7 OUTPUT POWER MEASUREMENT

7.1 Standard Applicable

For direct sequence system, according to 15.247(b), the maximum peak output power of the transmitter shall not exceed 1 Watt. If transmitting antennas of directional gain greater than 6 dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

7.2 Measurement Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT as shown in figure 2. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range.
3. Measure the highest amplitude appearing on spectral display and record the level to calculate result data.
4. Repeat above procedures until all frequencies measured were complete.

7.3 Measurement Equipment

Equipment	Manufacturer	Model No.	Next Cal. Due
Power Meter	Boonton	4532	06/13/2005
Peak Power Sensor	Boonton	56518	07/21/2005

7.4 Measurement Data

Test Date: Apr. 29, 2005 Temperature: 15 ℃ Humidity: 71 %

Channel	Frequency (MHz)	Data Transfer Rate (Mbps)	Reading (dBm)	Attenuator & Cable Loss (dB)	Maximum Peak Output Power (dBm)	Maximum Peak Output Power (mW)	FCC Limit (mW)
1	2412	1	12.264	0.5	12.764	18.897	1000
		2	12.316	0.5	12.816	19.125	1000
		5.5	12.333	0.5	12.833	19.200	1000
		11	12.712	0.5	13.212	20.950	1000
6	2437	1	11.562	0.5	12.062	16.077	1000
		2	11.475	0.5	11.975	15.758	1000
		5.5	11.424	0.5	11.924	15.574	1000
		11	11.510	0.5	12.010	15.886	1000
11	2462	1	11.355	0.5	11.855	15.329	1000
		2	11.268	0.5	11.768	15.024	1000
		5.5	11.251	0.5	11.751	14.966	1000
		11	11.406	0.5	11.906	15.510	1000

Note:

The estimated measurement uncertainty of the result measurement is ±1.5dB(1GHz≦f≦18GHz)

8 POWER DENSITY MEASUREMENT

8.1 Standard Applicable

According to 15.247(d), for direct sequence systems, the transmitted power density averaged over any 1 second interval shall not be greater than 8 dBm in any 3 kHz bandwidth within these bands.

8.2 Measurement Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT as shown in figure 2. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set EUT to any one measured frequency within its operating range and make sure the instrument is operated in its linear range.
3. Adjust the center frequency of spectrum analyzer on highest level appearing on spectral display within a 300 kHz frequency span.
4. Set the spectrum analyzer on a 3 kHz resolution bandwidth and 10 kHz video bandwidth as well as max. hold function, then record the measurement result.
5. Repeat above procedures until all measured frequencies were complete.

8.3 Measurement Equipment

Equipment	Manufacturer	Model No.	Next Cal. Due
Spectrum Analyzer	Hewlett-Packard	8564EC	09/16/2005

