



# **TEST REPORT**

**Report Number:** 13190901-E2V1

**Applicant :** APPLE, INC.  
1 APPLE PARK WAY  
CUPERTINO, CA 95014, U.S.A

**Model :** A2398

**FCC ID :** BCG-E3540A

**IC :** 579C-E3540A

**EUT Description :** SMARTPHONE

**Test Standard(s) :** FCC 47 CFR PART 15 SUBPART C  
ISED RSS-247 ISSUE 2  
ISED RSS-GEN ISSUE 5

**Date of Issue:**  
September 21, 2020

**Prepared by:**  
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## REPORT REVISION HISTORY

Rev.	Issue Date	Revisions	Revised By
V1	9/21/2020	Initial Issue	Vien Tran

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## 1. ATTESTATION OF TEST RESULTS

**COMPANY NAME:** APPLE INC.  
1 APPLE PARK WAY  
CUPERTINO, CA 95014, U.S.A

**EUT DESCRIPTION:** SMARTPHONE

**MODEL:** A2398

**SERIAL NUMBER:** Original: C7CD603Z08HK, C7CCT014Q90Y  
Spot check: C7CCV009Q8YX, C7CCT008Q908

**DATE TESTED:** SEPTEMBER 8, 2020 TO SEPTEMBER 8, 2020

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

UL Verification Services Inc. tested the above equipment in accordance with the requirements set forth in the above standards. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. It is the manufacturer's responsibility to assure that additional production units of this model are manufactured with identical electrical and mechanical components. All samples tested were in good operating condition throughout the entire test program. Measurement Uncertainties are published for informational purposes only and were not taken into account unless noted otherwise.

This document may not be altered or revised in any way unless done so by UL Verification Services Inc. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL Verification Services Inc. will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, any agency of the Federal Government, or any agency of the U.S. government.

Approved & Released For  
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Consumer Technology Division  
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Prepared By:



Tony Li  
Test Engineer  
Consumer Technology Division  
UL Verification Services Inc.

## 2. TEST SUMMARY

FCC Clause	ISED Clause	Requirement	Result	Comment
15.209, 15.205	RSS-GEN 8.9, 8.10	Radiated Emissions	Complies	None.

## 3. TEST METHODOLOGY

The tests documented in this report were performed in accordance with FCC CFR 47 Part 2, FCC CFR 47 Part 15, ANSI C63.10-2013, KDB 558074 D01 15.247 Meas Guidance v05r02, KDB 662911, RSS-GEN Issue 5, and RSS-247 Issue 2.

## 4. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 47173 and 47266 Benicia Street, and 47658 Kato Road, Fremont, California, USA. Line conducted emissions are measured only at the 47173 address. The following table identifies which facilities were utilized for radiated emission measurements documented in this report. Specific facilities are also identified in the test results sections.

47173 Benicia Street	47266 Benicia Street	47658 Kato Rd.
<input type="checkbox"/> Chamber A (IC:2324B-1)	<input type="checkbox"/> Chamber D (IC:22541-1)	<input type="checkbox"/> Chamber I (IC: 2324A-5)
<input type="checkbox"/> Chamber B (IC:2324B-2)	<input checked="" type="checkbox"/> Chamber E (IC:22541-2)	<input checked="" type="checkbox"/> Chamber J (IC: 2324A-6)
<input type="checkbox"/> Chamber C (IC:2324B-3)	<input type="checkbox"/> Chamber F (IC:22541-3)	<input type="checkbox"/> Chamber K (IC: 2324A-1)
	<input type="checkbox"/> Chamber G (IC:22541-4)	<input type="checkbox"/> Chamber L (IC: 2324A-3)
	<input type="checkbox"/> Chamber H (IC:22541-5)	<input type="checkbox"/> Chamber M (IC: 2324A-2)

The above test sites and facilities are covered under FCC Test Firm Registration # 208313. Chambers above are covered under Industry Canada company address and respective code.

UL Verification Services Inc. is accredited by NVLAP, Laboratory Code 200065-0

## 5. DECISION RULES AND MEASUREMENT UNCERTAINTY

### 5.1. METROLOGICAL TRACEABILITY

All test and measuring equipment utilized to perform the tests documented in this report are calibrated on a regular basis, with a maximum time between calibrations of one year or the manufacturers' recommendation, whichever is less, and where applicable is traceable to recognized national standards.

### 5.2. DECISION RULES

The Decision Rule is based on Simple Acceptance in accordance with ISO Guide 98-4:2012 Clause 8.2. (Measurement uncertainty is not taken into account when stating conformity with a specified requirement.)

### 5.3. MEASUREMENT UNCERTAINTY

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

PARAMETER	U <sub>LAB</sub>
Worst Case Conducted Disturbance, 9KHz to 0.15 MHz	3.39 dB
Worst Case Conducted Disturbance, 0.15 to 30 MHz	3.07 dB
Worst Case Radiated Disturbance, 9KHz to 30 MHz	2.52 dB
Worst Case Radiated Disturbance, 30 to 1000 MHz	4.88 dB
Worst Case Radiated Disturbance, 1000 to 18000 MHz	4.24 dB
Worst Case Radiated Disturbance, 18000 to 26000 MHz	4.37 dB
Worst Case Radiated Disturbance, 26000 to 40000 MHz	5.17 dB

Uncertainty figures are valid to a confidence level of 95%.

## 6. EQUIPMENT UNDER TEST

### 6.1. EUT DESCRIPTION

The Apple iPhone is a smartphone with multimedia functions (music, application support, and video), cellular GSM, GPRS, EGPRS, UMTS, LTE, 5G, CDMA, IEEE 802.11a/b/g/n/ac/ax, Bluetooth, Ultra-Wideband, GPS, NFC and WPT. All models support at least one UICC based SIM. The second SIM is either an UICC based p-SIM (physical SIM) or e-SIM (electronic SIM). The device supports a built-in inductive charging transmitter and receiver. The rechargeable battery is not user accessible.

### 6.2. INTRODUCTION

This application for certification is leveraging the data reuse procedures from KDB 484596 D01 based on reference FCC ID: BCG-E3539A, IC ID: 579C-E3539A to cover variant BCG-E3540A, 579C-E3540A. The major difference between the parent/reference model and the variant model is the depopulation in the variant model of the mmWave transmitter. All other circuitry and features are identical. The data reuse test plan was approved via manufacturer KDB inquiry.

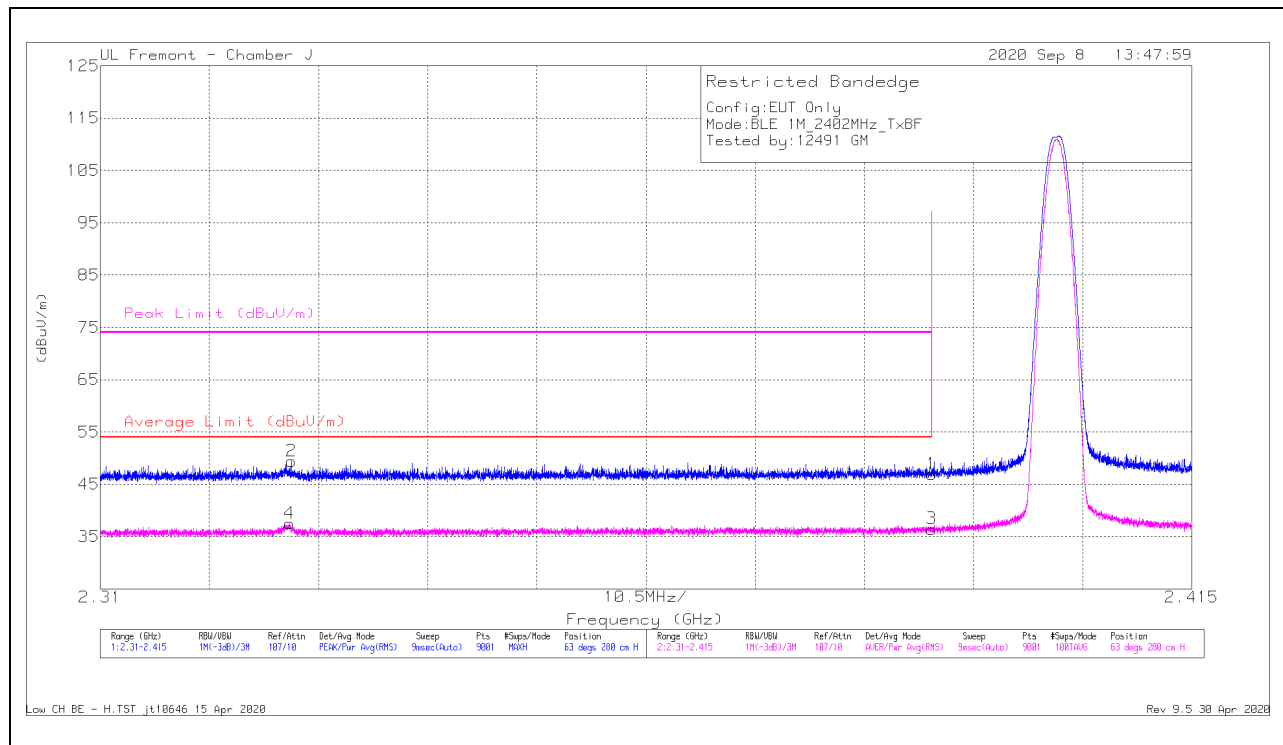
### 6.3. SPOT CHECK VERIFICATION RESULTS SUMMARY

Spot check verification has been done on device model A2398, FCC ID: BCG-E3540A, IC: 579C-E3540A for radiated spurious and radiated band-edge in accordance with the Test Plan that was approved via KDB inquiry.

BCG-E3540A / 579C-E3540A SPOT CHECK RESULTS										
Technology	Mode	Test Item	Channel	Measured	Original model		Spot check model		Delta (dB)	
					A2176		A2398			
					BCG-E3539A 579C-E3539A		BCG-E3540A 579C-E3540A			
				Frequency (MHz)	Peak	Ave	Peak	Ave	Peak	Ave
BLE	TxBF 1Mbps	RBE	Low	2389.1	48.52	36.75	49.57	37.48	1.05	0.73
		RBE	High	2484.11/ 2512.85	51.07	39.36	52.00	40.59	0.93	1.23
	TxBF 2Mbps	RSE	Mid	8143.29 / 8342.84	48.88	37.97	47.33	35.89	-1.55	-2.08

Comparison of the models, upper deviation is within 3dB range and all tests are under FCC Technical Limits. The test report for FCC ID: BCG-E3539A, IC: 579C-E3539A is therefore being used to support the application for certification for FCC ID: BCG-E3540A, IC: 579C-E3540A.

Note: The output powers were verified on model A2398 to match with model A2176 before radiated emissions spot check was performed

**SPOT CHECK DATA****BANDEDGE (LOW CHANNEL)****HORIZONTAL RESULT**

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T963 (dB/m)	Amp/Cbl/Filt/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.38999	43.15	Pk	29	-25.2	46.95	-	-	74	-27.05	63	280	H
2	* 2.32841	45.86	Pk	28.9	-25.3	49.46	-	-	74	-24.54	63	280	H
3	* 2.38999	32.65	RMS	29	-25.2	36.45	54	-17.55	-	-	63	280	H
4	* 2.3282	33.88	RMS	28.9	-25.3	37.48	54	-16.52	-	-	63	280	H

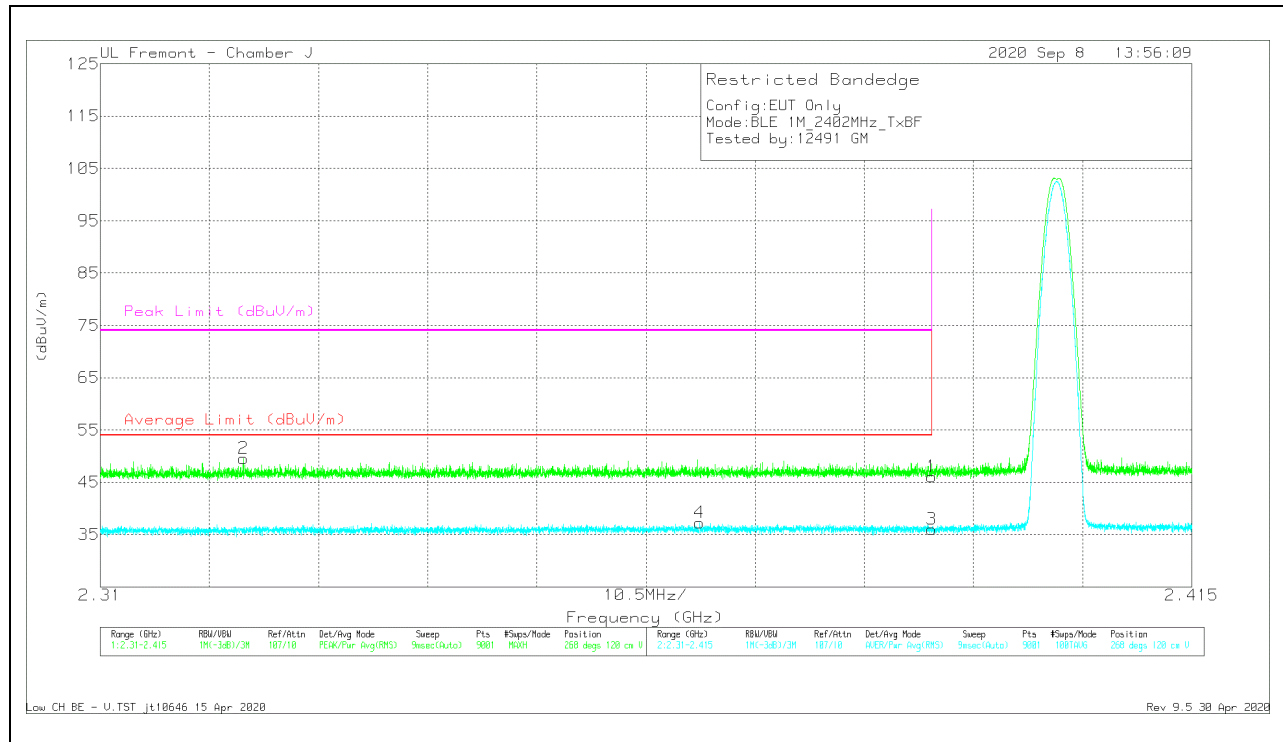
\* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

Pk - Peak detector

RMS - RMS detection



## VERTICAL RESULT

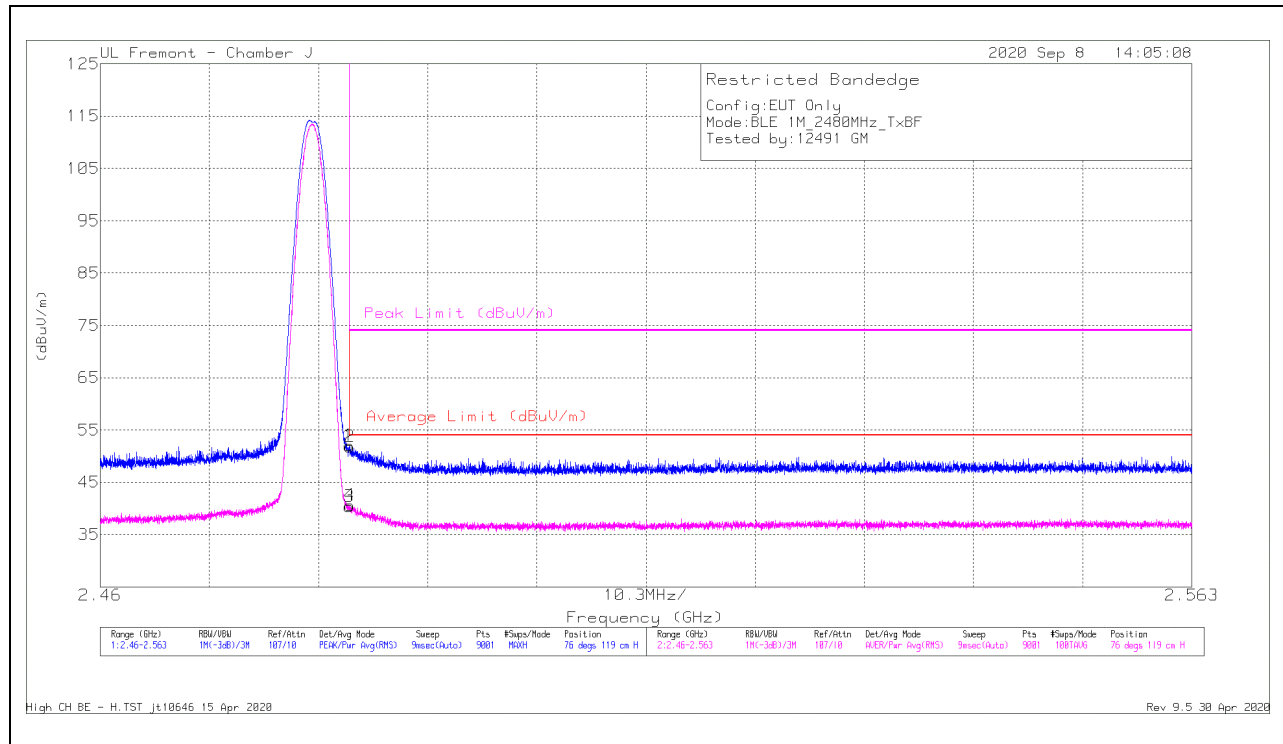


Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T963 (dB/m)	Amp/Cbl/Fitr/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.38999	42.25	Pk	29	-25.2	46.05	-	-	74	-27.95	268	120	V
2	* 2.32376	46.07	Pk	28.8	-25.3	49.57	-	-	74	-24.43	268	120	V
3	* 2.38999	32.17	RMS	29	-25.2	35.97	54	-18.03	-	-	268	120	V
4	* 2.36764	33.57	RMS	29	-25.3	37.27	54	-16.73	-	-	268	120	V

\* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

Pk - Peak detector

RMS - RMS detection

**BANDEDGE (HIGH CHANNEL)****HORIZONTAL RESULT**

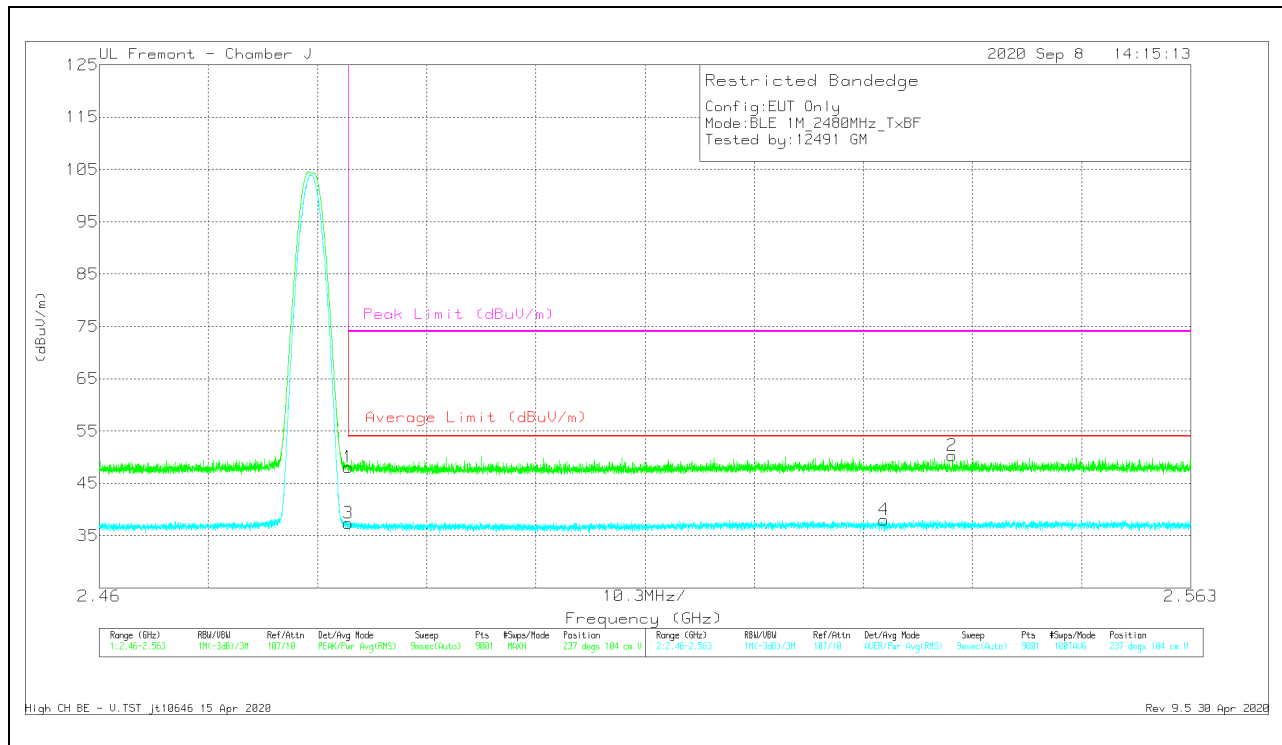
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T963 (dB/m)	Amp/Cbl/Filtr/Pa d (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.48351	47.7	Pk	29.5	-25.2	52	-	-	74	-22	76	119	H
2	* 2.48353	47.44	Pk	29.5	-25.2	51.74	-	-	74	-22.26	76	119	H
3	* 2.48351	36.05	RMS	29.5	-25.2	40.35	54	-13.65	-	-	76	119	H
4	* 2.48353	36.29	RMS	29.5	-25.2	40.59	54	-13.41	-	-	76	119	H

\* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

Pk - Peak detector

RMS - RMS detection

## VERTICAL RESULT

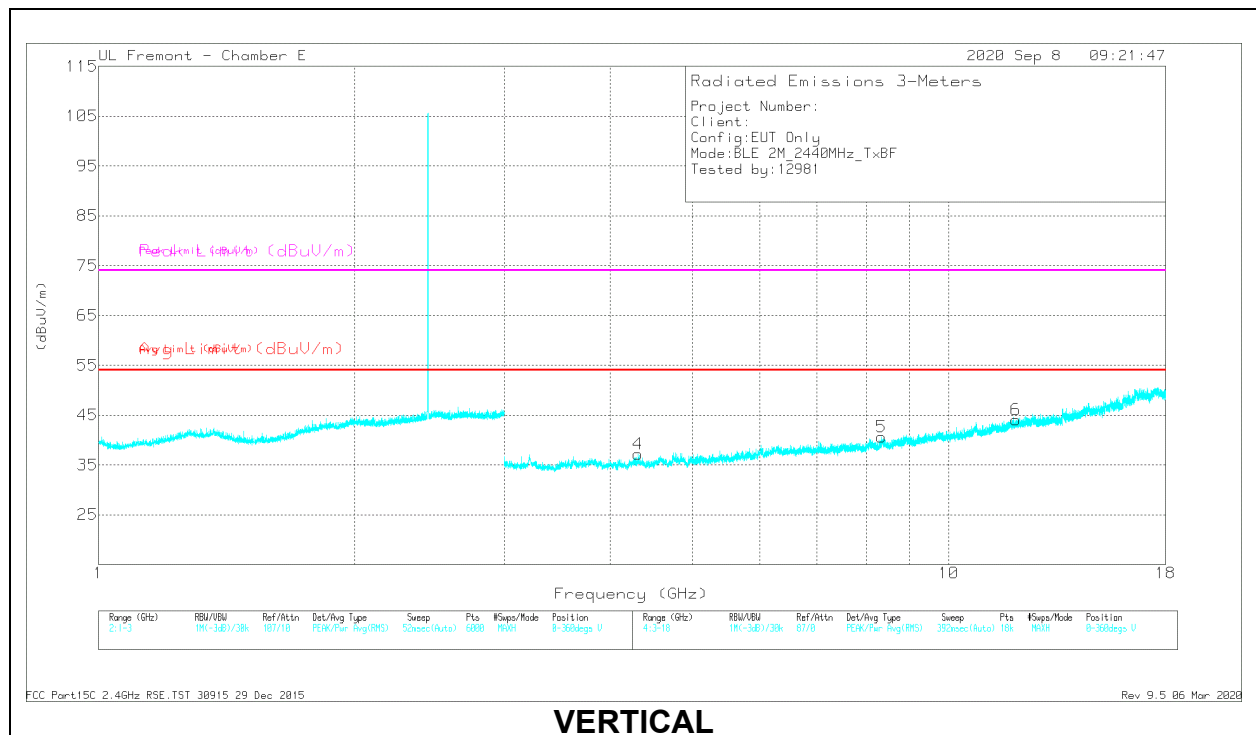
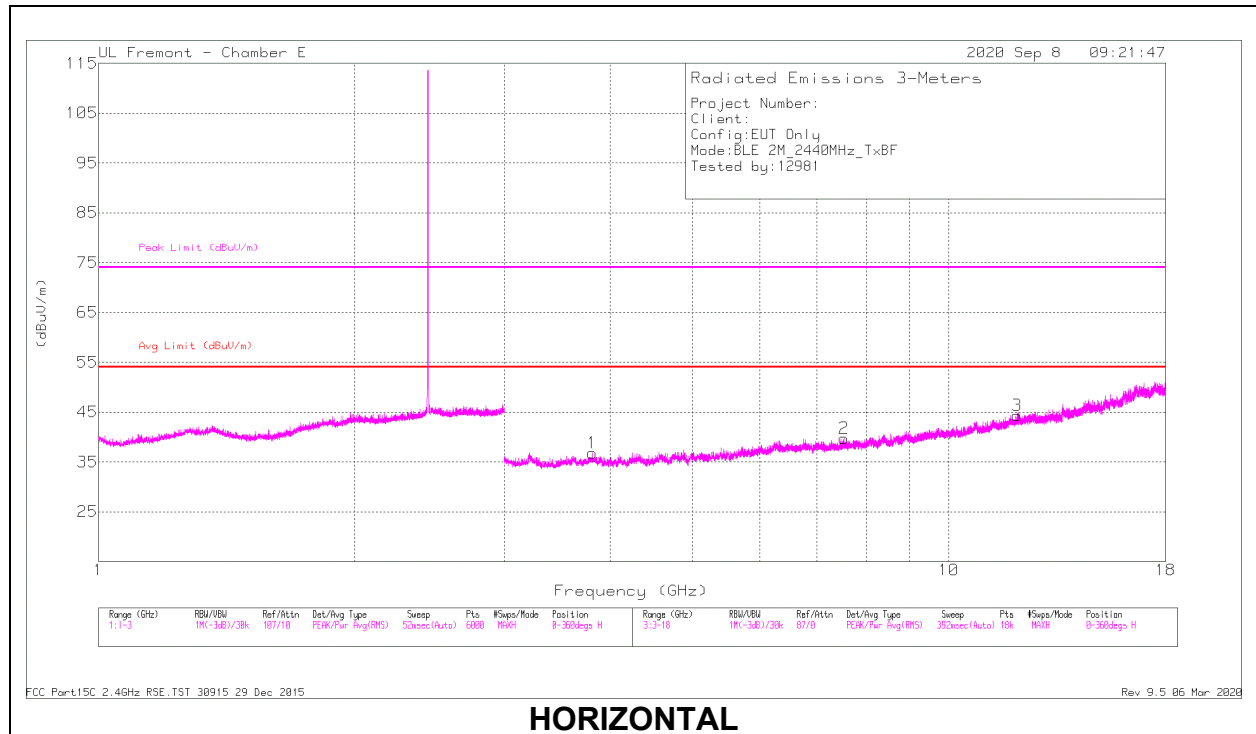


Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T963 (dB/m)	Amp/Cbl/Filt/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.48351	43.75	Pk	29.5	-25.2	48.05	-	-	74	-25.95	237	104	V
2	2.5405	45.54	Pk	29.8	-25.1	50.24	-	-	74	-23.76	237	104	V
3	* 2.48351	33.05	RMS	29.5	-25.2	37.35	54	-16.65	-	-	237	104	V
4	2.53407	33.32	RMS	29.8	-25.1	38.02	54	-15.98	-	-	237	104	V

\* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

Pk - Peak detector

RMS - RMS detection

**HARMONICS AND SPURIOUS EMISSIONS****MID CHANNEL RESULTS**

## Radiated Emissions

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T712 (dB/m)	Amp/Cbl/Filtr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 3.81157	42.83	PK2	33.6	-33	43.43	-	-	74	-30.57	52	279	H
	* 3.80996	31.09	MAv1	33.6	-33	31.69	54	-22.31	-	-	52	279	H
2	* 7.54187	37.68	PK2	35.7	-27.8	45.58	-	-	74	-28.42	63	240	H
	* 7.54053	26.74	MAv1	35.7	-27.8	34.64	54	-19.36	-	-	63	240	H
3	* 12.04009	35.07	PK2	38.6	-22.9	50.77	-	-	74	-23.23	256	294	H
	* 12.03969	23.5	MAv1	38.6	-22.9	39.2	54	-14.8	-	-	256	294	H
4	* 4.31365	42.11	PK2	33.7	-31.8	44.01	-	-	74	-29.99	248	260	V
	* 4.31392	30.63	MAv1	33.7	-31.8	32.53	54	-21.47	-	-	248	260	V
5	* 8.34284	37.83	PK2	35.8	-26.3	47.33	-	-	74	-26.67	233	209	V
	* 8.34155	26.39	MAv1	35.8	-26.3	35.89	54	-18.11	-	-	233	209	V
6	* 11.99843	35.13	PK2	38.6	-23.1	50.63	-	-	74	-23.37	237	250	V
	* 11.99701	23.35	MAv1	38.6	-23.1	38.85	54	-15.15	-	-	237	250	V

\* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

PK2 - KDB558074 Method: Maximum Peak

MAv1 - KDB558074 Option 1 Maximum RMS Average

#### 6.4. REFERENCE DETAIL

Reference application that contains the reused reference data which is attached to this report in Appendix A.

Equipment Class	Reference FCC ID & IC	Reference Report Number	Report Title/Section
DTS	BCG-E3539A 579C-E3539A	13179110-E2	FCC_IC Report BLE / All sections

#### 6.5. DESCRIPTION OF AVAILABLE ANTENNAS

Frequency Range (GHz)	ANT4 (dBi)	ANT3 (dBi)
2.4	-2.3	-0.6

#### 6.6. SOFTWARE AND FIRMWARE

The EUT firmware installed during testing was FW Version: 18.1.148.558

#### 6.7. WORST-CASE CONFIGURATION AND MODE

Radiated band edge, harmonic, and spurious emissions from 1GHz to 18GHz were performed based on the Model A2176 worst case with the EUT set at higher power.

BLE TXBF, 1Mbps, ePA for Radiated Bandedge.  
BLE TXBF, 2Mbps, ePA for Radiated Spurious Emissions.

There are two vendors of the WiFi/Bluetooth radio modules: variant 1 and variant 2. The Wi-Fi/Bluetooth radio modules have the same mechanical outline (e.g., the same package dimension and pin-out layout), use the same on-board antenna matching circuit, have an identical antenna structure, and are built and tested to conform to the same specifications and to operate within the same tolerances.

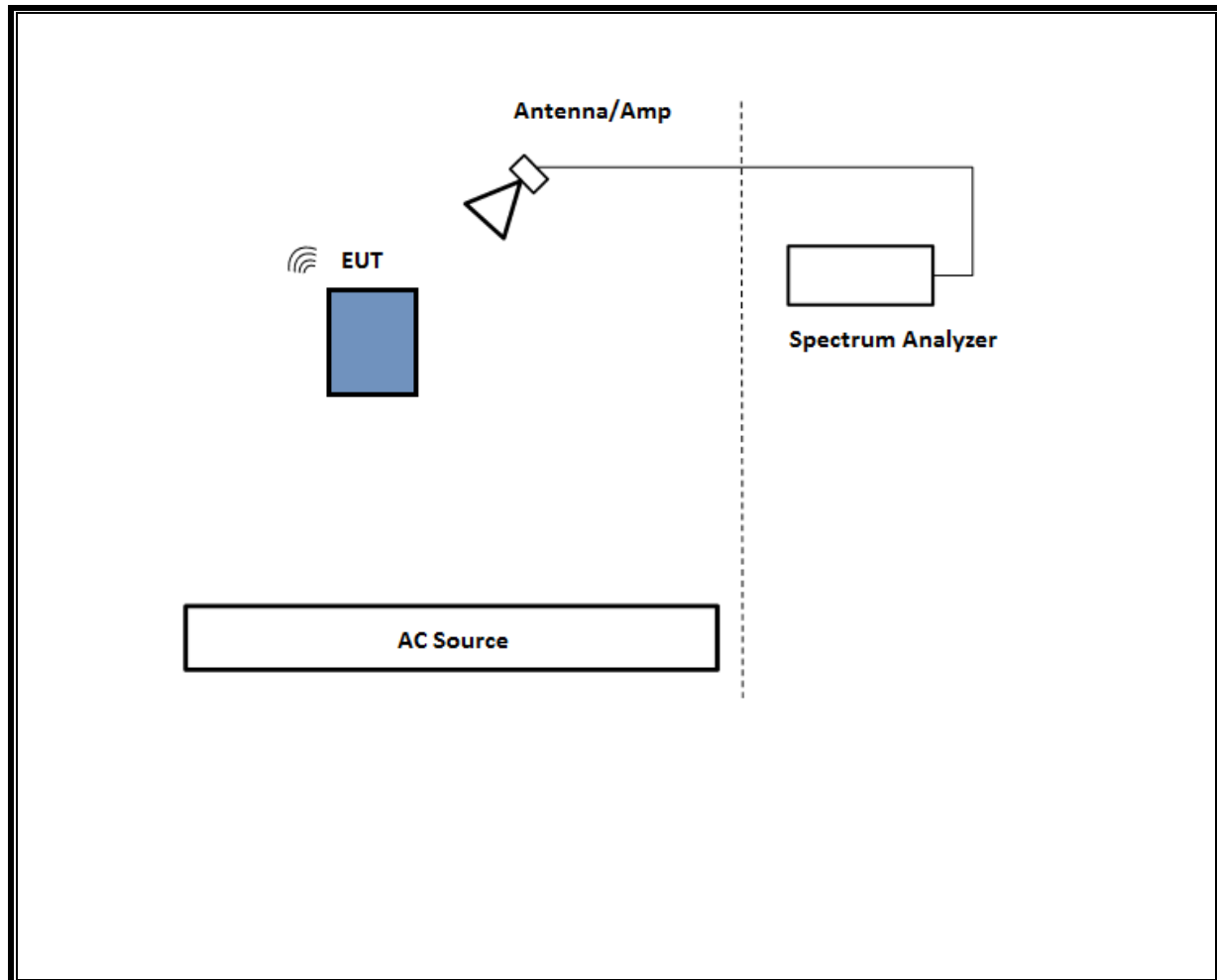
Baseline testing was performed on the two variants to determine the worst case on all conducted power and radiated emissions.

## 6.8. DESCRIPTION OF TEST SETUP

SUPPORT TEST EQUIPMENT						
Description		Manufacturer	Model	Serial Number		FCC ID/ DoC
Laptop		Apple	A1398	C02PM012G3QD		DQS-BRCM1069
Laptop AC/DC adapter		Liteon Technology	PA-1450-BA1	B123		N/A
EUT AC/DC adapter		Apple	A1385	D29325SM03XDHLHC9		N/A
I/O CABLES (RF RADIATED TEST)						
Cable No.	Port	# of Identical Ports	Connector Type	Cable Type	Cable Length (m)	Remarks
1	AC	1	AC	Un-shielded	2	N/A
2	USB	1	USB	Un-shielded	1	N/A

### TEST SETUP

#### SETUP DIAGRAM FOR RADIATED TESTS Above 1 GHz



## 7. MEASUREMENT METHOD

Output Power: ANSI C63.10 Subclause -11.9.1.3 Method PKPM1 Peak-reading power meter

Output Power: ANSI C63.10 Subclause -11.9.2.3.2 Measurement using gated average power meter.

Radiated emissions restricted frequency bands: ANSI C63.10 Subclause -11.12.1 & Clause 13

Band-edge: ANSI C63.10 Subclause -11.13.3.3 & Clause 13: Integration method -Trace averaging with continuous transmission at full power

Radiated emissions non-restricted frequency bands ANSI C63.10 Subclause -11.11 & Clause 13

**NOTE:** All conducted antenna port tests for Beamforming applied the same test procedures as BLE 1Mbps and BLE 2Mbps normal modes.

## 8. TEST AND MEASUREMENT EQUIPMENT

The following test and measurement equipment was utilized for the tests documented in this report:

Description	Manufacturer	Model	ID Num	Cal Due	Last Cal
Spectrum Analyzer, PXA, 3Hz to 44GHz	Keysight Technologies Inc	N9030A	T1466	01/23/2021	01/23/2020
Antenna, Horn 1-18GHz	ETS-Lindgren	3117	T712	03/09/2021	03/10/2020
RF Filter Box, 1-18GHz	UL (IN HOUSE)	N/A	PRE0182865	03/03/2021	03/03/2020
EMI TEST RECEIVER	Rohde & Schwarz	ESW44	PRE0179372	02/25/2021	02/25/2020
Antenna, Horn 1-18GHz	ETS-Lindgren	3117	T963	01/25/2021	01/25/2020
RF Filter Box, 1-18GHz	UL (IN HOUSE)	N/A	PRE0181597	08/20/2021	08/20/2020
<b>UL AUTOMATION SOFTWARE</b>					
Radiated Software	UL	UL EMC	Ver 9.5, Mar 6, 2020		

## 9. SETUP PHOTOS

Please refer to 13179110-EP1 for setup photos

## END OF TEST REPORT



## **Appendix A – Reference Test Report**

Attached is the test report (13179110-E2) containing the reference data from the parent model as detailed in section 6.4.



# **TEST REPORT**

**Report Number:** 13179110-E1V2

**Applicant :** APPLE, INC.  
1 APPLE PARK WAY  
CUPERTINO, CA 95014, U.S.A

**Model :** A2176

**FCC ID :** BCG-E3539A

**IC :** 579C-E3539A

**EUT Description :** SMARTPHONE

**Test Standard(s) :** FCC 47 CFR PART 15 SUBPART C  
ISED RSS-247 ISSUE 2  
ISED RSS-GEN ISSUE 5

**Date of Issue:**  
September 30, 2020

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NVLAP Lab code: 200065-0

## REPORT REVISION HISTORY

Rev.	Issue Date	Revisions	Revised By
V1	9/21/2020	Initial Issue	Vien Tran
V2	9/30/2020	Addressed TCB questions	Francisco Guarnero

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## 1. ATTESTATION OF TEST RESULTS

**COMPANY NAME:** APPLE INC.  
1 APPLE PARK WAY  
CUPERTINO, CA 95014, U.S.A

**EUT DESCRIPTION:** SMARTPHONE

**MODEL:** A2176

**SERIAL NUMBER:** C7CD603Z08HK, C7CCT014Q90Y

**DATE TESTED:** MAY 06 TO SEPTEMBER 08, 2020

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

UL Verification Services Inc. tested the above equipment in accordance with the requirements set forth in the above standards. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. It is the manufacturer's responsibility to assure that additional production units of this model are manufactured with identical electrical and mechanical components. All samples tested were in good operating condition throughout the entire test program. Measurement Uncertainties are published for informational purposes only and were not taken into account unless noted otherwise.

This document may not be altered or revised in any way unless done so by UL Verification Services Inc. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL Verification Services Inc. will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, any agency of the Federal Government, or any agency of the U.S. government.

Approved & Released For  
UL Verification Services Inc. By:



Chin Pang  
Senior Engineer  
Consumer Technology Division  
UL Verification Services Inc.

Prepared By:



Tony Li  
Test Engineer  
Consumer Technology Division  
UL Verification Services Inc.

## 2. TEST SUMMARY

FCC Clause	ISED Clause	Requirement	Result	Comment
See Comment		Duty Cycle	Reporting purposes only	ANSI C63.10 Section 11.6.
-	RSS-GEN 6.7	99% OBW	Reporting purposes only	ANSI C63.10 Section 6.9.3.
15.247 (a) (2)	RSS-247 5.2 (a)	6dB BW	Complies	None.
15.247 (b) (3)	RSS-247 5.4 (d)	Output Power	Complies	None.
See Comment		Average power	Reporting purposes only	Per ANSI C63.10, Section 11.9.2.3.2.
15.247 (e)	RSS-247 5.2 (b)	PSD	Complies	None.
15.247 (d)	RSS-247 5.5	Conducted Spurious Emissions	Complies	None.
15.209, 15.205	RSS-GEN 8.9, 8.10	Radiated Emissions	Complies	None.
15.207	RSS-Gen 8.8	AC Mains Conducted Emissions	Complies	None.

## 3. TEST METHODOLOGY

The tests documented in this report were performed in accordance with FCC CFR 47 Part 2, FCC CFR 47 Part 15, ANSI C63.10-2013, KDB 558074 D01 15.247 Meas Guidance v05r02, KDB 662911, RSS-GEN Issue 5, and RSS-247 Issue 2.

## 4. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 47173 and 47266 Benicia Street, and 47658 Kato Road, Fremont, California, USA. Line conducted emissions are measured only at the 47173 address. The following table identifies which facilities were utilized for radiated emission measurements documented in this report. Specific facilities are also identified in the test results sections.

47173 Benicia Street	47266 Benicia Street	47658 Kato Rd.
<input type="checkbox"/> Chamber A (IC:2324B-1)	<input type="checkbox"/> Chamber D (IC:22541-1)	<input checked="" type="checkbox"/> Chamber I (IC: 2324A-5)
<input type="checkbox"/> Chamber B (IC:2324B-2)	<input type="checkbox"/> Chamber E (IC:22541-2)	<input checked="" type="checkbox"/> Chamber J (IC: 2324A-6)
<input type="checkbox"/> Chamber C (IC:2324B-3)	<input type="checkbox"/> Chamber F (IC:22541-3)	<input type="checkbox"/> Chamber K (IC: 2324A-1)
	<input type="checkbox"/> Chamber G (IC:22541-4)	<input type="checkbox"/> Chamber L (IC: 2324A-3)
	<input checked="" type="checkbox"/> Chamber H (IC:22541-5)	<input type="checkbox"/> Chamber M (IC: 2324A-2)

The above test sites and facilities are covered under FCC Test Firm Registration # 208313. Chambers above are covered under Industry Canada company address and respective code.

UL Verification Services Inc. is accredited by NVLAP, Laboratory Code 200065-0



## 5. DECISION RULES AND MEASUREMENT UNCERTAINTY

### 5.1. METROLOGICAL TRACEABILITY

All test and measuring equipment utilized to perform the tests documented in this report are calibrated on a regular basis, with a maximum time between calibrations of one year or the manufacturers' recommendation, whichever is less, and where applicable is traceable to recognized national standards.

### 5.2. DECISION RULES

The Decision Rule is based on Simple Acceptance in accordance with ISO Guide 98-4:2012 Clause 8.2. (Measurement uncertainty is not taken into account when stating conformity with a specified requirement.)

### 5.3. MEASUREMENT UNCERTAINTY

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

PARAMETER	U <sub>LAB</sub>
Worst Case Conducted Disturbance, 9KHz to 0.15 MHz	3.39 dB
Worst Case Conducted Disturbance, 0.15 to 30 MHz	3.07 dB
Worst Case Radiated Disturbance, 9KHz to 30 MHz	2.52 dB
Worst Case Radiated Disturbance, 30 to 1000 MHz	4.88 dB
Worst Case Radiated Disturbance, 1000 to 18000 MHz	4.24 dB
Worst Case Radiated Disturbance, 18000 to 26000 MHz	4.37 dB
Worst Case Radiated Disturbance, 26000 to 40000 MHz	5.17 dB

Uncertainty figures are valid to a confidence level of 95%.

## 6. EQUIPMENT UNDER TEST

### 6.1. EUT DESCRIPTION

The Apple iPhone is a smartphone with multimedia functions (music, application support, and video), cellular GSM, GPRS, EGPRS, UMTS, LTE, 5G, CDMA, IEEE 802.11a/b/g/n/ac/ax, Bluetooth, Ultra-Wideband, GPS, NFC and WPT. All models support at least one UICC based SIM. The second SIM is either an UICC based p-SIM (physical SIM) or e-SIM (electronic SIM). The device supports a built-in inductive charging transmitter and receiver. The rechargeable battery is not user accessible.

### 6.2. MAXIMUM OUTPUT POWER

The transmitter has a maximum peak conducted output power as follows:

Antenna	Configuration	Frequency Range (MHz)	Mode	Output Power (dBm)	Output Power (mW)
ANT4	High Power	2402 - 2480	BLE 1M	20.31	107.40
	Low Power			12.85	19.28
	High Power		BLE 2M	20.31	107.40
	Low Power			12.85	19.28
ANT3	High Power	2402 - 2480	BLE 1M	20.28	106.66
	Low Power			12.86	19.32
	High Power		BLE 2M	20.34	108.14
	Low Power			12.81	19.10
BF, ANT4+ANT3	High Power	2402 - 2480	BLE 1M	20.34	108.14
	Low Power			15.82	38.19
	High Power		BLE 2M	20.3	107.15
	Low Power			15.85	38.46

### 6.3. DESCRIPTION OF AVAILABLE ANTENNAS

Frequency Range (GHz)	ANT4 (dBi)	ANT3 (dBi)
2.4	-2.3	-0.6

### 6.4. SOFTWARE AND FIRMWARE

The EUT firmware installed during testing was FW Version: 18.1.148.558

## **6.5. WORST-CASE CONFIGURATION AND MODE**

The EUT was investigated in three orthogonal orientations X, Y and Z on ANT3 and ANT4. It was determined that X (Flatbed) orientation was the worst-case orientation for ANT4, ANT3, and beamforming 2TX.

Radiated band edge, harmonic, and spurious emissions from 1GHz to 18GHz were performed with the EUT was set to transmit at highest power on Low/Middle/High channels.

Radiated emissions below 1GHz, 18-26GHz and power line conducted emissions were performed with the EUT transmits at the channel with the highest output power as worst-case scenario. There were no emissions found below 30MHz within 20dB of the limit

For below 1GHz tests were performed with EUT connected to AC power adapter as the worst case; and for above 1GHz, the worst-case configuration reported was tested with EUT only. For AC line conducted emission, test was investigated with AC power adapter and with laptop.

For simultaneous transmission of multiple channels in the 2.4GHz BLE and 5GHz bands. No noticeable emission was found.

There are two vendors of the WiFi/Bluetooth radio modules: variant 1 and variant 2. The Wi-Fi/Bluetooth radio modules have the same mechanical outline (e.g., the same package dimension and pin-out layout), use the same on-board antenna matching circuit, have an identical antenna structure, and are built and tested to conform to the same specifications and to operate within the same tolerances.

