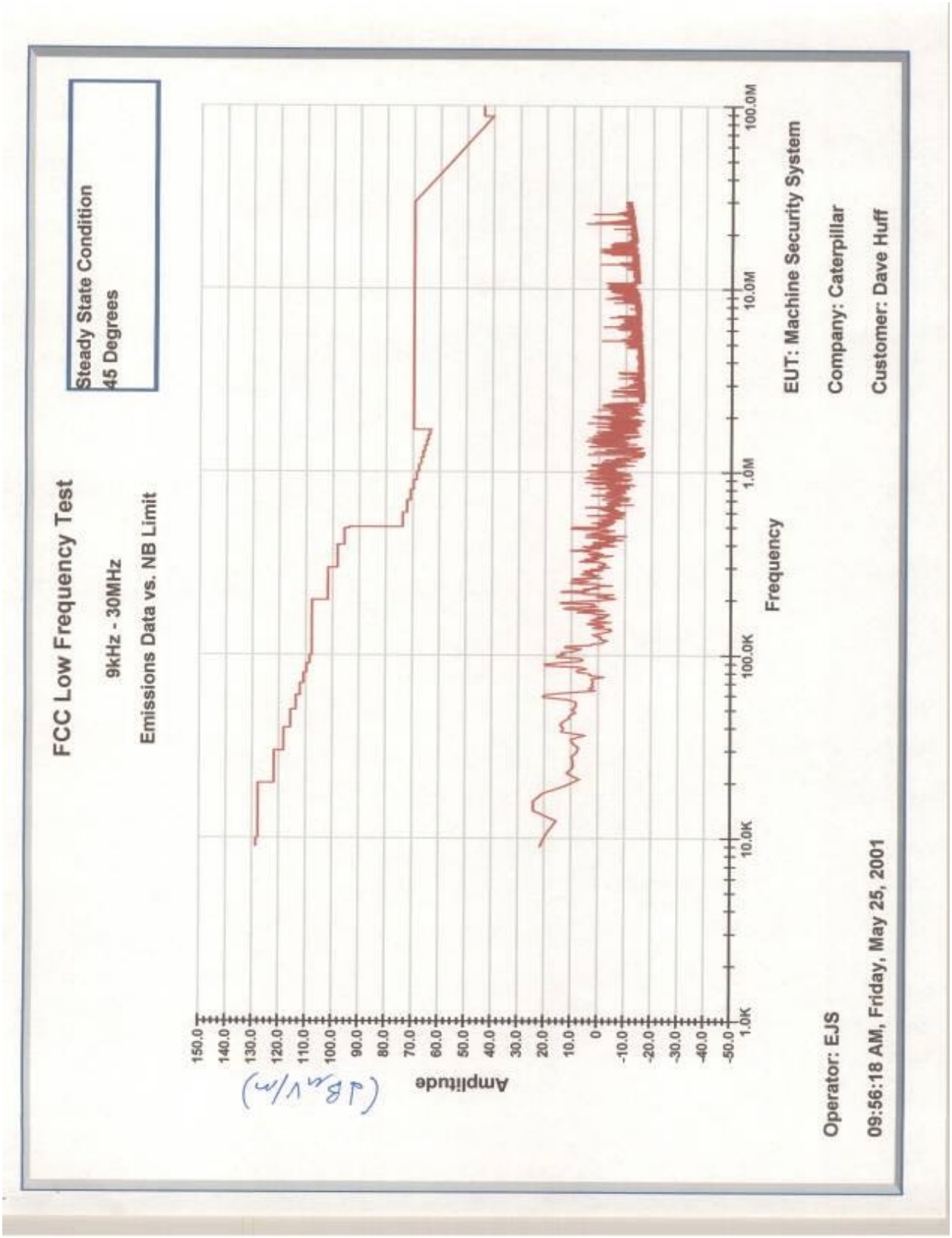
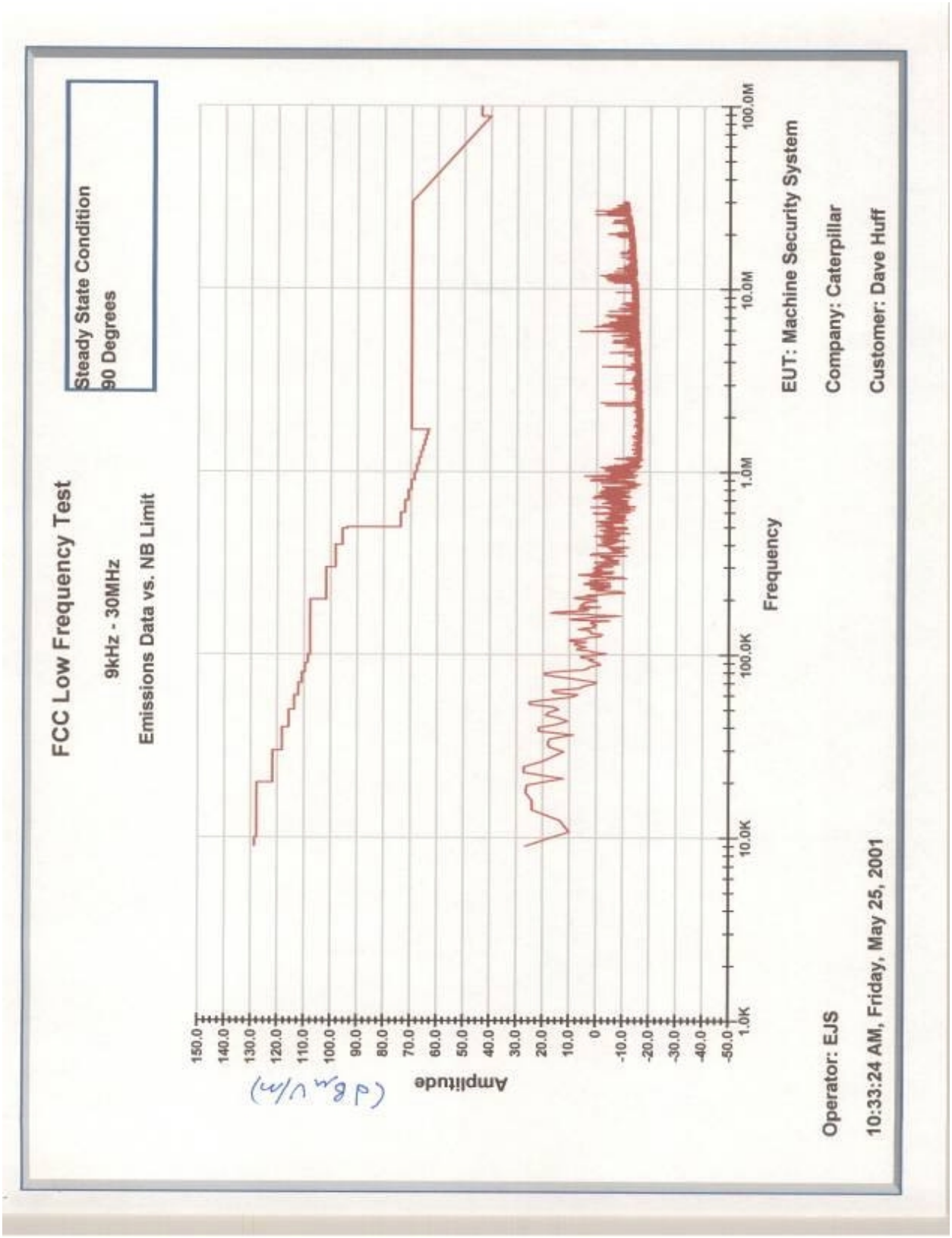
