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.
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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
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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.
☐ Chamber A (IC:2324B-1)	☐ Chamber D (IC:22541-1)	☒ Chamber I (IC: 2324A-5)
☐ Chamber B (IC:2324B-2)	☐ Chamber E (IC:22541-2)	☒ Chamber J (IC: 2324A-6)
☐ Chamber C (IC:2324B-3)	☐ Chamber F (IC:22541-3)	☐ Chamber K (IC: 2324A-1)
	☐ Chamber G (IC:22541-4)	☐ Chamber L (IC: 2324A-3)
	☒ Chamber H (IC:22541-5)	☐ 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

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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_{LAB}
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%.

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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

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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.

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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.

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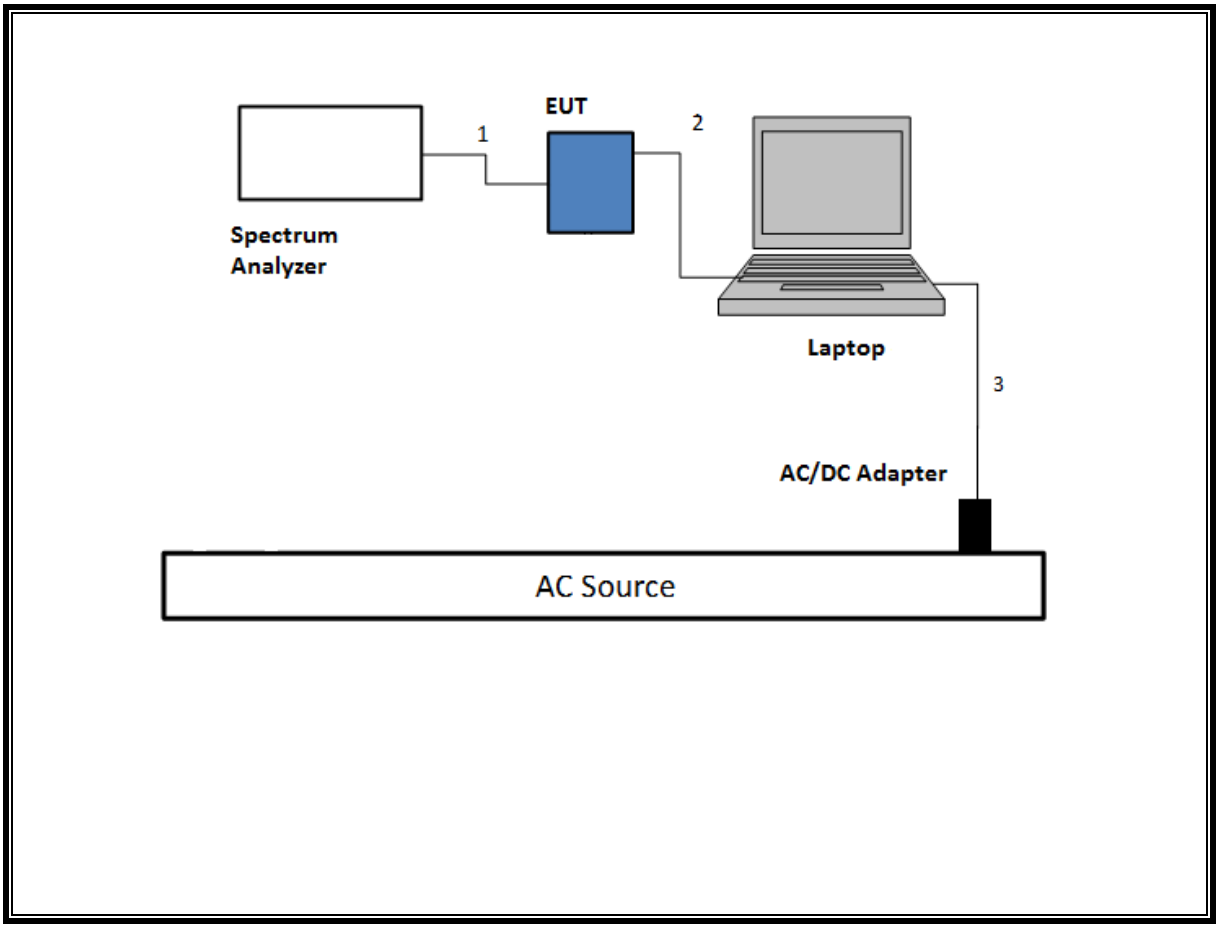
SETUP DIAGRAM FOR CONDUCTED TESTS



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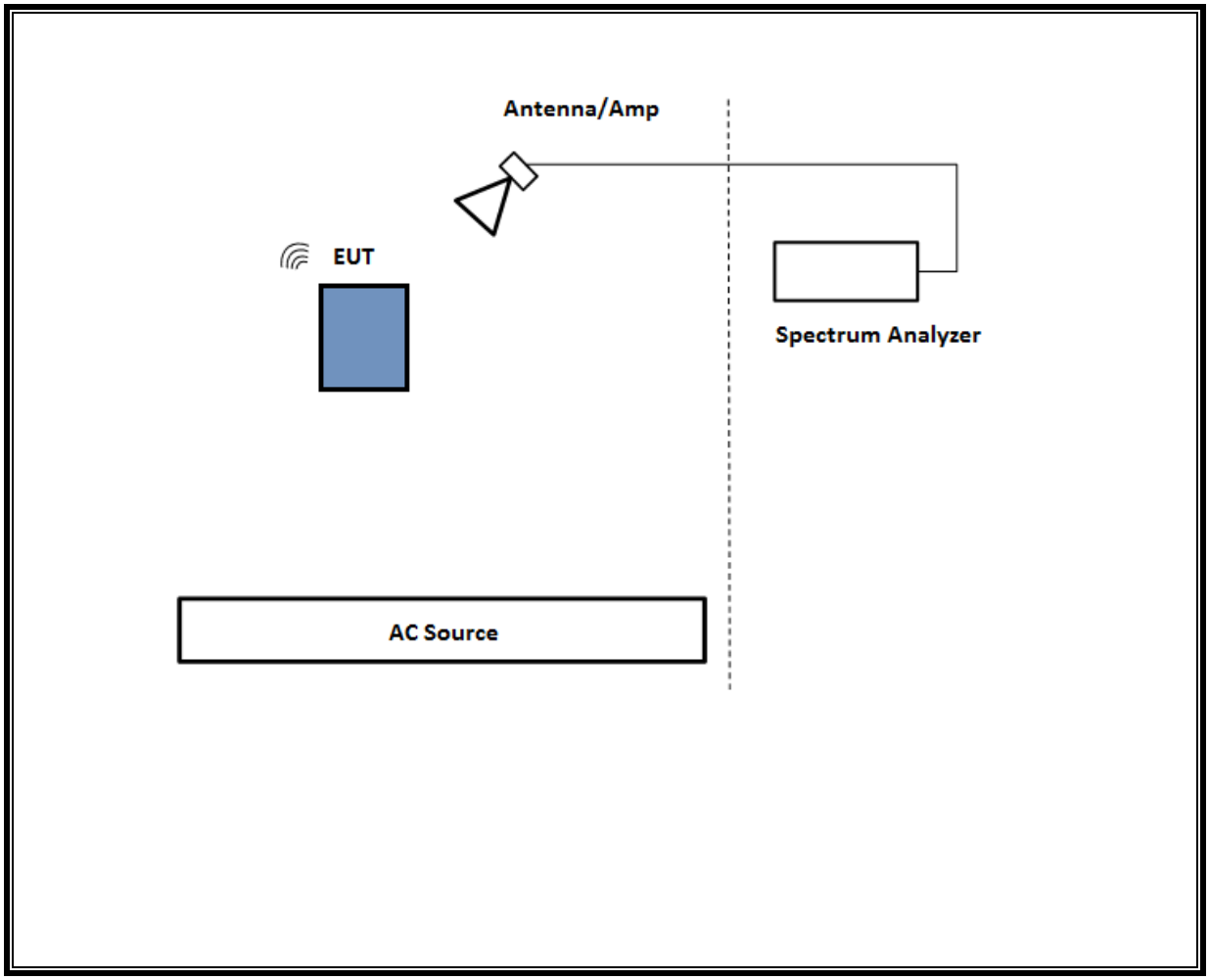
SETUP DIAGRAM FOR RADIATED TESTS Above 1 GHz



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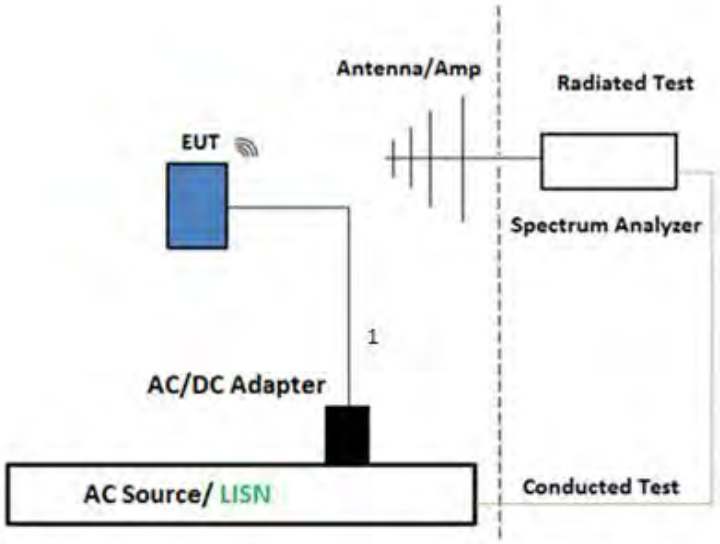
SETUP DIAGRAM FOR Below 1GHz and AC LINE CONDUCTED TEST



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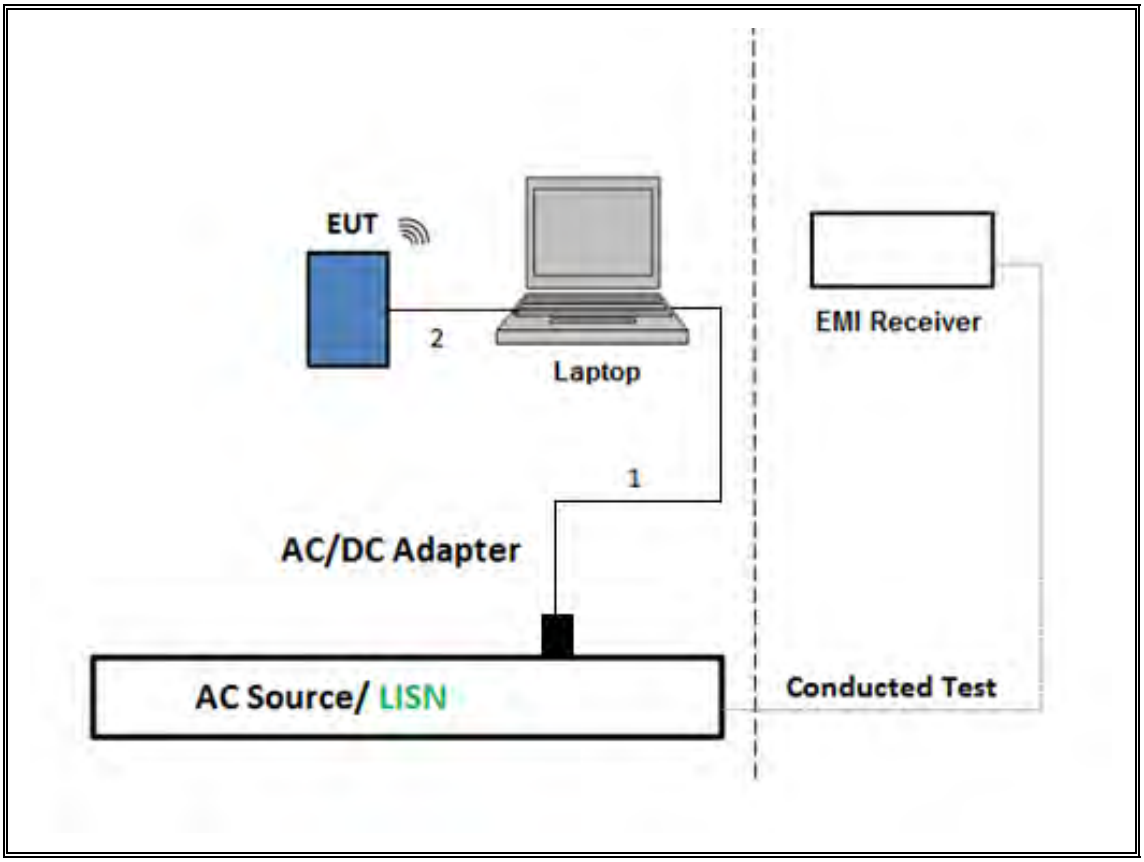
TEST SETUP- AC LINE CONDUCTED: LAPTOP CONFIGURATION



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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 ≥ 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.

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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.

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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)
2.4GHz Band						
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

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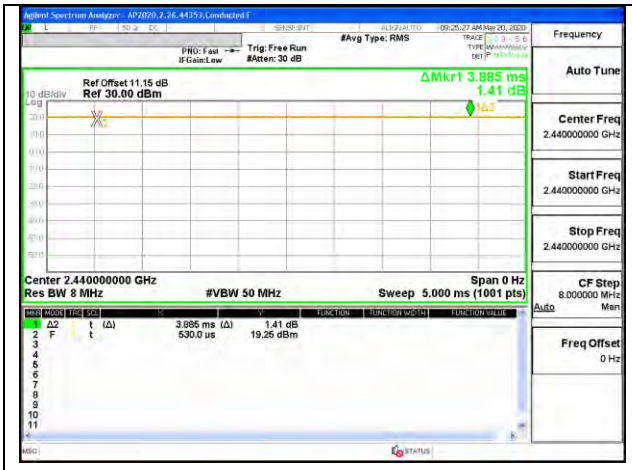
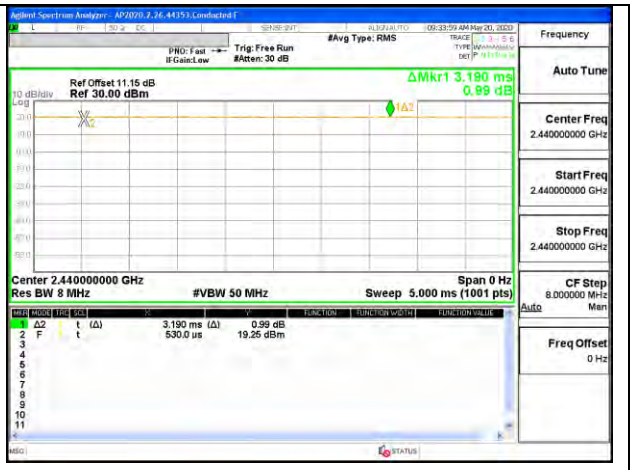
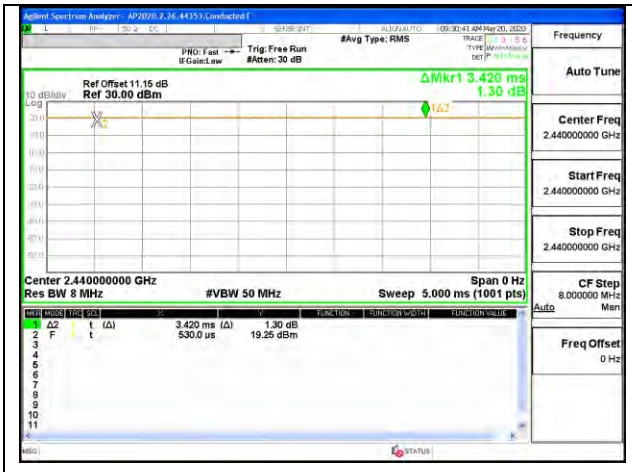
DUTY CYCLE PLOTS



