Nemko Korea CO., Ltd.

300-2, Osan-Ri, Mohyeon-Myeon, Cheoin-Gu, Yongin-Si, Gyeonggi-Do, KOREA

TEL:+82 31 322 2333 FAX:+82 31 322 2332

FCC and IC EVALUATION REPORT FOR CERTIFICATION

Applicant :

Samsung Electronics Co., Ltd.
416, Maetan-3Dong, Yeongtong-Gu,
Suwon-Si, Gyeonggi-Do, Korea.
(Post code : 443-742)
Attn. : Mr. Jaywoo. Lee

Dates of Issue : January 5, 2011
Test Report No. : NK-10-R-378-2
Test Site : Nemko Korea Co., Ltd.

FCC ID	**A3LWISP30**
IC ID	**649E-WISP30**
Brand Name	**SAMSUNG**
Contact Person	**Samsung Electronics Co., Ltd.** **416, Maetan-3Dong, Yeongtong-Gu,** **Suwon-Si, Gyeonggi-Do, Korea, 442-742.** **Mr. Jaywoo. Lee** **Telephone No. : +82-31-277-2569**

Applied Standard:	FCC 47 CFR Part 15 Subpart E §15.407 and IC RSS-210 Annex 9
Classification:	Unlicensed National Information Infrastructure (UNII)
EUT Type:	Audio transceiver 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 C63.4-2003. 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.

Jan 5, 2011

Tested By : Jinha Ko
Engineer

Jan. 5. 2011

Reviewed By : H.H. Kim
Manager & Chief Engineer

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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 and IC RSS-210.

Responsible Party :	Samsung Electronics Co., Ltd.
Contact Person :	Mr. Jaywoo. Lee
Manufacturer :	Samsung Electronics Co., Ltd. 416 Maetan-3Dong, Yeongtong-Gu, Suwon-Si, Gyeonggi-Do, 443-742 KOREA

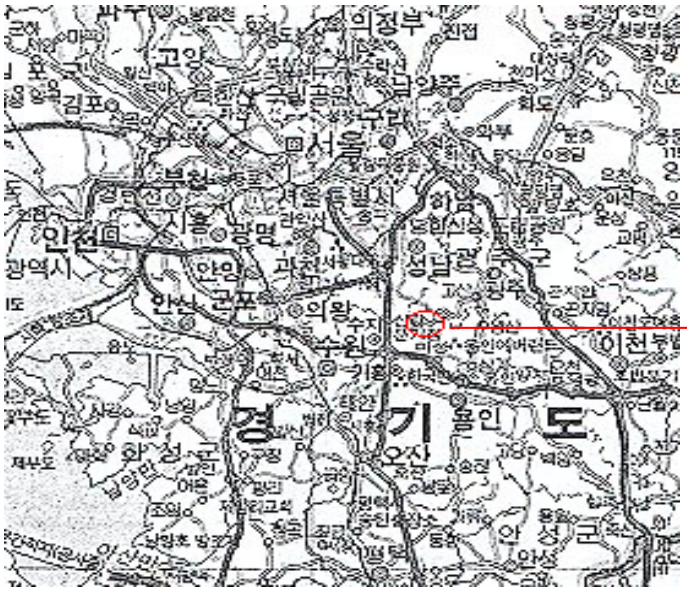
- FCC ID: A3LWISP30
- IC ID: 649E-WISP30
- Model: WISP30
- Brand Name: SAMSUNG
- EUT Type: Audio transceiver module
- Classification: Unlicensed National Information Infrastructure(UNII)
- Applied Standard: FCC 47 CFR Part 15 subpart E 15.407 and IC RSS-210 Annex 9
- Test Procedure(s): ANSI C63.4 (2003)
- Dates of Test: Nov. 23, 2010 ~ Dec. 9, 2010
- 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 9kHz to 40GHz (ANSI C63.4-2003) was used in determining radiated and conducted emissions emanating from **Samsung Electronics Co., Ltd.**
FCC ID : **A3LWISP30** and **IC ID : 649E-WISP30**

These measurement tests were conducted at ***Nemko Korea Co., Ltd. EMC Laboratory*** .
The site address is 300-2, Osan-Ri, Mohyeon-Myeon, Cheoin-Gu, Yongin-Si, Gyeonggi-Do, KOREA.
The area of Nemko Korea Corporation Ltd. EMC Test Site is located in a mountain area at 80 kilo-meters (48 miles) southeast and Incheon International Airport (Incheon Airport), 30 kilometers (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 §2.948 according to ANSI C63.4 2003.



Nemko Korea Co., Ltd.
EMC Lab.
300-2, Osan-Ri, Mohyeon-Myeon, Cheoin-Gu, Yongin-Si, Gyeonggi-Do, KOREA 449-852
Tel)+82-31-322-2333

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
FC	FCC part 15/18 Filing site	Registration No. 97992
	CAB Accreditation for DOC	Designation No. KR0026
KOLAS	KOLAS Accredited Lab. (Korea Laboratory Accreditation Scheme)	Registration No. 155
Industry Canada	Canada IC Registered site	Site No. 2040E-1
VCCI	VCCI registration site(RE/CE/Telecom CE)	Member No. 2118
IECEE CB SCHEME	EMC CBTL	-
방송통신위원회	KCC(RRL)Designated Lab.	Registration No. KR0026
	SASO registered Lab and Certification Body	Registration No. 2008-15

3. TEST CONDITIONS & EUT INFORMATION

3.1 Operation During Test

The EUT was controlled and monitored by testing jig which manufacturer supported.
The EUT have two antennas which are not working simultaneously. All tests were performed At two antenna pathes then the worst case was recored.

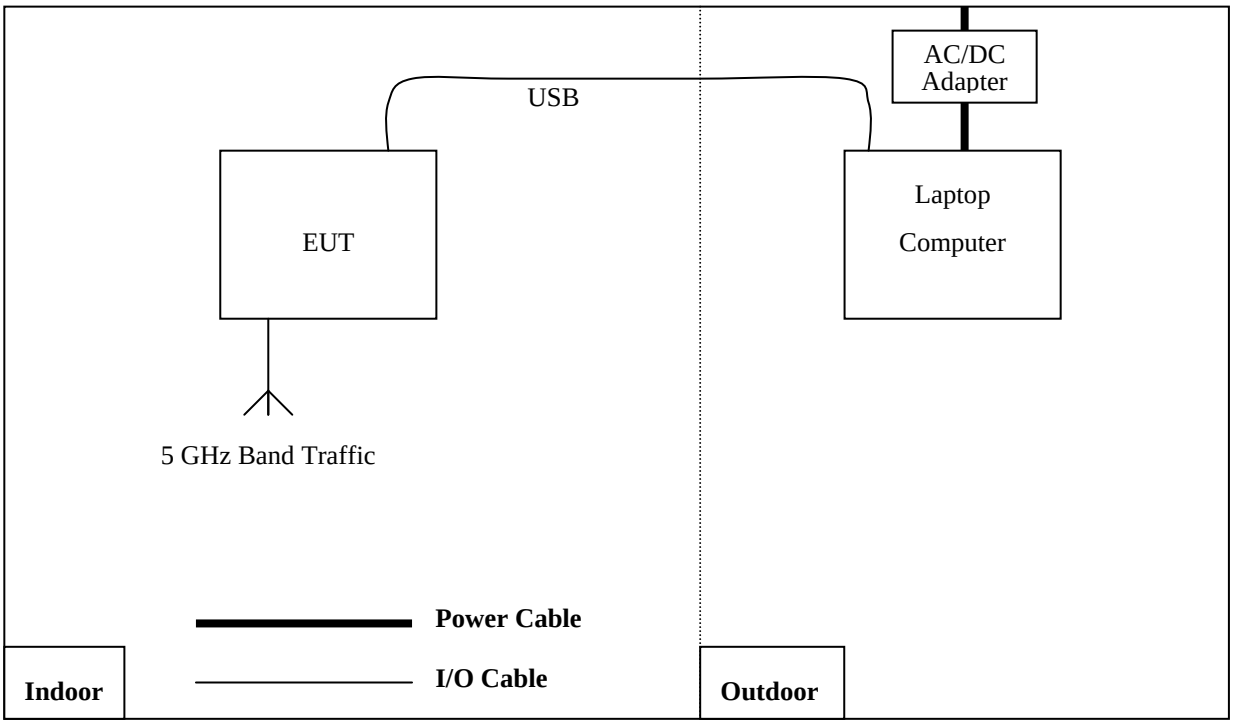
The EUT was programmed with the following power setting that used during the testing:

Frequency	5180 MHz	5210 MHz	5240 MHz
Power Level	6	6	6

3.2 Support Equipment

EUT	Samsung Electronics Co., Ltd. FCC ID: A3LWISP30	S/N: N/A
Laptop Computer	Dell Inc. Model : PP27L 1.5 m shielded USB cable	FCC DOC S/N : N/A
AC/DC Adapter	Hipro Electronics(Dongguan) Co., Ltd. Model : HA90PE1-00 1.0 m unshielded power cable	FCC DOC S/N : N/A

3.3 Setup Drawing



3.4 EUT Information

The EUT is the **Samsung Audio transceiver module FCC ID: A3LWISP30, IC ID: 649E-WISP30.**

Specifications:

Category	Audio transceiver module
Model Name	WISP30
Brand Name	SAMSUNG
Frequency of Operation	5180 MHz to 5240 MHz
Power Output (Conducted)	16.10 dBm
Channels	3 ch
Antenna Gain (peak)	3.36 dBi
Modulations	QPSK
Temperature Range	0 ℃ ~ +55 ℃
Voltage	5.0 Vdc
Dimensions (W x H x D)	26 mm x 60 mm X 3 mm
Weight	6 g
Remarks	-

4. SUMMARY OF TEST RESULTS

The EUT has been tested according to the following specification:

Name of Test	FCC Paragraph No.	IC Paragraph No.	Result	Remark
Conducted Emission	15.207	RSS-GEN 7.2.4	Complies	
Radiated Emission	15.209	RSS-210 A9.2	Complies	
26 dB Spectrum Bandwidth	15.407(a)	RSS-210 A9.2	Complies	
Peak Power Output	15.407(a)	RSS-210 A9.2	Complies	
Power Spectral Density	15.407(a)	RSS-210 A9.2	Complies	
Peak Excursion Measurement	15.407(a)	-	Complies	
Radiated Spurious Emission	15.407(b)	RSS-210 A9.2	Complies	
Frequency Stability	15.407(g)	RSS-210 A9.4	Complies	
Maximum Permissible Exposure	1.1307(b)	RSS-102	Complies	

5. RECOMMENDATION/CONCLUSION

The data collected shows that the **Samsung Audio transceiver module FCC ID: A3LWISP30, IC ID: 649E-WISP30** is in compliance with Part 15 Subpart C 15.407 of the FCC Rules.

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: A3LWISP30, IC ID: 649E-WISP30** 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 uH 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; which ever determined the worst case emission.
Each EME reported was calibrated using the R&S signal generator.

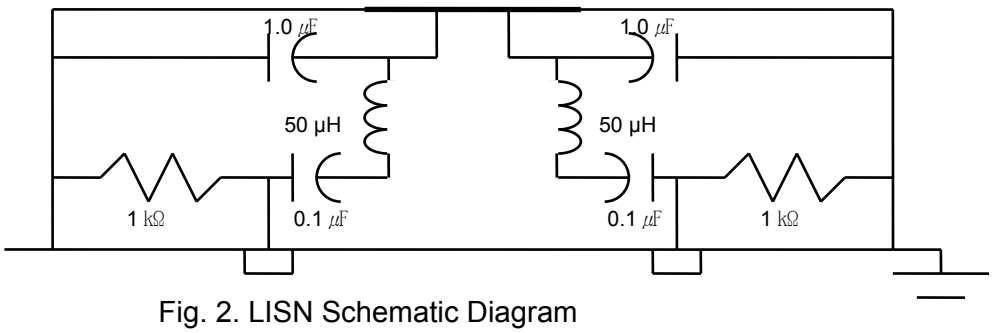


Fig. 2. LISN Schematic Diagram

7.2 Radiated Emissions

Preliminary measurements were made indoors at 3 meter using broad band antennas, broadband amplifier, and spectrum analyzer to determine the frequency producing the maximum EME. Appropriate precaution was taken to ensure that all EME from the EUT were maximized and investigated. The Technology configuration, clock speed, mode of operation or video resolution, turntable azimuth with respect to the antenna was note for each frequency found. The spectrum was scanned from 9 kHz to 30 MHz using Loop Antenne(EMCO, 6502) and 30 to 1000 MHz using Bi-conical log Antenna(ARA, LPB-2520/A). Above 1 GHz, Horn antenna (Scwarzbeck BBHA 9120D: up to 18 GHz , Q-par Angus QSH20S20 : 18 to 26.5 GHz, QSH22K20: up to 40 GHz) was used. Final Measurements were made outdoors at 3 or 10 m test range using Loop Antenne(EMCO, 6502) and Logbicon Super Antenna (Schwarzbeck, VULB9168) or Horn antenna.(Scwarzbeck BBHA 9120D: up to 18 GHz , Q-par Angus QSH20S20 : 18 to 26.5 GHz, QSH22K20: up to 40 GHz).
The test equipment was placed on a wooden table. Sufficient time for the EUT, support 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 reexamined and investigated using EMI test receiver (ESCS30) & (FSP40). The detector function was set to CISPR peak mode or quasi-peak mode or average mode and the band-width of the receiver was set to 120 kHz or 1 MHz depending on the frequency or type of signal. The half wave dipole antenna was tuned to the frequency found during preliminary radiated measurements. The EUT support equipment and interconnecting cables were re configured to the setup producing the maximum emission for the frequency and were placed on top of a 0.8 m high non- metallic 1.0 x 1.5 meter table. The EUT, support equipment and interconnecting cables were re-arranged and manipulated to maximize each EME emission. The turn table containing the Technology was rotated; the antenna height was varied 1 to 4meter and stopped at the azimuth or height producing the maximum 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; which ever determined the worst case emission.
Each EME reported was calibrated using the R/S signal generator.

