Measuring the power of the ShareWave Radio
2/16/99

The transmit power for the ShareWave radio was measured by several methods previously. Generally the average power is powered using a thermistor type probe. The peak power is measured using a peak power meter. The object of this report is to obtain the measurement of the peak power.

Initial measurements from Elliot Labs listed below is 19.4 dBm.
The meter used by Elliot labs was an HP432 with 478A Thermistor Probe, first measured on 9/10/98.

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To determine the peak power, several factors need to be considered.

- The packet duty cycle.
- The sinusoidal cresting factor.
- Multiple symbol power levels.
- Compound ringing caused by baseband filtering and turn-on overshoot.

Using 19.4 dBm (87.1 mW) as the average power over time, the average power during the transmit 'on' time can be found using the duty cycle factor. The transmit 'on' time for the above measurements is 2000 uS. The time between packets (receive mode) is 650 uS. The duty cycle factor is 2650 / 2000 = 1.325.
Given this, the power during transmit is 87.1 mW * 1.325 = 115.4 mW (20.62 dBm).

Using the sinusoidal cresting factor to calculate the peak power, based on the relationship of peak to average power of a sine wave, we get an additional 3 dBm.
This gives a peak power of 23.62dBm.

The additional power due to symbol power level can be shown by the waveform pictures below. The peak to average symbol power ratio is 1.25:1 for the Harris 3724 modulator. In dB this is 1.0 dB, above the peak.
This gives a power of 24.62 dBm.
This can also be shown below:

The power was measured using a Gigatronics 8541 Universal Power Meter with the 80350A Peak Power Sensor and a 20 dB attenuator, M/ACom p/n 2082-6043-20. The sensor has a detector monitor port that can be connected to an oscilloscope.

The two attached waveforms show that the power fluctuates with packet data. Wav1.bmp shows the peak levels stored as highest shaded area. (An infrequent peak shown at the leading edge due to transient overshoot is not being considered.) Wav2.bmp is an expanded time scale of the same waveform showing the variations in power over a longer period.
A cursor line on wav1.bmp labeled Av shows the peak voltage as 0.2364V (top of stored shaded area).

The Attached Excel Spreadsheet shows the voltage to peak power relationship for the Gigatronics sensor. For the Av voltage of 0.236 Volts the peak power is 24.76 dBm. (with the 20 dB attenuator).

This agrees with the 1.25:1 (1.0 dB) peak to average ratio.

Conclusion
Given an average power of 19.4 dBm over many packets the peak power is 24.62 dBm
A measurement using a peak power meter confirms the results to within acceptable limits.

