



FCC CFR47 PART 15 SUBPART C

CERTIFICATION TEST REPORT

FOR

GSM/WCDMA/LTE Tablet + Bluetooth/BLE and DTS/UNII a/b/g/n/ac and ANT+

MODEL NUMBER : SM-T815

FCC ID: A3LSMT815

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: SAMSUNG ELECTRONICS CO., LTD.
EUT DESCRIPTION: GSM/WCDMA/LTE Tablet+Bluetooth/BLE, DTS/UNII a/b/g/n/ac and ANT+
MODEL NUMBER: SM-T815
SERIAL NUMBER: R32G300M6CW (RADIATED); R32G300N6DL (CONDUCTED)
DATE TESTED: APRIL 06 - MAY 18, 2015

APPLICABLE STANDARDS	
STANDARD	TEST RESULTS
CFR 47 Part 15 Subpart C	Pass

UL Korea, Ltd. 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 Korea, Ltd. 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 Korea, Ltd. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL Korea, Ltd. 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 IAS, any agency of the Federal Government, or any agency of any government.

Approved & Released For
UL Korea, Ltd. By:

Tested By:



Ji Ho Choi
Suwon Lab Manager
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CY Choi
Suwon Lab Engineer
UL Korea, Ltd.

2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with ANSI C63.4-2009, FCC CFR 47 Part 2, FCC CFR 47 Part 15.

3. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 218 Maeyeong-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 443-823, Korea. Line conducted emissions are measured only at the 218 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.

218 Maeyeong-ro	
☒	Chamber 1
☐	Chamber 2

UL Korea, Ltd. is accredited by IAS, Laboratory Code TL-637. The full scope of accreditation can be viewed at <http://www.iasonline.org/PDF/TL/TL-637.pdf>.

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:

$$\begin{aligned}\text{Field Strength (dBuV/m)} &= \text{Measured Voltage (dBuV)} + \text{Antenna Factor (dB/m)} + \\ &\text{Cable Loss (dB)} - \text{Preamp Gain (dB)} \\ 36.5 \text{ dBuV} + 18.7 \text{ dB/m} + 0.6 \text{ dB} - 26.9 \text{ dB} &= 28.9 \text{ dBuV/m}\end{aligned}$$

4.3. MEASUREMENT UNCERTAINTY

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

PARAMETER	UNCERTAINTY
Conducted Disturbance, 0.15 to 30 MHz	2.32 dB
Radiated Disturbance, Below 1GHz	4.14 dB
Radiated Disturbance, Above 1 GHz	5.97 dB

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

5. EQUIPMENT UNDER TEST

5.1. DESCRIPTION OF EUT

The EUT is a GSM/WCDMA/LTE Tablet + Bluetooth/BLE, DTS/UNII a/b/g/n/ac and ANT+. This test report addresses the DTS (WLAN) operational mode.

WiFi MIMO Condition

Frequency	Mode	Antenna 1	Antenna 2
2.4 GHz	802.11b	TX / RX	TX / RX
	802.11g	TX / RX	TX / RX
	802.11n	TX / RX	TX / RX
	802.11n MIMO	TX / RX	TX / RX
5 GHz	802.11a	TX / RX	TX / RX
	802.11n	TX / RX	TX / RX
	802.11ac	TX / RX	TX / RX
	802.11n/ac MIMO	TX / RX	TX / RX

5.2. MAXIMUM OUTPUT POWER

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

Frequency Range [MHz]	Mode	Frequency [MHz]	Output Power [dBm]		Output Power [mW]	
			Antenna1	Antenna2	Antenna1	Antenna2
2412 - 2472	802.11b	2412 - 2462	17.28	17.47	53.46	55.85
		2467 - 2472	0.25	-0.31	1.06	0.93
	802.11g	2412 - 2462	14.72	15.21	29.65	33.19
		2467 - 2472	-0.12	-0.69	0.97	0.85
	802.11n SISO	2412 - 2462	13.74	13.74	23.66	23.66
		2467 - 2472	-0.78	-0.78	0.84	0.84
	802.11n MIMO	2412 - 2462	16.57		45.39	
		2467 - 2472	2.49		1.77	

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes an FPCB antennas, with a antenna1's maximum gain of -0.34 dBi and antenna2's maximum gain of 0.48 dBi .

5.4. LIST OF TEST REDUCTION AND MODES

2400 - 2483.5 MHz Authorized Frequency Band (Antenna Port & Radiated Testing)		
Frequency Range [MHz]	Mode	Covered by
2412 - 2472	802.11b Legacy 1TX	802.11b Legacy 2TX
	802.11g Legacy 1TX	802.11g CDD 2TX
	802.11n 1TX	802.11n HT20 CDD 2TX
	802.11n STBC 2TX	802.11n HT20 CDD 2TX

5.5. WORST-CASE CONFIGURATION AND MODE

Radiated emission and power line conducted emission were performed with the EUT set to transmit at the channel with highest output power as worst-case scenario.

The fundamental of the EUT was investigated in three orthogonal orientations X, Y and Z it was determined that Z orientation was worst-case orientation; therefore, all final radiated testing was performed with the EUT in Z orientation.

Based on the baseline scan, the worst-case data rates were:

802.11b mode: 1 Mbps

802.11g mode: 6 Mbps

802.11n HT20 mode: MCS0

5.6. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Support Equipment List				
Description	Manufacturer	Model	Serial Number	FCC ID
Charger	SAMSUNG	EP-TA12EWE	N/A	N/A
Data Cable	SAMSUNG	ECB-DG925UWE	N/A	N/A
Earphone	SAMSUNG	GH59-11129H	N/A	N/A

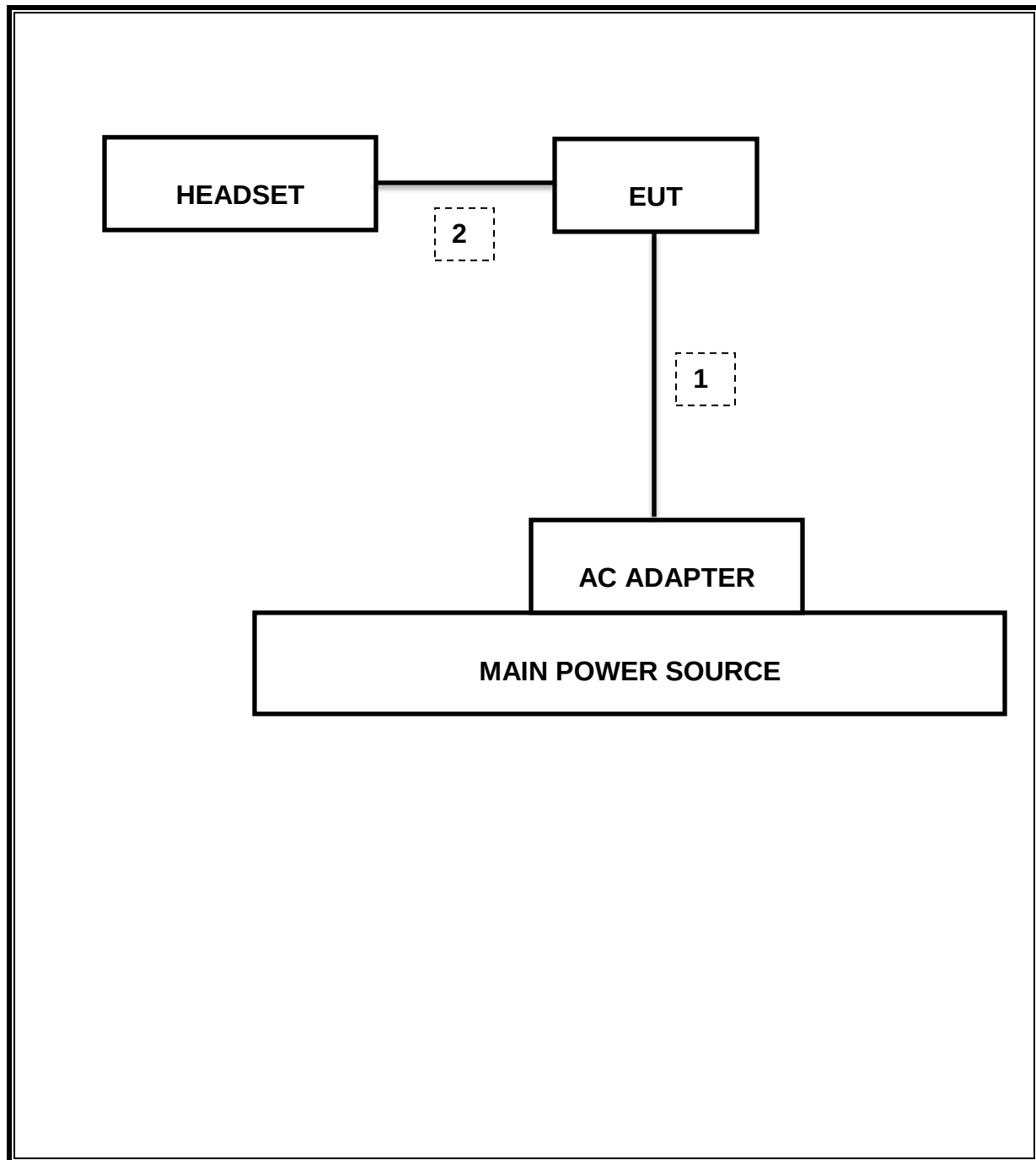
I/O CABLES

I/O Cable List						
Cable No	Port	# of identical ports	Connector Type	Cable Type	Cable Length (m)	Remarks
1	DC Power	1	Mini-USB	Shielded	0.8m	N/A
2	Audio	1	Mini-Jack	Unshielded	1.0m	N/A

TEST SETUP

The EUT is a stand-alone unit during the tests. Test software exercised the radio card.

