



FCC 47 CFR PART 15 SUBPART E

**CERTIFICATION TEST REPORT
CLASS II PERMISSIVE CHANGE**

FOR

PORTABLE COMPUTER

MODEL NUMBER: A1534

FCC ID: BCGA1534

REPORT NUMBER: 16U22814-E4V4

ISSUE DATE: FEBRUARY 25, 2016

Prepared for
**APPLE, INC.
1 INFINITE LOOP
CUPERTINO, CA 95014, U.S.A.**

Prepared by
**UL VERIFICATION SERVICES INC.
47173 BENICIA STREET
FREMONT, CA 94538, U.S.A.
TEL: (510) 771-1000
FAX: (510) 661-0888**



NVLAP LAB CODE 200065-0

Revision History

Rev.	Issue Date	Revisions	Revised By
V1	02/19/2016	Initial Issue	M. Mekuria
V2	02/22/2016	Address TCB's Questions	C. Pang
V3	02/23/2016	Updated STBC power Ch149, 2 Tx	J. Vang
V4	02/25/2016	Added TPC results.	E.Yu

TABLE OF CONTENTS

1. ATTESTATION OF TEST RESULTS	14
2. TEST METHODOLOGY	15
3. FACILITIES AND ACCREDITATION	15
4. CALIBRATION AND UNCERTAINTY	16
4.1. MEASURING INSTRUMENT CALIBRATION	16
4.2. SAMPLE CALCULATION	16
4.3. MEASUREMENT UNCERTAINTY	16
5. EQUIPMENT UNDER TEST.....	17
5.1. DESCRIPTION OF EUT.....	17
5.2. MAXIMUM OUTPUT POWER	17
5.3. DESCRIPTION OF AVAILABLE ANTENNAS.....	20
5.4. SOFTWARE AND FIRMWARE	20
5.5. WORST-CASE CONFIGURATION AND MODE.....	21
5.6. DESCRIPTION OF TEST SETUP	22
6. TEST AND MEASUREMENT EQUIPMENT	27
7. ON TIME, DUTY CYCLE AND MEASUREMENT METHODS	28
7.1. ON TIME AND DUTY CYCLE.....	28
7.2. MEASUREMENT METHODS.....	35
8. ANTENNA PORT TEST RESULTS.....	36
8.1. 802.11n HT20 CHAIN 0 MODE IN THE 5.2 GHz BAND	36
8.1.1. 26 dB BANDWIDTH	36
8.1.2. 99% BANDWIDTH.....	38
8.1.3. AVERAGE POWER (FCC).....	40
8.1.4. OUTPUT POWER AND PSD (FCC).....	41
8.2. 802.11n HT20 CHAIN 1 MODE IN THE 5.2 GHz BAND	45
8.2.1. 26 dB BANDWIDTH	45
8.2.2. 99% BANDWIDTH.....	47
8.2.3. AVERAGE POWER (FCC).....	49
8.2.4. OUTPUT POWER AND PSD (FCC).....	50
8.3. 802.11n HT20 2Tx CDD MODE IN THE 5.2 GHz BAND	54
8.3.1. 26 dB BANDWIDTH	54
8.3.2. 99% BANDWIDTH.....	58
8.3.3. AVERAGE POWER (FCC).....	62
8.3.4. OUTPUT POWER AND PSD (FCC).....	63
8.4. 802.11n HT20 2Tx STBC MODE IN THE 5.2 GHz BAND.....	69
8.4.1. 26 dB BANDWIDTH	69
8.4.2. 99% BANDWIDTH.....	73

8.4.3.	AVERAGE POWER (FCC)	77
8.4.4.	OUTPUT POWER AND PSD (FCC)	78
8.5.	<i>802.11ac VHT20 2Tx BEAM FORMING MODE IN THE 5.2 GHz BAND</i>	84
8.5.1.	26 dB BANDWIDTH	84
8.5.2.	99% BANDWIDTH.....	88
8.5.3.	AVERAGE POWER (FCC)	92
8.5.4.	OUTPUT POWER AND PSD (FCC)	93
8.6.	<i>802.11n HT40 CHAIN 0 MODE IN THE 5.2 GHz BAND</i>	99
8.6.1.	26 dB BANDWIDTH	99
8.6.2.	99% BANDWIDTH.....	101
8.6.3.	AVERAGE POWER (FCC)	103
8.6.4.	OUTPUT POWER AND PSD (FCC)	104
8.7.	<i>802.11n HT40 CHAIN 1 MODE IN THE 5.2 GHz BAND</i>	107
8.7.1.	26 dB BANDWIDTH	107
8.7.2.	99% BANDWIDTH.....	109
8.7.3.	AVERAGE POWER (FCC)	111
8.7.4.	OUTPUT POWER AND PSD (FCC)	112
8.8.	<i>802.11n HT40 2Tx CDD MODE IN THE 5.2 GHz BAND</i>	115
8.8.1.	26 dB BANDWIDTH	115
8.8.2.	99% BANDWIDTH.....	118
8.8.3.	AVERAGE POWER (FCC)	121
8.8.4.	OUTPUT POWER AND PSD (FCC)	122
8.9.	<i>802.11n HT40 2Tx STBC MODE IN THE 5.2 GHz BAND</i>	127
8.9.1.	26 dB BANDWIDTH	127
8.9.2.	99% BANDWIDTH.....	130
8.9.3.	AVERAGE POWER (FCC)	133
8.9.4.	OUTPUT POWER AND PSD (FCC)	134
8.10.	<i>802.11ac VHT40 2Tx BEAM FORMING MODE IN THE 5.2 GHz BAND</i>	139
8.10.1.	26 dB BANDWIDTH	139
8.10.2.	99% BANDWIDTH	142
8.10.3.	AVERAGE POWER (FCC)	145
8.10.4.	OUTPUT POWER AND PSD (FCC)	146
8.11.	<i>802.11ac VHT80 CHAIN 0 MODE IN THE 5.2 GHz BAND</i>	151
8.11.1.	26 dB BANDWIDTH.....	151
8.11.2.	99% BANDWIDTH.....	152
8.11.3.	AVERAGE POWER (FCC)	153
8.11.4.	OUTPUT POWER AND PSD (FCC)	154
8.12.	<i>802.11ac VHT80 CHAIN 1 MODE IN THE 5.2 GHz BAND</i>	157
8.12.1.	26 dB BANDWIDTH.....	157
8.12.2.	99% BANDWIDTH	158
8.12.3.	AVERAGE POWER (FCC)	159
8.12.4.	OUTPUT POWER AND PSD (FCC)	160
8.13.	<i>802.11ac VHT80 2Tx CDD MODE IN THE 5.2 GHz BAND</i>	163
8.13.1.	26 dB BANDWIDTH.....	163
8.13.2.	99% BANDWIDTH	165
8.13.3.	AVERAGE POWER	167
8.13.4.	OUTPUT POWER AND PSD	168
8.14.	<i>802.11ac VHT80 2Tx STBC MODE IN THE 5.2 GHz BAND</i>	172

8.14.1.	26 dB BANDWIDTH	172
8.14.2.	99% BANDWIDTH	174
8.14.3.	AVERAGE POWER	176
8.14.4.	OUTPUT POWER AND PSD	177
8.15.	<i>802.11ac VHT80 2Tx BEAM FORMING MODE IN THE 5.2 GHz BAND</i>	<i>181</i>
8.15.1.	26 dB BANDWIDTH	181
8.15.2.	99% BANDWIDTH	183
8.15.3.	AVERAGE POWER	185
8.15.4.	OUTPUT POWER AND PSD	186
8.16.	<i>802.11n HT20 CHAIN 0 MODE IN THE 5.3 GHz BAND</i>	<i>190</i>
8.16.1.	26 dB BANDWIDTH	190
8.16.2.	99% BANDWIDTH	192
8.16.3.	AVERAGE POWER	194
8.16.4.	OUTPUT POWER AND PSD	195
8.17.	<i>802.11n HT20 CHAIN 1 MODE IN THE 5.3 GHz BAND</i>	<i>199</i>
8.17.1.	26 dB BANDWIDTH	199
8.17.2.	99% BANDWIDTH	201
8.17.3.	AVERAGE POWER	203
8.17.4.	OUTPUT POWER AND PSD	204
8.18.	<i>802.11n HT20 2Tx CDD MODE IN THE 5.3 GHz BAND</i>	<i>208</i>
8.18.1.	26 dB BANDWIDTH	208
8.18.2.	99% BANDWIDTH	212
8.18.3.	AVERAGE POWER	216
8.18.4.	OUTPUT POWER AND PSD	217
8.19.	<i>802.11n HT20 2Tx STBC MODE IN THE 5.3 GHz BAND</i>	<i>222</i>
8.19.1.	26 dB BANDWIDTH	222
8.19.2.	99% BANDWIDTH	226
8.19.3.	AVERAGE POWER	230
8.19.4.	OUTPUT POWER AND PSD	231
8.20.	<i>802.11an VHT20 2Tx BEAM FORMING MODE IN THE 5.3 GHz BAND</i>	<i>236</i>
8.20.1.	26 dB BANDWIDTH	236
8.20.2.	99% BANDWIDTH	240
8.20.3.	AVERAGE POWER	244
8.20.4.	OUTPUT POWER AND PSD	245
8.21.	<i>802.11n HT40 CHAIN 0 MODE IN THE 5.3 GHz BAND</i>	<i>250</i>
8.21.1.	26 dB BANDWIDTH	250
8.21.2.	99% BANDWIDTH	252
8.21.3.	AVERAGE POWER	254
8.21.4.	OUTPUT POWER AND PSD	255
8.22.	<i>802.11n HT40 CHAIN 1 MODE IN THE 5.3 GHz BAND</i>	<i>258</i>
8.22.1.	26 dB BANDWIDTH	258
8.22.2.	99% BANDWIDTH	260
8.22.3.	AVERAGE POWER	262
8.22.4.	OUTPUT POWER AND PSD	263
8.23.	<i>802.11n HT40 2Tx CDD MODE IN THE 5.3 GHz BAND</i>	<i>266</i>
8.23.1.	26 dB BANDWIDTH	266
8.23.2.	99% BANDWIDTH	269
8.23.3.	AVERAGE POWER	272
8.23.4.	OUTPUT POWER AND PSD	273

8.24.	802.11n HT40 2Tx STBC MODE IN THE 5.3 GHz BAND	277
8.24.1.	26 dB BANDWIDTH	277
8.24.2.	99% BANDWIDTH	280
8.24.3.	AVERAGE POWER	283
8.24.4.	OUTPUT POWER AND PSD	284
8.25.	802.11an VHT40 2Tx BEAM FORMING MODE IN THE 5.3 GHz BAND.....	288
8.25.1.	26 dB BANDWIDTH.....	288
8.25.2.	99% BANDWIDTH	291
8.25.3.	AVERAGE POWER	294
8.25.4.	OUTPUT POWER AND PSD	295
8.26.	802.11ac VHT80 CHAIN 0 MODE IN THE 5.3 GHz BAND	299
8.26.1.	26 dB BANDWIDTH	299
8.26.2.	99% BANDWIDTH	300
8.26.3.	AVERAGE POWER	301
8.26.4.	OUTPUT POWER AND PSD	302
8.27.	802.11ac VHT80 CHAIN 1 MODE IN THE 5.3 GHz BAND	305
8.27.1.	26 dB BANDWIDTH	305
8.27.2.	99% BANDWIDTH	306
8.27.3.	AVERAGE POWER	307
8.27.4.	OUTPUT POWER AND PSD	308
8.28.	802.11ac VHT80 2Tx CDD MODE IN THE 5.3 GHz BAND.....	311
8.28.1.	26 dB BANDWIDTH	311
8.28.2.	99% BANDWIDTH	313
8.28.3.	AVERAGE POWER	315
8.28.4.	OUTPUT POWER AND PSD	316
8.29.	802.11ac VHT80 2Tx STBC MODE IN THE 5.3 GHz BAND	319
8.29.1.	26 dB BANDWIDTH	319
8.29.2.	99% BANDWIDTH	321
8.29.3.	AVERAGE POWER	323
8.29.4.	OUTPUT POWER AND PSD	324
8.30.	802.11ac VHT80 2Tx BEAM FORMING MODE IN THE 5.3 GHz BAND.....	327
8.30.1.	26 dB BANDWIDTH	327
8.30.2.	99% BANDWIDTH	329
8.30.3.	AVERAGE POWER	331
8.30.4.	OUTPUT POWER AND PSD	332
8.31.	802.11n HT20 CHAIN 0 MODE IN THE 5.6 GHz BAND	335
8.31.1.	26 dB BANDWIDTH	335
8.31.2.	99% BANDWIDTH	338
8.31.3.	AVERAGE POWER	341
8.31.4.	OUTPUT POWER AND PSD	342
8.32.	802.11ac VHT20 CHAIN 0 STRADDLE CHANNEL 144 RESULTS (FCC).....	346
8.32.1.	OUTPUT POWER AND PSD	346
8.32.2.	6 dB BANDWIDTH.....	350
8.33.	802.11n HT20 CHAIN 1 MODE IN THE 5.6 GHz BAND	351
8.33.1.	26 dB BANDWIDTH	351
8.33.2.	99% BANDWIDTH	354
8.33.3.	AVERAGE POWER	357
8.33.4.	OUTPUT POWER AND PSD	358

8.34.	802.11ac VHT20 CHAIN 1 STRADDLE CHANNEL 144 RESULTS (FCC)	362
8.34.1.	OUTPUT POWER AND PSD	362
8.34.2.	6 dB BANDWIDTH	366
8.35.	802.11n HT20 2Tx CDD MODE IN THE 5.6 GHz BAND	367
8.35.1.	26 dB BANDWIDTH	367
8.35.2.	99% BANDWIDTH	372
8.35.3.	AVERAGE POWER	377
8.35.4.	OUTPUT POWER AND PSD	378
8.36.	802.11ac VHT20 2Tx CDD STRADDLE CHANNEL 144 RESULTS (FCC)	384
8.36.1.	OUTPUT POWER AND PSD	384
8.36.2.	6 dB BANDWIDTH	390
8.37.	802.11n HT20 2Tx STBC MODE IN THE 5.6 GHz BAND	392
8.37.1.	26 dB BANDWIDTH	392
8.37.2.	99% BANDWIDTH	397
8.37.3.	AVERAGE POWER	402
8.37.4.	OUTPUT POWER AND PSD	403
8.38.	802.11ac VHT20 2Tx STBC STRADDLE CHANNEL 144 RESULTS (FCC)	408
8.38.1.	OUTPUT POWER AND PSD	408
8.38.2.	6 dB BANDWIDTH	414
8.39.	802.11ac VHT20 2Tx BEAM FORMING MODE IN THE 5.6 GHz BAND	416
8.39.1.	26 dB BANDWIDTH	416
8.39.2.	99% BANDWIDTH	421
8.39.3.	AVERAGE POWER	426
8.39.4.	OUTPUT POWER AND PSD	427
8.40.	802.11ac VHT20 2Tx BEAM FORMING STRADDLE CHANNEL 144 RESULTS (FCC)	432
8.40.1.	OUTPUT POWER AND PSD	432
8.40.2.	6 dB BANDWIDTH	438
8.41.	802.11n HT40 CHAIN 0 MODE IN THE 5.6 GHz BAND	440
8.41.1.	26 dB BANDWIDTH	440
8.41.2.	99% BANDWIDTH	443
8.41.3.	AVERAGE POWER	446
8.41.4.	OUTPUT POWER AND PSD	447
8.42.	802.11ac VHT40 CHAIN 0 STRADDLE CH 142 RESULTS (FCC)	451
8.42.1.	OUTPUT POWER AND PSD	451
8.42.2.	6 dB BANDWIDTH	455
8.43.	802.11n HT40 CHAIN 1 MODE IN THE 5.6 GHz BAND	456
8.43.1.	26 dB BANDWIDTH	456
8.43.2.	99% BANDWIDTH	459
8.43.3.	AVERAGE POWER	462
8.43.4.	OUTPUT POWER AND PSD	463
8.44.	802.11ac VHT40 CHAIN 1 STRADDLE CH 142 RESULTS (FCC)	467
8.44.1.	OUTPUT POWER AND PSD	467
8.44.2.	6 dB BANDWIDTH	471
8.45.	802.11n HT40 2Tx CDD MODE IN THE 5.6 GHz BAND	472
8.45.1.	26 dB BANDWIDTH	472
8.45.2.	99% BANDWIDTH	477
8.45.3.	AVERAGE POWER	482
8.45.4.	OUTPUT POWER AND PSD	483

