CERTIFICATION TEST REPORT

Report Number. : 11949808-E3V3

Applicant	:	APPLE, INC. 1 INFINITE LOOP CUPERTINO, CA 95014, U.S.A.
Model	:	A1639
FCC ID	:	BCG-A1639
IC	:	579C-A1639
EUT Description	:	WIRELESS SPEAKER
Test Standard(s)	:	FCC 47 CFR PART 15 SUBPART C INDUSTRY CANADA RSS - 247 ISSUE 2

Date Of Issue:
November 08, 2017

Prepared by:
UL Verification Services Inc.
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NVLAP LAB CODE 200065-0

REPORT REVISION HISTORY

Rev.	Issue Date	Revisions	Revised By
V1	10/9/2017	Initial Issue	Tri Pham
V2	10/16/2017	Address TCB questions	Jin Li
V3	11/08/2017	Address TCB questions	Chin Pang

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: APPLE, INC.
1 INFINITE LOOP
CUPERTINO, CA 95014, U.S.A.

EUT DESCRIPTION: WIRELESS SPEAKER

MODEL: A1639

SERIAL NUMBER: CC4V2283J5Y3

DATE TESTED: AUGUST 16, 2017 – OCTOBER 03, 2017

APPLICABLE STANDARDS	
STANDARD	**TEST RESULTS**
CFR 47 Part 15 Subpart C	Pass
INDUSTRY CANADA RSS-247 Issue 2	Pass
INDUSTRY CANADA RSS-GEN Issue 4	Pass

UL Verification Services Inc. tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by UL Verification Services Inc. based on interpretations and/or observations of test results. Measurement Uncertainties were not taken into account and are published for informational purposes only. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

Note: The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. 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 any government.

Approved & Released For
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2. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 47173 and 47266 Benicia Street, 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
☐ Chamber A (IC:2324B-1)	☐ Chamber D (IC:22541-1)
☐ Chamber B (IC:2324B-2)	☒ Chamber E (IC:22541-2)
☐ Chamber C (IC:2324B-3)	☒ Chamber F (IC:22541-3)
	☐ Chamber G (IC:22541-4)
	☐ Chamber H (IC:22541-5)

UL Verification Services Inc. is accredited by NVLAP, Laboratory Code 200065-0. The full scope of accreditation can be viewed at http://ts.nist.gov/standards/scopes/2000650.htm.

3. TEST METHODOLOGY

The tests documented in this report were performed in accordance with FCC CFR 47 Part 2, FCC CFR 47 Part 15, KDB 558074 D01 v04, ANSI C63.10-2013, MIMO KDB 662911, RSS-GEN Issue 4, and RSS-247 Issue 2.

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

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

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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	3.15 dB
Worst Case Radiated Disturbance, 30 to 1000 MHz	5.36 dB
Worst Case Radiated Disturbance, 1000 to 18000 MHz	4.32 dB
Worst Case Radiated Disturbance, 18000 to 26000 MHz	4.45 dB
Worst Case Radiated Disturbance, 26000 to 40000 MHz	5.24 dB
Occupied Channel Bandwidth	±0.39 %
Time	±0.02 %

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

5. SUMMARY OF TESTING

SUMMARY TABLE

FCC Part Section	RSS Section(s)	Test Description	Test Limit	Test Condition	Test Result	Worst Case
15.247 (a)(2)	RSS-247 5.2.1	Occupied Band width (6dB)	>500KHz	Conducted	Pass	MHz
2.1051, 15.247 (d)	RSS-247 5.5	Band Edge / Conducted Spurious Emission	-20dBc		Pass	dBm
15.247	RSS-247 5.4.4	TX conducted output power	<30dBm		Pass	dBm
15.247	RSS-247 5.2.2	PSD	<8dBm		Pass	dBm
15.207 (a)	RSS-GEN 8.8	AC Power Line conducted emissions	Section 10		Pass	dBuV(AV)
15.205, 15.209	RSS-GEN 8.9/7	Radiated Spurious Emission	< 54dBuV/m	Radiated	Pass	dBuV/m

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6. MEASUREMENT METHOD

6 dB BW: KDB 558074 D01 v04, Section 8.1.

Output Power: KDB 558074 D01 v04, Section 9.1.2.

Power Spectral Density: KDB 558074 D01 v04, Section 10.2.

Out-of-band emissions in non-restricted bands: KDB 558074 D01 v04, Section 11.0.

Out-of-band emissions in restricted bands: KDB 558074 D01 v04, Section 12.1.

Band-edge: KDB 558074 D01 v04, Section 12.1.

Conducted line emissions: C63.10, Clause 6.2

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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**	**Asset**	**Cal Due**
Antenna, Horn 1-18GHz	ETS Lindgren	3117	T346	3/28/2018
Amplifier, 1 to 18GHz	Miteq	AFS42-00101800-25-S-42	T741	11/29/2017
Spectrum Analyzer, PXA 3Hz to 44GHz	Keysight	N9030A	T906	2/14/2018
Antenna, Horn 1-18GHz	ETS Lindgren	3117	T119	3/28/2018
Antenna, Broadband Hybrid, 30MHz to 2000MHz	Sunol Sciences	JB1	T122	1/31/2018
Amplifier, 1 to 18GHz	Miteq	AFS42-00101800-25-S-42	T742	11/29/2017
Amplifier, 10KHz to 1GHz, 32dB	Sonoma	310N	T173	6/24/2018
Spectrum Analyzer, PSA, 3Hz to 44GHz	Agilent (Keysight) Technologies	E4446A	T177	03/20/2018
Spectrum Analyzer, PXA 3Hz to 44GHz	Keysight	N9030A	T1613	12/2/2017
Power Meter, P-series single channel	Keysight	N1911A	T1268	6/15/2018
Power Sensor	Keysight	N1921A	T1224	1/31/2018
*Antenna Horn, 18 to 26GHz	ARA	MWH-1826	T447	6/24/2018
Spectrum Analyzer, PXA, 3Hz to 44GHz	Agilent (Keysight) Technologies	N9030A	T459	06/22/2018
Pre-Amp 18-26GHz	Agilent Technology	8449B	T404	7/23/2018
AC Line Conducted				
EMI Test Receiver 9Khz-7GHz	Rohde & Schwarz	ESCI7	T1124	10/07/2017
*LISN for Conducted Emissions CISPR-16	Fischer	50/250-25-2-01	T1310	06/15/2018
Power Cable, Line Conducted Emissions	UL	PG1	T861	8/31/2018
UL AUTOMATION SOFTWARE				
Radiated Software	UL	UL EMC	Ver 9.5, April 26, 2016	
Conducted Software	UL	UL EMC	Ver 5.4, October 13, 2016	
AC Line Conducted Software	UL	UL EMC	Ver 9.5, May 26, 2015	

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8. EQUIPMENT UNDER TEST

8.1. DESCRIPTION OF EUT

The EUT is a Wireless speaker with multimedia function, IEEE 802.11a/b/g/n/ac and Bluetooth radio. It has no rechargeable battery. It is powered by 100-240V ~ 50-60Hz, 1A AC Supply Line.

8.2. 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)
1Tx			
2412 - 2462	802.11b	26.20	416.87
2412 - 2462	802.11g	Covered by HT20 1TX	
2412 - 2462	802.11n HT20	25.31	339.63
2TX			
2412 - 2462	802.11n HT20 CDD	29.19	829.85

8.3. DESCRIPTION OF AVAILABLE ANTENNAS

Frequency Band (GHz)	Antenna A (dBi)	Antenna B (dBi)
2.4	3.8	3.8

8.4. SOFTWARE AND FIRMWARE

The firmware installed in the EUT during testing was version 15A420.

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8.5. WORST-CASE CONFIGURATION AND MODE

Radiated band edge, harmonic, and spurious emissions from 1GHz to 18GHz were performed with the EUT set to transmit at highest power on Low/Middle/High channels.

Radiated emissions below 30MHz, below 1GHz, above 18GHz and power line conducted emissions were performed with the EUT transmits at the channel with the highest output power as worst-case scenario.

EUT was tested at normal standup operating Y-axis position.

Worst-case data rates as provided by the client were:
Based on the baseline scan, the worst-case data rates were:

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

There are two vendors of the WiFi/Bluetooth radio modules: variant 1 and variant 2. The Wi-Fi/Bluetooth radio modules have the same mechanical outline (e.g., the same package dimension and pin-out layout), use the same on-board antenna matching circuit, have an identical antenna structure, and are built and tested to conform to the same specifications and to operate within the same tolerances.

Baseline testing was performed on the two variants to determine the worst case on all conducted power and radiated emissions.

For simultaneous transmission of multiple channels from the same antenna in the 2.4GHz and 5GHz bands, tests were conducted for various configurations having the highest power. No noticeable new emission was found.

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8.6. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Support Equipment List				
Description	Manufacturer	Model	Serial Number	FCC ID
Laptop AC/DC adapter	Liteon Technology	PA-1450-BA1	B123	NA
Laptop	Apple	MackBook Air 4	NA	NA
Dongle	N/A	N/A	HDG1409226823	NA

I/O CABLES

I/O Cable List						
Cable No	Port	# of identical ports	Connector Type	Cable Type	Cable Length (m)	Remarks
1	Antenna	1	SMA	Un-Shielded	0.2	To spectrum Analyzer
2	USB	1	USB	Shielded	1	N/A
3	AC	1	AC	Un-shielded	3	N/A

I/O CABLES (RADIATED ABOVE 1 GHZ)

I/O Cable List						
Cable No	Port	# of identical ports	Connector Type	Cable Type	Cable Length (m)	Remarks
1	AC	1	AC	Un-shielded	3	N/A

I/O CABLES (AC POWER CONDUCTED TEST AND BELOW 1 GHZ)

I/O Cable List						
Cable No	Port	# of identical ports	Connector Type	Cable Type	Cable Length (m)	Remarks
1	AC	1	AC	Un-shielded	3	N/A