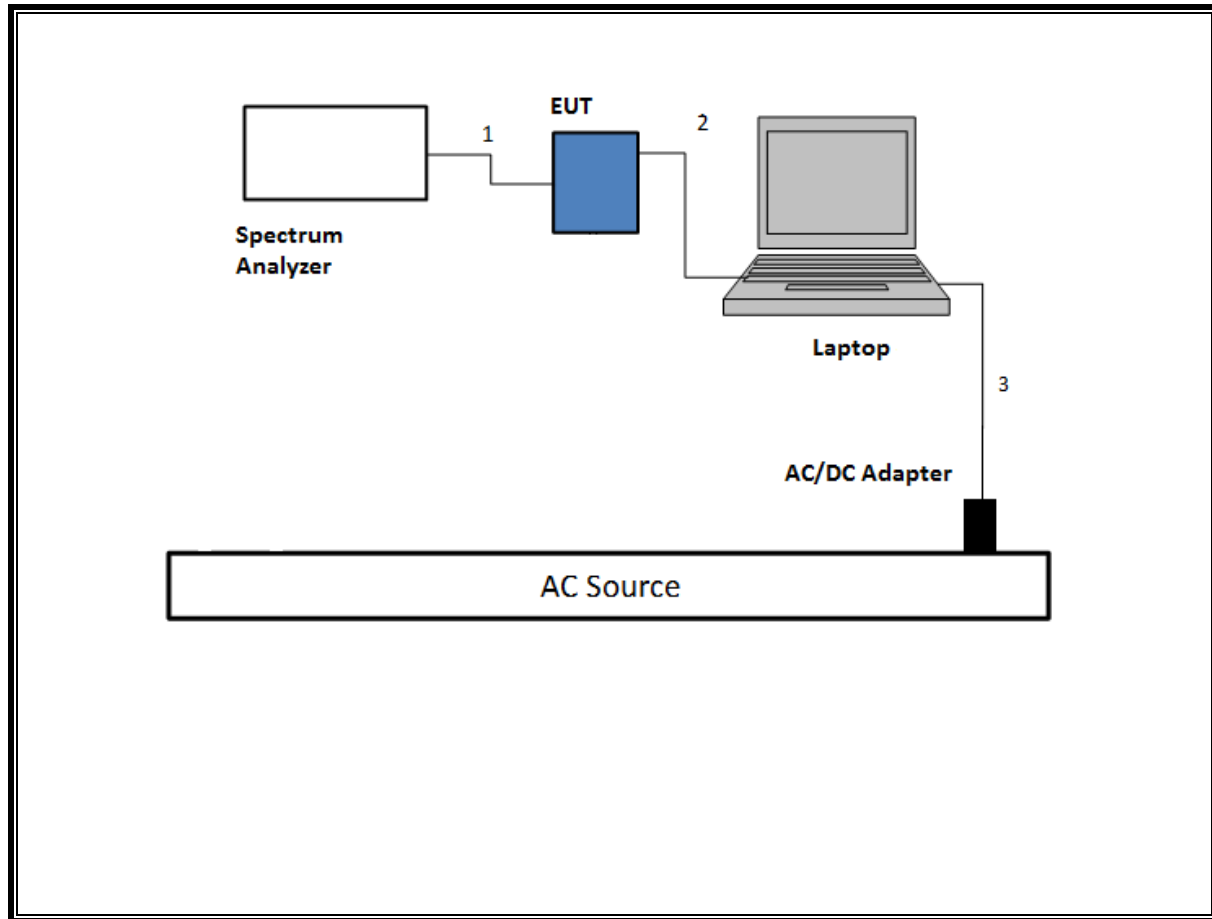
Baseline testing was performed on the two variants to determine the worst case on all conducted power and radiated emissions.

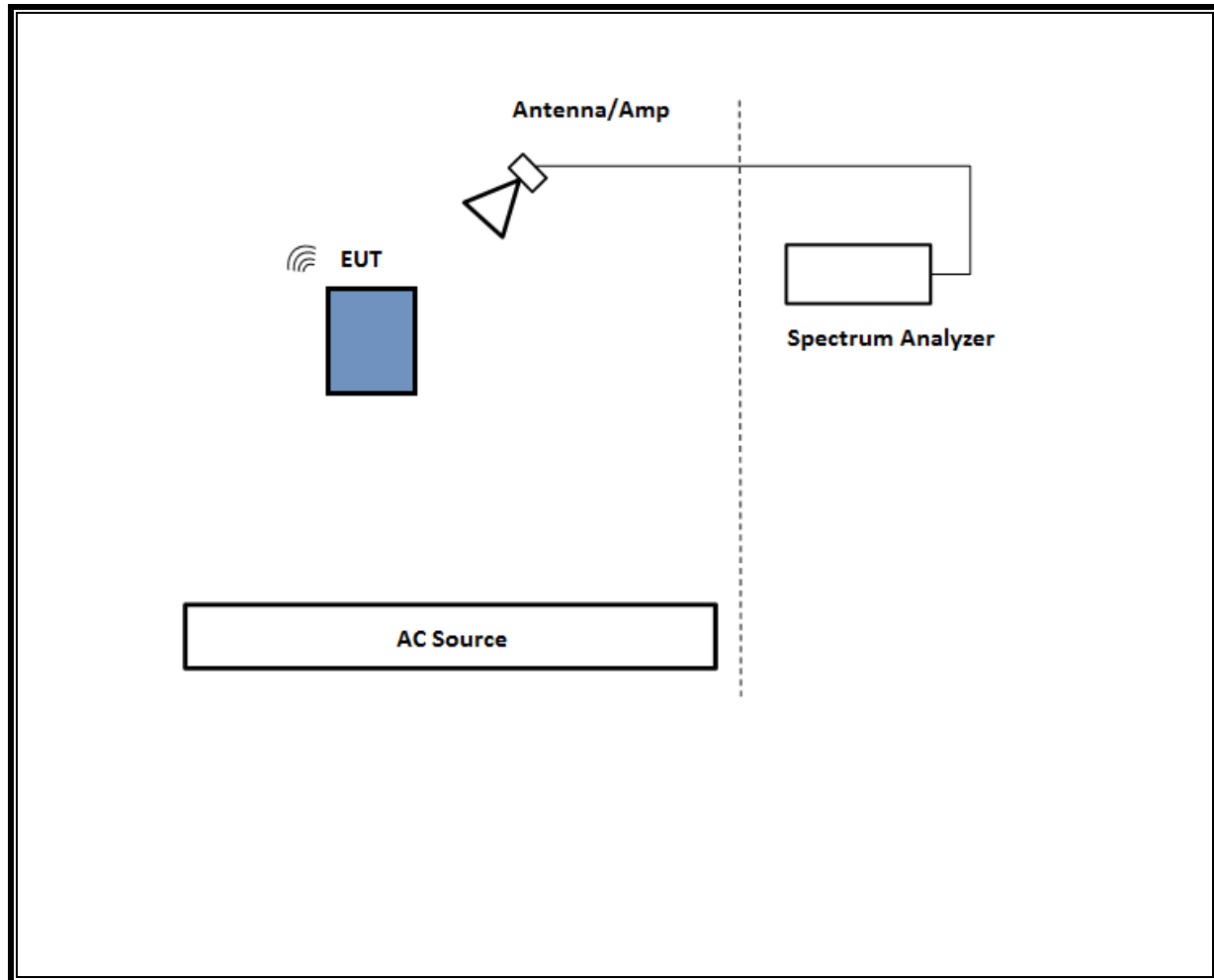
## 6.6. DESCRIPTION OF TEST SETUP

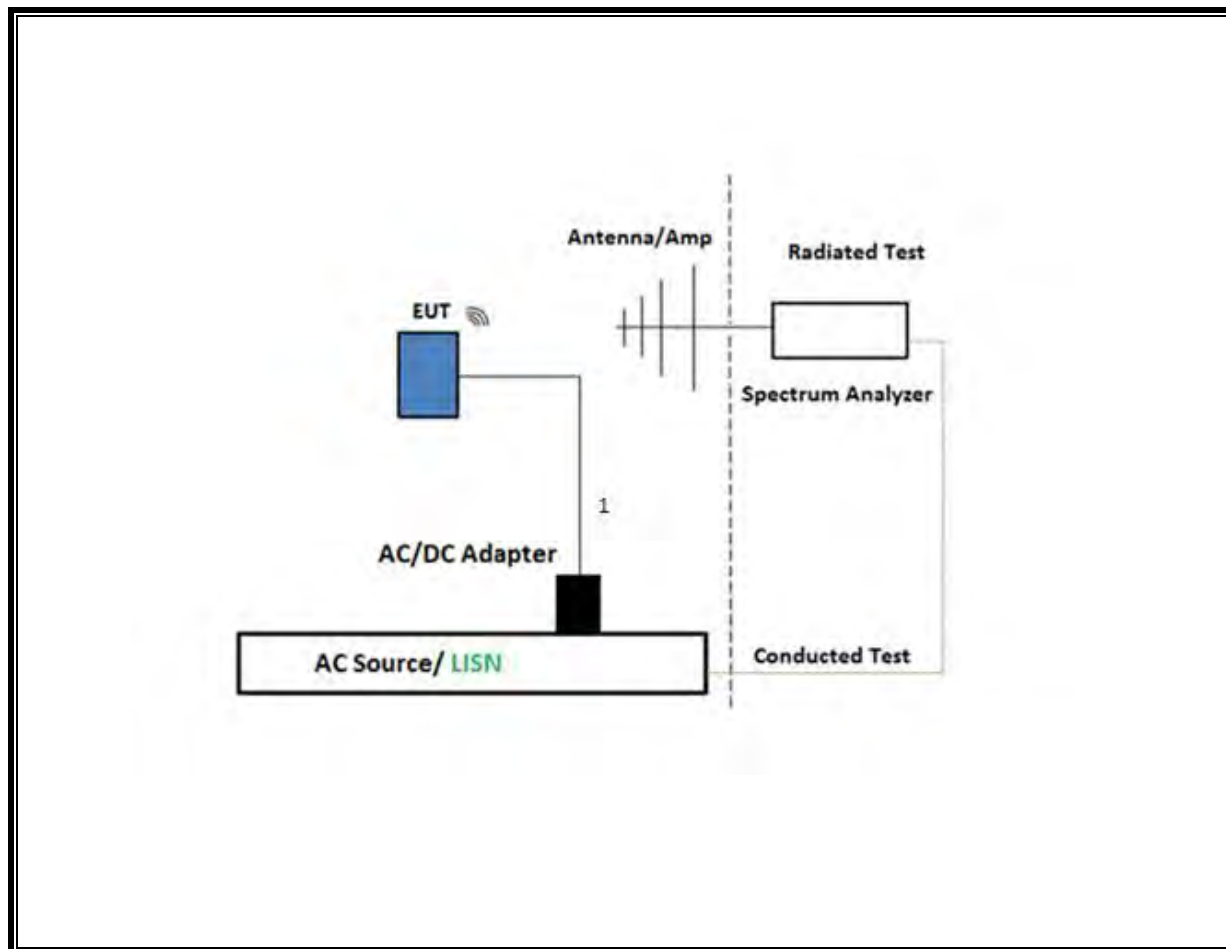
SUPPORT TEST EQUIPMENT						
Description		Manufacturer	Model	Serial Number		FCC ID/ DoC
Laptop		Apple	A1398	C02PM012G3QD		DQS-BRCM1069
Laptop AC/DC adapter		Liteon Technology	PA-1450-BA1	B123		N/A
EUT AC/DC adapter		Apple	A1385	D29325SM03XDHLHC9		N/A
I/O CABLES (RF CONDUCTED TEST)						
Cable No.	Port	# of Identical Ports	Connector Type	Cable Type	Cable Length (m)	Remarks
1	Antenna	1	SMA	Un-shielded	0.2	To spectrum Analyzer
2	USB	1	USB	Shielded	1.0	N/A
3	AC	1	AC	Un-shielded	2	N/A
I/O CABLES (RF RADIATED TEST)						
Cable No.	Port	# of Identical Ports	Connector Type	Cable Type	Cable Length (m)	Remarks
1	AC	1	AC	Un-shielded	2	N/A
2	USB	1	USB	Un-shielded	1	N/A

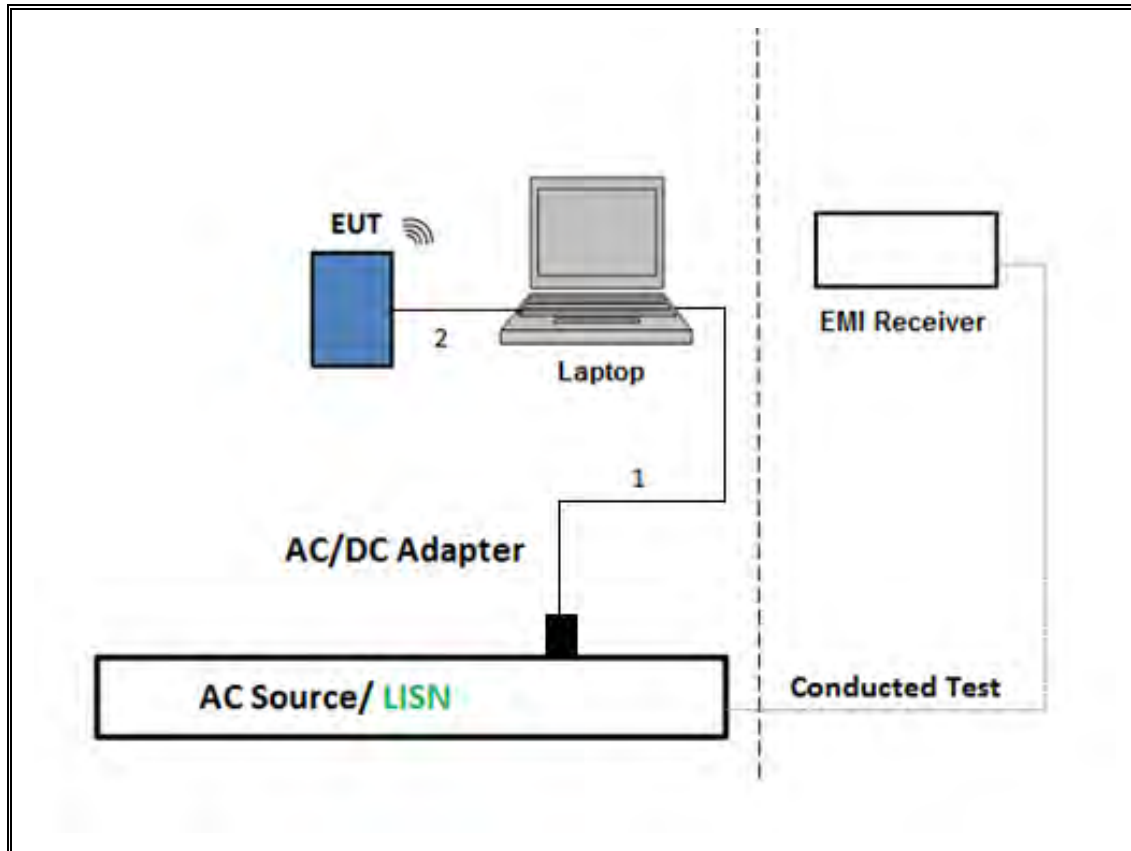
### TEST SETUP

The EUT setup is shown as below. Test software exercised the radio card.

**SETUP DIAGRAM FOR CONDUCTED TESTS**

**SETUP DIAGRAM FOR RADIATED TESTS Above 1 GHz**

**SETUP DIAGRAM FOR Below 1GHz and AC LINE CONDUCTED TEST**

**TEST SETUP- AC LINE CONDUCTED: LAPTOP CONFIGURATION**



## 7. MEASUREMENT METHOD

On Time and Duty Cycle: KDB 558074 D01 v05r02, Section 6.

6 dB BW: ANSI C63.10 Subclause -11.8.1 RBW  $\geq$  DTS BW

Occupied BW (99%): ANSI C63.10-2013 Section 6.9.3

Output Power: ANSI C63.10 Subclause -11.9.1.3 Method PKPM1 Peak-reading power meter

Output Power: ANSI C63.10 Subclause -11.9.2.3.2 Measurement using gated average power meter.

PSD: ANSI C63.10 Subclause -11.10.2 Method PKPSD (peak PSD)

Radiated emissions restricted frequency bands: ANSI C63.10 Subclause -11.12.1 & Clause 13

Conducted emissions in restricted frequency bands: ANSI C63.10 Subclause -11.12.2

Band-edge: ANSI C63.10 Subclause -11.13.3.2 & Clause 13: Integration method -Peak detection

Band-edge: ANSI C63.10 Subclause -11.13.3.3 & Clause 13: Integration method -Trace averaging with continuous transmission at full power

AC Power Line Conducted Emissions: ANSI C63.10-2013, Section 6.2.

Radiated emissions non-restricted frequency bands: ANSI C63.10 Subclause -11.11 & Clause 13

Radiated Spurious Emissions Below 30MHz: ANSI C63.10-2013 Section 6.4 & 13

**NOTE:** All conducted antenna port tests for Beamforming applied the same test procedures as BLE 1Mbps and BLE 2Mbps normal modes.

## 8. TEST AND MEASUREMENT EQUIPMENT

The following test and measurement equipment was utilized for the tests documented in this report:

Description	Manufacturer	Model	ID Num	Cal Due	Last Cal
Antenna, Double Ridge Guide Horn Antenna 700MHz to 18GHz	A.H, Systems Inc.	SAS-571	T963	01/25/2021	01/25/2020
Amplifier, 1 to 18GHz, 35dB	AMPLICAL	AMP1G18-35	T1571	08/20/2021	08/20/2020
EMI Test Receiver	Rohde & Schawrz	ESW44	PRE0179372	02/25/2021	02/25/2020
*Antenna, Horn 1-18GHz	ETS-Lindgren	3117	T344	05/26/2021	05/26/2020
*Antenna, Horn 1-18GHz	ETS-Lindgren	3117	T346	07/20/2021	07/20/2020
RF Amplifier, 1-18GHz	MITEQ	AFS42- 00101800-25-S- 42	171460	05/06/2021	05/06/2020
EMI Test Receiver	Rohde & Schawrz	ESW44	PRE0179522	02/20/2021	02/20/2020
*Antenna, Broadband Hybrid, 30MHz to 2000MHz	Sunol Sciences Corp.	JB3	T899	08/23/2020	08/23/2019
*Amplifier, 9kHz to 1GHz, 32dB	SONOMA INSTRUMENT	310	PRE0180174	06/01/2020	06/01/2019
Power Meter, P-series single channel	Keysight	N1911A	PRE0177682	01/21/2021	01/21/2020
Power Sensor	Keysight	N1921A	T1226	02/13/2021	02/13/2020
Antenna Horn, 18 to 26GHz	ARA	SWH-28	T125	04/17/2021	04/17/2020
Pre-Amp 18-26GHz	Agilent Technology	8449B	T404	04/08/2021	04/08/2020
Spectrum Analyzer, PXA, 3Hz to 44GHz	Agilent (Keysight) Technologies	N9030A	T339	01/21/2021	01/21/2020
AC Line Conducted					
Description	Manufacturer	Model	ID Num	Cal Due	Last Cal
EMI Test Receiver 9KHz-7GHz	Rohde & Schwarz	ESCI7	T1436	02/20/2021	02/20/2020
Power Cable, Line Conducted Emissions	UL	PG1	T861	10/27/2020	10/27/2019
LISN for Conducted Emissions CISPR-16	Fischer	50/250-25-2-01	PRE0186446	01/23/2021	01/23/2020
UL AUTOMATION SOFTWARE					
Radiated Software	UL	UL EMC	Ver 9.5, Mar 6, 2020		
Conducted Software	UL	UL EMC	2020.2.26		
AC Line Conducted Software	UL	UL EMC	Ver 9.5, February 21, 2020		

\*Testing is completed before equipment expiration date.

## 9. ANTENNA PORT TEST RESULTS

### 9.1. ON TIME AND DUTY CYCLE

#### LIMITS

None; for reporting purposes only.

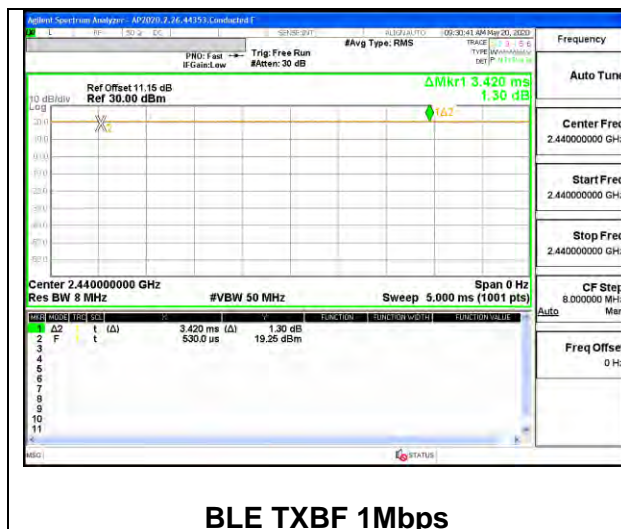
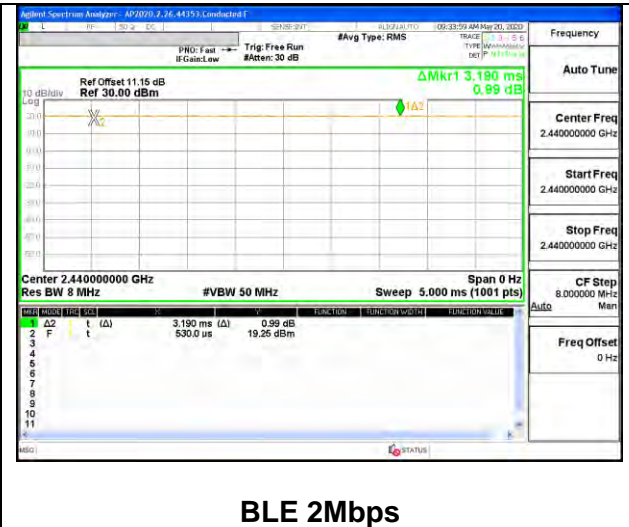
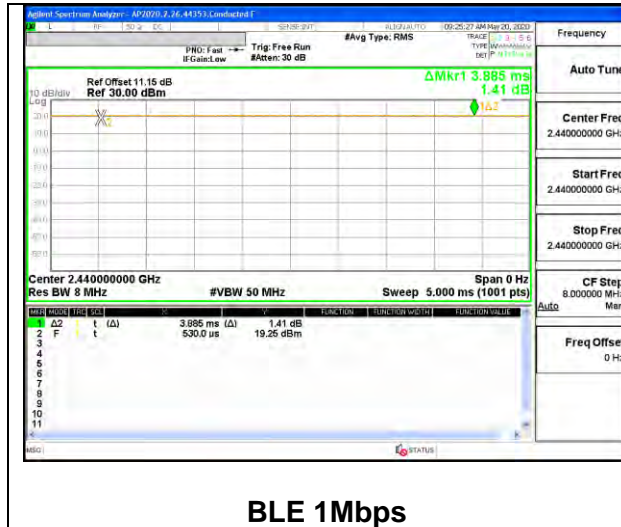
#### PROCEDURE

KDB 558074 Zero-Span Spectrum Analyzer Method.

#### ON TIME AND DUTY CYCLE RESULTS

Mode	ON Time B (msec)	Period (msec)	Duty Cycle x (linear)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)	1/B Minimum VBW (kHz)
<b>2.4GHz Band</b>						
BLE, 1Mbps	3.89	3.89	1.00	100.0	0.00	0.010
BLE, 2Mbps	3.19	3.19	1.00	100.0	0.00	0.010
BLE, TXBF, 1Mbps	3.42	3.42	1.00	100.0	0.00	0.010
BLE, TXBF, 2Mbps	4.01	4.01	1.00	100.0	0.00	0.010

## DUTY CYCLE PLOTS



## **9.2. 99% BANDWIDTH**

### **LIMITS**

None; for reporting purposes only.

