Test 3: Radiated Emissions - Spurious Emissions

Test Requirement: 47 CFR Part 15, Subpart C

Test Specification: 47 CFR Part 15, Subpart C Section 15.247

Test Procedure:

The test was performed in accordance with the Test Requirement and Specification and configured as noted in the Test Setup. The EUT was placed inside the anechoic chamber with a fresh battery installed or operating at nominal voltage. A peak measurement was first made by scanning the entire test frequency range and maximizing the EUT emissions by rotating the EUT and raising the antenna height from 1 to 4 meters above the ground reference plane. Resolution Bandwidth is set to 120 kHz for measurements below 1 GHz. Resolution Bandwidth is set 1 MHz for measurements above 1 GHz. Video Bandwidth is set to 1 MHz for all measurements. Then, a measurement was taken for all significant peak emissions to verify each were below the Test Limits.

Radiated Disturbance Limits for Frequency Hopping Spread Spectrum Transmitters - Section 15.247

Fundamental Frequency (MHz)	Hopping Channels	Permissible Output Power (milliwatts)	Permissible Output Power (dBm)	Permissible Spurious Emissions (milliwatts)	Permissible Spurious Emissions (dBm)
902 – 928	25 to 49	250	24	25	14
	50 or more	1000	30	100	20
	Digital Modulation	1000	30	100	20
2400 – 2483	15 to 74	125	21	12.5	11
	75 or more	1000	30	100	20
	Digital Modulation	1000	30	100	20
5725 – 5850	75 or more	1000	30	100	20
	Digital Modulation	1000	30	100	20

Output Power Adjustment:
Other than fixed point-to-point applications, power adjustment for antenna gain is as follows:

Gain of 6 dBi or less	No reduction is required
Gain greater than 6 dBi	Reduce the maximum output power by 1 dB for each 1 dB of antenna gain above 6 dBi

Restriced Bands:

The following harmonics were determined to reside partially or fully within a restricted band. These harmonics must comply with the general limits in 15.205.

Harmonic Frequency	Restricted Band?
1804 to 1852	No
2712 to 2778	Yes
3616 to 3704	Yes
4520 to 4630	Yes
5424 to 5556	Yes

Harmonic Frequency	Restricted Band?
6328 to 6482	No
7232 to 7408	Yes
8136 to 8334	Yes
9040 to 9260	Yes

Test Deviations:

None

Test Setup: Only the following ports were tested. See EUT Information for details.

Test Item	Port #	Port Name	EUT Operation Mode	EUT Configuration	Power Interface
A	0	Enclosure	1 (Low Channel)	2* (Antenna attached)	1
B	0	Enclosure	2 (Mid Channel)	2* (Antenna attached)	1
C	0	Enclosure	3 (High Channel)	2* (Antenna attached)	1

* Note: Matched load used from 800-1000 MHz to suppress carrier. Other frequencies use antenna.

Test 3 - Results: Radiated Emissions - Spurious Emissions

Test Results Summary:

Test Item	Test Location	Pass/Fail (P/F)	Date Completed	Comment (#)
A	A	P	7/5/03	1-4
B	A	P	7/5/03	1-4
C	A	P	7/5/03	1-4

The EUT was considered to **Pass** the Requirements.

Comments:

Comment #	Description
1	Measurements was performed with a matched load in place of attaching antenna to suppress transmit frequency for 800 to 1000 MHz measurement.
2	Note for 1 to 4 GHz measurements: Measurements were performed with a 902 MHz to 928 MHz notch filter attached to the receiving horn antenna. A factor for the insertion loss was included in the calculations.
3	Note for 4 to 10 GHz measurements: Measurements were performed with a single stage high-pass filter attached to the receiving horn antenna. A factor for the insertion loss was included in the calculations.
4	Typical patch antenna was used with 8 dBi gain. Output power was unreduced from maximum to ensure no enclosure-sourced spurious harmonics were present at full power. In an actual installation the output power would be reduced to +28 dBm with this antenna.

Test Equipment Used:

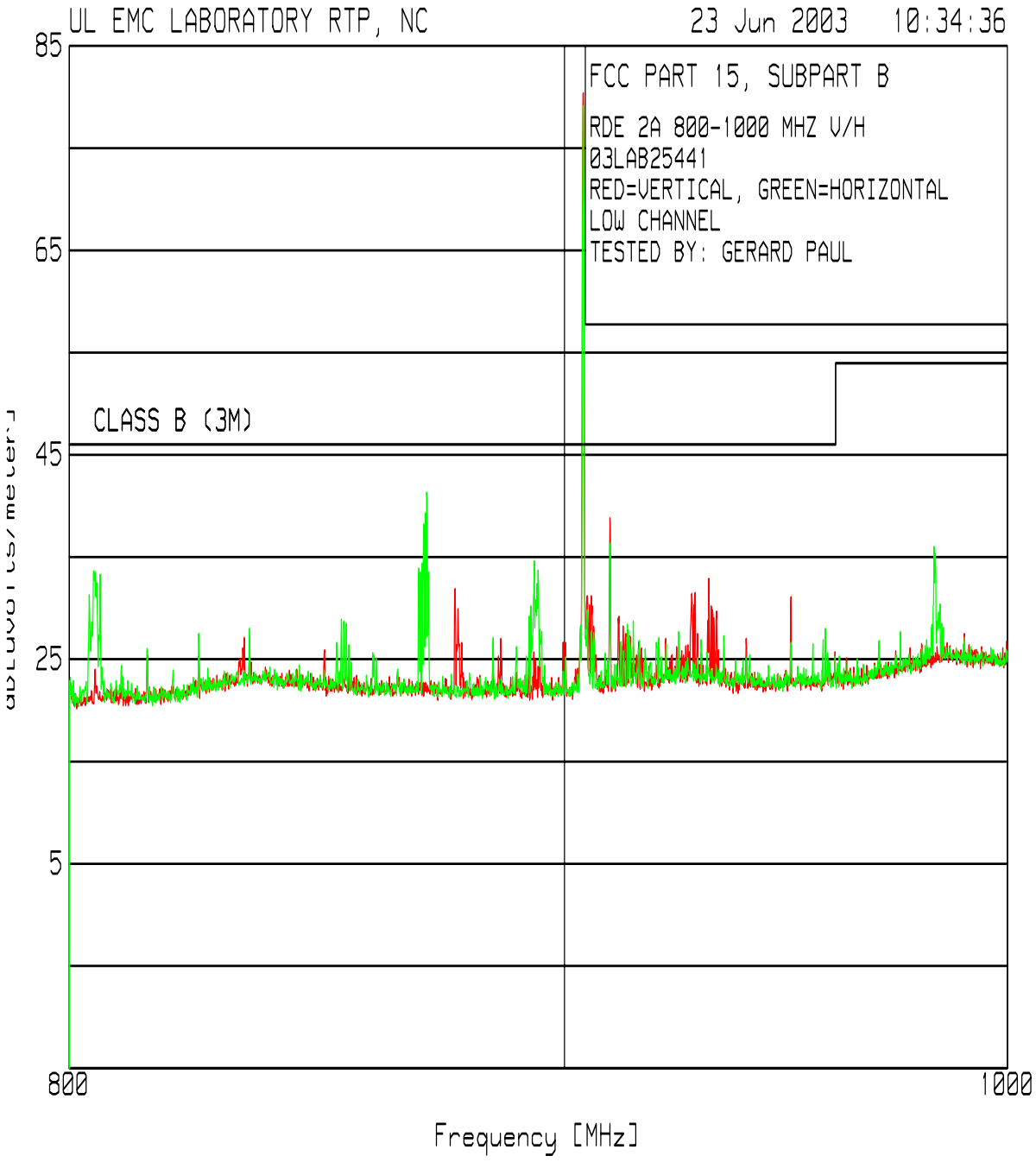
Equipment ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
AT0022	Log Periodic Antenna, 200-1000 MHz	Chase	UPA6109	7/22/02	7/31/03
AT0026	Horn Antenna, 1 to 18 GHz	EMC Test Systems	3115	5/8/03	5/31/04
ATA085	Attenuator 6 dB, 2 GHz	Pasternack	PE7002-6	3/19/03	3/31/04
ATA095	6 ft, N male - N male	Micro-Coax	Coaxial Cable	3/19/03	9/30/03
ATA096	50 ft, N male - N male	Micro-Coax	Coaxial Cable	3/20/03	9/30/03
ATA110	RF Amplifier, 1 to 1000 MHz	Miteq	AM-3A-000110-N	3/19/03	3/31/04
ATA140	RG214 Ferrite Cable	EMC Eupen	N/A	3/19/03	3/31/04
ATA143	6ft., N-male to N-male	Microcoax	Coaxial Cable	3/19/03	3/31/04
ATA144	Amplifier, 0.1 to 18 GHz	Miteq	AFS42-00101800-2	3/20/03	3/31/04
ATA153	27 ft. N male - N male low loss cable	Micro-coax	UFB293C-0-3149-50504	2/25/03	8/31/04
HI0034	Environmental Indicator	Cole-Palmer	99760-00	10/2/02	10/31/03
SAR002	Spectrum Analyzer / Receiver	Hewlett-Packard	8566B	11/21/02	11/30/03
ATA163	High-pass Filter	UL	-	7/5/03	7/31/04
ZATA31	Tunable Notch Filter	Eastern Wireless, Inc.	EWT-14-0002	NA*	NA*

