CERTIFICATION TEST REPORT

Report Number. : R12935938-E3

Applicant	:	Microsoft Corporation One Microsoft Way Redmond, WA 98052-6399 USA
Model	:	1868
FCC ID	:	C3K1868
IC	:	3048A-1868
EUT Description	:	Portable Computing Device
Test Standard(s)	:	FCC 47 CFR PART 15 SUBPART C ISED RSS-247 ISSUE 2 ISED RSS-GEN ISSUE 5

Date Of Issue:
2019-09-10

Prepared by:
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NVLAP Lab code: 200246-0

REPORT REVISION HISTORY

Rev.	Issue Date	Revisions	Revised By
V1	--	Initial Issue	
2	2019-09-10	Added AC power adaptor to support equipment. Added justification for waiving SISO testing to Section 6.5 Revised 99% BW 802.11nHT40 results. Added model similarity explanation to Section 4.	Brian T. Kiewra

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: Microsoft Corporation
One Microsoft Way
Redmond, WA 98052-6399
USA

EUT DESCRIPTION: Portable Computing Device

MODEL: 1868

SERIAL NUMBER: See section 6.4

DATE TESTED: 2019-07-15 to 2019-09-10

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 LLC 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.

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2. 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, RSS-GEN Issue 5, and RSS-247 Issue 2.

3. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 12 Laboratory Drive, Research Triangle Park, North Carolina, USA and 2800 Perimeter Park Dr. Suite B, Morrisville, North Carolina, USA. 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.

12 Laboratory Dr.	2800 Perimeter Park Dr. Suite B
ISED Site Code: 2180C	
☐ Chamber A	☒ Chamber North
☐ Chamber C	☒ Chamber South

The above test sites and facilities are covered under FCC Test Firm Registration # 703469. Chambers above are covered under Industry Canada company address and respective code.

UL LLC (RTP) is accredited by NVLAP, Laboratory Code 200246-0

4. SCOPE OF REPORT

This test report covers the radiated emissions, antenna port conducted emissions, and AC power line conducted emissions data for model 1868 for 2.4 GHz 802.11 b/g/n HT20/HT40. Antenna port conducted emissions data in this report is leveraged by model 1867. For model 1867, radiated emissions and AC power line conducted emissions can be found in UL report number R12922855-E3. Radiated spurious emissions 1-18 GHz for 802.11n HT20 and 802.11 nHT40 is covered by using the 802.11ax HE20 and 802.11ax HE40 radiated spurious emissions 1-18 GHz data for model 1868 from UL report number R12935938-E4. Note – This report, R12935938-E3 does include Radiated Bandedge plots for 802.11 n HT20/HT40.

For the antenna port conducted emissons portion of this report, the worst-case antenna gain across both models was used to represent a worst-case scenario. Both models will be implemented with the same power.

Models 1867 and 1868 are electrically and RF equivalent as they use the same motherboard, radio module and on-board RF components. Both models share a common WiFi and BT power table. The radio-related firmware and driver versions are the same for the two models. The peak antenna gains are in the antenna gain section of the report. Antenna port conducted emissions measurements are done on model 1868 (FCC ID: C3K1868, IC: 3048A-1868) and the data is leveraged for model 1867 (FCC ID: C3K1867, IC: 3048A-1867). Highest antenna gain across the two models in each band has been considered while doing the conducted emissions measurements. Separate radiated & SAR measurements are done on each model.

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5. CALIBRATION AND UNCERTAINTY

5.1. MEASURING INSTRUMENT CALIBRATION

The measuring equipment utilized to perform the tests documented in this report has been calibrated in accordance with the manufacturer's recommendations, and is traceable to recognized national standards.

5.2. 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

5.3. MEASUREMENT UNCERTAINTY

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

PARAMETER	UNCERTAINTY
Radio Frequency (Spectrum Analyzer)	141.2 Hz
Occupied Channel Bandwidth	2.00%
RF output power, conducted	1.3 dB (PK) 0.45 dB (AV)
RF output power, radiated (SAC)	4.52 dB
Power Spectral Density, conducted	2.47 dB
Unwanted Emissions, conducted	2.50 dB
All emissions, radiated	4.88 dB
Temperature	2.26°C
Humidity	6.79%
DC Supply voltages	1.70%
Time	3.39%

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

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6. EQUIPMENT UNDER TEST

6.1. EUT DESCRIPTION

The EUT is a Portable Computing Device that contains 802.11 a/ac/ax/b/g/n 20/40/80/160MHz 2x2 dual band and BT/BLE radios.

6.2. MAXIMUM OUTPUT POWER

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

2.4GHz BAND

Frequency Range (MHz)	Mode	Output Power (dBm)	Output Power (mW)
2Tx			
2412 - 2472	802.11b CDD	24.33	271.02
2412 - 2472	802.11g CDD	25.93	391.74
2412 - 2472	802.11n HT20 SDM	25.59	362.24
2422 - 2462	802.11n HT40 SDM	25.51	355.63

SISO and MIMO per chain power are set to the same level.

6.3. DESCRIPTION OF AVAILABLE ANTENNAS

Frequency Range (GHz)	Antenna Type	Peak Gain (dBi) Chain 0 (Right)	Peak Gain (dBi) Chain 1 (Left)
Model 1867			
2.4 to 2.48	PIFA	0.7	2.6
5.15 to 5.25		4.9	4.4
5.25 to 5.35		6.1	5.0
5.47 to 5.72		7.2	5.5
5.725 to 5.85		9.4	5.6
Model 1868			
2.4 to 2.48	PIFA	0.4	1.0
5.15 to 5.25		3.6	2.2
5.25 to 5.35		5.2	3.5
5.47 to 5.72		6.4	4.7
5.725 to 5.85		7.8	4.5

The 2.4 WLAN radio utilizes Chain 0 and chain 1.

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

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6.4. SOFTWARE AND FIRMWARE

EUT	Serial Number	DRTU Version	OS Version	BT Driver Version	WiFi Driver Version	EUT's Power Supply (s/n)
R-557-1868-FCC-CONDUCTED-02	005210692757	11.1916.0-09531	MTEOS 1.652.0	21.0.19157.20088	99.0.43.8	0D130P01P9596
R-557-1868-FCC-CONDUCTED-03	005216792757	11.1916.0-09531	MTEOS 1.652.0	21.0.19157.20088	99.0.43.8	0D130P03GE596
R-557-1868-FCC-RADIATED-10	013886292757	11.1916.0-09531	MTEOS 1.652.0	21.0.19157.20088	99.0.43.8	0D130P02KC596
R-557-1868-FCC-RADIATED-11	013891692757	11.1916.0-09531	MTEOS 1.652.0	21.0.19157.20088	99.0.43.8	0D130P01S7596

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 EUT has one intended orientations, X; therefore, all final radiated testing was performed with the EUT in X 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 NSS2
802.11n HT40mode: MCS0 NSS2

All radios that can transmit simultaneously have been evaluated for radiated for all possible combinations of transmission and found to be in compliance.

MIMO and SISO power are same setting per chain, therefore MIMO mode tested as worst-case to cover SISO mode.

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6.6. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Support Equipment List				
Description	**Manufacturer**	**Model**	**Serial Number**	**FCC ID**
USB Hub	J5 Create	JCA374	AY2A1904000477 / AY6A1903004261	N/A
Earbuds	Sony	MDR-EX14AP	Non-serialized	N/A
USB Flash Drive	Kingston	DataTraveler G4	Non-serialized	N/A
AC power adaptor	Microsoft	1706	0D130P02KC596	N/A

I/O CABLES

I/O Cable List						
Cable No	**Port**	**# of identical ports**	**Connector Type**	**Cable Type**	**Cable Length (m)**	**Remarks**
1	Mains	1	12-pin	Mains	<3	None
2	USB-A	1	USB-A	USB	<3	None
3	USB-C	1	USB-C	USB	<3	None
4	Aux	1	Aux	Aux	<3	None

TEST SETUP

The test utility software was located on the EUT during the tests and was used to exercised the radios.

SETUP DIAGRAMS

Please refer to R12935938-EP1 for setup diagrams

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7. MEASUREMENT METHOD

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

6 dB BW: ANSI C63.10 Subclause -11.8.1

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

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

Conducted emissions non-restricted frequency bands: ANSI C63.10 Subclause -11.11, 6.10.4

Radiated emissions restricted frequency bands: ANSI C63.10 Subclause -11.12.1, 6.10.5

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

Radiated Emissions Requirements: ANSI C63.10-2013 Section 6.3-6.6

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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 Used - Radiated Disturbance Emissions Test Equipment (Morrisville - South Chamber)

Equip. ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
	1-18 GHz				
AT0072	Double-Ridged Waveguide Horn Antenna, 1 to 18 GHz	ETS Lindgren	3117	2019-04-22	2020-04-22
	18-40 GHz				
AT0076	Horn Antenna, 18-26.5GHz	ARA	MWH-1826/B	2018-11-08	2019-11-08
	Gain-Loss Chains				
S-SAC03	Gain-loss string: 1-18GHz	Various	Various	2019-03-13	2020-03-13
S-SAC04	Gain-loss string: 18-40GHz	Various	Various	2018-09-30	2019-09-30
	Receiver & Software				
SA0025	Spectrum Analyzer	Agilent	N9030A	2019-02-28	2020-02-28
SA0027 (18-40GHz RSE)	Spectrum Analyzer	Agilent	N9030A	2019-05-15	2020-05-15
SOFTEMI	EMI Software	UL	Version 9.5	NA	NA
	Additional Equipment used				
s/n 181474409	Environmental Meter	Fisher Scientific	15-077-963	2018-07-27	2020-07-27

NOTES:

1. For equipment listed above that was calibrated during the testing period, please note the equipment was used for testing after calibration.
2. For equipment listed above that has a calibration due date during the testing period, the testing was completed before the equipment expiration date.

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Test Equipment Used – Line Conducted Emissions Voltage (Morrisville – Conducted 1)

Equipment ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
CBL087	Coax cable, RG223, N-male to BNC-male, 20-ft.	Pasternack	PE3W06143-240	2019-05-29	2020-05-29
s/n 161016511	Environmental Meter	Fisher Scientific	14-650-118	2018-09-04	2020-09-04
LISN003	LISN, 50-ohm/50-uH, 2-conductor, 25A	Fischer Custom Com.	FCC-LISN-50-25-2-01-550V	2018-08-21	2019-08-21
75141 (PRE0101521)	EMI Test Receiver 9kHz-7GHz	Rohde & Schwarz	ESCI 7	2018-08-22	2019-08-22
TL001	Transient Limiter, 0.009-30MHz	Com-Power	LIT-930A	2019-05-29	2020-05-29
PS215	AC Power Source	Elgar	CW2501M (s/n 1523A02397)	NA	NA
SOFTEMI	EMI Software	UL	Version 9.5	NA	NA

NOTES:

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2. For equipment listed above that has a calibration due date during the testing period, the testing was completed before the equipment expiration date.

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Test Equipment Used - Radiated Disturbance Emissions Test Equipment (Morrisville - North Chamber)

Equip. ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
	0.009-30MHz	**(Loop Ant.)**			
AT0059	Active Loop Antenna	ETS-Lindgren	6502	2018-07-20	2019-07-31
	30-1000 MHz				
AT0073	Hybrid Broadband Antenna	Sunol Sciences Corp.	JB3	2018-08-06	2019-08-31
AT0074	Hybrid Broadband Antenna	Sunol Sciences Corp.	JB3	2019-07-16	2020-07-16
	1-18 GHz				
AT0067	Double-Ridged Waveguide Horn Antenna, 1 to 18 GHz	ETS Lindgren	3117	2019-03-22	2020-03-22
	Gain-Loss Chains				
N-SAC01	Gain-loss string: 0.009-30MHz	Various	Various	2019-05-02	2020-05-02
N-SAC02	Gain-loss string: 25-1000MHz	Various	Various	2019-05-02	2020-05-02
N-SAC03	Gain-loss string: 1-18GHz	Various	Various	2019-03-15	2020-03-15
	Receiver & Software				
SA0026	Spectrum Analyzer	Agilent	N9030A	2019-03-19	2020-03-19
SOFTEMI	EMI Software	UL	Version 9.5	NA	NA
	Additional Equipment used				
s/n 181474341	Environmental Meter	Fisher Scientific	15-077-963	2018-07-27	2020-07-27

NOTES:

1. For equipment listed above that was calibrated during the testing period, please note the equipment was used for testing after calibration.
2. For equipment listed above that has a calibration due date during the testing period, the testing was completed before the equipment expiration date.

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Test Equipment Used – Antenna Port Conducted Testing (Morrisville – RP)

Equipment ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
SA0027	PXA Signal Analyzer	Keysight Technologies	MY54490254	2019-05-15	2020-05-15
s/n 160938893	Environmental Meter	Fisher Scientific	14-650-118	2019-06-17	2020-06-17
224604-002	Coaxial Testing Cable	Uti-flex	UFA147A-0-0180-200200	NA	NA
Antenna Port	Antenna Port Software	Antenna	Version 10.0.1	NA	NA
126431 (PRE0128068)	RF Power Meter	Anritsu	ML2495A	2019-04-30	2020-04-30
126430 (PRE0128067)	Pulse Power Sensor, 300MHz to 40GHz	Anritsu	MA2411B	2019-04-30	2020-04-30
PWM001 (PRE0136343)	RF Power Meter	Keysight Technologies	N1912A	2019-06-14	2020-06-14
PWS001 (PRE0137347)	Peak and Avg Power Sensor, 50MHz to 18GHz	Keysight Technologies	N1921A	2019-05-06	2020-05-06

NOTES:

1. For equipment listed above that was calibrated during the testing period, please note the equipment was used for testing after calibration.
2. For equipment listed above that has a calibration due date during the testing period, the testing was completed before the equipment expiration date.

