Telewave 44A RF wattmeter
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Introduction

The Telewave 44A is a bi-directional RF wattmeter that directly measures forward and reflected power in a coaxial line. It is similar in construction, size and functionality to the popular Bird 43 thru-line wattmeter. However, the Telewave 44A includes both a wide-band coupler and a high dynamic range power sensor so it does not require the use of inserts to cover its full power- and frequency range. The meter movement can be turned off for rough handling when not in use. And rubber feet on the back and bottom, and a leather carrying strap permit convenience in mounting and transporting.

Figure 1: Telewave 44AP Front Panel

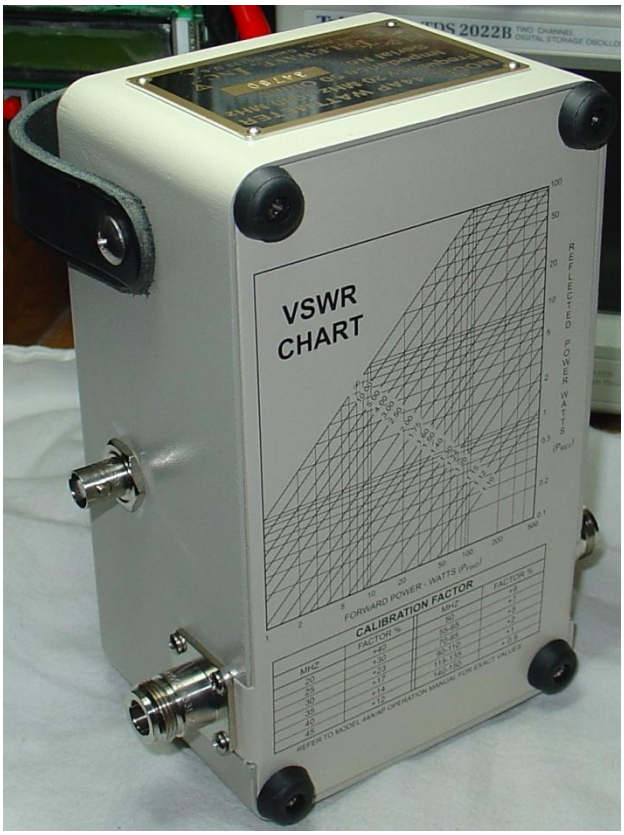

Figure 2: Rear with VSWR & Correction charts.

The Telewave 44AP reviewed here includes a BNC RF sampling port that is coupled nominally 40 dB below the transmission line level. This coupled port may be used to inject a signal into a unit under test, or for frequency measurement and/or spectrum analysis. Normal operation of the 44AP is unaffected when using this coupled port.

Some Operational Details

The Telewave 44A is not a peak-reading instrument. Its precision directional coupler and detectors sample forward and reverse continuous current which is then scaled to drive an analog, multi-scaled meter. Forward and reflected power is displayed by selecting FWD or REV on the front-panel switch. VSWR is determined by using the chart on the back of the instrument, or the

equation provided in the manual. The five power scales provide for testing most transmitters from QRP levels to 500 watts. Table 1 lists the 44A specifications.

Table 1: Specifications, Telewave 44AP, and measurement summary

Parameter	Specification	Test Results
Frequency range	20-1000 MHz	As specified
Full-scale power ranges	5, 15, 50, 150 and 500 watts	As specified
Accuracy:	20-150 MHz ± 6% of full scale after correction 150-1000 MHz± 6% of full scale w/N connectors. UHF connectors reduce accuracy 400-1000 MHz.	See Table 2
Impedance, primary line	50 ohms	As specified
VSWR(max)	1.1:1	Spec met to 800MHz. See Figure 3
Insertion Loss	0.1 dB maximum	Spec met to 370MHz. See Figure 4
RF sample port coupling	(44AP) -40 dB +/-2 dB below total power	Spec met 100-1000MHz. See Figure 5
Quick Change Connectors	Std N-Female, Optional UHF, DIN, TNC, BNC	
Sample port connector	(44AP) BNC-Female	
Dimensions (HWD)	6.625 x 4 x 3.25" (168.3 x 101.6 x 82.6mm)	
Weight lbs (kg)	3 (1.3)	

