



# TEST REPORT

**Report Number:** 13146732-E2V1

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

**Model :** A2439, A2400, A2401

**FCC ID :** BCG-E3541A

**IC :** 579C-E3541A

**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:**  
UL Verification Services Inc.  
47173 Benicia Street  
Fremont, CA 94538 U.S.A.  
TEL: (510) 319-4000  
FAX: (510) 661-0888

## REPORT REVISION HISTORY

Rev.	Issue Date	Revisions	Revised By
V1	9/21/2020	Initial Issue	Chin Pang

## TABLE OF CONTENTS

<b>TABLE OF CONTENTS .....</b>	<b>3</b>
<b>1. ATTESTATION OF TEST RESULTS .....</b>	<b>4</b>
<b>2. TEST SUMMARY .....</b>	<b>5</b>
<b>3. TEST METHODOLOGY .....</b>	<b>5</b>
<b>4. FACILITIES AND ACCREDITATION .....</b>	<b>5</b>
<b>5. DECISION RULES AND MEASUREMENT UNCERTAINTY .....</b>	<b>6</b>
5.1. <i>METROLOGICAL TRACEABILITY</i> .....	6
5.2. <i>DECISION RULES</i> .....	6
5.3. <i>MEASUREMENT UNCERTAINTY</i> .....	6
<b>6. INTRODUCTION OF TEST DATA REUSE.....</b>	<b>7</b>
6.1. <i>EUT DESCRIPTION</i> .....	7
6.2. <i>INTRODUCTION</i> .....	7
6.3. <i>DIFFERENCE IN MODEL NUMBER</i> .....	7
6.4. <i>SPOT CHECK VERIFICATION RESULTS SUMMARY</i> .....	7
6.5. <i>REFERENCE DETAIL</i> .....	14
6.6. <i>DESCRIPTION OF AVAILABLE ANTENNAS</i> .....	14
6.7. <i>SOFTWARE AND FIRMWARE</i> .....	14
6.8. <i>WORST-CASE CONFIGURATION AND MODE</i> .....	14
6.9. <i>DESCRIPTION OF TEST SETUP</i> .....	15
<b>7. MEASUREMENT METHOD.....</b>	<b>16</b>
<b>8. TEST AND MEASUREMENT EQUIPMENT .....</b>	<b>16</b>
<b>9. SETUP PHOTOS.....</b>	<b>16</b>
<b>Appendix A – Reference Test Report .....</b>	<b>17</b>

## 1. ATTESTATION OF TEST RESULTS

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

**EUT DESCRIPTION:** SMARTPHONE

**MODEL:** A2439, A2400, A2401

**SERIAL NUMBER:** (Original): C7CD603Z08HK, C7CCT014Q90Y  
(Spot Check): C7CD600S08JP, C7CCV00GQ91K

**DATE TESTED:** SEPTEMBER 08-09, 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
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 Road
<input type="checkbox"/> Chamber A	<input type="checkbox"/> Chamber D	<input type="checkbox"/> Chamber I
<input type="checkbox"/> Chamber B	<input checked="" type="checkbox"/> Chamber E	<input checked="" type="checkbox"/> Chamber J
<input type="checkbox"/> Chamber C	<input type="checkbox"/> Chamber F	<input type="checkbox"/> Chamber K
	<input type="checkbox"/> Chamber G	<input type="checkbox"/> Chamber L
	<input type="checkbox"/> Chamber H	<input type="checkbox"/> Chamber M

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: 2324A.

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. INTRODUCTION OF TEST DATA REUSE

### 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: 579C-E3539A to cover variant model BCG-E3541A, 579C-E3541A. 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. DIFFERENCE IN MODEL NUMBER

Models A2399, A2400 and A2401 are electrically identical and the model numbers are allocated for marketing and logistic purposes only. Model A2399 was used for the spot check testing described in this report.

### 6.4. SPOT CHECK VERIFICATION RESULTS SUMMARY

Spot check verification has been done on device model A2399, FCC ID: BCG-E3541A, IC: 579C-E3541A for radiated spurious and radiated band-edge in accordance with the Test Plan that was approved via KDB inquiry.

BCG-E3541A SPOT CHECK RESULTS										
Technology	Mode	Test Item	Channel	Measured	Original model		Spot check model		Delta (dB)	
					A2176		A2399, A2400, A2401			
					BCG-E3539A		BCG-E3541A			
					579C-E3539A		579C-E3541A			
BLE	TXBF 1Mbps	RBE RBE	Low	2390	48.52	36.75	49.17	37.56	0.65	0.81
			High	2483.5	51.07	39.36	51.24	40.65	0.17	1.29
	TXBF 2Mbps	RSE	Mid	8143.29 / 83581.2	48.88	37.97	47.37	35.78	-1.51	-2.19

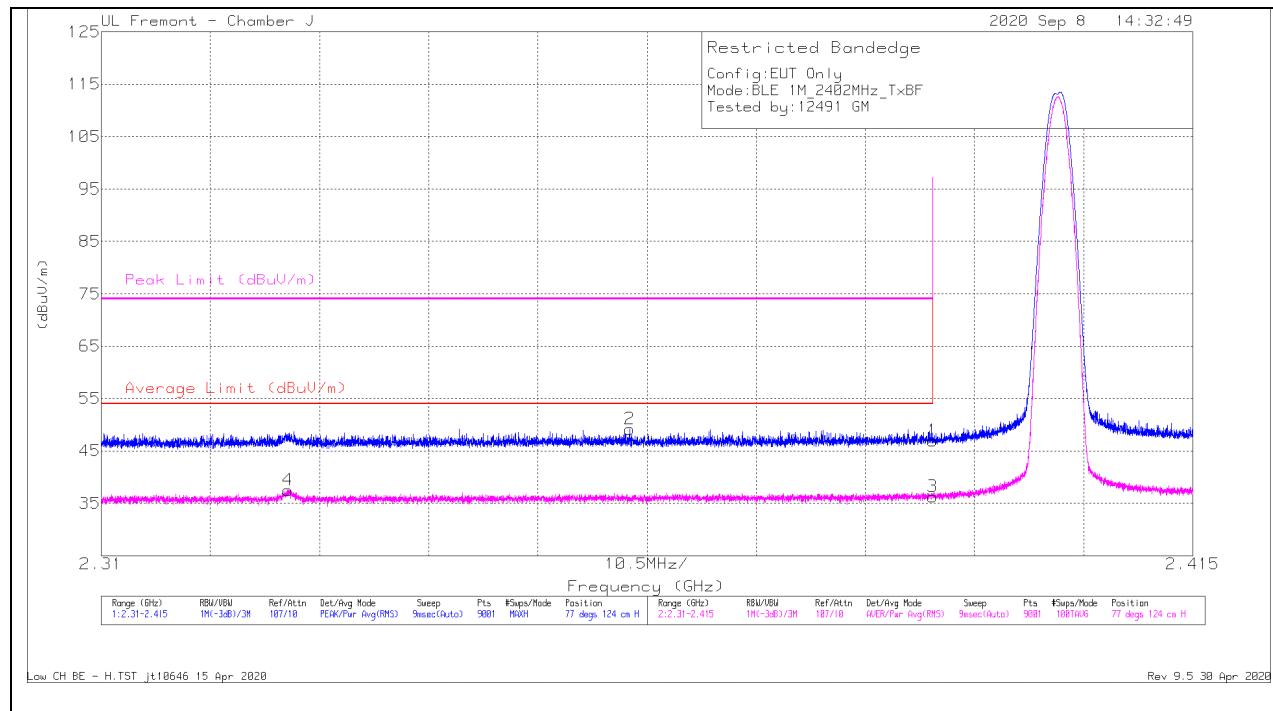
Comparison of the models, upper deviation is within 3dB range and all tests are under FCC Technical Limits. The test report for FCC ID BCG-E3539A, IC: 579C-E3539A is therefore being used to support the application for certification for FCC ID: BCG-E3541A & IC: 579C-E3541A

Note: The output powers were verified on model A2399 to match with model A2176 before radiated emissions spot check was performed.

## SPOT CHECK DATA

### BANDEDGE (LOW CHANNEL)

#### HORIZONTAL RESULT



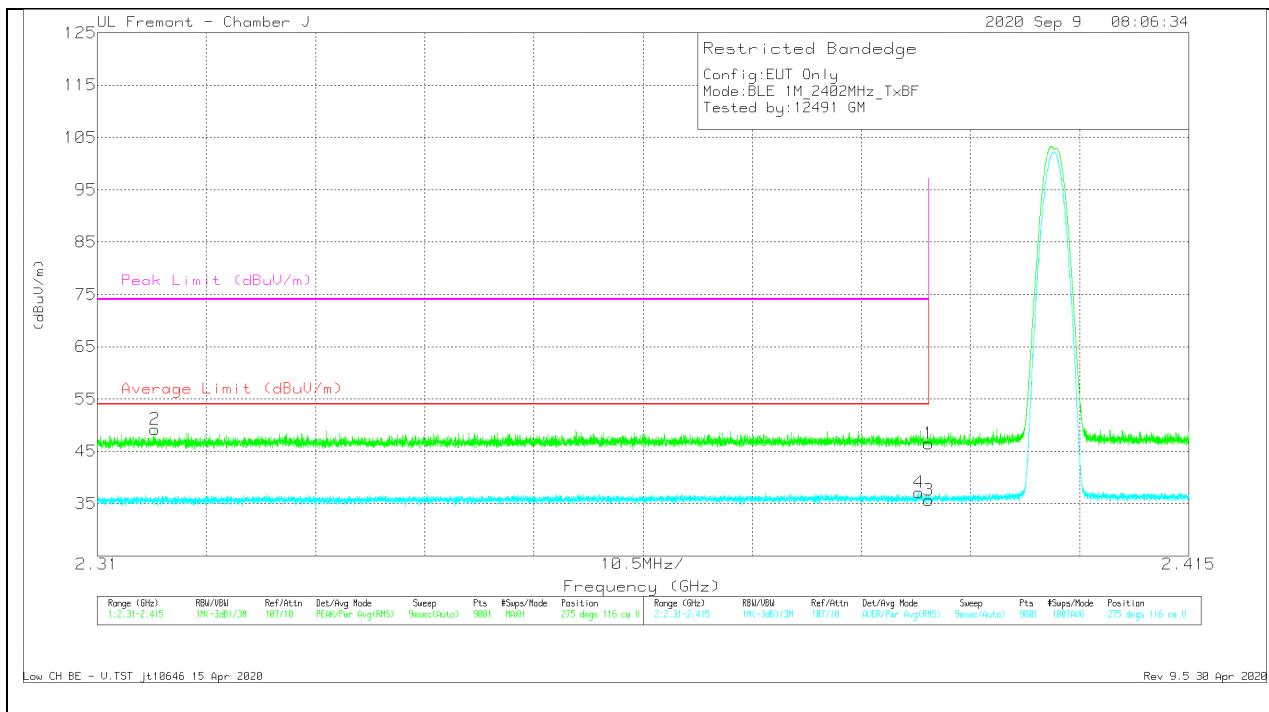
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T963 (dB/m)	Amp/C bl/Fltr/ Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.38999	43.18	Pk	29	-25.2	46.98	-	-	74	-27.02	77	124	H
2	* 2.36086	45.37	Pk	29	-25.2	49.17	-	-	74	-24.83	77	124	H
3	* 2.38999	32.5	RMS	29	-25.2	36.3	54	-17.7	-	-	77	124	H
4	* 2.32794	33.96	RMS	28.9	-25.3	37.56	54	-16.44	-	-	77	124	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/Cb I/Ftr/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	42.59	Pk	29	-25.2	46.39	-	-	74	-27.61	275	116	V
2	* 2.31555	45.78	Pk	28.7	-25.3	49.18	-	-	74	-24.82	275	116	V
3	* 2.38999	31.88	RMS	29	-25.2	35.68	54	-18.32	-	-	275	116	V
4	* 2.38906	33.3	RMS	29	-25.2	37.1	54	-16.9	-	-	275	116	V

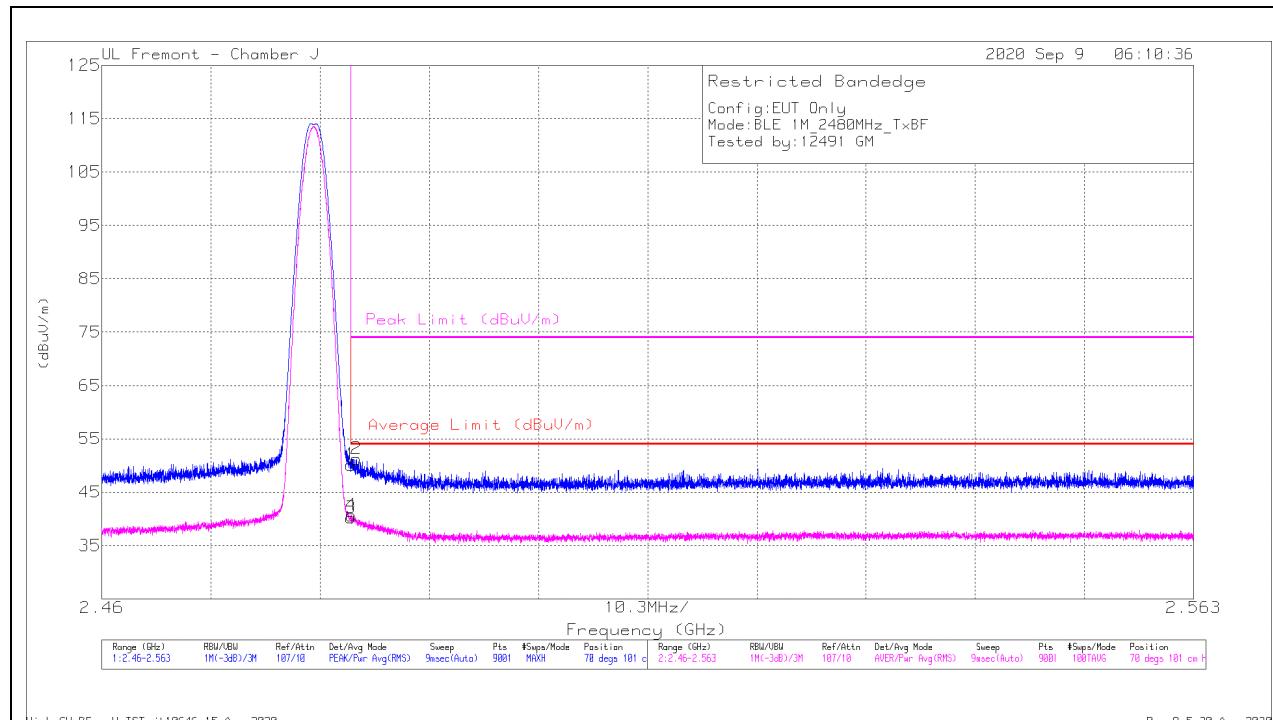
\* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

PK - Peak detector

RMS - RMS detection

## BANDEDGE (HIGH CHANNEL)

### HORIZONTAL RESULT



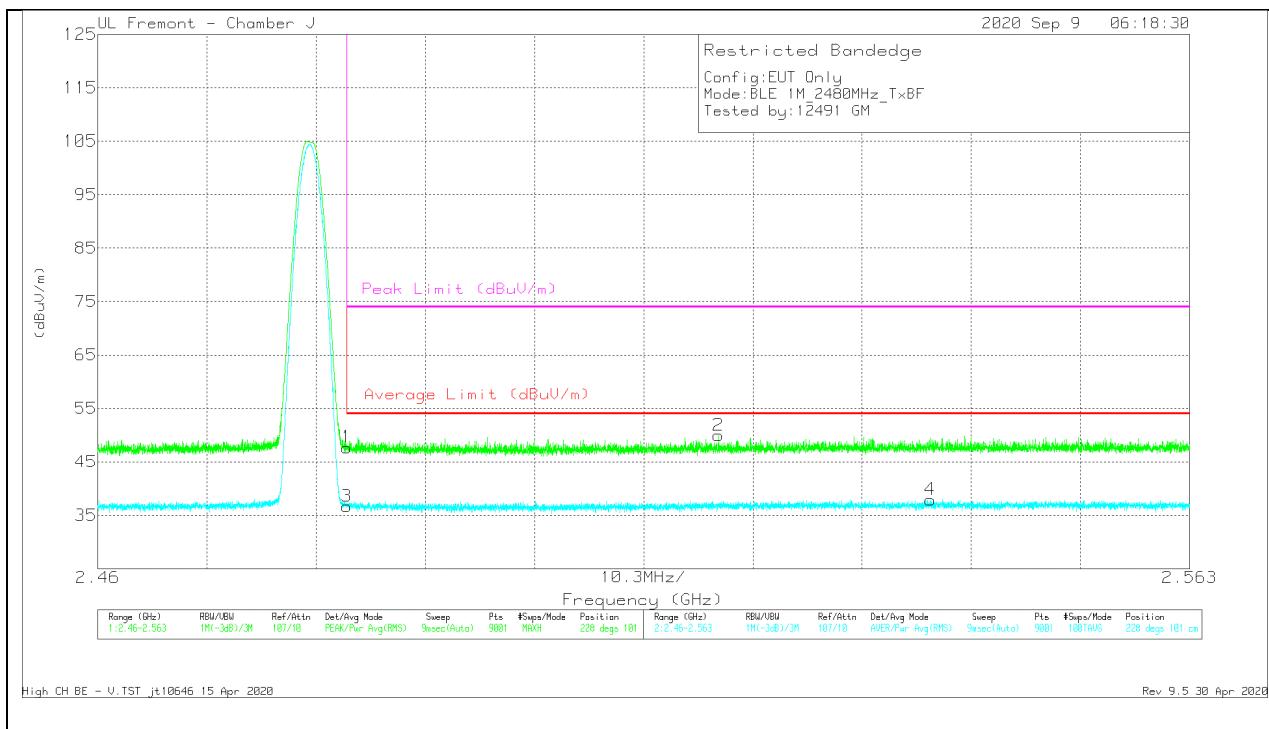
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T963 (dB/m)	Amp/Cb I/Ftr/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.48351	45.85	Pk	29.5	-25.2	50.15	-	-	74	-23.85	70	101	H
2	* 2.48401	46.94	Pk	29.5	-25.2	51.24	-	-	74	-22.76	70	101	H
3	* 2.48351	35.91	RMS	29.5	-25.2	40.21	54	-13.79	-	-	70	101	H
4	* 2.48355	36.35	RMS	29.5	-25.2	40.65	54	-13.35	-	-	70	101	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/Cb I/Ftr/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin	Peak (dB)	Peak Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.48351	43.4	Pk	29.5	-25.2	47.7	-	-	74	-26.3	228	101	V
2	2.51855	45.23	Pk	29.8	-25.1	49.93	-	-	74	-24.07	228	101	V
3	* 2.48351	32.36	RMS	29.5	-25.2	36.66	54	-17.34	-	-	228	101	V
4	2.53854	33.11	RMS	29.9	-25.1	37.91	54	-16.09	-	-	228	101	V

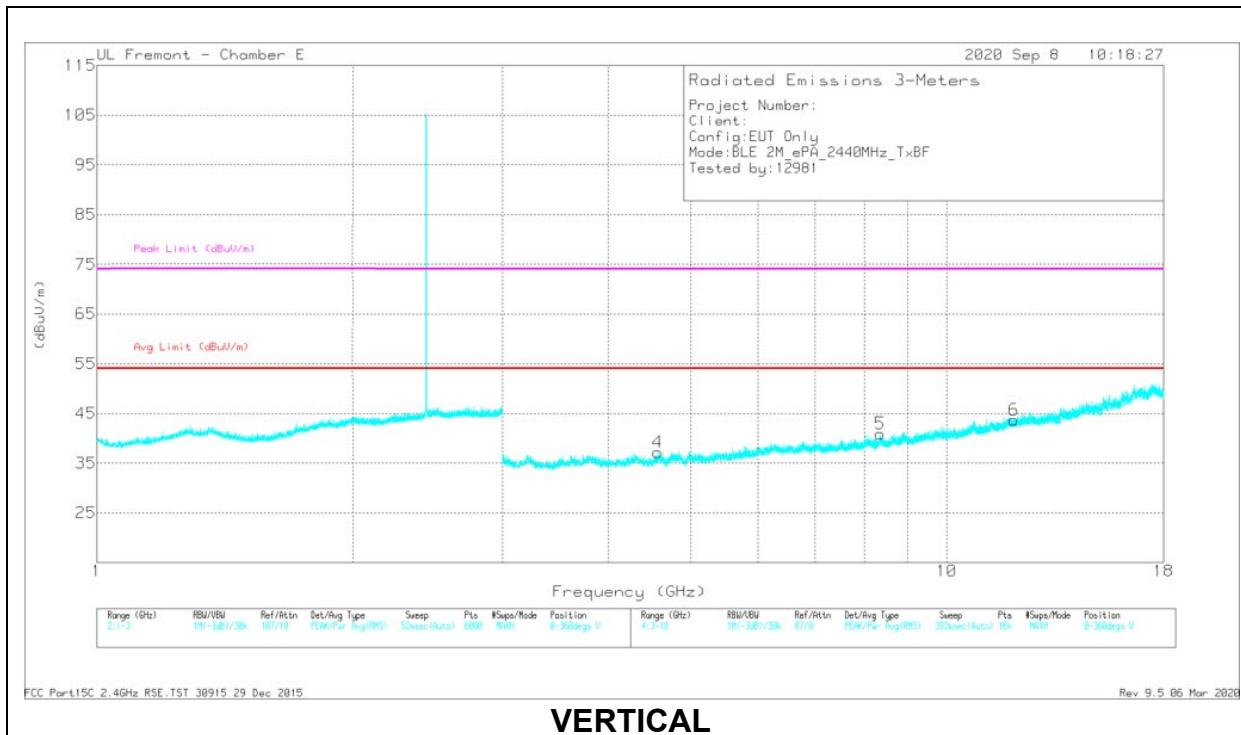
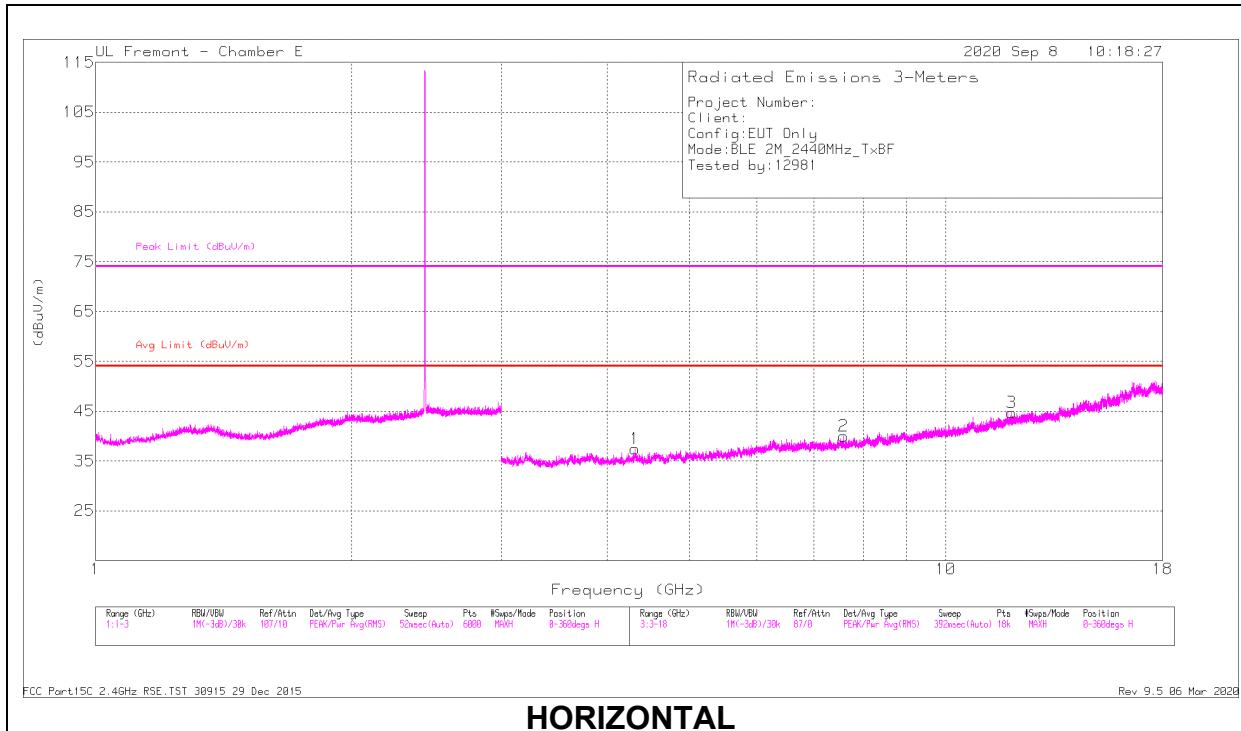
\* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

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/Filt/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	* 4.31018	41.4	PK2	33.6	-31.8	43.2	-	-	74	-30.8	282	145	H
	* 4.30985	30.88	MAv1	33.6	-31.8	32.68	54	-21.32	-	-	282	145	H
2	* 7.5815	37.37	PK2	35.7	-27.7	45.37	-	-	74	-28.63	281	215	H
	* 7.58422	26.11	MAv1	35.7	-27.7	34.11	54	-19.89	-	-	281	215	H
3	* 11.96478	34.83	PK2	38.6	-23.1	50.33	-	-	74	-23.67	20	179	H
	* 11.96435	23.43	MAv1	38.6	-23.2	38.83	54	-15.17	-	-	20	179	H
4	* 4.56761	41.45	PK2	34.2	-32.2	43.45	-	-	74	-30.55	158	147	V
	* 4.56851	29.93	MAv1	34.2	-32.2	31.93	54	-22.07	-	-	158	147	V
5	* 8.35812	37.57	PK2	35.9	-26.1	47.37	-	-	74	-26.63	151	296	V
	* 8.35791	25.98	MAv1	35.9	-26.1	35.78	54	-18.22	-	-	151	296	V
6	* 12.01019	34.71	PK2	38.6	-23.1	50.21	-	-	74	-23.79	112	290	V
	* 12.00765	23.44	MAv1	38.6	-23.1	38.94	54	-15.06	-	-	112	290	V

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

PK2 - KDB558074 Method: Maximum Peak

MAv1 - KDB558074 Option 1 Maximum RMS Average

## 6.5. 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	Report Title/Section
DTS	BCG-E3539A 579C-E3539A	13179110-E2	FCC IC_BLE Report / All sections

## 6.6. DESCRIPTION OF AVAILABLE ANTENNAS

Frequency Range (GHz)	ANT 4 (dBi)	ANT 3 (dBi)
2.4	-2.3	-0.6

## 6.7. SOFTWARE AND FIRMWARE

The EUT firmware installed during testing was 18.1.148.558

## 6.8. 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 WiFi/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.

## 6.9. DESCRIPTION OF TEST SETUP

SUPPORT TEST EQUIPMENT				
Description	Manufacturer	Model	Serial Number	FCC ID/ DoC
Laptop	Apple	A1398	C02PM012G3QD	QDS-BRCM1069
Laptop AC/DC adapter	Liteon Technology	PA-1450-BA1	B123	N/A
EUT AC/DC adapter	Apple	A1385	D29325SM03XDHLHC9	N/A

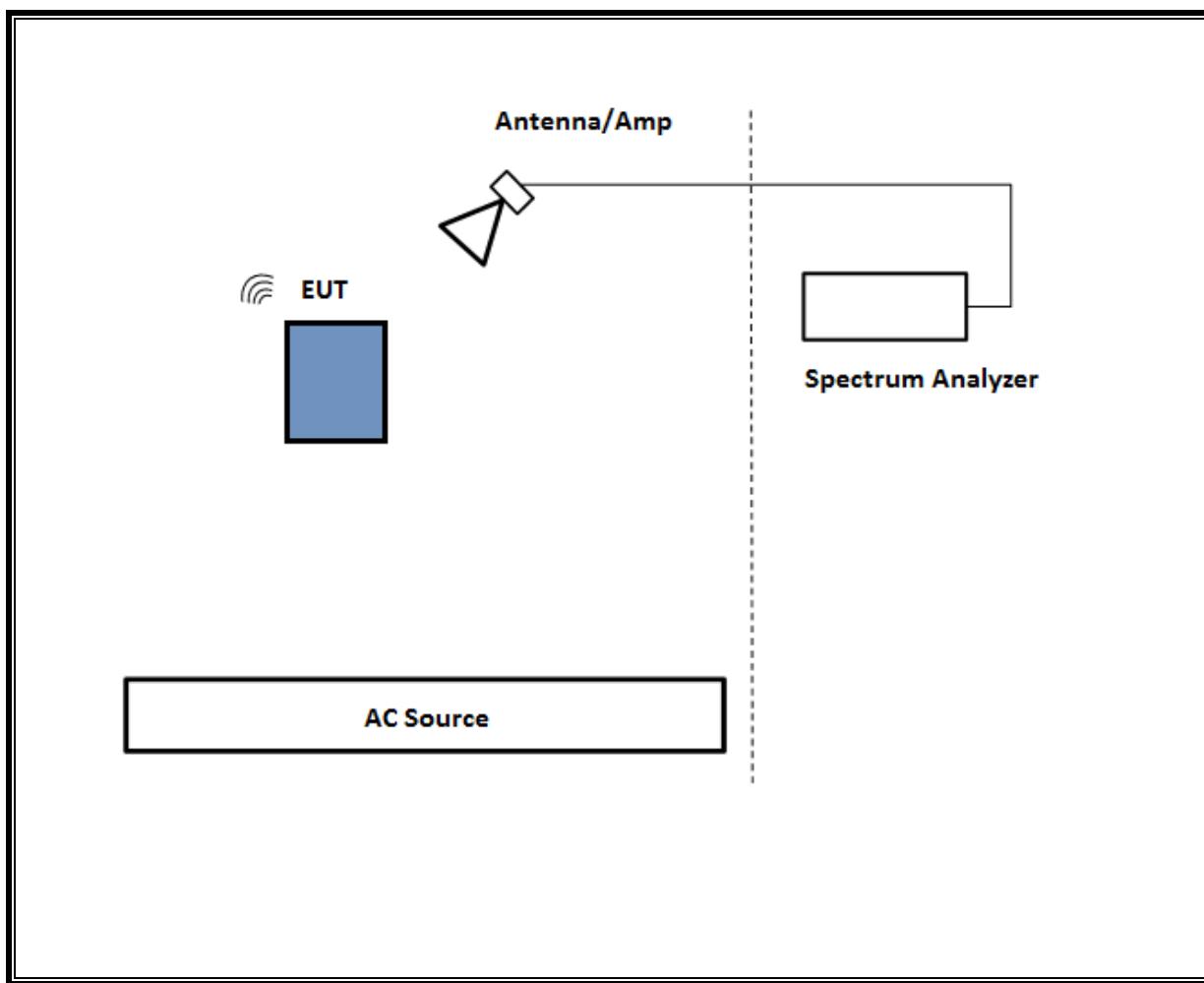
  

I/O CABLES (RF RADIATED TEST)						
Cable No.	Port	# of Identical Ports	Connector Type	Cable Type	Cable Length (m)	Remarks
1	AC	1	AC	Un-shielded	2	N/A
2	USB	1	USB	Un-shielded	1	N/A

### TEST SETUP

The EUT is connected to a test laptop during the tests. Test software exercised the radio card.

