



**FCC 47 CFR PART 15 SUBPART C
ISED RSS-247 ISSUE 2**

CERTIFICATION TEST REPORT

For

Communication Module

MODEL NUMBER: 1CQ

PROJECT NUMBER: 4788296310

REPORT NUMBER: 4788296310-1

FCC ID: VPYLB1CQ

IC ID: 772C-LB1CQ

ISSUE DATE: Jan. 31, 2019

Prepared for

Murata Manufacturing Co.,Ltd.

Prepared by

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Revision History

Rev.	Issue Date	Revisions	Revised By
--	1/31/2019	Initial Issue	



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1. ATTESTATION OF TEST RESULTS

Applicant Information

Company Name: Murata Manufacturing Co.,Ltd.
Address: 10-1,Higashikotari 1-chome,Nagaokakyo-shi,Kyoto
617-8555,Japan

Manufacturer Information

Company Name: Murata Manufacturing Co.,Ltd.
Address: 10-1,Higashikotari 1-chome,Nagaokakyo-shi,Kyoto
617-8555,Japan

EUT Description

Product Name: Communication Module
Model Name: 1CQ
Sample ID: 1468264
Sample Received date: March 8, 2018
Date Tested: March 8, 2018~Jan 31, 2019

APPLICABLE STANDARDS	
STANDARD	TEST RESULTS
CFR 47 Part 15 Subpart C	PASS
ISED RSS-247 Issue 2	PASS
ISED RSS-GEN Issue 5	PASS



Summary of Test Results			
Clause	Test Items	FCC/IC Rules	Test Results
1	6db DTS Bandwidth and 99% Bandwidth	FCC 15.247 (a) (2) RSS-247 Clause 5.2 (a) RSS-Gen Clause 6.6	PASS
2	Peak Conducted Power	FCC 15.247 (b) (3) RSS-247 Clause 5.4 (e)	PASS
3	Power Spectral Density	FCC 15.247 (e) RSS-247 Clause 5.2 (b)	PASS
4	Conducted Band edge And Spurious emission	FCC 15.247 (d) RSS-247 Clause 5.5	PASS
5	Radiated Band edges and Spurious emission	FCC 15.247 (d) FCC 15.209 FCC 15.205 RSS-247 Clause 5.5 RSS-GEN Clause 8.9 RSS-GEN Clause 8.10	PASS
6	Conducted Emission Test For AC Power Port	FCC 15.207 RSS-GEN Clause 8.8	PASS
7	Antenna Requirement	FCC 15.203 RSS-GEN Clause 8.3	PASS
Remark: 1) For this product, it has two antennas, antenna1 and antenna2, it can transmit at the same time during work at 802.11B & 802.11G & 802.11N20 & 802.11N40 mode. 2) Pre-testing Antenna 1 and Antenna2, and pre-testing SISO and MIMO modes, only the data of the worst case is shown in this test report.			

Tested By:

Checked By:

Kebo Zhang
Engineer

Shawn Wen
Laboratory Leader

Approved By:

Stephen Guo
Laboratory Manager



2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with KDB414788 D01 Radiated Test Site v01r01, ANSI C63.10-2013, KDB558074 D01 DTS Meas Guidance v05, FCC CFR 47 Part 2, FCC CFR 47 Part 15, RSS-GEN Issue 5, and RSS-247 Issue 2.

3. FACILITIES AND ACCREDITATION

Test Location	UL Verification Services (Guangzhou) Co., Ltd. Song Shan Lake Branch.
Address	Building 10, Innovation Technology Park, Song Shan Lake Hi tech Development Zone, Dongguan, 523808, China
Accreditation Certificate	<p>A2LA (Certificate No.: 4102.01) UL Verification Services (Guangzhou) Co., Ltd. Song Shan Lake Branch. has been assessed and proved to be in compliance with A2LA.</p> <p>FCC (FCC Designation No.: CN1187) UL Verification Services (Guangzhou) Co., Ltd. Song Shan Lake Branch. Has been recognized to perform compliance testing on equipment subject to the Commission's Declaration of Conformity (DoC) and Certification rules</p> <p>IC(Company No.: 21320) UL Verification Services (Guangzhou) Co., Ltd. Song Shan Lake Branch. has been registered and fully described in a report filed with Industry Canada. The Company Number is 21320.</p> <p>VCCI (Registration No.: G-20019, R-20004, C-20012 and T-20011) UL Verification Services (Guangzhou) Co., Ltd. Song Shan Lake Branch. has been assessed and proved to be in compliance with VCCI, the Membership No. is 3793.</p> <p>Facility Name: Chamber D, the VCCI registration No. is G-20019 and R-20004 Shielding Room B, the VCCI registration No. is C-20012 and T-20011</p>

Note:

1. All tests measurement facilities use to collect the measurement data are located at Building 10, Innovation Technology Park, Song Shan Lake Hi tech Development Zone, Dongguan, 523808, China
2. The test anechoic chamber in UL Verification Services (Guangzhou) Co., Ltd. Song Shan Lake Branch had been calibrated and compared to the open field sites and the test anechoic chamber is shown to be equivalent to or worst case from the open field site.
3. For below 30MHz, lab had performed measurements at test anechoic chamber and comparing to measurements obtained on an open field site. And these measurements below 30MHz had been correlated to measurements performed on an OATS.



4. CALIBRATION AND UNCERTAINTY

4.1 MEASURING INSTRUMENT CALIBRATION

The measuring equipment utilized to perform the tests documented in this report has been calibrated in accordance with the manufacturer's recommendations, and is traceable to recognize national standards.

4.2 MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

Test Item	Uncertainty
Uncertainty for Conduction emission test	2.90dB
Uncertainty for Radiation Emission test(include Fundamental emission) (9KHz-30MHz)	2.2dB
Uncertainty for Radiation Emission test(include Fundamental emission) (30MHz-1GHz)	4.52dB
Uncertainty for Radiation Emission test (1GHz to 26GHz)(include Fundamental emission)	5.04dB(1-6GHz)
	5.30dB (6GHz-18Gz)
	5.23dB (18GHz-26Gz)
Note: This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.	



5. EQUIPMENT UNDER TEST

5.1. DESCRIPTION OF EUT

Equipment	Communication Module		
Model Name	1CQ		
Product Description	Operation Frequency	2402 MHz ~ 2480 MHz	
	Modulation Type		Data Rate
	GFSK		1Mbps
Power Supply	VDD_3P3/SWREG_IN/VDD_FEM: Typ. DC3.3V, Max. DC3.5V, Min. DC3.1V		
	VDDIO_GPIO0/1/VDDIO_Xtal: Typ. DC1.8V or DC3.3V, Max. DC3.46V, Min. DC1.71V		
Bluetooth Version	LE		
Hardware Version	V1.0		

5.2. MAXIMUM OUTPUT POWER

Bluetooth Mode	Frequency (MHz)	Channel Number	Max Output Power (dBm)	EIRP (dBm)
BLE	2402-2480	0-39[40]	1.24	0

5.3. CHANNEL LIST

Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
0	2402	11	2424	22	2446	33	2468
1	2404	12	2426	23	2448	34	2470
2	2406	13	2428	24	2450	35	2472
3	2408	14	2430	25	2452	36	2474
4	2410	15	2432	26	2454	37	2476
5	2412	16	2434	27	2456	38	2478
6	2414	17	2436	28	2458	39	2480
7	2416	18	2438	29	2460		
8	2418	19	2440	30	2462		
9	2420	20	2442	31	2464		
10	2422	21	2444	32	2468		

5.4. TEST CHANNEL CONFIGURATION

Test Mode	Test Channel	Frequency
GFSK	CH 0, CH 19, CH 39	2402MHz, 2440MHz, 2480MHz

5.5. THE WORSE CASE POWER SETTING PARAMETER

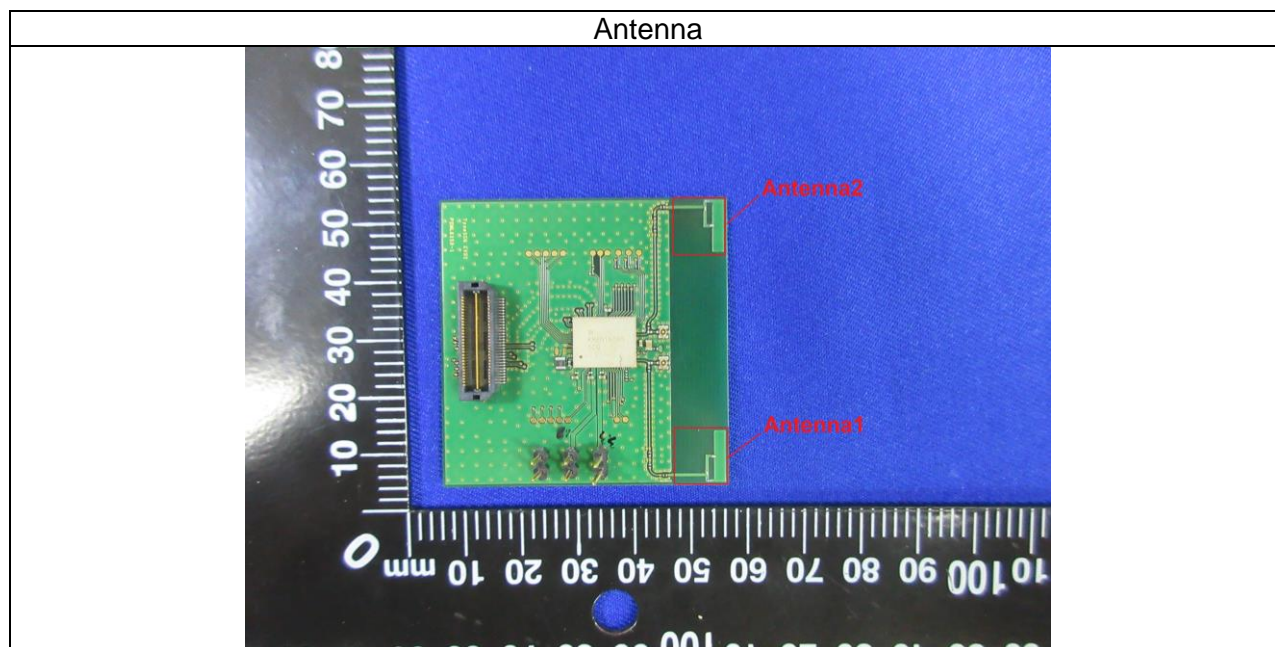
The Worst Case Power Setting Parameter under 2400 ~ 2483.5MHz Band				
Test Software		Tera Term & QRCT		
Modulation Type	Transmit Antenna Number	Test Channel		
		CH 00	CH 19	CH 39
GFSK	1	37	37	37

5.6. DESCRIPTION OF AVAILABLE ANTENNAS

Ant.	Frequency (MHz)	Antenna Type	Antenna Gain (dBi)
1	2402-2480	Internal Antenna	0

Note: There are two antennas in the EUT, only antenna 1 support BLE mode.

Test Mode	Transmit and Receive Mode	Description
GFSK	1TX, 1RX	Chain 1 can be used as transmitting/receiving antenna.





5.7. WORST-CASE CONFIGURATIONS

Bluetooth Mode	Modulation Technology	Modulation Type	Data Rate (Mbps)
BLE	DTS	GFSK	1Mbit/s

5.8. TEST ENVIRONMENT

Environment Parameter	Selected Values During Tests	
Relative Humidity	55 ~ 65%	
Atmospheric Pressure:	1005Pa	
Temperature	TN	-20 ~ 70°C
Voltage	VL	N/A
	VN	VDD_3P3/SWREG_IN/VDD_FEM:DC3.3V VDDIO_GPIO0/1/VDDIO_Xtal:DC1.8V
	VH	N/A

Note: VL= Lower Extreme Test Voltage
VN= Nominal Voltage
VH= Upper Extreme Test Voltage
TN= Normal Temperature



5.9. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Item	Equipment	Brand Name	Model Name	Remarks
1	Laptop	ThinkPad	E450	N/A

I/O CABLES

Cable No	Port	Connector Type	Cable Type	Cable Length(m)	Remarks
1	LAN	LAN	N/A	0.2	N/A
2	USB	USB	Unshielded	0.5	N/A

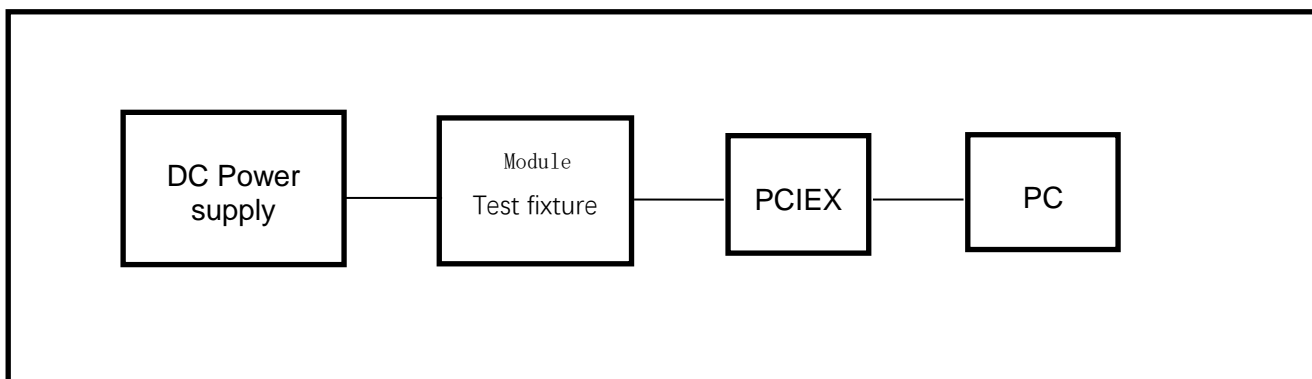
ACCESSORY

Item	Accessory	Brand Name	Model Name	Description
1	N/A	N/A	N/A	N/A

TEST SETUP

The EUT can work in an engineer mode with a software through a PC.

