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Using Sun Noise Measurements to Evaluate System Performance

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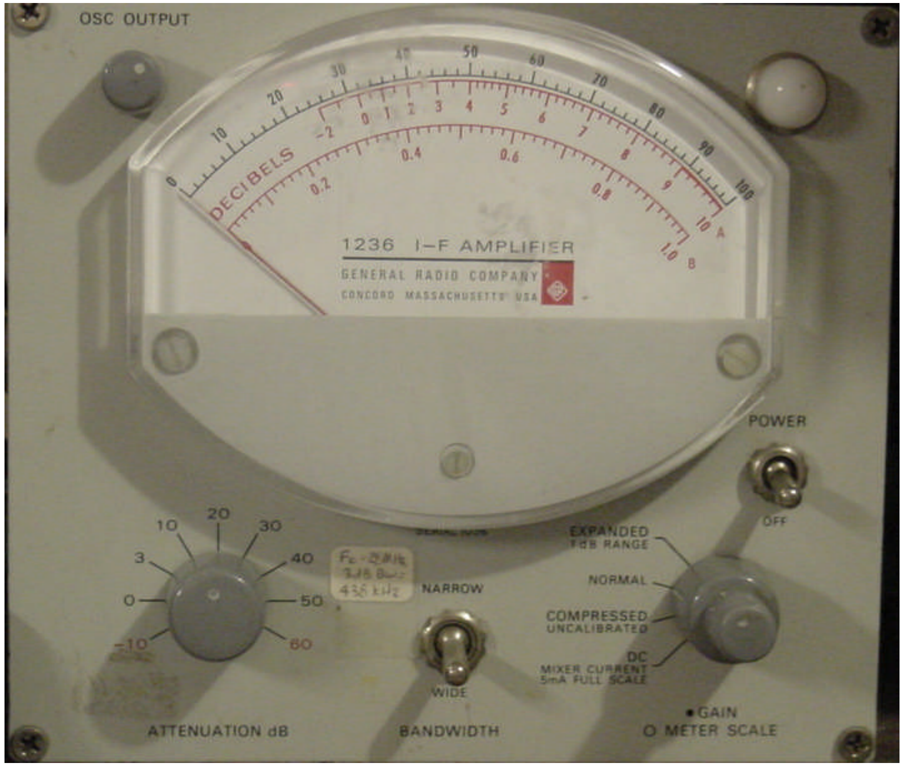
W5LUA

March 3, 2012

GR-1216 & GR-1236 IF Amplifiers



These meters provide a 30 MHz IF amplifier with up to several MHz of bandwidth which makes it easy to measure sun and moon noise – they can be easily retuned for 28 MHz

How do we compare sun noise readings?

