



FCC RF Test Report

APPLICANT : OnePlus Technology (Shenzhen) Co., Ltd
EQUIPMENT : Smart Phone
BRAND NAME : ONEPLUS
MODEL NAME : IN2025
FCC ID : 2ABZ2-EE007
STANDARD : FCC Part 15 Subpart C §15.247
CLASSIFICATION : (DTS) Digital Transmission System

The product was received on Nov. 20, 2019 and testing was completed on Mar. 03, 2020. We, Sporton International (ShenZhen) 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 (ShenZhen) Inc., the test report shall not be reproduced except in full.

Reviewed by: Derreck Chen / Supervisor

Approved by: Eric Shih / Manager



Sporton International (ShenZhen) Inc.

1/F, 2/F, Bldg 5, Shiling Industrial Zone, Xinwei Village, Xili, Nanshan, Shenzhen, 518055
 People's Republic of China



TABLE OF CONTENTS

REVISION HISTORY..... 3

SUMMARY OF TEST RESULT 4

1 GENERAL DESCRIPTION..... 5

 1.1 Applicant 5

 1.2 Manufacturer 5

 1.3 Product Feature of Equipment Under Test..... 5

 1.4 Product Specification of Equipment Under Test..... 6

 1.5 Modification of EUT 6

 1.6 Testing Location 7

 1.7 Test Software 7

 1.8 Applicable Standards..... 7

2 TEST CONFIGURATION OF EQUIPMENT UNDER TEST..... 8

 2.1 Carrier Frequency Channel 8

 2.2 Test Mode 9

 2.3 Connection Diagram of Test System 10

 2.4 Support Unit used in test configuration and system 11

 2.5 EUT Operation Test Setup 11

 2.6 Measurement Results Explanation Example..... 11

3 TEST RESULT 12

 3.1 6dB and 99% Bandwidth Measurement 12

 3.2 Output Power Measurement..... 29

 3.3 Power Spectral Density Measurement 30

 3.4 Conducted Band Edges and Spurious Emission Measurement 47

 3.5 Radiated Band Edges and Spurious Emission Measurement 64

 3.6 AC Conducted Emission Measurement..... 68

 3.7 Antenna Requirements 70

4 LIST OF MEASURING EQUIPMENT 71

5 UNCERTAINTY OF EVALUATION..... 72

APPENDIX A. CONDUCTED TEST RESULTS

APPENDIX B. AC CONDUCTED EMISSION TEST RESULT

APPENDIX C. RADIATED SPURIOUS EMISSION

APPENDIX D. DUTY CYCLE PLOTS

APPENDIX E. SETUP PHOTOGRAPHS



REVISION HISTORY

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FR9N2009-01B	Rev. 01	Initial issue of report	Mar. 19, 2020



SUMMARY OF TEST RESULT

Report Section	FCC Rule	Description	Limit	Result	Remark
3.1	15.247(a)(2)	6dB Bandwidth	≥ 0.5MHz	Pass	-
3.1	-	99% Bandwidth	-	Pass	-
3.2	15.247(b)(3)	Peak Output Power	≤ 30dBm	Pass	-
3.3	15.247(e)	Power Spectral Density	≤ 8dBm/3kHz	Pass	-
3.4	15.247(d)	Conducted Band Edges and Spurious Emission	≤ 20dBc	Pass	-
3.5	15.247(d)	Radiated Band Edges and Spurious Emission	15.209(a) & 15.247(d)	Pass	Under limit 9.42 dB at 30.000 MHz
3.6	15.207	AC Conducted Emission	15.207(a)	Pass	Under limit 15.72 dB at 0.490 MHz
3.7	15.203 & 15.247(b)	Antenna Requirement	N/A	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 Applicant

OnePlus Technology (Shenzhen) Co., Ltd

18C02, 18C03, 18C04 and 18C05, Shum Yip Terra Building, Binhe Avenue North, Futian District, Shenzhen

1.2 Manufacturer

OnePlus Technology (Shenzhen) Co., Ltd

18C02, 18C03, 18C04 and 18C05, Shum Yip Terra Building, Binhe Avenue North, Futian District, Shenzhen

1.3 Product Feature of Equipment Under Test

Product Feature	
Equipment	Smart Phone
Brand Name	ONEPLUS
Model Name	IN2025
FCC ID	2ABZ2-EE007
EUT supports Radios application	CDMA/GSM/WCDMA/LTE/5G NR WLAN 2.4GHz 802.11b/g/n HT20 WLAN 2.4GHz 802.11ax HE20/HE40 WLAN 5GHz 802.11a/n HT20/HT40 WLAN 5GHz 802.11ac VHT20/VHT40/VHT80 WLAN 5GHz 802.11ax HE20/HE40/HE80 Bluetooth BR/EDR/LE GNSS/NFC/WPC
IMEI Code	Conducted: 865422040000333/865422040000286 Conduction: 865422040025876/865422040025868 Radiation: 865422040025991/865422040025983
HW Version	15
SW Version	Oxygen OS 10.5.IN11AA
EUT Stage	Production Unit

Remark: The above EUT's information was declared by manufacturer. Please refer to the specifications or user's manual for more detailed description.

1.4 Product Specification of Equipment Under Test

Standards-related Product Specification	
Tx/Rx Frequency Range	2402 MHz ~ 2480 MHz
Number of Channels	40
Carrier Frequency of Each Channel	40 Channel(37 hopping + 3 advertising channel)
Maximum Output Power to Antenna	Ant. 1: Bluetooth v4.2 LE: 9.24 dBm (0.0084 W) Bluetooth v5.1 LE: 9.67 dBm (0.0093 W) Ant. 2: Bluetooth v4.2 LE: 3.62 dBm (0.0023 W) Bluetooth v5.1 LE: 4.12 dBm (0.0026 W)
99% Occupied Bandwidth	Ant. 1: Bluetooth v4.2 LE: 1.013MHz Bluetooth v5.1 LE: 1.990MHz Ant. 2: Bluetooth v4.2 LE: 1.015MHz Bluetooth v5.1 LE: 1.990MHz
Antenna Type / Gain	Ant. 1: PIFA Antenna type with gain -2.80 dBi Ant. 2: PIFA Antenna type with gain -3.00 dBi
Type of Modulation	Bluetooth LE : GFSK

Note:

1. For Radiation testing, the whole testing has assessed only BLE 5.0 of Ant 1 by referring to their higher conducted power.
2. The Antenna 1 and Antenna 2 can't transmit simultaneously.

1.5 Modification of EUT

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



1.6 Testing Location

Sporton International (Shenzhen) Inc. is accredited to ISO/IEC 17025:2017 by American Association for Laboratory Accreditation with Certificate Number 5145.01.

Test Firm	Sporton International (Shenzhen) Inc.		
Test Site Location	1/F, 2/F, Bldg 5, Shiling Industrial Zone, Xinwei Village, Xili, Nanshan, Shenzhen, 518055 People's Republic of China TEL: +86-755-86379589 FAX: +86-755-86379595		
Test Site No.	Sporton Site No.	FCC Designation No.	FCC Test Firm Registration No.
	CO01-SZ TH01-SZ	CN1256	421272

Test Firm	Sporton International (Shenzhen) Inc.		
Test Site Location	No. 3 Bldg the third floor of south, Shahe River west, Fengzeyuan Warehouse, Nanshan Shenzhen, 518055 People's Republic of China TEL: +86-755-33202398		
Test Site No.	Sporton Site No.	FCC Designation No.	FCC Test Firm Registration No.
	03CH03-SZ	CN1256	421272

1.7 Test Software

Item	Site	Manufacture	Name	Version
1.	03CH03-SZ	AUDIX	E3	6.2009-8-24
2.	CO01-SZ	AUDIX	E3	6.120613b

1.8 Applicable Standards

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

- ♦ 47 CFR Part 15 Subpart C §15.247
- ♦ FCC KDB 558074 D01 15.247 Meas Guidance v05r02
- ♦ 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. 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

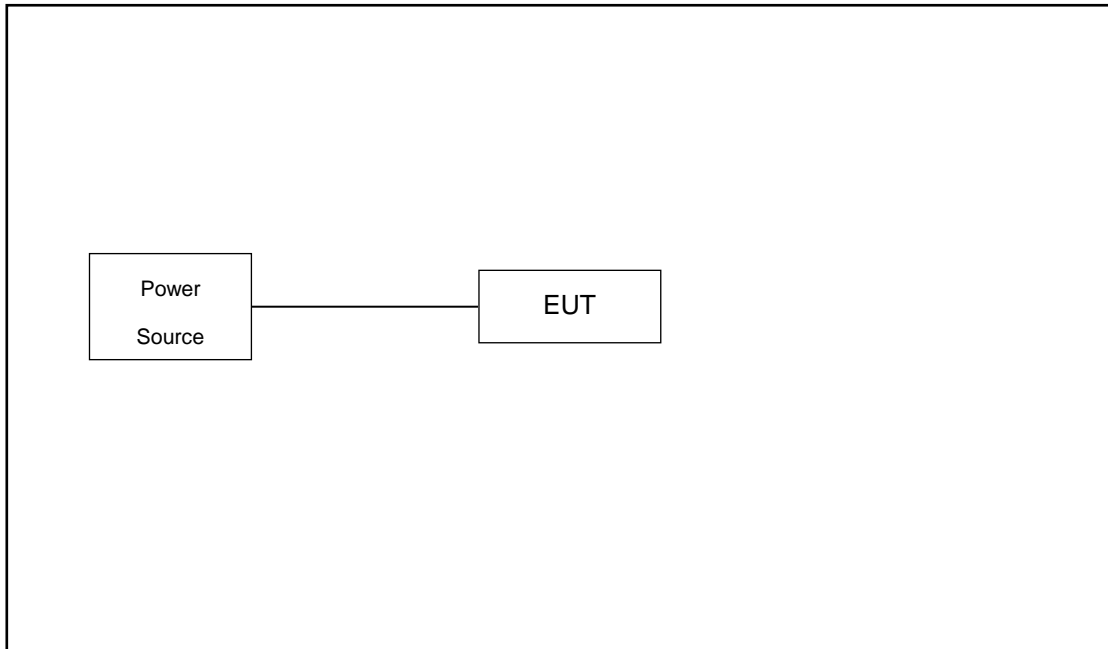
- a. The EUT has been associated with peripherals and configuration operated in a manner tended to maximize its emission characteristics in a typical application. Frequency range investigated: conduction emission (150 kHz to 30 MHz), radiation emission (9 kHz to the 10th harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower). For radiated measurement, pre-scanned in three orthogonal panels, X, Y, Z. The worst cases (Z plane) 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.

