Fermilab Morocco Site Visit Summary

Kevin Bandura (Carnegie)
Kermit Carlson (Fermilab)
John Marriner (Fermilab)
Dave McGinnis (Fermilab)
Ralph Pasquinelli (Fermilab)

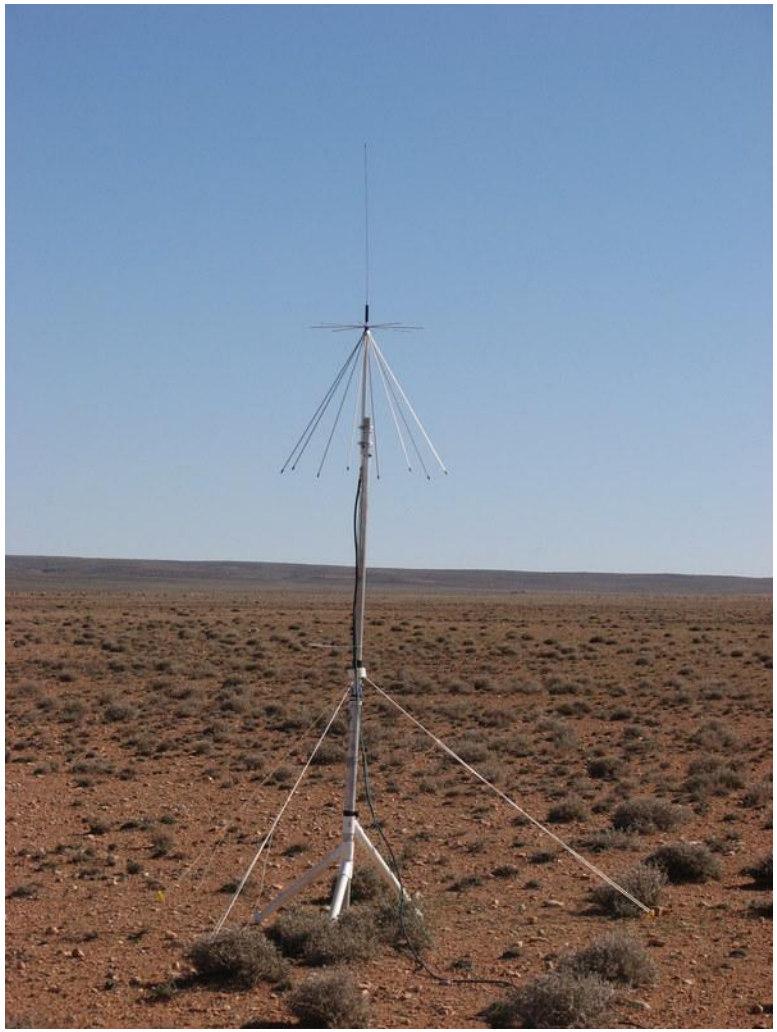
The Hosts
Hassane and Khalid

Moroccan Hospitality

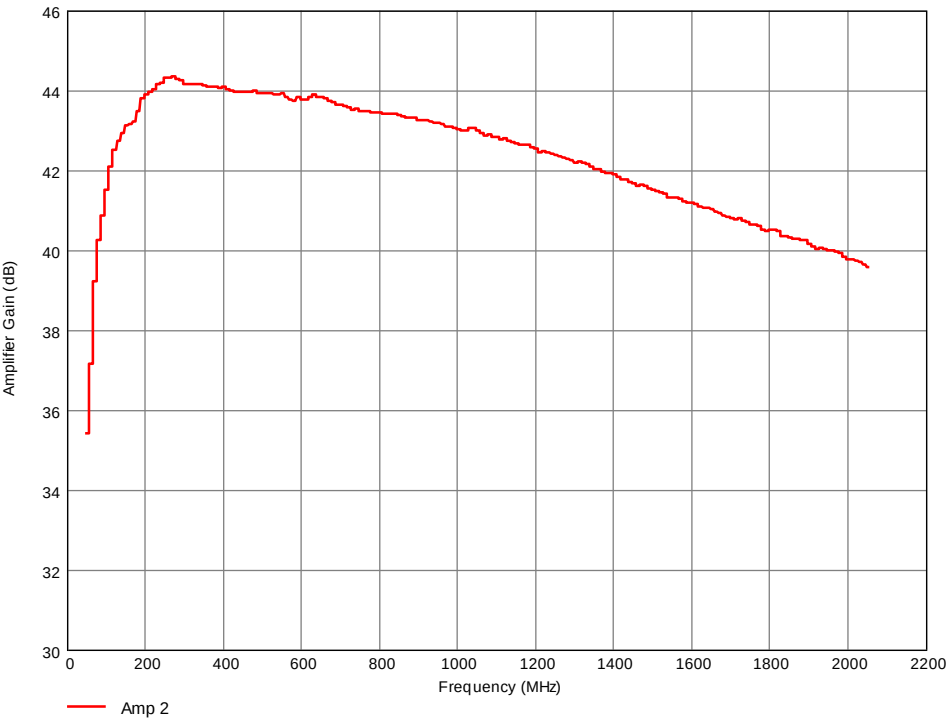
Antenna and Amplifier

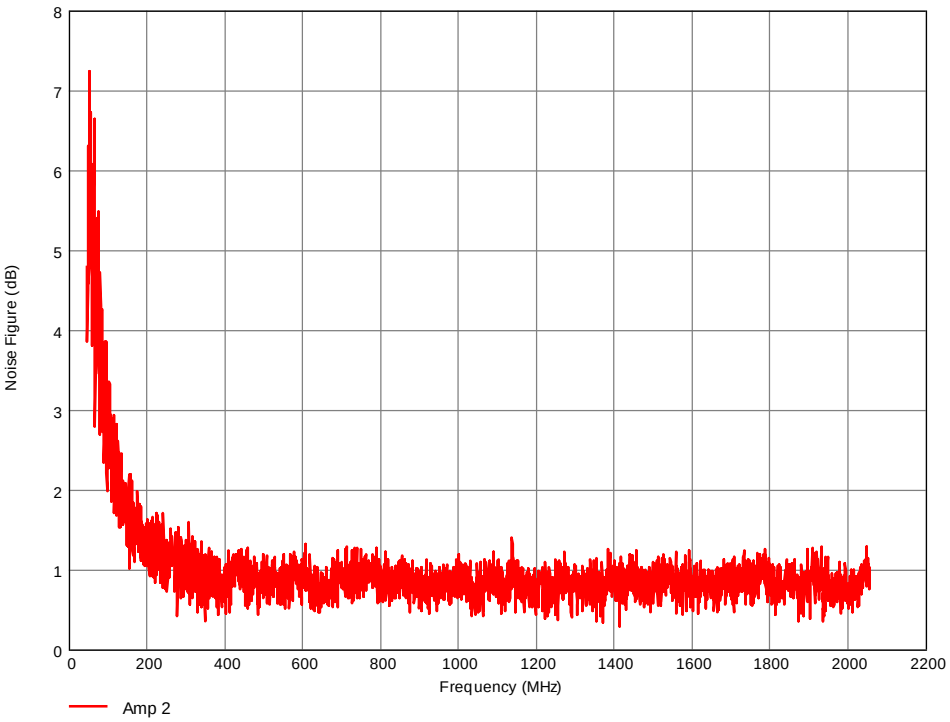
- Antennas
  - Broadband Discone antenna (150-1300 MHz)
  - Log Periodic Antenna (150-1500 MHz)
  - Telescoping mast up to 5 meters in height with portable stand
  - 30 meters of flexible heliax coaxial cable
- Amplifiers
  - <1dB NF
  - >45dB Gain
  - 500-1000 MHz
  - 15V power supply and regulator included