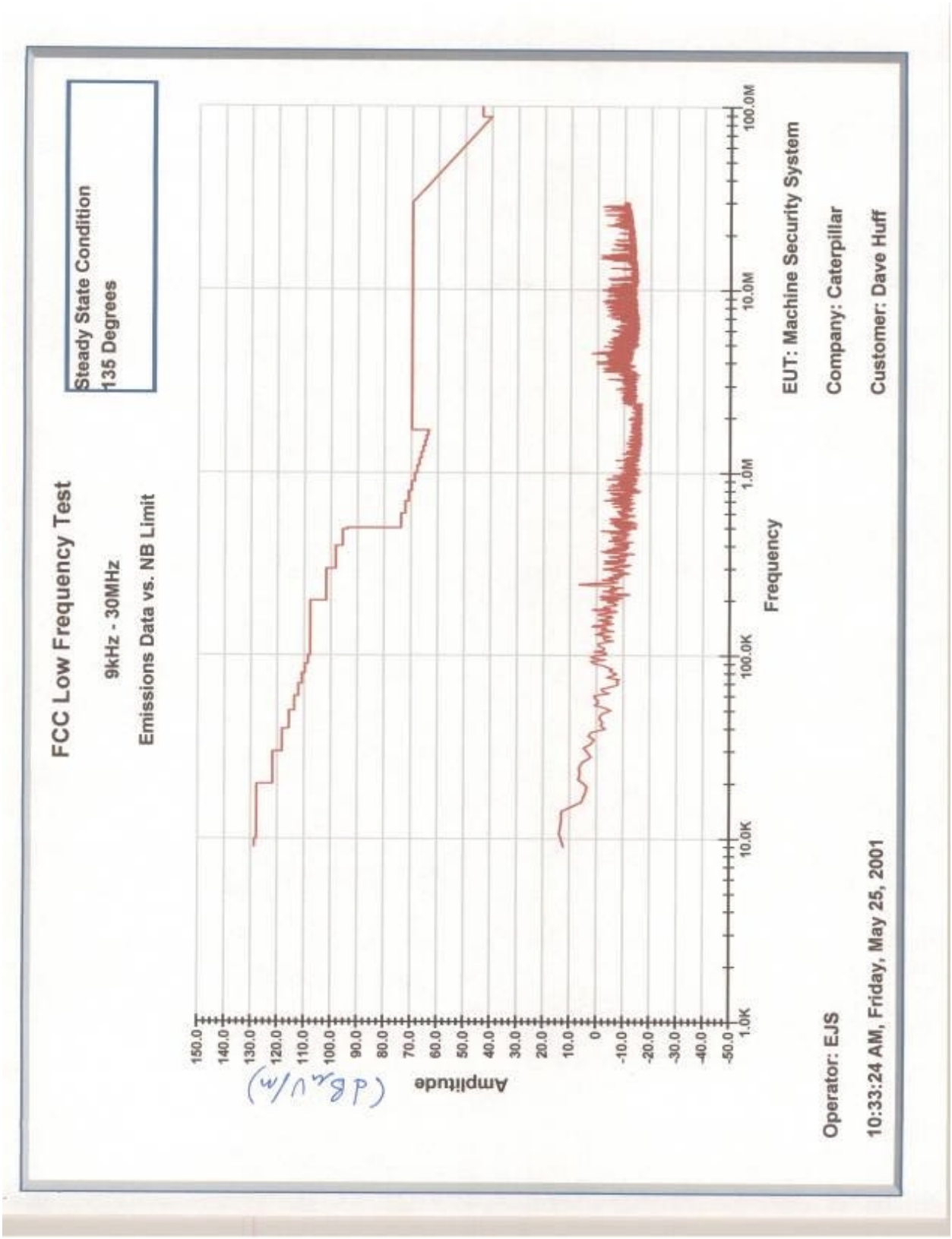
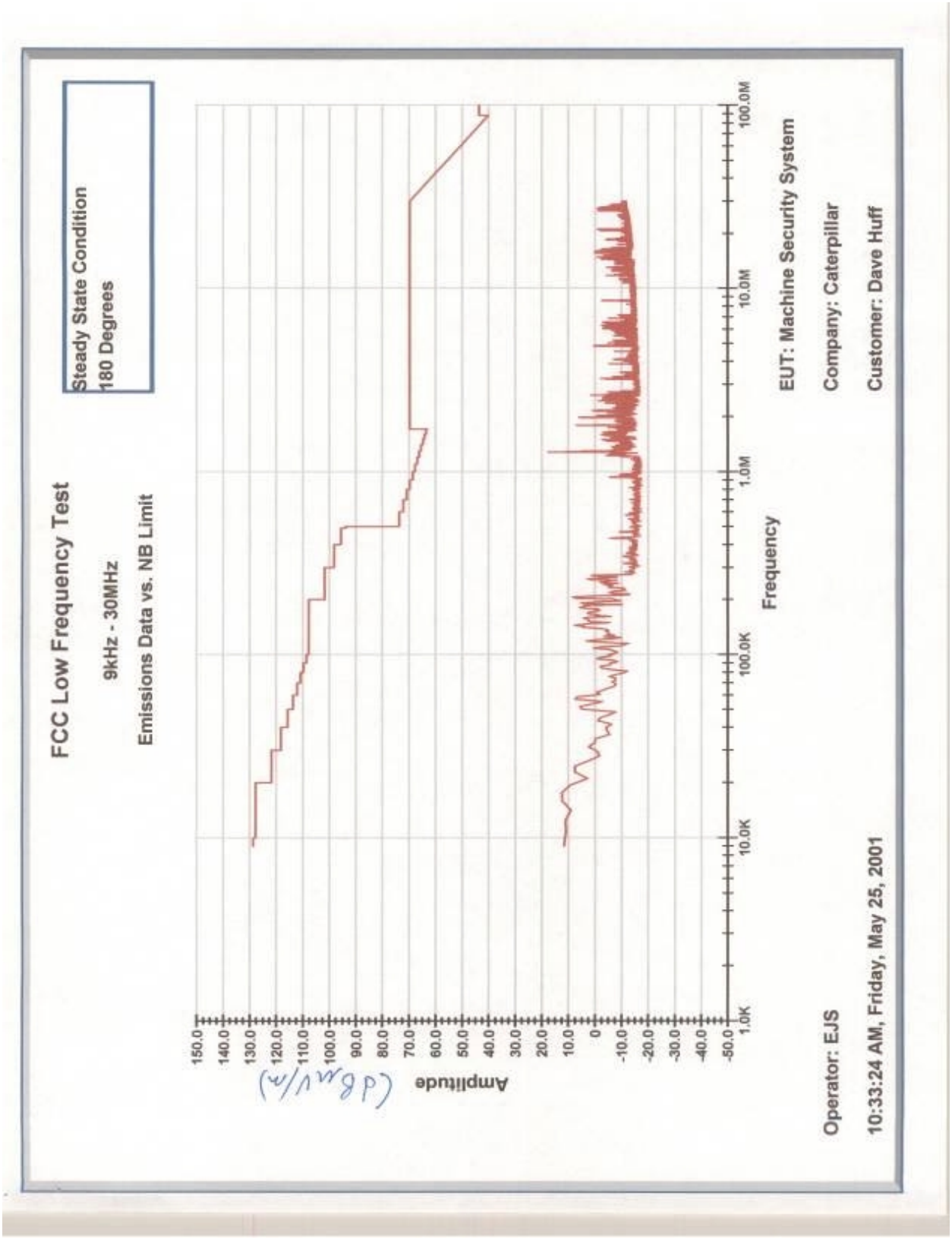