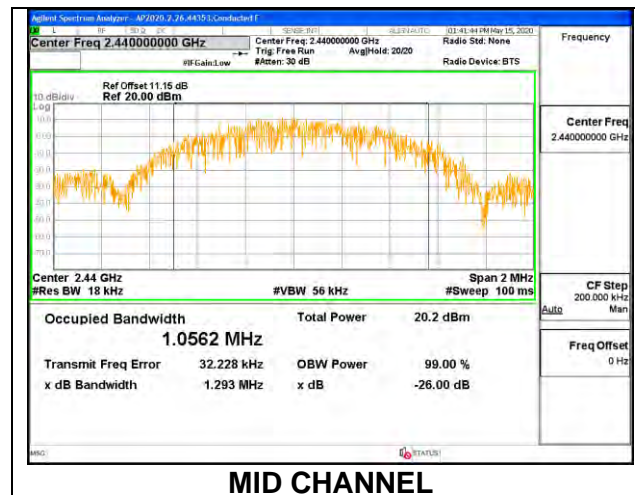
### **RESULTS**

Only High Power modes result is reported, it covers all Low Power modes. Only Mid channel plot is reported to show setting parameter complies with testing method/procedure

## 9.2.1. HIGH POWER BLE (1Mbps)

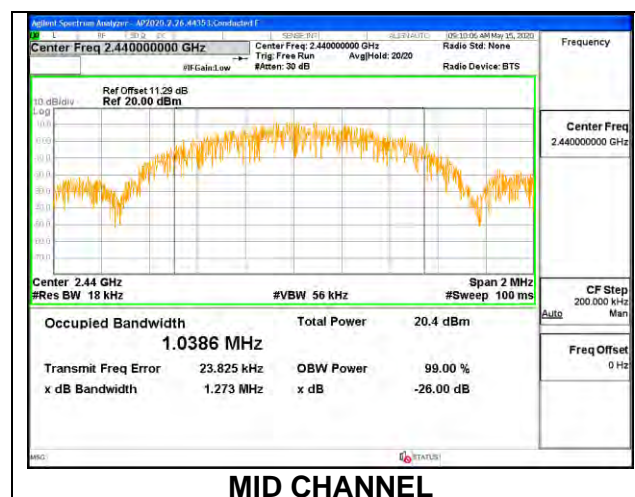
### ANT4

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	2402	1.0379
Middle	2440	1.0562
High	2480	1.0393



### ANT3

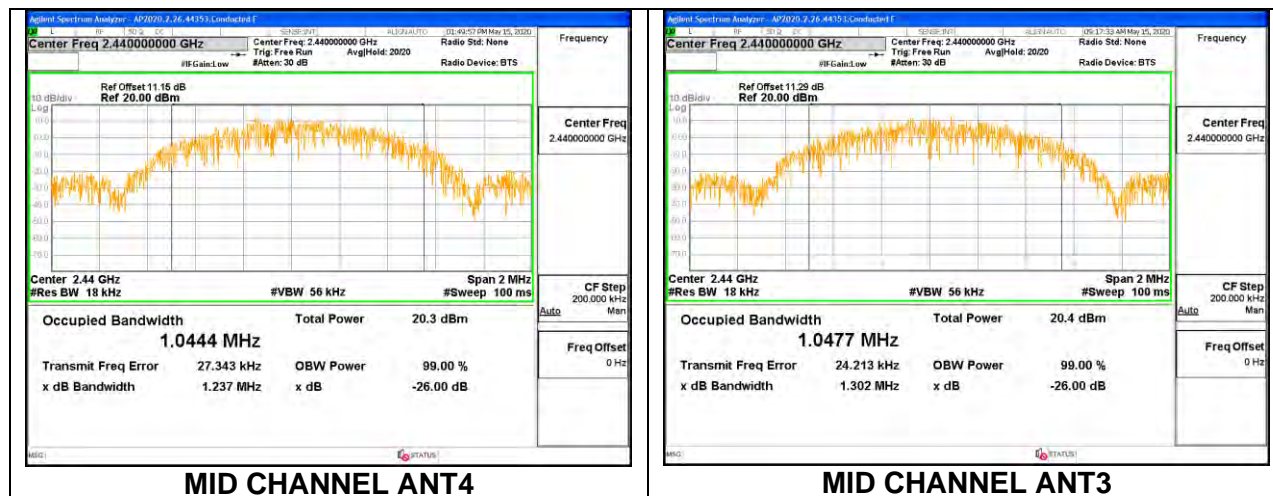
Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	2402	1.0281
Middle	2440	1.0386
High	2480	1.0281



**9.2.2. HIGH POWER BLE TXBF (1Mbps)**

Channel	Frequency (MHz)	99% Bandwidth ANT4 (MHz)	99% Bandwidth ANT3 (MHz)
Low	2402	1.0286	1.0478
Mid	2440	1.0444	1.0477
High	2480	1.0583	1.0320

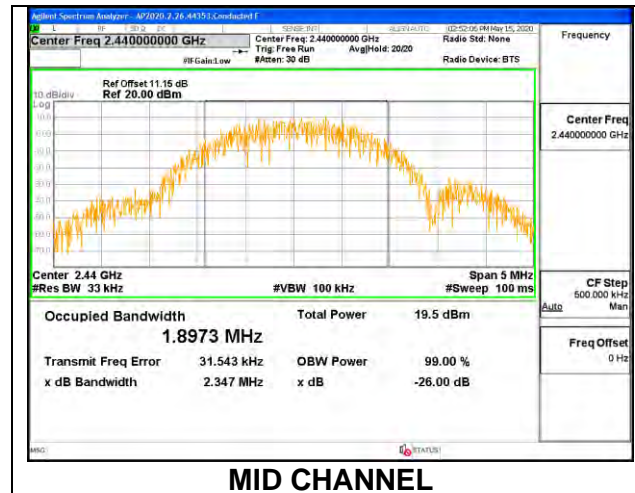
Note: Test procedures and setting are same as BLE normal mode.



### 9.2.3. HIGH POWER BLE (2Mbps)

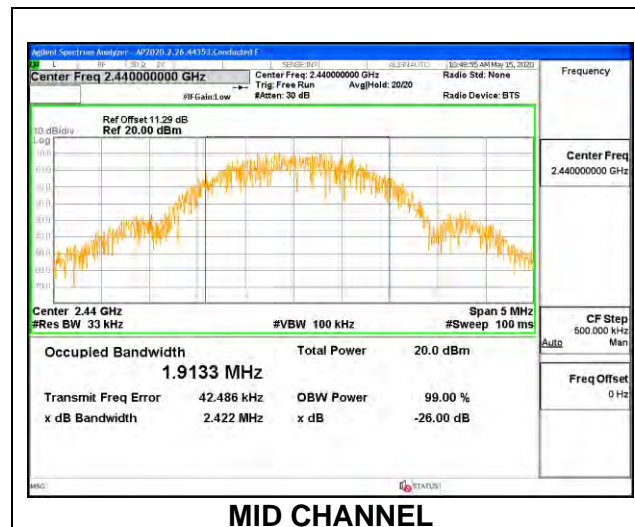
#### ANT4

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	2404	1.9135
Middle	2440	1.8973
High	2478	1.9008



#### ANT3

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	2404	1.8971
Middle	2440	1.9133
High	2478	1.9008

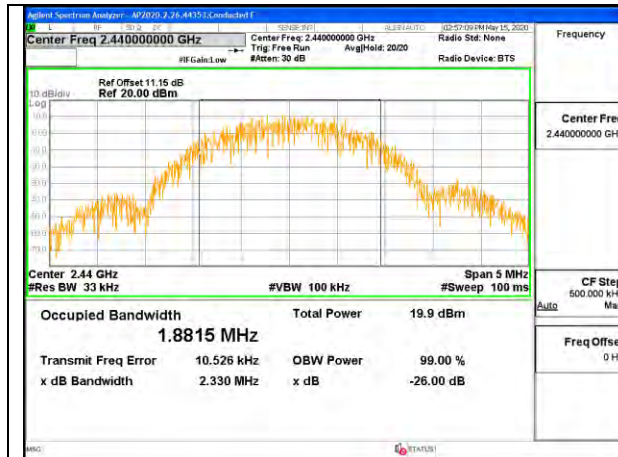




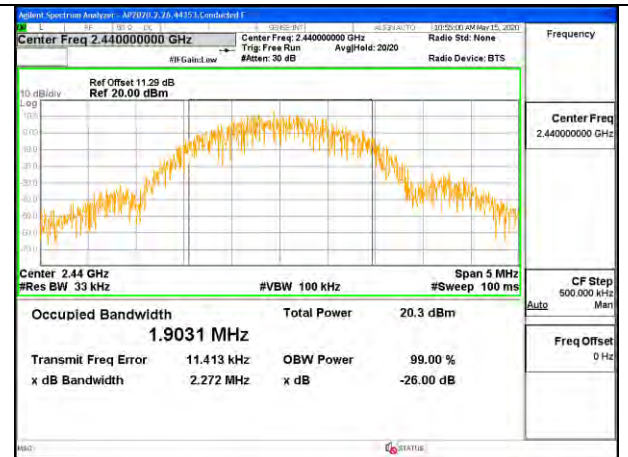
### 9.2.4. HIGH POWER BLE TXBF (2Mbps)

Channel	Frequency (MHz)	99% Bandwidth ANT4 (MHz)	99% Bandwidth ANT3 (MHz)
Low	2402	1.8968	1.9092
Mid	2440	1.8815	1.9031
High	2480	1.9057	1.9104

Note: Test procedures and setting are same as BLE normal mode.



**MID CHANNEL ANT4**



**MID CHANNEL ANT3**

### **9.3. 6 dB BANDWIDTH**

#### **LIMITS**

FCC §15.407 (e)

RSS-247 5.2 (a)

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

#### **RESULTS**

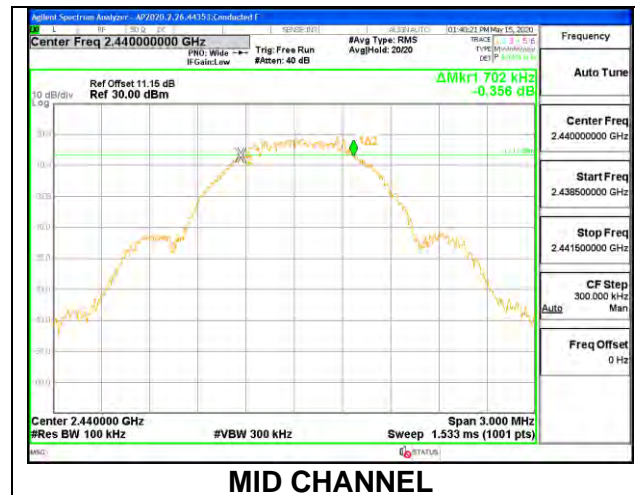
The 6dB bandwidth was measured for the narrowest bandwidth mode, High Power 1Mbps, to demonstrate compliance with the minimum required bandwidth of 500 kHz. Other modes were not tested as their bandwidth is greater than the High Power 1Mbps mode, as demonstrated by the 99% bandwidth measurements performed on all modes.

Only Mid channel plot is reported to show setting parameter complies with testing method/procedure.

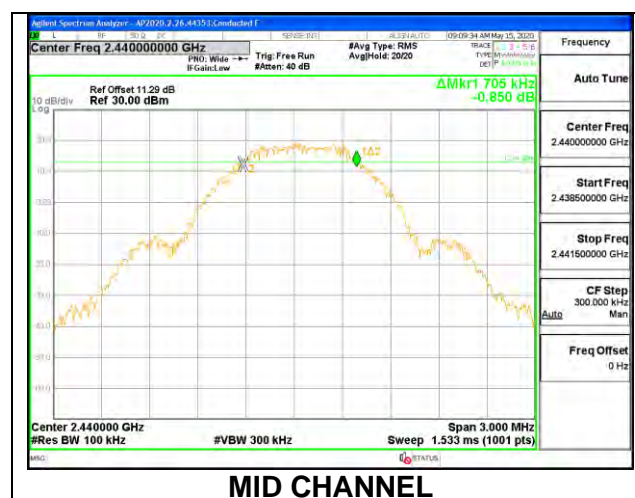
## 9.3.1. HIGH POWER BLE (1Mbps)

**ANT4**

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)
Low	2402	0.735	0.5
Middle	2440	0.702	0.5
High	2480	0.702	0.5

**ANT3**

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)
Low	2402	0.717	0.5
Middle	2440	0.705	0.5
High	2480	0.741	0.5



## 9.4. OUTPUT POWER

### LIMITS

FCC §15.247 (b) (3)

RSS-247 5.4 (d)

The maximum antenna gain is less than or equal to 6 dBi, therefore the limit is 30 dBm.

### TEST PROCEDURE

The power output was measured on the EUT antenna port using SMA cable with 10dB attenuator connected to a power meter via wideband peak power sensor. Peak output power was read directly from power meter

### DIRECTIONAL ANTENNA GAIN

For 1 TX:

There is only one transmitter output therefore the directional gain is equal to the antenna gain.

For 2TX:

Tx chains are correlated for power and PSD due to the device supporting Beamforming mode. The directional gains are as follows:

Band (GHz)	ANT4 Antenna Gain (dBi)	ANT3 Antenna Gain (dBi)	Uncorrelated Chains Directional Gain (dBi)	Correlated Chains Directional Gain (dBi)
2.4	-2.30	-0.60	-1.37	1.60

### RESULTS

#### 9.4.1. HIGH POWER BLE (1Mbps)

##### ANT4

<b>Tested By:</b>	44366
<b>Date:</b>	9/3/2020

Channel	Frequency (MHz)	Peak Power Reading (dBm)	Limit (dBm)	Margin (dB)
Low	2402	20.24	30	-9.76
Middle	2440	20.31	30	-9.69
High	2480	20.26	30	-9.74

##### ANT3

<b>Tested By:</b>	44366
<b>Date:</b>	9/3/2020

Channel	Frequency (MHz)	Peak Power Reading (dBm)	Limit (dBm)	Margin (dB)
Low	2402	20.18	30	-9.82
Middle	2440	20.28	30	-9.72
High	2480	20.24	30	-9.76

#### 9.4.2. HIGH POWER BLE TXBF (1Mbps)

##### ANT4 + ANT3

<b>Tested By:</b>	44366
<b>Date:</b>	9/3/2020

Channel	Frequency (MHz)	Output Power ANT4 (dBm)	Output Power ANT3 (dBm)	Total Power (dBm)	Limit (dBm)	Margin (dB)
Low	2402	17.26	17.30	20.29	30	-9.71
Middle	2440	17.31	17.34	20.34	30	-9.66
High	2480	17.24	17.27	20.27	30	-9.73

### 9.4.3. HIGH POWER BLE (2Mbps)

#### ANT4

<b>Tested By:</b>	44366
<b>Date:</b>	9/3/2020

Channel	Frequency (MHz)	Peak Power Reading (dBm)	Limit (dBm)	Margin (dB)
Low	2402	20.17	30	-9.83
Middle	2440	20.31	30	-9.69
High	2480	20.26	30	-9.74

#### ANT3

<b>Tested By:</b>	44366
<b>Date:</b>	9/3/2020

Channel	Frequency (MHz)	Peak Power Reading (dBm)	Limit (dBm)	Margin (dB)
Low	2402	20.20	30	-9.80
Middle	2440	20.34	30	-9.66
High	2480	20.25	30	-9.75

### 9.4.4. HIGH POWER BLE TXBF (2Mbps)

#### ANT4 + ANT3

<b>Tested By:</b>	44366
<b>Date:</b>	9/3/2020

Channel	Frequency (MHz)	Output Power ANT4 (dBm)	Output Power ANT3 (dBm)	Total Power (dBm)	Limit (dBm)	Margin (dB)
Low	2402	17.24	17.20	20.23	30	-9.77
Middle	2440	17.29	17.29	20.30	30	-9.70
High	2480	17.28	17.24	20.27	30	-9.73

#### 9.4.5. LOW POWER BLE (1Mbps)

##### ANT4

<b>Tested By:</b>	44366
<b>Date:</b>	9/3/2020

Channel	Frequency (MHz)	Peak Power Reading (dBm)	Limit (dBm)	Margin (dB)
Low	2402	12.75	30	-17.25
Middle	2440	12.85	30	-17.15
High	2480	12.74	30	-17.26

##### ANT3

<b>Tested By:</b>	44366
<b>Date:</b>	9/3/2020

Channel	Frequency (MHz)	Peak Power Reading (dBm)	Limit (dBm)	Margin (dB)
Low	2402	12.73	30	-17.27
Middle	2440	12.86	30	-17.14
High	2480	12.72	30	-17.28

#### 9.4.6. LOW POWER BLE TXBF (1Mbps)

##### ANT4 + ANT3

<b>Tested By:</b>	44366
<b>Date:</b>	9/3/2020

Channel	Frequency (MHz)	Output Power ANT4 (dBm)	Output Power ANT3 (dBm)	Total Power (dBm)	Limit (dBm)	Margin (dB)
Low	2402	12.79	12.73	15.77	30	-14.23
Middle	2440	12.85	12.76	15.82	30	-14.18
High	2480	12.73	12.74	15.75	30	-14.25

#### 9.4.7. LOW POWER BLE (2Mbps)

##### ANT4

<b>Tested By:</b>	44366
<b>Date:</b>	9/3/2020

Channel	Frequency (MHz)	Peak Power Reading (dBm)	Limit (dBm)	Margin (dB)
Low	2402	12.81	30	-17.19
Middle	2440	12.85	30	-17.15
High	2480	12.83	30	-17.17

##### ANT3

<b>Tested By:</b>	44366
<b>Date:</b>	9/3/2020

Channel	Frequency (MHz)	Peak Power Reading (dBm)	Limit (dBm)	Margin (dB)
Low	2402	12.77	30	-17.23
Middle	2440	12.81	30	-17.19
High	2480	12.72	30	-17.28

#### 9.4.8. LOW POWER BLE TXBF (2Mbps)

##### ANT4 + ANT3

<b>Tested By:</b>	44366
<b>Date:</b>	9/3/2020

Channel	Frequency (MHz)	Output Power ANT4 (dBm)	Output Power ANT3 (dBm)	Total Power (dBm)	Limit (dBm)	Margin (dB)
Low	2402	12.86	12.73	15.81	30	-14.19
Middle	2440	12.91	12.77	15.85	30	-14.15
High	2480	12.88	12.75	15.83	30	-14.17



## **9.5. AVERAGE POWER**

### **LIMITS**

None; for reporting purposes only.

### **TEST PROCEDURE**

The power output was measured on the EUT antenna port using SMA cable with 10dB attenuator connected to a power meter via wideband average power sensor. Gated average output power was read directly from power meter.

### **RESULTS**

### 9.5.1. HIGH POWER BLE (1Mbps)

#### ANT4

<b>Tested By:</b>	44366
<b>Date:</b>	9/3/2020

Channel	Frequency (MHz)	AV power (dBm)
Low	2402	19.88
Middle	2440	19.93
High	2480	19.87

#### ANT3

<b>Tested By:</b>	44366
<b>Date:</b>	9/3/2020

Channel	Frequency (MHz)	AV power (dBm)
Low	2402	19.84
Middle	2440	19.92
High	2480	19.86

### 9.5.2. HIGH POWER BLE TXBF (1Mbps)

#### ANT4 + ANT3

<b>Tested By:</b>	44366
<b>Date:</b>	9/3/2020

Channel	Frequency (MHz)	Average Power ANT4 (dBm)	Average Power ANT3 (dBm)	Total Power (dBm)
Low	2402	16.87	16.86	19.88
Middle	2440	16.91	16.93	19.93
High	2480	16.85	16.88	19.88

### 9.5.3. HIGH POWER BLE (2Mbps)

#### ANT4

<b>Tested By:</b>	44366
<b>Date:</b>	9/3/2020

Channel	Frequency (MHz)	AV power (dBm)
Low	2402	19.82
Middle	2440	19.92
High	2480	19.80

#### ANT3

<b>Tested By:</b>	44366
<b>Date:</b>	9/3/2020

Channel	Frequency (MHz)	AV power (dBm)
Low	2402	19.84
Middle	2440	19.90
High	2480	19.88

### 9.5.4. HIGH POWER BLE TXBF (2Mbps)

#### ANT4 + ANT3

<b>Tested By:</b>	44366
<b>Date:</b>	9/3/2020

Channel	Frequency (MHz)	Average Power ANT4 (dBm)	Average Power ANT3 (dBm)	Total Power (dBm)
Low	2402	16.85	16.84	19.86
Middle	2440	16.93	16.90	19.93
High	2480	16.89	16.89	19.90

### 9.5.5. LOW POWER BLE (1Mbps)

#### ANT4

<b>Tested By:</b>	44366
<b>Date:</b>	9/3/2020

Channel	Frequency (MHz)	AV power (dBm)
Low	2402	12.40
Middle	2440	12.42
High	2480	12.37

#### ANT3

<b>Tested By:</b>	44366
<b>Date:</b>	9/3/2020

Channel	Frequency (MHz)	AV power (dBm)
Low	2402	12.40
Middle	2440	12.43
High	2480	12.36

### 9.5.6. LOW POWER BLE TXBF (1Mbps)

#### ANT4 + ANT3

<b>Tested By:</b>	44366
<b>Date:</b>	9/3/2020

Channel	Frequency (MHz)	Average Power ANT4 (dBm)	Average Power ANT3 (dBm)	Total Power (dBm)
Low	2402	12.44	12.37	15.42
Middle	2440	12.46	12.39	15.44
High	2480	12.38	12.33	15.37

### 9.5.7. LOW POWER BLE (2Mbps)

#### ANT4

<b>Tested By:</b>	44366
<b>Date:</b>	9/3/2020

Channel	Frequency (MHz)	AV power (dBm)
Low	2402	12.44
Middle	2440	12.46
High	2480	12.40

#### ANT3

<b>Tested By:</b>	44366
<b>Date:</b>	9/3/2020

Channel	Frequency (MHz)	AV power (dBm)
Low	2402	12.42
Middle	2440	12.43
High	2480	12.39

### 9.5.8. LOW POWER BLE TXBF (2Mbps)

#### ANT4 + ANT3

<b>Tested By:</b>	44366
<b>Date:</b>	9/3/2020

Channel	Frequency (MHz)	Average Power ANT4 (dBm)	Average Power ANT3 (dBm)	Total Power (dBm)
Low	2402	12.41	12.42	15.43
Middle	2440	12.43	12.43	15.44
High	2480	12.36	12.38	15.38

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## **9.6. POWER SPECTRAL DENSITY**

### **LIMITS**

FCC §15.247 (e)

RSS-247 (5.2) (b)

The power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

### **RESULTS**

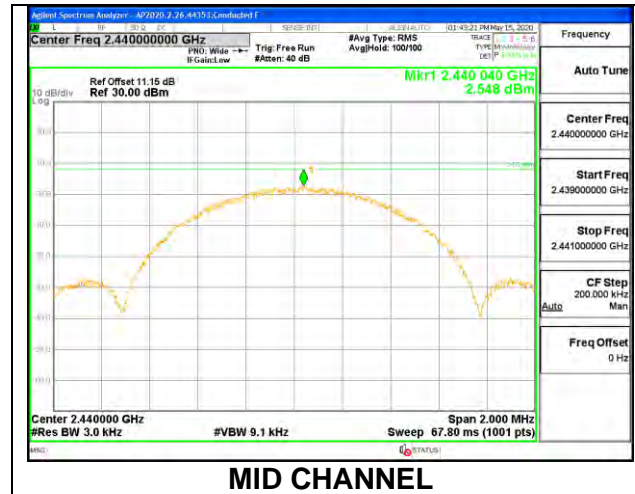
Power spectral density was measured on the low, mid and high channels for all supported modes. Additional measurements on adjacent channels to the low and/or high channels were limited to cases where the edge channels have a significantly lower rated power than the adjacent channels.

Only Mid channel plot is reported to show setting parameter complies with testing method/procedure.

