



FCC 47 CFR PART 15 SUBPART C

CERTIFICATION TEST REPORT

For

TaroVR

MODEL NUMBER: TaroVR I

PROJECT NUMBER: 4788148204

REPORT NUMBER: 4788148204-1

FCC ID: 2AQ7D-TARO-VR001

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Prepared for

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Prepared by

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Revision History

<u>Rev.</u>	<u>Issue Date</u>	<u>Revisions</u>	<u>Revised By</u>
--	09/24/2018	Initial Issue	

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1. ATTESTATION OF TEST RESULTS

Applicant Information

Company Name: HANGZHOU TARUO INFORMATION TECHNOLOGY LLC.
Address: A703 HUAXING SHIDAIGUANGCHANG, NO.478, WENSAN RD,
HANGZHOU, CHINA

Manufacturer Information

Company Name: WESTLAKE ELETRONIC
Address: NO.23, NUMBER 10 RD, ECONOMIC DEVELOPMENT ZONE,
HANGZHOU

Factory Information

Company Name: WESTLAKE ELETRONIC
Address: NO.23, NUMBER 10 RD, ECONOMIC DEVELOPMENT ZONE,
HANGZHOU

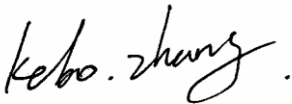
EUT Description

Product Name TaroVR
Model Name TaroVR I
Sample ID 1179290
Sample Received date Dec .7, 2017
Date Tested May 10~May 20, 2018

APPLICABLE STANDARDS	
STANDARD	TEST RESULTS
CFR 47 Part 15 Subpart C	PASS

Summary of Test Results			
Clause	Test Items	FCC Rules	Test Results
1	6db DTS Bandwidth	FCC 15.247 (a) (2)	Complied
2	Peak Conducted Power	FCC 15.247 (b) (3)	Complied
3	Power Spectral Density	FCC 15.247 (e)	Complied
4	Conducted Band edge And Spurious emission	FCC 15.247 (d)	Complied
5	Radiated Band edges and Spurious emission	FCC 15.247 (d) FCC 15.209 FCC 15.205	Complied
6	Conducted Emission Test For AC Power Port	FCC 15.207	Complied
7	Antenna Requirement	FCC 15.203	Complied

Tested By:



Kebo Zhang
Engineer

Checked By:



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 v01, ANSI C63.10-2013, KDB558074 D01 DTS Meas Guidance v04, FCC CFR 47 Part 2, FCC CFR 47 Part 15.

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	UL Verification Services (Guangzhou) Co., Ltd. Song Shan Lake Branch. EMC Laboratory has been accredited by A2LA for technical competence in the field of electrical testing, and proved to be in compliance with ISO/IEC 17025: 2005 General Requirements for the Competence of Testing and Calibration Laboratories and any additional program requirements in the identified field of testing. The Certificate Registration Number is 4102.01. UL Verification Services (Guangzhou) Co., Ltd. Song Shan Lake Branch. EMC Laboratory has been registered and fully described in a report filed with the FCC (Federal Communications Commission). The Designation Number is CN1187. UL Verification Services (Guangzhou) Co., Ltd. Song Shan Lake Branch. EMC Laboratory has been registered and fully described in a report filed with Industry Canada. The Company Number is 21320.

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	TaroVR		
Model Name	TaroVR I		
Product Description	Operation Frequency	2402 MHz ~ 2480 MHz	
	Modulation Type	Data Rate	
	GFSK	1Mbps	
Power Supply	DC3.7V		
Bluetooth Version	BT 4.1LE Remark: This test report just include the data of the BLE mode		
Hardware Version	V1.0		
Software Version	V1.2		

5.2. MAXIMUM OUTPUT POWER

Bluetooth Mode	Frequency (MHz)	Channel Number	Max Output Power (dBm)	EIRP (dBm)
BLE	2402-2480	0-39[40]	-1.488	-1.488

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

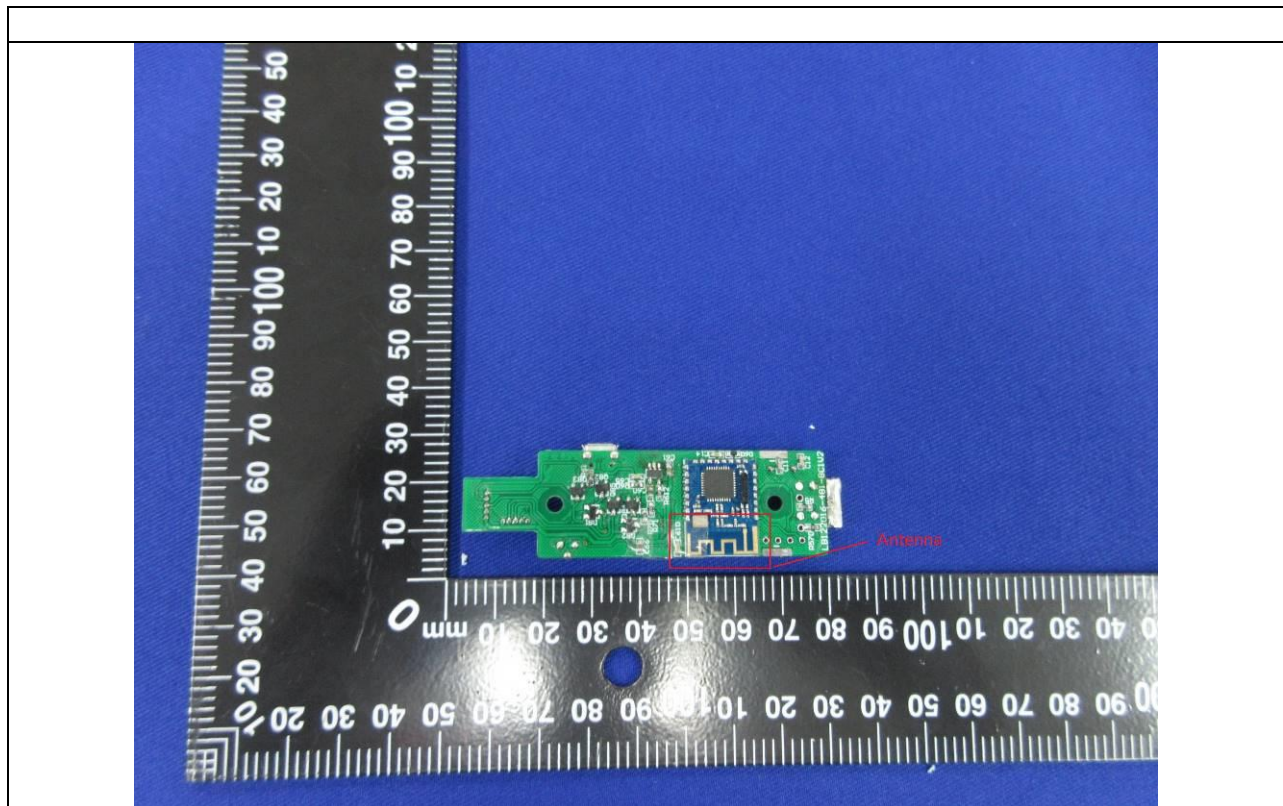
5.5. THE WORSE CASE POWER SETTING PARAMETER

The Worst Case Power Setting Parameter under 2400 ~ 2483.5MHz Band				
Test Software		SmartRF Studio7		
Modulation Type	Transmit Antenna Number	Test Channel		
		CH 00	CH 19	CH 39
GFSK	1	0	0	0

5.6. DESCRIPTION OF AVAILABLE ANTENNAS

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

Test Mode	Transmit and Receive Mode	Description
GFSK	1TX, 1RX	The antenna 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:	1025Pa	
Temperature	TN	23 ~ 28°C
Voltage :	VL	N/A
	VN	DC 3.7V
	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

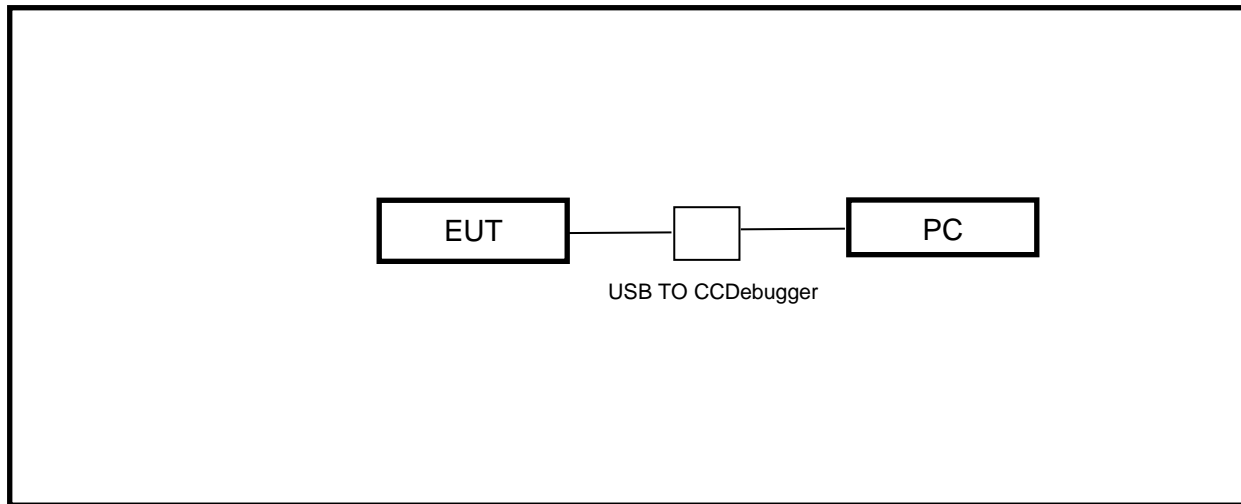
SUPPORT EQUIPMENT

Item	Equipment	Brand Name	Model Name	P/N
1	Laptop	ThinkPad	E550c	N/A
2	Fixed Frequency Board	Supply by customer	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	Manufacturer	Model No.	Serial No.	Upper Last Cal.	Last Cal.	Next Cal.
<input checked="" type="checkbox"/>	EMI Test Receiver	R&S	ESR3	101961	Dec.20, 2016	Dec.12, 2017	Dec.11, 2018
<input checked="" type="checkbox"/>	Two-Line V-Network	R&S	ENV216	101983	Dec.20, 2016	Dec.12, 2017	Dec.11, 2018
<input checked="" type="checkbox"/>	Artificial Mains Networks	Schwarzbeck	NSLK 8126	8126465	Feb.10, 2017	Dec.12, 2017	Dec.11, 2018
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	Manufacturer	Model No.	Serial No.	Upper Last Cal.	Last Cal.	Next Cal.
<input checked="" type="checkbox"/>	MXE EMI Receiver	KESIGHT	N9038A	MY56400036	Dec.12, 2017	Dec.12, 2017	Dec.11, 2018
<input checked="" type="checkbox"/>	Hybrid Log Periodic Antenna	TDK	HLP-3003C	130960	Jan.09, 2016	Jan.09, 2016	Jan.08, 2019
<input checked="" type="checkbox"/>	Preamplifier	HP	8447D	2944A09099	Dec.12, 2017	Dec.12, 2017	Dec.11, 2018
<input checked="" type="checkbox"/>	EMI Measurement Receiver	R&S	ESR26	101377	Dec.12, 2017	Dec.12, 2017	Dec.11, 2018
<input checked="" type="checkbox"/>	Horn Antenna	TDK	HRN-0118	130939	Jan. 09, 2016	Jan. 09, 2016	Jan. 08, 2019
<input checked="" type="checkbox"/>	High Gain Horn Antenna	Schwarzbeck	BBHA-9170	691	Jan.06, 2016	Jan.06, 2016	Jan.05, 2019
<input checked="" type="checkbox"/>	Preamplifier	TDK	PA-02-0118	TRS-305-00066	Dec.12, 2017	Dec.12, 2017	Dec.11, 2018
<input checked="" type="checkbox"/>	Preamplifier	TDK	PA-02-2	TRS-307-00003	Dec.12, 2017	Dec.12, 2017	Dec.11, 2018
<input checked="" type="checkbox"/>	Loop antenna	Schwarzbeck	1519B	00008	Mar. 26, 2016	Mar. 26, 2016	Mar. 25, 2019
<input checked="" type="checkbox"/>	Band Reject Filter	Wainwright	WRCJV8-2350-2400-2483.5-2533.5-40SS	4	Dec.12, 2017	Dec.11, 2018	Dec.10, 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	Manufacturer	Model No.	Serial No.	Upper Last Cal.	Last Cal.	Next Cal.
<input checked="" type="checkbox"/>	Spectrum Analyzer	Keysight	N9030A	MY55410512	Dec.20, 2016	Dec.12, 2017	Dec.11, 2018
<input checked="" type="checkbox"/>	Power Meter	Keysight	N9031A	MY55416024	Feb.13, 2017	Dec.12, 2017	Dec.11, 2018
<input checked="" type="checkbox"/>	Power Sensor	Keysight	N9323A	MY55440013	Feb.13, 2017	Dec.12, 2017	Dec.11, 2018

6. MEASUREMENT METHODS

No.	Test Item	KDB Name	Section
1	6 dB Bandwidth	KDB 558074 D01 DTS Meas Guidance v04	8.0
2	Peak Output Power	KDB 558074 D01 DTS Meas Guidance v04	9.1.1
3	Power Spectral Density	KDB 558074 D01 DTS Meas Guidance v04	10.2
4	Out-of-band emissions in non-restricted bands	KDB 558074 D01 DTS Meas Guidance v04	11.0
5	Out-of-band emissions in restricted bands	KDB 558074 D01 DTS Meas Guidance v04	12.1
6	Band-edge	KDB 558074 D01 DTS Meas Guidance v04	13.3.2
7	Conducted Emission Test For AC Power Port	ANSI C63.10-2013	7.3

7. ANTENNA PORT TEST RESULTS

7.1. ON TIME AND DUTY CYCLE

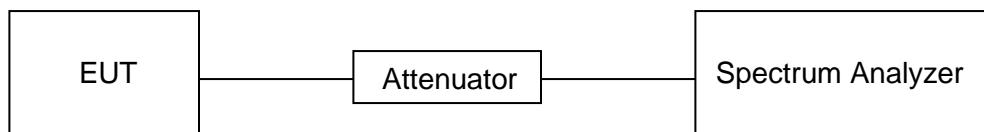
LIMITS

None; for reporting purposes only

PROCEDURE

KDB 558074 Zero-Span Spectrum Analyzer Method

TEST SETUP

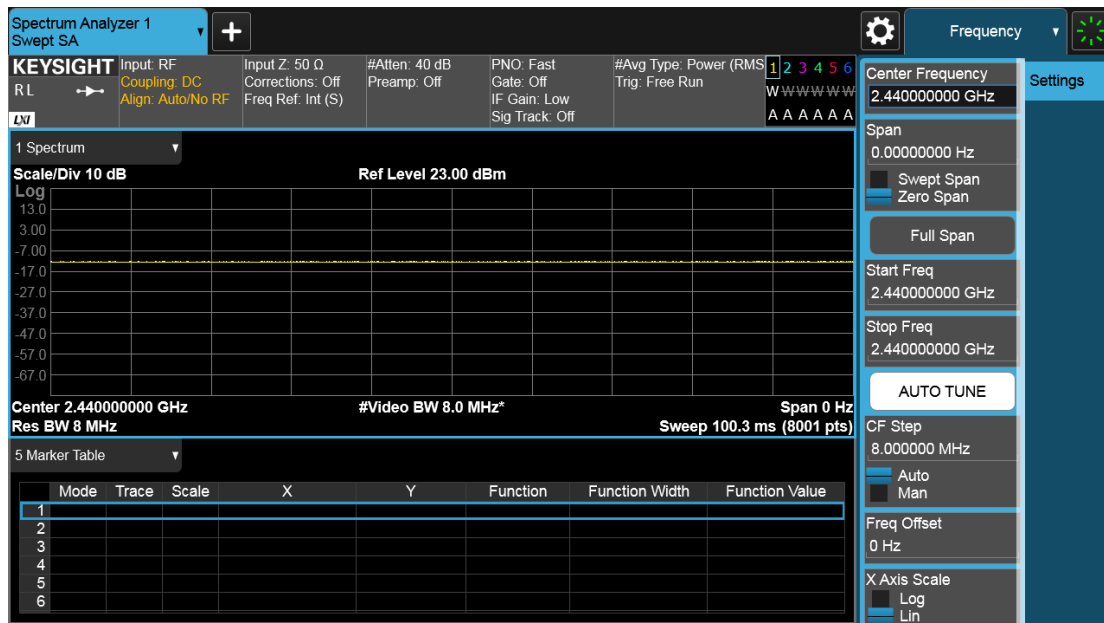


RESULTS

Mode	On Time (msec)	Period (msec)	Duty Cycle x (Linear)	Duty Cycle (%)	Duty Cycle Correction Factor (db)	1/T Minimum VBW (KHz)
BLE	100	100	1	100	0	0.01

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

ON TIME AND DUTY CYCLE MID CH



7.2. 6 dB DTS BANDWIDTH

LIMITS

FCC Part15 (15.247) Subpart C			
Section	Test Item	Limit	Frequency Range (MHz)
FCC 15.247(a)(2)	6dB Bandwidth	$\geq 500\text{KHz}$	2400-2483.5

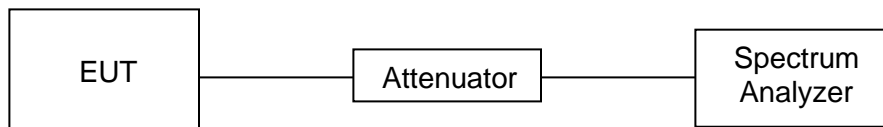
TEST PROCEDURE

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

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

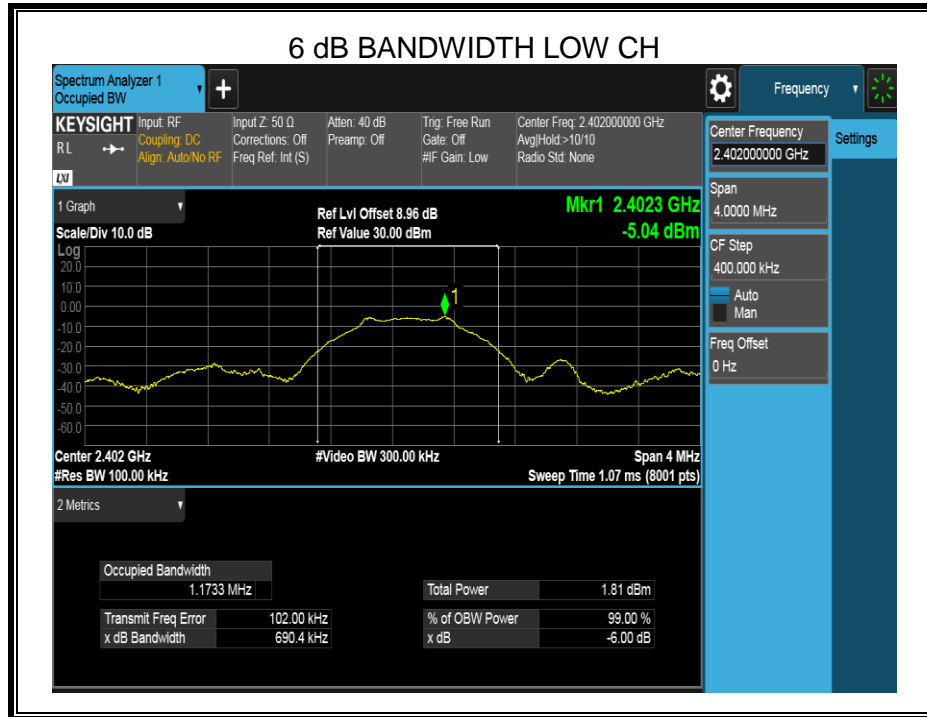
Allow the trace to stabilize and measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

