



# CERTIFICATION TEST REPORT

## FCC CFR47 PART 15 SUBPART C

Test Report File No.	14-IST-0283	<input checked="" type="checkbox"/> Basic	<input type="checkbox"/> Alternate
Date of Receipt	April 07, 2014	Begin of test date	April 24, 2014
Date of Issue	May 19, 2014	End of test date	May 08, 2014

Kind of Product	Portable Music Player
Basic Model(s)	PPM21
FCC ID	QDMPPM21

Applicant	IRIVER LIMITED.
Address	Irivhouse, 5, Bangbae-ro 18-gil, Seocho-gu, Seoul, Korea
Manufacturer	IRIVER LIMITED.
Address	Irivhouse, 5, Bangbae-ro 18-gil, Seocho-gu, Seoul, Korea

Test Result

☒ Positive

☐ Negative

Tested By

Reviewed By

B.O.KO

S.J.CHO

### Comment(s)

- Investigations requested : Measurement to the relevant clauses of FCC rules and regulations Part 15 Subpart C.
- The test report is consists of 45 pages.
- The test result only responds to the tested sample.
- It is not allowed to copy this report even partly without the allowance of IST Co., Ltd.
- This equipment as for has been shown to be capable of continued compliance with the applicable technical standards as indicated in the measurement report and was tested in accordance with the measurement procedures specified in ANSI C63.4  
I assume full responsibility for accuracy and completeness of these data.





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## INFORMATION OF TEST LABORATORY

EMC LABORATORY of IST Co., Ltd.  
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Yongin-si, Gyeonggi-do, Korea.

TEL : +82 31 326 6700 FAX : +82 31 326 6797

KOLAS Testing No. : KT118  
RRA Designation No. : KR0018  
FCC Registration No. : 400603  
VCCI Member No. : 1739



## Measurement Uncertainty

Conducted Emissions	$U = 2.98$ [dB] (Confidence level approximately 95 %, $k = 2$ )
Radiated Emissions (Antenna - Horizontal)	$U = 3.83$ [dB] (Confidence level approximately 95 %, $k = 2$ )
Radiated Emissions (Antenna - Vertical)	$U = 4.50$ [dB] (Confidence level approximately 95 %, $k = 2$ )



## PRODUCT INFORMATION

### Portable Music Player(PPM21)

Body Color	STONE SILVER
Body Material	Aluminum
Display	3.31inch WVGA(480X800) AMOLED Touch Screen
Supported Audio Formats	WAV, FLAC, WMA, MP3, OGG, APE(Normal High Fast), AAC, ALAC, AIFF, DFF, DSF
Sample Rate	FLAC, WAV, ALAC, AIFF : 8kHz~192KHz(8/16/24bits per Sample) DSD Native : DSD64(1bit 2.8MHz), Stereo/ DSD128(1bit 5.6MHz), Stereo
Output Level	Unbalance 2.1Vrms/ Balance 2.3Vrms(Condition No Load)
DAC	Cirrus Logic CS4398 X 2(Dual DAC)
Decoding	Support up to 24bit/ 192kHz Bit to Bit Decoding
Input	USB Micro-B input(for charging & data transfer(PC&MAC)/ Connection Mode : MTP(Media Device)
Outputs	PHONES(3.5mm)/ Optical Out(3.5mm)/ Balanced Out(2.5mm, only 4-pole supported)
Wi-Fi	802.11 b/g/n(2.4GHz)
Bluetooth	V4.0
Dimensions	2.59" (66mm)[W] X 4.21" (107mm)[H] X 0.68" (17.5mm)[D]
Weight	6.5 oz(185g)
Feature Enhancements	Firmware upgrade supported(OTA)
Audio Specification	
Frequency Response	$\pm 0.023\text{dB}$ (Condition:20Hz~20kHz)Unbalance & Balance/ $\pm 0.3\text{dB}$ (Conditon:10Hz~70kHz)Unbalance & Balance
S/N	116dB @ 1kHz, Unbalance/ 117dB @ 1kHz, Balance
Crosstalk	130dB @ 1KHz, Unbalance/ 135dB @ 1kHz, Balance
THD+N	0.0007% @ 1kHz, Unbalance/ 0.0005% @ 1kHz, Balance
IMD SMPTE	0.0004% 800Hz 10kHz(4:1) Unbalance/ 0.0003% 800Hz 10kHz(4:1) Balance
Output impedance	1 ohm
Clock Jitter	50ps(Typ)
Memory	Built-in Memory : 128 GB[NAND] External Memory : microSD(Max, 128GB) X 1
Battery	Capacity : 3100 mAh 3.7V Li-Polymer Battery
Supported OS	Supported OS : Window XP, Window 7,8(32/64bit) MAC OS X 10.7

**Note:** All the testing were performed according to the procedures in  
FCC CFR47 PART 15 SUBPART C



## SUMMARY

WLAN(2412 MHz ~ 2462 MHz)

Applied Standard : FCC CRF Part 15 Subpart C

Standard Section	Description	result	remark
15.207	AC Conducted Emission	Pass	Meet the requirements
15.209	Field Strength of Harmonics	Pass	Meet the requirements
15.247(b)	Peak Power Output	Pass	Meet the requirements
15.247(d)	Conducted Band Edges	Pass	Meet the requirements
	Conducted Spurious Emission	Pass	Meet the requirements
	Radiated Band Edges	Pass	Meet the requirements
	Radiated Spurious Emission	Pass	Meet the requirements
15.247(a)(2)	6dB Bandwidth	Pass	Meet the requirements
15.247(e)	Power Spectral Density	Pass	Meet the requirements
15.203 & 15.247(b)	Antenna requirement	-	Meet the requirements

### Applied Standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the Following standards:

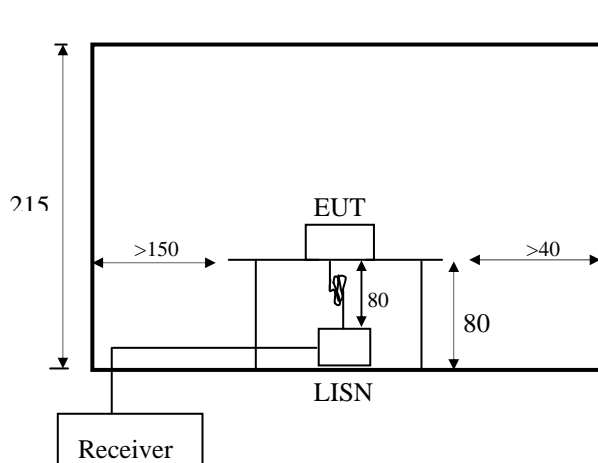
- ✧ FCC Part 15 Subpart C § 15.247
- ✧ FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v03r02
- ✧ FCC TCB Workshop 2013, April 9.
- ✧ ANSI C63.4-2003 and ANSI C63.10-2009

**Conducted Emissions:**

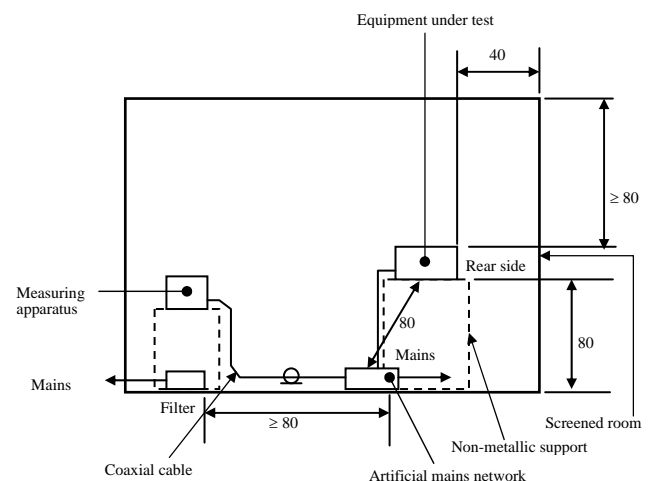
The measurement were performed over the frequency range of 0.15 MHz to 30 MHz using a 50  $\Omega$ /50 uH LISN as the input transducer to a Spectrum Analyzer or a Field Intensity Meter. The measurements were made with the detector set for "quasi-peak" & "Average" within a bandwidth of 9 KHz.

- Procedure of Test

The line-conducted facility is located inside a shielded room No.1. A 1 m X 1.5 m wooden table 80 cm height is placed 40 cm away from the vertical wall and 1.5 m away from the other wall of the shielded room. The R/S ENV216 and R/S ESH3-Z5 LISN are bonded to bottom of the shielded room. The EUT is located on the wooden table with distance more than 80 cm from the LISN and powered from the R/S ENV216 LISN. The peripheral equipment is powered from the other LISN. If the EUT is a DC-powered device, power will be derived from the source power supply it normally will be powered from and this supply lines will be connected to the R/S ESH3-Z6 LISN. All interconnected cables more than 1 m were shortened by non-inductive bundling to a 1 m length. Sufficient time for the EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating conditions. The RF output of the LISN was connected to the R/S receiver to determine the frequency producing the maximum emission from the EUT. The frequency producing the maximum level was reexamined using Quasi-Peak mode by manual measurement. The EUT, peripheral equipment, and interconnecting cables were arranged and manipulated to maximize each emission.



**< Side View >**



### < Concept Drawing >



## Limits

According to §15.207(a) except as shown in paragraphs (b) and (c) of this section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50  $\mu$ H/50 ohms line impedance stabilization network(LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

Frequency Range (MHz)	Limits	
	Quasi-peak	Average
0.15 to 0.50	66 to 56*	56 to 46*
0.50 to 5	56	46
5 to 30	60	50

\* Decreases with the logarithm of the frequency.

Test specification.

According to FCC CFR Title 47 Part 15 Subpart C Section 15.207



## Conducted Emissions

[Applicable]

### ◆ Test Equipment Used

Model Name	Description	Manufacturer	Due for Cal	Serial No.
ESCI	Test Receiver	Rohde & Schwarz	Jul. 16, 2014	100373
ENV216	LISN	Rohde & Schwarz	Dec. 09, 2014	101718

*Note : The equipment used is calibrated in regular for every year.*

### ◆ Test Accessories Used

Equipment	Type	Brand	Serial No.
PPM21	PPM21	IRIVER LIMITED.	N/A
Laptop	LGR51	LG Electronics	902QTEQ035540
Adapter(Laptop)	PA-1900-08	LG Electronics	N/A
AP	DIR-825	D-Link	F3T02C9000588
Micro SD	N/A	SanDisk	N/A
Bluetooth Speaker	XAM11	XMI	X0035744

### Connecting Interface Cables :

AC Power Cable : 1.8 m (Unshielded)

USB Cable(Micro 5pin to USB) : 1.0 m (shielded)

### ◆ Test Conditions

Temperature ( 20.4 ± 0.2 ) °C  
Humidity ( 43.8 ± 0.2 ) % R.H.  
Atmosphere ( 1000 ) mbar

