Final Spectral Analysis of first Generation Mitsubishi BPL Hardware in Cottonwood, AZ 3-9-2005

Six Month Report - Call Sign WD2XMB
0007-EX-AL-2004

MTI is in the process of phasing out the current Mitsubishi hardware being used in our Cottonwood trial to install the next generation of hardware from Mitsubishi. We felt it critical to take one last look at the installed system before decommissioning the gear and document what we have learned from our initial trial of Broadband over Power Line Technology.

During the initial trial MTI learned how to install and maintain a BPL system including physical installation, RF mitigation and measurement, provisioning, and monitoring. During the trial we had many different challenges ranging from operation support to RF interference issues and we learned from all of them. The lessons learned have been shared with Mitsubishi and have been critical in the development of the next generation product.

Additionally MTI learned volumes about the RF characteristics of BPL and the importance of working with the HAM operators in investigating RF interference complaints. During the initial phases of the trial, there were countless complaints about RF interference from the local HAM group (the VVARA). Over the course of the trial MTI has worked very hard to accommodate the local HAM operators and has built a solid relationship with them as a result. MTI quickly became experts in the area of BPL power masking and spectrum shifting to make sure we did not interfere with the HAM operators or potentially transmit in the recently announced “excluded” frequencies. MTI has received a “clean bill of health” from the local HAM club in Cottonwood, AZ and will continue to strengthen our relationship with the amateur community as we deploy the next generation hardware.

MTI has gained valuable knowledge from our efforts during the trial of first generation BPL hardware from Mitsubishi. We have taken all the lessons learned and have worked hard with Mitsubishi to engineer a better product for the next generation deployment. MTI intends to replace the existing Mitsubishi BPL hardware with next generation BPL Hardware in April/May of 2005. Prior to this change MTI wanted to take sample RF measurements of the installed gear using the newly defined FCC Part 15 Rules to keep for historical documentation purposes.

The following Spectral Analysis was conducted on 3-9-2005 by MTI in Cottonwood, AZ. The tests were conducted at the following locations (+/- 10M due to GPS accuracy) and will be referred to by the BPL NODE NAME associated with the locations throughout this document:

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BPL NODE NAME	LAT	LONG
Sawmill Node 2	34.7286	-112.00266
Sawmill Node 4	34.72959	-112.00346

There will be no in depth analysis of these results as we intend to replace the hardware within the next 30-60 days.

All tests were performed using the following equipment:

1) Advantest R3132 9 kHz through 3 GHz Spectrum Analyzer
    a. Calibrated 5/2004
2) EMCO 6502 20" Magnetic Loop Antenna for frequencies through 30 MHz
    a. Calibrated 10/2004

All test results were analyzed using the following software tools:

1) Dell Latitude D600 running Windows XP Pro
2) SoftPlot Measurement Presentation Software for GPIB Instruments
    a. version 5.0.79
    b. Connected to Advantest R3132 via Serial Cable
3) End to end Ping test were running during all RF measurements and verified at our Network Control Center.
    a. Ping was run using 1000 byte packets

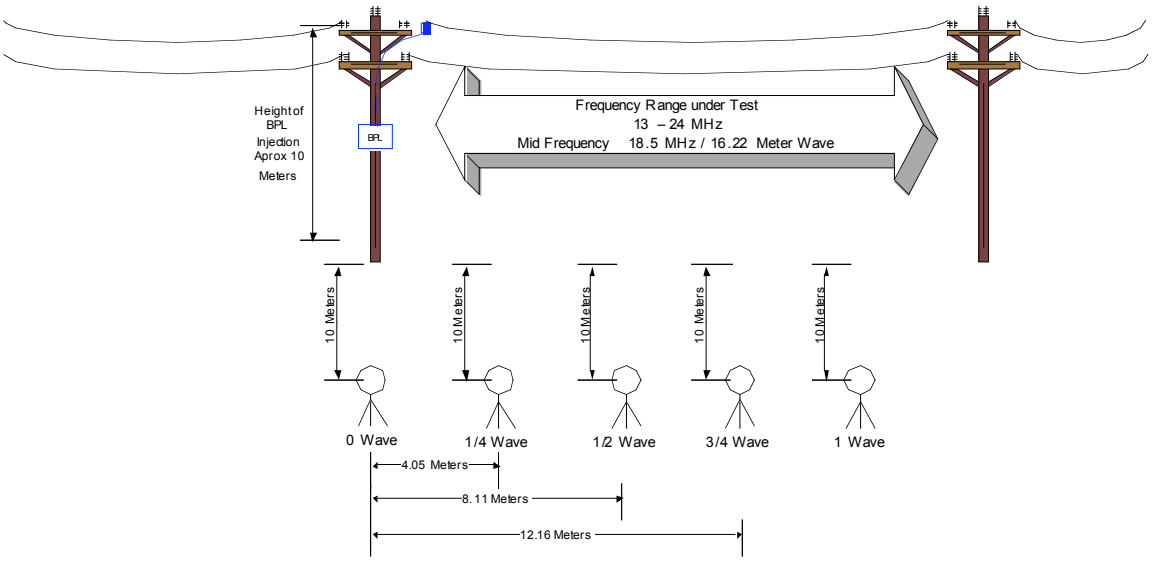
Pole Mounted – Overhead Access BPL test were performed using the following guidelines:

1) Frequency to be tested was determined by the frequency range in use by the BPL node installed at the point of test.
    a. Mid frequency was determined based on the frequency range
    b. The wave length of the mid frequency was determined using the formula of: (300/Mid Frequency)
2) Based on Wavelength, we de points of measurement at 0 Wave, ¼ Wave, ½ Wave, ¾ Wave and 1 Wave.
    a. Points of measure were then determined based on FCC Part 15 rules, specifically we made sure to adhere to the following guideline
        i. Where lowest frequency used by EUT is less than half of mid frequency of EUT, continue measuring until distance equal

to ½ wave of lowest frequency 10 Meters from base of utility pole in the case of pole mount BPL equipment

1. In our specific overhead test, we did not encounter a need to measure beyond a full wave

3) Once points of measure were identified, the antenna height was set at 3M and aligned parallel to the BPL node and associated overhead utility line.
   a. Antenna was place at 10 Meters from the BPL node on the pole for 0 Wave
   b. Antenna was moved parallel to the overhead line under test to the predetermined ¼, ½, ¾ and Full Wave locations maintaining antenna height of 3 Meters and distance from overhead line of 10 meters.
      i. A diagram of our overhead testing setup is below:



4) Spectrum Analyzer setup for the Overhead testing of Sawmill BPL Node 2 was as follows:
   a. Freq range was 13MHz to 24MHz which encompassed operating frequencies of the Sawmill BPL Node 2
   b. Quasi Peak detection was used
   c. RBW was set at 9 kHz
   d. VBW was set at 30 kHz
   e. Sweep time was set at 180 seconds
   f. The application used to capture Spectrum Analyzer readings performed a full sweep and hold process prior to capturing data to ensure we had data from current test and not data from prior test.

5) Test results[1]
    a. Following are test results form the overhead pole mount Sawmill Node 2

[1] Note: Spikes in graphs are discrete signals, likely short wave or amateur transmissions, not BPL broadband signals which have a broad spectrum signature.