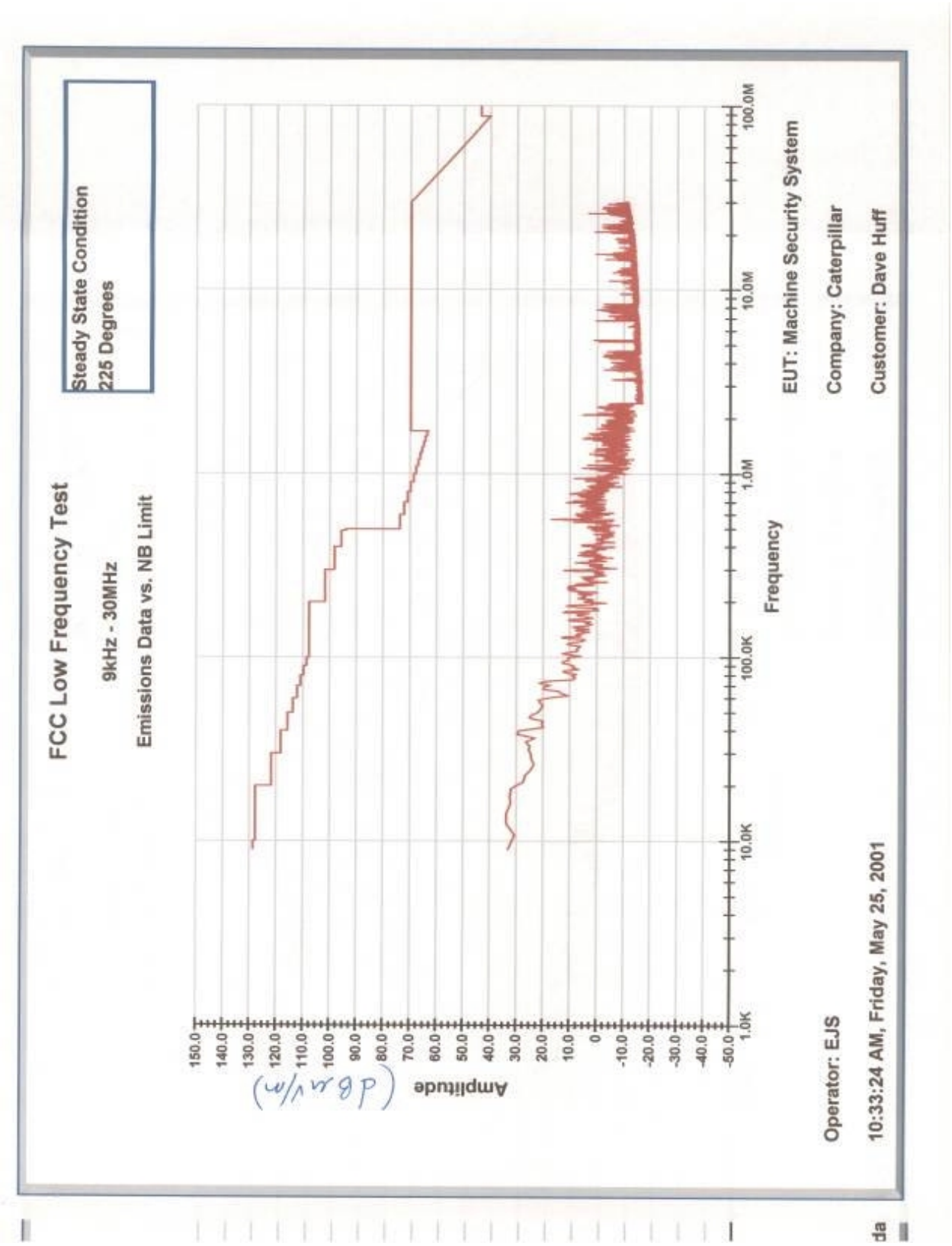
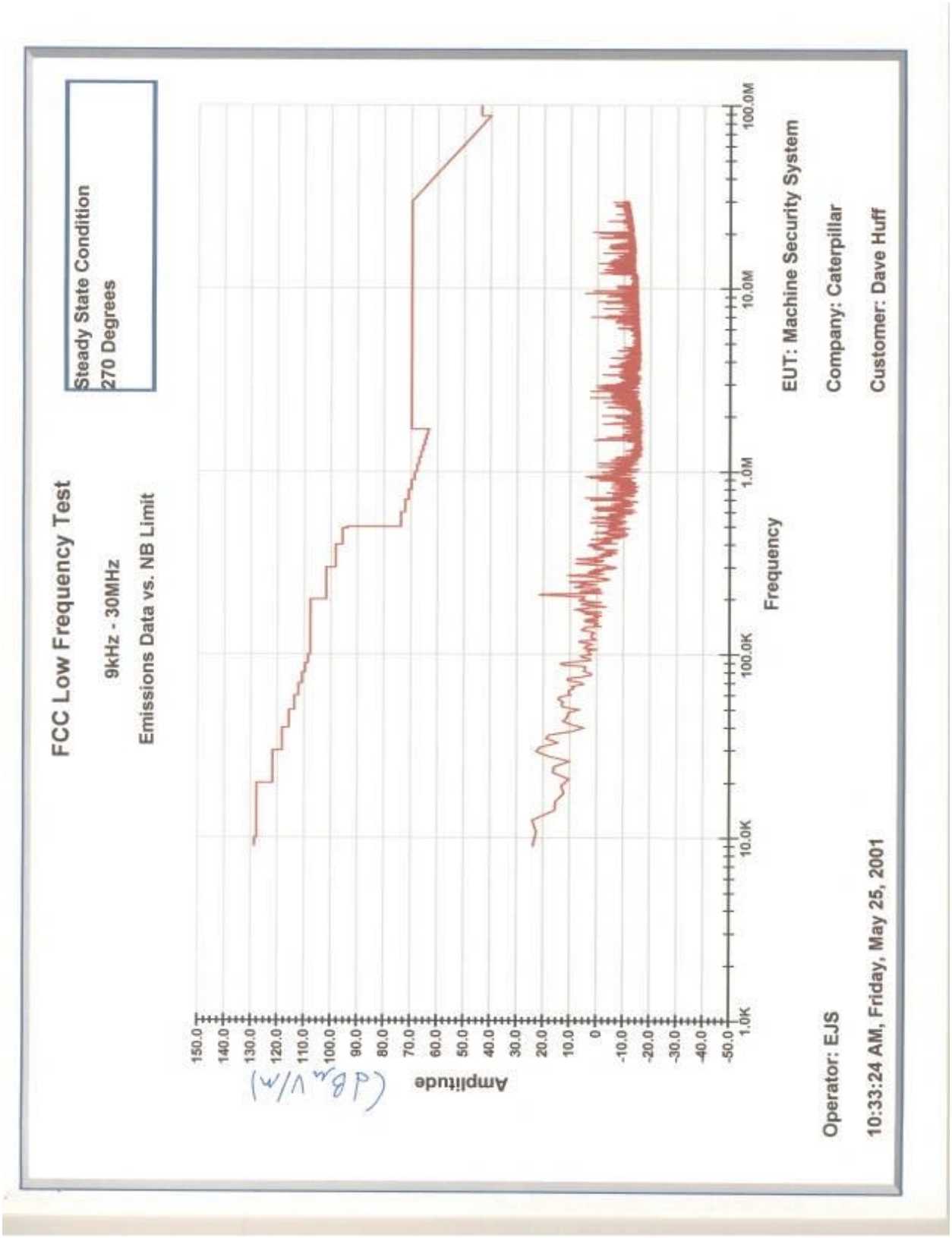

