TEST REPORT

Report Number. : 13268681-E3V3

Applicant	:	SONOS INC. 614 CHAPALA STREET SANTA BARBARA, CA, 93101, U.S.A
Model	:	S27
FCC ID	:	SBVRM027
ISED	:	5373A-RM027
EUT Description	:	802.11 a/b/g/n/ac 2x2 Client Device with BT and BLE
Test Standard(s)	:	FCC 47 CFR PART 15 SUBPART C ISED RSS-247 ISSUE 2 ISED RSS-GEN ISSUE 5

Date Of Issue:
January 22, 2021

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

NVLAP Lab code: 200065-0

REPORT REVISION HISTORY

Rev.	Issue Date	Revisions	Revised By
V1	12/18/2020	Initial Issue	
V2	1/4/2021	Updated Section 3 &11 Added BT and BLE to EUT Description	Kiya Kedida
V3	1/22/2021	Added Note to Section 6.3 Description of Available Antennas, Section 10 added statement Updated Section 4.	Kiya Kedida

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: SONOS INC.
614 CHAPALA STREET
SANTA BARBARA, CA 93101, U.S.A.

EUT DESCRIPTION: 802.11 a/b/g/n/ac 2x2 Client Device with BT and BLE

MODEL: S27

SERIAL NUMBER: A1002009W54-2A-1B-40-06-6E3 (Radiated Sample)
A1002009W54-2A-1B-B0-02-94D (Radiated Sample)
5CFFDD0001067 (Conducted Sample)

DATE TESTED: November 04, 2020-November 18, 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.

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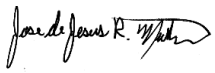
Approved & Released For
UL Verification Services Inc. By:

Dan Coronia
Operations Leader
Consumer Technology Division
UL Verification Services Inc.

Prepared By:



Jose Martinez
Laboratory Engineer
Consumer Technology Division
UL Verification Services Inc.

Reviewed By:

Kiya Kedida
Senior Project Engineer
Consumer Technology Division
UL Verification Services Inc.

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2. TEST RESULTS 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		None.
15.247 (b) (3)	RSS-247 5.4 (d)	Output Power		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		None.
15.247 (d)	RSS-247 5.5	Conducted Spurious Emissions		None.
15.209, 15.205	RSS-GEN 8.9, 8.10	Radiated Emissions		None.
15.207	RSS-Gen 8.8	AC Mains Conducted Emissions		None.

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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 414788 D01 Radiated Test Site v01r01, RSS-GEN Issue 5, and RSS-247 Issue 2.

4. FACILITIES AND ACCREDITATION

UL Verification Services Inc. is accredited by NVLAP, Laboratory Code 200065-0, for all testing performed within the scope of this report. Testing was performed at the locations noted below.

	Address	ISED CABID	ISED Company Number	FCC Registration
☐	Building 1: 47173 Benicia Street, Fremont, California 94538, USA	US0104	2324A	208313
☐	Building 2: 47266 Benicia Street, Fremont, California 94538, USA	US0104	22541	208313
☒	Building 4: 47658 Kato Rd, Fremont, California 94538, USA	US0104	2324B	208313

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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	3.78 dB
Worst Case Conducted Disturbance, 0.15 to 30 MHz	3.4 dB
Worst Case Radiated Disturbance, 9KHz to 30 MHz	2.84 dB
Worst Case Radiated Disturbance, 30 to 1000 MHz	4.84 dB
Worst Case Radiated Disturbance, 1000 to 18000 MHz	4.73 dB
Worst Case Radiated Disturbance, 18000 to 26000 MHz	4.51 dB
Worst Case Radiated Disturbance, 26000 to 40000 MHz	5.29 dB

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

5.4. SAMPLE CALCULATION

RADIATED EMISSIONS

Where relevant, the following sample calculation is provided:
Field Strength (dBuV/m) = Measured Voltage (dBuV) + Antenna Factor (dB/m) + Cable Loss (dB) – Preamp Gain (dB)
36.5 dBuV + 18.7 dB/m + 0.6 dB – 26.9 dB = 28.9 dBuV/m

MAINS CONDUCTED EMISSIONS

Where relevant, the following sample calculation is provided:
Final Voltage (dBuV) = Measured Voltage (dBuV) + Cable Loss (dB) + Limiter Factor (dB) + LISN Insertion Loss.
36.5 dBuV + 0 dB +10.1 dB+ 0 dB = 46.6 dBuV

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6. EQUIPMENT UNDER TEST

6.1. EUT DESCRIPTION

The EUT is a 802.11 a/b/g/n/ac 2x2 Client Device with BT and BLE .

6.2. MAXIMUM OUTPUT POWER

The transmitter has a maximum conducted output power as follows:

2.4GHz BAND

Frequency Range (MHz)	Mode	Output Power (dBm)	Output Power (mW)
2Tx			
2412 - 2462	802.11b	21.41	138.36
2412 - 2462	802.11g	25.33	341.19
2412 - 2462	802.11n HT20 CDD	25.3	338.84

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6.3. DESCRIPTION OF AVAILABLE ANTENNAS

Frequency Range (MHz)	EUT at Horizontal Orientation		EUT at Vertical Orientation	
	Horizontal Polarization	Vertical Polarization	Vertical Polarization	Horizontal Polarization
2400-2483.5	Chain 0 / 0.8 dBi	Chain 1 / 2.6 dBi	Chain 0 / 0.2 dBi	Chain 1 / 2.0 dBi

NOTE:
Antenna 1 = Chain 0
Antenna 2 = Chain 1

6.4. SOFTWARE AND FIRMWARE

The EUT firmware installed during testing was V13.0.

The test utility software used during testing was QRCT v3.0.264.0

6.5. WORST-CASE CONFIGURATION AND MODE

Radiated emissions below 1GHz, above 18GHz, and power line conducted emission were performed with the EUT set to transmit at the channel with highest output power as worst-case scenario.

Band edge and radiated emissions between 1GHz and 18GHz were performed with the EUT set to transmit at the highest power on low, middle and high channels.

The fundamental of the EUT was investigated in 5 configurations, it was determined that Configurations 5 was worst-case orientation; therefore, all final radiated testing was performed with the EUT in Configurations 5 orientation.

Worst-case data rates as provided by the client were:

802.11b mode: 1 Mbps
802.11g mode: 6 Mbps
802.11n HT20mode: MCS0

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6.6. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Support Equipment List				
Description	**Manufacturer**	**Model**	**Serial Number**	**FCC ID**
Laptop	Lenovo	X1 Carbon	R90HKAXY	N/A
AC Adaptor	Lenovo	ADLX45NCC2A	8SSA10E75794C1SG78H7210	N/A
Type-C Power Adapter	IIIP	PDS75-4UT01	N/A	N/A
Charger	ICT	LPS-05WB-1	20200908	N/A
Switching Power Supply	Phihong	PSAA10A-050QL6	P161401526A1	N/A

I/O CABLES

Cable No	Port	# of identical	Connector Type	Cable Type	Cable Length	Remarks
1	AC Adapter	1	AC	Unshielded	1m	AC Mains to Power Adapter
2	Type-C	2	USB Type-C	Unshielded	2m	Power Adapter to Power-In Splitter
3	Type-A	1	USB Type-A/Mini-USB	Unshielded	2m	Power Adapter to Power-In Splitter
4	Type-C	2	USB Type-C	Unshielded	1.5m	Splitter Output to EUT
5	Ethernet Adapt	1	Type-A to RJ45	Unshielded	0.2m	Splitter Output to Ethernet Adapter
6	Ethernet	2	RJ45	Unshielded	1m	Ethernet Adapter to Ethernet Adapter
7	Ethernet Adapt	1	RJ45 to Type A	Unshielded	0.3m	Ethernet Adapter to Laptop
8	AC Power	1	AC	Unshielded	1m	AC Mains to Power Adapter
9	DC Power	1	DC	Unshielded	1m	Power Adapter to Laptop
10	Type-A	1	USB Type-A	Unshielded	1m	Cabel to Switching Power Supply

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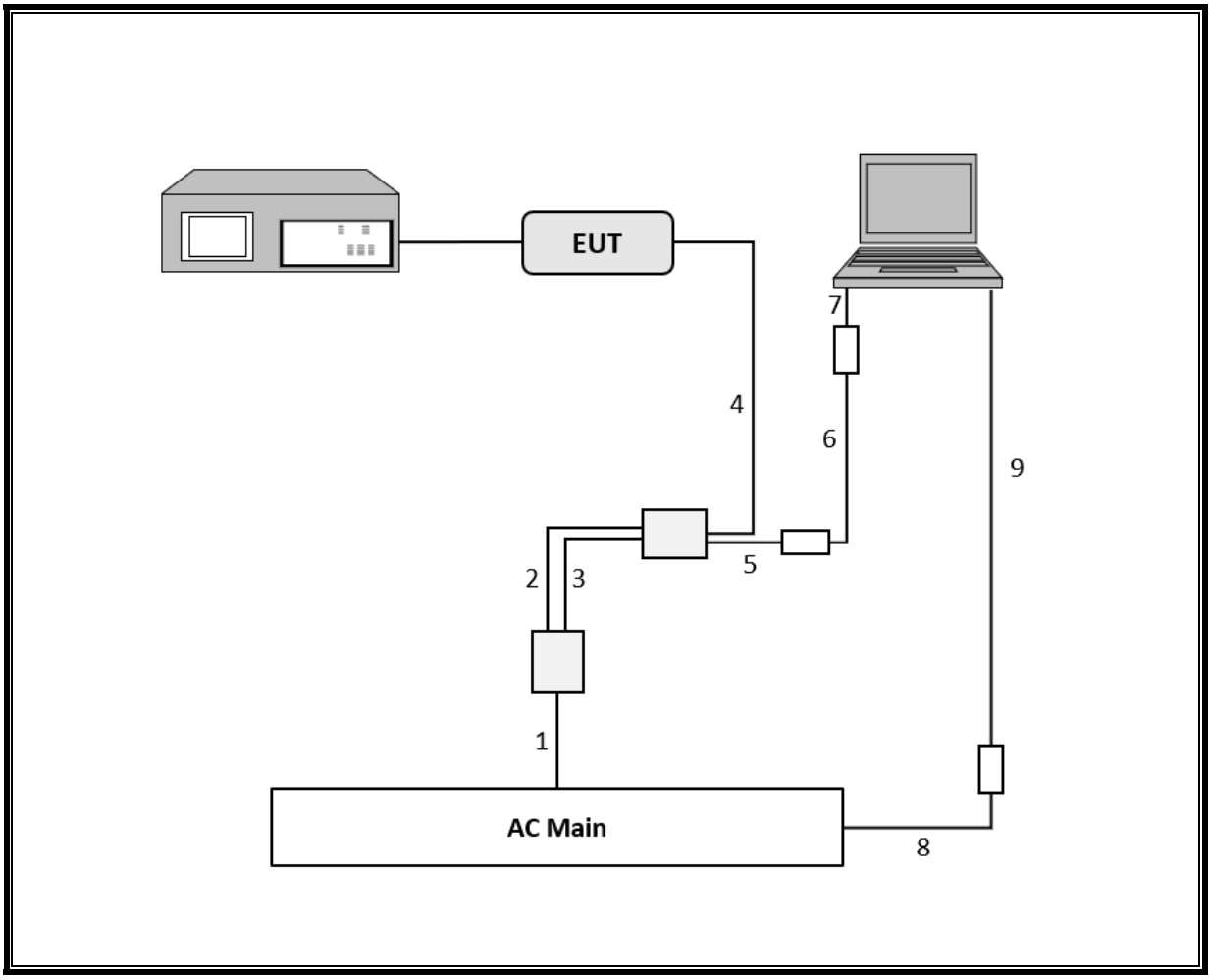
CONDUCTED TEST SETUP DIAGRAM



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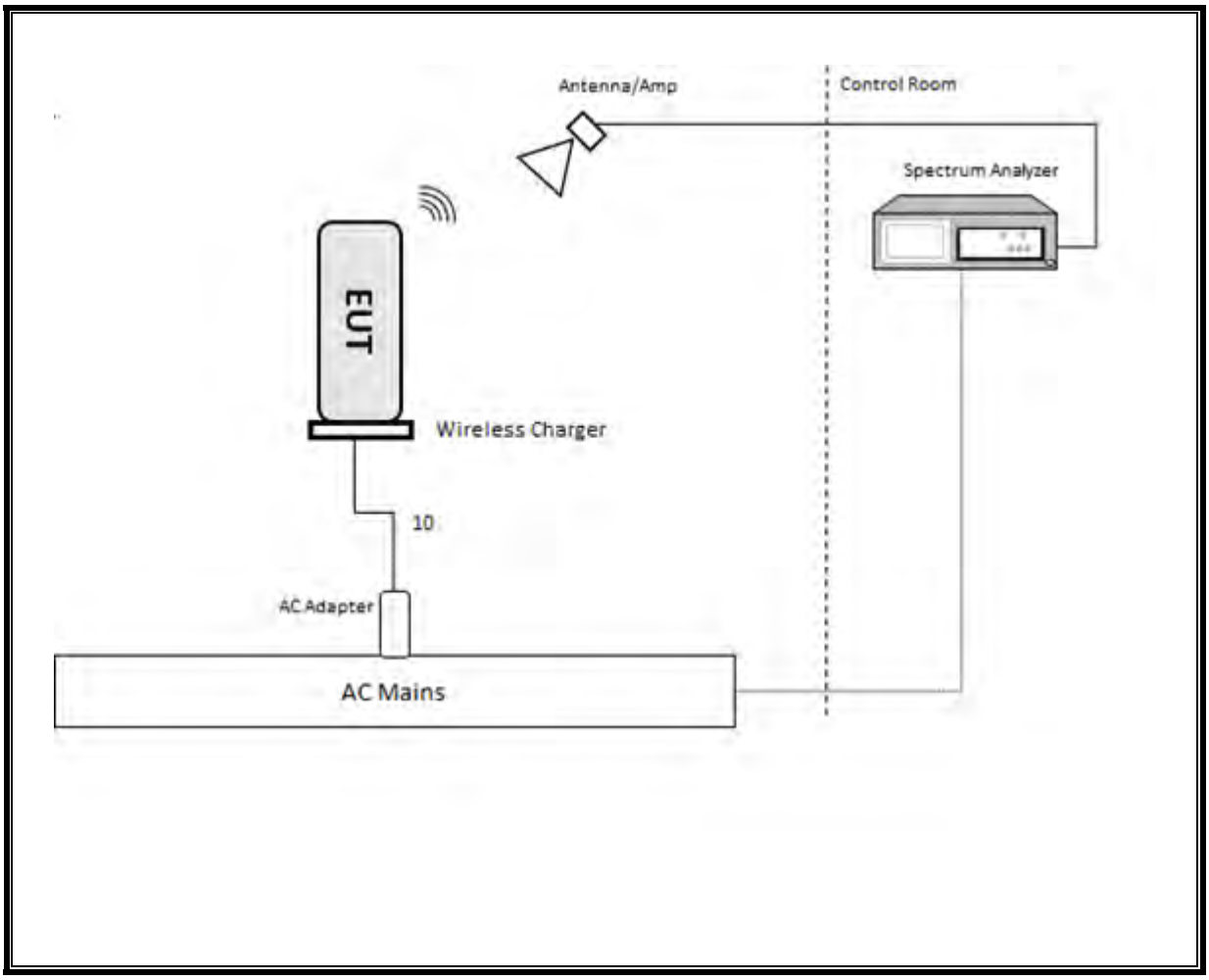
RADIATED TEST SETUP DIAGRAM



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7. MEASUREMENT METHOD

On Time and Duty Cycle: ANSI C63.10 Section 11.6.

6 dB BW: ANSI C63.10 Section 11.8.1

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

Output Power: ANSI C63.10 Section 11.9.2.3.2Method AVGPM-G (Measurement using a gated RF average-reading power meter)

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

Radiated emissions non-restricted frequency bands: ANSI C63.10 Section -11.11

Radiated emissions restricted frequency bands: ANSI C63.10 Section -11.12.1

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

Band-edge: ANSI C63.10 Section 6.10

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

AC Powerline conducted emissions: ANSI C63.10-2013, Section 6.2.

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8. TEST AND MEASUREMENT EQUIPMENT

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

TEST EQUIPMENT LIST					
Description	**Manufacturer**	**Model**	**ID Num**	**Cal Due**	**Last Cal**
EMI TEST RECEIVER	Rohde & Schwarz	ESW44	PRE0203383	02/18/2021	02/18/2020
Antenna, Broadband Hybrid, 30MHz to 2000MHz	Sunol Sciences Corp.	JB3	T477	09/24/2021	09/24/2020
Amplifier, 9KHz to 1GHz, 32dB	SONOMA INSTRUMENT	310	175953	01/23/2021	01/23/2020
Antenna, Horn 1-18GHz	ETS-Lindgren	3117	T863	08/31/2021	08/31/2020
Amplifier, 100MHz-18GHz	AMPLICAL	AMP0.1G18-47-20	PRE0197319	05/04/2021	05/04/2020
Antenna, Passive Loop 30Hz - 1MHz	ELECTRO-METRICS	EM-6871	PRE0179465	07/27/2021	07/27/2020
Antenna, Passive Loop 100kHz to 30MHz	ELECTRO-METRICS	EM-6872	PRE0179467	07/27/2021	07/27/2020
Antenna, Horn 18 to 26.5GHz	ARA	MWH-1826/B	T447	09/24/2021	09/24/2020
Rf Amplifier, 18-26.5GHz, 60dB gain	AMPLICAL	AMP18G26.5-60	171590	06/07/2021	06/07/2020
Power Meter, P-series single channel	Keysight Technologies Inc	N1911A	T1264	01/21/2021	01/21/2020
Power Sensor, P - series, 50MHz to 18GHz, Wideband	Keysight Technologies Inc	N1921A	T1223	04/10/2021	04/10/2020
Spectrum Analyzer, PXA, 3Hz to 44GHz	Keysight Technologies Inc	N9030A	T341	07/29/2021	07/29/2020
AC Line Conducted					
EMI Receiver	Rohde & Schwarz	ESR	T1436	02/20/2021	02/20/2020
LISN for Conducted Emissions CISPR-16	Fischer Custom Communications, Inc	FCC-LISN-50/250-25-2-01-480V	PRE0186446	01/21/2021	01/21/2020
Test Software List					
Radiated Software	UL	UL EMC		Ver 9.5, April 30, 2020	
Antenna Port Software	UL	UL RF		Ver 2020.11.8	
AC Line Conducted Software	UL	UL EMC		Ver 9.5, July 7, 2020	

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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						
802.11b 1TX	8.380	8.420	0.995	99.52%	0.00	0.010
802.11g 1TX	1.391	1.448	0.961	96.06%	0.17	0.719
802.11n HT20 1TX	1.300	1.355	0.959	95.94%	0.18	0.769

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DUTY CYCLE PLOTS

DUTY CYCLE 802.11b MODE

DUTY CYCLE 802.11g MODE

DUTY CYCLE 802.11n HT20 MODE

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9.2. 99% BANDWIDTH

LIMITS

None; for reporting purposes only.

