

Nemko Korea Co., Ltd.

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FCC EVALUATION REPORT FOR CLASS II PERMISSIVE CHANGE

Applicant :

Samsung Electronics Co., Ltd.
129, Samsung-ro, Yeongtong-gu,
Suwon-si, Gyeonggi-do, Korea.
(Post code : 16677)
Attn. : Minhyung Cho

Dates of Issue : May 25, 2016
Test Report No. : NK-16-R-049
Test Site : Nemko Korea Co., Ltd.

FCC ID**A3LWISP50S****Brand Name****SAMSUNG****Contact Person**

Samsung Electronics Co., Ltd.
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Suwon-si, Gyeonggi-do, Korea, 16677.
Minhyung Cho
Telephone No. : +82-31-277-2688

Applied Standard: FCC 47 CFR Part 15.407

Classification: Unlicensed National Information Infrastructure (UNII)

EUT Type: WiFi module

The device bearing the brand name and model specified above has been shown to comply with the applicable technical standards as indicated in the measurement report and was tested in accordance with the measurement procedures specified in ANSI C63.10-2013. The client should not use it to claim product endorsement by TAF or any government agencies. The test results in the report only apply to the tested sample.

I attest to the accuracy of data and all measurements reported herein were performed by me or were made under my supervision and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.


Tested By : Seungyong Shin
Engineer


Reviewed By : Deokha Ryu
Technical Manager

Revision History

Rev.	Issue Date	Revisions	Revised By
00	Nov.15,2012	Initial issue (NK-12-R-170)	
01	May 25,2016	UNII new rule update	

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1. SCOPE

Measurement and determination of electromagnetic emissions (EME) of radio frequency devices including intentional and/or unintentional radiators for compliance with the technical rules and regulations of the Federal Communications Commission under FCC part 15.407.

Responsible Party :	Samsung Electronics Co., Ltd.
Contact Person :	Minhyung Cho
Manufacturer :	Samsung Electronics Co., Ltd. 129, Samsung-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, Korea 16677

- FCC ID: A3LWISP50S
- Model: WISP50S
- Brand Name: SAMSUNG
- EUT Type: Audio transceiver module
- Classification: Unlicensed National Information Infrastructure (UNII)
- Applied Standard: FCC 47 CFR Part 15.407
- Test Procedure(s): ANSI 63.10-2013, KDB 789033 D02 General UNII Test Procedures New Rules v01r02 dated April 8, 2016 entitled "Guidelines for Compliance Testing of Unlicensed National Information Infrastructure (U-NII) Devices – Part 15, Subpart E".
- Dates of Test: May 11, 2016 ~ May 24, 2016
- Place of Tests: Nemko Korea Co., Ltd.

2. INTRODUCTION

2.1 Test facility

The measurement procedure described in American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz (ANSI C63.4-2014), the American National Standard for Testing Unlicensed Wireless Devices (ANSI C63.10-2013) was used in determining radiated and conducted emissions emanating from **Samsung Electronics Co., Ltd.**

FCC ID : A3LWISP50S

These measurement tests were conducted at **Nemko Korea Co., Ltd. EMC Laboratory**.

The site address 155 & 159, Osan-Ro, Mohyeon-Myeon, Cheoin-Gu, Yongin-Si, Gyeonggi-Do 16885 KOREA, REPUBLIC OF.

The area of Nemko Korea Corporation Ltd. EMC Test Site is located in a mountain area at 80 km (48 miles) southeast and Incheon International Airport (Incheon Airport), 30 km (18miles) south-southeast from central Seoul.

It is located in the valley surrounded by mountains in all directions where ambient radio signal conditions are quiet and a favorable area to measure the radio frequency interference on open field test site for the computing and ISM devices manufactures.

The detailed description of the measurement facility was found to be in compliance with the requirements of ANSI C63.4-2014 according to §2.948.



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Fig. 1. The map above shows the Seoul in Korea vicinity area.
The map also shows Nemko Korea Corporation Ltd. EMC Lab. and Incheon Airport.

2.2 Accreditation and listing

Accreditation type		Accreditation number
	CAB Accreditation for DOC	Designation No. KR0026
	KOLAS Accredited Lab. (Korea Laboratory Accreditation Scheme)	Registration No. 155
	Canada IC Registered site	Site No. 2040E
	VCCI registration site(RE/CE/Telecom CE)	Member No. 2118
	EMC CBTL	-
	KCC(RRL)Designated Lab.	Registration No. KR0026

3. TEST CONDITIONS & EUT INFORMATION

3.1 Operation During Test

The EUT was controlled and monitored by test program and testing Jig which manufacturer supported.

The EUT have two antennas which are not working simultaneously. All tests were performed at two antenna paths then the worst case was recorded.

The EUT was programmed with the following power setting that used during the testing:

Frequency	5180 MHz ~ 5240 MHz	5736 MHz ~ 5814 MHz
Power setting Level	255	238

3.1.1 Table of test channels

Frequency band	Modulation	Test Channel (CH)	Frequency (MHz)
5180~5240 MHz	QPSK	4	5180
		5	5210
		6	5240
5736~5814 MHz	QPSK	7	5736
		8	5762
		9	5814

3.1.2 Table of test modes

Test Items	Modulation	Test Channel (CH)
26 dB Bandwidth	QPSK	4 / 5 / 6 7 / 8 / 9
6 dB Bandwidth	QPSK	4 / 5 / 6 7 / 8 / 9
Maximum Conducted Output Power	QPSK	4 / 5 / 6 7 / 8 / 9
Power Spectral Density	QPSK	4 / 5 / 6 7 / 8 / 9
Radiated Spurious Emission, Band edge Emission	QPSK	4 / 5 / 6 7 / 8 / 9

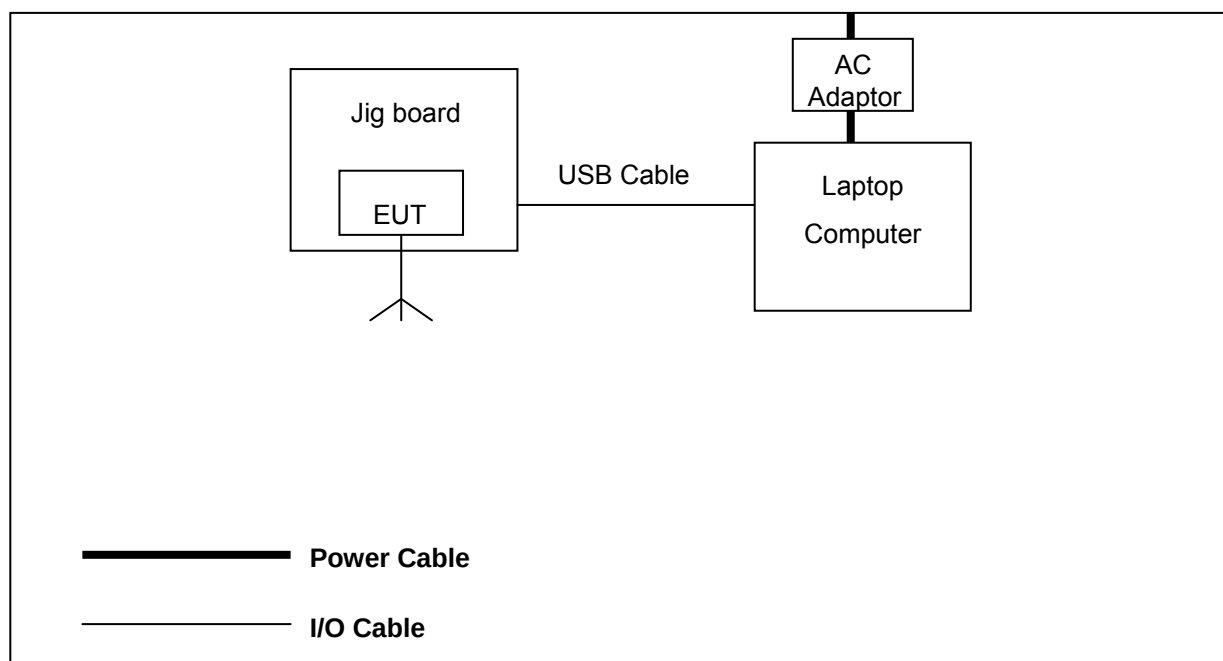
3.1.3. Additional Information Related to Testing

- Printed circuit board, component lay out and frequency bands are the same as previous model. Therefore testing was not performed in UNII-1.
However, all testing in UNII-3 band was retested to show compliance with 15.407 limit of new rule for UNII device.
- For FCC part 15.207,15.209 testing, the data in original report was used in this report.

3.2 Support Equipment

EUT	Samsung Electronics Co., Ltd. FCC ID: A3LWISP50S	S/N: N/A
Laptop Computer	HP Model : HSTNN-Q61C 1.2 m shielded USB cable	FCC DOC S/N : CNF0489WDT
AC/DC Adapter	DELTA ELECTRONICS(JIANG SU), LTD Model : PPP009D 1.2 m unshielded power cable	FCC DOC S/N :WBGSV0ACXZH162

3.3 Setup Drawing



3.4 EUT Information

The EUT is the **Samsung Audio transceiver module FCC ID: A3LWISP50S**.

Specifications:

Category	Audio transceiver module
Model Name	WISP50S
Brand Name	SAMSUNG
Frequency of Operation	UNII-1 band : 5180 MHz ~ 5240 MHz UNII-3 band : 5736 MHz ~ 5814 MHz
Power Output (Conducted)	UNII-1 band : 10.20 dBm UNII-3 band : 5.20 dBm
Channels	UNII-1 band : 3 ch UNII-3 band : 3 ch
Antenna Gain (peak)	UNII-1 band : 2.8 dBi UNII-3 band : 6.0 dBi
Modulations	QPSK
Temperature Range	-10 °C ~ +50 °C
Voltage	5.0 Vdc
Dimensions (D x W x H)	26 mm x 60.2 mm X 3.2 mm
Weight	5 g
Remarks	-

4. SUMMARY OF TEST RESULTS

The EUT has been tested according to the following specification:

Name of Test	FCC Paragraph No.	Result	Remark
Conducted Emission	15.207	Complies	
Radiated Emission	15.209	Complies	
26 dB Spectrum Bandwidth and 99% Occupied bandwidth	15.407(a)	Complies	
6 dB Bandwidth	15.407(e)	Complies	
Maximum Conducted Output Power	15.407(a)	Complies	
Power Spectral Density	15.407(a)	Complies	
Radiated Spurious Emission	15.407(b)	Complies	
Maximum Permissible Exposure	1.1307(b)	Complies	

5. RECOMMENDATION/CONCLUSION

The data collected shows that the **Samsung Audio transceiver module FCC ID: A3LWISP50S** is in compliance with Part 15.407 of the FCC Rule.

6. ANTENNA REQUIREMENTS

§15.203 of the FCC Rules part 15 Subpart C

: An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of 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 the **Samsung Audio transceiver module FCC ID: A3LWISP50S** is **permanently attached** and there are no provisions for connection to an external antenna. It complies with the requirement of §15.203.

7. DESCRIPTION OF TESTS

7.1 Conducted Emissions

The Line conducted emission test facility is located inside a 4 x 7 x 2.5 meter shielded enclosure. It is manufactured by EM engineering. The shielding effectiveness of the shielded room is in accordance with MIL-STD-285 or NSA 65-6. A 1 m x 1.5 m wooden table 0.8 m height is placed 0.4 m away from the vertical wall and 1.5 m away from the side of wall of the shielded room Rohde & Schwarz (ESH3-Z5) and (ESH2-Z5) of the 50 ohm/50 μ H Line Impedance Stabilization Network (LISN) are bonded to the shielded room. The EUT is powered from the Rohde & Schwarz LISN (ESH3-Z5) and the support equipment is powered from the Rohde & Schwarz LISN (ESH2-Z5). Power to the LISNs are filtered by high-current high insertion loss Power line filters. The purpose of filter is to attenuate ambient signal interference and this filter is also bonded to shielded enclosure. All electrical cables are shielded by tinned copper zipper tubing with inner diameter of 1 / 2 ". If DC power 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 LISNs, All interconnecting cables more than 1 meter were shortened by non inductive bundling (serpentine fashion) to a 1 meter length. Sufficient time for EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating condition. The RF output of the LISN was connected to the spectrum analyzer to determine the frequency producing the maximum EME from the EUT. The spectrum was scanned from 150 kHz to 30 MHz with 200 msec sweep time. The frequency producing the maximum level was re-examined using the EMI test receiver. (Rohde & Schwarz ESCS30). The detector functions were set to CISPR quasi-peak mode & average mode. The bandwidth of receiver was set to 9 kHz. The EUT, support equipment, and interconnecting cables were arranged and manipulated to maximize each EME emission. Each emission was maximized by; switching power lines; varying the mode of operation or resolution; clock or data exchange speed; scrolling H pattern to the EUT and of support equipment, and powering the monitor from the floor mounted outlet box and computer aux AC outlet, if applicable; whichever determined the worst case emission. Each EME reported was calibrated using the R&S signal generator.

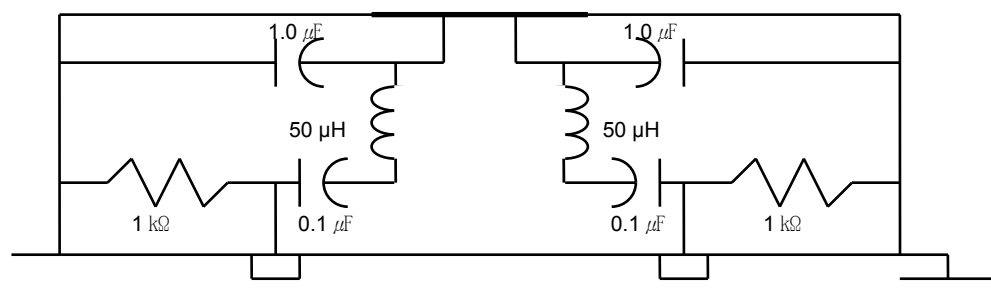


Fig. 2. LISN Schematic Diagram

7.2 Radiated Emissions

The measurement was performed at the test site that is specified in accordance with ANCI C63.10-2013.

The spurious emission was scanned from 9 kHz to 30 MHz using Loop Antenna(Rohde&Schwarz, HFH2-Z2) and 30 to 1000 MHz using Trilog broadband test antenna(Schwarzbeck, VULB 9163). Above 1 GHz, Horn antenna (Schwarzbeck BBHA 9120D: up to 18 GHz, Q-par Angus QSH20S20 : 18 to 26.5 GHz, QSH22K20: up to 40 GHz) was used.

For emissions testing at below 1GHz, The test equipment was placed on turntable with 0.8 m above ground. For emission measurements above 1 GHz, The test equipment was placed on turntable with 1.5 m above ground. Sufficient time for the EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating condition. The EUT, cable, wire arrangement and mode of operation that has the highest amplitude relative to the limit was selected. Then, the turn table was rotated from 0° to 360° and an antenna mast was moved from 1 m to 4 m height to maximize the suspected highest amplitude signal. The final maximized level was recorded.

Unwanted emissions in the restricted bands

At frequencies below 1000 MHz, measurements performed using the CISPR quasi-peak detection.

At frequencies above 1000 MHz, measurements performed using the peak and average measurement procedures described in KDB “789033 D02 General UNII Test Procedures New Rules v01r02” in section G)5) and G)6). Peak emission levels was measured by setting the analyzer RBW = 1 MHz, VBW = 3 MHz, Detector = Peak, Trace mode = max hold. Average emission levels was measured using the “Method VB” by setting the analyzer RBW = 1 MHz, VBW = 3 kHz ($VBW \leq RBW/100$), Detector = Peak, if the EUT is configured to transmit with duty cycle ≥ 98 percent. When the duty cycle ≤ 98 percent, $VBW \geq 1/T$ (T = minimum transmission duration over which the transmitter is on) was used.

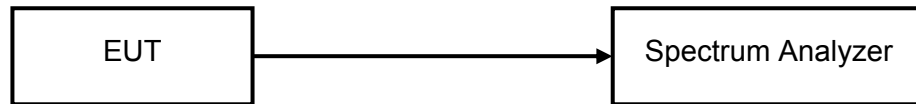
Unwanted emissions outside of the restricted bands

At frequencies below 1000 MHz, measurements performed using the CISPR quasi-peak detection.

At frequencies above 1000 MHz, measurements performed using the peak and average measurement procedures described in KDB “789033 D02 General UNII Test Procedures New Rules v01r02” in section G)5). Peak emission levels was measured by setting the analyzer RBW = 1 MHz, VBW = 3 MHz, Detector = Peak, Trace mode = max hold. If the transmission is not continuous, the time required for the trace to stabilize will increase by a factor of approximately $1/x$, where x is the duty cycle.

7.3 26 dB Bandwidth and 99% Occupied bandwidth

Test Setup



Test Procedure

EUTs 26 dB bandwidth is measured at low, middle, high channels with a spectrum analyzer connected to the antenna terminal while the EUTs operating at its maximum power control level.

The spectrum analyzer setting is as follows.