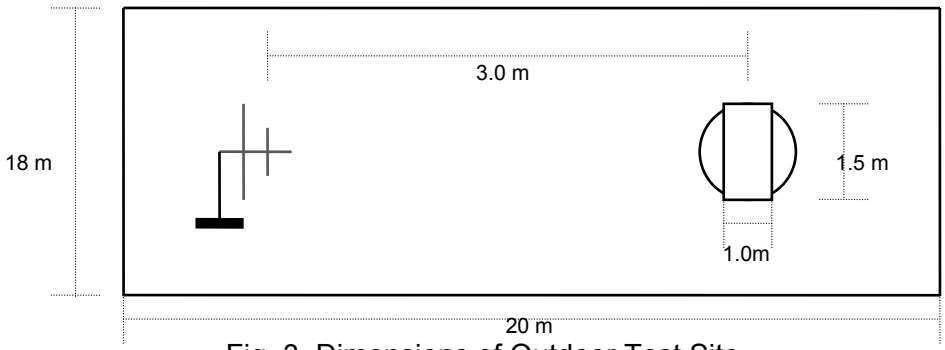


Fig. 3. Dimensions of Outdoor Test Site

7.3 Radiated Spurious & Harmonic Emission (EIRP)

Test Set-up:
Effective Radiated Power Output and Equivalent Isotropic Radiated Power output Measurements by Substitution Method according to ANSI/TIA/EIA-603-A-2003.

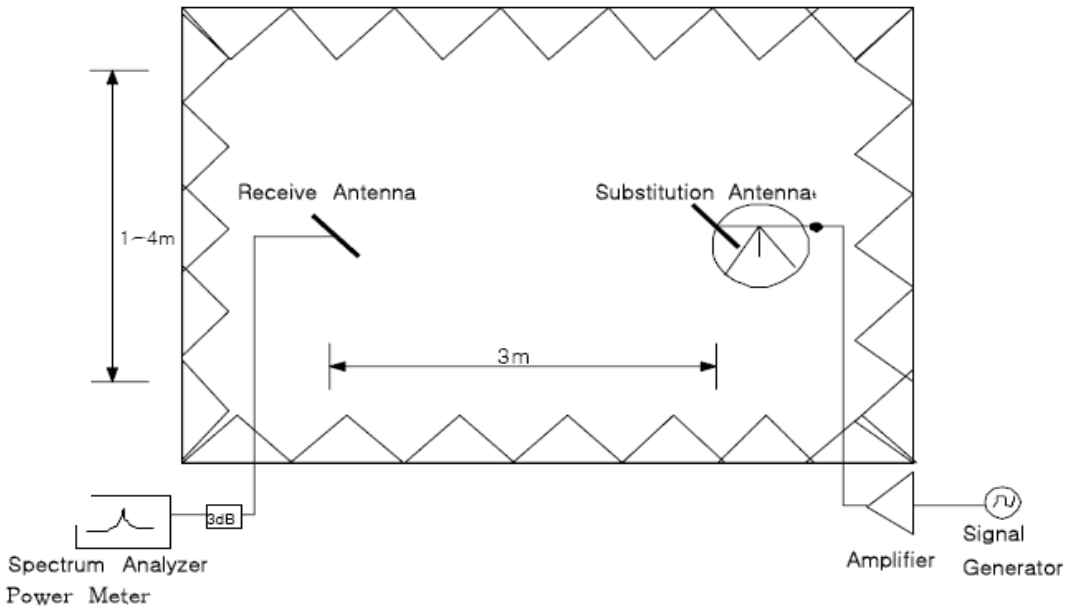


Diagram of Radiated Spurious & Harmonic test Set-up

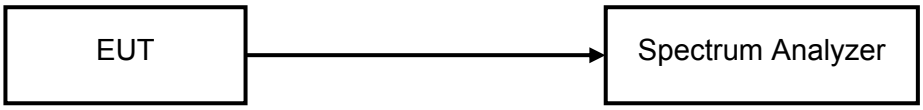
The EUT was set on a non-conductive turntable in a full anechoic chamber.
The radiated power from the EUT was measured with an antenna fixed to a antenna tower. The tower and turn table were remotely controlled to turn the EUT and change the antenna polarization. The measured signal was routed from the measuring antenna to the spectrum analyzer. The radiated spurious and harmonic emission were measured up to 10^{th} harmonic of the fundamental frequency of operation.

Test Method:

1. The maximum power level was searched by moving the turn table and measuring antenna and manipulating the EUT. This level (P_{EUT}) was recorded.
2. For measurements the resolution bandwidth and video bandwidth were set to 100 kHz for emissions below 1GHz and 1 MHz for emissions over 1GHz.
3. Replce the EUT with a substituting antenna and feed the substitution antenna at the EUT end with a signal generator connected to the antenna.
4. Adjust the level of the signal generator output until the previously recorded maximum reading for this set of conditions is obtained(P_{EUT}).
5. Calculate the EIRP, in dBm, by the power loss in the cable between the generator and antenna, corrected for the gain of the substitution antenna.

7.4 26 dB Bandwidth and 99% Occupied bandwidth

Test Setup

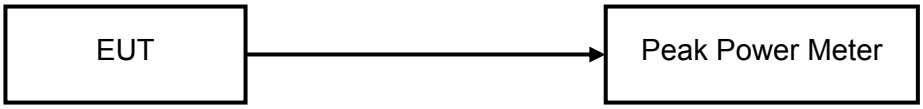


Test Procedure

The transmitter is set to the Low, Middle, High channels is connected to the spectrum analyzer.
The RBW of spectrum analyzer is set to 300 kHz and VBW is set to 1000 kHz.
The sweep time is coupled. The spectrum analyzer is set for peak detected and Max hold scan mode.

7.5 Maximum Peak Output Power

Test Setup

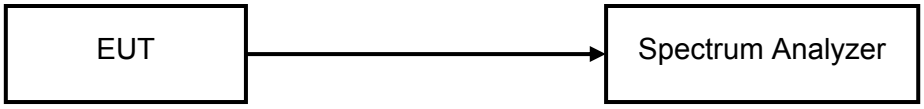


Test Procedure

The transmitter is set to the Low, Middle, High channels is connected to the Peak Power Meter.

7.6 Peak Power Spectral Density

Test Setup

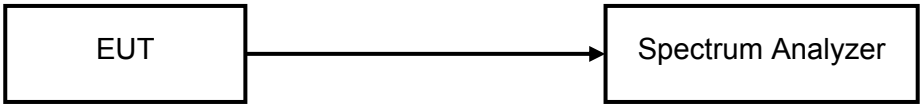


Test Procedure

The transmitter is connected to the Spectrum analyzer.
The maximum level in a 1 MHz bandwidth is measured with the spectrum analyzer.
The RBW of spectrum analyzer is set to 1 MHz and VBW is set to 3 MHz.
The sweep time is set to auto. Sample detected and trace average are used.

7.7 Peak Excursion Measurement

Test Setup

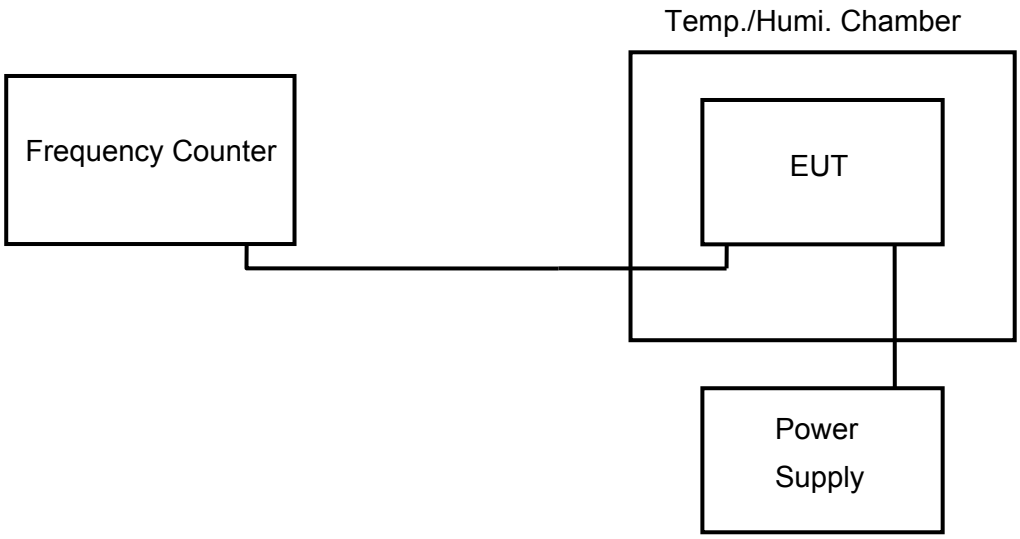


Test Procedure

The transmitter is connected to the spectrum analyzer.
Set the spectrum analyzerspan to view the entire emissions bandwidth.
Set the 1st trace with RBW 1 MHz, VBW 3 MHz, peak detector and max hold.
Set the 2st trace with RBW 1 MHz, VBW 3 MHz, sample detector and trace average 100 traces.

7.8 Frequency Stability

Test Set-up:



Test Method :

The transmitter output is connected to the frequency counter.
EUT have transmitted absence of modulation signal and fixed channelize.
fc is declaring of channel frequency. Then the frequency error formula is
(fc - f) / fc x 10^6 ppm and the limit is less than ± 20 ppm.
The test extreme voltge is to change the primary supply voltage from 85 to 115 percent of the nominal value.
Extreme temperature rule is - 30 ℃ ~ 50 ℃.

8. TEST DATA

8.1 Conducted Emissions

FCC §15.207, RSS-Gen 7.2.4

Frequency	Level(dBμV)		*)Factor	**) Line	Limit(dBμV)		Margin(dB)	
(MHz)	Q-Peak	Average	(dB)		Q-Peak	Average	Q-Peak	Average
0.15	39.0	16.3	0.2	N	66.0	56.0	27.0	39.7
0.23	41.7	20.4	0.2	N	62.4	52.4	20.7	32.0
0.26	43.7	35.5	0.2	L	61.4	51.4	17.7	15.9
0.29	42.3	29.8	0.2	N	60.5	50.5	18.2	20.7
1.07	34.6	32.3	0.2	L	56.0	46.0	21.4	13.7
1.75	37.2	31.2	0.2	N	56.0	46.0	18.8	14.8

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 Part section 15.207(a).

PLOTS OF EMISSIONS

- ***Conducted Emission at the Mains port (Line)***

NEMKO KOREA (NK-10-R-378-2) 30 Nov 2010 20:45

Conducted Emissions

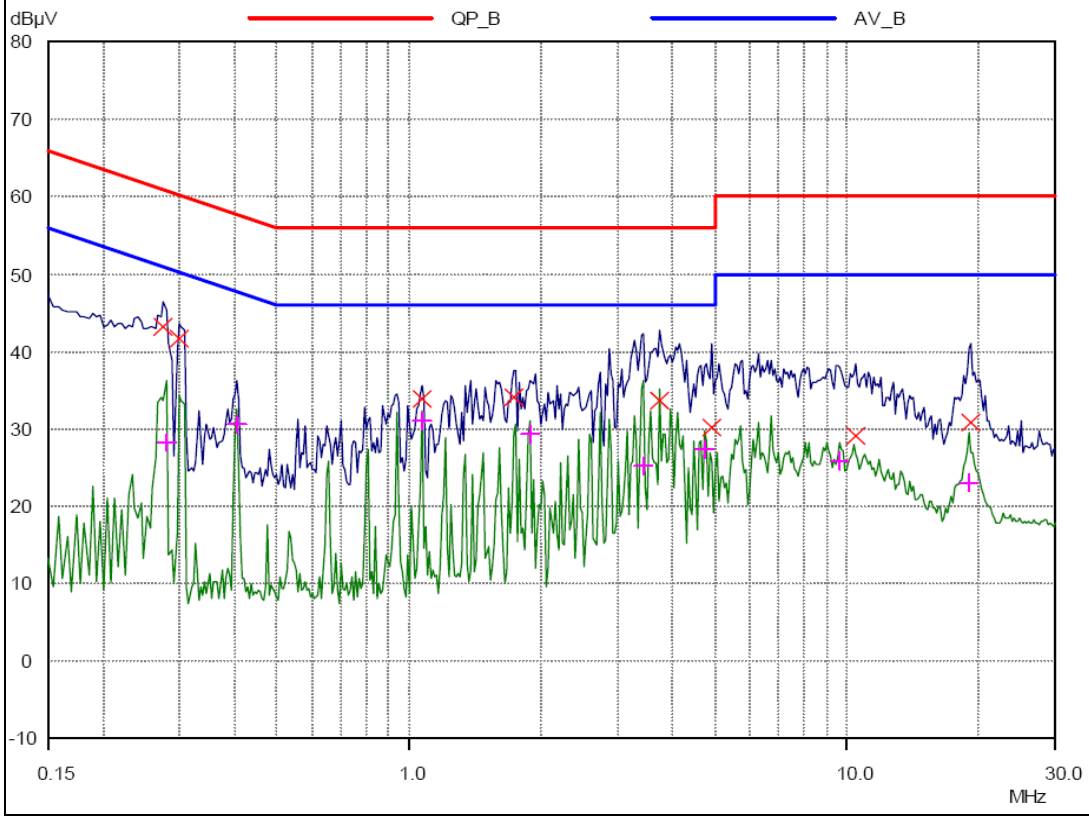
EUT:	Audio transceiver module
Manuf:	Samsung Electronics Co., Ltd.
Op Cond:	a.c. 120 V / 60 Hz (Traffic Mode)
Operator:	Jin-Ha, Ko
Test Spec:	FCC Part 15 Subpart C
Comment:	MODEL : WISP30
	LINE : LINE-PE
Result File:	r378l1.dat : 5GHz WLAN Band Traffic

Scan Settings (1 Range)

Frequencies			Receiver Settings					
Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp	OpRge
150kHz	30MHz	3.9063kHz	9kHz	PK+AV	20msec	20 dB	OFF	60dB

Transducer	No.	Start	Stop	Name
	2	150kHz	30MHz	ESH3_LINE

Final Measurement:		
	Detectors:	X QP / + AV
	Meas Time:	1sec
	Subranges:	8
	Acc Margin:	60 dB



