SVHFS Antenna Range for 10 GHz Testing

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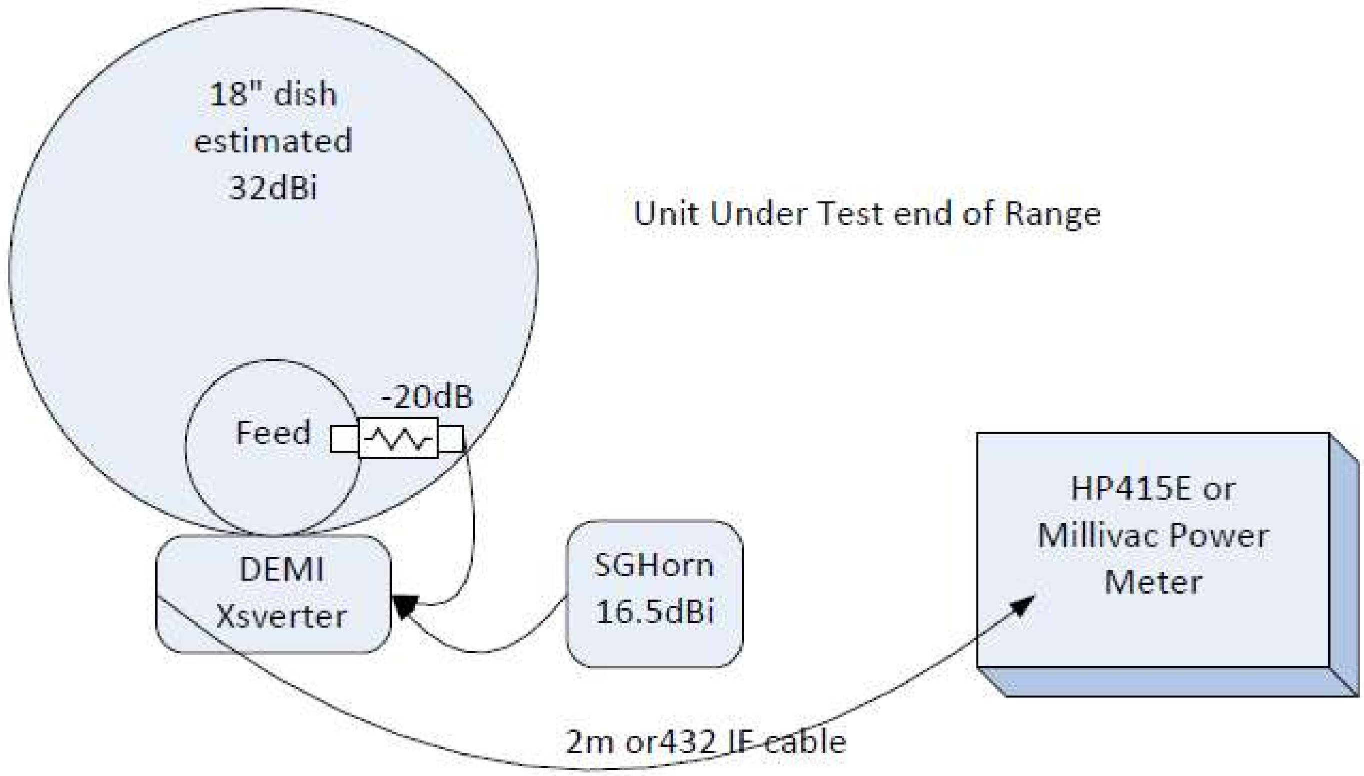
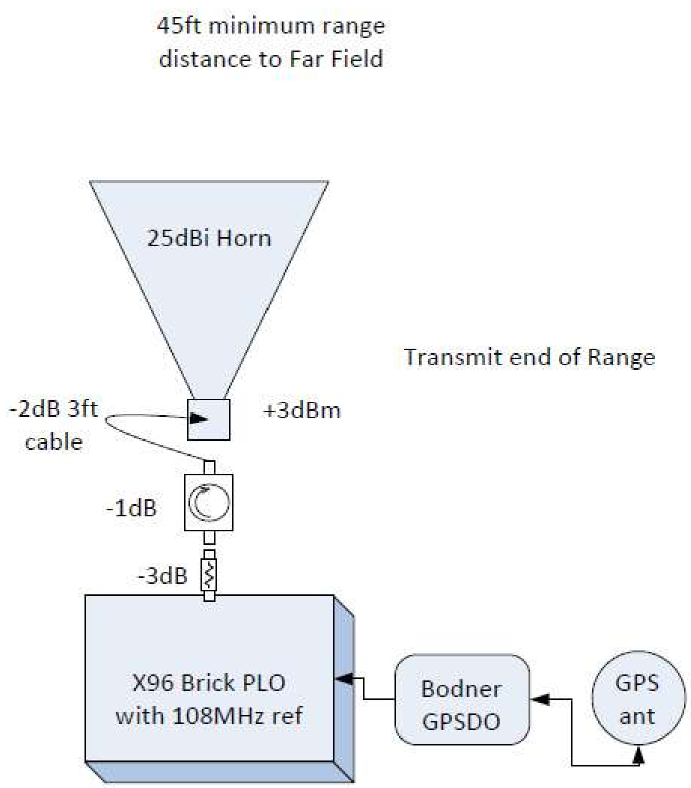
This is the first year in my memory that we've done 10 GHz antenna tests at the SVHFS Conference. The following is a brief discussion of the equipment we've assembled to do that and the range distances required.