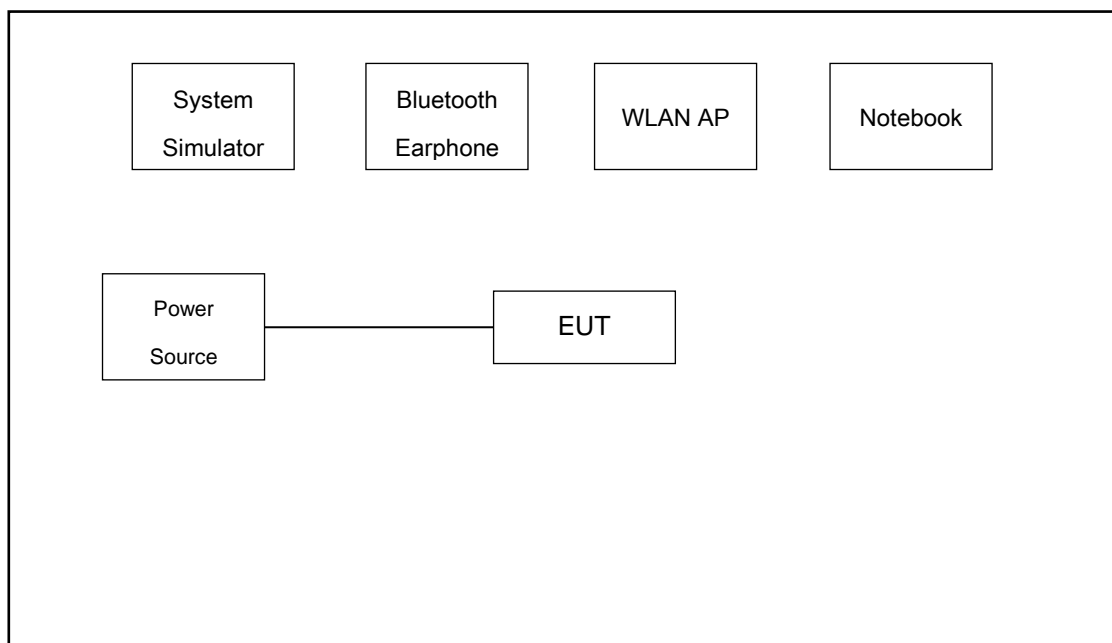
Summary table of Test Cases	
Test Item	Data Rate / Modulation
	Bluetooth LE / GFSK
Conducted TCs	Mode 1: Bluetooth Tx CH00_2402 MHz_1Mbps Mode 2: Bluetooth Tx CH19_2440 MHz_1Mbps Mode 3: Bluetooth Tx CH39_2480 MHz_1Mbps
Radiated TCs	Mode 1: Bluetooth Tx CH00_2402 MHz_1Mbps Mode 2: Bluetooth Tx CH19_2440 MHz_1Mbps Mode 3: Bluetooth Tx CH39_2480 MHz_1Mbps
AC Conducted Emission	Mode 1: GSM 850 Idle + Bluetooth Link + WLAN Link (2.4G) + USB Cable2 (Charging from Adapter3) + Battery1

2.3 Connection Diagram of Test System

For Radiation



For Conducted Emission





2.4 Support Unit used in test configuration and system

Item	Equipment	Trade Name	Model Name	FCC ID	Data Cable	Power Cord
1.	Base Station	Anritsu	MT8820C	N/A	N/A	Unshielded,1.8m
2.	Bluetooth Earphone	Samsung	EO-MG900	N/A	N/A	N/A
3.	WLAN AP	D-Link	DIR-820L	KA2IR820LA1	N/A	Unshielded,1.8m
4.	NOTE BOOK	Lenovo	E540	FCC DoC	N/A	Unshielded,1.8m

2.5 EUT Operation Test Setup

For BLE function, the engineering test program was provided and enabled to make EUT continuous transmit/receive.

For AC power line conducted emissions, the EUT was set to connect with the WLAN AP under large package sizes transmission.

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 1.20 dB and 20dB attenuator.

$$\begin{aligned}
 \text{Offset(dB)} &= \text{RF cable loss(dB)} + \text{attenuator factor(dB)}. \\
 &= 1.20 + 20 = 21.20 \text{ (dB)}
 \end{aligned}$$

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

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

3.1.3 Test Procedures

1. The testing follows ANSI C63.10-2013 clause 11.8
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 30kHz and set the Video bandwidth (VBW) = 100kHz.
6. Measure and record the results in the test report.

3.1.4 Test Setup



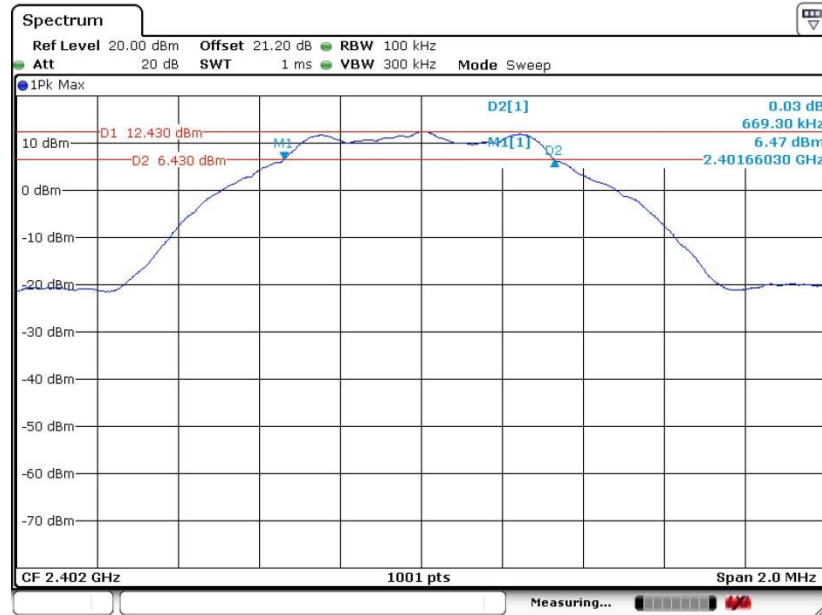


3.1.5 Test Result of 6dB Bandwidth

Please refer to Appendix A.

Bluetooth v4.2 LE for Ant1:

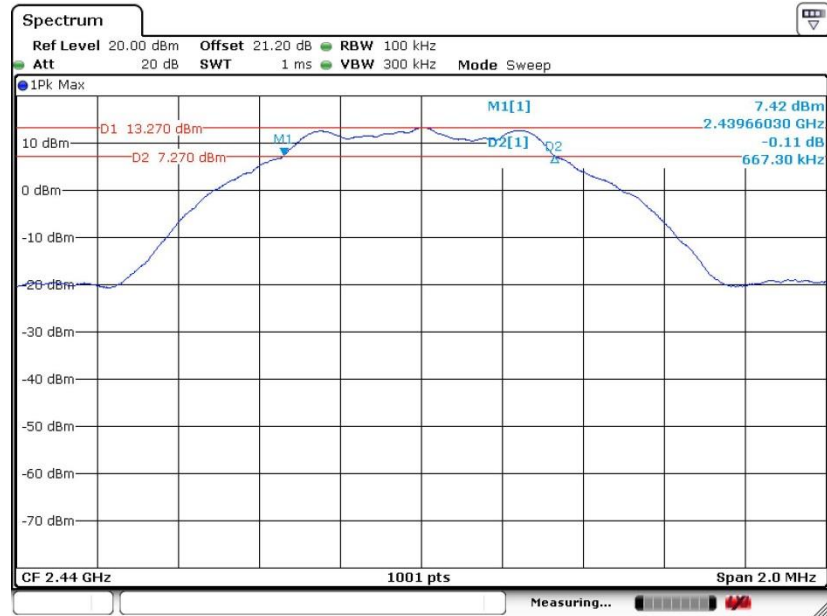
6 dB Bandwidth Plot on Channel 00



Date: 12.FEB.2020 14:23:04

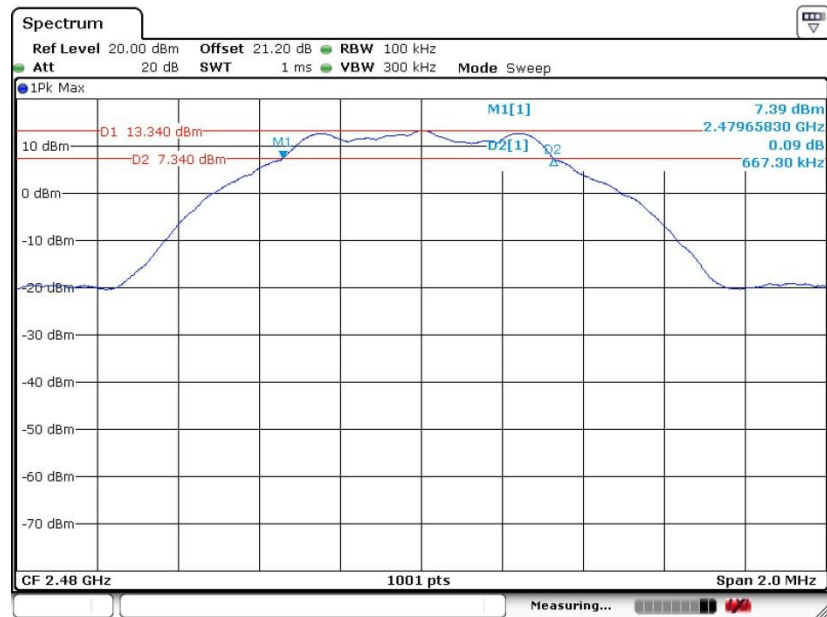


6 dB Bandwidth Plot on Channel 19



Date: 12.FEB.2020 14:29:38

6 dB Bandwidth Plot on Channel 39

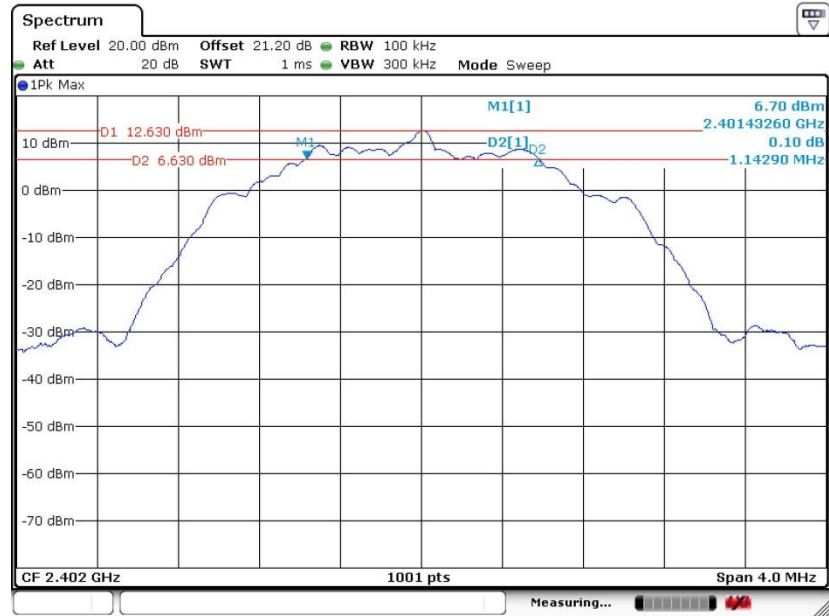


Date: 12.FEB.2020 14:32:36



Bluetooth v5.1 LE For Ant1:

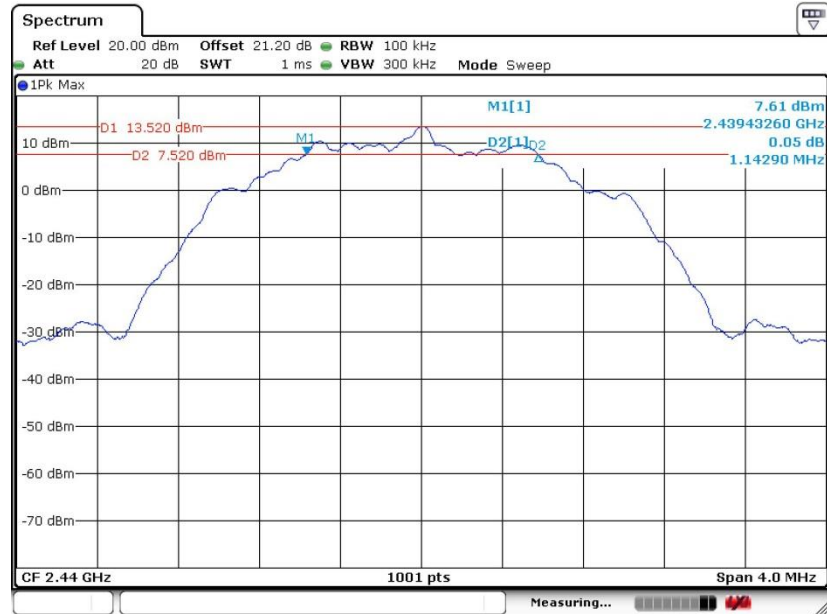
6 dB Bandwidth Plot on Channel 00



Date: 12.FEB.2020 14:42:58



6 dB Bandwidth Plot on Channel 19



Date: 12.FEB.2020 15:07:55

6 dB Bandwidth Plot on Channel 39

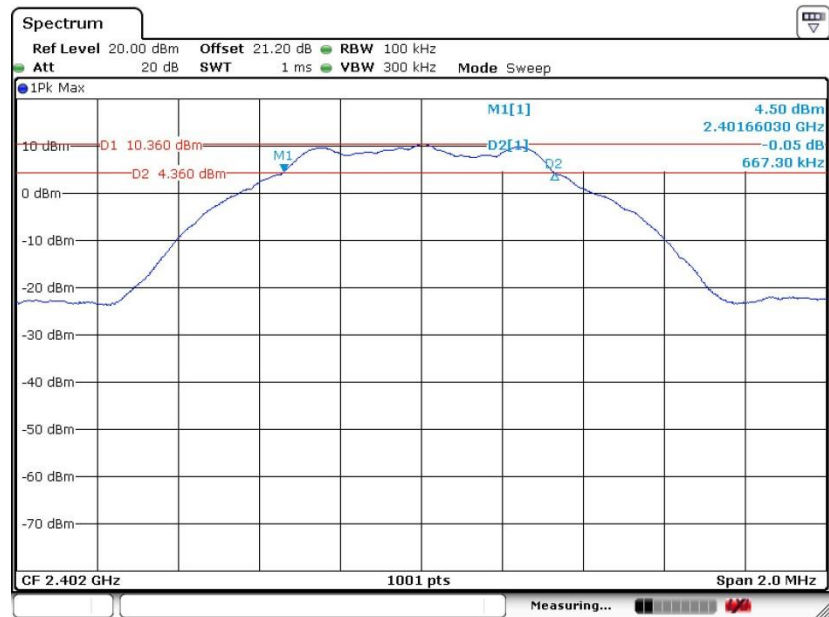


Date: 12.FEB.2020 15:14:35



Bluetooth v4.2 LE For Ant2:

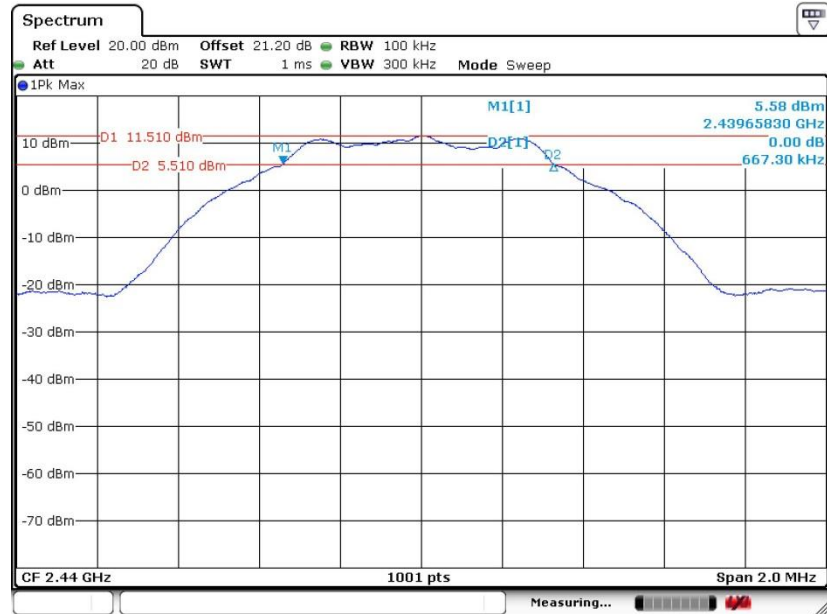
6 dB Bandwidth Plot on Channel 00



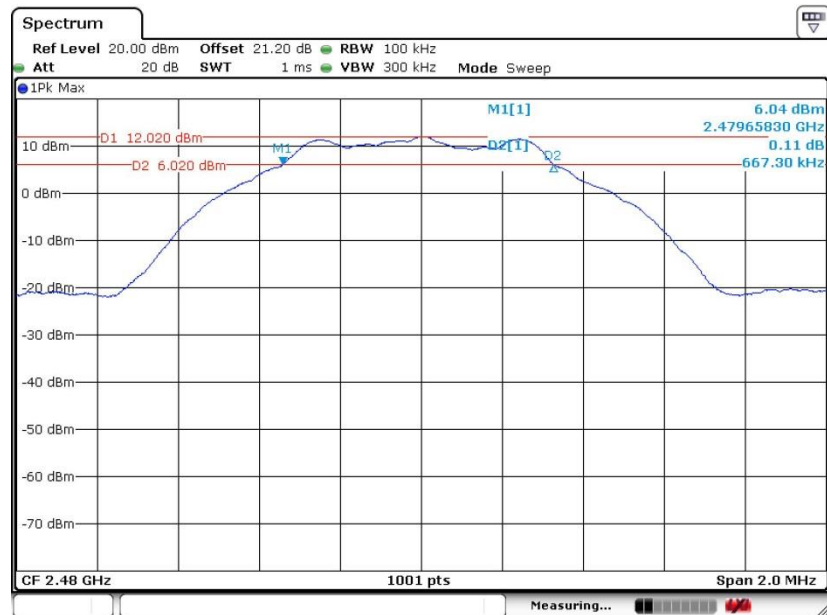
Date: 29.JAN.2020 17:14:35



6 dB Bandwidth Plot on Channel 19



6 dB Bandwidth Plot on Channel 39





Bluetooth v5.1 LE For Ant2:

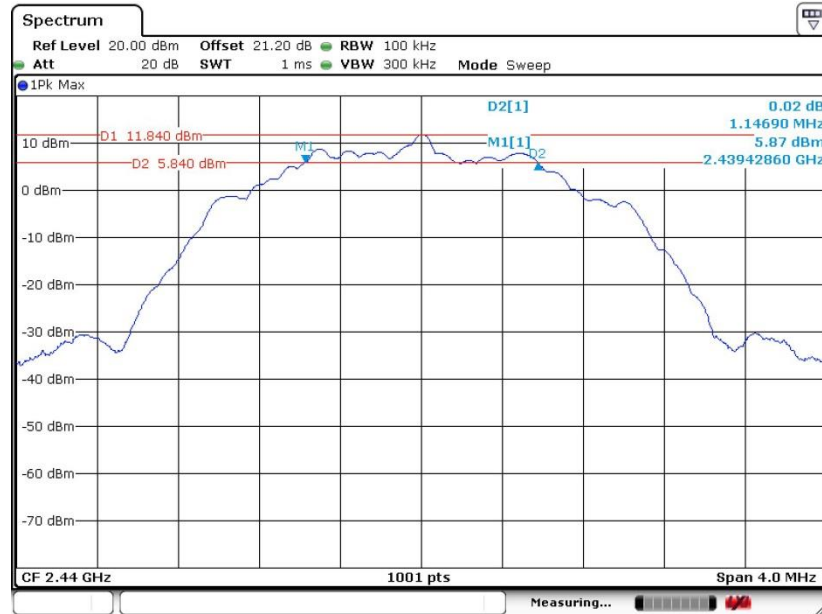
6 dB Bandwidth Plot on Channel 00



Date: 29.JAN.2020 17:31:08



6 dB Bandwidth Plot on Channel 19



Date: 29.JAN.2020 17:41:11

6 dB Bandwidth Plot on Channel 39



Date: 30.JAN.2020 10:57:22

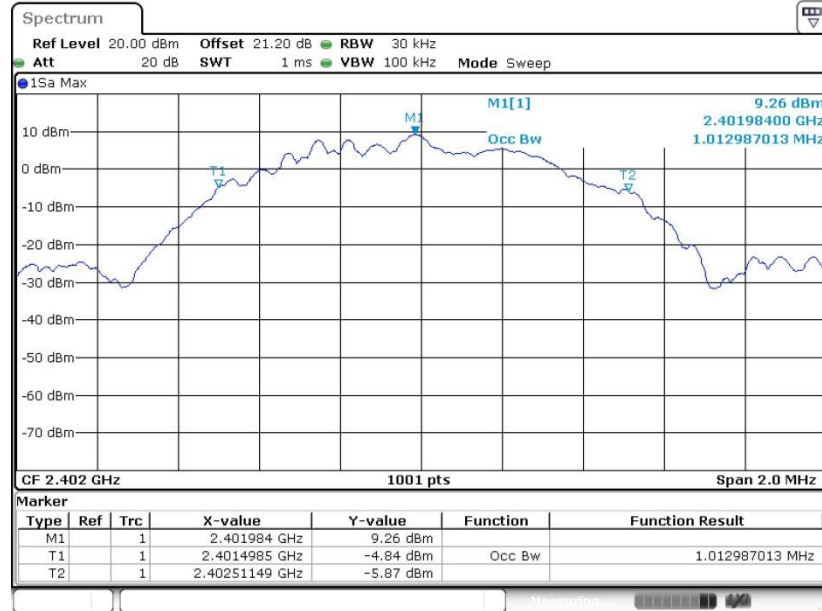


3.1.6 Test Result of 99% Occupied Bandwidth

Please refer to Appendix A.