◆ Test Area Conducted Room #1

◆ Test Date May 08, 2014

*Note :*





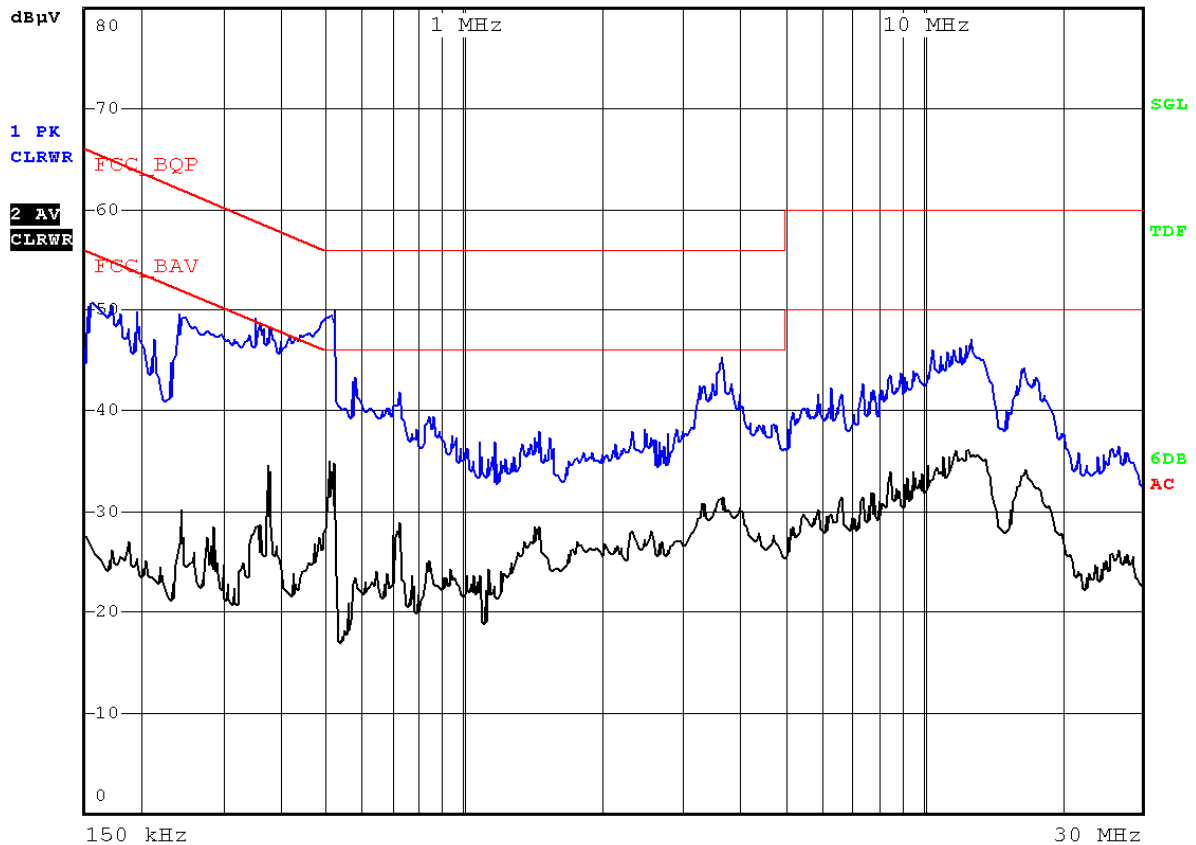
## Conducted Emissions result

Live



RBW 9 kHz  
MT 100 ms  
PREAMP OFF

Att 10 dB



150 kHz

Model Name : PPM21

120 Vac

60 Hz

Live

30 MHz

Freq. [MHz]	Measurement [dB $\mu$ V]		Limit [dB $\mu$ V]		Insertion Loss	Cable Loss	Result [dB $\mu$ V]		Margin [dB]	
	Q-peak	Average	Q-peak	Average			Q-peak	Average	Q-peak	Average
0.154	31.73	16.54	65.78	55.78	9.55	0.05	41.33	26.14	24.45	29.64
0.374	31.37	25.73	58.41	48.41	9.56	0.10	41.03	35.39	17.38	13.02
0.522	38.82	24.85	56.00	46.00	9.56	0.04	48.42	34.45	7.58	11.55
3.626	27.76	20.94	56.00	46.00	9.58	0.15	37.49	30.67	18.51	15.33
12.742	30.71	26.03	60.00	50.00	9.65	0.15	40.51	35.83	19.49	14.17
16.642	28.13	23.48	60.00	50.00	9.68	0.24	38.05	33.40	21.95	16.60



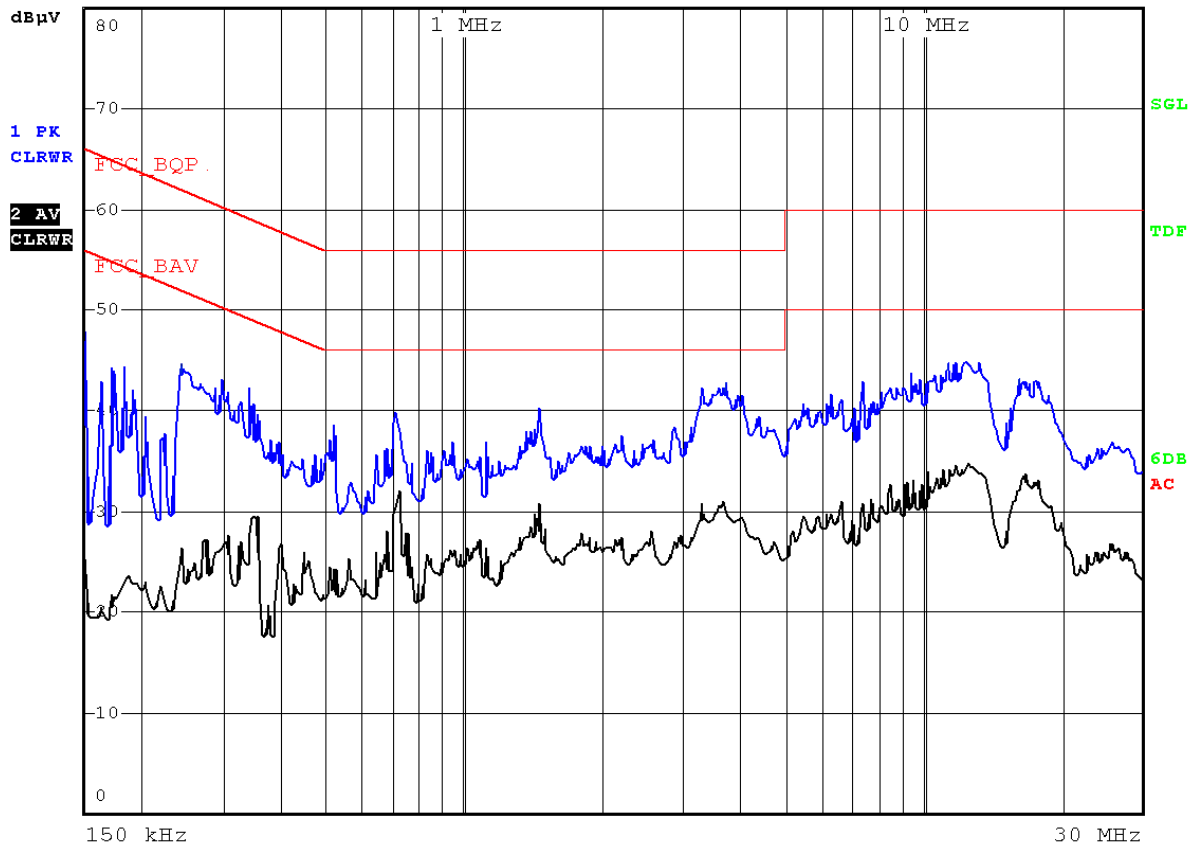
## Conducted Emissions result

Neutral



RBW 9 kHz  
MT 100 ms  
PREAMP OFF

Att 10 dB



150 kHz

Model Name : PPM21

120 Vac

60 Hz

Neutral

30 MHz

Freq. [MHz]	Measurement [dB $\mu$ V]		Limit [dB $\mu$ V]		Insertion Loss	Cable Loss	Result [dB $\mu$ V]		Margin [dB]	
	Q-peak	Average	Q-peak	Average			Q-peak	Average	Q-peak	Average
0.150	33.92	17.04	65.57	55.57	9.56	0.05	43.53	26.65	22.47	29.35
0.170	31.58	15.52	64.77	54.77	9.56	0.04	41.18	25.12	23.78	29.84
0.242	32.31	15.84	58.59	48.59	9.55	0.03	41.90	25.43	20.13	26.60
3.726	27.45	21.63	56.00	46.00	9.59	0.15	37.18	31.36	18.82	14.64
11.298	28.32	22.45	56.00	46.00	9.64	0.14	38.10	32.23	21.90	17.77
16.270	27.46	22.41	60.00	50.00	9.67	0.25	37.37	32.32	22.63	17.68



## Peak Power Output

### ◆ Test Equipment

The following test equipment are used during the test:

Item	Equipment	Manufacturer	Model no/Serial No.	Due for Cal.
1	Power Meter	Agilent	N1911A/ MY53280018	Oct. 07, 2014
2	Wideband Power Sensor	Agilent	N1921A/ MY52300024	Oct. 07, 2014
3	RF ROOM			

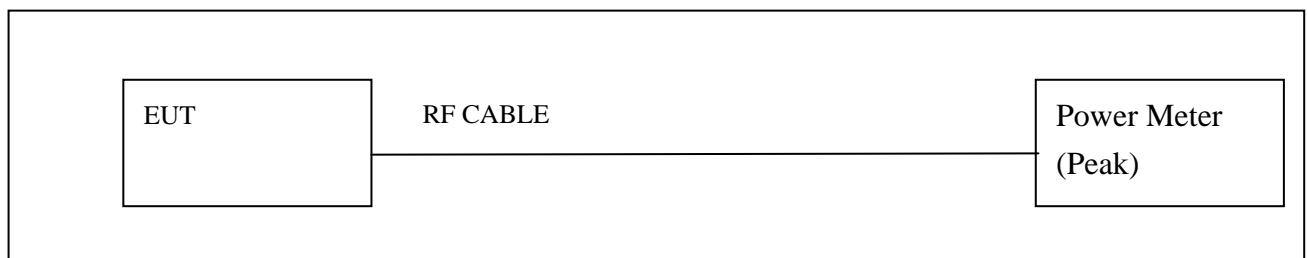
Note : All equipment upon which need to calibrated are with calibration period of 1 year.

### ◆ Limits

The maximum peak output power of the intentional radiator shall not exceed the following :

1. According to §15.247(b)(3), for systems using digital modulation in the bands of 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz : 1Watt.
2. According to §15.247(b)(4), the conducted output power limit specified in paragraph(b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph(c) of this section, is transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs(b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi

### ◆ Test Setup



### ◆ Test Procedure

1. The transmitter output is connected to the Power meter.

The Power meter is set to the peak power detection.

2. The testing follows the Measurement Procedure FCC KDB No. 558074 D01 DTS Meas. Guidance v03r02.

9.1.2 PKPM1 Peak power meter method.



### Peak Power Output Test result

Product	PPM21
Test Method	Measurement using an RF peak power meter
Test Mode	Transmit
Test Site	RF Room
Measurement Method	Conducted

802.11b Mode		Rate (Mbps)	Measured Power (dBm)	Limit (dBm)
Frequency (MHz)	Channel No.			
2412	1	1 Mbps	17.86	1Watt=30dBm
		2 Mbps	17.55	1Watt=30dBm
		5.5 Mbps	17.58	1Watt=30dBm
		11 Mbps	17.60	1Watt=30dBm
2437	6	1 Mbps	17.89	1Watt=30dBm
		2 Mbps	17.73	1Watt=30dBm
		5.5 Mbps	17.77	1Watt=30dBm
		11 Mbps	17.86	1Watt=30dBm
2462	11	1 Mbps	17.71	1Watt=30dBm
		2 Mbps	17.54	1Watt=30dBm
		5.5 Mbps	17.51	1Watt=30dBm
		11 Mbps	17.62	1Watt=30dBm

Note : Measurement Power = reading level + correct factor



802.G Mode		Rate (Mbps)	Measured Power (dBm)	Limit (dBm)
Frequency (MHz)	Channel No.			
2412	1	6 Mbps	22.87	1Watt=30dBm
		9 Mbps	22.82	1Watt=30dBm
		12 Mbps	22.38	1Watt=30dBm
		18 Mbps	22.43	1Watt=30dBm
		24 Mbps	22.41	1Watt=30dBm
		36 Mbps	22.49	1Watt=30dBm
		48 Mbps	22.47	1Watt=30dBm
		54 Mbps	22.45	1Watt=30dBm
2437	6	6 Mbps	22.92	1Watt=30dBm
		9 Mbps	22.99	1Watt=30dBm
		12 Mbps	22.46	1Watt=30dBm
		18 Mbps	22.29	1Watt=30dBm
		24 Mbps	22.63	1Watt=30dBm
		36 Mbps	22.48	1Watt=30dBm
		48 Mbps	22.43	1Watt=30dBm
		54 Mbps	22.48	1Watt=30dBm
2462	11	6 Mbps	22.86	1Watt=30dBm
		9 Mbps	22.85	1Watt=30dBm
		12 Mbps	22.37	1Watt=30dBm
		18 Mbps	22.25	1Watt=30dBm
		24 Mbps	22.57	1Watt=30dBm
		36 Mbps	22.44	1Watt=30dBm
		48 Mbps	22.36	1Watt=30dBm
		54 Mbps	22.41	1Watt=30dBm

Note : Measurement Power = reading level + correct factor



802.N Mode (HT20)		Rate (Mbps)	Measure Power (dBm)	Limit (dBm)
Frequency (MHz)	Channel No.			
2412	1	6.5 Mbps	22.59	1Watt=30dBm
		13 Mbps	22.33	1Watt=30dBm
		19.5 Mbps	22.49	1Watt=30dBm
		26 Mbps	22.55	1Watt=30dBm
		39 Mbps	22.38	1Watt=30dBm
		52 Mbps	22.64	1Watt=30dBm
		58.5 Mbps	22.52	1Watt=30dBm
		65 Mbps	22.51	1Watt=30dBm
2437	6	6.5 Mbps	22.47	1Watt=30dBm
		13 Mbps	22.41	1Watt=30dBm
		19.5 Mbps	22.45	1Watt=30dBm
		26 Mbps	22.57	1Watt=30dBm
		39 Mbps	22.37	1Watt=30dBm
		52 Mbps	22.65	1Watt=30dBm
		58.5 Mbps	22.61	1Watt=30dBm
		65 Mbps	22.47	1Watt=30dBm
2462	11	6.5 Mbps	22.62	1Watt=30dBm
		13 Mbps	22.30	1Watt=30dBm
		19.5 Mbps	22.56	1Watt=30dBm
		26 Mbps	22.52	1Watt=30dBm
		39 Mbps	22.35	1Watt=30dBm
		52 Mbps	22.66	1Watt=30dBm
		58.5 Mbps	22.45	1Watt=30dBm
		65 Mbps	22.44	1Watt=30dBm