PLOTS OF EMISSIONS

- ***Conducted Emission at the Mains port (Neutral)***

NEMKO KOREA (NK-10-R-378-2) 30 Nov 2010 20:57

Conducted Emissions

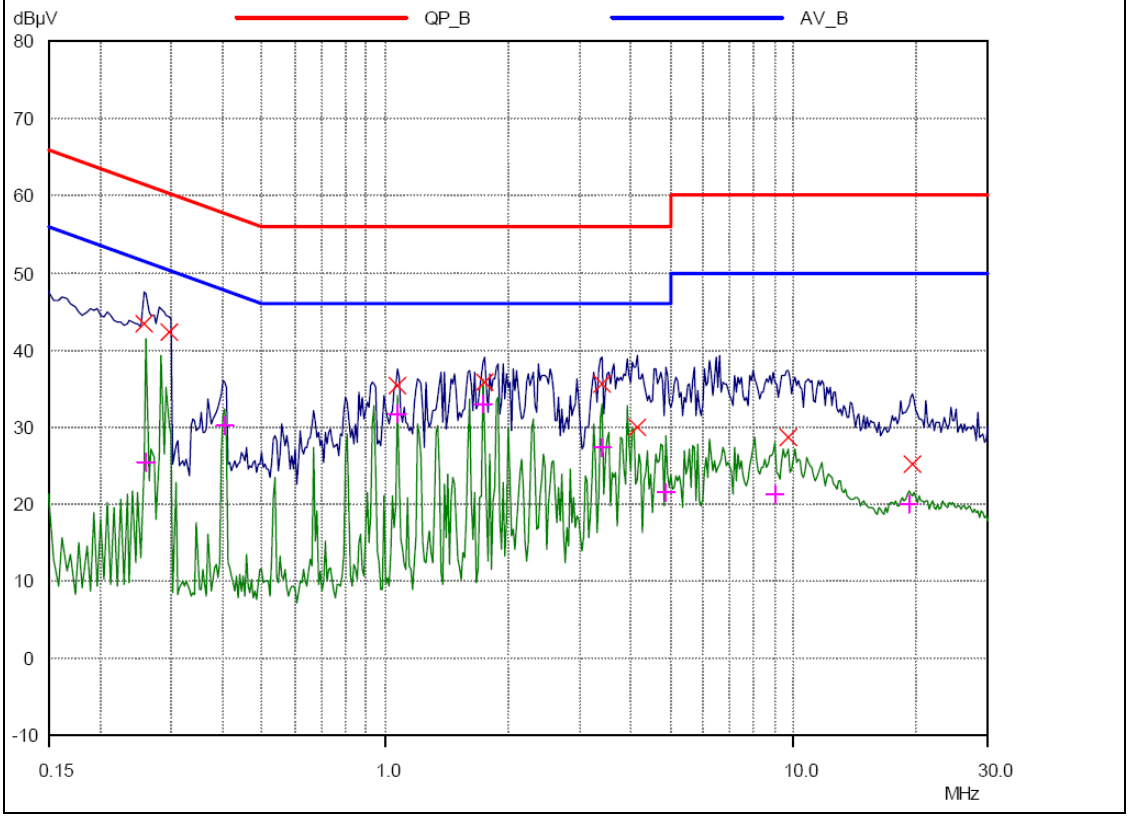
EUT:	Audio transceiver module
Manuf:	Samsung Electronics Co., Ltd.
Op Cond:	a.c. 120 V / 60 Hz (Traffic Mode)
Operator:	Jin-Ha, Ko
Test Spec:	FCC Part 15 Subpart C
Comment:	MODEL : WISP30
	LINE : NEUTRAL-PE
Result File:	r378n1.dat : 5GHz WLAN Band Traffic

Scan Settings (1 Range)

Frequencies			Receiver Settings					
Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp	OpRge
150kHz	30MHz	3.9063kHz	9kHz	PK+AV	20msec	20 dB	OFF	60dB

Transducer	No.	Start	Stop	Name
	1	150kHz	30MHz	ESH3_NEUT

Final Measurement: Detectors: X QP / + AV
Meas Time: 1sec
Subranges: 8
Acc Margin: 60 dB

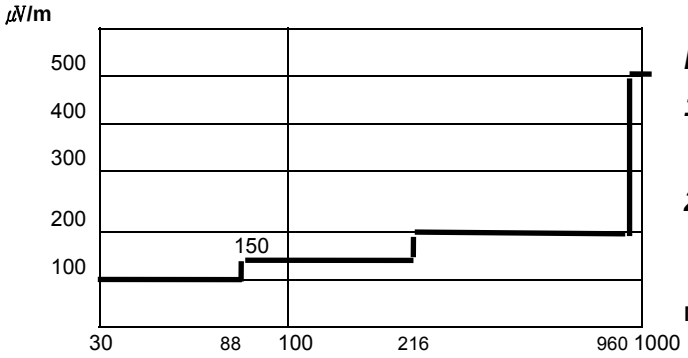


8.2 Radiated Emissions

FCC §15.209, RSS-210 A9.2

Frequency (MHz)	Reading (dBμV/m)	Pol* (H/V)	Antenna Heights (cm)	Turntable Angles (°)	AF+CL+Amp (dB)**	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)
195.40	38.6	V	100	309	-16.2	22.4	43.5	21.1
213.82	46.6	H	164	4	-19.1	27.5	43.5	16.0
254.20	28.8	H	159	359	-15.5	13.3	46.0	32.7
285.15	47.9	H	260	170	-15.5	32.4	46.0	13.6
320.75	30.1	H	212	346	-13.6	16.5	46.0	29.5
351.99	49.0	H	100	336	-13.6	35.4	46.0	10.6

Radiated Measurements at 3meters



NOTES:

1. All modes were measured and the worst-case emission was reported.

2 The radiated limits are shown on Figure 4. Above 1 GHz the limit is 500 μV/m.

Fig. 4. Limits at 3 meters

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 Part section 15.209(a).

8.3 6 dB Bandwidth and 99 % Occupied bandwidth

FCC §15.407(a), RSS-210 A9.2

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

Result:

Ant A

Channel	Frequency (MHz)	26 dB Bandwidth (MHz)	99 % Occupied Bandwidth (MHz)
Low	5180	16.358	15.091
Middle	5210	16.353	15.076
High	5240	16.379	15.090

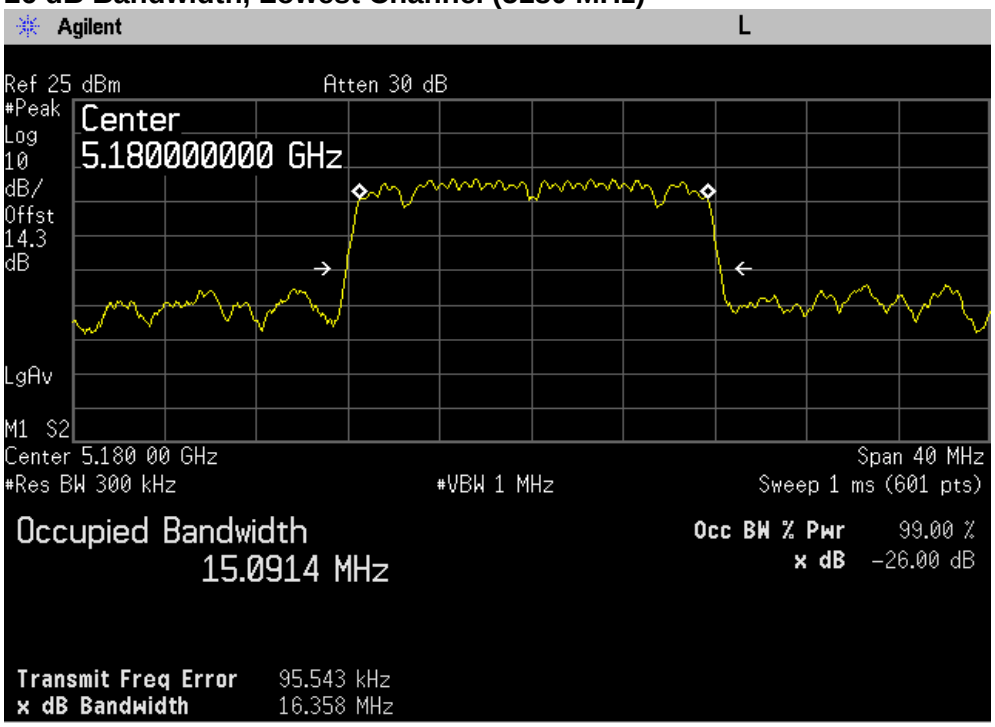
Ant B

Channel	Frequency (MHz)	26 dB Bandwidth (MHz)	99 % Occupied Bandwidth (MHz)
Low	5180	16.362	15.088
Middle	5210	16.358	15.084
High	5240	16.383	15.092

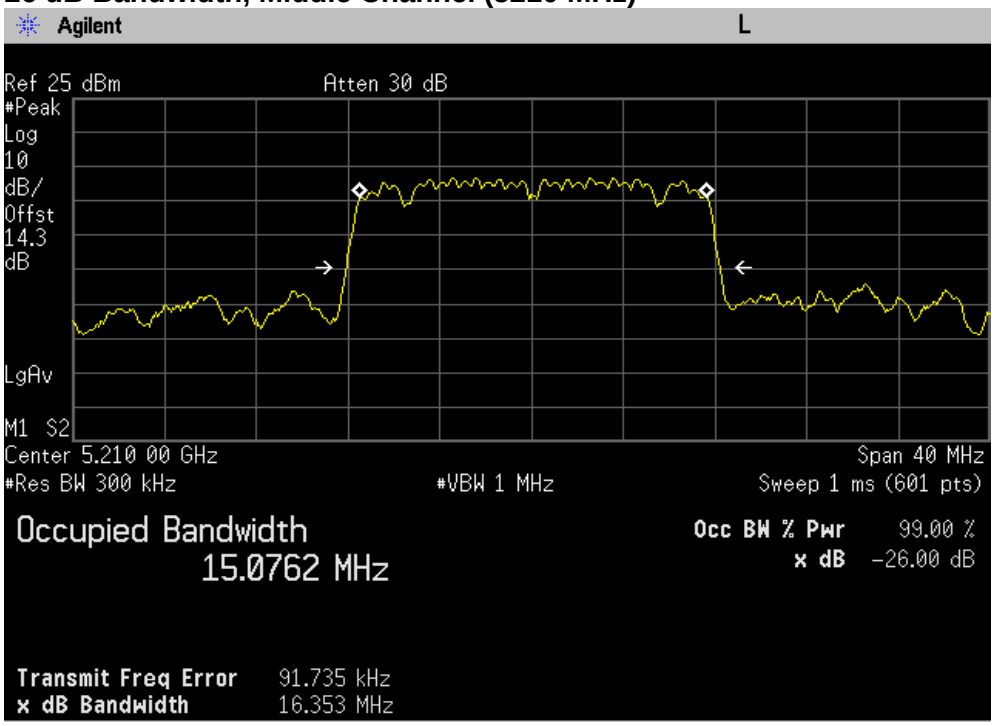
PLOTS OF EMISSIONS

Ant A

26 dB Bandwidth, Lowest Channel (5180 MHz)

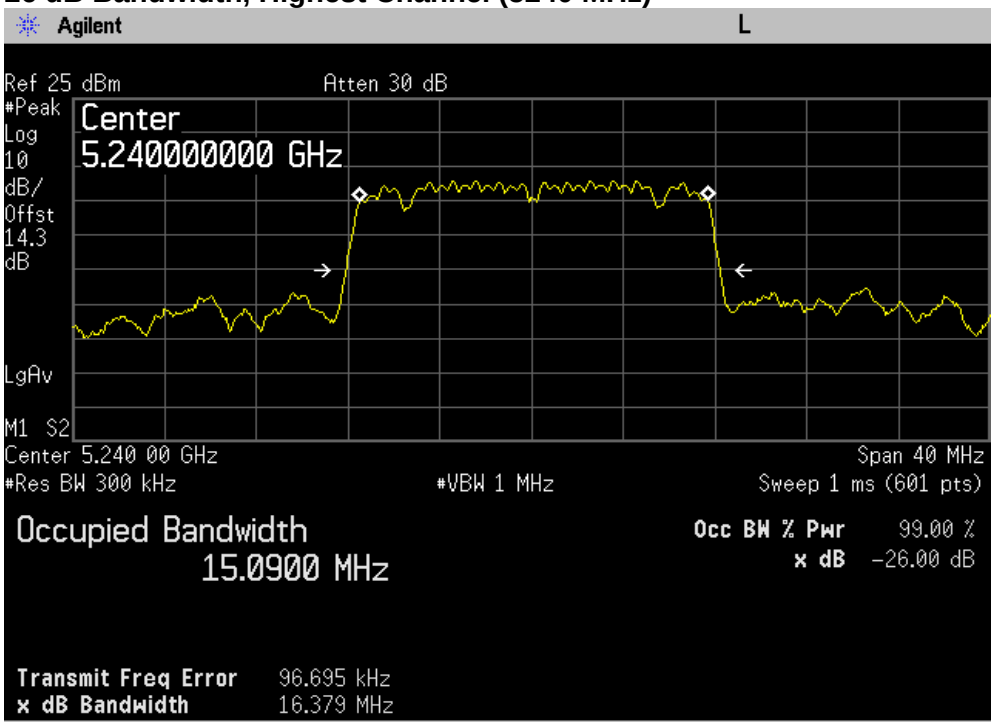


26 dB Bandwidth, Middle Channel (5210 MHz)



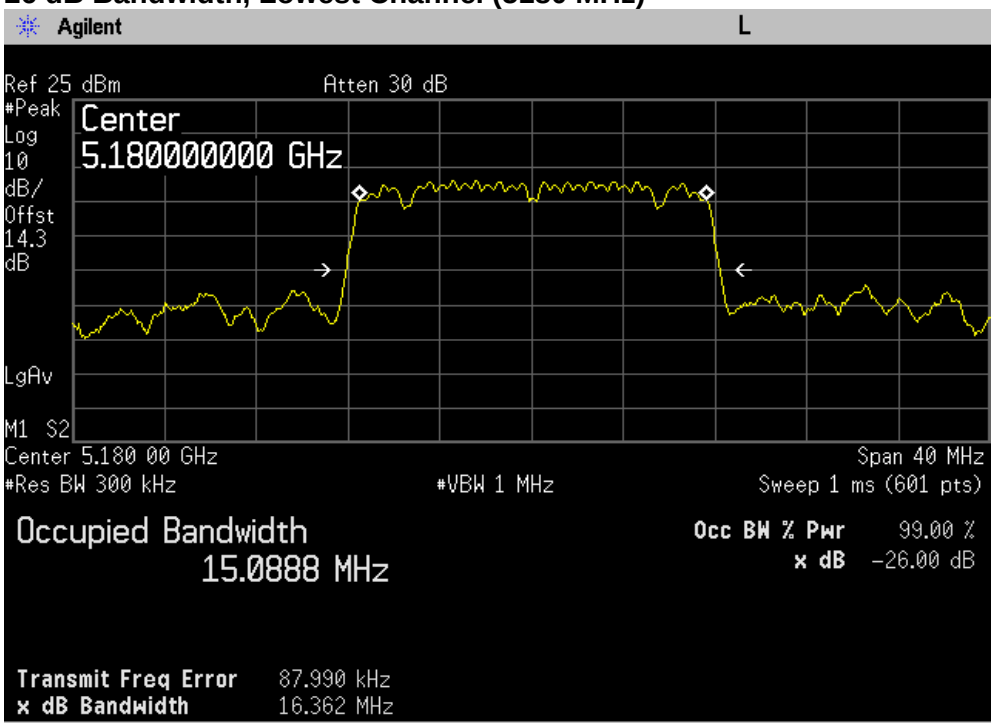
PLOTS OF EMISSIONS

26 dB Bandwidth, Highest Channel (5240 MHz)