RESULTS

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9.2.1. 802.11b MODE

2TX Chain 0 + Chain 1

Channel	Frequency (MHz)	99% Bandwidth Antenna 1 (MHz)	99% Bandwidth Antenna 2 (MHz)
Low 1	2412	13.545	13.513
Mid 6	2437	13.703	13.610
High 11	2462	13.940	13.446

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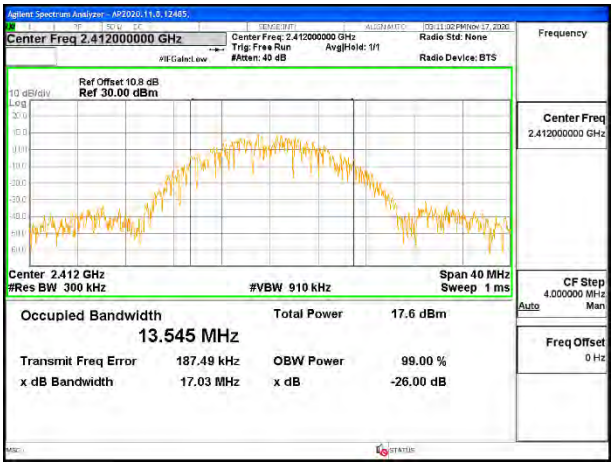
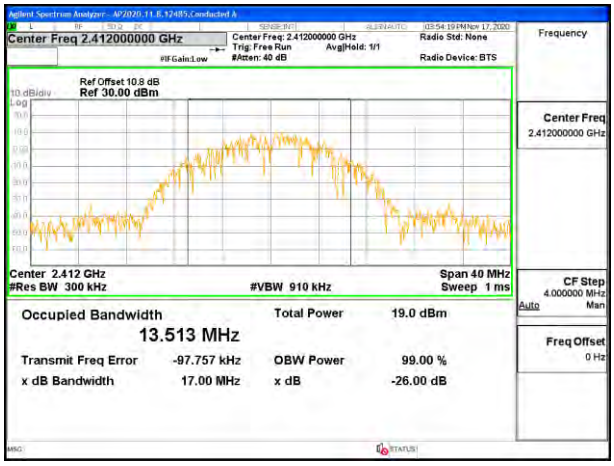
LOW CHANNEL 1

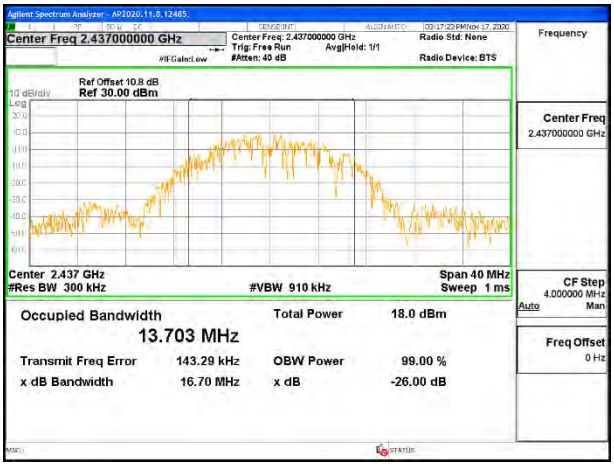


LOW CHANNEL 1 CHAIN 0

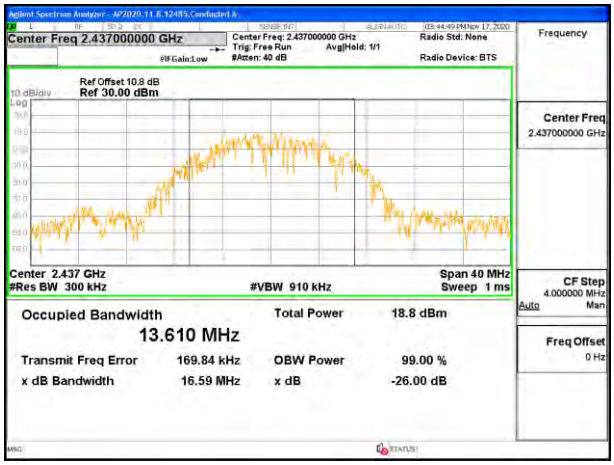


LOW CHANNEL 1 CHAIN 1

MID CHANNEL 6



MID CHANNEL 6 CHAIN 0



MID CHANNEL 6 CHAIN 1

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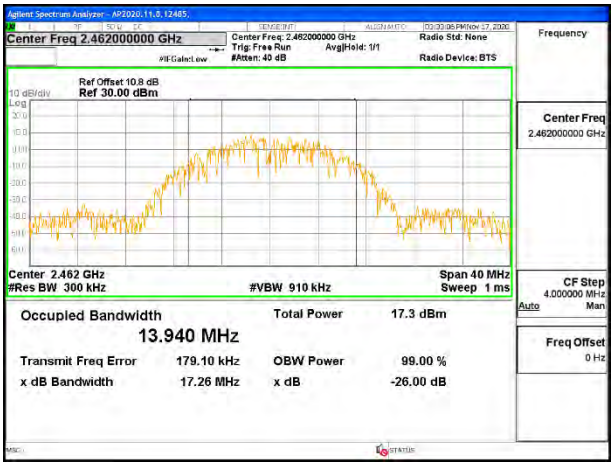
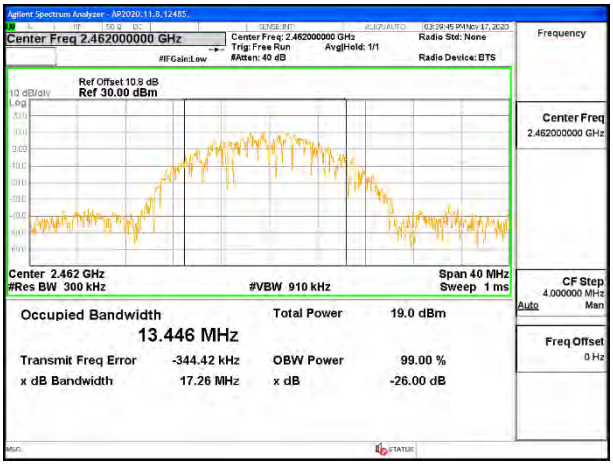
HIGH CHANNEL 11



HIGH CHANNEL 11 CHAIN 0



HIGH CHANNEL 11 CHAIN 1

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9.2.2. 802.11g MODE

2TX Chain 0 + Chain 1

Channel	Frequency (MHz)	99% Bandwidth Antenna 1 (MHz)	99% Bandwidth Antenna 2 (MHz)
Low 1	2412	16.362	16.323
Low 2	2417	16.451	16.556
Low 3	2422	16.532	16.548
Low 4	2427	16.580	16.639
Mid 6	2437	16.535	16.451
High 9	2452	16.637	16.780
High 10	2457	16.486	16.472
High 11	2462	16.395	16.321

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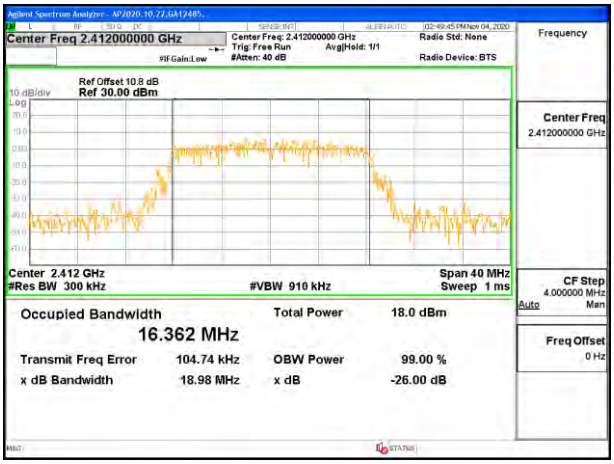
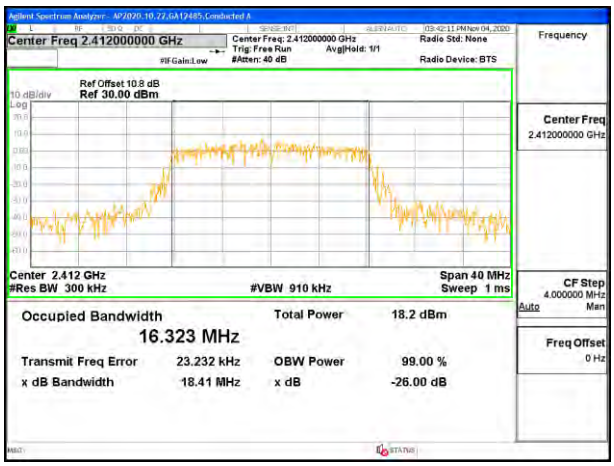
LOW CHANNEL 1

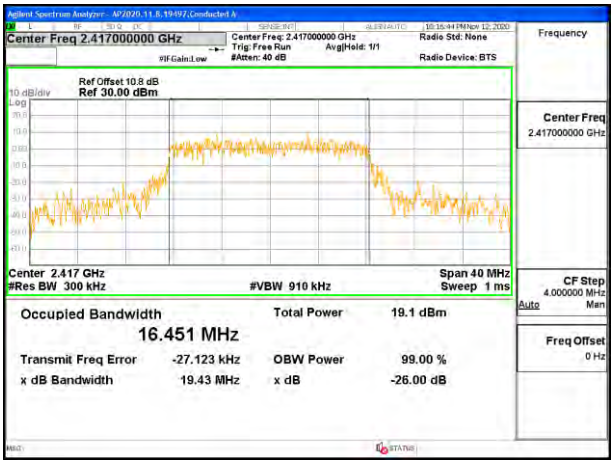


LOW CHANNEL 1 CHAIN 0



LOW CHANNEL 1 CHAIN 1

LOW CHANNEL 2



LOW CHANNEL 2 CHAIN 0

LOW CHANNEL 2 CHAIN 1

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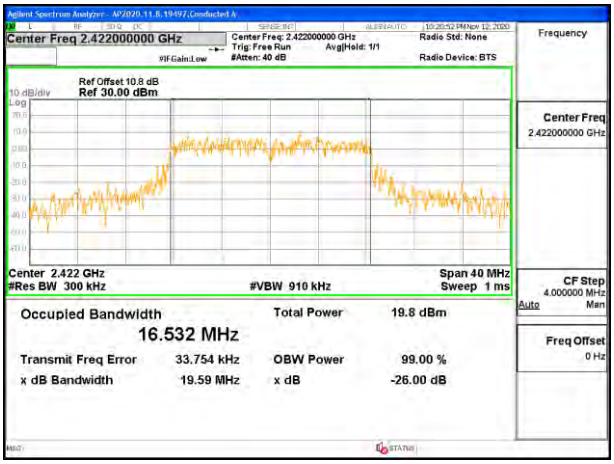
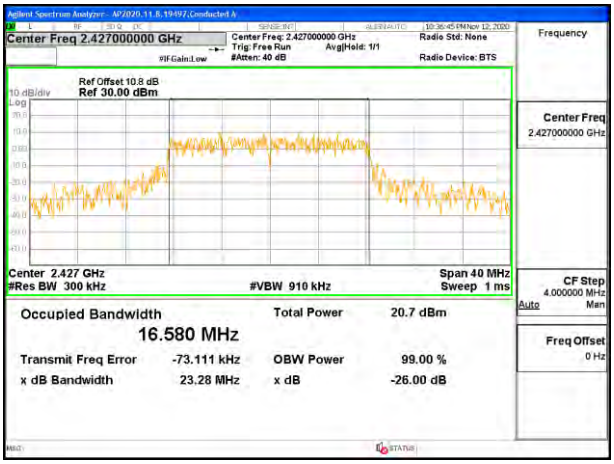
LOW CHANNEL 3



LOW CHANNEL 3 CHAIN 0

LOW CHANNEL 3 CHAIN 1

LOW CHANNEL 4



LOW CHANNEL 4 CHAIN 0

LOW CHANNEL 4 CHAIN 1

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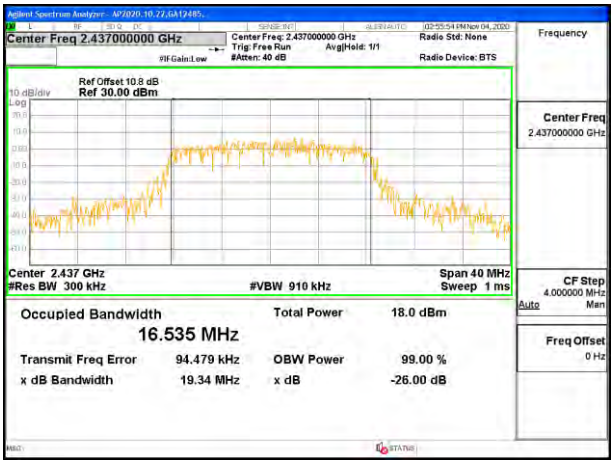
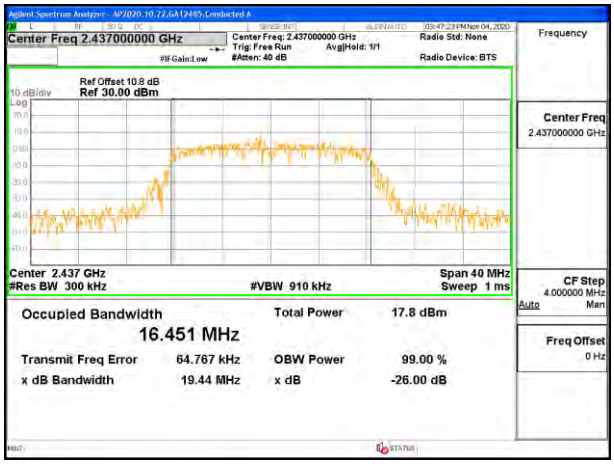
MID CHANNEL 6

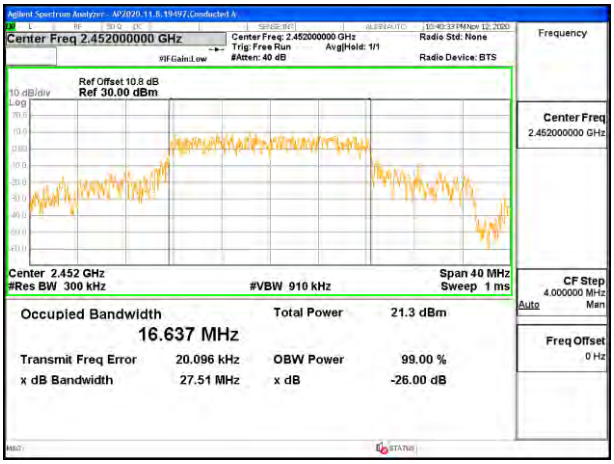


MID CHANNEL 6 CHAIN 0



MID CHANNEL 6 CHAIN 1

HIGH CHANNEL 9



HIGH CHANNEL 9 CHAIN 0

HIGH CHANNEL 9 CHAIN 1

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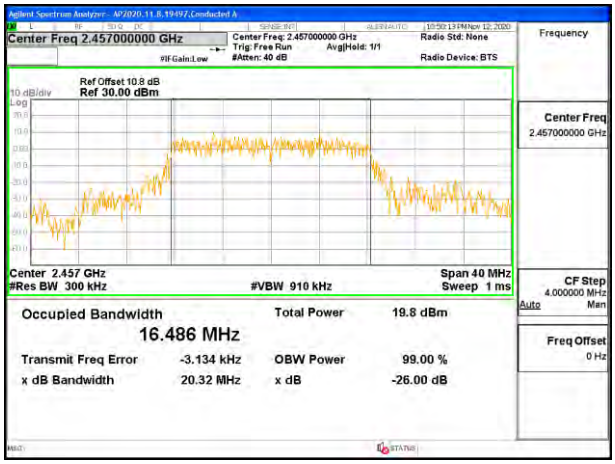
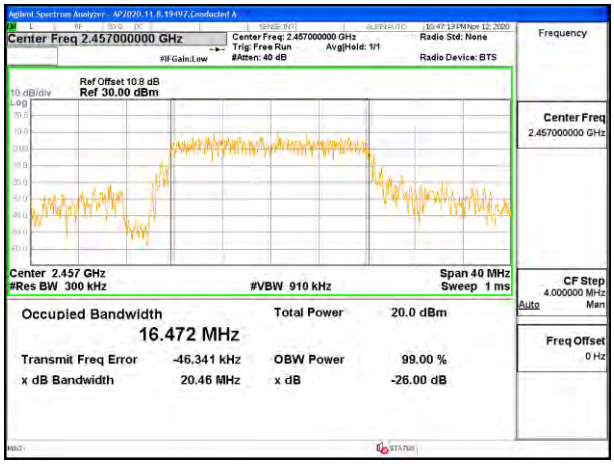
HIGH CHANNEL 10

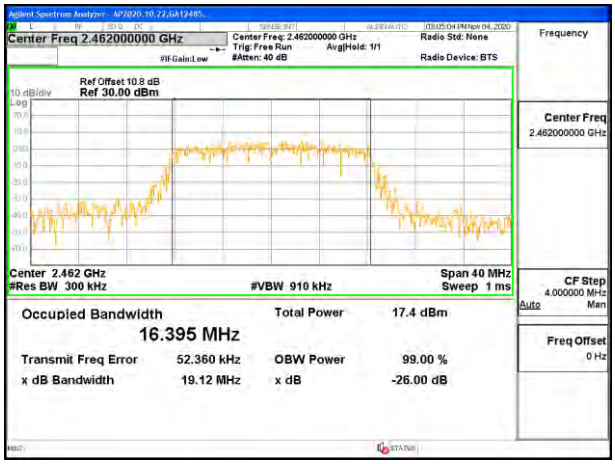


HIGH CHANNEL 10 CHAIN 0

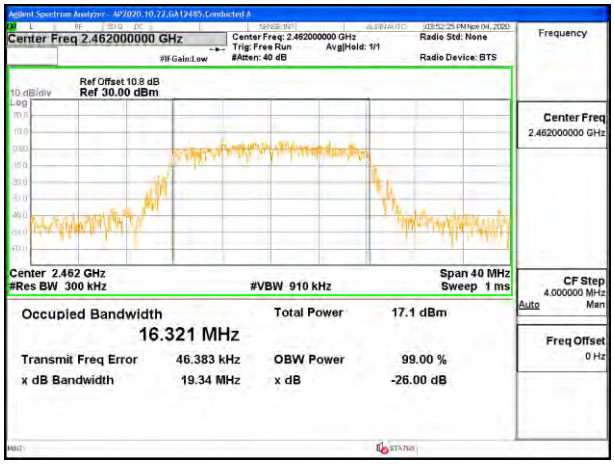


HIGH CHANNEL 10 CHAIN 1

HIGH CHANNEL 11



HIGH CHANNEL 11 CHAIN 0



HIGH CHANNEL 11 CHAIN 1

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9.2.3. 802.11n HT20 MODE

2TX Chain 0 + Chain 1

Channel	Frequency (MHz)	99% Bandwidth Antenna 1 (MHz)	99% Bandwidth Antenna 2 (MHz)
Low 1	2412	17.552	17.607
Low 2	2417	17.689	17.793
Low 3	2422	17.751	17.758
Mid 6	2437	17.638	17.578
High 9	2452	17.837	17.858
High 10	2457	17.842	17.680
High 11	2462	17.611	17.484

