



CERTIFICATION TEST REPORT

FCC CFR47 PART 15 SUBPART C

Test Report File No.	14-IST-0357	☒ Basic	☐ Alternate
Date of Receipt	May 14, 2014	Begin of test date	June 03, 2014
Date of Issue	June 26, 2014	End of test date	June 13, 2014

Kind of Product	Portable Music Player
Basic Model(s)	PPE21
FCC ID	QDMPPE21

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 54 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.





TABLE OF CONTENTS

Table of contents	2
Information of test laboratory, Measurement Uncertainty	3
Product Information	4
Summary of the test results	5
- Conducted Emissions	6-10
- Peak Output Power	11-14
- 6dB BandWidth	15-18
- Power Spectral Density	19-22
- Conducted Spurious Emissions & Band Edge	23
- Conducted Spurious Emissions	24-28
- Conducted Band Edges	29-31
- Radiated Emissions	32-33
- Radiated Spurious Emissions & Band Edge	34
- Radiated Emissions, 9KHz to 30MHz(Magnetic Field Test)	35
- Radiated Spurious Emissions	36-41
- Radiated Restricted Band Edge	42-53
- Antenna Requirements	54

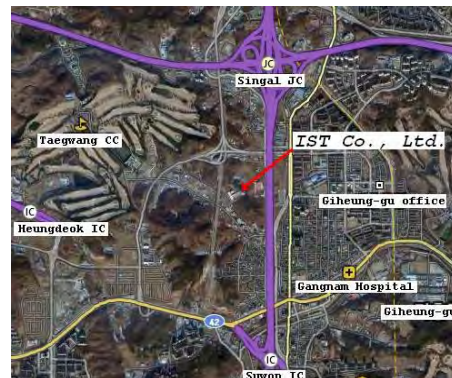


INFORMATION OF TEST LABORATORY

EMC LABORATORY of IST Co., Ltd.
52-20, Sinjeong-ro 41beon-gil, Giheung-gu
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 - Verical)	$U = 4.50$ [dB] (Confidence level approximately 95 %, $k = 2$)



PRODUCT INFORMATION

Portable Music Player(PPE21)

Body Color	Smoky Blue
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 2.0Vrms/ Balance 1.7Vrms(Condition No Load)
DAC	Cirrus Logic CS4398 X 1(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	2.16" (55mm)[W] X 4.37" (111mm)[H] X 0.58" (14.9mm)[D]
Weight	5.99 oz(170 g)
Feature Enhancements	Firmware upgrade supported(OTA)
Audio Specification	
Frequency Response	$\pm 0.023\text{dB}$ (Condition:20Hz~20kHz)Unbalance & Balance/ $\pm 0.6\text{dB}$ (Conditon:10Hz~70kHz)Unbalance & Balance
S/N	115dB @ 1kHz, Unbalance/ 115dB @ 1kHz, Balance
Crosstalk	127dB @ 1KHz, Unbalance/ 130dB @ 1kHz, Balance
THD+N	0.0009% @ 1kHz, Unbalance/ 0.0008% @ 1kHz, Balance
IMD SMPTE	0.0004% 800Hz 10kHz(4:1) Unbalance/ 0.0003% 800Hz 10kHz(4:1) Balance
Output impedance	Balanced out 2.5mm(1 ohm)/ PHONES 3.5mm(2 ohm)
Clock Jitter	50ps
Memory	Built-in Memory : 64 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.and up

**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 Output Power	Pass	Meet the requirements
15.247(d)	Conducted Band Edges	Pass	Meet the requirements
	Conducted Spurious Emission	Pass	Meet the requirements
	Radiated restricted bands Emission	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

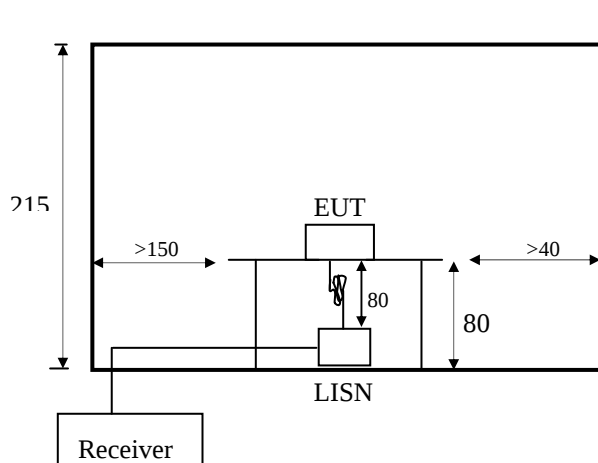


Conducted Emissions:

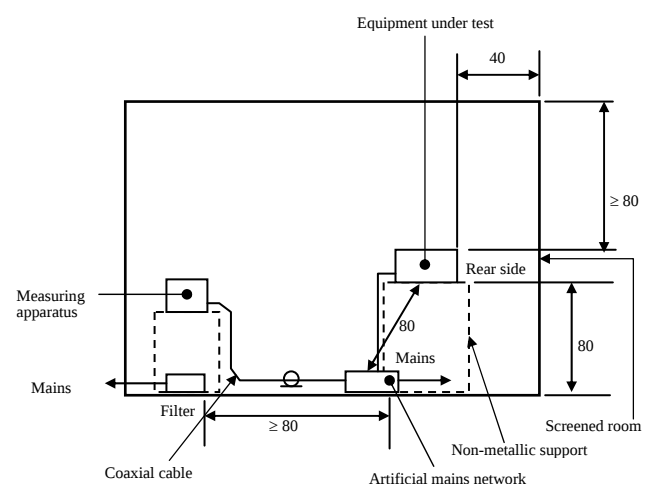
The measurement were performed over the frequency range of 0.15 MHz to 30 MHz using a 50 Ω /50 μ H LISN as the input transducer to a Spectrum Analyzer or a Field Intensity Meter. The measurements were made with the detector set for "quasi-peak" & "Average" within a bandwidth of 9 KHz.

- 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 μ 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.
PPE21	PPE21	IRIVER LIMITED.	N/A
Laptop	NT450R5E	Samsung Electronics	JKKG91HF400689R
Adapter(Laptop)	PA-1400-14	LITE-ON TECHNOLOGY CORPORATION	AD-4019S
AP	DIR-825	D-Link	F3T02C9000588
Micro SD	N/A	SanDisk	N/A
Bluetooth Speaker	XAM11	XMI	X0035744

Connecting Interface Cables :

AC Power Cable : 1.0 m (Unshielded)

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

◆ Test Conditions

Temperature (24.5 ± 0.2) °C
Humidity (52.7 ± 0.2) % R.H.
Atmosphere (1000) mbar

◆ Test Area Conducted Room #1

◆ Test Date June 13, 2014

Note :



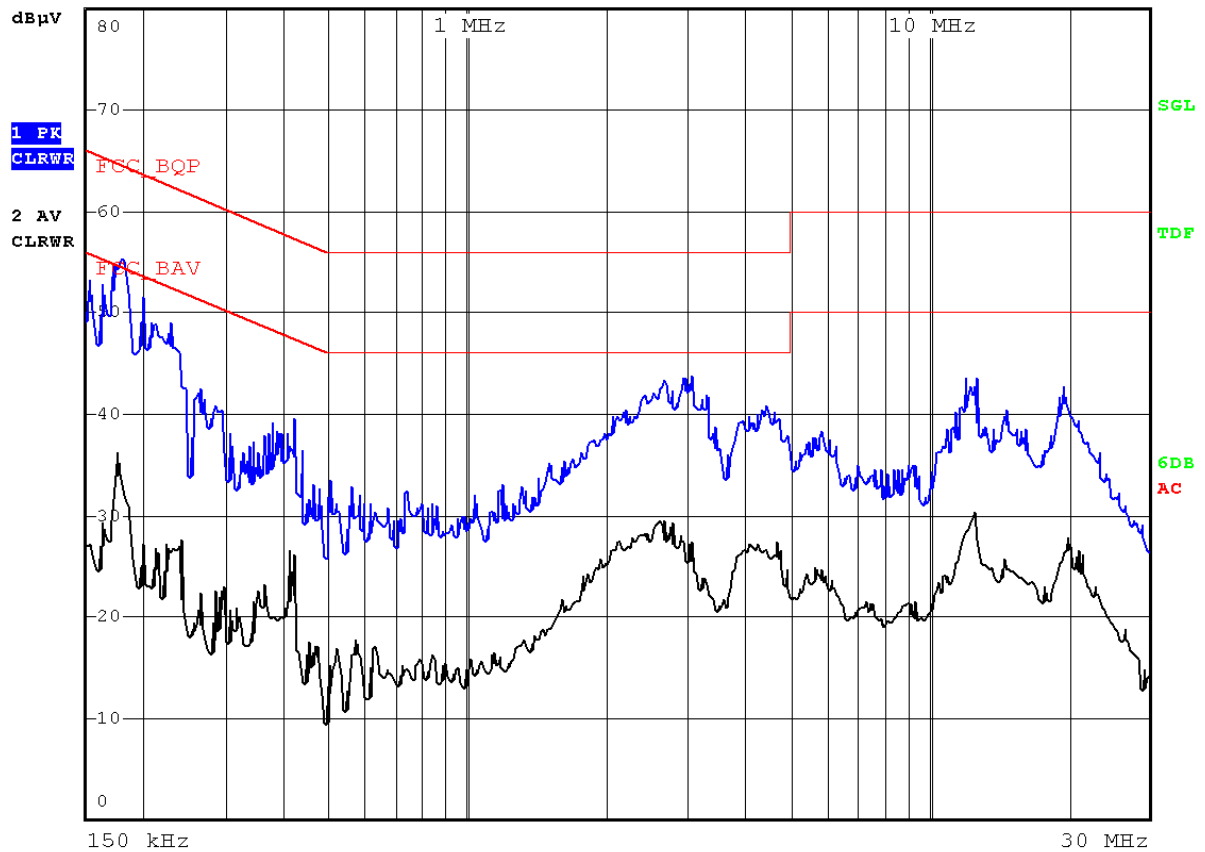
Conducted Emissions result

Live



RBW 9 kHz
MT 160 ms
PREAMP OFF

Att 10 dB



Model Name : PPE21 120 Vac 60 Hz Phase : Live

Freq. [MHz]	Measurement [dB μ V]		Limit [dB μ V]		Insertion Loss	Cable Loss	Result [dB μ V]		Margin [dB]	
	Q-peak	Average	Q-peak	Average			Q-peak	Average	Q-peak	Average
0.170	42.89	25.23	64.96	54.96	9.55	0.04	52.48	34.82	12.48	20.14
0.178	43.35	25.81	64.58	54.58	9.55	0.04	52.94	35.40	11.64	19.18
0.198	35.38	16.20	63.69	53.69	9.55	0.03	44.96	25.78	18.73	27.91
0.226	34.24	17.08	62.60	52.60	9.55	0.03	43.82	26.66	18.77	25.93
2.682	28.45	19.92	56.00	46.00	9.58	0.10	38.13	29.60	17.87	16.40
3.062	26.79	16.46	56.00	46.00	9.58	0.11	36.48	26.15	19.52	19.85



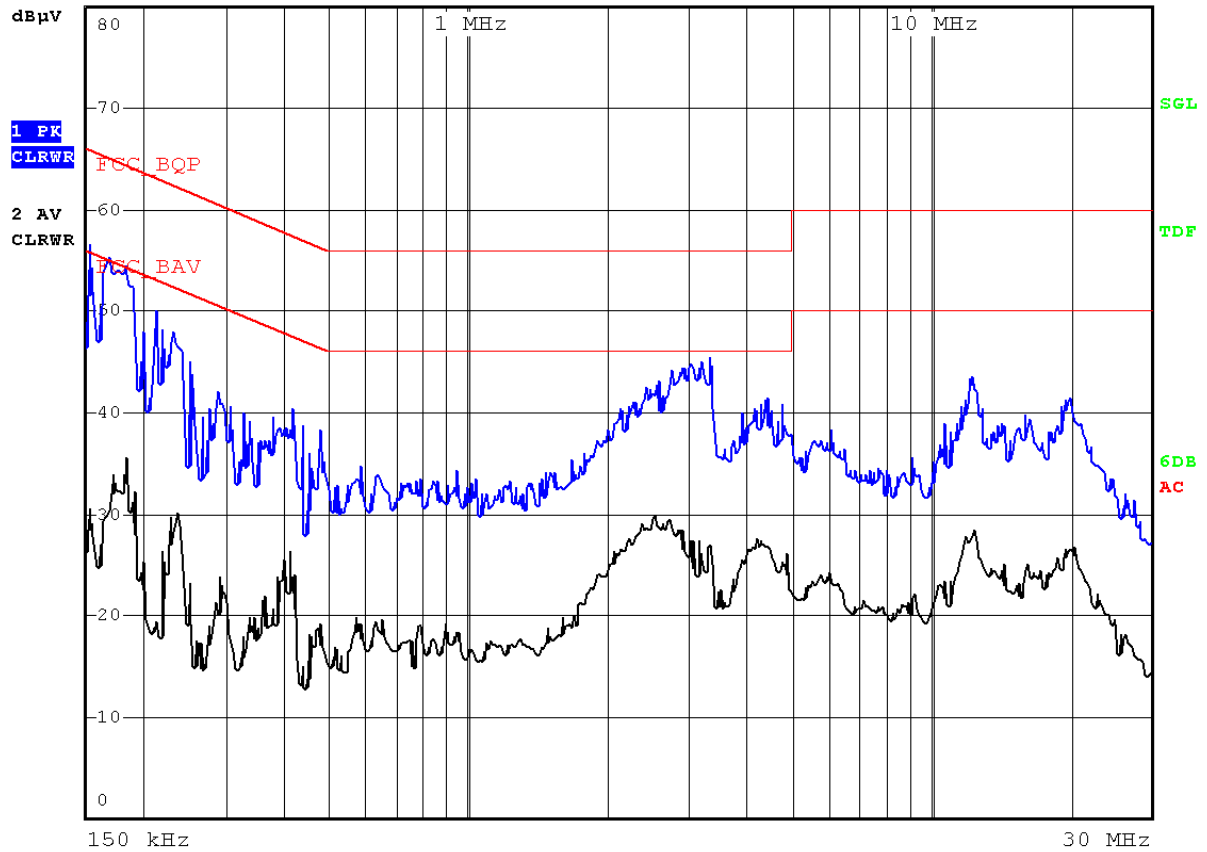
Conducted Emissions result

Neutral



RBW 9 kHz
MT 160 ms
PREAMP OFF

Att 10 dB



Model Name : PPE21 120 Vac 60 Hz Phase : Neutral

Freq. [MHz]	Measurement [dB μ V]		Limit [dB μ V]		Insertion Loss	Cable Loss	Result [dB μ V]		Margin [dB]	
	Q-peak	Average	Q-peak	Average			Q-peak	Average	Q-peak	Average
0.154	42.57	25.05	65.78	55.78	9.56	0.05	52.18	34.66	13.60	21.12
0.166	42.21	23.76	65.16	55.16	9.56	0.05	51.82	33.37	13.34	21.79
0.182	41.25	24.63	64.39	54.39	9.56	0.04	50.85	34.23	13.55	20.17
0.230	33.94	18.92	62.45	52.45	9.55	0.03	43.53	28.51	18.92	23.94
2.598	27.36	19.90	56.00	46.00	9.58	0.10	37.04	29.58	18.96	16.42
3.358	23.81	13.93	56.00	46.00	9.58	0.14	33.54	23.66	22.47	22.35



Peak Output Power

◆ 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			

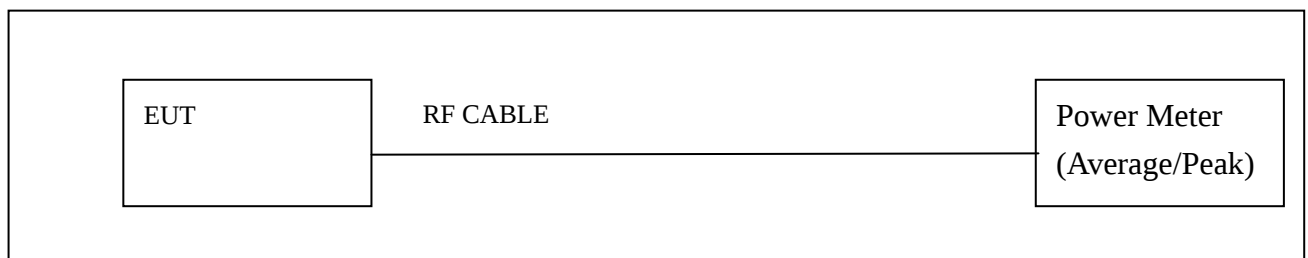
Note : All equipment upon which need to calibrated are with calibration period of 1 year.

