Test Report No: 01-11-35005/499

Electromagnetic Compatibility
Of A
Machine Security System (MSS)
156-6155

Customer: **Caterpillar, Inc.**
EEBU
Site & Wireless Communications Systems
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Peoria, Il. 61615

Contact: **Greg Gipp**
494-4128

Appendix to Test Report No: 01-11-35005/499

Electromagnetic Compatibility
Of A
Machine Security System (MSS)

Author: _____
Ed Stine, Test Engineer

Manager: _____
Gene Anders, President

Test Lab and FCC Ident: **EMC Testing, Inc. #99460**

Report Date: _____

FCC Registration: PQMMSS1

Appendix A

1) Description of Test:

The testing was performed at EMC Testing Inc, which is registered with the FCC #99460. The test was performed on 8/15/01 according to FCC part 15.209. The device under test (DUT) was positioned on a nonmetallic table. The active loop antenna was placed at a distance of 3 meters from the DUT. The emissions were measured from 9KHz to 30MHz, at 16 turntable positions, equally spaced 22.5° apart. The emission software was programmed to store the data taken at all turntable positions and present one graph representing the maximum data taken at each frequency. Test data was acquired with the antenna both perpendicular to and parallel to the test table. The preliminary scan was recorded in the Peak Detector function in order to save time. Any data points at or above the limit line were re-evaluated using the quasi peak detector.

2) Derivation of Limit Line

The limit lines as specified in Section 15.209 were employed.

Section 15.209 Radiated emission limits, general requirements

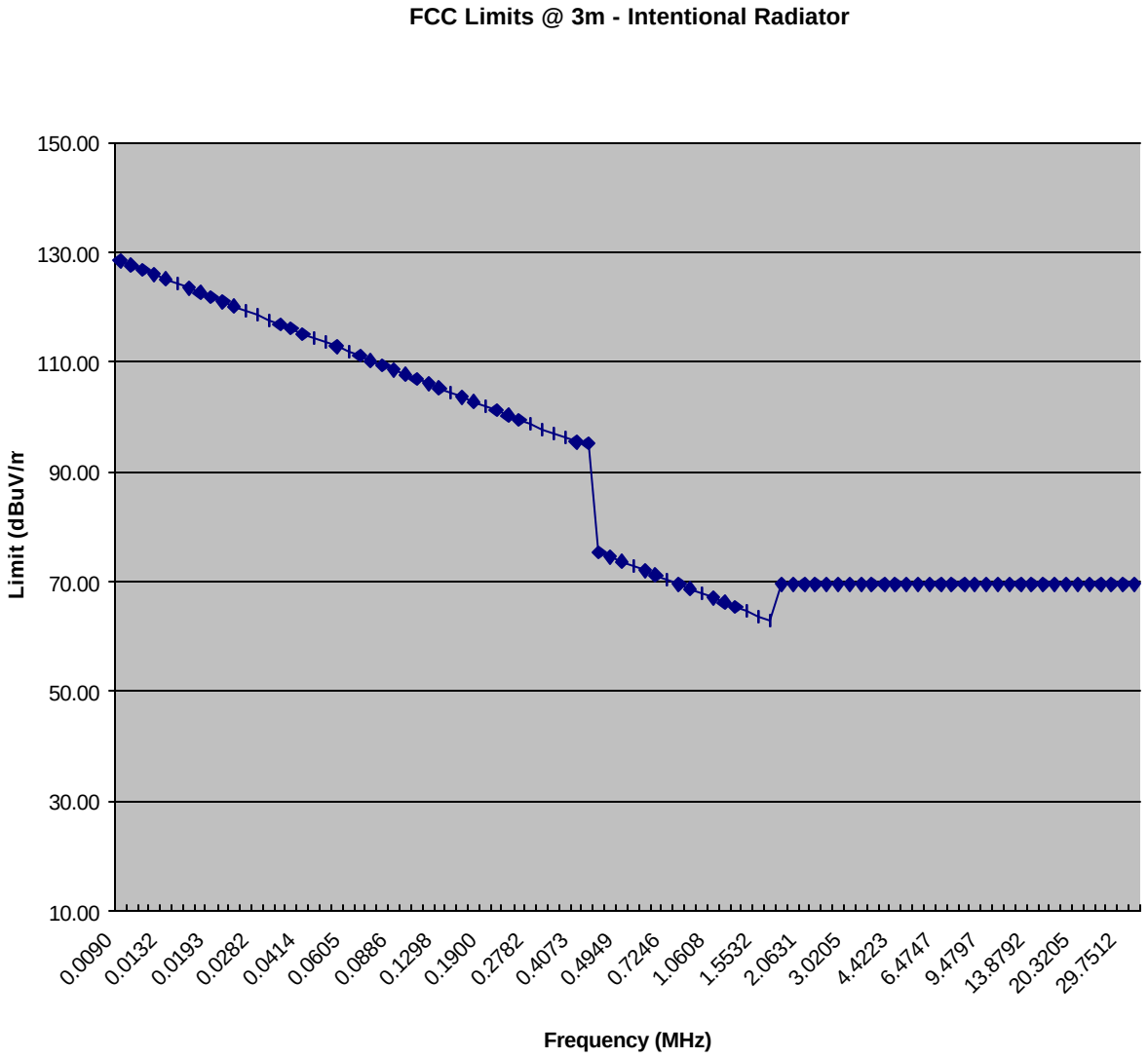
Frequency (MHz)	Field Strength (uV/m)	Meas. Distance (meters)
0.009 – 0.490	2400/F(kHz)	300
0.490 – 1.705	24000/F(kHz)	30
1.705 – 30.0	30	30
30 – 88	100 **	3
88 – 216	150 **	3
216 – 960	200 **	3
above 960	500	3