### 9.6.1. HIGH POWER BLE (1Mbps)

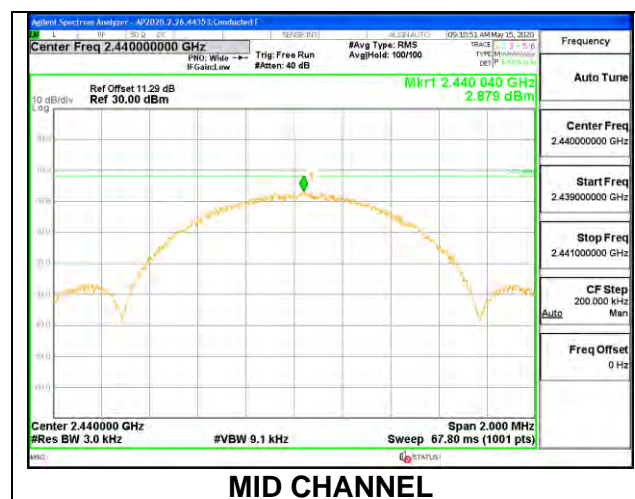
#### ANT4

Channel	Frequency (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)	Margin (dB)
Low	2402	3.021	8	-4.98
Middle	2440	2.548	8	-5.45
High	2480	2.509	8	-5.49



#### ANT3

Channel	Frequency (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)	Margin (dB)
Low	2402	2.325	8	-5.68
Middle	2440	2.879	8	-5.12
High	2480	2.524	8	-5.48



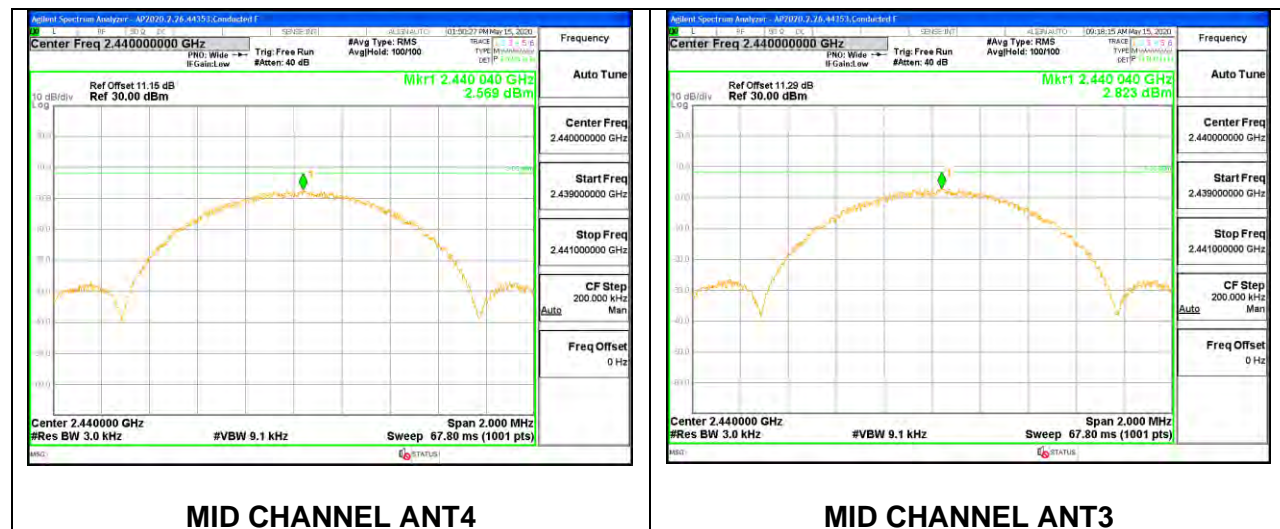
## 9.6.2. HIGH POWER BLE TXBF (1Mbps)

Duty Cycle CF (dB)	0.00	Included in Calculations of Corr'd PSD
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### PSD Results

Channel	Frequency (MHz)	ANT4 Meas (dBm/ 3kHz)	ANT3 Meas (dBm/ 3kHz)	Total Corr'd PSD (dBm/ 3kHz)	Limit (dBm/ 3kHz)	Margin (dB)
Low	2402	3.181	2.277	5.76	8.0	-2.2
Mid	2440	2.569	2.823	5.71	8.0	-2.3
Hjigh	2480	2.496	2.523	5.52	8.0	-2.5

Note: Test procedures and setting are same as BLE normal mode.

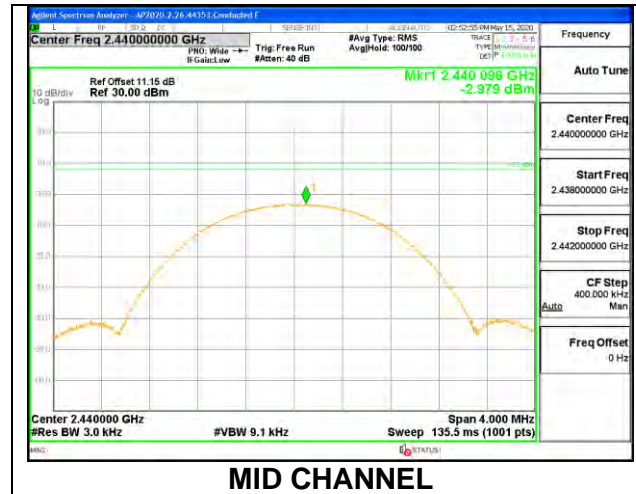




### 9.6.3. HIGH POWER BLE (2Mbps)

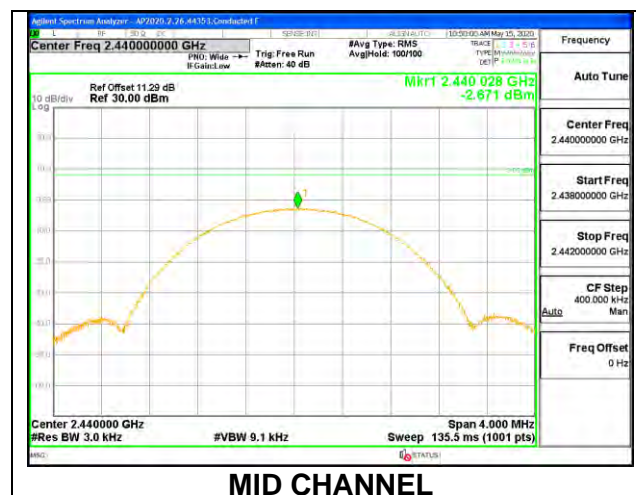
#### ANT4

Channel	Frequency (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)	Margin (dB)
Low	2404	-2.081	8	-10.08
Middle	2440	-2.979	8	-10.98
High	2478	-2.657	8	-10.66



#### ANT3

Channel	Frequency (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)	Margin (dB)
Low	2404	-2.827	8	-10.83
Middle	2440	-2.671	8	-10.67
High	2478	-2.627	8	-10.63



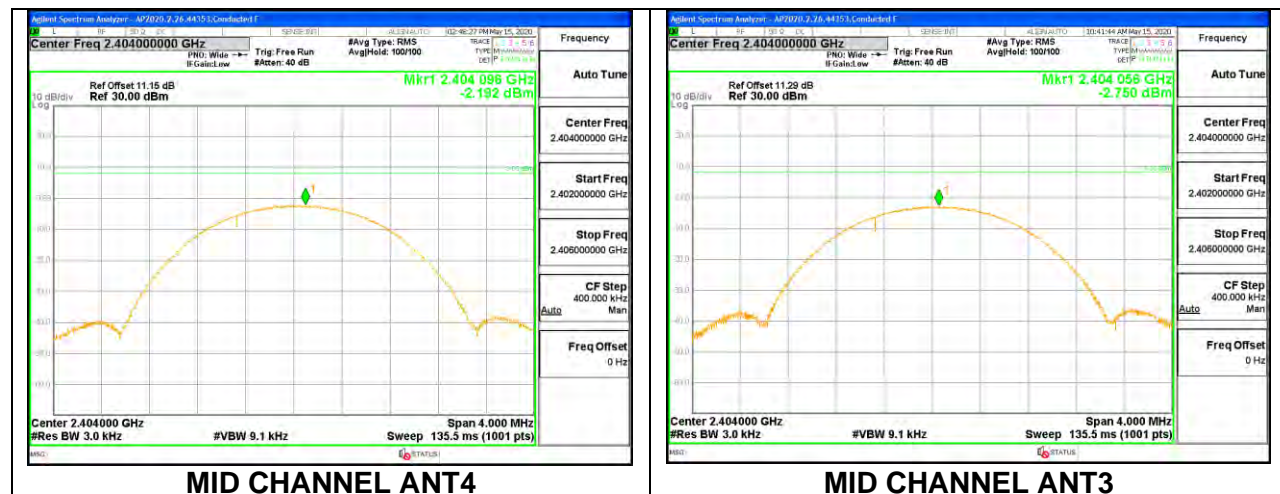
#### 9.6.4. HIGH POWER BLE TXBF (2Mbps)

Duty Cycle CF (dB)	0.00	Included in Calculations of Corr'd PSD
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#### PSD Results

Channel	Frequency (MHz)	ANT4 Meas (dBm/ 3kHz)	ANT3 Meas (dBm/ 3kHz)	Total Corr'd PSD (dBm/ 3kHz)	Limit (dBm/ 3kHz)	Margin (dB)
Low	2404	-2.192	-2.750	0.55	8.0	-7.5
Mid	2440	-2.955	-2.627	0.22	8.0	-7.8
Hjigh	2478	-2.638	-2.647	0.37	8.0	-7.6

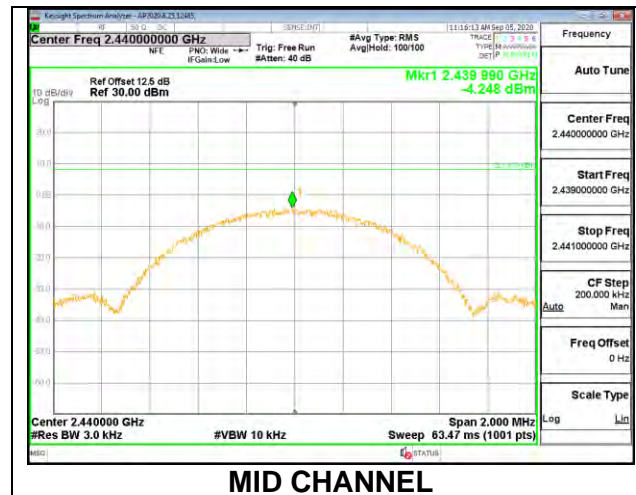
Note: Test procedures and setting are same as BLE normal mode.



### 9.6.5. LOW POWER BLE (1Mbps)

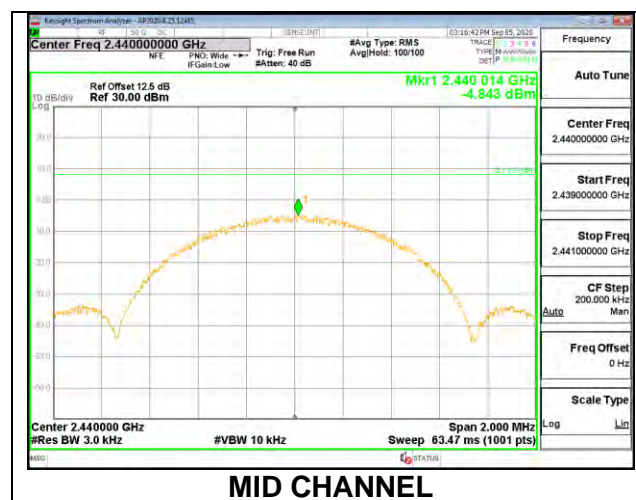
#### ANT4

Channel	Frequency (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)	Margin (dB)
Low	2402	-4.504	8	-12.50
Middle	2440	-4.248	8	-12.25
High	2480	-5.480	8	-13.48



#### ANT3

Channel	Frequency (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)	Margin (dB)
Low	2402	-5.607	8	-13.61
Middle	2440	-4.834	8	-12.83
High	2480	-6.108	8	-14.11



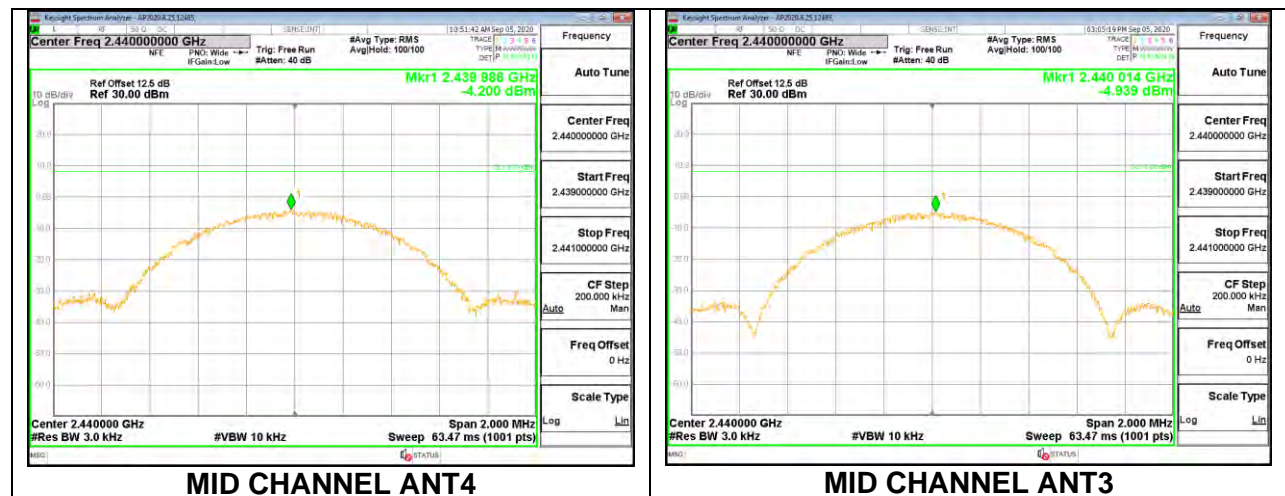
### 9.6.6. LOW POWER BLE TXBF (1Mbps)

Duty Cycle CF (dB)	0.00	Included in Calculations of Corr'd PSD
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#### PSD Results

Channel	Frequency (MHz)	ANT4 Meas (dBm/ 3kHz)	ANT3 Meas (dBm/ 3kHz)	Total Corr'd PSD (dBm/ 3kHz)	Limit (dBm/ 3kHz)	Margin (dB)
Low	2402	-4.572	-5.705	-2.09	8.0	-10.1
Mid	2440	-4.200	-4.939	-1.54	8.0	-9.5
High	2480	-5.686	-6.299	-2.97	8.0	-11.0

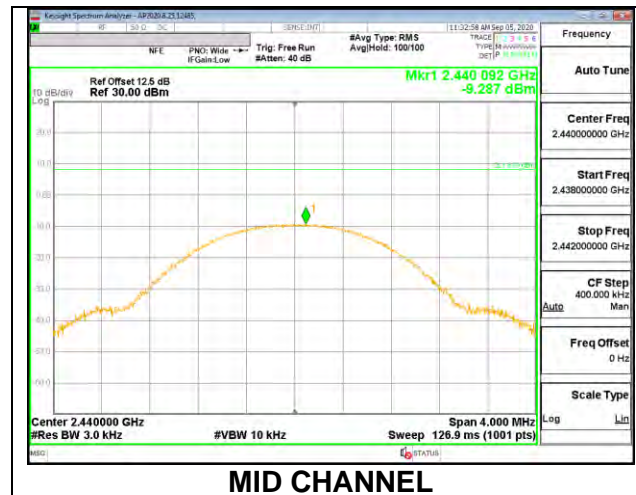
Note: Test procedures and setting are same as BLE normal mode.



### 9.6.7. LOW POWER BLE (2Mbps)

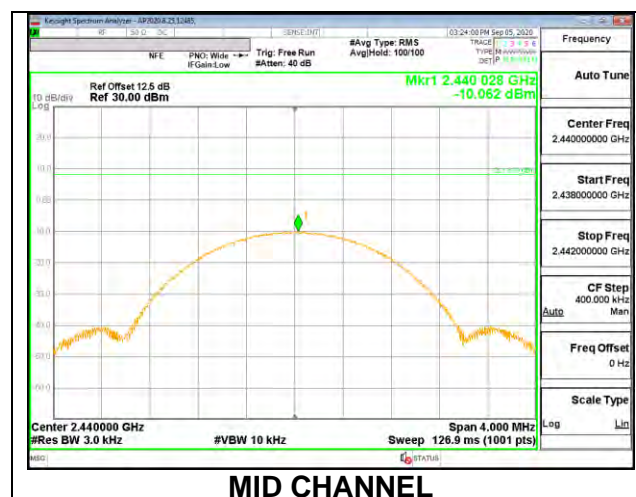
#### ANT4

Channel	Frequency (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)	Margin (dB)
Low	2404	-9.780	8	-17.78
Middle	2440	-9.287	8	-17.29
High	2478	-10.176	8	-18.18



#### ANT3

Channel	Frequency (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)	Margin (dB)
Low	2402	-10.666	8	-18.67
Middle	2440	-10.062	8	-18.06
High	2480	-11.040	8	-19.04





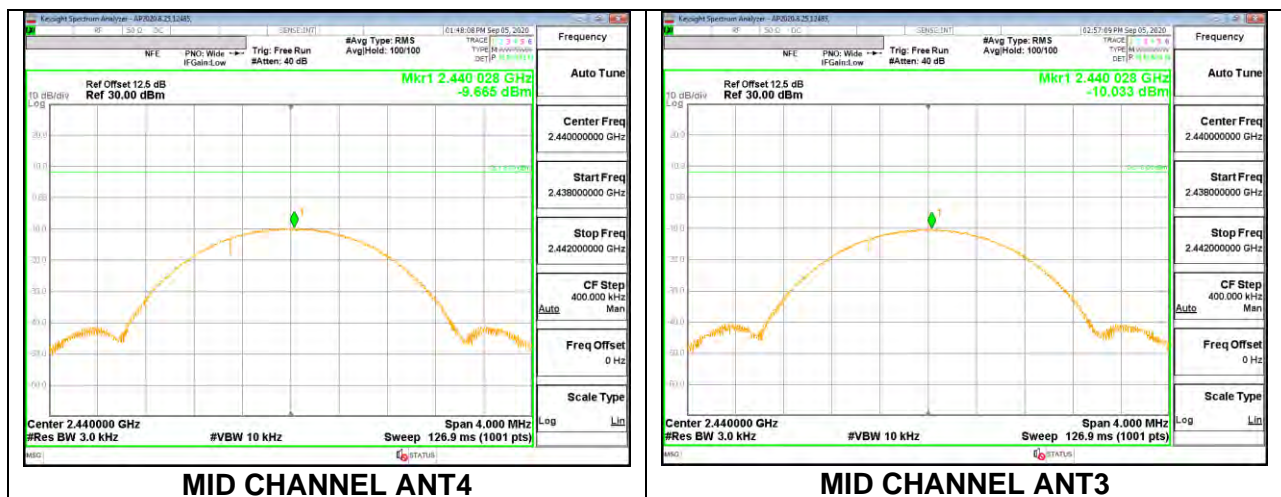
### 9.6.8. LOW POWER BLE TXBF (2Mbps)

Duty Cycle CF (dB)	0.00	Included in Calculations of Corr'd PSD
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#### PSD Results

Channel	Frequency (MHz)	ANT4 Meas (dBm/ 3kHz)	ANT3 Meas (dBm/ 3kHz)	Total Corr'd PSD (dBm/ 3kHz)	Limit (dBm/ 3kHz)	Margin (dB)
Low	2404	-9.996	-10.797	-7.37	8.0	-15.4
Mid	2440	-9.665	-10.033	-6.83	8.0	-14.8
Hjgh	2478	-10.313	-11.177	-7.71	8.0	-15.7

Note: Test procedures and setting are same as BLE normal mode.



## **9.7. CONDUCTED SPURIOUS EMISSIONS**

### **LIMITS**

FCC §15.247 (d)

RSS-247 5.5

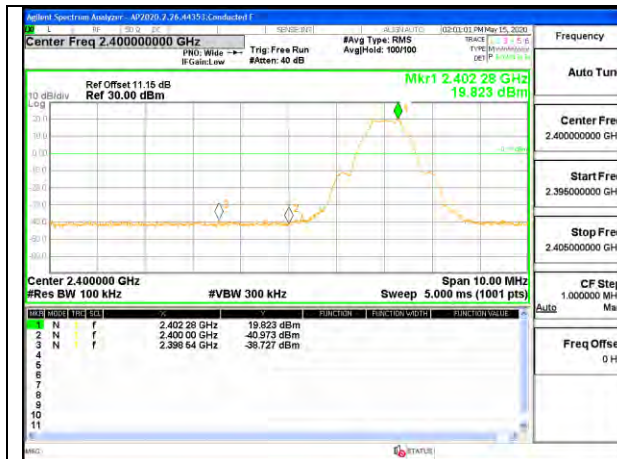
Output power was measured based on the use of a peak measurement; therefore, spurious emissions are required to be 20dBc.

Note: Test procedures and setting are same as BLE normal mode.