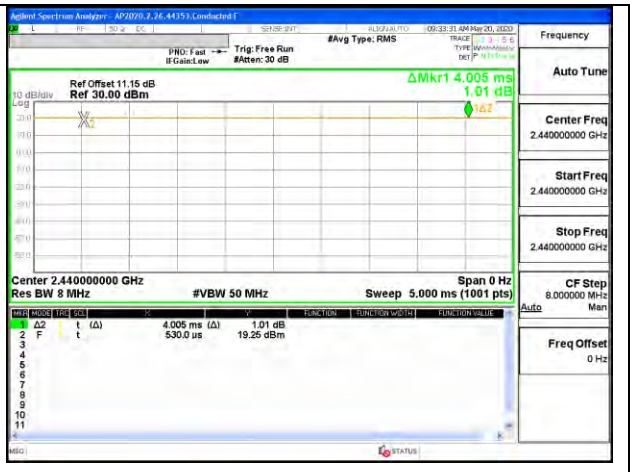
BLE 1Mbps



BLE 2Mbps



BLE TXBF 1Mbps



BLE TXBF 2Mbps

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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

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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

MID CHANNEL

ANT3

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

MID CHANNEL

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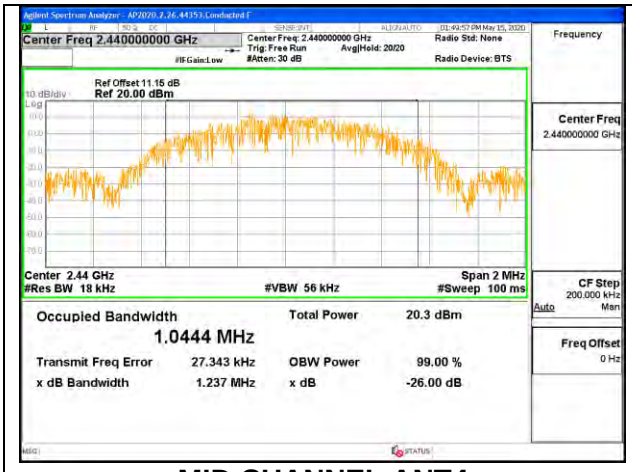
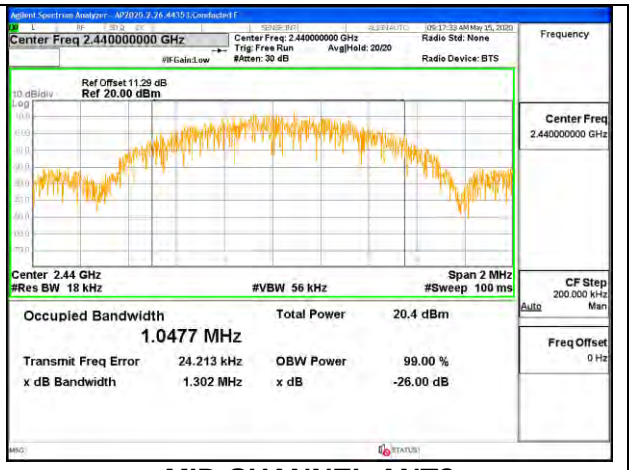
9.2.2. **HIGH POWER BLE TXBF (1Mbps)**

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.



MID CHANNEL ANT4



MID CHANNEL ANT3

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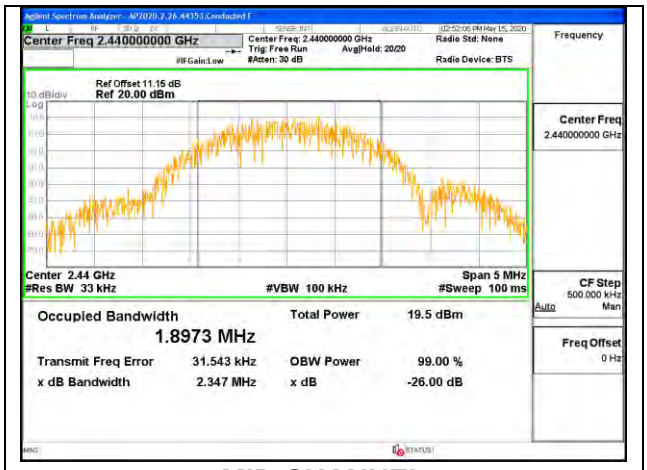
9.2.3. **HIGH POWER BLE (2Mbps)**

ANT4

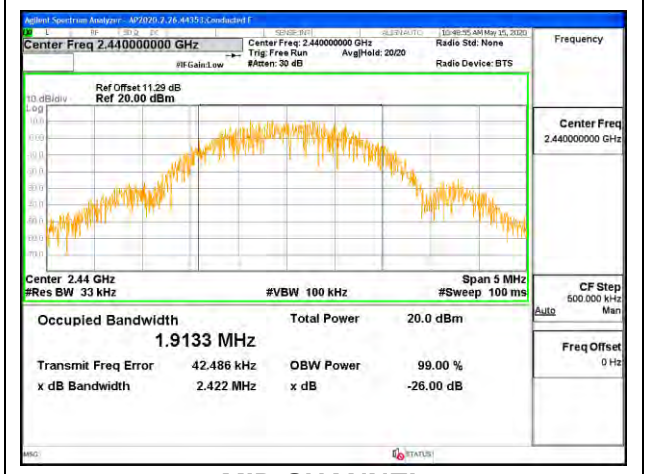
Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	2404	1.9135
Middle	2440	1.8973
High	2478	1.9008



MID CHANNEL

ANT3

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



MID CHANNEL

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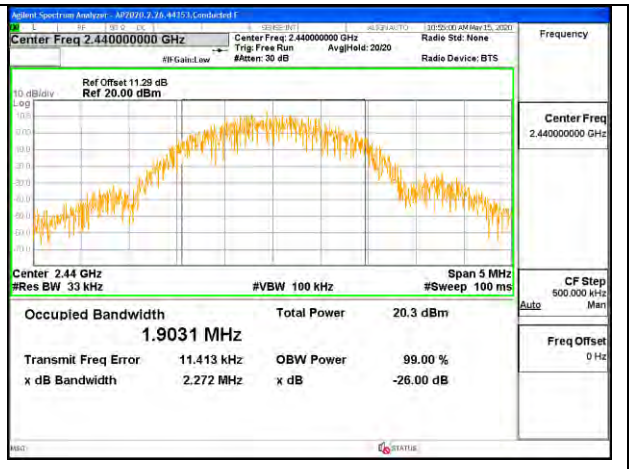
9.2.4. **HIGH POWER BLE TXBF (2Mbps)**

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

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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.

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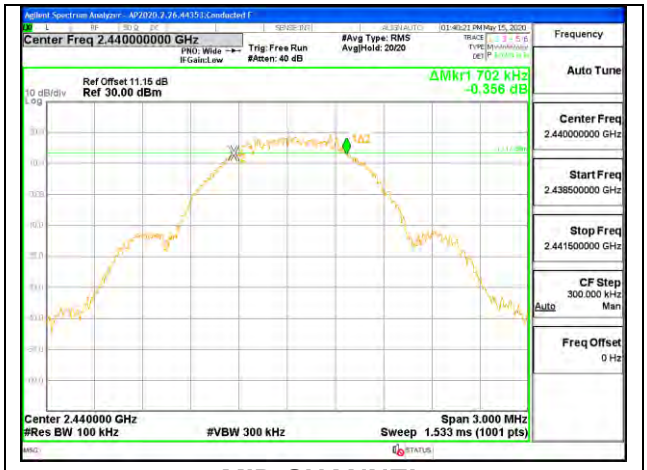
9.3.1. **HIGH POWER BLE (1Mbps)**

ANT4

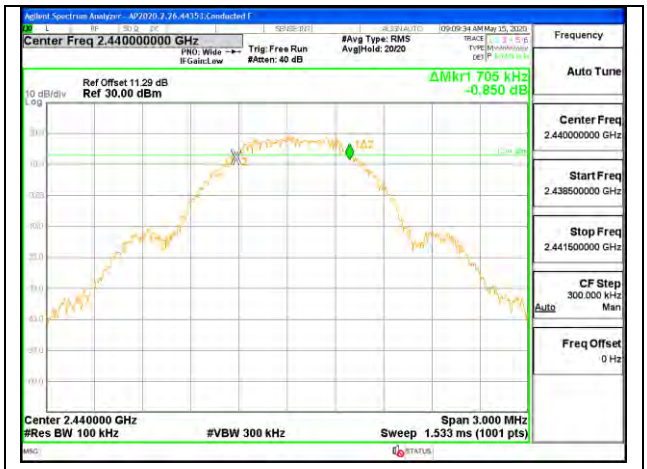
Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)
Low	2402	0.735	0.5
Middle	2440	0.702	0.5
High	2480	0.702	0.5



MID CHANNEL

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



MID CHANNEL

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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

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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

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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

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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

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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

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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

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9.5.1. HIGH POWER BLE (1Mbps)

ANT4

Tested By:	44366
Date:	9/3/2020

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

ANT3

Tested By:	44366
Date:	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

Tested By:	44366
Date:	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

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9.5.3. HIGH POWER BLE (2Mbps)

ANT4

Tested By:	44366
Date:	9/3/2020

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

ANT3

Tested By:	44366
Date:	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

Tested By:	44366
Date:	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

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9.5.5. LOW POWER BLE (1Mbps)

ANT4

Tested By:	44366
Date:	9/3/2020

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

ANT3

Tested By:	44366
Date:	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

Tested By:	44366
Date:	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

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9.5.7. LOW POWER BLE (2Mbps)

ANT4

Tested By:	44366
Date:	9/3/2020

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

ANT3

Tested By:	44366
Date:	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

Tested By:	44366
Date:	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.

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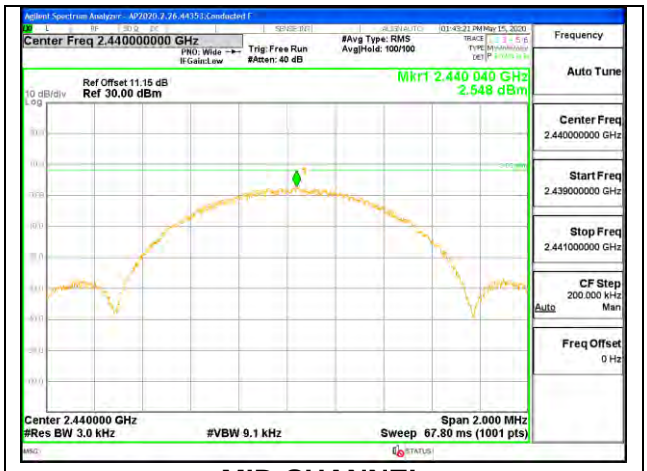
9.6.1. **HIGH POWER BLE (1Mbps)**

ANT4

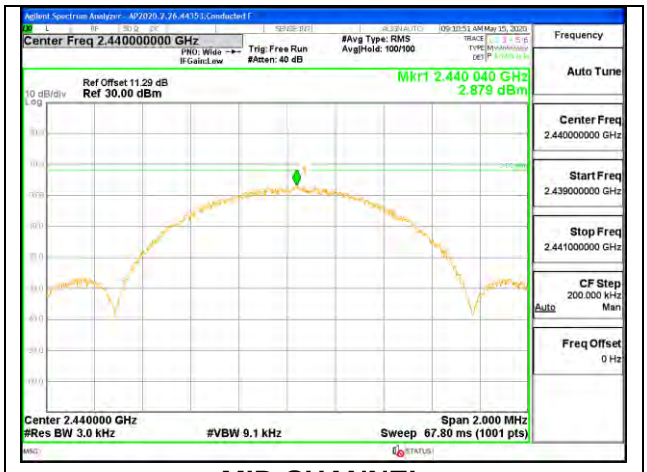
Channel	Frequency (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)	Margin (dB)
Low	2402	3.021	8	-4.98
Middle	2440	2.548	8	-5.45
High	2480	2.509	8	-5.49



MID CHANNEL

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



MID CHANNEL

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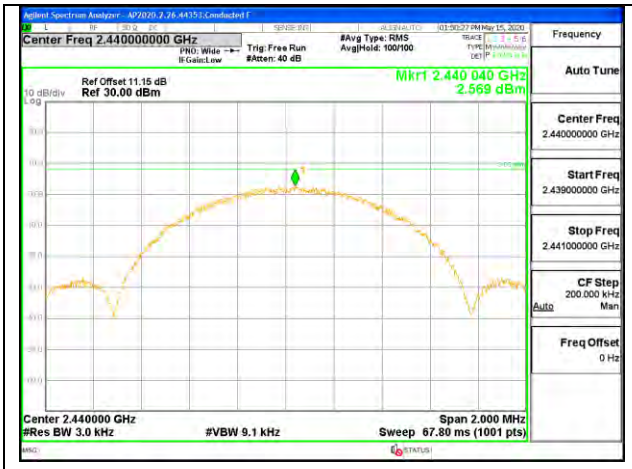
9.6.2. **HIGH POWER BLE TXBF (1Mbps)**

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

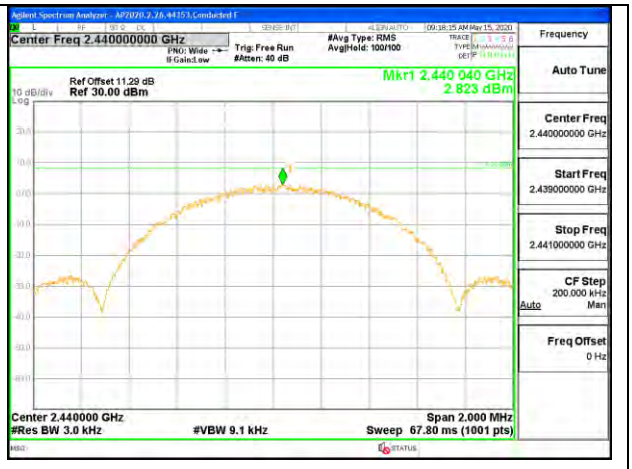
PSD Results

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
Hjigh	2480	2.496	2.523	5.52	8.0	-2.5

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



MID CHANNEL ANT4



MID CHANNEL ANT3

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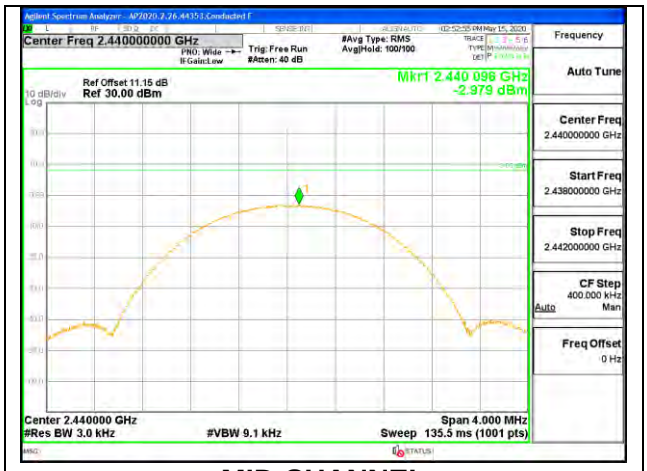
9.6.3. **HIGH POWER BLE (2Mbps)**