The above equipment has been calibrated and is within the manufacturer's published limit of error. Calibration is traceable to the National Institute of Standards & Technology(NIST) and conforms to ANSI/NCSL Z540-1-1994.

*Notch filter insertion loss is measured before each use.

Test 3, Item A (Low Channel) - Peak Plot (Amplitude in dBuV/m):

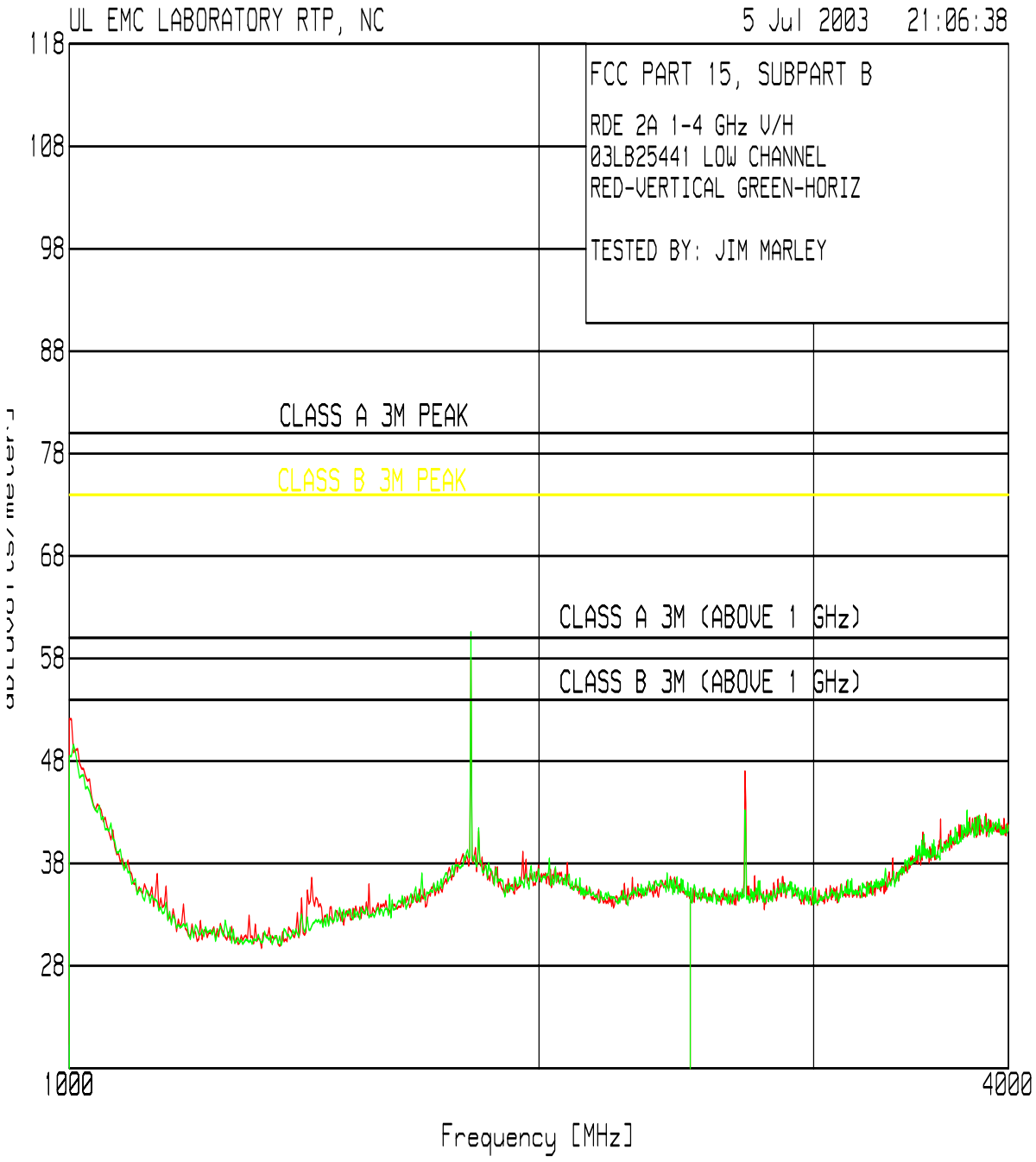
Radiated Emissions - Spurious Emissions – 800 to 1000 MHz



Note: Transmit Frequency is disregarded.

