



FCC 47 CFR PART 15 SUBPART E

UNII

CERTIFICATION TEST REPORT

FOR

Wi-Fi/BT Transceiver

MODEL NUMBER : WCM730Q

FCC ID: A3LWCM730Q

REPORT NUMBER: 4787630783-E4V4

ISSUE DATE: NOV 04, 2016

Prepared for
SAMSUNG ELECTRONICS CO., LTD.
129 SAMSUNG-RO, YEONGTONG-GU, SUWON-SI,
GYEONGGI-DO, 16677, KOREA

Prepared by
UL Korea, Ltd. Suwon Laboratory
218 Maeyeong-ro, Yeongtong-gu,
Suwon-si, Gyeonggi-do, 16675, Korea
TEL: (031) 337-9902
FAX: (031) 213-5433



DDRevision History

<u>Rev.</u>	<u>Issue Date</u>	<u>Revisions</u>	<u>Revised By</u>
V1	10/31/16	Initial issue	Junwhan Lee
V2	11/02/16	Revised section 5.1	Junwhan Lee
V3	11/03/16	Removed IC section	Junwhan Lee
V4	11/04/16	Revised section 10.4	Junwhan Lee

TABLE OF CONTENTS

1. ATTESTATION OF TEST RESULTS	7
2. TEST METHODOLOGY	8
3. FACILITIES AND ACCREDITATION	8
4. CALIBRATION AND UNCERTAINTY	8
4.1. <i>MEASURING INSTRUMENT CALIBRATION</i>	<i>8</i>
4.2. <i>SAMPLE CALCULATION</i>	<i>8</i>
4.3. <i>MEASUREMENT UNCERTAINTY.....</i>	<i>9</i>
5. EQUIPMENT UNDER TEST.....	10
5.1. <i>DESCRIPTION OF EUT</i>	<i>10</i>
5.2. <i>MAXIMUM OUTPUT POWER.....</i>	<i>11</i>
5.3. <i>DESCRIPTION OF AVAILABLE ANTENNAS</i>	<i>12</i>
5.4. <i>List of test reduction and modes covering other modes:</i>	<i>12</i>
5.5. <i>WORST-CASE CONFIGURATION AND MODE.....</i>	<i>14</i>
5.6. <i>DESCRIPTION OF TEST SETUP.....</i>	<i>15</i>
6. TEST AND MEASUREMENT EQUIPMENT	17
7. SUMMARY TABLE	18
8. ON TIME, DUTY CYCLE AND MEASUREMENT METHODS	19
8.1. <i>ON TIME AND DUTY CYCLE RESULTS.....</i>	<i>19</i>
8.2. <i>DUTY CYCLE PLOTS</i>	<i>19</i>
9. MEASUREMENT METHOD.....	22
10. ANTENNA PORT TEST RESULTS.....	23
10.1. <i>6 dB BANDWIDTH</i>	<i>23</i>
10.1.1. <i>802.11a MODE IN THE 5.8 GHz BAND.....</i>	<i>24</i>
10.1.2. <i>802.11n HT20 MODE IN THE 5.8 GHz BAND</i>	<i>24</i>
10.1.3. <i>802.11n HT40 MODE IN THE 5.8 GHz BAND</i>	<i>24</i>
10.1.4. <i>802.11n VHT80 MODE IN THE 5.8 GHz BAND.....</i>	<i>24</i>
10.1.5. <i>6 dB BANDWIDTH PLOTS</i>	<i>25</i>
10.2. <i>26 dB BANDWIDTH</i>	<i>31</i>
10.2.1. <i>802.11a MODE IN THE 5.2 GHz BAND</i>	<i>32</i>
10.2.2. <i>802.11n HT20 MODE IN THE 5.2 GHz BAND</i>	<i>32</i>
10.2.3. <i>802.11n HT40 MODE IN THE 5.2 GHz BAND</i>	<i>32</i>
10.2.4. <i>802.11ac VHT80 MODE IN THE 5.2 GHz BAND</i>	<i>32</i>
10.2.5. <i>802.11a MODE IN THE 5.3 GHz BAND.....</i>	<i>33</i>
10.2.6. <i>802.11n HT20 MODE IN THE 5.3 GHz BAND</i>	<i>33</i>

10.2.7.	802.11n HT40 MODE IN THE 5.3 GHz BAND	33
10.2.8.	802.11ac VHT80 MODE IN THE 5.3 GHz BAND	33
10.2.1.	802.11a MODE IN THE 5.5 GHz BAND	34
10.2.2.	802.11n HT20 MODE IN THE 5.5 GHz BAND	34
10.2.3.	802.11n HT40 MODE IN THE 5.5 GHz BAND	34
10.2.4.	802.11ac VHT80 MODE IN THE 5.5 GHz BAND	34
10.2.5.	802.11a MODE IN THE 5.8 GHz BAND	35
10.2.6.	802.11n HT20 MODE IN THE 5.8 GHz BAND	35
10.2.7.	802.11n HT40 MODE IN THE 5.8 GHz BAND	35
10.2.8.	802.11ac VHT80 MODE IN THE 5.8 GHz BAND	35
10.2.9.	26 dB BANDWIDTH PLOTS	36
10.3.	99% BANDWIDTH	50
10.3.1.	802.11a MODE IN THE 5.2 GHz BAND	51
10.3.2.	802.11n HT20 MODE IN THE 5.2 GHz BAND	51
10.3.3.	802.11n HT40 MODE IN THE 5.2 GHz BAND	51
10.3.4.	802.11ac VHT80 MODE IN THE 5.2 GHz BAND	51
10.3.5.	802.11a MODE IN THE 5.3 GHz BAND	52
10.3.6.	802.11n HT20 MODE IN THE 5.3 GHz BAND	52
10.3.7.	802.11n HT40 MODE IN THE 5.3 GHz BAND	52
10.3.8.	802.11ac VHT80 MODE IN THE 5.3 GHz BAND	52
10.3.9.	802.11a MODE IN THE 5.5 GHz BAND	53
10.3.10.	802.11n HT20 MODE IN THE 5.5 GHz BAND	53
10.3.11.	802.11n HT40 MODE IN THE 5.5 GHz BAND	53
10.3.12.	802.11ac VHT80 MODE IN THE 5.5 GHz BAND	53
10.3.13.	802.11a MODE IN THE 5.8 GHz BAND	54
10.3.14.	802.11n HT20 MODE IN THE 5.8 GHz BAND	54
10.3.15.	802.11n HT40 MODE IN THE 5.8 GHz BAND	54
10.3.16.	802.11ac VHT80 MODE IN THE 5.8 GHz BAND	54
10.3.17.	99% BANDWIDTH PLOTS	55
10.4.	OUTPUT POWER AND PPSD	69
10.4.1.	802.11a MODE IN THE 5.2 GHz BAND	71
10.4.2.	802.11n HT20 MODE IN THE 5.2 GHz BAND	72
10.4.3.	802.11n HT40 MODE IN THE 5.2 GHz BAND	73
10.4.4.	802.11ac VHT80 MODE IN THE 5.2 GHz BAND	74
10.4.5.	802.11a MODE IN THE 5.3 GHz BAND	75
10.4.6.	802.11n HT20 MODE IN THE 5.3 GHz BAND	76
10.4.7.	802.11n HT40 MODE IN THE 5.3 GHz BAND	77
10.4.8.	802.11ac VHT80 MODE IN THE 5.3 GHz BAND	78
10.4.9.	802.11a MODE IN THE 5.5 GHz BAND	79
10.4.10.	802.11n HT20 MODE IN THE 5.5 GHz BAND	80
10.4.11.	802.11n HT40 MODE IN THE 5.5 GHz BAND	81
10.4.12.	802.11ac VHT80 MODE IN THE 5.5 GHz BAND	82
10.4.13.	802.11a MODE IN THE 5.8 GHz BAND	83
10.4.14.	802.11n HT20 MODE IN THE 5.8 GHz BAND	84
10.4.15.	802.11n HT40 MODE IN THE 5.8 GHz BAND	85
10.4.16.	802.11ac VHT80 MODE IN THE 5.8 GHz BAND	86
10.4.17.	802.11a MODE AT STRADDLE CHANNEL	87
10.4.18.	802.11n HT20 MODE AT STRADDLE CHANNEL	88
10.4.19.	802.11n HT40 MODE AT STRADDLE CHANNEL	89
10.4.20.	802.11ac VHT80 MODE AT STRADDLE CHANNEL	90

10.4.21. OUTPUT POWER AND PPSD PLOTS.....91

11. TRANSMITTER ABOVE 1 GHz..... 105

11.1. 5.2 GHz..... 108

11.1.1. TX Above 1GHz 802.11a 2TX CDD MODE IN THE 5.2GHz BAND 108

11.1.2. TX Above 1GHz 802.11n HT20 2TX CDD MODE IN THE 5.2GHz BAND 116

11.1.3. TX Above 1GHz 802.11n HT40 2TX CDD MODE IN THE 5.2GHz BAND 124

11.1.4. TX ABOVE 1GHz 802.11ac VHT80 2TX CDD MODE IN THE 5.2GHz BAND 132

11.2. 5.3 GHz..... 136

11.2.1. TX ABOVE 1 GHz 802.11a 2TX CDD MODE IN THE 5.3 GHz BAND 136

11.2.2. TX ABOVE 1GHz 802.11n HT20 2TX CDD MODE IN THE 5.3GHz BAND 144

11.2.3. TX ABOVE 1GHz 802.11n HT40 2TX CDD MODE IN THE 5.3GHz BAND 152

11.2.4. TX ABOVE 1GHz 802.11ac VHT80 2TX CDD MODE IN THE 5.3GHz BAND 160

11.3. 5.5-5.6 GHz..... 164

11.3.1. TX ABOVE 1 GHz 802.11a 2TX CDD MODE IN THE 5.5 GHz BAND 164

11.3.2. TX ABOVE 1GHz 802.11n HT20 2TX CDD MODE IN THE 5.5GHz BAND 174

11.3.3. TX ABOVE 1GHz 802.11n HT40 2TX CDD MODE IN THE 5.5GHz BAND 184

11.3.4. TX ABOVE 1GHz 802.11ac VHT80 2TX CDD MODE IN THE 5.5GHz BAND 196

11.4. 5.8 GHz..... 206

11.4.1. TX ABOVE 1GHz 802.11a 2TX CDD MODE IN THE 5.8GHz BAND 206

11.4.2. TX ABOVE 1GHz 802.11n HT20 2TX CDD MODE IN THE 5.8GHz BAND 218

11.4.3. TX ABOVE 1GHz 802.11n HT40 2TX CDD MODE IN THE 5.8GHz BAND 230

11.4.4. TX ABOVE 1GHz 802.11ac VHT80 2TX CDD MODE IN THE 5.8GHz BAND 240

11.5. TEST REULST OF LAPTOP STAD ALONE CONDITION..... 248

12. WORST-CASE BELOW 1 GHz (in the 5.3 GHz Band)..... 250

13. AC POWER LINE CONDUCTED EMISSIONS 252

14. DYNAMIC FREQUENCY SELECTION..... 257

14.1. OVERVIEW..... 257

14.1.1. LIMITS..... 257

14.1.1. TEST AND MEASUREMENT SYSTEM 261

14.1.2. SETUP OF EUT..... 264

14.1.3. DESCRIPTION OF EUT 265

14.2. RESULTS FOR 20 MHz BANDWIDTH..... 266

14.2.1. TEST CHANNEL 266

14.2.2. RADAR WAVEFORM AND TRAFFIC 266

14.2.3. OVERLAPPING CHANNEL TESTS 268

14.2.4. MOVE AND CLOSING TIME 268

14.3. RESULTS FOR 40 MHz BANDWIDTH..... 271

14.3.1. TEST CHANNEL 271

14.3.2. RADAR WAVEFORM AND TRAFFIC 271

14.3.3. OVERLAPPING CHANNEL TESTS 273

14.3.4. MOVE AND CLOSING TIME 273

14.4. RESULTS FOR 80 MHz BANDWIDTH..... 276

14.4.1. TEST CHANNEL 276

14.4.2. RADAR WAVEFORM AND TRAFFIC	276
14.4.3. OVERLAPPING CHANNEL TESTS	278
14.4.4. MOVE AND CLOSING TIME	278
15. SETUP PHOTOS.....	281

1. ATTESTATION OF TEST RESULTS

COMPANY NAME: SAMSUNG ELECTRONICS CO., LTD.
EUT DESCRIPTION: Wi-Fi/BT Transceiver
MODEL NUMBER: WCM730Q
EUT WLAN MAC ADDRESS: B8BBAFC457EA, B8BBAFC457E9
B8BBAFC45874, B8BBAFC458A6 (RADIATED)
B8BBAFC45850, B8BBAFC45844 (CONDUCTED)
DATE TESTED: OCT 10, 2016 - OCT 31, 2016

APPLICABLE STANDARDS	
STANDARD	TEST RESULTS
CFR 47 Part 15 Subpart E	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:



CY Choi
Suwon Lab Engineer
UL Korea, Ltd.

Tested By:



Junwhan Lee
Suwon Lab Engineer
UL Korea, Ltd.