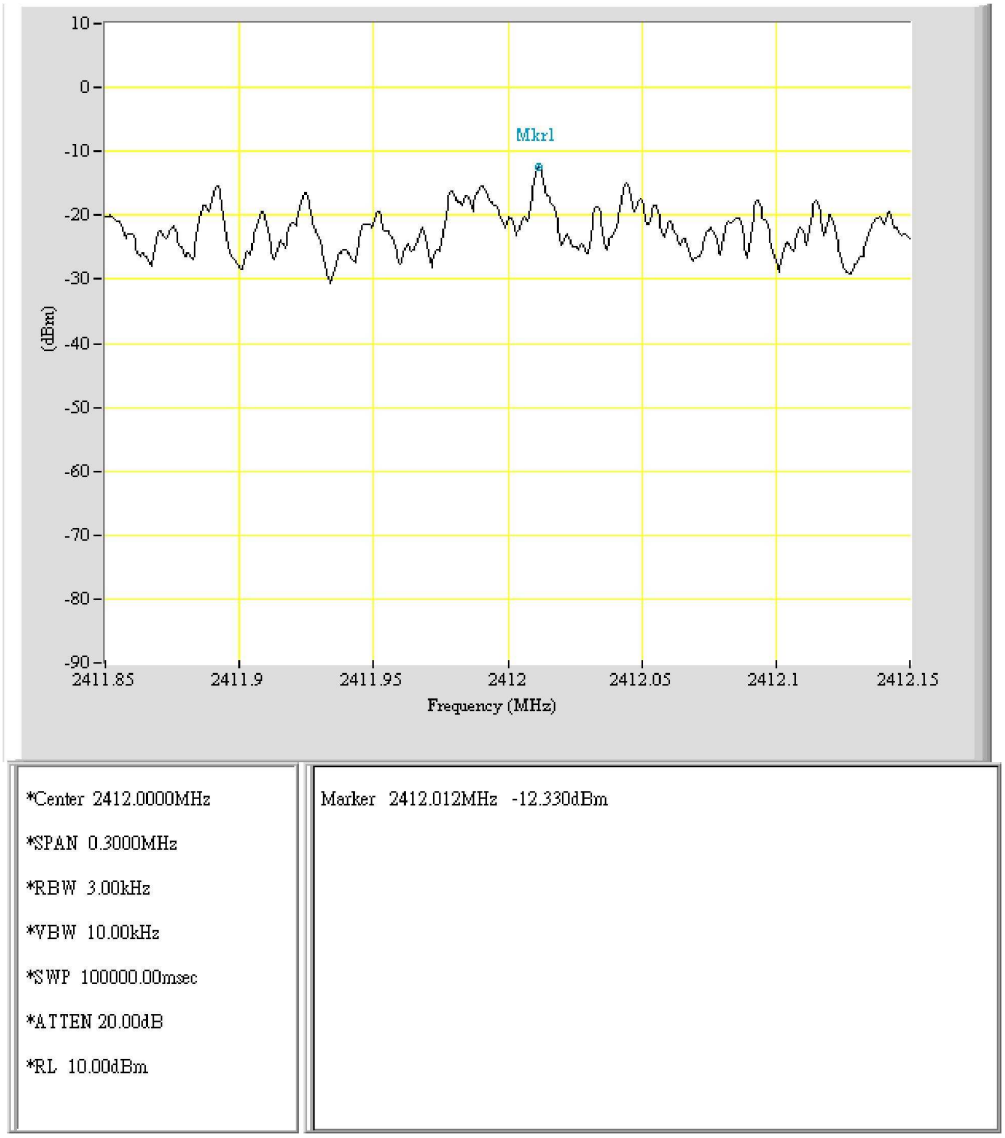
8.4 Measurement Data

Test Date: Apr. 29, 2005 Temperature: 15 ℃ Humidity: 71 %

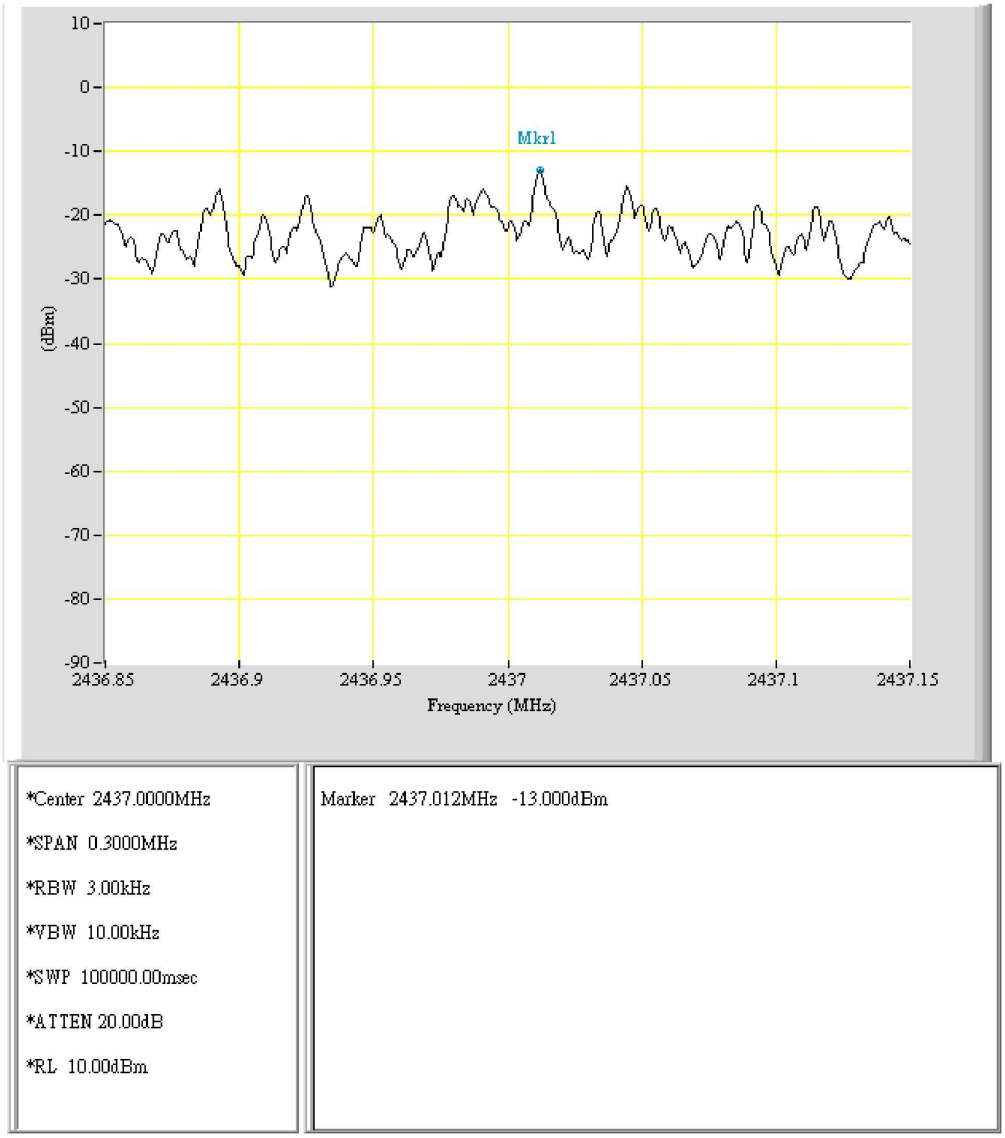
Channel	Frequency (MHz)	Data Transfer Rate (Mbps)	Reading (dBm)	Cable Loss (dB)	Peak Power Spectral Density (dBm)	FCC Limit (dBm)	Chart
1	2412	1	-20.00	0.5	-19.50	8	-
		2	-19.00	0.5	-18.50	8	-
		5.5	-13.33	0.5	-12.83	8	-
		11	-12.33	0.5	-11.83	8	Page 31
6	2437	1	-20.50	0.5	-20.00	8	-
		2	-19.50	0.5	-19.00	8	-
		5.5	-14.16	0.5	-13.66	8	-
		11	-13.00	0.5	-12.50	8	Page 32
11	2462	1	-21.66	0.5	-21.16	8	-
		2	-20.33	0.5	-19.83	8	-
		5.5	-15.16	0.5	-14.66	8	-
		11	-14.16	0.5	-13.66	8	Page 33

Note:

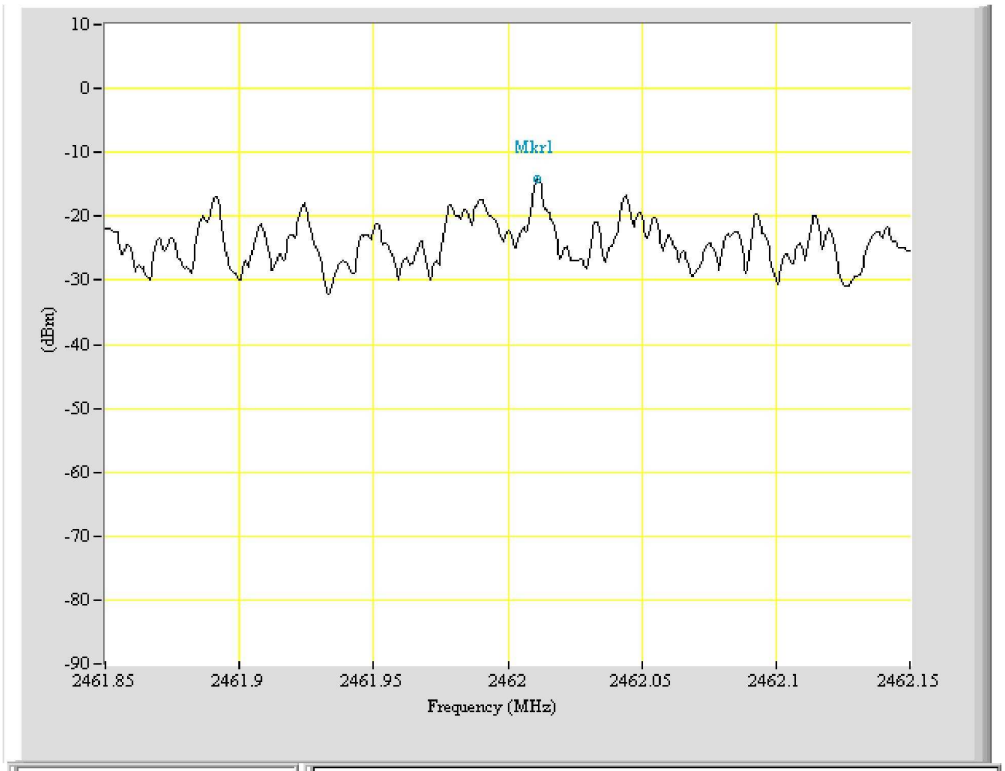
1. ***Please refer to page 31 to page 33 for chart***
2. *The estimated measurement uncertainty of the result measurement is ±1.5dB(1GHz≦f≦18GHz)*



EUT: WLAN-11b
Purpose: PwrDensity
Condition: CH1_11M
Note:



EUT: WLAN-11b
Purpose: PwrDensity
Condition: CH6_11M
Note:



*Center 2462.0000MHz *SPAN 0.3000MHz *RBW 3.00kHz *VBW 10.00kHz *SWP 100000.00msec *ATTEN 20.00dB *RL 10.00dBm	Marker 2462.011MHz -14.160dBm

EUT: WLAN-11b
Purpose: PwrDensity
Condition: CH11_11M
Note:

9 SPURIOUS EMISSION - RF CONDUCTED MEASUREMENT

9.1 Standard Applicable

According to 12.247 (c) , in any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

9.2 Measurement Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT as shown in figure 2. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range and make sure the instrument is operated in its linear range.
3. Set both RBW and VBW of spectrum analyzer to 100 kHz with a convenient frequency span including 100kHz bandwidth from band edge.
4. Measure the highest amplitude appearing on spectral display and set it as a reference level. Plot the graph with marking the highest point and edge frequency.
5. Repeat above procedures until all measured frequencies were complete.

9.3 Measurement Equipment

Equipment	Manufacturer	Model No.	Next Cal. Due
Spectrum Analyzer	Hewlett-Packard	8564EC	09/16/2005