Section 15.31 Measurement standards, subparagraph (f)(2) states that distances other than those listed in the preceding table may be used, and if used, an extrapolation factor of 40dB/decade may be used.

In the frequency range of 9KHz – 490KHz, the limit is specified at 300m as 2400/F(KHz) uV/m. The limit was calculated for a distance of 300m, and then converted to dB. Since the actual measurement distance was 3 meters or two decades less than in the table, 80 dB was added to the limit.

In the frequency range of 490KHz – 1.705MHz, the limit is specified at 30m as 24000/F(KHz) uV/m. The limit was calculated for a distance of 30m, and then converted to dB. Since the actual measurement distance was 3 meters or one decade less than in the table, 40 dB was added to the limit.

In the frequency range of 1.705MHz – 30MHz, the limit is specified at 30m as 30uV/m. The limit was converted to dB. Since the actual measurement distance was 3 meters or one decade less than in the table, 40 dB was added to the limit. The following chart shows the limit line used in our testing.


FCC Limits @ 3m - Intentional Radiator
150.00
130.00
110.00
90.00
70.00
50.00
30.00
10.00
Limit (dBuV/m
0.0090
0.0132
0.0193
0.0282
0.0414
0.0605
0.0886
0.1298
0.1900
0.2782
0.4073
0.4949
0.7246
1.0608
1.5532
2.0631
3.0205
4.4223
6.4747
9.4797
13.8792
20.3205
29.7512
Frequency (MHz)

3) Test Procedure:

Testing was performed at EMC Testing, Inc. which has their setup documented at the FCC (EMC Testing is registered with FCC #99460). Testing was performed 8/15/01 per FCC part 15 (measurement standards defined in Section 15.31), using an active loop antenna.

4) Equipment Used

The following list shows the equipment that was used for this testing and the calibration dates of the equipment.

Emissions Calibration Report

Technician: ADH **Test Date:** 8/15/01
Test Spec.: FCC Intentional Radiator Low Freq. Test **File #:** 538

Equipment Used:

Check if Used:	Description:	IRIS #	Last Calibration	Next Calibration
	Antenna - Bilog	54386		
		54388		
	Antenna - Biconnical	13115		
		54130		
	Antenna – Active Rod	64665		
✓	EMI Receiver	53327	4/27/01	4/27/02
✓	EMI Receiver Filter Section	53326	4/27/01	4/27/02
	Spectrum Analyzer	68945		
	LISN	29101	Calibration	Not Req.
✓		64226	Calibration	Not Req.
		75950	Calibration	Not Req.
✓	Loop Antenna	81412	4/16/01	4/16/02

Author: Howard Plumier Date: ___/___/_____ Page _____of _____

5) Radiated Emission Tests and Results

The following graphs show the low frequency emissions as recorded on 8/15/01 at EMC Testing Inc. From these graphs, it can be seen that no data was recorded that exceeded the limit line.