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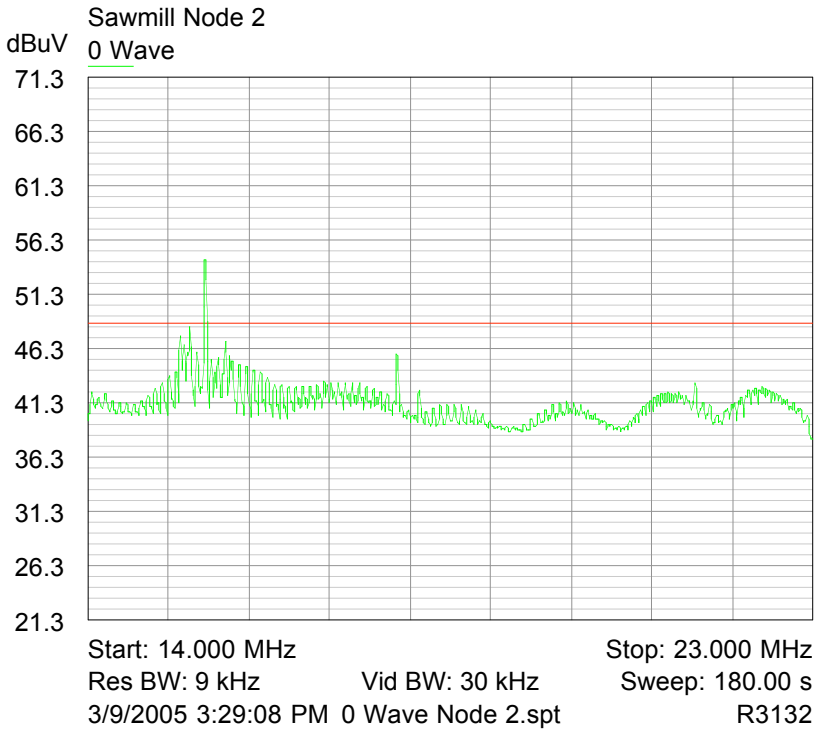
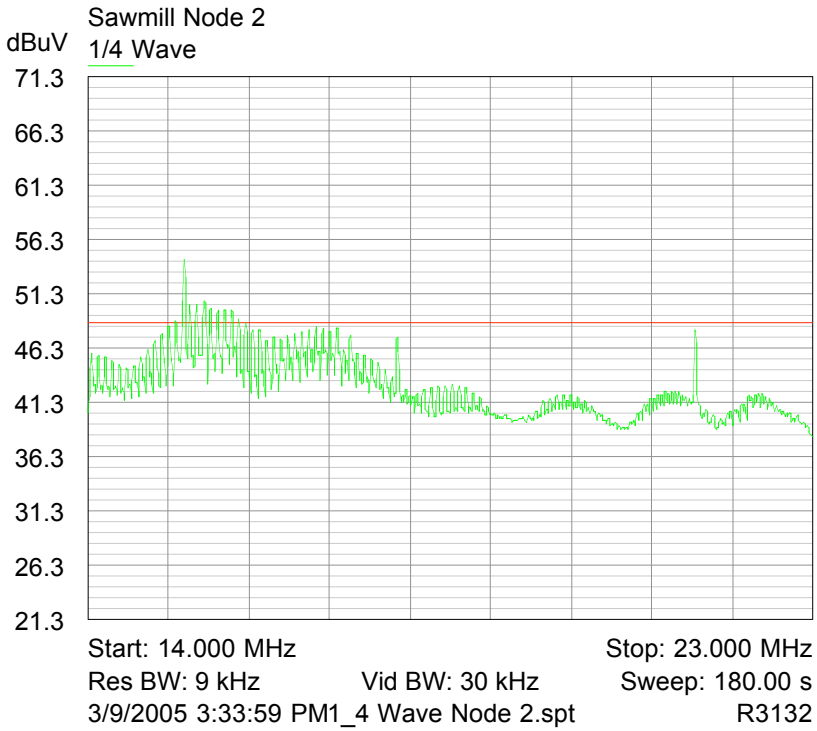
0 Wave Results



¼ Wave Results



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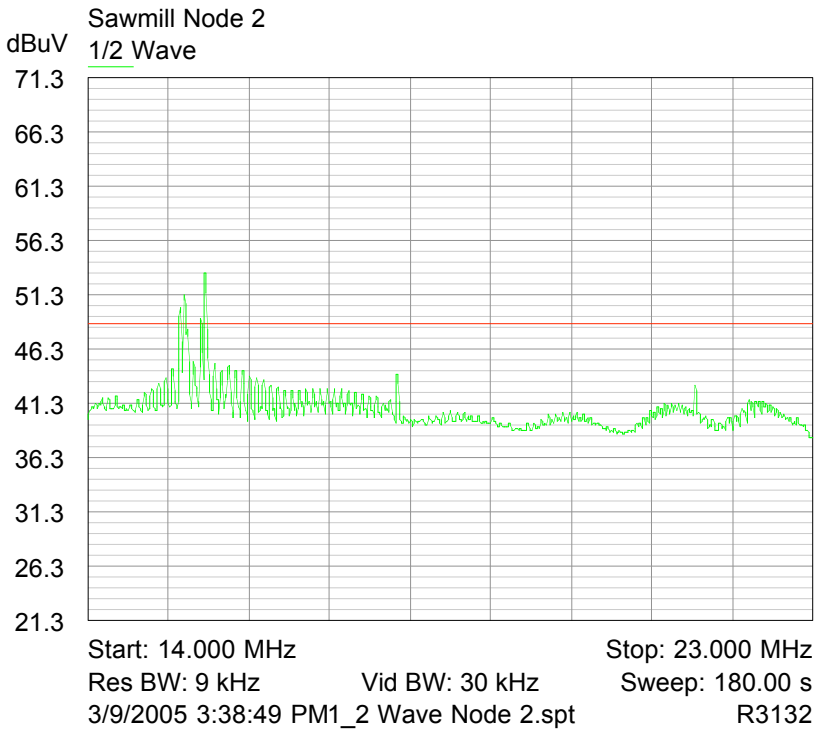
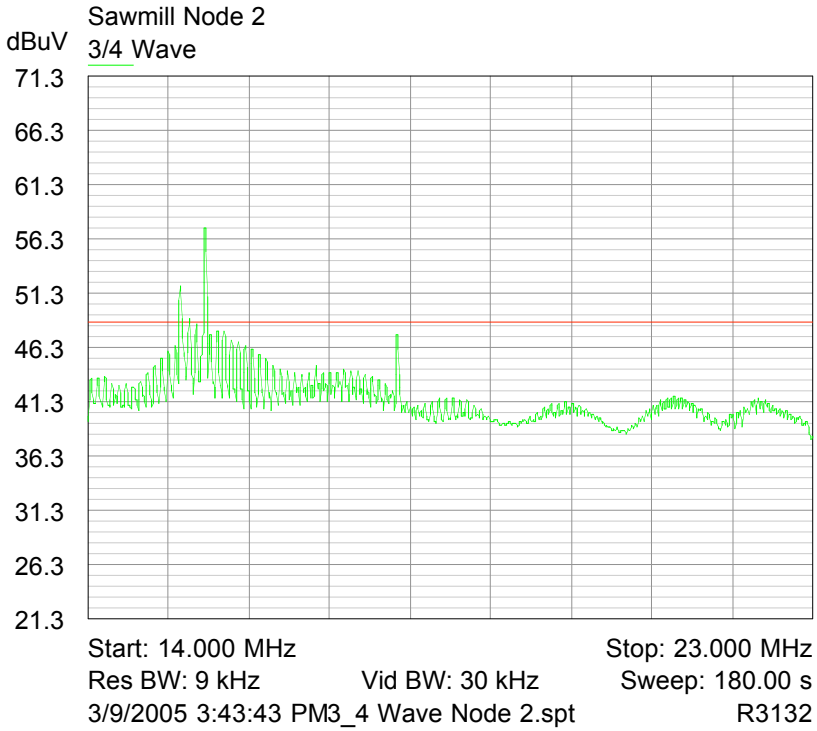
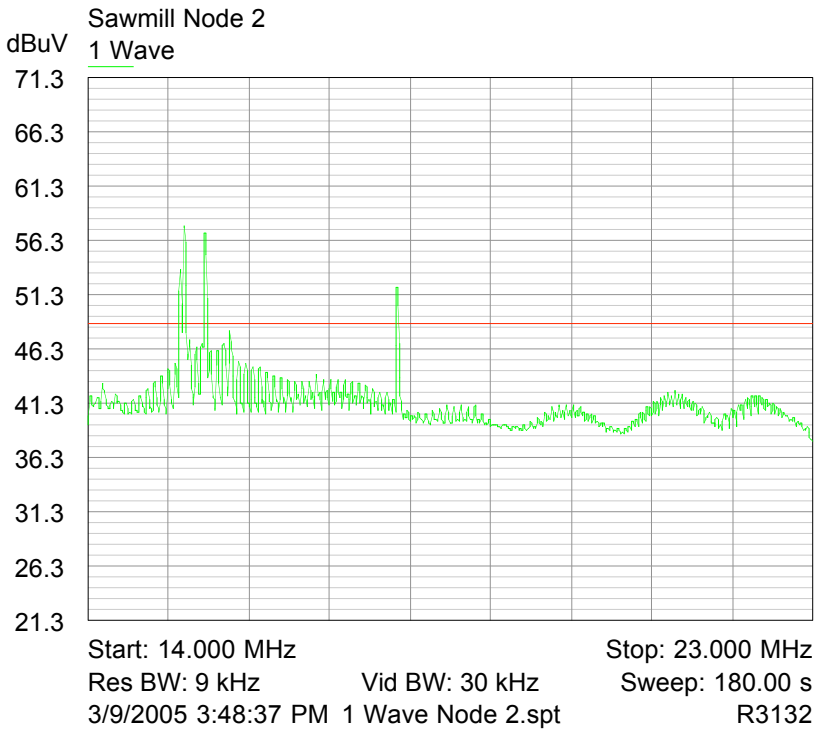
½ Wave Results