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9. ANTENNA PORT TEST RESULTS

NOTE: Throughout this section, please note that
Antenna 1 = Chain 0
Antenna 2 = Chain 1

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 CDD	8.353	8.407	0.994	99.36%	0.00	0.010
802.11g CDD	2.086	2.132	0.978	97.84%	0.09	0.479
802.11n HT20 SDM	3.980	4.024	0.989	98.91%	0.00	0.010
802.11n HT40 SDM	3.982	4.026	0.989	98.91%	0.00	0.010

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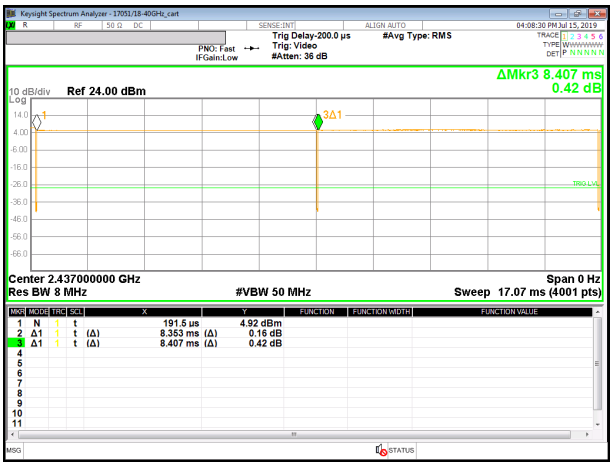
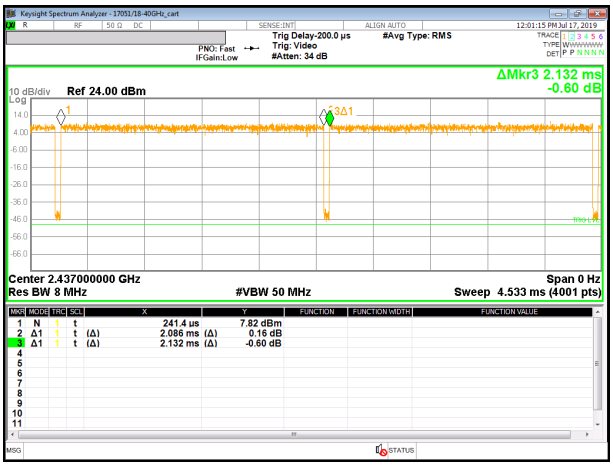
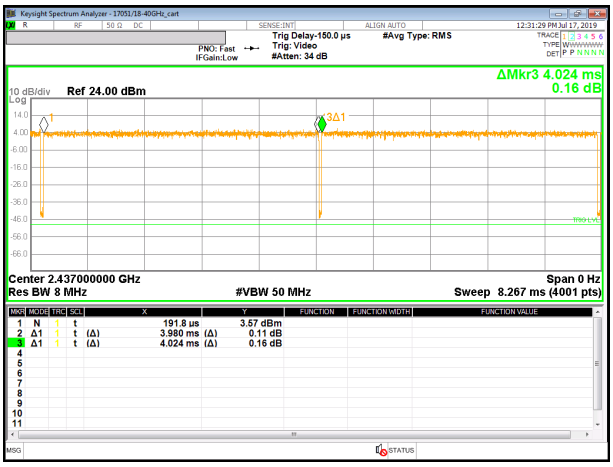
DUTY CYCLE PLOTS



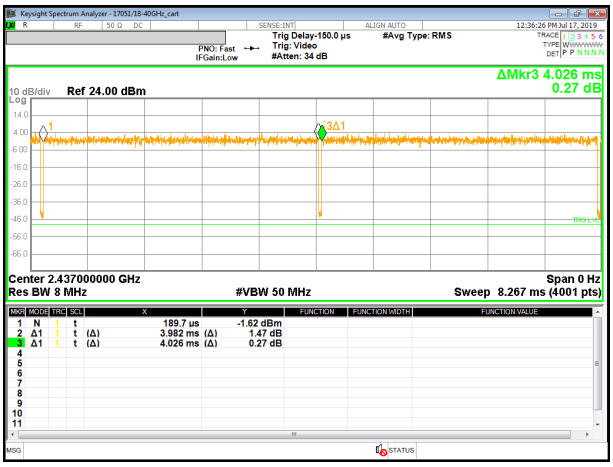
DUTY CYCLE 802.11b CDD MODE



DUTY CYCLE 802.11g CDD MODE



DUTY CYCLE 802.11n HT20 SDM MODE



DUTY CYCLE 802.11n HT40 SDM MODE

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9.2. 99% BANDWIDTH

LIMITS

None; for reporting purposes only.

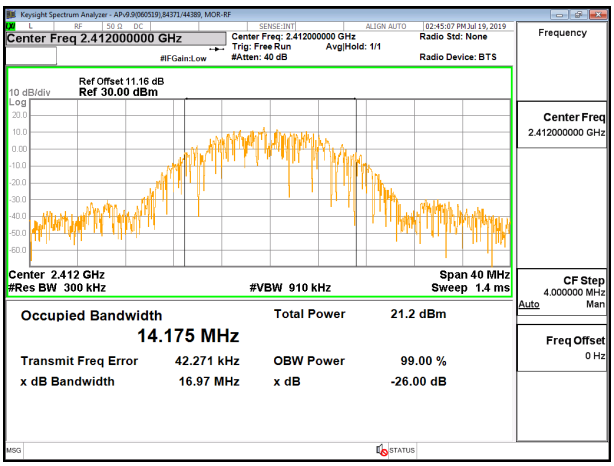
RESULTS

9.2.1. 802.11b MODE

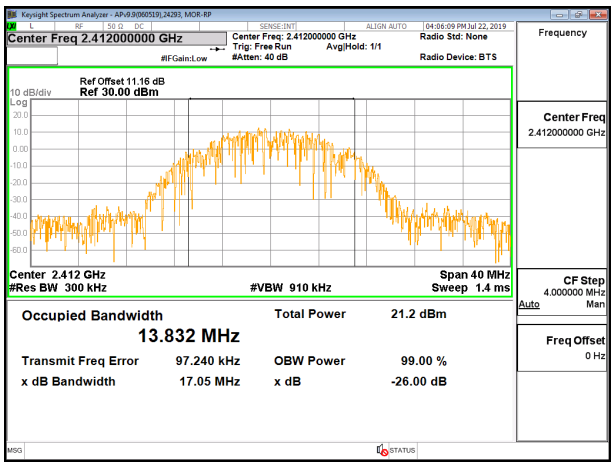
2TX Chain 0 + Chain 1 CDD MODE

Channel	Frequency (MHz)	99% Bandwidth Chain 0 (MHz)	99% Bandwidth Chain 1 (MHz)
Low 1	2412	14.1750	13.8320
Mid 6	2437	14.3900	14.0660
High 11	2462	13.9910	14.4230
High 12	2467	13.9020	13.8770
High 13	2472	13.8260	13.7790

LOW CHANNEL 1



LOW CHANNEL 1 CHAIN 0



LOW CHANNEL 1 CHAIN 1

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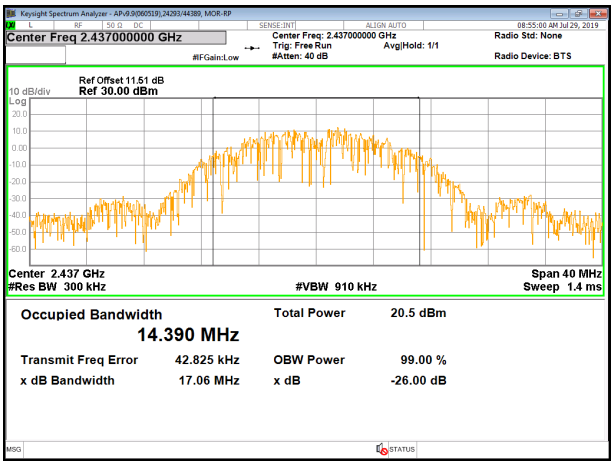
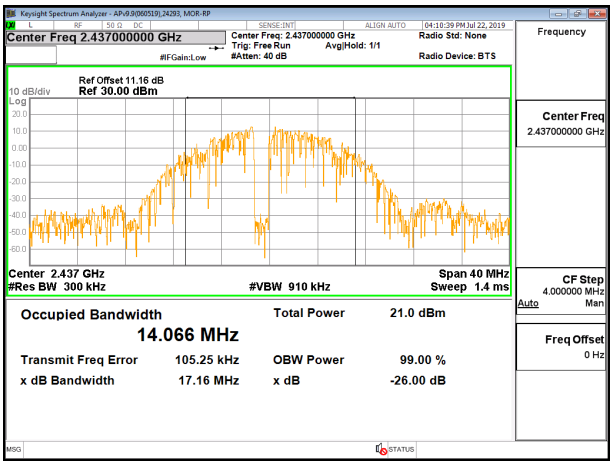
MID CHANNEL 6

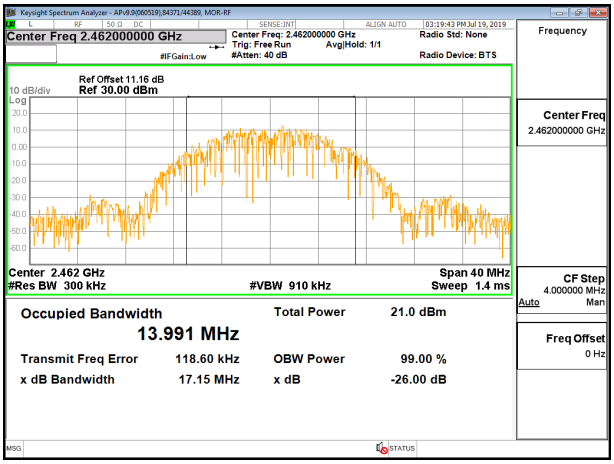


MID CHANNEL 6 CHAIN 0

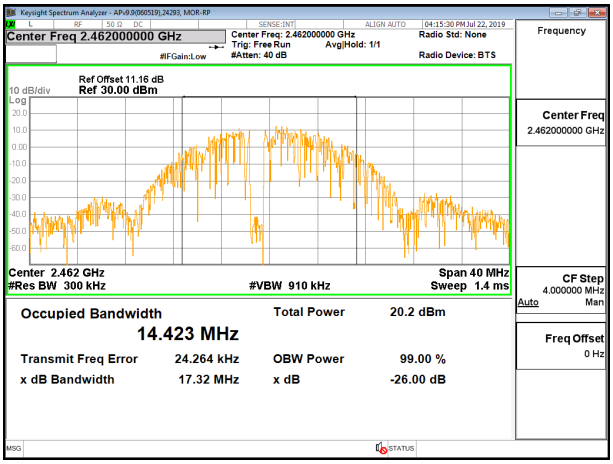


MID CHANNEL 6 CHAIN 1

HIGH CHANNEL 11



HIGH CHANNEL 11 CHAIN 0



HIGH CHANNEL 11 CHAIN 1

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TEL:(919) 549-1400

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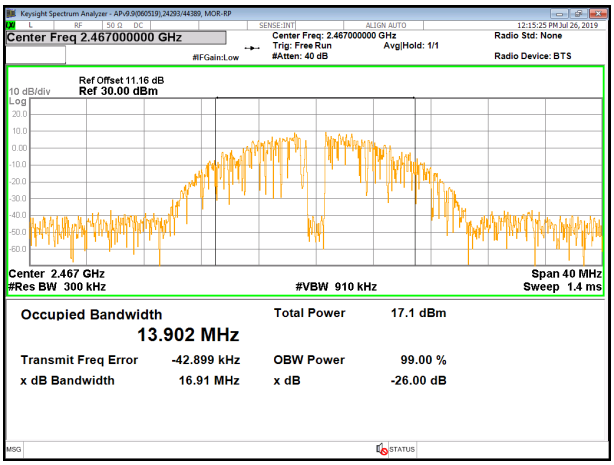
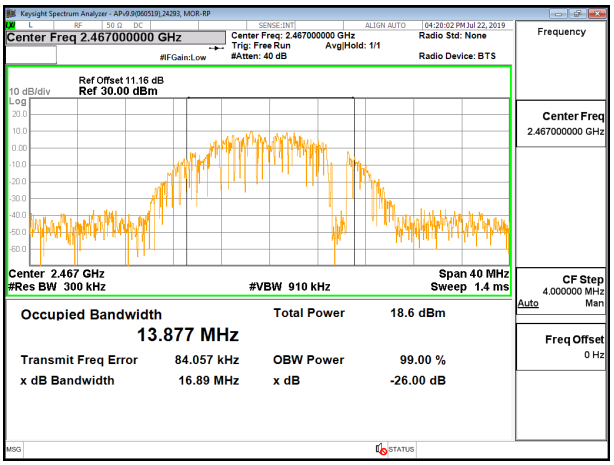
HIGH CHANNEL 12

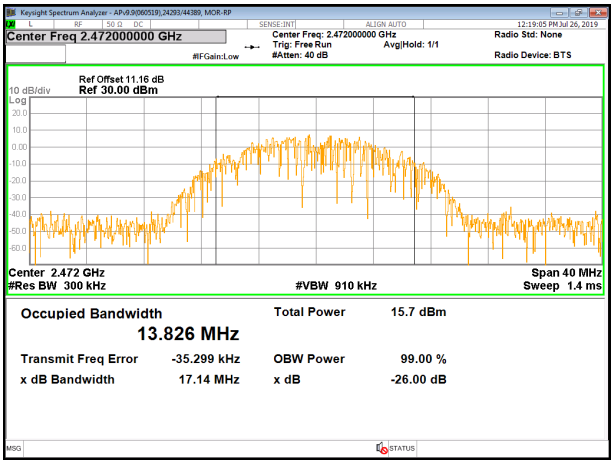


HIGH CHANNEL 12 CHAIN 0

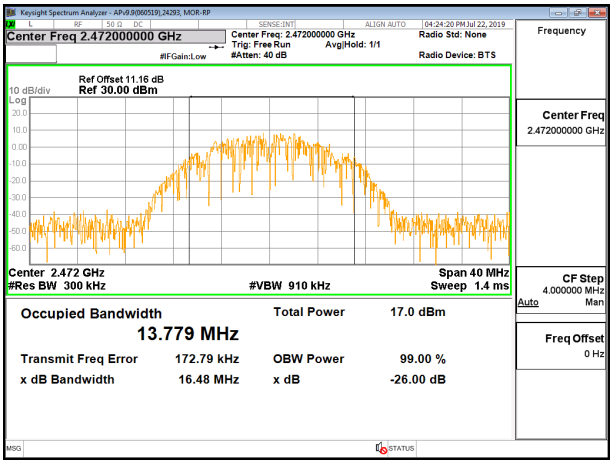


HIGH CHANNEL 12 CHAIN 1

HIGH CHANNEL 13



HIGH CHANNEL 13 CHAIN 0



HIGH CHANNEL 13 CHAIN 1

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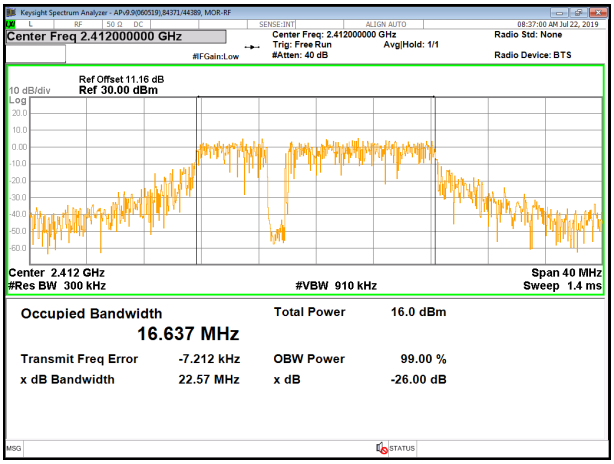
9.2.2. 802.11g MODE

