FCC 47 CFR PART 15 SUBPART C AND ANSI C63.4:2009
TEST REPORT

For

Cable modem

Model : 5363

Trade Name : Zoom

Issued for

Zoom Telephonics Inc

207 South Street , Boston, Massachusetts 02111, United States

Issued by

Compliance Certification Services Inc.
Hsinchu Lab.
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Revision History

Rev.	Issue Date	Revisions	Effect Page	Revised By
00	12/05/2013	Initial Issue	All Page 223	Gloria Chang

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1. TEST REPORT CERTIFICATION

Applicant	:	Zoom Telephonics Inc
Address	:	207 South Street , Boston, Massachusetts 02111, United States
Equipment Under Test	:	Cable modem
Model	:	5363
Trade Name	:	Zoom
Tested Date	:	November 14 ~ December 05, 2013

APPLICABLE STANDARD	
Standard	**Test Result**
FCC Part 15 Subpart C AND ANSI C63.4:2009	PASS

WE HEREBY CERTIFY THAT: The above equipment has been tested by Compliance Certification Services Inc., and found compliance with the requirements set forth in the technical standards mentioned above. The results of testing in this report apply only to the product/system, which was tested. Other similar equipment will not necessarily produce the same results due to production tolerance and measurement uncertainties.

Approved by:

Sb. Lu
Sr. Engineer

Reviewed by:

Gundam Lin
Sr. Engineer

2. EUT DESCRIPTION

Product Name	Cable modem
Model Number	5363
Identify Number	T131114S02
Received Date	November 14, 2013
Frequency Range	IEEE 802.11a, 802.11an HT20 : 5745MHz ~ 5825Hz IEEE 802.11an HT40 : 5755MHz ~ 5795MHz IEEE 802.11b/g, 802.11n HT20 : 2412MHz ~ 2462MHz IEEE 802.11n HT40 : 2422MHz ~ 2452MHz IEEE 802.11ac HT80 : 5775MHz
Transmit Power	5GHz : IEEE 802.11a : 28.52 dBm (0.7115W) IEEE 802.11an HT20 : 28.84 dBm (0.7659W) IEEE 802.11an HT40 : 28.58 dBm (0.7212W) IEEE 802.11ac HT80 : 28.33 dBm (0.6801W) 2.4GHz : IEEE 802.11b : 23.16 dBm (0.2068W) IEEE 802.11g : 27.37 dBm (0.5452W) IEEE 802.11n HT20 : 27.40 dBm (0.5494W) IEEE 802.11n HT40 : 22.56 dBm (0.1804W)
Channel Spacing	IEEE 802.11a, 802.11an HT20 : 20MHz IEEE 802.11an HT40 : 40MHz IEEE 802.11b/g, 802.11n HT20/HT40 : 5MHz IEEE 802.11ac HT80 : N/A
Channel Number	IEEE 802.11a, 802.11an HT20: 5 Channels IEEE 802.11an HT40 : 2 Channels IEEE 802.11b/g, 802.11an HT20: 11 Channels IEEE 802.11an HT40 : 7 Channels IEEE 80.211ac HT80 : 1 Channel

Transmit Data Rate	IEEE 802.11b : 11, 5.5, 2, 1 Mbps IEEE 802.11a/g : 54, 48, 36, 24, 18, 12, 9, 6 Mbps IEEE 802.11an HT20 : 216.7, 195, 175.5, 173.3, 156, 144.4, 130, 117, 115.6, 104, 86.7, 78, 72.2, 65, 58.5, 57.8, 52, 43.3, 39, 28.9, 26, 21.7, 19.5, 14.4, 13, 7.2, 6.5 Mbps IEEE 802.11an HT40 : 450, 405, 364, 360, 324, 300, 270, 243, 240, 216, 180, 162, 150, 135, 121.5, 120, 108, 90, 81, 60, 54, 45, 40.5, 30, 27, 15, 13.5 Mbps IEEE 802.11an HT80 : 1299.9, 1170, 1053, 975, 877.5, 866.6, 789.9, 780, 702, 650, 585, 526.5, 526, 520, 468, 433.3, 390, 351, 325, 292.5, 263.4, 263.3, 260, 234, 195, 175.6, 175.5, 130, 117, 97.5, 87.9, 87.8, 65, 58.5, 32.5, 29.3Mbps :
Type of Modulation	IEEE 802.11b : DSSS (CCK, DQPSK, DBPSK) IEEE 802.11a/g : OFDM (64QAM, 16QAM, QPSK, BPSK) IEEE 802.11an/n HT20/40 : OFDM (64QAM, 16QAM, QPSK, BPSK) IEEE 802.11ac : OFDM (256QAM, 64QAM, 16QAM, QPSK, BPSK)
Antenna Type	PCB Antenna × 3 (2.4GHz & 5GHz), 2.4GHz : Antenna 0 (Chain 0), Antenna Gain 2.84 dBi Antenna 1 (Chain 1), Antenna Gain 2.38 dBi Antenna 2 (Chain 2), Antenna Gain 2.84 dBi 5GHz : Antenna 0 (Chain 0), Antenna Gain 3.58 dBi Antenna 1 (Chain 1), Antenna Gain 3.42 dBi Antenna 2 (Chain 2), Antenna Gain 3.26 dBi
Power Rating	12Vdc
Test Voltage	120Vac, 60Hz
DC Power Cable Type	Non-shielded cable, 1.5m × 2 (Non-detachable)
I/O Port	RJ-45 Port × 4, Power Port × 1, Coaxial Port × 1

Power Adapter :

No.	Manufacturer	Model No.	Power Input	Power Output
1	A.P.D	WA-18X12FU	100-240Vac, 50-60Hz, 0.5A Max	12Vdc, 1.5A
2	A.P.D	WA-24I12FU	100-240Vac, 50-60Hz, 0.7A	12Vdc, 2A

Remark :

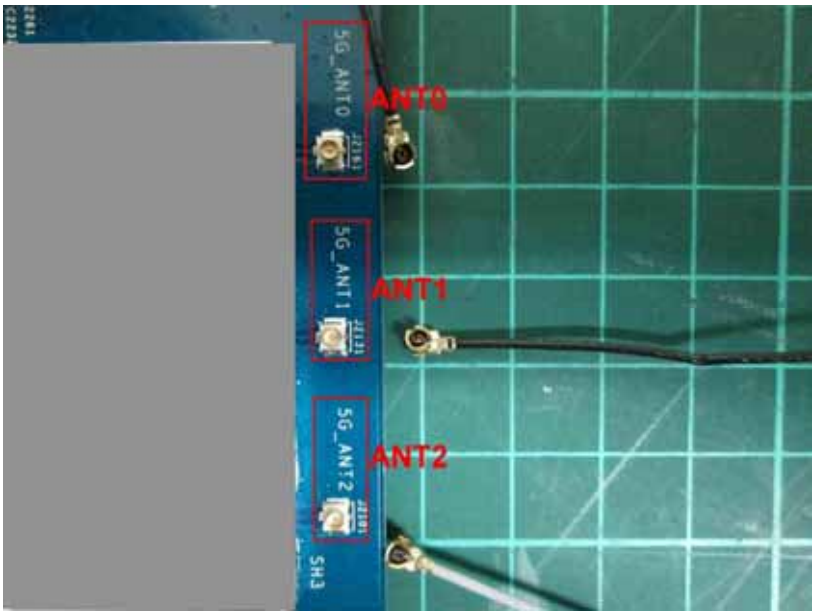
1. *The sample selected for test was engineering sample that approximated to production product and was provided by manufacturer.*
2. *For more details, please refer to the User's manual of the EUT.*
3. *This submittal(s) (test report) is intended for FCC ID: BDN1106WL filing to comply with Section 15.207, 15.209 and 15.247 of the FCC Part 15, Subpart C Rules.*

3. DESCRIPTION OF TEST MODES

The EUT is an 802.11n MIMO transceiver in Cable modem form factor.

For IEEE 802.11a, 802.11an HT20/HT40, 802.11b/g, 802.11n HT20/HT40, 802.11ac HT80 mode (3TX / 3RX) :

Chain 0 / Ant0 & Chain 1/ Ant1 & Chain 2 / Ant2 three transmit/receive.



Conducted Emission / Radiated Emission Test (Below 1 GHz)

1. The following test modes were scanned during the preliminary test:

No.	Pre-Test Mode
1	Normal Operating / Adpater 1
2	Normal Operating / Adpater 2

2. After the preliminary scan, the following test mode was found to produce the highest emission level.

Final Test Mode		
Emission	Radiated Emission	Normal Operating / Adpater 1
	Conducted Emission	Normal Operating / Adpater 2

Remark : *Then, the above highest emission mode of the configuration of the EUT and cable was chosen for all final test items.*

Conducted / Radiated Emission Test (Above 1 GHz)

IEEE ,802.11a ,802.11an HT20 mode

The EUT had been tested under operating condition.

There are three channels have been tested as following :

Channel	Frequency (MHz)
Low	5745
Middle	5785
High	5825

IEEE 802.11a mode : 6Mbps data rate (worst case) were chosen for full testing.
IEEE 802.11an HT20 mode : 6.5Mbps data rate (worst case) were chosen for full testing.

IEEE 802.11an HT40 mode

The EUT had been tested under operating condition.

There are three channels have been tested as following :

Channel	Frequency (MHz)
Low	5755
High	5795

IEEE 802.11n HT40 mode : 13.5Mbps data rate (worst case) were chosen for full testing.

IEEE 802.11b, 802.11g, 802.11n HT20 mode

The EUT had been tested under operating condition.

There are three channels have been tested as following :

Channel	Frequency (MHz)
Low	2412
Middle	2437
High	2462

IEEE 802.11b mode : 1Mbps data rate (worst case) were chosen for full testing.

IEEE 802.11g mode : 6Mbps data rate (worst case) were chosen for full testing.

IEEE 802.11n HT20 mode : 6.5Mbps data rate (worst case) were chosen for full testing.

IEEE 802.11n HT40 mode

The EUT had been tested under operating condition.

There are three channels have been tested as following :

Channel	Frequency (MHz)
Low	2422
Middle	2437
High	2452

IEEE 802.11n HT40 mode : 13.5Mbps data rate (worst case) were chosen for full testing.

IEEE 802.11ac HT80 mode

The EUT had been tested under operating condition.

There are three channels have been tested as following :

Channel	Frequency (MHz)
Low	5775

IEEE 802.11ac mode : 29.3Mbps data rate (worst case) were chosen for full testing.

4. TEST METHODOLOGY

The tests documented in this report were performed in accordance with ANSI C63.4: 2009 and FCC CFR 47, 15.207, 15.209 and 15.247.

5. FACILITIES AND ACCREDITATION

5.1 FACILITIES

All measurement facilities used to collect the measurement data are located at

NO. 989-1 Wen Shan Rd., Shang Shan Village,
Qionglin Shiang Hsinchu County 30741, Taiwan, R.O.C

The sites are constructed in conformance with the requirements of ANSI C63.4:2009 and CISPR 22. All receiving equipment conforms to CISPR 16-1-1, CISPR 16-1-2, CISPR 16-1-3, CISPR 16-1-4, CISPR 16-1-5.

5.2 ACCREDITATIONS

Our laboratories are accredited and approved by the following approval agencies according to ISO/IEC 17025.

Taiwan	TAF

The measuring facility of laboratories has been authorized or registered by the following approval agencies.

Canada	INDUSTRY CANADA
Japan	VCCI
Taiwan	BSMI
USA	FCC MRA

Copies of granted accreditation certificates are available for downloading from our web site, http:///www.ccsrf.com

5.3 MEASUREMENT UNCERTAINTY

The following table is for the measurement uncertainty, which is calculated as per the document CISPR 16-4-2.

PARAMETER	UNCERTAINTY
Semi Anechoic Chamber (966 Chamber_B) / Radiated Emission, 30 to 1000 MHz	+/- 3.97
Semi Anechoic Chamber (966 Chamber_B) / Radiated Emission, 1 to 18GHz	+/- 3.58
Semi Anechoic Chamber (966 Chamber_B) / Radiated Emission, 18 to 26 GHz	+/- 3.59
Semi Anechoic Chamber (966 Chamber_B) / Radiated Emission, 26 to 40 GHz	+/- 3.81
Conducted Emission (Mains Terminals), 9kHz to 30MHz	+/- 2.48

This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

Consistent with industry standard (e.g. CISPR 22, clause 11, Measurement Uncertainty) determining compliance with the limits shall be base on the results of the compliance measurement. Consequently the measure emissions being less than the maximum allowed emission result in this be a compliant test or passing test.

The acceptable measurement uncertainty value without requiring revision of the compliance statement is base on conducted and radiated emissions being less than U_{CISPR} which is 3.6dB and 5.2dB respectively. CCS values (called U_{Lab} in CISPR 16-4-2) is less than U_{CISPR} as shown in the table above. Therefore, MU need not be considered for compliance.

6. SETUP OF EQUIPMENT UNDER TEST

SUPPORT EQUIPMENT

No.	Product	Manufacturer	Model No.	Serial No.	FCC ID
1	Notebook PC	HP	ProBook 4421s	CNF03242PJ	DoC
2	Notebook PC	HP	ProBook 4421s	CNF03242PM	DoC
3	CMTS	MOTOROLA	BSR2000	Q060351000087447	---
4	Switch Hub	ASUS	GX1008B	90-Q872AN1N0NA MA0-88QSA1003522	---

No.	Signal Cable Description
1	Non-shielded RJ-45 cable, 10 m × 1
2	Non-shielded RJ-45 cable, 1.2 m × 3
3	Shielded Coaxial cable, 10 m × 1

SETUP DIAGRAM FOR TESTS

EUT & peripherals setup diagram is shown in appendix setup photos.

EUT OPERATING CONDITION

RF Mode :

1. Setup RF Tool (MTool_2.0.0.9) in
2. Control NB set fixed ip, 192.168.100.11
3. Run MTool_2.0.0.9
4. Select : Station -> DUT Settings
5. Set as follows

Location : AccessPoint
Hostname : 192.168.100.1
Wireless Hostname : 192.168.100.11
AP Login Name : admin
AP Password : CBN
CLI Prompt : Console>
Shell Command : cd /wifi
Shell Prompt : Console/wifi>
WI Command : wl –I wl0 (0 ---For 5G, 1 ---For 2.4G)

6.TX Mode:
Select -> Manual Tx/Rx
STF Mode : CDD
Packet IFS : 30

⇨ **Tx Data Rate:**

1Mbps Bandwidth 20 (IEEE 802.11b mode)
6Mbps Bandwidth 20 (IEEE 802.11g mode)
6.5Mbps Bandwidth 20 (IEEE 802.11n HT20 mode)
13.5Mbps Bandwidth 40 (IEEE 802.11n HT40 mode)
6.5Mbps Bandwidth 20 (IEEE 802.11a mode)
6.5Mbps Bandwidth 20 (IEEE 802.11an HT20 mode)
13.5Mbps Bandwidth 40 (IEEE 802.11an HT40 mode)
29.3Mbps Bandwidth 80 (IEEE 802.11ac HT80 mode)

⇨ **Power control**

IEEE 802.11b Channel Low (2412MHz) Chain0/Chain1/Chain2 Power set 60
IEEE 802.11b Channel Mid (2437MHz) Chain0/Chain1/Chain2 Power set 76
IEEE 802.11b Channel High (2462MHz) Chain0/Chain1/Chain2 Power set 64
IEEE 802.11g Channel Low (2412MHz) Chain0/Chain1/Chain2 Power set 64
IEEE 802.11g Channel Mid (2437MHz) Chain0/Chain1/Chain2 Power set 90
IEEE 802.11g Channel High (2462MHz) Chain0/Chain1/Chain2 Power set 72
IEEE 802.11n HT20 Channel Low (2412MHz) Chain0/Chain1/Chain2 Power set 64
IEEE 802.11n HT20 Channel Mid (2437MHz) Chain0/Chain1/Chain2 Power set 90
IEEE 802.11n HT20 Channel High (2462MHz) Chain0/Chain1/Chain2 Power set 70
IEEE 802.11n HT40 Channel Low (2422MHz) Chain0/Chain1/Chain2 Power set 62
IEEE 802.11n HT40 Channel Mid (2437MHz) Chain0/Chain1/Chain2 Power set 74
IEEE 802.11n HT40 Channel High (2452MHz) Chain0/Chain1/Chain2 Power set 68

IEEE 802.11a Channel Low (5745MHz) Chain0/Chain1/Chain2 Power set 102
IEEE 802.11a Channel Mid (5785MHz) Chain0/Chain1/Chain2 Power set 102
IEEE 802.11a Channel High (5825MHz) Chain0/Chain1/Chain2 Power set 102
IEEE 802.11an HT20 Channel Low (5745MHz) Chain0/Chain1/Chain2 Power set 102
IEEE 802.11an HT20 Channel Mid (5785MHz) Chain0/Chain1/Chain2 Power set 102
IEEE 802.11an HT20 Channel High (5825MHz) Chain0/Chain1/Chain2 Power set102
IEEE 802.11an HT40 Channel Low (5755MHz) Chain0/Chain1/Chain2 Power set 102
IEEE 802.11an HT40 Channel High (5795MHz) Chain0/Chain1/Chain2 Power set102
IEEE 802.11ac HT80 Channel High (5775MHz) Chain0/Chain1/Chain2 Power set 102

7. All of the functions are under run.
8. Start test.

Normal Mode :

1. EUT & peripherals setup diagram is shown in appendix setup photos.
2. Power on all equipments.
3. Coaxial cable link headend-CMTS.
   CMTS set DOWN STREAM : -10 dBmV, UP STREAM: + 40 dBmV.
4. Notebook PC ping EUT IP through LAN connected by RJ-45 cable.
5. Notebook PC ping EUT IP through wireless LAN.
6. EUT and laptop connection transfer rate appears as 100Mbps.
7. Set telephones on the talking mode.
8. Start test.

7. FCC PART 15.247 REQUIREMENTS

7.1 6dB BANDWIDTH

LIMITS

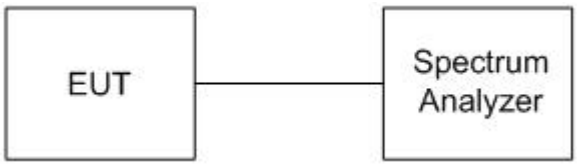
§ 15.247(a) (2) For direct sequence systems, the minimum 6dB bandwidth shall be at least 500kHz.

TEST EQUIPMENT

Name of Equipment	Manufacturer	Model	Serial Number	Calibration Due
Spectrum Analyzer	Agilent	E4446A	MY43360132	06/10/2014

Remark: *Each piece of equipment is scheduled for calibration once a year.*

TEST SETUP



TEST PROCEDURE

1. The transmitter output was connected to a spectrum analyzer.
2. Set RBW = 100 kHz.
3. Set the video bandwidth (VBW) ≥ 3 x RBW.
4. Detector = Peak.
5. Trace mode = max hold.
6. Sweep = auto couple.
7. Allow the trace to stabilize.
8. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

TEST RESULTS

IEEE 802.11a Mode (Three TX)

Channel	Channel Frequency (MHz)	6dB Bandwidth (MHz)			Minimum Limit (kHz)	Pass / Fail
		Chain 0	Chain 1	Chain 2		
Low	5745	16.325	16.375	15.685	500	PASS
Middle	5785	15.065	16.350	16.330	500	PASS
High	5825	16.330	16.325	16.340	500	PASS

IEEE 802.11an HT20 Mode (Three TX)

Channel	Channel Frequency (MHz)	6dB Bandwidth (MHz)			Minimum Limit (kHz)	Pass / Fail
		Chain 0	Chain 1	Chain 2		
Low	5745	16.915	17.270	17.280	500	PASS
Middle	5785	17.280	17.625	17.575	500	PASS
High	5825	16.535	17.530	16.920	500	PASS

IEEE 802.11an HT40 Mode (Three TX)

Channel	Channel Frequency (MHz)	6dB Bandwidth (MHz)			Minimum Limit (kHz)	Pass / Fail
		Chain 0	Chain 1	Chain 2		
Low	5755	35.870	36.280	35.985	500	PASS
High	5795	35.830	35.900	35.715	500	PASS

IEEE 802.11b Mode (Three TX)

Channel	Channel Frequency (MHz)	6dB Bandwidth (MHz)			Minimum Limit (kHz)	Pass / Fail
		Chain 0	Chain 1	Chain 2		
Low	2412	8.065	8.090	8.085	500	PASS
Middle	2437	8.080	8.055	8.080	500	PASS
High	2462	7.580	8.085	8.020	500	PASS

IEEE 802.11g Mode (Three TX)

Channel	Channel Frequency (MHz)	6dB Bandwidth (MHz)			Minimum Limit (kHz)	Pass / Fail
		Chain 0	Chain 1	Chain 2		
Low	2412	16.360	16.345	16.345	500	PASS
Middle	2437	15.685	15.710	15.725	500	PASS
High	2462	16.345	16.355	16.325	500	PASS

IEEE 802.11n HT20 Mode (Three TX)

Channel	Channel Frequency (MHz)	6dB Bandwidth (MHz)			Minimum Limit (kHz)	Pass / Fail
		Chain 0	Chain 1	Chain 2		
Low	2412	17.545	17.565	17.595	500	PASS
Middle	2437	16.285	16.940	16.355	500	PASS
High	2462	17.585	17.185	16.950	500	PASS

IEEE 802.11n HT40 Mode (Three TX)

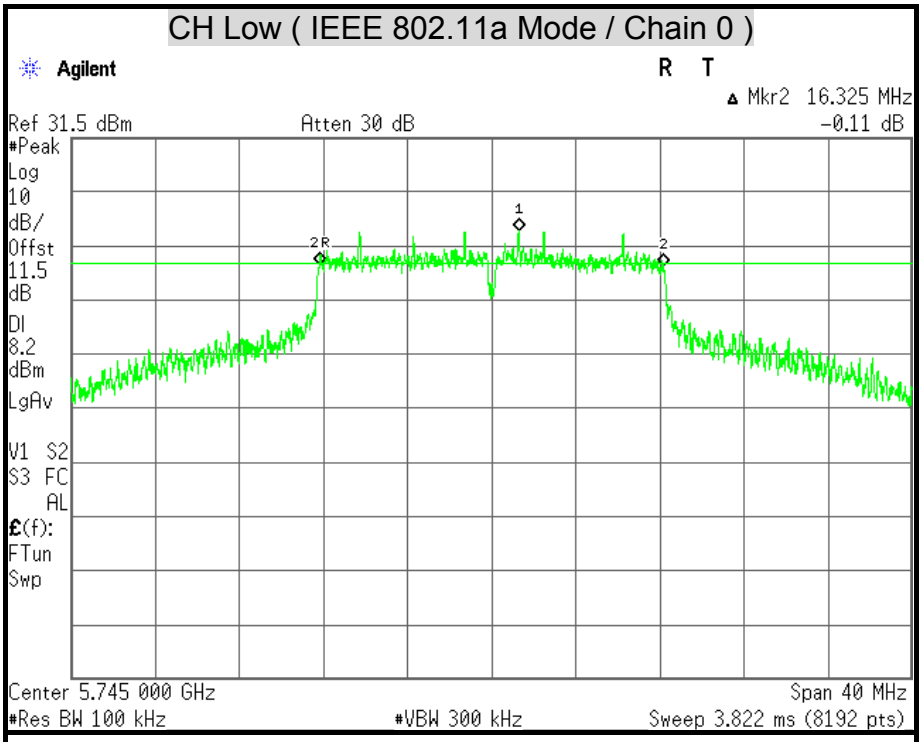
Channel	Channel Frequency (MHz)	6dB Bandwidth (MHz)			Minimum Limit (kHz)	Pass / Fail
		Chain 0	Chain 1	Chain 2		
Low	2422	36.065	36.330	36.310	500	PASS
Middle	2437	35.755	35.745	35.725	500	PASS
High	2452	35.890	35.800	35.725	500	PASS

IEEE 802.11ac HT80 Mode (Three TX)

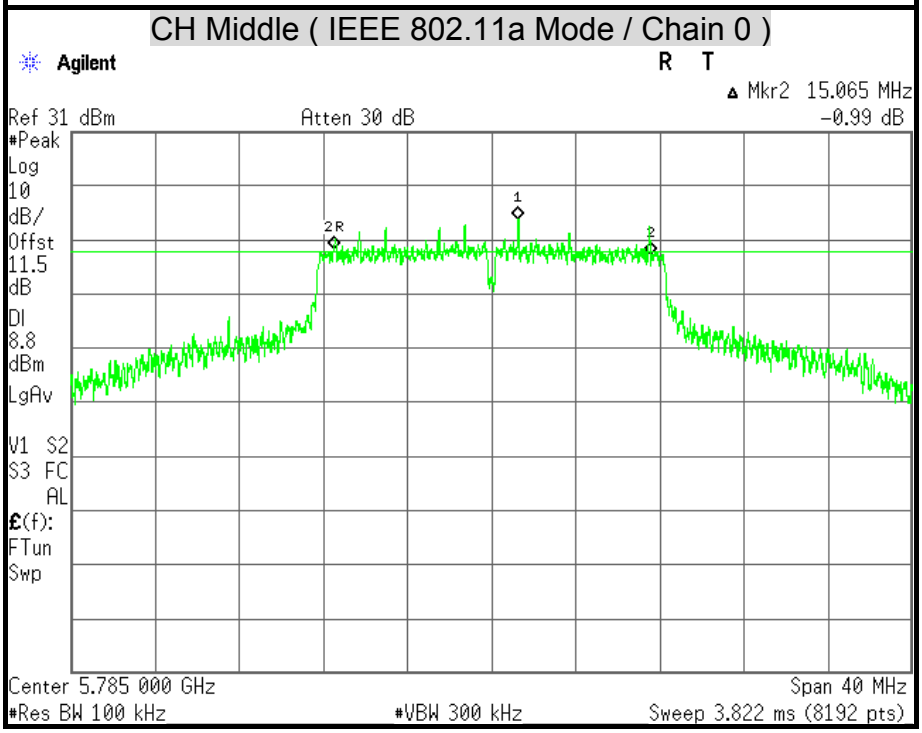
Channel	Channel Frequency (MHz)	6dB Bandwidth (MHz)			Minimum Limit (kHz)	Pass / Fail
		Chain 0	Chain 1	Chain 2		
Low	5775	75.150	75.150	75.130	500	PASS

6dB BANDWIDTH

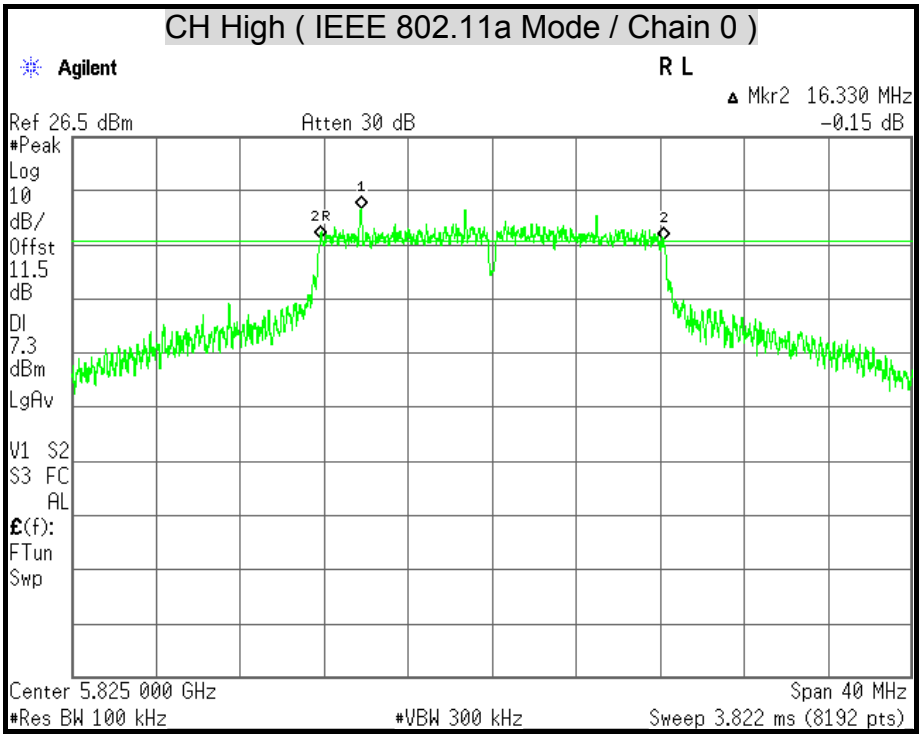
CH Low (IEEE 802.11a Mode / Chain 0)



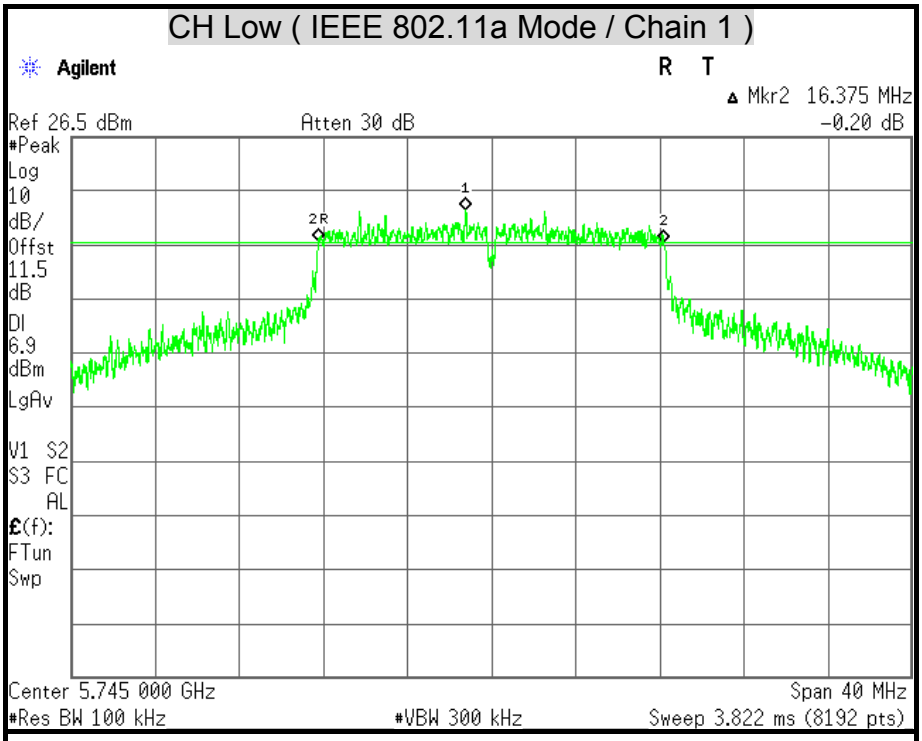
CH Middle (IEEE 802.11a Mode / Chain 0)



CH High (IEEE 802.11a Mode / Chain 0)



CH Low (IEEE 802.11a Mode / Chain 1)



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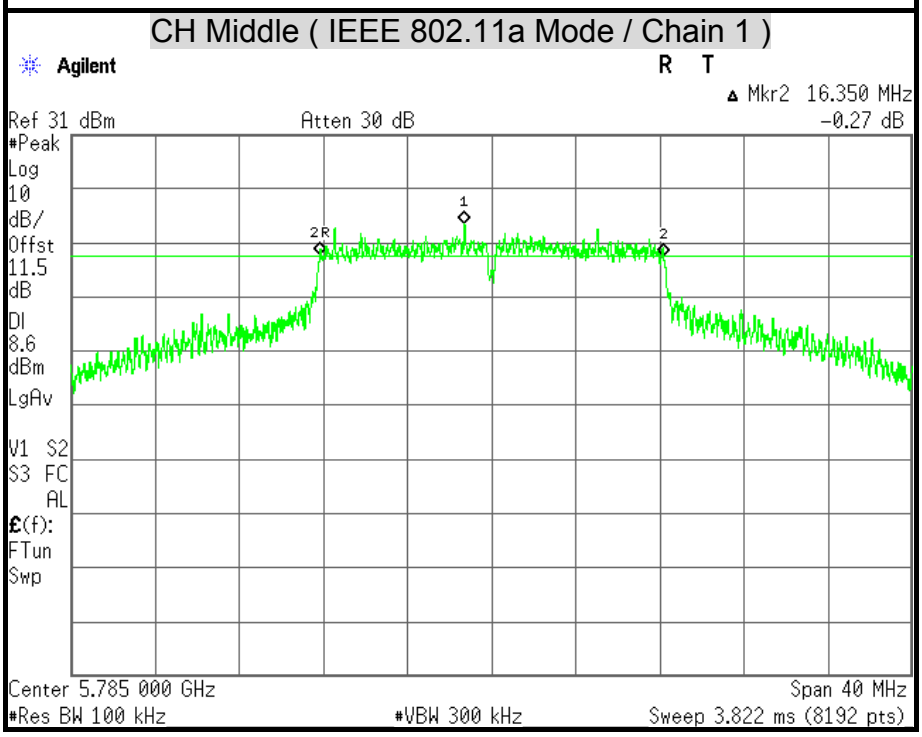

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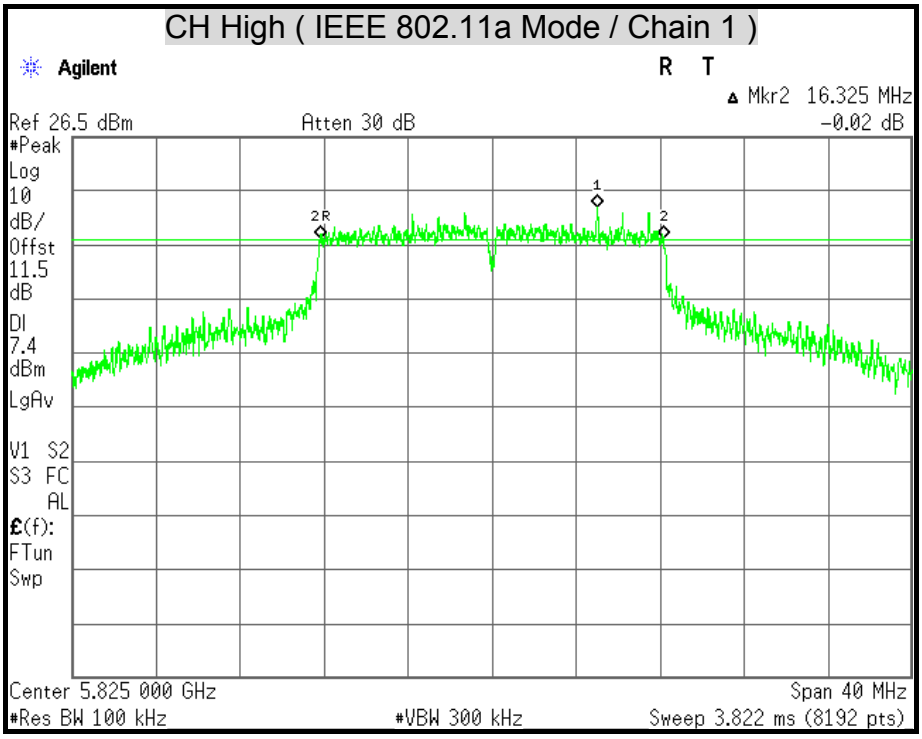

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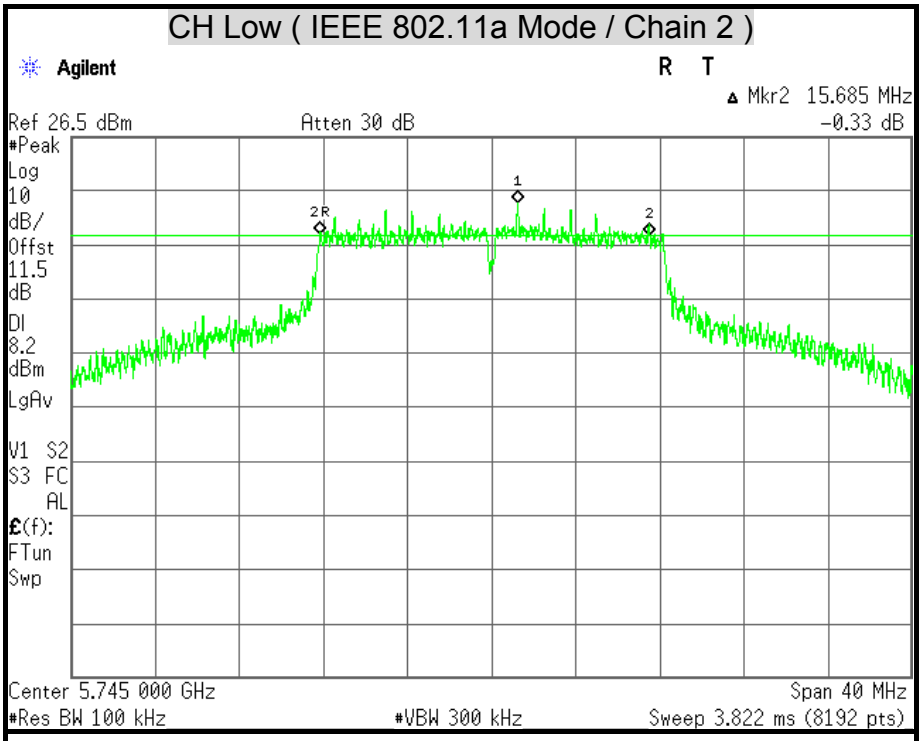
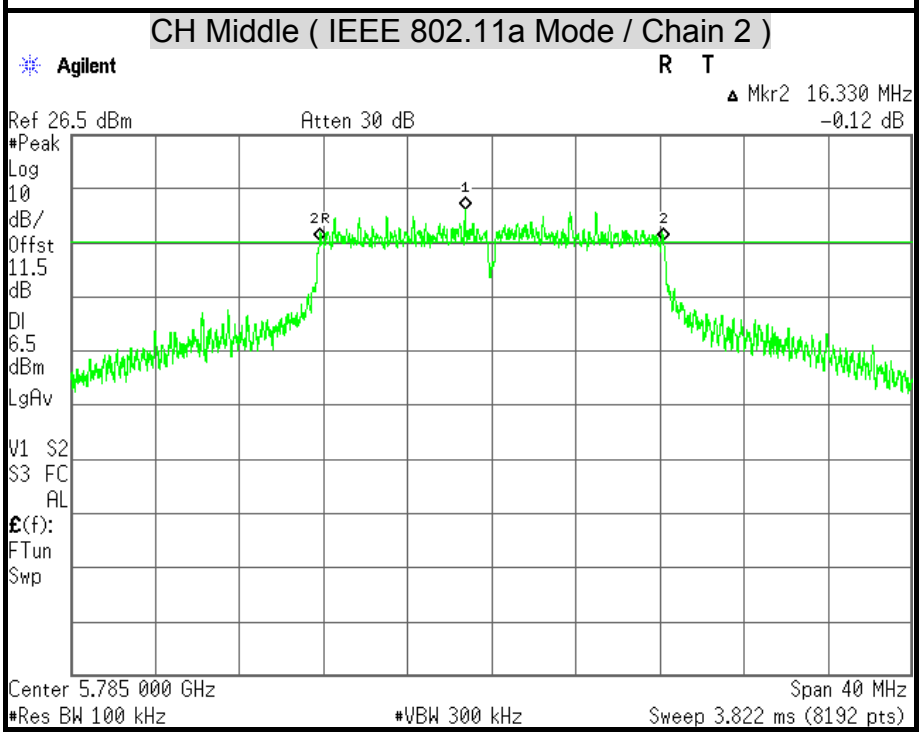
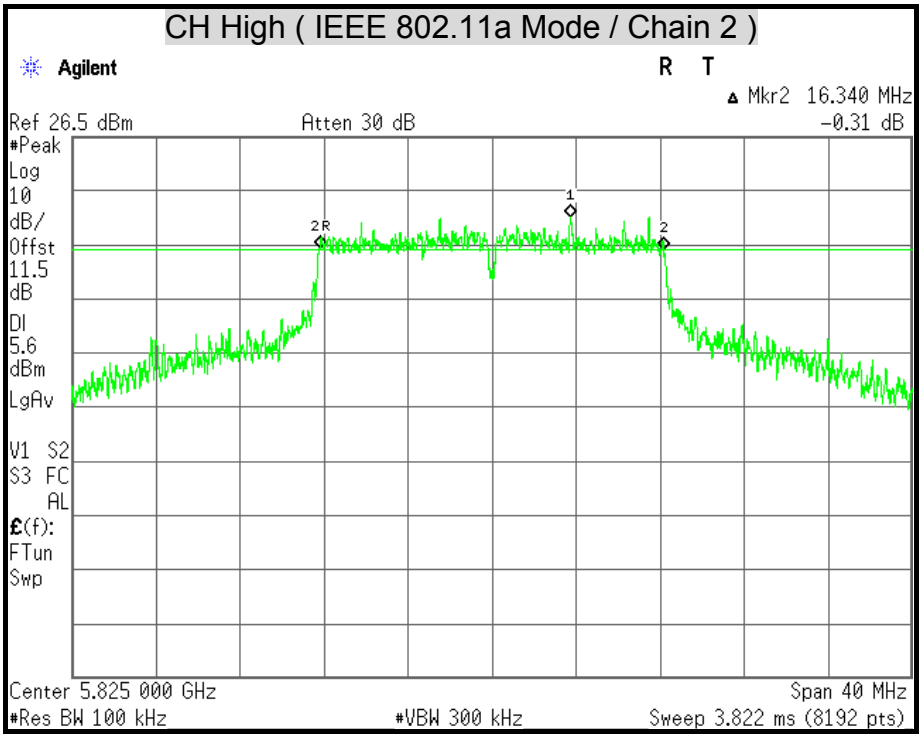