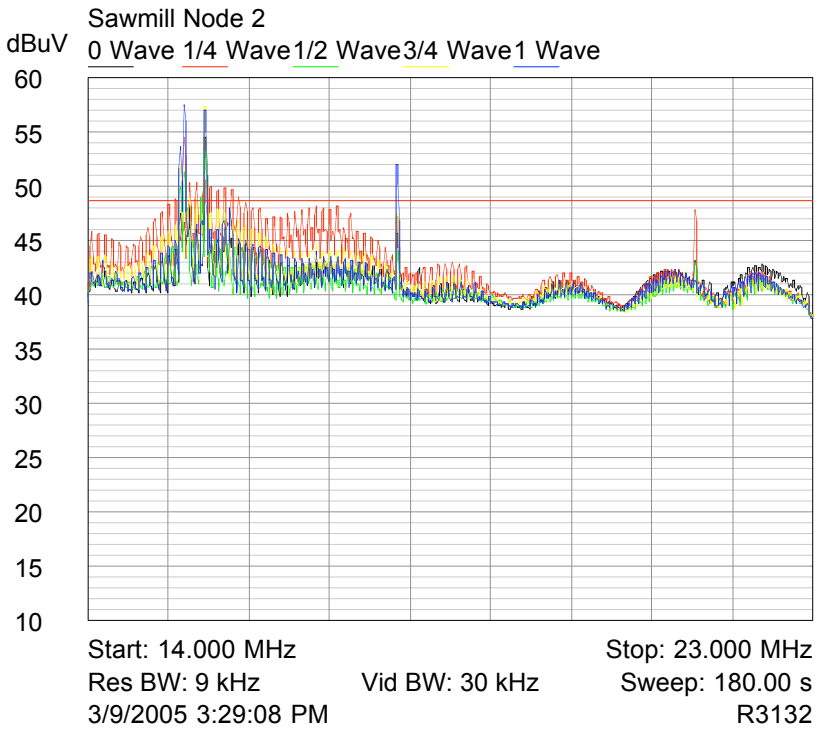
¾ Wave Results



1 Wave Results



Combined Results

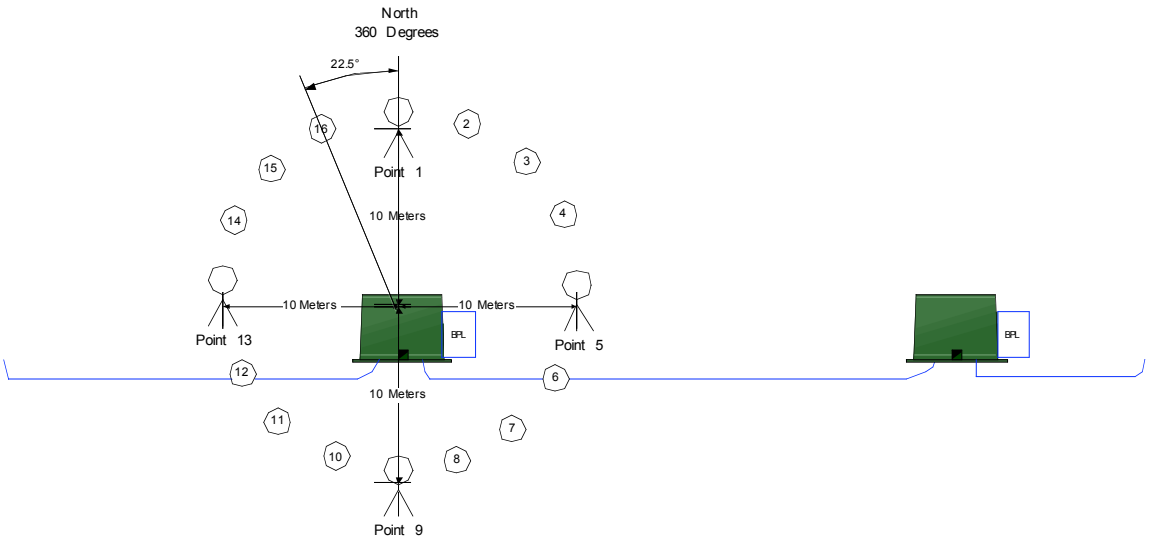


Pad Mount – Underground Access BPL test were performed using the following guidelines:

1) For the Pad Mount used the following guidelines in establishing test set up and measurement criteria
    a. Node 4 in the Sawmill trial are was used for this test
    b. Measured frequency range was 2 MHz to 30 MHz
    c. Measurement points were identified representing 16 equal points around a Pad mount transformer that had a BPL node installed
    d. These points were 10 meters from the center of the transformer
    e. Point 1 and the first measurement point was designated by the point that represented North on a compass
        a. Compass was placed in middle of transformer and Point 1 was established at the 360 degree mark.
        b. The additional points were placed 22.5 degrees off the 360 degree mark, creating 16 equally spaced points

2) Once points of measure were identified and marked, the antenna height was set at 3M and aligned parallel to the pad mount transformer that the BPL node under test was installed

a. Antenna was place at 10 Meters from the center of the transformer and measurements were taken at each of the 16 points as described above
    a. A diagram of our overhead testing setup is below:



3) Spectrum Analyzer setup for the underground pad mount testing of Sawmill BPL Node 4 was as follows:
    a. Freq range was 2 MHz to 30 MHz which encompassed entire spectrum available to MTI under experimental license
    b. Quasi Peak detection was used
    c. RBW was set at 9 kHz
    d. VBW was set at 30 kHz
    e. Sweep time was set at 180 seconds
    f. The application used to capture Spectrum Analyzer readings performed a full sweep and hold process prior to capturing data to ensure we had data from current test and not data from prior test.