8.46.	802.11ac VHT40 2Tx CDD STRADDLE CHANNEL 142 RESULTS (FCC)	489
8.46.1.	OUTPUT POWER AND PSD	489
8.46.2.	6 dB BANDWIDTH	495
8.47.	802.11n HT40 2Tx STBC MODE IN THE 5.6 GHz BAND	497
8.47.1.	26 dB BANDWIDTH	497
8.47.2.	99% BANDWIDTH	502
8.47.3.	AVERAGE POWER	507
8.47.4.	OUTPUT POWER AND PSD	508
8.48.	802.11ac VHT40 2Tx STBC STRADDLE CHANNEL 142 RESULTS (FCC)	513
8.48.1.	OUTPUT POWER AND PSD	513
8.48.2.	6 dB BANDWIDTH	519
8.49.	802.11ac VHT40 2Tx BEAM FORMING MODE IN THE 5.6 GHz BAND	521
8.49.1.	26 dB BANDWIDTH	521
8.49.2.	99% BANDWIDTH	526
8.49.3.	AVERAGE POWER	531
8.49.4.	OUTPUT POWER AND PSD	532
8.50.	802.11ac VHT40 2Tx BEAM FORMING STRADDLE CHANNEL 142 RESULTS (FCC)	537
8.50.1.	OUTPUT POWER AND PSD	537
8.50.2.	6 dB BANDWIDTH	543
8.51.	802.11ac VHT80 CHAIN 0 MODE IN THE 5.6 GHz BAND	545
8.51.1.	26 dB BANDWIDTH	545
8.51.2.	99% BANDWIDTH	547
8.51.3.	AVERAGE POWER	549
8.51.4.	OUTPUT POWER AND PSD	550
8.51.5.	STRADDLE CHANNEL 138 RESULTS (FCC)	553
8.51.6.	6 dB BANDWIDTH	557
8.52.	802.11ac VHT80 CHAIN 1 MODE IN THE 5.6 GHz BAND	558
8.52.1.	26 dB BANDWIDTH	558
8.52.2.	99% BANDWIDTH	560
8.52.3.	AVERAGE POWER	562
8.52.4.	OUTPUT POWER AND PSD	563
8.52.5.	STRADDLE CHANNEL 138 RESULTS (FCC)	566
8.52.6.	6 dB BANDWIDTH	570
8.53.	802.11ac VHT80 2Tx CDD MODE IN THE 5.6 GHz BAND	571
8.53.1.	26 dB BANDWIDTH	571
8.53.2.	99% BANDWIDTH	575
8.53.3.	AVERAGE POWER	579
8.53.4.	OUTPUT POWER AND PSD	580
8.53.5.	STRADDLE CHANNEL 138 RESULTS (FCC)	585
8.53.6.	6 dB BANDWIDTH	591
8.54.	802.11ac VHT80 2Tx STBC MODE IN THE 5.6 GHz BAND	593
8.54.1.	26 dB BANDWIDTH	593
8.54.2.	99% BANDWIDTH	597
8.54.3.	AVERAGE POWER	601
8.54.4.	OUTPUT POWER AND PSD	602
8.54.5.	STRADDLE CHANNEL 138 RESULTS (FCC)	606
8.54.6.	6 dB BANDWIDTH	612
8.55.	802.11ac VHT80 2Tx BEAM FORMING MODE IN THE 5.6 GHz BAND	614
8.55.1.	26 dB BANDWIDTH	614

8.55.2.	99% BANDWIDTH	618
8.55.3.	AVERAGE POWER	622
8.55.4.	OUTPUT POWER AND PSD	623
8.55.5.	TPC POWER	627
8.55.7.	STRADDLE CHANNEL 138 RESULTS (FCC)	629
8.55.8.	TPC POWER STRADDLE CHANNEL 138 RESULTS (FCC).....	635
8.55.10.	6 dB BANDWIDTH.....	641
8.56.	<i>802.11n HT20 CHAIN 0 MODE IN THE 5.8 GHz BAND</i>	<i>643</i>
8.56.1.	6 dB BANDWIDTH.....	643
8.56.2.	26 dB BANDWIDTH.....	645
8.56.3.	99% BANDWIDTH	647
8.56.4.	AVERAGE POWER	649
8.56.5.	OUTPUT POWER.....	650
8.56.6.	PSD	651
8.57.	<i>802.11n HT20 CHAIN 1 MODE IN THE 5.8 GHz BAND</i>	<i>654</i>
8.57.1.	6 dB BANDWIDTH.....	654
8.57.2.	26 dB BANDWIDTH.....	656
8.57.3.	99% BANDWIDTH	658
8.57.4.	AVERAGE POWER	660
8.57.5.	OUTPUT POWER.....	661
8.57.6.	PSD	662
8.58.	<i>802.11n HT20 2Tx CDD MODE IN THE 5.8 GHz BAND</i>	<i>665</i>
8.58.1.	6 dB BANDWIDTH.....	665
8.58.2.	26 dB BANDWIDTH.....	669
8.58.3.	99% BANDWIDTH	673
8.58.4.	AVERAGE POWER	677
8.58.5.	OUTPUT POWER.....	678
8.58.6.	PSD	680
8.59.	<i>802.11n HT20 2Tx STBC MODE IN THE 5.8 GHz BAND</i>	<i>685</i>
8.59.1.	6 dB BANDWIDTH.....	685
8.59.2.	26 dB BANDWIDTH.....	689
8.59.3.	99% BANDWIDTH	693
8.59.4.	AVERAGE POWER	697
8.59.5.	OUTPUT POWER.....	698
8.59.6.	PSD	700
8.60.	<i>802.11ac VHT20 2Tx BEAM FORMING MODE IN THE 5.8 GHz BAND</i>	<i>705</i>
8.60.1.	6 dB BANDWIDTH.....	705
8.60.2.	26 dB BANDWIDTH.....	709
8.60.3.	99% BANDWIDTH	713
8.60.4.	AVERAGE POWER	717
8.60.5.	OUTPUT POWER.....	718
8.60.6.	PSD	720
8.61.	<i>802.11n HT40 CHAIN 0 MODE IN THE 5.8 GHz BAND</i>	<i>725</i>
8.61.1.	6 dB BANDWIDTH.....	725
8.61.2.	26 dB BANDWIDTH.....	727
8.61.3.	99% BANDWIDTH	729
8.61.4.	AVERAGE POWER	731
8.61.5.	OUTPUT POWER.....	732
8.61.6.	PSD	734
8.62.	<i>802.11n HT40 CHAIN 1 MODE IN THE 5.8 GHz BAND</i>	<i>737</i>

8.62.1.	6 dB BANDWIDTH.....	737
8.62.2.	26 dB BANDWIDTH.....	739
8.62.3.	99% BANDWIDTH.....	741
8.62.4.	AVERAGE POWER.....	743
8.62.5.	OUTPUT POWER.....	744
8.62.6.	PSD.....	746
8.63.	<i>802.11n HT40 2Tx CDD MODE IN THE 5.8 GHz BAND.....</i>	<i>749</i>
8.63.1.	6 dB BANDWIDTH.....	749
8.63.2.	26 dB BANDWIDTH.....	752
8.63.3.	99% BANDWIDTH.....	755
8.63.4.	AVERAGE POWER.....	758
8.63.5.	OUTPUT POWER.....	759
8.63.6.	PSD.....	761
8.64.	<i>802.11n HT40 2Tx STBC MODE IN THE 5.8 GHz BAND.....</i>	<i>765</i>
8.64.1.	6 dB BANDWIDTH.....	765
8.64.2.	26 dB BANDWIDTH.....	768
8.64.3.	99% BANDWIDTH.....	771
8.64.4.	AVERAGE POWER.....	774
8.64.5.	OUTPUT POWER.....	775
8.64.6.	PSD.....	777
8.65.	<i>802.11ac VHT40 2Tx BEAM FORMING MODE IN THE 5.8 GHz BAND.....</i>	<i>781</i>
8.65.1.	6 dB BANDWIDTH.....	781
8.65.2.	26 dB BANDWIDTH.....	784
8.65.3.	99% BANDWIDTH.....	787
8.65.4.	AVERAGE POWER.....	790
8.65.5.	OUTPUT POWER.....	791
8.65.6.	PSD.....	793
8.66.	<i>802.11ac VHT80 CHAIN 0 MODE IN THE 5.8 GHz BAND.....</i>	<i>797</i>
8.66.1.	6 dB BANDWIDTH.....	797
8.66.2.	26 dB BANDWIDTH.....	798
8.66.3.	99% BANDWIDTH.....	799
8.66.4.	AVERAGE POWER.....	800
8.66.5.	OUTPUT POWER.....	801
8.66.6.	PSD.....	803
8.67.	<i>802.11ac VHT80 CHAIN 1 MODE IN THE 5.8 GHz BAND.....</i>	<i>805</i>
8.67.1.	6 dB BANDWIDTH.....	805
8.67.2.	26 dB BANDWIDTH.....	806
8.67.3.	99% BANDWIDTH.....	807
8.67.4.	AVERAGE POWER.....	808
8.67.5.	OUTPUT POWER.....	809
8.67.6.	PSD.....	811
8.68.	<i>802.11ac VHT80 2Tx CDD MODE IN THE 5.8 GHz BAND.....</i>	<i>813</i>
8.68.1.	6 dB BANDWIDTH.....	813
8.68.2.	26 dB BANDWIDTH.....	815
8.68.3.	99% BANDWIDTH.....	817
8.68.4.	AVERAGE POWER.....	819
8.68.5.	OUTPUT POWER.....	820
8.68.6.	PSD.....	822
8.69.	<i>802.11ac VHT80 2Tx STBC MODE IN THE 5.8 GHz BAND.....</i>	<i>825</i>
8.69.1.	6 dB BANDWIDTH.....	825

8.69.2.	26 dB BANDWIDTH	827
8.69.3.	99% BANDWIDTH	829
8.69.4.	AVERAGE POWER	831
8.69.5.	OUTPUT POWER.....	832
8.69.6.	PSD	834
8.70.	802.11ac VHT80 2Tx BEAM FORMING MODE IN THE 5.8 GHz BAND.....	837
8.70.1.	6 dB BANDWIDTH.....	837
8.70.2.	26 dB BANDWIDTH.....	839
8.70.3.	99% BANDWIDTH	841
8.70.4.	AVERAGE POWER	843
8.70.5.	OUTPUT POWER.....	844
8.70.6.	PSD	846
9.	RADIATED TEST RESULTS	849
9.1.	LIMITS AND PROCEDURE.....	849
9.2.	802.11n HT20 1Tx MODE IN THE 5.2 GHz BAND	850
9.3.	802.11n HT20 2Tx CDD MODE IN THE 5.2 GHz BAND	866
9.4.	802.11n HT20 2Tx STBC MODE IN THE 5.2 GHz BAND.....	874
9.5.	802.11ac VHT20 2Tx BEAM FORMING MODE IN THE 5.2 GHz BAND	876
9.6.	802.11n HT40 1Tx MODE IN THE 5.2 GHz BAND	884
9.7.	802.11n HT40 2Tx CDD MODE IN THE 5.2 GHz BAND	896
9.8.	802.11n HT40 2Tx STBC MODE IN THE 5.2 GHz BAND.....	902
9.9.	802.11ac VHT40 2Tx BEAM FORMING MODE IN THE 5.2 GHz BAND	904
9.10.	802.11ac VHT80 1Tx MODE IN THE 5.2 GHz BAND	910
9.11.	802.11ac VHT80 2Tx CDD MODE IN THE 5.2 GHz BAND.....	918
9.12.	802.11ac VHT80 2Tx STBC MODE IN THE 5.2 GHz BAND.....	922
9.13.	802.11ac VHT80 2Tx BEAM FORMING MODE IN THE 5.2 GHz BAND.....	924
9.14.	802.11n HT20 1Tx MODE IN THE 5.3 GHz BAND	928
9.15.	802.11n HT20 2Tx CDD MODE IN THE 5.3 GHz BAND.....	944
9.16.	802.11n HT20 2Tx STBC MODE IN THE 5.3 GHz BAND	952
9.17.	802.11ac VHT20 2Tx BEAM FORMING MODE IN THE 5.3 GHz BAND.....	954
9.18.	802.11n HT40 1Tx MODE IN THE 5.3 GHz BAND	962
9.19.	802.11n HT40 2Tx CDD MODE IN THE 5.3 GHz BAND.....	974
9.20.	802.11n HT40 2Tx STBC MODE IN THE 5.3 GHz BAND	980
9.21.	802.11ac VHT40 2Tx BEAM FORMING MODE IN THE 5.3 GHz BAND.....	982
9.22.	802.11ac VHT80 1Tx MODE IN THE 5.3 GHz BAND	988
9.23.	802.11ac VHT80 2Tx CDD MODE IN THE 5.3 GHz BAND.....	996
9.24.	802.11ac VHT80 2Tx STBC MODE IN THE 5.3 GHz BAND	1000
9.25.	802.11ac VHT80 2Tx BEAM FORMING MODE IN THE 5.3 GHz BAND.....	1002
9.26.	802.11n HT20 1Tx MODE IN THE 5.6 GHz BAND	1006

9.27.	802.11ac VHT20 1Tx STRADDLE CHANNEL 144 HARMONICS AND SPURIOUS EMISSIONS.....	1026
9.28.	802.11n HT20 2Tx CDD MODE IN THE 5.6 GHz BAND.....	1030
9.29.	802.11ac VHT20 2Tx CDD STRADDLE CHANNEL 144 HARMONICS AND SPURIOUS EMISSIONS.....	1040
9.30.	802.11n HT20 2Tx STBC MODE IN THE 5.6 GHz BAND.....	1042
9.31.	802.11ac VHT20 2Tx BEAM FORMING MODE IN THE 5.6 GHz BAND.....	1046
9.32.	802.11ac VHT20 2Tx BEAM FORMING STRADDLE CHANNEL 144 HARMONIS AND SPURIOUS EMISSIONS.....	1056
9.33.	802.11n HT40 1Tx MODE IN THE 5.6 GHz BAND	1058
9.34.	802.11n HT40 2Tx CDD MODE IN THE 5.6 GHz BAND.....	1082
9.35.	802.11ac VHT40 2Tx CDD STRADDLE CHANNEL 142 HARMONICS AND SPURIOUS EMISSIONS.....	1092
9.36.	802.11n HT40 2Tx STBC MODE IN THE 5.6 GHz BAND.....	1094
9.37.	802.11ac VHT40 2Tx BEAM FORMING MODE IN THE 5.6 GHz BAND.....	1098
9.38.	802.11ac VHT40 2Tx BEAM FORMING STRADDLE CHANNEL 142 HARMONICS AND SPURIOUS EMISSIONS.....	1108
9.39.	802.11ac VHT80 1Tx MODE IN THE 5.6 GHz BAND	1110
9.40.	802.11ac VHT80 2Tx CDD MODE IN THE 5.6 GHz BAND.....	1126
9.41.	802.11ac VHT80 2Tx STBC MODE IN THE 5.6 GHz BAND	1134
9.42.	802.11ac VHT80 2Tx BEAM FORMING MODE IN THE 5.6 GHz BAND.....	1136
9.43.	802.11n HT20 1Tx MODE IN THE 5.8 GHz BAND	1144
9.44.	802.11n HT20 2Tx CDD MODE IN THE 5.8 GHz BAND.....	1164
9.45.	802.11n HT20 2Tx STBC MODE IN THE 5.8 GHz BAND.....	1174
9.46.	802.11n HT20 2Tx BEAM FORMING MODE IN THE 5.8 GHz BAND.....	1178
9.47.	802.11n HT40 1Tx MODE IN THE 5.8 GHz BAND	1188
9.48.	802.11n HT40 2Tx CDD MODE IN THE 5.8 GHz BAND.....	1204
9.49.	802.11n HT40 2Tx STBC MODE IN THE 5.8 GHz BAND	1212
9.50.	802.11ac VHT40 2Tx BEAM FORMING MODE IN THE 5.8 GHz BAND.....	1216
9.51.	802.11ac VHT80 1Tx MODE IN THE 5.8 GHz BAND	1224
9.52.	802.11ac VHT80 2Tx CDD MODE IN THE 5.8 GHz BAND.....	1236
9.53.	802.11ac VHT80 2Tx STBC MODE IN THE 5.8 GHz BAND	1242
9.54.	802.11ac VHT80 2Tx BEAM FORMING MODE IN THE 5.8 GHz BAND.....	1246
9.55.	WORST-CASE BELOW 1 GHz.....	1252
9.56.	WORST-CASE ABOVE 18 GHz	1254
10.	AC POWER LINE CONDUCTED EMISSIONS.....	1256
10.1.	EUT POWERED BY AC/DC ADAPTER.....	1257

11.	DYNAMIC FREQUENCY SELECTION.....	1259
11.1.	OVERVIEW	1259
11.1.1.	LIMITS	1259
11.1.2.	TEST AND MEASUREMENT SYSTEM	1263
11.1.3.	SETUP OF EUT (CLIENT MODE)	1266
11.1.4.	SETUP OF EUT (CLIENT-TO-CLIENT COMMUNICATIONS MODE).....	1267
11.1.5.	DESCRIPTION OF EUT	1268
11.2.	CLIENT MODE RESULTS FOR 20 MHz BANDWIDTH	1270
11.2.1.	TEST CHANNEL.....	1270
11.2.2.	RADAR WAVEFORM AND TRAFFIC	1270
11.2.3.	OVERLAPPING CHANNEL TESTS	1273
11.2.4.	MOVE AND CLOSING TIME	1273
11.3.	CLIENT MODE RESULTS FOR 40 MHz BANDWIDTH	1277
11.3.1.	TEST CHANNEL.....	1277
11.3.2.	RADAR WAVEFORM AND TRAFFIC	1277
11.3.3.	OVERLAPPING CHANNEL TESTS	1280
11.3.4.	MOVE AND CLOSING TIME	1280
11.4.	CLIENT-TO-CLIENT COMMUNICATIONS MODE RESULTS FOR 20 MHz BANDWIDTH 1284	
11.4.1.	TEST CHANNEL.....	1284
11.4.2.	RADAR WAVEFORM AND TRAFFIC	1284
11.4.3.	OVERLAPPING CHANNEL TESTS	1287
11.4.4.	MOVE AND CLOSING TIME	1287
11.5.	CLIENT-TO-CLIENT COMMUNICATIONS MODE RESULTS FOR 40 MHz BANDWIDTH 1291	
11.5.1.	TEST CHANNEL.....	1291
11.5.2.	RADAR WAVEFORM AND TRAFFIC	1291
11.5.3.	OVERLAPPING CHANNEL TESTS	1294
11.5.4.	MOVE AND CLOSING TIME	1294
11.5.5.	10-MINUTE CLIENT Tx MONITORING PERIOD	1298
12.	SETUP PHOTOS.....	1299

1. ATTESTATION OF TEST RESULTS

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

EUT DESCRIPTION: PORTABLE COMPUTER

MODEL: A1534

SERIAL NUMBER: C02R400GH4W8 (CONDUCTED), C02R4006H501 (RADIATED)
C02R400BH501 (STANDARD CLIENT MODE), and
C02R4002H501 (CLIENT TO CLIENT MODE)

DATE TESTED: JANUARY 26, 2016 TO FEBRUARY 25, 2016

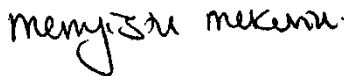
APPLICABLE STANDARDS	
STANDARD	TEST RESULTS
CFR 47 Part 15 Subpart E	Pass

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

Note: The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by UL Verification Services Inc. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL Verification Services Inc. will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, any agency of the Federal Government, or any agency of any government.

