FCC RADIO TEST REPORT

FCC ID	:	**B94SNPRC2150**
Equipment	:	**802.11b/g/n (2.4GHz) Wi-Fi + BT / BLE Radio Module**
Brand Name	:	
Model Name	:	**SNPRC-2150**
Applicant	:	**HP Singapore (Private) Limited** **1 Depot Close, Singapore 109841**
Manufacturer	:	**HP Inc.** **1501 Page Mill Road, Palo Alto 94304, U.S.A. 650-857-1501**
Standard	:	**FCC Part 15 Subpart C §15.247**

The product was received on Oct. 22, 2020 and testing was started from Oct. 22, 2020 and completed on Dec. 16, 2020. We, Sporton International (USA) Inc., would like to declare that the tested sample has been evaluated in accordance with the test procedures and has been in compliance with the applicable technical standards.

The test results in this report apply exclusively to the tested model / sample. Without written approval of Sporton International (USA) Inc., the test report shall not be reproduced except in full.

Neil Kao

Approved by: Neil Kao

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History of this test report

Report No.	Version	Description	Issued Date
FR200819001B	01	Initial issue of report	Feb. 08, 2021

Summary of Bluetooth LE Test Result

Report Clause	Ref Std. Clause	Test Items	Result (PASS/FAIL)	Remark
3.1	15.247(a)(2)	6dB Bandwidth	Pass	-
3.1	2.1049	99% Occupied Bandwidth	Reporting only	-
3.2	15.247(b)(3)	Output Power	Pass	-
3.3	15.247(e)	Power Spectral Density	Pass	-
3.4	15.247(d)	Conducted Band Edges and Spurious Emission	Pass	-
3.5	15.247(d)	Radiated Band Edges and Spurious Emission	Pass	Under limit 2.52 dB at 4804.000 MHz
3.6	15.207	AC Conducted Emission	Pass	Under limit 13.83 dB at 0.511 MHz
3.7	15.203 & 15.247(b)	Antenna Requirement	Pass	-

Declaration of Conformity:
The test results with all measurement uncertainty excluded are presented in accordance with the regulation limits or requirements declared by manufacturers.
Comments and Explanations:
The declared of product specification for EUT presented in the report are provided by the manufacturer, and the manufacturer takes all the responsibilities for the accuracy of product specification.

1 General Description

1.1 Product Feature of Equipment Under Test

Product Feature	
Equipment	802.11b/g/n (2.4GHz) Wi-Fi + BT / BLE Radio Module
Brand Name	hp
Model Name	SNPRC-2150
FCC ID	B94SNPRC2150
EUT supports Radios application	WLAN 11b/g/n HT20 Bluetooth BR/EDR/LE
EUT Stage	Identical Prototype

Sample Information			
Sample	Sample 1	Sample 2	Sample 3
Labelled	0960-4992	0960-4991	0960-4977
Antenna	Main: PCB Antenna	Main: PCB Antenna	Main: PCB Antenna
	Aux.: PCB Antenna	Aux.: External Antenna with cable 300mm (or 200mm)	Aux.: PCB Antenna
Config	Miligrid / 12 pin header connector	Miliigrid / 12 pin header connector	FFC connector

Remark:

1. The EUT's information listed above is declared by manufacturer. Please refer to Comments and Explanations in report summary
2. There are two antenna cables of different lengths that can be equipped on Sample 2 (Labelled: 0960-4991), 300mm and 200mm. As per technical assessment, the cable of 200mm length equipped on Sample 2 is determined to be a worse case and tested as a representative in this report.

1.2 Product Specification of Equipment Under Test

Product Specification subjective to this standard	
Tx/Rx Frequency Range	2400 MHz ~ 2483.5 MHz (Channel 00: 2402 MHz ~ Channel 39: 2480 MHz)
Number of Channels	40
Carrier Frequency of Each Channel	40 Channel (37 hopping + 3 advertising channel)
Maximum Output Power to Antenna	**<Main Antenna for Sample 1>** 5.69 dBm (0.0037 W) **<Aux. Antenna for Sample 1>** 5.79 dBm (0.0038 W)
99% Occupied Bandwidth	**<Main Antenna for Sample 1>** 1.051 MHz **<Aux. Antenna for Sample 1>** 1.053 MHz
Antenna Gain	PCB Antenna: 4 dBi External Antenna: 0.9 dBi
Type of Modulation	Bluetooth LE : GFSK

Remark: The EUT's information listed above is declared by manufacturer. Please refer to Comments and Explanations in report summary

1.3 Modification of EUT

No modifications are made to the EUT during all test items.

1.4 Testing Location

Test Site	SPORTON INTERNATIONAL (USA) INC.		
Test Site Location	1175 Montague Expressway, Milpitas, CA 95035 TEL: (408) 904-3300		
Test Site No.	**Sporton Site No.**		
	TH01-CA	CO01-CA	03CH02-CA
Test Engineer	Andy Kao	Ram Prashanth Vallam	Calvin Wu
Temperature	20.8~23.5°C	18~21℃	19~ 22℃
Relative Humidity	43.4~45.7%	30.6~34.8%	39 ~45%

1.5 Applicable Standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

- FCC Part 15 Subpart C §15.247
- FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v05r02
- FCC KDB 414788 D01 Radiated Test Site v01r01
- ANSI C63.10-2013

Remark:

1. All test items were verified and recorded according to the standards and without any deviation during the test.
2. The TAF code is not including all the FCC KDB listed without accreditation.
3. This EUT has also been tested and complied with the requirements of FCC Part 15, Subpart B, recorded in a separate test report.

2 Test Configuration of Equipment Under Test

2.1 Carrier Frequency Channel

Frequency Band	Channel	Freq. (MHz)	Channel	Freq. (MHz)
2400-2483.5 MHz	0	2402	21	2444
	1	2404	22	2446
	2	2406	23	2448
	3	2408	24	2450
	4	2410	25	2452
	5	2412	26	2454
	6	2414	27	2456
	7	2416	28	2458
	8	2418	29	2460
	9	2420	30	2462
	10	2422	31	2464
	11	2424	32	2466
	12	2426	33	2468
	13	2428	34	2470
	14	2430	35	2472
	15	2432	36	2474
	16	2434	37	2476
	17	2436	38	2478
	18	2438	39	2480
	19	2440	-	-
	20	2442	-	-

2.2 Test Mode

a. The EUT has been associated with peripherals and configuration operated in a manner tended to maximize its emission characteristics in a typical application. Frequency range investigated: radiation emission (9 kHz to the 10th harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower). For radiated measurement, pre-scanned in three orthogonal panels, X, Y, Z. The worst cases (X plane for Main Antenna; Y Plane for Aux. Antenna) were recorded in this report.

b. AC power line Conducted Emission was tested under maximum output power.

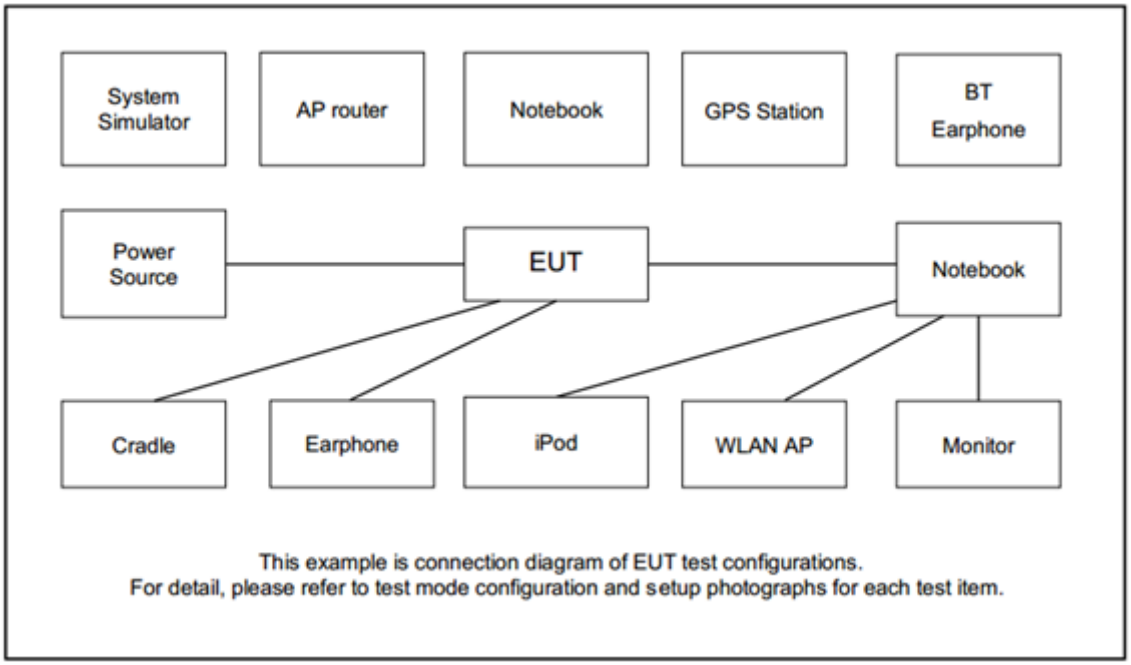
The following summary table is showing all test modes to demonstrate in compliance with the standard.

Summary table of Conducted Test Cases						
Modulation	**Mode**	**Channel**	**Frequency**	**Data Rate**	**Antenna**	**Sample**
Bluetooth – LE	Tx	CH00	2402 MHz	1Mbps	Main	1
	Tx	CH19	2440 MHz	1Mbps	Main	1
	Tx	CH39	2480 MHz	1Mbps	Main	1
	Tx	CH00	2402 MHz	1Mbps	Aux.	1
	Tx	CH19	2440 MHz	1Mbps	Aux.	1
	Tx	CH39	2480 MHz	1Mbps	Aux.	1

Summary table of Radiated Test Cases						
Modulation	**Mode**	**Channel**	**Frequency**	**Data Rate**	**Antenna**	**Sample**
Bluetooth – LE	Tx	CH00	2402 MHz	1Mbps	Main	1
	Tx	CH19	2440 MHz	1Mbps	Main	1
	Tx	CH39	2480 MHz	1Mbps	Main	1
	Tx	CH00	2402 MHz	1Mbps	Aux.	1
	Tx	CH19	2440 MHz	1Mbps	Aux.	1
	Tx	CH39	2480 MHz	1Mbps	Aux.	1
	Tx	CH39	2480 MHz	1Mbps	Main	2
	Tx	CH00	2402 MHz	1Mbps	Aux.	2
	Tx	CH19	2440 MHz	1Mbps	Aux.	2
	Tx	CH39	2480 MHz	1Mbps	Aux.	2

Summary table of AC Conducted Emission
Mode 1 : WLAN (2.4GHz) Link + Bluetooth Idle for Sample 3
Mode 2 : WLAN (2.4GHz) Idle + Bluetooth Link for Sample 3
Mode 3 : WLAN (2.4GHz) Link + Bluetooth Idle for Sample 2
Remark: The worst case of conducted emission is mode 2; only the test data of it was reported.

2.3 Connection Diagram of Test System



2.4 Support Unit used in test configuration and system

Item	Equipment	Brand Name	Model Name	FCC ID	Data Cable	Power Cord
1.	Notebook	Altos PS548 Series	82600085033	FCC DoC	N/A	AC I/P: Unshielded, 1.2 m DC O/P: Shielded, 1.8 m
2.	AP Router	NetGear	R6080	PY316400359	N/A	N/A
3.	Power Adapter	CanaKit	DCAR-052A5	N/A	N/A	Unshielded, 1..3 m with core
4.	Fixture	Raspberry Pi	N/A	N/A	N/A	N/A

2.5 EUT Operation Test Setup

The RF test items, utility “PuTTY &Release 0.70” was installed in Notebook which was programmed in order to make the EUT get into the engineering modes to provide channel selection, power level, data rate and the application type and for continuous transmitting signals.

2.6 Measurement Results Explanation Example

For all conducted test items:

The offset level is set in the spectrum analyzer to compensate the RF cable loss and attenuator factor between EUT conducted output port and spectrum analyzer. With the offset compensation, the spectrum analyzer reading level is exactly the EUT RF output level.

Example :

The spectrum analyzer offset is derived from RF cable loss and attenuator factor.

Offset = RF cable loss + attenuator factor.

Following shows an offset computation example with cable loss 4.2 dB and 10dB attenuator.

Offset(dB) = RF cable loss(dB) + attenuator factor(dB).

= 4.2 + 10 = 14.2 (dB)

3 Test Result

3.1 6dB and 99% Bandwidth Measurement

3.1.1 Limit of 6dB and 99% Bandwidth

The minimum 6 dB bandwidth shall be at least 500 kHz.

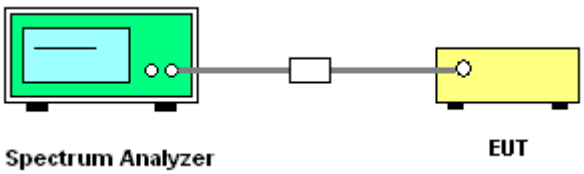
3.1.2 Measuring Instruments

See list of measuring equipment of this test report.

3.1.3 Test Procedures

1. The testing follows the ANSI C63.10 Section 6.9.3 (OBW) and 11.8.1 (6dB BW).
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. Make the measurement with the spectrum analyzer's resolution bandwidth (RBW) = 100 kHz. Set the Video bandwidth (VBW) = 300 kHz. In order to make an accurate measurement. The 6 dB bandwidth must be greater than 500 kHz.
5. For 99% Bandwidth Measurement, the spectrum analyzer's resolution bandwidth (RBW) is set 1-5% of the emission bandwidth and set the Video bandwidth (VBW) ≥ 3 * RBW.
6. Measure and record the results in the test report.

3.1.4 Test Setup

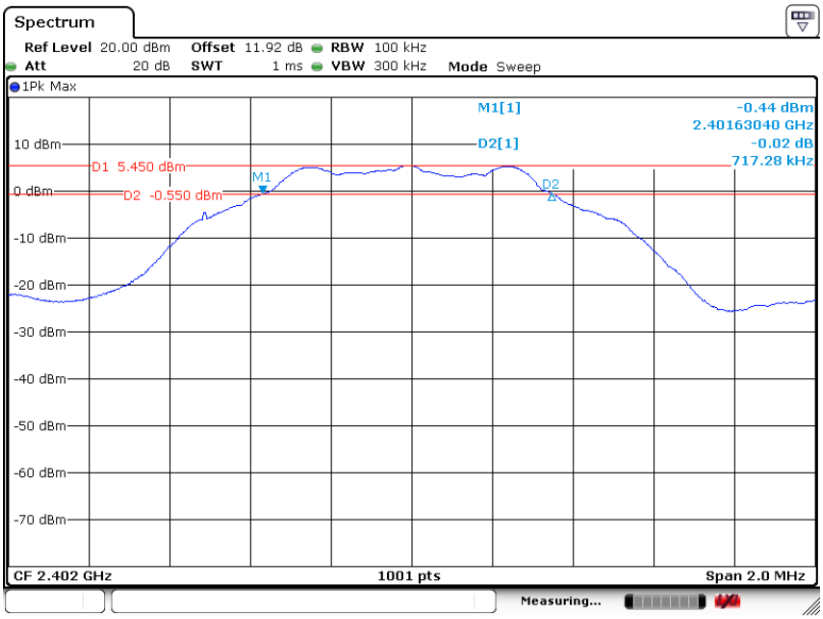


3.1.5 Test Result of 6dB Bandwidth

<Main Antenna>

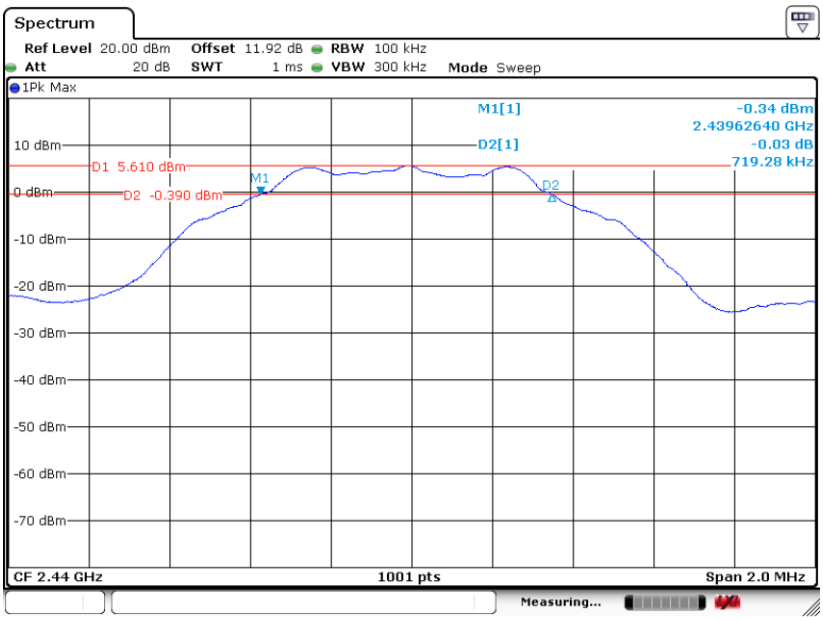
Mod.	Data Rate	NTX	CH.	Freq. (MHz)	6dB BW (MHz)	6dB BW Limit (MHz)	Pass/Fail
BLE	1Mbps	1	0	2402	0.717	0.50	Pass
BLE	1Mbps	1	19	2440	0.719	0.50	Pass
BLE	1Mbps	1	39	2480	0.715	0.50	Pass

6 dB Bandwidth Plot on Channel 00



Date: 3.NOV.2020 10:35:14

6 dB Bandwidth Plot on Channel 19



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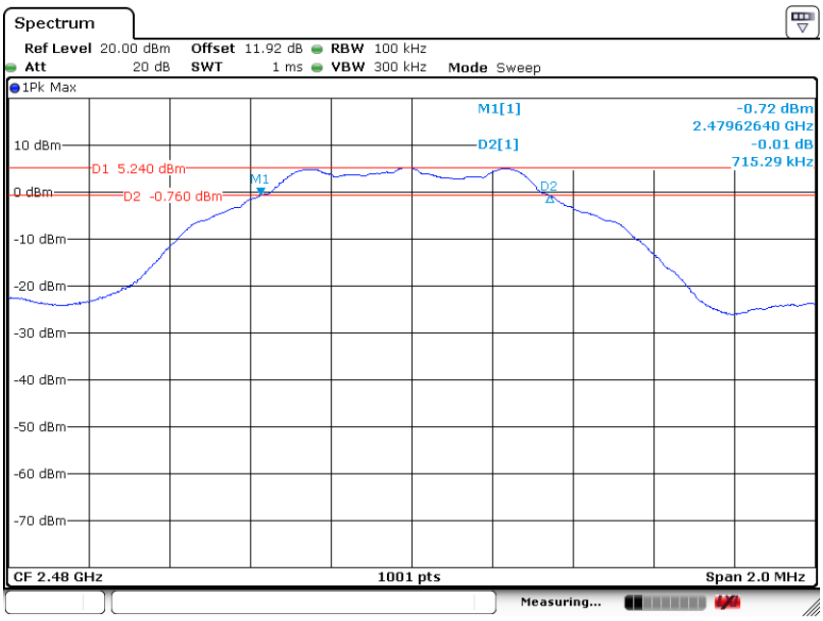
6 dB Bandwidth Plot on Channel 39



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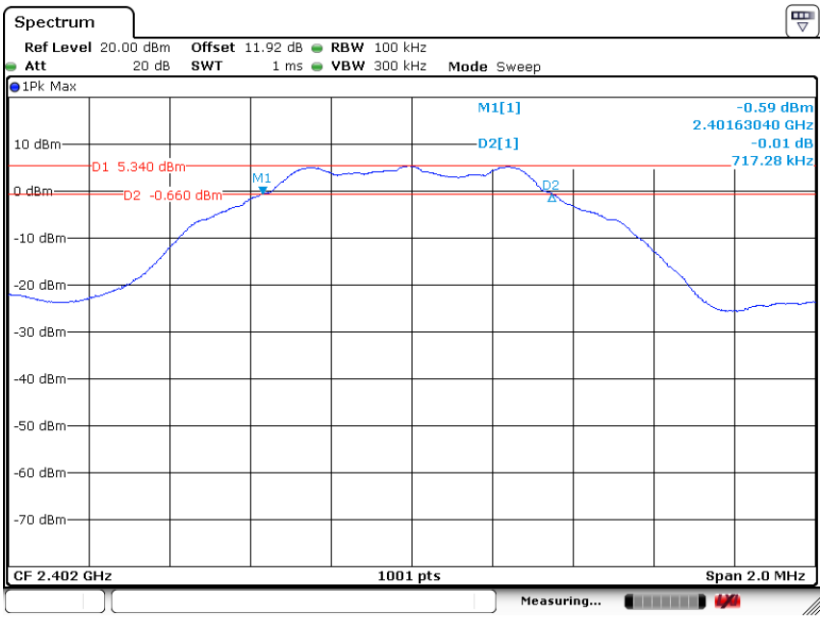
<Aux. Antenna>

Mod.	Data Rate	NTX	CH.	Freq. (MHz)	6dB BW (MHz)	6dB BW Limit (MHz)	Pass/Fail
BLE	1Mbps	1	0	2402	0.717	0.50	Pass
BLE	1Mbps	1	19	2440	0.715	0.50	Pass
BLE	1Mbps	1	39	2480	0.715	0.50	Pass

6 dB Bandwidth Plot on Channel 00



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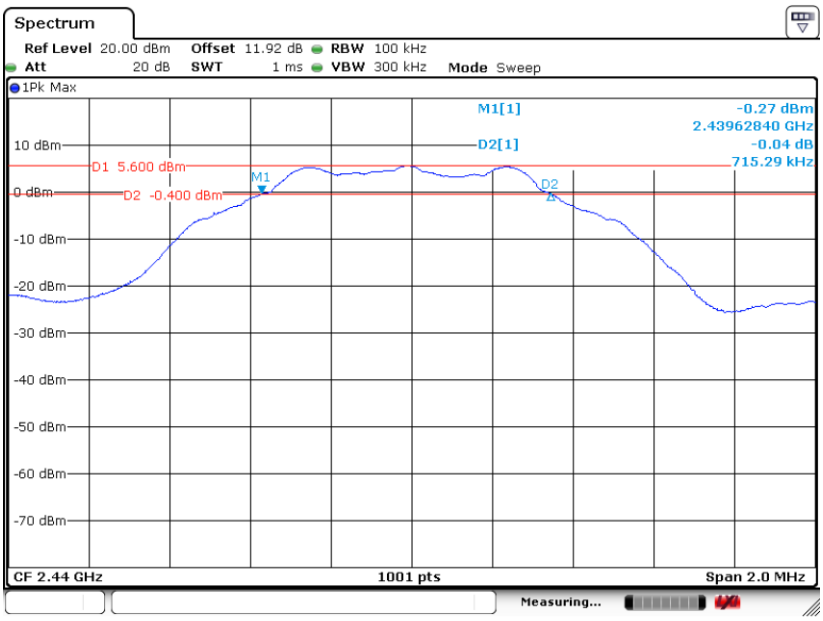
6 dB Bandwidth Plot on Channel 19



