DEVELOPMENT OF AN OPTIMIZED ANTENNA FOR AN OZONE SPECTROMETER

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Noise Figure

The noise figure is the ratio of actual output noise to that which would remain if the device itself did not introduce noise. It is a number by which the performance of a radio receiver can be specified.

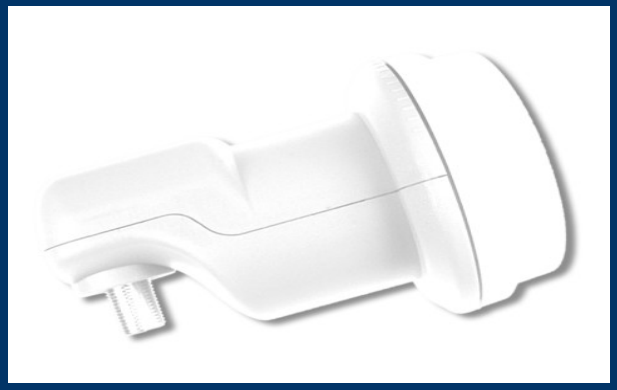
$$NF_{dB} = 10 \log \left(\frac{\mathrm{SNR_{in}}}{\mathrm{SNR_{out}}} \right) = \mathrm{SNR_{in,dB}} - \mathrm{SNR_{out,dB}}$$

LNBs/Feeds Tested

Fortec Star FSKUVN
(Claim of 0.2 dB)

Invacom Antenna
SNF-031
(Claim of 0.3 dB)

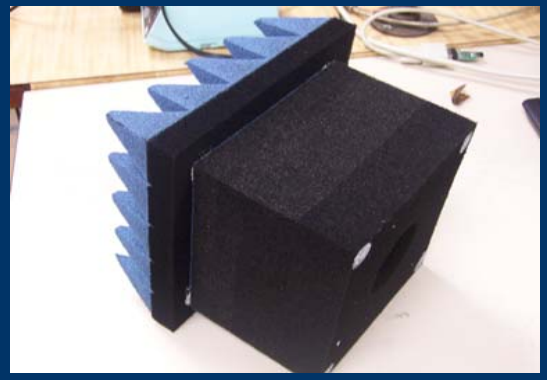
Invacom Flange
(Claim of 0.3 dB w/ feed)

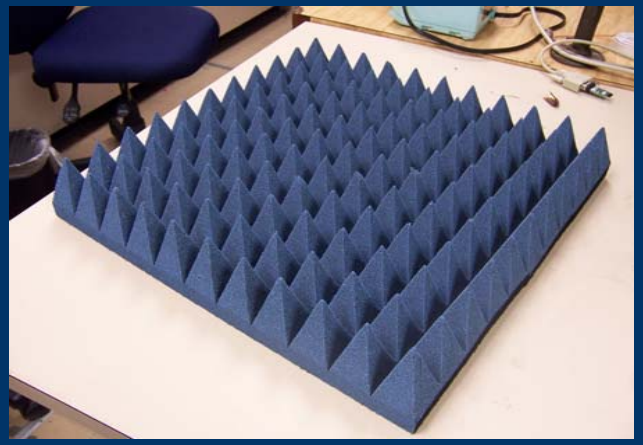


Smart Antenna (Claim of 0.1 dB)