Unit Under Test End of Range



Source End of the Range



The goal is to be far enough to be in the antenna's Far Field. This is defined by keeping the phase error across the aperture of the receive antenna flat basically planar waves as much as possible.

Fraunhofer Distance $df= (2(D)^2)/\lambda$

Wavelength Lambda λ at 10.368 GHz = 3 cm

D = diameter of the largest dish to be testable 18" = 45.72cm

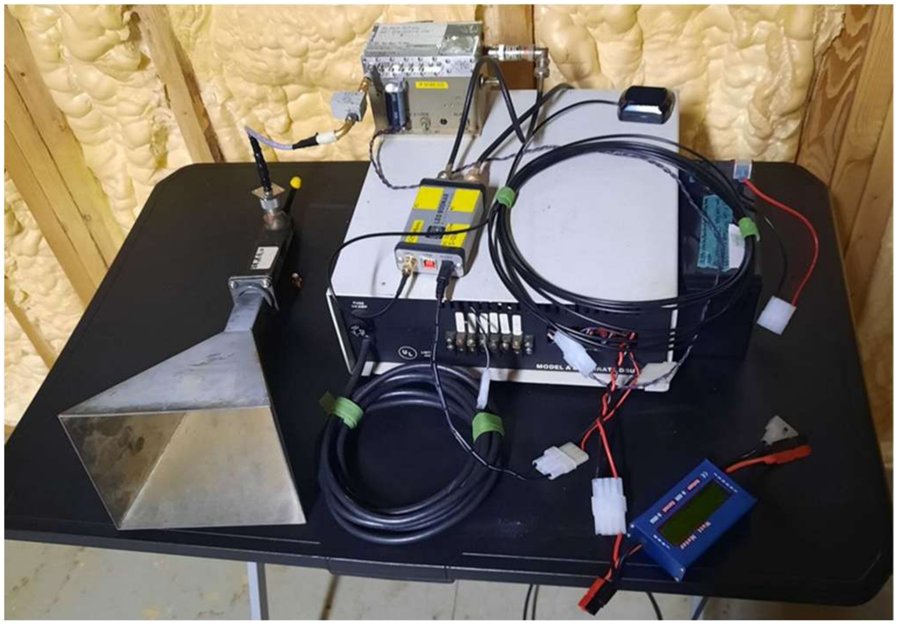
$Df= (2(45.72)^2)/3 = 2(2090)/3 = 1393.5$ cm = 549 inches = 45.72 feet

For a 1m dish $Df =(2(100cm)^2)/3 = 20000/3 = 6666$ cm = 2625" = 219 feet

For a 3.7m dish $Df = (2(370)^2)/3 = 91,266$cm =3000 feet = 0.567 miles

You can see this quickly gets out of hand. Looking at available space around the hotel we are hoping to get mostly 18" and smaller dishes requiring a 45.72 foot range

The Source Hardware



The goal was to make a +7dBm 10368 MHz signal for the antenna range source end which was battery operated and would run for at least two hours on a gel cell battery.

The Leo Bodner GPSDO provides 0 dBm of 108.000 MHz to act as the reference for a phase locked oscillator “brick”.

An attenuator and isolator on the 10 GHz output serves to keep VSWR from affecting the source lock.

A 25dBi horn narrows the beam to concentrate energy downrange to minimize reflections off cars and other objects. The horn is placed on the ground looking slightly upward toward the receive Unit Under Test (UUT) setup. Microwave Absorber is placed in front of the horn to help mitigate ground reflections.