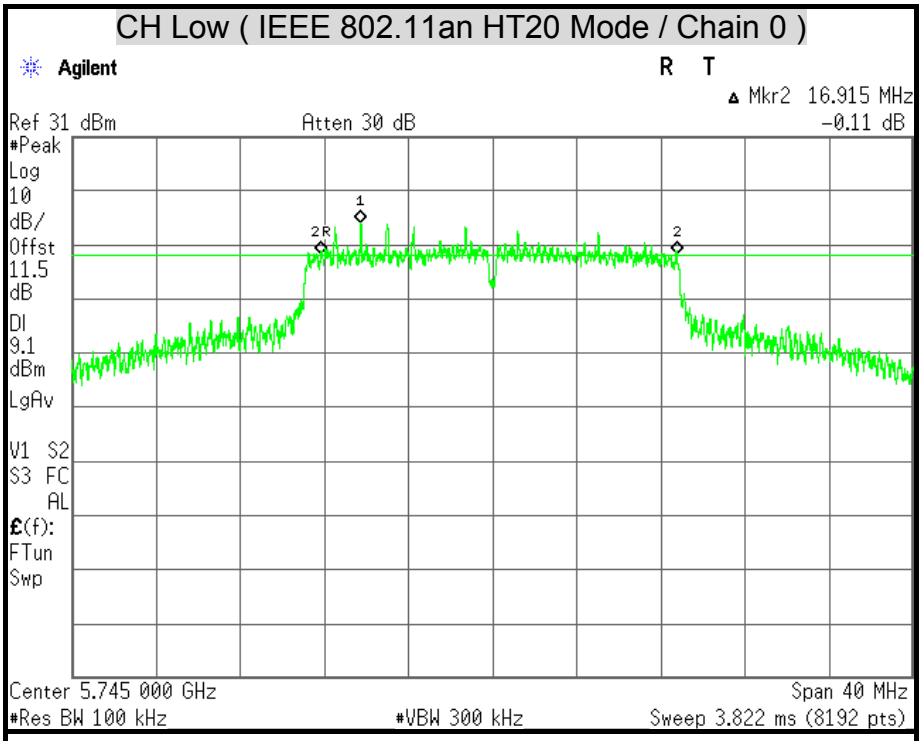
CH Middle (IEEE 802.11a Mode / Chain 2)



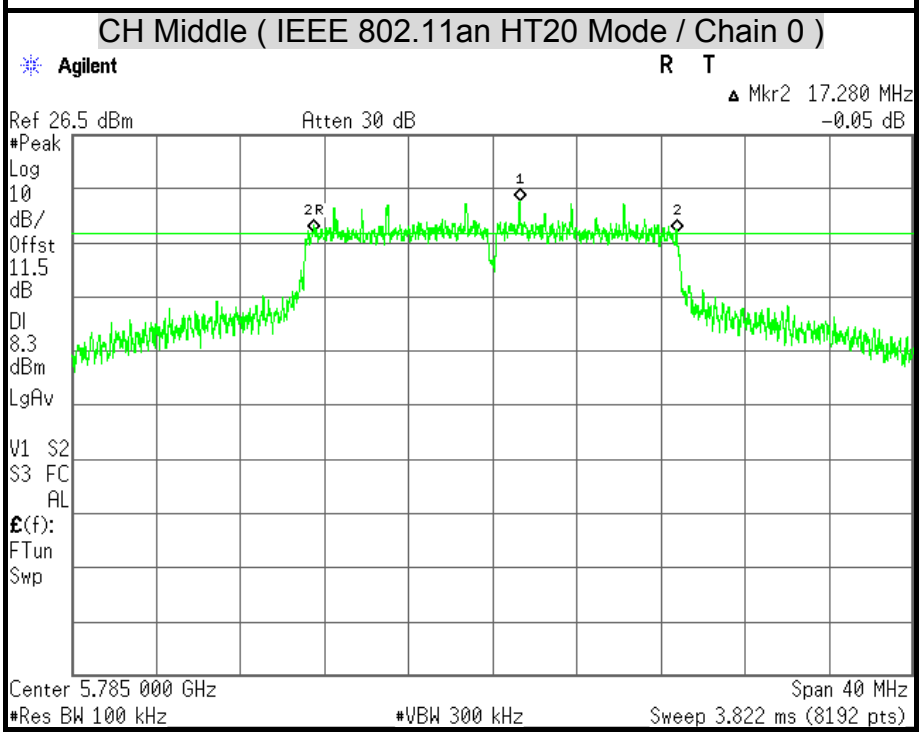
CH High (IEEE 802.11a Mode / Chain 2)



CH Low (IEEE 802.11an HT20 Mode / Chain 0)



CH Middle (IEEE 802.11an HT20 Mode / Chain 0)



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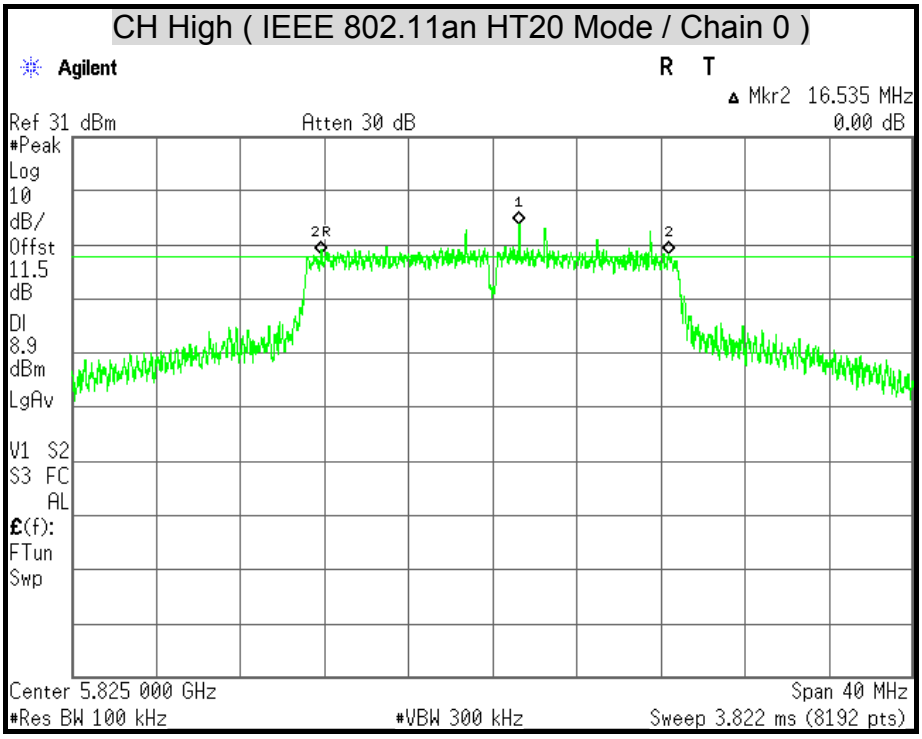
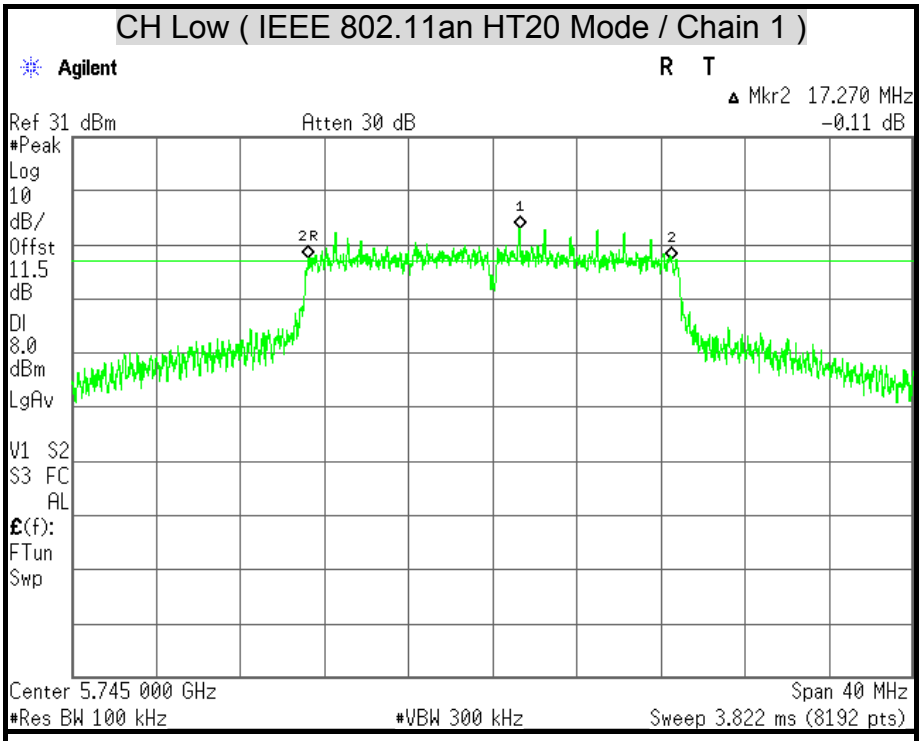
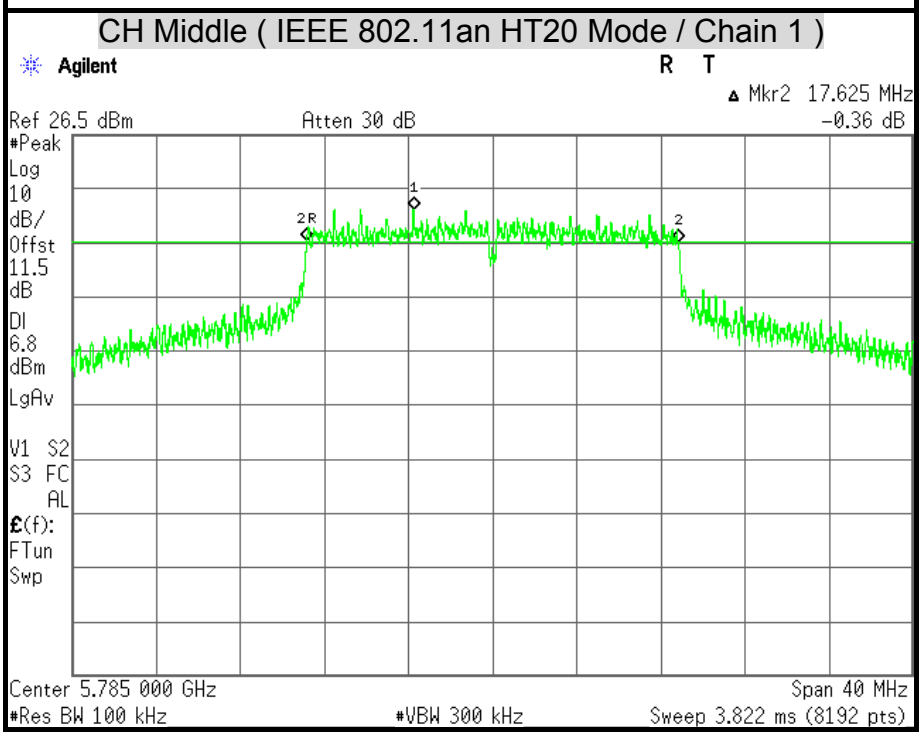


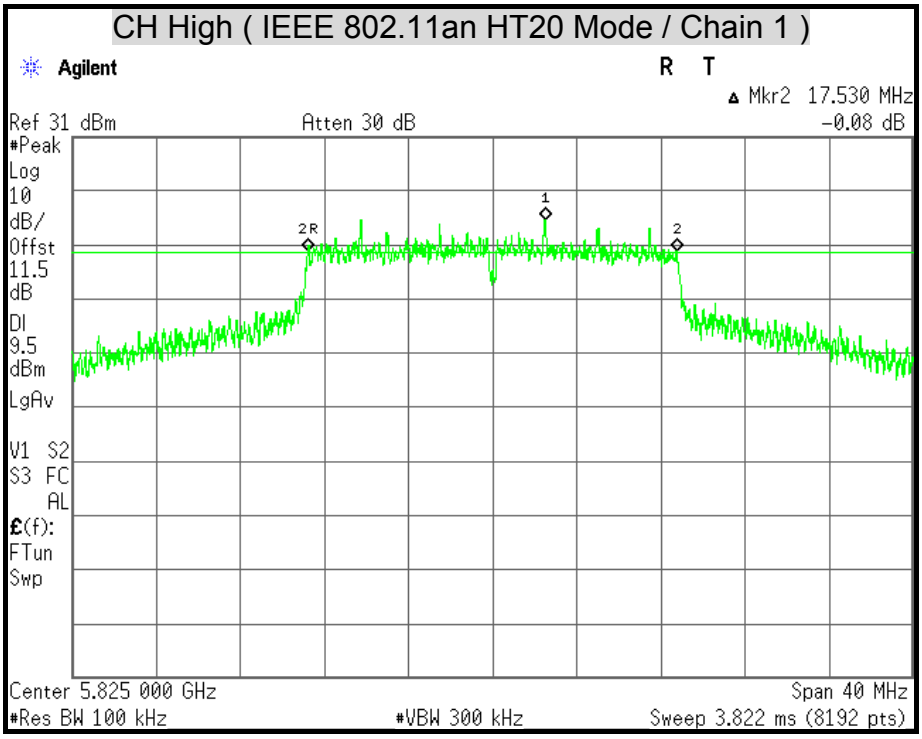
CH Low (IEEE 802.11an HT20 Mode / Chain 1)



CH Middle (IEEE 802.11an HT20 Mode / Chain 1)



CH High (IEEE 802.11an HT20 Mode / Chain 1)



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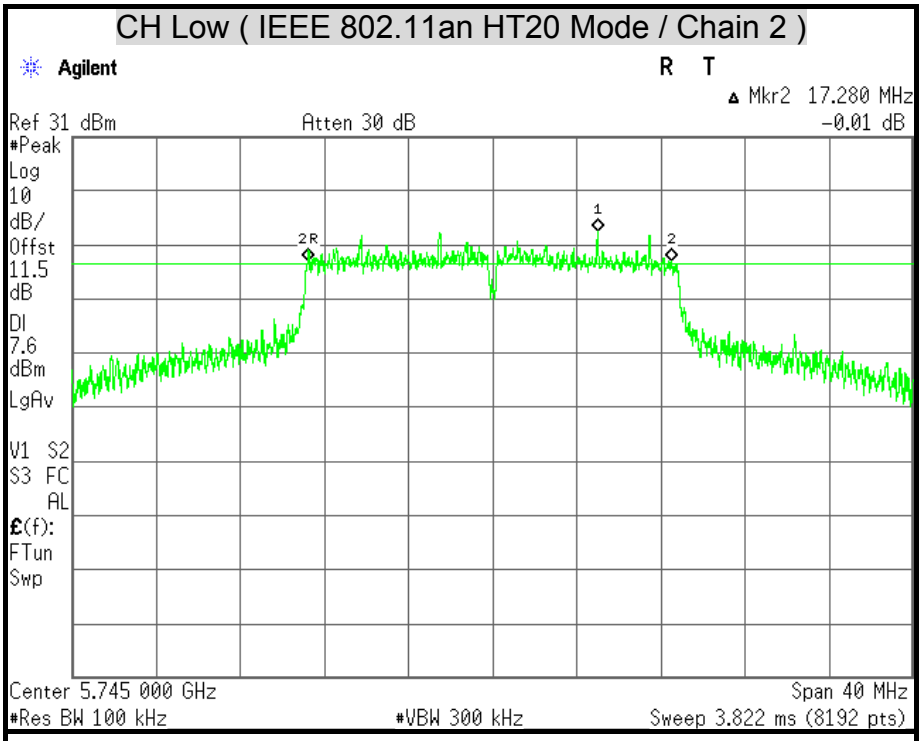

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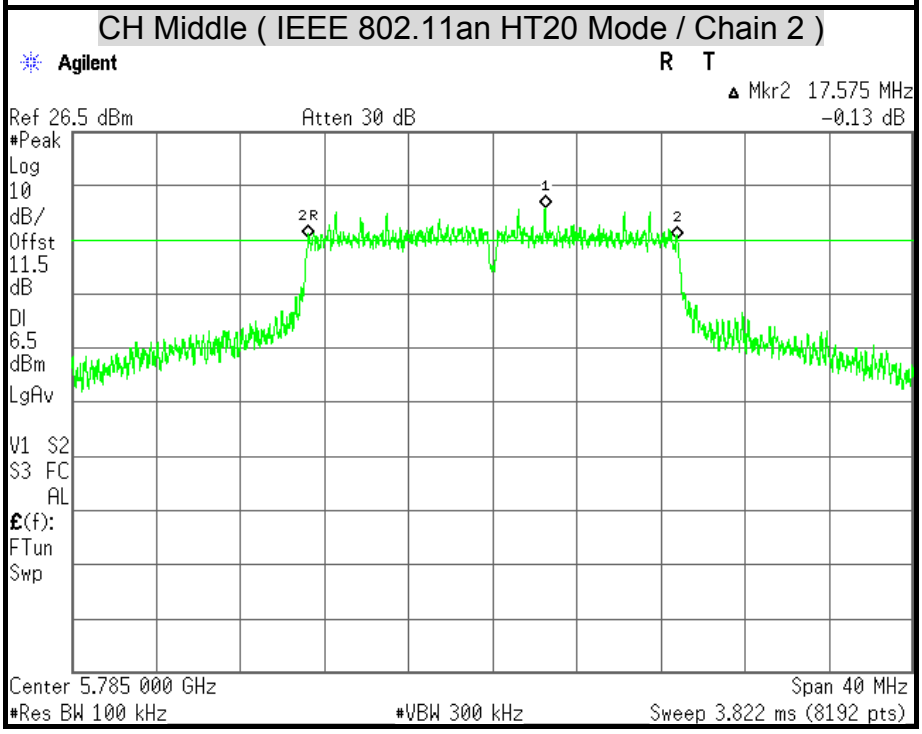

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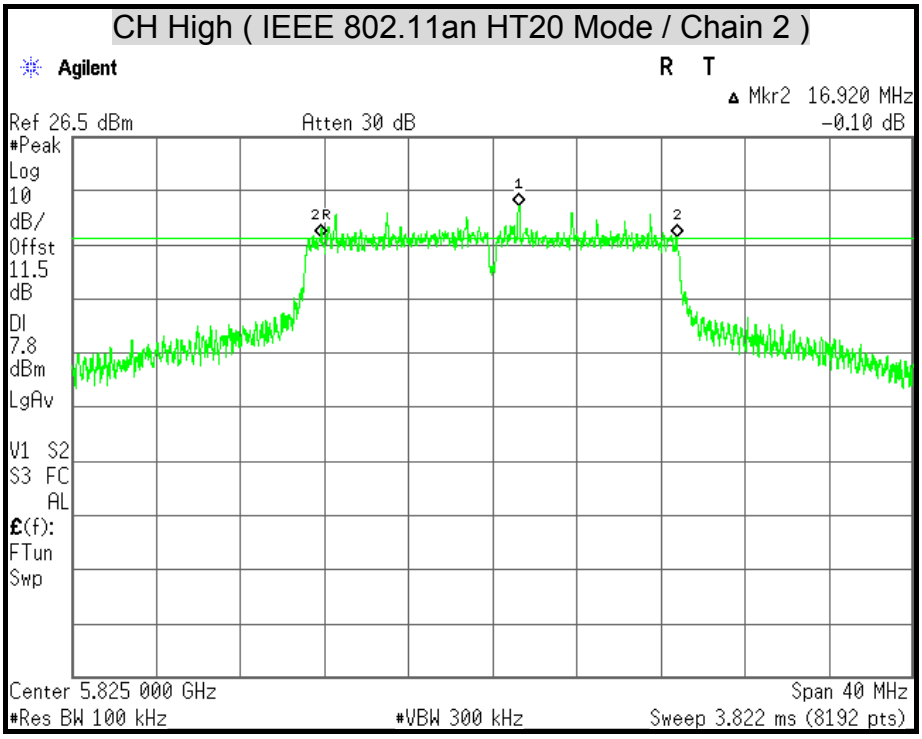

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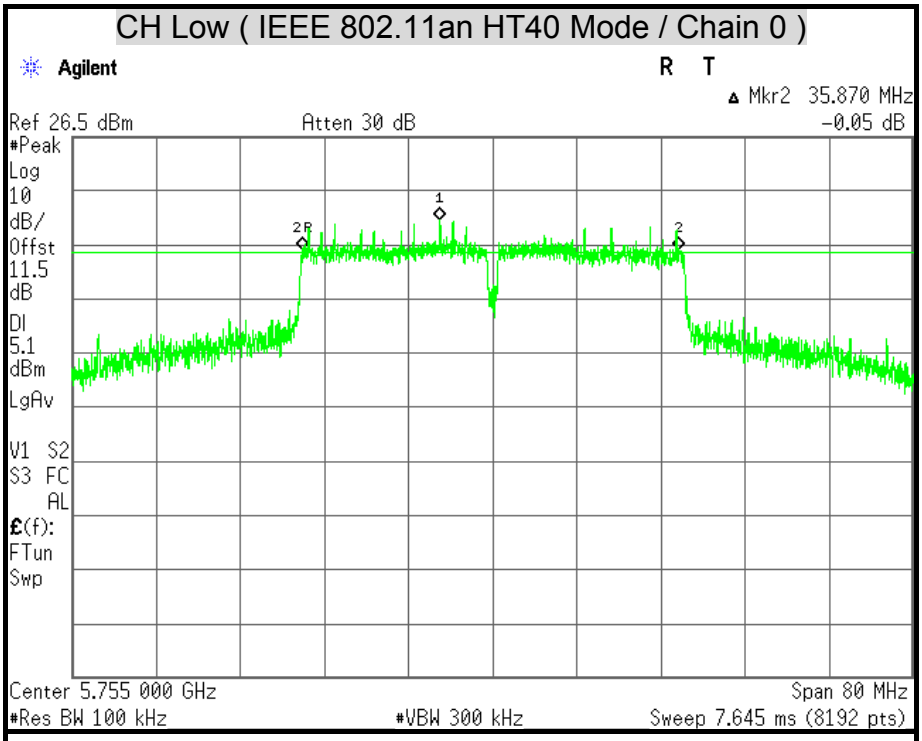

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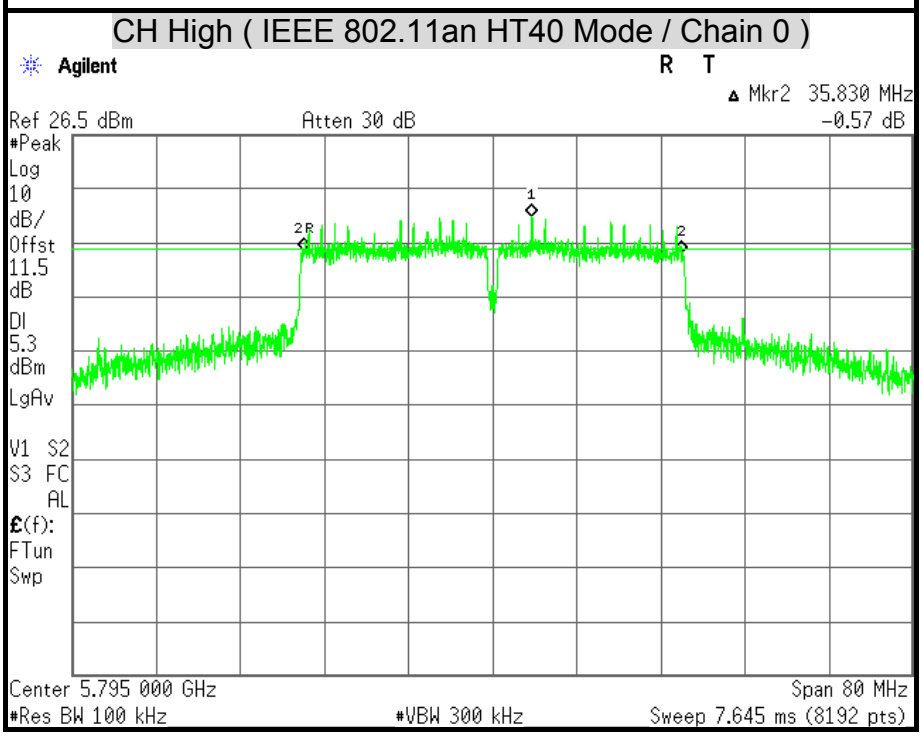

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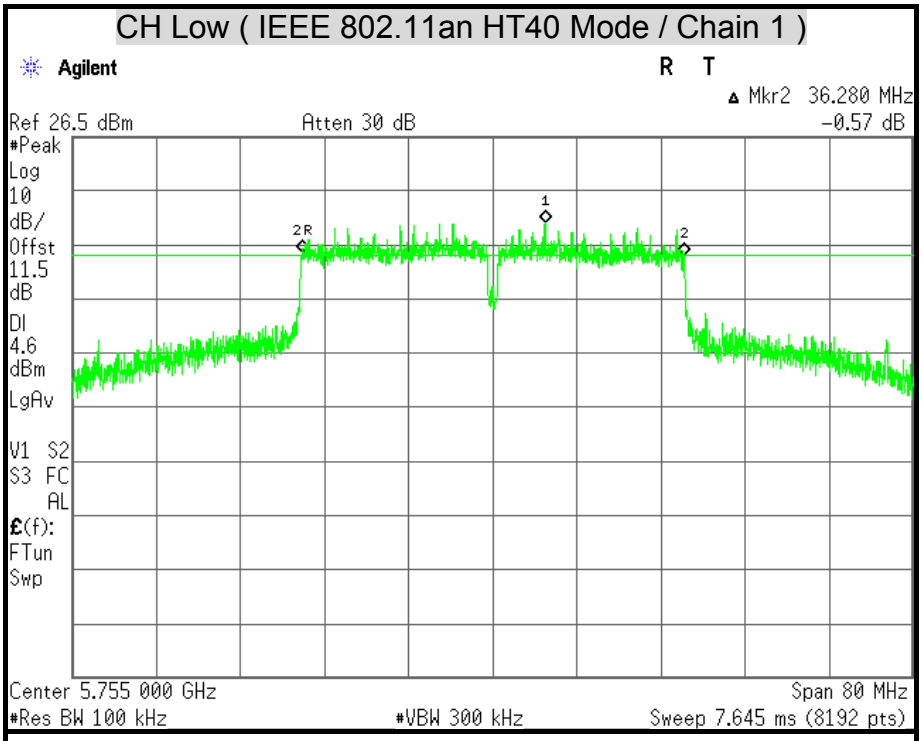

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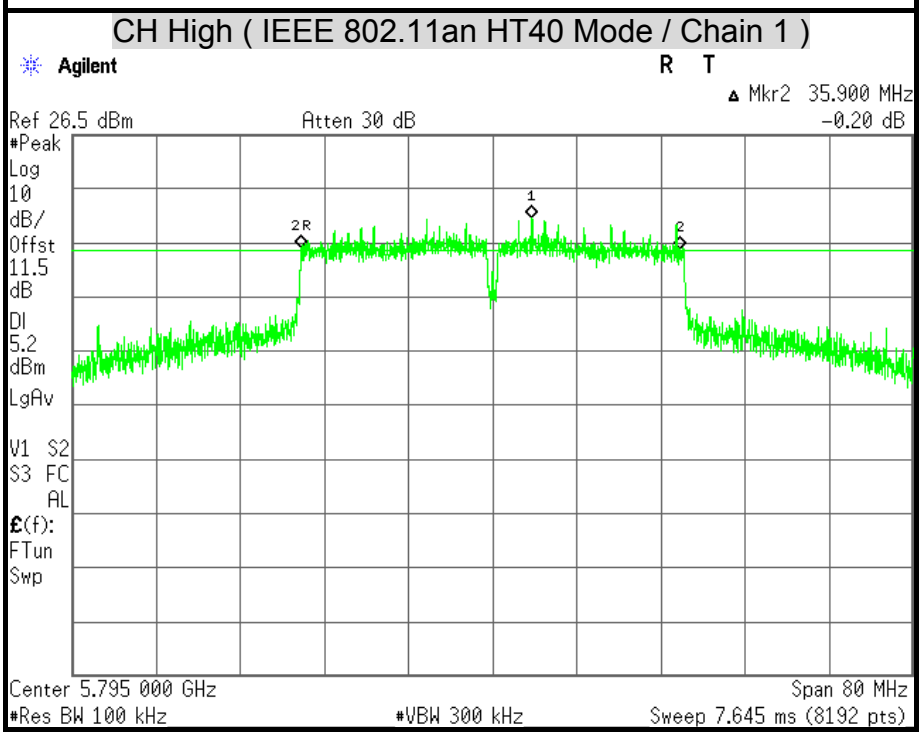

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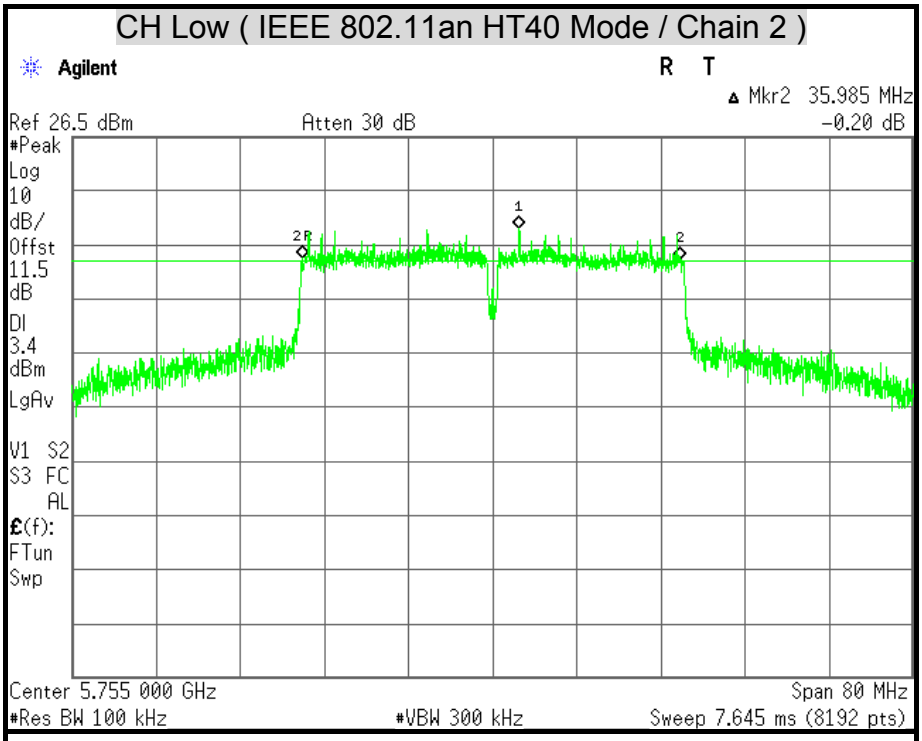

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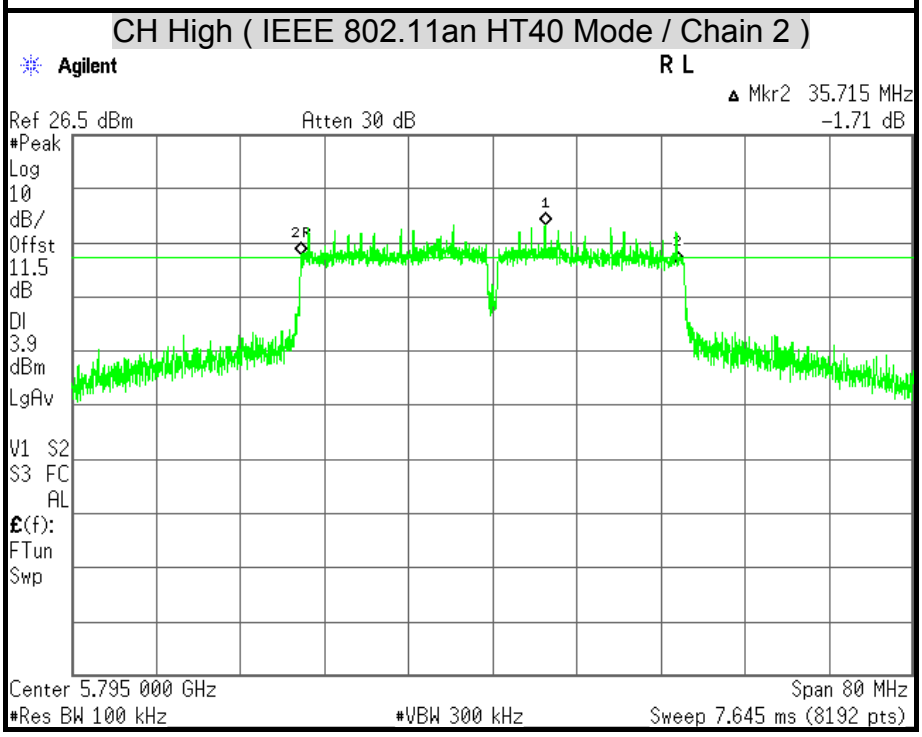
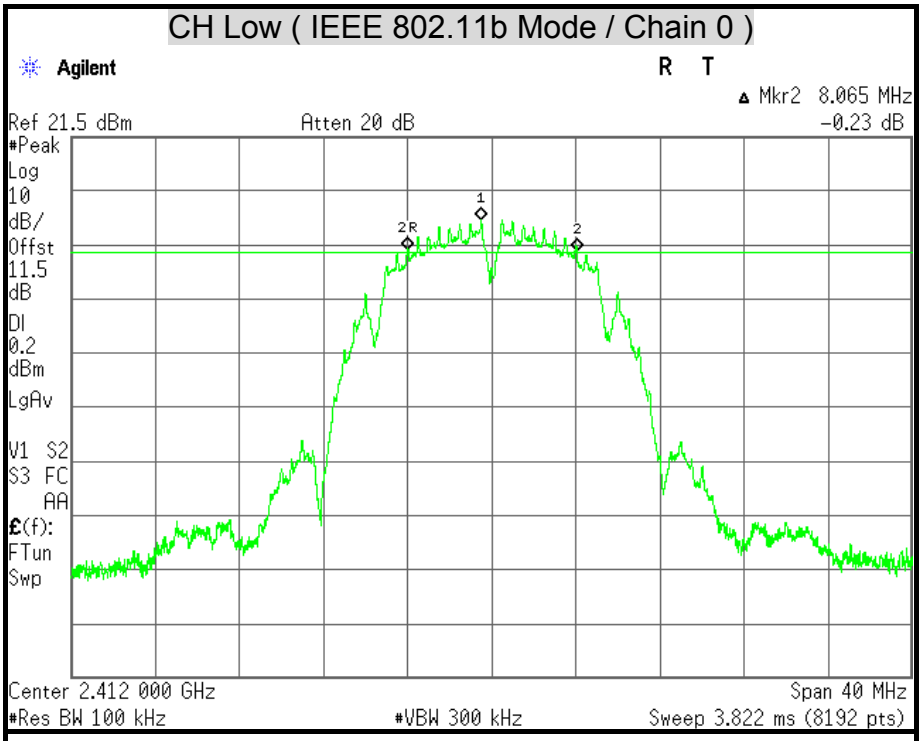


CH Low (IEEE 802.11b Mode / Chain 0)



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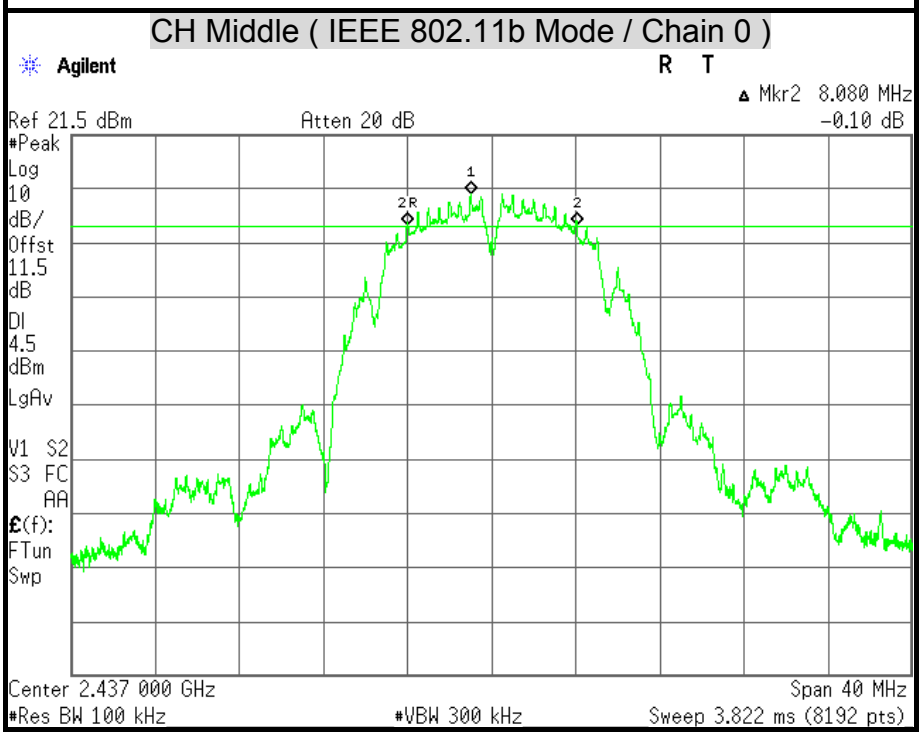