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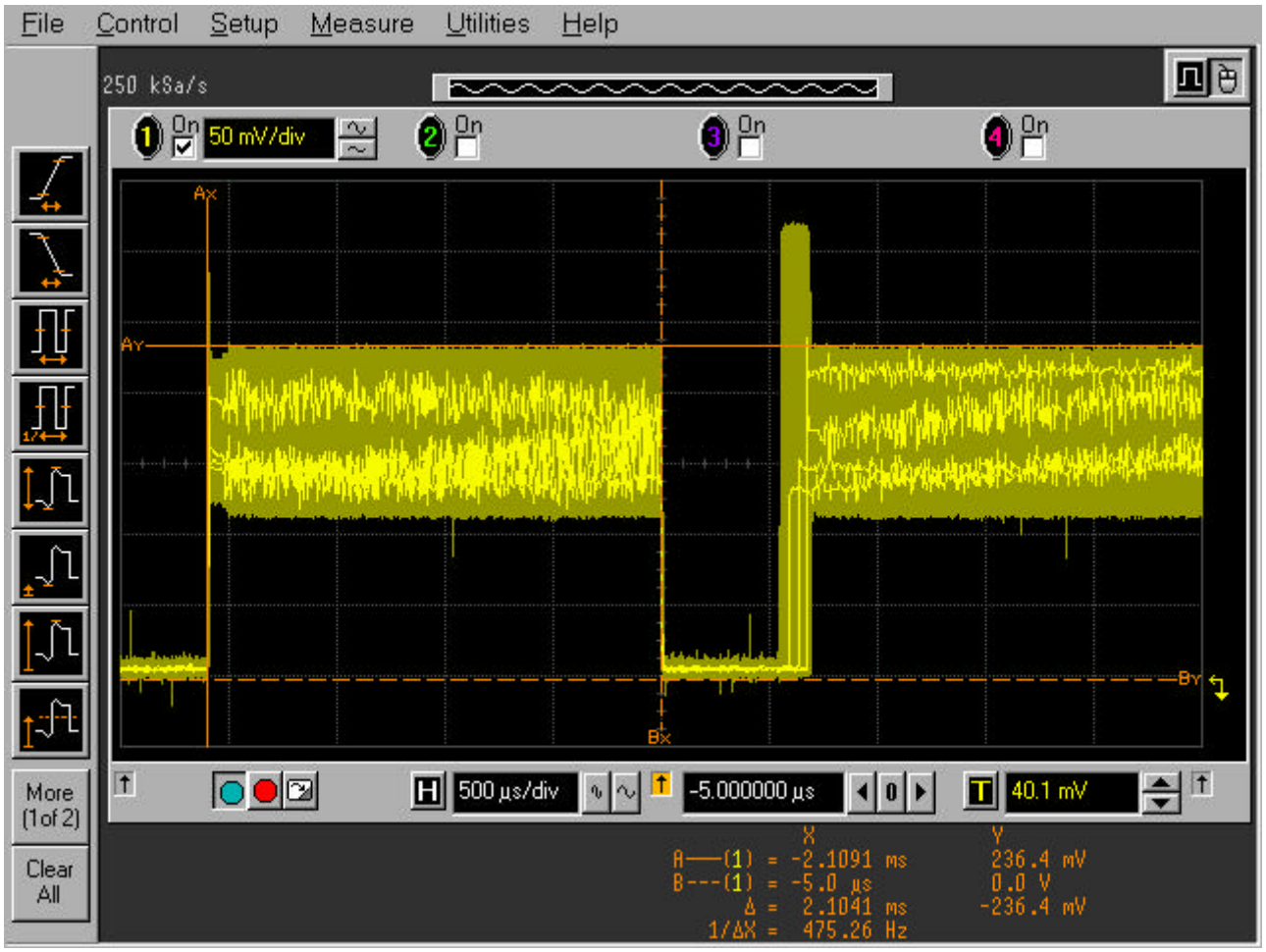
File
Control
Setup
Measure
Utilities
Help
250 kSa/s
1 On
50 mV/div
2 On
3 On
4 On
Ax
Ay
Bx
By
More (1 of 2)
Clear All
500 µs/div
-5.000000 µs
40.1 mV
X
Y
A—(1) = -2.1091 ms
236.4 mV
B---(1) = -5.0 µs
0.0 V
Δ = 2.1041 ms
-236.4 mV
1/ΔX = 475.26 Hz


File
Control
Setup
Measure
Utilities
Help
25.0 kSa/s
1 On
50 mV/div
2 On
3 On
4 On
Ax
Ay
Bx
By
More (1 of 2)
Clear All
5.00 ms/div
-5.000000 µs
40.1 mV
X
Y
A—(1) = -2.109 ms
236.4 mV
B---(1) = -5 µs
0.0 V
Δ = 2.104 ms
-236.4 mV
1/ΔX = 475.3 Hz

Detector Voltage	Power Level [dBm]	Calculated Power [dBm]
116	0	0.063466133
126	0.5	0.545080808
136	1	1.008063055
146	1.5	1.45313624
158	2	1.964579806
170	2.5	2.45244698
184	3	2.993375931
196	3.5	3.434104749
212	4	3.990806617
228	4.5	4.514440007
244	5	5.007405736
262	5.5	5.528194288
278	6	5.963501357
300	6.5	6.523568994
322	7	7.043702866
344	7.5	7.528650093
368	8	8.022697262
394	8.5	8.522565906
422	9	9.02638347
450	9.5	9.500752722
480	10	9.982619559
512	10.5	10.47267997
544	11	10.94316471
580	11.5	11.45353618
620	12	12.0001643
660	12.5	12.52518235
700	13	13.02465646
745	13.5	13.54606531
795	14	14.0545384
845	14.5	14.45653044

Enter the Voltage

236

The Output Power [dBm]

4.764610226

The True Power

24.76461023 dBm

PL = 20