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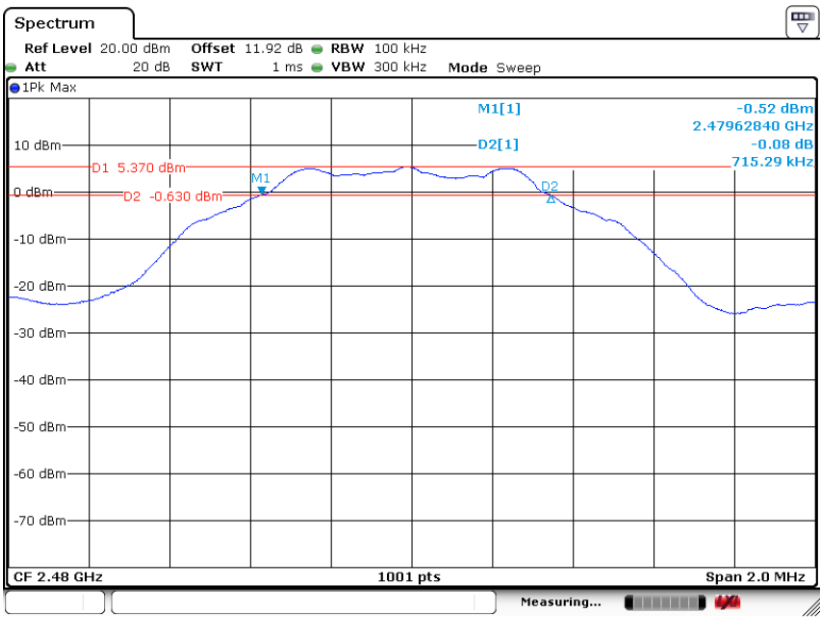
6 dB Bandwidth Plot on Channel 39



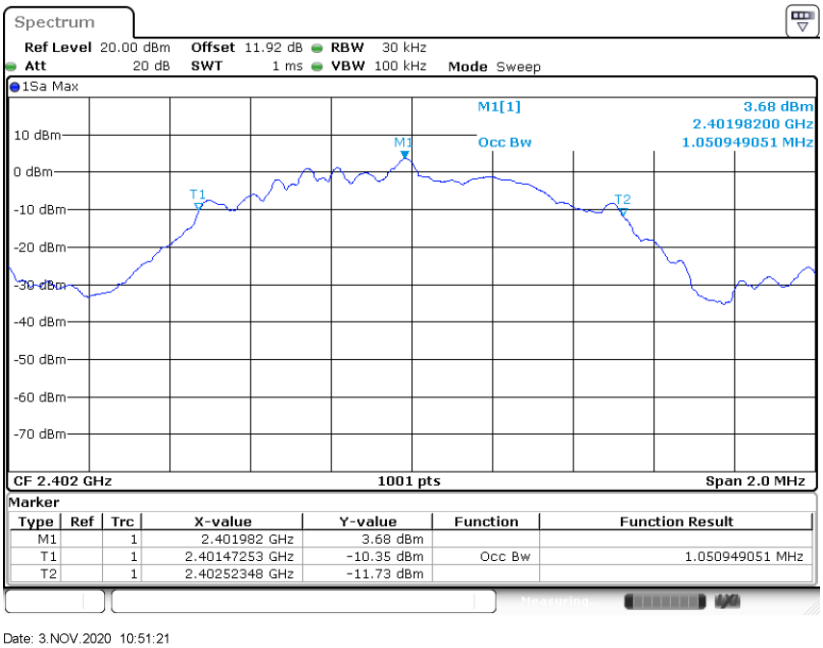
Date: 3.NOV.2020 11:59:31

3.1.6 Test Result of 99% Occupied Bandwidth

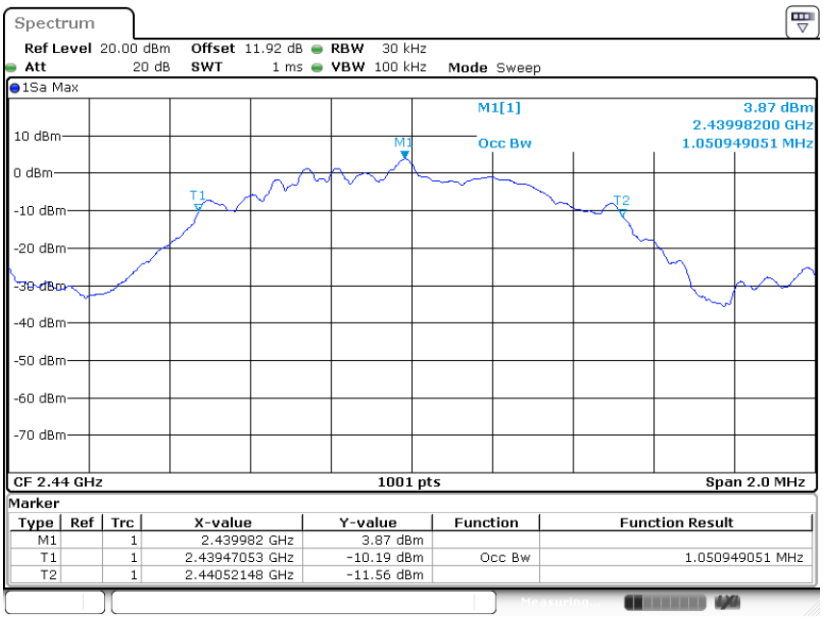
<Main Antenna>

Mod.	Data Rate	NTX	CH.	Freq. (MHz)	99% Occupied BW (MHz)	Pass/Fail
BLE	1Mbps	1	0	2402	1.051	Pass
BLE	1Mbps	1	19	2440	1.051	Pass
BLE	1Mbps	1	39	2480	1.051	Pass

99% Bandwidth Plot on Channel 00



99% Occupied Bandwidth Plot on Channel 19



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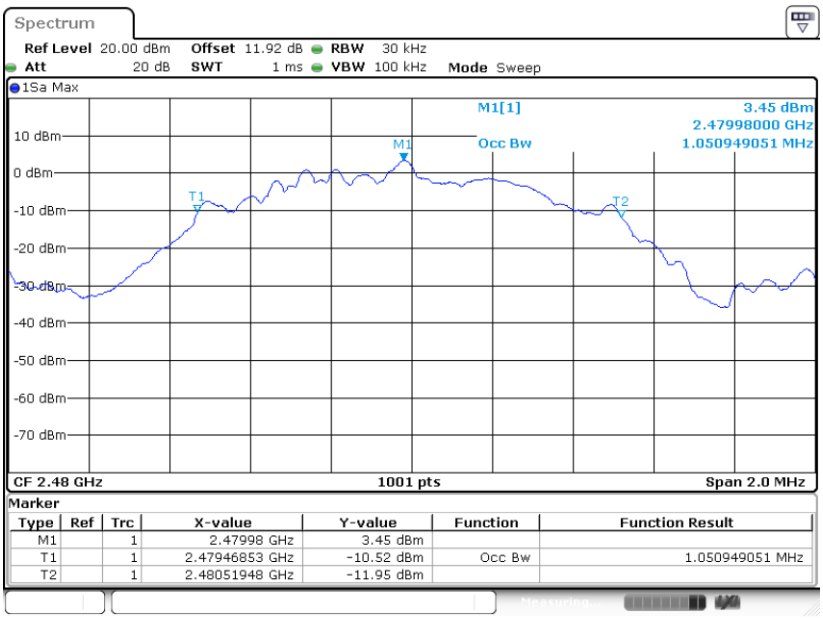
99% Occupied Bandwidth Plot on Channel 39

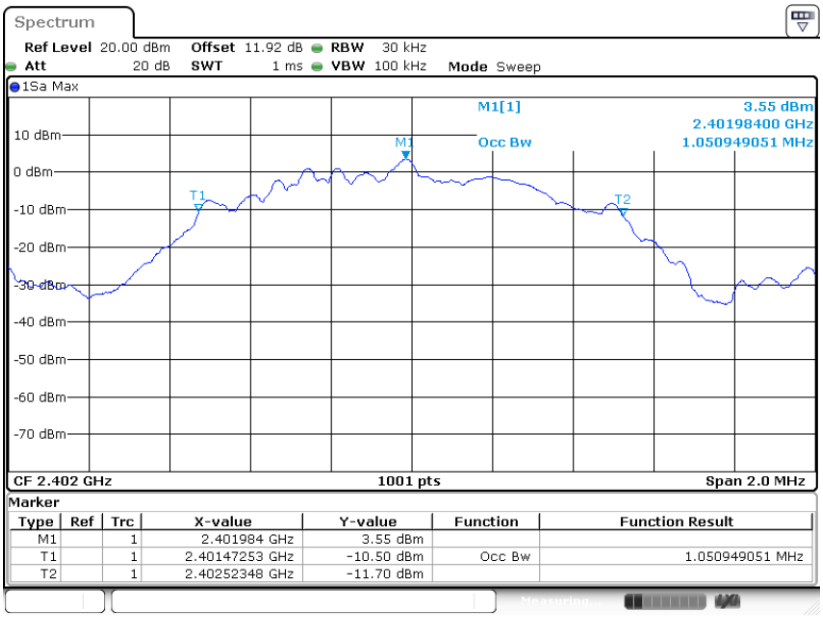


Date: 3.NOV.2020 11:17:30

<Aux. Antenna>

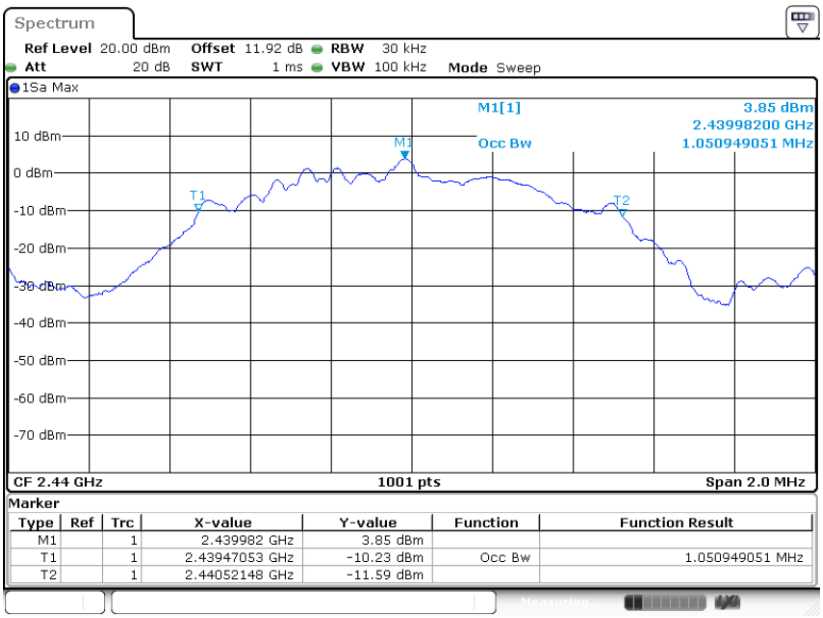
Mod.	Data Rate	NTX	CH.	Freq. (MHz)	99% Occupied BW (MHz)	Pass/Fail
BLE	1Mbps	1	0	2402	1.051	Pass
BLE	1Mbps	1	19	2440	1.051	Pass
BLE	1Mbps	1	39	2480	1.053	Pass

99% Bandwidth Plot on Channel 00



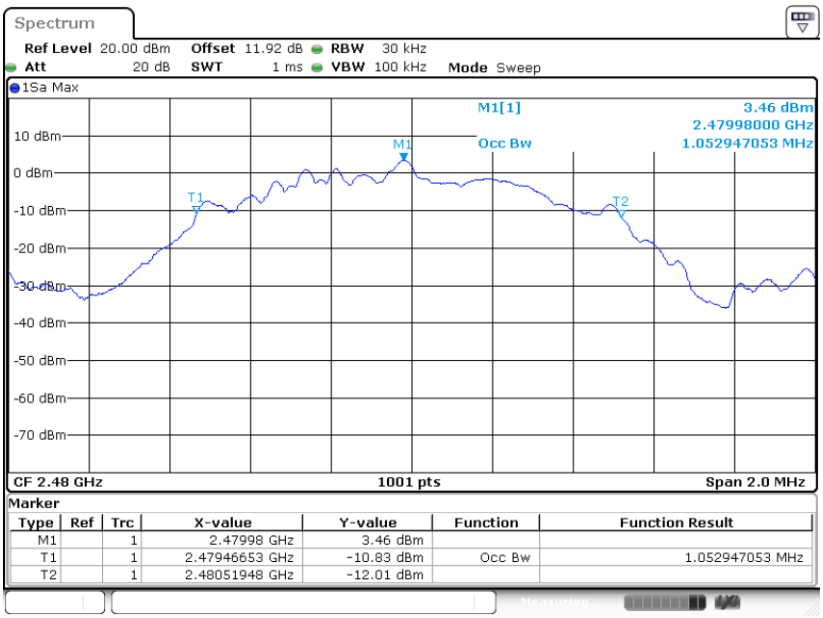
Date: 3.NOV.2020 11:41:28

99% Occupied Bandwidth Plot on Channel 19



Date: 3.NOV.2020 11:55:42

99% Occupied Bandwidth Plot on Channel 39



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Note: The occupied channel bandwidth is maintained within the band of operation for all of the modulations.

3.2 Output Power Measurement

3.2.1 Limit of Output Power

For systems using digital modulation in the 2400-2483.5MHz, the limit for output power is 30dBm. If transmitting antenna of directional gain greater than 6dBi is used, the peak output power from the intentional radiator shall be reduced below the above stated value by the amount in dB that the directional gain of the antenna exceeds 6 dBi. In case of point-to-point operation, the limit has to be reduced by 1dB for every 3dB that the directional gain of the antenna exceeds 6dBi.

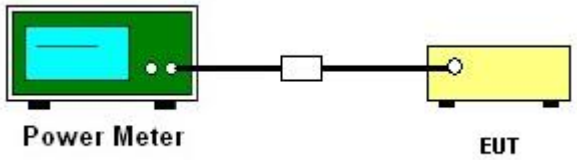
3.2.2 Measuring Instruments

See list of measuring equipment of this test report.

3.2.3 Test Procedures

1. For Average Power, the testing follows ANSI C63.10 Section 11.9.2.3.2 Method AVGPM-G
2. The RF output of EUT was connected to the power meter by RF cable and attenuator.
3. The path loss was compensated to the results for each measurement.
4. Set to the maximum power setting and enable the EUT transmit continuously.
5. Measure the conducted output power and record the results in the test report.

3.2.4 Test Setup



3.2.5 Test Result of Average Output Power

<Main Antenna>

Mod.	Data Rate	NTX	CH.	Freq. (MHz)	Average Conducted Power (dBm)	Conducted Power Limit (dBm)	DG (dBi)	EIRP Power (dBm)	EIRP Power Limit (dBm)	Pass /Fail
BLE	1Mbps	1	0	2402	5.49	30.00	4.00	9.49	36.00	Pass
BLE	1Mbps	1	19	2440	5.69	30.00	4.00	9.69	36.00	Pass
BLE	1Mbps	1	39	2480	5.29	30.00	4.00	9.29	36.00	Pass

<Aux. Antenna>

Mod.	Data Rate	NTX	CH.	Freq. (MHz)	Average Conducted Power (dBm)	Conducted Power Limit (dBm)	DG (dBi)	EIRP Power (dBm)	EIRP Power Limit (dBm)	Pass /Fail
BLE	1Mbps	1	0	2402	5.39	30.00	4.00	9.39	36.00	Pass
BLE	1Mbps	1	19	2440	5.79	30.00	4.00	9.79	36.00	Pass
BLE	1Mbps	1	39	2480	5.39	30.00	4.00	9.39	36.00	Pass

3.3 Power Spectral Density Measurement

3.3.1 Limit of Power Spectral Density

The peak power spectral density shall not be greater than 8dBm in any 3kHz band at any time interval of continuous transmission.

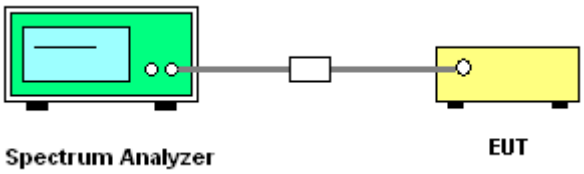
3.3.2 Measuring Instruments

See list of measuring equipment of this test report.

3.3.3 Test Procedures

1. The testing follows the ANSI C63.10 Section 11.10.2 Method PKPSD.
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. Make the measurement with the spectrum analyzer's resolution bandwidth (RBW) = 3 kHz. Video bandwidth VBW = 10 kHz In order to make an accurate measurement, set the span to 1.5 times DTS Channel Bandwidth. (6dB BW)
5. Detector = peak, Sweep time = auto couple, Trace mode = max hold, Allow trace to fully stabilize. Use the peak marker function to determine the maximum power level.
6. Measure and record the results in the test report.
7. The Measured power density (dBm)/ 100kHz is a reference level and used as 20dBc down limit line for Conducted Band Edges and Conducted Spurious Emission.

3.3.4 Test Setup



3.3.5 Test Result of Power Spectral Density

<Main Antenna>

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	5.42	-8.29	4.00	8.00	Pass
BLE	1Mbps	1	19	2440	5.56	-8.09	4.00	8.00	Pass
BLE	1Mbps	1	39	2480	5.20	-8.47	4.00	8.00	Pass
Note: PSD (dBm/ 100kHz) is a reference level used for Conducted Band Edges and Conducted Spurious Emission 30dBc limit.									

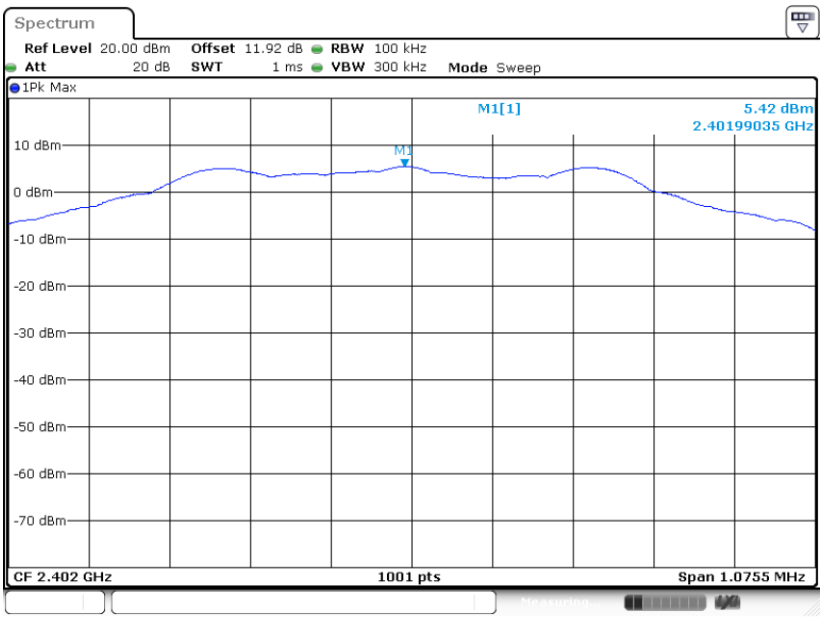
<Aux. Antenna>

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	5.36	-8.37	4.00	8.00	Pass
BLE	1Mbps	1	19	2440	5.61	-8.09	4.00	8.00	Pass
BLE	1Mbps	1	39	2480	5.32	-8.44	4.00	8.00	Pass
Note: PSD (dBm/ 100kHz) is a reference level used for Conducted Band Edges and Conducted Spurious Emission 30dBc limit.									