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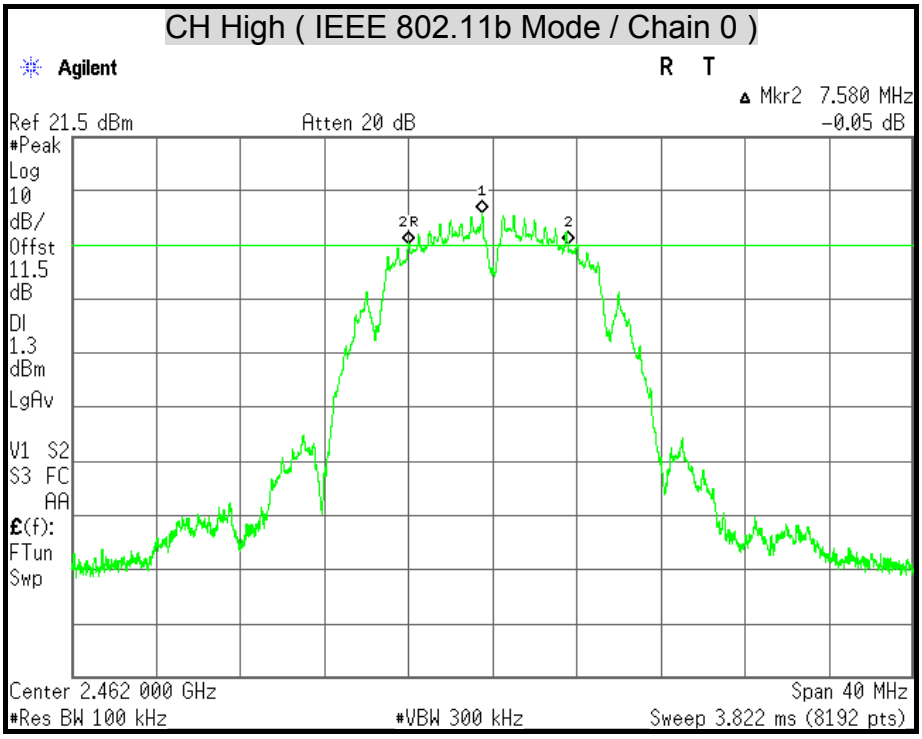

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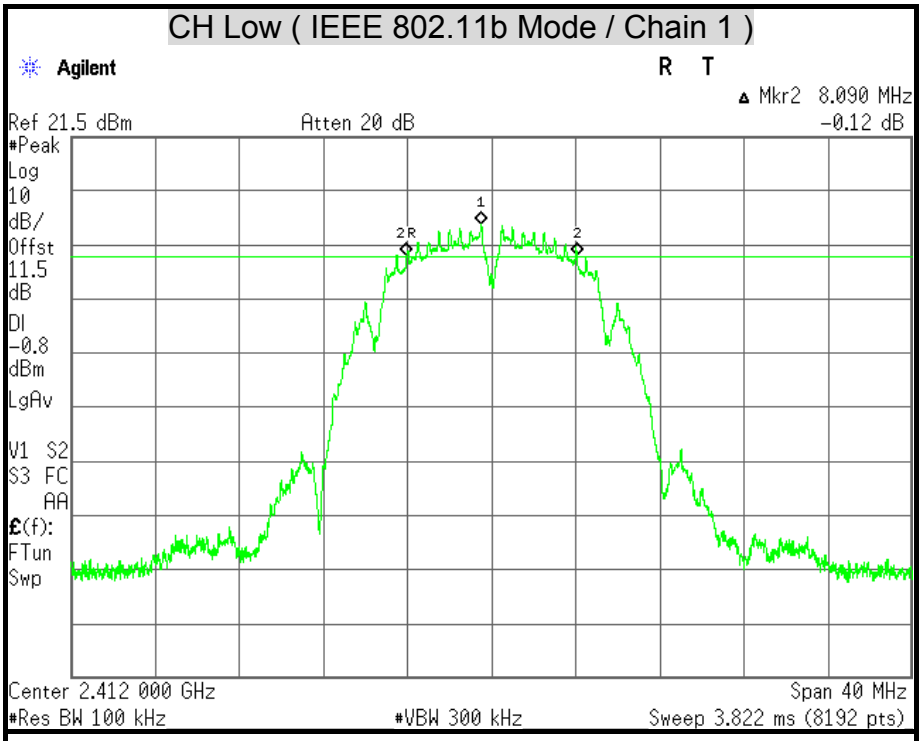

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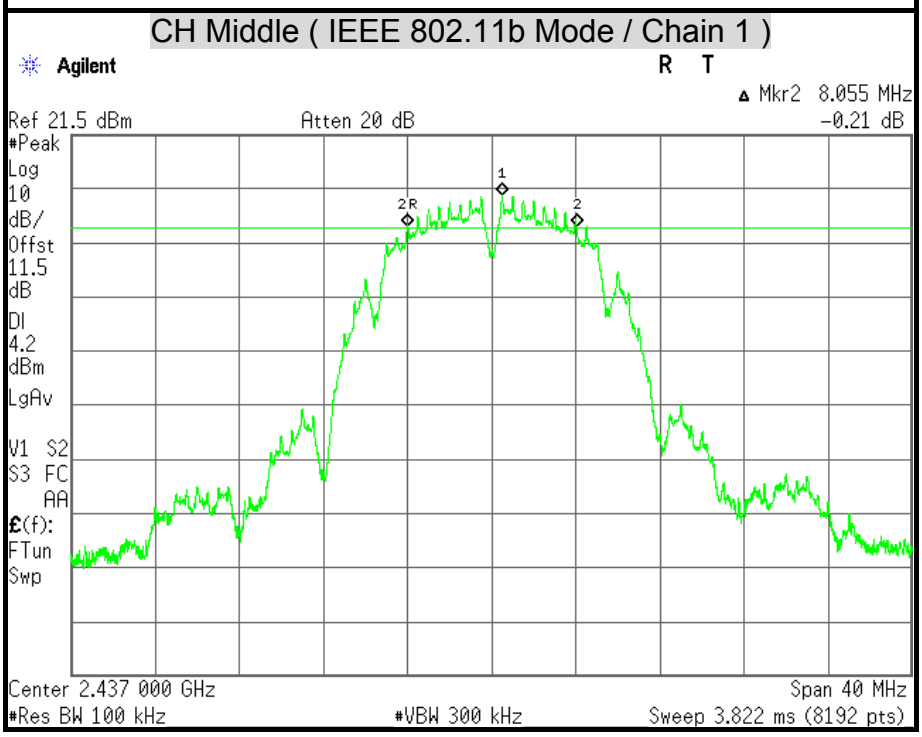

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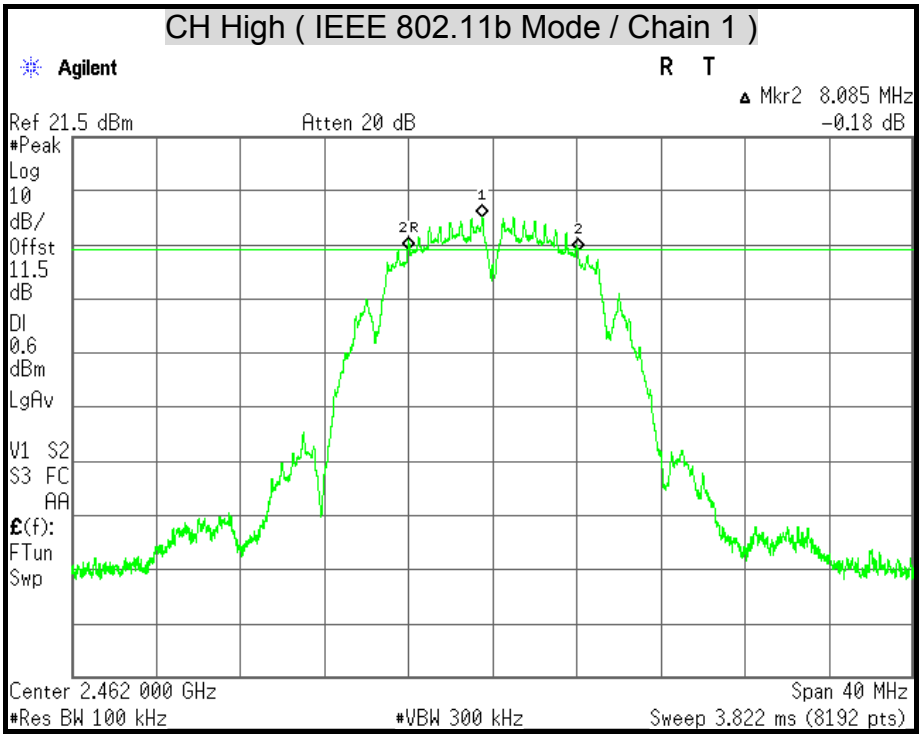

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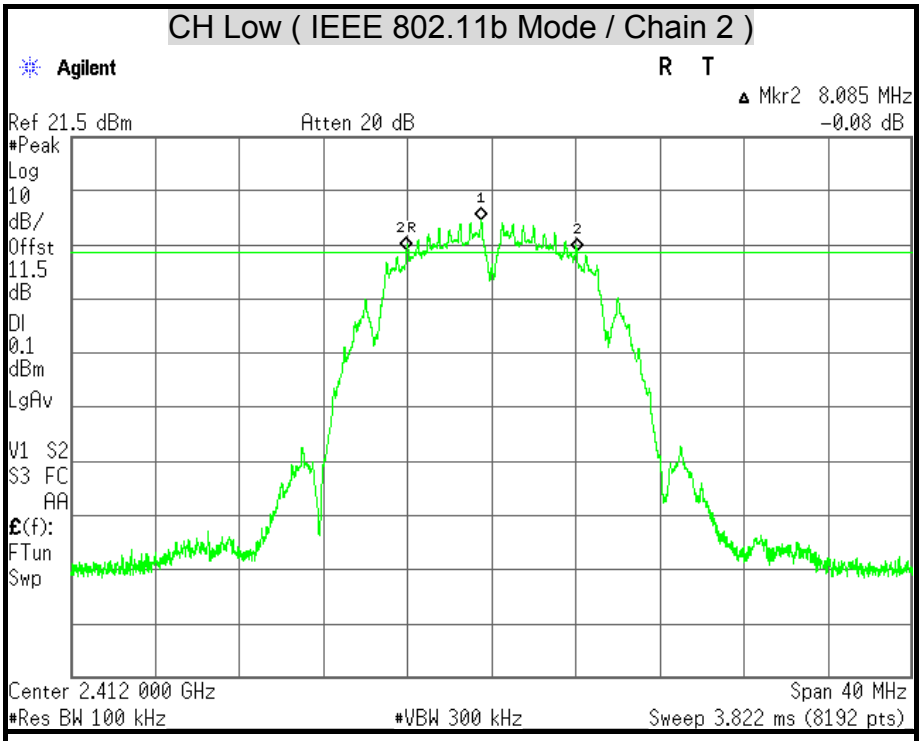

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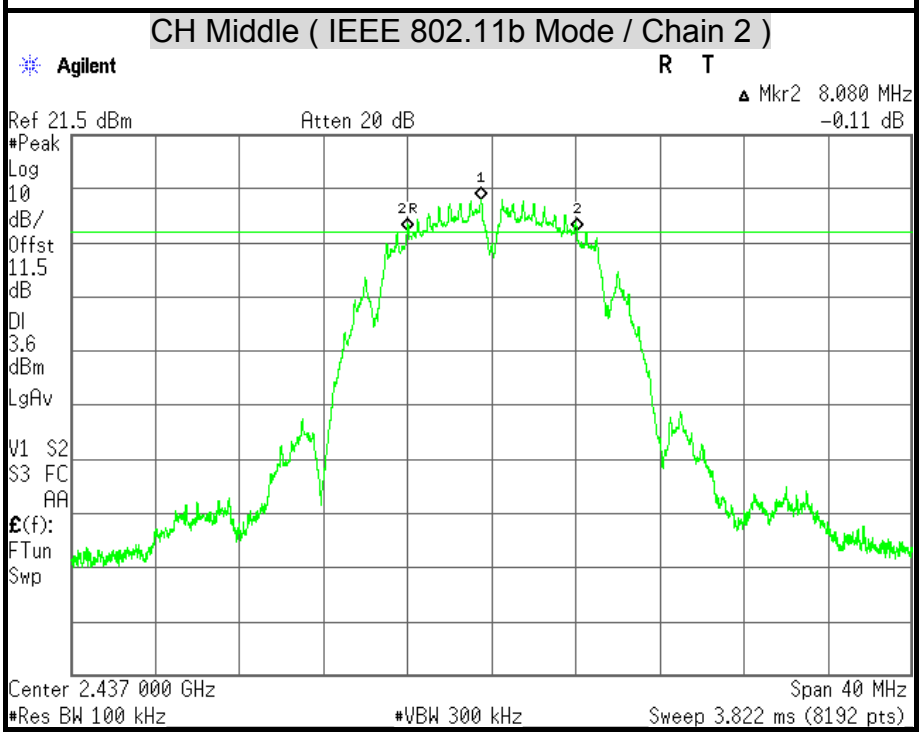

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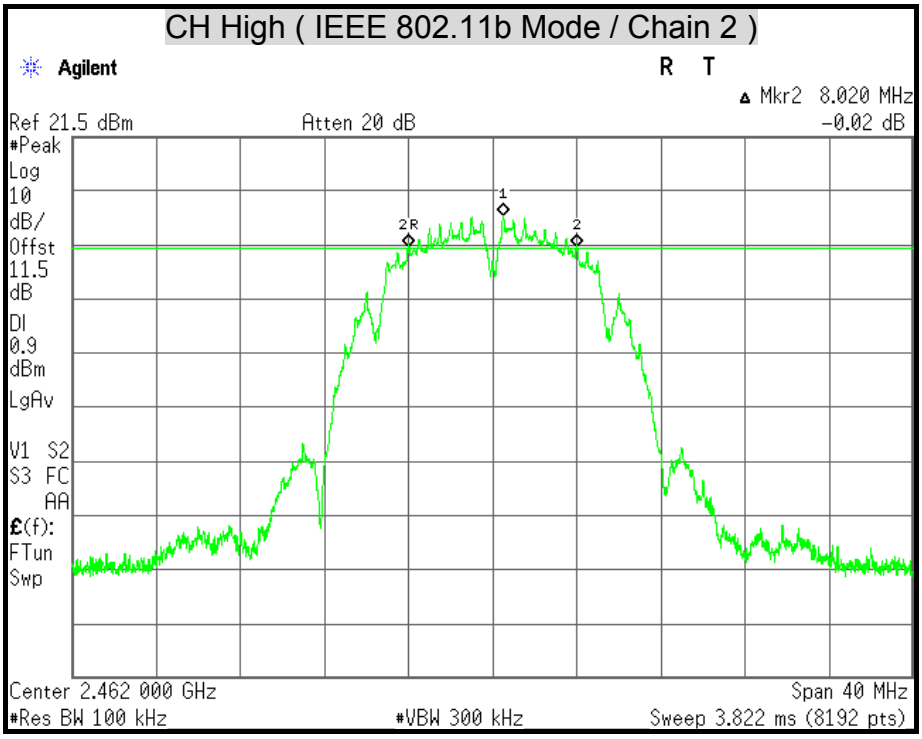
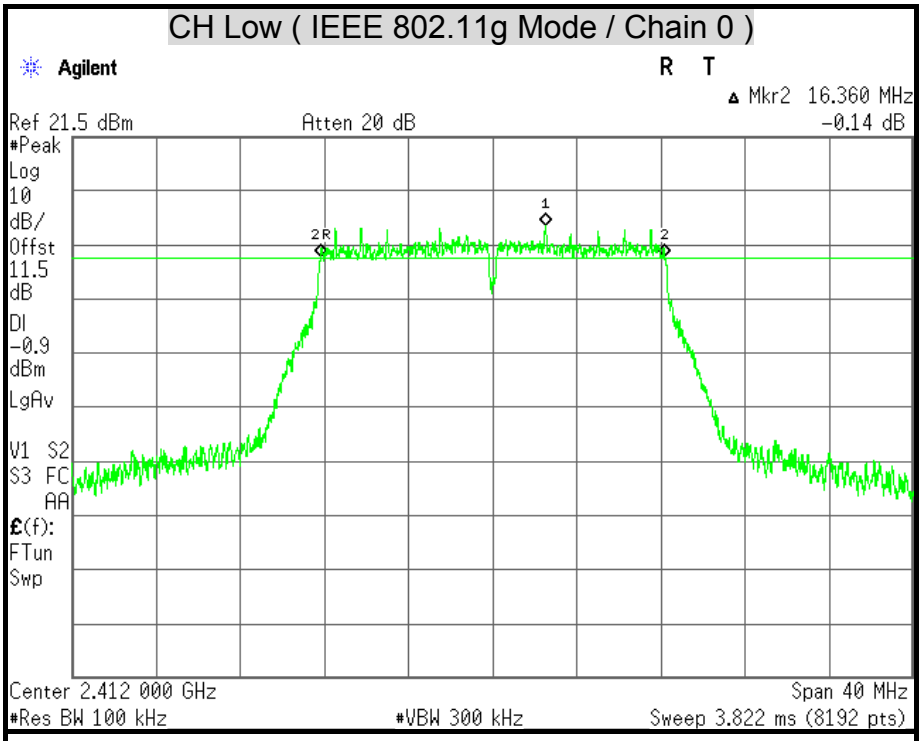
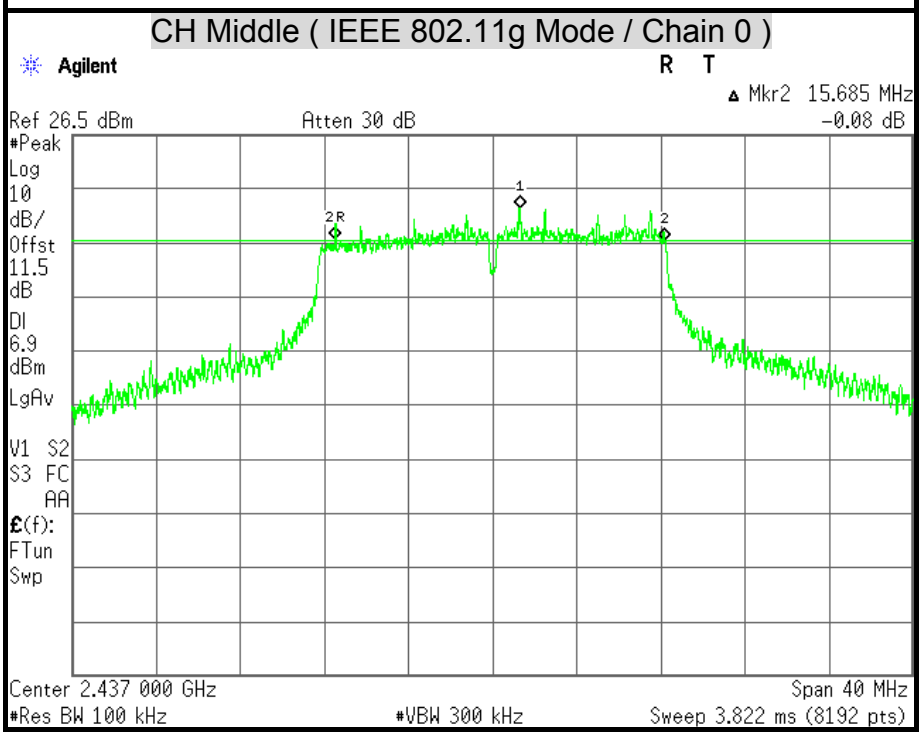


CH Low (IEEE 802.11g Mode / Chain 0)



CH Middle (IEEE 802.11g Mode / Chain 0)



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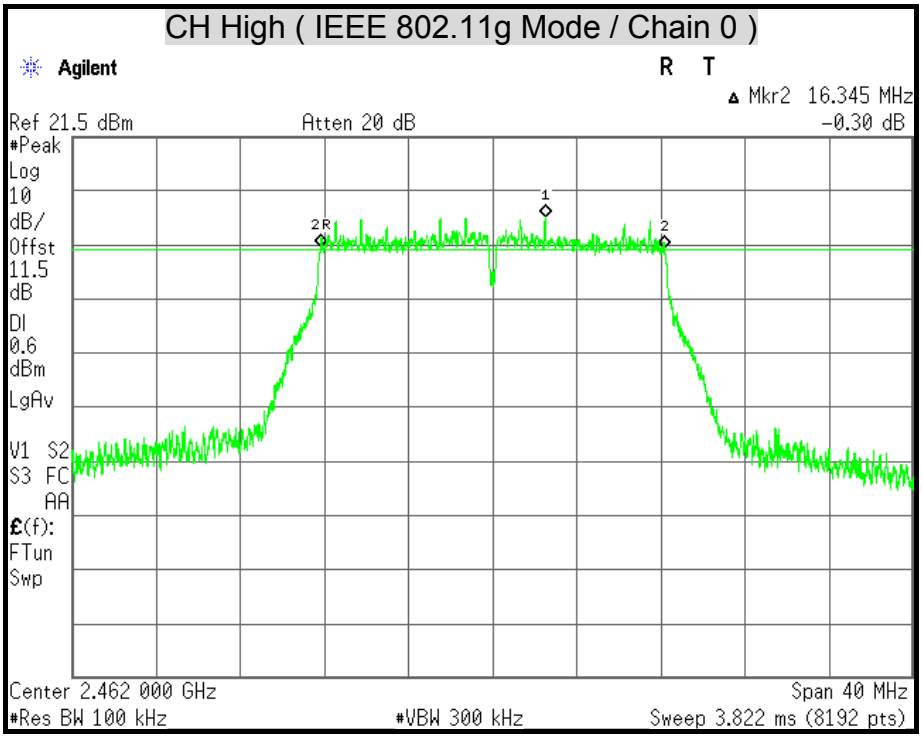

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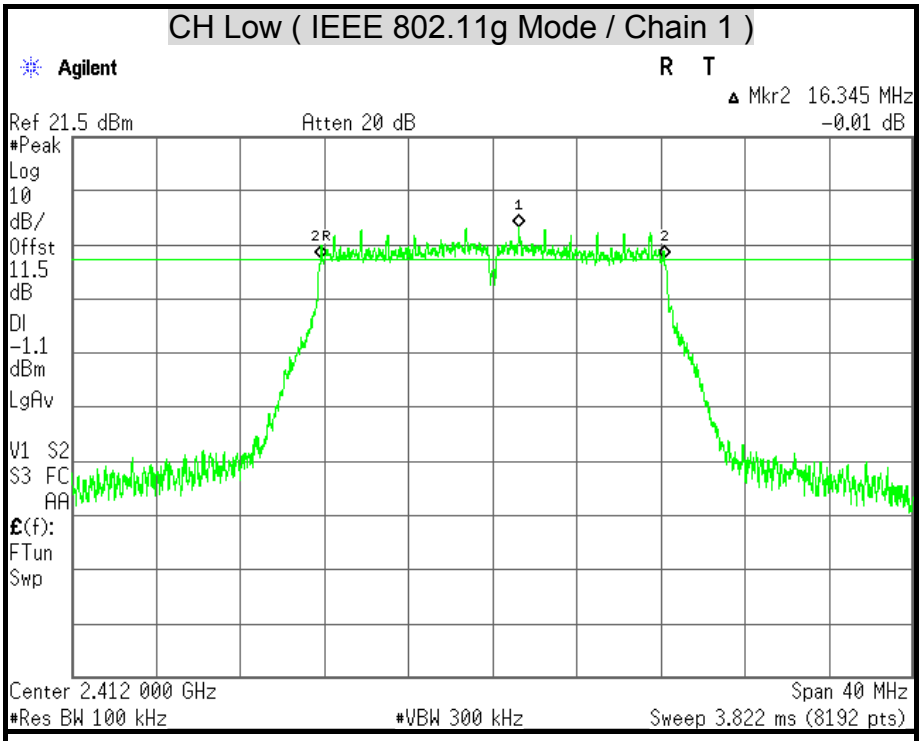

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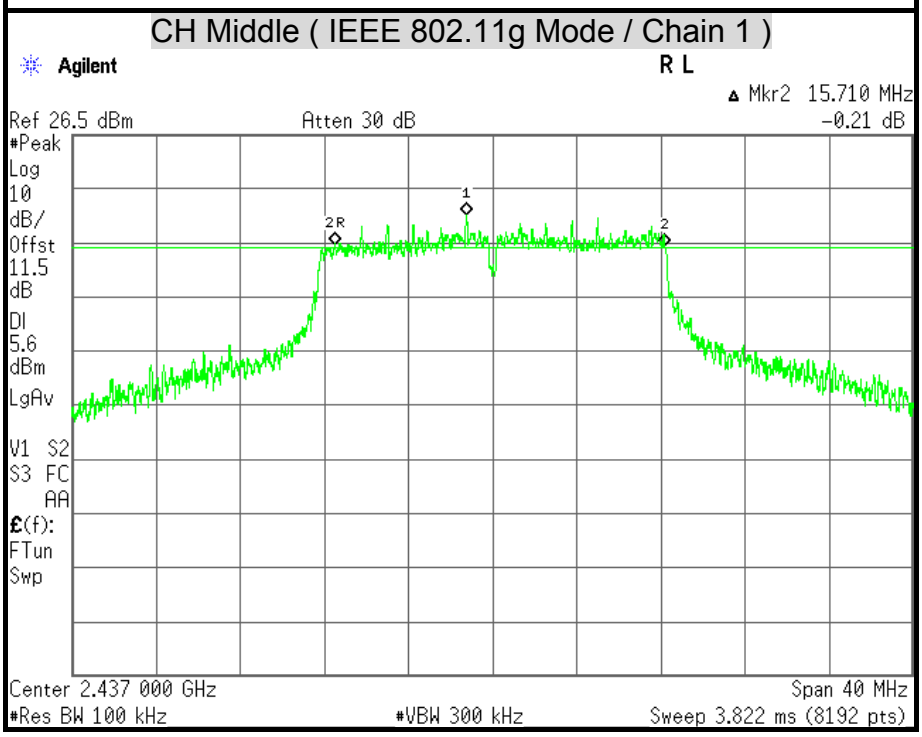

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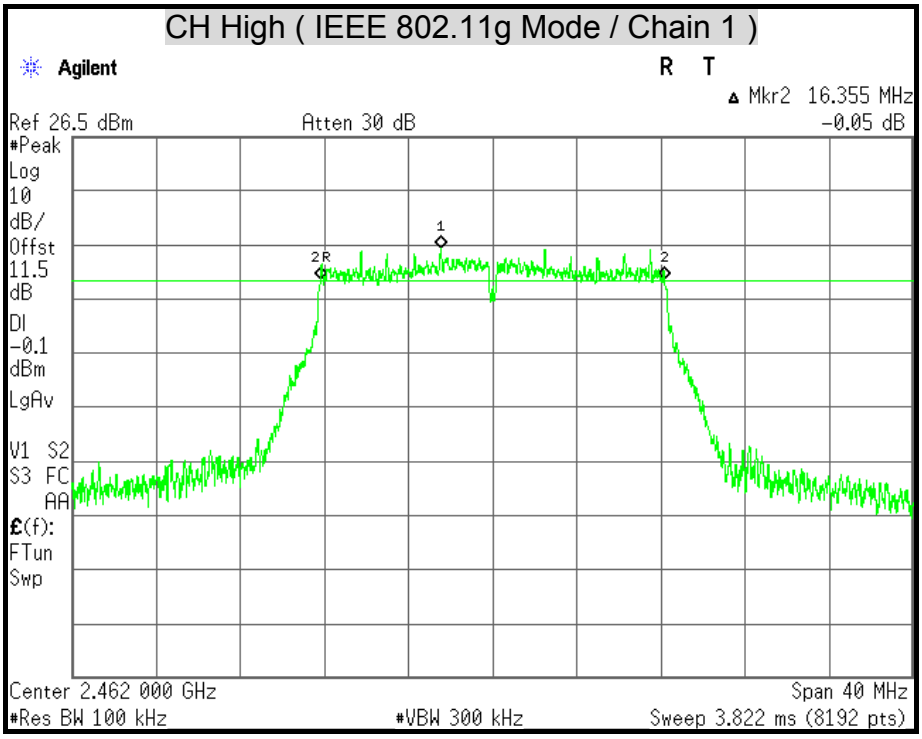

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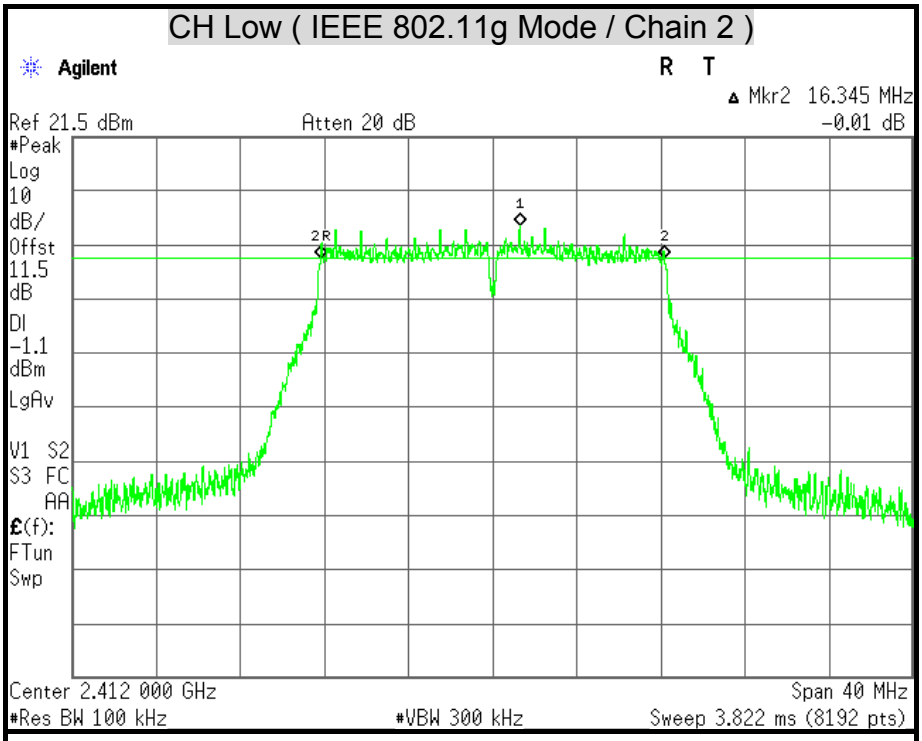

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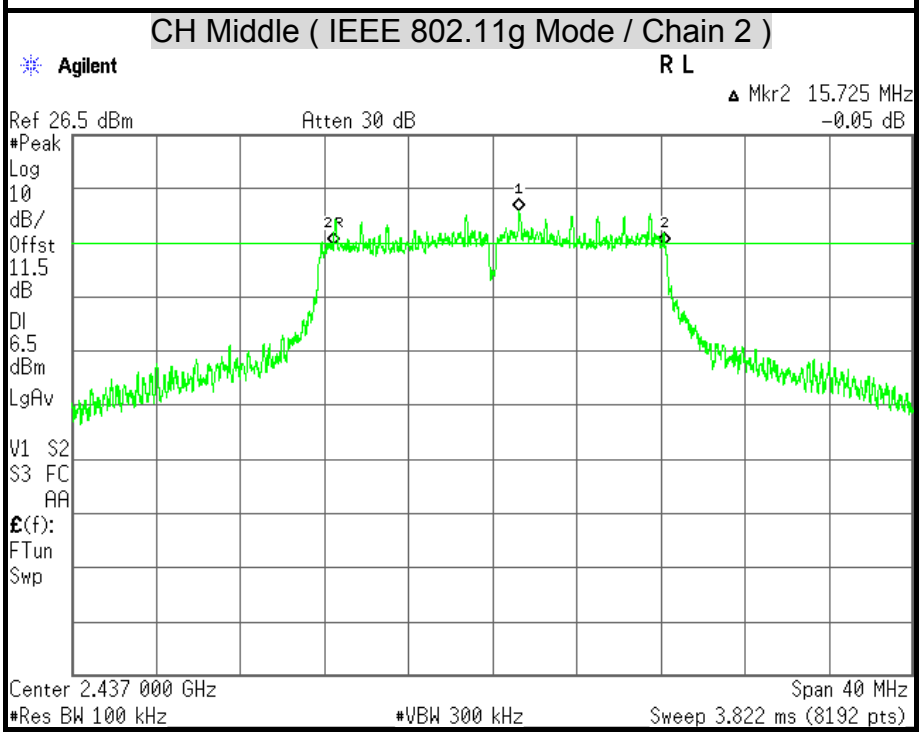

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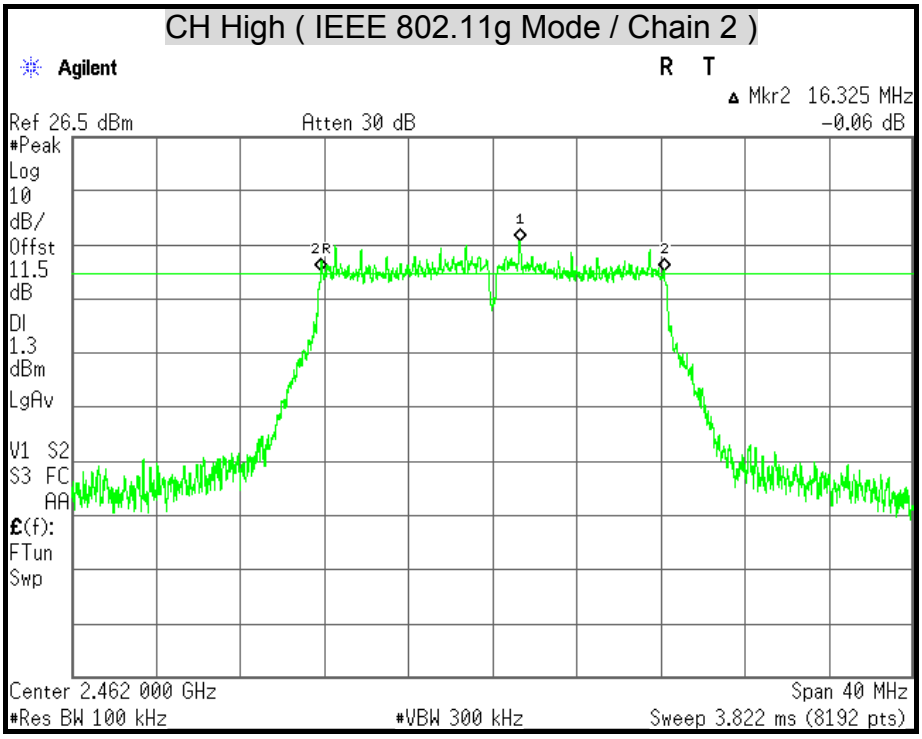
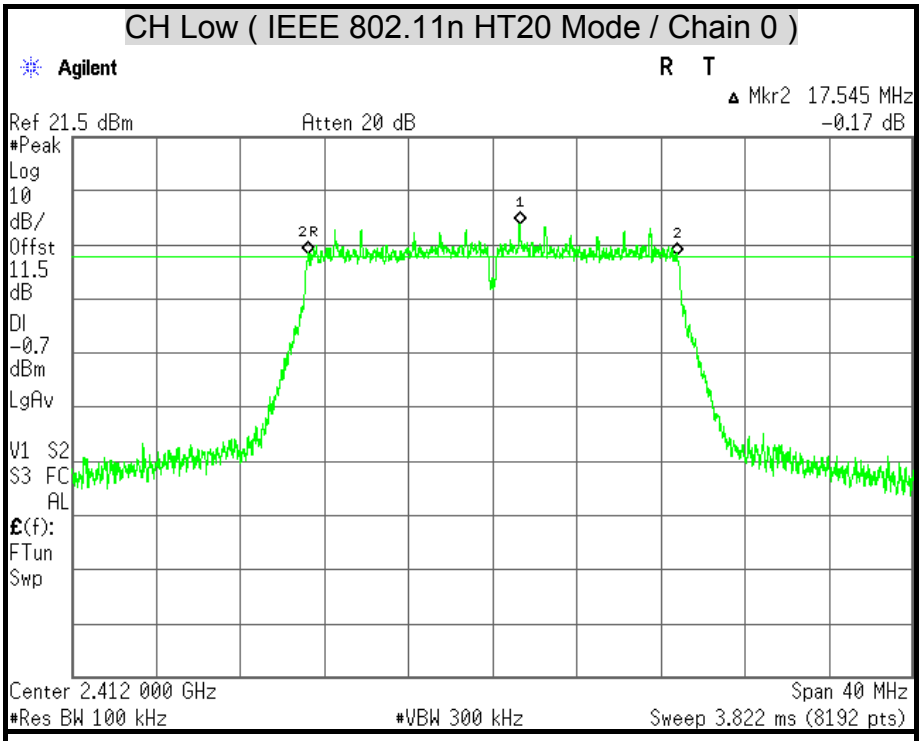


CH Low (IEEE 802.11n HT20 Mode / Chain 0)



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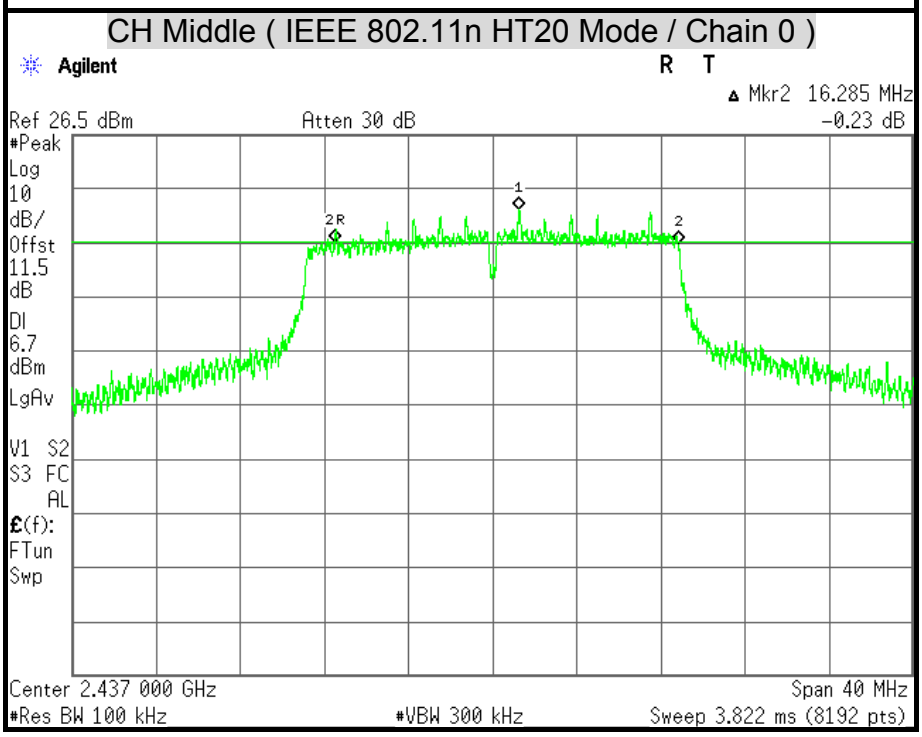