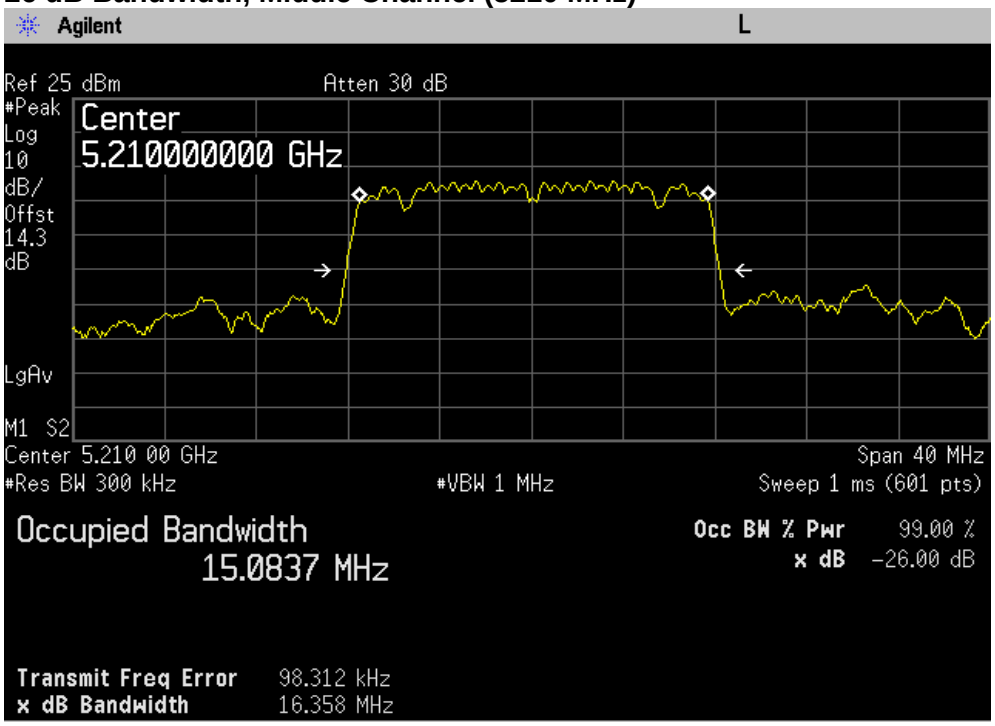
Ant B

26 dB Bandwidth, Lowest Channel (5180 MHz)

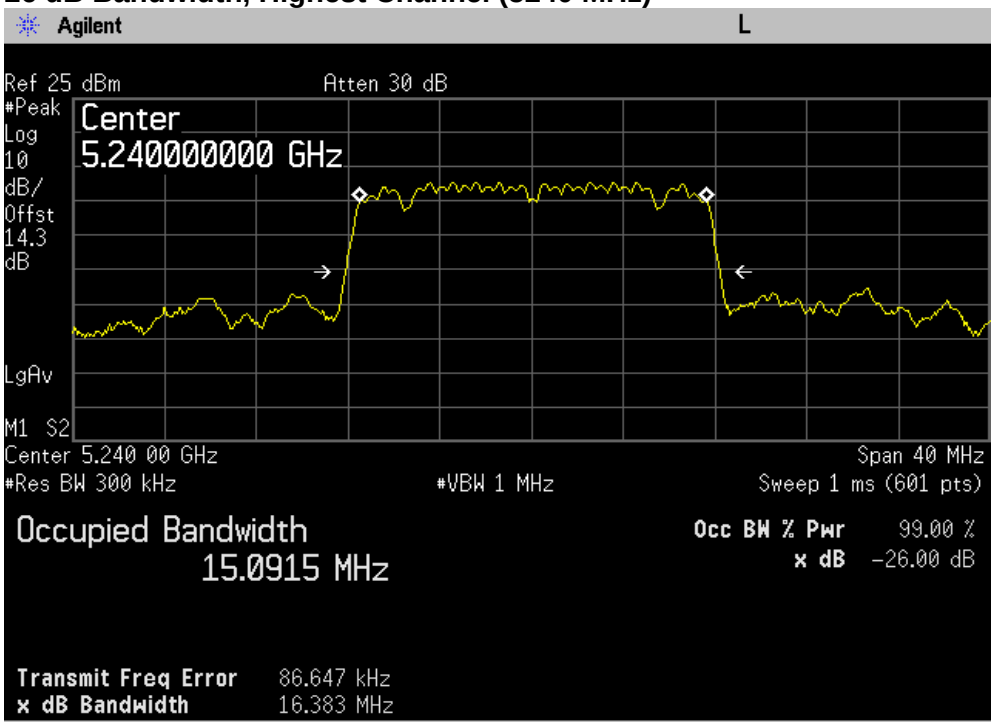


PLOTS OF EMISSIONS

26 dB Bandwidth, Middle Channel (5210 MHz)



26 dB Bandwidth, Highest Channel (5240 MHz)



8.4 Peak Power Output

FCC §15.407(a), RSS-210 A9.2

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

Result:

Ant A

Channel	Frequency (MHz)	Peak Power (dBm)	Limit (dBm)	Margin (dB)
Low	5180	15.90	16.14	0.24
Middle	5210	16.10	16.14	0.04
High	5240	15.41	16.14	0.73

Ant B

Channel	Frequency (MHz)	Peak Power (dBm)	Limit (dBm)	Margin (dB)
Low	5180	15.66	16.14	0.48
Middle	5210	15.82	16.14	0.32
High	5240	16.01	16.14	0.13

Note:

For the band 5.15~5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed the lesser of 50 mW(17 dBm) or 4 dBm + 10log B, Where B is the 26 dB emissions bandwidth in MHz.

The maximum conducted output limit = 4 dBm + 10log(16.383) = 16.14 dBm

8.5 Power Spectral Density

FCC §15.407(a), IC RSS-210 A9.2

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

Result:

Ant A

Channel	Frequency(MHz)	Power Spectral Density (dBm)	Limit(dBm)	Margin(dB)
Low	5180	2.13	4	1.87
Middle	5210	1.59	4	2.41
High	5240	1.50	4	2.50

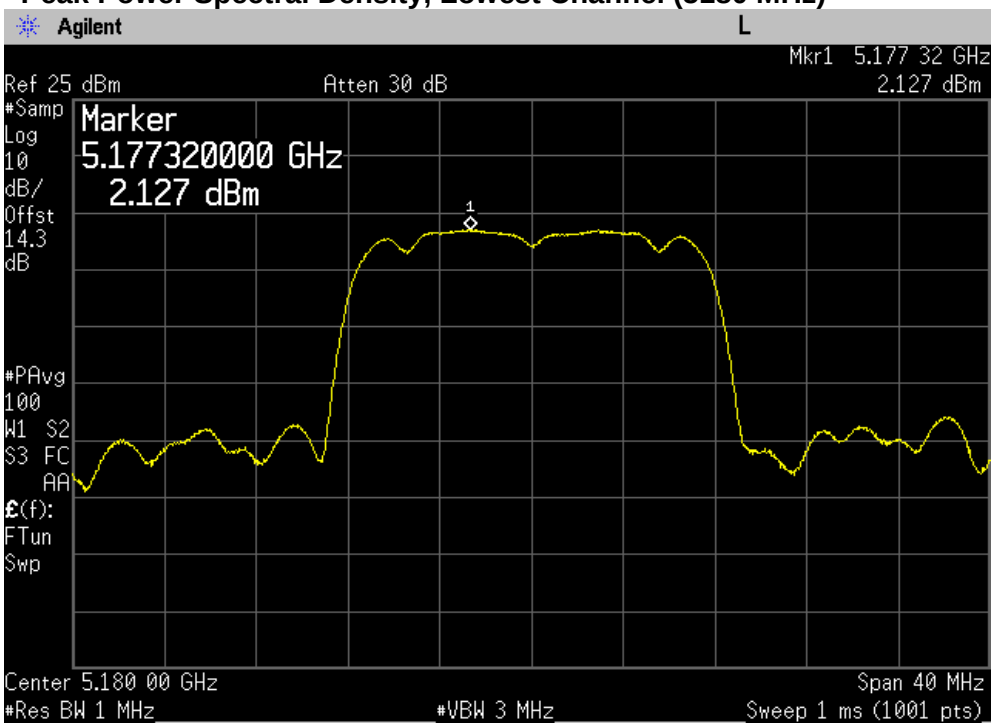
Ant B

Channel	Frequency(MHz)	Power Spectral Density (dBm)	Limit(dBm)	Margin(dB)
Low	5180	1.69	4	2.31
Middle	5210	1.34	4	2.66
High	5240	1.39	4	2.61

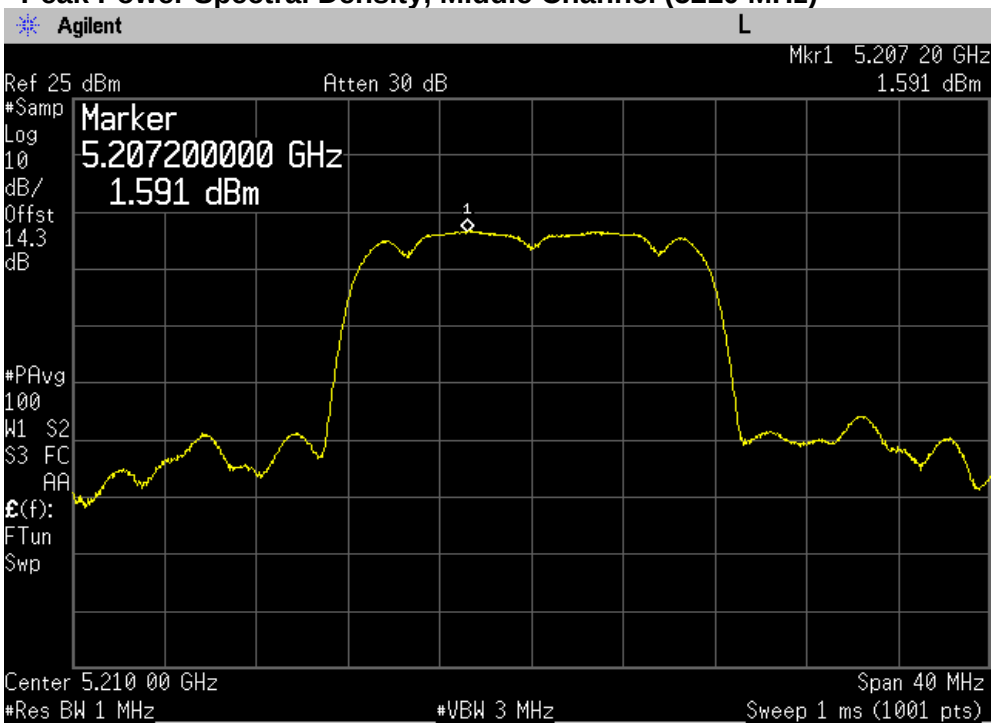
PLOT OF TEST DATA

Ant A

Peak Power Spectral Density, Lowest Channel (5180 MHz)

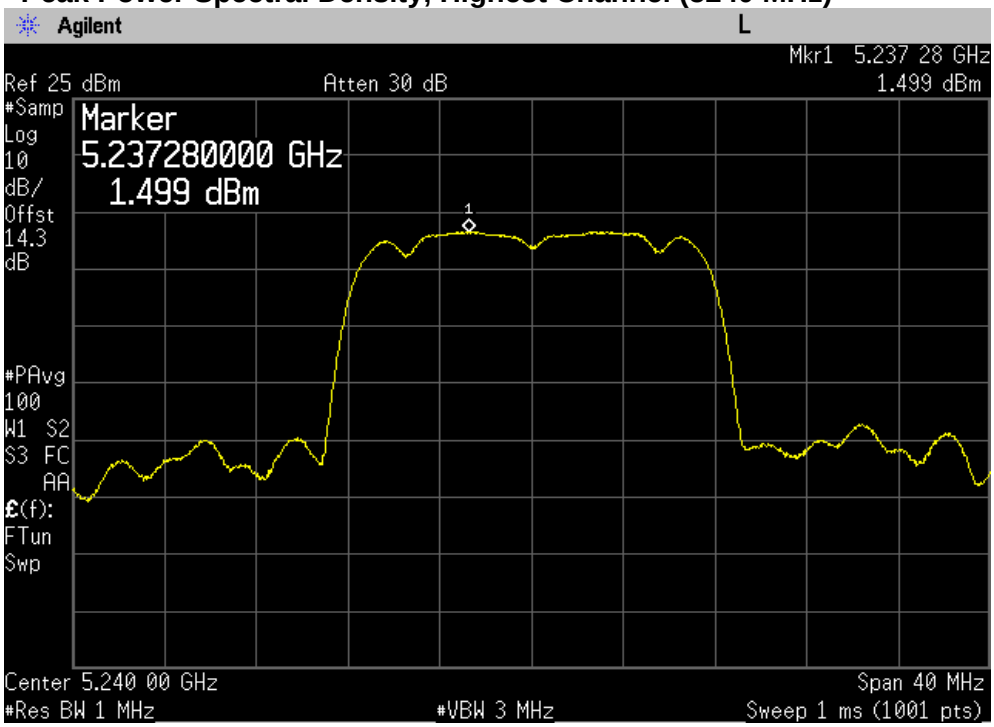


Peak Power Spectral Density, Middle Channel (5210 MHz)



