



FCC CFR47 PART 15 SUBPART C

DTS Wireless LAN

CERTIFICATION TEST REPORT

FOR

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

MODEL NUMBER : SM-W728, SM-W728N0, SM-W727, SM-W727N0

FCC ID: A3LSMW728

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: SAMSUNG ELECTRONICS CO., LTD.
EUT DESCRIPTION: WCDMA/LTE Tablet + Bluetooth/BLE and DTS/UNII a/b/g/n/ac
MODEL NUMBER: SM-W728, SM-W728N0, SM-W727, SM-W727N0
SERIAL NUMBER: R9KCR32HC000QD, 9RKCR32HC000QF (RADIATED);
9RKCR32HC000RZ (CONDUCTED)
DATE TESTED: JAN 20, 2017 - FEB 17, 2017

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
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UL Korea, Ltd.

Tested By:



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Suwon Lab Engineer
UL Korea, Ltd.

2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with following methods.

1. FCC CFR 47 Part 2.
2. FCC CFR 47 Part 15.
3. KDB 558074 D01 DTS Meas Guidance v03r05.
4. ANSI C63.10-2013.

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, 16675, 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
<input checked="" type="checkbox"/> Chamber 1
<input checked="" type="checkbox"/> 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 WCDMA/LTE Tablet + Bluetooth/BLE and DTS/UNII a/b/g/n/ac. This test report addresses the DTS (WLAN) operational mode.

SM-W728 and multi-models(SM-W727, SM-W727N0, SM-W728N0) are same hardware, but difference is Windows version and HSDPA categories. PED document described detail of difference. All compliance tests were performed using SM-W728 and HSDPA conducted power checks for multi-models were performed.

WiFi MIMO Condition

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

5.2. MAXIMUM OUTPUT POWER

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

Frequency Range [MHz]	Mode	Output Power [dBm]		Output Power [mW]	
		Antenna1	Antenna2	Antenna1	Antenna2
2412 - 2472	802.11b	14.12	14.25	25.82	26.61
	802.11g SISO	11.85	11.87	15.31	15.38
	802.11g MIMO	14.85		30.55	
	802.11n20 SISO	11.65	11.75	14.62	14.96
	802.11n20 MIMO	14.71		29.58	

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes internal antenna, with a antenna1's maximum gain of -0.54 dBi and antenna2's maximum gain of -1.18 dBi .

5.4. LIST OF TEST REDUCTION AND MODES

The output power on covered modes is equal to or less than one referenced.

Frequency Range (MHz)	Mode	Covered by
2412 - 2472	802.11b Legacy 1TX	802.11b Legacy 1TX
	802.11g 1TX	802.11g CDD 2TX
	802.11g CDD 2TX	802.11g CDD 2TX
	802.11n HT20 1TX	802.11n HT20 CDD 2TX
	802.11n HT20 STBC/SDM/CDD 2TX	802.11n HT20 CDD 2TX

5.5. WORST-CASE CONFIGURATION AND MODE

Radiated emission below 1GHz and power line conducted emission were performed with the EUT set to transmit at the channel with highest output power as worst-case scenario. Radiated emission above 1GHz was performed with the EUT set to transmit low/mid/high channels.

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

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

802.11b mode: 1 Mbps (Legacy 1TX)
 802.11g mode: 6 Mbps (2TX CDD)
 802.11n HT20 mode: MCS0 (2TX CDD)

5.6. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Support Equipment List				
Description	Manufacturer	Model	Serial Number	FCC ID
Adapter	SAMSUNG	EP-TA300	R37HCSB00A3SE3	N/A
Data Cable	SAMSUNG	EP-DW720CWE	N/A	N/A
Earphone	SAMSUNG	EO-EG920BW	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	C Type USB	Shielded	1.2m	N/A
2	Audio	2	Mini-Jack	Unshielded	1.1m	N/A

ADDITIONAL EQUIPMENT

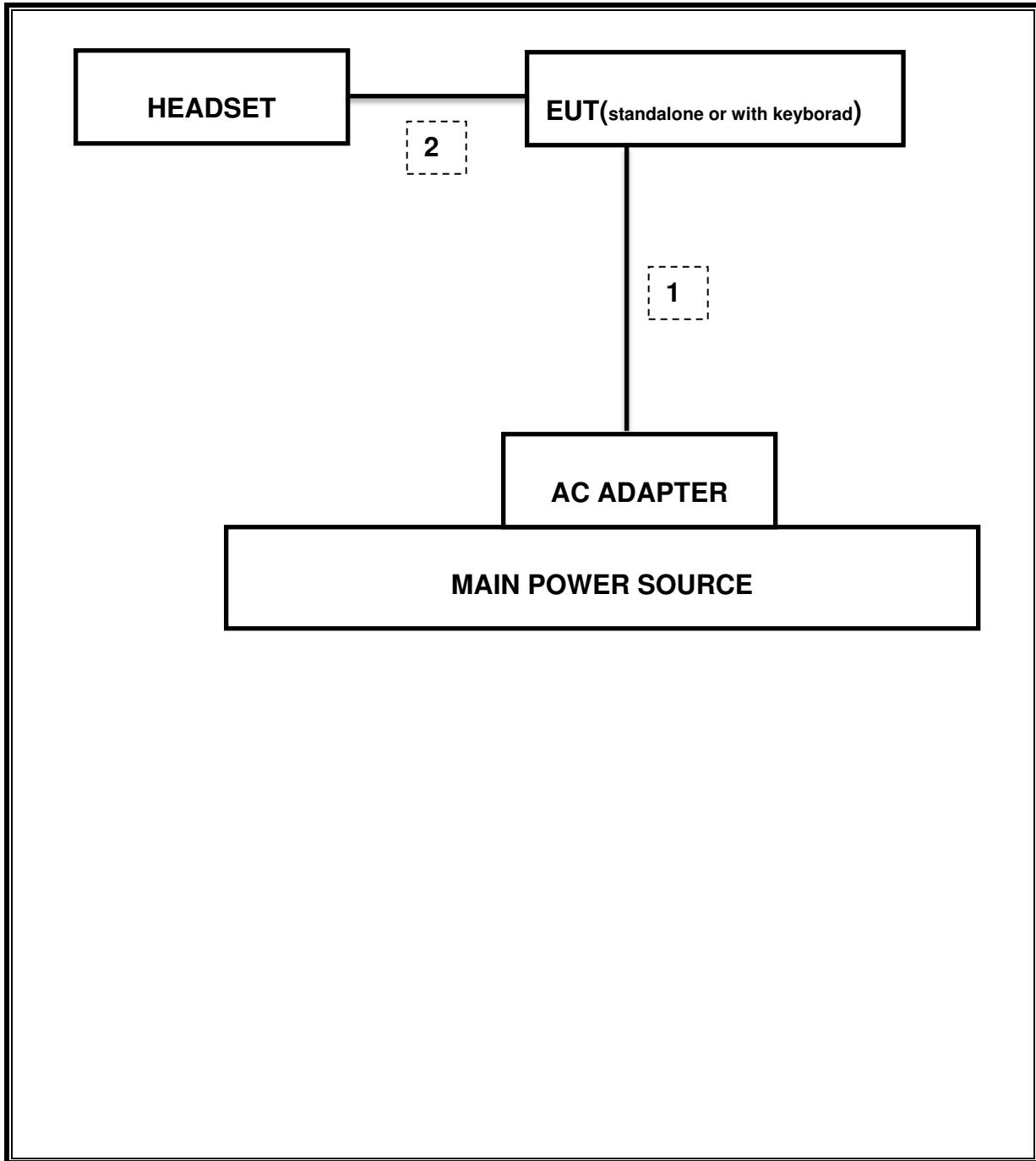
Support Equipment List				
Description	Manufacturer	Model	Serial Number	FCC ID
Keyboard	SAMSUNG	EJ-CW720	N/A	N/A
S-pen	SAMSUNG	EJ-PT820	N/A	N/A

Additional radiated spurious emission measurements were performed on worst case condition(Max conducted power) equipped with keyboard. Test data shown on section 10 and setup photo shown on section 12. Also radiated spurious emission below 1GHz and AC line conducted test were performed both condition(Stand-alone and with equipped keyboard).