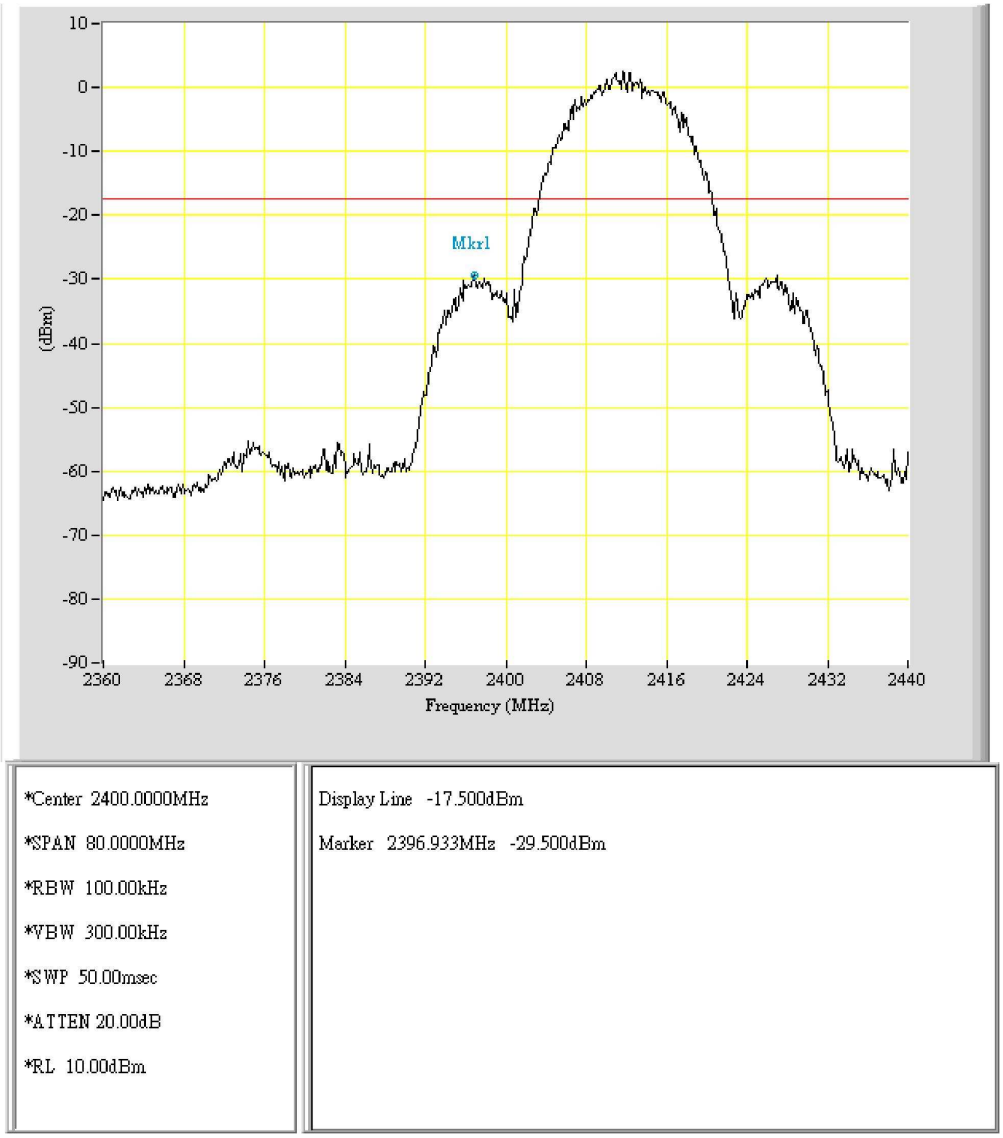
9.4 Measurement Data

Test Date: Apr. 29, 2005 Temperature: 15 ℃ Humidity: 71 %

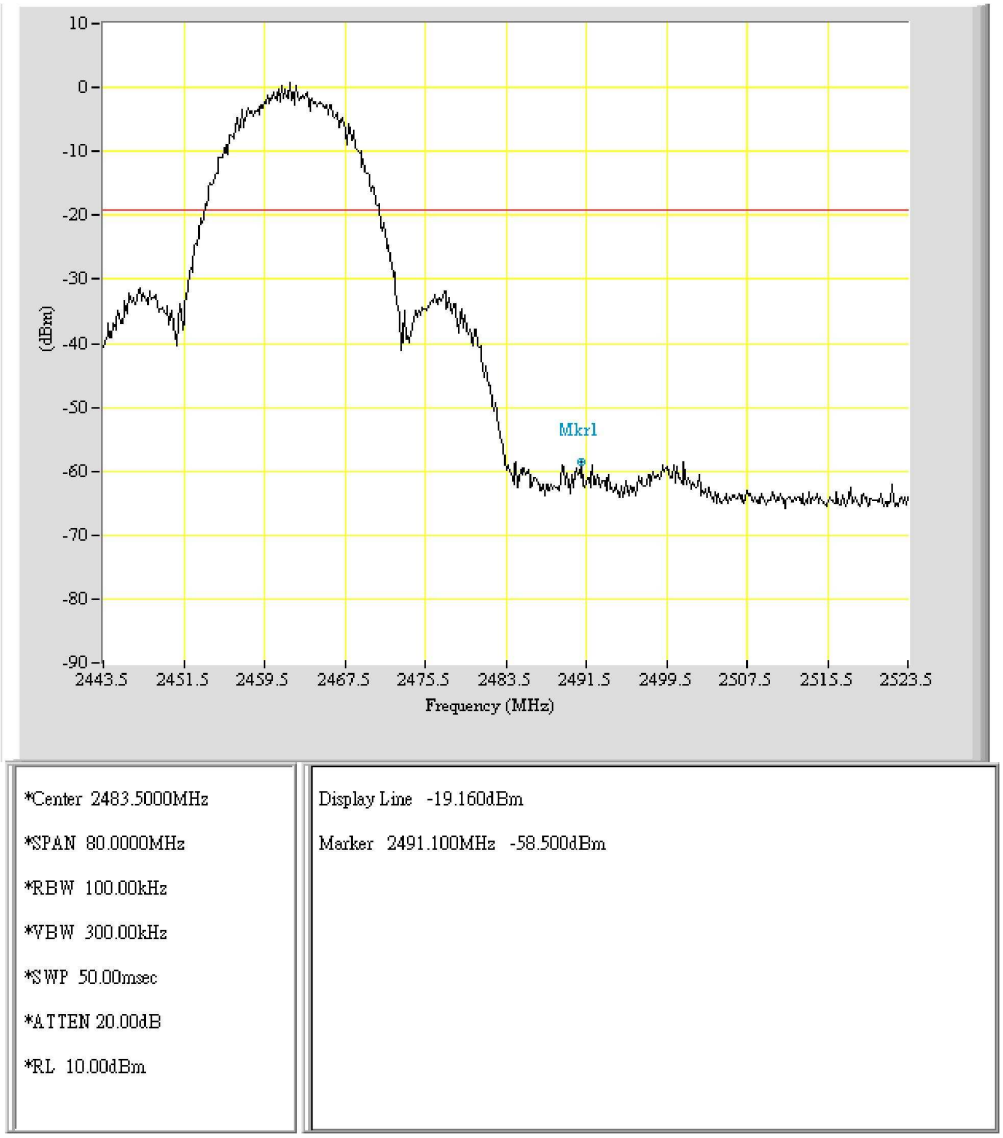
Channel	Frequency(MHz)	Chart
1	2412	Page 36, Page 38
6	2437	Page 39
11	2462	Page 37Page 40

All out-of –band conducted emissions were more than 20dB below the carrier.