### 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 were 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
UL AUTOMATION SOFTWARE					
Radiated Software	UL	UL EMC	Ver 9.5, Mar 6, 2020		

## 9. SETUP PHOTOS

Please refer to 13179110-EP1 for setup photos

## Appendix A – Reference Test Report

Attached is the test report (13179110-E2) containing the reference data from the parent model as detailed in section 6.5.

## END OF TEST REPORT



# 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

**Prepared by:**  
UL Verification Services Inc.  
47173 Benicia Street  
Fremont, CA 94538 U.S.A.  
TEL: (510) 319-4000  
FAX: (510) 661-0888

## 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

## TABLE OF CONTENTS

<b>TABLE OF CONTENTS .....</b>	<b>3</b>
<b>1. ATTESTATION OF TEST RESULTS .....</b>	<b>6</b>
<b>2. TEST SUMMARY .....</b>	<b>7</b>
<b>3. TEST METHODOLOGY .....</b>	<b>7</b>
<b>4. FACILITIES AND ACCREDITATION .....</b>	<b>7</b>
<b>5. DECISION RULES AND MEASUREMENT UNCERTAINTY .....</b>	<b>8</b>
5.1. <i>METROLOGICAL TRACEABILITY</i> .....	8
5.2. <i>DECISION RULES</i> .....	8
5.3. <i>MEASUREMENT UNCERTAINTY</i> .....	8
<b>6. EQUIPMENT UNDER TEST .....</b>	<b>9</b>
6.1. <i>EUT DESCRIPTION</i> .....	9
6.2. <i>MAXIMUM OUTPUT POWER</i> .....	9
6.3. <i>DESCRIPTION OF AVAILABLE ANTENNAS</i> .....	9
6.4. <i>SOFTWARE AND FIRMWARE</i> .....	9
6.5. <i>WORST-CASE CONFIGURATION AND MODE</i> .....	10
6.6. <i>DESCRIPTION OF TEST SETUP</i> .....	11
<b>7. MEASUREMENT METHOD .....</b>	<b>16</b>
<b>8. TEST AND MEASUREMENT EQUIPMENT .....</b>	<b>17</b>
<b>9. ANTENNA PORT TEST RESULTS .....</b>	<b>18</b>
9.1. <i>ON TIME AND DUTY CYCLE</i> .....	18
9.2. <i>99% BANDWIDTH</i> .....	20
9.2.1. <i>HIGH POWER BLE (1Mbps)</i> .....	21
9.2.2. <i>HIGH POWER BLE TXBF (1Mbps)</i> .....	22
9.2.3. <i>HIGH POWER BLE (2Mbps)</i> .....	23
9.2.4. <i>HIGH POWER BLE TXBF (2Mbps)</i> .....	24
9.3. <i>6 dB BANDWIDTH</i> .....	25
9.3.1. <i>HIGH POWER BLE (1Mbps)</i> .....	26
9.4. <i>OUTPUT POWER</i> .....	27
9.4.1. <i>HIGH POWER BLE (1Mbps)</i> .....	28
9.4.2. <i>HIGH POWER BLE TXBF (1Mbps)</i> .....	28
9.4.3. <i>HIGH POWER BLE (2Mbps)</i> .....	29
9.4.4. <i>HIGH POWER BLE TXBF (2Mbps)</i> .....	29
9.4.5. <i>LOW POWER BLE (1Mbps)</i> .....	30
9.4.6. <i>LOW POWER BLE TXBF (1Mbps)</i> .....	30
9.4.7. <i>LOW POWER BLE (2Mbps)</i> .....	31

9.4.8. LOW POWER BLE TXBF (2Mbps) .....	31
9.5. AVERAGE POWER .....	32
9.5.1. HIGH POWER BLE (1Mbps).....	33
9.5.2. HIGH POWER BLE TXBF (1Mbps).....	33
9.5.3. HIGH POWER BLE (2Mbps).....	34
9.5.4. HIGH POWER BLE TXBF (2Mbps).....	34
9.5.5. LOW POWER BLE (1Mbps) .....	35
9.5.6. LOW POWER BLE TXBF (1Mbps) .....	35
9.5.7. LOW POWER BLE (2Mbps) .....	36
9.5.8. LOW POWER BLE TXBF (2Mbps) .....	36
9.6. POWER SPECTRAL DENSITY .....	37
9.6.1. HIGH POWER BLE (1Mbps).....	38
9.6.2. HIGH POWER BLE TXBF (1Mbps).....	39
9.6.3. HIGH POWER BLE (2Mbps).....	40
9.6.4. HIGH POWER BLE TXBF (2Mbps).....	41
9.6.5. LOW POWER BLE (1Mbps) .....	42
9.6.6. LOW POWER BLE TXBF (1Mbps) .....	43
9.6.7. LOW POWER BLE (2Mbps) .....	44
9.6.8. LOW POWER BLE TXBF (2Mbps) .....	45
9.7. CONDUCTED SPURIOUS EMISSIONS.....	46
9.7.1. HIGH POWER BLE (1Mbps).....	47
9.7.2. HIGH POWER BLE TXBF (1Mbps).....	49
9.7.3. HIGH POWER BLE (2Mbps).....	51
9.7.4. HIGH POWER BLE TXBF (2Mbps).....	53
9.7.5. LOW POWER BLE (1Mbps) .....	55
9.7.6. LOW POWER BLE TXBF (1Mbps) .....	57
9.7.7. LOW POWER BLE (2Mbps) .....	59
9.7.8. LOW POWER BLE TXBF (2Mbps) .....	61
<b>10. RADIATED TEST RESULTS .....</b>	<b>63</b>
10.1. LIMITS AND PROCEDURE.....	63
10.2. TRANSMITTER ABOVE 1 GHz.....	65
10.2.1. HIGH POWER BLE (1Mbps).....	65
10.2.2. HIGH POWER BLE TXBF (1Mbps) .....	73
10.2.3. HIGH POWER BLE (2Mbps) .....	77
10.2.4. HIGH POWER BLE TXBF (2Mbps) .....	85
10.2.5. LOW POWER BLE (1Mbps) .....	89
10.2.6. LOW POWER BLE TXBF (1Mbps) .....	97
10.2.7. LOW POWER BLE (2Mbps).....	101
10.2.8. LOW POWER BLE TXBF (2Mbps) .....	109
10.2.9. HIGH POWER HARMONICS AND SPURIOUS EMISSIONS TXBF BLE (1Mbps) 113	
10.3. WORST CASE BELOW 1 GHz .....	119
10.4. WORST CASE 18-26 GHz .....	121
<b>11. AC POWER LINE CONDUCTED EMISSIONS .....</b>	<b>123</b>
11.1. AC POWER LINE WITH LAPTOP .....	124
11.2. AC POWER LINE WITH AC/DC ADAPTER .....	126



## 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 WiFi/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.

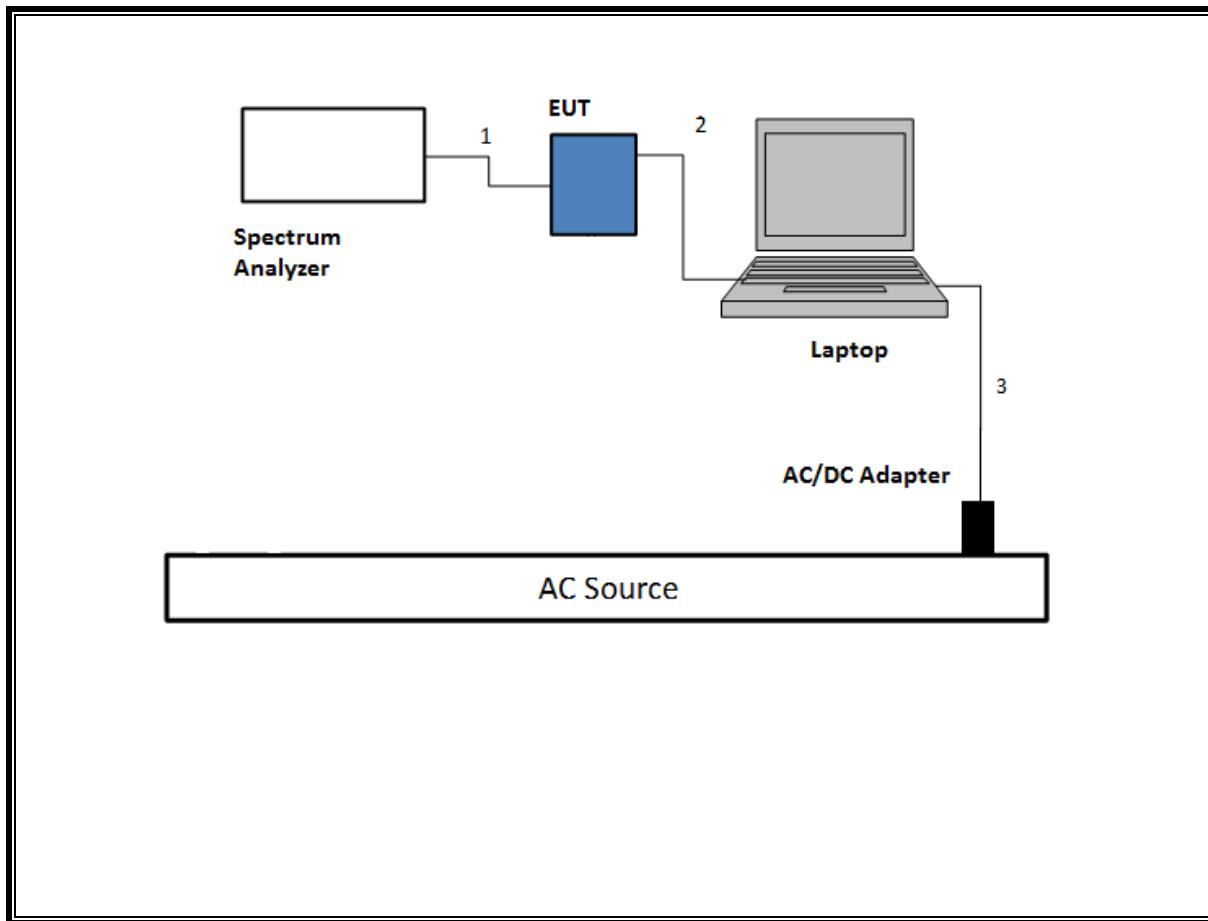
## 6.6. DESCRIPTION OF TEST SETUP

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)
1	Antenna	1	SMA	Un-shielded	0.2
2	USB	1	USB	Shielded	1.0
3	AC	1	AC	Un-shielded	2
I/O CABLES (RF RADIATED TEST)					
Cable No.	Port	# of Identical Ports	Connector Type	Cable Type	Cable Length (m)
1	AC	1	AC	Un-shielded	2
2	USB	1	USB	Un-shielded	1

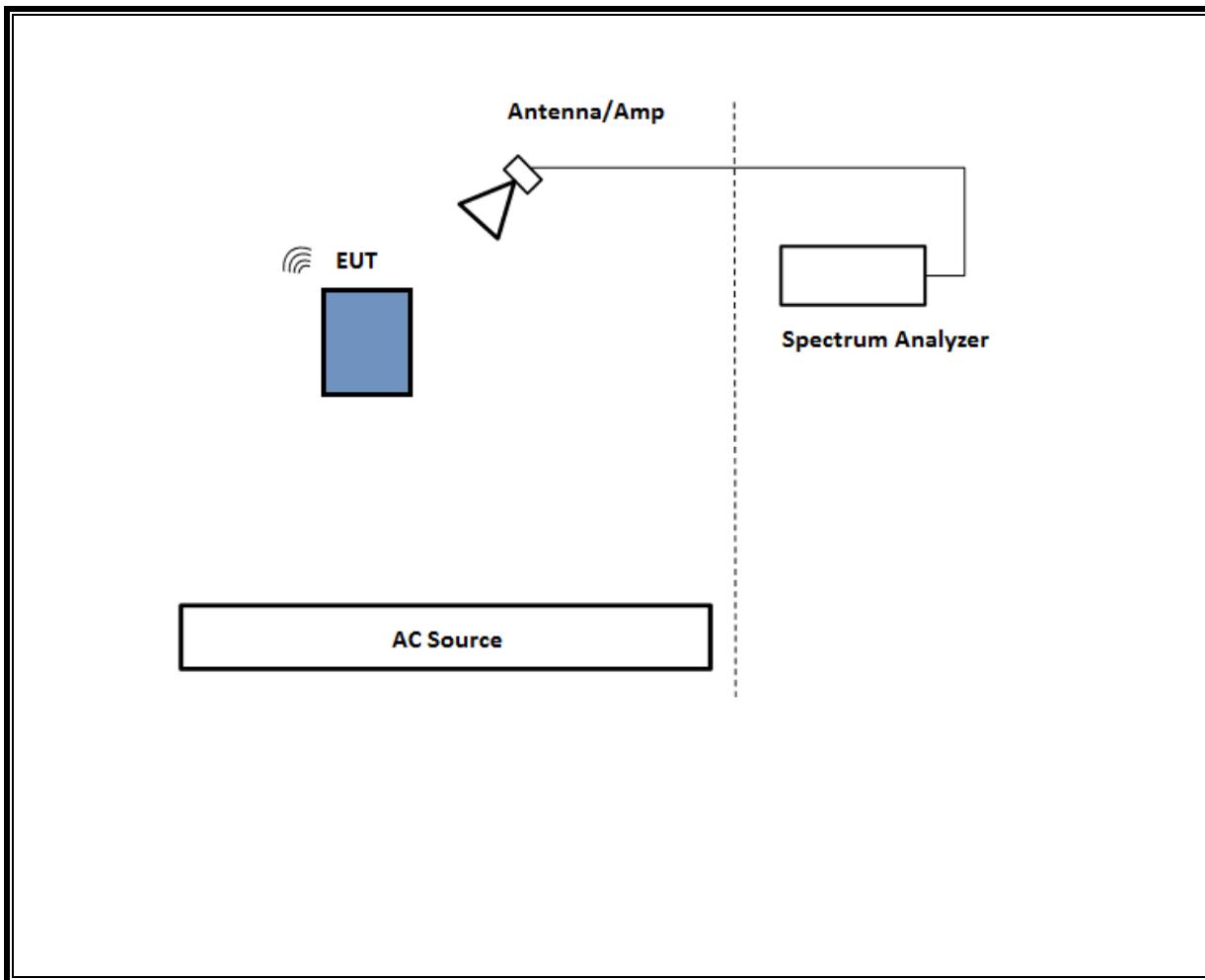
### TEST SETUP

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

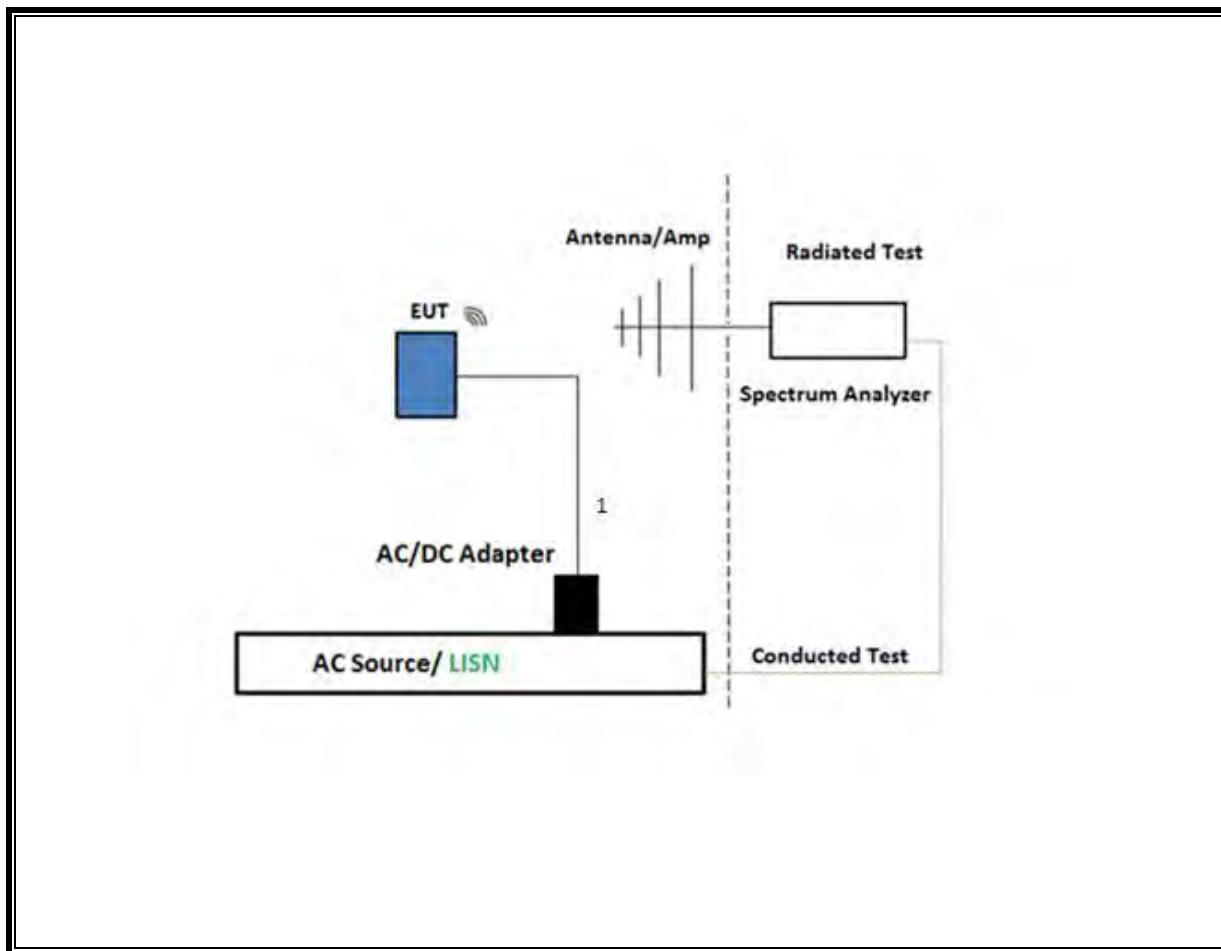
**SETUP DIAGRAM FOR CONDUCTED TESTS**



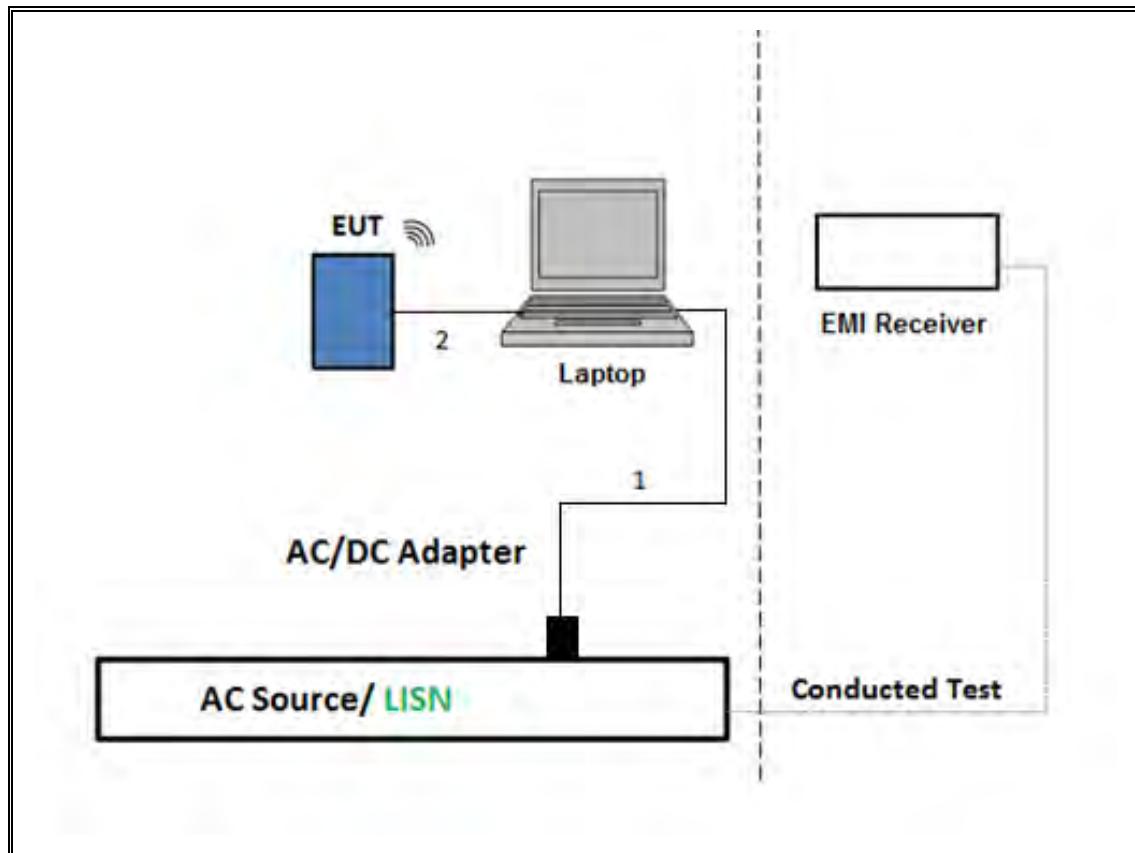
**SETUP DIAGRAM FOR RADIATED TESTS Above 1 GHz**



**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.

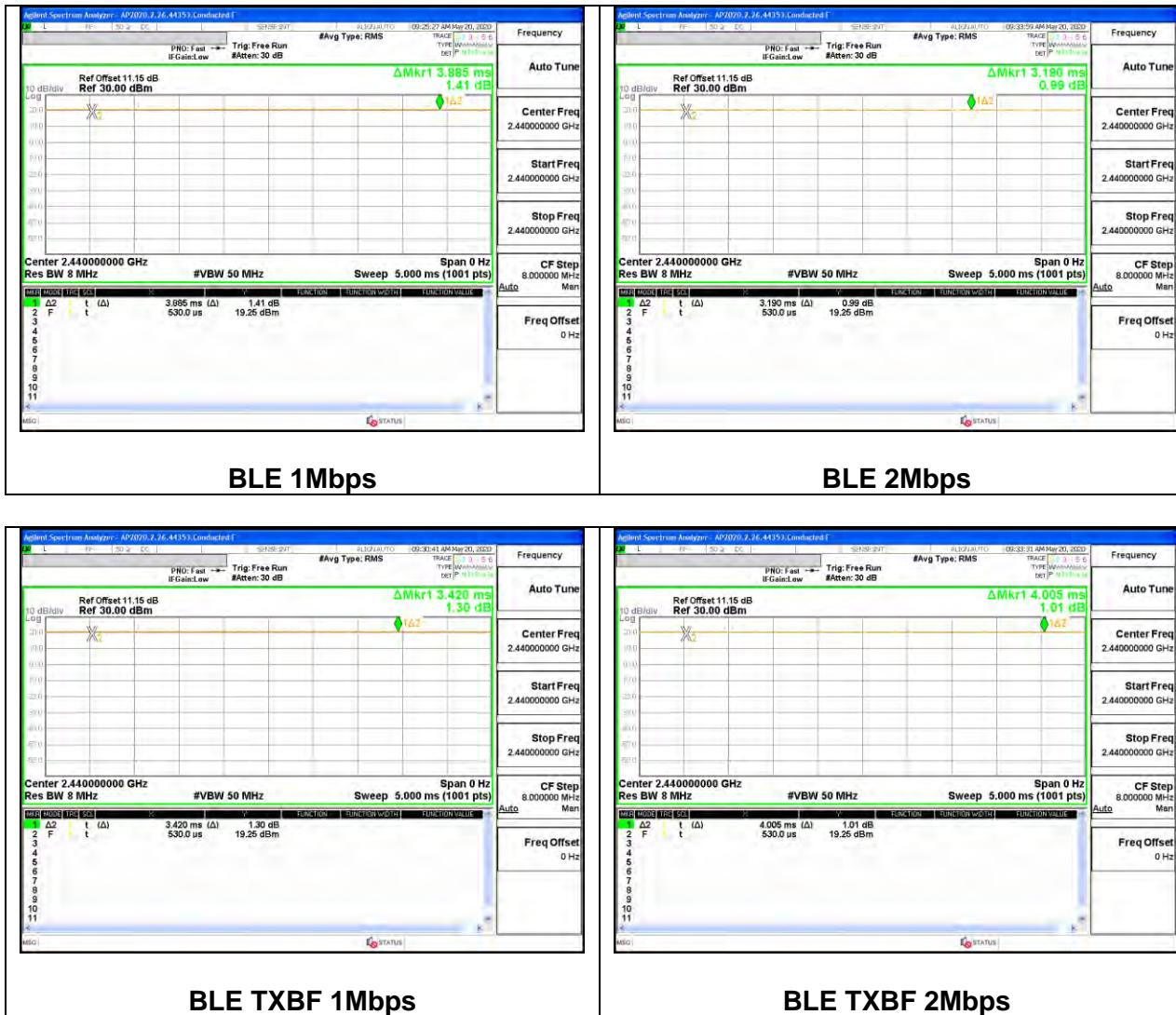
#### PROCEDURE

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.

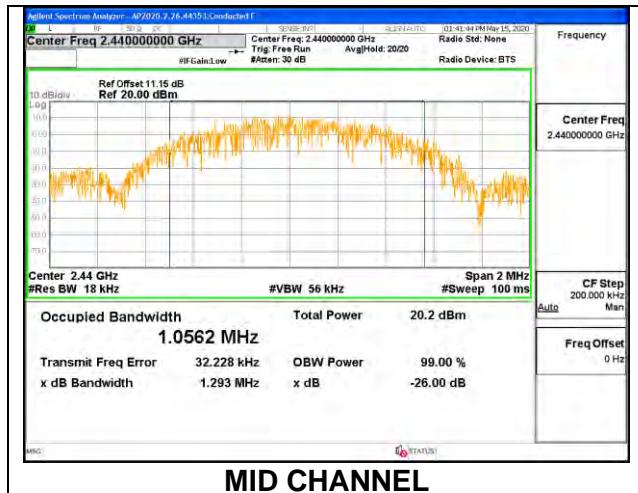
### RESULTS

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)

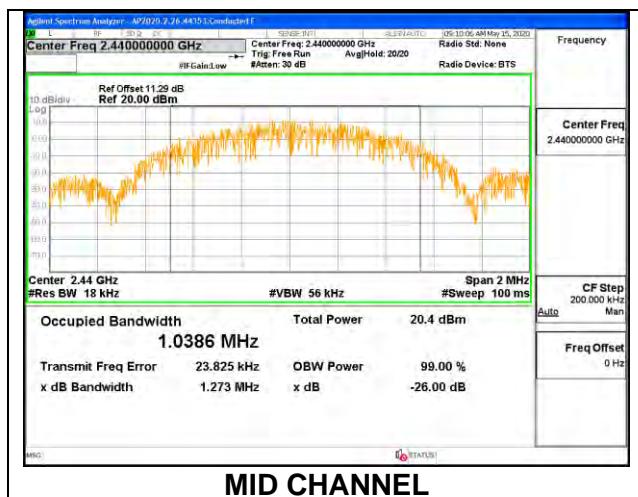
#### ANT4

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



#### ANT3

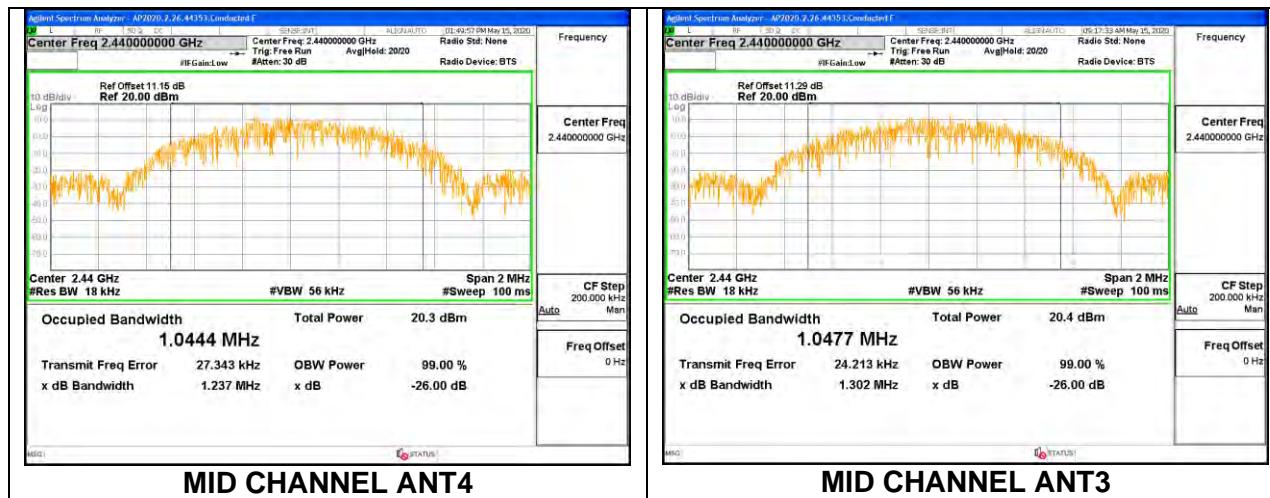
Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	2402	1.0281
Middle	2440	1.0386
High	2480	1.0281



### 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

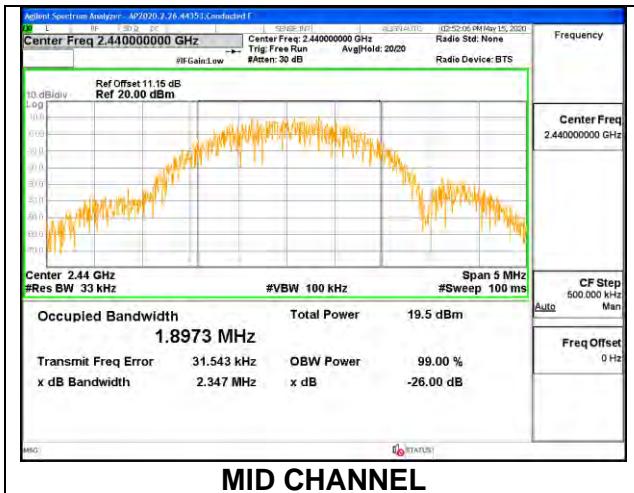
Note: Test procedures and setting are same as BLE normal mode.