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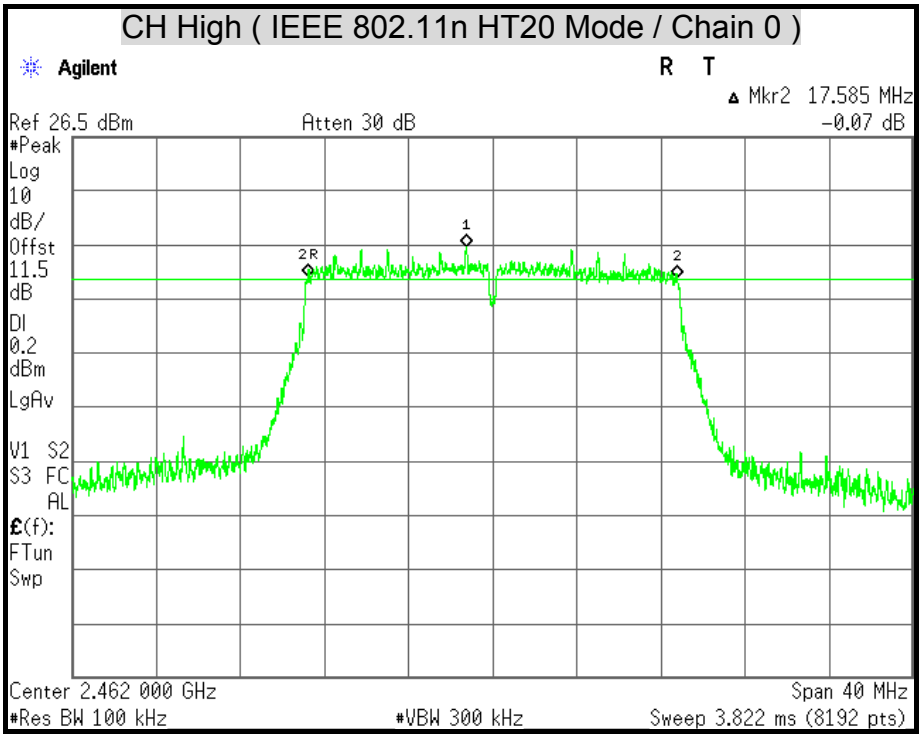

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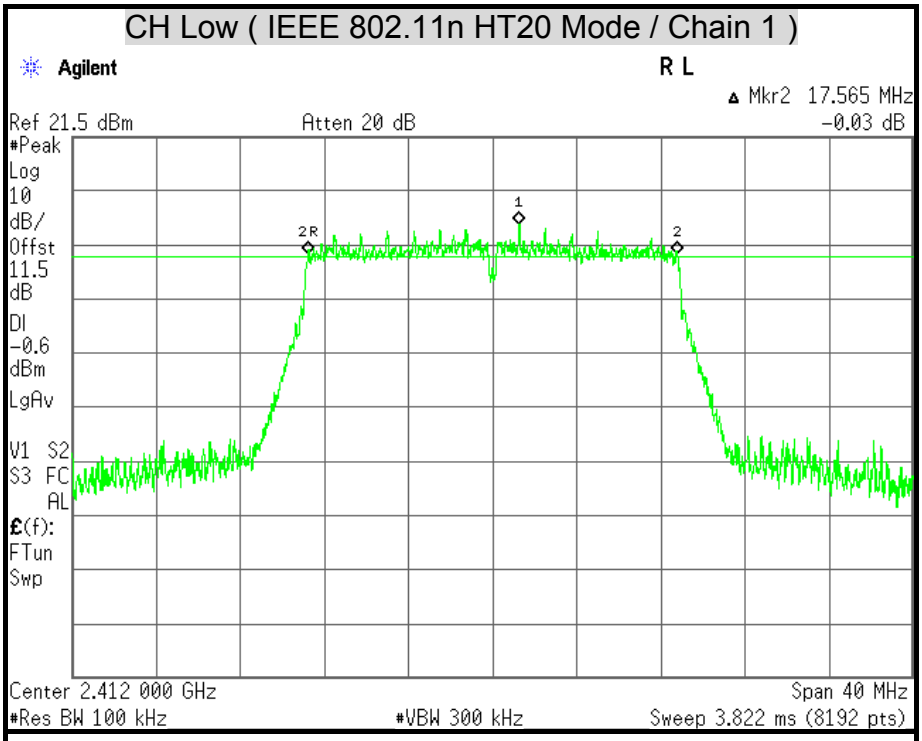

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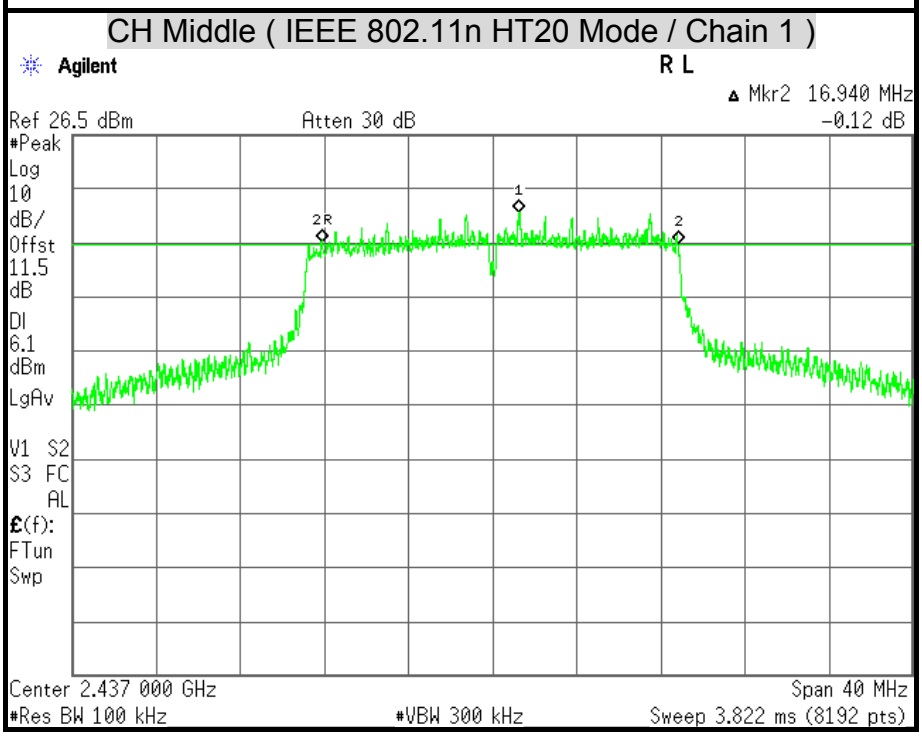

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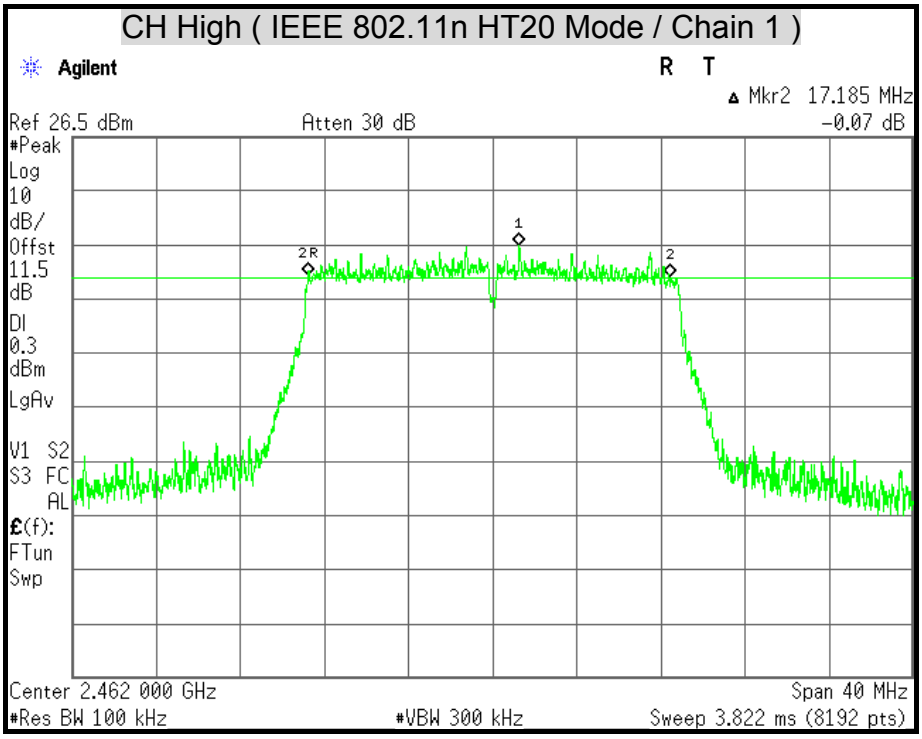

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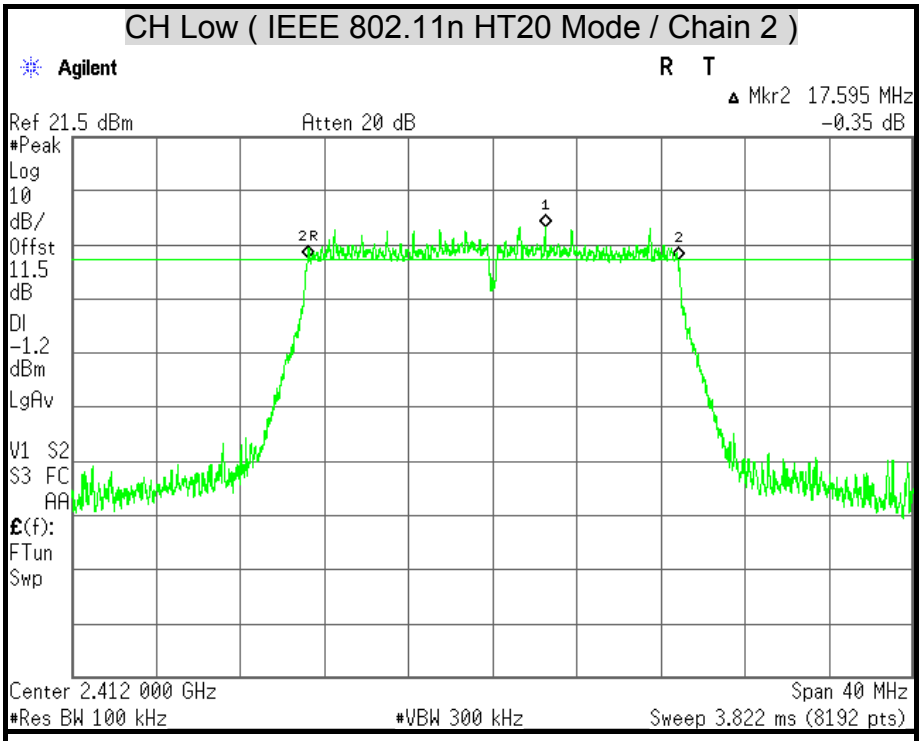

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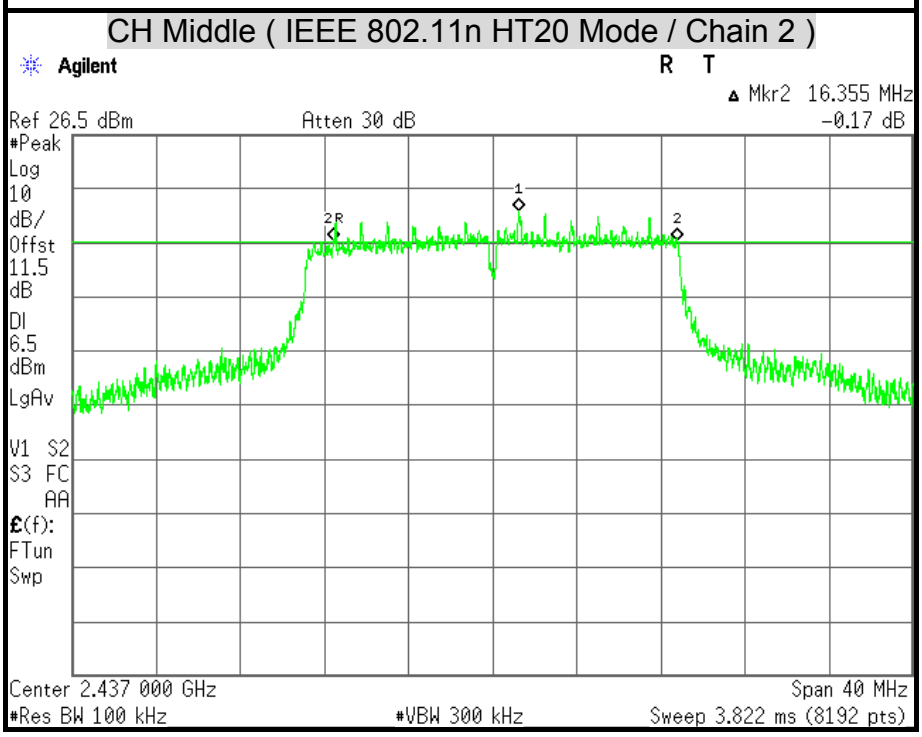

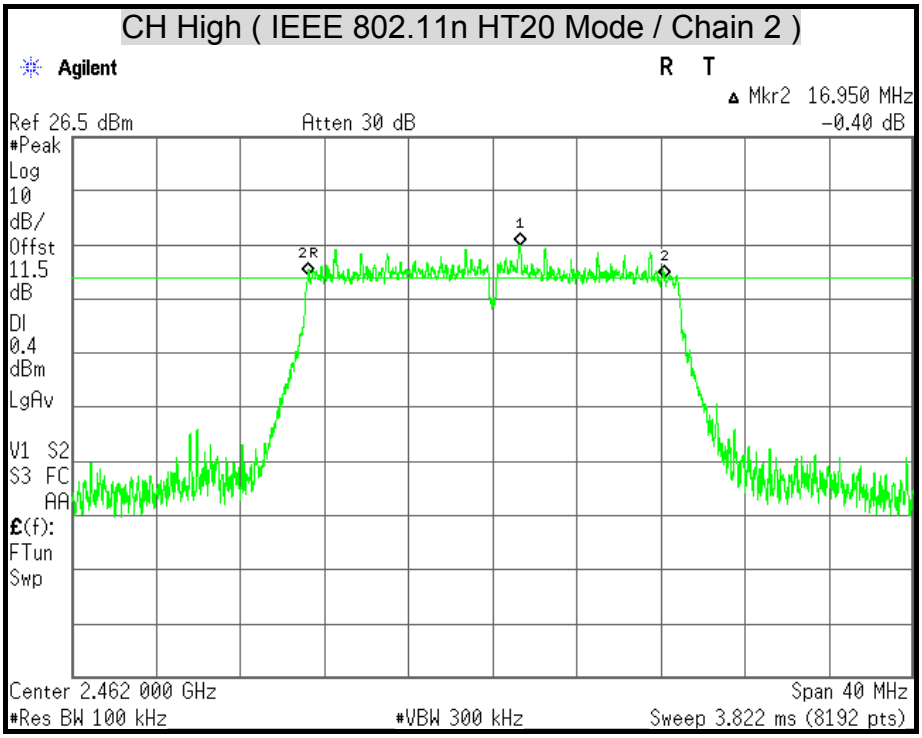

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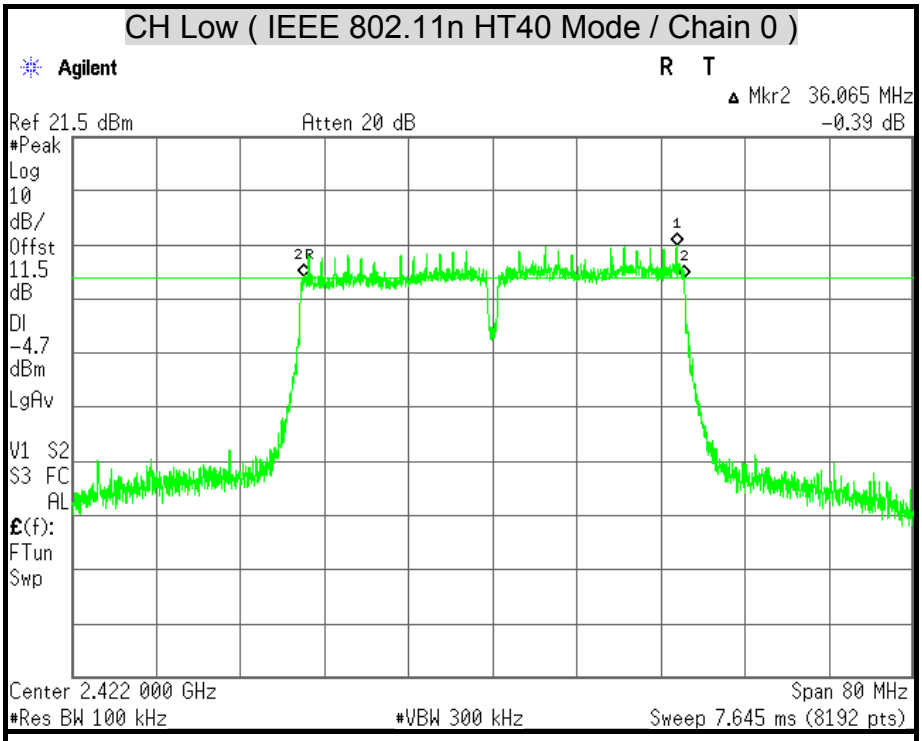

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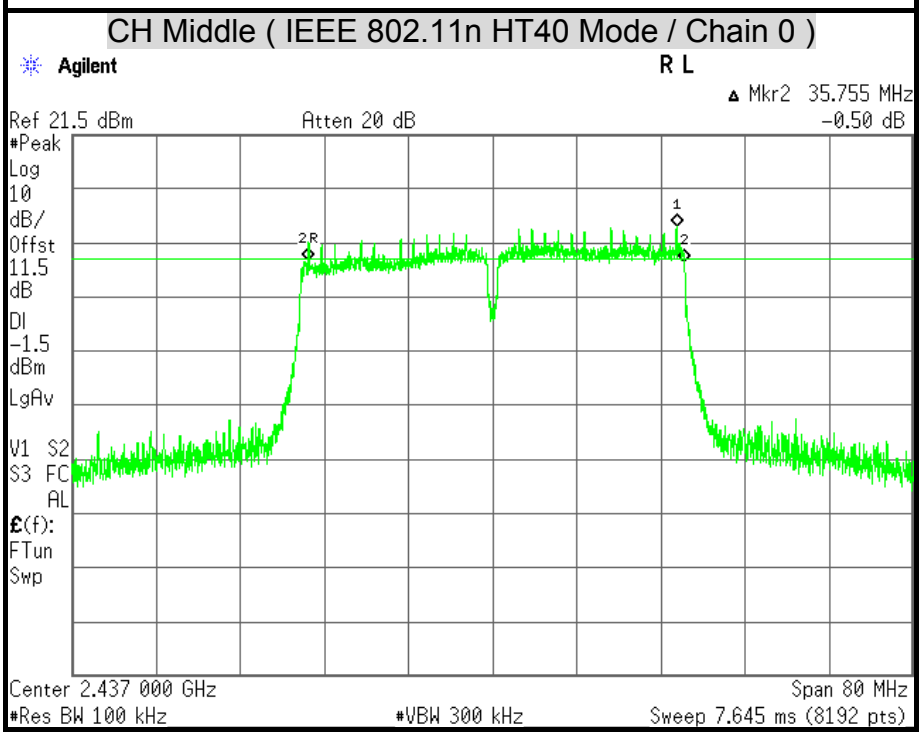
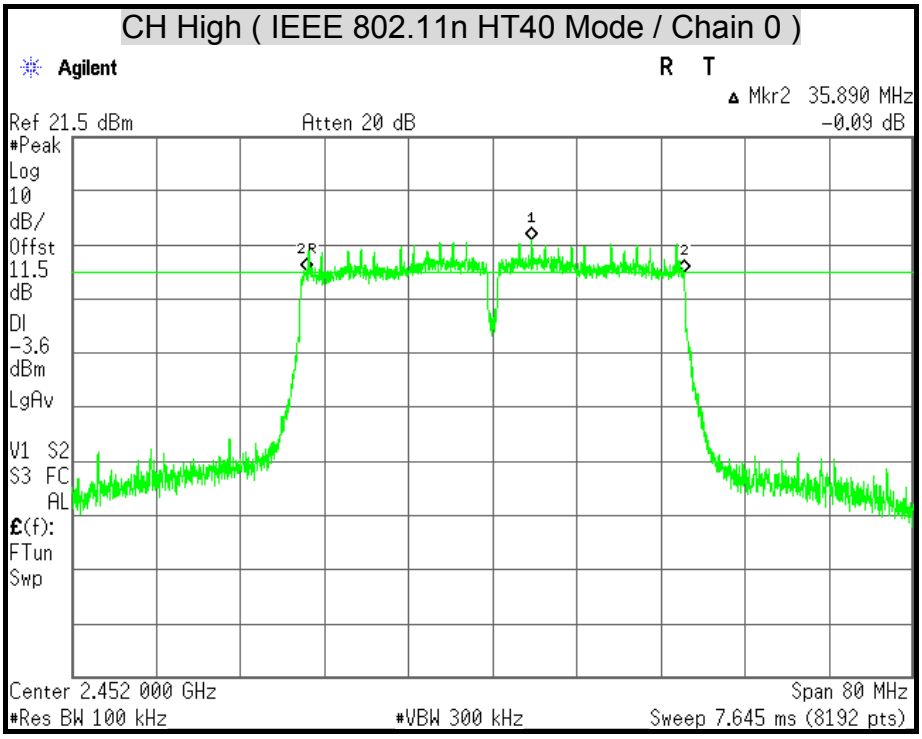
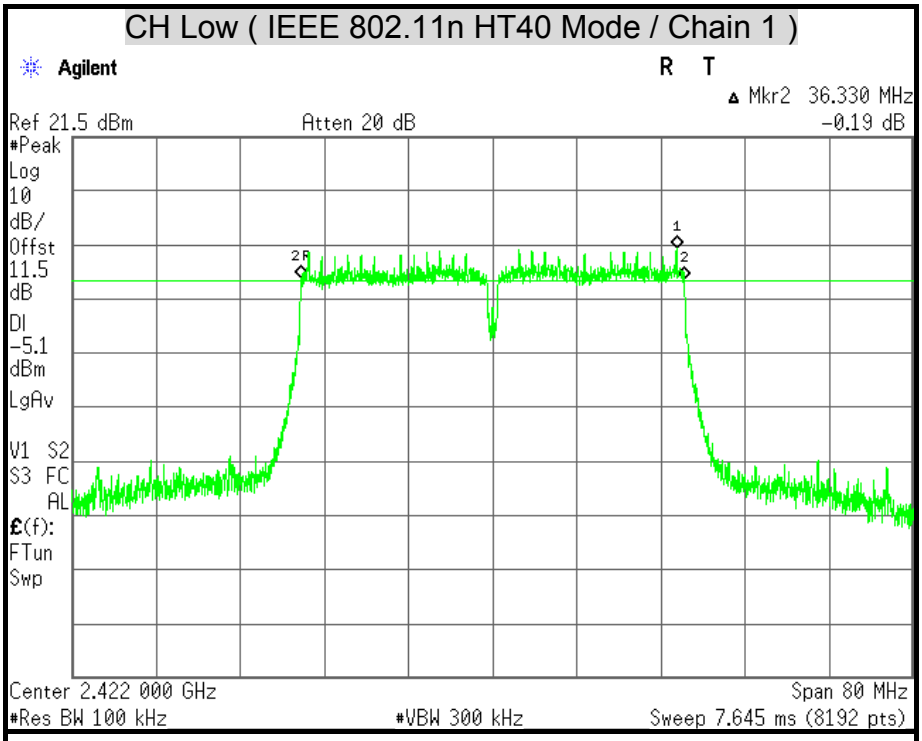


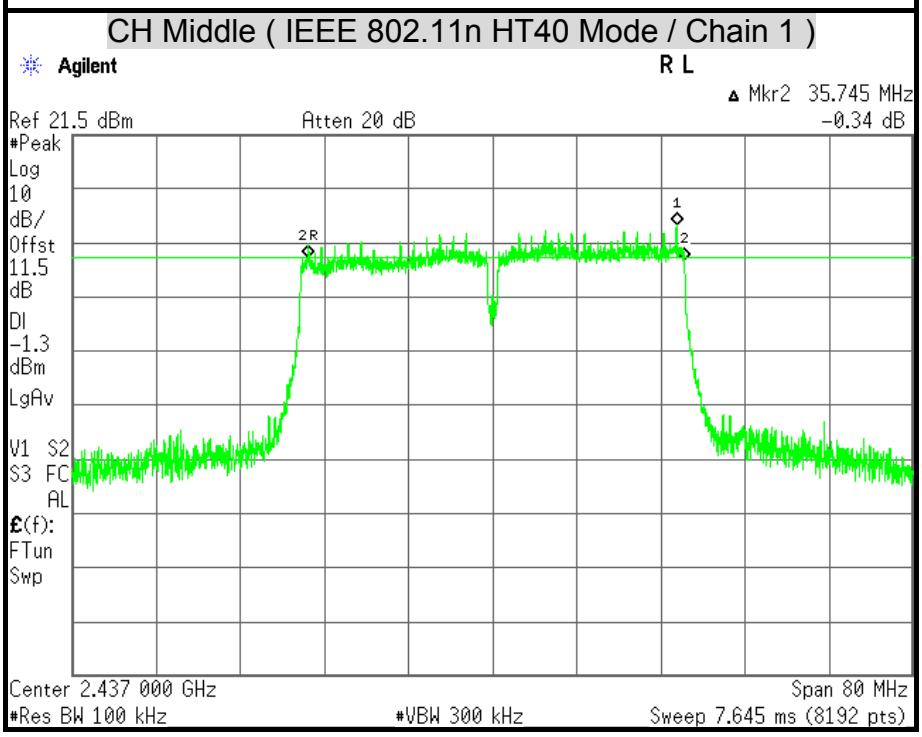
CH High (IEEE 802.11n HT40 Mode / Chain 0)

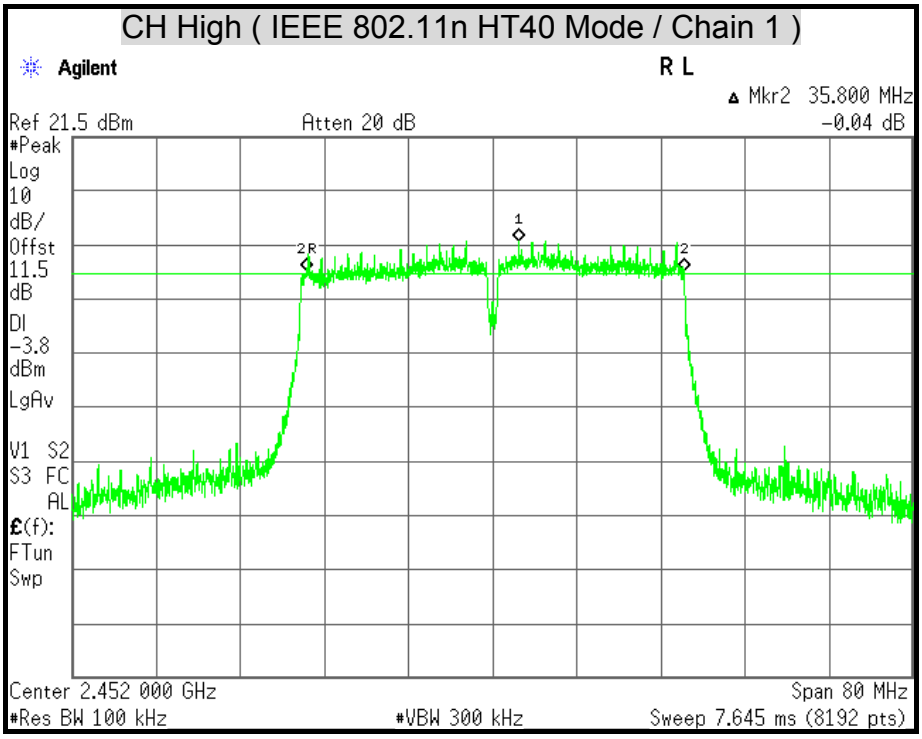


CH Low (IEEE 802.11n HT40 Mode / Chain 1)

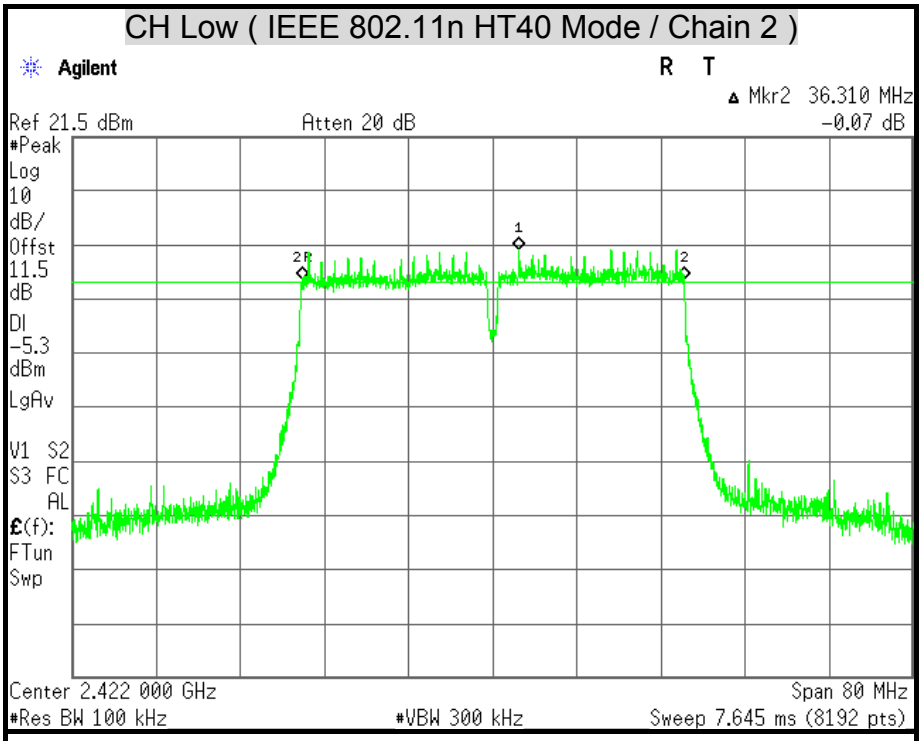


CH Middle (IEEE 802.11n HT40 Mode / Chain 1)





CH Low (IEEE 802.11n HT40 Mode / Chain 2)



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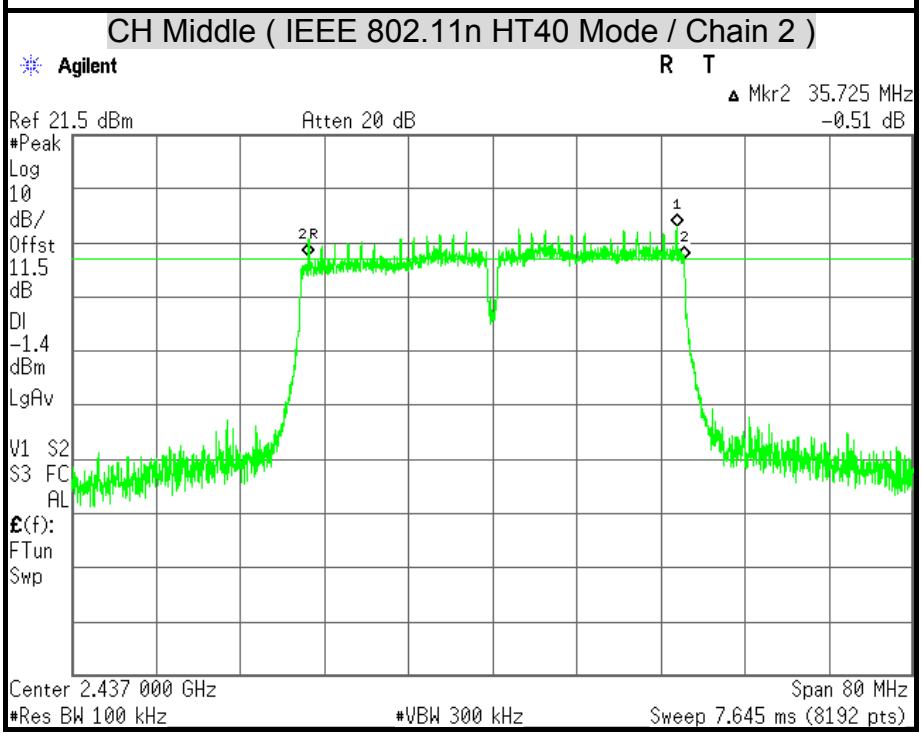

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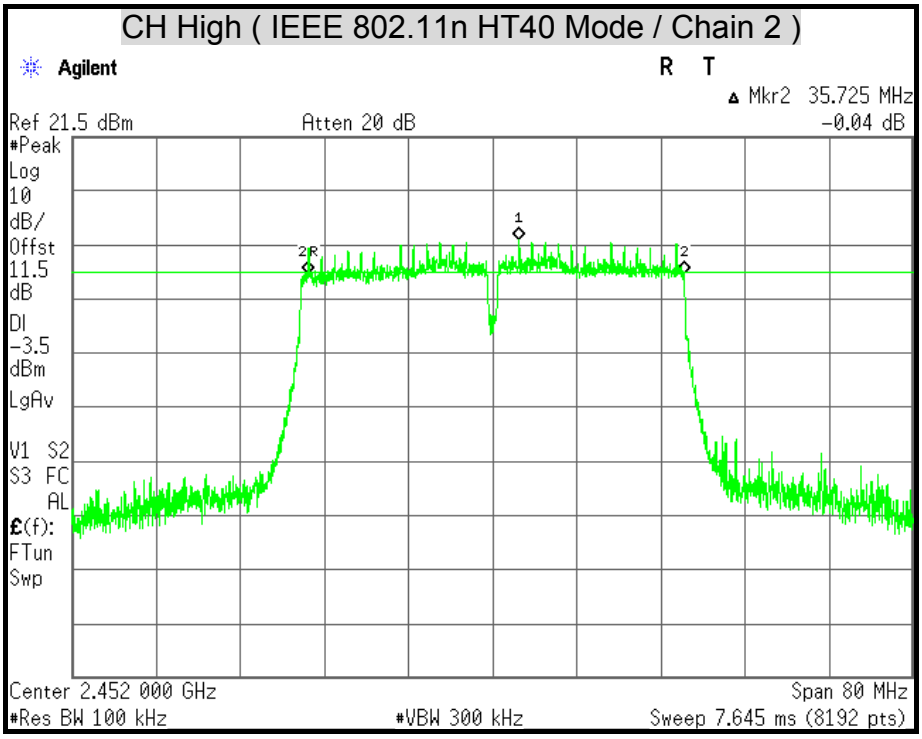
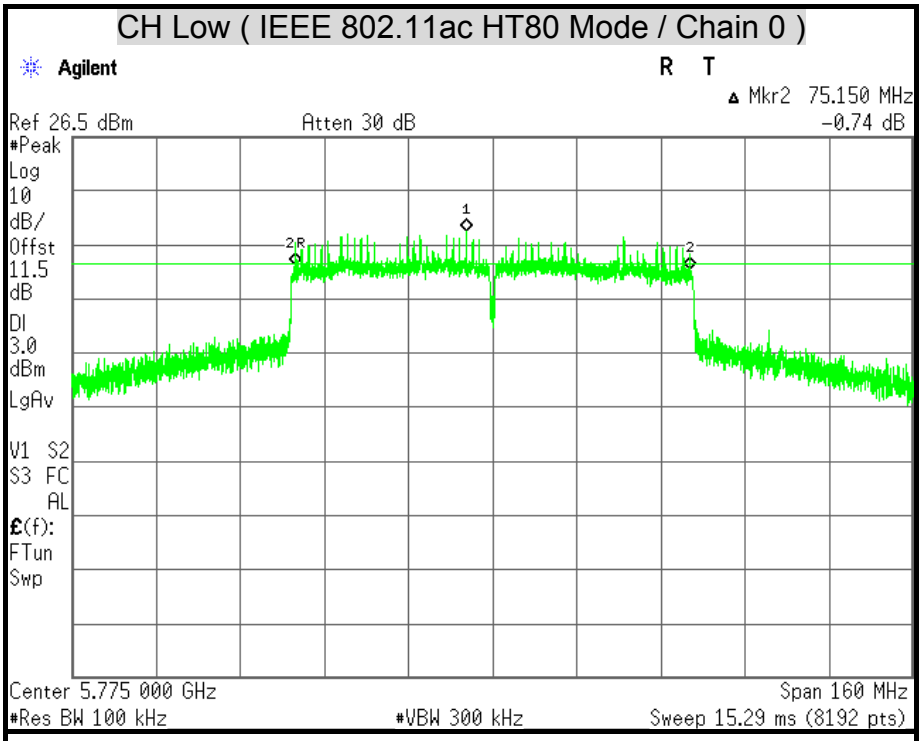


CH Low (IEEE 802.11ac HT80 Mode / Chain 0)



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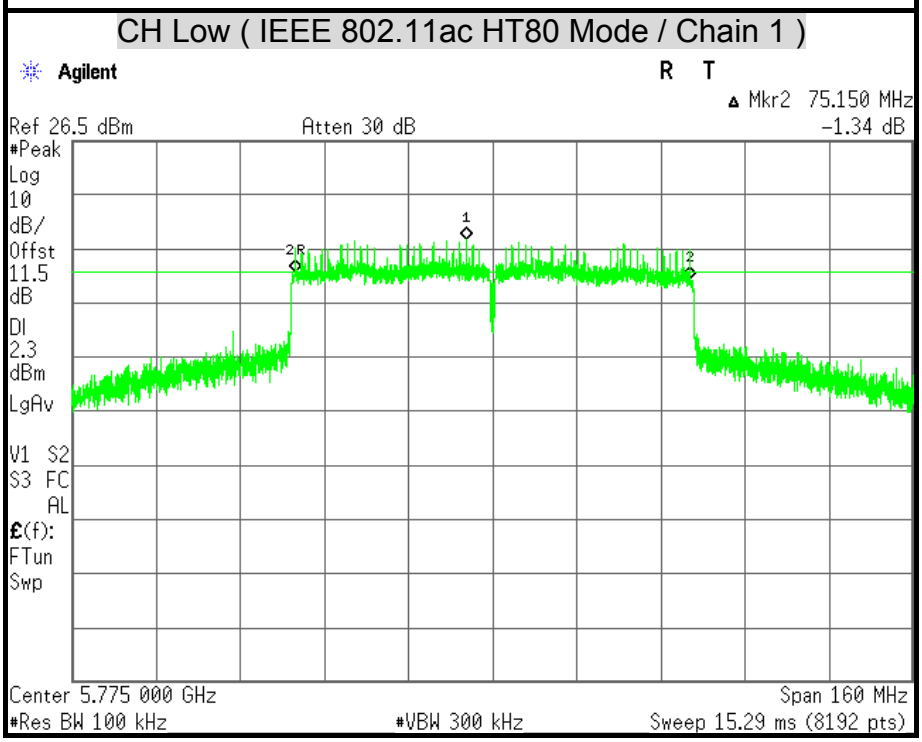
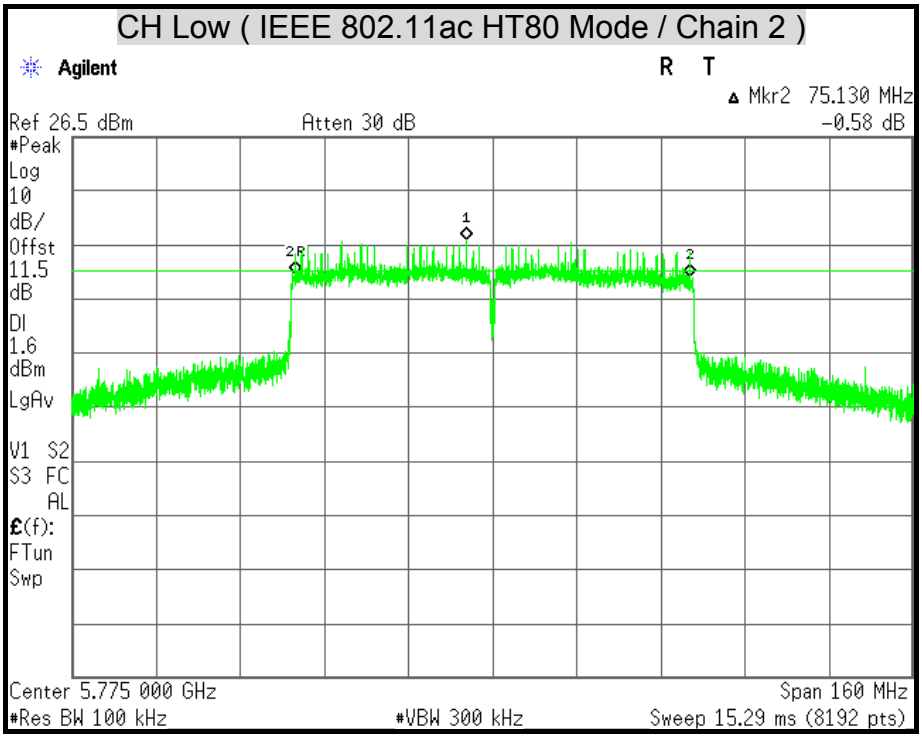


CH Low (IEEE 802.11ac HT80 Mode / Chain 2)



7.2 MAXIMUM OUTPUT POWER

LIMITS

§ 15.247(b) The maximum peak output power of the intentional radiator shall not exceed the following :

§ 15.247(b) (3) For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands : 1 watt.