3.3.6 Test Result of Power Spectral Density Plots (100kHz)

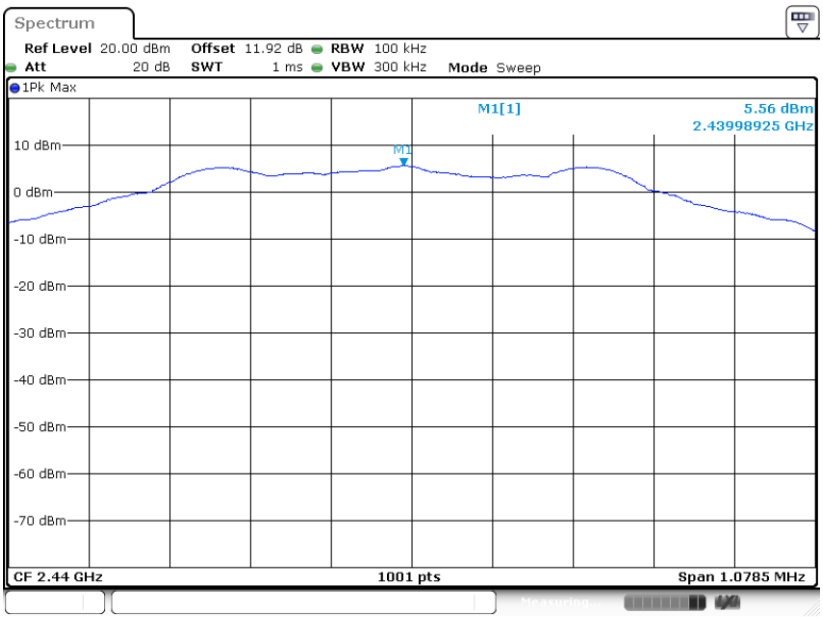
<Main Antenna>

PSD 100kHz Plot on Channel 00



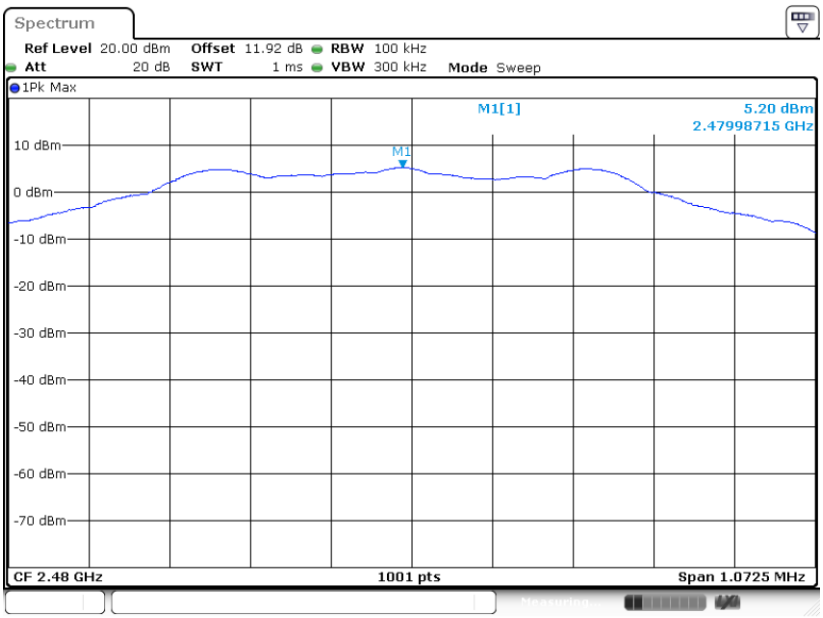
Date: 3.NOV.2020 10:36:56

PSD 100kHz Plot on Channel 19



Date: 3.NOV.2020 10:57:27

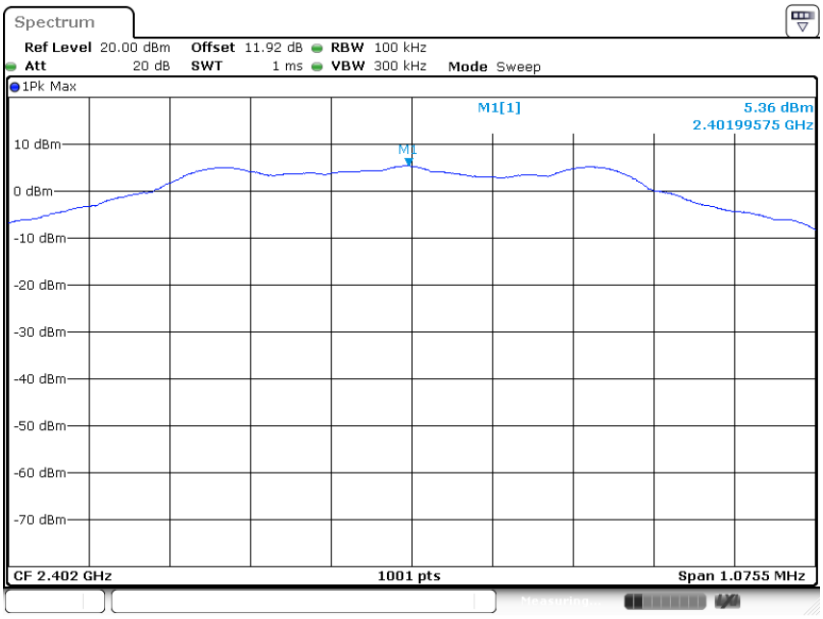
PSD 100kHz Plot on Channel 39



Date: 3.NOV.2020 11:13:46

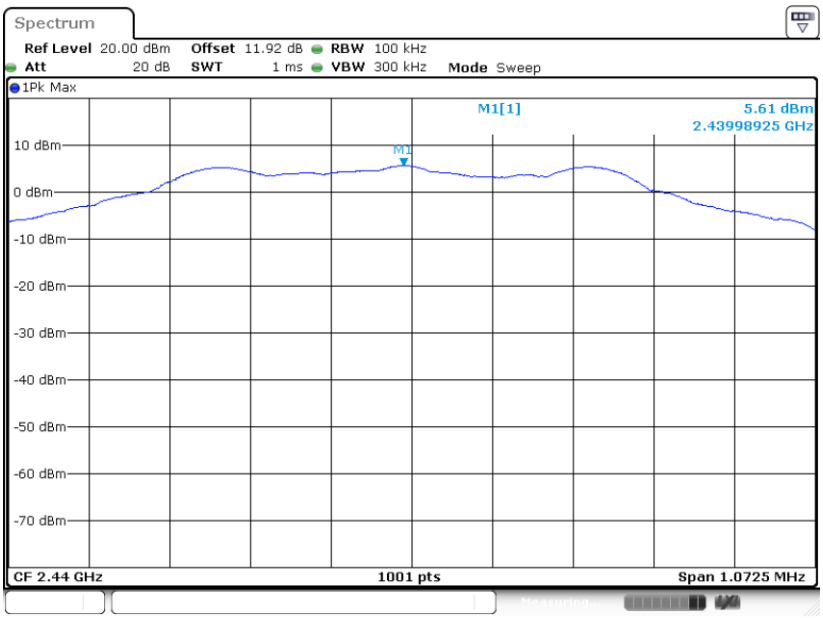
<Aux. Antenna>

PSD 100kHz Plot on Channel 00



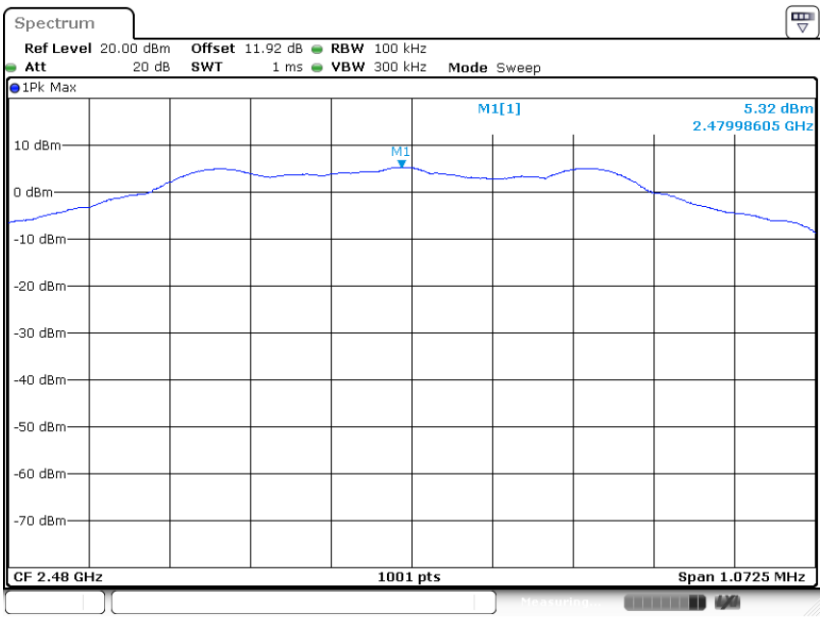
Date: 3.NOV.2020 11:36:49

PSD 100kHz Plot on Channel 19



Date: 3.NOV.2020 11:52:12

PSD 100kHz Plot on Channel 39

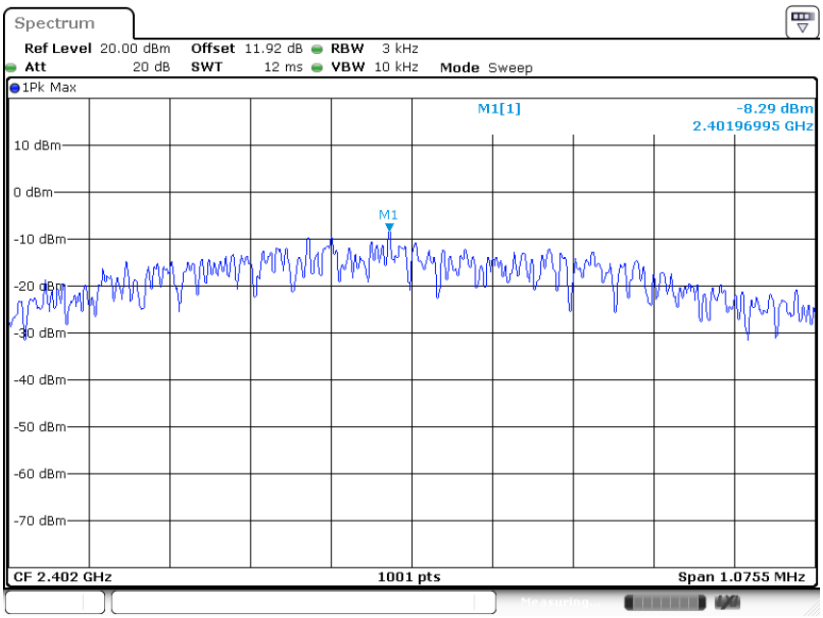


Date: 3.NOV.2020 12:01:53

3.3.7 Test Result of Power Spectral Density Plots (3kHz)

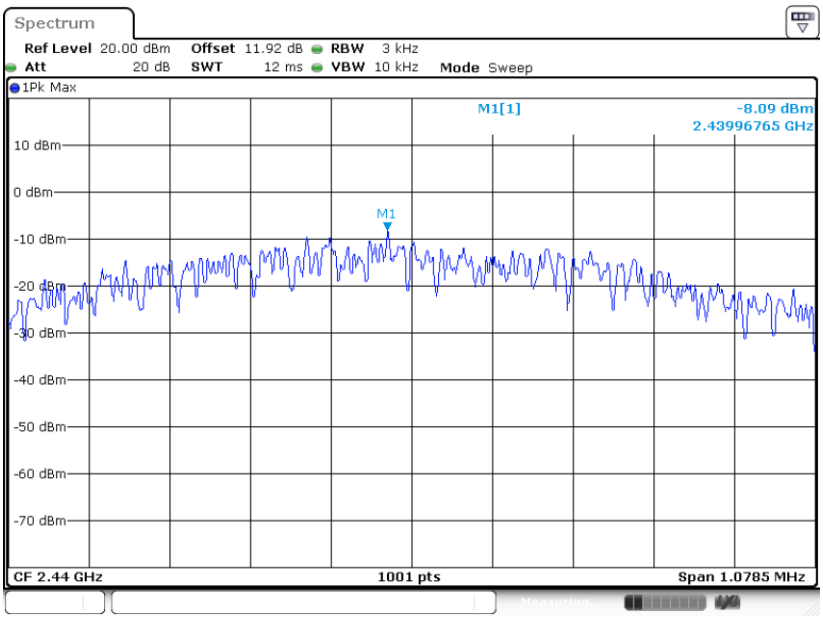
<Main Antenna>

PSD 3kHz Plot on Channel 00



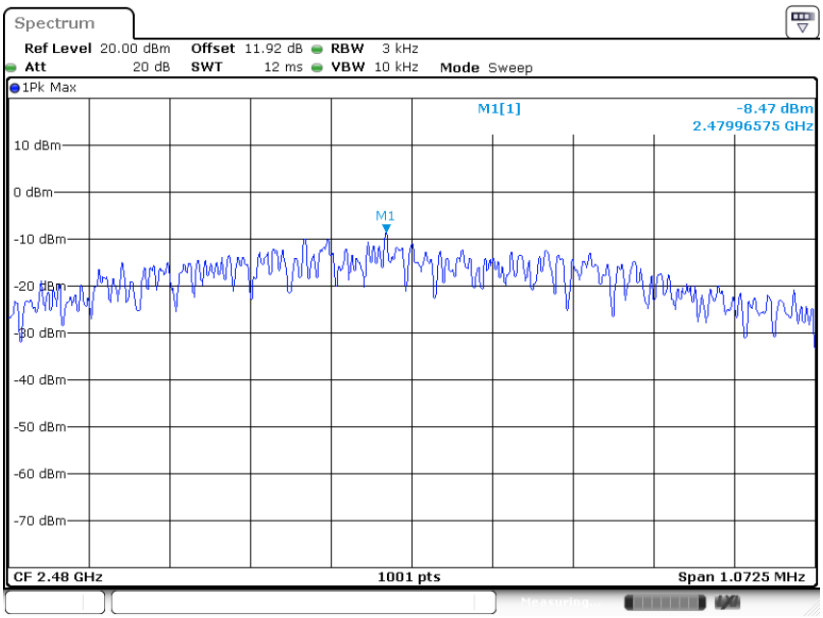
Date: 3.NOV.2020 10:36:37

PSD 3kHz Plot on Channel 19



Date: 3.NOV.2020 10:56:55

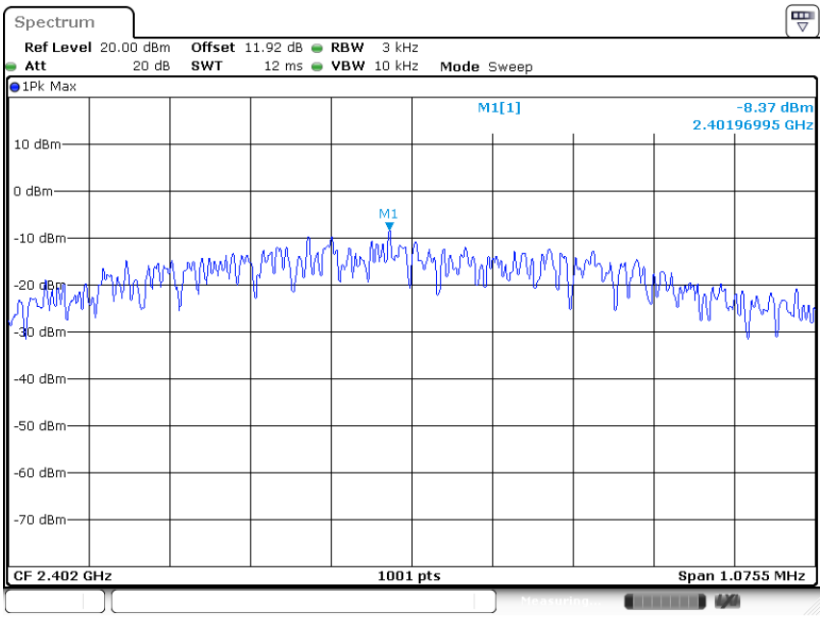
PSD 3kHz Plot on Channel 39



Date: 3.NOV.2020 11:13:15

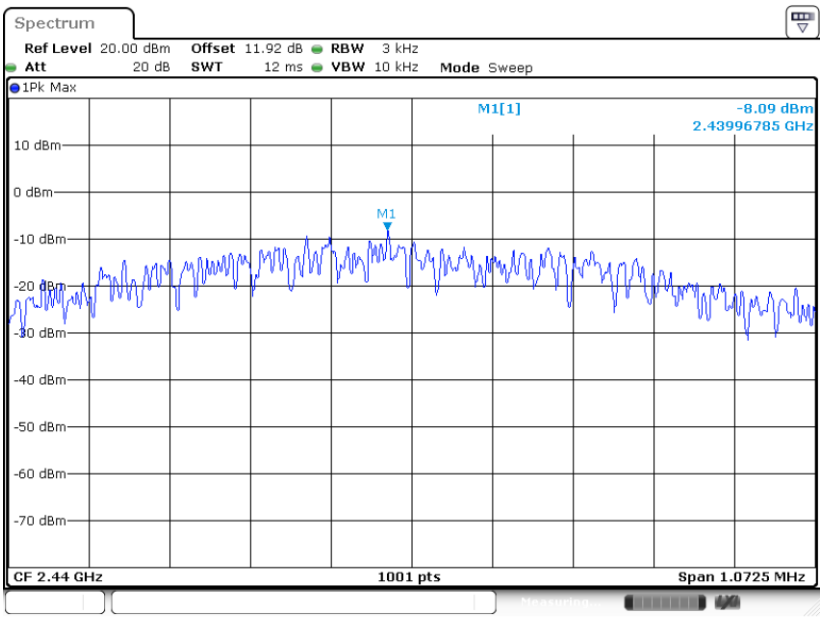
<Aux. Antenna>

PSD 3kHz Plot on Channel 00



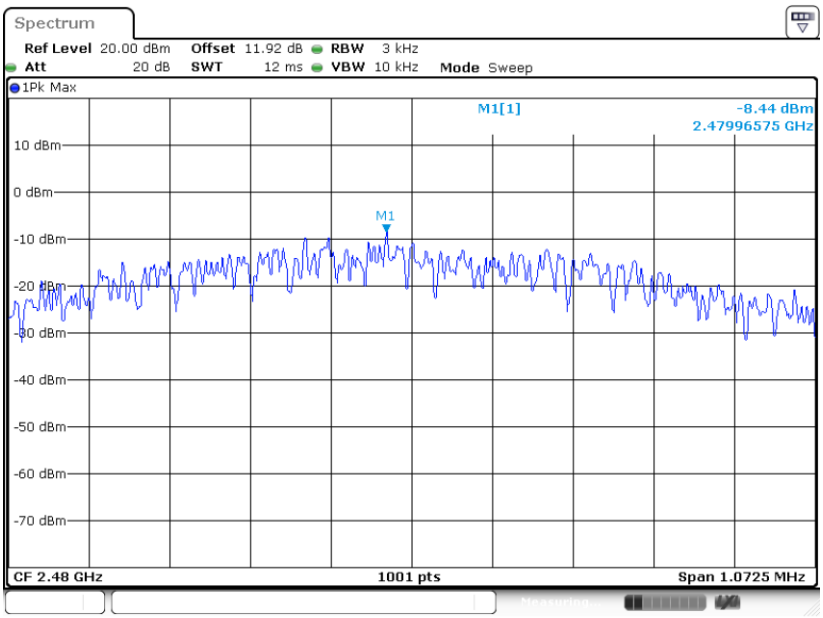
Date: 3.NOV.2020 11:34:45

PSD 3kHz Plot on Channel 19



Date: 3.NOV.2020 11:51:40

PSD 3kHz Plot on Channel 39



Date: 3.NOV.2020 12:01:18

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.

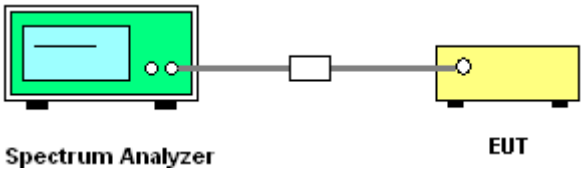
3.4.2 Measuring Instruments

See list of measuring equipment of this test report.

3.4.3 Test Procedure

1. The testing follows the ANSI C63.10 Section 11.11.3 Emission level measurement.
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.

