Namaste Project 3.4 GHz Interference Study

Preliminary document - Work in Progress
updated 05-29-08

The intent of this study is to collect data which may be used to help determine the noise floor expected to be received by a typical 3.4 GHz Namaste earth station from a satellite. This study will collect data in the 3.4-3.47 GHz frequency range using a 30" or similar size offset parabolic dish antenna which is anticipated to be about what might be used by a typical earth station.

Equipment overview -

The setup will consist of a antenna, suitable feed with vertical and horizontal selectable polarization a TVRO block down converter with low noise figure, a spectrum analyzer, and a laptop computer with GPIB interface and data collection software.

The anticipated gain for the antenna with feed is estimated at 26 dBi. The low noise block converter (BSC-421) is a low cost "C" Band LNBF (low noise block converter with feed) costing about $30. The converter uses an internal 5150 MHz DRO as a high side local oscillator. The IF output from the converter is frequency inverted due to the high side LO.
The frequency conversion provides an IF output of 1.75 GHz for a 3.4 GHz input (5.15-3.40=1.75 GHz).
For a 3.47 GHz input the IF output is 1.68 GHz (5.15-3.47=1.68 GHz). The stated noise temperature for the LNBF is 13K or a noise figure of about 0.2 dB. The sated gain of the LNBF is about 55 dB which should be sufficient to overcome the 25 dB noise figure of the spectrum analyzer. The combined noise figure of the LNBF with spectrum analyzer is estimated at TBD dB.

Power and polarization control for the LNBF and feed is provided through the Bias "T" which allows the DC power to be combined with the IF signal on the LNBF output connector. The IF signal is DC blocked by the Bias "T" and passed on to the spectrum analyzer

The spectrum analyzer will be set to capture the maximum signal amplitude detected within the 1.68-1.75 GHz IF range as the antenna is slowly moved to various positions and polarizations. A snapshot of the spectrum analyzer screen data will be either down loaded to a laptop computer using a GPIB interface or a digital camera may be used to take a picture of the spectrum analyzer screen.

Sanity checks and calibration -

Sun noise system test -
Noise measurements:
Spectrum analyzer set for 2 MHz RBW
Cold sky = -62.2 dBm
Earth = -59.3 dBm
Sun (cloudy) = -58.7 dBm

Terrestrial weak signal test -
This will be performed using a signal source of know amplitude and frequency connected to a antenna of known gain placed at a suitable distance from the equipment to be tested. This data should allow Antenna/feed optimization and overall system gain determination, approximate noise floor calibration and frequency calibration.

Initial test results:
Ant BW total between 3 dB points = 6 deg
Spectrum analyzer set for 2 MHz RBW
Beacon -20 dBm into dipole with reflector at 100'
Rx signal -5 dBm