Circular Ringed Feed Horn

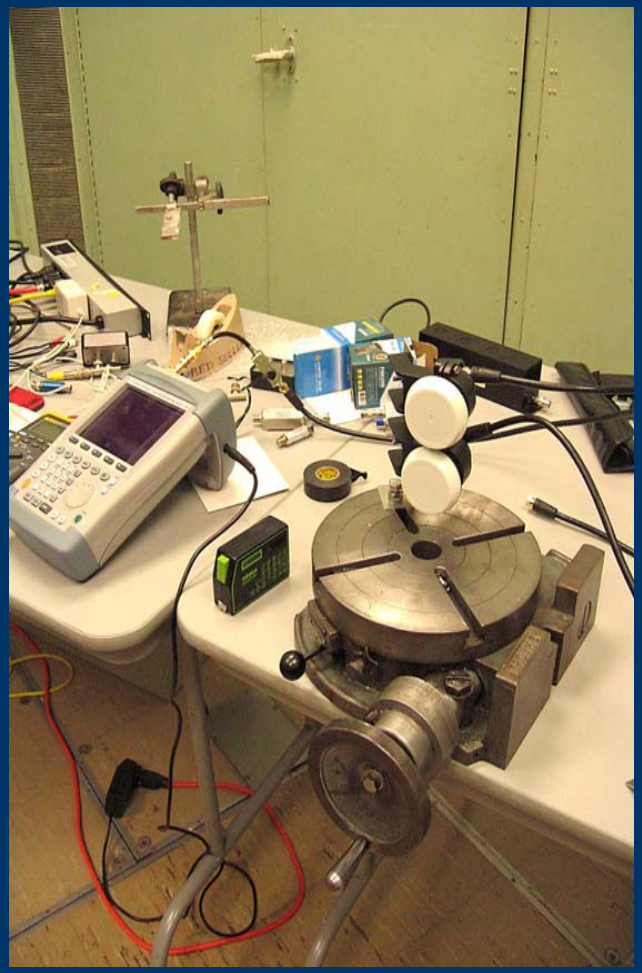
Types of Absorbers Used





Ozone Spectrometer Dish and Antenna

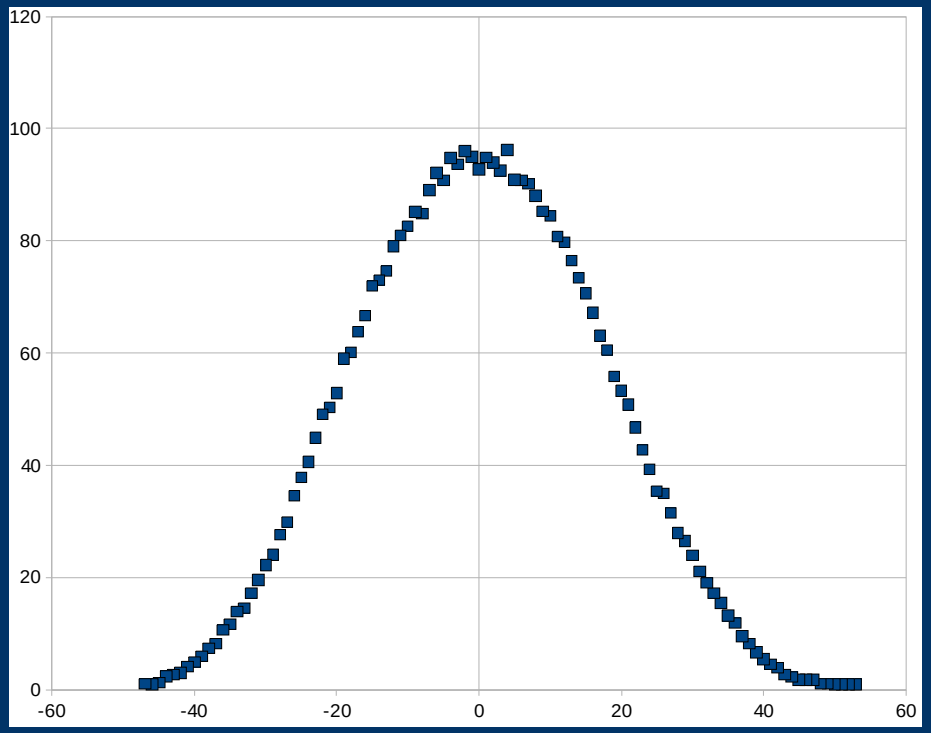
Measuring LNB Beam Width

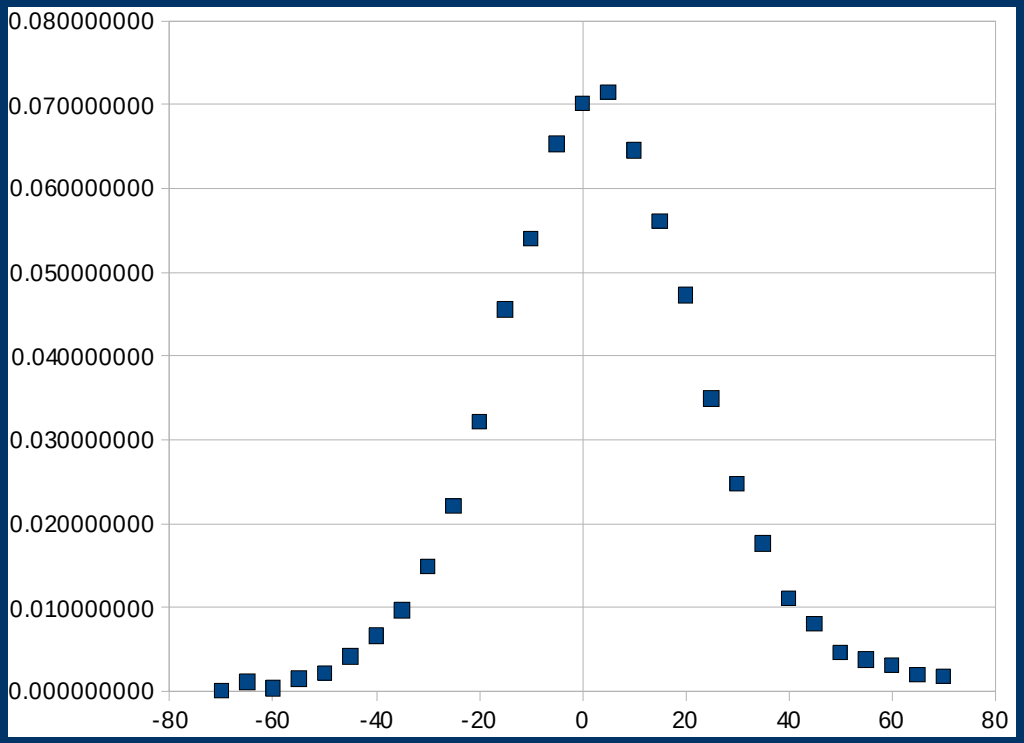


Two methods were used to measure the beam pattern.

- Correlation method using two LNBFs
- Method using signal generator and spectrum analyzer

Received Power vs. Angle for LNBFs





$$B(\theta) = e^{-0.693(\theta / 21.5)^2} + 0.002$$

Main Equations

$$\text{Y-factor} = (T_{amb}+T_{LNA})/(T_{sky}+T_{LNA})$$

- $NF = 10*\log10(\ T_{LNA}/290 +1.0)$

Liquid Nitrogen Calibration

Preliminary Y-factor Measurements in dB

Ratio of Absorber on/absorber off power in dB, for each particular voltage, LNB, absorber, and frequency

13 V voltage

	Absorber 1			Absorber 2		
	800 MHz	1300 MHz	1800 MHz	800 MHz	1300 MHz	1800 MHz
Fortec #1*	6.3	6.4	5.7	5.8	6.1	5.4
Fortec #2*	5.9	6.6	6.4	5.6	6.3	6.2
Invacom	4.4	6.5	6.4	4	6.2	6.5