◆ 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 Output Power Test result

Product	PPE21
Test Method	Measurement using an RF average/peak power meter
Test Mode	Transmit
Test Site	RF Room
Measurement Method	Conducted

802.11b Mode		Rate (Mbps)	Measure Power (dBm)	Limit (dBm)
Frequency (MHz)	Channel No.			
2412	1	1 Mbps	17.23	1Watt=30dBm
		2 Mbps	17.29	1Watt=30dBm
		5.5 Mbps	17.26	1Watt=30dBm
		11 Mbps	17.33	1Watt=30dBm
2437	6	1 Mbps	17.22	1Watt=30dBm
		2 Mbps	17.14	1Watt=30dBm
		5.5 Mbps	17.16	1Watt=30dBm
		11 Mbps	17.19	1Watt=30dBm
2462	11	1 Mbps	16.78	1Watt=30dBm
		2 Mbps	16.71	1Watt=30dBm
		5.5 Mbps	16.83	1Watt=30dBm
		11 Mbps	16.85	1Watt=30dBm

Note : Measurement Power = reading level + correct factor



802.G Mode		Rate (Mbps)	Measure Power (dBm)	Limit (dBm)
Frequency (MHz)	Channel No.			
2412	1	6 Mbps	22.74	1Watt=30dBm
		9 Mbps	22.78	1Watt=30dBm
		12 Mbps	22.13	1Watt=30dBm
		18 Mbps	22.21	1Watt=30dBm
		24 Mbps	22.32	1Watt=30dBm
		36 Mbps	22.30	1Watt=30dBm
		48 Mbps	22.21	1Watt=30dBm
		54 Mbps	22.22	1Watt=30dBm
2437	6	6 Mbps	22.51	1Watt=30dBm
		9 Mbps	22.52	1Watt=30dBm
		12 Mbps	22.14	1Watt=30dBm
		18 Mbps	22.13	1Watt=30dBm
		24 Mbps	22.23	1Watt=30dBm
		36 Mbps	22.26	1Watt=30dBm
		48 Mbps	22.30	1Watt=30dBm
		54 Mbps	22.23	1Watt=30dBm
2462	11	6 Mbps	22.20	1Watt=30dBm
		9 Mbps	22.19	1Watt=30dBm
		12 Mbps	21.63	1Watt=30dBm
		18 Mbps	21.70	1Watt=30dBm
		24 Mbps	21.71	1Watt=30dBm
		36 Mbps	21.89	1Watt=30dBm
		48 Mbps	21.75	1Watt=30dBm
		54 Mbps	21.77	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	22.57	1Watt=30dBm
		13 Mbps	22.17	1Watt=30dBm
		19.5 Mbps	22.20	1Watt=30dBm
		26 Mbps	22.26	1Watt=30dBm
		39 Mbps	22.21	1Watt=30dBm
		52 Mbps	22.54	1Watt=30dBm
		58.5 Mbps	22.38	1Watt=30dBm
		65 Mbps	22.41	1Watt=30dBm
2437	6	6.5 Mbps	22.23	1Watt=30dBm
		13 Mbps	22.08	1Watt=30dBm
		19.5 Mbps	22.31	1Watt=30dBm
		26 Mbps	22.30	1Watt=30dBm
		39 Mbps	22.20	1Watt=30dBm
		52 Mbps	22.43	1Watt=30dBm
		58.5 Mbps	22.33	1Watt=30dBm
		65 Mbps	22.16	1Watt=30dBm
2462	11	6.5 Mbps	21.97	1Watt=30dBm
		13 Mbps	21.72	1Watt=30dBm
		19.5 Mbps	21.82	1Watt=30dBm
		26 Mbps	21.93	1Watt=30dBm
		39 Mbps	21.75	1Watt=30dBm
		52 Mbps	22.01	1Watt=30dBm
		58.5 Mbps	21.84	1Watt=30dBm
		65 Mbps	21.71	1Watt=30dBm

Note : Measurement Power = reading level + correct factor



6dB BandWidth

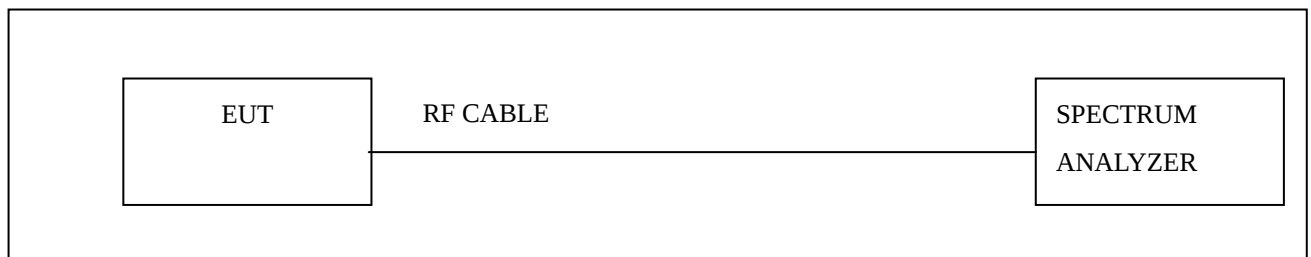
◆ Test Equipment

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.

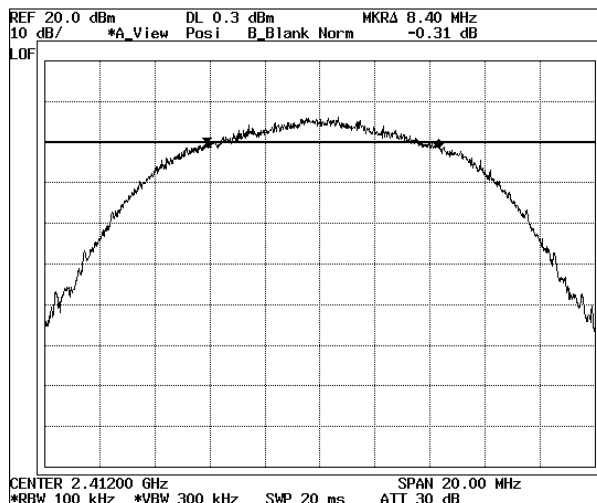


6dB BandWidth Test result

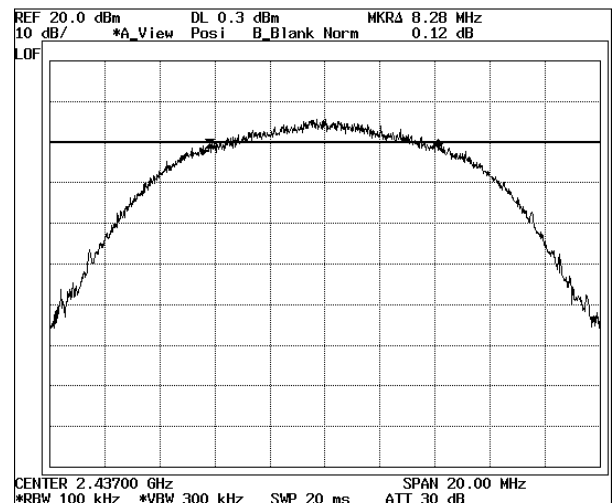
Product	PPE21
Test Item	6dB BandWidth
Test Mode	Transmit
Test Site	RF Room
Measurement Method	Conducted

802.11b				
Channel No.	Frequency (MHz)	Measure Level (MHz)	Limit (KHz)	Result
Low	2412	8.40	>500	Pass
Mid	2437	8.28	>500	Pass
High	2462	8.36	>500	Pass

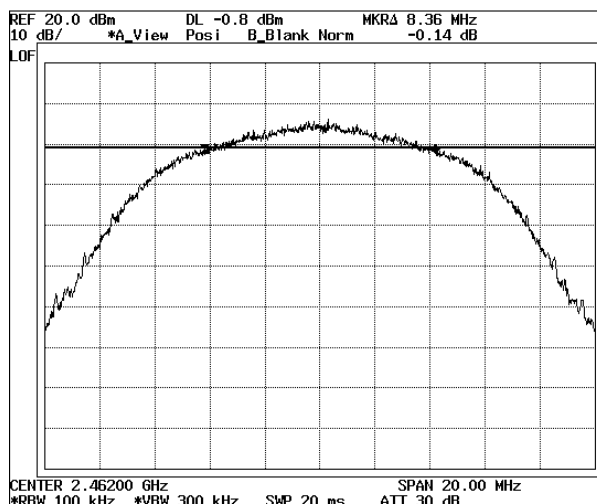
Low(2412 MHz)



Mid(2437 MHz)



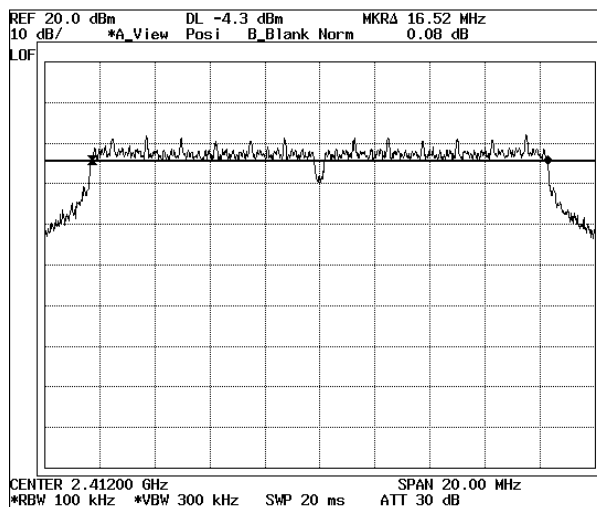
High(2462 MHz)



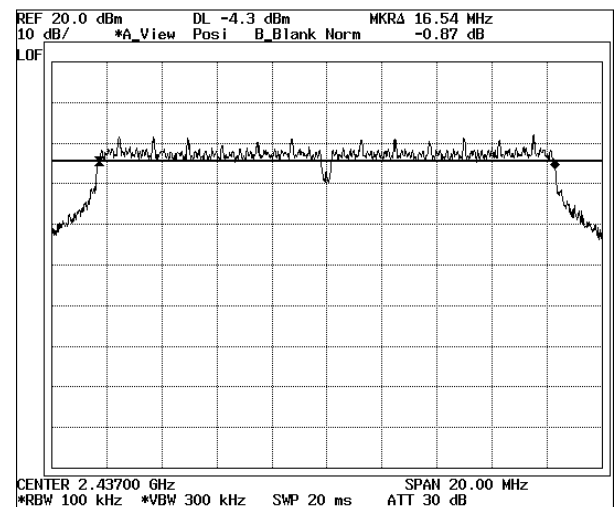


802.11g				
Channel No.	Frequency (MHz)	Measure Level (MHz)	Limit (KHz)	Result
Low	2412	16.52	>500	Pass
Mid	2437	16.54	>500	Pass
High	2462	16.52	>500	Pass

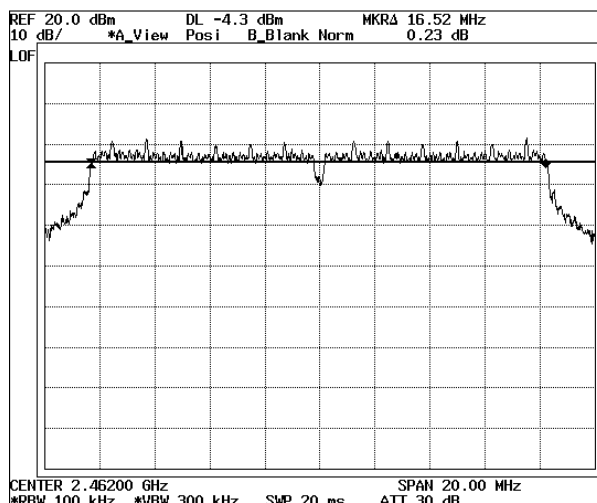
Low(2412 MHz)



Mid(2437 MHz)



High(2462 MHz)