4) Test results
    a. Following are test results form the overhead pole mount Sawmill Node 4

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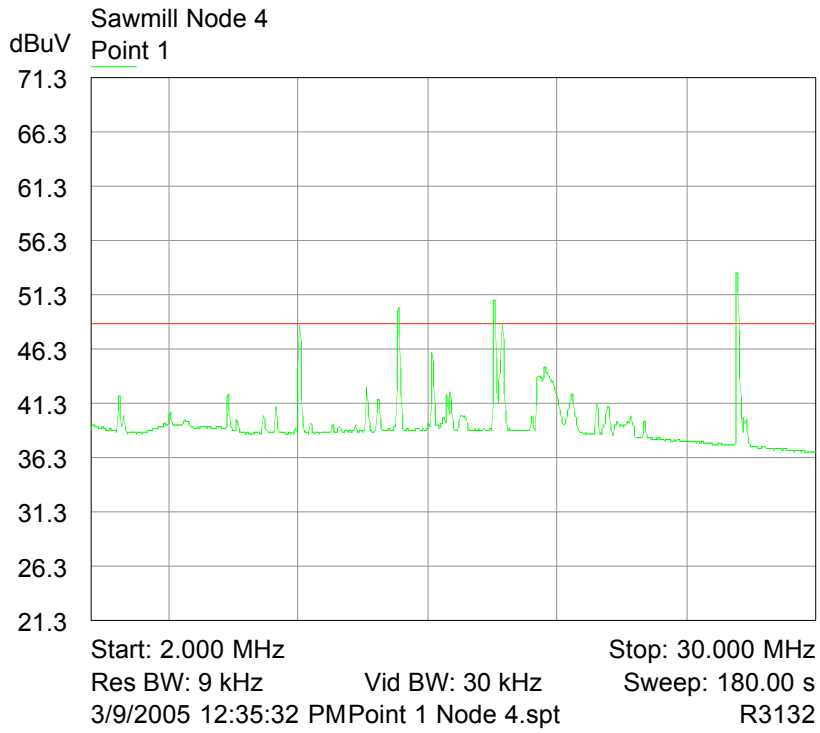
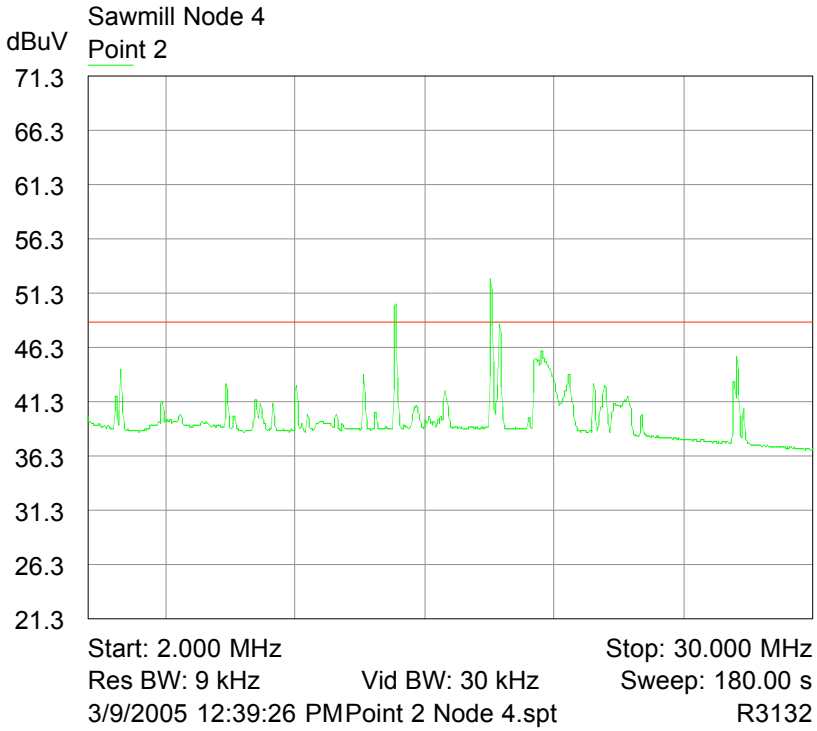
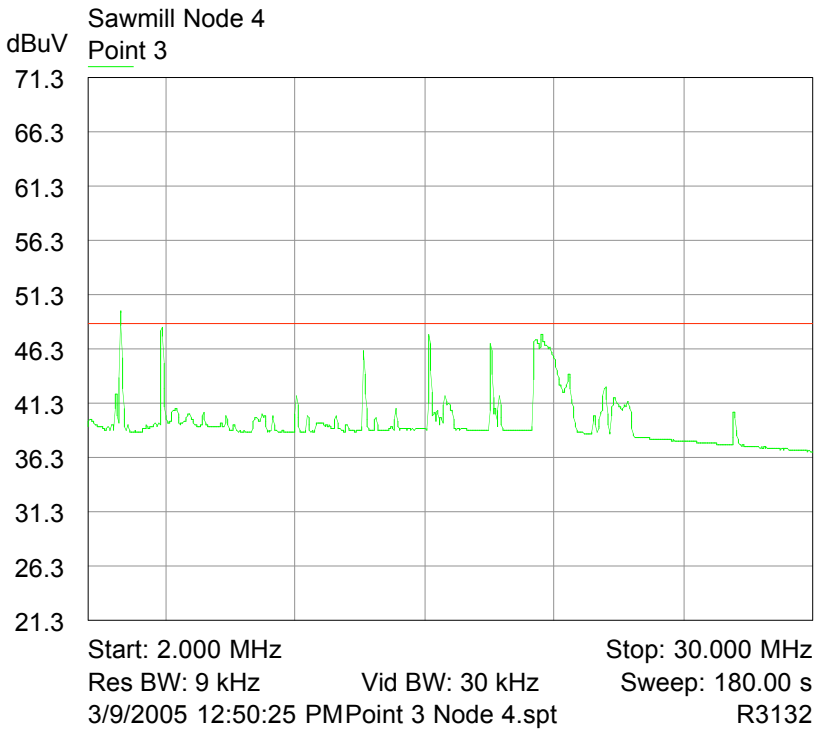
Point 1