FCC Low Frequency Test
9kHz - 30MHz
Emissions Data vs. NB Limit
Steady State Condition
45 Degrees
Amplitude
Frequency
EUT: Machine Security System
Company: Caterpillar
Customer: Dave Huff
Operator: EJS
09:56:18 AM, Friday, May 25, 2001

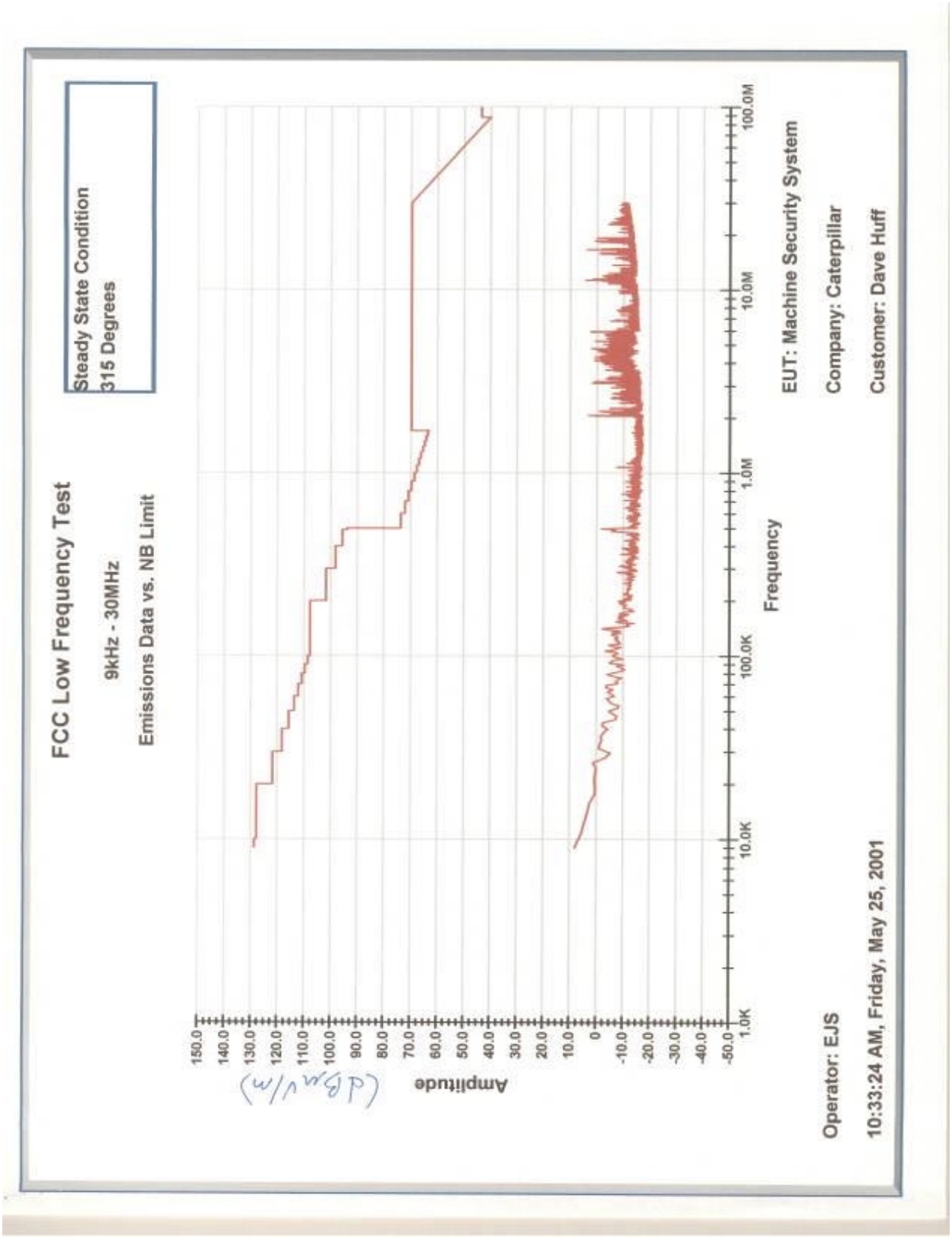

FCC Low Frequency Test
9kHz - 30MHz
Emissions Data vs. NB Limit
Steady State Condition
90 Degrees
Amplitude
Frequency
EUT: Machine Security System
Company: Caterpillar
Customer: Dave Huff
Operator: EJS
10:33:24 AM, Friday, May 25, 2001


FCC Low Frequency Test
9kHz - 30MHz
Emissions Data vs. NB Limit
Steady State Condition
135 Degrees
EUT: Machine Security System
Company: Caterpillar
Customer: Dave Huff
Operator: EJS
10:33:24 AM, Friday, May 25, 2001
Amplitude
(dBuV/m)
150.0
140.0
130.0
120.0
110.0
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0
-10.0
-20.0
-30.0
-40.0
-50.0
1.0K
10.0K
100.0K
1.0M
10.0M
100.0M
Frequency