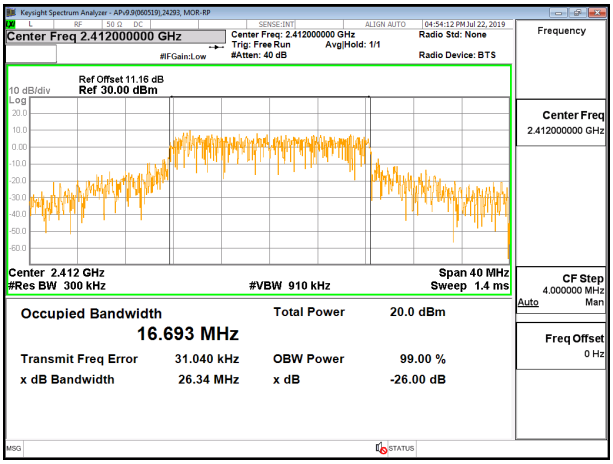
2TX Chain 0 + Chain 1 CDD MODE

Channel	Frequency (MHz)	99% Bandwidth Chain 0 (MHz)	99% Bandwidth Chain 1 (MHz)
Low 1	2412	16.6370	16.6930
Mid 6	2437	16.5480	16.6130
High 11	2462	16.7090	16.6370
High 12	2467	16.6420	16.5810
High 13	2472	16.4650	16.5580

LOW CHANNEL 1



LOW CHANNEL 1 CHAIN 0



LOW CHANNEL 1 CHAIN 1

UL LLC
12 Laboratory Dr., RTP, NC 27709; USA TEL:(919) 549-1400
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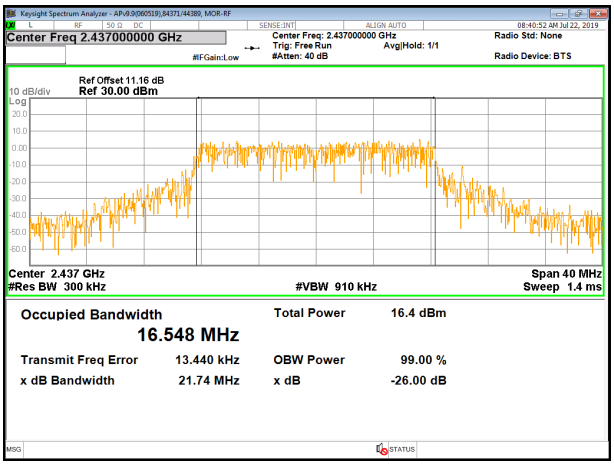
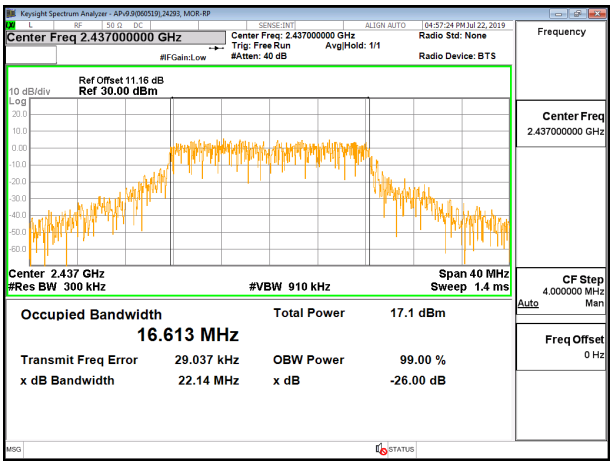
MID CHANNEL 6

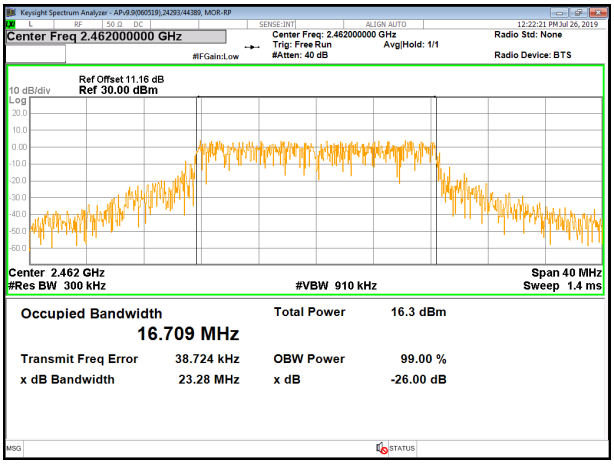


MID CHANNEL 6 CHAIN 0

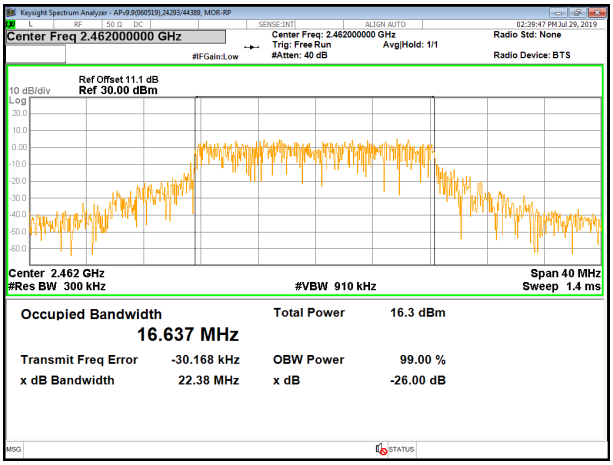


MID CHANNEL 6 CHAIN 1

HIGH CHANNEL 11



HIGH CHANNEL 11 CHAIN 0



HIGH CHANNEL 11 CHAIN 1

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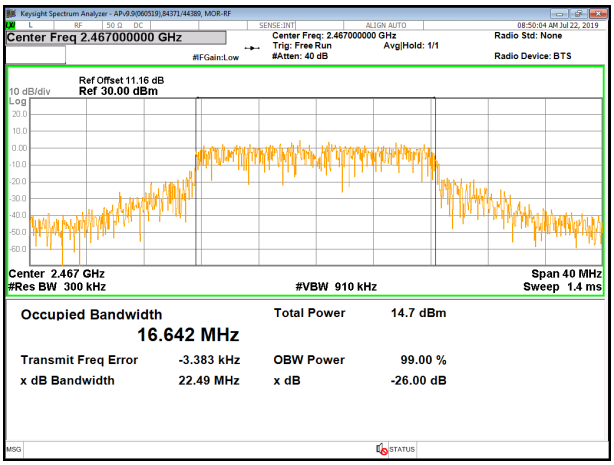
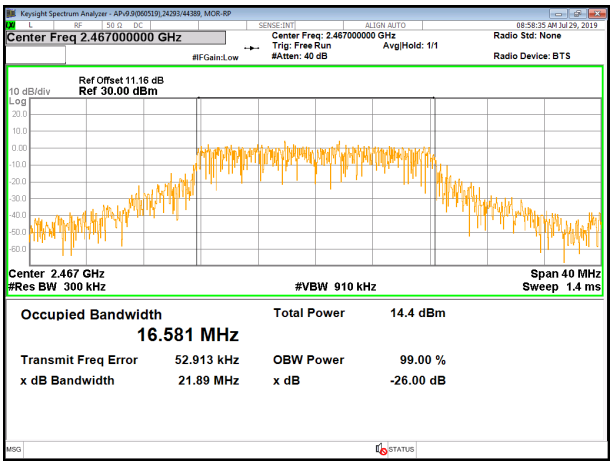
HIGH CHANNEL 12

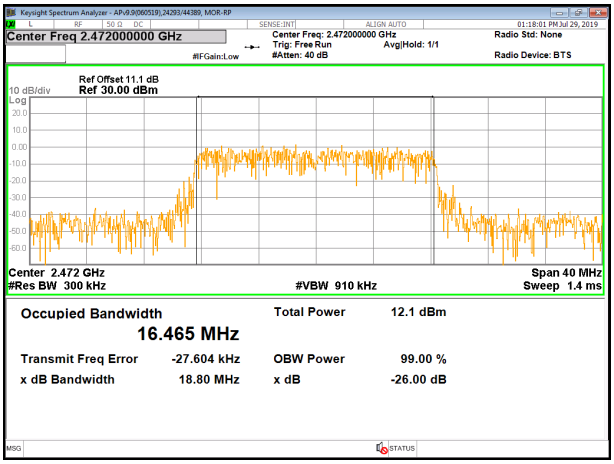


HIGH CHANNEL 12 CHAIN 0

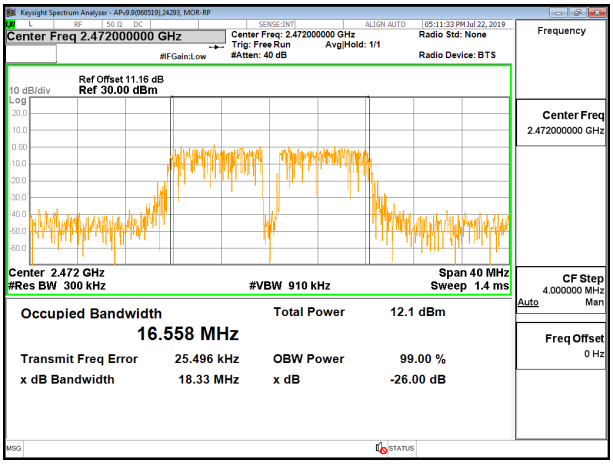


HIGH CHANNEL 12 CHAIN 1

HIGH CHANNEL 13



HIGH CHANNEL 13 CHAIN 0



HIGH CHANNEL 13 CHAIN 1

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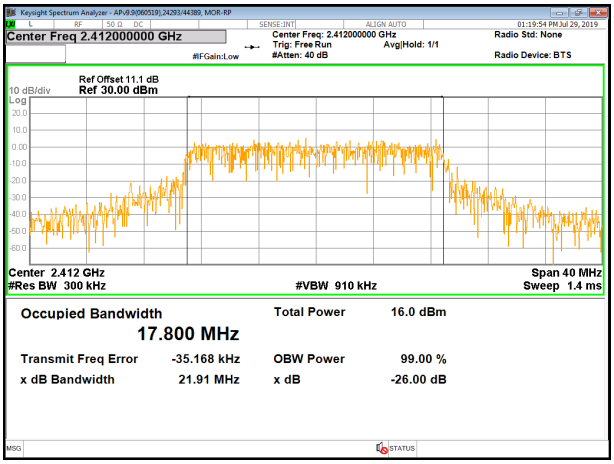
9.2.3. 802.11n HT20 MODE

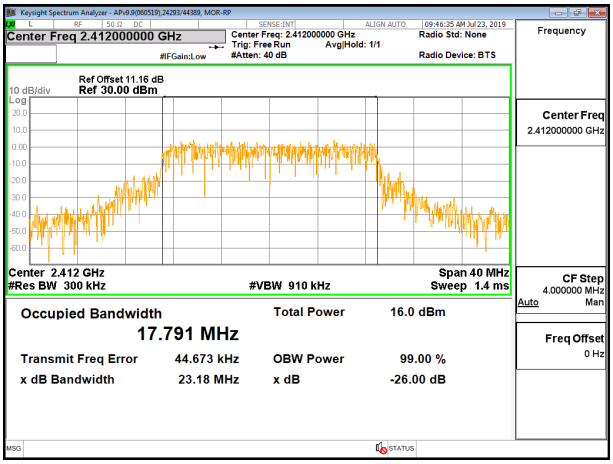
2TX Chain 0 + Chain 1 SDM MODE

Channel	Frequency (MHz)	99% Bandwidth Chain 0 (MHz)	99% Bandwidth Chain 1 (MHz)
Low 1	2412	17.8000	17.7910
Mid 6	2437	17.7990	17.7930
High 11	2462	17.7540	17.8030
High 12	2467	17.7940	17.8260
High 13	2472	17.6980	17.6420

LOW CHANNEL 1



LOW CHANNEL 1 CHAIN 0



LOW CHANNEL 1 CHAIN 1

UL LLC
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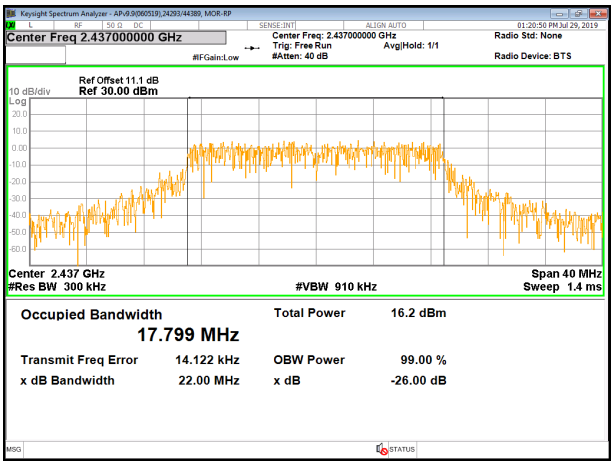
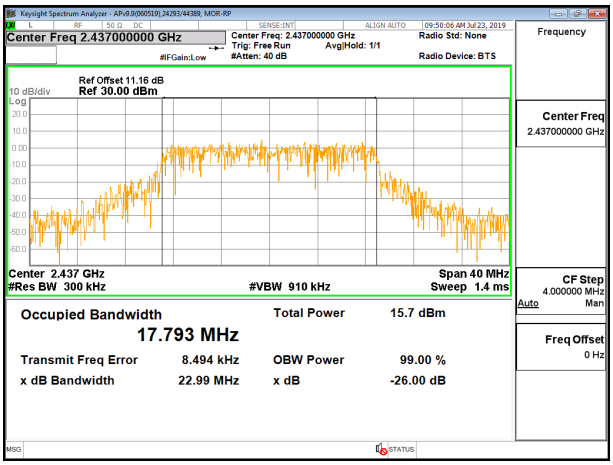
MID CHANNEL 6