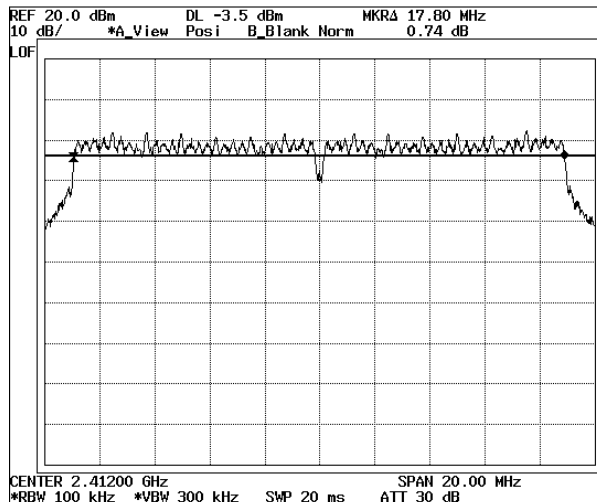


Note : Measurement level = reading level + correct factor

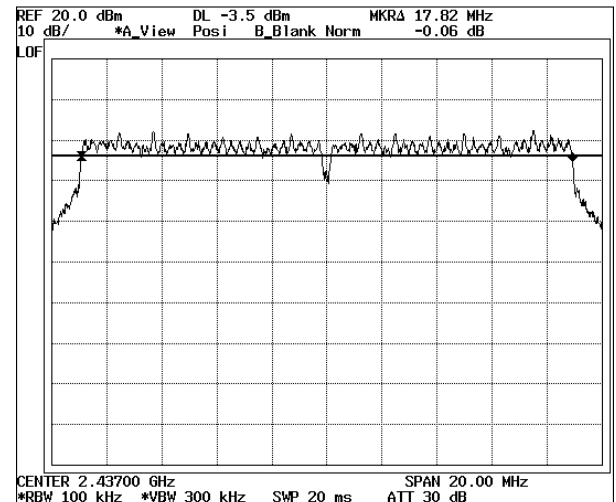


802.11n				
Channel No.	Frequency (MHz)	Measure Level (MHz)	Limit (KHz)	Result
Low	2412	17.80	>500	Pass
Mid	2437	17.82	>500	Pass
High	2462	17.80	>500	Pass

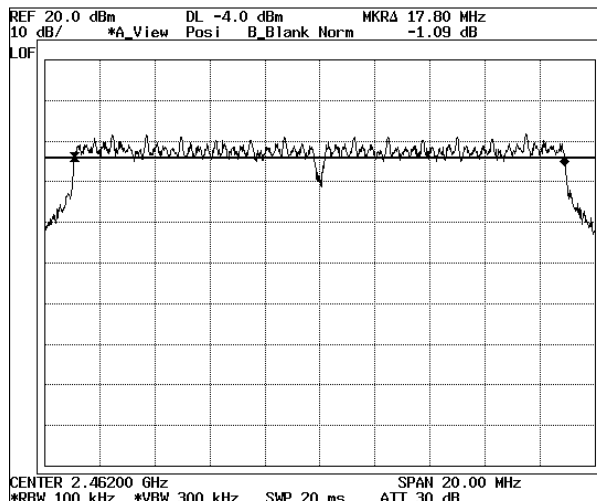
Low(2412 MHz)



Mid(2437 MHz)



High(2462 MHz)



Note : Measurement level = reading level + correct factor



Power Spectral Density

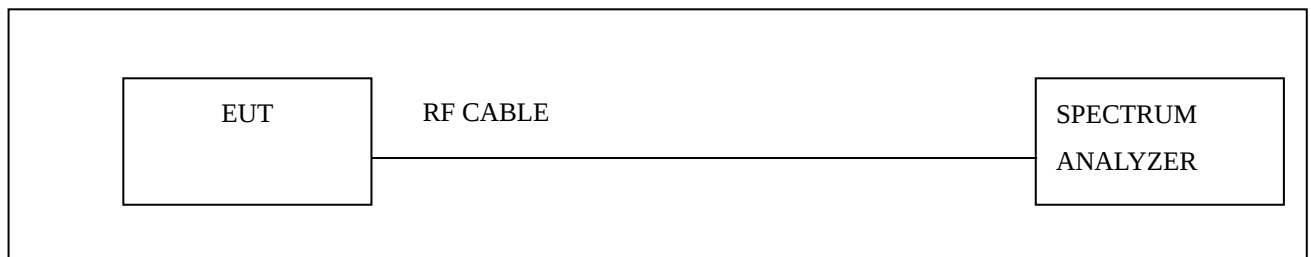
◆ Test Equipment

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 PDPSP (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 x RBW, 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.

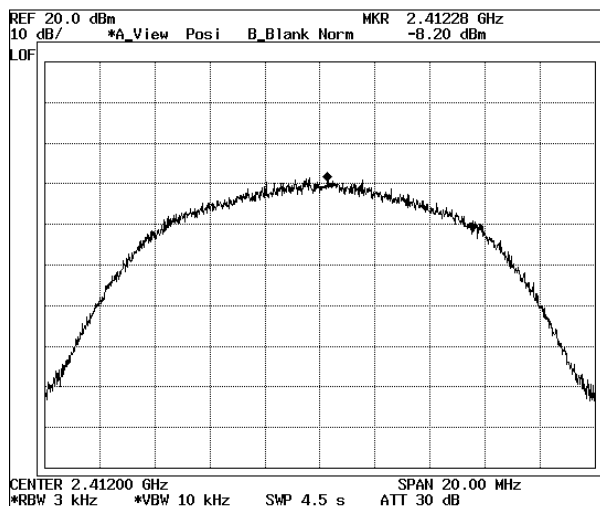


PSD Test result

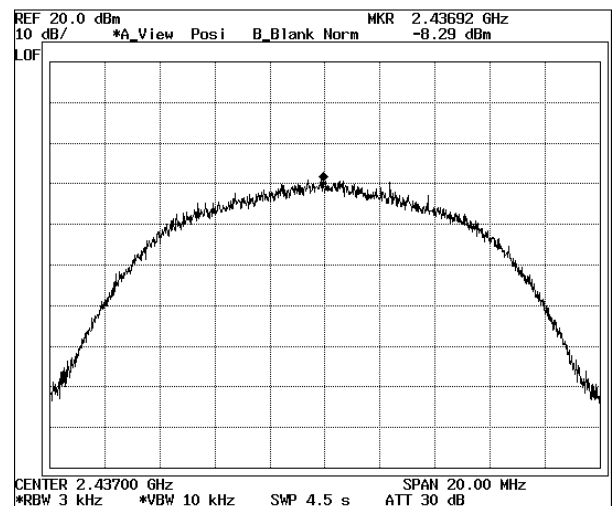
Product	PPE21
Test Item	Power Spectral Density
Test Mode	Transmit
Test Site	RF Room
Measurement Method	Conducted

802.11b				
Channel	Frequency (MHz)	PSD/3KHz (dBm)	Limit (dBm)	Result
Low	2412	-8.20	< 8	Pass
Mid	2437	-8.29	< 8	Pass
High	2462	-8.53	< 8	Pass

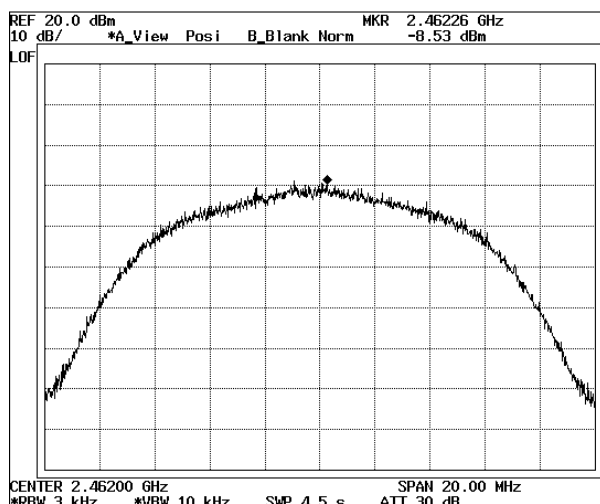
Low(2412 MHz)



Mid(2442 MHz)



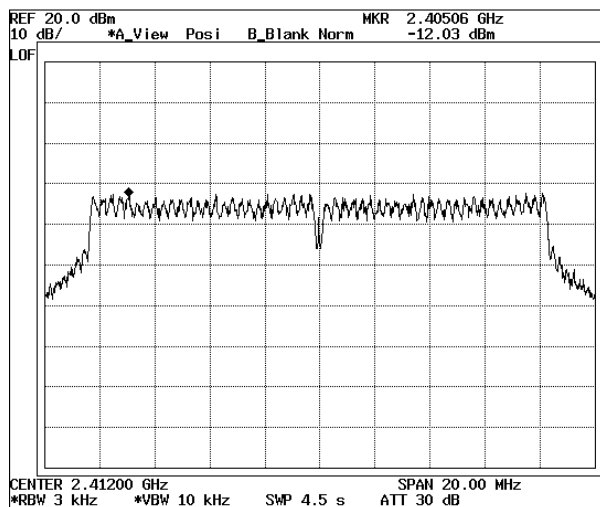
High(2462 MHz)



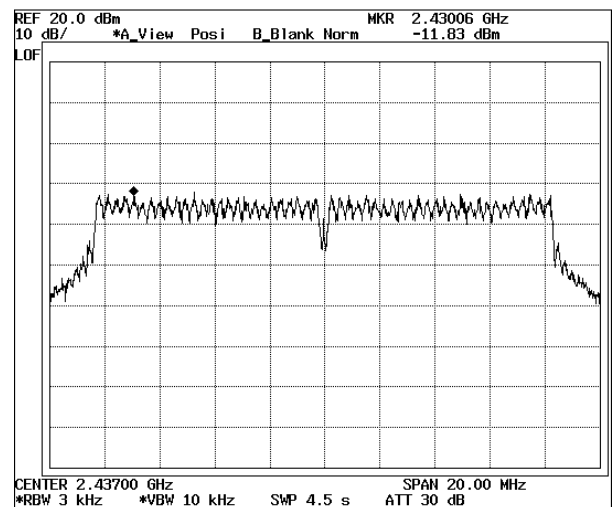


802.11g				
Channel	Frequency (MHz)	PSD/3KHz (dBm)	Limit (dBm)	Result
Low	2412	-12.03	< 8	Pass
Mid	2437	-11.83	< 8	Pass
High	2462	-11.98	< 8	Pass

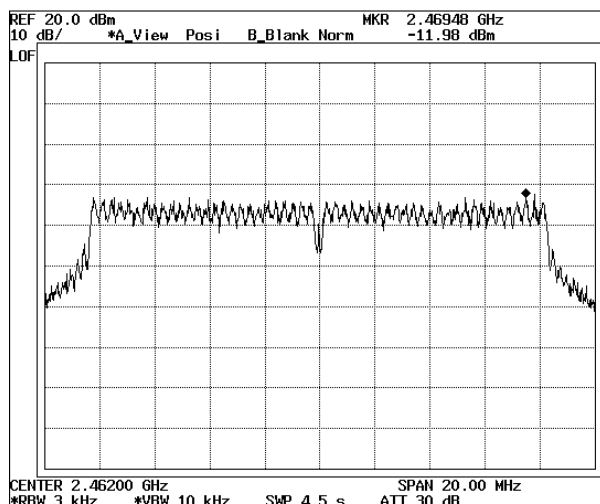
Low(2412 MHz)



Mid(2442 MHz)



High(2462 MHz)

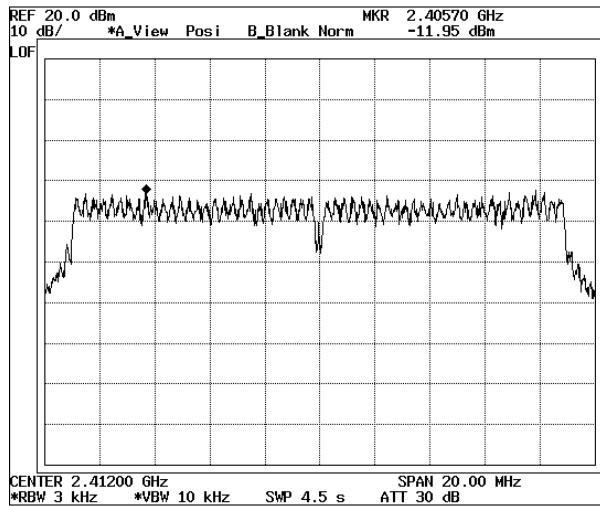


Note : Measurement level = reading level + correct factor

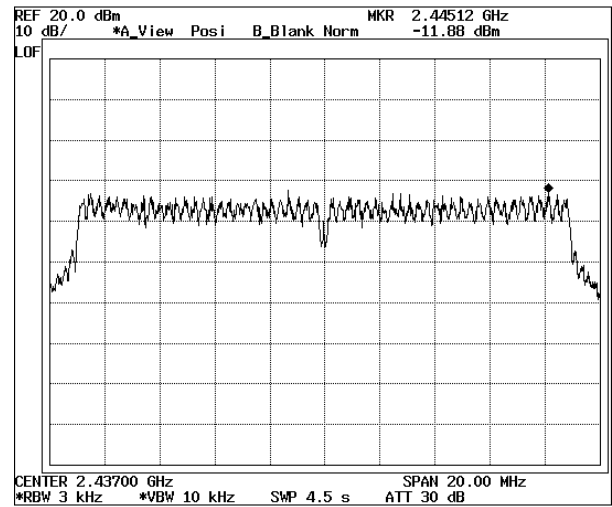


802.11n				
Channel	Frequency (MHz)	PSD/3KHz (dBm)	Limit (dBm)	Result
Low	2412	-11.95	< 8	Pass
Mid	2437	-11.88	< 8	Pass
High	2462	-12.77	< 8	Pass

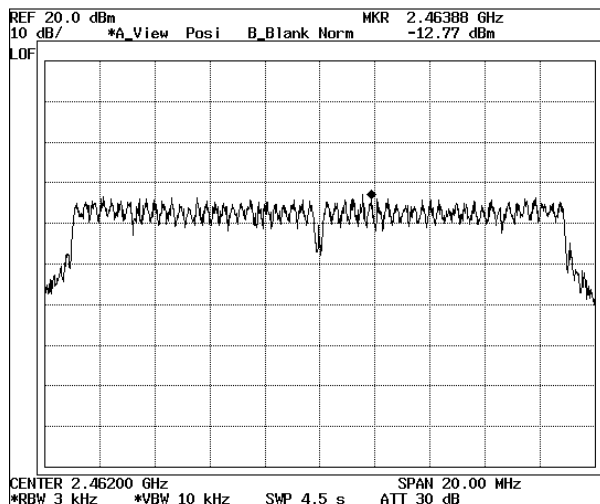
Low(2412 MHz)



Mid(2437 MHz)



High(2462 MHz)



Note : Measurement level = 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			

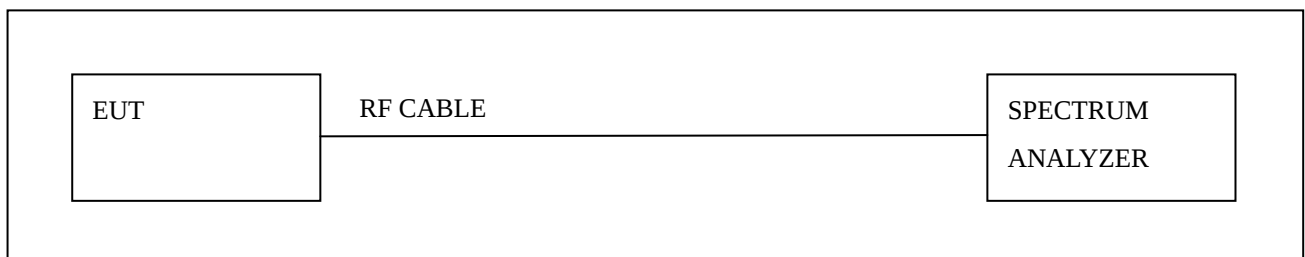
*Note : 1. The calibration interval of the above test instruments is 12 months
and the calibrations are traceable to RRL, KRISS, KTL and HCT.*

◆ 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.
 - 11.2 Reference level measurement.
 - 11.3 Emission level measurement.