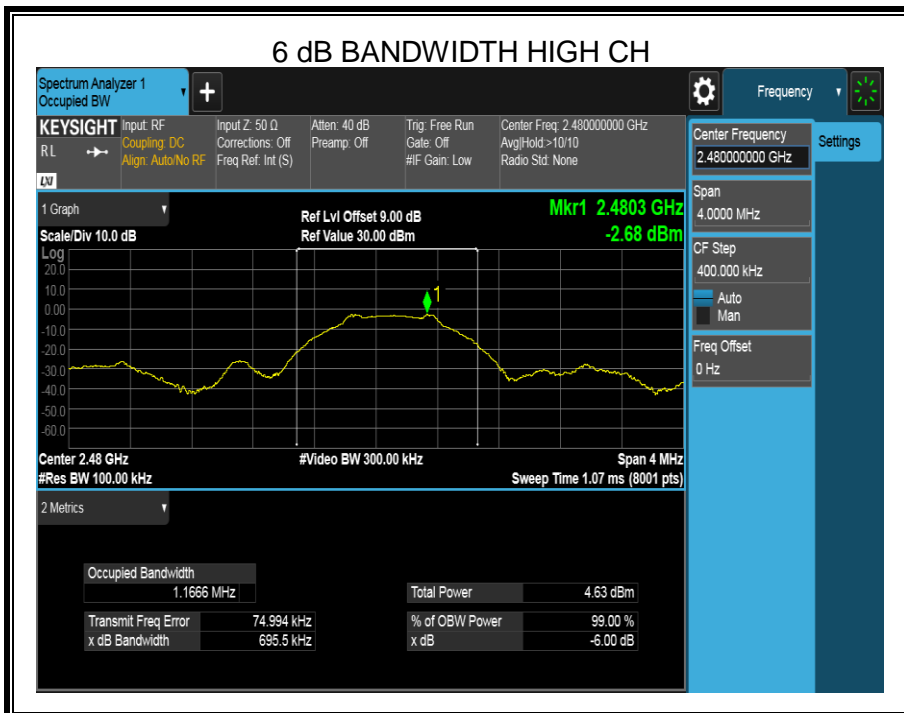
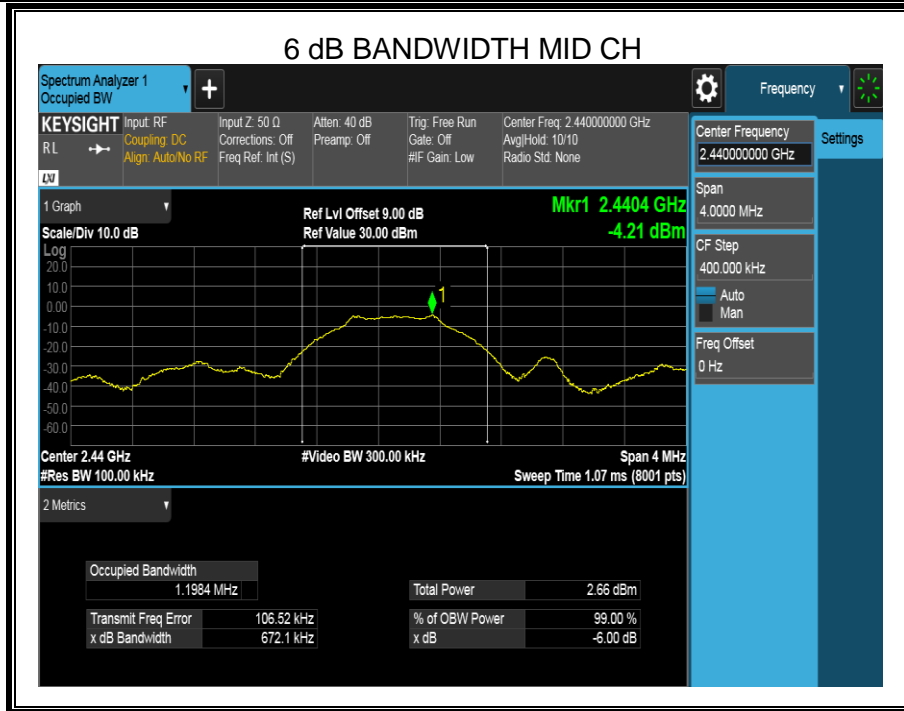
TEST SETUP



RESULTS

Channel	Frequency (MHz)	6dB bandwidth (MHz)	Limit (kHz)	Result
Low	2402	0.690	500	Pass
Middle	2440	0.672	500	Pass
High	2480	0.696	500	Pass





7.3. PEAK CONDUCTED OUTPUT POWER

LIMITS

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

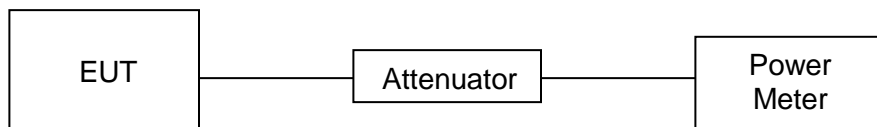
TEST PROCEDURE

Place the EUT on the table and set it in the transmitting mode.

Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the Power sensor.

Measure peak power each channel.

TEST SETUP



RESULTS

Test Channel	Frequency	Maximum Conducted Output Power(PK)	EIRP	LIMIT
	(MHz)	(dBm)	(dBm)	dBm
CH00	2402	-0.59	-0.59	30
CH19	2440	-1.11	-1.11	30
CH39	2480	-1.57	-1.57	30

Test Channel	Frequency	Maximum Conducted Output Power(AV)	EIRP	LIMIT
	(MHz)	(dBm)	(dBm)	dBm
CH00	2402	-2.77	-2.77	30
CH19	2440	-3.16	-3.16	30
CH39	2480	-3.50	-3.50	30

7.4. POWER SPECTRAL DENSITY

LIMITS

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

TEST PROCEDURE

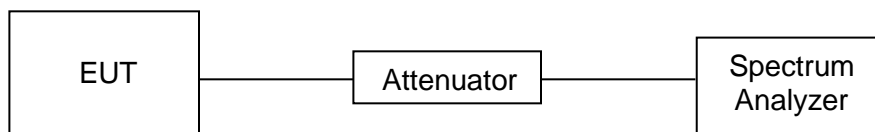
Connect the UUT to the spectrum analyser and use the following settings:

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.

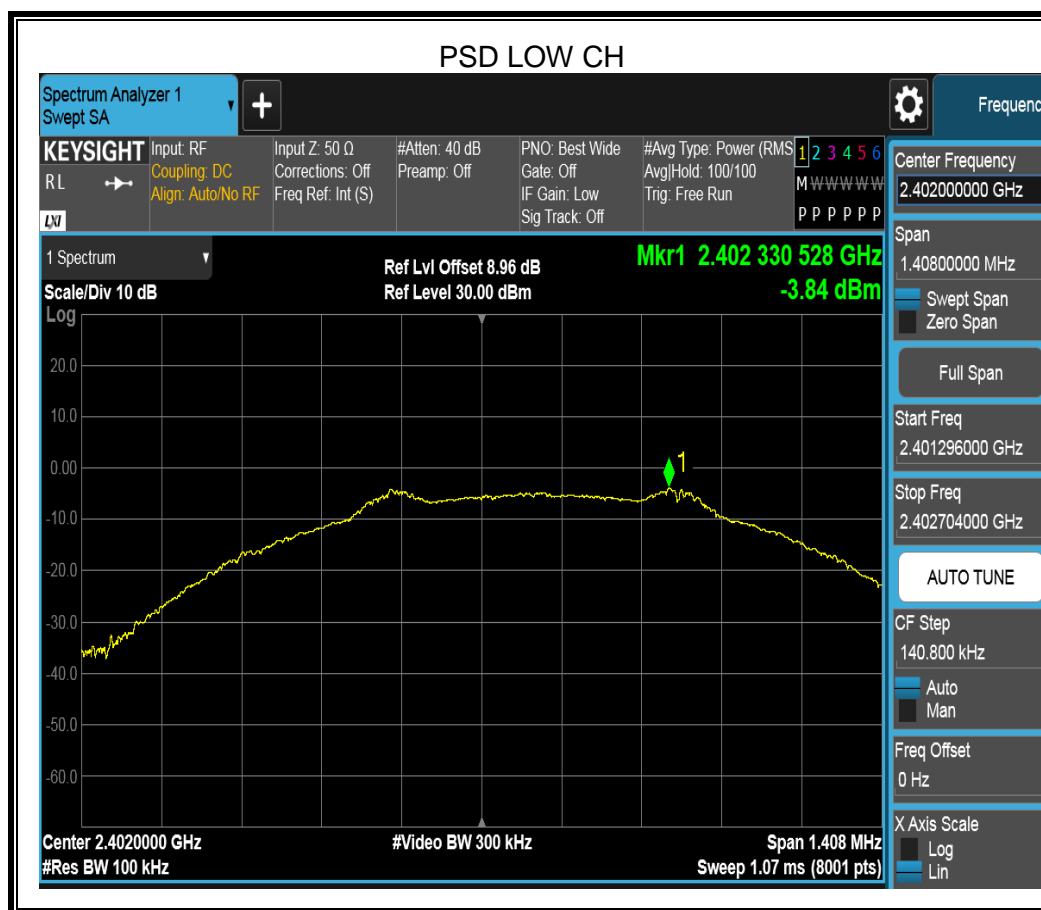
If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

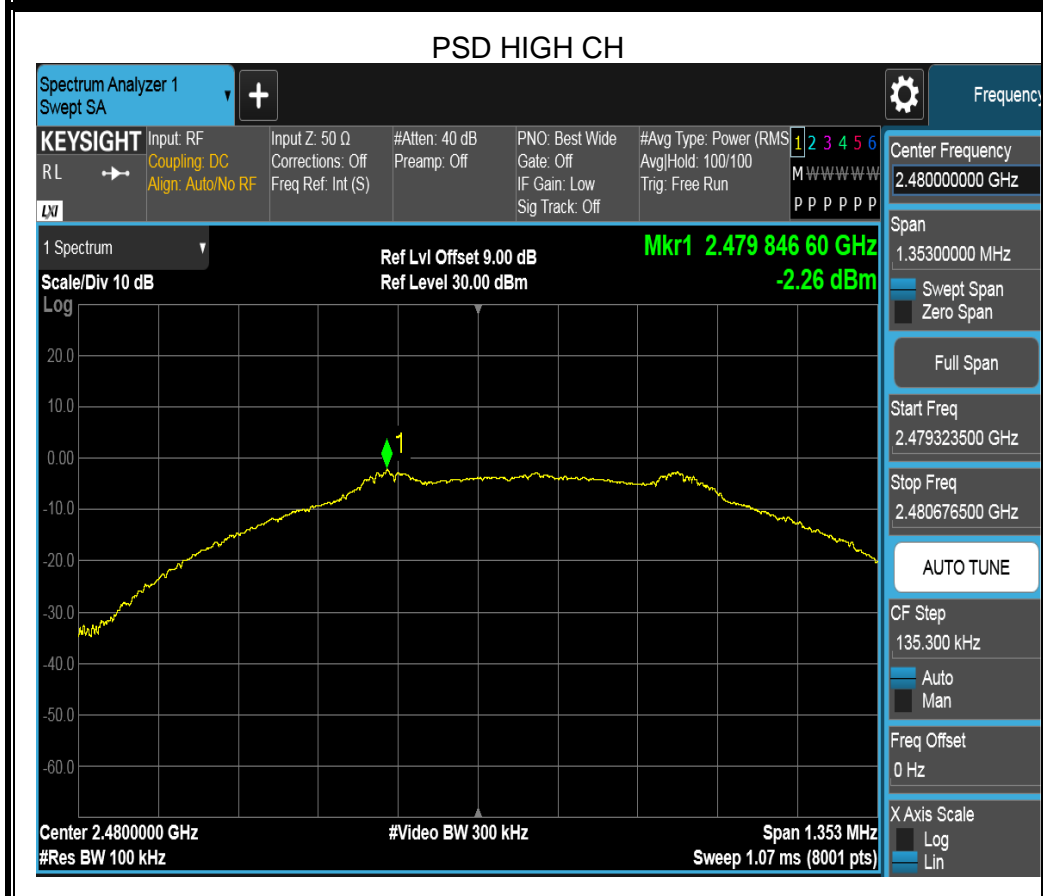
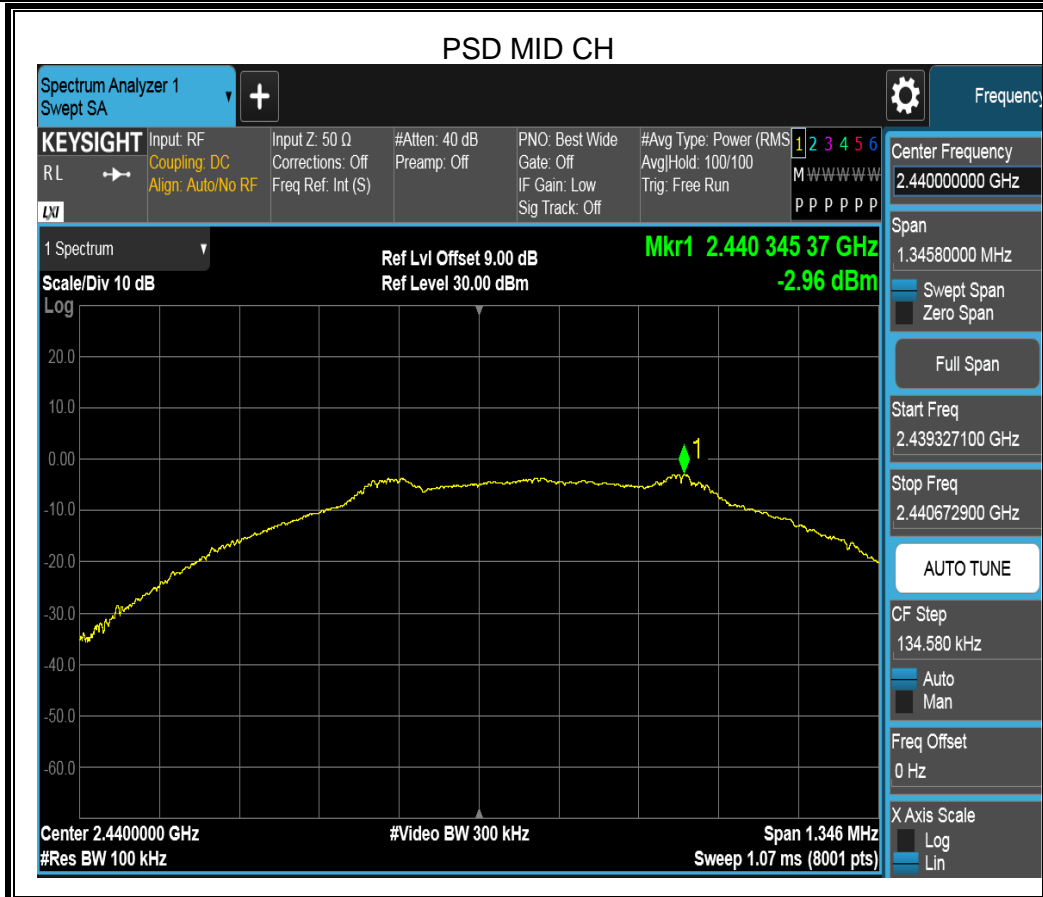
TEST SETUP



RESULTS

Frequency	Power Spectral Density (dBm/100kHz)	Limit (dBm/3kHz)	Result
2402 MHz	-3.84	8	PASS
2440 MHz	-2.96	8	PASS
2480 MHz	-2.26	8	PASS





7.5. CONDUCTED BANDEGE AND SPURIOUS EMISSIONS

LIMITS

FCC Part15 (15.247) Subpart C		
Section	Test Item	Limit
FCC §15.247 (d)	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 analyser and use the following settings:

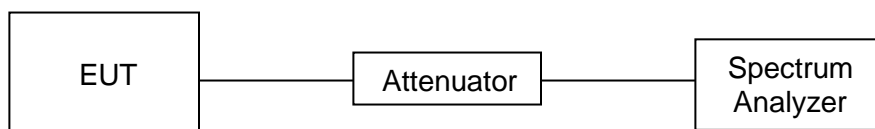
Center Frequency	The center frequency of the channel under test
Detector	Peak
RBW	100K
VBW	$\geq 3 \times \text{RBW}$
Span	1.5 x DTS bandwidth
Trace	Max hold
Sweep time	Auto couple.

