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FCC RADIO TEST REPORT

Applicant's company	**WOORIRO Co., Ltd.**
Applicant Address	102-22, Pyeongdongsandan 6beon-ro, Gwangsan-gu, Gwanju, South Korea
FCC ID	2AM57WDR300
Manufacturer's company	**WOORIRO Co., Ltd.**
Manufacturer Address	102-22, Pyeongdongsandan 6beon-ro, Gwangsan-gu, Gwanju, South Korea

Product Name	24GHz micro Doppler Radar
Brand Name	WooriRadar
Model Name	WDR300
Test Rule Part(s)	47 CFR FCC Part 15 Subpart C § 15.249
Frequency Range	24000 ~ 24250 MHz
Received Date	Jun. 02, 2017
Final Test Date	Jul. 31, 2017
Submission Type	Original Equipment

Statement

The test result in this report refers exclusively to the presented test model / sample.
Without written approval of SPORTON International Inc., the test report shall not be reproduced except in full.
The measurements and test results shown in this test report were made in accordance with the procedures and found in compliance with the limit given in **ANSI C63.10-2013** and **47 CFR FCC Part 15 Subpart C**.
The test equipment used to perform the test is calibrated and traceable to NML/ROC.

Testing Laboratory
1190

Table of Contents

History of This Test Report

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FR760130	Rev. 01	Initial issue of report	Aug. 18, 2017

1 VERIFICATION OF COMPLIANCE

Product Name	:	24GHz micro Doppler Radar
Brand Name	:	WooriRadar
Model Name	:	WDR300
Applicant	:	WOORIRO Co., Ltd.
Test Rule Part(s)	:	47 CFR FCC Part 15 Subpart C § 15.249

Sporton International as requested by the applicant to evaluate the EMC performance of the product sample received on Jun. 02, 2017 would like to declare that the tested sample has been evaluated and found to be in compliance with the tested rule parts. The data recorded as well as the test configuration specified is true and accurate for showing the sample's EMC nature.

Reviewed By:
Cliff Chang

2 SUMMARY OF THE TEST RESULT

Applied Standard: 47 CFR FCC Part 15 Subpart C			
Part	**Rule Section**	**Description of Test**	**Result**
4.1	15.207	AC Power Line Conducted Emissions	Complies
4.2	15.249(a)	Field Strength of Fundamental Emissions	Complies
4.3	15.215(c)	20dB Spectrum Bandwidth	Complies
4.4	15.249(a)/(d)	Radiated Emissions	Complies
4.5	15.249(d)	Band Edge Emissions	Complies
4.6	15.203	Antenna Requirements	Complies

3 GENERAL INFORMATION

3.1 Product Details

Items	Description
Power Type	From DC 5V
Modulation	CW
Frequency Range	24000 ~ 24250 MHz
Operation Frequency Range	24070 ~ 24230 MHz
Channel Number	4
Channel Bandwidth (99%)	0.66 MHz
Max. Field Strength	99.68 dBuV/m at 3m(Average) / 109.22 dBuV/m at 1m (Average)
Carrier Frequencies	Please refer to section 3.3
Antenna	Antenna Gain: 8.25 dBi

Note:

1. The EUT has two antennas, one transmit antenna and other one is receive antenna.
2. The value of max. field strength at 3m is converted with the 1m test result.
   A distance factor is offset and the formula is 20*LOG(D1/D2)
   Which D1 = Specification Distance, D2 = Measurement Distance

3.2 Accessories

N/A

3.3 Table for Carrier Frequencies

Frequency Band	Channel No.	Frequency
24000 ~ 24250 MHz	1	24070 MHz
	2	24125 MHz
	3	24170 MHz
	4	24230 MHz

3.4 Table for Test Modes

The following table is a list of the test modes shown in this test report.

Test Items	Mode	Channel
AC Power Line Conducted Emissions	Normal Link	-
Field Strength of Fundamental Emissions 20dB Spectrum Bandwidth	CTX	1/2/4
Radiated Emissions 30MHz~1GHz	Normal Link	-
Radiated Emissions 1GHz~40GHz	CTX	1/2/4
Radiated Emissions 40GHz~100GHz	CTX	1/2/4
Band Edge Emissions	CTX	1/2/4

Note: CTX=continuously transmitting

The following test modes were performed for all tests:

For AC Power Line Conducted Emissions test:

Mode 1. Normal Link

For Radiated Emissions Below1GHz test:

Mode 1. EUT in Z axis

Mode 2. EUT in Y axis

Mode 1 is the worst case, so it was selected to record in this test report.

For Radiated Emissions Above 1GHz test:

The EUT was performed at X axis, Y axis and Z axis position for Radiated emission test, and the worst case was found at Y axis. So the measurement will follow this same test configuration.

Mode 1. EUT in Y axis

3.5 Table for Testing Locations

Test Site Location					
Address:	No.8, Lane 724, Bo-ai St., Jhubei City, Hsinchu County 302, Taiwan, R.O.C.				
TEL:	886-3-656-9065				
FAX:	886-3-656-9085				
Test Site No.	**Site Category**	**Location**	**FCC Designation No.**	**IC File No.**	**VCCI Reg. No**
03CH01-CB	SAC	Hsin Chu	TW0006	IC 4086D	-
CO01-CB	Conduction	Hsin Chu	TW0006	IC 4086D	-
TH01-CB	OVEN Room	Hsin Chu	-	-	-

Open Area Test Site (OATS); Semi Anechoic Chamber (SAC).

3.6 Table for Supporting Units

For Test Site No: 03CH01-CB

<Below 1GHz>

Support Unit	Brand	Model	FCC ID
Notebook	DELL	E4300	DoC
Earphone	SHYARO CHI	MIC-04	N/A
Mouse	Logitech	M-U0026	DoC
Power Supply	Advanced	LPS-305	N/A
Fixture	NEXT	485/422	N/A

<Above1GHz>

Support Unit	Brand	Model	FCC ID
Notebook	DELL	E4300	DoC
Power Supply	Advanced	LPS-305	N/A
Fixture	NEXT	485/422	DoC

For Test Site No: CO01-CB

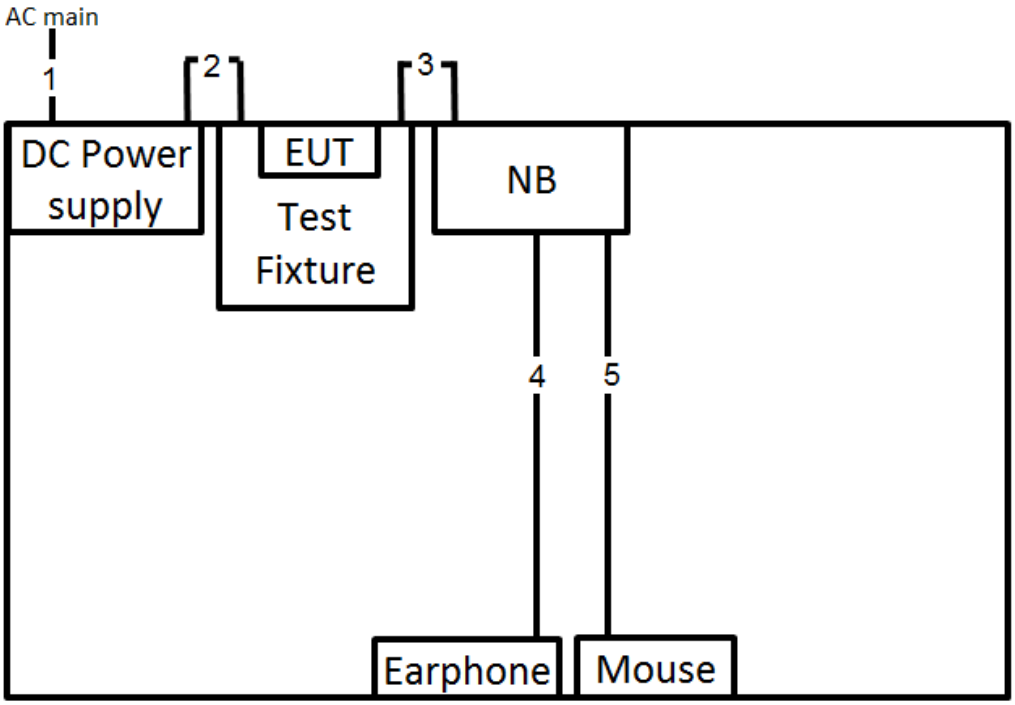
Support Unit	Brand	Model	FCC ID
NB	DELL	E6430	DoC
Power Supply	Advanced	LPS-305	N/A
Earphone	SHYARO CHI	MIC-04	N/A
Mouse	Logitech	M-U0026	DoC
Test Fixture	NEXT	485/422	N/A

3.7 Duty Cycle

On Time (ms)	On+Off Time (ms)	Duty Cycle (%)	Duty Factor (dB)	1/T Minimum VBW (kHz)
1.000	1.000	100.00%	0.00	0.01