Converting (S+N)/N to S/N

$$\frac{S+N}{N} = \frac{S}{N} + 1$$

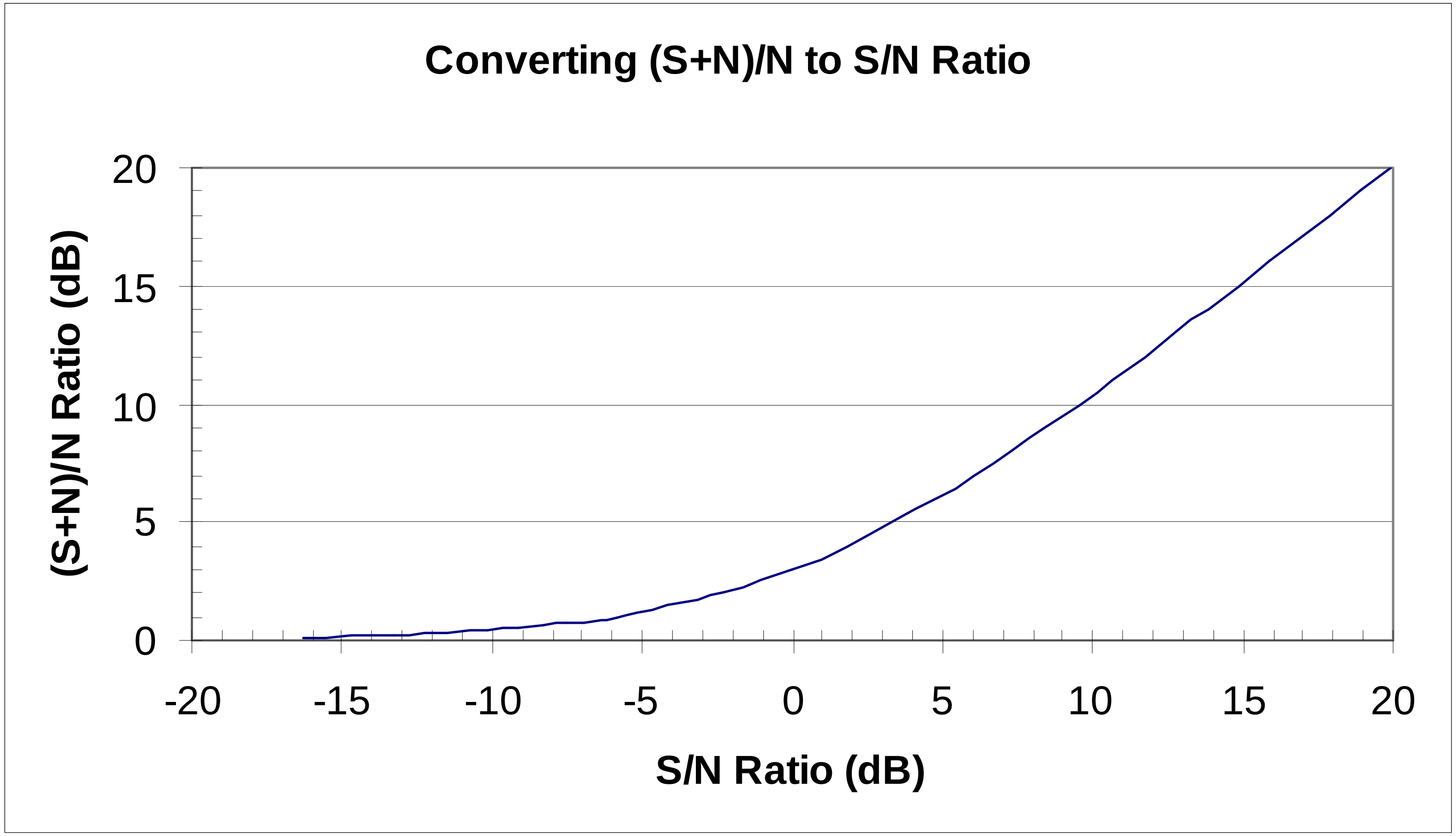
$$\text{Therefore } \frac{S}{N} = \frac{S+N}{N} - 1$$

Convert dBs to ratios, then substitute in equations

(S+N)/N	S/N
20 dB	19.96 dB
10 dB	9.54 dB
7 dB	6.03 dB
5 dB	3.35 dB
3 dB	-0.02 dB
2 dB	-2.33 dB
1 dB	-5.87 dB

Since we have very low sky noise on the microwave bands, we measure our sun noise and moon noise over cold sky. When comparing sun noise readings among amateurs with different systems in order to determine one’s performance versus someone else, it is common place to compare these readings. At low S meter readings the measured level is actually signal plus noise and when we compare it to the noise level we must first convert (S+N)/N to S/N before making relative dB comparisons