Antennas



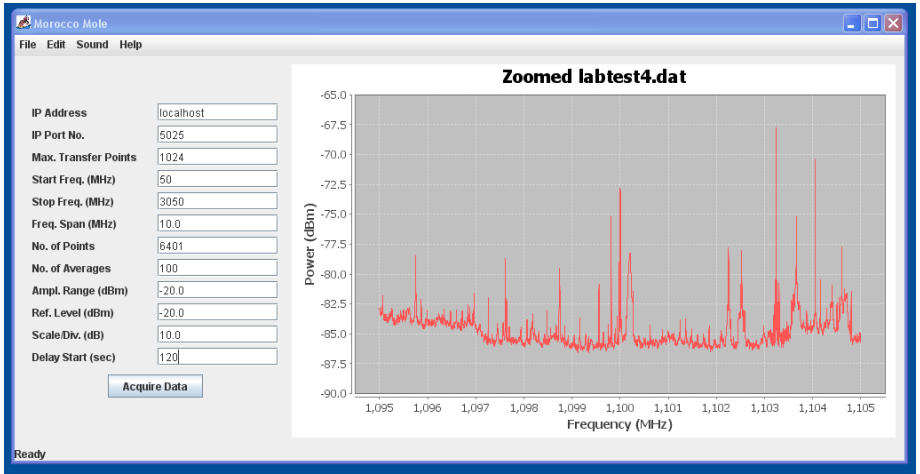
Amplifier and Cable Gain





Data Acquisition

- Agilent 9020 MXA signal analyzer with vector signal and swept spectrum analysis
- On board data Acquisition program
- Program features
  - Audio status, Graphical Status, Peak hold large sweep display, zoomable display
  - Acquisition Rate ~ 3 sec/ GHz-Sweep for a resolution Bandwidth of 6 kHz (need to check this again)
  - 1GHz of bandwidth at 6 kHz resolution bandwidth requires 640kB of storage. (MXA has over 10GB of spare storage space)



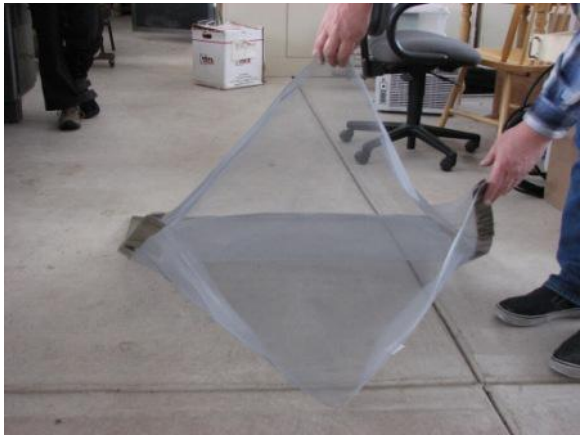
Power Source

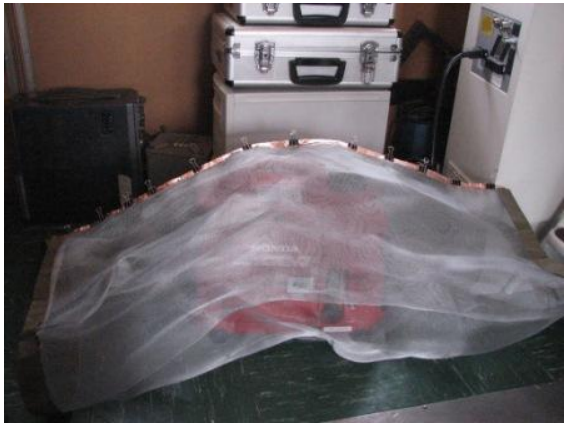
- Honda 4 cycle gasoline power generator
  - Can supply 900Watts of Power
  - MXA and amplifiers consume < 180Watts of Power
  - 8 hours of operation at 200 Watts require 2 liters of gasoline

RFI Shielding

- MXA and Generator will be inside double walled Ronco™ Shield bags
- Power cord between the generator and the MXA consists of RG8 coaxial pair with shields tied together and RFI filter at both ends of the cord.
- Shield bags will be grounded together with low distributed low inductance
- Antenna will be over 30 meters away from power generator
- Amplifier will be mounted on the antenna mast

Ronco Screen Bag*





*Technician not included

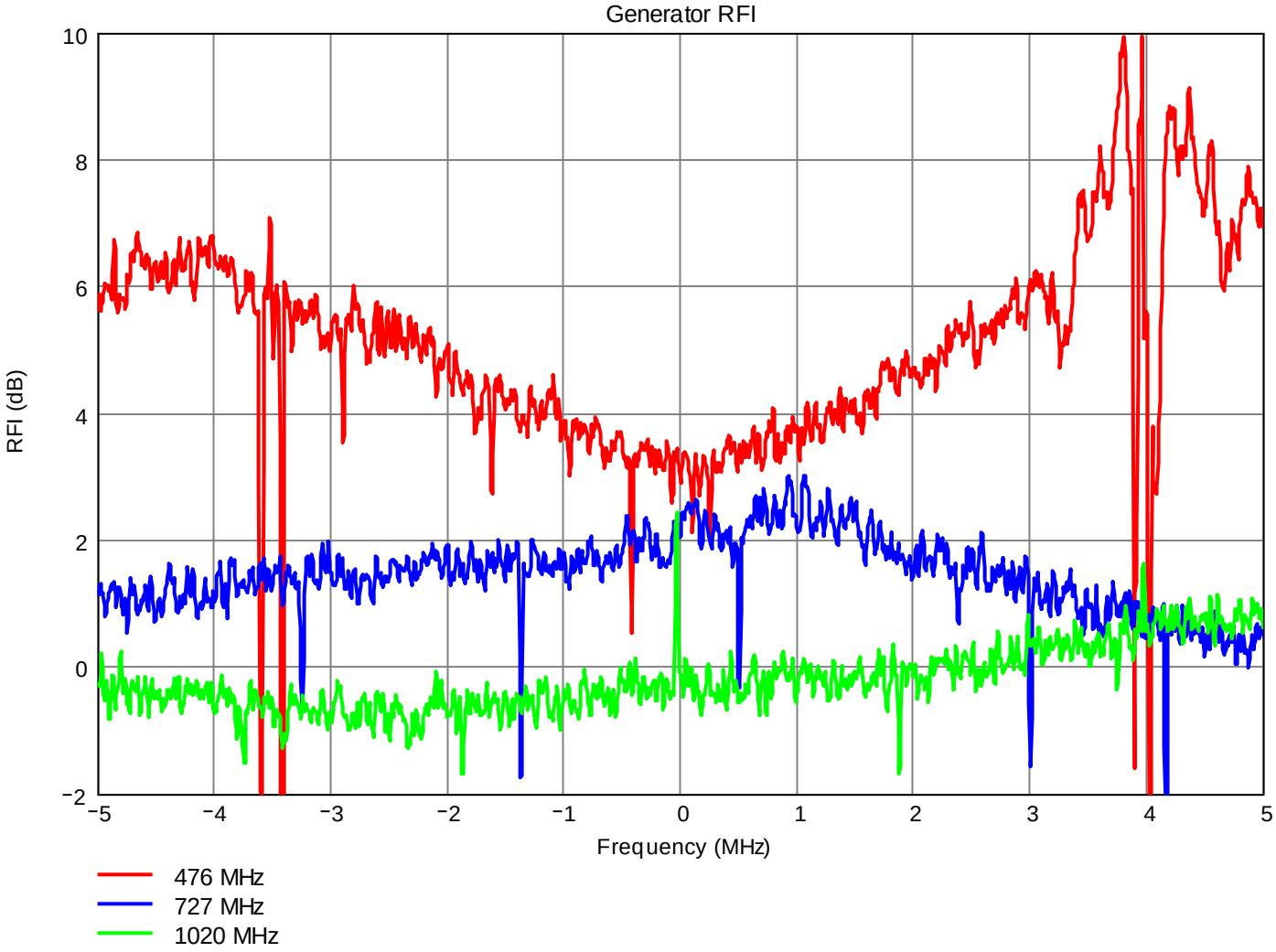
If ordered TODAY!