3.8 Test Configurations

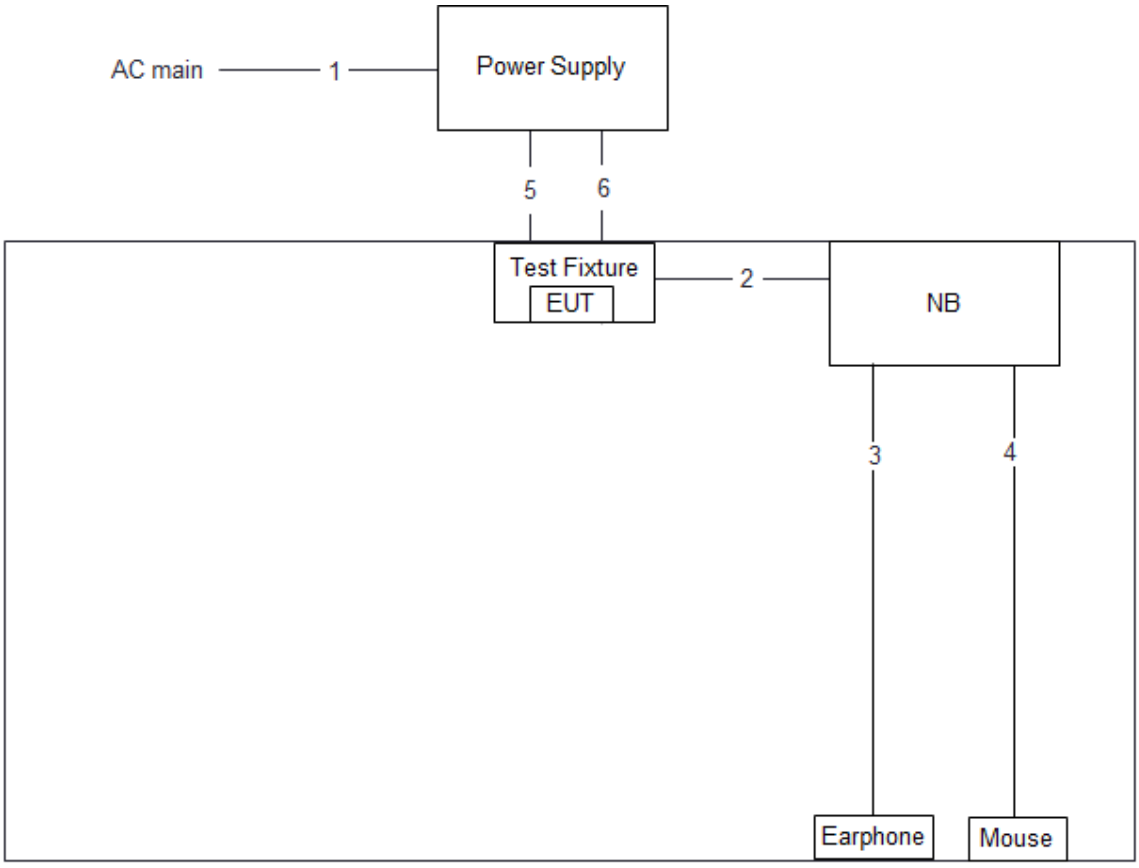
3.8.1 AC Power Line Conduction Emissions Test Configuration



Item	Connection	Shielded	Length
1	Power cable	No	1.8m
2	DC Power cable	No	1.5m
3	USB cable	Yes	0.9m
4	Audio cable	No	1.6m
5	USB cable	Yes	1.8m

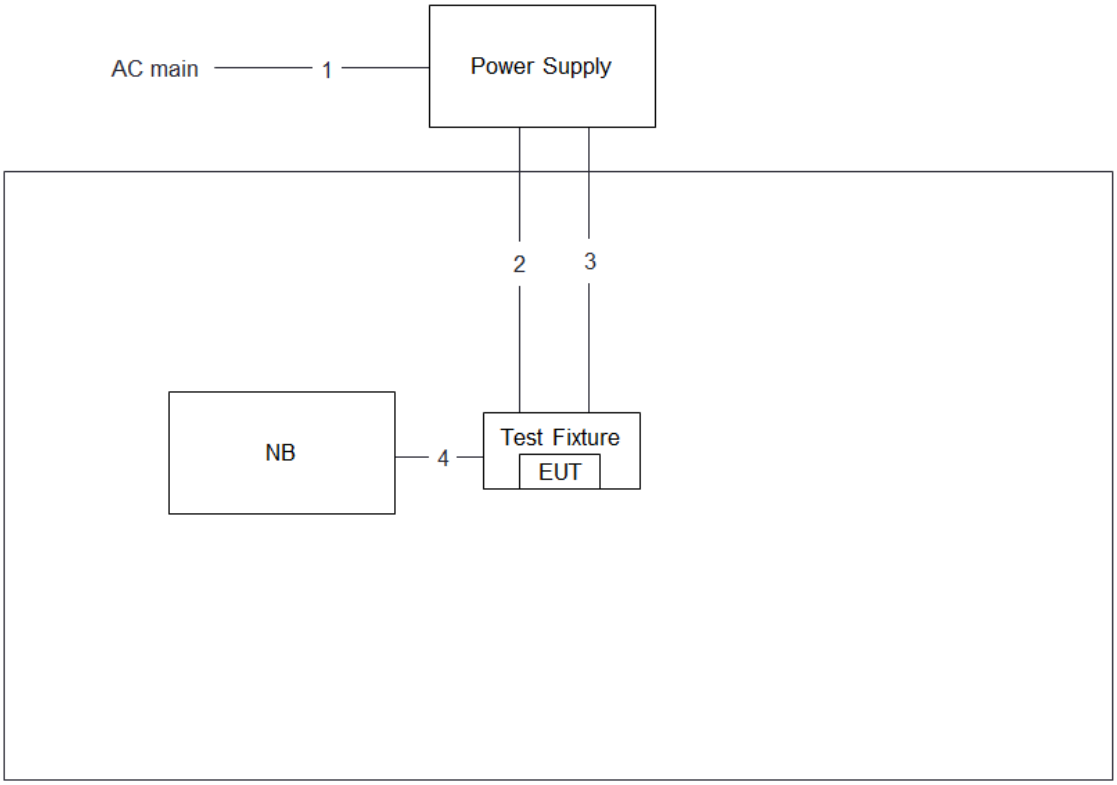
3.8.2 Radiation Emissions Test Configuration

Test Configuration: 30MHz~1GHz



Item	Connection	Shielded	Length
1	Power cable	No	1.5m
2	USB cable	Yes	0.9m
3	USB cable	Yes	1.6m
4	USB cable	Yes	1.8m
5	DC Power cable	No	1m
6	DC Power cable	No	1m

Test Configuration: Above 1GHz



Item	Connection	Shielded	Length
1	Power cable	No	1.5m
2	DC Power cable	No	1m
3	DC Power cable	No	1m
4	USB cable	Yes	0.9m

4 TEST RESULT

4.1 AC Power Line Conducted Emissions Measurement

4.1.1 Limit

For this product which is designed to be connected to the 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 below limits table.

Frequency (MHz)	QP Limit (dBuV)	AV Limit (dBuV)
0.15~0.5	66~56	56~46
0.5~5	56	46
5~30	60	50

4.1.2 Measuring Instruments and Setting

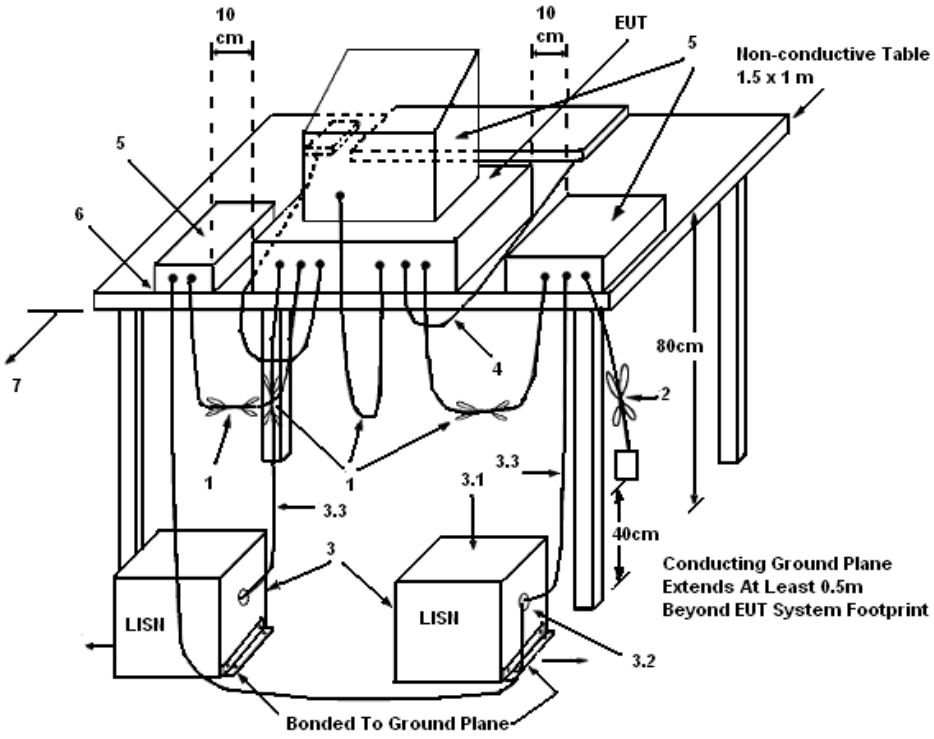
Please refer to section 5 of equipments list in this report. The following table is the setting of the receiver.

Receiver Parameters	Setting
Attenuation	10 dB
Start Frequency	0.15 MHz
Stop Frequency	30 MHz
IF Bandwidth	9 kHz

4.1.3 Test Procedures

1. Configure the EUT according to ANSI C63.10. The EUT or host of EUT has to be placed 0.4 meter far from the conducting wall of the shielding room and at least 80 centimeters from any other grounded conducting surface.
2. Connect EUT or host of EUT to the power mains through a line impedance stabilization network (LISN).
3. All the support units are connected to the other LISNs. The LISN should provide 50uH/50ohms coupling impedance.
4. The frequency range from 150 kHz to 30 MHz was searched.
5. Set the test-receiver system to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
6. The measurement has to be done between each power line and ground at the power terminal.

4.1.4 Test Setup Layout



LEGEND:

(1) Interconnecting cables that hang closer than 40 cm to the ground plane shall be folded back and forth in the center forming a bundle 30 to 40 cm long.

(2) I/O cables that are not connected to a peripheral shall be bundled in the center. The end of the cable may be terminated, if required, using the correct terminating impedance. The overall length shall not exceed 1 m.

(3) EUT connected to one LISN. Unused LISN measuring port connectors shall be terminated in 50 Ω. LISN can be placed on top of, or immediately beneath, reference ground plane.

(3.1) All other equipment powered from additional LISN(s).

(3.2) Multiple outlet strip can be used for multiple power cords of non-EUT equipment.

(3.3) LISN at least 80 cm from nearest part of EUT chassis.

(4) Cables of hand-operated devices, such as keyboards, mice, etc., shall be placed as for normal use.

(5) Non-EUT components of EUT system being tested.

(6) Rear of EUT, including peripherals, shall all be aligned and flush with rear of tabletop.

(7) Rear of tabletop shall be 40 cm removed from a vertical conducting plane that is bonded to the ground plane.

