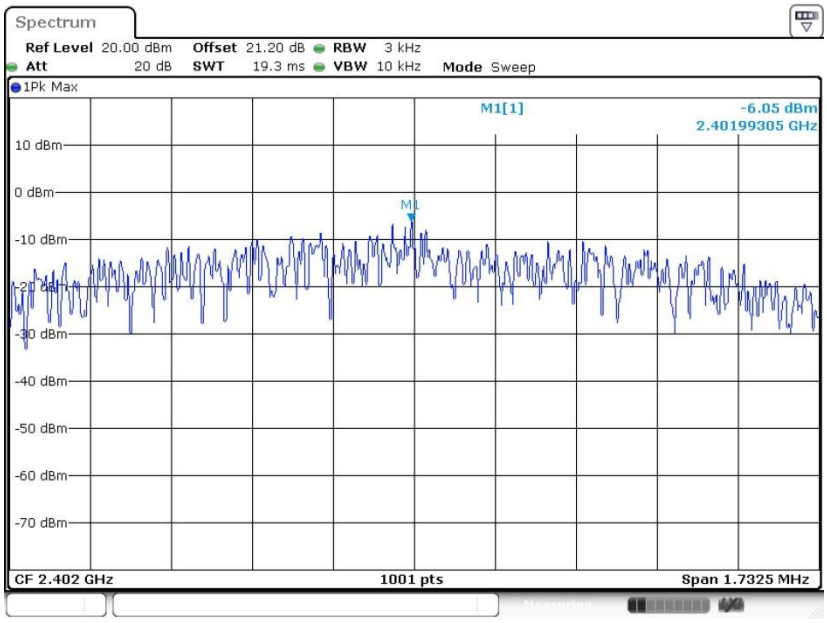
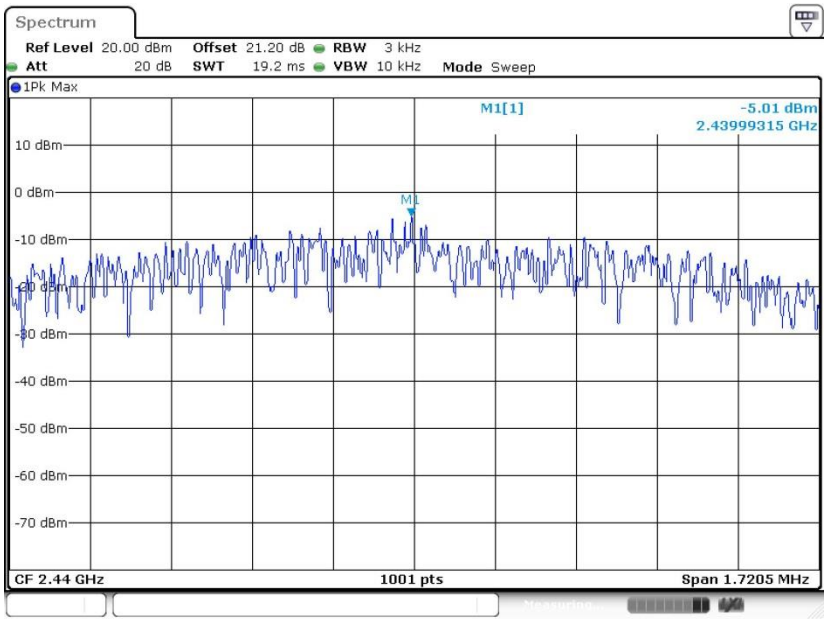
Bluetooth v5.1 LE For Ant2:

PSD 3kHz Plot on Channel 00



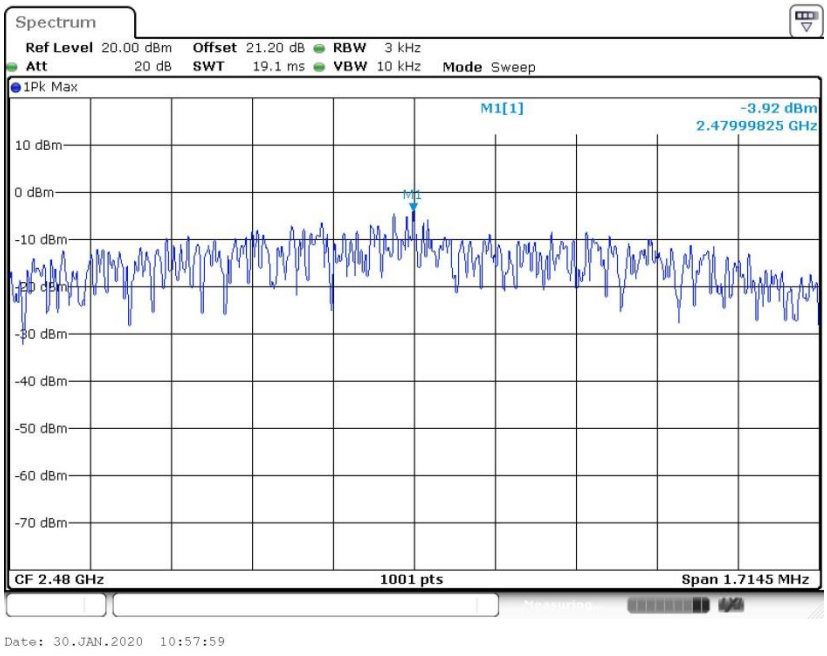
Date: 29.JAN.2020 17:32:27

PSD 3kHz Plot on Channel 19



Date: 29.JAN.2020 17:42:40

PSD 3kHz Plot on Channel 39



3.4 Conducted Band Edges and Spurious Emission Measurement

3.4.1 Limit of Conducted Band Edges and Spurious Emission

All harmonics/spurious must be at least 20 dB down from the highest emission level within the authorized band.

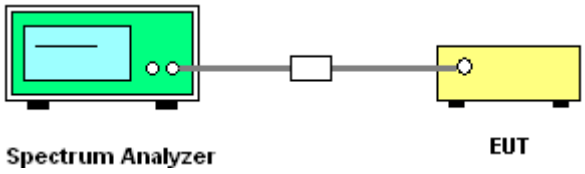
3.4.2 Measuring Instruments

The section 4.0 of List of Measuring Equipment of this test report is used for test.

3.4.3 Test Procedure

1. The testing follows ANSI C63.10-2013 clause 11.13
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Set RBW = 100 kHz, VBW=300 kHz, Peak Detector. Unwanted Emissions measured in any 100 kHz bandwidth outside of the authorized frequency band shall be attenuated by at least 20 dB relative to the maximum in-band peak PSD level in 100 kHz when maximum peak conducted output power procedure is used. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.
5. Measure and record the results in the test report.
6. The RF fundamental frequency should be excluded against the limit line in the operating frequency band.

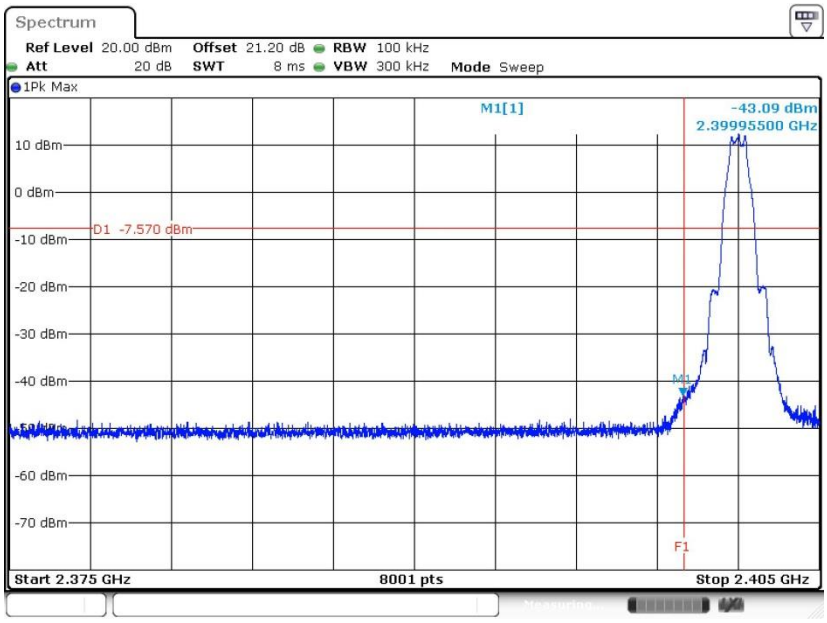
3.4.4 Test Setup



3.4.5 Test Result of Conducted Band Edges Plots

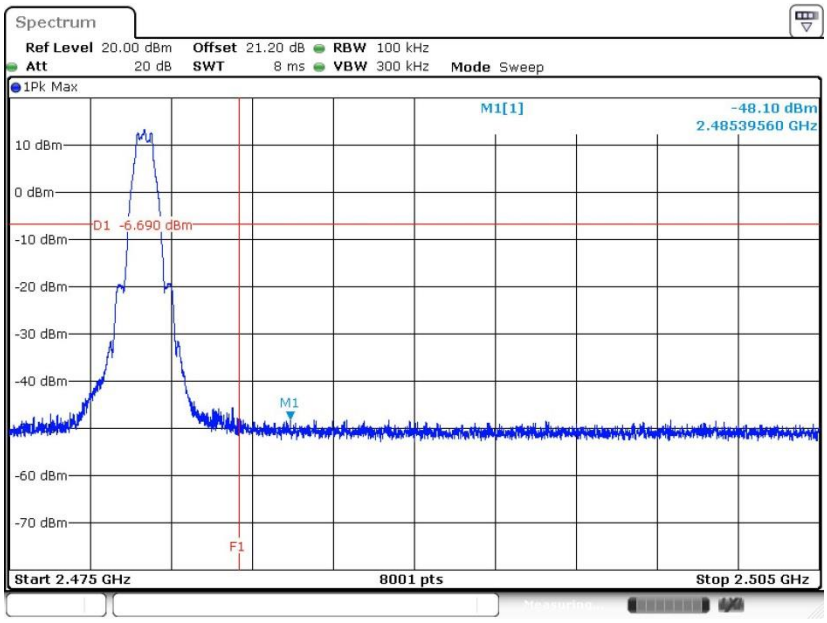
Bluetooth v4.2 LE For Ant1:

Low Band Edge Plot on Channel 00



Date: 12.FEB.2020 14:24:29

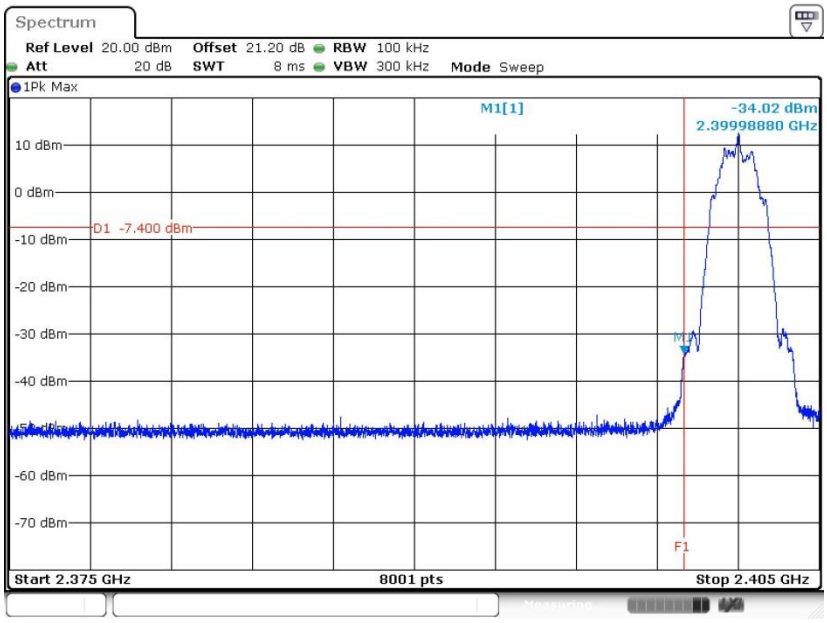
High Band Edge Plot on Channel 39



Date: 12.FEB.2020 14:33:48

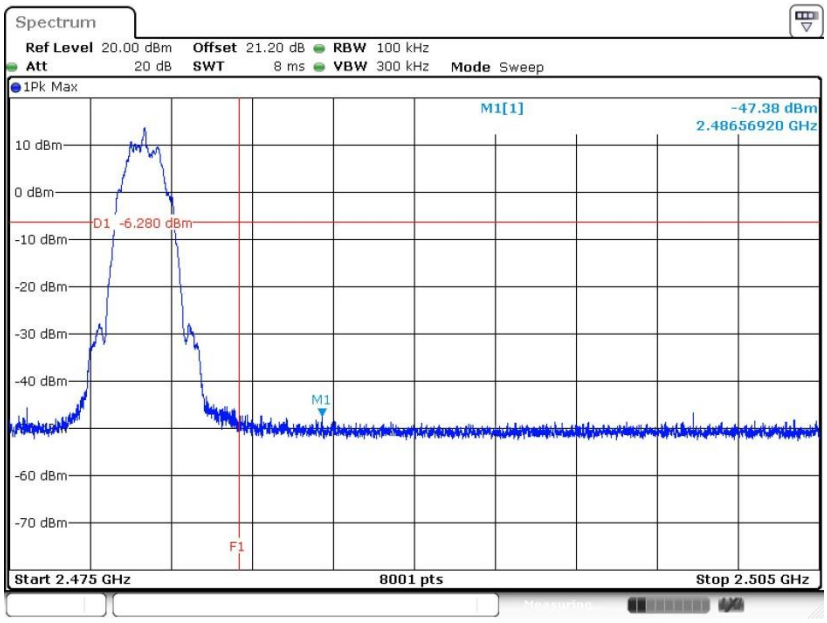
Bluetooth v5.1 LE For Ant1:

Low Band Edge Plot on Channel 00



Date: 12.FEB.2020 14:51:29

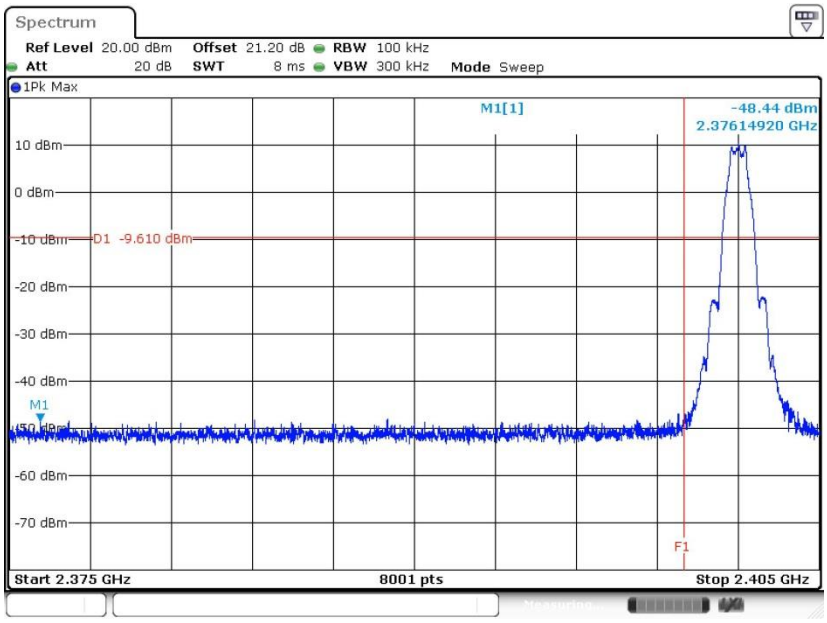
High Band Edge Plot on Channel 39



Date: 12.FEB.2020 15:16:52

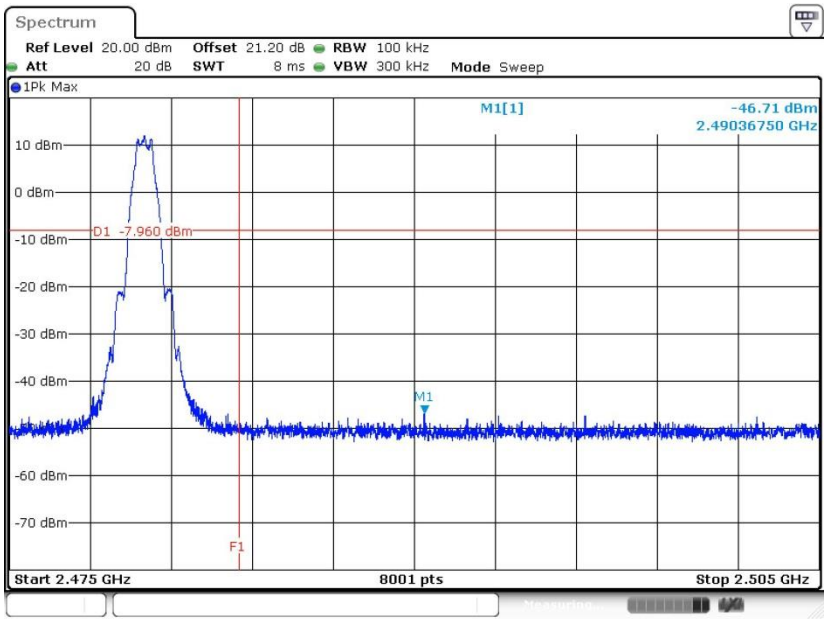
Bluetooth v4.2 LE For Ant2:

Low Band Edge Plot on Channel 00



Date: 29.JAN.2020 17:15:59

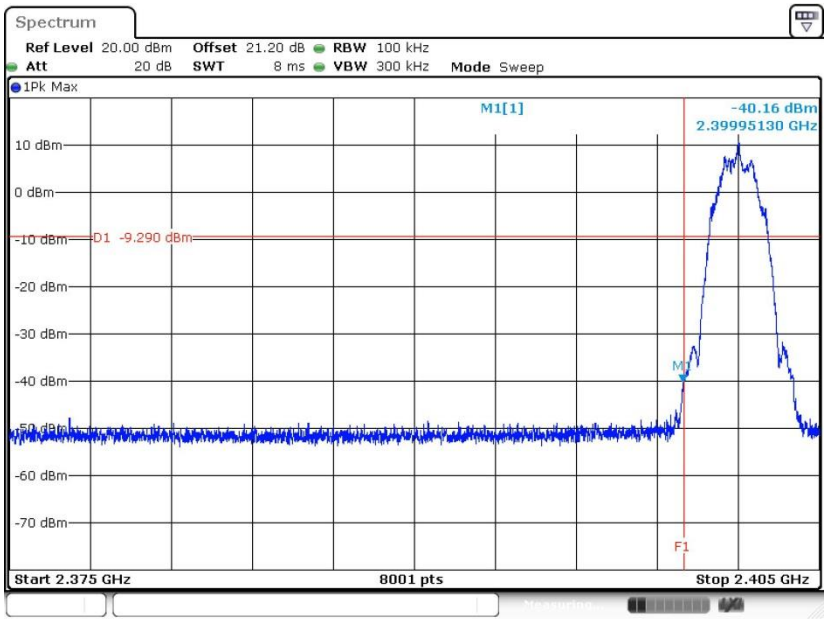
High Band Edge Plot on Channel 39



Date: 29.JAN.2020 17:25:33

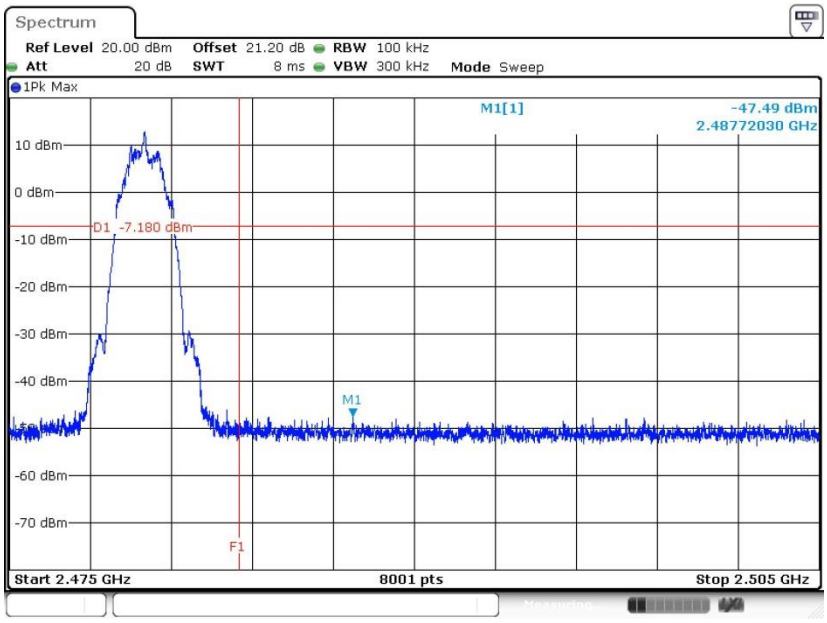
Bluetooth v5.1 LE For Ant2:

Low Band Edge Plot on Channel 00



Date: 29.JAN.2020 17:33:41

High Band Edge Plot on Channel 39



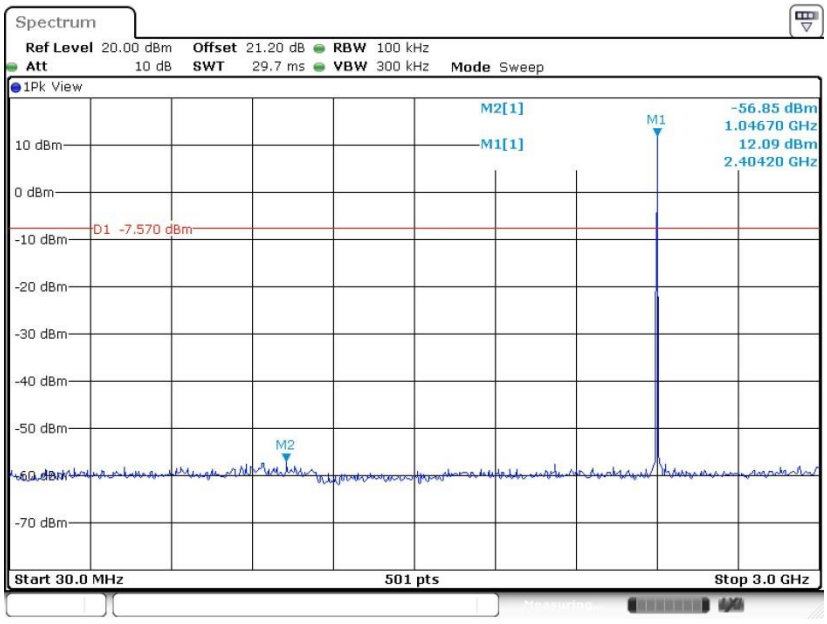
Date: 30.JAN.2020 10:58:29

3.4.6 Test Result of Conducted Spurious Emission Plots

Bluetooth v4.2 LE For Ant1:

Conducted Spurious Emission Plot on Bluetooth LE 1Mbps

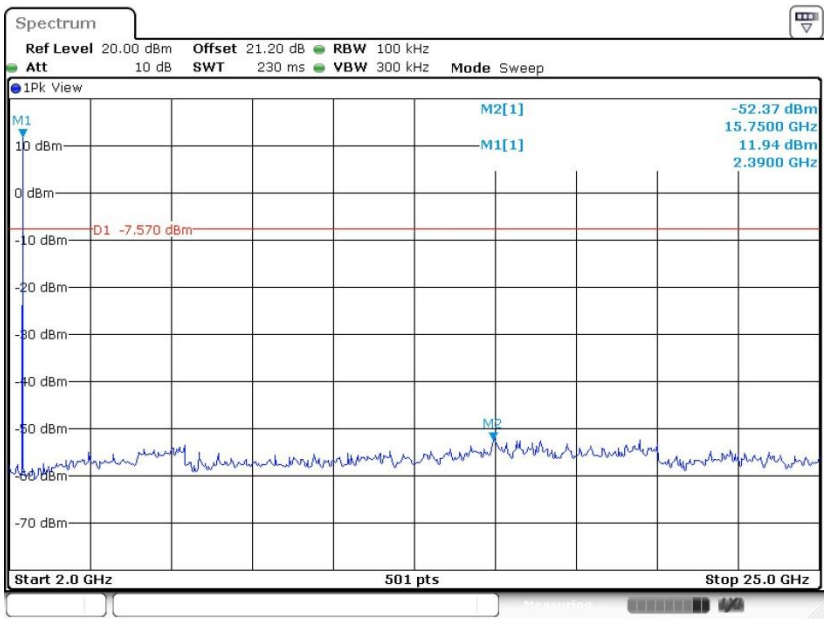
GFSK Channel 00



Date: 12.FEB.2020 14:25:53

Conducted Spurious Emission Plot on Bluetooth LE 1Mbps

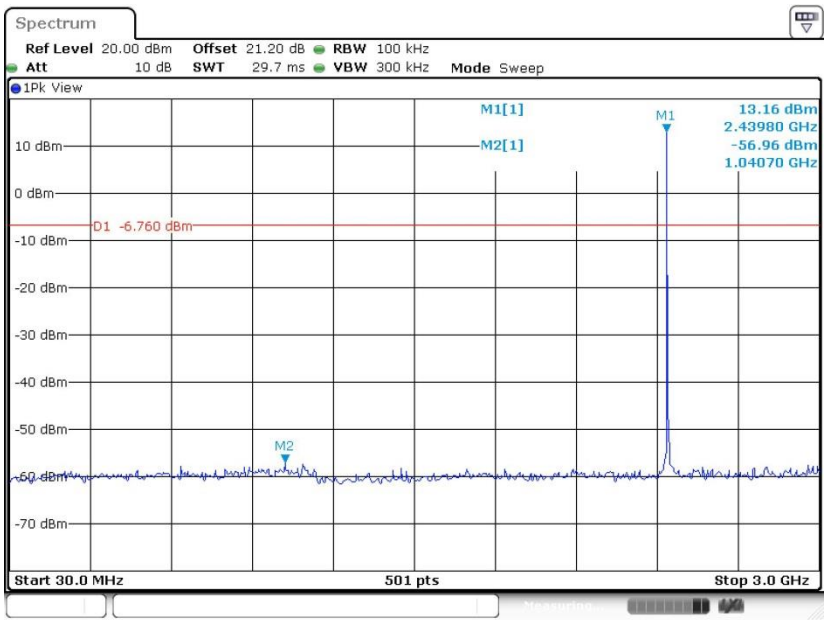
GFSK Channel 00



Date: 12.FEB.2020 14:26:05

Conducted Spurious Emission Plot on Bluetooth LE 1Mbps

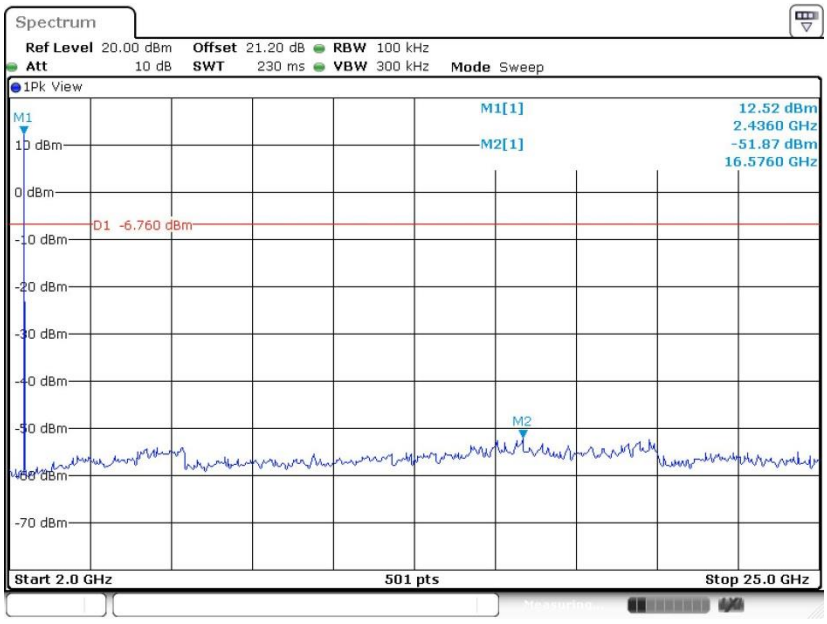
GFSK Channel 19



Date: 12.FEB.2020 14:30:55

Conducted Spurious Emission Plot on Bluetooth LE 1Mbps

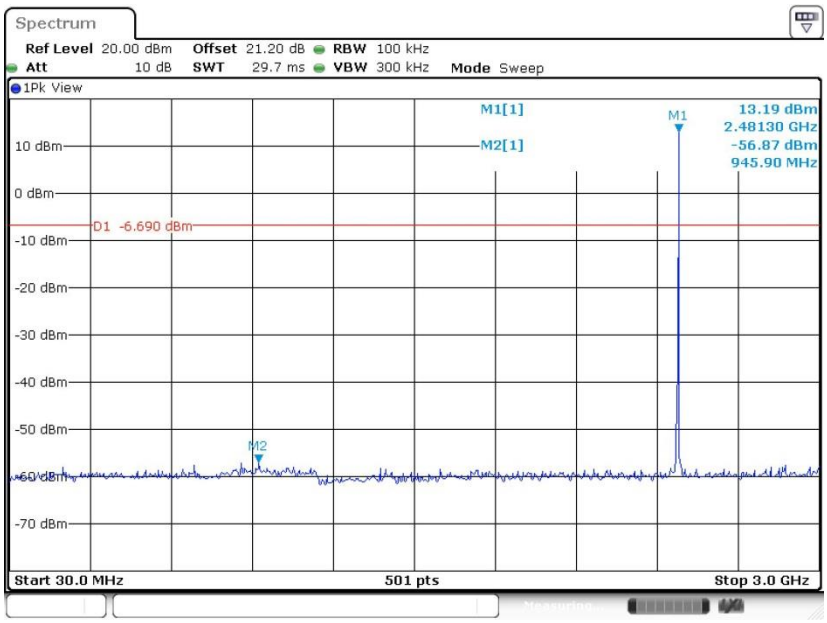
GFSK Channel 19



Date: 12.FEB.2020 14:31:08

Conducted Spurious Emission Plot on Bluetooth LE 1Mbps

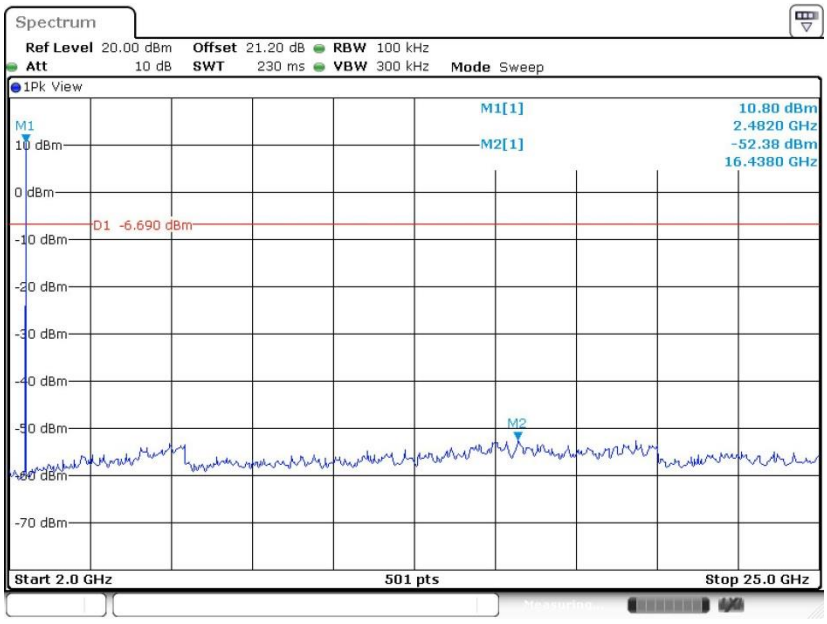
GFSK Channel 39



Date: 12.FEB.2020 14:34:08

Conducted Spurious Emission Plot on Bluetooth LE 1Mbps

GFSK Channel 39

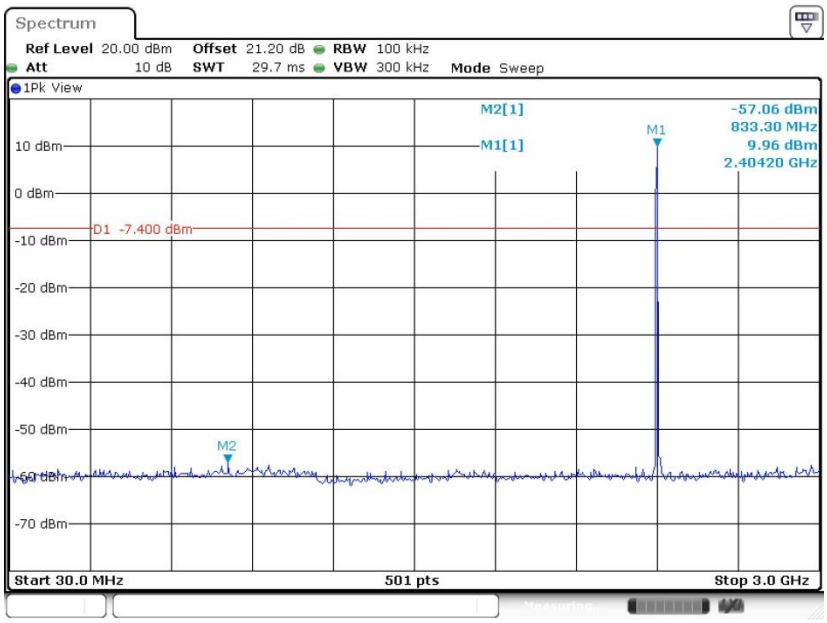


Date: 12.FEB.2020 14:34:20

Bluetooth v5.1 LE For Ant1:

Conducted Spurious Emission Plot on Bluetooth LE 1Mbps

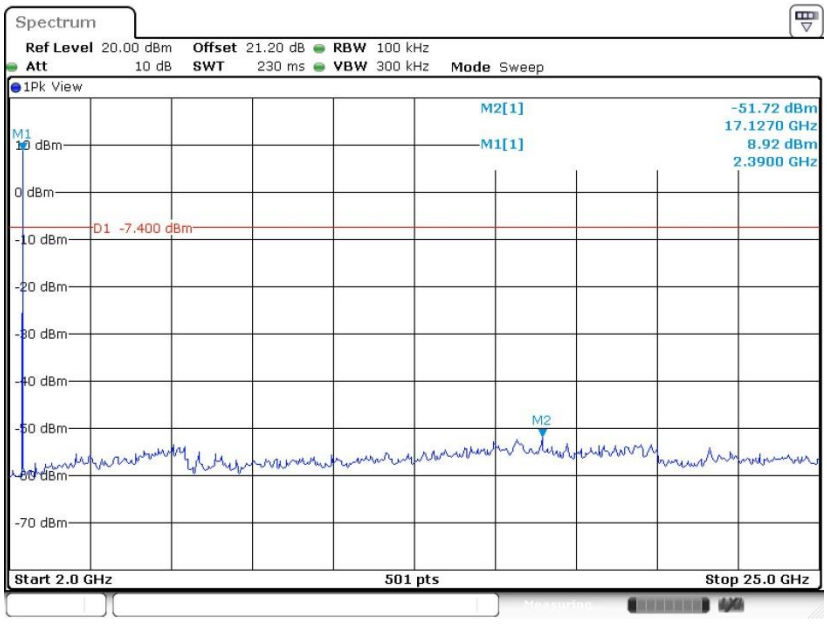
GFSK Channel 00



Date: 12.FEB.2020 14:54:43

Conducted Spurious Emission Plot on Bluetooth LE 1Mbps

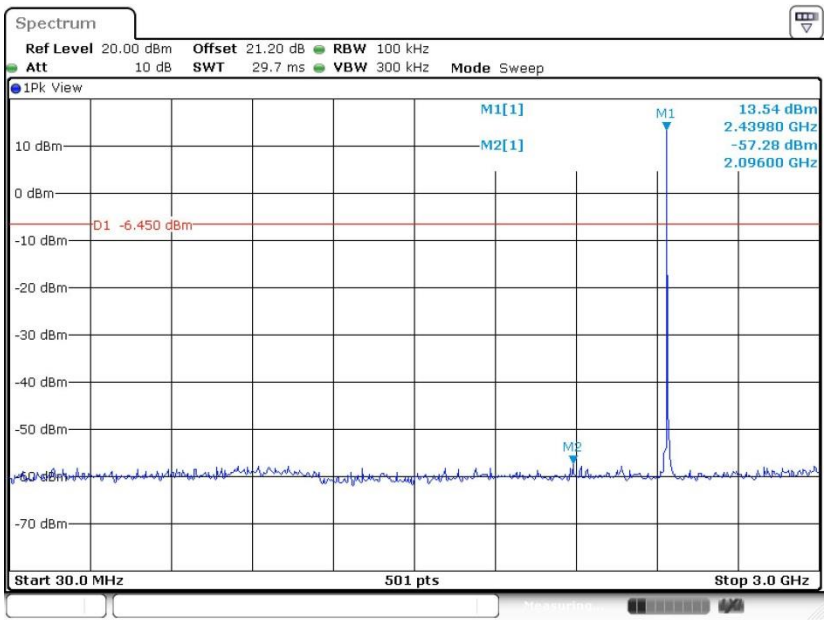
GFSK Channel 00



Date: 12.FEB.2020 14:55:34

Conducted Spurious Emission Plot on Bluetooth LE 1Mbps

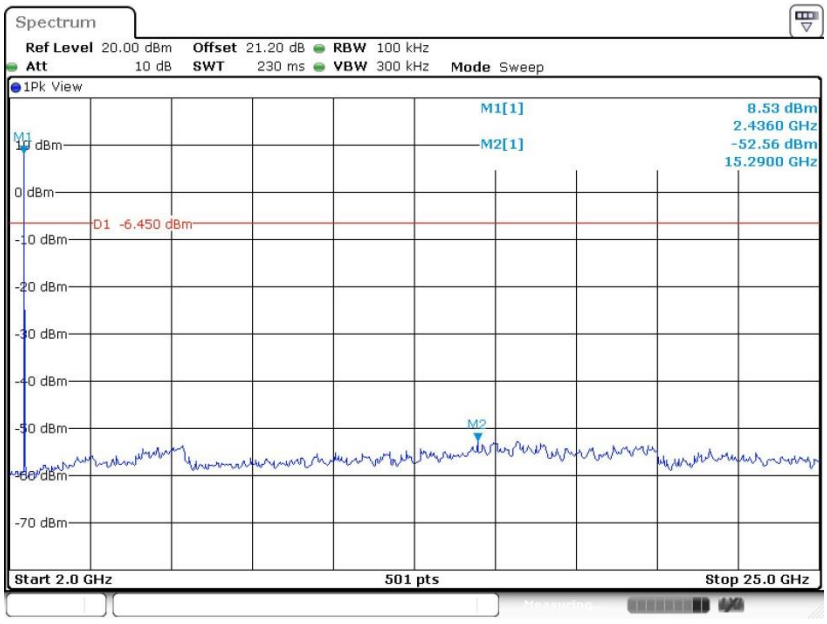
GFSK Channel 19



Date: 12.FEB.2020 15:12:08

Conducted Spurious Emission Plot on Bluetooth LE 1Mbps

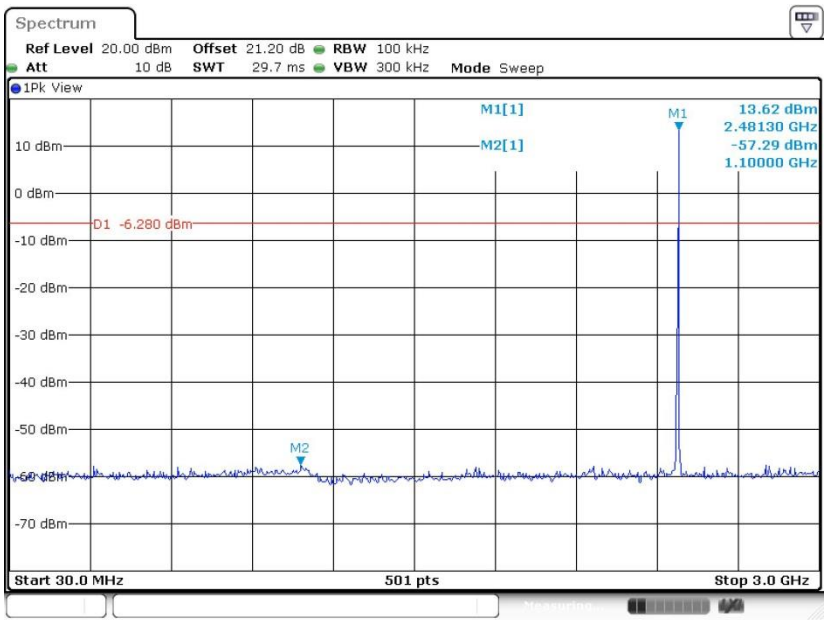
GFSK Channel 19



Date: 12.FEB.2020 15:12:20

Conducted Spurious Emission Plot on Bluetooth LE 1Mbps

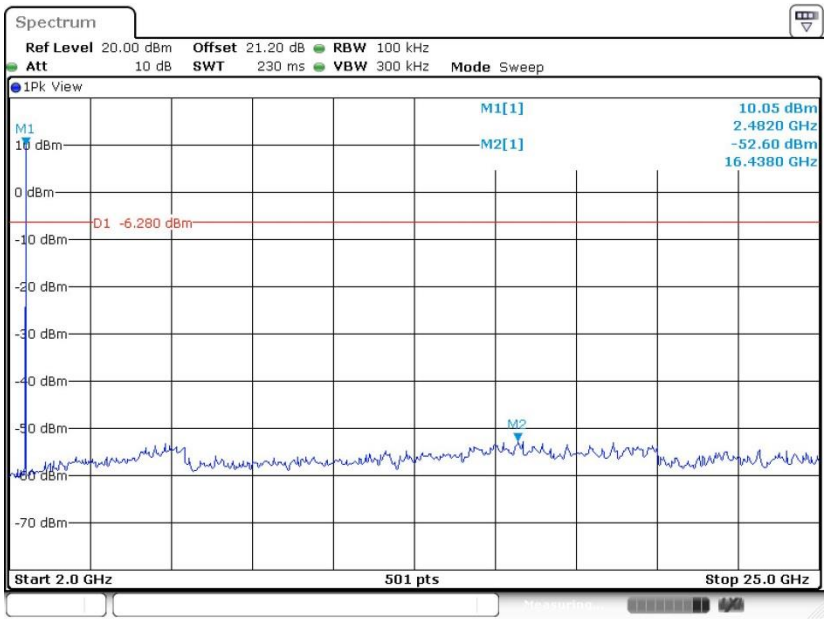
GFSK Channel 39



Date: 12.FEB.2020 15:17:57

Conducted Spurious Emission Plot on Bluetooth LE 1Mbps

GFSK Channel 39

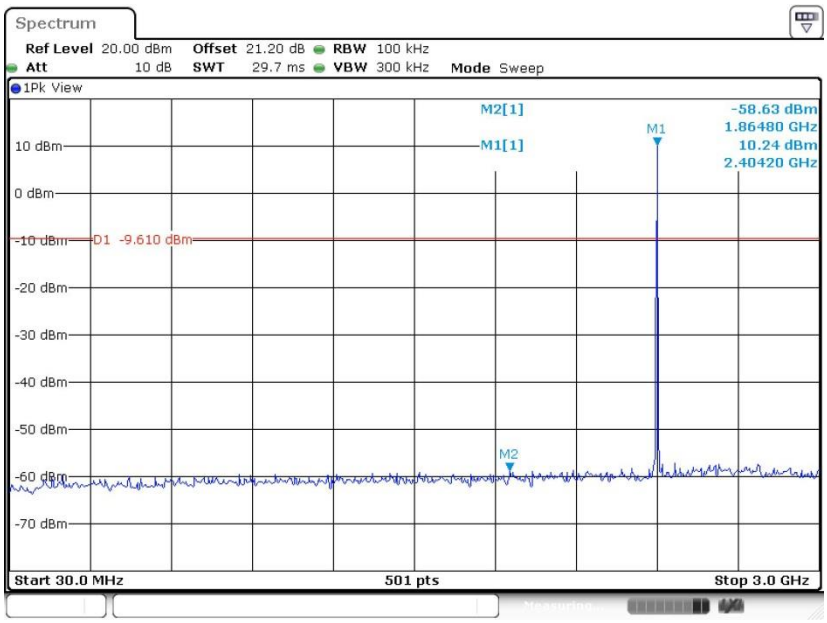


Date: 12.FEB.2020 15:18:09

Bluetooth v4.2 LE For Ant2:

Conducted Spurious Emission Plot on Bluetooth LE 1Mbps

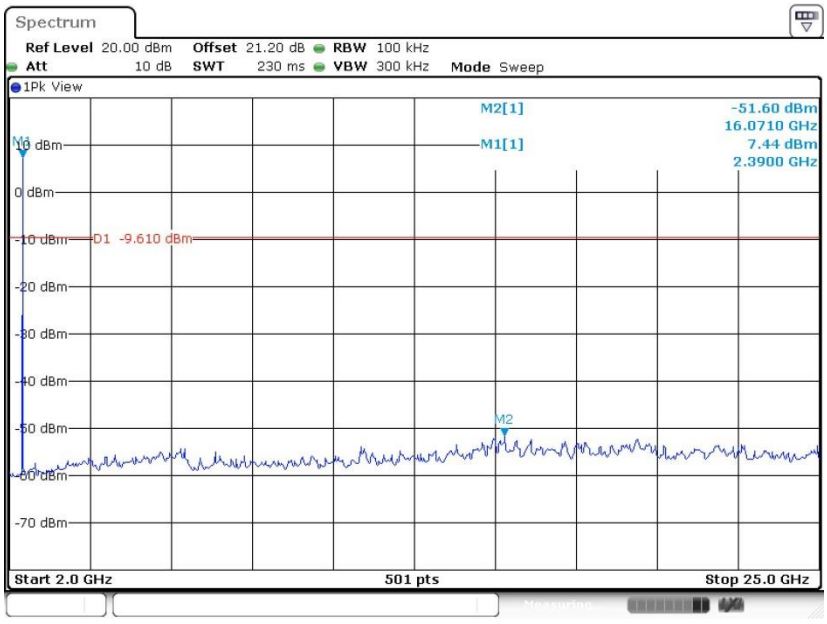
GFSK Channel 00



Date: 29.JAN.2020 17:16:30

Conducted Spurious Emission Plot on Bluetooth LE 1Mbps

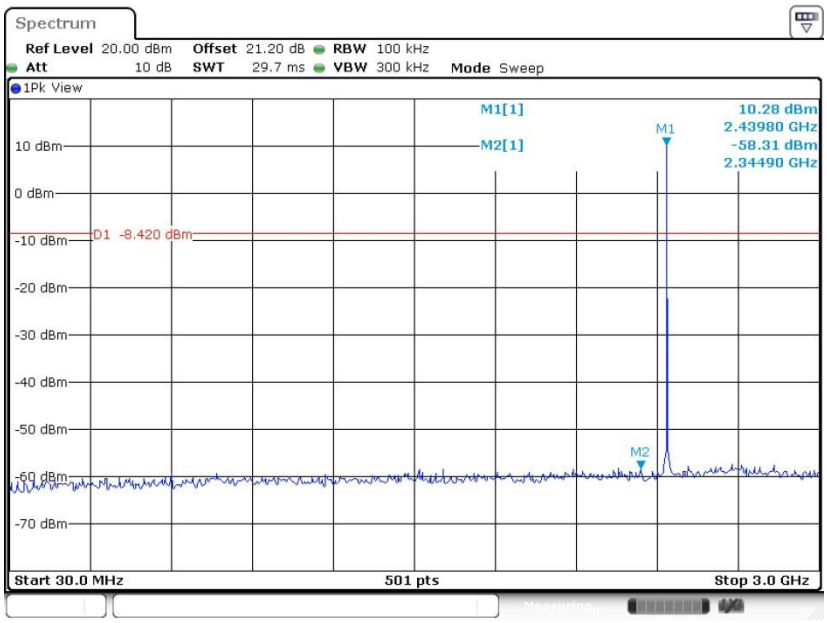
GFSK Channel 00



Date: 29.JAN.2020 17:16:43

Conducted Spurious Emission Plot on Bluetooth LE 1Mbps

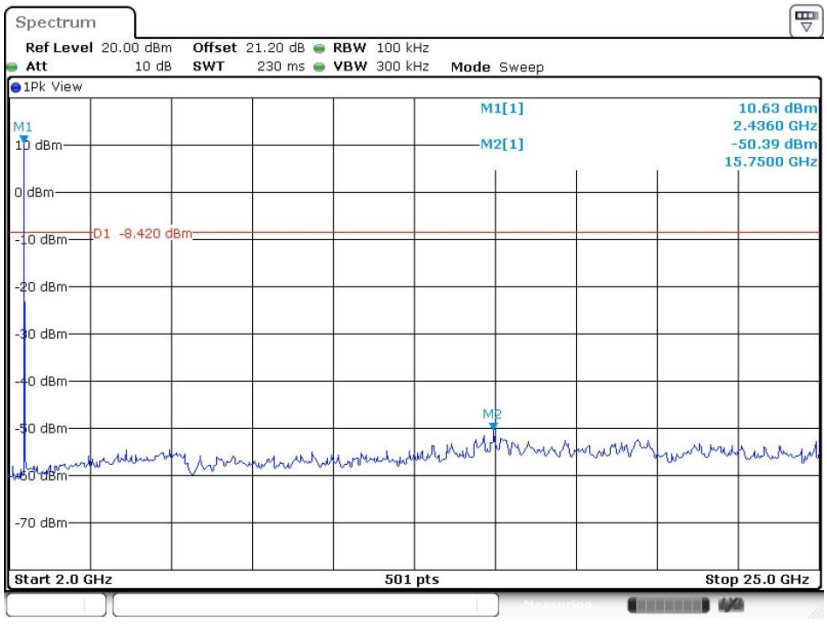
GFSK Channel 19



Date: 29.JAN.2020 17:21:20

Conducted Spurious Emission Plot on Bluetooth LE 1Mbps

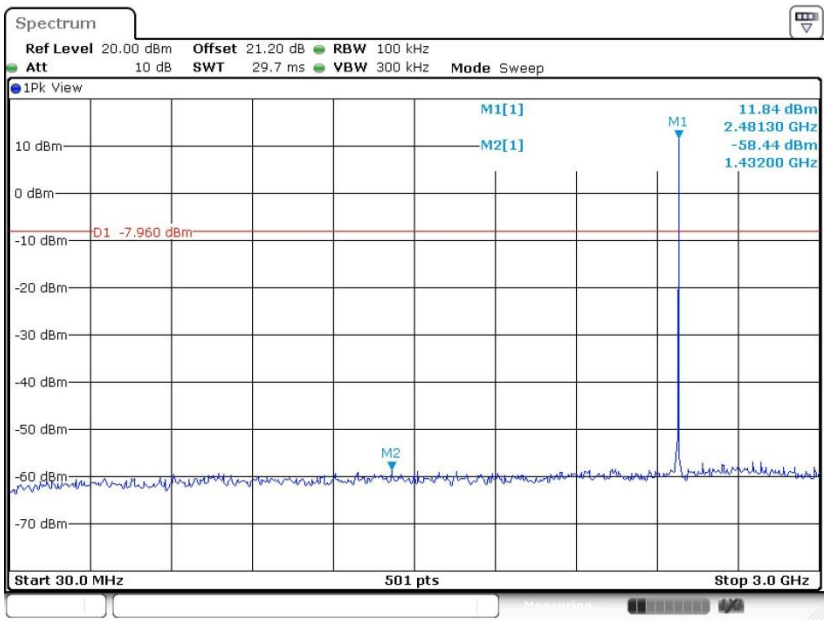
GFSK Channel 19



Date: 29.JAN.2020 17:21:34

Conducted Spurious Emission Plot on Bluetooth LE 1Mbps

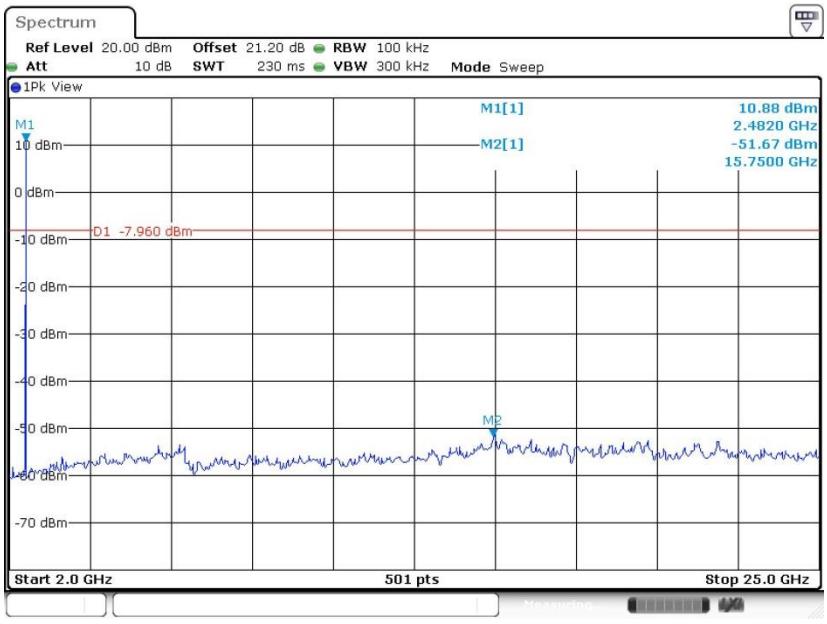
GFSK Channel 39



Date: 29.JAN.2020 17:26:08

Conducted Spurious Emission Plot on Bluetooth LE 1Mbps

GFSK Channel 39

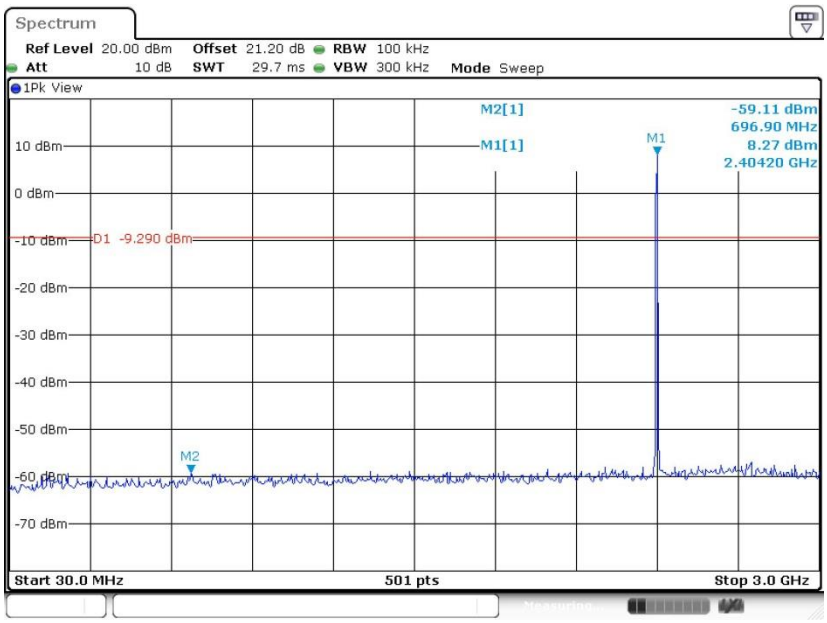


Date: 29.JAN.2020 17:26:50

Bluetooth v5.1 LE For Ant2:

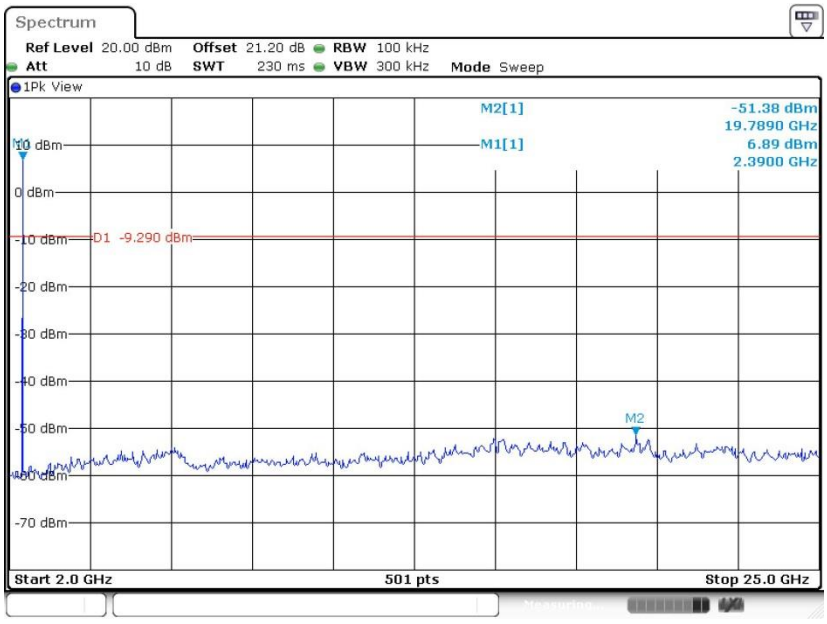
Conducted Spurious Emission Plot on Bluetooth LE 1Mbps

GFSK Channel 00



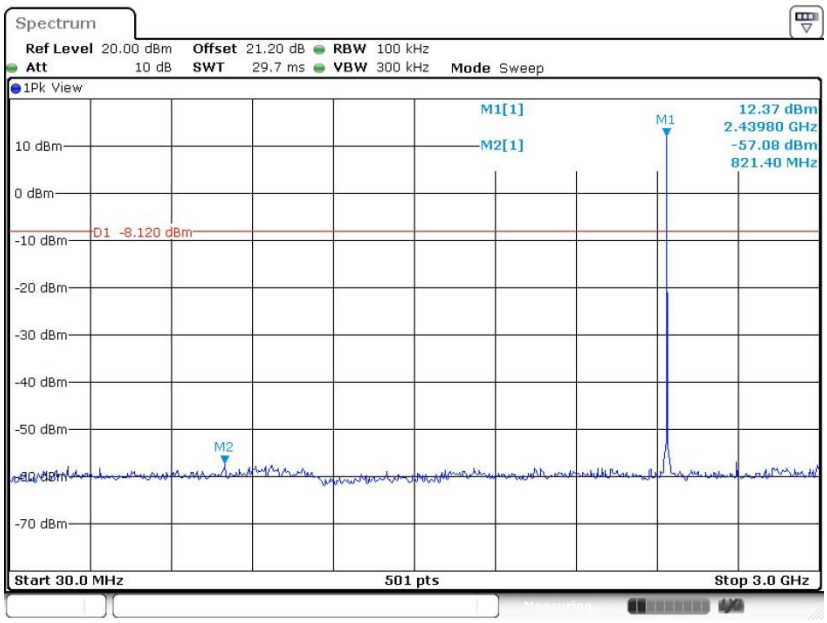
Conducted Spurious Emission Plot on Bluetooth LE 1Mbps

GFSK Channel 00



Conducted Spurious Emission Plot on Bluetooth LE 1Mbps

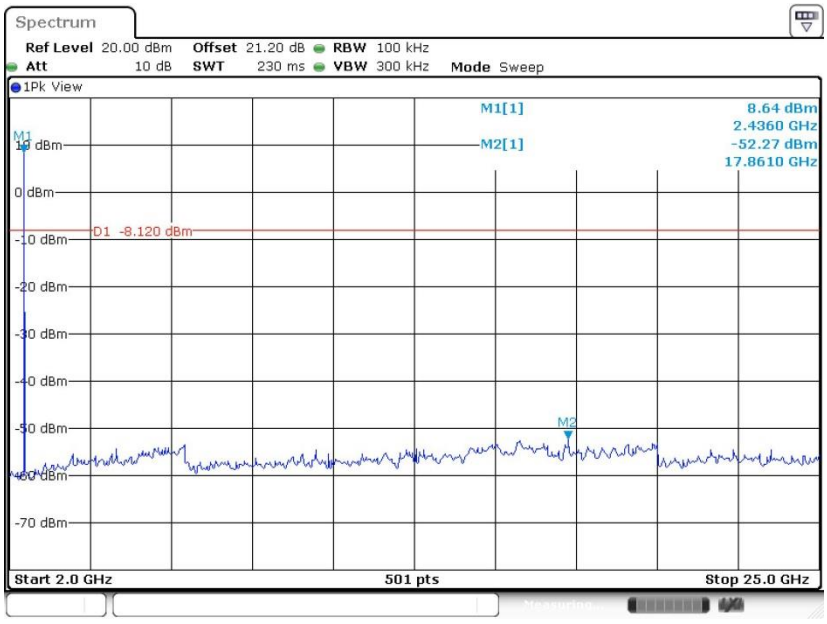
GFSK Channel 19



Date: 23.FEB.2020 12:55:08

Conducted Spurious Emission Plot on Bluetooth LE 1Mbps

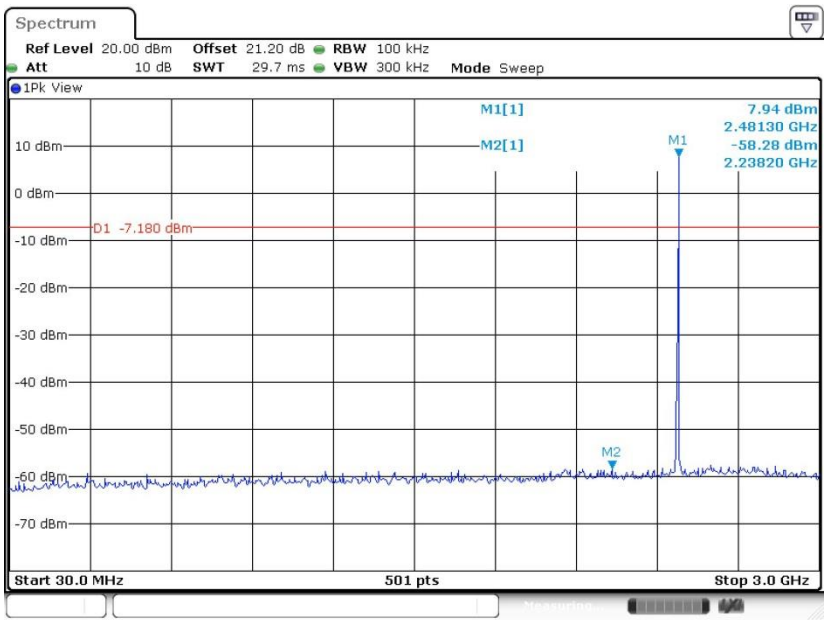
GFSK Channel 19



Date: 23.FEB.2020 12:55:24

Conducted Spurious Emission Plot on Bluetooth LE 1Mbps

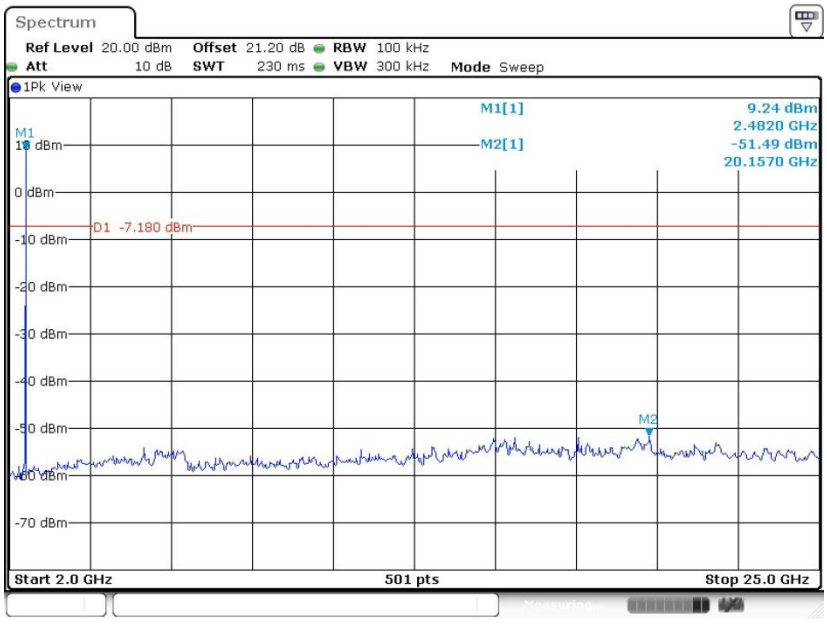
GFSK Channel 39



Date: 30.JAN.2020 11:00:08

Conducted Spurious Emission Plot on Bluetooth LE 1Mbps

GFSK Channel 39



Date: 30.JAN.2020 11:00:22

3.5 Radiated Band Edges and Spurious Emission Measurement

3.5.1 Limit of Radiated Band Edges and Spurious Emission

In any 100 kHz bandwidth outside the intentional radiator frequency band, all harmonics/spurious must be at least 20 dB below the highest emission level within the authorized band. If the output power of this device was measured by spectrum analyzer, the attenuation under this paragraph shall be 30 dB instead of 20 dB. In addition, radiated emissions which fall in the restricted bands must also comply with the limits as below.