2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with FCC CFR 47 Part 2, FCC CFR 47 Part 15, FCC 06-96, FCC KDB 789033 D02 v01r02, 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 Wi-Fi/BT Transceiver.
 This test report addresses the NII (UNII) 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
	802.11g 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
5180 - 5240	802.11a SISO	12.62	13.10	18.28	20.41
	802.11a MIMO	15.88		38.69	
	802.11n HT20 SISO	12.38	12.97	17.29	19.81
	802.11n HT20 MIMO	15.69		37.10	
5190 - 5230	802.11n HT40 SISO	15.82	15.61	38.22	36.37
	802.11n HT40 MIMO	18.73		74.59	
5210	802.11ac VHT80 SISO	12.34	12.00	17.13	15.86
	802.11ac VHT80 MIMO	15.18		32.99	
5260 - 5320	802.11a SISO	17.62	17.29	57.81	53.60
	802.11a MIMO	20.32		107.65	
	802.11n HT20 SISO	17.33	17.09	54.08	51.11
	802.11n HT20 MIMO	20.12		102.80	
5270 - 5310	802.11n HT40 SISO	17.95	17.62	62.36	57.85
	802.11n HT40 MIMO	20.80		120.21	
5290	802.11ac VHT80 SISO	11.81	11.35	15.18	13.64
	802.11ac VHT80 MIMO	14.60		28.82	
5500 - 5720	802.11a SISO	17.61	17.29	57.72	53.53
	802.11a MIMO	20.46		111.25	
	802.11n HT20 SISO	17.40	17.50	54.99	56.18
	802.11n HT20 MIMO	20.46		111.17	
5510 - 5710	802.11n HT40 SISO	18.19	18.01	65.86	63.20
	802.11n HT40 MIMO	21.11		129.05	
5530 - 5690	802.11ac VHT80 SISO	16.27	16.79	42.33	47.76
	802.11ac VHT80 MIMO	19.55		90.09	
5745 - 5825	802.11a SISO	17.49	17.19	56.04	52.30
	802.11a MIMO	20.35		108.34	
	802.11n HT20 SISO	17.27	17.43	53.27	55.28
	802.11n HT20 MIMO	20.36		108.56	
5755 - 5795	802.11n HT40 SISO	16.89	17.03	48.91	50.51
	802.11n HT40 MIMO	19.97		99.42	
5775	802.11ac VHT80 SISO	13.92	14.34	24.68	27.17
	802.11ac VHT80 MIMO	17.15		51.85	

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes a Metal Inverted F antenna, with a maximum gain of:

Frequency Range [MHz]	Antenna Gain [dBi]	
	Antenna 1	Antenna 2
UNII 1 5150 – 5250	1.1	-0.1
UNII 2A 5250 – 5350	1.6	1.9
UNII 2C 5470 – 5725	1.1	2.4
UNII 3 5725 – 5850	0.6	3

5.4. List of test reduction and modes covering other modes:

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

UNII 1

5150 - 5250 MHz Authorized Frequency Band (Radiated Testing)		
Frequency Range [MHz]	Mode	Covered by
5180 - 5240	802.11a legacy 1TX/CDD 2TX	802.11a 2TX CDD
5180 - 5240	802.11HT20 1TX	802.11n HT20 2TX CDD
5180 - 5240	802.11HT20 2TX STBC/CDD	802.11n HT20 2TX CDD
5180 - 5240	802.11ac VHT20 1TX	802.11n HT20 2TX CDD
5180 - 5240	802.11ac VHT20 2TX STBC/SDM/CDD	802.11n HT20 2TX CDD
5190 - 5230	802.11n HT40 1TX	802.11n HT40 2TX CDD
5190 - 5230	802.11n HT40 2TX STBC/CDD	802.11n HT40 2TX CDD
5190 - 5230	802.11ac VHT40 1TX	802.11n HT40 2TX CDD
5190 - 5230	802.11ac VHT40 2TX STBC/SDM/CDD	802.11n HT40 2TX CDD
5210	802.11ac VHT80 1TX	802.11ac VHT80 2TX CDD
5210	802.11ac VHT80 2TX STBC/SDM/CDD	802.11ac VHT80 2TX CDD

UNII 2A

5250 - 5350 MHz Authorized Frequency Band (Radiated Testing)		
Frequency Range [MHz]	Mode	Covered by
5260 - 5320	802.11a legacy 1TX/CDD 2TX	802.11a 2TX CDD
5260 - 5320	802.11HT20 1TX	802.11n HT20 2TX CDD
5260 - 5320	802.11HT20 2TX STBC/CDD	802.11n HT20 2TX CDD
5260 - 5320	802.11ac VHT20 1TX	802.11n HT20 2TX CDD
5260 - 5320	802.11ac VHT20 2TX STBC/SDM/CDD	802.11n HT20 2TX CDD
5270 - 5310	802.11n HT40 1TX	802.11n HT40 2TX CDD
5270 - 5310	802.11n HT40 2TX STBC/CDD	802.11n HT40 2TX CDD
5270 - 5310	802.11ac VHT40 1TX	802.11n HT40 2TX CDD
5270 - 5310	802.11ac VHT40 2TX STBC/SDM/CDD	802.11n HT40 2TX CDD
5290	802.11ac VHT80 1TX	802.11ac VHT80 2TX CDD
5290	802.11ac VHT80 2TX STBC/SDM/CDD	802.11ac VHT80 2TX CDD

UNII 2C

5470 - 5725 MHz Authorized Frequency Band (Radiated Testing)		
Frequency Range [MHz]	Mode	Covered by
5500 - 5720	802.11a legacy 1TX/CDD 2TX	802.11a 2TX CDD
5500 - 5720	802.11HT20 1TX	802.11n HT20 2TX CDD
5500 - 5720	802.11HT20 2TX STBC/CDD	802.11n HT20 2TX CDD
5500 - 5720	802.11ac VHT20 1TX	802.11n HT20 2TX CDD
5500 - 5720	802.11ac VHT20 2TX STBC/SDM/CDD	802.11n HT20 2TX CDD
5510 - 5710	802.11n HT40 1TX	802.11n HT40 2TX CDD
5510 - 5710	802.11n HT40 2TX STBC/CDD	802.11n HT40 2TX CDD
5510 - 5710	802.11ac VHT40 1TX	802.11n HT40 2TX CDD
5510 - 5710	802.11ac VHT40 2TX STBC/SDM/CDD	802.11n HT40 2TX CDD
5530 - 5690	802.11ac VHT80 1TX	802.11ac VHT80 2TX CDD
5530 - 5690	802.11ac VHT80 2TX STBC/SDM/CDD	802.11ac VHT80 2TX CDD

UNII 3

5725 - 5850 MHz Authorized Frequency Band (Radiated Testing)		
Frequency Range [MHz]	Mode	Covered by
5745 - 5825	802.11a legacy 1TX/CDD 2TX	802.11a 2TX CDD
5745 - 5825	802.11HT20 1TX	802.11n HT20 2TX CDD
5745 - 5825	802.11HT20 2TX STBC/CDD	802.11n HT20 2TX CDD
5745 - 5825	802.11ac VHT20 1TX	802.11n HT20 2TX CDD
5745 - 5825	802.11ac VHT20 2TX STBC/SDM/CDD	802.11n HT20 2TX CDD
5755 - 5795	802.11n HT40 1TX	802.11n HT40 2TX CDD
5755 - 5795	802.11n HT40 2TX STBC/CDD	802.11n HT40 2TX CDD
5755 - 5795	802.11ac VHT40 1TX	802.11n HT40 2TX CDD
5755 - 5795	802.11ac VHT40 2TX STBC/SDM/CDD	802.11n HT40 2TX CDD
5775	802.11ac VHT80 1TX	802.11ac VHT80 2TX CDD
5775	802.11ac VHT80 2TX STBC/SDM/CDD	802.11ac VHT80 2TX CDD

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,Z, it was determined that the X orientation was worst-case orientation; therefore, all final radiated testing was performed with the EUT in the X orientation.

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

- 802.11a mode: 6 Mbps (2TX CDD)
- 802.11n HT20mode: MCS0 (2TX CDD)
- 802.11n HT40mode: MCS0 (2TX CDD)
- 802.11ac VHT80mode: MCS0 (2TX CDD)

5.6. DESCRIPTION OF TEST SETUP

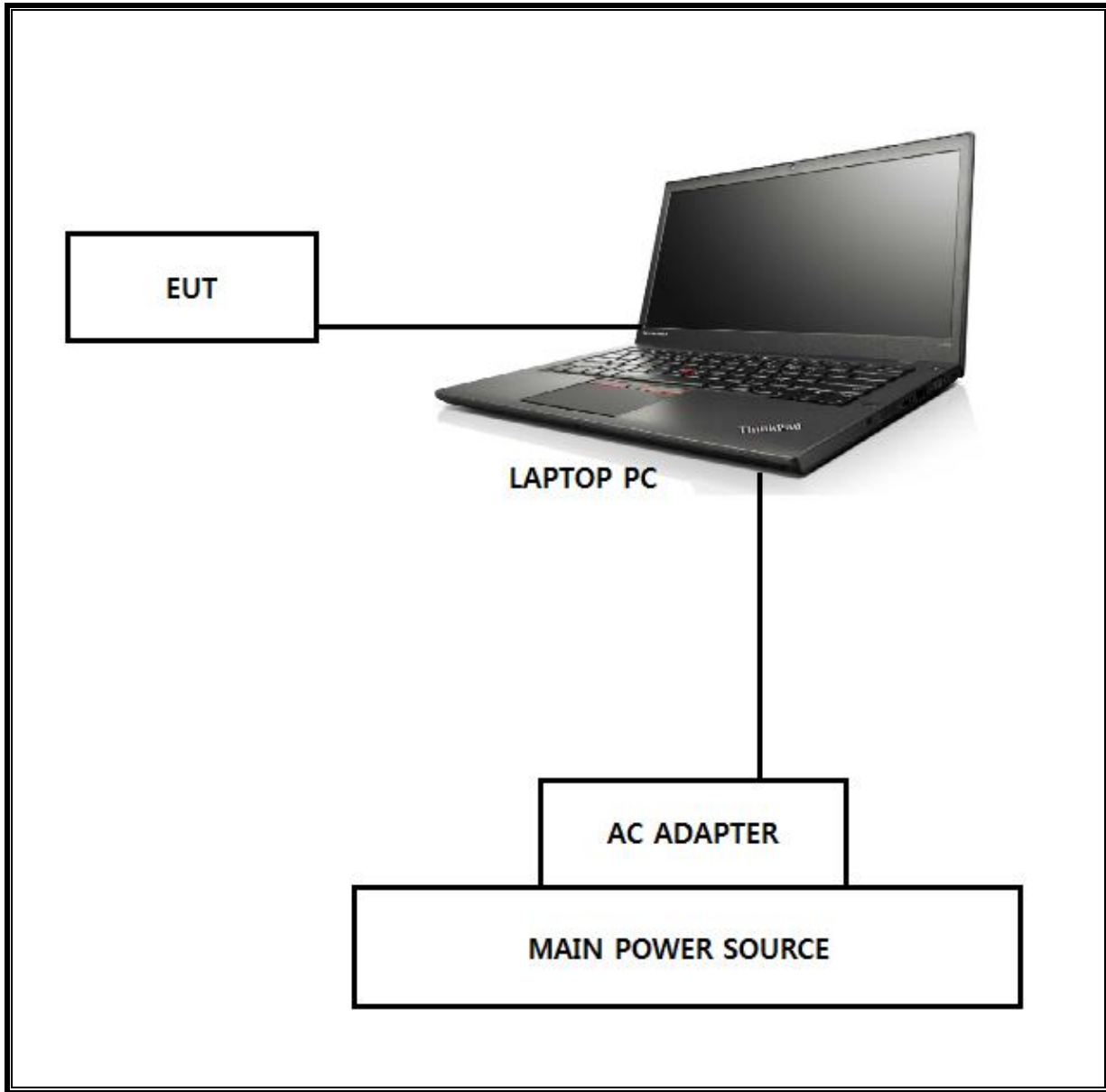
SUPPORT EQUIPMENT

Support Equipment List				
Description	Manufacturer	Model	Serial Number	FCC ID
USB Cable	SAMSUNG	USB Cable	N/A	N/A
LAPTOP PC	LENOVO	T450	PC-07B394	N/A
ADAPTER	LENOVO	ADLX65NDC3A	N/A	N/A