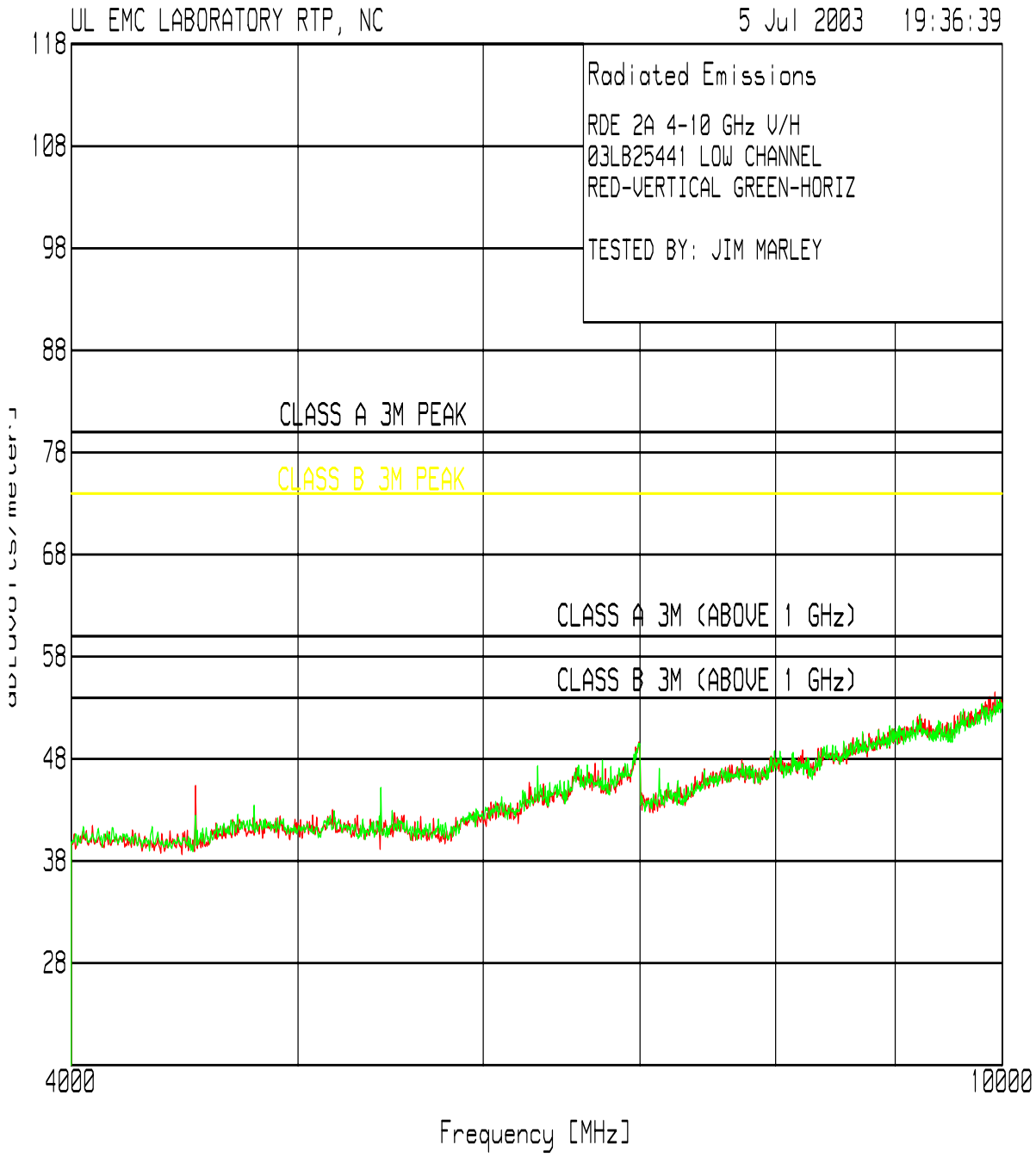
Test 3, Item A (Low Channel) - Peak Plot (Amplitude in dBuV/m):

Radiated Emissions - Spurious Emissions – 1 to 4 GHz



Test 3, Item A (Low Channel) - Peak Plot (Amplitude in dBuV/m):

Radiated Emissions - Spurious Emissions – 4 to 10 GHz



Test 3, Item A - Discrete Data: Radiated Emissions - Spurious Emissions

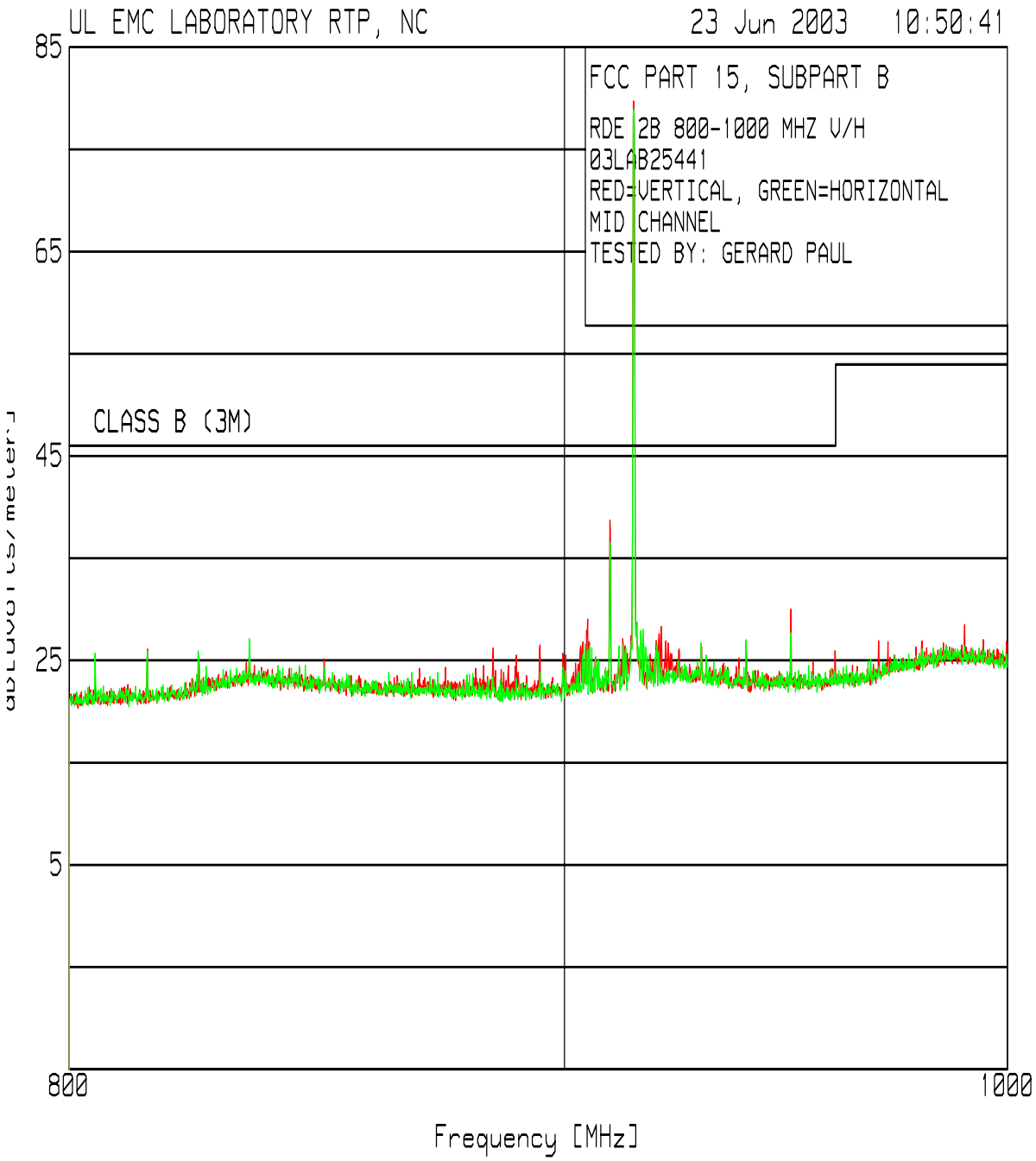
Test Item (A-Z)	Detector Type* (P/Q/A)	Antenna Polarity (H/V)	Antenna Distance (m)	Measured Frequency (MHz)	Measured Value (dBuV)	Equip Correction (dB/m)	Corrected Value (dBuV/m)	Specified Limit** (dBuV/m)	Spec Margin (dB)	See Comment (#)***
Low Channel (Worst-case polarity for each emission shown)										
A	P	H	3	1808.617	58.1	2.5	60.6	115.2	-54.6	2
A	P	V	3	2710.421	47.7	-0.7	47.0	74	-27.0	
A	A	V	3	2710.421	-	-	45.5	54	-8.5	1
A	P	V	3	3616.280	38.6	3.7	42.3	74	-31.7	
A	A	V	3	3616.280	-	-	40.8	54	-13.2	1
A	P	V	3	4520.350	39.6	6.0	45.4	74	-29.6	
A	A	V	3	4520.350	-	-	43.9	54	-9.1	1
A	P	H	3	5424.950	37.6	5.6	45.2	74	-31.8	
A	A	H	3	5424.950	-	-	43.7	54	-10.3	1
A	P	H	3	6329.550	37.2	10.1	47.3	74	-26.7	
A	A	H	3	6329.550	-	-	45.8	54	-8.2	1
A	P	H	3	7134.090	33.6	13.4	47.0	74	-27.0	
A	A	H	3	7134.090	-	-	45.5	54	-8.5	1
A	P	H	3	9035.360	30.2	21.0	51.2	74	-22.8	
A	A	H	3	9035.360	-	-	49.7	54	-4.3	1