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

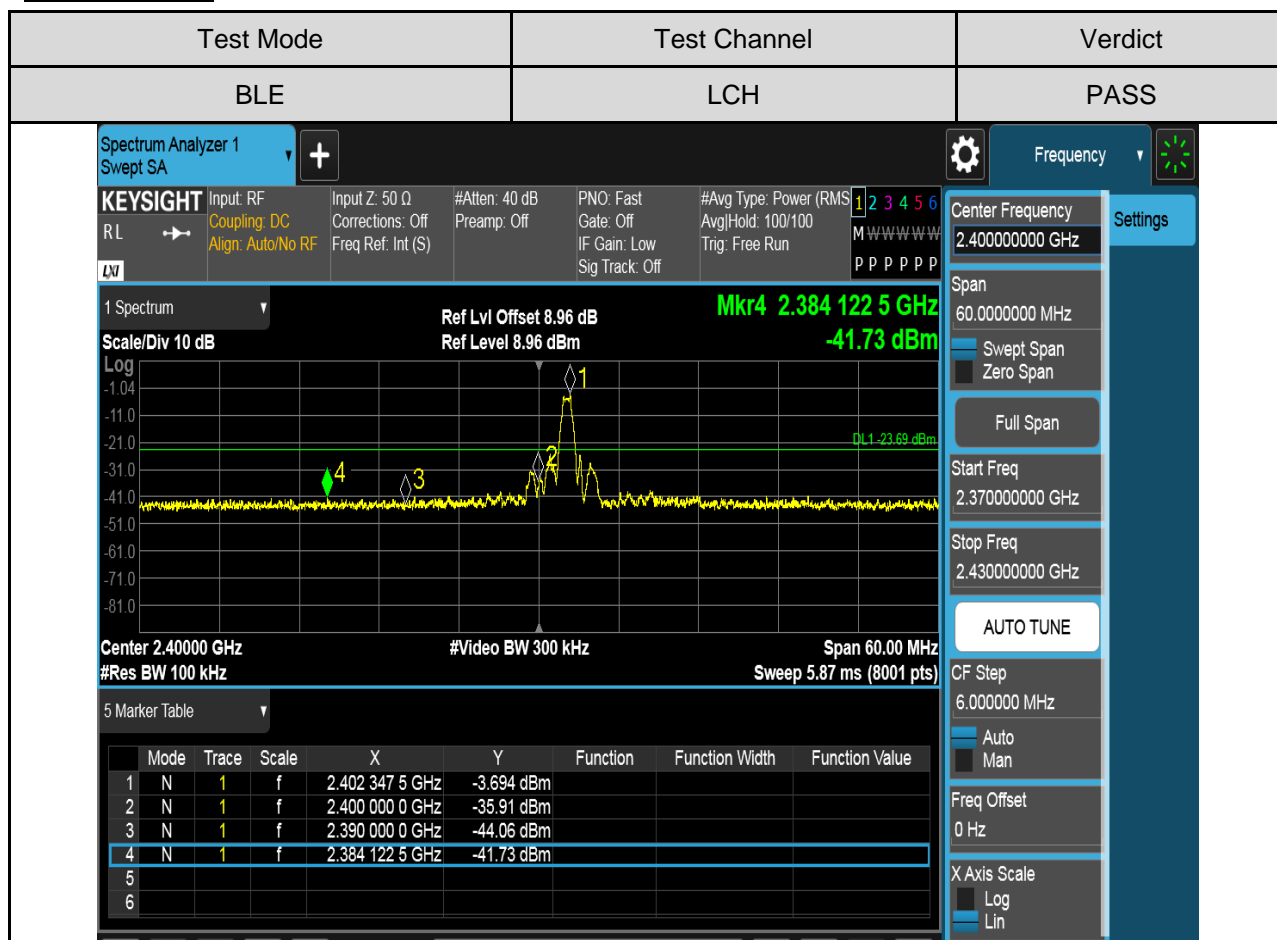


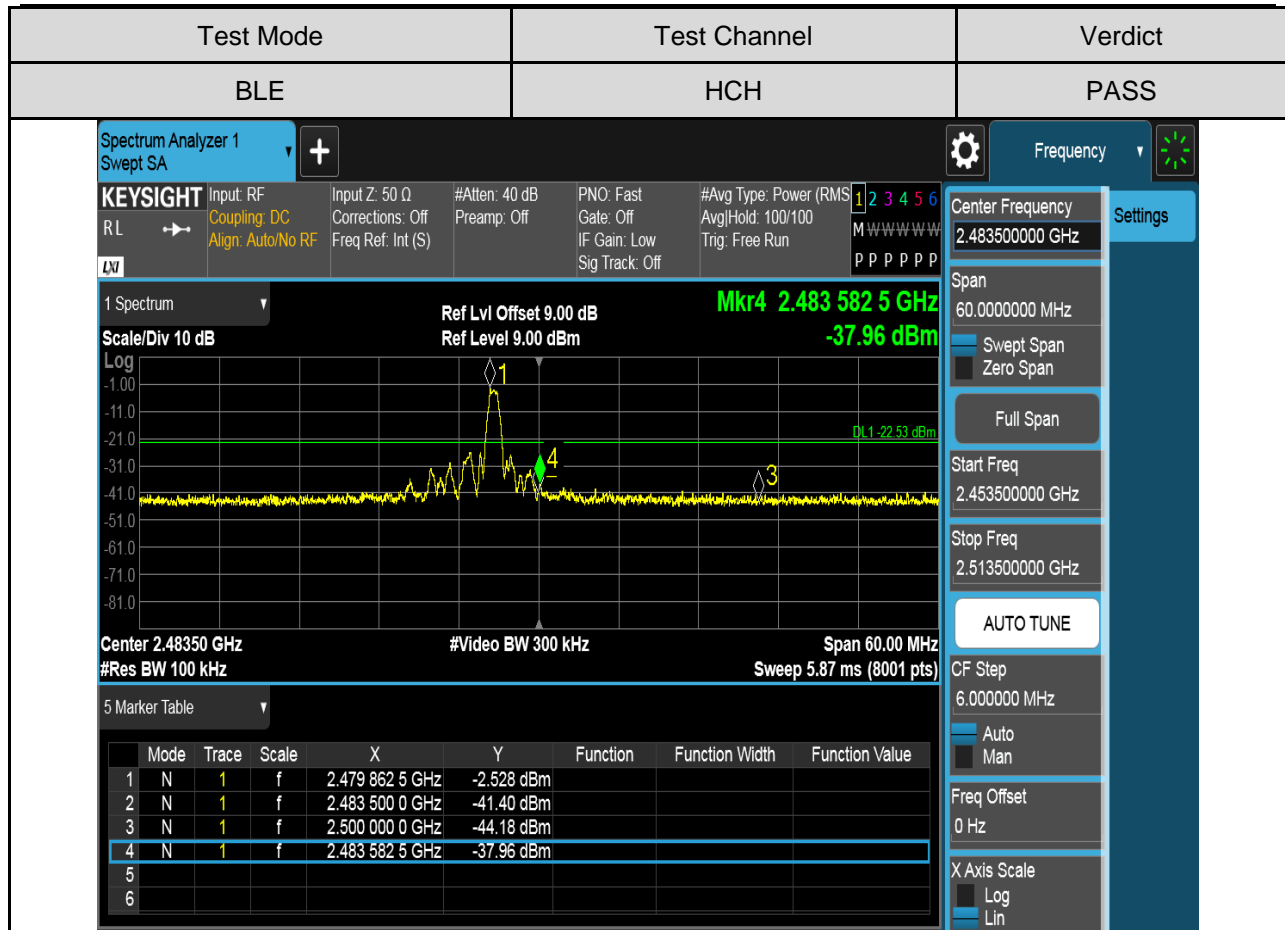
Part I :Conducted Bandedge

RESULTS TABLE

Test Mode	Test Channel	Carrier Power[dBm]	Max. Spurious Level [dBm]	Limit [dBm]	Verdict
BLE	LCH	-3.694	-41.727	-23.69	PASS
BLE	HCH	-2.528	-37.957	-22.53	PASS

TEST GRAPHS





Part II :Conducted Emission

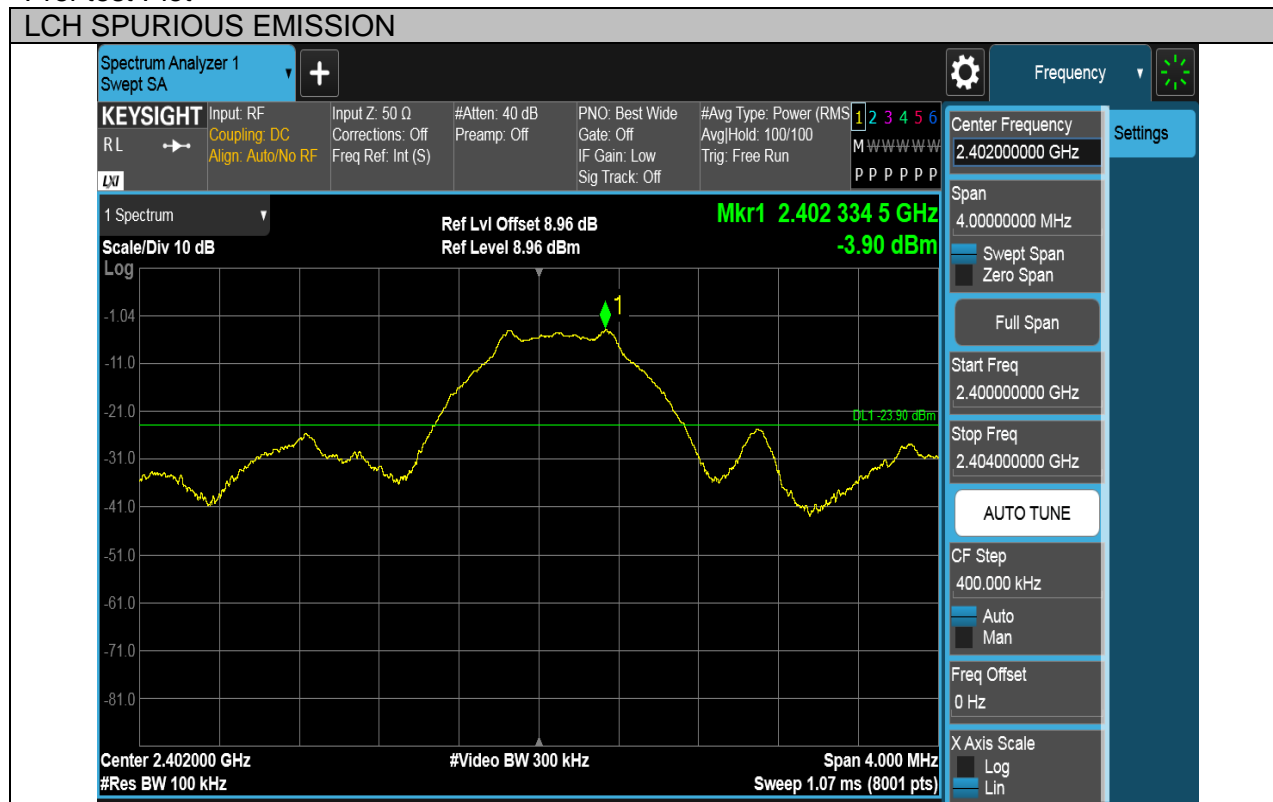
Test Result Table

Test Mode	Channel	Pref(dBm)	Puw(dBm)	Verdict
BLE	LCH	-3.90	<Limit	PASS
	MCH	-3.00	<Limit	PASS
	HCH	-2.39	<Limit	PASS