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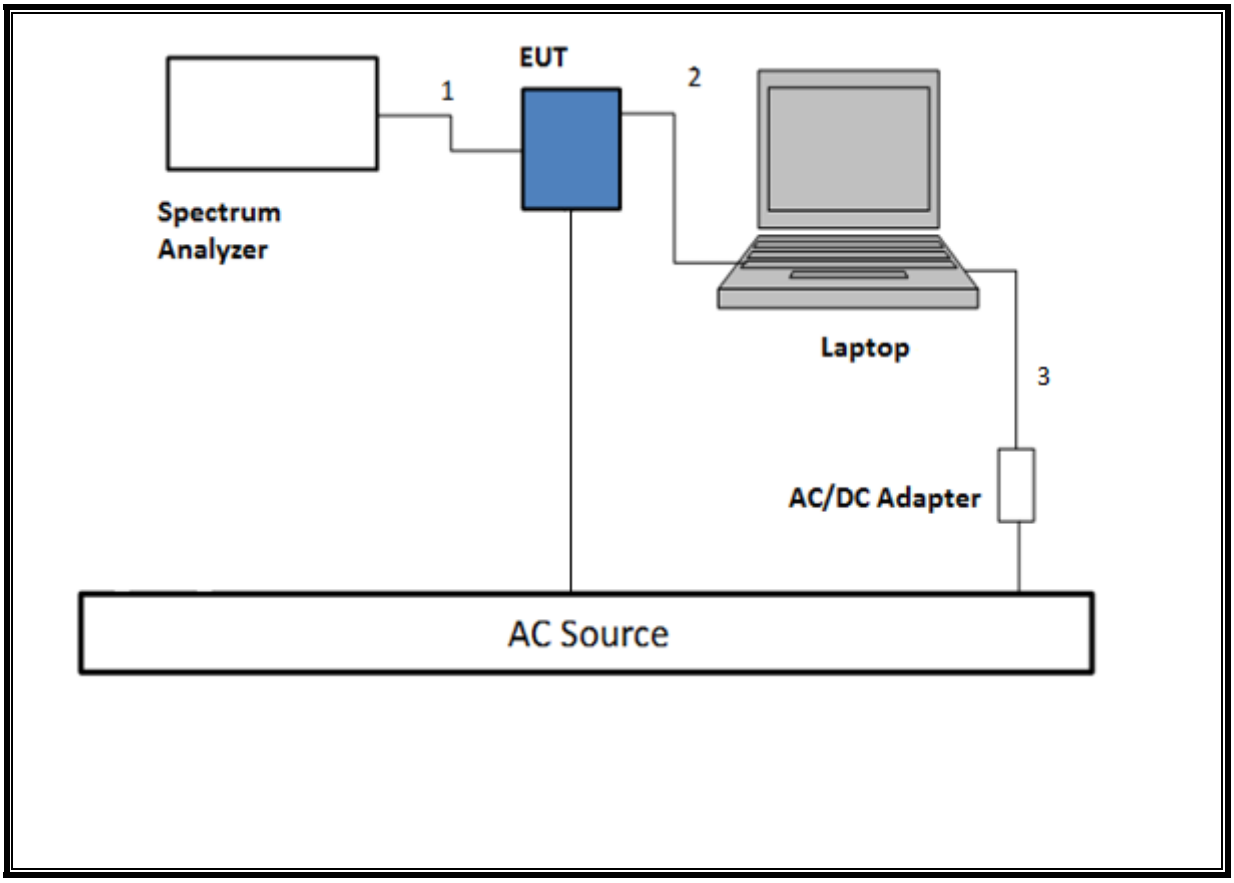
TEST SETUP- CONDUCTED PORT

The EUT was tested connected to a host Laptop via USB cable adapter and spectrum analyzer to antenna port. Test software exercised the EUT.

SETUP DIAGRAM



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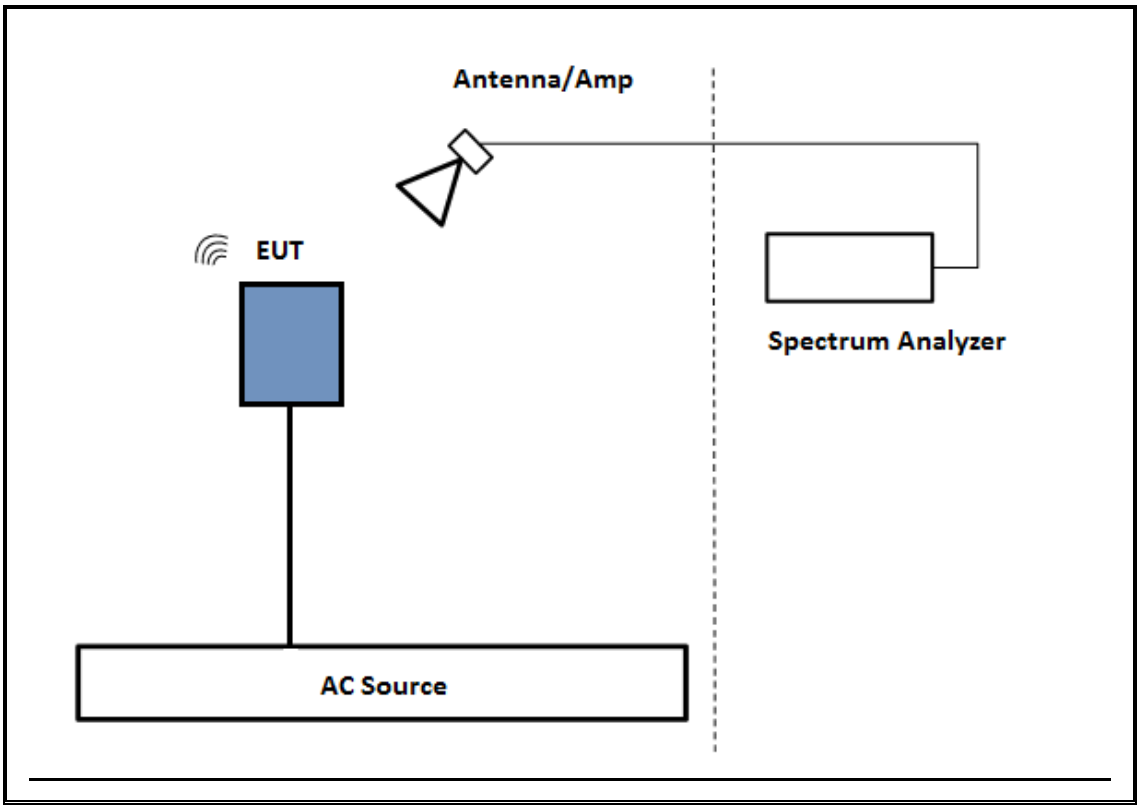
TEST SETUP- RADIATED-ABOVE 1 GHZ

The EUT was powered by AC cord. Test software exercised the EUT.

SETUP DIAGRAM



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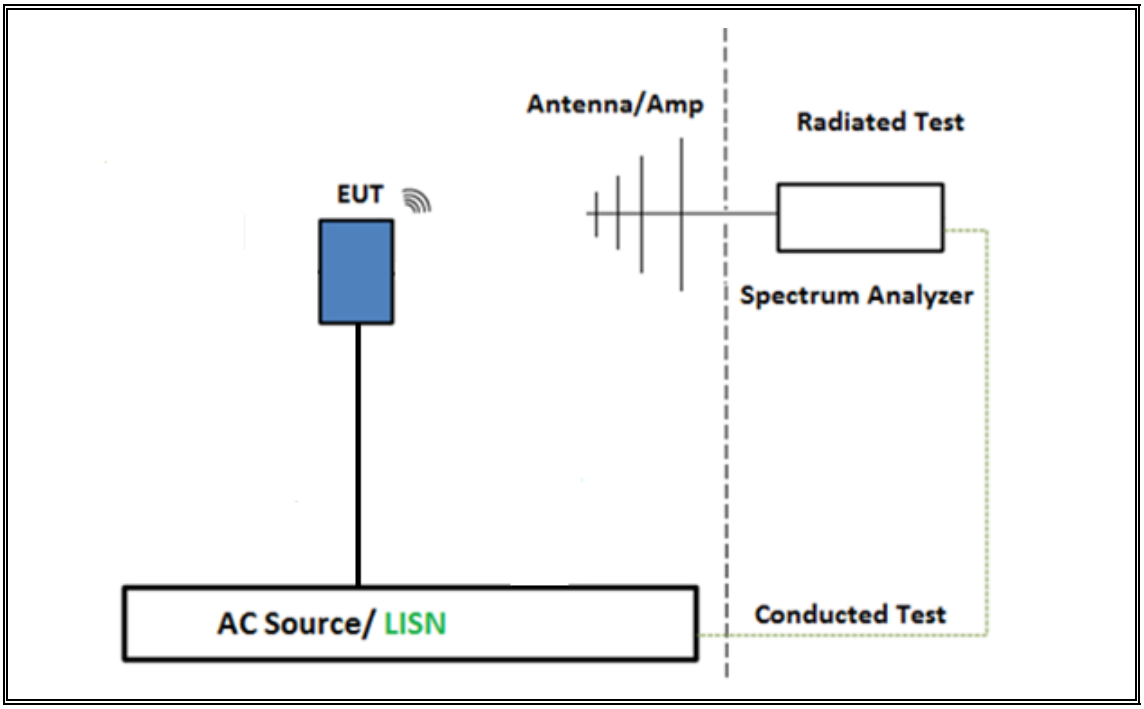
TEST SETUP- BELOW 1GHZ & AC LINE CONDUCTED TESTS

The EUT was powered by AC cord. Test software exercised the EUT.

SETUP DIAGRAM



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9. ANTENNA PORT TEST RESULTS

9.1. 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	128.200	128.200	1.000	100.00%	0.00	0.010
802.11n HT20 1TX	1.915	1.938	0.988	98.81%	0.00	0.010
802.11n HT20 CDD	1.913	1.935	0.989	98.86%	0.00	0.010

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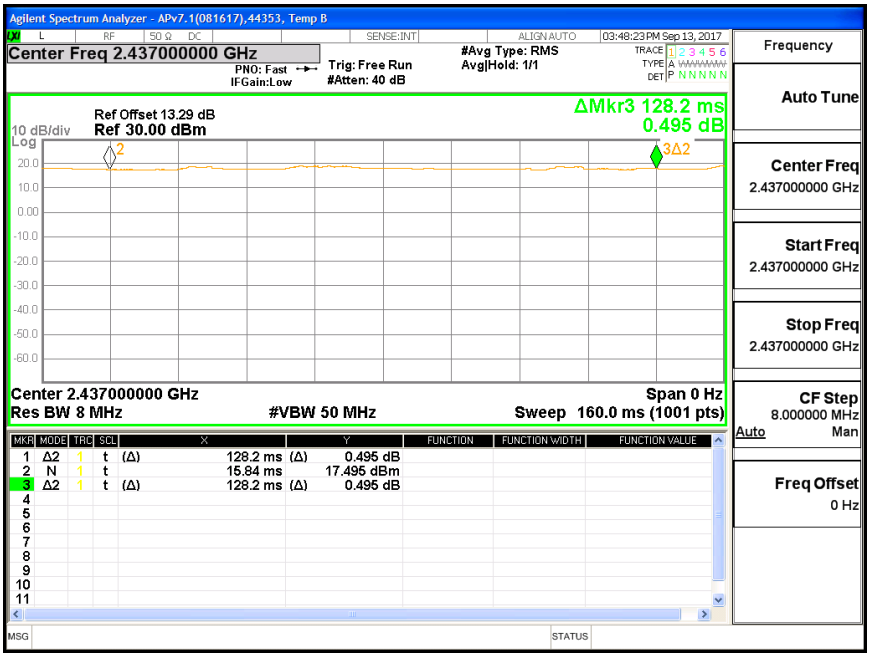
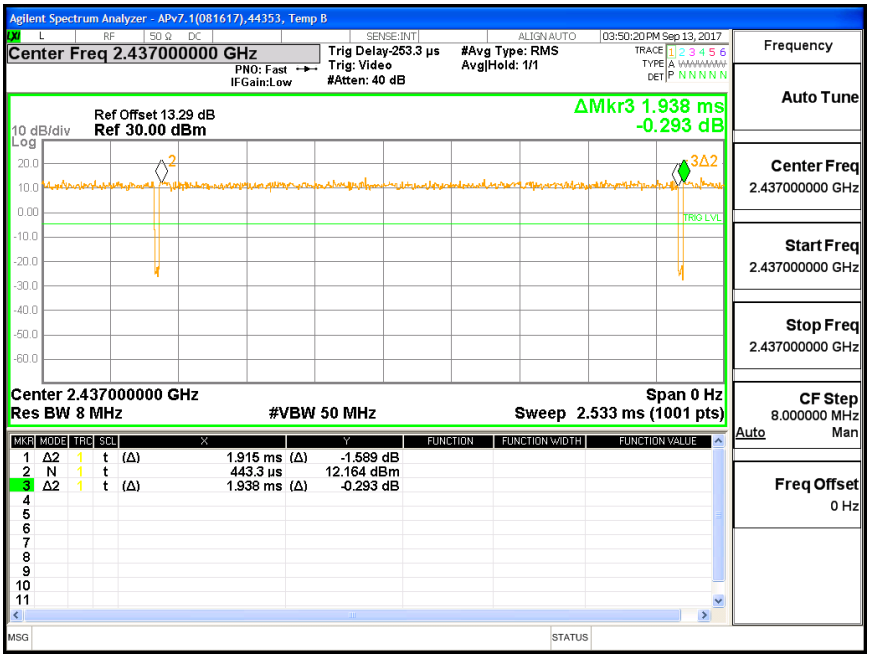
DUTY CYCLE PLOTS