### **RESULTS**

## 9.7.1. HIGH POWER BLE (1Mbps)

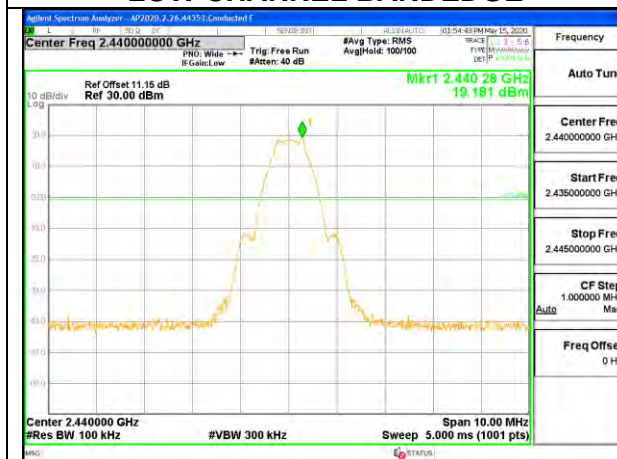
## ANT4



LOW CHANNEL BANDEDGE



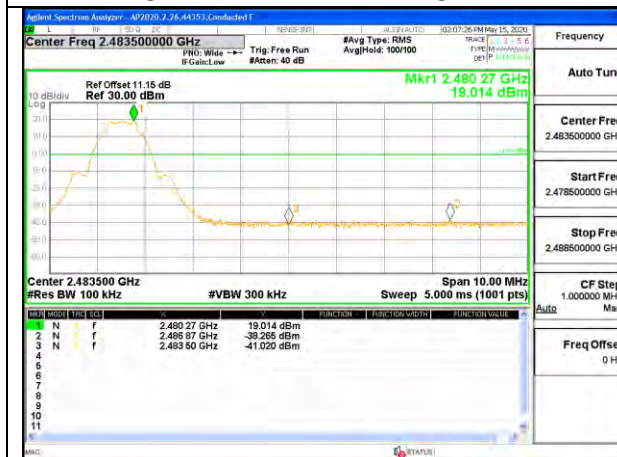
OUT-OF-BAND LOW CHANNEL



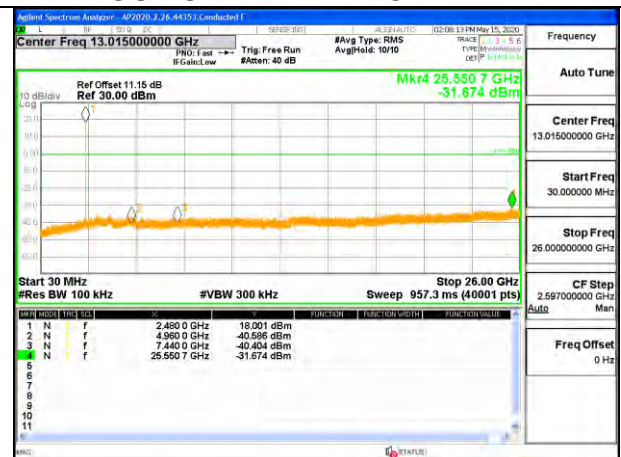
MID CHANNEL REFERENCE LEVEL



OUT-OF-BAND MID CHANNEL



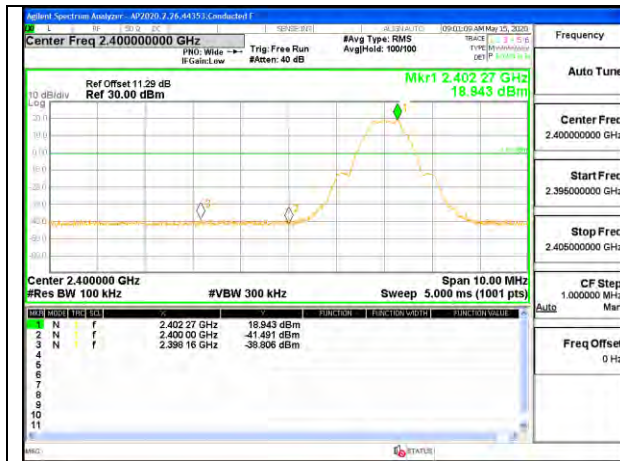
HIGH CHANNEL BANDEDGE



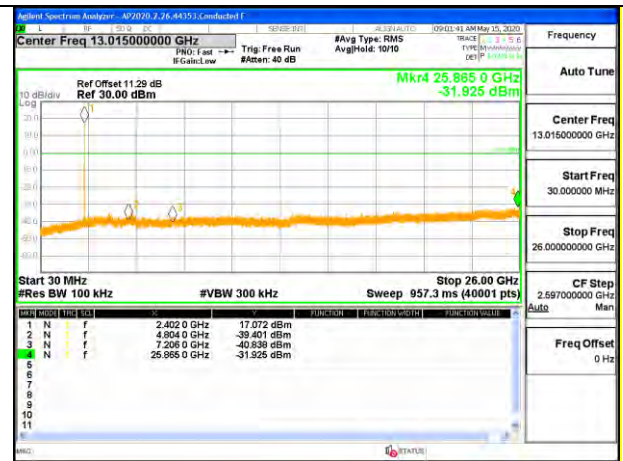
OUT-OF-BAND HIGH CHANNEL



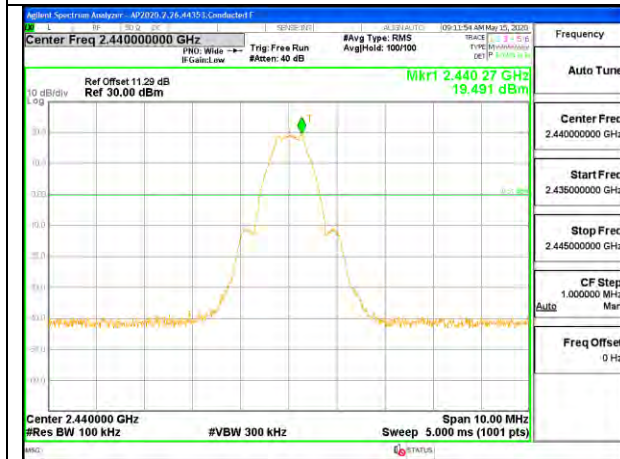
**ANT3**



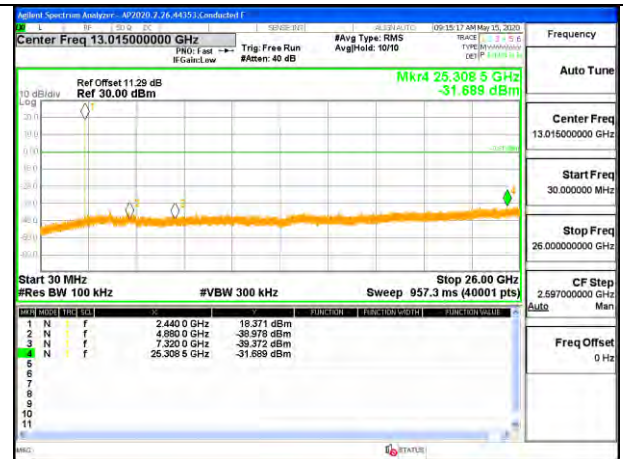
**LOW CHANNEL BANDEDGE**



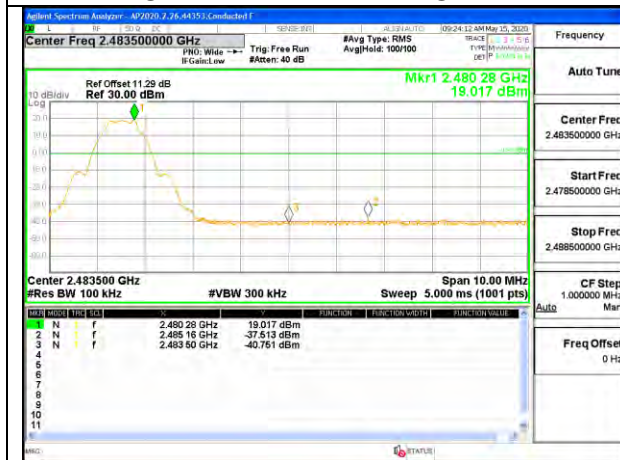
**OUT-OF-BAND LOW CHANNEL**



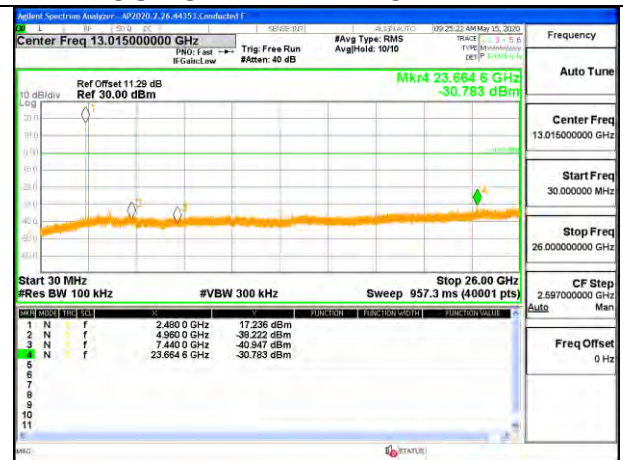
**MID CHANNEL REFERENCE LEVEL**



**OUT-OF-BAND MID CHANNEL**



**HIGH CHANNEL BANDEDGE**

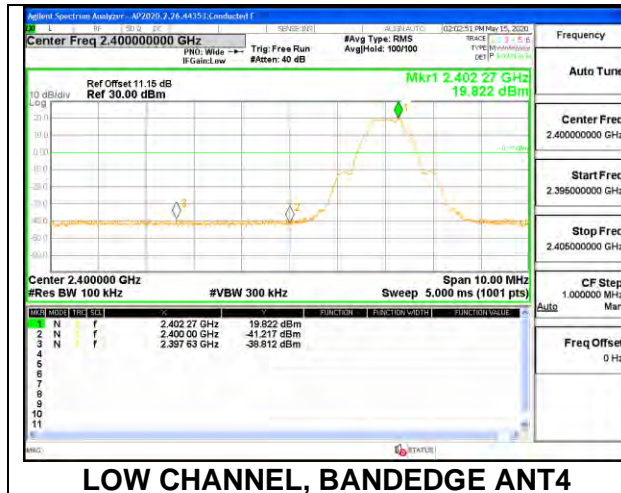


**OUT-OF-BAND HIGH CHANNEL**

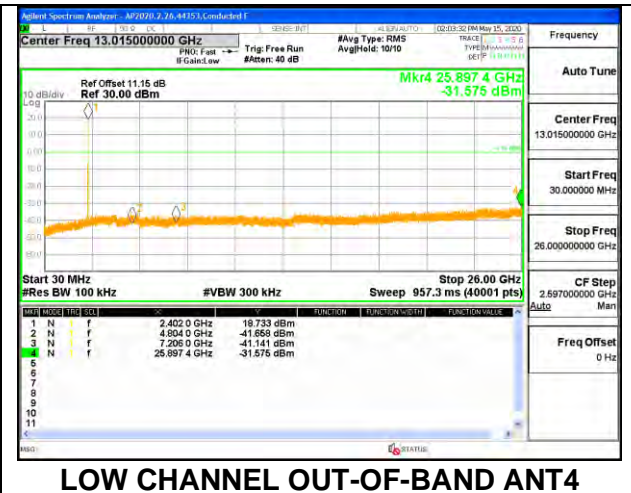
## 9.7.2. HIGH POWER BLE TXBF (1Mbps)

Note: Test procedures and setting are same as BLE normal mode.

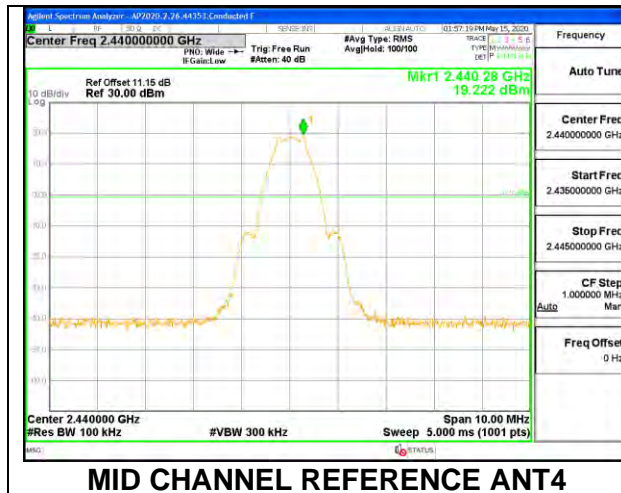
### ANT4



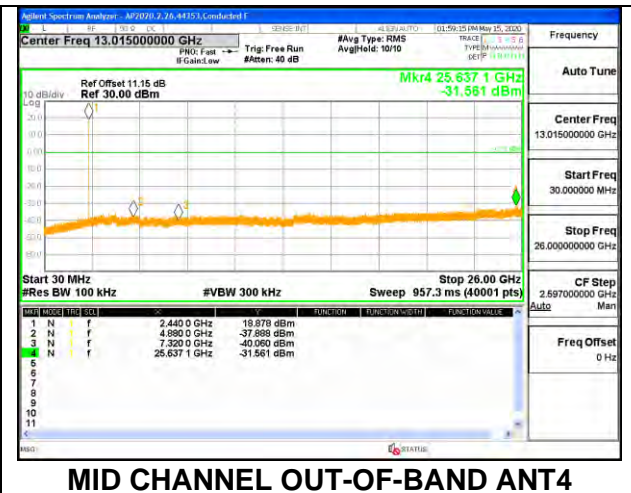
LOW CHANNEL, BANDEDGE ANT4



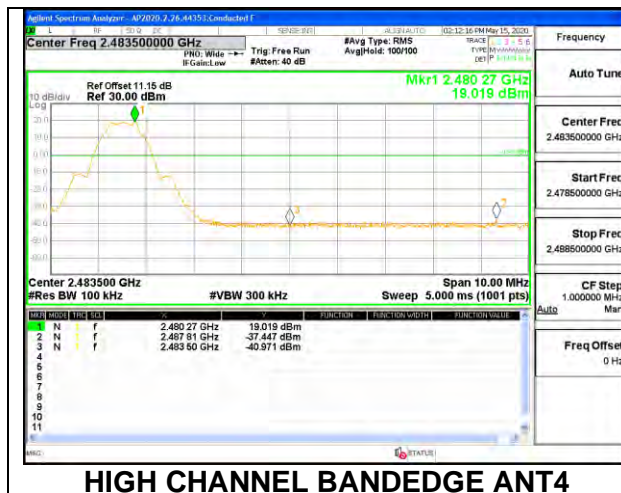
LOW CHANNEL OUT-OF-BAND ANT4



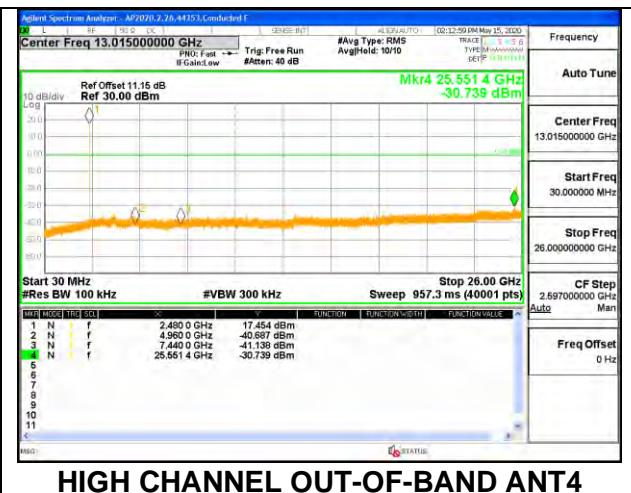
MID CHANNEL REFERENCE ANT4



MID CHANNEL OUT-OF-BAND ANT4

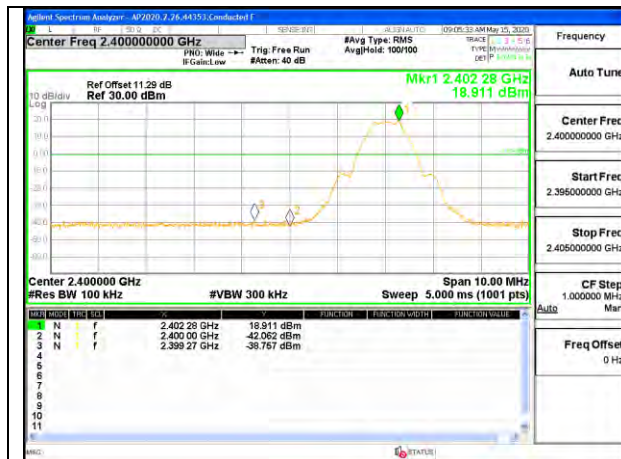
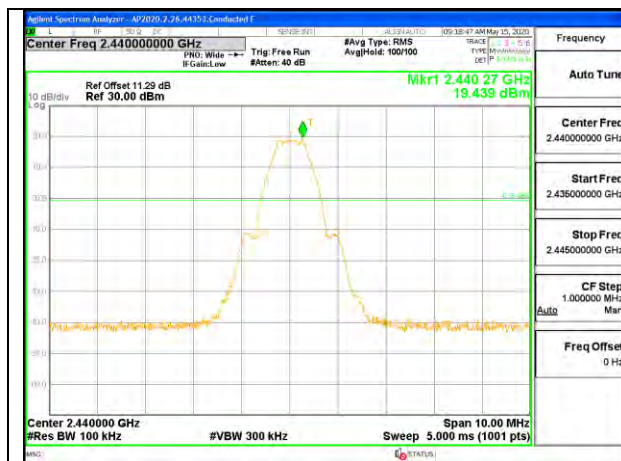


HIGH CHANNEL BANDEDGE ANT4



HIGH CHANNEL OUT-OF-BAND ANT4



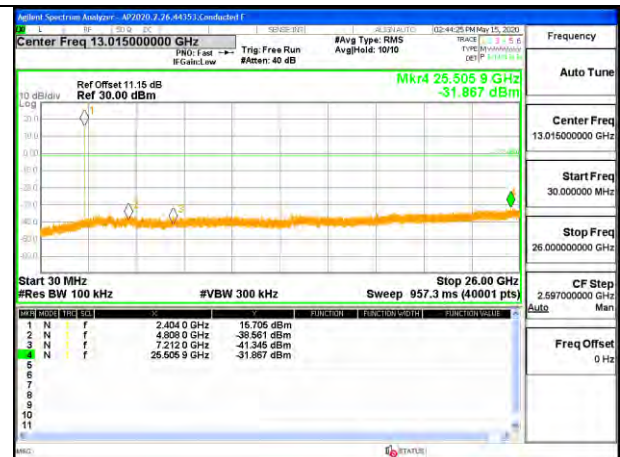
**ANT3****LOW CHANNEL , BANDEDGE ANT3****LOW CHANNEL OUT-OF-BAND ANT3****MID CHANNEL REFERENCE ANT3****MID CHANNEL OUT-OF-BAND ANT3****HIGH CHANNEL BANDEDGE ANT3****HIGH CHANNEL OUT-OF-BAND ANT3**

## 9.7.3. HIGH POWER BLE (2Mbps)

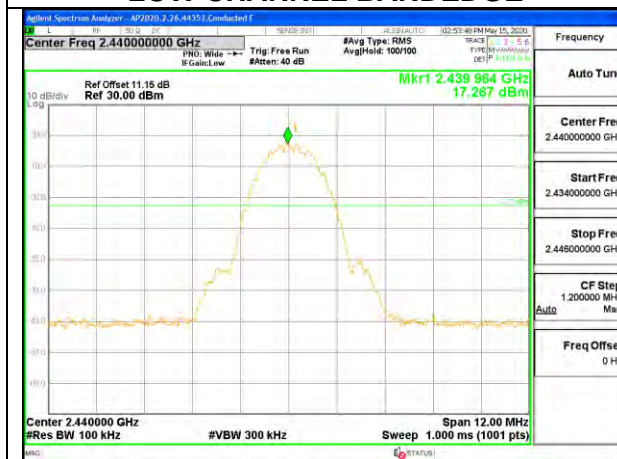
## ANT4



LOW CHANNEL BANDEDGE



OUT-OF-BAND LOW CHANNEL



MID CHANNEL REFERENCE LEVEL



OUT-OF-BAND MID CHANNEL

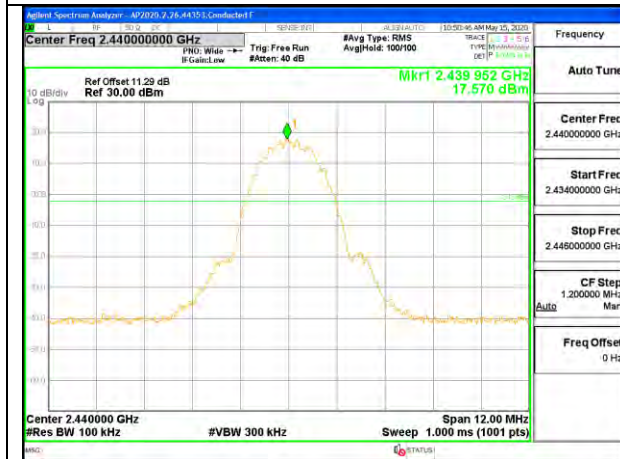
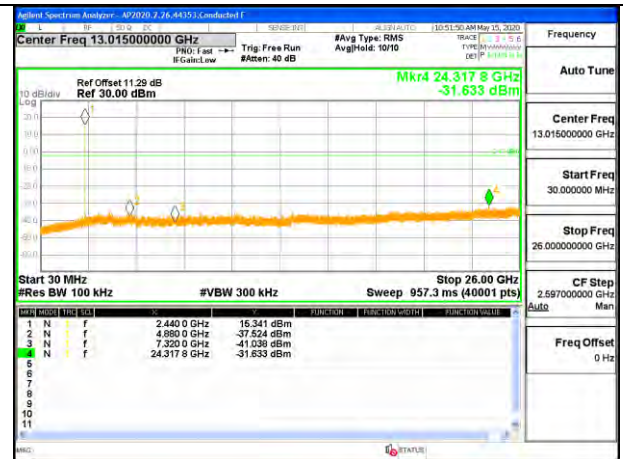
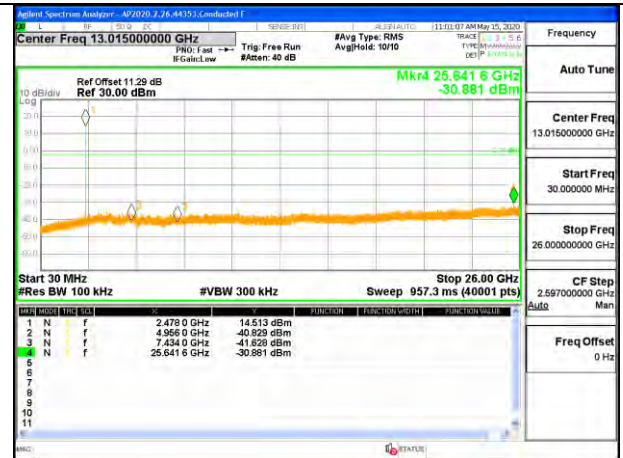


HIGH CHANNEL BANDEDGE



OUT-OF-BAND HIGH CHANNEL

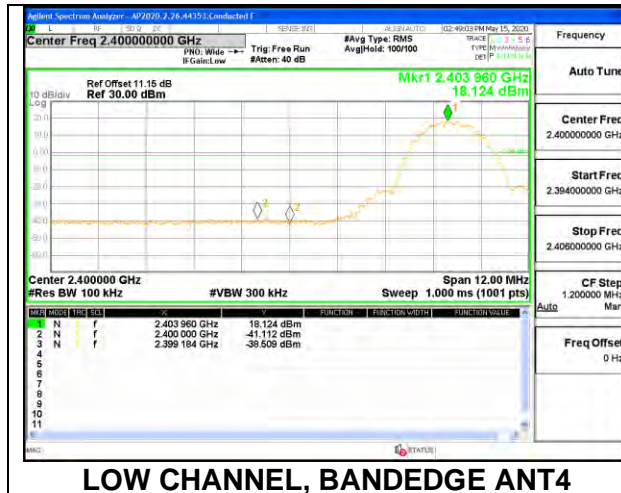


**ANT3****LOW CHANNEL BANDEDGE****OUT-OF-BAND LOW CHANNEL****MID CHANNEL REFERENCE LEVEL****OUT-OF-BAND MID CHANNEL****HIGH CHANNEL BANDEDGE****OUT-OF-BAND HIGH CHANNEL**

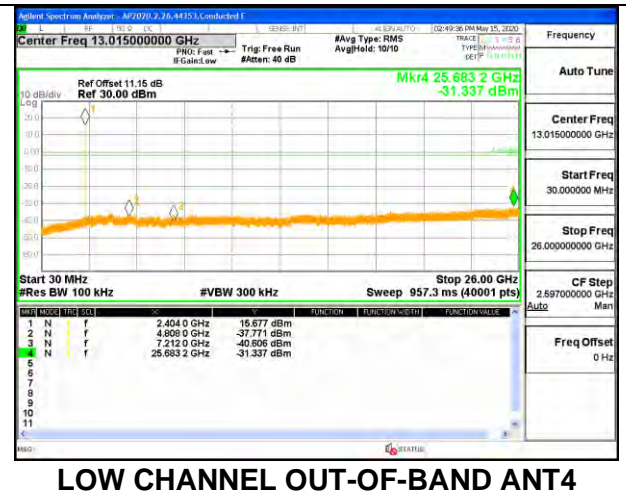
### 9.7.4. HIGH POWER BLE TXBF (2Mbps)

Note: Test procedures and setting are same as BLE normal mode.

