

Appendix D. Co-location

1. Radiated Emissions Measurement

1.1.1. Limit

20dBc in any 100 kHz bandwidth outside the operating frequency band. In case the emission fall within the restricted band specified on 15.205(a), then the 15.209(a) limit in the table below has to be followed.

Frequencies (MHz)	Field Strength (microvolts/meter)	Measurement 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

1.1.2. Measuring Instruments and Setting

Please refer to section 5 of equipments list in this report. The following table is the setting of spectrum analyzer and receiver.

Spectrum Parameter	Setting
Attenuation	Auto
Start Frequency	1000 MHz
Stop Frequency	10th carrier harmonic
RB / VB (Emission in restricted band)	1MHz / 1MHz for Peak, 1 MHz / 10Hz for Average
RB / VB (Emission in non-restricted band)	1000KHz / 1000KHz for peak

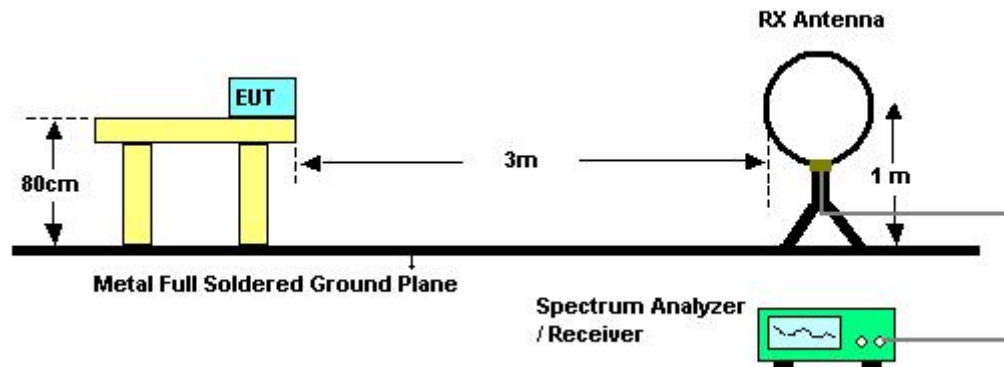
Receiver Parameter	Setting
Attenuation	Auto
Start ~ Stop Frequency	9kHz~150kHz / RB 200Hz for QP
Start ~ Stop Frequency	150kHz~30MHz / RB 9kHz for QP
Start ~ Stop Frequency	30MHz~1000MHz / RB 120kHz for QP

1.1.3. Test Procedures

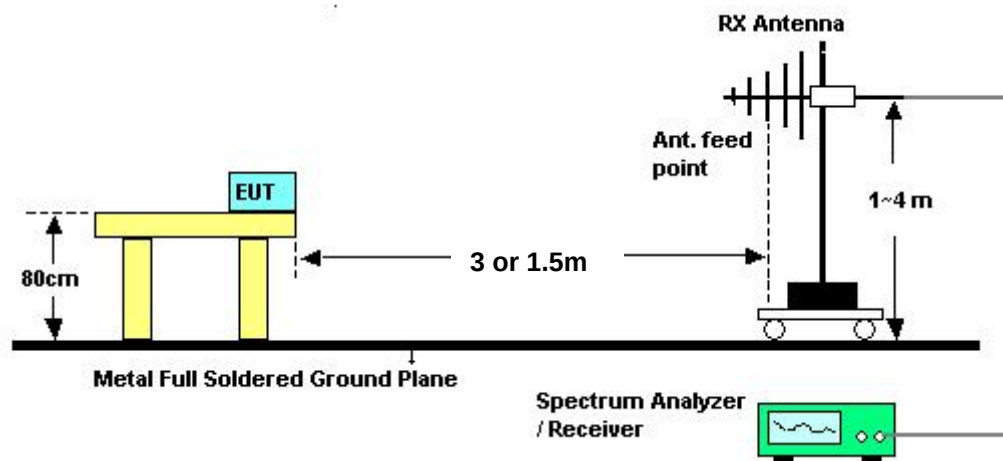
1. Configure the EUT according to ANSI C63.4. The EUT was placed on the top of the turntable 0.8 meter above ground. The phase center of the receiving antenna mounted on the top of a height-variable antenna tower was placed 3 meters far away from the turntable.
2. Power on the EUT and all the supporting units. The turntable was rotated by 360 degrees to determine the position of the highest radiation.
3. The height of the broadband receiving antenna was varied between one meter and four meters above ground to find the maximum emissions field strength of both horizontal and vertical polarization.
4. For each suspected emissions, the antenna tower was scan (from 1 M to 4 M) and then the turntable was rotated (from 0 degree to 360 degrees) to find the maximum reading.
5. Set the test-receiver system to Peak or CISPR quasi-peak Detect Function with specified bandwidth under Maximum Hold Mode.
6. For emissions above 1GHz, use 1MHz VBW and RBW for peak reading. Then 1MHz RBW and 10Hz VBW for average reading in spectrum analyzer.
7. When the radiated emissions limits are expressed in terms of the average value of the emissions, and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 seconds. As an alternative (provided the transmitter operates for longer than 0.1 seconds) or in cases where the pulse train exceeds 0.1 seconds, the measured field strength shall be determined from the average absolute voltage during a 0.1 second interval during which the field strength is at its maximum value.
8. If the emissions level of the EUT in peak mode was 3 dB lower than the average limit specified, then testing will be stopped and peak values of EUT will be reported, otherwise, the emissions which do not have 3 dB margin will be repeated one by one using the quasi-peak method for below 1GHz.
9. For testing above 1GHz, the emissions level of the EUT in peak mode was lower than average limit (that means the emissions level in peak mode also complies with the limit in average mode), then testing will be stopped and peak values of EUT will be reported, otherwise, the emissions will be measured in average mode again and reported.
10. In case the emission is lower than 30MHz, loop antenna has to be used for measurement and the recorded data should be QP measured by receiver. High – Low scan is not required in this case.