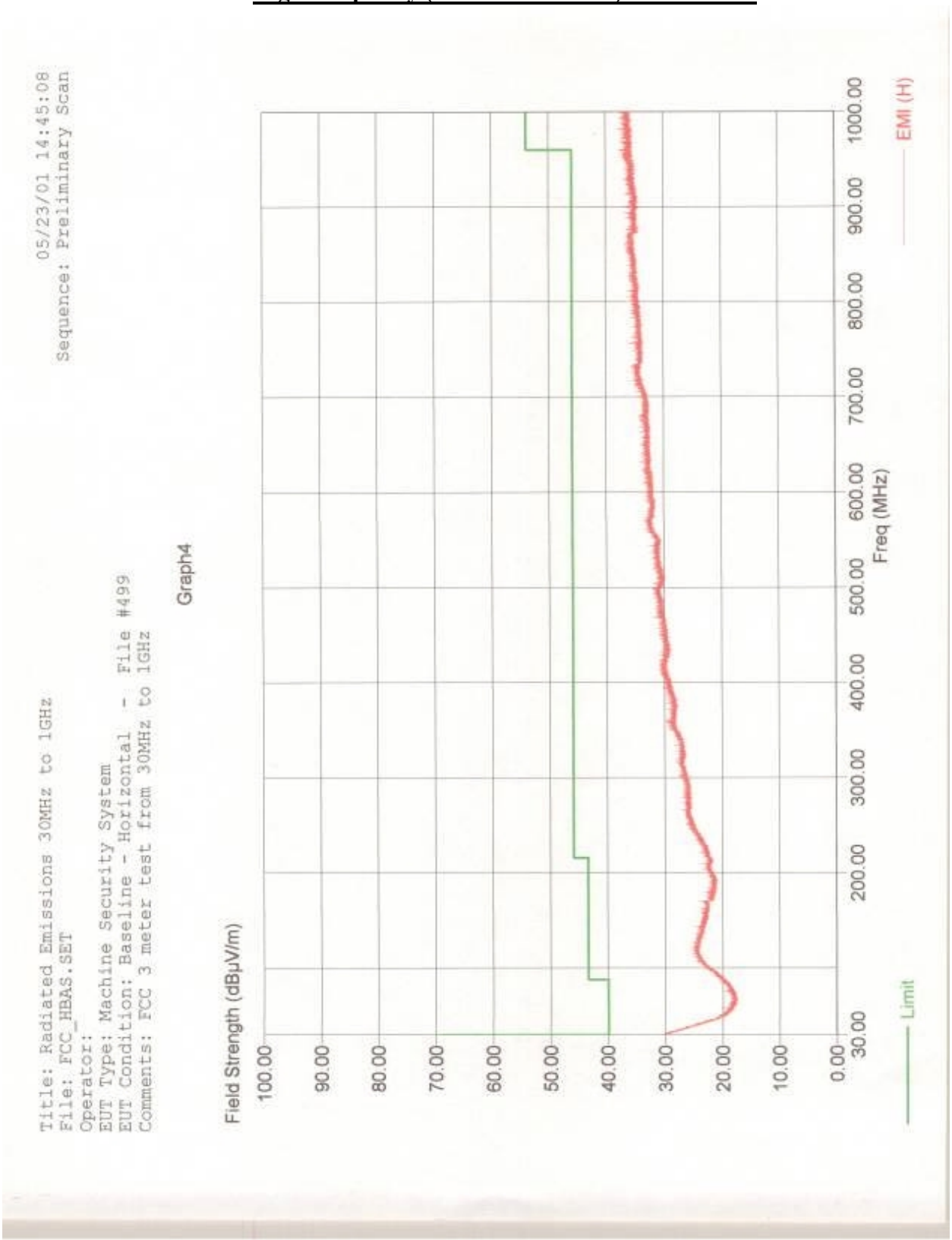

FCC Low Frequency Test
9kHz - 30MHz
Emissions Data vs. NB Limit
Steady State Condition
180 Degrees
Amplitude
Frequency
EUT: Machine Security System
Company: Caterpillar
Customer: Dave Huff
Operator: EJS
10:33:24 AM, Friday, May 25, 2001


FCC Low Frequency Test
9kHz - 30MHz
Emissions Data vs. NB Limit
Steady State Condition
225 Degrees
EUT: Machine Security System
Company: Caterpillar
Customer: Dave Huff
Operator: EJS
10:33:24 AM, Friday, May 25, 2001
Amplitude
(dBuV/m)
Frequency
150.0
140.0
130.0
120.0
110.0
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0
-10.0
-20.0
-30.0
-40.0
-50.0
1.0K
10.0K
100.0K
1.0M
10.0M
100.0M


FCC Low Frequency Test
9kHz - 30MHz
Emissions Data vs. NB Limit
Steady State Condition
270 Degrees
EUT: Machine Security System
Company: Caterpillar
Customer: Dave Huff
Operator: EJS
10:33:24 AM, Friday, May 25, 2001
Amplitude
Frequency
150.0
140.0
130.0
120.0
110.0
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0
-10.0
-20.0
-30.0
-40.0
-50.0
1.0K
10.0K
100.0K
1.0M
10.0M
100.0M


FCC Low Frequency Test
9kHz - 30MHz
Emissions Data vs. NB Limit
Steady State Condition
315 Degrees
Amplitude
(dBuV/m)
150.0
140.0
130.0
120.0
110.0
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0
-10.0
-20.0
-30.0
-40.0
-50.0
1.0K
10.0K
100.0K
1.0M
10.0M
100.0M
Frequency
EUT: Machine Security System
Company: Caterpillar
Customer: Dave Huff
Operator: EJS
10:33:24 AM, Friday, May 25, 2001

High Frequency (30 MHz to 1 GHz) - Horizontal




05/24/01 08:23:02
Sequence: Prelimimary Scan
Title: Radiated Emissions 30MHz to 1GHz
File: FCC_HSS.SET
Operator: EJS
EUT Type: Machine Security System
EUT Condition: Horizontal - Steady State Condition - File #499
Comments: FCC 3 meter test from 30MHz to 1GHz
Graph4
Field Strength (dBµV/m)
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
30.00
200.00
300.00
400.00
500.00
600.00
700.00
800.00
900.00
1000.00
Freq (MHz)
EMI (H)
Limit


05/23/01 13:28:11
Sequence: Preliminary Scan
Title: Radiated Emissions 30MHz to 1GHz
File: FCC_HCRF.SET
Operator:
EUT Type: Machine Security System
EUT Condition: Continuous RF - Horizontal
Comments: FCC 3 meter test from 30MHz to 1GHz
Graph4
Field Strength (dBµV/m)
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
30.00
200.00
300.00
400.00
500.00
600.00
700.00
800.00
900.00
1000.00
Freq (MHz)
EMI (H)
Limit