SETUP DIAGRAM FOR TESTS



6. 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	S/N	Cal Due
Antenna, Bilog, 30MHz-1GHz	SCHWARZBECK	VULB9163	950	11-17-15
Antenna, Horn, 18 GHz	ETS	3115	00167211	09-20-15
Antenna, Horn, 40 GHz	ETS	3116C	00166255	09-23-15
Antenna, Horn, 40 GHz	ETS	3116C-PA	00168841	09-29-15
Preamplifier, 1000 MHz	Sonoma	310N	341282	11-17-15
Preamplifier, 18 GHz	Miteq	AFS42-00101800-25-S-42	1876511	11-18-15
Spectrum Analyzer, 44 GHz	Agilent / HP	N9030A	MY54170614	09-23-15
Bluetooth Tester	TESCOM	TC-3000C	3000C000546	11-17-15
Average Power Sensor	R&S	NRZ-Z91	102681	11-17-15
Average Power Sensor	Agilent / HP	U2000	MY54270007	09-23-15
EMI Test Receive, 40 GHz	R&S	ESU40	100439	11-17-15
EMI Test Receive, 3 GHz	R&S	ESR3	101832	11-17-15
Attenuator / Switch driver	HP	11713A	3748A04272	N/A
Low Pass Filter 3GHz	Micro-Tronics	LPS17541	009	11-17-15
High Pass Filter 5GHz	Micro-Tronics	HPS17542	009	11-17-15
High Pass Filter 6GHz	Micro-Tronics	HPM17543	010	11-17-15
LISN	R&S	ENV-216	101836	04-09-16
LISN	R&S	ENV-216	101837	04-09-16

7. MEASUREMENT METHODS

KDB 558074 D01 DTS Meas Guidance v03r02: Measurement Procedure AVGPM-G is used for power and AVGPS-3 is used for power spectral density.

Unwanted emissions within Restricted Bands are measured using traditional radiated procedures.

Band edge emissions within Restricted Bands are measured using RMS with duty cycle factor offset method.

8. ON TIME, DUTY CYCLE AND MEASUREMENT METHODS

LIMITS

None; for reporting purposes only.

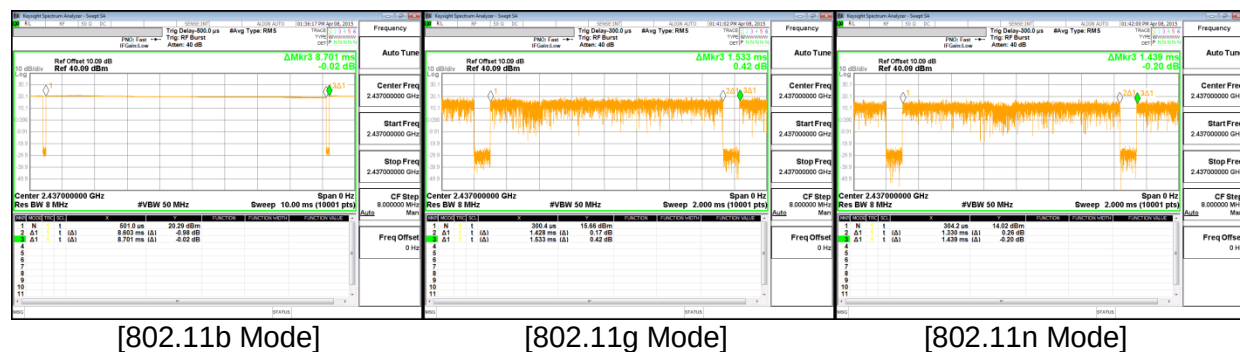
PROCEDURE

KDB 789033 Zero-Span Spectrum Analyzer Method.

8.1. 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/T Minimum VBW [kHz]
2400MHz Bands						
802.11b	8.603	8.701	0.989	98.9%	0.00	0.010
802.11g	1.428	1.533	0.932	93.2%	0.31	0.700
802.11n HT20	1.330	1.439	0.924	92.4%	0.34	0.752

Plot of Duty Cycle



9. SUMMARY TABLE

FCC Part Section	Test Description	Test Limit	Test Condition	Test Result	Worst Case
15.247 (a)(2)	Occupied Band width (6dB)	>500KHz	Conducted	Pass	8.054 MHz
2.1051, 15.247 (d)	Band Edge / Conducted Spurious Emission	-20dBc		Pass	-31.011 dBm
15.247	TX conducted output power	<30dBm		Pass	17.47 dBm
15.247	PSD	<8dBm		Pass	-4.11 dBm
15.207 (a)	AC Power Line conducted emissions	Section 10	Power Line conducted	Pass	45.89 dBuV (QP)
15.205, 15.209	Radiated Spurious Emission	< 54dBuV/m	Radiated	Pass	48.65dBuV/m (AV)

10. ANTENNA PORT TEST RESULTS

10.1. 6 dB BANDWIDTH

LIMITS

FCC §15.247 (a) (2)

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

TEST PROCEDURE

Reference to KDB 558074 D01 DTS Meas Guidance v03r02: The transmitter output is connected to a spectrum analyzer with the RBW set to 100KHz, the VBW $\geq 3 \times$ RBW, peak detector and max hold.

RESULTS

10.1.1. 802.11b MODE IN THE 2.4 GHZ BAND

Channel	Frequency [MHz]	6 dB Bandwidth [MHz]		Minimum Limit [MHz]
		Primary Antenna 1	Secondary Antenna 2	
Low	2412	8.054	8.061	0.5
Mid	2437	8.072	8.069	0.5
High	2462	8.060	8.056	0.5
12	2467	8.053	8.066	0.5
13	2472	8.048	8.056	0.5
Worst		8.048		

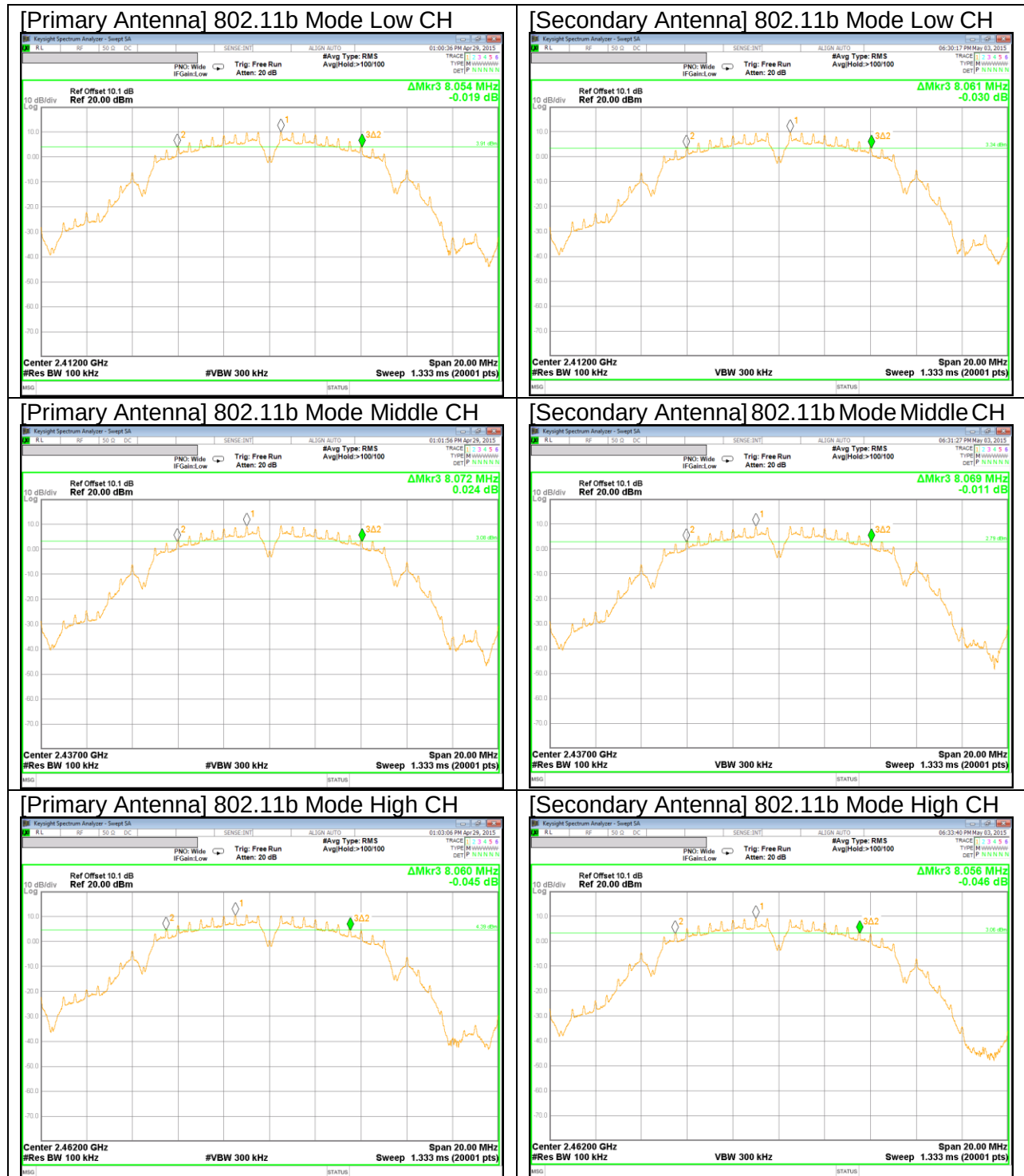
10.1.2. 802.11g MODE IN THE 2.4 GHZ BAND