TEST SETUP

The EUT is a stand-alone unit during the tests.
 Test software exercised the EUT to enable DTS mode.

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	750	10-14-18
Antenna, Bilog, 30MHz-1GHz	SCHWARZBECK	VULB9163	749	04-25-17
Antenna, Horn, 18 GHz	ETS	3115	00167211	10-14-18
Antenna, Horn, 18 GHz	ETS	3115	00161451	05-17-17
Antenna, Horn, 18 GHz	ETS	3117	00168724	06-17-17
Antenna, Horn, 18 GHz	ETS	3117	00168717	06-17-17
Antenna, Horn, 40 GHz	ETS	3116C	00166155	11-30-17
Antenna, Horn, 40 GHz	ETS	3116C-PA	00168841	12-15-17
Preamplifier, 1000 MHz	Sonoma	310N	341282	08-17-17
Preamplifier, 1000 MHz	Sonoma	310N	351741	08-16-17
Preamplifier	ETS	3115-PA	00167475	08-17-17
Preamplifier, 18 GHz	Miteq	AFS42-00101800-25-S-42	1896138	08-16-17
Spectrum Analyzer, 44 GHz	Agilent / HP	N9030A	MY54170614	08-17-17
Spectrum Analyzer, 44 GHz	Agilent / HP	N9030A	MY54490312	08-16-17
Antenna, Loop, 9kHz-30MHz	R&S	HFH2-Z2	100418	11-25-17
Average Power Sensor	R&S	NRP-Z91	102681	08-16-17
Average Power Sensor	Agilent / HP	U2000	MY54270007	08-17-17
EMI Test Receive, 40 GHz	R&S	ESU40	100439	08-17-17
EMI Test Receive, 40 GHz	R&S	ESU40	100457	08-16-17
EMI Test Receive, 3 GHz	R&S	ESR3	101832	08-16-17
Attenuator / Switch driver	HP	11713A	3748A04272	N/A
Low Pass Filter 5GHz	Micro-Tronics	LPS17541	009	08-17-17
Low Pass Filter 5GHz	Micro-Tronics	LPS17541	015	08-16-17
High Pass Filter 3GHz	Micro-Tronics	HPM17543	010	08-17-17
High Pass Filter 3GHz	Micro-Tronics	HPM17543	015	08-16-17
High Pass Filter 6GHz	Micro-Tronics	HPM17542	009	08-17-17
High Pass Filter 6GHz	Micro-Tronics	HPM17542	016	08-16-17
LISN	R&S	ENV-216	101836	08-16-17
LISN	R&S	ENV-216	101837	08-16-17
Attenuator	PASTERNAK	PE7087-10	A009	08-16-17
UL Software				
Description	Manufacturer	Model	Version	
Radiated software	UL	UL EMC	Ver 9.5	
AC Line Conducted software	UL	UL EMC	Ver 9.5	

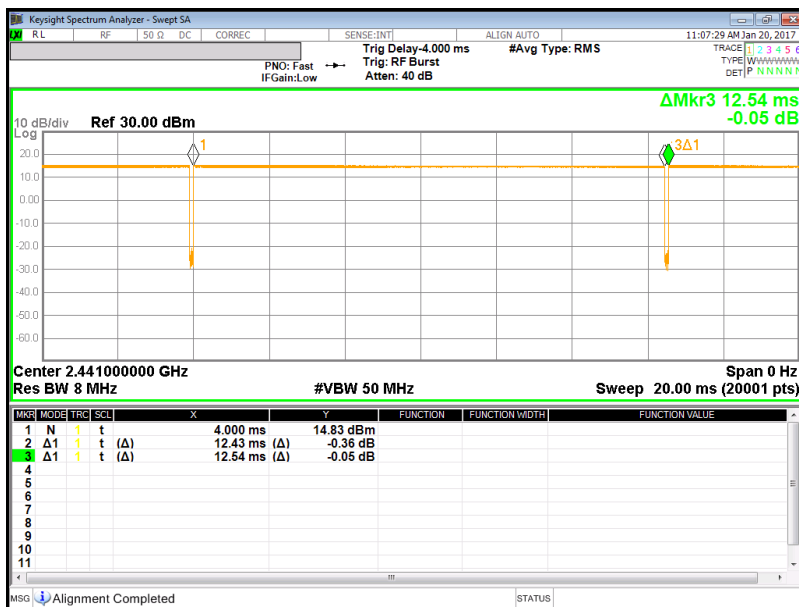
7. REFERENCE MEASUREMENT RESULTS

7.1. ON TIME AND DUTY CYCLE RESULTS

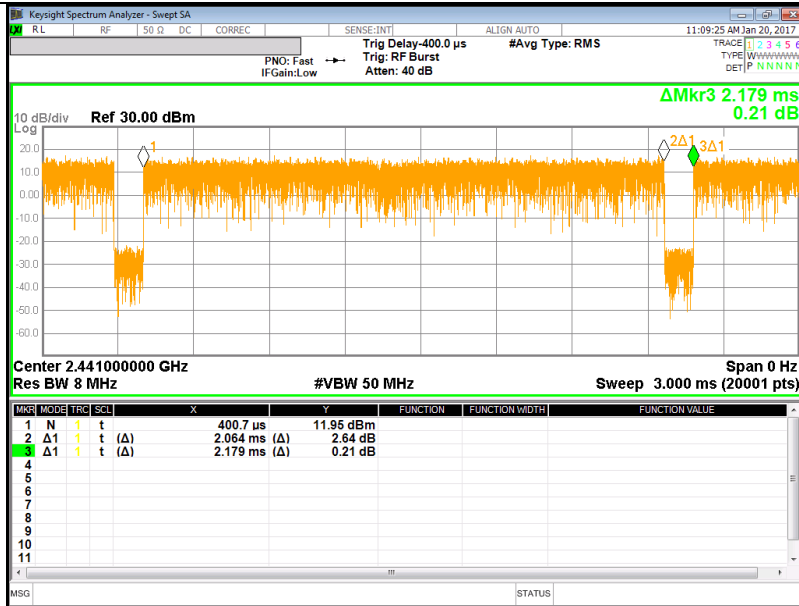
Mode	ON Time B [msec]	Period [msec]	Duty Cycle x [linear]	Duty Cycle [%]	Duty Cycle Correction Factor [dB]	1/T Minimum VBW [kHz]
2400MHz Bands						
802.11b	12.43	12.54	0.991	99.1%	0.00	0.010
802.11g	2.064	2.179	0.947	94.7%	0.24	0.484
802.11n HT20	1.923	2.039	0.943	94.3%	0.25	0.520