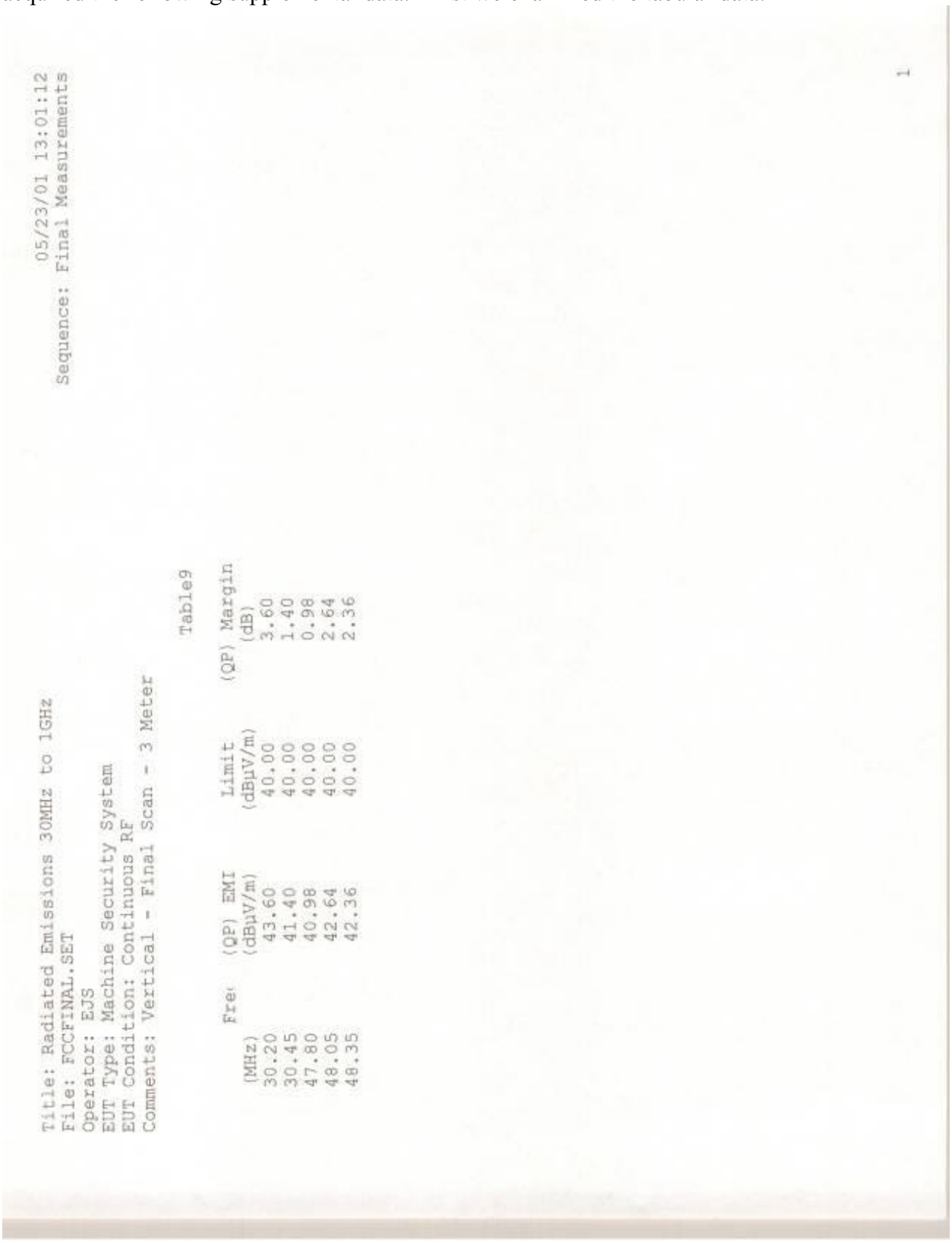
High Frequency (30 MHz to 1 GHz) - Vertical


05/23/01 09:03:26
Sequence: Preliminary Scan
Title: Radiated Emissions 30MHz to 1GHz
File: FCC_VSS.SET
Operator:
EUT Type: Machine Security System
EUT Condition: Steady State-Vertical
Comments: FCC 3 meter test from 30MHz to 1GHz
Graph4
Field Strength (dBµV/m)
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
30.00
200.00
300.00
400.00
500.00
600.00
700.00
800.00
900.00
1000.00
Freq (MHz)
EMI (H)
Limit


05/23/01 11:34:03
Sequence: Preliminary Scan
Title: Radiated Emissions 30MHz to 1GHz
File: FCC_VCRF.SET
Operator:
EUT Type: Machine Security System
EUT Condition: Continuous RF - Vertical
Comments: FCC 3 meter test from 30MHz to 1GHz
Graph4
Field Strength (dBµV/m)
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
30.00
200.00
300.00
400.00
500.00
600.00
700.00
800.00
900.00
1000.00
Freq (MHz)
EMI (H)
Class B
Class A

Additional Measurements and Computations

In observing the presence of radiated emissions in the range 30 MHz to 50 MHz, even though they were found to be below the established limits for a Class A device, we ran additional testing and acquired the following supplemental data. First we examined the tabular data:



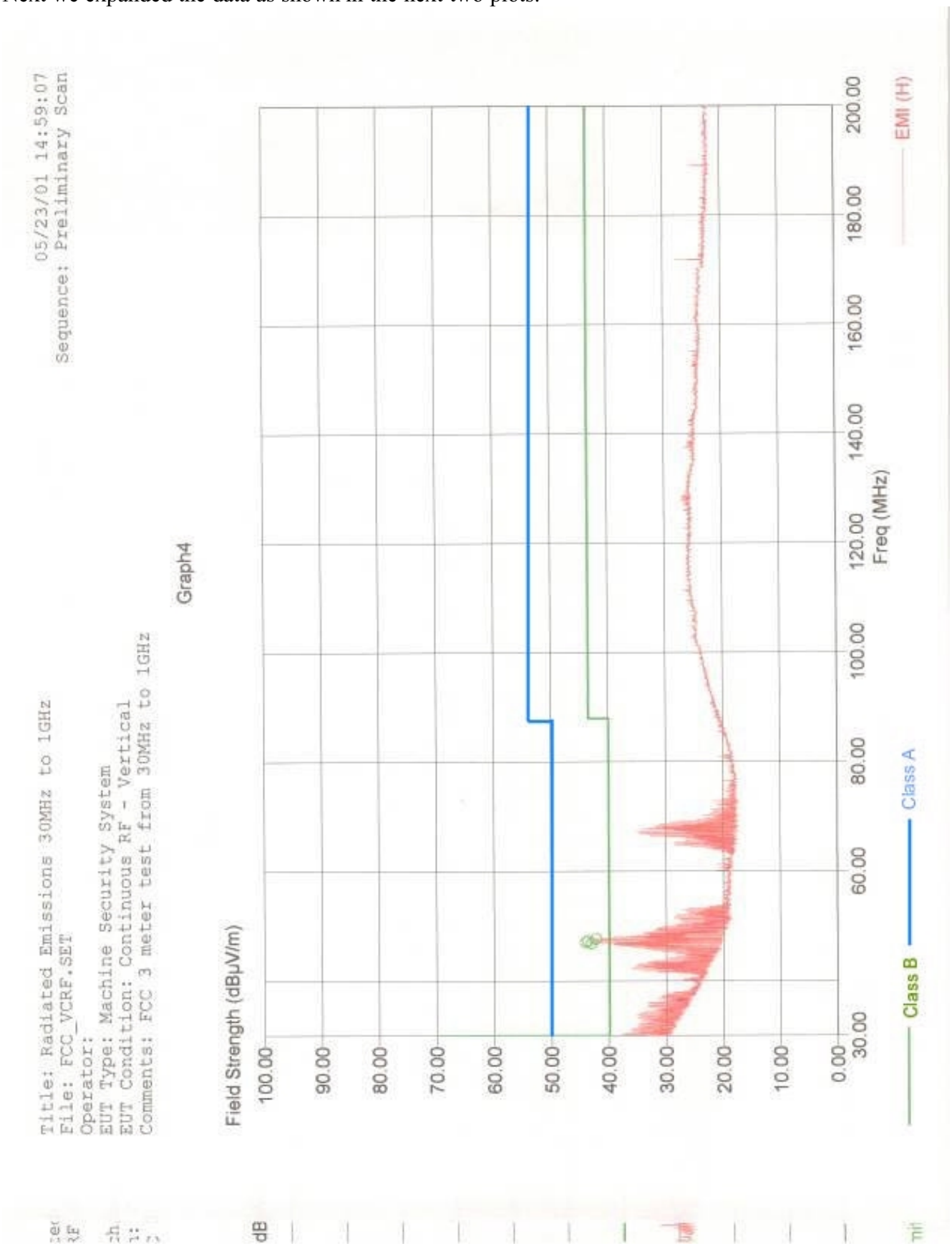
05/23/01 13:01:12 1
Sequence: Final Measurements