1.1.4. Test Setup Layout

For radiated emissions below 30MHz



For radiated emissions above 30MHz



Above 10 GHz shall be extrapolated to the specified distance using an extrapolation factor of 20 dB/decade from 3m to 1.5m.

Distance extrapolation factor = $20 \log (\text{specific distance [3m]} / \text{test distance [1.5m]})$ (dB);

Limit line = specific limits (dBuV) + distance extrapolation factor [6 dB].

1.1.5. Test Deviation

There is no deviation with the original standard.

1.1.6. EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

1.1.7. Results of Radiated Emissions (9kHz~30MHz)

Temperature	25°C	Humidity	63%
Test Engineer	Jordan Hsiao	Configurations	802.11g CH 6 + Bluetooth Channel 39

Freq. (MHz)	Level (dBuV)	Over Limit (dB)	Limit Line (dBuV)	Remark
-	-	-	-	See Note

Note:

The amplitude of spurious emissions which are attenuated by more than 20dB below the permissible value has no need to be reported.

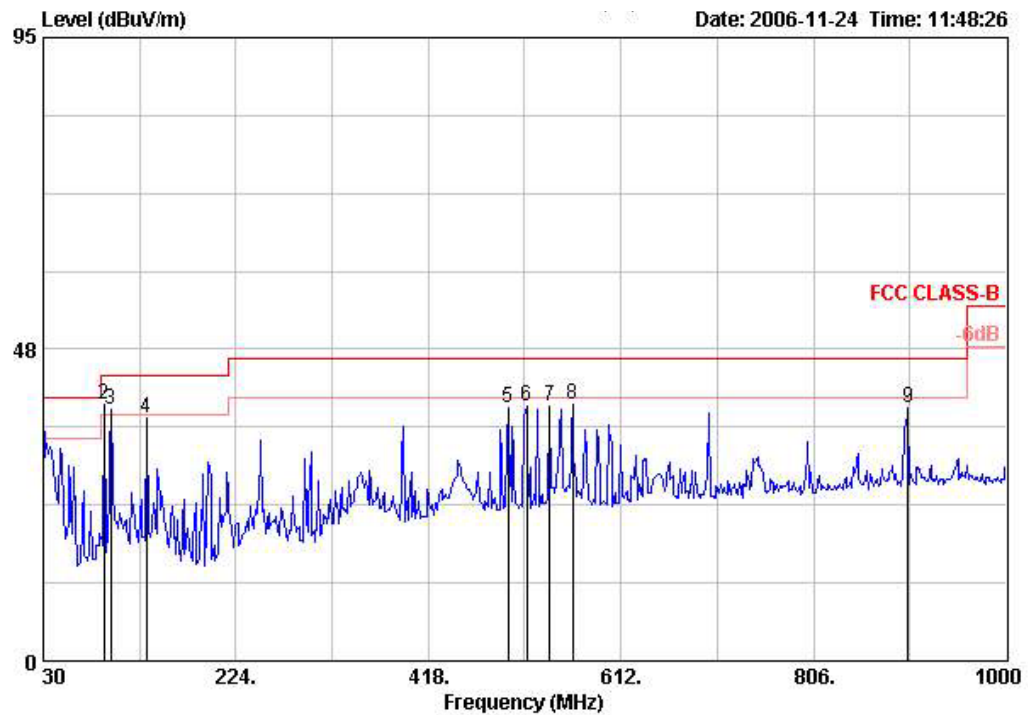
Distance extrapolation factor = $40 \log (\text{specific distance} / \text{test distance})$ (dB);

Limit line = specific limits (dBuV) + distance extrapolation factor.