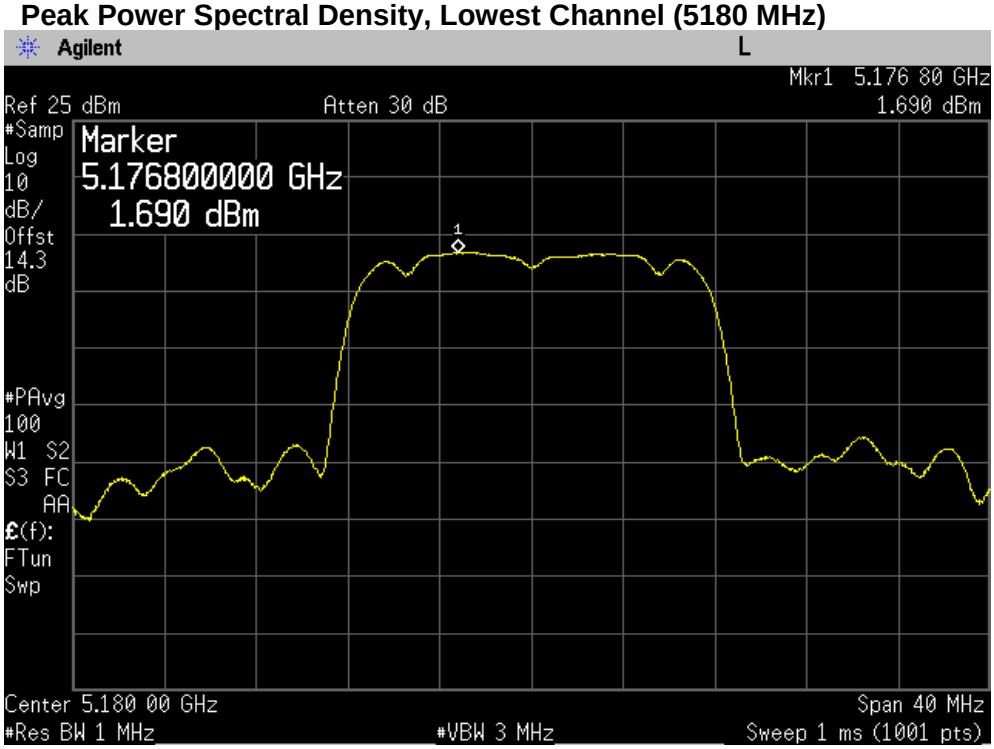
PLOT OF TEST DATA

Peak Power Spectral Density, Highest Channel (5240 MHz)



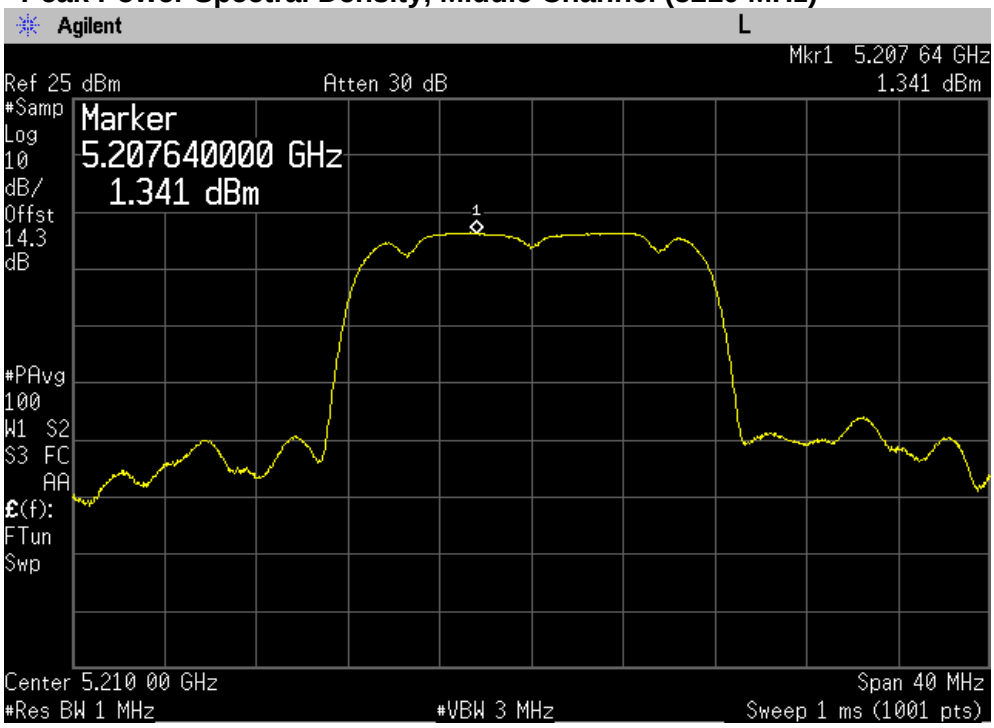
Ant B

Peak Power Spectral Density, Lowest Channel (5180 MHz)

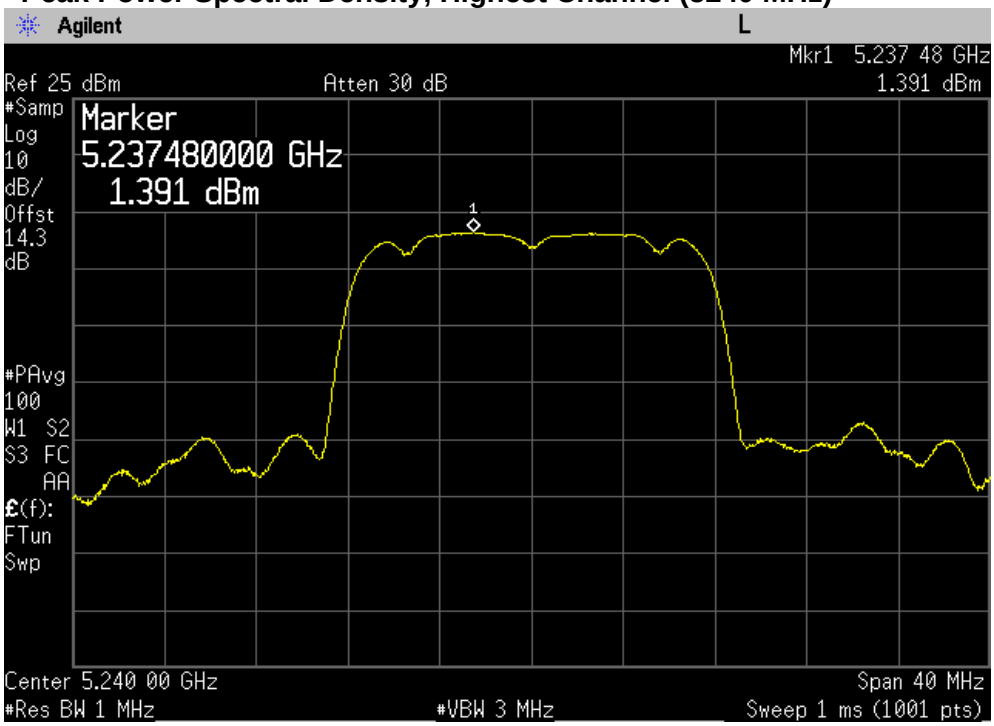


PLOT OF TEST DATA

Peak Power Spectral Density, Middle Channel (5210 MHz)



Peak Power Spectral Density, Highest Channel (5240 MHz)



8.6 Peak Excursion

FCC §15.407(a)

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

Result:

Ant A

Channel	Frequency (MHz)	Peak Excursion (dB)	Limit (dB)	Margin(dB)
Low	5180	2.83	13	10.17
Middle	5210	3.02	13	9.98
High	5240	2.73	13	10.27

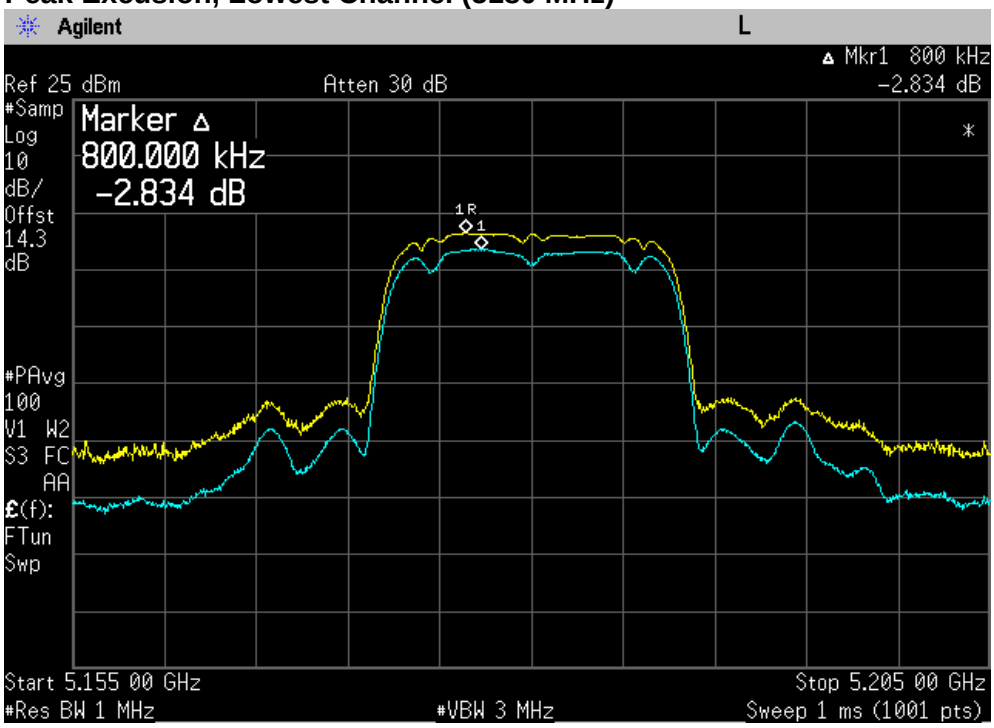
Ant B

Channel	Frequency (MHz)	Peak Excursion (dB)	Limit (dB)	Margin(dB)
Low	5180	3.21	13	9.79
Middle	5210	3.01	13	9.99
High	5240	2.67	13	10.33

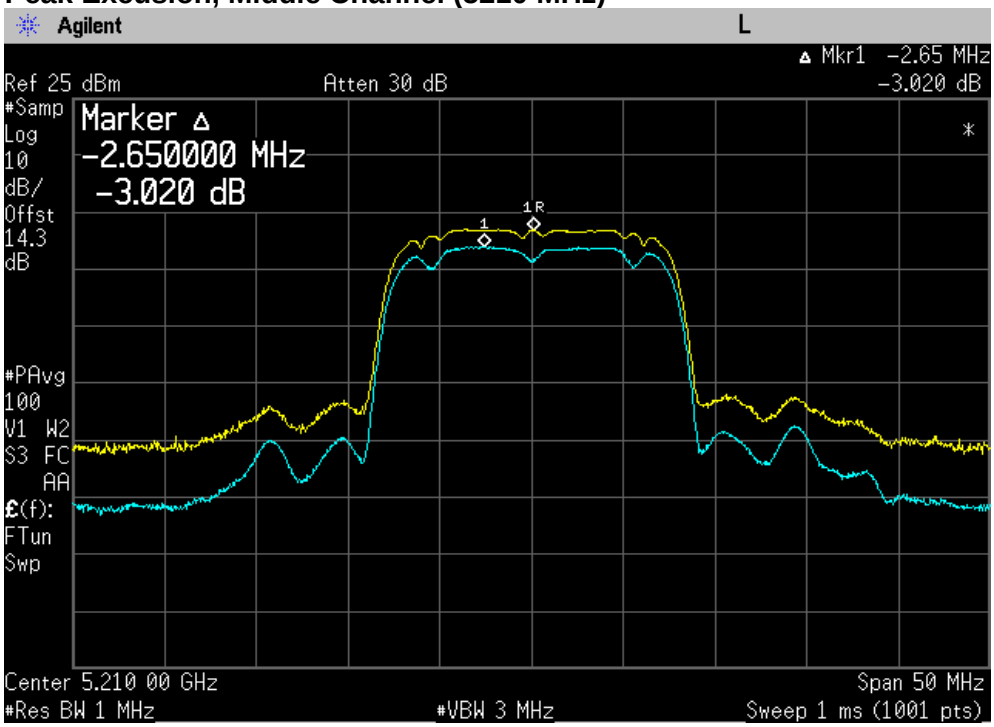
PLOT OF TEST DATA

Ant A

Peak Excusion, Lowest Channel (5180 MHz)

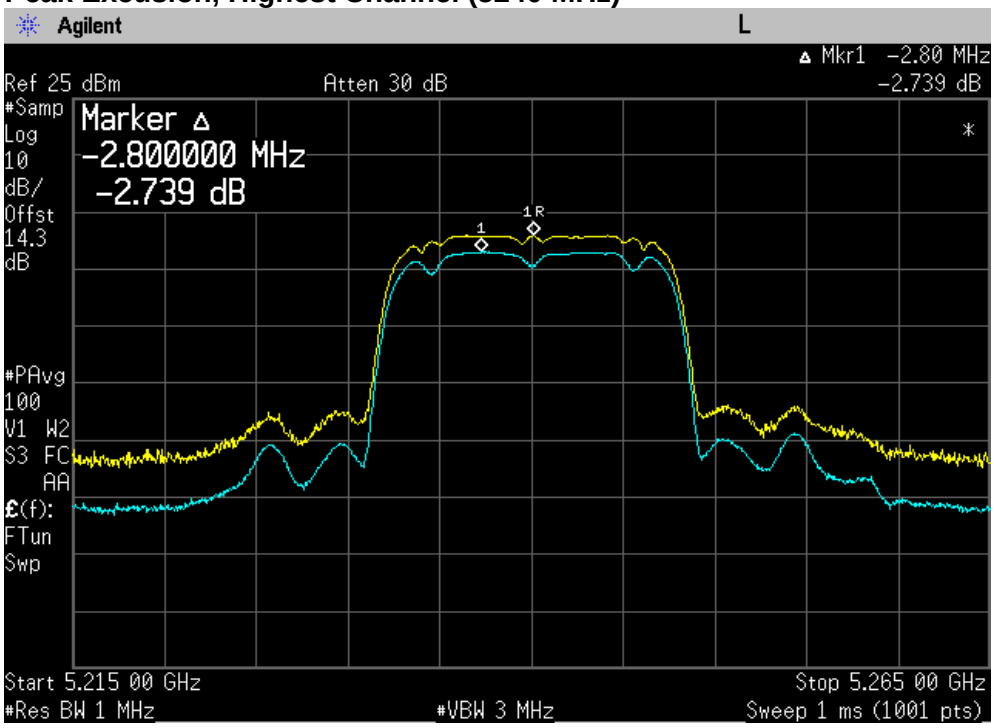


Peak Excusion, Middle Channel (5210 MHz)