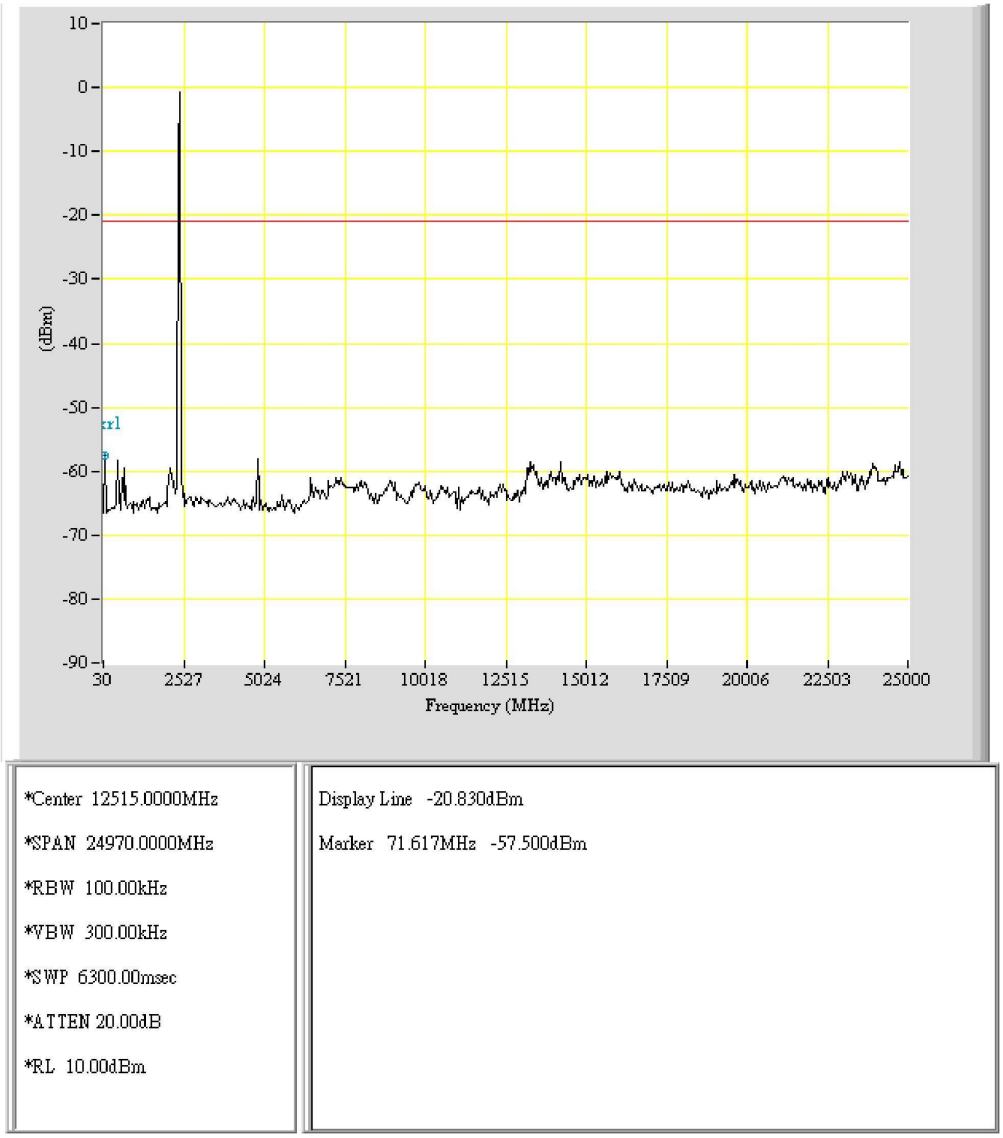
Note: Please refer to page 36 to page 40 for chart



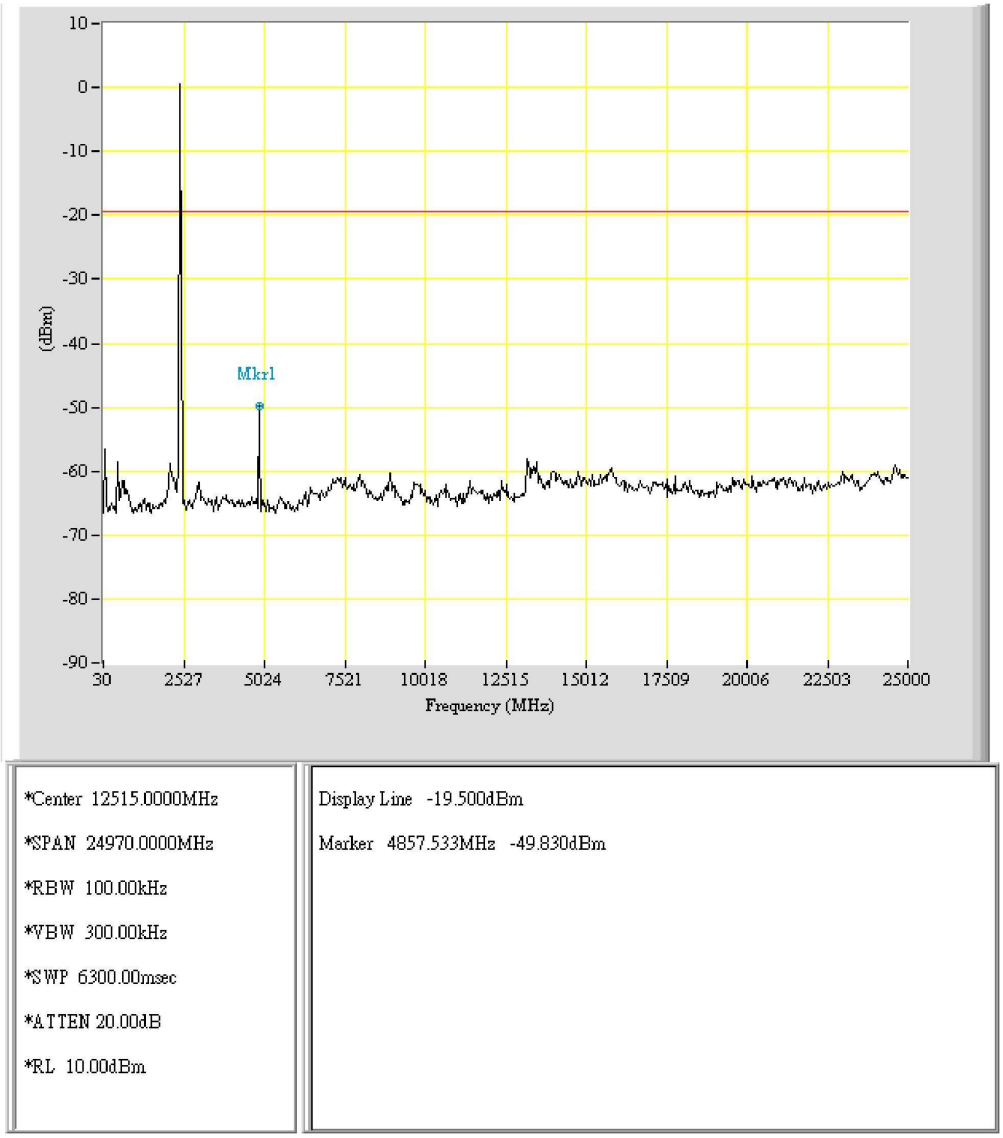
EUT: WLAN-11b
Purpose: Band_Edge
Condition: CH1
Note:



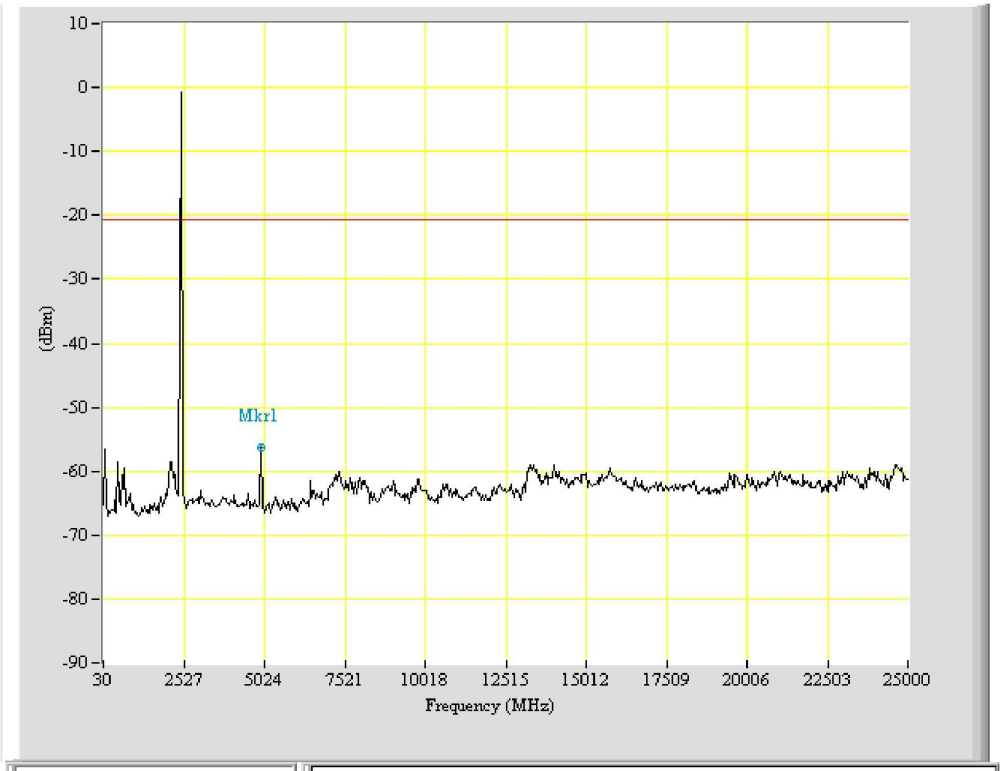
EUT: WLAN-11b
Purpose: Band_Edge
Condition: CH11
Note:



EUT: WLAN-11b
Purpose: Band_Edge_All
Condition: CH1
Note:



EUT: WLAN-11b
Purpose: Band_Edge_All
Condition: CH6
Note:



*Center 12515.0000MHz	Display Line -20.660dBm
*SPAN 24970.0000MHz	Marker 4940.767MHz -56.330dBm
*RBW 100.00kHz	
*VBW 300.00kHz	
*SWP 6300.00msec	
*ATTEN 20.00dB	
*RL 10.00dBm	

EUT: WLAN-11b
Purpose: Band_Edge_All
Condition: CH11
Note:

10 RADIATED EMISSION MEASUREMENT

10.1 Standard Applicable

For unintentional radiator, the radiated emission shall comply with §15.109(a).

For intentional radiators, according to §15.247 (a), operation under this provision is limited to frequency hopping and direct sequence spread spectrum, and the out band emission shall be comply with §15.247 (c)

10.2 Measurement Procedure

A.Preliminary Measurement For Portable Devices.

For portable devices, the following procedure was performed to determine the maximum emission axis of EUT (X,Y and Z axis):

1. With the receiving antenna is H polarization, rotate the EUT in turns with three orthogonal axes to determine the axis of maximum emission.
2. With the receiving antennna is V polarization, rotate the EUT in turns with three orthogonal axes to determine the axis of maximum emission.
3. Compare the results derived from above two steps. The axis of maximum emission from EUT was determined and the configuration was used to perform the final measurement.
4. The position in which the maximum noise occurred was “Y axis”. (Please see the test setup photos)

B. Final Measurement

1. Setup the configuration per figure 4 and 5 for frequencies measured below and above 1 GHz respectively.
2. For emission frequencies measured below 1 GHz, it is performed in a semi-anechoic chamber to determine the accurate frequencies of higher emissions. For emission frequencies measured above 1 GHz, a pre-scan be performed with a 1 meter measuring distance before final test.
3. For emission frequencies measured below and above 1 GHz, set the spectrum analyzer on a 120 kHz and 1 MHz resolution bandwidth respectively for each frequency measured in step 2.
4. The search antenna is to be raised and lowered over a range from 1 to 4 meters in horizontally polarized orientation. Position the highness when the highest value is indicated on spectrum analyzer, then change the orientation of EUT on test table over a range from 0 ° to 360 ° with a speed as slow as possible, and keep the azimuth that highest emission is indicated on the spectrum analyzer. Vary the antenna position again and record the highest value as a final reading. A RF test receiver is also used to confirm emissions measured.

   Note : A filter was used to avoid pre-amplifier saturated when measure TX operation mode.
5. Repeat step 4 until all frequencies need to be measured were complete.
6. Repeat step 5 with search antenna in vertical polarized orientations.
7. Check the three frequencies of highest emission with varying the datarate, placement of ANT. cables associated with EUT to obtain the worse case and record the result.