Bluetooth v4.2 LE For Ant1:

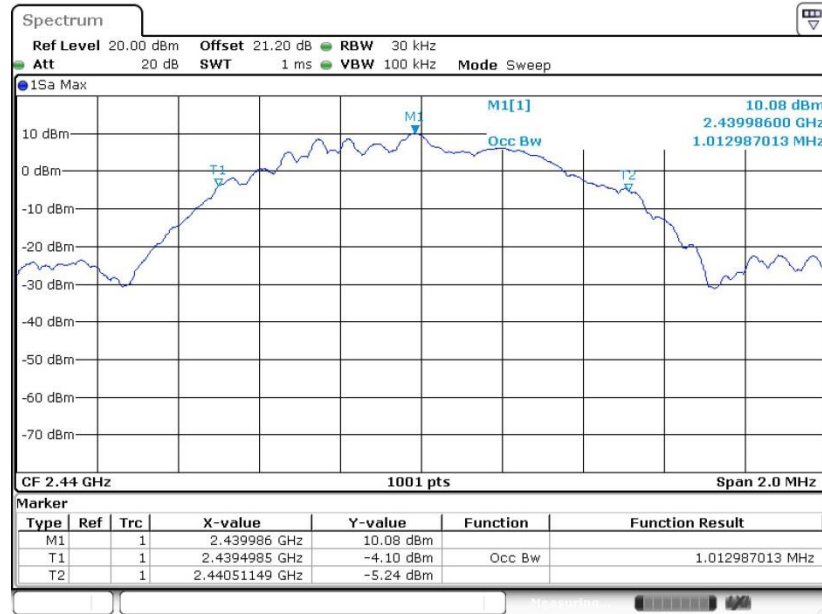
99% Bandwidth Plot on Channel 00



Date: 12.FEB.2020 14:26:29

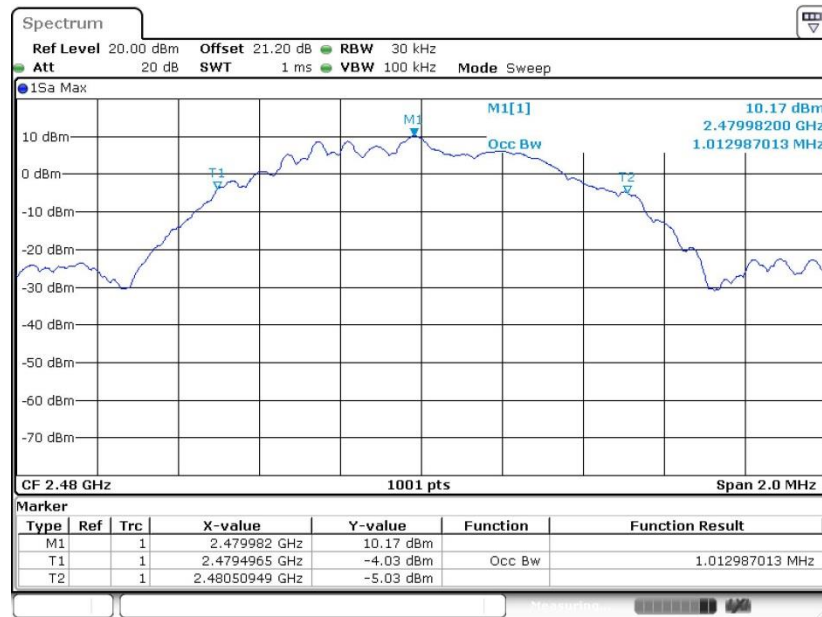


99% Occupied Bandwidth Plot on Channel 19



Date: 12.FEB.2020 14:31:27

99% Occupied Bandwidth Plot on Channel 39



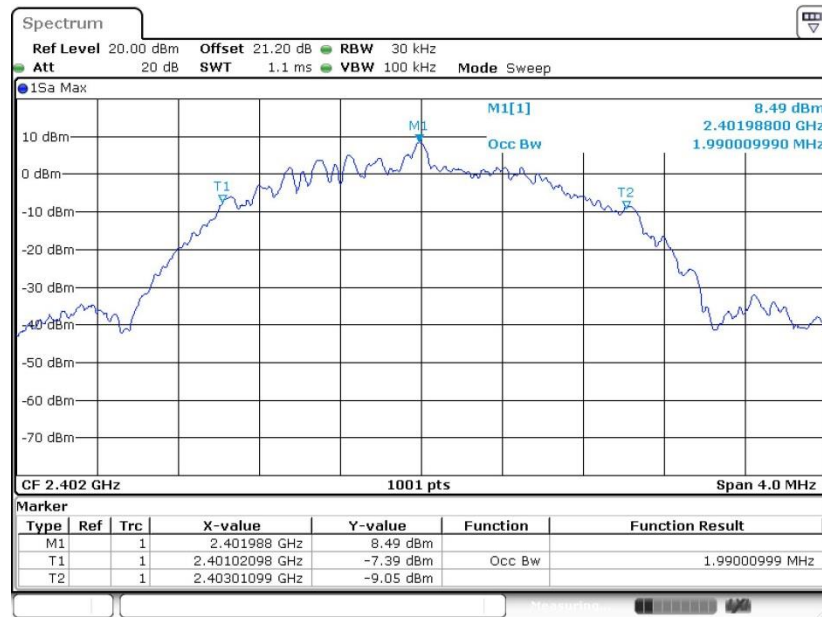
Date: 12.FEB.2020 14:34:50

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



Bluetooth v5.1 LE For Ant1:

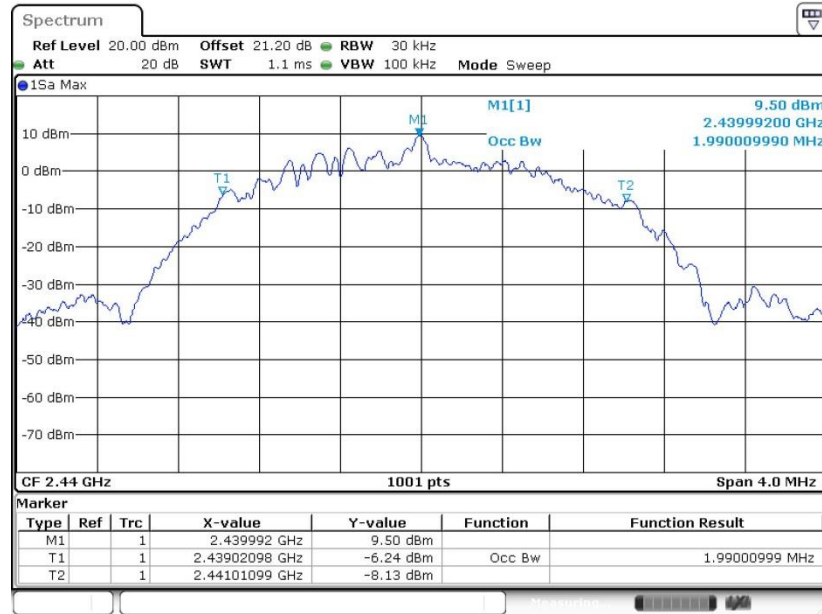
99% Bandwidth Plot on Channel 00



Date: 12.FEB.2020 14:55:48

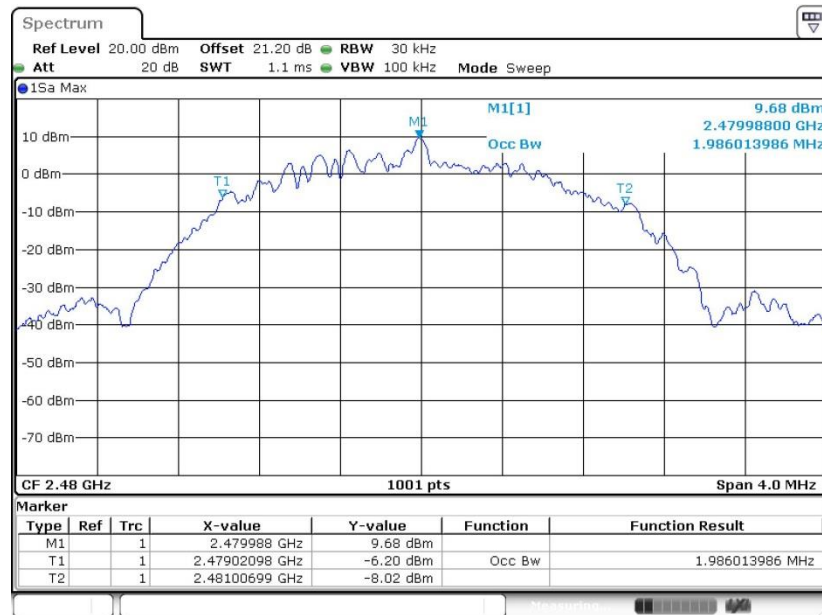


99% Occupied Bandwidth Plot on Channel 19



Date: 12.FEB.2020 15:13:14

99% Occupied Bandwidth Plot on Channel 39



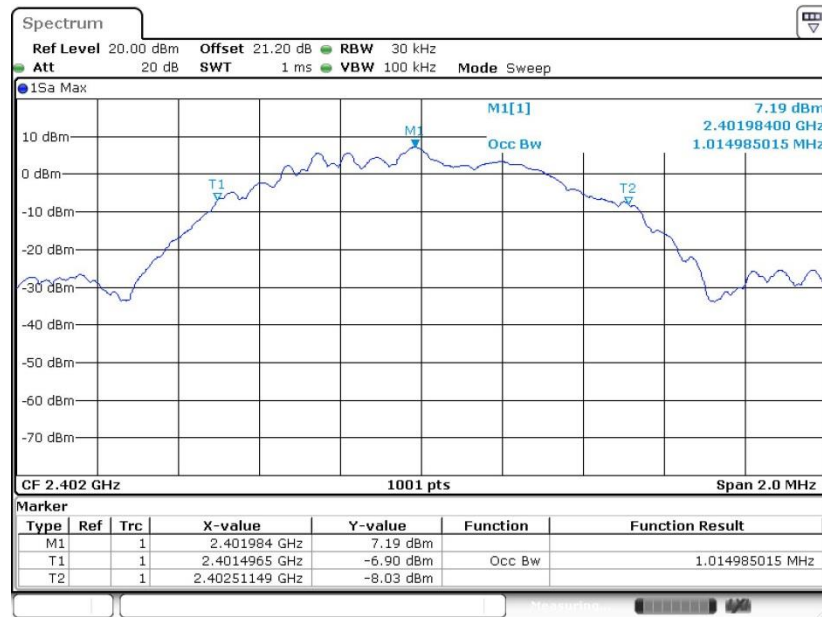
Date: 12.FEB.2020 15:18:40

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



Bluetooth v4.2 LE For Ant2:

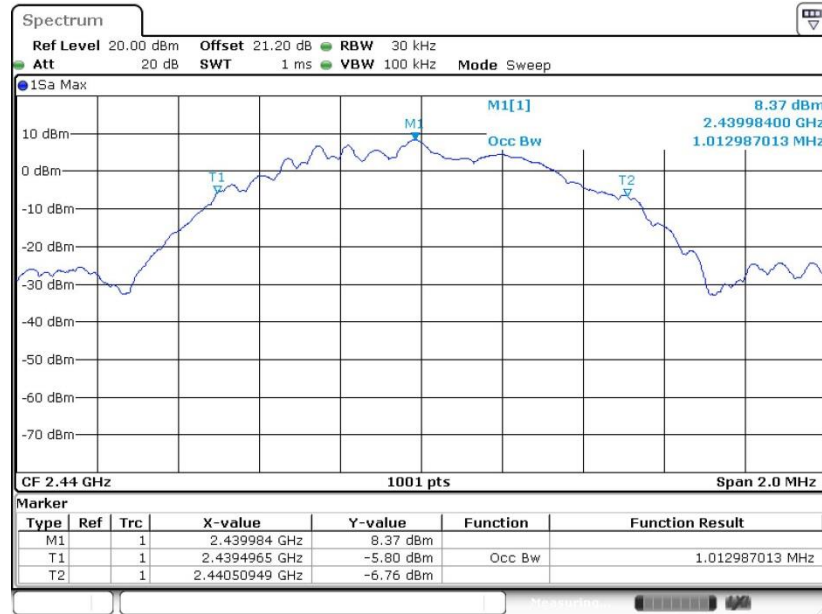
99% Bandwidth Plot on Channel 00



Date: 29.JAN.2020 17:17:39

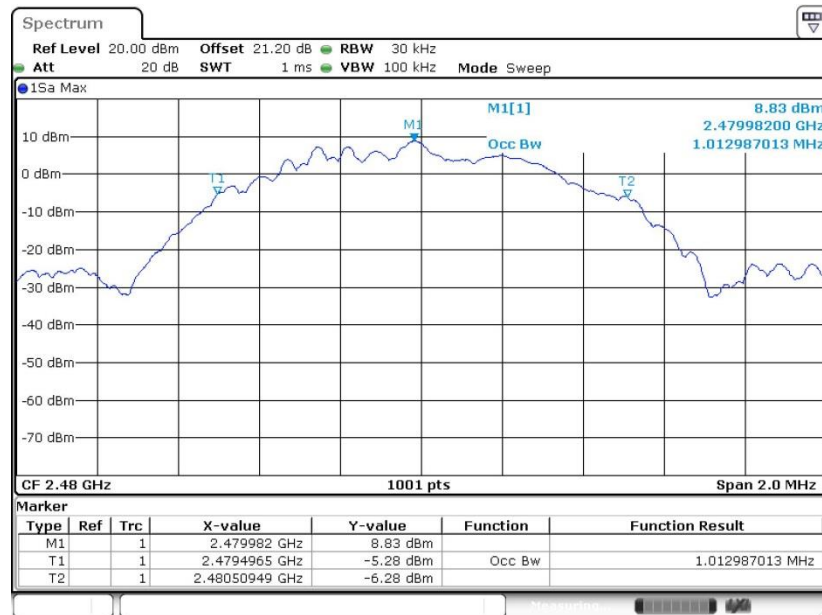


99% Occupied Bandwidth Plot on Channel 19



Date: 29.JAN.2020 17:21:54

99% Occupied Bandwidth Plot on Channel 39



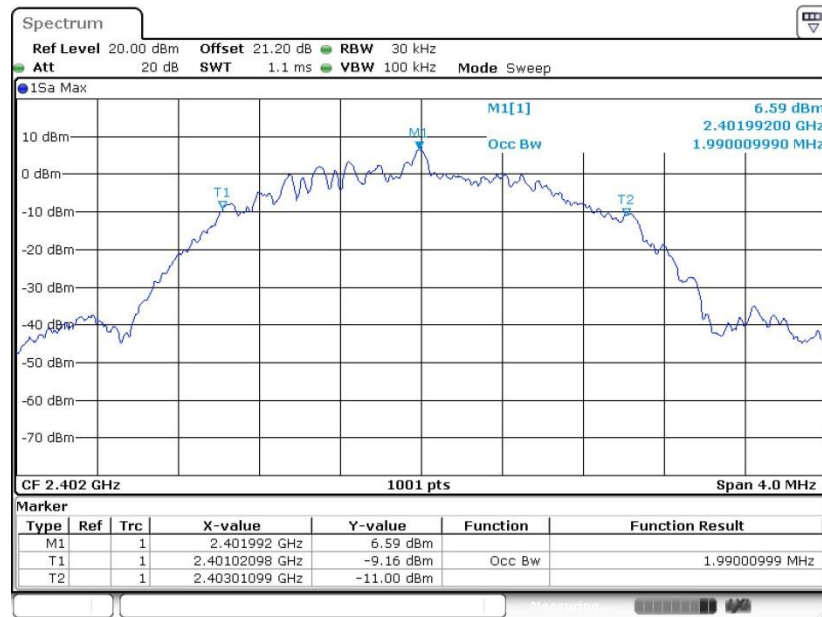
Date: 29.JAN.2020 17:27:55

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



Bluetooth v5.1 LE For Ant2:

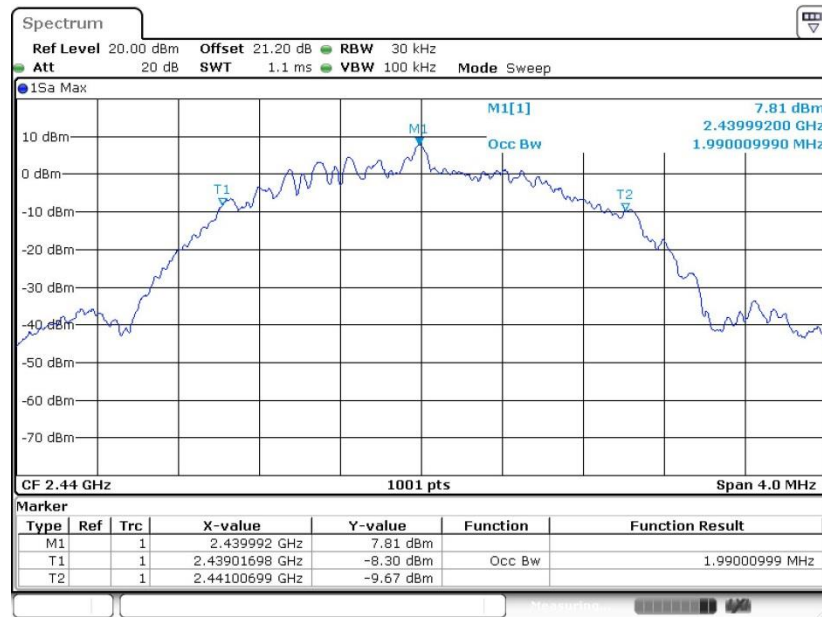
99% Bandwidth Plot on Channel 00



Date: 29.JAN.2020 17:35:03

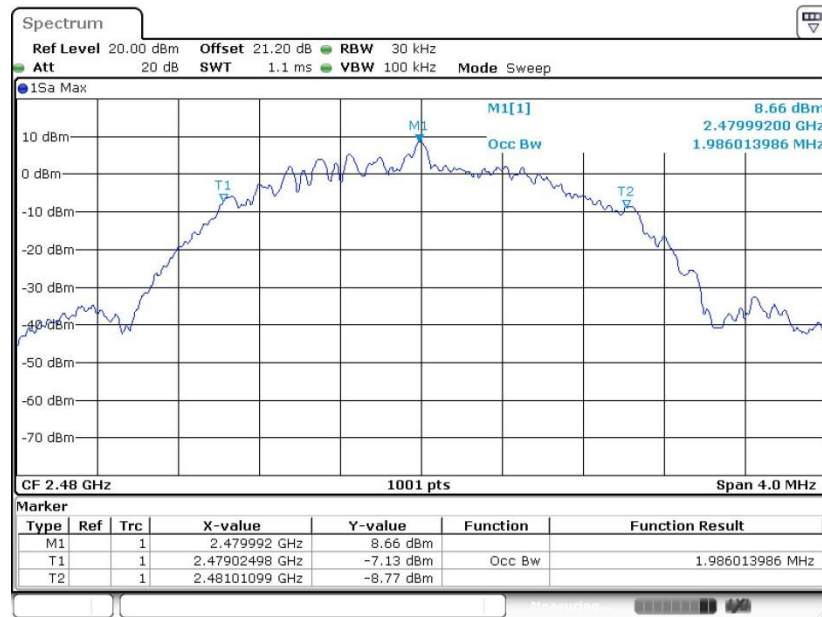


99% Occupied Bandwidth Plot on Channel 19



Date: 29.JAN.2020 17:44:10

99% Occupied Bandwidth Plot on Channel 39



Date: 30.JAN.2020 11:00:40

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 peak 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.

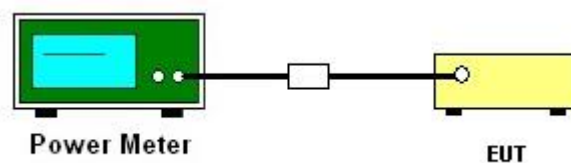
3.2.2 Measuring Instruments

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

3.2.3 Test Procedures

1. The testing follows the Measurement Procedure of ANSI C63.10-2013 clause 11.9.1.3 PKPM1 Peak power meter or ANSI C63.10-2013 clause 11.9.2.3.2 Method AVGPM-G method.
2. The RF output of EUT was connected to the power meter 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. Measure the conducted output power and record the results in the test report.

3.2.4 Test Setup



3.2.5 Test Result of Peak Output Power

Please refer to Appendix A.

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.

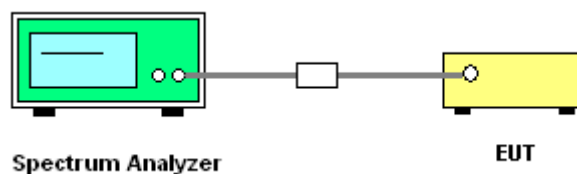
3.3.2 Measuring Instruments

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

3.3.3 Test Procedures

1. The testing follows Measurement Procedure of ANSI C63.10-2013 clause 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

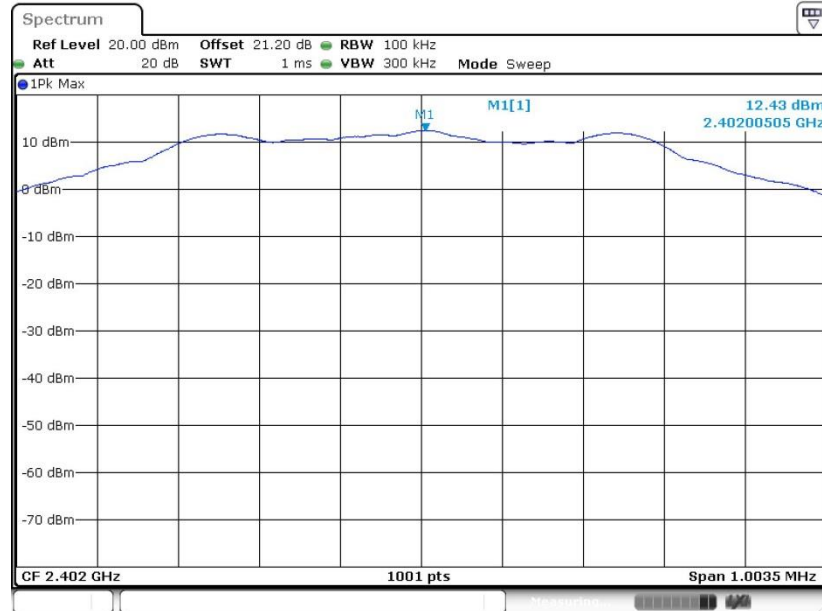
Please refer to Appendix A.