DUTY CYCLE 802.11b 1TX MODE



DUTY CYCLE 802.11n HT20 1TX MODE



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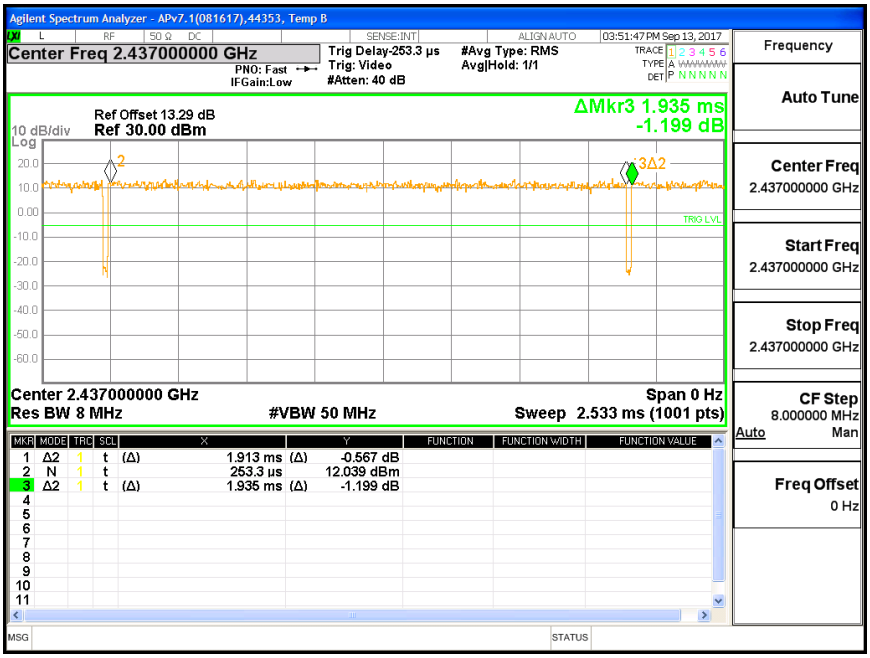
DUTY CYCLE 802.11n HT20 CDD MODE



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9.2. 99% BANDWIDTH

LIMITS

None; for reporting purposes only.

RESULTS

9.2.1. 802.11b MODE

1TX Antenna A

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low 1	2412	12.404
Low 2	2417	12.150
Low 3	2422	12.658
Mid 6	2437	12.807
High 9	2452	12.866
High 10	2457	12.580
High 11	2462	12.381
High 12	2467	12.747
High 13	2472	12.747

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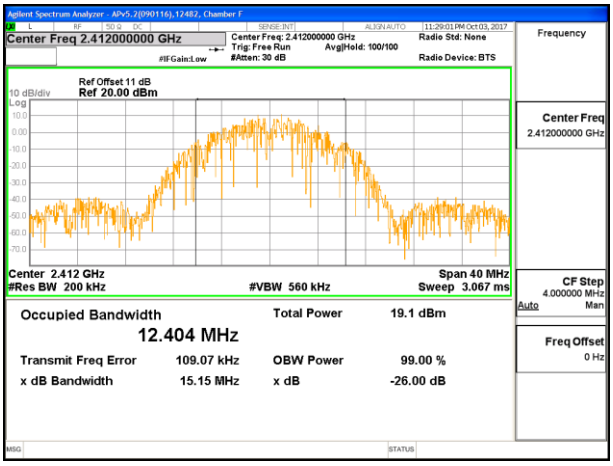
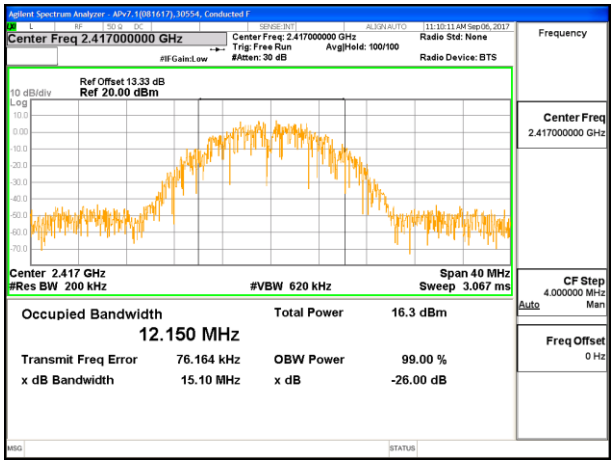
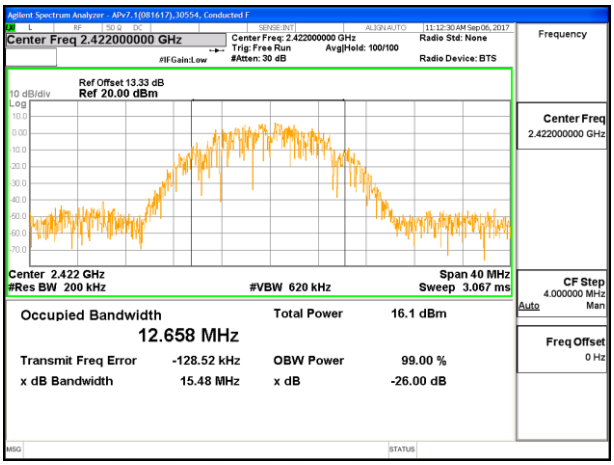