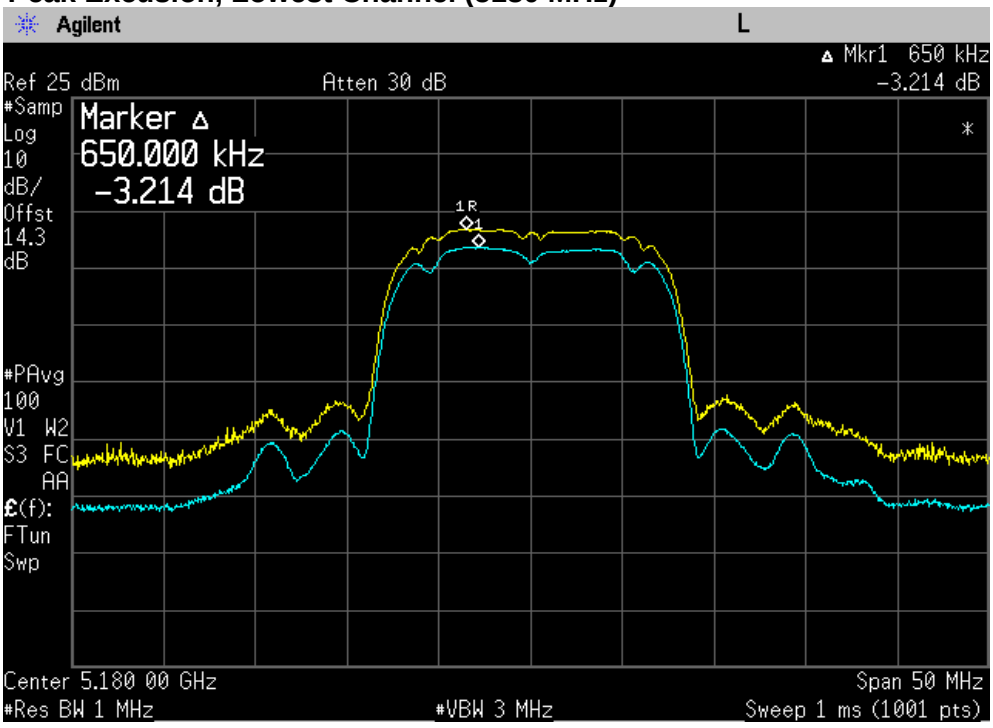
PLOT OF TEST DATA

Peak Excusion, Highest Channel (5240 MHz)



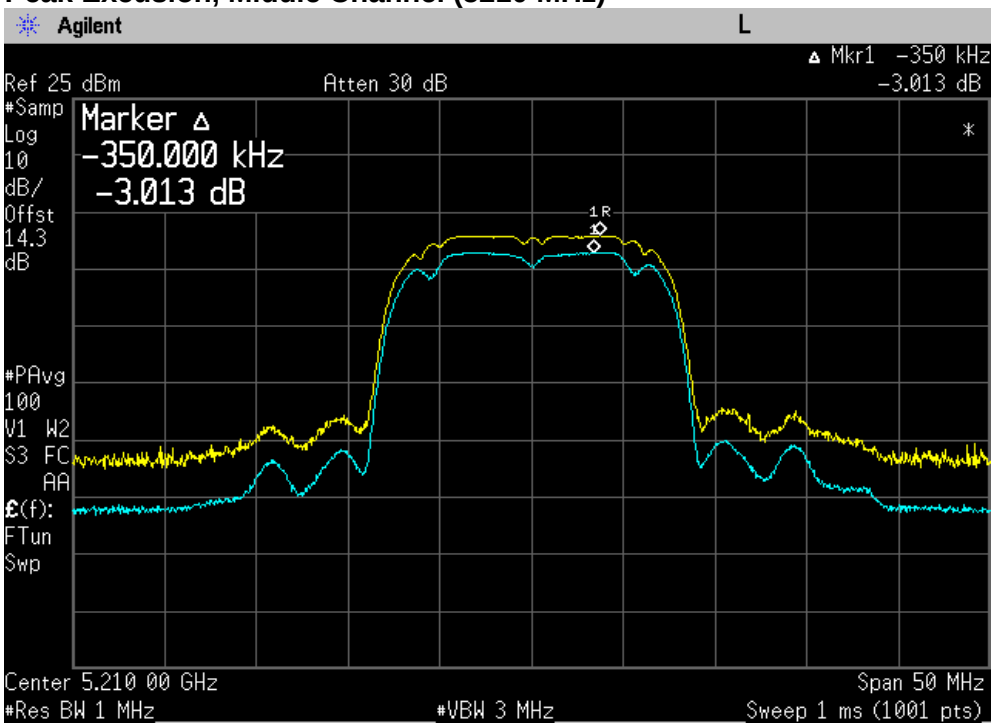
Ant B

Peak Excusion, Lowest Channel (5180 MHz)

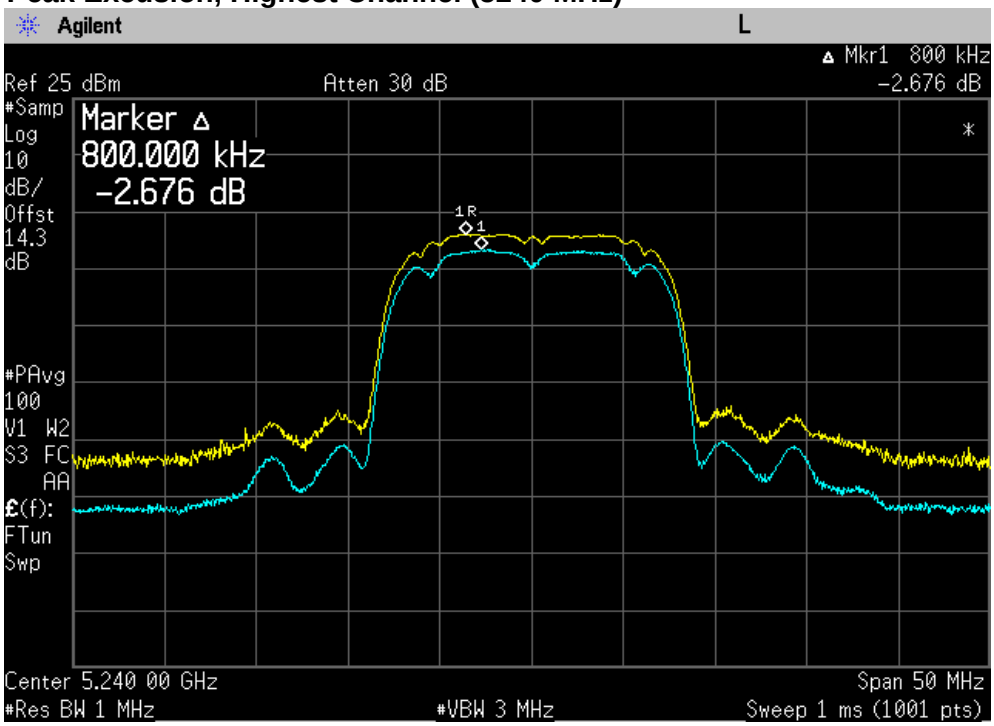


PLOT OF TEST DATA

Peak Excusion, Middle Channel (5210 MHz)



Peak Excusion, Highest Channel (5240 MHz)



8.7 Radiated Spurious Emissions

FCC §15.407(b), RSS-210 A9.2

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

Result:

Ant A

Lowest Channel

Frequency (GHz)	Reading (dBμV)	Pol* (H/V)	Signal Generator Output (dBm)	Cable Loss (dB)	Tx Antenna Gain (dBi)	EIRP (dBm)	Limit (dBm)	Margin (dB)
10.36	57.99	H	-52.21	-4.99	11.19	-46.01	-27.0	19.01
10.36	56.82	V	-53.38	-4.99	11.19	-47.18	-27.0	20.18

Frequency (GHz)	Reading (dBμV)	Pol* (H/V)	mode	AF+CL+Amp (dB)**	Distance (dB)***	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)
15.54	56.08	V	peak	0.84	-9.54	47.38	74.0	26.62
15.54	52.42	V	average	0.84	-9.54	43.72	54.0	10.28

Middle Channel

Frequency (GHz)	Reading (dBμV)	Pol* (H/V)	Signal Generator Output (dBm)	Cable Loss (dB)	Tx Antenna Gain (dBi)	EIRP (dBm)	Limit (dBm)	Margin (dB)
10.42	56.44	H	-53.38	-5.06	11.17	-47.27	-27.0	20.27
10.42	55.70	V	-54.12	-5.06	11.17	-48.01	-27.0	21.01

Frequency (GHz)	Reading (dBμV)	Pol* (H/V)	mode	AF+CL+Amp (dB)**	Distance (dB)***	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)
15.63	55.43	V	peak	1.67	-9.54	47.56	74.0	26.44
15.63	51.33	V	average	1.67	-9.54	43.46	54.0	10.54

TEST DATA

Highest Channel

Frequency (GHz)	Reading (dBμV)	Pol* (H/V)	Signal Generator Output (dBm)	Cable Loss (dB)	Tx Antenna Gain (dBi)	EIRP (dBm)	Limit (dBm)	Margin (dB)
10.48	55.08	H	-54.10	-5.07	11.10	-48.07	-27.0	21.07
10.48	53.89	V	-55.29	-5.07	11.10	-49.26	-27.0	22.26

Frequency (GHz)	Reading (dBμV)	Pol* (H/V)	mode	AF+CL+Amp (dB)**	Distance (dB)***	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)
15.72	51.74	H	peak	2.06	-9.54	44.26	74.0	29.74
15.72	47.63	H	average	2.06	-9.54	40.15	54.0	13.85

Ant B

Lowest Channel

Frequency (GHz)	Reading (dBμV)	Pol* (H/V)	Signal Generator Output (dBm)	Cable Loss (dB)	Tx Antenna Gain (dBi)	EIRP (dBm)	Limit (dBm)	Margin (dB)
10.36	58.04	H	-52.16	-4.99	11.19	-45.96	-27.0	18.96
10.36	56.28	V	-53.92	-4.99	11.19	-47.72	-27.0	20.72

Frequency (GHz)	Reading (dBμV)	Pol* (H/V)	mode	AF+CL+Amp (dB)**	Distance (dB)***	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)
15.54	54.81	H	peak	0.84	-9.54	46.11	74.0	27.89
15.54	50.63	H	average	0.84	-9.54	41.93	54.0	12.07

TEST DATA

Middle Channel

Frequency (GHz)	Reading (dBμV)	Pol* (H/V)	Signal Generator Output (dBm)	Cable Loss (dB)	Tx Antenna Gain (dBi)	EIRP (dBm)	Limit (dBm)	Margin (dB)
10.42	57.12	H	-52.70	-5.06	11.17	-46.59	-27.0	19.59
10.42	54.98	V	-54.84	-5.06	11.17	-48.73	-27.0	21.73

Frequency (GHz)	Reading (dBμV)	Pol* (H/V)	mode	AF+CL+Amp (dB)**	Distance (dB)***	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)
15.63	54.83	H	peak	1.67	-9.54	46.96	74.0	27.04
15.63	50.2	H	average	1.67	-9.54	42.33	54.0	11.67

Highest Channel

Frequency (GHz)	Reading (dBμV)	Pol* (H/V)	Signal Generator Output (dBm)	Cable Loss (dB)	Tx Antenna Gain (dBi)	EIRP (dBm)	Limit (dBm)	Margin (dB)
10.48	57.84	H	-51.34	-5.07	11.10	-45.31	-27.0	18.31
10.48	55.15	V	-54.03	-5.07	11.10	-48.00	-27.0	21.00

Frequency (GHz)	Reading (dBμV)	Pol* (H/V)	mode	AF+CL+Amp (dB)**	Distance (dB)***	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)
15.72	53.06	H	peak	2.06	-9.54	45.58	74.0	28.42
15.72	48.16	H	average	2.06	-9.54	40.68	54.0	13.32

Note:

1. *Pol. H = Horizontal V = Vertical

2. **AF + CL + Amp. = Antenna Factor + Cable Loss + Amplifier.

3. ***Distance = 20log(1/3), The limit above 8 GHz shall be extrapolated to the specified distance using an extrapolation factor of 20 dB/decade from 3 m to 1 m.

4. Other spurious are under 20 dB below Fundamental.

5. The radiated emissions testing were made by rotating through three orthogonal axes. The worst date was recorded.

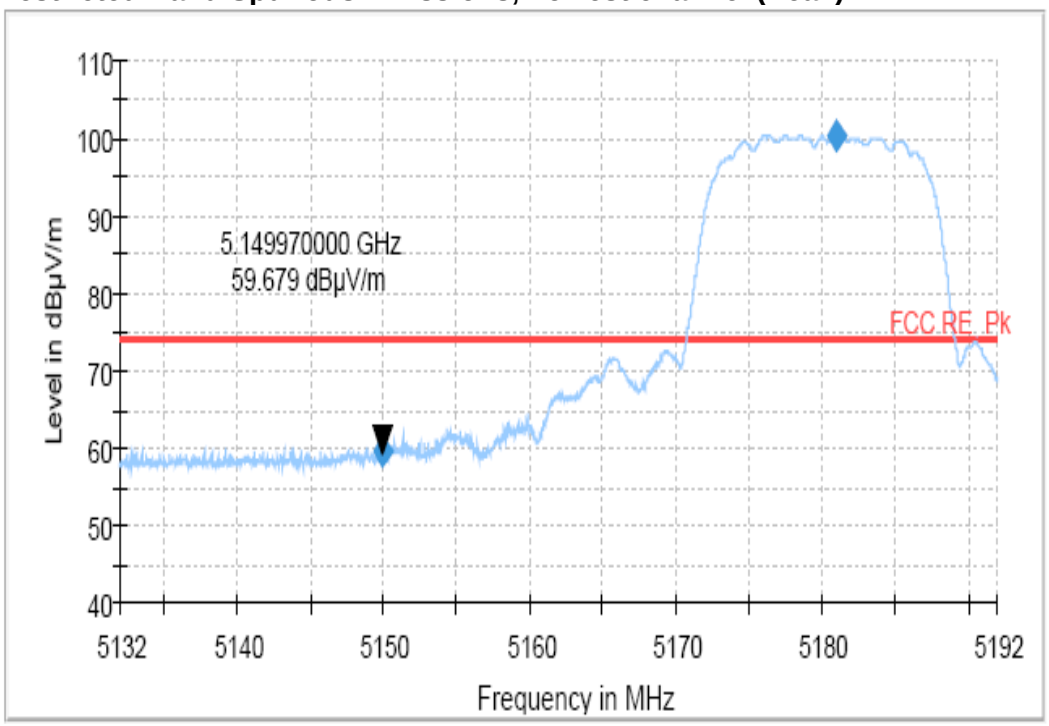
6. For measurements the resolution bandwidth is set to 1 MHz, and then the video bandwidth is set to 1 MHz for peak measurements and 10 Hz for average measurements.

7. The spectrum is measured from 9 kHz to 10th harmonic and the worst-case emissions are reported. No significant emissions were found beyond the fifth harmonic for this device.