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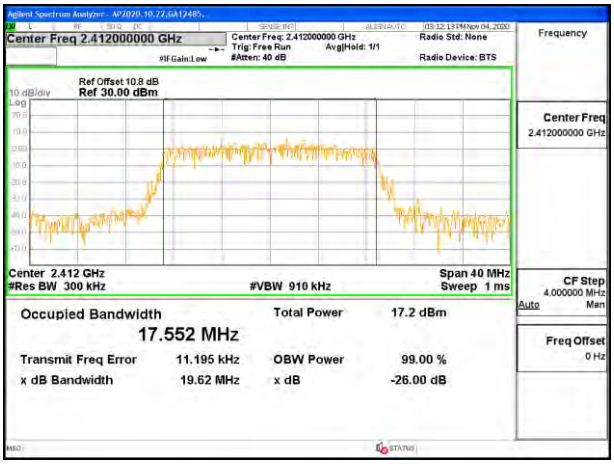
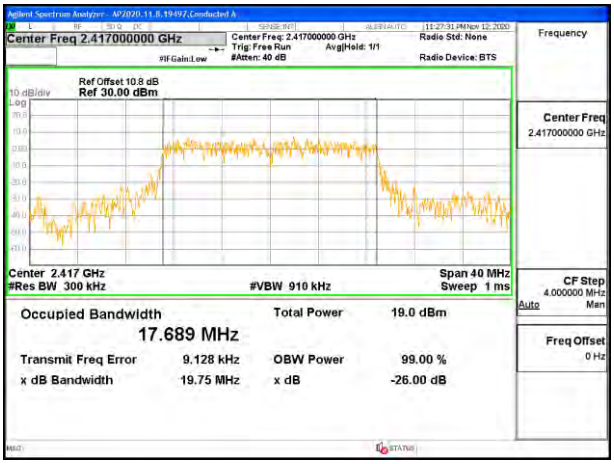
LOW CHANNEL 1



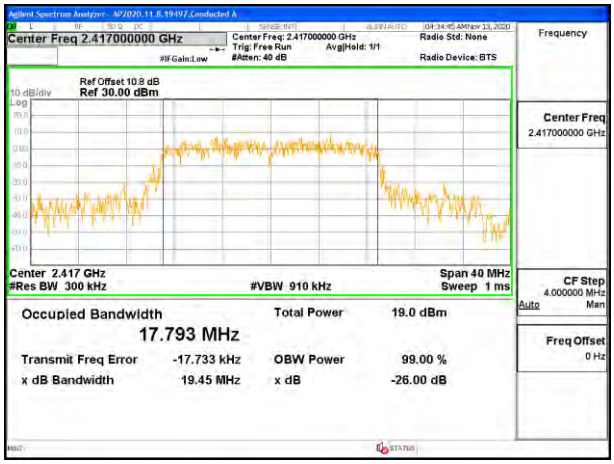
LOW CHANNEL 1 CHAIN 0

LOW CHANNEL 1 CHAIN 1

LOW CHANNEL 2



LOW CHANNEL 2 CHAIN 0



LOW CHANNEL 2 CHAIN 1

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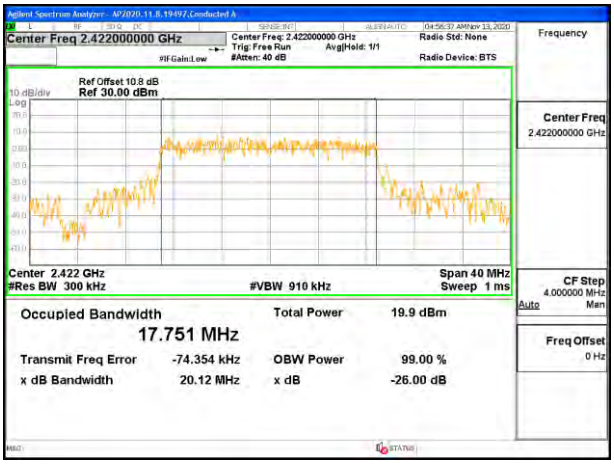
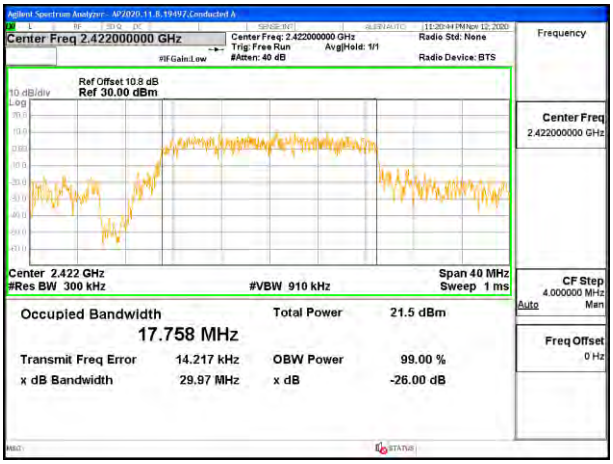
LOW CHANNEL 3

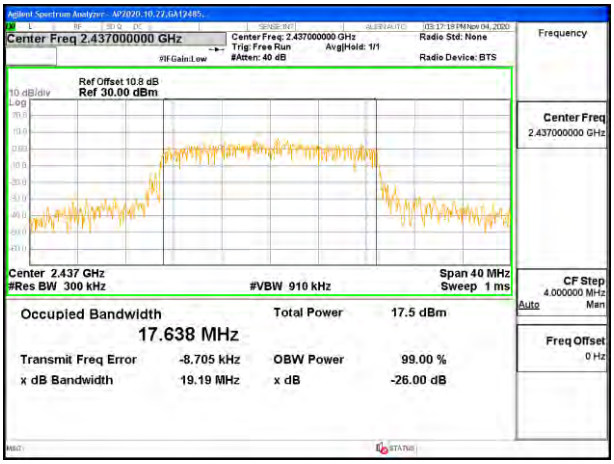


LOW CHANNEL 3 CHAIN 0

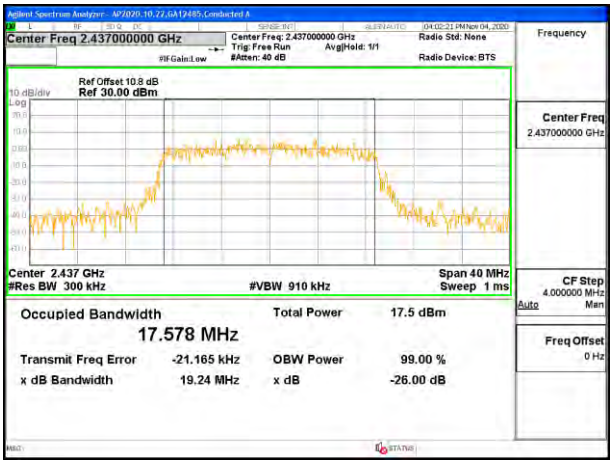


LOW CHANNEL 3 CHAIN 1

MID CHANNEL 6



MID CHANNEL 6 CHAIN 0



MID CHANNEL 6 CHAIN 1

UL VERIFICATION SERVICES INC.
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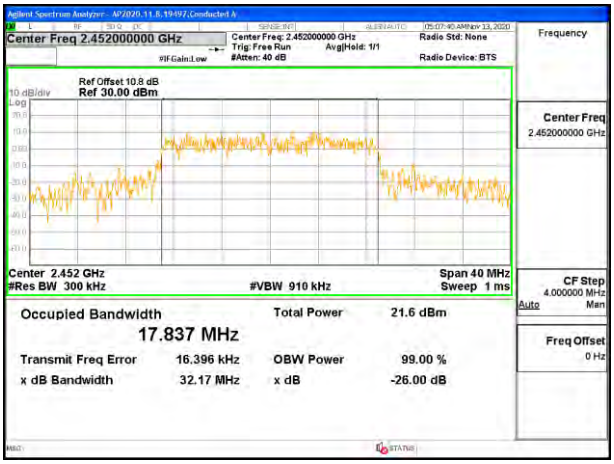
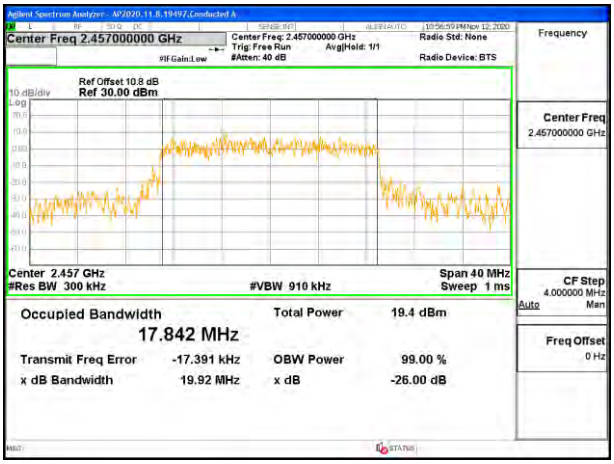
HIGH CHANNEL 9



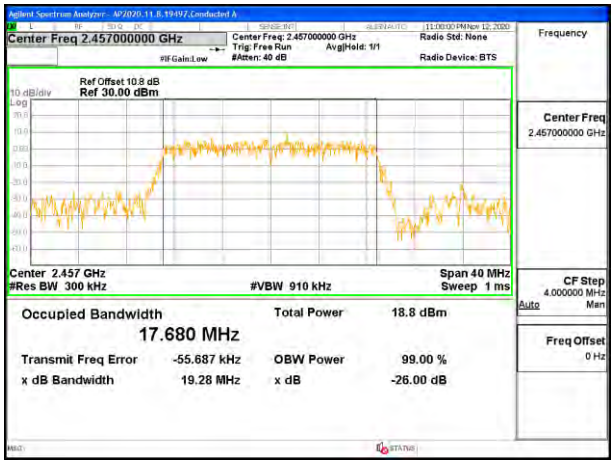
HIGH CHANNEL 9 CHAIN 0

HIGH CHANNEL 9 CHAIN 1

HIGH CHANNEL 10



HIGH CHANNEL 10 CHAIN 0



HIGH CHANNEL 10 CHAIN 1

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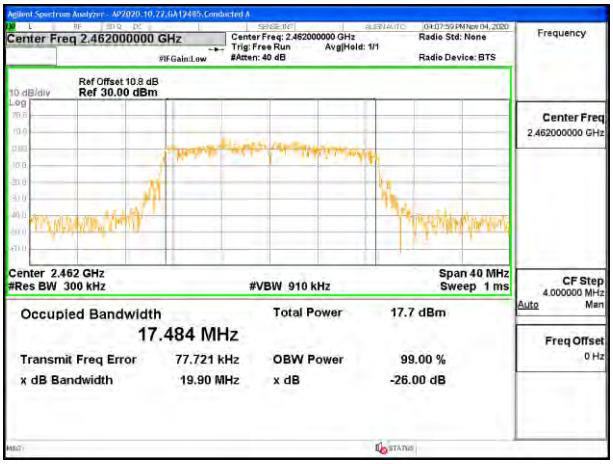
HIGH CHANNEL 11

HIGH CHANNEL 11 CHAIN 0



HIGH CHANNEL 11 CHAIN 1

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9.3. 6 dB BANDWIDTH

LIMITS

FCC §15.247 (a) (2)

RSS-247 5.2 (a)

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

RESULTS

UL VERIFICATION SERVICES INC.
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9.3.1. 802.11b MODE

2TX Chain 0 + Chain 1

Channel	Frequency (MHz)	6 dB BW Antenna 1 (MHz)	6 dB BW Antenna 2 (MHz)	Minimum Limit (MHz)
Low 1	2412	7.88	8.20	0.5
Mid 6	2437	8.68	9.16	0.5
High 11	2462	8.60	9.40	0.5

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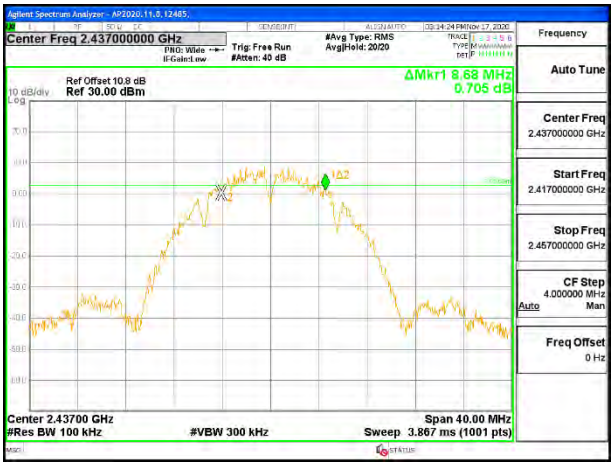
LOW CHANNEL 1

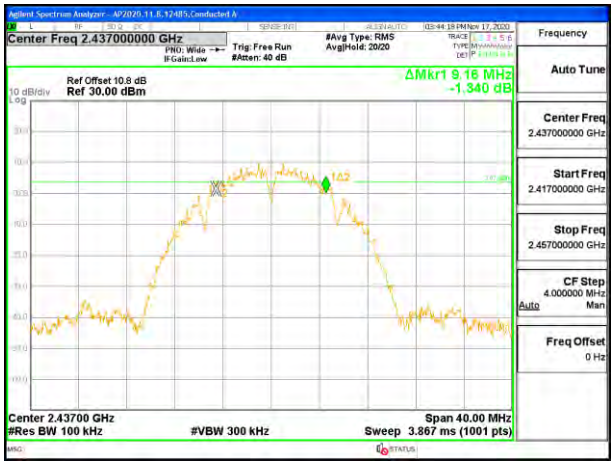
LOW CHANNEL 1 CHAIN 0

LOW CHANNEL 1 CHAIN 1

MID CHANNEL 6



MID CHANNEL 6 CHAIN 0



MID CHANNEL 6 CHAIN 1

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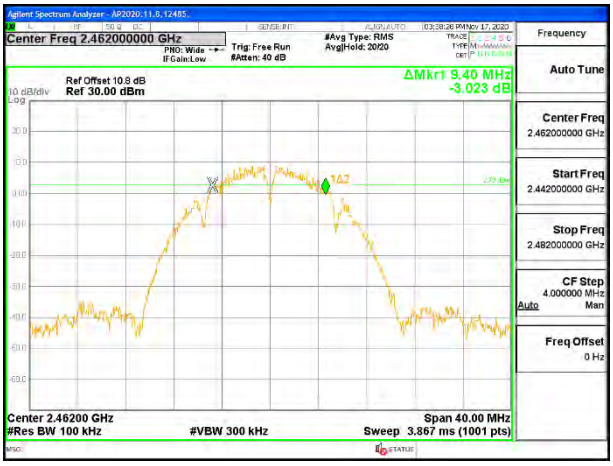
HIGH CHANNEL 11

HIGH CHANNEL 11 CHAIN 0



HIGH CHANNEL 11 CHAIN 1

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9.3.2. 802.11g MODE

2TX Chain 0 + Chain 1

Channel	Frequency (MHz)	6 dB BW Antenna 1 (MHz)	6 dB BW Antenna 2 (MHz)	Minimum Limit (MHz)
Low 1	2412	16.12	16.44	0.5
Low 2	2417	16.48	15.40	0.5
Low 3	2422	16.40	16.04	0.5
Low 4	2427	16.44	16.56	0.5
Mid 6	2437	16.44	16.16	0.5
High 9	2452	16.56	16.44	0.5
High 10	2457	16.48	16.40	0.5
High 11	2462	16.40	16.48	0.5

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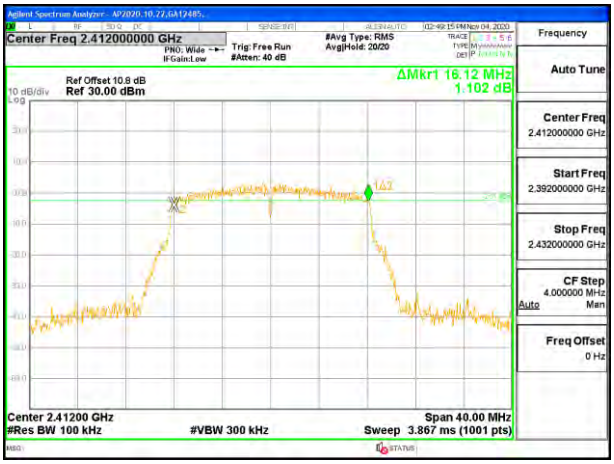
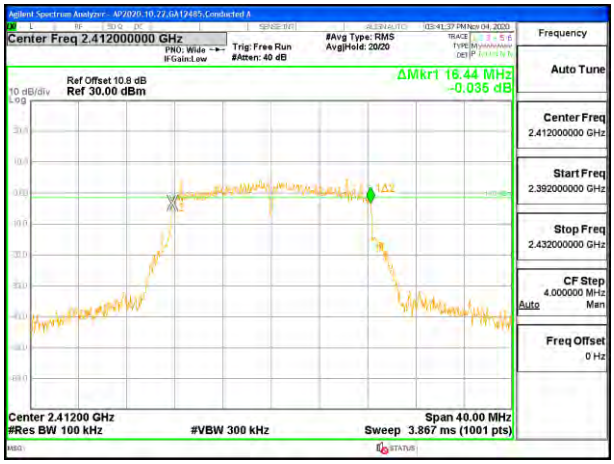
LOW CHANNEL 1