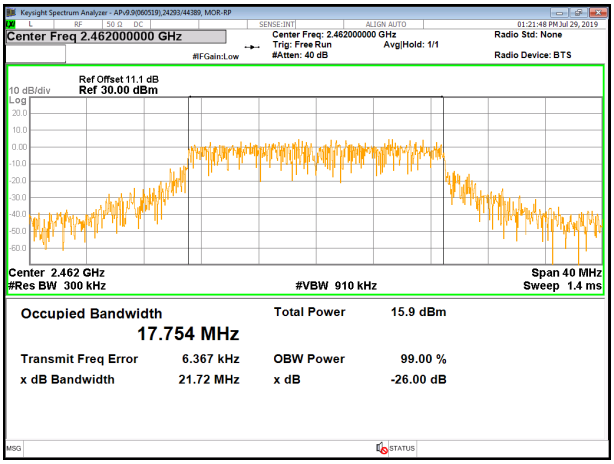


MID CHANNEL 6 CHAIN 0

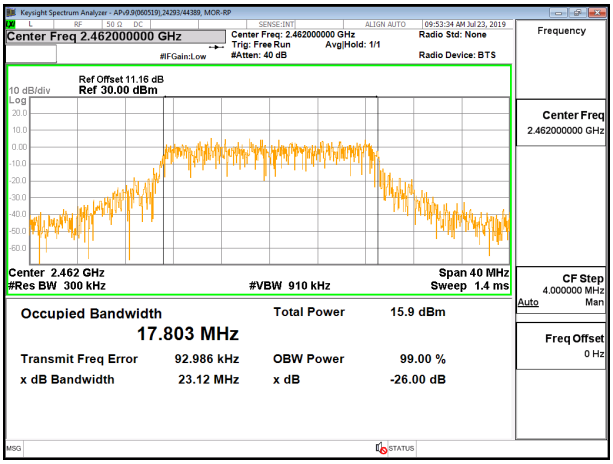


MID CHANNEL 6 CHAIN 1

HIGH CHANNEL 11



HIGH CHANNEL 11 CHAIN 0



HIGH CHANNEL 11 CHAIN 1

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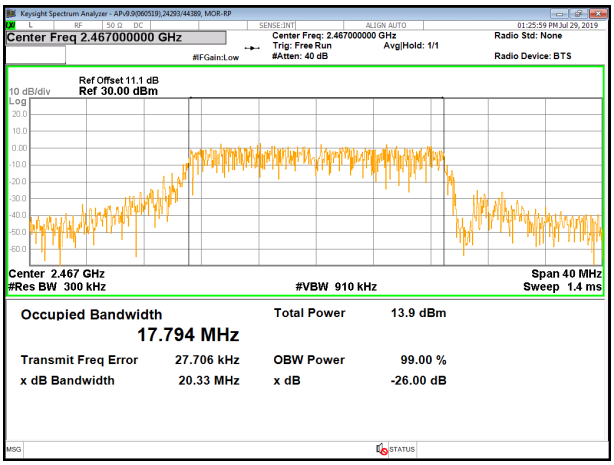
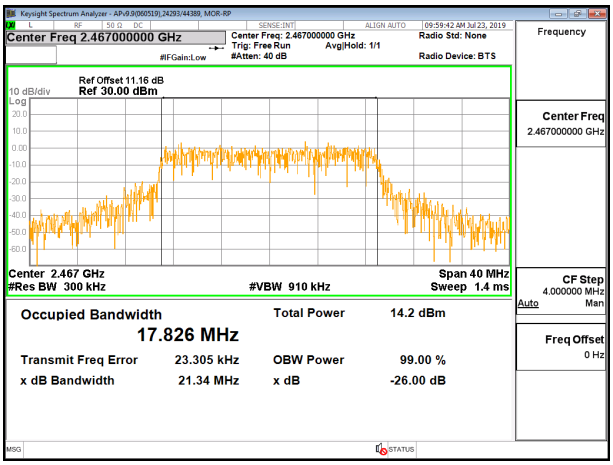
HIGH CHANNEL 12

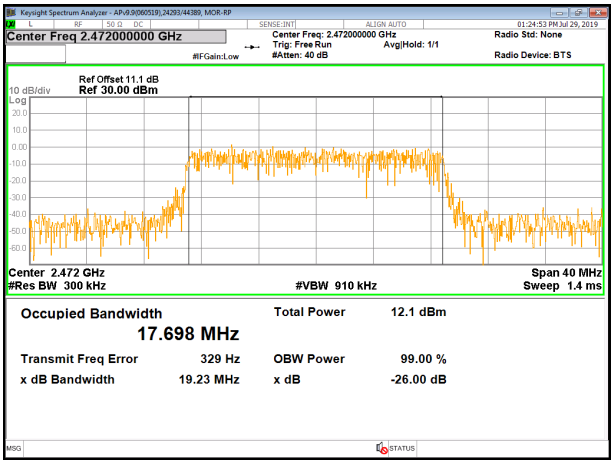


HIGH CHANNEL 12 CHAIN 0

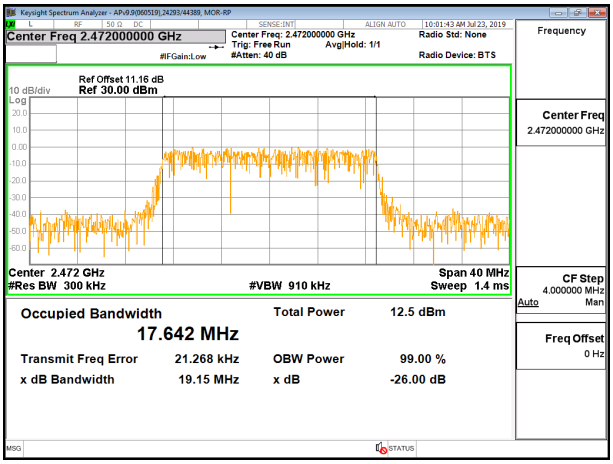


HIGH CHANNEL 12 CHAIN 1

HIGH CHANNEL 13



HIGH CHANNEL 13 CHAIN 0



HIGH CHANNEL 13 CHAIN 1

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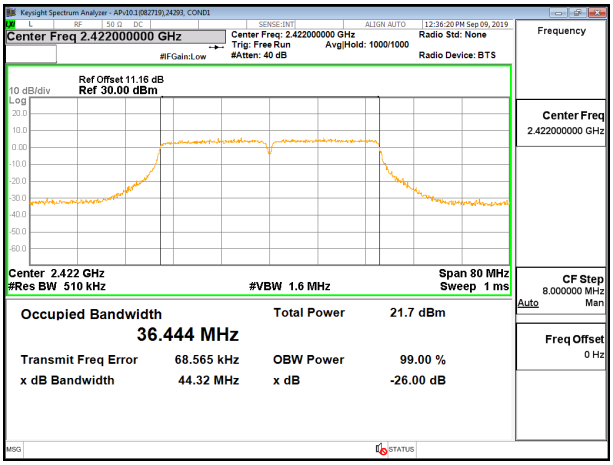
9.2.4. 802.11n HT40 MODE

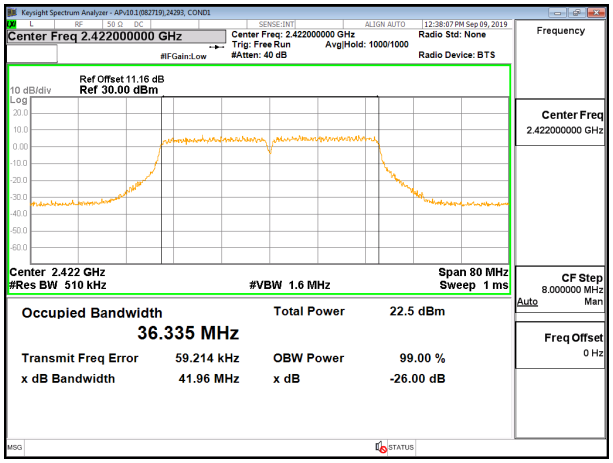
2TX Chain 0 + Chain 1 SDM MODE

Channel	Frequency (MHz)	99% Bandwidth Chain 0 (MHz)	99% Bandwidth Chain 1 (MHz)
Low 3	2422	36.444	36.335
Mid 6	2437	36.399	36.349
High 8	2447	36.429	36.066
High 9	2452	36.414	36.343
High 10	2457	36.420	36.020
High 11	2462	36.212	36.179

LOW CHANNEL 3

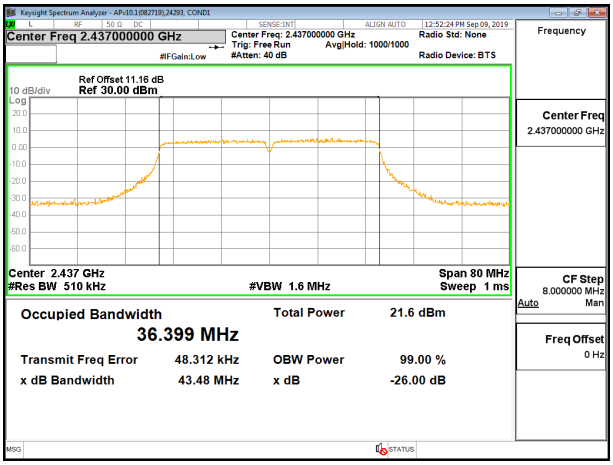


LOW CHANNEL 3 CHAIN 0

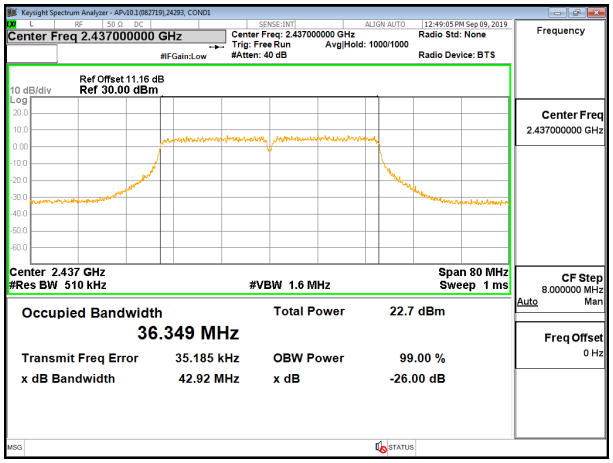


LOW CHANNEL 3 CHAIN 1

MID CHANNEL 6



MID CHANNEL 6 CHAIN 0



MID CHANNEL 6 CHAIN 1

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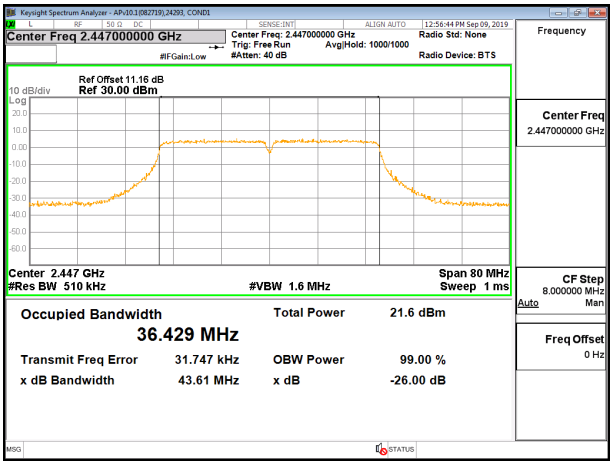
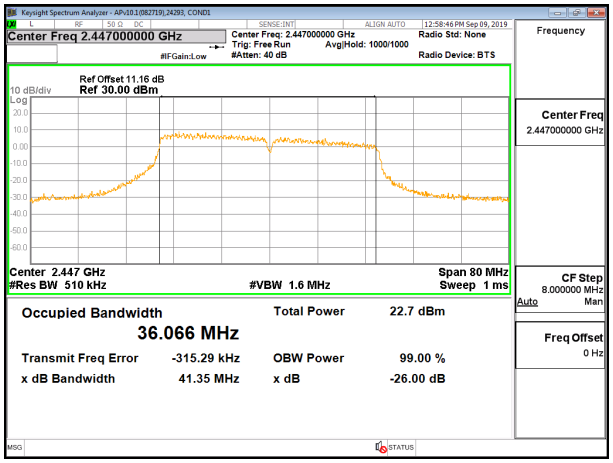
HIGH CHANNEL 8