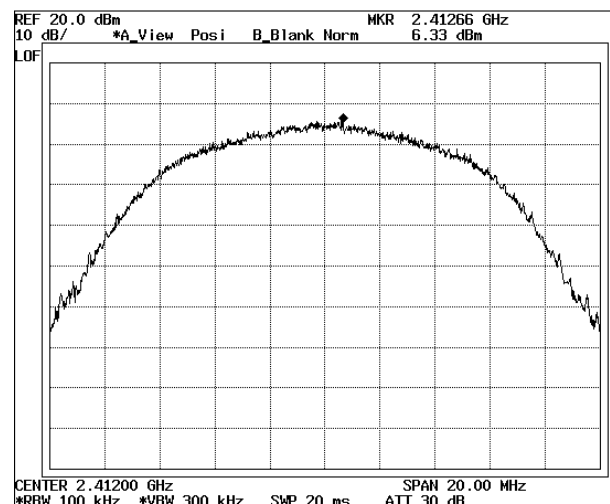
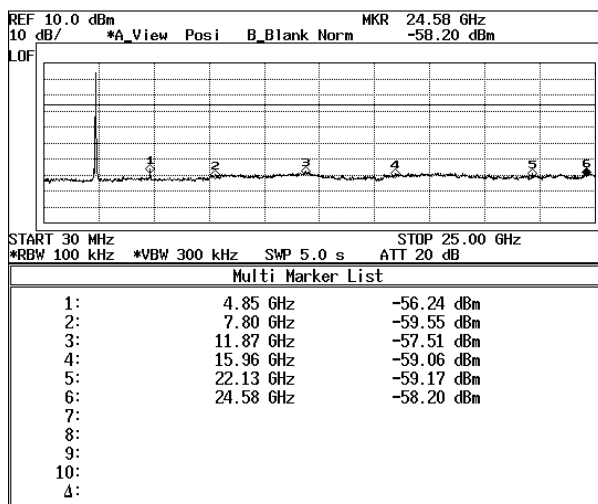


Spurious Emission Test result

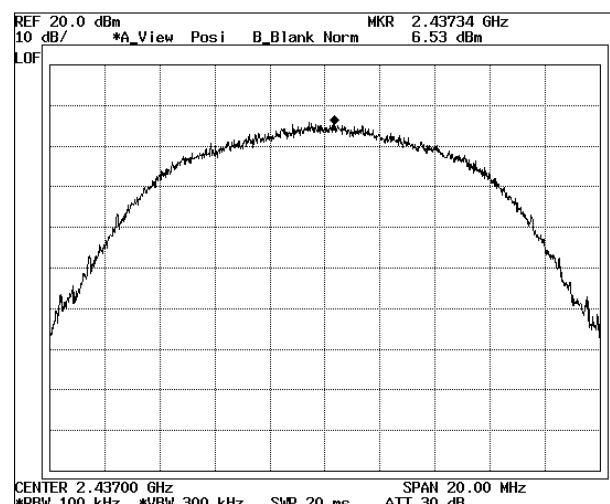
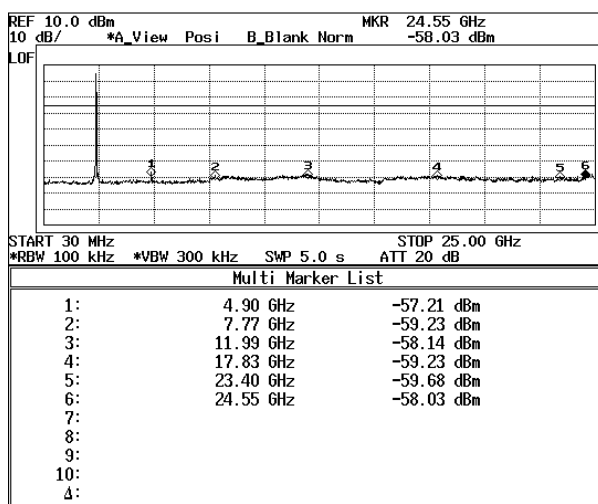
Product	PPE21
Test Item	Spurious (30 MHz ~ 25 GHz)
Test Mode	Transmit Low/Mid/High
Test Site	RF Room
Measurement Method	Conducted

● 802.11b

Low(2412 MHz)

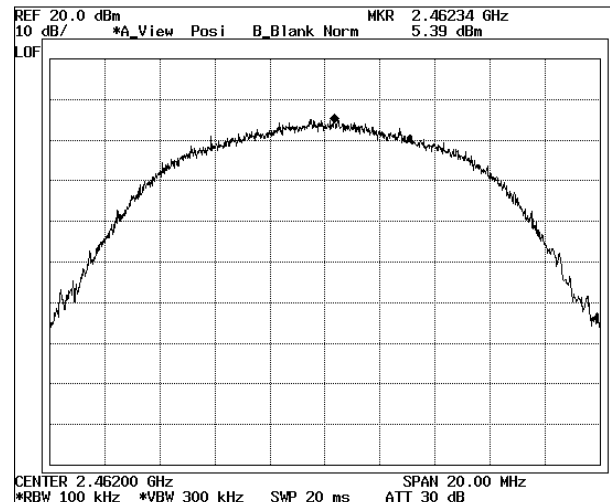
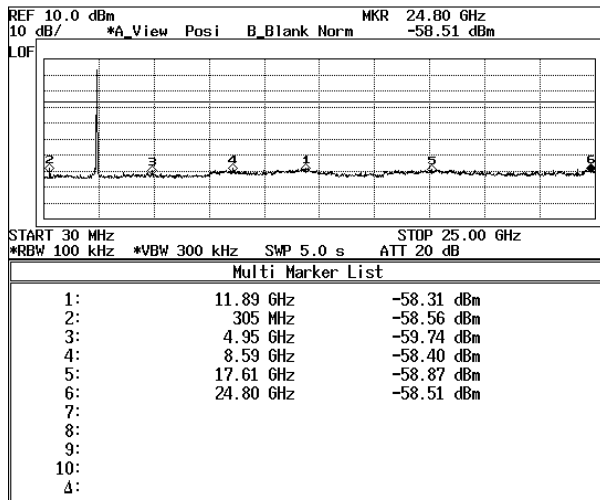


Mid(2437 MHz)





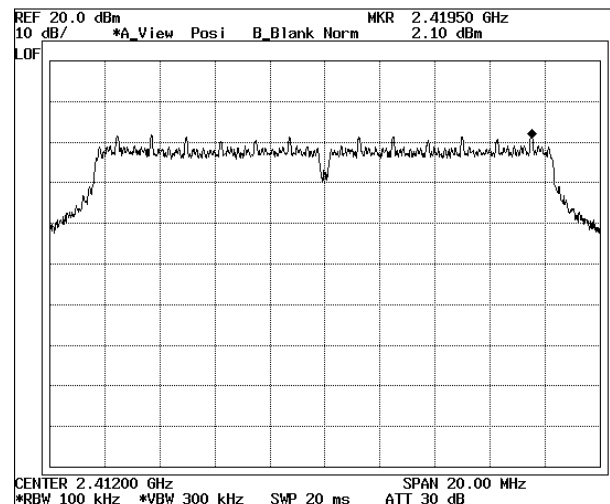
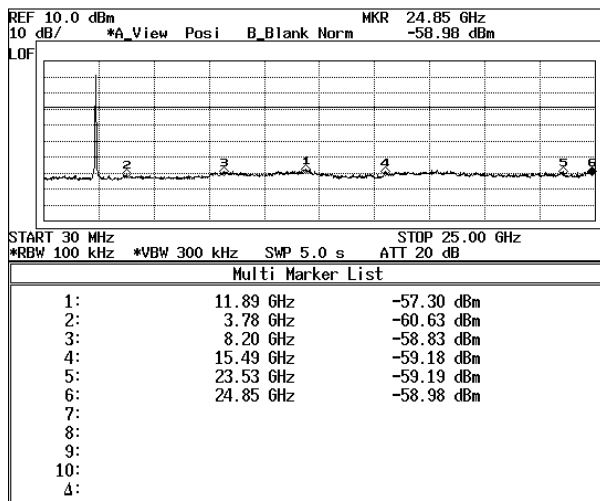
High(2462 MHz)



Note : Measurement level = reading level + correct factor

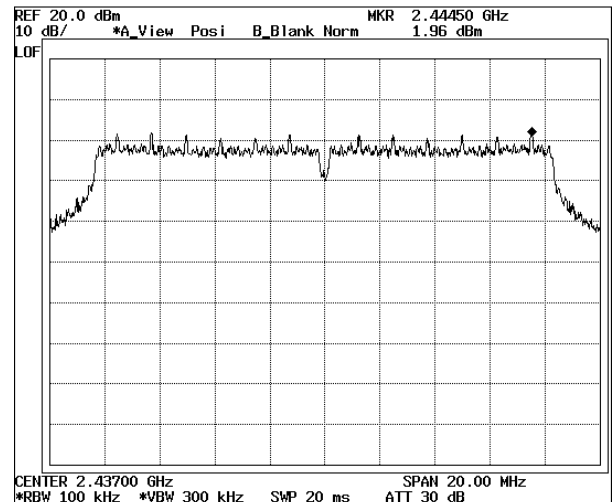
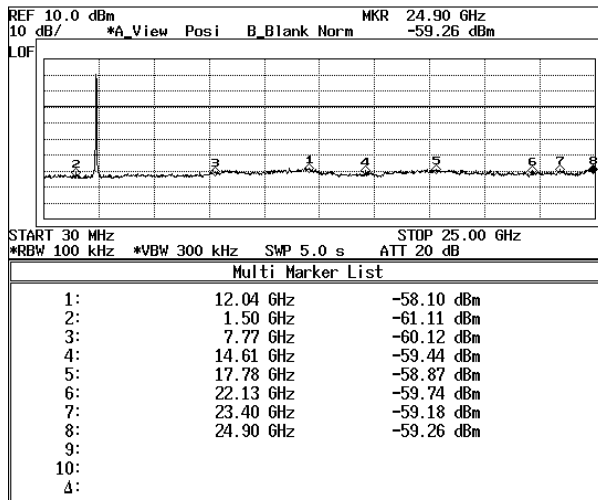
● 802.11g

Low(2412 MHz)

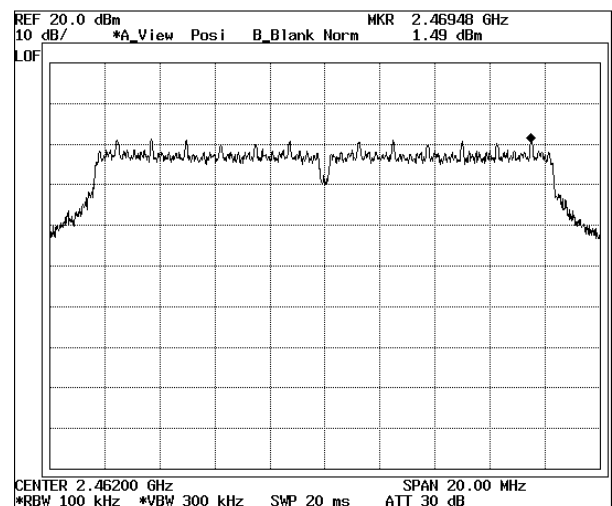
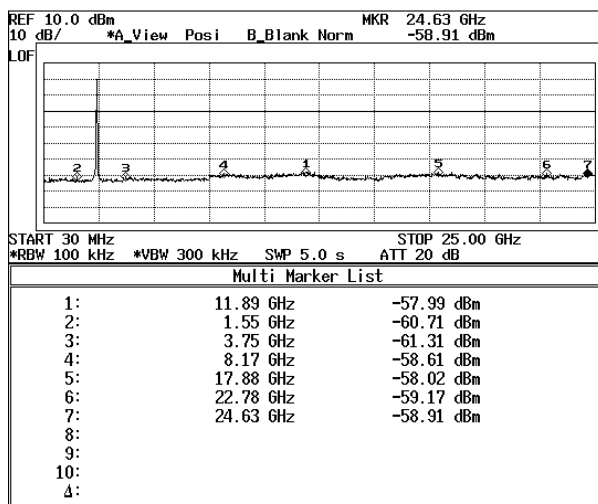




Mid(2437 MHz)



High(2462 MHz)

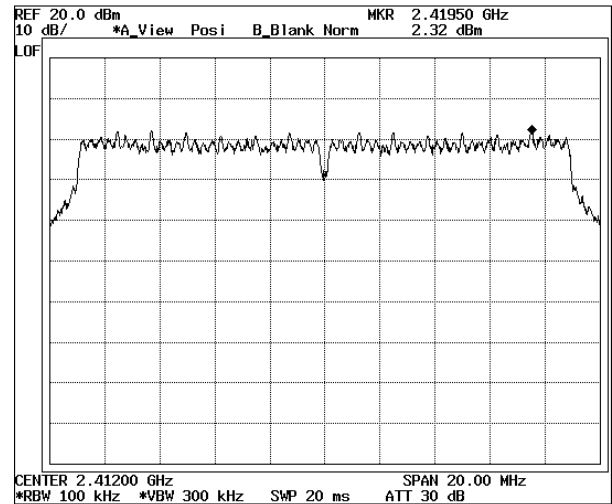
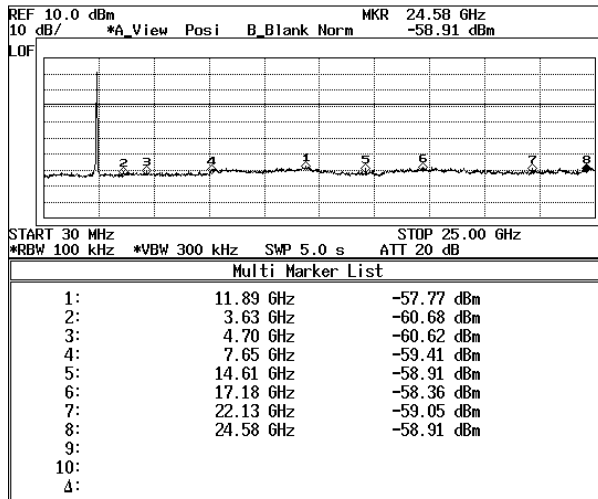


