



CERTIFICATION TEST REPORT

Report Number. : 12935947-E3V2

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

Model : 1872

FCC ID : C3K1872

IC : 3048A-1872

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:
September 10, 2019

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NVLAP Lab code: 200065-0

REPORT REVISION HISTORY

Rev.	Issue Date	Revisions	Revised By
V1	8/29/2019	Initial Issue	
V2	9/10/2019	Section 5.5: Statements Updated & added Section 8.2.4: 99% OBW updated Section 8.4.2: Power updated Section 11: Statement added, Setup photos Removed	Henry Lau

REPORT REVISION HISTORY	2
1. ATTESTATION OF TEST RESULTS	5
2. TEST METHODOLOGY	7
3. FACILITIES AND ACCREDITATION	7
4. CALIBRATION AND UNCERTAINTY	8
4.1. MEASURING INSTRUMENT CALIBRATION	8
4.2. SAMPLE CALCULATION	8
4.3. MEASUREMENT UNCERTAINTY	8
5. EQUIPMENT UNDER TEST	9
5.1. EUT DESCRIPTION	9
5.2. MAXIMUM OUTPUT POWER.....	9
5.3. DESCRIPTION OF AVAILABLE ANTENNAS	9
5.4. SOFTWARE AND FIRMWARE.....	9
5.5. WORST-CASE CONFIGURATION AND MODE	10
5.6. DESCRIPTION OF TEST SETUP.....	11
6. MEASUREMENT METHOD.....	14
7. TEST AND MEASUREMENT EQUIPMENT	15
8. ANTENNA PORT TEST RESULTS.....	16
8.1. ON TIME AND DUTY CYCLE.....	16
8.2. 99% BANDWIDTH.....	18
8.2.1. 802.11b MODE	19
8.2.2. 802.11g MODE	23
8.2.3. 802.11n HT20 MODE	27
8.2.4. 802.11n HT40 MODE	32
8.3. 6 dB BANDWIDTH.....	37
8.3.1. 802.11b MODE	38
8.3.2. 802.11g MODE	42
8.3.3. 802.11n HT20 MODE	46
8.3.4. 802.11n HT40 MODE	51
8.4. OUTPUT POWER.....	56
8.4.1. 802.11b MODE	57
8.4.2. 802.11g MODE	58
8.4.3. 802.11n HT20 MODE	59
8.4.4. 802.11n HT40 MODE	60
8.5. AVERAGE POWER	61
8.5.1. 802.11b MODE	62
8.5.2. 802.11g MODE	63
8.5.3. 802.11n HT20 MODE	64

8.5.4.	802.11n HT40 MODE	65
8.6.	<i>POWER SPECTRAL DENSITY</i>	66
8.6.1.	802.11b MODE	67
8.6.2.	802.11g MODE	71
8.6.3.	802.11n HT20 MODE	75
8.6.4.	802.11n HT40 MODE	80
8.7.	<i>CONDUCTED SPURIOUS EMISSIONS</i>	85
8.7.1.	802.11b MODE	86
8.7.2.	802.11g MODE	90
8.7.3.	802.11n HT20 MODE	94
8.7.4.	802.11n HT40 MODE	100
9.	RADIATED TEST RESULTS	106
9.1.	<i>TRANSMITTER ABOVE 1 GHz</i>	108
9.1.1.	TX ABOVE 1 GHz 802.11b MODE IN THE 2.4 GHz BAND	108
9.1.2.	TX ABOVE 1 GHz 802.11g MODE IN THE 2.4 GHz BAND	122
9.1.3.	TX ABOVE 1 GHz 802.11n HT20 MODE IN THE 2.4 GHz BAND.....	136
9.1.4.	TX ABOVE 1 GHz 802.11n HT40 MODE IN THE 2.4 GHz BAND.....	154
9.2.	<i>WORST CASE BELOW 30MHZ</i>	176
9.3.	<i>WORST CASE BELOW 1 GHZ</i>	178
9.4.	<i>WORST CASE 18-26 GHZ</i>	180
10.	AC POWER LINE CONDUCTED EMISSIONS	182
10.1.1.	AC Power Line Norm	183
11.	SETUP PHOTOS	185

1. ATTESTATION OF TEST RESULTS

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

EUT DESCRIPTION: Portable Computing Device

MODEL: 1872

SERIAL NUMBER: 006404792757(Conducted)
013880192757(Conducted)
013885392757(Radiated)
014813492757(Radiated)

DATE TESTED: July 17, 2019 - July 29, 2019 and September 9, 2019

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.

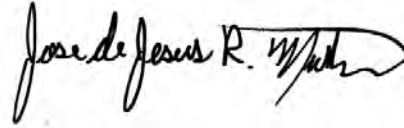
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2. TEST METHODOLOGY

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

47173 Benicia Street	47266 Benicia Street	47658 Kato Road
☐ Chamber A	☐ Chamber D	☒ Chamber I
☐ Chamber B	☐ Chamber E	☐ Chamber J
☐ Chamber C	☐ Chamber F	☒ Chamber K
	☐ Chamber G	☐ Chamber L
	☐ Chamber H	☐ Chamber M

The above test sites and facilities are covered under FCC Test Firm Registration # 208313. Chambers above are covered under Industry Canada company address and respective code: 2324A.

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

4. CALIBRATION AND UNCERTAINTY

4.1. 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.

4.2. 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)
 $36.5 \text{ dBuV} + 18.7 \text{ dB/m} + 0.6 \text{ dB} - 26.9 \text{ dB} = 28.9 \text{ dBuV/m}$

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.
 $36.5 \text{ dBuV} + 0 \text{ dB} + 10.1 \text{ dB} + 0 \text{ dB} = 46.6 \text{ dBuV}$

4.3. MEASUREMENT UNCERTAINTY

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

PARAMETER	UNCERTAINTY
Worst Case Conducted Disturbance, 9KHz to 0.15 MHz	3.84 dB
Worst Case Conducted Disturbance, 0.15 to 30 MHz	3.65 dB
Worst Case Radiated Disturbance, 9KHz to 30 MHz	2.52 dB
Worst Case Radiated Disturbance, 30 to 1000 MHz	4.88 dB
Worst Case Radiated Disturbance, 1000 to 18000 MHz	4.24 dB
Worst Case Radiated Disturbance, 18000 to 26000 MHz	4.37 dB
Worst Case Radiated Disturbance, 26000 to 40000 MHz	5.17 dB

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

5. EQUIPMENT UNDER TEST

5.1. EUT DESCRIPTION

The EUT is a Portable Computing Device.

5.2. 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 - 2472	802.11b	24.25	266.07
2412 - 2472	802.11g	26.38	434.51
2412 - 2472	802.11n HT20	26.27	423.64
2422 - 2462	802.11n HT40	24.85	305.49

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes two dual band PIFA antennas, with a maximum gain of:

Frequency Band (MHz)	Chain 0 Antenna Gain (dBi)	Chain 1 Antenna Gain (dBi)
2412-2472	-2.2	1.6

5.4. SOFTWARE AND FIRMWARE

The operating system installed on the EUT is MTEOS 1.652.0.

The Wifi Driver installed on the EUT is version 99.0.43.8.

The test utility software used during testing was version 11.1916.0-09531

5.5. WORST-CASE CONFIGURATION AND MODE

Radiated emissions below 30MHz , 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. This includes 802.11ax modes.

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.

For all modes, tests were performed with the EUT set at the 2Tx MIMO mode with power setting equal to SISO modes as the worst case scenario thus MIMO is representative of SISO.

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: HT8
802.11n HT40mode: HT8

EUT does not employ CDD for HT, VHT and HE rates. CDD is supported for legacy modes only.

5.6. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Support Equipment List				
Description	Manufacturer	Model	Serial Number	FCC ID
AC DC Adapter	Microsoft	1706	0C130J02T8396	DoC
USB Mouse	Microsoft	1113	X821908-002	DoC
USB Type C to Audio Jack	SONY	A1-0231	N/A	DoC
Earphone	SONY	AG1100	N/A	DoC
Earphone	SONY	AG1100	N/A	DoC

I/O CABLES (CONDUCTED TEST)

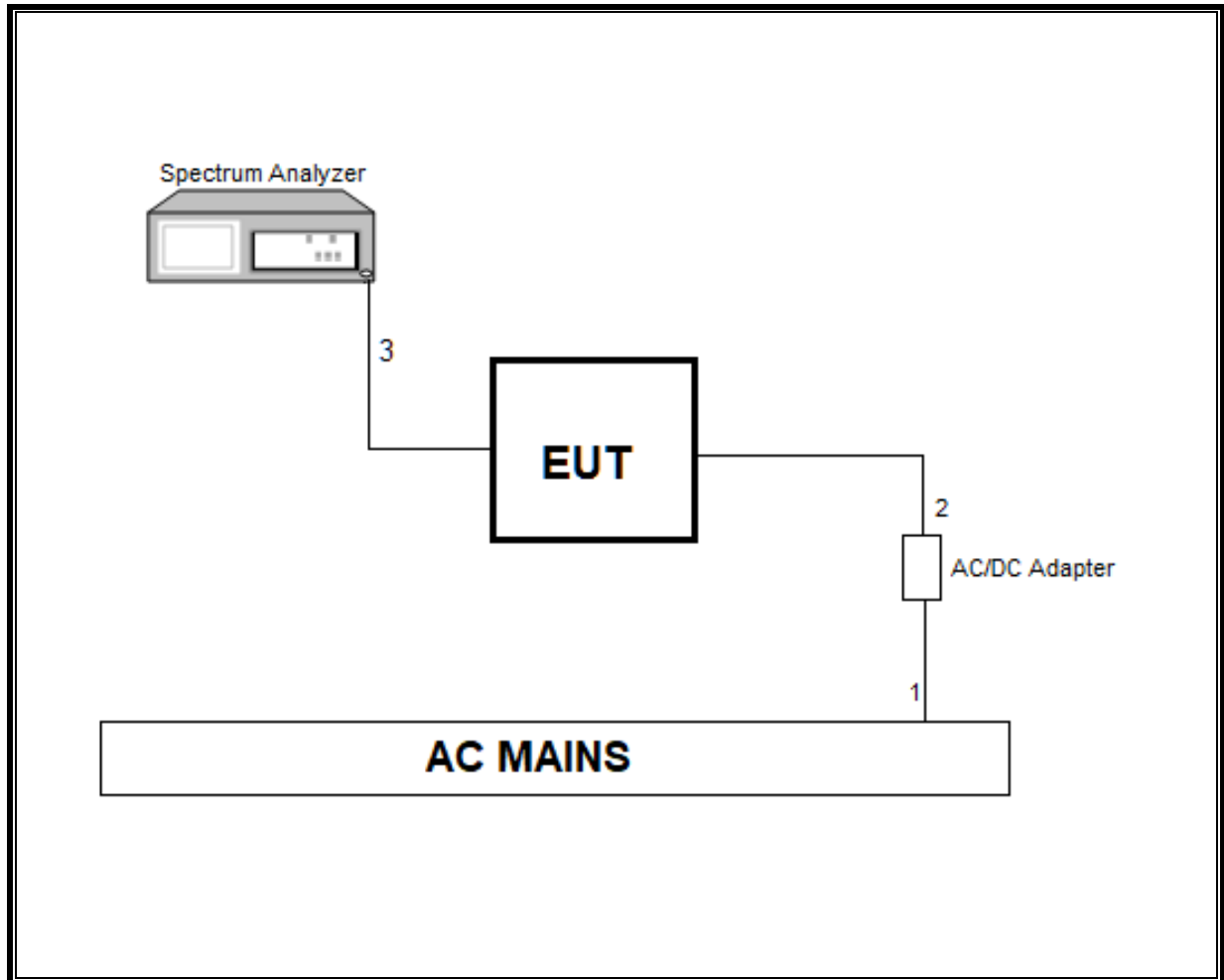
I/O Cable List						
Cable No	Port	# of identical ports	Connector Type	Cable Type	Cable Length (m)	Remarks
1	AC	1	AC	Un-Shielded	0.2	to AC/DC Adaptor
2	DC	1	DC	Shielded	1	to Laptop, to EUT
3	Antenna	1	SMA	Un-Shielded	0.2	to Analyzer

I/O CABLES (RADIATED AND CONDUCTED EMISSIONS)

I/O Cable List						
Cable No	Port	# of identical ports	Connector Type	Cable Type	Cable Length (m)	Remarks
1	AC	1	Type C	Un-shielded	0.2	to AC/DC Adapter
2	DC	1	DC	Shielded	1	to EUT
3	USB	1	TYPE A	Shielded	1.5	EUT To Mouse
4	USB	1	Type C	Shielded	0.1	EUT to earphone AUX
5	earphone	1	3.5mm	Un-shielded	1	EUT to earphone