* P = Peak, Q = Quasi-Peak, A = Average.
** The Specified Limit is for the type measurement indicated. When Peak data is indicated, the tightest limit applicable is indicated.
*** # = See Comment Number Under This Test's Comments Section.
Sample Calculation: Corrected Value = Measured Value + Equip Correction
Sample Calculation: Equip Correction = Antenna Factor (dB/m) + Cable Loss (dB) - Amplifier Gain (dB, if used)

Comment #	Description
1	Average is calculated by applying peak-to-average ratio of 1.5 dB to peak measurement.
2	2nd harmonic does not fall within restricted band. 100 mW limit calculated to equivalent field strength at 3 meter distance.

Test 3, Item B (Mid Channel) - Peak Plot (Amplitude in dBuV/m):

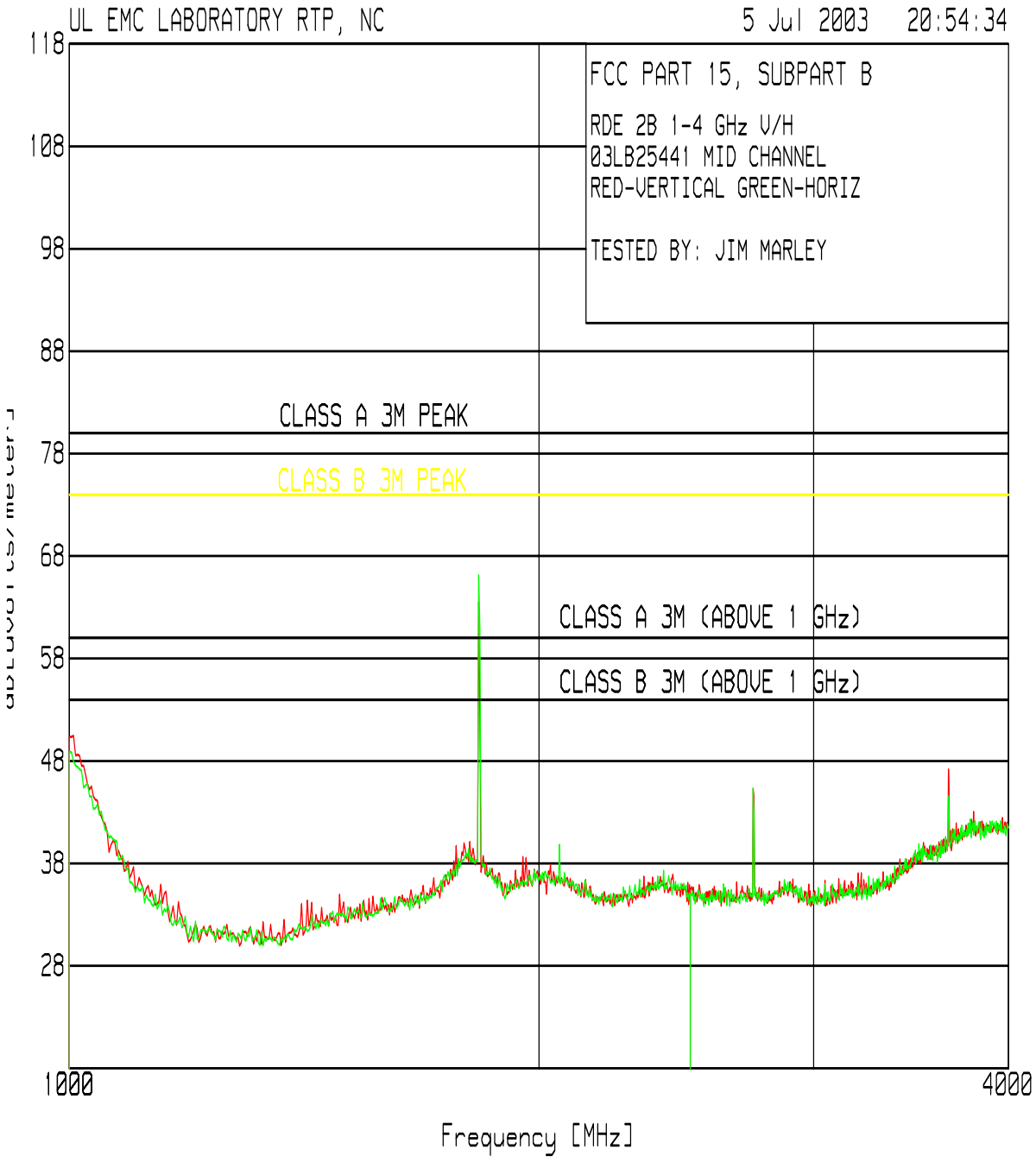
Radiated Emissions - Spurious Emissions – 800 to 1000 MHz



Note: Transmit Frequency is disregarded.