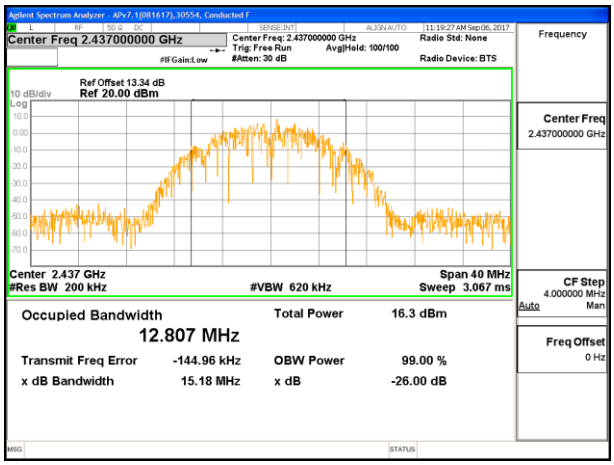
LOW CHANNEL 1



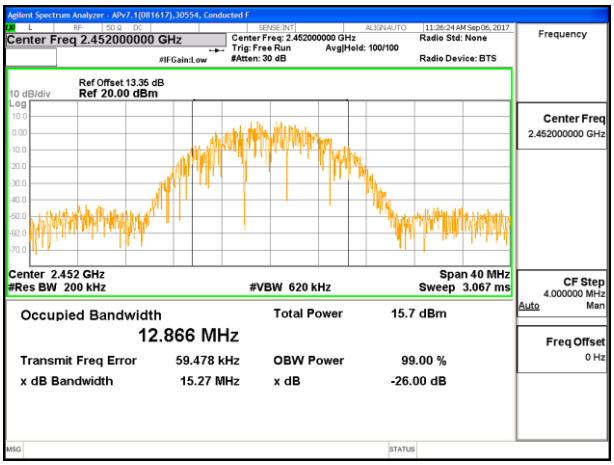
LOW CHANNEL 2



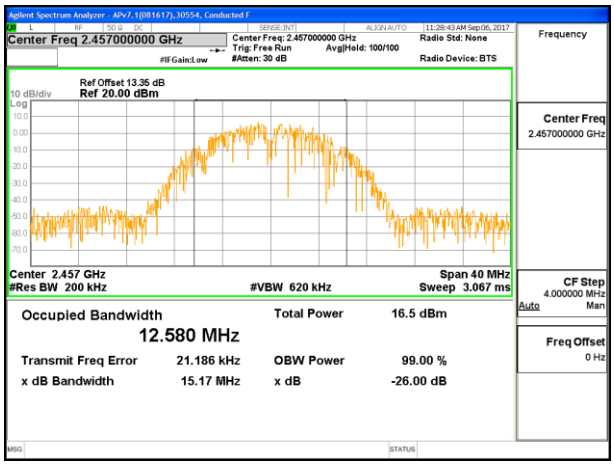
LOW CHANNEL 3



MID CHANNEL 6



HIGH CHANNEL 9



HIGH CHANNEL 10

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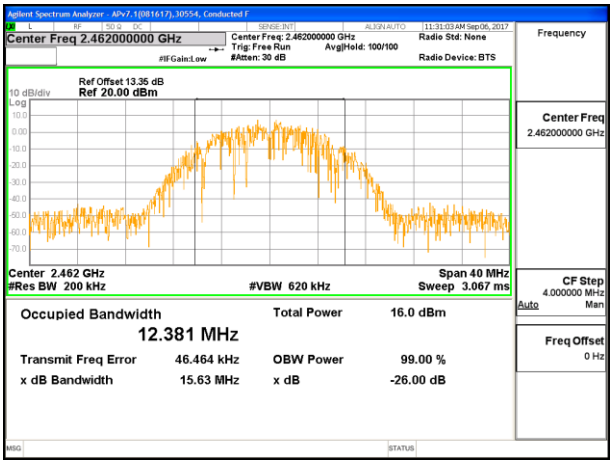
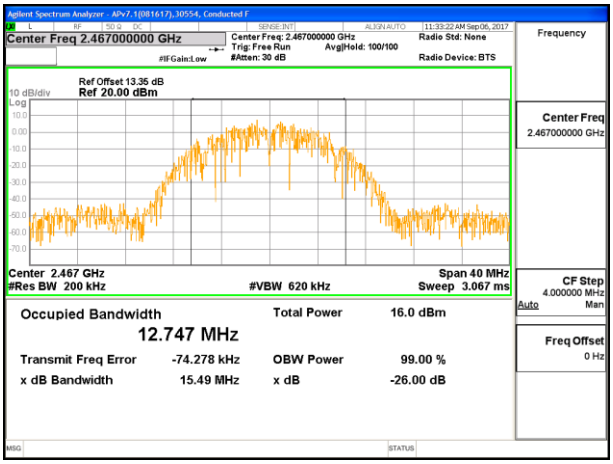
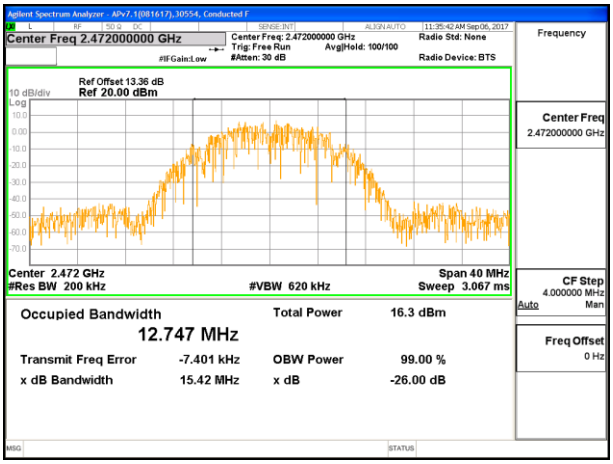


HIGH CHANNEL 11



HIGH CHANNEL 12



HIGH CHANNEL 13

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1TX Antenna B

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low 1	2412	12.339
Low 2	2417	12.375
Low 3	2422	12.531
Mid 6	2437	12.616
High 9	2452	12.854
High 10	2457	12.250
High 11	2462	12.505
High 12	2467	12.901
High 13	2472	12.663

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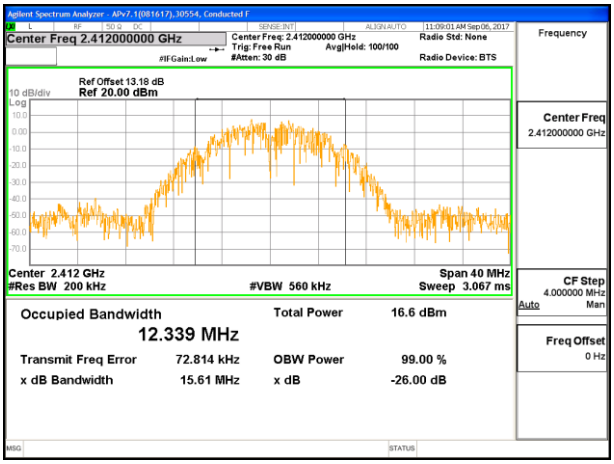
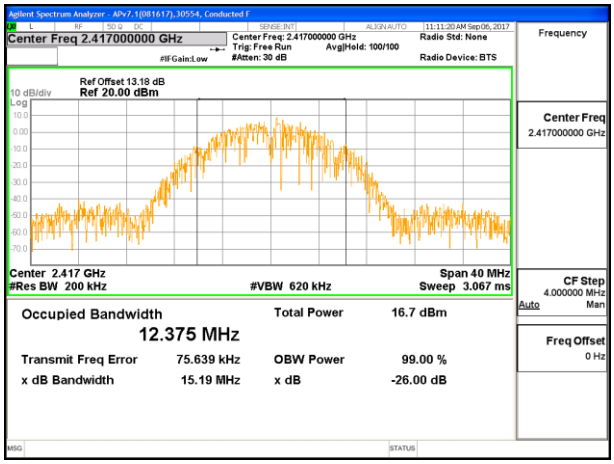


LOW CHANNEL 1



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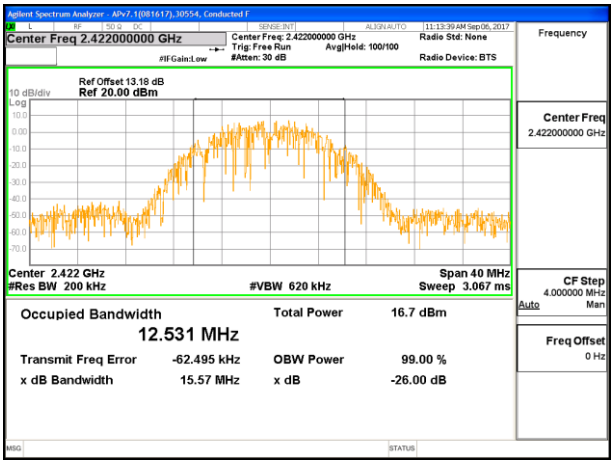
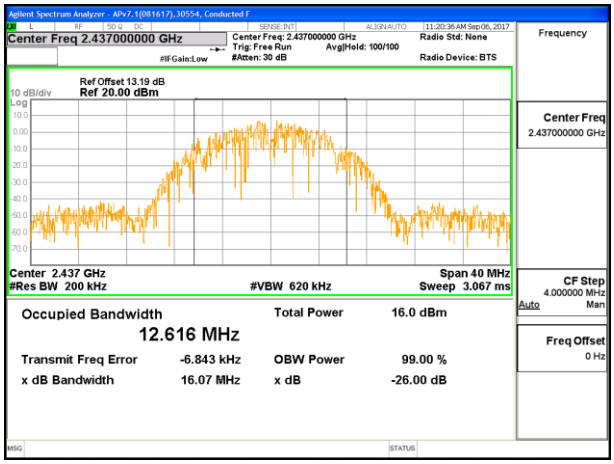
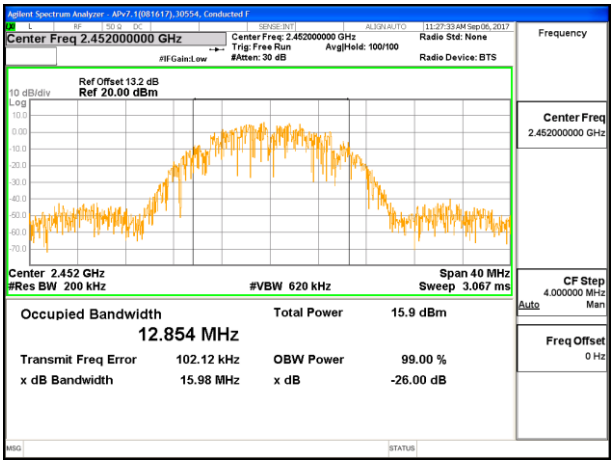


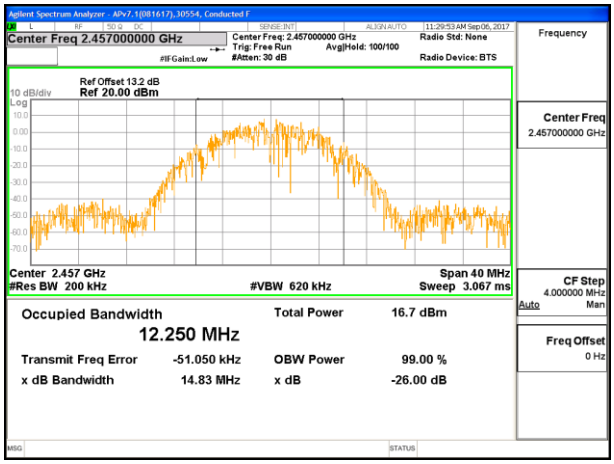
LOW CHANNEL 3



MID CHANNEL 6



HIGH CHANNEL 9



HIGH CHANNEL 10

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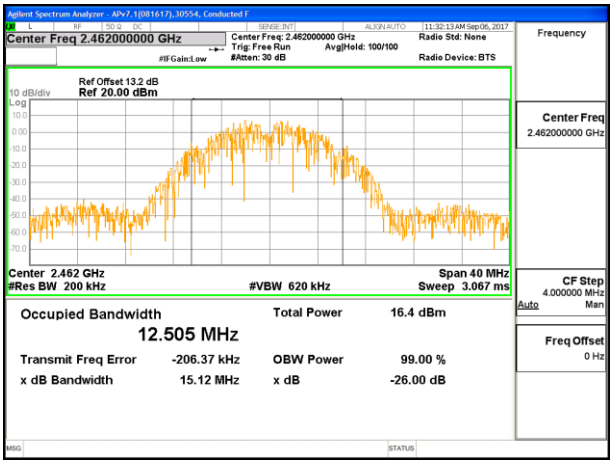
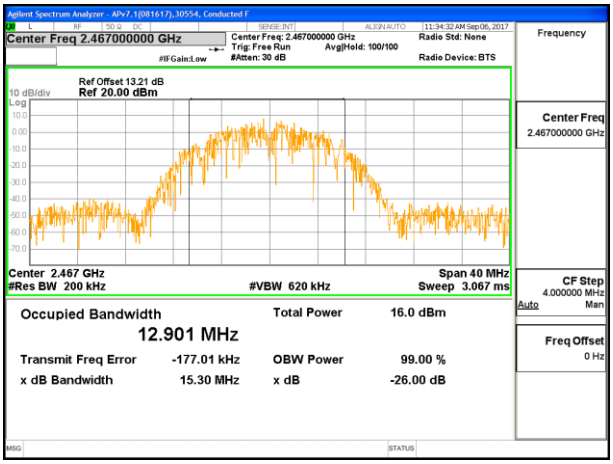
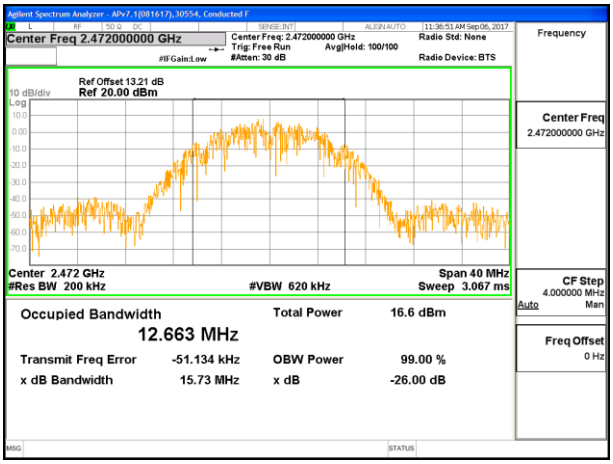


HIGH CHANNEL 11



HIGH CHANNEL 12



HIGH CHANNEL 13

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9.2.2. 802.11n HT20 SISO MODE