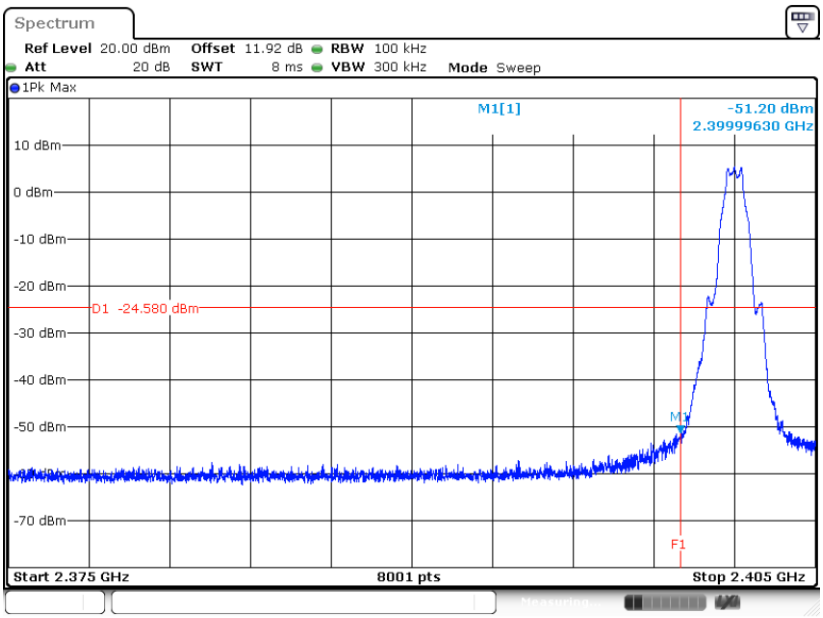
3.4.4 Test Setup



3.4.5 Test Result of Conducted Band Edges Plots

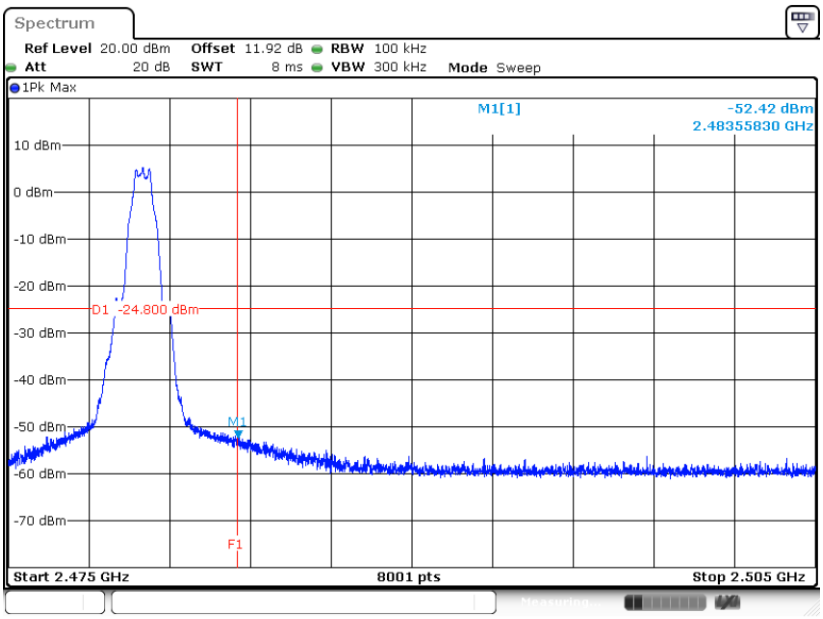
<Main Antenna>

Low Band Edge Plot on Channel 00



Date: 3.NOV.2020 11:05:12

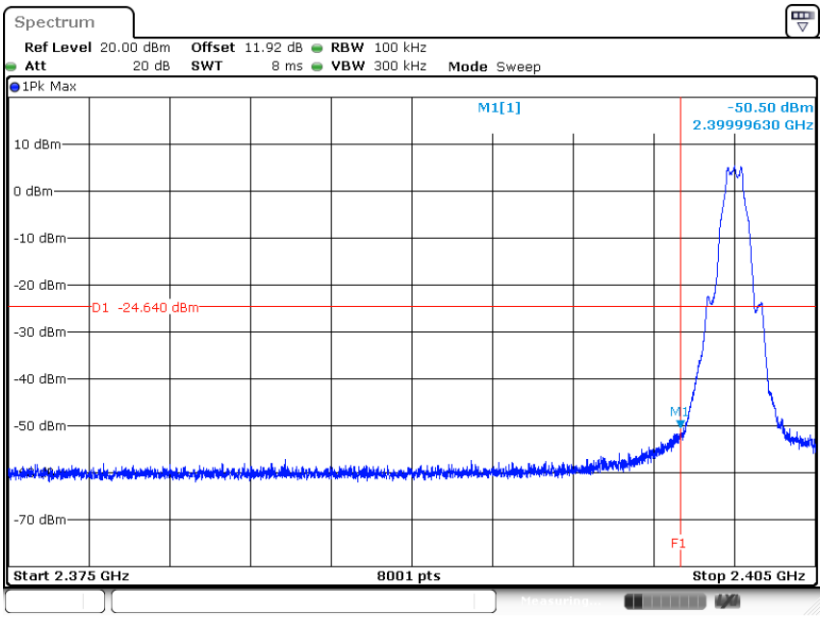
High Band Edge Plot on Channel 39



Date: 3.NOV.2020 11:15:31

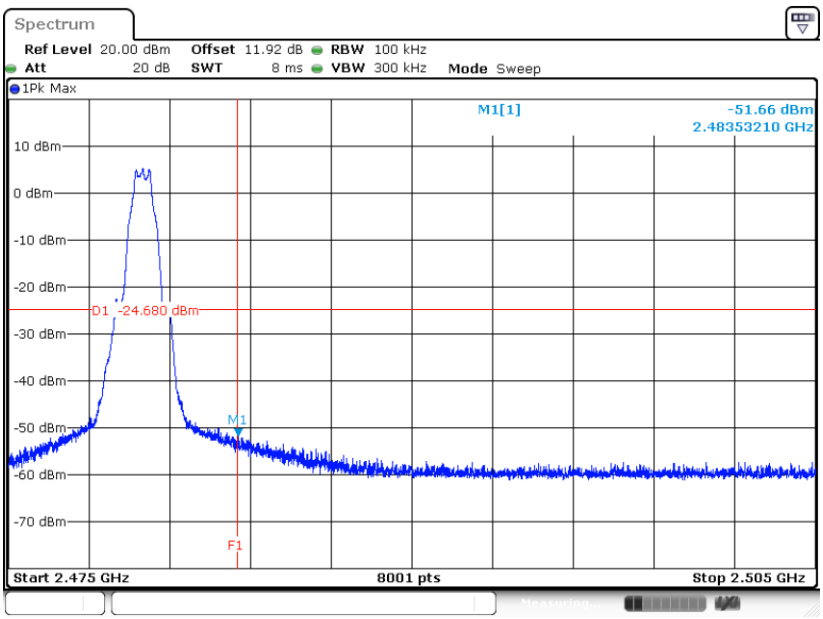
<Aux. Antenna>

Low Band Edge Plot on Channel 00



Date: 3.NOV.2020 11:38:08

High Band Edge Plot on Channel 39



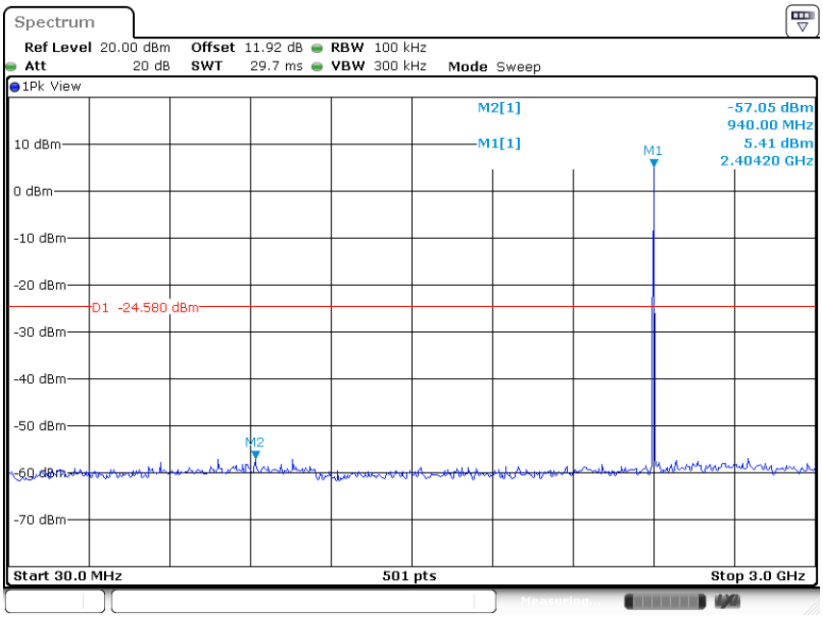
Date: 3.NOV.2020 12:02:54

3.4.6 Test Result of Conducted Spurious Emission Plots

<Main Antenna>

Conducted Spurious Emission Plot on Bluetooth LE 1Mbps

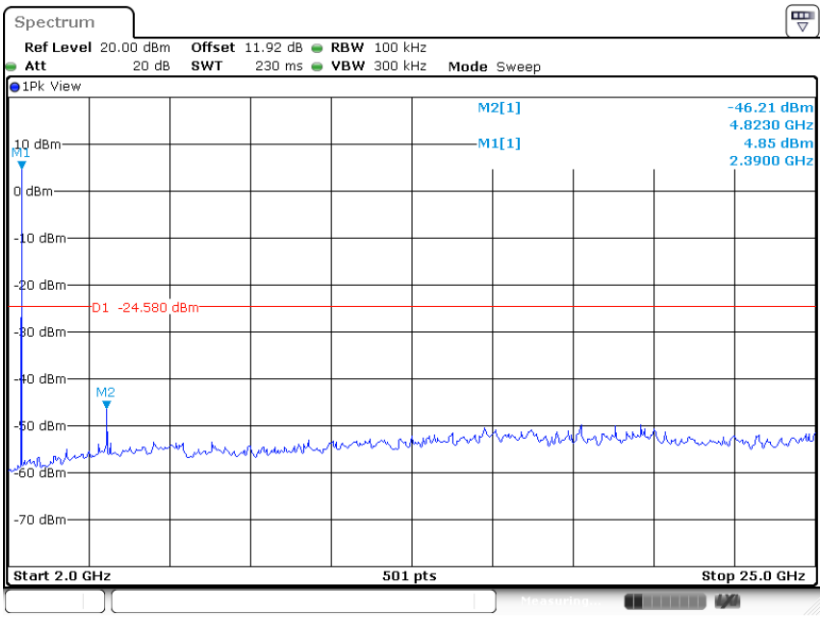
GFSK Channel 00



Date: 3.NOV.2020 11:06:48

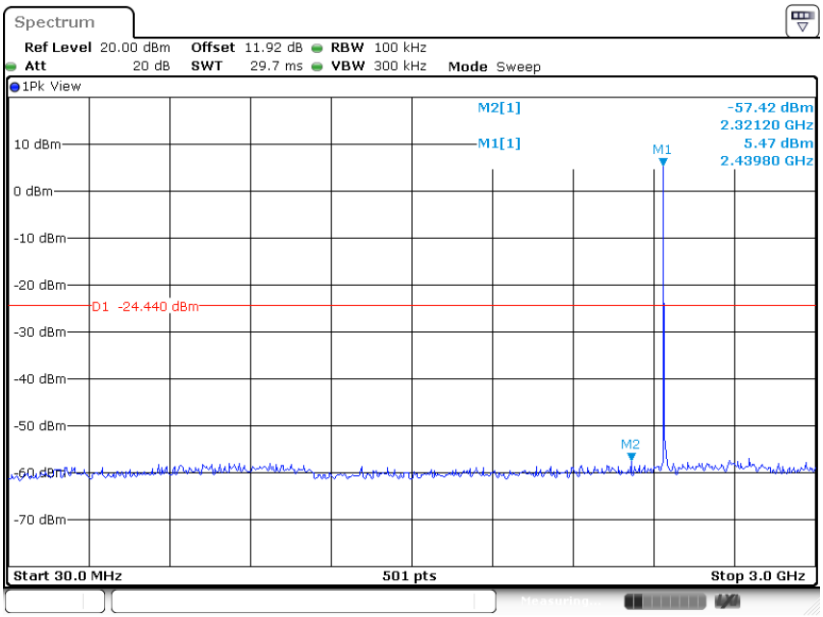
Conducted Spurious Emission Plot on Bluetooth LE 1Mbps

GFSK Channel 00



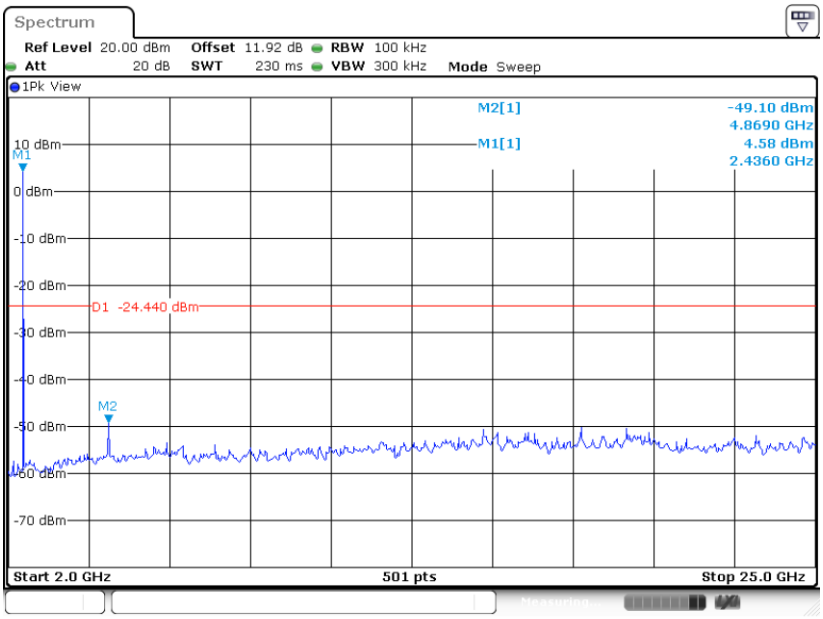
Date: 3.NOV.2020 11:08:09

Conducted Spurious Emission Plot on Bluetooth LE 1Mbps GFSK Channel 19



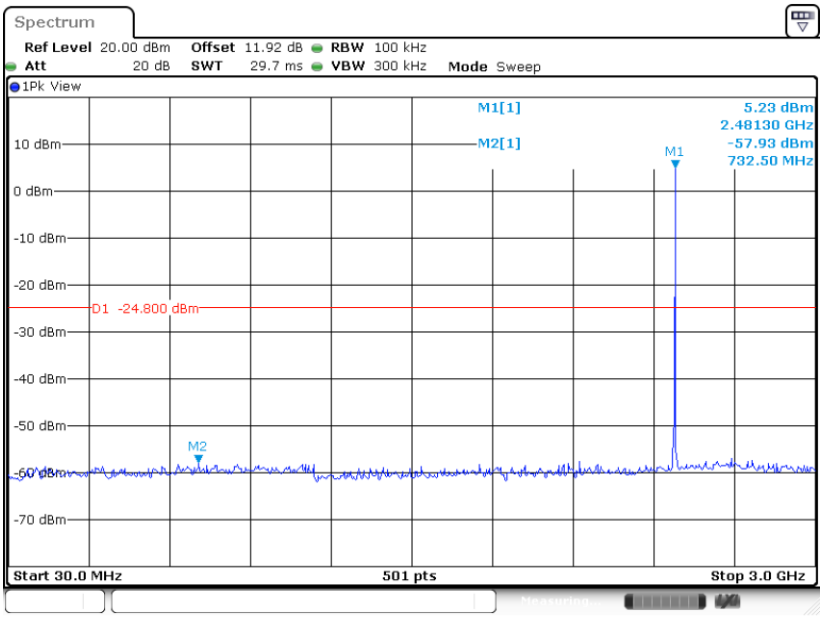
Date: 3.NOV.2020 11:00:42

Conducted Spurious Emission Plot on Bluetooth LE 1Mbps GFSK Channel 19



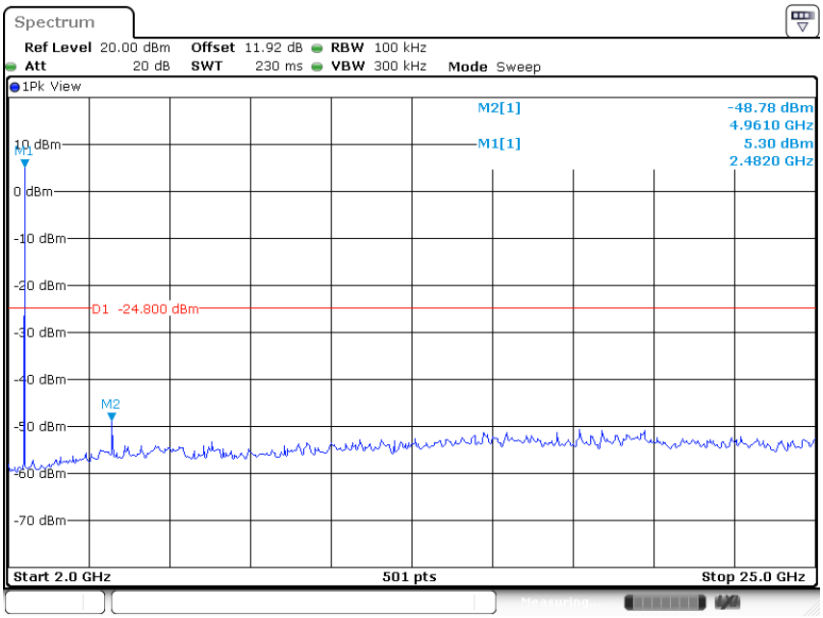
Date: 3.NOV.2020 11:01:04

Conducted Spurious Emission Plot on Bluetooth LE 1Mbps GFSK Channel 39



Date: 3.NOV.2020 11:15:52

Conducted Spurious Emission Plot on Bluetooth LE 1Mbps GFSK Channel 39

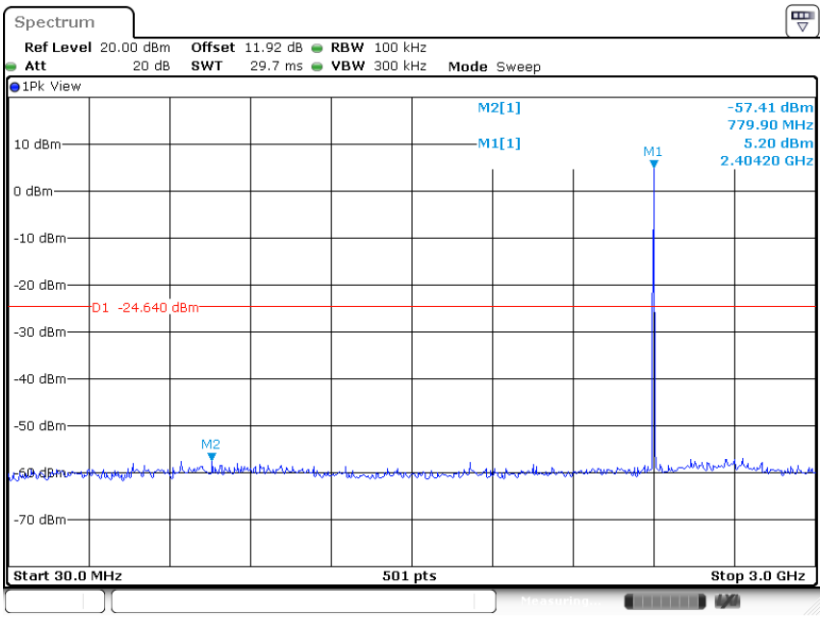


Date: 3.NOV.2020 11:16:50

<Aux. Antenna>

Conducted Spurious Emission Plot on Bluetooth LE 1Mbps

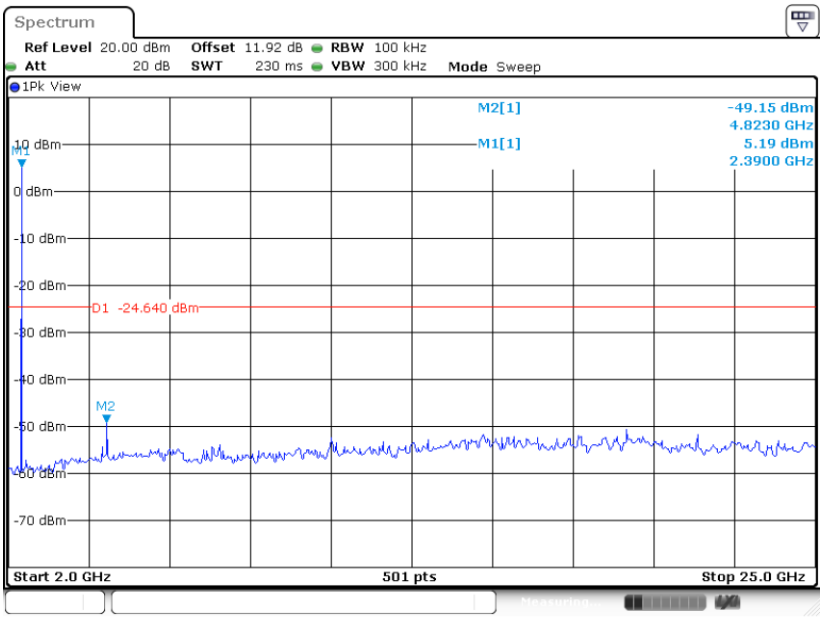
GFSK Channel 00



Date: 3.NOV.2020 11:40:21

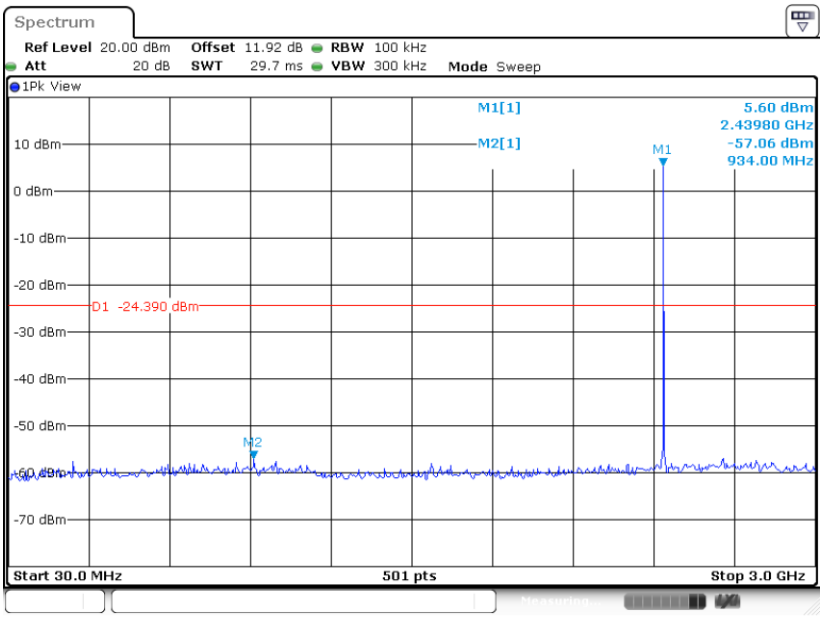
Conducted Spurious Emission Plot on Bluetooth LE 1Mbps

GFSK Channel 00



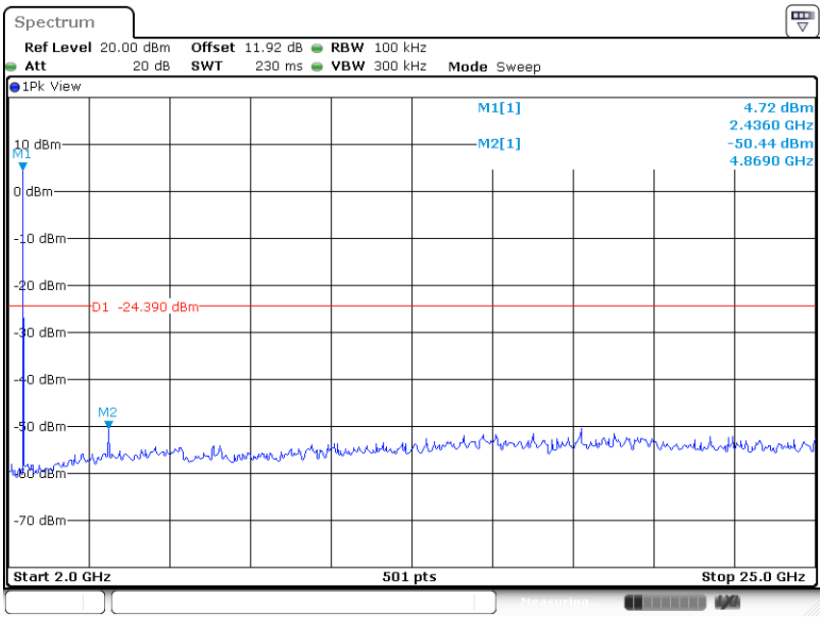
Date: 3.NOV.2020 11:40:57

Conducted Spurious Emission Plot on Bluetooth LE 1Mbps GFSK Channel 19



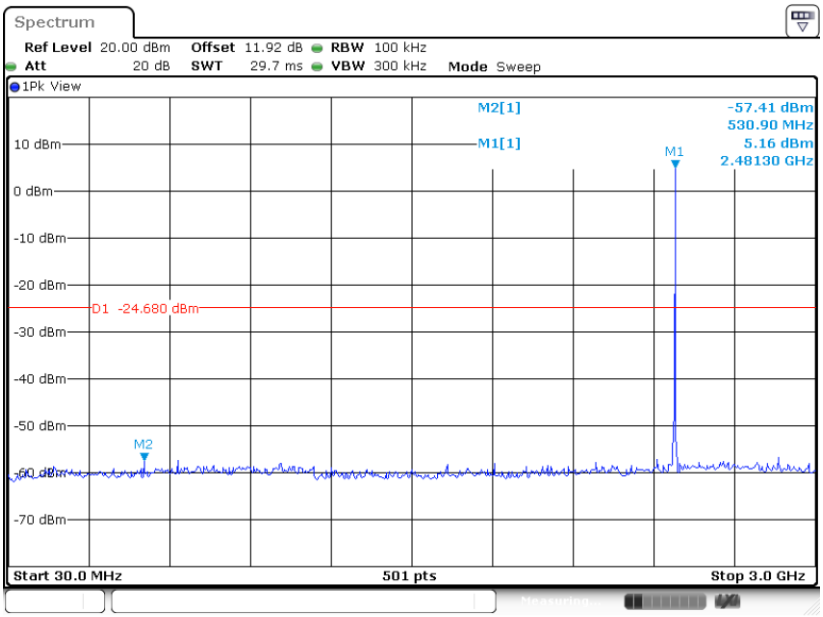
Date: 3.NOV.2020 11:54:21

Conducted Spurious Emission Plot on Bluetooth LE 1Mbps GFSK Channel 19



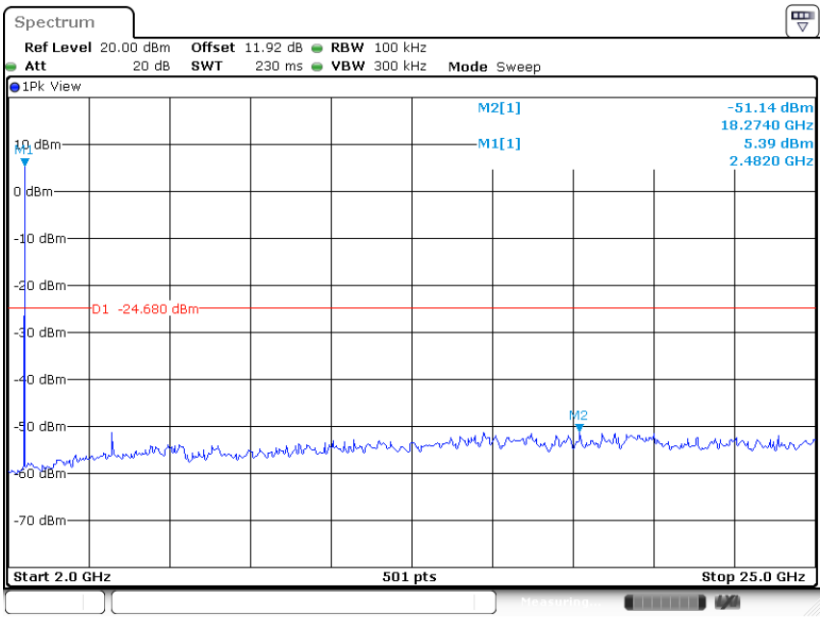
Date: 3.NOV.2020 11:54:40

Conducted Spurious Emission Plot on Bluetooth LE 1Mbps GFSK Channel 39



Date: 3.NOV.2020 12:04:41

Conducted Spurious Emission Plot on Bluetooth LE 1Mbps GFSK Channel 39



Date: 3.NOV.2020 12:05:35

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

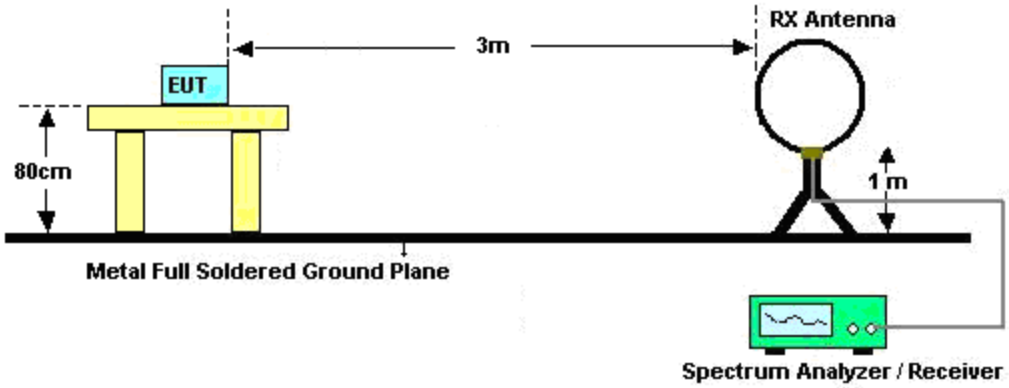
See list of measuring equipment of this test report.