RBW = approximately 1 % of the emission bandwidth

VBW $\geq$ 3 x RBW

Detector = Peak

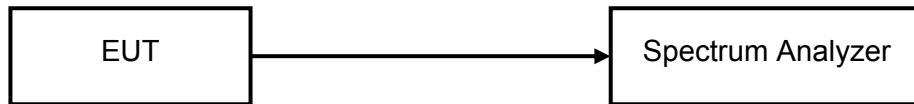
Trace mode = max hold

Sweep = auto couple.

The bandwidth measurement function on the spectrum analyzer is used to measure the 26 dB bandwidth and 99% occupied bandwidth.

7.4 6 dB Bandwidth

Test Setup



Test Procedure

EUTs 6 dB bandwidth is measured at low, middle, high channels with a spectrum analyzer connected to the antenna terminal while the EUTs operating at its maximum power control level.

The spectrum analyzer setting is as follows.

RBW = 100 kHz

VBW > 3 x RBW

Detector = Peak

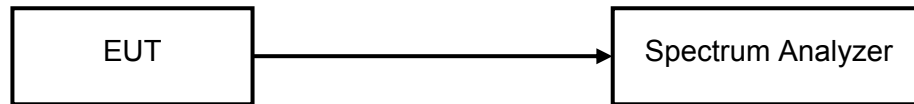
Trace mode = max hold

Sweep = auto couple

The bandwidth measurement function on the spectrum analyzer is used to measure the 6 dB bandwidth.

7.5 Maximum Conducted Output Power (average)

Test Setup



Test Procedure

EUTs Maximum Conducted Output Power is measured at low, middle, high channels with a spectrum analyzer connected to the antenna terminal while the EUTs operating at its maximum power control level.

The spectrum analyzer setting is as follows.

Measure the duty cycle

Span = encompass the EBW of the signal.

RBW = 1 MHz

VBW $\geq$ 3 MHz

Number of points in sweep $\geq$ 2 Span / RBW

Sweep time = auto

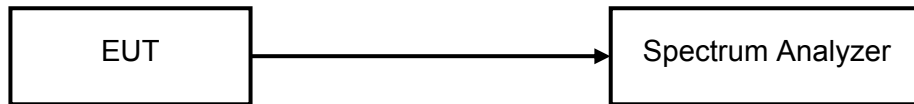
Detector = RMS

Trace average at least 100 traces in power averaging mode

The band power measurement function on the spectrum analyzer is used to measure the Maximum conducted output power.

7.6 Maximum Power Spectral Density (average)

Test Setup



Test Procedure

EUTs Maximum Conducted Output Power is measured at low, middle, high channels with a spectrum analyzer connected to the antenna terminal while the EUTs operating at its maximum power control level.

Measure the duty cycle.

The spectrum analyzer setting is as follows.

Span = encompass the EBW of the signal.

RBW = 510 kHz

VBW $\geq$ 1.5 MHz

Number of points in sweep $\geq$ 2 Span / RBW

Sweep time = auto

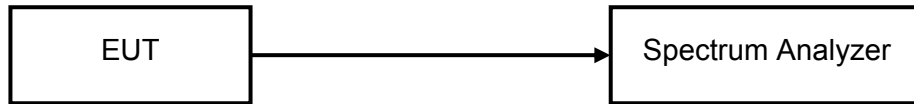
Detector = RMS

Trace average at least 100 traces in power averaging mode

The peak search function on the spectrum analyzer is used to find the peak of the spectrum.

7.7 Duty Cycle

Test Setup



Test Procedure

EUTs duty cycle are measured at middle channel with a spectrum analyzer connected to the antenna terminal while the EUTs operating at its maximum power control level. The spectrum analyzer setting is as follows.

Center frequency = Center frequency of the transmission

Span = zero

RBW = 8 MHz

VBW = 8 MHz

Detector = peak

Sweep time = at least 30ms

Trace mode = view

The marker function on the spectrum analyzer is used to determine the duty cycle.

Following is the worst result of the duty cycle measurements according to the above test procedure

UNII-1, UNII-3 band

	On time (ms)	On + Off time (ms)	Duty Cycle (%)	Duty Factor (dB)
5180~5240 MHz	-	-	100	N.A
5736~5814 MHz	-	-	100	N.A

8. TEST DATA

8.1 Conducted Emissions

FCC §15.207

Frequency (MHz)	Level(dBμV)		*)Factor (dB)	**) Line	Limit(dBμV)		Margin(dB)	
	Q-Peak	Average			Q-Peak	Average	Q-Peak	Average
0.15	53.3	44.2	0.2	N	66.0	56.0	12.7	11.8
0.23	46.9	41.6	0.2	L	62.4	52.4	15.5	10.8
0.31	43.3	39.8	0.2	L	60.0	50.0	16.7	10.2
0.39	36.9	34.4	0.2	L	58.1	48.1	21.2	13.7
0.55	38.7	36.2	0.2	N	56.0	46.0	17.3	9.8
27.64	39.4	39.3	1.7	L	60.0	50.0	20.6	10.7

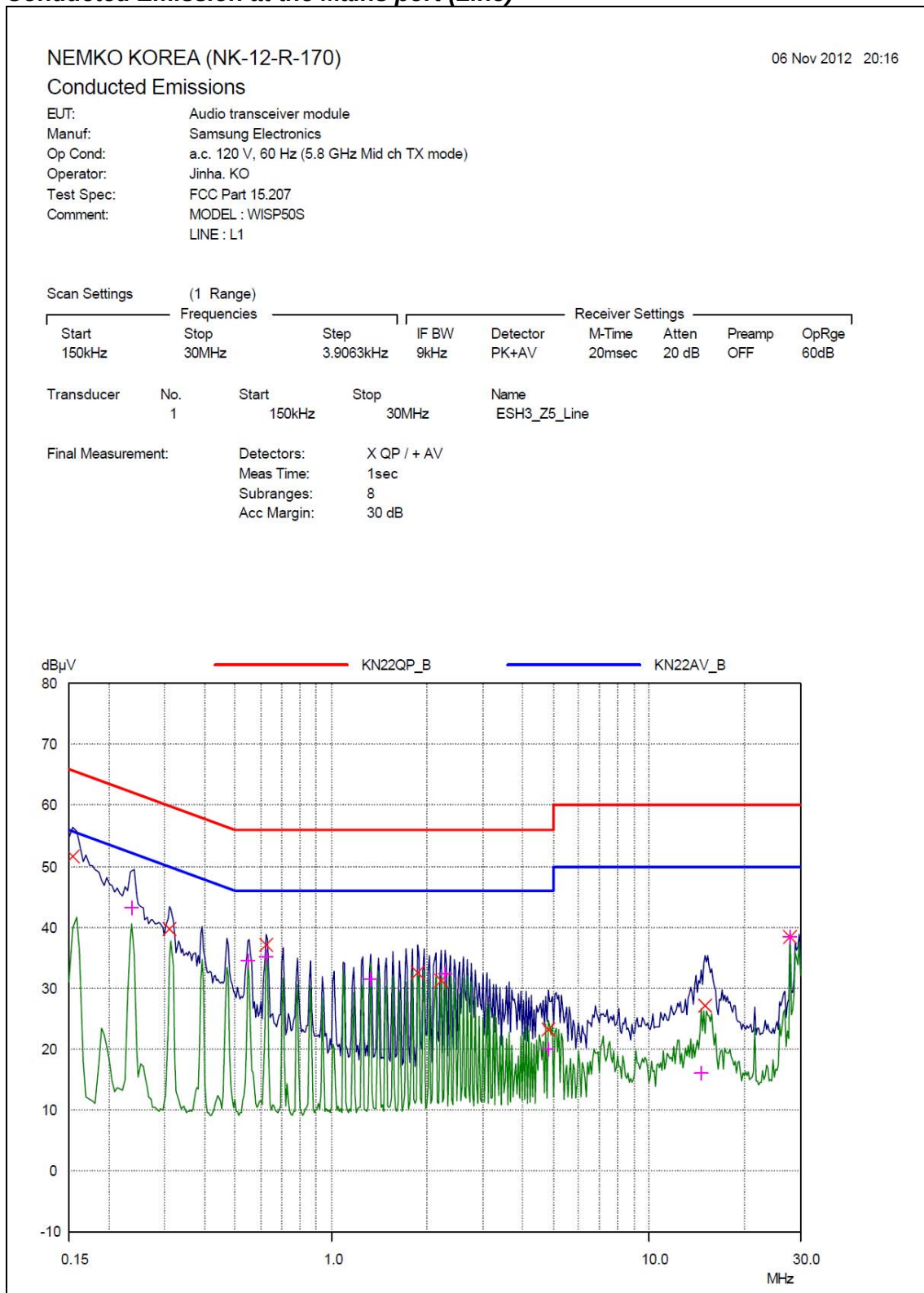
Line Conducted Emissions Tabulated Data

Notes:

1. Measurements using CISPR quasi-peak mode & average mode.
2. All modes of operation were investigated and the worst -case emission are reported. See attached Plots.
3. *) Factor = LISN + Cable Loss
4. **) LINE : L = Line , N = Neutral
5. The limit is on the FCC §15.207(a)

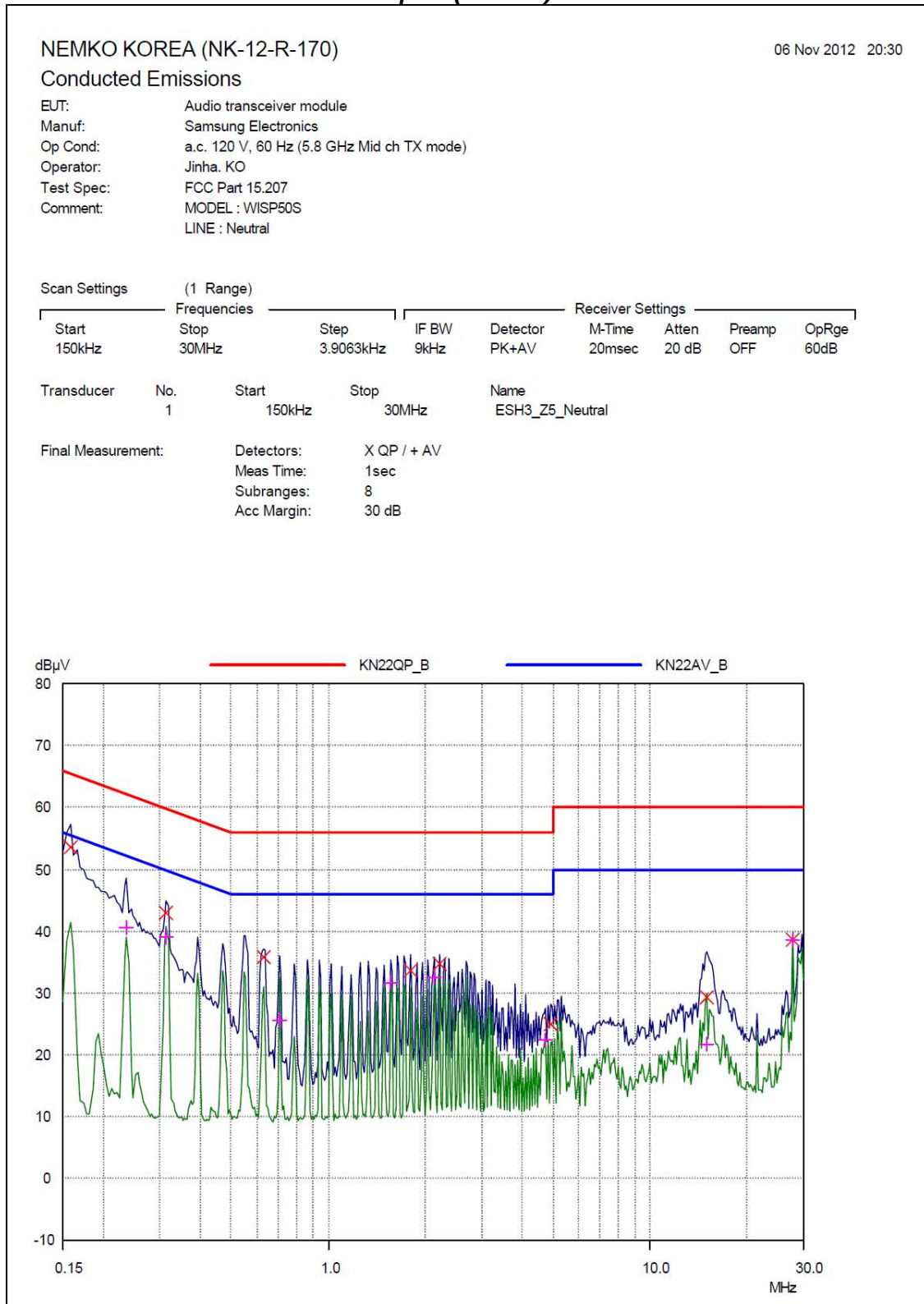
PLOTS OF EMISSIONS

Conducted Emission at the Mains port (Line)



PLOTS OF EMISSIONS

Conducted Emission at the Mains port (Neutral)



TEST DATA

8.2 Radiated Emissions

FCC §15.209

Frequency (MHz)	Reading (dBμV/m)	Pol* (H/V)	Antenna Height (cm)	Turntable Angles (°)	AF+CL+Amp (dB)**	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)
36.84	54.8	V	115	195	-21.8	33.0	40.0	7.0
184.33	58.5	H	385	45	-24.8	33.7	43.5	9.8
208.92	54.4	V	100	71	-23.2	31.2	43.5	12.3
233.46	60.3	H	385	72	-21.8	38.5	46.0	7.5
258.05	62.5	H	301	82	-20.8	41.7	46.0	4.3
264.01	60.8	H	315	75	-20.6	40.2	46.0	5.8

Radiated Measurements at 3meters

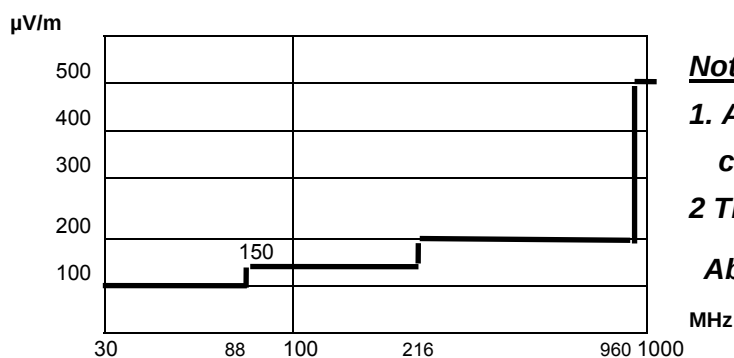


Fig. 3. Limits at 3 meters

Notes:

1. All modes were measured and the worst-case emission was reported.
- 2 The radiated limits are shown on Figure 3.
- Above 1 GHz the limit is 500 μV/m.