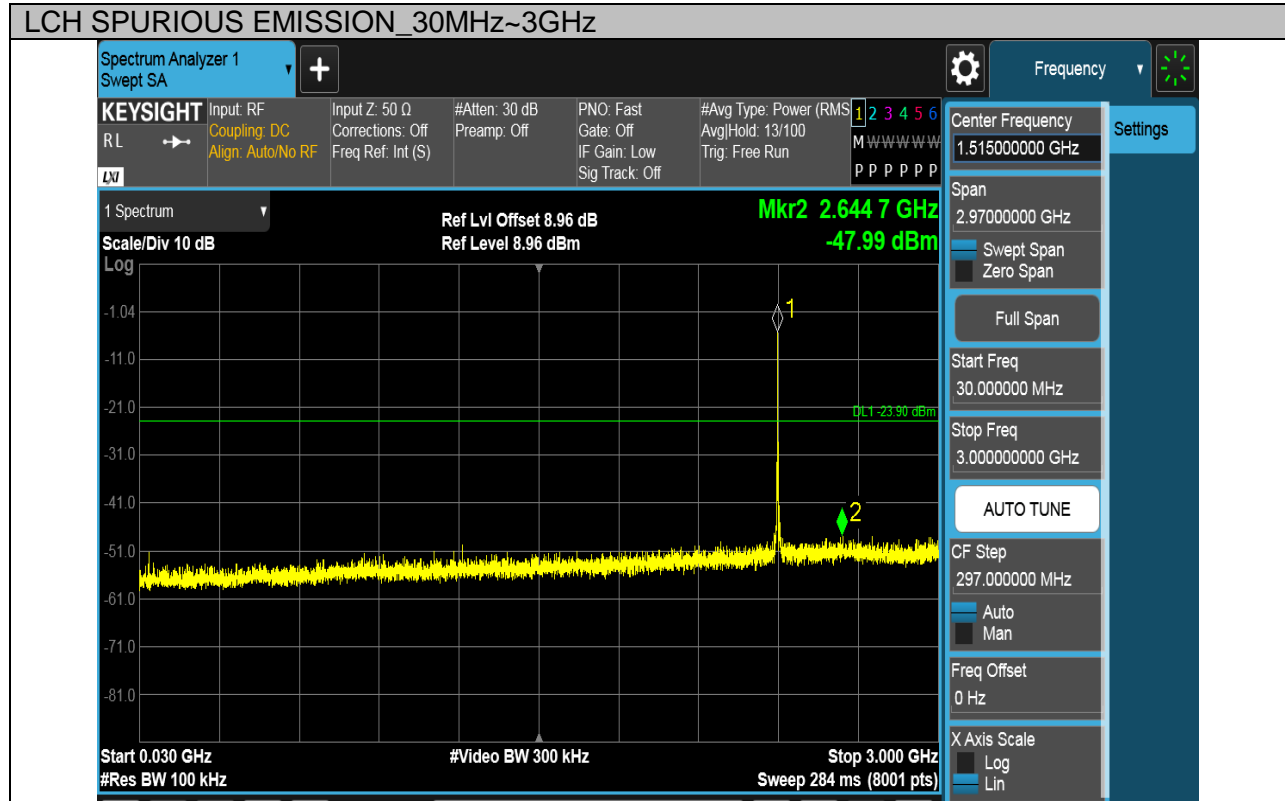
Test Plots

Test Mode	Channel	Verdict
BLE	LCH	PASS

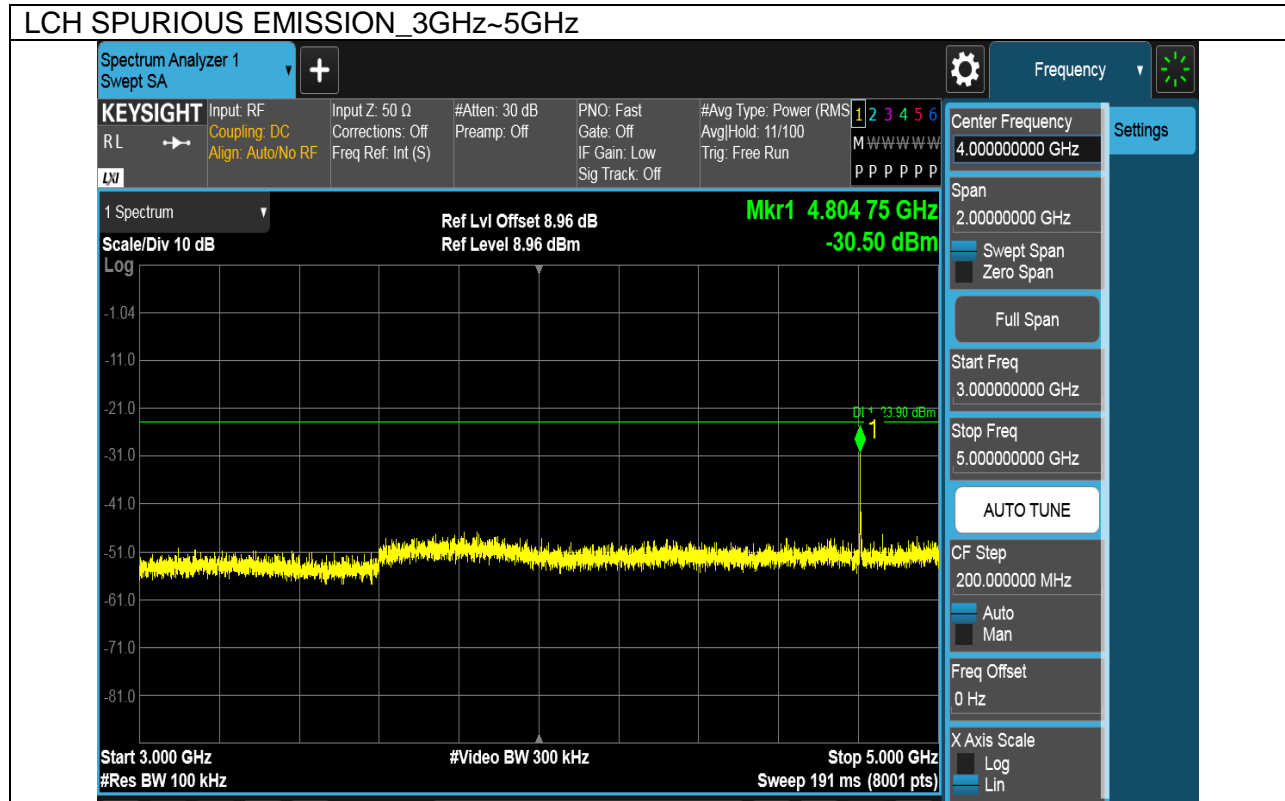
Pref test Plot



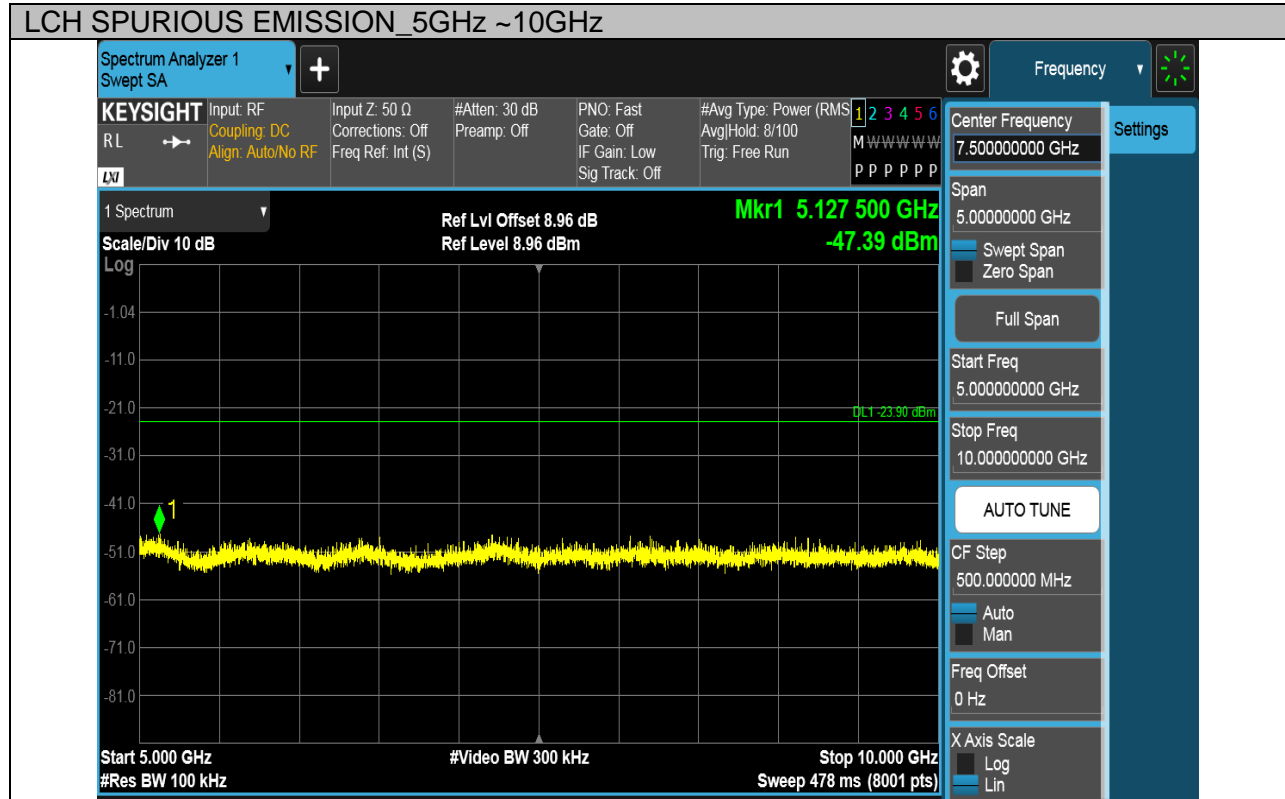
Puw test Plot



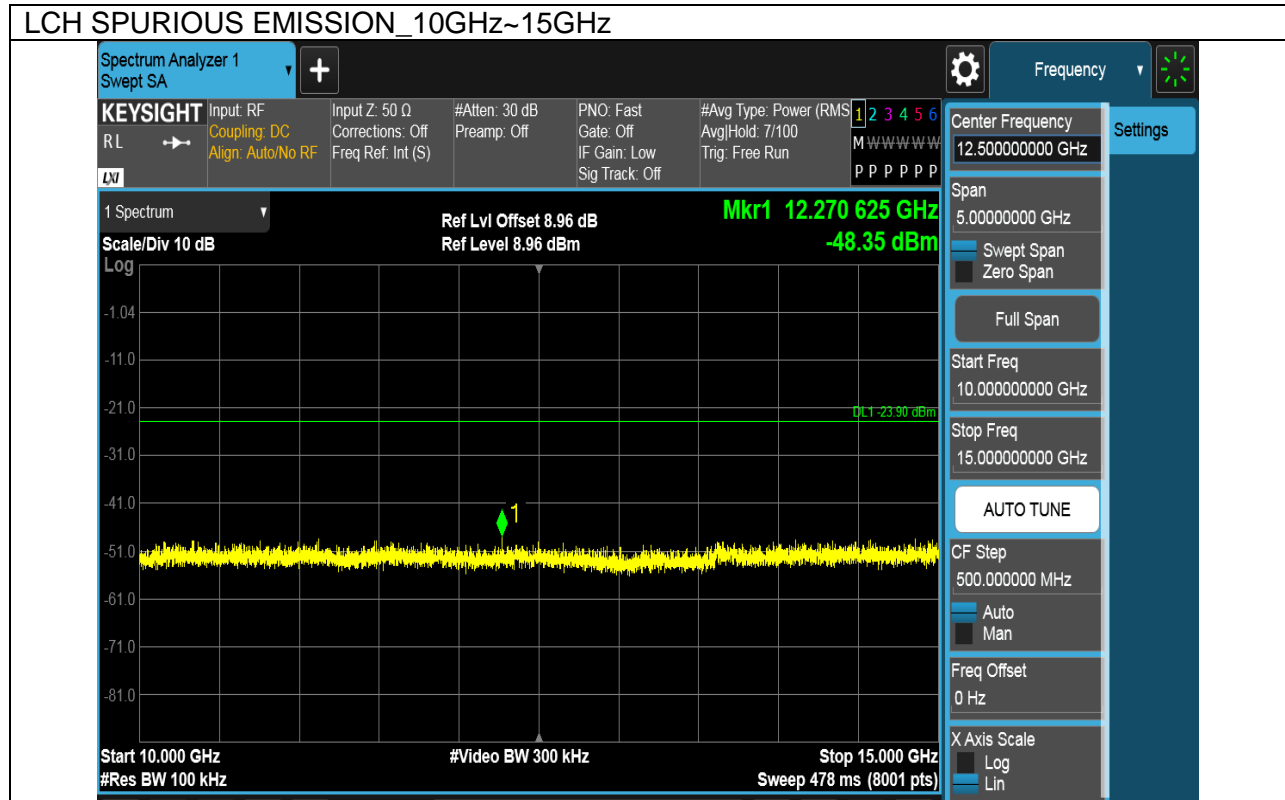
Puw test Plot



Puw test Plot

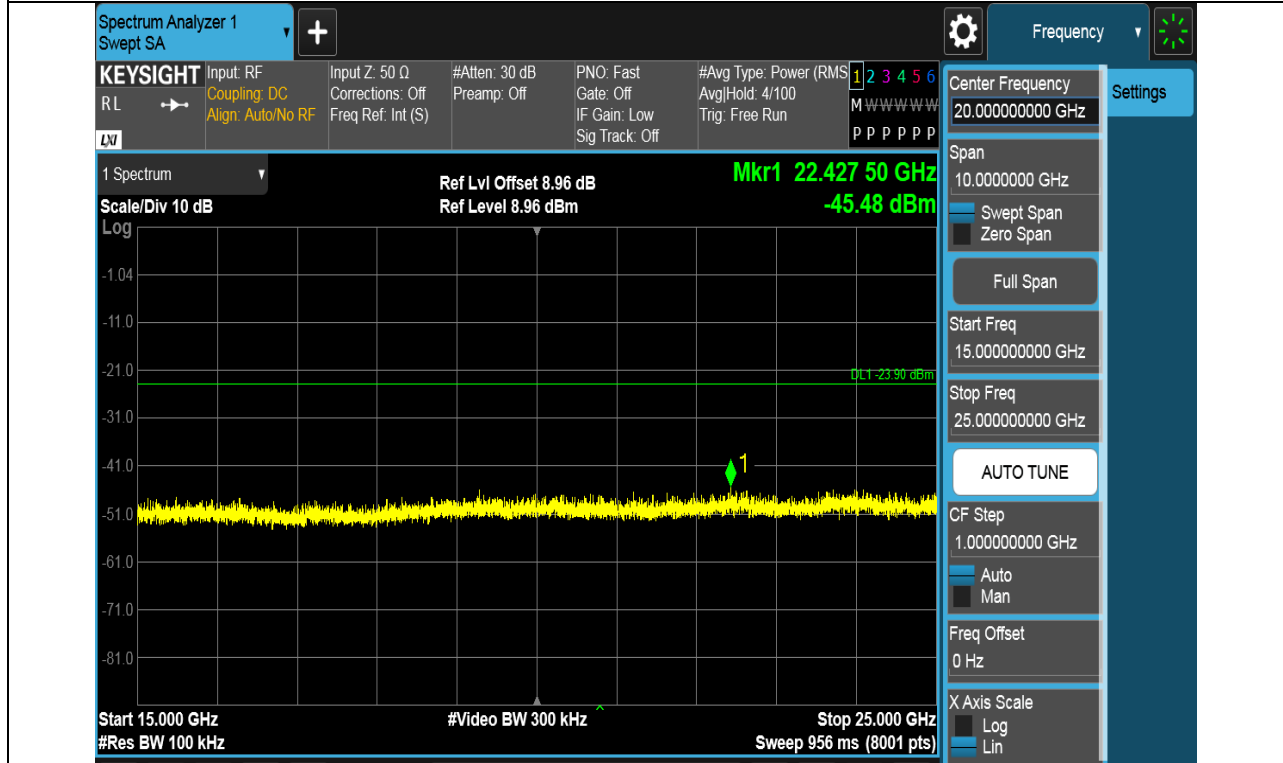


Puw test Plot



Puw test Plot

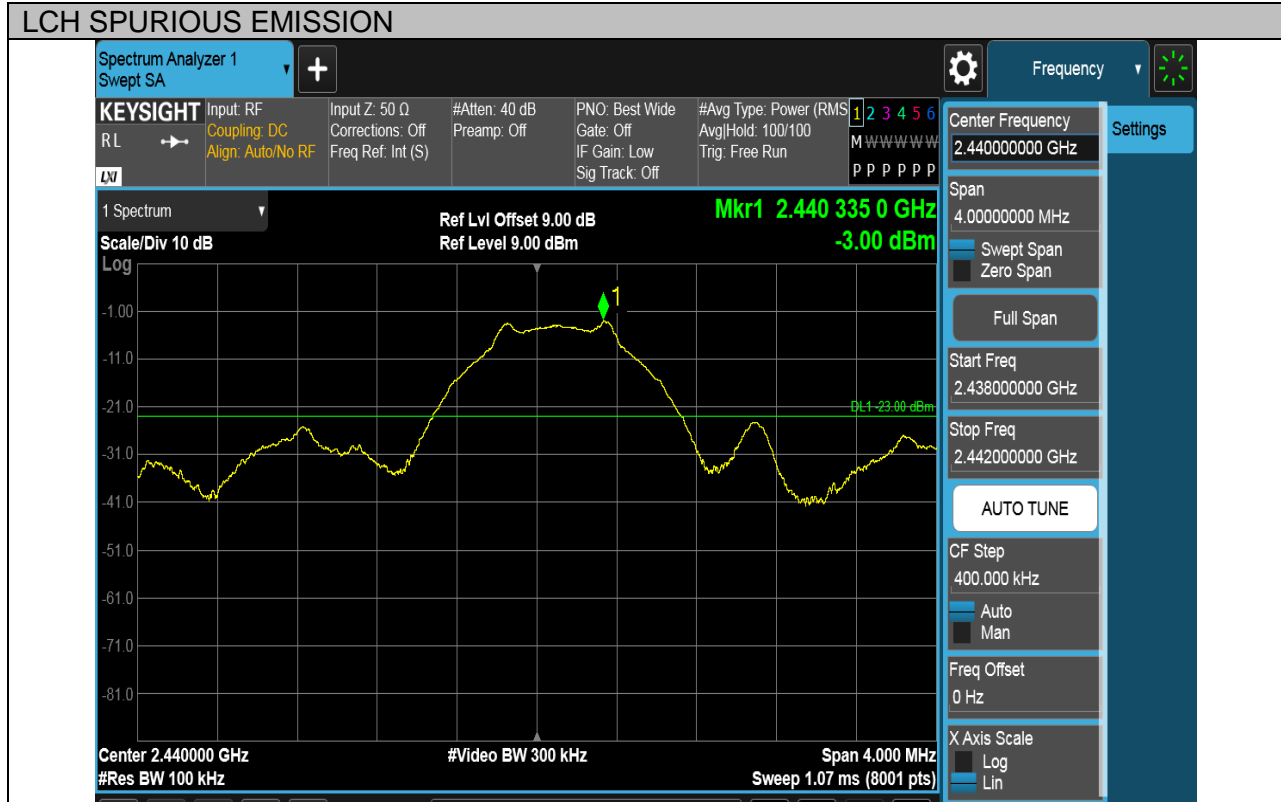
LCH SPURIOUS EMISSION_15GHz~25GHz



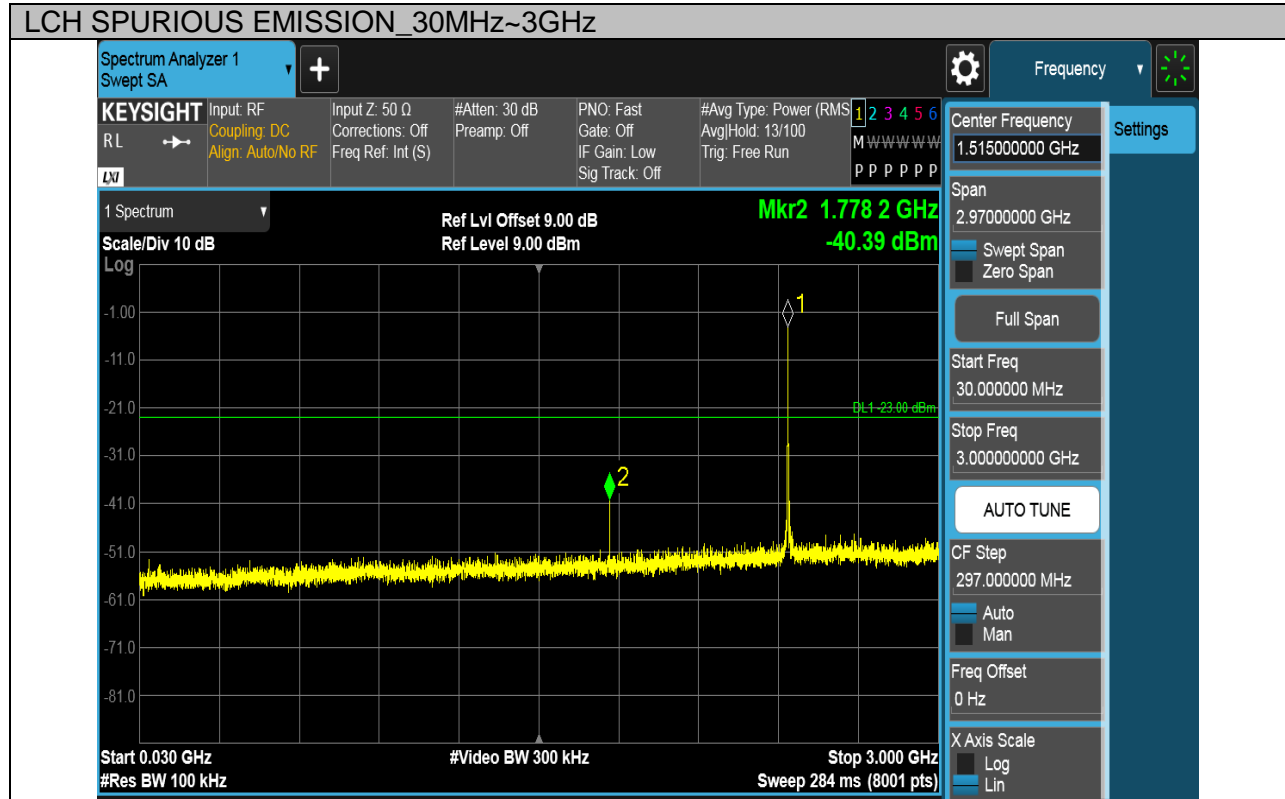
Test Plots

Test Mode	Channel	Verdict
BLE	MCH	PASS

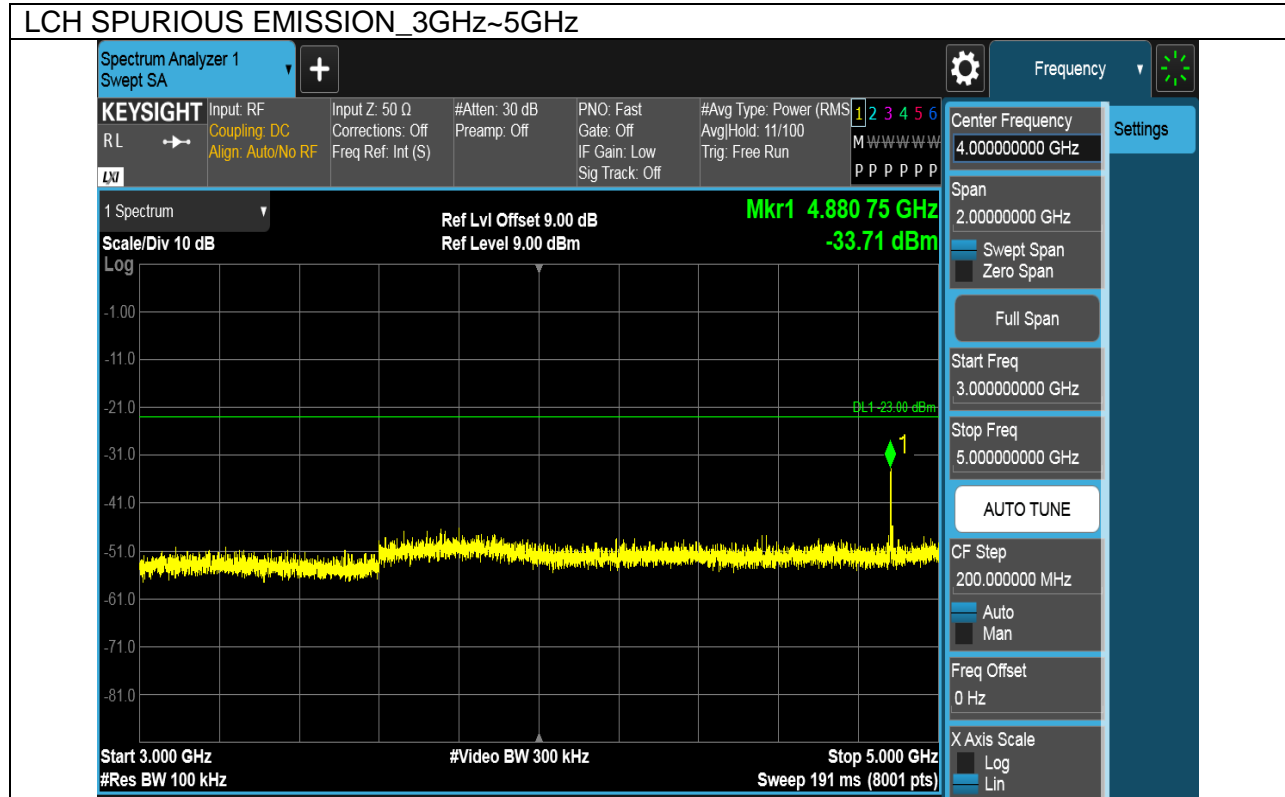
Pref test Plot



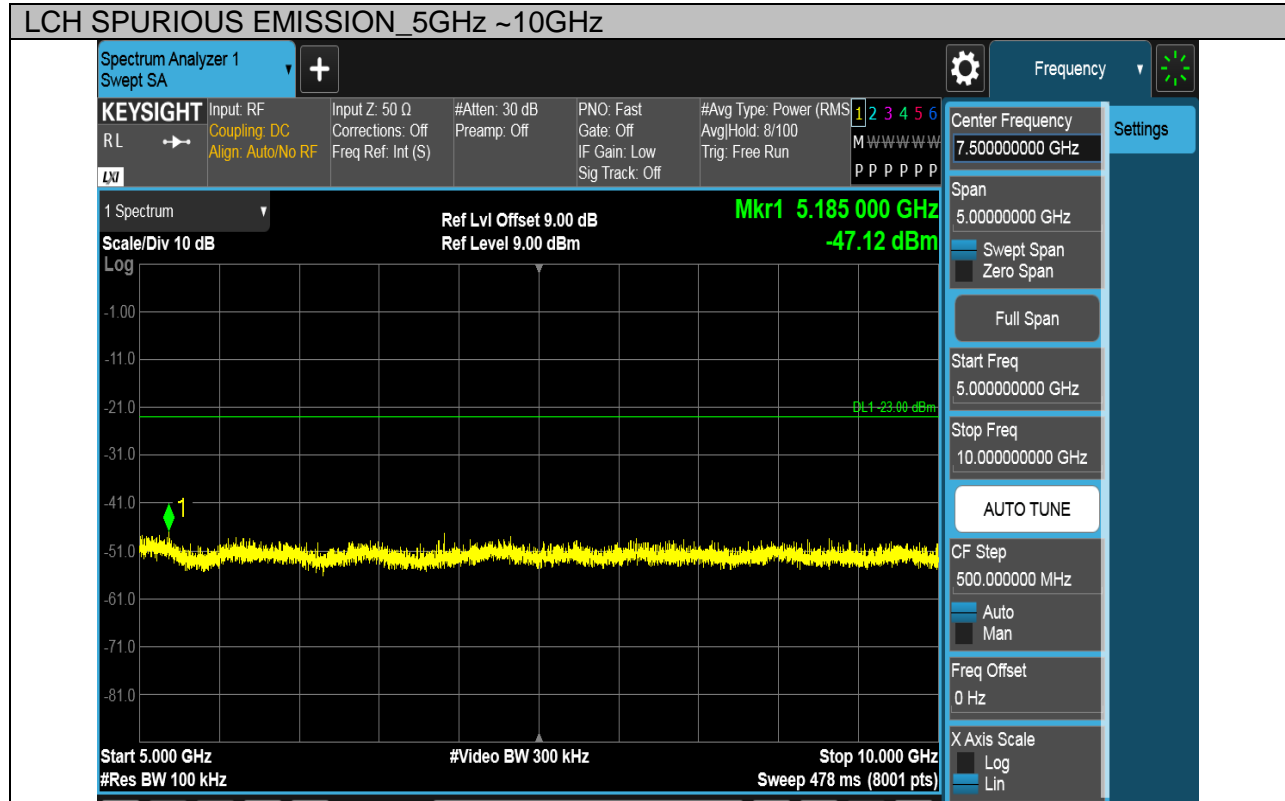
Puw test Plot



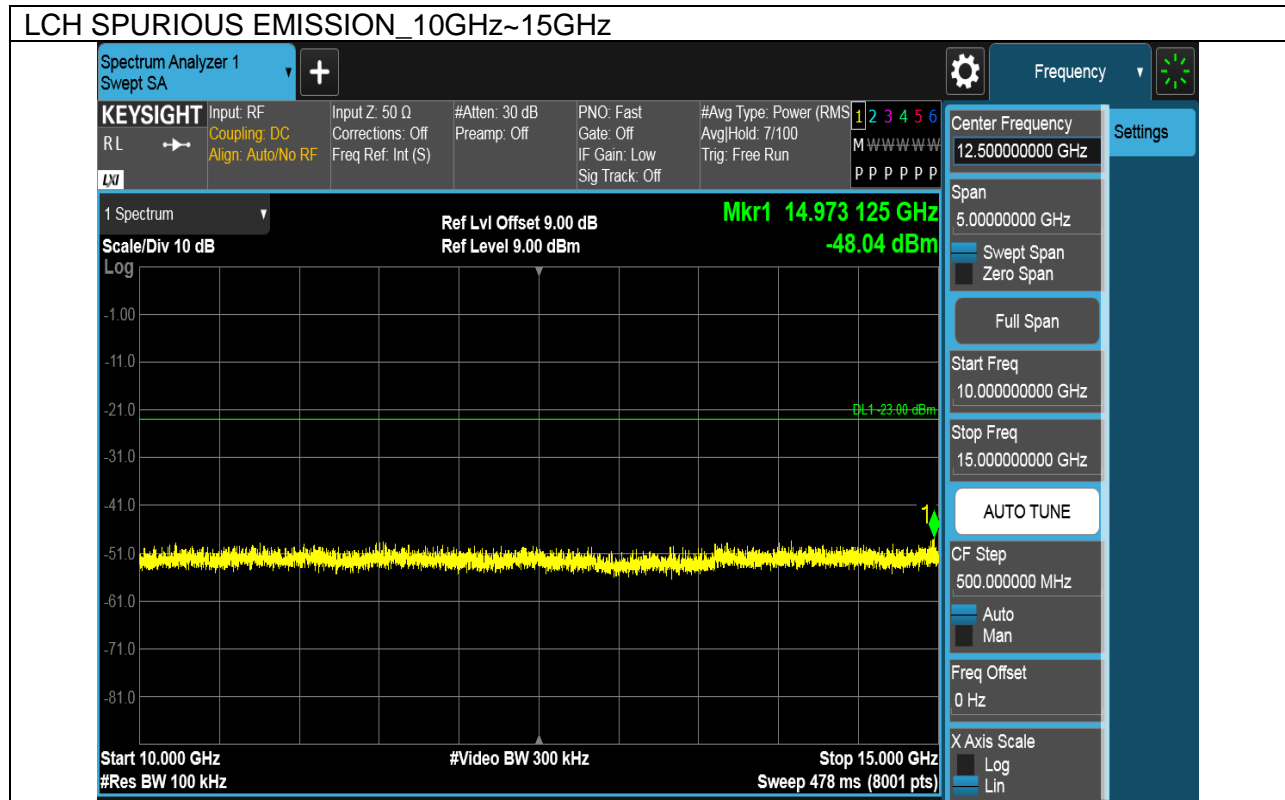
Puw test Plot



Puw test Plot

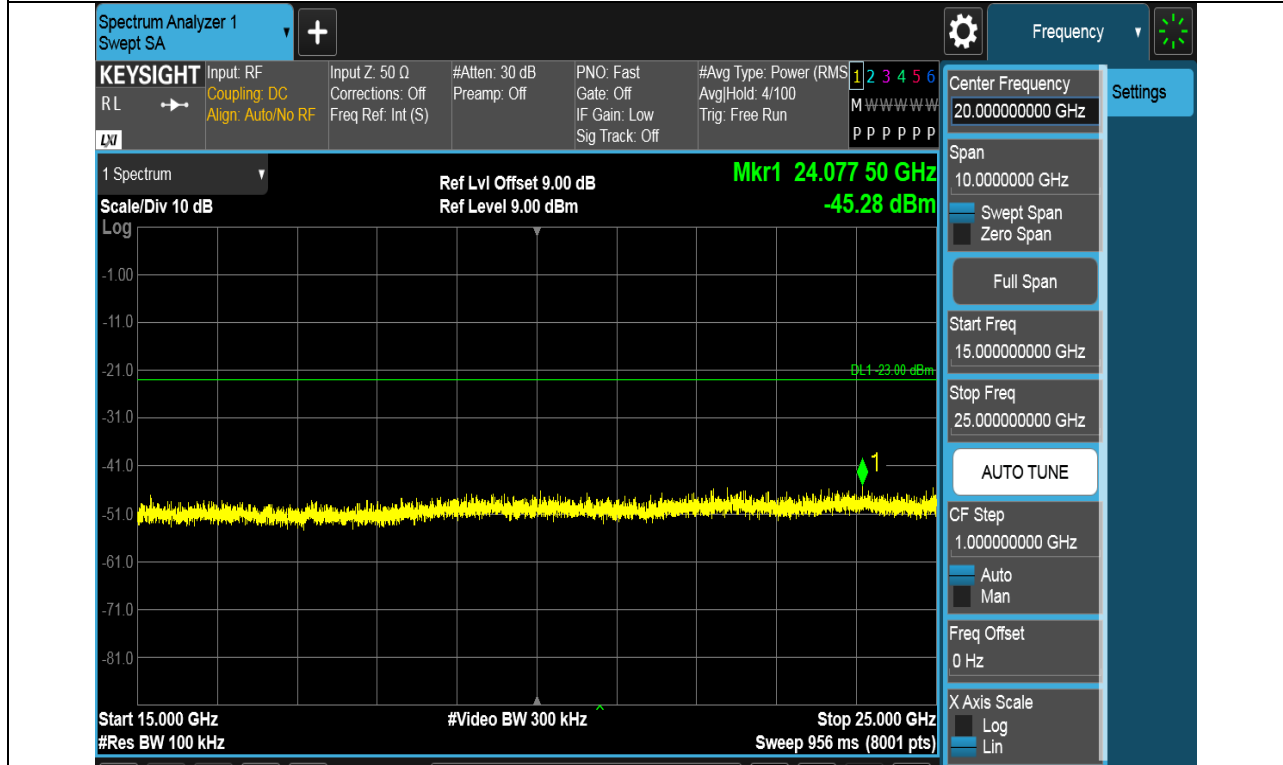


Puw test Plot



Puw test Plot