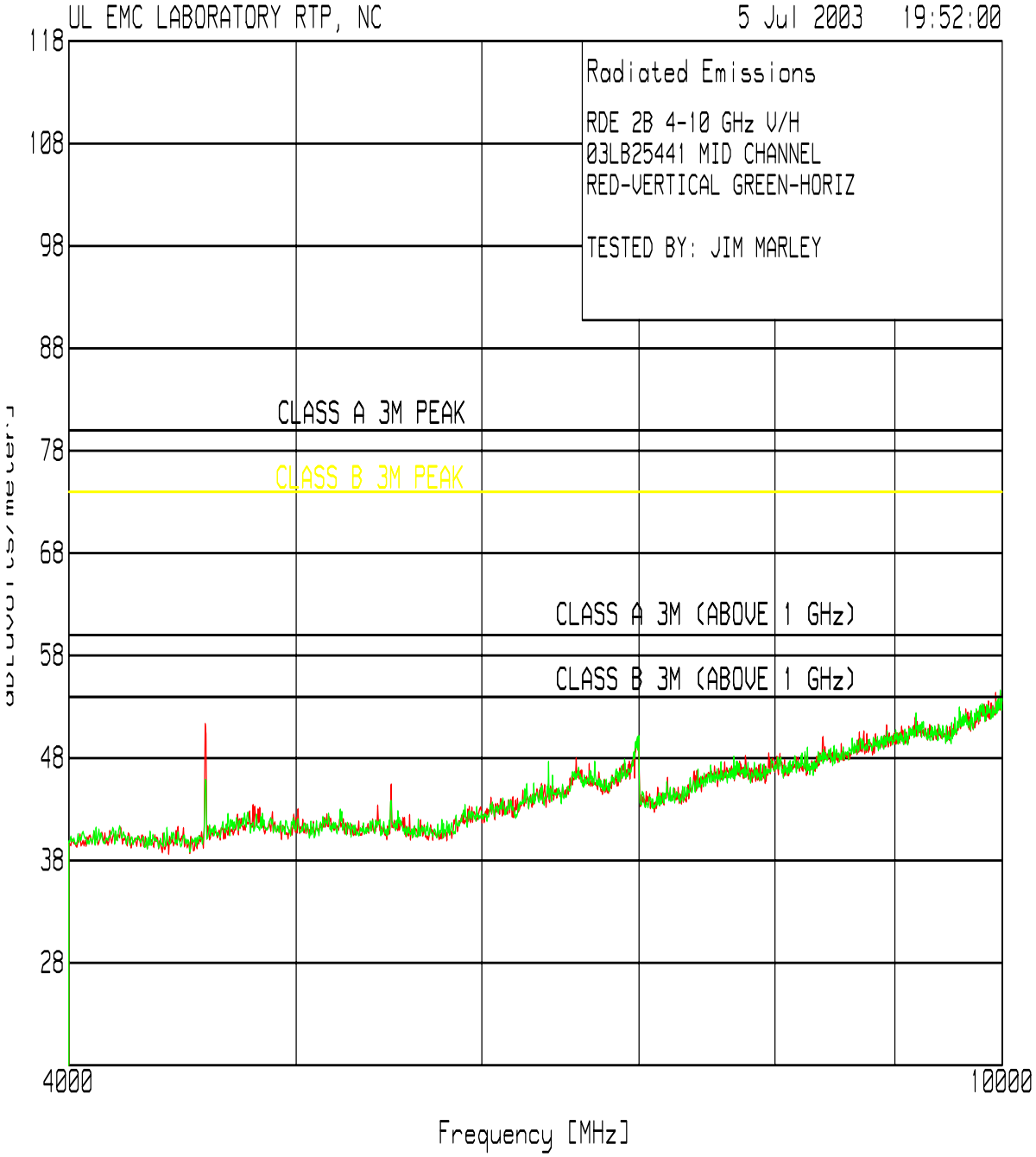
Test 3, Item B (Mid Channel) - Peak Plot (Amplitude in dBuV/m):

Radiated Emissions - Spurious Emissions – 1 to 4 GHz



Test 3, Item B (Mid Channel) - Peak Plot (Amplitude in dBuV/m):