MHz

Notes:

1. *Pol. H = Horizontal, V = Vertical
2. **AF + CL + Amp. = Antenna Factor + Cable Loss + Amplifier.
3. Measurements using CISPR quasi-peak mode.
4. The radiated emissions testing were made by rotating through three orthogonal axes.
The worst date was recorded.
5. The limit is on the FCC §15.209(a)

TEST DATA

8.3 26 dB Bandwidth and 99 % Occupied bandwidth

FCC §15.407(a)

Test Mode : Set to Lowest channel, Middle channel and Highest channel

Tx mode

UNII-1 band

Channel	Frequency (MHz)	26 dB Bandwidth (MHz)		99% Occupied Bandwidth (MHz)	
		Ant A	Ant B	Ant A	Ant B
Low	5180	16.17	16.14	15.05	15.04
Middle	5210	16.15	16.15	15.03	15.05
High	5240	16.17	16.16	15.03	15.04

UNII-3 band

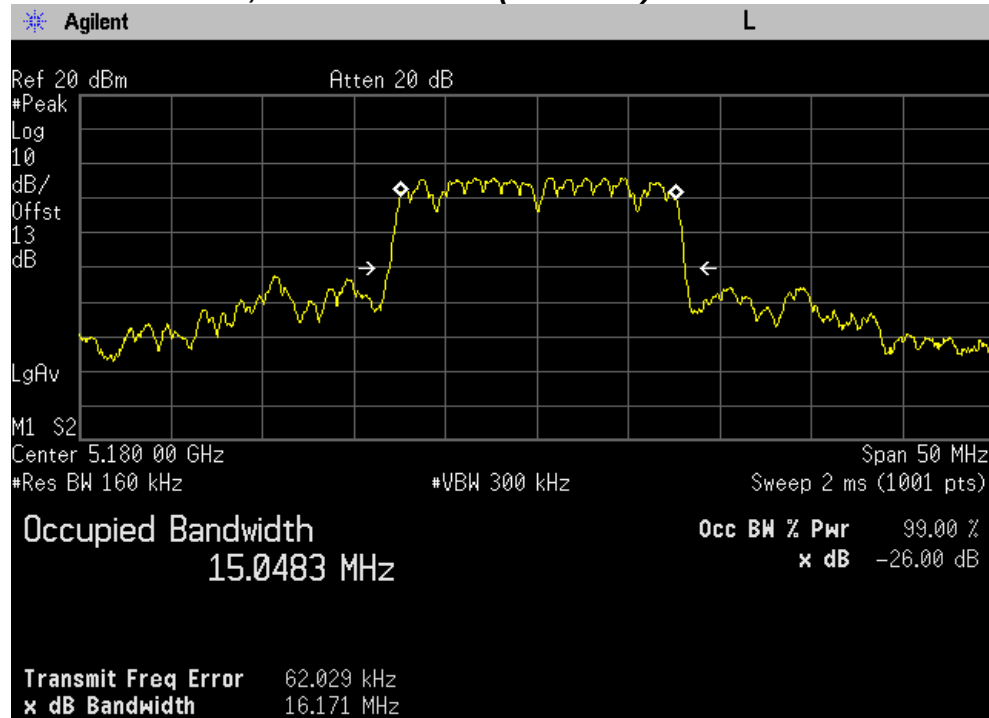
Channel	Frequency (MHz)	26 dB Bandwidth (MHz)		99% Occupied Bandwidth (MHz)	
		Ant A	Ant B	Ant A	Ant B
Low	5736	16.57	16.54	14.01	13.97
Middle	5762	16.56	16.55	14.01	13.98
High	5814	16.56	16.56	14.01	13.99

PLOTS OF EMISSIONS

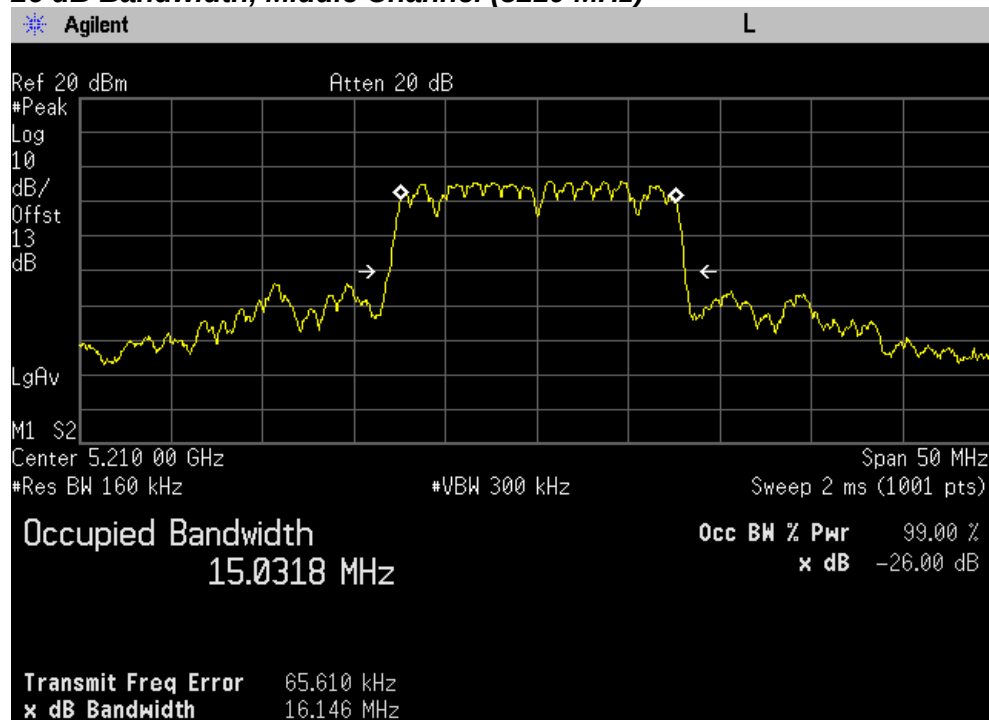
UNII-1 band

Ant A

26 dB Bandwidth, Lowest Channel (5180 MHz)

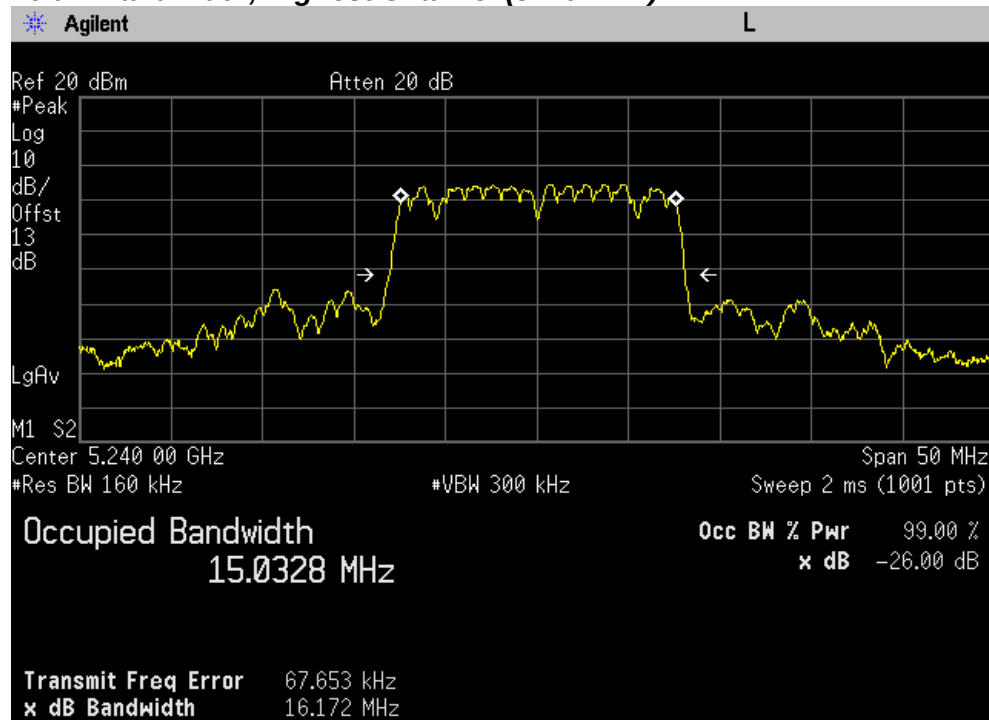


26 dB Bandwidth, Middle Channel (5210 MHz)



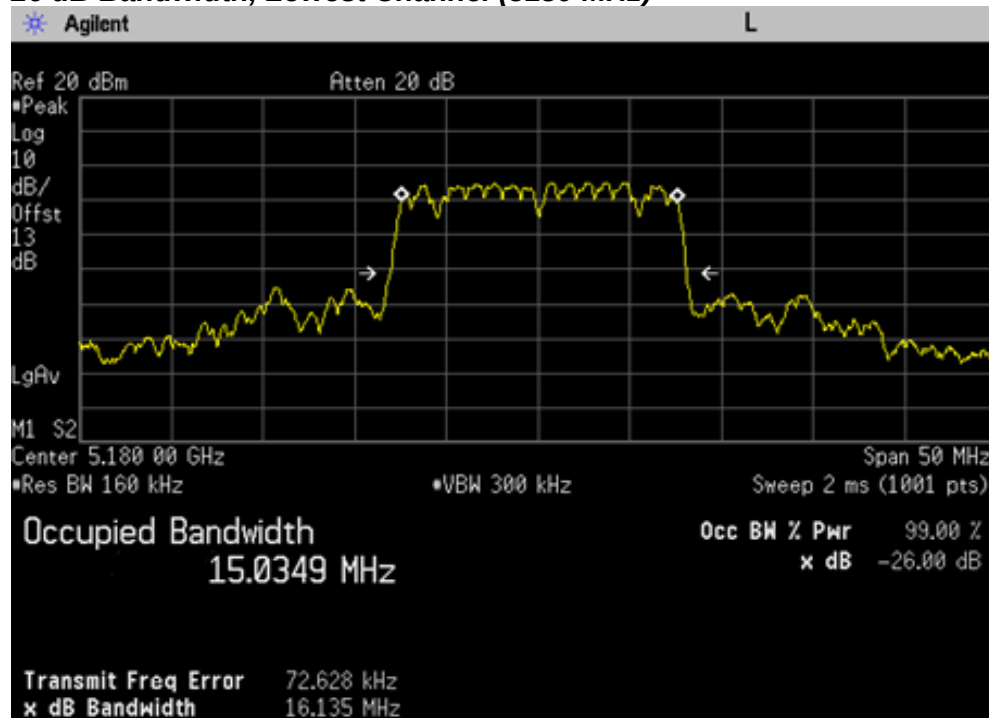
PLOTS OF EMISSIONS

26 dB Bandwidth, Highest Channel (5240 MHz)



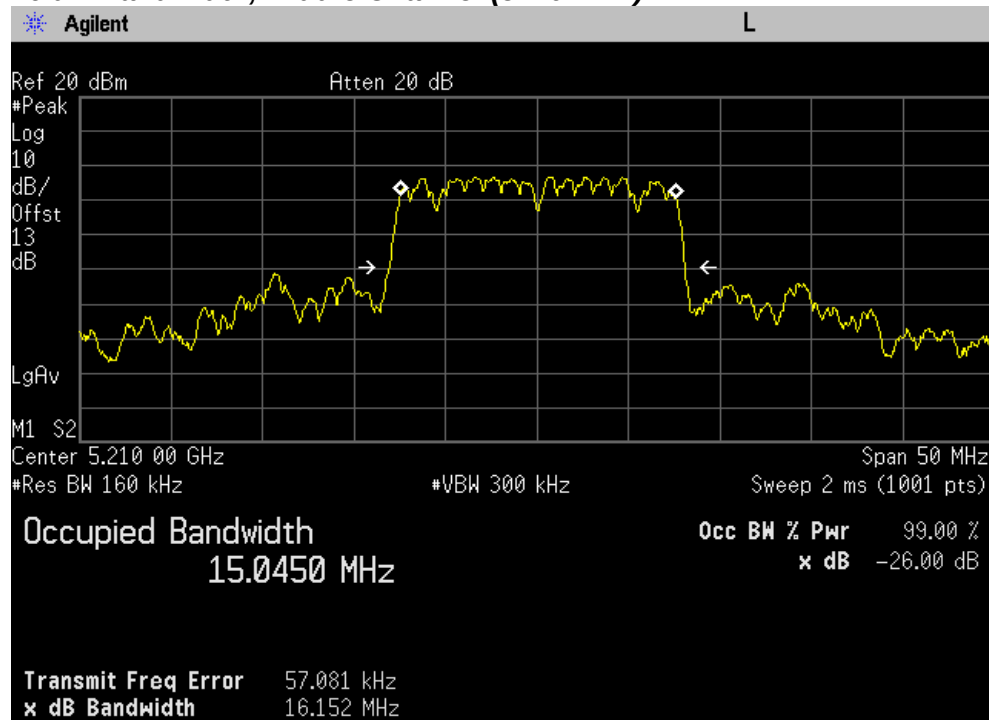
Ant B

26 dB Bandwidth, Lowest Channel (5180 MHz)

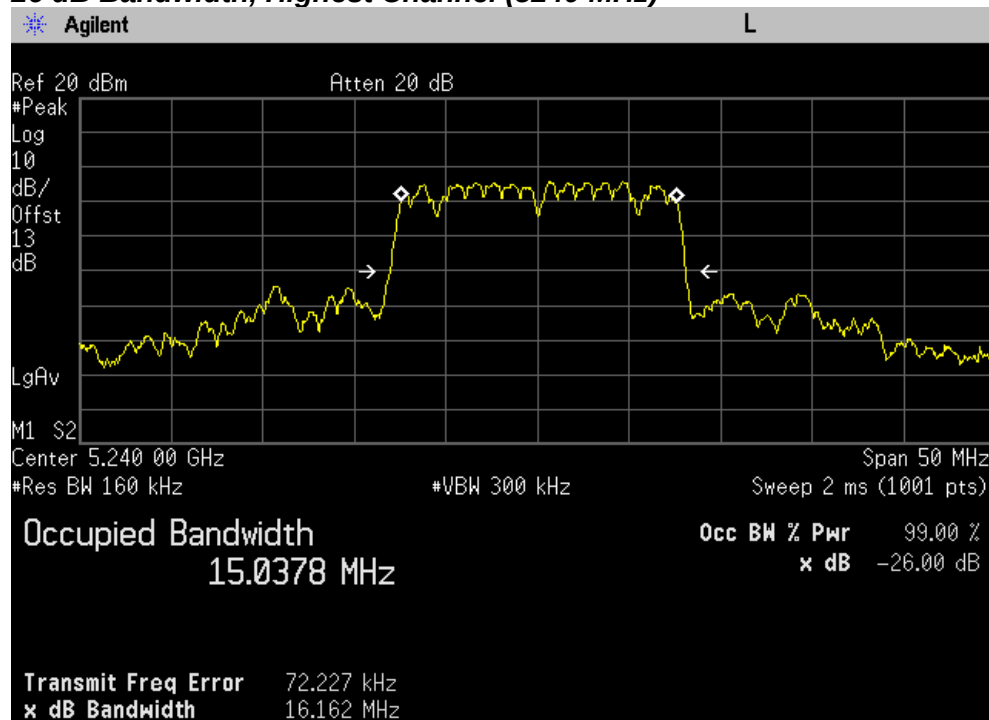


PLOTS OF EMISSIONS

26 dB Bandwidth, Middle Channel (5210 MHz)



26 dB Bandwidth, Highest Channel (5240 MHz)



PLOTS OF EMISSIONS

UNII-3 band

Ant A

26 dB Bandwidth, Lowest Channel (5736 MHz)



26 dB Bandwidth, Middle Channel (5762 MHz)



PLOTS OF EMISSIONS

26 dB Bandwidth, Highest Channel (5814 MHz)



Ant B

26 dB Bandwidth, Lowest Channel (5736 MHz)



PLOTS OF EMISSIONS

26 dB Bandwidth, Middle Channel (5762 MHz)



26 dB Bandwidth, Highest Channel (5814 MHz)



TEST DATA

8.4 6dB Emission Bandwidth – UNII-3 band

FCC §15.407(e)

Test Mode : Set to Lowest channel, Middle channel and Highest channel

Tx mode

UNII-3 band

Channel	Frequency(MHz)	6dB Emission Bandwidth(MHz)		Limit (kHz)
		Ant A	Ant B	
Low	5736	9.85	9.85	>500
Middle	5762	9.85	9.85	
High	5814	9.85	9.85	

PLOTS OF EMISSIONS

UNII-3 band

Ant A

6 dB Bandwidth, Lowest Channel (5736 MHz)



6 dB Bandwidth, Middle Channel (5762 MHz)



PLOTS OF EMISSIONS

6 dB Bandwidth, Highest Channel (5814 MHz)



Ant B

6 dB Bandwidth, Lowest Channel (5736 MHz)



PLOTS OF EMISSIONS

6 dB Bandwidth, Middle Channel (5762 MHz)



6 dB Bandwidth, Highest Channel (5814 MHz)



TEST DATA

8.5 Maximum Conducted Output Power (average)

FCC §15.407(a)

Test Mode : Set to Lowest channel, Middle channel and Highest channel

Tx mode

UNII-1 band

Channel	Frequency (MHz)	Maximum Conducted Power (dBm)*		Conducted Limit (dBm)
		Chain 0	Chain 1	
Lowest	5180	9.08	10.20	23.98
Middle	5210	8.75	9.93	23.98
Highest	5240	8.57	9.77	23.98

UNII-3 band

Channel	Frequency (MHz)	Maximum Conducted Power (dBm)*		Conducted Limit (dBm)
		Chain 0	Chain 1	
Lowest	5736	0.72	3.62	30.00
Middle	5762	0.56	3.75	30.00
Highest	5814	2.41	5.20	30.00

Note:

1. *Maximum Conducted (average) Power was measured according to II.E.2.b) Method SA-1 in **KDB 789033**

D02 General UNII Test Procedures New Rules v01r02

2. The following equation was used for spectrum offset:

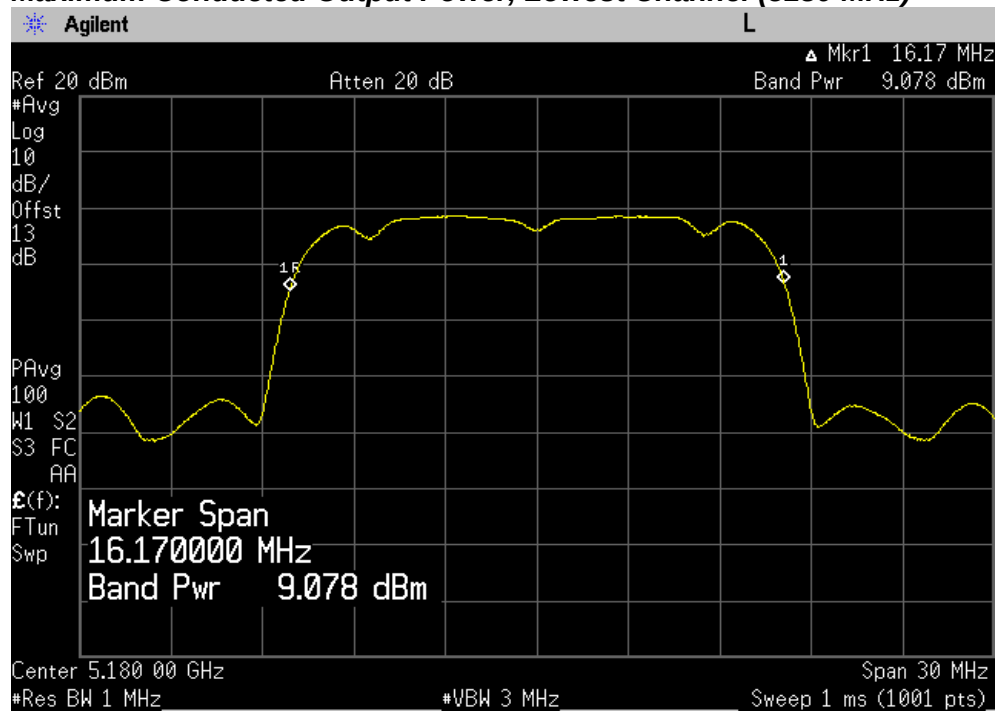
$$\text{Spectrum offset (dB)} = \text{Attenuator (dB)} + \text{Cable Loss (dB)} + \text{SMA Type Connector Loss (dB)}$$