Note : Measurement level = reading level + correct factor

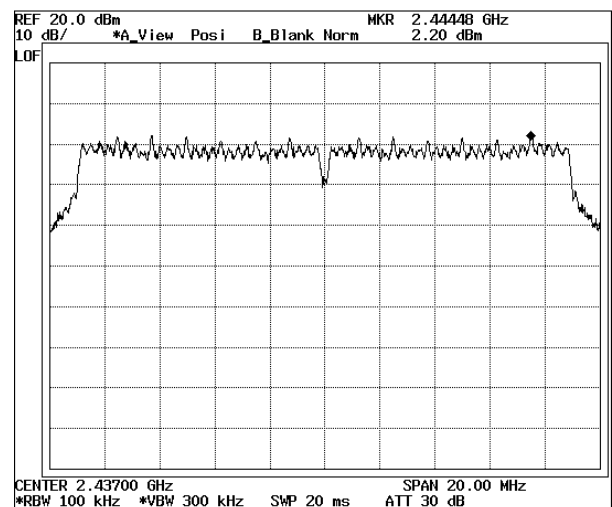
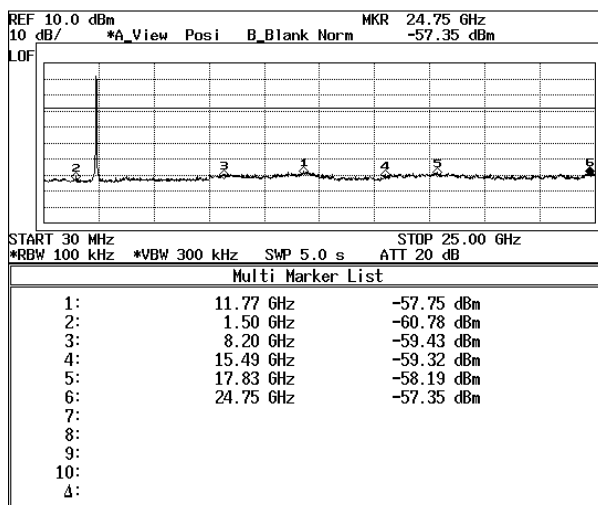


● 802.11n

Low(2412 MHz)

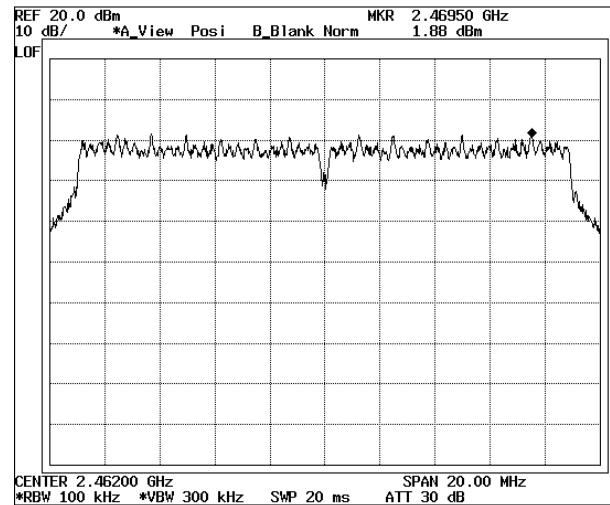
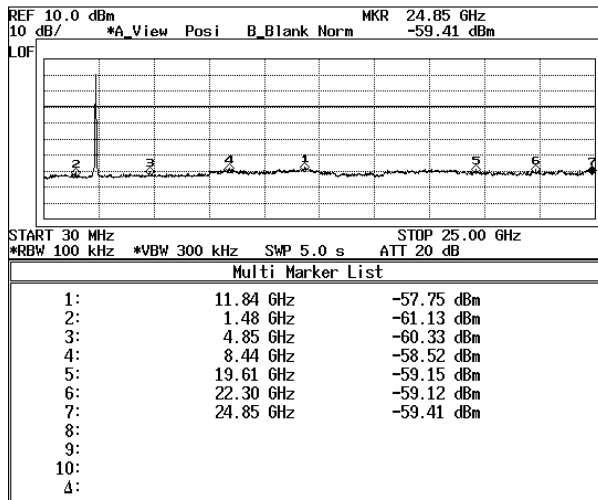


Mid(2437 MHz)





High(2462 MHz)



Note : Measurement level = reading level + correct factor

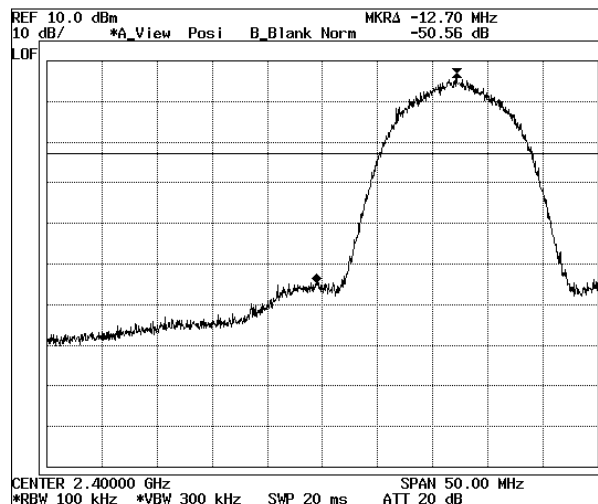


Band Edge Test result

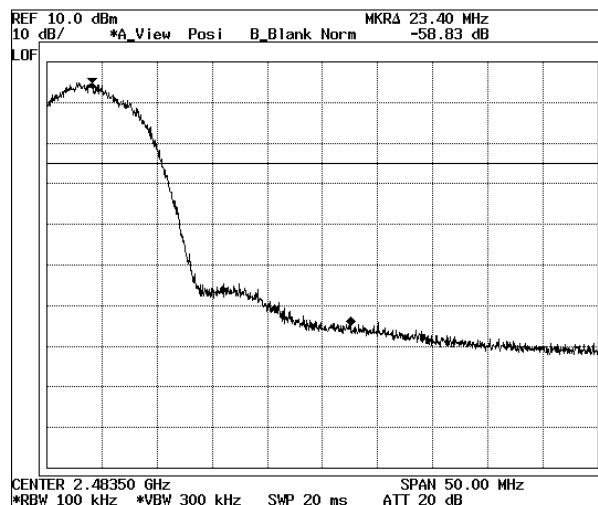
Product	PPE21
Test Item	Band Edge
Test Mode	Transmit Low/High
Test Site	RF Room
Measurement Method	Conducted

● 802.11b

Low (2412 MHz)



High (2462 MHz)

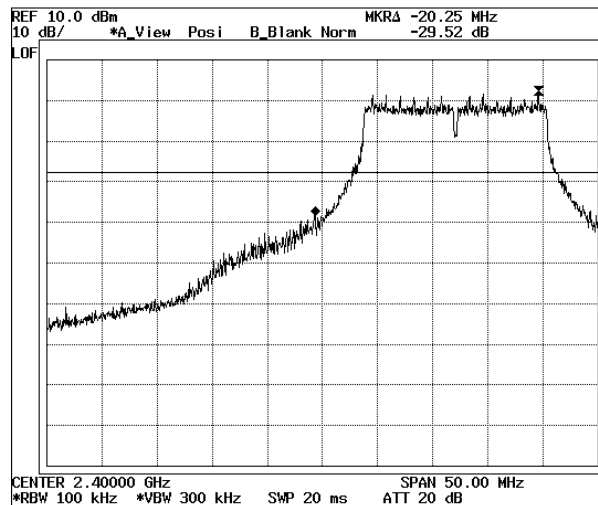


Note : Measurement level = reading level + correct factor

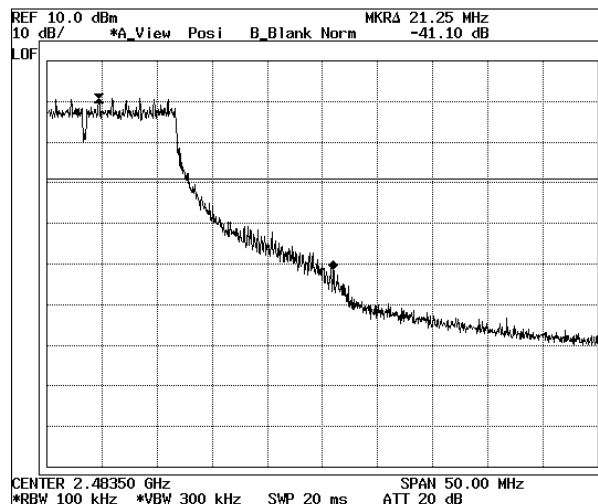


● 802.11g

Low (2412 MHz)



High (2462 MHz)

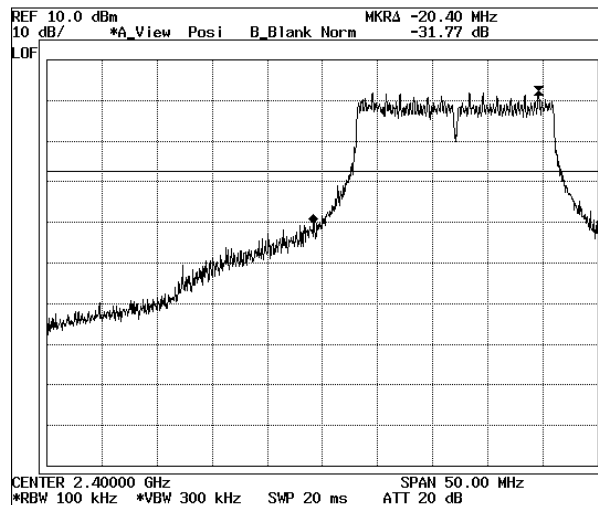


Note : Measurement level = reading level + correct factor

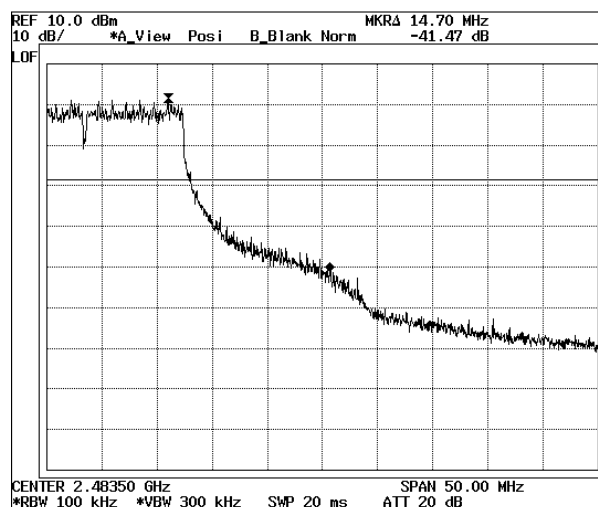


● 802.11n

Low (2412 MHz)



High (2462 MHz)



Note : Measurement level = reading level + correct factor



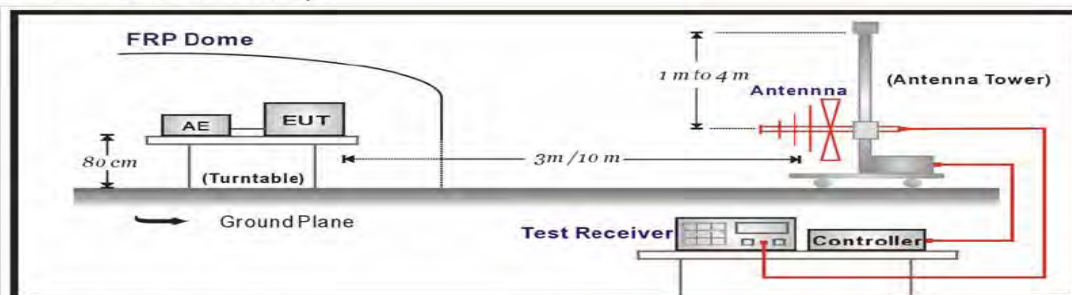
Radiated Emissions:

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.

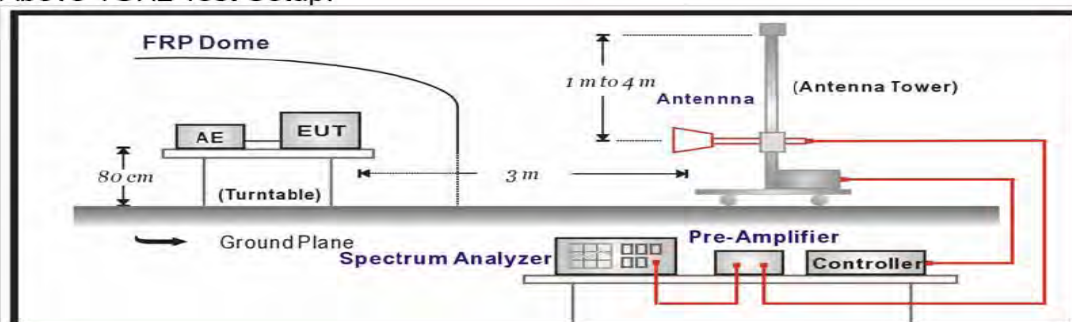
Procedure of Test

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:

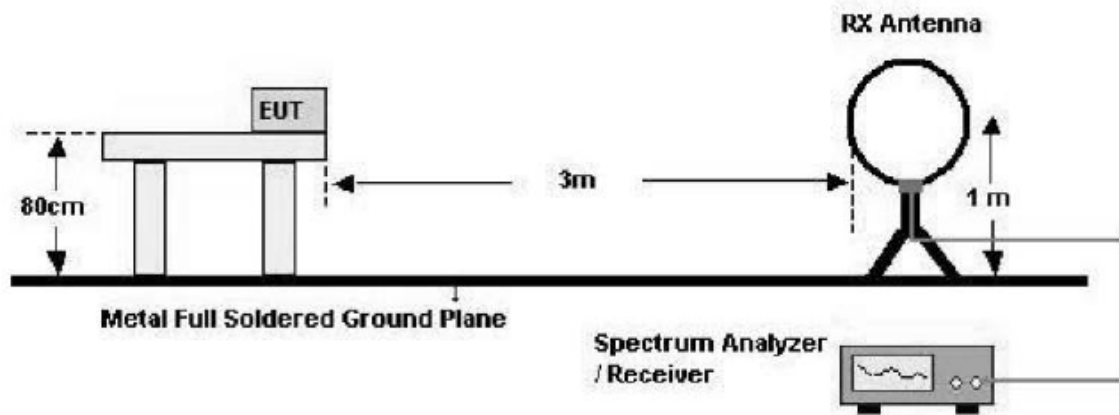


Above 1GHz Test Setup:





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)	$\mu\text{V}/\text{meter}$	$\text{dB}\mu\text{V}/\text{meter}(3\text{m})$
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. $\text{RF Voltage}(\text{dBuV})=20\log \text{RF Voltage}(\mu\text{V})$
2. $\text{dBuV}/\text{m} = \text{ERP}(\text{dBm})+106.92 \text{ dB} + 20\log(10\text{m}/3\text{m}) + 2.15\text{dB}(\text{conversion Factor for E.I.R.P})$
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
Log-bicon Antenna	VULB9160	Schwarz beck	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 (24.6 ± 0.2) °C
Humidity (54.7 ± 0.2) % R.H.
Atmosphere (1000) mbar

◆ Test Area Full-Anechoic Room (3m)

◆ Test Date June 11, 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	PPE21	PROBE	Below 1 GHz
POWER	DC 3.7 V	NOTE	WLAN mode

Frequency MHz	Reading dBuV	P (H,V)	Ant. Factor dB	Cable Loss dB	Limit dBuV	Total dBuV	Margin dB
55.221	19.20	V	11.30	1.26	40.00	31.76	-8.24
344.285	19.30	H	14.04	3.11	46.00	36.45	-9.55
455.837	16.70	H	16.91	3.56	46.00	37.17	-8.83
483.082	17.20	V	17.55	3.66	46.00	38.41	-7.59
578.106	16.80	H	19.25	4.12	46.00	40.17	-5.83
*618.115	17.10	H	19.70	4.27	46.00	41.07	-4.93

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	PPE21	PROBE	Above 1 GHz
POWER	DC 3.7 V	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
1.042	34.98	21.73	V	74.00	54.00	39.02	32.27
1.763	37.85	24.34	V	74.00	54.00	36.15	29.66
4.835	48.66	35.79	V	74.00	54.00	25.34	18.21
5.242	45.95	34.53	V	74.00	54.00	28.05	19.47
5.763	45.94	34.96	V	74.00	54.00	28.06	19.04
1.013	34.84	22.68	H	74.00	54.00	39.16	31.32
4.832	48.01	35.20	H	74.00	54.00	25.99	18.80
5.285	45.18	34.43	H	74.00	54.00	28.82	19.57
7.524	49.23	37.25	H	74.00	54.00	24.77	16.75

EUT	PPE21	PROBE	Above 1 GHz
POWER	DC 3.7 V	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
1.053	34.44	22.16	V	74.00	54.00	39.56	31.84
3.032	42.79	31.01	V	74.00	54.00	31.21	22.99
4.892	48.24	34.66	V	74.00	54.00	25.76	19.34
5.296	45.23	34.62	V	74.00	54.00	28.77	19.38
1.941	39.55	28.37	H	74.00	54.00	34.45	25.63
3.882	43.09	32.32	H	74.00	54.00	30.91	21.68
4.891	47.88	35.12	H	74.00	54.00	26.12	18.88



EUT	PPE21	PROBE	Above 1 GHz
POWER	DC 3.7 V	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
1.975	39.25	26.45	V	74.00	54.00	34.75	27.55
4.952	45.90	34.56	V	74.00	54.00	28.10	19.44
6.253	47.58	35.47	V	74.00	54.00	26.42	18.53
2.175	39.29	26.14	H	74.00	54.00	34.71	27.86
4.952	44.73	35.61	H	74.00	54.00	29.27	18.39
5.176	46.07	33.99	H	74.00	54.00	27.93	20.01

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	PPE21	PROBE	Above 1 GHz
POWER	DC 3.7 V	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
1.037	34.70	22.69	V	74.00	54.00	39.30	31.31
2.532	39.66	27.30	V	74.00	54.00	34.34	26.70
4.835	43.96	34.10	V	74.00	54.00	30.04	19.90
5.951	46.46	34.88	V	74.00	54.00	27.54	19.12
1.831	37.54	24.90	H	74.00	54.00	36.46	29.10
3.342	43.36	32.21	H	74.00	54.00	30.64	21.79
5.054	45.36	33.39	H	74.00	54.00	28.64	20.61
10.025	49.52	37.85	H	74.00	54.00	24.48	16.15



EUT	PPE21	PROBE	Above 1 GHz
POWER	DC 3.7 V	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
1.012	35.61	22.62	V	74.00	54.00	38.39	31.38
2.045	39.39	26.41	V	74.00	54.00	34.61	27.59
3.331	43.65	31.37	V	74.00	54.00	30.35	22.63
4.891	43.80	34.28	V	74.00	54.00	30.20	19.72
1.856	37.60	25.22	H	74.00	54.00	36.40	28.78
3.964	43.93	32.37	H	74.00	54.00	30.07	21.63
5.743	46.30	35.13	H	74.00	54.00	27.70	18.87

EUT	PPE21	PROBE	Above 1 GHz
POWER	DC 3.7 V	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
1.082	33.93	22.53	V	74.00	54.00	40.07	31.47
2.015	38.90	26.30	V	74.00	54.00	35.10	27.70
3.354	43.16	31.51	V	74.00	54.00	30.84	22.49
4.953	43.73	34.11	V	74.00	54.00	30.27	19.89
1.801	37.85	25.08	H	74.00	54.00	36.15	28.92
4.042	43.32	32.28	H	74.00	54.00	30.68	21.72
5.551	45.98	34.52	H	74.00	54.00	28.02	19.48
8.962	48.56	37.17	H	74.00	54.00	25.44	16.83

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	PPE21	PROBE	Above 1 GHz
POWER	DC 3.7 V	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
1.042	34.29	21.72	V	74.00	54.00	39.71	32.28
1.886	37.33	24.82	V	74.00	54.00	36.67	29.18
3.143	42.72	31.21	V	74.00	54.00	31.28	22.79
4.825	44.67	33.76	V	74.00	54.00	29.33	20.24
1.253	34.41	21.74	H	74.00	54.00	39.59	32.26
2.513	39.75	27.86	H	74.00	54.00	34.25	26.14
4.824	45.14	33.55	H	74.00	54.00	28.86	20.45
5.201	45.98	34.69	H	74.00	54.00	28.02	19.31

EUT	PPE21	PROBE	Above 1 GHz
POWER	DC 3.7 V	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
1.035	34.54	22.50	V	74.00	54.00	39.46	31.50
4.892	44.15	34.47	V	74.00	54.00	29.85	19.53
5.163	46.16	34.31	V	74.00	54.00	27.84	19.69
1.682	36.65	23.45	H	74.00	54.00	37.35	30.55
2.015	38.73	26.40	H	74.00	54.00	35.27	27.60
4.892	45.08	33.94	H	74.00	54.00	28.92	20.06
7.765	47.39	36.81	H	74.00	54.00	26.61	17.19



EUT	PPE21	PROBE	Above 1 GHz
POWER	DC 3.7 V	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
1.014	35.02	22.59	V	74.00	54.00	38.98	31.41
3.211	43.31	31.56	V	74.00	54.00	30.69	22.44
5.132	45.26	34.18	V	74.00	54.00	28.74	19.82
8.257	47.82	37.05	V	74.00	54.00	26.18	16.95
1.455	35.70	22.59	H	74.00	54.00	38.30	31.41
1.992	38.74	26.72	H	74.00	54.00	35.26	27.28
4.951	45.05	33.97	H	74.00	54.00	28.95	20.03
5.836	46.58	34.50	H	74.00	54.00	27.42	19.50

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.



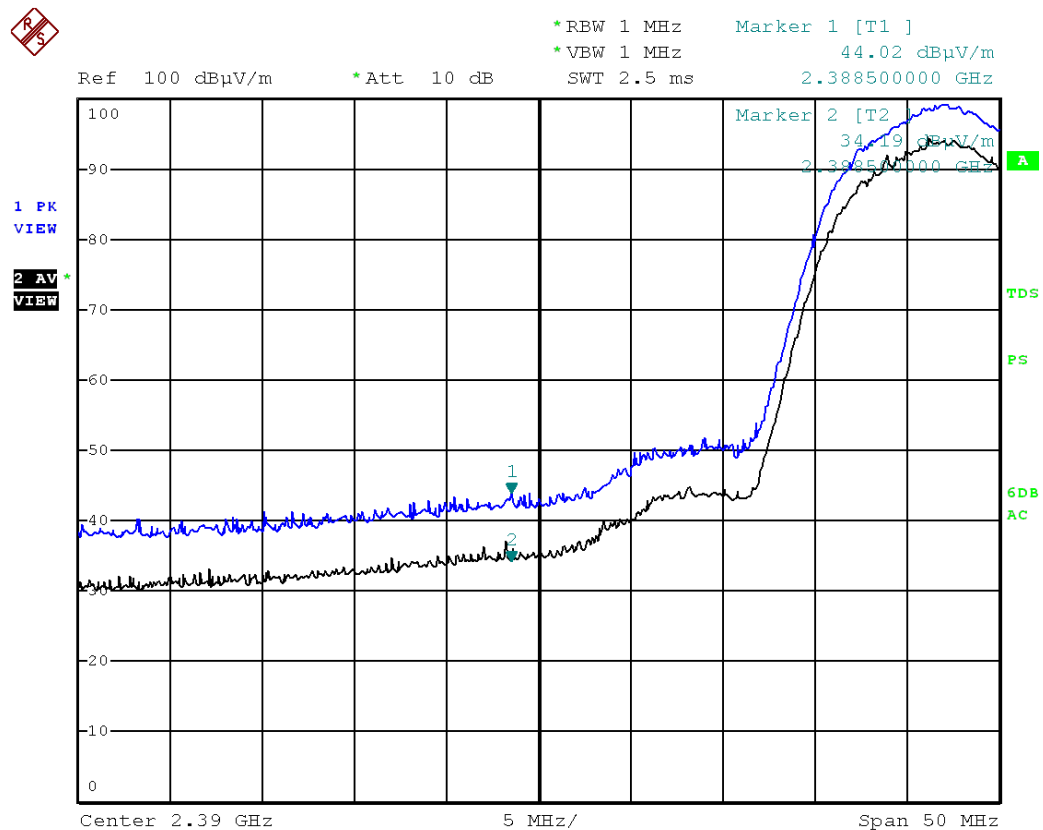
Radiated Restricted bands Emissions Result

● 802.11b

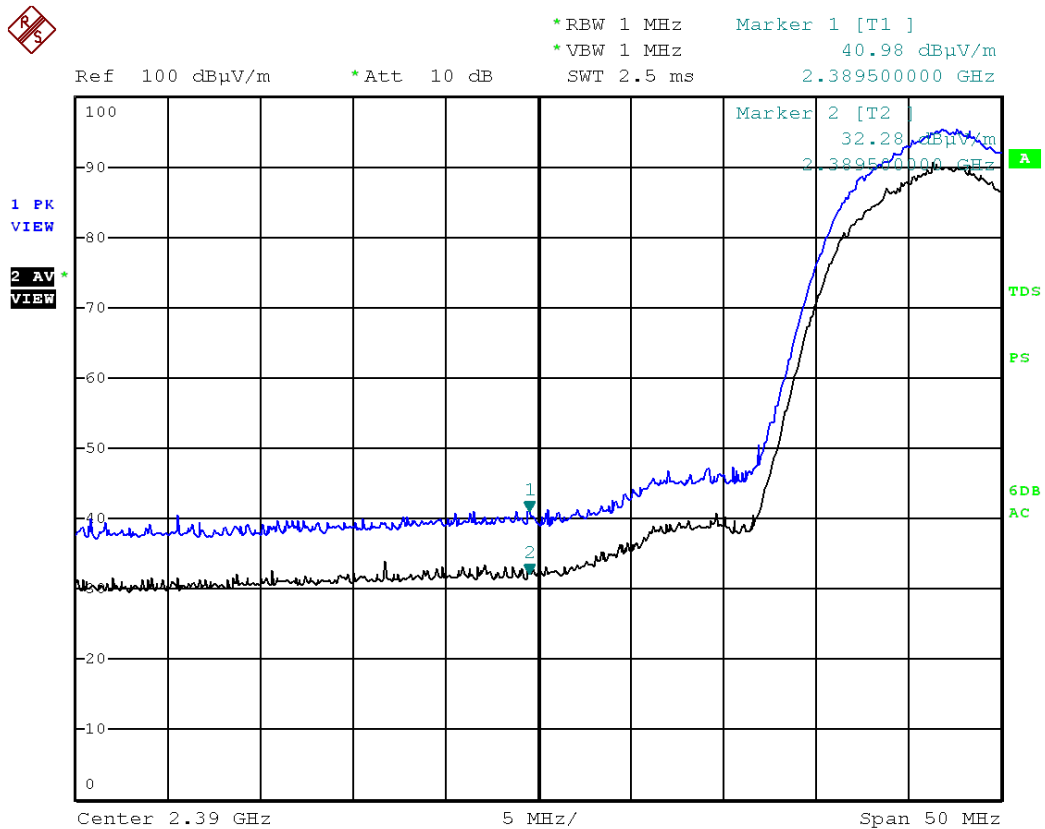
EUT	PPE21	PROBE	Above 1 GHz
POWER	DC 3.7 V	NOTE	1 Channel (2412 MHz)
MODE	802.11b		

Test Data

Frequency GHz	Reading dBuV		P	Limit dBuV		Margin dB	
	Peak	AV		Peak	AV	Peak	AV
2.3885	44.02	34.19	V	74.00	54.00	29.98	19.81
2.3895	40.98	32.28	H	74.00	54.00	33.02	21.72



802.11b Low (Horizontal)