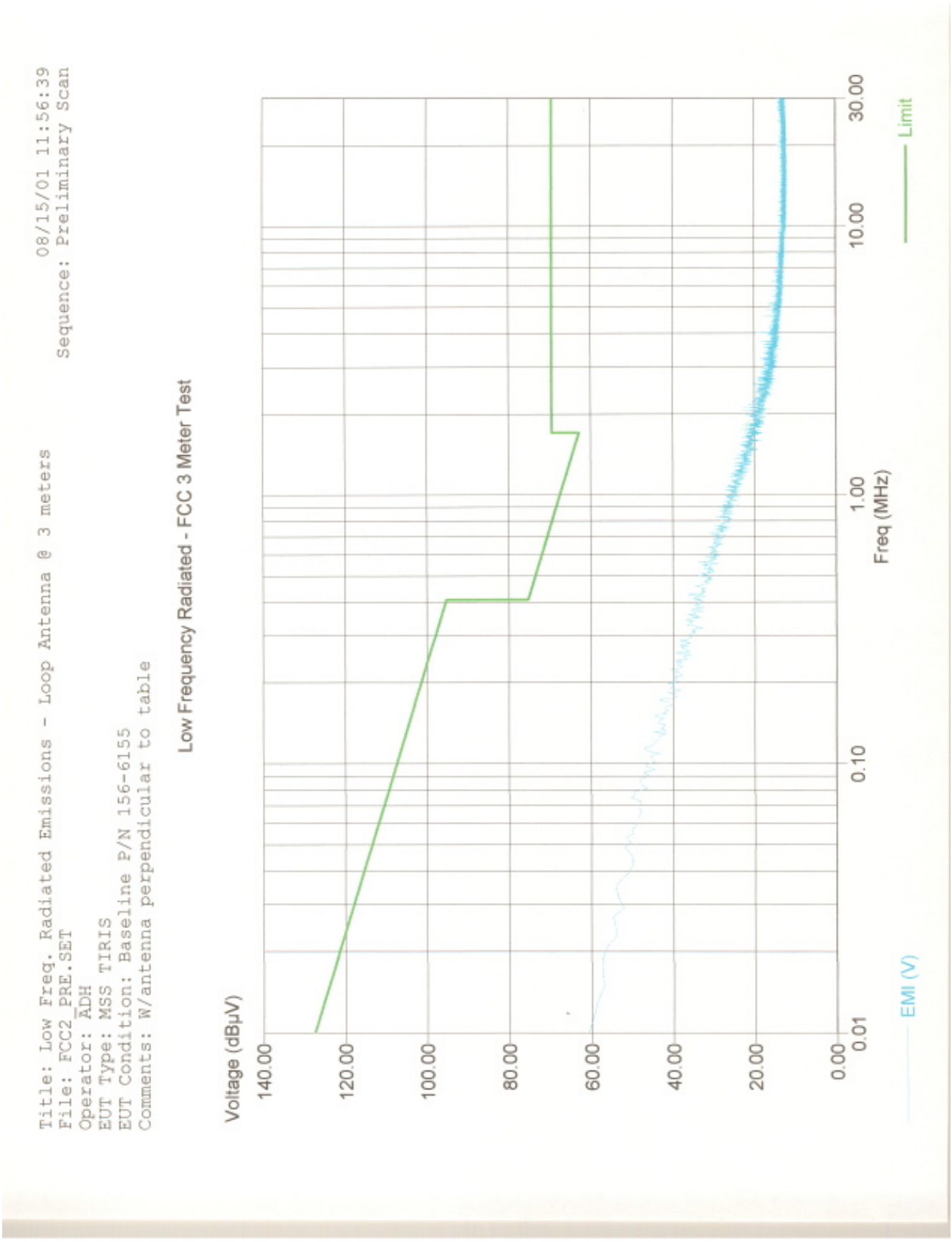
The first graph is a baseline emissions scan of the semi anechoic chamber with no emissions in the chamber. The attenuation is set to the same attenuation that was used during scans of the Machine Security System (MSS).