4.1.5 Test Deviation

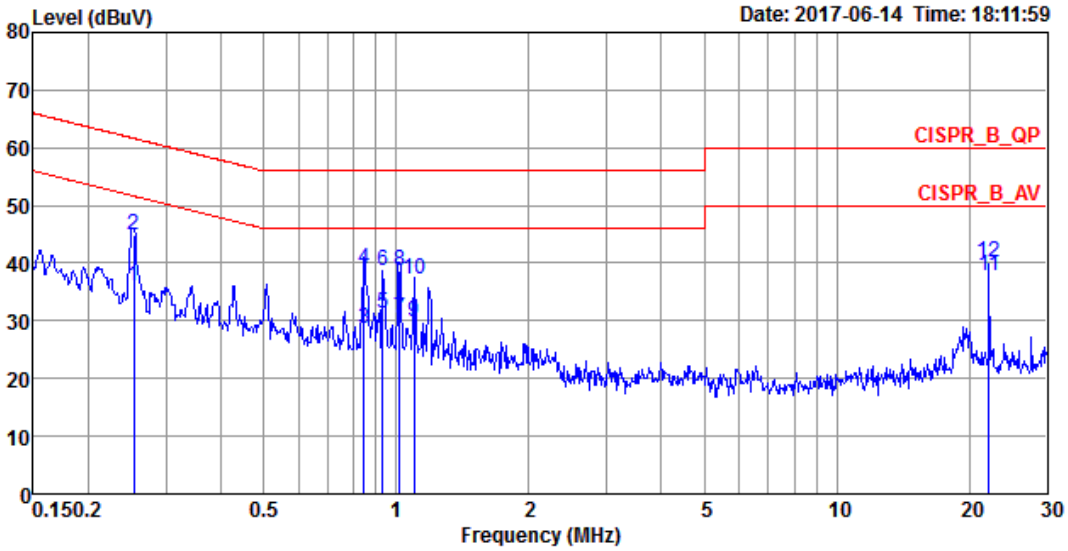
There is no deviation with the original standard.

4.1.6 EUT Operation during Test

The EUT was placed on the test table and programmed in normal function.

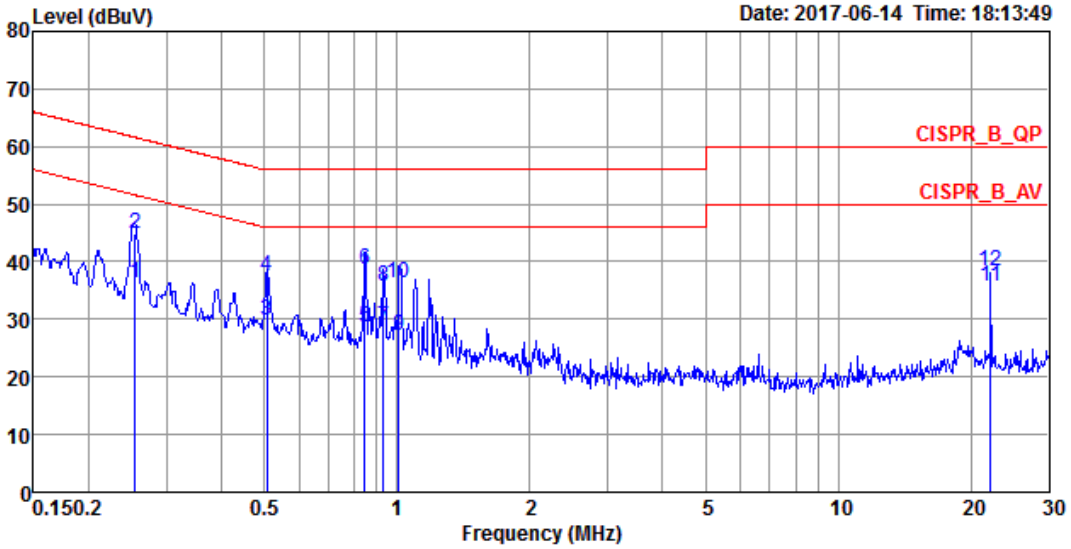
4.1.7 Results of AC Power Line Conducted Emissions Measurement

Temperature	25°C	Humidity	55%
Test Engineer	Rick Yeh	Phase	Line
Configuration	Normal Link		



	Freq	Level	Over Limit	Limit Line	Read Level	LISN Factor	Cable Loss	Remark	Pol/Phase
	MHz	dBuV	dB	dBuV	dBuV	dB	dB		
1	0.2535	35.87	-15.77	51.64	25.86	9.92	0.09	Average	LINE
2	0.2535	44.80	-16.84	61.64	34.79	9.92	0.09	QP	LINE
3	0.8438	28.69	-17.31	46.00	18.57	9.96	0.16	Average	LINE
4	0.8438	39.08	-16.92	56.00	28.96	9.96	0.16	QP	LINE
5	0.9331	31.34	-14.66	46.00	21.20	9.96	0.18	Average	LINE
6	0.9331	38.68	-17.32	56.00	28.54	9.96	0.18	QP	LINE
7	1.0157	30.34	-15.66	46.00	20.19	9.96	0.19	Average	LINE
8	1.0157	38.58	-17.42	56.00	28.43	9.96	0.19	QP	LINE
9	1.0997	29.90	-16.10	46.00	19.75	9.96	0.19	Average	LINE
10	1.0997	37.13	-18.87	56.00	26.98	9.96	0.19	QP	LINE
11	22.1181	37.90	-12.10	50.00	27.30	10.38	0.22	Average	LINE
12	22.1181	40.13	-19.87	60.00	29.53	10.38	0.22	QP	LINE

Temperature	25°C	Humidity	55%
Test Engineer	Rick Yeh	Phase	Neutral
Configuration	Normal Link		



	Freq	Level	Over Limit	Limit Line	Read Level	LISN Factor	Cable Loss	Remark	Pol/Phase
	MHz	dBuV	dB	dBuV	dBuV	dB	dB		
1	0.2545	36.20	-15.41	51.61	26.03	10.08	0.09	Average	NEUTRAL
2	0.2545	44.90	-16.71	61.61	34.73	10.08	0.09	QP	NEUTRAL
3	0.5077	29.85	-16.15	46.00	19.57	10.22	0.06	Average	NEUTRAL
4	0.5077	37.57	-18.43	56.00	27.29	10.22	0.06	QP	NEUTRAL
5	0.8433	28.63	-17.37	46.00	18.37	10.10	0.16	Average	NEUTRAL
6	0.8433	38.74	-17.26	56.00	28.48	10.10	0.16	QP	NEUTRAL
7	0.9303	28.59	-17.41	46.00	18.34	10.07	0.18	Average	NEUTRAL
8	0.9303	35.78	-20.22	56.00	25.53	10.07	0.18	QP	NEUTRAL
9	1.0100	27.02	-18.98	46.00	16.78	10.05	0.19	Average	NEUTRAL
10	1.0100	36.18	-19.82	56.00	25.94	10.05	0.19	QP	NEUTRAL
11	22.1181	35.78	-14.22	50.00	25.17	10.39	0.22	Average	NEUTRAL
12	22.1181	38.36	-21.64	60.00	27.75	10.39	0.22	QP	NEUTRAL

Note:

Level = Read Level + LISN Factor + Cable Loss

4.2 Field Strength of Fundamental Emissions Measurement

4.2.1 Limit

The field strength of fundamental emissions within these bands specified at a distance of 3 meters (measurement instrumentation employing an average detector) shall comply with the following table.

Frequency Band	Fundamental Emissions Limit Average/Peak (dBuV/m) at 3m
24000 ~ 24250 MHz	107.96/127.96

Note 1: 107.96 dBuV/m rounding to 108dBuV/m and 127.96 dBuV/m rounding to 128dBuV/m

Note 2: Above 10 GHz shall be extrapolated to the specified distance using an extrapolation factor of 20 dB/decade from 3m to 1m.

Distance extrapolation factor = 20 log (specific distance [3m] / test distance [1m]) (dB);

Limit line = specific limits (dBuV) + distance extrapolation factor [9.54 dB].

Average limit = 108dBuV/m + distance extrapolation factor (9.54 dB) =117.54dBuV/m.

Peak limit = 128dBuV/m + distance extrapolation factor (9.54 dB) =137.54dBuV/m.

4.2.2 Measuring Instruments and Setting

Please refer to section 5 of equipments list in this report. The following table is the setting of the spectrum analyzer.

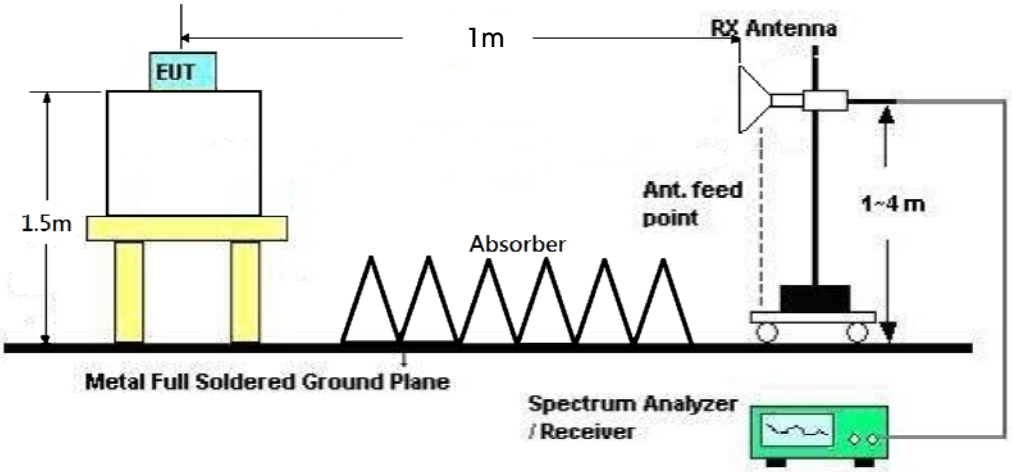
Power Meter Parameter	Setting
RBW	1 MHz Peak / 3MHz Average
VBW	1 MHz Peak / 1/T Average
Detector	Peak
Trace	Max Hold
Sweep Time	Auto

4.2.3 Test Procedures

1. Configure the EUT according to ANSI C63.10. The EUT was placed on the top of the turntable 1.5 meter above ground. The phase center of the receiving antenna mounted on the top of a height-variable antenna tower was placed 3 meters far away from the turntable.
2. Power on the EUT and all the supporting units. The turntable was rotated by 360 degrees to determine the position of the highest radiation.
3. The height of the broadband receiving antenna was varied between one meter and four meters above ground to find the maximum emissions field strength of both horizontal and vertical polarization.
4. For each suspected emissions, the antenna tower was scan (from 1 M to 4 M) and then the turntable was rotated (from 0 degree to 360 degrees) to find the maximum reading.
5. For Fundamental emissions, use 1MHz VBW and 3MHz RBW for peak reading. Then 1MHz RBW and 1/T VBW for average reading in spectrum analyzer.