TEST SETUP

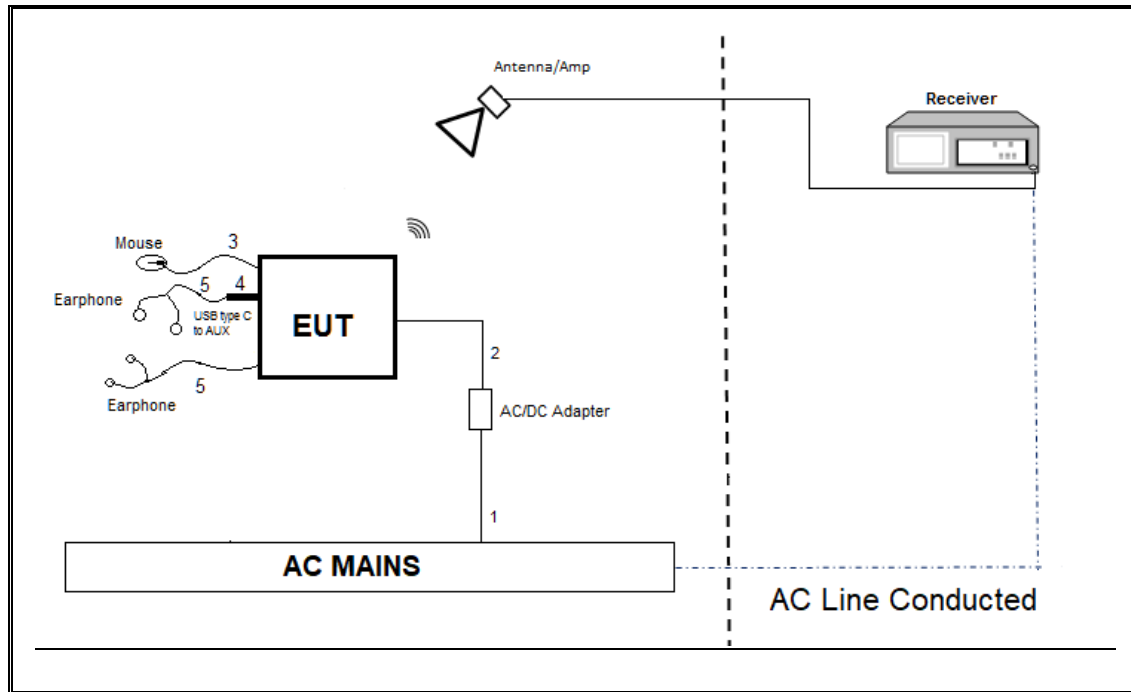
CONDUCTED TEST SETUP DIAGRAM



TEST SETUP

For conducted tests, the test software exercises the radio.

RADIATED AND AC LINE CONDUCTED EMISSIONS SETUP DIAGRAM



TEST SETUP

For radiated tests: EUT is connected to all support equipment. The test software exercises the radio.

6. MEASUREMENT METHOD

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

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

6 dB BW: ANSI C63.10 Subclause -11.8.1

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

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

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

Band-edge: ANSI C63.10 Subclause -11.13.3.4 Trace averaging across ON and OFF times of the EUT transmissions followed by duty cycle correction

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

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

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

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

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

7. 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
Antenna, Passive Loop 30Hz to 1MHz	ELETRO METRICS	EM-6871	PRE0179465	05/31/2020	05/31/2019
Antenna, Passive Loop 100kHz to 30MHz	ELETRO METRICS	EM-6872	PRE0179467	05/31/2020	05/31/2019
Amplifier, 9KHz to 1GHz, 32dB	Sonoma Instrument	310	PRE0186650	12/13/2019	12/13/2018
Hybrid Antenna, 30MHz to 3GHz	Sunol Sciences Corp	JB3	PRE0184971	11/13/2019	11/13/2018
Amplifier, 9kHz to 1GHz, 32 dB	Sonoma Instrument	310	PRE0180175	06/29/2020	06/29/2019
Antenna, Horn 1-18GHz	ETS-Lindgren	3117	EMC4294	06/14/2020	06/14/2019
Amplifier, 1 to18GHz, 35dB	AMPLICAL	AMP1G18-35	T1569	06/04/2020	06/04/2019
Antenna, Horn 1-18GHz	ETS-Lindgren	3117	T862	06/05/2020	06/05/2019
Amplifier, 1 to18GHz	MITEQ	AFS42-00101800-25-S-42	PRE018078	08/01/2019	08/01/2018
Antenna, Horn 18 to 26.5GHz	ARA	MWH-1826/B	PRE0182188	08/29/2019	08/29/2018
Rf Amplifier, 18-26.5GHz, 60dB gain	Amplical	AMP18G26.5-60	PRE0181238	05/01/2020	05/01/2019
Power Meter, P-series single channel	Agilent (Keysight) Technologies	N1911A	T1265	01/29/2020	01/29/2019
Power Sensor, P-series, 50MHz to 18GHz, Wideband	Agilent (Keysight) Technologies	N1921A	T1227	02/05/2020	02/05/2019
EMI Test Receiver	Rohde & Schwarz	ESW44	PRE0179367	05/16/2020	05/16/2019
EMI Test Receiver	Rohde & Schwarz	ESW44	PRE0179372	02/16/2020	02/16/2019
Spectrum Analyzer, PXA, 3Hz to 44GHz	Agilent (Keysight) Technologies	N9030A	T908	01/23/2020	01/23/2019
Spectrum Analyzer, PXA, 3Hz to 44GHz	Agilent (Keysight) Technologies	N9030A	T917	01/24/2020	01/24/2019
AC Line Conducted					
EMI Receiver	Rohde & Schwarz	ESR	T1436	02/14/2020	02/14/2019
LISN for Conducted Emissions CISPR-16	FCC INC.	FCC LISN 50/250	T1310	01/24/2020	01/24/2019
Test Software List					
Radiated Software	UL	UL EMC	Ver 9.5, June 22, 2018 & Jan 11, 2019		
Antenna Port Software	UL	UL RF	Ver 9.7, May 7, 2019		
AC Line Conducted Software	UL	UL EMC	Ver 9.5, May 26, 2015		

NOTES:

1. Equipment listed above that calibrated during the testing period was set for test after the calibration.
2. Equipment listed above that has a calibration due date during the testing period, the testing is completed before equipment expiration date.

8. ANTENNA PORT TEST RESULTS

8.1. 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	8.346	8.408	0.993	99.26%	0.00	0.010
802.11g	2.086	2.128	0.980	98.03%	0.00	0.010
802.11n HT20	3.986	4.028	0.990	98.96%	0.00	0.010
802.11n HT40	3.976	4.028	0.987	98.71%	0.00	0.010

DUTY CYCLE PLOTS



8.2. 99% BANDWIDTH

LIMITS

None; for reporting purposes only.

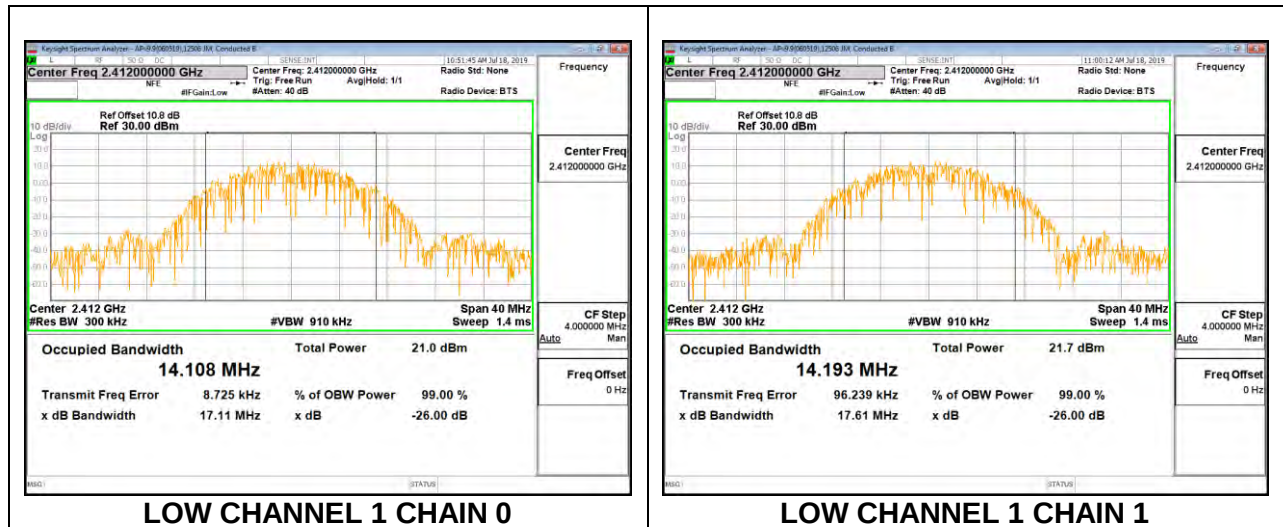
RESULTS

8.2.1. 802.11b MODE

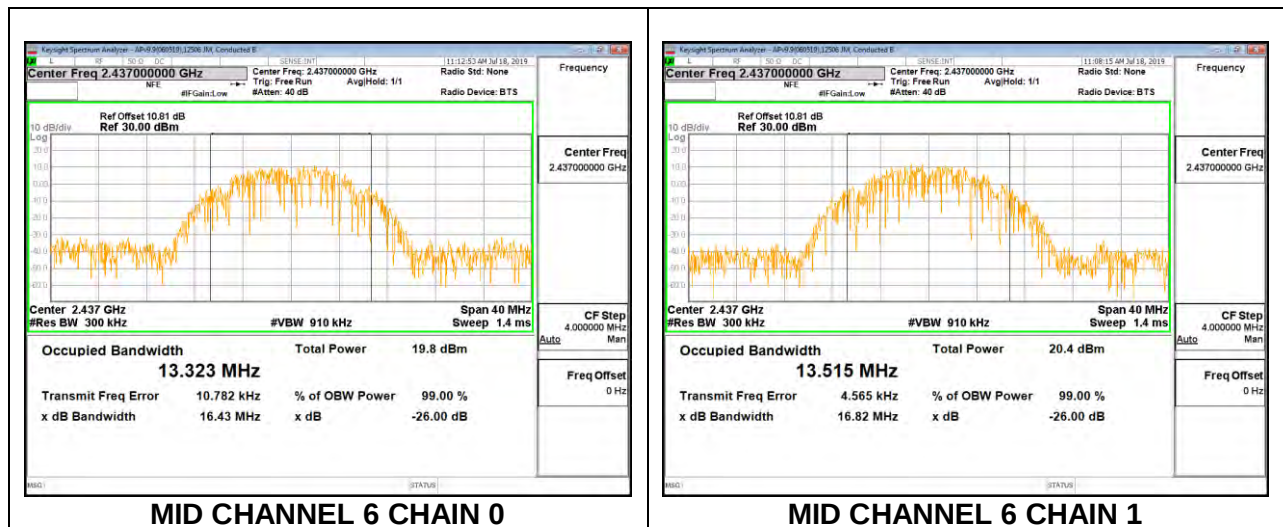
2TX Chain 0 + Chain 1 CDD MODE

Channel	Frequency (MHz)	99% Bandwidth Chain 0 (MHz)	99% Bandwidth Chain 1 (MHz)
Low 1	2412	14.108	14.193
Mid 6	2437	13.323	13.515
High 11	2462	14.436	14.090
High 12	2467	13.457	13.925
High 13	2472	13.853	13.959