§ 15.247(b) (4) Except as shown in paragraphs (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used the peak output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1) or (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

§ KDB 662911 : For power measurements on IEEE 802.11 devices

Array Gain = 0 dB (i.e., no array gain) for $N_{ANT} \leq 4$;

Array Gain = 0 dB (i.e., no array gain) for channel widths ≥ 40 MHz for any N_{ANT} ;

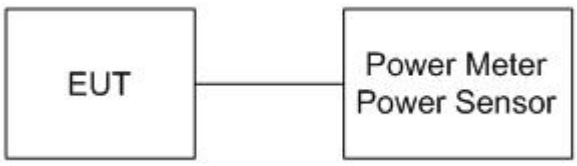
Array Gain = 5 log(N_{ANT}/N_{SS}) dB or 3 dB, whichever is less, for 20-MHz channel widths with $N_{ANT} \geq 5$.

TEST EQUIPMENT

Name of Equipment	Manufacturer	Model	Serial Number	Calibration Due
Power Meter	Anritsu	ML2495A	1149001	12/06/2013
Power Sensor	Anritsu	MA2411B	1126148	12/07/2013

Remark: *Each piece of equipment is scheduled for calibration once a year.*

TEST SETUP



TEST PROCEDURE

The transmitter output is connected to the Power Meter. The Power Meter is set to the power detection.

TEST RESULTS

IEEE 802.11a Mode (Three TX)

Channel	Channel Frequency (MHz)	Power (dBm)			Total Power		Power Limit		Pass / Fail
		Chain 0	Chain 1	Chain 2	(dBm)	(W)	(dBm)	(W)	
Low	5745	24.24	23.70	23.00	28.45	0.6994	30	1	PASS
Middle	5785	24.20	23.88	23.10	28.52	0.7115	30	1	PASS
High	5825	24.23	23.72	22.56	28.33	0.6807	30	1	PASS

Remark:

1. *At finial test to get the worst-case emission at 6Mbps.*
2. *The cable assembly insertion loss of 11.5 dB (including 10 dB pad and 1.5 dB cable) was Entered as an offset in the power meter to allow for direct reading of power.*
3. *Array gain = 0 dB for $N_{ANT} \leq 4$, power limit do not reduce.*
4. *Total power = Chain 0 + Chain 1 + Chain 2.*

IEEE 802.11an HT20 Mode (Three TX)

Channel	Channel Frequency (MHz)	Power (dBm)			Total Power		Power Limit		Pass / Fail
		Chain 0	Chain 1	Chain 2	(dBm)	(W)	(dBm)	(W)	
Low	5745	24.36	24.18	23.64	28.84	0.7659	30	1	PASS
Middle	5785	24.56	24.16	23.21	28.78	0.7558	30	1	PASS
High	5825	24.16	23.94	23.25	28.57	0.7197	30	1	PASS

Remark:

1. *At finial test to get the worst-case emission at 6.5Mbps.*
2. *The cable assembly insertion loss of 11.5 dB (including 10 dB pad and 1.5 dB cable) was Entered as an offset in the power meter to allow for direct reading of power.*
3. *Array gain = 0 dB for $N_{ANT} \leq 4$, power limit do not reduce.*
4. *Total power = Chain 0 + Chain 1 + Chain 2.*

IEEE 802.11an HT40 Mode (Three TX)

Channel	Channel Frequency (MHz)	Power (dBm)			Total Power		Power Limit		Pass / Fail
		Chain 0	Chain 1	Chain 2	(dBm)	(W)	(dBm)	(W)	
Low	5755	24.14	24.07	23.15	28.58	0.7212	30	1	PASS
High	5795	24.13	23.85	23.17	28.51	0.7090	30	1	PASS

Remark:

1. *At finial test to get the worst-case emission at 13.5Mbps.*
2. *The cable assembly insertion loss of 11.5 dB (including 10 dB pad and 1.5 dB cable) was Entered as an offset in the power meter to allow for direct reading of power.*
3. *Array gain = 0 dB for $N_{ANT} \leq 4$, power limit do not reduce.*
4. *Total power = Chain 0 + Chain 1 + Chain 2.*

IEEE 802.11b Mode (Three TX)

Channel	Channel Frequency (MHz)	Power (dBm)			Total Power		Power Limit		Pass / Fail
		Chain 0	Chain 1	Chain 2	(dBm)	(W)	(dBm)	(W)	
Low	2412	14.34	14.40	14.48	19.18	0.0828	30	1	PASS
Middle	2437	18.67	18.26	18.21	23.16	0.2068	30	1	PASS
High	2462	15.32	15.19	15.18	20.00	0.1000	30	1	PASS

Remark:

1. At finial test to get the worst-case emission at 1Mbps.
2. The cable assembly insertion loss of 11.5 dB (including 10 dB pad and 1.5 dB cable) was Entered as an offset in the power meter to allow for direct reading of power.
3. Array gain = 0 dB for $N_{ANT} \leq 4$, power limit do not reduce.
4. Total power = Chain 0 + Chain 1 + Chain 2.

IEEE 802.11g Mode (Three TX)

Channel	Channel Frequency (MHz)	Power (dBm)			Total Power		Power Limit		Pass / Fail
		Chain 0	Chain 1	Chain 2	(dBm)	(W)	(dBm)	(W)	
Low	2412	16.21	16.12	16.15	20.93	0.1239	30	1	PASS
Middle	2437	22.70	22.50	22.58	27.37	0.5452	30	1	PASS
High	2462	18.05	17.81	17.84	22.67	0.1850	30	1	PASS

Remark:

1. At finial test to get the worst-case emission at 6Mbps.
2. The cable assembly insertion loss of 11.5 dB (including 10 dB pad and 1.5 dB cable) was Entered as an offset in the power meter to allow for direct reading of power.
3. Array gain = 0 dB for $N_{ANT} \leq 4$, power limit do not reduce.
4. Total power = Chain 0 + Chain 1 + Chain 2.

IEEE 802.11n HT20 Mode (Three TX)

Channel	Channel Frequency (MHz)	Power (dBm)			Total Power		Power Limit		Pass / Fail
		Chain 0	Chain 1	Chain 2	(dBm)	(W)	(dBm)	(W)	
Low	2412	16.28	16.19	16.17	20.98	0.1255	30	1	PASS
Middle	2437	22.73	22.51	22.64	27.40	0.5494	30	1	PASS
High	2462	17.55	17.42	17.28	22.19	0.1655	30	1	PASS

Remark:
1. *At finial test to get the worst-case emission at 6.5Mbps.*
2. *The cable assembly insertion loss of 11.5 dB (including 10 dB pad and 1.5 dB cable) was Entered as an offset in the power meter to allow for direct reading of power.*
3. *Array gain = 0 dB for $N_{ANT} \leq 4$, power limit do not reduce.*
4. *Total power = Chain 0 + Chain 1 + Chain 2.*

IEEE 802.11n HT40 Mode (Three TX)

Channel	Channel Frequency (MHz)	Power (dBm)			Total Power		Power Limit		Pass / Fail
		Chain 0	Chain 1	Chain 2	(dBm)	(W)	(dBm)	(W)	
Low	2422	15.03	14.70	14.72	19.59	0.0910	30	1	PASS
Middle	2437	17.85	17.73	17.79	22.56	0.1804	30	1	PASS
High	2452	16.37	16.08	16.23	21.00	0.1259	30	1	PASS

Remark:
1. *At finial test to get the worst-case emission at 13.55Mbps.*
2. *The cable assembly insertion loss of 11.5 dB (including 10 dB pad and 1.5 dB cable) was Entered as an offset in the power meter to allow for direct reading of power.*
3. *Array gain = 0 dB for $N_{ANT} \leq 4$, power limit do not reduce.*
4. *Total power = Chain 0 + Chain 1 + Chain 2.*

IEEE 802.11ac HT80 Mode (Three TX)

Channel	Channel Frequency (MHz)	Power (dBm)			Total Power		Power Limit		Pass / Fail
		Chain 0	Chain 1	Chain 2	(dBm)	(W)	(dBm)	(W)	
Low	5775	24.15	23.82	22.53	28.33	0.6801	30	1	PASS

Remark:
1. *At finial test to get the worst-case emission at 29.3Mbps.*
2. *The cable assembly insertion loss of 11.5 dB (including 10 dB pad and 1.5 dB cable) was Entered as an offset in the power meter to allow for direct reading of power.*
3. *Array gain = 0 dB for $N_{ANT} \leq 4$, power limit do not reduce.*
4. *Total power = Chain 0 + Chain 1 + Chain 2.*

7.3 POWER SPECTRAL DENSITY

LIMITS

§ 15.247(e) For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

§ KDB 662911 :

Cross-polarized antennas with N_{ANT} = 2. In the case of a transmitter with only two outputs driving antennas that are cross-polarized (e.g., vertical and horizontal or left-circular and right-circular), directional gain is the gain of an individual antenna.

TEST EQUIPMENT

Name of Equipment	Manufacturer	Model	Serial Number	Calibration Due
Spectrum Analyzer	Agilent	E4446A	MY43360132	06/10/2014

Remark: *Each piece of equipment is scheduled for calibration once a year.*

TEST SETUP

TEST PROCEDURE

1. The transmitter output was connected to the spectrum analyzer.
2. Set analyzer center frequency to DTS channel center frequency.
3. Set the span to 1.5 times the DTS channel bandwidth.
4. Set the RBW to: 3 kHz ≤ RBW ≤ 100 kHz.
5. Set the VBW ≥ 3 x RBW.
6. Detector = peak.
7. Sweep time = auto couple.
8. Trace mode = max hold.
9. Allow trace to fully stabilize.
10. Use the peak marker function to determine the maximum amplitude level within the RBW.
11. If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

TEST RESULTS

IEEE 802.11a Mode (Three TX)

Channel	Channel Frequency (MHz)	Final RF Power Level in 3KHz BW (dBm)			PSD Total (dBm)	Minimum Limit (dBm)	Pass / Fail
		Chain 0	Chain 1	Chain 2			
Low	5745	-1.05	-1.34	-1.04	3.63	7.41	PASS
Middle	5785	-1.85	-0.25	-1.91	3.51	7.41	PASS
High	5825	-1.12	-2.09	-1.56	3.20	7.41	PASS

Remark:

1. *At finial test to get the worst-case emission at 6Mbps.*
2. *The cable assembly insertion loss of 11.5 dB (including 10 dB pad and 1.5 dB cable) was Entered as an offset in the spectrum analyzer to allow for direct reading of power.*
3. *The Directional gain = G_{ANT} + Array Gain = 6.59dBi which is more than 6dBi, the limit should be 7.41dBm.*
4. *Total power spectral density = Chain 0 + Chain 1 + Chain 2.*

IEEE 802.11an HT20 Mode (Three TX)

Channel	Channel Frequency (MHz)	Final RF Power Level in 3KHz BW (dBm)			PSD Total (dBm)	Minimum Limit (dBm)	Pass / Fail
		Chain 0	Chain 1	Chain 2			
Low	5745	-1.16	-0.71	-1.95	3.53	7.41	PASS
Middle	5785	-1.37	-1.87	-2.05	3.02	7.41	PASS
High	5825	-2.09	-0.81	-2.81	2.95	7.41	PASS

Remark:

1. *At finial test to get the worst-case emission at 6.5Mbps.*
2. *The cable assembly insertion loss of 11.5 dB (including 10 dB pad and 1.5 dB cable) was Entered as an offset in the spectrum analyzer to allow for direct reading of power.*
3. *The Directional gain = G_{ANT} + Array Gain = 6.59dBi which is more than 6dBi, the limit should be 7.41dBm.*
4. *Total power spectral density = Chain 0 + Chain 1 + Chain 2.*

IEEE 802.11an HT40 Mode (Three TX)

Channel	Channel Frequency (MHz)	Final RF Power Level in 3KHz BW (dBm)			PSD Total (dBm)	Minimum Limit (dBm)	Pass / Fail
		Chain 0	Chain 1	Chain 2			
Low	5755	-3.94	-3.80	-5.42	0.44	7.41	PASS
High	5795	-4.01	-4.86	-4.79	0.24	7.41	PASS

Remark:

1. At finial test to get the worst-case emission at 13.5Mbps.

2. The cable assembly insertion loss of 11.5 dB (including 10 dB pad and 1.5 dB cable) was Entered as an offset in the spectrum analyzer to allow for direct reading of power.

3. The Directional gain = G_{ANT} + Array Gain = 6.59dBi which is more than 6dBi, the limit should be 7.41dBm.

4. Total power spectral density = Chain 0 + Chain 1 + Chain 2.

IEEE 802.11b Mode (Three TX)

Channel	Channel Frequency (MHz)	Final RF Power Level in 3KHz BW (dBm)			PSD Total (dBm)	Minimum Limit (dBm)	Pass / Fail
		Chain 0	Chain 1	Chain 2			
Low	2412	-7.50	-9.44	-8.77	-3.72	8	PASS
Middle	2437	-4.00	-4.44	-4.05	0.61	8	PASS
High	2462	-7.00	-7.17	-7.10	-2.32	8	PASS

Remark:

1. *At finial test to get the worst-case emission at 1Mbps.*
2. *The cable assembly insertion loss of 11.5 dB (including 10 dB pad and 1.5 dB cable) was Entered as an offset in the spectrum analyzer to allow for direct reading of power.*
3. *The Directional gain = G_{ANT} + Array Gain = 5.85dBi which is less than 6dBi, the limit should be 8dBm.*
4. *Total power spectral density = Chain 0 + Chain 1 + Chain 2.*

IEEE 802.11g Mode (Three TX)

Channel	Channel Frequency (MHz)	Final RF Power Level in 3KHz BW (dBm)			PSD Total (dBm)	Minimum Limit (dBm)	Pass / Fail
		Chain 0	Chain 1	Chain 2			
Low	2412	-8.05	-9.40	-8.07	-3.69	8	PASS
Middle	2437	-1.47	3.11	-1.99	5.30	8	PASS
High	2462	-7.34	-7.55	-7.09	-2.55	8	PASS

Remark:

1. *At finial test to get the worst-case emission at 6Mbps.*
2. *The cable assembly insertion loss of 11.5 dB (including 10 dB pad and 1.5 dB cable) was Entered as an offset in the spectrum analyzer to allow for direct reading of power.*
3. *The Directional gain = G_{ANT} + Array Gain = 5.85dBi which is less than 6dBi, the limit should be 8dBm.*
4. *Total power spectral density = Chain 0 + Chain 1 + Chain 2.*

IEEE 802.11n HT20 Mode (Three TX)

Channel	Channel Frequency (MHz)	Final RF Power Level in 3KHz BW (dBm)			PSD Total (dBm)	Minimum Limit (dBm)	Pass / Fail
		Chain 0	Chain 1	Chain 2			
Low	2412	-8.13	-9.98	-9.94	-4.49	8	PASS
Middle	2437	-2.90	-2.05	-2.92	2.17	8	PASS
High	2462	-8.15	-7.91	-8.51	-3.41	8	PASS

Remark:

1. *At finial test to get the worst-case emission at 6.5Mbps.*
2. *The cable assembly insertion loss of 11.5 dB (including 10 dB pad and 1.5 dB cable) was Entered as an offset in the spectrum analyzer to allow for direct reading of power.*
3. *The Directional gain = G_{ANT} + Array Gain = 5.85dBi which is less than 6dBi, the limit should be 8dBm.*
4. *Total power spectral density = Chain 0 + Chain 1 + Chain 2.*

IEEE 802.11n HT40 Mode (Three TX)

Channel	Channel Frequency (MHz)	Final RF Power Level in 3KHz BW (dBm)			PSD Total (dBm)	Minimum Limit (dBm)	Pass / Fail
		Chain 0	Chain 1	Chain 2			
Low	2422	-14.37	-13.79	-13.87	-9.23	8	PASS
Middle	2437	-10.37	-10.48	-10.82	-5.78	8	PASS
High	2452	-11.47	-12.31	-11.64	-7.02	8	PASS

Remark:

1. *At finial test to get the worst-case emission at 13.5Mbps.*
2. *The cable assembly insertion loss of 11.5 dB (including 10 dB pad and 1.5 dB cable) was Entered as an offset in the spectrum analyzer to allow for direct reading of power.*
3. *The Directional gain = G_{ANT} + Array Gain = 5.85dBi which is less than 6dBi, the limit should be 8dBm.*
4. *Total power spectral density = Chain 0 + Chain 1 + Chain 2.*

IEEE 802.11ac HT80 Mode (Three TX)

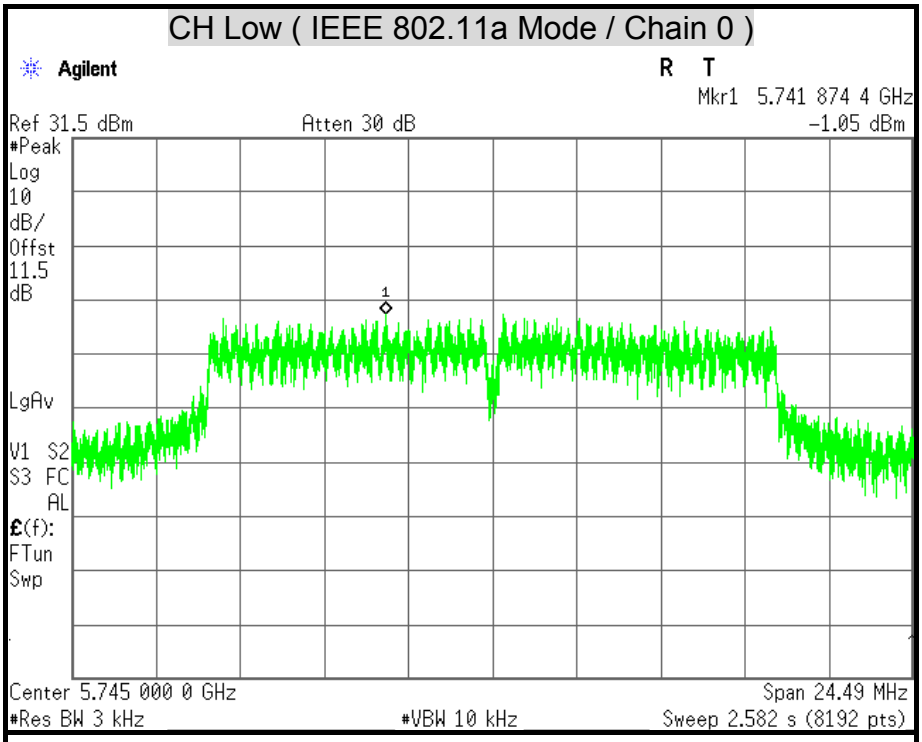
Channel	Channel Frequency (MHz)	Final RF Power Level in 3KHz BW (dBm)			PSD Total (dBm)	Minimum Limit (dBm)	Pass / Fail
		Chain 0	Chain 1	Chain 2			
Low	5775	-6.74	-6.58	-7.71	-2.21	7.41	PASS

Remark:

1. *At finial test to get the worst-case emission at 6Mbps.*
2. *The cable assembly insertion loss of 11.5 dB (including 10 dB pad and 1.5 dB cable) was Entered as an offset in the spectrum analyzer to allow for direct reading of power.*
3. *The Directional gain = G_{ANT} + Array Gain = 6.59dBi which is more than 6dBi, the limit should be 7.41dBm.*
4. *Total power spectral density = Chain 0 + Chain 1 + Chain 2.*

POWER SPECTRAL DENSITY

CH Low (IEEE 802.11a Mode / Chain 0)



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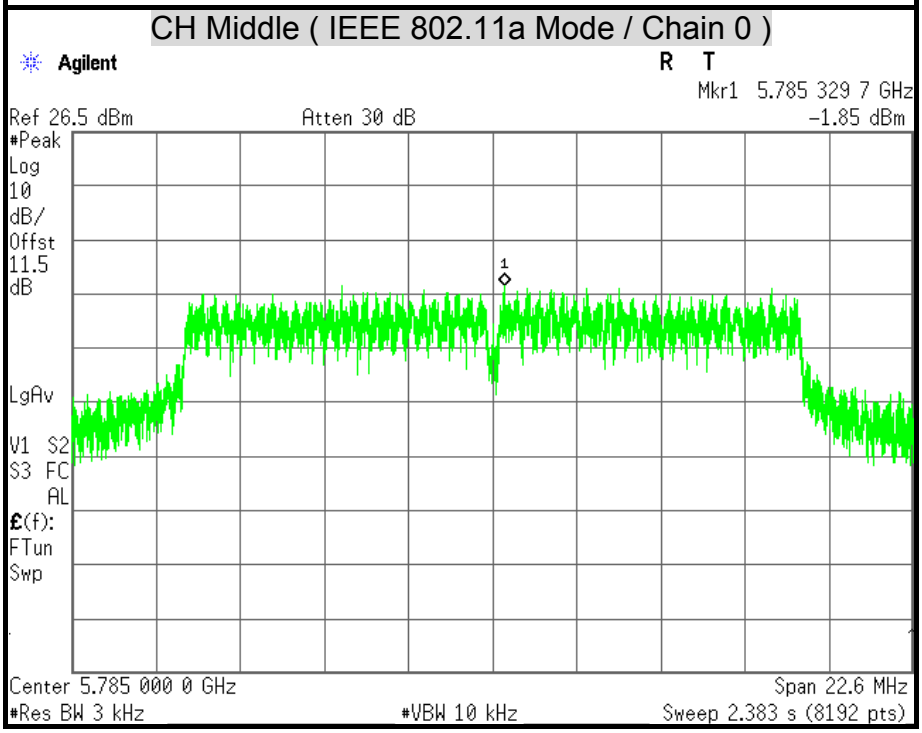

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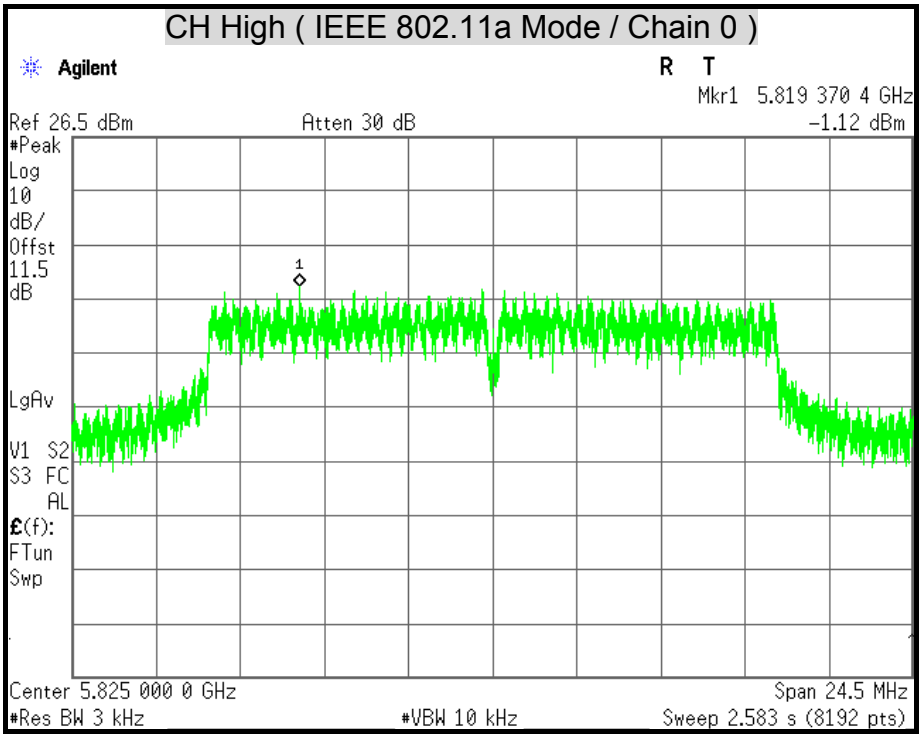

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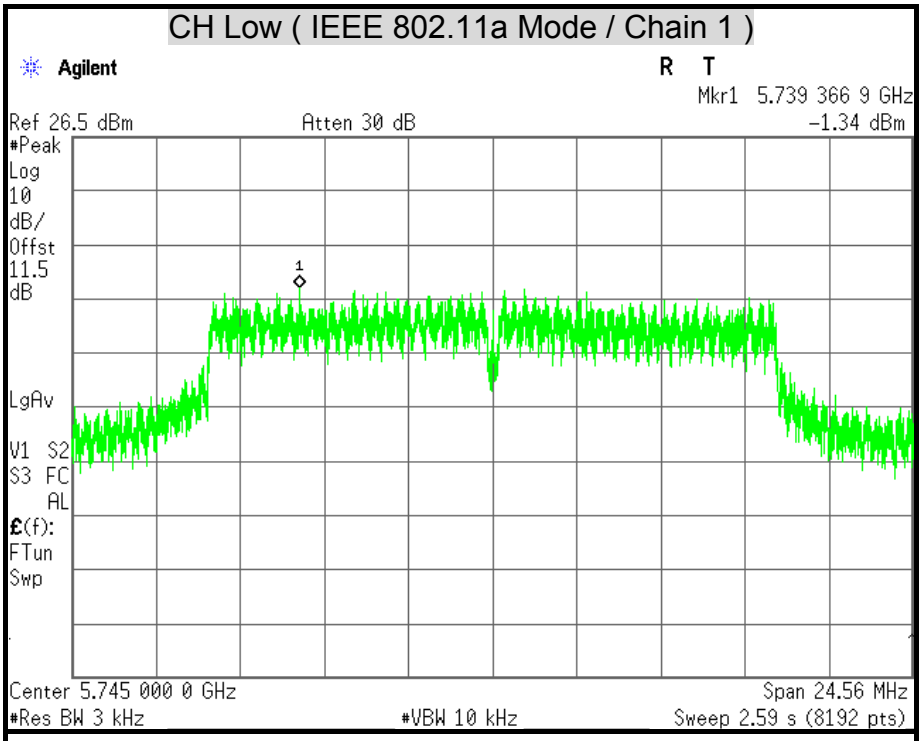

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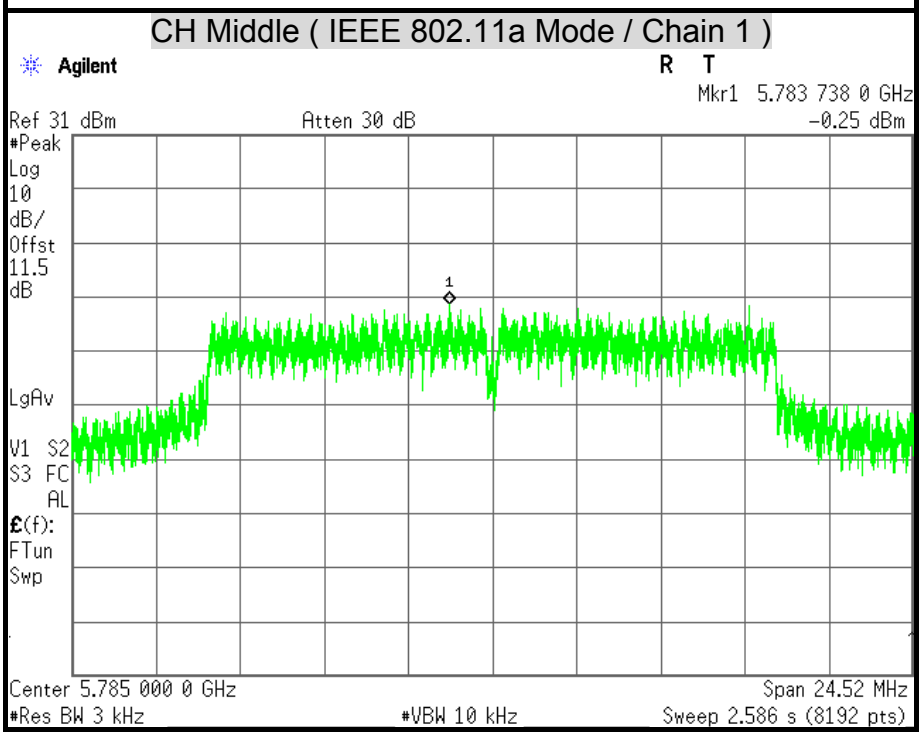

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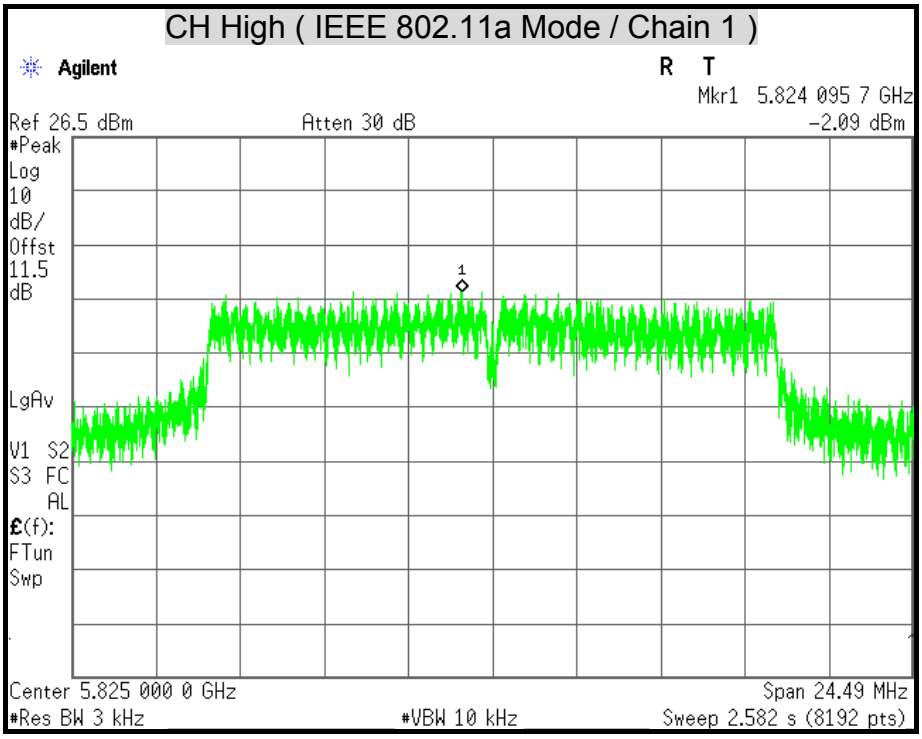

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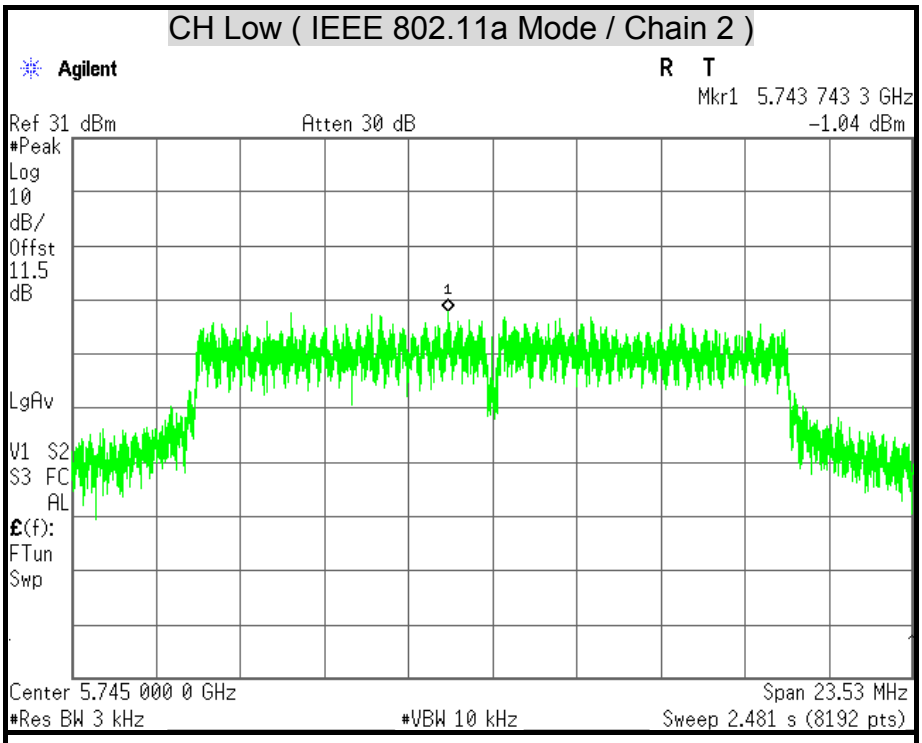

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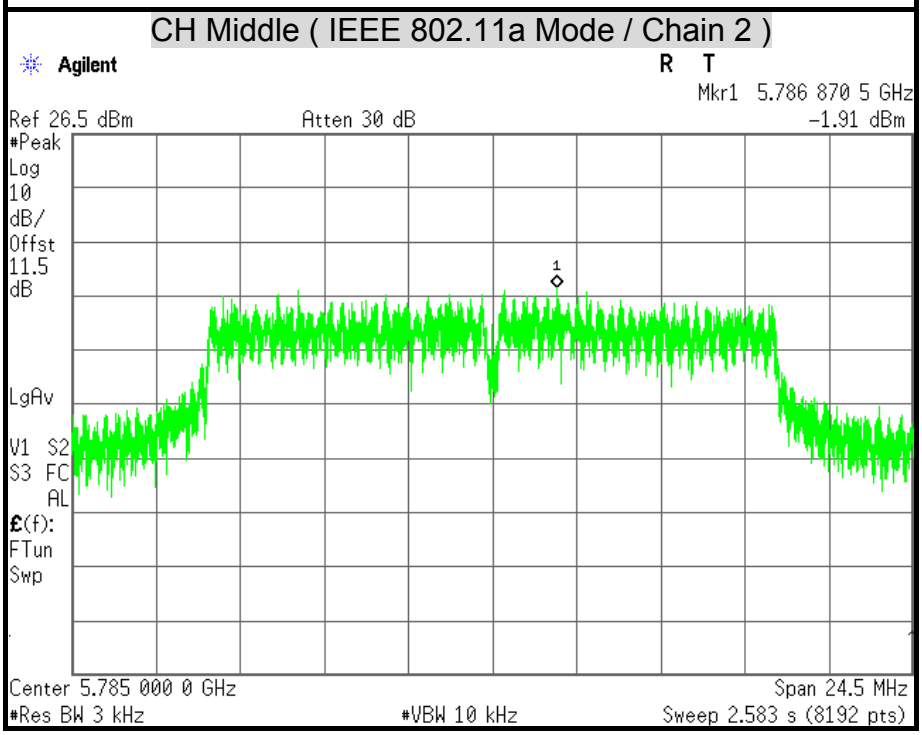

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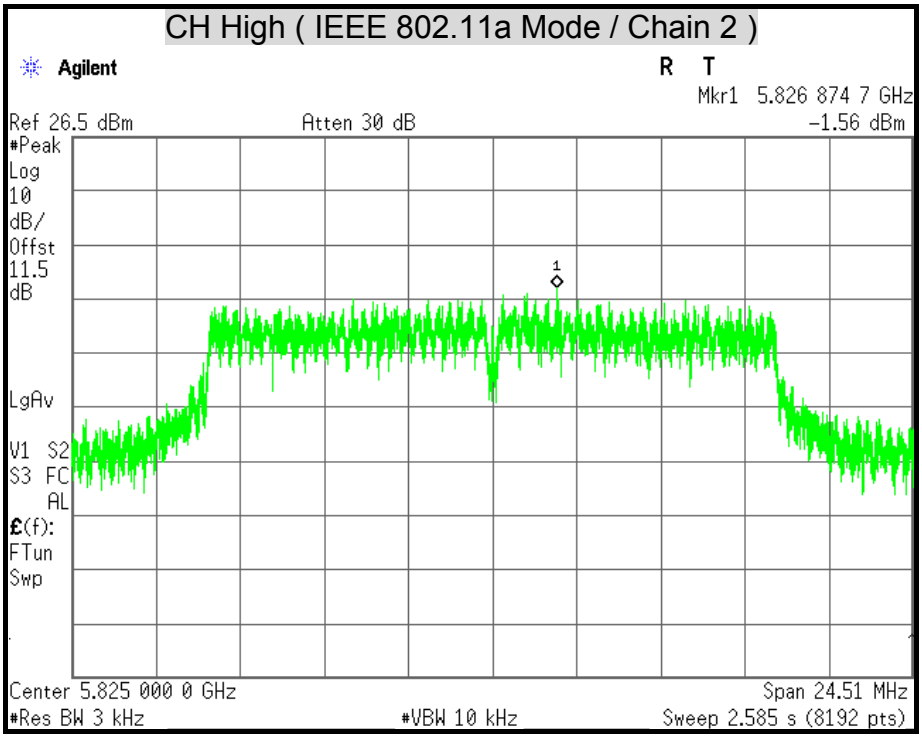