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

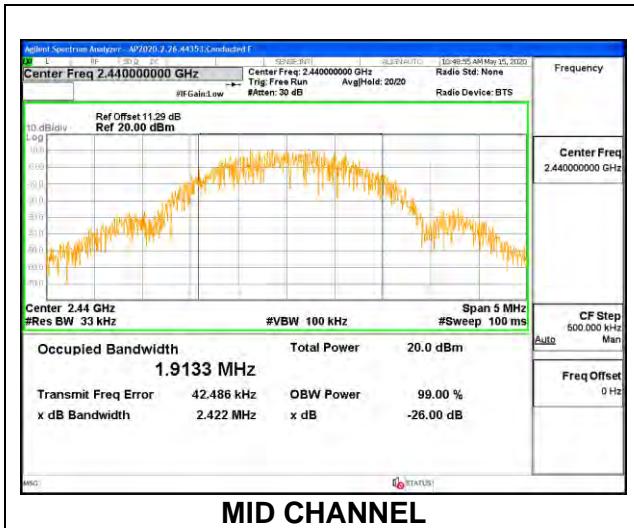
#### ANT4

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



#### ANT3

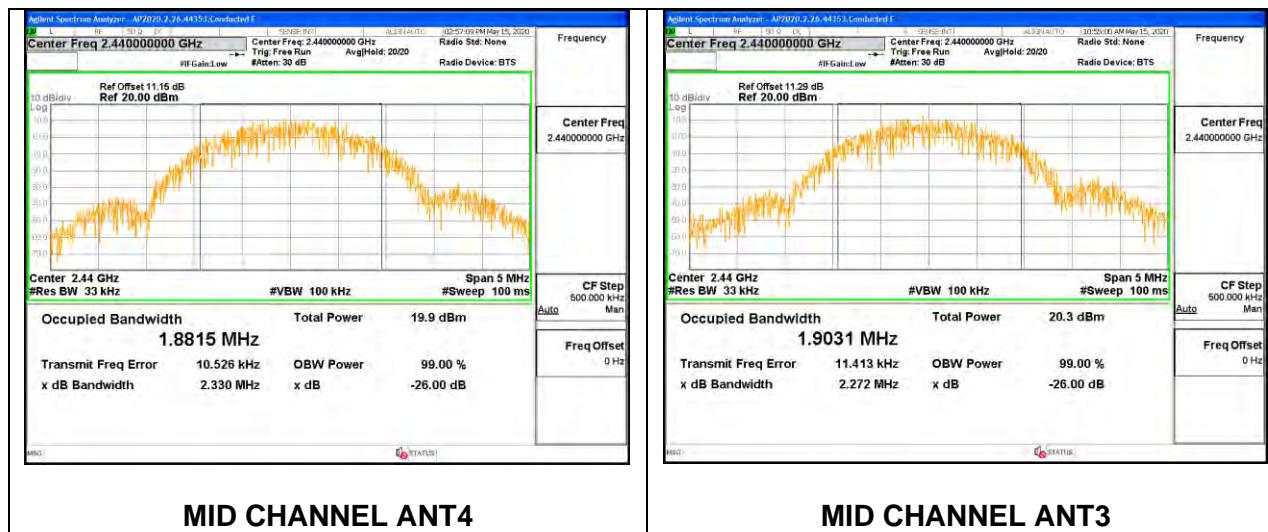
Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	2404	1.8971
Middle	2440	1.9133
High	2478	1.9008



### 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.



### 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

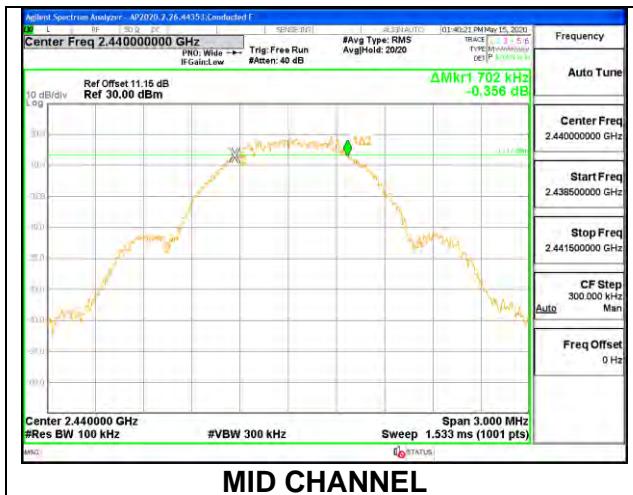
The 6dB bandwidth was measured for the narrowest bandwidth mode, High Power 1Mbps, to demonstrate compliance with the minimum required bandwidth of 500 kHz. Other modes were not tested as their bandwidth is greater than the High Power 1Mbps mode, as demonstrated by the 99% bandwidth measurements performed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

Tested By:	44366
Date:	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

Tested By:	44366
Date:	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

Tested By:	44366
Date:	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

Tested By:	44366
Date:	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

Tested By:	44366
Date:	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

Tested By:	44366
Date:	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

Tested By:	44366
Date:	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

Tested By:	44366
Date:	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

Tested By:	44366
Date:	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

Tested By:	44366
Date:	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

Tested By:	44366
Date:	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

Tested By:	44366
Date:	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

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

#### ANT3

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

<b>Channel</b>	<b>Frequency</b> <b>(MHz)</b>	<b>AV power</b> <b>(dBm)</b>
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

<b>Channel</b>	<b>Frequency</b> <b>(MHz)</b>	<b>Average Power</b> <b>ANT4</b> <b>(dBm)</b>	<b>Average Power</b> <b>ANT3</b> <b>(dBm)</b>	<b>Total Power</b> <b>(dBm)</b>
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

## 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

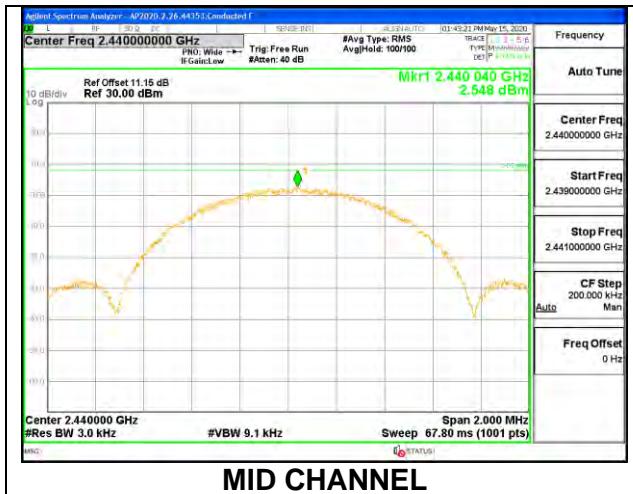
Power spectral density was measured on the low, mid and high channels for all supported modes. Additional measurements on adjacent channels to the low and/or high channels were limited to cases where the edge channels have a significantly lower rated power than the adjacent channels.

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

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

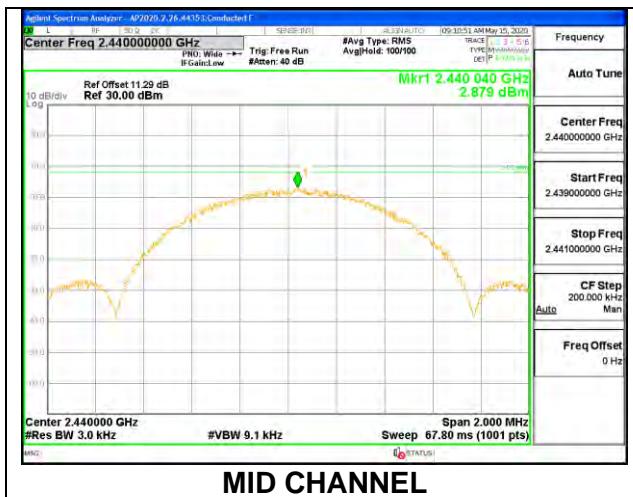
#### ANT4

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



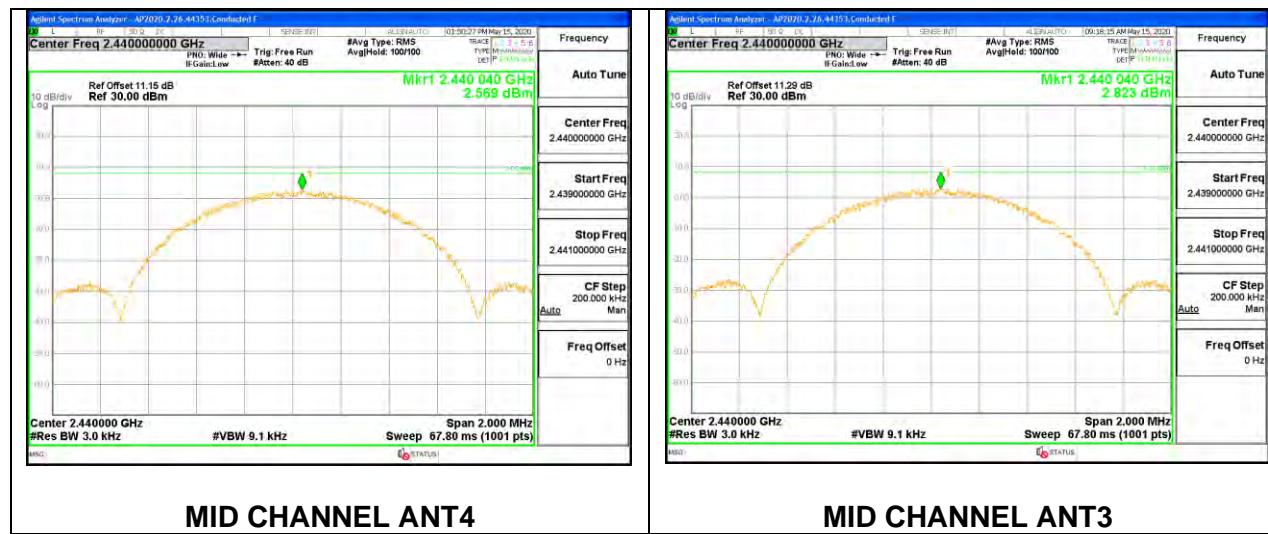
### 9.6.2. HIGH POWER BLE TXBF (1Mbps)

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

#### 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
High	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)

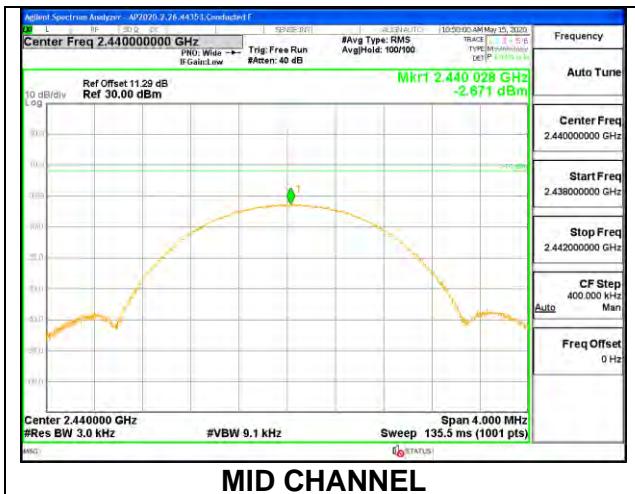
## **ANT4**

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



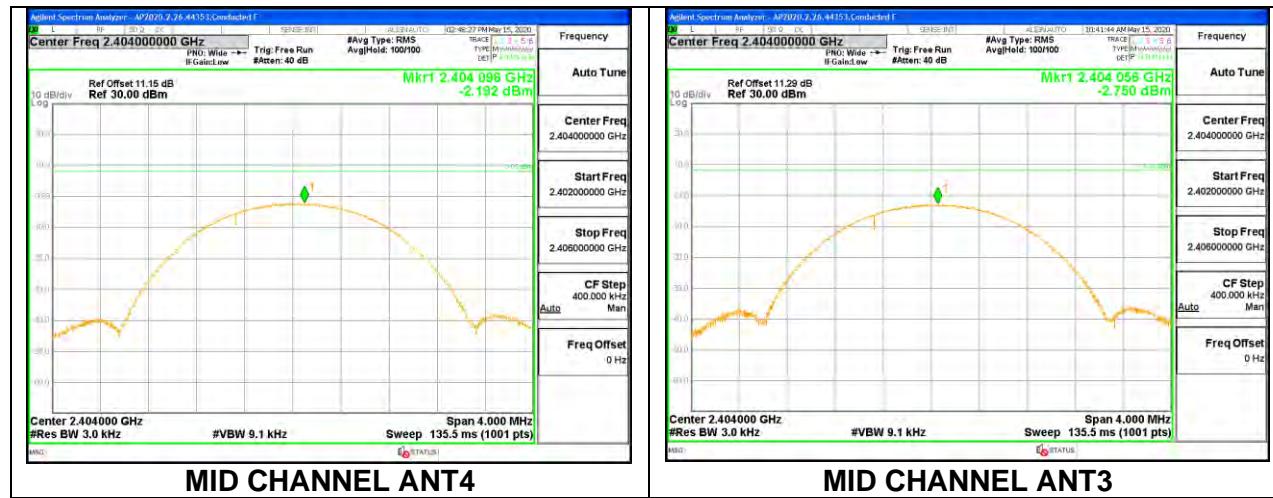
### 9.6.4. HIGH POWER BLE TXBF (2Mbps)

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

#### 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
High	2478	-2.638	-2.647	0.37	8.0	-7.6

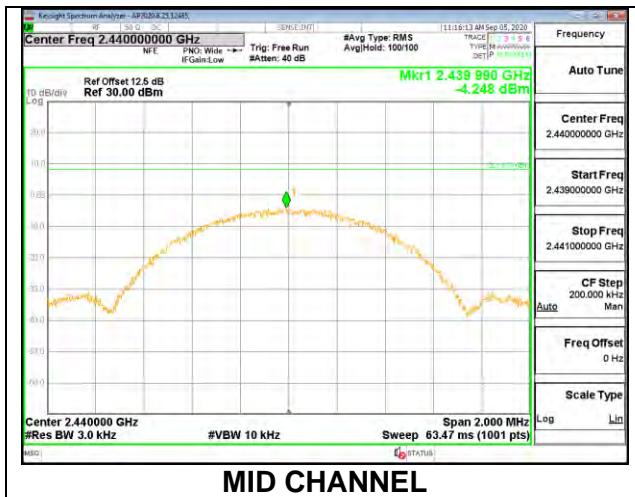
Note: Test procedures and setting are same as BLE normal mode.



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

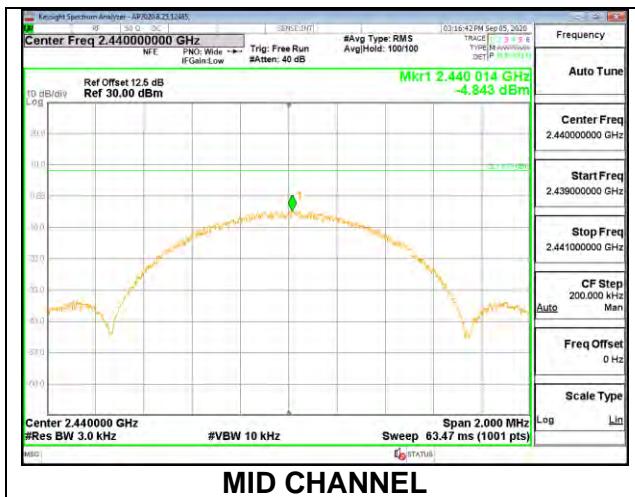
#### ANT4

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



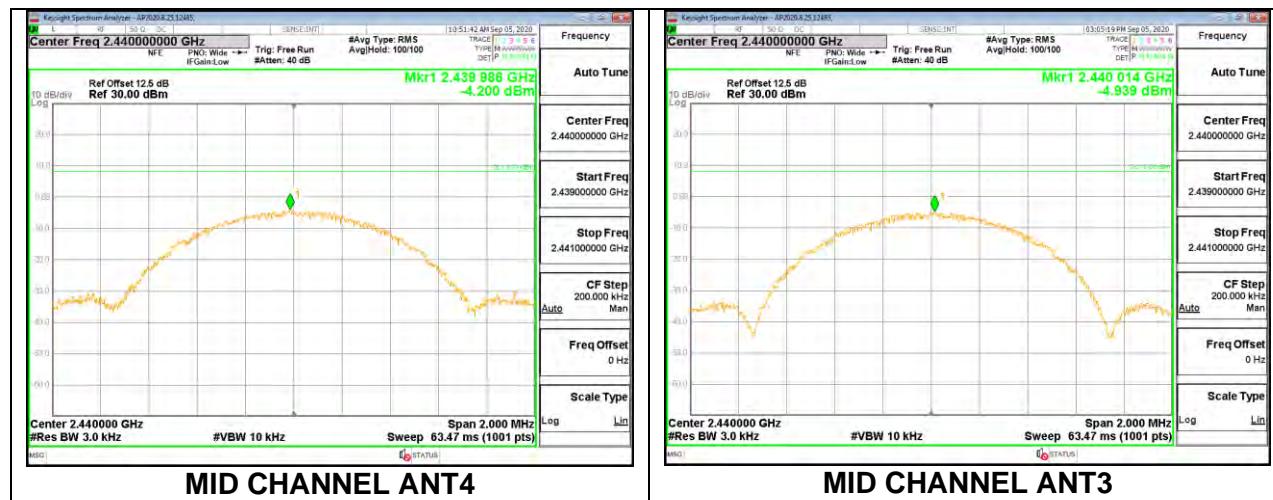
### 9.6.6. LOW POWER BLE TXBF (1Mbps)

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

#### 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

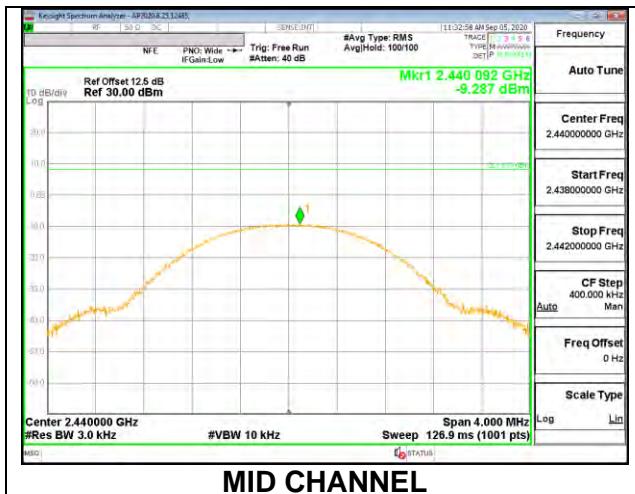
Note: Test procedures and setting are same as BLE normal mode.



### 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



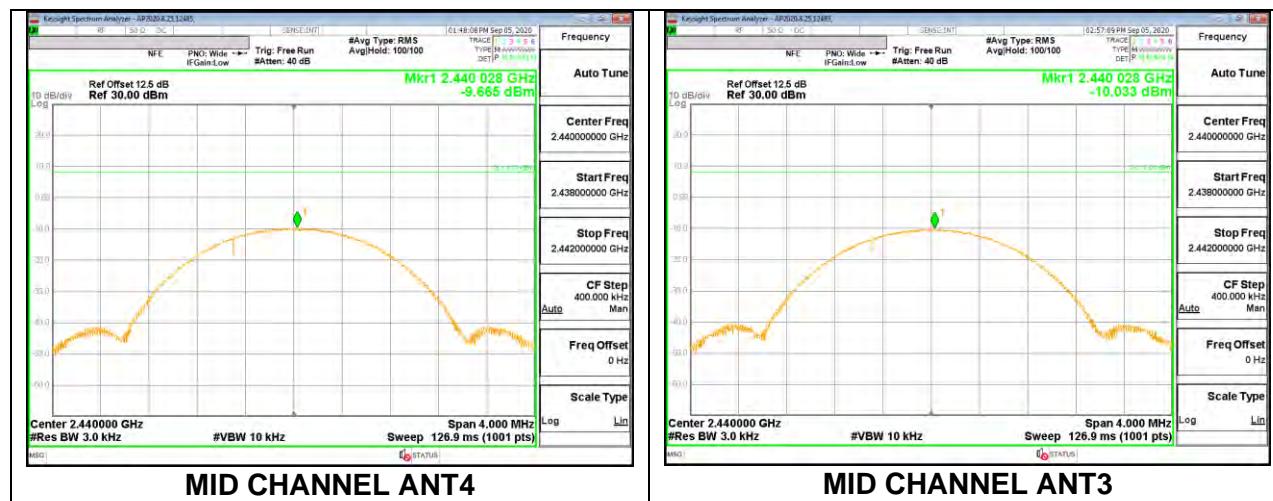
### 9.6.8. LOW POWER BLE TXBF (2Mbps)

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

#### 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
High	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

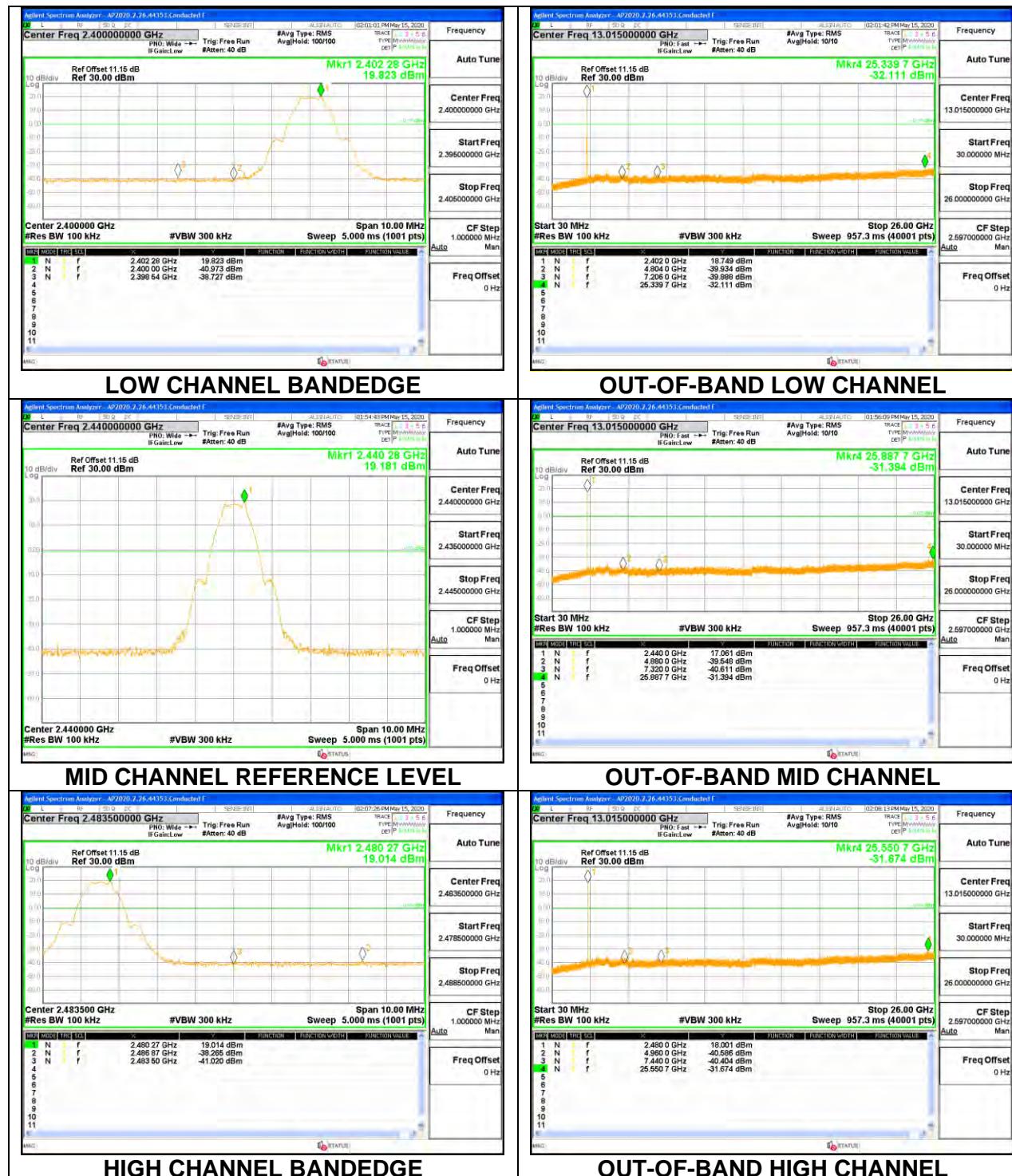
Output power was measured based on the use of a peak measurement; therefore, spurious emissions are required to be 20dBc.

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

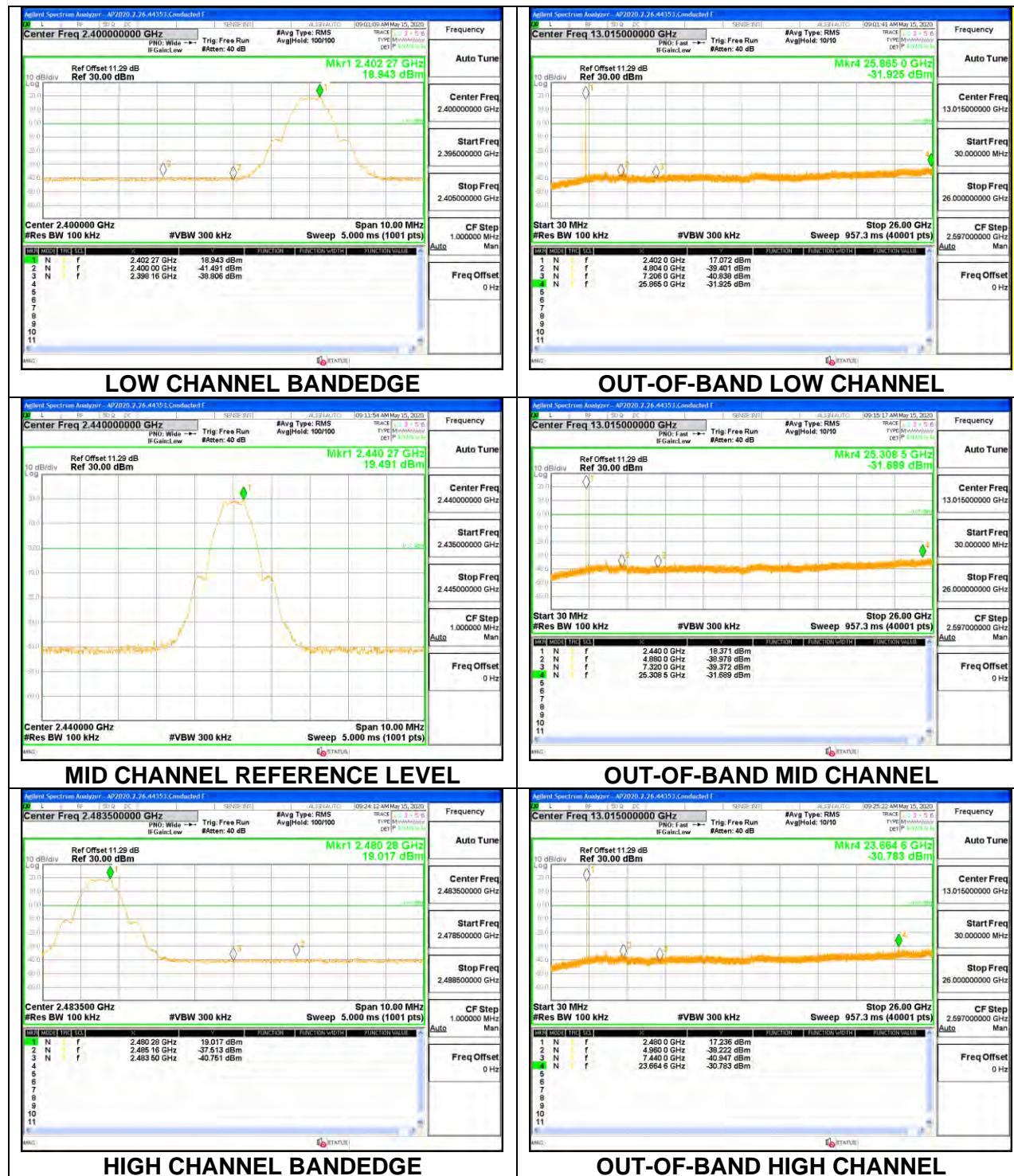
### RESULTS

## 9.7.1. HIGH POWER BLE (1Mbps)

### ANT4



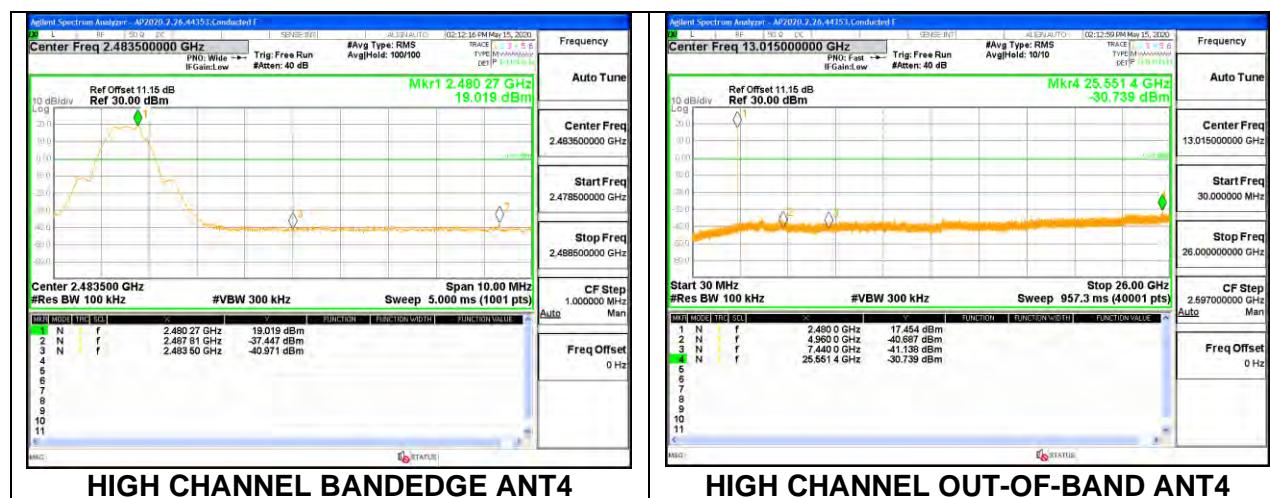
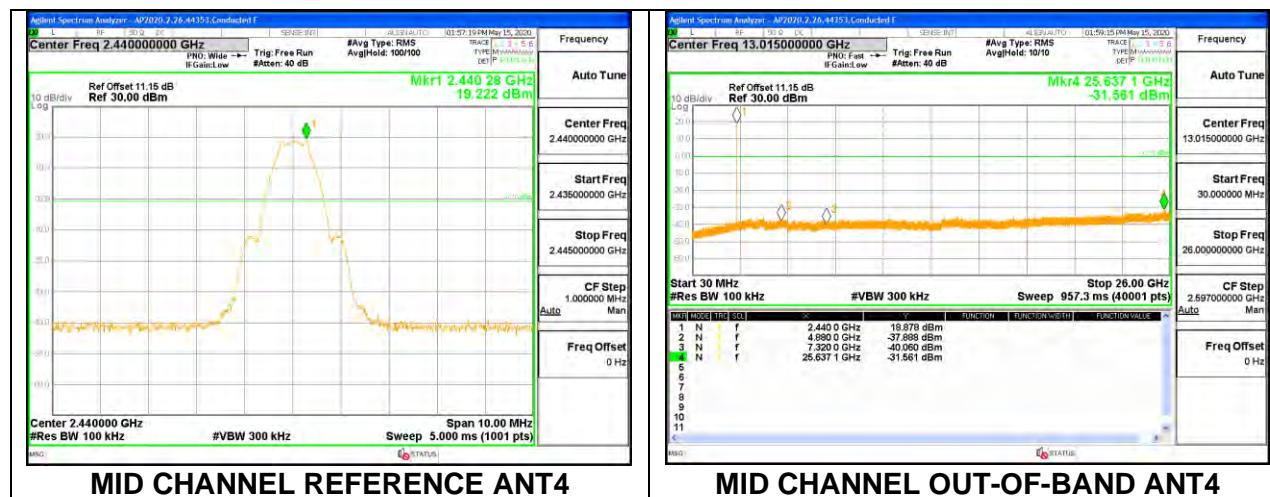
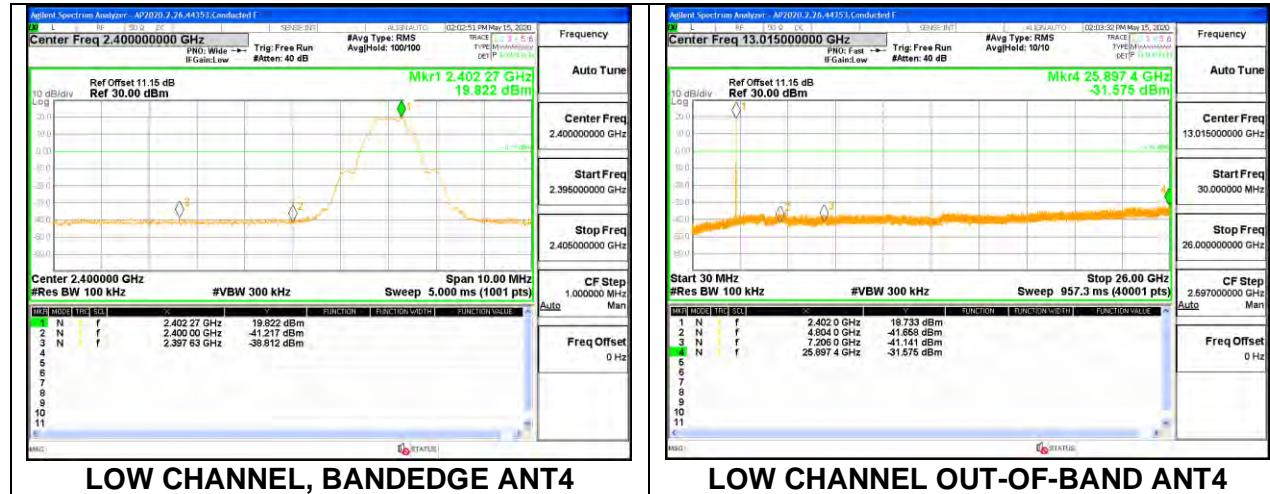
ANT3