1TX Antenna A

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low 1	2412	17.755
Low 2	2417	17.694
Low 3	2422	17.743
Low 4	2427	17.831
Low 5	2432	17.460
Mid 6	2437	17.784
High 7	2442	17.783
High 8	2447	17.725
High 9	2452	17.804
High 10	2457	17.648
High 11	2462	17.714
High 12	2467	17.779
High 13	2472	17.809

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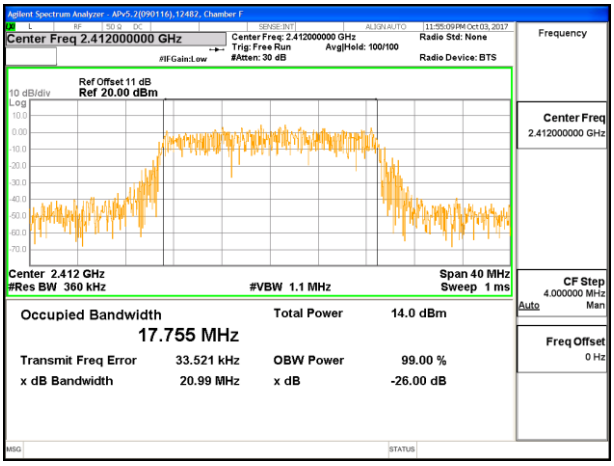
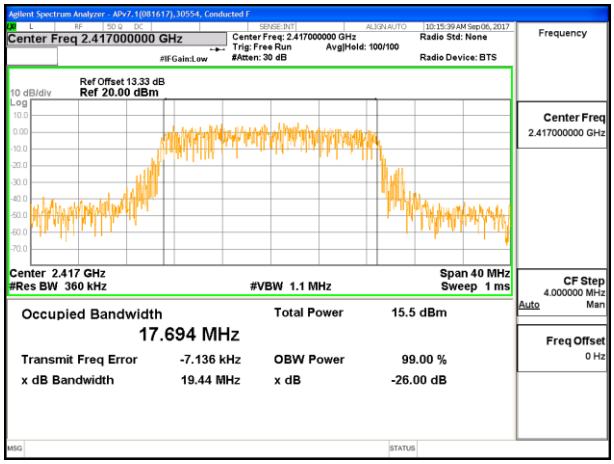
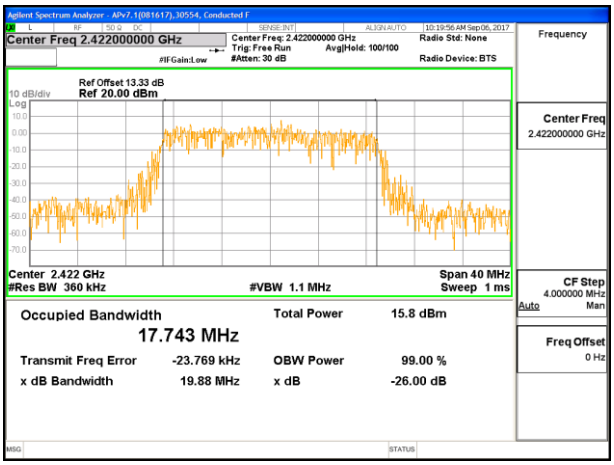


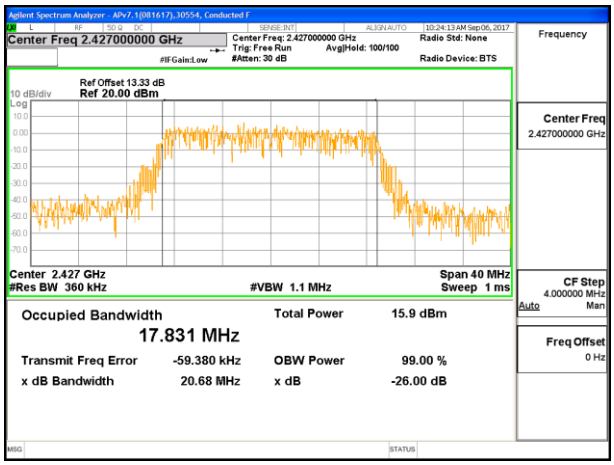
LOW CHANNEL 1



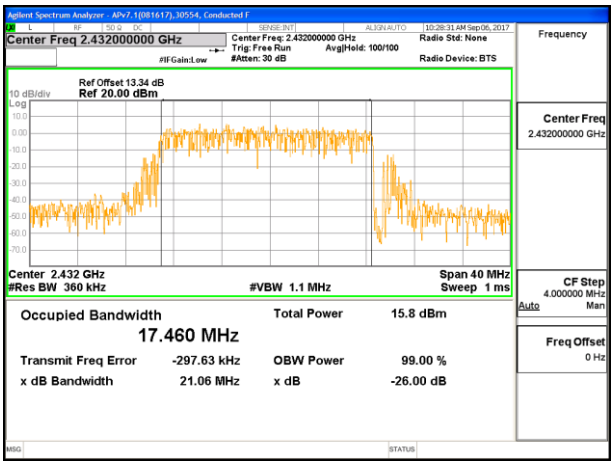
LOW CHANNEL 2



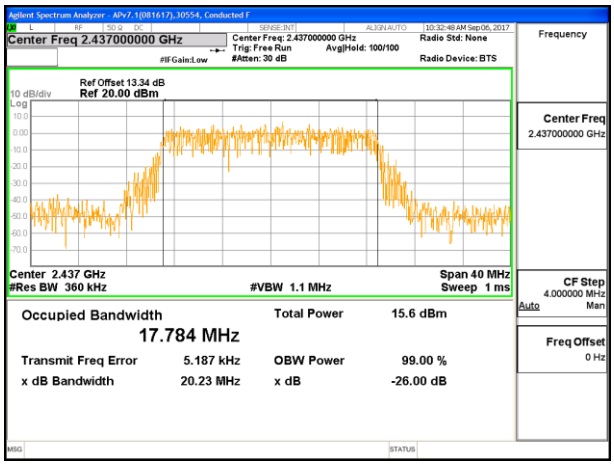
LOW CHANNEL 3



LOW CHANNEL 4



LOW CHANNEL 5



MID CHANNEL 6

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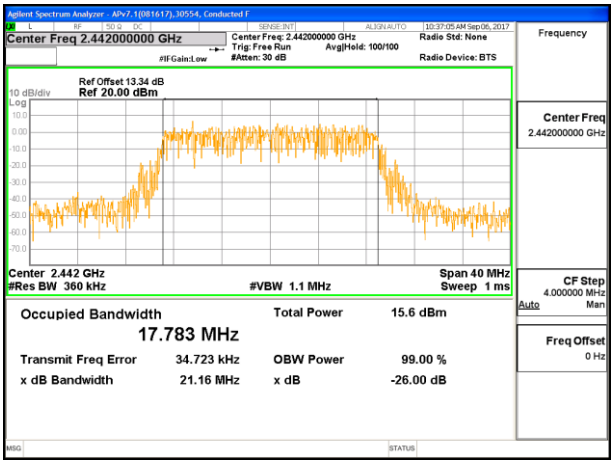
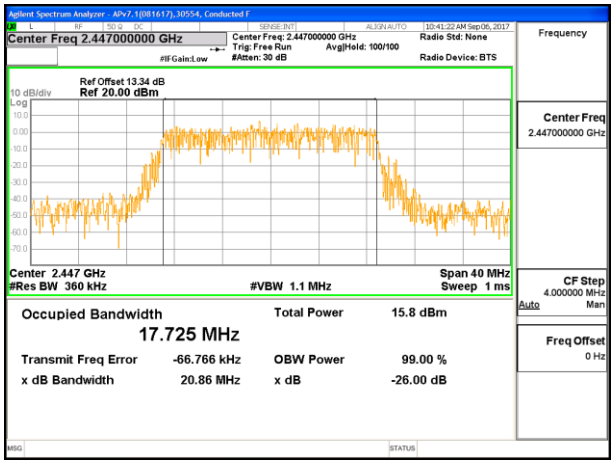
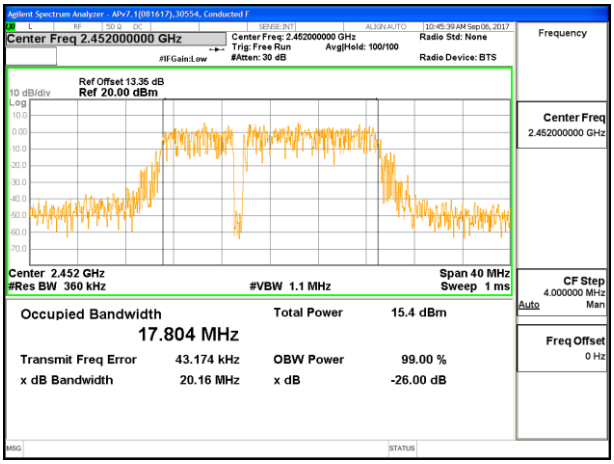