SETUP DIAGRAM FOR TEST





5.10. MEASURING INSTRUMENT AND SOFTWARE USED

Conducted Emissions							
Used	Equipment	Manufactur	Model No.	Serial No.	Upper Cal.	Last Cal.	Next Cal.
<input checked="" type="checkbox"/>	EMI Test Receiver	R&S	ESR3	101961	Dec.12,2017	Dec.10, 2018	Dec.10, 2019
<input checked="" type="checkbox"/>	Two-Line V-Network	R&S	ENV216	101983	Dec.12,2017	Dec.10, 2018	Dec.10, 2019
Software							
Used	Description		Manufacturer	Name		Version	
<input checked="" type="checkbox"/>	Test Software for Conducted disturbance		UL	Antenna port		Ver. 7.2	
Radiated Emissions							
Used	Equipment	Manufactur	Model No.	Serial No.	Upper Cal.	Last Cal.	Next Cal.
<input checked="" type="checkbox"/>	MXE EMI Receiver	KESIGHT	N9038A	MY564000	Dec.12,2017	Dec.10, 2018	Dec.10, 2019
<input checked="" type="checkbox"/>	Hybrid Log Periodic Antenna	TDK	HLP-3003C	130960	Jan.09, 2016	Sept. 17, 2018	Sept.17, 2021
<input checked="" type="checkbox"/>	Preamplifier	HP	8447D	2944A0909	Dec.12,2017	Dec.10, 2018	Dec.10, 2019
<input checked="" type="checkbox"/>	EMI Measurement Receiver	R&S	ESR26	101377	Dec.12,2017	Dec.10, 2018	Dec.10, 2019
<input checked="" type="checkbox"/>	Horn Antenna	TDK	HRN-0118	130939	Jan. 09, 2016	Sept. 17, 2018	Sept.17, 2021
<input checked="" type="checkbox"/>	High Gain Horn	Schwarzbe	BBHA-9170	691	Jan.06, 2016	Aug.11, 2018	Aug.11, 2019
<input checked="" type="checkbox"/>	Preamplifier	TDK	PA-02-0118	TRS-305-00066	Dec.12,2017	Dec.10, 2018	Dec.10, 2019
<input checked="" type="checkbox"/>	Preamplifier	TDK	PA-02-2	TRS-307-00003	Dec.12,2017	Dec.10, 2018	Dec.10, 2019
<input checked="" type="checkbox"/>	Loop antenna	Schwarzbe	1519B	00008	Mar. 26,	Mar. 26, 2016	Mar. 26, 2019
Software							
Used	Description		Manufacturer	Name		Version	
<input checked="" type="checkbox"/>	Test Software for Radiated disturbance		Farad	EZ-EMC		Ver. UL-3A1	
Other instruments							
Used	Equipment	Manufactur er	Model No.	Serial No.	Upper Cal.	Last Cal.	Next Cal.
<input checked="" type="checkbox"/>	Spectrum Analyzer	Keysight	N9030A	MY55410512	Dec.12,2017	Dec.10,2018	Dec.10,2019
<input checked="" type="checkbox"/>	Power Sensor	Keysight	U2021XA	MY57030004	Dec.12,2017	Dec.10,2018	Dec.10,2019
<input checked="" type="checkbox"/>	Power Meter	Keysight	N1911A	MY55416024	Dec.12,2017	Dec.11,2018	Dec.10,2019
<input checked="" type="checkbox"/>	High Pass Filter	Wainwright	WHKX10-5850-6500-1800-40SS	4	Dec.12,2017	Dec.11,2018	Dec.10,2019
<input checked="" type="checkbox"/>	Band Reject Filter	Wainwright	WRCJV20-5440-5470-5725-5755-60SS	1	Dec.12,2017	Dec.11,2018	Dec.10,2019

6. ANTENNA PORT TEST RESULTS

6.1. ON TIME AND DUTY CYCLE

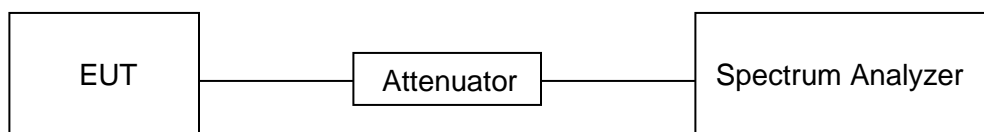
LIMITS

None; for reporting purposes only

PROCEDURE

KDB 558074 Zero-Span Spectrum Analyzer Method

TEST SETUP

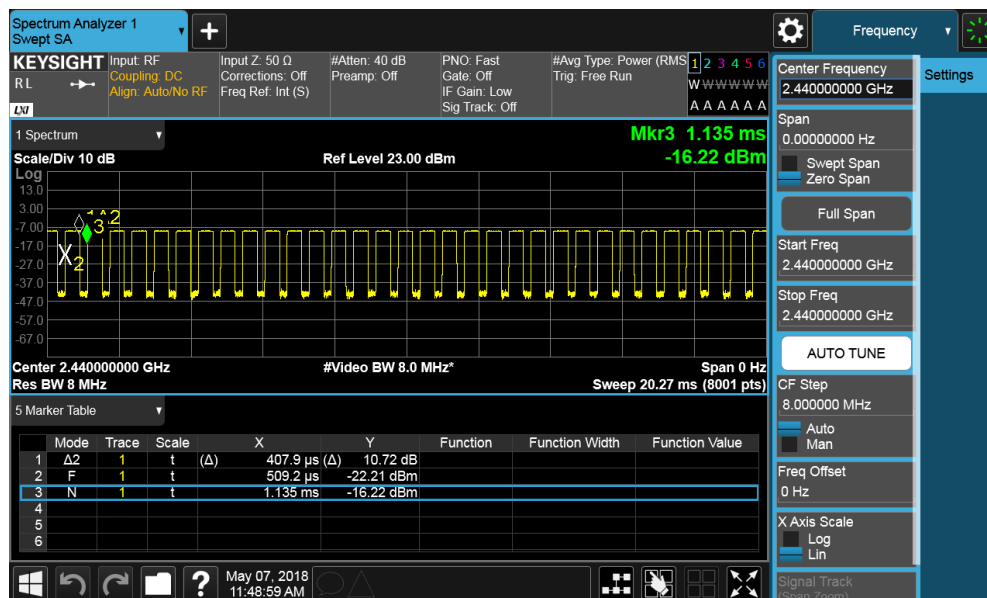


RESULTS

Mode	On Time (msec)	Period (msec)	Duty Cycle x (Linear)	Duty Cycle (%)	Duty Cycle Correction Factor (db)	1/T Minimum VBW (KHz)
BLE	0.4079	0.6258	0.6518	65.18	1.86	2.45

Note: Duty Cycle Correction Factor=10log(1/x).
Where: x is Duty Cycle(Linear)
Where: T is On Time (transmit duration)

ON TIME AND DUTY CYCLE MID CH





6.2. 6 dB DTS BANDWIDTH AND 99% BANDWIDTH

LIMITS

FCC Part15 (15.247) Subpart C RSS-247 ISSUE 2			
Section	Test Item	Limit	Frequency Range (MHz)
FCC 15.247(a)(2) RSS-247 5.2 (a)	6dB Bandwidth	$\geq 500\text{KHz}$	2400-2483.5
RSS-Gen Clause 6.6	99% Bandwidth	For reporting purposes only.	2400-2483.5

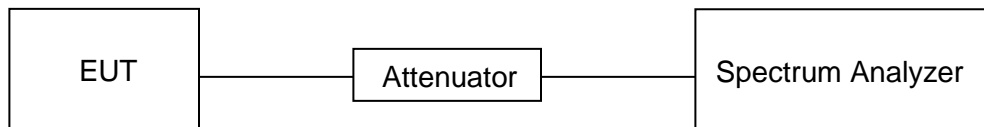
TEST PROCEDURE

Connect the UUT to the spectrum analyzer and use the following settings:

Center Frequency	The center frequency of the channel under test
Detector	Peak
RBW	For 6 dB Bandwidth :100K For 99% Bandwidth :1% to 5% of the occupied bandwidth
VBW	For 6dB Bandwidth : $\geq 3 \times \text{RBW}$ For 99% Bandwidth : approximately $3 \times \text{RBW}$
Trace	Max hold
Sweep	Auto couple

Allow the trace to stabilize and measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

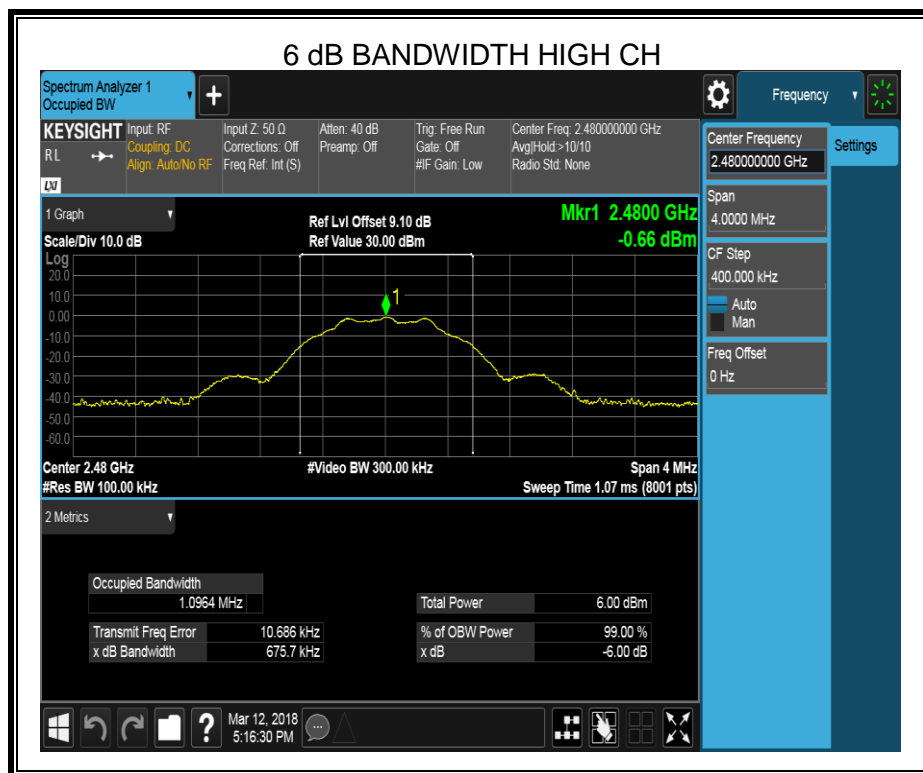
TEST SETUP



RESULTS

Channel	Frequency (MHz)	6dB bandwidth (MHz)	99% bandwidth (MHz)	Limit (kHz)	Result
Low	2402	0.6744	1.0967	500	Pass
Middle	2440	0.6723	1.0968	500	Pass
High	2480	0.6757	1.0964	500	Pass







6.3. PEAK CONDUCTED OUTPUT POWER

LIMITS

FCC Part15 (15.247) Subpart C RSS-247 ISSUE 2			
Section	Test Item	Limit	Frequency Range (MHz)
FCC 15.247(b)(3) RSS-247 5.4 (e)	Peak Output Power	1 watt or 30dBm	2400-2483.5

TEST PROCEDURE

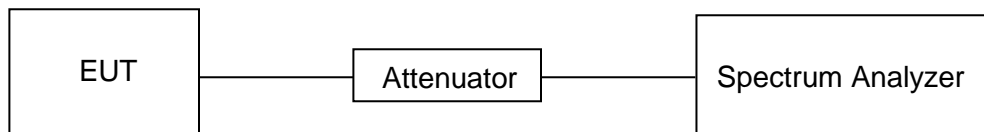
Connect the UUT to the spectrum analyzer and use the following settings:

Center Frequency	The center frequency of the channel under test
Detector	Peak
RBW	\geq DTS bandwidth(e.g. 1 MHz for BLE)
VBW	$\geq 3 \times$ RBW
Span	$3 \times$ RBW
Trace	Max hold
Sweep time	Auto couple.

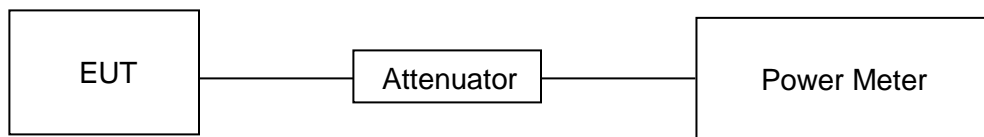
Allow trace to fully stabilize and use peak marker function to determine the peak amplitude level.

TEST SETUP

for peak power measurement:



for average power measurement:



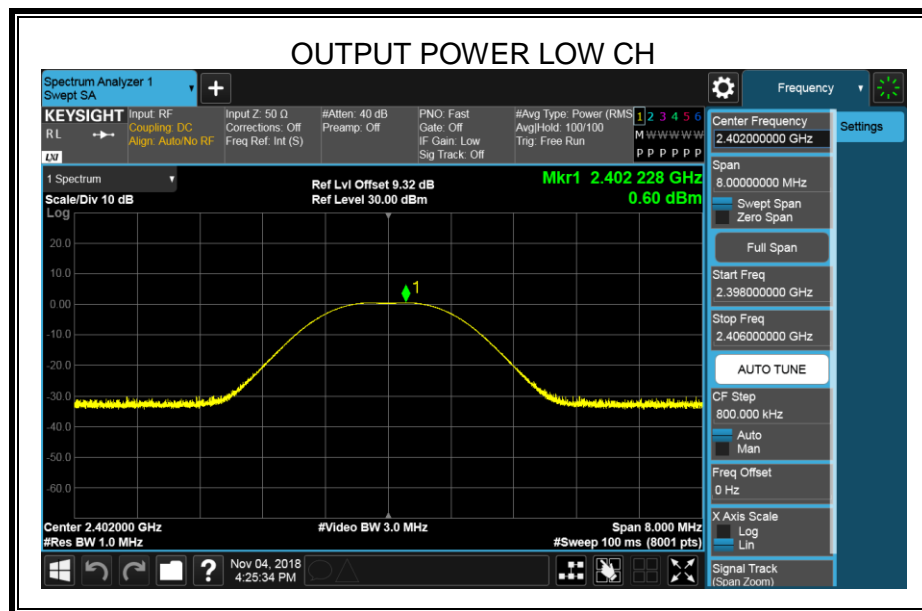
RESULTS

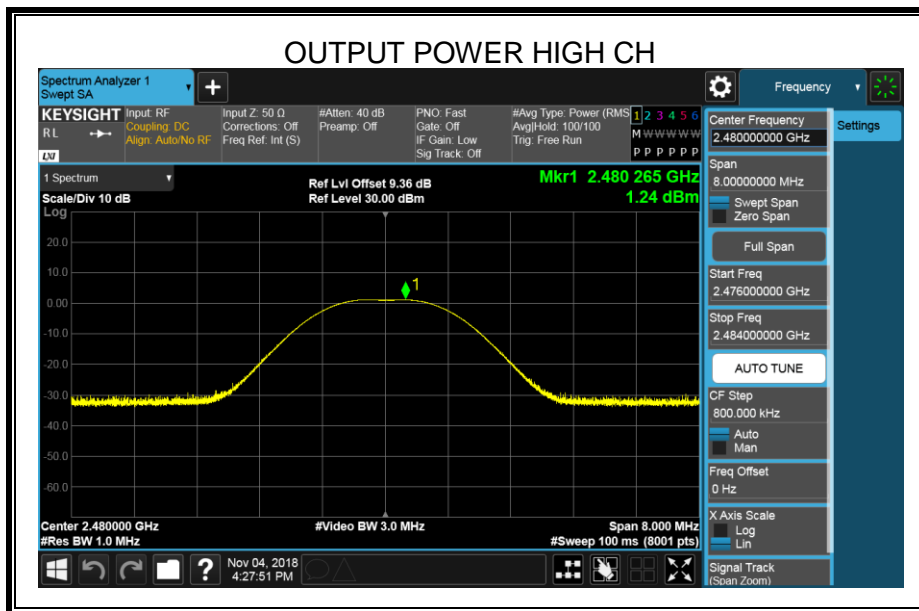
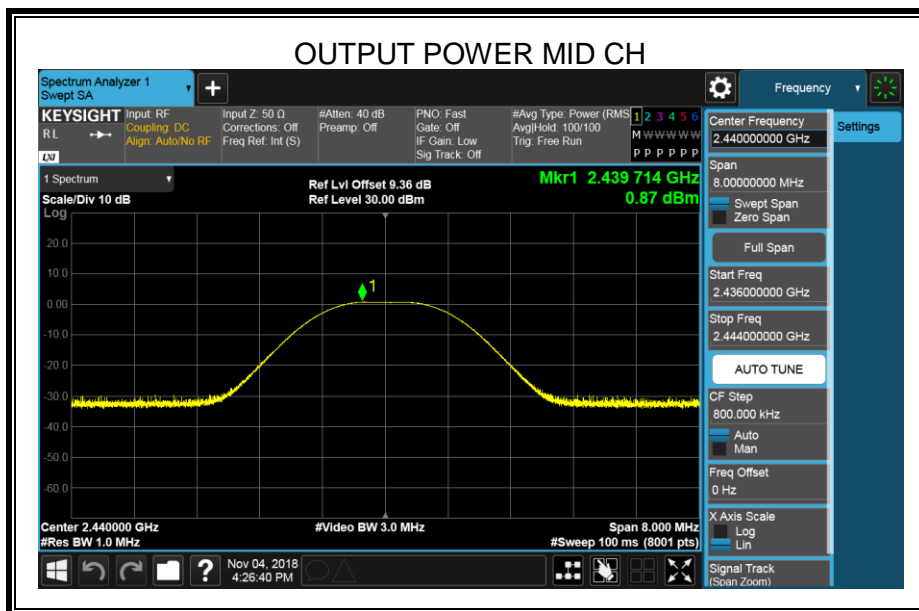
Test Channel	Frequency	Maximum Conducted Output Power(PK)	EIRP	Result
	(MHz)	(dBm)	(dBm)	
CH00	2402	0.60	0.60	PASS
CH19	2440	0.87	0.87	PASS
CH39	2480	1.24	1.24	PASS

Test Channel	Frequency	Maximum Average Conducted Output Power(dBm)	EIRP	Result
	(MHz)	(dBm)	(dBm)	
CH00	2402	0.39	0.39	PASS
CH19	2440	0.19	0.19	PASS
CH39	2480	0.67	0.67	PASS

Note:

1. The average conducted output power is measured by power meter for calculating the tune-up power.
2. Average conducted output power = power meter reading level + duty cycle correction factor.
3. For duty cycle correction factor please refer to clause 6.1. ON TIME AND DUTY CYCLE.