3.5.3 Test Procedures

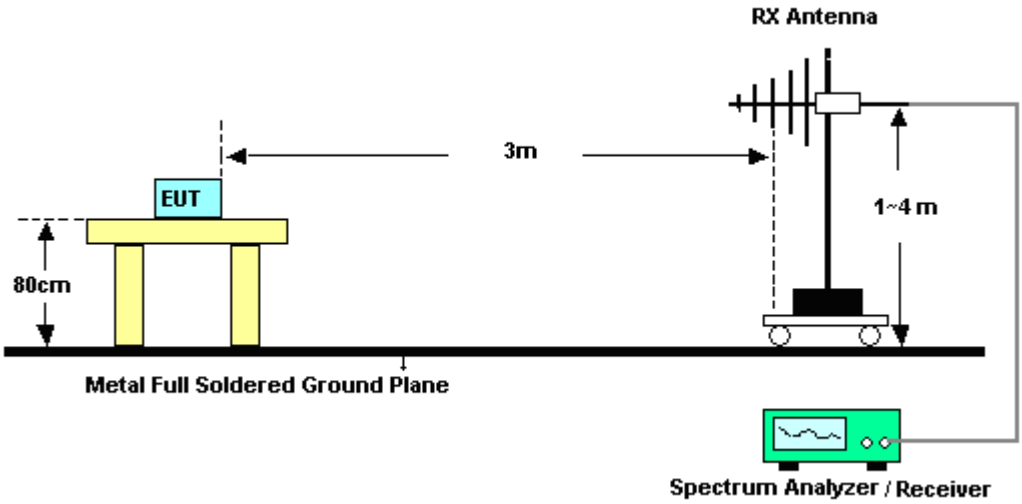
1. The testing follows the ANSI C63.10 Section 11.12.1 Radiated emission measurements.
2. The EUT was arranged to its worst case and then tune the antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the 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

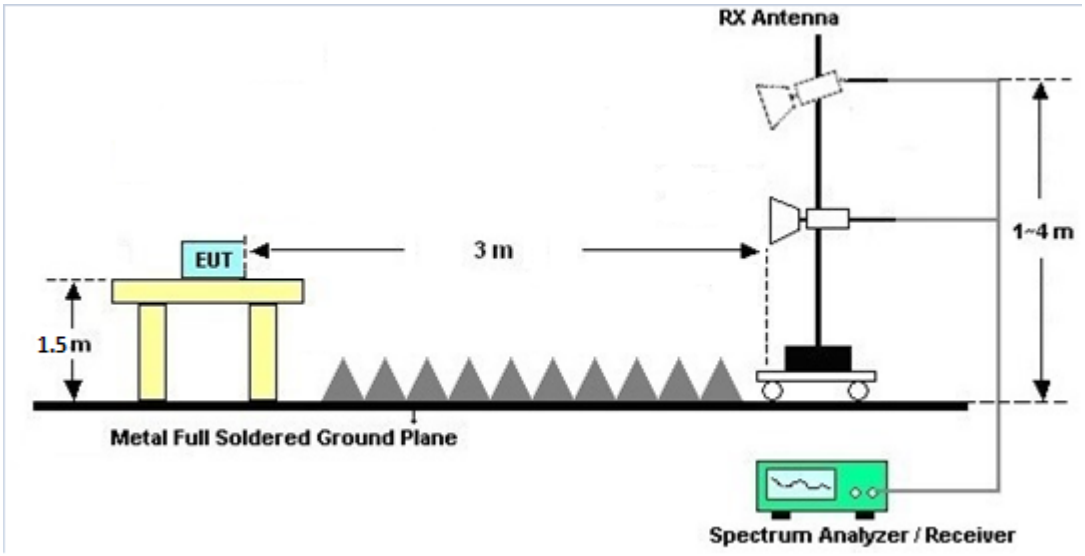
For radiated test below 30MHz



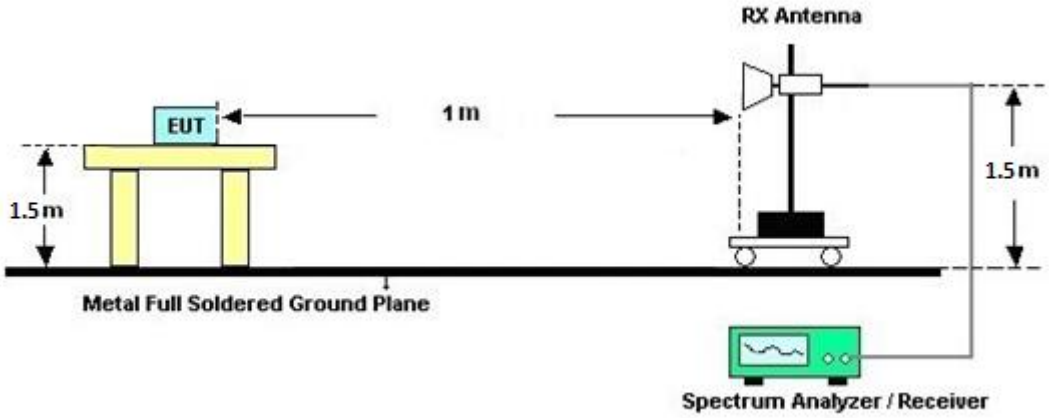
For radiated test from 30MHz to 1GHz



For radiated test from 1GHz to 18GHz



For radiated test above 18GHz



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 alternative test site - semi-Anechoic chamber according to 414788 D01 Radiated Test Site v01r01, and the result came out very similar.

3.5.6 Test Result of Radiated Spurious at Band Edges and Radiated Spurious Emission (30MHz ~ 10th Harmonic)

Radiated Spurious Emission

<Main Antenna for Sample 1>

2.4GHz 2400~2483.5MHz

BLE (Band Edge @ 3m)

BLE	Note	Frequency (MHz)	Level (dBμV/m)	Over Limit (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB/m)	Path Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
BLE CH 00 2402MHz		2366.07	55.76	-18.24	74	42.1	27.68	17.37	31.39	290	188	P	H
		2331	45.57	-8.43	54	31.89	27.8	17.3	31.42	290	188	A	H
	*	2402	102.54	-	-	88.87	27.61	17.42	31.36	290	188	P	H
	*	2402	102.21	-	-	88.54	27.61	17.42	31.36	290	188	A	H
		2349.585	55.41	-18.59	74	41.68	27.81	17.33	31.41	364	223	P	V
		2382.66	45.5	-8.5	54	31.83	27.66	17.39	31.38	364	223	A	V
	*	2402	97.73	-	-	84.1	27.57	17.42	31.36	364	223	P	V
	*	2402	97.34	-	-	83.71	27.57	17.42	31.36	364	223	A	V
BLE CH 19 2440MHz		2338.95	55.33	-18.67	74	41.67	27.76	17.31	31.41	246	186	P	H
		2329.8	45.52	-8.48	54	31.83	27.81	17.3	31.42	246	186	A	H
	*	2440	103.28	-	-	89.57	27.59	17.48	31.36	246	186	P	H
	*	2440	102.98	-	-	89.27	27.59	17.48	31.36	246	186	A	H
		2486.88	55.33	-18.67	74	41.56	27.56	17.56	31.35	246	186	P	H
		2496.48	45.5	-8.5	54	31.7	27.56	17.58	31.34	246	186	A	H
		2336.7	55.57	-18.43	74	41.86	27.82	17.31	31.42	396	226	P	V
		2370.6	45.52	-8.48	54	31.83	27.71	17.37	31.39	396	226	A	V
	*	2440	98.53	-	-	84.96	27.45	17.48	31.36	396	226	P	V
	*	2440	98.23	-	-	84.66	27.45	17.48	31.36	396	226	A	V
		2492.72	54.37	-19.63	74	40.75	27.39	17.57	31.34	396	226	P	V
		2497.2	45.31	-8.69	54	31.69	27.38	17.58	31.34	396	226	A	V
BLE CH 39 2480MHz	*	2480	103.7	-	-	89.93	27.57	17.55	31.35	312	155	P	H
	*	2480	103.21	-	-	89.44	27.57	17.55	31.35	312	155	A	H
		2484.04	58.94	-15.06	74	45.17	27.56	17.56	31.35	312	155	P	H
		2483.76	46.17	-7.83	54	32.39	27.57	17.56	31.35	312	155	A	H
	*	2480	98.14	-	-	84.54	27.4	17.55	31.35	100	139	P	V
	*	2480	97.67	-	-	84.07	27.4	17.55	31.35	100	139	A	V
		2484.52	55.48	-18.52	74	41.88	27.39	17.56	31.35	100	139	P	V
		2484	45.39	-8.61	54	31.79	27.39	17.56	31.35	100	139	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	Level	Over	Limit	Read	Antenna	Path	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)
BLE CH 00 2402MHz		4804	42.34	-31.66	74	65.97	31.38	11.28	66.29	100	0	P	H
		4804	41.97	-32.03	74	65.59	31.39	11.28	66.29	100	0	P	V
BLE CH 19 2440MHz		4880	42.73	-31.27	74	66.09	31.35	11.43	66.14	100	0	P	H
		7320	45.1	-28.9	74	60.71	36.36	13.89	65.86	100	0	P	H
		4880	41.57	-32.43	74	65	31.28	11.43	66.14	100	0	P	V
		7320	47	-27	74	62.55	36.42	13.89	65.86	100	0	P	V
BLE CH 39 2480MHz		4960	44.12	-29.88	74	67.04	31.47	11.59	65.98	100	0	P	H
		7440	46.11	-27.89	74	61.46	36.51	14.03	65.89	100	0	P	H
		4960	42.93	-31.07	74	65.9	31.42	11.59	65.98	100	0	P	V
		7440	46.64	-27.36	74	62.02	36.48	14.03	65.89	100	0	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	Path	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		74.62	22.93	-17.07	40	40.96	12.86	1.54	32.43	-	-	P	H
		148.34	29.07	-14.43	43.5	42.28	17.2	1.99	32.4	-	-	P	H
		263.77	35.17	-10.83	46	44.62	20.32	2.64	32.41	-	-	P	H
		307.42	39.03	-6.97	46	49.32	19.3	2.84	32.43	100	0	P	H
		385.99	33.06	-12.94	46	40.88	21.3	3.37	32.49	-	-	P	H
		958.29	35.36	-10.64	46	30.33	31	5.21	31.18	-	-	P	H
		59.1	29.55	-10.45	40	48.97	11.7	1.31	32.43	100	0	P	V
		138.64	30.89	-12.61	43.5	43.86	17.5	1.94	32.41	-	-	P	V
		263.77	34.53	-11.47	46	43.98	20.32	2.64	32.41	-	-	P	V
		307.42	34.49	-11.51	46	44.78	19.3	2.84	32.43	-	-	P	V
		579.99	32.93	-13.07	46	35.84	25.8	3.92	32.63	-	-	P	V
		950.53	34.56	-11.44	46	29.9	30.73	5.18	31.25	-	-	P	V
Remark	1. No other spurious found. 2. All results are PASS against limit line.												

<Aux. Antenna for Sample 1>

2.4GHz 2400~2483.5MHz

BLE (Band Edge @ 3m)

BLE	Note	Frequency	Level	Over	Limit	Read	Antenna	Path	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)
BLE CH 00 2402MHz		2358.825	55.62	-18.38	74	41.97	27.7	17.35	31.4	119	341	P	H
		2315.145	45.95	-8.05	54	32.23	27.87	17.27	31.42	119	341	A	H
	*	2402	96.65	-	-	82.98	27.61	17.42	31.36	119	341	P	H
	*	2402	96.33	-	-	82.66	27.61	17.42	31.36	119	341	A	H
		2336.565	55.72	-18.28	74	42.01	27.82	17.31	31.42	215	7	P	V
		2377.2	46.13	-7.87	54	32.45	27.68	17.38	31.38	215	7	A	V
	*	2402	95.57	-	-	81.94	27.57	17.42	31.36	215	7	P	V
	*	2402	95.25	-	-	81.62	27.57	17.42	31.36	215	7	A	V
BLE CH 19 2440MHz		2331.75	55.4	-18.6	74	41.72	27.8	17.3	31.42	112	343	P	H
		2326.8	45.89	-8.11	54	32.2	27.82	17.29	31.42	112	343	A	H
	*	2440	97.27	-	-	83.56	27.59	17.48	31.36	112	343	P	H
	*	2440	96.93	-	-	83.22	27.59	17.48	31.36	112	343	A	H
		2492.48	55.99	-18.01	74	42.2	27.56	17.57	31.34	112	343	P	H
		2486.8	45.88	-8.12	54	32.11	27.56	17.56	31.35	112	343	A	H
		2352.45	55.45	-18.55	74	41.73	27.8	17.33	31.41	186	8	P	V
		2341.95	45.94	-8.06	54	32.22	27.81	17.32	31.41	186	8	A	V
	*	2440	98.3	-	-	84.73	27.45	17.48	31.36	186	8	P	V
	*	2440	98.02	-	-	84.45	27.45	17.48	31.36	186	8	A	V
		2496.56	54.92	-19.08	74	41.29	27.39	17.58	31.34	186	8	P	V
		2490.56	45.95	-8.05	54	32.33	27.39	17.57	31.34	186	8	A	V
BLE CH 39 2480MHz	*	2480	97.37	-	-	83.6	27.57	17.55	31.35	115	340	P	H
	*	2480	96.81	-	-	83.04	27.57	17.55	31.35	115	340	A	H
		2483.6	56.71	-17.29	74	42.93	27.57	17.56	31.35	115	340	P	H
		2493.92	46.56	-7.44	54	32.76	27.56	17.58	31.34	115	340	A	H
	*	2480	100.16	-	-	86.56	27.4	17.55	31.35	200	9	P	V
	*	2480	99.65	-	-	86.05	27.4	17.55	31.35	200	9	A	V
		2483.64	57.88	-16.12	74	44.28	27.39	17.56	31.35	200	9	P	V
		2484.6	46.09	-7.91	54	32.49	27.39	17.56	31.35	200	9	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)	Path Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
BLE CH 00 2402MHz		4804	42.33	-31.67	74	65.96	31.38	11.28	66.29	100	0	P	H
		4804	42.79	-31.21	74	66.41	31.39	11.28	66.29	100	0	P	V
BLE CH 19 2440MHz		4880	43.35	-30.65	74	66.71	31.35	11.43	66.14	100	0	P	H
		7320	46.44	-27.56	74	62.05	36.36	13.89	65.86	100	0	P	H
		4880	43.06	-30.94	74	66.49	31.28	11.43	66.14	100	0	P	V
		7320	46.51	-27.49	74	62.06	36.42	13.89	65.86	100	0	P	V
BLE CH 39 2480MHz		4960	44.21	-29.79	74	67.13	31.47	11.59	65.98	100	0	P	H
		7440	45.99	-28.01	74	61.34	36.51	14.03	65.89	100	0	P	H
		4960	43.82	-30.18	74	66.79	31.42	11.59	65.98	100	0	P	V
		7440	45.48	-28.52	74	60.86	36.48	14.03	65.89	100	0	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 (MHz)	Level (dBμV/m)	Over Limit (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB/m)	Path Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
2.4GHz BLE LF		173.56	29.45	-14.05	43.5	44.28	15.44	2.14	32.41	-	-	P	H
		260.86	34.88	-11.12	46	44.49	20.17	2.63	32.41	-	-	P	H
		307.42	36.76	-9.24	46	47.05	19.3	2.84	32.43	100	0	P	H
		385.99	35.64	-10.36	46	43.46	21.3	3.37	32.49	-	-	P	H
		745.86	33.61	-12.39	46	33.45	28	4.6	32.44	-	-	P	H
		979.63	34.72	-19.28	54	29.61	30.81	5.27	30.97	-	-	P	H
		43.58	28.8	-11.2	40	42.29	17.85	1.1	32.44	100	0	P	V
		118.27	31.96	-11.54	43.5	45.14	17.5	1.73	32.41	-	-	P	V
		258.92	32	-14	46	42	19.79	2.62	32.41	-	-	P	V
		301.6	30.38	-15.62	46	40.7	19.3	2.82	32.44	-	-	P	V
		385.99	29.72	-16.28	46	37.54	21.3	3.37	32.49	-	-	P	V
		971.87	35.51	-18.49	54	30.41	30.9	5.24	31.04	-	-	P	V
Remark	1. No other spurious found. 2. All results are PASS against limit line.												

<Main Antenna for Sample 2>

2.4GHz 2400~2483.5MHz

BLE (Band Edge @ 3m)

BLE	Note	Frequency	Level	Over	Limit	Read	Antenna	Path	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)
BLE CH 39 2480MHz	*	2480	104.39	-	-	90.62	27.57	17.55	31.35	214	179	P	H
	*	2480	103.96	-	-	90.19	27.57	17.55	31.35	214	179	A	H
		2483.8	56.78	-17.22	74	43.01	27.56	17.56	31.35	214	179	P	H
		2483.64	45.9	-8.1	54	32.12	27.57	17.56	31.35	214	179	A	H
	*	2480	94.15	-	-	80.55	27.4	17.55	31.35	306	292	P	V
	*	2480	93.85	-	-	80.25	27.4	17.55	31.35	306	292	A	V
		2490.36	54.53	-19.47	74	40.91	27.39	17.57	31.34	306	292	P	V
		2489.4	45.68	-8.32	54	32.06	27.39	17.57	31.34	306	292	A	V
Remark	3. No other spurious found. 4. All results are PASS against Peak and Average limit line.												

2.4GHz 2400~2483.5MHz

BLE (Harmonic @ 3m)

BLE	Note	Frequency	Level	Over	Limit	Read	Antenna	Path	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)
BLE CH 39 2480MHz		4960	43.83	-30.17	74	66.75	31.47	11.59	65.98	100	0	P	H
		7440	45.14	-28.86	74	60.49	36.51	14.03	65.89	100	0	P	H
		4960	42.4	-31.6	74	65.37	31.42	11.59	65.98	100	0	P	V
		7440	45.78	-28.22	74	61.16	36.48	14.03	65.89	100	0	P	V
Remark	3. No other spurious found. 4. All results are PASS against Peak and Average limit line.												