Approved & Released For
UL Verification Services Inc. By:

Tested By:



MENGISTU MEKURIA
SENIOR ENGINEER
UL VERIFICATION SERVICES INC.

JOE VANG
EMC LAB ENGINEER
UL VERIFICATION SERVICES INC.

2. TEST METHODOLOGY

FCC: The tests documented in this report were performed in accordance with FCC CFR 47 Part 2, FCC CFR 47 Part 15, FCC 14-30, FCC KDB 662911 D01 v02r01, FCC KDB 905462 D02 v01r02/D03 v01r01/D06 v01, FCC KDB 789033 D02 v01r01, FCC KDB 644545 D03 v01, ANSI C63.10-2013.

3. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 47173 and 47266 Benicia Street, Fremont, California, USA. Line conducted emissions are measured only at the 47173 address. The following table identifies which facilities were utilized for radiated emission measurements documented in this report. Specific facilities are also identified in the test results sections.

47173 Benicia Street	47266 Benicia Street
☐ Chamber A	☒ Chamber D
☐ Chamber B	☒ Chamber E
☐ Chamber C	☒ Chamber F
	☒ Chamber G
	☒ Chamber H

The above test sites and facilities are covered under FCC Test Firm Registration # 208313. Chambers A through H are covered under Industry Canada company address code 2324B with site numbers 2324B -1 through 2324B-8, respectively.

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

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:

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

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	± 3.52 dB
Radiated Disturbance, 30 to 1000 MHz	± 4.94 dB
Radiated Disturbance, 1 to 6 GHz	± 3.86 dB
Radiated Disturbance, 6 to 18 GHz	± 4.23 dB
Radiated Disturbance, 18 to 26 GHz	± 5.30 dB
Radiated Disturbance, 26 to 40 GHz	± 5.23 dB

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

5. EQUIPMENT UNDER TEST

5.1. DESCRIPTION OF EUT

The EUT is a Laptop Device with Bluetooth and WLAN Radios (AC 80 MHZ Beam-Forming).

5.2. MAXIMUM OUTPUT POWER

The transmitter has a maximum conducted output power as follows: NOTE: Covered modes are test reduction modes. The output powers on the “covered modes are equal to or less than the mode referenced and use the same modulation.

Frequency Range (MHz)	Mode	Output Power (dBm)	Output Power (mW)
5180 - 5240	802.11a	Covered by 802.11n HT20 SISO	
	802.11n HT20 SISO	17.96	62.52
	802.11n HT20 CDD 2TX	18.86	76.91
	802.11n HT20 2TX STBC	19.92	98.17
	802.11n HT20 2TX BEAM FORMING	18.99	79.25
5190 - 5230	802.11n HT40 SISO	17.80	60.26
	802.11n HT40 CDD 2TX	18.91	77.80
	802.11n HT40 2TX STBC	19.96	99.08
	802.11n HT40 2TX BEAM FORMING	18.97	78.89
5210	802.11ac VHT80 SISO	11.99	15.81
	802.11ac VHT80 2TX CDD	13.90	24.55
	802.11ac VHT80 2TX STBC	13.91	24.60
	802.11ac VHT80 2TX SDM	Covered by 802.11ac VHT80 STBC 2TX	
	802.11ac VHT80 2TX BEAM FORMING	12.39	17.34

5.3GHz Band

Frequency Range (MHz)	Mode	Output Power (dBm)	Output Power (mW)
5260 - 5320	802.11a	Covered by 802.11n HT20 SISO	
	802.11n HT20 SISO	17.93	62.09
	802.11n HT20 2TX CDD	18.97	78.89
	802.11n HT20 2TX STBC	19.98	99.54
	802.11n HT20 2TX BEAM FORMING	18.94	78.34
5270 - 5310	802.11n HT40 SISO	17.72	59.16
	802.11n HT40 2TX CDD	18.87	77.09
	802.11n HT40 2TX STBC	19.91	97.95
	802.11n HT40 2TX BEAM FORMING	18.89	77.45
5290	802.11ac VHT80 SISO	10.96	12.47
	802.11ac VHT80 2TX CDD	11.44	13.93
	802.11ac VHT80 2TX STBC	12.47	17.66
	802.11ac VHT80 2TX SDM	Covered by 802.11ac VHT80 STBC 2TX	
	802.11ac VHT80 2TX BEAM FORMING	12.46	17.62

Frequency Range (MHz)	Mode	Output Power (dBm)	Output Power (mW)
5500 - 5700	802.11a	Covered by 802.11n HT20 SISO	
5500 - 5700	802.11n HT20 SISO	17.95	62.37
5720	802.11ac VHT20 SISO (based on UNII-2C band output power)	14.75	29.85
5500 - 5700	802.11n HT20 2TX CDD	17.33	54.08
5720	802.11ac VHT20 2TX CDD (based on UNII-2C band output power)	16.31	42.76
5500 - 5700	802.11n HT20 2TX STBC	19.93	98.40
5720	802.11ac VHT20 2TX STBC (based on UNII-2C band output power)	18.32	67.92
5500 - 5700	802.11n HT20 2TX BEAM FORMING	17.41	55.08
5720	802.11ac VHT20 2TX BEAM FORMING (based on UNII-2C band output power)	16.30	42.66
5510 - 5670	802.11n HT40 SISO	17.92	61.94
5710	802.11ac VHT40 SISO (based on UNII-2C band output power)	16.67	46.45
5510 - 5670	802.11n HT40 2TX CDD	17.48	55.98
5710	802.11ac VHT40 2TX CDD (based on UNII-2C band output power)	17.09	51.17
5510 - 5670	802.11n HT40 2TX STBC	19.91	97.95
5710	802.11ac VHT40 STBC 2TX (based on UNII-2C band output power)	19.05	80.35
5510 - 5670	802.11n HT40 2TX SDM	Covered by 802.11n HT40 STBC 2TX	
5710	802.11ac VHT40 SDM 2TX (based on UNII-2C band output power)	Covered by 802.11n HT40 STBC 2TX	
5510 - 5670	802.11n HT40 2TX BEAM FORMING	17.45	55.59
5710	802.11ac VHT40 BEAM FORMING 2TX (based on UNII-2C band output power)	16.64	46.13
5530-5610	802.11ac VHT80 SISO	17.86	61.09
5690	802.11ac VHT80 SISO (based on UNII-2C band output power)	18.00	63.10
5530-5610	802.11ac VHT80 CDD 2TX	20.97	125.03
5690	802.11ac VHT80 CDD 2TX (based on UNII-2C band output power)	21.03	126.77
5530-5610	802.11ac VHT80 2TX STBC	20.90	123.03
5690	802.11ac VHT80 2TX STBC (based on UNII-2C band output power)	20.15	103.51
5530-5610	802.11ac VHT80 2TX BEAM FORMING	19.91	97.95
5690	802.11ac VHT80 2TX BEAM FORMING (based on UNII-2C band output power)	18.36	68.55

5.8GHz Band

Frequency Range (MHz)	Mode	Output Power (dBm)	Output Power (mW)
5745 - 5825	802.11a	Covered by 802.11n HT20 SISO	
5745 - 5825	802.11n HT20 SISO	18.00	63.10
5745 - 5825	802.11a 2TX CDD	Covered by 802.11n HT20 CDD 2TX	
5745 - 5825	802.11n HT20 CDD 2TX	20.61	115.08
5745 - 5825	802.11n HT20 STBC 2TX	20.79	119.95
5745 - 5825	802.11n HT20 SDM 2TX	Covered by 802.11n HT20 STBC 2TX	
5745 - 5825	802.11n HT20 BEAM FORMING 2TX	20.88	122.46
5755 - 5795	802.11n HT40 SISO	16.48	44.46
5755 - 5795	802.11n HT40 CDD 2TX	17.81	60.39
5755 - 5795	802.11n HT40 STBC 2TX	18.92	77.98
5755 - 5795	802.11n HT40 SDM 2TX	Covered by 802.11n HT20 STBC 2TX	
5755 - 5795	802.11n HT40 BEAM FORMING 2TX	18.42	69.50
5775	802.11ac VHT80 SISO	13.50	22.39
5775	802.11ac VHT80 CDD 2TX	14.80	30.20
5775	802.11ac VHT80 STBC 2TX	14.96	31.33
5775	802.11ac VHT80 SDM 2TX	Covered by 802.11ac VHT80 CDD 2TX	
5775	802.11ac VHT80 BEAM FORMING	11.46	14.00

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

Frequency Band (GHz)	Antenna Gain (dBi)	
	Chain 0	Chain 1
5.2	3.11	2.90
5.3	3.05	3.33
5.5	5.00	4.57
5.8	4.78	5.26

5.4. SOFTWARE AND FIRMWARE

The firmware installed in the EUT during testing was 7.21 RC94.152, ver 7.21.94.152.

5.5. WORST-CASE CONFIGURATION AND MODE

For radiated harmonics spurious and power line conducted emissions were performed with the EUT set at the CDD mode at highest power setting among the CDD/STBC/SDM/Beamforming modes as worst-case scenario.

For 1Tx modes, both chains have the same power; output power and PSD measurement for 1Tx modes on both antennas are reported.

All radiated testing was performed with the EUT in normal use orientation.

The following configurations were investigated on AC line conducted test.

Configuration	Descriptions
1	EUT powered by AC/DC adapter via USB cable

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

5.6. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Support Equipment List				
Description	Manufacturer	Model	Serial Number	FCC ID
AC/ DC Adapter	Apple Inc.	A1540	N/A	N/A
Earphone	Apple Inc.	N/A	N/A	N/A

I/O CABLES (CONDUCTED TEST)

I/O Cable List						
Cable No	Port	# of identical ports	Connector Type	Cable Type	Cable Length (m)	Remarks
1	Antenna	2	SMA	Un-Shielded	0.2	To Spectrum Analyzer

I/O CABLES (ABOVE 1G RADIATED TEST)

I/O Cable List						
Cable No	Port	# of identical ports	Connector Type	Cable Type	Cable Length (m)	Remarks
1	DC	1	Lightning	Un-Shielded	2	N/A

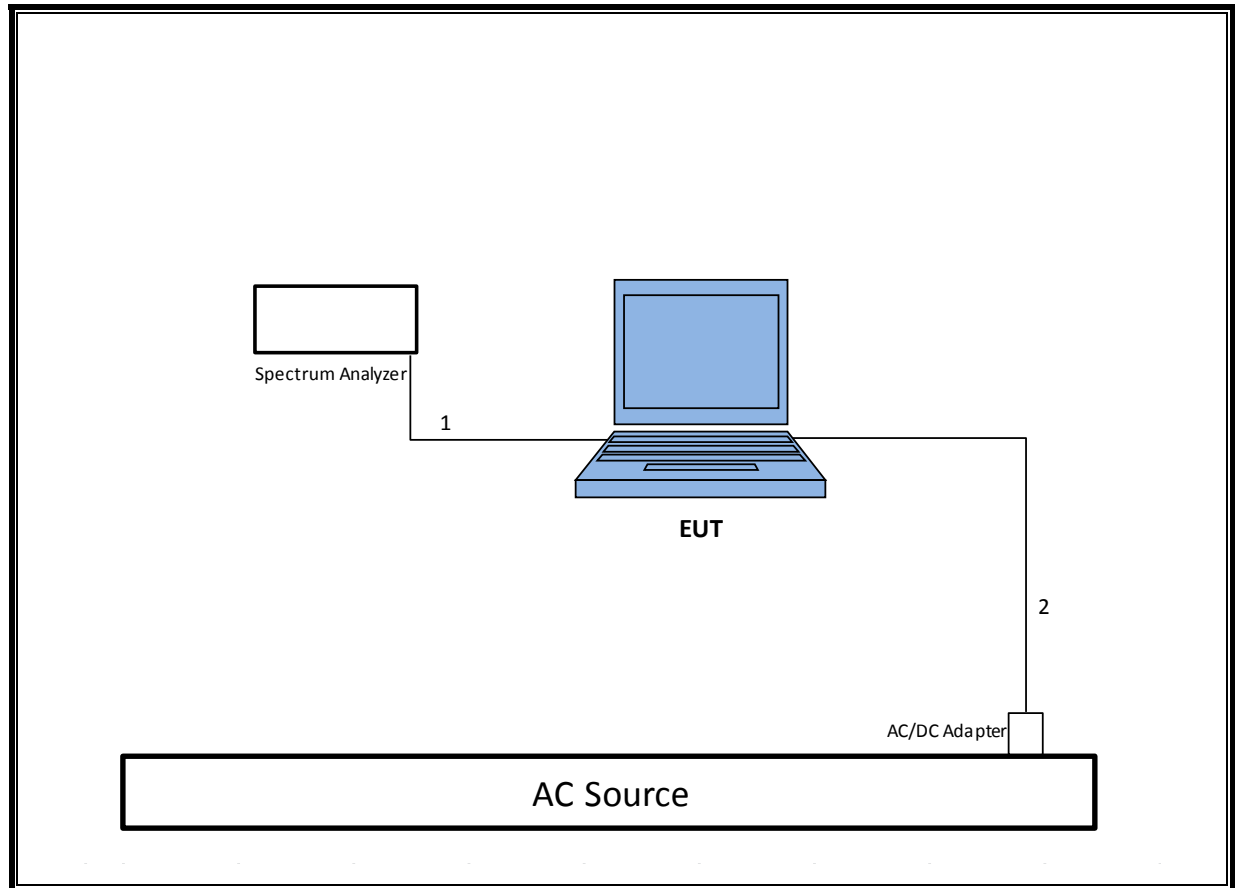
I/O CABLES (BELOW AND ABOVE 1G RADIATED AND AC POWER CONDUCTED TEST)

I/O Cable List						
Cable No	Port	# of identical ports	Connector Type	Cable Type	Cable Length (m)	Remarks
2	DC	1	Lightning	Un-Shielded	2	N/A
3	Audio	1	Jack	Un-Shielded	0.5	N/A

TEST SETUP- CONDUCTED PORT

The EUT was tested connected to spectrum analyzer via antenna port. Test software exercised the EUT.