6. When the radiated emissions limits are expressed in terms of the average value of the emissions, and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 seconds. As an alternative (provided the transmitter operates for longer than 0.1 seconds) or in cases where the pulse train exceeds 0.1 seconds, the measured field strength shall be determined from the average absolute voltage during a 0.1 second interval during which the field strength is at its maximum value.

4.2.4 Test Setup Layout



4.2.5 Test Deviation

There is no deviation with the original standard.

4.2.6 EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

4.2.7 Test Result of Field Strength of Fundamental Emissions

Temperature	22°C	Humidity	54%
Test Engineer	Jay Luo	Configurations	Channel 1
Test Date	Jun. 09, 2017 ~ Jul. 31, 2017		

Horizontal

	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	A/Pos	T/Pos	Remark	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB	cm	deg		
1	24066.00	94.88	117.54	-22.66	98.04	9.30	38.80	51.26	154	326	Average	HORIZONTAL
2	24066.00	95.64	137.54	-41.90	98.80	9.30	38.80	51.26	154	326	Peak	HORIZONTAL

Vertical

	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	A/Pos	T/Pos	Remark	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB	cm	deg		
1	24065.00	109.22	117.54	-8.32	112.38	9.30	38.80	51.26	154	348	Average	VERTICAL
2	24065.00	109.20	137.54	-28.34	112.36	9.30	38.80	51.26	154	348	Peak	VERTICAL

Temperature	22°C	Humidity	54%
Test Engineer	Jay Luo	Configurations	Channel 2
Test Date	Jun. 09, 2017 ~ Jul. 31, 2017		

Horizontal

	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	A/Pos	T/Pos	Remark	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB	cm	deg		
1	24116.00	95.81	137.54	-41.73	98.95	9.31	38.80	51.25	154	329	Peak	HORIZONTAL
2	24117.00	95.75	117.54	-21.79	98.89	9.31	38.80	51.25	154	329	Average	HORIZONTAL

Vertical

	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	A/Pos	T/Pos	Remark	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB	cm	deg		
1	24120.00	107.77	117.54	-9.77	110.89	9.32	38.80	51.24	154	359	Average	VERTICAL
2	24120.00	107.95	137.54	-29.59	111.07	9.32	38.80	51.24	154	359	Peak	VERTICAL

Temperature	22°C	Humidity	54%
Test Engineer	Jay Luo	Configurations	Channel 3
Test Date	Jun. 09, 2017 ~ Jul. 31, 2017		

Horizontal

	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	A/Pos	T/Pos	Remark	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB	cm	deg		
1	24226.00	94.66	117.54	-22.88	97.74	9.34	38.80	51.22	154	329	Average	HORIZONTAL
2	24226.00	95.07	137.54	-42.47	98.15	9.34	38.80	51.22	154	329	Peak	HORIZONTAL

Vertical

	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	A/Pos	T/Pos	Remark	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB	cm	deg		
1	24228.00	107.30	117.54	-10.24	110.38	9.34	38.80	51.22	154	359	Average	VERTICAL
2	24228.00	107.30	137.54	-30.24	110.38	9.34	38.80	51.22	154	359	Peak	VERTICAL

Note:

Emission level (dBuV/m) = 20 log Emission level (uV/m).

Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level.

4.3 20dB Spectrum Bandwidth Measurement

4.3.1 Limit

Intentional radiators must be designed to ensure that the 20 dB bandwidth of the emissions in the specific band (24000 ~ 24250 MHz).

4.3.2 Measuring Instruments and Setting

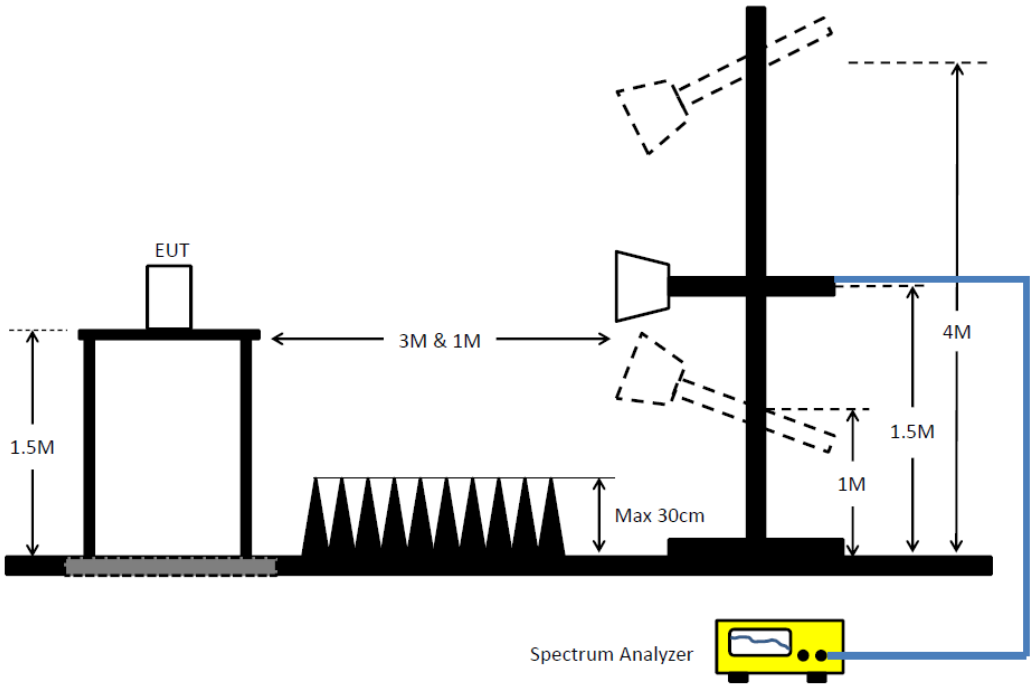
Please refer to section 5 of equipments list in this report. The following table is the setting of the spectrum analyzer.

Spectrum Parameters	Setting
Attenuation	Auto
Span Frequency	> 20dB Bandwidth
RBW	100 kHz
VBW	100 kHz
Detector	Peak
Trace	Max Hold
Sweep Time	Auto

4.3.3 Test Procedures

1. The test procedure is the same as section 4.4.3.
2. The resolution bandwidth of 100 kHz and the video bandwidth of 100 kHz were used.
3. Measured the spectrum width with power higher than 20dB below carrier.

4.3.4 Test Setup Layout



4.3.5 Test Deviation

There is no deviation with the original standard.

4.3.6 EUT Operation during Test

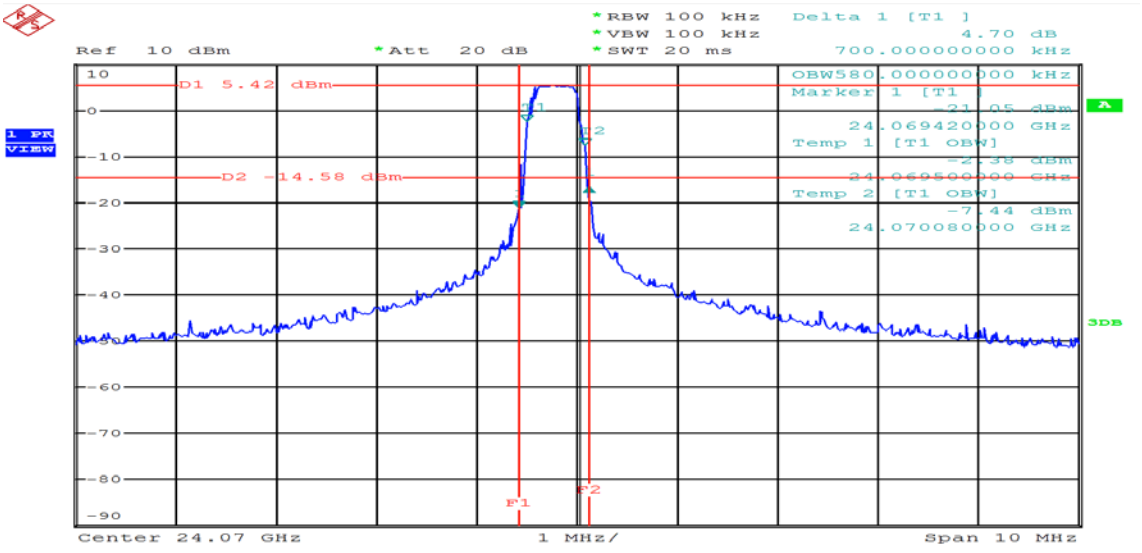
The EUT was programmed to be in continuously transmitting mode.

4.3.7 Test Result of 20dB Spectrum Bandwidth

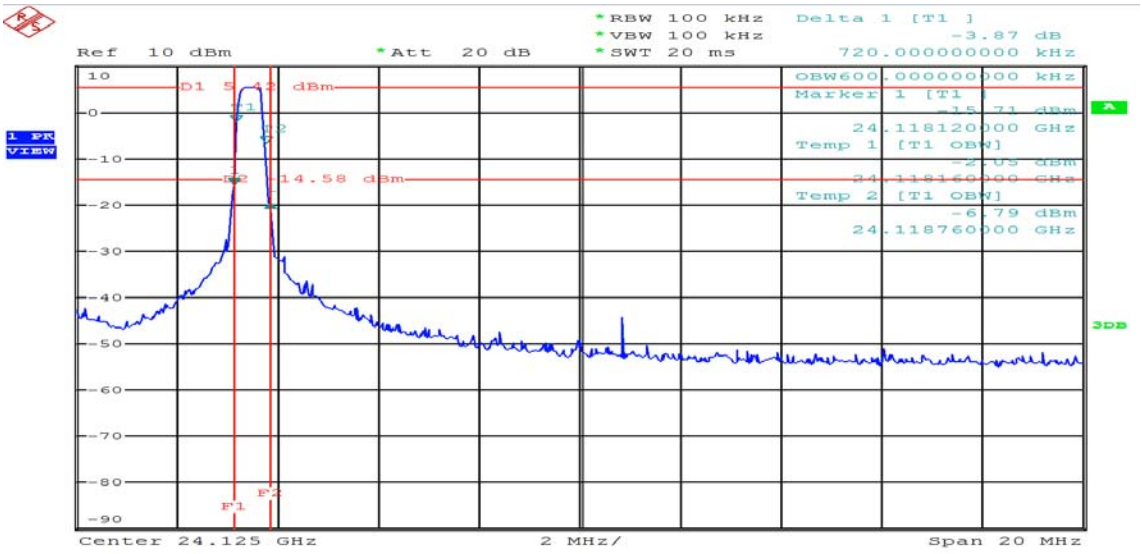
Temperature	22°C	Humidity	54%
Test Engineer	Jay Luo	Configurations	Channel 1/2/4