ANT4

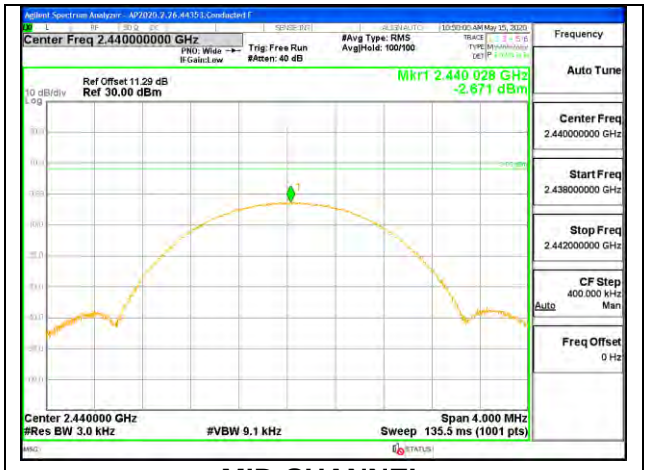
Channel	Frequency (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)	Margin (dB)
Low	2404	-2.081	8	-10.08
Middle	2440	-2.979	8	-10.98
High	2478	-2.657	8	-10.66



MID CHANNEL

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



MID CHANNEL

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

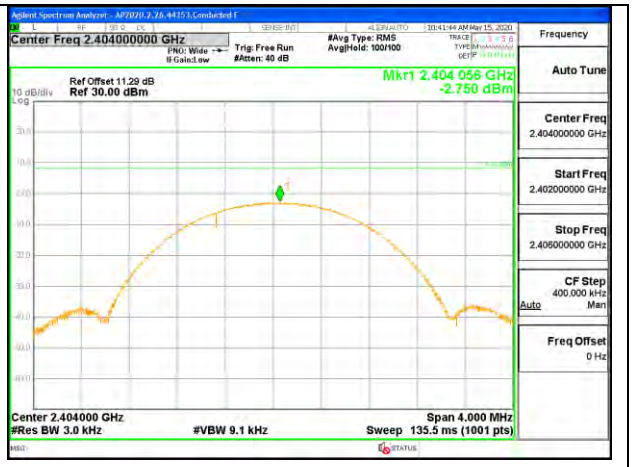
Duty Cycle CF (dB)	0.00	Included in Calculations of Corr'd PSD

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
Hjigh	2478	-2.638	-2.647	0.37	8.0	-7.6

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

MID CHANNEL ANT4



MID CHANNEL ANT3

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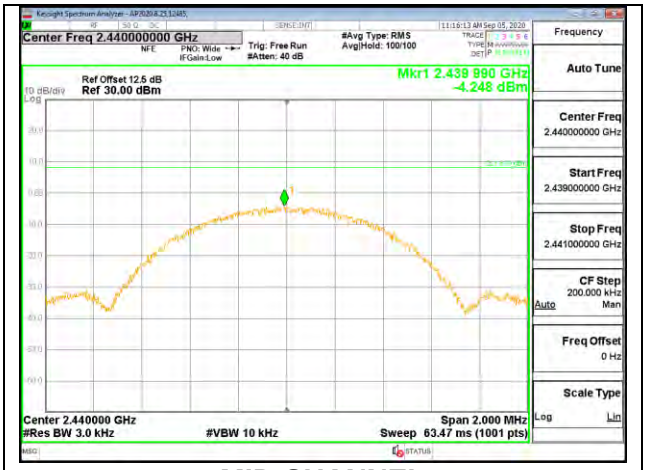
9.6.5. **LOW POWER BLE (1Mbps)**

ANT4

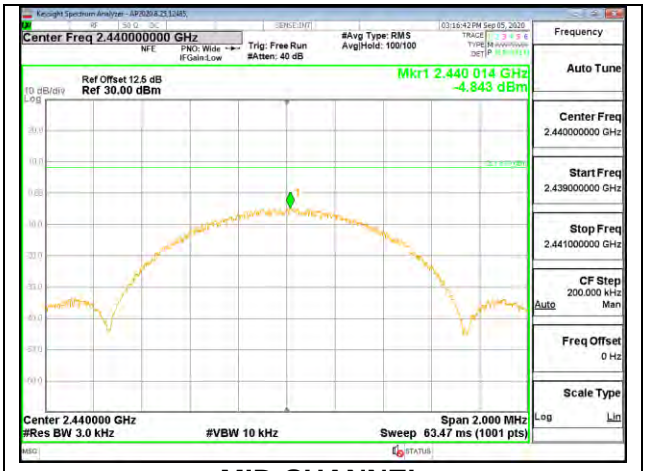
Channel	Frequency (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)	Margin (dB)
Low	2402	-4.504	8	-12.50
Middle	2440	-4.248	8	-12.25
High	2480	-5.480	8	-13.48



MID CHANNEL

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



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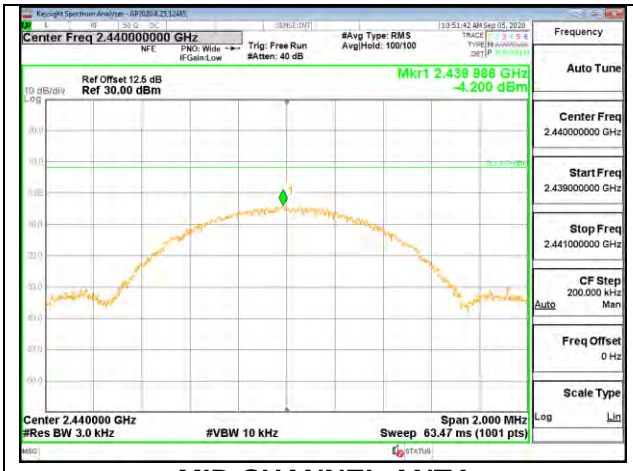
9.6.6. **LOW POWER BLE TXBF (1Mbps)**

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

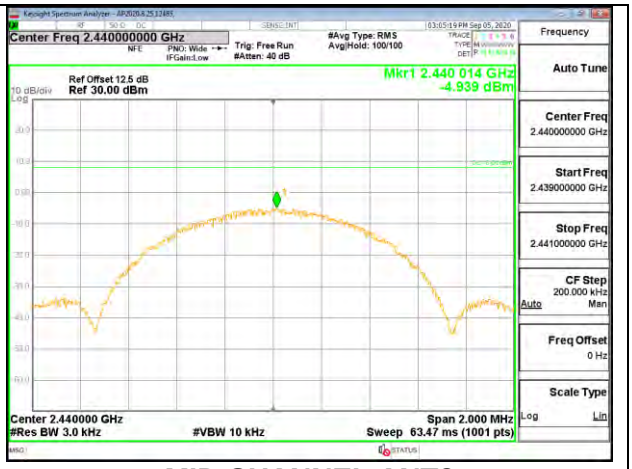
PSD Results

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.



MID CHANNEL ANT4



MID CHANNEL ANT3

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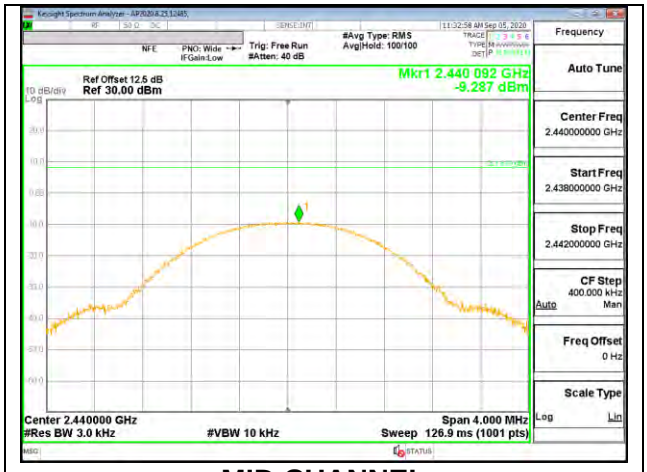
9.6.7. **LOW POWER BLE (2Mbps)**

ANT4

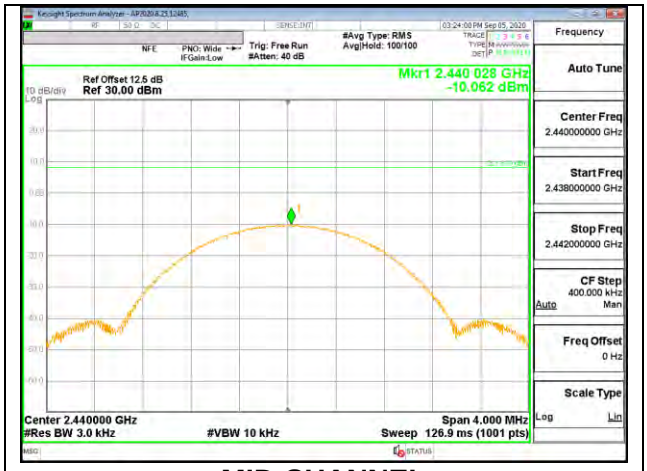
Channel	Frequency (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)	Margin (dB)
Low	2404	-9.780	8	-17.78
Middle	2440	-9.287	8	-17.29
High	2478	-10.176	8	-18.18



MID CHANNEL

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



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

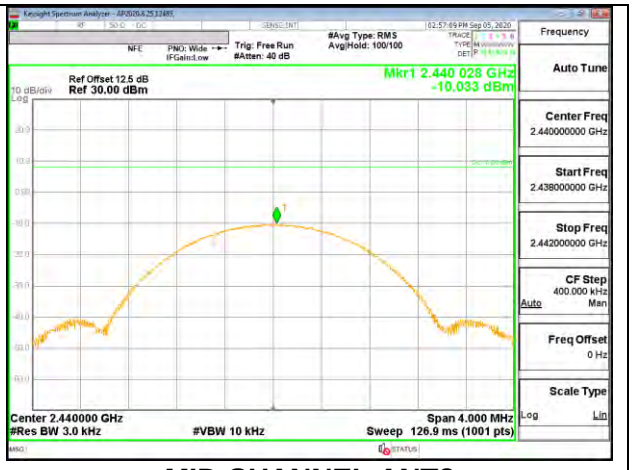
Duty Cycle CF (dB)	0.00	Included in Calculations of Corr'd PSD

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
Hjigh	2478	-10.313	-11.177	-7.71	8.0	-15.7

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

MID CHANNEL ANT4



MID CHANNEL ANT3

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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

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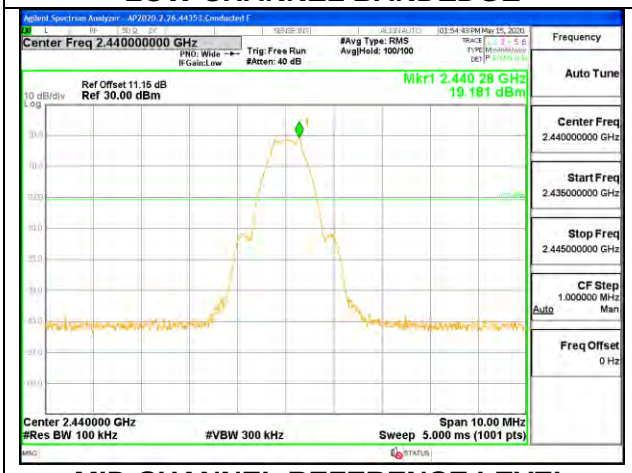
9.7.1. **HIGH POWER BLE (1Mbps)**

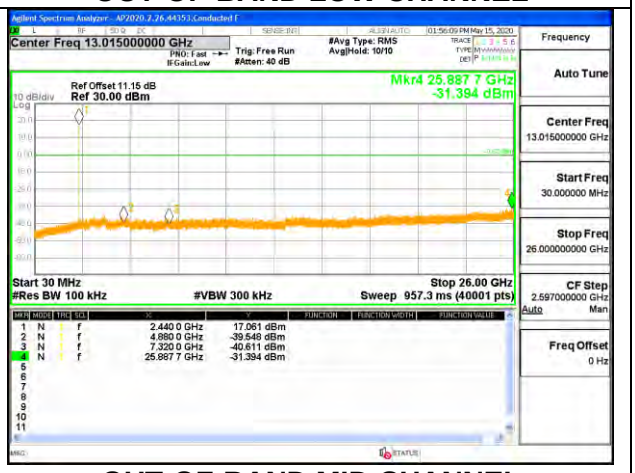
ANT4

LOW CHANNEL BANDEDGE

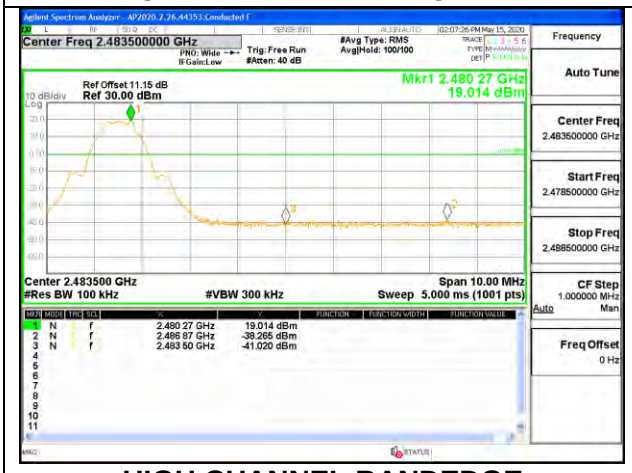
OUT-OF-BAND LOW CHANNEL



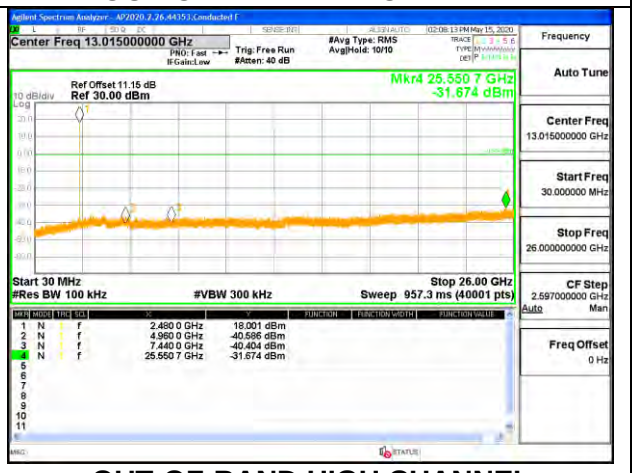
MID CHANNEL REFERENCE LEVEL



OUT-OF-BAND MID CHANNEL



HIGH CHANNEL BANDEDGE



OUT-OF-BAND HIGH CHANNEL

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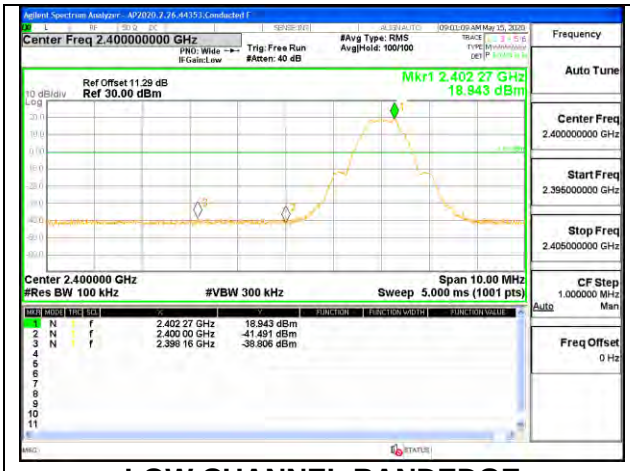
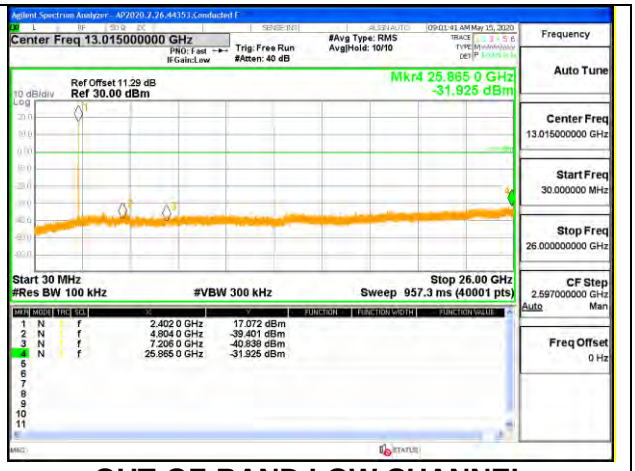
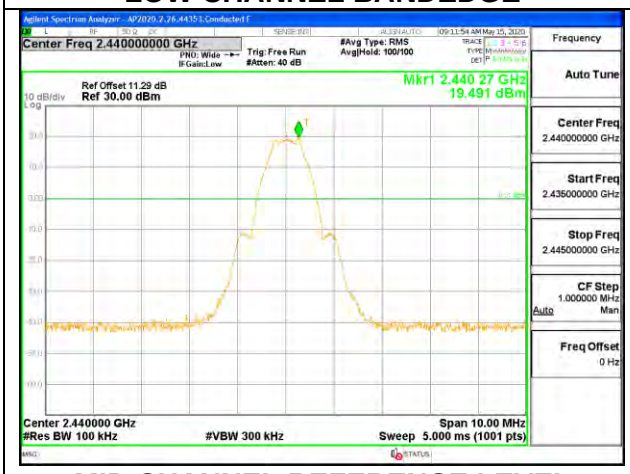
ANT3