Gasoline Generator RFI

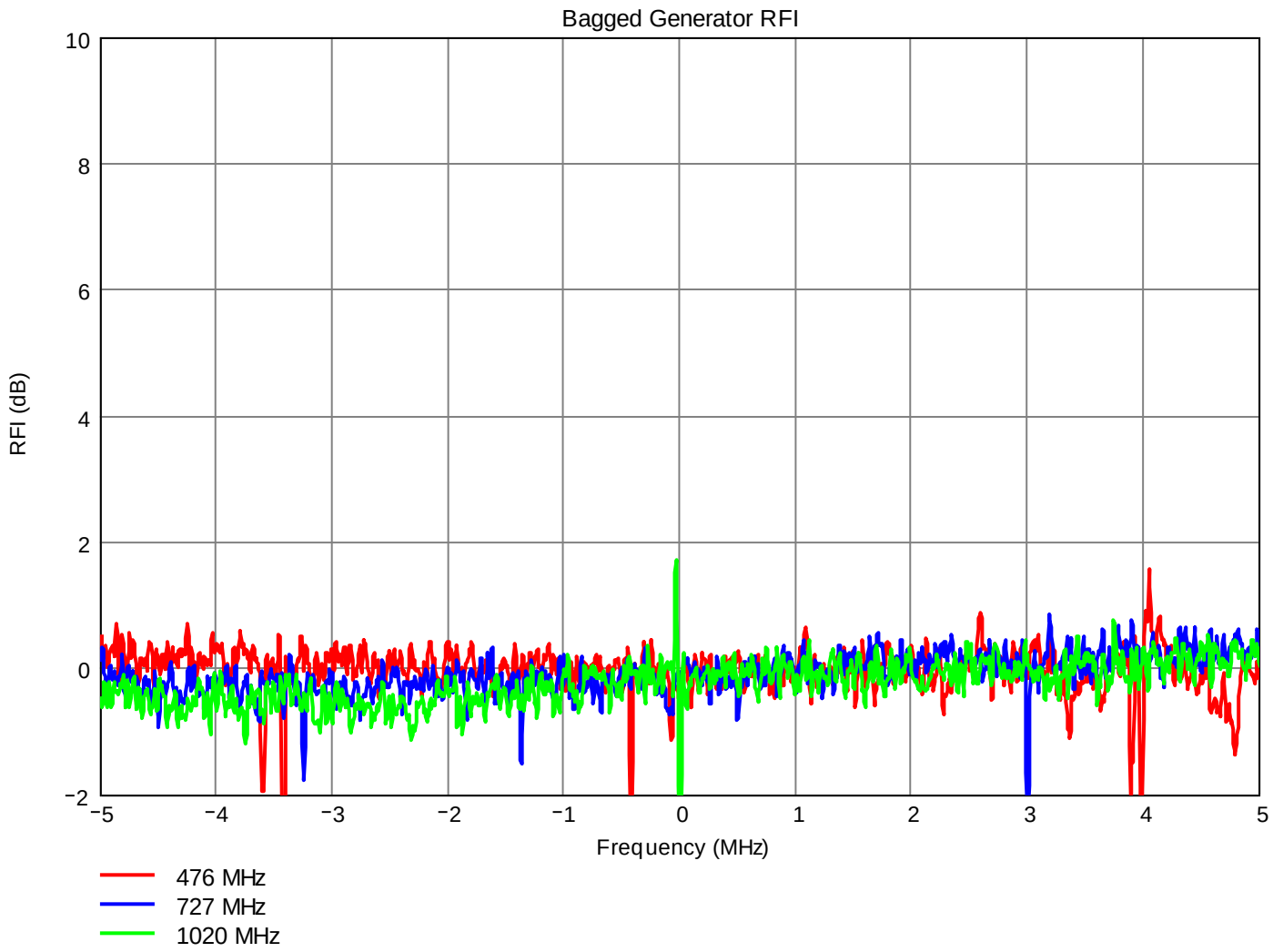
- Configuration
  - Measurements made inside a screen room
  - Discone antenna connected to a 40dB gain, 1db NF amplifier . Amplifier bandwidth 500 – 1000 MHz bandwidth
  - Antenna placed 1 meter away from generator
  - Made with Agilent Vector signal analyzer with a 10 MHz instantaneous bandwidth, a resolution bandwidth of 6.25 kHz, 1000 averages at three frequencies with low external RFI (476, 727, 1020 MHz)
- Measurements
  - Generator on with no screen bag
  - Generator on with screen bag
  - Generator off with screen bag