1.1.8. Results of Radiated Emissions (30MHz~1GHz)

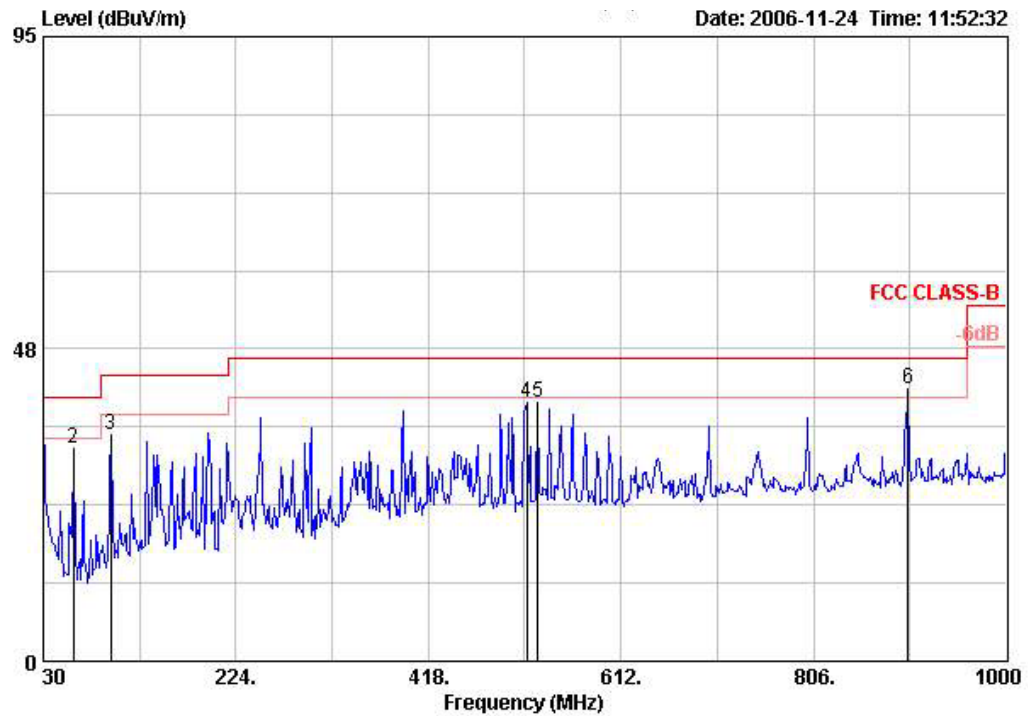
Temperature	25°C	Humidity	63%
Test Engineer	Jordan Hsiao	Configurations	802.11g CH 6 + Bluetooth Channel 39

Vertical



	Freq	Level	Over Limit	Limit Line	Read Level	Cable Loss	Preamp Factor	Remark	Ant Pos	Table Antenna Pos	Antenna Factor
	MHz	dBuV/m	dB	dBuV/m	dBuV	dB	dB		cm	deg	dB/m
1 !	30.000	35.42	-4.58	40.00	46.19	0.80	31.67	Peak	---	---	20.10
2 *	91.110	39.03	-4.47	43.50	59.61	1.43	31.59	Peak	---	---	9.58
3 !	97.900	38.32	-5.18	43.50	57.71	1.50	31.73	Peak	---	---	10.84
4	133.790	36.99	-6.51	43.50	54.70	1.70	31.63	Peak	---	---	12.22
5	498.510	38.61	-7.39	46.00	48.39	3.28	30.94	Peak	---	---	17.87
6	516.940	38.84	-7.16	46.00	48.21	3.27	30.88	Peak	---	---	18.23
7	540.220	38.94	-7.06	46.00	47.81	3.22	30.79	Peak	---	---	18.70
8	563.500	39.18	-6.82	46.00	47.80	3.17	30.75	Peak	---	---	18.95
9	901.060	38.54	-7.46	46.00	42.52	4.10	29.69	Peak	---	---	21.61

Horizontal



	Freq	Level	Over	Limit	Read	Cable	Preamp		Ant	Table	Antenna
	MHz	dBuV/m	Limit	Line	Level	Loss	Factor	Remark	Pos	Pos	Factor
	MHz	dBuV/m	dB	dBuV/m	dBuV	dB	dB		cm	deg	dB/m
1 !	30.000	35.41	-4.59	40.00	46.18	0.80	31.67	Peak	---	---	20.10
2	60.070	32.27	-7.73	40.00	56.06	1.40	31.79	Peak	---	---	6.60
3	97.900	34.30	-9.20	43.50	53.69	1.50	31.73	Peak	---	---	10.84
4	516.940	39.30	-6.70	46.00	48.67	3.27	30.88	Peak	---	---	18.23
5	528.580	39.24	-6.76	46.00	48.36	3.24	30.83	Peak	---	---	18.47
6 *	901.060	41.53	-4.47	46.00	45.51	4.10	29.69	Peak	---	---	21.61

Note:

The amplitude of spurious emissions which are attenuated by more than 20dB below the permissible value has no need to be reported.

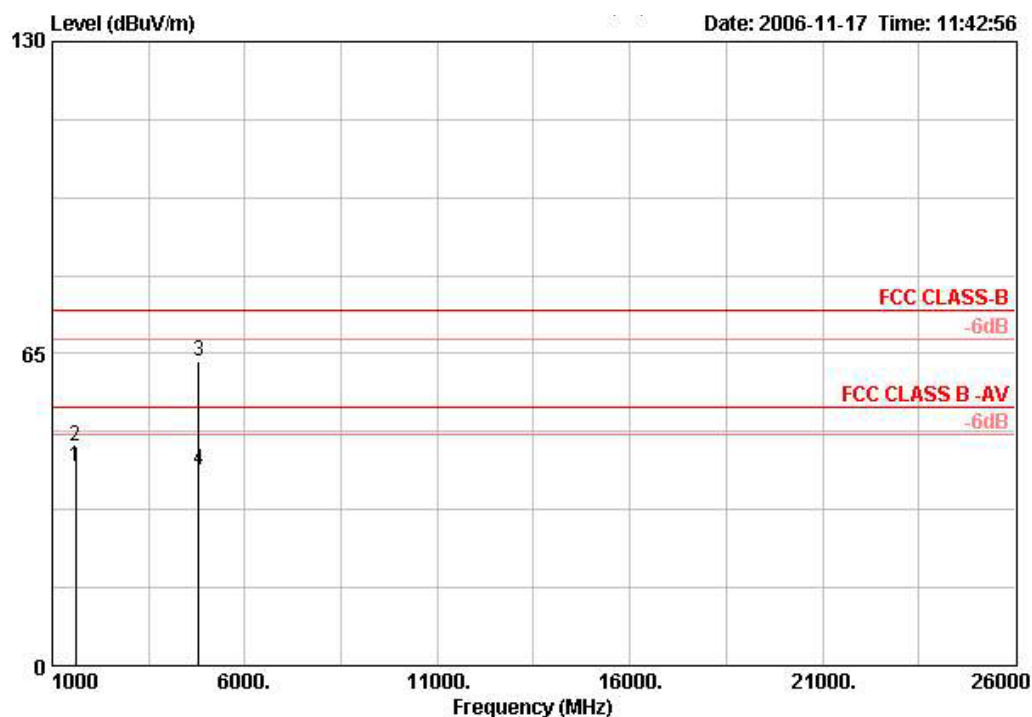
Emission level (dBuV/m) = 20 log Emission level (uV/m).

Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level.

1.1.9. Results for Radiated Emissions (1GHz~10th Harmonic)

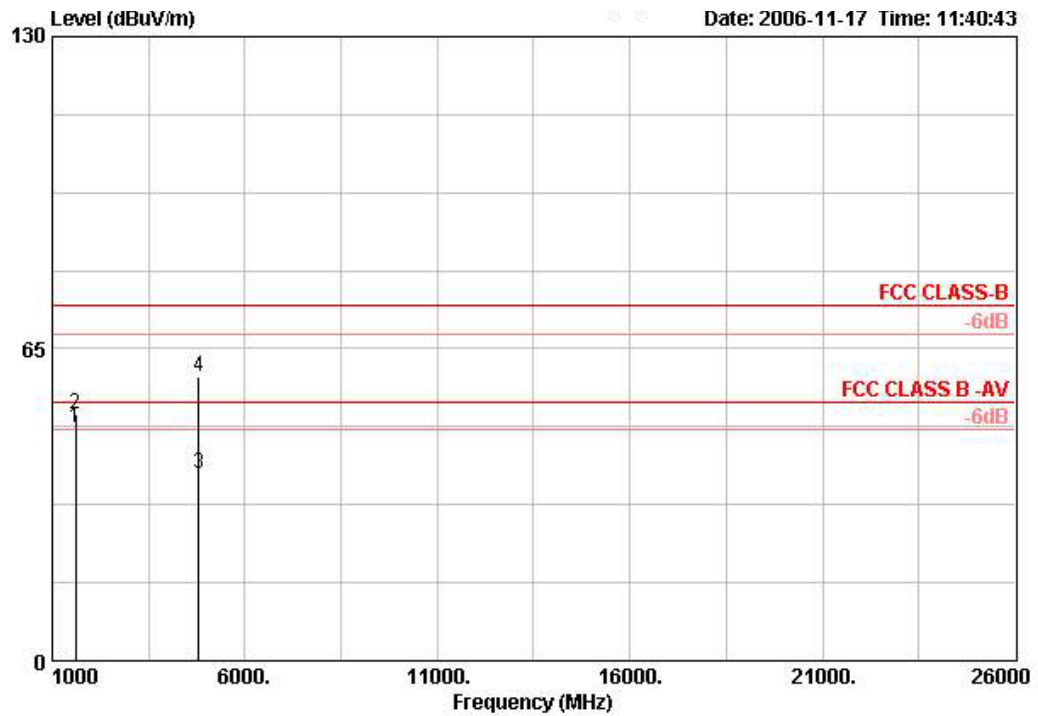
Temperature	25°C	Humidity	63%
Test Engineer	Jordan Hsiao	Configurations	802.11b CH 6 + Bluetooth Channel 0

Vertical



	Freq	Level	Over Limit	Limit Line	Read Level	Cable Loss	Preamp Factor	Remark	Ant Pos	Table Antenna Pos	Antenna Factor
	MHz	dBuV/m	dB	dBuV/m	dBuV	dB	dB		cm	deg	dB/m
1	1602.010	41.40	-12.60	54.00	48.14	2.28	34.72	AVERAGE	99	191	25.70
2	1602.180	45.69	-28.31	74.00	52.43	2.28	34.72	PEAK	99	191	25.70
3	4803.690	63.52	-10.48	74.00	61.37	4.30	35.17	PEAK	99	298	33.02
4	4804.030	40.70	-13.30	54.00	38.55	4.30	35.17	AVERAGE	99	298	33.02