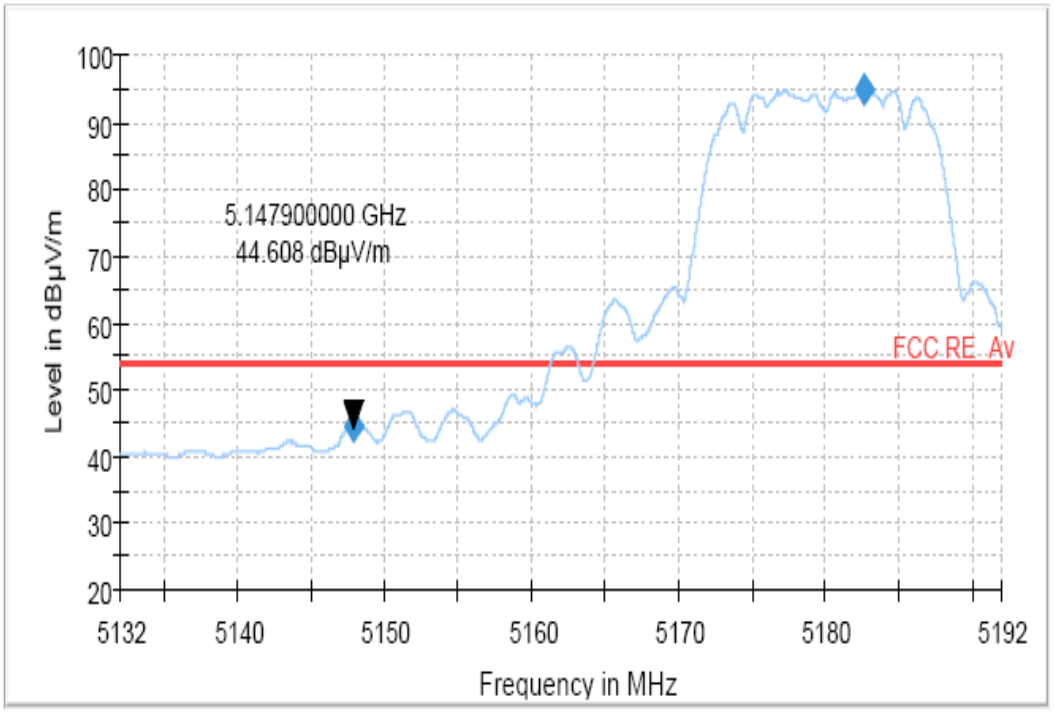
PLOT OF TEST DATA

Ant A

Restricted Band Spurious Emissions, Lowest channel (Peak)

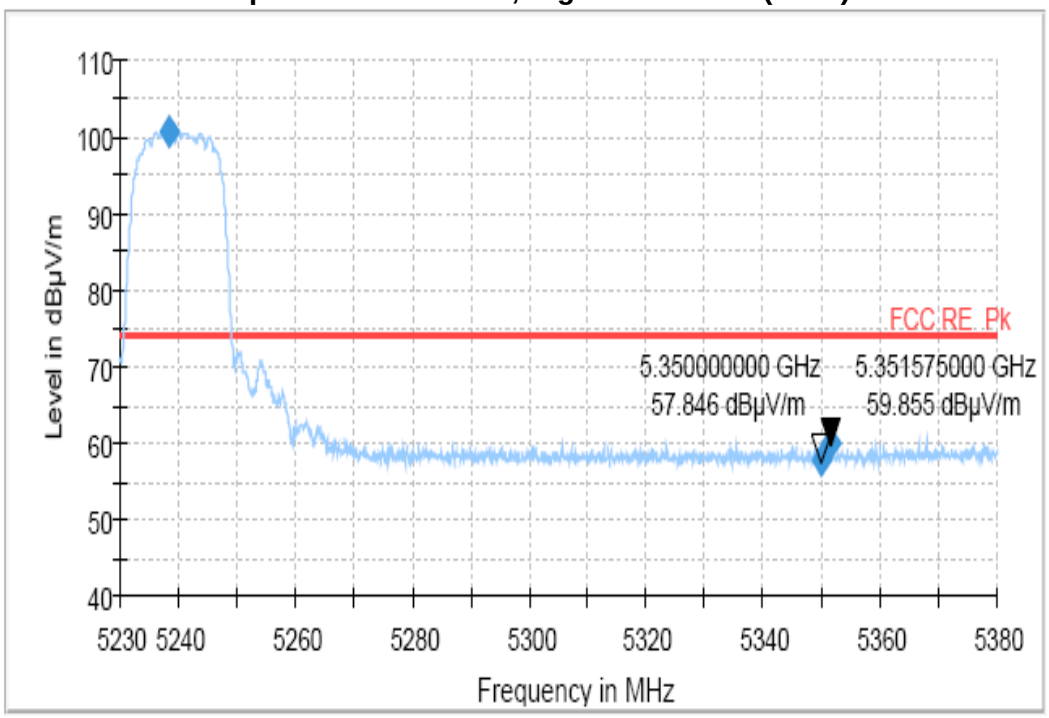


Restricted Band Spurious Emissions, Lowest channel (Average)

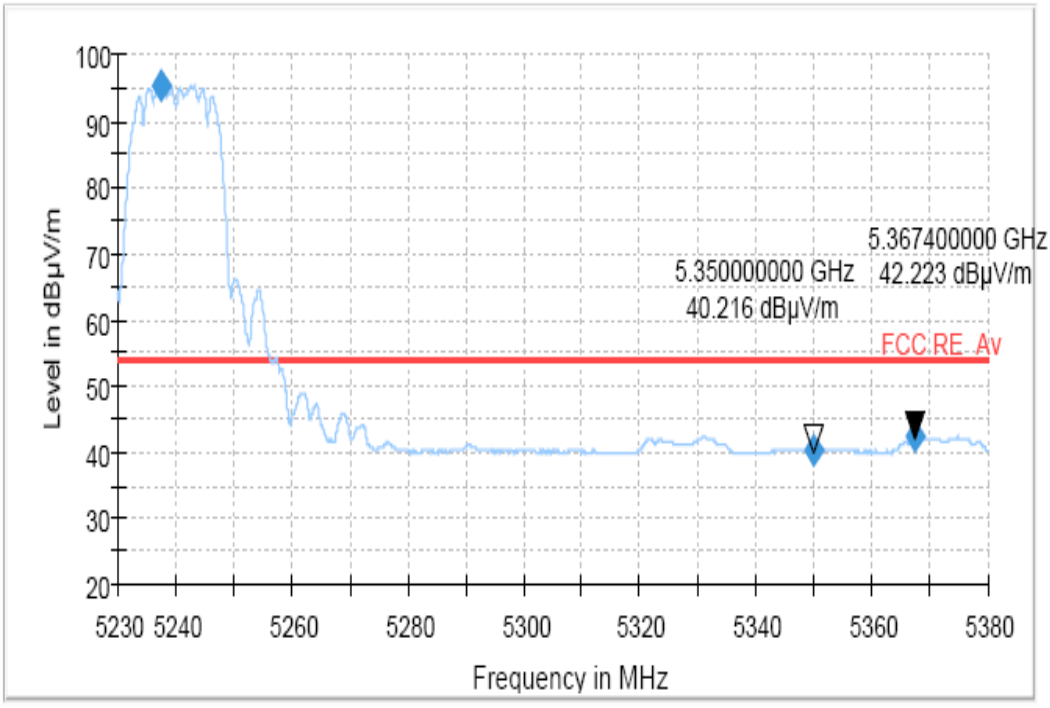


PLOT OF TEST DATA

Restricted Band Spurious Emissions, Highest channel (Peak)



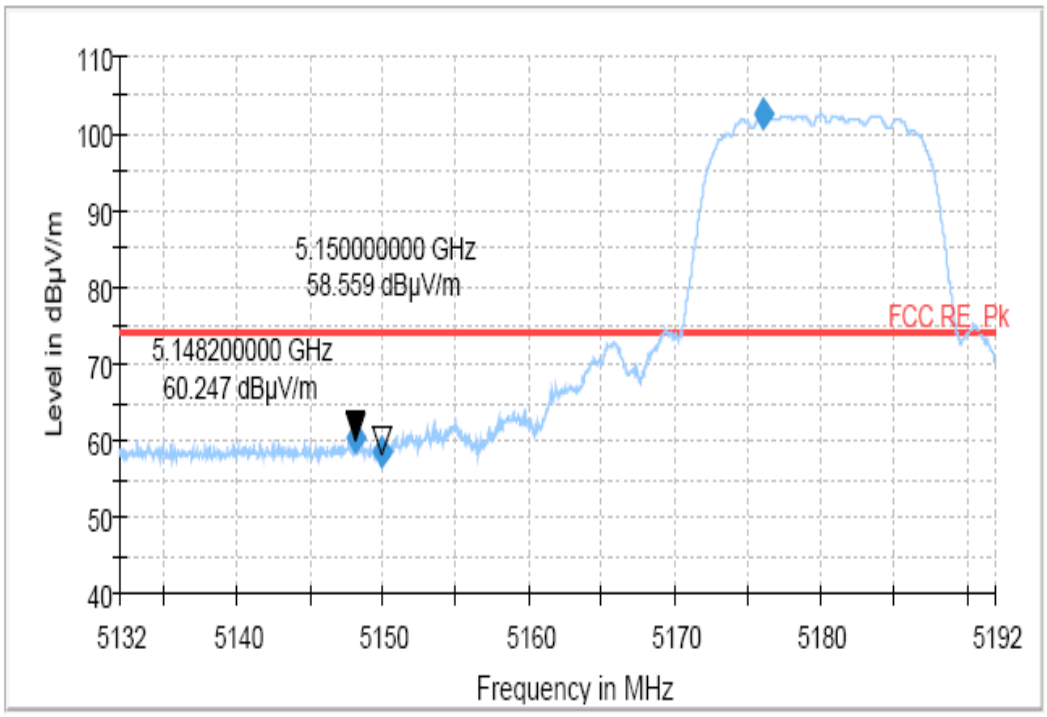
Restricted Band Spurious Emissions, Highest channel (Average)



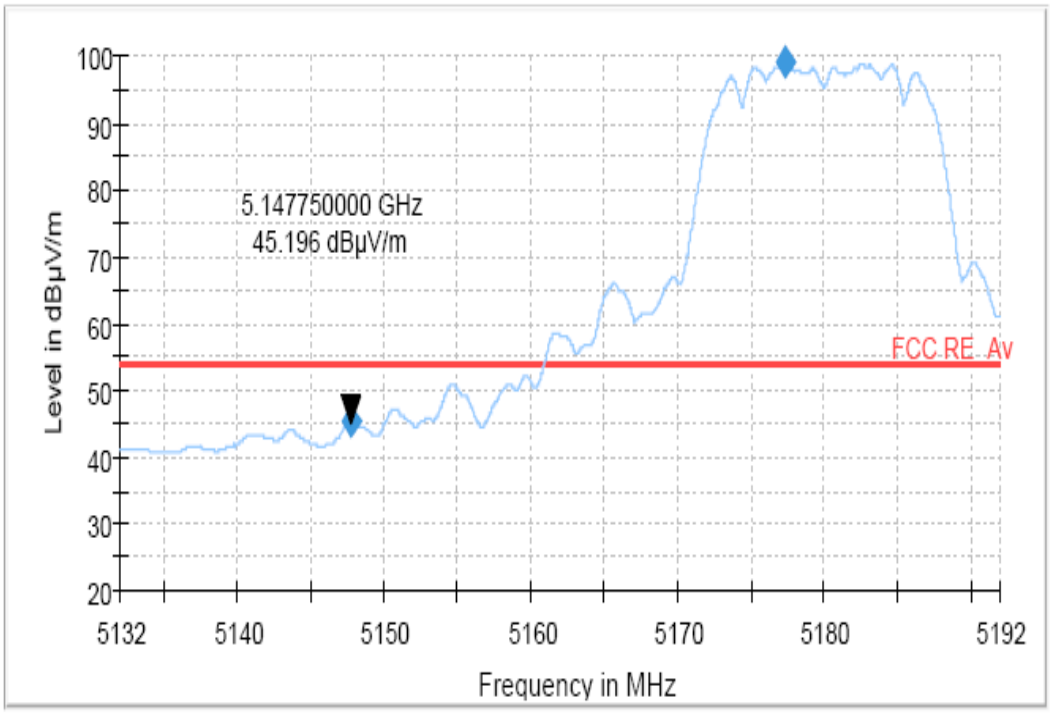
PLOT OF TEST DATA

Ant B

Restricted Band Spurious Emissions, Lowest channel (Peak)

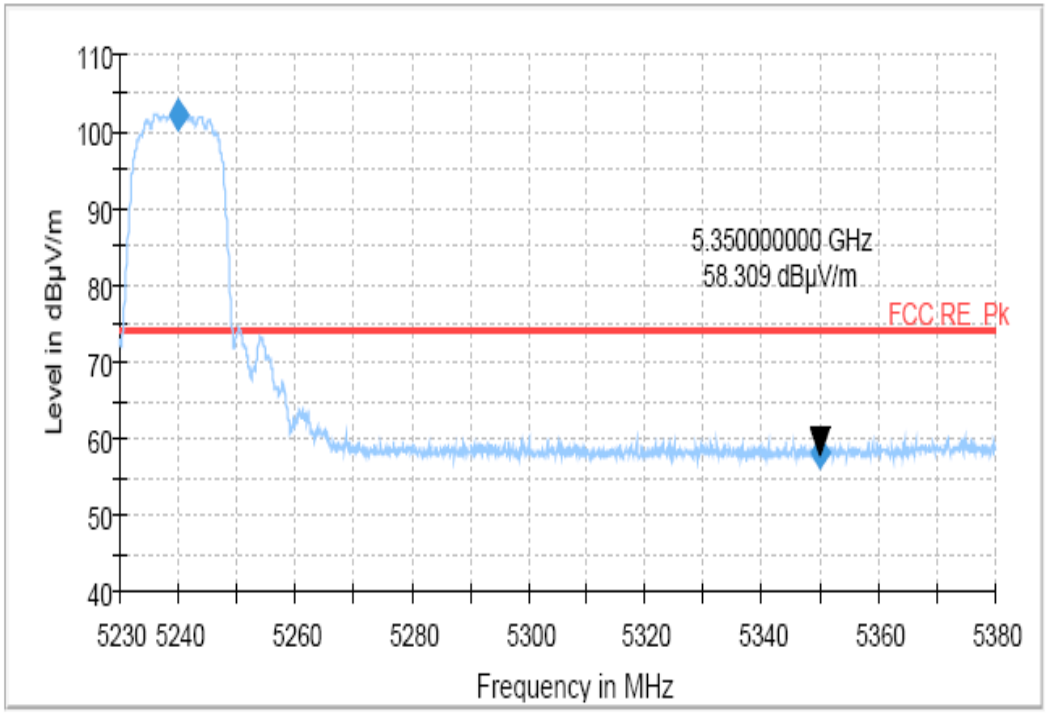


Restricted Band Spurious Emissions, Lowest channel (Average)