LIMITS

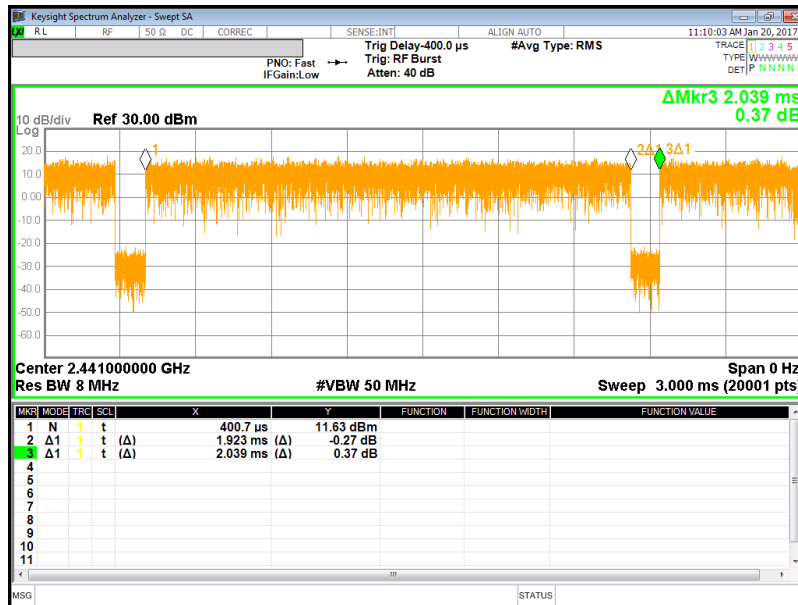
None; for reporting purposes only.



[802.11b Mode]



[802.11g Mode]



[802.11n20 Mode]

7.2. 99% BANDWIDTH

LIMITS

None; for reporting purposes only.

RESULTS

7.2.1. 802.11b MODE IN THE 2.4 GHz BAND

Channel	Frequency [MHz]	99% Bandwidth [MHz]	
		Primary Antenna 1	Secondary Antenna 2
1	2412	12.965	12.674
6	2437	12.986	13.029
11	2462	12.813	12.824
12	2467	12.970	13.097
13	2472	13.329	13.353