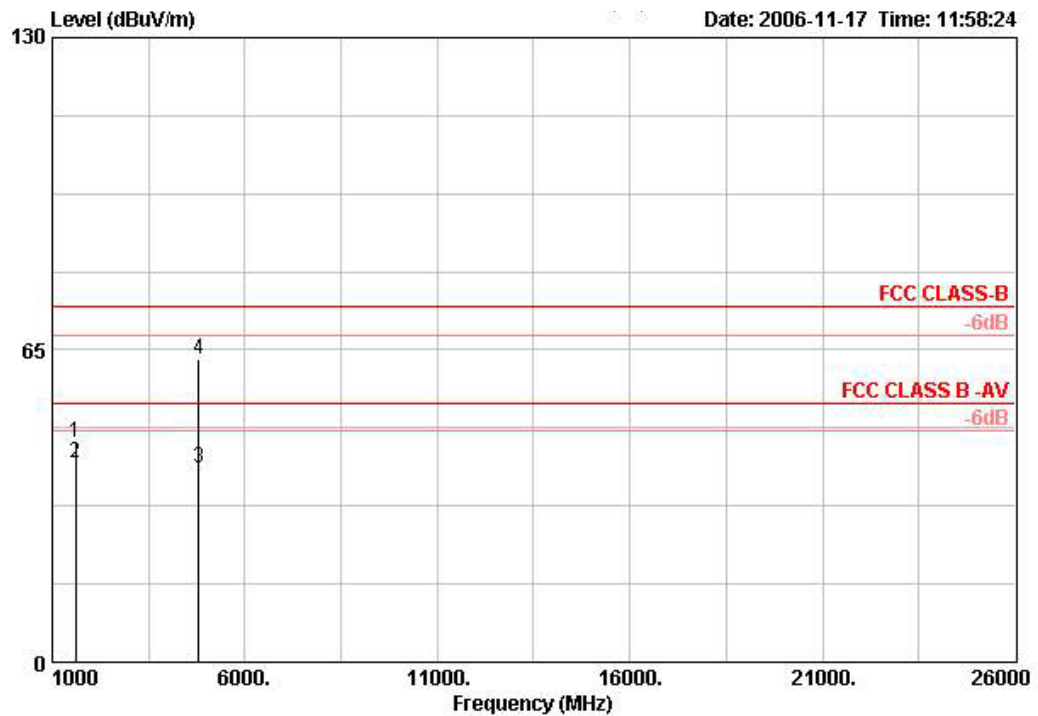
Horizontal



	Freq	Level	Over Limit	Limit Line	Read Level	Cable Loss	Preamp Factor	Remark	Ant Pos	Table Antenna Pos	Antenna Factor
	MHz	dBuV/m	dB	dBuV/m	dBuV	dB	dB		cm	deg	dB/m
1 !	1602.010	48.55	-5.45	54.00	55.29	2.28	34.72	AVERAGE	102	99	25.70
2	1602.100	51.50	-22.50	74.00	58.24	2.28	34.72	PEAK	102	99	25.70
3	4803.980	39.00	-15.00	54.00	36.85	4.30	35.17	AVERAGE	100	217	33.02
4	4804.040	59.25	-14.75	74.00	57.10	4.30	35.17	PEAK	100	217	33.02

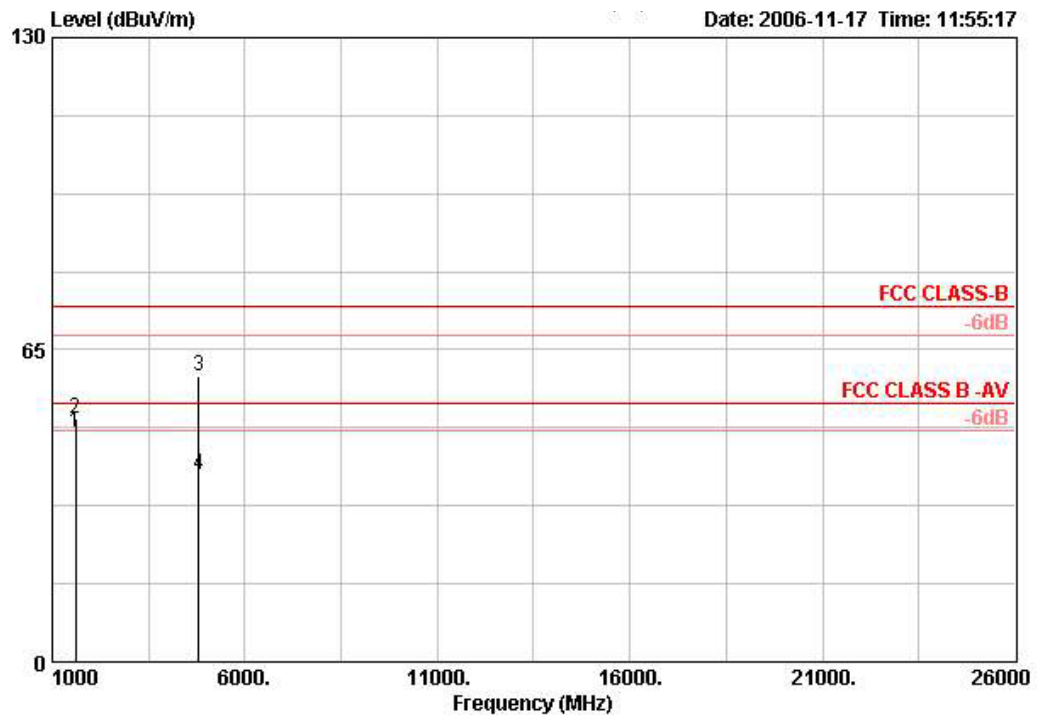
Temperature	25°C	Humidity	63%
Test Engineer	Jordan Hsiao	Configurations	802.11g CH 6 + Bluetooth Channel 0

Vertical



	Freq	Level	Over Limit	Limit Line	Read Level	Cable Loss	Preamp Factor	Remark	Ant Pos	Table Antenna Pos	Antenna Factor
	MHz	dBuV/m	dB	dBuV/m	dBuV	dB	dB		cm	deg	dB/m
1	1601.950	45.53	-28.47	74.00	52.27	2.28	34.72	PEAK	100	192	25.70
2	1602.030	41.35	-12.65	54.00	48.09	2.28	34.72	AVERAGE	100	192	25.70
3	4804.050	40.45	-13.55	54.00	38.29	4.30	35.17	AVERAGE	100	298	33.02
4	4804.050	63.18	-10.82	74.00	61.03	4.30	35.17	PEAK	100	298	33.02