Converting (S+N)/N to S/N Ratio



Converting (S+N)/N to S/N Ratio Expanded Scale

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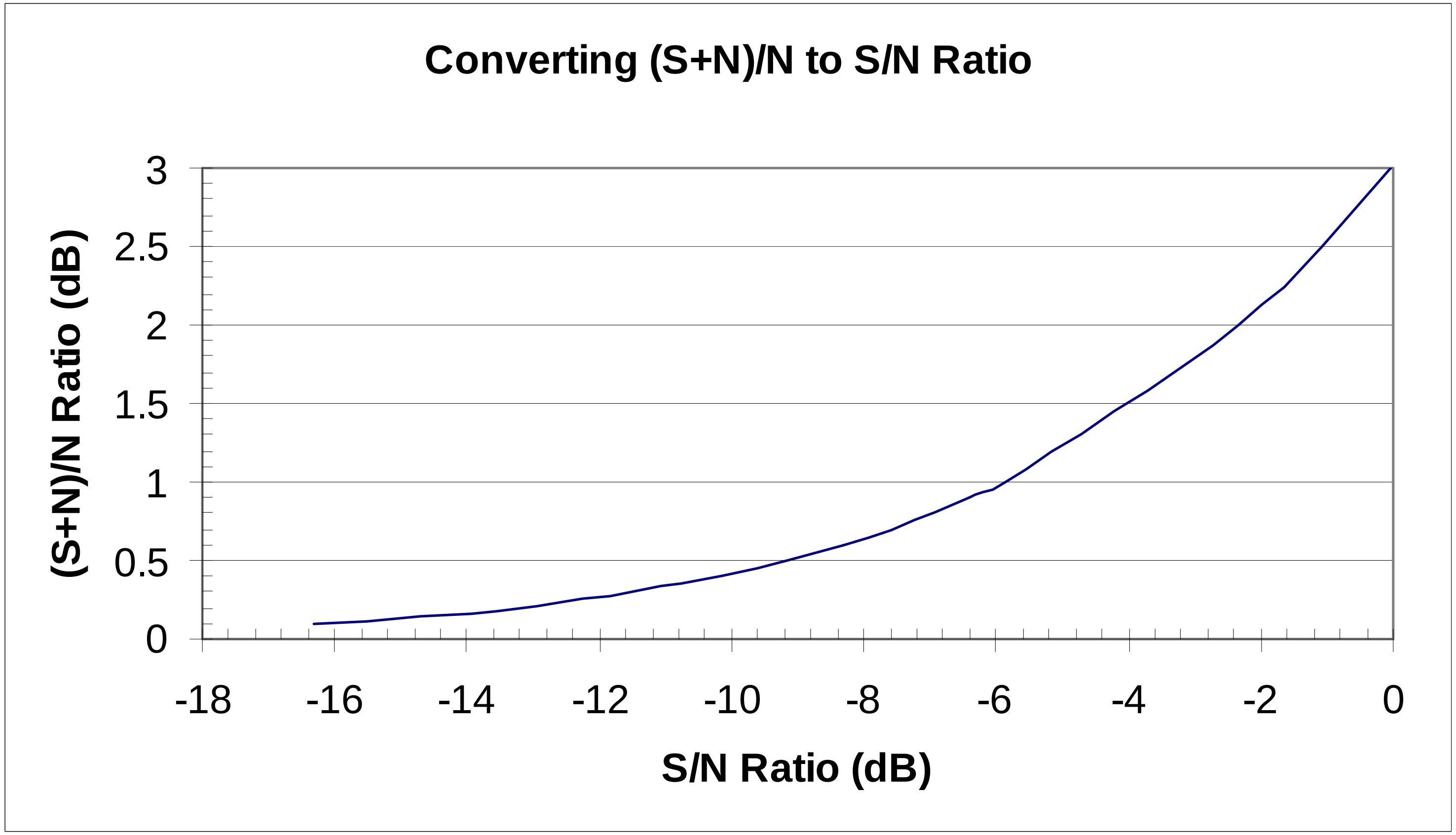

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Example #1 & #2

Converting (S+N)/N to S/N

$$\frac{S+N}{N} = \frac{S}{N} + 1$$

Therefore $$\frac{S}{N} = \frac{S+N}{N} - 1$$

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If station A is measuring 20 dB of sun noise and station B is measuring only 10 dB of sun noise then the difference is 19.96 - 9.54 = 10.42 dB or a change in sensitivity of 10.42 dB.