Figure 3 : Frequencies measured below 1 GHz configuration

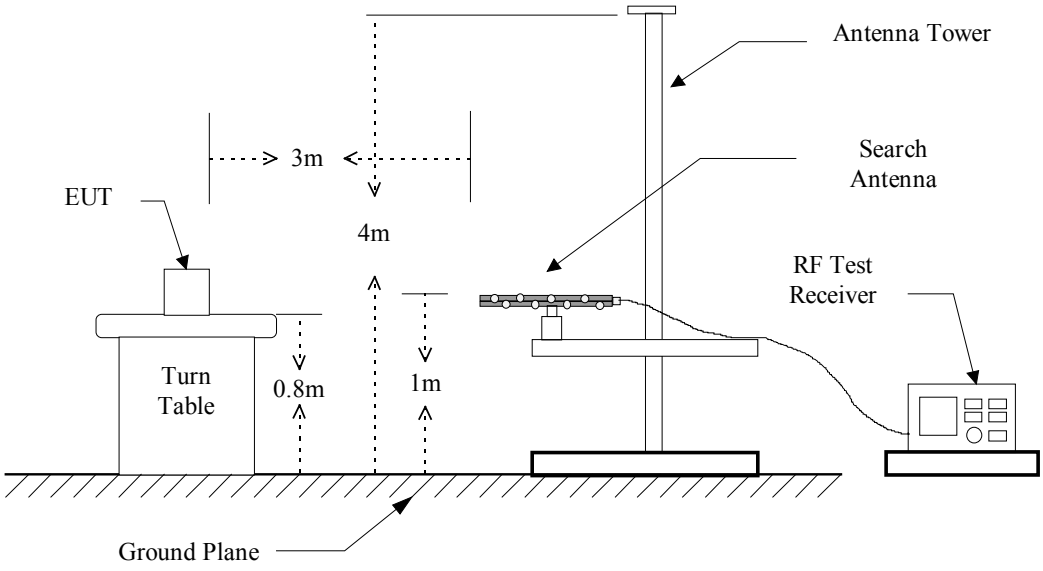
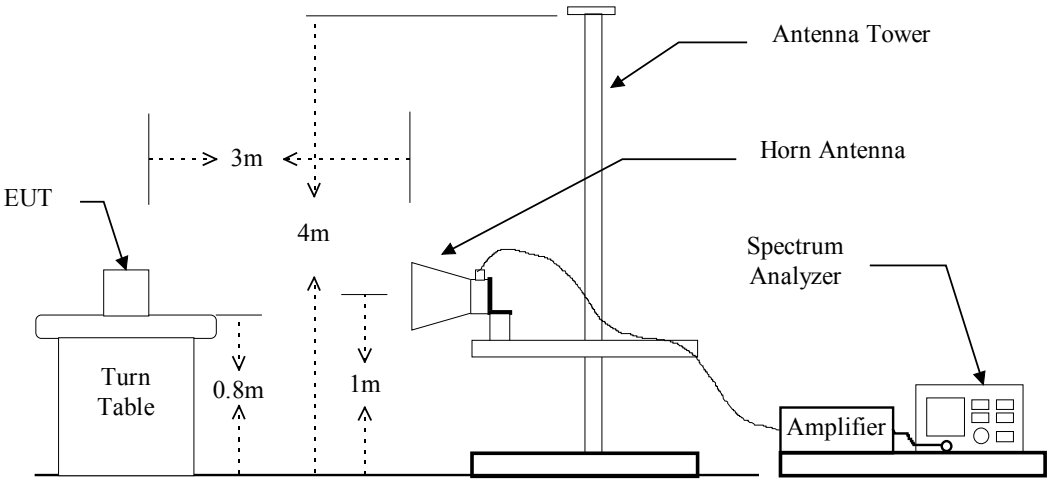


Figure 4 : Frequencies measured above 1 GHz configuration



10.3 Measuring Instrument

The following instrument are used for radiated emissions measurement :

Equipment	Manufacturer	Model No.	Next Cal. Due
EMI Test Receiver	Hewlett-Packard	8546A	09/06/2005
BiconiLog Antenna	Schwarzbeck	9160	11/24/2005
Horn Antenna	EMCO	3115	06/04/2005
Horn Antenna	EMCO	3116	07/19/2005
Preamplifier	Hewlett-Packard	8449B	09/16/2005
Spectrum Analyzer	Hewlett-Packard	8564EC	09/15/2005
Spectrum Analyzer	Rohde & Schwarz	FSU46	10/03/2005

Measuring instrument setup in measured frequency band when specified detector function is used :

Frequency Band (MHz)	Instrument	Function	Resolution Bandwidth	Video Bandwidth
30 to 1000	RF Test Receiver	Quasi-Peak	120 kHz	300 kHz
	Spectrum Analyzer	Peak	120 kHz	300 kHz
Above 1000	Spectrum Analyzer	Peak	1 MHz	1 MHz
	Spectrum Analyzer	Average	1 MHz	10 Hz

10.4 Radiated Emission Data

10.4.1 Harmonic

Operation Mode: TX
Test Date: Apr. 27, 2005 Temperature: 21 ℃ Humidity: 76 %

a) Channel 1
Fundamental Frequency: 2412 MHz

Frequency	Reading (dBuV)				Factor	Result @3m		Limit @3m	
	H		V		(dB)	(dBuV/m)		(dBuV/m)	
(MHz)	Peak	Ave	Peak	Ave	Corr.	Peak	Ave	Peak	Ave.
4824.000	---	---	---	---	-6.8	---	---	74.0	54.0
7236.000	---	---	---	---	2.0	---	---	74.0	54.0
12060.000	---	---	---	---	3.3	---	---	74.0	54.0
19296.000	---	---	---	---	4.5	---	---	74.0	54.0

b) Channel 6
Fundamental Frequency: 2437 MHz

Frequency	Reading (dBuV)				Factor	Result @3m		Limit @3m	
	H		V		(dB)	(dBuV/m)		(dBuV/m)	
(MHz)	Peak	Ave	Peak	Ave	Corr.	Peak	Ave	Peak	Ave.
4874.000	---	---	---	---	-6.8	---	---	74.0	54.0
7311.000	---	---	---	---	2.0	---	---	74.0	54.0
12185000	---	---	---	---	3.3	---	---	74.0	54.0
19496000	---	---	---	---	4.5	---	---	74.0	54.0

c) Channel 11
Fundamental Frequency: 2462 MHz

Frequency	Reading (dBuV)				Factor	Result @3m		Limit @3m	
	H		V		(dB)	(dBuV/m)		(dBuV/m)	
(MHz)	Peak	Ave	Peak	Ave	Corr.	Peak	Ave	Peak	Ave.
4924.000	---	---	---	---	-6.8	---	---	74.0	54.0
7386.000	---	---	---	---	2.0	---	---	74.0	54.0
19696.000	---	---	---	---	3.3	---	---	74.0	54.0
22158.000	---	---	---	---	4.5	---	---	74.0	54.0

Note :
1. Item of margin shown in above table refer to average limit.
2. Remark "---" means that the emissions level is too low to be measured.