PLOTS OF EMISSIONS

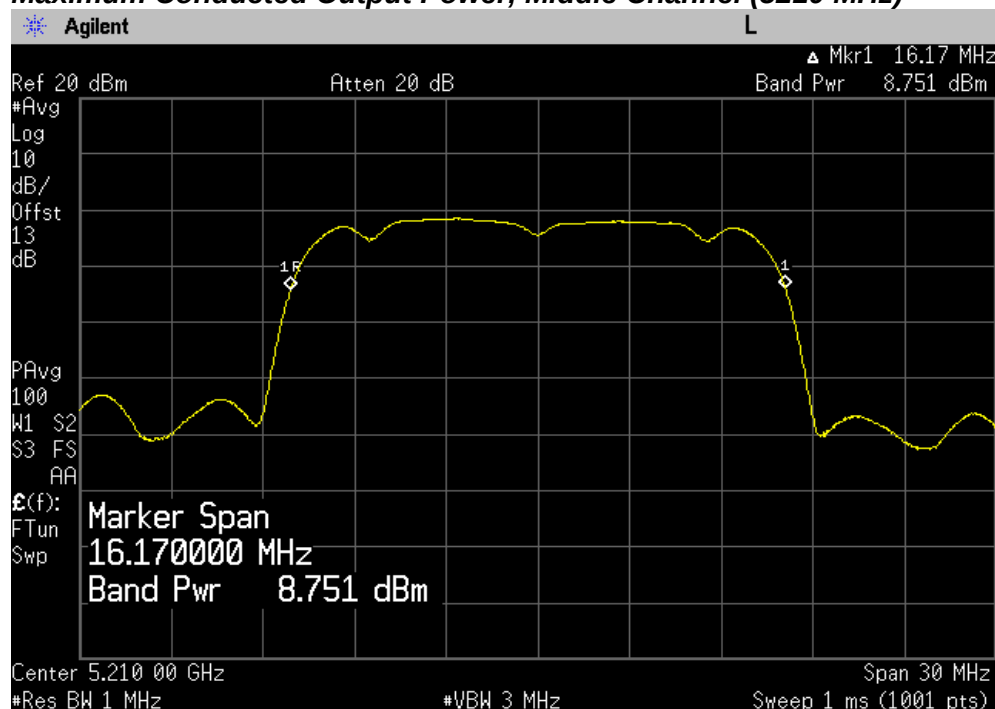
UNII-1 band

Ant A

Maximum Conducted Output Power, Lowest Channel (5180 MHz)

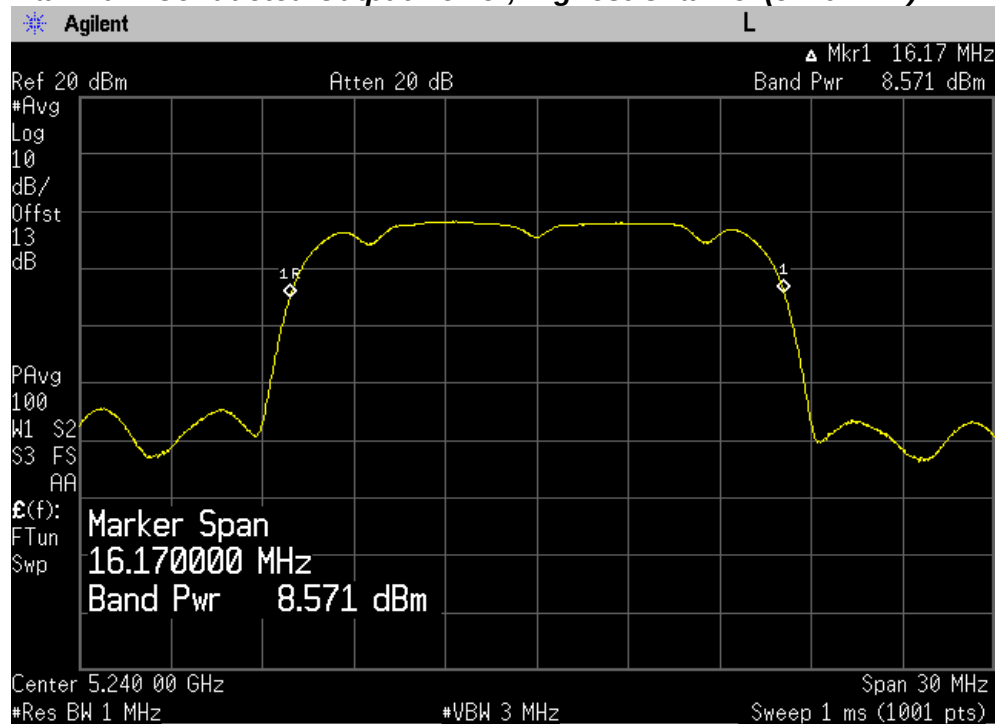


Maximum Conducted Output Power, Middle Channel (5210 MHz)



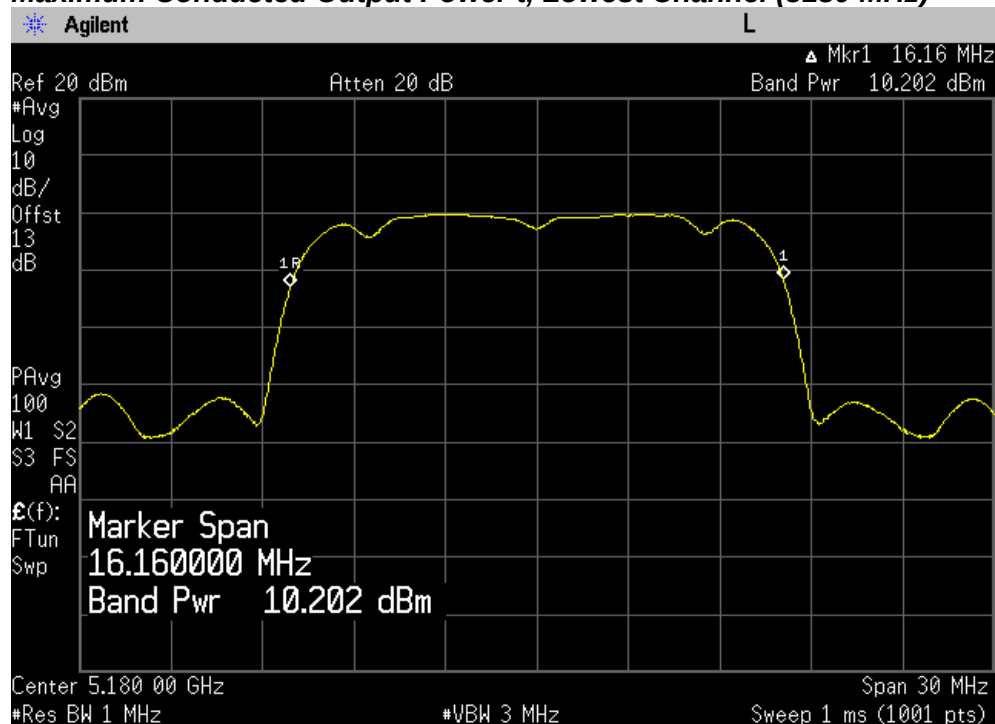
PLOTS OF EMISSIONS

Maximum Conducted Output Power, Highest Channel (5240 MHz)



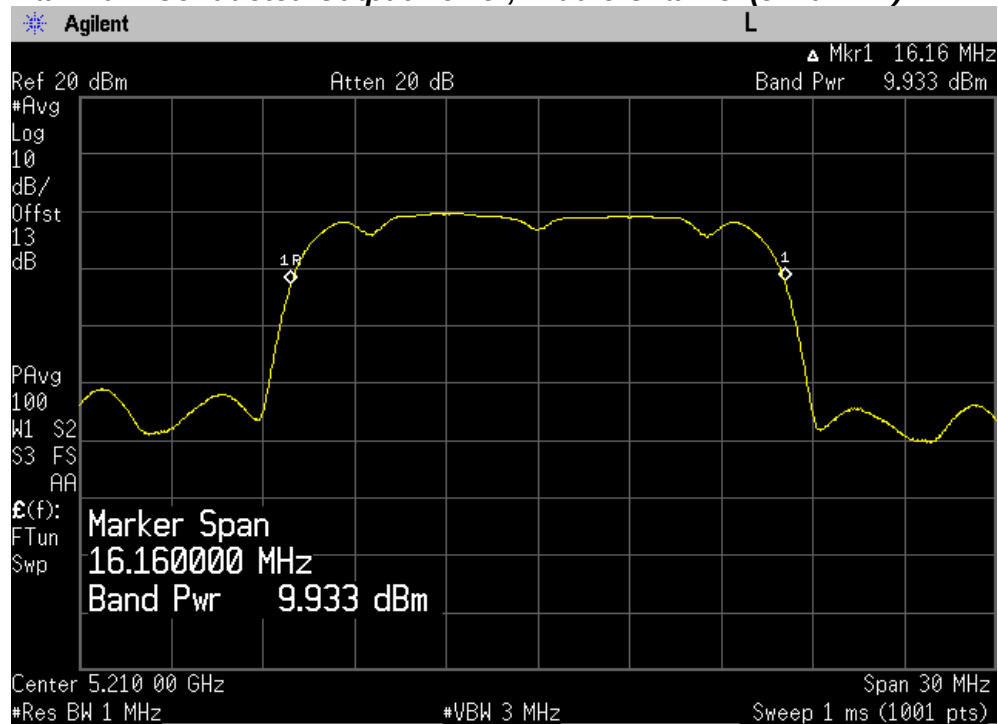
Ant B

Maximum Conducted Output Power t, Lowest Channel (5180 MHz)

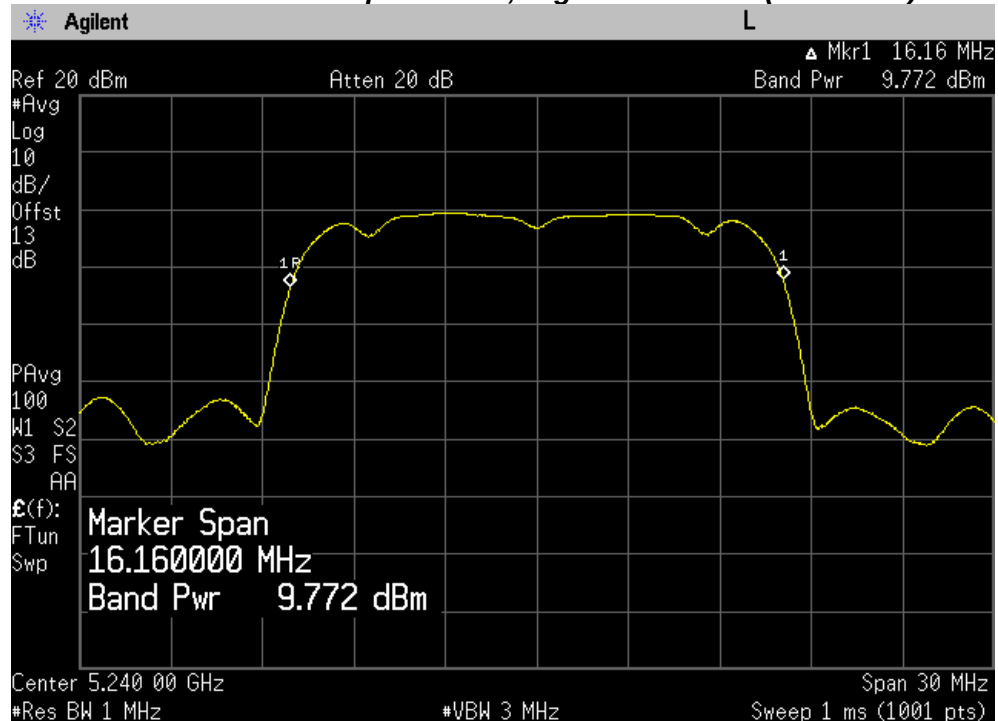


PLOTS OF EMISSIONS

Maximum Conducted Output Power, Middle Channel (5210 MHz)



Maximum Conducted Output Power, Highest Channel (5240 MHz)

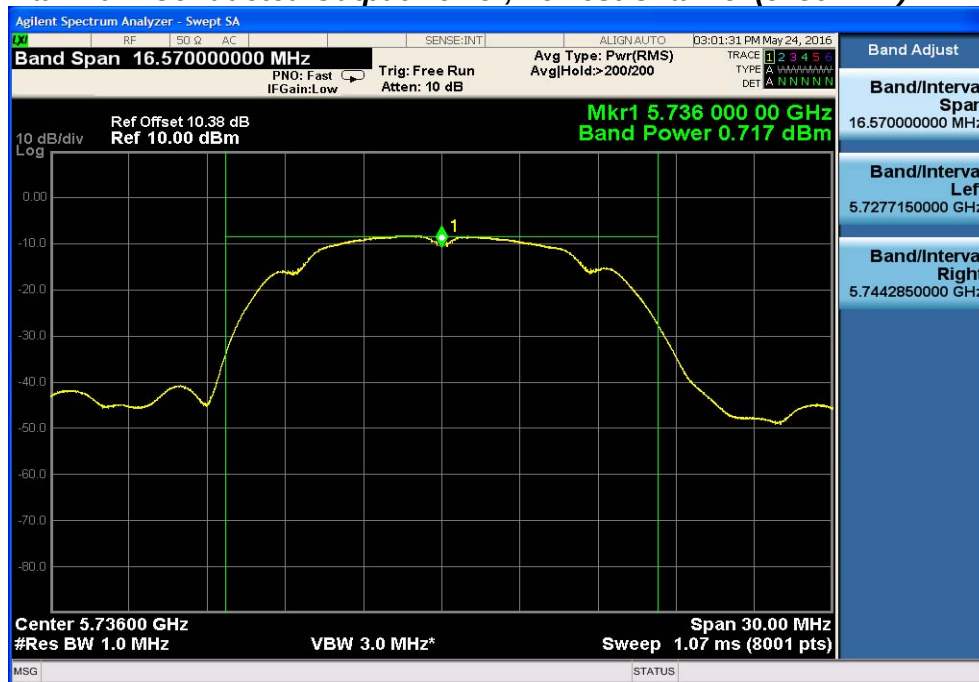


PLOT OF TEST DATA

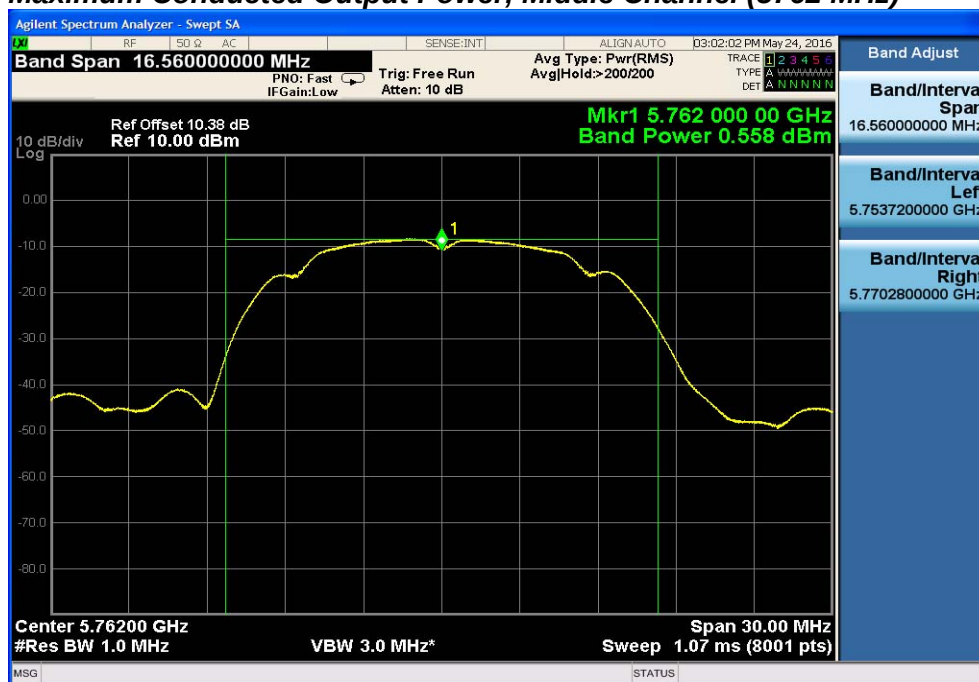
UNII-3 band

Ant A

Maximum Conducted Output Power, Lowest Channel (5736 MHz)

