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Using Sun Noise Measurements to Evaluate System Performance

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W5LUA

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GR-1216 & GR-1236 IF Amplifiers

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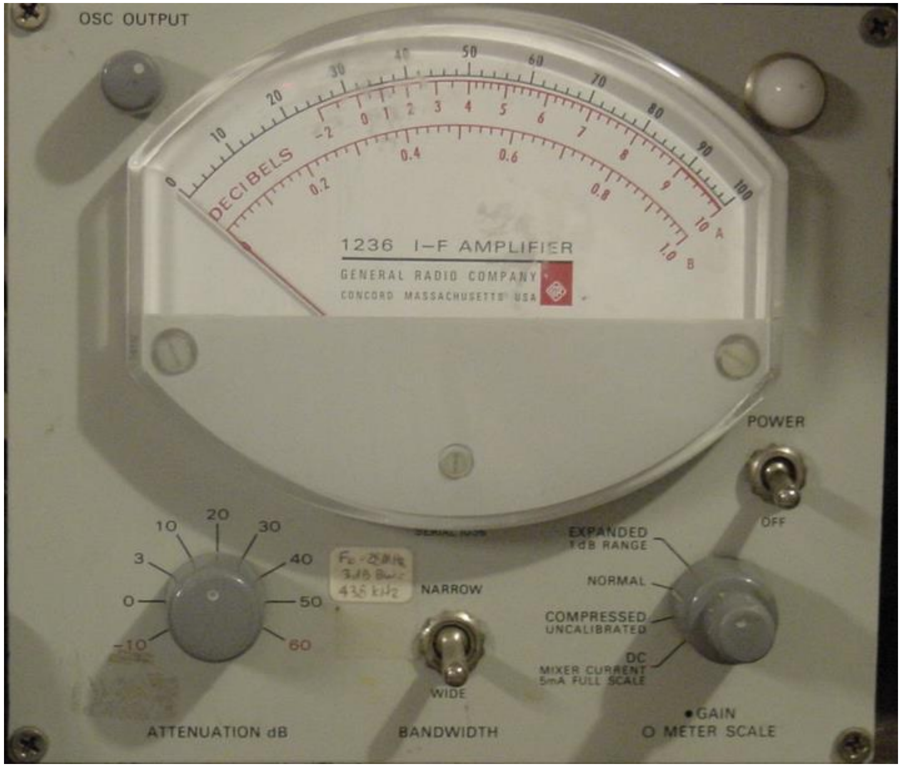

These meters provide a 30 MHz IF amplifier with up to several MHz of bandwidth which makes it easy to measure sun and moon noise – they can be easily retuned for 28 MHz

Setup for measuring sun/moon noise on portable systems

HB 144 to 28 MHz downconverter

Optional 144 MHz (2m) preamplifier – comes in handy for use with low gain converters

Using an Audio Meter

An option that has worked well over the years

Options include the HP 400 or 3400 AC voltmeter or even your old Triplett or Simpson VOM measuring AC voltage – the meter include a convenient dB scale which is simply 20 log (V2/V1)

The ac voltmeter is connected to the radio's speaker or headphone jack. On the radio, turn AGC off, turn audio gain up and reduce RF gain to set the radio in a linear range and not in compression.

Since the bandwidth of the "audio meter" approach is only several kHz, the readings maybe "jumpy", therefore a capacitor across the input terminals may be needed to help obtain an average reading

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How do we compare sun noise readings?