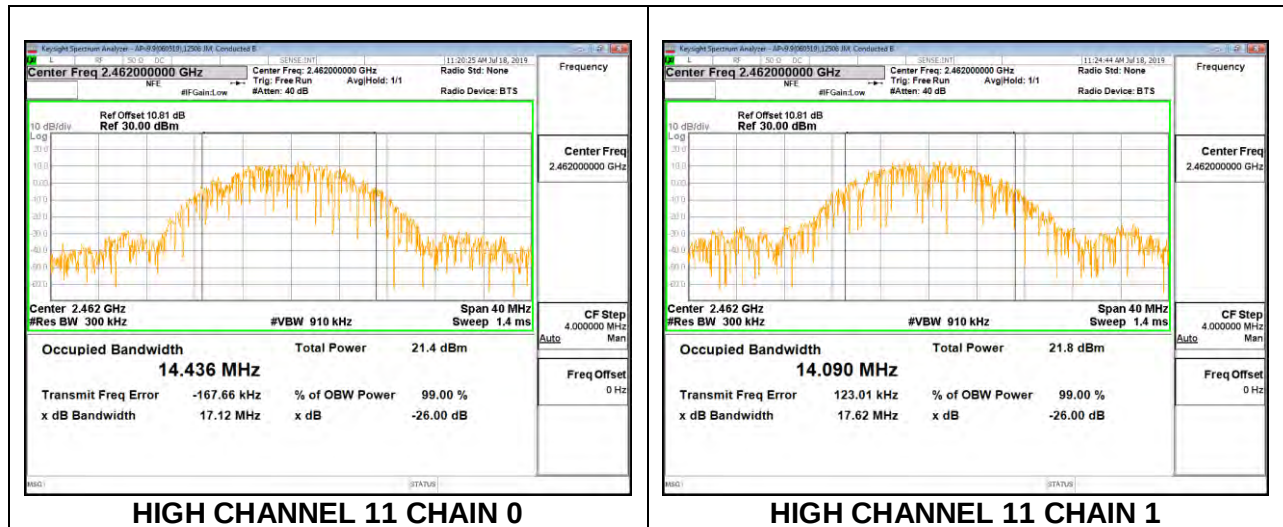
LOW CHANNEL 1



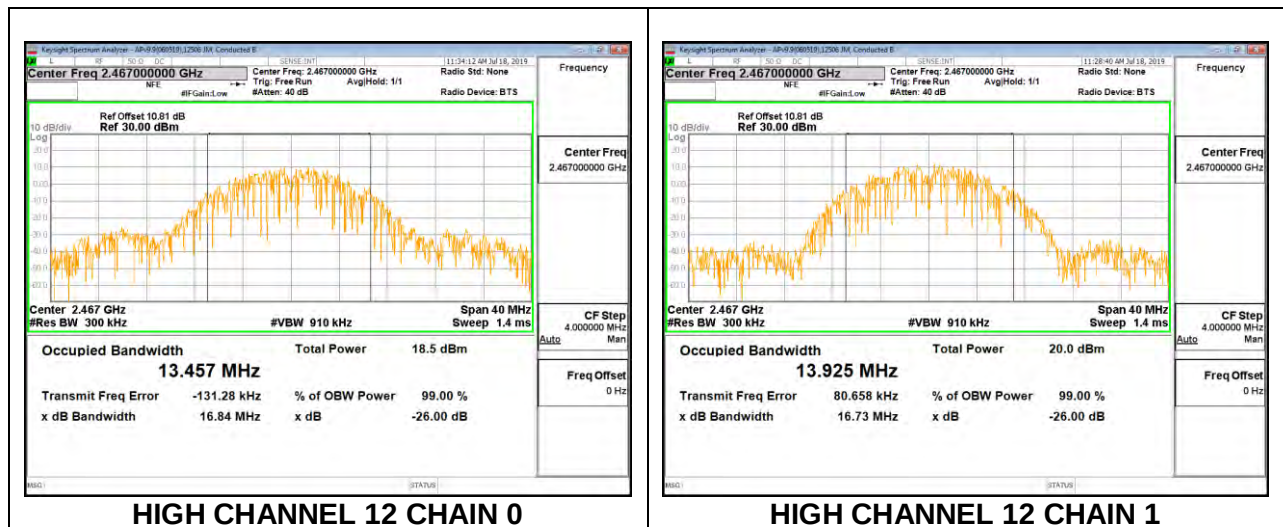
MID CHANNEL 6



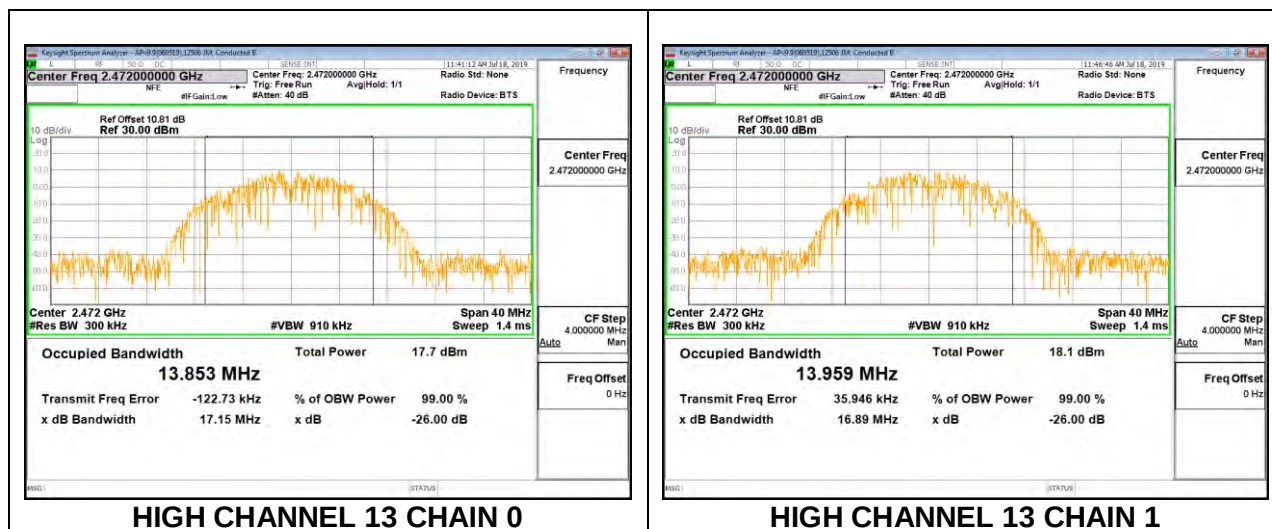
HIGH CHANNEL 11



HIGH CHANNEL 12



HIGH CHANNEL 13



8.2.2. 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	16.625	16.697
Mid 6	2437	16.634	16.616
High 11	2462	16.545	16.640
High 12	2467	16.579	16.590
High 13	2472	16.518	16.459