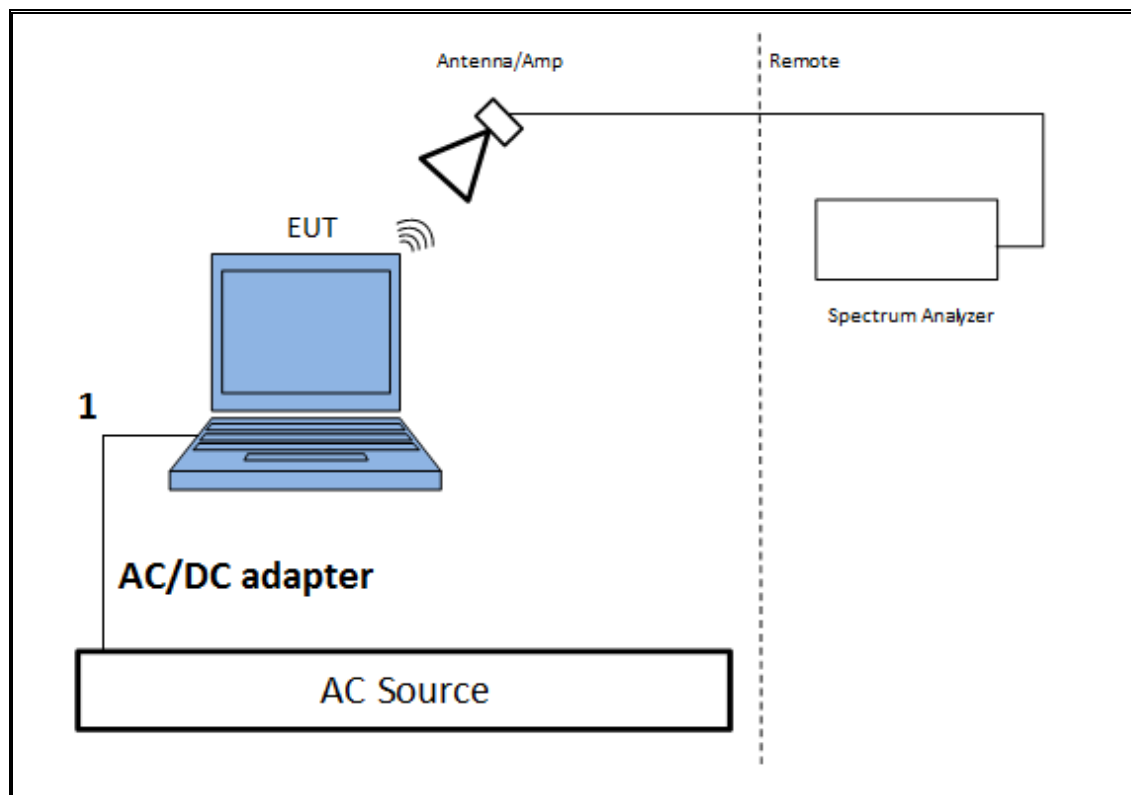
SETUP DIAGRAM



TEST SETUP- RADIATED- ABOVE 1 GHz

The EUT was powered by AC/DC adapter. Test software exercised the EUT.

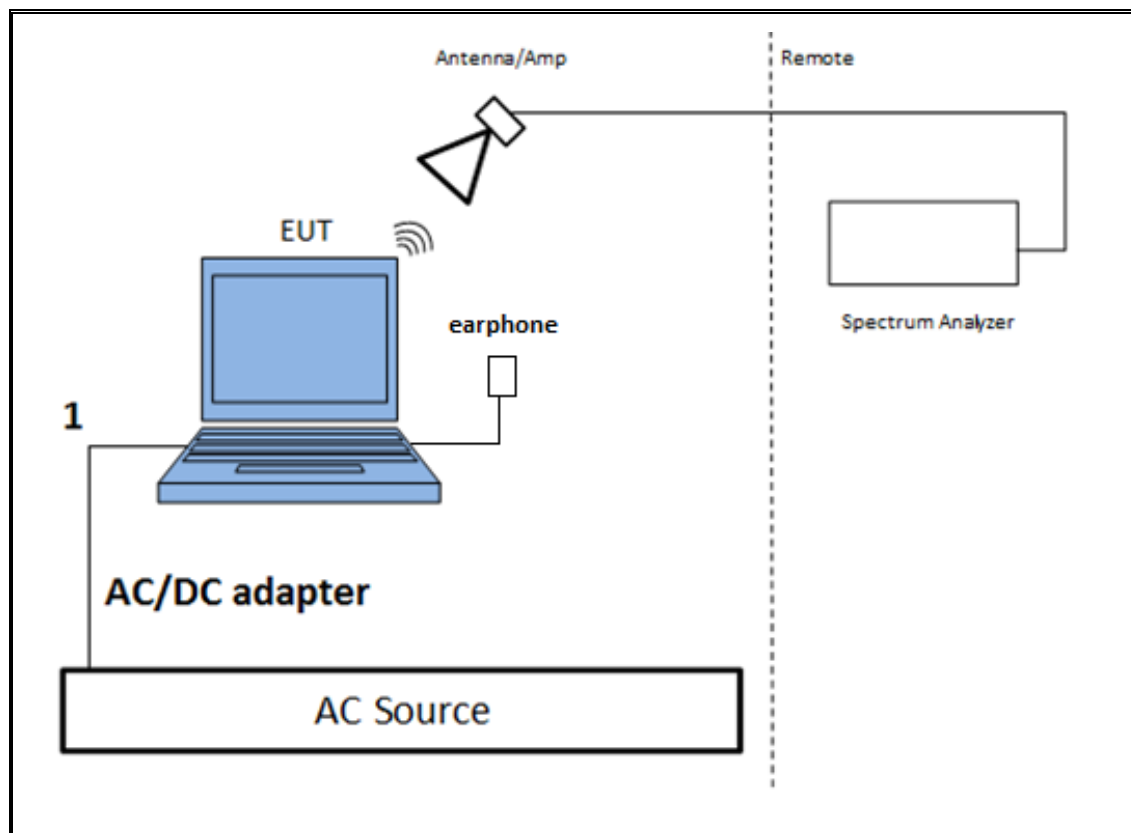
SETUP DIAGRAM



TEST SETUP- RADIATED-BELOW 1 GHz

The EUT was powered by AC/DC adapter. Test software exercised the EUT.

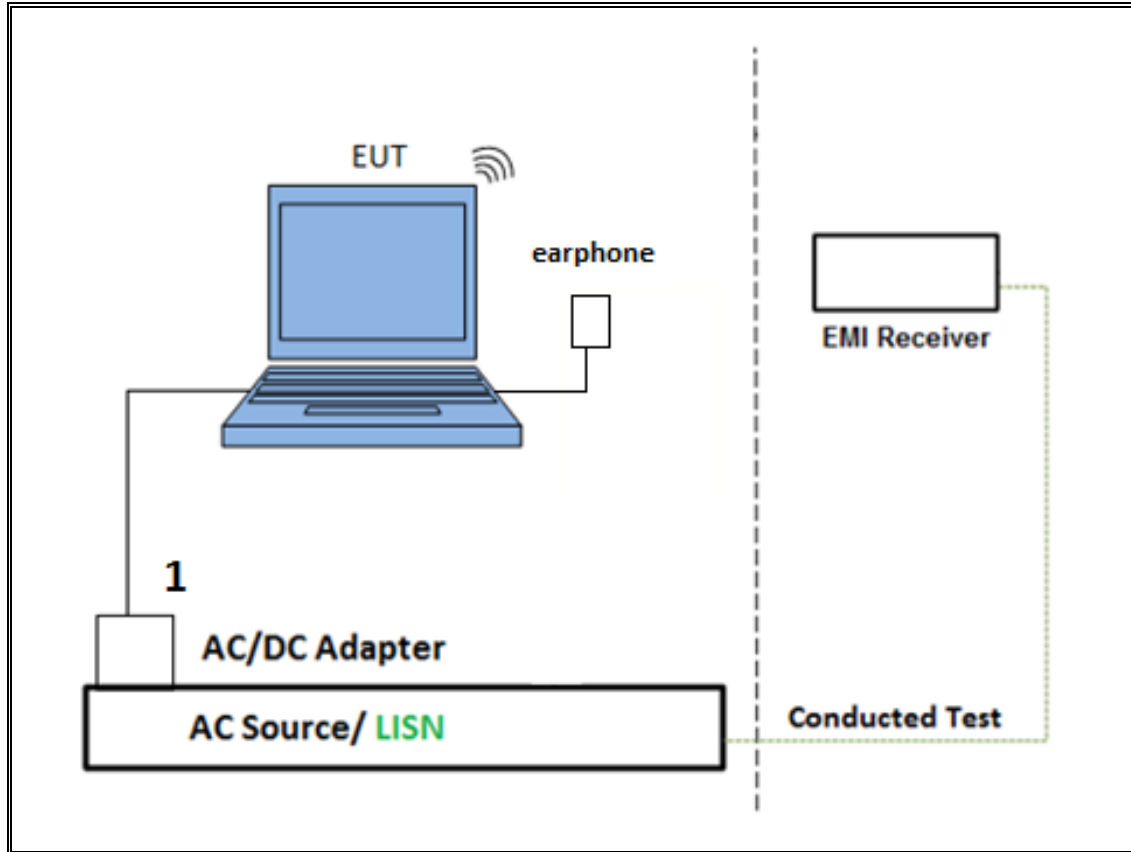
SETUP DIAGRAM



TEST SETUP- AC LINE CONDUCTED TESTS

The EUT was powered by AC/DC adapter. Test software exercised the EUT.

SETUP DIAGRAM



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	Asset	Cal Due
**Antenna, Horn 1-18GHz	ETS Lindgren	3117	00143448	2/10/2016
Antenna, Broadband Hybrid, 30MHz to 2000MHz	Sunol Sciences	JB3	A022813-1	10/28/2016
Amplifier, 1 - 18GHz	Miteq	AFS42-00101800-25-S-42	1782158	1/25/2017
Amplifier, 10KHz to 1GHz, 32dB	Sonoma	310N	323561	6/8/2016
Spectrum Analyzer, PXA, 3Hz to 50GHz	Agilent	N9030A	MY52350427	8/4/2016
Antenna, Horn 1-18GHz	ETS Lindgren	3117	00165318	4/10/2016
Antenna, Broadband Hybrid, 30MHz to 2000MHz	Sunol Sciences	JB3	A051314-2	4/30/2016
Amplifier, 1 - 18GHz	Miteq	AFS42-00101800-25-S-42	1818464	4/25/2016
Amplifier, 10KHz to 1GHz, 32dB	Sonoma	310N	325118	6/8/2016
Spectrum Analyzer, PXA, 3Hz to 44GHz	Keysight	N9030A	MY53310959	2/3/2017
Amplifier, 10KHz to 1GHz, 32dB	Sonoma	310N	325117	6/9/2016
Spectrum Analyzer, PXA, 3Hz to 44GHz	Agilent	N9030A-544	US51160264	11/19/2016
Power Meter, P-series single channel	Agilent	N1911A	GB45100212	9/25/2016
Power Sensor, P - series, 50MHz to 18GHz, Wideband	Agilent	N1921A	MY53260010	7/12/2016
Amplifier, 1 to 26.5GHz, 23.5dB Gain minimum	Keysight	8449B	3008A04710	6/29/2016
Amplifier, 26 - 40GHz	Miteq	NSP4000-SP2	924343	4/7/2016
Spectrum Analyzer, 40 GHz	Keysight	8564E	3943A01643	8/14/2016
Horn Antenna, 40GHz	ARA	MWH-2640/B	1029	7/28/2016
Antenna, Horn 18 to 26.5GHz	ARA	MWH-1826	209336	5/12/2016
AC Line Conducted				
EMI Test Receiver 9KHz-7GHz	Rohde & Schwarz	ESC17	100935	9/16/2016
LISN for Conducted Emissions CISPR-16	Fischer	50/250-25-2	161124	9/16/2016
Power Cable, Line Conducted Emissions	U L	PG1	N/A	7/28/2016
UL SOFTWARE				
*Radiated Software	UL	UL EMC	Ver 9.5, June 24, 2015	
*Conducted Software	UL	UL EMC	Ver 4.0, January 11, 2016	
*AC Line Conducted Software	UL	UL EMC	Ver 9.5, May 26, 2015	

Note: * indicates automation software version used in the compliance certification testing

**Testing is completed before equipment calibration expiration date.

7. ON TIME, DUTY CYCLE AND MEASUREMENT METHODS

7.1. ON TIME AND DUTY CYCLE

LIMITS

None; for reporting purposes only.

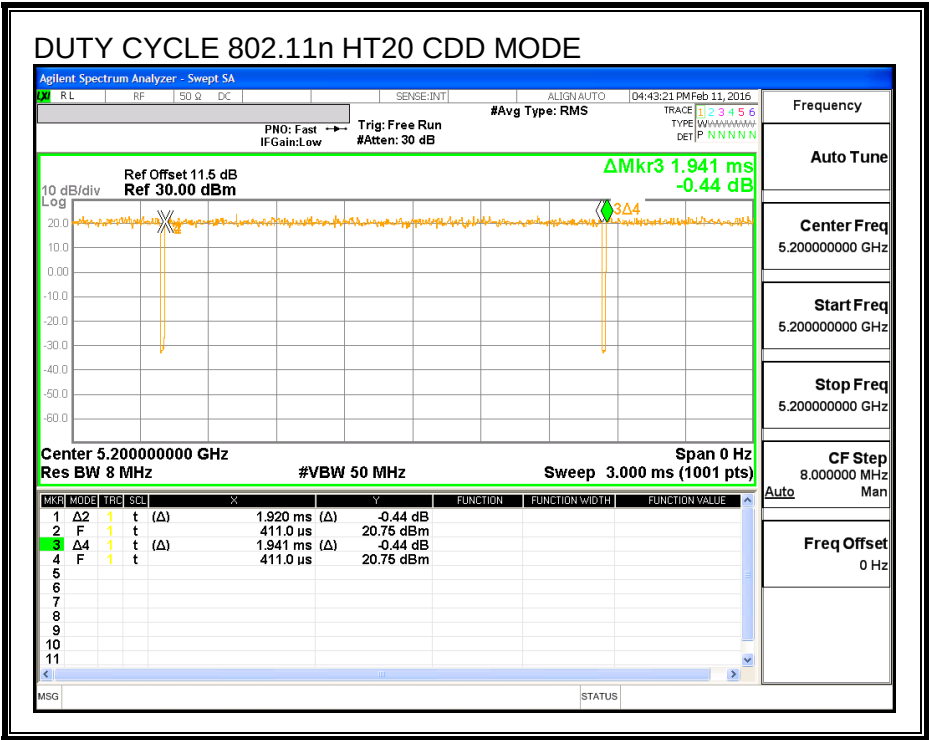
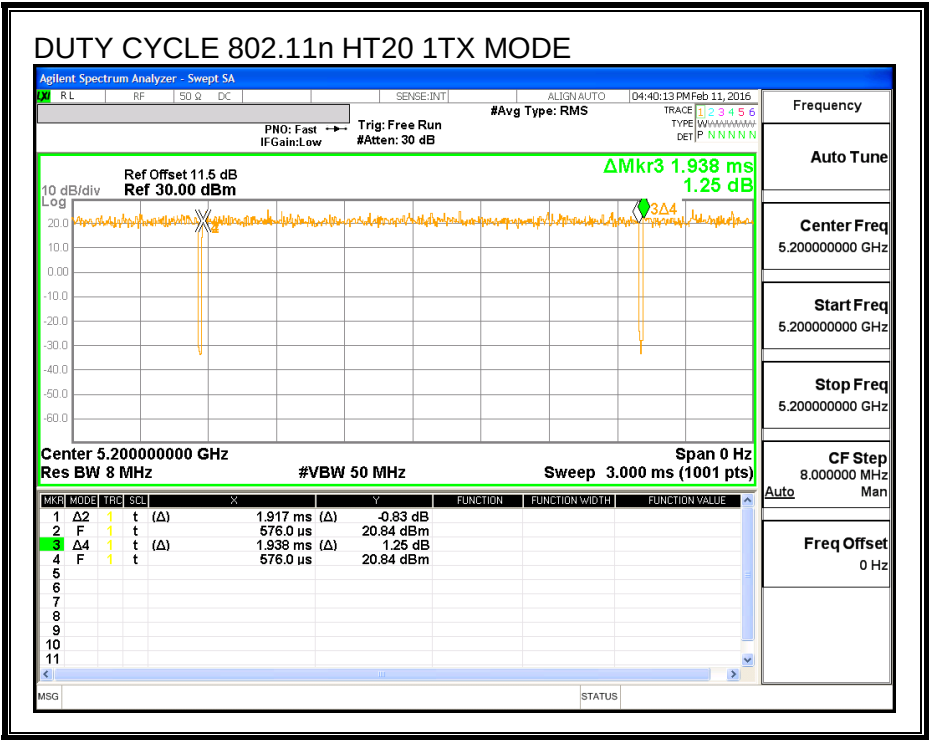
PROCEDURE