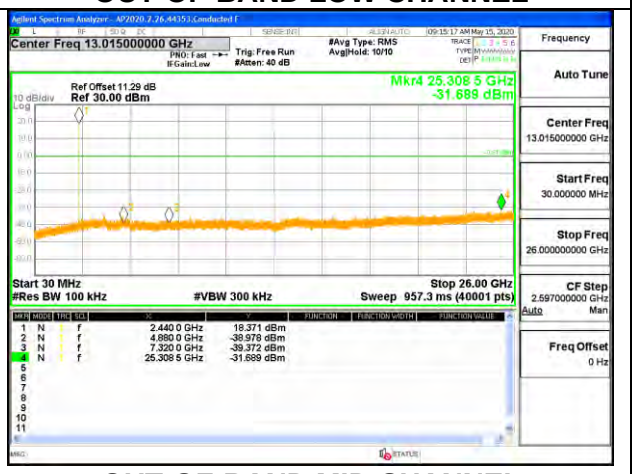
LOW CHANNEL BANDEDGE



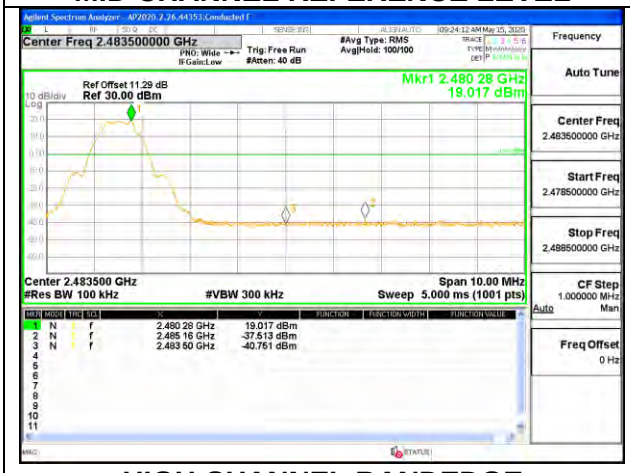
OUT-OF-BAND LOW CHANNEL



MID CHANNEL REFERENCE LEVEL



OUT-OF-BAND MID CHANNEL



HIGH CHANNEL BANDEDGE

OUT-OF-BAND HIGH CHANNEL

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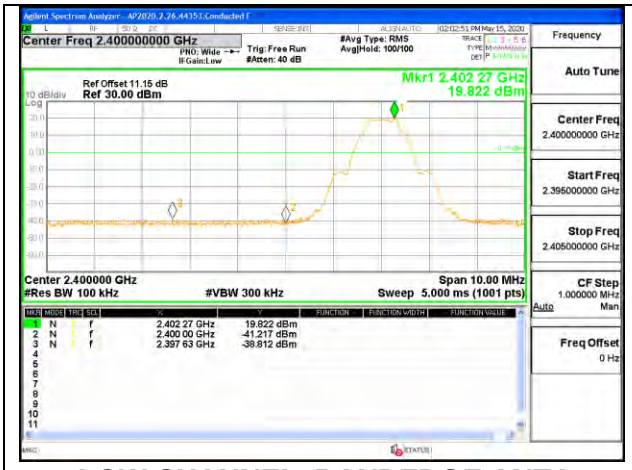
9.7.2. HIGH POWER BLE TXBF (1Mbps)

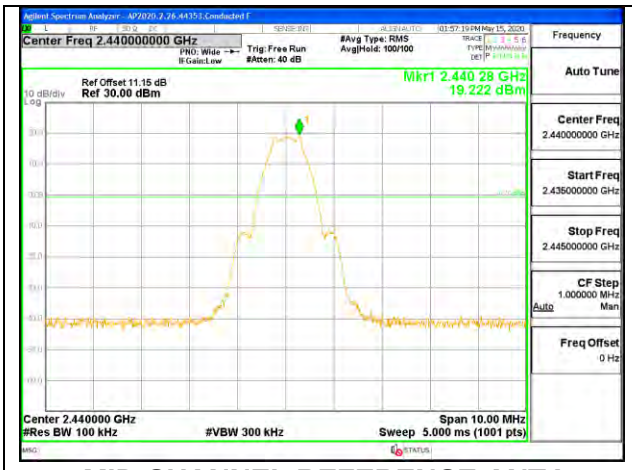
Note: Test procedures and setting are same as BLE normal mode.

ANT4

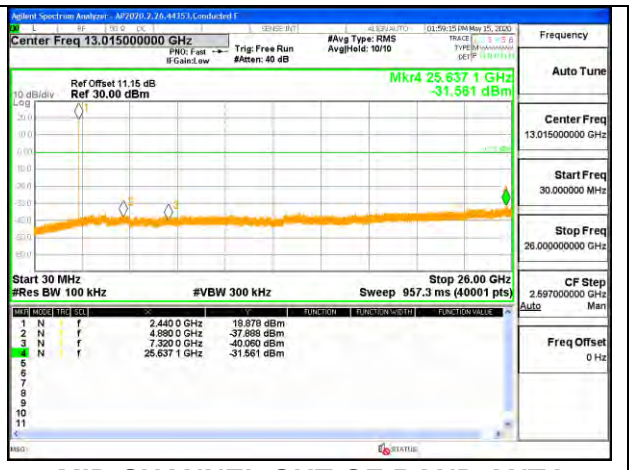


LOW CHANNEL, BANDEDGE ANT4

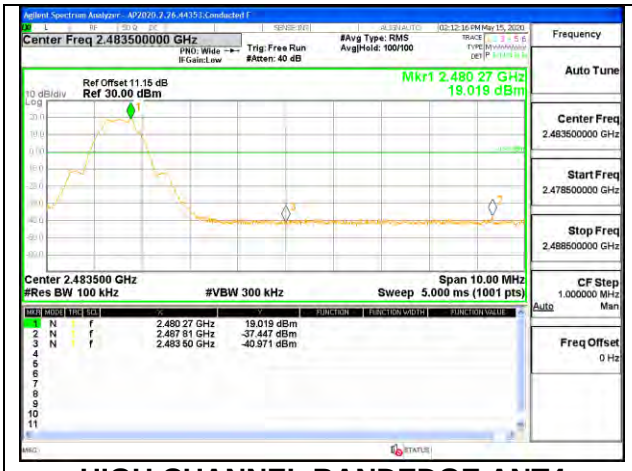
LOW CHANNEL OUT-OF-BAND ANT4



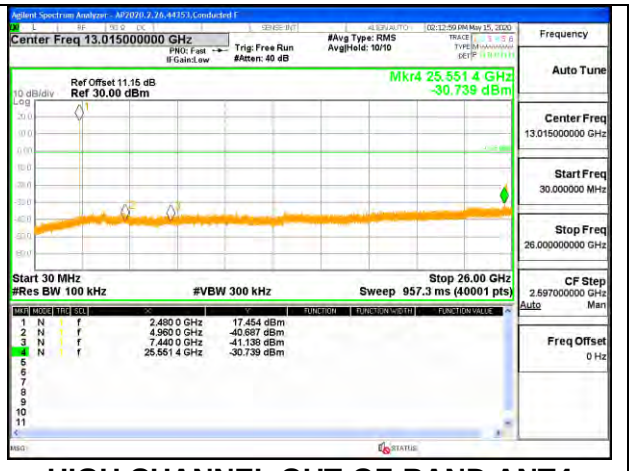
MID CHANNEL REFERENCE ANT4



MID CHANNEL OUT-OF-BAND ANT4



HIGH CHANNEL BANDEDGE ANT4



HIGH CHANNEL OUT-OF-BAND ANT4

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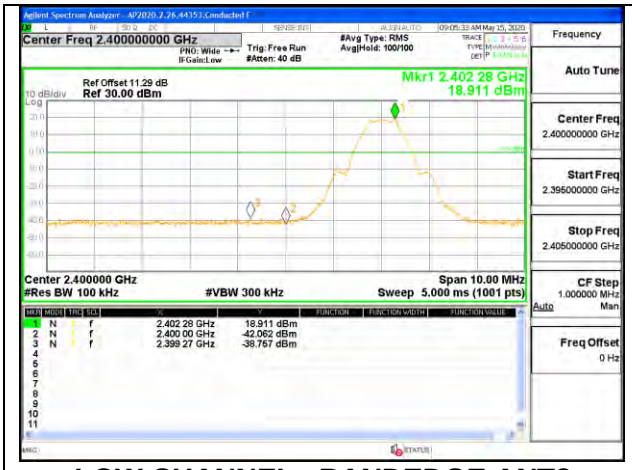
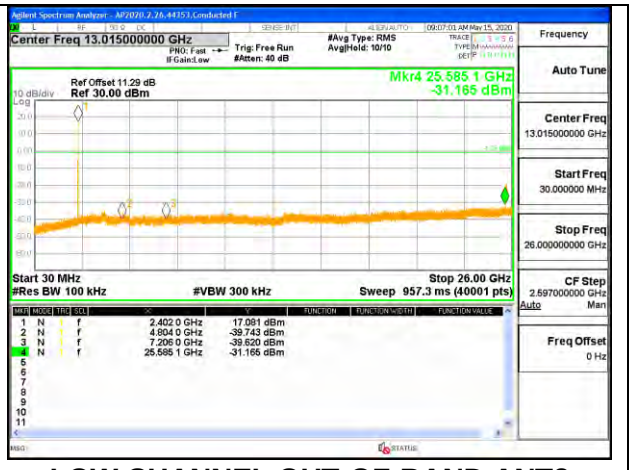
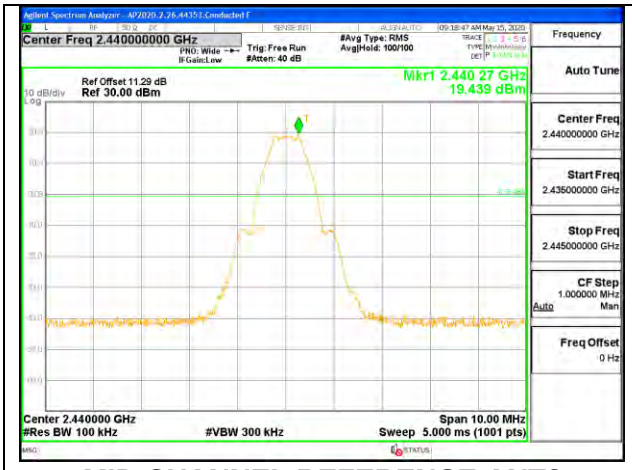
ANT3



LOW CHANNEL , BANDEDGE ANT3



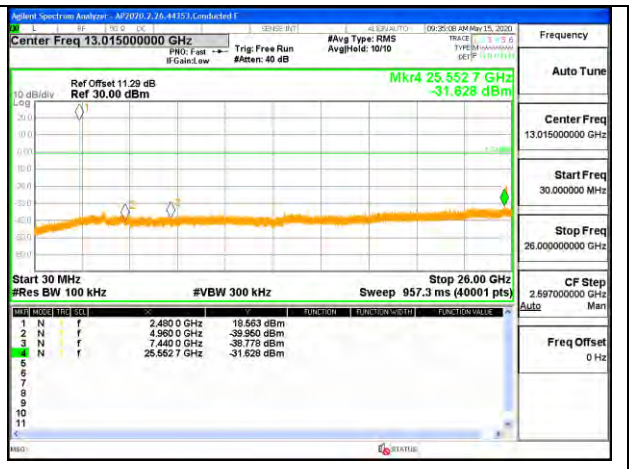
LOW CHANNEL OUT-OF-BAND ANT3



MID CHANNEL REFERENCE ANT3

MID CHANNEL OUT-OF-BAND ANT3

HIGH CHANNEL BANDEDGE ANT3



HIGH CHANNEL OUT-OF-BAND ANT3

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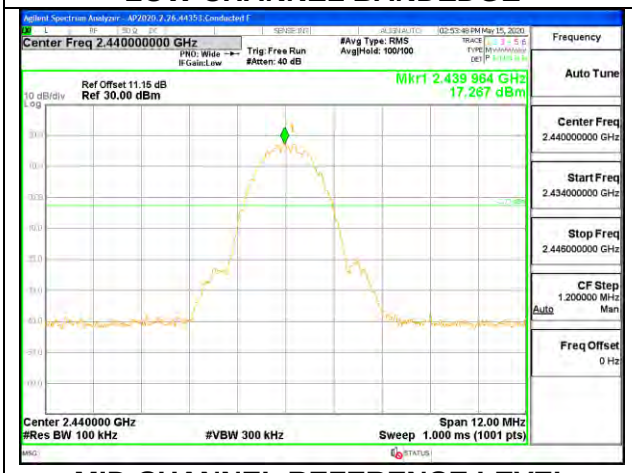
9.7.3. **HIGH POWER BLE (2Mbps)**