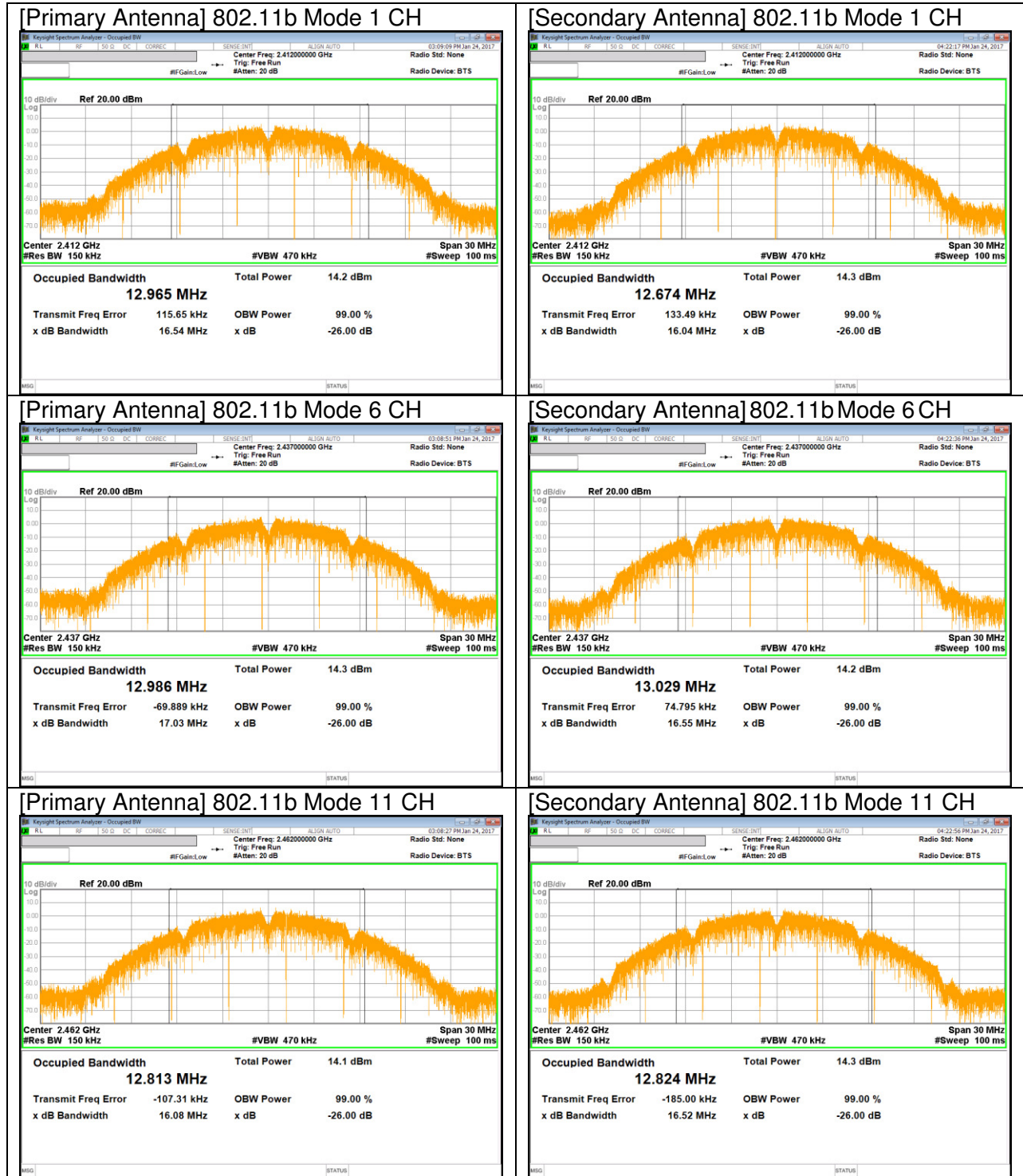
7.2.2. 802.11g MODE IN THE 2.4 GHz BAND

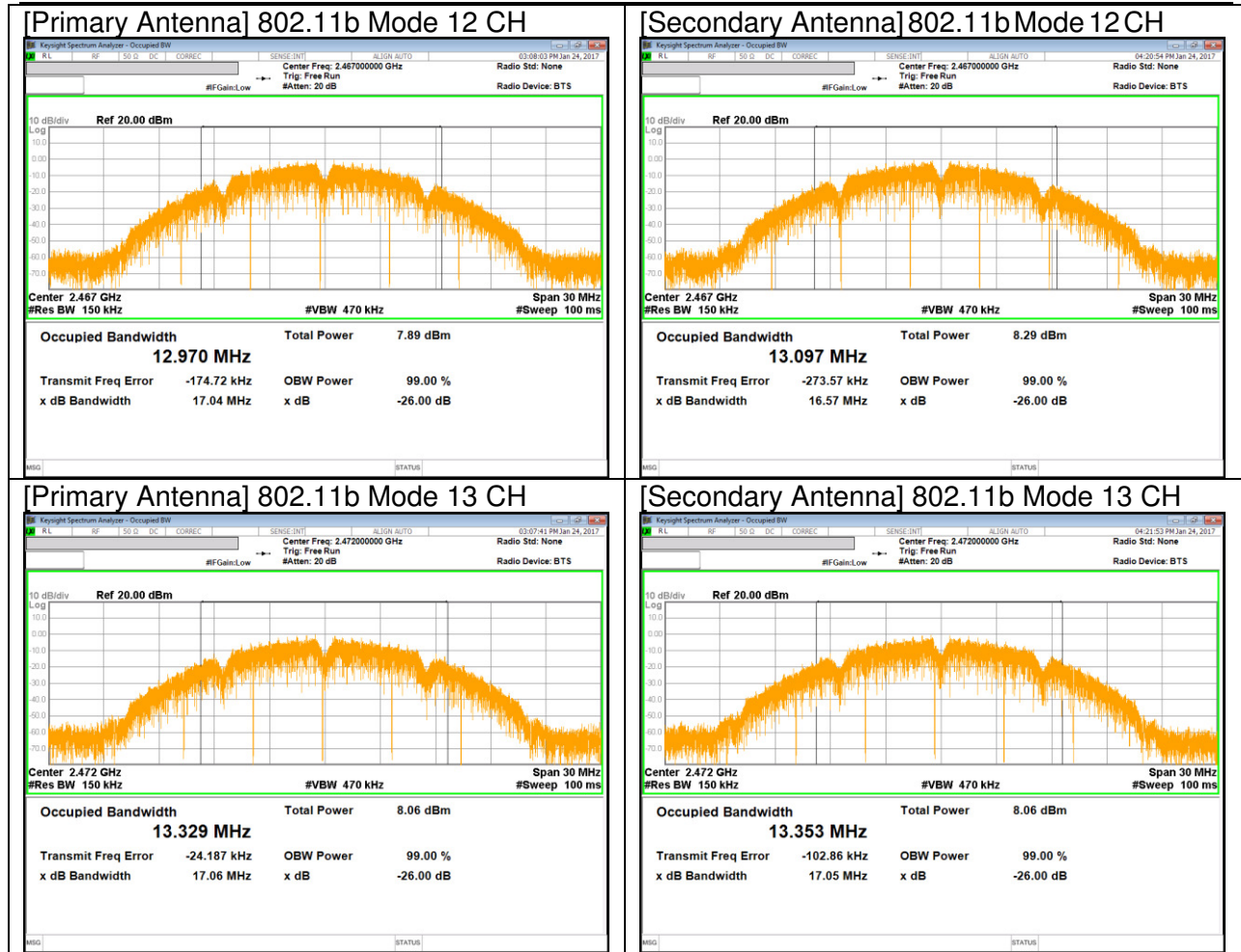
Channel	Frequency [MHz]	99% Bandwidth [MHz]	
		Primary Antenna 1	Secondary Antenna 2
1	2412	16.374	16.358
6	2437	16.414	16.399
11	2462	16.357	16.359
12	2467	16.370	16.403
13	2472	16.439	16.413

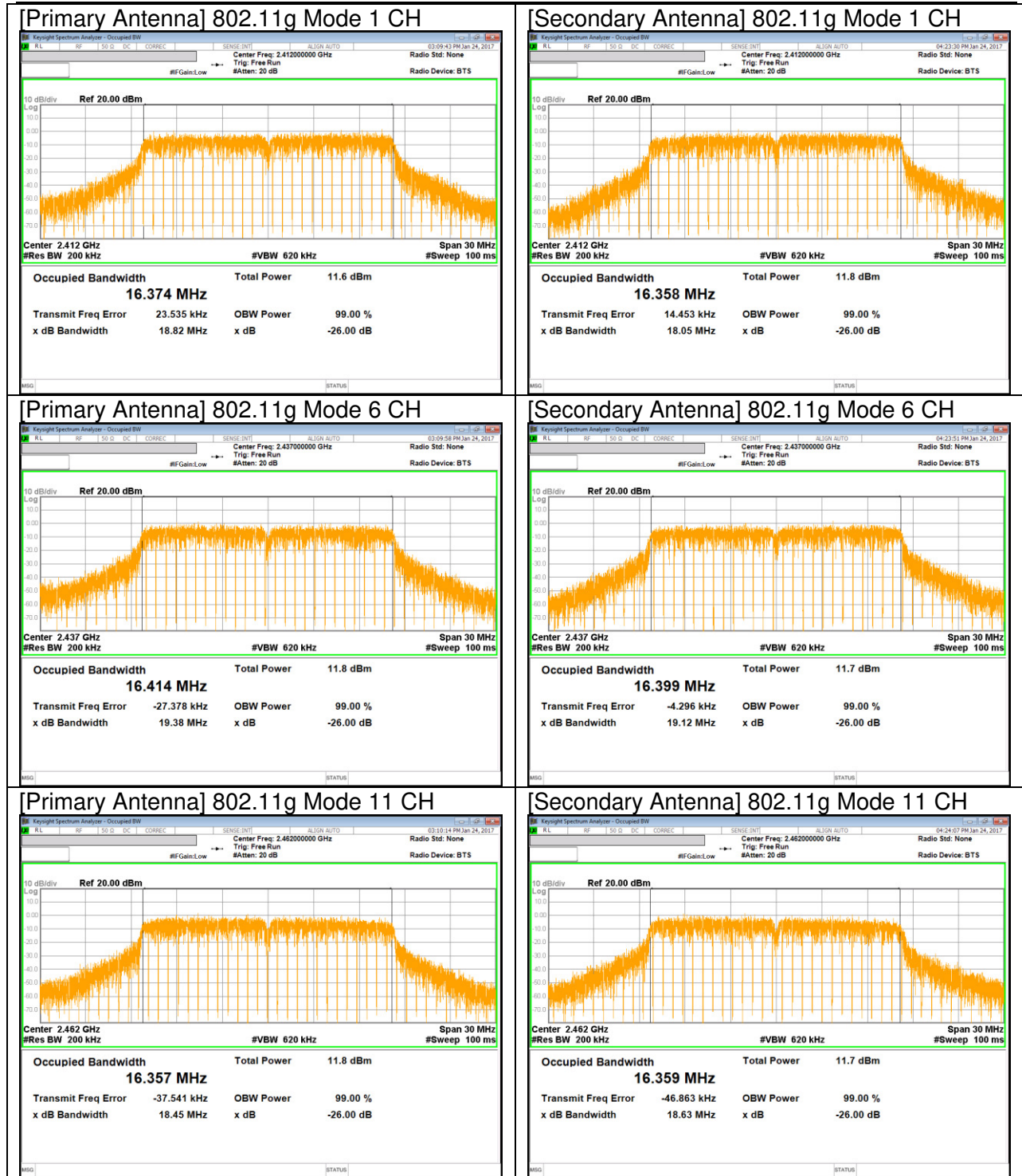
7.2.3. 802.11n HT20 MODE IN THE 2.4 GHz BAND

