RFI Test - UPRM GPS Station
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1 Introduction

This document shows RFI test info and results for the UPRM GPS Station - Geology. The test was performed using an electric field probe (ETS 7405 No.904) from 0 to 3.5GHz on Tue, 15 Sep 2015. This test was requested by Angel Vazquez.

Figure 1: UPRM GPS Receiver Test Setup

Figure 2: UPRM GPS Receiver Battery Charger

2 Test Equipment

Agilent E4445A Spectrum Analyzer:

- Trace 1: Clear Write, Average ON, 20 spec.
- Trace 2: Max Hold.
- Trace 3: Min Hold.
- RBW & VBW 39kHz, sweep 100.5ms.
- 8192 points per spec.
- Internal Amplifier ON.
- 6dB Attenuation.
- SCPI Commands from Python.

ETS Model 7405[1] probe No.904:

- Electric field.
- Res. Freq. >1.0GHz.
- H/E Rejection 30dB.
- Performance: Fig. 3.
- + 15ft coax cable

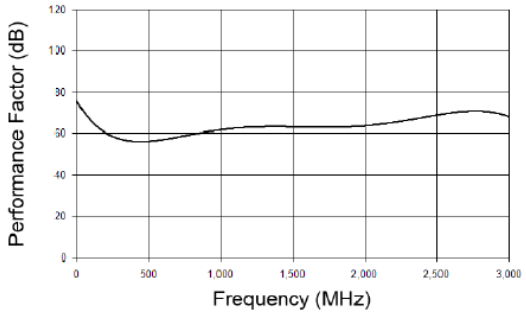

Figure 3: Probe No. 904 Performance.

3 Test Procedure

- We tested four components of the UPRM GPS Receiver, Fig. 1, GPS Receiver Unit (right), GPS Antenna (left), GPS Power Adapter (center); Fig. 2, GPS Battery Charger for Solar Panel (inside the case).
- Agilent E4445A Spectrum Analyzer preheated for more than 30min, outside of the screen room.
- Thirty (35) 100MHz bandwidth scans (12.207kHz per channel), from 0 to 3500MHz, electric field.
- Ten (10) seconds "integration" time.
- Screen/shielded room front door closed. Fluorescent lights ON.
- A/C ON, eth. switch OFF, 10MHz buffer OFF, 10MHz ref. cable disconnected.
- 430MHz and S-band transmitters OFF.

4 Test Results

- **GPS Receiver Unit:** receiver connected to GPS antenna and power adapter, separated around 1ft. No battery charger connected. E-field probe 904 in front of LCD display. See results in Table 1 and Fig. 4.
- **GPS Antenna:** same setup of receiver unit, but E-field probe 904 on top of the GPS Antenna, centered. See results in Table 2 and Fig. 5. No noticeable emissions above 1.5GHz.
- **GPS Power Adapter:** same setup of receiver unit, but E-field probe 904 on top of the GPS Power Adapter. See results in Table 3 and Fig. 6. No noticeable emissions above 1.5GHz.
- **GPS Battery Charger:** receiver connected to GPS antenna, no power adapter, instead battery charger. E-field probe 904 on top of battery charger. See results in Table 4 and Fig. 7. No noticeable emissions above 1.5GHz.
- Clear write trace in plots below, black line. Peaks in blue are RF emissions outside of our frequency coverage (327MHz receiver, 430MHz receiver, and more than 1150MHz). Red peaks for emissions probably causing interference at the radio-telescope.

5 Discussion

- The Received is the most noisy component, mostly at lower frequencies. 327MHz and 430MHz receiver could be affected. There is a strong L-band emission at 1389.99MHz, and few more above with less power.
- The Antenna looks better, despite there is a 1247.705MHz emission.
- The Power Adapter looks ok, just few emissions around 1.2GHz.
- The Battery Charger shows one peak at 325MHz, and few more around 1.4GHz.

6 Recommendations

- For the GPS station installed at the RFI hilltop monitor, it's recommended to install the Receiver and Power Adapter inside the RFI shack. No solar panel.
- If GPS station at the helipad (Solar Panel and Battery Charger, no Power Adapter) is approved for installation, we have to looks carefully for interference in L-band and S-band with the radio-telescope.

References

[1] ETS LINDGREN, *ETS Near-Field Probe Set Model 7405*.