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

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

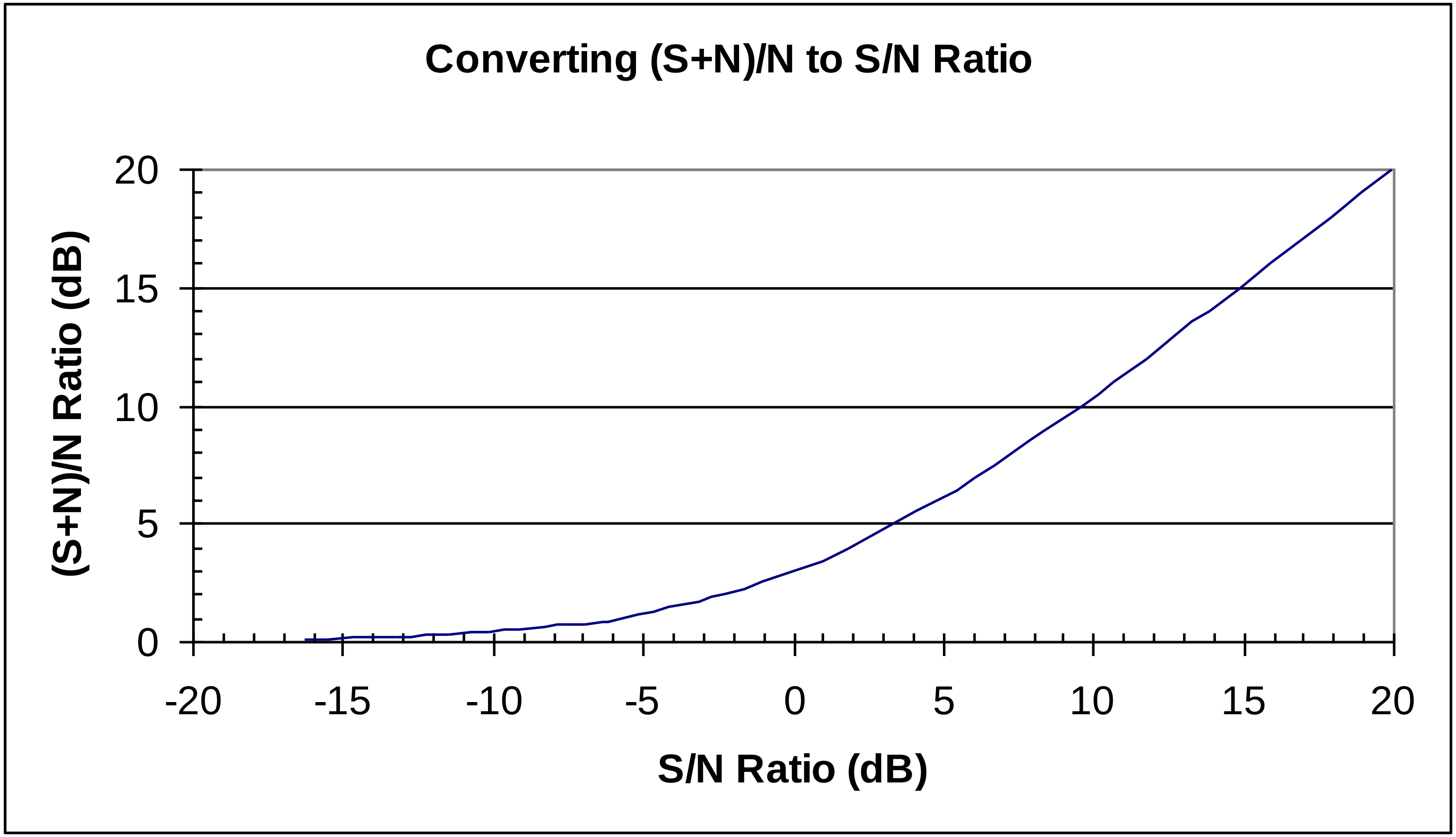
$$\text{Therefore } \frac{S}{N} = \frac{S+N}{N} - 1$$

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



Example #1 & #2

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

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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.