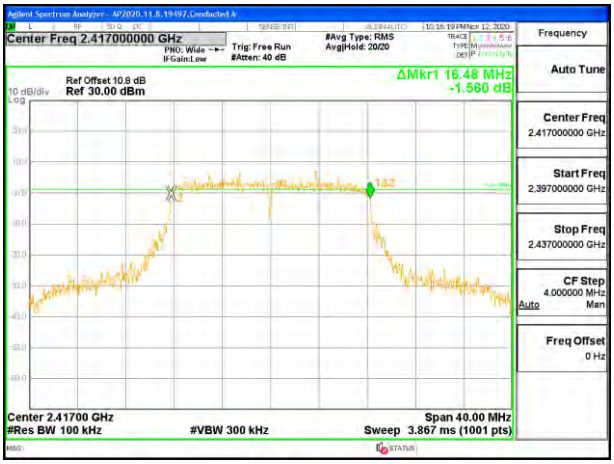


LOW CHANNEL 1 CHAIN 0



LOW CHANNEL 1 CHAIN 1

LOW CHANNEL 2



LOW CHANNEL 2 CHAIN 0

LOW CHANNEL 2 CHAIN 1

UL VERIFICATION SERVICES INC.
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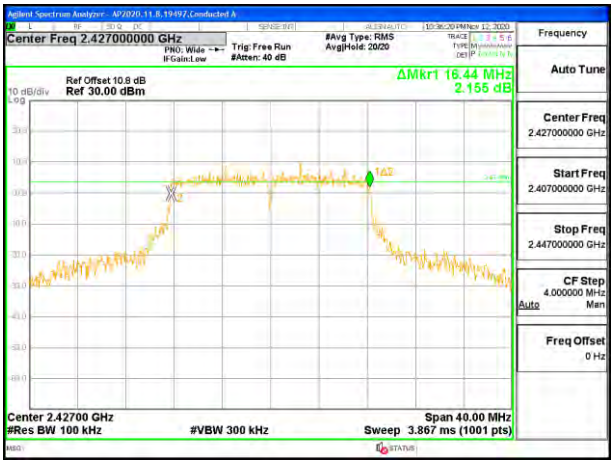
LOW CHANNEL 3

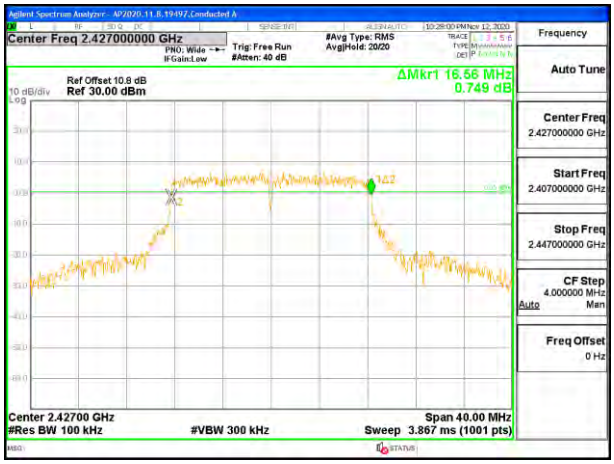
LOW CHANNEL 3 CHAIN 0

LOW CHANNEL 3 CHAIN 1

LOW CHANNEL 4



LOW CHANNEL 4 CHAIN 0

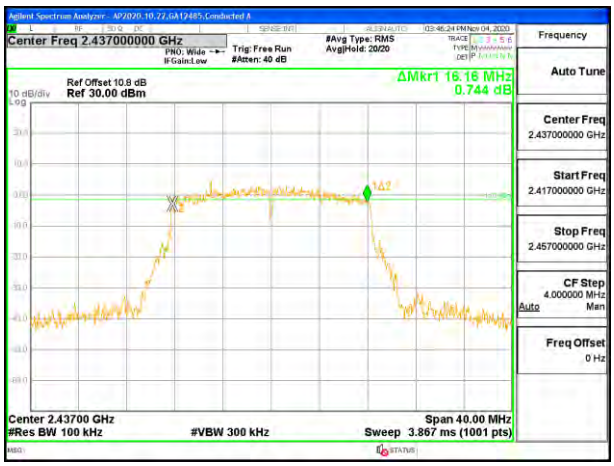


LOW CHANNEL 4 CHAIN 1

UL VERIFICATION SERVICES INC.
47173 Benicia Street, Fremont, CA 94538; USA TEL:(510) 319-4000 FAX:(510) 661-0888

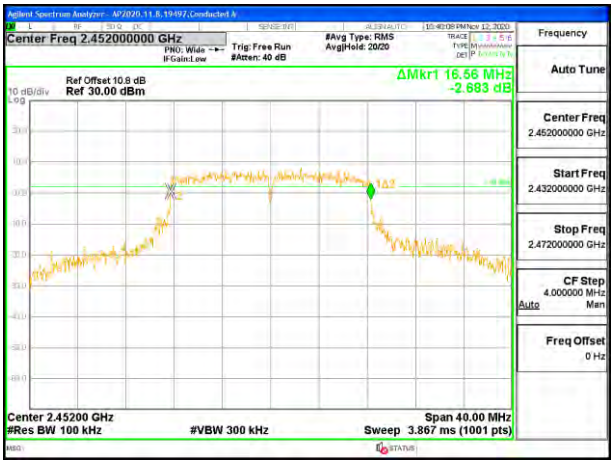
MID CHANNEL 6

MID CHANNEL 6 CHAIN 0



MID CHANNEL 6 CHAIN 1

HIGH CHANNEL 9



HIGH CHANNEL 9 CHAIN 0

HIGH CHANNEL 9 CHAIN 1

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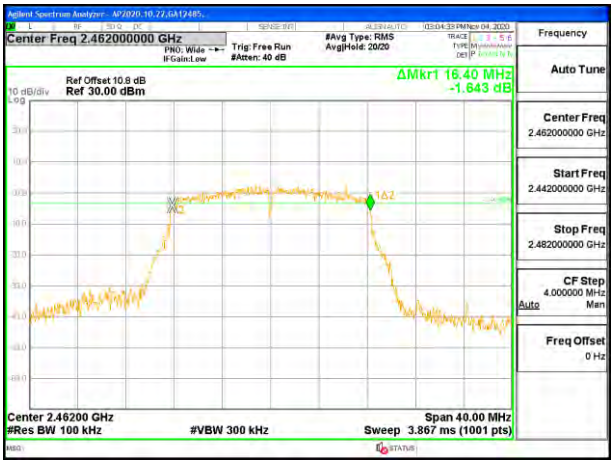
HIGH CHANNEL 10

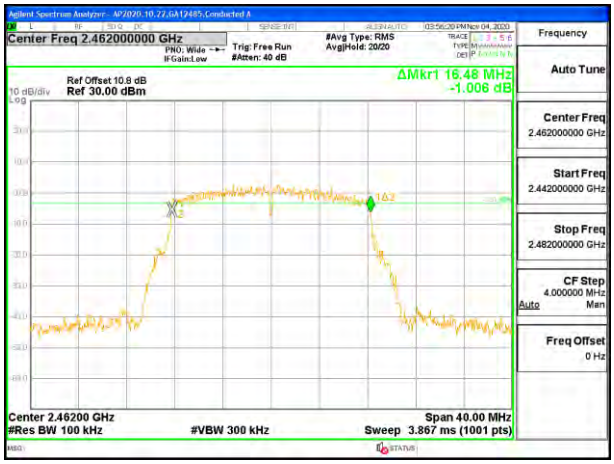
HIGH CHANNEL 10 CHAIN 0

HIGH CHANNEL 10 CHAIN 1

HIGH CHANNEL 11



HIGH CHANNEL 11 CHAIN 0



HIGH CHANNEL 11 CHAIN 1

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9.3.3. 802.11n HT20 MODE

2TX Chain 0 + Chain 1

Channel	Frequency (MHz)	6 dB BW Antenna 1 (MHz)	6 dB BW Antenna 2 (MHz)	Minimum Limit (MHz)
Low 1	2412	17.08	17.40	0.5
Low 2	2417	17.64	17.60	0.5
Low 3	2422	17.68	17.68	0.5
Mid 6	2437	17.68	17.20	0.5
High 9	2452	17.04	17.28	0.5
High 10	2457	17.64	17.72	0.5
High 11	2462	17.68	17.64	0.5

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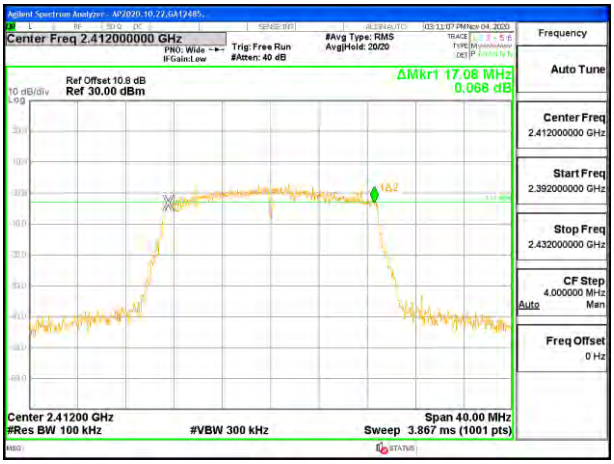
LOW CHANNEL 1



LOW CHANNEL 1 CHAIN 0

LOW CHANNEL 1 CHAIN 1

LOW CHANNEL 2

LOW CHANNEL 2 CHAIN 0

LOW CHANNEL 2 CHAIN 1

UL VERIFICATION SERVICES INC.
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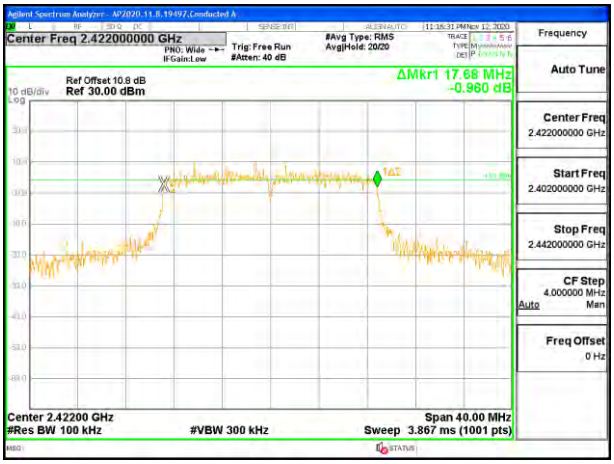
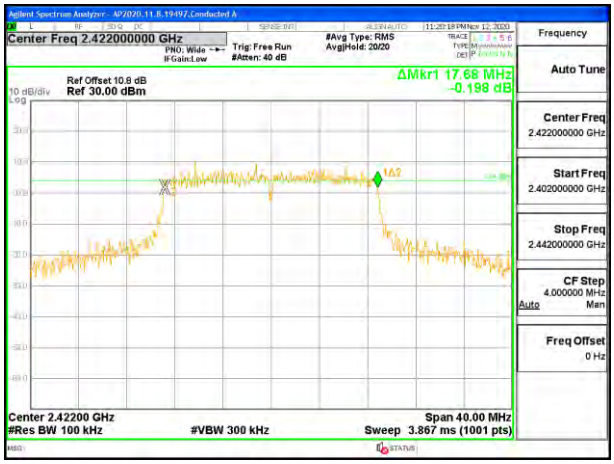
LOW CHANNEL 3

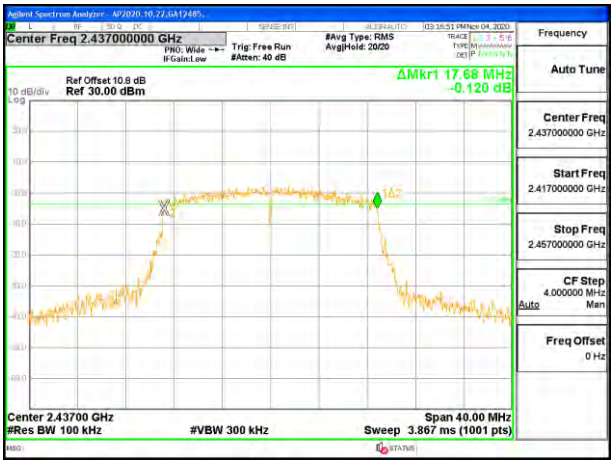


LOW CHANNEL 3 CHAIN 0



LOW CHANNEL 3 CHAIN 1

MID CHANNEL 6

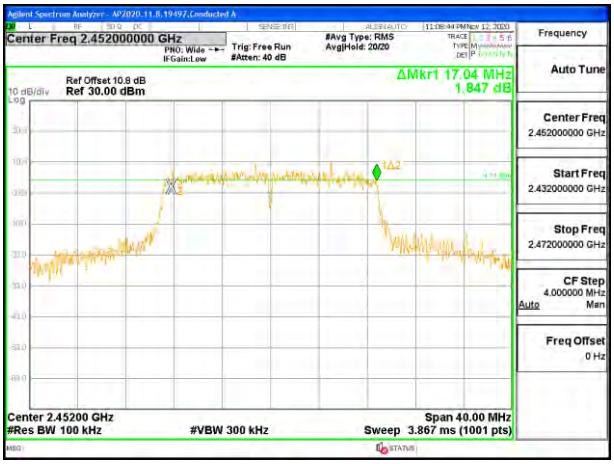


MID CHANNEL 6 CHAIN 0

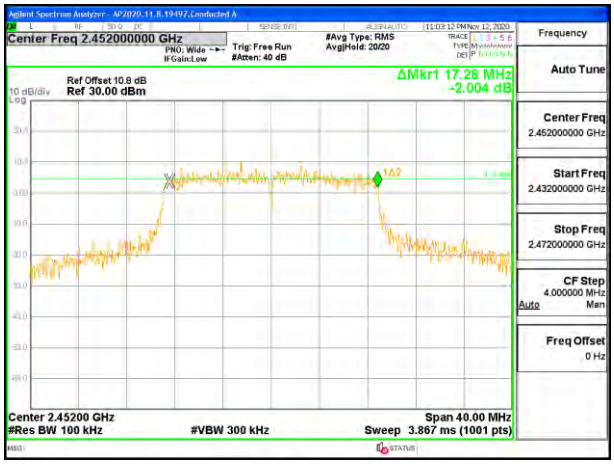
MID CHANNEL 6 CHAIN 1

UL VERIFICATION SERVICES INC.
47173 Benicia Street, Fremont, CA 94538; USA TEL:(510) 319-4000 FAX:(510) 661-0888

HIGH CHANNEL 9



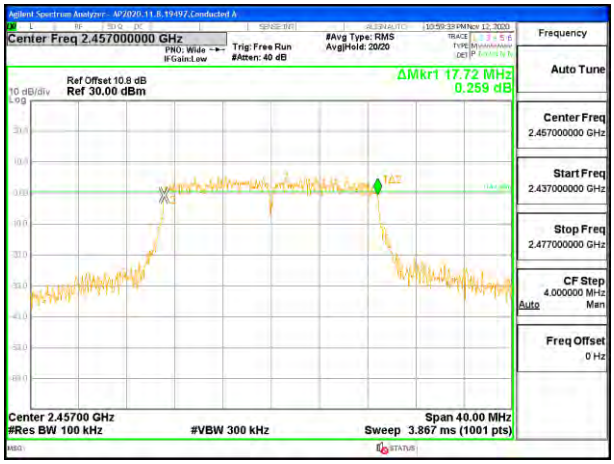
HIGH CHANNEL 9 CHAIN 0



HIGH CHANNEL 9 CHAIN 1

HIGH CHANNEL 10

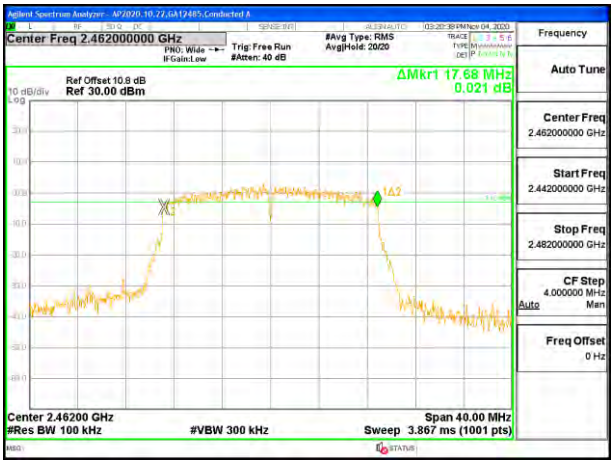
HIGH CHANNEL 10 CHAIN 0



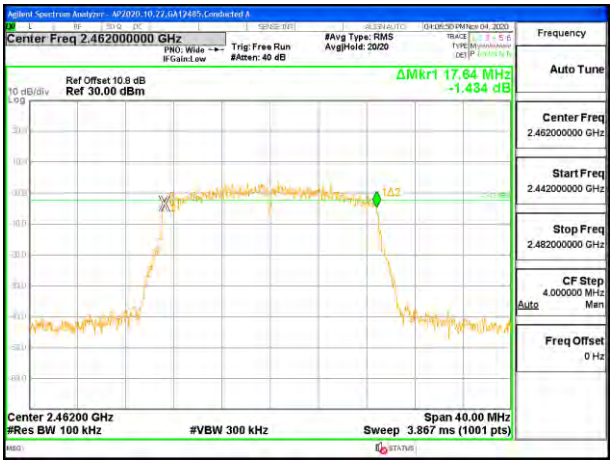
HIGH CHANNEL 10 CHAIN 1

UL VERIFICATION SERVICES INC.
47173 Benicia Street, Fremont, CA 94538; USA TEL:(510) 319-4000 FAX:(510) 661-0888

HIGH CHANNEL 11



HIGH CHANNEL 11 CHAIN 0



HIGH CHANNEL 11 CHAIN 1

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9.4. OUTPUT POWER

LIMITS

FCC §15.247 (b) (3)

RSS-247 5.4 (d)

For systems using digital modulation in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands: 1 Watt, based on the use of antennas with directional gains that do not exceed 6 dBi. If transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

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.

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DIRECTIONAL ANTENNA GAIN

For 1 TX:
There is only one transmitter output therefore the directional gain is equal to the antenna gain.