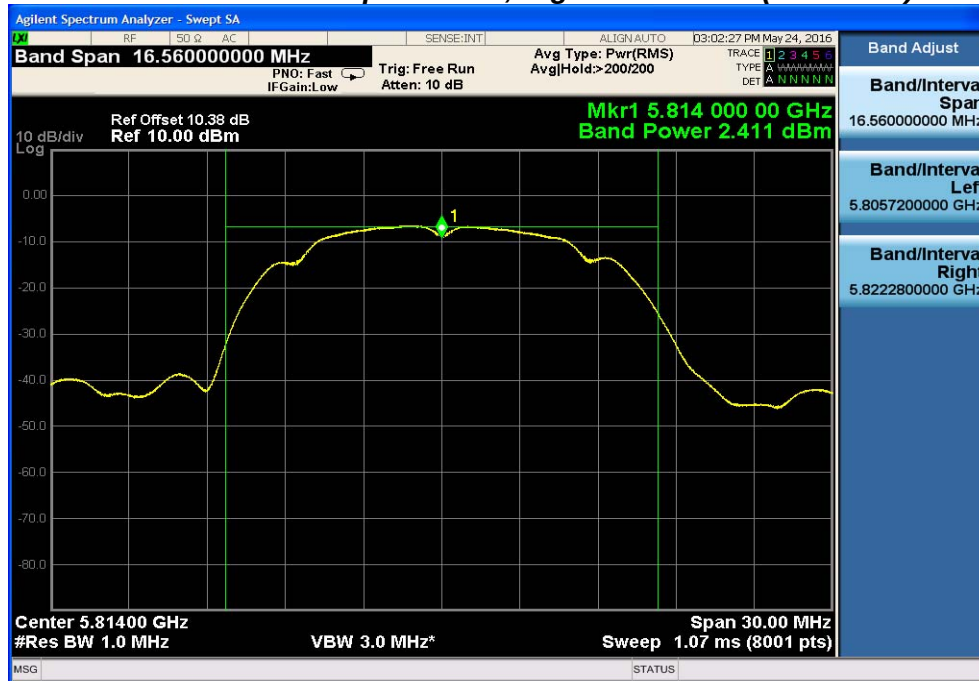


Maximum Conducted Output Power, Middle Channel (5762 MHz)



PLOT OF TEST DATA

Maximum Conducted Output Power, Highest Channel (5814 MHz)



Ant B

Maximum Conducted Output Power, Lowest Channel (5736 MHz)



PLOT OF TEST DATA

Maximum Conducted Output Power, Middle Channel (5762 MHz)



Maximum Conducted Output Power, Highest Channel (5814 MHz)



TEST DATA

8.6 Maximum Power Spectral Density

FCC §15.407(a)

Test Mode : Set to Lowest channel, Middle channel and Highest channel

Tx mode

UNII-1 band

Channel	Frequency (MHz)	Maximum PSD (dBm)*		FCC Limit (dBm/MHz)
		Ant A	Ant B	
Lowest	5180	-1.22	-0.16	11.00
Middle	5210	-1.41	-0.20	11.00
Highest	5240	-1.58	-0.50	11.00

UNII-3 band

Channel	Frequency (MHz)	Maximum PSD (dBm)*		FCC Limit (dBm/ 500kHz)
		Ant A	Ant B	
Lowest	5736	-10.61	-7.70	30.00
Middle	5762	-10.76	-7.50	30.00
Highest	5814	-8.60	-6.02	30.00

Note:

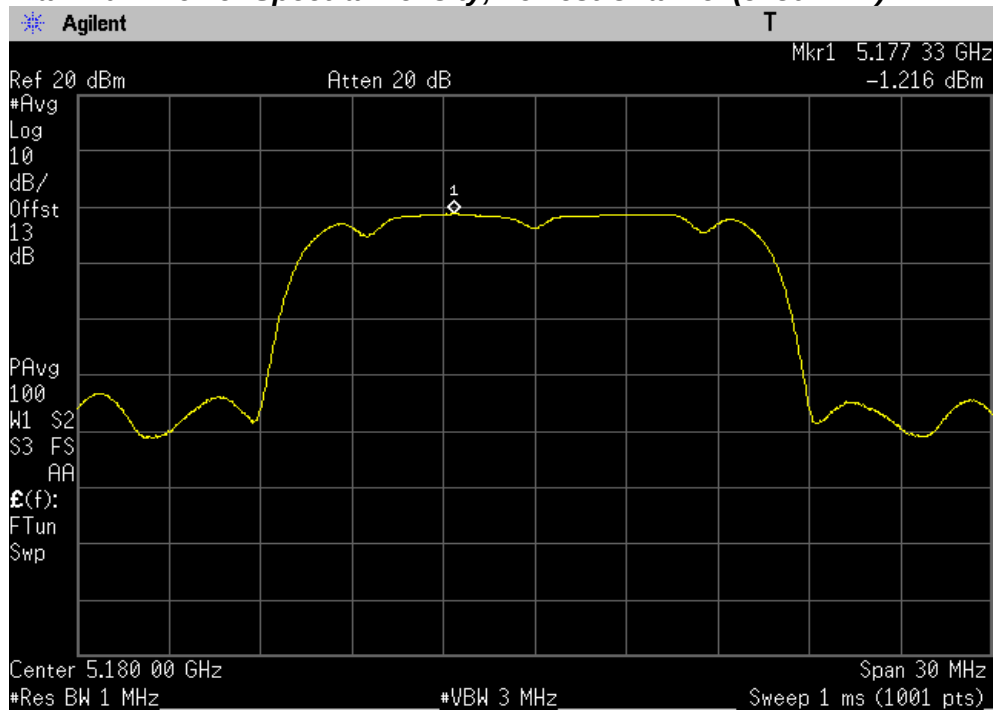
1. Power Spectral Density(PSD) was measured by same method with conducted output power according to II.F.1 in KDB 789033 D02 General UNII Test Procedures New Rules v01r02
2. The following equation was used for spectrum offset:
Spectrum offset (dB) = Attenuator (dB) + Cable Loss (dB) + SMA Type Connector Loss (dB)

PLOT OF TEST DATA

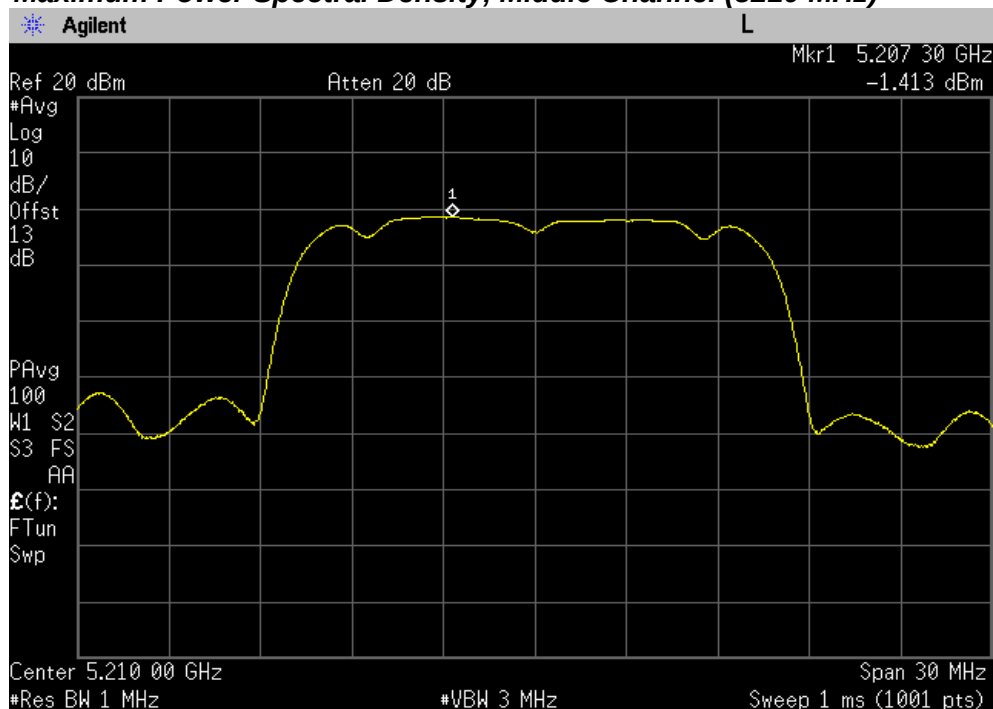
UNII1 band

Ant A

Maximum Power Spectral Density, Lowest Channel (5180 MHz)

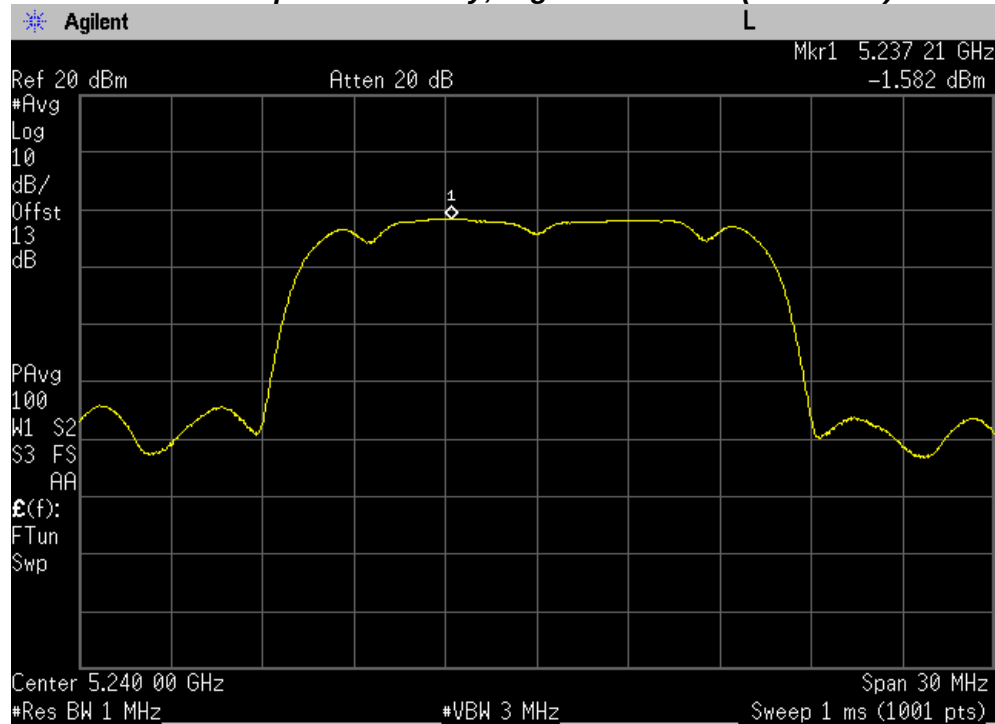


Maximum Power Spectral Density, Middle Channel (5210 MHz)



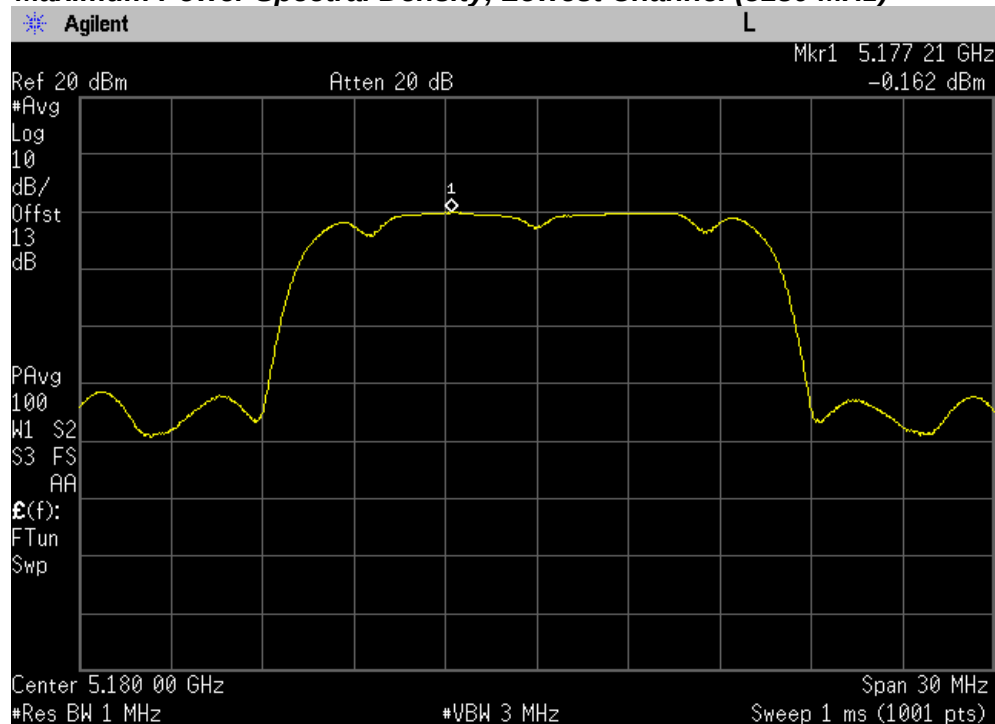
PLOT OF TEST DATA

Maximum Power Spectral Density, Highest Channel (5240 MHz)



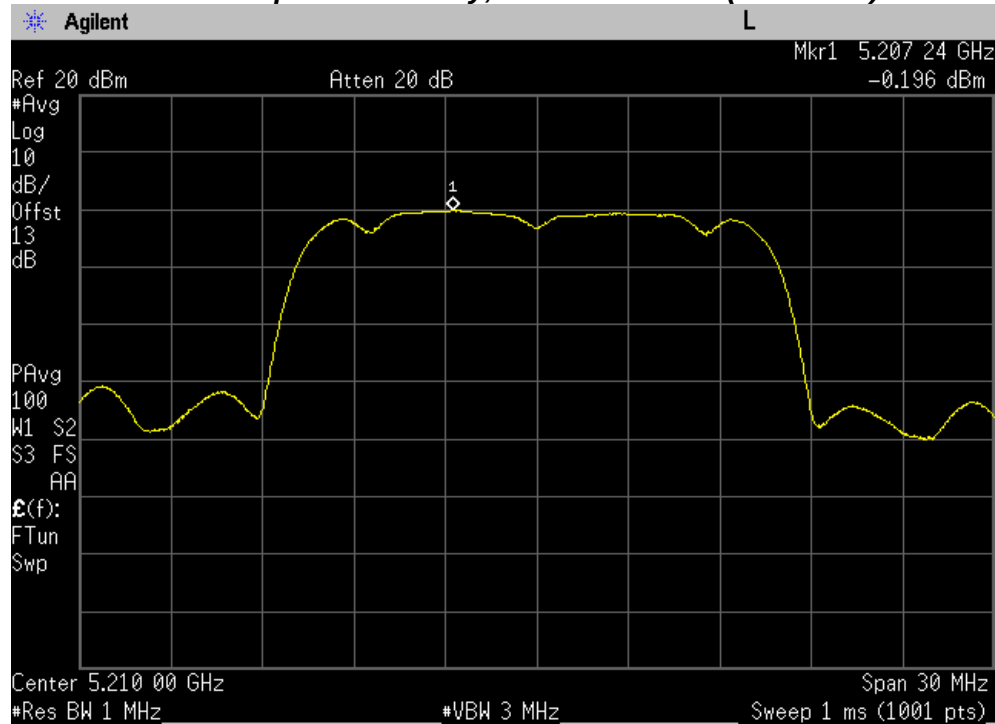
Ant B

Maximum Power Spectral Density, Lowest Channel (5180 MHz)