Radiated Emissions - Spurious Emissions – 4 to 10 GHz



Test 3, Item B - Discrete Data: Radiated Emissions - Spurious Emissions

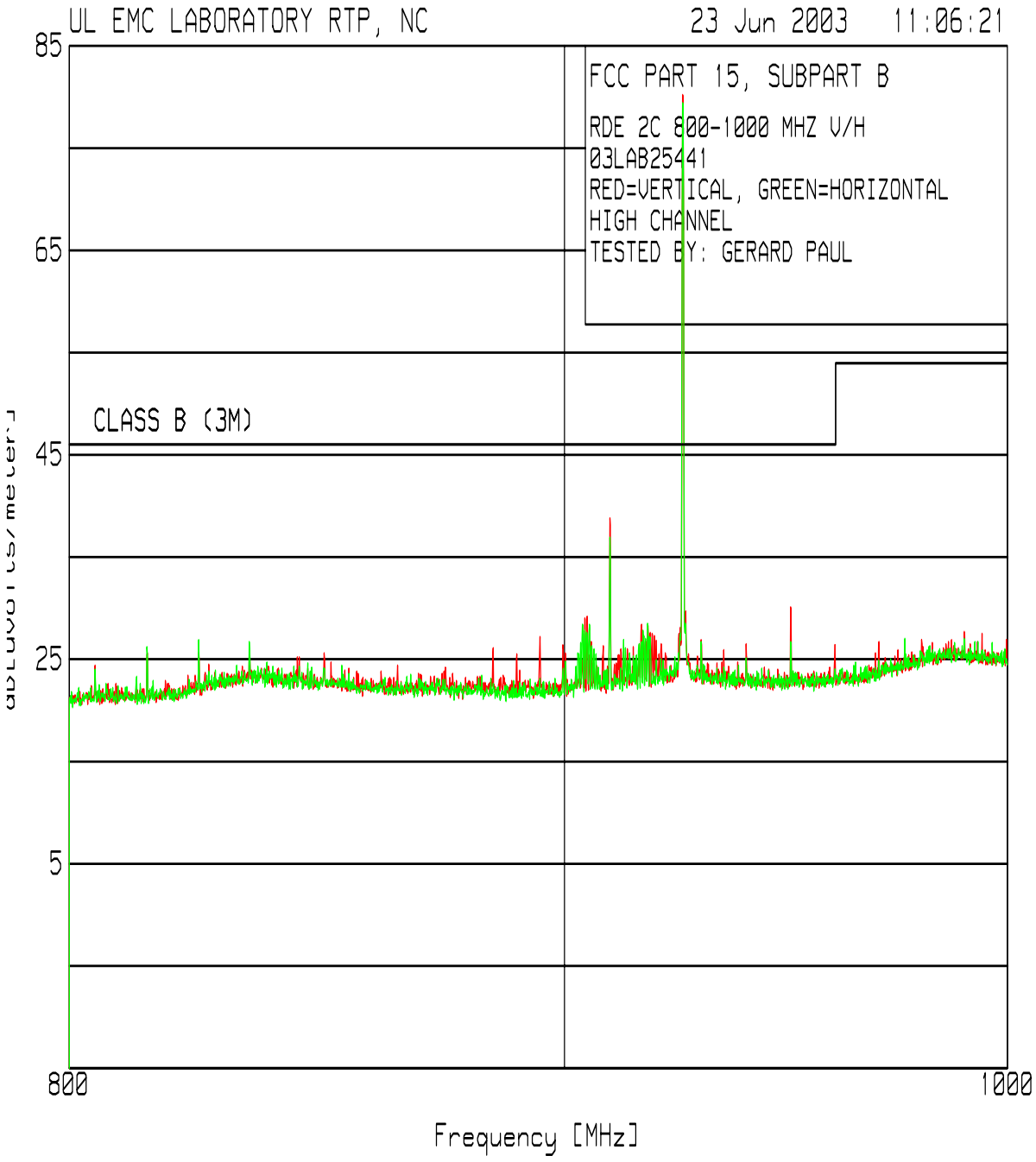
Test Item (A-Z)	Detector Type* (P/Q/A)	Antenna Polarity (H/V)	Antenna Distance (m)	Measured Frequency (MHz)	Measured Value (dBuV)	Equip Correction (dB/m)	Corrected Value (dBuV/m)	Specified Limit** (dBuV/m)	Spec Margin (dB)	See Comment (#)***
Mid Channel (Worst-case polarity for each emission shown)										
B	P	H	3	1829.660	64.6	1.5	66.1	115.2	-49.1	2
B	P	H	3	2745.230	46.3	-1.0	45.3	74	-28.7	
B	A	V	3	2745.230	-	-	43.8	54	-10.2	1
B	P	V	3	3660.320	43.3	3.9	47.2	74	-26.8	
B	A	V	3	3660.320	-	-	45.7	54	-8.3	1
B	P	V	3	4572.380	45.0	7.3	51.3	74	-22.7	
B	A	V	3	4572.380	-	-	49.8	54	-4.2	1
B	P	V	3	5489.000	37.5	7.9	45.4	74	-28.6	
B	A	V	3	5489.000	-	-	43.9	54	-10.1	1
B	P	H	3	6405.600	37.5	10.1	47.6	74	-26.4	
B	A	H	3	6405.600	-	-	46.1	54	-7.9	1
B	P	H	3	8258.840	31.8	17.2	49.0	74	-25.0	
B	A	H	3	8258.840	-	-	47.5	54	-6.5	1
B	P	H	3	9187.460	30.6	21.8	52.4	74	-21.6	
B	A	H	3	9187.460	-	-	50.9	54	-3.1	1

** The Specified Limit is for the type measurement indicated. When Peak data is indicated, the tightest limit applicable is indicated.
*** # = See Comment Number Under This Test's Comments Section.
Sample Calculation: Corrected Value = Measured Value + Equip Correction
Sample Calculation: Equip Correction = Antenna Factor (dB/m) + Cable Loss (dB) - Amplifier Gain (dB, if used)

Comment #	Description
1	Average is calculated by applying peak-to-average reduction of 1.5 dB to peak measurement.
2	2nd harmonic does not fall within restricted band. 100 mW limit calculated to equivalent field strength at 3 meter distance.

Test 3, Item C (High Channel) - Peak Plot (Amplitude in dBuV/m):

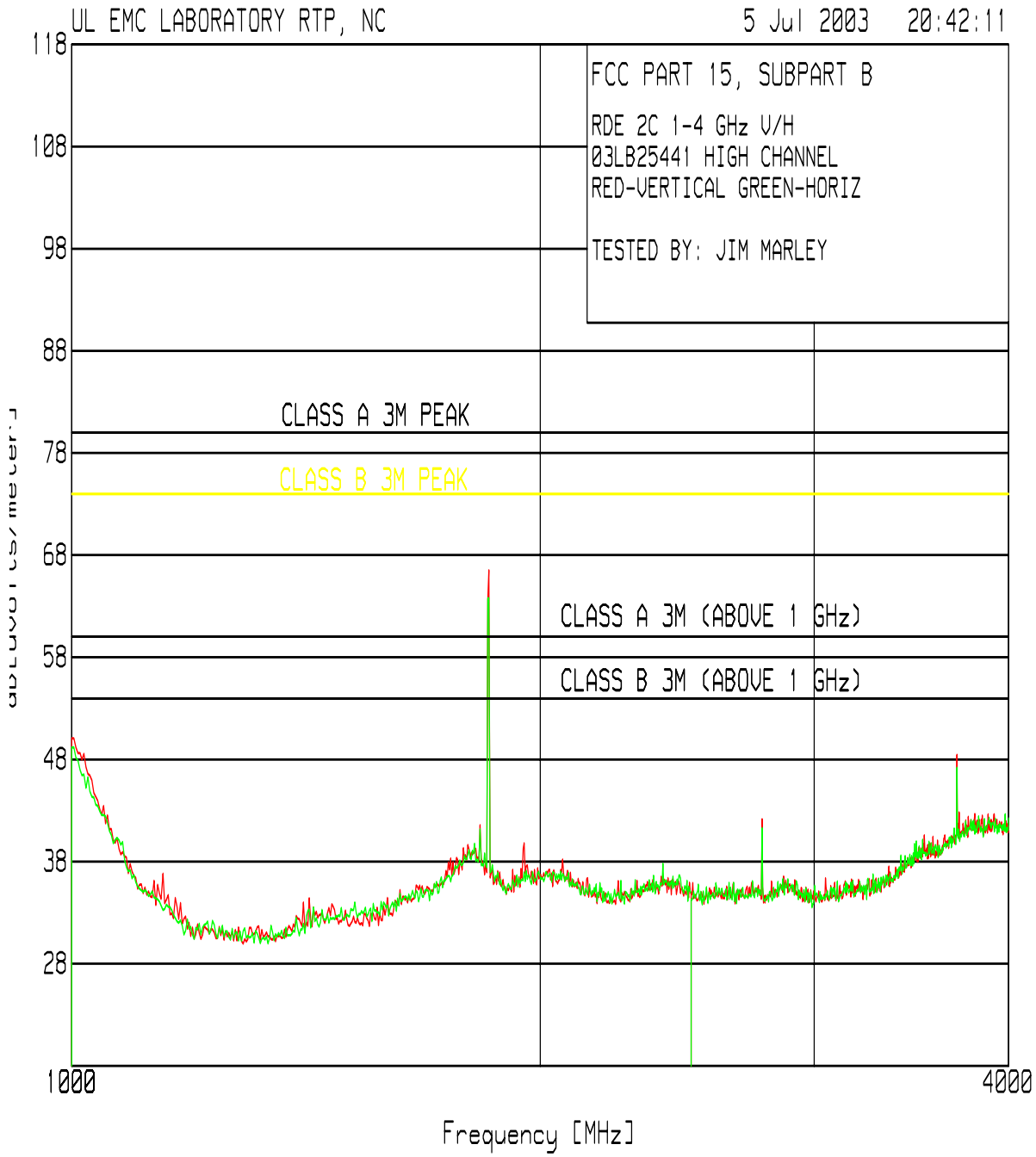
Radiated Emissions - Spurious Emissions – 800 to 1000 MHz



Note: Transmit Frequency is disregarded.