For 2 TX:

Tx chains are uncorrelated for power and correlated for PSD due to the device supporting CDD in all MIMO modes. The directional gains are as follows:

Horizontal Polarity (Worst Case)

Band (GHz)	Chain 0 Antenna Gain (dBi)	Chain 1 Antenna Gain (dBi)	Uncorrelated Chains Directional Gain (dBi)	Correlated Chains Directional Gain (dBi)
2.4	0.80	2.60	1.79	4.76

Vertical Polarity

Band (GHz)	Chain 0 Antenna Gain (dBi)	Chain 1 Antenna Gain (dBi)	Uncorrelated Chains Directional Gain (dBi)	Correlated Chains Directional Gain (dBi)
2.4	0.20	2.00	1.19	4.16

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RESULTS

9.4.1. 802.11b MODE

2TX Antenna 1 + Antenna 2

Test Engineer:	12485 GA
Test Date:	11/04/2020

Limits

Channel	Frequency (MHz)	Directional Gain (dBi)	FCC/ISED Power Limit (dBm)	ISED EIRP Limit (dBm)	Max Power (dBm)
Low 1	2412	1.79	30.00	36	30.00
Mid 6	2437	1.79	30.00	36	30.00
High 11	2462	1.79	30.00	36	30.00

Results

Channel	Frequency (MHz)	Antenna 1 Meas Power (dBm)	Antenna 2 Meas Power (dBm)	Total Corr'd Power (dBm)	Power Limit (dBm)	Margin (dB)
Low 1	2412	17.48	18.65	21.11	30.00	-8.89
Mid 6	2437	17.95	18.80	21.41	30.00	-8.59
High 11	2462	17.60	18.70	21.20	30.00	-8.80

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9.4.2. 802.11g MODE

2TX Chain 0 + Chain 1

Test Engineer:	12485 GA
Test Date:	11/04/2020

Limits

Channel	Frequency (MHz)	Directional Gain (dBi)	FCC/ISED Power Limit (dBm)	ISED EIRP Limit (dBm)	Max Power (dBm)
Low 1	2412	1.79	30.00	36	30.00
Low 2	2417	1.79	30.00	36	30.00
Low 3	2422	1.79	30.00	36	30.00
Low 4	2427	1.79	30.00	36	30.00
Mid 6	2437	1.79	30.00	36	30.00
High 9	2452	1.79	30.00	36	30.00
High 10	2457	1.79	30.00	36	30.00
High 11	2462	1.79	30.00	36	30.00

Results

Channel	Frequency (MHz)	Antenna 1 Meas Power (dBm)	Antenna 2 Meas Power (dBm)	Total Corr'd Power (dBm)	Power Limit (dBm)	Margin (dB)
Low 1	2412	15.92	17.12	19.57	30.00	-10.43
Low 2	2417	18.95	20.09	22.57	30.00	-7.43
Low 3	2422	20.03	21.05	23.58	30.00	-6.42
Low 4	2427	20.85	21.91	24.42	30.00	-5.58
Mid 6	2437	21.85	22.70	25.31	30.00	-4.69
High 9	2452	21.72	22.84	25.33	30.00	-4.67
High 10	2457	19.88	21.01	23.49	30.00	-6.51
High 11	2462	15.89	17.16	19.58	30.00	-10.42

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9.4.3. 802.11n HT20 MODE

2TX Antenna 1 + Antenna

Test Engineer:	12485 GA
Test Date:	11/04/2020

Limits

Channel	Frequency (MHz)	Directional Gain (dBi)	FCC/ISED Power Limit (dBm)	ISED EIRP Limit (dBm)	Max Power (dBm)
Low 1	2412	1.79	30.00	36	30.00
Low 2	2417	1.79	30.00	36	30.00
Low 3	2422	1.79	30.00	36	30.00
Mid 6	2437	1.79	30.00	36	30.00
High 9	2452	1.79	30.00	36	30.00
High 10	2457	1.79	30.00	36	30.00
High 11	2462	1.79	30.00	36	30.00

Results

Channel	Frequency (MHz)	Antenna 1 Meas Power (dBm)	Antenna 2 Meas Power (dBm)	Total Corr'd Power (dBm)	Power Limit (dBm)	Margin (dB)
Low 1	2412	14.98	16.15	18.61	30.00	-11.39
Low 2	2417	19.04	20.06	22.59	30.00	-7.41
Low 3	2422	21.71	22.80	25.30	30.00	-4.70
Mid 6	2437	21.81	22.66	25.27	30.00	-4.73
High 9	2452	21.68	22.81	25.29	30.00	-4.71
High 10	2457	18.90	20.09	22.55	30.00	-7.45
High 11	2462	15.86	17.01	19.48	30.00	-10.52

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9.5. 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

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9.5.1. 802.11b MODE

2TX Chain 0 + Chain 1

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

PSD Results

Channel	Frequency (MHz)	Antenna 1 Meas (dBm/ 3kHz)	Antenna 2 Meas (dBm/ 3kHz)	Total Corr'd PSD (dBm/ 3kHz)	Limit (dBm/ 3kHz)	Margin (dB)
Low 1	2412	-4.08	-3.08	-0.54	8.0	-8.5
Mid 6	2437	-3.40	-3.09	-0.23	8.0	-8.2
High 11	2462	-3.51	-2.74	-0.10	8.0	-8.1

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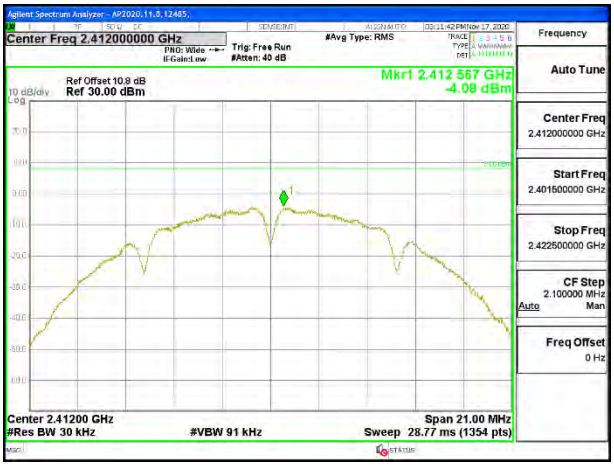
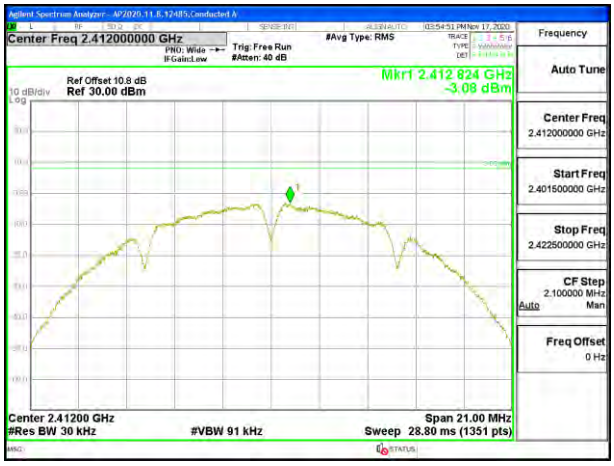
LOW CHANNEL 1

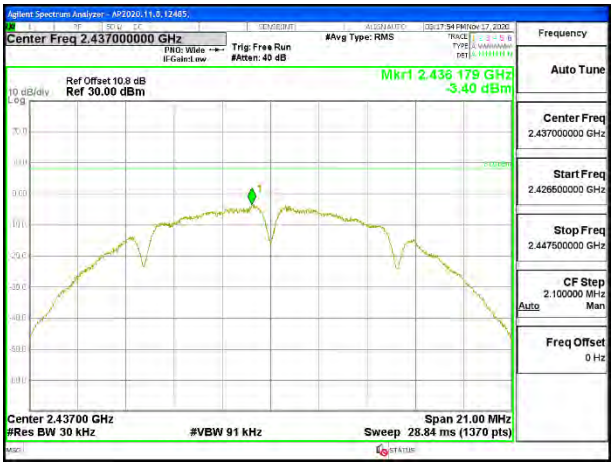


LOW CHANNEL 1 CHAIN 0

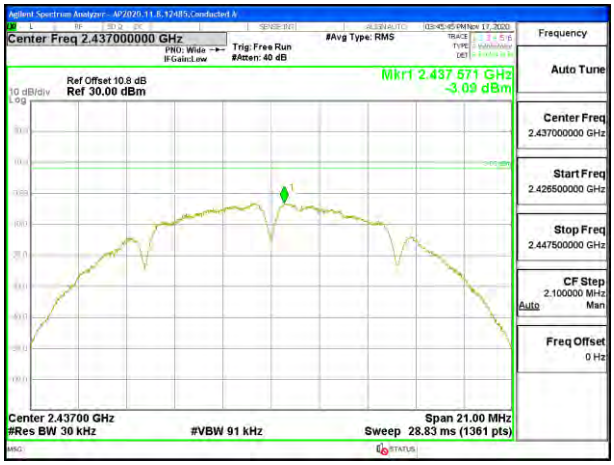


LOW CHANNEL 1 CHAIN 1

MID CHANNEL 6



MID CHANNEL 6 CHAIN 0



MID CHANNEL 6 CHAIN 1

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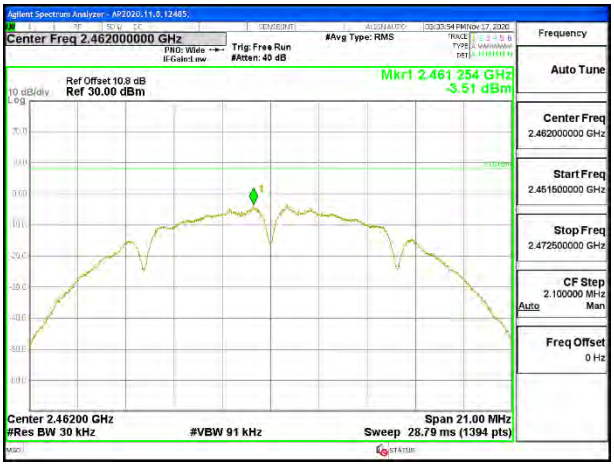
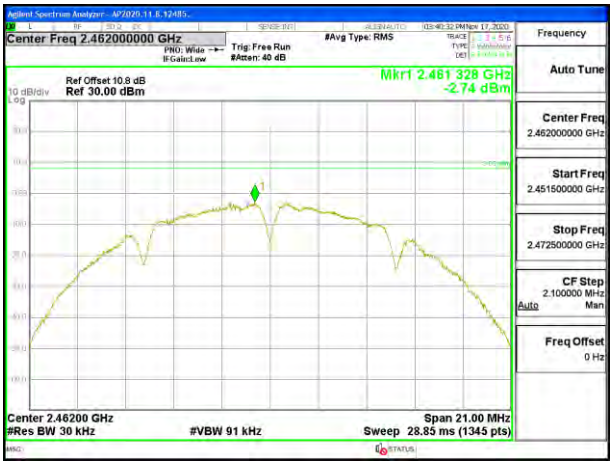
47173 Benicia Street, Fremont, CA 94538; USA TEL:(510) 319-4000 FAX:(510) 661-0888

HIGH CHANNEL 11



HIGH CHANNEL 11 CHAIN 0



HIGH CHANNEL 11 CHAIN 1

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9.5.2. 802.11g MODE

2TX Chain 0 + Chain 1

Duty Cycle CF (dB)	0.01	Included in Calculations of Corr'd PSD

PSD Results

Channel	Frequency (MHz)	Antenna 1 Meas (dBm/ 3kHz)	Antenna 2 Meas (dBm/ 3kHz)	Total Corr'd PSD (dBm/ 3kHz)	Limit (dBm/ 3kHz)	Margin (dB)
Low 1	2412	-7.27	-6.69	-3.95	8.0	-12.0
Low 2	2417	-5.82	-5.67	-2.72	8.0	-10.7
Low 3	2422	-4.93	-4.74	-1.81	8.0	-9.8
Low 4	2427	-4.08	-4.21	-1.12	8.0	-9.1
Mid 6	2437	-7.00	-6.90	-3.93	8.0	-11.9
High 9	2452	-3.02	-3.18	-0.08	8.0	-8.1
High 10	2457	-4.94	-4.82	-1.86	8.0	-9.9
High 11	2462	-7.88	-7.78	-4.81	8.0	-12.8

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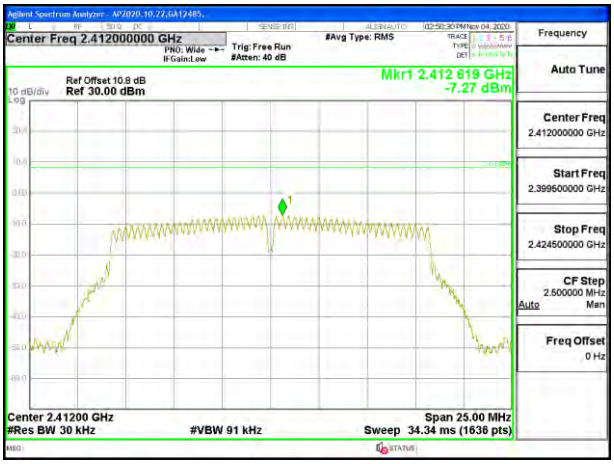
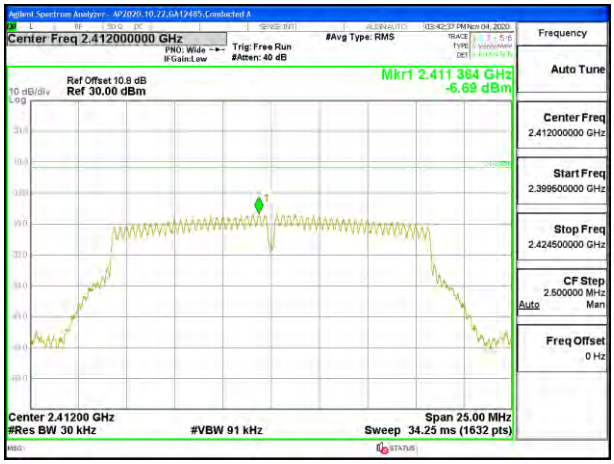
LOW CHANNEL 1

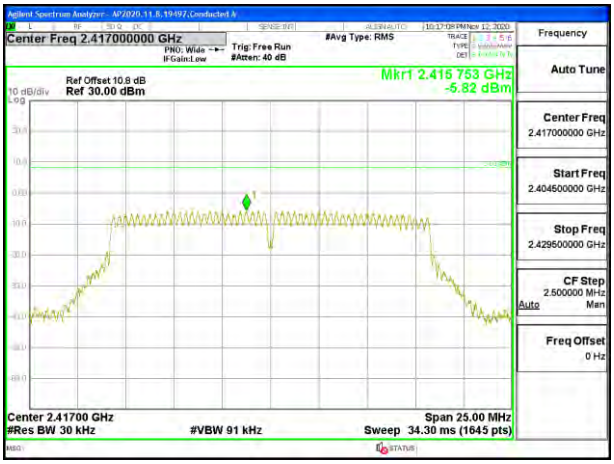


LOW CHANNEL 1 CHAIN 0

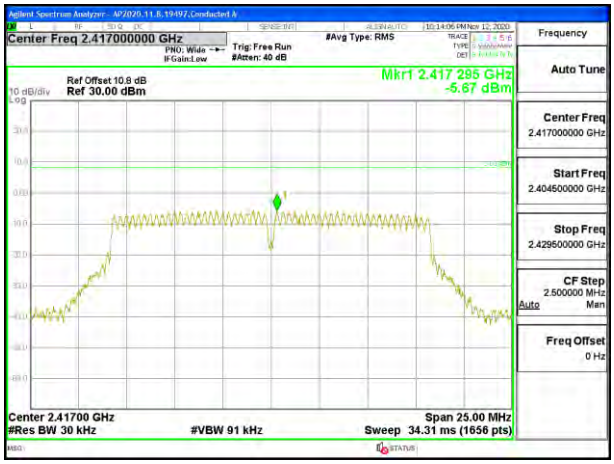


LOW CHANNEL 1 CHAIN 1

LOW CHANNEL 2



LOW CHANNEL 2 CHAIN 0



LOW CHANNEL 2 CHAIN 1

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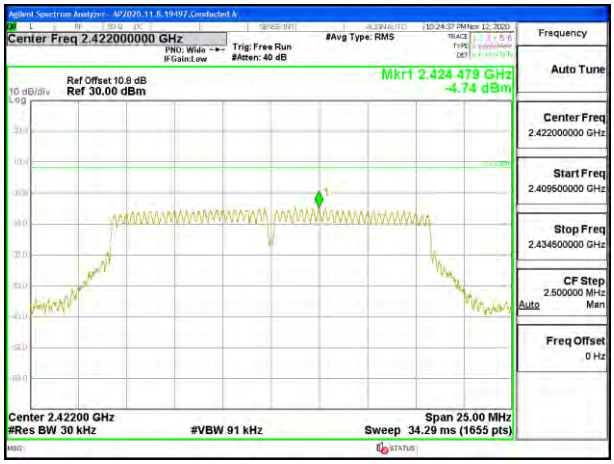
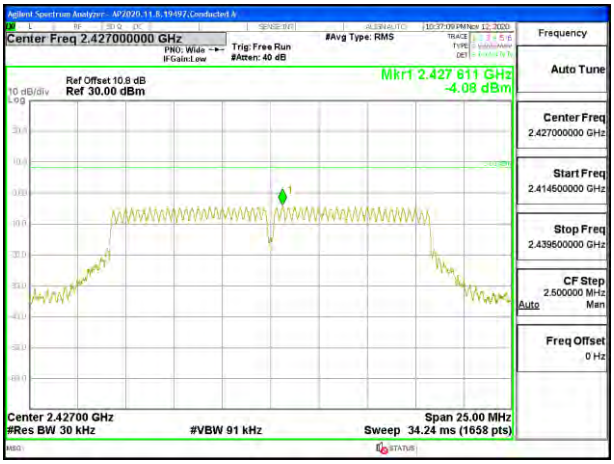
LOW CHANNEL 3

LOW CHANNEL 3 CHAIN 0

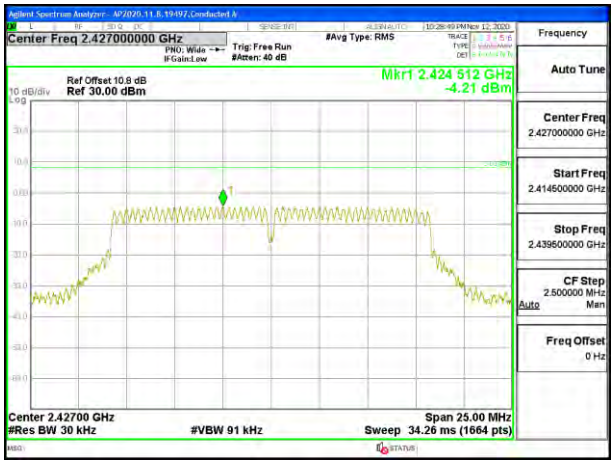


LOW CHANNEL 3 CHAIN 1

LOW CHANNEL 4



LOW CHANNEL 4 CHAIN 0



LOW CHANNEL 4 CHAIN 1

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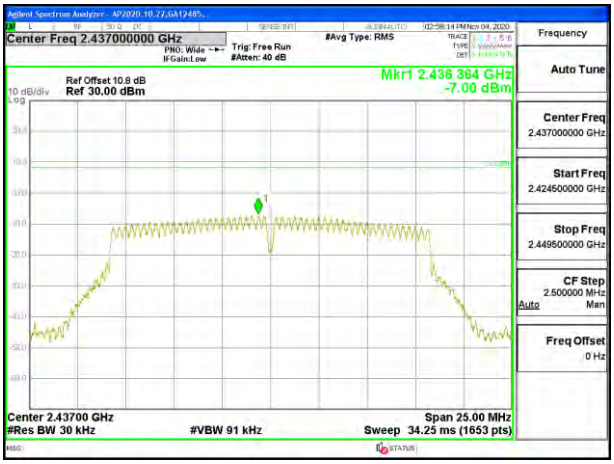
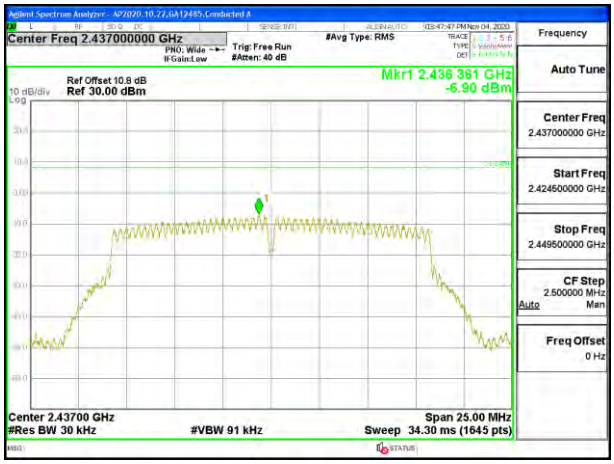
MID CHANNEL 6