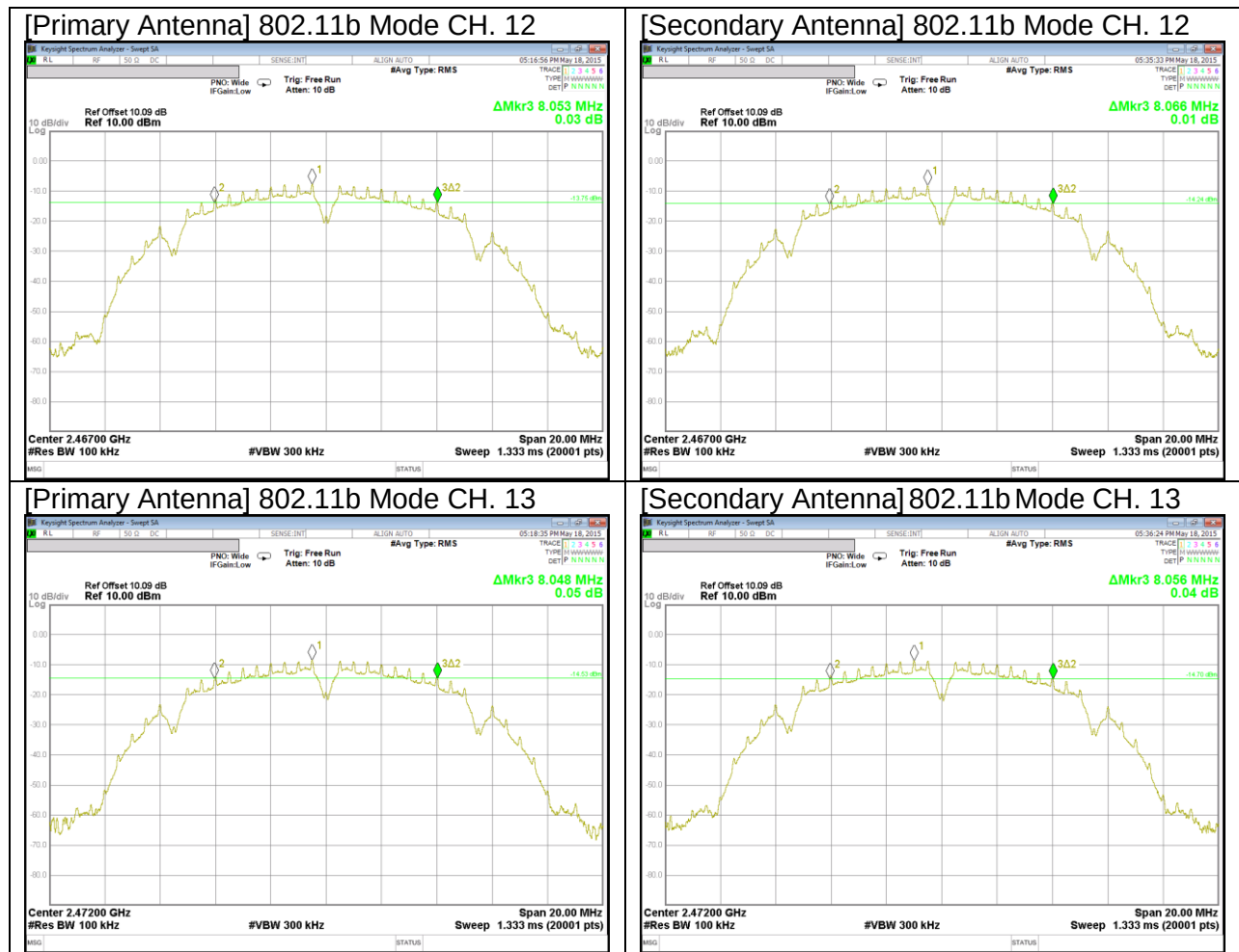
Channel	Frequency [MHz]	6 dB Bandwidth [MHz]		Minimum Limit [MHz]
		Chain 0	Chain 1	
Low	2412	16.338	16.335	0.5
Mid	2437	16.340	16.339	0.5
High	2462	15.738	16.045	0.5
12	2467	16.339	16.356	0.5
13	2472	16.346	16.354	0.5
Worst		15.738		

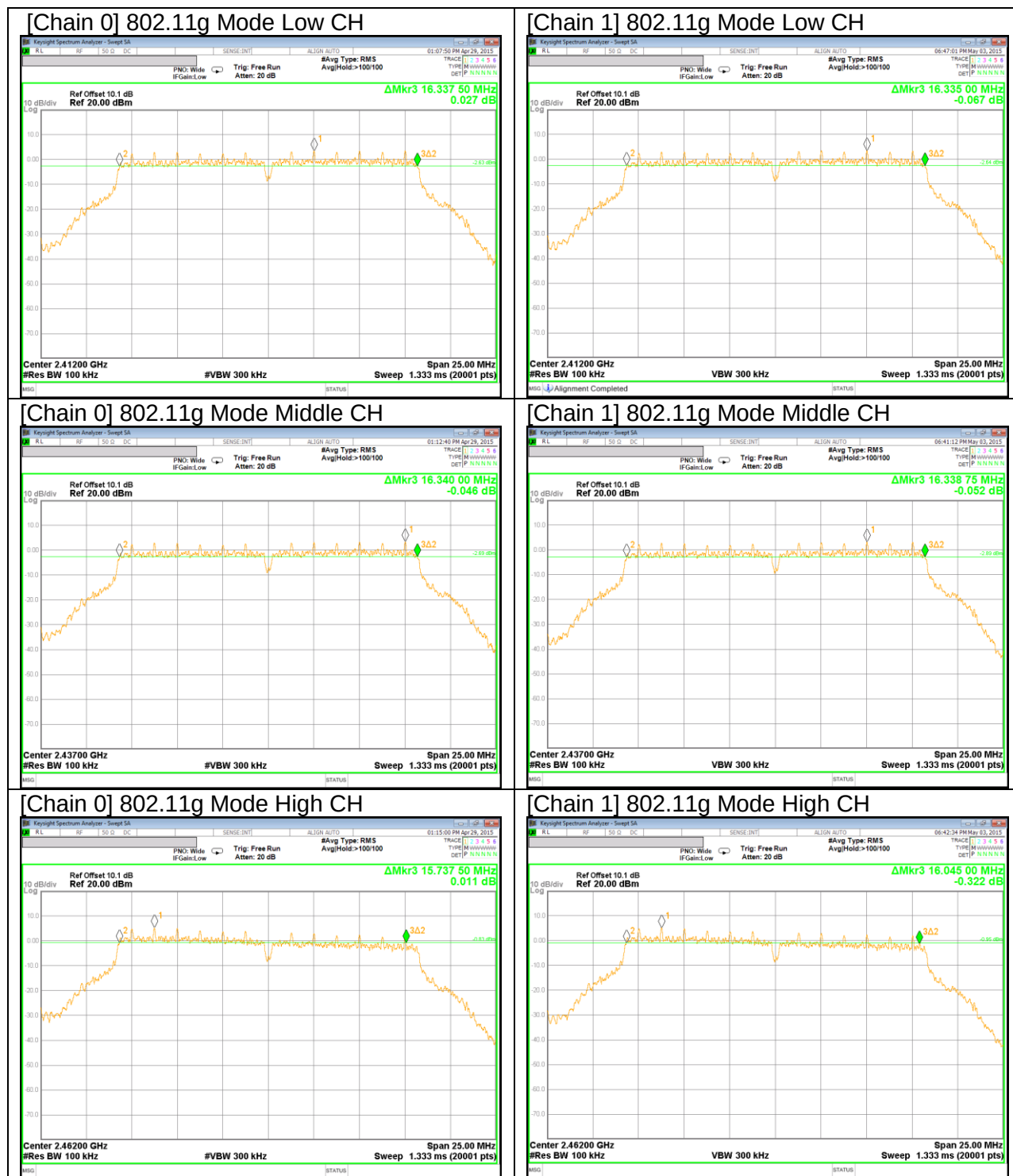
10.1.3. 802.11n HT20 MODE IN THE 2.4 GHZ BAND