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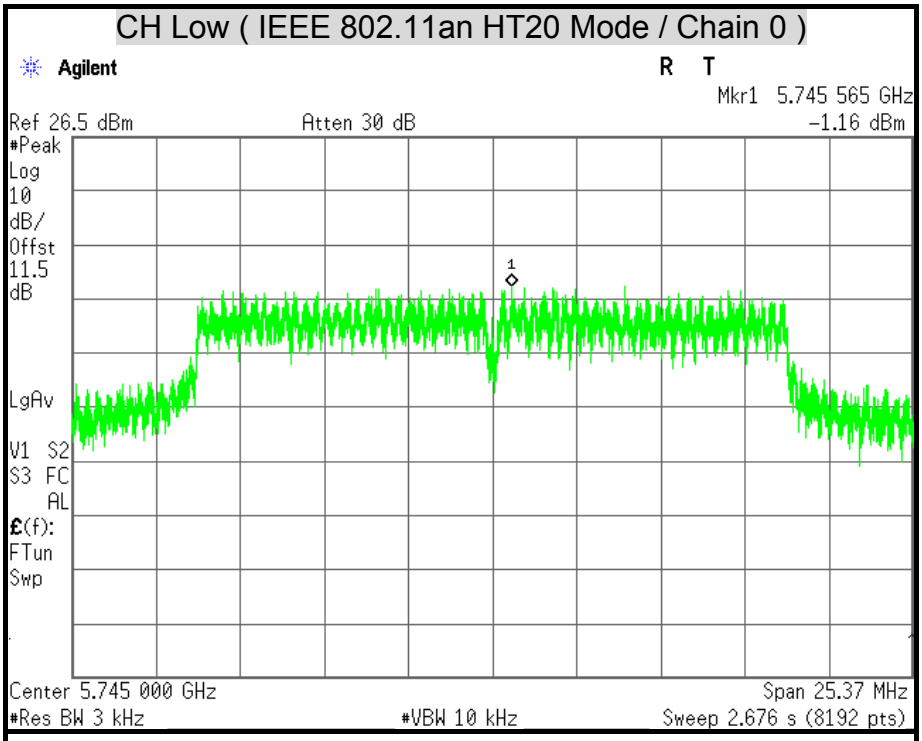

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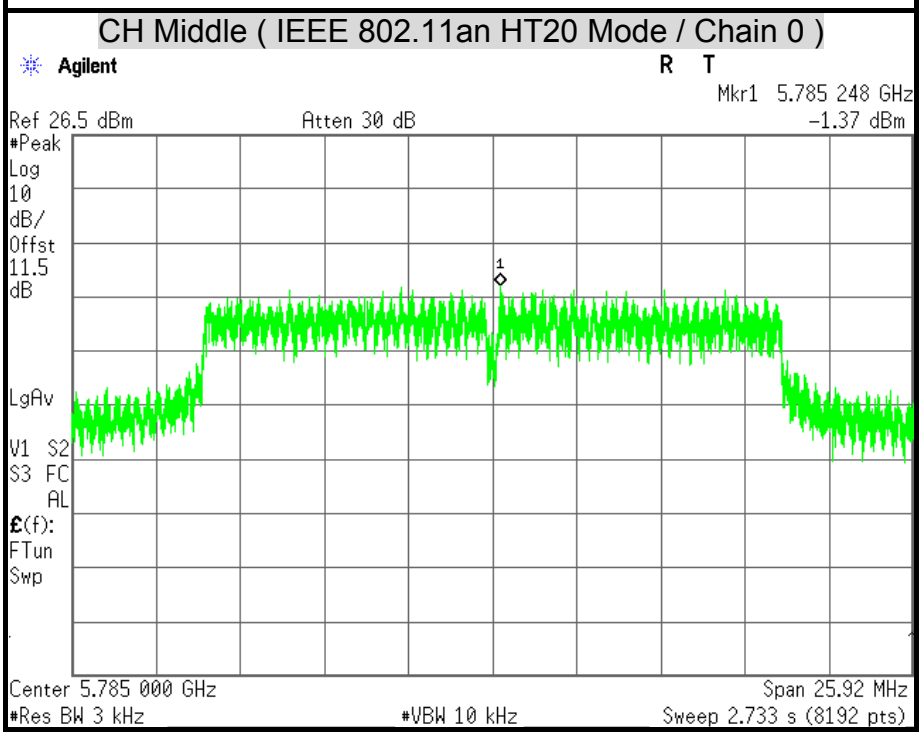

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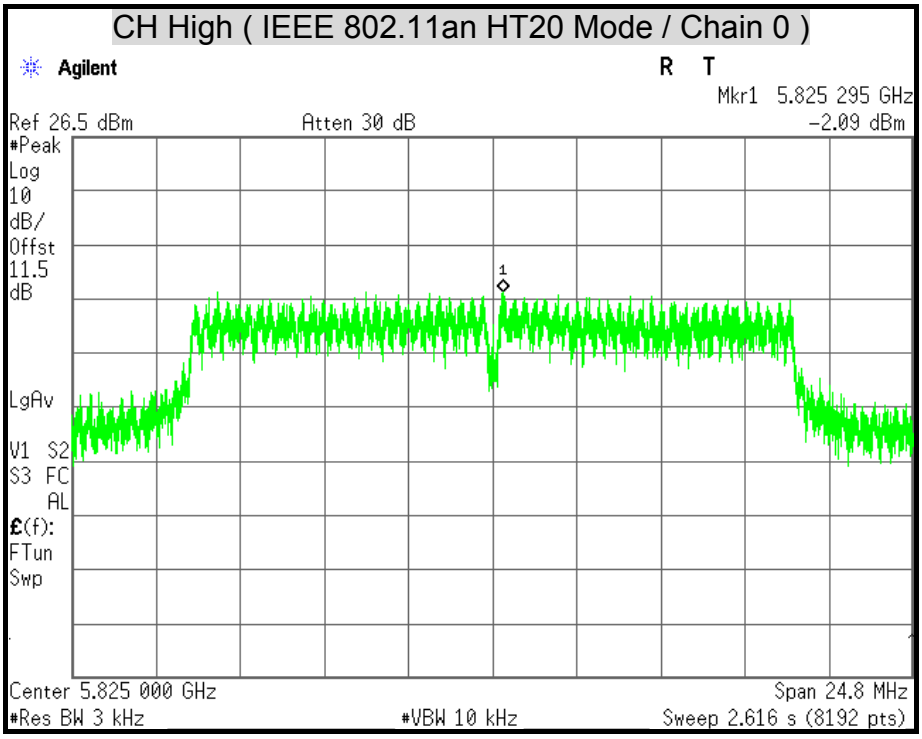

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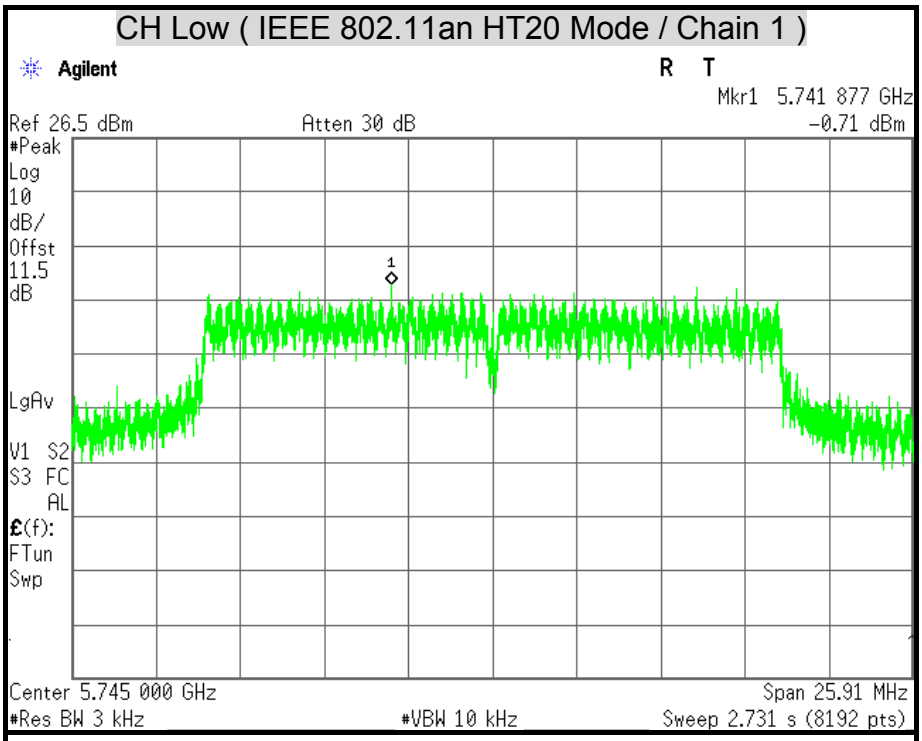

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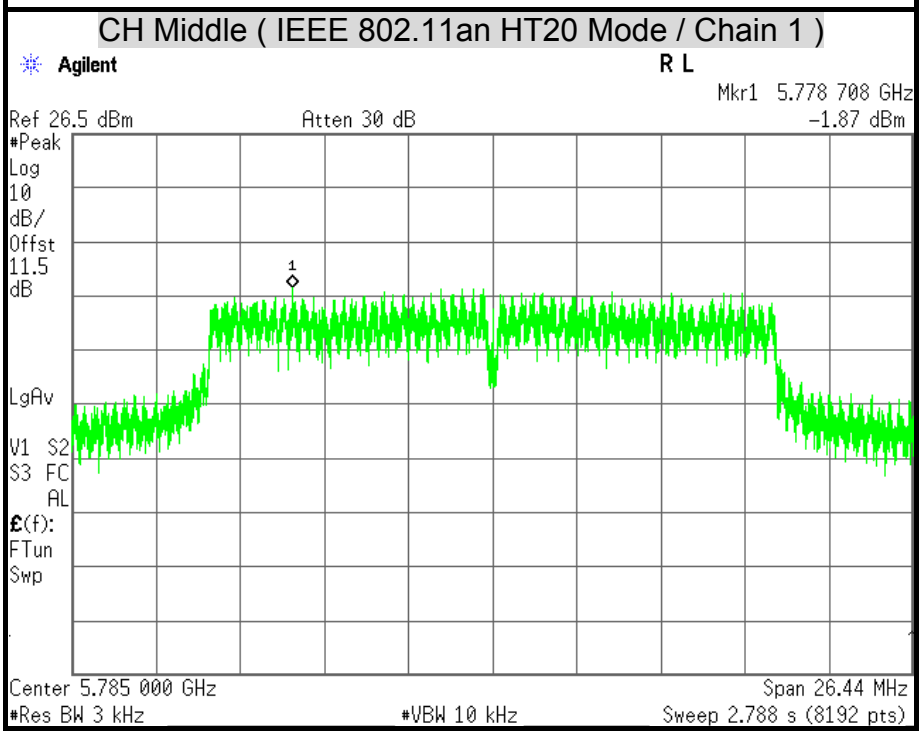
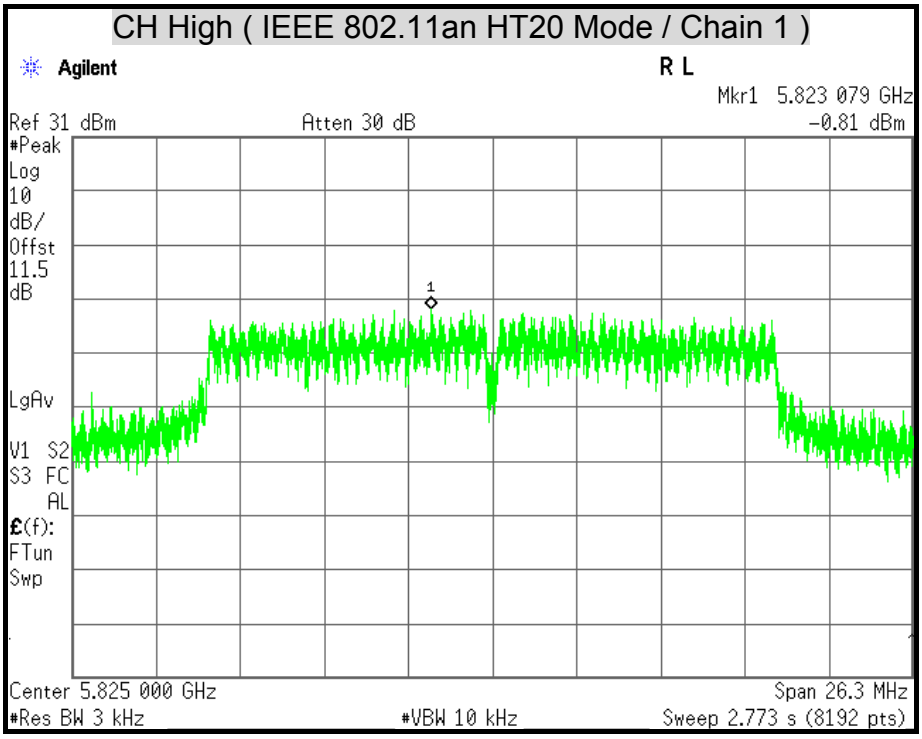
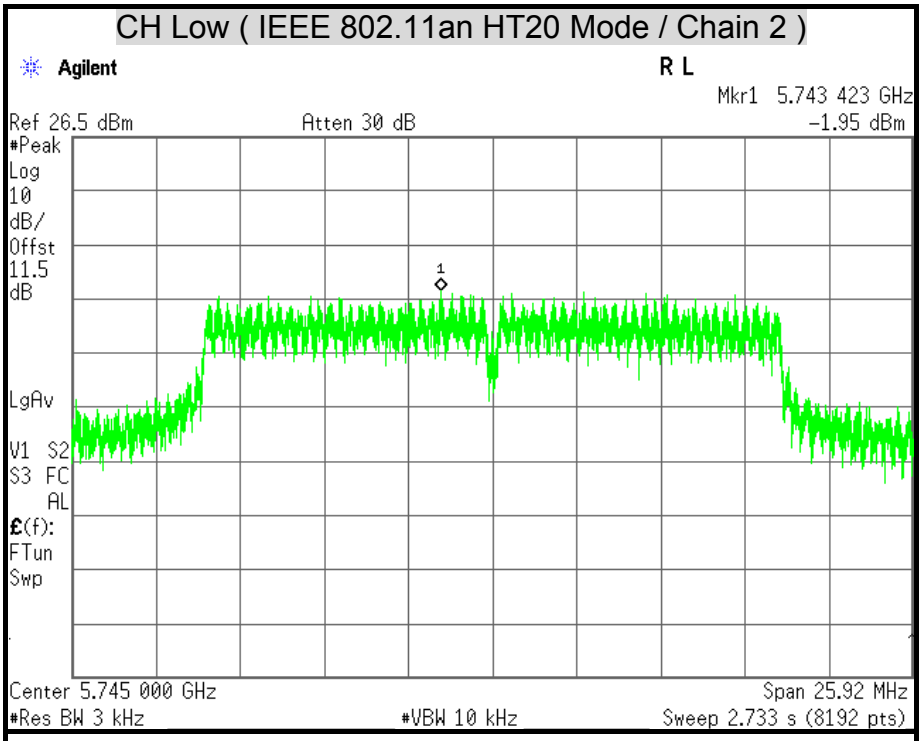




CH Low (IEEE 802.11an HT20 Mode / Chain 2)



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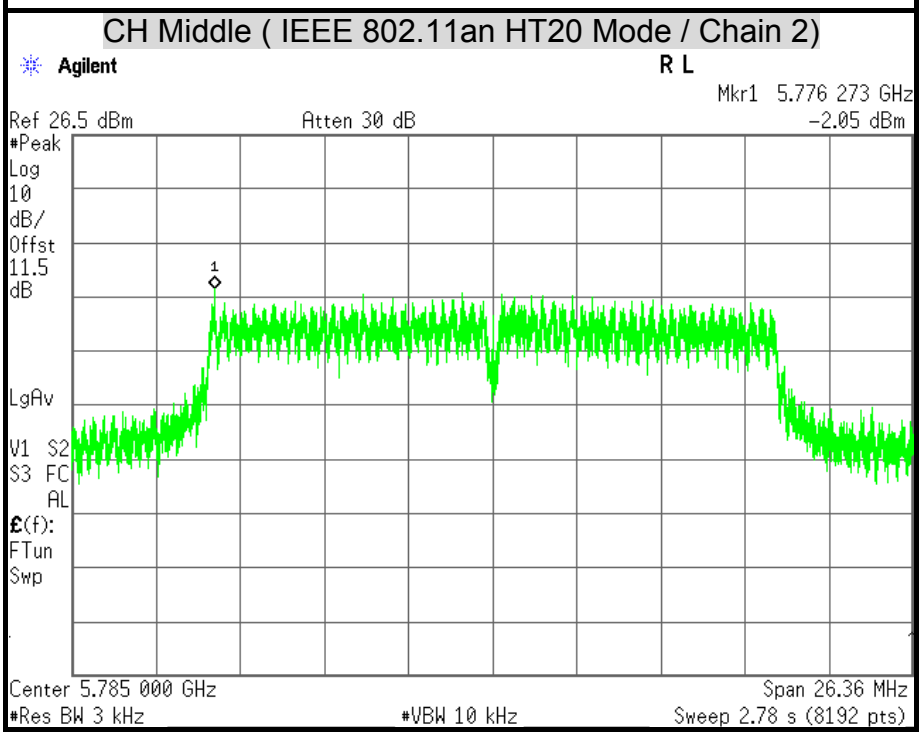

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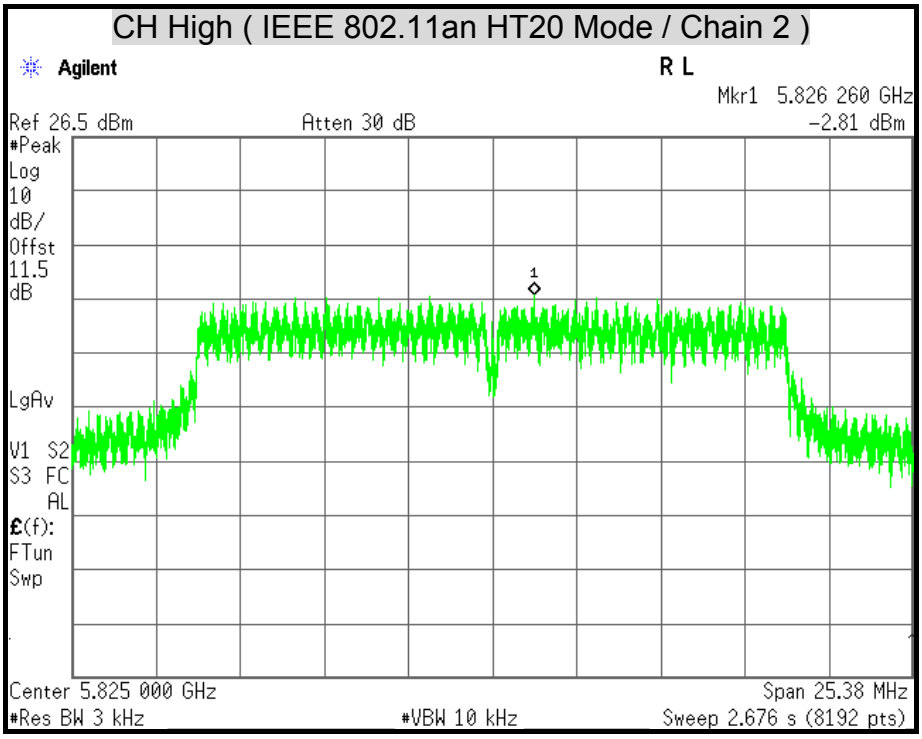

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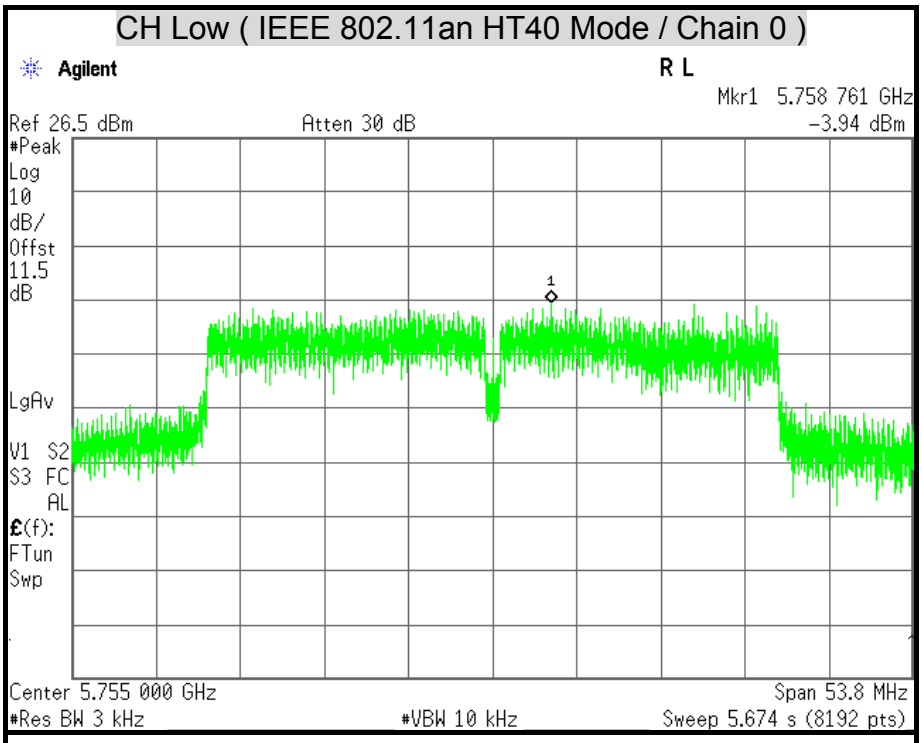

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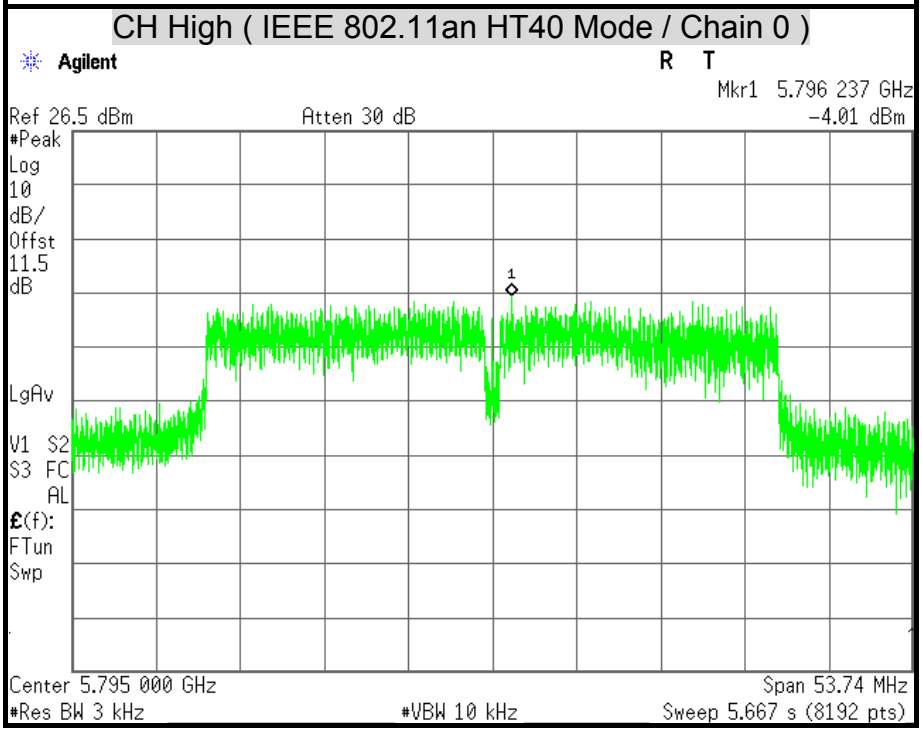
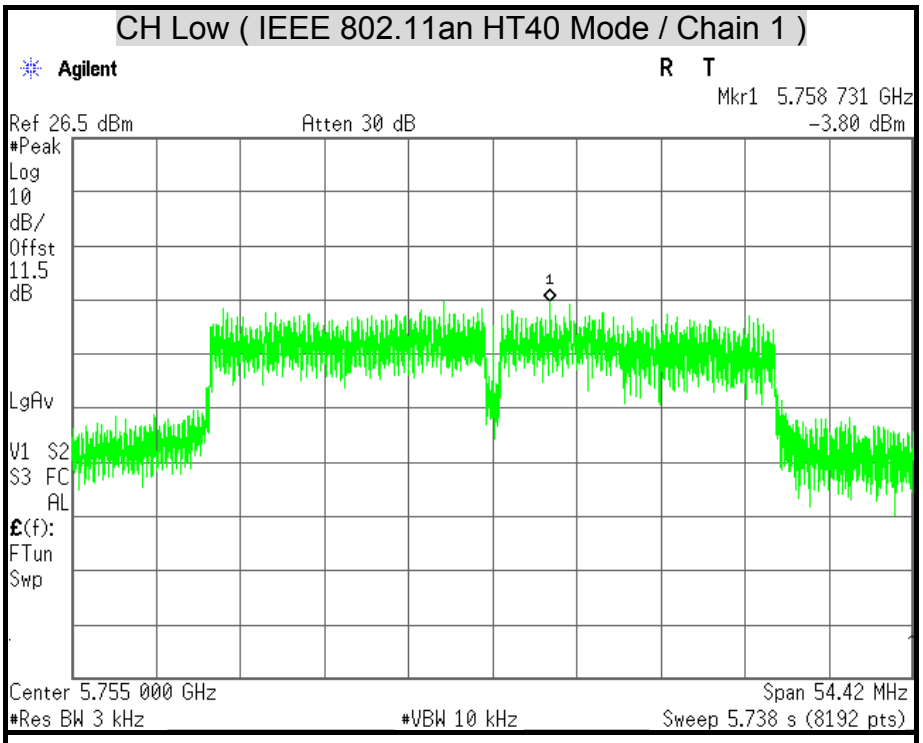
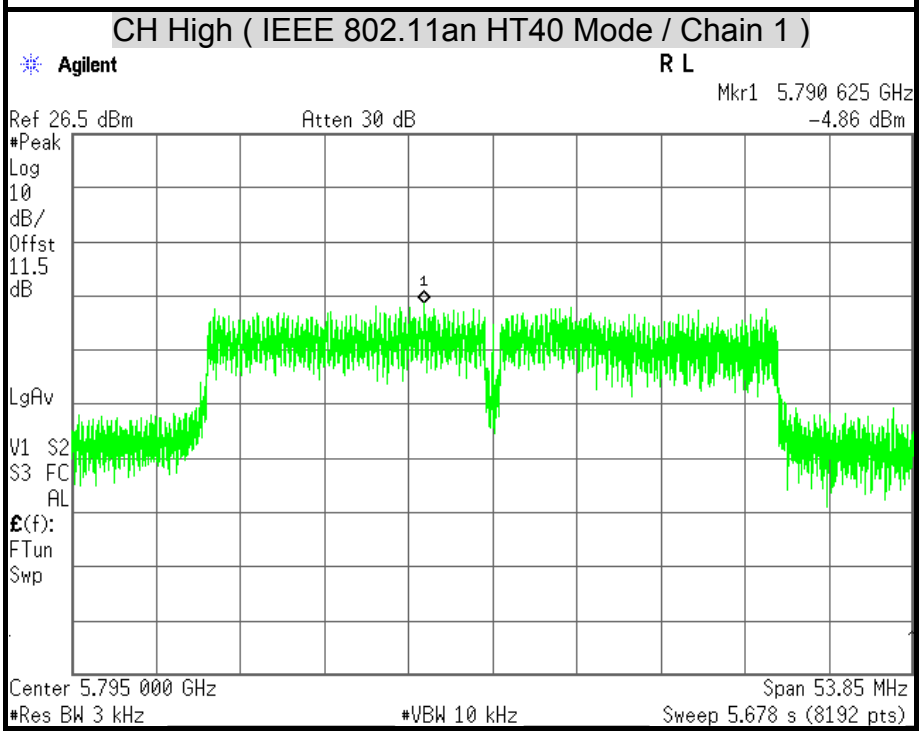


CH Low (IEEE 802.11an HT40 Mode / Chain 1)



CH High (IEEE 802.11an HT40 Mode / Chain 1)



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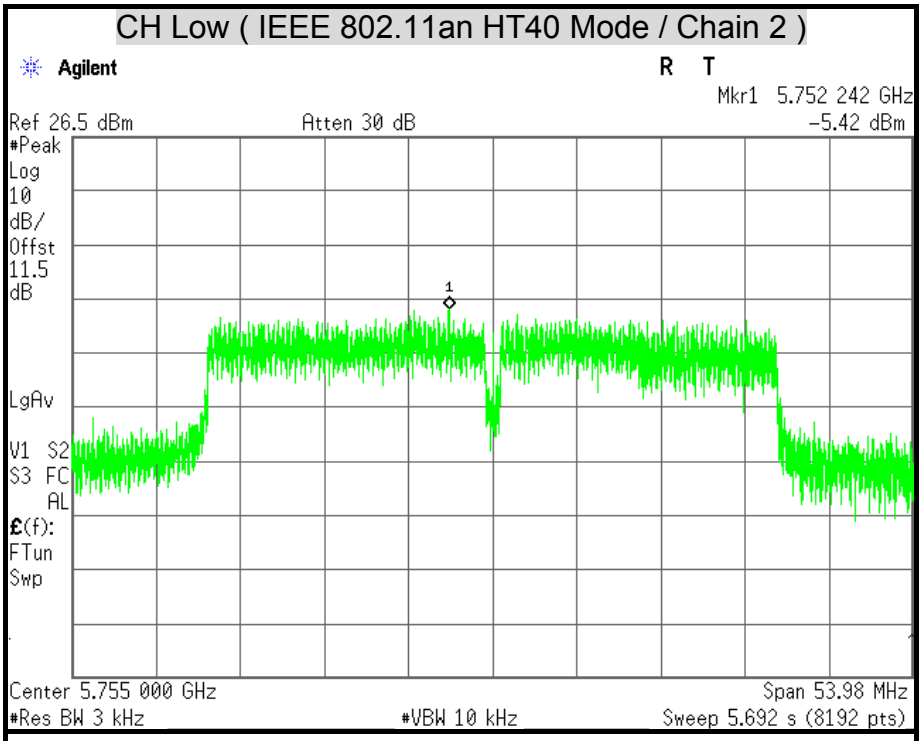

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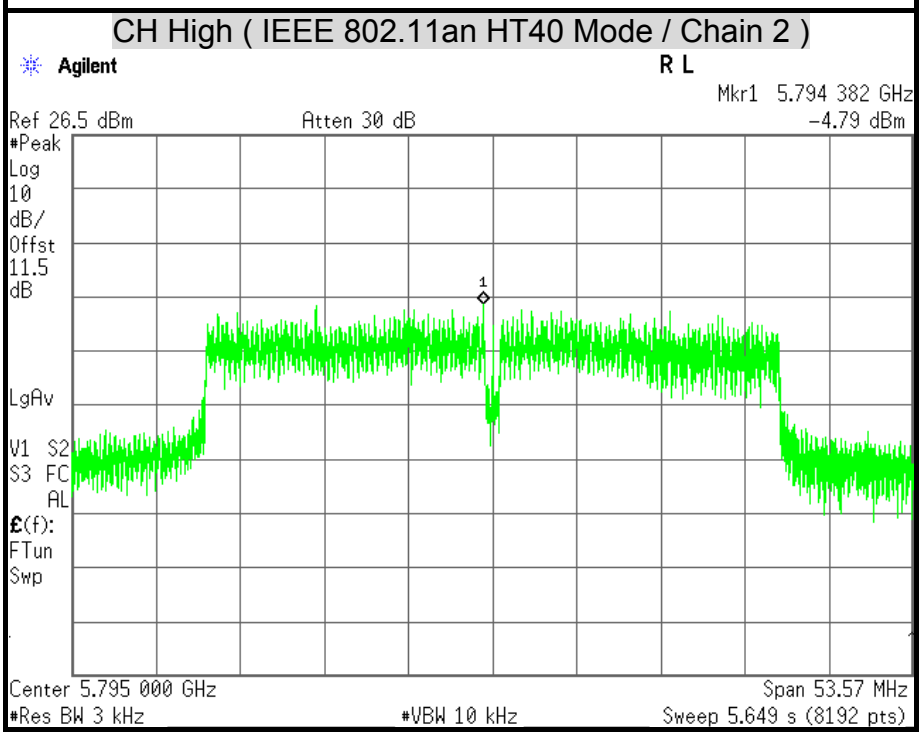

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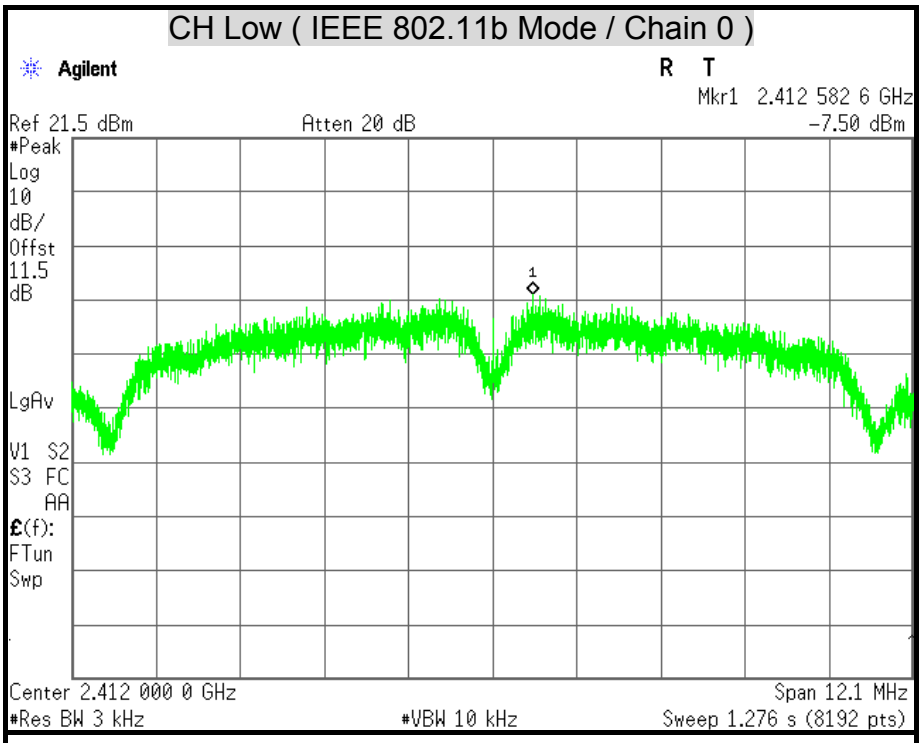
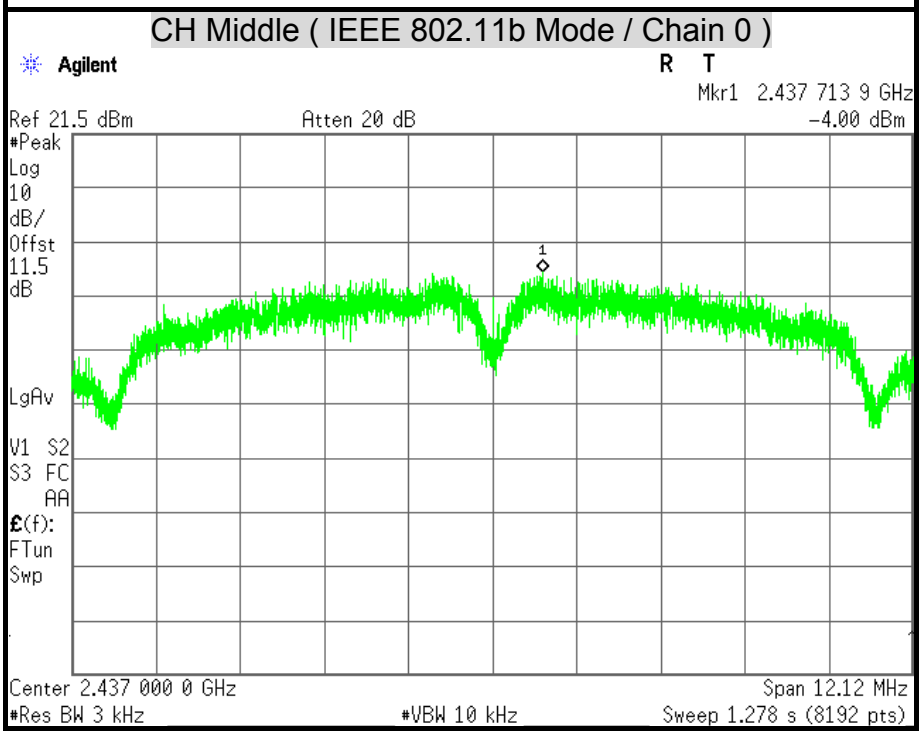
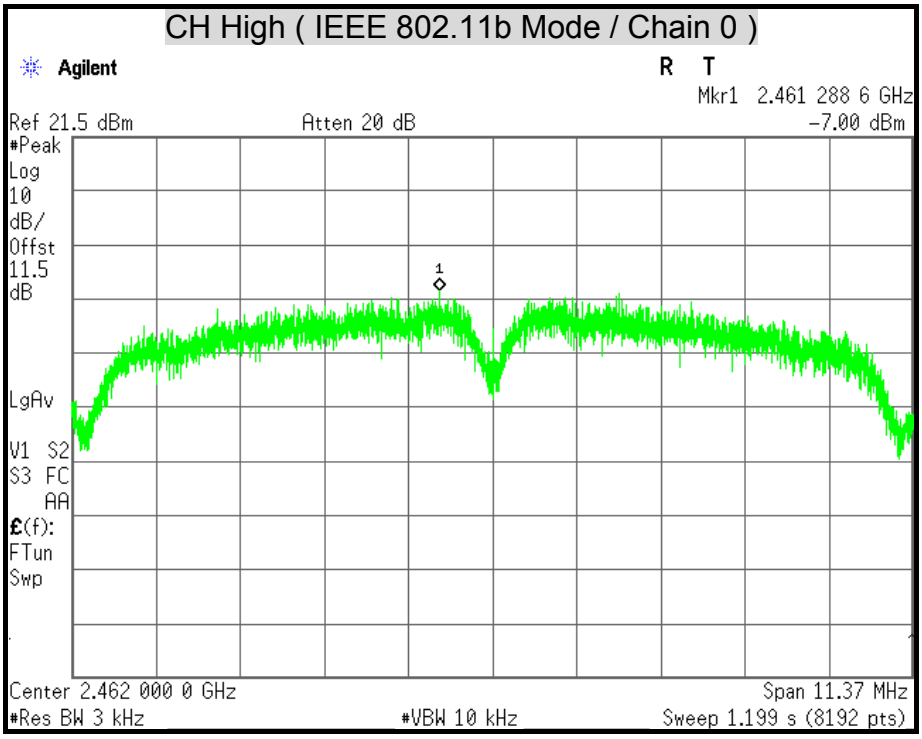