Note : Measurement Power = reading level + correct factor



## Conducted Spurious Emissions & Band Edge

### ◆ TEST Equipment

The following test equipment are used during the test:

Item	Equipment	Manufacturer	Model no/Serial No.	Last Cal.
1	Spectrum Analyzer	ADVANTEST	R3273 / 110600587	May. 08, 2015
2	RF ROOM			

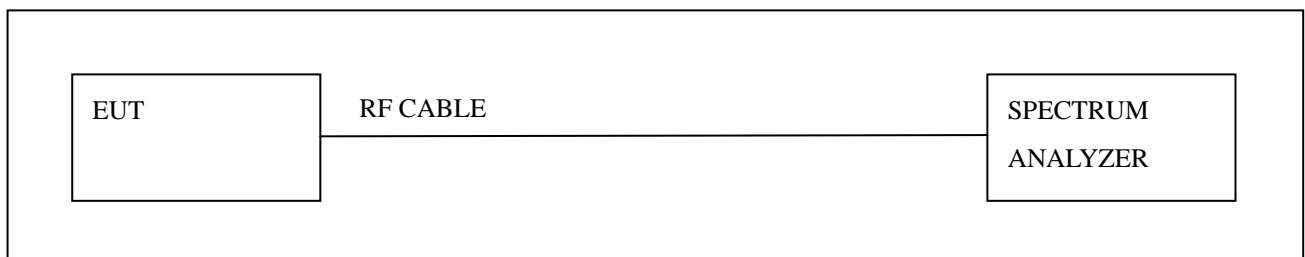
Note : 1. The calibration interval of the above test instruments is 12 months  
and the calibrations are traceable to RRL, KRISS, KTL and HCT.

### ◆ Limits

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum 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 emission 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)).

### ◆ Test Setup



### ◆ Test Procedure

1. The transmitter output is connected to the Spectrum analyzer. The Spectrum analyzer is set to the peak power detection.

2. The testing follows the Measurement Procedure FCC KDB No. 558074 D01 DTS Meas. Guidance v03r02

10.2 Method PKPSD (peak PSD).

11.3 Emission level measurement.

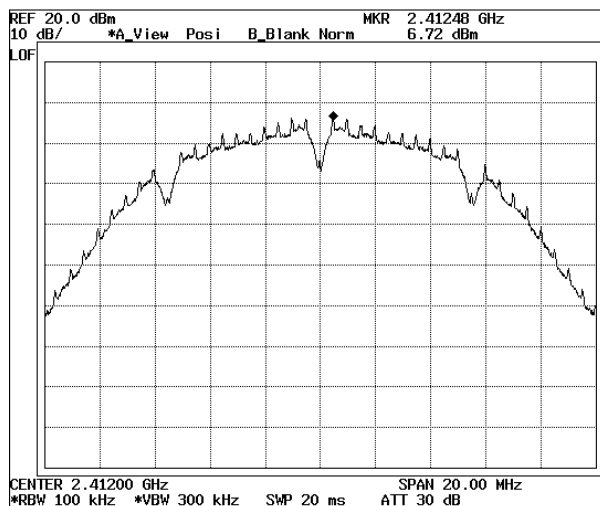


## Power Spectral Density in 100KHz test result

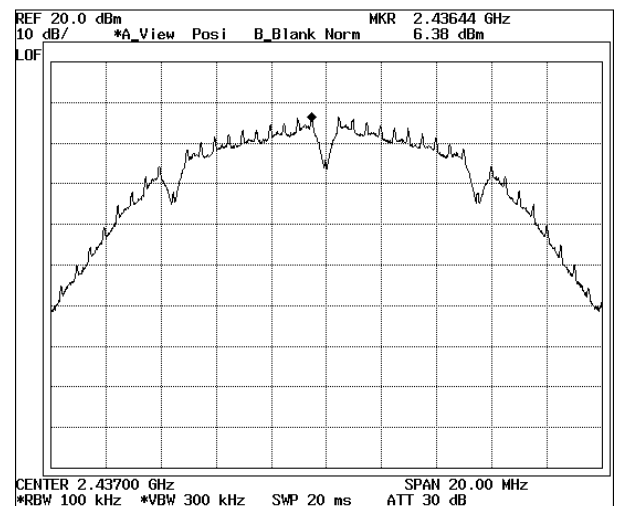
Product	PPM21
Test Item	Power Spectral Density in 100KHz
Test Mode	Transmit
Test Site	RF Room
Measurement Method	Conducted

802.11b		
Channel	Frequency (MHz)	PSD/100KHz (dBm)
Low	2412	6.72
Mid	2437	6.38
High	2462	6.30

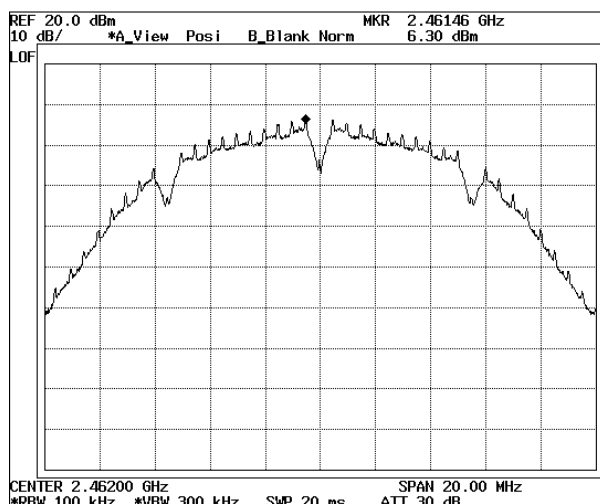
Low(2412 MHz)



Mid(2437 MHz)



High(2462 MHz)

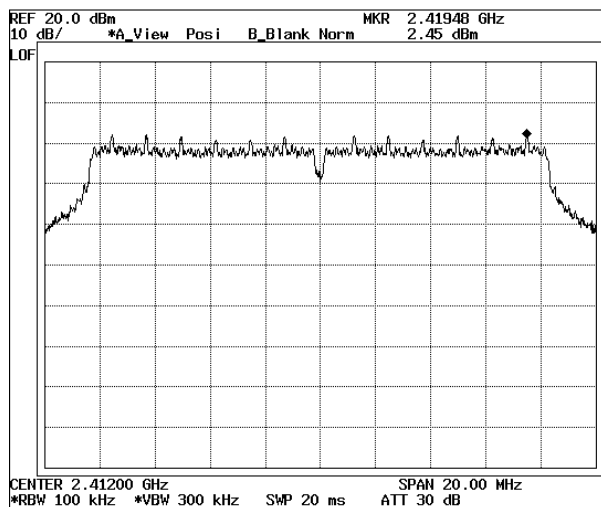




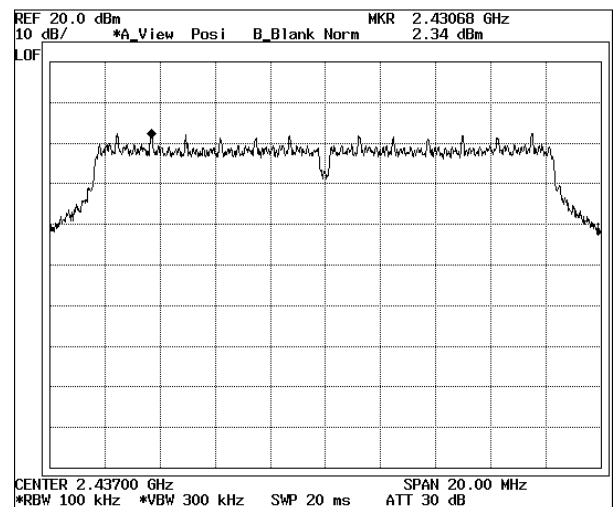


802.11g		
Channel	Frequency (MHz)	PSD/100KHz (dBm)
Low	2412	2.45
Mid	2437	2.34
High	2462	2.49

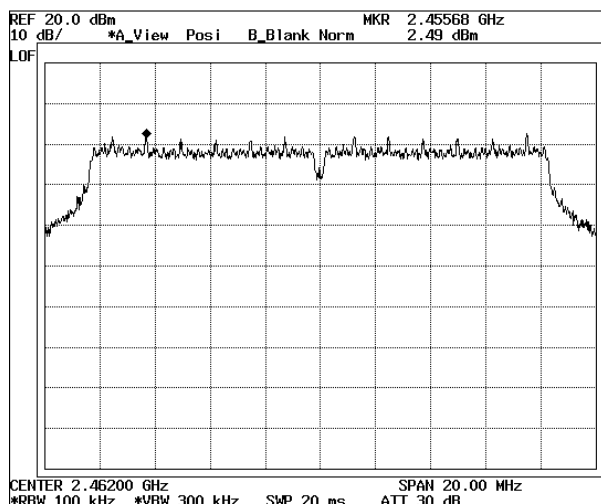
Low (2412 MHz)



Mid (2437 MHz)



High (2462 MHz)

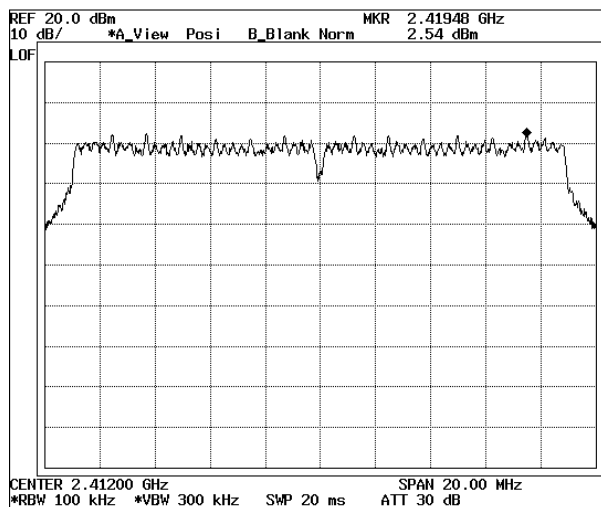


Note : Measurement level = reading level + correct factor

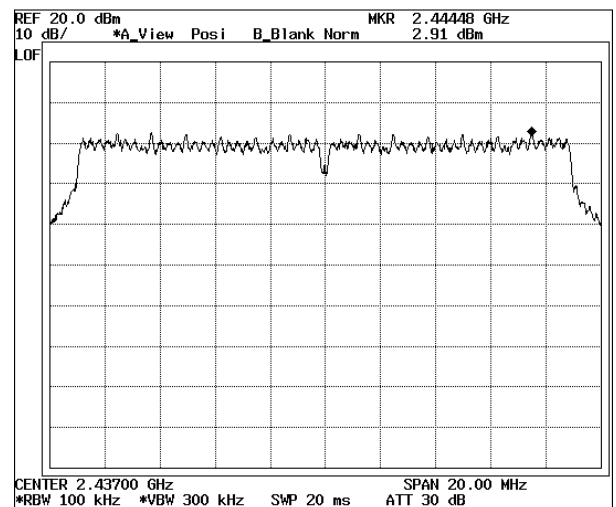


802.11n		
Channel	Frequency (MHz)	PSD/100KHz (dBm)
Low	2412	2.54
Mid	2437	2.91
High	2462	2.64

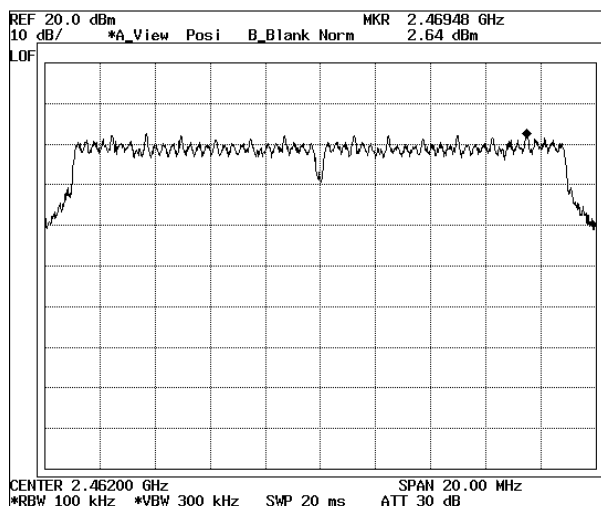
Low (2412 MHz)



Mid (2437 MHz)



High (2462 MHz)