TEST SETUP

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

SETUP DIAGRAM FOR TESTS



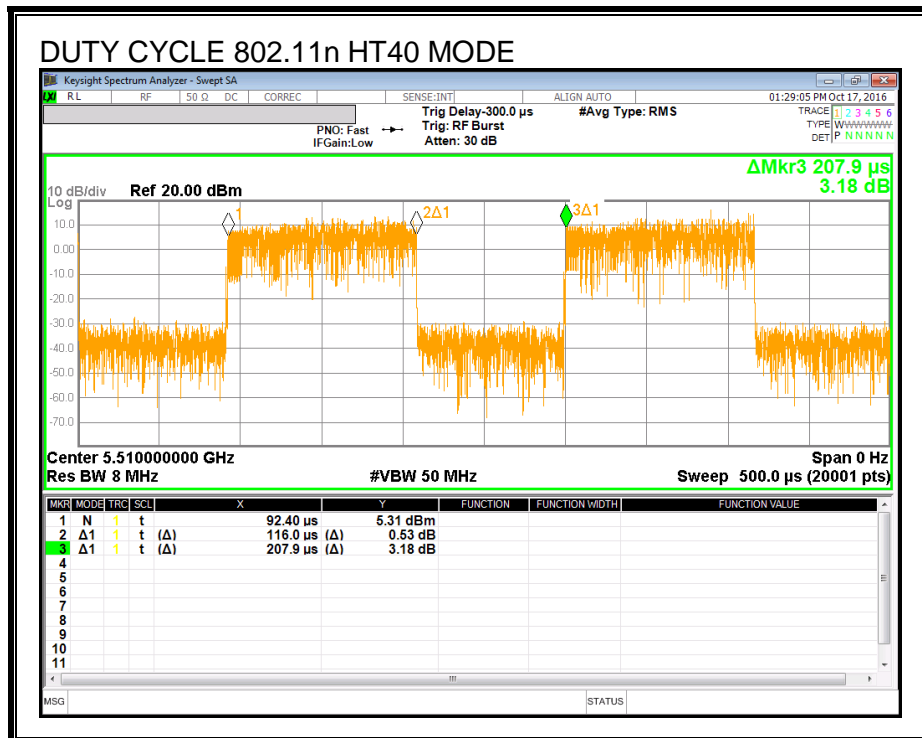
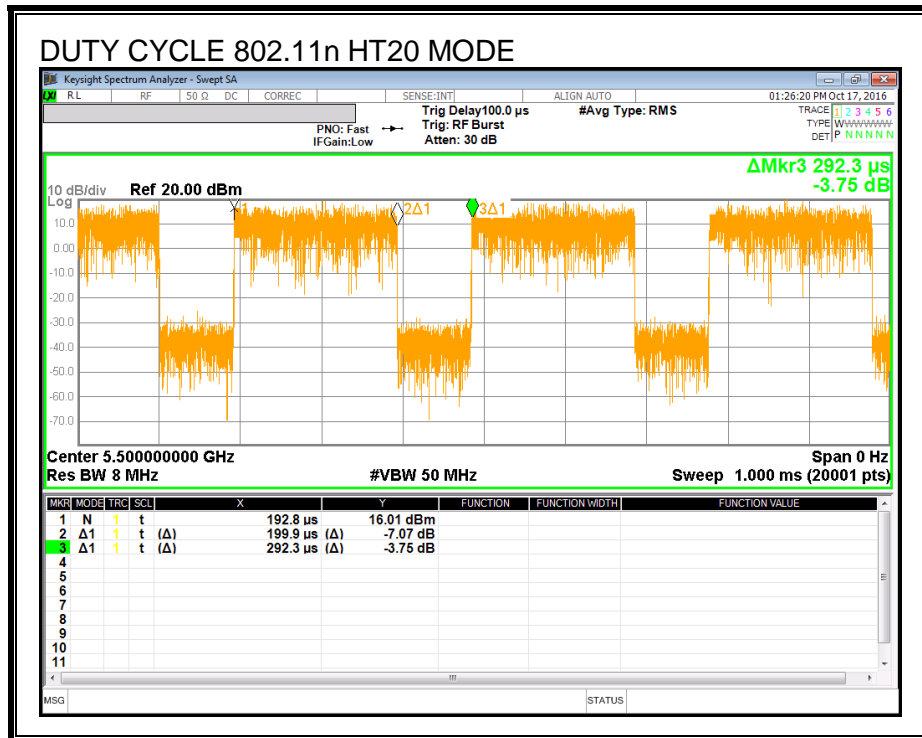
6. TEST AND MEASUREMENT EQUIPMENT

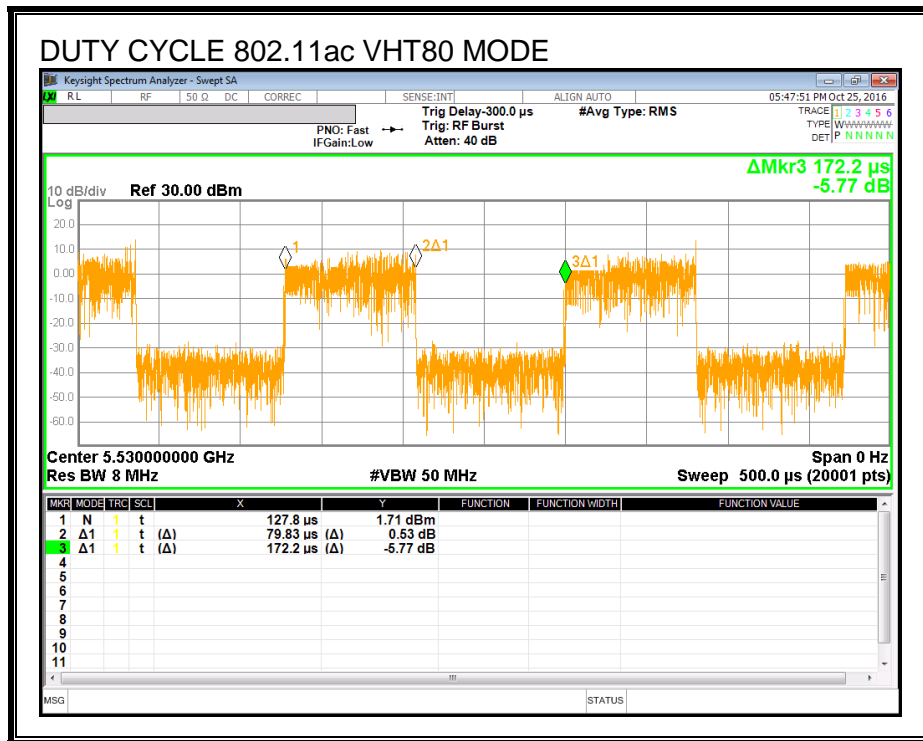
The following test and measurement equipment was utilized for the tests documented in this report:

Test Equipment List				
Description	Manufacturer	Model	S/N	Cal Due
Antenna, Bilog, 30MHz-1GHz	SCHWARZBECK	VULB9163	750	11-17-16
Antenna, Bilog, 30MHz-1GHz	SCHWARZBECK	VULB9163	749	04-25-17
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
Bluetooth Tester	TESCOM	TC-3000C	3000C000546	08-18-17
Average Power Sensor	R&S	NRZ-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

7. SUMMARY TABLE

FCC Part Section	Test Description	Test Limit	Test Condition	Test Result	Worst Case
15.407 (a)	Occupied Band width (26dB)	N/A	Conducted	Pass	92.597 MHz
15.407	6dB Band width (5.8Ghz)	500KHz		Pass	1.278 MHz (Straddle)
15.407 (a)(2)	TX Cond. Power 5.15-2.25, 5.25-5.35 & 5.47-5.725	<24dBm or 11+10Log(OBW)		Pass	21.11 dBm
15.407 (a)(3)	TX Cond. Power 5.725-5.825	< 30dBm or 17+10Log(OBW)		Pass	20.36 dBm
15.407 (a)(5)	PSD (5.2,5.3,5.5GHz)	<6.47dBm		Pass	6.06 dBm
15.407 (a)(5)	PSD (5.8GHz)	30dBm per 500kHz		Pass	7.75 dBm
15.207 (a)	AC Power Line conducted emissions	Section 10	Radiated	Pass	55.47 dBuV (Qp)
15.407 (b) & 15.209	Radiated Spurious Emission	< 54dBuV/m		Pass	51.81 dBuV/m (Av)
15.407 (h)(2)	Dynamic Frequency Selection	N/A	Radiated / Condcuted	Pass	N/A





9. MEASUREMENT METHOD

KDB 789033 D02 General UNII Test Procedures New Rules v01r02
KDB 905462 D02 UNII DFS Compliance Procedures New Rules v02
KDB 905462 D03 UNII Clients Without Radar Detection New Rules v01r01

The Duty Cycle is less than 98% and consistent therefore KDB 789033 Method SA-2 is used for power and PPSD

The Duty Cycle is less than 98% and consistent, KDB 789033 Method AD with Power RMS Averaging and duty cycle correction is used.

MIMO Device: KDB 662911 v02r01

10. ANTENNA PORT TEST RESULTS

10.1. 6 dB BANDWIDTH

LIMITS

FCC §15.407

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

TEST PROCEDURE

Reference to 789033 D02 General UNII Test Procedures New Rules v01r02: 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.

NOTE

- Calculation for 6dB Bandwidth of UNII-3 Straddle Channel

ex) 802.11a mode

- Fundamental frequency : 5720MHz
- 6dB BW : 16.350MHz
- Starting Frequency of UNII-3 band : 5725MHz
- 6dB Bandwidth of UNII-3 band Portion
 $= (5720 + (16.350 / 2) - 5725) = 3.175 \text{ MHz}$

RESULTS

10.1.1. 802.11a MODE IN THE 5.8 GHz BAND

Channel	Frequency [MHz]	6 dB Bandwidth [MHz]		Minimum Limit [MHz]
		Primary	Secondary	
Straddle	5720	2.557	2.555	0.5
Low	5745	15.120	15.120	0.5
Mid	5785	15.111	15.116	0.5
High	5825	15.081	15.120	0.5
Worst		2.555		

10.1.2. 802.11n HT20 MODE IN THE 5.8 GHz BAND

Channel	Frequency [MHz]	6 dB Bandwidth [MHz]		Minimum Limit [MHz]
		Chain 0	Chain 1	
Straddle	5720	2.563	2.559	0.5
Low	5745	15.128	15.079	0.5
Mid	5785	15.059	15.119	0.5
High	5825	15.120	15.123	0.5
Worst		2.559		

10.1.3. 802.11n HT40 MODE IN THE 5.8 GHz BAND

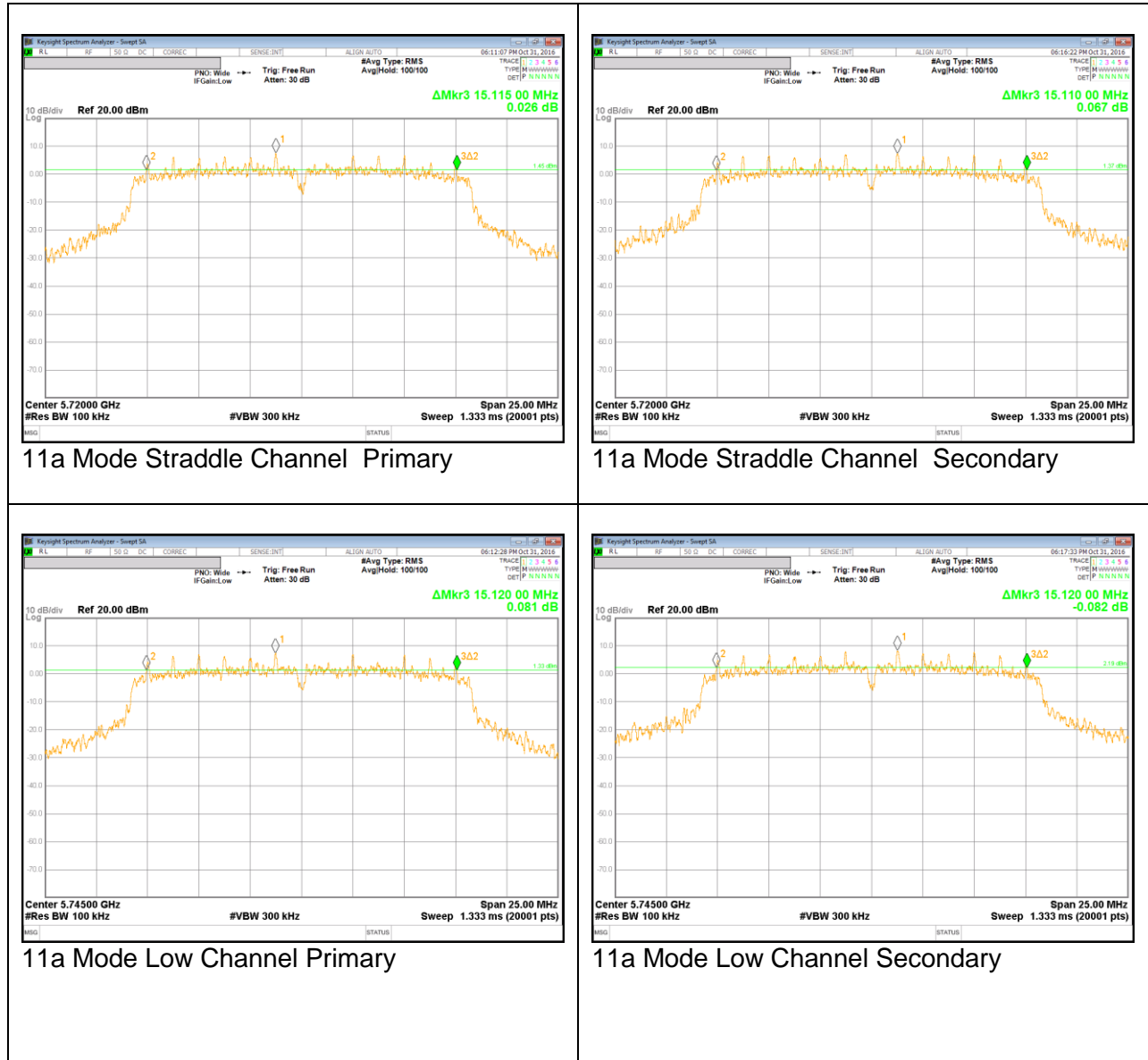
Channel	Frequency [MHz]	6 dB Bandwidth [MHz]		Minimum Limit [MHz]
		Chain 0	Chain 1	
Straddle	5710	2.539	2.536	0.5
Low	5765	35.095	35.073	0.5
High	5795	35.070	35.073	0.5
Worst		2.536		