"C" band satellite signal measurement - TBD

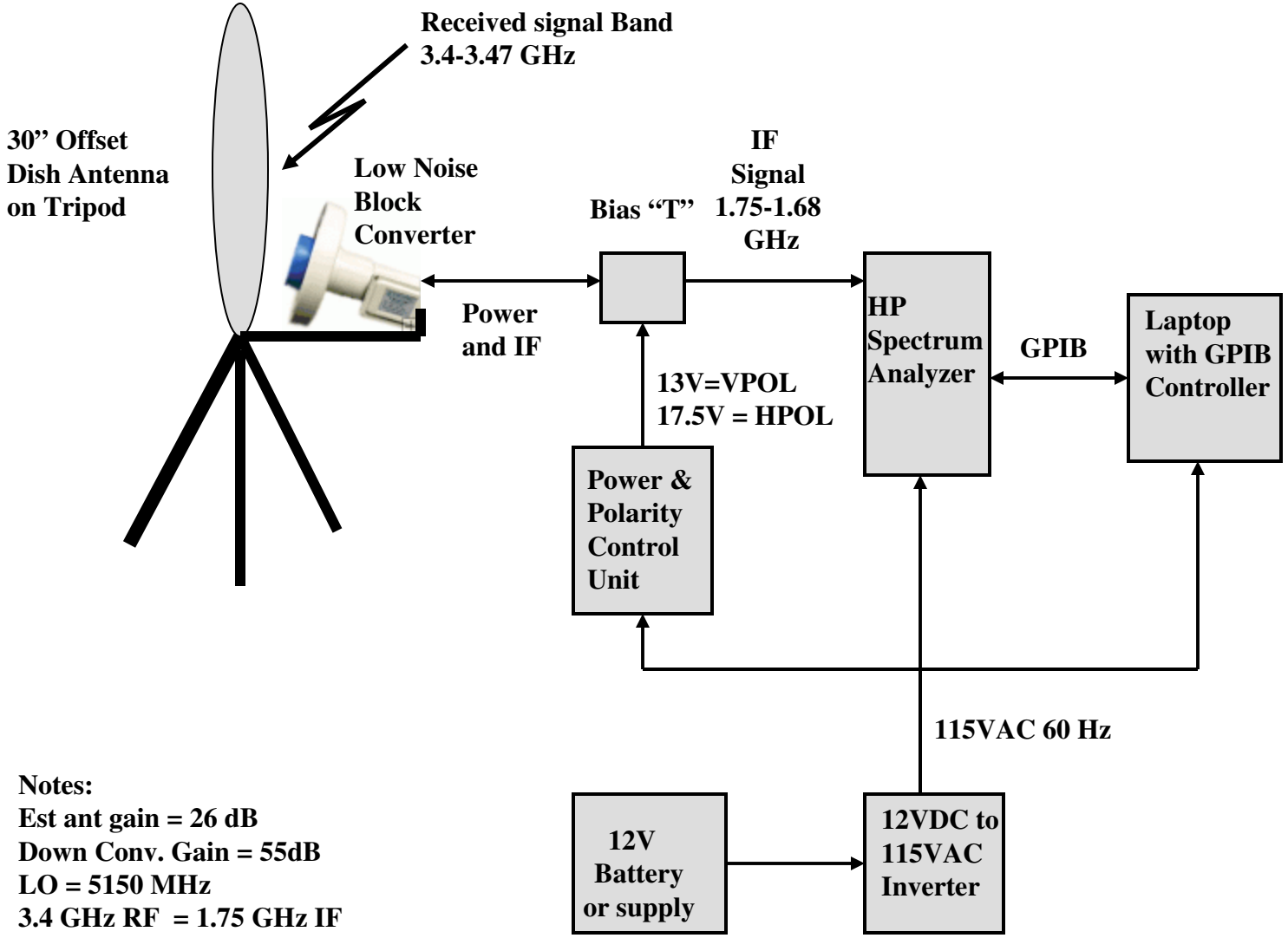
Data collection procedure -
The spectrum analyzer will be set as follows:
Start frequency 1680 MHz
Stop Frequency 1750 MHz
RBW 100 KHz
VBW 3 KHz
Detector in sampled mode
Max hold if needed

A search for terrestrial interference with the antenna aimed at the horizon (0 deg elevation)
is made rotating the antenna slowly over at least 360 degrees azimuth.
If any signals are detected. Pointing will be done to maximize the signal and a screen capture made.
The elevation will then be raised to see at what elevation the signal is diminished.

Data collection results to date

1. A horizon scan was made at La Mesa , Ca in front and back yard at N6IZW home. Found large signal due to 3rd harmonic of 1296 transverter LO of 1152 MHz located about 30 feet way. No other signals detected once transverter was turned off.

2. A horizon scan was made at home of K6QPV also in La Mesa over looking San Diego which is about 12 miles West. Detected signals about 10 dB above noise floor towards the West and captured using max hold as the signal appeared to be perhaps frequency hopping. There is considerable Navy activity in that direction. The interference dropped below the noise floor by the time the elevation was raised to about 8 deg.