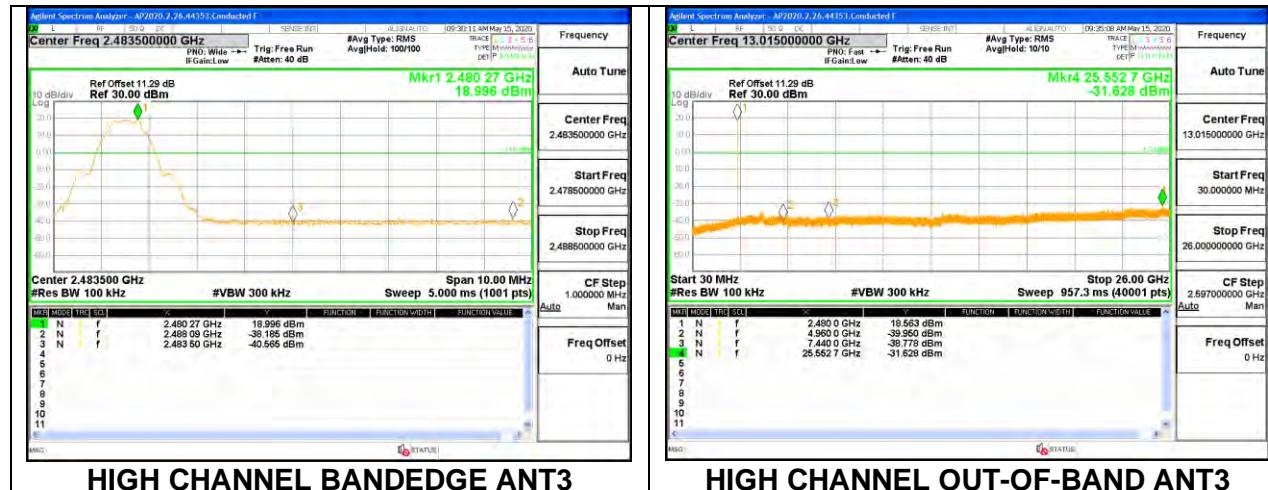
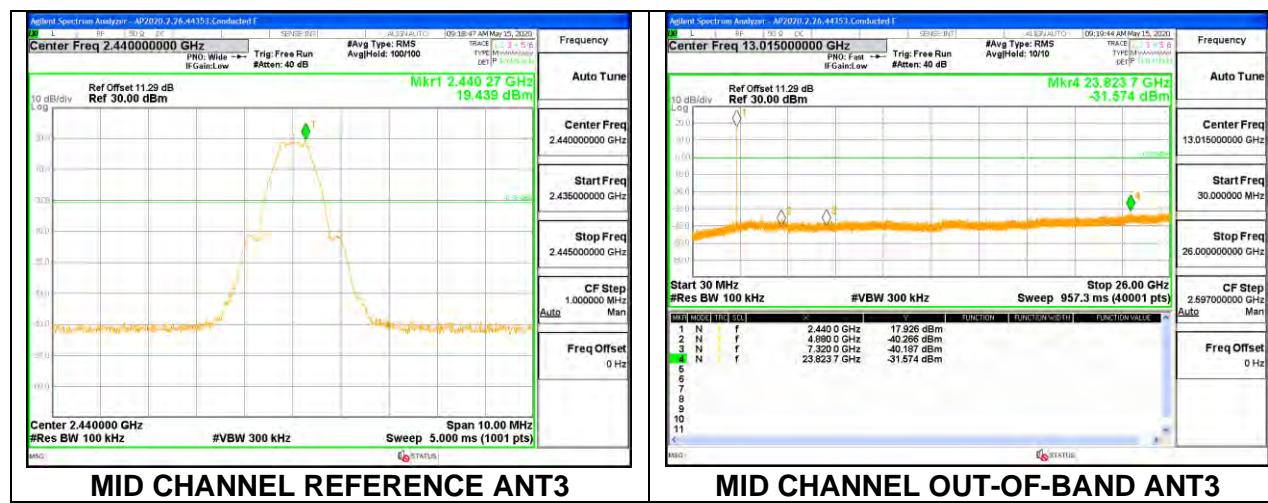
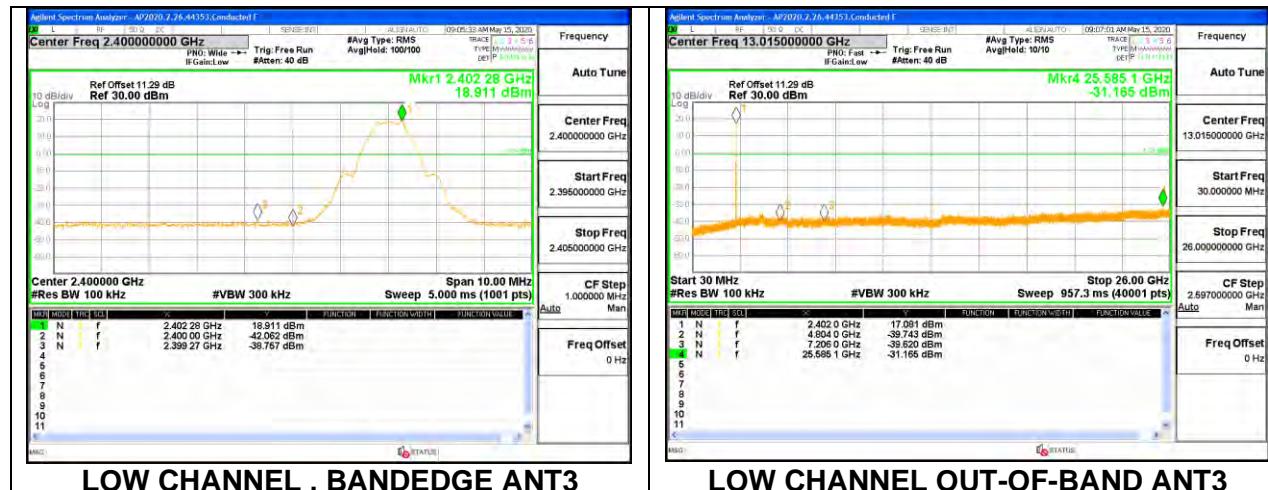
### 9.7.2. HIGH POWER BLE TXBF (1Mbps)

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

#### ANT4

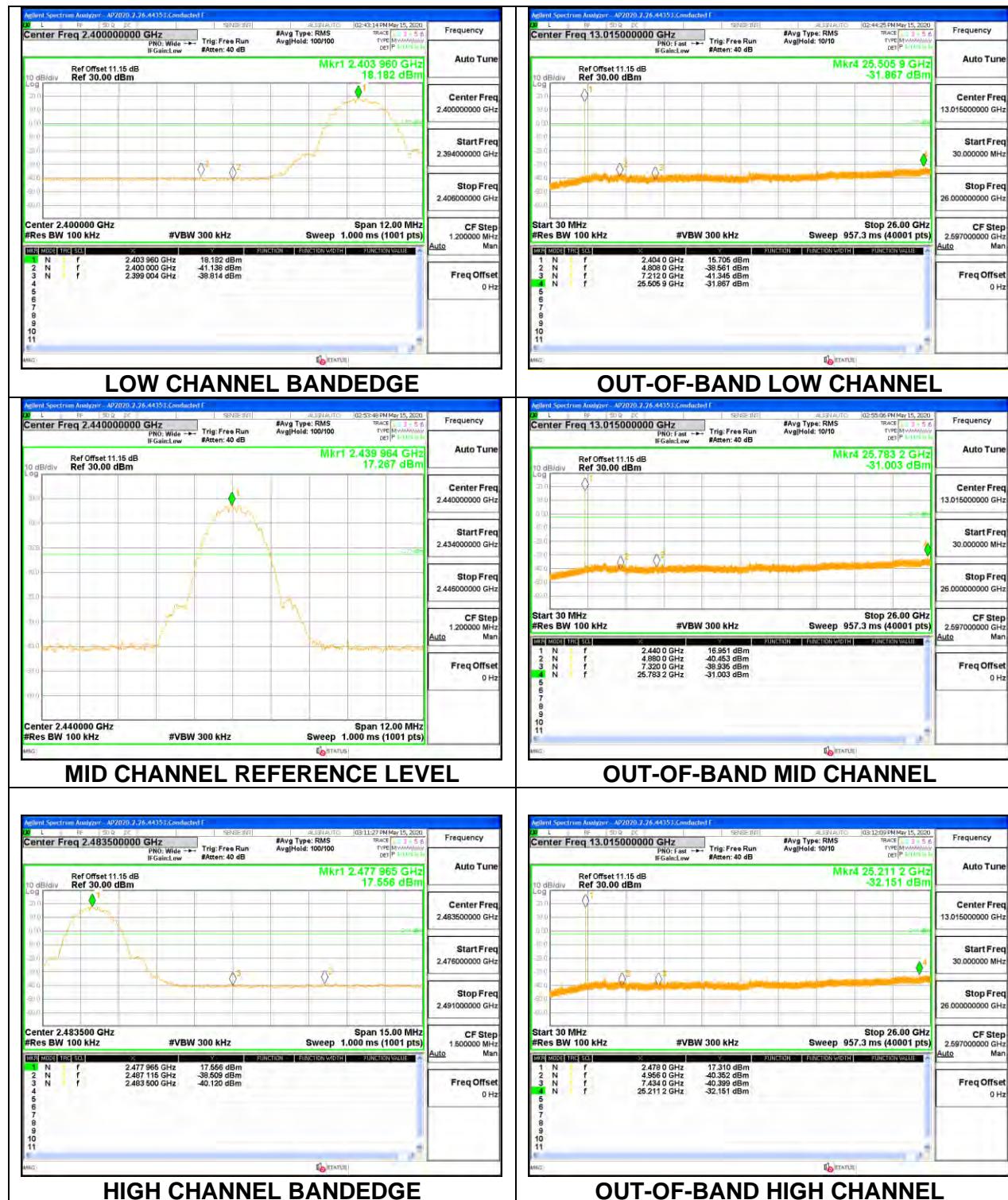


ANT3

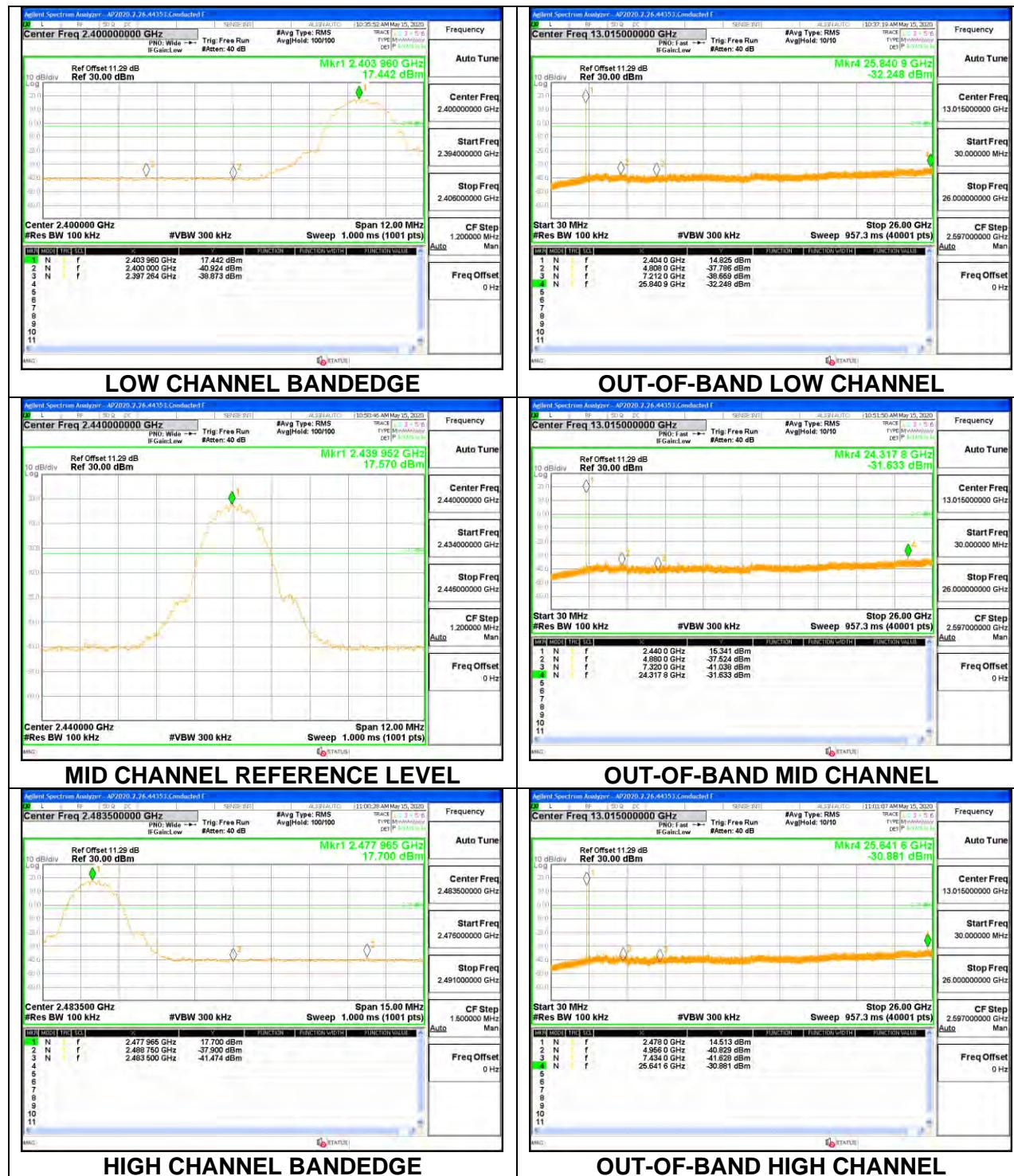


### 9.7.3. HIGH POWER BLE (2Mbps)

#### ANT4



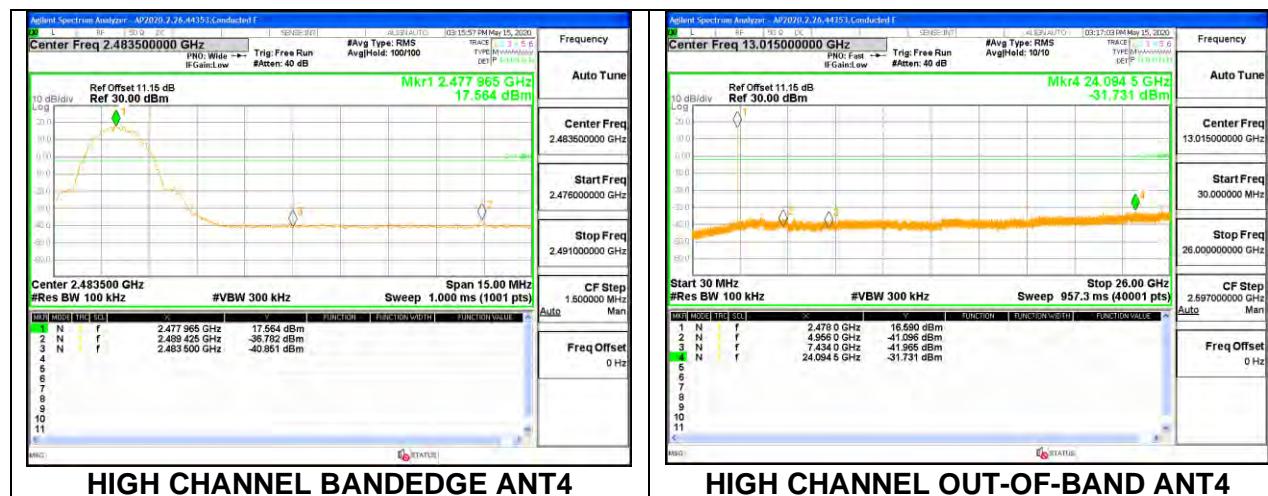
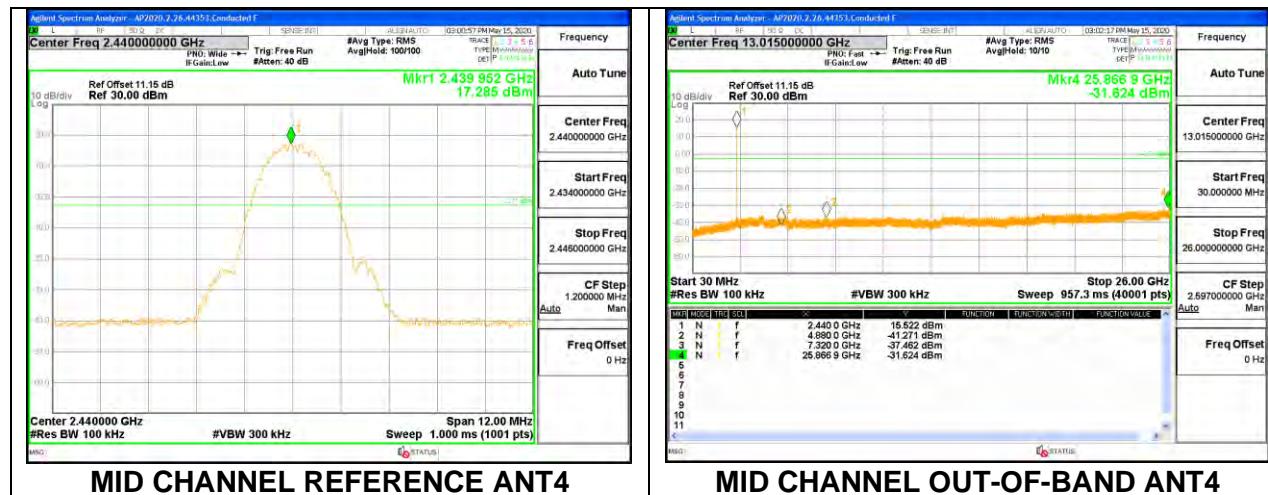
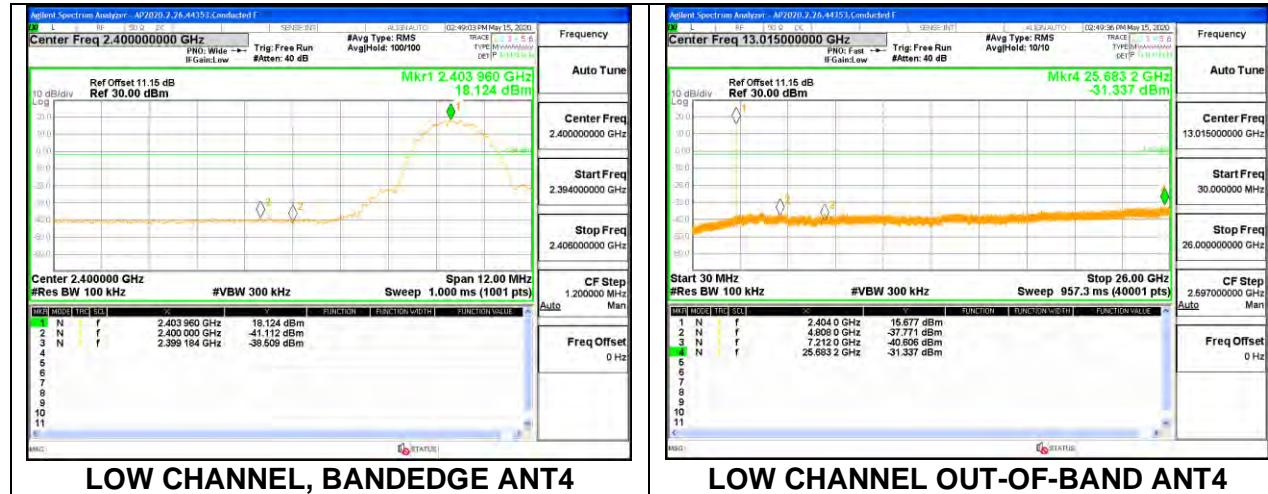
ANT3



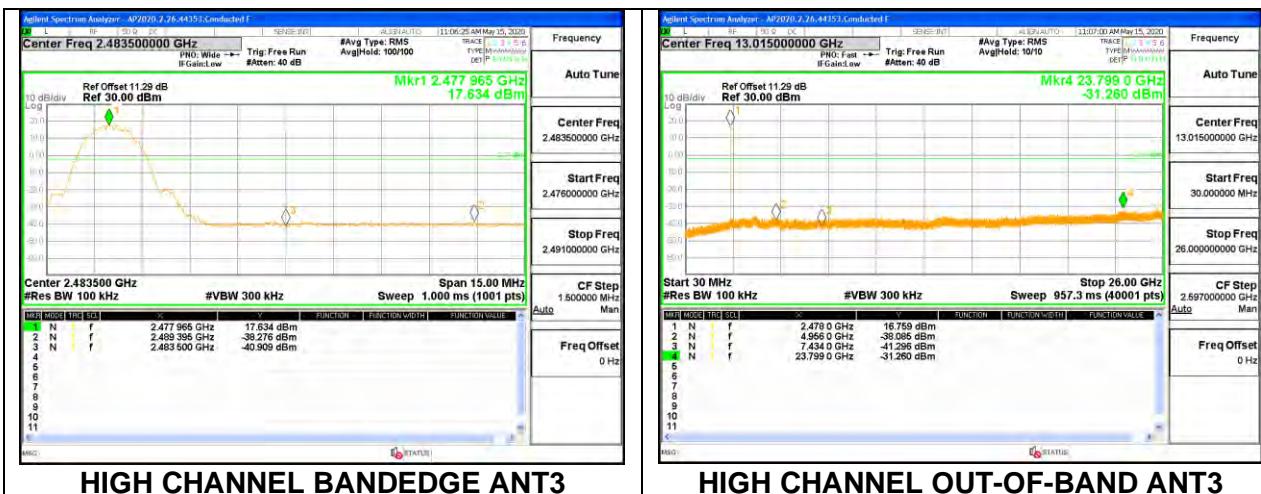
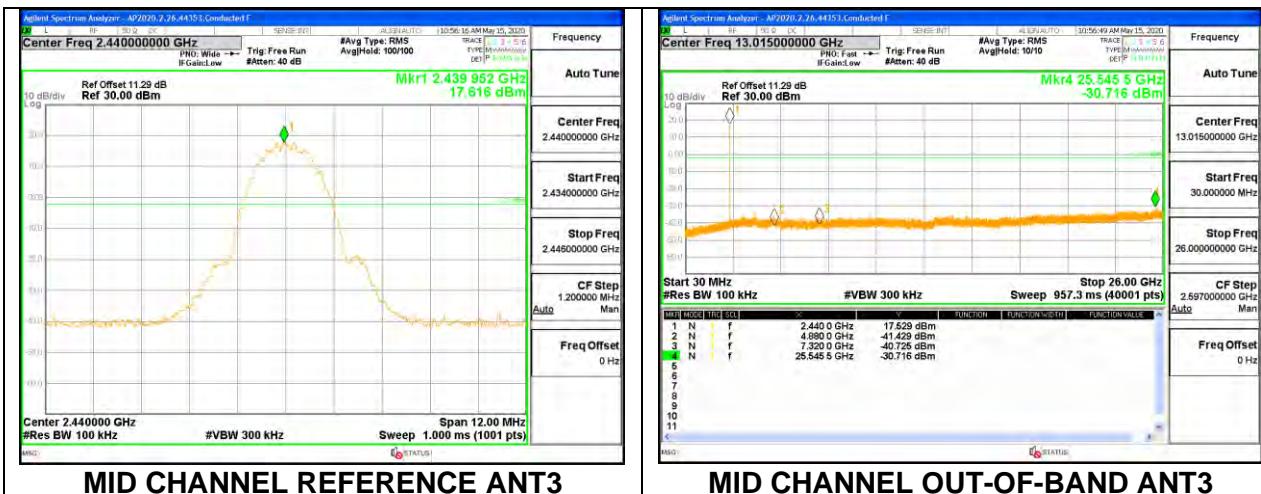
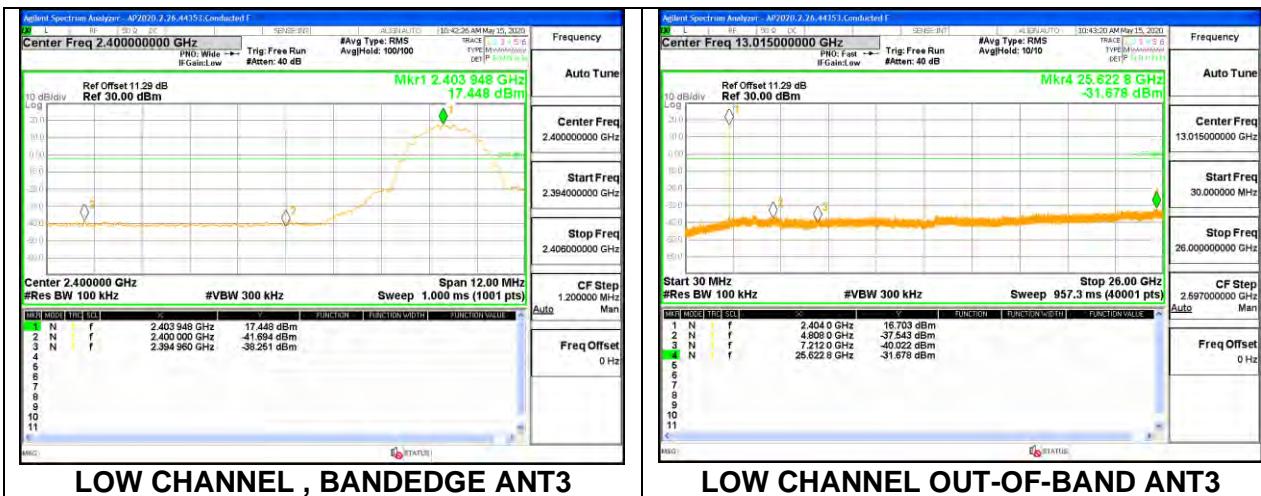
### 9.7.4. HIGH POWER BLE TXBF (2Mbps)