Horizontal



	Freq	Level	Over Limit	Limit Line	Read Level	Cable Loss	Preamp Factor	Remark	Ant Pos	Table Antenna Pos	Antenna Factor
	MHz	dBuV/m	dB	dBuV/m	dBuV	dB	dB		cm	deg	dB/m
1	1602.010	47.93	-6.07	54.00	54.67	2.28	34.72	AVERAGE	100	95	25.70
2	1602.080	50.79	-23.21	74.00	57.53	2.28	34.72	PEAK	100	95	25.70
3	4803.690	59.37	-14.63	74.00	57.22	4.30	35.17	PEAK	100	216	33.02
4	4804.050	38.99	-15.01	54.00	36.84	4.30	35.17	AVERAGE	100	216	33.02

Note:

The amplitude of spurious emissions which are attenuated by more than 20dB below the permissible value has no need to be reported.

Emission level (dBuV/m) = 20 log Emission level (uV/m).

Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level.

1.2. Band Edge Emissions Measurement

1.2.1. Limit

20dBc in any 100 kHz bandwidth outside the operating frequency band. In case the emission fall within the restricted band specified on 15.205(a), then the 15.209(a) limit in the table below has to be followed.

Frequencies (MHz)	Field Strength (micorvolts/meter)	Measurement 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

1.2.2. Measuring Instruments and Setting

Please refer to section 5 of equipments list in this report. The following table is the setting of the spectrum analyzer.

Spectrum Parameter	Setting
Attenuation	Auto
Span Frequency	100 MHz
RB / VB (Emission in restricted band)	1 MHz / 1 MHz for Peak, 1 MHz / 10Hz for Average
RB / VB (Emission in non-restricted band)	100 KHz /100 KHz for Peak

1.2.3. Test Procedures

- The test procedure is the same as section 4.5.3, only the frequency range investigated is limited to 100MHz around bandedges.
- In case the emission is fail due to the used RB/VB is too wide, marker-delta method of FCC Public Notice DA00-705 will be followed.

1.2.4. Test Setup Layout

This test setup layout is the same as that shown in section 4.5.4.

1.2.5. Test Deviation

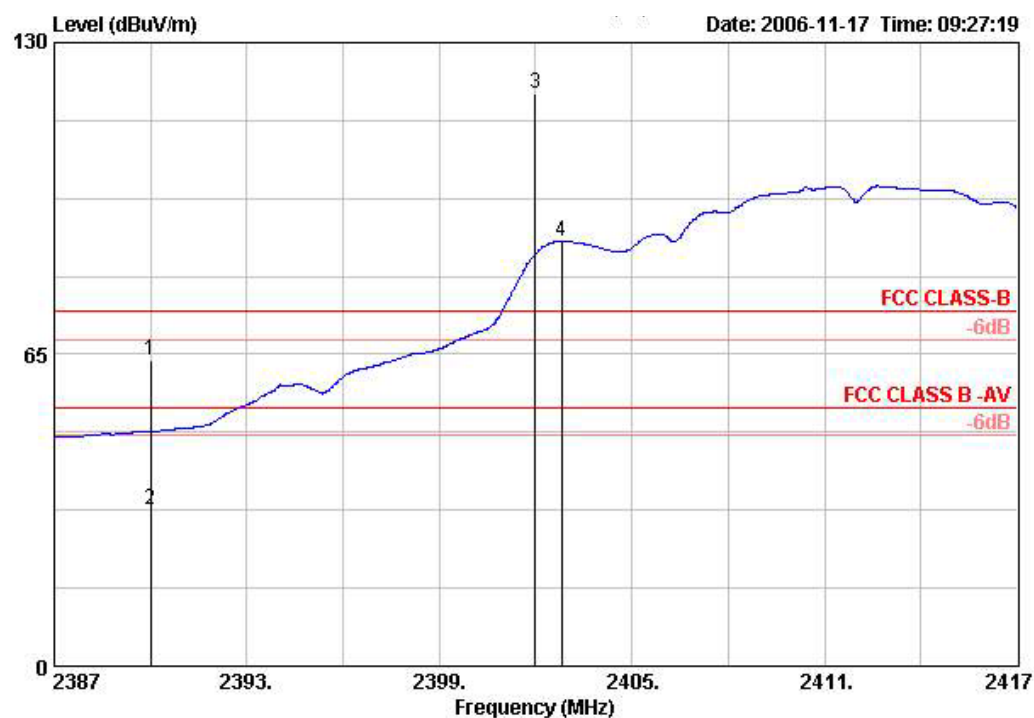
There is no deviation with the original standard.