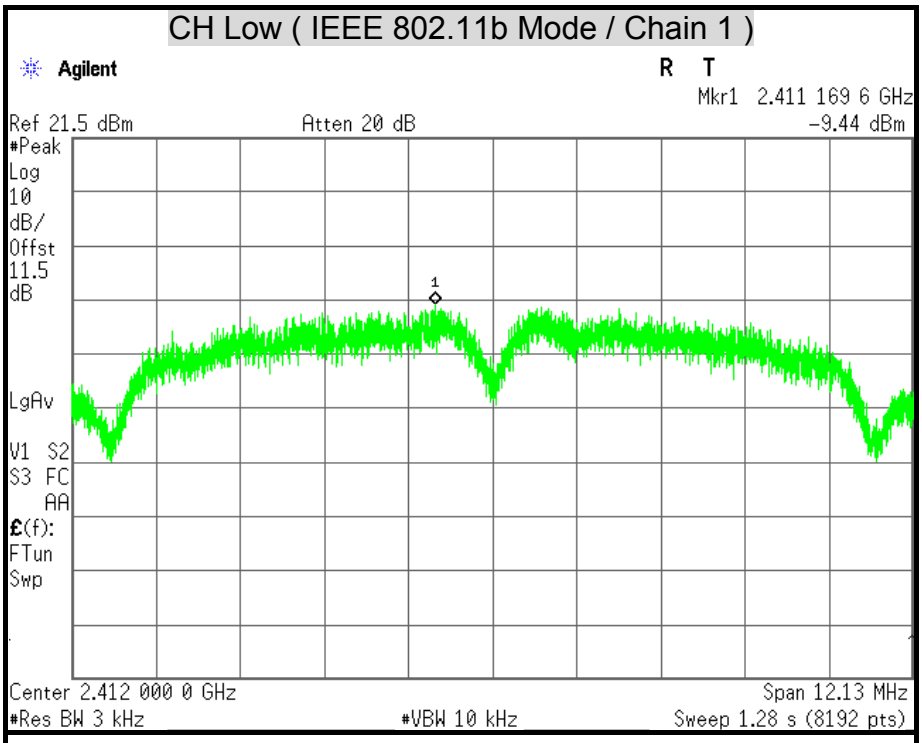
CH Middle (IEEE 802.11b Mode / Chain 0)



CH High (IEEE 802.11b Mode / Chain 0)



CH Low (IEEE 802.11b Mode / Chain 1)



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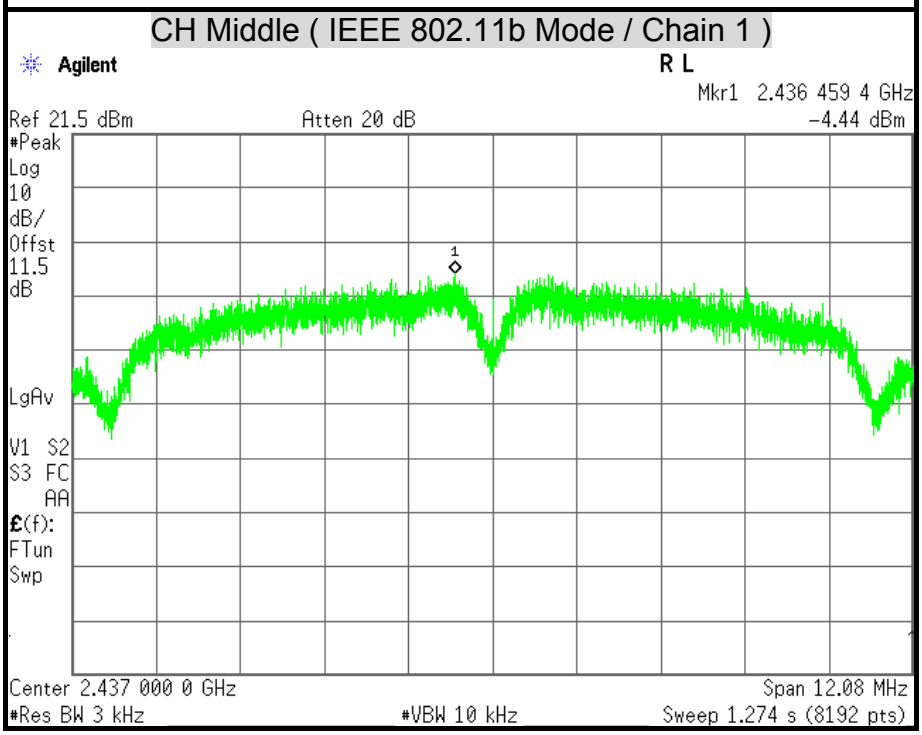

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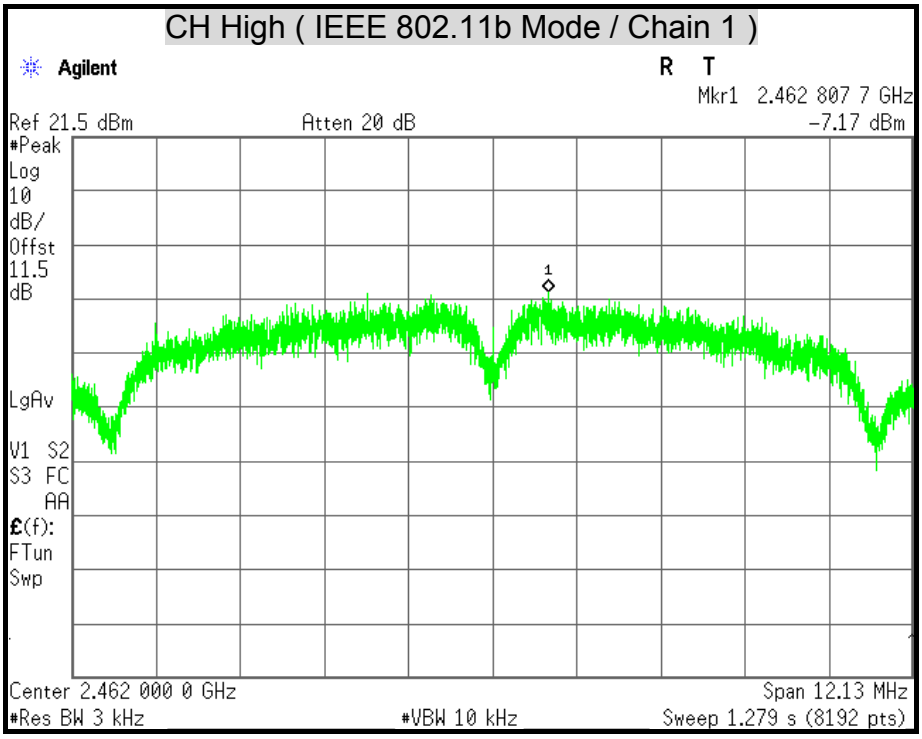

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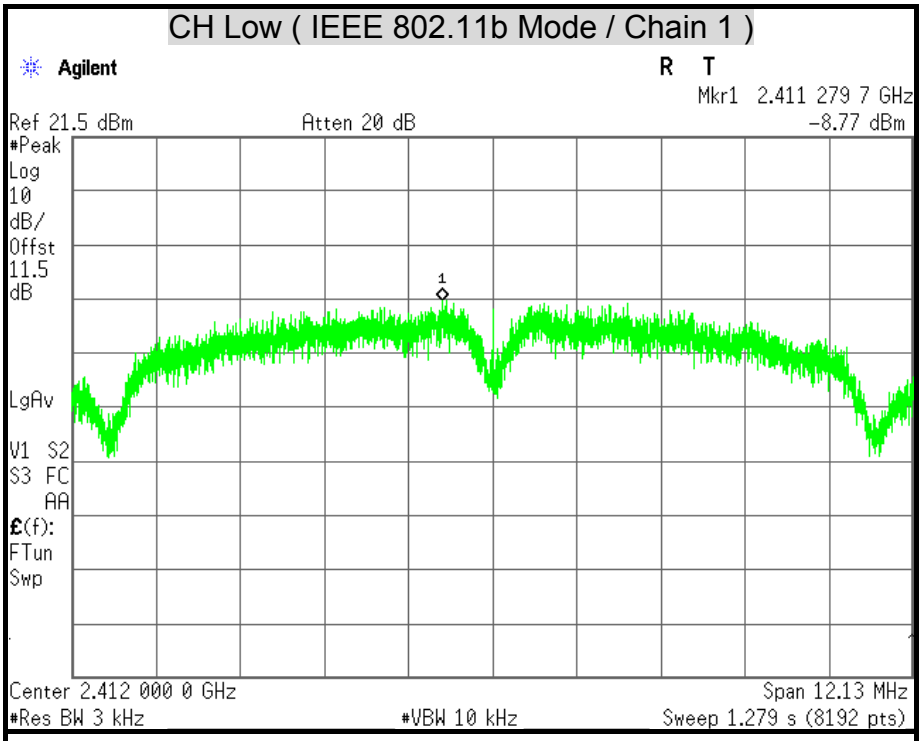

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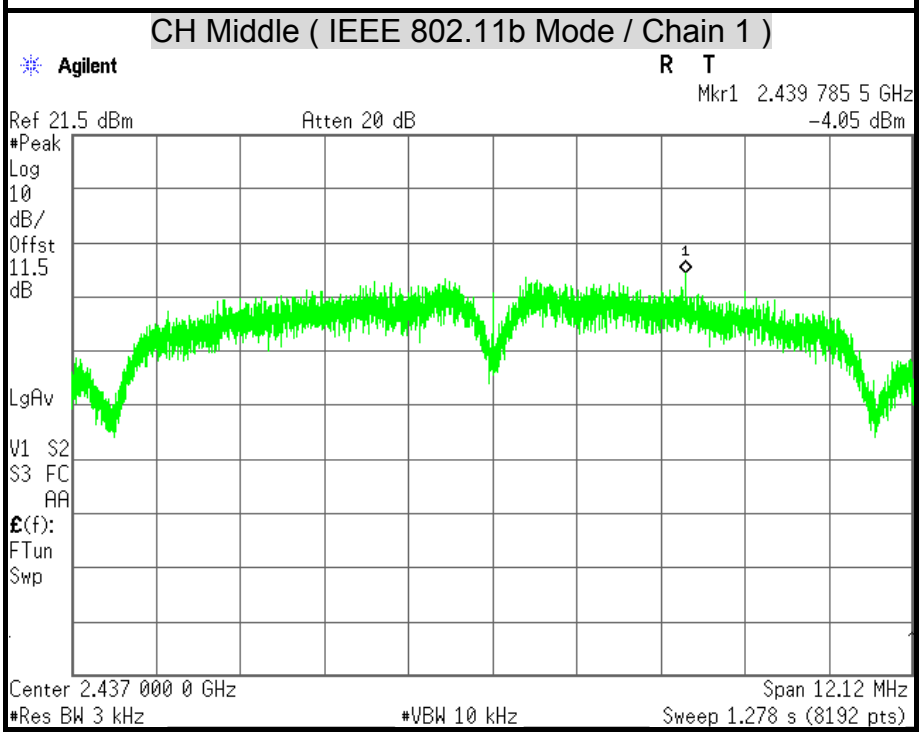
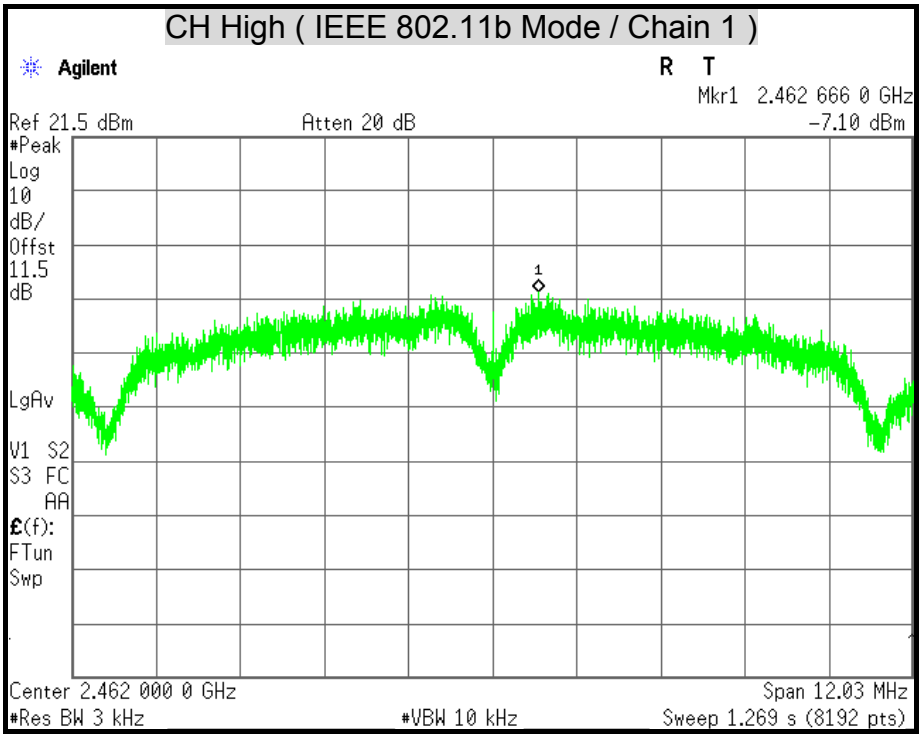
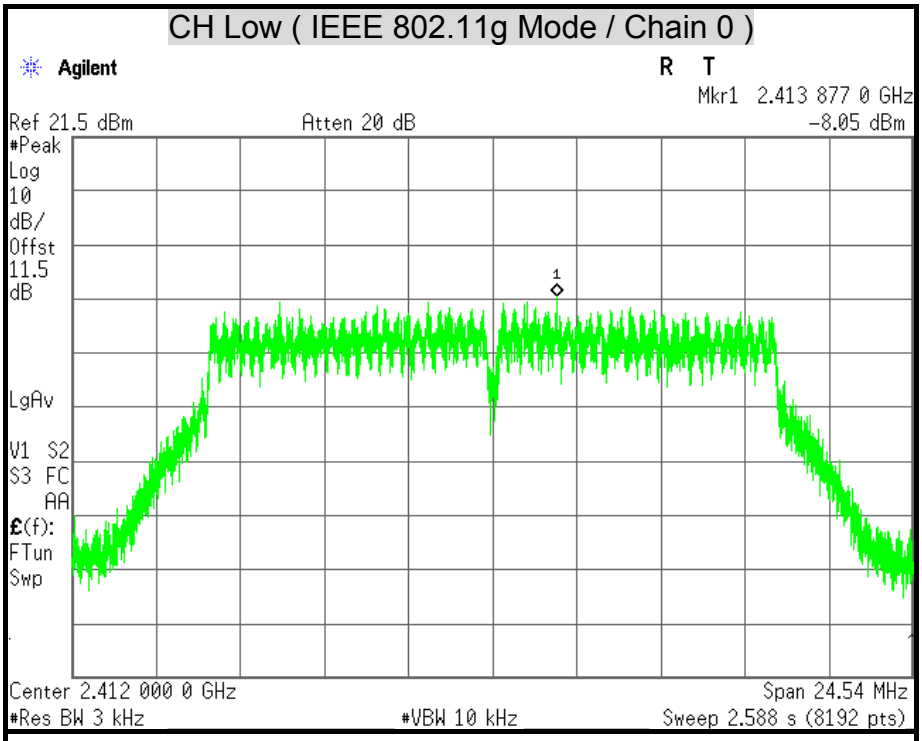


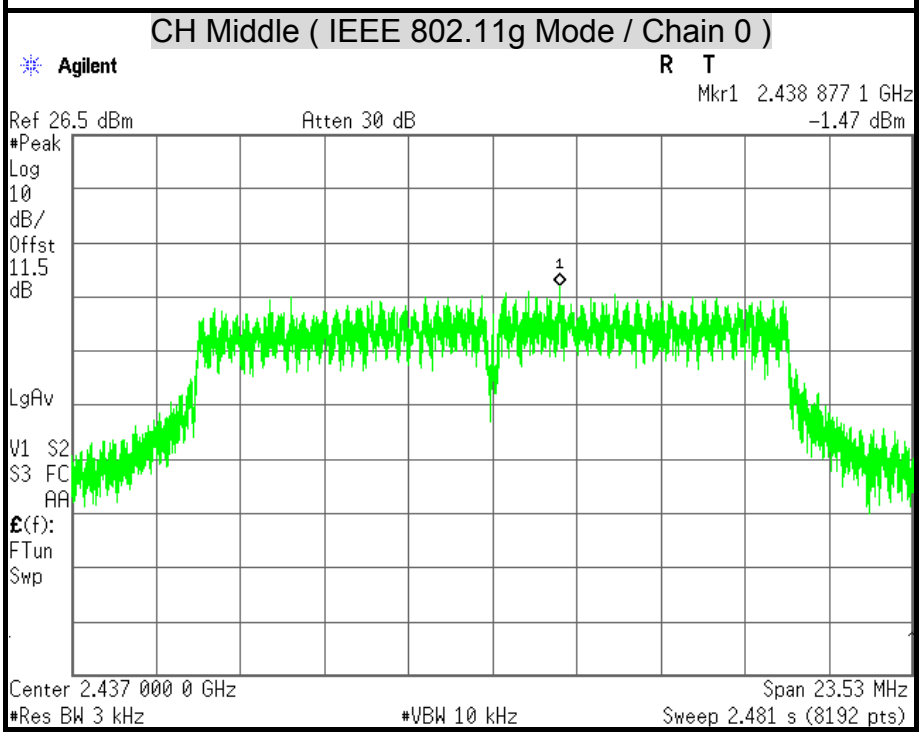
CH High (IEEE 802.11b Mode / Chain 1)



CH Low (IEEE 802.11g Mode / Chain 0)



CH Middle (IEEE 802.11g Mode / Chain 0)



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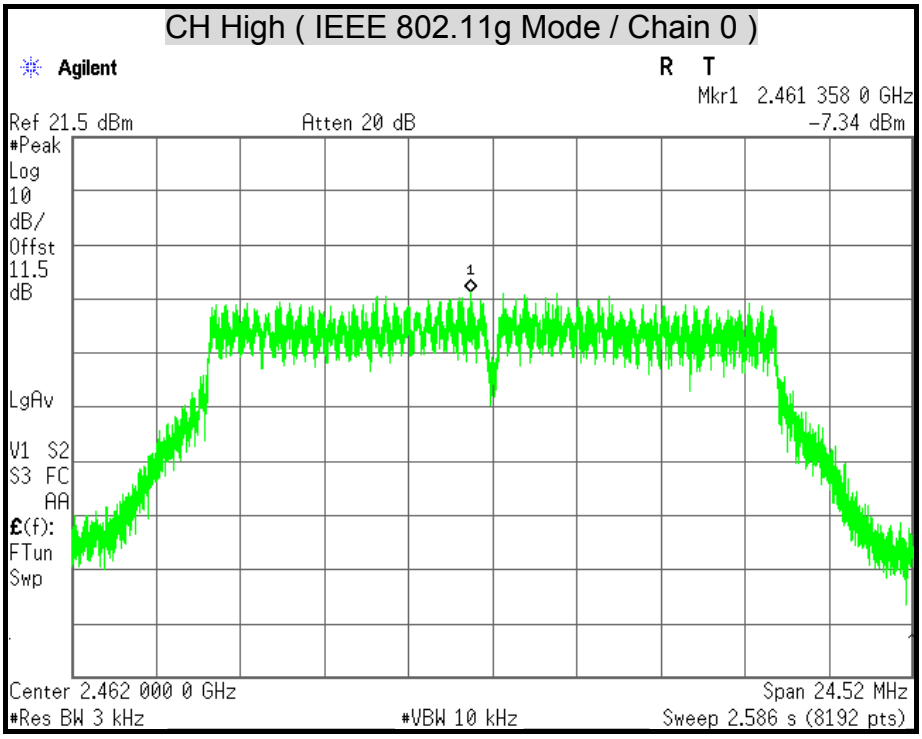
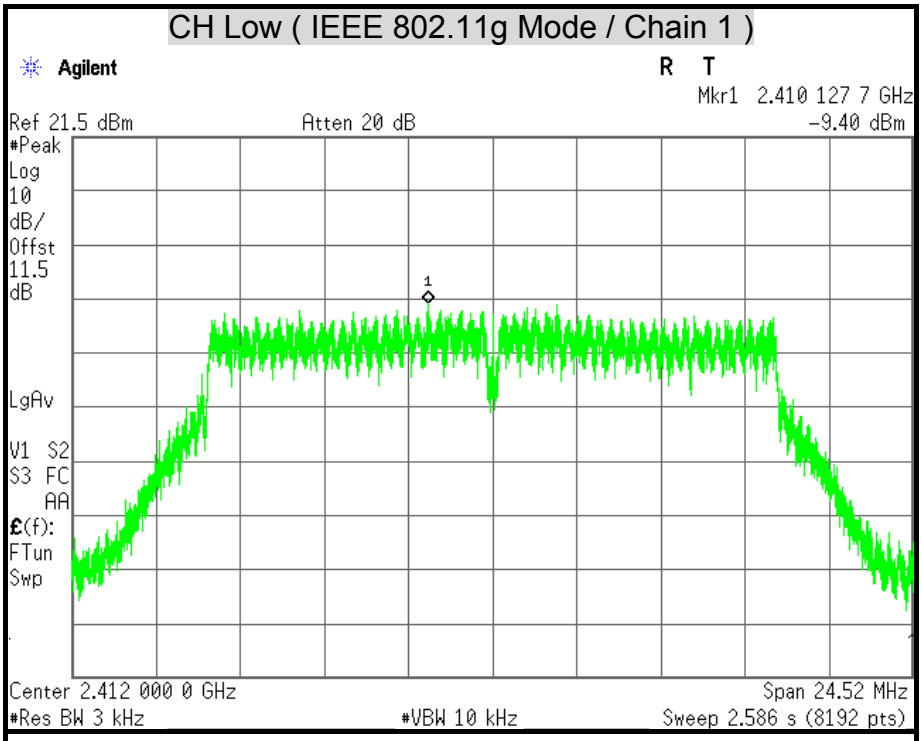


CH Low (IEEE 802.11g Mode / Chain 1)



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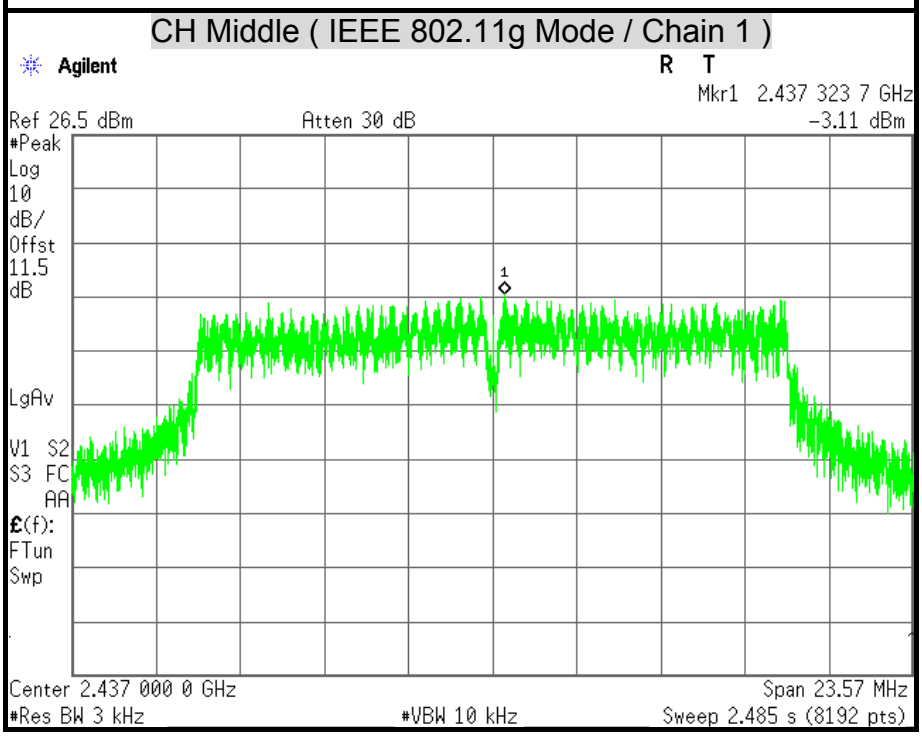

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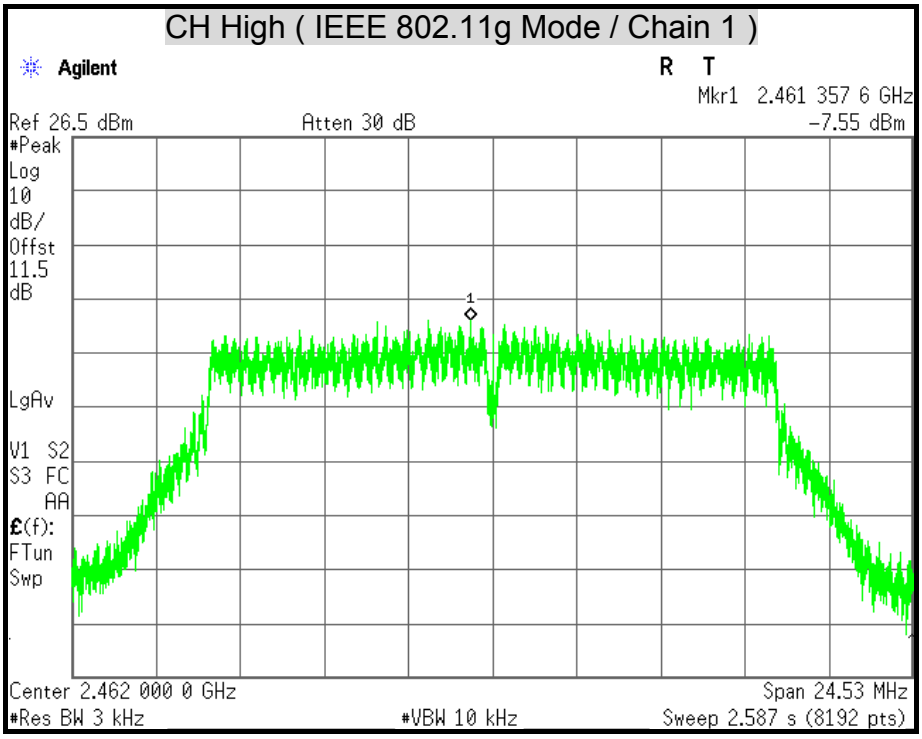
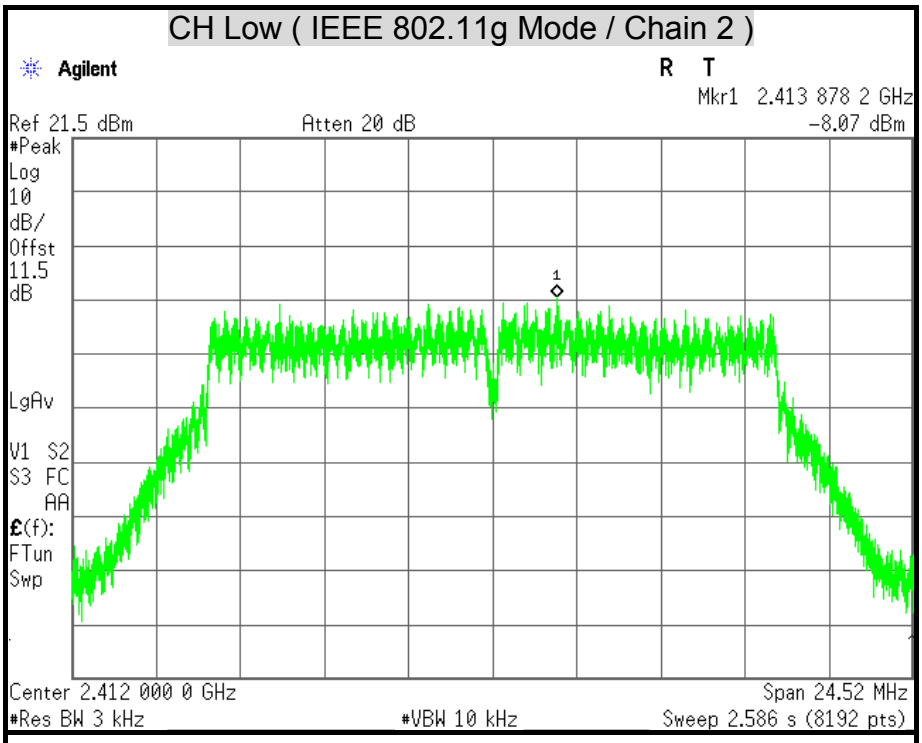
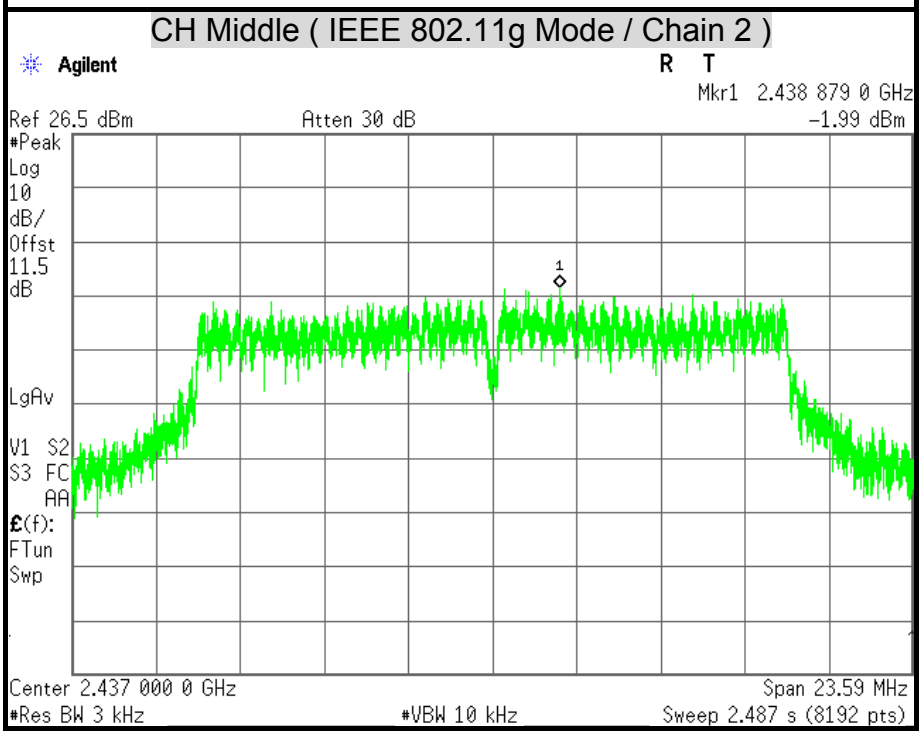


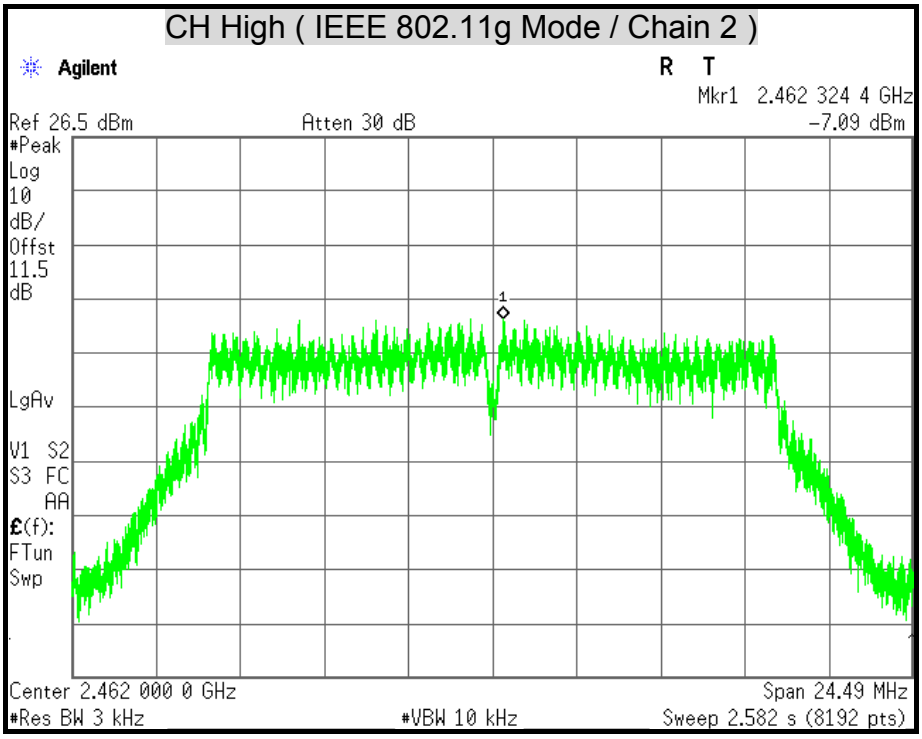
CH Low (IEEE 802.11g Mode / Chain 2)



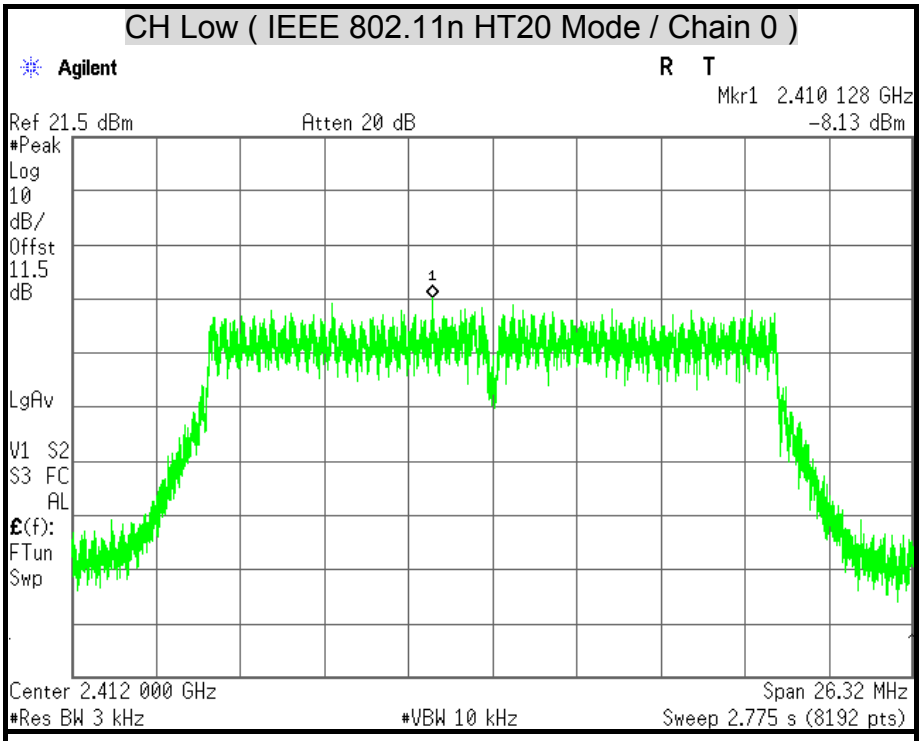
CH Middle (IEEE 802.11g Mode / Chain 2)



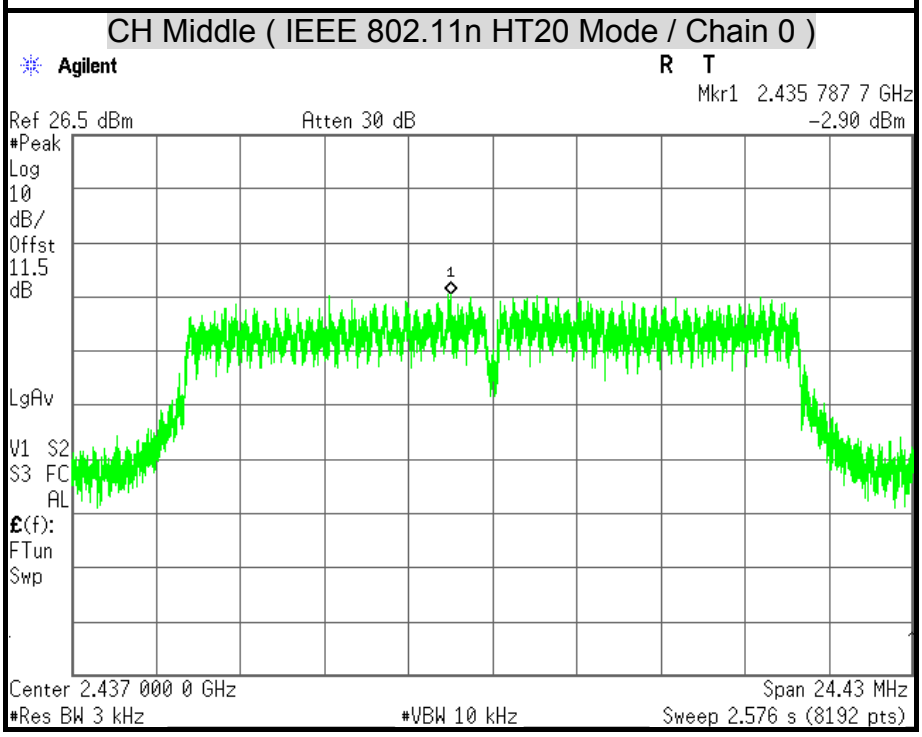
CH High (IEEE 802.11g Mode / Chain 2)



CH Low (IEEE 802.11n HT20 Mode / Chain 0)



CH Middle (IEEE 802.11n HT20 Mode / Chain 0)