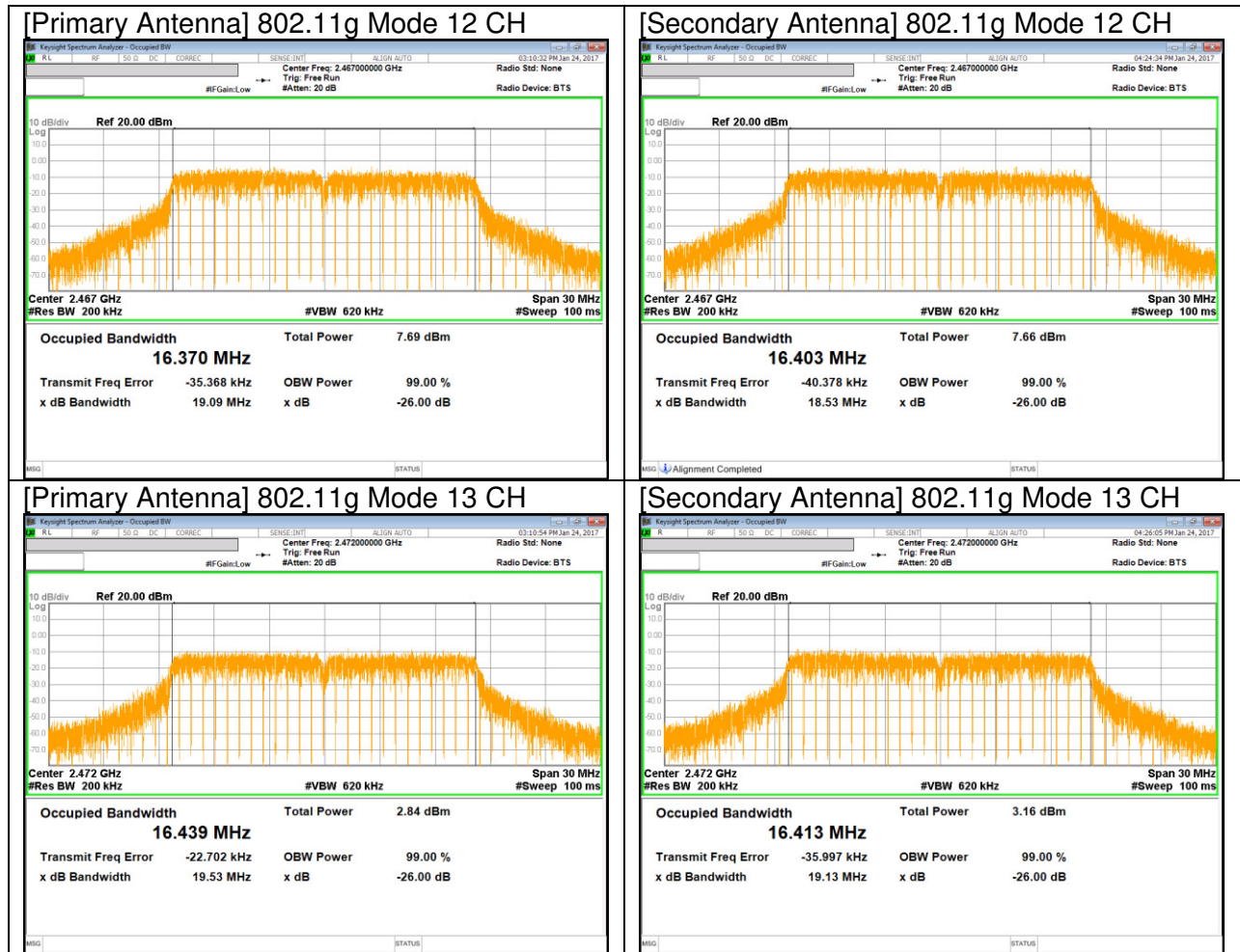
Channel	Frequency [MHz]	99% Bandwidth [MHz]	
		Chain 0	Chain 1
1	2412	17.601	17.541
6	2437	17.622	17.625
11	2462	17.570	17.568
12	2467	17.588	17.610
13	2472	17.635	17.644