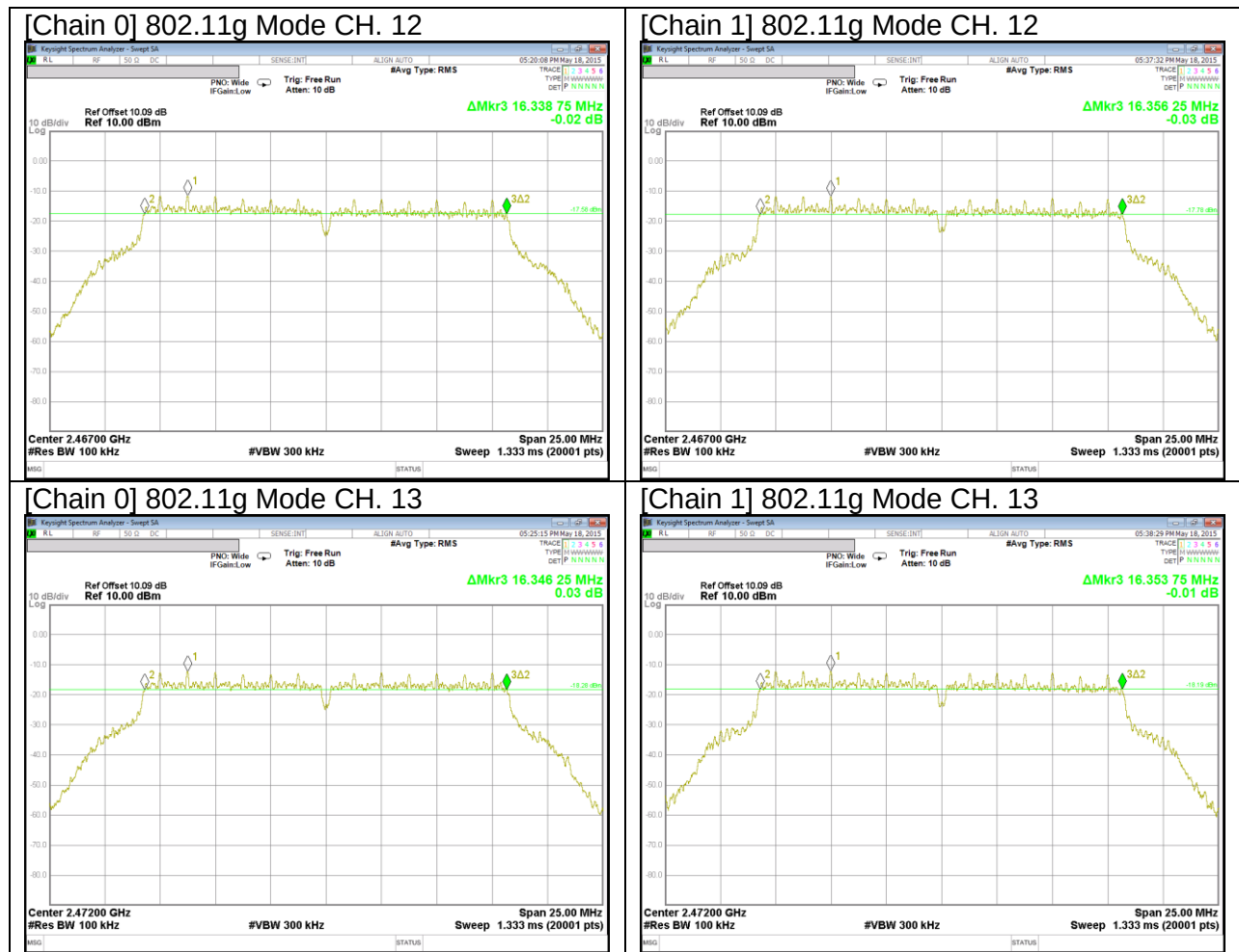
Channel	Frequency [MHz]	6 dB Bandwidth [MHz]		Minimum Limit [MHz]
		Chain 0	Chain 1	
Low	2412	17.591	17.581	0.5
Mid	2437	17.588	17.583	0.5
High	2462	16.363	16.679	0.5
12	2467	17.568	17.596	0.5
13	2472	17.601	17.599	0.5
Worst		16.363		