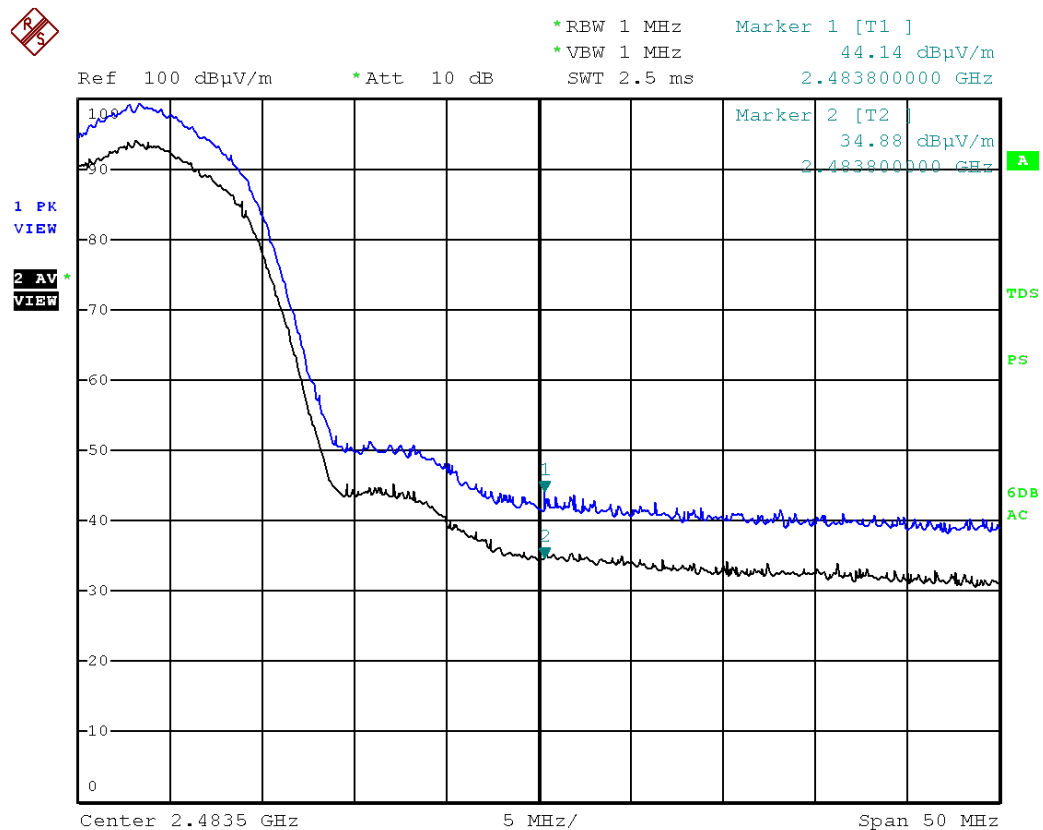
802.11b Low (Vertical)



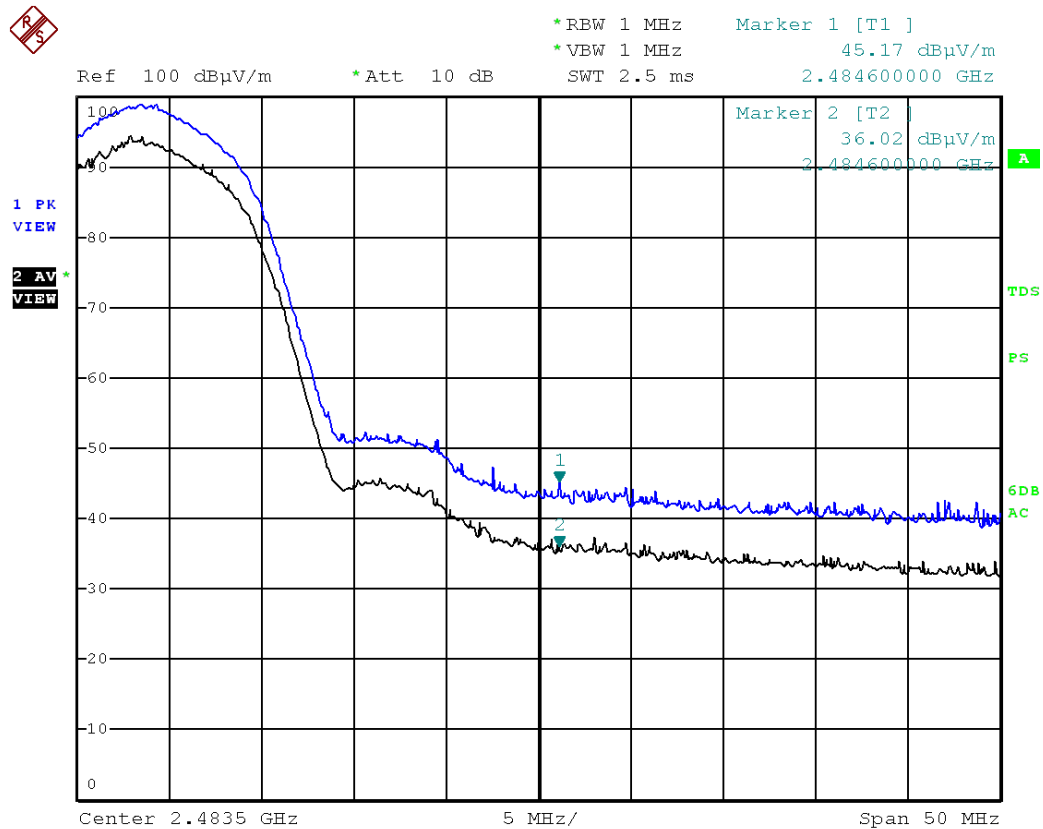
EUT	PPE21	PROBE	Above 1 GHz
POWER	DC 3.7 V	NOTE	11 Channel (2462 MHz)
MODE	802.11b		

Test Data

Frequency GHz	Reading dBuV		P	Limit dBuV		Margin dB	
	Peak	AV		Peak	AV	Peak	AV
2.4838	44.14	34.88	V	74.00	54.00	29.86	19.12
2.4846	45.17	36.02	H	74.00	54.00	28.83	17.98



802.11b High (Horizontal)



802.11b High (Vertical)

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

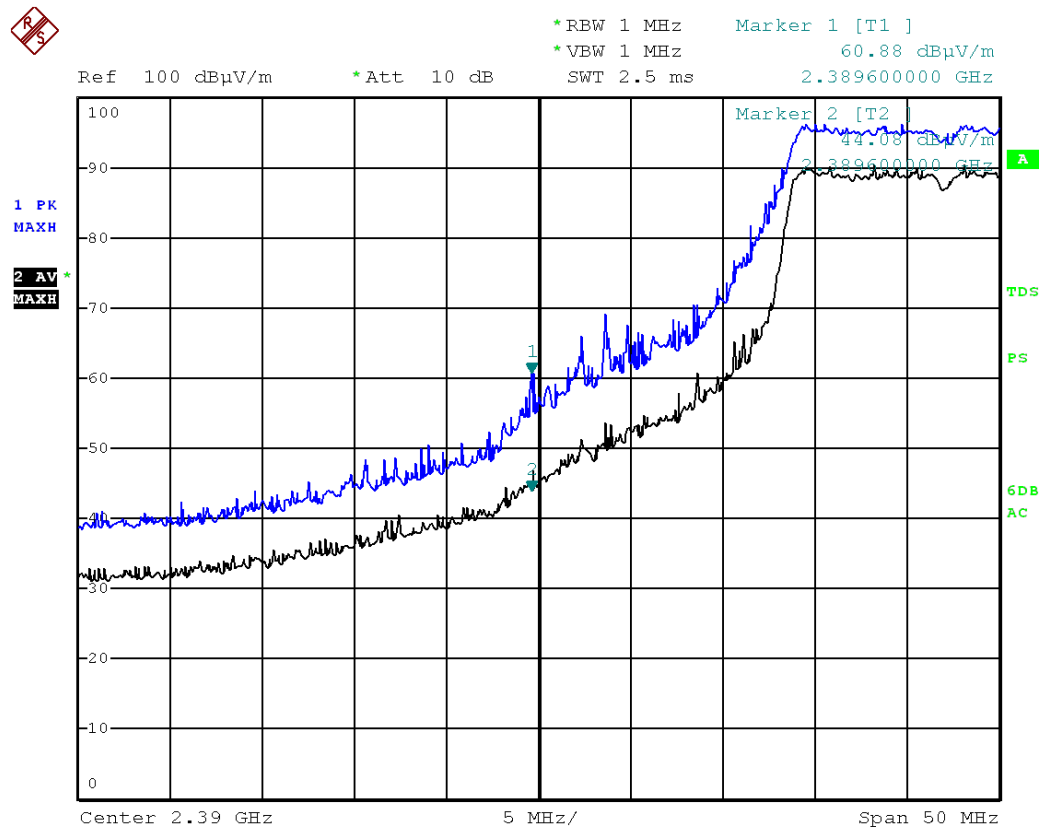


● 802.11g

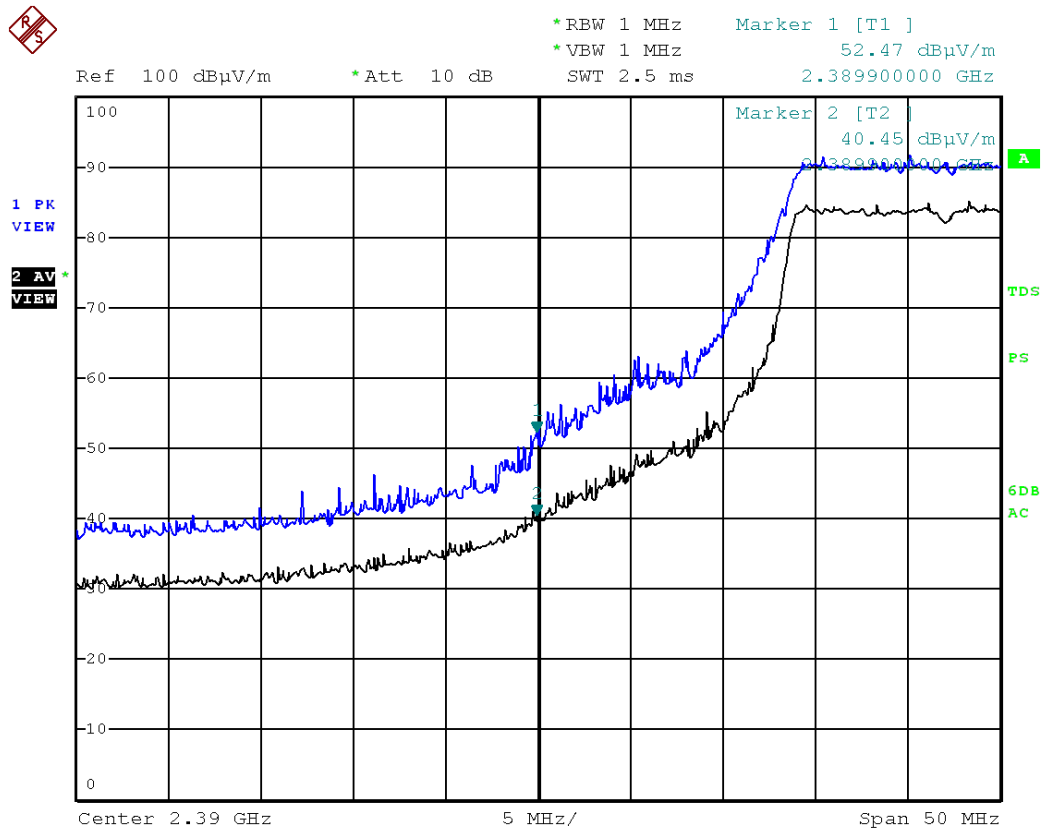
EUT	PPE21	PROBE	Above 1 GHz
POWER	DC 3.7 V	NOTE	1 Channel (2412 MHz)
MODE	802.11g		

Test Data

Frequency GHz	Reading dBuV		P	Limit dBuV		Margin dB	
	Peak	AV		Peak	AV	Peak	AV
2.3896	60.88	44.08	V	74.00	54.00	13.12	9.92
2.3899	52.47	40.45	H	74.00	54.00	21.53	13.55



802.11g Low (Horizontal)



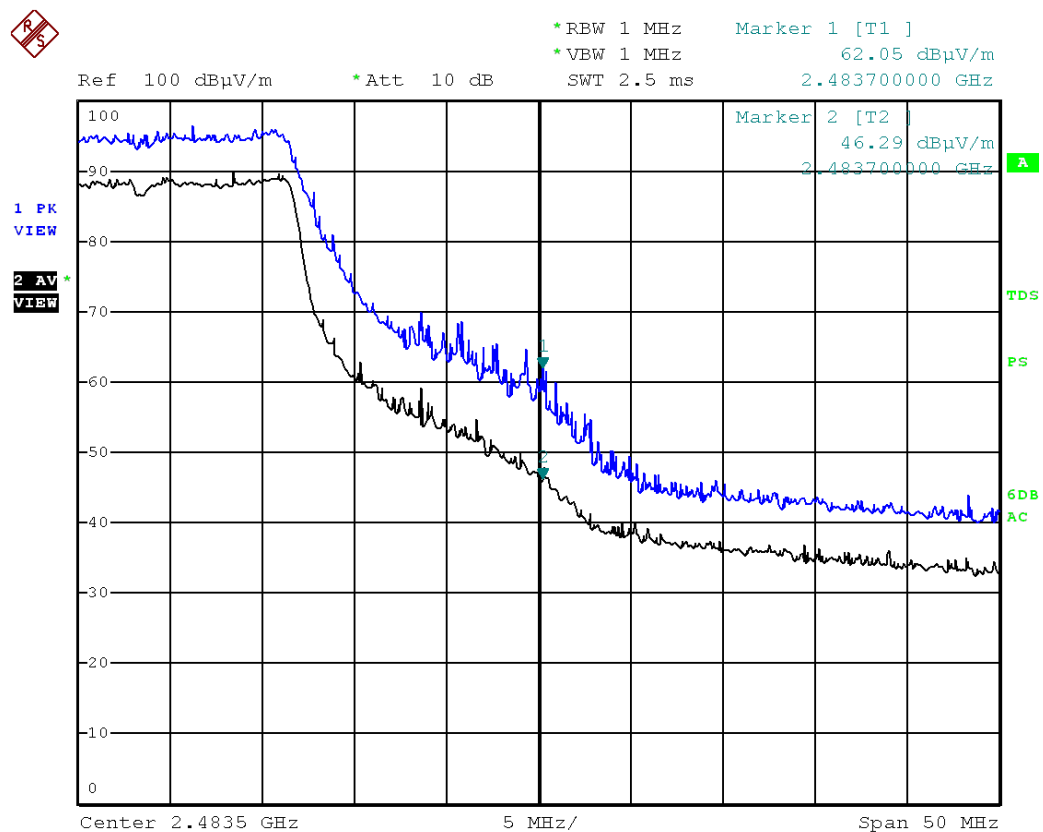
802.11g Low (Vertical)