**Two different LNBs of the same type were tested in case of defective equipment*

17.46 V voltage**

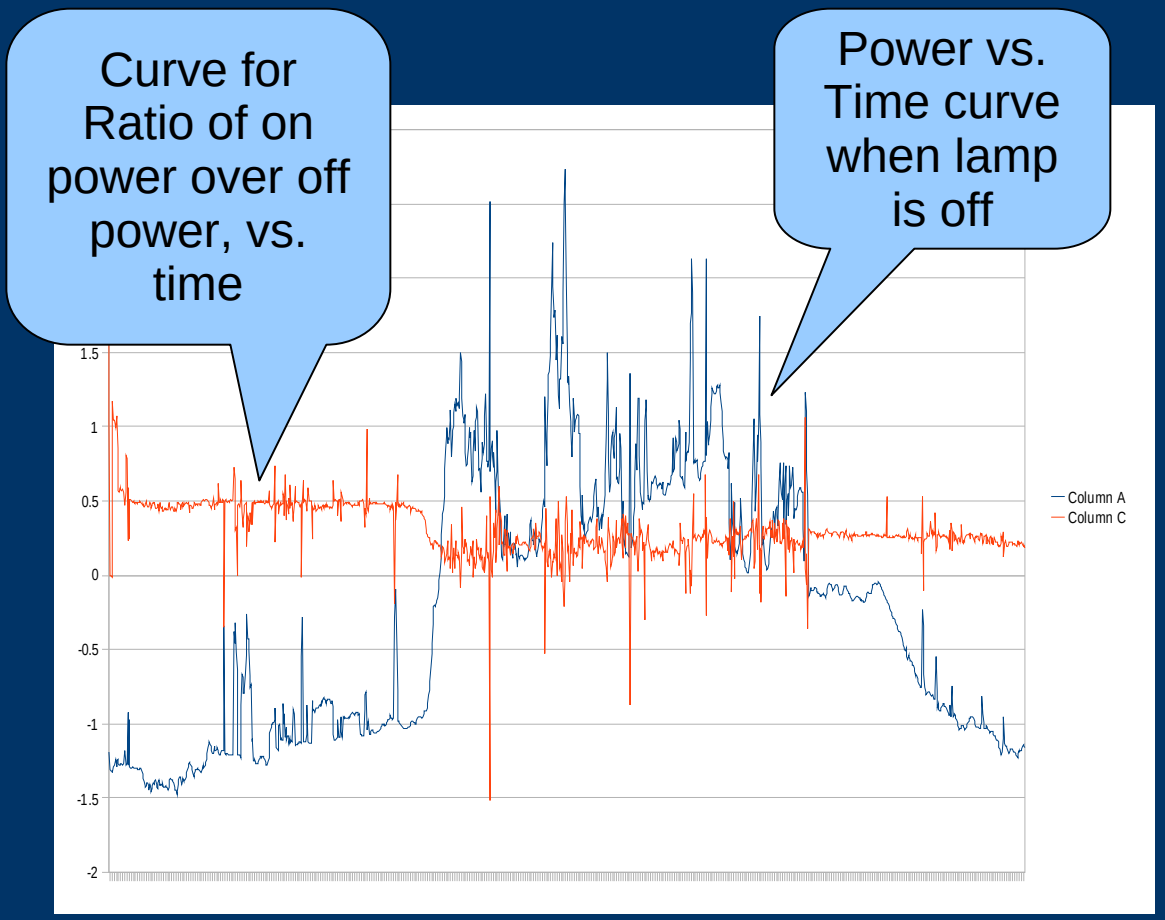
	Absorber 1			Absorber 2		
	800 MHz	1300 MHz	1800 MHz	800 MHz	1300 MHz	1800 MHz
Fortec 1	5.9	6.6	6	5.5	6.4	5.7
Fortec 2	5.8	6.5	6.6	5.4	6.2	6.2
Invacom	5.5	6.5	6.3	5.1	5.9	5.9