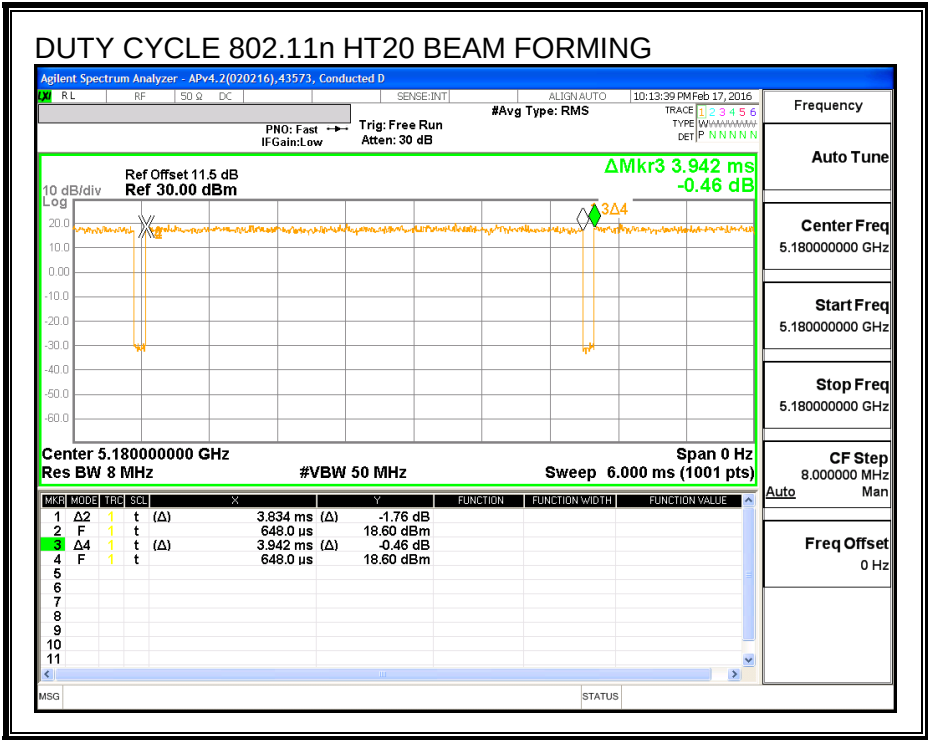
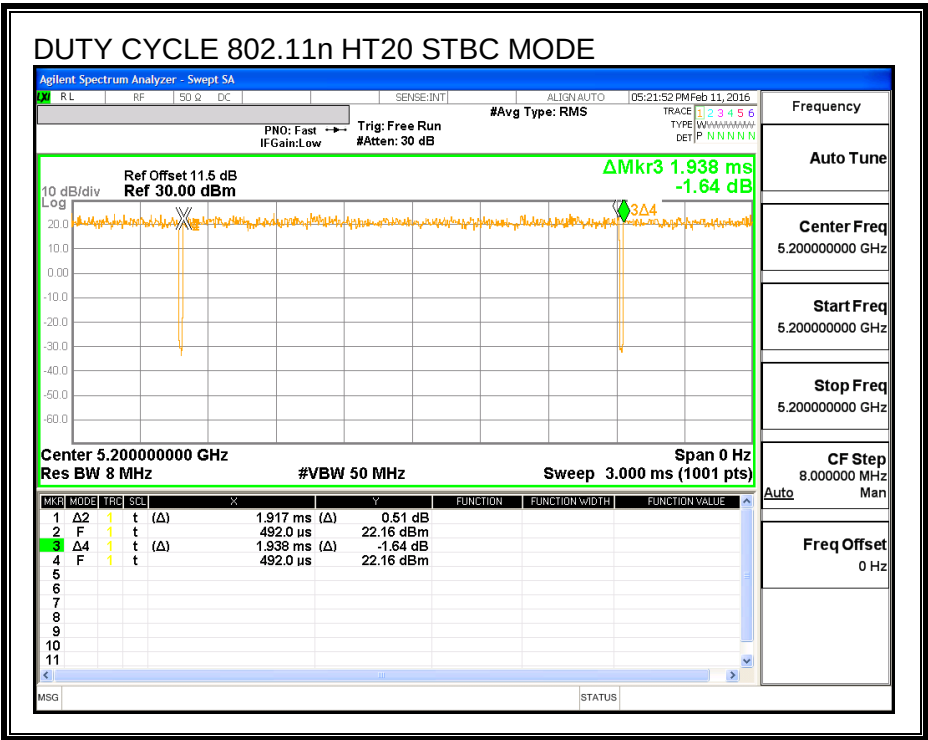
KDB 789033 Zero-Span Spectrum Analyzer Method.

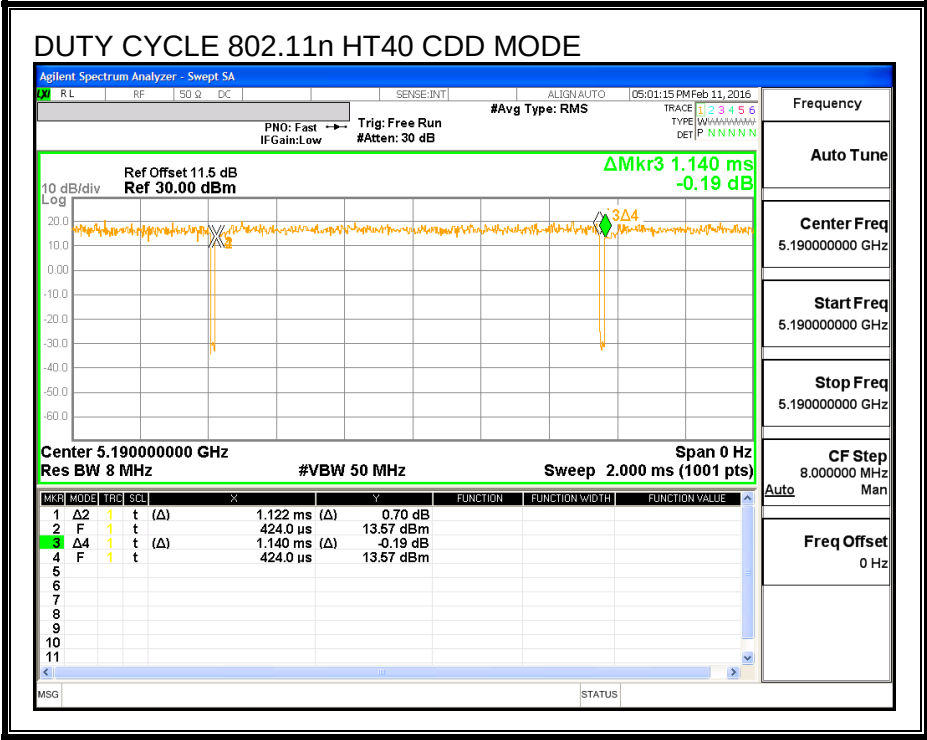
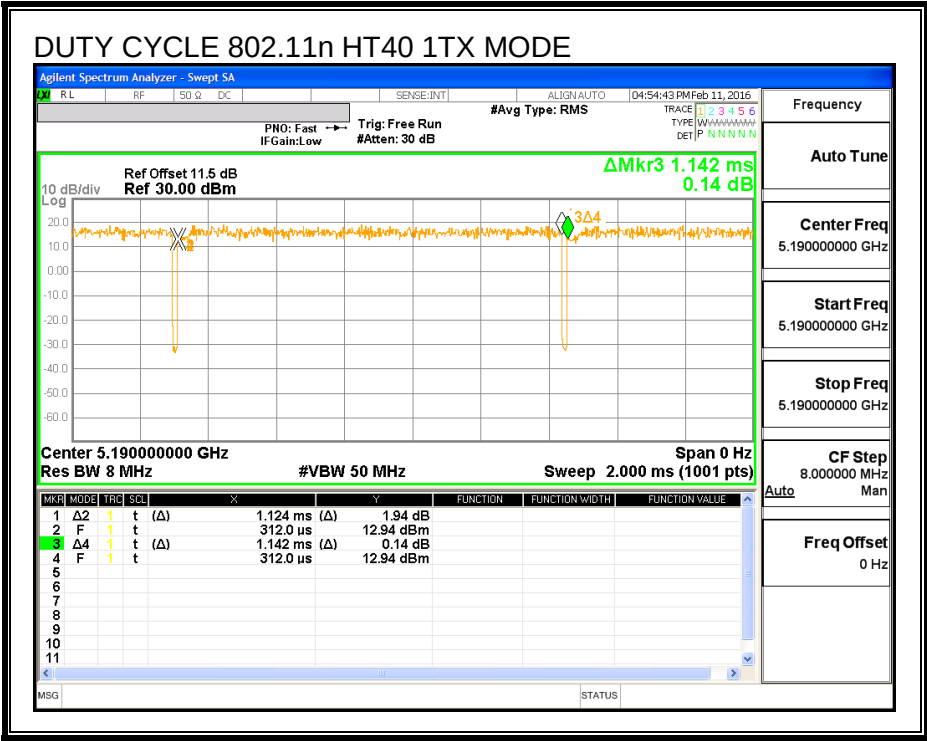
RESULTS RESULTS

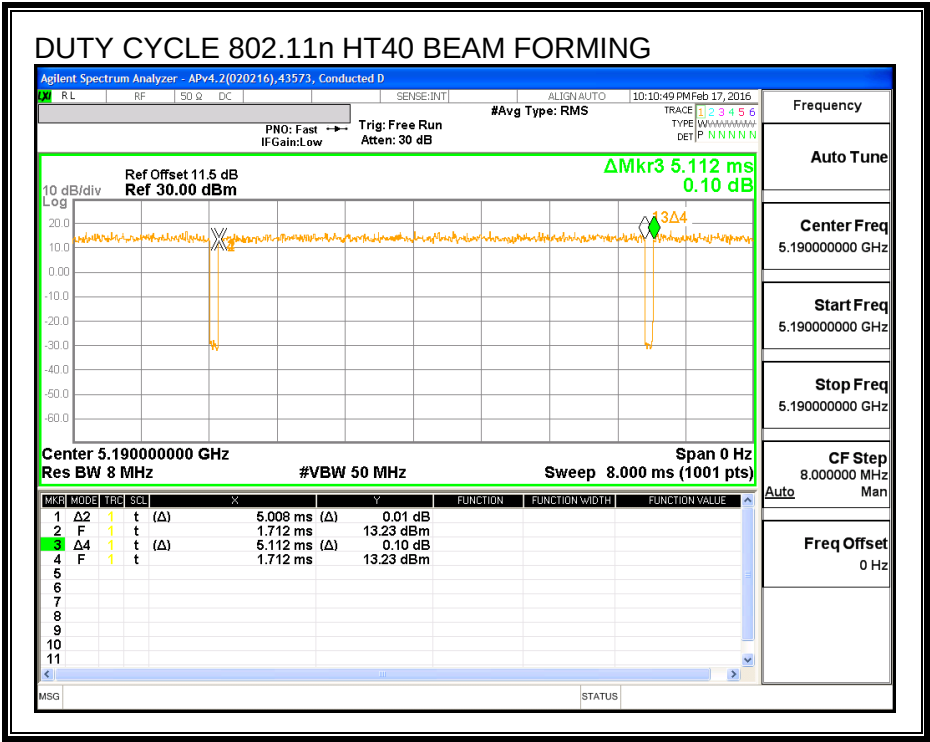
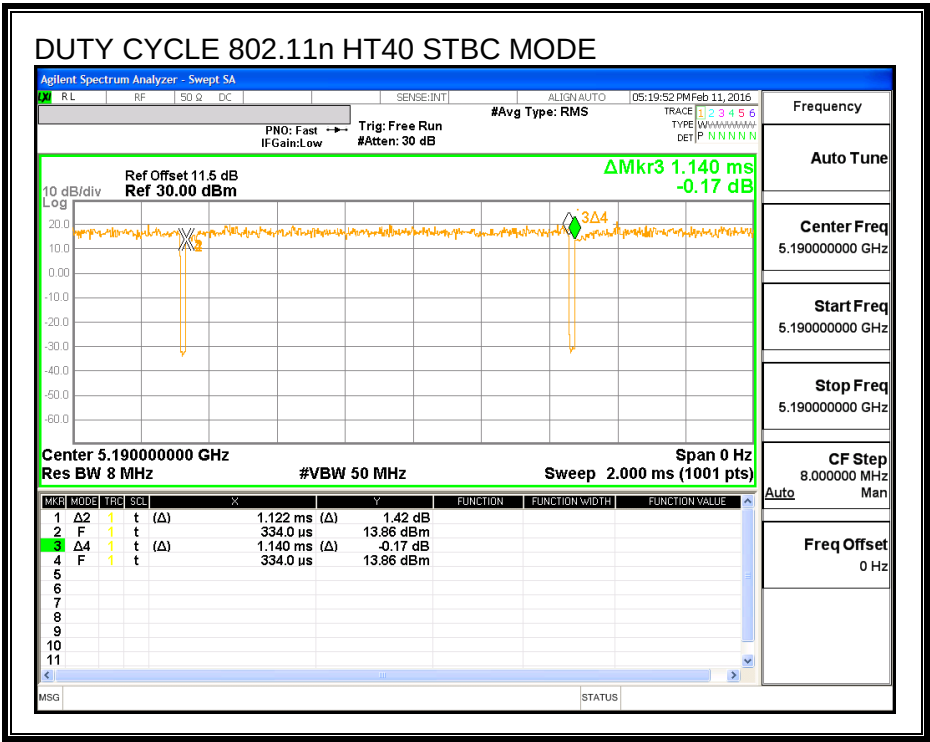
Mode	ON Time B (msec)	Period (msec)	Duty Cycle x (linear)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)	1/B Minimum VBW (kHz)
802.11n HT20 1TX	1.917	1.938	0.989	98.92%	0.00	0.010
802.11n HT20 CDD	1.920	1.941	0.989	98.92%	0.00	0.010
802.11n HT20 STBC	1.917	1.938	0.989	98.92%	0.00	0.010
802.11ac VHT20 BEAM FORMING	3.834	3.942	0.973	97.26%	0.12	0.261
802.11n HT40 1TX	1.124	1.142	0.984	98.42%	0.00	0.010
802.11n HT40 CDD	1.122	1.140	0.984	98.42%	0.00	0.010
802.11n HT40 STBC	1.122	1.140	0.984	98.42%	0.00	0.010
802.11ac VHT40 BEAM FORMING	5.008	5.112	0.980	97.97%	0.09	0.200
802.11ac VHT80 1TX	0.544	0.565	0.963	96.28%	0.16	1.838
802.11ac VHT80 CDD	0.460	0.483	0.952	95.24%	0.21	2.174
802.11ac VHT80 STBC	0.459	0.483	0.950	95.03%	0.22	2.179
802.11ac VHT80 BEAM FORMING	4.62	4.727	0.977	97.74%	0.10	0.216

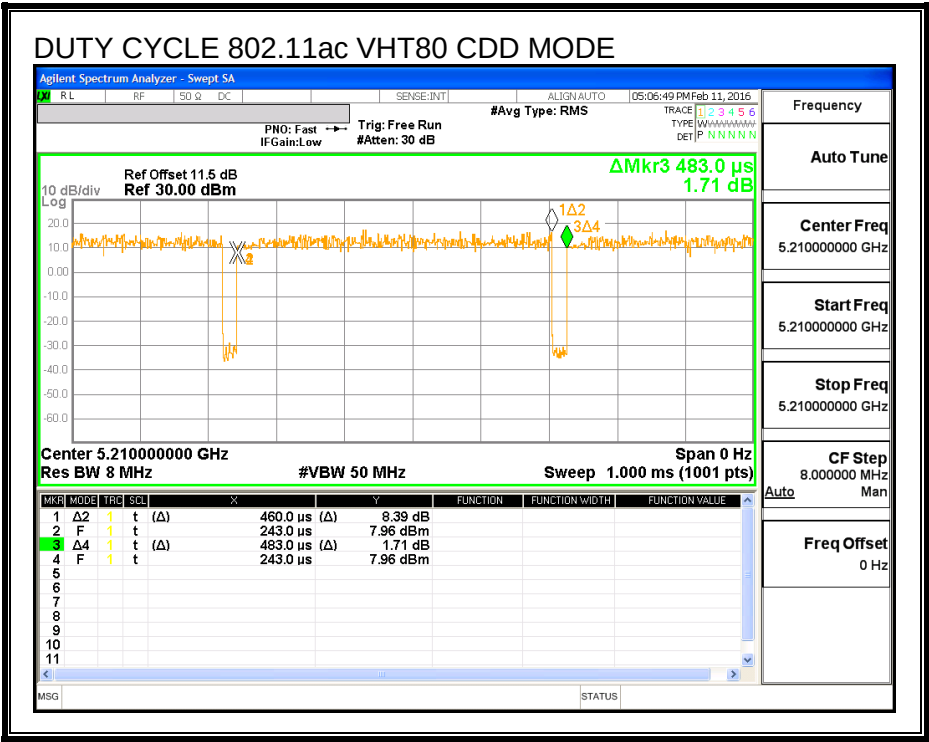
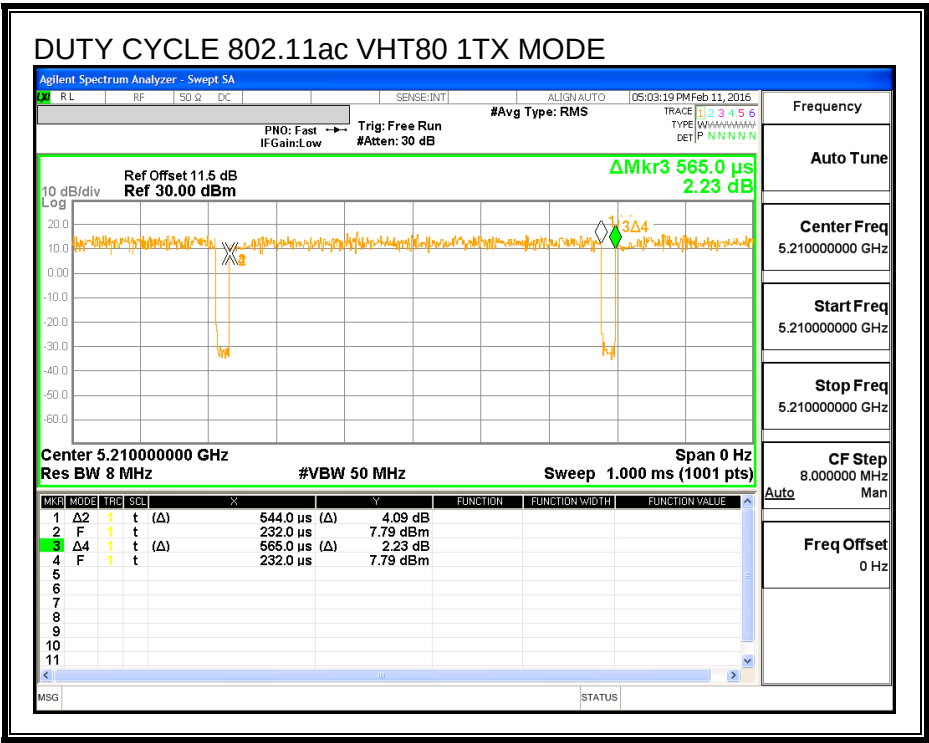
DUTY CYCLE PLOTS