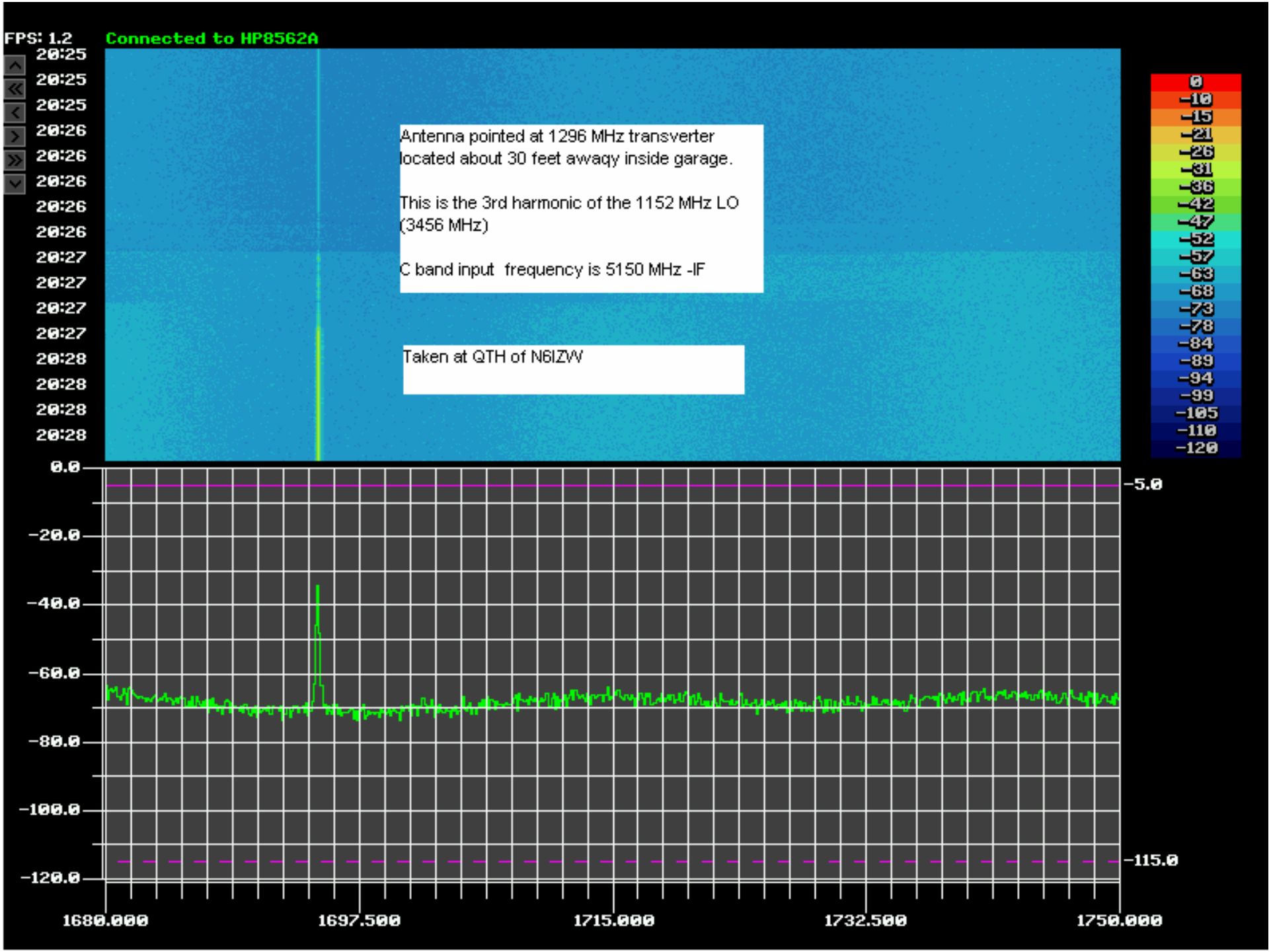
Notes:
Est ant gain = 26 dB
Down Conv. Gain = 55dB
LO = 5150 MHz
3.4 GHz RF = 1.75 GHz IF
3.47 GHz RF = 1.68 GHz IF