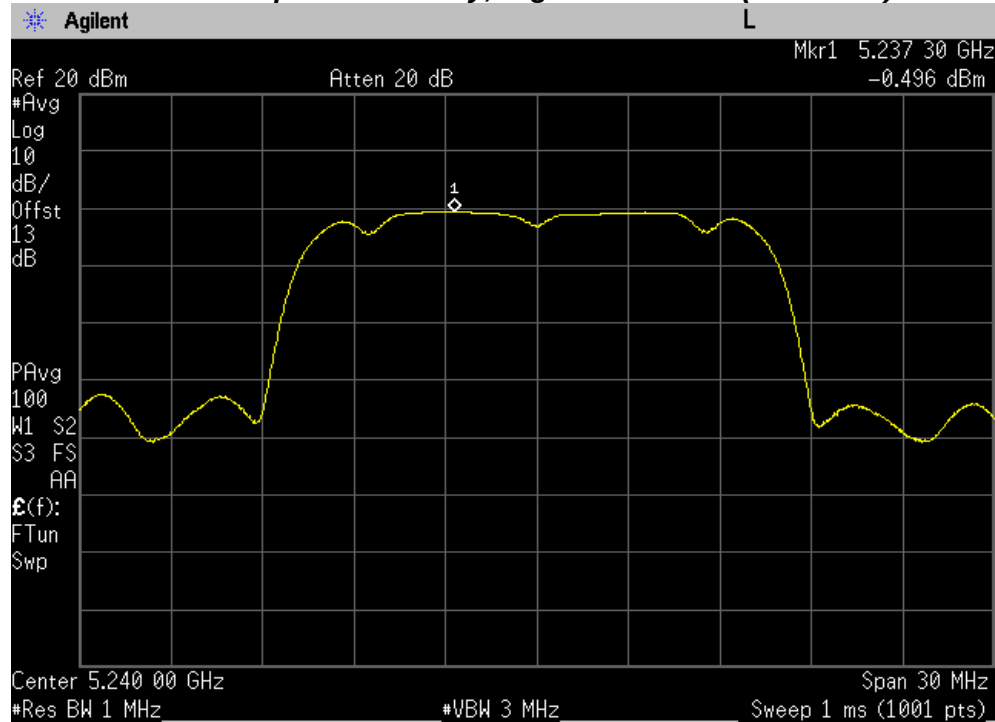


PLOT OF TEST DATA

Maximum Power Spectral Density, Middle Channel (5210 MHz)



Maximum Power Spectral Density, Highest Channel (5240 MHz)



PLOT OF TEST DATA

UNII-3 band

Ant A

Maximum Power Spectral Density, Lowest Channel (5736 MHz)



Maximum Power Spectral Density, Middle Channel (5762 MHz)



PLOT OF TEST DATA

Maximum Power Spectral Density, Highest Channel (5814 MHz)



Ant B

Maximum Power Spectral Density, Lowest Channel (5736 MHz)



PLOT OF TEST DATA

Maximum Power Spectral Density, Middle Channel (5762 MHz)



Maximum Power Spectral Density, Highest Channel (5814 MHz)



TEST DATA

8.7 Radiated Spurious Emissions

FCC §15.407(b)

Test Mode : Set to Lowest channel, Middle channel and Highest channel

Tx mode

UNII-1 band

Ant A

Lowest Channel (5180 MHz)

Frequency (GHz)	Reading (dBμV)	Pol* (H/V)	mode	AF+CL+Amp (dB)**	Distance (dB)***	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)
10.36	49.61	H	peak	2.52	-6.02	46.11	68.2	22.09
15.54	49.75	H	peak	3.66	-6.02	47.39	74.0	26.61
15.54	35.74	H	average	3.66	-6.02	33.38	54.0	20.62

Middle Channel (5210 MHz)

Frequency (GHz)	Reading (dBμV)	Pol* (H/V)	mode	AF+CL+Amp (dB)**	Distance (dB)***	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)
10.42	49.40	V	peak	2.14	-6.02	45.52	68.2	22.68
15.63	49.53	V	peak	3.45	-6.02	46.96	74.0	27.04
15.63	35.42	V	average	3.45	-6.02	32.85	54.0	21.15

Highest Channel (5240 MHz)

Frequency (GHz)	Reading (dBμV)	Pol* (H/V)	mode	AF+CL+Amp (dB)**	Distance (dB)***	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)
10.48	49.20	H	peak	2.89	-6.02	46.07	68.2	22.13
15.72	48.65	H	peak	4.68	-6.02	47.31	74.0	26.69
15.72	34.48	H	average	4.68	-6.02	33.14	54.0	20.86

TEST DATA

Ant B

Lowest Channel (5180 MHz)

Frequency (GHz)	Reading (dBμV)	Pol* (H/V)	mode	AF+CL+Amp (dB)**	Distance (dB)***	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)
10.36	50.71	V	peak	2.52	-6.02	47.21	68.2	20.99
15.54	50.03	V	peak	3.66	-6.02	47.67	74.0	26.33
15.54	36.22	V	average	3.66	-6.02	33.86	54.0	20.14

Middle Channel (5210 MHz)

Frequency (GHz)	Reading (dBμV)	Pol* (H/V)	mode	AF+CL+Amp (dB)**	Distance (dB)***	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)
10.42	48.46	V	peak	2.14	-6.02	44.58	68.2	23.62
15.63	49.98	H	peak	3.45	-6.02	47.41	74.0	26.59
15.63	35.47	H	average	3.45	-6.02	32.90	54.0	21.10

Highest Channel (5240 MHz)

Frequency (GHz)	Reading (dBμV)	Pol* (H/V)	mode	AF+CL+Amp (dB)**	Distance (dB)***	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)
10.48	49.52	H	peak	2.89	-6.02	46.39	68.2	21.81
15.72	48.69	H	peak	4.68	-6.02	47.35	74.0	26.65
15.72	34.46	H	average	4.68	-6.02	33.12	54.0	20.88

TEST DATA

UNII-3 band

Ant A

Lowest Channel (5736 MHz)

Frequency (MHz)	Reading (dBμV)	Pol* (H/V)	mode	AF+CL+Amp (dB)**	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)
1333.00****	53.5	V	peak	-3.1	50.4	74.0	23.6
1700.75****	54.4	V	peak	-2.1	52.3	74.0	21.7

Middle Channel (5762 MHz)

Frequency (MHz)	Reading (dBμV)	Pol* (H/V)	mode	AF+CL+Amp (dB)**	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)
2240.75****	52.4	V	peak	0.0	52.4	74.0	21.6
2548.00	50.3	V	peak	0.8	51.1	68.0	16.9

Highest Channel (5814 MHz)

Frequency (MHz)	Reading (dBμV)	Pol* (H/V)	mode	AF+CL+Amp (dB)**	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)
2549.75	49.9	V	peak	0.8	50.7	68.2	17.5

Ant B

Lowest Channel (5736 MHz)

Frequency (MHz)	Reading (dBμV)	Pol* (H/V)	mode	AF+CL+Amp (dB)**	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)
1699.50****	51.6	V	peak	-2.1	49.5	74.0	24.5
2394.75	52.0	V	peak	0.4	52.4	68.2	15.8
2397.50	52.3	V	peak	0.4	52.7	68.2	15.5

Middle Channel (5762 MHz)

Frequency (MHz)	Reading (dBμV)	Pol* (H/V)	mode	AF+CL+Amp (dB)**	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)
2461.50	48.5	H	peak	0.7	49.2	68.2	19.0

TEST DATA

Highest Channel (5814 MHz)

Frequency (MHz)	Reading (dBμV)	Pol* (H/V)	mode	AF+CL+Amp (dB)**	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)
1698.50****	51.3	H	peak	-2.1	49.2	74.0	24.8
2250.75****	50.2	H	peak	0.1	50.3	74.0	23.7
2459.75	51.1	V	peak	0.7	51.8	68.2	16.4

Note:

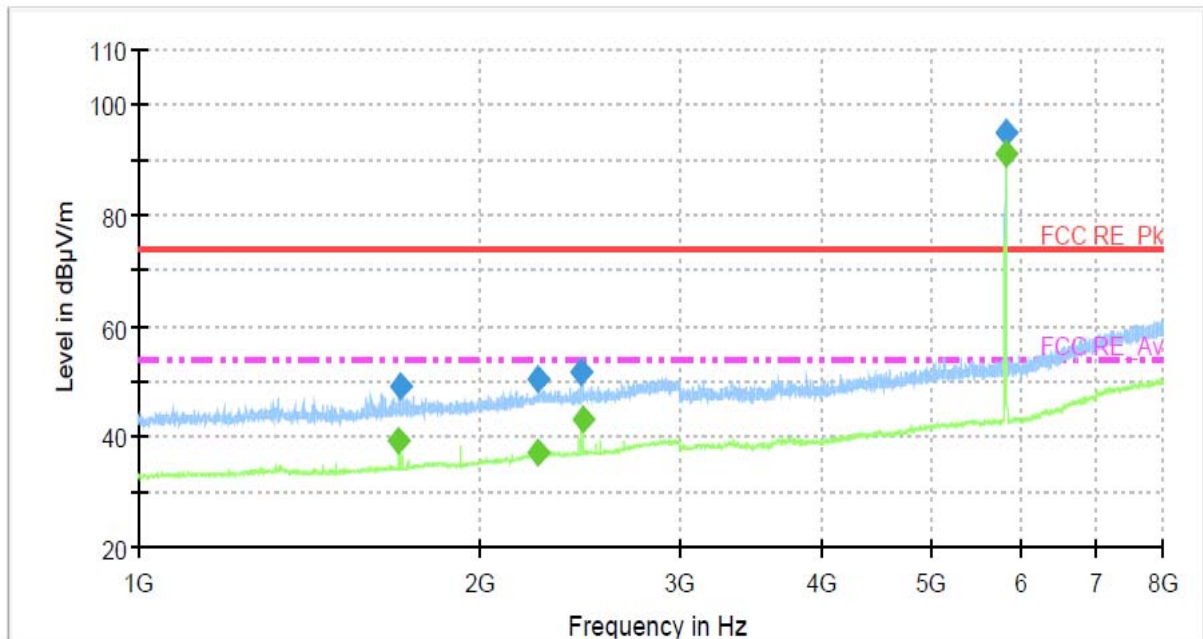
- *Pol. H = Horizontal V = Vertical
- **AF + CL + Amp. = Antenna Factor + Cable Loss + Amplifier.
- ***Distance factor = $20 \log (\text{test distance/specific distance}) = 20 \log (1.5 / 3)$
- ****The results were measured in restricted band. However average measurements were not performed since the peak measurements satisfied the average limit (54dBuV/m) of FCC §15.209
- At frequencies above 1 GHz, peak emissions were measured using RBW = 1 MHz, VBW = 3 MHz, Detector = Peak.
- As the EUT was configured to transmit with 100% duty cycle, at frequencies above 1 GHz, average emission levels were measured using the "Method VB" by setting the analyzer RBW = 1 MHz, VBW = 3 kHz ($\text{VBW} \leq \text{RBW}/100$), Detector = Peak.
- The spectrum is measured from 9 kHz to 10th harmonic and the worst-case emissions are reported. No significant emissions were found beyond the third harmonic and 26.5GHz for this device.
- For outside of the restricted band, the peak limit is 68.2 dBμV/m. ($E[\text{dBμV/m}] = \text{EIRP}[\text{dBm}] + 95.2 = 68.2 \text{ dBuV/m}$, for $\text{EIPR}[\text{dBm}] = -27\text{dBm}$.)
- For restricted band, the peak limit is 74 dBμV/m, the average limit is 54 dBμV/m per FCC §15.209
- There is no spurious emission in UNII-1 band.
Then, Highest channel(5814MHz) on Ant B was the worst case with respect to conducted outputpower.
- The radiated emissions testing were made by rotating EUT through three orthogonal axes and rotating the receive antenna with horizontal, Vertical polarization. The worst data was recorded.
- At frequencies above 1 GHz, EUT was placed at a height of 1.5m above the floor on a support according to ANSI 63.10-2013.

PLOTS OF EMISSIONS

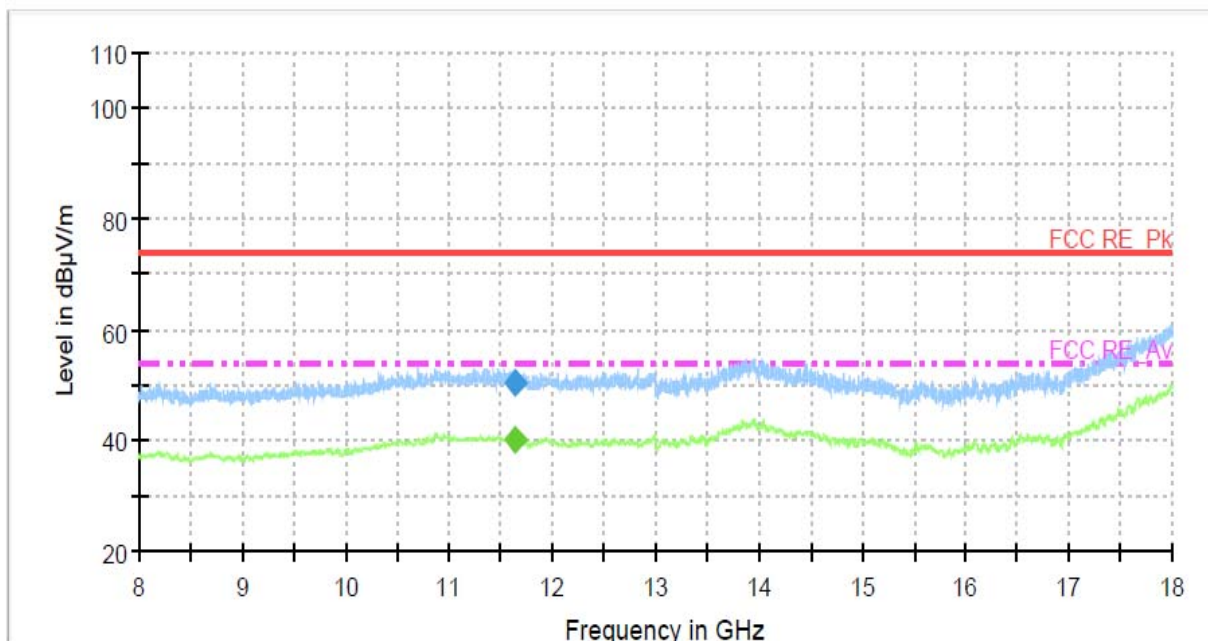
Worst Case

Ant B

Highest channel : 1 GHz to 8 GHz

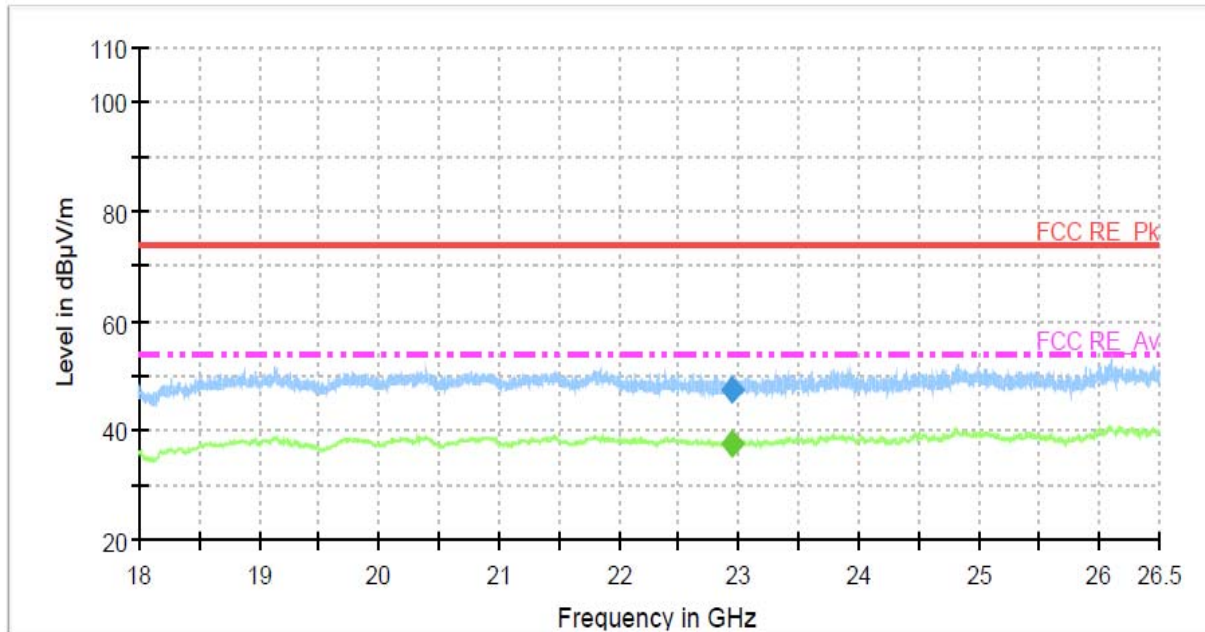


Highest channel : 8 GHz to 18 GHz (2nd harmonic)

