceiver.
- FT-8800R VHF/UHF mobile FM transceiver.
- Rig Expert Plus USB-transceiver interface.