Note : Measurement level = reading level + correct factor

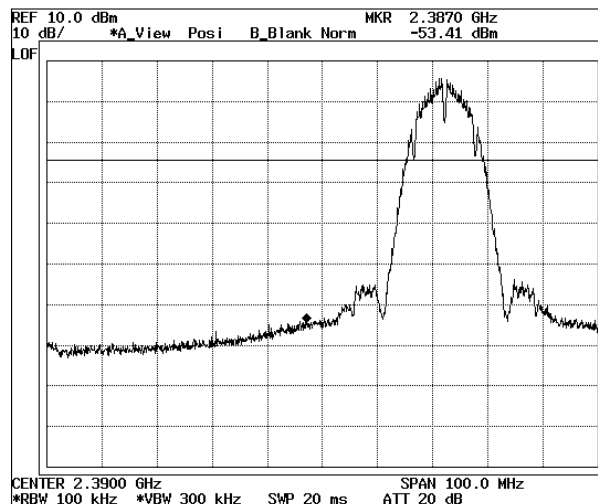


## Band Edge Test result

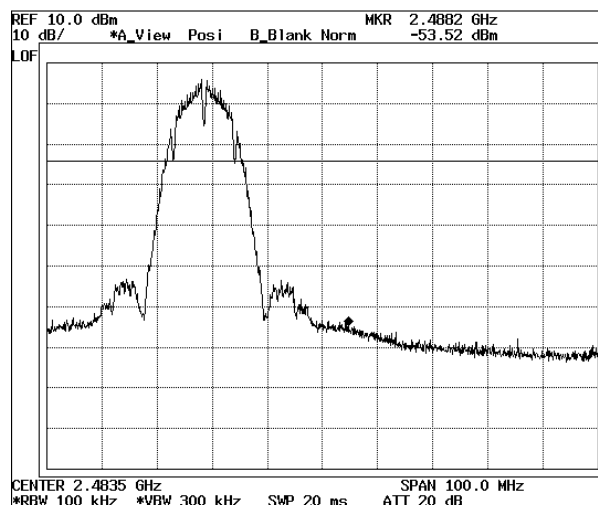
Product	PPM21
Test Item	Band Edge
Test Mode	Transmit Low/High
Test Site	RF Room
Measurement Method	Conducted

### ● 802.11b

Low (2412 MHz)



High (2462 MHz)

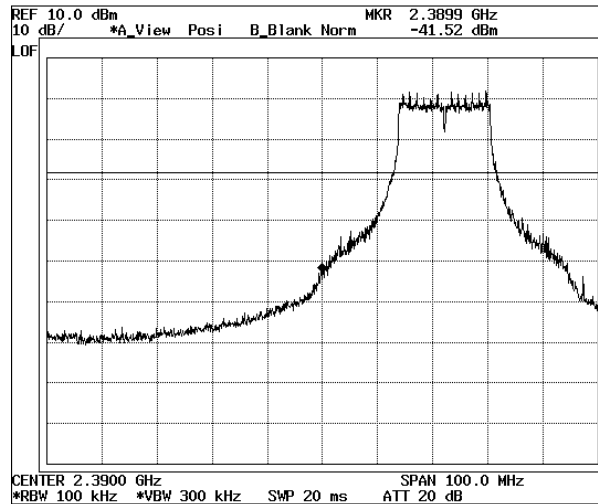


Note : Measurement level = reading level + correct factor

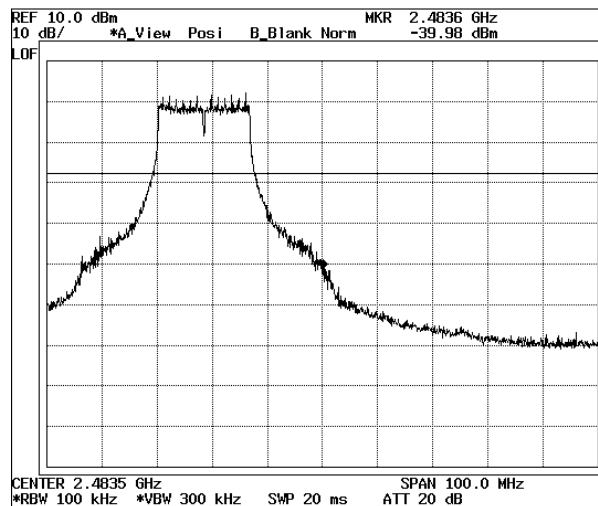


● 802.11g

Low (2412 MHz)



High (2462 MHz)

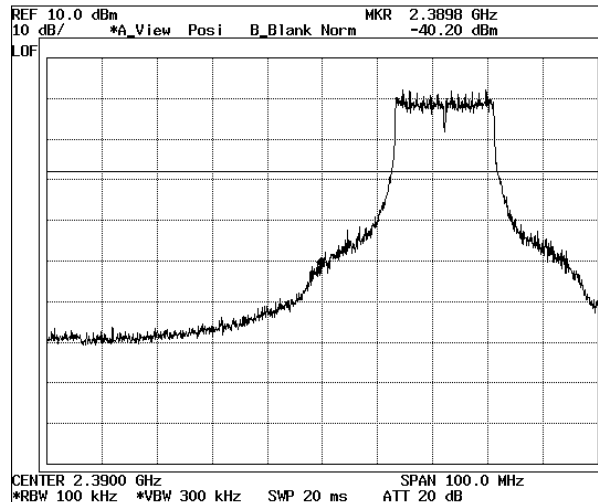


Note : Measurement level = reading level + correct factor

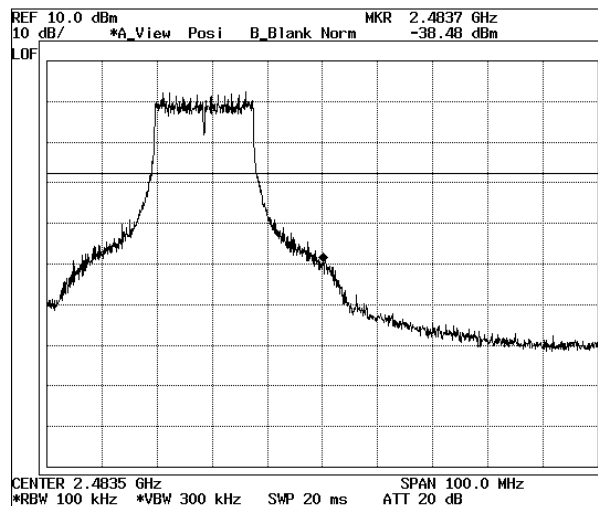


● 802.11n

Low (2412 MHz)



High (2462 MHz)



Note : Measurement level = reading level + correct factor

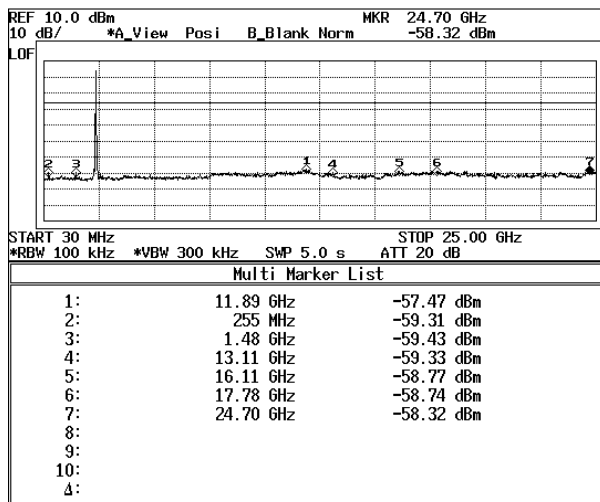


## Spurious Emission Test result

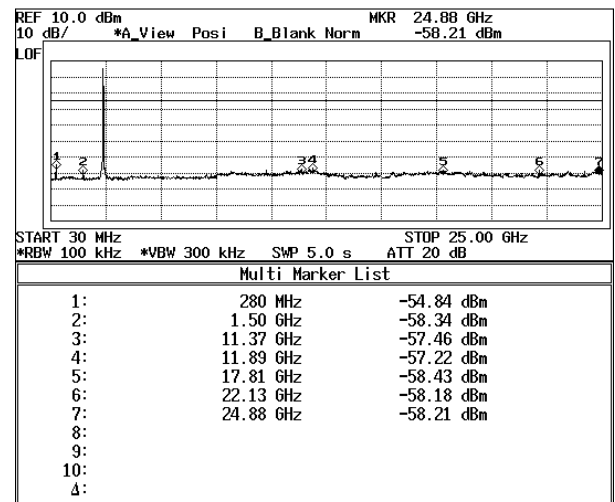
Product	PPM21
Test Item	Spurious (30 MHz ~ 25 GHz)
Test Mode	Transmit Low/Mid/High
Test Site	RF Room
Measurement Method	Conducted

### ● 802.11b

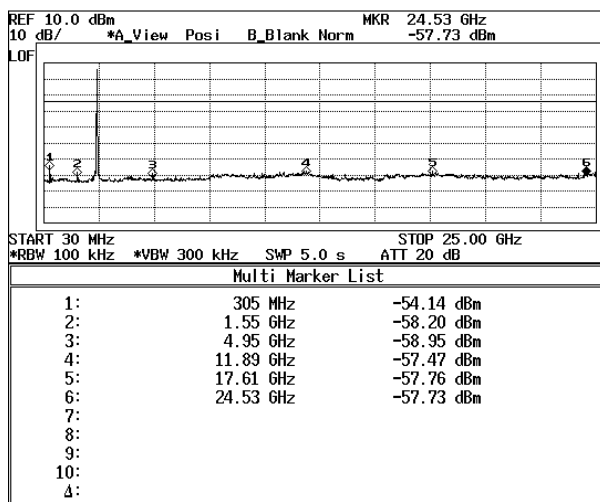
Low (2412 MHz)



Mid (2437 MHz)



High (2462 MHz)

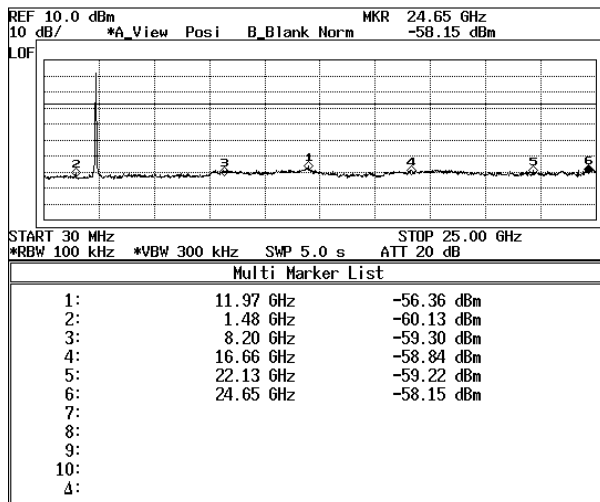


Note : Measurement level = reading level + correct factor

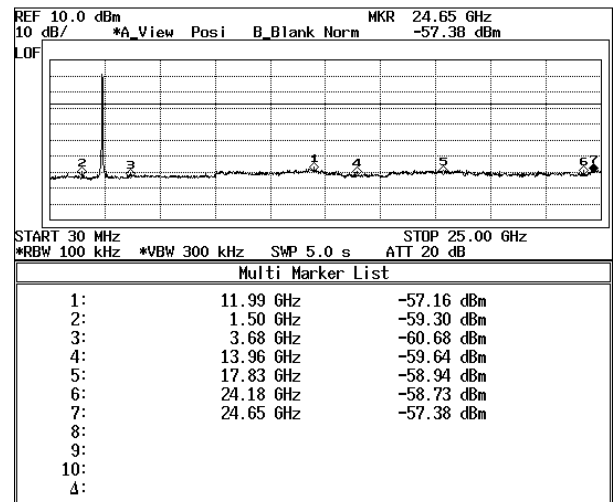


● 802.11g

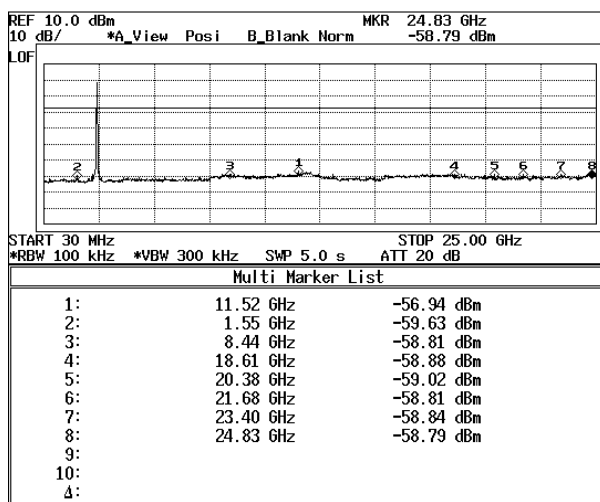
Low (2412 MHz)



Mid (2437 MHz)



High (2462 MHz)