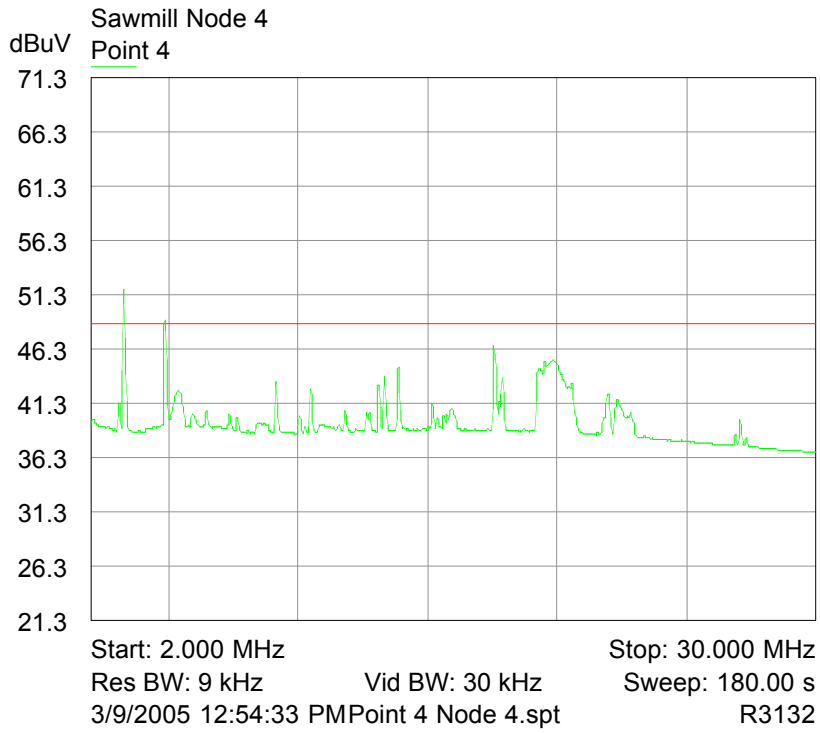
Point 2


Sawmill Node 4
Point 2
dBuV
71.3
66.3
61.3
56.3
51.3
46.3
41.3
36.3
31.3
26.3
21.3
Start: 2.000 MHz
Stop: 30.000 MHz
Res BW: 9 kHz
Vid BW: 30 kHz
Sweep: 180.00 s
3/9/2005 12:39:26 PM Point 2 Node 4.spt
R3132

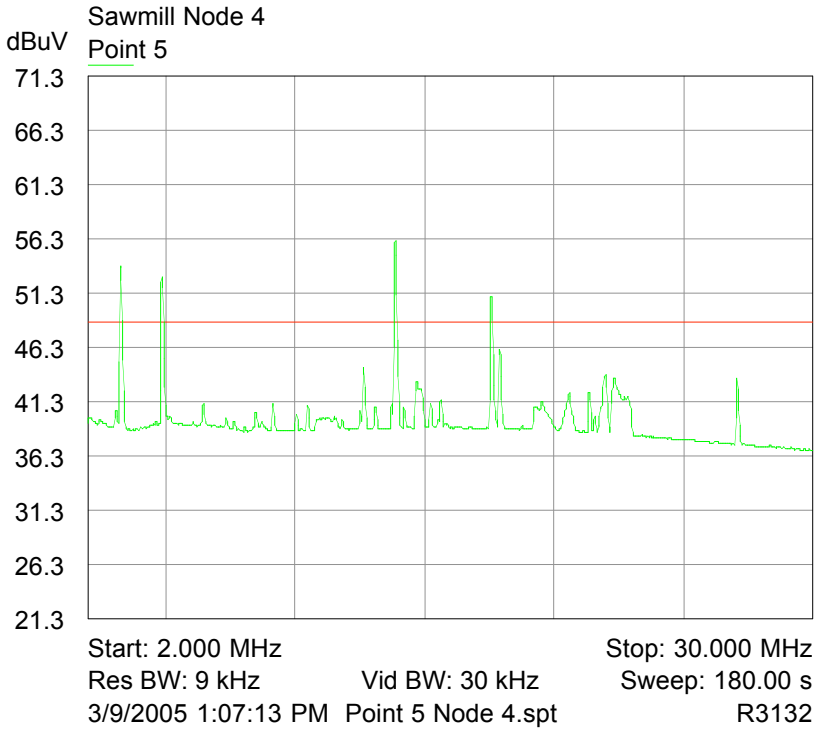
Point 3


Sawmill Node 4
Point 3
dBuV
71.3
66.3
61.3
56.3
51.3
46.3
41.3
36.3
31.3
26.3
21.3
Start: 2.000 MHz
Stop: 30.000 MHz
Res BW: 9 kHz
Vid BW: 30 kHz
Sweep: 180.00 s
3/9/2005 12:50:25 PM Point 3 Node 4.spt
R3132