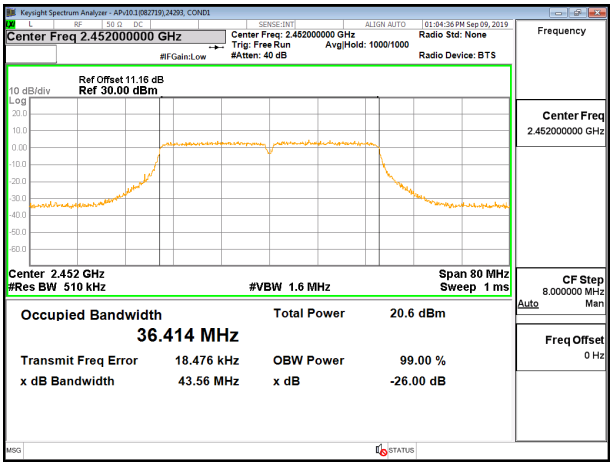


HIGH CHANNEL 8 CHAIN 0

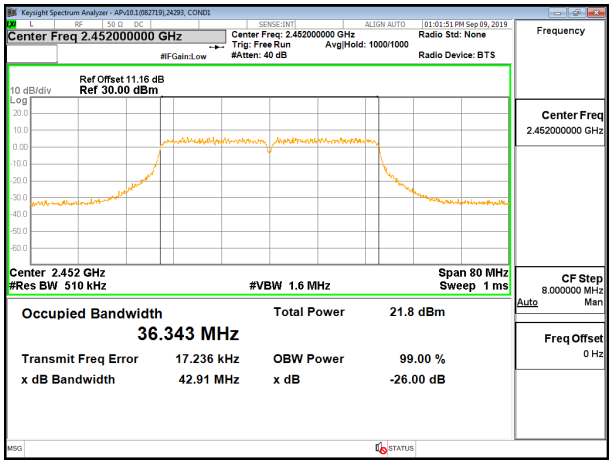


HIGH CHANNEL 8 CHAIN 1

HIGH CHANNEL 9



HIGH CHANNEL 9 CHAIN 0



HIGH CHANNEL 9 CHAIN 1

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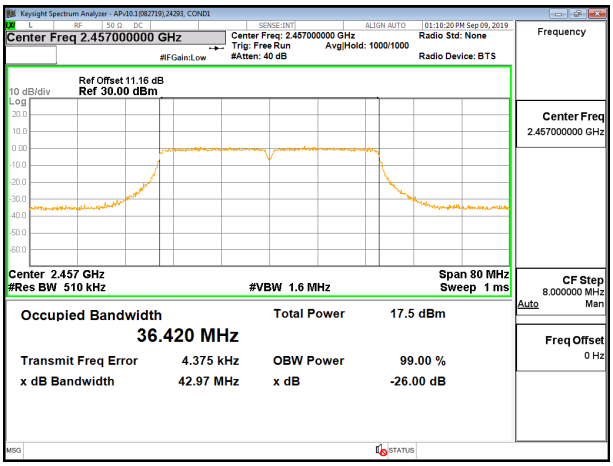
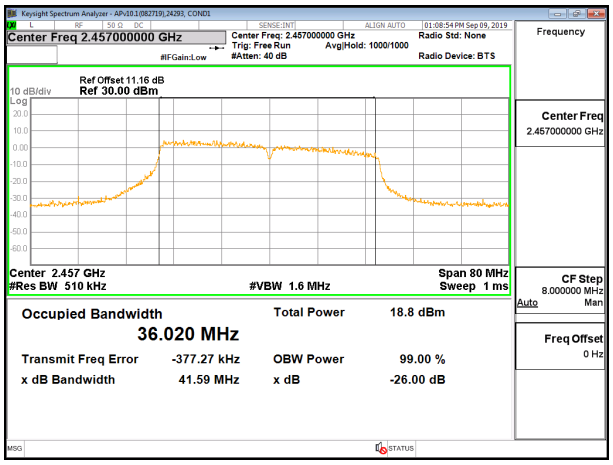
HIGH CHANNEL 10

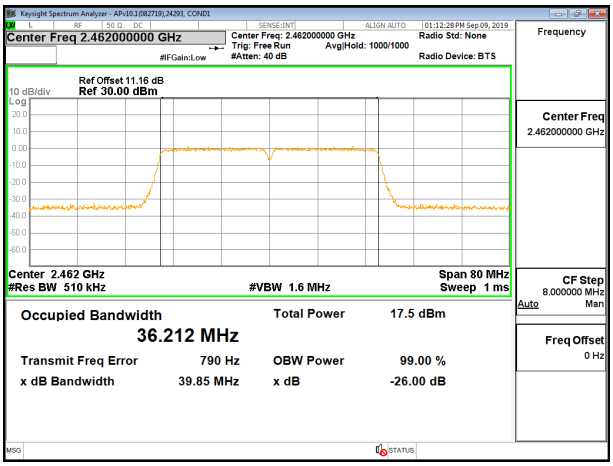


HIGH CHANNEL 10 CHAIN 0

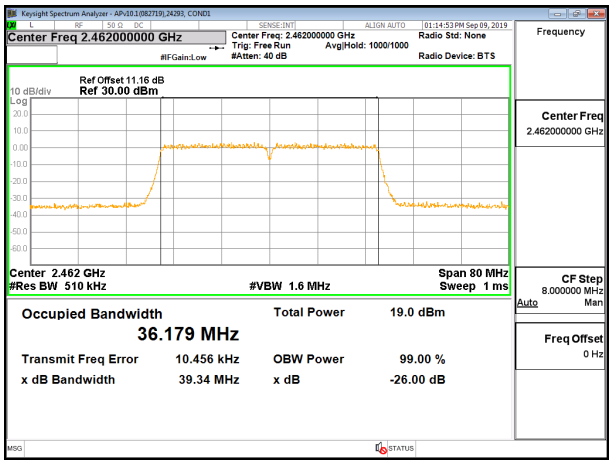


HIGH CHANNEL 10 CHAIN 1

HIGH CHANNEL 11



HIGH CHANNEL 11 CHAIN 0



HIGH CHANNEL 11 CHAIN 1

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9.3. 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.

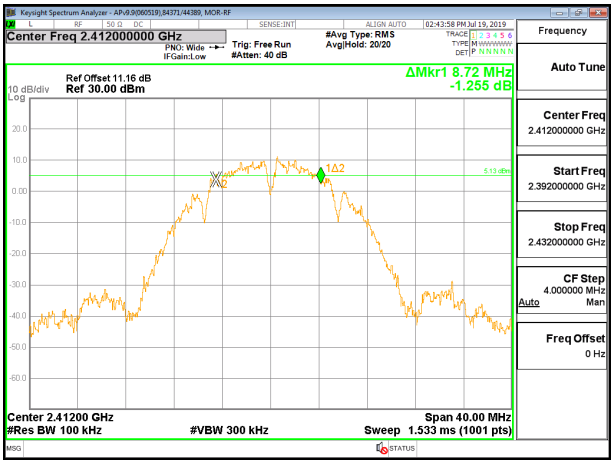
RESULTS

9.3.1. 802.11b MODE

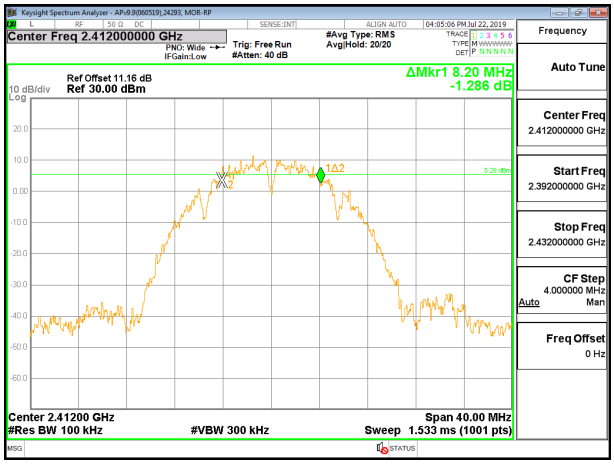
2TX Chain 0 + Chain 1 CDD MODE

Channel	Frequency (MHz)	6 dB BW Chain 0 (MHz)	6 dB BW Chain 1 (MHz)	Minimum Limit (MHz)
Low 1	2412	8.72	8.20	0.5
Mid 6	2437	8.68	7.96	0.5
High 11	2462	7.44	8.64	0.5
High 12	2467	8.16	9.20	0.5
High 13	2472	6.60	8.76	0.5

LOW CHANNEL 1



LOW CHANNEL 1 CHAIN 0



LOW CHANNEL 1 CHAIN 1

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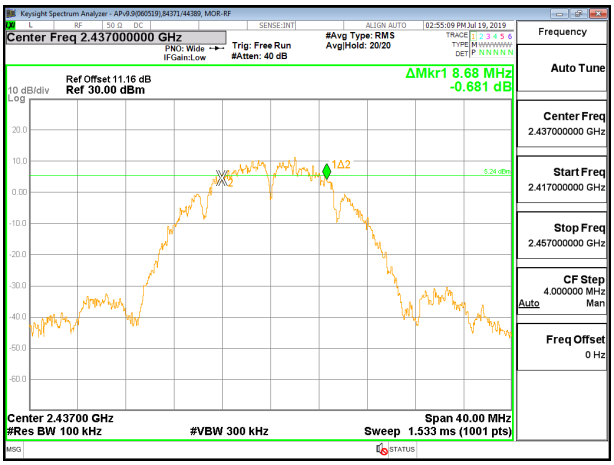
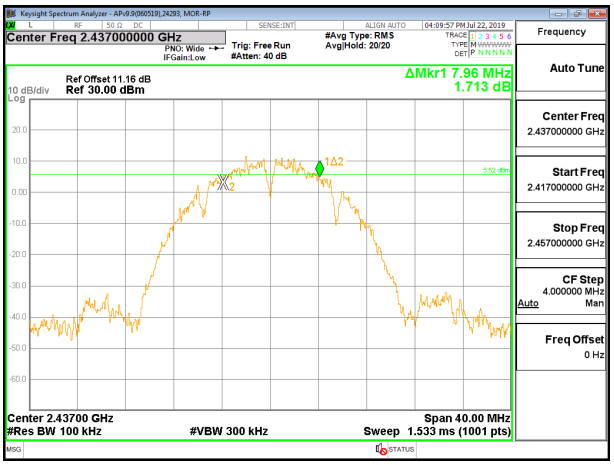
MID CHANNEL 6

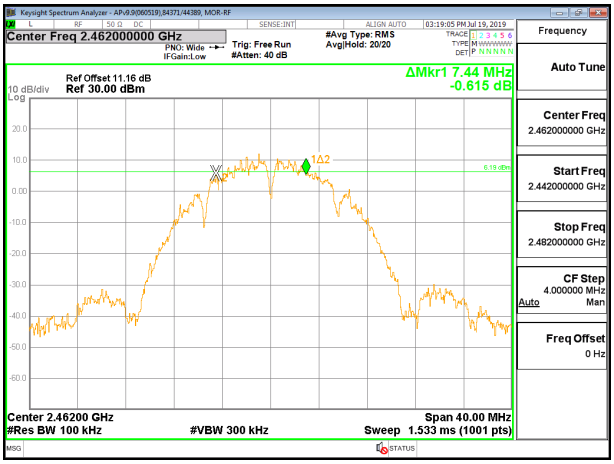


MID CHANNEL 6 CHAIN 0

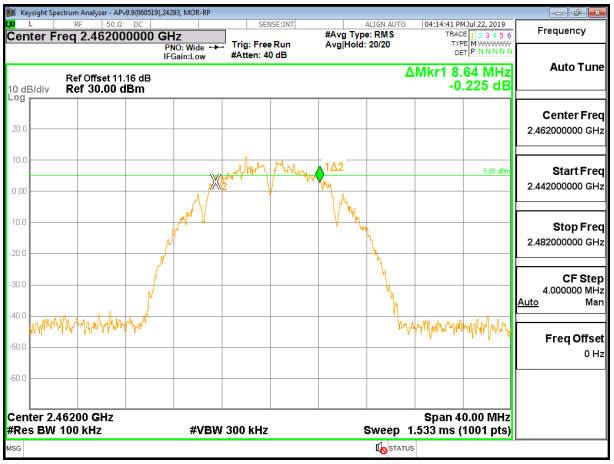


MID CHANNEL 6 CHAIN 1

HIGH CHANNEL 11



HIGH CHANNEL 11 CHAIN 0



HIGH CHANNEL 11 CHAIN 1

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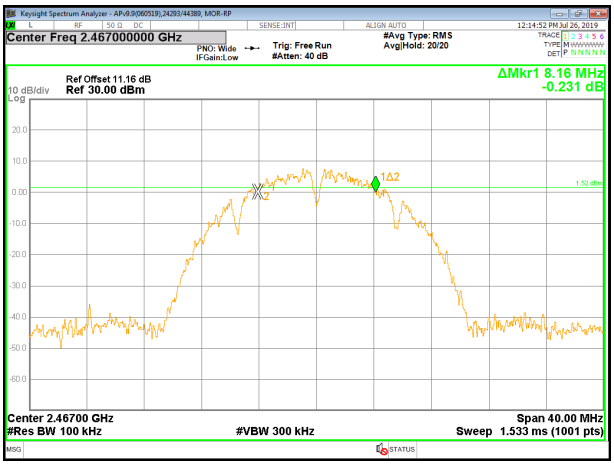
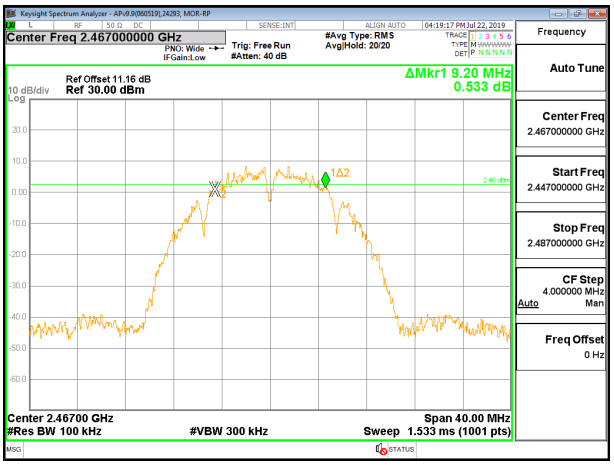
HIGH CHANNEL 12