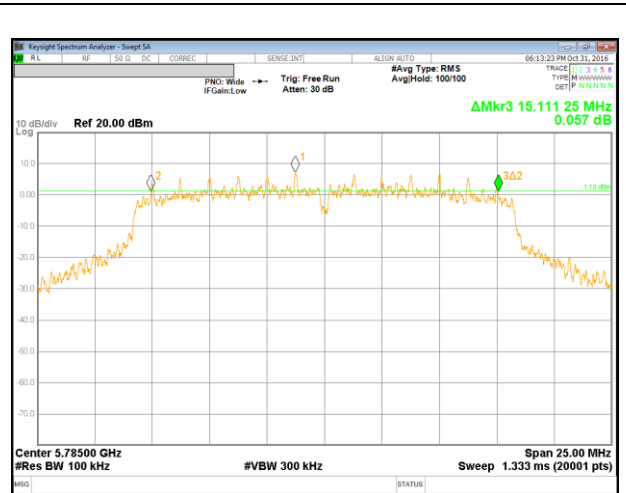
10.1.4. 802.11n VHT80 MODE IN THE 5.8 GHz BAND

Channel	Frequency [MHz]	6 dB Bandwidth [MHz]		Minimum Limit [MHz]
		Chain 0	Chain 1	
Straddle	5690	1.288	1.278	0.5
Middle	5775	75.025	73.805	0.5
Worst		1.278		