Generator RFI Test

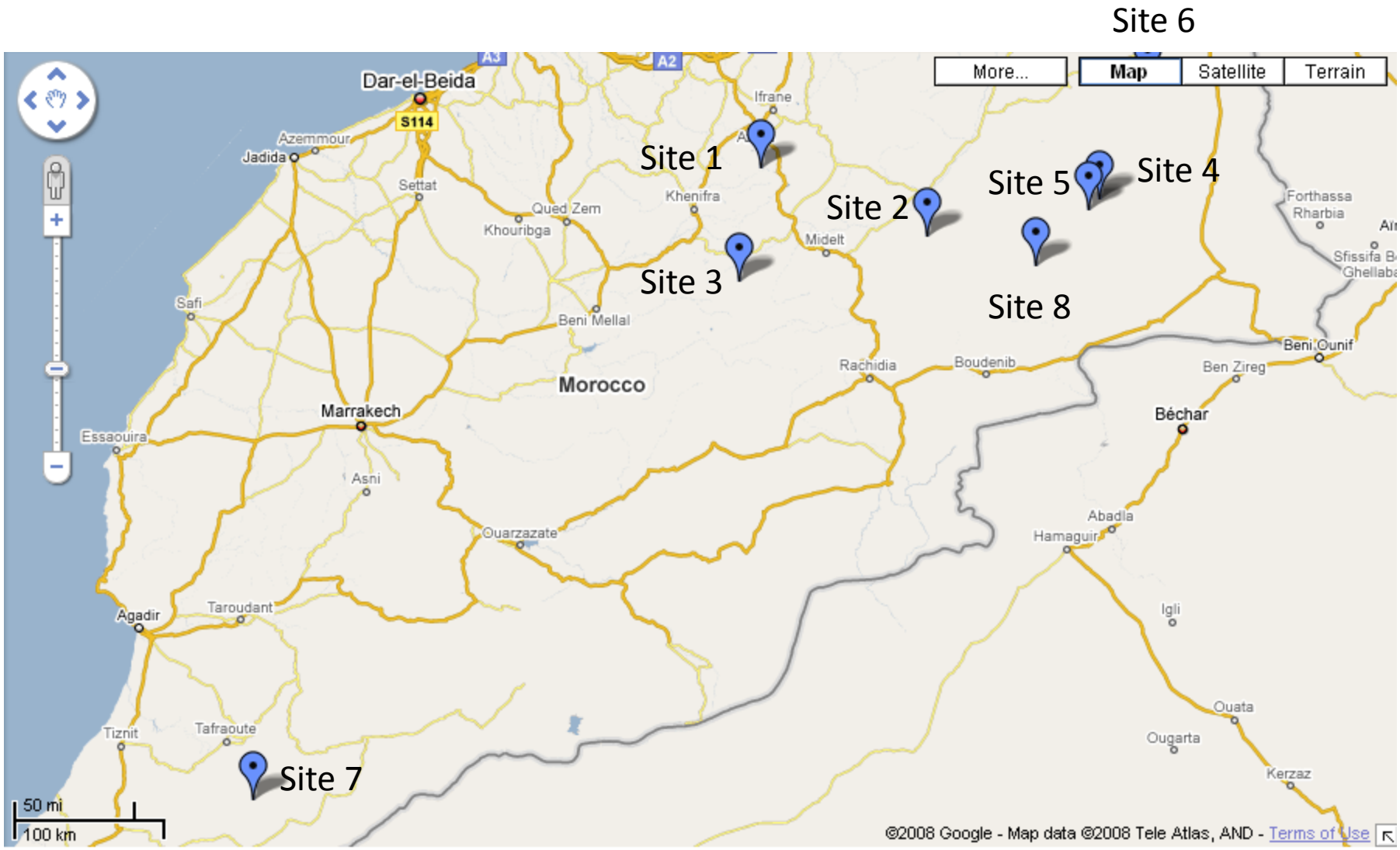
Unshielded Generator RFI



Shielded Generator RFI

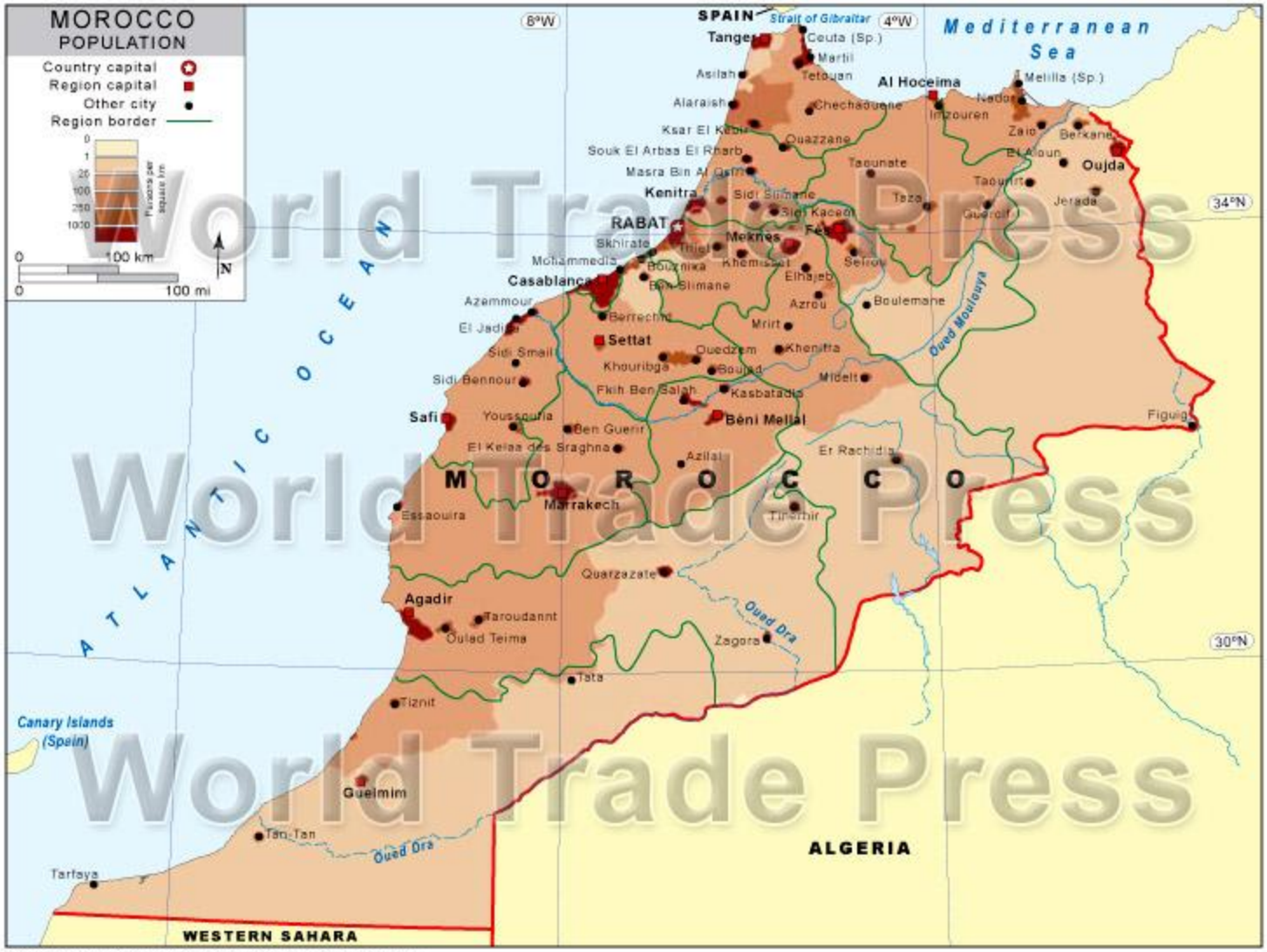


Site Candidates



http://maps.google.com/maps/ms?hl=en&ie=UTF8&oe=UTF8&msa=0&msid=110523762329473919365.00045c6ffcf421d4e8907

Candidates



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Site Candidates

Normalization

$$N = \frac{P(mW)}{G_{amp} R_{bw} \left(\frac{c}{f}\right)^2 \frac{D}{4\pi} \frac{1000mW}{W}}$$

G_{amp} = Amplifier Gain x Cable Loss

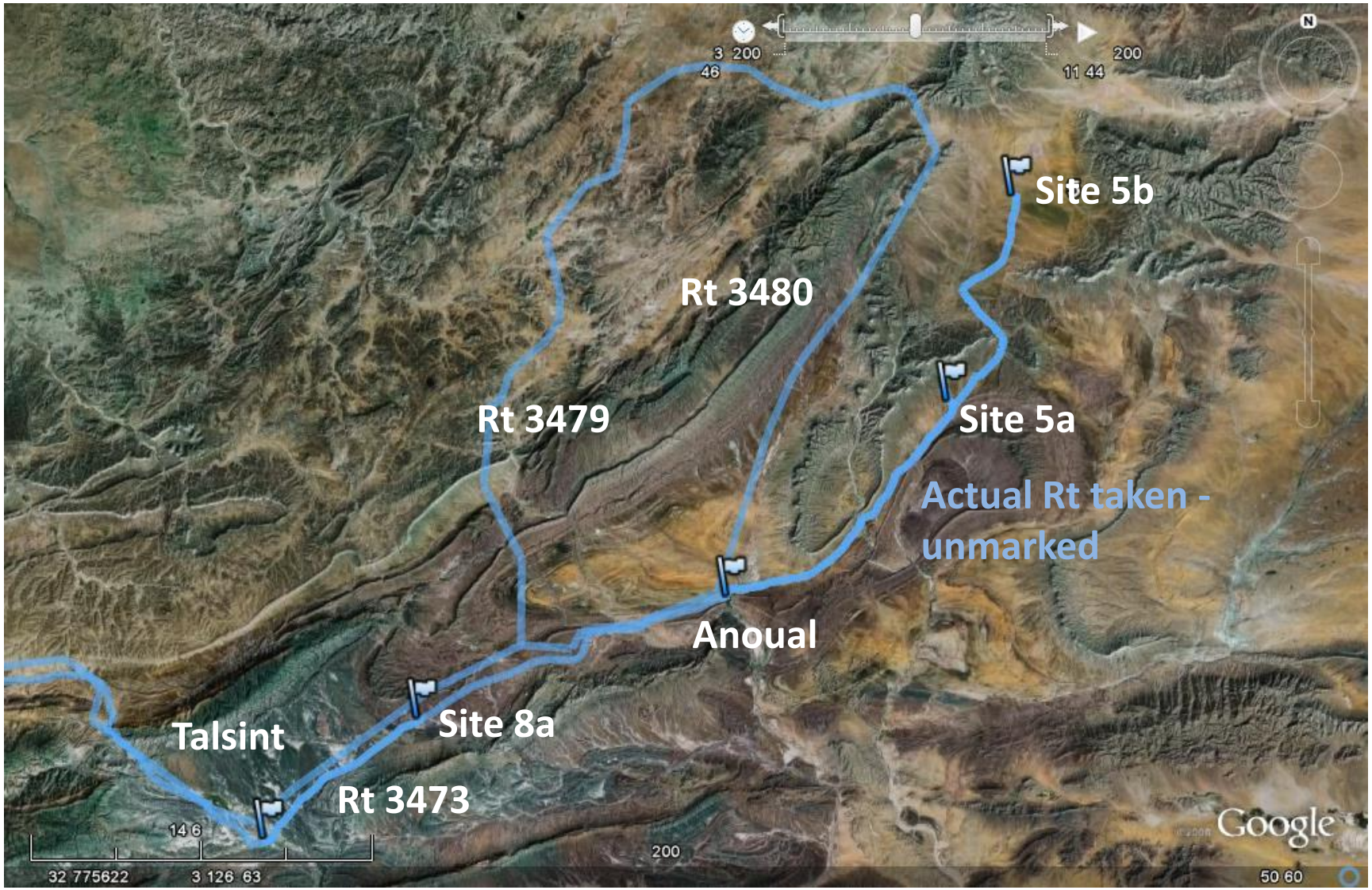
R_{bw} = Resolution Bandwidth of the spectrum (25kHz)

$\left(\frac{c}{f}\right)^2 \frac{D}{4\pi}$ = Area of the antenna

D=2dBi (Discone)