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

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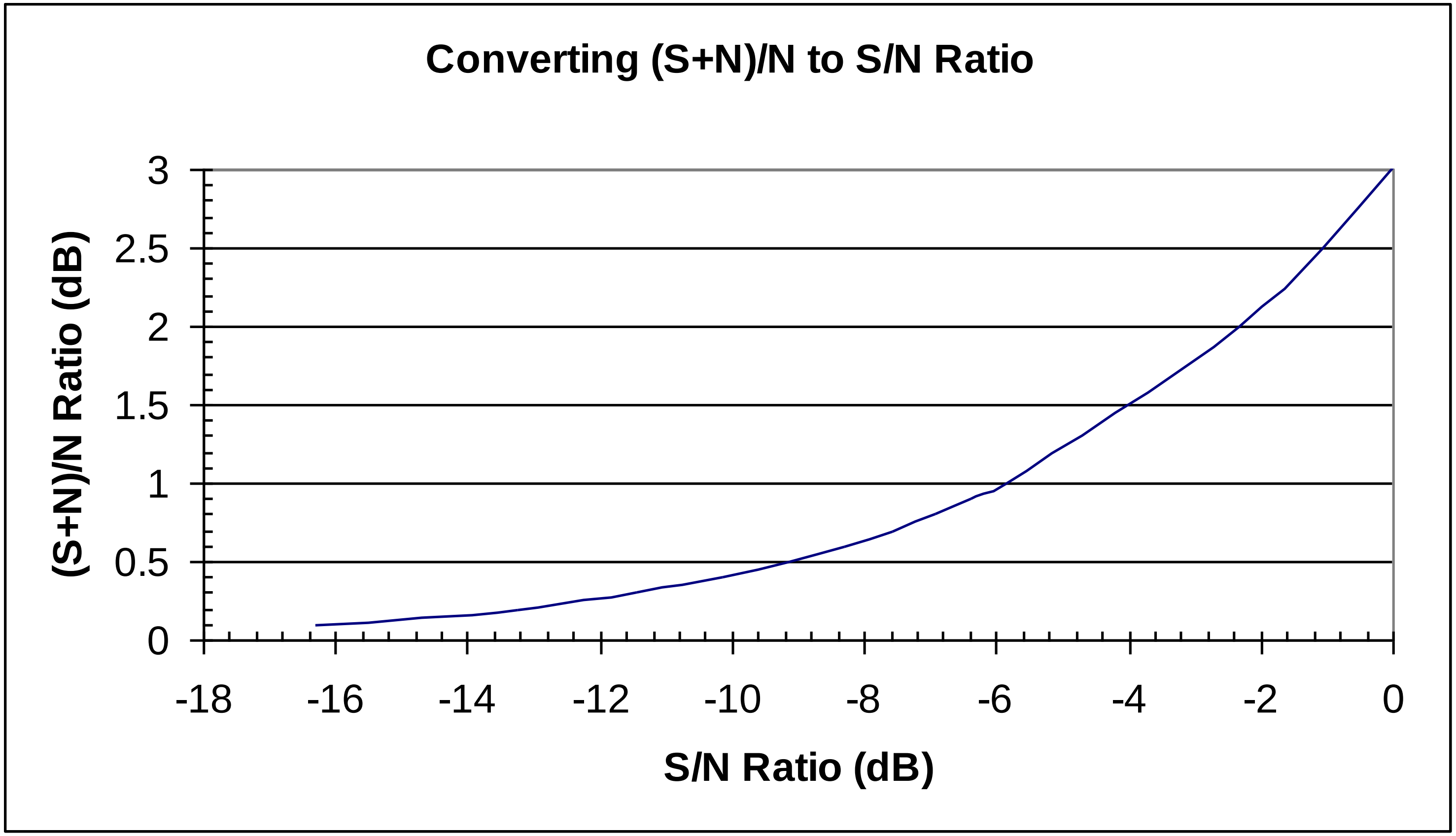

W5LUA
Sept 26, 2000

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

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

$$10\log(.585) = -2.33dB$$ **Ant 1**

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

$$10\log(1.5119) = 1.80dB$$ **Ant 2**

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

Gain Difference in dB

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

March 3, 2012 10 GHz Sun Noise Results

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			Sun noise		relative	
			S+N/N	S/N	gain	
W5LUA	24 inch	Prime focus	1.5 dB	-3.84 dB	0 dB	36 dBi
W5LUA	30 inch	Prime focus	1.3 dB	-4.57 dB	-.73 dB	35.3 dBi
W5RLG	24 inch	Prime focus	1.1 dB	-5.4 dB	-1.56 dB	34.4 dBi
WA5YWC	18 inch	Offset fed	1 dB	-5.87 dB	-2.03 dB	34 dBi
W5LUA	7.75 inch	Offset fed	.22 dB	-12.84 dB	-9 dB	27 dBi

Same 10 GHz transverter and cable used for all measurements

Moving Forward

- The preceding results were based on using the same downconverter on 10 and 24 GHz to make relative gain comparisons of antennas
- The plan in moving forward is to test 10/24/47 GHz as individual systems which includes the antenna, cabling and transverter…..this is the bottom line as we continue to improve our systems…..
- Stand by for additional test parties and results.