LCH SPURIOUS EMISSION_15GHz~25GHz



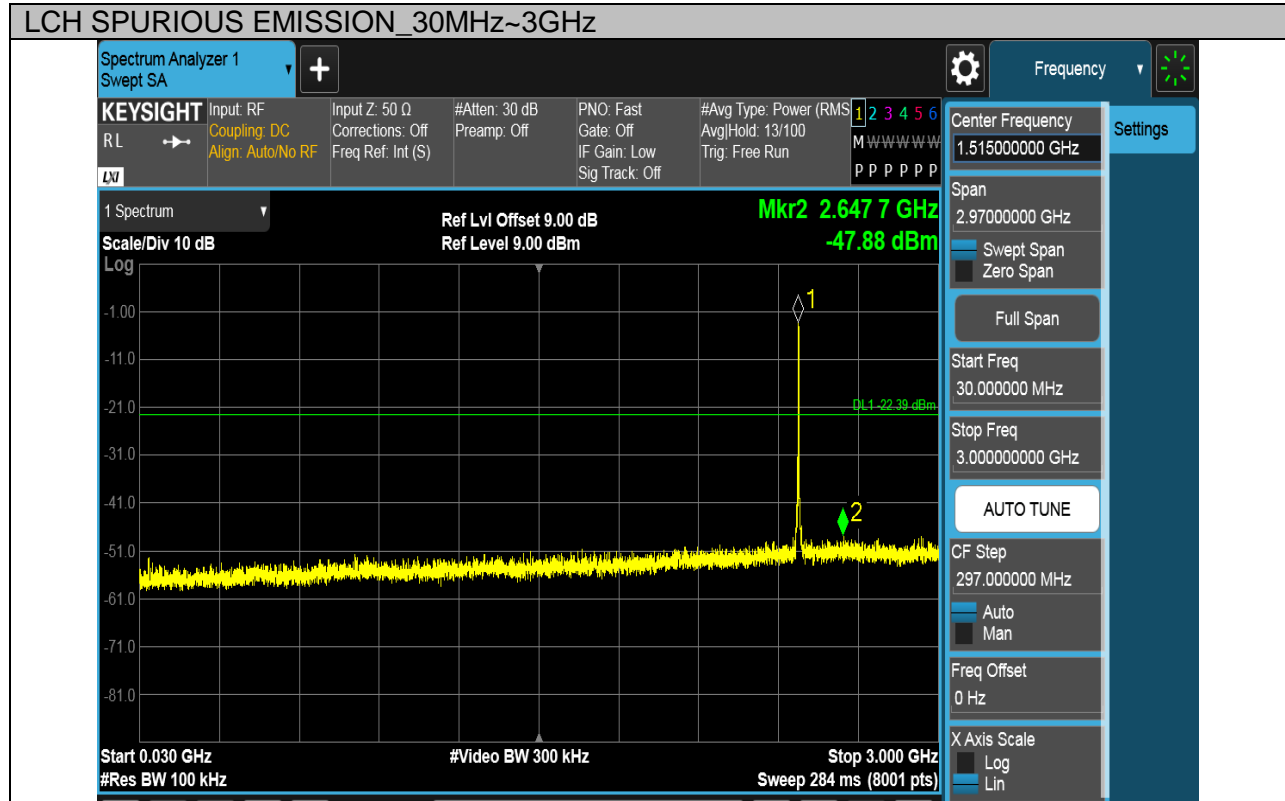
Test Plots

Test Mode	Channel	Verdict
BLE	HCH	PASS

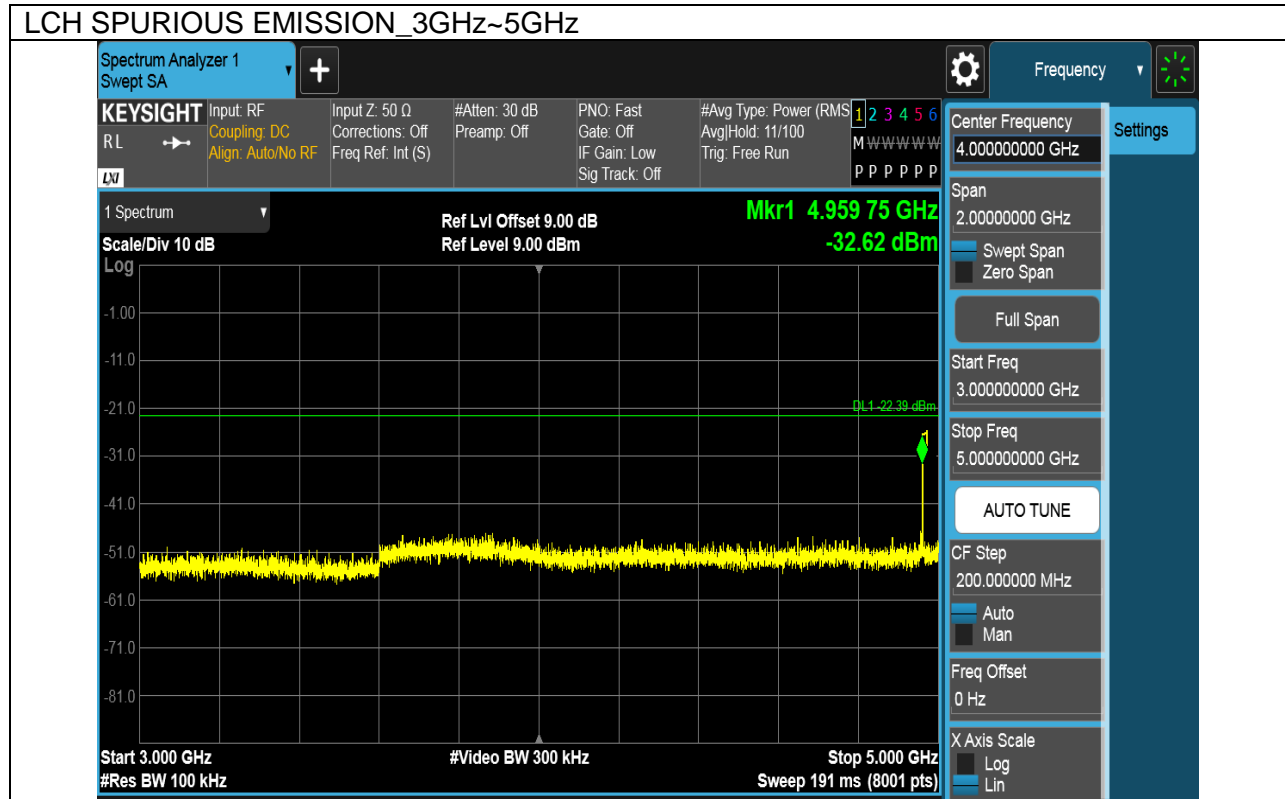
Pref test Plot



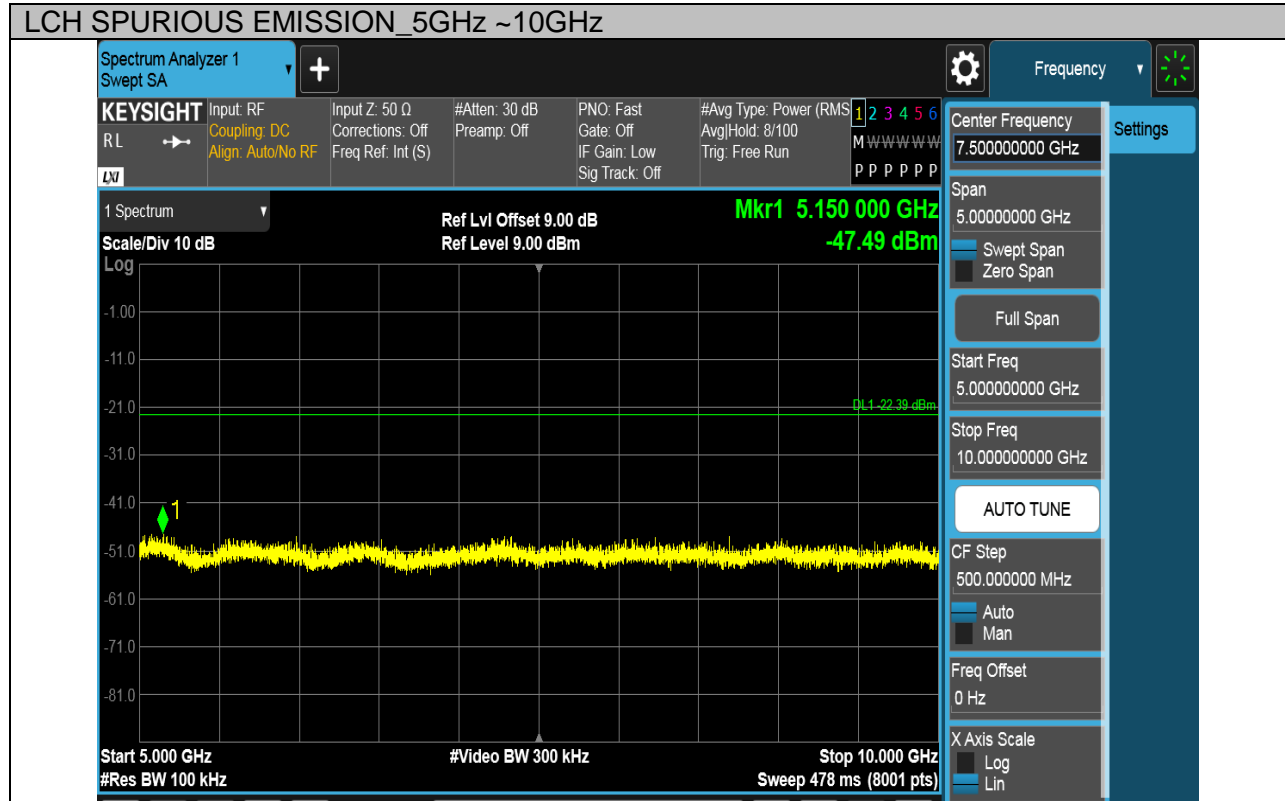
Puw test Plot



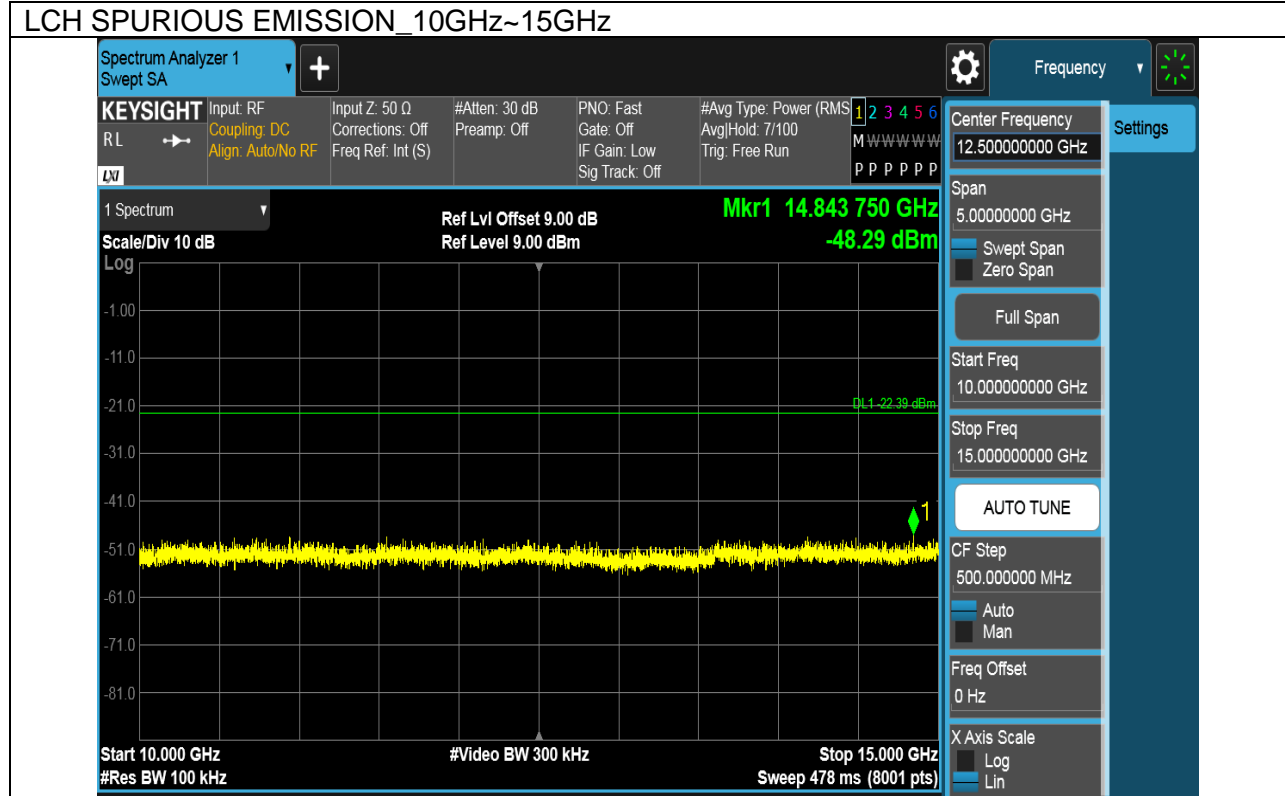
Puw test Plot



Puw test Plot

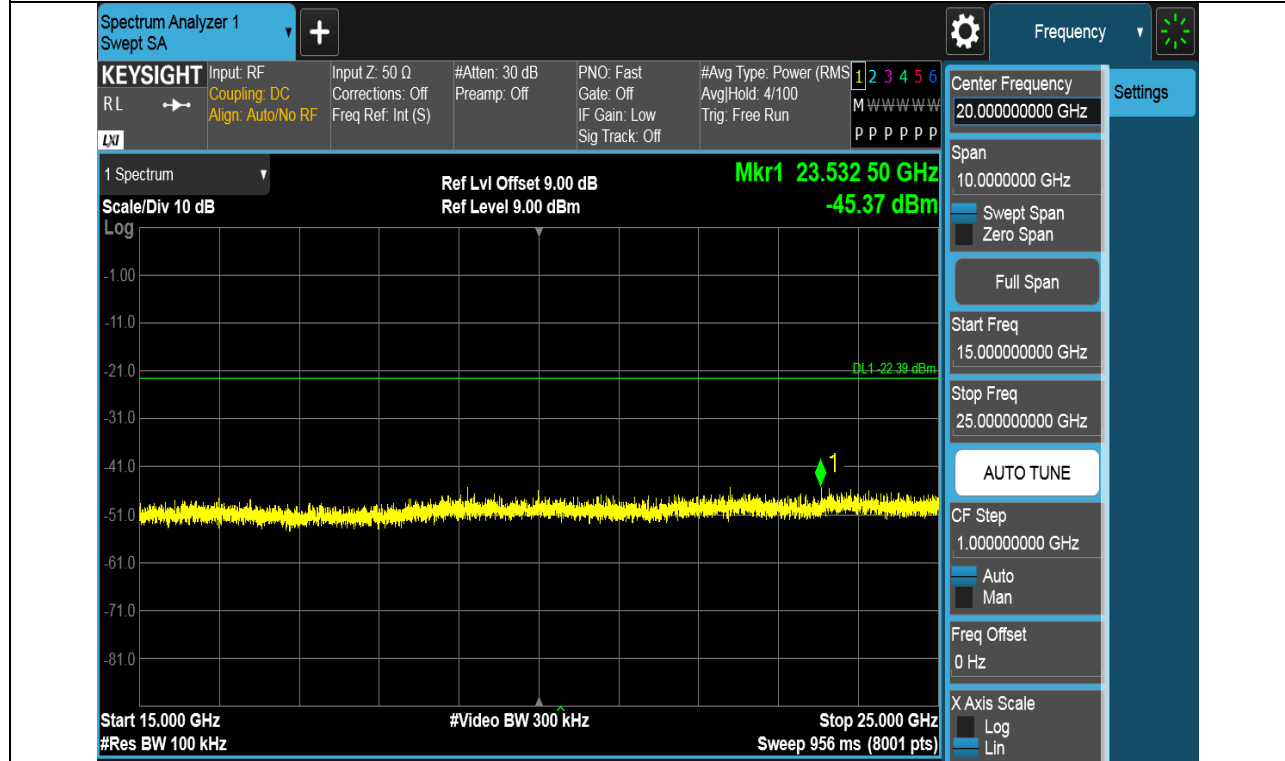


Puw test Plot



Puw test Plot

LCH SPURIOUS EMISSION_15GHz~25GHz



8. RADIATED TEST RESULTS

LIMITS

Please refer to FCC §15.205 and §15.209

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

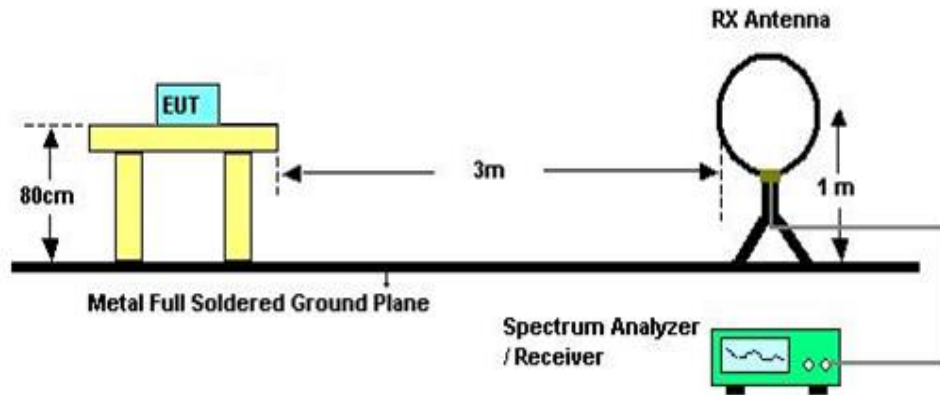
MHz	MHz	MHz	GHz
0.090-0.110	16.42-16.423	399.9-410	4.5-5.15
¹ 0.495-0.505	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.215-6.218	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