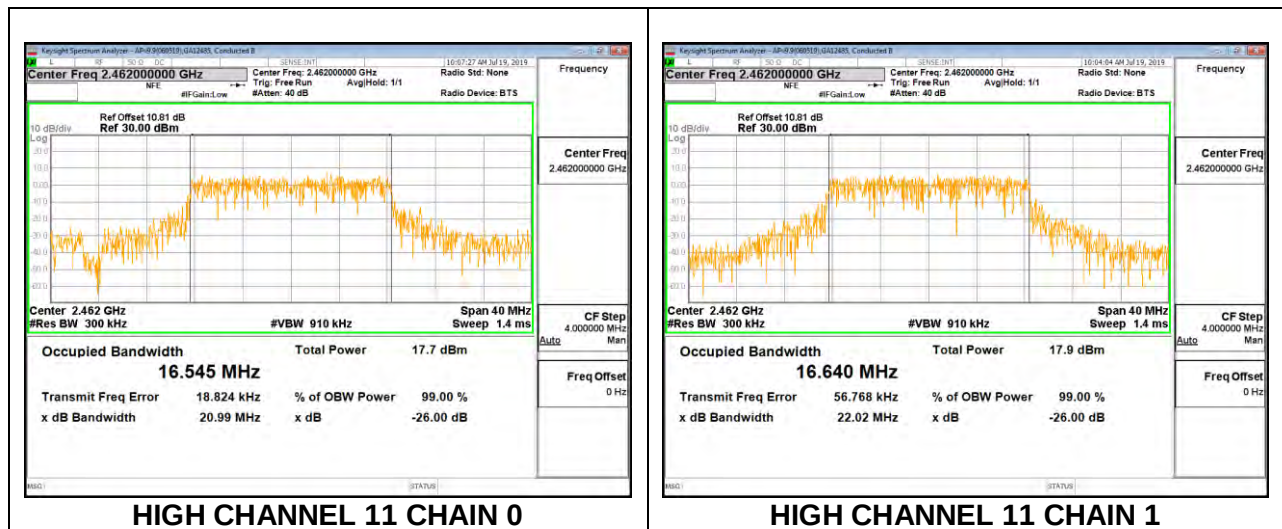
LOW CHANNEL 1 CHAIN 0

LOW CHANNEL 1 CHAIN 1

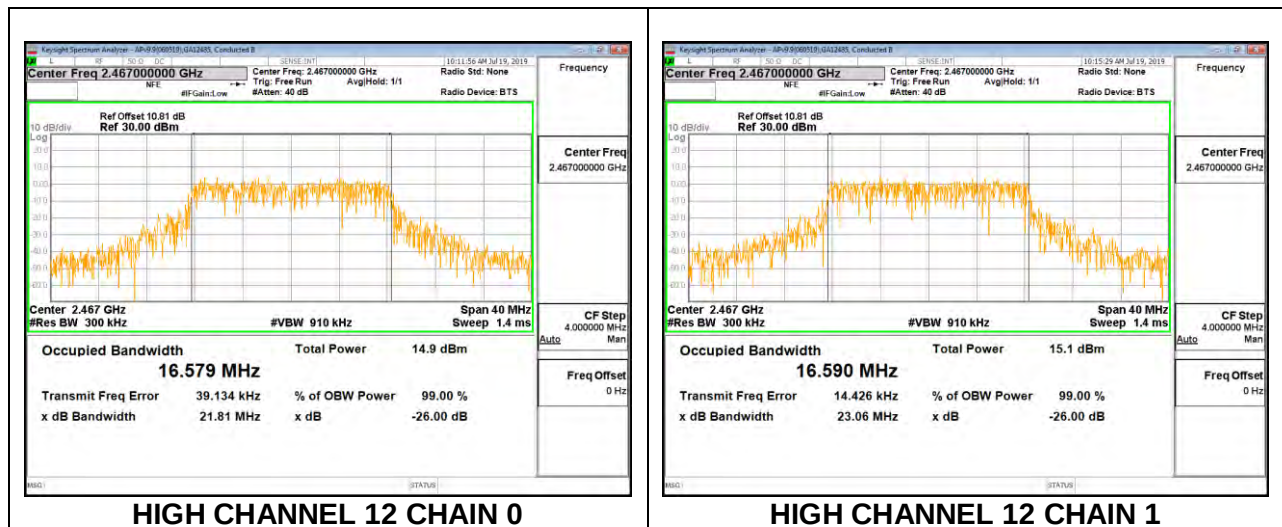
MID CHANNEL 6 CHAIN 0

MID CHANNEL 6 CHAIN 1

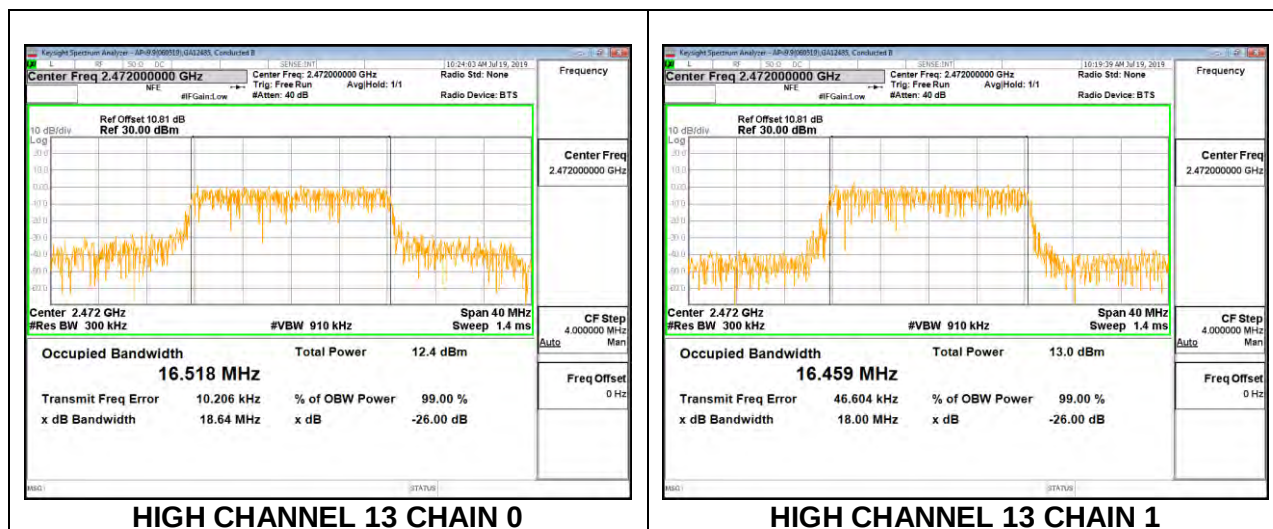
HIGH CHANNEL 11



HIGH CHANNEL 12



HIGH CHANNEL 13

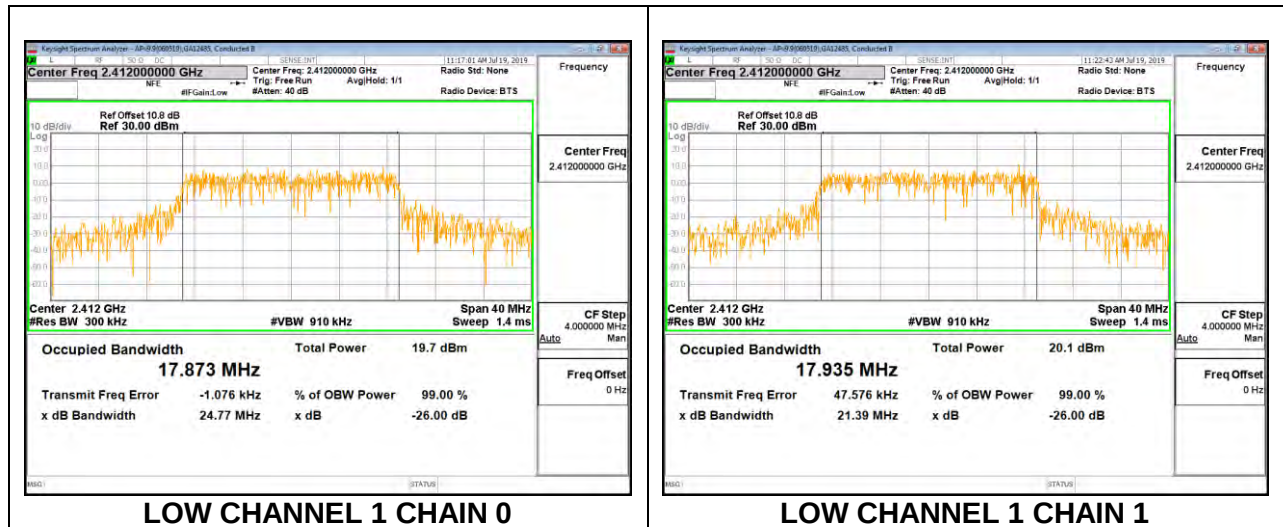


8.2.3. 802.11n HT20 MODE

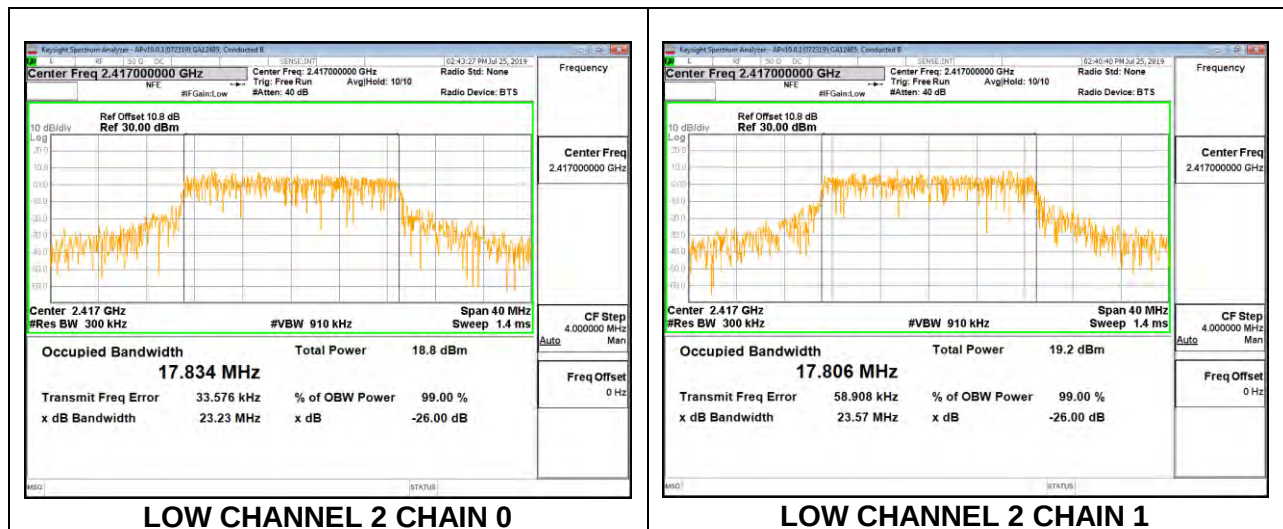
2TX Chain 0 + Chain 1 SDM MODE

Channel	Frequency (MHz)	99% Bandwidth Chain 0 (MHz)	99% Bandwidth Chain 1 (MHz)
Low 1	2412	17.873	17.935
Low 2	2417	17.834	17.806
Mid 6	2437	17.699	17.836
High 10	2457	17.683	17.710
High 11	2462	17.782	17.764
High 12	2467	17.769	17.800
High 13	2472	17.701	17.717

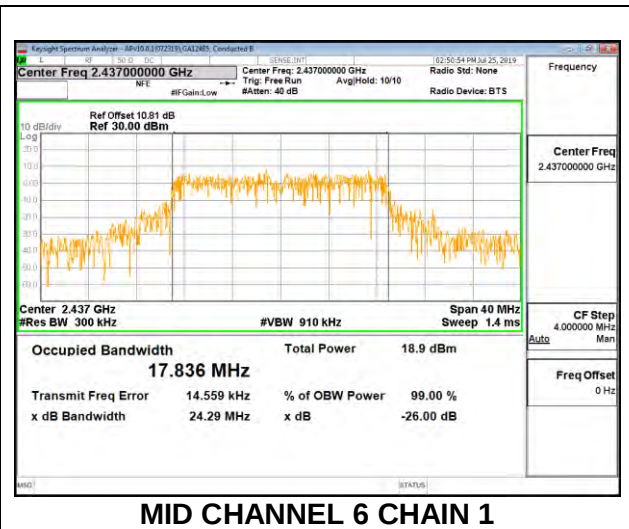
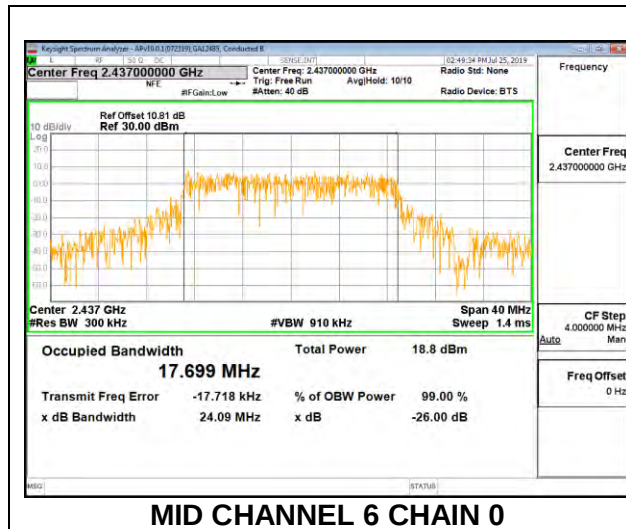
LOW CHANNEL 1



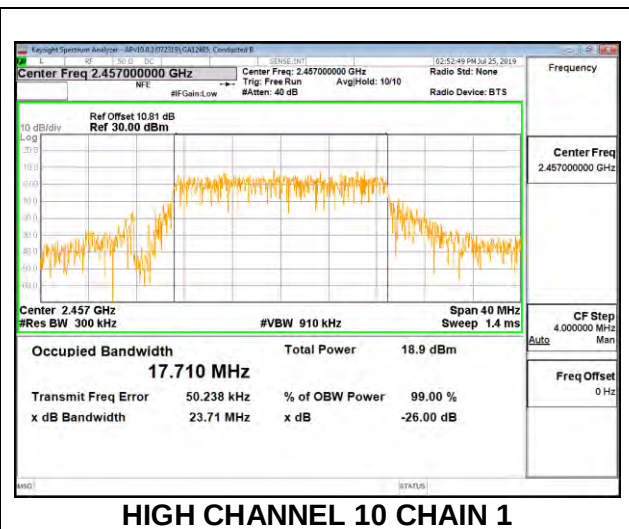
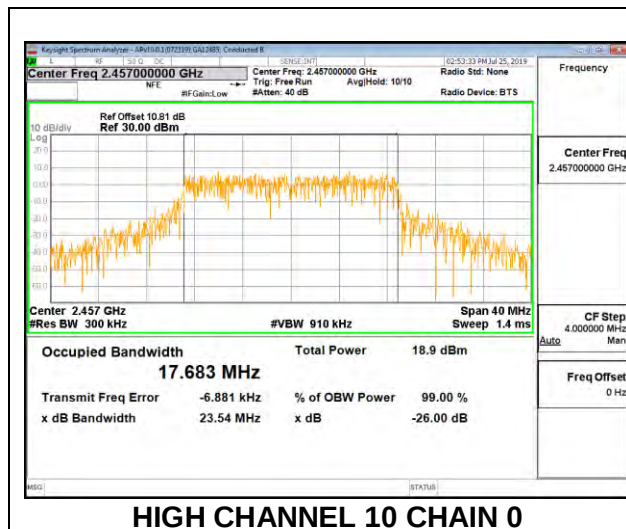
LOW CHANNEL 2



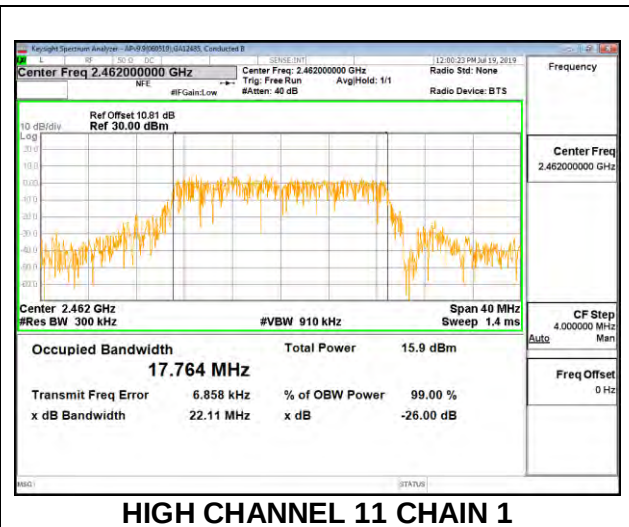
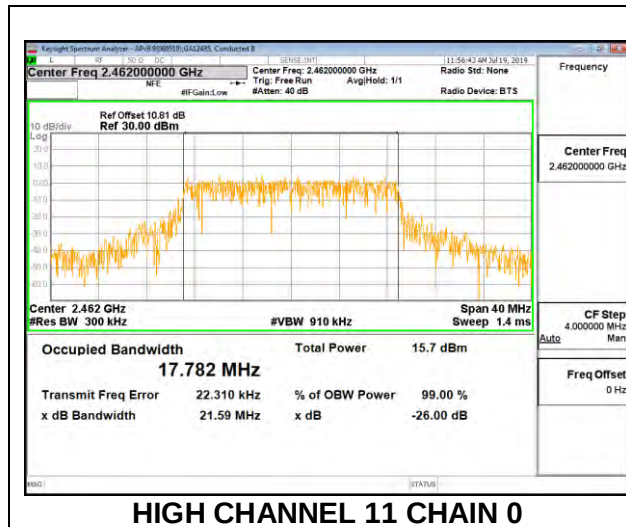
MID CHANNEL 6



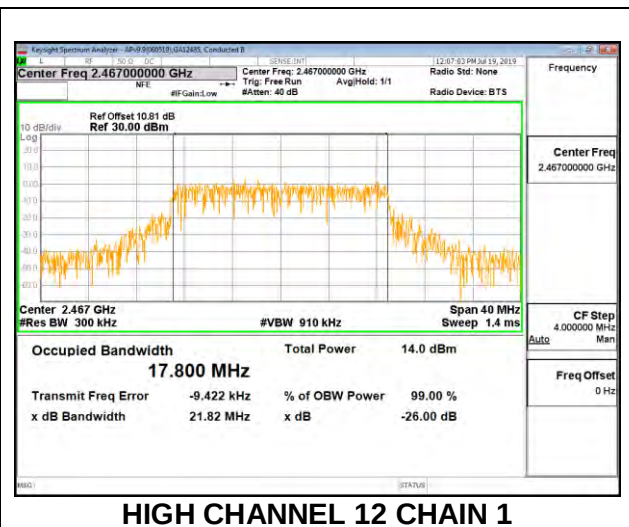
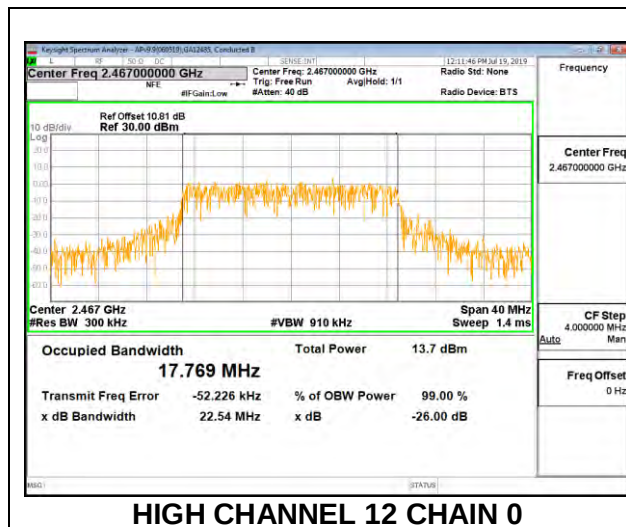
HIGH CHANNEL 10