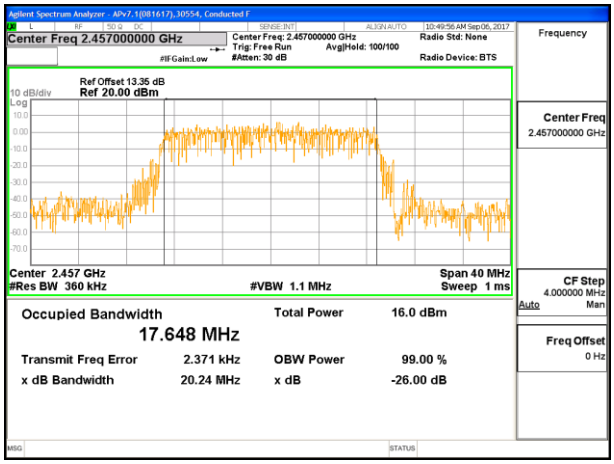
HIGH CHANNEL 7



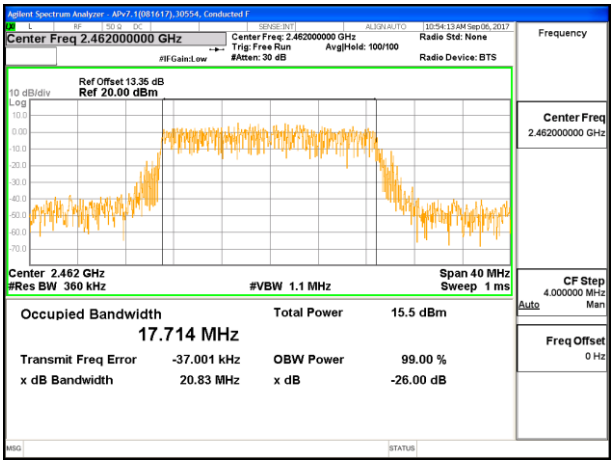
HIGH CHANNEL 8



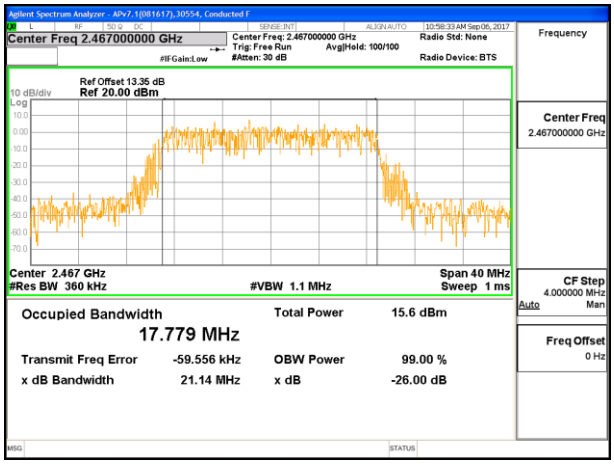
HIGH CHANNEL 9



HIGH CHANNEL 10



HIGH CHANNEL 11



HIGH CHANNEL 12

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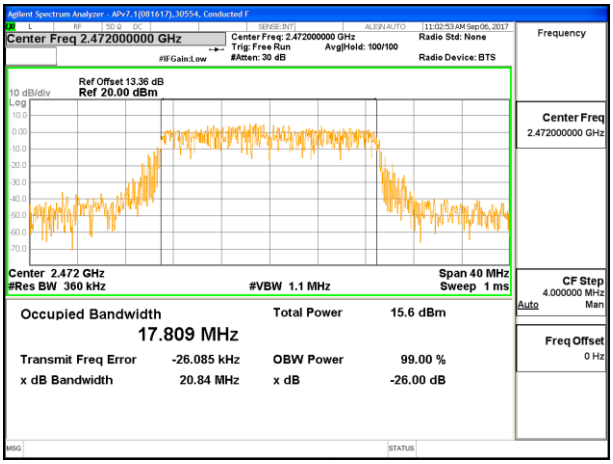

HIGH CHANNEL 13

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1TX Antenna B

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low 1	2412	17.654
Low 2	2417	17.746
Low 3	2422	17.745
Low 4	2427	17.780
Low 5	2432	17.770
Mid 6	2437	17.763
High 7	2442	17.843
High 8	2447	17.837
High 9	2452	17.641
High 10	2457	17.821
High 11	2462	17.667
High 12	2467	17.839
High 13	2472	17.822

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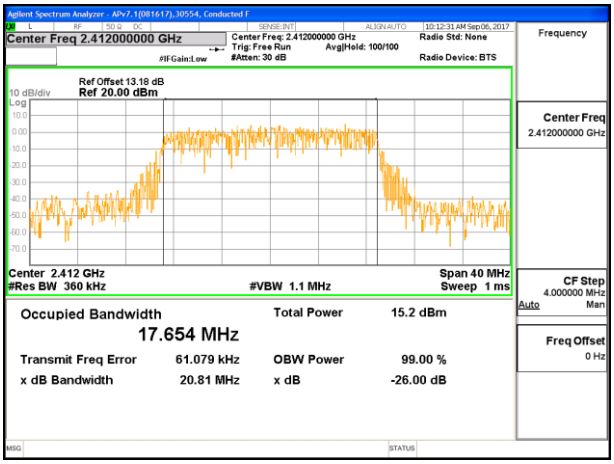
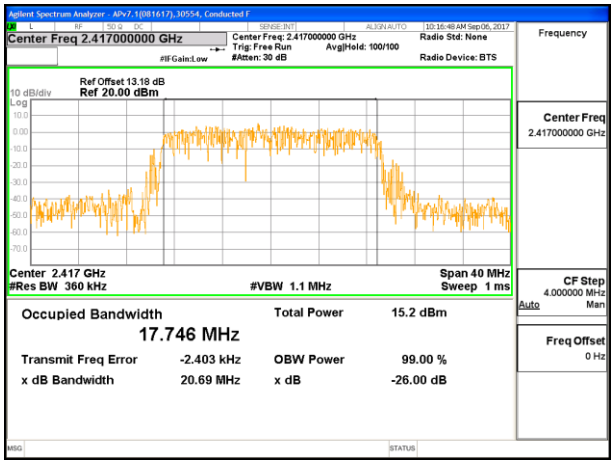
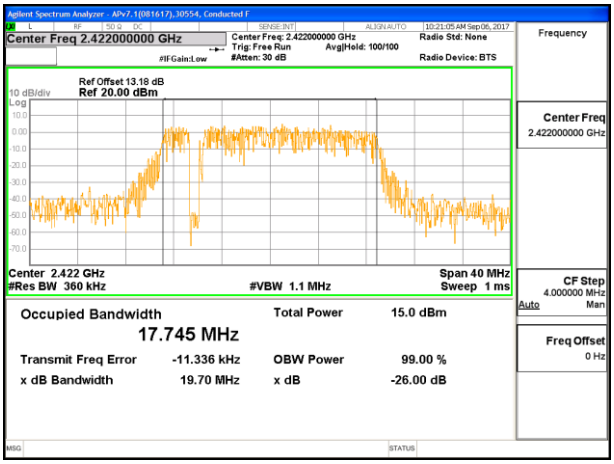


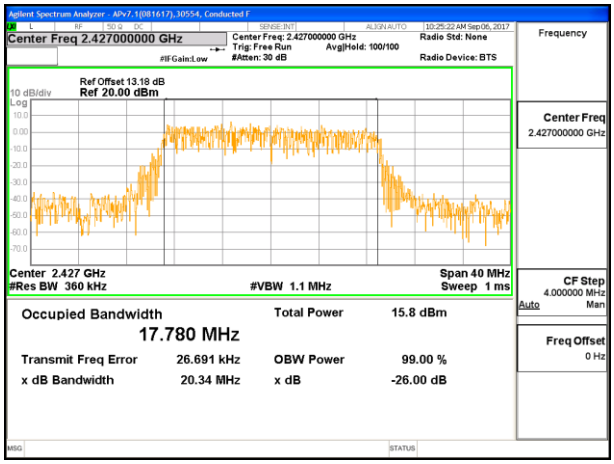
LOW CHANNEL 1



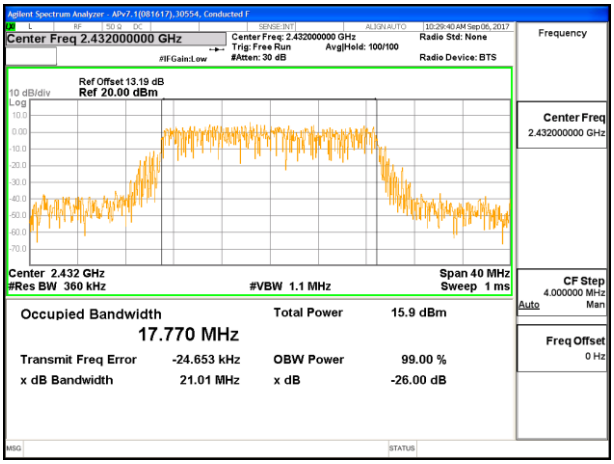
LOW CHANNEL 2



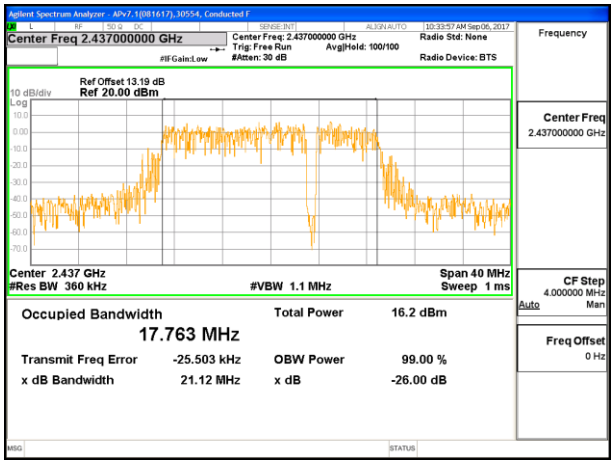
LOW CHANNEL 3



LOW CHANNEL 4



LOW CHANNEL 5



MID CHANNEL 6

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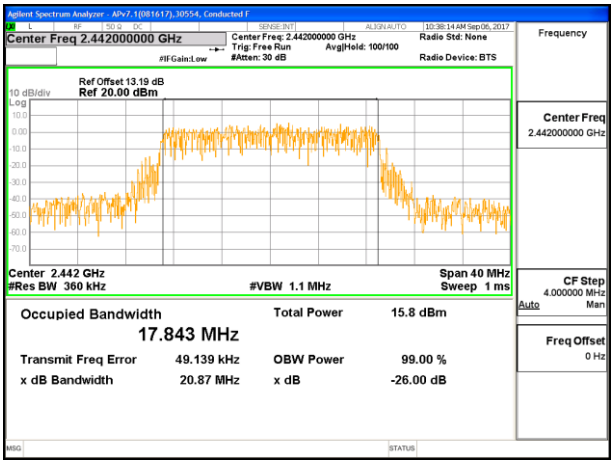
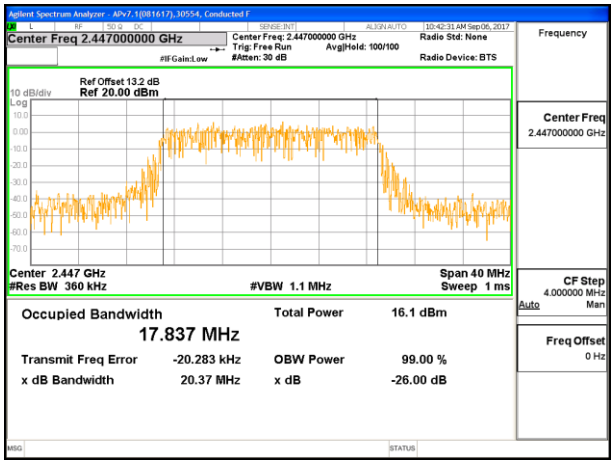
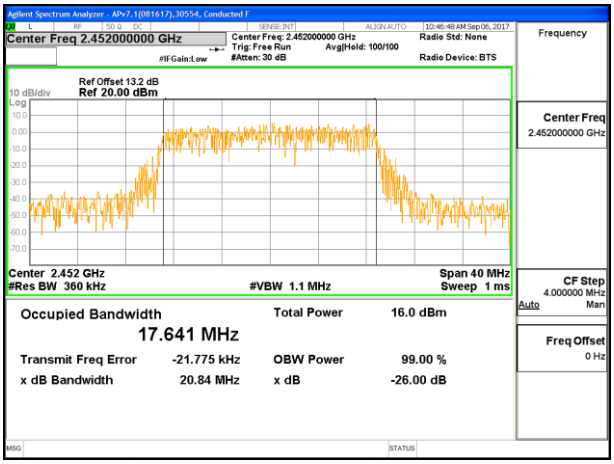