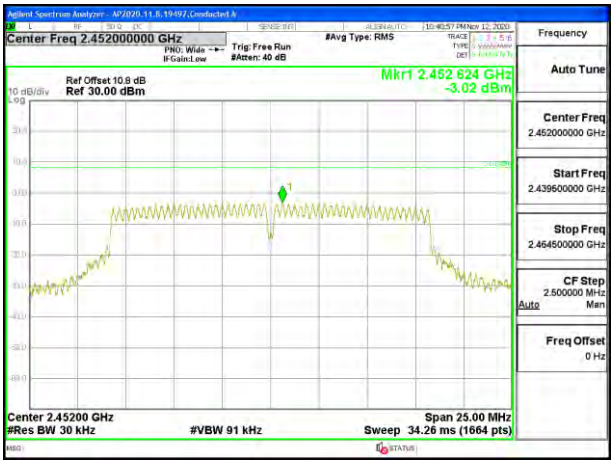


MID CHANNEL 6 CHAIN 0

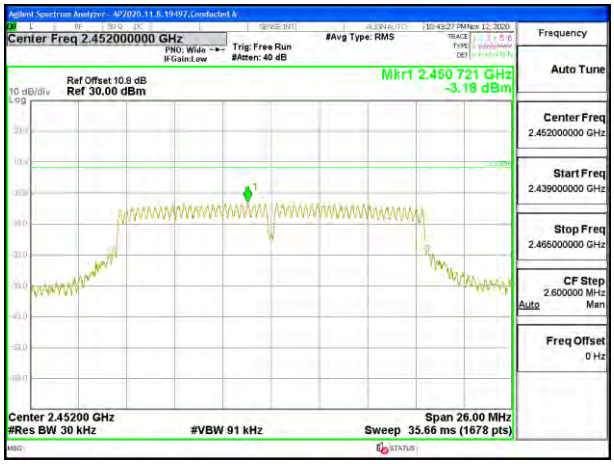


MID CHANNEL 6 CHAIN 1

HIGH CHANNEL 9



HIGH CHANNEL 9 CHAIN 0



HIGH CHANNEL 9 CHAIN 1

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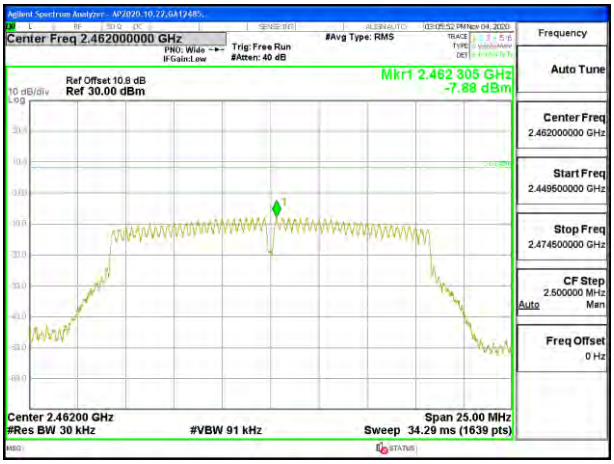
HIGH CHANNEL 10

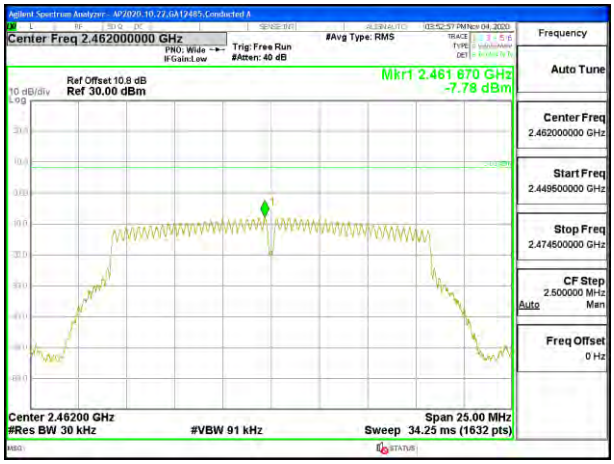
HIGH CHANNEL 10 CHAIN 0

HIGH CHANNEL 10 CHAIN 1

HIGH CHANNEL 11



HIGH CHANNEL 11 CHAIN 0



HIGH CHANNEL 11 CHAIN 1

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9.5.3. 802.11n HT20 MODE

2TX Chain 0 + Chain 1

Duty Cycle CF (dB)	0.18	Included in Calculations of Corr'd PSD

PSD Results

Channel	Frequency (MHz)	Antenna 1 Meas (dBm/ 3kHz)	Antenna 2 Meas (dBm/ 3kHz)	Total Corr'd PSD (dBm/ 3kHz)	Limit (dBm/ 3kHz)	Margin (dB)
Low 1	2412	-7.95	-7.01	-4.26	8.0	-12.3
Low 2	2417	-5.63	-5.69	-2.47	8.0	-10.5
Low 3	2422	-2.94	-3.08	0.18	8.0	-7.8
Mid 6	2437	-7.85	-7.59	-4.53	8.0	-12.5
High 9	2452	-2.35	-2.83	0.61	8.0	-7.4
High 10	2457	-5.05	-5.25	-1.96	8.0	-10.0
High 11	2462	-7.82	-6.37	-3.84	8.0	-11.8

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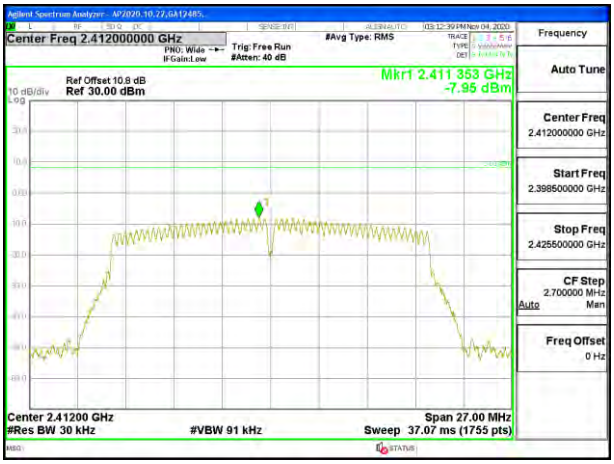
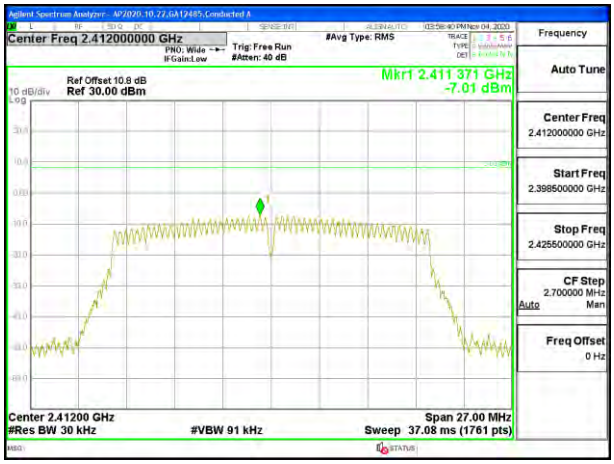
LOW CHANNEL 1

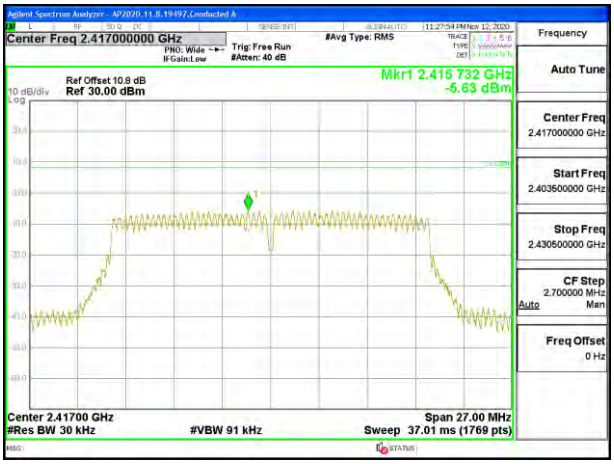


LOW CHANNEL 1 CHAIN 0

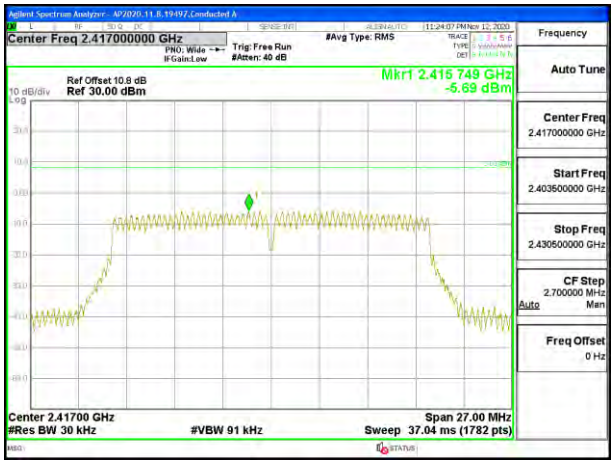


LOW CHANNEL 1 CHAIN 1

LOW CHANNEL 2



LOW CHANNEL 2 CHAIN 0



LOW CHANNEL 2 CHAIN 1

UL VERIFICATION SERVICES INC.
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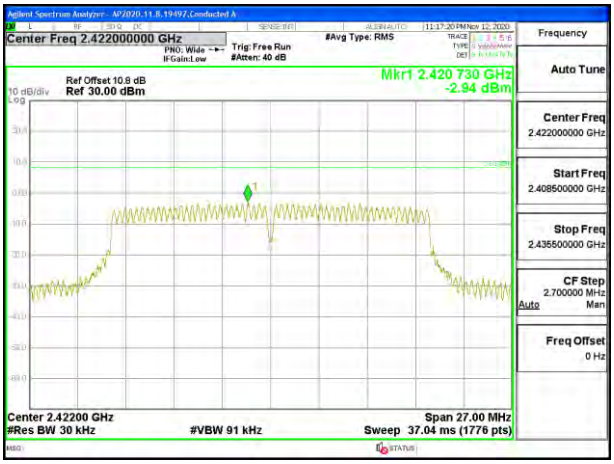
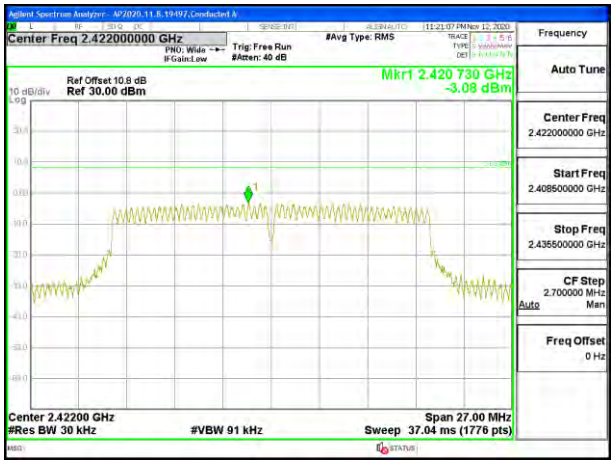
LOW CHANNEL 3

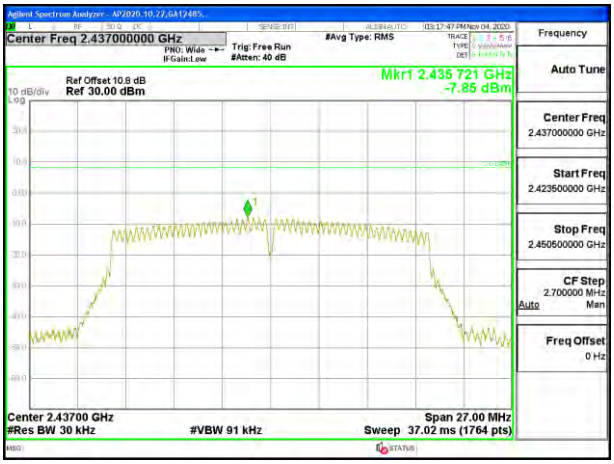


LOW CHANNEL 3 CHAIN 0

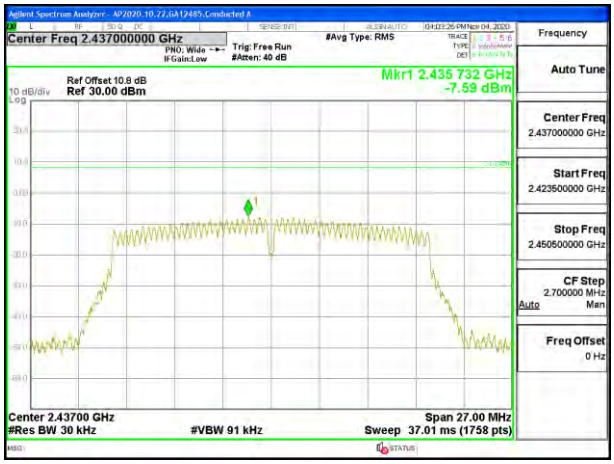


LOW CHANNEL 3 CHAIN 1

MID CHANNEL 6



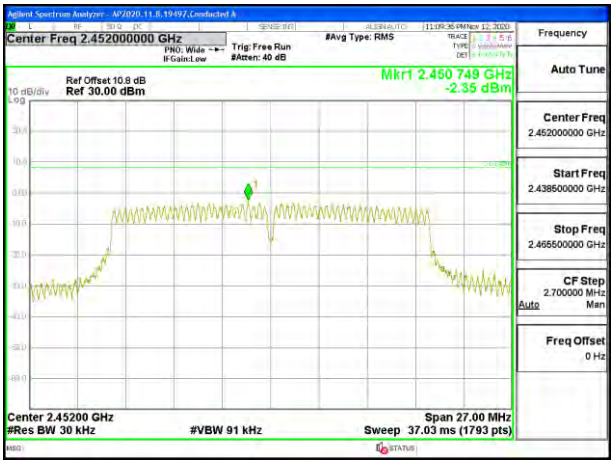
MID CHANNEL 6 CHAIN 0



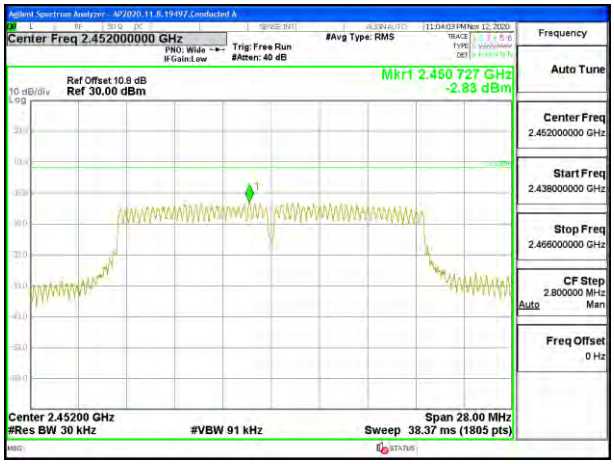
MID CHANNEL 6 CHAIN 1

UL VERIFICATION SERVICES INC.
47173 Benicia Street, Fremont, CA 94538; USA TEL:(510) 319-4000 FAX:(510) 661-0888

HIGH CHANNEL 9

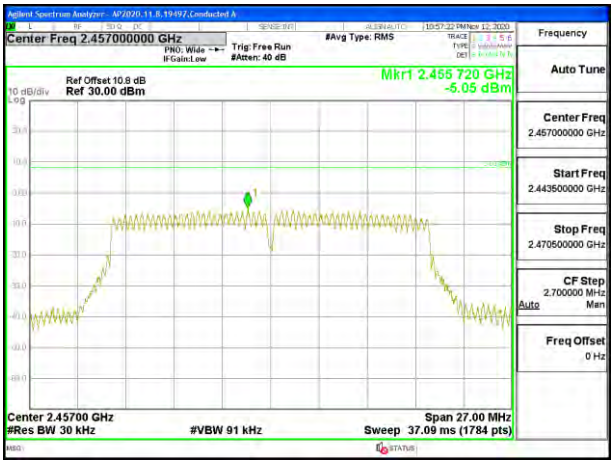


HIGH CHANNEL 9 CHAIN 0

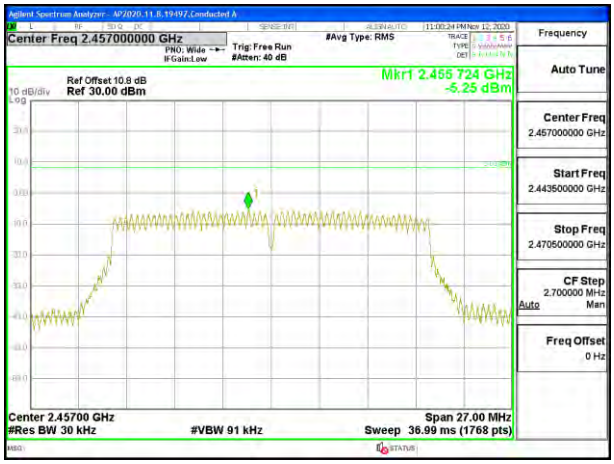


HIGH CHANNEL 9 CHAIN 1

HIGH CHANNEL 10



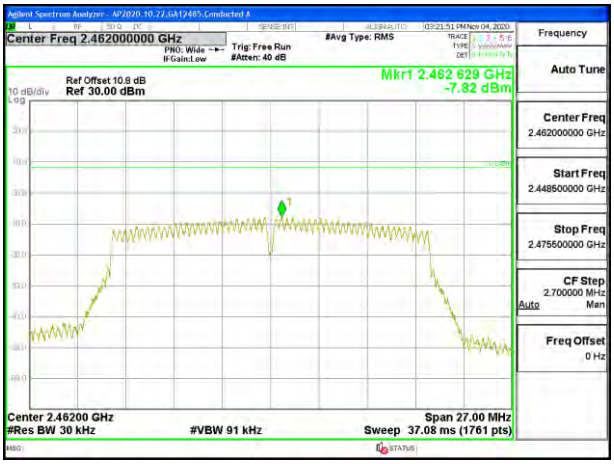
HIGH CHANNEL 10 CHAIN 0



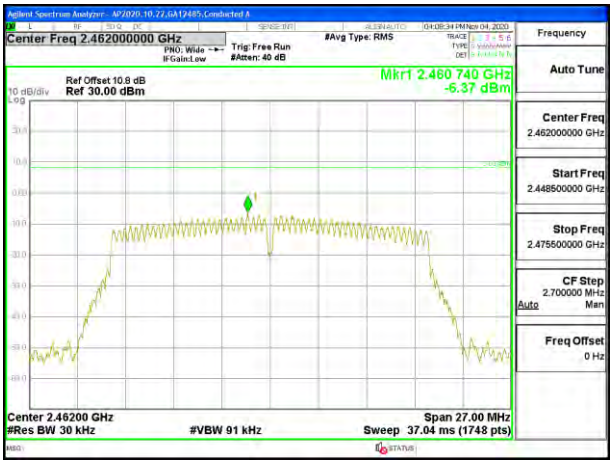
HIGH CHANNEL 10 CHAIN 1

UL VERIFICATION SERVICES INC.
47173 Benicia Street, Fremont, CA 94538; USA TEL:(510) 319-4000 FAX:(510) 661-0888

HIGH CHANNEL 11



HIGH CHANNEL 11 CHAIN 0



HIGH CHANNEL 11 CHAIN 1

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9.6. CONDUCTED SPURIOUS EMISSIONS

LIMITS

FCC §15.247 (d)

RSS-247 5.5

Output power was measured based on the use of a RMS averaging measurement, spurious emissions are required to be 30dBc.