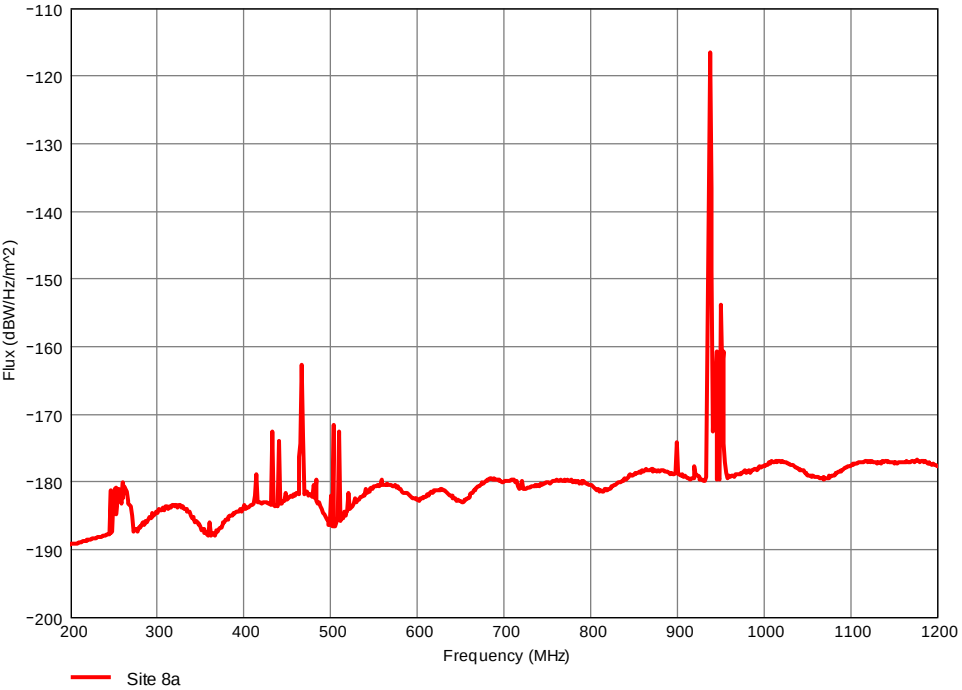
D=11dBi(Log Periodic) (~5dB half space)

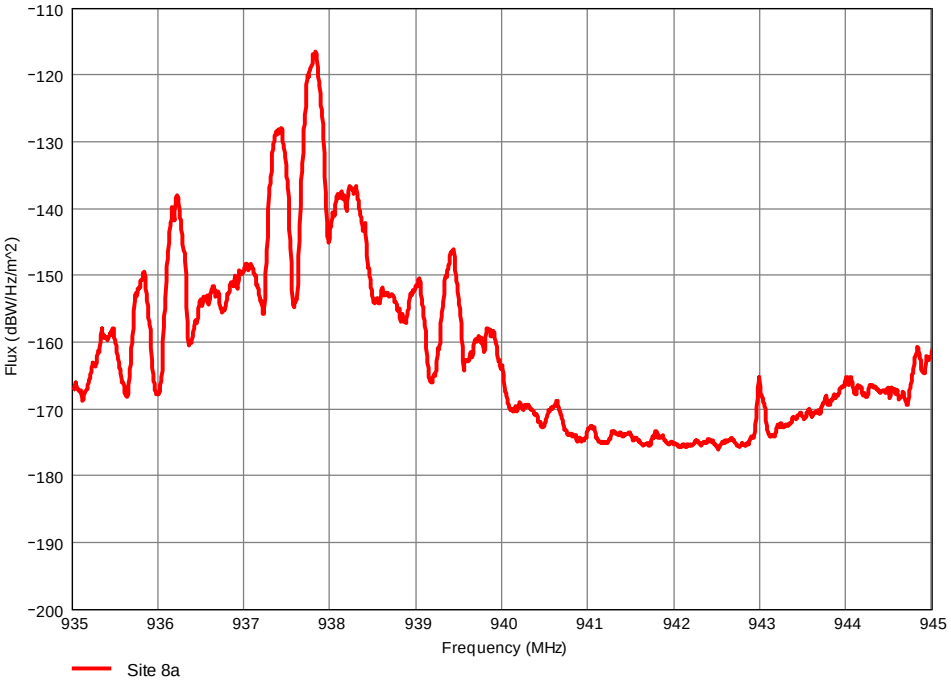
Measured Sites



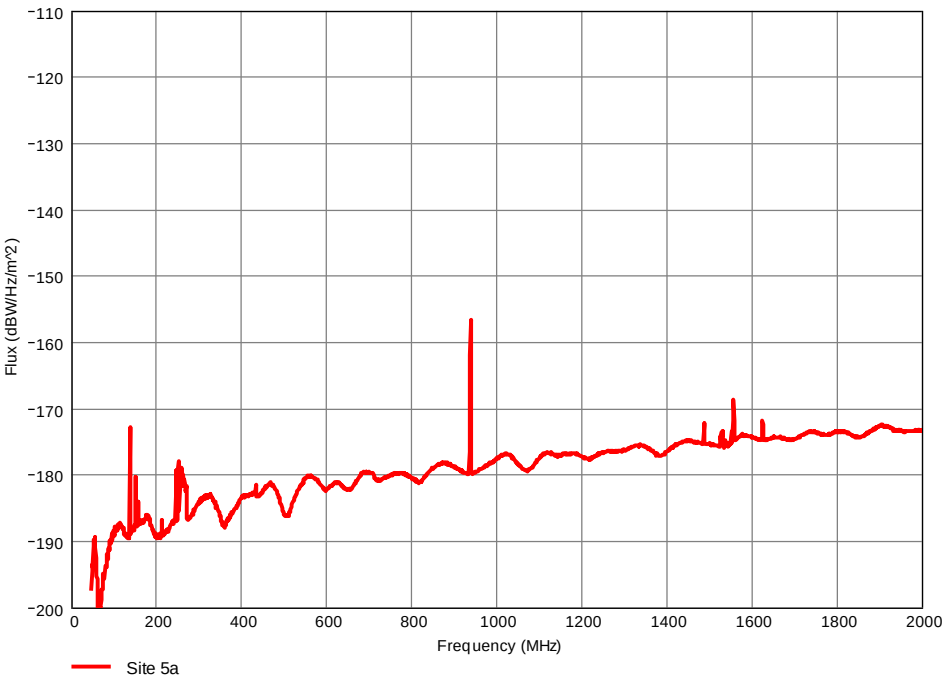
Site 5a

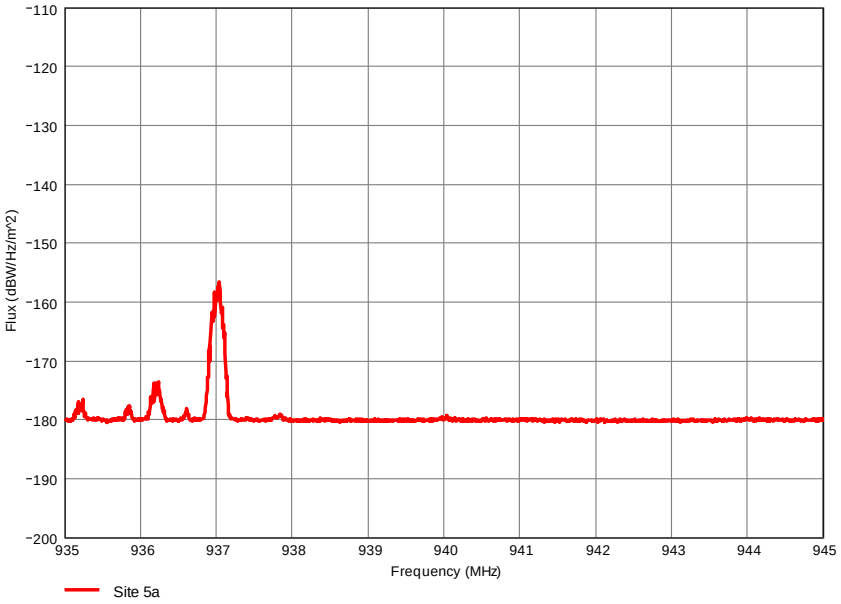
Site 8a


−110
−120
−130
−140
−150
−160
−170
−180
−190
−200
Flux (dBW/Hz/m^2)
200
300
400
500
600
700
800
900
1000
1100
1200
Frequency (MHz)
Site 8a