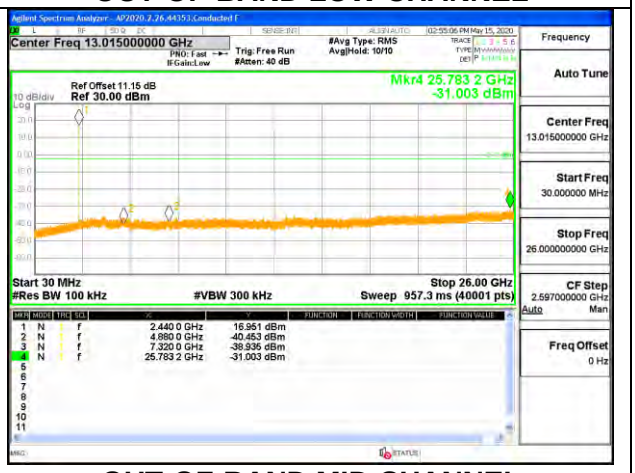
ANT4

LOW CHANNEL BANDEDGE

OUT-OF-BAND LOW CHANNEL

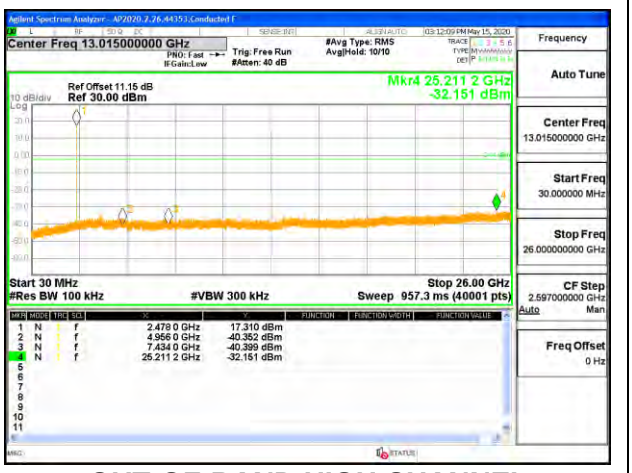


MID CHANNEL REFERENCE LEVEL



OUT-OF-BAND MID CHANNEL

HIGH CHANNEL BANDEDGE



OUT-OF-BAND HIGH CHANNEL

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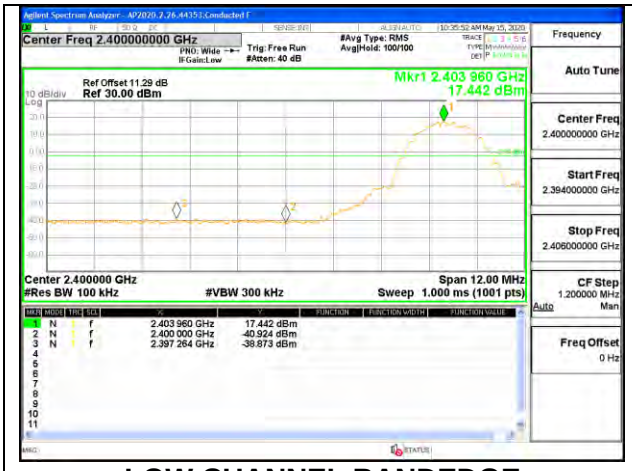
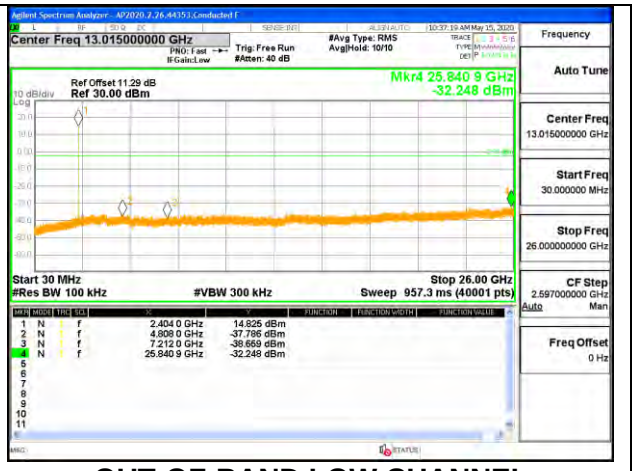
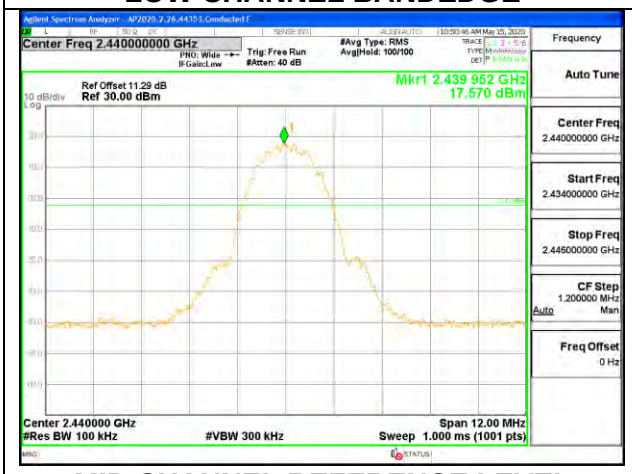
ANT3



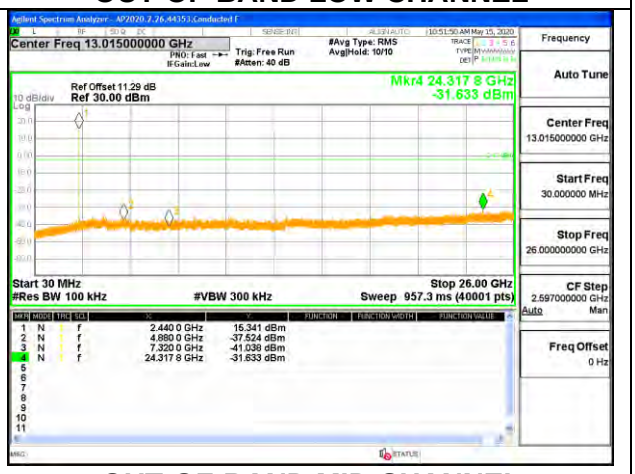
LOW CHANNEL BANDEDGE



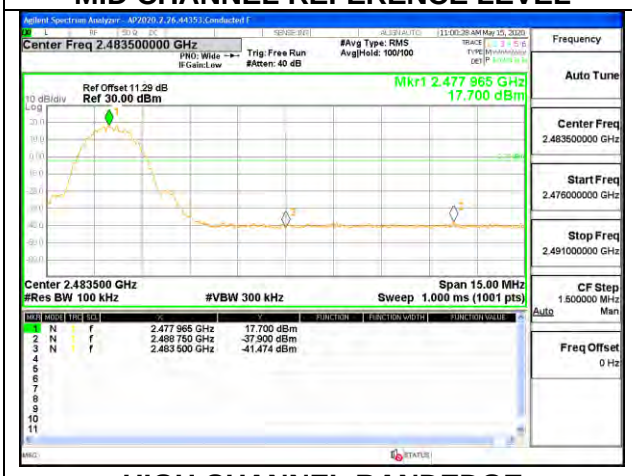
OUT-OF-BAND LOW CHANNEL



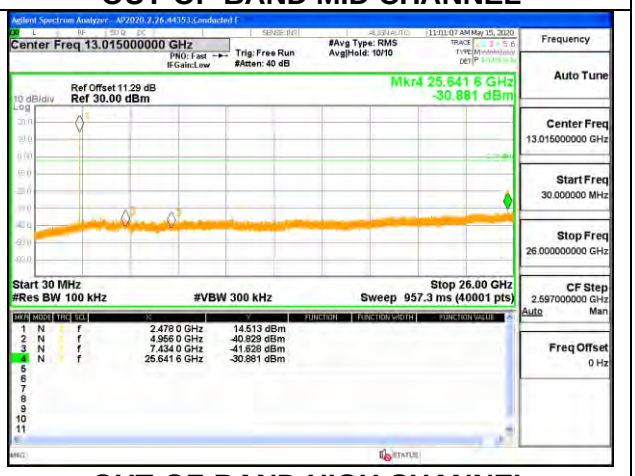
MID CHANNEL REFERENCE LEVEL



OUT-OF-BAND MID CHANNEL



HIGH CHANNEL BANDEDGE



OUT-OF-BAND HIGH CHANNEL

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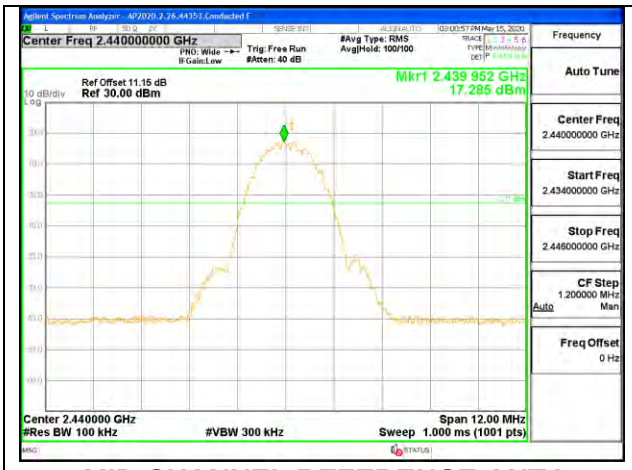
9.7.4. HIGH POWER BLE TXBF (2Mbps)

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

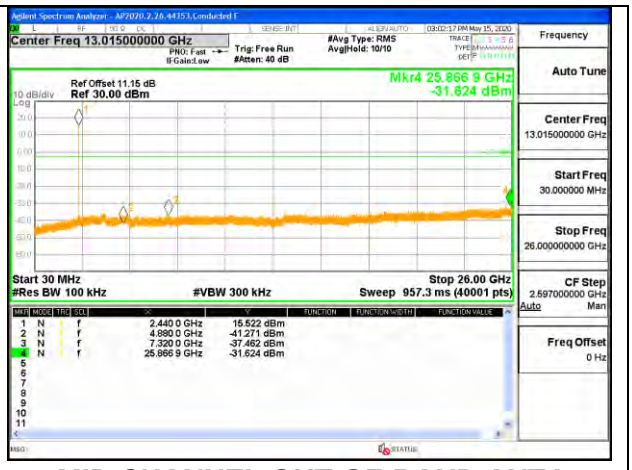
ANT4

LOW CHANNEL, BANDEDGE ANT4

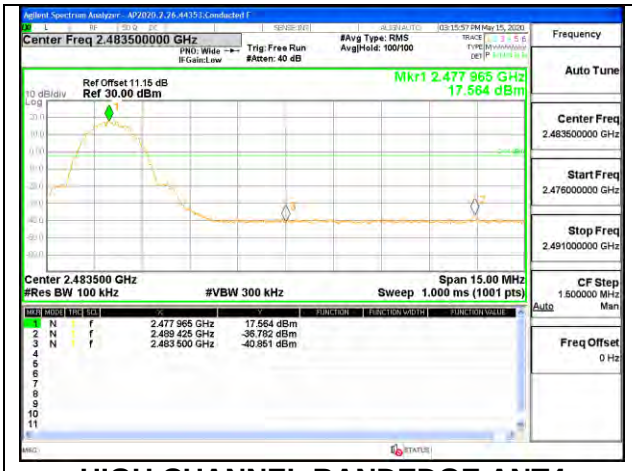
LOW CHANNEL OUT-OF-BAND ANT4



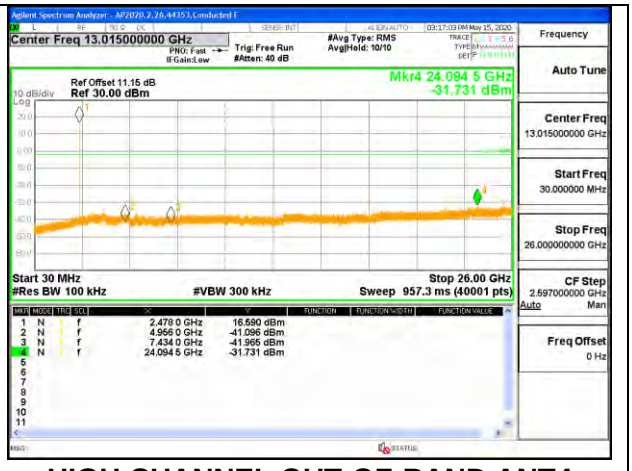
MID CHANNEL REFERENCE ANT4



MID CHANNEL OUT-OF-BAND ANT4



HIGH CHANNEL BANDEDGE ANT4



HIGH CHANNEL OUT-OF-BAND ANT4

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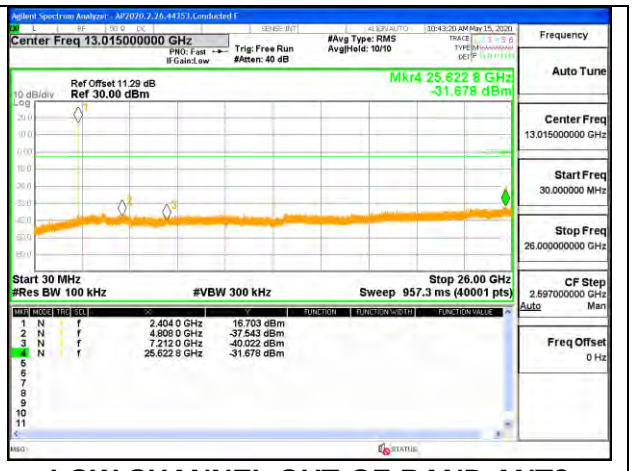
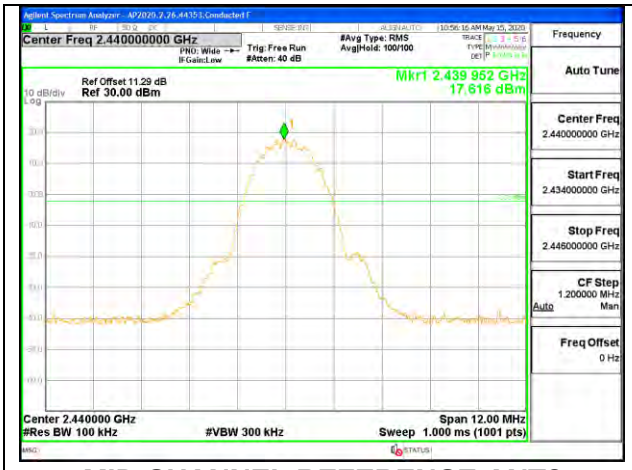
ANT3

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

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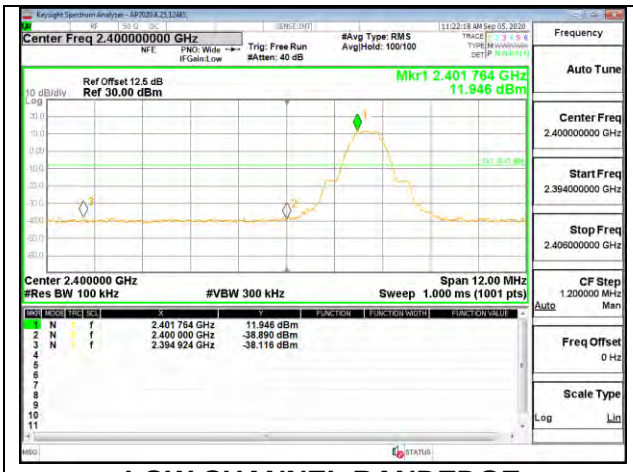
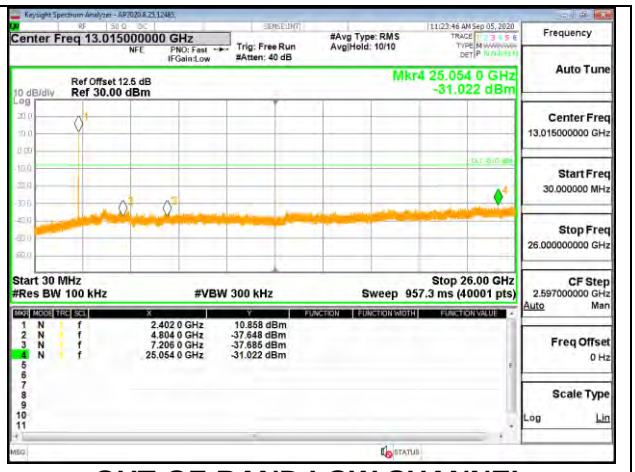
9.7.5. **LOW POWER BLE (1Mbps)**