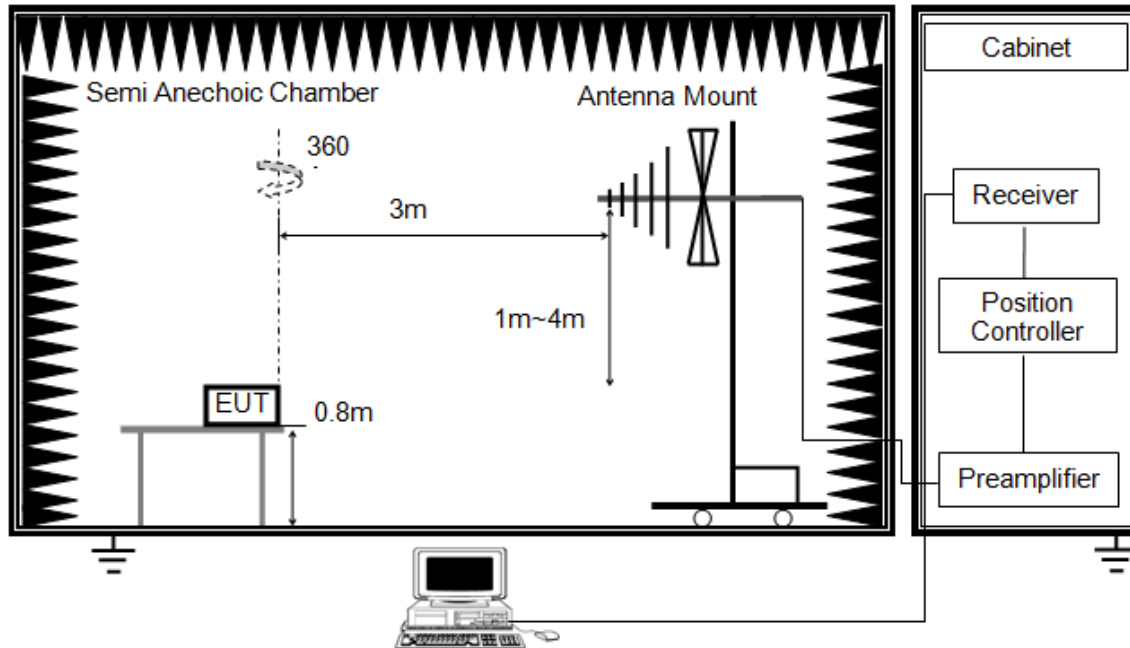


The setting of the spectrum analyser

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
Detector	Peak/QP/ Average
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 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 set $VBW \leq RBW/100$, but not less than 10Hz video bandwidth with peak detector, max hold to be run for at least 50 traces for average measurements.
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

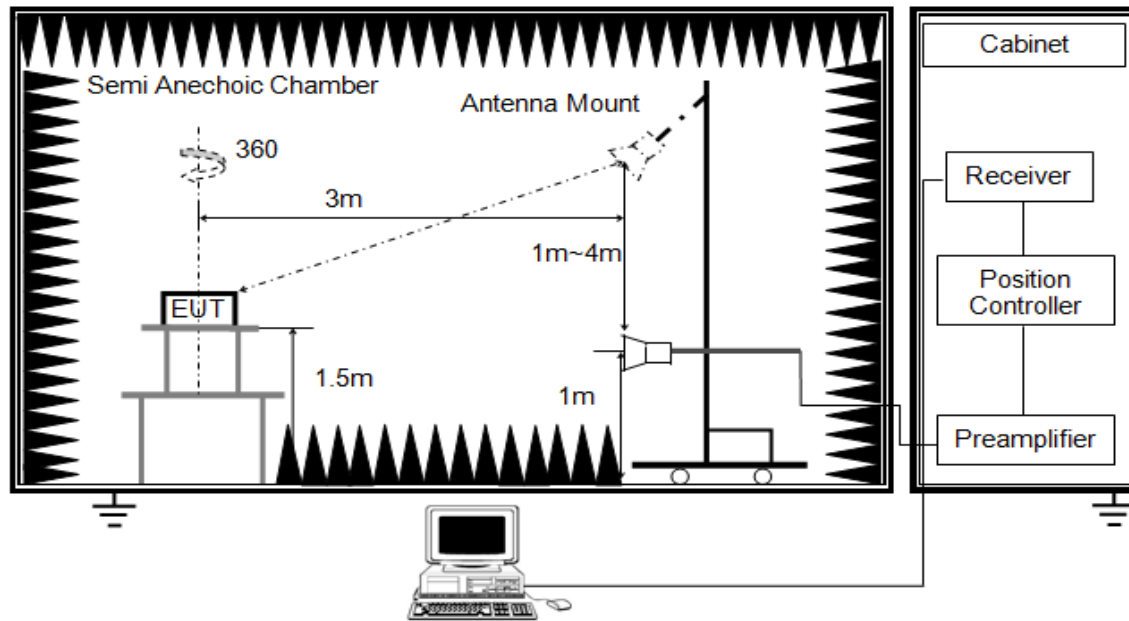


The setting of the spectrum analyser

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

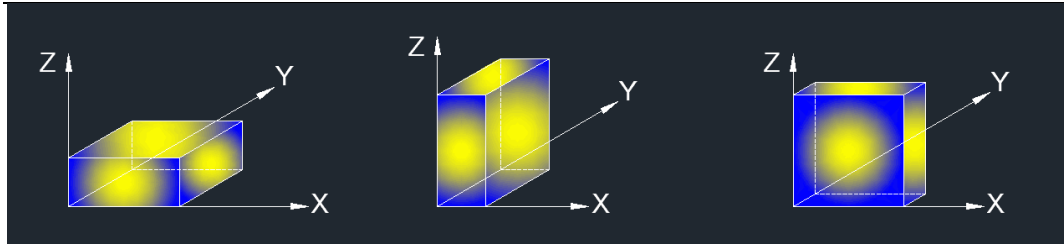


The setting of the spectrum analyser

RBW	1M
VBW	PEAK: 3M AVG: see note 6
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 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 above 1GHz, the emission measurement will be measured by the peak detector. This peak level, once corrected, must comply with the limit specified in Section 15.209.
6. 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 set $VBW \leq RBW/100$, but not less than 10Hz video bandwidth with peak detector, max hold to be run for at least 50 traces for average measurements.
7. 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.

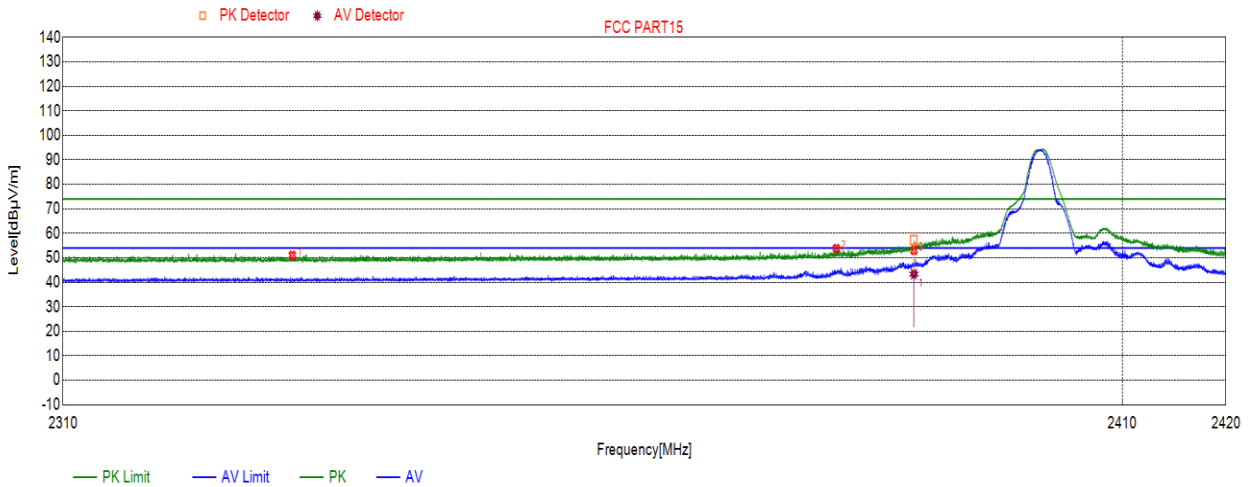
8.1. RESTRICTED BANDEDGE

Test Result Table

Test Mode	Channel	Puw(dBm)	Verdict
BLE	LCH	<Limit	PASS
	MCH	<Limit	PASS
	HCH	<Limit	PASS

Test Graphs:

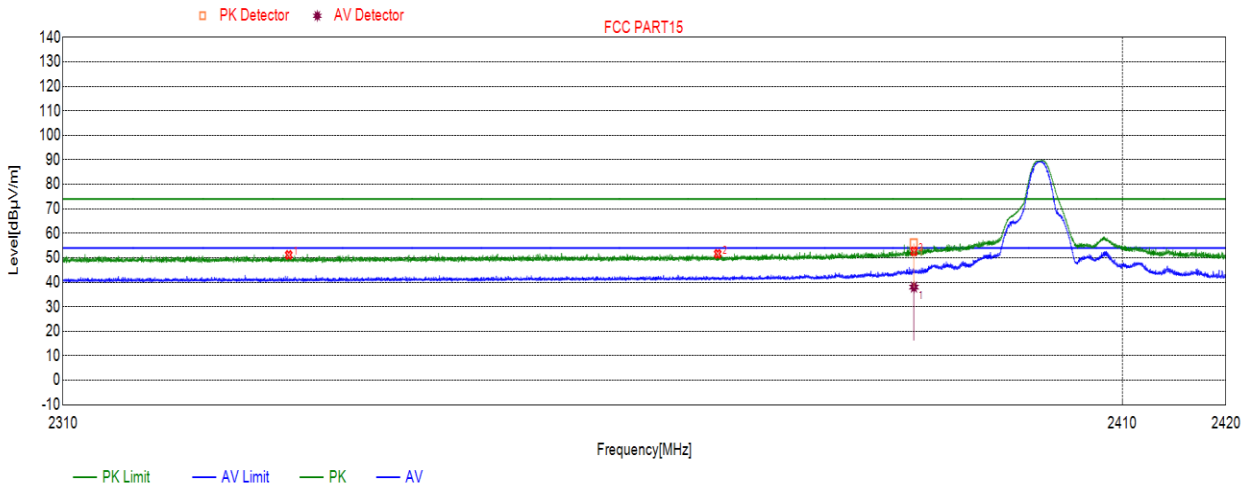
Test Mode	Channel	Polarization	Verdict
BLE	LCH	Horizontal	PASS



No.	Frequency (MHz)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2331.2981	51.00	74.00	-23.00	Peak
2	2382.5853	53.79	74.00	-20.21	Peak
3	2390.0000	57.16	74.00	-16.84	Peak
4	2390.0000	43.36	54.00	-10.64	Average

Note: 1. If Peak Result complies with AV limit, AV Result is deemed to comply with AV limit.
 2. Test setup: RBW: 1 MHz, VBW: 3 MHz, Sweep time: auto.

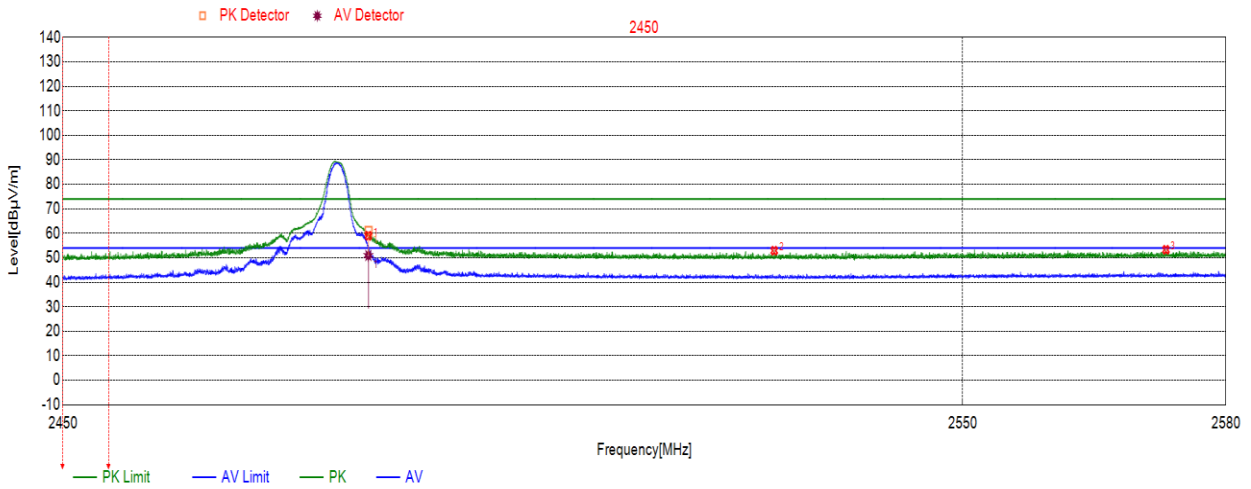
Test Mode	Channel	Polarization	Verdict
BLE	LCH	Vertical	PASS



No.	Frequency (MHz)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2330.9681	51.18	74.00	-22.82	Peak
2	2371.3091	51.61	74.00	-22.39	Peak
3	2390.000	55.81	74.00	-18.19	Peak
4	2390.0000	38.05	54.00	-15.95	Average

Note: 1. If Peak Result complies with AV limit, AV Result is deemed to comply with AV limit.
 2. Test setup: RBW: 1 MHz, VBW: 3 MHz, Sweep time: auto.

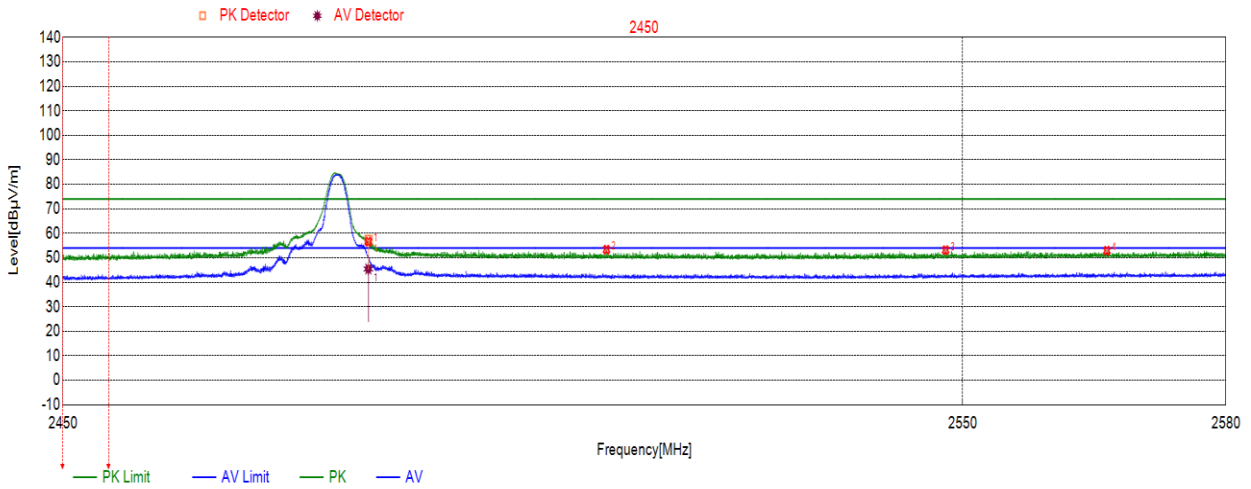
Test Mode	Channel	Polarization	Verdict
BLE	HCH	Horizontal	PASS



No.	Frequency (MHz)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2483.5000	60.96	74.00	-13.04	Peak
2	2483.5000	50.94	54.00	-3.06	Average
3	2528.7229	52.90	74.00	-21.10	Peak
4	2573.1483	53.29	74.00	-20.71	Peak

Note: 1. If Peak Result complies with AV limit, AV Result is deemed to comply with AV limit.
 2. Test setup: RBW: 1 MHz, VBW: 3 MHz, Sweep time: auto.