Table 1: UPRM GPS - Receiver Emissions

Frequency (MHz)	Amplitude (dBm)
312.280	-99.64
312.769	-98.83
312.915	-98.66
313.013	-100.53
313.550	-100.88
313.574	-100.58
313.660	-96.13
313.806	-98.89
314.868	-99.59
314.941	-98.62
...	...
330.652	-99.75
331.714	-96.96
332.373	-99.71
333.740	-100.10
333.850	-101.13
334.875	-100.53
335.022	-100.16
335.767	-100.52
335.938	-99.75
339.075	-101.23
422.205	-98.58
422.852	-99.03
423.486	-97.74
424.878	-99.06
425.525	-97.49
426.904	-99.21
429.565	-100.61
432.898	-100.53
436.304	-100.95
439.612	-100.86
1389.990	-81.62
1412.988	-102.55
1440.002	-99.40
1600.000	-100.95
1649.988	-102.00
2779.993	-101.33
2879.993	-100.35

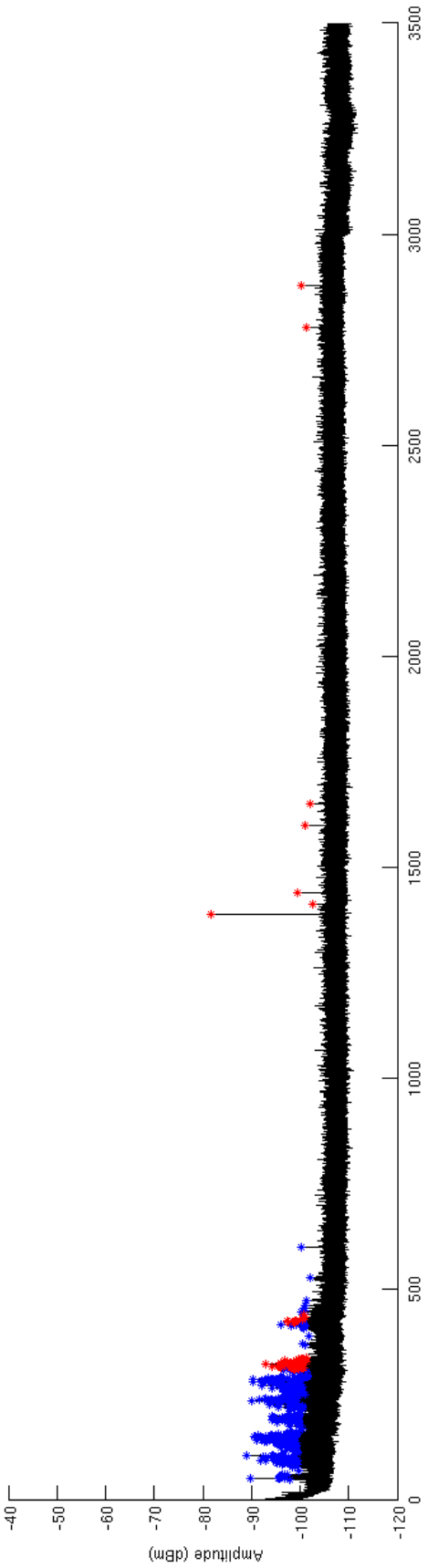

Figure 4: UPRM GPS - Receiver, Red Peaks Only

Table 2: UPRM GPS - Antenna Emissions

Frequency (MHz)	Amplitude (dBm)
2.563	-85.69
2.686	-87.37
30.884	-98.95
107.251	-93.48
917.139	-102.30
1247.705	-97.29

Figure 5: UPRM GPS - Antenna Emissions

Table 3: UPRM GPS - Power Supply Emissions

Frequency (MHz)	Amplitude (dBm)
19.800	-90.90
20.068	-90.65
20.129	-91.40
20.166	-91.53
61.890	-92.15
107.288	-94.68
225.000	-97.18
275.000	-97.02
1224.634	-102.57
1286.023	-97.31
1286.108	-100.64
1286.206	-98.45
1286.377	-100.89