The next two graphs show the actual emissions of the MSS in the continuous RF mode. It can be seen from these graphs that the emissions from the MSS do not approach the limit line

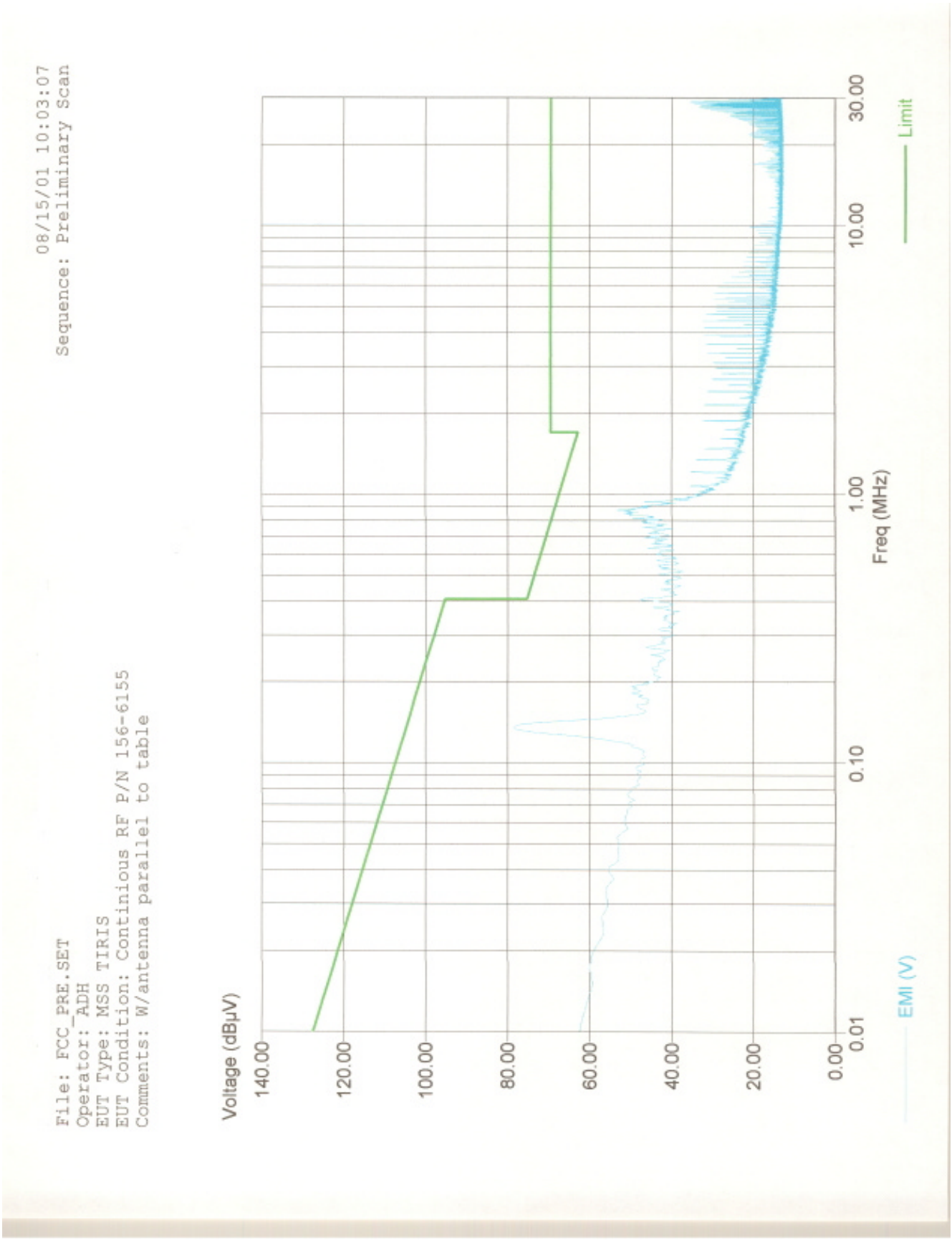
The following pictures are of the test set up that was used to test the MSS.