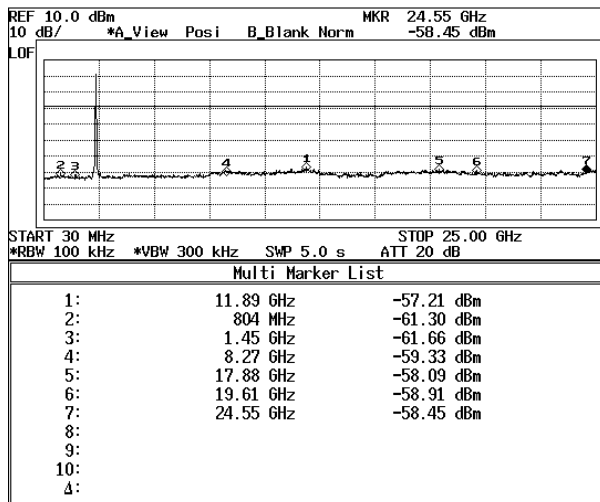


Note : Measurement level = reading level + correct factor

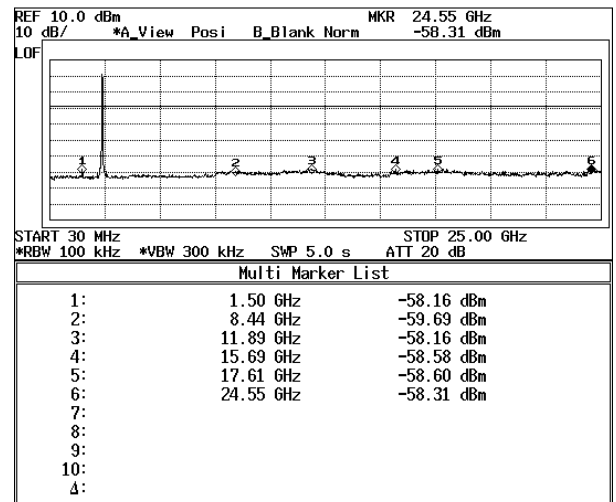


● 802.11n

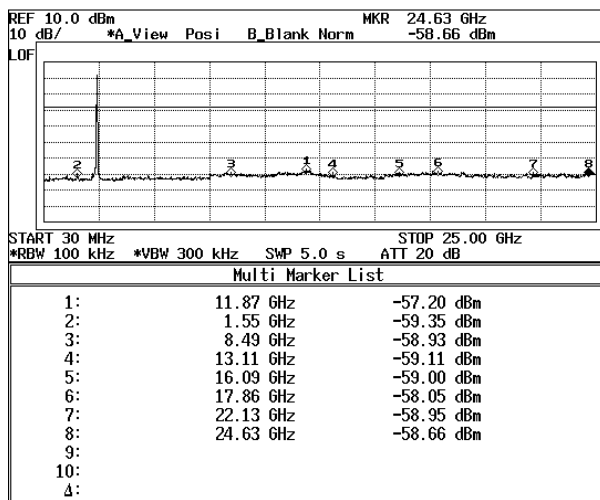
Low (2412 MHz)



Mid (2437 MHz)



High (2462 MHz)



Note : Measurement level = reading level + correct factor





## 6dB BandWidth

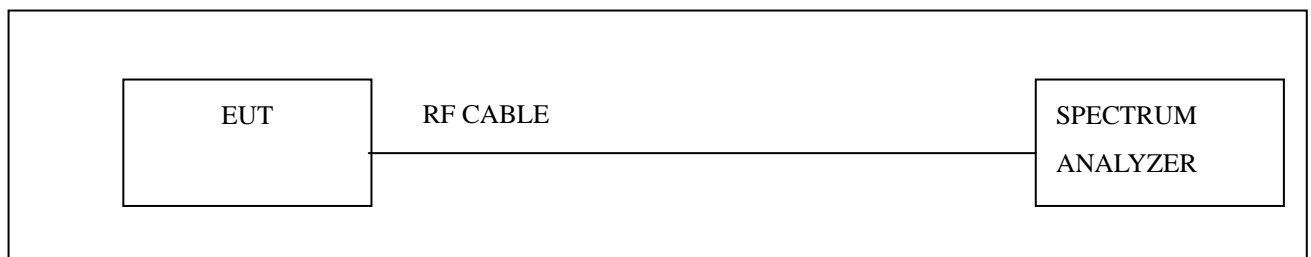
### ◆ Test Equipment

The following test equipment are used during the test:

Item	Equipment	Manufacturer	Model no/Serial No.	Due for Cal.
1	Spectrum Analyzer	ADVANTEST	R3273 / 110600587	May.08, 2015
2	RF ROOM			

Note : All equipment upon which need to calibrated are with calibration period of 1 year.

### ◆ Test Setup



### ◆ Limits

(a) Operation under the provisions of this Section is limited to frequency hopping and digitally modulated intentional radiators that comply with the following provisions :

(2) systems using digital modulation techniques may operate in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

### ◆ Test Procedure

1. The testing follows FCC KDB Publication No. 558074 D01 DTS Meas Guidance v03r02.
2. The RF output of EUT was connected to the spectrum analyzer by a low loss cable. The path loss was compensated to the results for each measurement.
3. Set the spectrum analyzer's resolution bandwidth (RBW) = 100KHz.  
Set the Video bandwidth (VBW) > 3 \*RBW.  
Set Peak Detector, max hold trace mode and auto couple sweep.
4. Measure the Maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (Upper and lower frequencies) that are attenuated by 6dB relative to the maximum level measured in the fundamental emission.

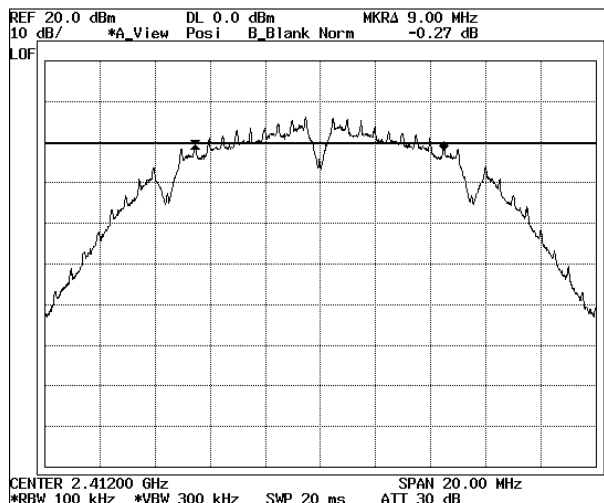


## Test result

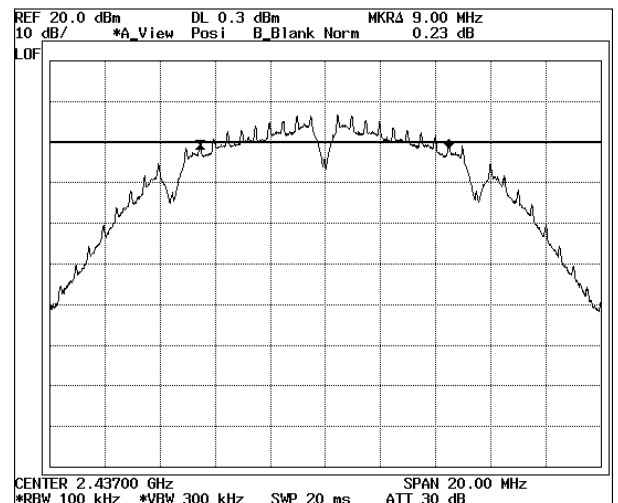
Product	PPM21
Test Item	6dB BandWidth
Test Mode	Transmit
Test Site	RF Room
Measurement Method	Conducted

802.11b				
Channel No.	Frequency (MHz)	Measure Level (MHz)	Limit (KHz)	Result
Low	2412	9.00	>500	Pass
Mid	2437	9.00	>500	Pass
High	2462	9.02	>500	Pass

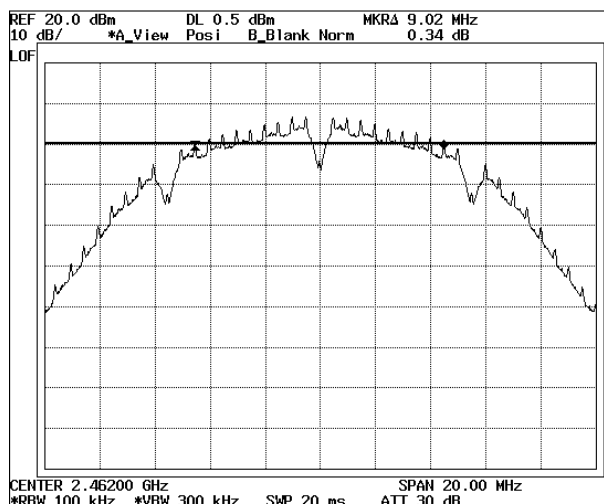
Low(2412 MHz)



Mid(2437 MHz)



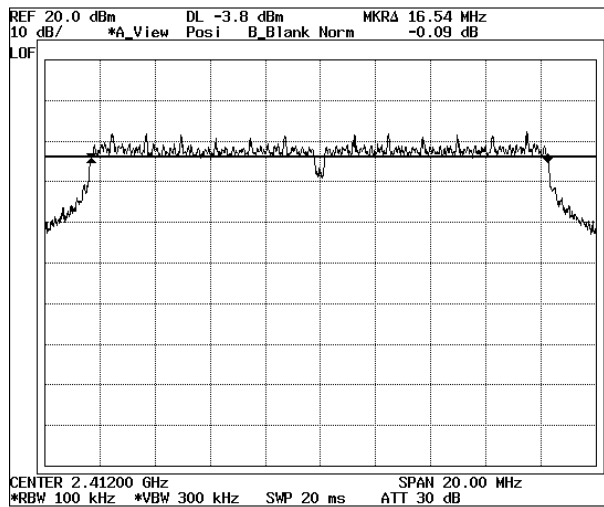
High(2462 MHz)



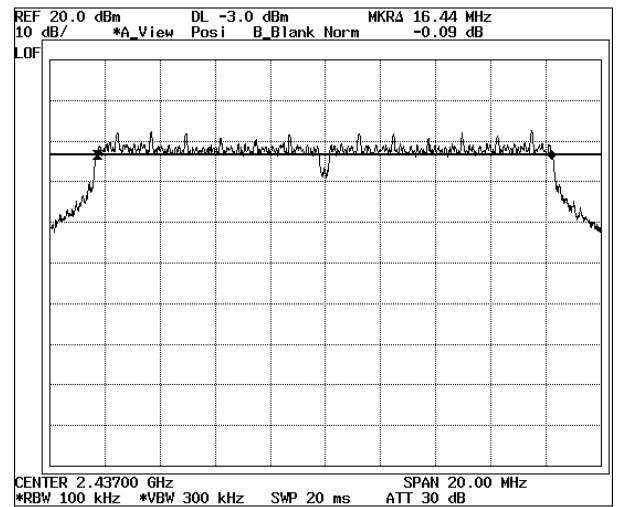


802.11g				
Channel No.	Frequency (MHz)	Measure Level (MHz)	Limit (KHz)	Result
Low	2412	16.54	>500	Pass
Mid	2437	16.44	>500	Pass
High	2462	16.56	>500	Pass

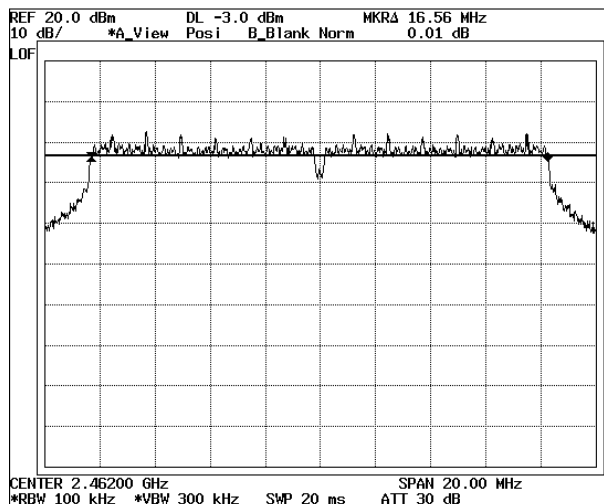
Low (2412 MHz)



Mid (2437 MHz)



High (2462 MHz)