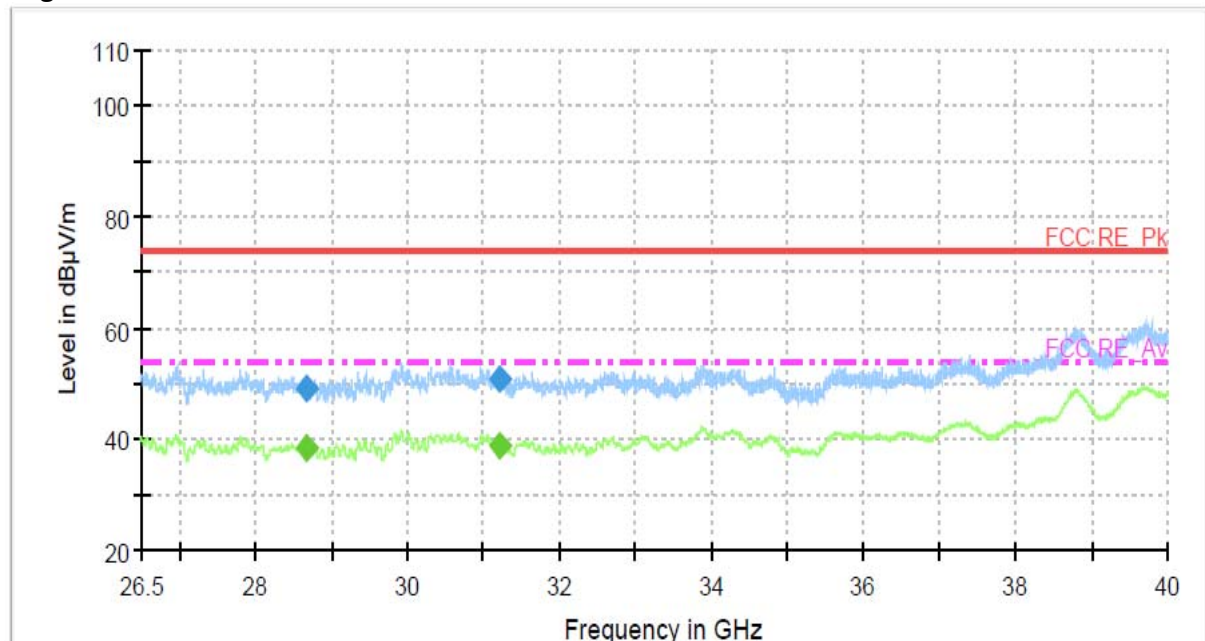


PLOTS OF EMISSIONS

Highest channel : 18 GHz to 26.5 GHz



Highest channel : 26.5 GHz to 40 GHz



TEST DATA

8.8 Radiated Band Edge

FCC §15.407(b)

Test Mode : Set to Lowest channel and Highest channel

Tx mode

UNII-1 band

Ant A

Lowest Channel (5180 MHz)

Frequency (MHz)	Reading (dBμV)	Pol* (H/V)	mode	AF+CL+Amp (dB)**	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)
5150.00***	40.70	H	peak	9.60	50.30	74.0	23.70

Highehst Channel (5240 MHz)

Frequency (MHz)	Reading (dBμV)	Pol* (H/V)	mode	AF+CL+Amp (dB)**	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)
5350.00***	38.50	H	peak	9.80	48.30	74.0	25.70

Ant B

Lowest Channel (5180 MHz)

Frequency (MHz)	Reading (dBμV)	Pol* (H/V)	mode	AF+CL+Amp (dB)**	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)
5150.00***	38.70	V	peak	9.60	48.30	74.0	25.70

Highehst Channel (5240 MHz)

Frequency (MHz)	Reading (dBμV)	Pol* (H/V)	mode	AF+CL+Amp (dB)**	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)
5350.11***	39.80	H	peak	9.80	49.60	74.0	24.40

TEST DATA

UNII-3 band

Ant A

Lowest Channel (5736 MHz)

Frequency (MHz)	Reading (dBμV)	Pol* (H/V)	mode	AF+CL+Amp (dB)**	Result (dBμV/m)	Limit**** (dBμV/m)	Margin (dB)
5721.27	56.70	H	peak	11.00	67.70	78.2	10.50
5725.00	55.10	H	peak	11.00	66.10	78.2	12.10

Highehst Channel (5814 MHz)

Frequency (MHz)	Reading (dBμV)	Pol* (H/V)	mode	AF+CL+Amp (dB)**	Result (dBμV/m)	Limit**** (dBμV/m)	Margin (dB)
5850.00	40.60	H	peak	11.40	52.00	78.2	26.20

Ant B

Lowest Channel (5736 MHz)

Frequency (MHz)	Reading (dBμV)	Pol* (H/V)	mode	AF+CL+Amp (dB)**	Result (dBμV/m)	Limit**** (dBμV/m)	Margin (dB)
5721.07	54.50	H	peak	11.00	65.50	78.2	12.70
5725.00	53.20	H	peak	11.00	64.20	78.2	14.00

Highehst Channel (5814 MHz)

Frequency (MHz)	Reading (dBμV)	Pol* (H/V)	mode	AF+CL+Amp (dB)**	Result (dBμV/m)	Limit**** (dBμV/m)	Margin (dB)
5850.00	41.00	H	peak	11.40	52.40	78.2	25.80

TEST DATA

Note:

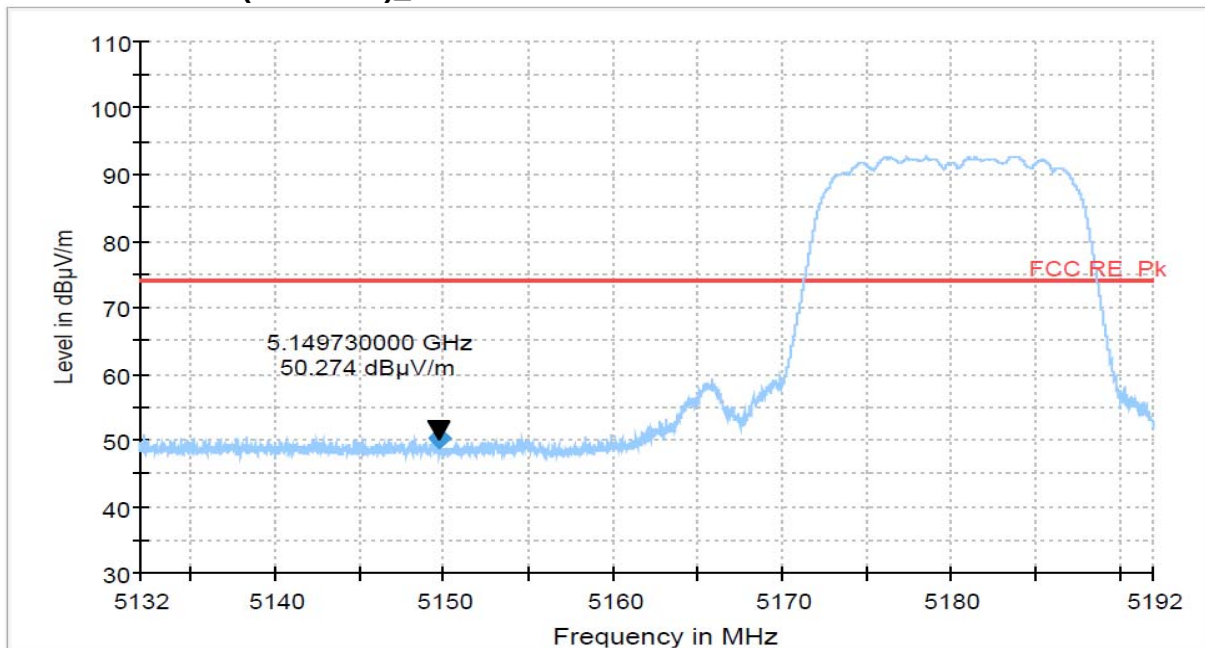
1. *Pol. H = Horizontal V = Vertical
2. **AF + CL + Amp. = Antenna Factor + Cable Loss + Amplifier.
3. ***The results were measured in restricted band. However average measurements were not performed since the peak measurements satisfied the average limit (54dBuV/m) of FCC §15.209
4. At frequencies above 1 GHz, peak emissions were measured using RBW = 1 MHz, VBW = 3 MHz, Detector = Peak.
5. As the EUT was configured to transmit with 100% duty cycle, at frequencies above 1 GHz, average emission levels were measured using the "Method VB" by setting the analyzer RBW = 1 MHz, VBW = 3 kHz ($VBW \leq RBW/100$), Detector = Peak.
6. For outside of the restricted band, the peak limit is 68.2 dBuV/m. ($E[dBuV/m] = EIRP[dBm] + 95.2 = 68.2$ dBuV/m, for $EIRP[dBm] = -27dBm$.)
****For 5.725-5.85 GHz band, All emissions within the frequency range from the band edge to 10 MHz above or below the band edge shall not exceed an e.i.r.p. of -17 dBm/MHz; for frequencies 10 MHz or greater above or below the band edge, emissions shall not exceed an e.i.r.p. of -27 dBm/MHz.
peak limit is 78.2 dBuV/m. ($E[dBuV/m] = EIRP[dBm] + 95.2 = 78.2$ dBuV/m, for $EIRP[dBm] = -17dBm$.)
peak limit is 68.2 dBuV/m. ($E[dBuV/m] = EIRP[dBm] + 95.2 = 68.2$ dBuV/m, for $EIRP[dBm] = -27dBm$.)
7. For restricted band, the peak limit is 74 dBuV/m, the average limit is 54 dBuV/m per FCC §15.209
8. The radiated emissions testing were made by rotating EUT through three orthogonal axes and rotating the receive antenna with horizontal, Vertical polarization. The worst data was recorded.
9. At frequencies above 1 GHz, EUT was placed at a height of 1.5m above the floor on a support according to ANSI 63.10-2013.