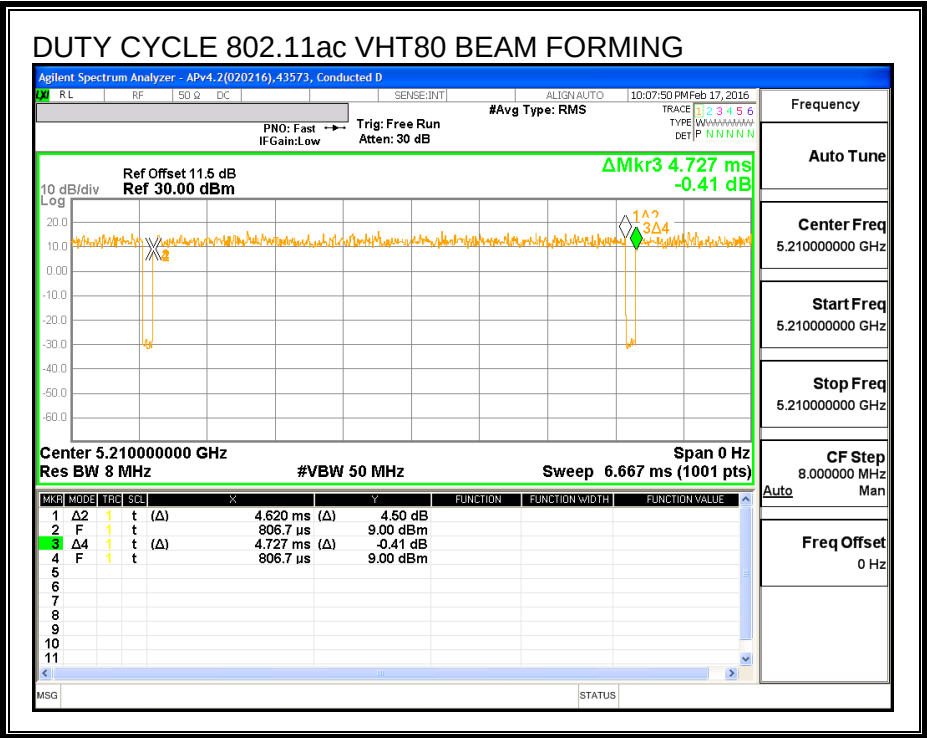
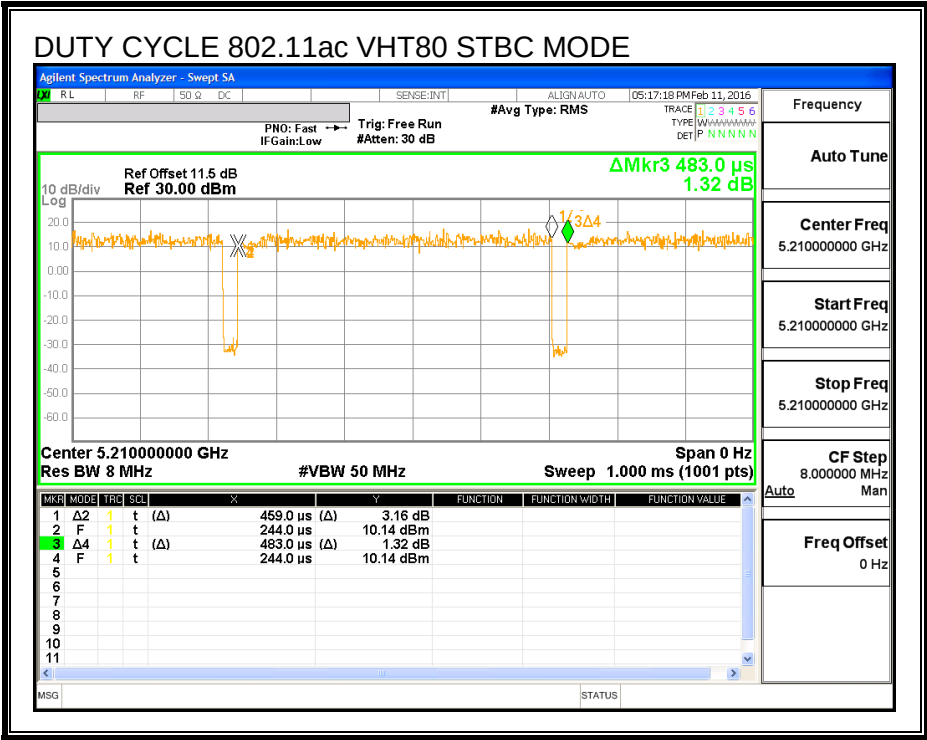












7.2. MEASUREMENT METHODS

26 dB Emission BW: KDB 789033 D02 v01r01, Section C.

99% Occupied BW: KDB 789033 D02 v01r01, Section D.

Conducted Output Power: KDB 789033 D02 v01r01, Section E.3.b (Method PM-G).

Power Spectral Density: KDB 789033 D02 v01r01, Section F.

Unwanted emissions in restricted bands: KDB 789033 D02 v01r01, Sections G.3, G.4, G.5, and G.6.

Unwanted emissions in non-restricted bands: KDB 789033 D02 v01r01, Sections G.3, G.4, and G.5.

8. ANTENNA PORT TEST RESULTS

8.1. 802.11n HT20 CHAIN 0 MODE IN THE 5.2 GHz BAND

8.1.1. 26 dB BANDWIDTH

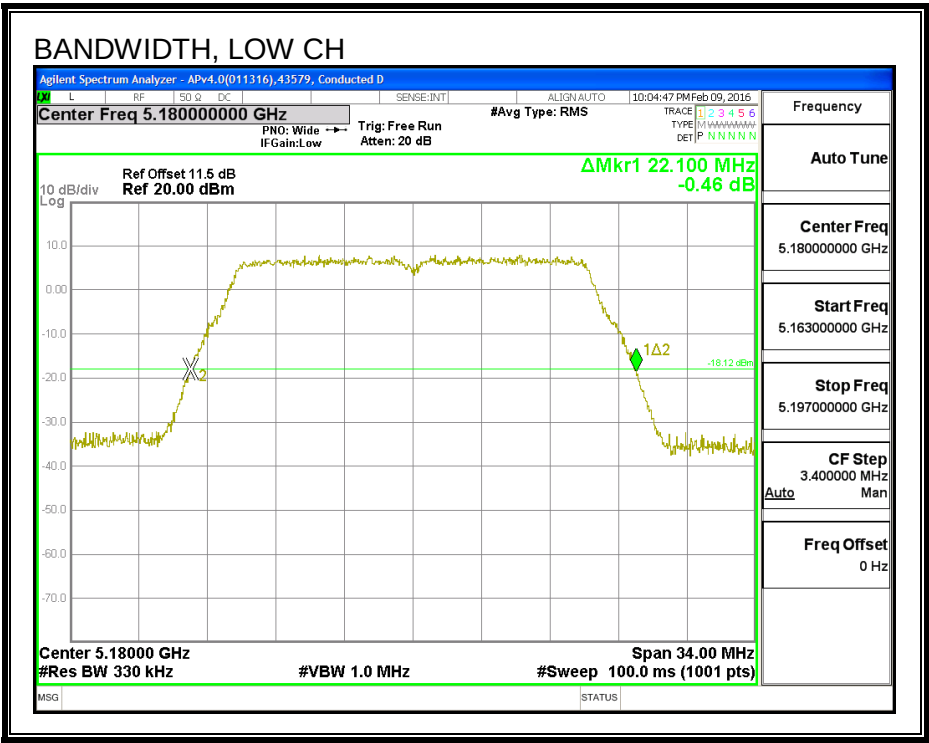
LIMITS

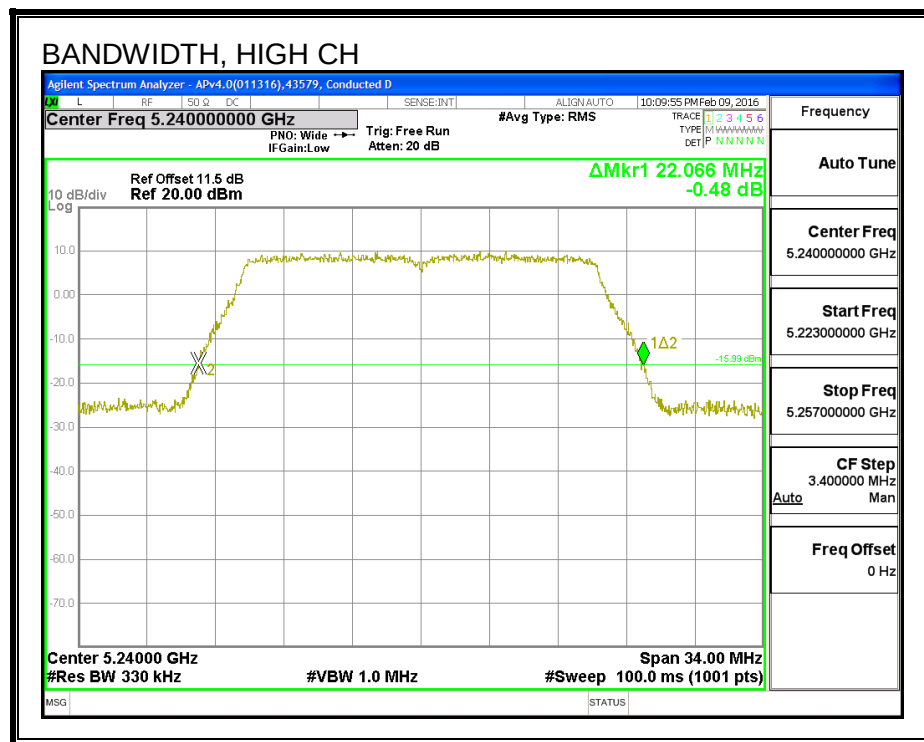
None; for reporting purposes only.

RESULTS

Channel	Frequency (MHz)	26 dB Bandwidth (MHz)
Low	5180	22.10
Mid	5200	22.03
High	5240	22.07

26 dB BANDWIDTH





8.1.2. 99% BANDWIDTH

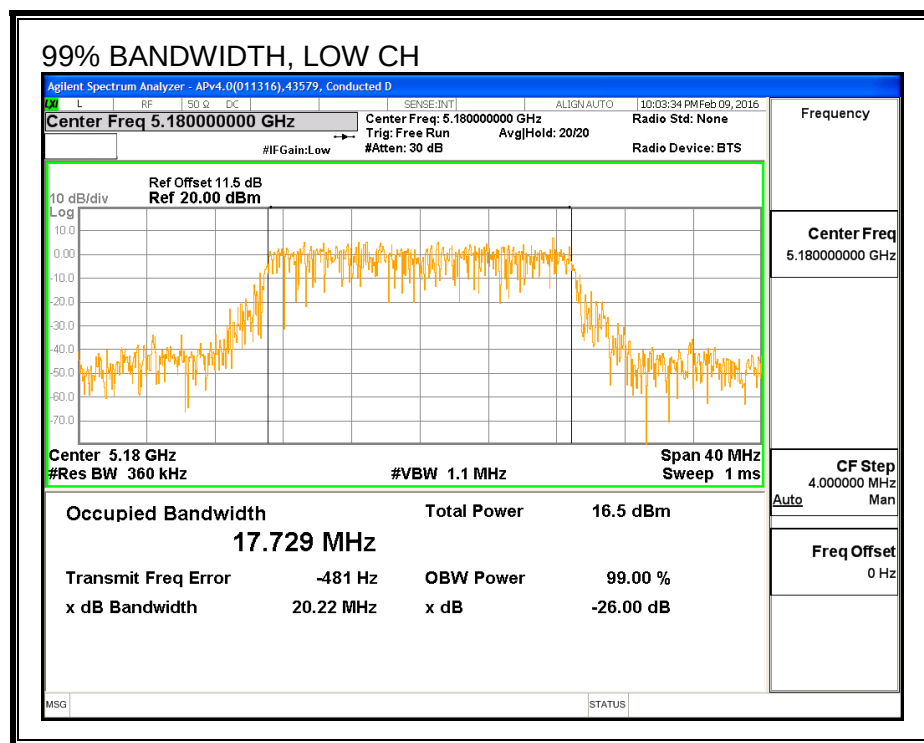
LIMITS

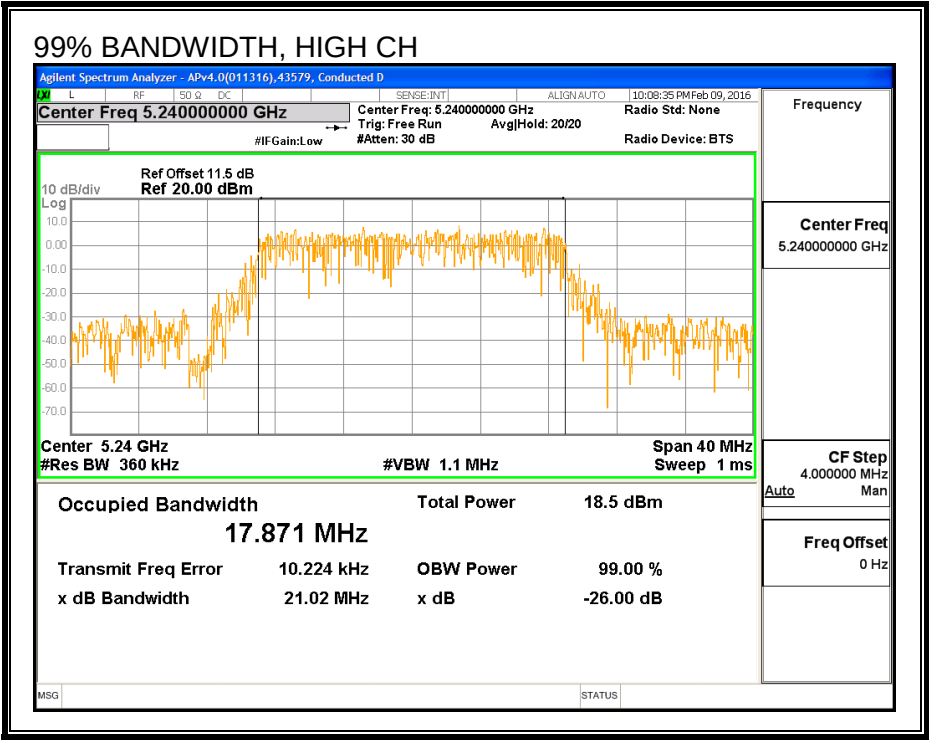
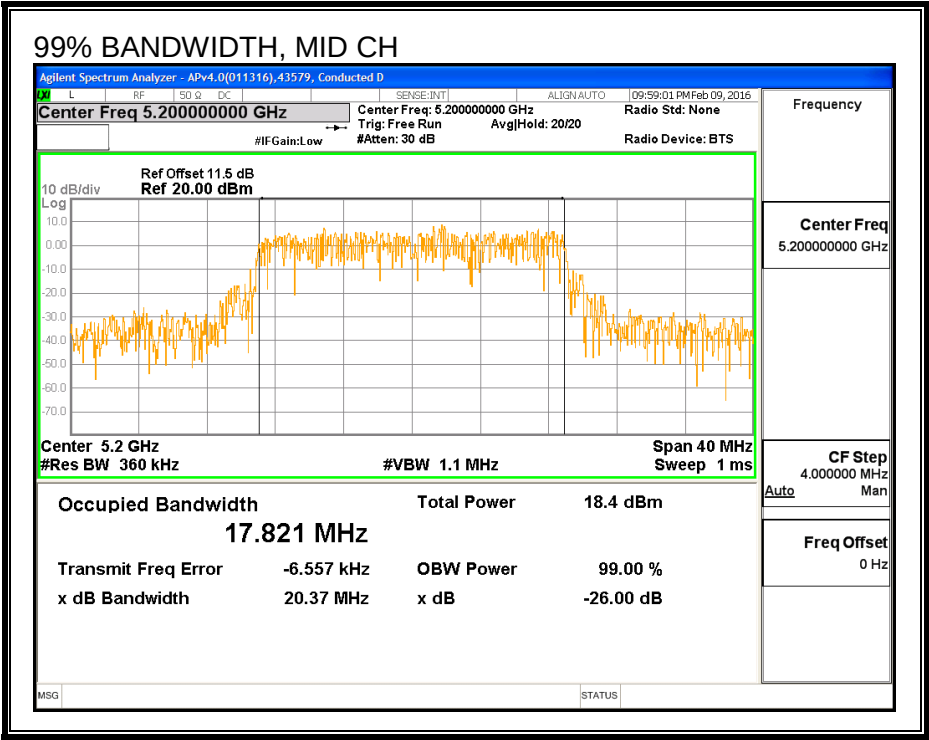
None; for reporting purposes only.