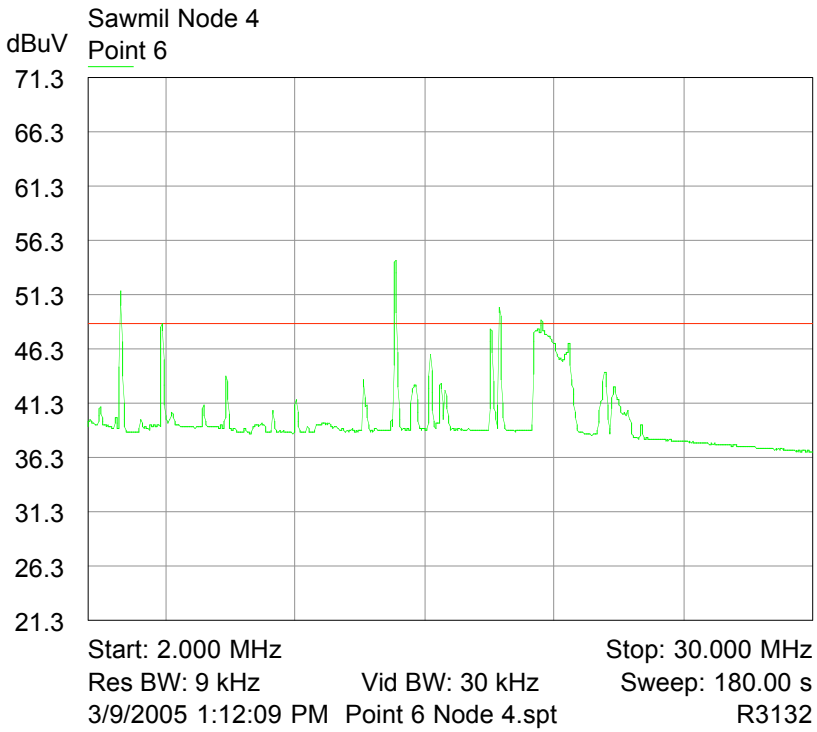
Point 4



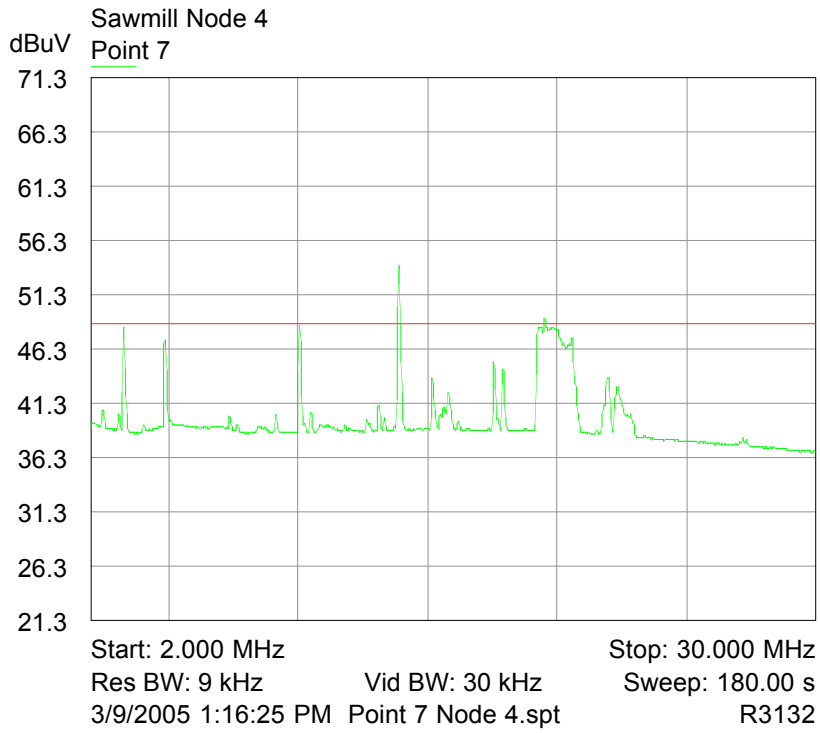
Point 5


Sawmill Node 4
Point 5
dBuV
71.3
66.3
61.3
56.3
51.3
46.3
41.3
36.3
31.3
26.3
21.3
Start: 2.000 MHz
Stop: 30.000 MHz
Res BW: 9 kHz
Vid BW: 30 kHz
Sweep: 180.00 s
3/9/2005 1:07:13 PM
Point 5 Node 4.spt
R3132

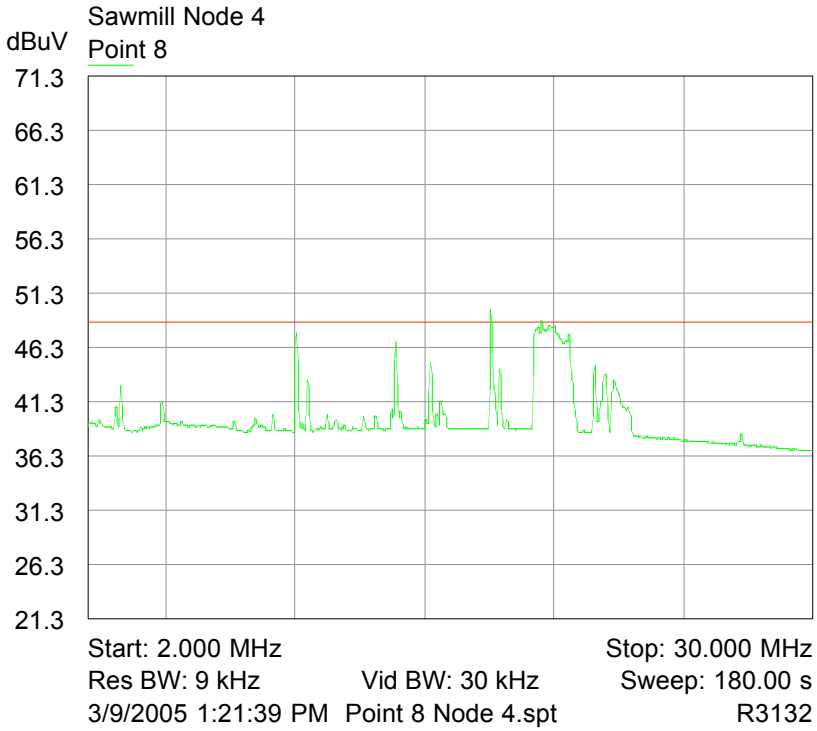
Point 6


Sawmil Node 4
Point 6
dBuV
71.3
66.3
61.3
56.3
51.3
46.3
41.3
36.3
31.3
26.3
21.3
Start: 2.000 MHz
Stop: 30.000 MHz
Res BW: 9 kHz
Vid BW: 30 kHz
Sweep: 180.00 s
3/9/2005 1:12:09 PM
Point 6 Node 4.spt
R3132

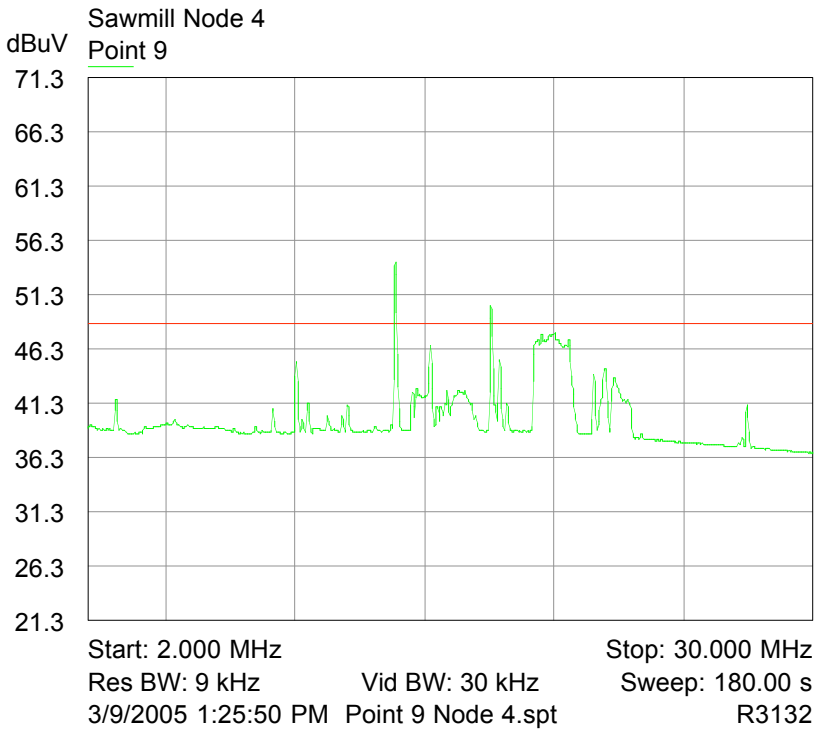
Point 7



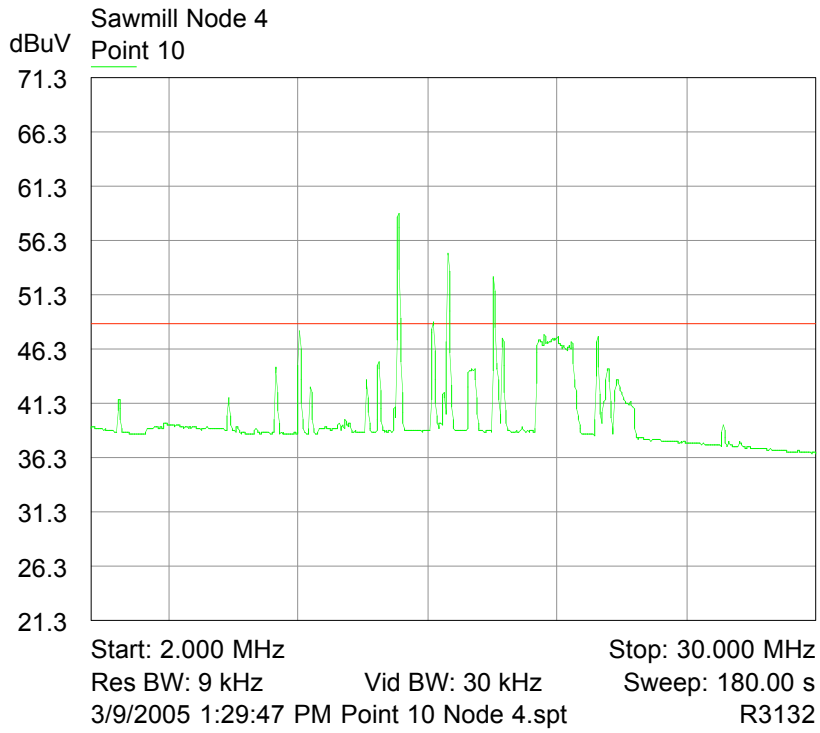
Point 8


Sawmill Node 4
Point 8
dBuV
71.3
66.3
61.3
56.3
51.3
46.3
41.3
36.3
31.3
26.3
21.3
Start: 2.000 MHz
Stop: 30.000 MHz
Res BW: 9 kHz
Vid BW: 30 kHz
Sweep: 180.00 s
3/9/2005 1:21:39 PM
Point 8 Node 4.spt
R3132