Detailed Testing Results

Table 2 details the power measuring tests. The actual measurements (Pact) were made with a NIST-traceable MiniCircuits PWR-6GHS+ power sensor and calibrated attenuators. The Telewave 44A measured power values include the correction factors from the Figure 7-2 curve in the manual. The correction values applied are +39% at 21MHz, +9.5% at 50MHz, and 0% from 144MHz and up. I used the scales that gave the maximum reading achievable with the equipment I had available. As you might expect, the greatest error occurs on the lowest frequency where the correction factor is changing rapidly.

Table 2: Telewave 44A RF Wattmeter, Serial Number SN34780 Power Measurements

	5W Range			15W Range			50W Range			150W Range		
Frequency	Pact	P44A	Error	Pact	P44A	Error	Pact	P44A	Error	Pact	P44A	Error
21MHz	5.0	5.4	+8%	15	16.7	+11%	50	55.6	+11%	100	111	+11%
50MHz	5.0	4.9	-2%	15.0	14.8	-1%	50	49	-2%	97	95	-2%
146MHz	4.7	4.5	-4%		-		49	47	-4%		-	
220MHz		-		11	11	0%	27	27	0%	53	53	0%
450MHz	4.0	4.0	0%	8.2	8.2	0%	43.5	43.5	0%		-	

Next I measured SWR accuracy. For this I used 4.8dB (2:1 SWR) and 3dB (3:1 SWR) microwave attenuators with open-circuit and short-circuit outputs so as to provide both low impedance and high impedance SWR loads. The loads were measured on an Array Solutions VNAuhf. The load measurements are tabulated in Table 3.

Table 3: LoZ and HiZ 2:1 and 3:1 SWR load measurements

Frequency	2:1 VSWR LoZ	2:1 VSWR HiZ	3:1 VSWR LoZ	3:1 VSWR HiZ
21MHz	2.00	2.02	3.14	3.00

50MHz	2.00	2.03	3.13	2.99
146MHz	1.99	2.01	3.13	2.99
220MHz	1.97	2.01	3.14	2.96
450MHz	2.04	2.03	3.09	2.87

Table 3 lists the Telewave 44AP measured SWR data when terminated with the mismatches described above. As in the power measurements, 44AP meter scales were used that gave the largest meter deflection. As you can see, the SWR determined from the forward and reflected power readings are reasonably accurate.

Table 3: Telewave 44A RF Wattmeter, Serial Number SN34780 SWR Measurements

	2:1 VSWR LoZ			2:1 VSWR HiZ			3:1 VSWR LoZ			3:1 VSWR HiZ		
Frequency	Pf	Pr	SWR	Pf	Pr	SWR	Pf	Pr	SWR	Pf	Pr	SWR
21MHz	21	1.5	1.73	22.5	3.75	2.38	20	3.7	2.51	22.5	7	3.52
50MHz	23	2	1.84	27	4	2.25	22.5	4.25	2.54	27.5	8.5	3.50
146MHz	13.5	2.3	2.41	11	1.2	1.99	11	3	3.19	12	3.6	3.42
220MHz	12.5	1	1.79	14	2.5	2.46	13	4	3.49	14	3.5	3.00
450MHz	10	1.3	2.13	12	2	2.38	12	3.25	3.17	9	2	2.78

Next the 44AP was terminated in a precision 50 ohm load (load return loss >30dB). The input SWR was measured with an Array Solutions VNAuhf, and the plot is shown in Figure 3. The 44AP meets its 1.1:1 SWR spec to about 800 MHz. It degrades to about 1.27:1 at 1000MHz.