10.4.2 Spurious Emission

10.4.2.1

Test Date: Apr. 29, 2005 Temperature: 15 ℃ Humidity: 71 %

Operation Mode: TX(CH 1)

a) Emission frequencies below 1 GHz

Frequency (MHz)	Ant-Pol H/V	Meter Reading (dBuV)	Corrected Factor (dB)	Result @3m (dBuV/m)	Limit @3m (dBuV/m)	Margin (dB)
61.040	H	18.9	13.2	32.1	40.0	-7.9
61.900	V	18.7	13.2	31.9	40.0	-8.1
106.100	V	17.3	12.5	29.8	43.5	-13.7
126.030	H	16.3	14.6	30.9	43.5	-12.6
463.590	H	16.0	21.1	37.1	46.0	-8.9
533.430	H	12.8	22.3	35.1	46.0	-10.9
533.430	V	12.9	22.3	35.2	46.0	-10.8
572.230	V	14.5	23.6	38.1	46.0	-7.9
630.430	H	19.4	24.5	43.9	46.0	-2.1
631.120	V	18.6	24.5	43.1	46.0	-2.9
919.490	H	12.0	29.4	41.4	46.0	-4.6
919.490	V	14.4	29.4	43.8	46.0	-2.2

b) Emission frequencies above 1 GHz

Frequency (MHz)	Ant-Pol H/V	Meter Reading (dBuV)	Corrected Factor (dB)	Result @3m (dBuV/m)	Limit @3m (dBuV/m)	Margin (dB)
Radiated emission frequencies above 1 GHz to 25 GHz were too low to be measured.						

10.4.2.2

Test Date: Apr. 29, 2005 Temperature: 15 ℃ Humidity: 71 %

Operation Mode: TX(CH 6)

a) Emission frequencies below 1 GHz

Frequency (MHz)	Ant-Pol H/V	Meter Reading (dBuV)	Corrected Factor (dB)	Result @3m (dBuV/m)	Limit @3m (dBuV/m)	Margin (dB)
61.020	H	19.6	13.2	32.8	40.0	-7.2
61.810	V	17.7	13.2	30.9	40.0	-9.1
126.120	H	16.3	14.6	30.9	43.5	-12.6
127.830	V	15.5	14.6	30.1	43.5	-13.4
462.830	H	16.1	20.7	36.8	46.0	-9.2
463.120	V	15.0	21.1	36.1	46.0	-9.9
533.120	H	12.8	22.3	35.1	46.0	-10.9
534.120	V	15.6	22.3	37.9	46.0	-8.1
630.830	V	18.3	24.5	42.8	46.0	-3.2
631.210	H	18.4	24.5	42.9	46.0	-3.1
918.920	V	14.0	29.4	43.4	46.0	-2.6
919.210	H	11.8	29.4	41.2	46.0	-4.8

b) Emission frequencies above 1 GHz

Frequency (MHz)	Ant-Pol H/V	Meter Reading (dBuV)	Corrected Factor (dB)	Result @3m (dBuV/m)	Limit @3m (dBuV/m)	Margin (dB)
Radiated emission frequencies above 1 GHz to 25 GHz were too low to be measured.						

10.4.2.3

Test Date: Apr. 29, 2005 Temperature: 15 ℃ Humidity: 71 %

Operation Mode: TX(CH 11)

a) Emission frequencies below 1 GHz

Frequency (MHz)	Ant-Pol H/V	Meter Reading (dBuV)	Corrected Factor (dB)	Result @3m (dBuV/m)	Limit @3m (dBuV/m)	Margin (dB)
61.830	V	18.6	13.2	31.8	40.0	-8.2
61.930	H	18.5	13.2	31.7	40.0	-8.3
125.930	H	16.2	14.6	30.8	43.5	-12.7
128.120	V	16.6	14.6	31.2	43.5	-12.3
462.720	V	15.6	20.7	36.3	46.0	-9.7
462.840	H	14.2	20.7	34.9	46.0	-11.1
532.710	H	12.5	22.3	34.8	46.0	-11.2
534.320	V	14.6	22.3	36.9	46.0	-9.1
631.210	H	18.6	24.5	43.1	46.0	-2.9
631.210	V	18.6	24.5	43.1	46.0	-2.9
919.380	H	11.5	29.4	40.9	46.0	-5.1
919.730	V	14.3	29.4	43.7	46.0	-2.3

b) Emission frequencies above 1 GHz

Frequency (MHz)	Ant-Pol H/V	Meter Reading (dBuV)	Corrected Factor (dB)	Result @3m (dBuV/m)	Limit @3m (dBuV/m)	Margin (dB)
Radiated emission frequencies above 1 GHz to 25 GHz were too low to be measured.						

Test Date: Apr. 29, 2005 Temperature: 15 ℃ Humidity: 71 %

Operation Mode: TX

Operation Channel	Test Frequency (MHz)	Reading (dBuV) H Peak	Reading (dBuV) H Ave	Reading (dBuV) V Peak	Reading (dBuV) V Ave	Factor (dB) Corr.	Result @3m (dBuV/m) Peak	Result @3m (dBuV/m) Ave	Limit @3m (dBuV/m) Peak	Limit @3m (dBuV/m) Ave.
1	2390.000	27.2	18.2	27.4	18.3	30.3	57.7	48.6	74.0	54.0
11	2483.500	27.8	18.6	27.9	18.7	30.3	58.2	49.0	74.0	54.0

Note :

1. Remark "---" means that the emissions level is too low to be measured.
2. The result is the highest value of radiated emission from restrict band of 2310 ~ 2390 MHz and 2483.5 ~ 2500 MHz.

10.5 Field Strength Calculation

The field strength is calculated by adding the Antenna Factor, High Pass Filter Loss(if used) and Cable Loss, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation calculation is as follows:

Result = Reading + Corrected Factor

where

Corrected Factor = Antenna Factor + Cable Loss + High Pass Filter Loss - Amplifier Gain