6.4. POWER SPECTRAL DENSITY

LIMITS

FCC Part15 (15.247) Subpart C RSS-247 ISSUE 2			
Section	Test Item	Limit	Frequency Range (MHz)
FCC §15.247 (e) RSS-247 5.2 (b)	Power Spectral Density	8 dBm in any 3 kHz band	2400-2483.5

TEST PROCEDURE

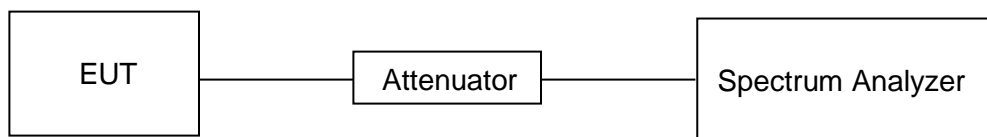
Connect the UUT to the spectrum analyzer and use the following settings:

Center Frequency	The center frequency of the channel under test
Detector	Peak
RBW	$3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$
VBW	$\geq 3 \times \text{RBW}$
Span	$1.5 \times \text{DTS bandwidth}$
Trace	Max hold
Sweep time	Auto couple.

Allow trace to fully stabilize and use the peak marker function to determine the maximum amplitude level within the RBW.

If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

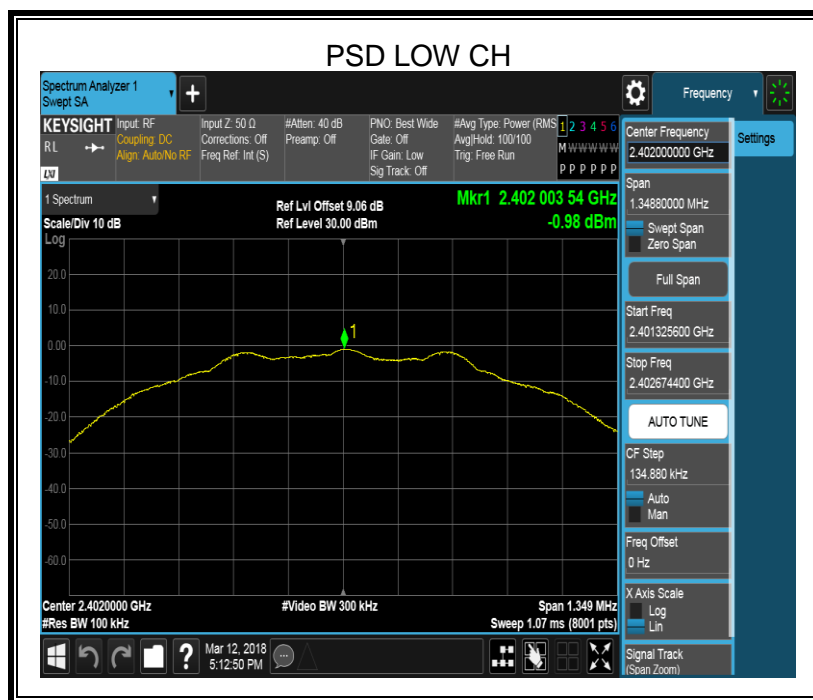
TEST SETUP

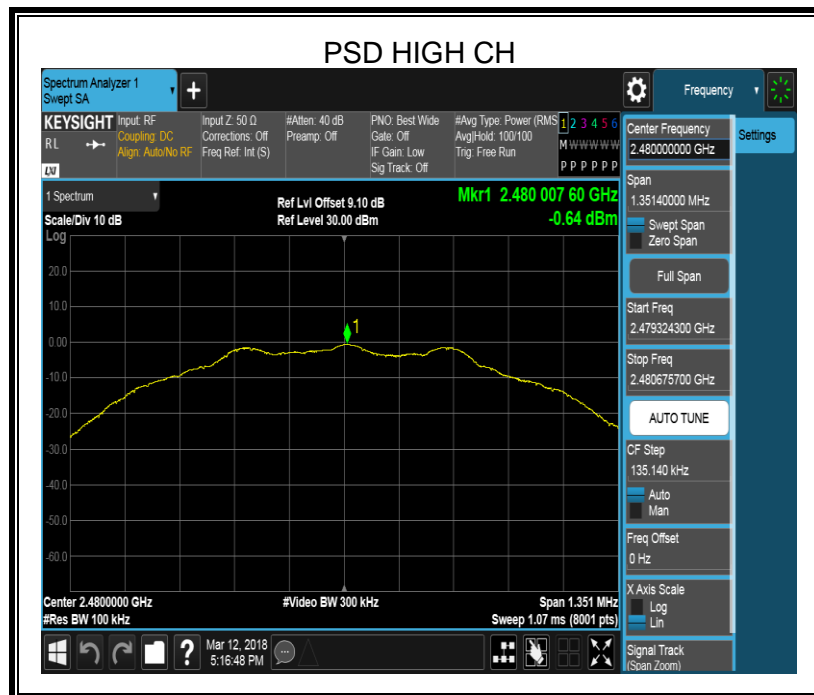
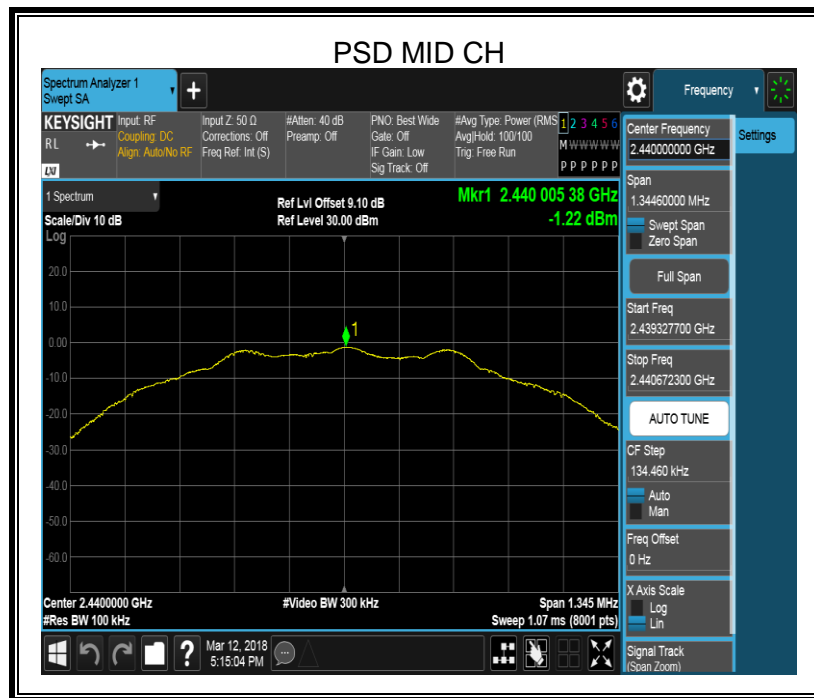




RESULTS

Frequency	Power Spectral Density (dBm/100kHz)	Limit (dBm/3kHz)	Result
2402 MHz	-0.982	8	PASS
2440 MHz	-1.216	8	PASS
2480 MHz	-0.637	8	PASS







6.5. CONDUCTED BANDEDGE AND SPURIOUS EMISSIONS

LIMITS

FCC Part15 (15.247) Subpart C RSS-247 ISSUE 2		
Section	Test Item	Limit
FCC §15.247 (d) RSS-247 5.5	Conducted Bandedge and Spurious Emissions	at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power

TEST PROCEDURE

Connect the UUT to the spectrum analyzer and use the following settings:

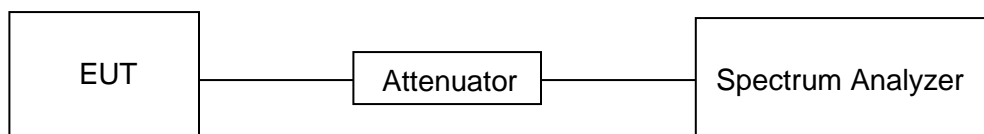
Center Frequency	The center frequency of the channel under test
Detector	Peak
RBW	100K
VBW	$\geq 3 \times \text{RBW}$
Span	1.5 x DTS bandwidth
Trace	Max hold
Sweep time	Auto couple.

Use the peak marker function to determine the maximum PSD level.

Span	Set the center frequency and span to encompass frequency range to be measured
Detector	Peak
RBW	100K
VBW	$\geq 3 \times \text{RBW}$
measurement points	$\geq \text{span}/\text{RBW}$
Trace	Max hold
Sweep time	Auto couple.

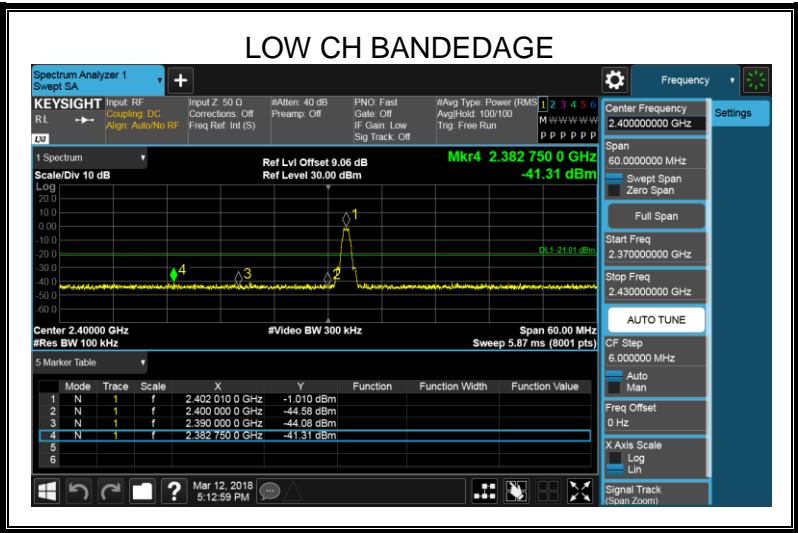
Use the peak marker function to determine the maximum amplitude level.