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

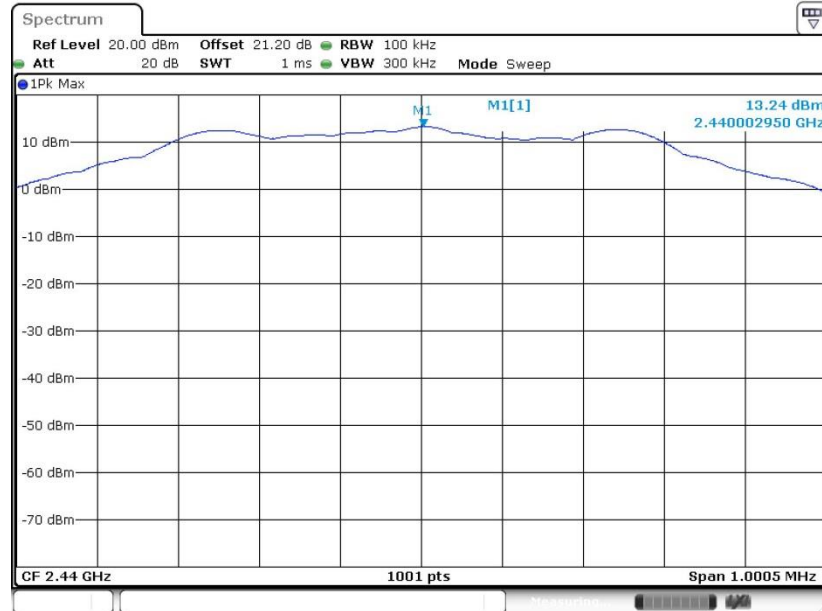
Bluetooth v4.2 LE For Ant1:

PSD 100kHz Plot on Channel 00



Date: 12.FEB.2020 14:23:48

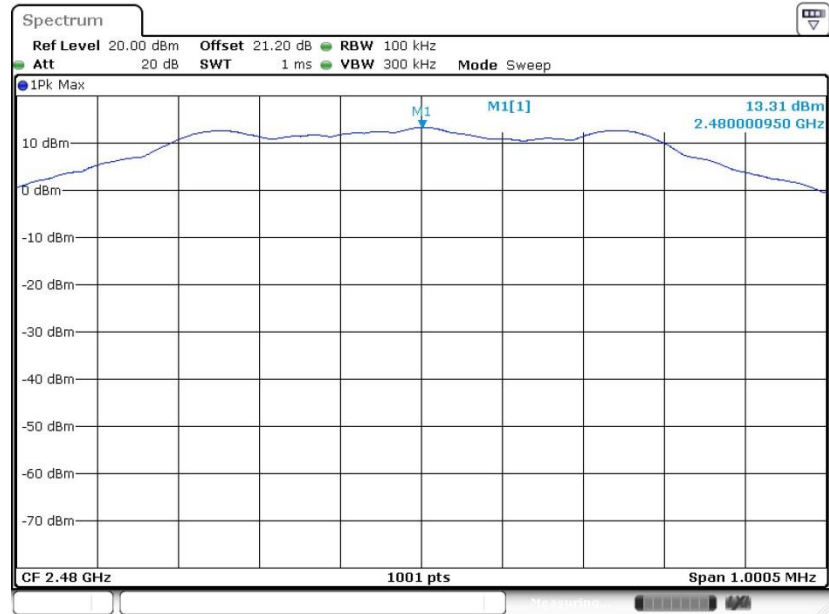
PSD 100kHz Plot on Channel 19



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



PSD 100kHz Plot on Channel 39

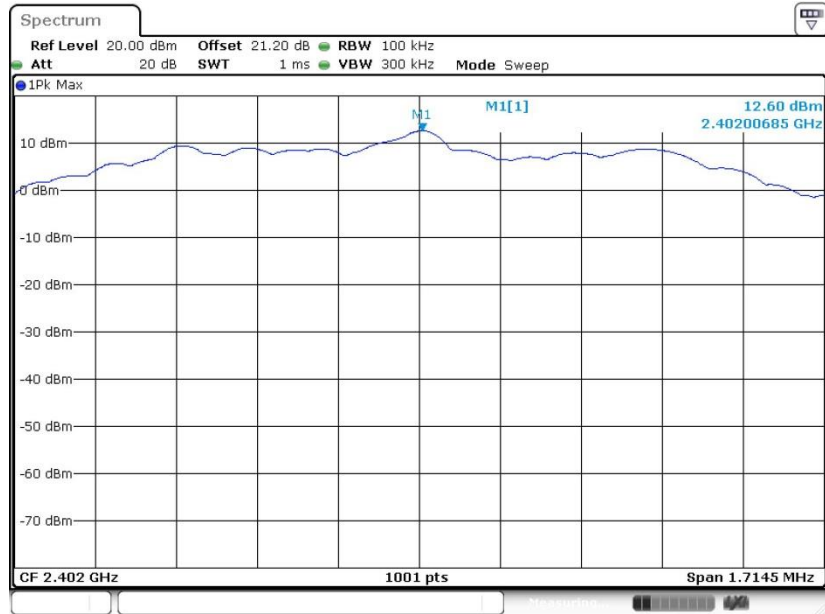


Date: 12.FEB.2020 14:33:25



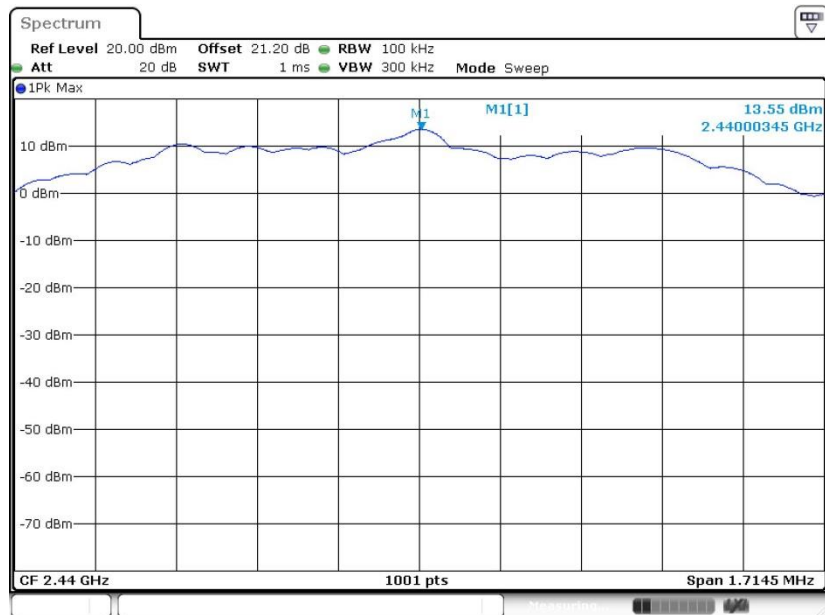
Bluetooth v5.1 LE For Ant1:

PSD 100kHz Plot on Channel 00



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

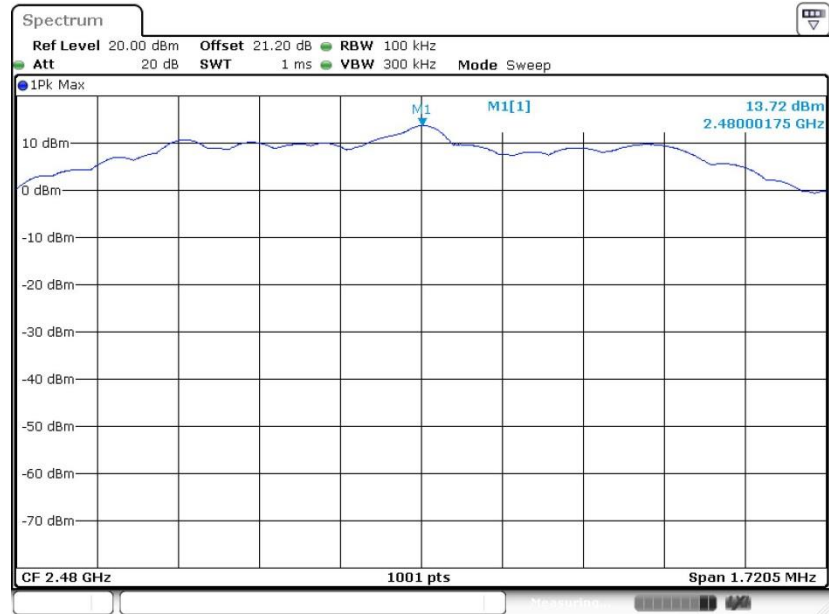
PSD 100kHz Plot on Channel 19



Date: 12.FEB.2020 15:11:42



PSD 100kHz Plot on Channel 39

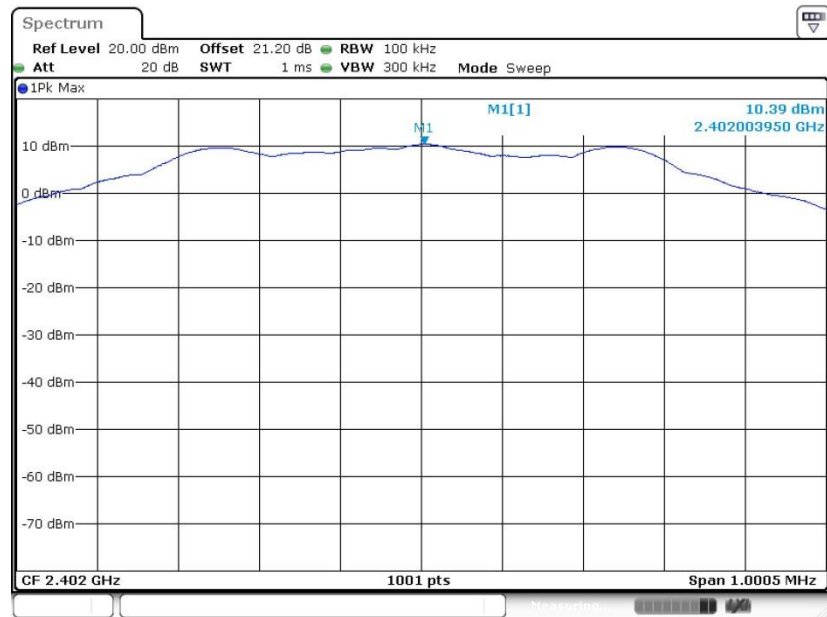


Date: 12.FEB.2020 15:16:27



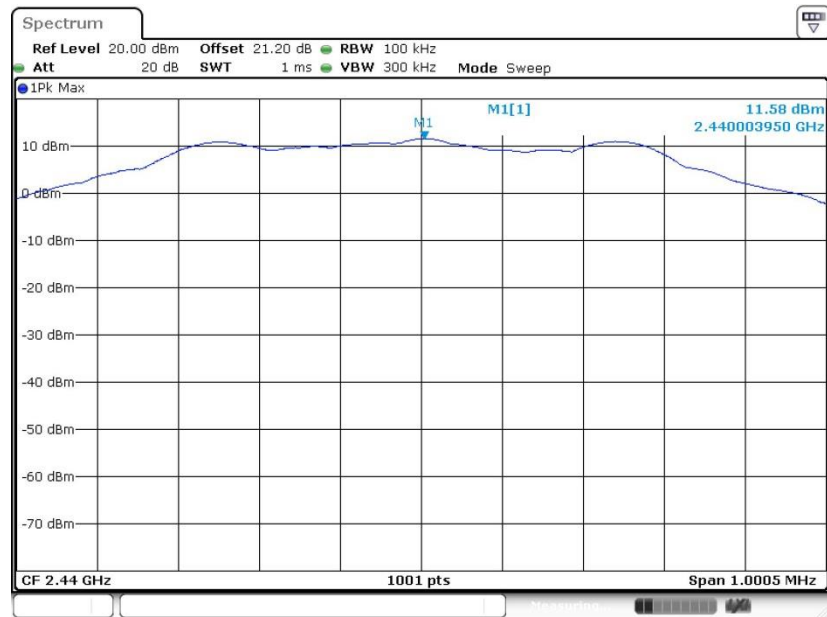
Bluetooth v4.2 LE For Ant2:

PSD 100kHz Plot on Channel 00



Date: 29.JAN.2020 17:15:36

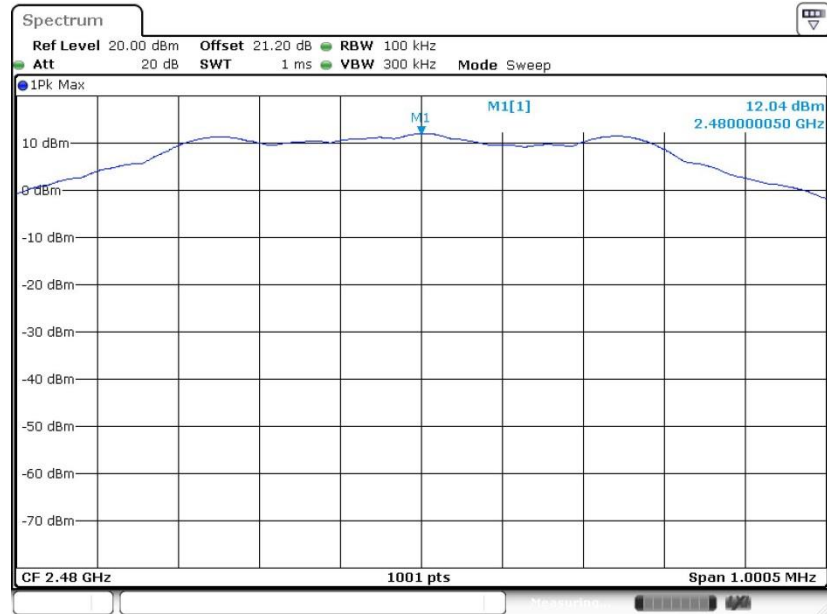
PSD 100kHz Plot on Channel 19



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



PSD 100kHz Plot on Channel 39

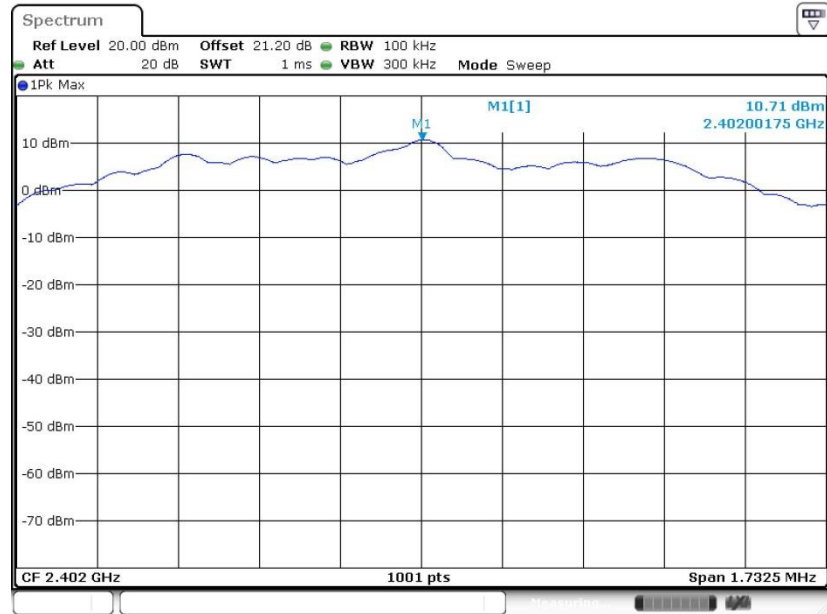


Date: 29.JAN.2020 17:24:34



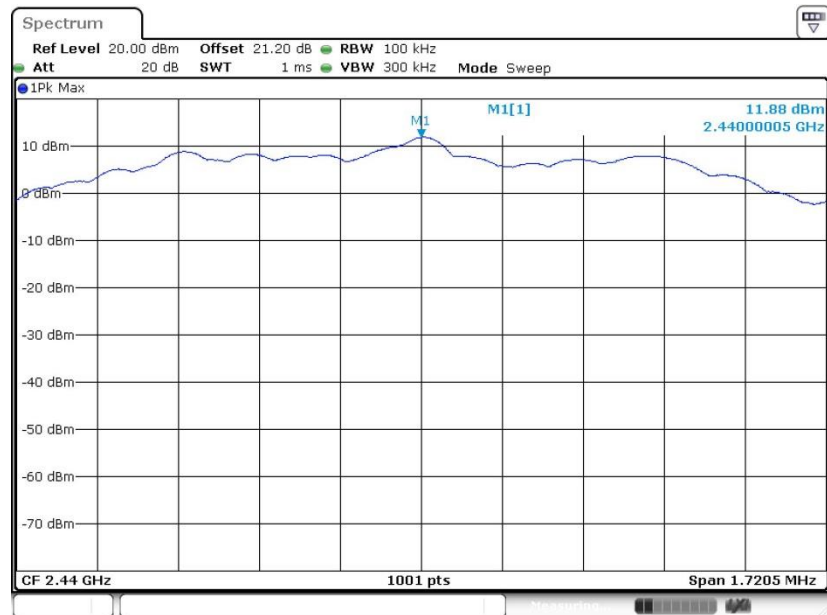
Bluetooth v5.1 LE For Ant2:

PSD 100kHz Plot on Channel 00



Date: 29.JAN.2020 17:32:49

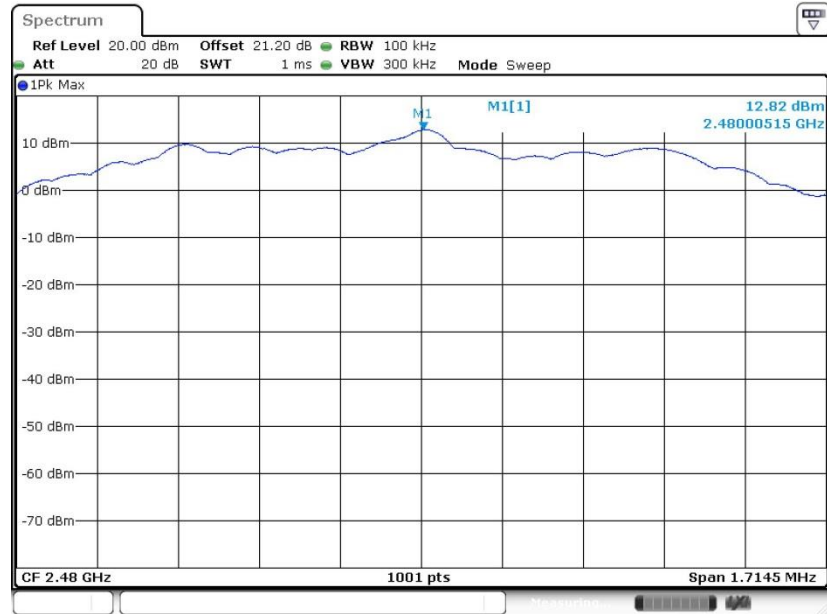
PSD 100kHz Plot on Channel 19



Date: 29.JAN.2020 17:42:55



PSD 100kHz Plot on Channel 39



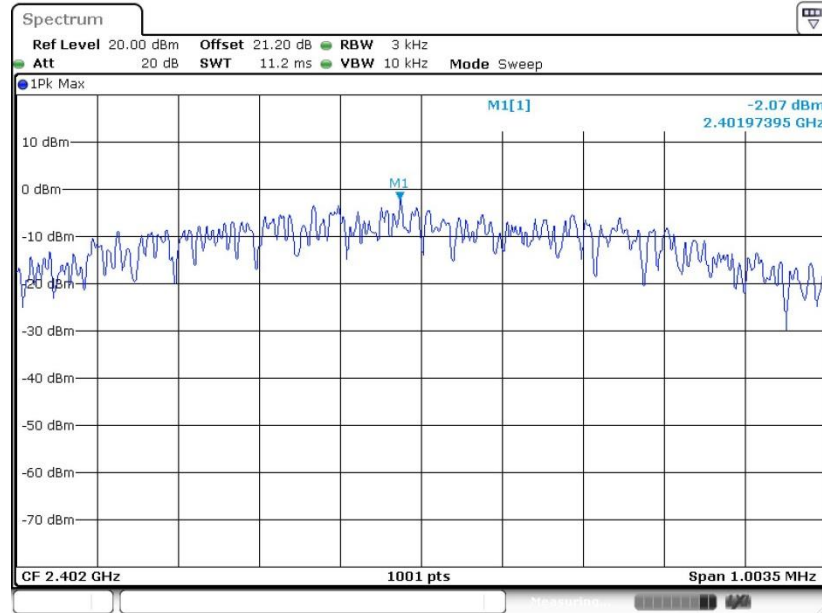
Date: 30.JAN.2020 10:58:14



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

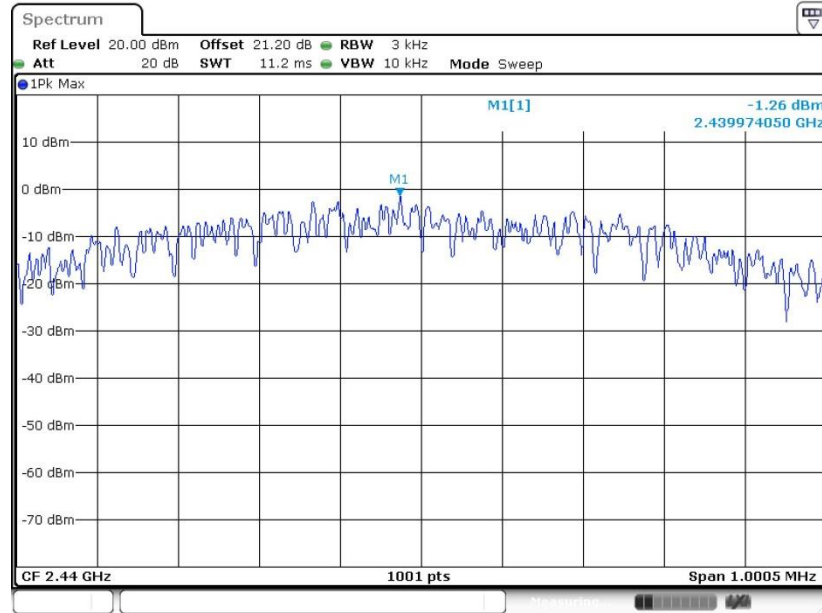
Bluetooth v4.2 LE For Ant1:

PSD 3kHz Plot on Channel 00



Date: 12.FEB.2020 14:23:28

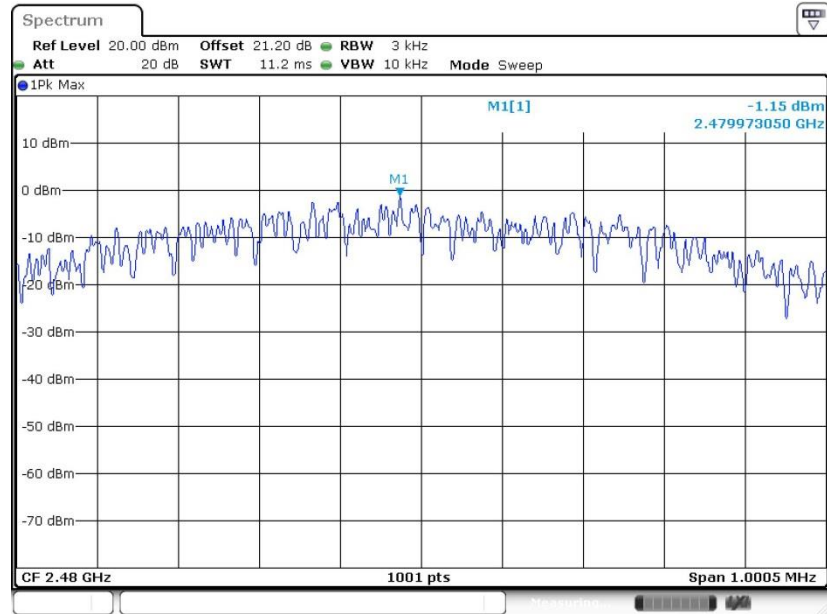
PSD 3kHz Plot on Channel 19



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



PSD 3kHz Plot on Channel 39

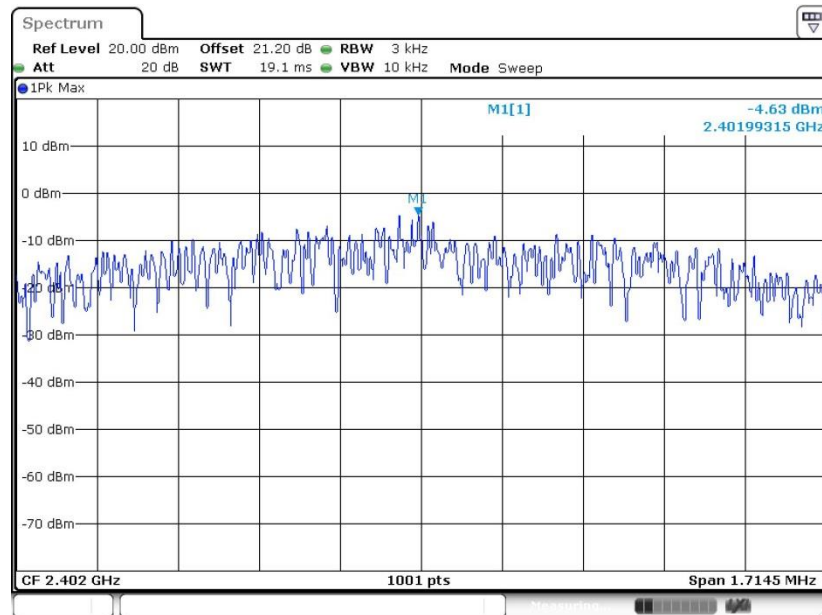


Date: 12.FEB.2020 14:32:58



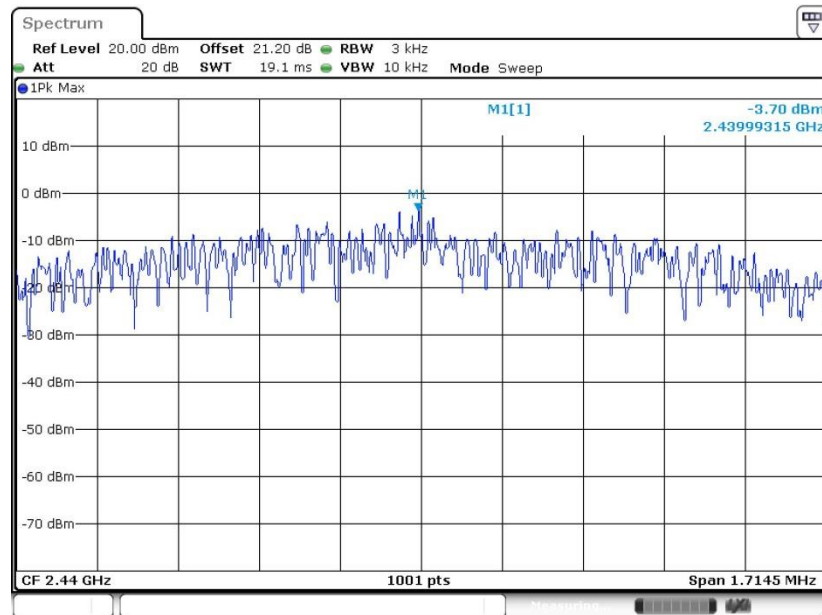
Bluetooth v5.1 LE For Ant1:

PSD 3kHz Plot on Channel 00



Date: 12.FEB.2020 14:44:44

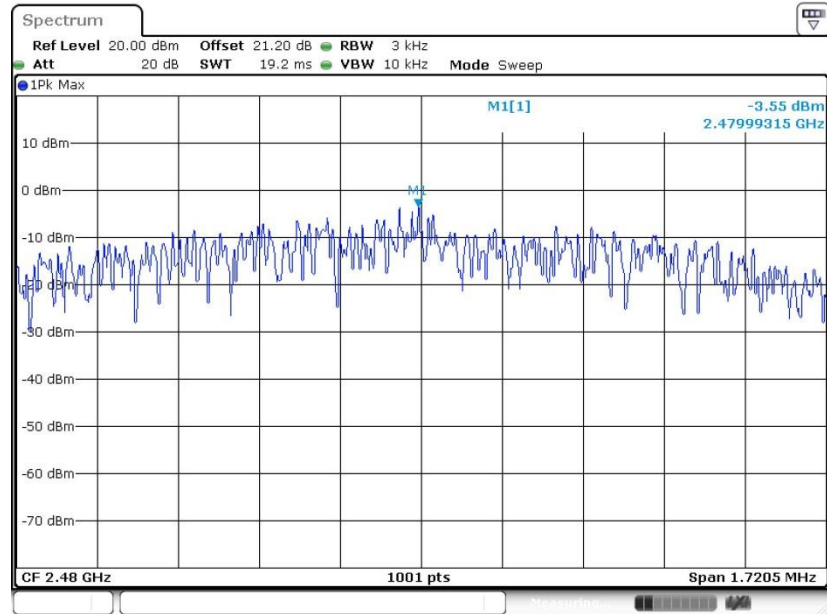
PSD 3kHz Plot on Channel 19



Date: 12.FEB.2020 15:11:25



PSD 3kHz Plot on Channel 39

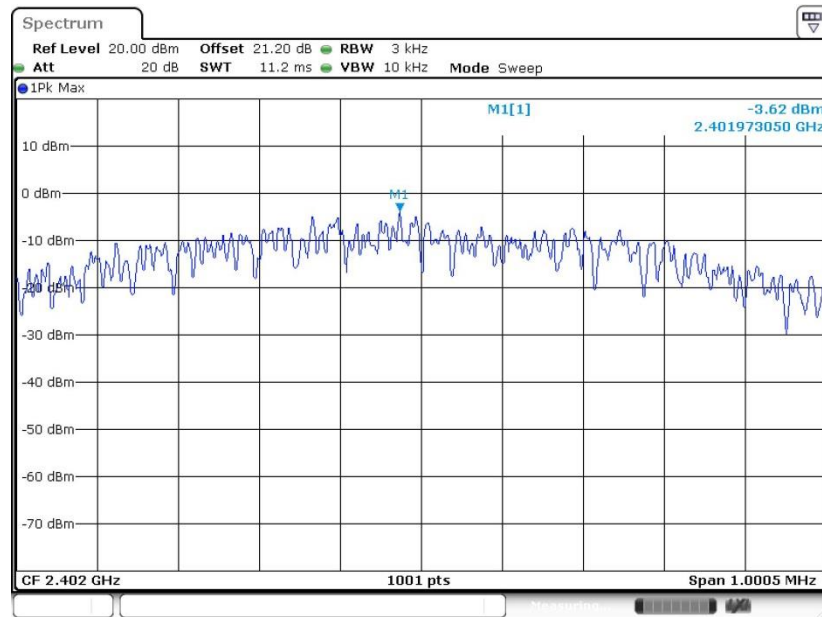


Date: 12.FEB.2020 15:16:02



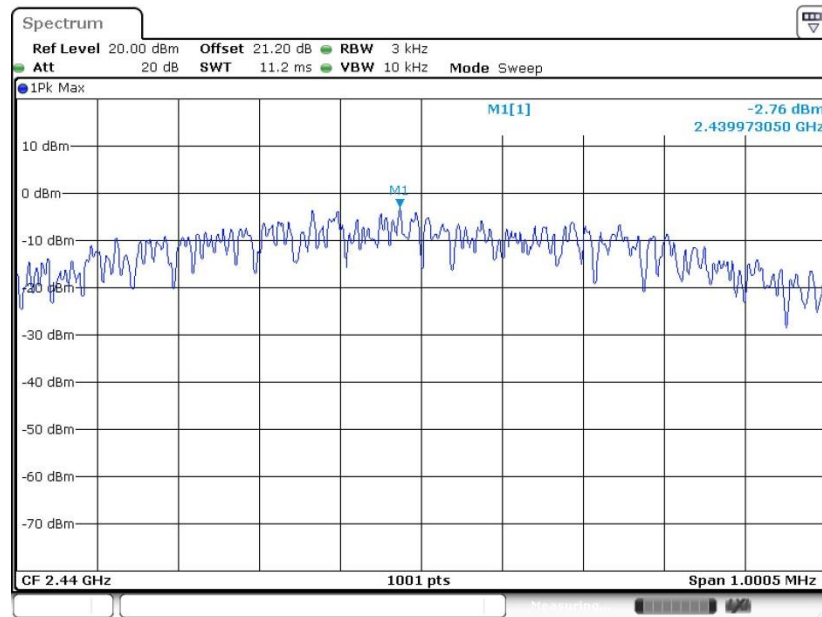
Bluetooth v4.2 LE For Ant2:

PSD 3kHz Plot on Channel 00



Date: 29.JAN.2020 17:15:12

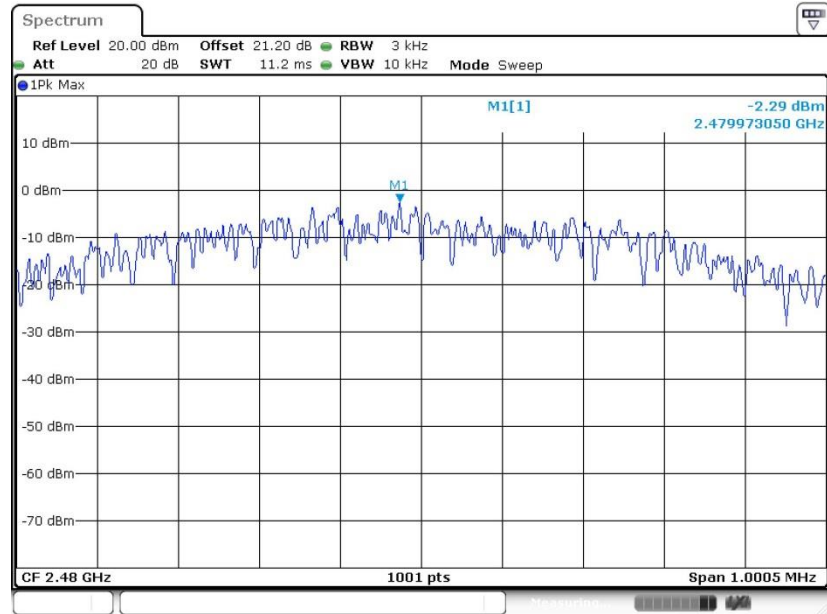
PSD 3kHz Plot on Channel 19



Date: 29.JAN.2020 17:19:53



PSD 3kHz Plot on Channel 39



Date: 29.JAN.2020 17:24:07