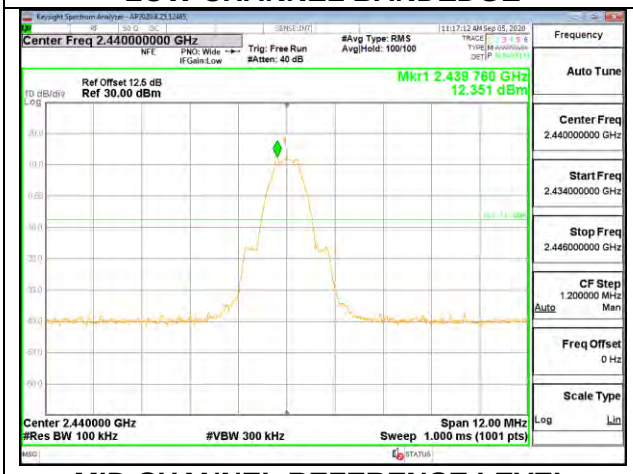
ANT4



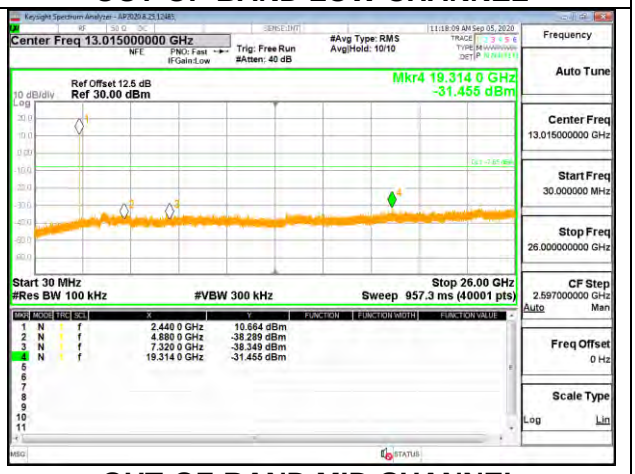
LOW CHANNEL BANDEDGE



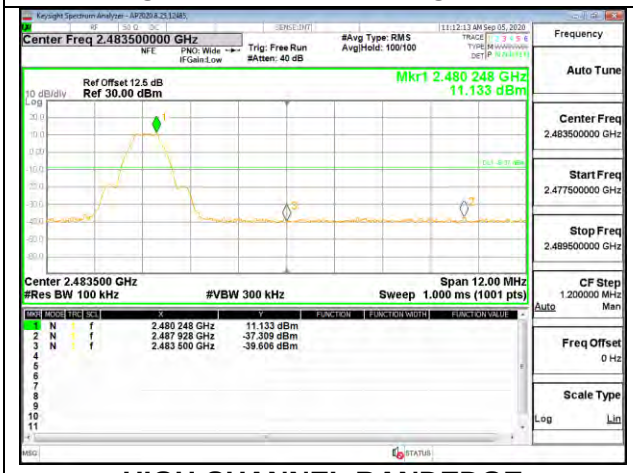
OUT-OF-BAND LOW CHANNEL



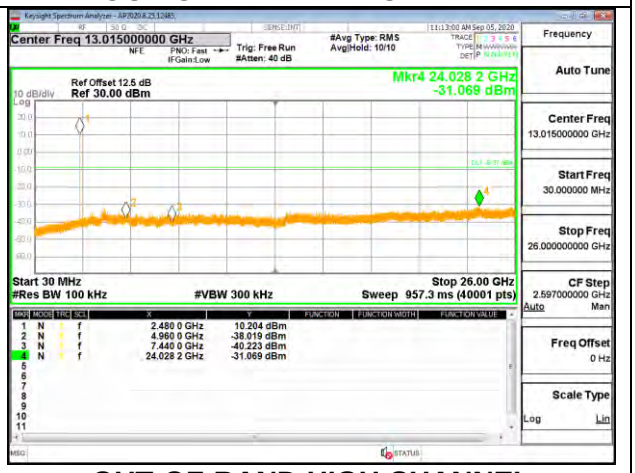
MID CHANNEL REFERENCE LEVEL



OUT-OF-BAND MID CHANNEL



HIGH CHANNEL BANDEDGE



OUT-OF-BAND HIGH CHANNEL

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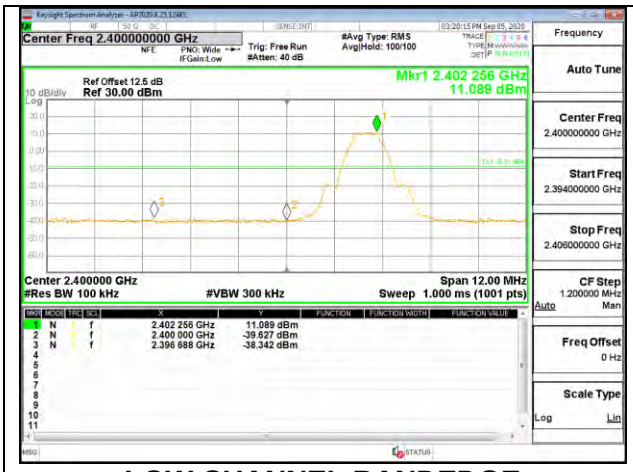
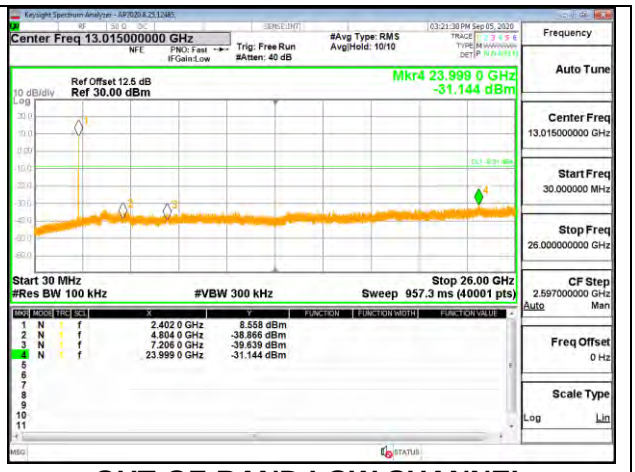
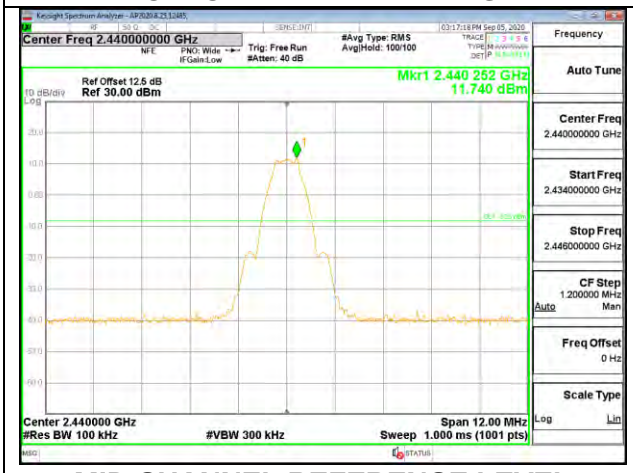
ANT3



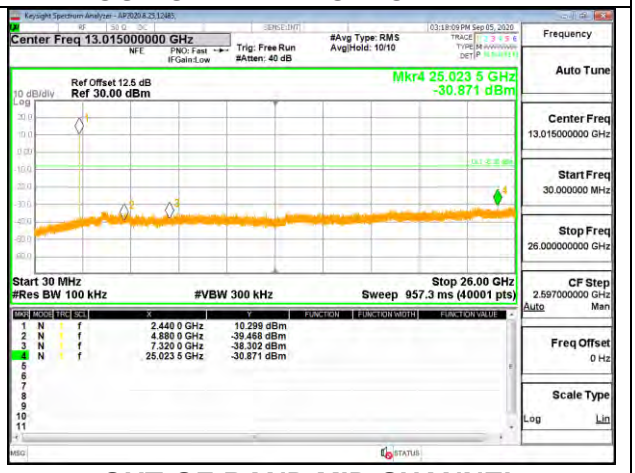
LOW CHANNEL BANDEDGE



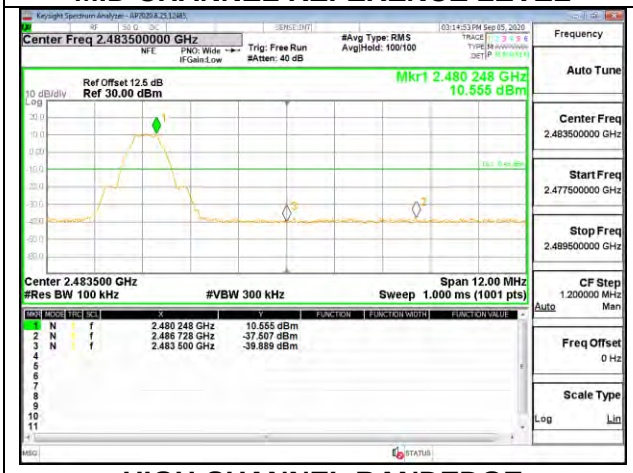
OUT-OF-BAND LOW CHANNEL



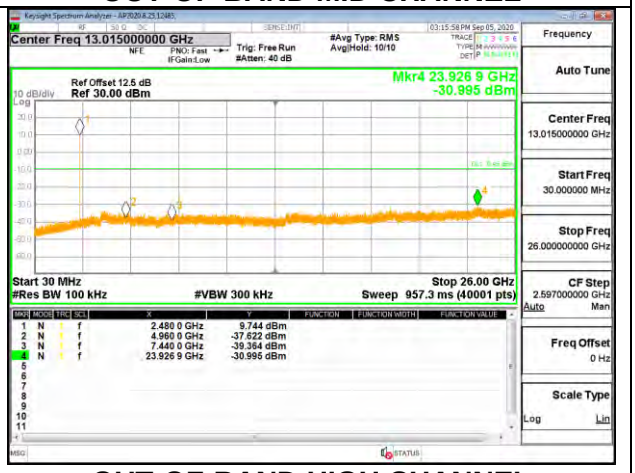
MID CHANNEL REFERENCE LEVEL



OUT-OF-BAND MID CHANNEL



HIGH CHANNEL BANDEDGE



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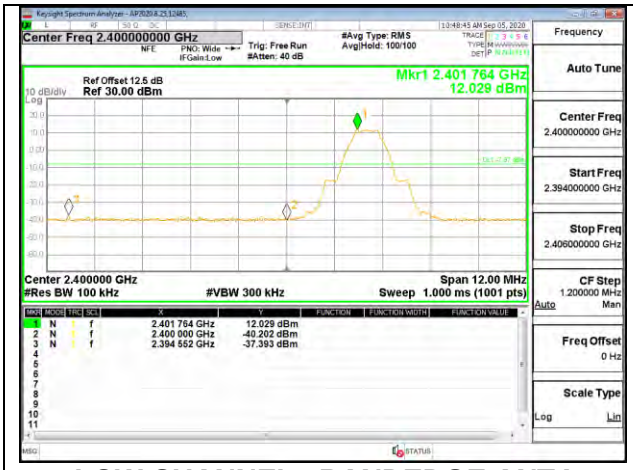
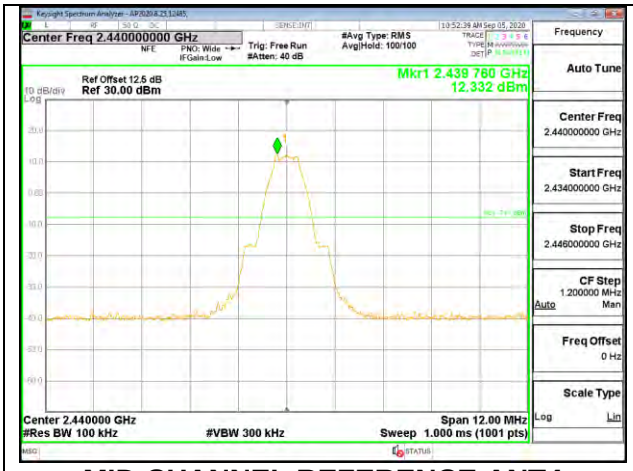
9.7.6. LOW POWER BLE TXBF (1Mbps)