PLOTS OF EMISSIONS

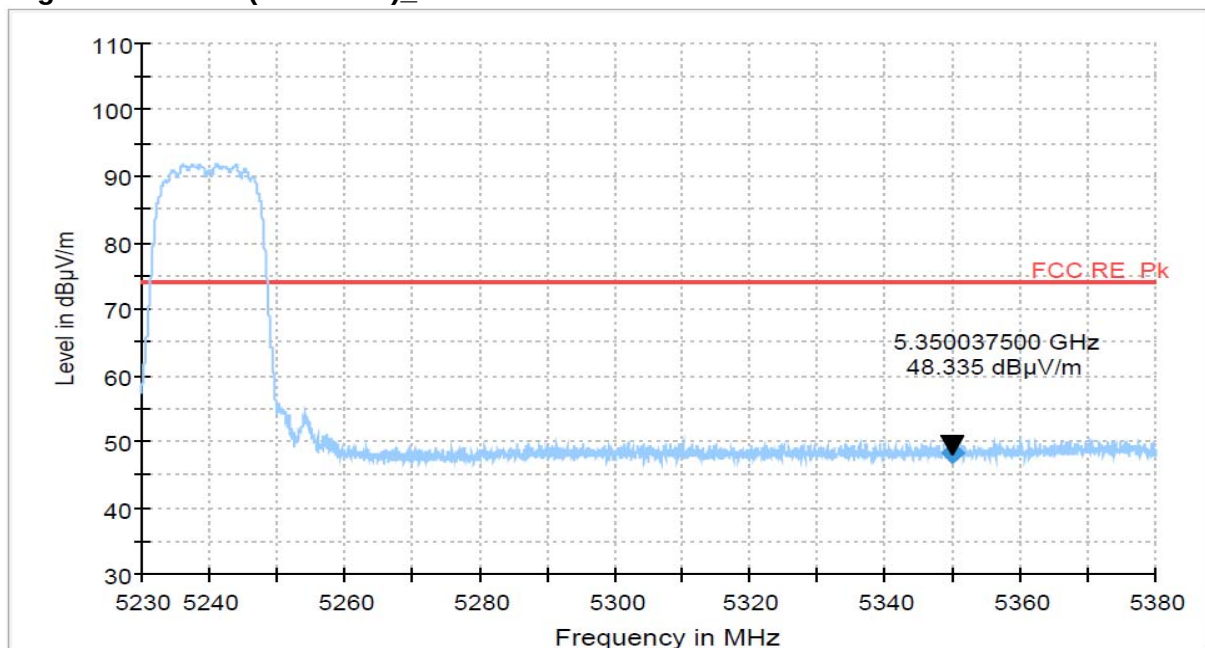
UNII-1 band

Ant A

Lowest Channel (5180 MHz)_PK



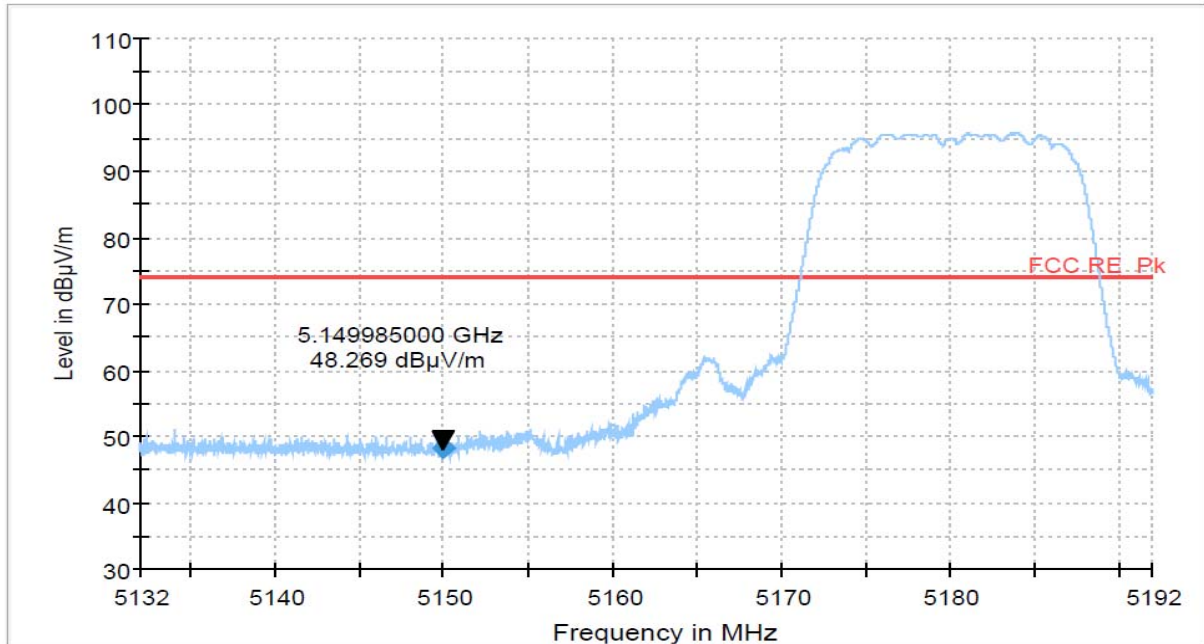
Highest Channel (5240 MHz)_PK



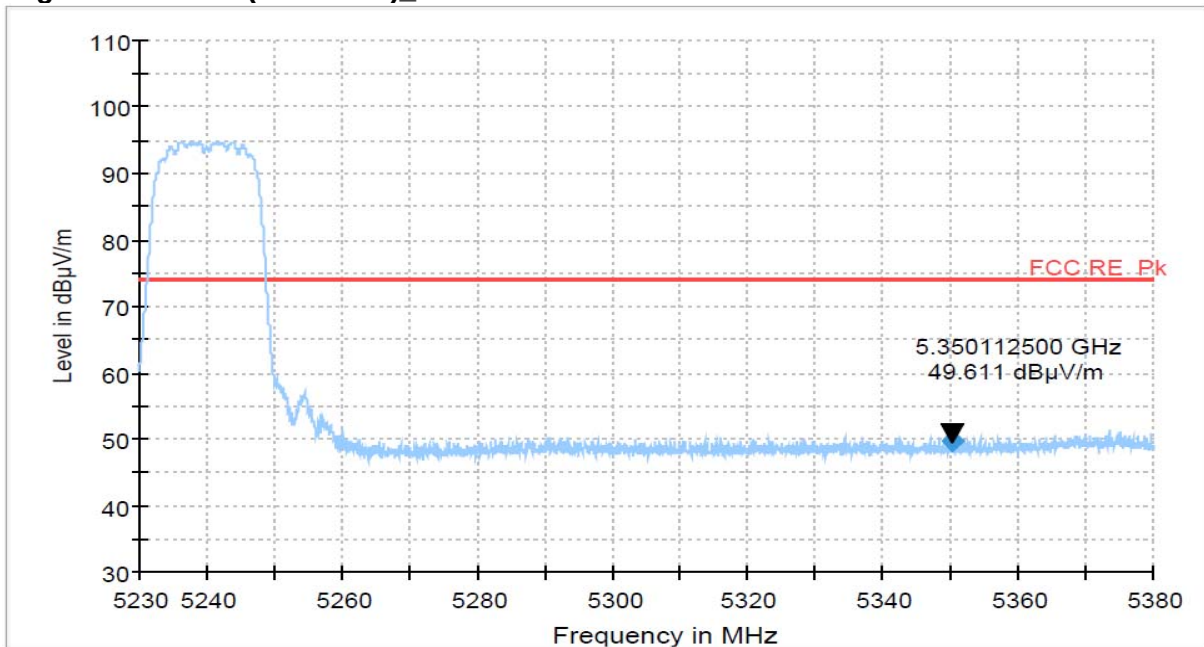
PLOTS OF EMISSIONS

Ant B

Lowest Channel (5180 MHz)_PK



Highest Channel (5240 MHz)_PK

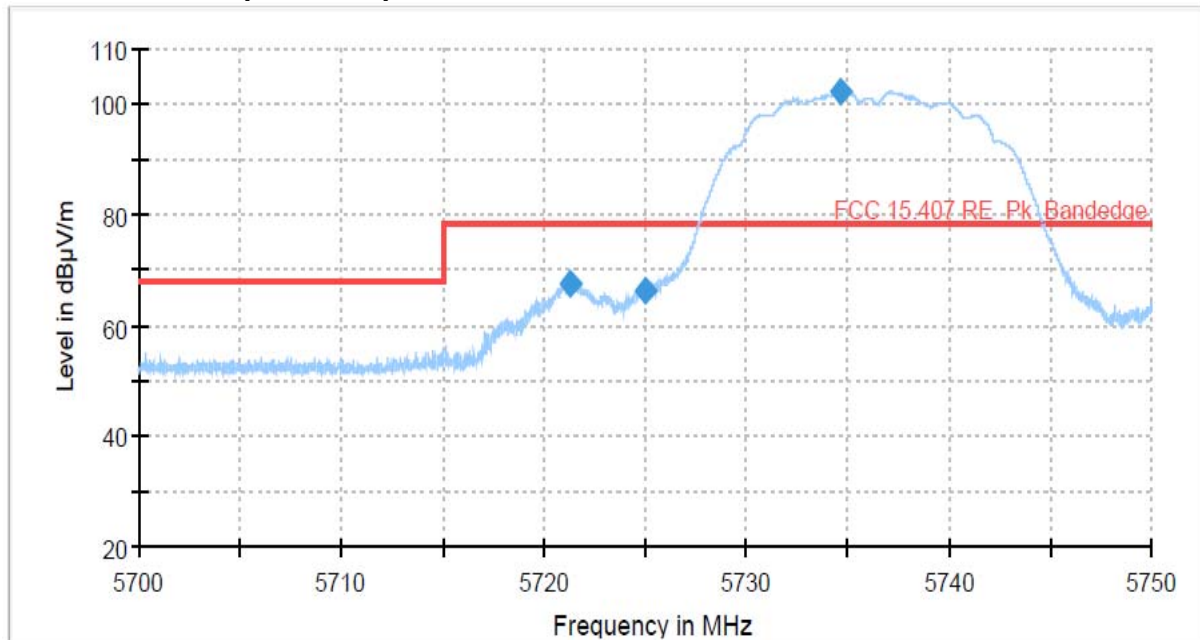


PLOTS OF EMISSIONS

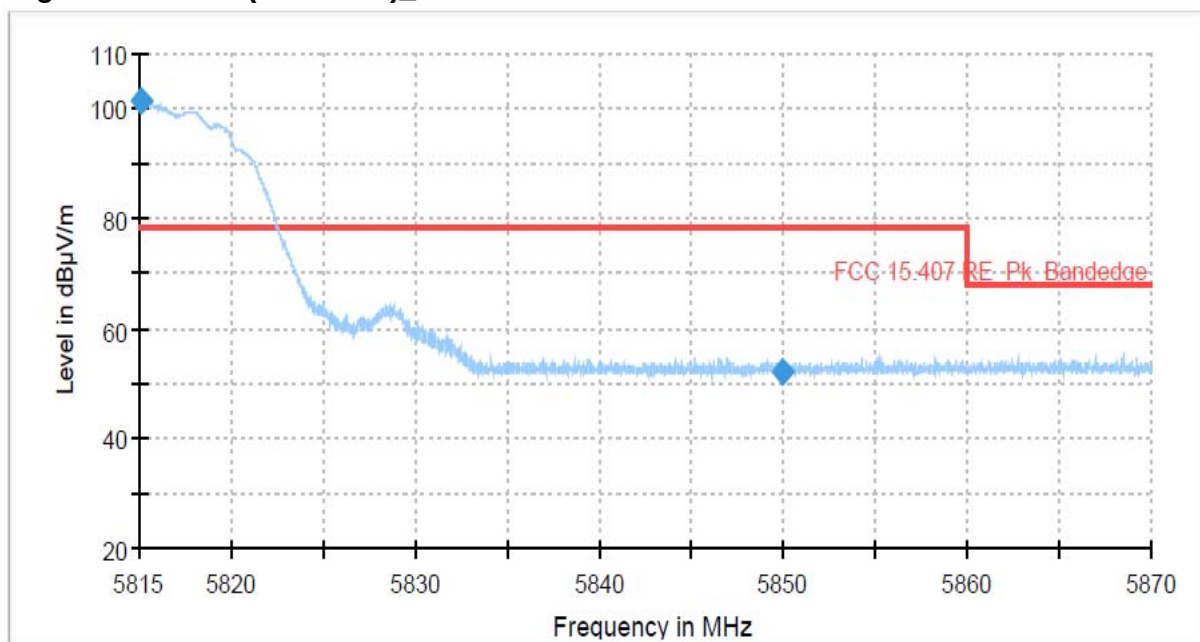
UNII-3 band

Ant A

Lowest Channel (5736 MHz)_PK



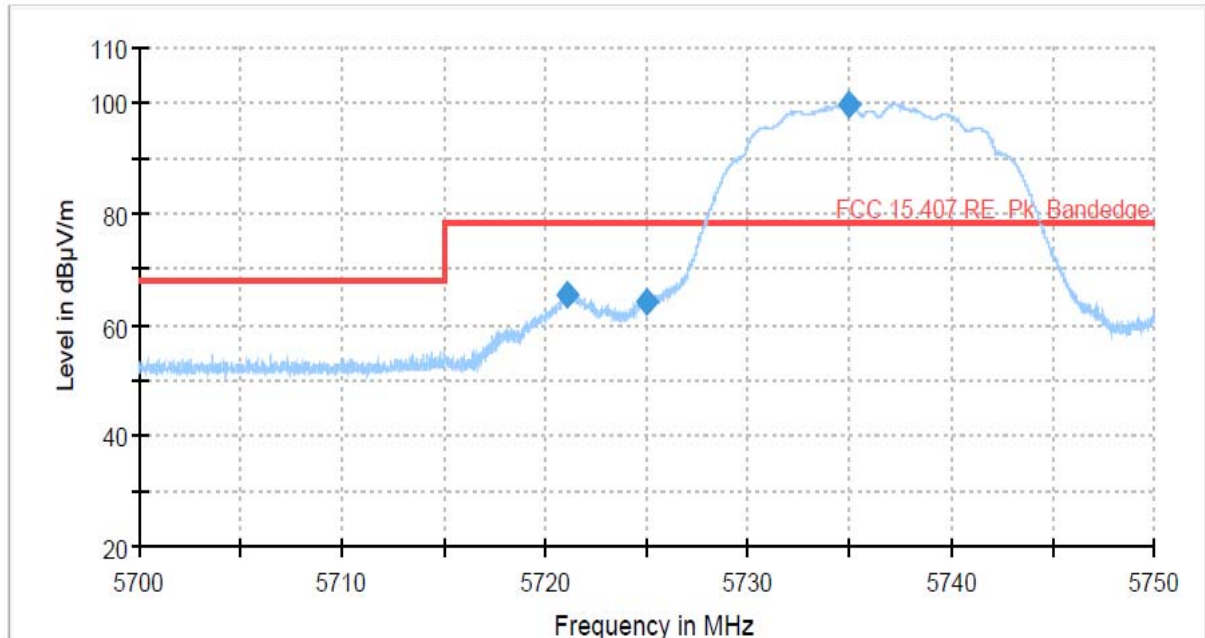
Highest Channel (5814 MHz)_PK



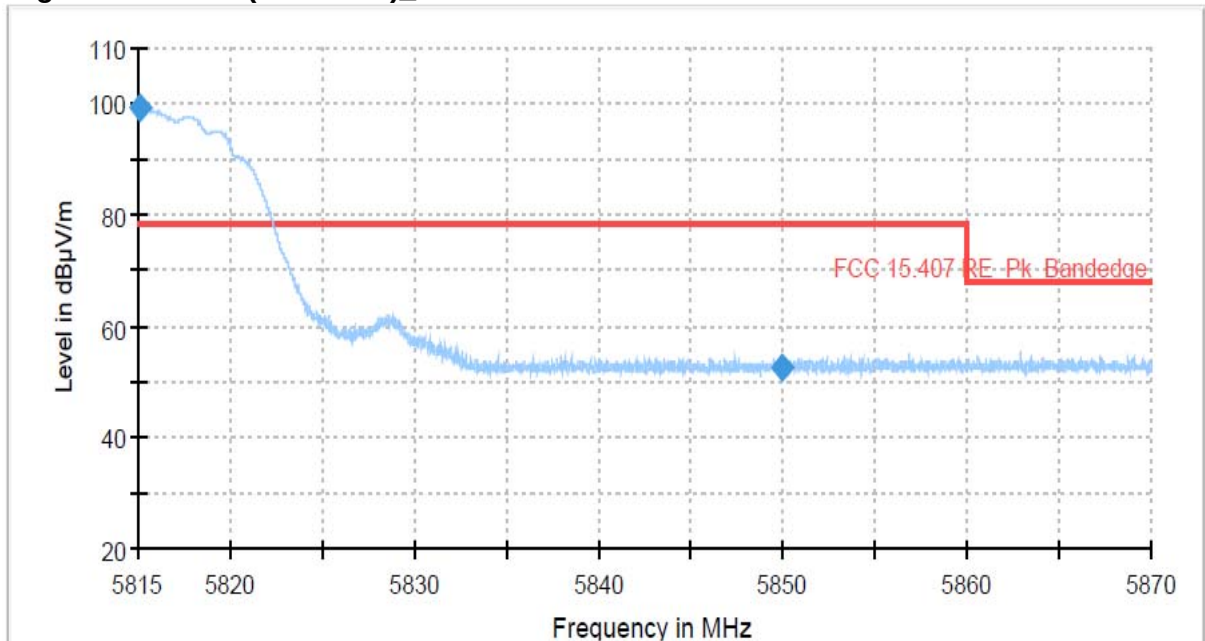
PLOTS OF EMISSIONS

Ant B

Lowest Channel (5736 MHz)_PK



Highest Channel (5814 MHz)_PK



9. TEST EQUIPMENT

No.	Instrument	Manufacturer	Model	Serial No.	Calibration Date	Calibration Interval
1	*Test Receiver	R & S	ESU 40	100202	Apr. 04 2016	1 year
2	*Test Receiver	R & S	ESCS30	100302	Oct. 06 2015	1 year
3	*Attenuator	PASTERNAK	PE7395-10	1441	Jan. 19 2016	1 year
4	*Attenuator	FAIRVIEW	SA3N5W-06	N/A	Apr. 04 2016	1 year
5	*Attenuator	FAIRVIEW	SA3N5W-10	N/A	Apr. 04 2016	1 year
6	*Attenuator	WEINSCHL	56-10	58765	Oct. 02 2015	1 year
7	*Amplifier	R & S	SCU 01	10030	Apr. 04 2016	1 year
8	*Amplifier	R & S	SCU18	10065	Apr. 04 2016	1 year
9	*Amplifier	R & S	SCU26	10011	Jul. 17 2015	1 year
10	*Amplifier	R & S	SCU40	10008	Aug. 10 2015	1 year
11	*Pre Amplifier	HP	8449B	3008A00107	Jan. 07 2016	1 year
12	*Spectrum Analyzer	Agilent	N9020A	MY51110087	Oct. 15 2015	1 year
13	*Spectrum Analyzer	Agilent	E4440A	MY44303257	Oct. 07 2015	1 year
14	*Spectrum Analyzer	R&S	FSP40	100361	Jul. 16 2015	1 year
15	DC Power Supply	HP	6574A	US36340190	Jul. 17 2015	1 year
16	*Loop Antenna	R & S	HFH2-Z2	100279	Feb. 22 2016	2 year
17	Wideband Power Sensor	R & S	NRP-Z81	100634	Jul. 17 2015	1 year
18	*Horn Antenna	SCHWARZBECK	BBHA9120D	9120D-474	Sep. 01 2014	2 year
19	*Horn Antenna	Q-par Angus	QSH20S20	8179	Apr. 30 2015	2 year
20	*Horn Antenna	Q-par Angus	QSH22K20	8180	Apr. 30 2015	2 year
21	*Trilog-Broadband Antenna	SCHWARZBECK	VULB 9163	9163-423	Nov. 04 2015	2 year
22	*LISN	R & S	ESH3-Z5	833874/006	Oct. 06 2015	1 year
23	*Controller	INNCO	CO2000-G	CO2000/562/23890210/L	N/A	N/A
24	*Turn Table	INNCO	DT3000-3T	N/A	N/A	N/A
25	*Antenna Mast	INNCO	MA4000-EP	N/A	N/A	N/A
26	*Open Switch And Control Unit	R & S	OSP-120	100015	N/A	N/A
27	*Anechoic Chamber	Seo-Young EMC	N/A	N/A	N/A	N/A
28	*Position Controller	INNCO	CO2000	12480406/L	N/A	N/A
29	*Turn Table	INNCO	DS1200S	N/A	N/A	N/A
30	*Antenna Mast	INNCO	MA4000	N/A	N/A	N/A
31	*Anechoic Chamber	Seo-Young EMC	N/A	N/A	N/A	N/A
32	Shielded Room	Seo-Young EMC	N/A	N/A	N/A	N/A
33	*Open Switch And Control Unit	R & S	OSP-120	100081	N/A	N/A

*) Test equipment used during the test

10. ACCURACY OF MEASUREMENT

The Measurement Uncertainties stated were calculated in accordance with the requirements of measurement uncertainty contained in CISPR 16-4-2 with the confidence level of 95%

1. Conducted Uncertainty Calculation

Source of Uncertainty	X_i	Uncertainty of X_i		Coverage factor k	$u(X_i)$ (dB)	C_i	$C_i u(X_i)$ (dB)
		Value (dB)	Probability Distribution				
Receiver reading	R_I	± 0.1	normal 1	1.000	0.1	1	0.1
Attenuation AMN-Receiver	LC	± 0.08	normal 2	2.000	0.04	1	0.04
AMN Voltage division factor	L_{AMN}	± 0.8	normal 2	2.000	0.4	1	0.4
Sine wave voltage	dV_{SW}	± 2.00	normal 2	2.000	1.00	1	1.00
Pulse amplitude response	dV_{PA}	± 1.50	rectangular	1.732	0.87	1	0.87
Pulse repetition rate response	dV_{PR}	± 1.50	rectangular	1.732	0.87	1	0.87
Noise floor proximity	dV_{NF}	± 0.00	-	-	0.00	1	0.00
AMN Impedance	dZ	± 1.80	triangular	2.449	0.73	1	0.73
Ⓐ Mismatch	M	+ 0.70	U-Shaped	1.414	0.49	1	0.49
Ⓑ Mismatch	M	- 0.80	U-Shaped	1.414	- 0.56	1	- 0.56
Measurement System Repeatability	RS	0.05	normal 1	1.000	0.05	1	0.05
Remark	Ⓐ: AMN-Receiver Mismatch : + Ⓑ: AMN-Receiver Mismatch : -						
Combined Standard Uncertainty	Normal			± 1.88			
Expended Uncertainty U	Normal ($k = 2$)			± 3.76			

2. Radiation Uncertainty Calculation

Source of Uncertainty	X_i	Uncertainty of X_i		Coverage factor k	$u(X_i)$ (dB)	C_i	$C_i u(X_i)$ (dB)
		Value (dB)	Probability Distribution				
Measurement System Repeatability	RS	0.34	normal 1	1.00	0.34	1	0.34
Receiver reading	Ri	± 0.02	normal 2	2.00	0.01	1	0.01
Sine wave voltage	dVsw	± 0.17	normal 2	2.00	0.09	1	0.09
Pulse amplitude response	dVpa	± 0.92	normal 2	2.00	0.46	1	0.46
Pulse repetition rate response	dVpr	± 0.35	normal 2	2.00	0.18	1	0.18
Noise floor proximity	dVnf	± 0.50	normal 2	2.00	0.25	1	0.25
Antenna Factor Calibration	AF	± 2.00	rectangular	$\sqrt{3}$	1.15	1	1.15
Cable Loss	CL	± 1.00	normal 2	2.00	0.50	1	0.50
Antenna Directivity	AD	± 0.00	rectangular	$\sqrt{3}$	0.00	1	0.00
Antenna Factor Height Dependence	AH	± 2.00	rectangular	$\sqrt{3}$	1.15	1	1.15
Antenna Phase Centre Variation	AP	± 0.20	rectangular	$\sqrt{3}$	0.12	1	0.12
Antenna Factor Frequency Interpolation	Ai	± 0.25	rectangular	$\sqrt{3}$	0.14	1	0.14
Site Imperfections	Si	± 4.00	triangular	$\sqrt{6}$	1.63	1	1.63
Measurement Distance Variation	DV	± 0.60	rectangular	$\sqrt{3}$	0.35	1	0.35
Antenna Balance	Dbal	± 0.90	rectangular	$\sqrt{3}$	0.52	1	0.52
Cross Polarisation	DCross	± 0.00	rectangular	$\sqrt{3}$	0.00	1	0.18
Mismatch	M	+ 0.98 - 1.11	U-Shaped	$\sqrt{2}$	0.74	1	0.74
EUT Volume Diameter	Vd	0.33	normal 1	1.00	0.33	1	0.11
Remark							
Combined Standard Uncertainty	Normal						
Expanded Uncertainty U	Normal ($k = 2$)						