RESULTS

UL VERIFICATION SERVICES INC.
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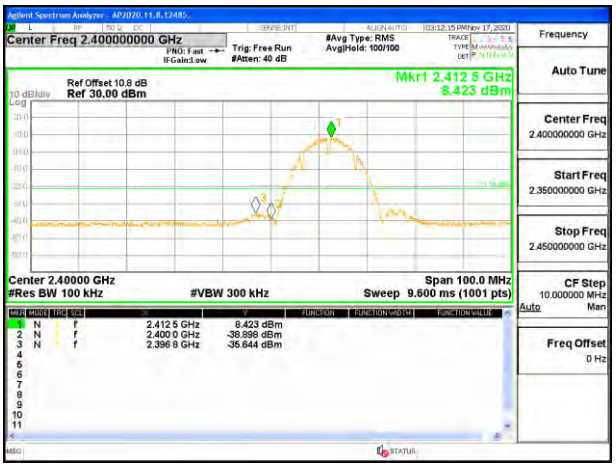
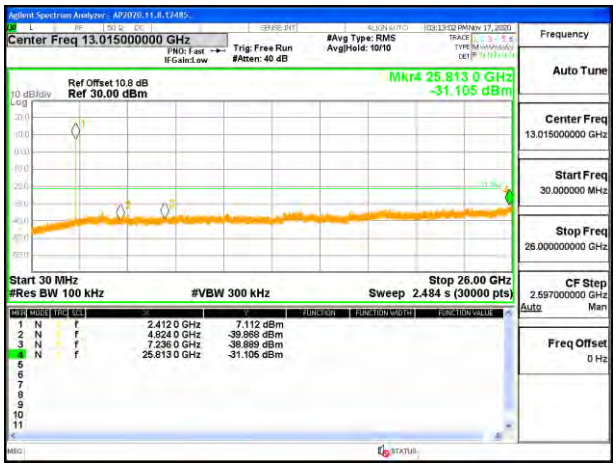
9.6.1. 802.11b MODE

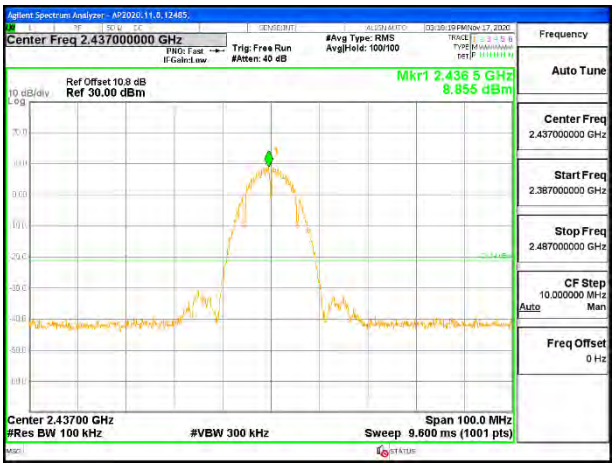
2TX Antenna 1 + Antenna 2



LOW CHANNEL 1 BANDEDGE CHAIN 0

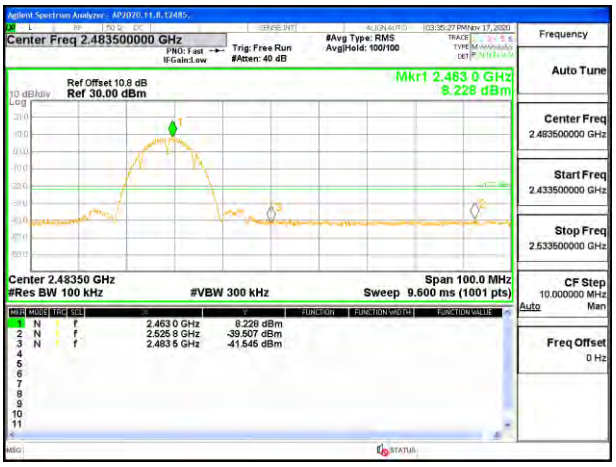


OUT-OF-BAND LOW CHANNEL 1 CHAIN 0

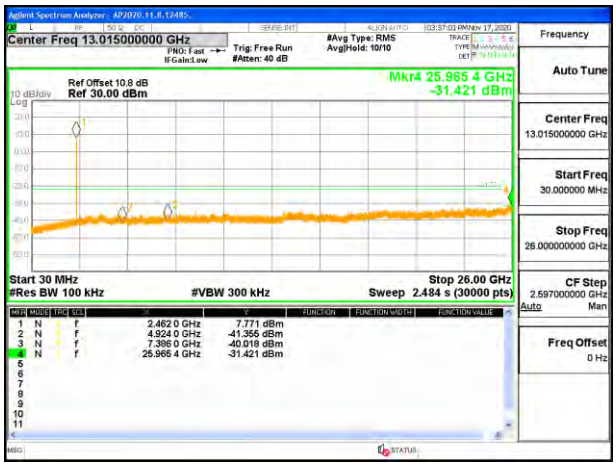


IN-BAND REFERENCE LEVEL CHAIN 0

OUT-OF-BAND MID CHANNEL CHAIN 0



HIGH CHANNEL 11 BANDEDGE CHAIN 0



OUT-OF-BAND HIGH CHANNEL 11 CHAIN 0

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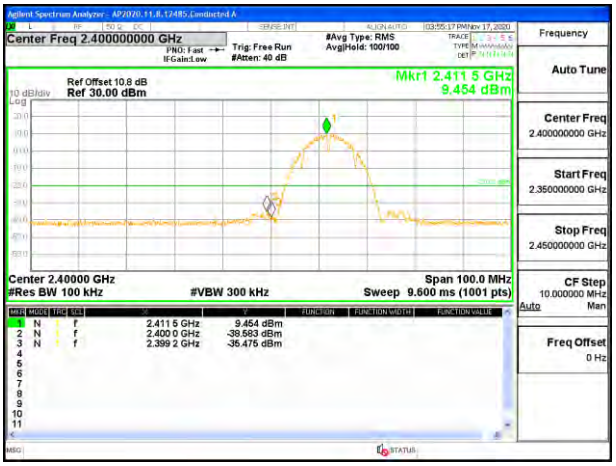
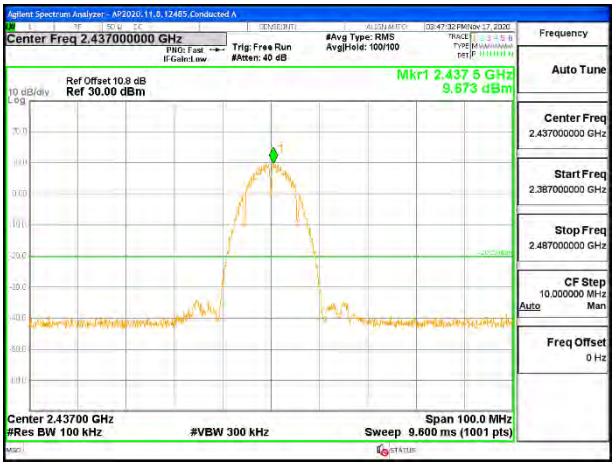


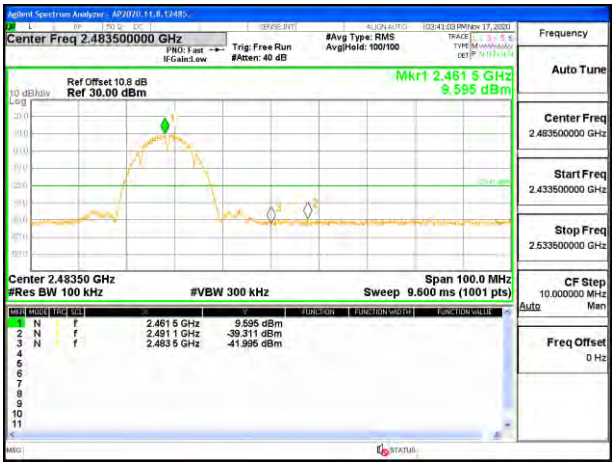
LOW CHANNEL 1 BANDEDGE CHAIN 1

OUT-OF-BAND LOW CHANNEL 1 CHAIN 1

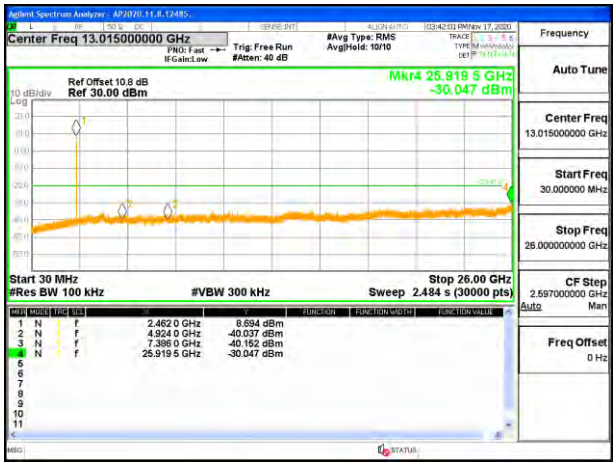


IN-BAND REFERENCE LEVEL CHAIN 1

OUT-OF-BAND MID CHANNEL CHAIN 1



HIGH CHANNEL 11 BANDEDGE CHAIN 1



OUT-OF-BAND HIGH CHANNEL 11 CHAIN 1

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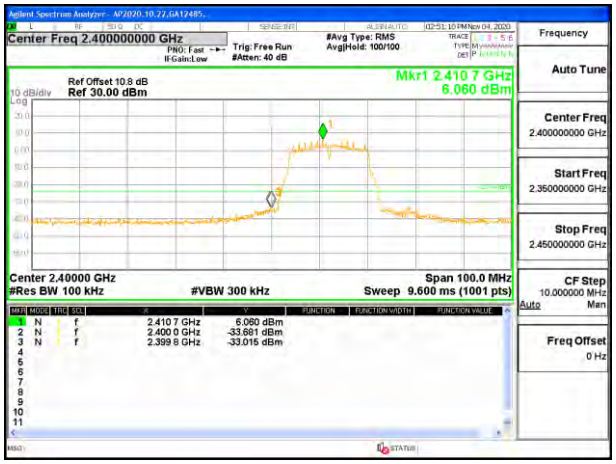
9.6.2. 802.11g MODE

2TX Chain 0 + Chain 1



LOW CHANNEL 1 BANDEDGE CHAIN 0

OUT-OF-BAND LOW CHANNEL 1 CHAIN 0

LOW CHANNEL 2 BANDEDGE CHAIN 0

OUT-OF-BAND LOW CHANNEL 2 CHAIN 0

LOW CHANNEL 3 BANDEDGE CHAIN 0

OUT-OF-BAND LOW CHANNEL 3 CHAIN 0

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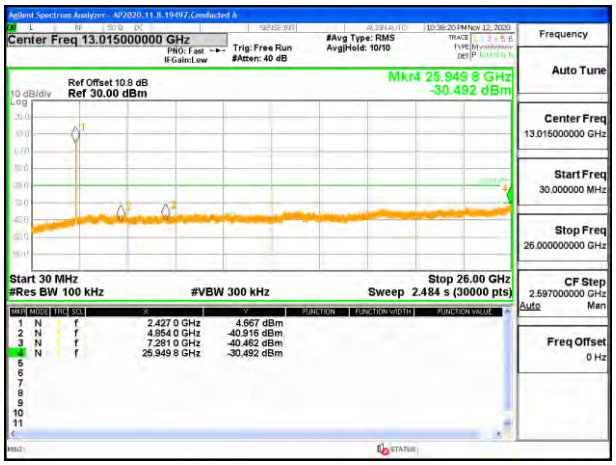
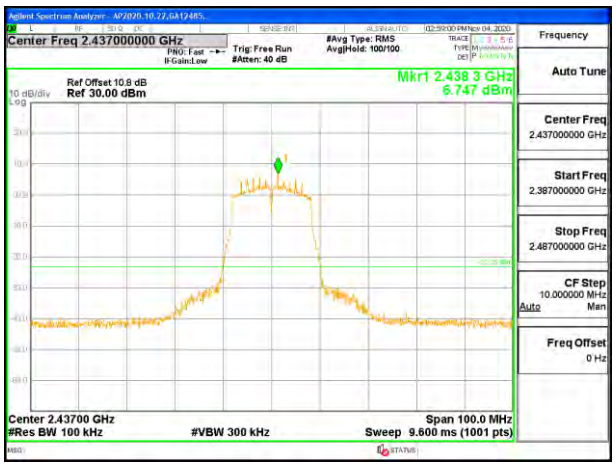
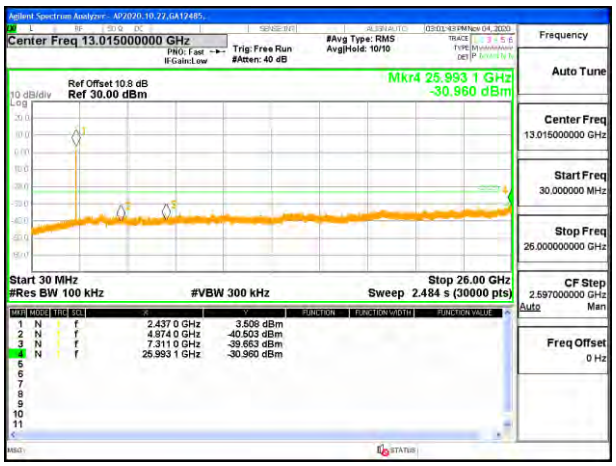
LOW CHANNEL 4 BANDEDGE CHAIN 0



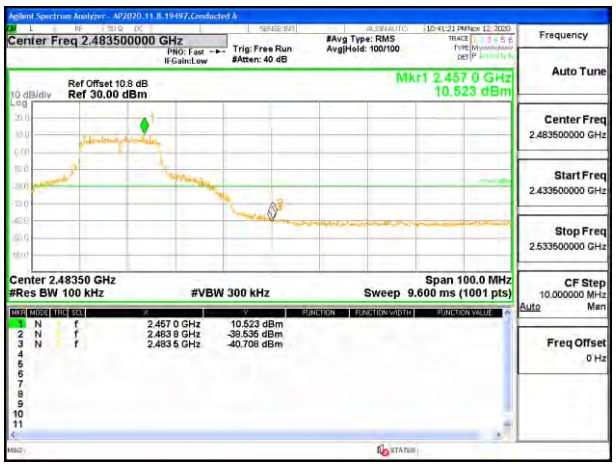
OUT-OF-BAND LOW CHANNEL 4 CHAIN 0



IN-BAND REFERENCE LEVEL CHAIN 0



OUT-OF-BAND MID CHANNEL CHAIN 0



HIGH CHANNEL 9 BANDEDGE CHAIN 0

OUT-OF-BAND HIGH CHANNEL 9 CHAIN 0

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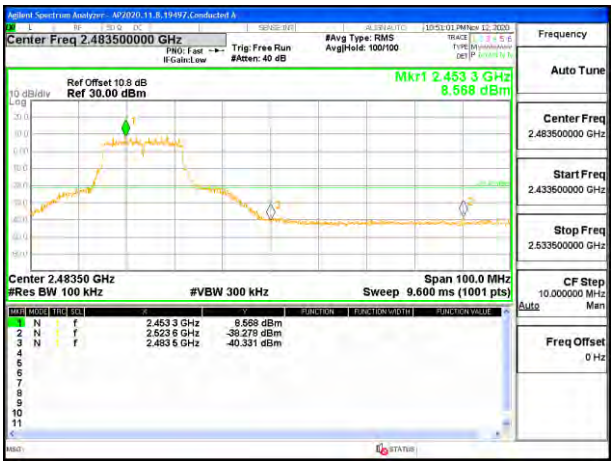
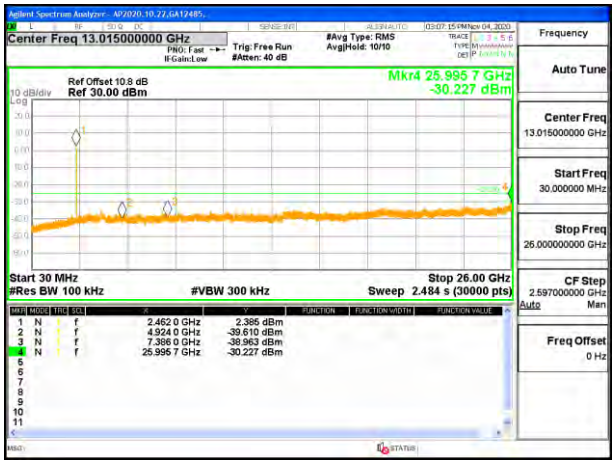


HIGH CHANNEL 10 BANDEDGE CHAIN 0

OUT-OF-BAND HIGH CHANNEL 10 CHAIN 0

HIGH CHANNEL 11 BANDEDGE CHAIN 0



OUT-OF-BAND HIGH CHANNEL 11 CHAIN 0

UL VERIFICATION SERVICES INC.
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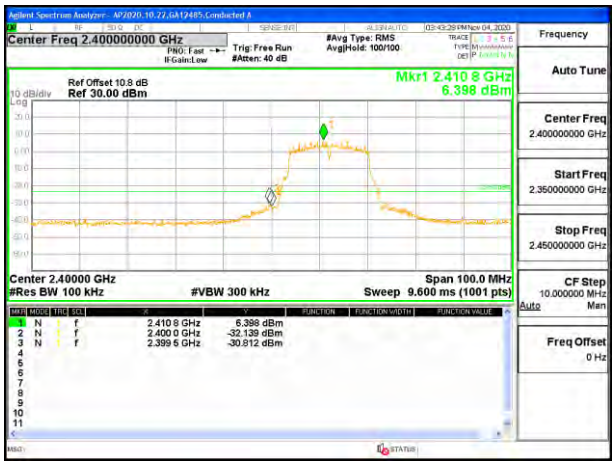
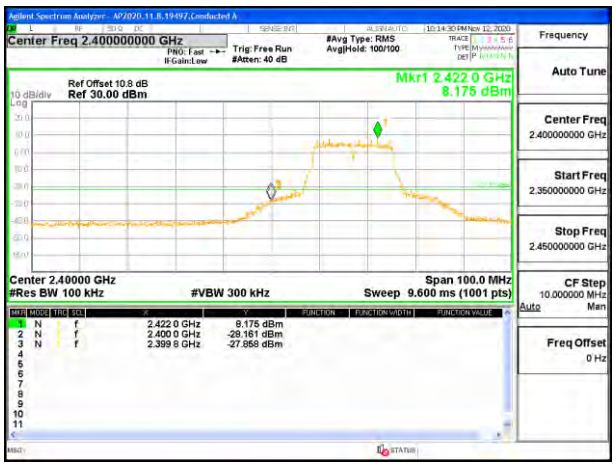