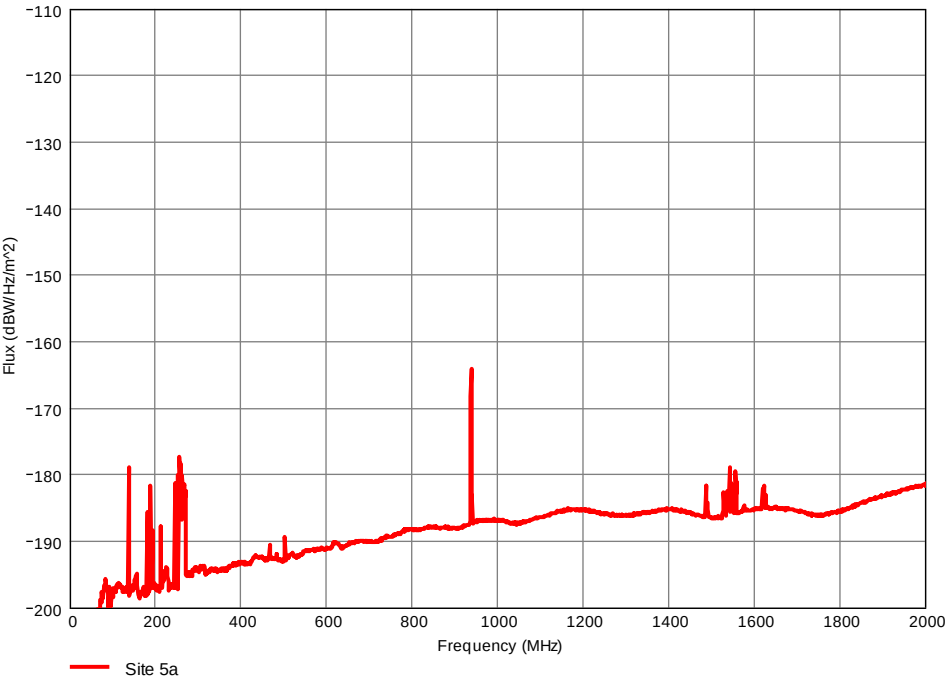

−110
−120
−130
−140
−150
−160
−170
−180
−190
−200
Flux (dBW/Hz/m^2)
935
936
937
938
939
940
941
942
943
944
945
Frequency (MHz)
Site 8a

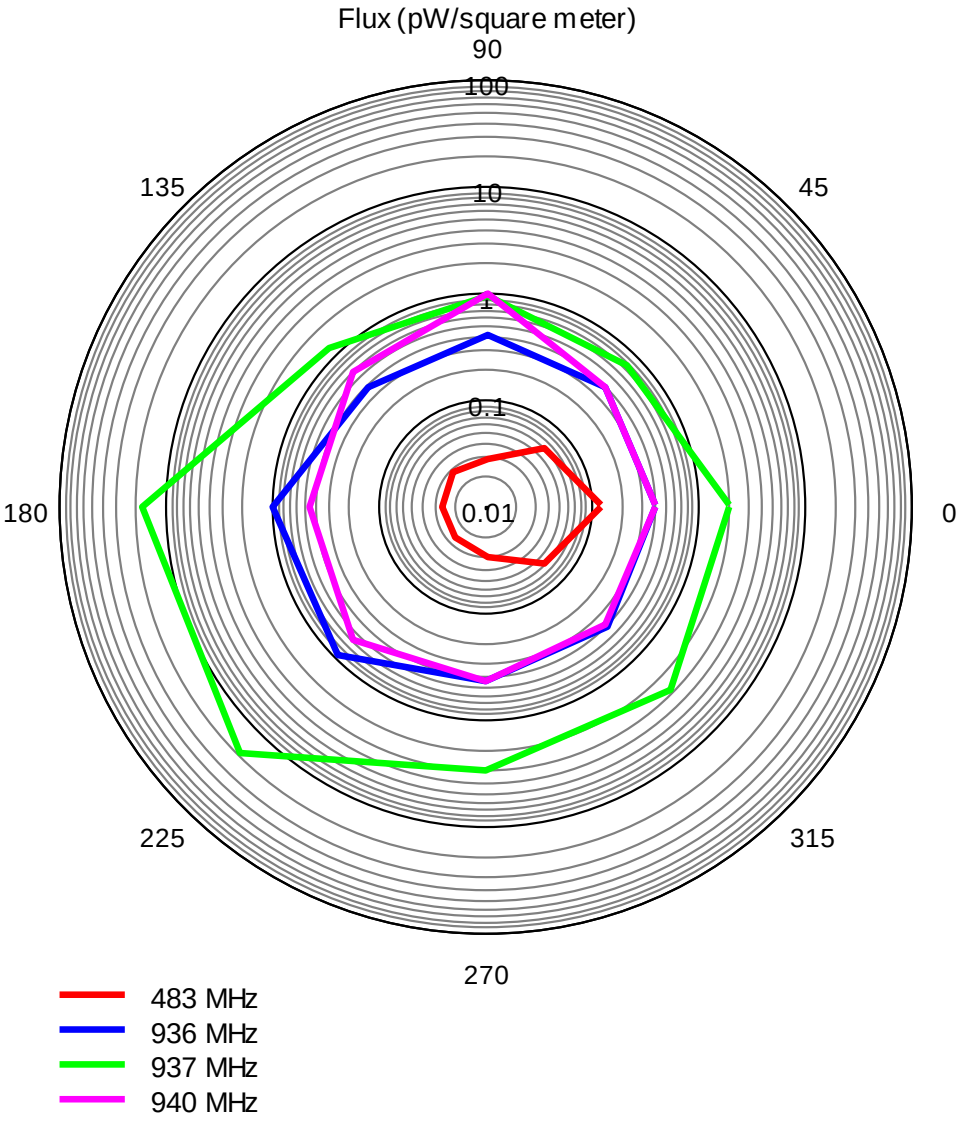
Site 5a


−110
−120
−130
−140
−150
−160
−170
−180
−190
−200
Flux (dBW/Hz/m^2)
0
200
400
600
800
1000
1200
1400
1600
1800
2000
Frequency (MHz)
Site 5a


−110
−120
−130
−140
−150
−160
−170
−180
−190
−200
Flux (dBW/Hz/m^2)
935
936
937
938
939
940
941
942
943
944
945
Frequency (MHz)
Site 5a