<Aux. Antenna for Sample 2>

2.4GHz 2400~2483.5MHz

BLE (Band Edge @ 3m)

BLE	Note	Frequency	Level	Over	Limit	Read	Antenna	Path	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)
BLE CH 00 2402MHz		2362.92	55.45	-18.55	74	41.8	27.69	17.36	31.4	208	9	P	H
		2341.185	45.92	-8.08	54	32.26	27.75	17.32	31.41	208	9	A	H
	*	2402	95.84	-	-	82.17	27.61	17.42	31.36	208	9	P	H
	*	2402	95.51	-	-	81.84	27.61	17.42	31.36	208	9	A	H
		2347.38	55.45	-18.55	74	41.72	27.81	17.33	31.41	120	35	P	V
		2353.365	46.35	-7.65	54	32.63	27.79	17.34	31.41	120	35	A	V
	*	2402	101.89	-	-	88.26	27.57	17.42	31.36	120	35	P	V
	*	2402	101.52	-	-	87.89	27.57	17.42	31.36	120	35	A	V
BLE CH 19 2440MHz		2373.75	55.2	-18.8	74	41.55	27.66	17.38	31.39	203	8	P	H
		2335.65	45.87	-8.13	54	32.2	27.78	17.31	31.42	203	8	A	H
	*	2440	97.6	-	-	83.89	27.59	17.48	31.36	203	8	P	H
	*	2440	97.3	-	-	83.59	27.59	17.48	31.36	203	8	A	H
		2491.92	54.83	-19.17	74	41.04	27.56	17.57	31.34	203	8	P	H
		2487.68	45.94	-8.06	54	32.15	27.56	17.57	31.34	203	8	A	H
		2379.3	55.45	-18.55	74	41.77	27.67	17.39	31.38	104	353	P	V
		2341.95	46.04	-7.96	54	32.32	27.81	17.32	31.41	104	353	A	V
	*	2440	103.54	-	-	89.97	27.45	17.48	31.36	104	353	P	V
	*	2440	103.2	-	-	89.63	27.45	17.48	31.36	104	353	A	V
		2495.84	55.4	-18.6	74	41.77	27.39	17.58	31.34	104	353	P	V
		2496.32	45.88	-8.12	54	32.25	27.39	17.58	31.34	104	353	A	V
BLE CH 39 2480MHz	*	2480	96.65	-	-	82.88	27.57	17.55	31.35	210	9	P	H
	*	2480	96.23	-	-	82.46	27.57	17.55	31.35	210	9	A	H
		2485.8	56.08	-17.92	74	42.31	27.56	17.56	31.35	210	9	P	H
		2497.12	46.12	-7.88	54	32.32	27.56	17.58	31.34	210	9	A	H
	*	2480	104.21	-	-	90.61	27.4	17.55	31.35	100	359	P	V
	*	2480	103.89	-	-	90.29	27.4	17.55	31.35	100	359	A	V
		2483.76	55.47	-18.53	74	41.87	27.39	17.56	31.35	100	359	P	V
		2483.56	46.2	-7.8	54	32.6	27.39	17.56	31.35	100	359	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	Level	Over	Limit	Read	Antenna	Path	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)
BLE CH 00 2402MHz		4804	51.23	-22.77	74	74.86	31.38	11.28	66.29	100	137	P	H
		4804	47.41	-6.59	54	71.04	31.38	11.28	66.29	100	137	A	H
		4804	54.48	-19.52	74	78.1	31.39	11.28	66.29	100	51	P	V
		4804	51.48	-2.52	54	75.1	31.39	11.28	66.29	100	51	A	V
BLE CH 19 2440MHz		4880	51	-23	74	74.36	31.35	11.43	66.14	260	114	P	H
		4880	46.94	-7.06	54	70.3	31.35	11.43	66.14	260	114	A	H
		7320	45.94	-28.06	74	61.55	36.36	13.89	65.86	100	0	P	H
		4880	52.75	-21.25	74	76.18	31.28	11.43	66.14	105	51	P	V
		4880	49.62	-4.38	54	73.05	31.28	11.43	66.14	105	51	A	V
		7320	45.96	-28.04	74	61.51	36.42	13.89	65.86	100	0	P	V
BLE CH 39 2480MHz		4960	52.05	-21.95	74	74.97	31.47	11.59	65.98	270	110	P	H
		4960	48.36	-5.64	54	71.28	31.47	11.59	65.98	270	110	A	H
		7440	46.64	-27.36	74	61.99	36.51	14.03	65.89	100	0	P	H
		4960	54.23	-19.77	74	77.2	31.42	11.59	65.98	100	52	P	V
		4960	51.06	-2.94	54	74.03	31.42	11.59	65.98	100	52	A	V
		7440	46.59	-27.41	74	61.97	36.48	14.03	65.89	100	0	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	Path	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		213.33	35.92	-7.58	43.5	51.02	14.9	2.4	32.4	-	-	P	H
		217.21	36.53	-9.47	46	51.49	15.02	2.42	32.4	-	-	P	H
		253.1	39.04	-6.96	46	49.95	18.91	2.59	32.41	100	0	P	H
		299.66	38.42	-7.58	46	48.85	19.2	2.81	32.44	-	-	P	H
		746.83	33.56	-12.44	46	33.4	28	4.6	32.44	-	-	P	H
		962.17	34.94	-19.06	54	29.83	31.04	5.21	31.14	-	-	P	H
		43.58	29.49	-10.51	40	42.98	17.85	1.1	32.44	100	0	P	V
		116.33	31.84	-11.66	43.5	45.12	17.4	1.73	32.41	-	-	P	V
		253.1	33.94	-12.06	46	44.85	18.91	2.59	32.41	-	-	P	V
		299.66	29.5	-16.5	46	39.93	19.2	2.81	32.44	-	-	P	V
		746.83	32.74	-13.26	46	32.58	28	4.6	32.44	-	-	P	V
		983.51	34.89	-19.11	54	29.82	30.73	5.28	30.94	-	-	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:

BLE	Note	Frequency	Level	Over Limit	Limit Line	Read Level	Antenna Factor	Path 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		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. Path Loss(dB) = Cable loss(dB) + Filter loss(dB) + Attenuator loss(dB)
2. Level(dBμV/m) =

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

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

For Peak Limit @ 2390MHz:

1. Level(dBμV/m)

= Antenna Factor(dB/m) + Path 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) + Path 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”.

Radiated Spurious Emission Plots

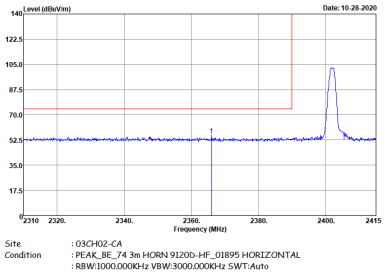
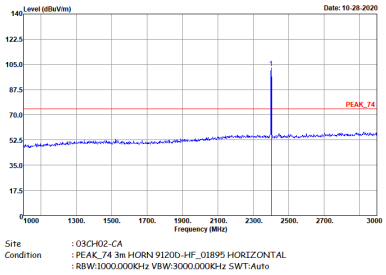
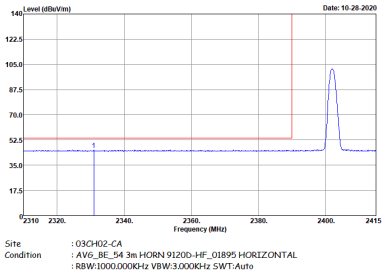
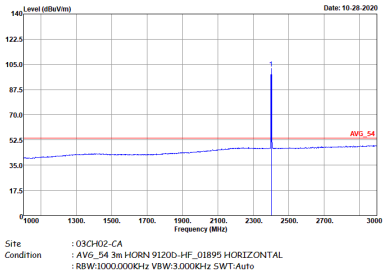
Note symbol

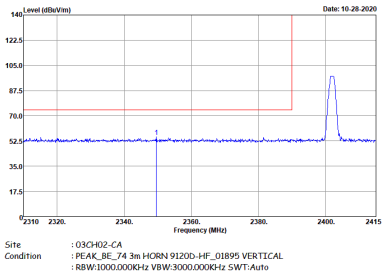
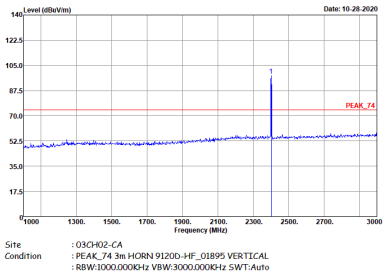
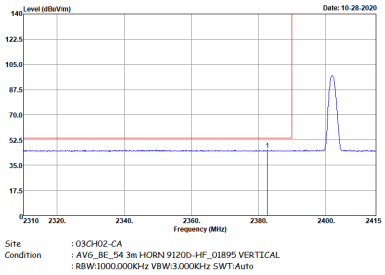
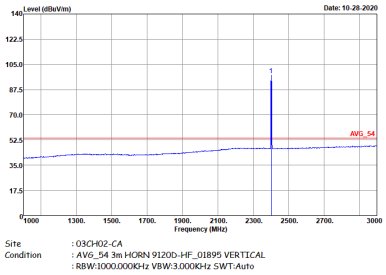
-L	**Low channel location**
-R	**High channel location**

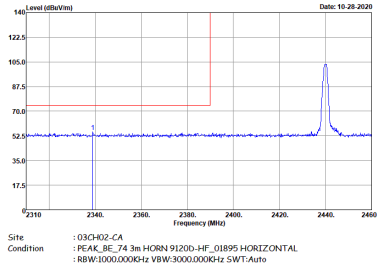
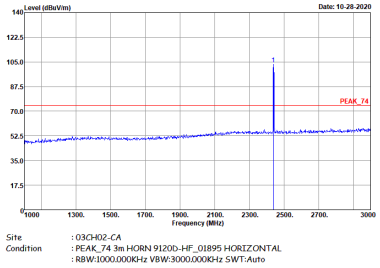
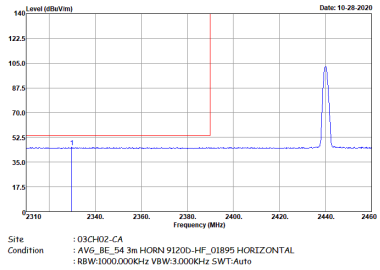
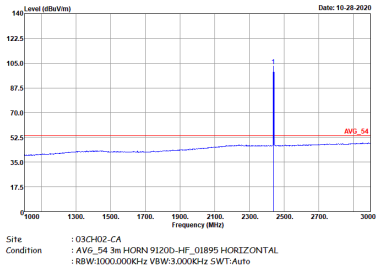
<Main Antenna for Sample 1>

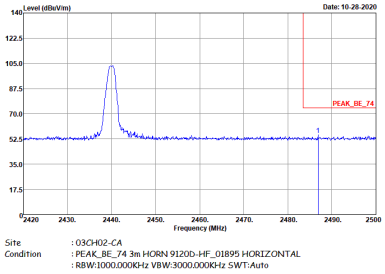
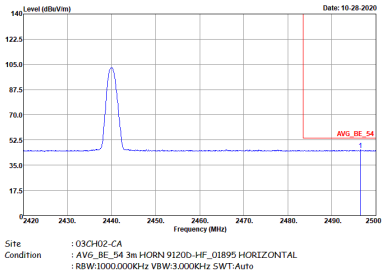
2.4GHz 2400~2483.5MHz

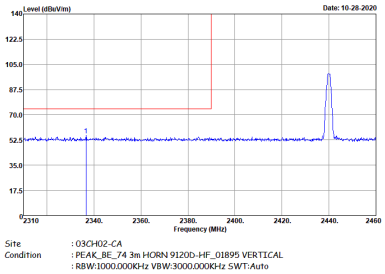
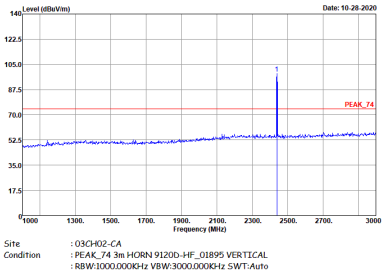
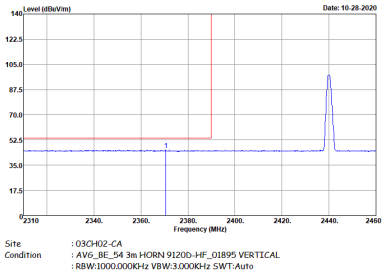
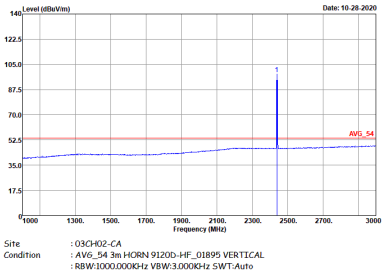
BLE (Band Edge @ 3m)

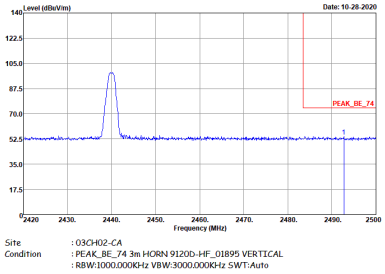
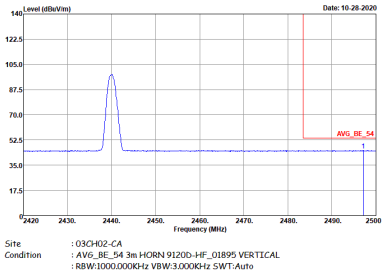
BLE	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
	BLE CH00 2402MHz	
	Horizontal	Fundamental
Peak		
Avg.		

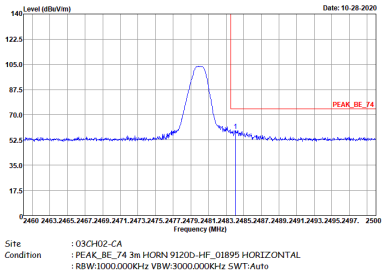
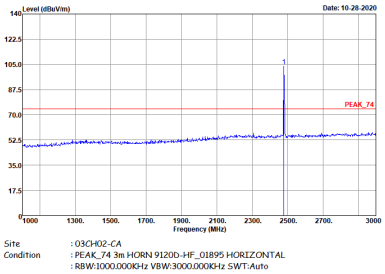
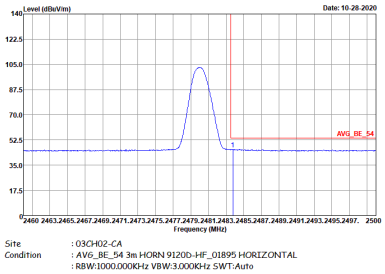
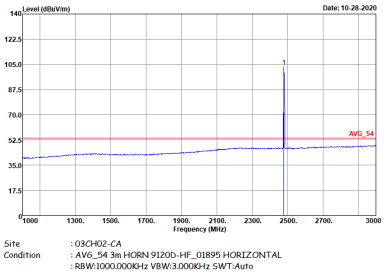
BLE	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
	BLE CH00 2402MHz	
	Vertical	Fundamental
Peak		
Avg		

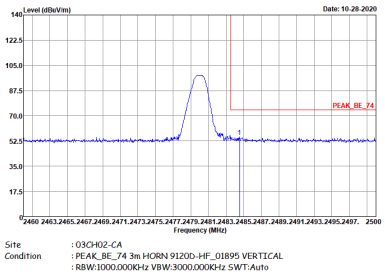
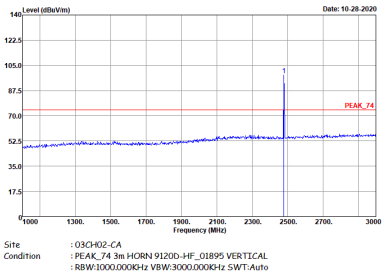
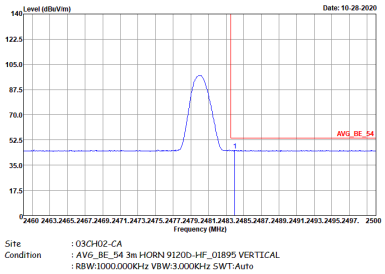
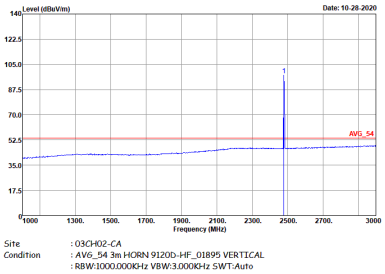
BLE	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
	BLE CH19 2440MHz - L	
	Horizontal	Fundamental
Peak		
Avg.		

BLE	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
	BLE CH19 2440MHz - R	
	Horizontal	Fundamental
Peak		Left blank
Avg.		Left blank

BLE	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
	BLE CH19 2440MHz - L	
	Vertical	Fundamental
Peak		
Avg.		

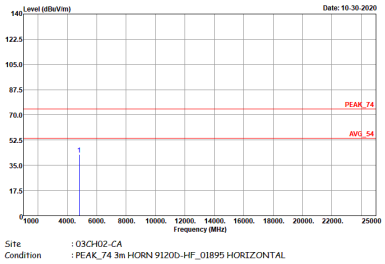
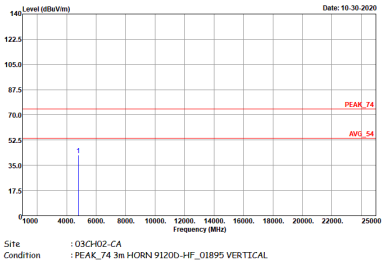
BLE	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
	BLE CH19 2440MHz - R	
	Vertical	Fundamental
Peak		Left blank
Avg.		Left blank

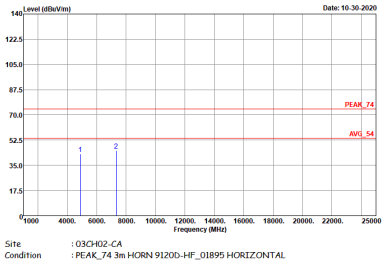
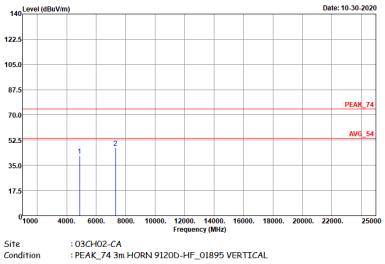
BLE	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
	BLE CH39 2480MHz	
	Horizontal	Fundamental
Peak		
Avg.		

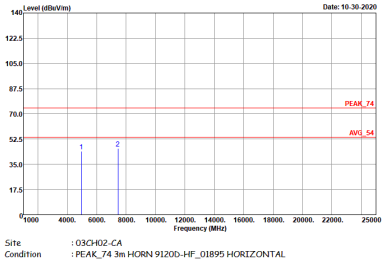
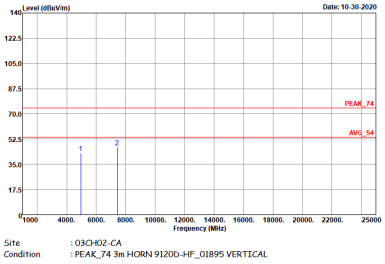
BLE	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
	BLE CH39 2480MHz	
	Vertical	Fundamental
Peak		
Avg.		

2.4GHz 2400~2483.5MHz

BLE (Harmonic @ 3m)

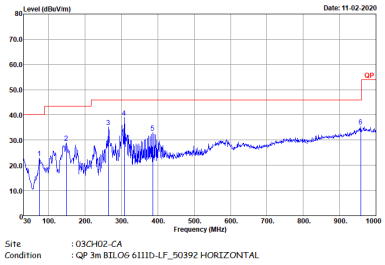
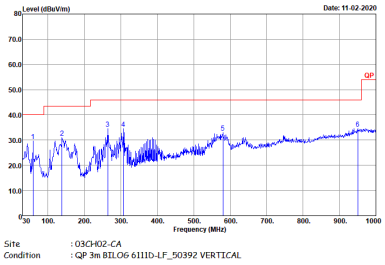
BLE	2.4GHz 2400~2483.5MHz Harmonic @ 3m	
	BLE CH00 2402MHz	
	Horizontal	Vertical
Peak Avg.		

BLE	2.4GHz 2400~2483.5MHz Harmonic @ 3m	
	BLE CH19 2440MHz	
	Horizontal	Vertical
Peak Avg.		

BLE	2.4GHz 2400~2483.5MHz Harmonic @ 3m	
	BLE CH39 2480MHz	
	Horizontal	Vertical
Peak		

Emission below 1GHz

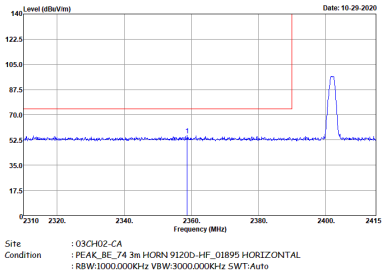
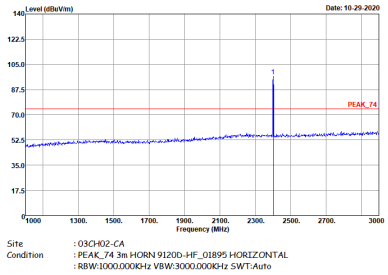
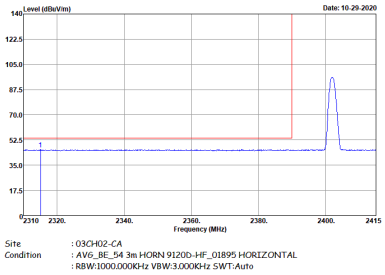
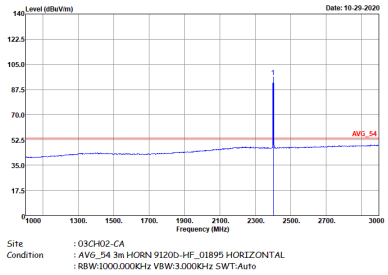
2.4GHz BLE (LF)

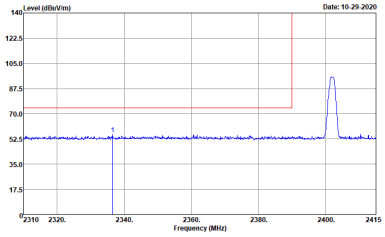
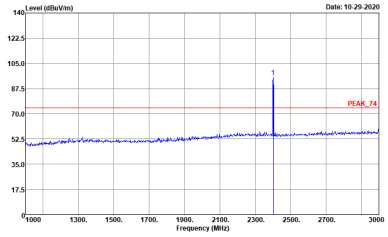
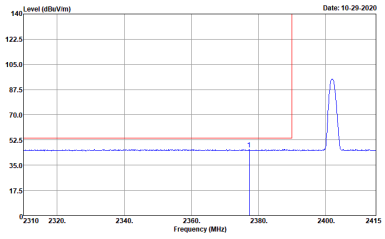
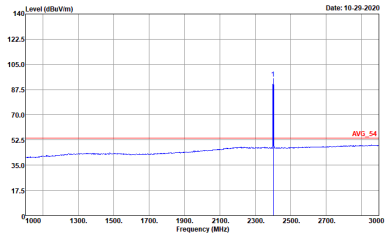
BLE	2.4GHz 2400~2483.5MHz	
	BLE LF	
	Horizontal	Vertical
QP / Peak		

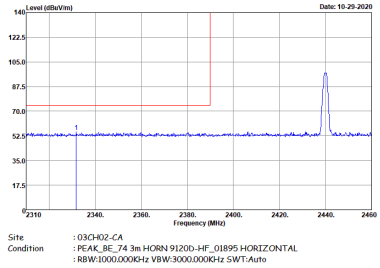
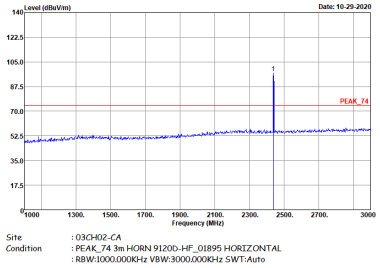
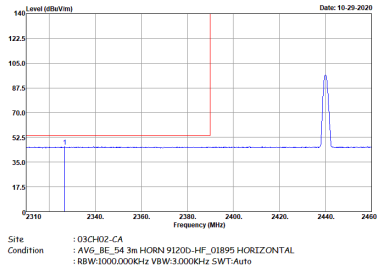
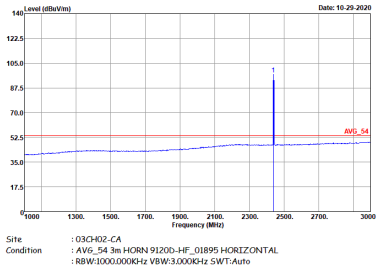
<Aux. Antenna for Sample 1>

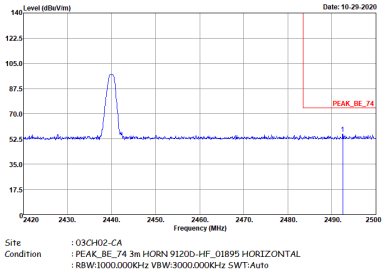
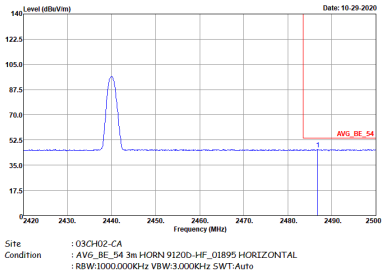
2.4GHz 2400~2483.5MHz

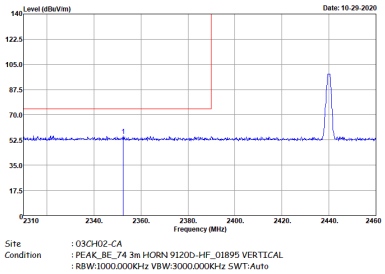
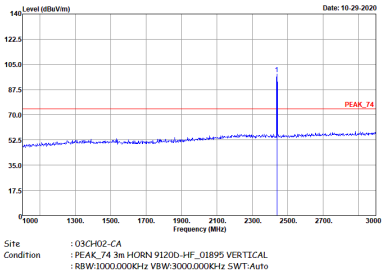
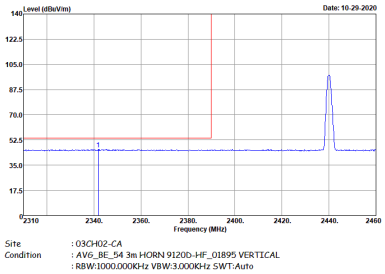
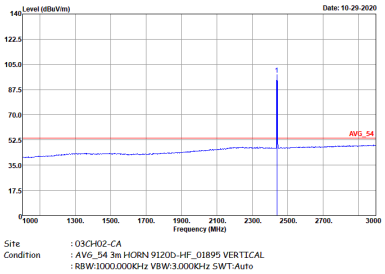
BLE (Band Edge @ 3m)

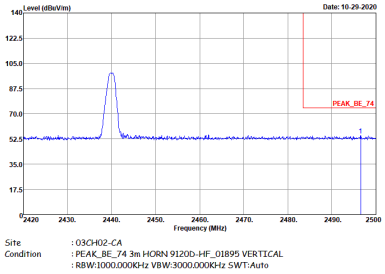
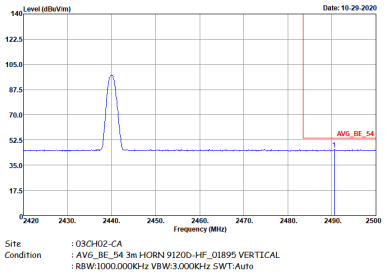
BLE	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
	BLE CH00 2402MHz	
	Horizontal	Fundamental
Peak		
Avg.		