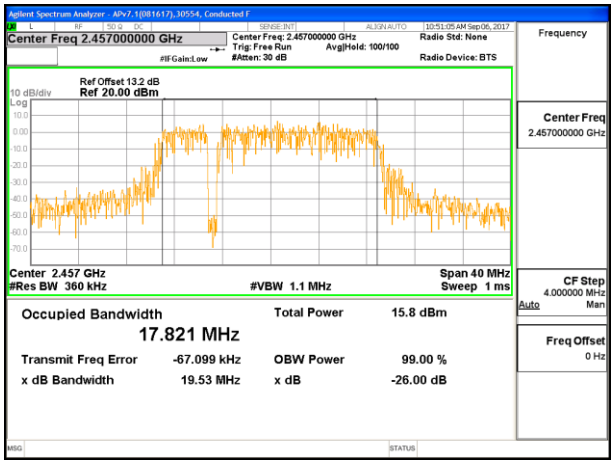
HIGH CHANNEL 7



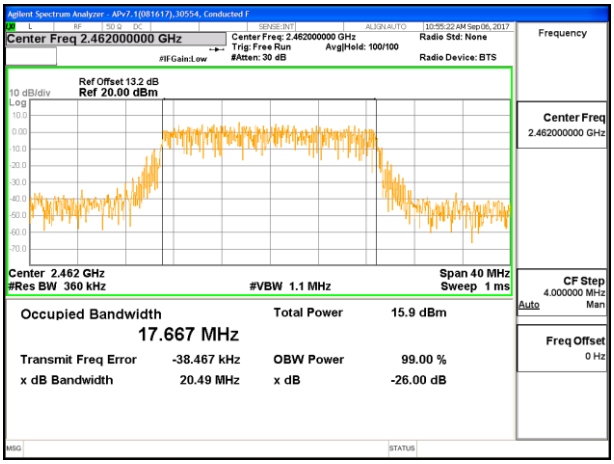
HIGH CHANNEL 8



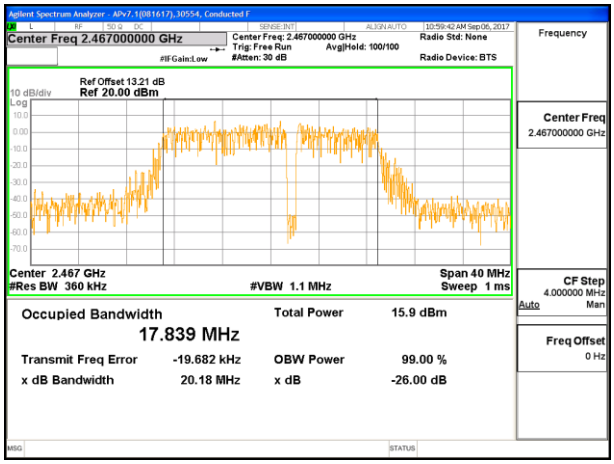
HIGH CHANNEL 9



HIGH CHANNEL 10



HIGH CHANNEL 11



HIGH CHANNEL 12

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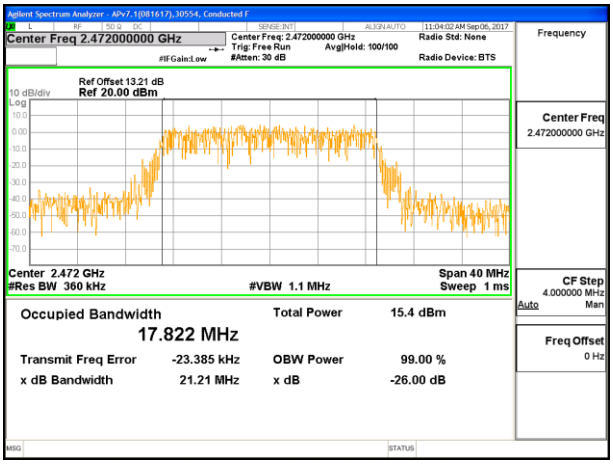

HIGH CHANNEL 13

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9.2.3. 802.11n HT20 MIMO MODE

2TX Antenna A + Antenna B CDD MODE

Channel	Frequency (MHz)	99% Bandwidth Ant A (MHz)	99% Bandwidth Ant B (MHz)
Low 1	2412	17.605	17.723
Low 2	2417	17.742	17.578
Low 3	2422	17.736	17.720
Low 4	2427	17.779	17.793
Low 5	2432	17.720	17.742
Mid 6	2437	17.816	17.869
High 7	2442	17.678	17.750
High 8	2447	17.807	17.687
High 9	2452	17.689	17.750
High 10	2457	17.717	17.817
High 11	2462	17.766	17.771
High 12	2467	17.631	17.778
High 13	2472	17.843	17.732

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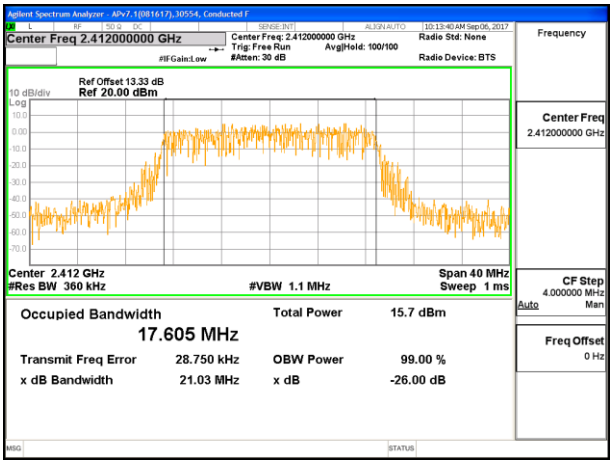
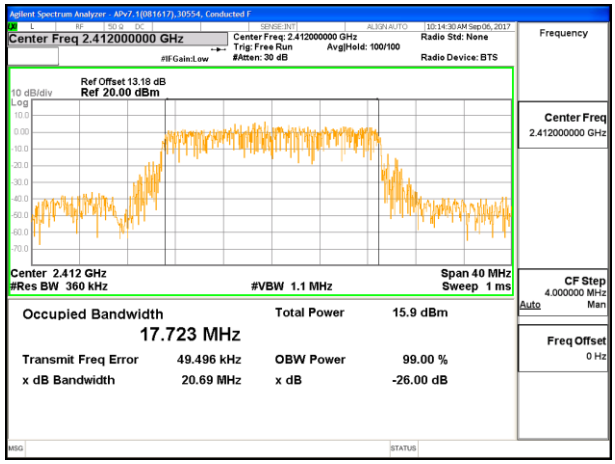
LOW CHANNEL 1

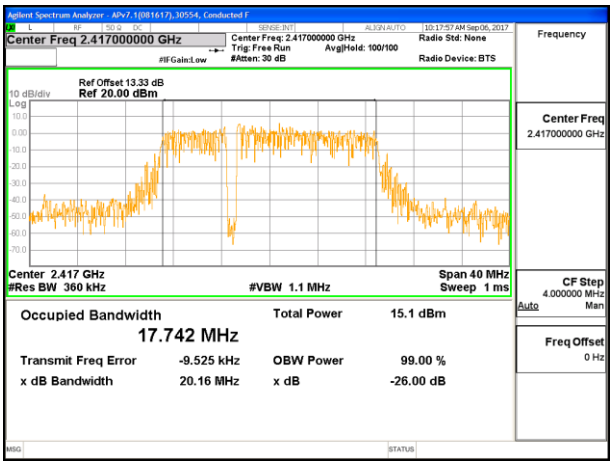


LOW CHANNEL 1 Antenna A

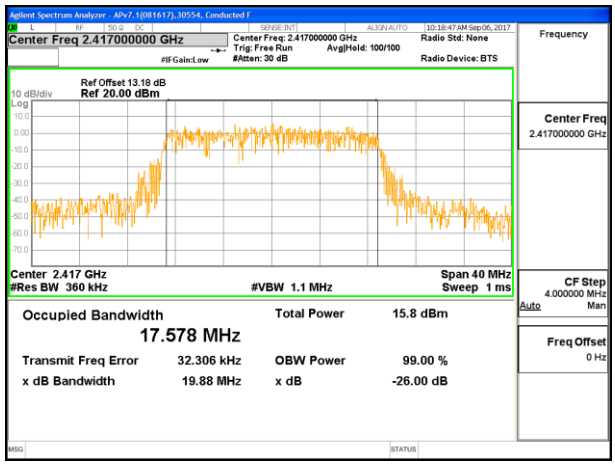


LOW CHANNEL 1 Antenna B

LOW CHANNEL 2

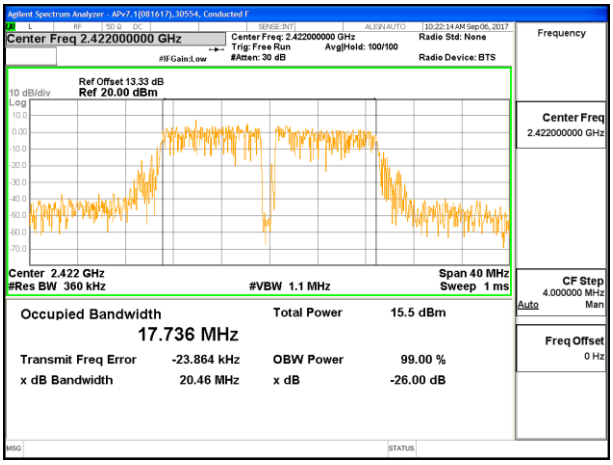


LOW CHANNEL 2 Antenna A

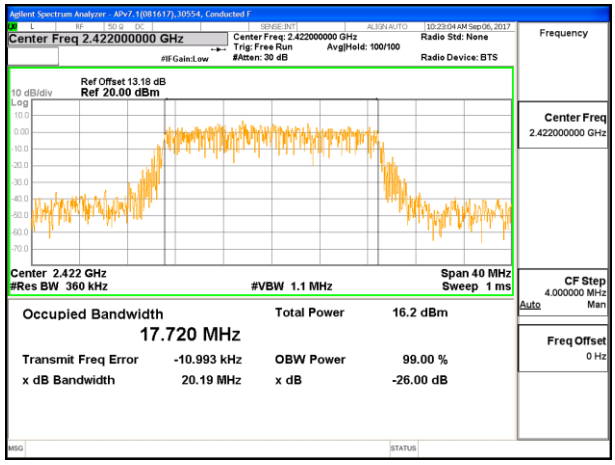


LOW CHANNEL 2 Antenna B

LOW CHANNEL 3



LOW CHANNEL 3 Antenna A



LOW CHANNEL 3 Antenna B

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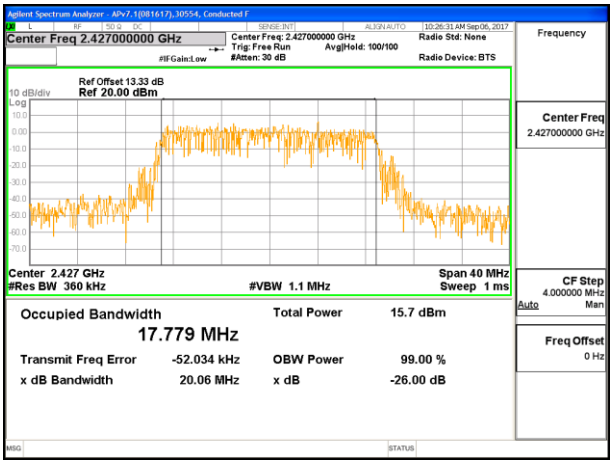
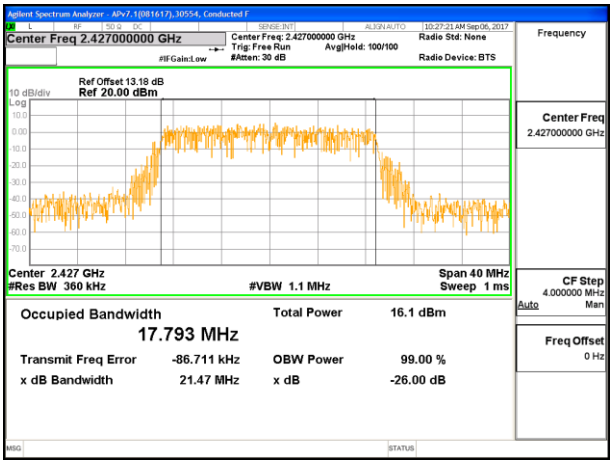
LOW CHANNEL 4