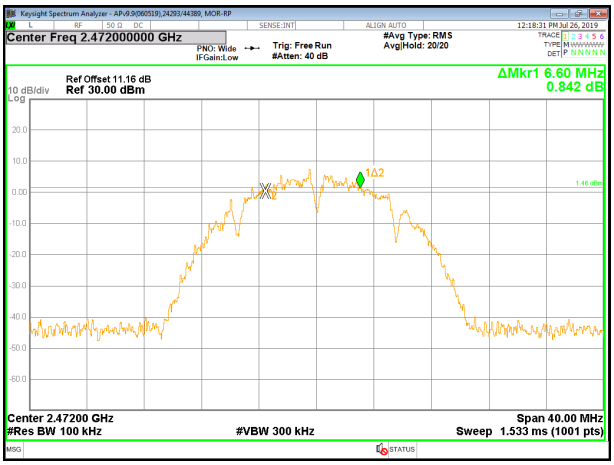


HIGH CHANNEL 12 CHAIN 0

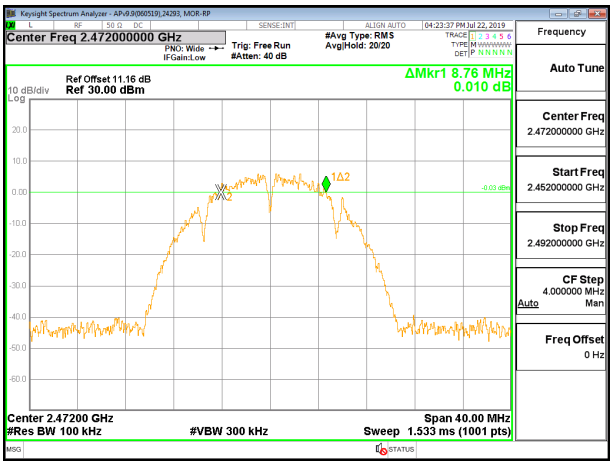


HIGH CHANNEL 12 CHAIN 1

HIGH CHANNEL 13



HIGH CHANNEL 13 CHAIN 0



HIGH CHANNEL 13 CHAIN 1

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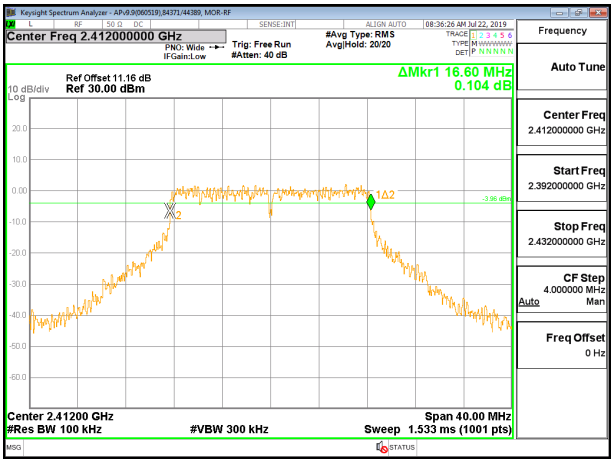
9.3.2. 802.11g MODE

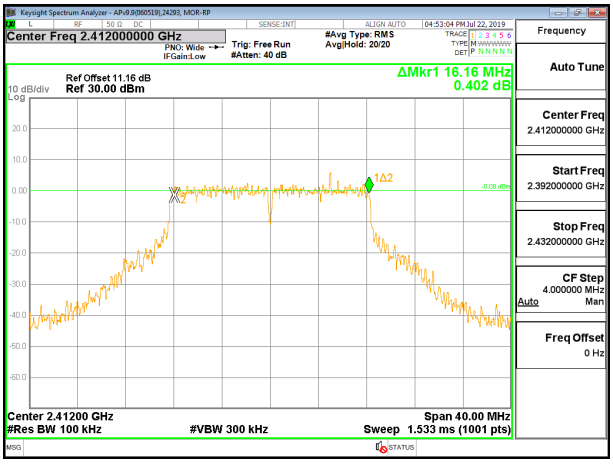
2TX Chain 0 + Chain 1 CDD MODE

Channel	Frequency (MHz)	6 dB BW Chain 0 (MHz)	6 dB BW Chain 1 (MHz)	Minimum Limit (MHz)
Low 1	2412	16.60	16.16	0.5
Mid 6	2437	16.56	16.64	0.5
High 11	2462	16.60	16.52	0.5
High 12	2467	16.48	16.48	0.5
High 13	2472	16.48	16.64	0.5

LOW CHANNEL 1



LOW CHANNEL 1 CHAIN 0



LOW CHANNEL 1 CHAIN 1

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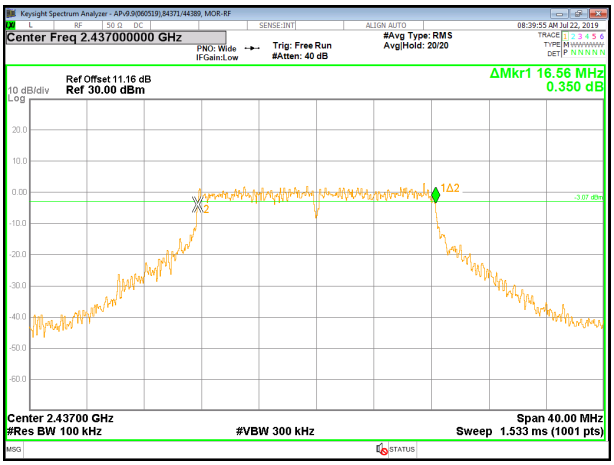
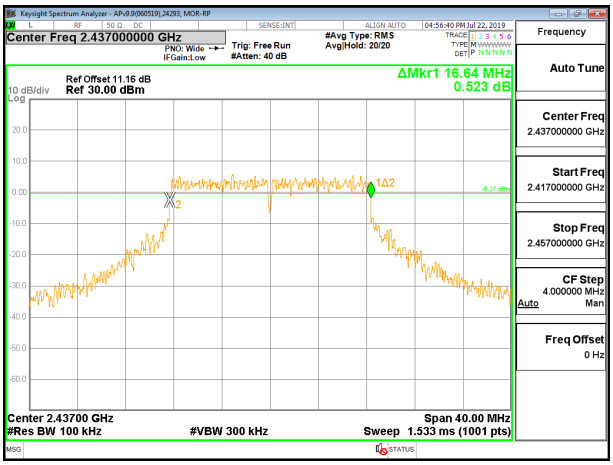
MID CHANNEL 6



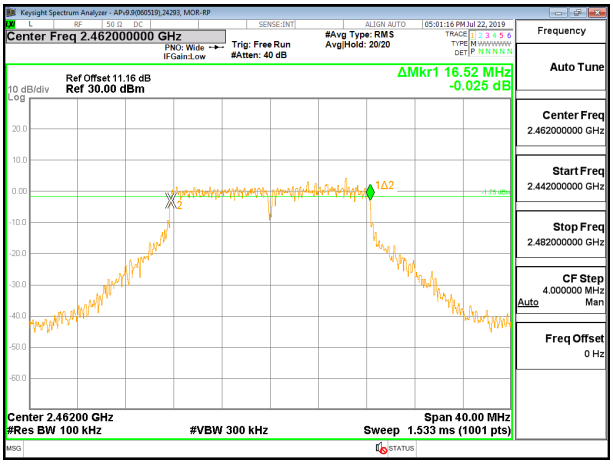
MID CHANNEL 6 CHAIN 0



MID CHANNEL 6 CHAIN 1

HIGH CHANNEL 11

HIGH CHANNEL 11 CHAIN 0



HIGH CHANNEL 11 CHAIN 1

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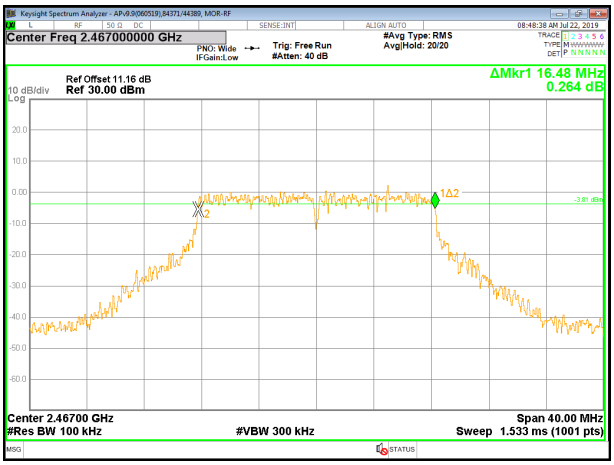
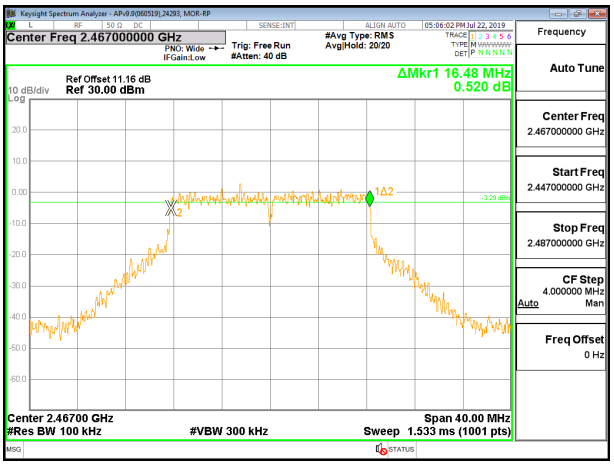
HIGH CHANNEL 12



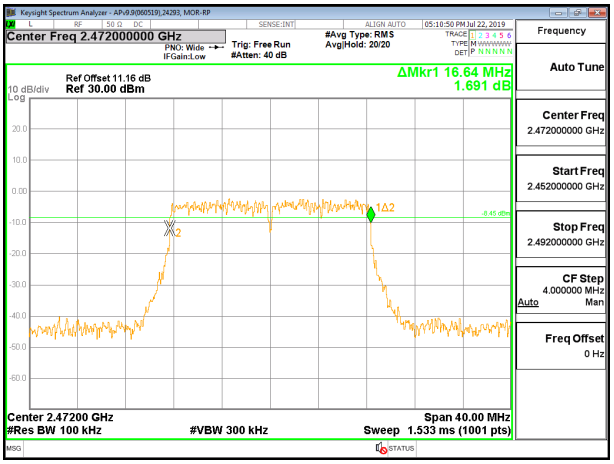
HIGH CHANNEL 12 CHAIN 0



HIGH CHANNEL 12 CHAIN 1

HIGH CHANNEL 13

HIGH CHANNEL 13 CHAIN 0



HIGH CHANNEL 13 CHAIN 1

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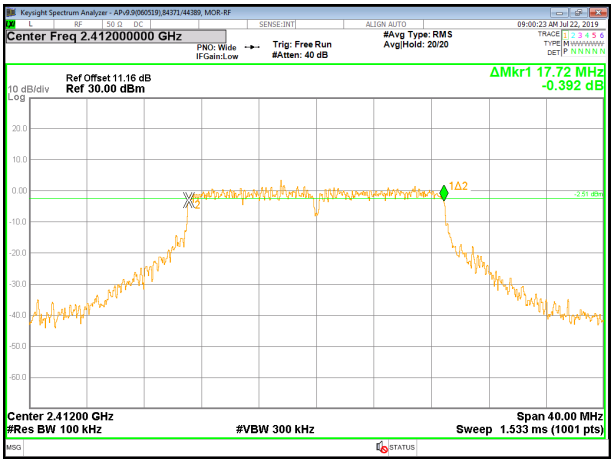
9.3.3. 802.11n HT20 MODE

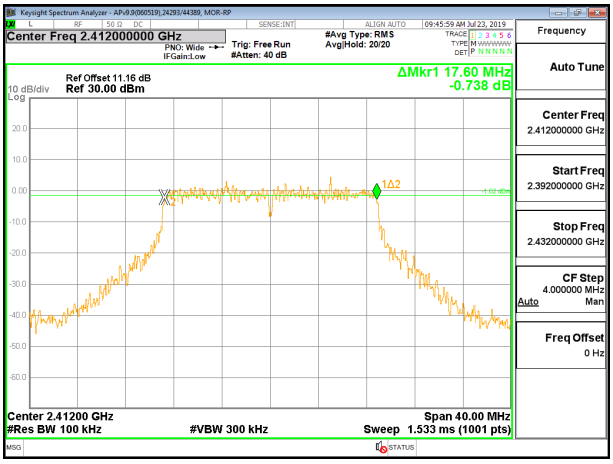
2TX Chain 0 + Chain 1 SDM MODE

Channel	Frequency (MHz)	6 dB BW Chain 0 (MHz)	6 dB BW Chain 1 (MHz)	Minimum Limit (MHz)
Low 1	2412	17.72	17.60	0.5
Mid 6	2437	17.64	17.76	0.5
High 11	2462	17.52	17.76	0.5
High 12	2467	17.68	17.88	0.5
High 13	2472	17.68	17.68	0.5

LOW CHANNEL 1



LOW CHANNEL 1 CHAIN 0



LOW CHANNEL 1 CHAIN 1

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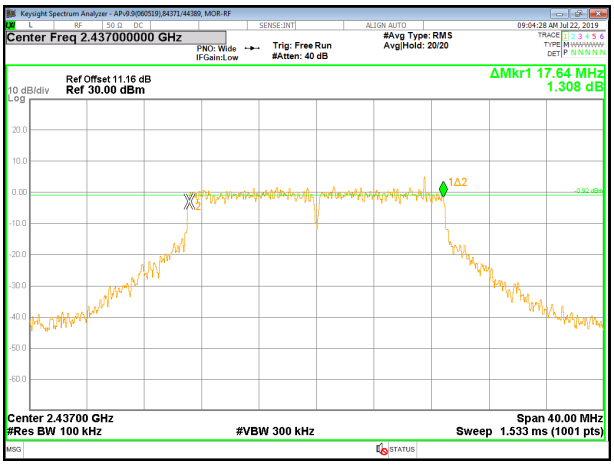
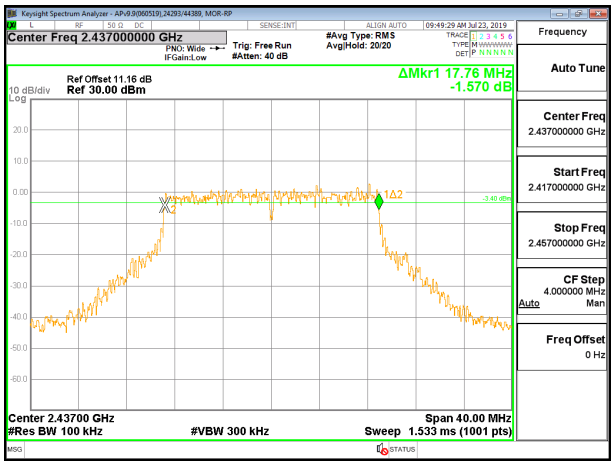
MID CHANNEL 6