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
Above 960	500	3

3.5.2 Measuring Instruments

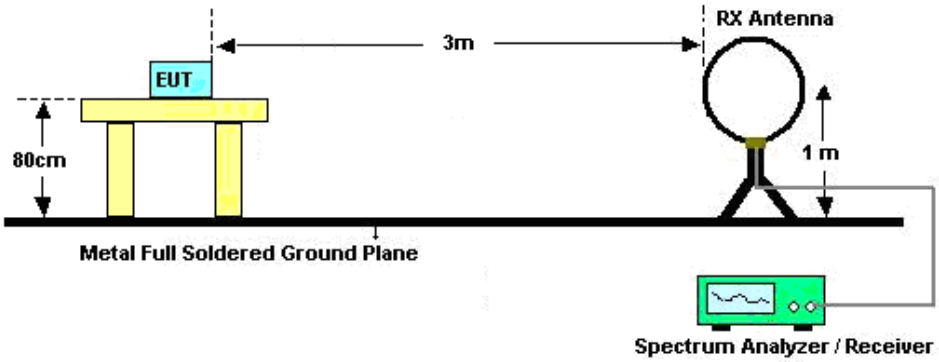
The section 4.0 of List of Measuring Equipment of this test report is used for test.

3.5.3 Test Procedures

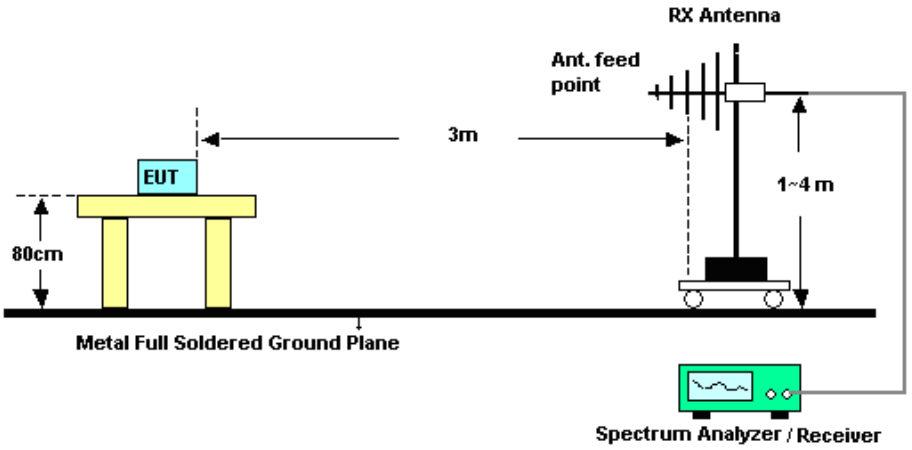
1. The testing follows ANSI C63.10-2013 clause 11.11 & 11.12
2. The EUT was arranged to its worst case and then tune the antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level.
3. The EUT was placed on a turntable with 0.8 meter for frequency below 1GHz and 1.5 meter for frequency above 1GHz respectively 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. Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level
6. For testing below 1GHz, if the emission level of the EUT in peak mode was 3 dB lower than the limit specified, then peak values of EUT will be reported, otherwise, the emissions will be repeated one by one using the CISPR quasi-peak method and reported.
7. For testing above 1GHz, the emission level of the EUT in peak mode was 20dB lower than average limit (that means the emission level in average mode also complies with the limit in average mode), then peak values of EUT will be reported, otherwise, the emissions will be measured in average mode again and reported.
8. Use the following spectrum analyzer settings:
   (1) Span shall wide enough to fully capture the emission being measured;
   (2) Set RBW=100 kHz for f < 1 GHz; VBW ≥ RBW; Sweep = auto; Detector function = peak; Trace = max hold;
   (3) Set RBW = 1 MHz, VBW= 3MHz for f ≥ 1 GHz for peak measurement.
   For average measurement:
   - VBW = 10 Hz, when duty cycle is no less than 98 percent.
   - VBW ≥ 1/T, when duty cycle is less than 98 percent where T is the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation.

3.5.4 Test Setup

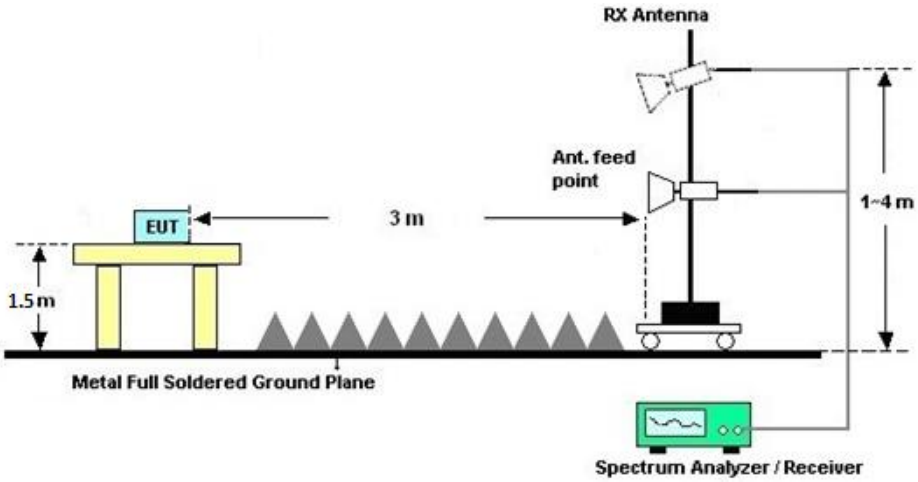
For radiated emissions below 30MHz



For radiated emissions from 30MHz to 1GHz



For radiated emissions above 1GHz



3.5.5 Test Results of Radiated Spurious Emissions (9 kHz ~ 30 MHz)

The low frequency, which started from 9 kHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit line was not reported.

There is a comparison data of both open-field test site and semi-Anechoic chamber, and the result came out very similar.

3.5.6 Test Result of Radiated Spurious at Band Edges

Please refer to Appendix C.

3.5.7 Duty Cycle

Please refer to Appendix D.

3.5.8 Test Result of Radiated Spurious Emission (30MHz ~ 10th Harmonic)

Please refer to Appendix C.

3.6 AC Conducted Emission Measurement

3.6.1 Limit of AC Conducted Emission

For equipment that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table.

Frequency of emission (MHz)	Conducted limit (dBμV)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

*Decreases with the logarithm of the frequency.

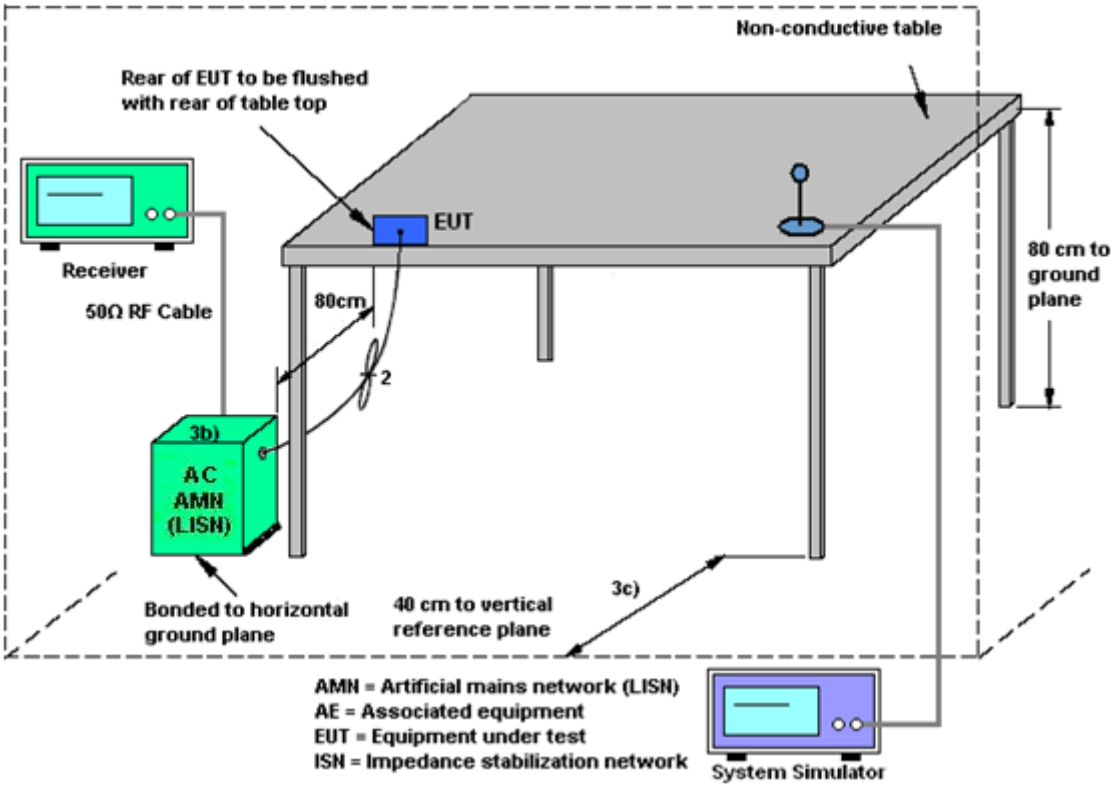
3.6.2 Measuring Instruments

The section 4.0 of List of Measuring Equipment of this test report is used for test.

3.6.3 Test Procedures

1. The EUT was placed 0.4 meter from the conducting wall of the shielding room was kept at least 80 centimeters from any other grounded conducting surface.
2. Connect EUT to the power mains through a line impedance stabilization network (LISN).
3. All the support units are connecting to the other LISN.
4. The LISN provides 50 ohm coupling impedance for the measuring instrument.
5. The FCC states that a 50 ohm, 50 microhenry LISN should be used.
6. Both sides of AC line were checked for maximum conducted interference.
7. The frequency range from 150 kHz to 30 MHz was searched.
8. Set the test-receiver system to Peak Detect Function and specified bandwidth (IF Bandwidth = 9kHz) with Maximum Hold Mode. Then measurement is also conducted by Average Detector and Quasi-Peak Detector Function respectively.

3.6.4 Test Setup



3.6.5 Test Result of AC Conducted Emission

Please refer to Appendix B.

3.7 Antenna Requirements

3.7.1 Standard Applicable

If directional gain of transmitting antennas is greater than 6dBi, the power shall be reduced by the same level in dB comparing to gain minus 6dBi. 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 rule.

3.7.2 Antenna Anti-Replacement Construction

An embedded-in antenna design is used.

3.7.3 Antenna Gain

The antenna peak gain of EUT is less than 6 dBi. Therefore, it is not necessary to reduce maximum peak output power limit.

4 List of Measuring Equipment

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Test Date	Due Date	Remark
Spectrum Analyzer	R&S	FSV40	101078	10Hz~40GHz	Apr. 18, 2019	Jan. 17, 2020~ Feb. 23, 2020	Apr. 17, 2020	Conducted (TH01-SZ)
Pulse Power Senor	Anritsu	MA2411B	1207253	30MHz~40GHz	Dec. 26, 2019	Jan. 17, 2020~ Feb. 23, 2020	Dec. 25, 2020	Conducted (TH01-SZ)
Power Meter	Anritsu	ML2495A	1218010	50MHz Bandwidth	Dec. 26, 2019	Jan. 17, 2020~ Feb. 23, 2020	Dec. 25, 2020	Conducted (TH01-SZ)
EMI Test Receiver&SA	KEYSIGHT	N9038A	MY54450083	20Hz~8.4GHz	Apr. 18, 2019	Mar. 03, 2020	Apr. 17, 2020	Radiation (03CH03-SZ)
EXA Spectrum Anaiyzer	KEYSIGHT	N9010A	MY55150246	10Hz~44GHz;	Apr. 18, 2019	Mar. 03, 2020	Apr. 17, 2020	Radiation (03CH03-SZ)
Loop Antenna	R&S	HFH2-Z2	100354	9kHz~30MHz	May 29, 2019	Mar. 03, 2020	May 28, 2020	Radiation (03CH03-SZ)
Bilog Antenna	TeseQ	CBL6112D	35408	30MHz-2GHz	Apr. 19, 2019	Mar. 03, 2020	Apr. 18, 2020	Radiation (03CH03-SZ)
Double Ridge Horn Antenna	SCHWARZBECK	BBHA9120D	9120D-1355	1GHz~18GHz	Apr. 01 2019	Mar. 03, 2020	Mar. 31, 2020	Radiation (03CH03-SZ)
HF Amplifier	MITEQ	TTA1840-35-HG	1871923	18GHz~40GHz	Jul. 22, 2019	Mar. 03, 2020	Jul. 21, 2020	Radiation (03CH03-SZ)
SHF-EHF Horn	com-power	AH-840	101071	18Ghz-40GHz	Apr. 18, 2019	Mar. 03, 2020	Apr. 17, 2020	Radiation (03CH03-SZ)
Amplifier	Burgeon	BPA-530	102210	0.01Hz ~3000MHz	Oct. 18, 2019	Mar. 03, 2020	Oct. 17, 2020	Radiation (03CH03-SZ)
HF Amplifier	MITEQ	AMF-7D-00101800-30-10P-R	1943528	1GHz~18GHz	Oct. 18, 2019	Mar. 03, 2020	Oct. 17, 2020	Radiation (03CH03-SZ)
Amplifier	Agilent Technologies	83017A	MY39501302	500MHz~26.5GHz	Dec. 23, 2019	Mar. 03, 2020	Dec. 22, 2020	Radiation (03CH03-SZ)
AC Power Source	Chroma	61601	616010001985	N/A	NCR	Mar. 03, 2020	NCR	Radiation (03CH03-SZ)
Turn Table	EM	EM1000	N/A	0~360 degree	NCR	Mar. 03, 2020	NCR	Radiation (03CH03-SZ)
EMI Receiver	R&S	ESR7	101630	9kHz~7GHz;	Dec. 26, 2019	Jan. 12, 2020	Dec. 25, 2020	Conduction (CO01-SZ)
AC LISN	EMCO	3816/2SH	00103912	9kHz~30MHz	Oct. 17, 2019	Jan. 12, 2020	Oct. 16, 2020	Conduction (CO01-SZ)
AC LISN (for auxiliary equipment)	EMCO	3816/2SH	00103892	9kHz~30MHz	Dec. 26, 2019	Jan. 12, 2020	Dec. 25, 2020	Conduction (CO01-SZ)
AC Power Source	Chroma	61602	616020000891	100Vac~250Vac	Jul. 23, 2019	Jan. 12, 2020	Jul. 22, 2020	Conduction (CO01-SZ)

NCR: No Calibration Required

5 Uncertainty of Evaluation

The measurement uncertainties shown below were calculated in accordance with the requirements of ANSI 63.10-2013. All the measurement uncertainty value were shown with a coverage K=2 to indicate 95% level of confidence. The measurement data show herein meets or exceeds the CISPR measurement uncertainty values specified in CISPR 16-4-2 and can be compared directly to specified limit to determine compliance.