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

#### ANT4

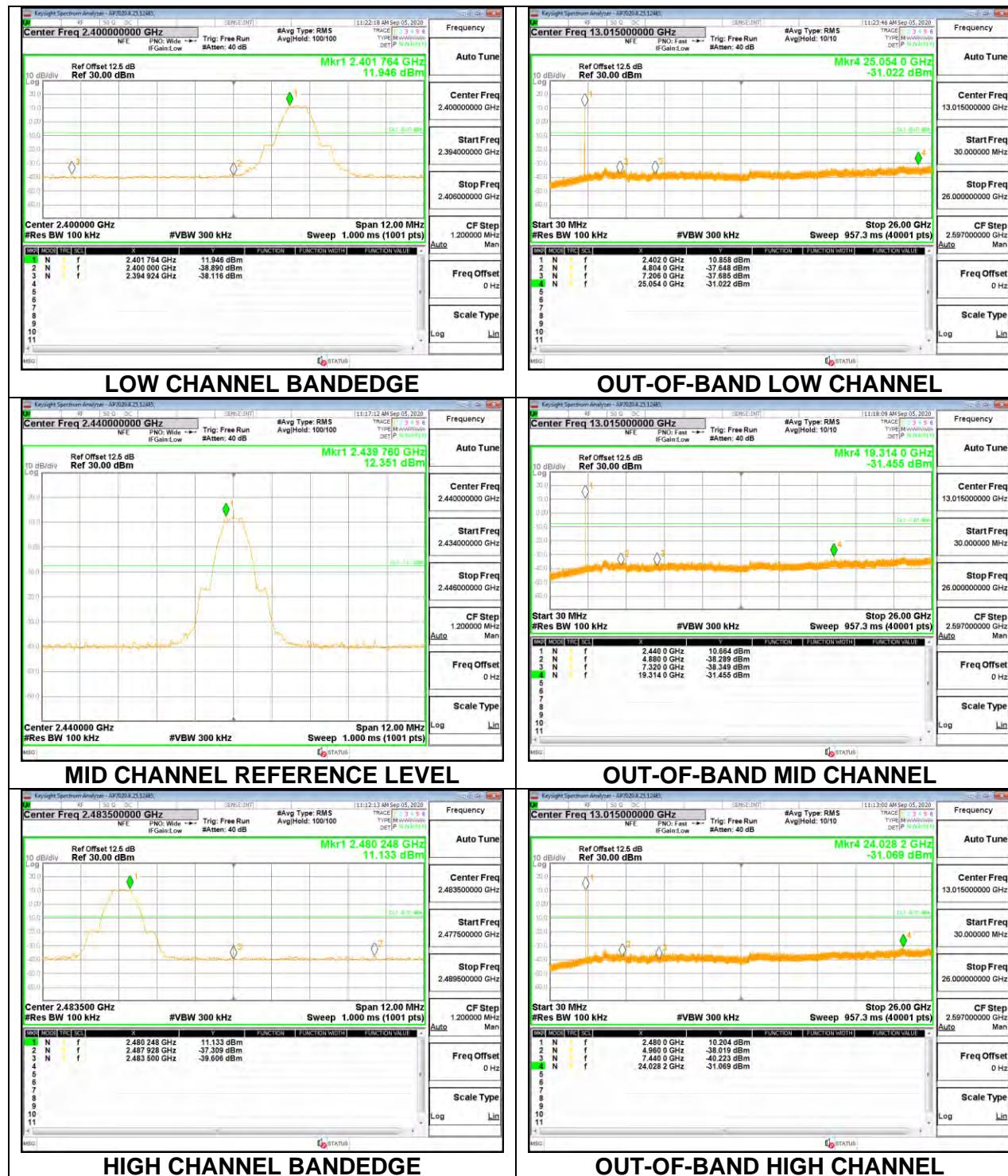


ANT3

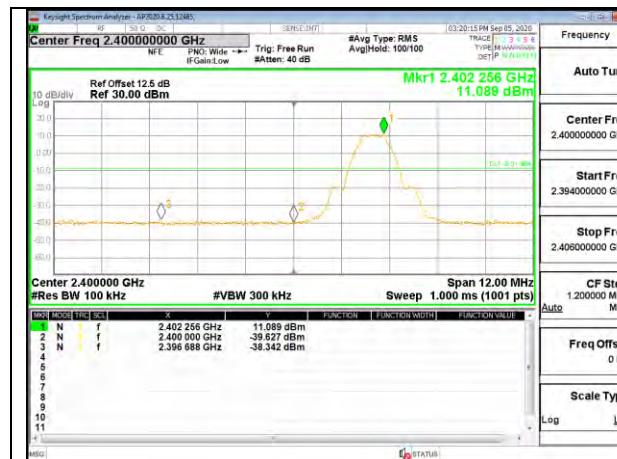


## 9.7.5. LOW POWER BLE (1Mbps)

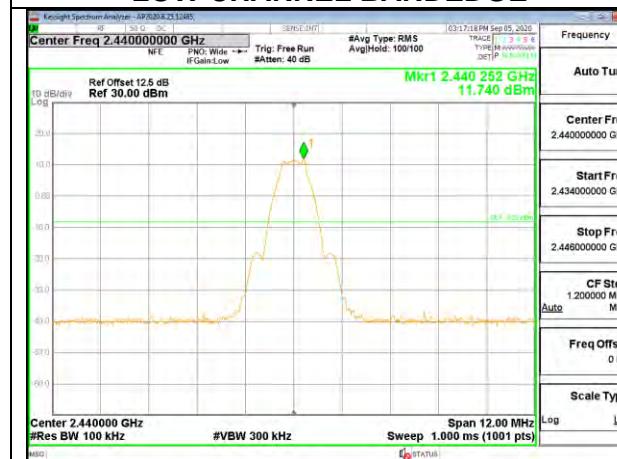
### ANT4



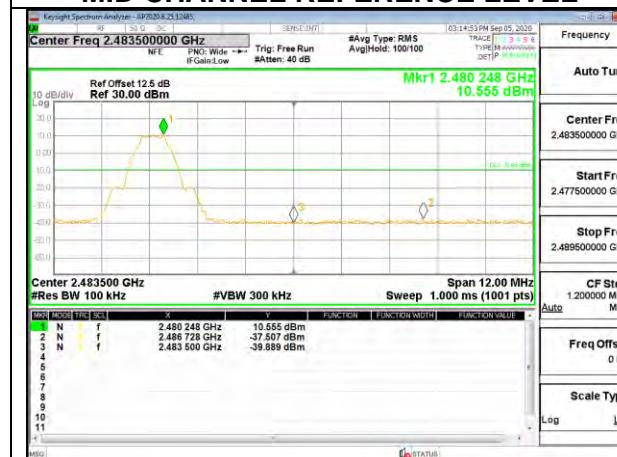
## ANT3



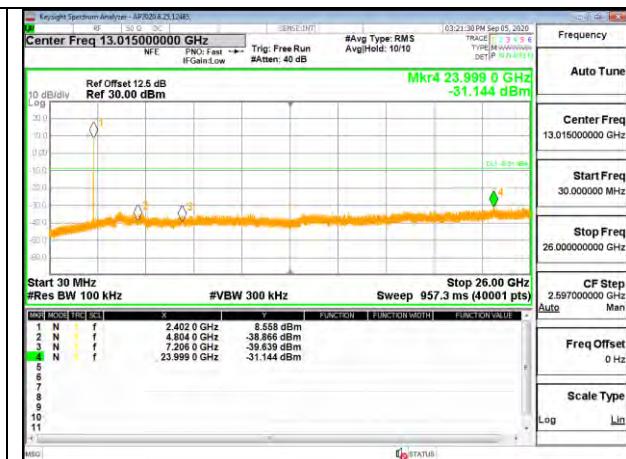
## LOW CHANNEL BANDEDGE



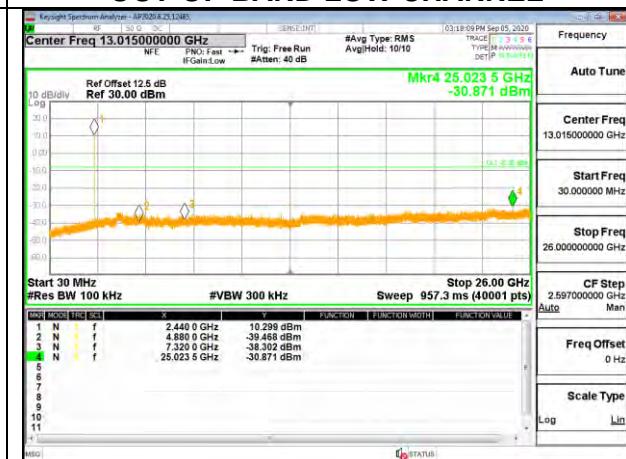
## MID CHANNEL REFERENCE LEVEL



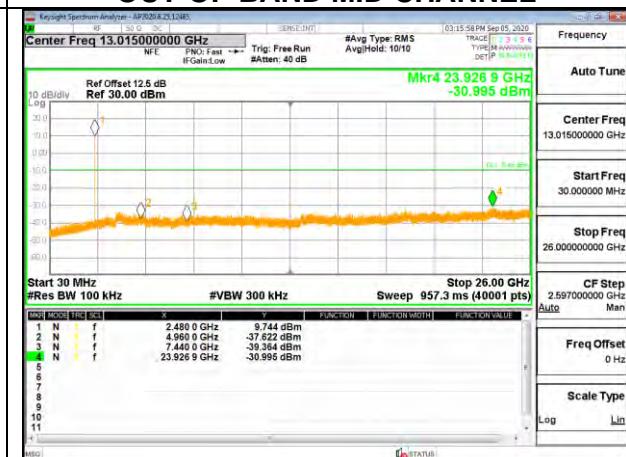
## HIGH CHANNEL BANDEDGE



## OUT-OF-BAND LOW CHANNEL



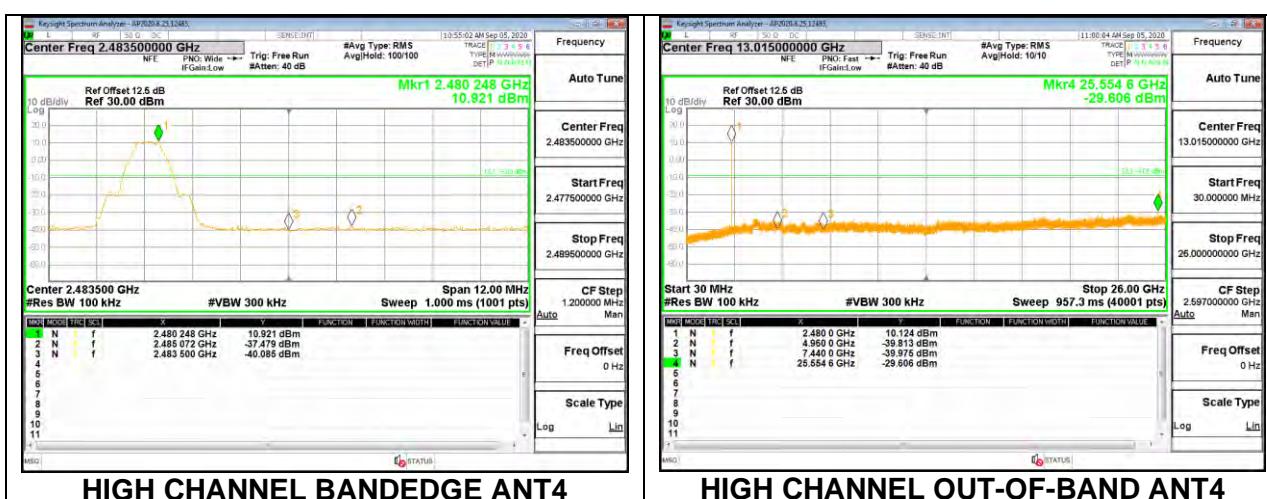
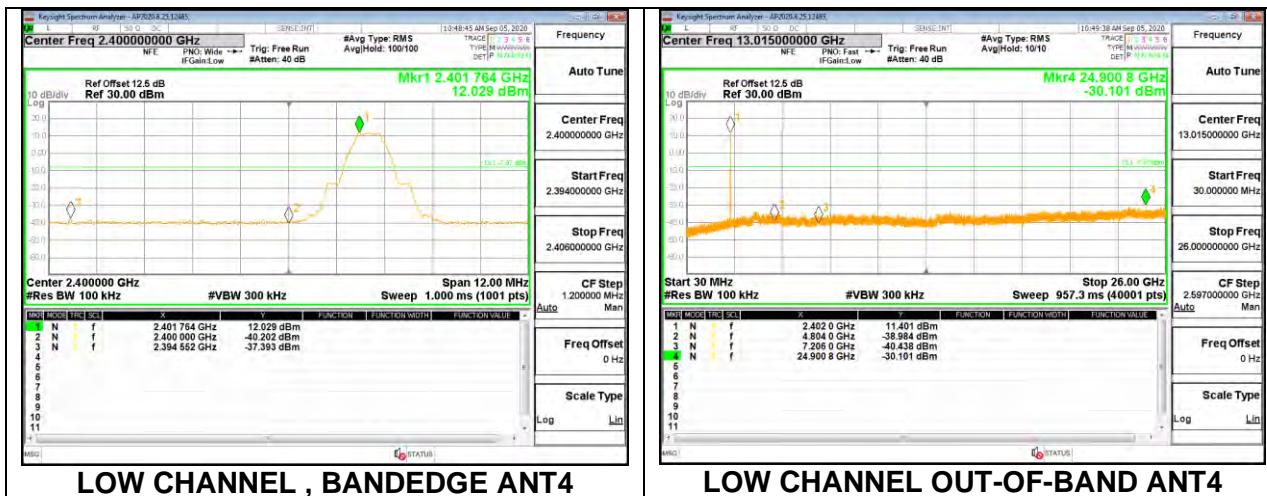
## OUT-OF-BAND MID CHANNEL



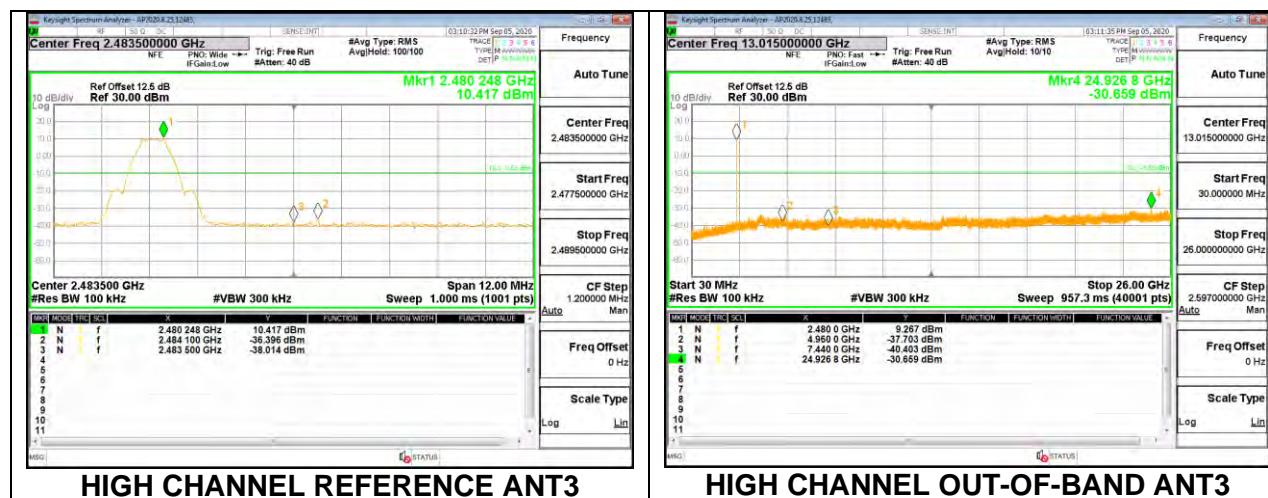
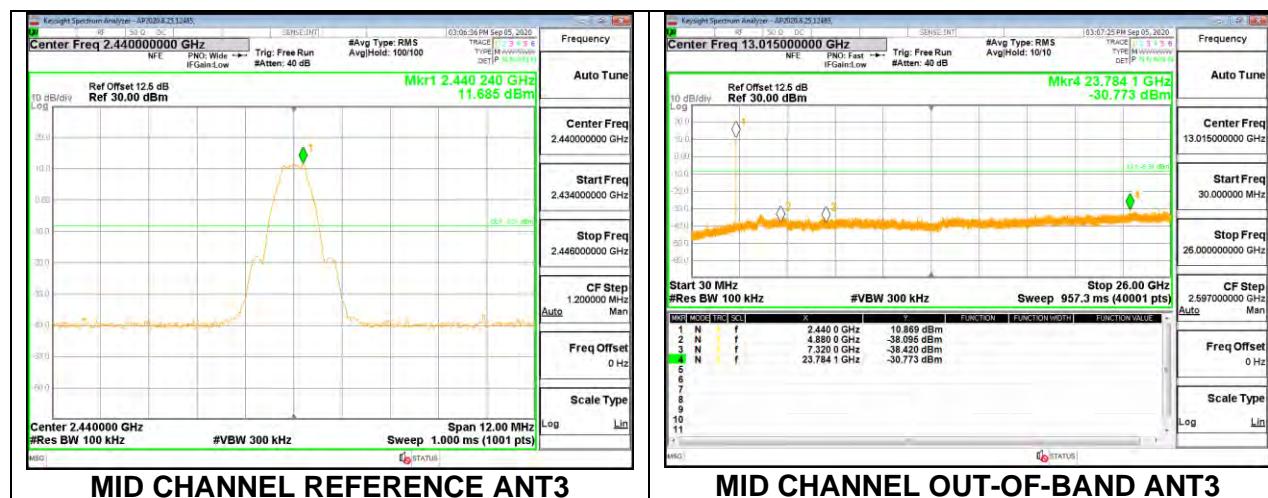
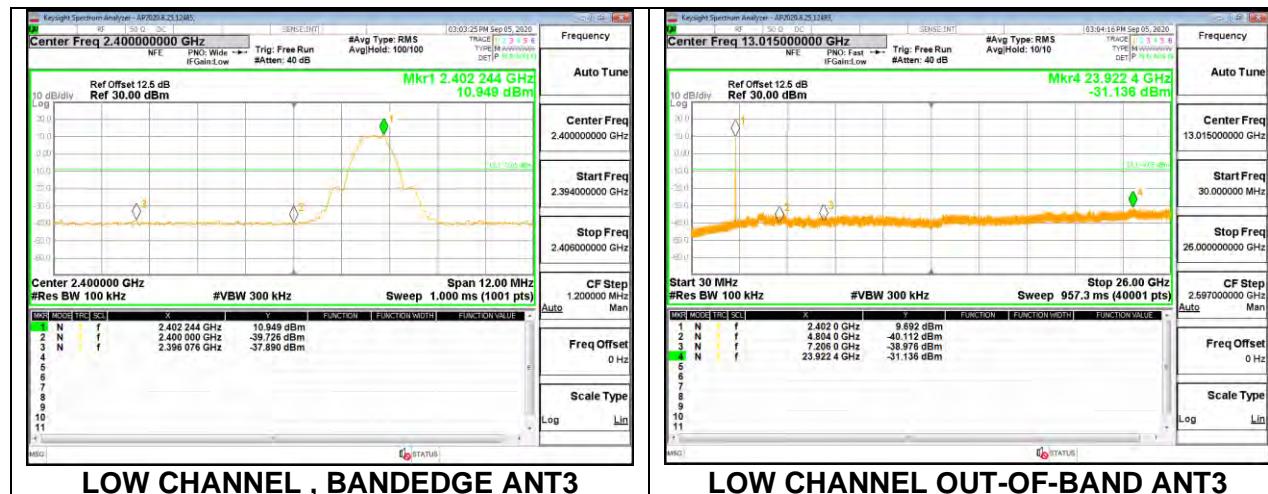
## OUT-OF-BAND HIGH CHANNEL

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

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

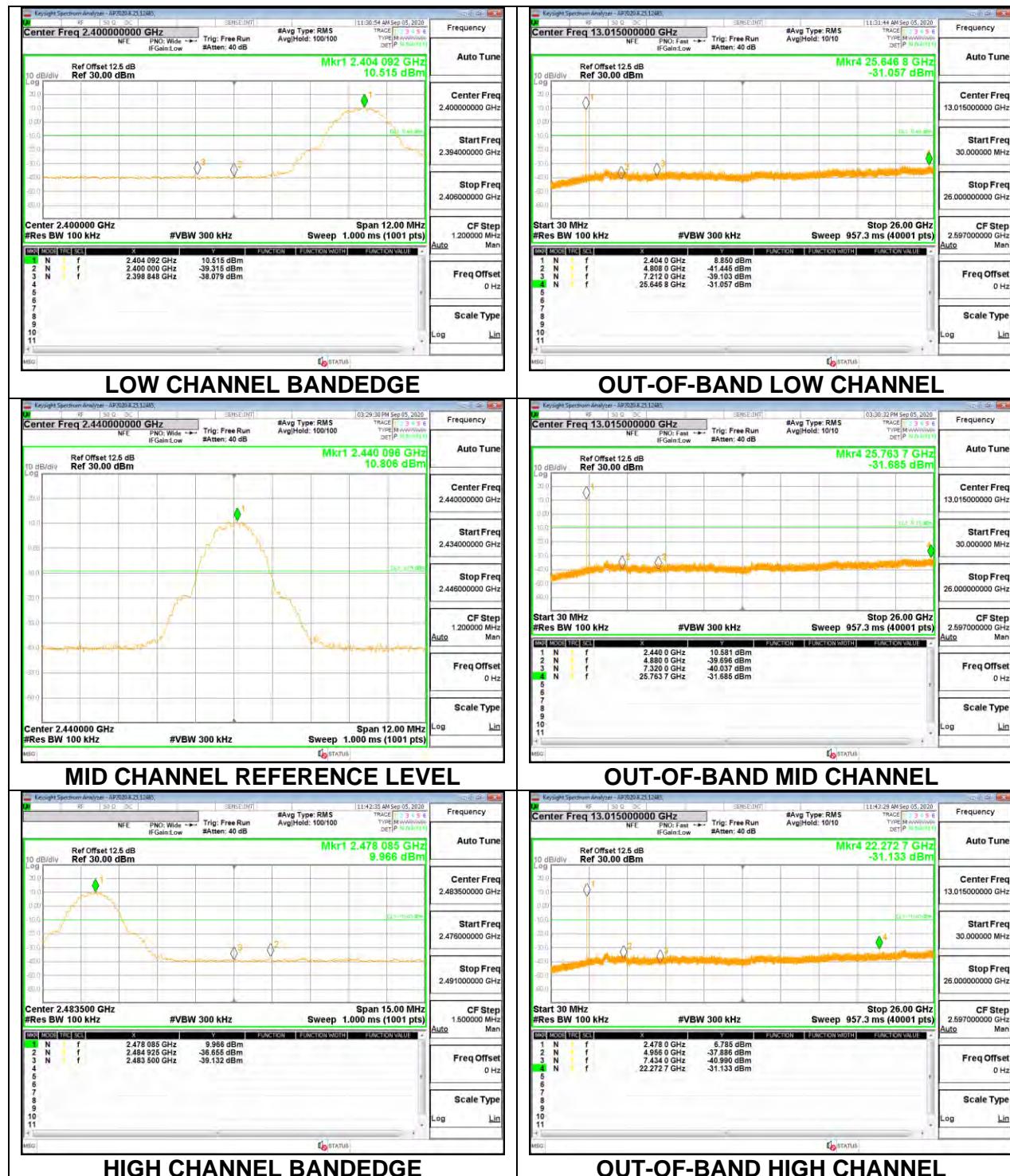


LOW POWER (1Mbps)

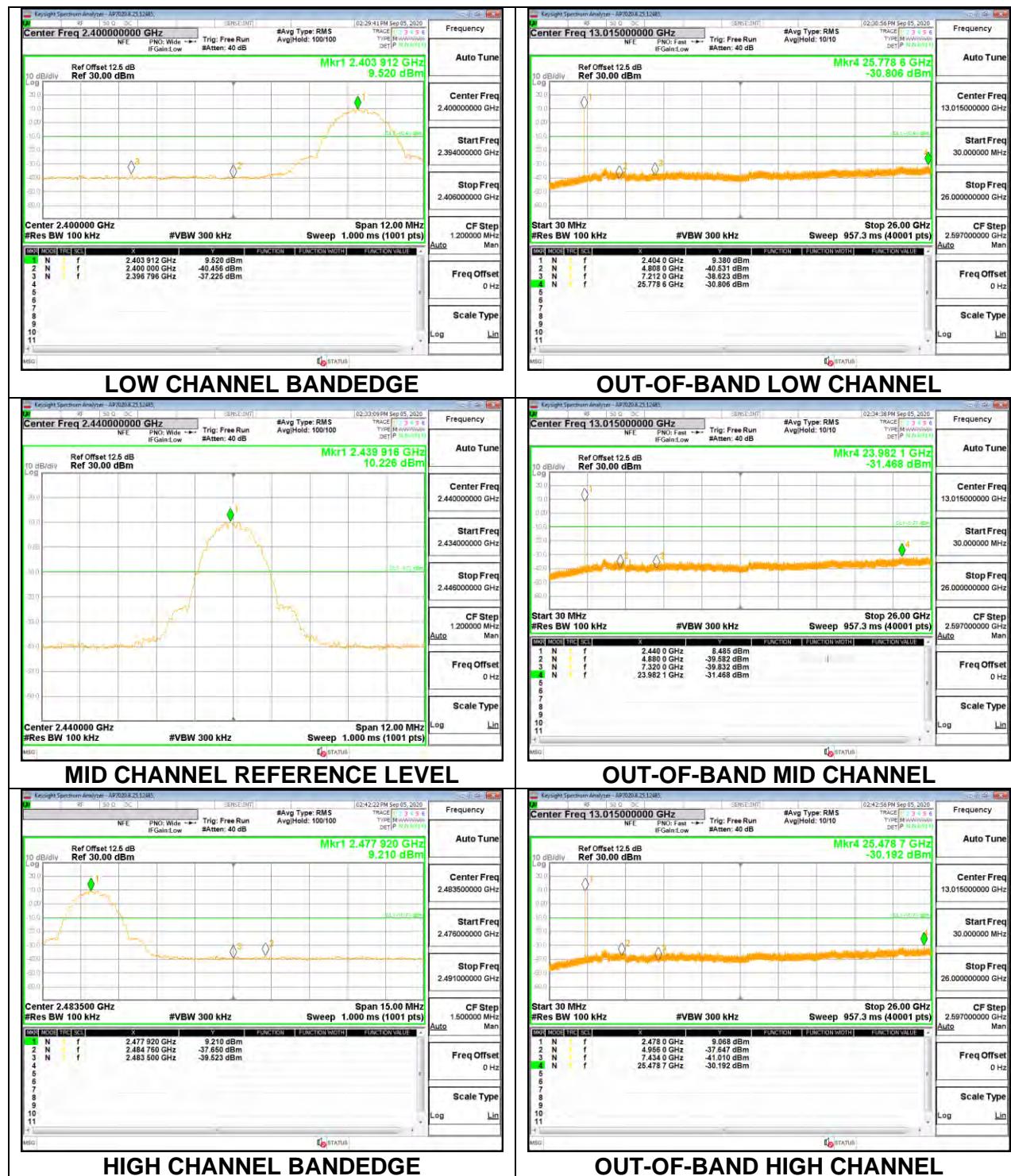


## 9.7.7. LOW POWER BLE (2Mbps)

### ANT4



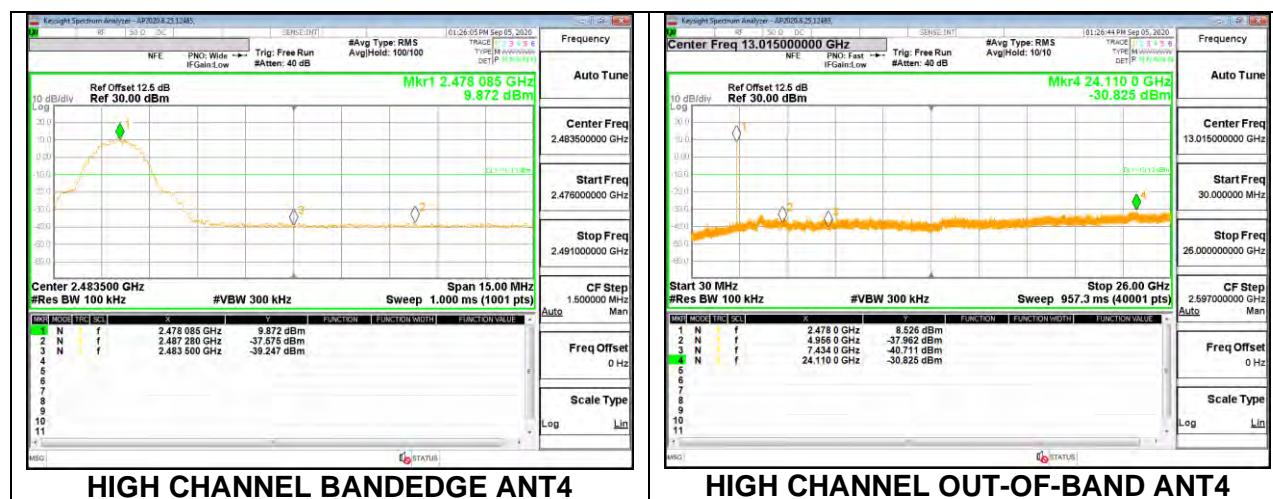
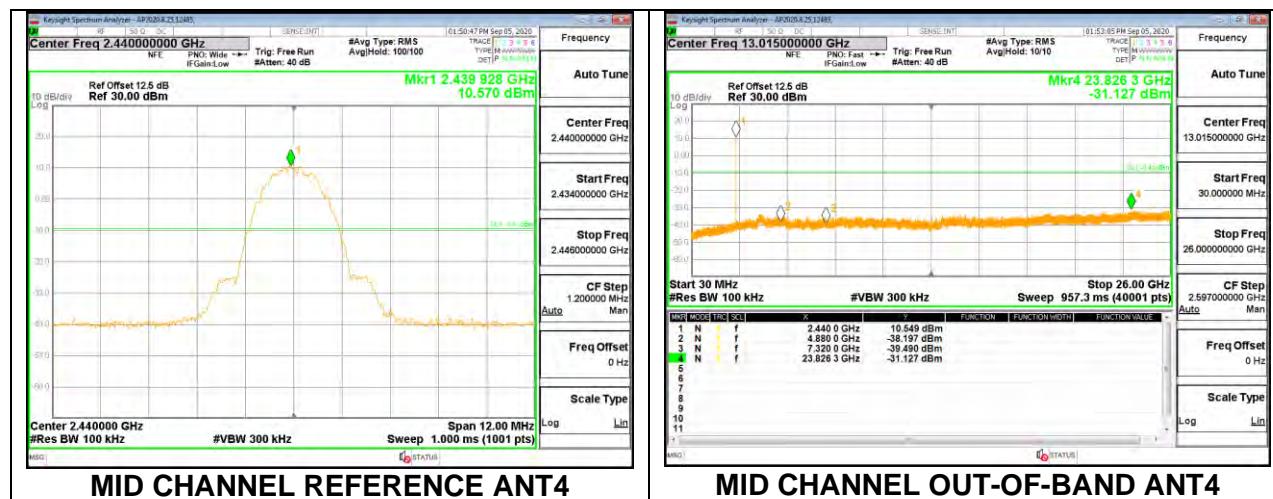
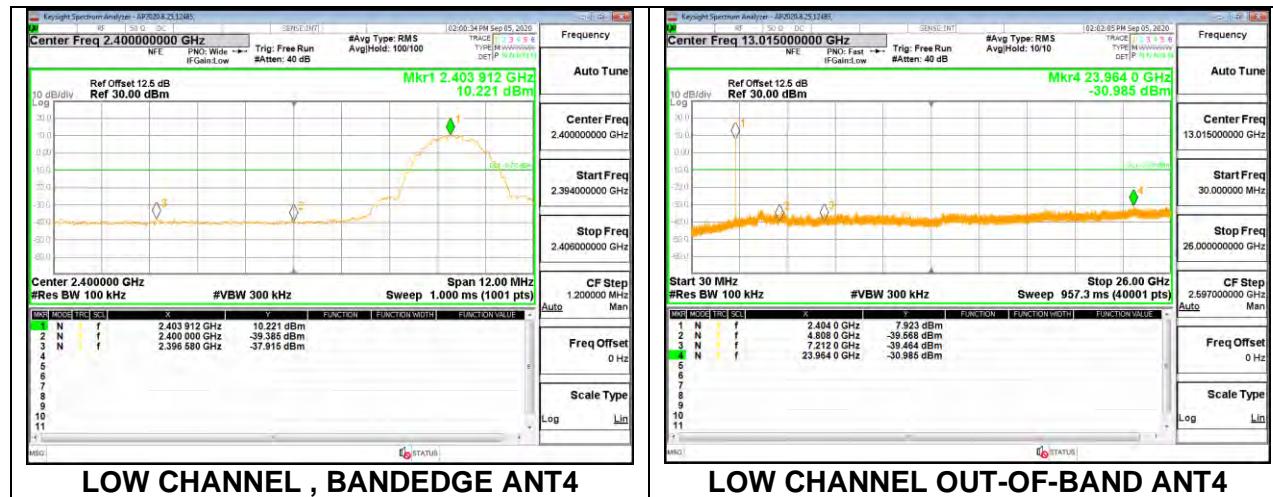
ANT3



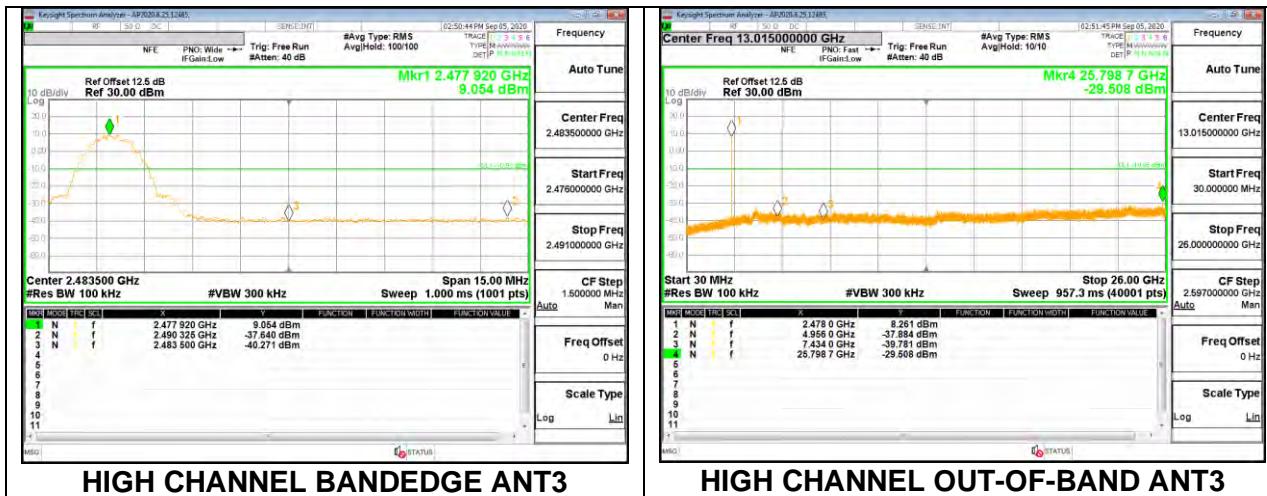
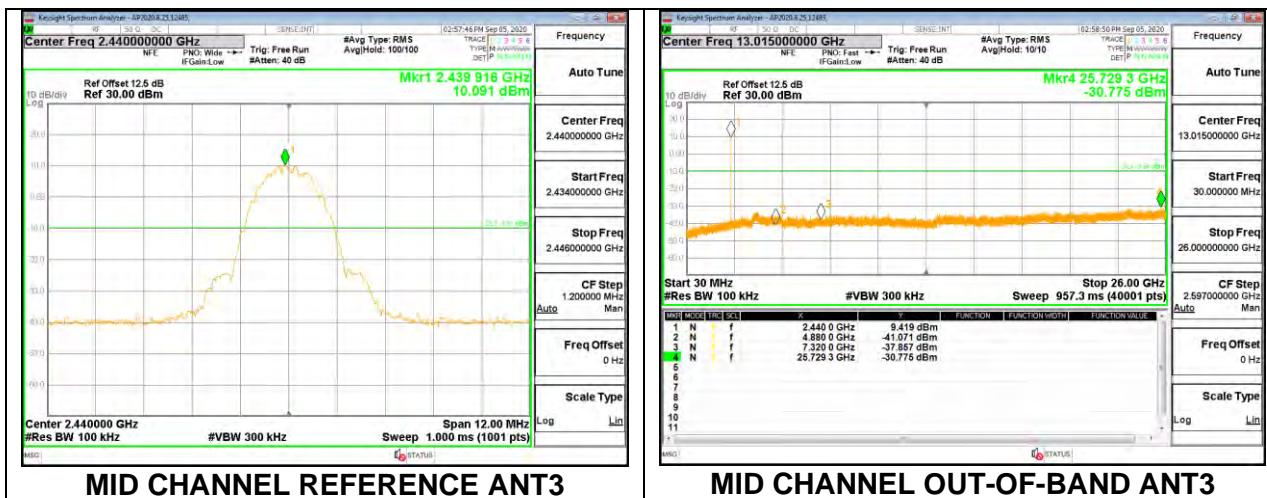
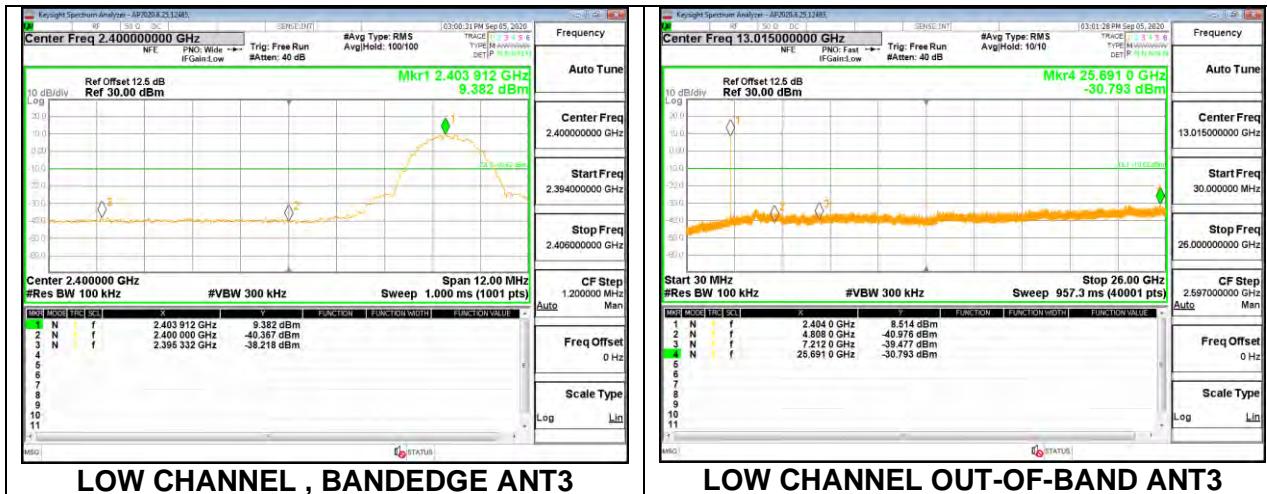
### 9.7.8. LOW POWER BLE TXBF (2Mbps)

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

#### ANT4



ANT3



## 10. RADIATED TEST RESULTS

### 10.1. LIMITS AND PROCEDURE

#### LIMITS

FCC §15.205 and §15.209

RSS-GEN, Section 8.9 and 8.10.