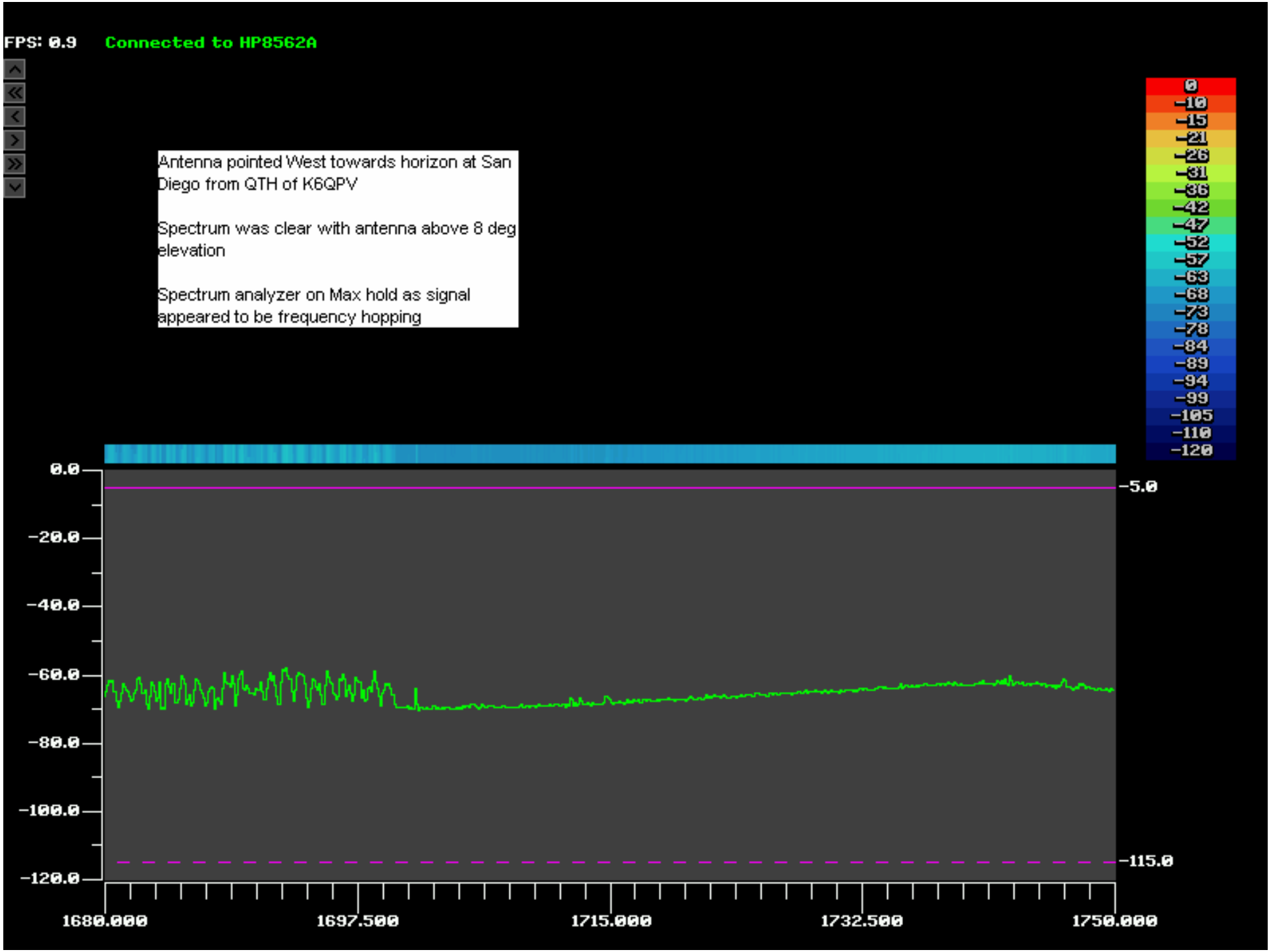
BSC - 421 Block Converter Specifications