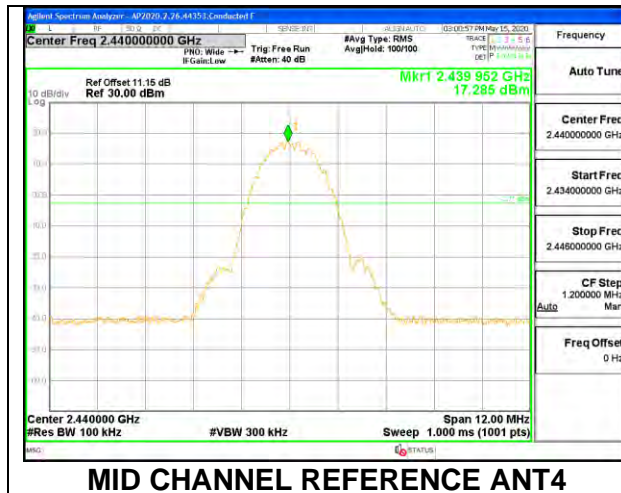
#### ANT4



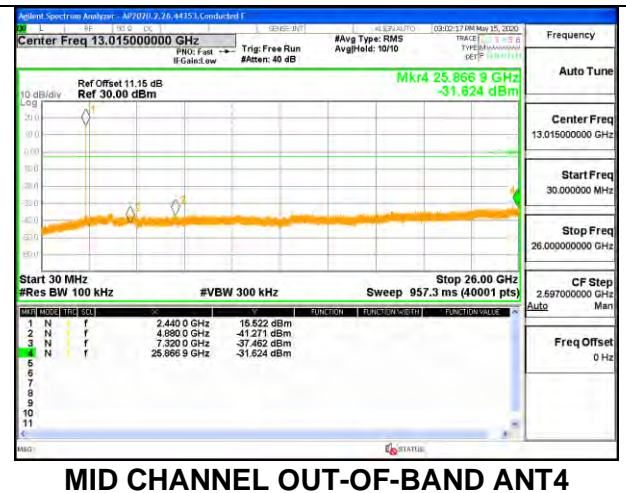
LOW CHANNEL, BANDEDGE ANT4



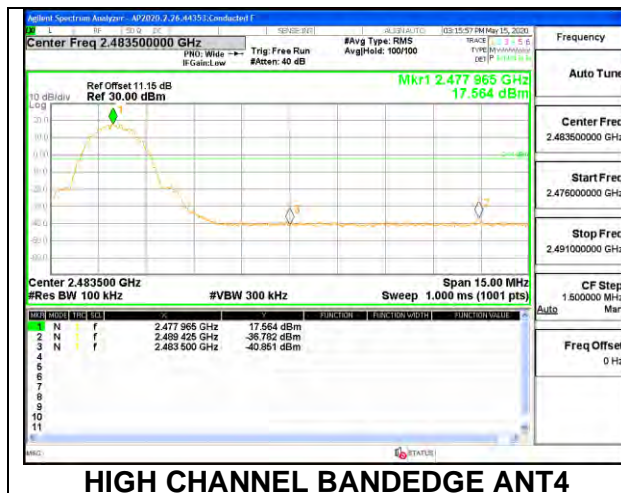
LOW CHANNEL OUT-OF-BAND ANT4



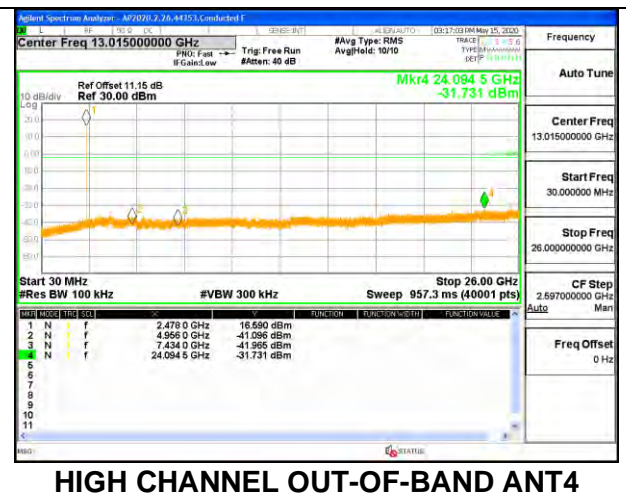
MID CHANNEL REFERENCE ANT4



MID CHANNEL OUT-OF-BAND ANT4



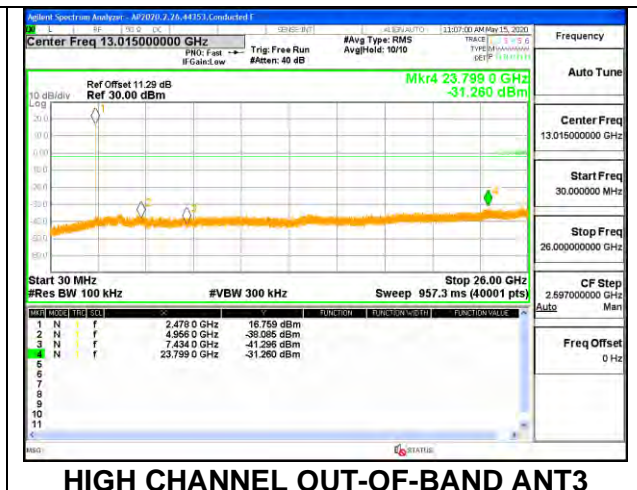
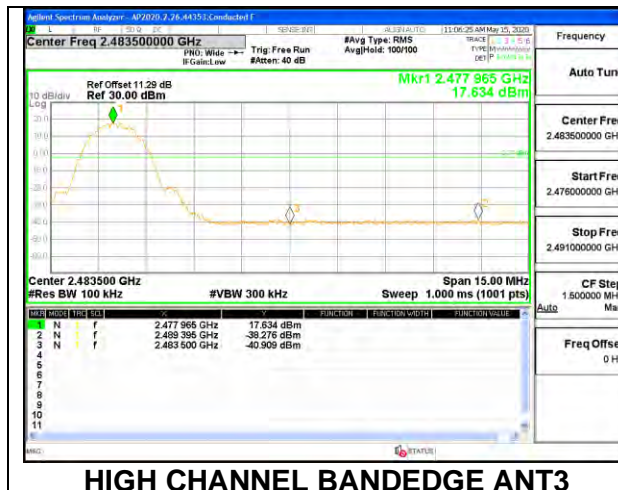
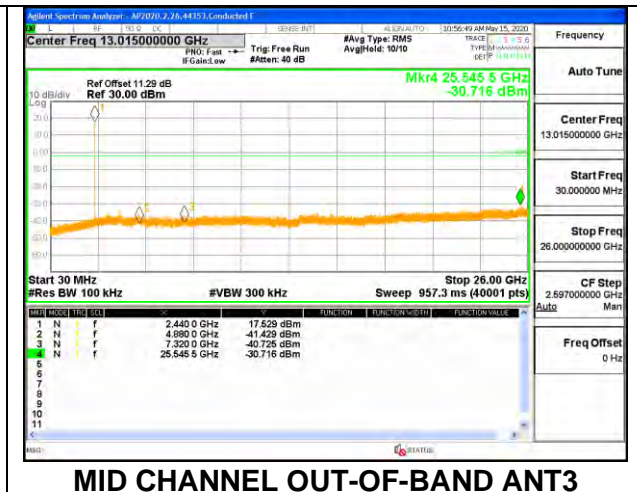
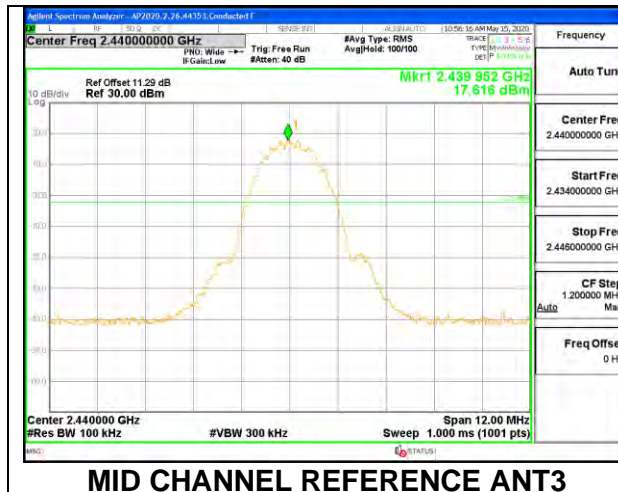
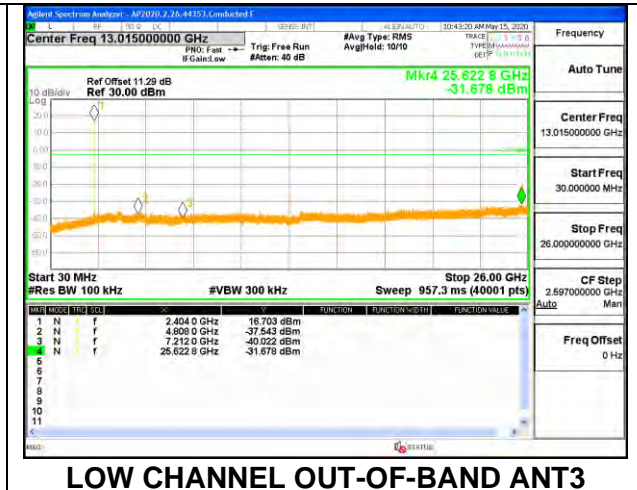
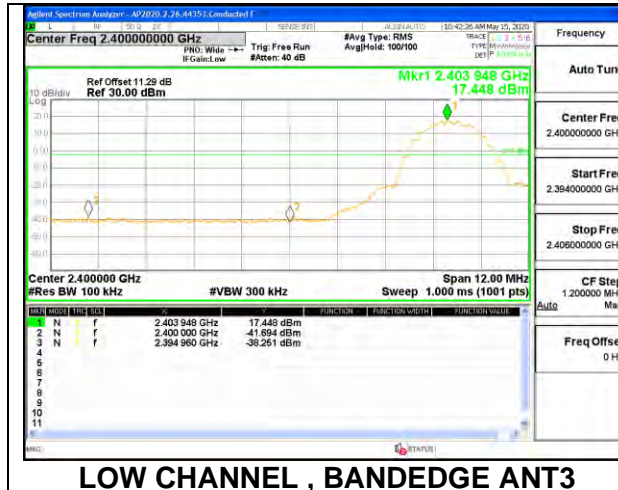
HIGH CHANNEL BANDEDGE ANT4



HIGH CHANNEL OUT-OF-BAND ANT4

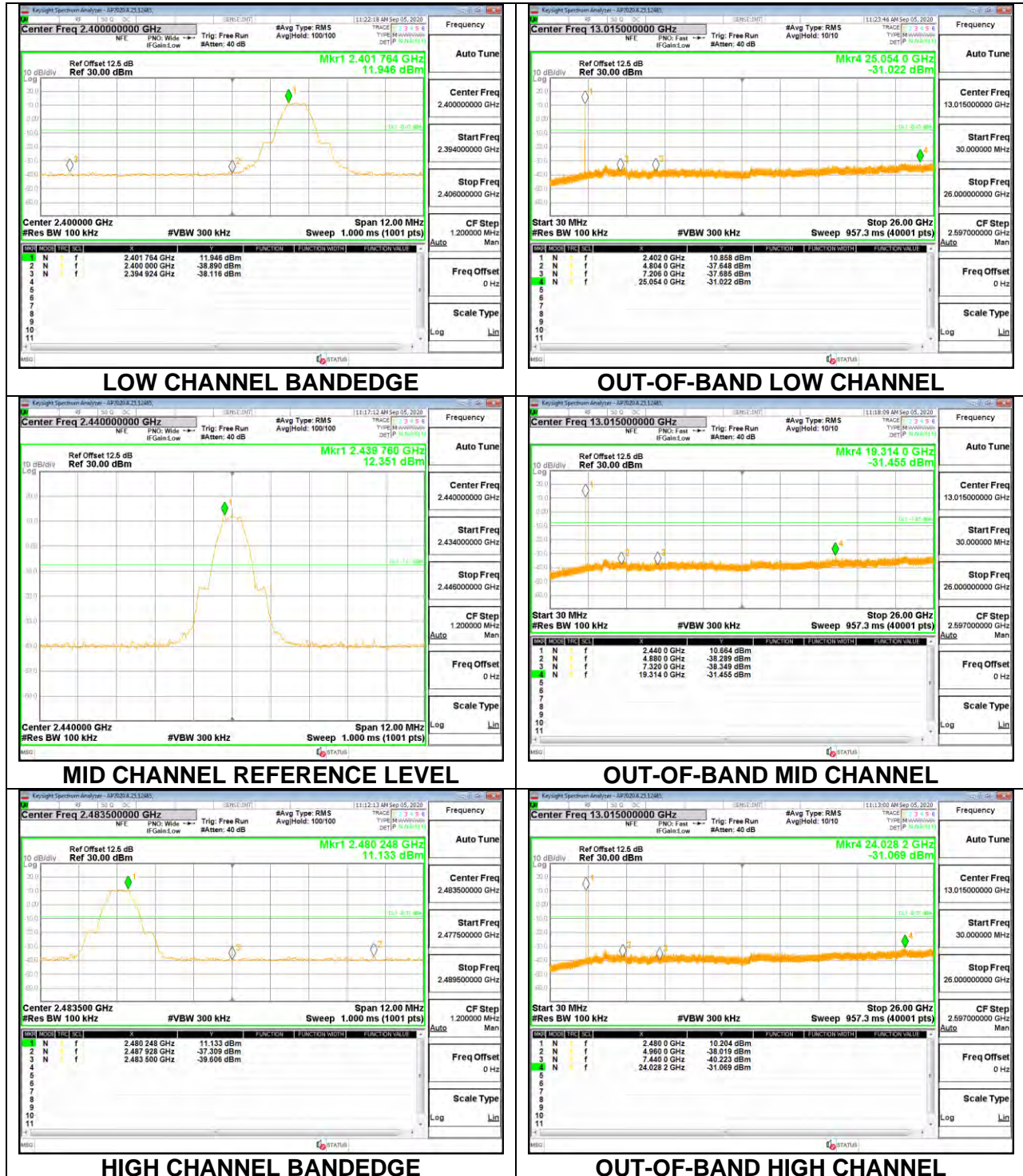


**ANT3**

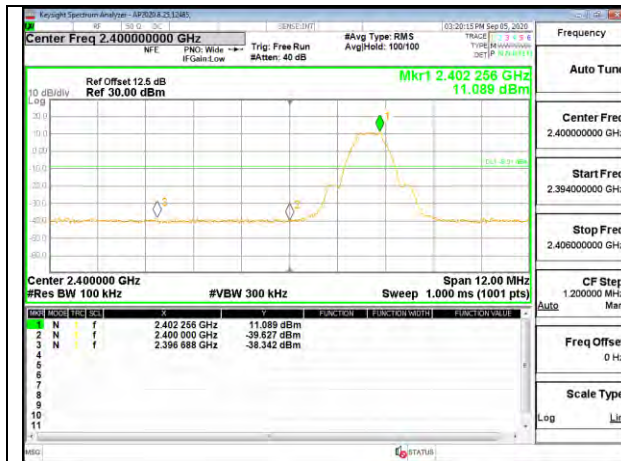
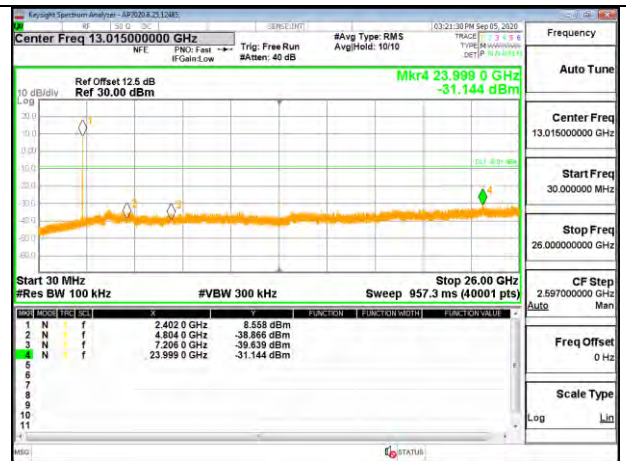
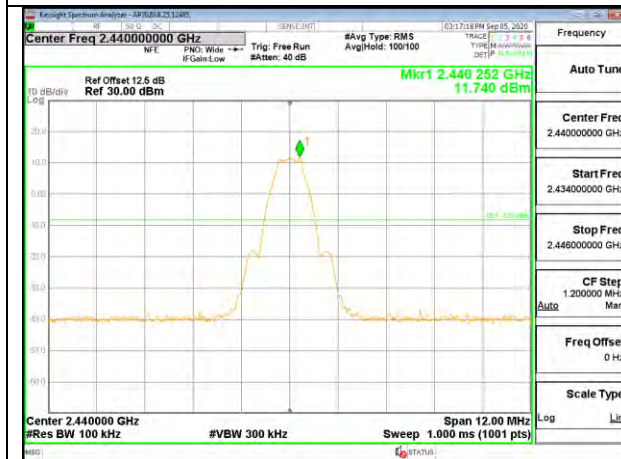
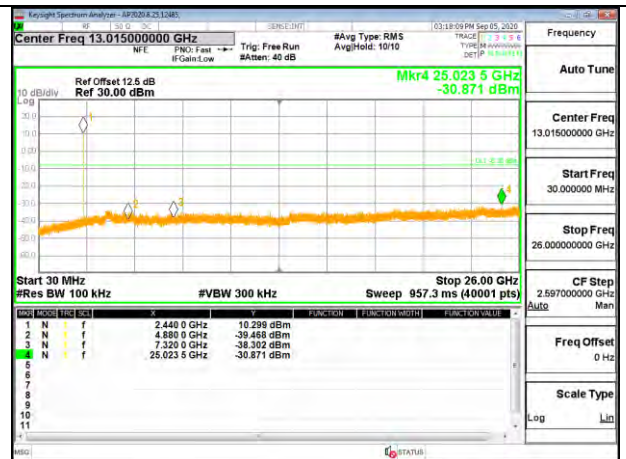
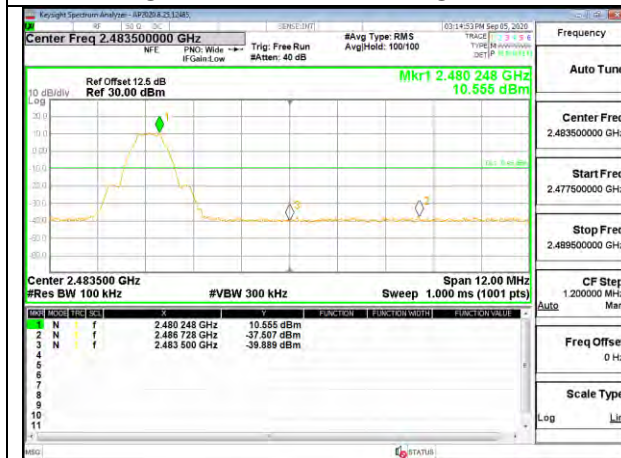
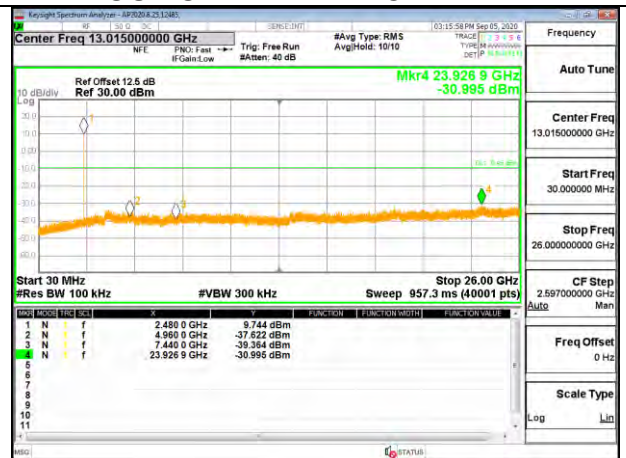


## 9.7.5. LOW POWER BLE (1Mbps)

### ANT4

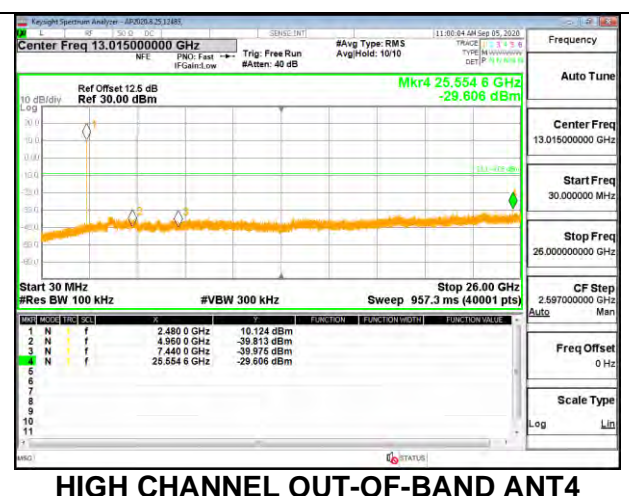
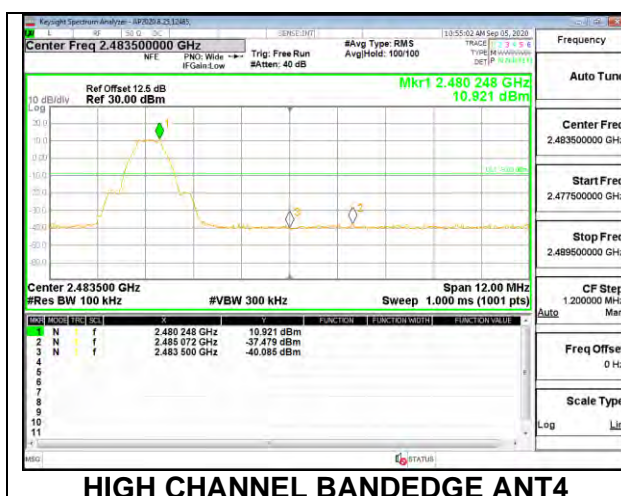
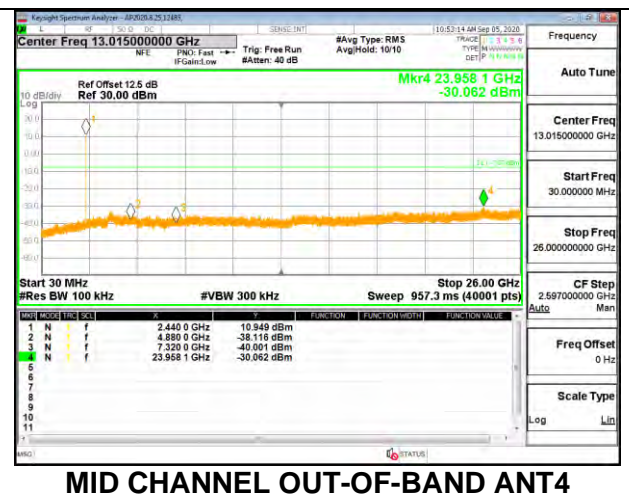
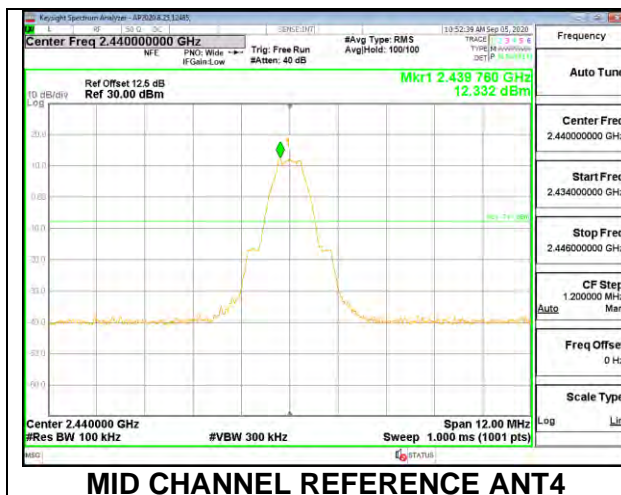
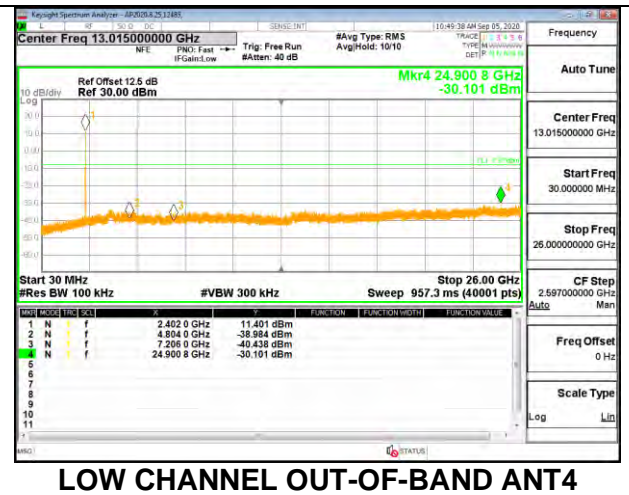
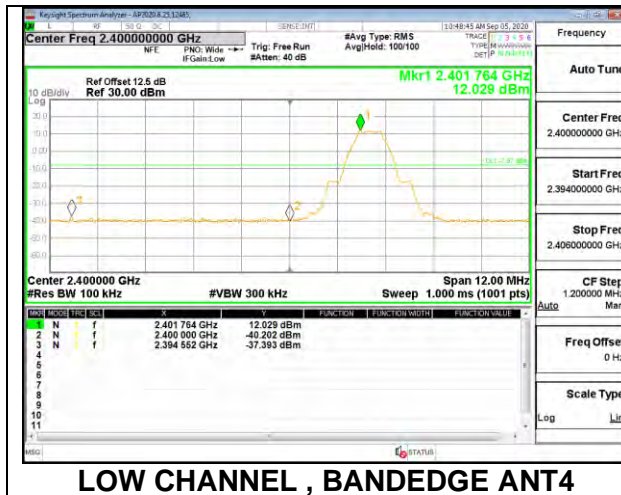