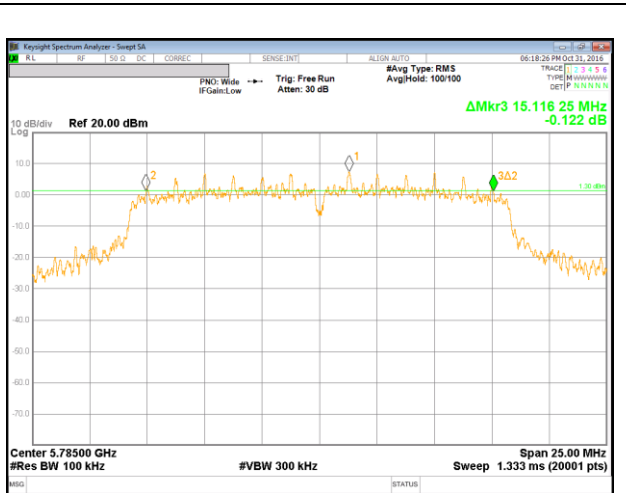
10.1.5. 6 dB BANDWIDTH PLOTS

IEEE 802.11a mode

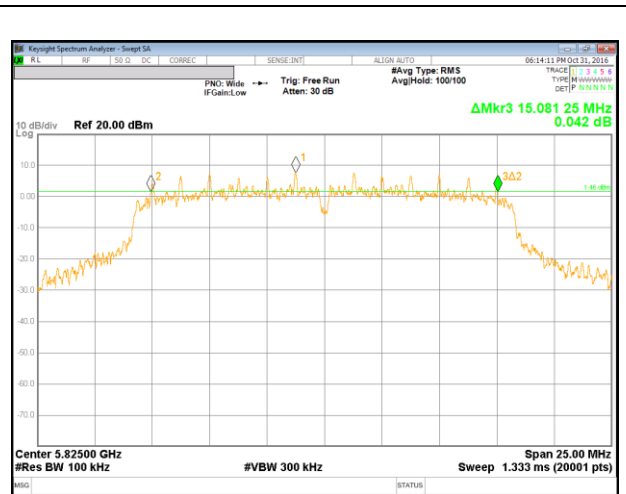




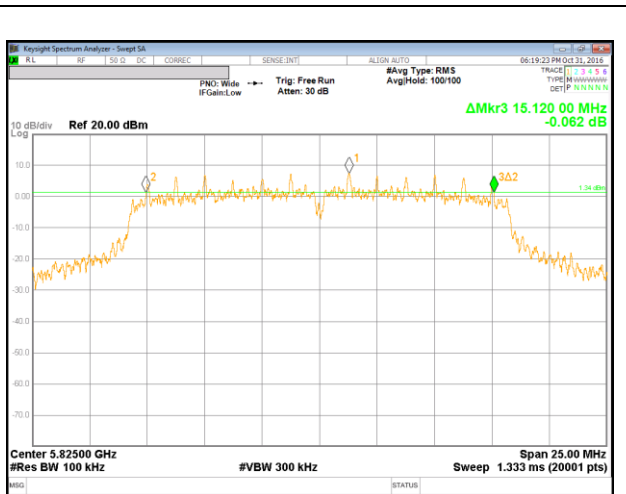
11a Mode Middle Channel Primary



11a Mode Middle Channel Secondary

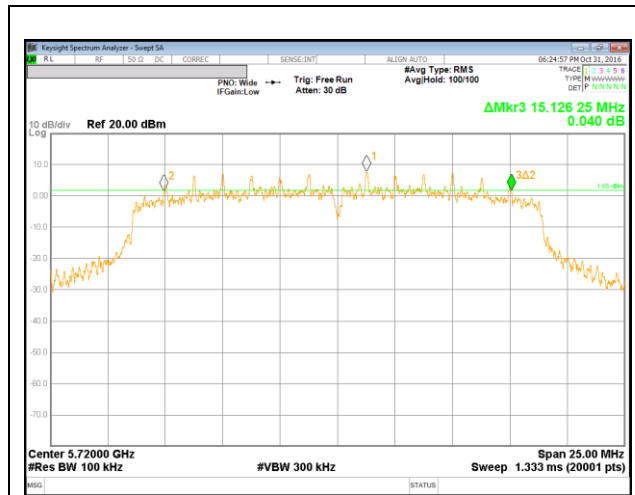


11a Mode High Channel Primary

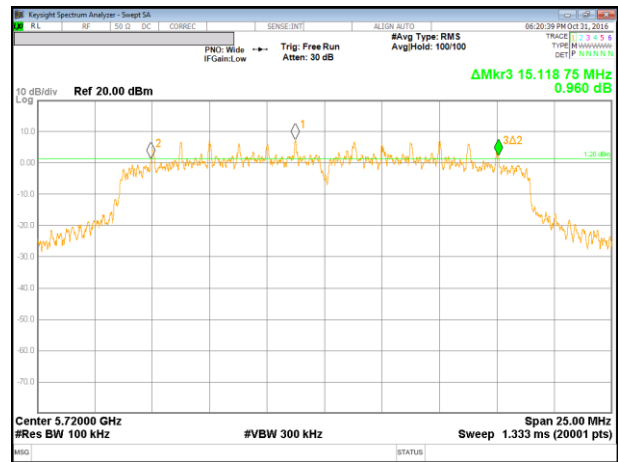


11a Mode High Channel Secondary

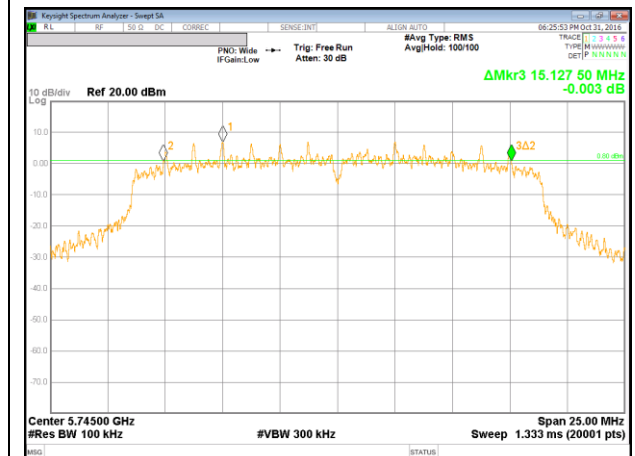
IEEE 802.11n HT20 mode



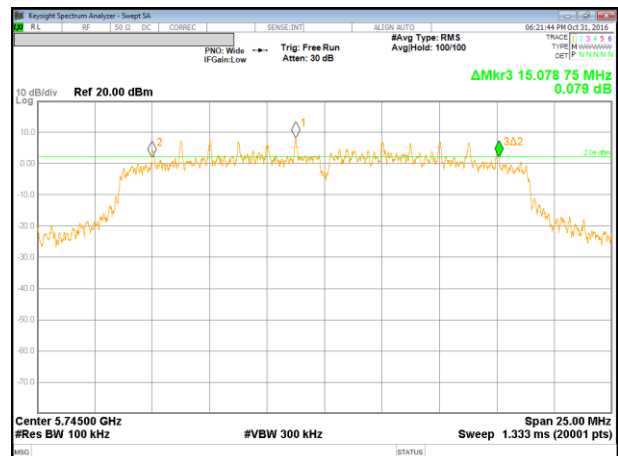
11n HT20 Mode Straddle Channel Chain 0



11n HT20 Mode Straddle Channel Chain 1



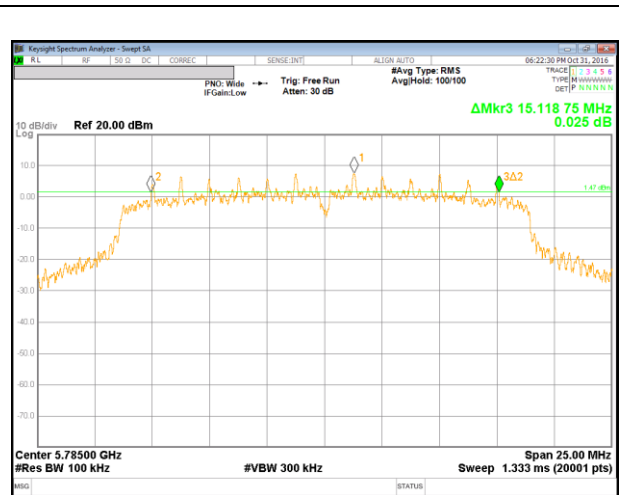
11n HT20 Mode Low Channel Chain 0



11n HT20 Mode Low Channel Chain 1



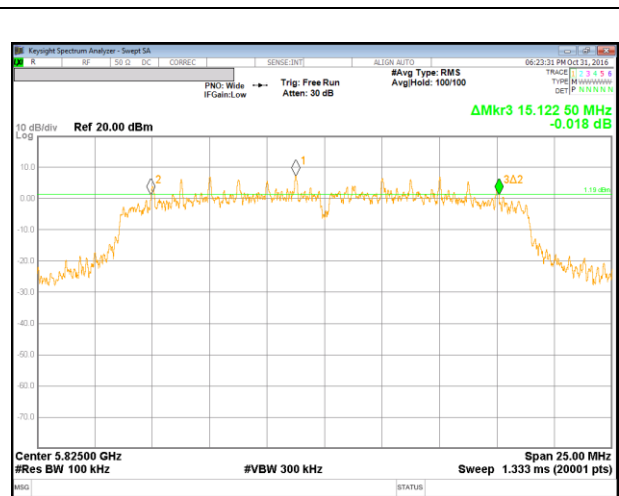
11n HT20 Mode Middle Channel Chain 0



11n HT20 Mode Middle Channel Chain 1

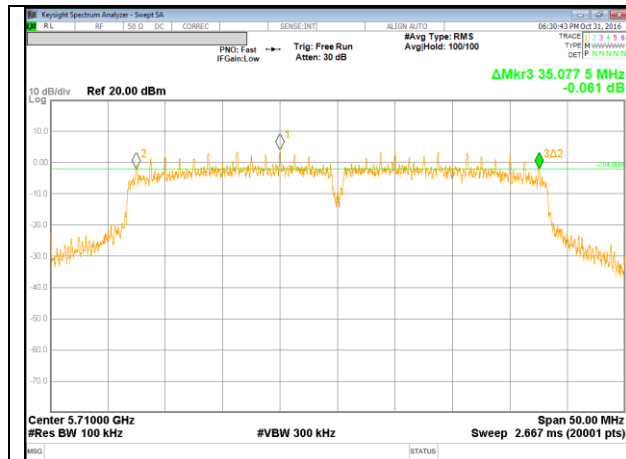


11n HT20 Mode High Channel Chain 0

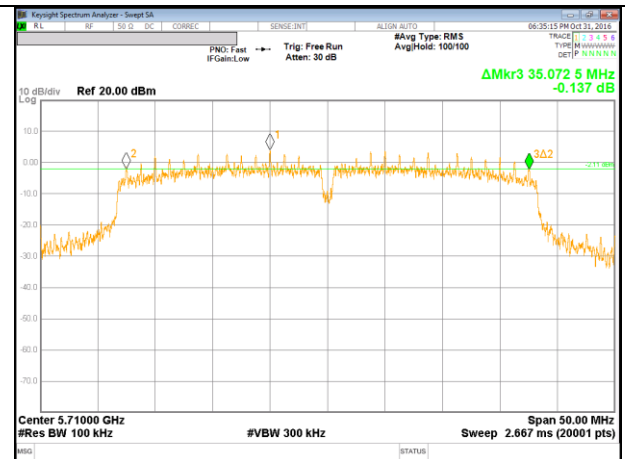


11n HT20 Mode High Channel Chain 1

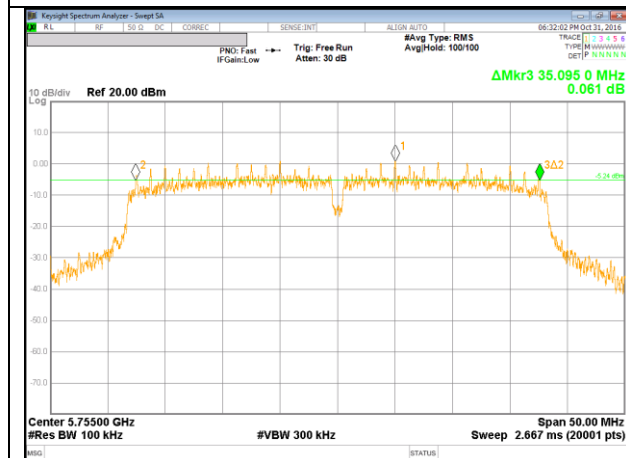
IEEE 802.11n HT40 mode



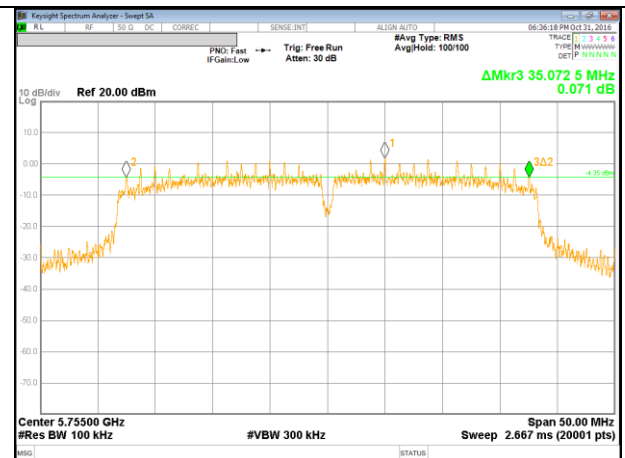
11n HT40 Mode Straddle Channel Chain 0



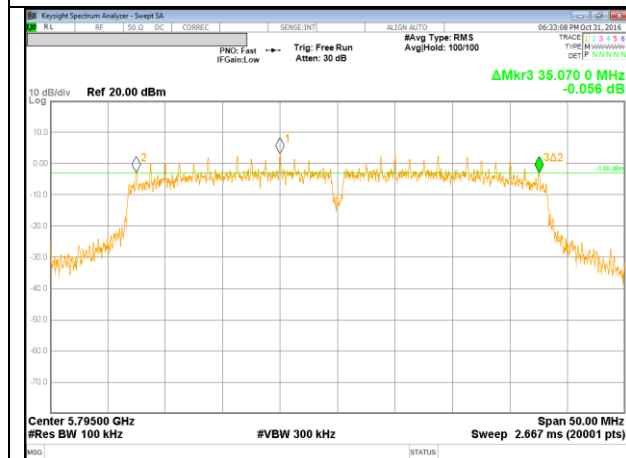
11n HT40 Mode Straddle Channel Chain 1



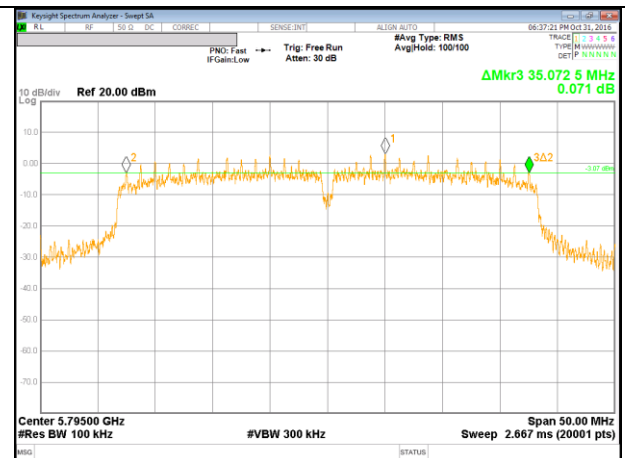
11n HT40 Mode Low Channel Chain 0



11n HT40 Mode Low Channel Chain 1

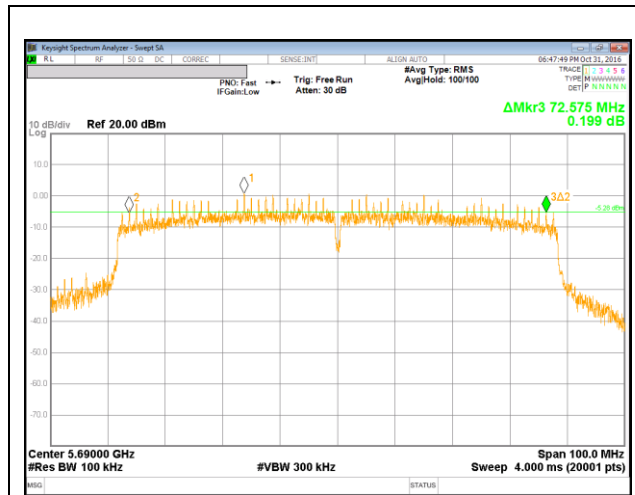


11n HT40 Mode High Channel Chain 0

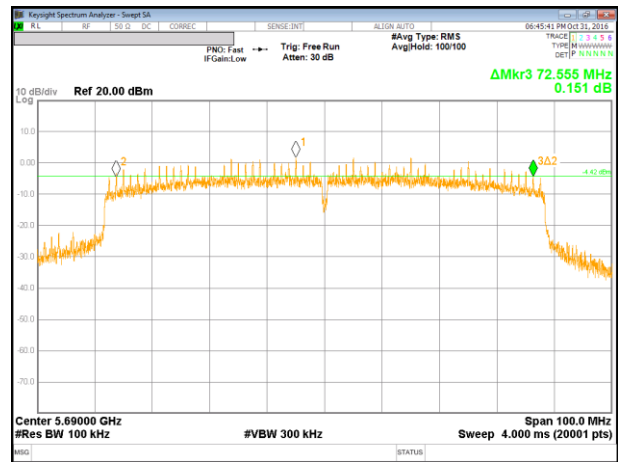


11n HT40 Mode High Channel Chain 1

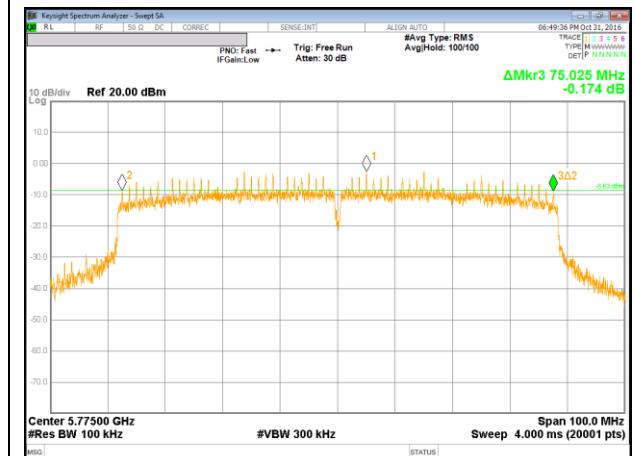
IEEE 802.11ac VHT80 mode



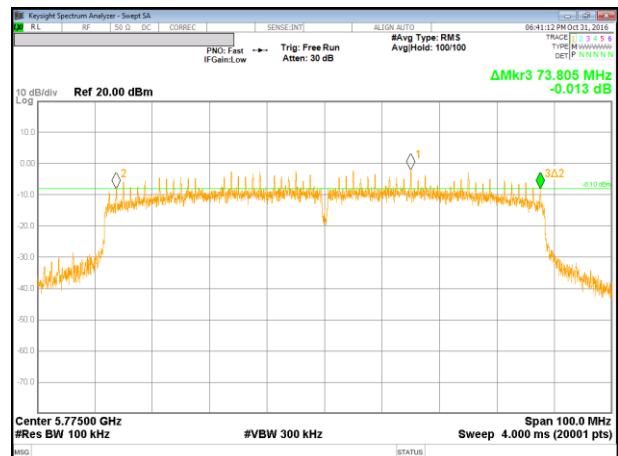
11ac HT80 Mode Straddle Channel Chain 0



11ac HT80 Mode Straddle Channel Chain 1



11ac HT80 Mode Middle Channel Chain 0



11ac HT80 Mode Middle Channel Chain 1

10.2. 26 dB BANDWIDTH

LIMITS

None; for reporting purposes only.

NOTE

- Calculation for 26dB Bandwidth of UNII-2C and UNII-3 Straddle Channel

ex) 802.11a mode

- Fundamental frequency : 5720MHz
- 26dB BW : 21.00MHz
- Turning Frequency : 5725MHz
- 26dB Bandwidth of UNII-2C band Portion
= $(5725 - (5720 - (21.00 / 2))) = 15.50$ MHz
- 26dB Bandwidth of UNII-3 band Portion
= $(5720 + (21.00 / 2) - 5725) = 5.50$ MHz

RESULTS

10.2.1. 802.11a MODE IN THE 5.2 GHz BAND

Channel	Frequency [MHz]	26 dB Bandwidth [MHz]	
		Primary	Secondary
Low	5180	20.57	21.31
Mid	5200	19.92	21.41
High	5240	19.92	21.60
Worst		21.60	

10.2.2. 802.11n HT20 MODE IN THE 5.2 GHz BAND

Channel	Frequency [MHz]	26 dB Bandwidth [MHz]	
		Chain 0	Chain 1
Low	5180	20.27	22.67
Mid	5200	20.38	21.38
High	5240	19.64	20.74
Worst		22.67	

10.2.3. 802.11n HT40 MODE IN THE 5.2 GHz BAND

Channel	Frequency [MHz]	26 dB Bandwidth [MHz]	
		Chain 0	Chain 1
Low	5190	44.65	48.75
High	5230	48.58	55.93
Worst		55.93	

10.2.4. 802.11ac VHT80 MODE IN THE 5.2 GHz BAND

Channel	Frequency [MHz]	26 dB Bandwidth [MHz]	
		Chain 0	Chain 1
Middle	5210	89.71	93.60
Worst		93.60	

10.2.5. 802.11a MODE IN THE 5.3 GHz BAND

Channel	Frequency [MHz]	26 dB Bandwidth [MHz]	
		Primary	Secondary
Low	5260	22.42	30.11
Mid	5300	21.81	30.17
High	5320	20.80	31.68
Worst		31.68	

10.2.6. 802.11n HT20 MODE IN THE 5.3 GHz BAND

Channel	Frequency [MHz]	26 dB Bandwidth [MHz]	
		Chain 0	Chain 1
Low	5260	20.51	30.09
Mid	5300	21.20	30.16
High	5320	21.81	30.16
Worst		30.16	

10.2.7. 802.11n HT40 MODE IN THE 5.3 GHz BAND

Channel	Frequency [MHz]	26 dB Bandwidth [MHz]	
		Chain 0	Chain 1
Low	5270	49.11	56.23
High	5310	44.13	48.32
Worst		56.23	

10.2.8. 802.11ac VHT80 MODE IN THE 5.3 GHz BAND

Channel	Frequency [MHz]	26 dB Bandwidth [MHz]	
		Chain 0	Chain 1
Middle	5290	88.82	92.83
Worst		92.83	

10.2.1. 802.11a MODE IN THE 5.5 GHz BAND

Channel	Frequency [MHz]	26 dB Bandwidth [MHz]	
		Primary	Secondary
Low	5500	19.51	22.56
Mid	5580	20.06	23.53
High	5700	20.64	24.00
Straddle	5720	15.17	16.50
Worst		24.00	

10.2.2. 802.11n HT20 MODE IN THE 5.5 GHz BAND

Channel	Frequency [MHz]	26 dB Bandwidth [MHz]	
		Chain 0	Chain 1
Low	5500	20.07	22.50
Mid	5580	20.72	22.04
High	5700	20.21	22.74
Straddle	5720	14.99	15.98
Worst		22.74	

10.2.3. 802.11n HT40 MODE IN THE 5.5 GHz BAND

Channel	Frequency [MHz]	26 dB Bandwidth [MHz]	
		Chain 0	Chain 1
Low	5510	42.86	45.75
Mid	5590	43.34	48.00
High	5670	41.60	48.86
Straddle	5710	36.652	38.448
Worst		48.86	

10.2.4. 802.11ac VHT80 MODE IN THE 5.5 GHz BAND

Channel	Frequency [MHz]	26 dB Bandwidth [MHz]	
		Chain 0	Chain 1
Low	5530	84.49	92.57
High	5610	84.76	90.85
Straddle	5690	77.39	80.42
Worst		92.57	

10.2.5. 802.11a MODE IN THE 5.8 GHz BAND

Channel	Frequency [MHz]	26 dB Bandwidth [MHz]	
		Primary	Secondary
Straddle	5720	5.17	6.50
Low	5745	20.08	23.91
Mid	5785	20.32	21.25
High	5825	20.33	21.76
Worst		23.91	

10.2.6. 802.11n HT20 MODE IN THE 5.8 GHz BAND

Channel	Frequency [MHz]	26 dB Bandwidth [MHz]	
		Chain 0	Chain 1
Straddle	5720	4.99	5.98
Low	5745	20.48	23.12
Mid	5785	20.44	21.71
High	5825	20.13	21.95
Worst		23.12	