Test Mode	Channel	Polarization	Verdict
BLE	HCH	Vertical	PASS



No.	Frequency (MHz)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2483.5000	57.14	74.00	-16.86	Peak
		45.47	54.00	-8.53	Average
3	2509.9360	53.33	74.00	-20.67	Peak
4	2548.0688	53.12	74.00	-20.88	Peak
5	2566.4006	52.92	74.00	-21.08	Peak

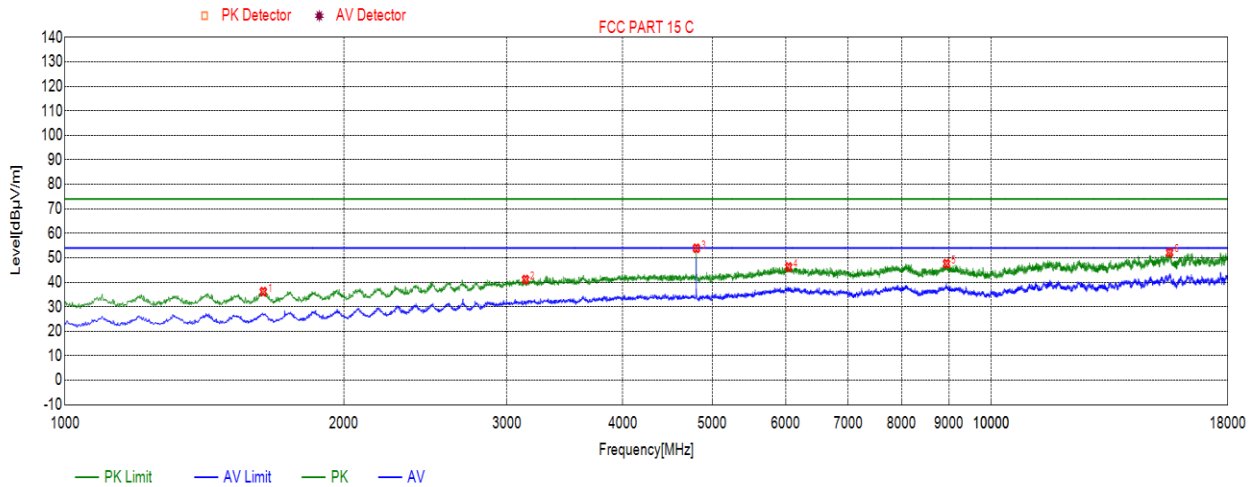
Note: 1. If Peak Result complies with AV limit, AV Result is deemed to comply with AV limit.
 2. Test setup: RBW: 1 MHz, VBW: 3 MHz, Sweep time: auto.

8.2. SPURIOUS EMISSIONS (1~18GHz)

Part I: 1GHz~18GHz

HARMONICS AND SPURIOUS EMISSIONS

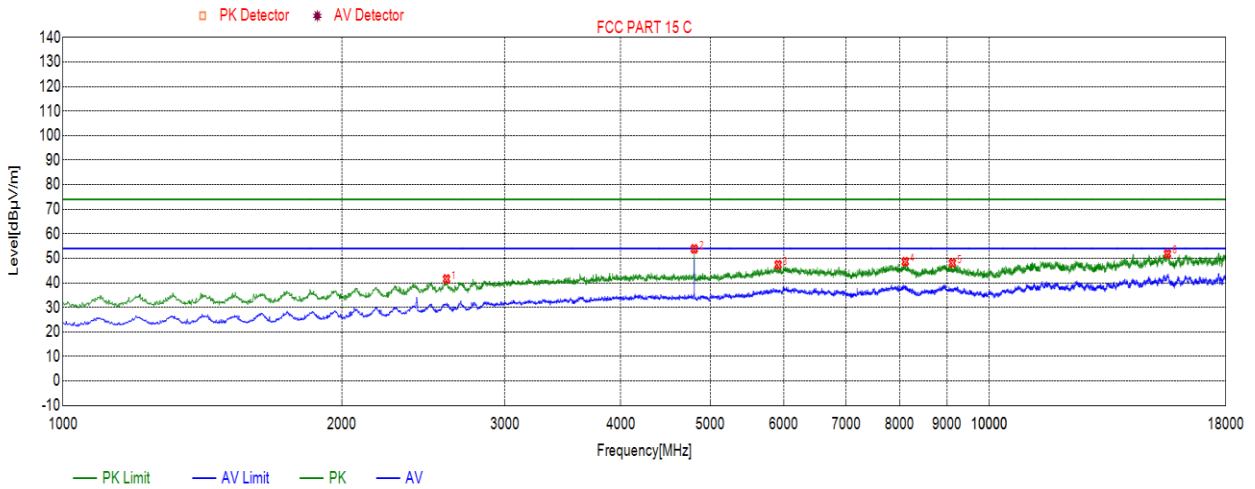
Test Mode	Channel	Polarization	Verdict
BLE	LCH	Horizontal	PASS



No.	Frequency (MHz)	Result (dBuV/m)	Limit (Peak) (dBuV/m)	Margin (Peak) (dB)	Limit (Ave) (dBuV/m)	Margin (Ave) (dB)	Remark
1	1637.5638	36.18	74.00	-37.82	54.00	-17.82	Peak
2	3142.2142	41.13	74.00	-32.87	54.00	-12.87	Peak
3	4804.9805	53.89	74.00	-20.11	54.00	-0.11	Peak
4	6042.7043	46.24	74.00	-27.76	54.00	-7.76	Peak
5	8948.2948	47.61	74.00	-26.39	54.00	-6.39	Peak
6	15578.9579	52.13	74.00	-21.87	54.00	-1.87	Peak

Note: 1. If Peak Result complies with AV limit, AV Result is deemed to comply with AV limit.
 2. Test setup: RBW: 1 MHz, VBW: 3 MHz, Sweep time: auto.

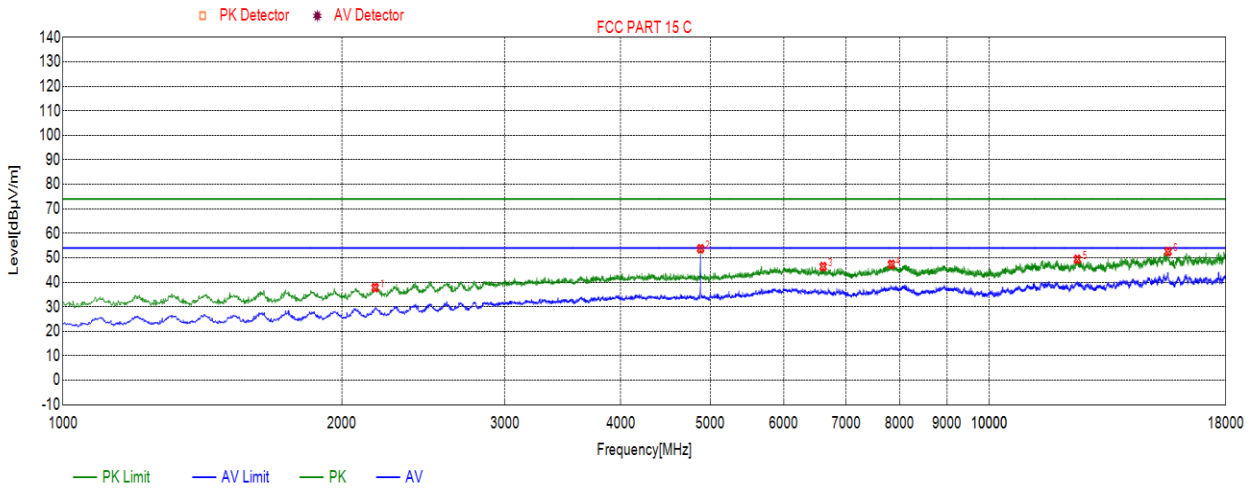
Test Mode	Channel	Polarization	Verdict
BLE	LCH	Vertical	PASS



No.	Frequency (MHz)	Result (dBuV/m)	Limit (Peak) (dBuV/m)	Margin (Peak) (dB)	Limit (Ave) (dBuV/m)	Margin (Ave) (dB)	Remark
1	2594.7595	41.59	74.00	-32.41	54.00	-12.41	Peak
2	4803.2803	53.84	74.00	-20.16	54.00	-0.16	Peak
3	5916.8917	47.39	74.00	-26.61	54.00	-16.61	Peak
4	8115.2115	48.61	74.00	-25.39	54.00	-5.39	Peak
5	9123.4123	48.10	74.00	-25.90	54.00	-5.90	Peak
6	15573.8574	51.82	74.00	-22.18	54.00	-2.18	Peak

Note: 1. If Peak Result complies with AV limit, AV Result is deemed to comply with AV limit.
 2. Test setup: RBW: 1 MHz, VBW: 3 MHz, Sweep time: auto.

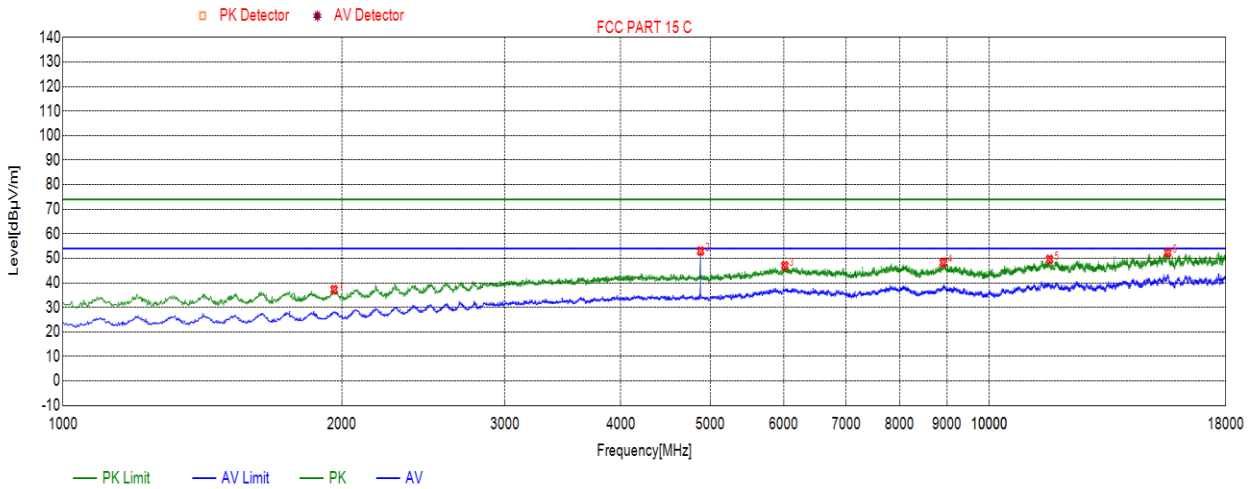
Test Mode	Channel	Polarization	Verdict
BLE	MCH	Horizontal	PASS



No.	Frequency (MHz)	Result (dBuV/m)	Limit (Peak) (dBuV/m)	Margin (Peak) (dB)	Limit (Ave) (dBuV/m)	Margin (Ave) (dB)	Remark
1	2173.1173	37.83	74.00	-36.17	54.00	-16.17	Peak
2	4879.7880	53.70	74.00	-20.30	54.00	-0.30	Peak
3	6617.3617	46.40	74.00	-27.60	54.00	-7.60	Peak
4	7841.4841	47.33	74.00	-26.67	54.00	-6.67	Peak
5	12448.9449	49.39	74.00	-24.61	54.00	-4.61	Peak
6	15597.6598	52.55	74.00	-21.45	54.00	-1.45	Peak

Note: 1. If Peak Result complies with AV limit, AV Result is deemed to comply with AV limit.
 2. Test setup: RBW: 1 MHz, VBW: 3 MHz, Sweep time: auto.

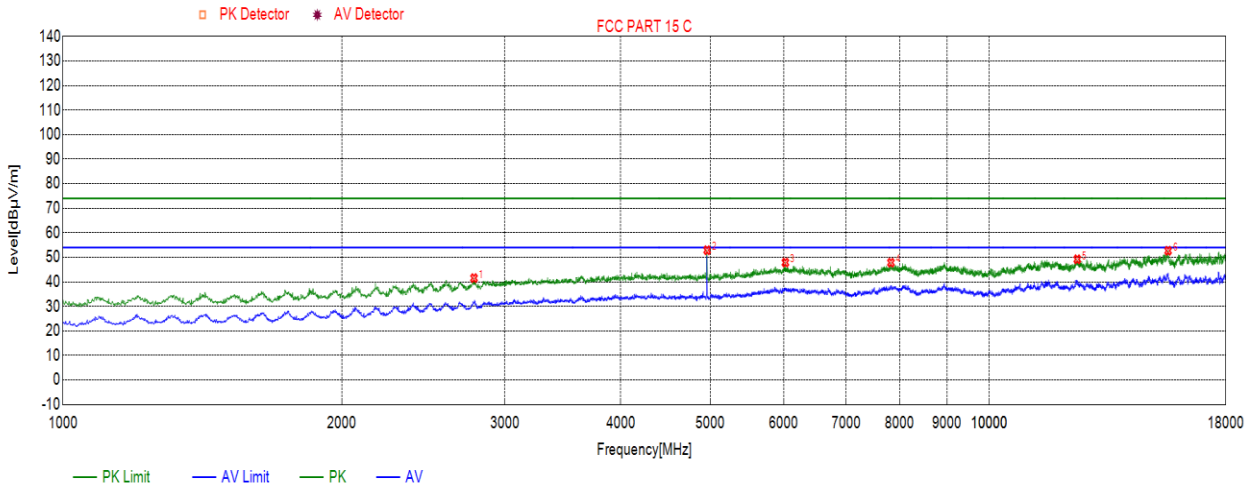
Test Mode	Channel	Polarization	Verdict
BLE	MCH	Vertical	PASS



No.	Frequency (MHz)	Result (dBuV/m)	Limit (Peak) (dBuV/m)	Margin (Peak) (dB)	Limit (Ave) (dBuV/m)	Margin (Ave) (dB)	Remark
1	1962.2962	37.25	74.00	-36.75	54.00	-16.75	Peak
2	4879.7880	52.94	74.00	-21.06	54.00	-1.06	Peak
3	6015.5016	46.97	74.00	-27.03	54.00	-7.03	Peak
4	8915.9916	48.26	74.00	-25.74	54.00	-5.74	Peak
5	11615.8616	49.56	74.00	-24.44	54.00	-4.44	Peak
6	15584.0584	52.25	74.00	-21.75	54.00	-1.75	Peak

Note: 1. If Peak Result complies with AV limit, AV Result is deemed to comply with AV limit.
 2. Test setup: RBW: 1 MHz, VBW: 3 MHz, Sweep time: auto.

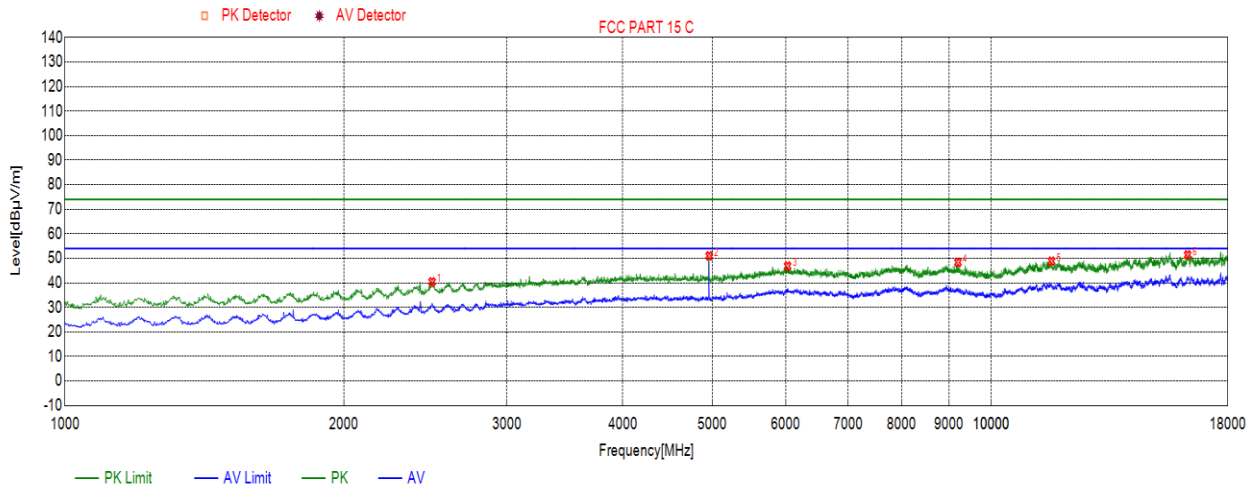
Test Mode	Channel	Polarization	Verdict
BLE	HCH	Horizontal	PASS



No.	Frequency (MHz)	Result (dBuV/m)	Limit (Peak) (dBuV/m)	Margin (Peak) (dB)	Limit (Ave) (dBuV/m)	Margin (Ave) (dB)	Remark
1	2778.3778	41.53	74.00	-32.47	54.00	-12.47	Peak
2	4959.6960	52.89	74.00	-21.11	54.00	-1.11	Peak
3	6024.0024	47.87	74.00	-26.13	54.00	-6.13	Peak
4	7831.2831	47.82	74.00	-26.18	54.00	-6.18	Peak
5	12445.5446	49.20	74.00	-24.80	54.00	-4.80	Peak
6	15597.6598	52.69	74.00	-21.31	54.00	-1.31	Peak

Note: 1. If Peak Result complies with AV limit, AV Result is deemed to comply with AV limit.
 2. Test setup: RBW: 1 MHz, VBW: 3 MHz, Sweep time: auto.

Test Mode	Channel	Polarization	Verdict
BLE	HCH	Vertical	PASS



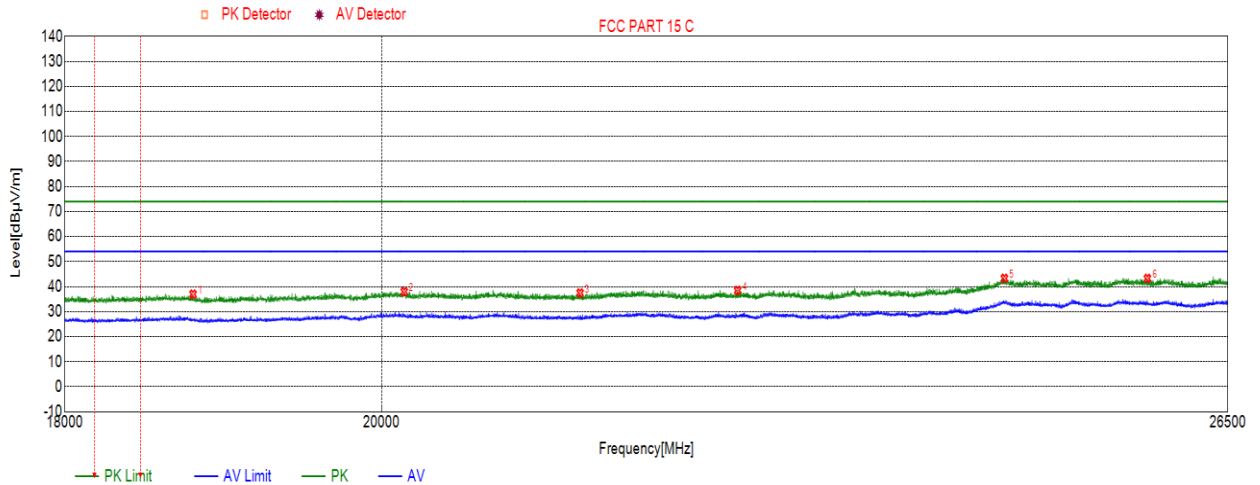
No.	Frequency (MHz)	Result (dBuV/m)	Limit (Peak) (dBuV/m)	Margin (Peak) (dB)	Limit (Ave) (dBuV/m)	Margin (Ave) (dB)	Remark
1	2491.0491	40.39	74.00	-33.61	54.00	-13.61	Peak
2	4959.6960	51.01	74.00	-22.99	54.00	-2.99	Peak
3	6027.4027	46.84	74.00	-27.16	54.00	-7.16	Peak
4	9205.0205	48.33	74.00	-25.67	54.00	-5.67	Peak
5	11615.8616	48.80	74.00	-25.20	54.00	-5.20	Peak
6	16291.3291	51.39	74.00	-22.61	54.00	-2.61	Peak

Note: 1. If Peak Result complies with AV limit, AV Result is deemed to comply with AV limit.
 2. Test setup: RBW: 1 MHz, VBW: 3 MHz, Sweep time: auto.