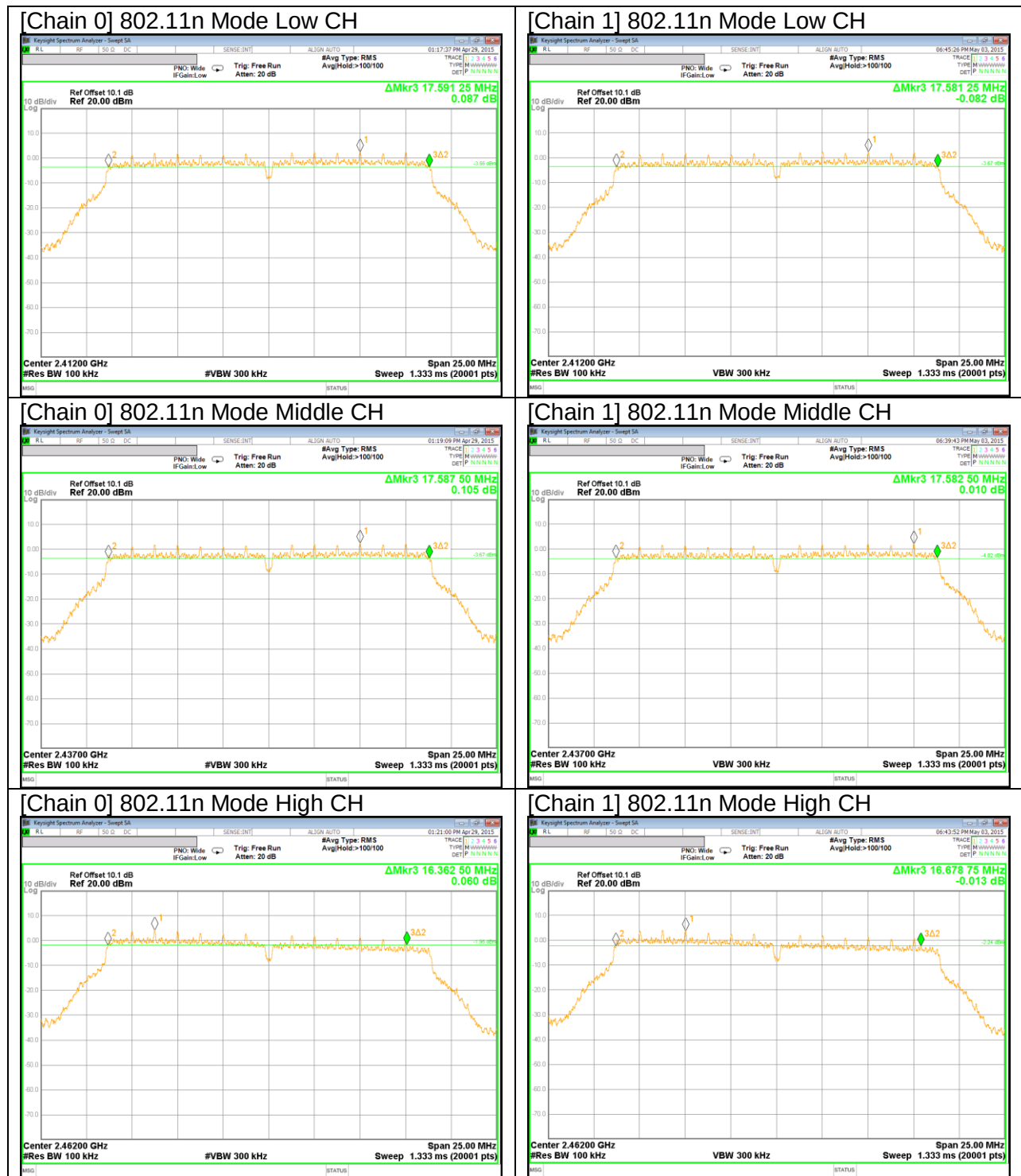
10.1.4. 6 dB BANDWIDTH PLOTS

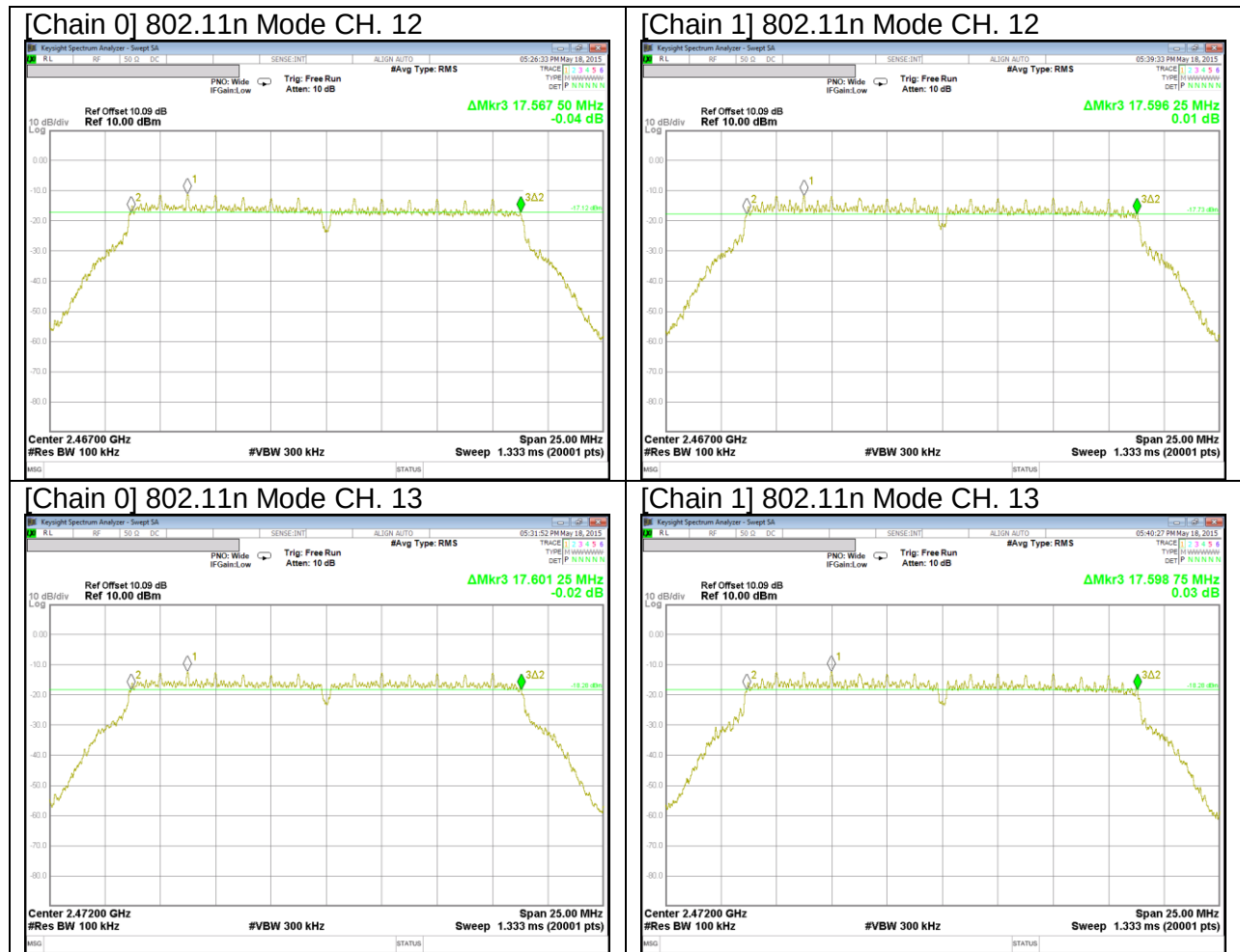












10.2. 99% BANDWIDTH

LIMITS

None; for reporting purposes only.

RESULTS

10.2.1. 802.11b MODE IN THE 2.4 GHZ BAND

Channel	Frequency [MHz]	99 % Bandwidth [MHz]	
		Primary Antenna 1	Secondary Antenna 2
Low	2412	10.364	10.583
Mid	2437	10.459	10.702
High	2462	10.561	10.868
12	2467	10.872	10.720
13	2472	10.617	10.467
Worst		10.872	

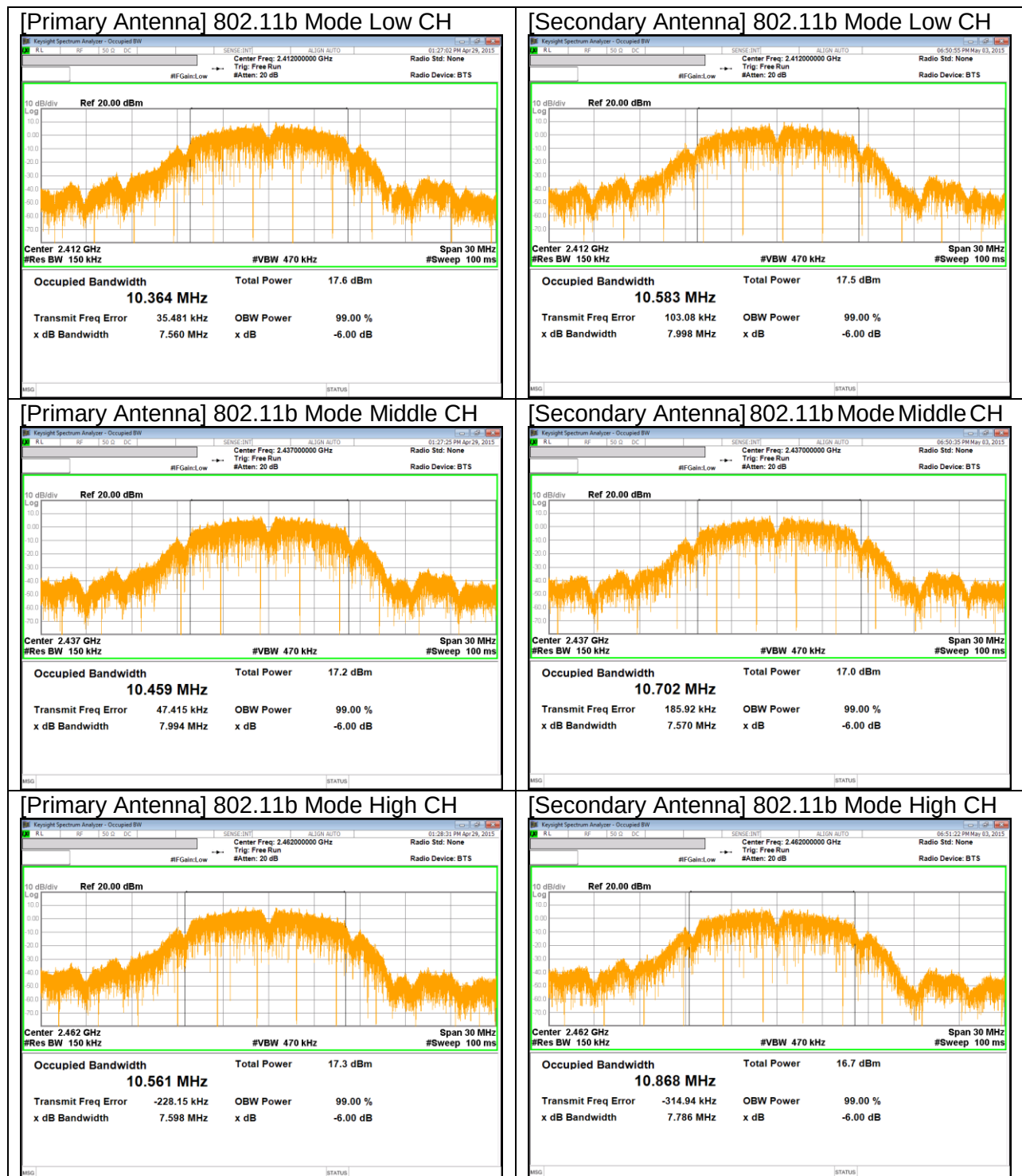
10.2.2. 802.11g MODE IN THE 2.4 GHZ BAND