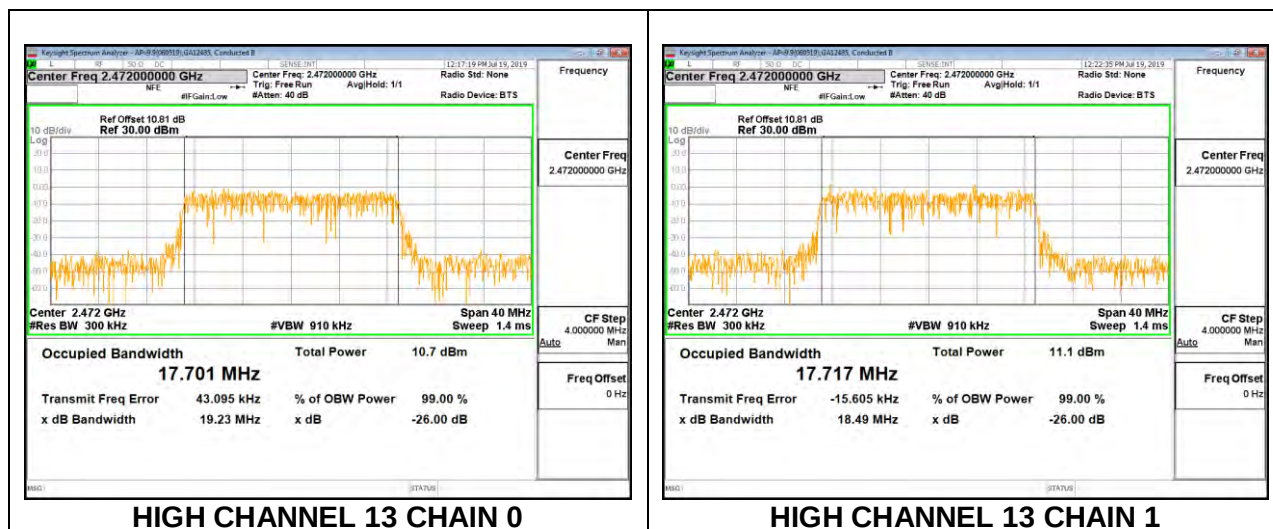
HIGH CHANNEL 11



HIGH CHANNEL 12



HIGH CHANNEL 13

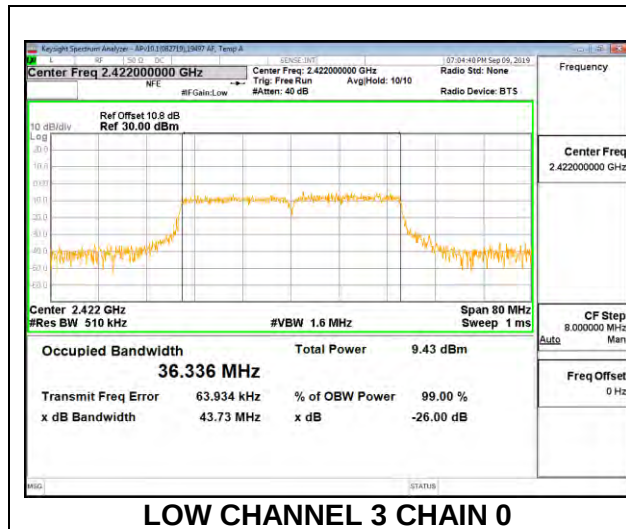


8.2.4. 802.11n HT40 MODE

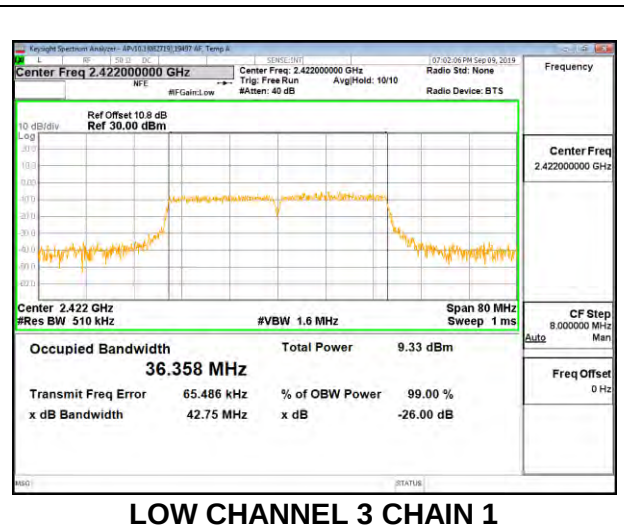
2TX Chain 0 + Chain 1 SDM MODE

Channel	Frequency (MHz)	99% Bandwidth Chain 0 (MHz)	99% Bandwidth Chain 1 (MHz)
Low 3	2422	36.336	36.358
Low 4	2427	36.336	36.290
Mid 6	2437	36.282	36.310
High 7	2442	36.285	36.333
High 8	2447	36.360	36.357
High 9	2452	36.300	36.388
High 10	2457	36.456	36.294
High 11	2462	36.209	36.294

LOW CHANNEL 3

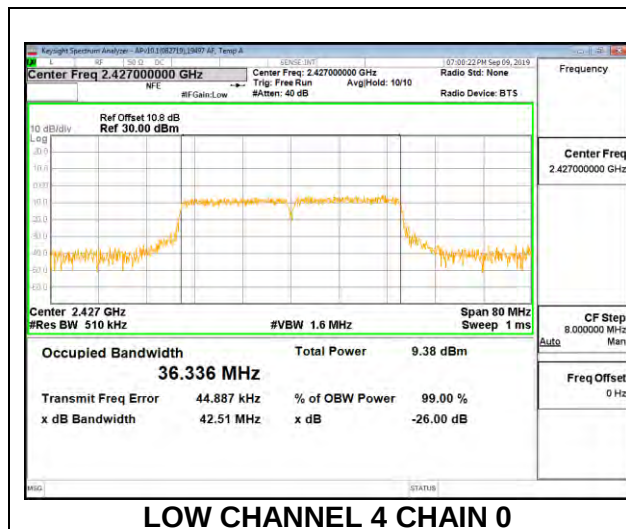


LOW CHANNEL 3 CHAIN 0

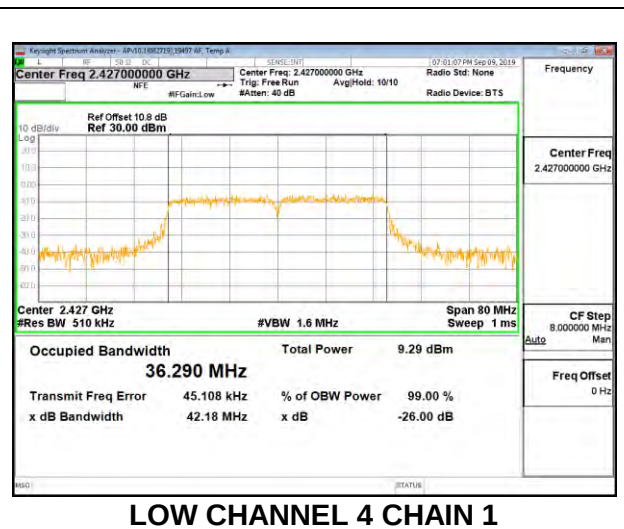


LOW CHANNEL 3 CHAIN 1

LOW CHANNEL 4

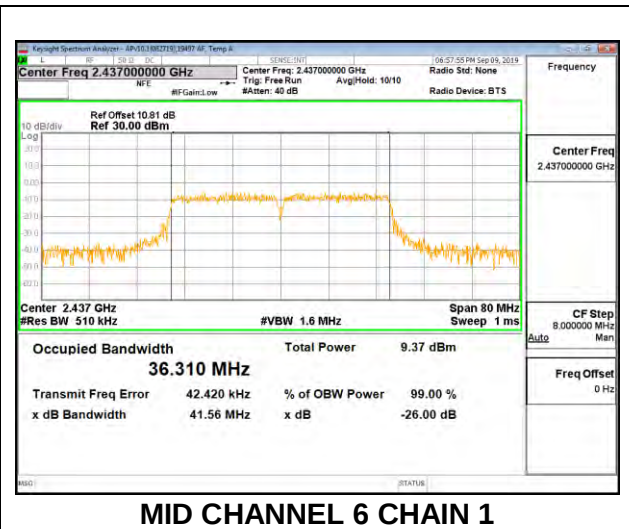
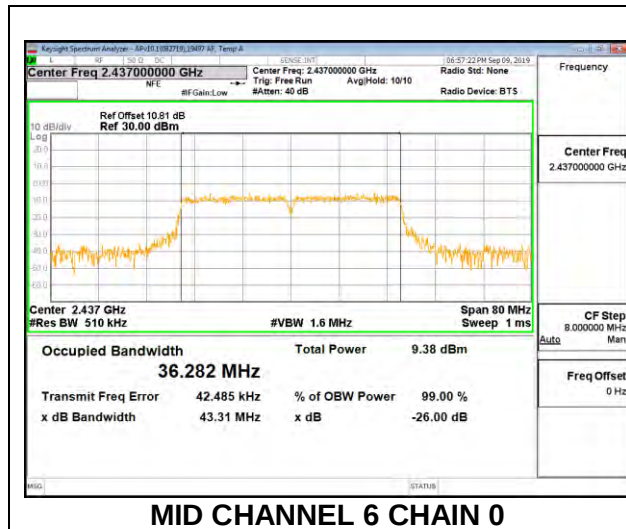


LOW CHANNEL 4 CHAIN 0

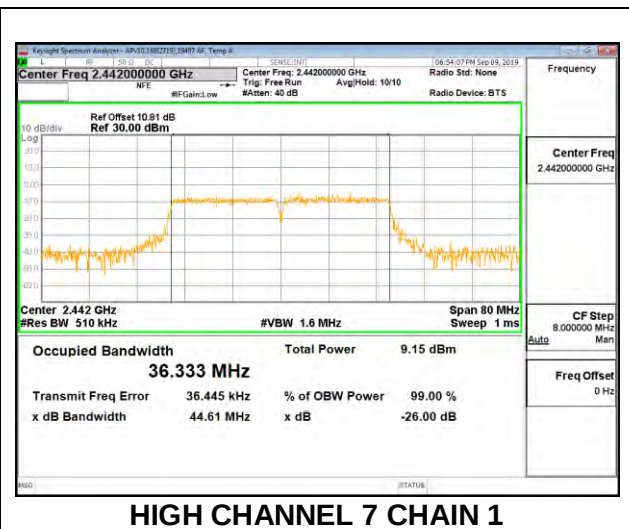
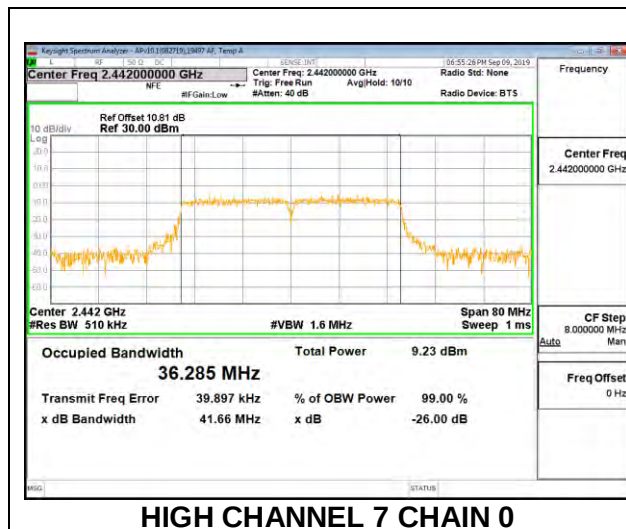