Uncertainty of Conducted Emission Measurement (150 kHz ~ 30 MHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**2.6dB**

Uncertainty of Radiated Emission Measurement (30 MHz ~ 1000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**5.0dB**

Uncertainty of Radiated Emission Measurement (1000 MHz ~ 18000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**4.8dB**

Uncertainty of Radiated Emission Measurement (18000 MHz ~ 40000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**4.6dB**

Appendix A. Conducted Test Results

Bluetooth v4.2 LE For Ant1:

Test Engineer:	Zhang Jiang	Temperature:	21~25	°C
Test Date:	2020/1/17~2020/2/23	Relative Humidity:	51~54	%

TEST RESULTS DATA
6dB and 99% Occupied Bandwidth

Mod.	Data Rate	NTX	CH.	Freq. (MHz)	99% Occupied BW (MHz)	6dB BW (MHz)	6dB BW Limit (MHz)	Pass/Fail
BLE	1Mbps	1	0	2402	1.013	0.669	0.50	Pass
BLE	1Mbps	1	19	2440	1.013	0.667	0.50	Pass
BLE	1Mbps	1	39	2480	1.013	0.667	0.50	Pass

TEST RESULTS DATA
Peak Power Table

Mod.	Data Rate	NTX	CH.	Freq. (MHz)	Peak Conducted Power (dBm)	Conducted Power Limit (dBm)	DG (dBi)	EIRP Power (dBm)	EIRP Power Limit (dBm)	Pass /Fail
BLE	1Mbps	1	0	2402	8.30	30.00	-2.80	5.50	36.00	Pass
BLE	1Mbps	1	19	2440	9.21	30.00	-2.80	6.41	36.00	Pass
BLE	1Mbps	1	39	2480	9.24	30.00	-2.80	6.44	36.00	Pass

TEST RESULTS DATA
AVG Power Table
(Reporting Only)

Mod.	Data Rate	NTX	CH.	Freq. (MHz)	Duty Factor (dB)	Conducted Power (dBm)
BLE	1Mbps	1	0	2402	2.09	7.80
BLE	1Mbps	1	19	2440	2.09	8.70
BLE	1Mbps	1	39	2480	2.09	8.70

TEST RESULTS DATA
Peak Power Density

Mod.	Data Rate	NTX	CH.	Freq. (MHz)	Peak PSD (dBm /100kHz)	Peak PSD (dBm /3kHz)	DG (dBi)	Peak PSD Limit (dBm /3kHz)	Pass/Fail
BLE	1Mbps	1	0	2402	12.43	-2.07	-2.80	8.00	Pass
BLE	1Mbps	1	19	2440	13.24	-1.26	-2.80	8.00	Pass
BLE	1Mbps	1	39	2480	13.31	-1.15	-2.80	8.00	Pass

Note: PSD (dBm/ 100kHz) is a reference level used for Conducted Band Edges and Conducted Spurious Emission 20dBc limit.

Bluetooth LE v5.1 For Ant1:

Test Engineer:	Zhang Jiang	Temperature:	21~25	°C
Test Date:	2020/1/17~2020/2/23	Relative Humidity:	51~54	%

TEST RESULTS DATA
6dB and 99% Occupied Bandwidth

Mod.	Data Rate	NTx	CH.	Freq. (MHz)	99% Occupied BW (MHz)	6dB BW (MHz)	6dB BW Limit (MHz)	Pass/Fail
BLE5.1	2Mbps	1	0	2402	1.990	1.143	0.50	Pass
BLE5.1	2Mbps	1	19	2440	1.990	1.143	0.50	Pass
BLE5.1	2Mbps	1	39	2480	1.986	1.147	0.50	Pass

TEST RESULTS DATA
Peak Power Table

Mod.	Data Rate	NTx	CH.	Freq. (MHz)	Peak Conducted Power (dBm)	Conducted Power Limit (dBm)	DG (dBi)	EIRP Power (dBm)	EIRP Power Limit (dBm)	Pass /Fail
BLE5.1	2Mbps	1	0	2402	8.65	30.00	-2.80	5.85	36.00	Pass
BLE5.1	2Mbps	1	19	2440	9.62	30.00	-2.80	6.82	36.00	Pass
BLE5.1	2Mbps	1	39	2480	9.67	30.00	-2.80	6.87	36.00	Pass

TEST RESULTS DATA
Avg Power Table
(Reporting Only)

Mod.	Data Rate	NTx	CH.	Freq. (MHz)	Duty Factor (dB)	Conducted Power (dBm)
BLE5.1	2Mbps	1	0	2402	4.91	7.90
BLE5.1	2Mbps	1	19	2440	4.91	8.80
BLE5.1	2Mbps	1	39	2480	4.91	8.80

TEST RESULTS DATA
Peak Power Density

Mod.	Data Rate	NTx	CH.	Freq. (MHz)	Peak PSD (dBm /100kHz)	Peak PSD (dBm /3kHz)	DG (dBi)	Peak PSD Limit (dBm /3kHz)	Pass/Fail
BLE5.1	2Mbps	1	0	2402	12.60	-4.63	-2.80	8.00	Pass
BLE5.1	2Mbps	1	19	2440	13.55	-3.70	-2.80	8.00	Pass
BLE5.1	2Mbps	1	39	2480	13.72	-3.55	-2.80	8.00	Pass

Note: PSD (dBm/ 100kHz) is a reference level used for Conducted Band Edges and Conducted Spurious Emission 20dBc limit.

Bluetooth v4.2 LE For Ant2:

Test Engineer:	Zhang Jiang	Temperature:	21~25	°C
Test Date:	2020/1/17~2020/2/23	Relative Humidity:	51~54	%

TEST RESULTS DATA
6dB and 99% Occupied Bandwidth

Mod.	Data Rate	NTx	CH.	Freq. (MHz)	99% Occupied BW (MHz)	6dB BW (MHz)	6dB BW Limit (MHz)	Pass/Fail
BLE	1Mbps	1	0	2402	1.015	0.667	0.50	Pass
BLE	1Mbps	1	19	2440	1.013	0.667	0.50	Pass
BLE	1Mbps	1	39	2480	1.013	0.667	0.50	Pass

TEST RESULTS DATA
Peak Power Table

Mod.	Data Rate	NTx	CH.	Freq. (MHz)	Peak Conducted Power (dBm)	Conducted Power Limit (dBm)	DG (dBi)	EIRP Power (dBm)	EIRP Power Limit (dBm)	Pass /Fail
BLE	1Mbps	1	0	2402	3.21	30.00	-3.00	0.21	36.00	Pass
BLE	1Mbps	1	19	2440	3.62	30.00	-3.00	0.62	36.00	Pass
BLE	1Mbps	1	39	2480	3.58	30.00	-3.00	0.58	36.00	Pass

TEST RESULTS DATA
Avg Power Table
(Reporting Only)

Mod.	Data Rate	NTx	CH.	Freq. (MHz)	Duty Factor (dB)	Conducted Power (dBm)
BLE	1Mbps	1	0	2402	2.09	2.60
BLE	1Mbps	1	19	2440	2.09	3.00
BLE	1Mbps	1	39	2480	2.09	2.90

TEST RESULTS DATA
Peak Power Density

Mod.	Data Rate	NTx	CH.	Freq. (MHz)	Peak PSD (dBm /100kHz)	Peak PSD (dBm /3kHz)	DG (dBi)	Peak PSD Limit (dBm /3kHz)	Pass/Fail
BLE	1Mbps	1	0	2402	10.39	-3.62	-3.00	8.00	Pass
BLE	1Mbps	1	19	2440	11.58	-2.76	-3.00	8.00	Pass
BLE	1Mbps	1	39	2480	12.04	-2.29	-3.00	8.00	Pass

Note: PSD (dBm/ 100kHz) is a reference level used for Conducted Band Edges and Conducted Spurious Emission 20dBc limit.

Bluetooth LE v5.1 For Ant2:

Test Engineer:	Zhang Jiang	Temperature:	21~25	°C
Test Date:	2020/1/17~2020/2/23	Relative Humidity:	51~54	%

TEST RESULTS DATA
6dB and 99% Occupied Bandwidth

Mod.	Data Rate	NTx	CH.	Freq. (MHz)	99% Occupied BW (MHz)	6dB BW (MHz)	6dB BW Limit (MHz)	Pass/Fail
BLE5.1	2Mbps	1	0	2402	1.990	1.155	0.50	Pass
BLE5.1	2Mbps	1	19	2440	1.990	1.147	0.50	Pass
BLE5.1	2Mbps	1	39	2480	1.986	1.143	0.50	Pass

TEST RESULTS DATA
Peak Power Table

Mod.	Data Rate	NTx	CH.	Freq. (MHz)	Peak Conducted Power (dBm)	Conducted Power Limit (dBm)	DG (dBi)	EIRP Power (dBm)	EIRP Power Limit (dBm)	Pass /Fail
BLE5.1	2Mbps	1	0	2402	3.72	30.00	-3.00	0.72	36.00	Pass
BLE5.1	2Mbps	1	19	2440	4.12	30.00	-3.00	1.12	36.00	Pass
BLE5.1	2Mbps	1	39	2480	4.03	30.00	-3.00	1.03	36.00	Pass

TEST RESULTS DATA
Avg Power Table
(Reporting Only)

Mod.	Data Rate	NTx	CH.	Freq. (MHz)	Duty Factor (dB)	Conducted Power (dBm)
BLE5.1	2Mbps	1	0	2402	4.92	2.70
BLE5.1	2Mbps	1	19	2440	4.92	3.10
BLE5.1	2Mbps	1	39	2480	4.92	2.90

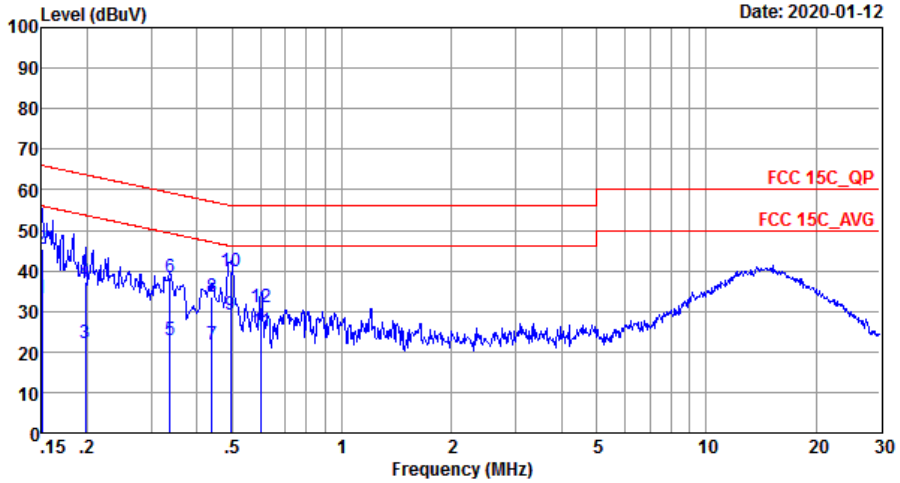
TEST RESULTS DATA
Peak Power Density

Mod.	Data Rate	NTx	CH.	Freq. (MHz)	Peak PSD (dBm /100kHz)	Peak PSD (dBm /3kHz)	DG (dBi)	Peak PSD Limit (dBm /3kHz)	Pass/Fail
BLE5.1	2Mbps	1	0	2402	10.71	-6.05	-3.00	8.00	Pass
BLE5.1	2Mbps	1	19	2440	11.88	-5.01	-3.00	8.00	Pass
BLE5.1	2Mbps	1	39	2480	12.82	-3.92	-3.00	8.00	Pass

Note: PSD (dBm/ 100kHz) is a reference level used for Conducted Band Edges and Conducted Spurious Emission 20dBc limit.