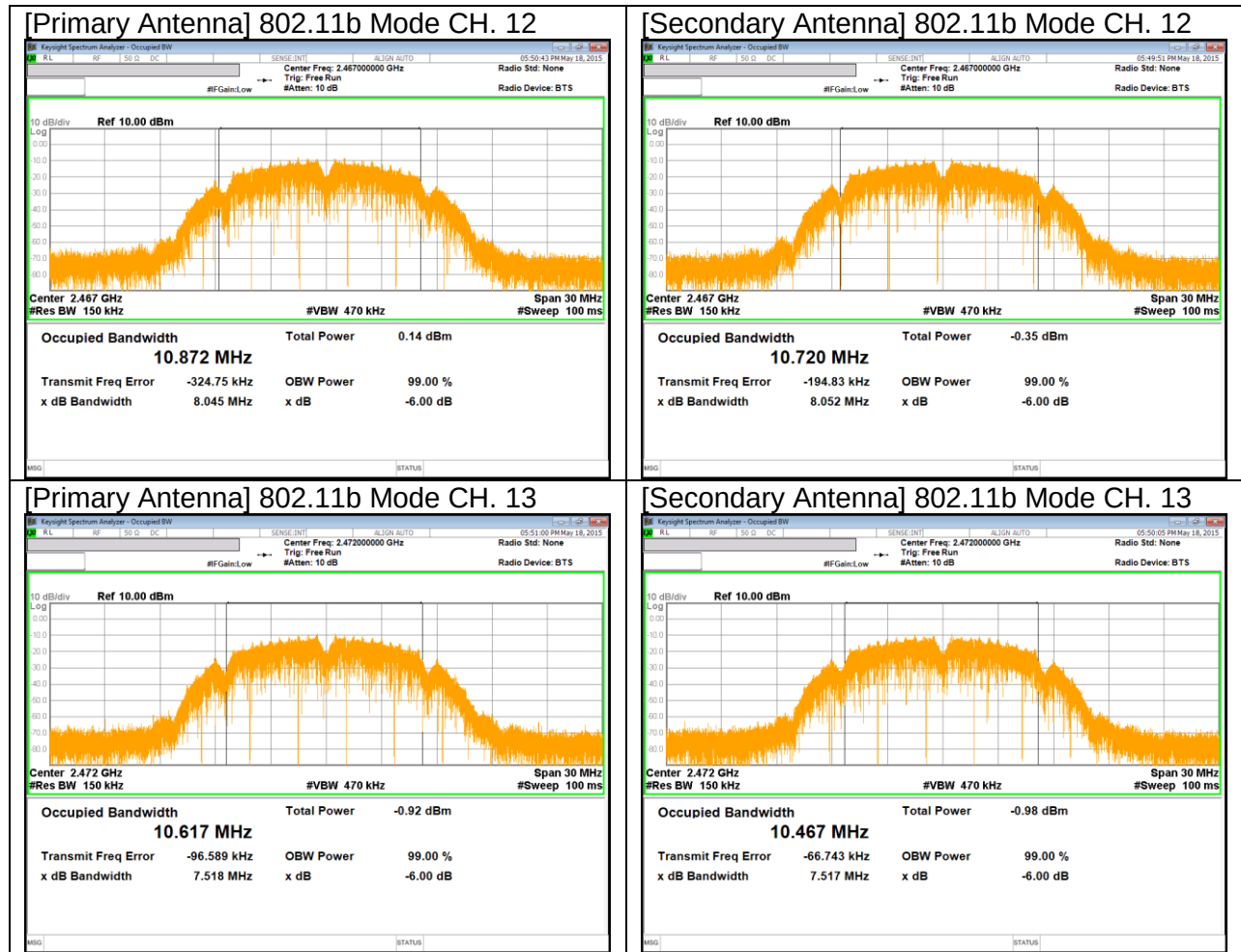
Channel	Frequency [MHz]	6 dB Bandwidth [MHz]	
		Chain 0	Chain 1
Low	2412	16.514	16.520
Mid	2437	16.533	16.548
High	2462	16.506	16.534
12	2467	16.555	16.522
13	2472	16.527	16.496
Worst		16.555	

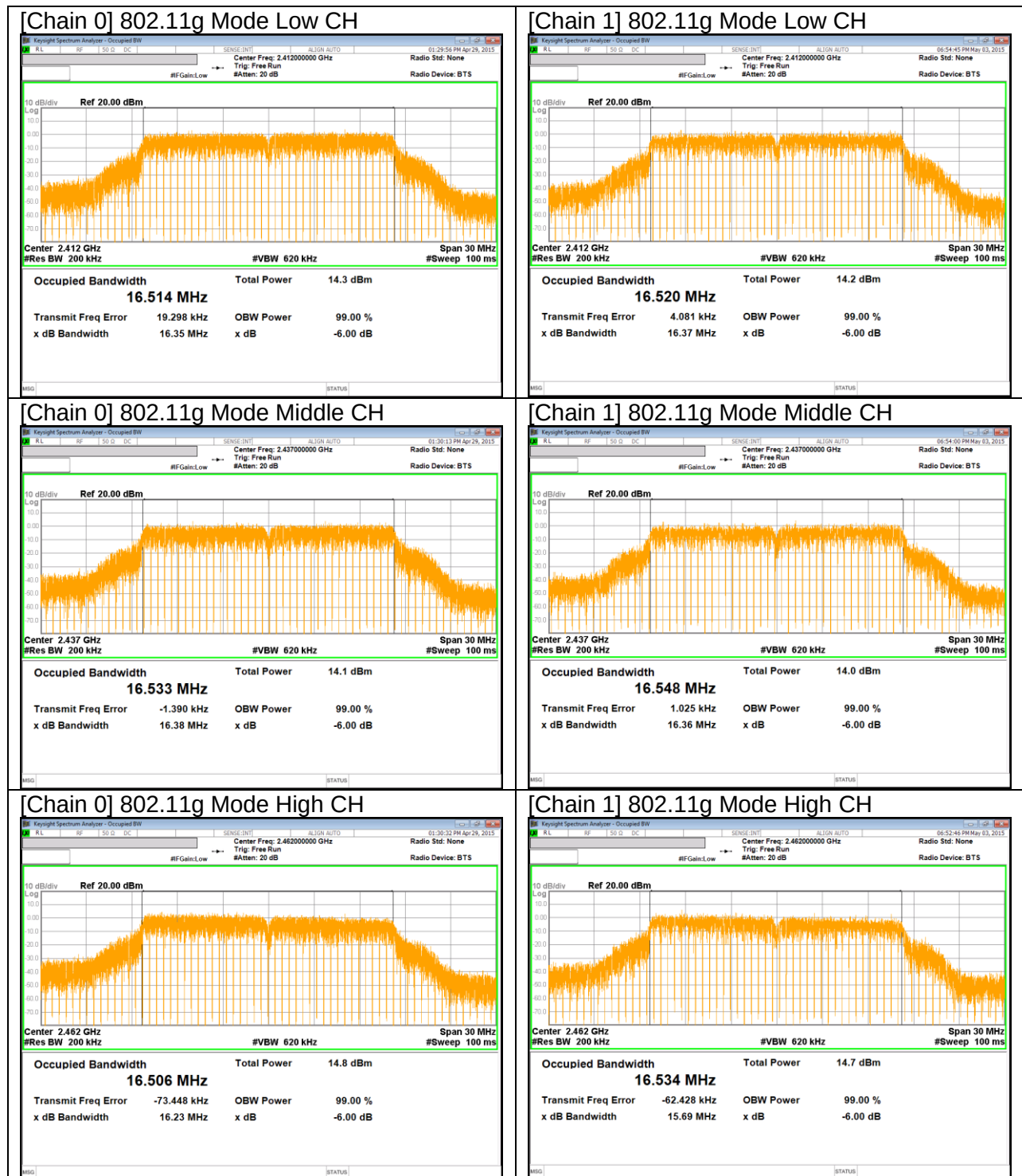
10.2.3. 802.11n HT20 MODE IN THE 2.4 GHZ BAND

Channel	Frequency [MHz]	6 dB Bandwidth [MHz]	
		Chain 0	Chain 1
Low	2412	17.707	17.710
Mid	2437	17.764	17.722
High	2462	17.716	17.745
12	2467	17.740	17.707
13	2472	17.757	17.691
Worst		17.764	