TEST SETUP

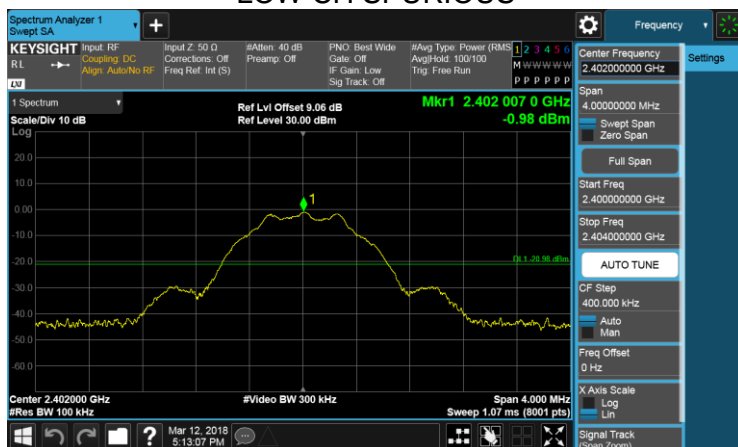




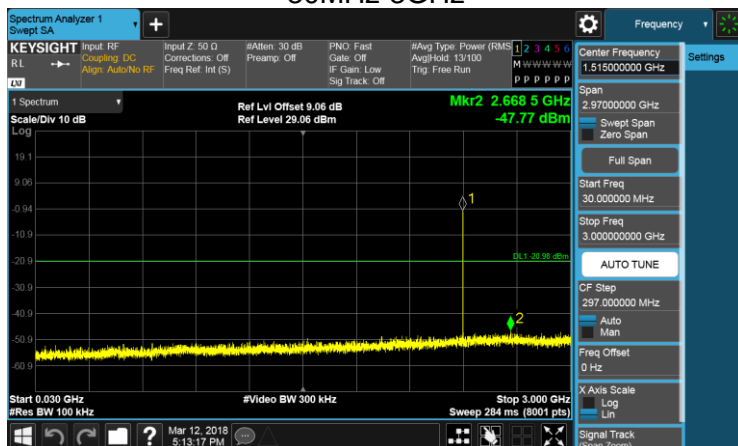
RESULTS



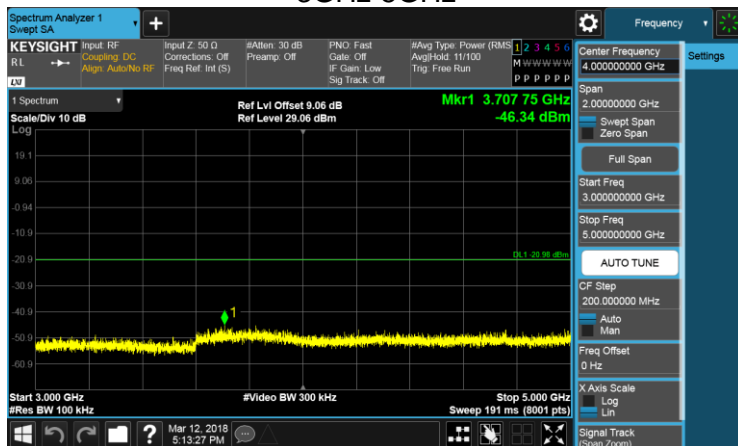
LOW CH SPURIOUS



30MHz-3GHz

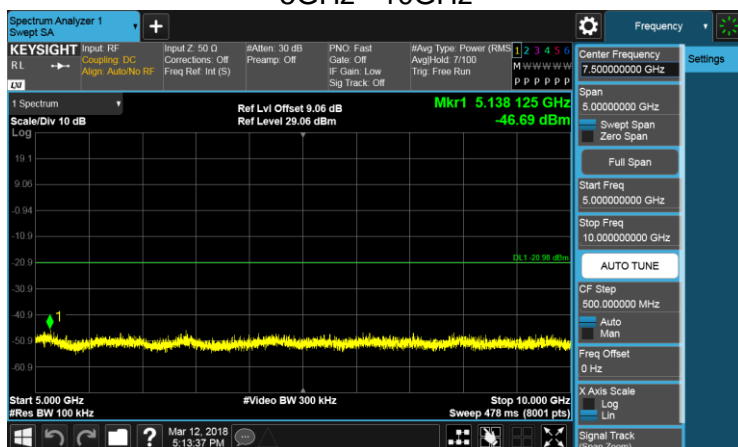


3GHz-5GHz

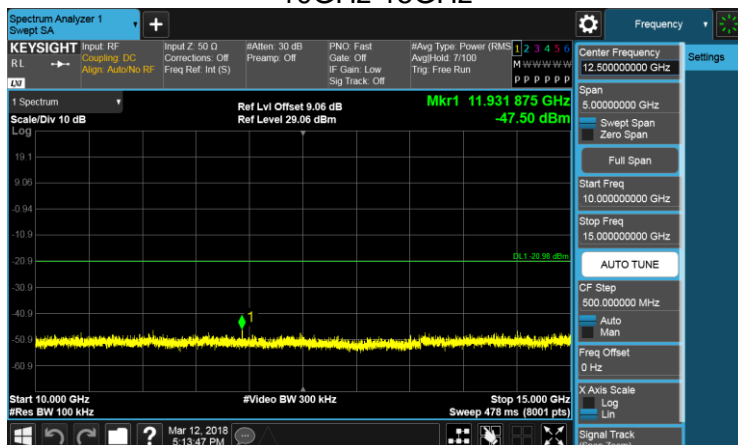




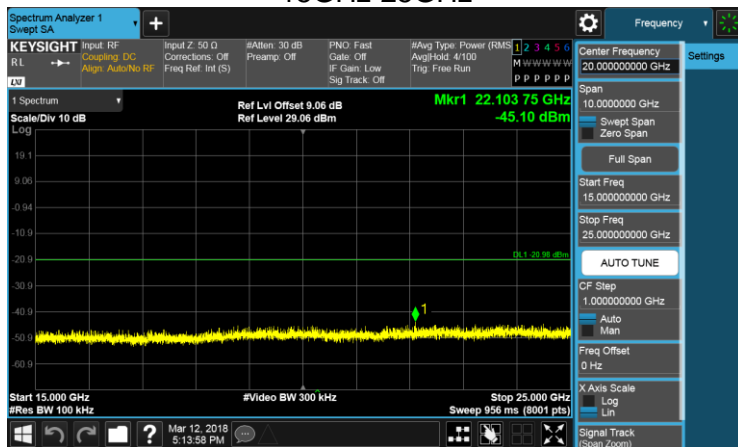
LOW CH SPURIOUS 5GHz - 10GHz

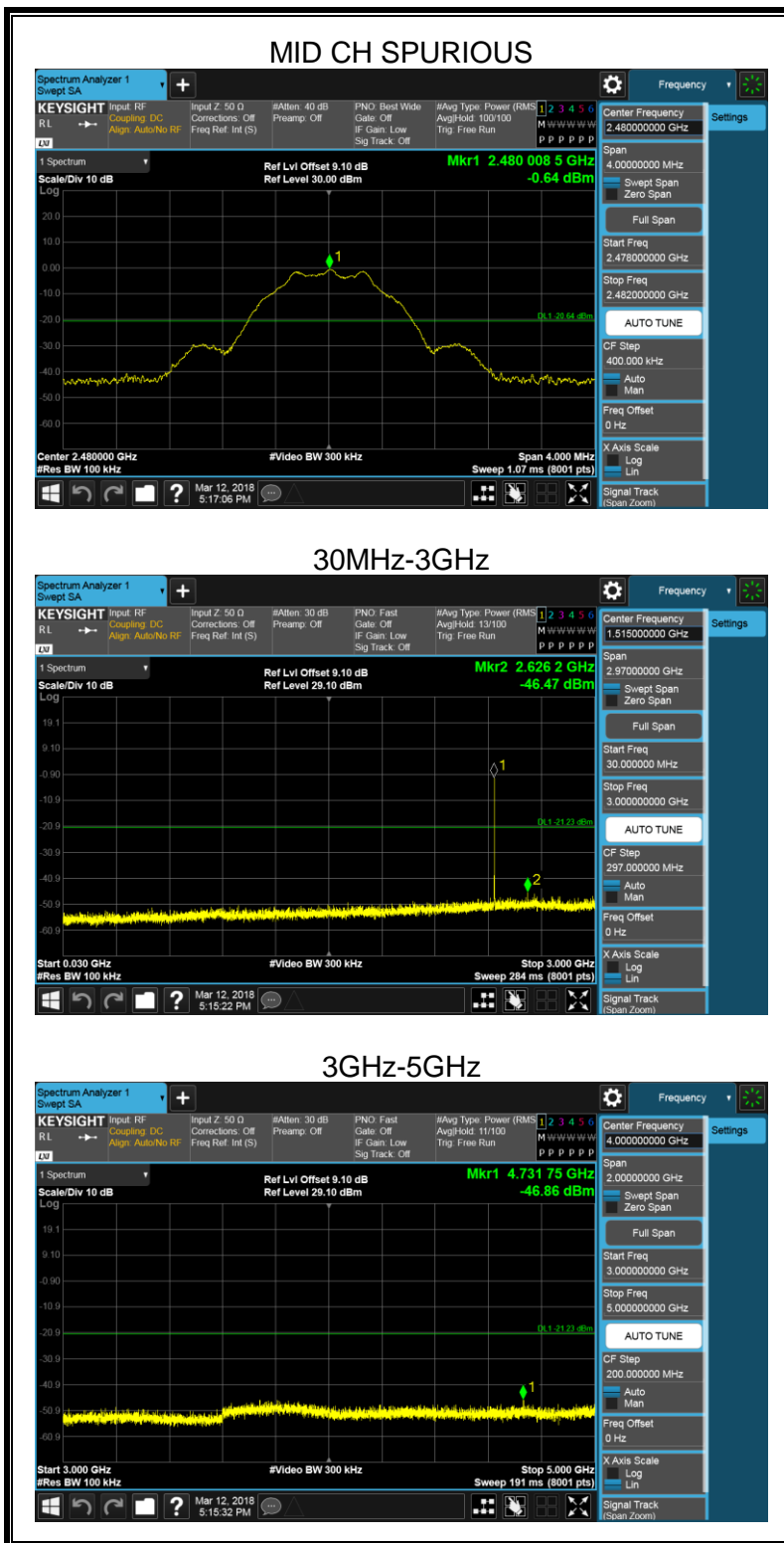


10GHz-15GHz



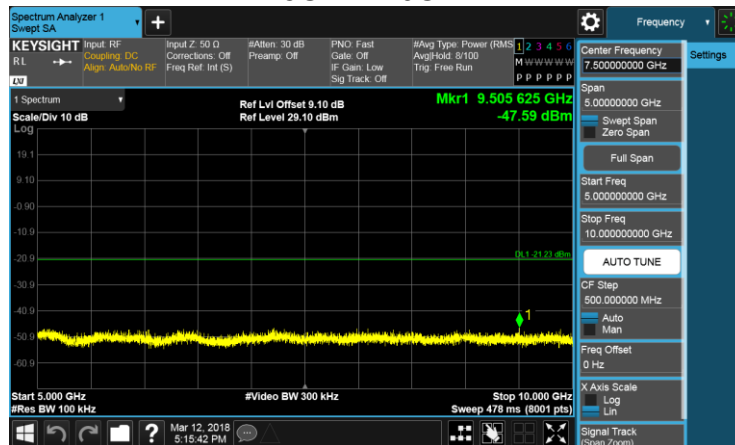
15GHz-25GHz



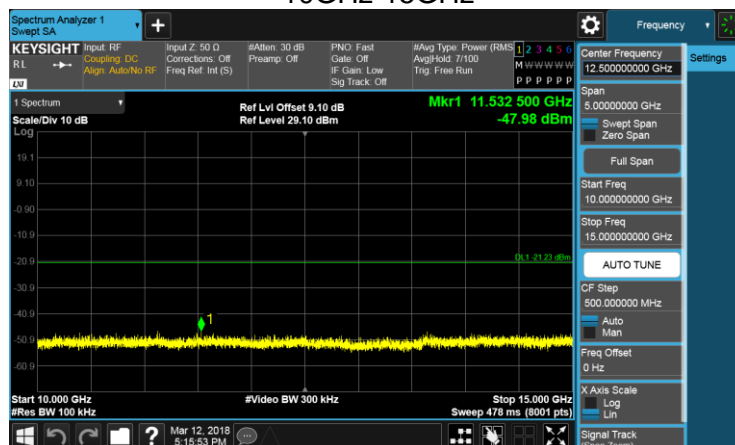




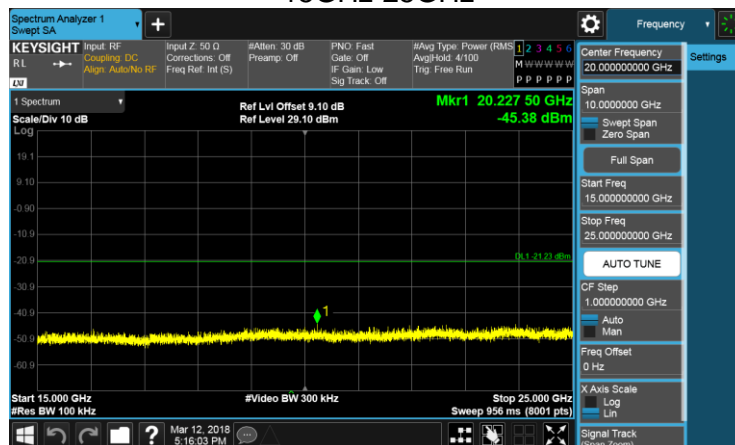
MID CH SPURIOUS 5GHz - 10GHz

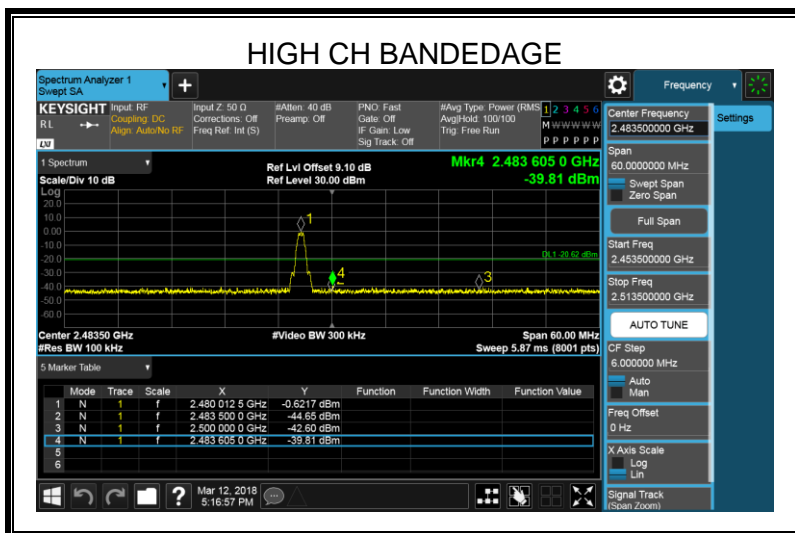


10GHz-15GHz

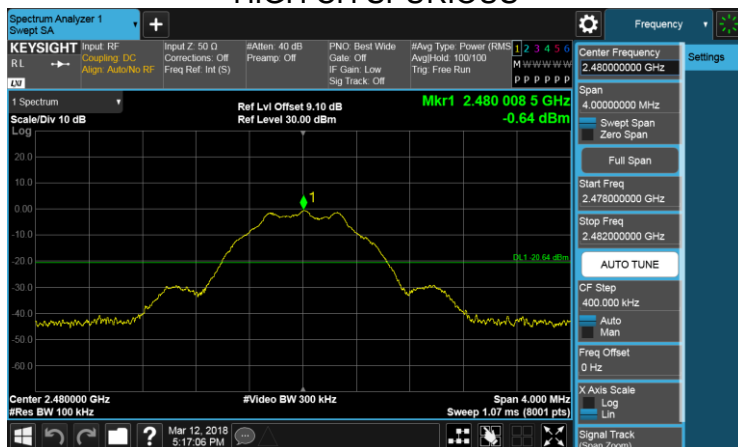


15GHz-25GHz

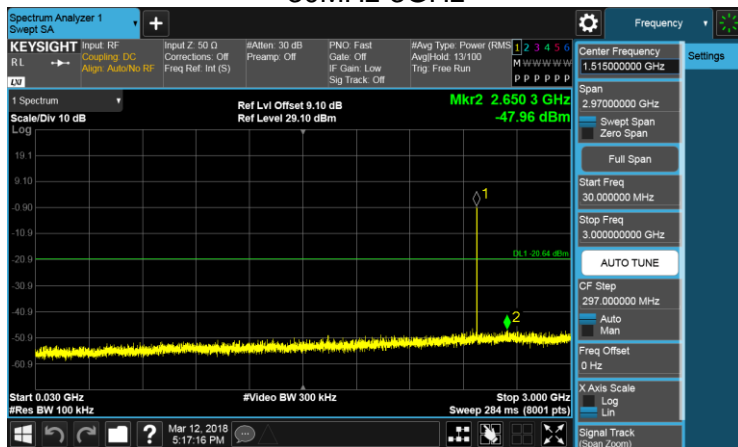




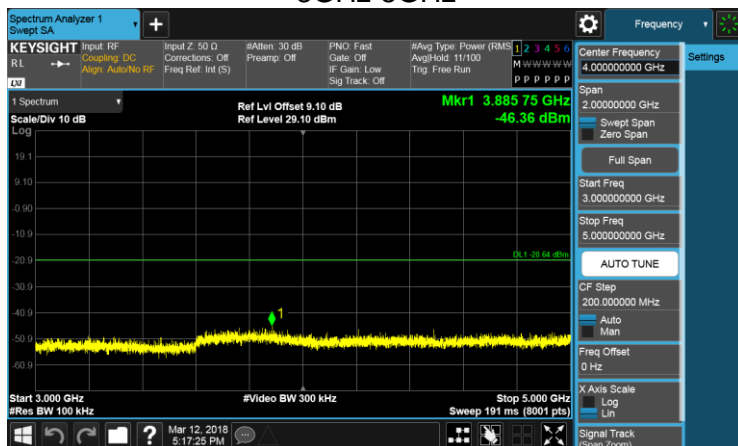
HIGH CH SPURIOUS



30MHz-3GHz

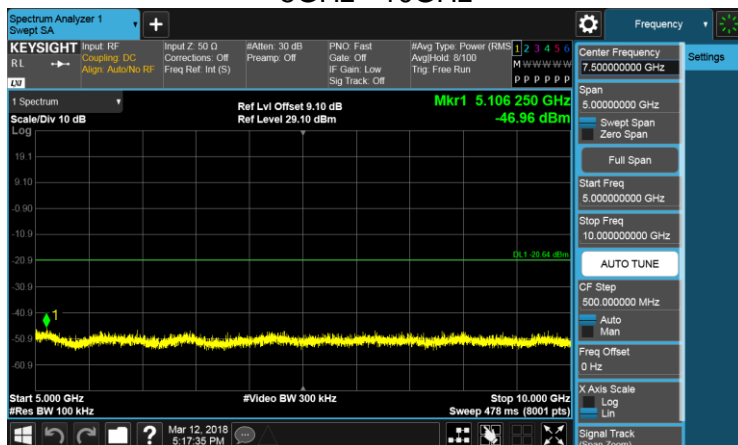


3GHz-5GHz

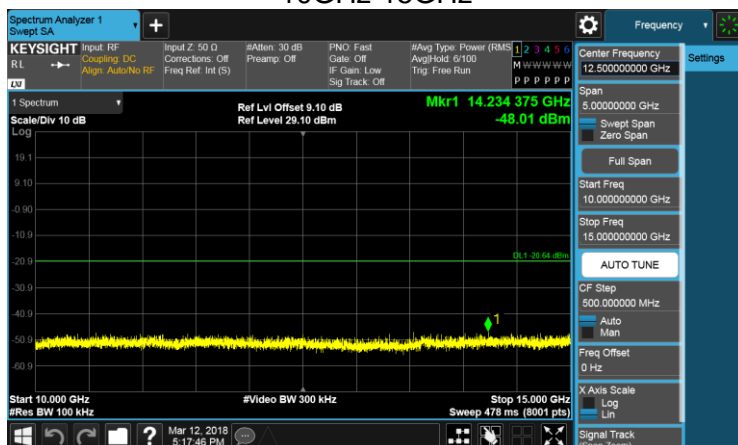




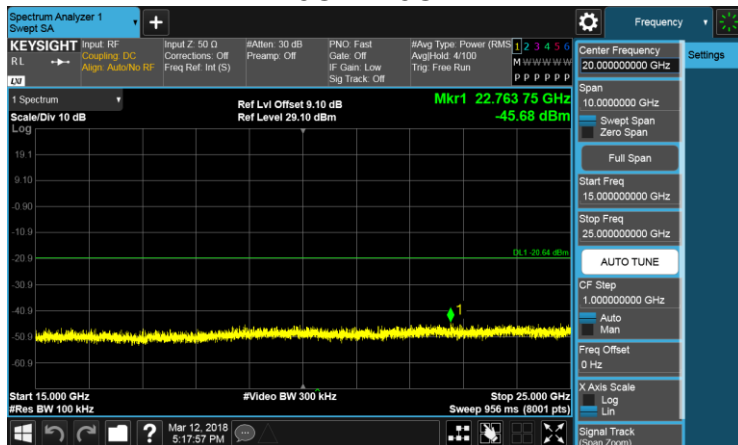
HIGH CH SPURIOUS 5GHz - 10GHz



10GHz-15GHz



15GHz-25GHz





7. RADIATED TEST RESULTS

LIMITS

Please refer to FCC §15.205 and §15.209

Please refer to RSS-GEN Clause 8.9 and Clause 8.10

Radiation Disturbance Test Limit for FCC (Class B)(9KHz-1GHz)

Frequency (MHz)	Field Strength (microvolts/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
960~1000	500	3

Note: 1) At frequencies at or above 30 MHz, measurements may be performed at a distance other than what is specified provided: measurements are not made in the near field except where it can be shown that near field measurements are appropriate due to the characteristics of the device; and it can be demonstrated that the signal levels needed to be measured at the distance employed can be detected by the measurement equipment. Measurements shall not be performed at a distance greater than 30 meters unless it can be further demonstrated that measurements at a distance of 30 meters or less are impractical. When performing measurements at a distance other than that specified, the results shall be extrapolated to the specified distance using an extrapolation factor of 20 dB/decade (inverse linear-distance for field strength measurements; inverse-linear-distance-squared for power density measurements).