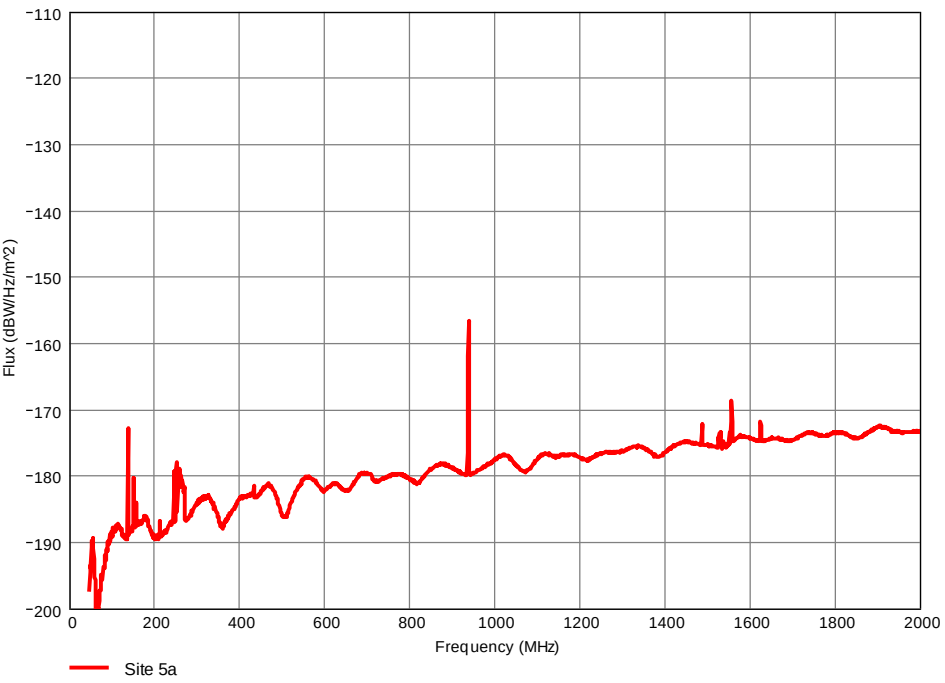
Site 5a Directional Measurements

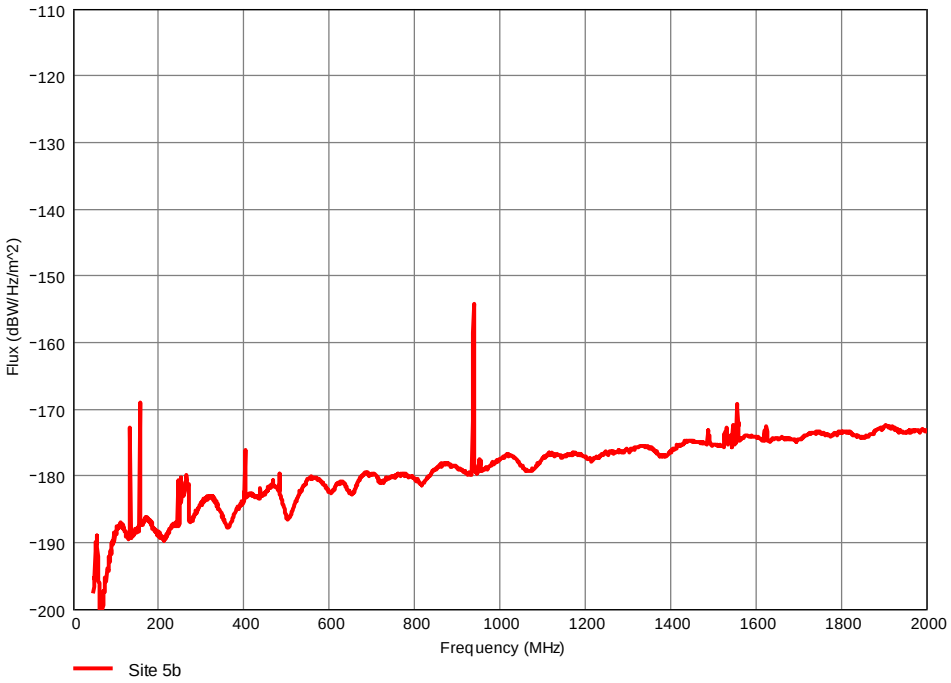




Night Measurements

Site 5a and 5b

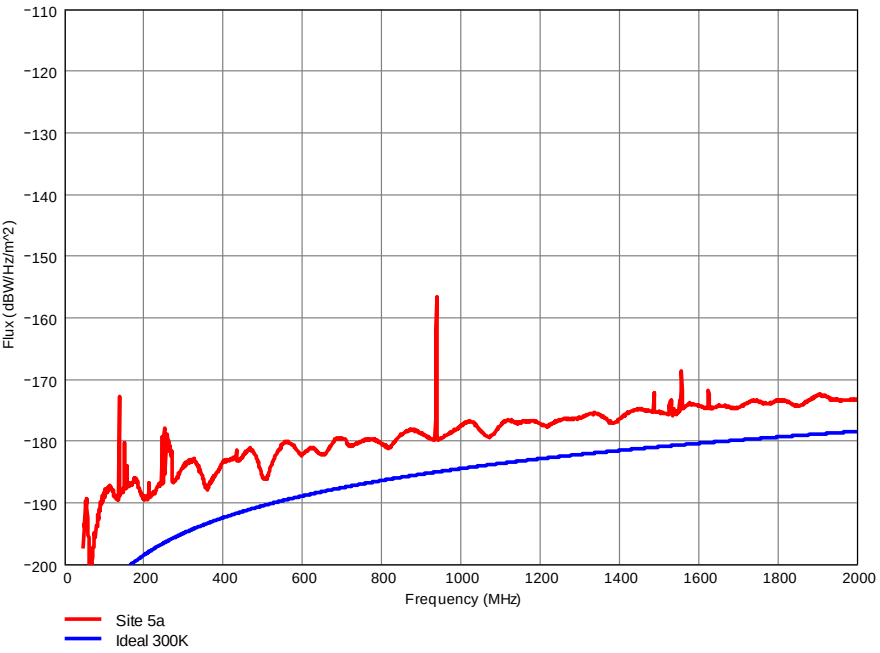


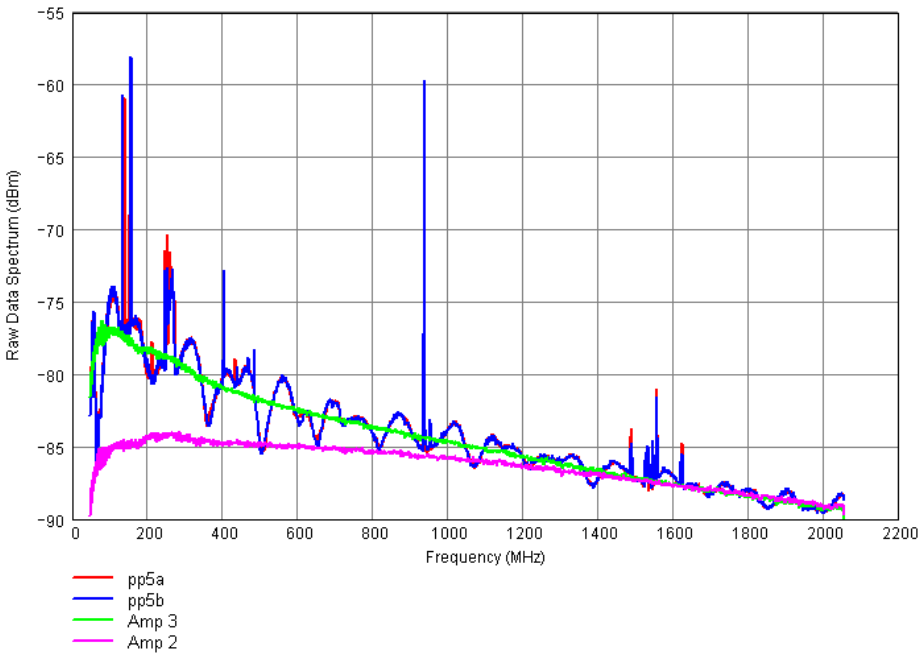


Measurements

File Name	Date	Latitude degees N	Longitude degrees W	Elevation m	Antenna	Pointing	Start Freq MHz	Stop Freq MHz	Step Freq kHz
pp8a	1/6/2009 16:55	32.60925	3.32593	1360	Discone	All	245	1255	6.25
pp5a	1/7/2009 16:54	32.79833	2.93024	1303	Discone	All	45	2055	1.5625
pp5aSS	1/7/2009 18:15	32.79833	2.93024	1303	Log Per	South	45	2055	6.25
pp5aWW	1/7/2009 19:28	32.79833	2.93024	1303	Log Per	West	45	2055	6.25
pp5aNN	1/7/2009 20:29	32.79833	2.93024	1303	Log Per	North	45	2055	6.25
pp5aEE	1/7/2009 21:23	32.79833	2.93024	1303	Log Per	East	45	2055	6.25
pp5aNE	1/7/2009 22:15	32.79833	2.93024	1303	Log Per	North East	45	2055	6.25
pp5aSE	1/7/2009 23:08	32.79833	2.93024	1303	Log Per	South East	45	2055	6.25
pp5aSW	1/8/2009 0:00	32.79833	2.93024	1303	Log Per	South West	45	2055	6.25
pp5aNW	1/8/2009 0:51	32.79833	2.93024	1303	Log Per	North West	45	2055	6.25
pp5b	1/8/2009 12:04	32.92462	2.87838	1465	Discone	All	45	2055	6.25