Frequency Range (MHz)	Field Strength Limit (uV/m) at 3 m	Field Strength Limit (dBuV/m) at 3 m
0.009-0.490	2400/F(kHz) @ 300 m	-
0.490-1.705	24000/F(kHz) @ 30 m	-
1.705 - 30	30 @ 30m	-
30 - 88	100	40
88 - 216	150	43.5
216 - 960	200	46
Above 960	500	54

#### TEST PROCEDURE

The EUT is placed on a non-conducting table 80 cm above the ground plane for measurement below 1GHz; 1.5 m above the ground plane for measurement above 1GHz. The antenna to EUT distance is 3 meters. The EUT is configured in accordance with ANSI C63.10. The EUT is set to transmit in a continuous mode.

For measurements below 1 GHz the resolution bandwidth is set to 100 kHz for peak detection measurements or 120 kHz for quasi-peak detection measurements. Peak detection is used unless otherwise noted as quasi-peak.

For pre-scans above 1 GHz the resolution bandwidth is set to 1 MHz; the video bandwidth is set to 30 KHz for peak measurements.

For final measurements above 1 GHz the resolution bandwidth is set to 1 MHz; the video bandwidth is set to 3 MHz for peak measurements and as applicable for average measurements.

The spectrum from 1 GHz to 18 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in each applicable band. Below 1GHz and above 18GHz emissions, the channel with the highest output power was tested.

The frequency range of interest is monitored at a fixed antenna height and EUT azimuth. The EUT is rotated through 360 degrees to maximize emissions received. The antenna is scanned from 1 to 4 meters above the ground plane to further maximize the emission. Measurements are made with the antenna polarized in both the vertical and the horizontal positions.

For below 30MHz testing, investigation was done on three antenna orientations (parallel, perpendicular, and ground-parallel), parallel and perpendicular are the worst orientations, therefore testing was performed on these two orientations only.

**KDB 414788 Open Field Site(OFS) and Chamber Correlation Justification**

Base on FCC 15.31 (f) (2): measurements may be performed at a distance closer than that specified in the regulations; however, an attempt should be made to avoid making measurements in the near field.

OFS and chamber correlation testing had been performed and chamber measured test result is the worst case test result.

Compliance with radiated spurious emissions limits in the restricted bands closest to the allocated 2402 – 2480 MHz band were performed on all modes for the low and high channels. 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.

Compliance with radiated spurious emissions limits in the restricted bands between 1GHz and 18GHz (except as explained for the band edge) the operating band were performed on the low, middle and high channel for 2Mbps mode. As this mode has the highest output power and highest power spectral density it is considered worst case for spurious emissions across all modes. For these tests both transmit chains were operating simultaneously and set to the maximum power per chain to cover both TXBF mode. Spurious emissions for frequencies below 1Ghz and above 18GHz were limited to the center channel as preliminary testing indicated that changing the operating frequency had no significant impact on the emissions in those frequency bands.

**RESULTS**

High Power Beamforming BLE 1Mbps mode is set to maximum power per chain to cover both SISO and MIMO modes to complies with radiated spurious emissions limits in the restricted bands between 1GHz and 18GHz low/mid/high channel (except the band edge).

Spurious emissions for frequencies below 1GHz and above 18GHz were limited to the middle channel as preliminary testing indicated that changing the operating frequency had no significant impact on the emissions in those frequency bands.

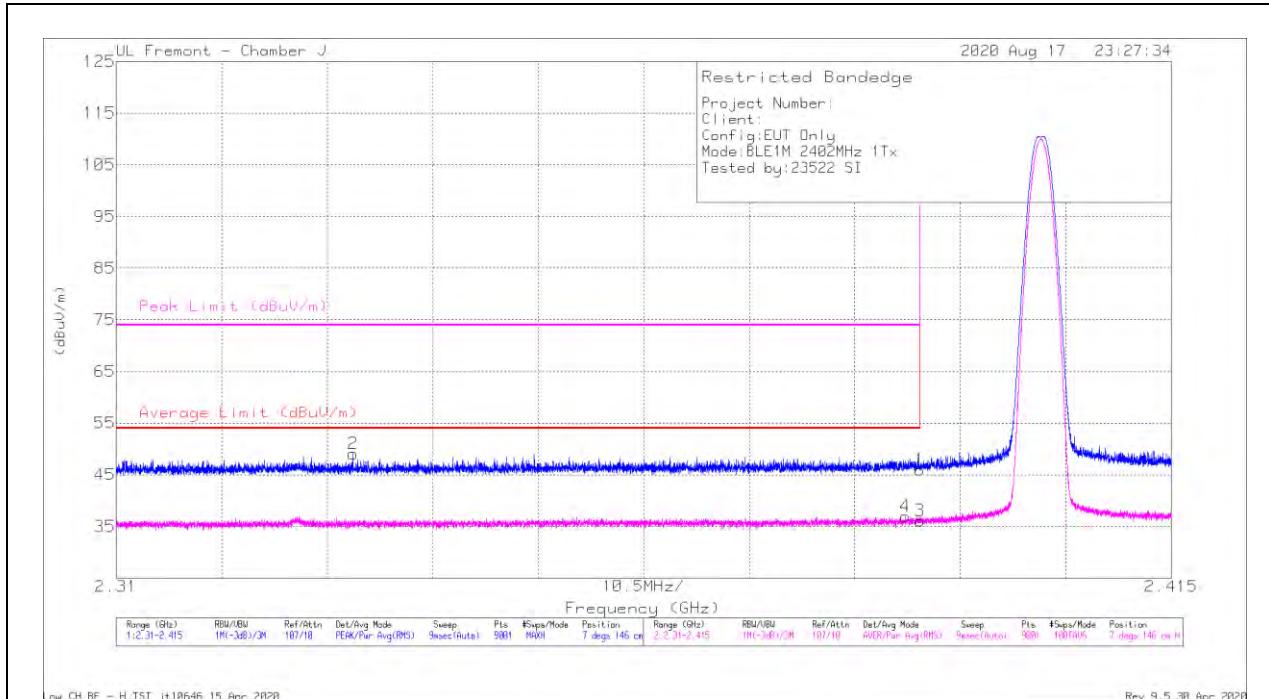
## 10.2. TRANSMITTER ABOVE 1 GHz

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

#### ANT4

#### BANDEDGE (LOW CHANNEL)

#### HORIZONTAL RESULT



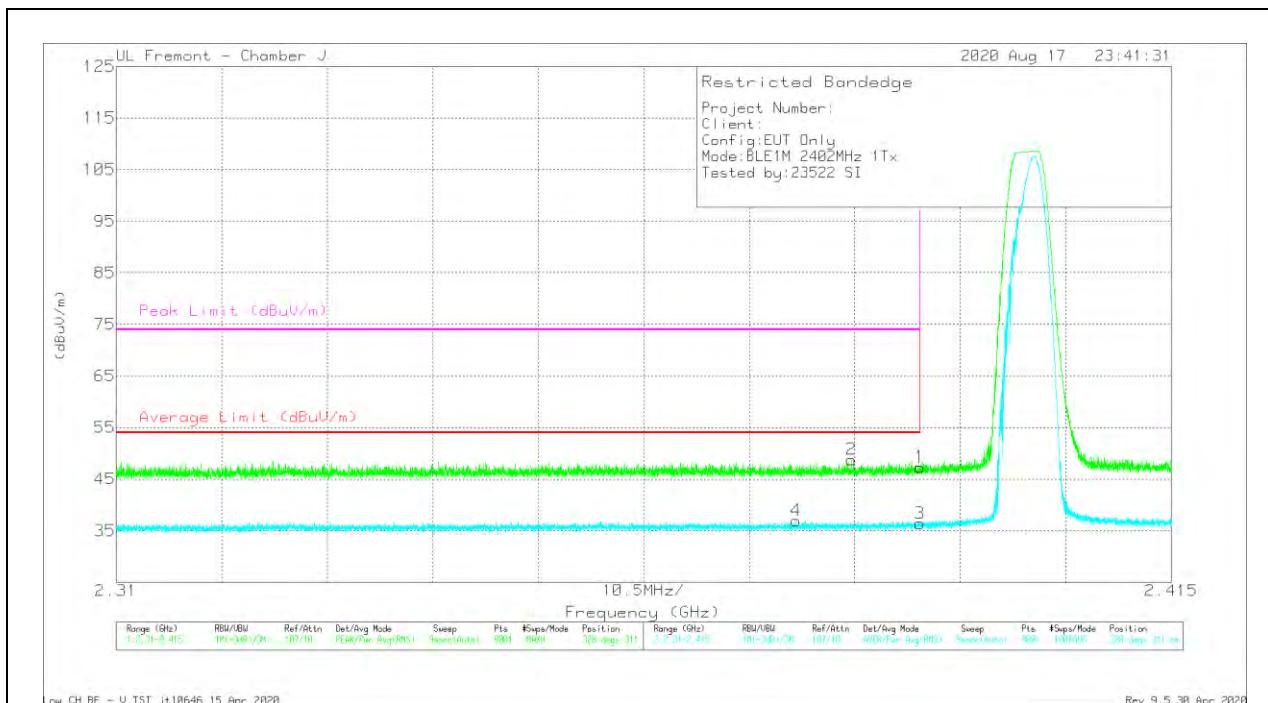
Marker	Frequency (GHz)	Meter Reading (dBm)	Det	AF T963 (dB/m)	Amp/Cbl/Filt/Pad (dB)	Corrected Reading (dBm)	Average Limit (dBm)	Margin (dB)	Peak Limit (dBm)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.38999	42.44	Pk	29	-25.5	45.94	-	-	74	-28.06	7	146	H
2	* 2.33354	45.75	Pk	28.9	-25.6	49.05	-	-	74	-24.95	7	146	H
3	* 2.38999	32.6	RMS	29	-25.5	36.1	54	-17.9	-	-	7	146	H
4	* 2.38854	33.44	RMS	29	-25.5	36.94	54	-17.06	-	-	7	146	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/Cb/Ftr/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	43.81	Pk	29	-25.5	47.31	-	-	74	-26.69	328	311	V
2	* 2.38314	45.3	Pk	29	-25.5	48.8	-	-	74	-25.2	328	311	V
3	* 2.38999	32.89	RMS	29	-25.5	36.39	54	-17.61	-	-	328	311	V
4	* 2.37765	33.43	RMS	29	-25.5	36.93	54	-17.07	-	-	328	311	V

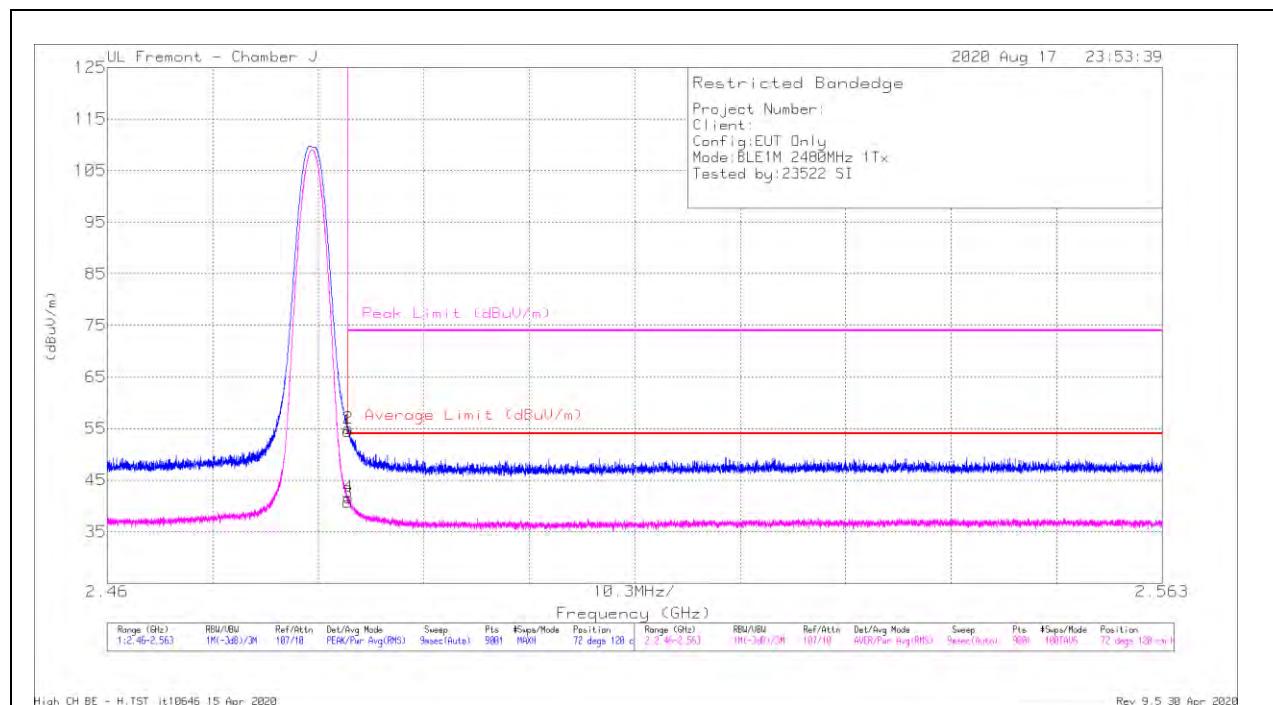
\* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

PK - Peak detector

RMS - RMS detection

**BANDEDGE (HIGH CHANNEL)**

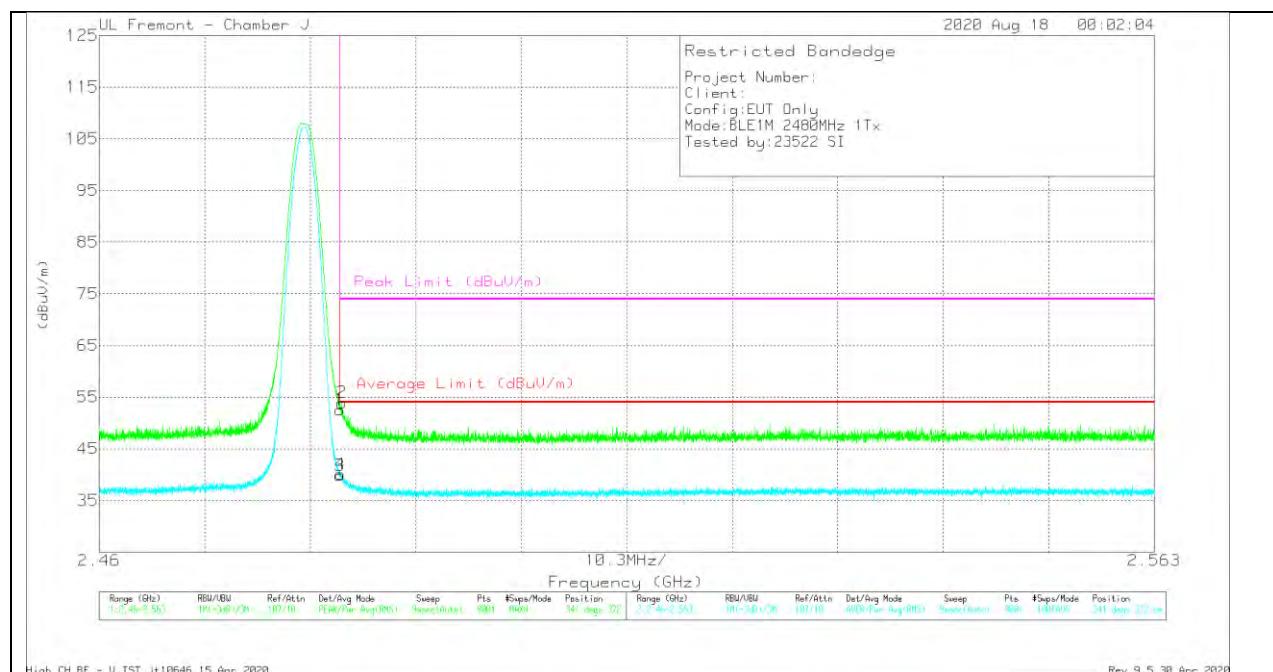
**HORIZONTAL RESULT**



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T963 (dB/m)	Amp/Cb/Ftr/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	50.52	Pk	29.5	-25.5	54.52	-	-	74	-19.48	72	120	H
2	* 2.48355	51.03	Pk	29.5	-25.5	55.03	-	-	74	-18.97	72	120	H
3	* 2.48351	36.67	RMS	29.5	-25.5	40.67	54	-13.33	-	-	72	120	H
4	* 2.48354	37.6	RMS	29.5	-25.5	41.6	54	-12.4	-	-	72	120	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/Cb/Filt/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	48.48	Pk	29.5	-25.5	52.48	-	-	74	-21.52	341	372	V
2	* 2.48365	49.91	Pk	29.5	-25.5	53.91	-	-	74	-20.09	341	372	V
3	* 2.48351	35.82	RMS	29.5	-25.5	39.82	54	-14.18	-	-	341	372	V
4	* 2.48353	36.07	RMS	29.5	-25.5	40.07	54	-13.93	-	-	341	372	V

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

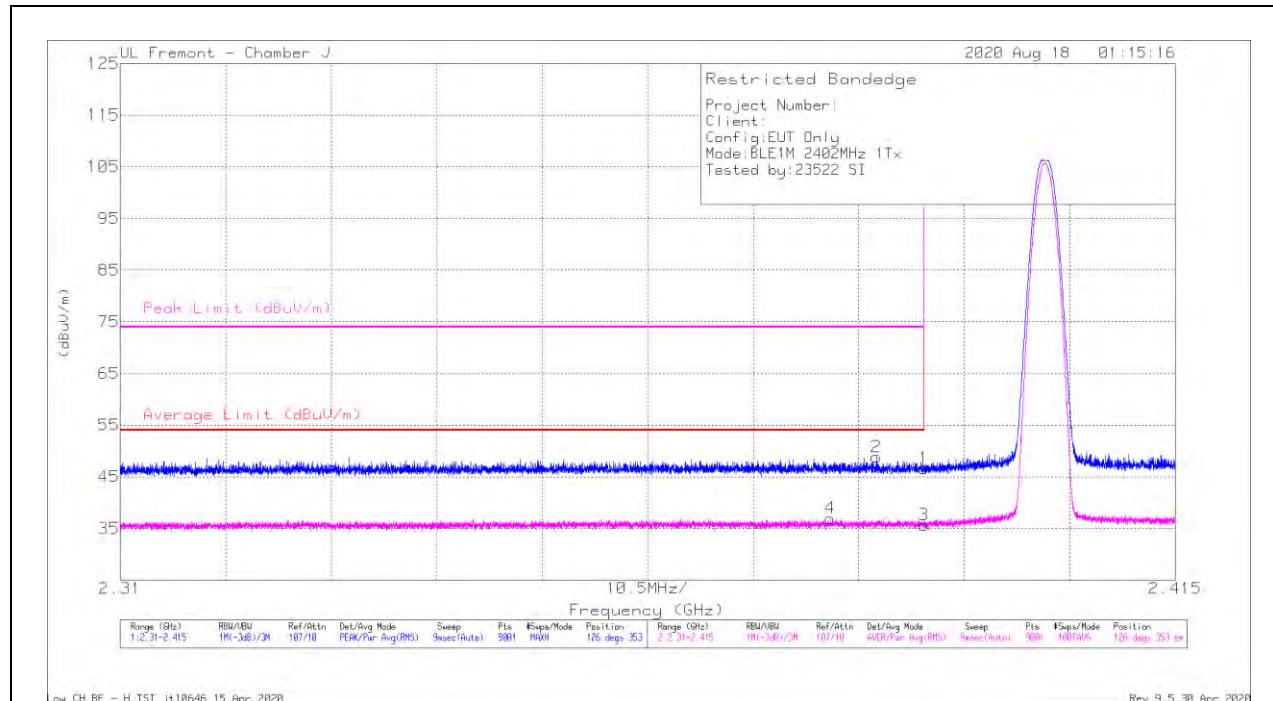
PK - Peak detector

RMS - RMS detection

ANT3

**BANDEDGE (LOW CHANNEL)**

**HORIZONTAL RESULT**



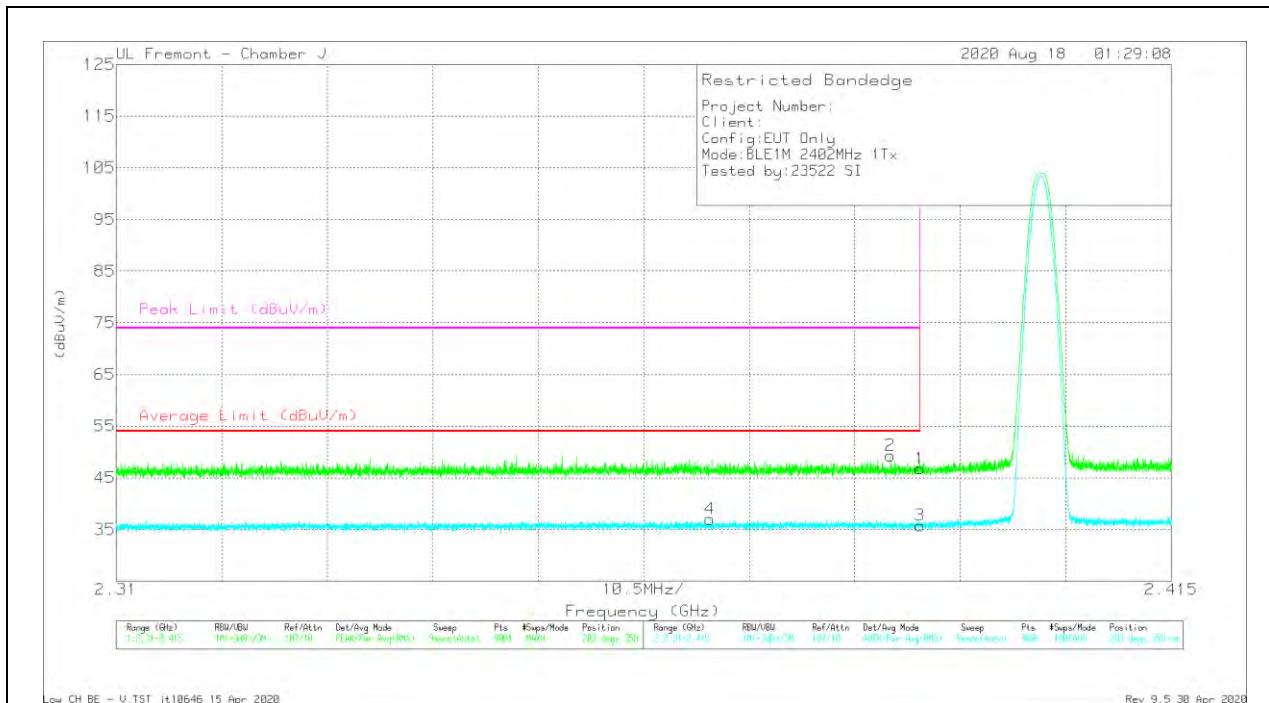
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T963 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.38999	43.13	Pk	29	-25.5	46.63	-	-	74	-27.37	126	353	H
2	* 2.38526	45.36	Pk	29	-25.5	48.86	-	-	74	-25.14	126	353	H
3	* 2.38999	32.15	RMS	29	-25.5	35.65	54	-18.35	-	-	126	353	H
4	* 2.38066	33.48	RMS	29	-25.5	36.98	54	-17.02	-	-	126	353	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/Cb/Filt/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	* 2.38999	43.29	Pk	29	-25.5	46.79	-	-	74	-27.21	203	358	V
2	* 2.38706	45.79	Pk	29	-25.5	49.29	-	-	74	-24.71	203	358	V
3	* 2.38999	32.26	RMS	29	-25.5	35.76	54	-18.24	-	-	203	358	V
4	* 2.36909	33.49	RMS	29	-25.5	36.99	54	-17.01	-	-	203	358	V

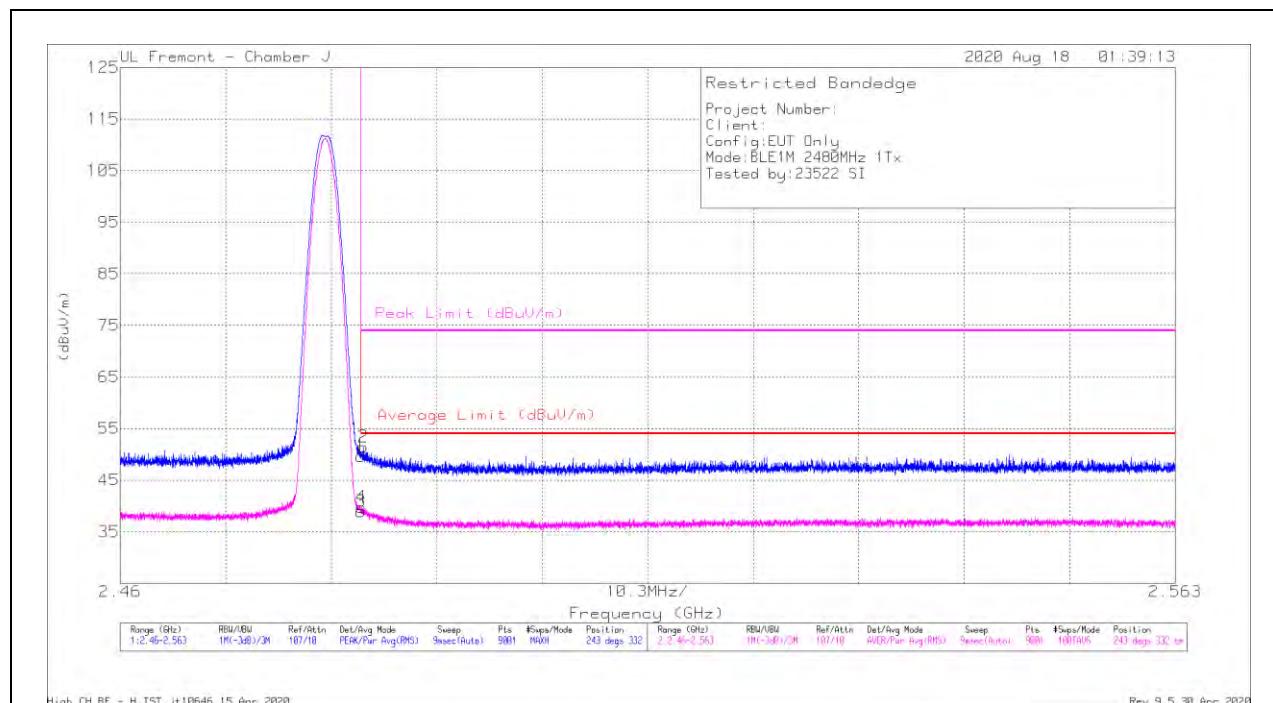
\* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