RESULTS

Channel	Frequency (MHz)	99% BW (MHz)
Low	5180	17.729
Mid	5200	17.821
High	5240	17.871

99% BANDWIDTH





8.1.3. AVERAGE POWER (FCC)

LIMITS

None; for reporting purposes only.

TEST PROCEDURE

Measurements perform using a wideband gated RF power meter.

RESULTS

Channel	Frequency (MHz)	Power (dBm)
Low	5180	16.32
Mid	5200	17.89
High	5240	17.96

8.1.4. OUTPUT POWER AND PSD (FCC)

LIMITS

FCC §15.407 (a) (1)

(i) For an outdoor access point operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. The maximum e.i.r.p. at any elevation angle above 30 degrees as measured from the horizon must not exceed 125 mW (21 dBm).

(ii) For an indoor access point operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

(iii) For fixed point-to-point access points operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W. Fixed point-to-point U-NII devices may employ antennas with directional gain up to 23 dBi without any corresponding reduction in the maximum conducted output power or maximum power spectral density. For fixed point-to-point transmitters that employ a directional antenna gain greater than 23 dBi, a 1 dB reduction in maximum conducted output power and maximum power spectral density is required for each 1 dB of antenna gain in excess of 23 dBi. Fixed, point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications, and multiple colocated transmitters transmitting the same information. The operator of the U-NII device, or if the equipment is professionally installed, the installer, is responsible for ensuring that systems employing high gain directional antennas are used exclusively for fixed, point-to-point operations.

(iv) For mobile and portable client devices in the 5.15-5.25 GHz band, the maximum conducted output power over the frequency band of operation shall not exceed 250 mW provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

TEST PROCEDURE

Measurements perform using a wideband gated RF power meter provided that the gate parameters are adjusted such that the power is measured only when the EUT is transmitting at its maximum power control level. Since the measurement is made only during the ON time of the transmitter, no duty cycle correction factor is required.

DIRECTIONAL ANTENNA GAIN

There is only one transmitter output therefore the directional gain is equal to the antenna gain.

RESULTS

Antenna Gain and Limits

Channel	Frequency (MHz)	Directional Gain for Power (dBi)	Directional Gain for PSD (dBi)	Power Limit (dBm)	PSD Limit (dBm)
Low	5180	3.11	3.11	24.00	11.00
Mid	5200	3.11	3.11	24.00	11.00
High	5240	3.11	3.11	24.00	11.00

Duty Cycle CF (dB)	0.00	Included in Calculations of Corr'd PSD
--------------------	------	--

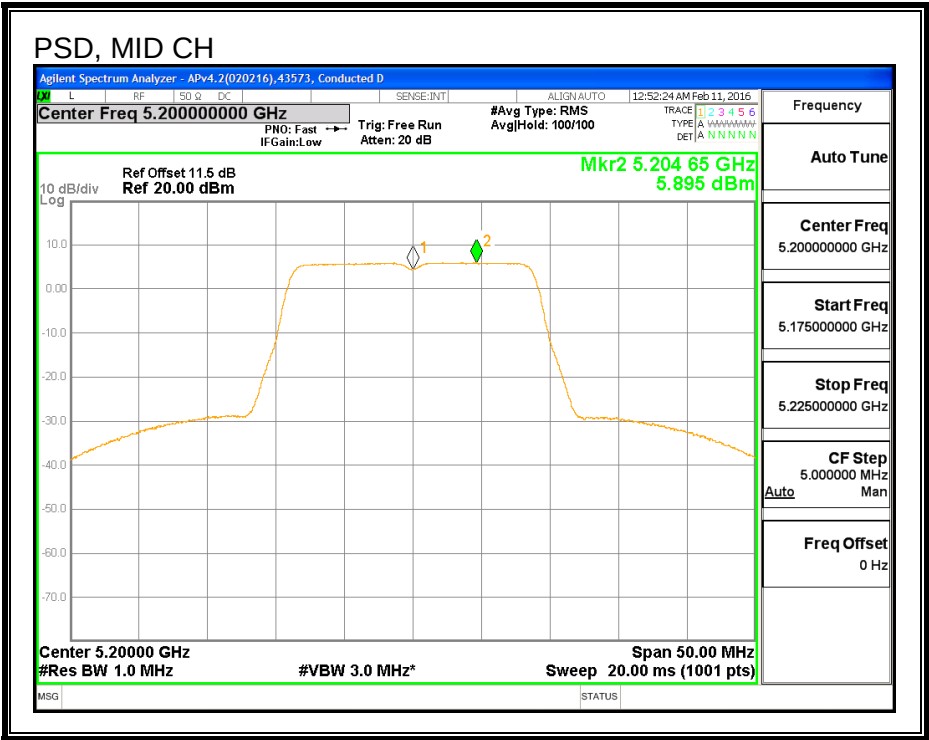
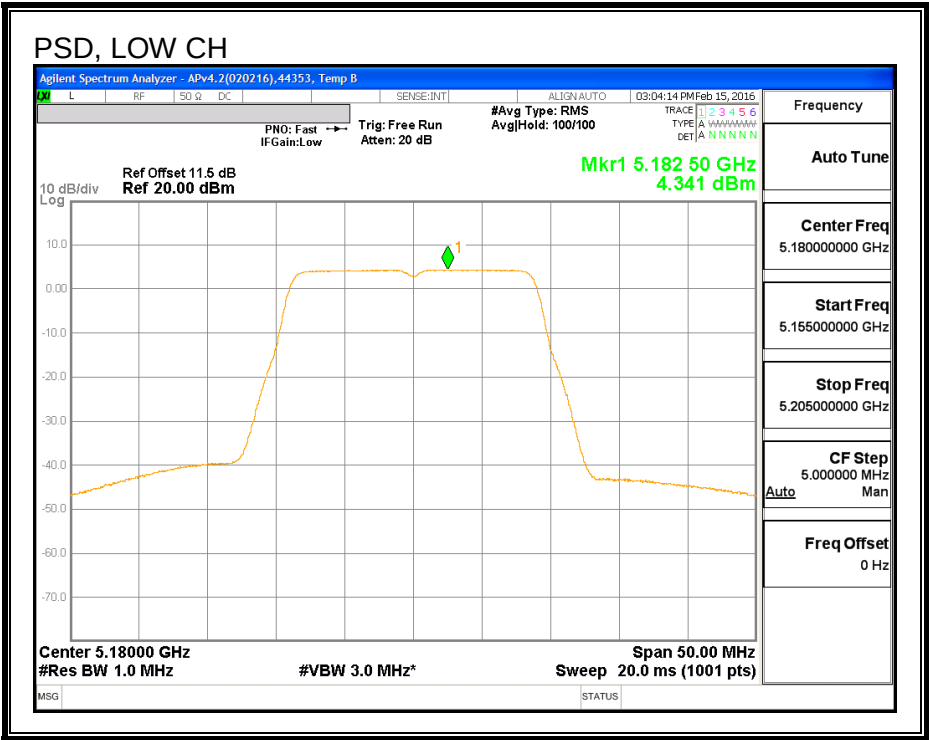
Output Power Results

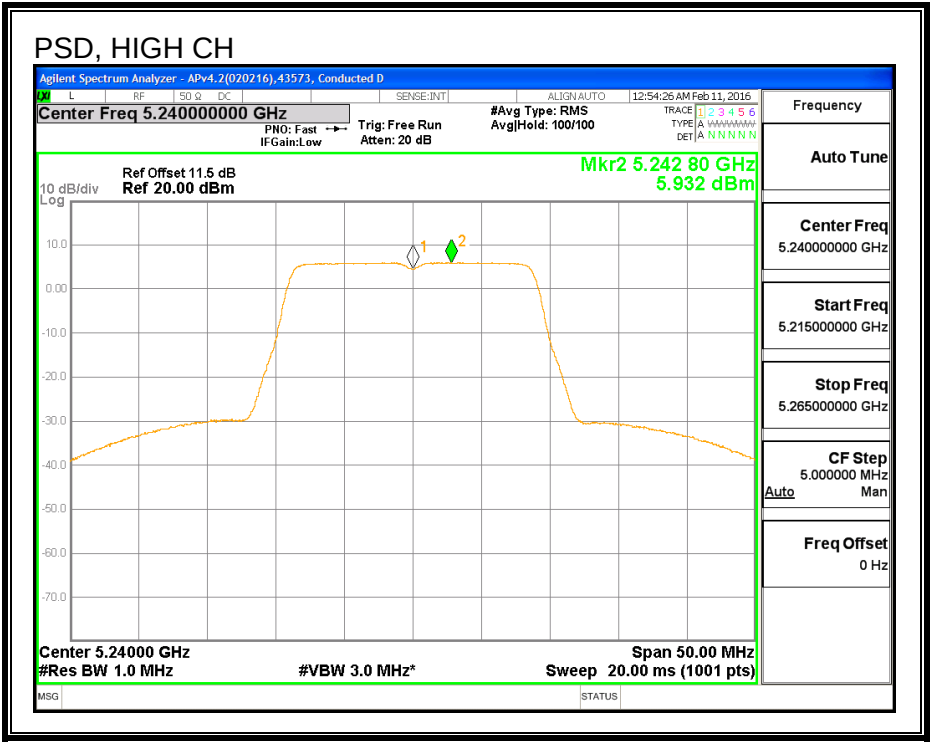
Channel	Frequency (MHz)	Chain 0 Meas Power (dBm)	Total Corr'd Power (dBm)	Power Limit (dBm)	Power Margin (dB)
Low	5180	16.32	16.32	24.00	-7.68
Mid	5200	17.89	17.89	24.00	-6.11
High	5240	17.96	17.96	24.00	-6.04

PSD Results

Channel	Frequency (MHz)	Chain 0 Meas PSD (dBm)	Total Corr'd PSD (dBm)	PSD Limit (dBm)	PSD Margin (dB)
Low	5180	4.34	4.34	11.00	-6.66
Mid	5200	5.90	5.90	11.00	-5.11
High	5240	5.93	5.93	11.00	-5.07

PSD





8.2. 802.11n HT20 CHAIN 1 MODE IN THE 5.2 GHz BAND

8.2.1. 26 dB BANDWIDTH

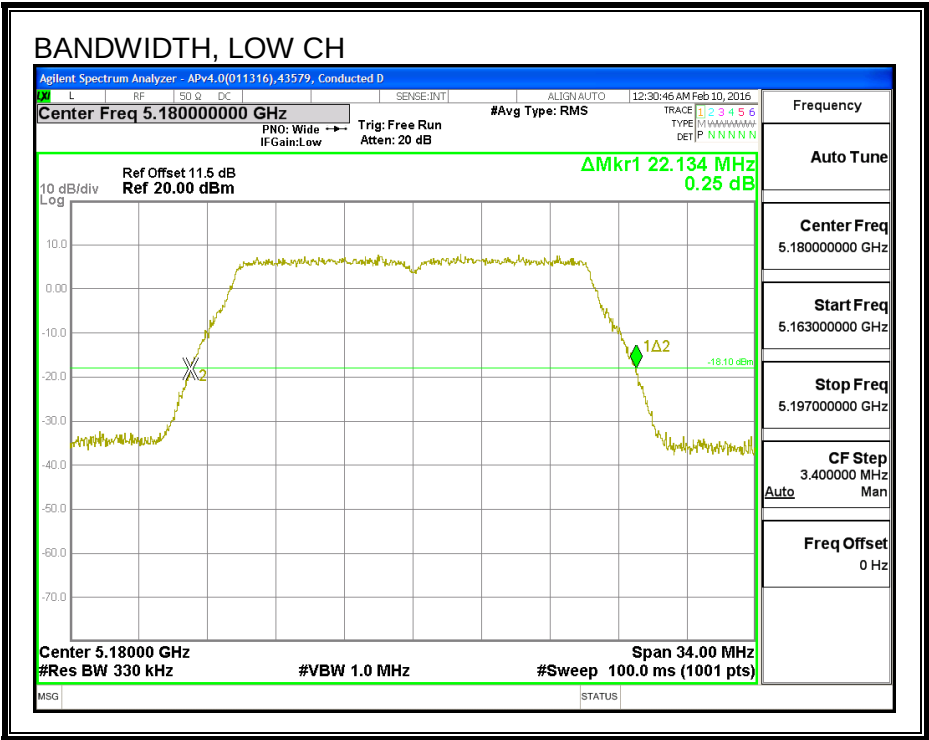
LIMITS

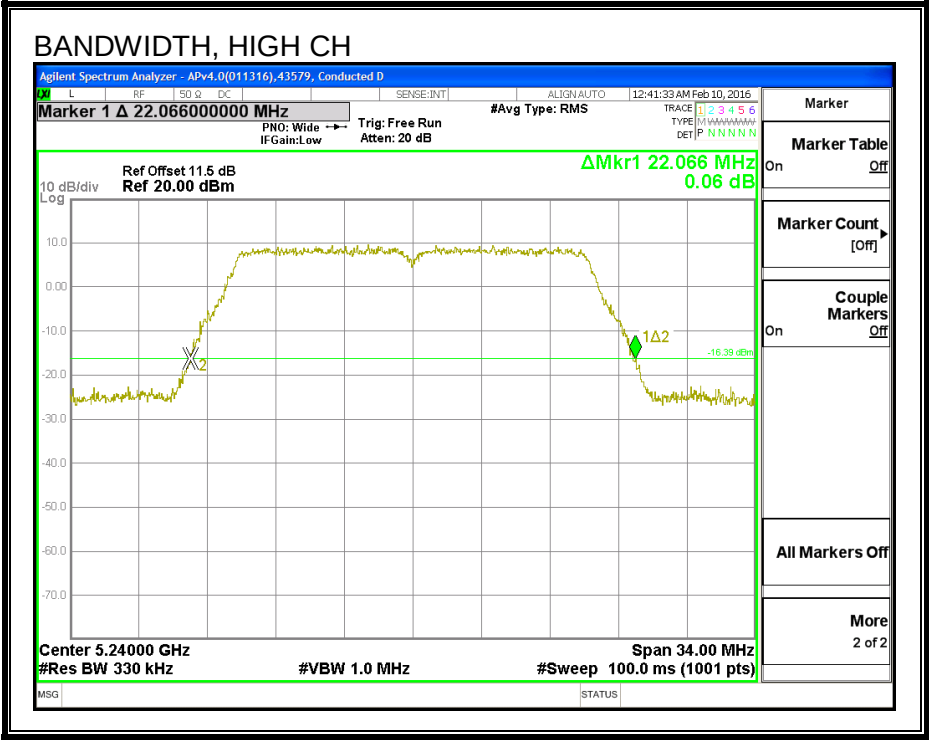
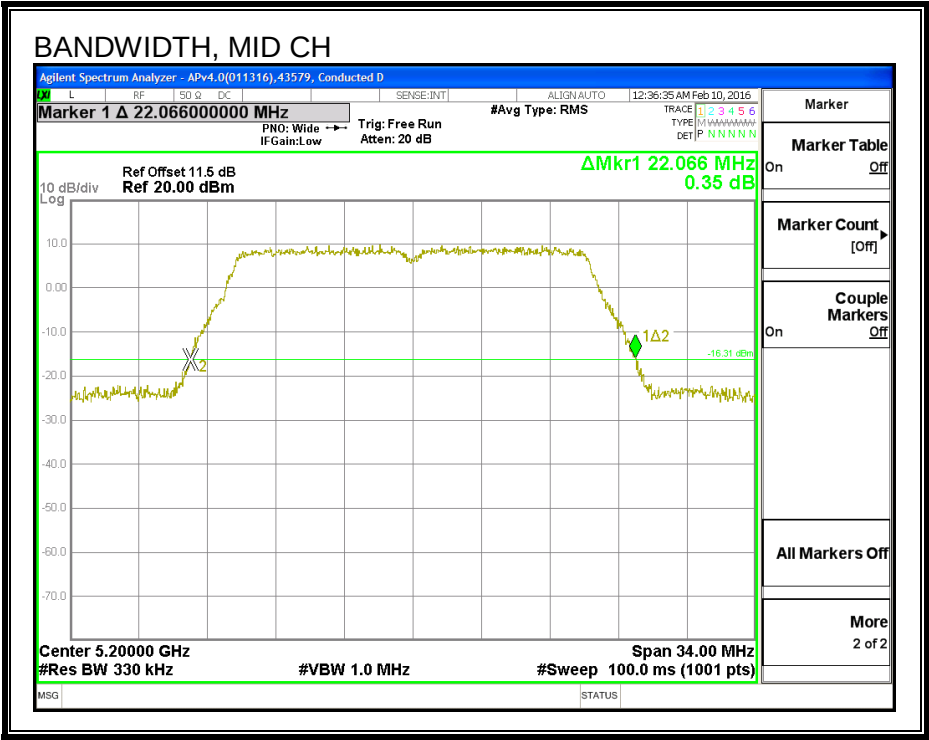
None; for reporting purposes only.