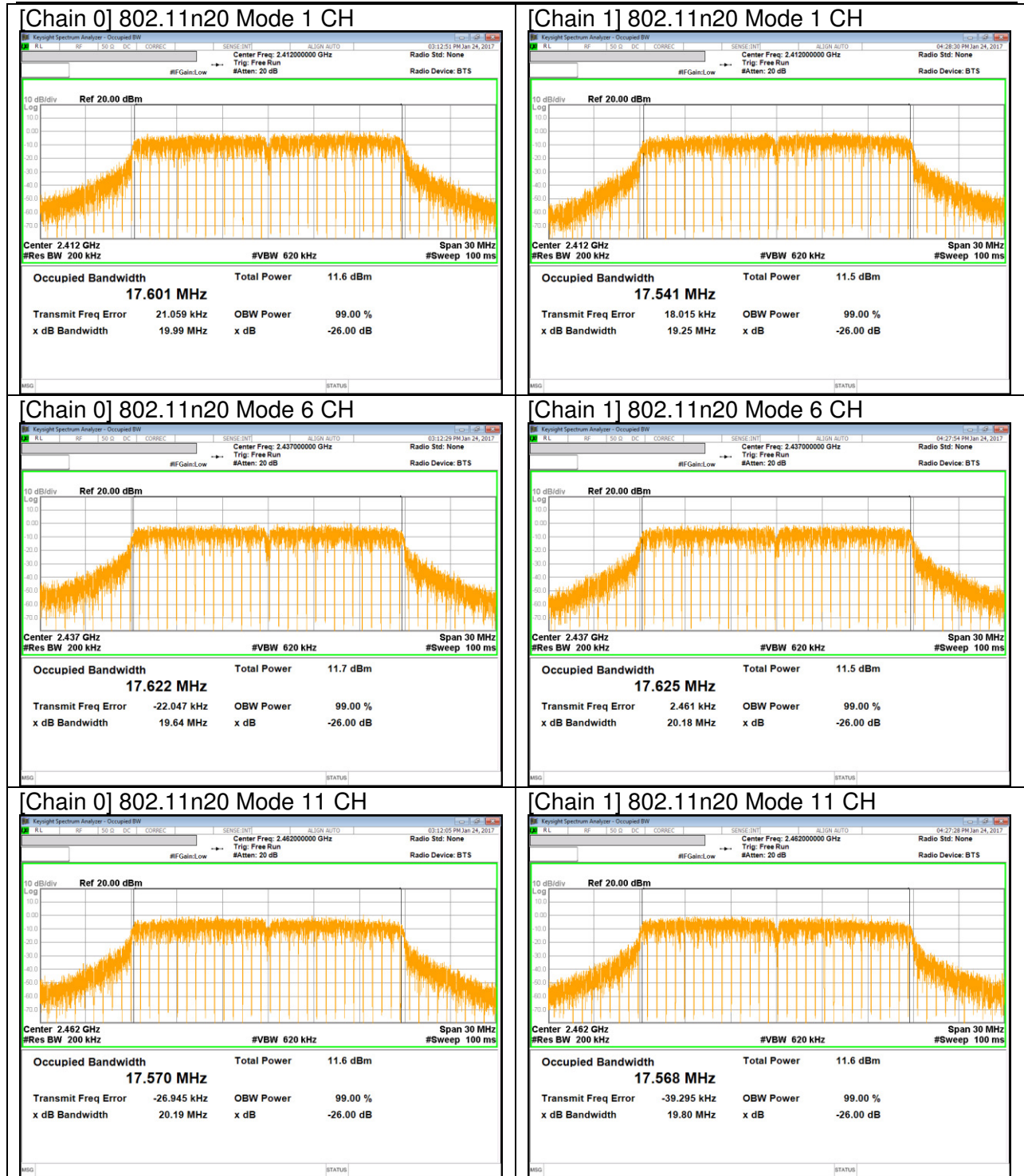
7.2.4. 99% BANDWIDTH PLOTS

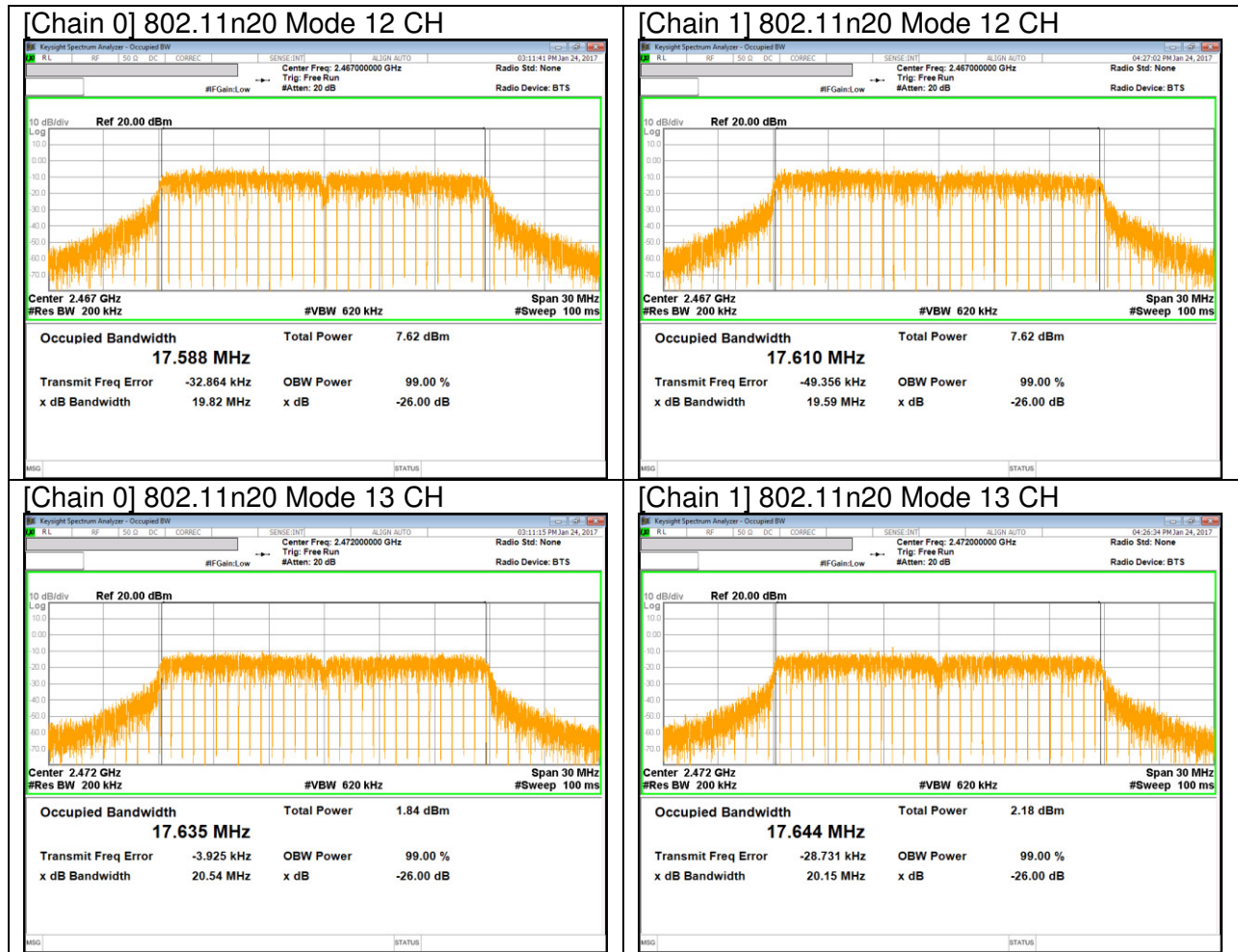












8. SUMMARY TABLE

FCC Part Section	Test Description	Test Limit	Test Condition	Test Result	Worst Case
15.247 (a)(2)	Occupied Band width (6dB)	>500KHz	Conducted	Pass	7.083 MHz
2.1051, 15.247 (d)	Band Edge / Conducted Spurious Emission	-20dBc		Pass	-43.434 dBm
15.247	TX conducted output power	<30dBm		Pass	14.85 dBm (AV)
15.247	PSD	<8dBm		Pass	-10.99 dBm (AV)
15.207 (a)	AC Power Line conducted emissions	Section 10	Power Line conducted	Pass	40.27 dBuV (QP)
15.205, 15.209	Radiated Spurious Emission	< 54dBuV/m	Radiated	Pass	50.61 dBuV/m (AV)

9. ANTENNA PORT TEST RESULTS

9.1. 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 v03r05: 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

9.1.1. 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	
1	2412	8.057	8.043	0.5
6	2437	8.061	8.059	0.5
11	2462	8.051	7.083	0.5
12	2467	8.047	8.042	0.5
13	2472	8.063	8.065	0.5
Worst		7.083		