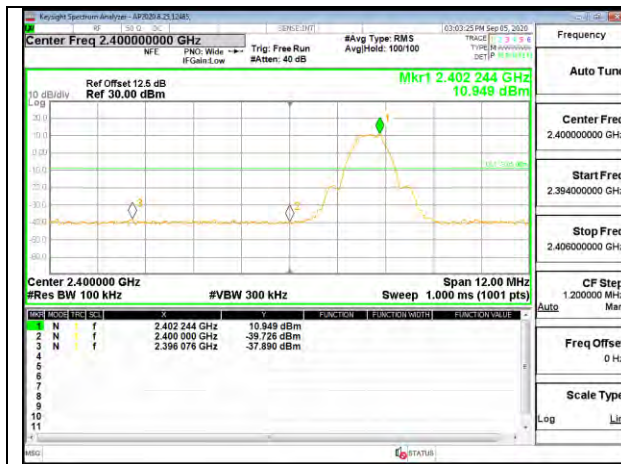
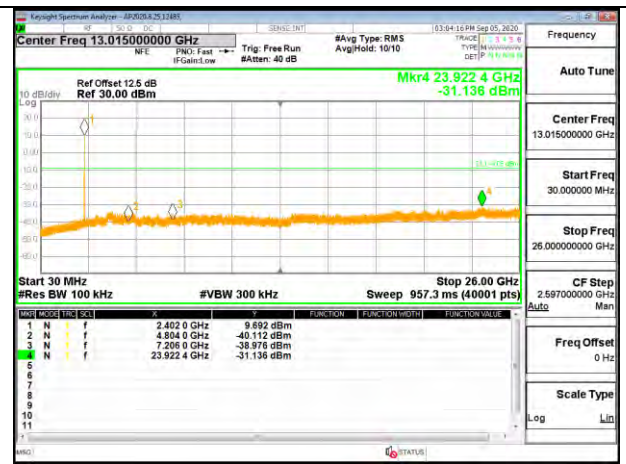
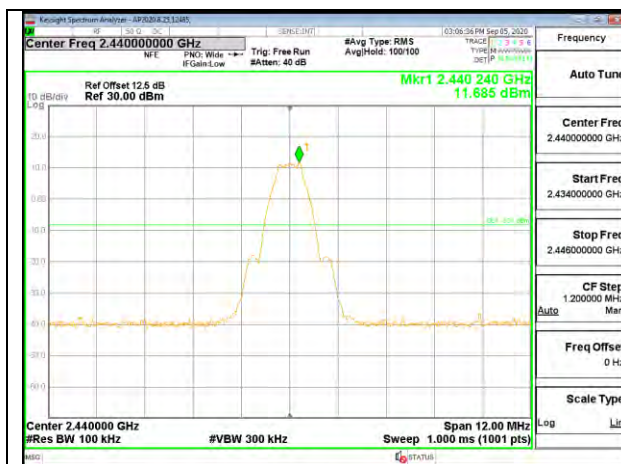
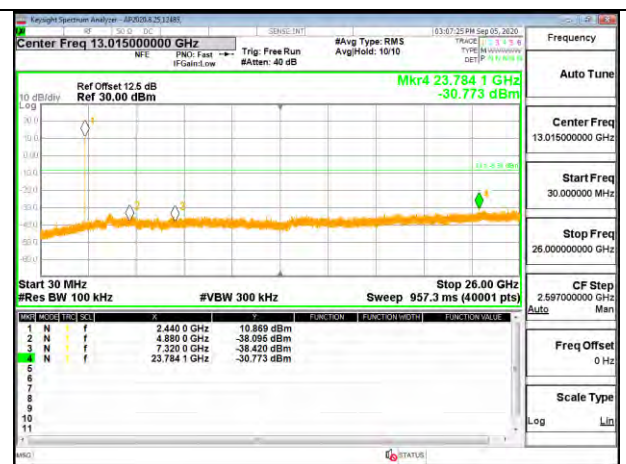
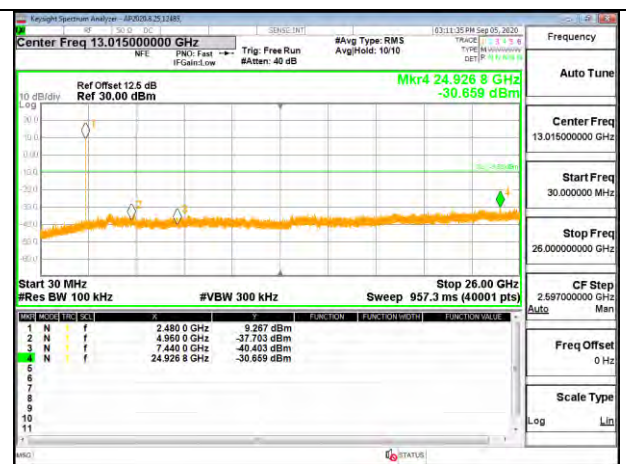
**ANT3****LOW CHANNEL BANDEDGE****OUT-OF-BAND LOW CHANNEL****MID CHANNEL REFERENCE LEVEL****OUT-OF-BAND MID CHANNEL****HIGH CHANNEL BANDEDGE****OUT-OF-BAND HIGH CHANNEL**

### 9.7.6. LOW POWER BLE TXBF (1Mbps)

Note: Test procedures and setting are same as BLE normal mode.

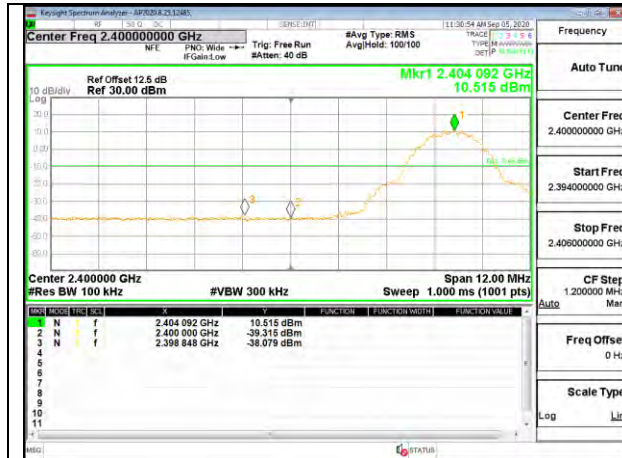




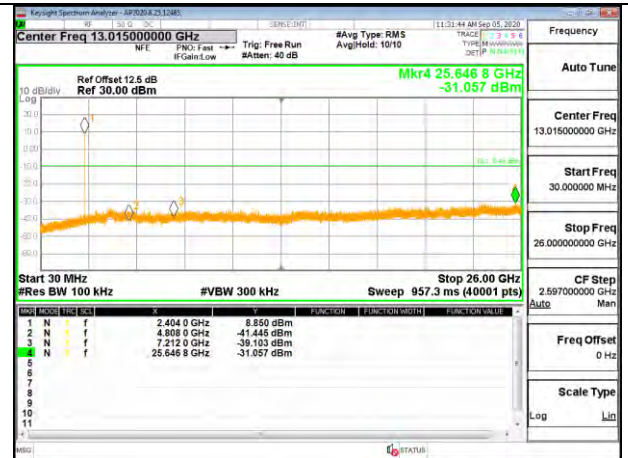
**LOW POWER (1Mbps)****LOW CHANNEL , BANDEDGE ANT3****LOW CHANNEL OUT-OF-BAND ANT3****MID CHANNEL REFERENCE ANT3****MID CHANNEL OUT-OF-BAND ANT3****HIGH CHANNEL REFERENCE ANT3****HIGH CHANNEL OUT-OF-BAND ANT3**

## 9.7.7. LOW POWER BLE (2Mbps)

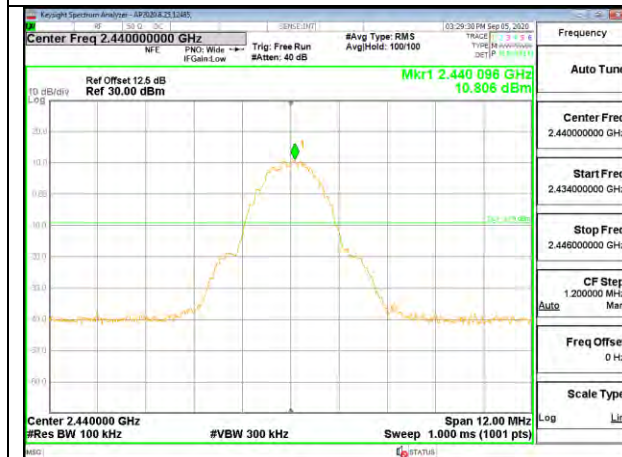
### ANT4



LOW CHANNEL BANDEDGE



OUT-OF-BAND LOW CHANNEL



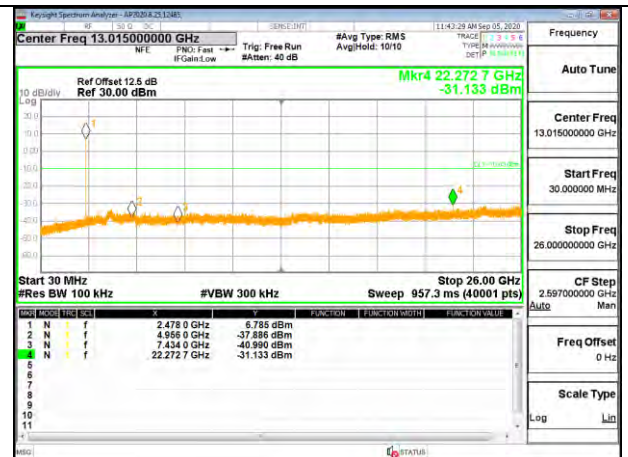
MID CHANNEL REFERENCE LEVEL



OUT-OF-BAND MID CHANNEL

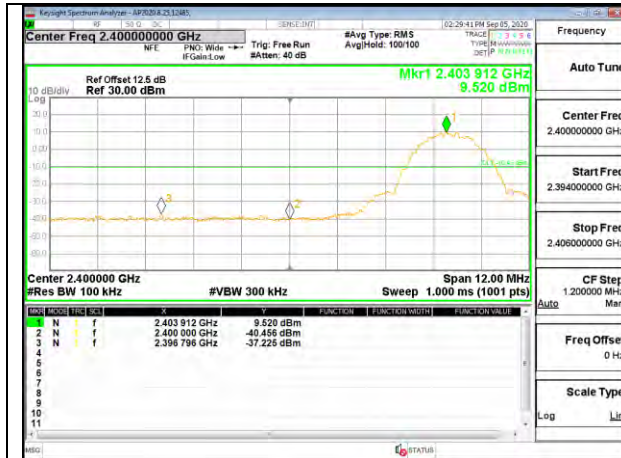
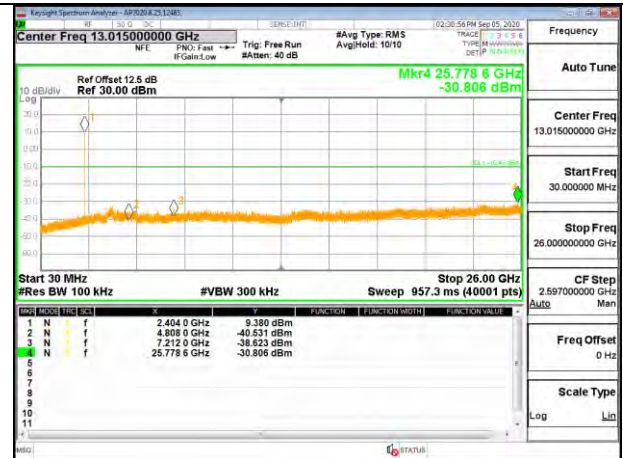
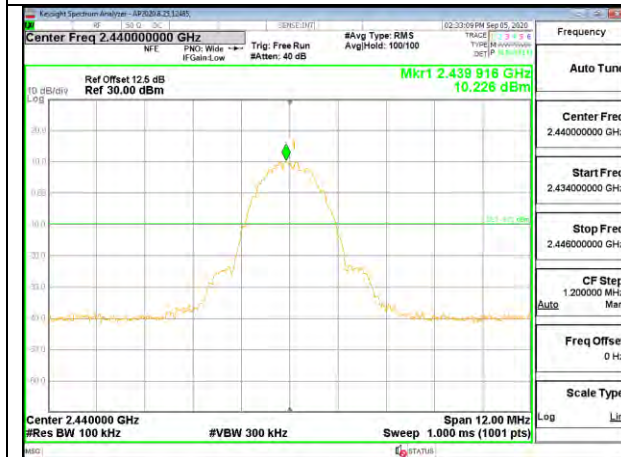
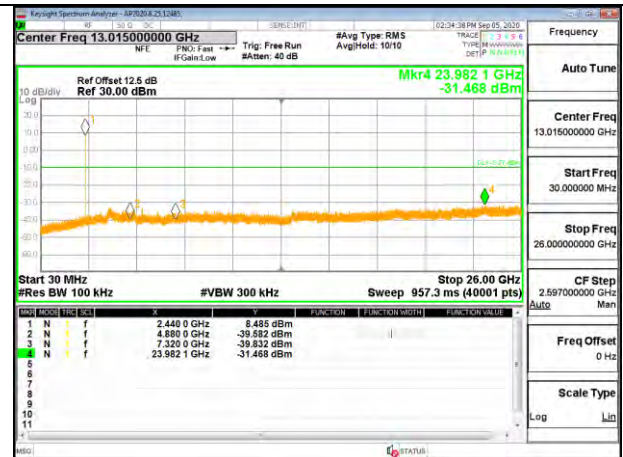
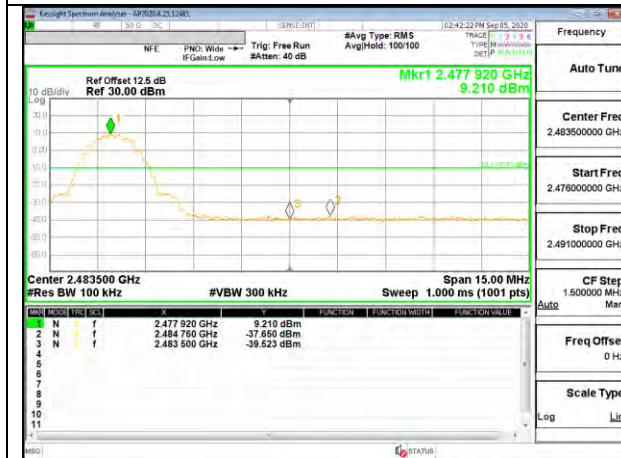
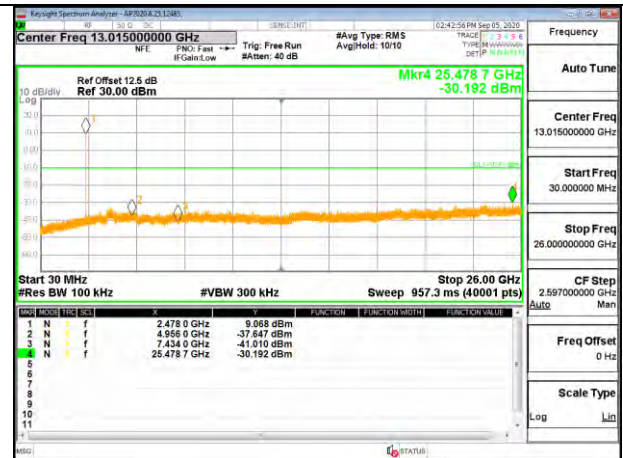


HIGH CHANNEL BANDEDGE



OUT-OF-BAND HIGH CHANNEL

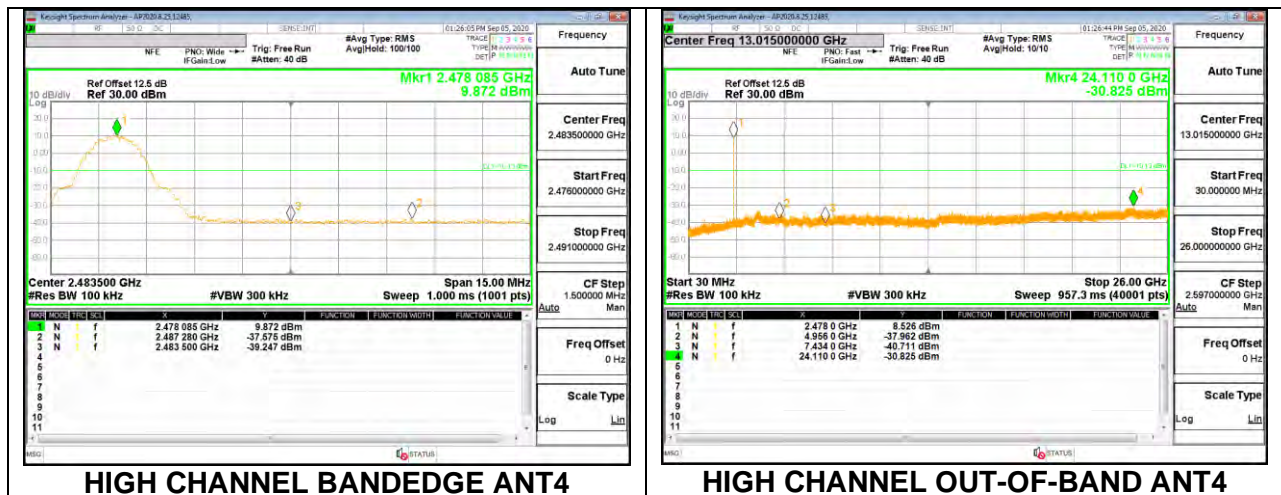
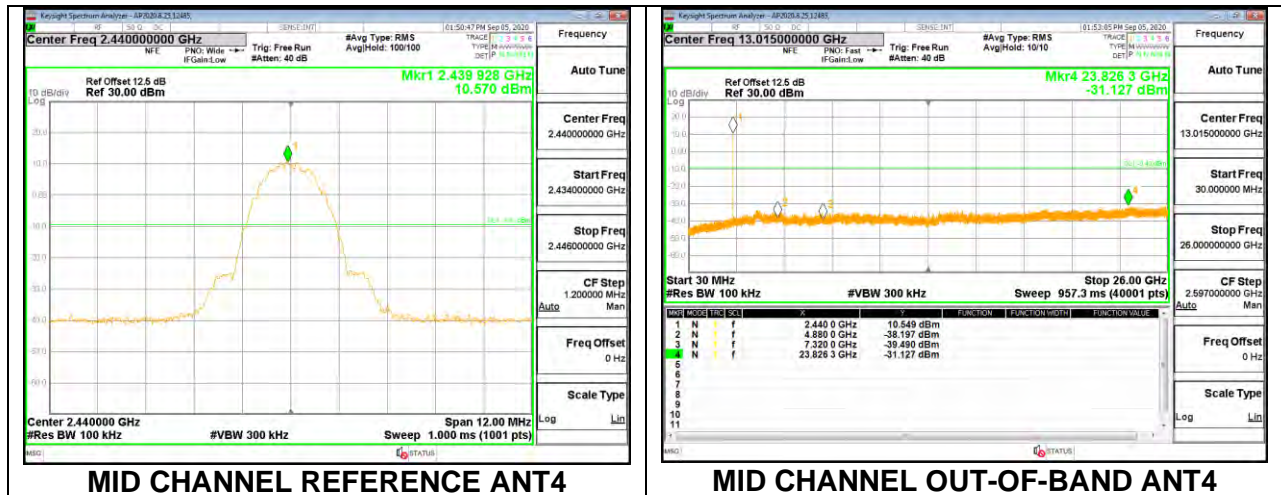
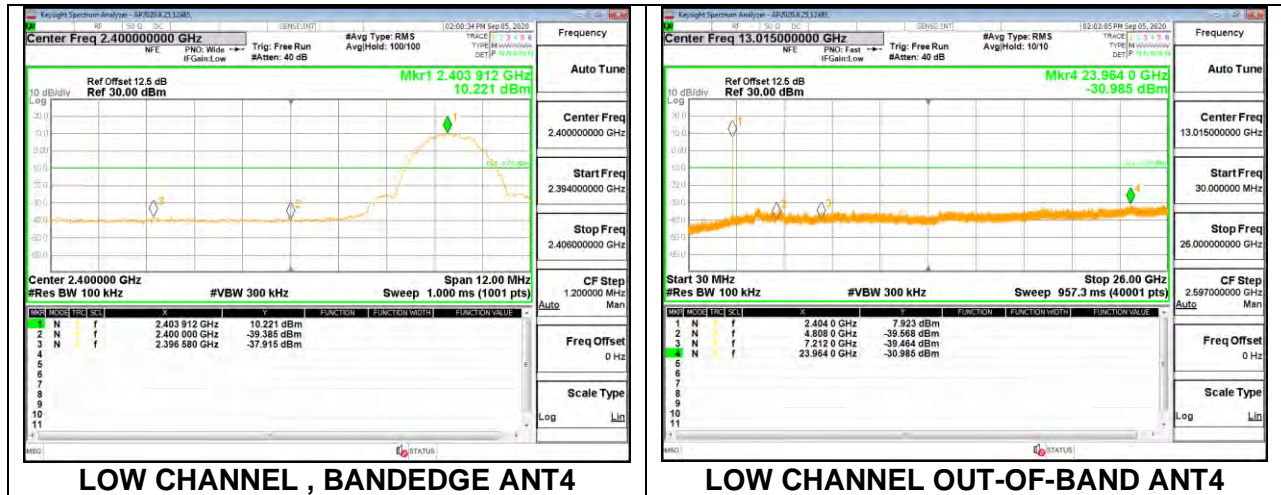


**ANT3****LOW CHANNEL BANDEDGE****OUT-OF-BAND LOW CHANNEL****MID CHANNEL REFERENCE LEVEL****OUT-OF-BAND MID CHANNEL****HIGH CHANNEL BANDEDGE****OUT-OF-BAND HIGH CHANNEL**

### 9.7.8. LOW POWER BLE TXBF (2Mbps)

Note: Test procedures and setting are same as BLE normal mode.

#### ANT4





**ANT3**