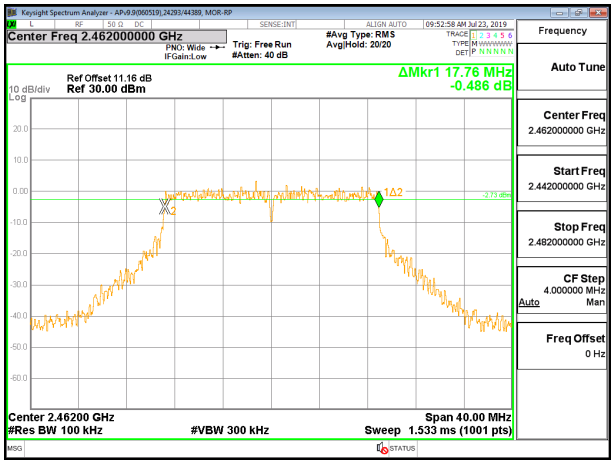
MID CHANNEL 6 CHAIN 0



MID CHANNEL 6 CHAIN 1

HIGH CHANNEL 11

HIGH CHANNEL 11 CHAIN 0



HIGH CHANNEL 11 CHAIN 1

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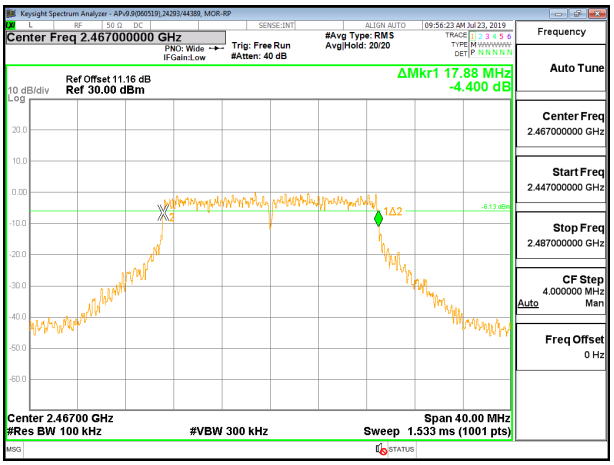
HIGH CHANNEL 12

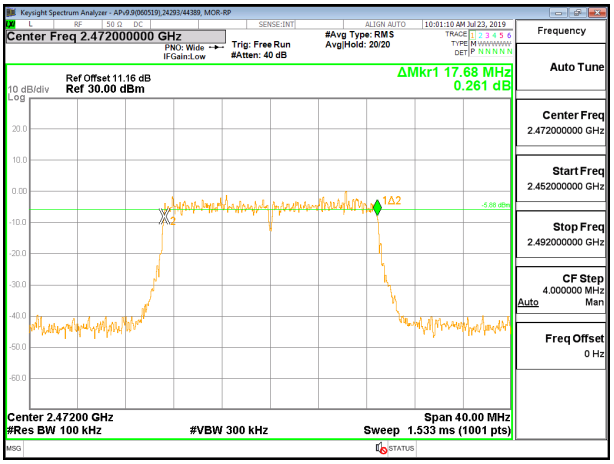
HIGH CHANNEL 12 CHAIN 0



HIGH CHANNEL 12 CHAIN 1

HIGH CHANNEL 13

HIGH CHANNEL 13 CHAIN 0



HIGH CHANNEL 13 CHAIN 1

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9.3.4. 802.11n HT40 MODE

2TX Chain 0 + Chain 1 SDM MODE

Channel	Frequency (MHz)	6 dB BW Chain 0 (MHz)	6 dB BW Chain 1 (MHz)	Minimum Limit (MHz)
Low 3	2422	34.72	36.08	0.5
Mid 6	2437	36.56	36.64	0.5
High 8	2447	36.64	36.64	0.5
High 9	2452	36.72	36.56	0.5
High 10	2457	35.52	33.36	0.5
High 11	2462	36.00	36.64	0.5

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

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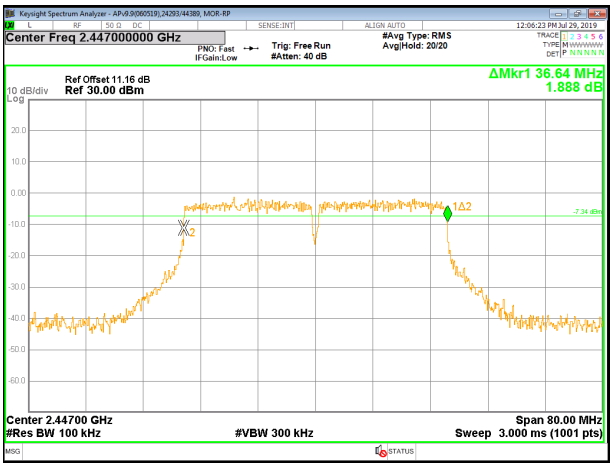
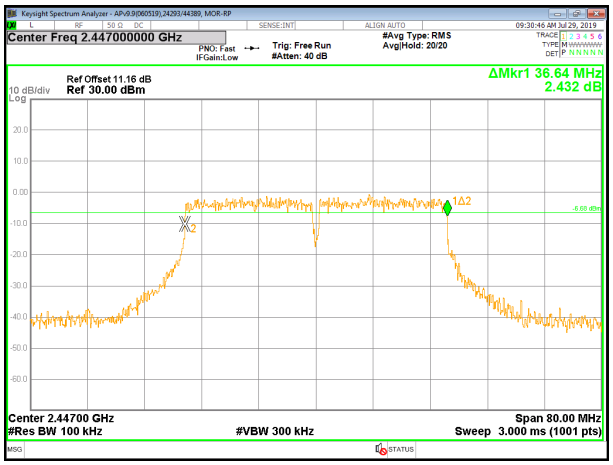
HIGH CHANNEL 8

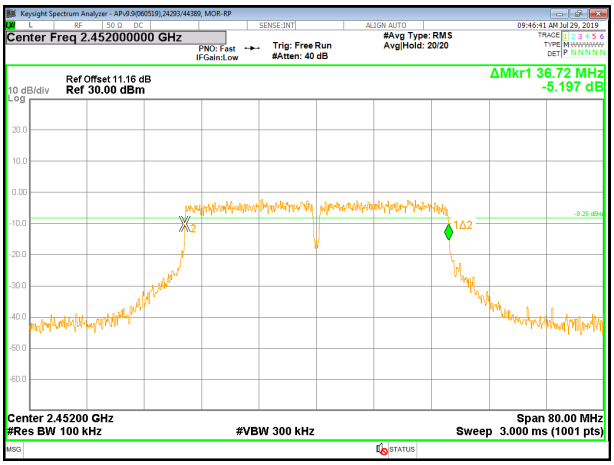


HIGH CHANNEL 8 CHAIN 0

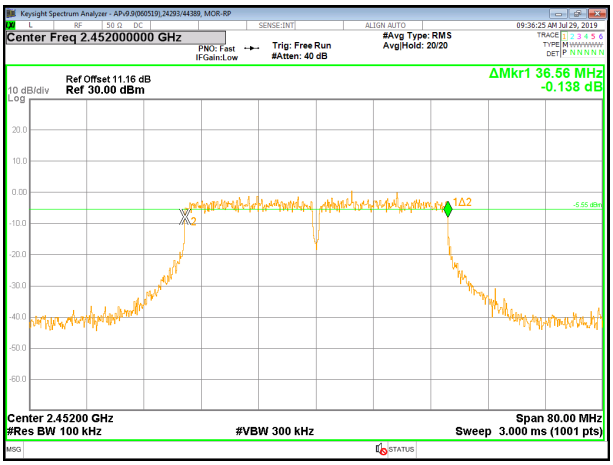


HIGH CHANNEL 8 CHAIN 1

HIGH CHANNEL 9



HIGH CHANNEL 9 CHAIN 0



HIGH CHANNEL 9 CHAIN 1

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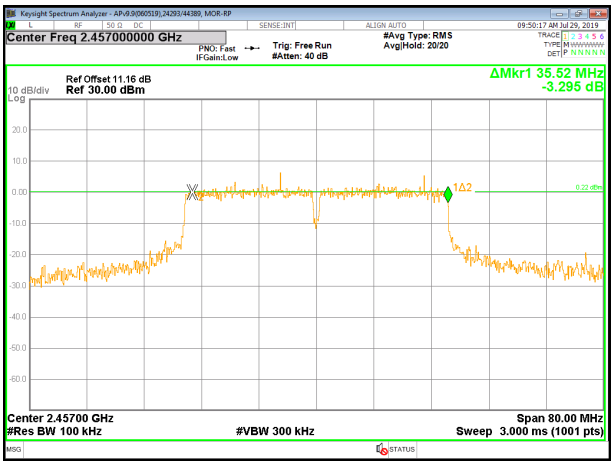
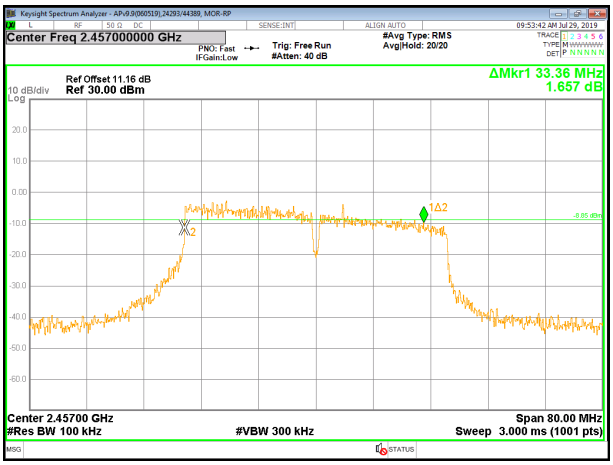
HIGH CHANNEL 10



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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9.4. 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 transmitter output is connected to a power meter.

The cable assembly insertion loss of 10.7 dB (including 10 dB pad and 0.7 dB cable) was entered as an offset in the power meter to allow for a peak reading of power.

Note - SISO and MIMO per chain power are set to the same level.

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DIRECTIONAL ANTENNA GAIN

For 2 TX:

Tx chains are uncorrelated for power, correlated for 802.11b and 802.11g PSD due to the device supporting CDD in 802.11b and 802.11g modes, and uncorrelated for 802.11n HT20 and 802.11n HT40 modes as CDD nor TxBF are supported in 802.11n HT20 and 802.11n HT40 modes. The directional gains are as follows:

Power

Band (GHz)	Chain 0 Antenna Gain (dBi)	Chain 1 Antenna Gain (dBi)	Directional Gain (dBi)
1867			
2.4	0.70	2.60	1.75
1868			
2.4	0.40	1.00	0.71

PSD

Band (GHz)	Chain 0 Antenna Gain (dBi)	Chain 1 Antenna Gain (dBi)	Uncorrelated Chains Directional Gain (dBi)	Correlated Chains Directional Gain (dBi)
1867				
2.4	0.70	2.60	1.75	4.71
1868				
2.4	0.40	1.00	0.71	3.72

Note – 1867 has worst-case gains. Therefore, 1867 gains were used for this testing.

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RESULTS

9.4.1. 802.11b MODE

2TX Chain 0 + Chain 1 CDD MODE

Limits

Channel	Frequency (MHz)	Directional Gain (dBi)	FCC/ISED Power Limit (dBm)	ISED EIRP Limit (dBm)	Max Power (dBm)
Low 1	2412	1.75	30.00	36	30.00
Mid 6	2437	1.75	30.00	36	30.00
High 11	2462	1.75	30.00	36	30.00
High 12	2467	1.75	30.00	36	30.00
High 13	2472	1.75	30.00	36	30.00

Results

Channel	Frequency (MHz)	Chain 0 Meas Power (dBm)	Chain 1 Meas Power (dBm)	Total Corr'd Power (dBm)	Power Limit (dBm)	Margin (dB)
Low 1	2412	21.24	21.34	24.30	30.00	-5.70
Mid 6	2437	21.26	21.37	24.33	30.00	-5.67
High 11	2462	21.16	21.25	24.22	30.00	-5.78
High 12	2467	20.66	20.83	23.76	30.00	-6.24
High 13	2472	19.25	19.37	22.32	30.00	-7.68

Tested by: 46722
Test date: 2019-07-22 to 2019-07-25

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9.4.2. 802.11g MODE

2TX Chain 0 + Chain 1 CDD MODE

Channel	Frequency (MHz)	Directional Gain (dBi)	FCC/ISED Power Limit (dBm)	ISED EIRP Limit (dBm)	Max Power (dBm)
Low 1	2412	1.75	30.00	36	30.00
Mid 6	2437	1.75	30.00	36	30.00
High 11	2462	1.75	30.00	36	30.00
High 12	2467	1.75	30.00	36	30.00
High 13	2472	1.75	30.00	36	30.00

Results

Channel	Frequency (MHz)	Chain 0 Meas Power (dBm)	Chain 1 Meas Power (dBm)	Total Corr'd Power (dBm)	Power Limit (dBm)	Margin (dB)
Low 1	2412	22.29	22.28	25.30	30.00	-4.70
Mid 6	2437	22.15	22.35	25.26	30.00	-4.74
High 11	2462	22.21	22.41	25.32	30.00	-4.68
High 12	2467	18.70	18.94	21.83	30.00	-8.17
High 13	2472	22.87	22.97	25.93	30.00	-4.07

Tested by: 46722
Test date: 2019-07-22 to 2019-07-25

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9.4.3. 802.11n HT20 MODE

2TX Chain 0 + Chain 1 SDM MODE

Limits

Channel	Frequency (MHz)	Directional Gain (dBi)	FCC/ISED Power Limit (dBm)	ISED EIRP Limit (dBm)	Max Power (dBm)
Low 1	2412	1.75	30.00	36	30.00
Mid 6	2437	1.75	30.00	36	30.00
High 11	2462	1.75	30.00	36	30.00
High 12	2467	1.75	30.00	36	30.00
High 13	2472	1.75	30.00	36	30.00

Results

Channel	Frequency (MHz)	Chain 0 Meas Power (dBm)	Chain 1 Meas Power (dBm)	Total Corr'd Power (dBm)	Power Limit (dBm)	Margin (dB)
Low 1	2412	21.64	21.58	24.62	30.00	-5.38
Mid 6	2437	21.58	21.74	24.67	30.00	-5.33
High 11	2462	21.38	21.56	24.48	30.00	-5.52
High 12	2467	18.92	19.09	22.02	30.00	-7.98
High 13	2472	22.56	22.59	25.59	30.00	-4.41

Tested by: 46722
Test date: 2019-07-22 to 2019-07-25

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9.4.4. 802.11n HT40 MODE

2TX Chain 0 + Chain 1 SDM MODE

Limits

Channel	Frequency (MHz)	Directional Gain (dBi)	FCC/ISED Power Limit (dBm)	ISED EIRP Limit (dBm)	Max Power (dBm)
Low 3	2422	1.75	30.00	36	30.00
Low 4	2427	1.75	30.00	36	30.00
Mid 6	2437	1.75	30.00	36	30.00
High 8	2447	1.75	30.00	36	30.00
High 9	2452	1.75	30.00	36	30.00
High 10	2457	1.75	30.00	36	30.00
High 11	2462	1.75	30.00	36	30.00

Results

Channel	Frequency (MHz)	Chain 0 Meas Power (dBm)	Chain 1 Meas Power (dBm)	Total Corr'd Power (dBm)	Power Limit (dBm)	Margi (dB)
Low 3	2422	20.95	21.02	24.00	30.00	-6.00
Low 4	2427	21.58	21.86	24.73	30.00	-5.27
Mid 6	2437	21.89	21.96	24.94	30.00	-5.06
High 8	2447	22.11	22.02	25.08	30.00	-4.92
High 9	2452	20.96	21.13	24.06	30.00	-5.94
High 10	2457	17.76	18.25	21.02	30.00	-8.98
High 11	2462	22.37	22.63	25.51	30.00	-4.49

Tested by: 46722
Test date: 2019-07-22 to 2019-07-30

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9.5. AVERAGE POWER

LIMITS

None; for reporting purposes only

TEST PROCEDURE

The transmitter output is connected to a power meter.