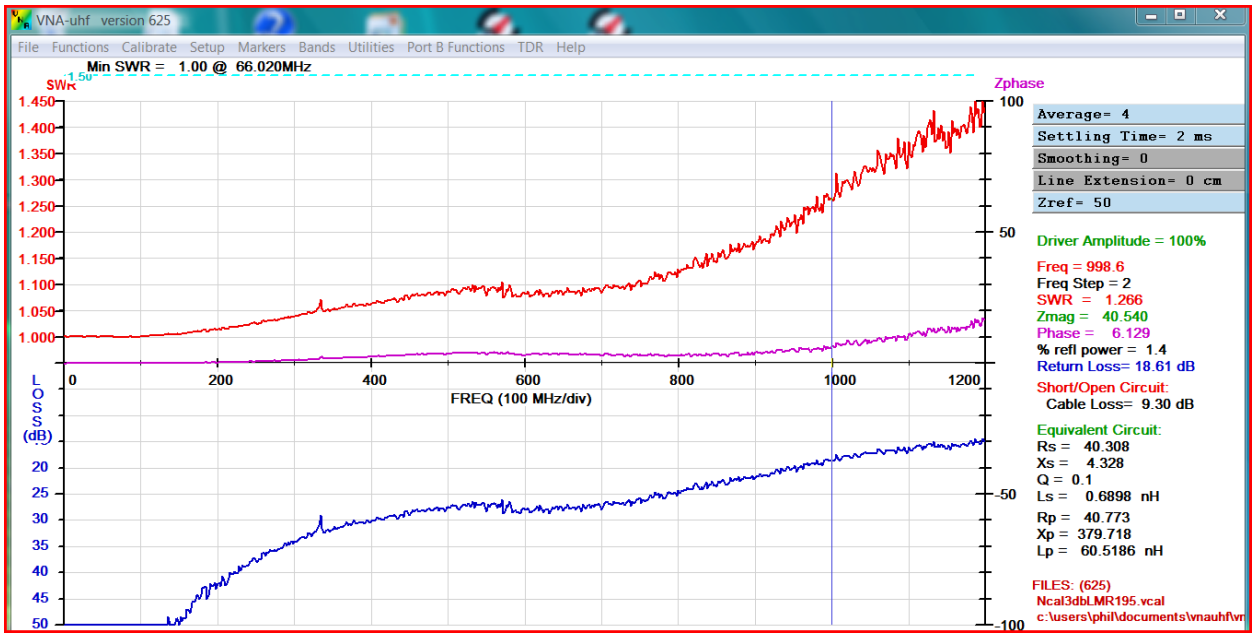

Figure 3: 44AP input SWR and return loss when terminated in a precision 50 ohm load

Figure 4 is a scan of insertion loss. The 0.1dB insertion loss spec is met to about 370MHz. Insertion loss degrades to about 0.60dB at 1000 MHz.

Figure 4: Insertion loss of the Telewave 44AP

The final test was a check of the coupled port. This plot is given in Figure 5. The 40dB ±2dB spec is met from 100-1000MHz. Below 100MHz the coupling increases rapidly, dropping to about 55dB at 21MHz.

Figure 5: Telewave 44AP coupled port measurement

A few comments on measurement accuracy

The Telewave 44A uses an analog meter so there may be some parallax error when reading it. The readings must also be interpreted when they don't fall exactly on a meter mark, keeping in mind that power markings are divided into 5ths on some power ranges, and fourths on other

power ranges. And below 150 MHz you must apply a correction factor that is read from a relatively coarse graph that changes rapidly below 100MHz. However, the bottom line is that the Telewave 44A is accurate enough for most transmit power and transmission line/antenna measurements.

Conclusion

The Telewave 44A is a compact, self-powered thru-line wattmeter that provides a wide measuring power range along with wide frequency coverage. While it is easiest to read when measuring transmitters and antenna systems from 140-1000MHz, it can be used down to 20MHz by adding in a correction factor.

Available Models

Model 44A Broadband Wattmeter, 20 MHz to 1000 MHz
Model 44AP Broadband Wattmeter, 20 MHz to 1000 MHz, -40 dBc sampling port
Model 44L1 Low Frequency Broadband Wattmeter, 2 MHz to 200 MHz
Model 44L1P Low Frequency Broadband Wattmeter, 2 MHz to 200 MHz, -40 dBc sampling port

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