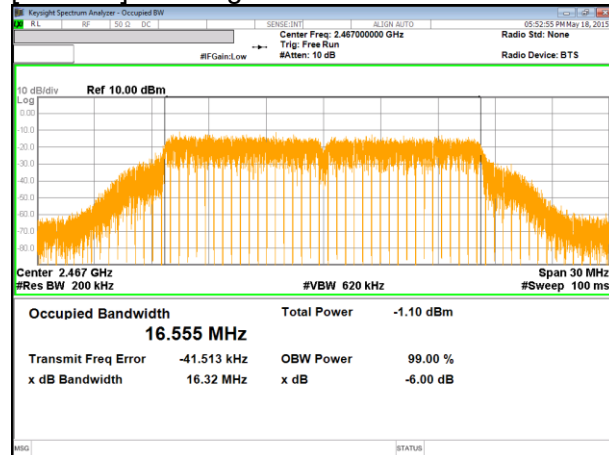
10.2.1. 99% BANDWIDTH PLOTS



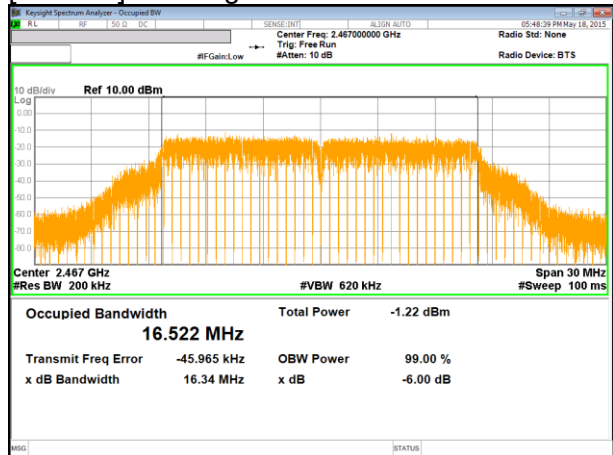




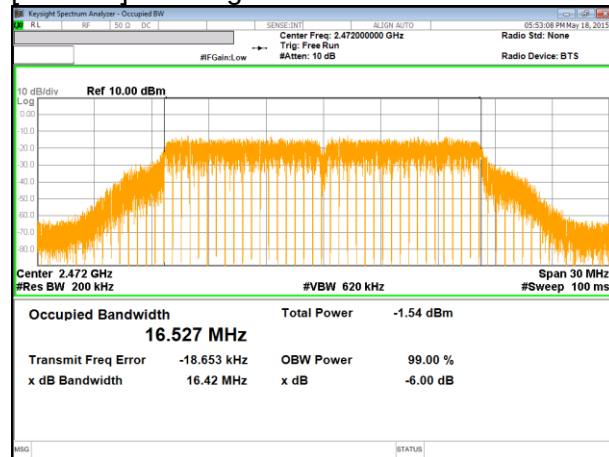
[Chain 0] 802.11g Mode CH. 12



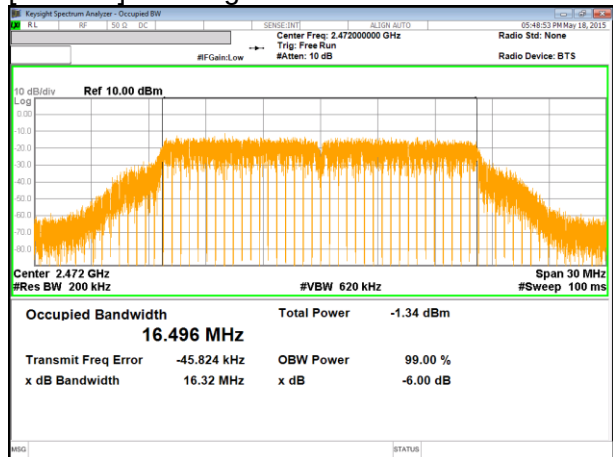
[Chain 1] 802.11g Mode CH. 12

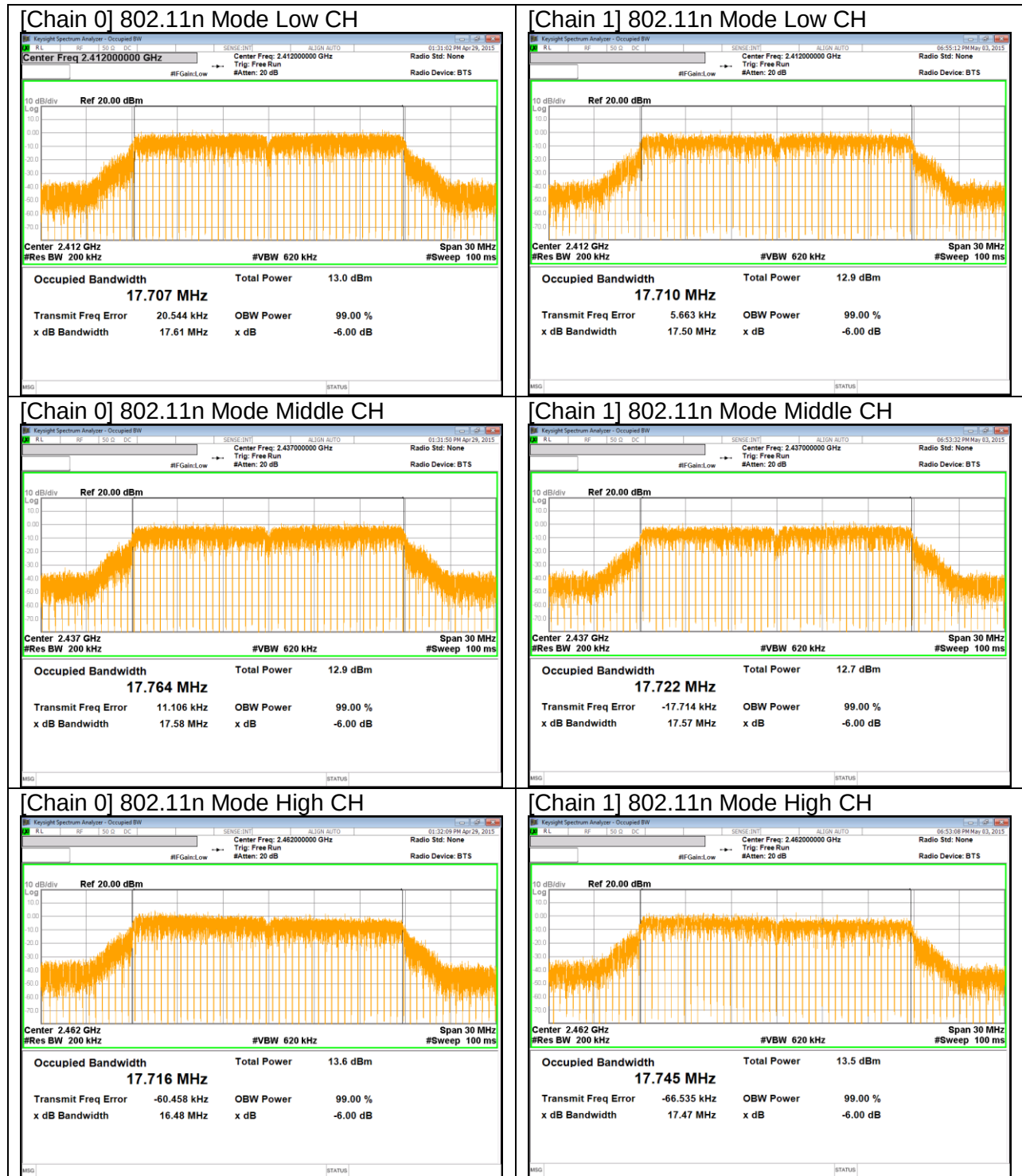


[Chain 0] 802.11g Mode CH. 13

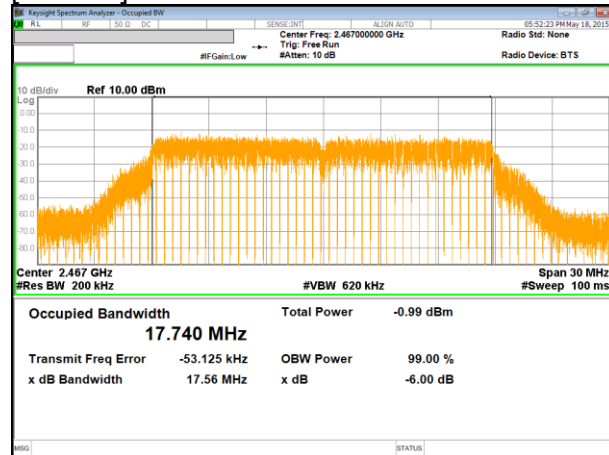


[Chain 1] 802.11g Mode CH. 13

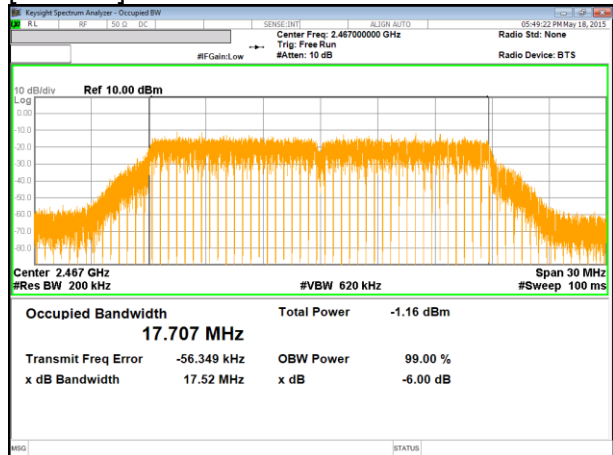




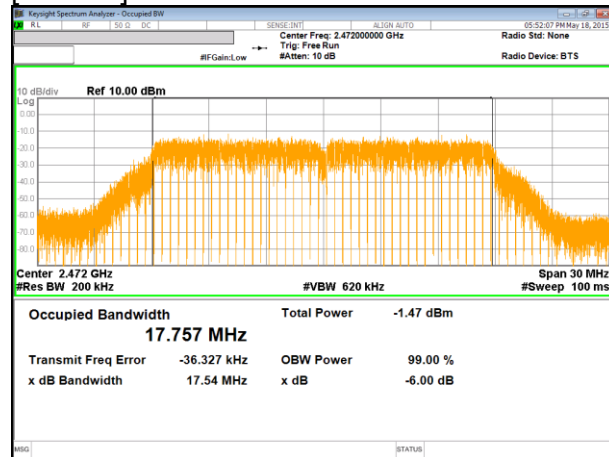
[Chain 0] 802.11n Mode CH. 12



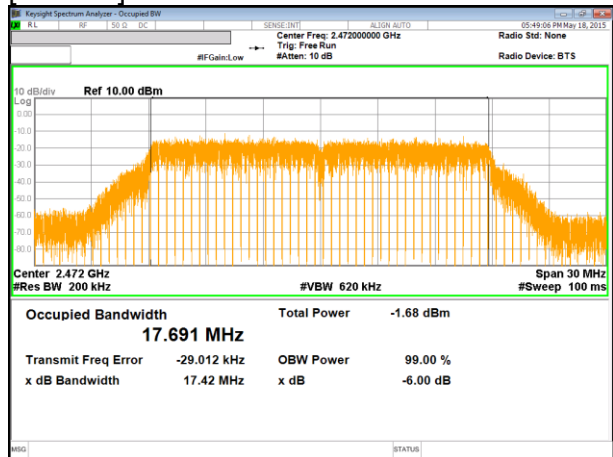
[Chain 1] 802.11n Mode CH. 12



[Chain 0] 802.11n Mode CH. 13



[Chain 1] 802.11n Mode CH. 13



10.3. OUTPUT POWER

LIMITS

FCC §15.247

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 10.1 dB (including 10 dB pad and 0.1 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

DIRECTIONAL ANTENNA GAIN

For Power: The TX chains are uncorrelated and the antenna gain is the same for each chain. The directional gain is equal to the antenna gain.

2.4GHz

Chain 0 Antenna Gain [dBi]	Chain 1 Antenna Gain [dBi]	Uncorrelated Chains Directional Gain [dBi]
-0.34	0.48	0.09

For PSD: The TX chains are correlated and the antenna gain is unequal among the chains. The directional gain is:

2.4GHz

Chain 0 Antenna Gain [dBi]	Chain 1 Antenna Gain [dBi]	Correlated Chains Directional Gain [dBi]
-0.34	0.48	3.09

10.3.1. 802.11b MODE IN THE 2.4 GHZ BAND

Limits

Channel	Frequency [MHz]	Directional Gain Primary [dBi]	Directional Gain Secondary [dBi]	FCC Power Limit [dBm]	IC Power Limit [dBm]	IC EIRP Limit [dBm]	Max Power [dBm]
Low	2412	-0.34	0.48	30.00	30.00	36.00	30.00
Mid	2437	-0.34	0.48	30.00	30.00	36.00	30.00
High	2462	-0.34	0.48	30.00	30.00	36.00	30.00
12	2467	-0.34	0.48	30.00	30.00	36.00	30.00
13	2472	-0.34	0.48	30.00	30.00	36.00	30.00

Results

Channel	Frequency [MHz]	Primary Meas Power [dBm]	Secondary Meas Power [dBm]	Maximum Power [dBm]	Power Limit [dBm]	Margin [dB]
Low	2412	17.01	17.47	17.47	36.00	-18.53
Mid	2437	17.11	17.12	17.12	36.00	-18.88
High	2462	17.28	17.01	17.28	36.00	-18.72
12	2467	0.25	-0.31	0.25	36.00	-35.75
13	2472	-0.40	-0.79	-0.40	36.00	-36.40
Worst				17.47		

- IEEE 802.11b Mode is not supported MIMO operation. So can't transmit on two antenna as same time.

10.3.2. 802.11g MODE IN THE 2.4 GHz BAND

Limits

Channel	Frequency [MHz]	Directional Gain [dBi]	FCC Power Limit [dBm]	IC Power Limit [dBm]	IC EIRP Limit [dBm]	Max Power [dBm]
Low	2412	0.09	30.00	30.00	36.00	30.00