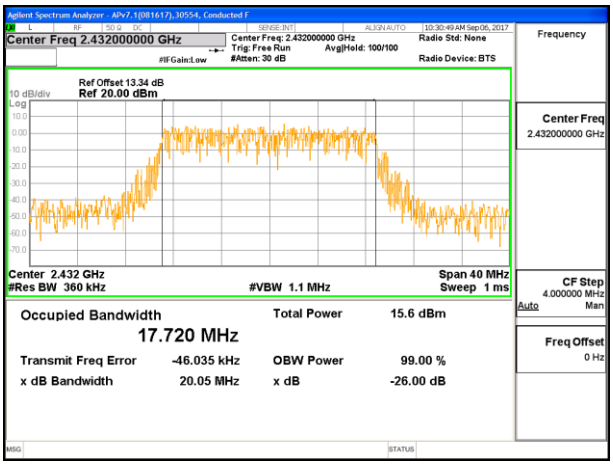


LOW CHANNEL 4 Antenna A

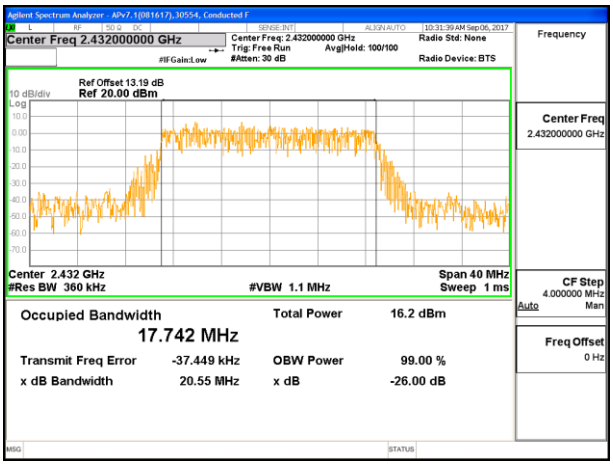


LOW CHANNEL 4 Antenna B

LOW CHANNEL 5

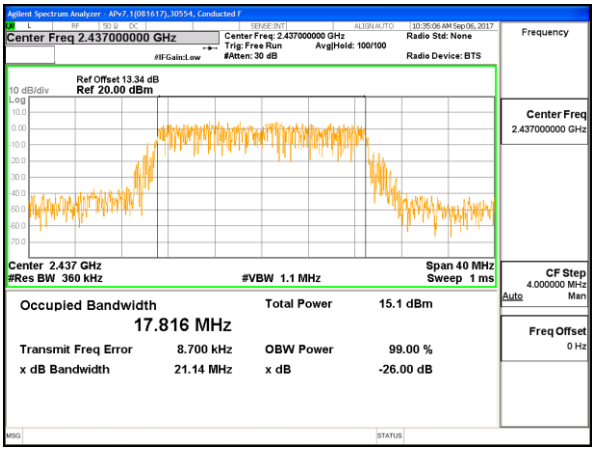


LOW CHANNEL 5 Antenna A

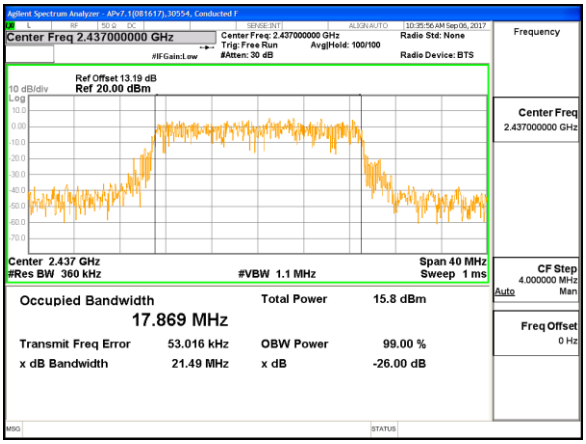


LOW CHANNEL 5 Antenna B

MID CHANNEL 6



MID CHANNEL 6 Antenna A



MID CHANNEL 6 Antenna B

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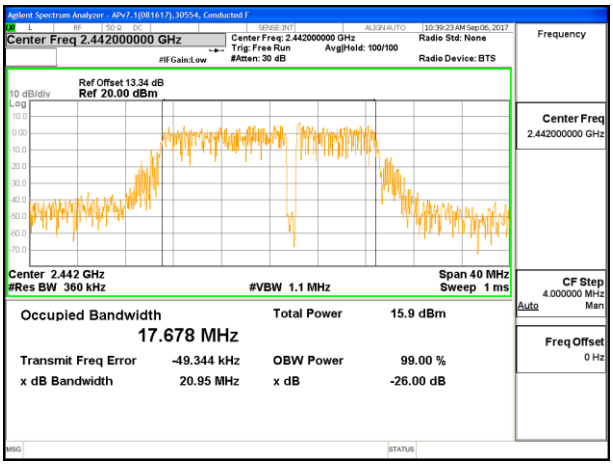
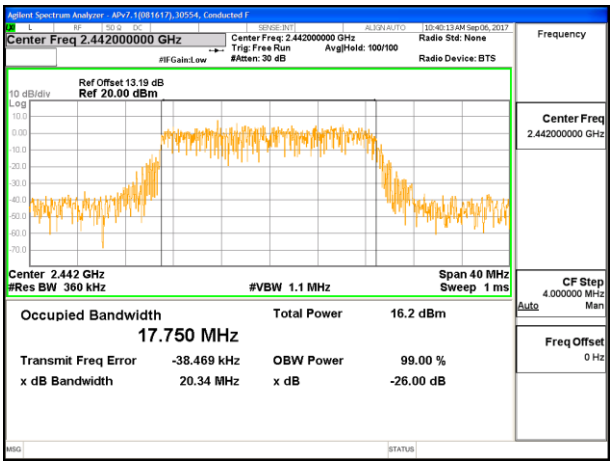
HIGH CHANNEL 7

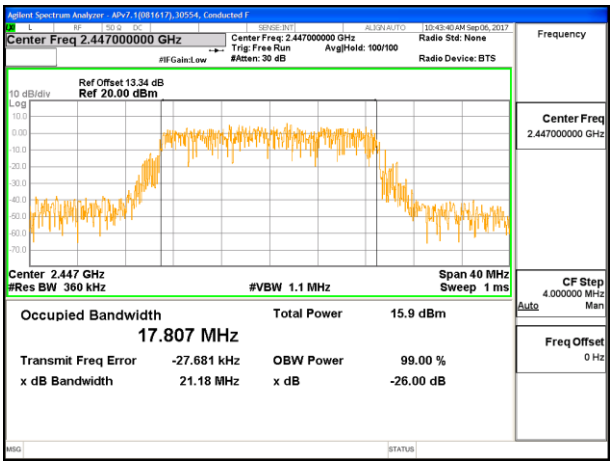


HIGH CHANNEL 7 Antenna A

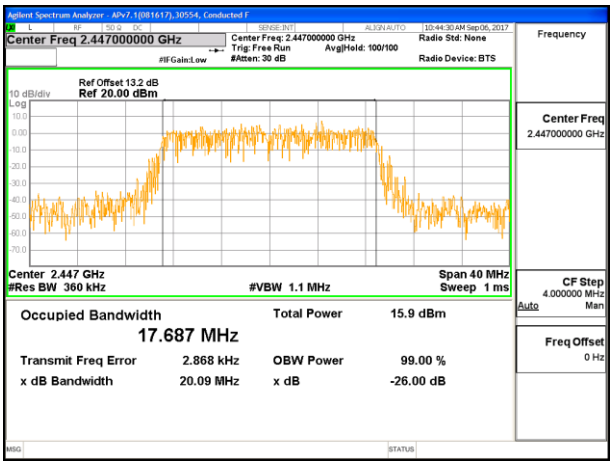


HIGH CHANNEL 7 Antenna B

HIGH CHANNEL 8

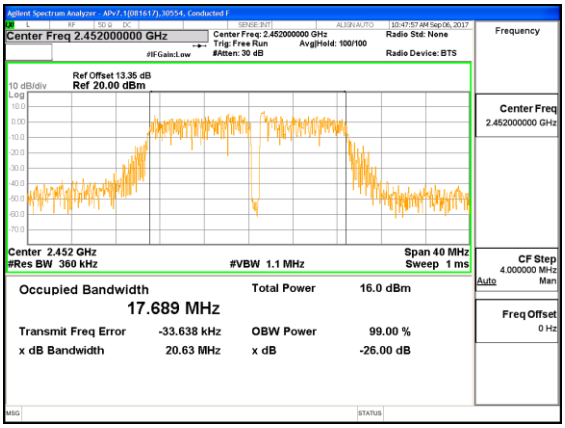


HIGH CHANNEL 8 Antenna A

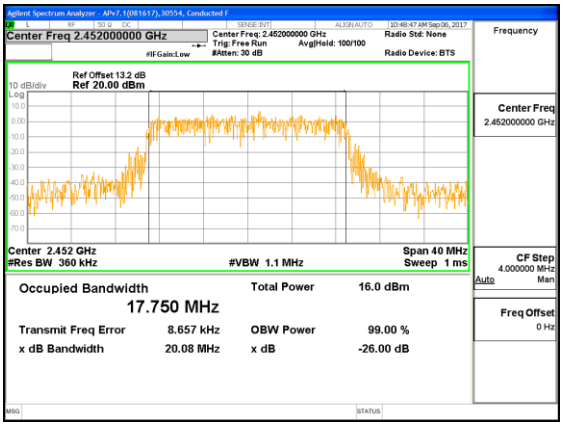


HIGH CHANNEL 8 Antenna B

HIGH CHANNEL 9



HIGH CHANNEL 9 Antenna A



HIGH CHANNEL 9 Antenna B

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