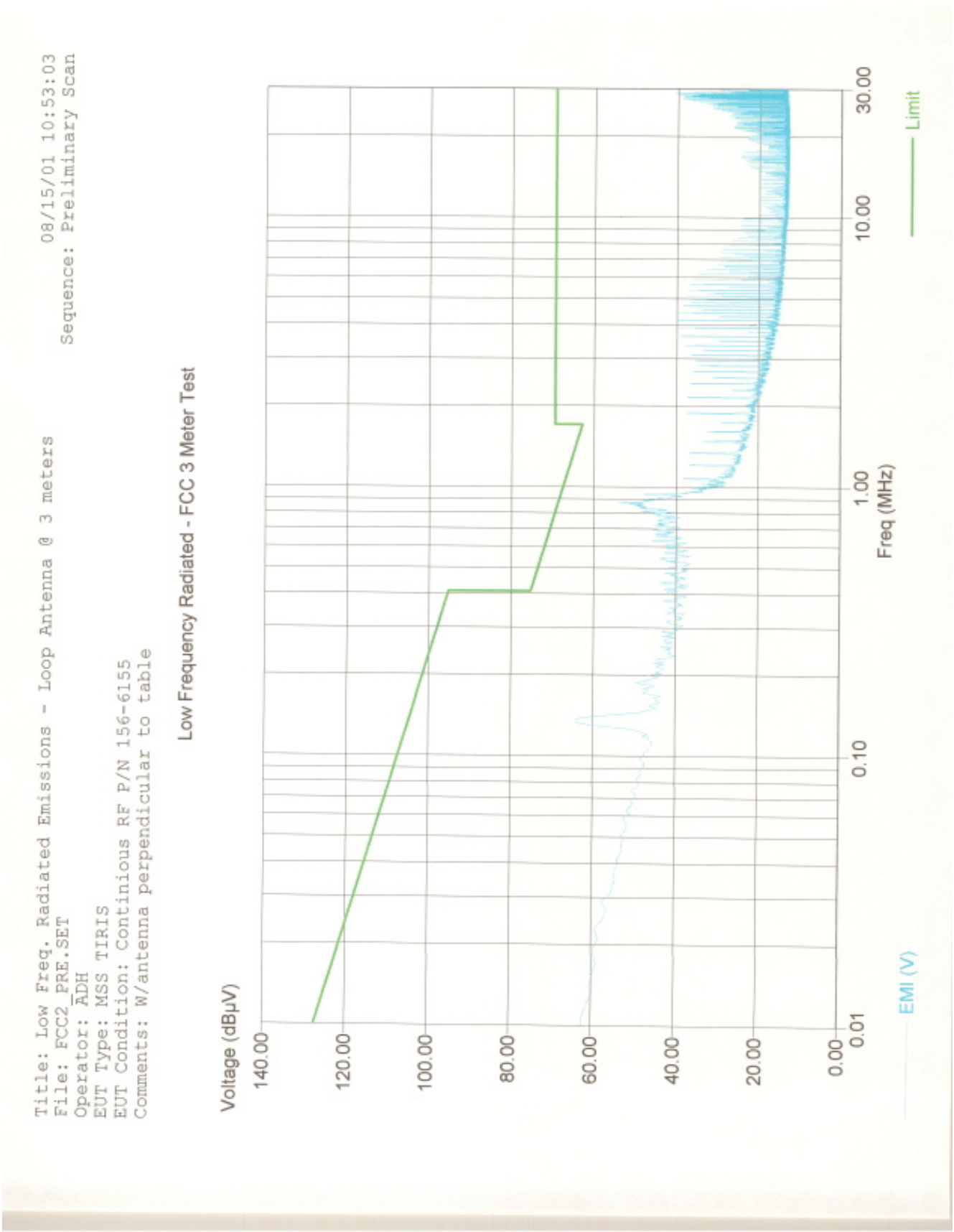
6 Conclusion

Therefore, the MSS was judged to have passed the FCC Low Frequency Radiated Emissions test.