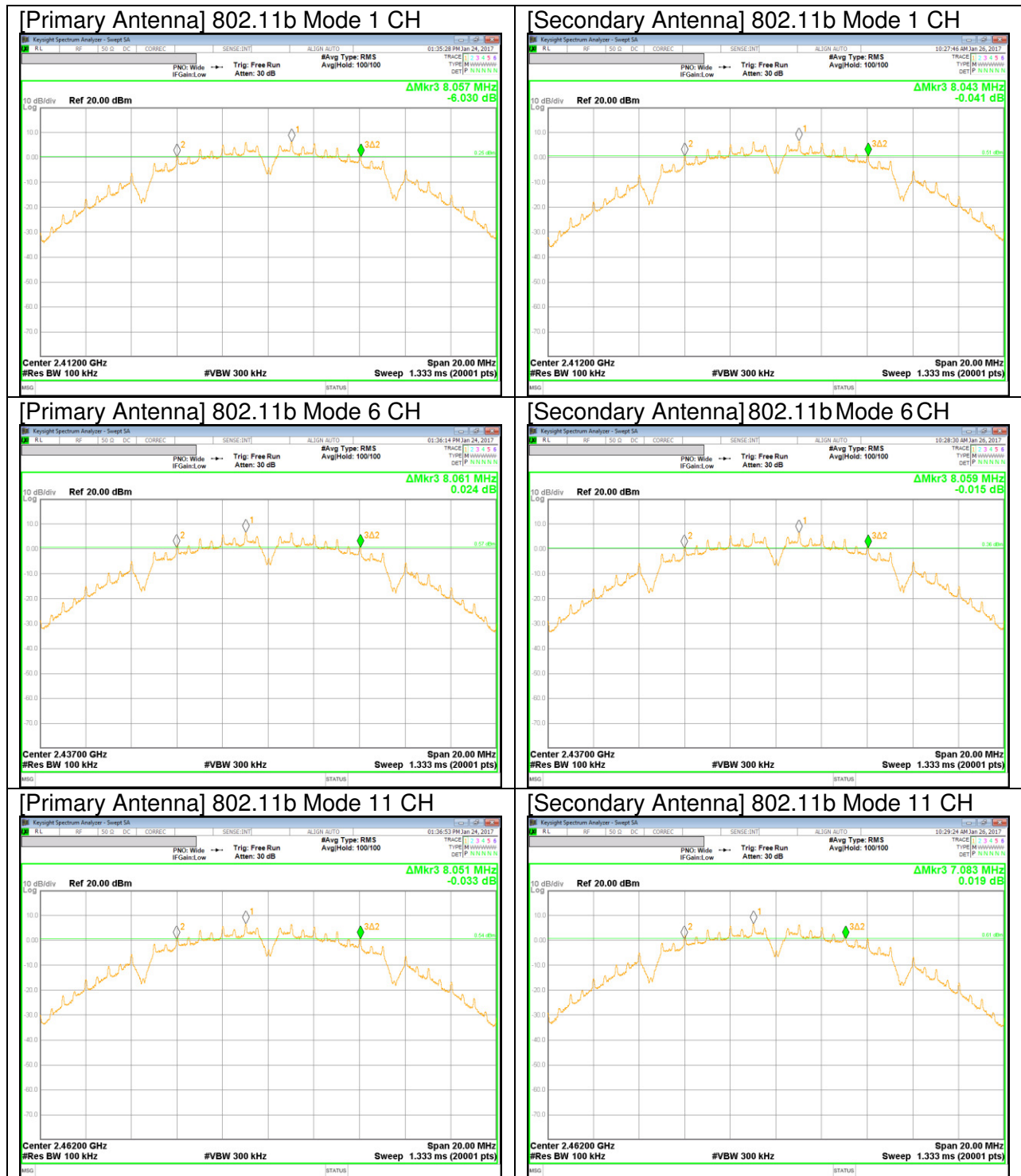
9.1.2. 802.11g MODE IN THE 2.4 GHz BAND

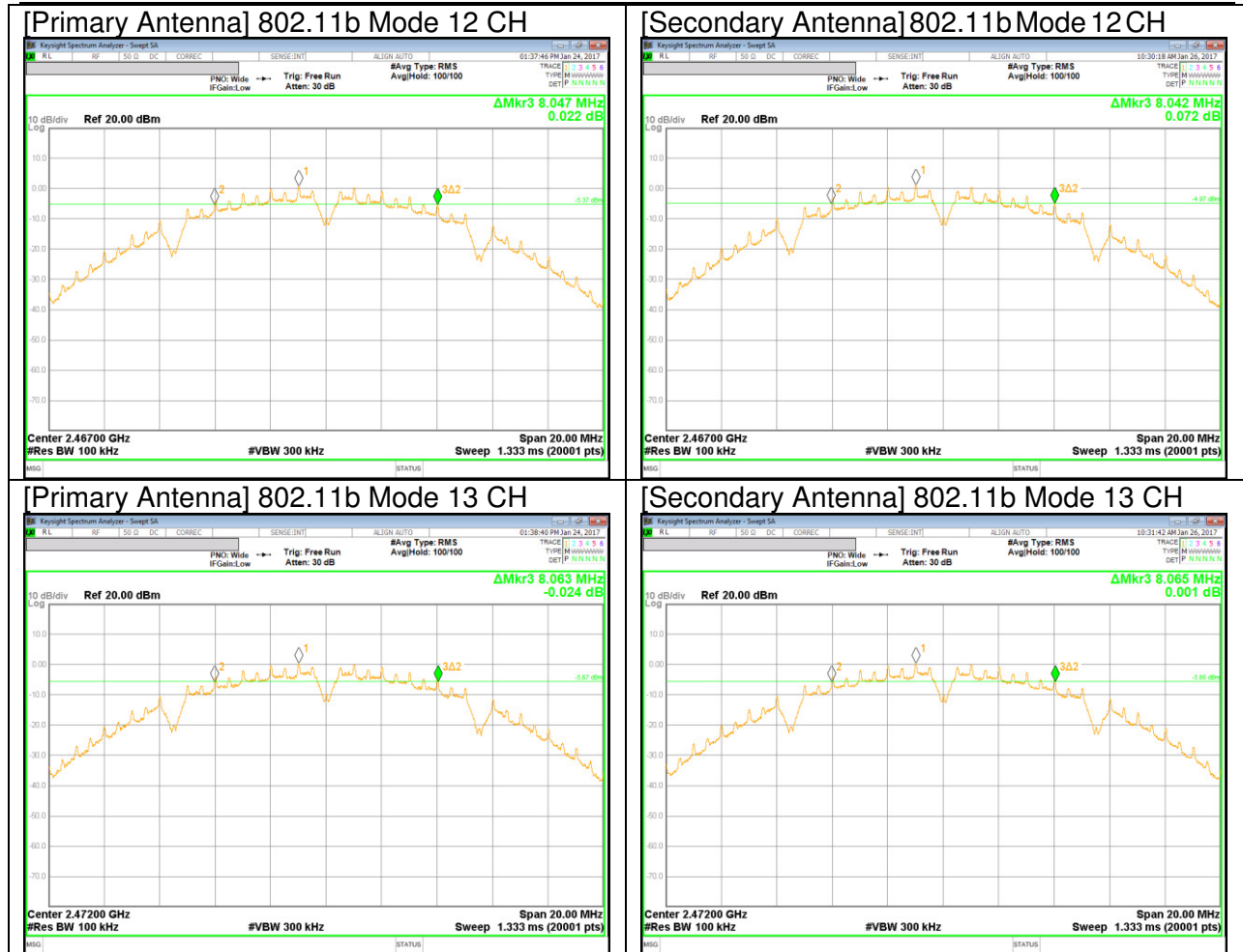
Channel	Frequency [MHz]	6 dB Bandwidth [MHz]		Minimum Limit [MHz]
		Primary Antenna 1	Secondary Antenna 2	
1	2412	15.915	15.478	0.5
6	2437	16.281	16.045	0.5
11	2462	15.442	15.706	0.5
12	2467	15.709	15.708	0.5
13	2472	16.018	16.034	0.5
Worst		15.442		

9.1.3. 802.11n HT20 MODE IN THE 2.4 GHz BAND

Channel	Frequency [MHz]	6 dB Bandwidth [MHz]		Minimum Limit [MHz]
		Chain 0	Chain 1	
1	2412	16.297	15.959	0.5
6	2437	16.802	16.910	0.5
11	2462	15.961	15.941	0.5
12	2467	15.967	16.074	0.5
13	2472	16.809	17.170	0.5
Worst		15.941		