(2) At frequencies below 30 MHz, measurements may be performed at a distance closer than that specified in the regulations; however, an attempt should be made to avoid making measurements in the near field. Pending the development of an appropriate measurement procedure for measurements performed below 30 MHz, when performing measurements at a closer distance than specified, the results shall be extrapolated to the specified distance by either making measurements at a minimum of two distances on at least one radial to determine the proper extrapolation factor or by using the square of an inverse linear distance extrapolation factor (40 dB/decade). This paragraph (f) shall not apply to Access BPL devices operating below 30 MHz.



Radiation Disturbance Test Limit for FCC (Above 1G)

Frequency (MHz)	dB(uV/m) (at 3 meters)	
	Peak	Average
Above 1000	74	54

Restricted bands of operation

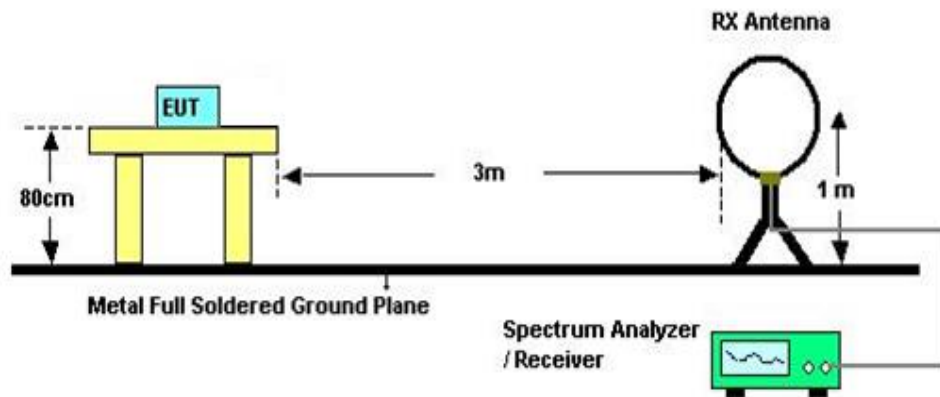
MHz	MHz	MHz	GHz
0.090-0.110	16.42-16.423	399.9-410	4.5-5.15
¹ 0.495-0.505	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.215-6.218	74.8-75.2	1660-1710	10.6-12.7
6.26775-6.26825	108-121.94	1718.8-1722.2	13.25-13.4
6.31175-6.31225	123-138	2200-2300	14.47-14.5
8.291-8.294	149.9-150.05	2310-2390	15.35-16.2
8.362-8.366	156.52475-156.52525	2483.5-2500	17.7-21.4
8.37625-8.38675	156.7-156.9	2690-2900	22.01-23.12
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29-12.293	167.72-173.2	3332-3339	31.2-31.8
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5
12.57675-12.57725	322-335.4	3600-4400	(²)
13.36-13.41			

Note: ¹Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz.

²Above 38.6c

TEST SETUP AND PROCEDURE

Below 30MHz

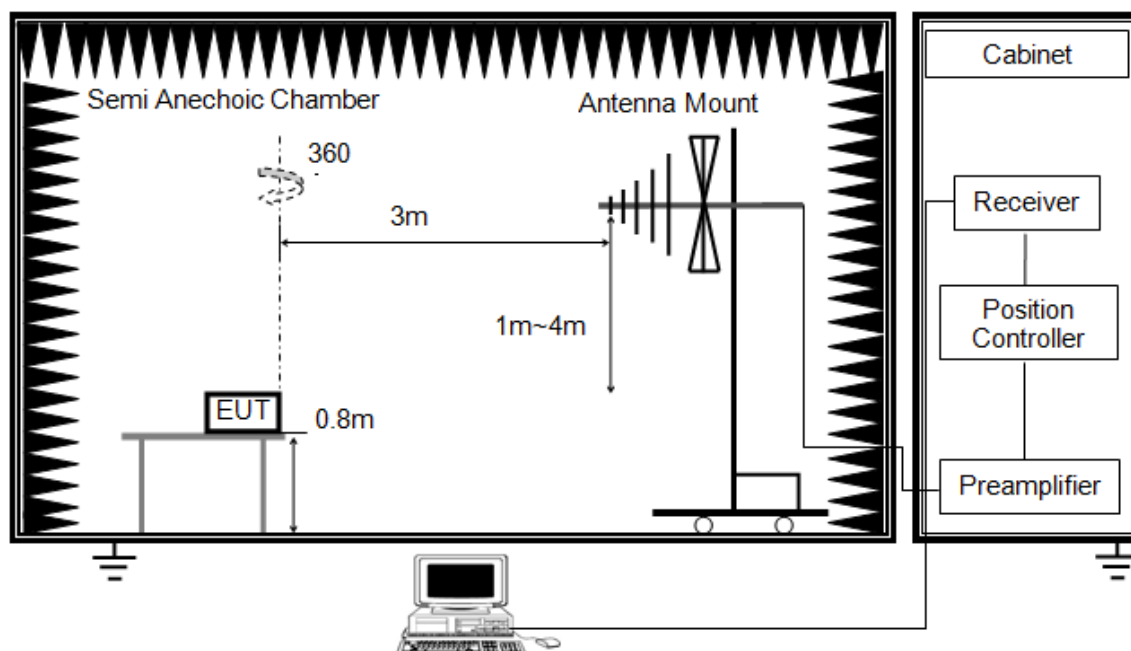


The setting of the spectrum analyzer

RBW	200Hz (From 9kHz to 0.15MHz)/ 9KHz (From 0.15MHz to 30MHz)
VBW	200Hz (From 9kHz to 0.15MHz)/ 9KHz (From 0.15MHz to 30MHz)
Sweep	Auto
Trace	Max hold

1. The testing follows the guidelines in ANSI C63.10-2013
2. The EUT was arranged to its worst case and then turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
3. The EUT was placed on a turntable with 80cm above ground.
4. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower.
5. The radiated emission limits are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector.
6. For measurement below 1GHz, the initial step in collecting conducted emission data is a spectrum analyzer peak detector mode pre-scanning the measurement frequency range. Significant peaks are then marked and then Quasi Peak and average detector mode re-measured. If the emission level of the EUT measured by the peak detector is 3 dB lower than the applicable limit, the peak emission level will be reported. Otherwise, the emission measurement will be repeated using the quasi-peak and average detector and reported.
7. For the actual test configuration, please refer to the related item in this test report (Photographs of the Test Configuration)

Below 1G and above 30MHz

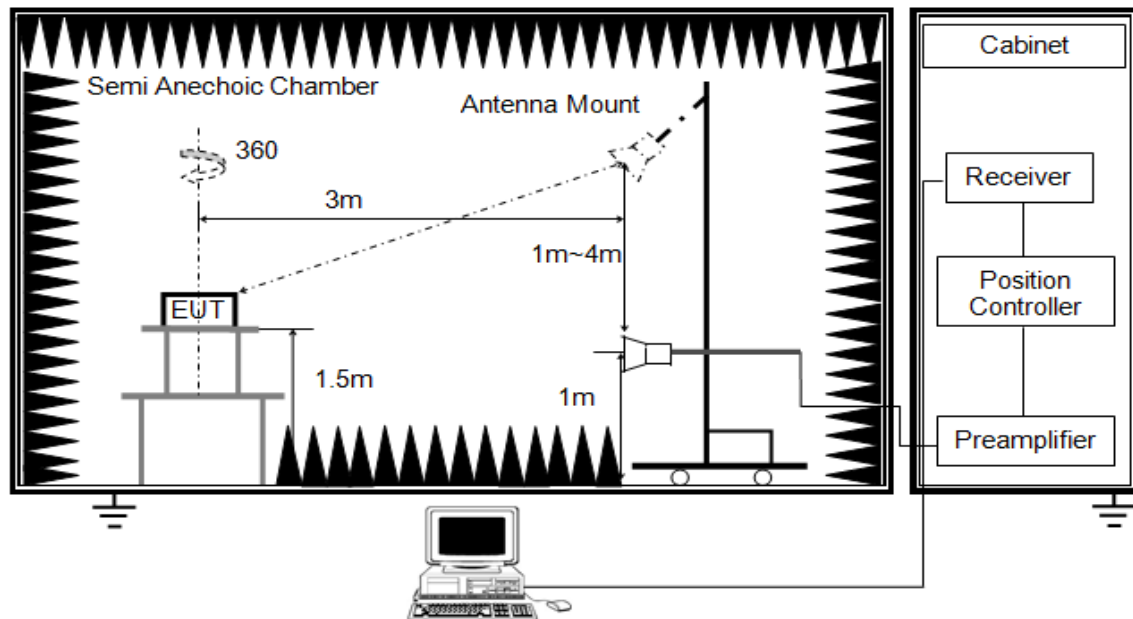


The setting of the spectrum analyzer

RBW	120K
VBW	300K
Sweep	Auto
Detector	Peak/QP
Trace	Max hold

1. The testing follows the guidelines in ANSI C63.10-2013.
2. The EUT was arranged to its worst case and then tune the antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
3. The EUT was placed on a turntable with 80cm above ground.
4. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower.
5. For measurement below 1GHz, the initial step in collecting conducted emission data is a spectrum analyzer peak detector mode pre-scanning the measurement frequency range. Significant peaks are then marked and then Quasi Peak detector mode re-measured. If the emission level of the EUT measured by the peak detector is 3 dB lower than the applicable limit, the peak emission level will be reported. Otherwise, the emission measurement will be repeated using the quasi-peak detector and reported.
6. For the actual test configuration, please refer to the related item in this test report (Photographs of the Test Configuration).

Above 1G

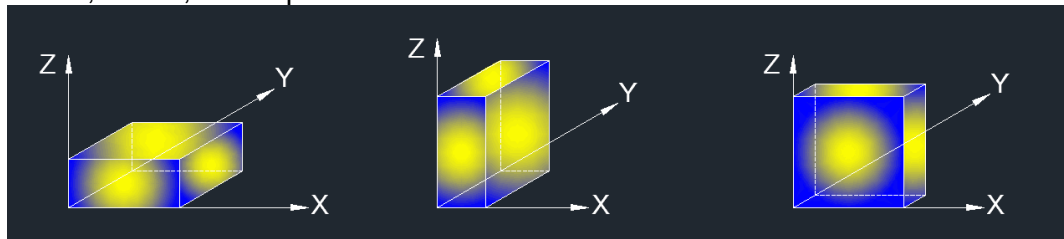


The setting of the spectrum analyzer

RBW	1M
VBW	PEAK: 3M AVG: see note 5
Sweep	Auto
Detector	Peak
Trace	Max hold

1. The testing follows the guidelines in ANSI C63.10-2013.
2. The EUT was arranged to its worst case and then tune the antenna tower (1.5 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
3. The EUT was placed on a turntable with 1.5m above ground.
4. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower.
5. For measurements above 1 GHz the resolution bandwidth is set to 1 MHz, then the video bandwidth is set to 3 MHz for peak measurements and 1 MHz resolution bandwidth with 1/T video bandwidth with peak detector, max hold to be run for at least 50 x (1/duty cycle) traces for average measurements. For the Duty Cycle please refer to clause 6.1.ON TIME AND DUTY CYCLE.
6. For the actual test configuration, please refer to the related item in this test report (Photographs of the Test Configuration).

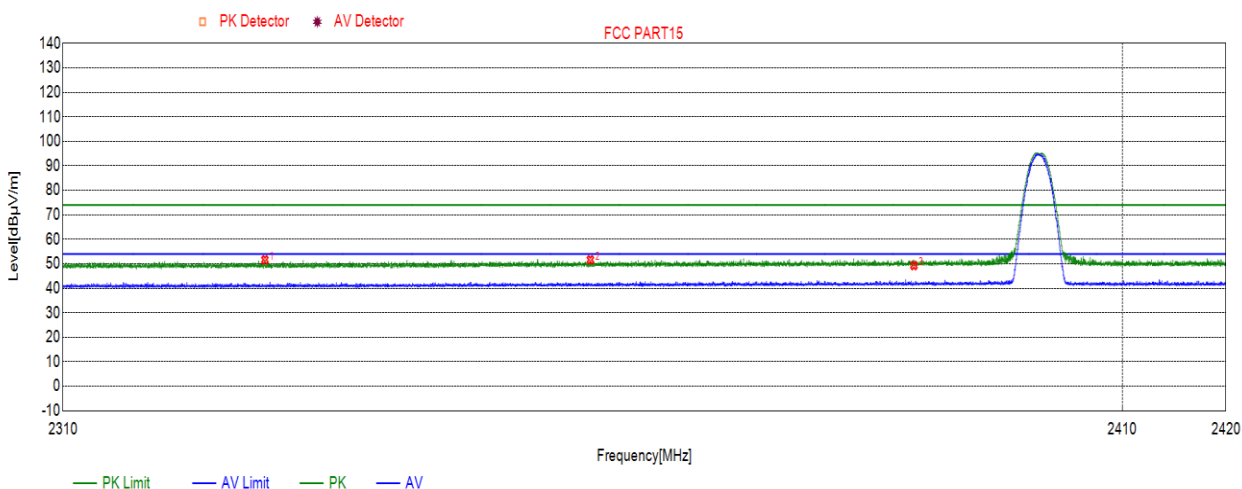
X axis, Y axis, Z axis positions:



Note: For all radiated test, EUT in each of three orthogonal axis emissions had been tested, but only the worst case (X axis) data recorded in the report.

7.1. RESTRICTED BANDEDGE

RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)

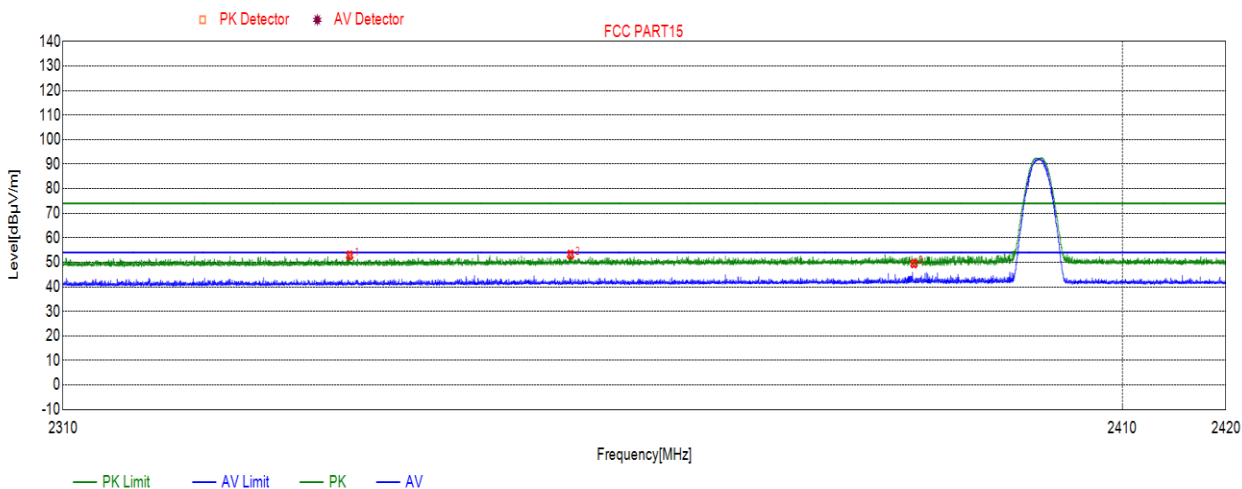


No.	Frequency (MHz)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2328.7459	51.62	74.00	-22.38	peak
2	2359.2629	51.62	74.00	-22.38	peak
3	2390.000	49.30	74.00	-24.70	peak

Note: 1. If Peak Result complies with AV limit, AV Result is deemed to comply with AV limit.
2. Peak: Peak detector.



RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)

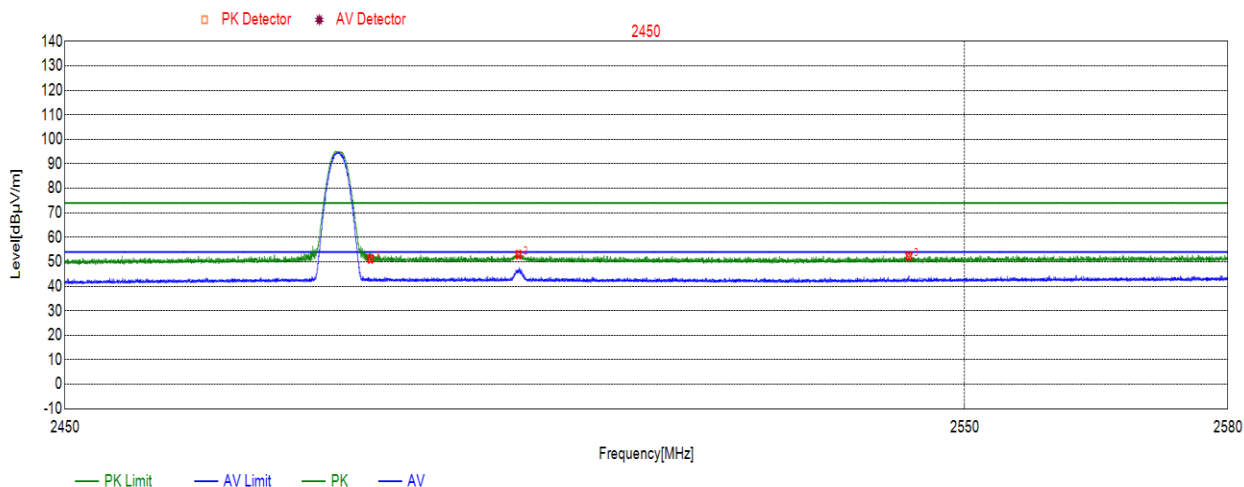


No.	Frequency (MHz)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2336.6557	52.84	74.00	-21.16	peak
2	2357.3927	53.17	74.00	-20.83	peak
3	2390.000	49.50	74.00	-24.50	peak

Note: 1. If Peak Result complies with AV limit, AV Result is deemed to comply with AV limit.
2. Peak: Peak detector.



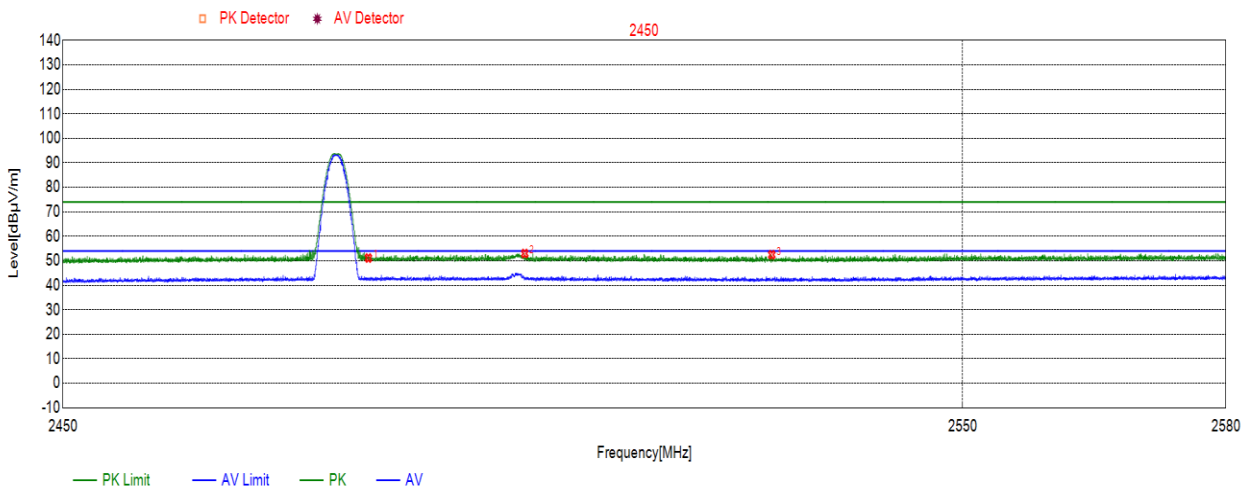
RESTRICTED BANDEDGE (HIGH CHANNEL, HORIZONTAL)



No.	Frequency (MHz)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2483.500	51.19	74.00	-22.81	peak
2	2499.9250	52.93	74.00	-21.07	peak
3	2543.6874	52.38	74.00	-21.62	peak

Note: 1. If Peak Result complies with AV limit, AV Result is deemed to comply with AV limit.
2. Peak: Peak detector.

RESTRICTED BANDEDGE (HIGH CHANNEL, VERTICAL)

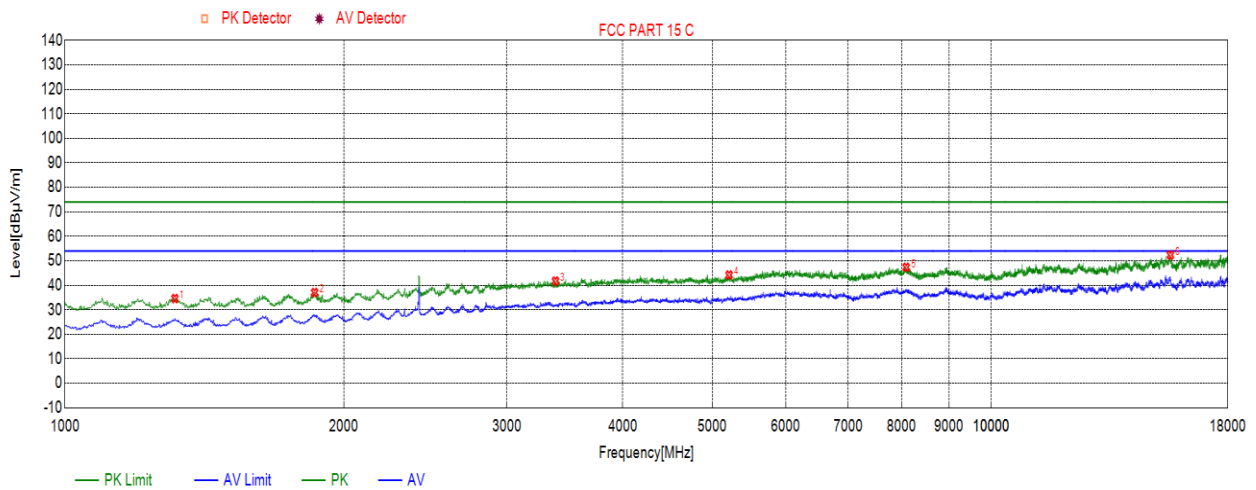


No.	Frequency (MHz)	Result (dBuV)	Limit (dBuV)	Margin (dB)	Remark
1	2483.500	51.14	74.00	-22.86	peak
2	2500.8351	52.97	74.00	-21.03	peak
3	2528.4498	52.47	74.00	-21.53	peak

Note: 1. If Peak Result complies with AV limit, AV Result is deemed to comply with AV limit.
2. Peak: Peak detector.

7.2. SPURIOUS EMISSIONS (1~18GHz)

HARMONICS AND SPURIOUS EMISSIONS (LOW CHANNEL, HORIZONTAL)

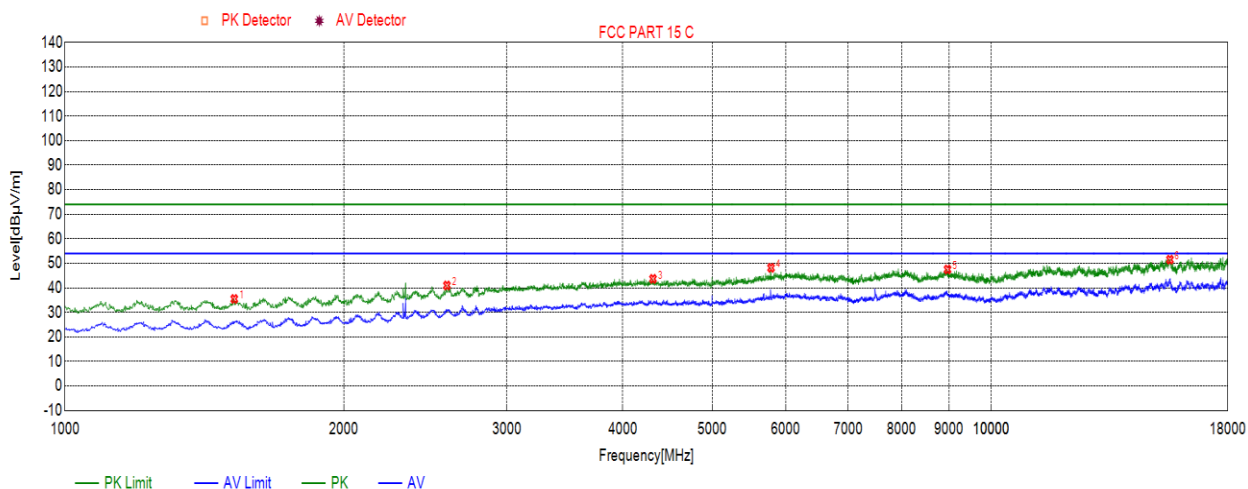


No.	Frequency (MHz)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	1314.5315	34.59	74.00	-39.41	Peak
2	1860.2860	37.05	74.00	-36.95	peak
3	3385.3385	41.72	74.00	-32.28	Peak
4	5211.3211	44.22	74.00	-29.78	peak
5	8094.8095	47.34	74.00	-26.66	Peak
6	15607.8608	52.35	74.00	-21.65	peak

Note: 1. If Peak Result complies with AV limit, AV Result is deemed to comply with AV limit.
 2. Peak: Peak detector.
 3. AVG: VBW=1/T, T is On Time (transmit duration)
 4. For transmit duration, please refer to clause 7.1.



HARMONICS AND SPURIOUS EMISSIONS (LOW CHANNEL, VERTICAL)

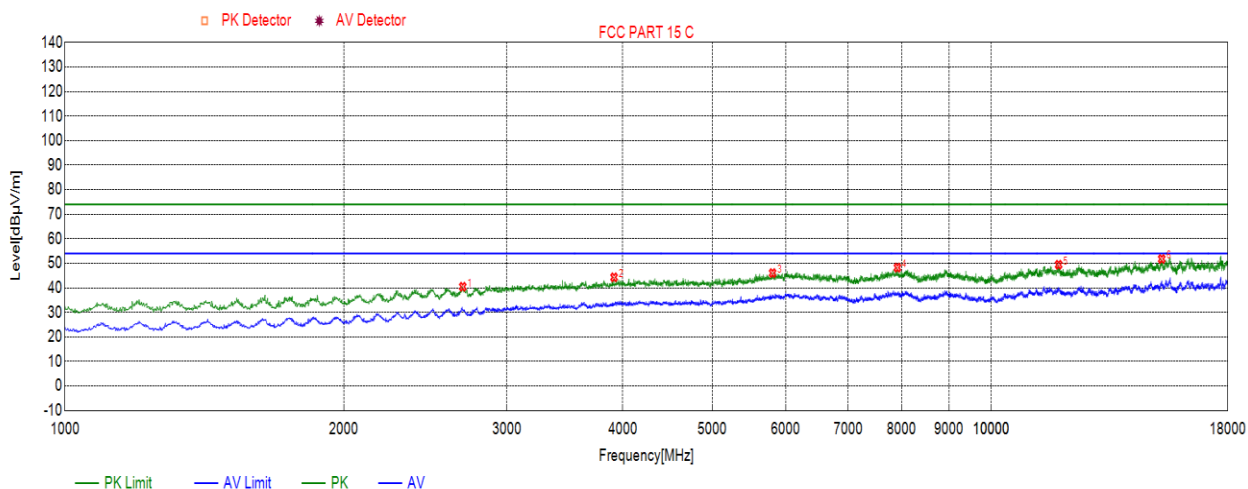


No.	Frequency (MHz)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	1523.6524	35.48	74.00	-38.52	Peak
2	2584.5585	40.97	74.00	-33.03	Peak
3	4313.6314	43.67	74.00	-30.33	Peak
4	5784.2784	48.16	74.00	-25.84	Peak
5	8970.3970	47.50	74.00	-26.50	Peak
6	15590.8591	51.50	74.00	-22.50	Peak

- Note: 1. If Peak Result complies with AV limit, AV Result is deemed to comply with AV limit.
2. Peak: Peak detector.
3. AVG: $VBW=1/T$, T is On Time (transmit duration)
4. For transmit duration, please refer to clause 7.1.



HARMONICS AND SPURIOUS EMISSIONS (MID CHANNEL, HORIZONTAL)

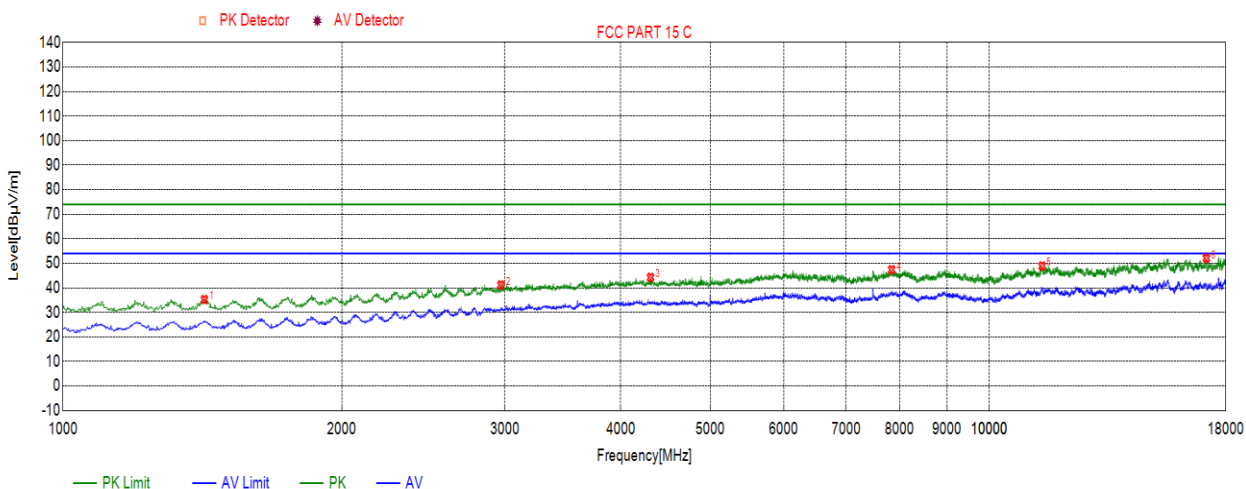


No.	Frequency (MHz)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2688.2688	40.46	74.00	-33.54	Peak
2	3915.7916	44.30	74.00	-29.70	Peak
3	5806.3806	46.03	74.00	-27.97	Peak
4	7919.6920	48.24	74.00	-25.76	Peak
5	11821.5822	49.44	74.00	-24.56	Peak
6	15274.6275	51.79	74.00	-22.21	Peak

Note: 1. If Peak Result complies with AV limit, AV Result is deemed to comply with AV limit.
2. Peak: Peak detector.
3. AVG: VBW=1/T, T is On Time (transmit duration)
4. For transmit duration, please refer to clause 7.1.