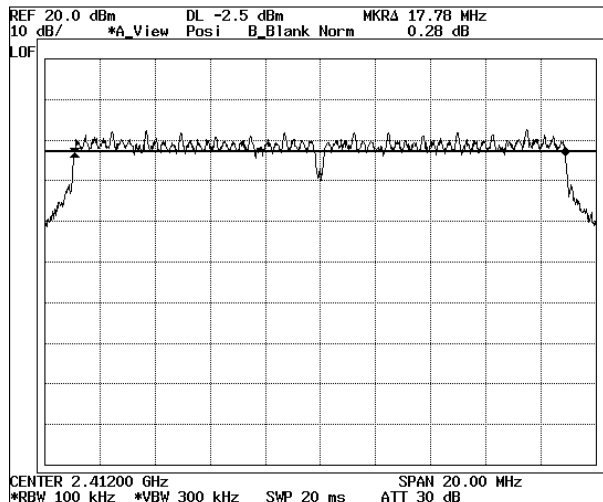


Note : Measurement level = reading level + correct factor

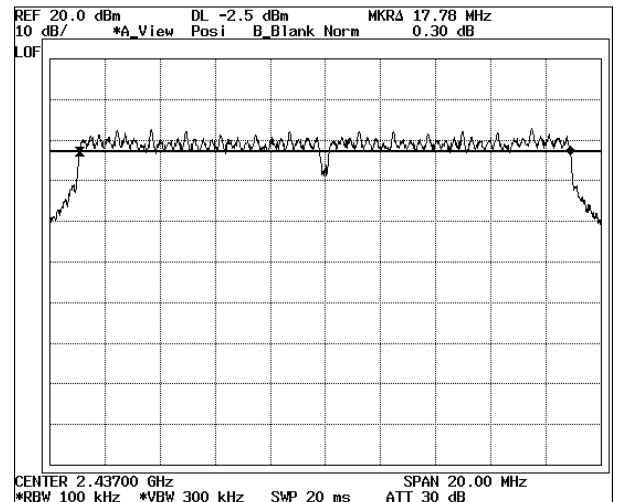


802.11n				
Channel No.	Frequency (MHz)	Measure Level (MHz)	Limit (KHz)	Result
Low	2412	17.78	>500	Pass
Mid	2437	17.78	>500	Pass
High	2462	17.78	>500	Pass

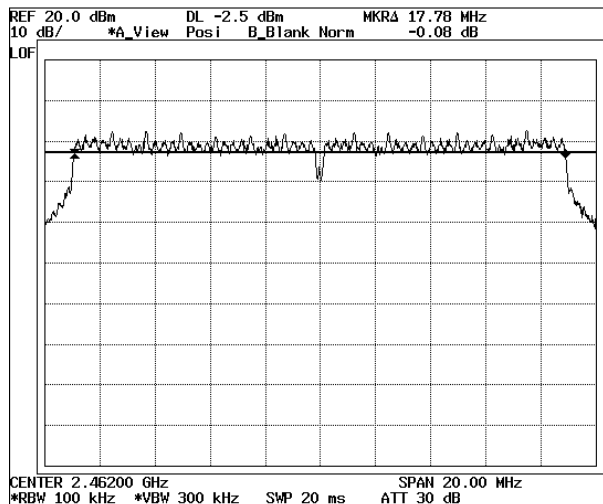
Low (2412 MHz)



Mid (2437 MHz)



High (2462 MHz)



Note : Measurement level = reading level + correct factor



## Power Spectral Density

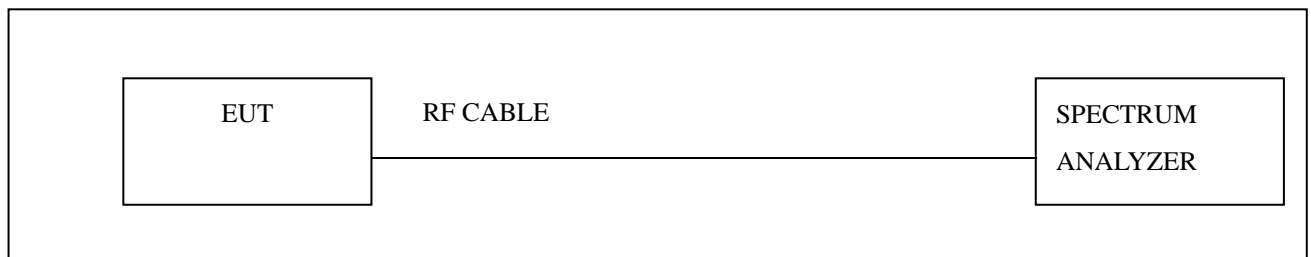
### ◆ Test Equipment

The following test equipment are used during the test:

Item	Equipment	Manufacturer	Model no/Serial No.	Due for Cal.
1	Spectrum Analyzer	ADVANTEST	R3273 / 110600587	May. 08, 2015
2	RF ROOM			

Note : All equipment upon which need to calibrated are with calibration period of 1 year.

### ◆ Test Setup



### ◆ Limits

Section 15.247 (e) For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (v) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

### ◆ Test Procedure

The Measurement Procedure PKPSD was set according to the FCC KDB 558074 D01 DTS Meas. Guidance v03r02. 10.2 Method PKPSD (peak PSD).

Use the peak marker function to determine the maximum power level in any 3 kHz band segment within the fundamental RBW.

(VBW  $\geq$  3 xRBW, Sweep time = auto couple, Trace mode = Max hold)

Antenna output of the EUT was coupled directly to spectrum analyzer; if an external attenuator and/or cable was used, these losses are compensated for with the analyzer OFFSET function.

Limit: The Power Density does not exceed 8dBm/ 3 kHz.

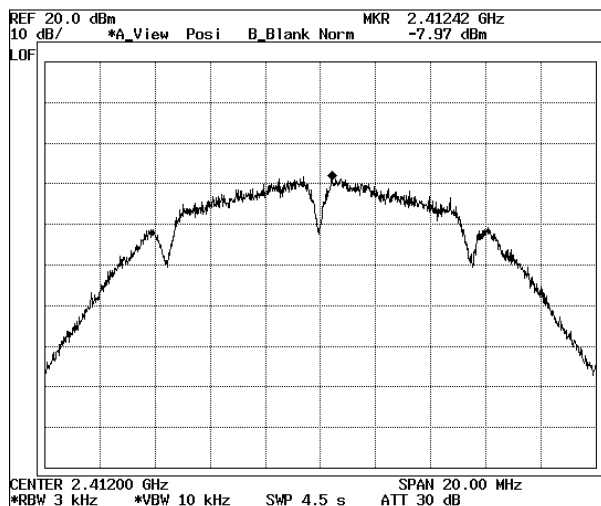


## Test result

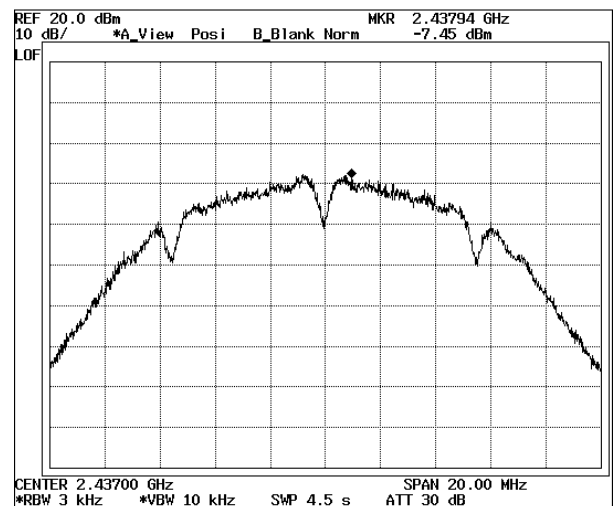
Product	PPM21
Test Item	Power Spectral Density
Test Mode	Transmit
Test Site	RF Room
Measurement Method	Conducted

802.11b				
Channel	Frequency (MHz)	PSD/3KHz (dBm)	Limit (dBm)	Result
Low	2412	-7.97	< 8	Pass
Mid	2437	-7.45	< 8	Pass
High	2462	-7.61	< 8	Pass

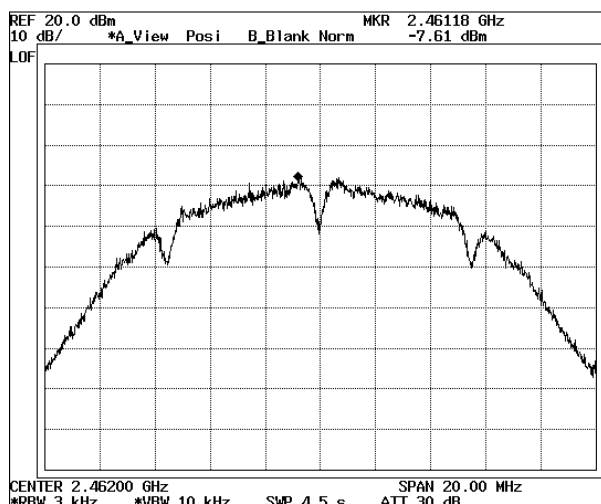
Low (2412 MHz)



Mid (2442 MHz)



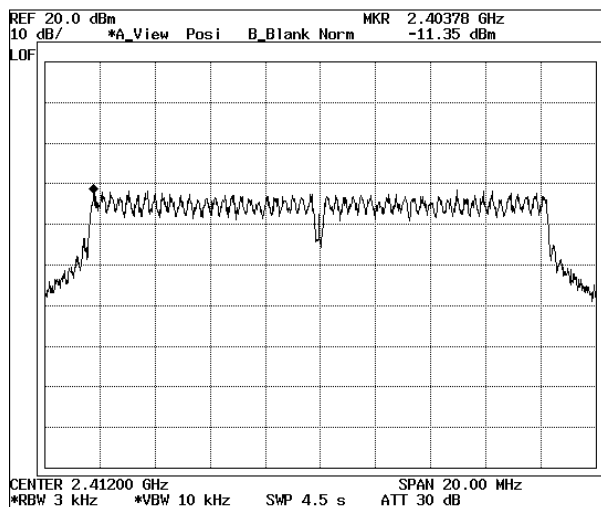
High (2462 MHz)



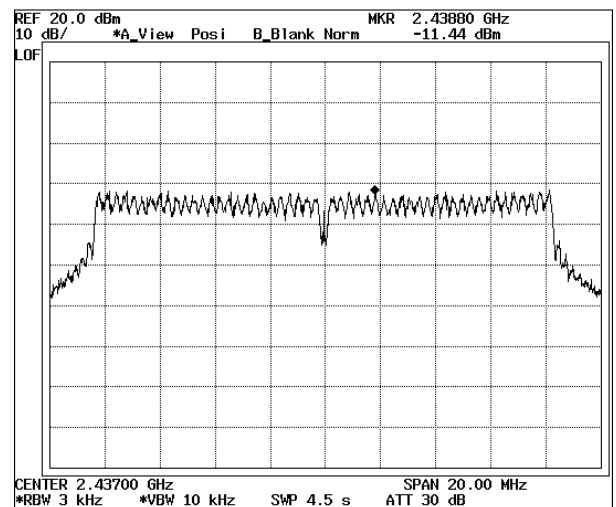


802.11g				
Channel	Frequency (MHz)	PSD/3KHz (dBm)	Limit (dBm)	Result
Low	2412	-11.35	< 8	Pass
Mid	2437	-11.44	< 8	Pass
High	2462	-11.01	< 8	Pass

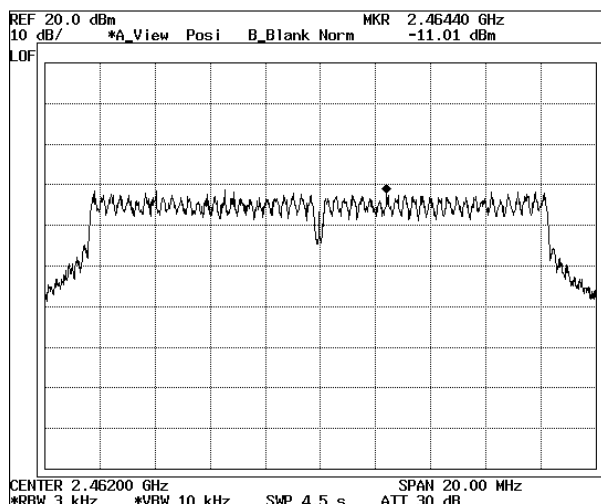
Low (2412 MHz)



Mid (2442 MHz)



High (2462 MHz)