1.2.6. EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

1.2.7. Test Result of Band Edge and Fundamental Emissions

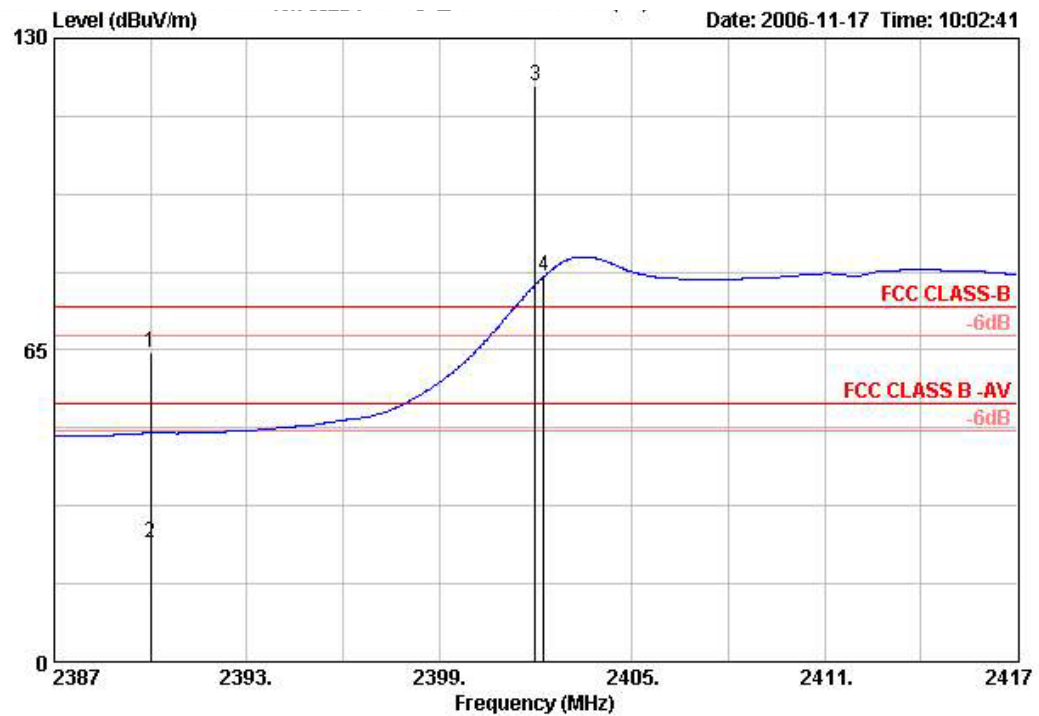
Temperature	25°C	Humidity	63%
Test Engineer	Jordan Hsiao	Configurations	802.11b CH 1 + Bluetooth Channel 0



	Freq	Level	Over	Limit	Read	Cable	Preamp		Ant	Table	Antenna
	MHz	dBUV/m	Limit	Line	Level	Loss	Factor	Remark	Pos	Pos	Factor
	MHz	dBUV/m	dB	dBUV/m	dBUV	dB	dB		cm	deg	dB/m
1	2390.000	63.63	-10.37	74.00	32.69	2.76	0.00	PEAK	100	81	28.17
2	2390.000	32.63	-21.37	54.00	1.69	2.76	0.00	Average	100	81	28.17
3 *	2402.000	119.53			88.60	2.76	0.00	PEAK	100	81	28.17
4 *	2402.810	88.53			57.56	2.76	0.00	Average	100	81	28.21

Item 3, 4 are the fundamental frequency at 2402 MHz.

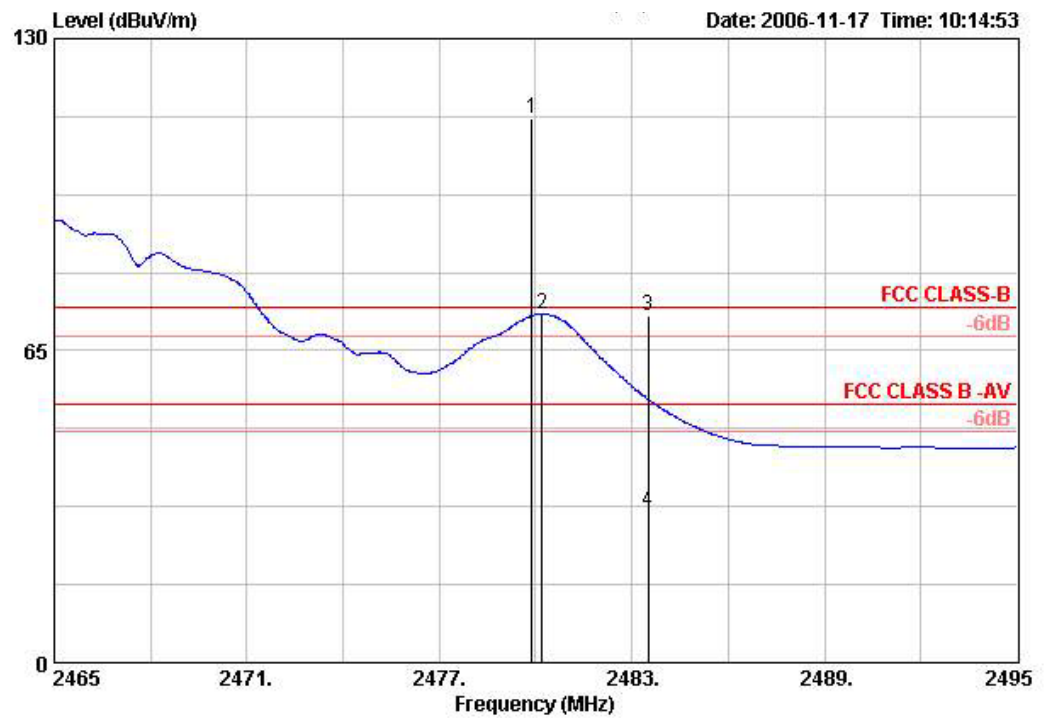
Temperature	25°C	Humidity	63%
Test Engineer	Jordan Hsiao	Configurations	802.11g CH 1 +Bluetooth Channel 0