9.1.4. 6 dB BANDWIDTH PLOTS

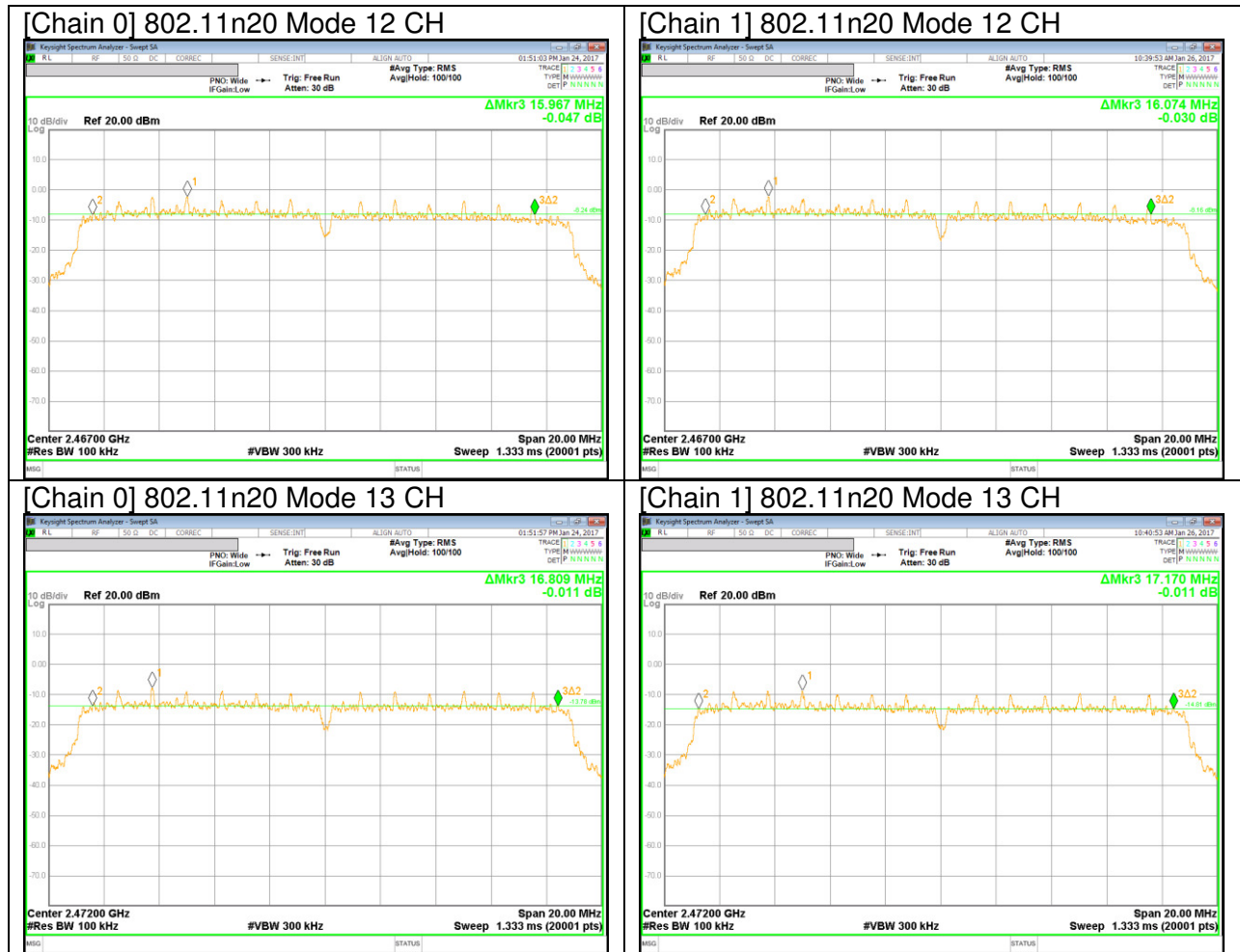












9.2. OUTPUT POWER

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 was entered as an offset in the power meter to allow for direct reading of power.

Output power measurement was performed utilizing the “§9.2.3.1 AVGPM” under KDB558074 D01 DTS Meas Guidance v03r05.

Duty cycle correction factor is already added to the average output power results for duty cycle factor < 98%. (802.11g, 802.11n mode)

DIRECTIONAL ANTENNA GAIN

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]
-0.54	-1.18	2.16

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

RESULTS

9.2.1. 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]	Max Power [dBm]
1	2412	-0.54	-1.18	30.00	30.00
6	2437	-0.54	-1.18	30.00	30.00
11	2462	-0.54	-1.18	30.00	30.00
12	2467	-0.54	-1.18	30.00	30.00
13	2472	-0.54	-1.18	30.00	30.00

Duty Cycle CF [dB]	0.00	Included in Calculations of Corr'd Power
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Results

Channel	Frequency [MHz]	Primary Meas Power [dBm]	Secondary Meas Power [dBm]	Maximum Power [dBm]	Power Limit [dBm]	Margin [dB]
1	2412	14.07	14.25	14.25	30.00	-15.75
6	2437	14.12	14.05	14.12	30.00	-15.88
11	2462	14.09	14.22	14.22	30.00	-15.78
12	2467	7.89	8.34	8.34	30.00	-21.66
13	2472	8.22	8.01	8.22	30.00	-21.78
Worst					30.00	

9.2.2. 802.11g MODE IN THE 2.4 GHz BAND

Limits

Channel	Frequency [MHz]	Directional Gain [dBi]	FCC Power Limit [dBm]	Max Power EIRP Limit [dBm]
1	2412	2.16	30.00	30.00
6	2437	2.16	30.00	30.00
11	2462	2.16	30.00	30.00
12	2467	2.16	30.00	30.00
13	2472	2.16	30.00	30.00

Duty Cycle CF [dB]	0.24	Included in Calculations of Corr'd Power
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Results

Channel	Frequency [MHz]	Primary Meas Power [dBm]	Secondary Meas Power [dBm]	Total Corr'd Power [dBm]	Power Limit [dBm]	Margin [dB]
1	2412	11.69	11.87	14.79	30.00	-15.21
6	2437	11.78	11.69	14.75	30.00	-15.25
11	2462	11.85	11.82	14.85	30.00	-15.15
12	2467	7.5	7.76	10.64	30.00	-19.36
13	2472	3.15	2.65	5.92	30.00	-24.08
Worst				14.85		

9.2.3. 802.11n HT20 MODE IN THE 2.4 GHz BAND

Limits

Channel	Frequency [MHz]	Directional Gain [dBi]	FCC Power Limit [dBm]	Max Power EIRP Limit [dBm]
1	2412	2.16	30.00	30.00
6	2437	2.16	30.00	30.00
11	2462	2.16	30.00	30.00
12	2467	2.16	30.00	30.00
13	2472	2.16	30.00	30.00

Duty Cycle CF [dB]	0.25	Included in Calculations of Corr'd Power
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Results

Channel	Frequency [MHz]	Chain 0 Meas Power [dBm]	Chain 1 Meas Power [dBm]	Total Corr'd Power [dBm]	Power Limit [dBm]	Margin [dB]
1	2412	11.53	11.7	14.63	30.00	-15.37
6	2437	11.63	11.54	14.60	30.00	-15.40
11	2462	11.65	11.75	14.71	30.00	-15.29
12	2467	7.58	7.53	10.57	30.00	-19.43
13	2472	2.23	1.78	5.02	30.00	-24.98
Worst				14.71		

9.3. 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 §10.3 AVGPS-1(802.11 b mode) and §10.5 AVGPS-2(802.11 g/n mode)” under KDB558074 D01 DTS Meas Guidance v03r05

RESULTS

9.3.1. 802.11b MODE IN THE 2.4 GHz BAND

Channel	Frequency [MHz]	Primary Antenna 1 [dBm]	Secondary Antenna 2 [dBm]	Max PSD [dBm]	Limit [dBm]	Margin [dB]
1	2412	-12.26	-14.19	-12.26	8.00	-20.26
6	2437	-14.19	-14.50	-14.19	8.00	-22.19
11	2462	-13.95	-10.99	-10.99	8.00	-18.99
12	2467	-20.20	-18.15	-18.15	8.00	-26.15
13	2472	-20.14	-20.70	-20.14	8.00	-28.14

Duty Cycle CF [dB]	0.00	Included in Calculations of PPSD
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9.3.2. 802.11g 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]
1	2412	-20.28	-20.27	-17.03	8.00	-25.03
6	2437	-20.83	-21.05	-17.69	8.00	-25.69
11	2462	-20.41	-20.31	-17.11	8.00	-25.11
12	2467	-24.48	-24.49	-21.23	8.00	-29.23
13	2472	-29.14	-28.99	-25.82	8.00	-33.82

Duty Cycle CF [dB]	0.24	Included in Calculations of PPSD
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9.3.3. 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]
1	2412	-21.17	-21.29	-17.97	8.00	-25.97
6	2437	-21.45	-21.62	-18.28	8.00	-26.28
11	2462	-21.00	-21.22	-17.84	8.00	-25.84
12	2467	-25.17	-25.14	-21.89	8.00	-29.89
13	2472	-31.09	-30.56	-27.55	8.00	-35.55

Duty Cycle CF [dB]	0.25	Included in Calculations of PPSD
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9.3.4. PSD PLOTS