PK - Peak detector

RMS - RMS detection

**BANDEDGE (HIGH CHANNEL)**

**HORIZONTAL RESULT**



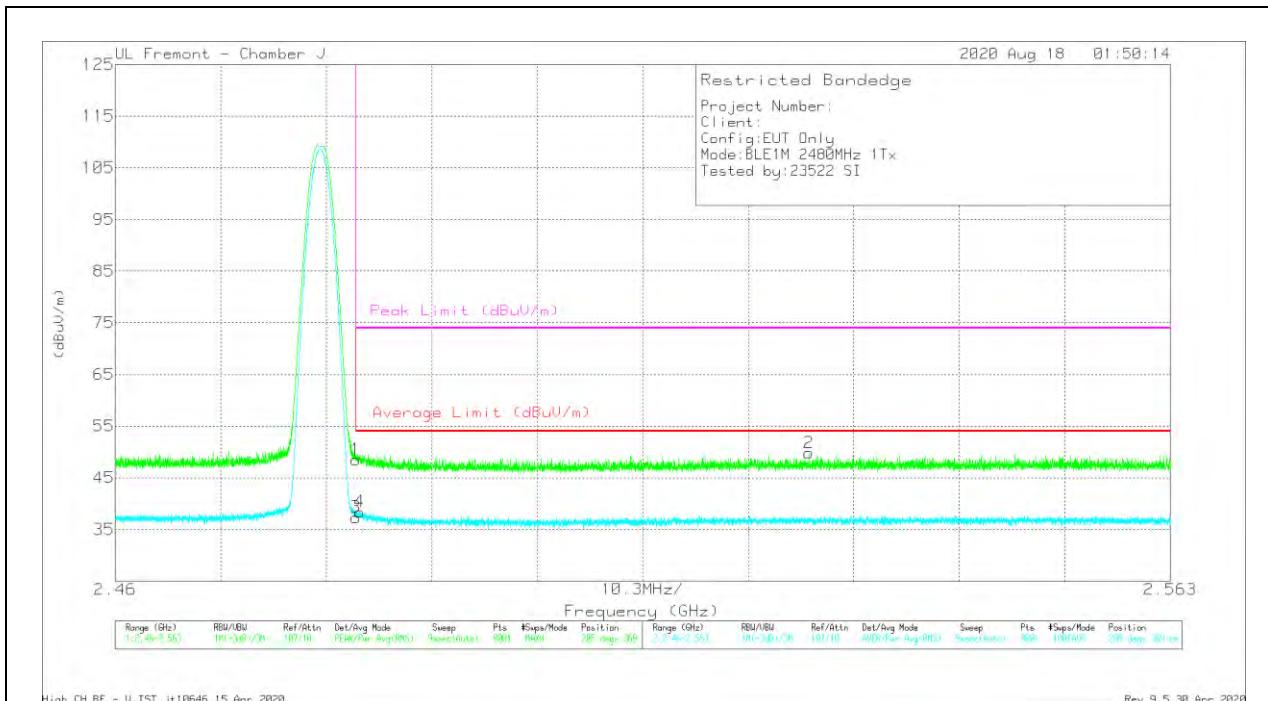
Marker	Frequency (GHz)	Meter Reading (dBmV)	Det	AF T963 (dB/m)	Amp/Cb/Ftr/Pad (dB)	Corrected Reading (dBmV/m)	Average Limit (dBmV/m)	Margin (dB)	Peak Limit (dBmV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.48351	45.63	Pk	29.5	-25.5	49.63	-	-	74	-24.37	243	332	H
2	* 2.48375	47.43	Pk	29.5	-25.5	51.43	-	-	74	-22.57	243	332	H
3	* 2.48351	34.95	RMS	29.5	-25.5	38.95	54	-15.05	-	-	243	332	H
4	* 2.48353	35.75	RMS	29.5	-25.5	39.75	54	-14.25	-	-	243	332	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/CbI/Fitr/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	44.54	Pk	29.5	-25.5	48.54	-	-	74	-25.46	205	369	V
2	2.5277	45.43	Pk	29.8	-25.4	49.83	-	-	74	-24.17	205	369	V
3	* 2.48351	33.35	RMS	29.5	-25.5	37.35	54	-16.65	-	-	205	369	V
4	* 2.48386	34.41	RMS	29.5	-25.5	38.41	54	-15.59	-	-	205	369	V

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

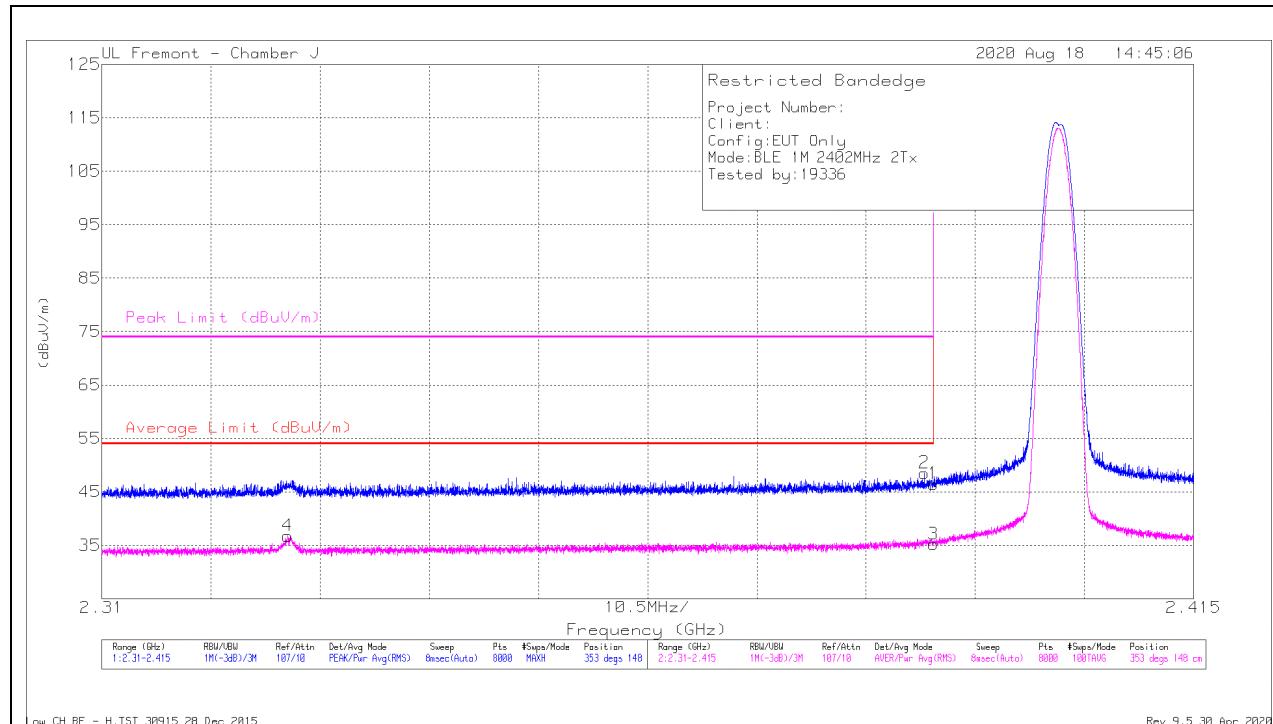
Pk - Peak detector

PK - Peak detector  
RMS - RMS detection

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

### BANDEDGE (LOW CHANNEL)

#### HORIZONTAL RESULT



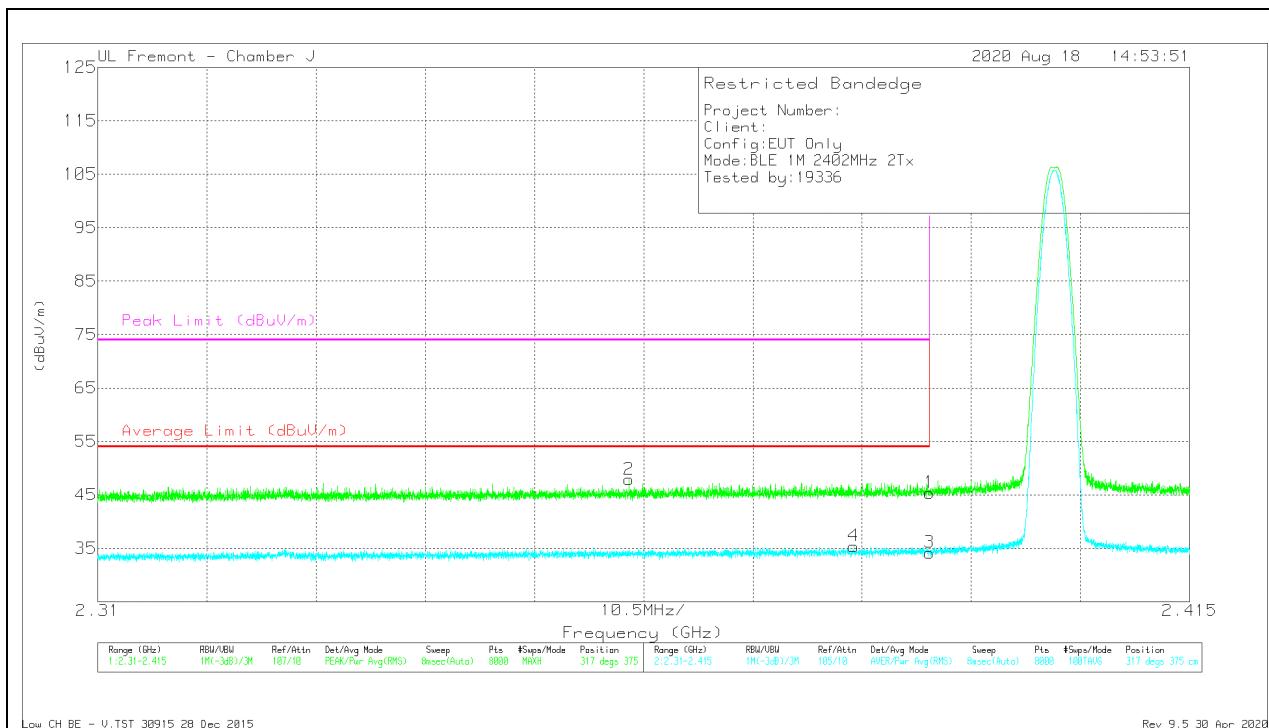
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T963 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.39	32.17	Pk	29	-14.7	46.47	-	-	74	-27.53	353	148	H
2	* 2.3891	34.22	Pk	29	-14.7	48.52	-	-	74	-25.48	353	148	H
3	* 2.39	20.91	RMS	29	-14.7	35.21	54	-18.79	-	-	353	148	H
4	* 2.32789	22.75	RMS	28.9	-14.9	36.75	54	-17.25	-	-	353	148	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/Fltr/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	* 2.39	31.06	Pk	29	-14.7	45.36	-	-	74	-28.64	317	375	V
2	* 2.36108	33.68	Pk	29	-14.8	47.88	-	-	74	-26.12	317	375	V
3	* 2.39	19.88	RMS	29	-14.7	34.18	54	-19.82	-	-	317	375	V
4	* 2.3827	21.09	RMS	29	-14.7	35.39	54	-18.61	-	-	317	375	V

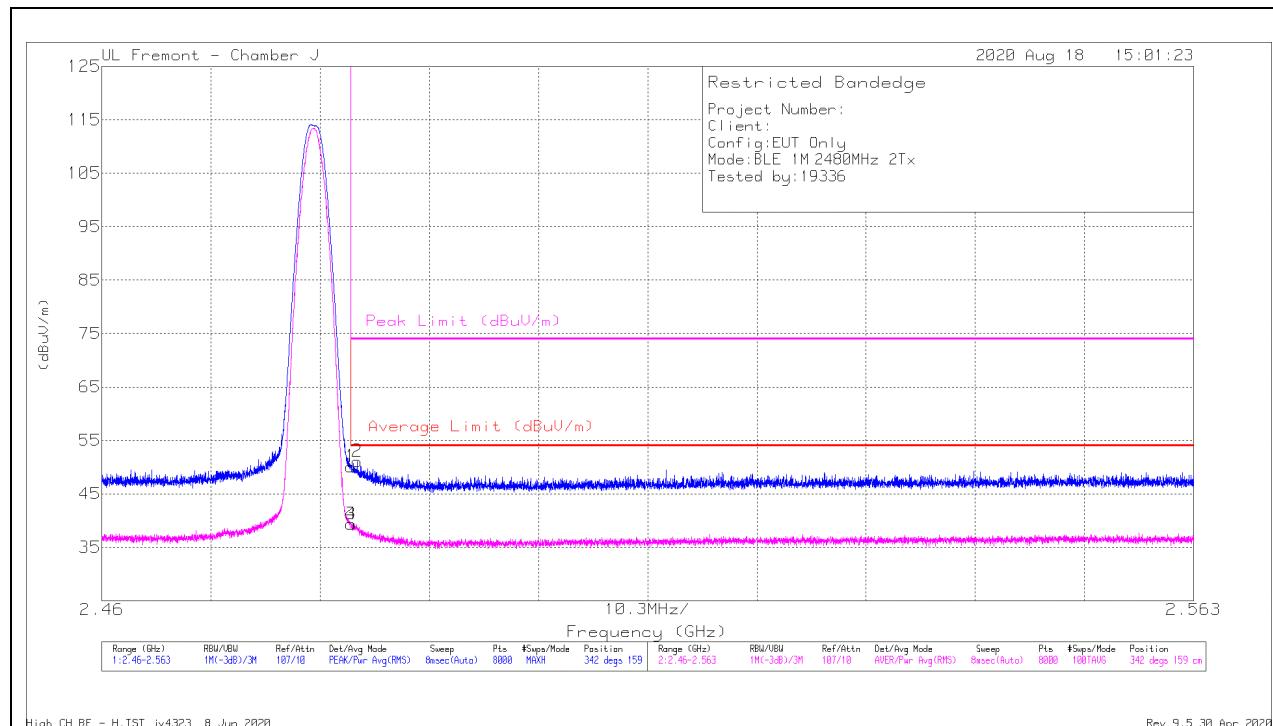
\* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

PK - Peak detector

RMS - RMS detection

## BANDEDGE (HIGH CHANNEL)

### HORIZONTAL RESULT



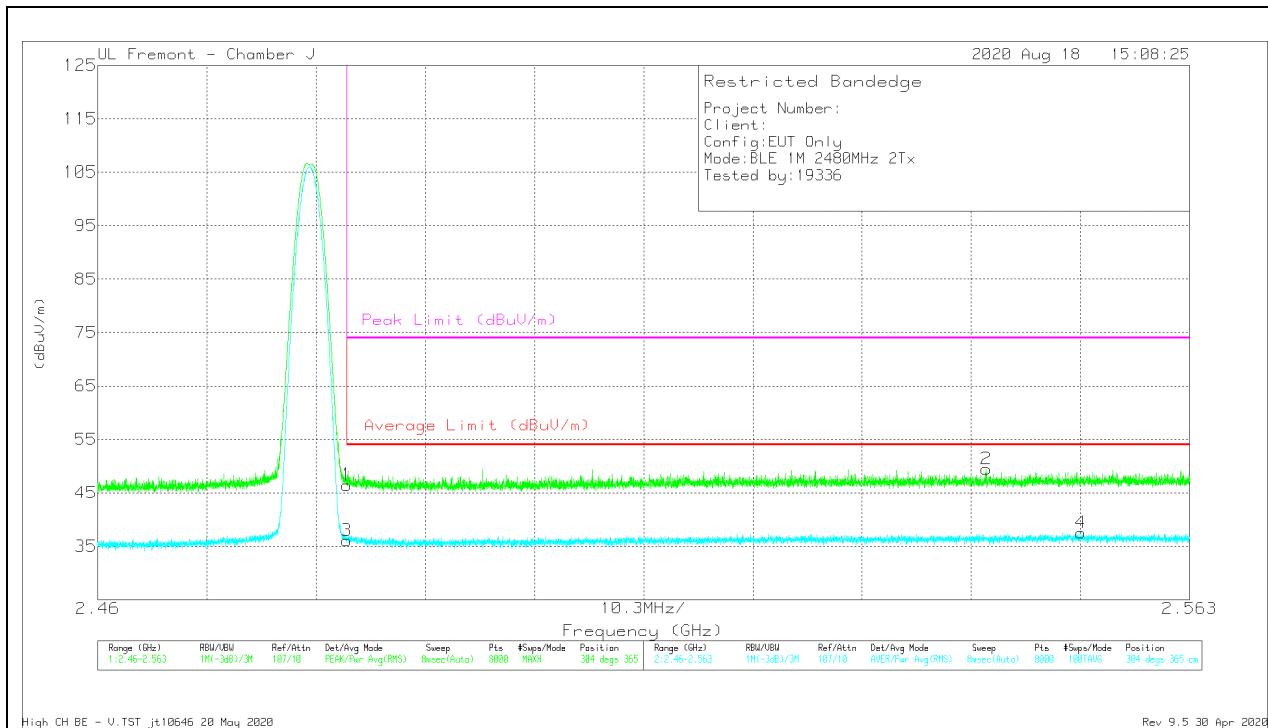
Marker	Frequency (GHz)	Meter Reading (dBm)	Det	AF T963 (dB/m)	Amp/Cbl/Filt/Pad (dB)	Corrected Reading (dBm)	Average Limit (dBm/m)	Margin (dB)	Peak Limit (dBm/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	*2.4835	35.2	Pk	29.5	-14.6	50.1	-	-	74	-23.9	342	159	H
2	*2.48411	36.17	Pk	29.5	-14.6	51.07	-	-	74	-22.93	342	159	H
3	*2.4835	24.45	RMS	29.5	-14.6	39.35	54	-14.65	-	-	342	159	H
4	*2.48351	24.46	RMS	29.5	-14.6	39.36	54	-14.64	-	-	342	159	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	* 2.4835	31.56	Pk	29.5	-14.6	46.46	-	-	74	-27.54	304	365	V
2	2.54382	34.17	Pk	29.8	-14.5	49.47	-	-	74	-24.53	304	365	V
3	* 2.4835	21.15	RMS	29.5	-14.6	36.05	54	-17.95	-	-	304	365	V
4	2.55275	22.02	RMS	29.9	-14.4	37.52	54	-16.48	-	-	304	365	V

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

Pk - Peak detector

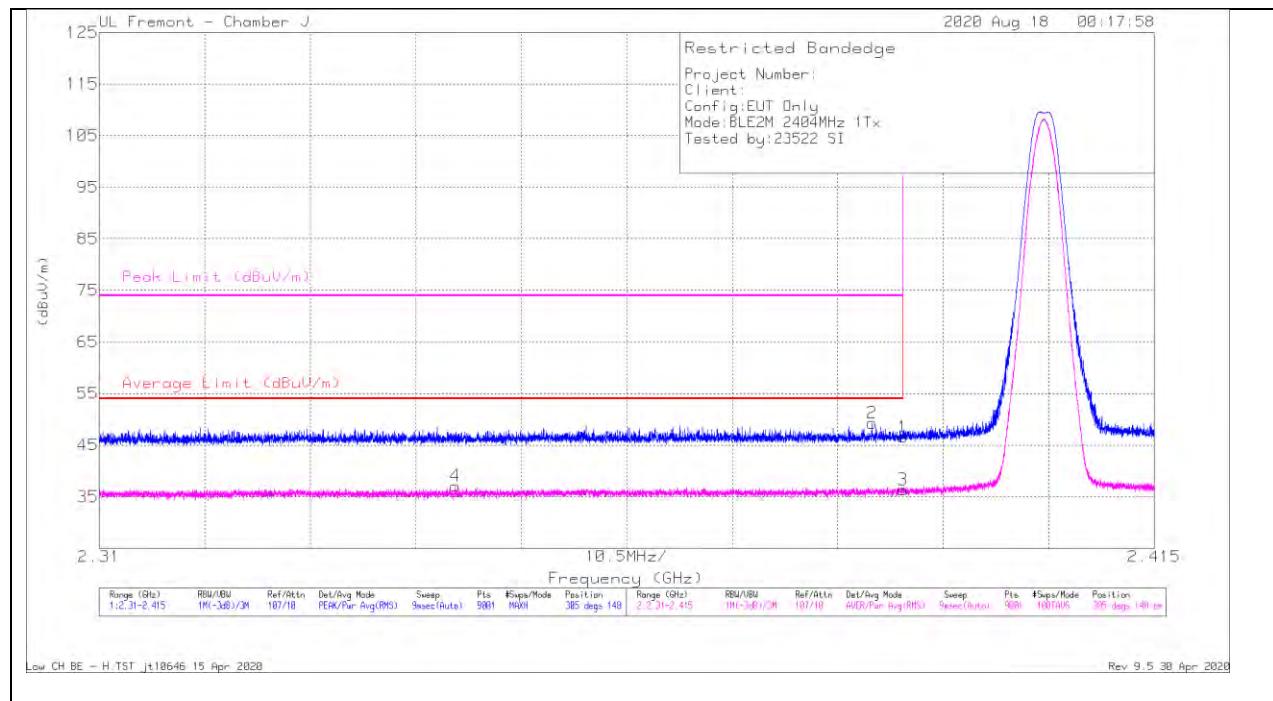
RMS - RMS detection

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

#### ANT4

#### BANDEDGE (LOW CHANNEL)

#### HORIZONTAL RESULT



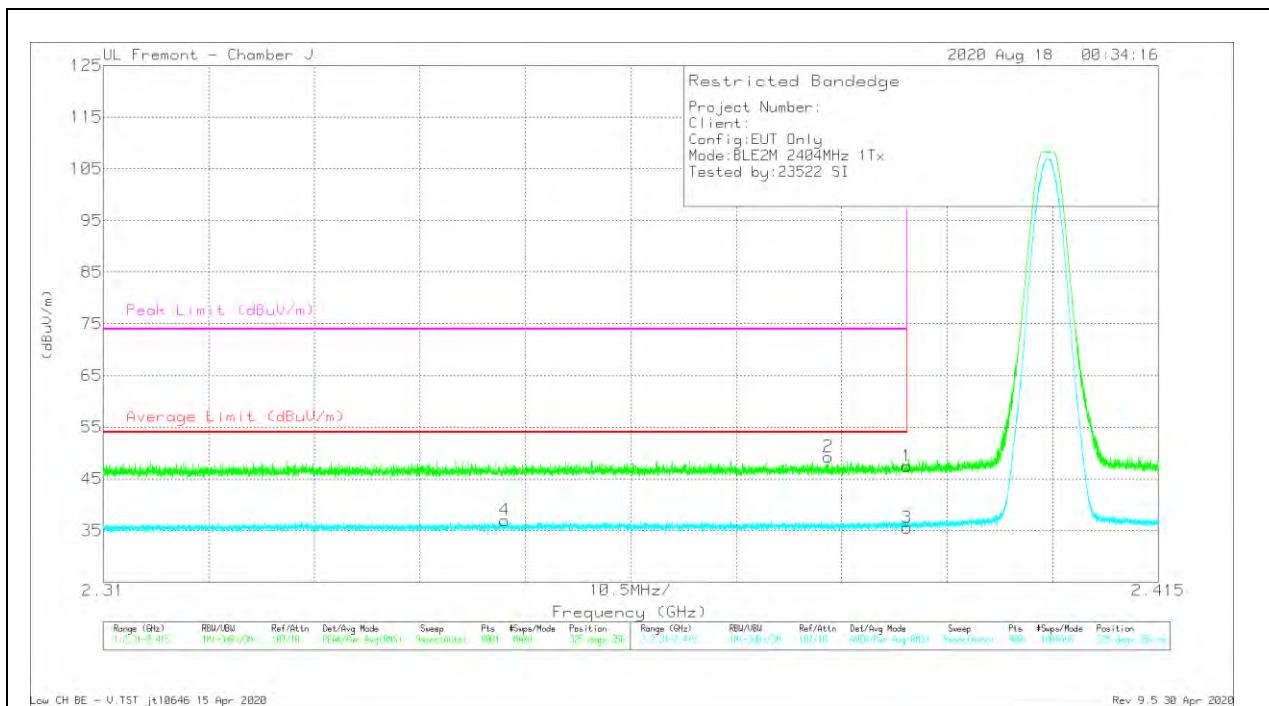
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T963 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.38999	43.03	Pk	29	-25.5	46.53	-	-	74	-27.47	305	148	H
2	* 2.38692	45.79	Pk	29	-25.5	49.29	-	-	74	-24.71	305	148	H
3	* 2.38999	32.83	RMS	29	-25.5	36.33	54	-17.67	-	-	305	148	H
4	* 2.34547	33.75	RMS	28.9	-25.6	37.05	54	-16.95	-	-	305	148	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/Cb/Fltr/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	43.96	Pk	29	-25.5	47.46	-	-	74	-26.54	325	356	V
2	* 2.38217	45.77	Pk	29	-25.5	49.27	-	-	74	-24.73	325	356	V
3	* 2.38999	32.03	RMS	29	-25.5	35.53	54	-18.47	-	-	325	356	V
4	* 2.34995	33.58	RMS	28.9	-25.5	36.98	54	-17.02	-	-	325	356	V

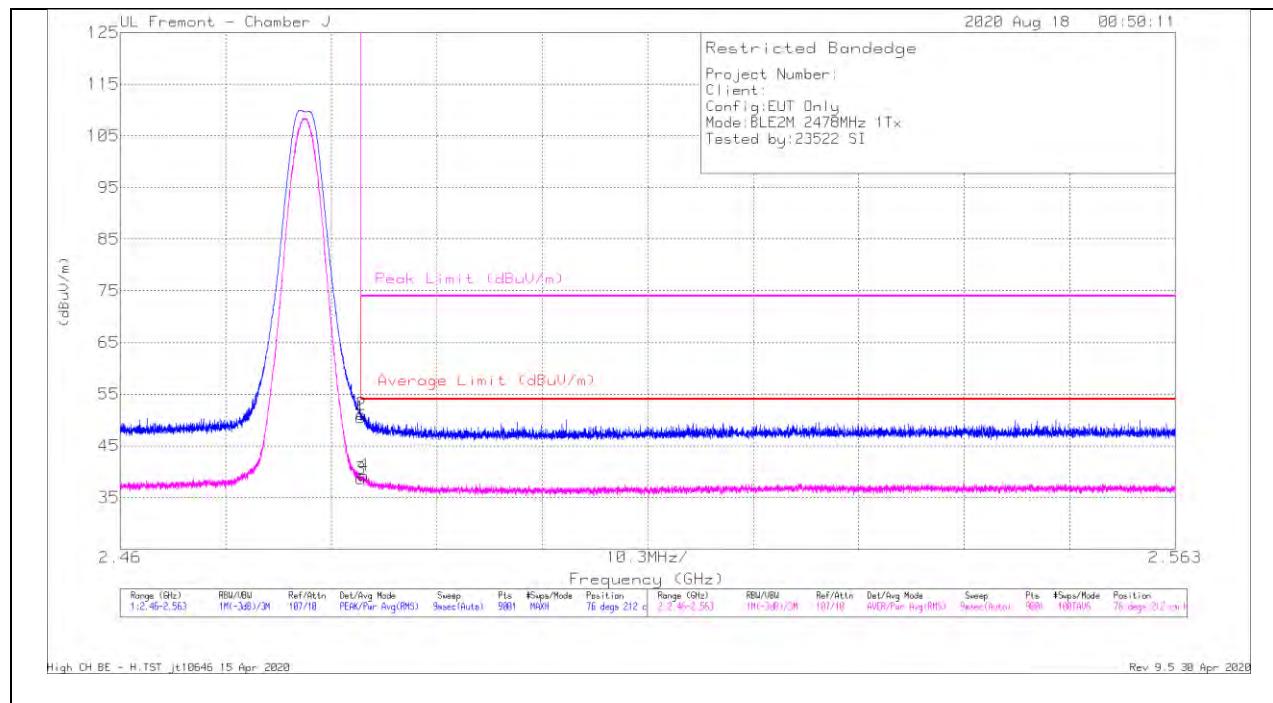
\* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

PK - Peak detector

RMS - RMS detection

## BANDEDGE (HIGH CHANNEL)

### HORIZONTAL RESULT



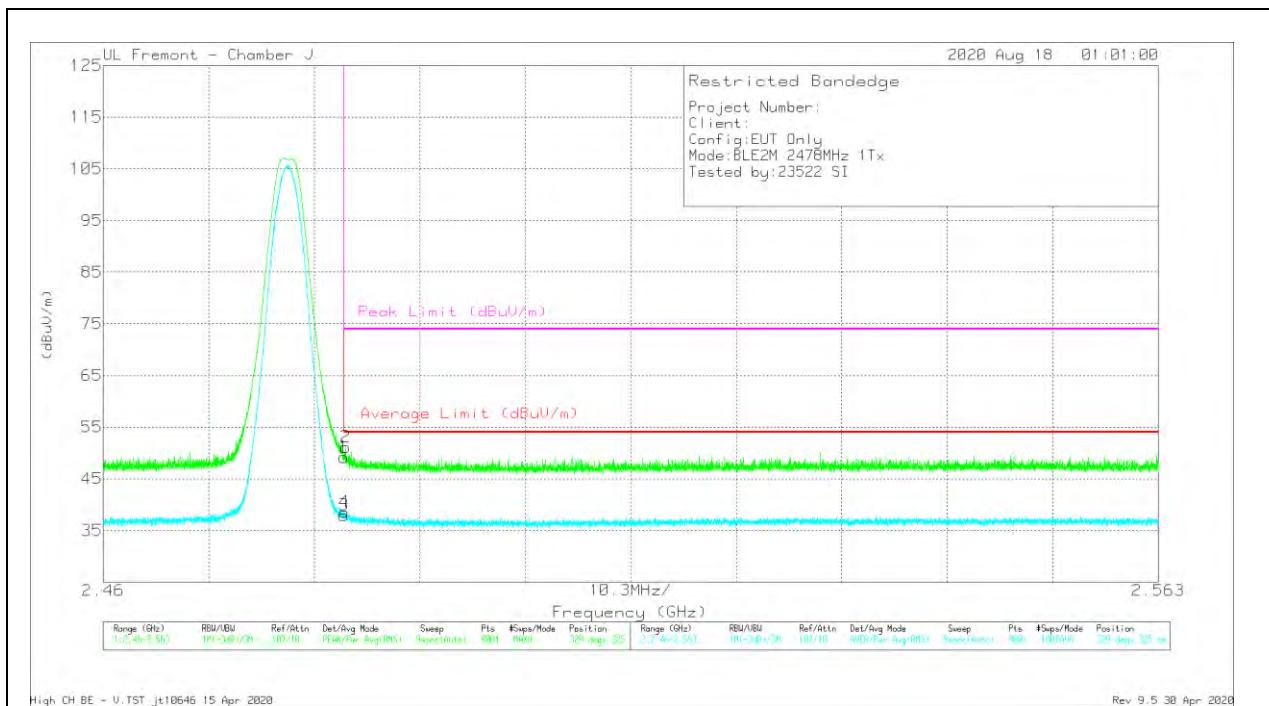
Marker	Frequency (GHz)	Meter Reading (dBm)	Det	AF T963 (dB/m)	Amp/Cb/Fltr/Pa (dB)	Corrected Reading (dBm)	Average Limit (dBm)	Margin (dB)	Peak Limit (dBm)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.48351	46.5	Pk	29.5	-25.5	50.5	-	-	74	-23.5	76	212	H
2	* 2.48354	47.07	Pk	29.5	-25.5	51.07	-	-	74	-22.93	76	212	H
3	* 2.48351	34.63	RMS	29.5	-25.5	38.63	54	-15.37	-	-	76	212	H
4	* 2.48376	35.26	RMS	29.5	-25.5	39.26	54	-14.74	-	-	76	212	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/Fltr/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	45.19	Pk	29.5	-25.5	49.19	-	-	74	-24.81	329	325	V
2	* 2.48365	47.13	Pk	29.5	-25.5	51.13	-	-	74	-22.87	329	325	V
3	* 2.48351	33.95	RMS	29.5	-25.5	37.95	54	-16.05	-	-	329	325	V
4	* 2.48355	34.51	RMS	29.5	-25.5	38.51	54	-15.49	-	-	329	325	V