LOW CHANNEL 4 CHAIN 1

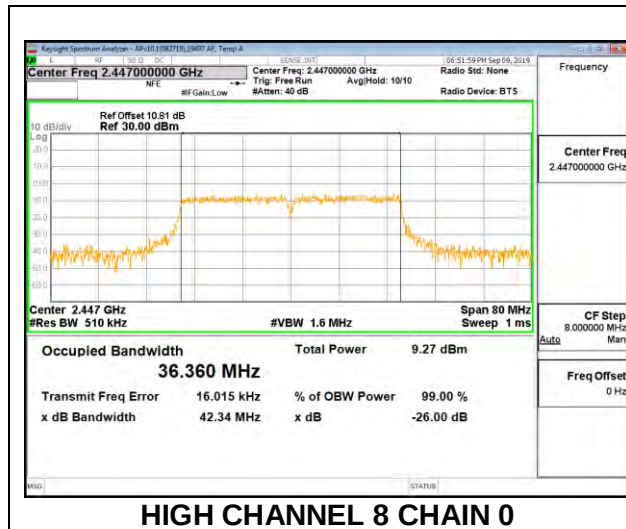
MID CHANNEL 6



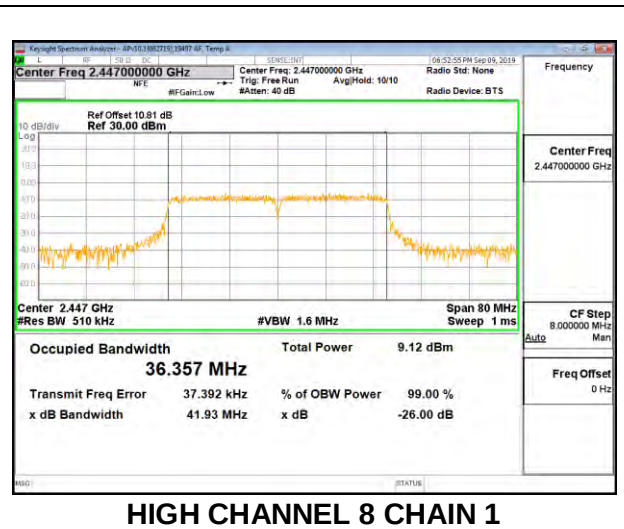
HIGH CHANNEL 7



HIGH CHANNEL 8

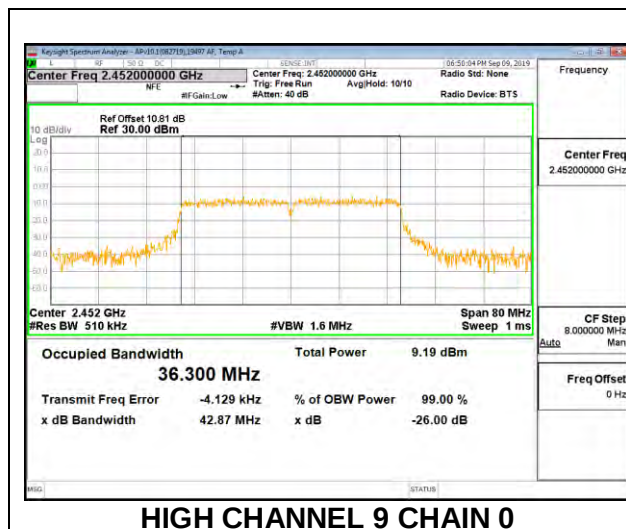


HIGH CHANNEL 8 CHAIN 0

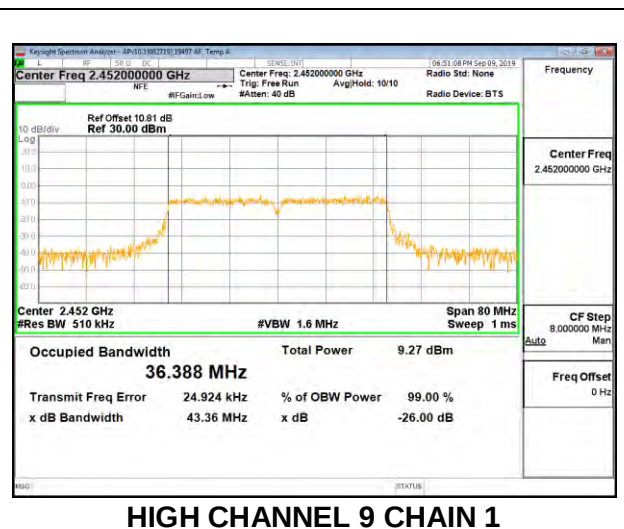


HIGH CHANNEL 8 CHAIN 1

HIGH CHANNEL 9

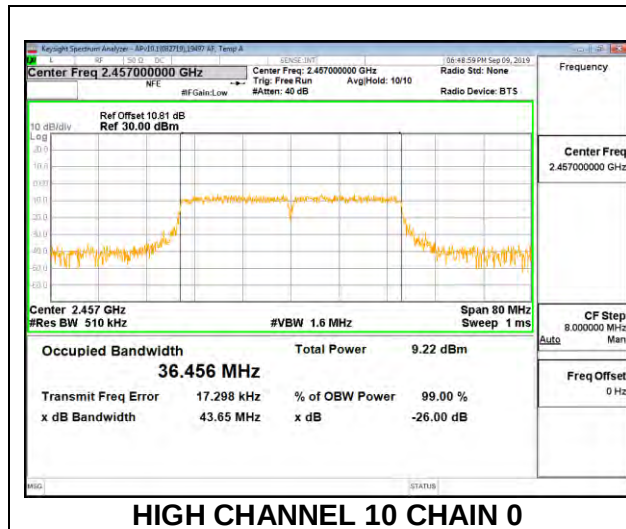


HIGH CHANNEL 9 CHAIN 0

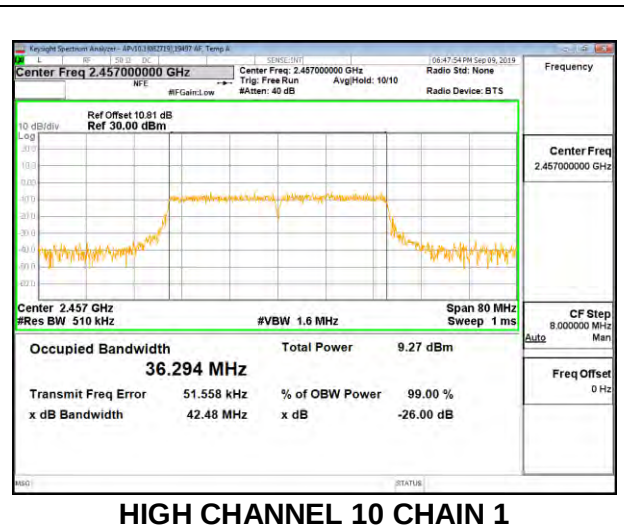


HIGH CHANNEL 9 CHAIN 1

HIGH CHANNEL 10

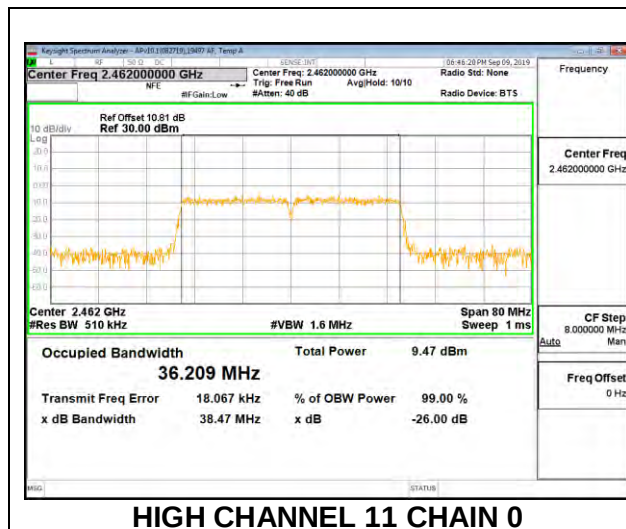


HIGH CHANNEL 10 CHAIN 0

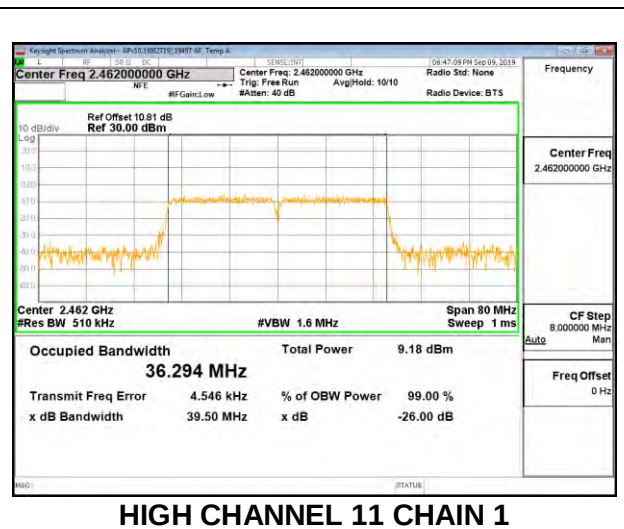


HIGH CHANNEL 10 CHAIN 1

HIGH CHANNEL 11



HIGH CHANNEL 11 CHAIN 0



HIGH CHANNEL 11 CHAIN 1

8.3. 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

8.3.1. 802.11b MODE

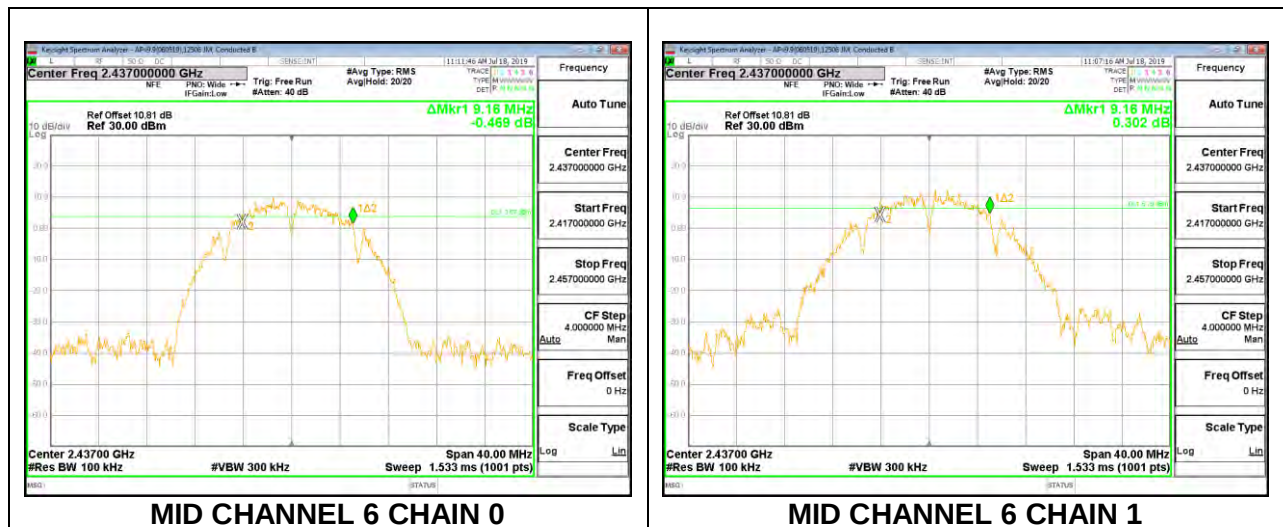
2TX Chain 0 + Chain 1 CDD MODE

Channel	Frequency (MHz)	6 dB BW Chain 0 (MHz)	6 dB BW Chain 1 (MHz)	Minimum Limit (MHz)
Low 1	2412	8.16	8.76	0.5
Mid 6	2437	9.16	9.16	0.5
High 11	2462	8.68	8.44	0.5
High 12	2467	8.16	8.24	0.5
High 13	2472	8.60	9.16	0.5