Noise Performance



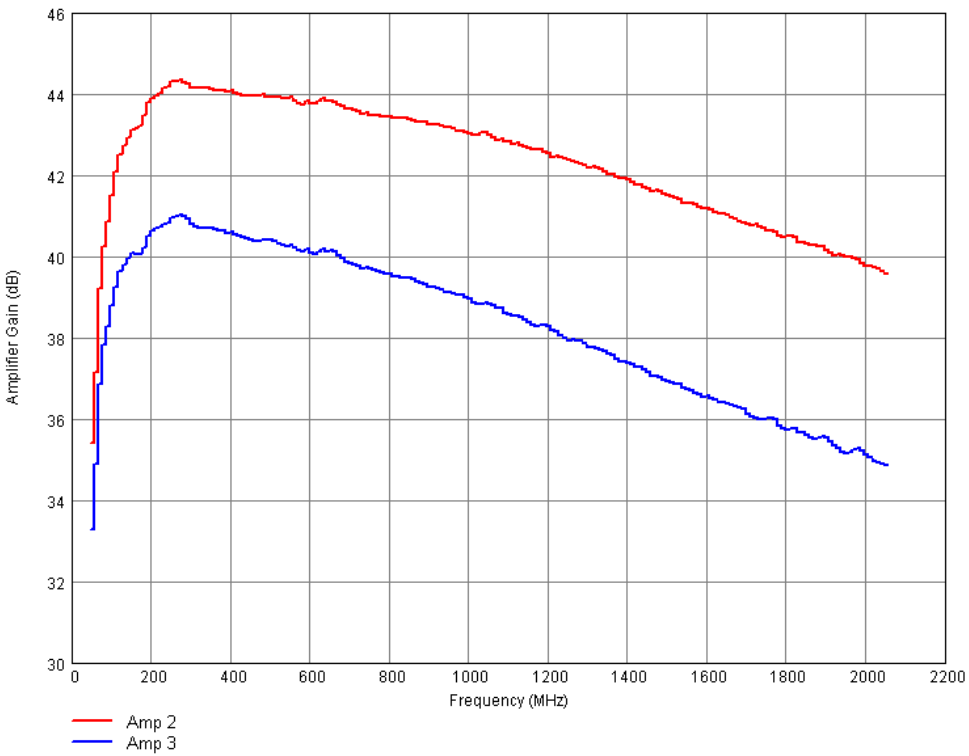


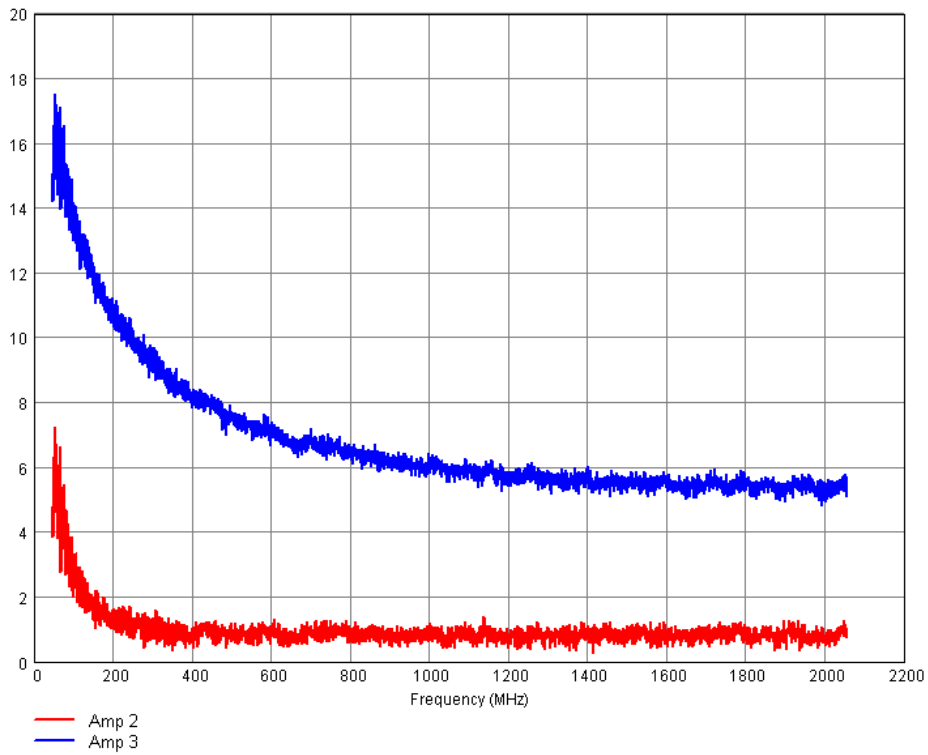
Amplifier Gain and Cable loss

- The amplifier used “lost” 5 dB of Gain during transit to Morocco
- Amp 3 was the amplifier used in Morocco.
- Amp 2 was the spare amplifier on the same plate.
- Before the trip to Morocco, both amplifiers had very similar gain.
- The measurement includes 100 ft of cable after the amplifier used during the measurements
- The loss of gain seemed to occur on the front end of the amp so the noise figure increased significantly

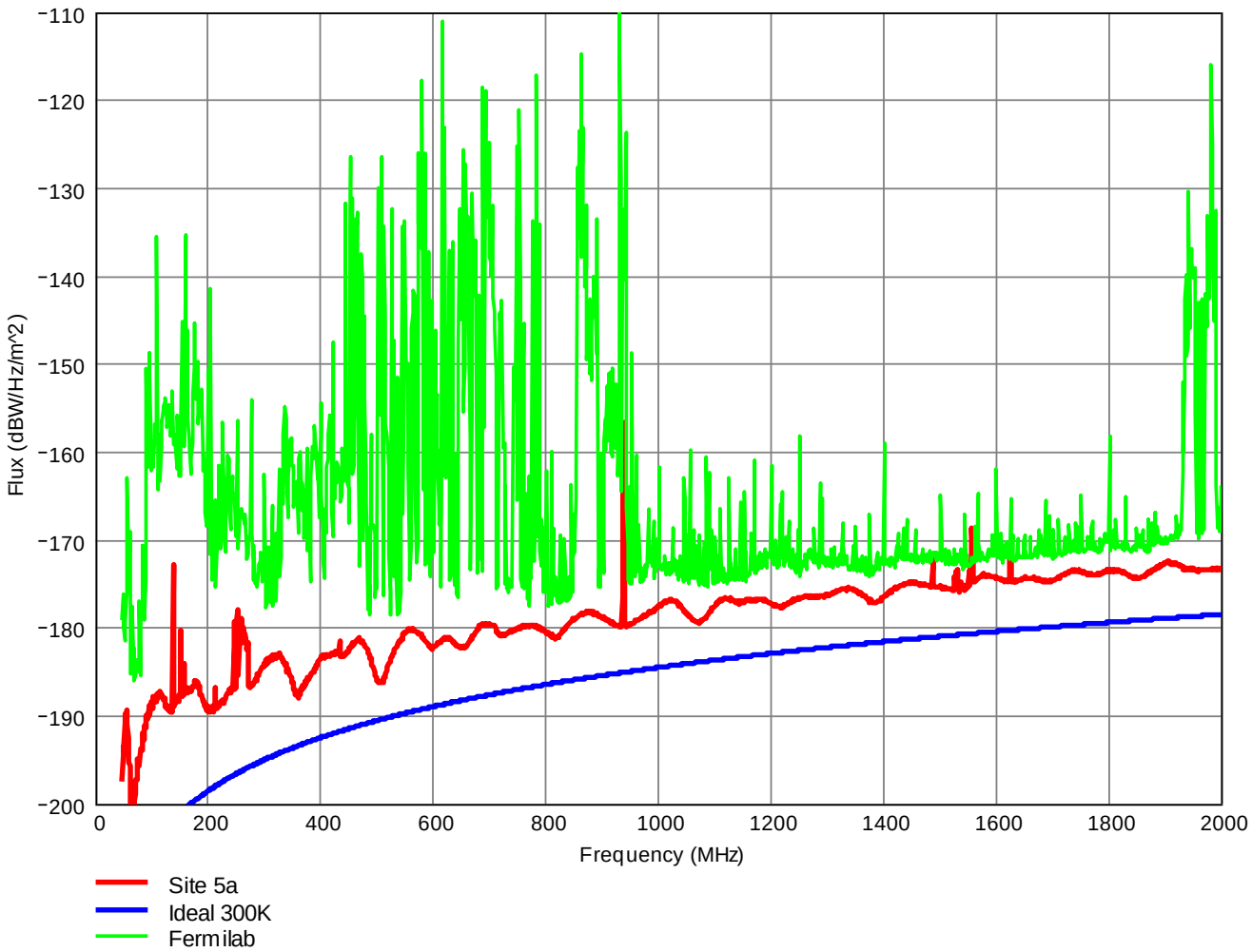
Amplifier Noise

- The loss of gain seemed to occur on the front end of the amp so the noise figure increased significantly





Summary


-110
-120
-130
-140
-150
-160
-170
-180
-190
-200
Flux (dBW/Hz/m^2)
0
200
400
600
800
1000
1200
1400
1600
1800
2000
Frequency (MHz)
Site 5a
Ideal 300K
Fermilab