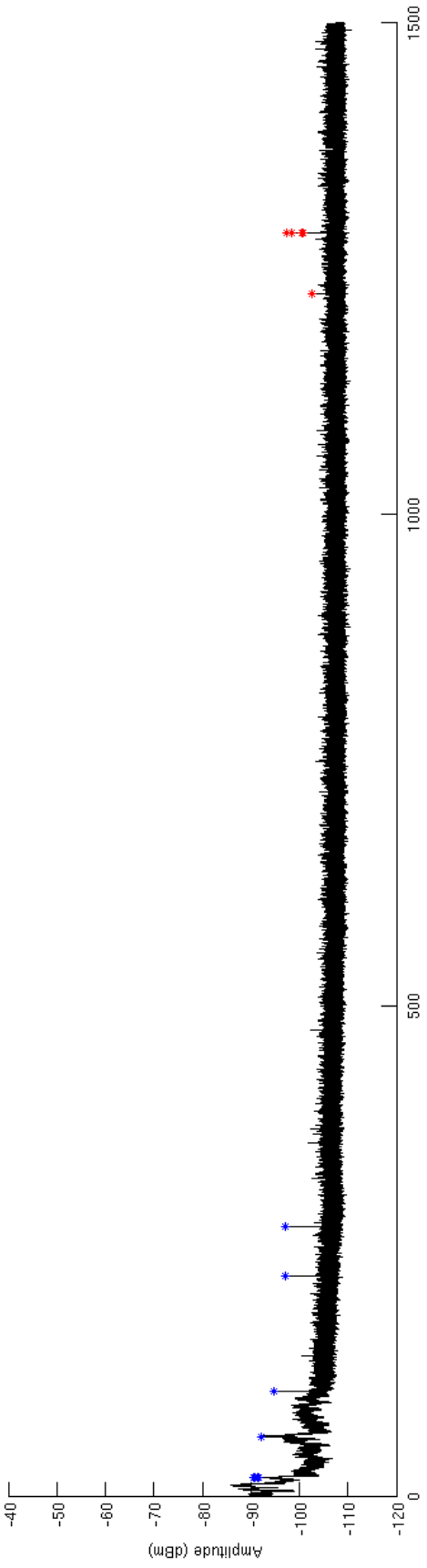

Figure 6: UPRM GPS - Power Supply Emissions

Table 4: UPRM GPS - Battery Charger Emissions

Frequency (MHz)	Amplitude (dBm)
10.132	-96.01
14.221	-97.12
16.138	-97.12
16.687	-97.45
17.224	-96.42
17.786	-96.67
107.288	-99.20
107.361	-99.13
125.000	-96.77
150.000	-99.00
174.988	-86.99
200.000	-99.26
225.000	-89.01
249.988	-98.38
275.000	-95.77
325.000	-93.81
349.988	-101.12
374.988	-89.64
475.000	-96.40
500.012	-86.52
525.000	-100.26
532.593	-93.11
699.988	-101.97
700.024	-101.84
750.000	-96.63
799.988	-101.63
850.000	-102.89
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1440.002	-102.27
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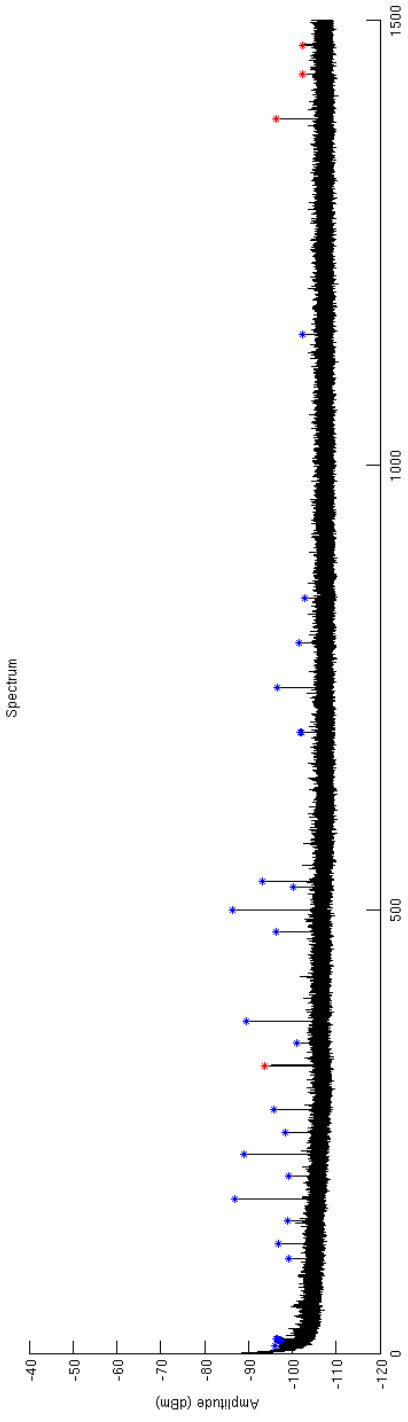

Figure 7: UPRM GPS - Battery Charger Emissions