Mid	2437	0.09	30.00	30.00	36.00	30.00
High	2462	0.09	30.00	30.00	36.00	30.00
12	2467	0.09	30.00	30.00	36.00	30.00
13	2472	0.09	30.00	30.00	36.00	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	2412	14.39	14.75	17.58	30.00	-12.42
Mid	2437	14.44	14.52	17.49	30.00	-12.51
High	2462	14.72	15.21	17.98	30.00	-12.02
12	2467	-0.12	-0.69	2.61	30.00	-27.39
13	2472	-0.81	-0.95	2.13	30.00	-27.87
Worst				17.98		

10.3.3. 802.11n HT20 MODE IN THE 2.4 GHz BAND

Limits

Channel	Frequency [MHz]	Directional Gain [dBi]	FCC Power Limit [dBm]	IC Power Limit [dBm]	IC EIRP Limit [dBm]	Max Power [dBm]
Low	2412	0.09	30.00	30.00	36.00	30.00
Mid	2437	0.09	30.00	30.00	36.00	30.00
High	2462	0.09	30.00	30.00	36.00	30.00
12	2467	0.09	30.00	30.00	36.00	30.00
13	2472	0.09	30.00	30.00	36.00	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	2412	13.02	13.27	16.16	30.00	-13.84
Mid	2437	13.27	13.27	16.28	30.00	-13.72
High	2462	13.37	13.74	16.57	30.00	-13.43
12	2467	-0.27	-0.78	2.49	30.00	-27.51
13	2472	-0.99	-1.03	2.00	30.00	-28.00
Worst				16.57		

10.4. PSD

LIMITS

FCC §15.247

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.

TEST PROCEDURE

Power Spectral Density was performed utilizing the "Method PKPSD (Peak PSD)" under KDB558074 D01 DTS Meas Guidance v03r02

RESULTS

10.4.1. 802.11b MODE IN THE 2.4 GHZ BAND

Channel	Frequency [MHz]	Primary Antenna 1 [dBm]	Secondary Antenna 2 [dBm]	Total PSD [dBm]	Limit [dBm]	Margin [dB]
Low	2412	-4.213	-4.112	-4.11	8.00	-12.11
Mid	2437	-5.013	-4.579	-4.58	8.00	-12.58
High	2462	-4.973	-4.990	-4.97	8.00	-12.97
12	2467	-20.250	-21.759	-20.25	8.00	-28.25
13	2472	-22.097	-23.048	-22.10	8.00	-30.10

- IEEE 802.11b Mode is not supported MIMO operation. So can't transmit on two antenna as same time.

10.4.2. 802.11g MODE IN THE 2.4 GHZ BAND

Channel	Frequency [MHz]	Chain 0 Meas [dBm]	Chain 1 Meas [dBm]	Total PSD [dBm]	Limit [dBm]	Margin [dB]
Low	2412	-10.566	-10.443	-7.49	8.00	-15.49
Mid	2437	-10.671	-10.774	-7.71	8.00	-15.71
High	2462	-8.461	-8.713	-5.57	8.00	-13.57
12	2467	-24.754	-25.335	-22.02	8.00	-30.02
13	2472	-26.028	-25.746	-22.87	8.00	-30.87

10.4.3. 802.11n HT20 MODE IN THE 2.4 GHZ BAND

Channel	Frequency [MHz]	Chain 0 Meas [dBm]	Chain 1 Meas [dBm]	Total PSD [dBm]	Limit [dBm]	Margin [dB]
Low	2412	-12.015	-11.836	-8.91	8.00	-16.91
Mid	2437	-12.322	-12.110	-9.20	8.00	-17.20
High	2462	-9.584	-10.671	-7.08	8.00	-15.08
12	2467	-24.782	-24.716	-21.74	8.00	-29.74
13	2472	-26.57	-26.037	-23.29	8.00	-31.29

10.4.1. PSD PLOTS