Now comparing station C who is receiving 10 dB of sun noise to station D who is receiving only 3 dB of sun noise then the difference is 9.54 - -.02 = 9.56 dB or a change in sensitivity of still nearly 10 dB for a 7 dB drop in sun noise.

Example #3

Example

Ant 1 Sun Noise = 2 dB
Ant 2 Sun Noise = 4 dB
Is the gain difference 2 dB or something else?

Convert each sun noise reading from (S+N)/N to S/N in dB

(S+N)/N = S/N + N/N
= S/N + 1
or S/N = (S+N)/N - 1

$$10^{\left(2dB/10\right)} - 1 = .585$$

Ant 1

$$10\log(.585) = -2.33dB$$

$$10^{\left(4dB/10\right)} - 1 = 1.5119$$

Ant 2

$$10\log(1.5119) = 1.80dB$$

$$1.80dB - (-2.33dB) = 4.13dB$$

Gain Difference in dB

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Sun Noise Measurements at 24 GHz – May 2001

DISH	Sun Noise Over Cold Sky (S+N)/N	Conversion To S/N	Delta Gain Compared to 12 in. Reference Dish	Theoretical Gain	Gain Based on 12 in Reference Dish	Theoretical 3 dB Beamwidth
12 in. Commercial	1.5 dB	-3.84 dB	0 dB	35.5 dBi	Reference	2.85^{o}
24 in. MACOM	4.2 dB	2.12 dB	5.96 dB	41.5 dBi	41.5 dBi	1.45^{o}
24 in. PCOM	3.8 dB	1.46 dB	5.3 dB	41.5 dBi	40.8 dBi	1.45^{o}
24 in. Ku with W5ZN 10/24 GHz Dual Band Feed, F/D=.375	4.0 dB	1.80 dB	5.64 dB	41.5 dBi	41.1 dBi	1.45^{o}
55 in. .solid with W5ZN 10/24 GHz Dual Band Feed, F/D=0.3	5.6 dB	4.2 dB	8.04 dB	48.5 dBi	43.5 dBi	0.63^{o}

Receiver Noise Figure = 2.4 dB, Solar Flux 175

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K5SO Sun Noise Chart for 1296 MHz vs Solar Flux