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

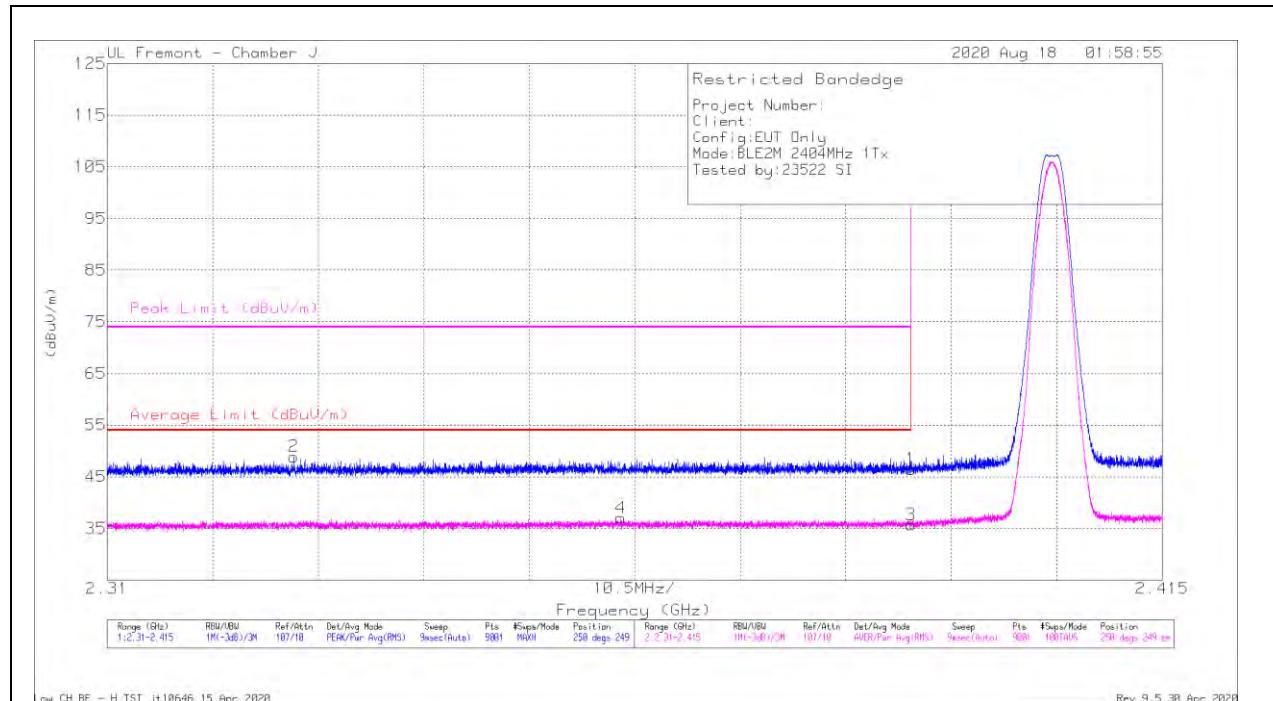
Pk - Peak detector

RMS - RMS detection

ANT3

**BANDEDGE (LOW CHANNEL)**

**HORIZONTAL RESULT**



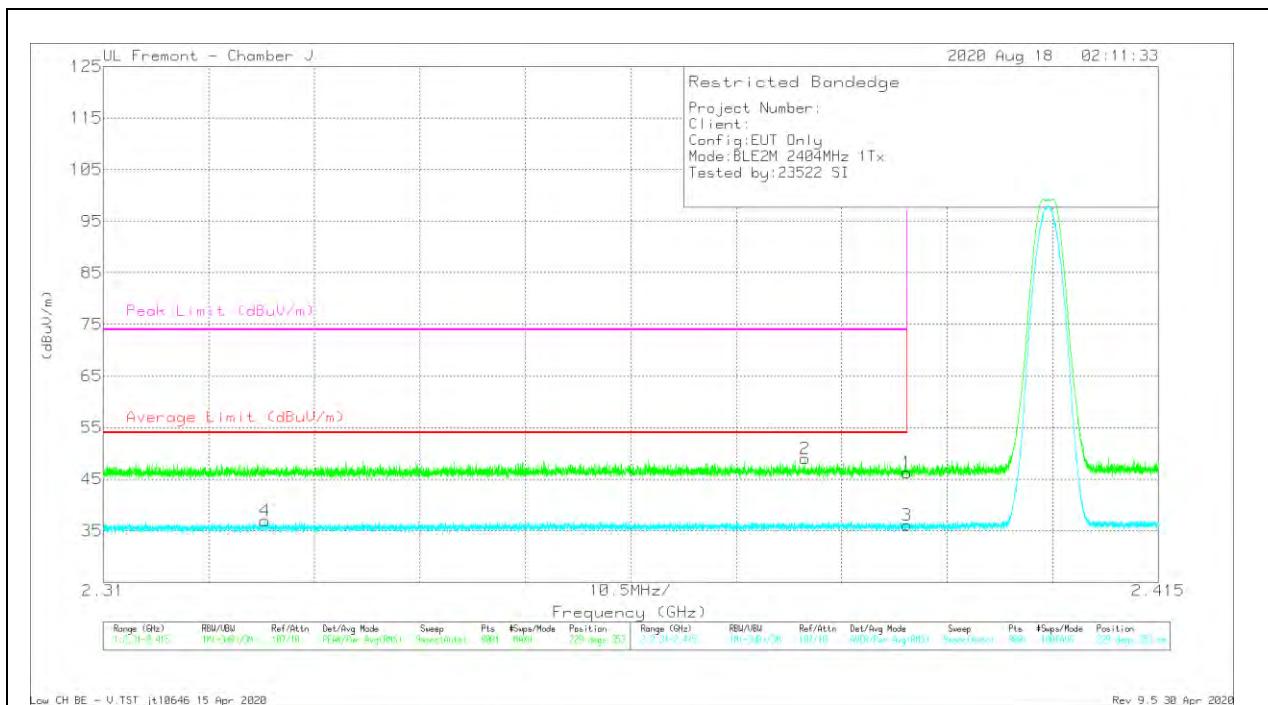
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T963 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.38999	42.94	Pk	29	-25.5	46.44	-	-	74	-27.56	250	249	H
2	* 2.32855	45.62	Pk	28.9	-25.6	48.92	-	-	74	-25.08	250	249	H
3	* 2.38999	32.22	RMS	29	-25.5	35.72	54	-18.28	-	-	250	249	H
4	* 2.36111	33.53	RMS	29	-25.5	37.03	54	-16.97	-	-	250	249	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/Cb/Fltr/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	42.76	Pk	29	-25.5	46.26	-	-	74	-27.74	229	353	V
2	* 2.37985	45.45	Pk	29	-25.5	48.95	-	-	74	-25.05	229	353	V
3	* 2.38999	32.56	RMS	29	-25.5	36.06	54	-17.94	-	-	229	353	V
4	* 2.3261	33.7	RMS	28.8	-25.6	36.9	54	-17.1	-	-	229	353	V

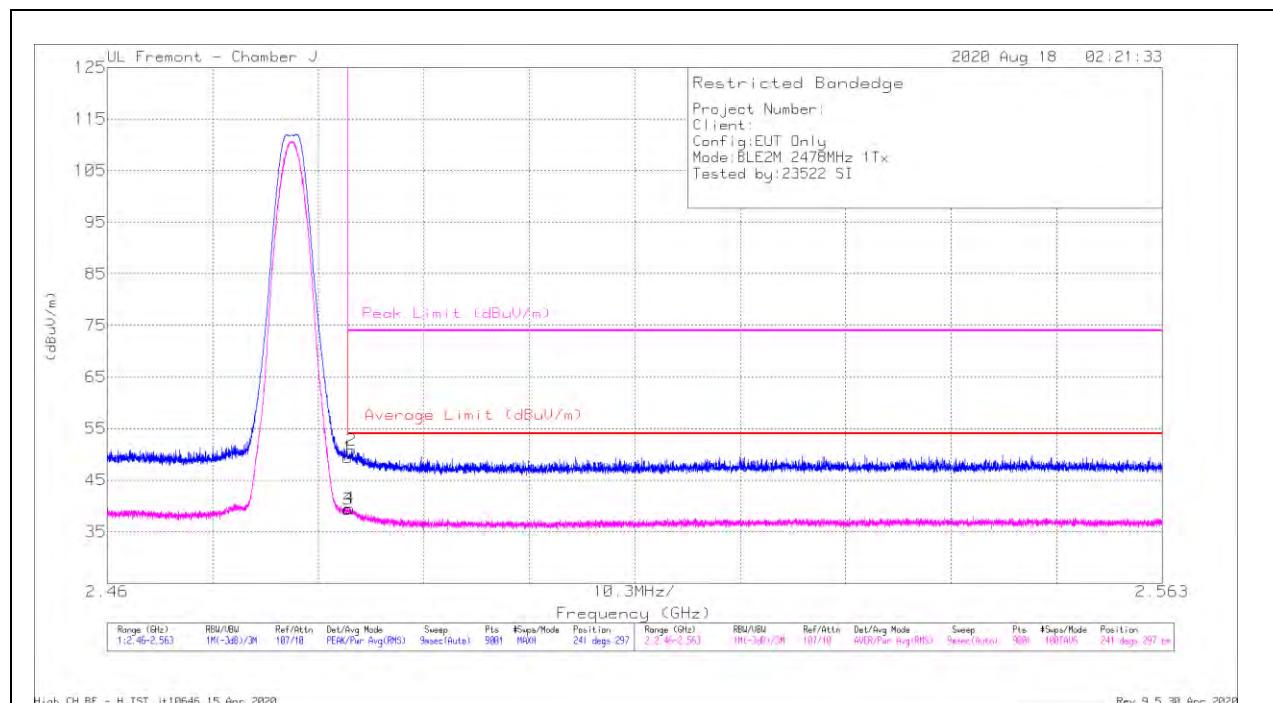
\* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

PK - Peak detector

RMS - RMS detection

**BANDEDGE (HIGH CHANNEL)**

**HORIZONTAL RESULT**



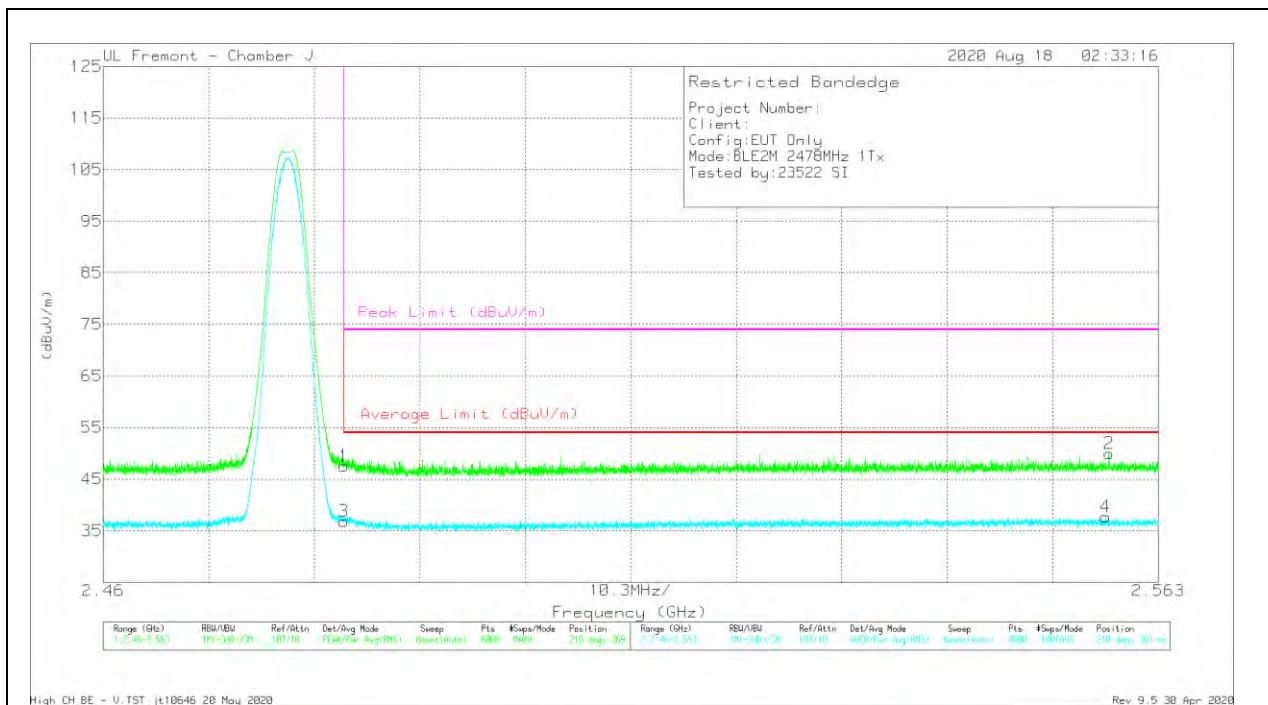
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T963 (dB/m)	Amp/Cb/Ftr/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.48351	45.35	Pk	29.5	-25.5	49.35	-	-	74	-24.65	241	297	H
2	* 2.48387	46.78	Pk	29.5	-25.5	50.78	-	-	74	-23.22	241	297	H
3	* 2.48351	35.34	RMS	29.5	-25.5	39.34	54	-14.66	-	-	241	297	H
4	* 2.48364	35.54	RMS	29.5	-25.5	39.54	54	-14.46	-	-	241	297	H

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

PK - Peak detector

RMS - RMS detection

## VERTICAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBm)	Det	AF T963 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBm)	Average Limit (dBm/m)	Margin (dB)	Peak Limit (dBm)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.4835	32.63	Pk	29.5	-14.6	47.53	-	-	74	-26.47	210	369	V
2	2.55819	34.57	Pk	29.8	-14.4	49.97	-	-	74	-24.03	210	369	V
3	* 2.4835	21.92	RMS	29.5	-14.6	36.82	54	-17.18	-	-	210	369	V
4	2.55787	22.27	RMS	29.8	-14.4	37.67	54	-16.33	-	-	210	369	V

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

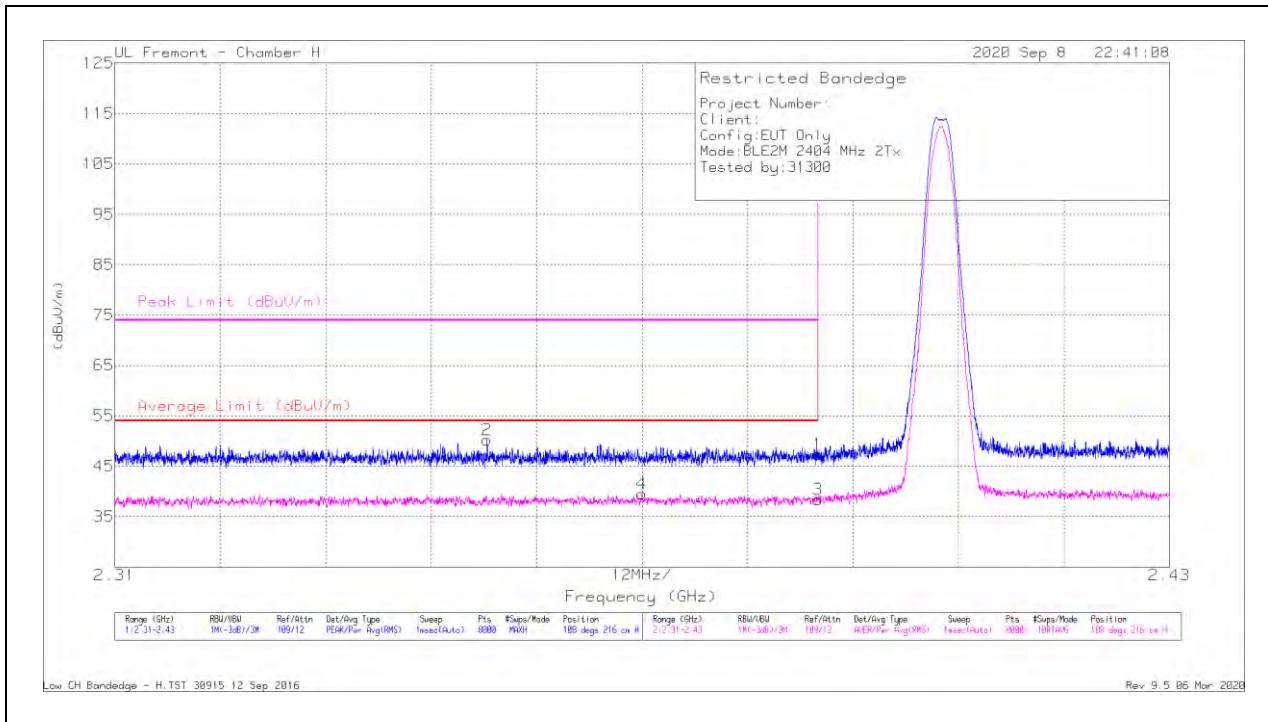
PK - Peak detector

RMS - RMS detection

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

### BANDEDGE (LOW CHANNEL)

#### HORIZONTAL RESULT



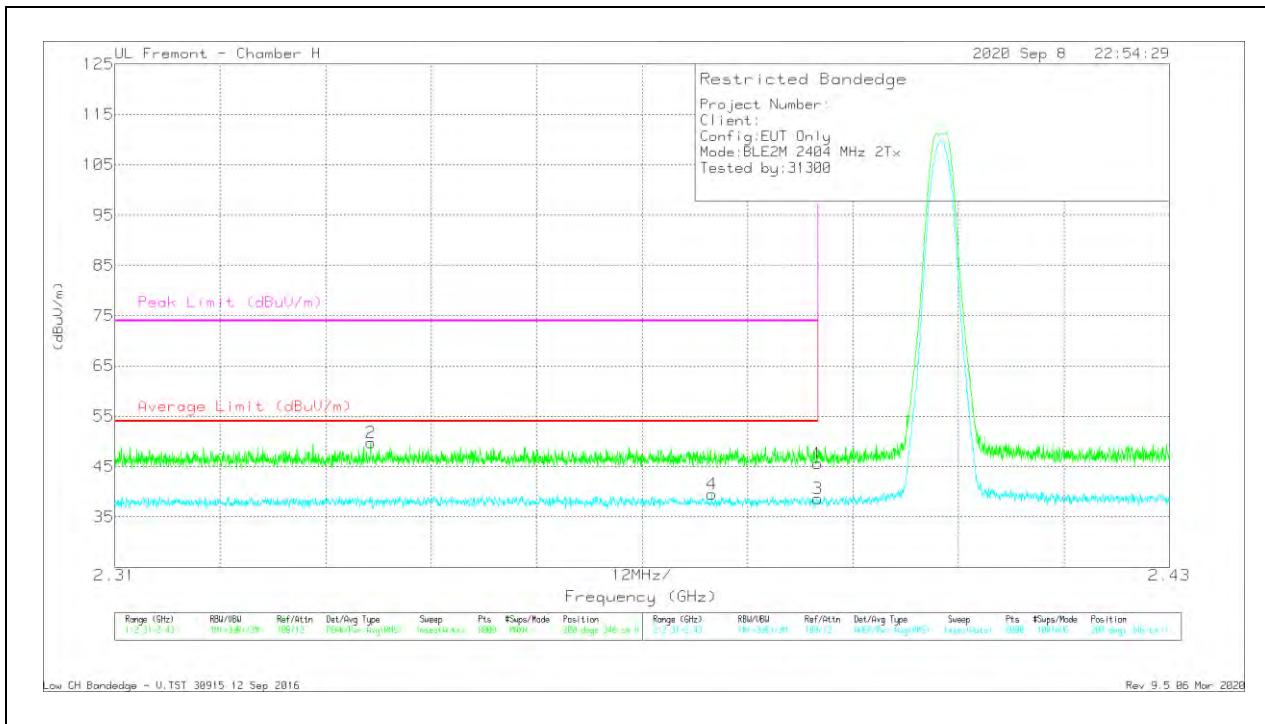
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T862 (dB/m)	Amp/Cb/Filt/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.38999	37.27	Pk	31.8	-21.7	47.37	-	-	74	-26.63	108	216	H
2	* 2.35237	40.25	Pk	31.8	-21.8	50.25	-	-	74	-23.75	108	216	H
3	* 2.38999	28.29	RMS	31.8	-21.7	38.39	54	-15.61	-	-	108	216	H
4	* 2.36998	29.41	RMS	31.8	-21.7	39.51	54	-14.49	-	-	108	216	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 T862 (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	35.58	Pk	31.8	-21.7	45.68	-	-	74	-28.32	200	346	V
2	* 2.33913	39.77	Pk	31.8	-21.8	49.77	-	-	74	-24.23	200	346	V
3	* 2.38999	28.55	RMS	31.8	-21.7	38.65	54	-15.35	-	-	200	346	V
4	* 2.37791	29.4	RMS	31.8	-21.7	39.5	54	-14.5	-	-	200	346	V

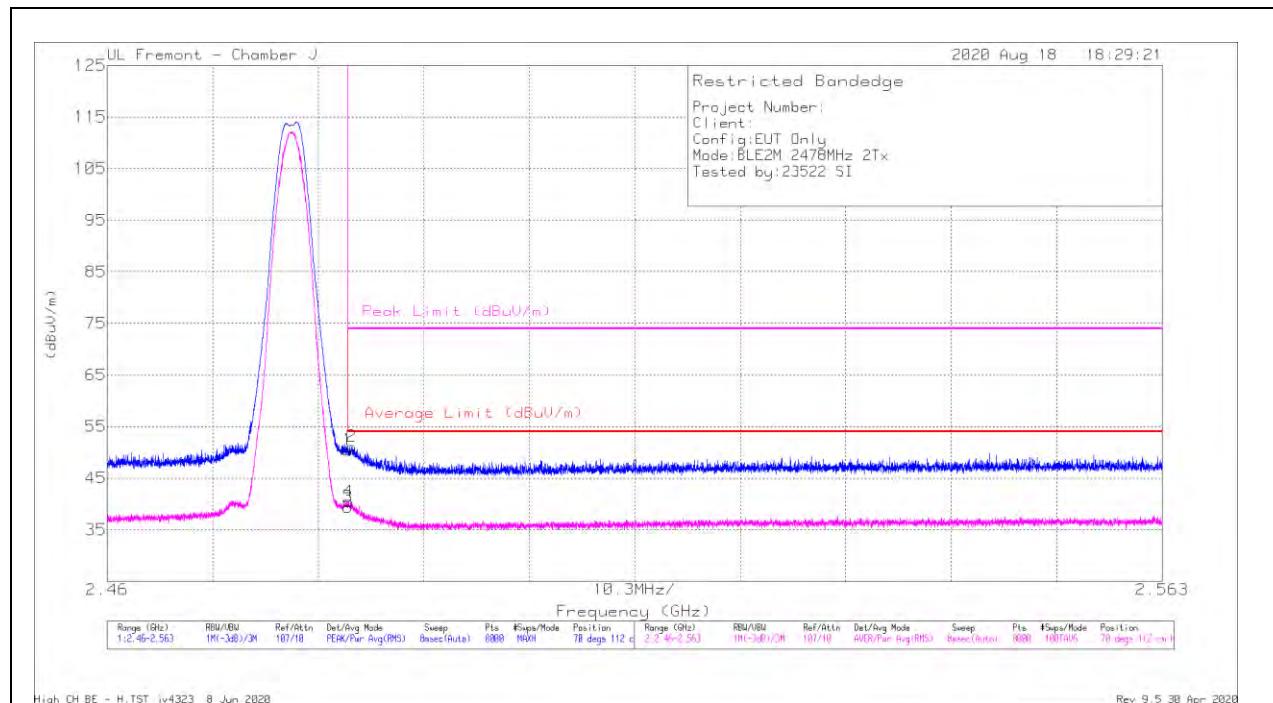
\* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

Pk - Peak detector

RMS - RMS detection

**BANDEDGE (HIGH CHANNEL)**

**HORIZONTAL RESULT**



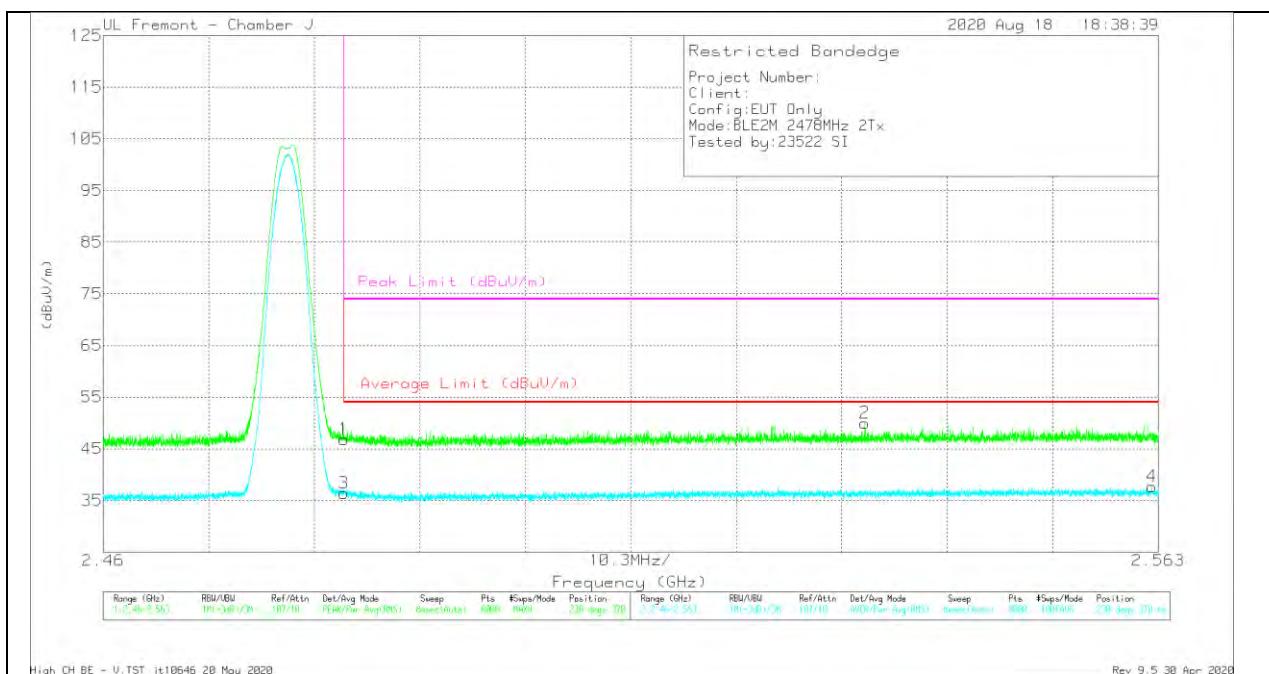
Marker	Frequency (GHz)	RBW/IBW	Ref/Attn	Det/Avg Mode	Amp/Cb/Fltr/Pa d (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.4835	35.57	PK	29.5	-14.6	50.47	-	-	74	-23.53	70	112	H
2	* 2.4836	36.2	PK	29.5	-14.6	51.1	-	-	74	-22.9	70	112	H
3	* 2.4835	24.51	RMS	29.5	-14.6	39.41	54	-14.59	-	-	70	112	H
4	* 2.48353	25.55	RMS	29.5	-14.6	40.45	54	-13.55	-	-	70	112	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/Fltr/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	* 2.4835	31.93	Pk	29.5	-14.6	46.83	-	-	74	-27.17	230	370	V
2	2.53436	34.68	Pk	29.8	-14.5	49.98	-	-	74	-24.02	230	370	V
3	* 2.4835	21.5	RMS	29.5	-14.6	36.4	54	-17.6	-	-	230	370	V
4	2.56239	22.28	RMS	29.8	-14.4	37.68	54	-16.32	-	-	230	370	V

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

PK - Peak detector

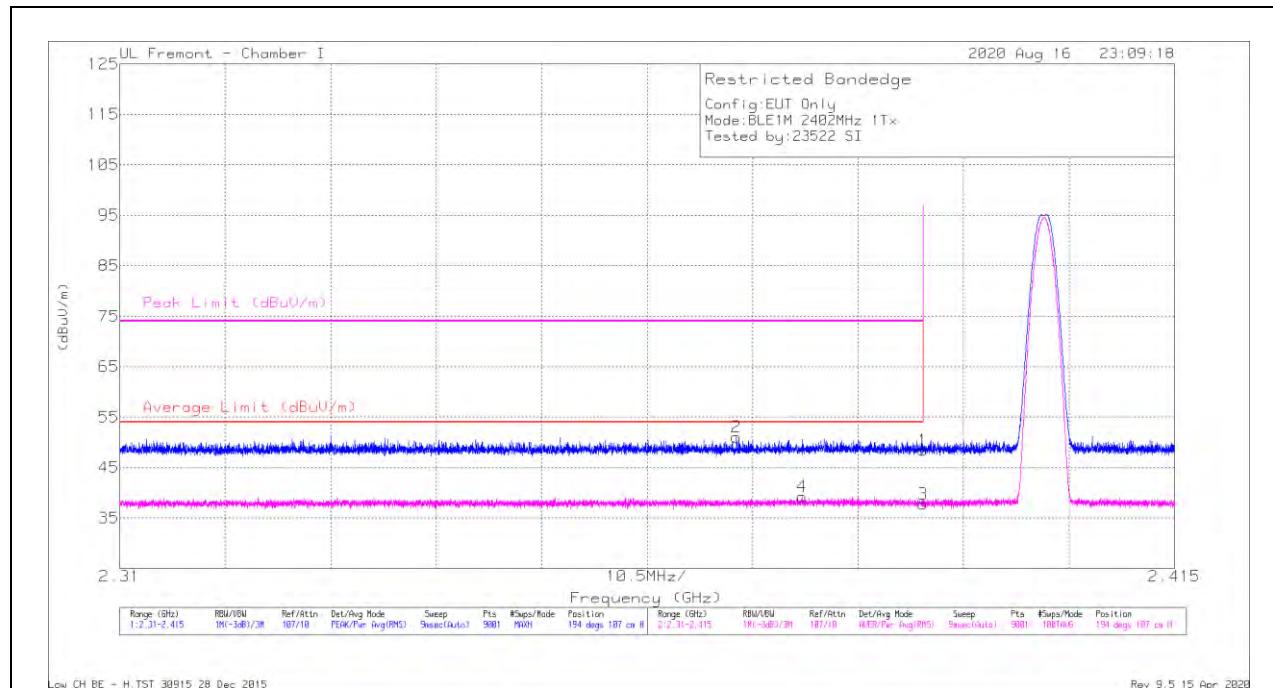
RMS - RMS detection

## 10.2.5. LOW POWER BLE (1Mbps)

### ANT4

### BANDEDGE (LOW CHANNEL)

### HORIZONTAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T346 (dB/m)	Amp/Cbl/Fltr/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	* 2.38999	33.77	Pk	32	-17.3	48.47	-	-	74	-25.53	194	107	H
2	* 2.37142	36.41	Pk	31.9	-17.3	51.01	-	-	74	-22.99	194	107	H
3	* 2.38999	23.03	RMS	32	-17.3	37.73	54	-16.27	-	-	194	107	H
4	* 2.37793	24.51	RMS	32	-17.3	39.21	54	-14.79	-	-	194	107	H

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

PK - Peak detector

RMS - RMS detection