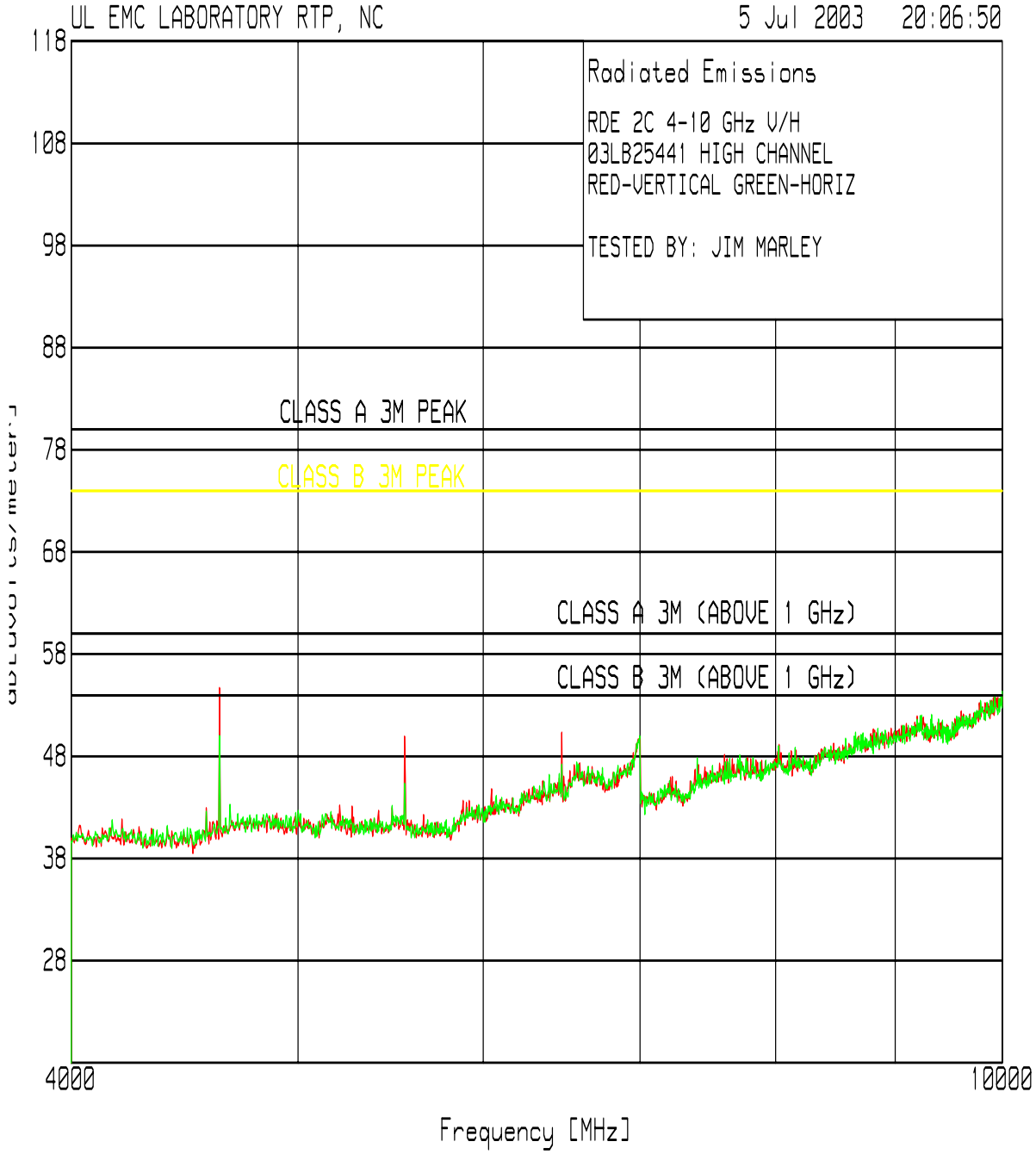
Test 3, Item C (High Channel) - Peak Plot (Amplitude in dBuV/m):

Radiated Emissions - Spurious Emissions – 1 to 4 GHz



Test 3, Item C (High Channel) - Peak Plot (Amplitude in dBuV/m):