HARMONICS AND SPURIOUS EMISSIONS (MID CHANNEL, VERTICAL)

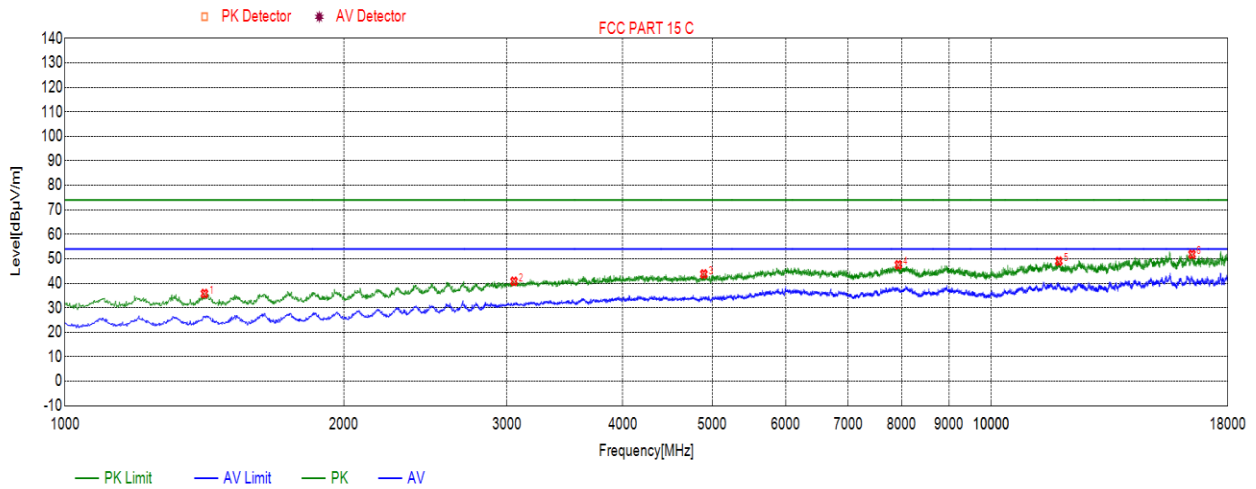


No.	Frequency (MHz)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	1421.6422	35.23	74.00	-38.77	Peak
2	2970.4971	41.20	74.00	-32.80	Peak
3	4308.5309	44.25	74.00	-29.75	Peak
4	7844.8845	47.39	74.00	-26.61	Peak
5	11399.9400	48.91	74.00	-25.09	Peak
6	17153.3153	52.07	74.00	-21.93	Peak

Note: 1. If Peak Result complies with AV limit, AV Result is deemed to comply with AV limit.
2. Peak: Peak detector.
3. AVG: VBW=1/T, T is On Time (transmit duration)
4. For transmit duration, please refer to clause 7.1.



HARMONICS AND SPURIOUS EMISSIONS (HIGH CHANNEL, HORIZONTAL)

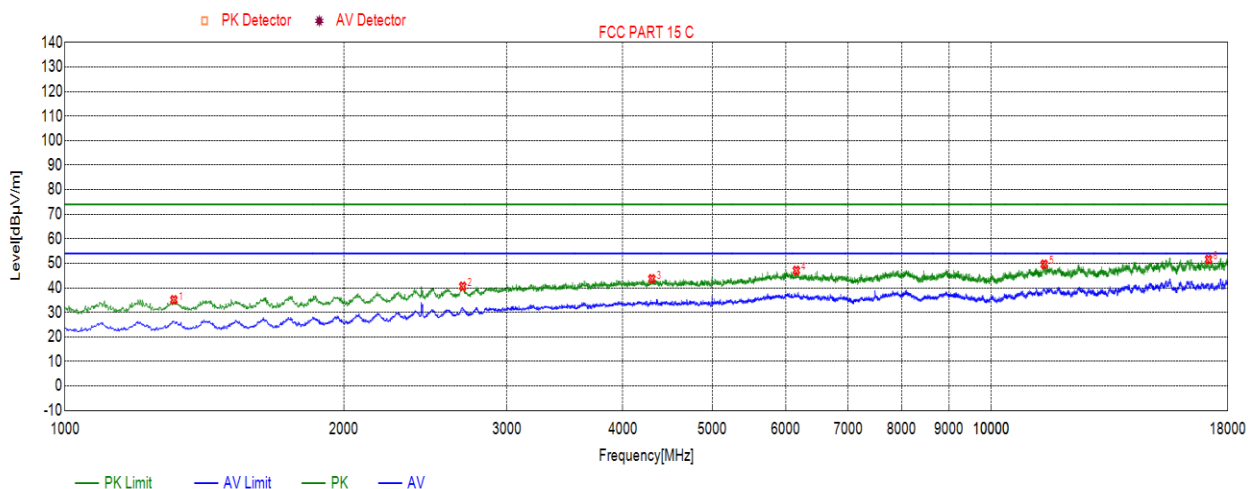


No.	Frequency (MHz)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	1414.8415	35.80	74.00	-38.20	Peak
2	3053.8054	40.80	74.00	-33.20	Peak
3	4895.0895	43.80	74.00	-30.20	Peak
4	7938.3938	47.53	74.00	-26.47	Peak
5	11828.3828	49.04	74.00	-24.96	Peak
6	16469.8470	51.83	74.00	-22.17	Peak

- Note: 1. If Peak Result complies with AV limit, AV Result is deemed to comply with AV limit.
2. Peak: Peak detector.
3. AVG: VBW=1/T, T is On Time (transmit duration)
4. For transmit duration, please refer to clause 7.1.



HARMONICS AND SPURIOUS EMISSIONS (HIGH CHANNEL, VERTICAL)

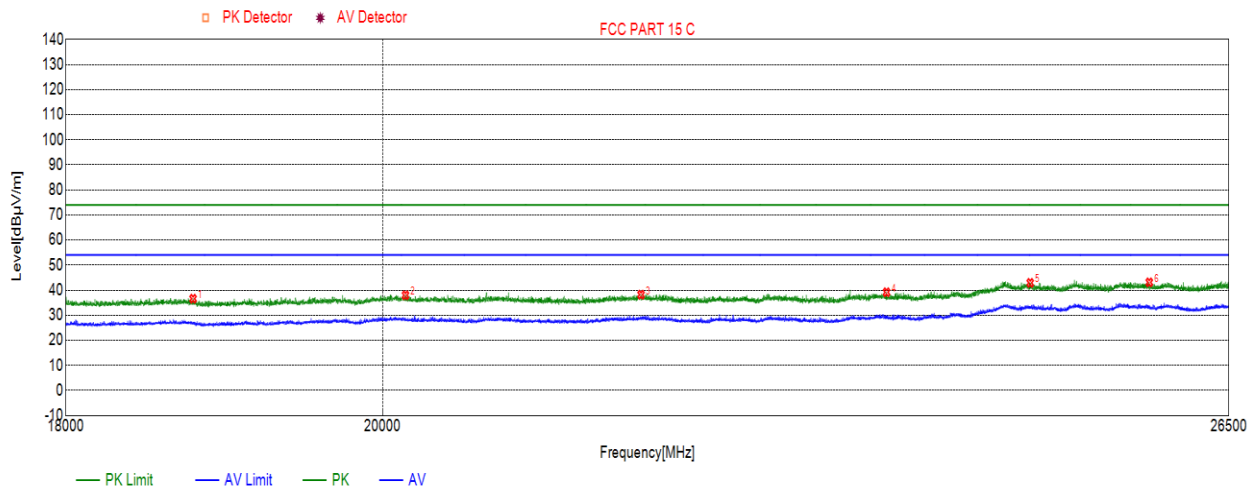


No.	Frequency (MHz)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	1311.1311	35.11	74.00	-38.89	Peak
2	2688.2688	40.62	74.00	-33.38	Peak
3	4301.7302	43.68	74.00	-30.32	Peak
4	6160.0160	47.09	74.00	-26.91	Peak
5	11405.0405	49.63	74.00	-24.37	Peak
6	17160.1160	51.60	74.00	-22.40	Peak

Note: 1. If Peak Result complies with AV limit, AV Result is deemed to comply with AV limit.
2. Peak: Peak detector.
3. AVG: $VBW=1/T$, T is On Time (transmit duration)
4. For transmit duration, please refer to clause 7.1.

7.3. SPURIOUS EMISSIONS 18G ~ 26GHz

SPURIOUS EMISSIONS (MID CHANNEL, WORST-CASE CONFIGURATION, HORIZONTAL)

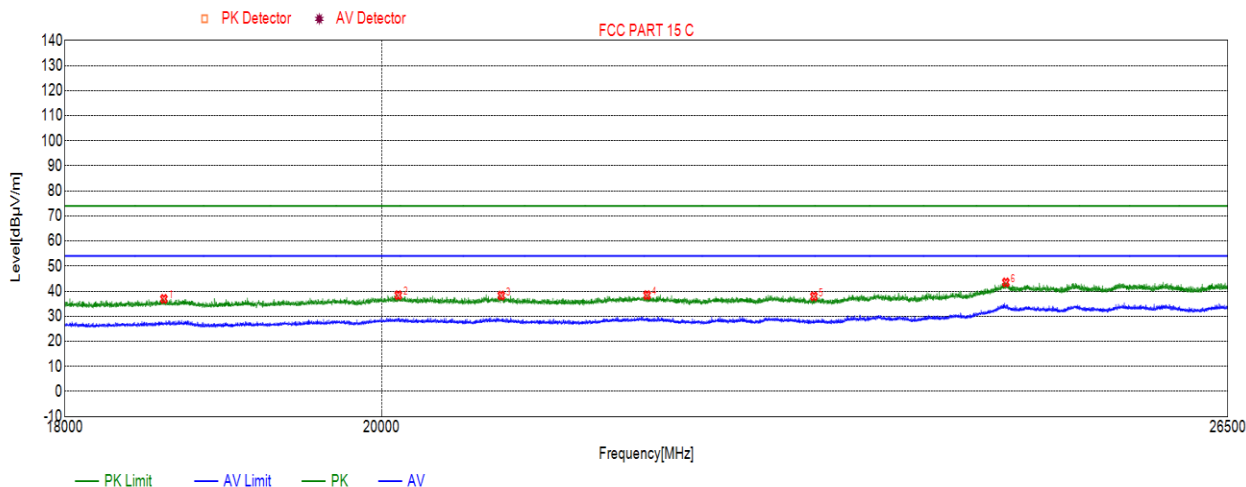


No.	Frequency (MHz)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	18777.8278	36.59	74.00	-37.41	Peak
2	20152.4152	37.96	74.00	-36.04	Peak
3	21794.7795	38.19	74.00	-35.81	Peak
4	23648.8149	39.17	74.00	-34.83	Peak
5	24806.6307	42.91	74.00	-31.09	Peak
6	25808.8809	43.11	74.00	-30.89	Peak

Note: 1. If Peak Result complies with AV limit, AV Result is deemed to comply with AV limit.
2. Peak: Peak detector.
3. All the modes had been tested, but only the worst data were recorded in the report.



SPURIOUS EMISSIONS (MID CHANNEL, WORST-CASE CONFIGURATION, VERTICAL)



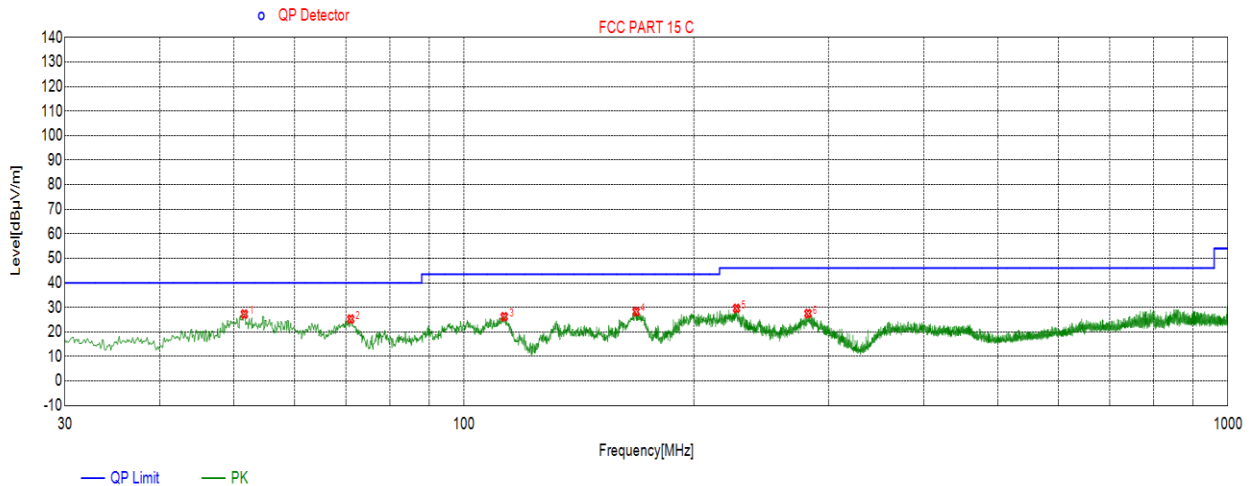
No.	Frequency (MHz)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	18602.7103	36.91	74.00	-37.09	Peak
2	20110.7611	38.38	74.00	-35.62	Peak
3	20812.0812	38.25	74.00	-35.75	Peak
4	21845.7846	38.41	74.00	-35.59	Peak
5	23092.0092	37.91	74.00	-36.09	Peak
6	24614.5115	43.48	74.00	-30.52	Peak

Note: 1. If Peak Result complies with AV limit, AV Result is deemed to comply with AV limit.
2. Peak: Peak detector.
3. All the modes had been tested, but only the worst data were recorded in the report.



7.4. SPURIOUS EMISSIONS 30M ~ 1 GHz

SPURIOUS EMISSIONS (MID CHANNEL, WORST-CASE CONFIGURATION, HORIZONTAL)

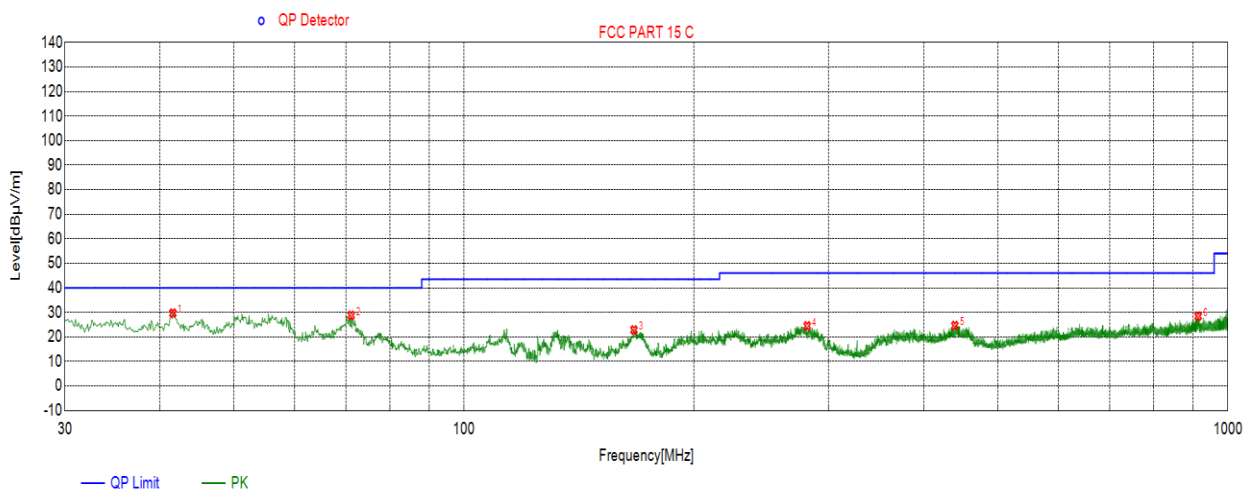


No.	Frequency (MHz)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	51.5362	27.27	40.00	-12.73	QP
2	71.0351	25.24	40.00	-14.76	QP
3	112.8463	26.20	43.50	-17.30	QP
4	167.9478	28.26	43.50	-15.24	QP
5	227.3177	29.58	46.00	-16.42	QP
6	282.0312	27.48	46.00	-18.52	QP

Note: 1. If Peak Result complies with AV limit, AV Result is deemed to comply with AV limit.
2. Peak: Peak detector.
3. All the modes had been tested, but only the worst data were recorded in the report.