Frequency	20dB BW (MHz)	99% OBW (MHz)	Frequency range (MHz) f_L > 24000MHz	Frequency range (MHz) f_H < 24250MHz	Test Result
24070 MHz	0.70	0.58	24069.5000	-	Complies
24125 MHz	0.72	0.60	-	-	Complies
24230 MHz	0.74	0.66	-	24228.8600	Complies

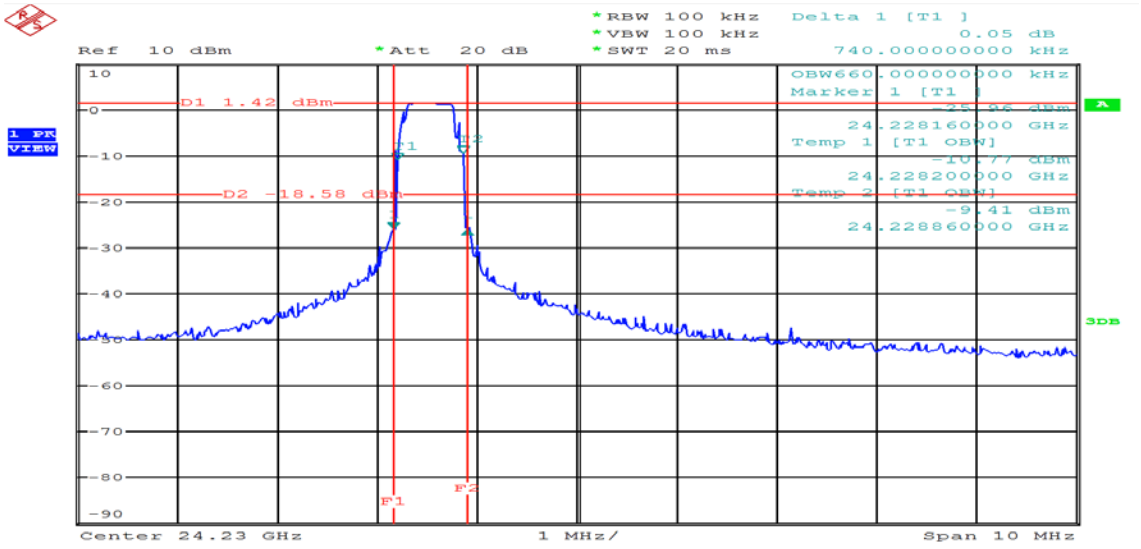
20 dB and 99% Bandwidth Plot on 24070 MHz



20 dB and 99% Bandwidth Plot on 24125 MHz



20 dB and 99% Bandwidth Plot on 24230 MHz



4.4 Radiated Emissions Measurement

4.4.1 Limit

For 9kHz~40GHz

Harmonic emissions limits comply with below 54 dBuV/m at 3m. Other emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or comply with the radiated emissions limits specified in section 15.209(a) limit in the table below has to be followed.

Frequencies (MHz)	Field Strength (micorvolts/meter)	Measurement Distance (meters)
0.009~0.490	2400/F(kHz)	300
0.490~1.705	24000/F(kHz)	30
1.705~30.0	30	30
30~88	100	3
88~216	150	3
216~960	200	3
Above 960	500	3

For 40GHz~100GHz

Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in 47 CFR Part 15.249, whichever is the lesser attenuation.

Operating Frequencies	Harmonics Strength (micorvolts/meter)	Harmonics Strength (dBuV/m) at 3m
24000 ~ 24250 MHz	2500 at 3m	68 (Average)
24000 ~ 24250 MHz	2500 at 3m	88 (Peak)

4.4.2 Measuring Instruments and Setting

Please refer to section 5 of equipments list in this report. The following table is the setting of the spectrum analyzer and receiver.

Spectrum Parameter	Setting
Attenuation	Auto
Start Frequency	1000 MHz
Stop Frequency	10th carrier harmonic
RBW / VBW	1MHz / 1MHz for Peak, 1 MHz / 1/T for Average

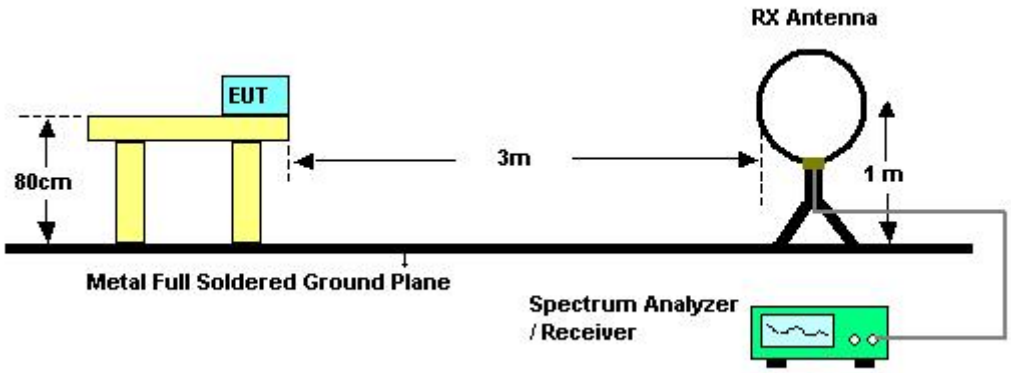
Receiver Parameter	Setting
Attenuation	Auto
Start ~ Stop Frequency	9kHz~150kHz / RBW 200Hz for QP
Start ~ Stop Frequency	150kHz~30MHz / RBW 9kHz for QP
Start ~ Stop Frequency	30MHz~1000MHz / RBW 120kHz for QP

4.4.3 Test Procedures

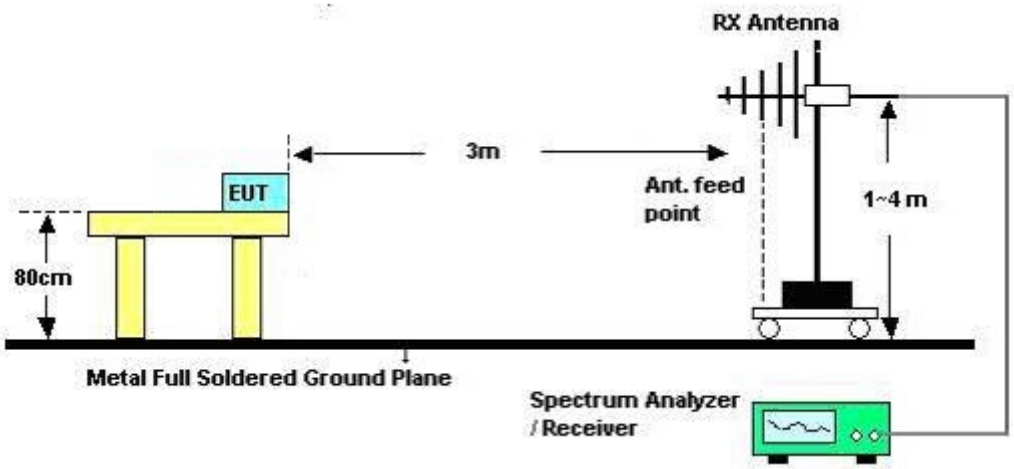
1. Configure the EUT according to ANSI C63.4. The EUT was placed on the top of the turntable 1.5 meter above ground. The phase center of the receiving antenna mounted on the top of a height-variable antenna tower was placed 3 meters far away from the turntable.
2. Power on the EUT and all the supporting units. The turntable was rotated by 360 degrees to determine the position of the highest radiation.
3. The height of the broadband receiving antenna was varied between one meter and four meters above ground to find the maximum emissions field strength of both horizontal and vertical polarization.
4. For each suspected emissions, the antenna tower was scan (from 1 M to 4 M) and then the turntable was rotated (from 0 degree to 360 degrees) to find the maximum reading.
5. Set the test-receiver system to Peak or CISPR quasi-peak Detect Function with specified bandwidth under Maximum Hold Mode.
6. For emissions above 1GHz, use 1MHz VBW and RBW for peak reading. Then 1MHz RBW and 1/T VBW for average reading in spectrum analyzer.
7. When the radiated emissions limits are expressed in terms of the average value of the emissions, and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 seconds. As an alternative (provided the transmitter operates for longer than 0.1 seconds) or in cases where the pulse train exceeds 0.1 seconds, the measured field strength shall be determined from the average absolute voltage during a 0.1 second interval during which the field strength is at its maximum value.
8. If the emissions level of the EUT in peak mode was 3 dB lower than the average limit specified, then testing will be stopped and peak values of EUT will be reported, otherwise, the emissions which do not have 3 dB margin will be repeated one by one using the quasi-peak method for below 1GHz.
9. For testing above 1GHz, the emissions level of the EUT in peak mode was lower than average limit (that means the emissions level in peak mode also complies with the limit in average mode), then testing will be stopped and peak values of EUT will be reported, otherwise, the emissions will be measured in average mode again and reported.
10. In case the emission is lower than 30MHz, loop antenna has to be used for measurement and the recorded data should be QP measured by receiver. High – Low scan is not required in this case.