10.2.7. 802.11n HT40 MODE IN THE 5.8 GHz BAND

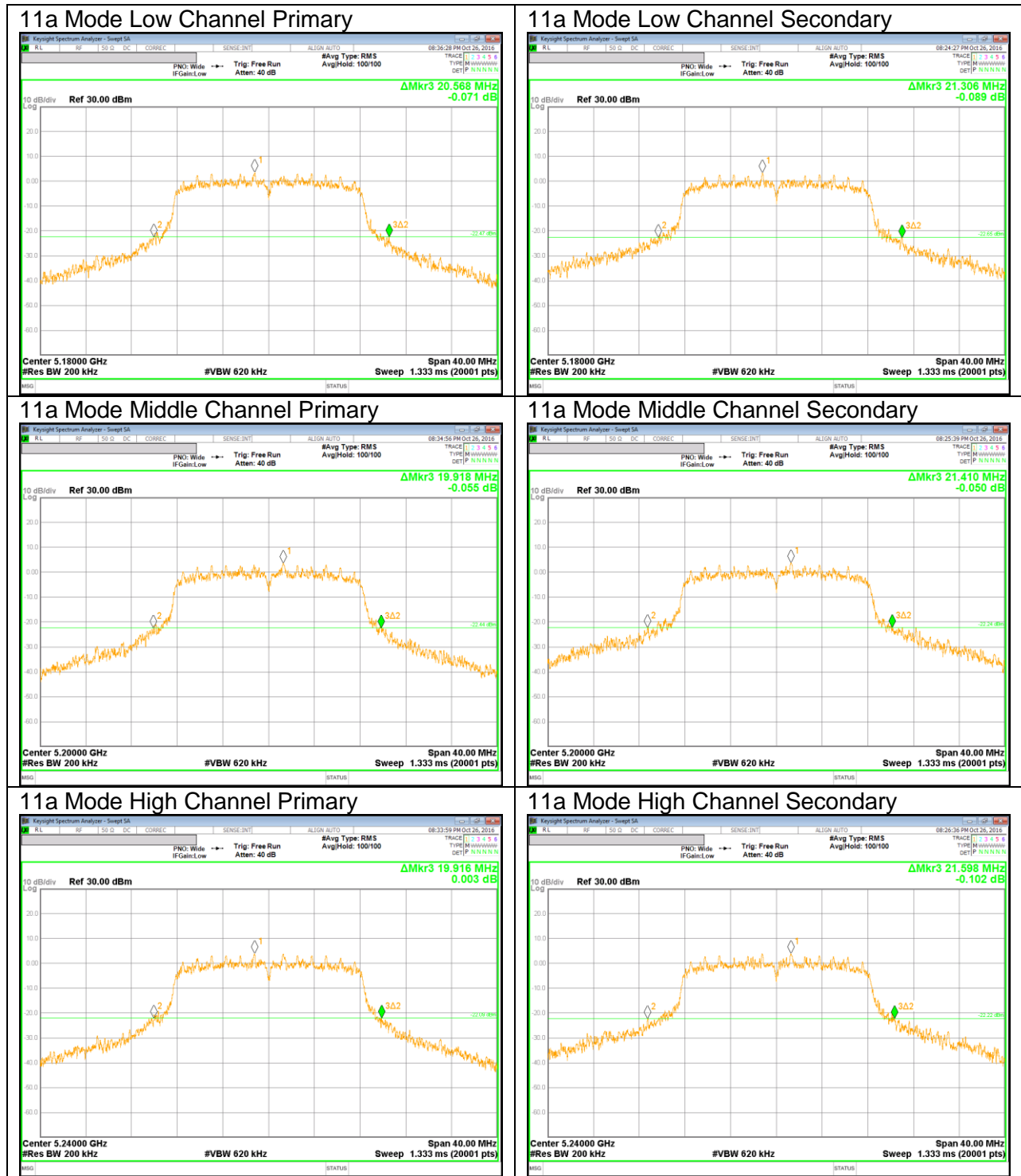
Channel	Frequency [MHz]	26 dB Bandwidth [MHz]	
		Chain 0	Chain 1
Straddle	5710	6.65	8.45
Low	5755	41.12	43.29
High	5795	41.17	47.42
Worst		47.42	

10.2.8. 802.11ac VHT80 MODE IN THE 5.8 GHz BAND

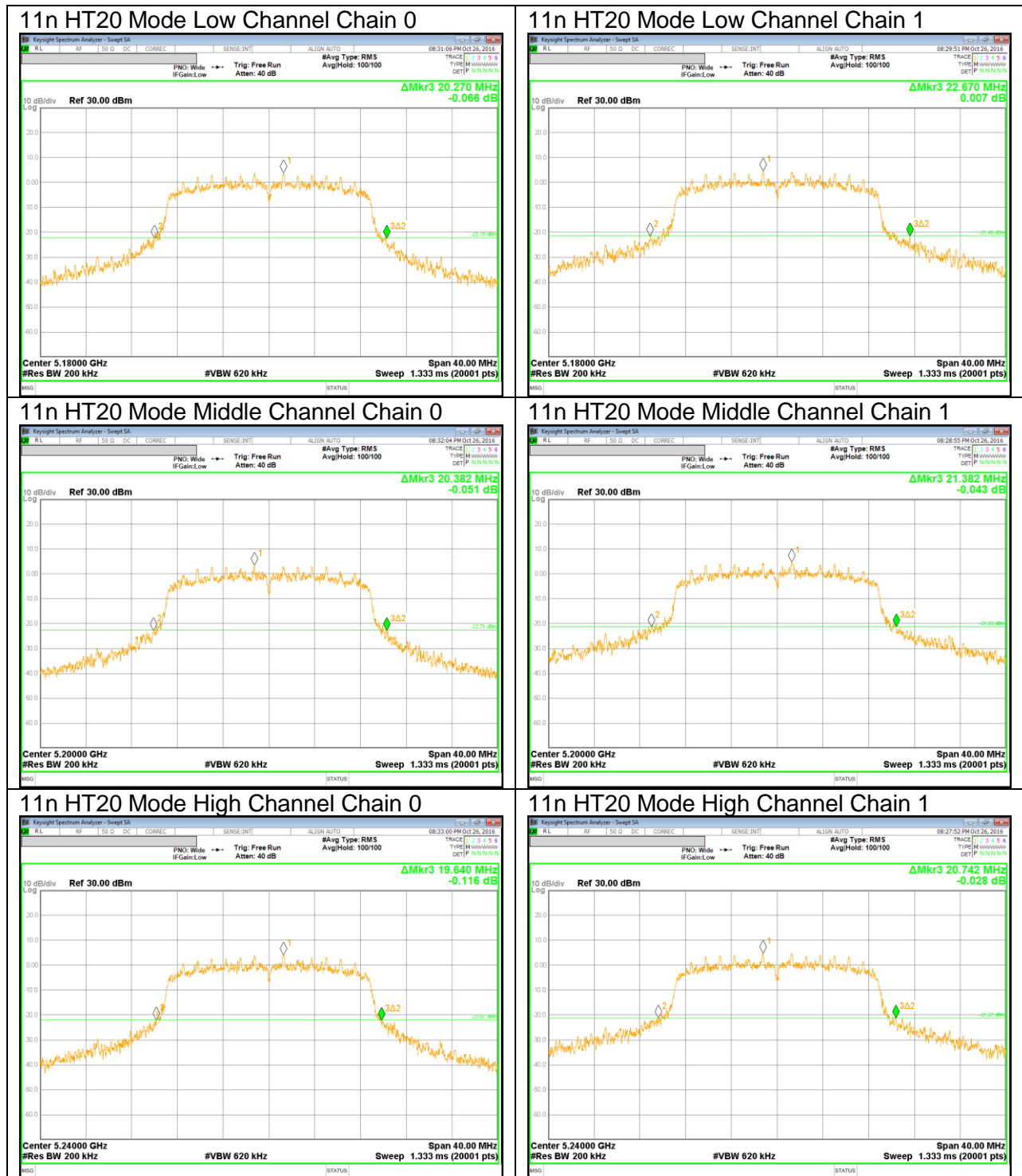
Channel	Frequency [MHz]	26 dB Bandwidth [MHz]	
		Chain 0	Chain 1
Straddle	5690	7.39	10.42
Middle	5775	84.37	84.71
Worst		84.71	