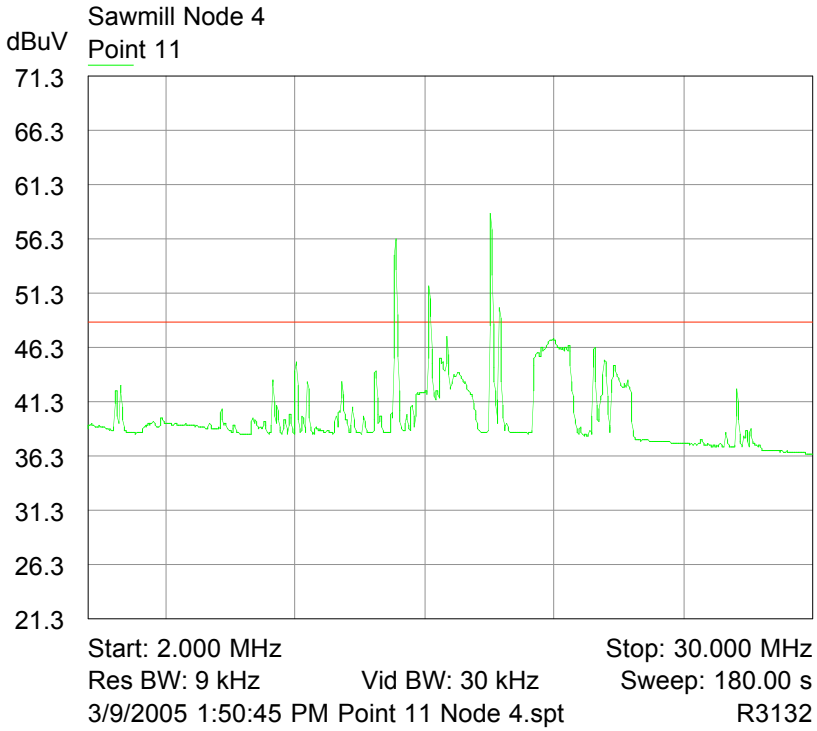
Point 9


Sawmill Node 4
Point 9
dBuV
71.3
66.3
61.3
56.3
51.3
46.3
41.3
36.3
31.3
26.3
21.3
Start: 2.000 MHz
Stop: 30.000 MHz
Res BW: 9 kHz
Vid BW: 30 kHz
Sweep: 180.00 s
3/9/2005 1:25:50 PM
Point 9 Node 4.spt
R3132

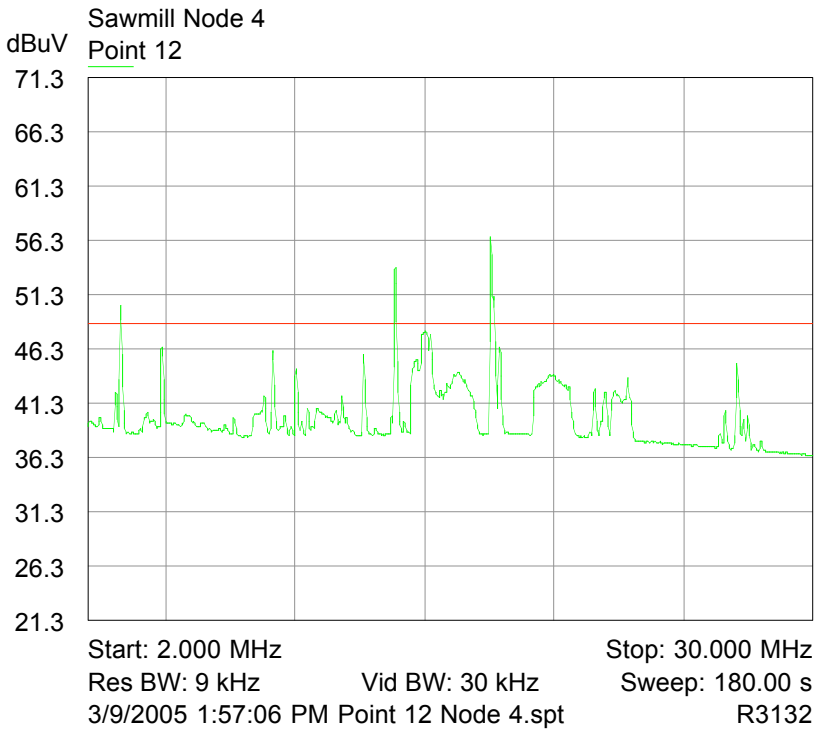
Point 10



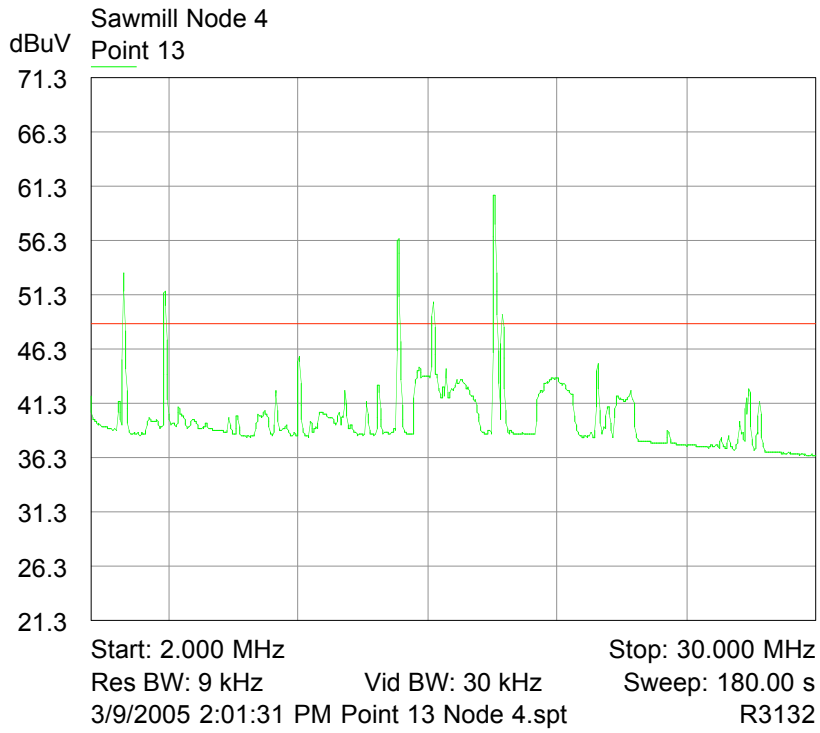
Point 11


Sawmill Node 4
Point 11
dBuV
71.3
66.3
61.3
56.3
51.3
46.3
41.3
36.3
31.3
26.3
21.3
Start: 2.000 MHz
Stop: 30.000 MHz
Res BW: 9 kHz
Vid BW: 30 kHz
Sweep: 180.00 s
3/9/2005 1:50:45 PM Point 11 Node 4.spt
R3132