4.4.4 Test Setup Layout

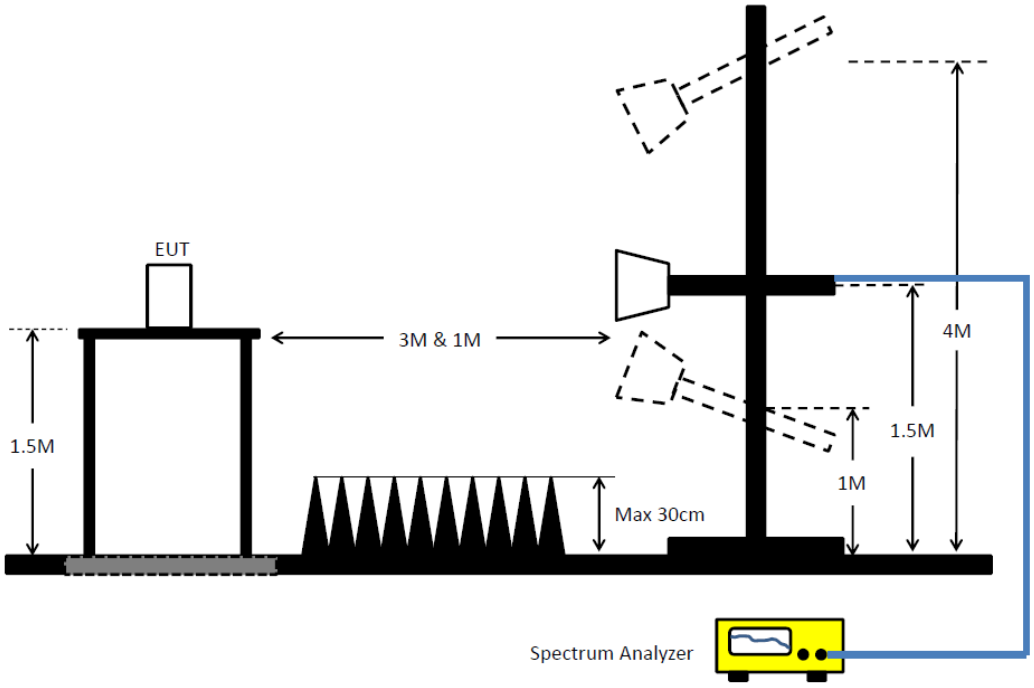
For Radiated Emissions: 9kHz ~30MHz



For Radiated Emissions: 30MHz~1GHz



For radiated emissions: 1GHz~40GHz

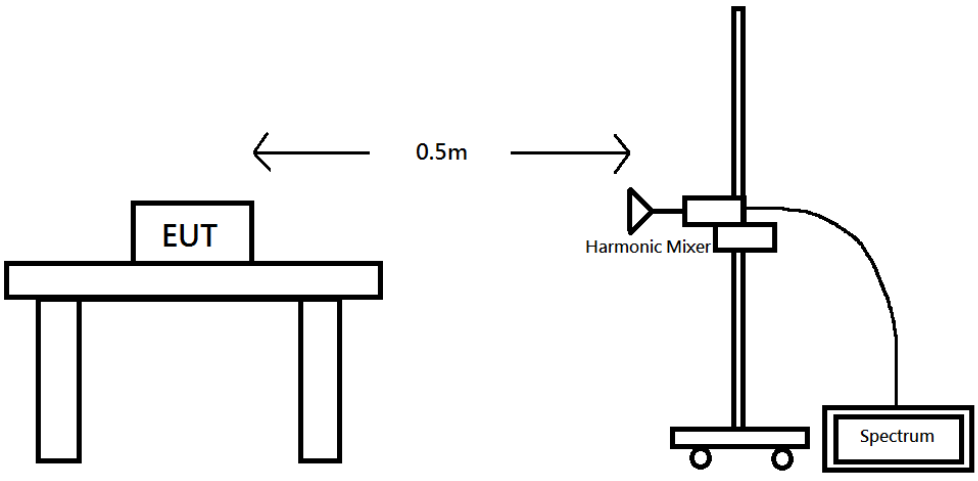


Above 10 GHz shall be extrapolated to the specified distance using an extrapolation factor of 20 dB/decade from 3m to 1m.

Distance extrapolation factor = 20 log (specific distance [3m] / test distance [1m]) (dB);

Limit line = specific limits (dBuV) + distance extrapolation factor [9.54 dB].

For radiated emissions: 40GHz~100GHz



4.4.5 Test Deviation

There is no deviation with the original standard.

4.4.6 EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

4.4.7 Results of Radiated Emissions (9kHz~30MHz)

Temperature	22°C	Humidity	54%
Test Engineer	Jay Luo	Configurations	Normal Link / Mode 1
Test Date	Jun. 09, 2017 ~ Jul. 31, 2017		

Freq. (MHz)	Level (dBuV)	Over Limit (dB)	Limit Line (dBuV)	Remark
-	-	-	-	See Note

Note:

The amplitude of spurious emissions which are attenuated by more than 20 dB below the permissible value has no need to be reported.

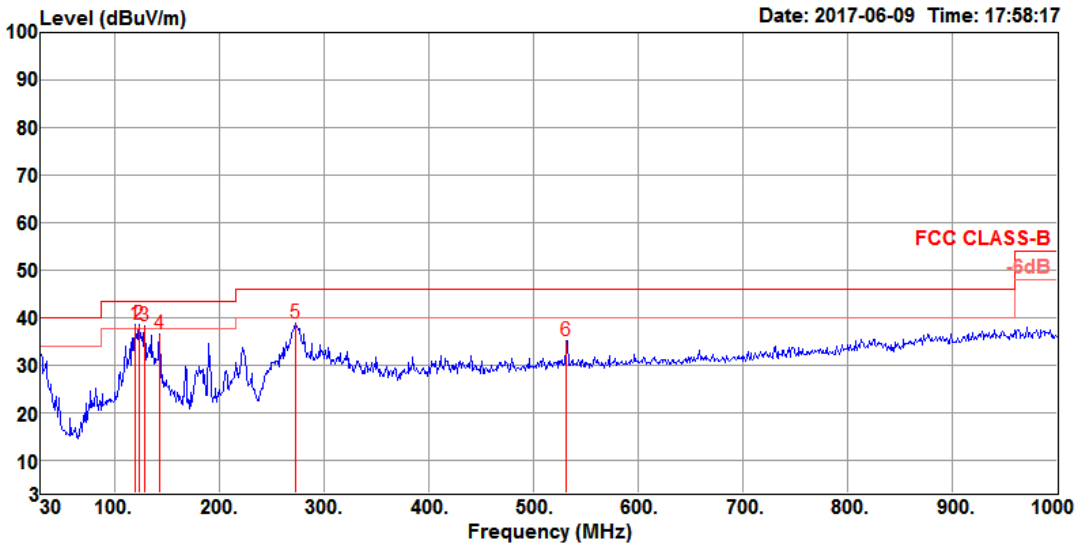
Distance extrapolation factor = 40 log (specific distance / test distance) (dB);

Limit line = specific limits (dBuV) + distance extrapolation factor.

4.4.8 Results of Radiated Emissions (30MHz~1GHz)

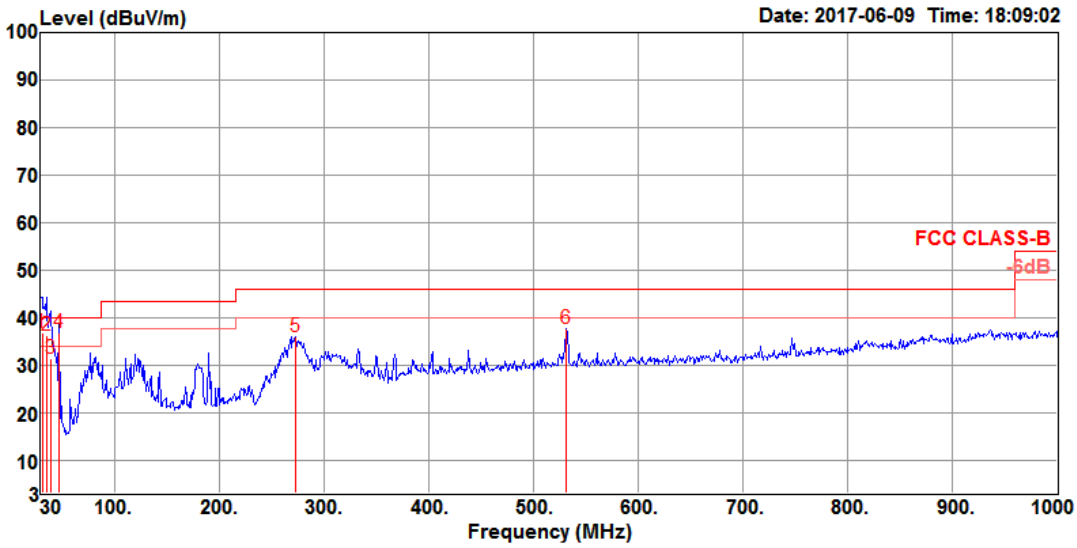
Temperature	22°C	Humidity	54%
Test Engineer	Jay Luo	Configurations	Normal Link / Mode 1

Horizontal



	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	A/Pos	T/Pos	Remark	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB	cm	deg		
1	119.24	38.55	43.50	-4.95	50.75	1.86	18.48	32.54	150	188	Peak	HORIZONTAL
2	124.09	38.45	43.50	-5.05	50.63	1.90	18.46	32.54	150	168	Peak	HORIZONTAL
3	128.94	38.33	43.50	-5.17	50.51	1.94	18.41	32.53	150	153	Peak	HORIZONTAL
4	143.49	36.57	43.50	-6.93	49.42	2.05	17.62	32.52	200	165	Peak	HORIZONTAL
5	272.50	38.91	46.00	-7.09	49.10	2.86	19.40	32.45	100	109	Peak	HORIZONTAL
6	531.49	35.03	46.00	-10.97	39.22	4.07	24.25	32.51	200	59	Peak	HORIZONTAL

Vertical



	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	A/Pos	T/Pos	Remark	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB	cm	deg		
1	30.97	36.74	40.00	-3.26	43.19	0.89	25.19	32.53	100	108	QP	VERTICAL
2	34.85	36.30	40.00	-3.70	44.99	0.96	22.87	32.52	100	81	QP	VERTICAL
3	38.73	31.32	40.00	-8.68	42.30	1.03	20.51	32.52	100	276	QP	VERTICAL
4	47.46	36.82	40.00	-3.18	52.30	1.12	15.90	32.50	100	355	QP	VERTICAL
5	273.47	35.89	46.00	-10.11	46.07	2.87	19.40	32.45	150	161	Peak	VERTICAL
6	530.52	37.50	46.00	-8.50	41.71	4.07	24.23	32.51	200	171	Peak	VERTICAL

Note:

The amplitude of spurious emissions which are attenuated by more than 20dB below the permissible value has no need to be reported.

Emission level (dBuV/m) = 20 log Emission level (uV/m).

Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level.

4.4.9 Results for Radiated Emissions (1GHz~40GHz)

Temperature	22°C	Humidity	54%
Test Engineer	Jay Luo	Configurations	Channel 1 / 1~40G
Test Date	Jun. 09, 2017 ~ Jul. 31, 2017		

Horizontal

	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	A/Pos	T/Pos	Remark	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB	cm	deg		
1	1847.09	34.29	54.00	-19.71	37.63	4.33	25.98	33.65	123	248	Average	HORIZONTAL
2	1847.09	41.79	74.00	-32.21	45.13	4.33	25.98	33.65	123	248	Peak	HORIZONTAL

Vertical

	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	A/Pos	T/Pos	Remark	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB	cm	deg		
1	1857.02	32.87	54.00	-21.13	36.17	4.34	25.99	33.63	132	260	Average	VERTICAL
2	1857.02	42.49	74.00	-31.51	45.79	4.34	25.99	33.63	132	260	Peak	VERTICAL

Note:

The amplitude of spurious emissions which are attenuated by more than 20dB below the permissible value has no need to be reported.