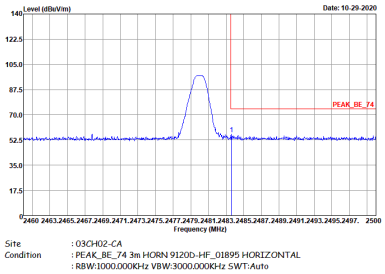
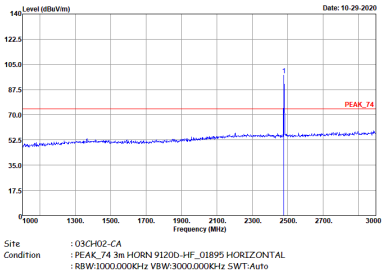
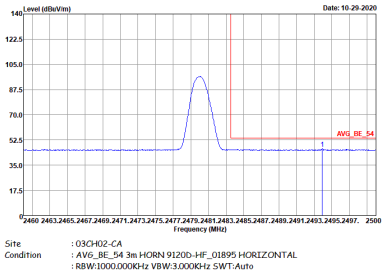
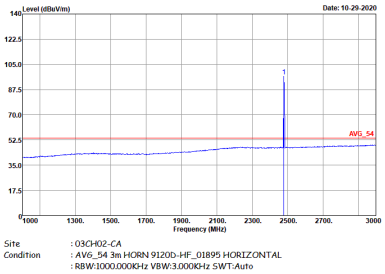
BLE	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
	BLE CH00 2402MHz	
	Vertical	Fundamental
Peak		
Avg		

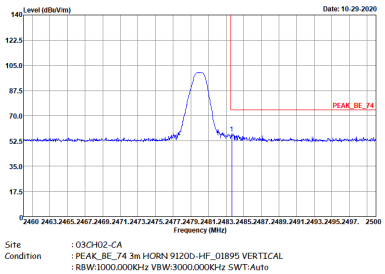
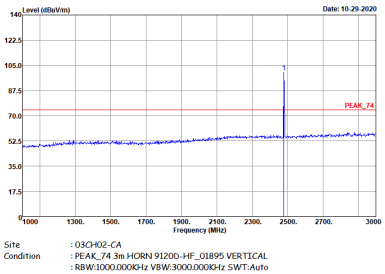
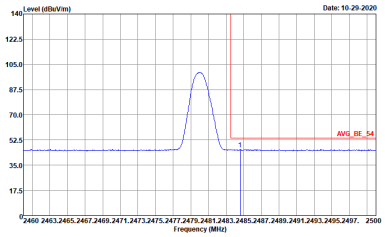
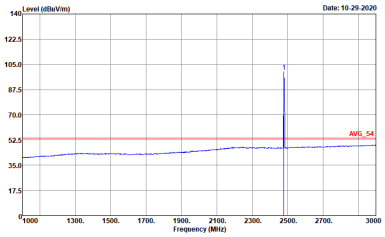
BLE	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
	BLE CH19 2440MHz - L	
	Horizontal	Fundamental
Peak		
Avg.		

BLE	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
	BLE CH19 2440MHz - R	
	Horizontal	Fundamental
Peak		Left blank
Avg.		Left blank

BLE	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
	BLE CH19 2440MHz - L	
	Vertical	Fundamental
Peak		
Avg.		

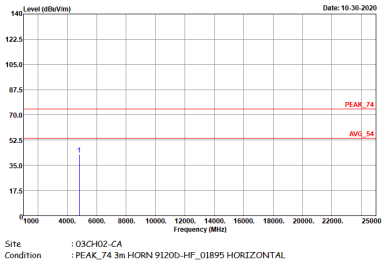
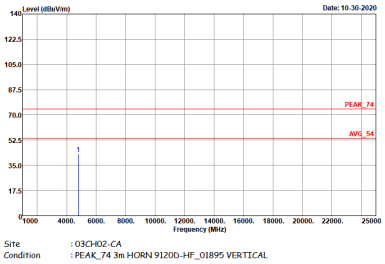
BLE	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
	BLE CH19 2440MHz - R	
	Vertical	Fundamental
Peak		Left blank
Avg.		Left blank

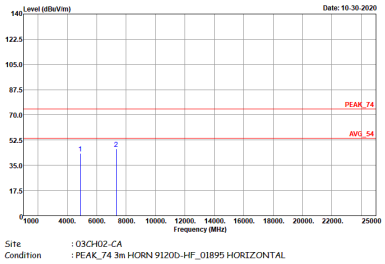
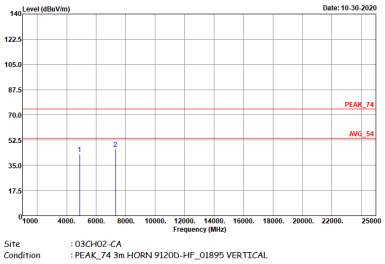
BLE	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
	BLE CH39 2480MHz	
	Horizontal	Fundamental
Peak		
Avg.		

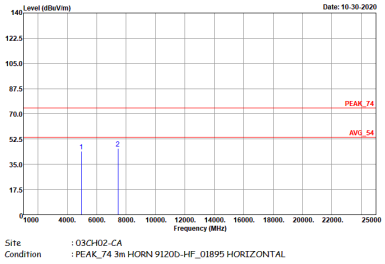
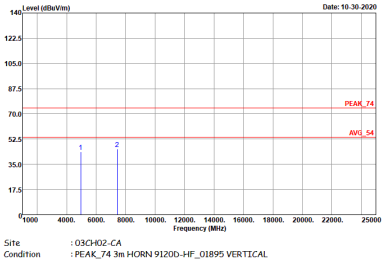
BLE	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
	BLE CH39 2480MHz	
	Vertical	Fundamental
Peak		
Avg.		

2.4GHz 2400~2483.5MHz

BLE (Harmonic @ 3m)

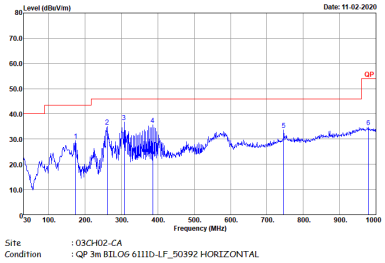
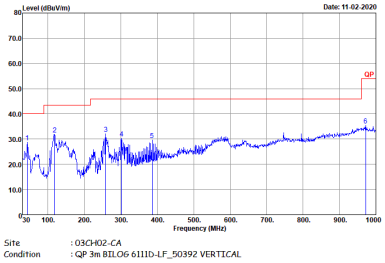
BLE	2.4GHz 2400~2483.5MHz Harmonic @ 3m	
	BLE CH00 2402MHz	
	Horizontal	Vertical
Peak Avg.		

BLE	2.4GHz 2400~2483.5MHz Harmonic @ 3m	
	BLE CH19 2440MHz	
	Horizontal	Vertical
Peak Avg.		

BLE	2.4GHz 2400~2483.5MHz Harmonic @ 3m	
	BLE CH39 2480MHz	
	Horizontal	Vertical
Peak		

Emission below 1GHz

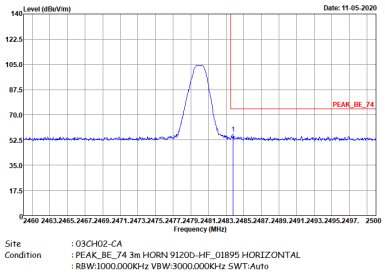
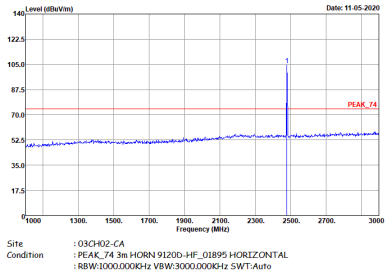
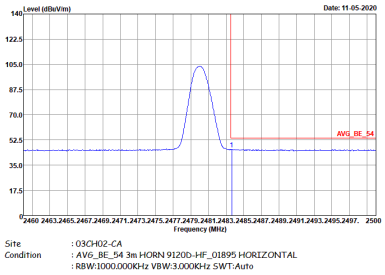
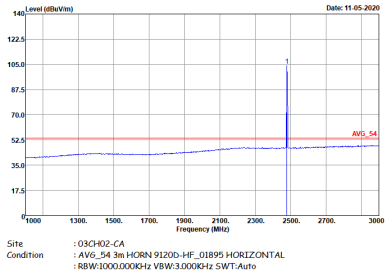
2.4GHz BLE (LF)

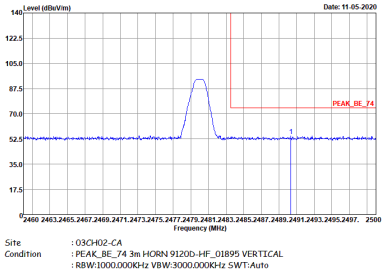
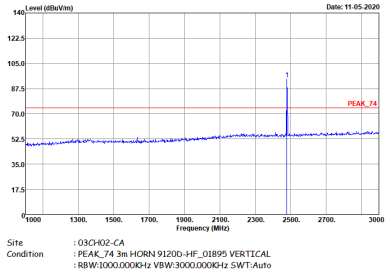
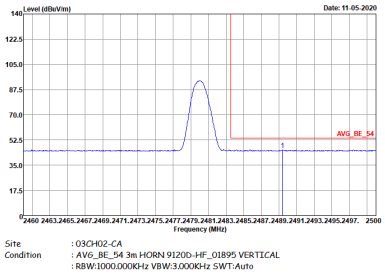
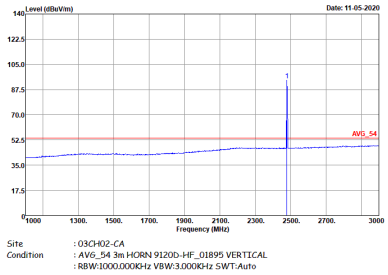
BLE	2.4GHz 2400~2483.5MHz	
	BLE LF	
	Horizontal	Vertical
QP / Peak		

<Main Antenna for Sample 2>

2.4GHz 2400~2483.5MHz

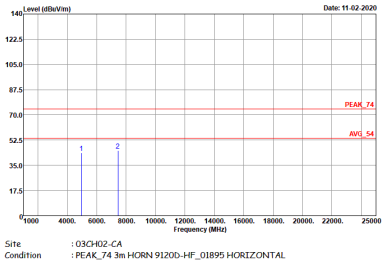
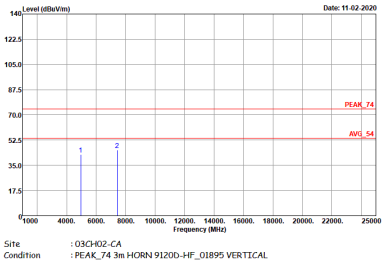
BLE (Band Edge @ 3m)

BLE	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
	BLE CH39 2480MHz	
	Horizontal	Fundamental
Peak		
Avg.		

BLE	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
	BLE CH39 2480MHz	
	Vertical	Fundamental
Peak		
Avg.		

2.4GHz 2400~2483.5MHz

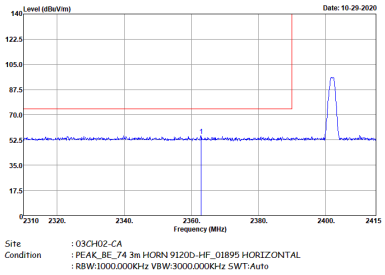
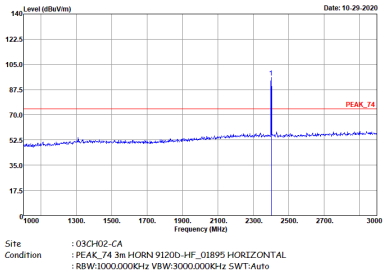
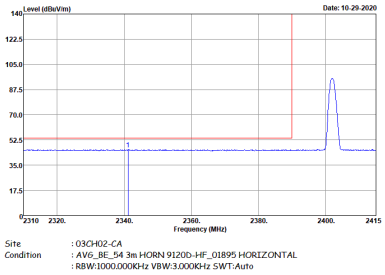
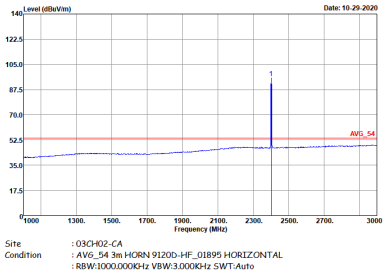
BLE (Harmonic @ 3m)

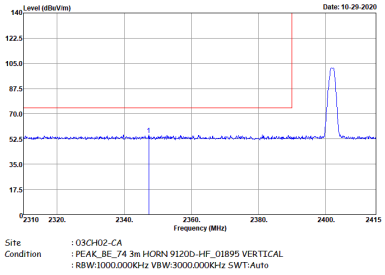
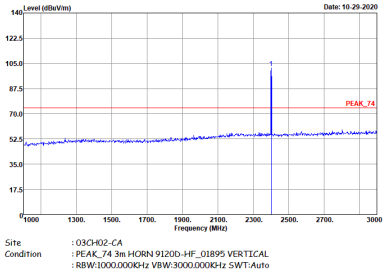
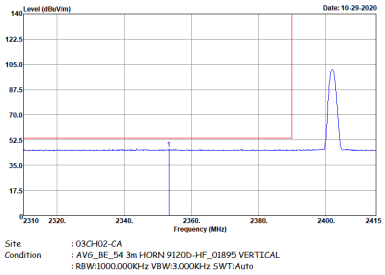
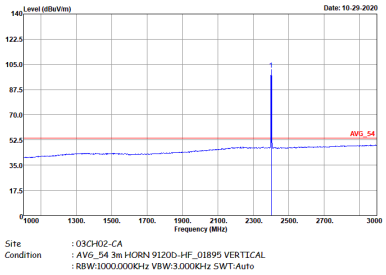
BLE	2.4GHz 2400~2483.5MHz Harmonic @ 3m	
	BLE CH39 2480MHz	
	Horizontal	Vertical
Peak		

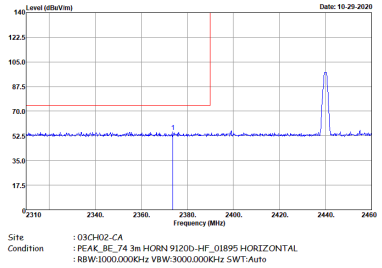
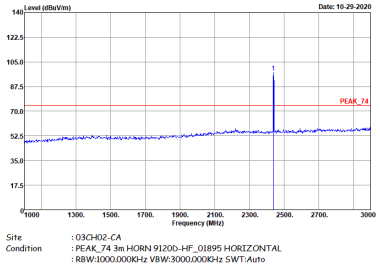
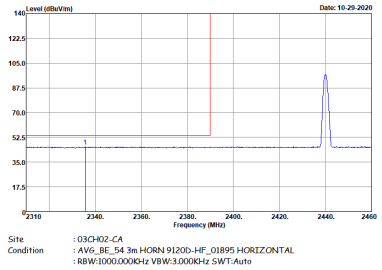
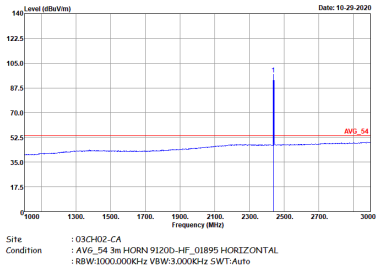
<Aux. Antenna for Sample 2>

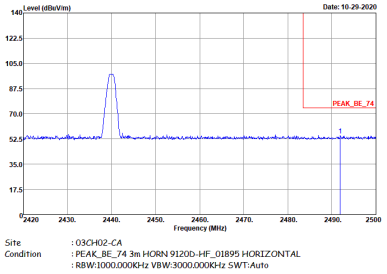
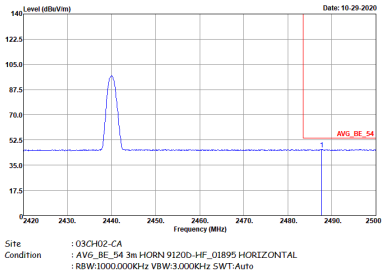
2.4GHz 2400~2483.5MHz

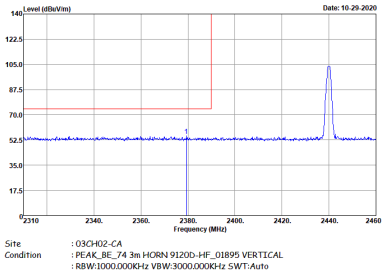
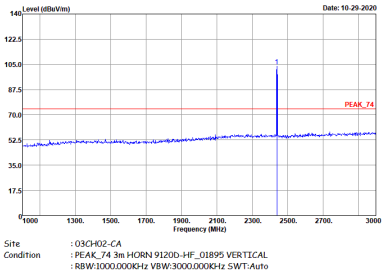
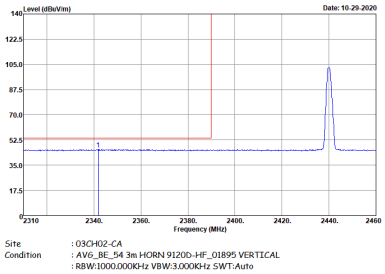
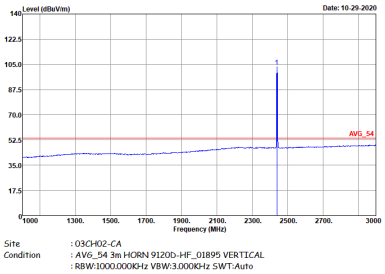
BLE (Band Edge @ 3m)

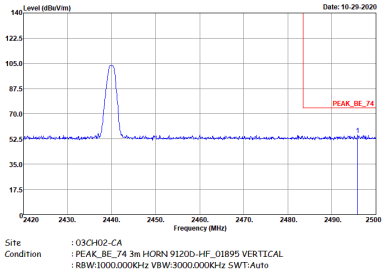
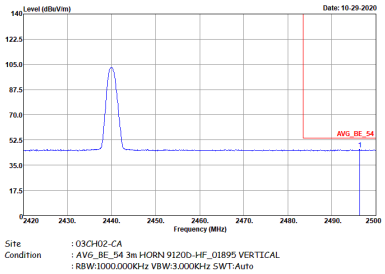
BLE	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
	BLE CH00 2402MHz	
	Horizontal	Fundamental
Peak		
Avg.		