10.2.9. 26 dB BANDWIDTH PLOTS

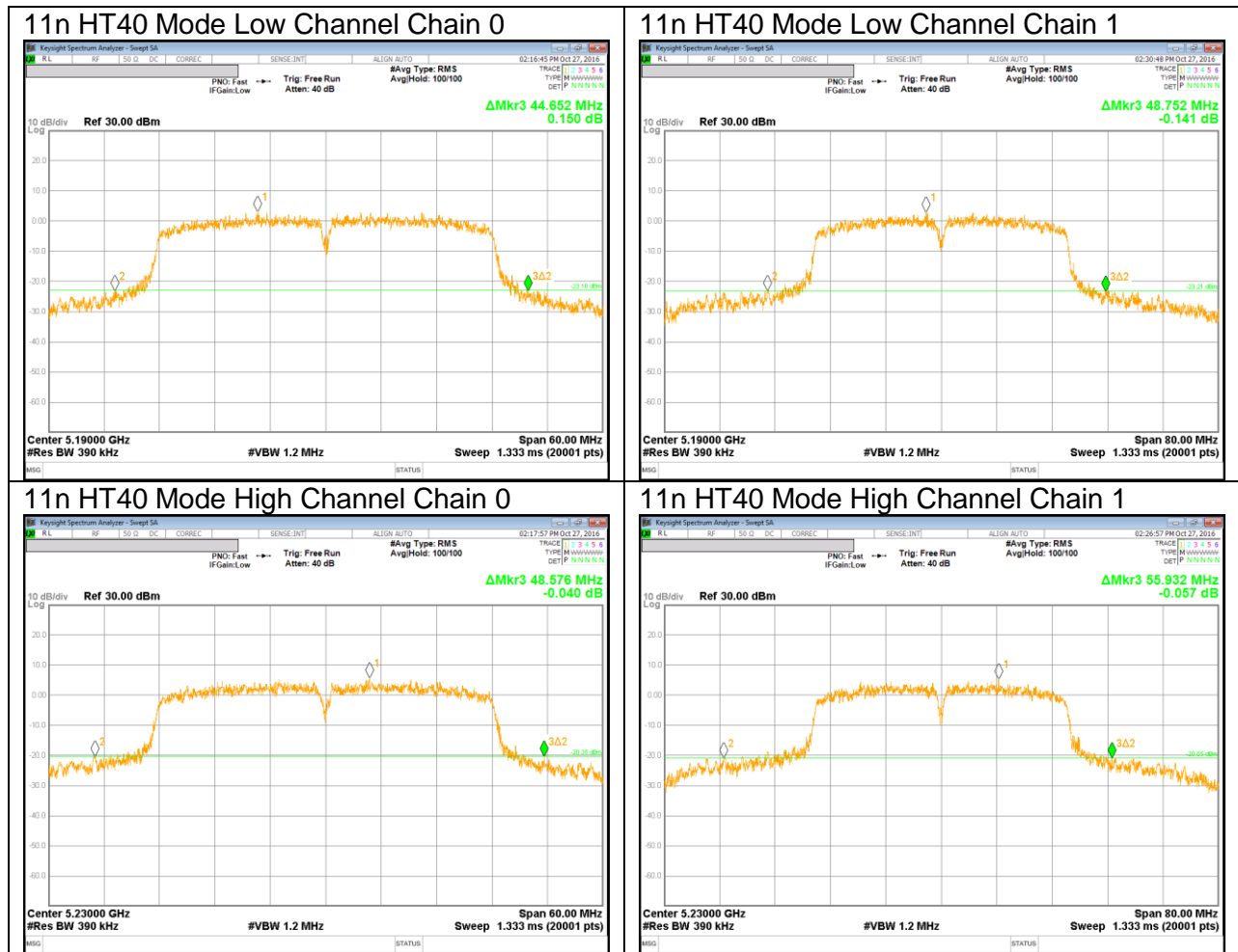
UNII 5.2 GHz IEEE 802.11a mode



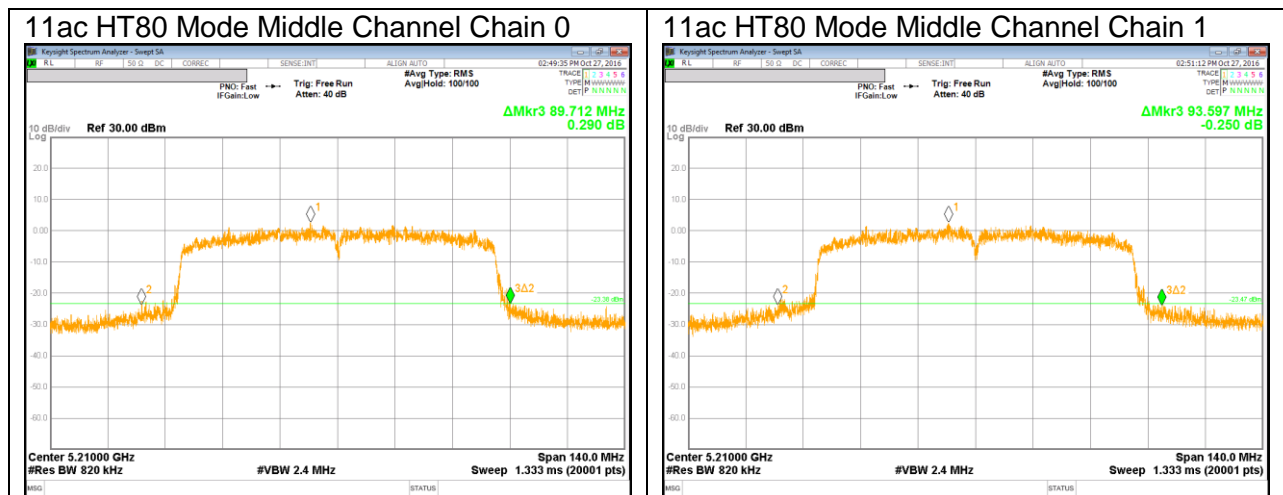
UNII 5.2 GHz IEEE 802.11n HT20 mode



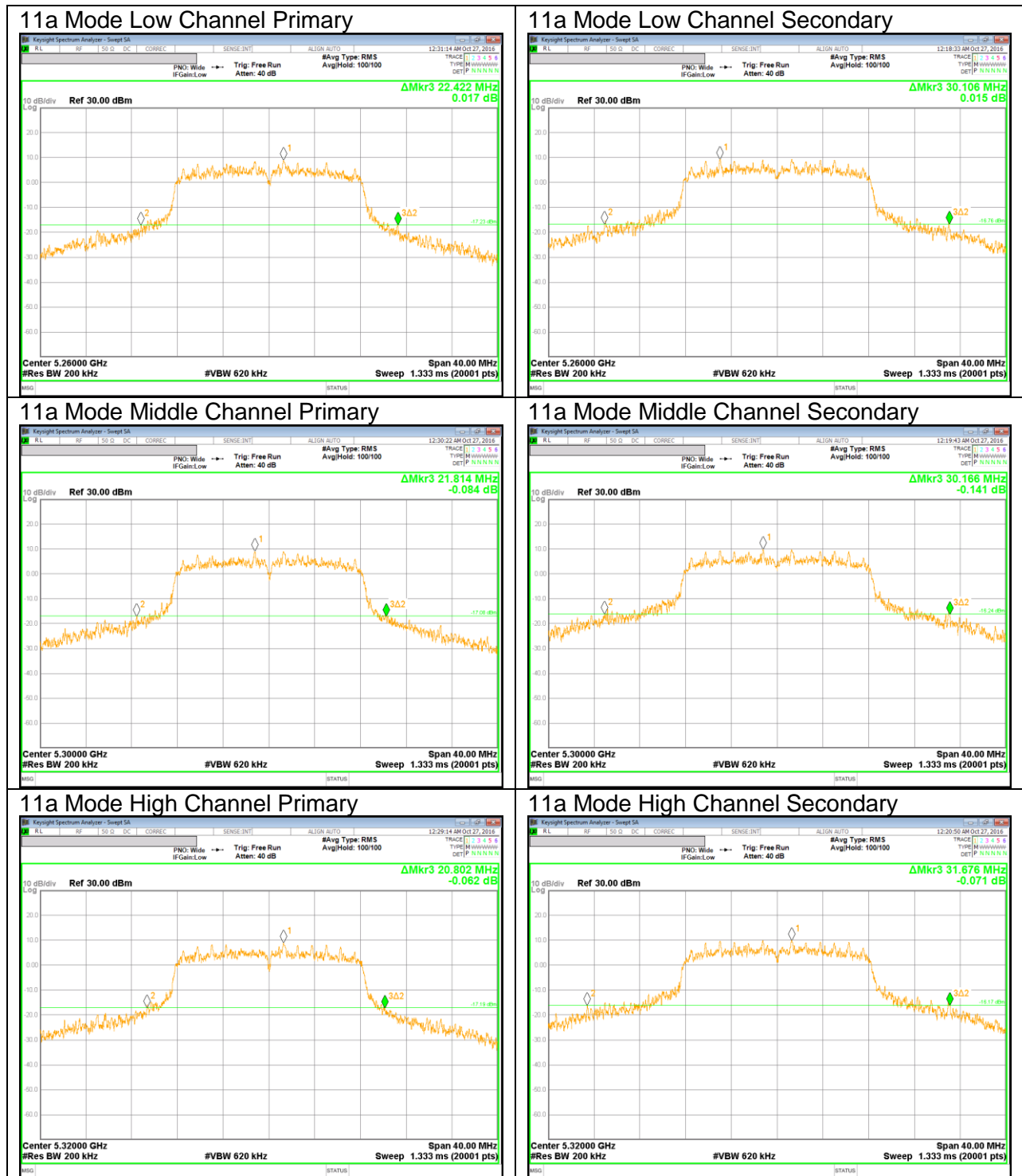
UNII 5.2 GHz IEEE 802.11n HT40 mode



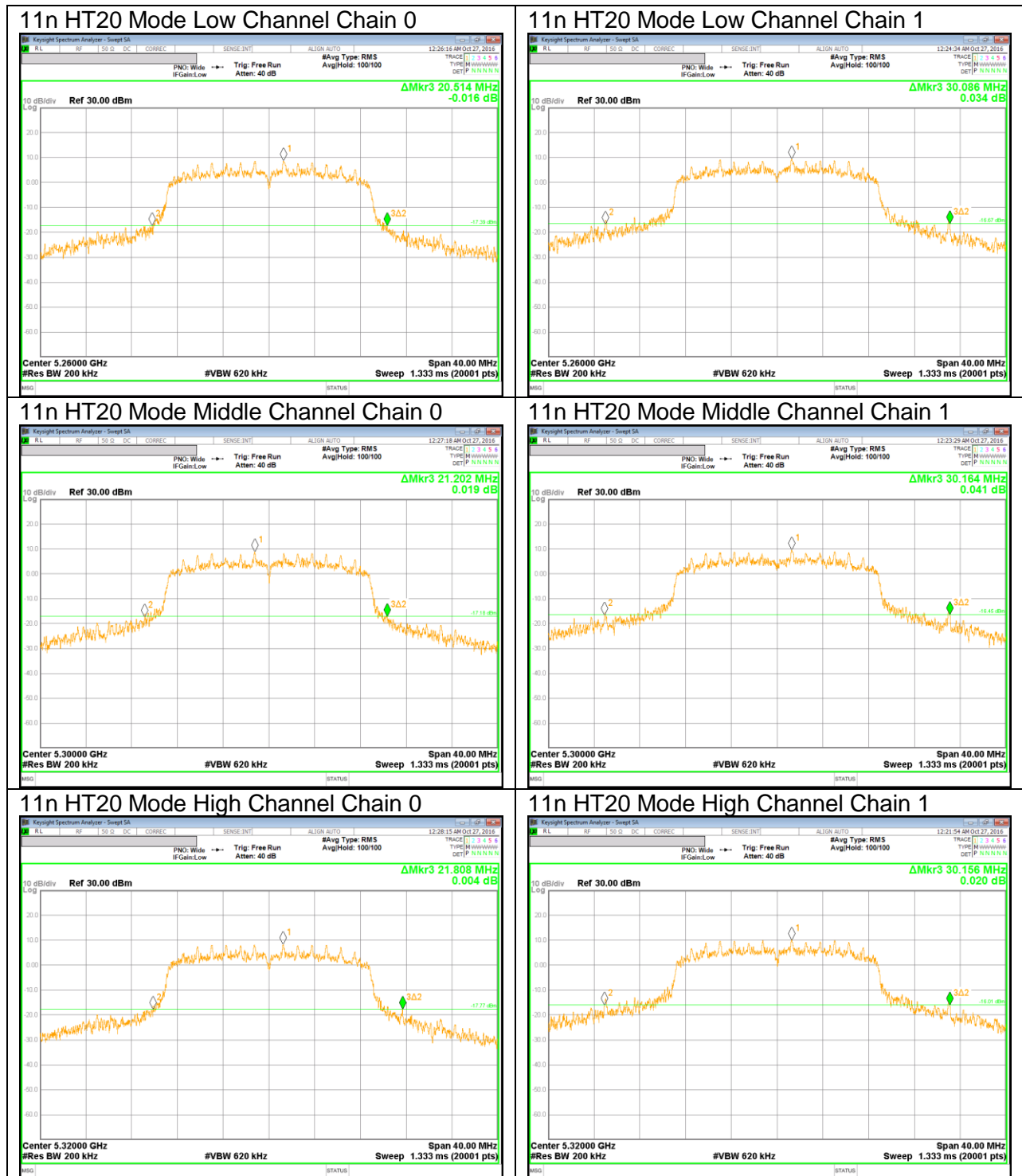
UNII 5.2 GHz IEEE 802.11ac VHT80 mode



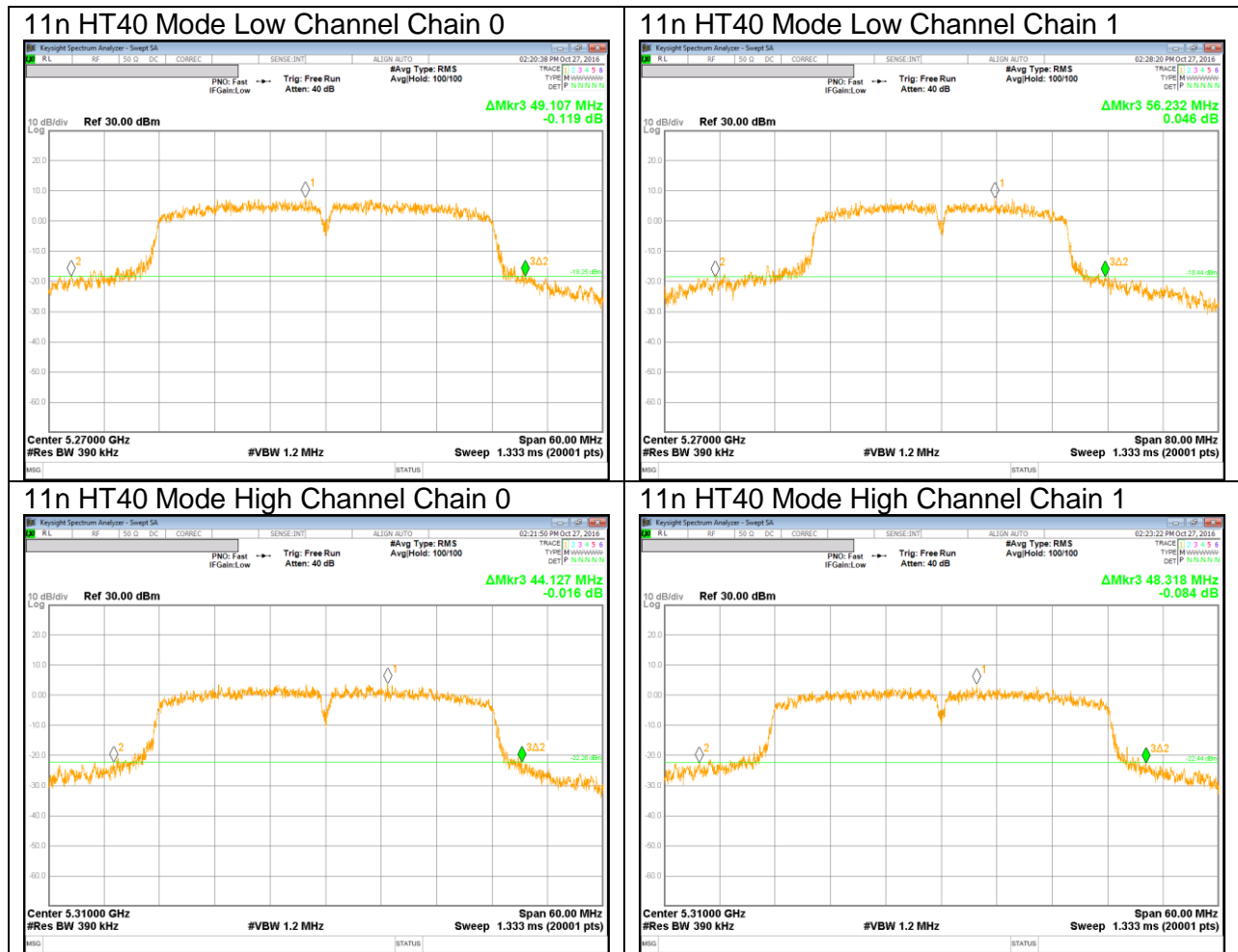
UNII 5.3 GHz IEEE 802.11a mode



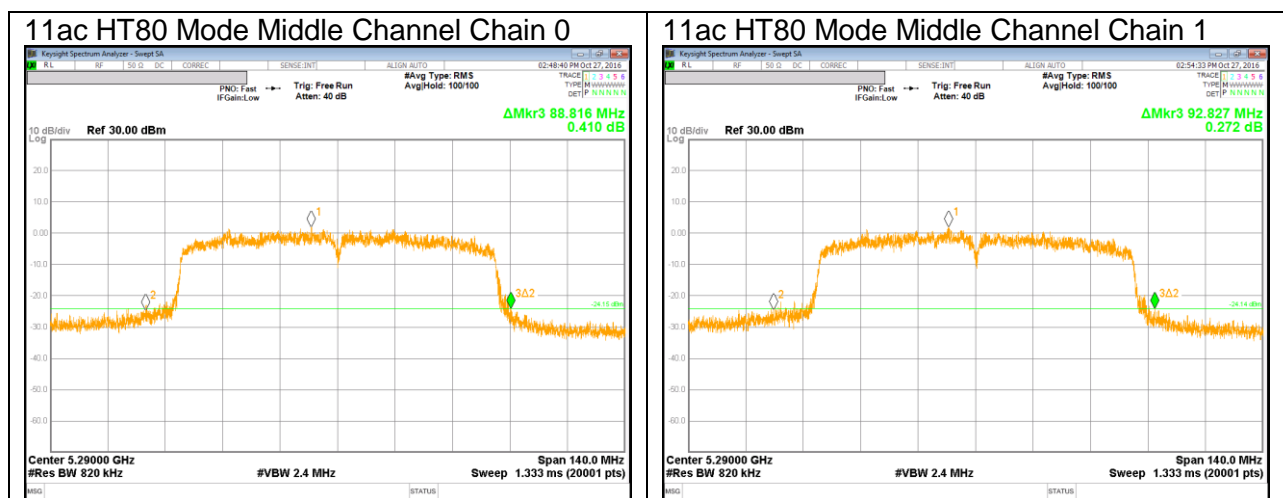
UNII 5.3 GHz IEEE 802.11n HT20 mode