Appendix B. AC Conducted Emission Test Results

Test Engineer :	LiuDaLin	Temperature :	22~25℃
		Relative Humidity :	50~55%
Test Voltage :	120Vac / 60Hz	Phase :	Line

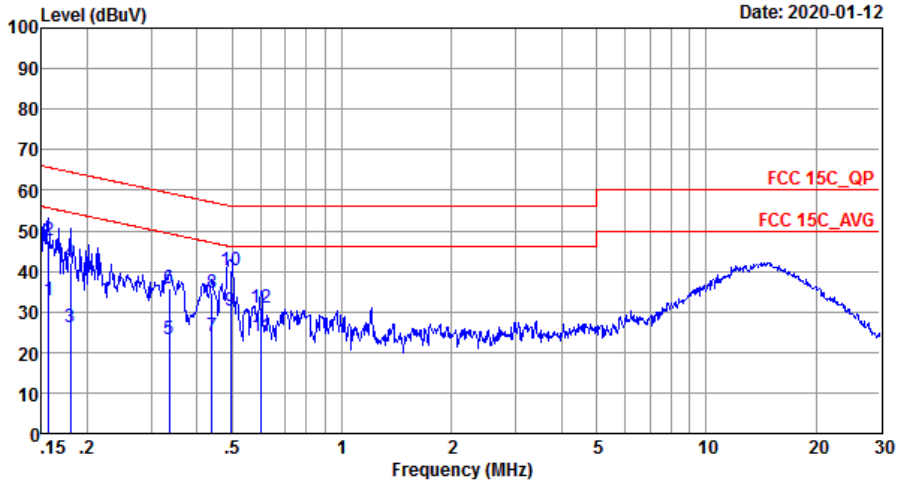


Site : CO01-SZ
Condition: FCC 15C_QP LISN_20190719_L LINE

IMEI : 865422040025876/865422040025868

		Freq	Level	Over Limit	Limit Line	Read Level	LISN Factor	Cable Loss	Remark
		MHz	dBuV	dB	dBuV	dBuV	dB	dB	
1		0.15	33.34	-22.66	56.00	23.30	0.03	10.01	Average
2		0.15	45.34	-20.66	66.00	35.30	0.03	10.01	QP
3		0.20	22.04	-31.67	53.71	12.00	0.03	10.01	Average
4		0.20	37.34	-26.37	63.71	27.30	0.03	10.01	QP
5		0.34	22.84	-26.43	49.27	12.80	0.03	10.01	Average
6		0.34	38.34	-20.93	59.27	28.30	0.03	10.01	QP
7		0.44	21.66	-25.41	47.07	11.60	0.03	10.03	Average
8		0.44	33.76	-23.31	57.07	23.70	0.03	10.03	QP
9		0.49	29.18	-16.92	46.10	19.10	0.02	10.06	Average
10	*	0.49	39.88	-16.22	56.10	29.80	0.02	10.06	QP
11		0.60	25.19	-20.81	46.00	15.10	0.02	10.07	Average
12		0.60	30.89	-25.11	56.00	20.80	0.02	10.07	QP

Test Engineer :	LiuDaLin	Temperature :	22~25℃
		Relative Humidity :	50~55%
Test Voltage :	120Vac / 60Hz	Phase :	Neutral



Site : CO01-SZ
Condition: FCC 15C_QP LISN_20190719_N NEUTRAL

IMEI : 865422040025876/865422040025868

		Freq	Level	Over Limit	Limit Line	Read Level	LISN Factor	Cable Loss	Remark
		MHz	dBuV	dB	dBuV	dBuV	dB	dB	
1		0.16	32.94	-22.71	55.65	22.90	0.03	10.01	Average
2		0.16	47.44	-18.21	65.65	37.40	0.03	10.01	QP
3		0.18	26.14	-28.36	54.50	16.10	0.03	10.01	Average
4		0.18	41.94	-22.56	64.50	31.90	0.03	10.01	QP
5		0.34	23.34	-25.97	49.31	13.30	0.03	10.01	Average
6		0.34	35.84	-23.47	59.31	25.80	0.03	10.01	QP
7		0.44	23.85	-23.22	47.07	13.80	0.02	10.03	Average
8		0.44	34.65	-22.42	57.07	24.60	0.02	10.03	QP
9		0.49	30.38	-15.72	46.10	20.30	0.02	10.06	Average
10	*	0.49	40.38	-15.72	56.10	30.30	0.02	10.06	QP
11		0.60	23.99	-22.01	46.00	13.90	0.02	10.07	Average
12		0.60	30.99	-25.01	56.00	20.90	0.02	10.07	QP

Note:

1. Level(dBμV) = Read Level(dBμV) + LISN Factor(dB) + Cable Loss(dB)
2. Over Limit(dB) = Level(dBμV) – Limit Line(dBμV)

Appendix C. Radiated Spurious Emission

2.4GHz 2400~2483.5MHz

BLE (Band Edge @ 3m)

BLE	Note	Frequency	Level	Over Limit	Limit Line	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Ant Pos	Table Pos	Peak Avg.	Pol.
		(MHz)	(dBµV/m)	(dB)	(dBµV/m)	(dBµV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
BLE CH 00 2402MHz		2386.755	48.74	-25.26	74	52.12	27.8	4.82	36	126	316	P	H
		2345.805	40.23	-13.77	54	43.59	27.88	4.78	36.02	126	316	A	H
		2402	100.7	-	-	104.06	27.8	4.82	35.98	126	316	P	H
		2402	98.3	-	-	101.66	27.8	4.82	35.98	126	316	A	H
		2326.17	48.04	-25.96	74	51.42	27.91	4.75	36.04	100	55	P	V
		2331.21	40.52	-13.48	54	43.9	27.91	4.75	36.04	100	55	A	V
		2402	98.45	-	-	101.81	27.8	4.82	35.98	100	55	P	V
		2402	97.24	-	-	100.6	27.8	4.82	35.98	100	55	A	V
BLE CH 19 2440MHz		2377.76	47.74	-26.26	74	51.13	27.83	4.78	36	130	315	P	H
		2387	40.07	-13.93	54	43.45	27.8	4.82	36	130	315	A	H
		2440	101.85	-	-	105.22	27.71	4.86	35.94	130	315	P	H
		2440	99.57	-	-	102.94	27.71	4.86	35.94	130	315	A	H
		2496.43	48.08	-25.92	74	51.45	27.63	4.9	35.9	130	315	P	H
		2499.44	40.28	-13.72	54	43.65	27.63	4.9	35.9	130	315	A	H
		2338.28	47.92	-26.08	74	51.31	27.88	4.75	36.02	112	56	P	V
		2374.54	40.59	-13.41	54	43.98	27.83	4.78	36	112	56	A	V
		2440	101	-	-	104.37	27.71	4.86	35.94	112	56	P	V
		2440	99.7	-	-	103.07	27.71	4.86	35.94	112	56	A	V
		2484.18	48	-26	74	51.36	27.66	4.9	35.92	112	56	P	V
		2496.71	40.25	-13.75	54	43.62	27.63	4.9	35.9	112	56	A	V

BLE CH 39 2480MHz		2480	101.03	-	-	104.39	27.66	4.9	35.92	125	318	P	H
		2480	99.68	-	-	103.04	27.66	4.9	35.92	125	318	A	H
		2483.88	48.98	-25.02	74	52.34	27.66	4.9	35.92	125	318	P	H
		2484.76	40.5	-13.5	54	43.86	27.66	4.9	35.92	125	318	A	H
		2480	100.69	-	-	104.05	27.66	4.9	35.92	140	300	P	V
		2480	99.37	-	-	102.73	27.66	4.9	35.92	140	300	A	V
		2483.88	48.98	-25.02	74	52.34	27.66	4.9	35.92	140	300	P	V
		2483.64	41.73	-12.27	54	45.09	27.66	4.9	35.92	140	300	A	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												

2.4GHz 2400~2483.5MHz

BLE (Harmonic @ 3m)

BLE	Note	Frequency (MHz)	Level (dBμV/m)	Over Limit (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
BLE CH 00 2402MHz		4804	41.74	-32.26	74	60.58	31.1	7.53	57.47	145	274	P	H
		4804	41.67	-32.33	74	60.51	31.1	7.53	57.47	165	232	P	V
BLE CH 19 2440MHz		4880	40.43	-33.57	74	59.2	31.17	7.58	57.52	157	201	P	H
		7320	46.51	-27.49	74	60.3	36.08	9.06	58.93	112	266	P	H
		4880	40.74	-33.26	74	59.51	31.17	7.58	57.52	138	298	P	V
		7320	45.23	-28.77	74	59.02	36.08	9.06	58.93	172	302	P	V
BLE CH 39 2480MHz		4960	41.5	-32.5	74	60.11	31.25	7.72	57.58	216	294	P	H
		7440	45.38	-28.62	74	58.84	36.44	9.08	58.98	245	174	P	H
		4960	40.6	-33.4	74	59.21	31.25	7.72	57.58	139	71	P	V
		7440	45.25	-28.75	74	58.71	36.44	9.08	58.98	110	221	P	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												

Emission below 1GHz

2.4GHz BLE (LF)

BLE	Note	Frequency	Level	Over	Limit	Read	Antenna	Cable	Preamp	Ant	Table	Peak	Pol.
				Limit	Line	Level	Factor	Loss	Factor	Pos	Pos	Avg.	
		(MHz)	(dBμV/m)	(dB)	(dBμV/m)	(dBμV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
2.4GHz BLE LF		30	23.03	-16.97	40	29.71	25.2	0.52	32.4	-	-	P	H
		107.6	22.94	-20.56	43.5	36.53	17.62	0.99	32.2	-	-	P	H
		232.73	29.45	-16.55	46	43.15	16.76	1.45	31.91	-	-	P	H
		410.24	32.87	-13.13	46	40.17	22.13	1.95	31.38	120	247	P	H
		756.53	29.01	-16.99	46	31.58	25.93	2.64	31.14	-	-	P	H
		987.39	29.6	-24.4	54	30.24	27.48	3.03	31.15	-	-	P	H
		30	30.58	-9.42	40	37.26	25.2	0.52	32.4	100	232	P	V
		56.19	24.74	-15.26	40	43.2	13.22	0.72	32.4	-	-	P	V
		97.9	25.33	-18.17	43.5	40	16.54	0.94	32.15	-	-	P	V
		159.01	24.49	-19.01	43.5	39.14	16.32	1.21	32.18	-	-	P	V
		500.45	28.42	-17.58	46	33.76	23.7	2.16	31.2	-	-	P	V
		968.96	29.51	-24.49	54	30.55	27.29	2.99	31.32	-	-	P	V
Remark	1. No other spurious found. 2. All results are PASS against limit line.												

Note symbol

*	**Fundamental Frequency** which can be ignored. However, the level of any unwanted emissions shall not exceed the level of the fundamental frequency.
!	Test result is **over limit** line.
P/A	**P**eak or **A**verage
H/V	**H**orizontal or **V**ertical

A calculation example for radiated spurious emission is shown as below:

WIFI	Note	Frequency	Level	Over	Limit	Read	Antenna	Cable	Preamp	Ant	Table	Peak	Pol.
Ant.				Limit	Line	Level	Factor	Loss	Factor	Pos	Pos	Avg.	
1+2		(MHz)	(dBμV/m)	(dB)	(dBμV/m)	(dBμV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
802.11b CH 01 2412MHz		2390	55.45	-18.55	74	54.51	32.22	4.58	35.86	103	308	P	H
		2390	43.54	-10.46	54	42.6	32.22	4.58	35.86	103	308	A	H

1. Level(dBμV/m) =

Antenna Factor(dB/m) + Cable Loss(dB) + Read Level(dBμV) - Preamp Factor(dB)

2. Over Limit(dB) = Level(dBμV/m) – Limit Line(dBμV/m)

For Peak Limit @ 2390MHz:

1. Level(dBμV/m)

= Antenna Factor(dB/m) + Cable Loss(dB) + Read Level(dBμV) - Preamp Factor(dB)

= 32.22(dB/m) + 4.58(dB) + 54.51(dBμV) – 35.86 (dB)

= 55.45 (dBμV/m)

2. Over Limit(dB)

= Level(dBμV/m) – Limit Line(dBμV/m)

= 55.45(dBμV/m) – 74(dBμV/m)

= -18.55(dB)

For Average Limit @ 2390MHz:

1. Level(dBμV/m)

= Antenna Factor(dB/m) + Cable Loss(dB) + Read Level(dBμV) - Preamp Factor(dB)

= 32.22(dB/m) + 4.58(dB) + 42.6(dBμV) – 35.86 (dB)

= 43.54 (dBμV/m)

2. Over Limit(dB)

= Level(dBμV/m) – Limit Line(dBμV/m)

= 43.54(dBμV/m) – 54(dBμV/m)

= -10.46(dB)

Both peak and average measured complies with the limit line, so test result is "PASS".

Appendix D. Duty Cycle Plots

Band	Duty Cycle(%)	T(ms)	1/T(kHz)	VBW Setting
Bluetooth LE v5.1	32.29	0.202	4.946	10KHz

Bluetooth LE v5.1