LOW CHANNEL 1



MID CHANNEL 6



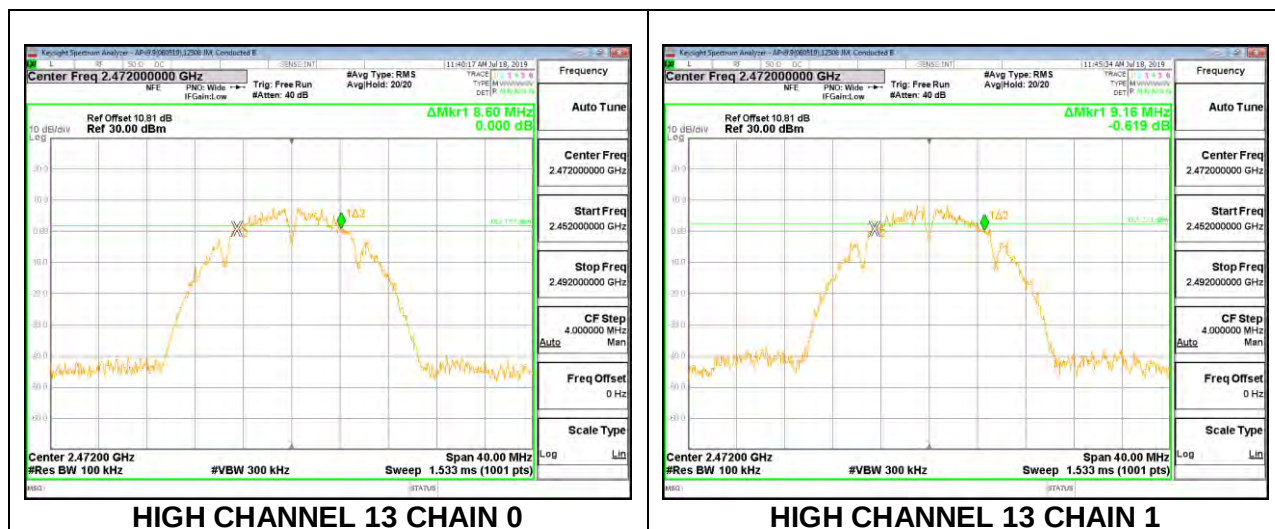
HIGH CHANNEL 11



HIGH CHANNEL 12



HIGH CHANNEL 13

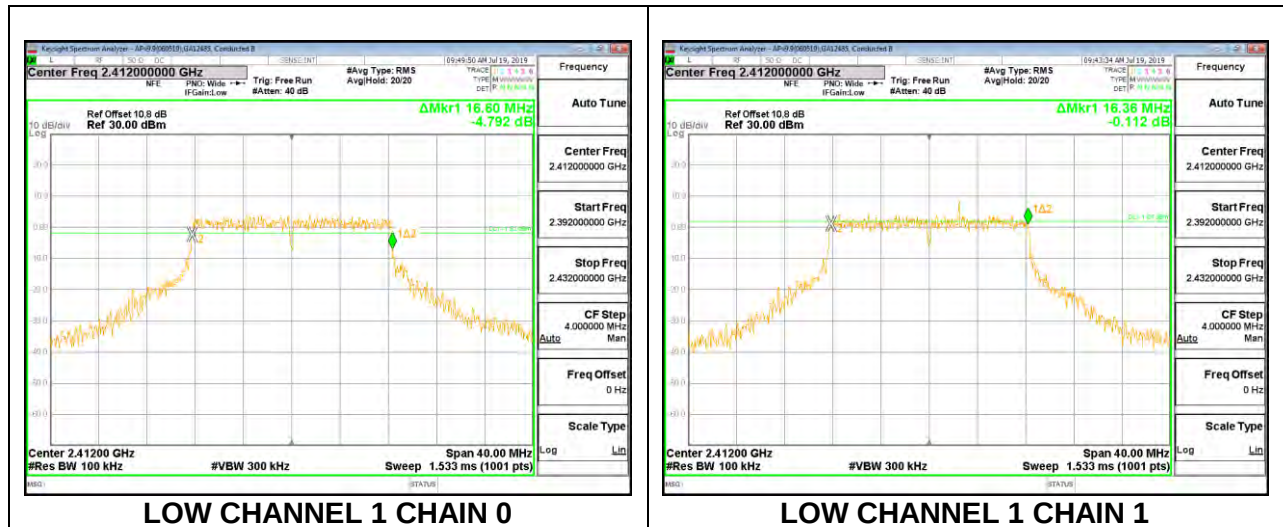


8.3.2. 802.11g MODE

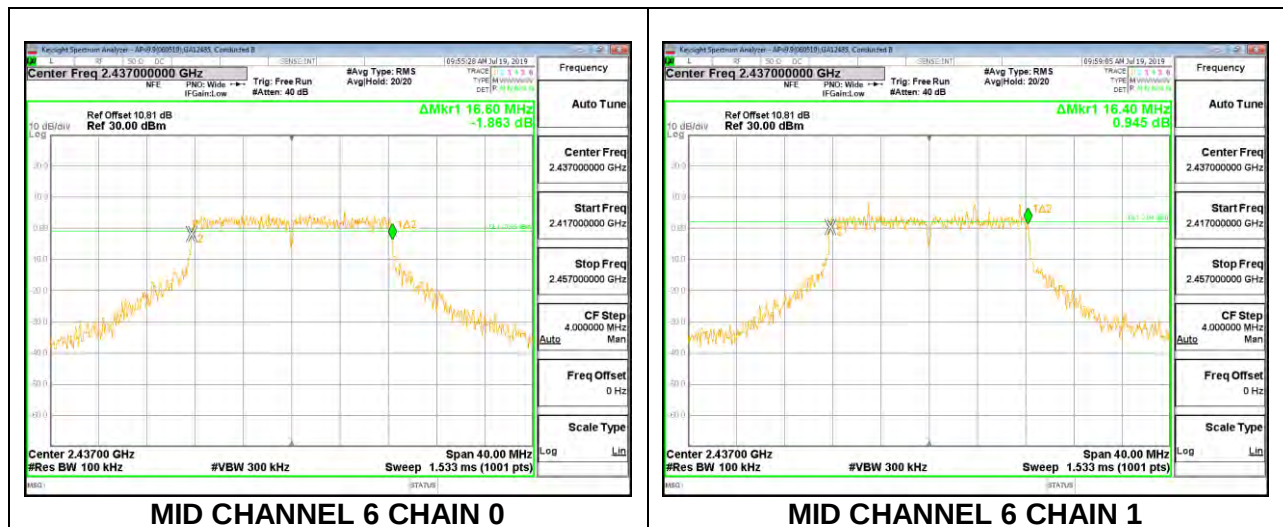
2TX Chain 0 + Chain 1 CDD MODE

Channel	Frequency (MHz)	6 dB BW Chain 0 (MHz)	6 dB BW Chain 1 (MHz)	Minimum Limit (MHz)
Low 1	2412	16.60	16.36	0.5
Mid 6	2437	16.60	16.40	0.5
High 11	2462	16.40	16.60	0.5
High 12	2467	16.48	16.40	0.5
High 13	2472	16.44	16.64	0.5