Emission level (dBuV/m) = 20 log Emission level (uV/m).

Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level.

Temperature	22℃	Humidity	54%
Test Engineer	Jay Luo	Configurations	Channel 2 / 1~40G
Test Date	Jun. 09, 2017 ~ Jul. 31, 2017		

Horizontal

	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	A/Pos	T/Pos	Remark	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB	cm	deg		
1	1849.32	34.83	54.00	-19.17	38.16	4.33	25.98	33.64	150	261	Average	HORIZONTAL
2	1852.97	46.77	74.00	-27.23	50.10	4.33	25.98	33.64	150	261	Peak	HORIZONTAL

Vertical

	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	A/Pos	T/Pos	Remark	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB	cm	deg		
1	1857.77	34.78	54.00	-19.22	38.08	4.34	25.99	33.63	150	321	Average	VERTICAL
2	1858.35	45.22	74.00	-28.78	48.52	4.34	25.99	33.63	150	321	Peak	VERTICAL

Note:

The amplitude of spurious emissions which are attenuated by more than 20dB below the permissible value has no need to be reported.

Emission level (dBuV/m) = 20 log Emission level (uV/m).

Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level.

Temperature	22℃	Humidity	54%
Test Engineer	Jay Luo	Configurations	Channel 3 / 1~40G
Test Date	Jun. 09, 2017 ~ Jul. 31, 2017		

Horizontal

	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	A/Pos	T/Pos	Remark	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB	cm	deg		
1	1849.55	34.59	54.00	-19.41	37.92	4.33	25.98	33.64	150	213	Average	HORIZONTAL
2	1851.29	45.35	74.00	-28.65	48.68	4.33	25.98	33.64	150	213	Peak	HORIZONTAL

Vertical

	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	A/Pos	T/Pos	Remark	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB	cm	deg		
1	1848.39	45.74	74.00	-28.26	49.08	4.33	25.98	33.65	150	128	Peak	VERTICAL
2	1857.77	33.98	54.00	-20.02	37.28	4.34	25.99	33.63	150	128	Average	VERTICAL

Note:

The amplitude of spurious emissions which are attenuated by more than 20dB below the permissible value has no need to be reported.

Emission level (dBuV/m) = 20 log Emission level (uV/m).

Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level.

4.4.10 Results for Radiated Emissions (40GHz~100GHz)

Temperature	22°C	Humidity	54%
Test Engineer	Jay Luo	Configurations	Channel 1
Test Date	Jun. 09, 2017 ~ Jul. 31, 2017		

Frequency (GHz)	Measurement Distance (m)	Measurement Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
41.16	0.5	58.481	103.56	-45.082
Frequency (GHz)	**Measurement Distance (m)**	**Measurement Level (dBuV/m)**	**Limit (dBuV/m)**	**Margin (dB)**
48.14	0.5	61.211	83.56	-22.352

Temperature	22°C	Humidity	54%
Test Engineer	Jay Luo	Configurations	Channel 2
Test Date	Jun. 09, 2017 ~ Jul. 31, 2017		

Frequency (GHz)	Measurement Distance (m)	Measurement Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
41.2	0.5	60.889	103.56	-42.674
Frequency (GHz)	**Measurement Distance (m)**	**Measurement Level (dBuV/m)**	**Limit (dBuV/m)**	**Margin (dB)**
48.25	0.5	67.871	83.56	-15.692

Temperature	22°C	Humidity	54%
Test Engineer	Jay Luo	Configurations	Channel 3
Test Date	Jun. 09, 2017 ~ Jul. 31, 2017		

Frequency (GHz)	Measurement Distance (m)	Measurement Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
48.44	0.5	60.045	103.56	-43.518
Frequency (GHz)	**Measurement Distance (m)**	**Measurement Level (dBuV/m)**	**Limit (dBuV/m)**	**Margin (dB)**
48.46	0.5	68.919	83.56	-14.644

Distance extrapolation factor = 20 log (specific distance [3m] / test distance [0.5m]) (dB);

Limit line = specific limits (dBuV) + distance extrapolation factor [15.56 dB].

EIRP = PT * GT = (PR / GR) * (4 * Pi * D / λ)^2

EIRP = Meas. Level - RX Antenna Gain + 20*log(4*Pi(3.14159)*D/(300/(Frequency*1000)))

4.5 Band Edge Emissions Measurement

4.5.1 Limit

Band edge emissions radiated outside of the specified frequency bands shall be attenuated by at least 50 dB below the level of the fundamental or comply with the radiated emissions limits specified in section 15.209(a) limit in the table below has to be followed.

Frequencies (MHz)	Field Strength (micorvolts/meter)	Measurement Distance (meters)
0.009~0.490	2400/F(kHz)	300
0.490~1.705	24000/F(kHz)	30
1.705~30.0	30	30
30~88	100	3
88~216	150	3
216~960	200	3
Above 960	500	3

4.5.2 Measuring Instruments and Setting

Please refer to section 5 of equipments list in this report. The following table is the setting of the spectrum analyzer.

Spectrum Parameter	Setting
Attenuation	Auto
Span Frequency	100 MHz
RBW / VBW	1MHz / 1MHz for Peak, 1 MHz / 1/T for Average

4.5.3 Test Procedures

The test procedure is the same as section 4.4.3.

4.5.4 Test Setup Layout

This test setup layout is the same as that shown in section 4.4.4

4.5.5 Test Deviation

There is no deviation with the original standard.

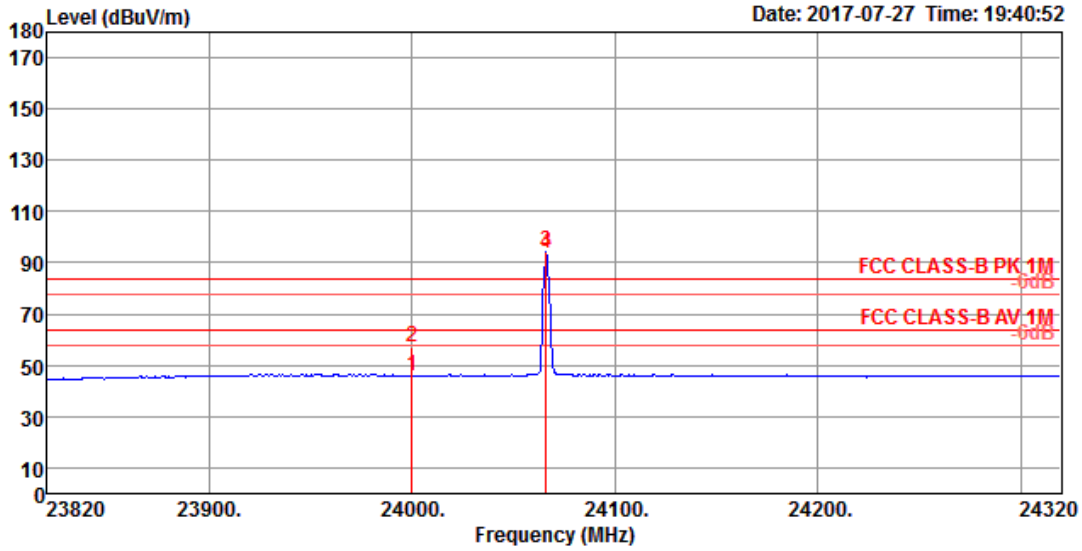
4.5.6 EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

4.5.7 Test Result of Band Edge and Fundamental Emissions

Temperature	22°C	Humidity	54%
Test Engineer	Jay Luo	Configurations	Channel 1, 2, 4
Test Date	Jun. 09, 2017 ~ Jul. 31, 2017		

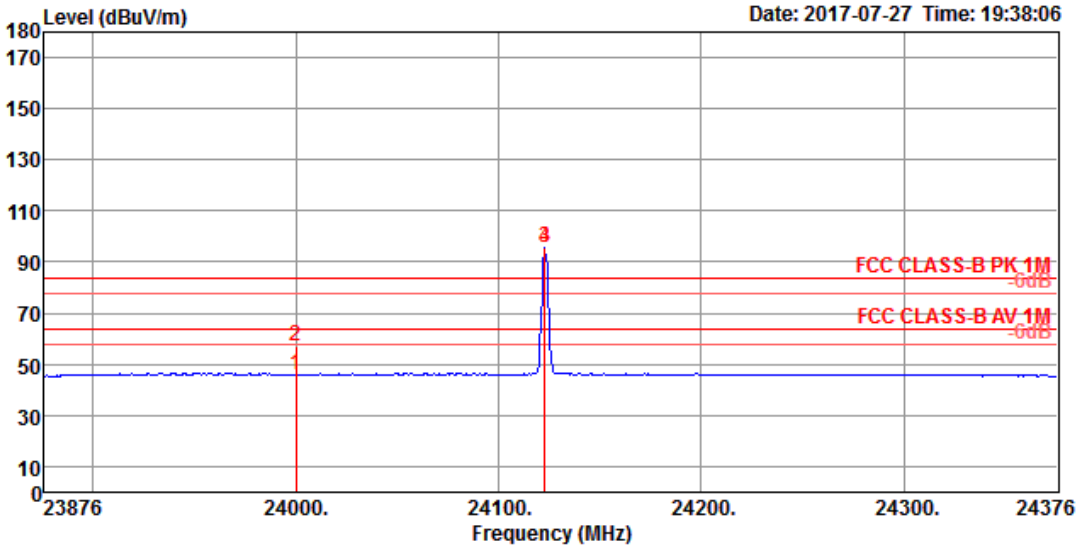
Channel 1



	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	A/Pos	T/Pos	Remark	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB	cm	deg		
1	24000.00	45.88	63.54	-17.66	49.08	9.28	38.80	51.28	154	329	Average	HORIZONTAL
2	24000.00	57.04	83.54	-26.50	60.24	9.28	38.80	51.28	154	329	Peak	HORIZONTAL
3 @	24066.00	94.13			97.29	9.30	38.80	51.26	154	329	Average	HORIZONTAL
4 @	24066.00	93.68			96.84	9.30	38.80	51.26	154	329	Peak	HORIZONTAL

Item 3, 4 are the fundamental frequency at 24070 MHz.