The cable assembly insertion loss of 10.7 dB (including 10 dB pad and 0.7 dB cable) was entered as an offset in the power meter to allow for a gated average reading of power

RESULTS

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9.5.1. 802.11b MODE

2TX Chain 0 + Chain 1 CDD MODE

Channel	Frequency (MHz)	Chain 0 Power (dBm)	Chain 1 Power (dBm)	Total Power (dBm)
Low 1	2412	19.07	19.16	22.13
Mid 6	2437	19.10	19.10	22.11
High 11	2462	18.94	19.04	22.00
High 12	2467	18.44	18.58	21.52
High 13	2472	17.01	17.16	20.10

Tested by: 46722
Test date: 2019-07-22 to 2019-07-25

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9.5.2. 802.11g MODE

2TX Chain 0 + Chain 1 CDD MODE

Channel	Frequency (MHz)	Chain 0 Power (dBm)	Chain 1 Power (dBm)	Total Power (dBm)
Low 1	2412	16.89	16.94	19.93
Mid 6	2437	16.81	16.89	19.86
High 11	2462	16.69	16.87	19.79
High 12	2467	13.46	13.56	16.52
High 13	2472	12.21	12.44	15.34

Tested by: 46722
Test date: 2019-07-22 to 2019-07-25

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9.5.3. 802.11n HT20 MODE

2TX Chain 0 + Chain 1 SDM MODE

Channel	Frequency (MHz)	Chain 0 Power (dBm)	Chain 1 Power (dBm)	Total Power (dBm)
Low 1	2412	16.10	16.11	19.12
Mid 6	2437	16.03	16.08	19.07
High 11	2462	15.88	15.94	18.92
High 12	2467	13.41	13.56	16.50
High 13	2472	12.71	12.89	15.81

Tested by: 46722
Test date: 2019-07-22 to 2019-07-25

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9.5.4. 802.11n HT40 MODE

2TX Chain 0 + Chain 1 SDM MODE

Channel	Frequency (MHz)	Chain 0 Power (dBm)	Chain 1 Power (dBm)	Total Power (dBm)
Low 3	2422	14.93	15.20	18.08
Low 4	2427	15.95	16.19	19.08
Mid 6	2437	16.05	16.16	19.12
High 8	2447	16.04	16.15	19.11
High 9	2452	14.97	15.19	18.09
High 10	2457	12.02	12.28	15.16
High 11	2462	12.13	12.36	15.26

Tested by: 46722
Test date: 2019-07-22 to 2019-07-30

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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

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9.6.1. 802.11b MODE

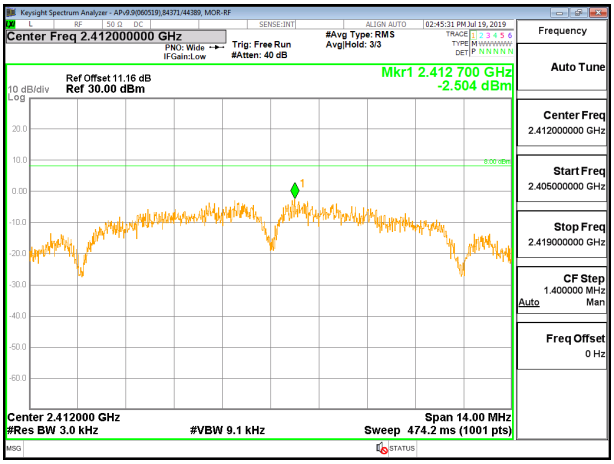
2TX Chain 0 + Chain 1 CDD MODE

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

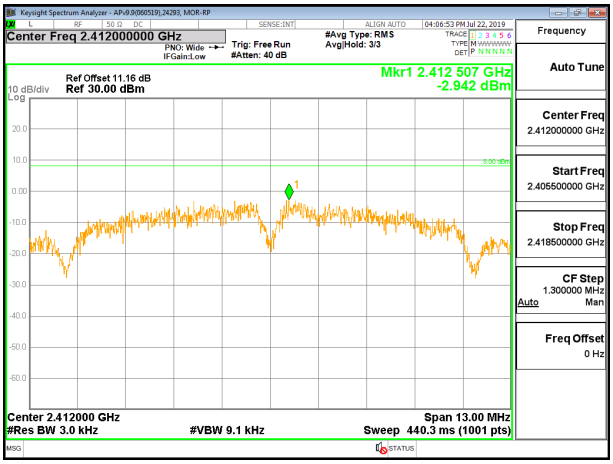
PSD Results

Channel	Frequency (MHz)	Chain 0 Meas (dBm/3kHz)	Chain 1 Meas (dBm/3kHz)	Total Corr'd PSD (dBm/3kHz)	Limit (dBm/3kHz)	Margin (dB)
Low 1	2412	-2.50	-2.94	0.29	8.0	-7.7
Mid 6	2437	-3.06	-2.12	0.45	8.0	-7.6
High 11	2462	-2.36	-2.72	0.48	8.0	-7.5
High 12	2467	-5.87	-4.48	-2.11	8.0	-10.1
High 13	2472	-6.83	-7.11	-3.96	8.0	-12.0

LOW CHANNEL 1



LOW CHANNEL 1 CHAIN 0



LOW CHANNEL 1 CHAIN 1

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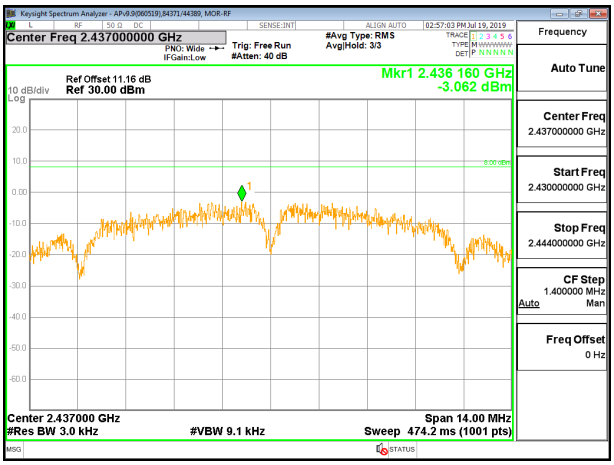
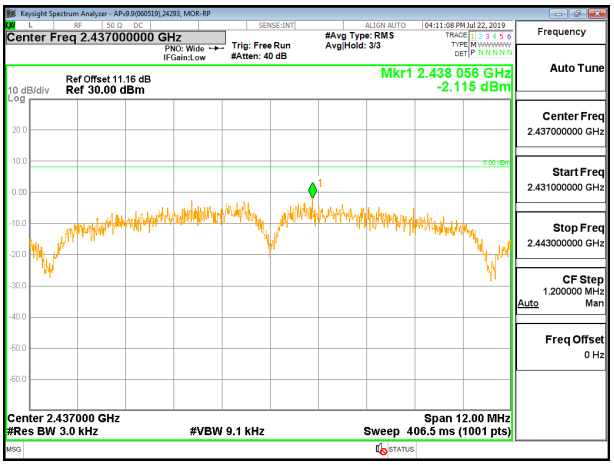
MID CHANNEL 6

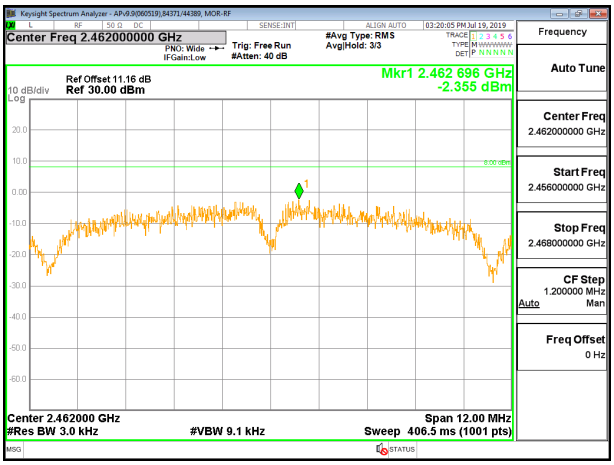


MID CHANNEL 6 CHAIN 0

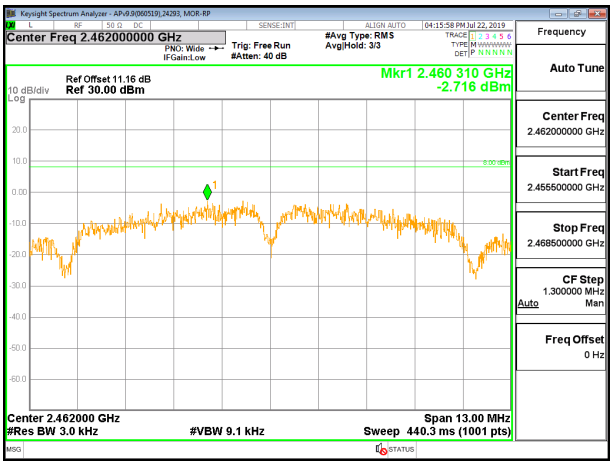


MID CHANNEL 6 CHAIN 1

HIGH CHANNEL 11



HIGH CHANNEL 11 CHAIN 0



HIGH CHANNEL 11 CHAIN 1

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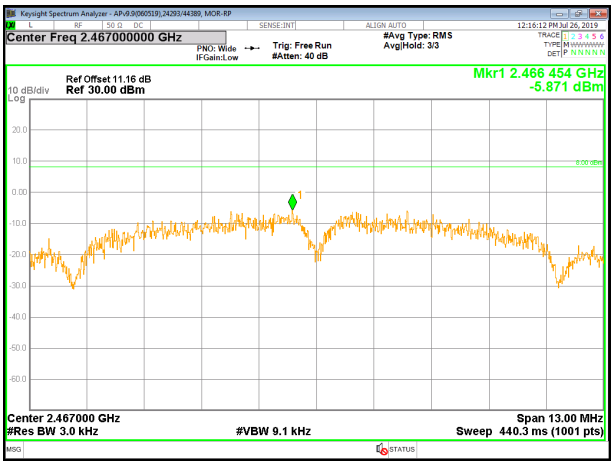
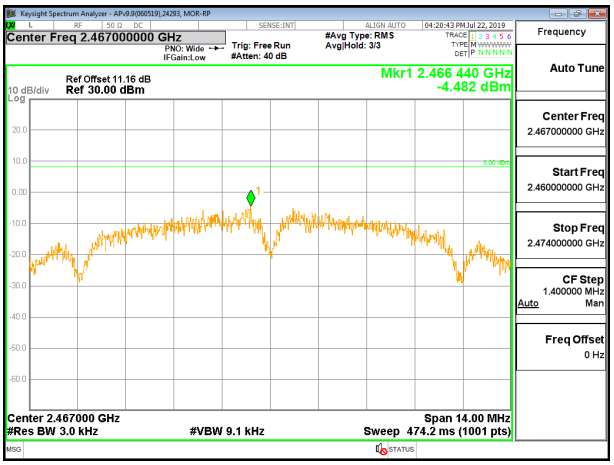
HIGH CHANNEL 12

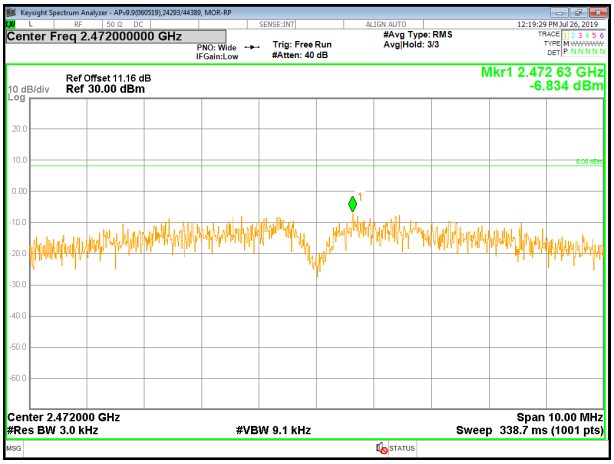


HIGH CHANNEL 12 CHAIN 0

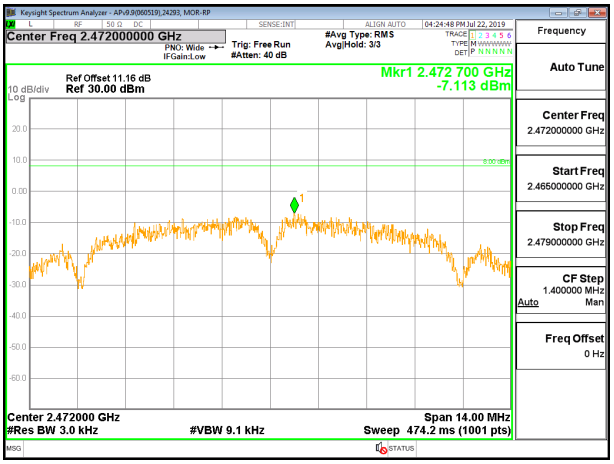


HIGH CHANNEL 12 CHAIN 1

HIGH CHANNEL 13



HIGH CHANNEL 13 CHAIN 0



HIGH CHANNEL 13 CHAIN 1

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