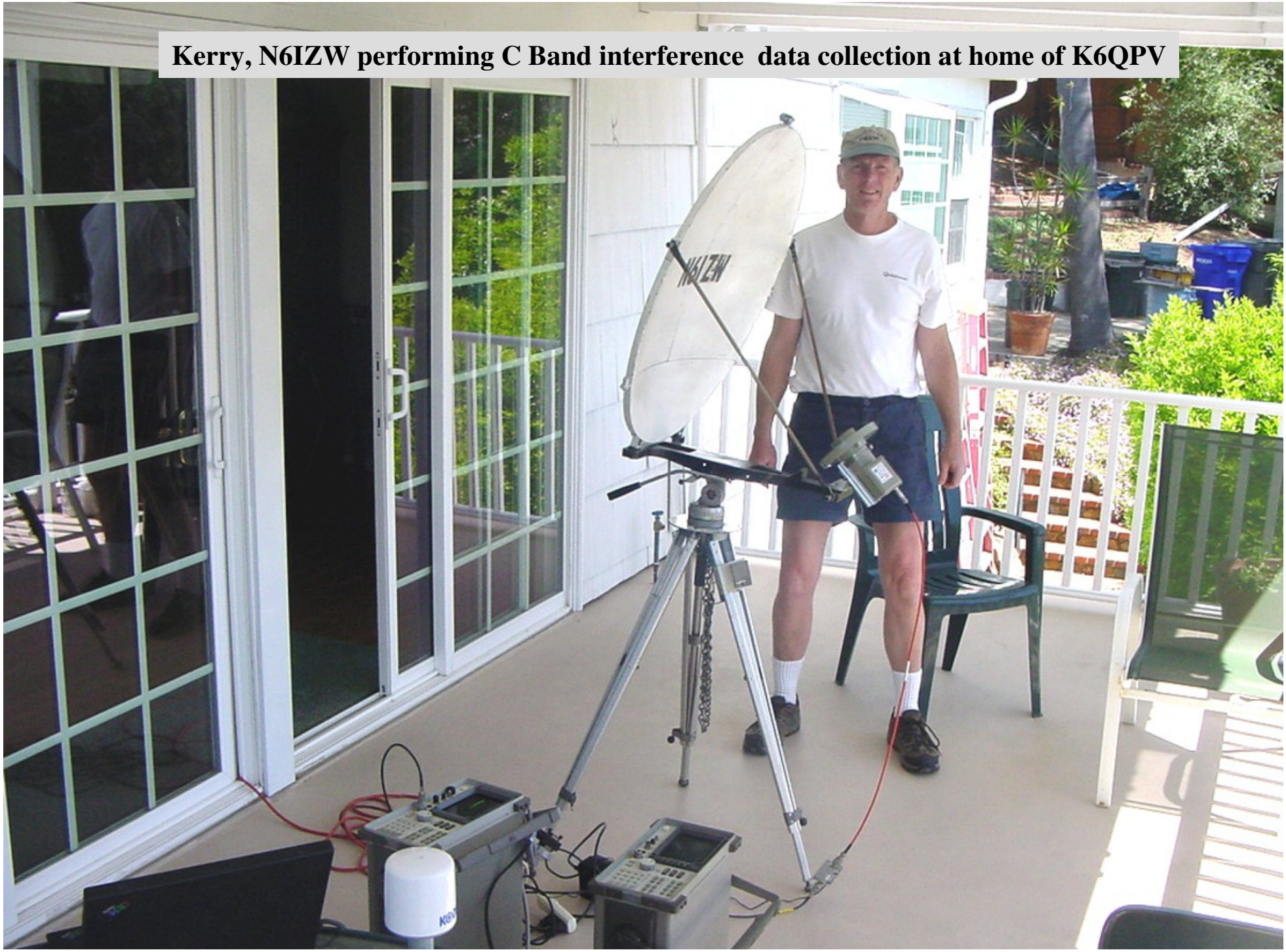
SPECIFICATIONS	
Input Frequency	3.4 to 4.2 GHz
L.O. Frequency	5150 MHz (± 500 KHz @ 25°C)
L.O. Stability	± 1.5 MHz (-40 to +70°C)
Output Frequency	950 to 1750 MHz
Noise figure	13°K typical
Conversion gain	55 dB typical
Input VSWR	2.5:1 (maximum)
Output VSWR	2.0:1 (maximum)
O0utput connector	F female connector
Output Impedance	75 ohms
Cross Polar Isolation	20 dB (minimum)
Image Rejection	45 dB (minimum)
Phase Noise	-85 dBc @ 10 Khz (minimum)

BSC - 421 Block Converter Specifications (continued)

Supply Voltage	11.5 to 14.0 V (vertical) 16.0 to 19.0 V (horizontal)
Operating Temperature	-40 to +70°C
Storage Temperature	-40 to +80°C
Relative Humidity	0% to 95%
Size	168mm x 130mm x 190mm
Weight	680g


FPS: 1.2
Connected to HP8562A
20:25
20:25
20:25
20:26
20:26
20:26
20:26
20:26
20:27
20:27
20:27
20:27
20:28
20:28
20:28
20:28
Antenna pointed at 1296 MHz transverter
located about 30 feet awaqy inside garage.
This is the 3rd harmonic of the 1152 MHz LO
(3456 MHz)
C band input frequency is 5150 MHz -IF
Taken at QTH of N6IZW
0
-10
-15
-21
-26
-31
-36
-42
-47
-52
-57
-63
-68
-73
-78
-84
-89
-94
-99
-105
-110
-120
0.0
-20.0
-40.0
-60.0
-80.0
-100.0
-120.0
-5.0
-115.0
1680.000
1697.500
1715.000
1732.500
1750.000


FPS: 0.9
Connected to HP8562A
Antenna pointed West towards horizon at San Diego from QTH of K6QPV
Spectrum was clear with antenna above 8 deg elevation
Spectrum analyzer on Max hold as signal appeared to be frequency hopping
0
-10
-15
-21
-26
-31
-36
-42
-47
-52
-57
-63
-68
-73
-78
-84
-89
-94
-99
-105
-110
-120
0.0
-20.0
-40.0
-60.0
-80.0
-100.0
-120.0
-5.0
-115.0
1680.000
1697.500
1715.000
1732.500
1750.000



Kerry, N6IZW performing C Band interference data collection at home of K6QPV

TELEPHOTO VIEW FROM TEST MEASUREMENT SITE

View West from home of K6QPV where interference was seen at horizon