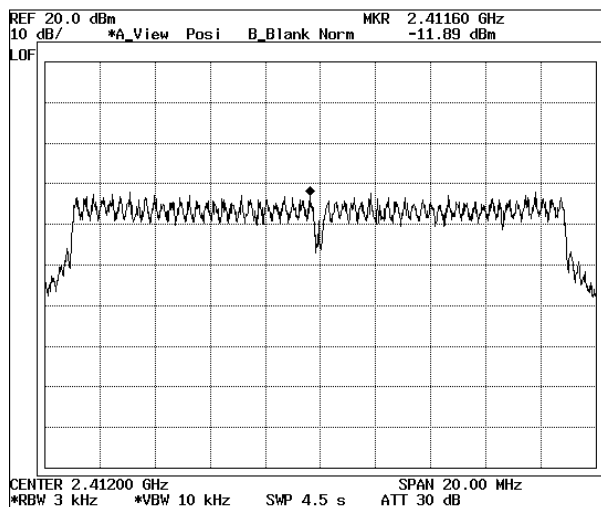


Note : Measurement level = reading level + correct factor

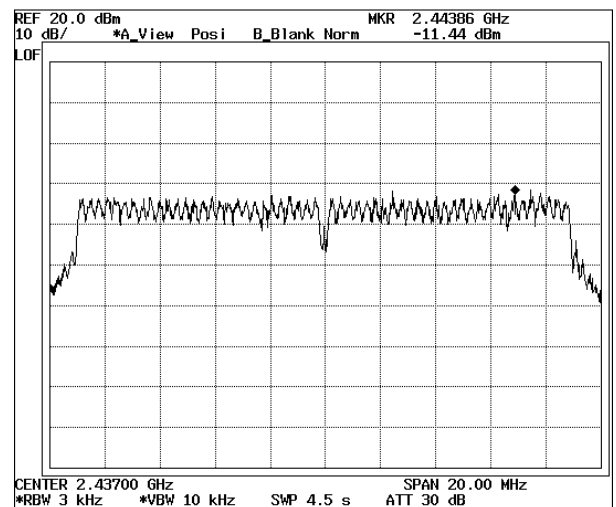


802.11n				
Channel	Frequency (MHz)	PSD/3KHz (dBm)	Limit (dBm)	Result
Low	2412	-11.89	< 8	Pass
Mid	2437	-11.44	< 8	Pass
High	2462	-11.82	< 8	Pass

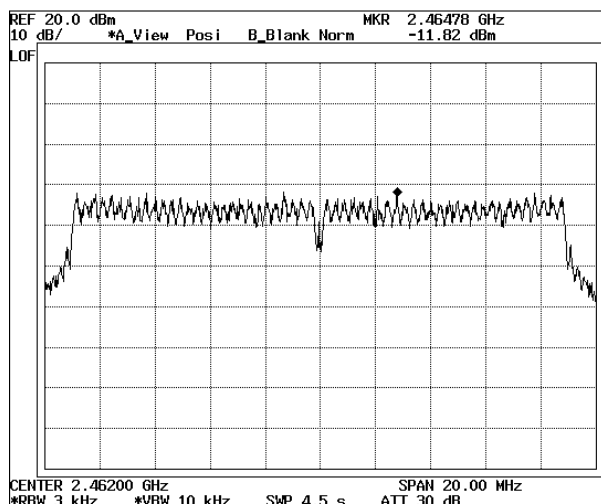
Low (2412 MHz)



Mid (2437 MHz)



High (2462 MHz)



Note : Measurement level = reading level + correct factor





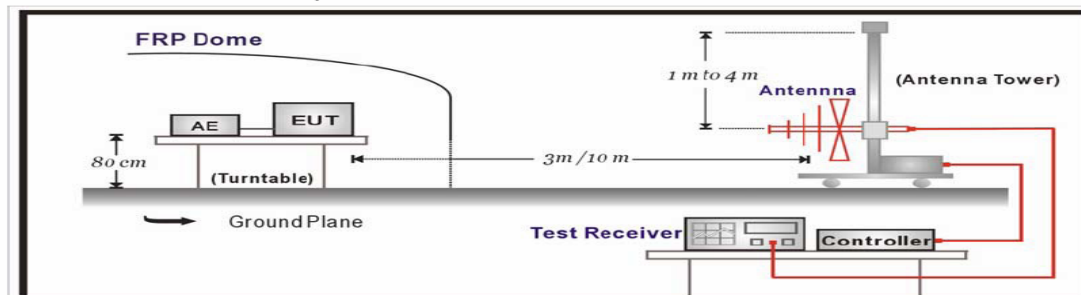
## Radiated Emissions:

The measurement was performed over the frequency range of 30MHz to 1GHz using antenna as the input transducer to a Spectrum analyzer or a Field Intensity Meter. The measurement was made with the detector set for "quasi-peak" within a bandwidth of 120kHz.

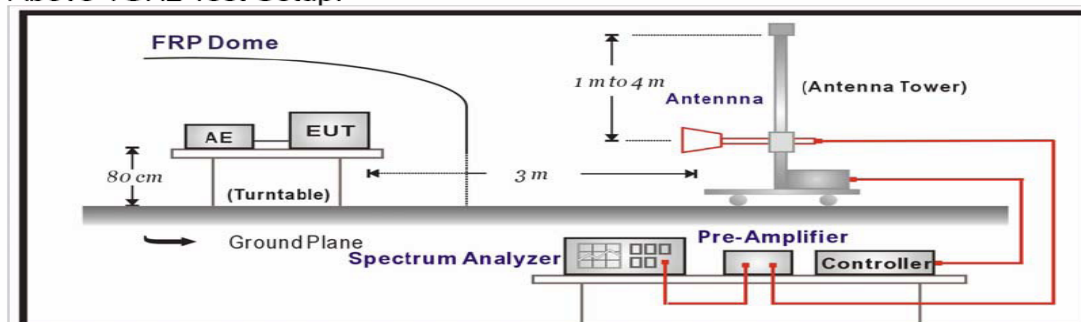
### Procedure of Test

Preliminary measurements were made at 3 meter using bi-log antennas, and spectrum analyzer to determine the frequency producing the max. emission in anechoic chamber. Appropriate precaution was taken to ensure that all emission from the EUT were maximized and investigated. The system configuration, mode of operation, turn-table azimuth and height with respect to the antenna were noted for each frequency found. The spectrum was scanned from 30MHz to 1000MHz using bi-log antenna. Above 1GHz, linearly polarized double ridge horn antennas were used. Final measurements were made at open site with 3-meters test distance using bi-log antenna or horn antenna. The OATS have been verified in regular for its normalized site attenuation. The test equipment was placed on a wooden table. Sufficient time for the EUT, peripheral equipment, and test equipment was allowed in order for them to warm up to their normal operating condition. Each frequency found during pre-scan measurements was re-examined by manual. The detector function was set to CISPR quasi-peak mode and the bandwidth of the receiver was set to 120kHz or 1MHz depending on the frequency of type of signal. The EUT, peripheral equipment and interconnecting cables were re-configured to the set-up producing the max. emission for the frequency and were placed on top of a 0.8-meter high nonmetallic 1 x 1.5 meter table. The EUT, peripheral equipment, and interconnecting cables were re-arranged and manipulated to maximize each emission. The turntable containing the system was rotated; the antenna height was varied 1 to 4 meters and stopped at the azimuth or height producing the maximum emission. Each emission was maximized by: varying the mode of operation to the EUT and/or peripheral equipment and changing the polarity of the antenna, whichever determined the worst-case emission. (The bandwidth below 1GHz setting on the field strength meter is 120KHz and above 1GHz is 1MHz.)

Under 1GHz Test Setup:

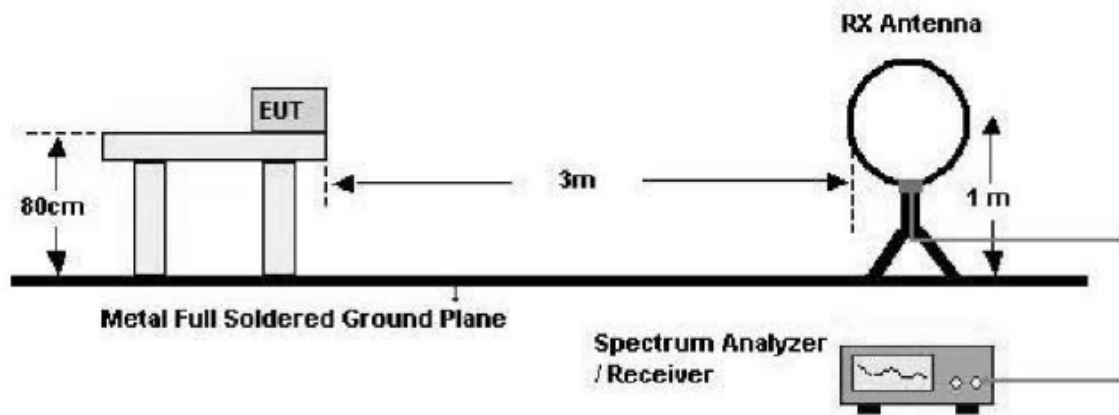


Above 1GHz Test Setup:





### Below 30 MHz



### Limits

Emissions radiated outside of the specified frequency bands, except for harmonics, Shall be attenuated by at least 20dB below the level of the fundamental or to the General radiated emission limits in paragraph 15.209, whichever is the lesser attenuation:

FCC Part 15 Subpart C Section 15.209 Limits		
Frequency (MHz)	$\mu\text{V}/\text{meter}$	$\text{dB}\mu\text{V}/\text{meter (3m)}$
0.009-0.490	$2400/F(\text{KHz})$ at 300 m	$20\log 2400/F(\text{KHz})+80$
0.490-1.705	$24000/F(\text{KHz})$ at 30m	$20\log 24000/F(\text{KHz})+40$
1.705-30	30 at 30 m	49.5
30-88	100	40
88-216	150	43.5
216-960	200	46
Above 960	500	54

#### Remarks :

1.  $\text{RF Voltage (dBuV)} = 20\log \text{RF Voltage (uV)}$
2.  $\text{dBuV/m} = \text{ERP (dBm)} + 106.92 \text{ dB} + 20\log(10\text{m}/3\text{m}) + 2.15\text{dB (conversion Factor for E.I.R.P)}$
3. In the Above Table, the tighter limit applies at the band edges.
4. Distance refers to the distance in meters between the measuring instrument antenna and the closed point of any part of the device or system.

Test specification.

According to FCC CFR Title 47 Part 15 Subpart C Section 15.209



**Radiated Spurious Emissions**  
**& Band Edge**

[Applicable]

◆ Test Equipment Used

Name	Type	Manufacturer	Due for Cal	Serial Number
EMI Receiver	ESCS30	Rohde & Schwarz	May 08, 2015	100171
EMI Receiver	ESCI7	Rohde & Schwarz	Jul. 16, 2014	100872
SPECTRUM ANALYZER	R3273	ADVANTEST	May. 08, 2015	110600587
Loop Antenna	HFH2-Z2	Rohde & Schwarz	Oct. 26, 2014	8620771017
Bi-Log Antenna	VULB9160	Schwarzbeck	Jun. 03, 2015	3071
HORN-Antenna	3115	EMCO	Dec. 04, 2015	9012-3602
BROADBAND HORN-Antenna	BBHA9170	Schwarzbeck	Sep. 06, 2015	BBHA9170318
PRE AMPLIFIER	8449B OPT H02	HP	Oct. 08, 2014	3008A0530

Note : 1. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to RRL, KRISS, KTL and HCT.

2. The calibration interval of horn ant. and loop ant. is 24 months

◆ Test Conditions

Temperature ( 19.7 ± 0.2 ) °C  
Humidity ( 45.6 ± 0.2 ) % R.H.  
Atmosphere ( 1005 ) mbar

◆ Test Area Full-Anechoic Room (3m)

◆ Test Date May 07, 2014

**Note :**

**Field Strength Calculation**

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. For the limit is employed average value, therefore the peak value can be transferred to average value by subtracting the duty factor. The basic equation with a sample calculation is as follows:

$$\text{Peak} = \text{Reading} + \text{Corrected Factor}$$

Where Corr. Factor = Antenna Factor + Cable Factor - Amplifier Gain (if any)



## **Radiated Emissions Test, 9 kHz to 30 MHz** **(Magnetic Field Test)**

1. The preliminary radiated measurements were performed to determine the frequency producing the maximum emissions at a distance of 3 meters according to Section 15.31(f) (2) .
2. The EUT was placed on the top of the 0.8-meter height, 1 x 1.5 meter non-metallic table.
3. Emissions from the EUT are maximized by adjusting the orientation of the Loop antenna and rotating the EUT on the turntable. Manipulating the system cables also maximizes EUT emissions if applicable.
4. To obtain the final measurement data, each frequency found during preliminary measurements was re-examined and investigated. The test-receiver system was set up to average, peak, and quasi-peak detector with specified bandwidth.
5. The result was 20dB lower than the limit line 15.31(o) was not reported.

### **Radiated Emissions Result**

Frequency MHz	Reading dBuV	P (H, V)	Ant. Factor dB	Cable Loss dB	Limit dBuV	Total dBuV	Margin dB

Note : The measured value have enough margin over 20dB than the limit, therefore they are not reported.



## Radiated Spurious Emissions Result

[Applicable]

### Spurious Emissions Test (Below 1GHz) :

☒ Pre-scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates, packet types and antenna ports (if EUT with antenna diversity architecture), and X, Y, Z Axis.