SPURIOUS EMISSIONS (MID CHANNEL, WORST-CASE CONFIGURATION, VERTICAL)

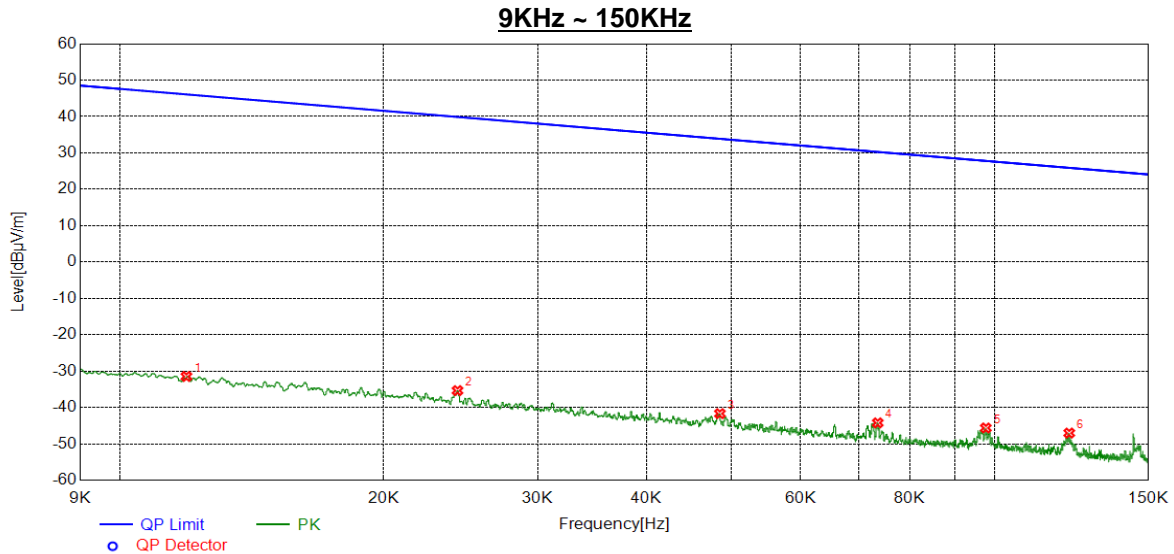


No.	Frequency (MHz)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	41.5442	29.71	40.00	-10.29	QP
2	71.1321	28.79	40.00	-11.21	QP
3	166.8807	22.84	43.50	-20.66	QP
4	281.3521	24.50	46.00	-21.50	QP
5	439.1869	24.63	46.00	-21.37	QP
6	914.4374	28.43	46.00	-17.57	QP

Note: 1. If Peak Result complies with AV limit, AV Result is deemed to comply with AV limit.
2. Peak: Peak detector.
3. All the modes had been tested, but only the worst data were recorded in the report.

7.5. SPURIOUS EMISSIONS BELOW 30M

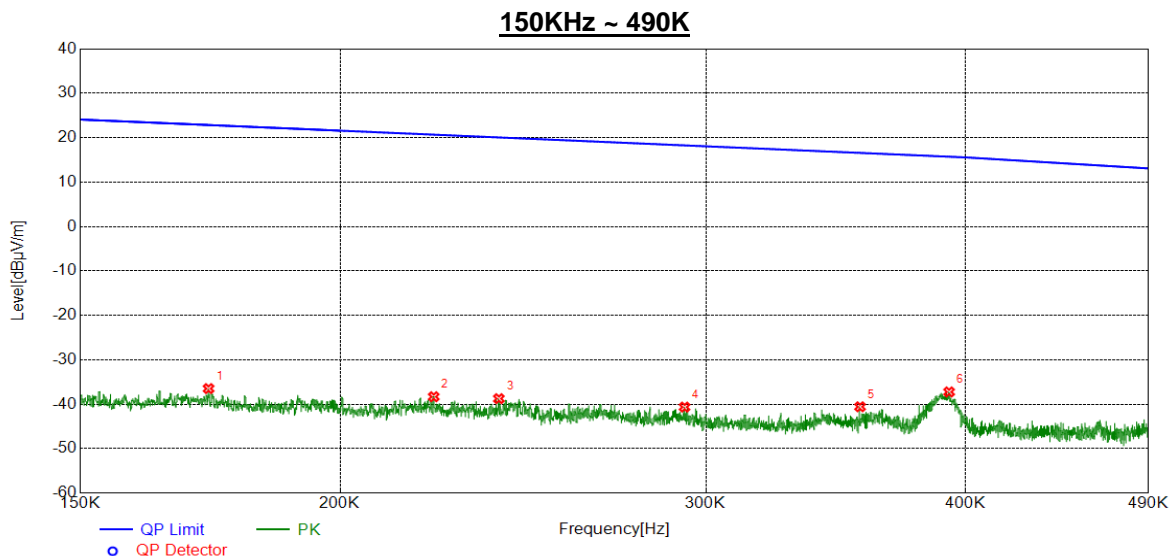
SPURIOUS EMISSIONS (MID CHANNEL, WORST-CASE CONFIGURATION)



No.	Frequency (MHz)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	0.0119	-31.48	46.05	-77.53	Peak
2	0.0243	-35.36	39.88	-75.24	Peak
3	0.0485	-41.69	33.88	-75.57	Peak
4	0.0735	-44.23	30.27	-74.50	Peak
5	0.0977	-45.64	27.80	-73.44	Peak
6	0.1217	-47.04	25.90	-72.94	Peak

Note:

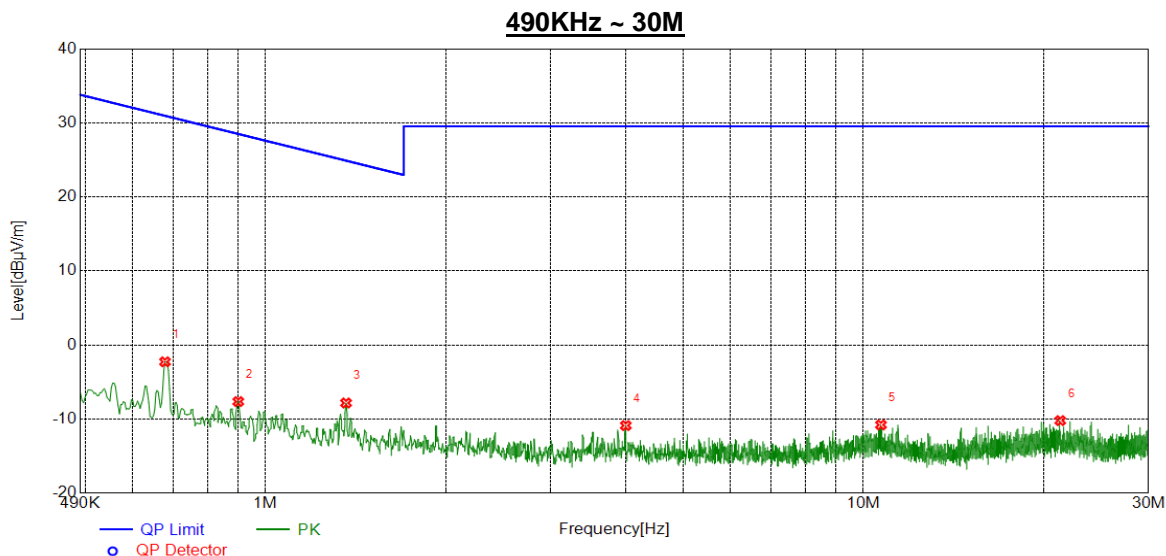
1. All the modes had been tested, but only the worst data were recorded in the report.
2. If Peak Result complies with AV and QP limit, AV and QP Result are deemed to comply with AV limit.



No.	Frequency (MHz)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	0.1729	-36.48	22.85	-59.33	Peak
2	0.2219	-38.31	20.68	-58.99	Peak
3	0.2385	-38.74	20.05	-58.79	Peak
4	0.2930	-40.64	18.27	-58.91	Peak
5	0.3559	-40.57	16.58	-57.15	Peak
6	0.3928	-37.23	15.72	-52.95	Peak

Note:

1. All the modes had been tested, but only the worst data were recorded in the report.
2. If Peak Result complies with AV and QP limit, AV and QP Result are deemed to comply with AV limit.



No.	Frequency (MHz)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	0.6789	-2.27	30.97	-33.24	Peak
2	0.9002	-7.64	28.52	-36.16	Peak
3	1.3636	-7.83	24.91	-32.74	Peak
4	4.0050	-10.88	29.54	-40.42	Peak
5	10.7015	-10.79	29.54	-40.33	Peak
6	21.3439	-10.21	29.54	-39.75	Peak

Note:

1. All the modes had been tested, but only the worst data were recorded in the report.
2. If Peak Result complies with AV and QP limit, AV and QP Result are deemed to comply with AV limit.

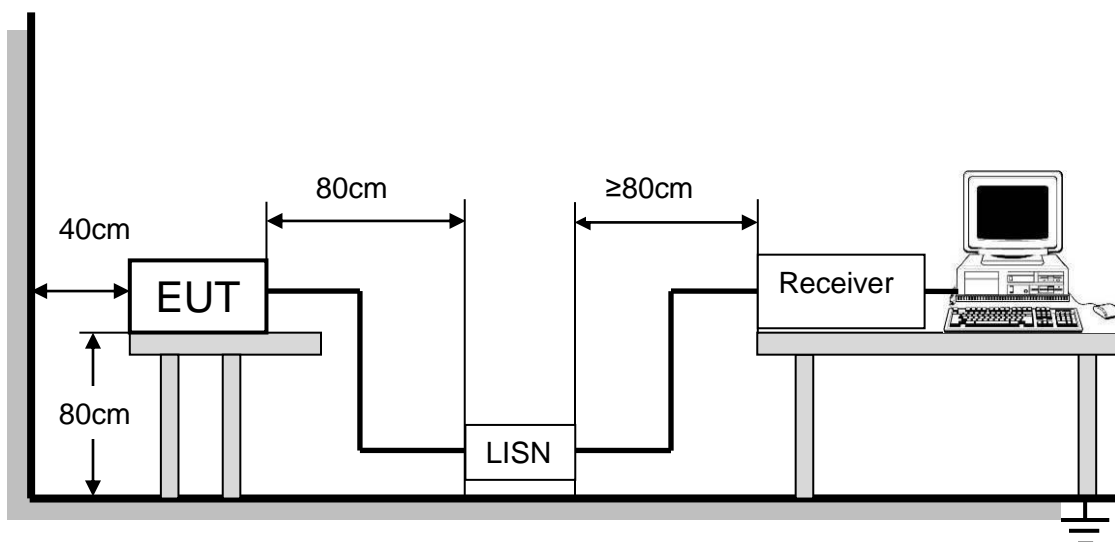
8. AC POWER LINE CONDUCTED EMISSIONS

LIMITS

Please refer to FCC §15.207 (a)

FREQUENCY (MHz)	Class A (dBuV)		Class B (dBuV)	
	Quasi-peak	Average	Quasi-peak	Average
0.15 -0.5	79.00	66.00	66 - 56 *	56 - 46 *
0.50 -5.0	73.00	60.00	56.00	46.00
5.0 -30.0	73.00	60.00	60.00	50.00

TEST SETUP AND PROCEDURE



The EUT is put on a table of non-conducting material that is 80cm high. The vertical conducting wall of shielding is located 40cm to the rear of the EUT. The power line of the EUT is connected to the AC mains through a Artificial Mains Network (A.M.N.). A EMI Measurement Receiver (R&S Test Receiver ESR3) is used to test the emissions from both sides of AC line. According to the requirements in Section 6.2 of ANSI C63.10-2013. Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30MHz using CISPR Quasi-Peak and average detector mode. The bandwidth of EMI test receiver is set at 9kHz.

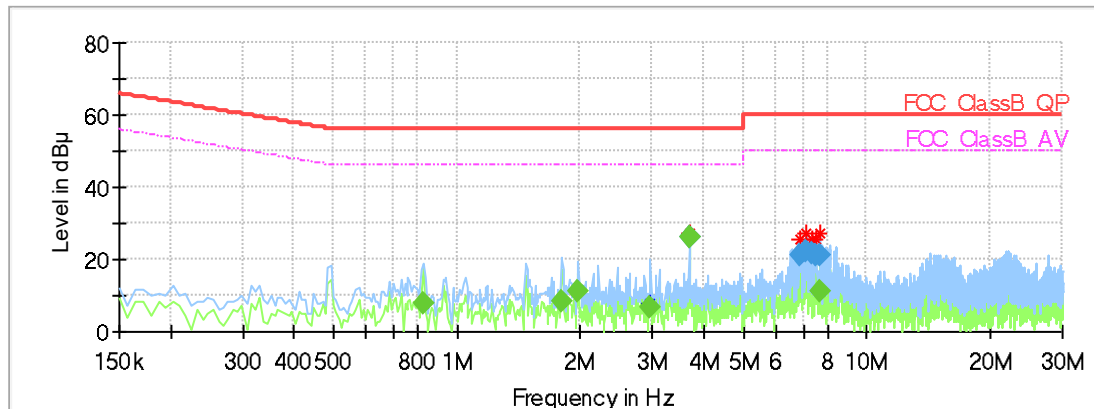
The arrangement of the equipment is installed to meet the standards and operating in a manner, which tends to maximize its emission characteristics in a normal application.



Test Result Table:
For 9KHz-30MHz (worst case)

Test Mode	Test Antenna	Channel	Puw(dBm)	Verdict
BLE	Antenna 1	HCH	<Limit	PASS

TEST RESULTS (WORST-CASE CONFIGURATION)



Final_Result

Frequency (MHz)	QuasiPeak (dB μ V)	Average (dB μ V)	Limit (dB μ V)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.829088	---	7.90	46.00	38.10	1000.0	9.000	L1	OFF	9.6
1.806675	---	8.28	46.00	37.72	1000.0	9.000	L1	OFF	9.7
1.978313	---	11.03	46.00	34.97	1000.0	9.000	L1	OFF	9.7
2.970825	---	6.65	46.00	39.35	1000.0	9.000	N	OFF	9.7
3.694688	---	25.98	46.00	20.02	1000.0	9.000	L1	OFF	9.7
3.694688	25.90	---	56.00	30.10	1000.0	9.000	L1	OFF	9.7
6.851325	21.09	---	60.00	38.91	1000.0	9.000	N	OFF	9.8
7.127438	22.04	---	60.00	37.96	1000.0	9.000	N	OFF	9.8
7.388625	21.74	---	60.00	38.26	1000.0	9.000	N	OFF	9.8
7.508025	21.20	---	60.00	38.80	1000.0	9.000	N	OFF	9.8
7.687125	---	11.07	50.00	38.93	1000.0	9.000	N	OFF	9.8
7.687125	21.23	---	60.00	38.77	1000.0	9.000	N	OFF	9.8

(continuation of the "Final_Result" table from column 15 ...)

- Note: 1. If QP Result complies with AV limit, AV Result is deemed to comply with AV limit.
2. Test setup: RBW: 200 Hz (9 kHz—150 kHz), 9 kHz (150 kHz—30 MHz).
3. Step size: 80Hz (0.009MHz-0.15MHz), 4 kHz (0.15MHz-30MHz), Scan time: auto.

9. ANTENNA REQUIREMENTS

Applicable requirements

Please refer to FCC §15.203

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 a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

Please refer to FCC §15.247(b)(4)

The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

Antenna Connector

EUT has two Dipole Antennas with a PIFA PCB Antenna, only antenna 1 support BT mode..

Antenna Gain

The antenna gain of EUT is less than 6 dBi.

END OF REPORT