***The voltage changes the polarization of the LNBF*

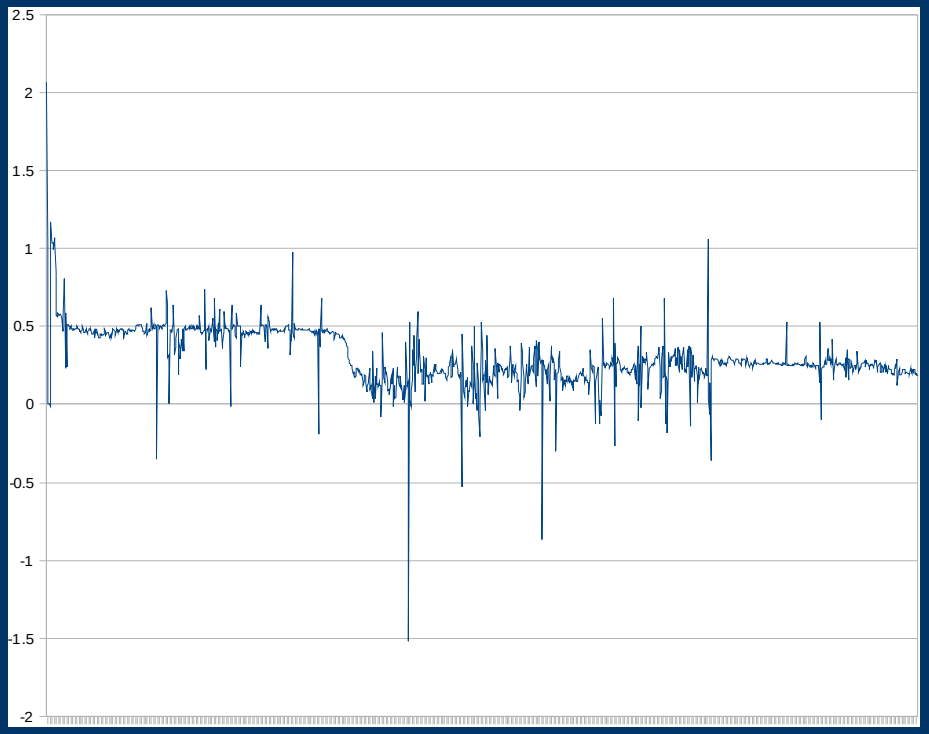
The Highest Y-factor in these particular tests appears to be the Fortec Star LNB with a Y-factor of 6.6 dB, which converts to a noise figure of 0.42 dB.

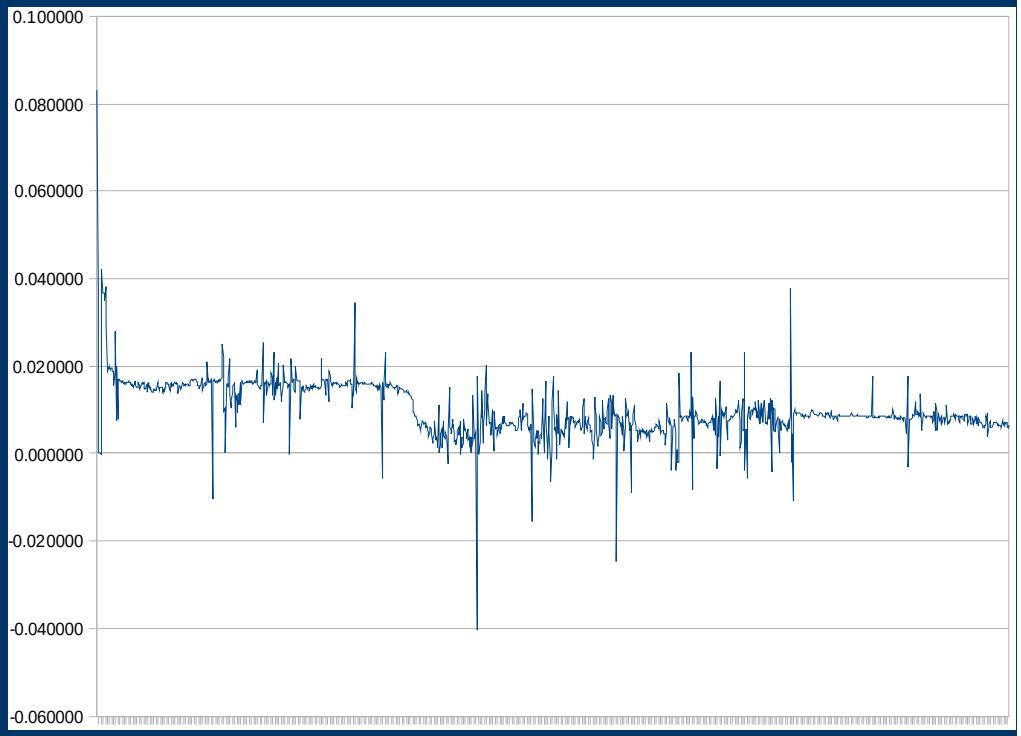
LNBs with actual noise figures between 0.2-0.3 dB are preferred.