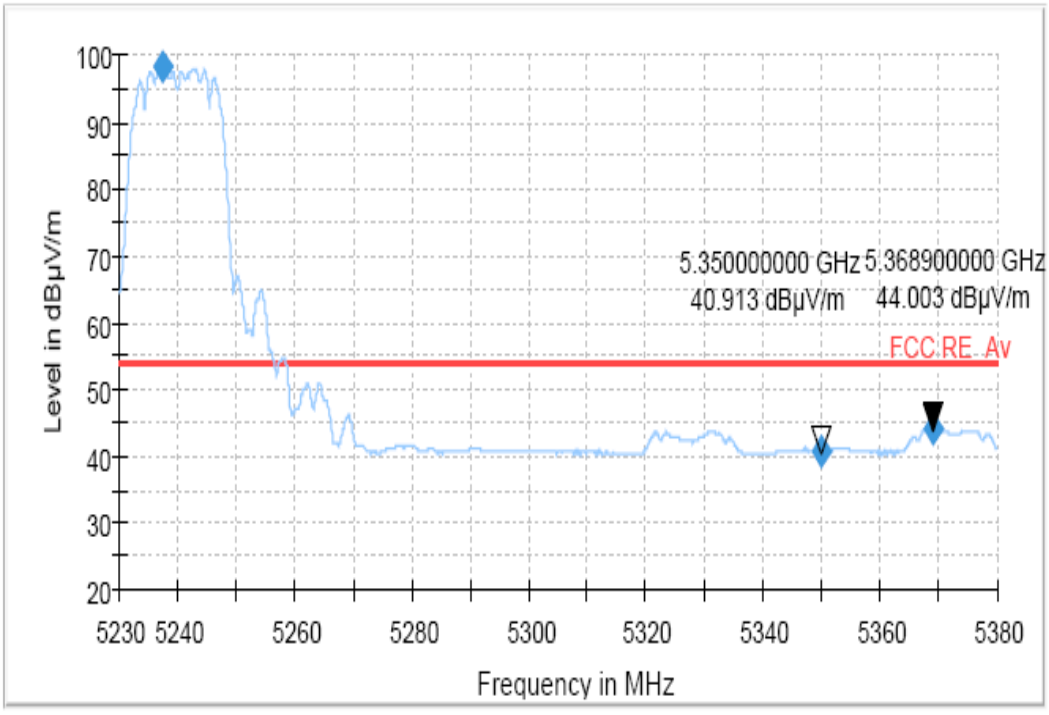


PLOT OF TEST DATA

Restricted Band Spurious Emissions, Highest channel (Peak)



Restricted Band Spurious Emissions, Highest channel (Average)



Note: For the radiated emission field strength measurements at the bandedges, the resolution bandwidth and video bandwidth were set to 1 MHz. Peak detector was used.

TEST DATA

8.8 Receiver Spurious Emissions

IC RSS-GEN 7.2.5

Frequency (MHz)	Reading (dBμV/m)	Pol* (H/V)	Antenna Heights (cm)	Turntable Angles (°)	AF+CL+Amp (dB)**	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)
195.40	38.2	V	100	305	-16.2	22.0	43.5	21.5
213.82	46.2	H	165	4	-19.1	27.1	43.5	16.4
254.20	28.7	H	163	360	-15.5	13.2	46.0	32.8
285.15	47.4	H	260	165	-15.5	31.9	46.0	14.1
320.75	29.9	H	216	345	-13.6	16.3	46.0	29.7
351.99	48.8	H	100	339	-13.6	35.2	46.0	10.8

Radiated Measurements at 3meters

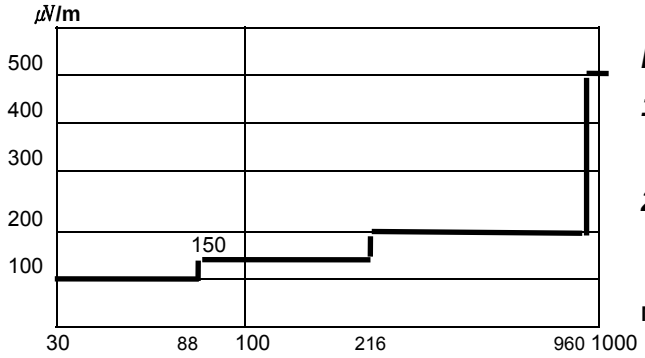


Fig. 5. Limits at 3 meters

NOTES:

1. All modes were measured and the worst-case emission was reported.

2 The radiated limits are shown on Figure 5.

Above 1GHz the limit is 500 μV/m.

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 IC RSS GEN Clause 6.

TEST DATA

8.9 Frequency Stability

FCC §15.407(g), IC RSS-210 A9.4

Test channel : Middle channel (5210 MHz)

Standard test voltage : 5 Vdc

Deviation Limit : ±20 ppm

Measurement Result :

Voltage (%)	Power (Vdc)	Temp. (℃)	Frequency (Hz)	Frequency Error (Hz)	ppm
100 %	5.00	+ 23(Ref.)	5210056381	56381	10.8217
100 %		- 30	5210097297	97297	18.6750
100 %		- 20	5210103035	103035	19.7764
100 %		- 10	5210102677	102677	19.7077
100 %		0	5210095387	95387	18.3084
100 %		10	5210093441	93441	17.9349
100 %		20	5210079332	79332	15.2269
100 %		30	5210067469	67469	12.9499
100 %		40	5410058762	58762	11.2787
100 %		50	5210057097	57097	10.9591
85 %	4.25	23	5210040762	40762	7.8238
115 %	5.75	23	5210057312	57312	11.0004

Note:
The temperature is varied from – 30 °C to + 50 °C using an environmental chamber.

9. MAXIMUM PERMISSIBLE EXPOSURE

RF Exposure Limit

According to FCC 1.1310: The criteria listed in the following table shall be used to evaluate the Environmental of human exposure to radio frequency (RF) radiation as specified in 1.1307(b)

Limits for Maximum Permissible Exposure (MPE)

Frequency Range(MHz)	Electric Field Strength(V/m)	Magnetic Field Strength(A/m)	Power Density (mW/cm^2)	Averaging Time (Minutes)
(A) Limits for occupational / Contral Exposure				
30 - 300	61.4	0.163	1	6
300 - 1500	…	…	F/300	6
1500 - 100000	…	…	5	6
(B) Limits for General Population / Uncontrolled Exposure				
30 - 300	27.5	0.073	0.2	30
300 - 1500	…	…	F/1500	30
1500 - 100000	…	…	1	30

F = Frequency (MHz)

Fries formula

Fries transmission formula : $Pd = (Pout * G) / (4 * \pi * r^2)$

$r = \sqrt{((Pout * G) / 4 * \pi * Pd)}$

Where

Pd = Power density in ㎽/㎠

Pout = Output power to antenna in ㎽

G = Gain of antenna in linear scale

π= 3.1416

r = Distance between observation point center of the radiator in cm

Pd is the limit of MPE, 1 ㎽/㎠. If we know the Maximum Gain of the antenna and the total power input to the antenna, through the calculation, we will know the Maximum distance r where the MPE limit is reached and Power density at prediction frequency.

TEST DATA

Test Result :

The maximum antenna gain is **3.36 dBi**.

Maximum peak output power at antenna input terminal:	16.10	(dBm)
Maximum peak output power at antenna input terminal:	40.74	(mW)
Antenna gain(typical):	3.36	(dBi)
Maximum antenna gain:	2.17	(numeric)
Prediction distance:	20	(cm)
Prediction frequency:	5210	(MHz)
MPE limit for uncontrolled exposure at prediction frequency:	1	(mW/cm^2)

Maximum allowable antenna gain:	20.91	(dBi)
Maximum Distance:	2.65	(cm)

Power density at prediction frequency : 0.017568 (mW/cm^2)

Test result: PASS

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	Xi	Uncertainty of Xi		Coverage factor k	u(Xi) (dB)	Ci	Ci u(Xi) (dB)
		Value (dB)	Probability Distribution				
Receiver reading	***RI***	± 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	***LAMN***	± 0.8	normal 2	2.000	0.4	1	0.4
Sine wave voltage	***dVSW***	± 2.00	normal 2	2.000	1.00	1	1.00
Pulse amplitude response	***dVPA***	± 1.50	rectangular	1.732	0.87	1	0.87
Pulse repetition rate response	***dVPR***	± 1.50	rectangular	1.732	0.87	1	0.87
Noise floor proximity	***dVNF***	± 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	Xi	Uncertainty of Xi		Coverage factor k	u(Xi) (dB)	Ci	Ci u(Xi) (dB)
		Value (dB)	Probability Distribution				
Receiver reading	***RI***	± 0.10	normal 1	1.000	0.10	1	0.10
Sine wave voltage	***dVsw***	± 2.00	normal 2	2.000	1.00	1	1.00
Pulse amplitude response	***dVpa***	± 1.50	rectangular	1.732	0.87	1	0.87
Pulse repetition rate response	***dVpr***	± 1.50	rectangular	1.732	0.87	1	0.87
Noise floor proximity	***dVnf***	± 0.50	normal 2	2.000	0.25	1	0.25
Antenna Factor Calibration	***AF***	± 1.50	normal 2	2.000	0.75	1	0.75
Attenuation Antenna-receiver	***CL***	± 0.52	normal 2	2.000	0.26	1	0.26
Antenna Directivity	***AD***	± 1.00	rectangular	1.732	0.58	1	0.58
Antenna Factor Height Dependence	***AH***	± 0.50	rectangular	1.732	0.29	1	0.29
Antenna Phase Centre Variation	***AP***	± 0.30	rectangular	1.732	0.17	1	0.17
Antenna Factor Frequency Interpolation	***AI***	± 0.30	rectangular	1.732	0.17	1	0.17
Site Imperfections	***SI***	± 4.00	triangular	2.449	1.63	1	1.63
Measurement Distance Variation	***DV***	± 0.10	rectangular	1.732	0.06	1	0.06
Antenna Balance	***Dbal***	± 0.90	rectangular	1.732	0.52	1	0.52
Cross Polarisation	***DCross***	± 0.90	rectangular	1.732	0.52	1	0.52
ⓐ Mismatch	***M***	+ 0.25	U-Shaped	1.414	0.18	1	0.18
ⓑ Mismatch	***M***	- 0.26	U-Shaped	1.414	- 0.18	1	- 0.18
ⓒ Mismatch	***M***	+ 0.98	U-Shaped	1.414	0.69	1	0.69
ⓓ Mismatch	***M***	- 1.11	U-Shaped	1.414	- 0.79	1	- 0.79
Measurement System Repeatability	***RS***	0.09	normal 1	1.000	0.09	1	0.09
Remark	ⓐ: Biconical Antenna-receiver Mismatch : + (< 200 MHz) ⓑ: Biconical Antenna-receiver Mismatch : - (< 200 MHz) ⓒ: Log Periodic Antenna-receiver Mismatch : + (≧ 200 MHz) ⓓ: Log Periodic Antenna-receiver Mismatch : - (≧ 200 MHz)						
Combined Standard Uncertainty	Normal			± 2.63 (< 200 MHz) ± 2.74 (≧200 MHz)			
Expended Uncertainty U	Normal (k = 2)			± 5.26 (< 200 MHz) ± 5.48 (≧200 MHz)			

11. TEST EQUIPMENT

No.	Instrument	Manufacturer	Model	Serial No.	Calibration Date	Calibration Interval
1	*Test Receiver	R & S	ESCS 30	833364/020	Mar. 24 2010	1 year
2	*Test Receiver	R & S	ESCS 30	100302	Nov. 10 2010	1 year
3	*Amplifier	HP	8447F	2805A03427	Jul. 20 2010	1 year
4	*Amplifier	Sonoma Instrument	310N	291916	Jul. 20 2010	1 year
5	*Amplifier	R & S	SCU18	10065	Jun. 11 2010	1 year
6	*Amplifier	R & S	SCU26	10011	Jun. 11 2010	1 year
7	*Amplifier	R & S	SCU40	10011	Jun. 18 2010	1 year
8	*Pre Amplifier	HP	8449B	3008A00107	Feb. 03 2010	1 year
9	*Pre Amplifier	HP	8447F	2805A03351	Oct. 06 2010	1 year
10	*Spectrum Analyzer	Agilent	E4440A	MY44303257	Jul. 20 2010	1 year
11	*Spectrum Analyzer	Agilent	E4440A	MY44022567	Jun. 03 2010	1 year
12	*Spectrum Analyzer	R & S	FSP40	100361	Sep. 02 2010	1 year
13	*Loop Antenna	EMCO	6502	8911-2436	Jan. 11 2009	2 year
14	*Wideband Power Sensor	R & S	NRP-Z81	100634	May. 26 2010	1 year
15	Peak Power Sensor	R & S	NRV-Z32	836019/028	Nov. 10 2010	1 year
16	*Biconical Log Antenna	ARA	LPB-2520/A	1180	Apr. 14 2010	2 year
17	*Horn Antenna	SCHWARZBECK	BBHA9120D	9120D-508	Dec.24 2010	2 year
18	Horn Antenna	SCHWARZBECK	BBHA9120D	9120D-474	Jul. 14 2010	2 year
19	*Horn Antenna	Q-par Angus	QSH20S20	8179	Apr. 12 2010	2 year
20	*Horn Antenna	Q-par Angus	QSH22K20	8180	Apr. 12 2010	2 year
21	*Trilog-Broadband Antenna	SCHWARZBECK	VULB 9168	9168-257	Apr. 14 2010	2 year
22	*LISN	R & S	ESH3-Z5	833874/006	Nov. 10 2010	1 year
23	*LISN	R & S	ESH2-Z5	100227	Feb. 03 2010	1 year
24	*Position Controller	DAEIL EMC	N/A	N/A	N/A	N/A
25	*Turn Table	DAEIL EMC	N/A	N/A	N/A	N/A
26	*Antenna Mast	DAEIL EMC	N/A	N/A	N/A	N/A
27	*Anechoic Chamber	EM Eng.	N/A	N/A	N/A	N/A
28	*Shielded Room	EM Eng.	N/A	N/A	N/A	N/A
29	*Position Controller	Seo-Young EMC	N/A	N/A	N/A	N/A
30	*Turn Table	Seo-Young EMC	N/A	N/A	N/A	N/A
31	*Antenna Mast	Seo-Young EMC	N/A	N/A	N/A	N/A
32	*Anechoic Chamber	Seo-Young EMC	N/A	N/A	N/A	N/A
33	*Shielded Room	Seo-Young EMC	N/A	N/A	N/A	N/A

*) Test equipment used during the test