Radiated Emissions - Spurious Emissions – 4 to 10 GHz



Test 3, Item C - Discrete Data: Radiated Emissions - Spurious Emissions

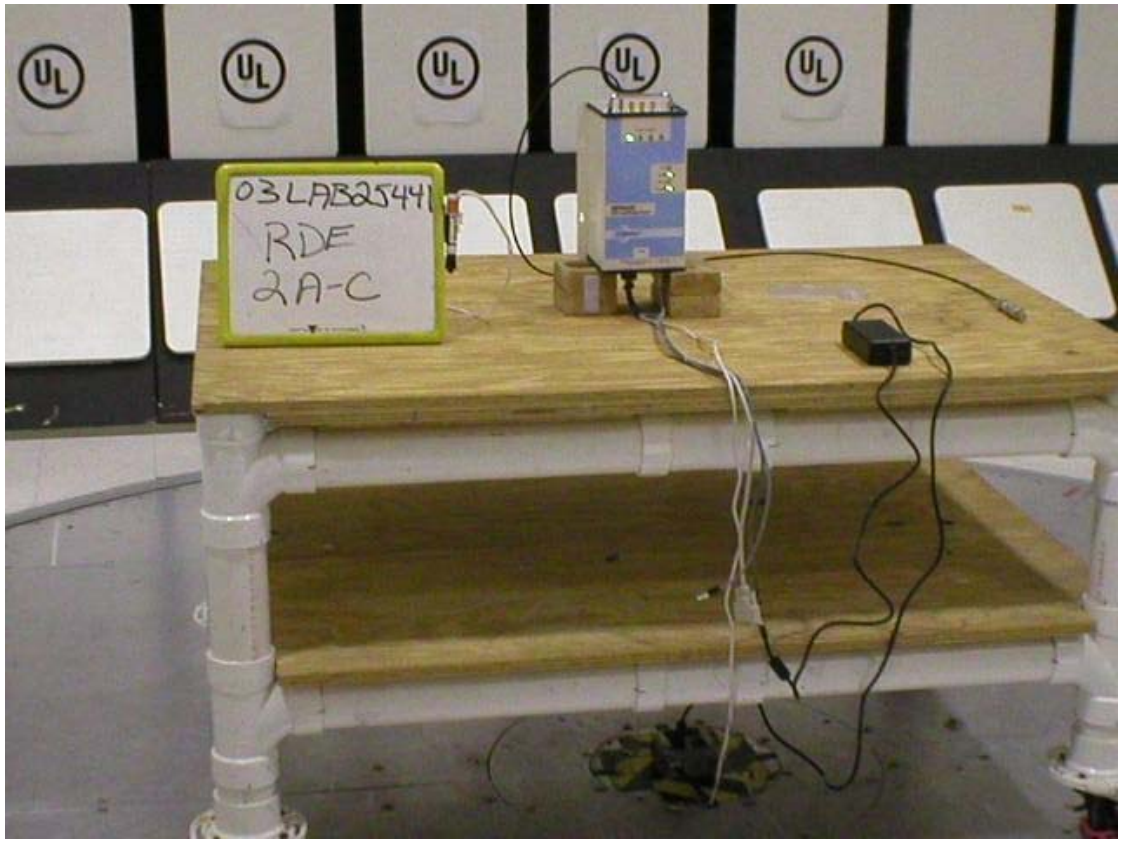
Test Item (A-Z)	Detector Type* (P/Q/A)	Antenna Polarity (H/V)	Antenna Distance (m)	Measured Frequency (MHz)	Measured Value (dBuV)	Equip Correction (dB/m)	Corrected Value (dBuV/m)	Specified Limit** (dBuV/m)	Spec Margin (dB)	See Comment (#)***
High Channel (Worst-case polarity for each emission shown)										
C	P	H	3	1853.710	66.1	0.4	66.5	115.2	-48.7	2
C	P	V	3	2776.550	43.4	-1.2	42.2	74	-31.8	
C	A	V	3	2776.550	-	-	40.7	54	-13.3	1
C	P	V	3	3705.410	44.1	1.3	48.5	74	-25.5	
C	A	V	3	3705.410	-	-	47.0	54	-7.0	1
C	P	V	3	4628.420	48.2	6.5	54.7	74	-19.3	
C	A	V	3	4628.420	-	-	53.2	54	-0.8	1, 3
C	P	H	3	5553.035	39.8	7.8	47.6	74	-26.4	
C	A	H	3	5553.035	-	-	46.1	54	-27.9	1
C	P	V	3	6481.650	37.8	10.2	48.0	74	-26.0	
C	A	V	3	6481.650	-	-	46.5	54	-7.5	1
C	P	V	3	7414.280	29.5	15.3	44.8	74	-29.2	
C	A	V	3	7414.280	-	-	43.3	54	-10.7	1
C	P	H	3	9409.960	30.2	21.8	52.0	74	-22.0	
C	A	H	3	9409.960	-	-	50.5	54	-3.5	1

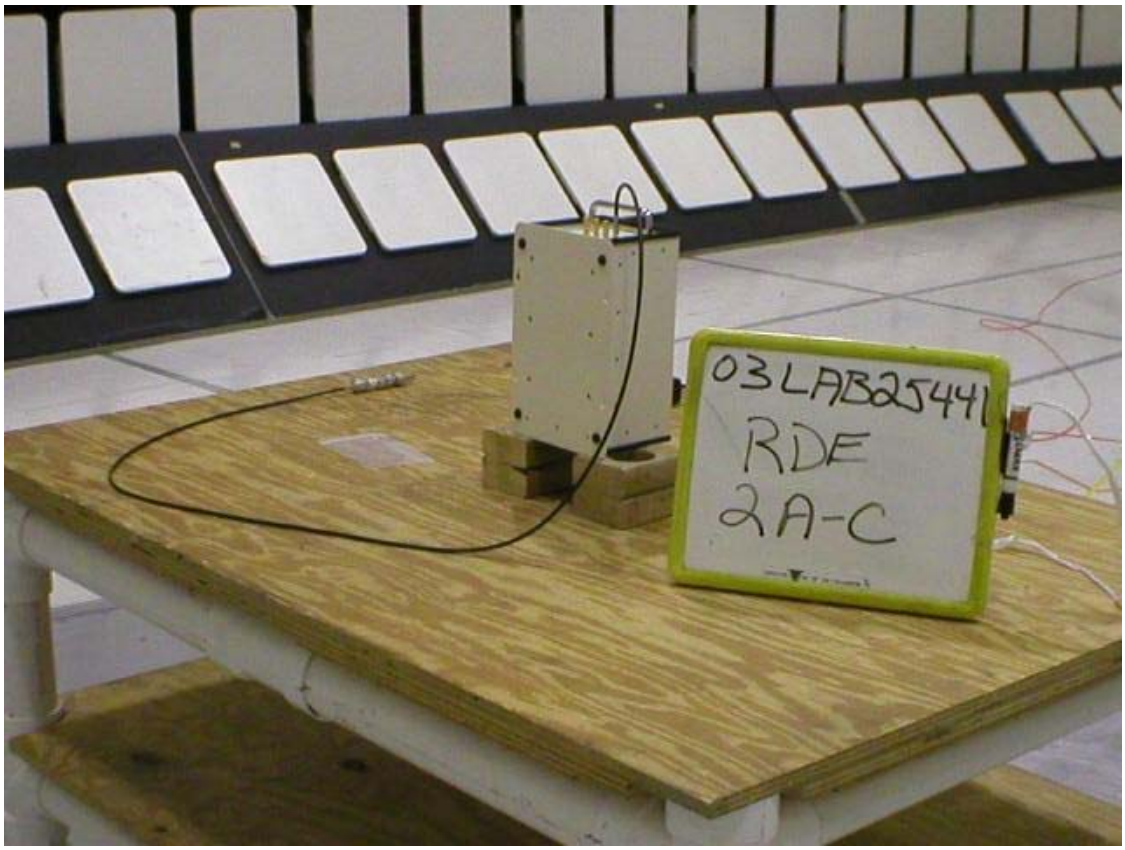
* P = Peak, Q = Quasi-Peak, A = Average.
** The Specified Limit is for the type measurement indicated. When Peak data is indicated, the tightest limit applicable is indicated.
*** # = See Comment Number Under This Test's Comments Section.
Sample Calculation: Corrected Value = Measured Value + Equip Correction
Sample Calculation: Equip Correction = Antenna Factor (dB/m) + Cable Loss (dB) - Amplifier Gain (dB, if used)

Comment #	Description
1	Average is calculated by applying peak-to-average reduction of 1.5 dB to peak measurement.
2	2nd harmonic does not fall within restricted band. 100 mW limit calculated to equivalent field strength at 3 meter distance.
3	Harmonic closest to limit. 53.2 dBuV/m = 457 uV/m. Limit = 500 uV/m

Test 3, Item A - Test Set-Up Photo:

Radiated Emissions - Spurious Emissions - 800 to 1000 MHz





Test 3, Item A - Test Set-Up Photo:

Radiated Emissions - Spurious Emissions – 1 to 10 GHz