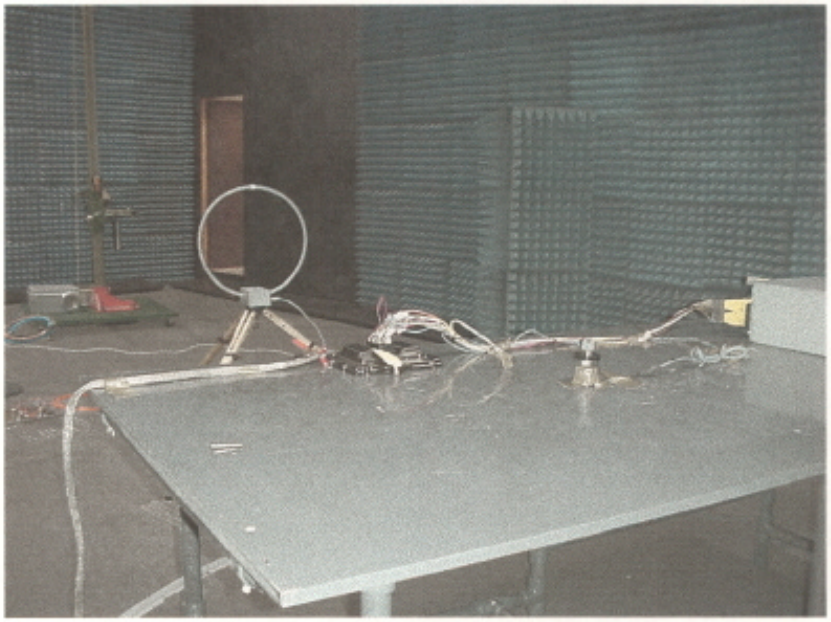

Title: Low Freq. Radiated Emissions - Loop Antenna @ 3 meters
File: FCC2_PRE.SET
Operator: ADH
EUT Type: MSS TIRIS
EUT Condition: Baseline P/N 156-6155
Comments: W/antenna perpendicular to table
08/15/01 11:56:39
Sequence: Preliminary Scan
Low Frequency Radiated - FCC 3 Meter Test
Voltage (dBµV)
140.00
120.00
100.00
80.00
60.00
40.00
20.00
0.00
0.01
0.10
1.00
10.00
30.00
Freq (MHz)
Limit
EMI (V)

Baseline measurement for Low Frequency (9 KHz to 30 MHz):

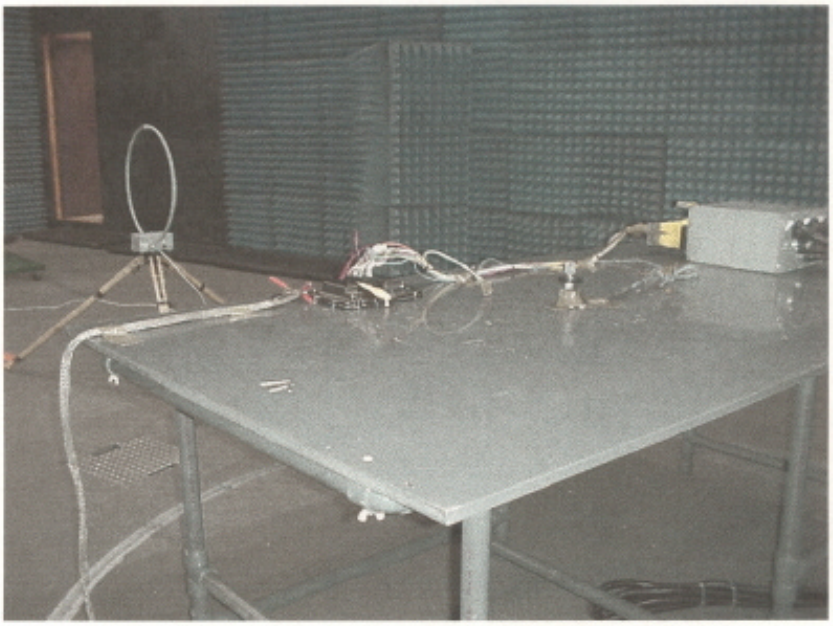

08/15/01 10:03:07
Sequence: Preliminary Scan
File: FCC_PRE.SET
Operator: ADH
EUT Type: MSS TIRIS
EUT Condition: Continious RF P/N 156-6155
Comments: W/antenna parallel to table
Voltage (dBµV)
140.00
120.00
100.00
80.00
60.00
40.00
20.00
0.00
0.01
0.10
1.00
10.00
30.00
Freq (MHz)
Limit
EMI (V)


Title: Low Freq. Radiated Emissions - Loop Antenna @ 3 meters
File: FCC2_PRE.SET
Operator: ADH
EUT Type: MSS TIRIS
EUT Condition: Continious RF P/N 156-6155
Comments: W/antenna perpendicular to table
08/15/01 10:53:03
Sequence: Preliminary Scan
Low Frequency Radiated - FCC 3 Meter Test
Voltage (dBµV)
140.00
120.00
100.00
80.00
60.00
40.00
20.00
0.00
0.01
0.10
1.00
10.00
30.00
Freq (MHz)
Limit
EMI (V)

Near Field Radiated Emissions
10 kHz - 30 MHz
FCC Part 15B Intentional Radiator



Parallel Antenna



Perpendicular Antenna