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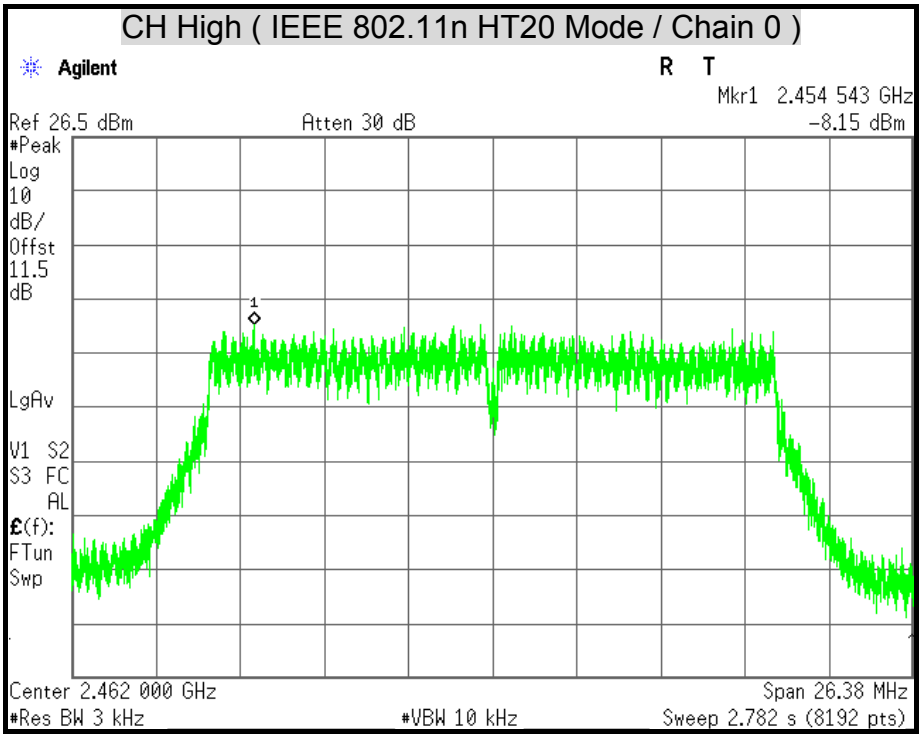
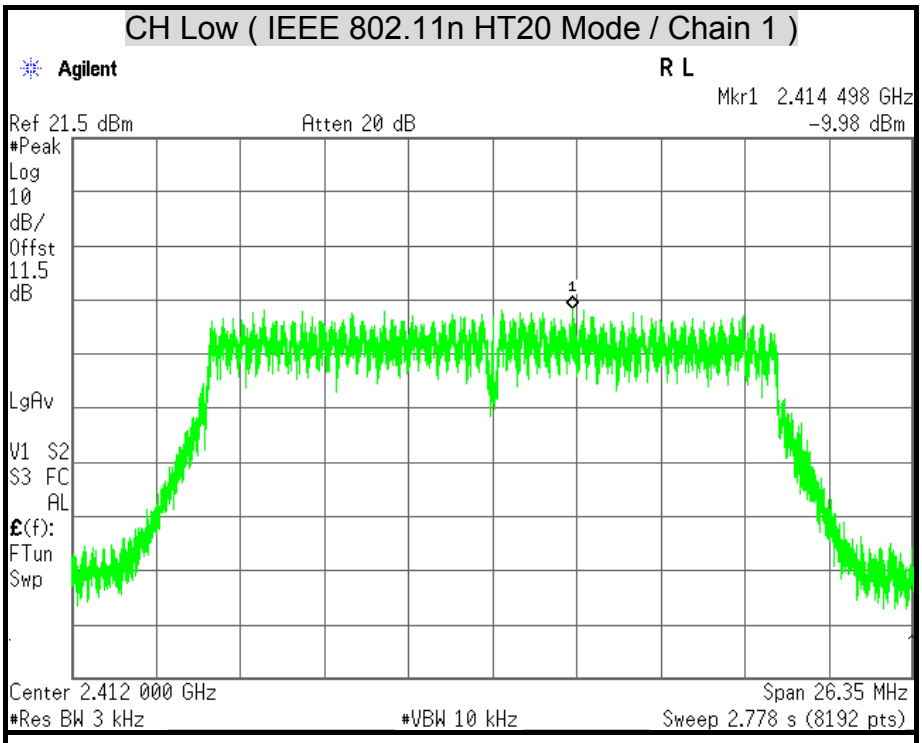
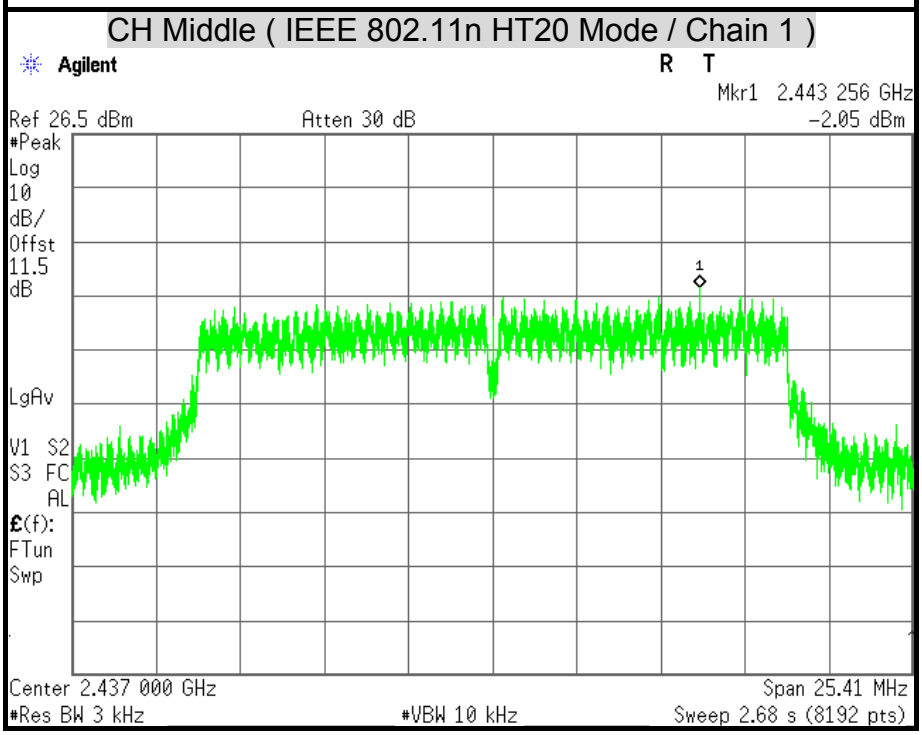


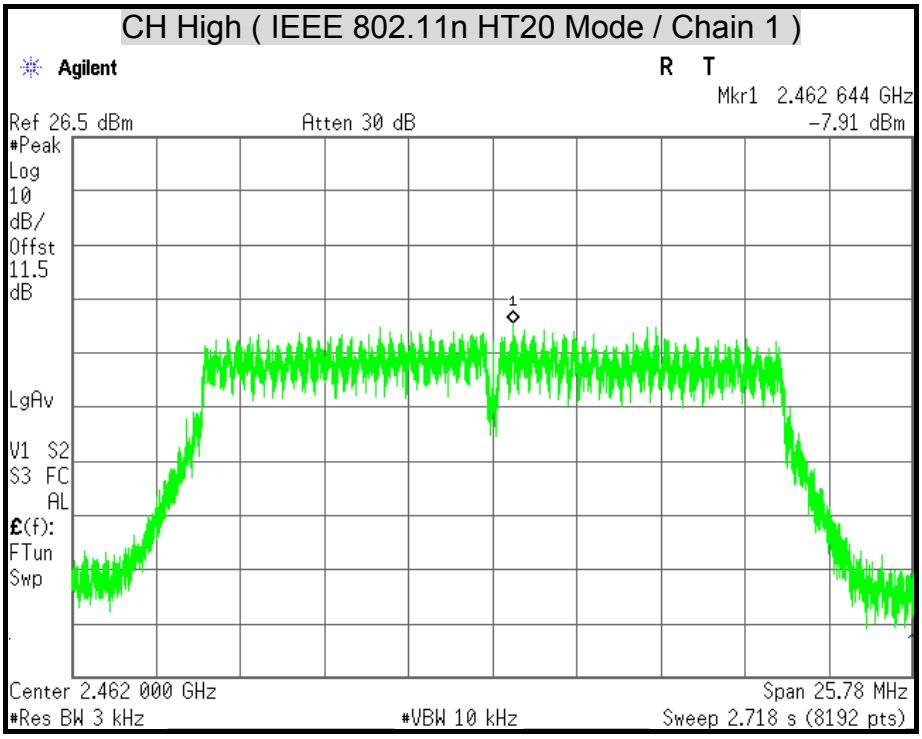
CH Low (IEEE 802.11n HT20 Mode / Chain 1)



CH Middle (IEEE 802.11n HT20 Mode / Chain 1)



CH High (IEEE 802.11n HT20 Mode / Chain 1)



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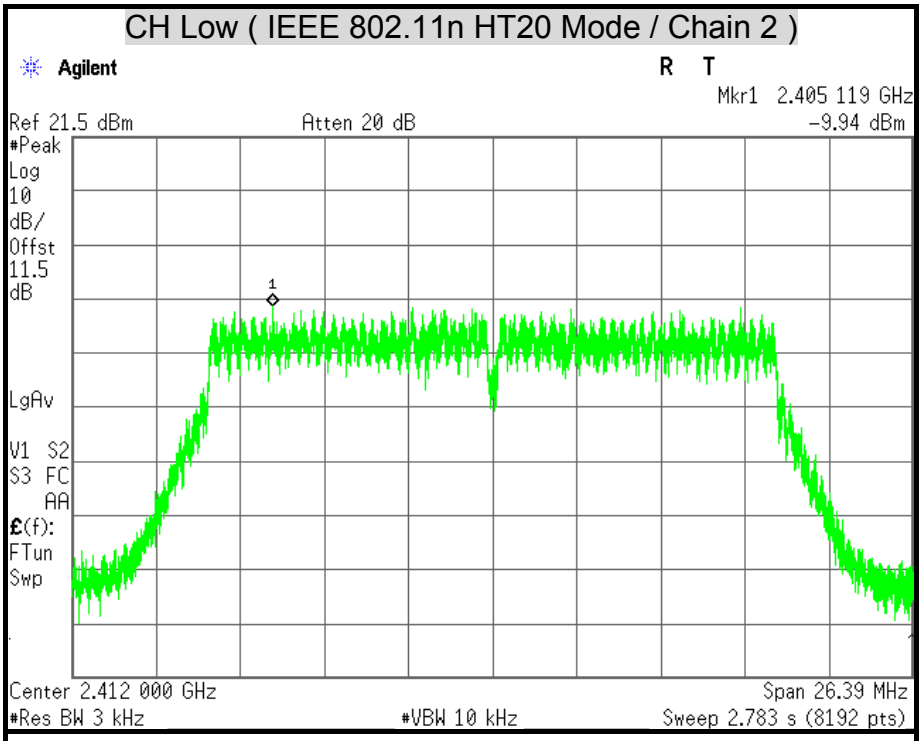
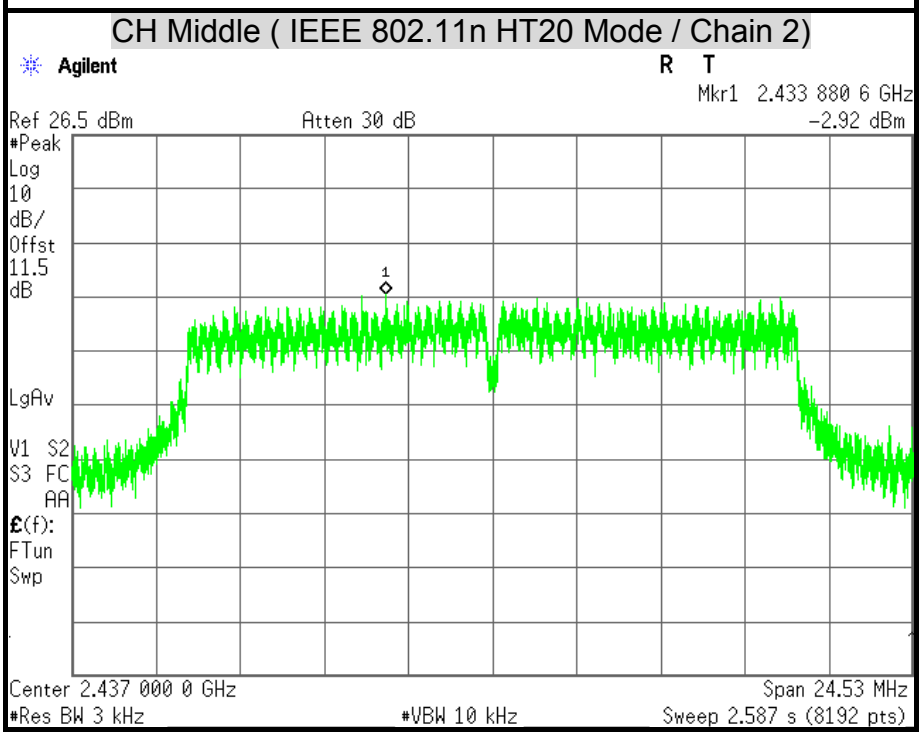
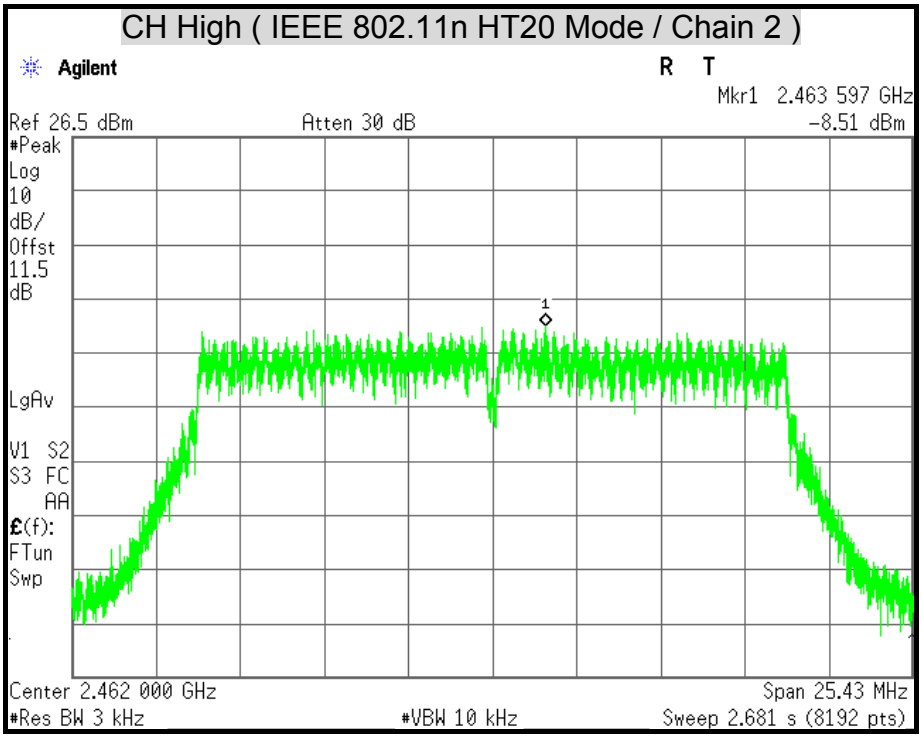


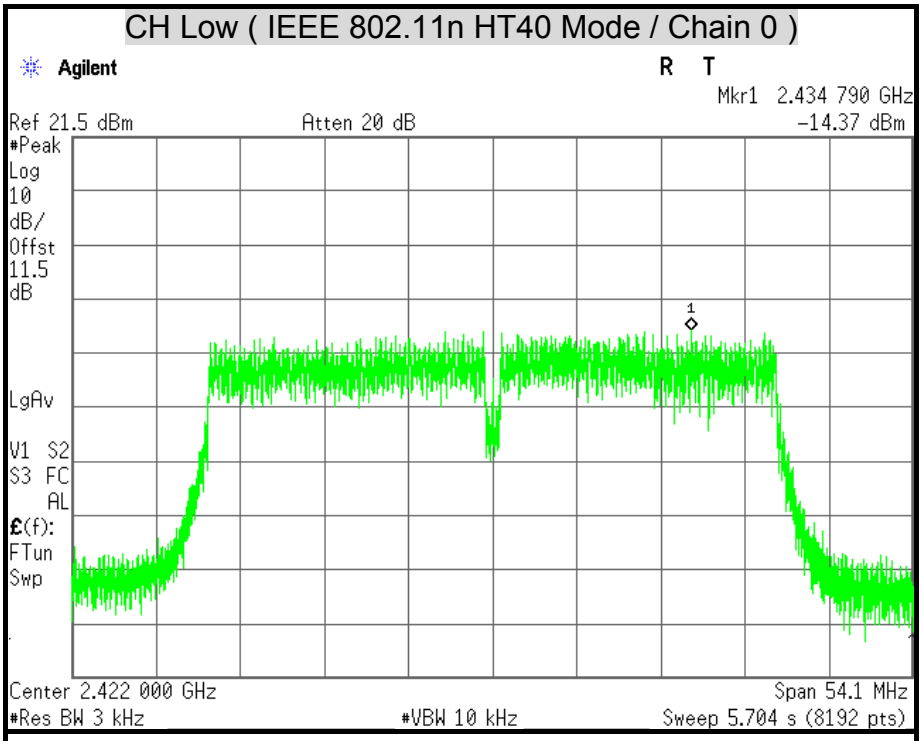
CH Middle (IEEE 802.11n HT20 Mode / Chain 2)



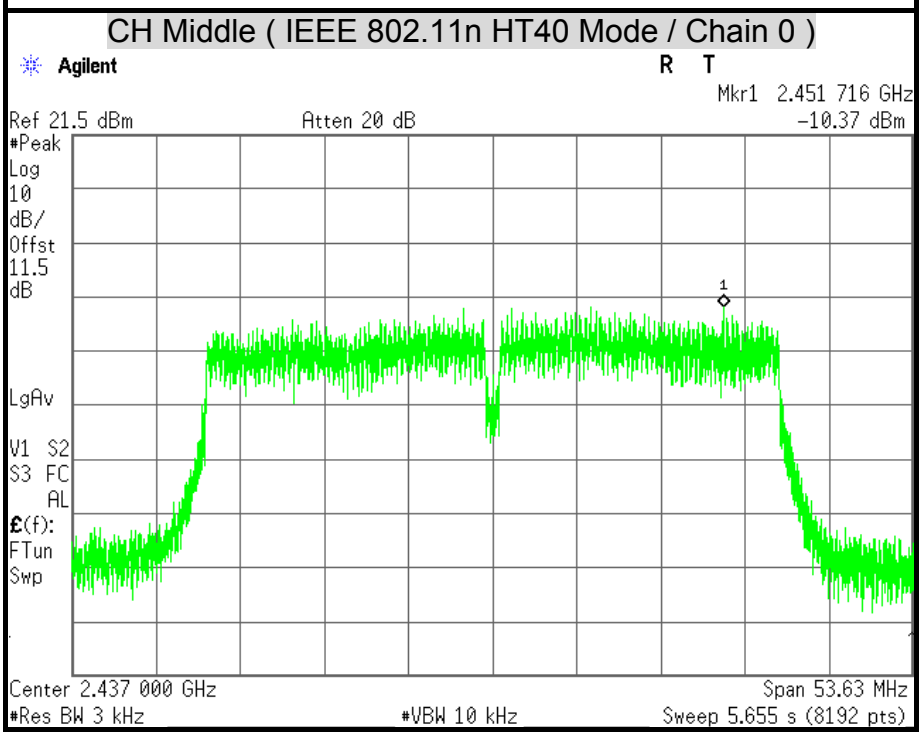
CH High (IEEE 802.11n HT20 Mode / Chain 2)



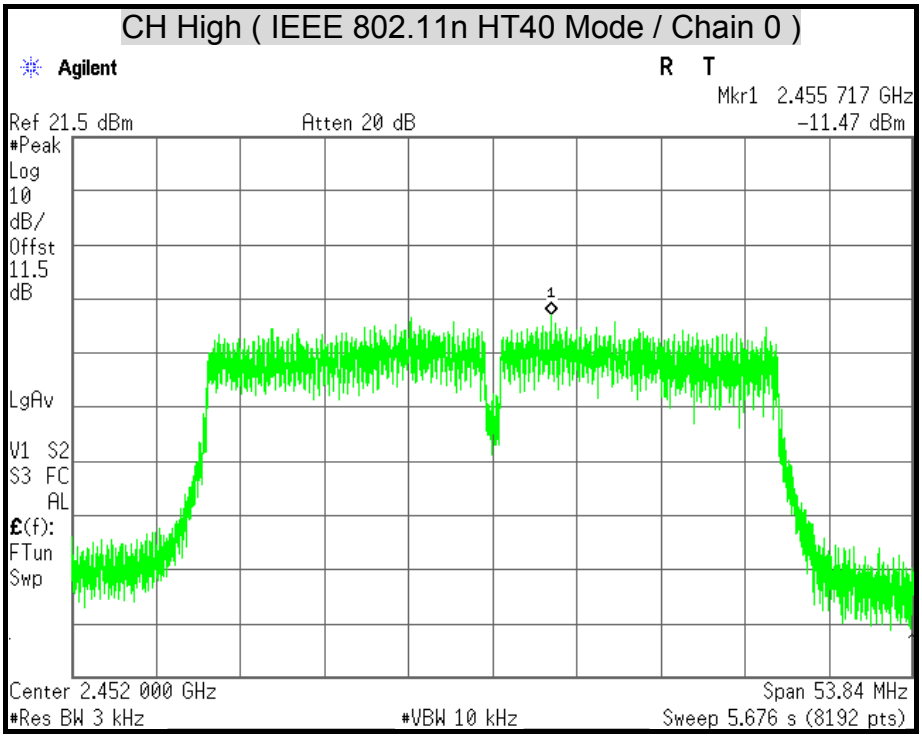
CH Low (IEEE 802.11n HT40 Mode / Chain 0)



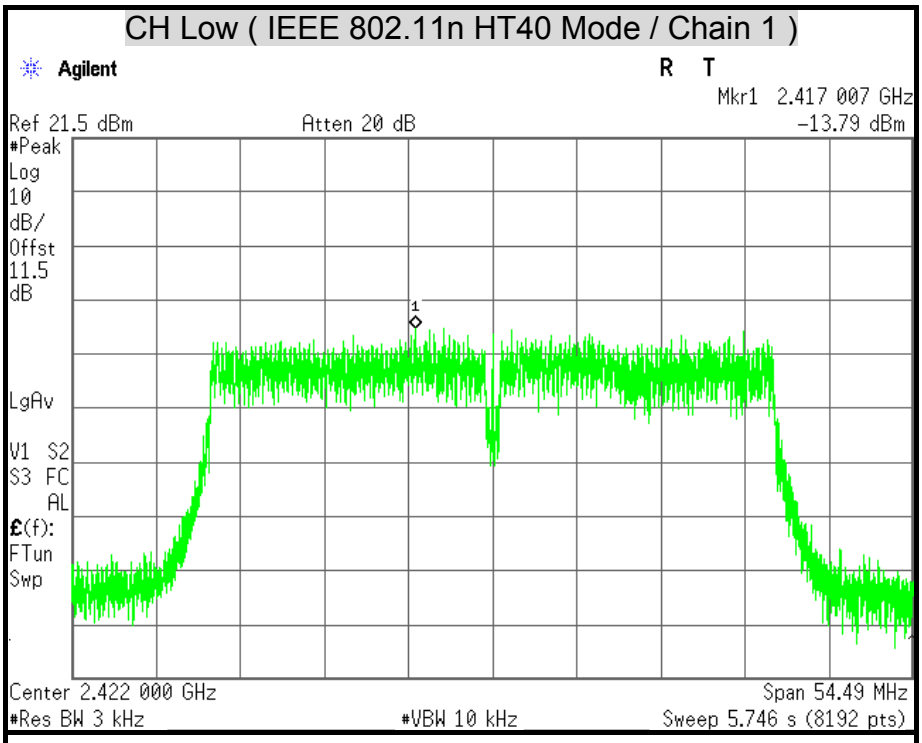
CH Middle (IEEE 802.11n HT40 Mode / Chain 0)



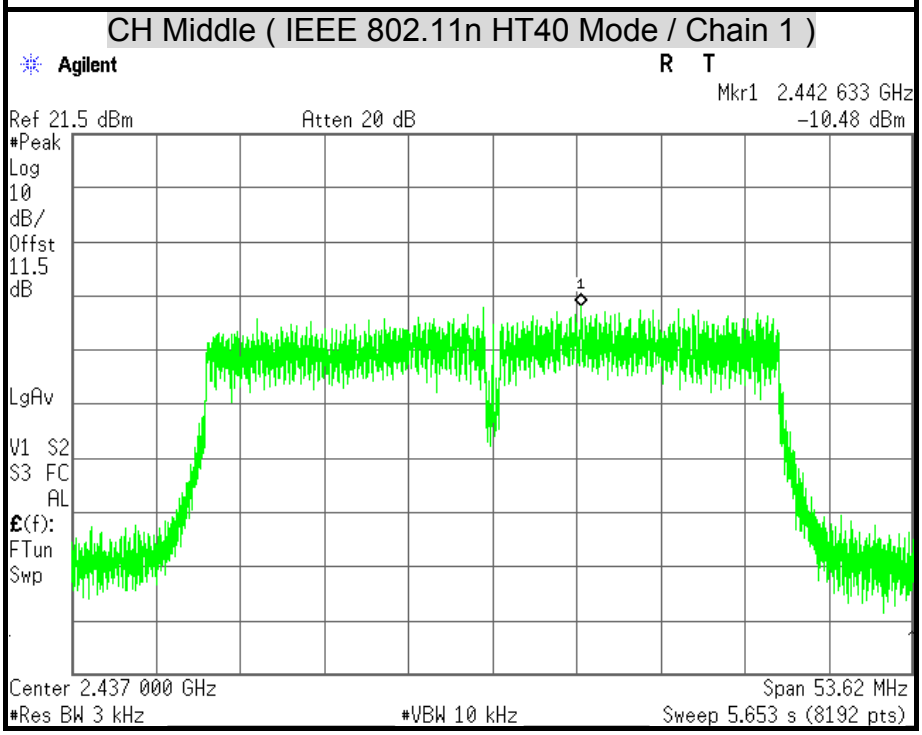
CH High (IEEE 802.11n HT40 Mode / Chain 0)

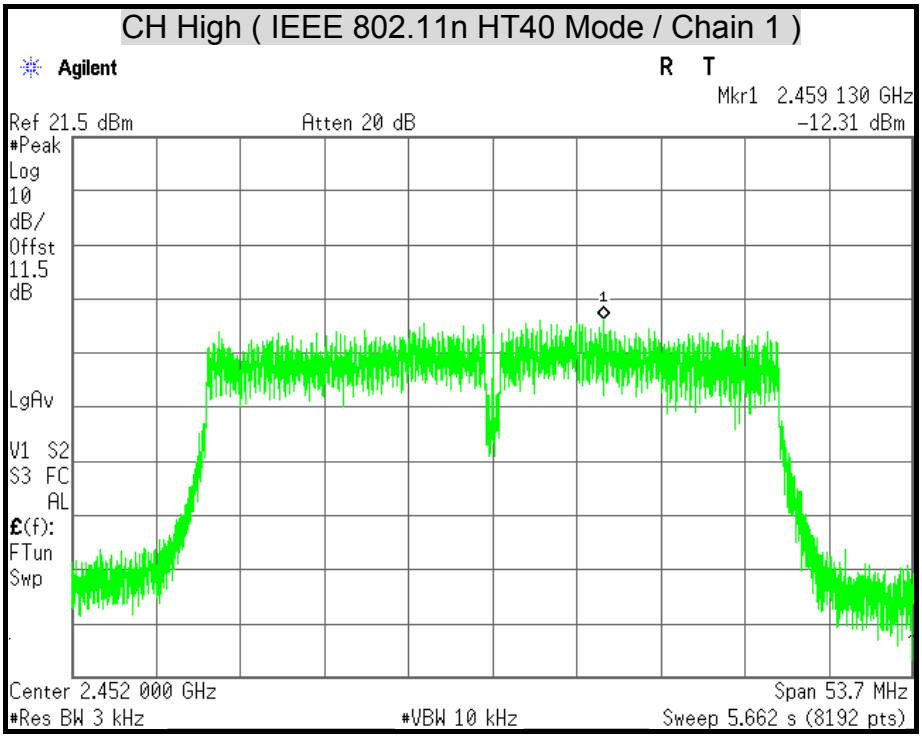


CH Low (IEEE 802.11n HT40 Mode / Chain 1)

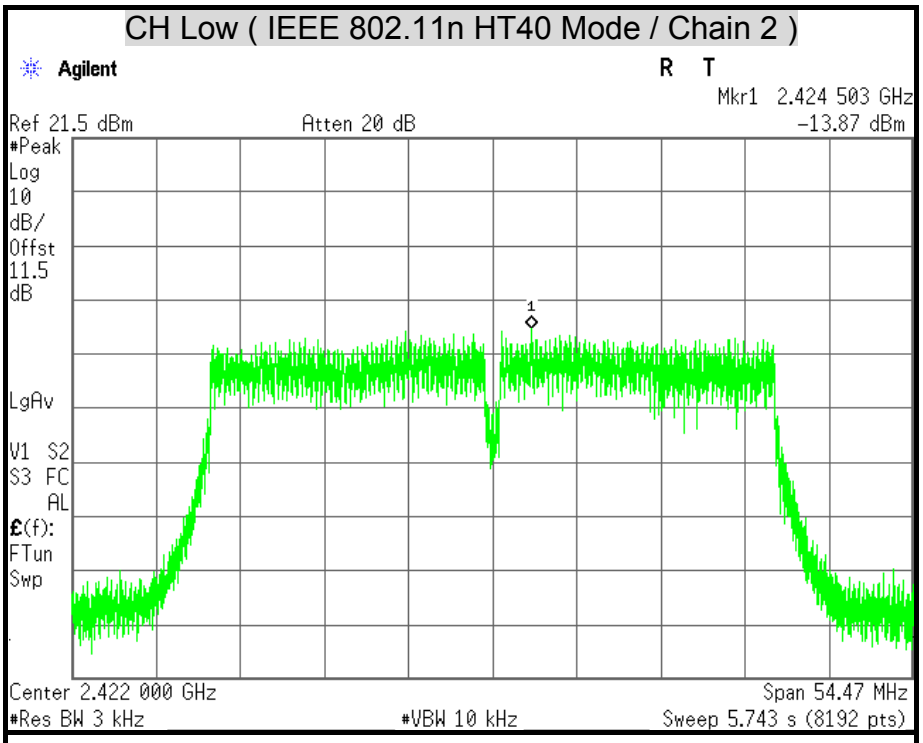


CH Middle (IEEE 802.11n HT40 Mode / Chain 1)

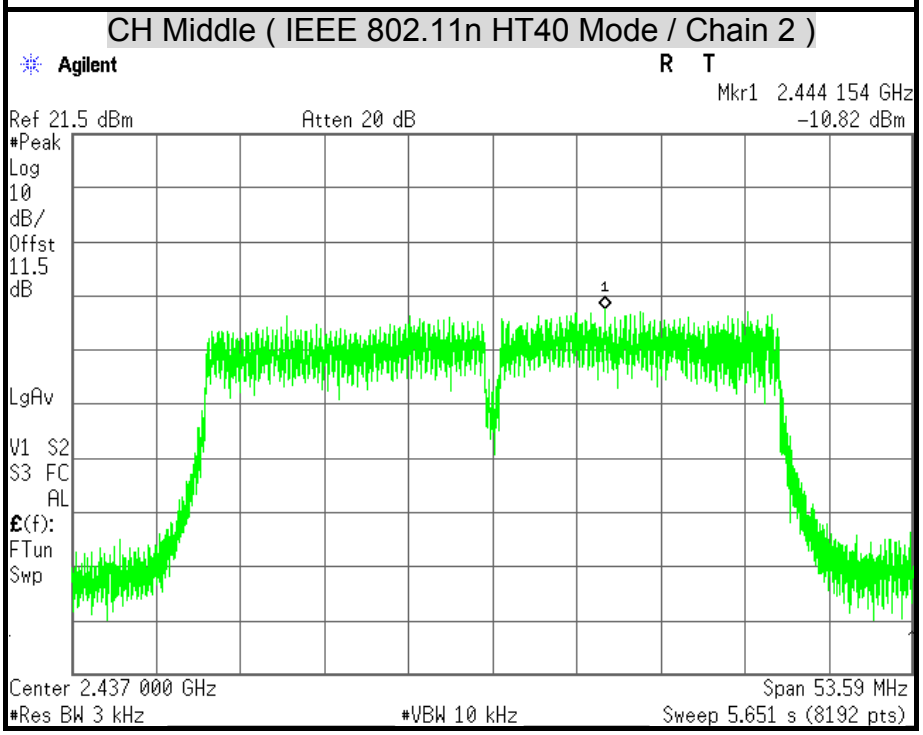




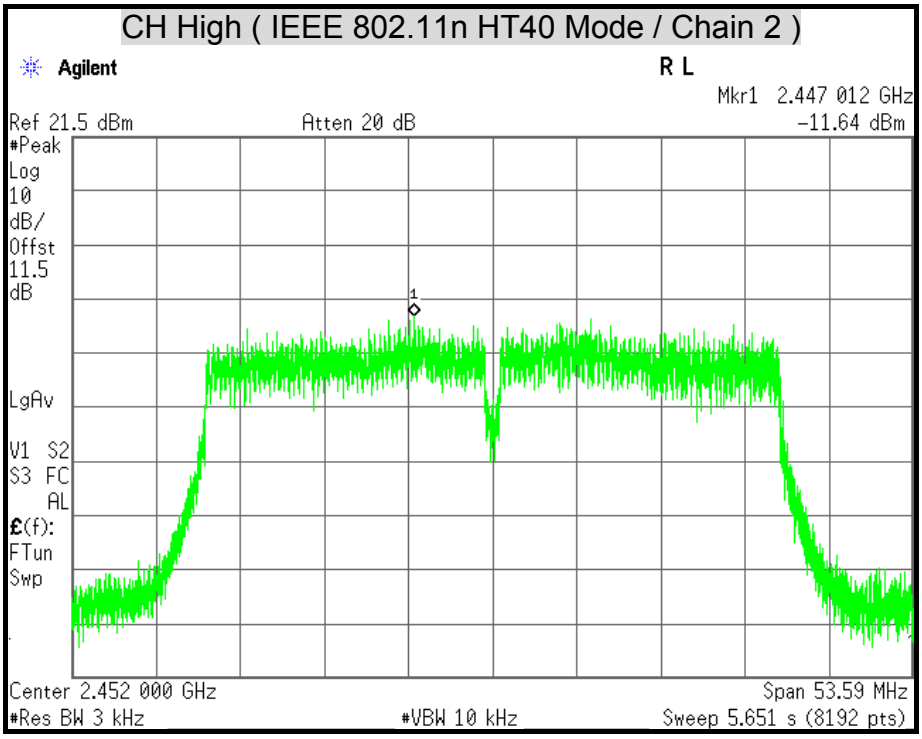
CH Low (IEEE 802.11n HT40 Mode / Chain 2)



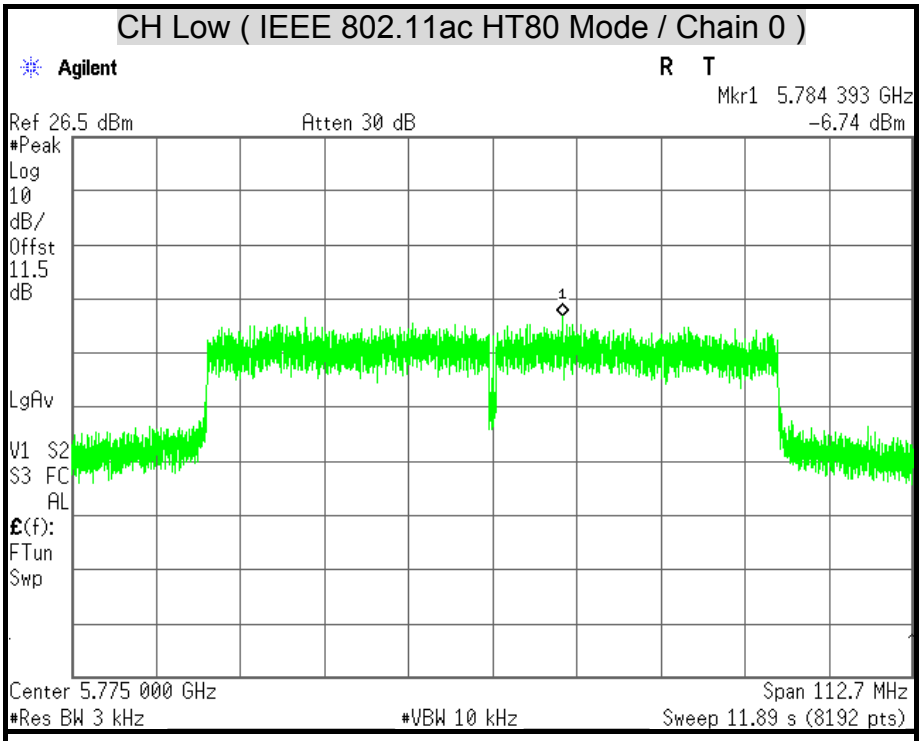
CH Middle (IEEE 802.11n HT40 Mode / Chain 2)



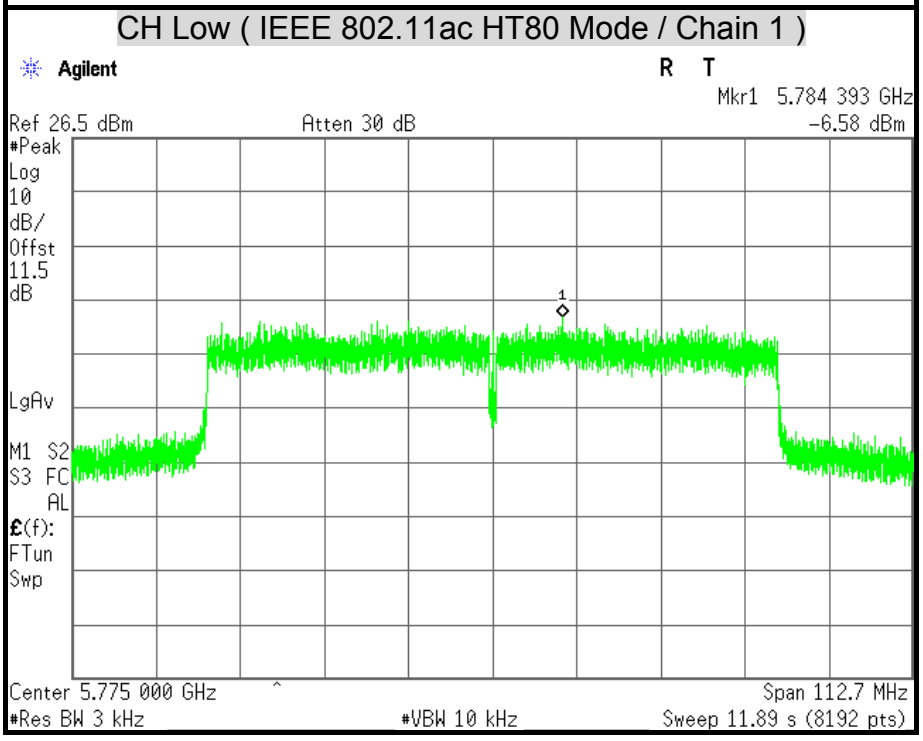
CH High (IEEE 802.11n HT40 Mode / Chain 2)



CH Low (IEEE 802.11ac HT80 Mode / Chain 0)



CH Low (IEEE 802.11ac HT80 Mode / Chain 1)



CH Low (IEEE 802.11ac HT80 Mode / Chain 2)