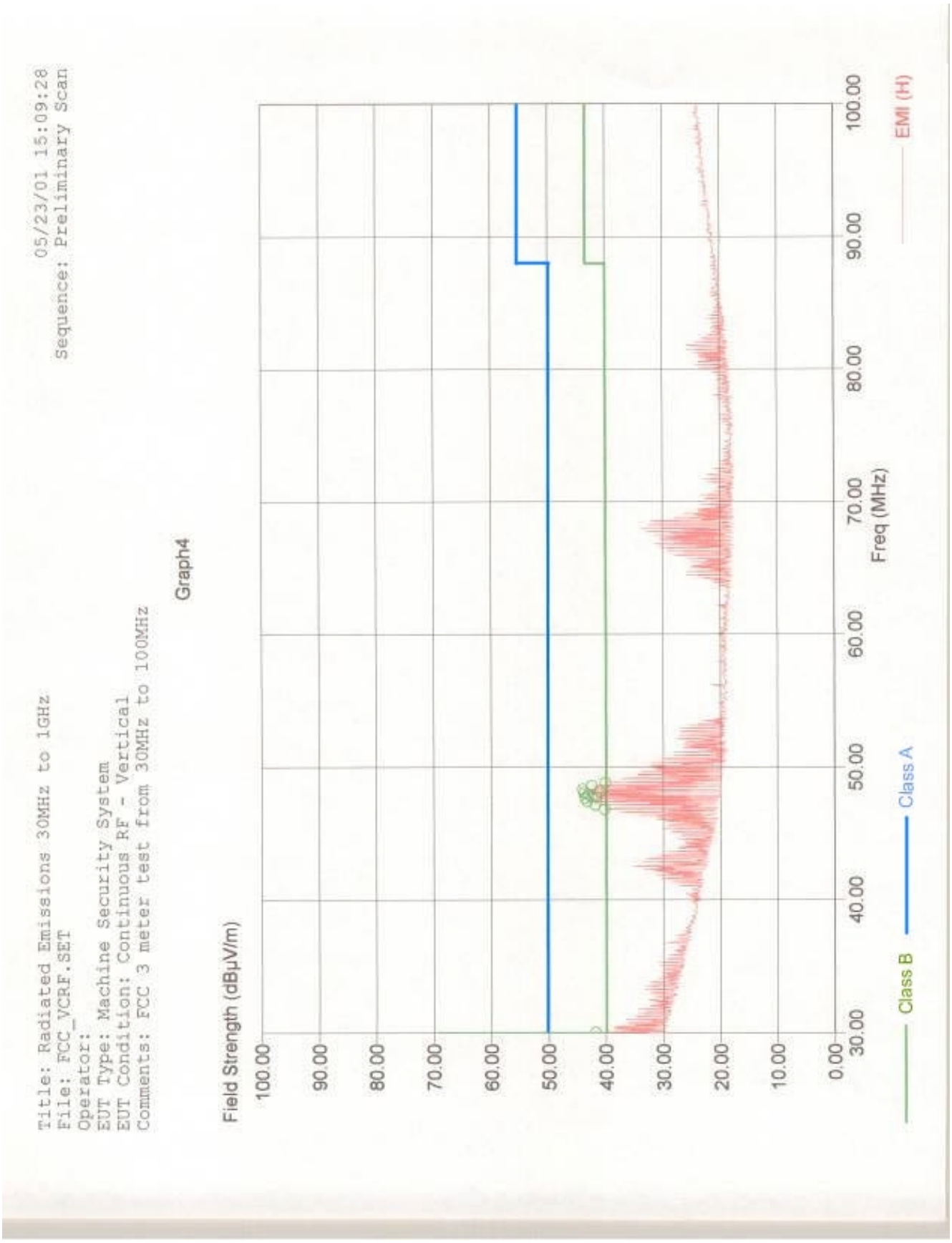
Title: Radiated Emissions 30MHz to 1GHz
File: FCCFINAL.SET
Operator: EJS
EUT Type: Machine Security System
EUT Condition: Continuous RF
Comments: Vertical - Final Scan - 3 Meter

Table9

Frequency (MHz)	(QP) EMI (dBµV/m)	Limit (dBµV/m)	(QP) Margin (dB)
30.20	43.60	40.00	3.60
30.45	41.40	40.00	1.40
47.80	40.98	40.00	0.98
48.05	42.64	40.00	2.64
48.35	42.36	40.00	2.36

Next we expanded the data as shown in the next two plots:




05/23/01 15:09:28
Sequence: Preliminary Scan
Title: Radiated Emissions 30MHz to 1GHz
File: FCC_VCRF.SET
Operator:
EUT Type: Machine Security System
EUT Condition: Continuous RF - Vertical
Comments: FCC 3 meter test from 30MHz to 100MHz
Graph4
Field Strength (dBµV/m)
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
30.00
40.00
50.00
60.00
70.00
80.00
90.00
100.00
Freq (MHz)
EMI (H)
Class A
Class B

The tabular data from the above plot is shown below:

05/23/01 15:19:07
Sequence: Final Measurements

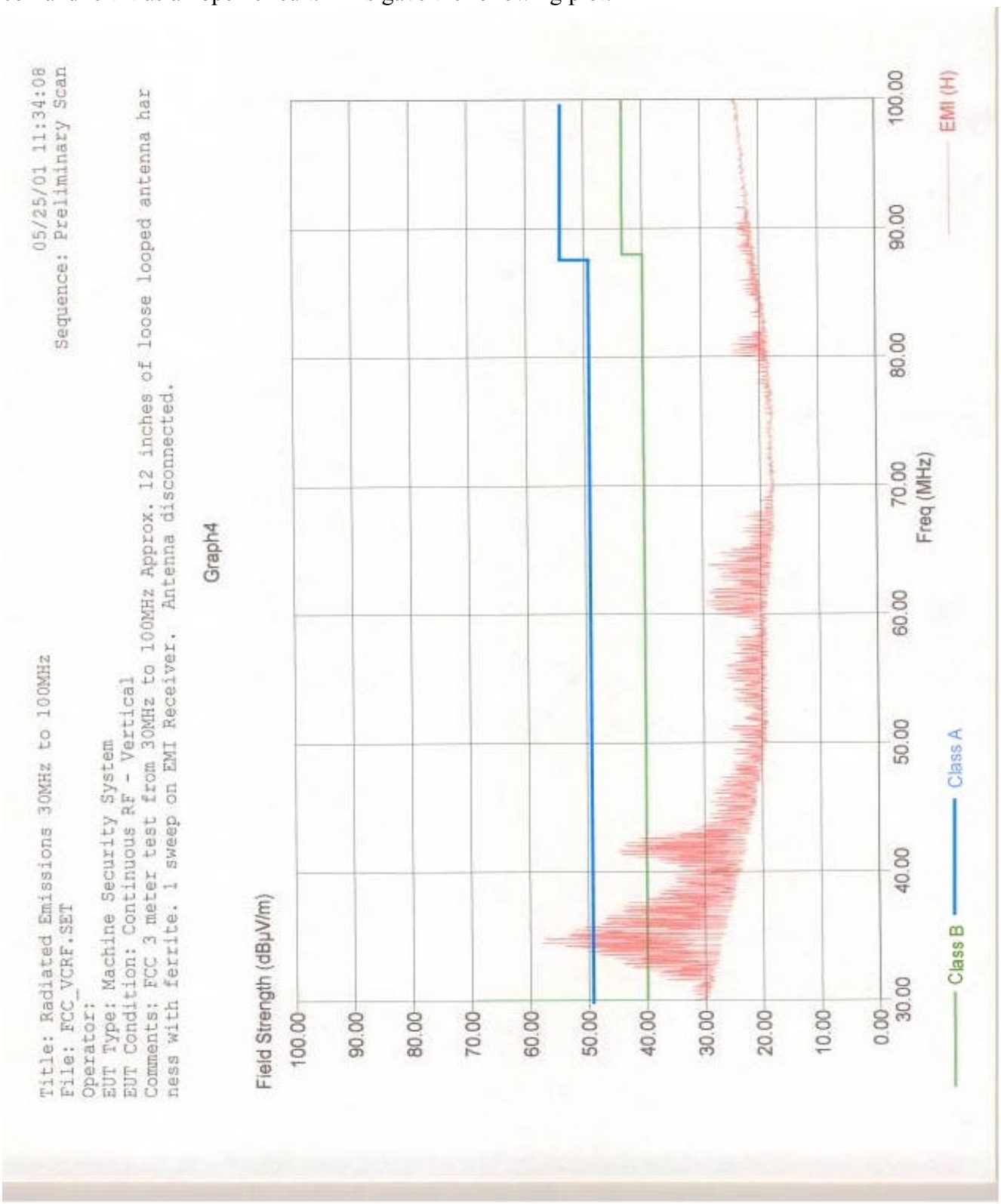
Title: Far Field Radiated Emissions 30MHz to 1GHz
File: FCCFINAL.SET
Operator: EJS
EUT Type: Machine Security System
EUT Condition: Continuous RF
Comments: Vertical - Final Scan - 30MHz to 100MHz

Table9

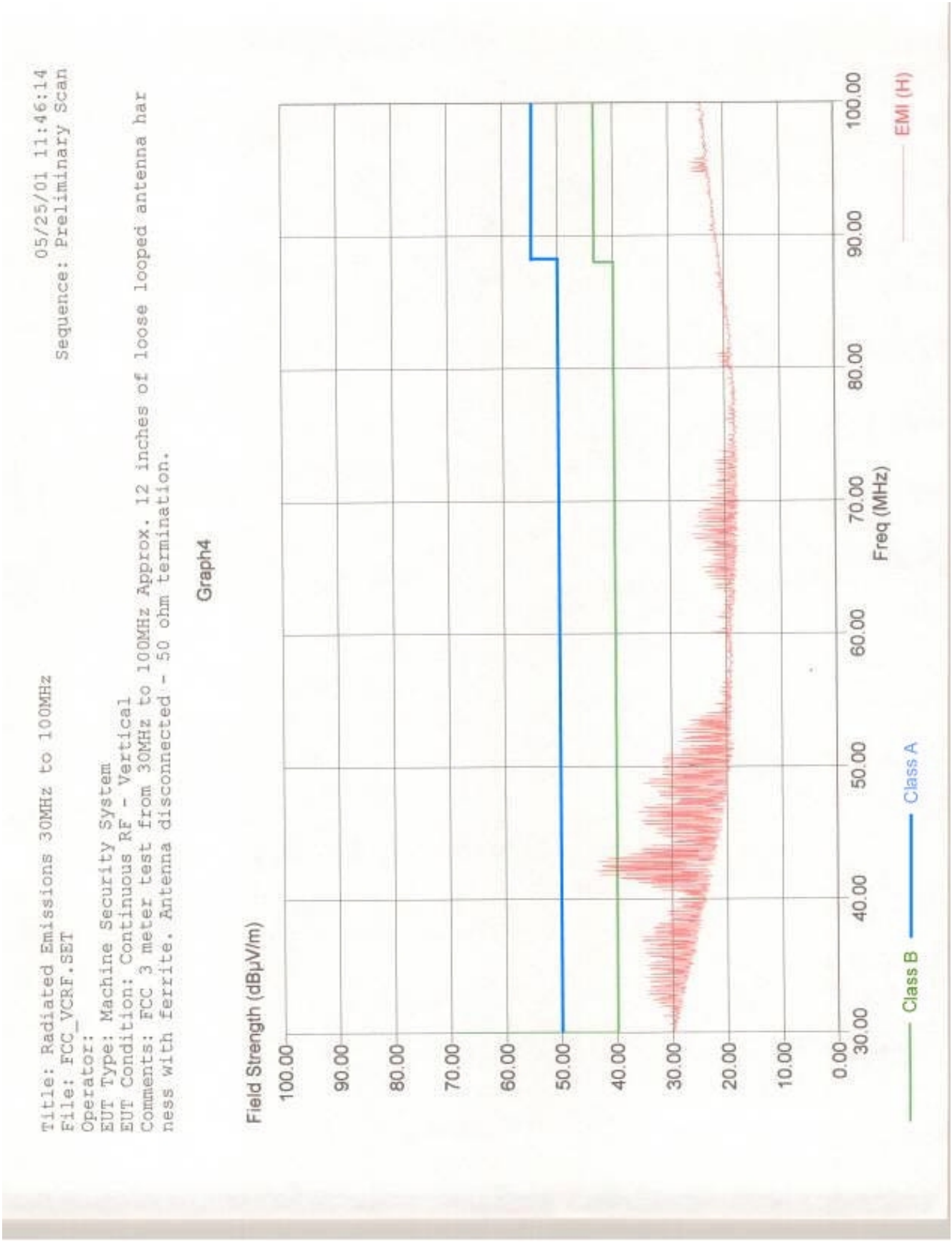
Frequency (MHz)	(QP) EMI (dBµV/m)	Limit (dBµV/m)	(QP) Margin (dB)
30.05	39.99	40.00	-0.01
46.85	37.91	40.00	-2.09
47.15	38.79	40.00	-1.21
47.40	42.52	40.00	2.52
47.65	39.17	40.00	-0.83
47.80	45.41	40.00	5.41
47.95			

1

To demonstrate that these emissions were the result of digital processing of signals within the ECM and not harmonics of the intentional radiator portion of the system we first disconnected the exciter coil and left it as an open circuit. This gave the following plot:



Next we connected a 50-ohm resistive load to show that additional emissions which came about when we disconnected the coil were the result of reflections. These results are shown below:



Conclusions

Testing was conducted at EMC Testing, Inc. on 5/23/01 and 5/25/01 on the Machine Security System (MSS) being developed by Caterpillar, Inc. EEBU.

The testing showed that the fundamental frequency of the MSS and its harmonics are within FCC part 15 levels for an intentional radiator at 134.2 KHz. The emissions above 30 MHz are within Class A limits, however because they are generated by the digital portion of the control they are exempt by Section 15.103 (a).