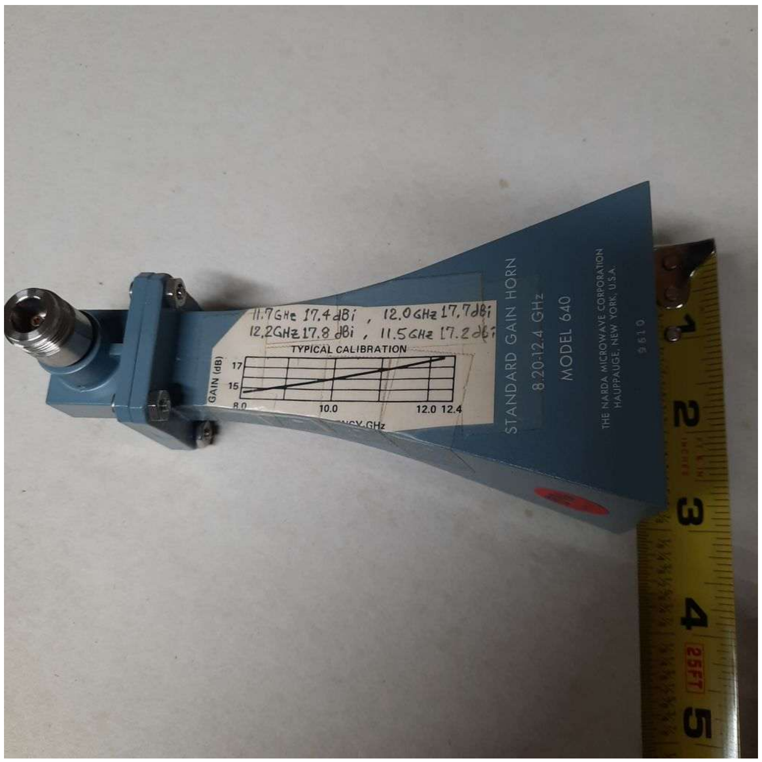
Path Loss

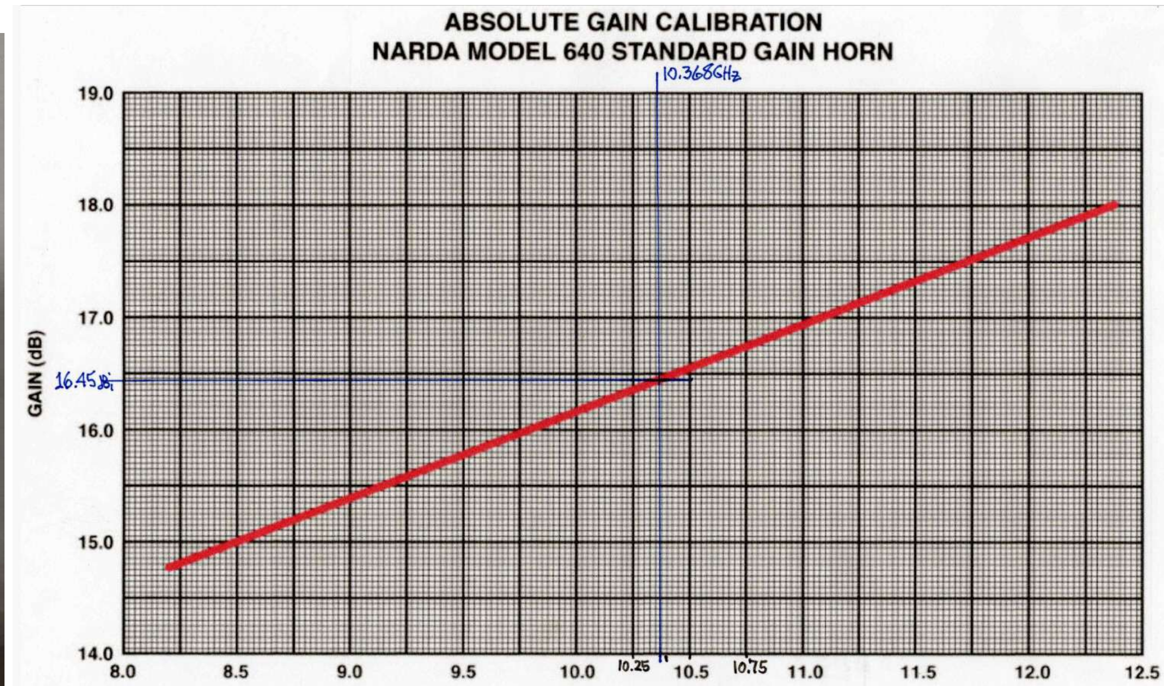
Using a path loss calculator

https://www.pasternack.com/t-calculator-fspl.aspx?srsltid=AfmBOorxdUxfSUGvemCkHD0AXewlALvmTUyfLaWJ2TEC8d8VbvgkrD-b we find the free space path loss to be:

20’ = 68.45 dB	50’ = 76.4 dB	80’ = 80.5 dB
30’ = 72 dB	60’ = 78 dB	90’ = 81.52 dB
40’ = 74.5 dB	70’ = 79.34 dB	100’ = 82.43 dB

Standard Gain Horn





Approach

- We basically use a DEMI 10 GHz transverter to get some 25dB gain and filtering while down converting to 144 or 432 MHz where the power measurement is done.
- A Standard Gain Horn (SGH) with 16.45 dBi gain is our basis for comparison. Using the same cables we switch from SGH to UUT dish feed. Anticipating about 32 dBi gain on the 18" Unit Under Test (UUT) dish means we need 16 dB of attenuation added to cause the power reading to be roughly the same for SGH and dish with attenuator. This manual measurement should read almost the same. We add up the difference and then correct for the measured value of the attenuator.