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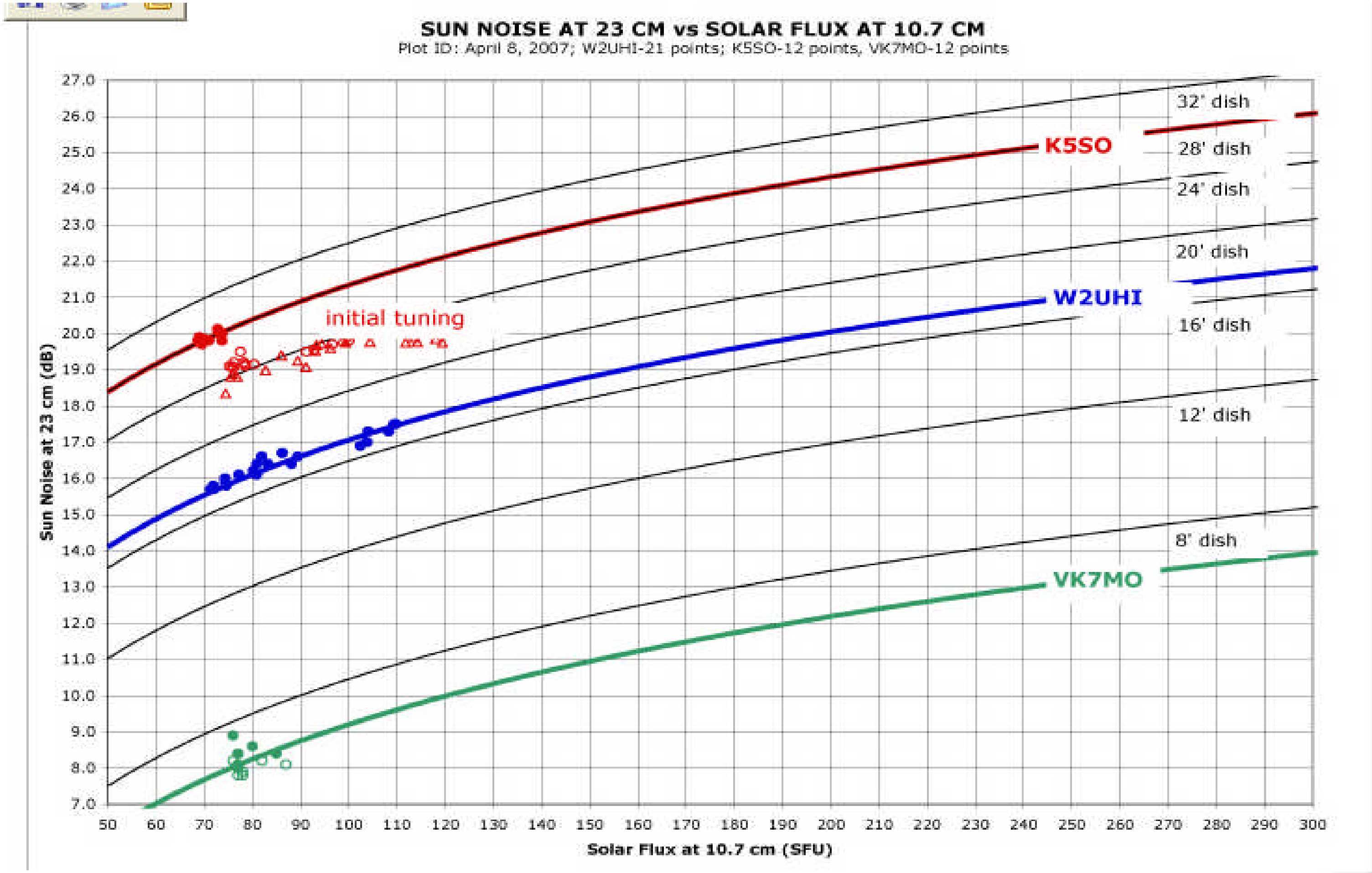

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March 3, 2012 10 GHz Sun Noise Results

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Solar Flux = 108

			Sun noise	Calculated	Gain relative	Calculated	Theoretical Gain	
			S+N/N	S/N	to 7.75 inch dish	Gain*	based on 55% eff.	
W5LUA	24 inch	Prime focus with dual band 10/24 GHz Feed	1.4 dB	-4.2 dB	8.64 dB	34.6 dBi	34 dBi	
W5LUA	30 inch	Prime focus with dual band 5/10 GHz Feed	1.3 dB	-4.57 dB	8.27 dB	34.3 dBi	36 dBi	
W5RLG	24 inch	Prime focus	1.1 dB	-5.4 dB	7.44 dB	33.4 dBi	34 dBi	
WA5YWC	18 inch	Offset fed with horn feed	1 dB	-5.87 dB	7 dB	33 dBi		
WA5YWC	22 inch	Prime focus with DBS feed	.7 dB	-7.57 dB	5.27 dB	31.3 dBi		
W5LUA	7.75 inch	Offset fed with DBS feed	.22 dB	-12.84 dB	0 dB	26 dBi	26 dBi	
		* Gain calculated based on measured gain of 7.75 inch dish at recent NTMS gain measuring event						

The noise figure of the 10 GHz transverter was 1.75 dB plus the 5 ft length of flexible test cable which has 3 dB loss provided an effective noise figure at the feed of 4.75 dB.