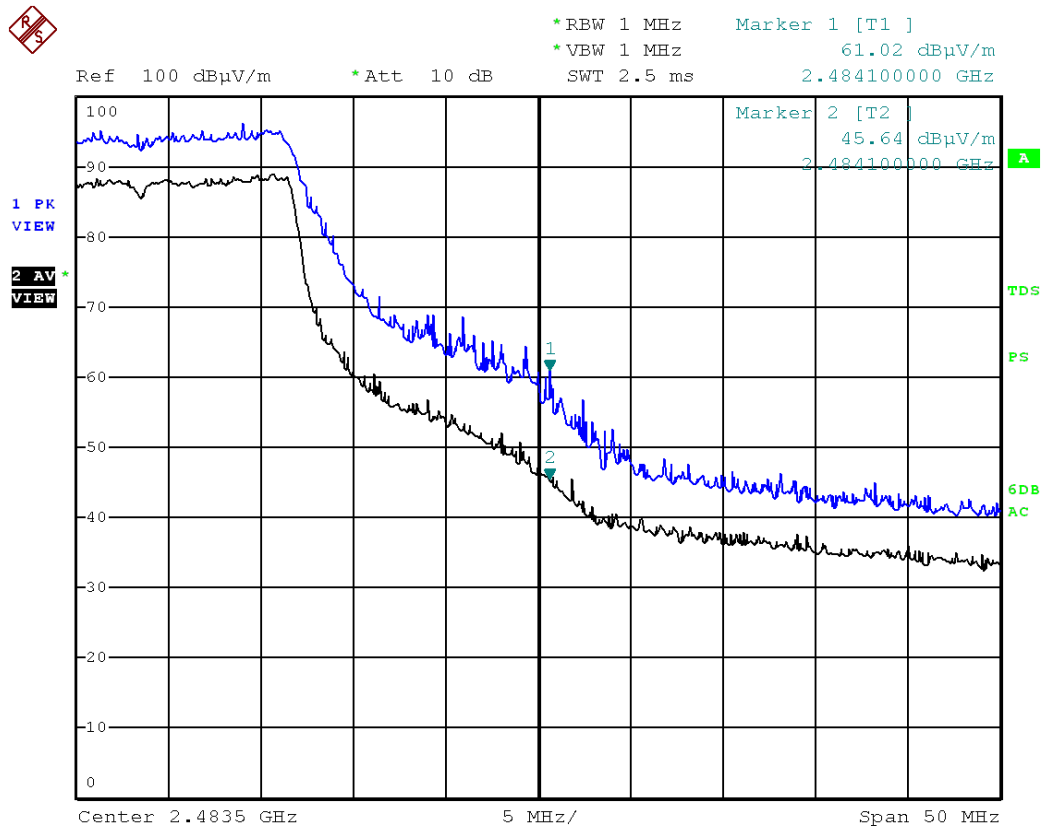
EUT	PPE21	PROBE	Above 1 GHz
POWER	DC 3.7 V	NOTE	11 Channel (2462 MHz)
MODE	802.11g		

Test Data

Frequency GHz	Reading dBuV		P	Limit dBuV		Margin dB	
	Peak	AV		Peak	AV	Peak	AV
2.4837	62.05	46.29	V	74.00	54.00	11.95	7.71
2.4841	61.02	45.64	H	74.00	54.00	12.98	8.36



802.11g High (Horizontal)



802.11g High (Vertical)

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

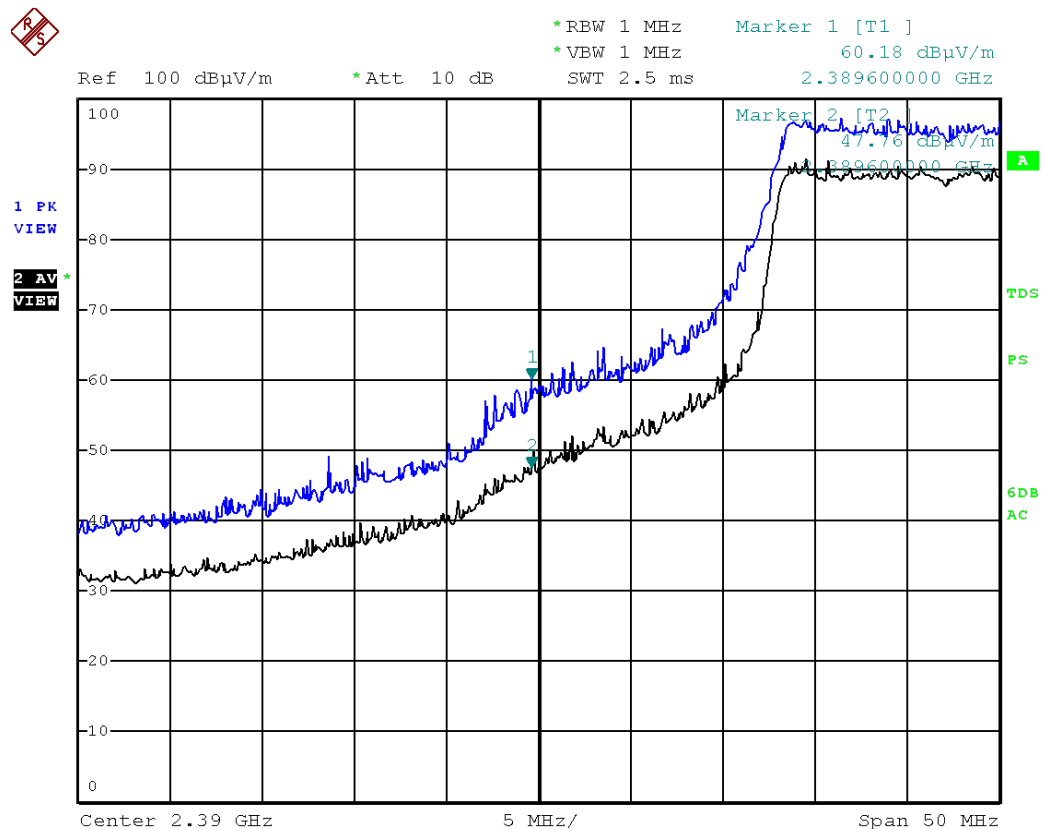


● 802.11n

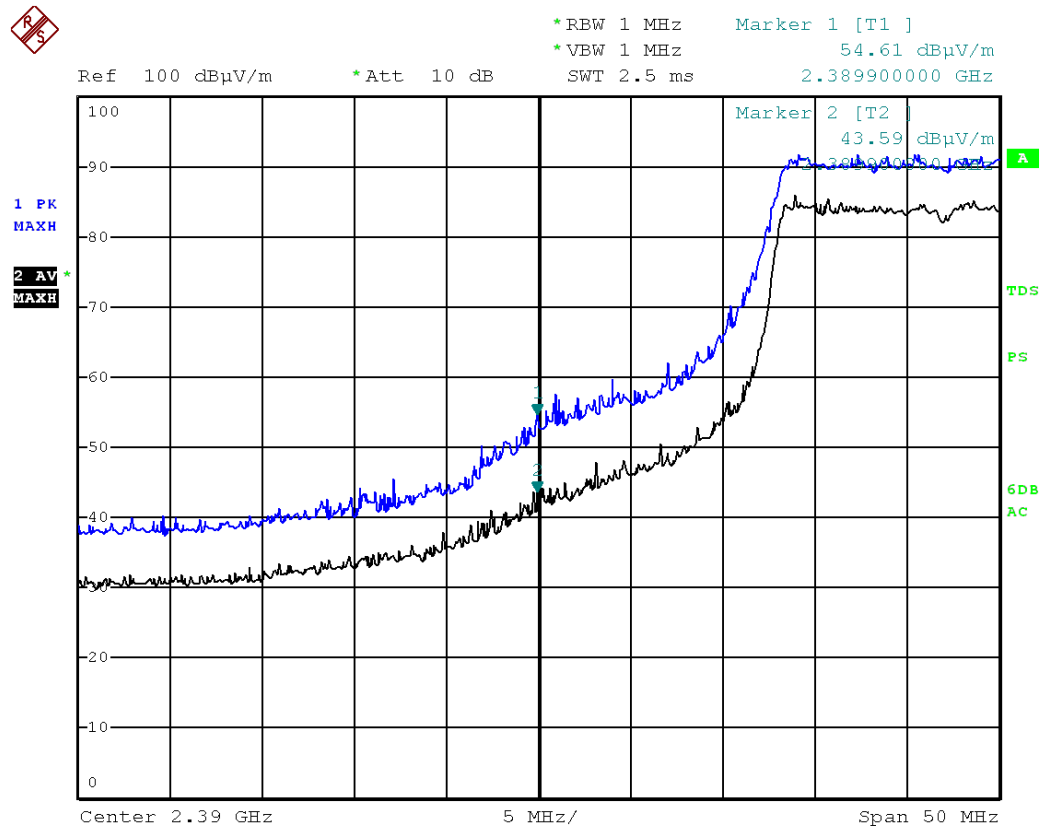
EUT	PPE21	PROBE	Above 1 GHz
POWER	DC 3.7 V	NOTE	1 Channel (2412 MHz)
MODE	802.11n		

Test Data

Frequency GHz	Reading dBuV		P	Limit dBuV		Margin dB	
	Peak	AV		Peak	AV	Peak	AV
2.3896	60.18	47.76	V	74.00	54.00	13.82	6.24
2.3899	54.61	43.59	H	74.00	54.00	19.39	10.41



802.11n Low (Horizontal)



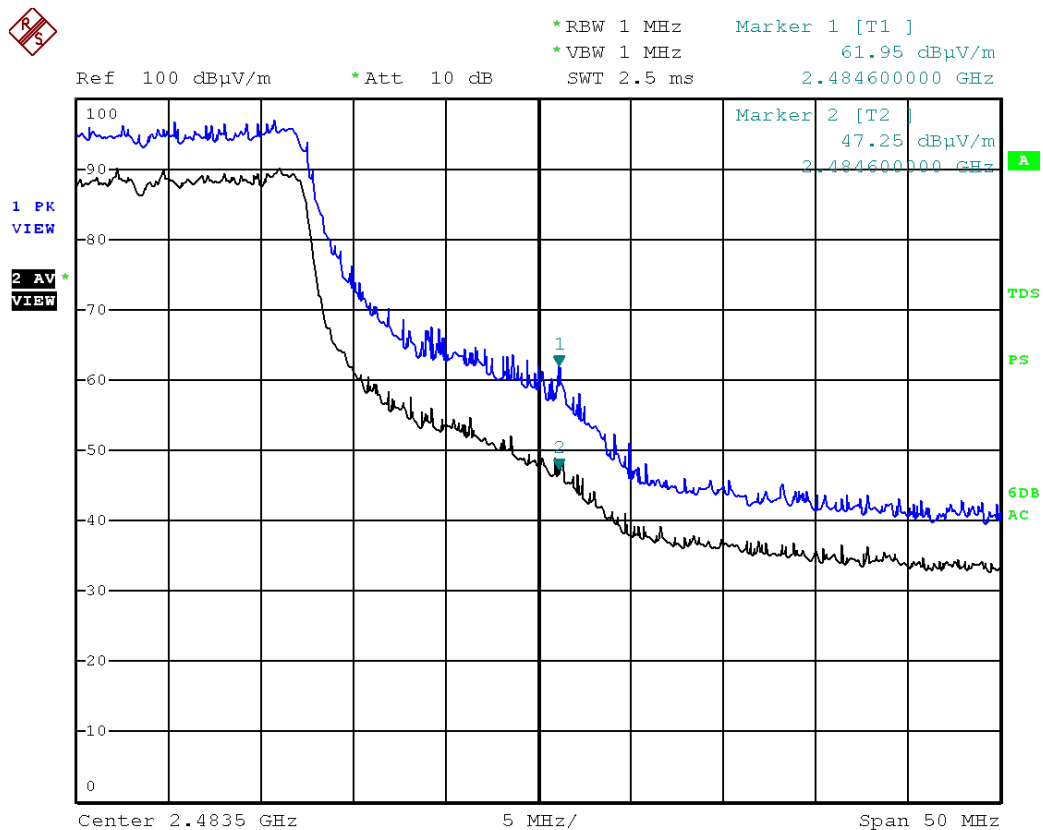
802.11n Low (Vertical)



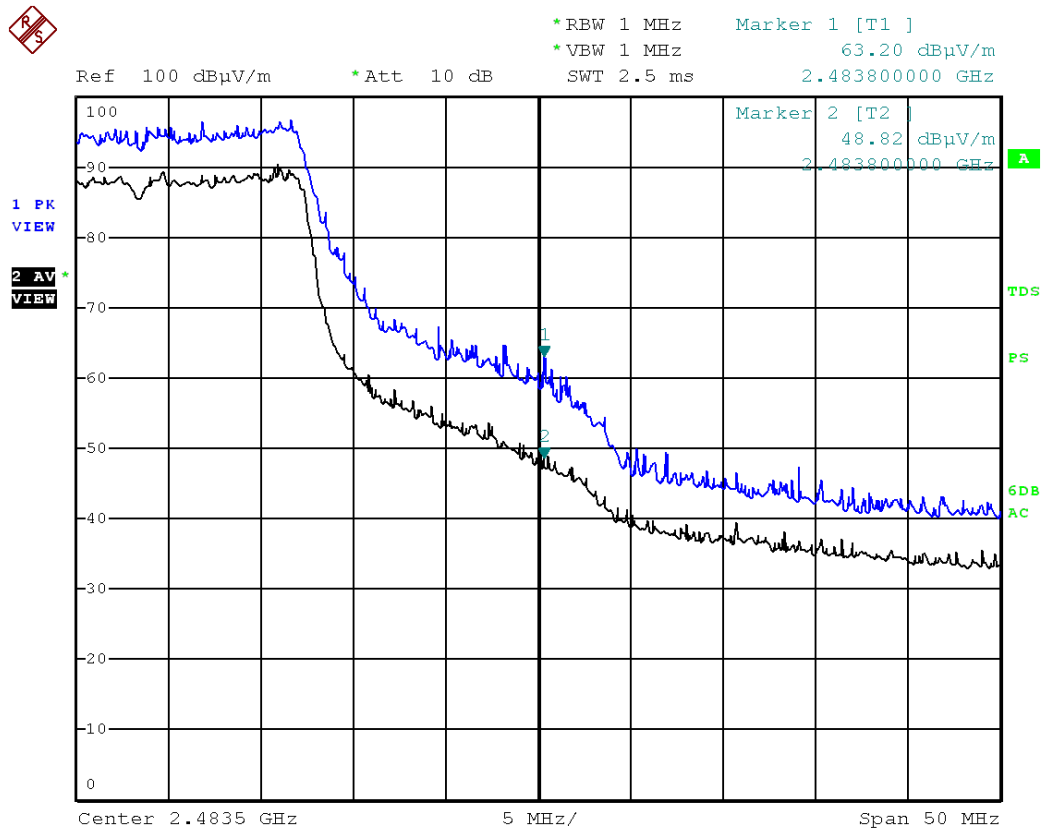
EUT	PPE21	PROBE	Above 1 GHz
POWER	DC 3.7 V	NOTE	11 Channel (2462 MHz)
MODE	802.11n		

Test Data

Frequency GHz	Reading dBuV		P	Limit dBuV		Margin dB	
	Peak	AV		Peak	AV	Peak	AV
2.4846	61.95	47.25	V	74.00	54.00	12.05	6.75
2.4838	63.20	48.82	H	74.00	54.00	10.80	5.18



802.11n High (Horizontal)



802.11n High (Vertical)

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