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

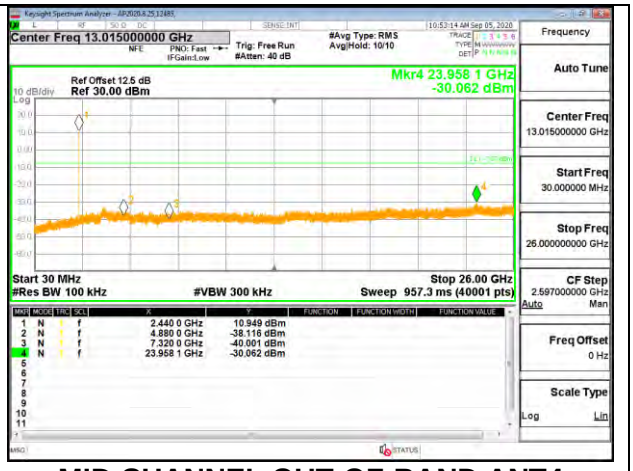


LOW CHANNEL , BANDEDGE ANT4

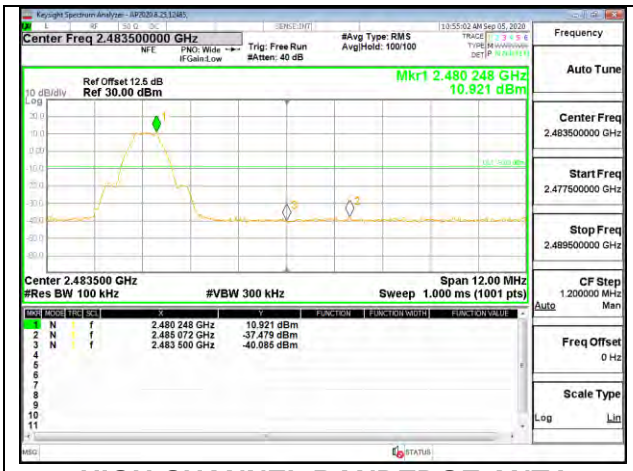
LOW CHANNEL OUT-OF-BAND ANT4



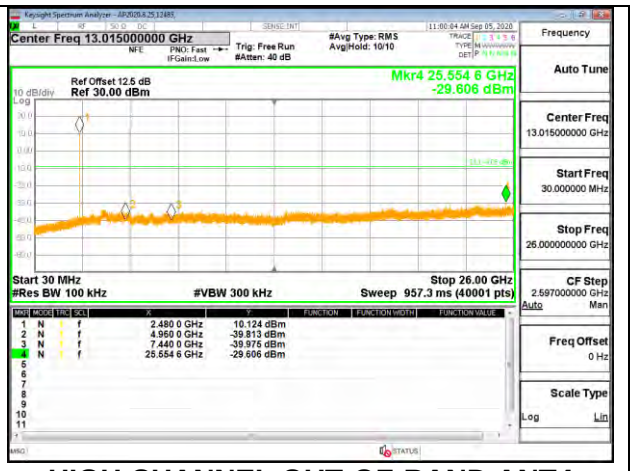
MID CHANNEL REFERENCE ANT4



MID CHANNEL OUT-OF-BAND ANT4



HIGH CHANNEL BANDEDGE ANT4



HIGH CHANNEL OUT-OF-BAND ANT4

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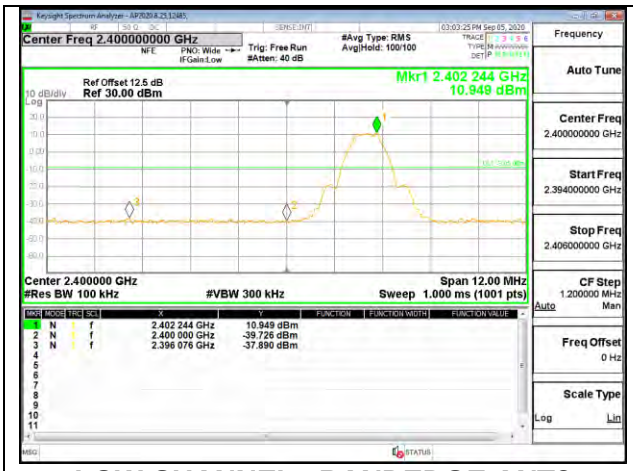
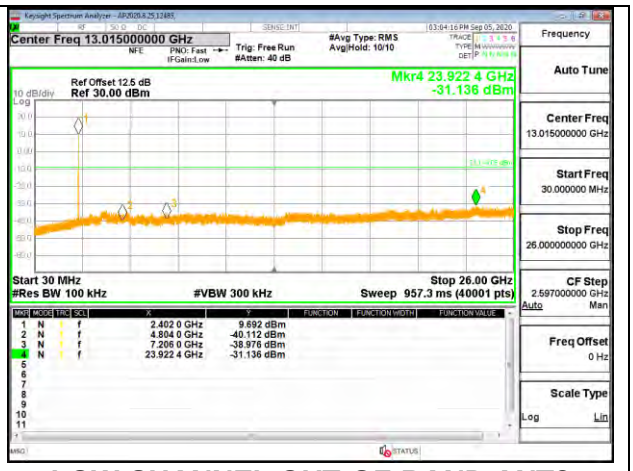
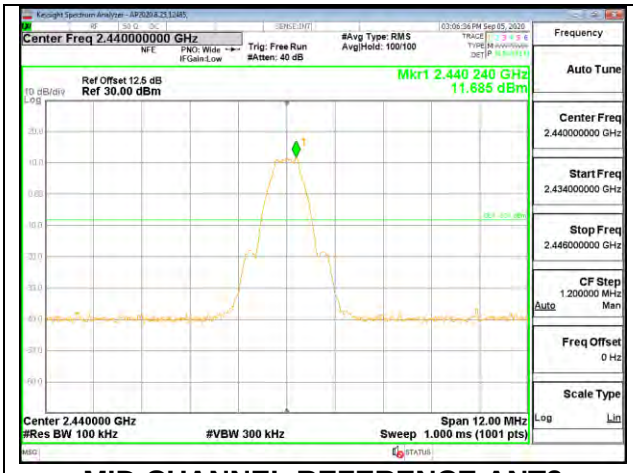
LOW POWER (1Mbps)



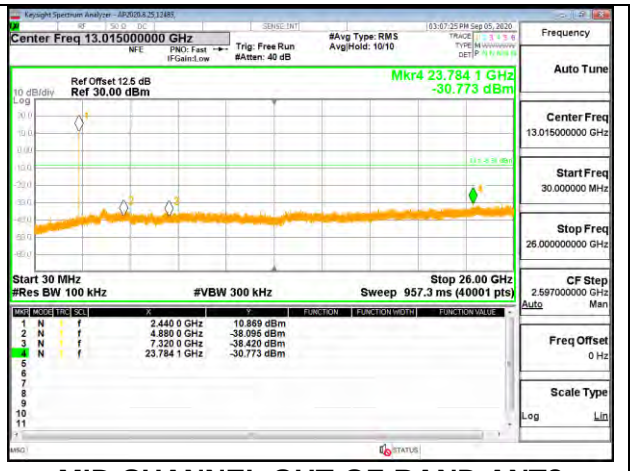
LOW CHANNEL , BANDEDGE ANT3



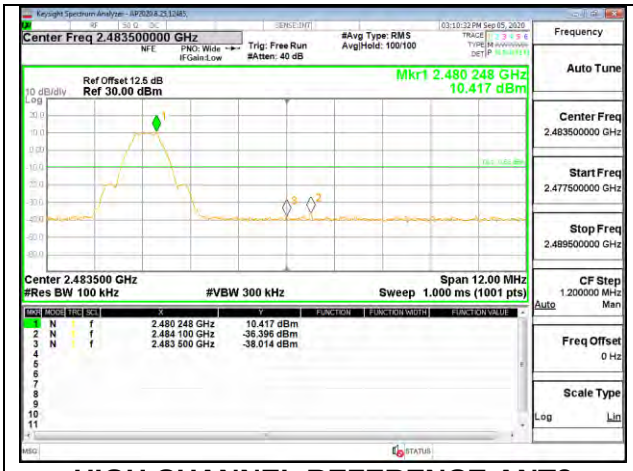
LOW CHANNEL OUT-OF-BAND ANT3



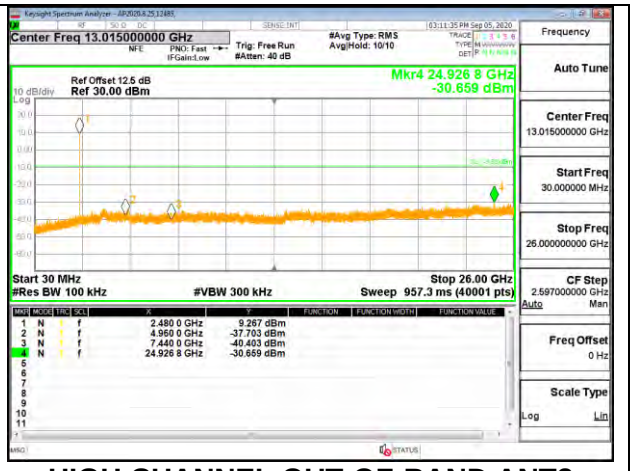
MID CHANNEL REFERENCE ANT3



MID CHANNEL OUT-OF-BAND ANT3



HIGH CHANNEL REFERENCE ANT3



HIGH CHANNEL OUT-OF-BAND ANT3

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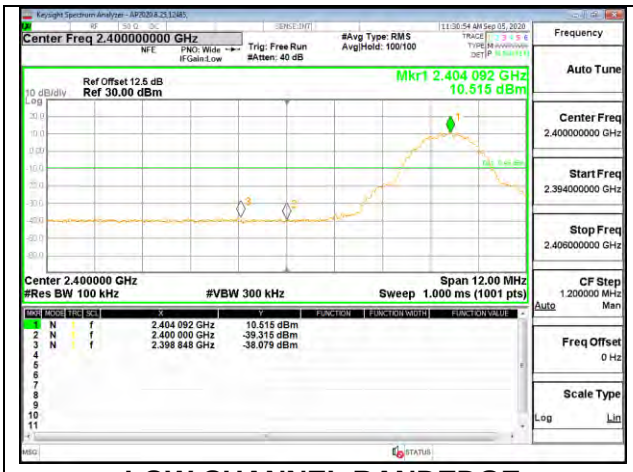
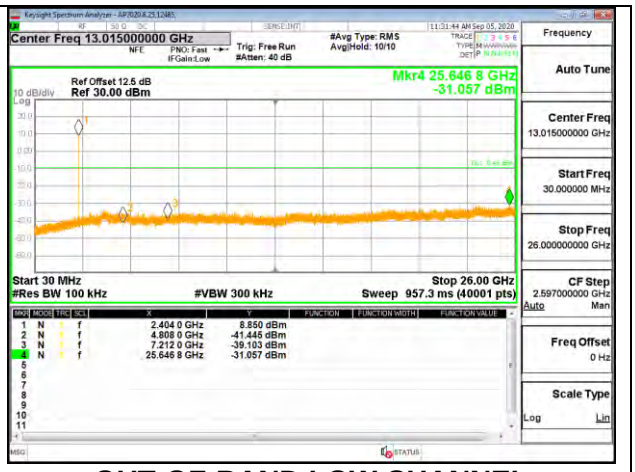
9.7.7. **LOW POWER BLE (2Mbps)**

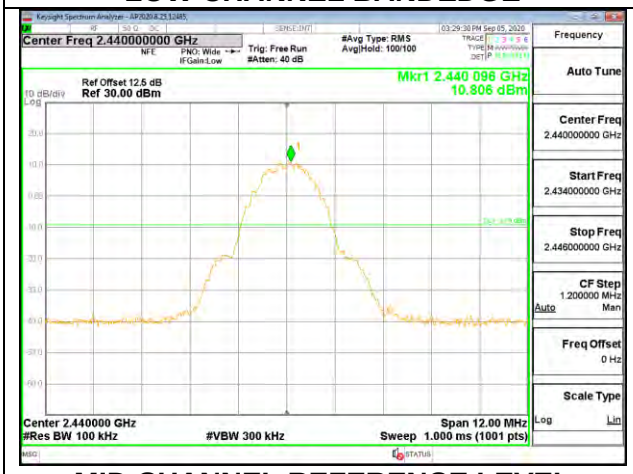
ANT4



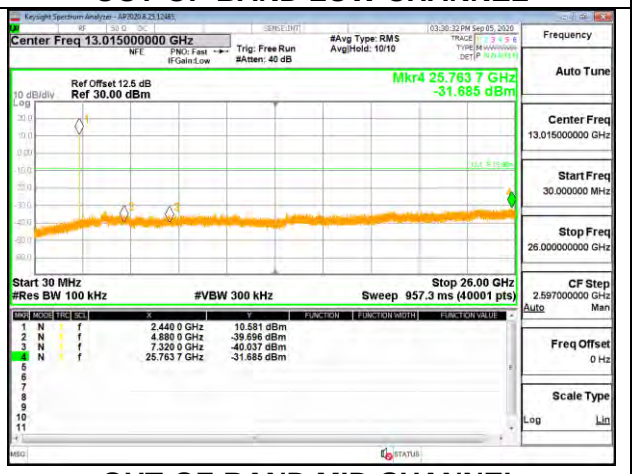
LOW CHANNEL BANDEDGE



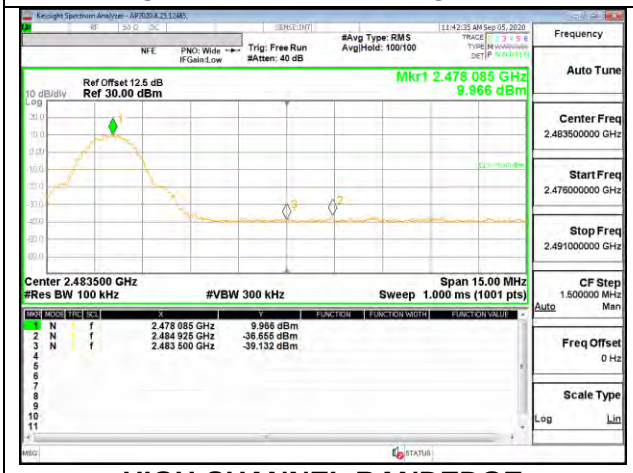
OUT-OF-BAND LOW CHANNEL



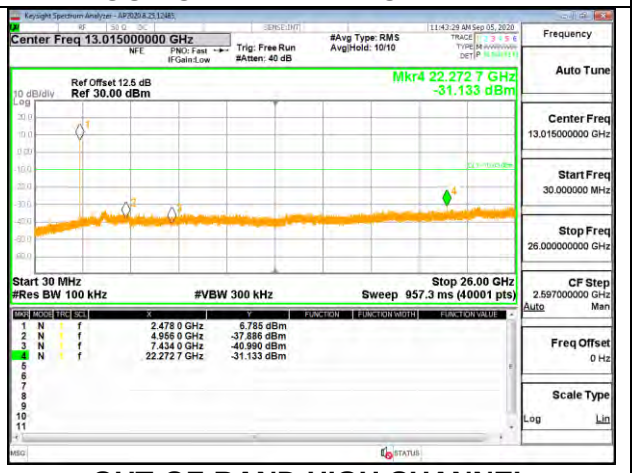
MID CHANNEL REFERENCE LEVEL



OUT-OF-BAND MID CHANNEL



HIGH CHANNEL BANDEDGE



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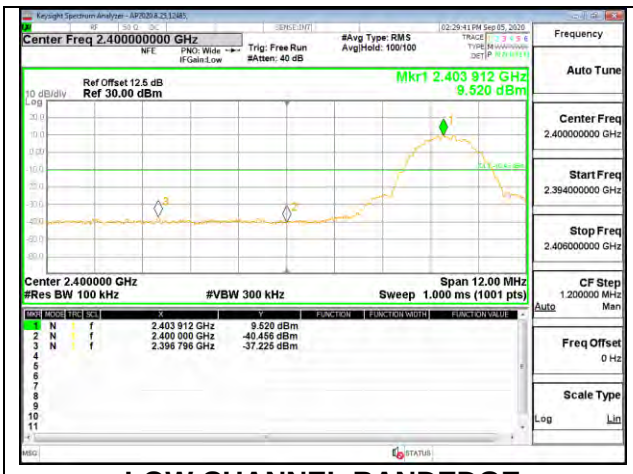
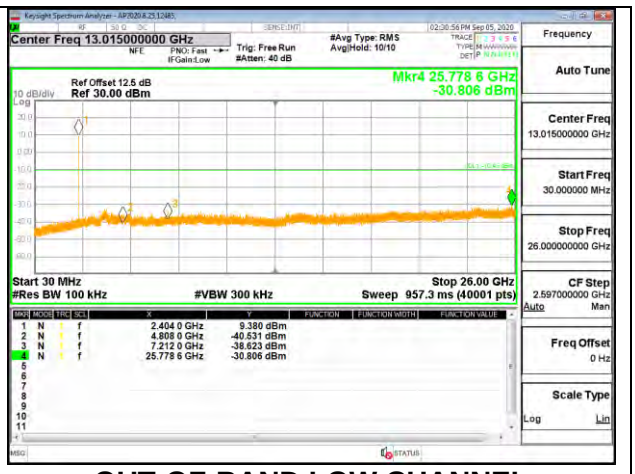
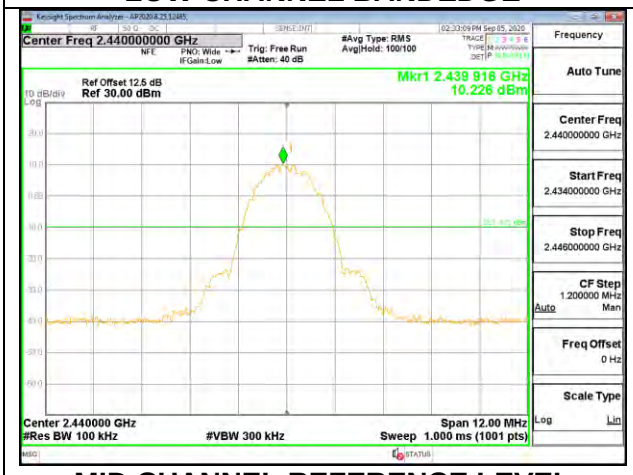
ANT3