8.3. SPURIOUS EMISSIONS 18G ~ 26GHz

SPURIOUS EMISSIONS (WORST-CASE CONFIGURATION)

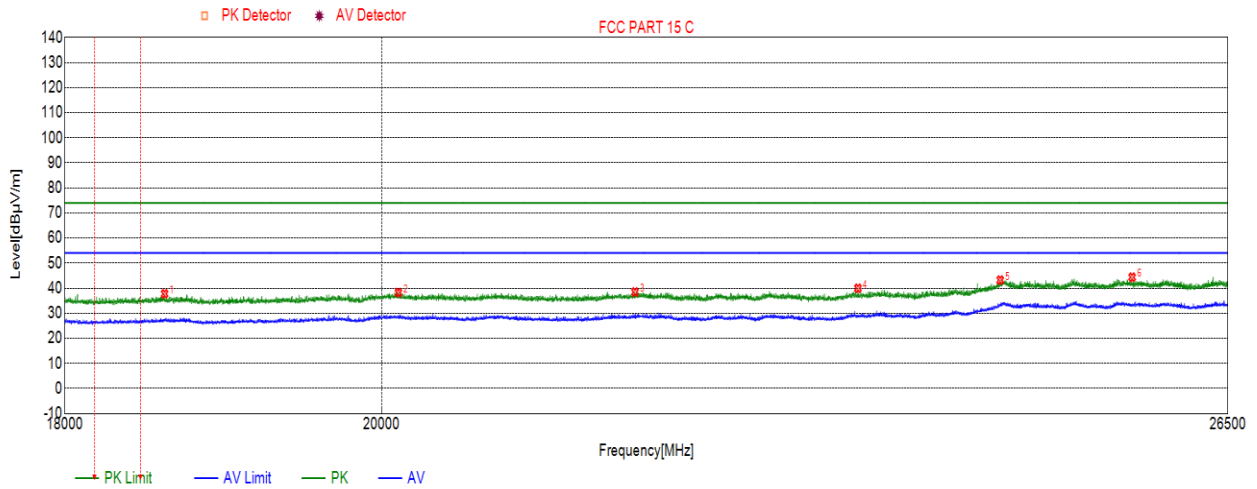
Test Mode	Channel	Polarization	Verdict
BLE	HCH	Horizontal	PASS



No.	Frequency (MHz)	Result (dBuV/m)	Limit (Peak) (dBuV/m)	Margin (Peak) (dB)	Limit (Ave) (dBuV/m)	Margin (Ave) (dB)	Remark
1	18783.7784	36.94	74.00	-37.06	54.00	-17.06	Peak
2	20150.7151	37.98	74.00	-36.02	54.00	-16.02	Peak
3	21364.6365	37.44	74.00	-36.56	54.00	-16.56	Peak
4	22513.9514	38.45	74.00	-35.55	54.00	-15.55	Peak
5	24602.6103	43.28	74.00	-30.72	54.00	-10.72	Peak
6	25801.2301	43.25	74.00	-30.75	54.00	-10.75	Peak

- Note: 1. If Peak Result complies with AV limit, AV Result is deemed to comply with AV limit.
 2. Test setup: RBW: 1 MHz, VBW: 3 MHz, Sweep time: auto.
 3. All the channels had been tested, but only the worst data were recorded in the report.

Test Mode	Channel	Polarization	Verdict
BLE	HCH	Vertical	PASS



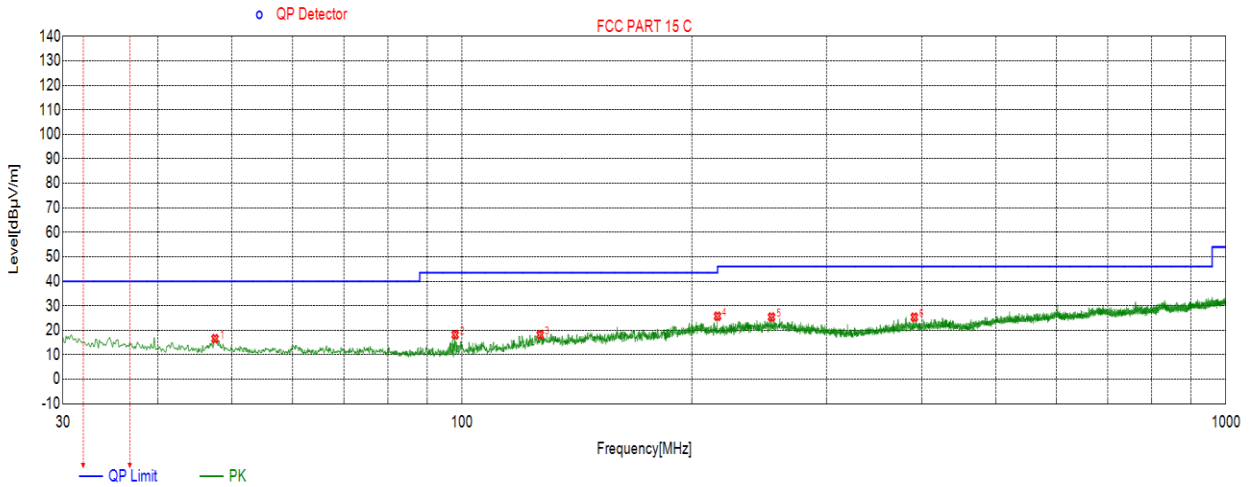
No.	Frequency (MHz)	Result (dBuV/m)	Limit (Peak) (dBuV/m)	Margin (Peak) (dB)	Limit (Ave) (dBuV/m)	Margin (Ave) (dB)	Remark
1	18606.9607	37.75	74.00	-36.25	54.00	-16.25	Peak
2	20111.6112	38.21	74.00	-35.79	54.00	-15.79	Peak
3	21758.2258	38.45	74.00	-35.55	54.00	-15.55	Peak
4	23432.8933	39.96	74.00	-34.04	54.00	-14.04	Peak
5	24568.6069	43.21	74.00	-30.79	54.00	-10.79	Peak
6	25670.3170	44.36	74.00	-29.64	54.00	-9.64	Peak

Note: 1. If Peak Result complies with AV limit, AV Result is deemed to comply with AV limit.
 2. Test setup: RBW: 1 MHz, VBW: 3 MHz, Sweep time: auto.
 3. All the channels had been tested, but only the worst data were recorded in the report.

8.4. SPURIOUS EMISSIONS 30M ~ 1 GHz

SPURIOUS EMISSIONS (WORST-CASE CONFIGURATION)

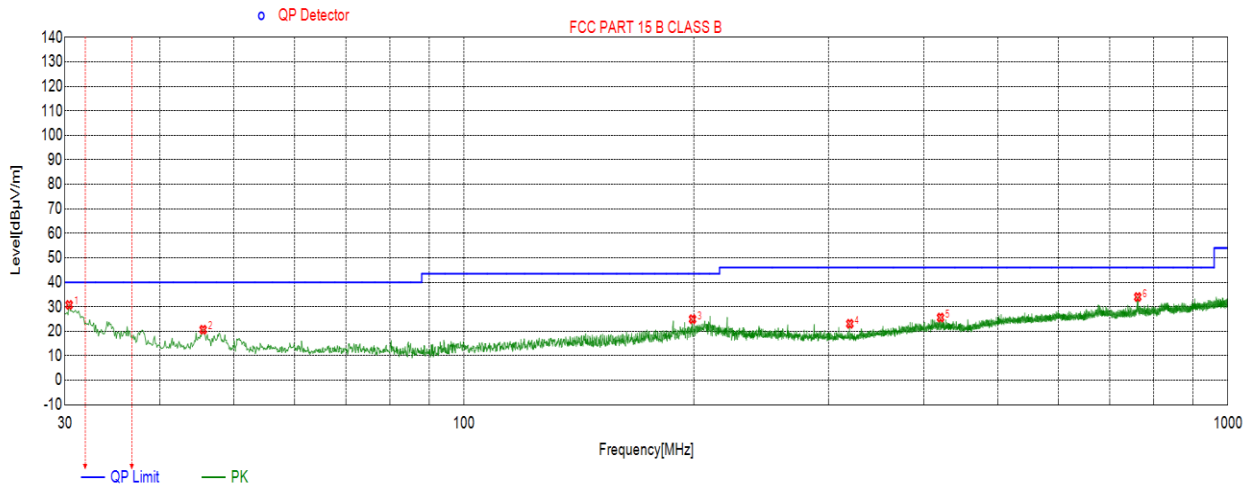
Test Mode	Channel	Polarization	Verdict
BLE	HCH	Horizontal	PASS



No.	Frequency (MHz)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	47.4617	16.57	40.00	-23.43	QP
2	97.9068	18.19	43.50	-25.31	QP
3	126.5247	18.18	43.50	-25.32	QP
4	215.9676	25.73	43.50	-17.77	QP
5	254.1894	25.42	46.00	-20.58	QP
6	390.9731	25.35	46.00	-20.65	QP

- Note: 1. If Peak Result complies with QP limit, QP Result is deemed to comply with QP limit.
 2. Test setup: RBW: 120 kHz, VBW: 300 kHz, Sweep time: auto.
 3. All the channels had been tested, but only the worst data were recorded in the report.

Test Mode	Channel	Polarization	Verdict
BLE	HCH	Vertical	PASS



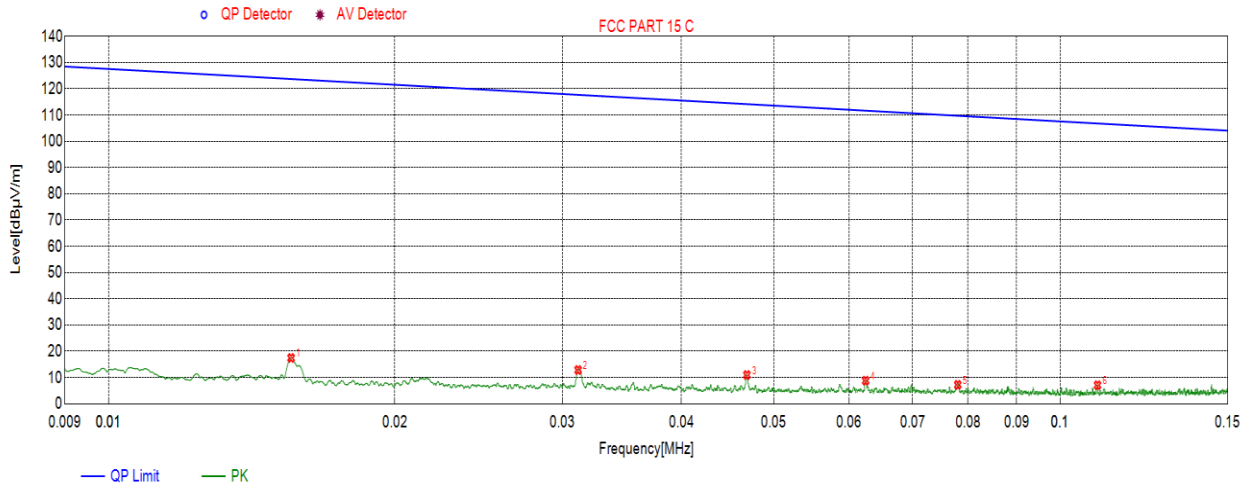
No.	Frequency (MHz)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	30.3880	30.78	40.00	-9.22	QP
2	45.5216	20.64	40.00	-19.36	QP
3	199.0879	24.94	43.50	-18.56	QP
4	319.9620	23.07	46.00	-22.93	QP
5	420.5611	25.61	46.00	-20.39	QP
6	762.2292	34.00	46.00	-12.00	QP

- Note:
1. If Peak Result complies with QP limit, QP Result is deemed to comply with QP limit.
 2. Test setup: RBW: 120 kHz, VBW: 300 kHz, Sweep time: auto.
 3. All the channels had been tested, but only the worst data were recorded in the report.

8.5. SPURIOUS EMISSIONS BELOW 30M

SPURIOUS EMISSIONS (WORST-CASE CONFIGURATION)

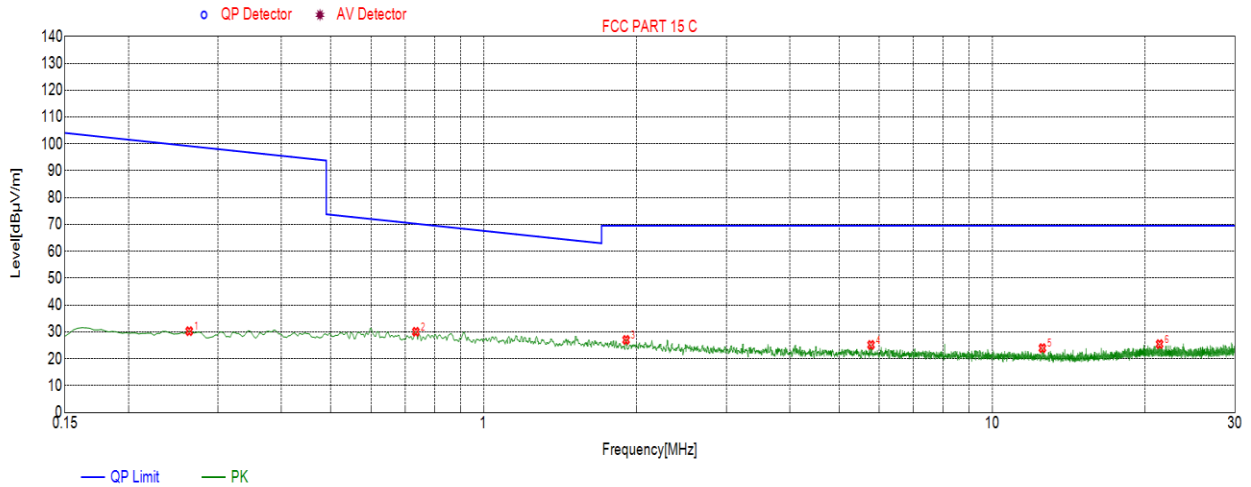
Test Mode	Channel	Frequency Range	Verdict
BLE	HCH	9KHz~150KHz	PASS



No.	Frequency (MHz)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	0.0156	17.46	123.73	-106.27	Peak
2	0.0312	12.88	117.71	-104.83	Peak
3	0.0469	10.97	114.18	-103.21	Peak
4	0.0625	8.79	111.68	-102.89	Peak
5	0.0781	7.22	109.74	-102.52	Peak
6	0.1095	7.08	106.81	-99.73	Peak

Note: 1. All the channels 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.

Test Mode	Channel	Frequency Range	Verdict
BLE	HCH	150KHz~30MHz	PASS



No.	Frequency (MHz)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	0.2634	30.28	99.19	-68.91	Peak
2	0.7351	30.05	70.29	-40.24	Peak
3	1.9054	27.04	69.50	-42.46	Peak
4	5.7773	25.17	69.50	-44.33	Peak
5	12.5539	23.95	69.50	-45.55	Peak
6	21.3396	25.46	69.50	-44.04	Peak

Note: 1. All the channels 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.

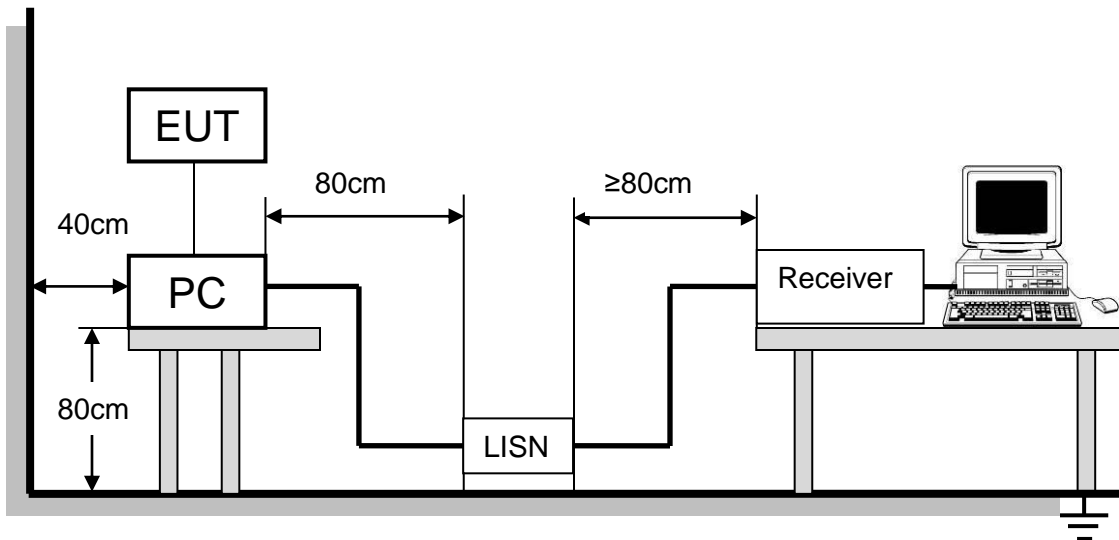
9. AC POWER LINE CONDUCTED EMISSIONS

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

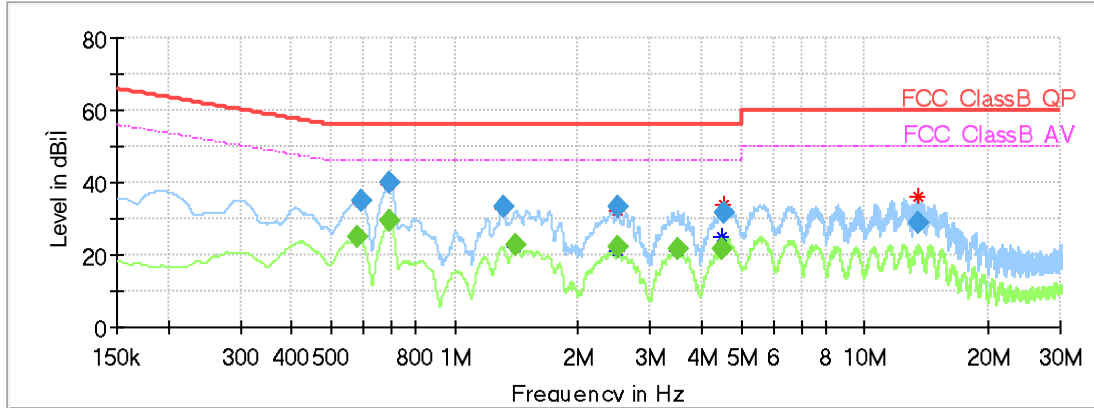
TEST SETUP AND PROCEDURE



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.

RESULTS (LOW CHANNEL, WORST-CASE CONFIGURATION)

Test Mode	Channel	Verdict
BLE	HCH	PASS



Frequency (MHz)	QuasiPeak (dBμV)	CAverage (dBμV)	Limit (dBμV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)
0.577850	---	25.27	46.00	20.73	1000.0	9.000	N	10.1
0.593770	34.89	---	56.00	21.11	1000.0	9.000	L1	10.0
0.691280	---	29.58	46.00	16.42	1000.0	9.000	L1	10.2
0.691280	40.03	---	56.00	15.97	1000.0	9.000	L1	10.2
1.308180	33.08	---	56.00	22.92	1000.0	9.000	L1	9.7
1.412655	---	22.81	46.00	23.19	1000.0	9.000	N	9.7
2.501185	---	22.10	46.00	23.90	1000.0	9.000	L1	10.0
2.509145	33.57	---	56.00	22.43	1000.0	9.000	L1	10.0
3.490215	---	21.93	46.00	24.07	1000.0	9.000	L1	10.0
4.496160	---	21.87	46.00	24.13	1000.0	9.000	L1	10.1
4.538945	31.41	---	56.00	24.59	1000.0	9.000	L1	10.1
13.448175	28.62	---	60.00	31.38	1000.0	9.000	N	10.5

- 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.
 4. The extension cord/outlet strip was calibrated with the LISN as required by ANSI C63.10:2013 Clause 6.2.2.

Note: All the channels had been tested, but only the worst data recorded in the report.

10. 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 a PCB antenna

Antenna Gain

The antenna gain of EUT is less than 6 dBi.

END OF REPORT