	Freq	Level	Over Limit	Limit Line	Read Level	Cable Loss	Preamp Factor	Remark	Ant Pos	Table Antenna Pos	Antenna Factor
	MHz	dBuV/m	dB	dBuV/m	dBuV	dB	dB		cm	deg	dB/m
1	2390.000	64.40	-9.60	74.00	33.46	2.76	0.00	PEAK	100	279	28.17
2	2390.000	24.64	-29.36	54.00	-6.30	2.76	0.00	Average	100	279	28.17
3 *	2402.000	120.08			89.14	2.76	0.00	PEAK	100	279	28.17
4 *	2402.240	80.32			49.38	2.76	0.00	Average	100	279	28.17

Item 3, 4 are the fundamental frequency at 2402 MHz.

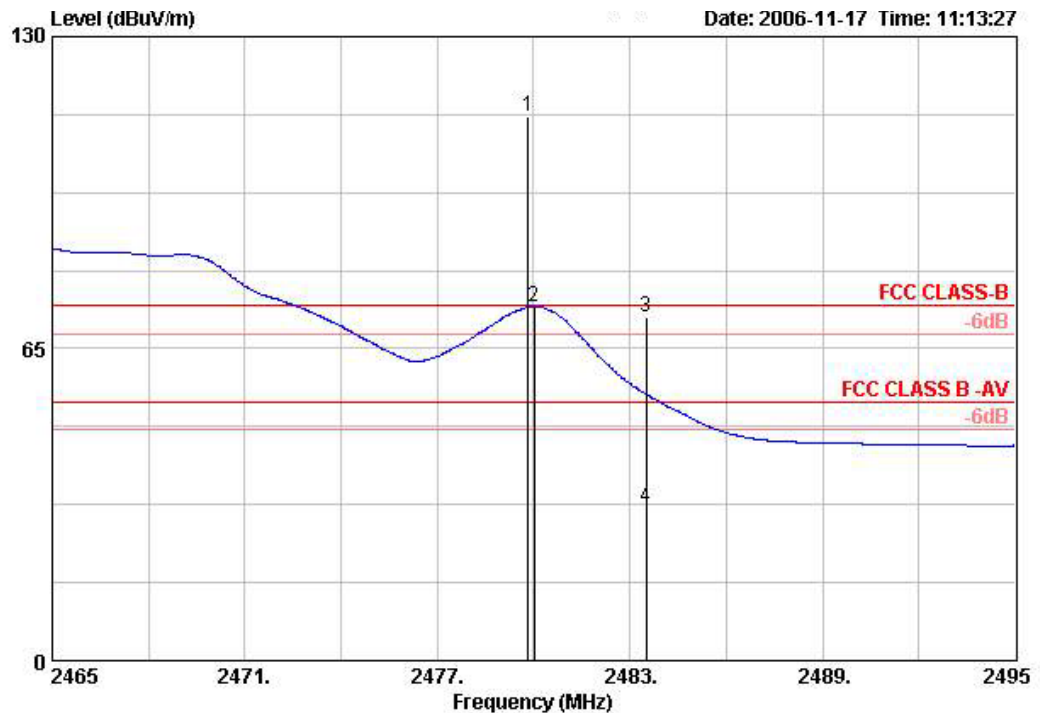
Temperature	25°C	Humidity	63%
Test Engineer	Jordan Hsiao	Configurations	802.11b CH 11 + Bluetooth Channel 78



	Freq	Level	Over Limit	Limit Line	Read Level	Cable Loss	Preamp Factor	Remark	Ant Pos	Table Pos	Antenna Factor
	MHz	dBuV/m	dB	dBuV/m	dBuV	dB	dB		cm	deg	dB/m
1 *	2479.880	113.49			82.32	2.81	0.00	PEAK	100	282	28.36
2 *	2480.210	72.64			41.47	2.81	0.00	Average	100	282	28.36
3 *	2483.500	72.21	-1.79	74.00	41.01	2.84	0.00	PEAK	100	282	28.36
4	2483.500	31.36	-22.64	54.00	0.16	2.84	0.00	Average	100	282	28.36

Item 1, 2 are the fundamental frequency at 2480 MHz.

Temperature	25°C	Humidity	63%
Test Engineer	Jordan Hsiao	Configurations	802.11g CH 11 + Bluetooth Channel 78



	Freq	Level	Over Limit	Limit Line	Read Level	Cable Loss	Preamp Factor	Remark	Ant Pos	TableAntenna Pos	Antenna Factor
	MHz	dBUV/m			dBuV	dB	dB		cm	deg	dB/m
1 *	2479.820	113.33			82.15	2.81	0.00	PERK	100	120	28.36
2 *	2480.020	73.66			42.49	2.81	0.00	AVERAGE	100	120	28.36
3 *	2483.500	71.56	-2.44	74.00	40.36	2.84	0.00	PERK	100	120	28.36
4	2483.500	31.89	-22.11	54.00	0.69	2.84	0.00	Average	100	120	28.36

Item 1, 2 are the fundamental frequency at 2480 MHz.

Note:

Emission level (dBUV/m) = 20 log Emission level (uV/m).

Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level.