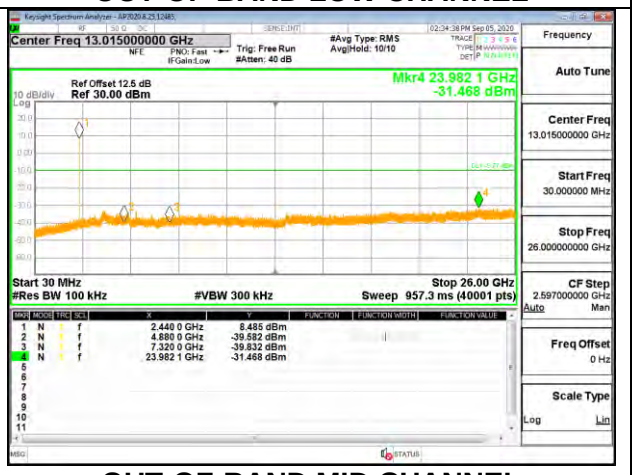
LOW CHANNEL BANDEDGE



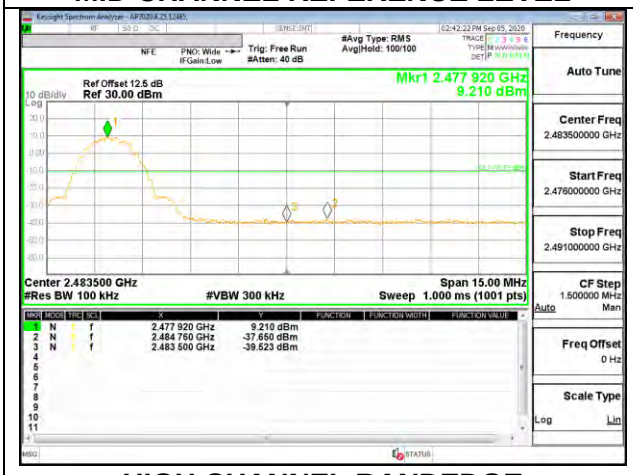
OUT-OF-BAND LOW CHANNEL



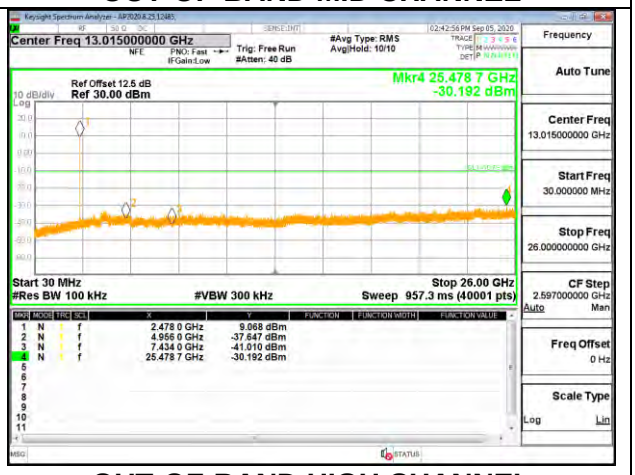
MID CHANNEL REFERENCE LEVEL



OUT-OF-BAND MID CHANNEL



HIGH CHANNEL BANDEDGE



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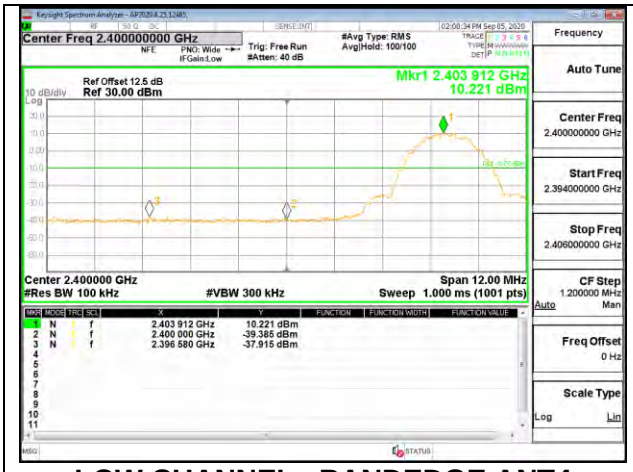
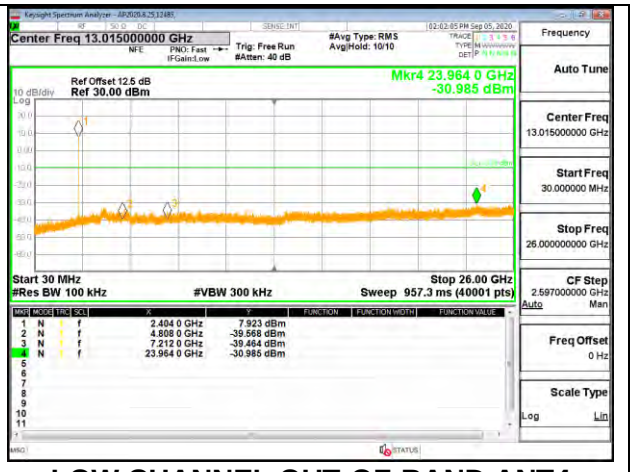
9.7.8. LOW POWER BLE TXBF (2Mbps)

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

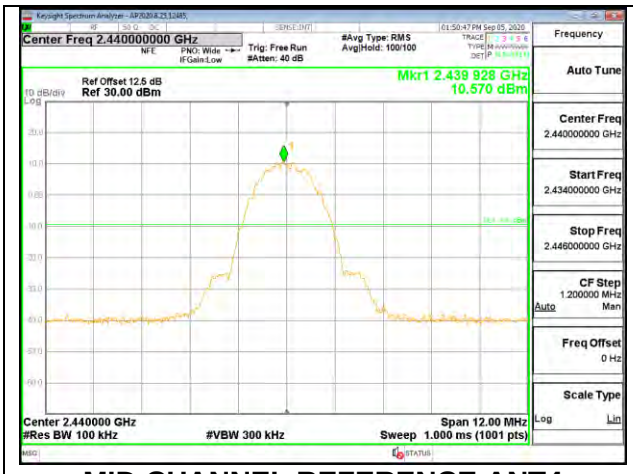
ANT4



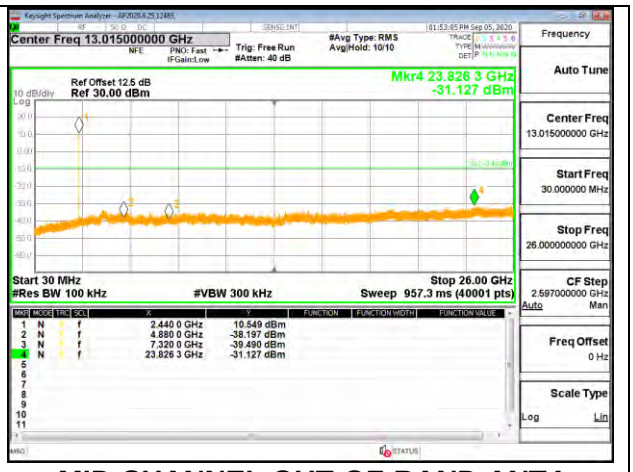
LOW CHANNEL , BANDEDGE ANT4



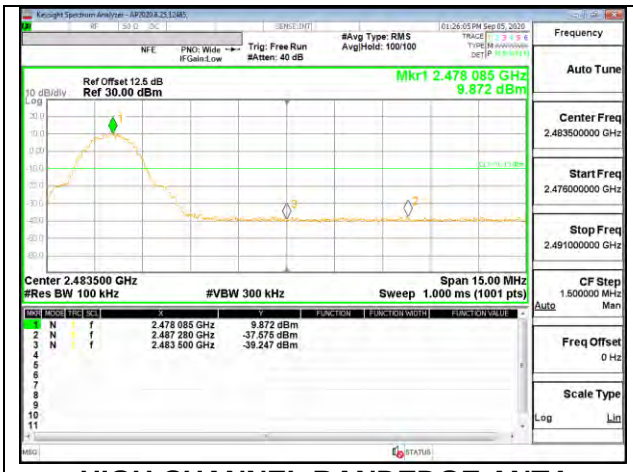
LOW CHANNEL OUT-OF-BAND ANT4



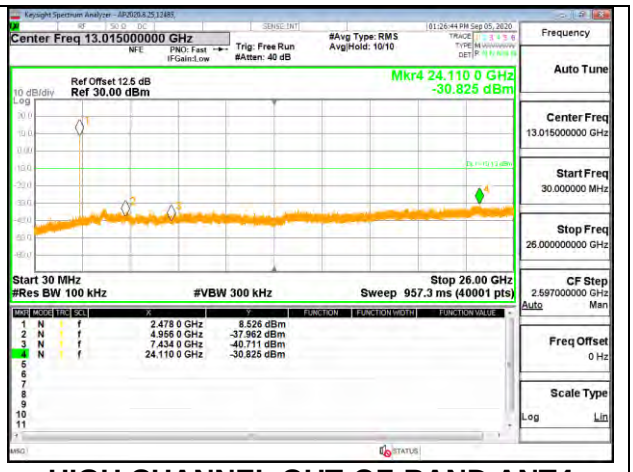
MID CHANNEL REFERENCE ANT4



MID CHANNEL OUT-OF-BAND ANT4



HIGH CHANNEL BANDEDGE ANT4



HIGH CHANNEL OUT-OF-BAND ANT4

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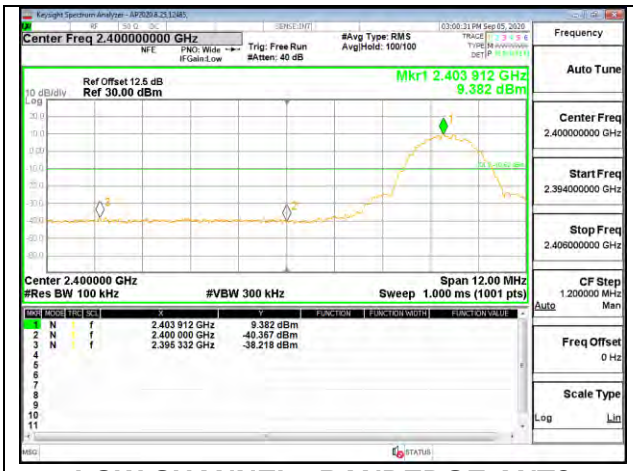
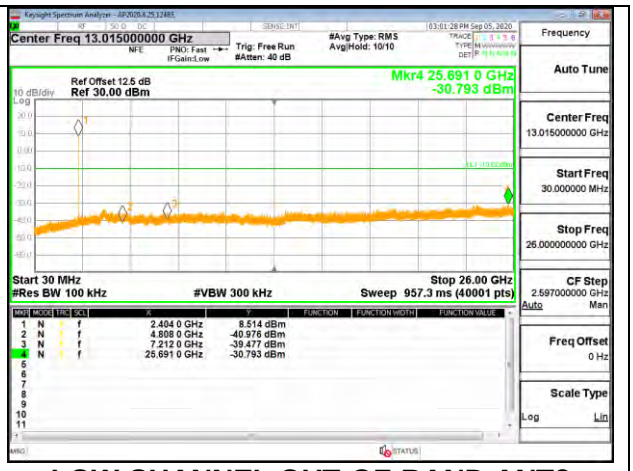
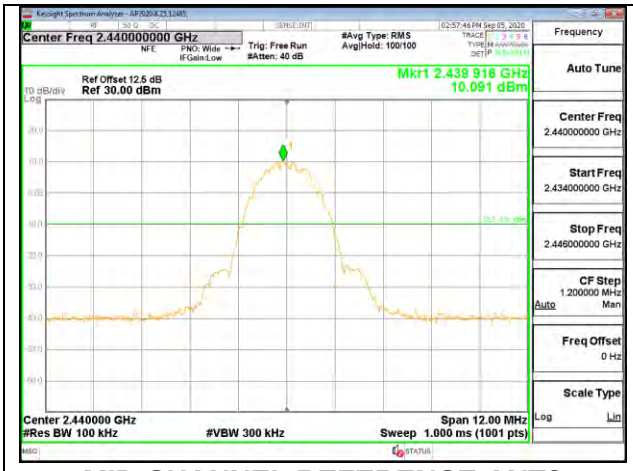
ANT3



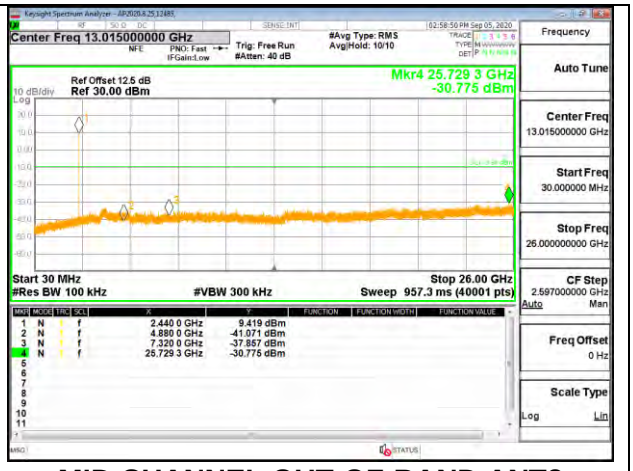
LOW CHANNEL , BANDEDGE ANT3



LOW CHANNEL OUT-OF-BAND ANT3



MID CHANNEL REFERENCE ANT3



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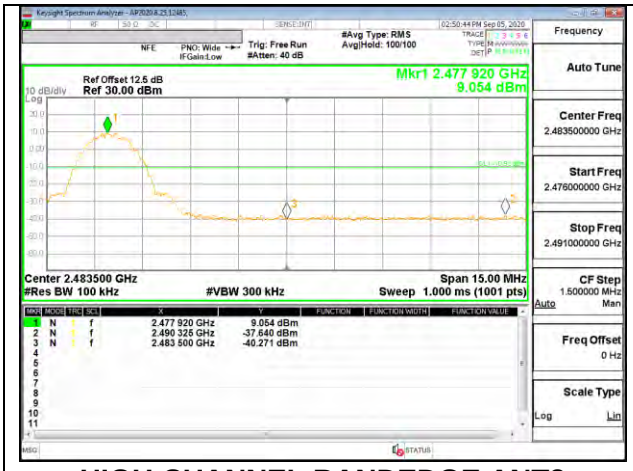
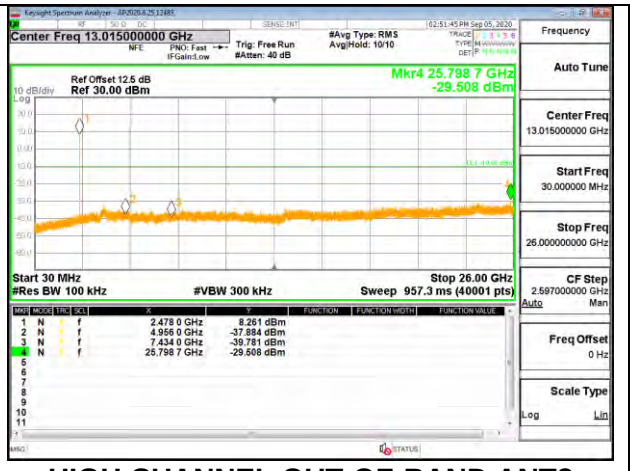


HIGH CHANNEL BANDEDGE ANT3



HIGH CHANNEL OUT-OF-BAND ANT3

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