EUT	PPM21	PROBE	Below 1 GHz
POWER	3.7 Vdc	NOTE	WLAN mode

Frequency MHz	Reading dBuV	P (H,V)	Ant. Factor dB	Cable Loss dB	Limit dBuV	Total dBuV	Margin dB
30.972	18.60	H	10.51	0.93	40.00	30.04	-9.96
*63.957	22.20	V	10.27	1.33	40.00	33.80	-6.20
71.716	18.90	V	9.34	1.39	40.00	29.63	-10.37
73.651	19.10	V	9.09	1.41	40.00	29.60	-10.40
120.215	19.50	V	10.71	1.78	43.50	31.99	-11.51
299.663	17.40	H	12.92	2.92	46.00	33.24	-12.76
433.524	19.10	H	16.32	3.48	46.00	38.90	-7.10
554.768	14.50	V	18.92	4.01	46.00	37.43	-8.57

Note :

1. Remark "\*" means that the data is the worst emission level.
2. All reading levels are Quasi-peak value.
3. Measurement level = reading level + correct factor



#### Spurious Emissions Test (Above 1GHz) :

☒ Pre-scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates, packet types and antenna ports (if EUT with antenna diversity architecture), and X, Y, Z Axis.

#### ● 802.11b

EUT	PPM21	PROBE	Above 1 GHz
POWER	3.7 Vdc	CHANNEL	1 Channel (2412 MHz)
MODE	802.11b		

#### Test Data

Frequency GHz	Reading dBuV		P	Limit dBuV		Margin dB	
	Peak	AV		Peak	AV	Peak	AV
1.552	35.25	23.46	V	74.00	54.00	38.75	30.54
3.157	44.12	30.34	V	74.00	54.00	29.88	23.66
3.886	43.53	31.72	V	74.00	54.00	30.47	22.28
4.825	49.86	35.74	V	74.00	54.00	24.14	18.26
5.585	43.25	30.14	V	74.00	54.00	30.75	23.86
1.553	36.37	25.62	H	74.00	54.00	37.63	28.38
3.165	41.89	29.37	H	74.00	54.00	32.11	24.63
4.826	50.1	36.53	H	74.00	54.00	23.90	17.47
5.223	46.25	35.41	H	74.00	54.00	27.75	18.59
5.624	45.45	33.86	H	74.00	54.00	28.55	20.14

EUT	PPM21	PROBE	Above 1 GHz
POWER	3.7 Vdc	CHANNEL	6 Channel (2437 MHz)
MODE	802.11b		

#### Test Data

Frequency GHz	Reading dBuV		P	Limit dBuV		Margin dB	
	Peak	AV		Peak	AV	Peak	AV
1.561	37.21	25.72	V	74.00	54.00	36.79	28.28
3.155	44.58	32.46	V	74.00	54.00	29.42	21.54
5.571	46.43	33.61	V	74.00	54.00	27.57	20.39
1.872	36.86	24.56	H	74.00	54.00	37.14	29.44
2.182	37.65	25.64	H	74.00	54.00	36.35	28.36
4.823	45.46	34.31	H	74.00	54.00	28.54	19.69
7.563	50.51	38.53	H	74.00	54.00	23.49	15.47



EUT	PPM21	PROBE	Above 1 GHz
POWER	3.7 Vdc	NOTE	11 Channel (2462 MHz)
MODE	802.11b		

#### Test Data

Frequency GHz	Reading dBuV		P	Limit dBuV		Margin dB	
	Peak	AV		Peak	AV	Peak	AV
1.531	37.20	24.03	V	74.00	54.00	36.80	29.97
3.158	42.15	30.82	V	74.00	54.00	31.85	23.18
4.832	44.54	32.17	V	74.00	54.00	29.46	21.83
1.531	35.27	24.29	H	74.00	54.00	38.73	29.71
4.835	43.63	31.06	H	74.00	54.00	30.37	22.94
5.203	44.42	34.28	H	74.00	54.00	29.58	19.72

Note : -Reading(dBuV) : Measurement Level + Ant Factor + Cable Loss - Amp Gain

- The measured value from 6GHz to 25GHz have enough margin over 20dB than the limit, therefore they are not reported.

#### ● 802.11g

EUT	PPM21	PROBE	Above 1 GHz
POWER	3.7 Vdc	CHANNEL	1 Channel (2412 MHz)
MODE	802.11g		

#### Test Data

Frequency GHz	Reading dBuV		P	Limit dBuV		Margin dB	
	Peak	AV		Peak	AV	Peak	AV
1.517	38.51	24.63	V	74.00	54.00	35.49	29.37
3.215	40.08	30.16	V	74.00	54.00	33.92	23.84
4.825	45.47	33.84	V	74.00	54.00	28.53	20.16
5.625	46.28	34.25	V	74.00	54.00	27.72	19.75
1.516	37.72	24.48	H	74.00	54.00	36.28	29.52
2.132	36.25	24.39	H	74.00	54.00	37.75	29.61
3.897	41.97	30.52	H	74.00	54.00	32.03	23.48
5.213	44.66	33.92	H	74.00	54.00	29.34	20.08



EUT	PPM21	PROBE	Above 1 GHz
POWER	3.7 Vdc	CHANNEL	6 Channel (2437 MHz)
MODE	802.11g		

#### Test Data

Frequency GHz	Reading dBuV		P	Limit dBuV		Margin dB	
	Peak	AV		Peak	AV	Peak	AV
2.142	37.13	24.06	V	74.00	54.00	36.87	29.94
5.205	46.26	34.75	V	74.00	54.00	27.74	19.25
10.033	50.52	37.44	V	74.00	54.00	23.48	16.56
1.524	37.63	23.72	H	74.00	54.00	36.37	30.28
4.895	43.52	32.13	H	74.00	54.00	30.48	21.87
5.214	45.41	34.72	H	74.00	54.00	28.59	19.28

EUT	PPM21	PROBE	Above 1 GHz
POWER	3.7 Vdc	NOTE	11 Channel (2462 MHz)
MODE	802.11g		

#### Test Data

Frequency GHz	Reading dBuV		P	Limit dBuV		Margin dB	
	Peak	AV		Peak	AV	Peak	AV
1.535	37.41	25.02	V	74.00	54.00	36.59	28.98
3.175	42.47	31.52	V	74.00	54.00	31.53	22.48
3.891	42.89	32.09	V	74.00	54.00	31.11	21.91
5.824	46.32	34.51	V	74.00	54.00	27.68	19.49
1.533	37.22	23.65	H	74.00	54.00	36.78	30.35
3.203	41.65	30.48	H	74.00	54.00	32.35	23.52
4.255	42.26	32.18	H	74.00	54.00	31.74	21.82
8.452	51.01	39.85	H	74.00	54.00	22.99	14.15

Note : -Reading(dBuv) : Measurement Level + Ant Factor + Cable Loss - Amp Gain

- The measured value from 6GHz to 25GHz have enough margin over 20dB than the limit, therefore they are not reported.





● 802.11n

EUT	PPM21	PROBE	Above 1 GHz
POWER	3.7 Vdc	CHANNEL	1 Channel (2412 MHz)
MODE	802.11n		

Test Data

Frequency GHz	Reading dBuV		P	Limit dBuV		Margin dB	
	Peak	AV		Peak	AV	Peak	AV
1.552	36.54	23.75	V	74.00	54.00	37.46	30.25
2.146	36.82	24.39	V	74.00	54.00	37.18	29.61
4.825	46.84	34.76	V	74.00	54.00	27.16	19.24
5.254	45.71	33.63	V	74.00	54.00	28.29	20.37
1.557	37.03	24.32	H	74.00	54.00	36.97	29.68
2.148	37.56	25.08	H	74.00	54.00	36.44	28.92
3.237	43.19	31.36	H	74.00	54.00	30.81	22.64
5.625	45.32	33.53	H	74.00	54.00	28.68	20.47
7.848	49.67	37.58	H	74.00	54.00	24.33	16.42

EUT	PPM21	PROBE	Above 1 GHz
POWER	3.7 Vdc	CHANNEL	6 Channel (2437 MHz)
MODE	802.11n		

Test Data

Frequency GHz	Reading dBuV		P	Limit dBuV		Margin dB	
	Peak	AV		Peak	AV	Peak	AV
1.613	37.54	24.82	V	74.00	54.00	36.46	29.18
1.847	36.43	24.34	V	74.00	54.00	37.57	29.66
4.895	45.26	33.97	V	74.00	54.00	28.74	20.03
1.626	36.85	24.33	H	74.00	54.00	37.15	29.67
2.838	39.61	26.54	H	74.00	54.00	34.39	27.46
3.952	42.74	31.38	H	74.00	54.00	31.26	22.62
5.725	46.32	34.28	H	74.00	54.00	27.68	19.72



EUT	PPM21	PROBE	Above 1 GHz
POWER	3.7 Vdc	NOTE	11 Channel (2462 MHz)
MODE	802.11n		

#### Test Data

Frequency GHz	Reading dBuV		P	Limit dBuV		Margin dB	
	Peak	AV		Peak	AV	Peak	AV
1.623	37.34	26.25	V	74.00	54.00	36.66	27.75
2.835	39.28	26.55	V	74.00	54.00	34.72	27.45
3.205	40.88	31.03	V	74.00	54.00	33.12	22.97
5.236	44.52	33.74	V	74.00	54.00	29.48	20.26
1.618	36.27	24.06	H	74.00	54.00	37.73	29.94
2.154	36.75	25.15	H	74.00	54.00	37.25	28.85
4.845	48.24	36.03	H	74.00	54.00	25.76	17.97
5.531	45.36	34.76	H	74.00	54.00	28.64	19.24

Note : -Reading(dBuv) : Measurement Level + Ant Factor + Cable Loss - Amp Gain

- The measured value from 6GHz to 25GHz have enough margin over 20dB than the limit, therefore they are not reported.



### Radiated Restricted Band Edge Result

#### ● 802.11b

EUT	PPM21	PROBE	Above 1 GHz
POWER	3.7 Vdc	NOTE	1 Channel (2412 MHz)
MODE	802.11b		

#### Test Data

Frequency GHz	Reading dBuV		P	Limit dBuV		Margin dB	
	Peak	AV		Peak	AV	Peak	AV
2.384	38.13	26.53	V	74.00	54.00	35.87	27.47
2.389	39.52	27.17	H	74.00	54.00	34.48	26.83

EUT	PPM21	PROBE	Above 1 GHz
POWER	3.7 Vdc	NOTE	11 Channel (2462 MHz)
MODE	802.11b		

#### Test Data

Frequency GHz	Reading dBuV		P	Limit dBuV		Margin dB	
	Peak	AV		Peak	AV	Peak	AV
2.484	44.52	34.66	V	74.00	54.00	29.48	19.34
2.484	45.13	35.54	H	74.00	54.00	28.87	18.46

Note : Reading(dBuV) : Measurement Level + Ant Factor + Cable Loss - Amp Gain

#### ● 802.11g

EUT	PPM21	PROBE	Above 1 GHz
POWER	3.7 Vdc	NOTE	1 Channel (2412 MHz)
MODE	802.11g		

#### Test Data

Frequency GHz	Reading dBuV		P	Limit dBuV		Margin dB	
	Peak	AV		Peak	AV	Peak	AV
2.389	52.73	36.75	V	74.00	54.00	21.27	17.25
2.389	51.38	33.41	H	74.00	54.00	22.62	20.59



EUT	PPM21	PROBE	Above 1 GHz
POWER	3.7 Vdc	NOTE	11 Channel (2462 MHz)
MODE	802.11g		

#### Test Data

Frequency GHz	Reading dBuV		P	Limit dBuV		Margin dB	
	Peak	AV		Peak	AV	Peak	AV
2.485	63.46	49.42	V	74.00	54.00	10.54	4.58
2.484	64.23	48.91	H	74.00	54.00	9.77	5.09

Note : Reading(dBuv) : Measurement Level + Ant Factor + Cable Loss - Amp Gain

#### ● 802.11n

EUT	PPM21	PROBE	Above 1 GHz
POWER	3.7 Vdc	NOTE	1 Channel (2412 MHz)
MODE	802.11n		

#### Test Data

Frequency GHz	Reading dBuV		P	Limit dBuV		Margin dB	
	Peak	AV		Peak	AV	Peak	AV
2.388	54.62	37.43	V	74.00	54.00	19.38	16.57
2.387	56.51	38.37	H	74.00	54.00	17.49	15.63

EUT	PPM21	PROBE	Above 1 GHz
POWER	120 Vac 60 Hz	NOTE	11 Channel (2462 MHz)
MODE	802.11n		

#### Test Data

Frequency GHz	Reading dBuV		P	Limit dBuV		Margin dB	
	Peak	AV		Peak	AV	Peak	AV
2.484	66.35	49.52	V	74.00	54.00	7.65	4.48
2.485	65.42	50.21	H	74.00	54.00	8.58	3.79

Note : Reading(dBuv) : Measurement Level + Ant Factor + Cable Loss - Amp Gain



## Antenna requirements

### **According to FCC 47 CFR 15.203**

“an intentional radiator antenna shall be designed to ensure that no antenna other than that furnished by the responsible party can be used with the device. The use of a permanently attached or an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section”

\* the antenna of this EUT is a unique(PCB Antenna).

\* the EUT complies with the requirement of 15.203