Fluorescent Lamp Calibration



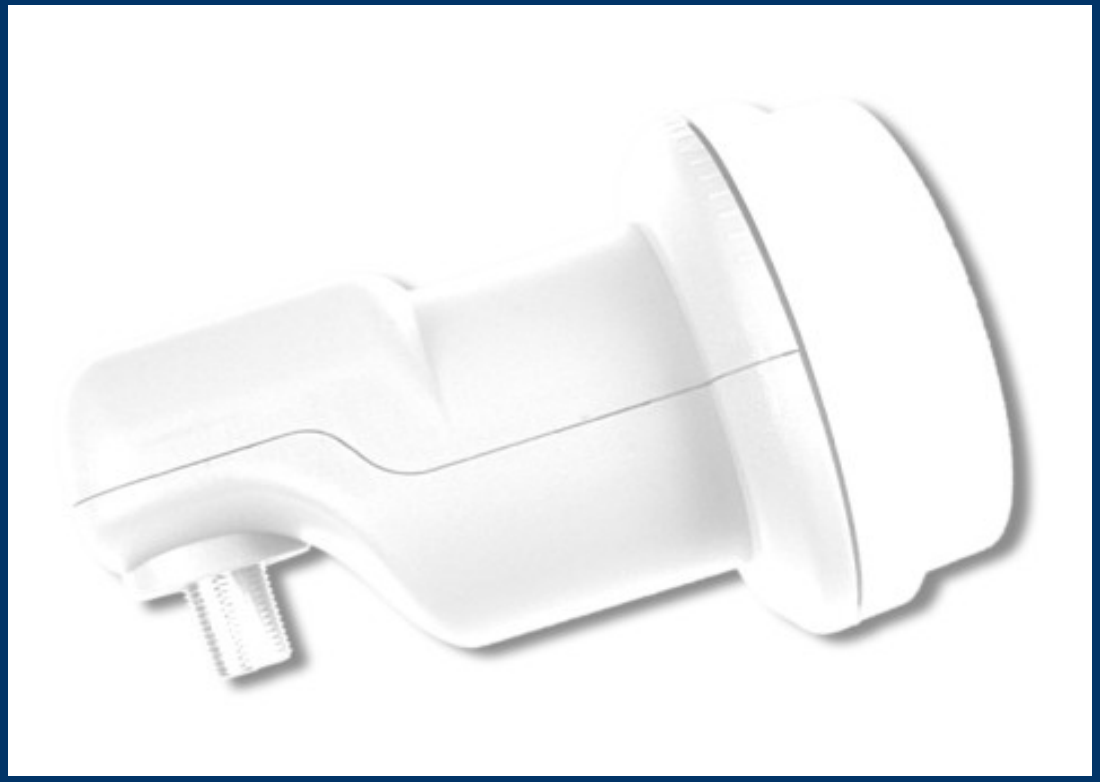
Y-lamp and Sensitivity Graphs





Equal when the lamp temperature is assumed to be about ***7.33 K***

AND THE WINNER IS...



Smart 0.1 dB, itself with a Y-factor of 7.3 dB, and when a metallic funnel mouth was placed around the feed, the LNB produced Y-factors of up to 7.5 dB, which converts to a noise figure of about

0.23 dB!

Results and Future Work

- Smart 0.1 dB outperformed all the other antennas in terms of noise figure.
- We were able to obtain reduced noise figures down to 0.23 dB.
- Using mouth of a metallic funnel does help to reduce noise, but only by a minor amount
- In the future, more practical solutions must be investigated to reduce spillover from the ground.

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