LOW CHANNEL 1 BANDEDGE CHAIN 1

OUT-OF-BAND LOW CHANNEL 1 CHAIN 1



LOW CHANNEL 2 BANDEDGE CHAIN 1

OUT-OF-BAND LOW CHANNEL 2 CHAIN 1

LOW CHANNEL 3 BANDEDGE CHAIN 1

OUT-OF-BAND LOW CHANNEL 3 CHAIN 1

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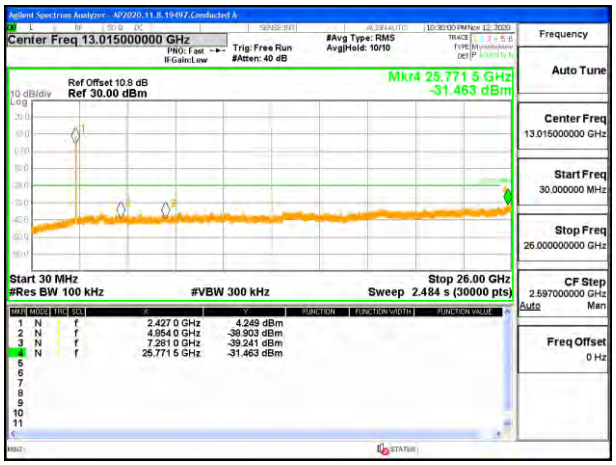
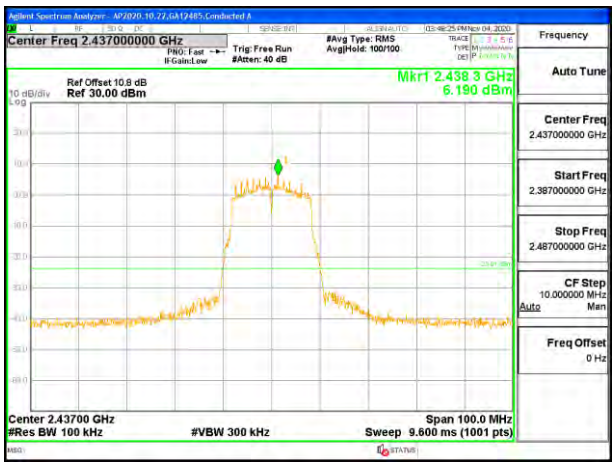
LOW CHANNEL 4 BANDEDGE CHAIN 1



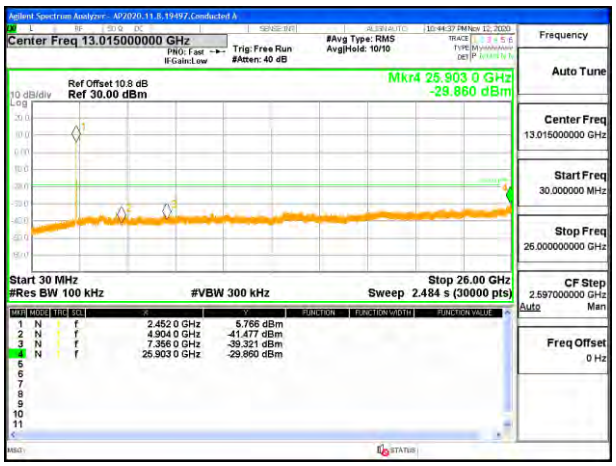
OUT-OF-BAND LOW CHANNEL 4 CHAIN 1



IN-BAND REFERENCE LEVEL CHAIN 1

OUT-OF-BAND MID CHANNEL CHAIN 1

HIGH CHANNEL 9 BANDEDGE CHAIN 1



OUT-OF-BAND HIGH CHANNEL 9 CHAIN 1

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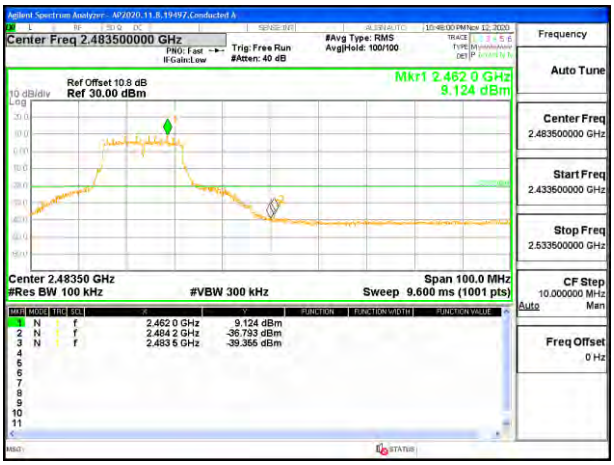

HIGH CHANNEL 10 BANDEDGE CHAIN 1

OUT-OF-BAND HIGH CHANNEL 10 CHAIN 1

HIGH CHANNEL 11 BANDEDGE CHAIN 1

OUT-OF-BAND HIGH CHANNEL 11 CHAIN 1

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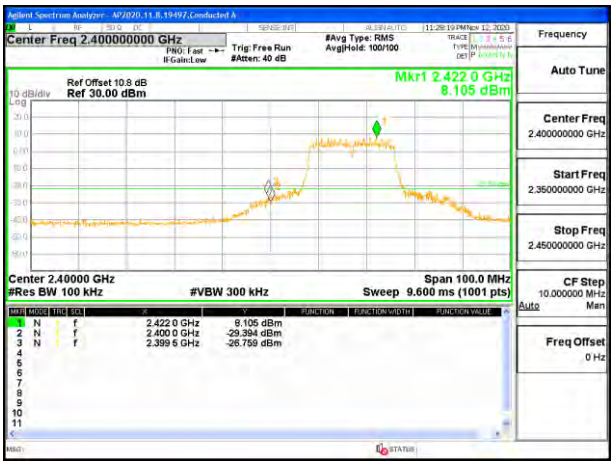
9.6.3. 802.11n HT20 MODE

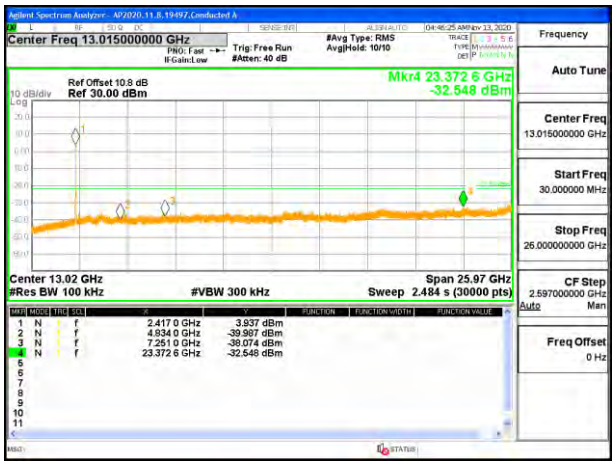
2TX Chain 0 + Chain 1

LOW CHANNEL 1 BANDEDGE CHAIN 0

OUT-OF-BAND LOW CHANNEL 1 CHAIN 0

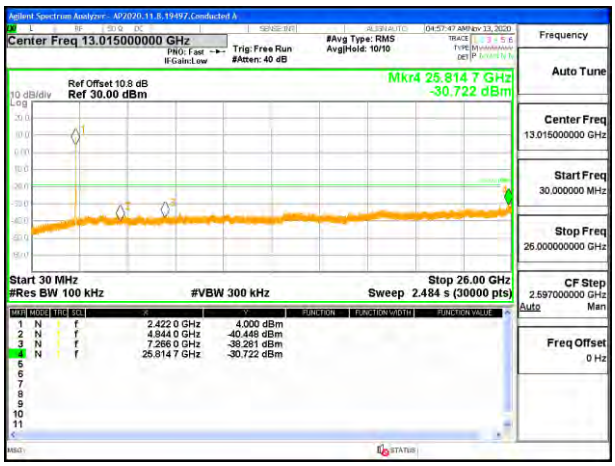


LOW CHANNEL 2 BANDEDGE CHAIN 0



OUT-OF-BAND LOW CHANNEL 2 CHAIN 0

LOW CHANNEL 3 BANDEDGE CHAIN 0



OUT-OF-BAND LOW CHANNEL 3 CHAIN 0

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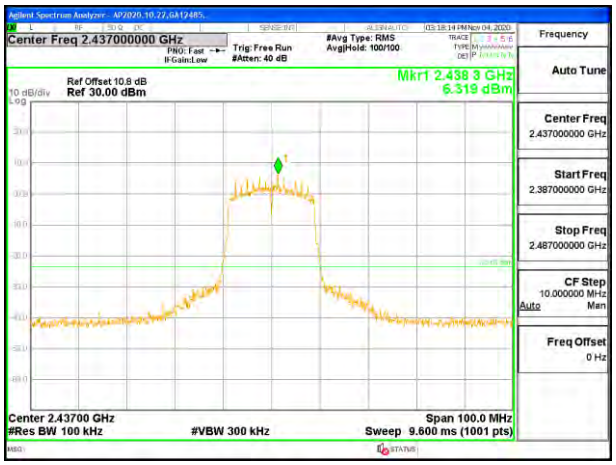


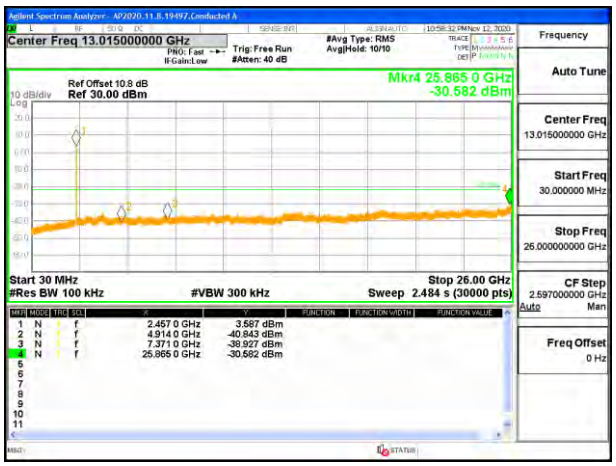
IN-BAND REFERENCE LEVEL CHAIN 0

OUT-OF-BAND MID CHANNEL CHAIN 0

HIGH CHANNEL 9 BANDEDGE CHAIN 0

OUT-OF-BAND HIGH CHANNEL 9 CHAIN 0

HIGH CHANNEL 10 BANDEDGE CHAIN 0



OUT-OF-BAND HIGH CHANNEL 10 CHAIN 0

UL VERIFICATION SERVICES INC.
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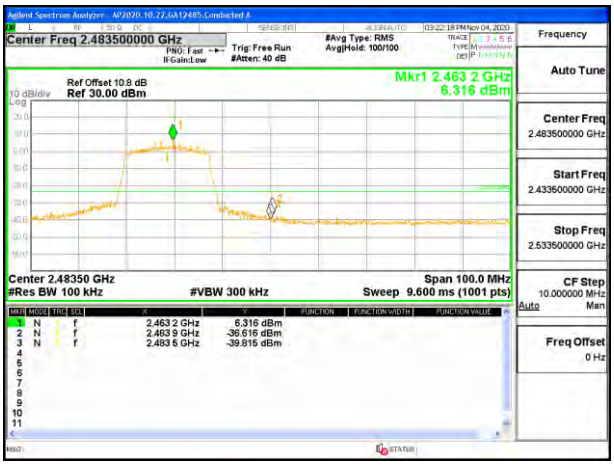
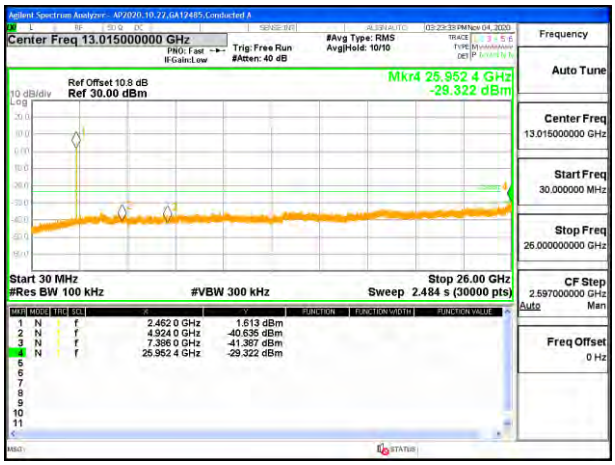


HIGH CHANNEL 11 BANDEDGE CHAIN 0



OUT-OF-BAND HIGH CHANNEL 11 CHAIN 0

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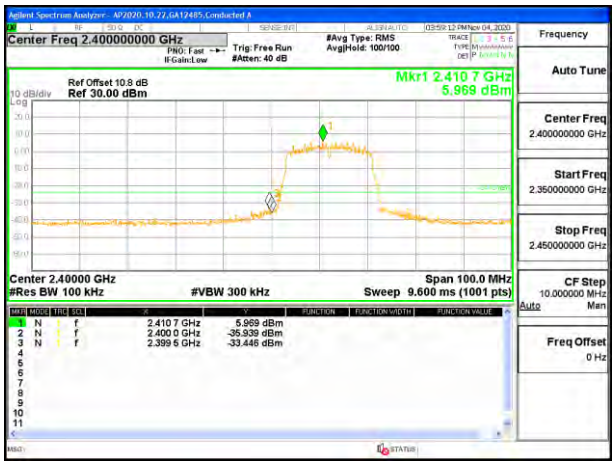


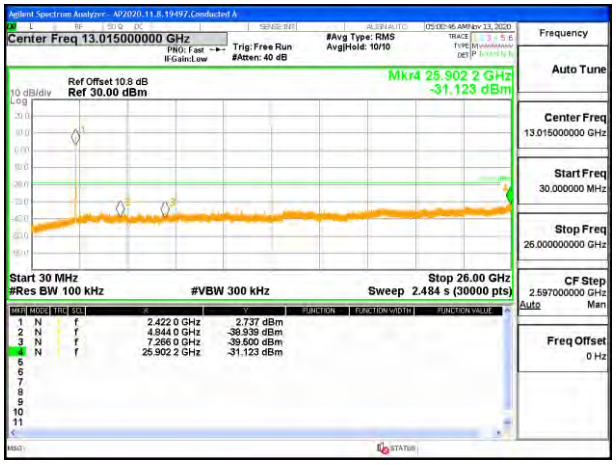
LOW CHANNEL 1 BANDEDGE CHAIN 1

OUT-OF-BAND LOW CHANNEL 1 CHAIN 1

LOW CHANNEL 2 BANDEDGE CHAIN 1

OUT-OF-BAND LOW CHANNEL 2 CHAIN 1

LOW CHANNEL 3 BANDEDGE CHAIN 1



OUT-OF-BAND LOW CHANNEL 3 CHAIN 1

UL VERIFICATION SERVICES INC.
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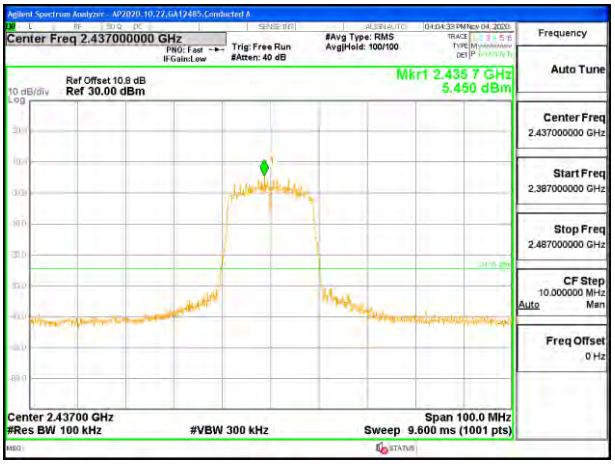
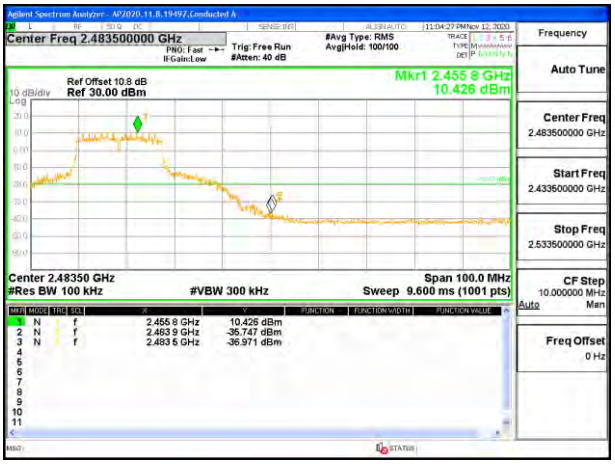
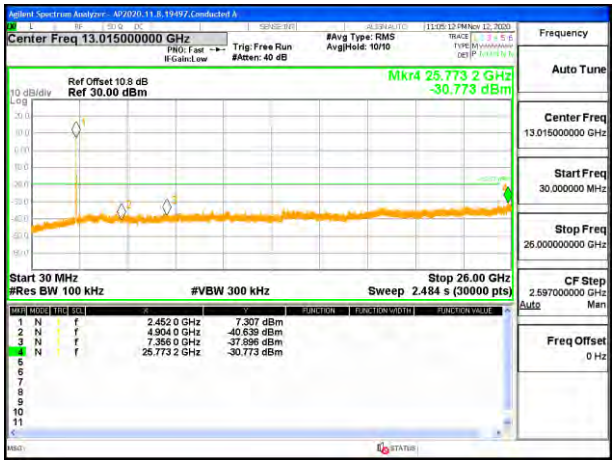


IN-BAND REFERENCE LEVEL CHAIN 1

OUT-OF-BAND MID CHANNEL CHAIN 1



HIGH CHANNEL 9 BANDEDGE CHAIN 1



OUT-OF-BAND HIGH CHANNEL 9 CHAIN 1

HIGH CHANNEL 10 BANDEDGE CHAIN 1

OUT-OF-BAND HIGH CHANNEL 10 CHAIN 1

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HIGH CHANNEL 11 BANDEDGE CHAIN 1

OUT-OF-BAND HIGH CHANNEL 11 CHAIN 1

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