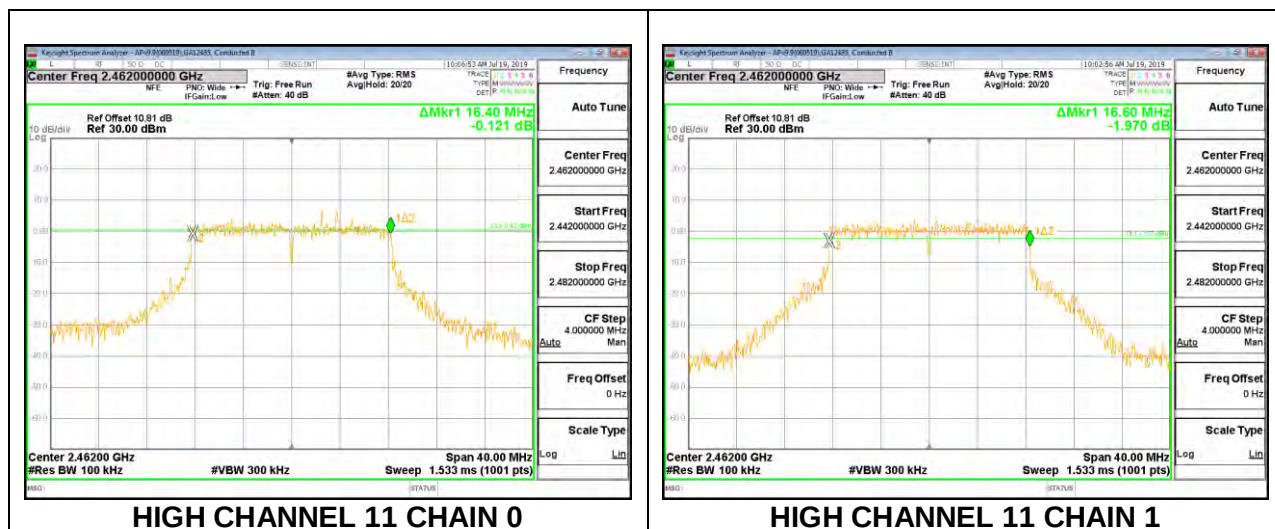
LOW CHANNEL 1



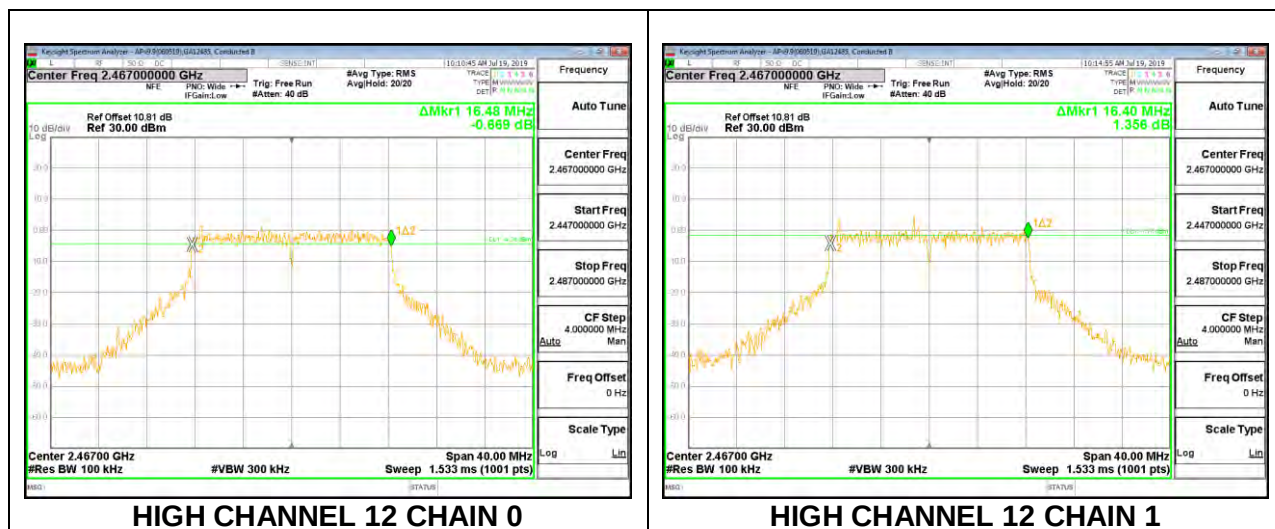
MID CHANNEL 6



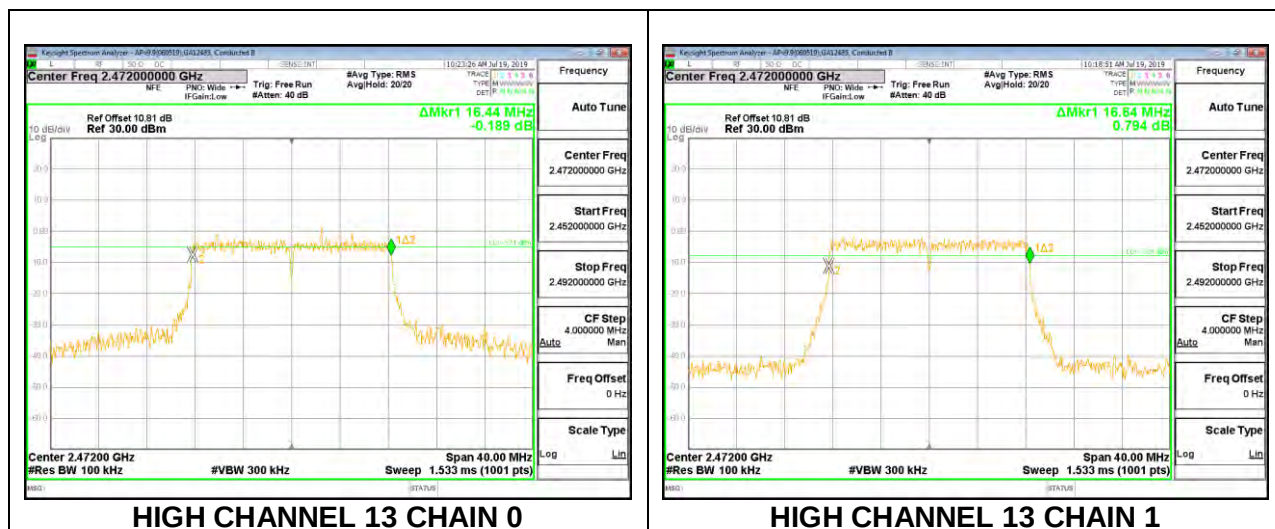
HIGH CHANNEL 11



HIGH CHANNEL 12



HIGH CHANNEL 13

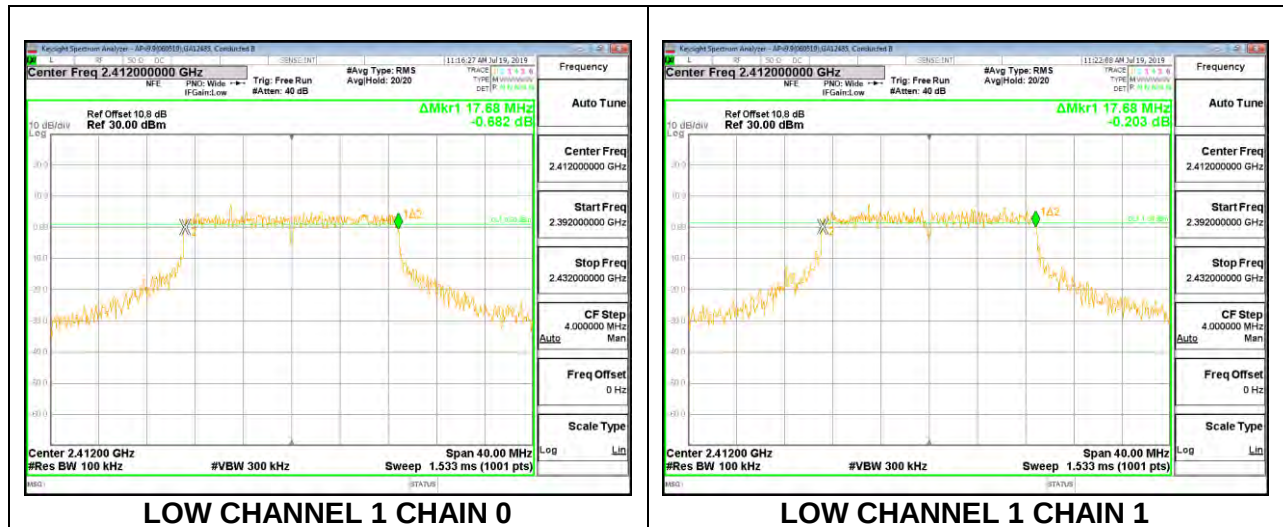


8.3.3. 802.11n HT20 MODE

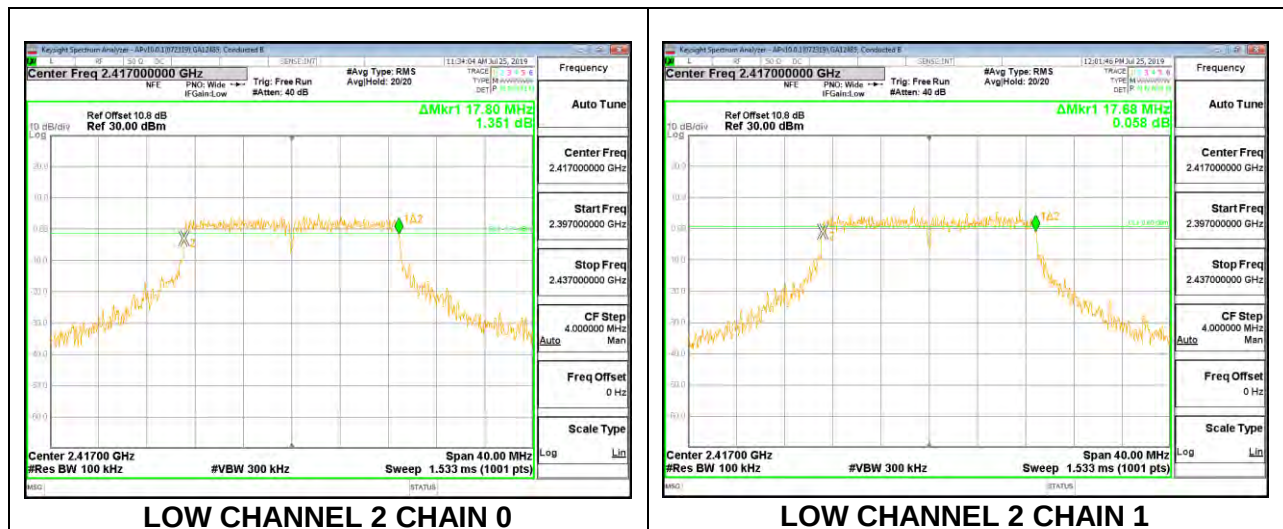
2TX Chain 0 + Chain 1 SDM MODE

Channel	Frequency (MHz)	6 dB BW Chain 0 (MHz)	6 dB BW Chain 1 (MHz)	Minimum Limit (MHz)
Low 1	2412	17.68	17.68	0.5
Low 2	2417	17.80	17.68	0.5
Mid 6	2437	17.80	17.88	0.5
High 10	2457	17.40	17.72	0.5
High 11	2462	17.64	17.76	0.5
High 12	2467	17.76	17.72	0.5
High 13	2472	17.68	17.84	0.5

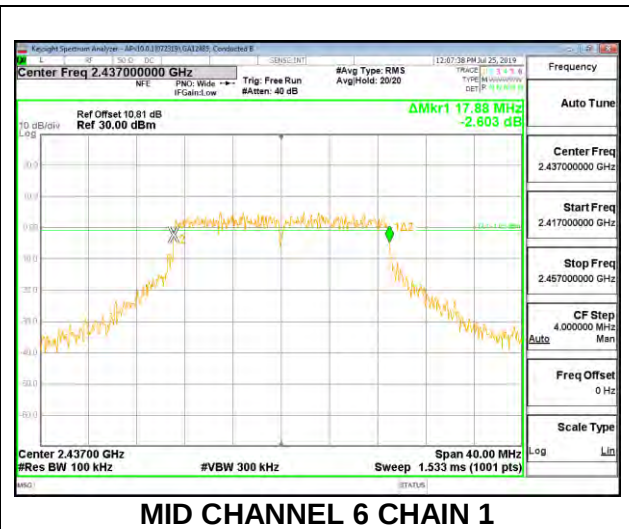
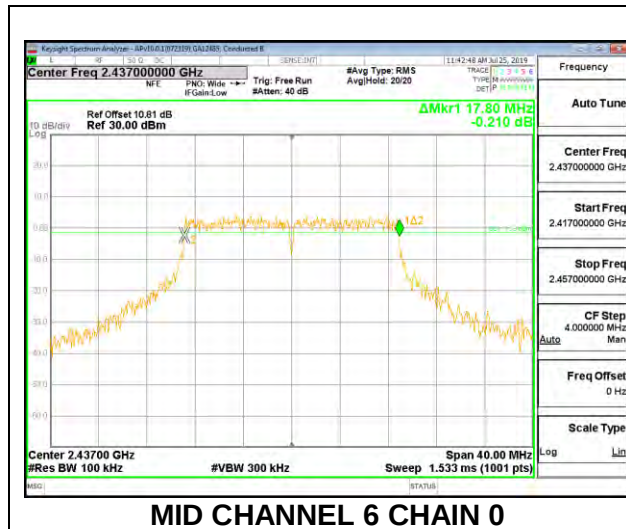
LOW CHANNEL 1



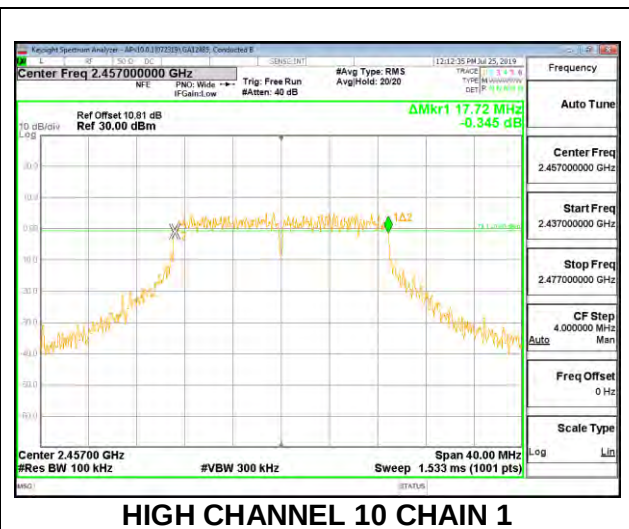
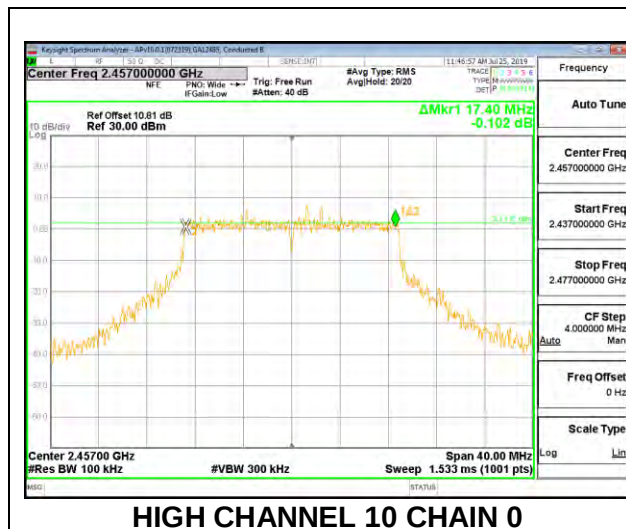
LOW CHANNEL 2



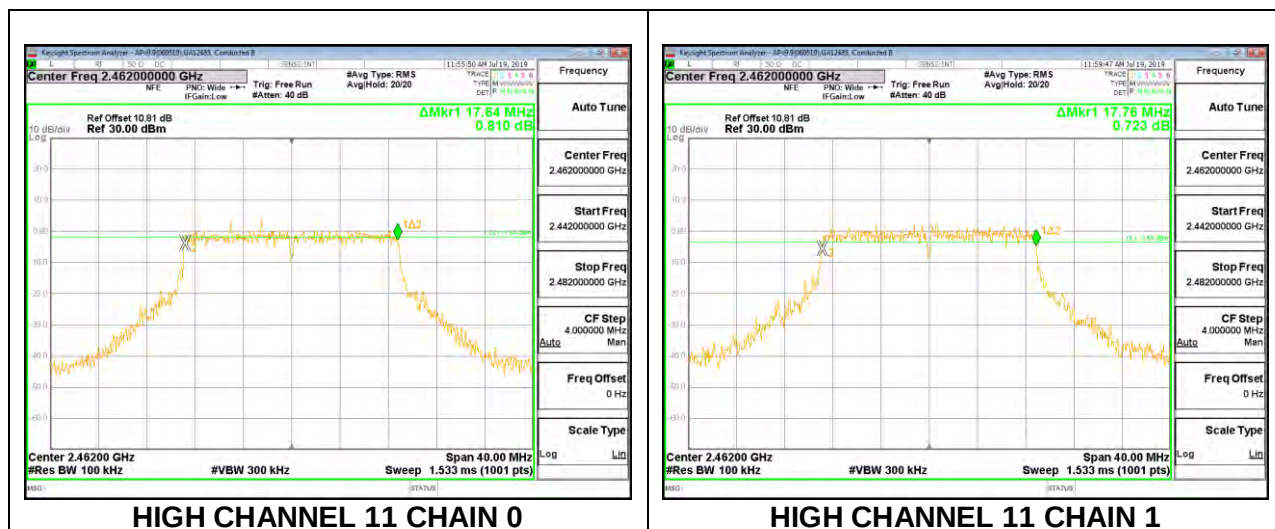
MID CHANNEL 6



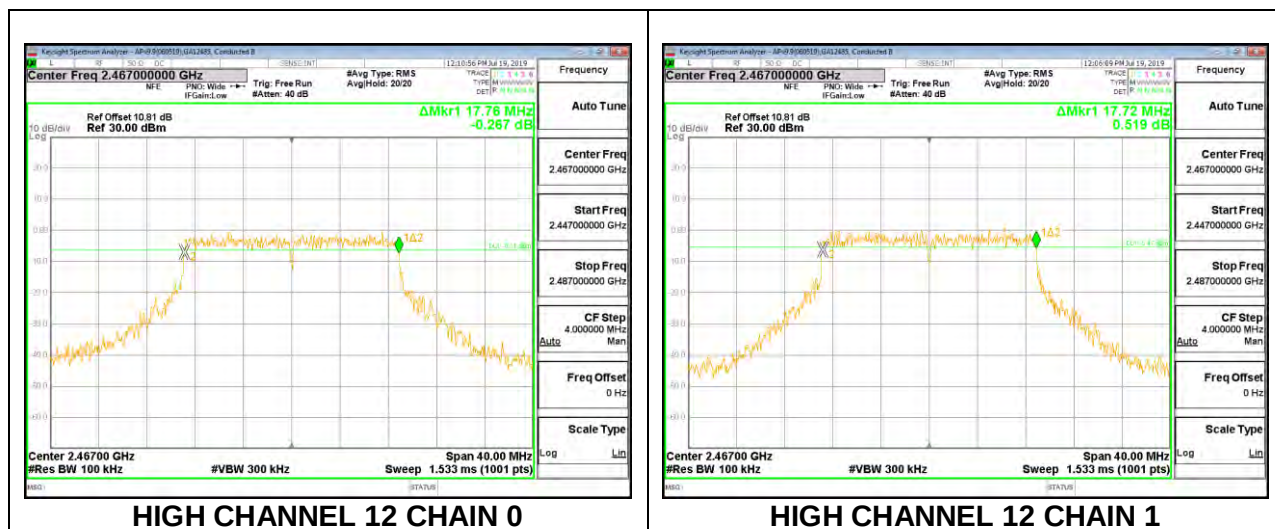
HIGH CHANNEL 10



HIGH CHANNEL 11



HIGH CHANNEL 12



HIGH CHANNEL 13