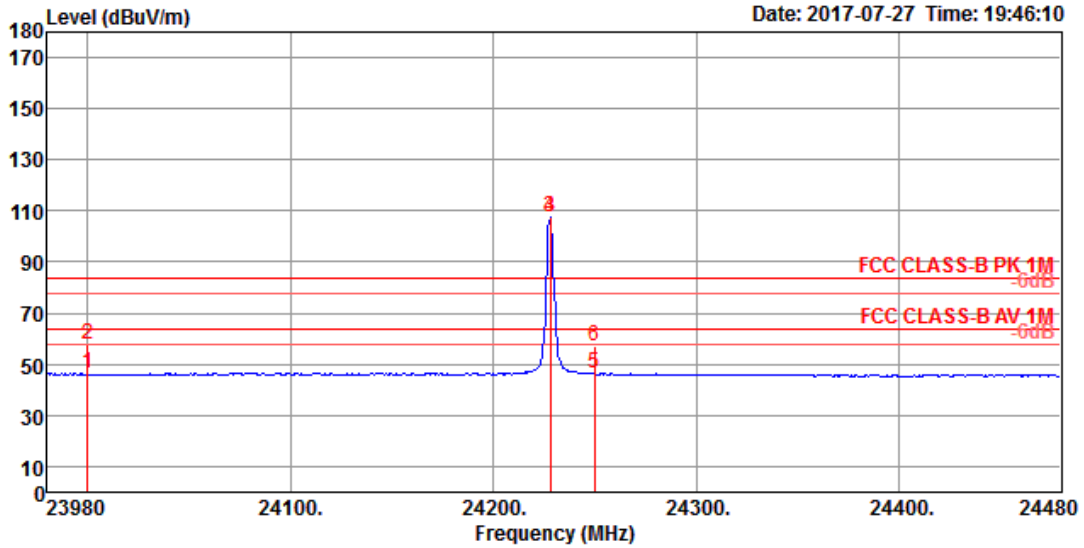
Channel 2



	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	A/Pos	T/Pos	Remark	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB	cm	deg		
1	24000.00	45.93	63.54	-17.61	49.13	9.28	38.80	51.28	154	330	Average	HORIZONTAL
2	24000.00	57.39	83.54	-26.15	60.59	9.28	38.80	51.28	154	330	Peak	HORIZONTAL
3 @	24123.00	95.75			98.87	9.32	38.80	51.24	154	330	Average	HORIZONTAL
4 @	24123.00	95.75			98.87	9.32	38.80	51.24	154	330	Peak	HORIZONTAL

Item 3, 4 are the fundamental frequency at 24125 MHz.

Channel 4



	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	A/Pos	T/Pos	Remark	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB	cm	deg		
1	24000.00	46.18	63.54	-17.36	49.38	9.28	38.80	51.28	154	359	Average	VERTICAL
2	24000.00	57.50	83.54	-26.04	60.70	9.28	38.80	51.28	154	359	Peak	VERTICAL
3 @	24228.00	107.31			110.39	9.34	38.80	51.22	154	359	Average	VERTICAL
4 @	24228.00	107.41			110.49	9.34	38.80	51.22	154	359	Peak	VERTICAL
5	24250.00	46.44	63.54	-17.10	49.50	9.35	38.80	51.21	154	359	Average	VERTICAL
6	24250.00	57.16	83.54	-26.38	60.22	9.35	38.80	51.21	154	359	Peak	VERTICAL

Item 3, 4 are the fundamental frequency at 24230 MHz.

Note:

Emission level (dBuV/m) = 20 log Emission level (uV/m).

Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level.

4.6 Antenna Requirements

4.6.1 Limit

Except for special regulations, the Low-power Radio-frequency Devices must not be equipped with any jacket for installing an antenna with extension cable. 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 manufacturer may design the unit so that the user can replace a broken antenna, but the use of a standard antenna jack or electrical connector is prohibited.

4.6.2 Antenna Connector Construction

Please refer to section 3.1 in this test report, antenna connector complied with the requirements.

5 LIST OF MEASURING EQUIPMENTS

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Calibration Until	Remark
EMI Receiver	Agilent	N9038A	My52260123	9kHz ~ 8.45GHz	Jan. 23, 2017	Jan. 22, 2018	Conduction (CO01-CB)
LISN	F.C.C.	FCC-LISN-50-16-2	04083	150kHz ~ 100MHz	Dec. 14, 2016	Dec. 13, 2017	Conduction (CO01-CB)
LISN	Schwarzbeck	NSLK 8127	8127647	9kHz ~ 30MHz	Dec. 21, 2016	Dec. 20, 2017	Conduction (CO01-CB)
COND Cable	Woken	Cable	01	150kHz ~ 30MHz	May 23, 2017	May 22, 2018	Conduction (CO01-CB)
Software	Audix	E3	6.120210n	-	N.C.R.	N.C.R.	Conduction (CO01-CB)
BILOG ANTENNA with 6dB Attenuator	TESEQ & EMCI	CBL6112D & N-6-06	37880 & AT-N0609	20MHz ~ 2GHz	Aug. 30, 2016	Aug. 29, 2017	Radiation (03CH01-CB)
Horn Antenna	EMCO	3115	00075790	750MHz ~ 18GHz	Nov. 10, 2016	Nov. 09, 2017	Radiation (03CH01-CB)
Horn Antenna	Schwarzbeck	BBHA 9170	BBHA9170252	15GHz ~ 40GHz	Jul. 25, 2016	Jul. 24, 2017	Radiation (03CH01-CB)
Horn Antenna	Schwarzbeck	BBHA 9170	BBHA9170252	15GHz ~ 40GHz	Jul. 05, 2017	Jul. 04, 2018	Radiation (03CH01-CB)
Pre-Amplifier	EMCI	EMC330N	980332	20MHz ~ 3GHz	May 02, 2017	May 01, 2018	Radiation (03CH01-CB)
Pre-Amplifier	Agilent	8449B	3008A02310	1GHz ~ 26.5GHz	Jan. 16, 2017	Jan. 15, 2018	Radiation (03CH01-CB)
Pre-Amplifier	MITEQ	TTA1840-35-HG	1864479	18GHz ~ 40GHz	Jun. 28, 2016	Jun. 27, 2017	Radiation (03CH01-CB)
Amplifier	-	-	TF-130N-R1	26GHz ~ 40GHz	Jun. 20, 2017	Jun. 19, 2018	Radiation (03CH01-CB)
Spectrum Analyzer	R&S	FSP40	100056	9kHz ~ 40GHz	Nov. 22, 2016	Nov. 21, 2017	Radiation (03CH01-CB)
EMI Test	R&S	ESCS	100355	9kHz ~ 2.75GHz	May 06, 2017	May 05, 2018	Radiation (03CH01-CB)
RF Cable-low	Woken	Low Cable-16+17	N/A	30 MHz ~ 1 GHz	Oct. 24, 2016	Oct. 23, 2017	Radiation (03CH01-CB)
RF Cable-high	Woken	High Cable-16	N/A	1 GHz ~ 18 GHz	Oct. 24, 2016	Oct. 23, 2017	Radiation (03CH01-CB)
RF Cable-high	Woken	High Cable-16+17	N/A	1 GHz ~ 18 GHz	Oct. 24, 2016	Oct. 23, 2017	Radiation (03CH01-CB)
RF Cable-high	Woken	High Cable-40G#1	N/A	18GHz ~ 40 GHz	Oct. 24, 2016	Oct. 23, 2017	Radiation (03CH01-CB)
RF Cable-high	Woken	High Cable-40G#2	N/A	18GHz ~ 40 GHz	Oct. 24, 2016	Oct. 23, 2017	Radiation (03CH01-CB)
Loop Antenna	Teseq	HLA 6120	24155	9kHz - 30 MHz	Mar. 16, 2016*	Mar. 15, 2018	Radiation (03CH01-CB)

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Calibration Until	Remark
Test Software	Audix	E3	6.2009-l0-7	N/A	N/A	N/A	Radiation (03CH01-CB)
Mixer	OML	M19HW/A	U91113-1	40 ~ 60 GHz	Sep. 09, 2015*	Sep. 08, 2017	Radiation (03CH01-CB)
Mixer	OML	M15HW/A	V91113-1	50 ~ 75 GHz	Sep. 14, 2015*	Sep. 13, 2017	Radiation (03CH01-CB)
Mixer	OML	M12HW/A	E91113-1	60 ~ 90 GHz	Sep. 17, 2015*	Sep. 16, 2017	Radiation (03CH01-CB)
Mixer	OML	M08HW/A	F91113-1	90 ~ 140 GHz	Sep. 21, 2015*	Sep. 20, 2017	Radiation (03CH01-CB)
100MS/s Digitizer	N.I	USB-5133	F65206	N/A	Nov. 18, 2016	Nov. 17, 2017	Radiation (03CH01-CB)
Standard Horn Antenna	Custom Microwave	M19RH	U91113-A	40 ~ 60 GHz	Sep. 09, 2015*	Sep. 08, 2017	Radiation (03CH01-CB)
Standard Horn Antenna	Custom Microwave	M15RH	V91113-A	50 ~ 75 GHz	Sep. 14, 2015*	Sep. 13, 2017	Radiation (03CH01-CB)
Standard Horn Antenna	Custom Microwave	M12RH	E91113-A	60 ~ 90 GHz	Sep. 17, 2015*	Sep. 16, 2017	Radiation (03CH01-CB)
Standard Horn Antenna	Custom Microwave	M08RH	F91113-A	90 ~ 140 GHz	Sep. 21, 2015*	Sep. 20, 2017	Radiation (03CH01-CB)

Note: Calibration Interval of instruments listed above is one year.

* Calibration Interval of instruments listed above is two year.

N.C.R. means Non-Calibration required.

6 MEASUREMENT UNCERTAINTY

Test Items	Uncertainty	Remark
Conducted Emission (150kHz ~ 30MHz)	3.2 dB	Confidence levels of 95%
Radiated Emission (30MHz ~ 1,000MHz)	3.6 dB	Confidence levels of 95%
Radiated Emission (1GHz ~ 18GHz)	3.7 dB	Confidence levels of 95%
Radiated Emission (18GHz ~ 40GHz)	3.5 dB	Confidence levels of 95%
Radiated Emission (40GHz ~ 220GHz)	4.7 dB	Confidence levels of 95%
Conducted Emission	1.7 dB	Confidence levels of 95%