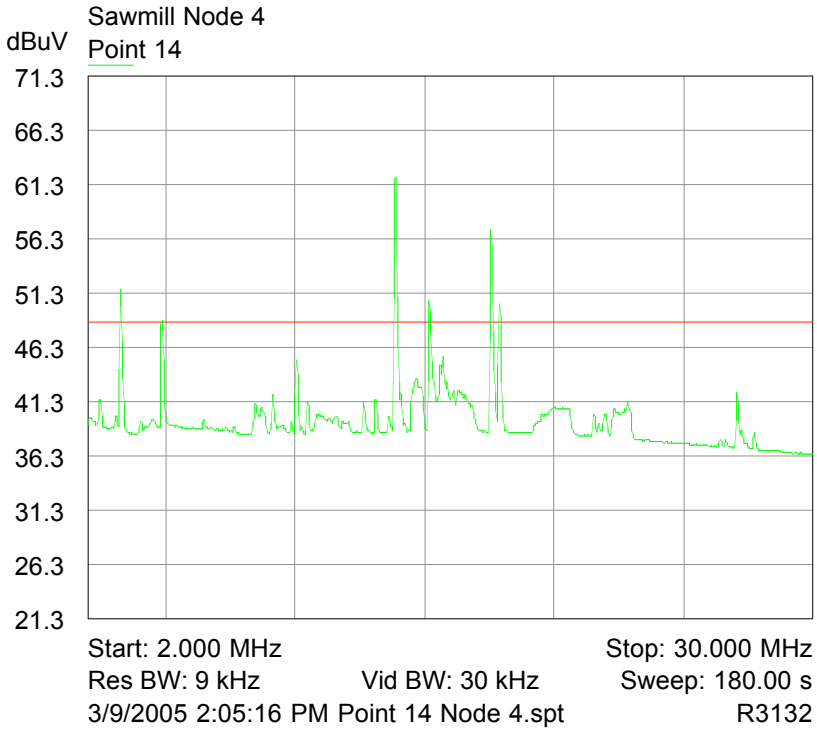
Point 12


Sawmill Node 4
Point 12
dBuV
71.3
66.3
61.3
56.3
51.3
46.3
41.3
36.3
31.3
26.3
21.3
Start: 2.000 MHz
Stop: 30.000 MHz
Res BW: 9 kHz
Vid BW: 30 kHz
Sweep: 180.00 s
3/9/2005 1:57:06 PM Point 12 Node 4.spt
R3132

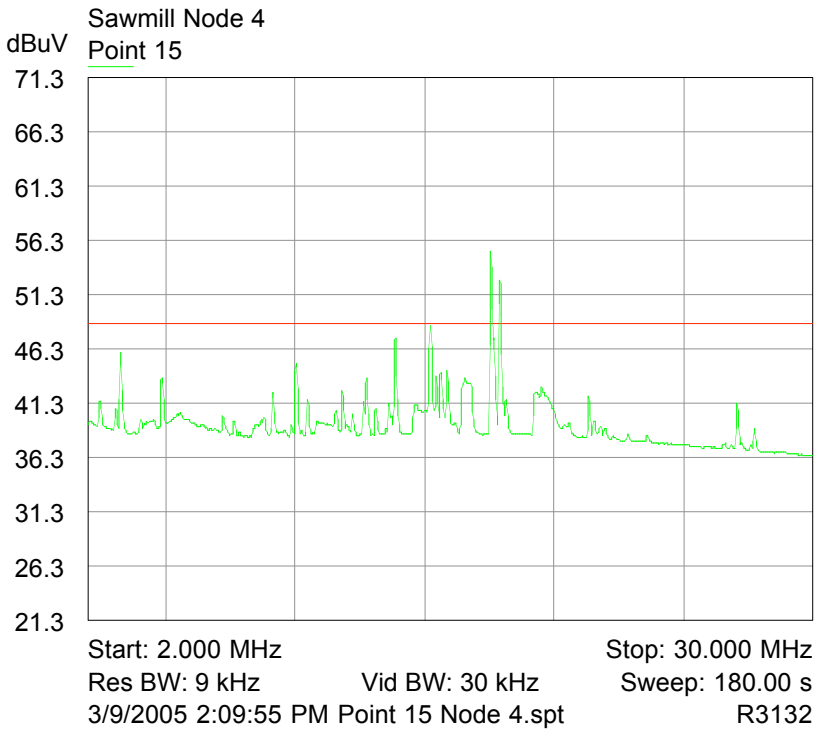
Point 13



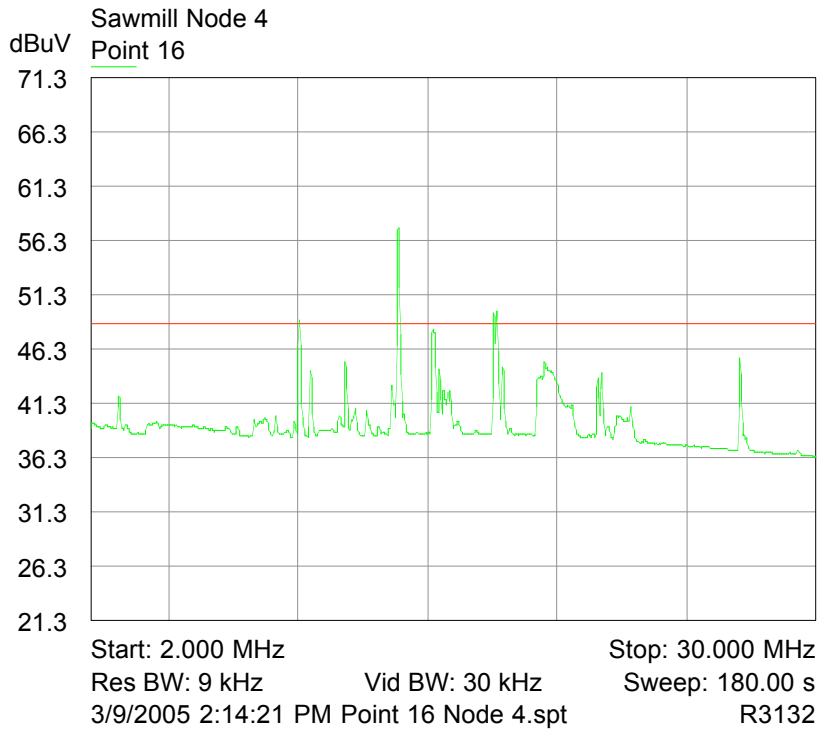
Point 14


Sawmill Node 4
Point 14
dBuV
71.3
66.3
61.3
56.3
51.3
46.3
41.3
36.3
31.3
26.3
21.3
Start: 2.000 MHz
Stop: 30.000 MHz
Res BW: 9 kHz
Vid BW: 30 kHz
Sweep: 180.00 s
3/9/2005 2:05:16 PM Point 14 Node 4.spt
R3132

Point 15


Sawmill Node 4
Point 15
dBuV
71.3
66.3
61.3
56.3
51.3
46.3
41.3
36.3
31.3
26.3
21.3
Start: 2.000 MHz
Stop: 30.000 MHz
Res BW: 9 kHz
Vid BW: 30 kHz
Sweep: 180.00 s
3/9/2005 2:09:55 PM Point 15 Node 4.spt
R3132

Point 16



All Points Combined

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