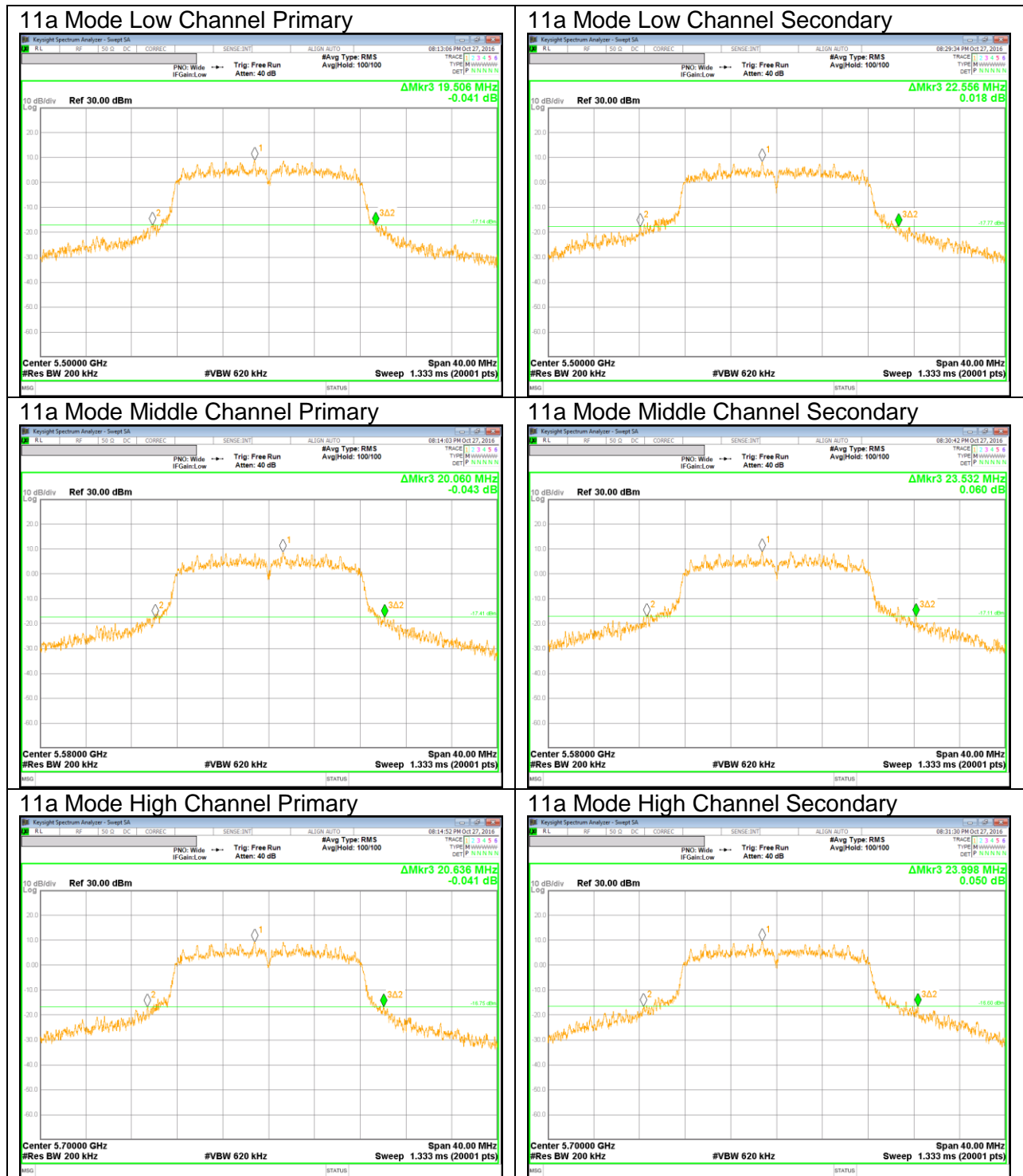
UNII 5.3 GHz IEEE 802.11n HT40 mode

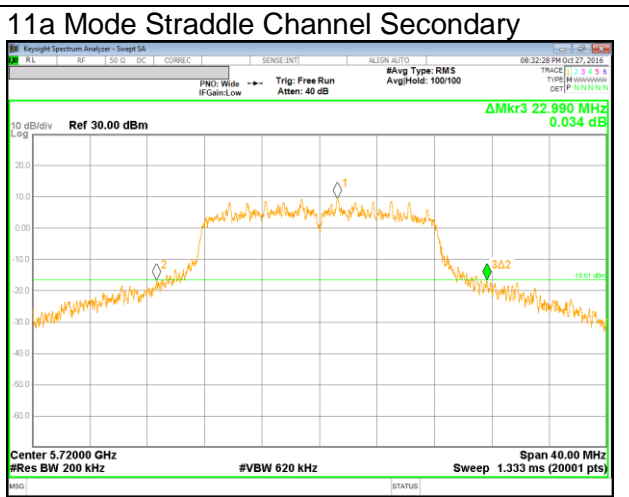
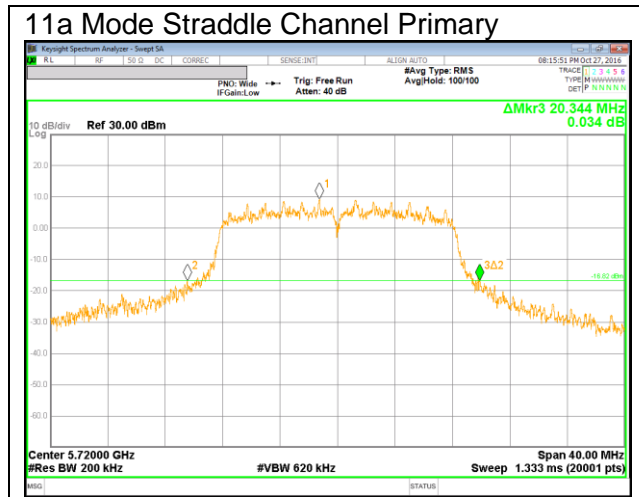


UNII 5.3 GHz IEEE 802.11ac VHT80 mode

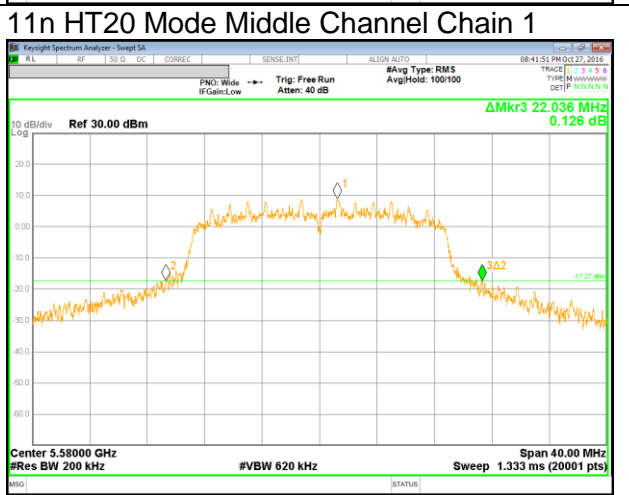
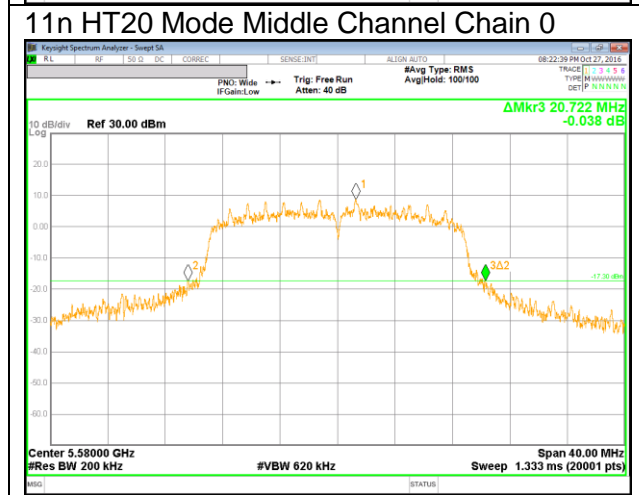
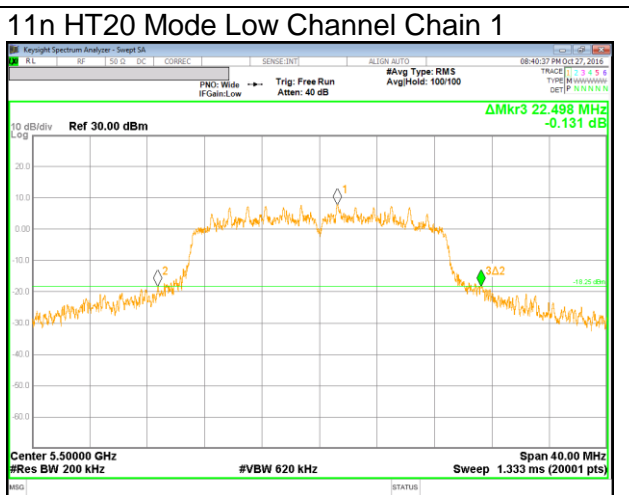
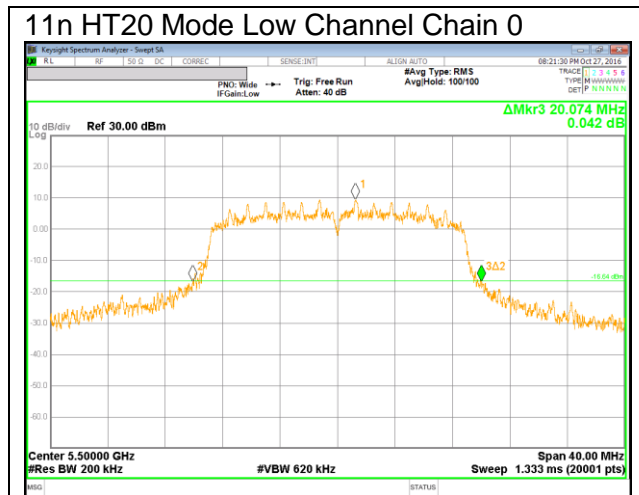


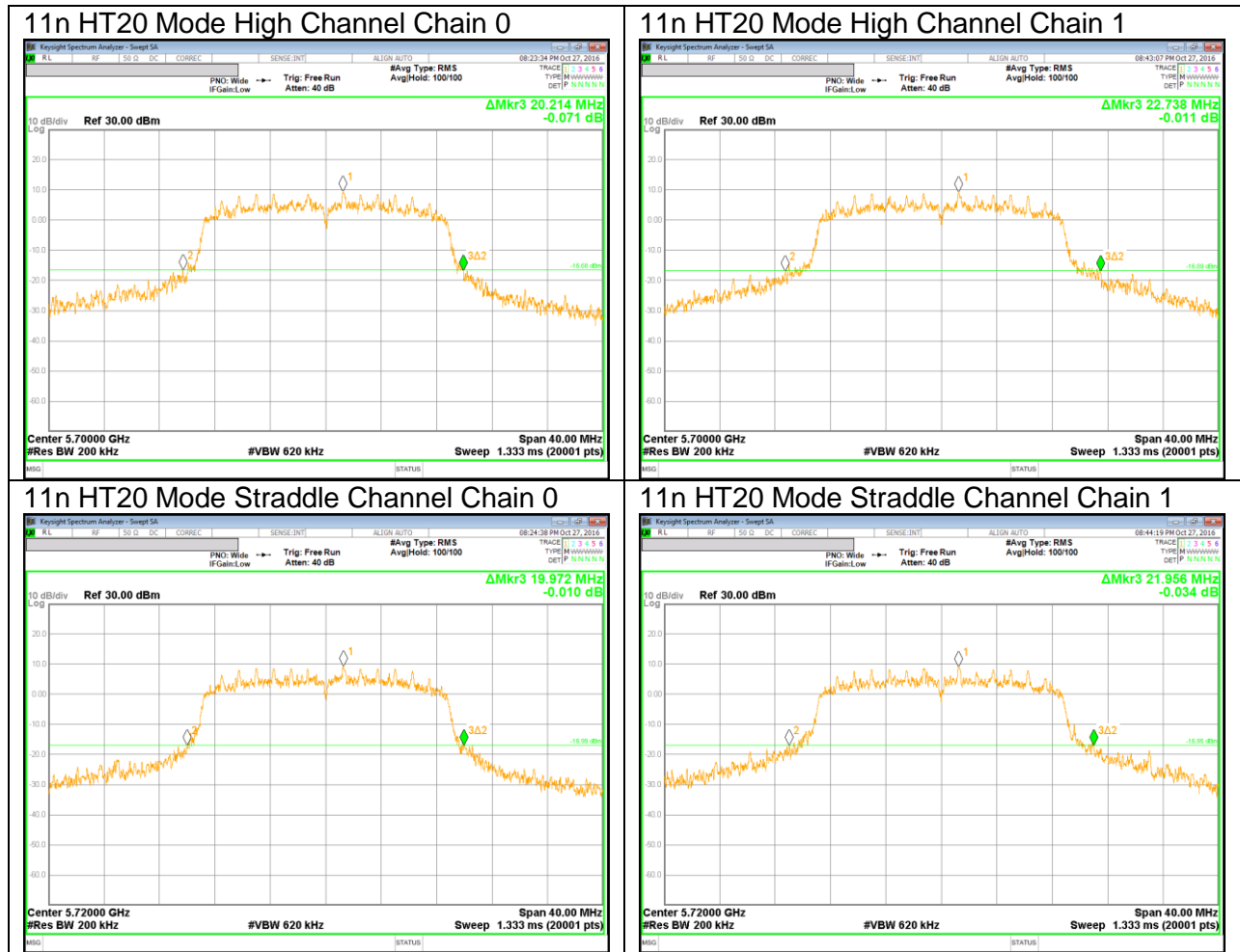
UNII 5.5 GHz IEEE 802.11a mode





UNII 5.5 GHz IEEE 802.11n HT20 mode





UNII 5.5 GHz IEEE 802.11n HT40 mode