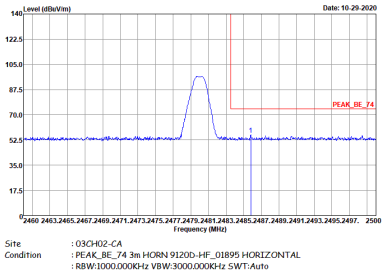
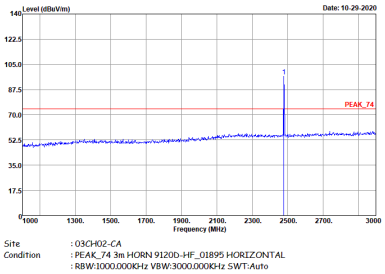
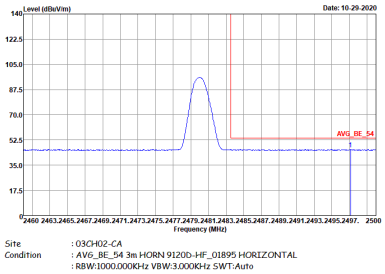
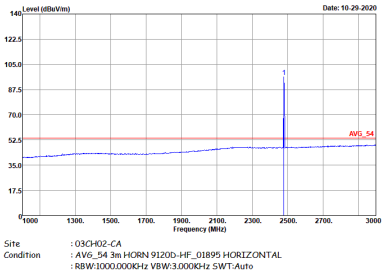
BLE	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
	BLE CH00 2402MHz	
	Vertical	Fundamental
Peak		
Avg		

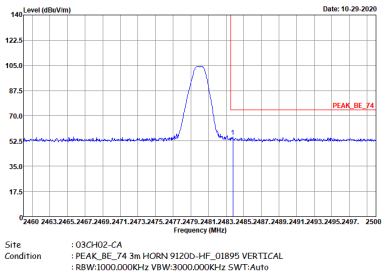
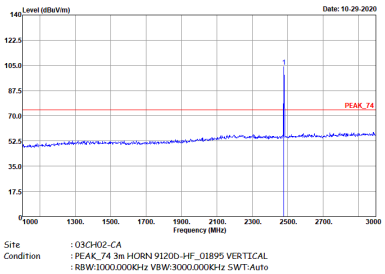
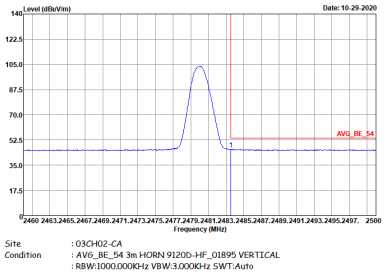
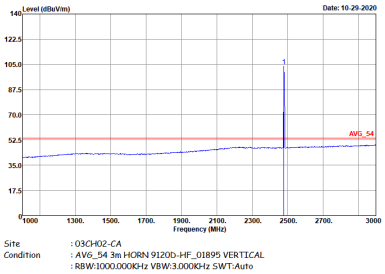
BLE	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
	BLE CH19 2440MHz - L	
	Horizontal	Fundamental
Peak		
Avg.		

BLE	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
	BLE CH19 2440MHz - R	
	Horizontal	Fundamental
Peak		Left blank
Avg.		Left blank

BLE	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
	BLE CH19 2440MHz - L	
	Vertical	Fundamental
Peak		
Avg.		

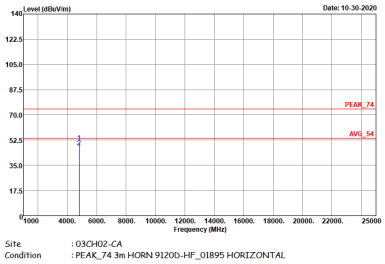
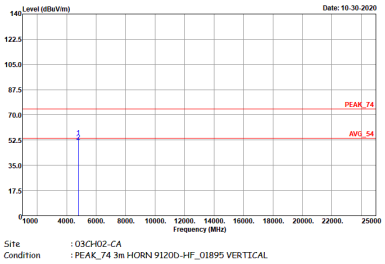
BLE	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
	BLE CH19 2440MHz - R	
	Vertical	Fundamental
Peak		Left blank
Avg.		Left blank

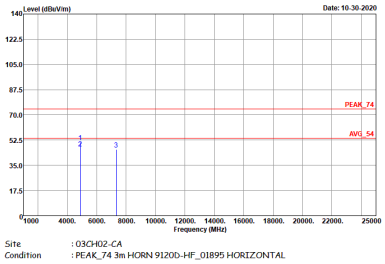
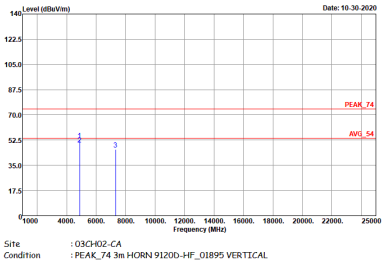
BLE	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
	BLE CH39 2480MHz	
	Horizontal	Fundamental
Peak		
Avg.		

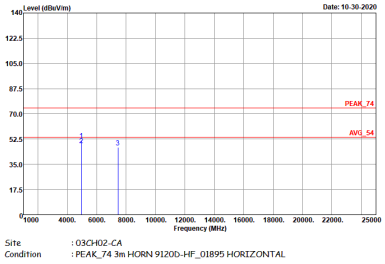
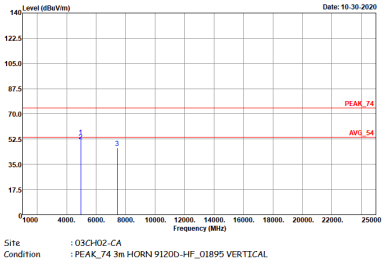
BLE	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
	BLE CH39 2480MHz	
	Vertical	Fundamental
Peak		
Avg.		

2.4GHz 2400~2483.5MHz

BLE (Harmonic @ 3m)

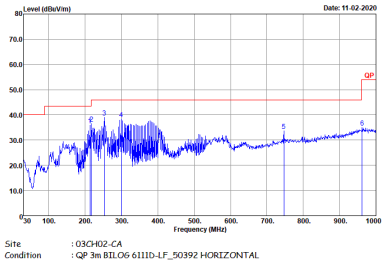
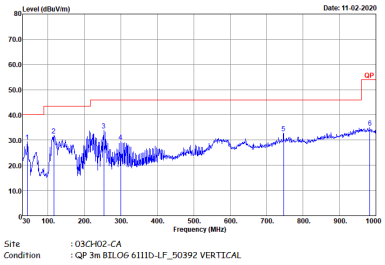
BLE	2.4GHz 2400~2483.5MHz Harmonic @ 3m	
	BLE CH00 2402MHz	
	Horizontal	Vertical
Peak Avg.		

BLE	2.4GHz 2400~2483.5MHz Harmonic @ 3m	
	BLE CH19 2440MHz	
	Horizontal	Vertical
Peak Avg.		

BLE	2.4GHz 2400~2483.5MHz Harmonic @ 3m	
	BLE CH39 2480MHz	
	Horizontal	Vertical
Peak		

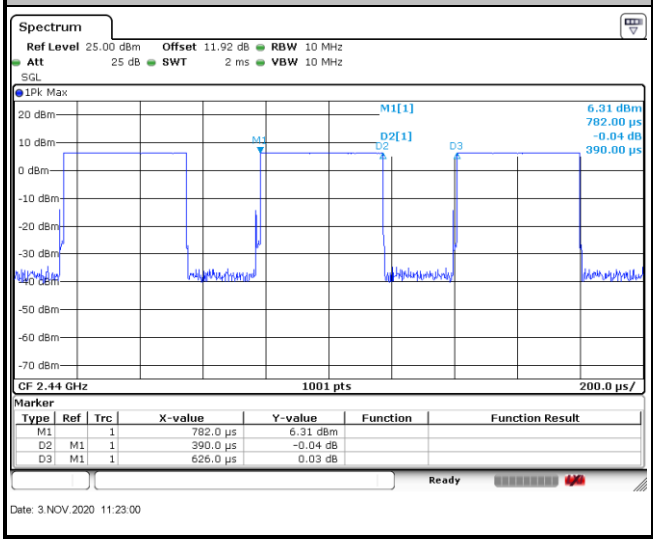
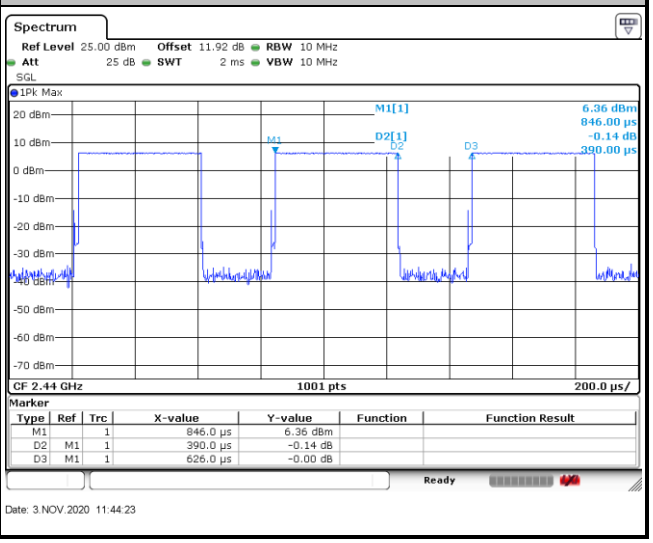
Emission below 1GHz

2.4GHz BLE (LF)

BLE	2.4GHz 2400~2483.5MHz	
	BLE LF	
	Horizontal	Vertical
QP / Peak		

3.5.7 Duty Cycle

Band	Duty Cycle(%)	T(us)	1/T(kHz)	VBW Setting	Duty Factor(dB)
Bluetooth –LE for Main Antenna	62.3	390	2.56	3kHz	2.06
Bluetooth -LE for Aux. Antenna	62.3	390	2.56	3kHz	2.06

Bluetooth –LE for Main Antenna	Bluetooth -LE for Aux. Antenna
	

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.

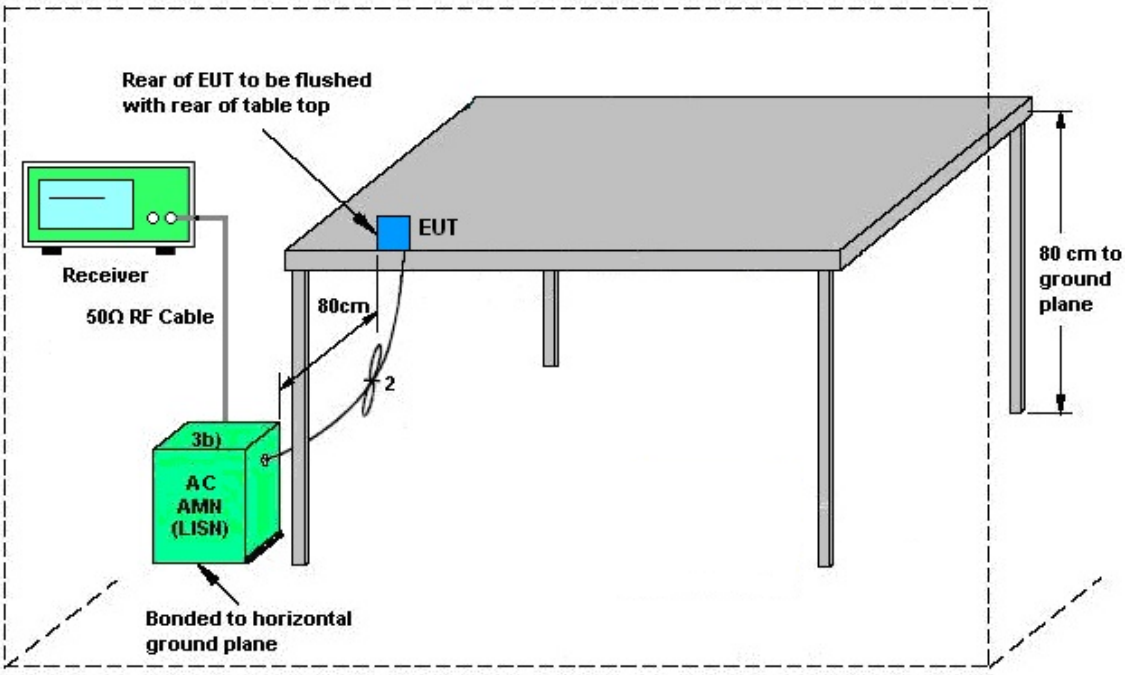
3.6.2 Measuring Instruments

See list of measuring equipment of this test report.

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



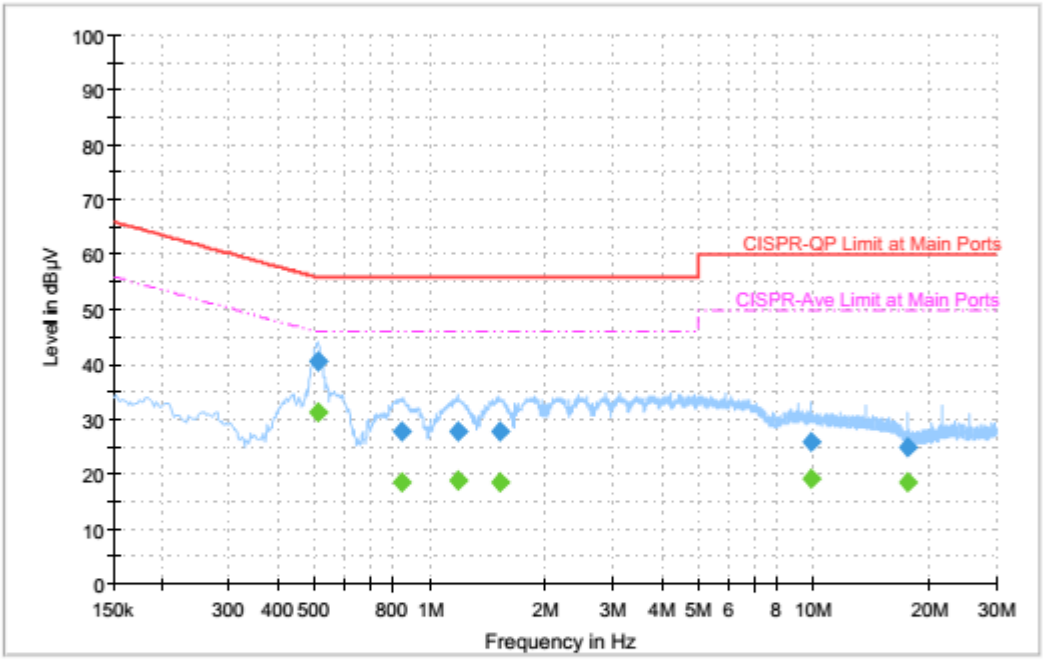
AMN = Artificial mains network (LISN)
AE = Associated equipment
EUT = Equipment under test
ISN = Impedance stabilization network

3.6.5 Test Result of AC Conducted Emission

EUT Information

Test Site :	CO01-CA
Mode	2
Test Voltage:	120Vac/60Hz
Project	Cypress Line 200819001
Config	3 WIFI idle + BT link

Full Spectrum



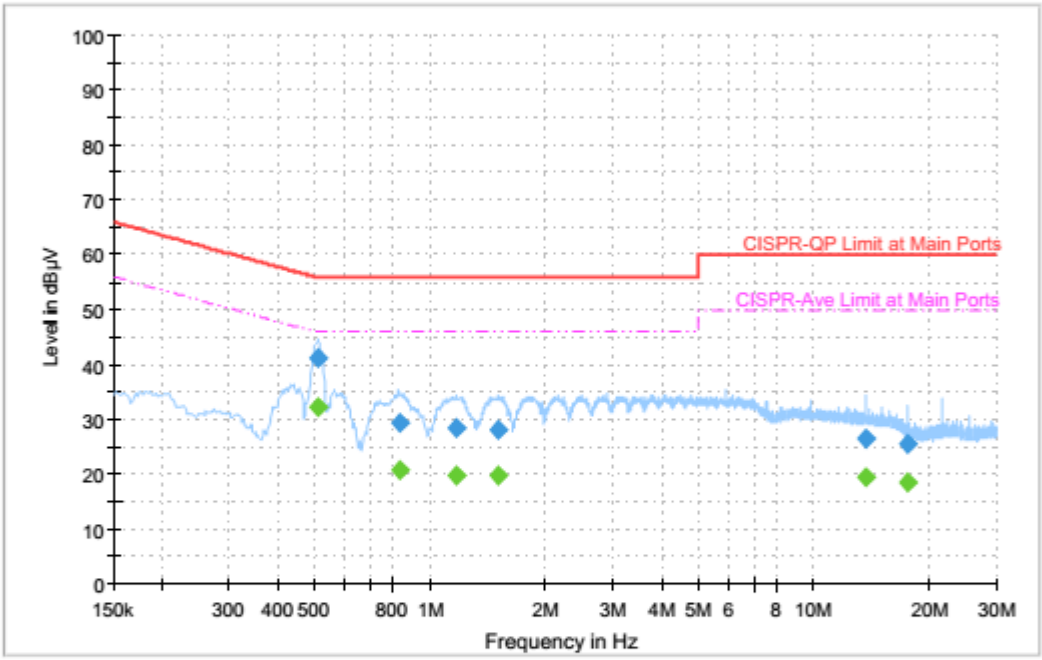
Final Result

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Limit (dBµV)	Margin (dB)	Line	Filter	Corr. (dB)
0.510450	---	31.33	46.00	14.67	L1	OFF	20.0
0.510450	40.72	---	56.00	15.28	L1	OFF	20.0
0.843000	---	18.52	46.00	27.48	L1	OFF	20.0
0.843000	27.74	---	56.00	28.26	L1	OFF	20.0
1.178250	---	18.87	46.00	27.13	L1	OFF	20.0
1.178250	27.78	---	56.00	28.22	L1	OFF	20.0
1.518000	---	18.66	46.00	27.34	L1	OFF	20.0
1.518000	27.80	---	56.00	28.20	L1	OFF	20.0
9.804030	---	19.19	50.00	30.81	L1	OFF	20.2
9.804030	25.90	---	60.00	34.10	L1	OFF	20.2
17.647170	---	18.47	50.00	31.53	L1	OFF	20.4
17.647170	24.96	---	60.00	35.04	L1	OFF	20.4

EUT Information

Test Voltage:	120Vac/60Hz
Config	3
Project	Cypress
Phase:	Neutral
Project#	200819001
Mode	2
	WIFI Idle +BT Link

Full Spectrum



Final Result

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Limit (dBµV)	Margin (dB)	Line	Filter	Corr. (dB)
0.510540	---	32.17	46.00	13.83	N	OFF	20.0
0.510540	41.34	---	56.00	14.66	N	OFF	20.0
0.831750	---	20.63	46.00	25.37	N	OFF	20.0
0.831750	29.40	---	56.00	26.60	N	OFF	20.0
1.174380	---	19.95	46.00	26.05	N	OFF	20.0
1.174380	28.44	---	56.00	27.56	N	OFF	20.0
1.501080	---	19.80	46.00	26.20	N	OFF	20.0
1.501080	28.20	---	56.00	27.80	N	OFF	20.0
13.725600	---	19.41	50.00	30.59	N	OFF	20.3
13.725600	26.36	---	60.00	33.64	N	OFF	20.3
17.647170	---	18.64	50.00	31.36	N	OFF	20.4
17.647170	25.52	---	60.00	34.48	N	OFF	20.4

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	Brand Name	Model No.	Serial No.	Characteristics	Calibration Date	Test Date	Due Date	Remark
Hygrometer	Testo	608-H1	45142595	N/A	Aug. 05, 2020	Oct. 22, 2020~ Dec. 16, 2020	Aug. 04, 2021	Conducted (TH01-CA)
Power Sensor	DARE!!	RPR3006W	RPR6W-1 901026	10MHz-6GHz	Jun. 24, 2020	Oct. 22, 2020~ Dec. 16, 2020	Jun. 23, 2021	Conducted (TH01-CA)
Spectrum Analyzer	Rohde & Schwarz	FSV40	101089	10Hz-40GHz	Sep. 14, 2020	Oct. 22, 2020~ Dec. 16, 2020	Sep. 13, 2021	Conducted (TH01-CA)
Switch Box & RF Cable	EM Electronics	EMSW26	1090304	N/A	Dec. 30, 2019	Oct. 22, 2020~ Dec. 16, 2020	Dec. 29, 2020	Conducted (TH01-CA)
LISN	TESEQ	NNB51	47407	N/A	Jul. 06, 2020	Nov. 12, 2020	Jul. 05, 2021	Conduction (CO01-CA)
EMI Test Receiver	R&S	ESR7	102177	9KHz~7GHz	Jul. 16, 2020	Nov. 12, 2020	Jul. 15, 2021	Conduction (CO01-CA)
Pulse limiter with 10dB attenuation	R&S	VTSD 9561-F N	9561-F-N00412	N/A	Jul. 08, 2020	Nov. 12, 2020	Jul. 07, 2021	Conduction (CO01-CA)
Test Software	R&S	EMC32 V10.30.0	N/A	N/A	N/A	Nov. 12, 2020	N/A	Conduction (CO01-CA)
Bilog Antenna	TESEQ	6111D	50392	30MHz~1GHz	Jul. 29, 2020	Oct. 28, 2020~ Dec. 08, 2020	Jul. 28, 2021	Radiation (03CH02-CA)
Horn Antenna	SCHWARZBE CK	BBHA 9120D	01895	1GHz~18GHz	Aug. 28, 2020	Oct. 28, 2020~ Dec. 08, 2020	Aug. 27, 2021	Radiation (03CH02-CA)
Amplifier	SONOMA	310N	372240	N/A	Aug. 12, 2020	Oct. 28, 2020~ Dec. 08, 2020	Aug. 11, 2021	Radiation (03CH02-CA)
Preamplifier	Keysight	83017A	MY532703 21	1GHz~26.5GHz	Jul. 28, 2020	Oct. 28, 2020~ Dec. 08, 2020	Jul. 27, 2021	Radiation (03CH02-CA)
Preamplifier	E-instrument	ERA-100M-18 G-56-01-A70	EC190025 1	1GHz~18GHz	Nov. 26, 2019	Oct. 28, 2020~ Dec. 08, 2020	Nov. 25, 2021	Radiation (03CH02-CA)
Spectrum Analyzer	Keysight	N9010A	MY574202 21	10Hz~44GHz	Sep. 11, 2020	Oct. 28, 2020~ Dec. 08, 2020	Sep. 10, 2021	Radiation (03CH02-CA)
Filter	Wainwright	WLK12-1200-1272-11000-4 0SS	SN2	1.2G Low Pass	Jul. 24, 2020	Oct. 28, 2020~ Dec. 08, 2020	Jul. 23, 2021	Radiation (03CH02-CA)
Filter	Wainwright	WHKX12-270 0-3000-18000 -60ST	SN10	3G Highpass	Jul. 24, 2020	Oct. 28, 2020~ Dec. 08, 2020	Jul. 23, 2021	Radiation (03CH02-CA)
Hygrometer	TESEO	608-H1	45142602	N/A	Aug. 05, 2020	Oct. 28, 2020~ Dec. 08, 2020	Aug. 04, 2021	Radiation (03CH02-CA)
Controller	ChainTek	3000-1	N/A	Control Turn table & Ant Mast	N/A	Oct. 28, 2020~ Dec. 08, 2020	N/A	Radiation (03CH02-CA)
Antenna Mast	ChainTek	MBS-520-1	N/A	1m~4m	N/A	Oct. 28, 2020~ Dec. 08, 2020	N/A	Radiation (03CH02-CA)
Turn Table	ChainTek	T-200-S-1	N/A	0~360 Degree	N/A	Oct. 28, 2020~ Dec. 08, 2020	N/A	Radiation (03CH02-CA)
Software	Audix	E3	N/A	N/A	N/A	Oct. 28, 2020~ Dec. 08, 2020	N/A	Radiation (03CH02-CA)

5 Uncertainty of Evaluation

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

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	2.2

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

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	4.5

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

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	6.1

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

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	6.5

———THE END———