RESULTS

Channel	Frequency (MHz)	26 dB Bandwidth (MHz)
Low	5180	22.13
Mid	5200	22.07
High	5240	22.07

26 dB BANDWIDTH





8.2.2. 99% BANDWIDTH

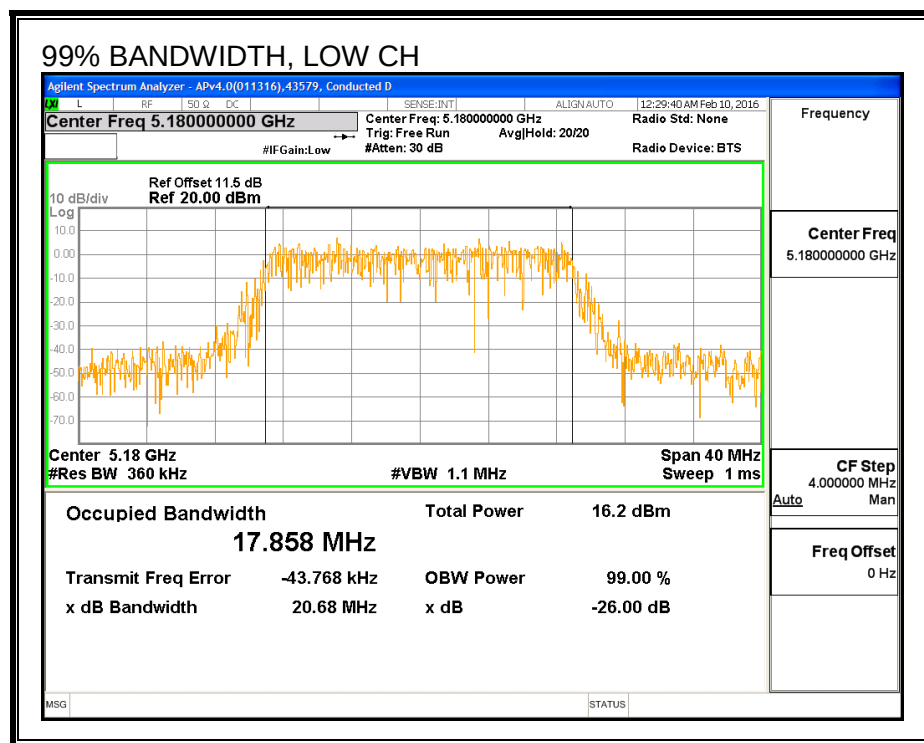
LIMITS

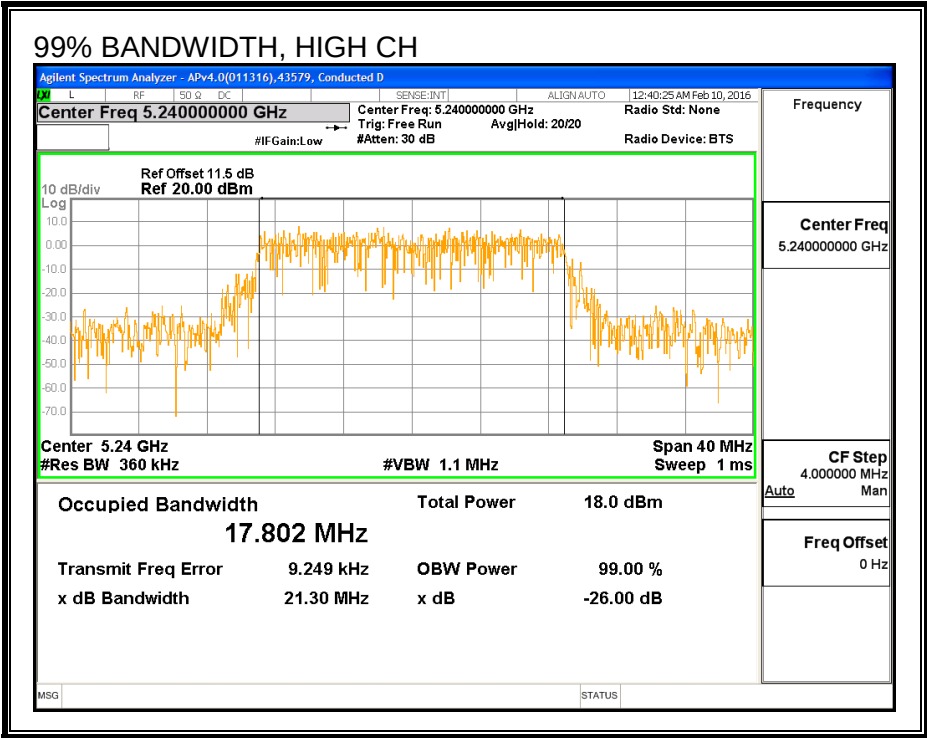
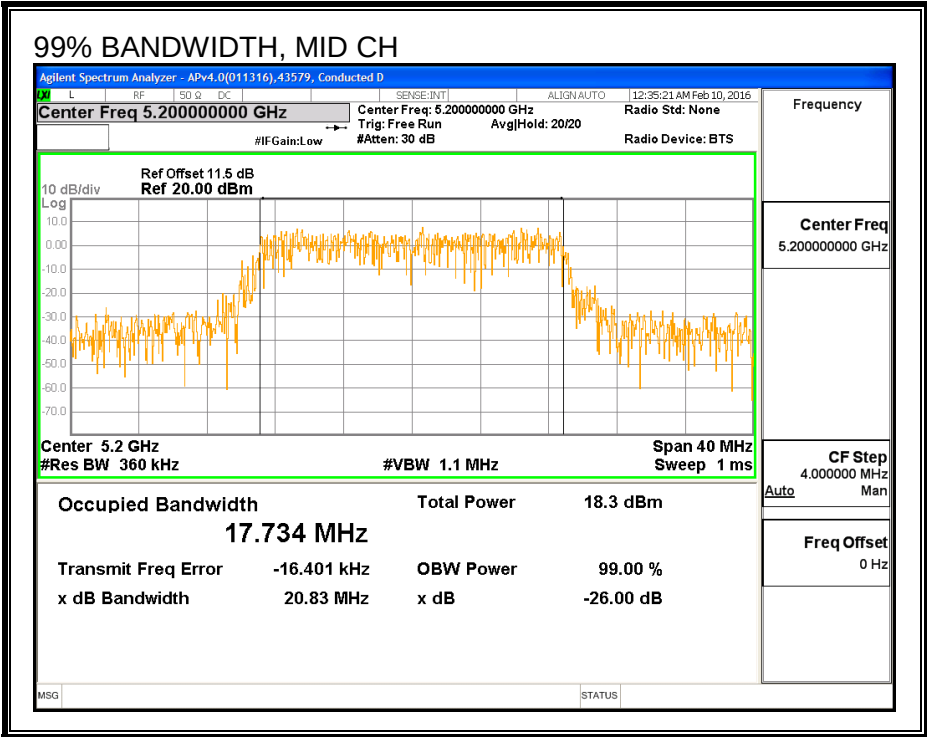
None; for reporting purposes only.

RESULTS

Channel	Frequency (MHz)	99% BW (MHz)
Low	5180	17.858
Mid	5200	17.734
High	5240	17.802

99% BANDWIDTH





8.2.3. AVERAGE POWER (FCC)

LIMITS

None; for reporting purposes only.

TEST PROCEDURE

Measurements perform using a wideband gated RF power meter.

RESULTS

Channel	Frequency (MHz)	Power (dBm)
Low	5180	16.33
Mid	5200	17.81
High	5240	17.91

8.2.4. OUTPUT POWER AND PSD (FCC)

LIMITS

FCC §15.407 (a) (1)

(i) For an outdoor access point operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. The maximum e.i.r.p. at any elevation angle above 30 degrees as measured from the horizon must not exceed 125 mW (21 dBm).

(ii) For an indoor access point operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

(iii) For fixed point-to-point access points operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W. Fixed point-to-point U-NII devices may employ antennas with directional gain up to 23 dBi without any corresponding reduction in the maximum conducted output power or maximum power spectral density. For fixed point-to-point transmitters that employ a directional antenna gain greater than 23 dBi, a 1 dB reduction in maximum conducted output power and maximum power spectral density is required for each 1 dB of antenna gain in excess of 23 dBi. Fixed, point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications, and multiple colocated transmitters transmitting the same information. The operator of the U-NII device, or if the equipment is professionally installed, the installer, is responsible for ensuring that systems employing high gain directional antennas are used exclusively for fixed, point-to-point operations.

(iv) For mobile and portable client devices in the 5.15-5.25 GHz band, the maximum conducted output power over the frequency band of operation shall not exceed 250 mW provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

TEST PROCEDURE

Measurements perform using a wideband gated RF power meter provided that the gate parameters are adjusted such that the power is measured only when the EUT is transmitting at its maximum power control level. Since the measurement is made only during the ON time of the transmitter, no duty cycle correction factor is required.

DIRECTIONAL ANTENNA GAIN

There is only one transmitter output therefore the directional gain is equal to the antenna gain.

RESULTS

Antenna Gain and Limits

Channel	Frequency (MHz)	Directional Gain for Power (dBi)	Directional Gain for PSD (dBi)	Power Limit (dBm)	PSD Limit (dBm)
Low	5180	2.90	2.90	24.00	11.00
Mid	5200	2.90	2.90	24.00	11.00
High	5240	2.90	2.90	24.00	11.00

Duty Cycle CF (dB)	0.00	Included in Calculations of Corr'd PSD
--------------------	------	--

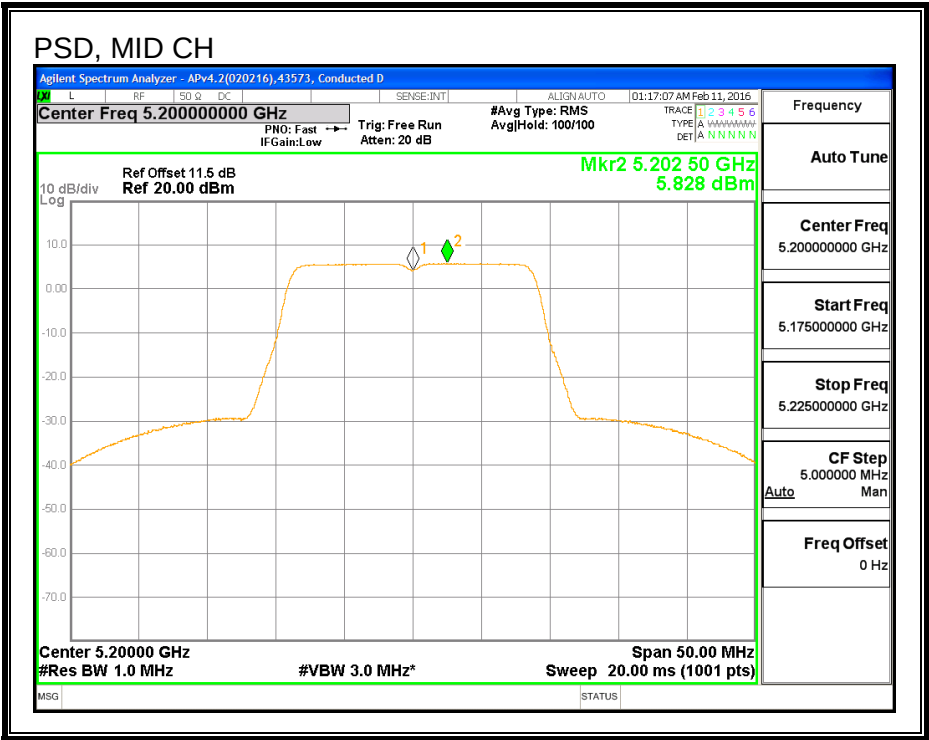
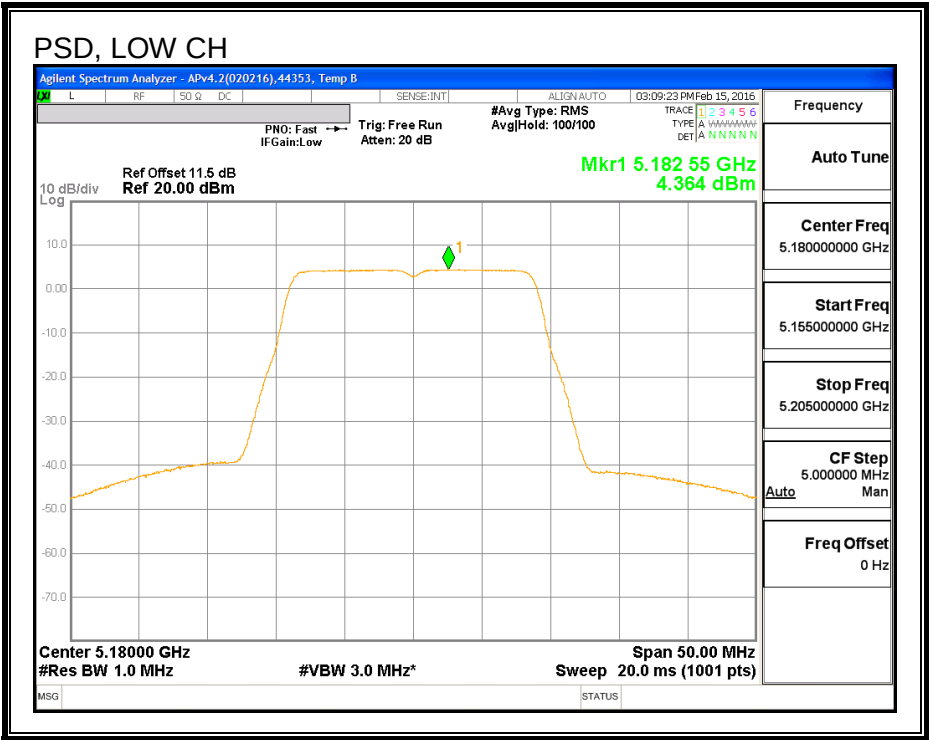
Output Power Results

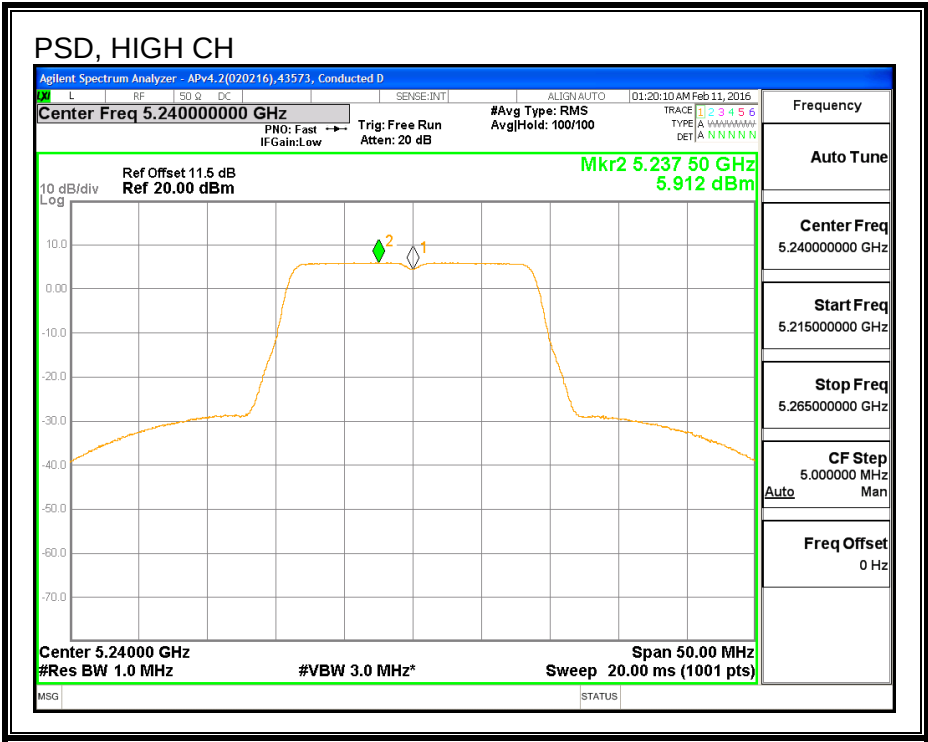
Channel	Frequency (MHz)	Chain 1 Meas Power (dBm)	Total Corr'd Power (dBm)	Power Limit (dBm)	Power Margin (dB)
Low	5180	16.33	16.33	24.00	-7.67
Mid	5200	17.81	17.81	24.00	-6.19
High	5240	17.91	17.91	24.00	-6.09

PSD Results

Channel	Frequency (MHz)	Chain 1 Meas PSD (dBm)	Total Corr'd PSD (dBm)	PSD Limit (dBm)	PSD Margin (dB)
Low	5180	4.36	4.36	11.00	-6.64
Mid	5200	5.83	5.83	11.00	-5.17
High	5240	5.91	5.91	11.00	-5.09

PSD





8.3. 802.11n HT20 2Tx CDD MODE IN THE 5.2 GHz BAND

8.3.1. 26 dB BANDWIDTH

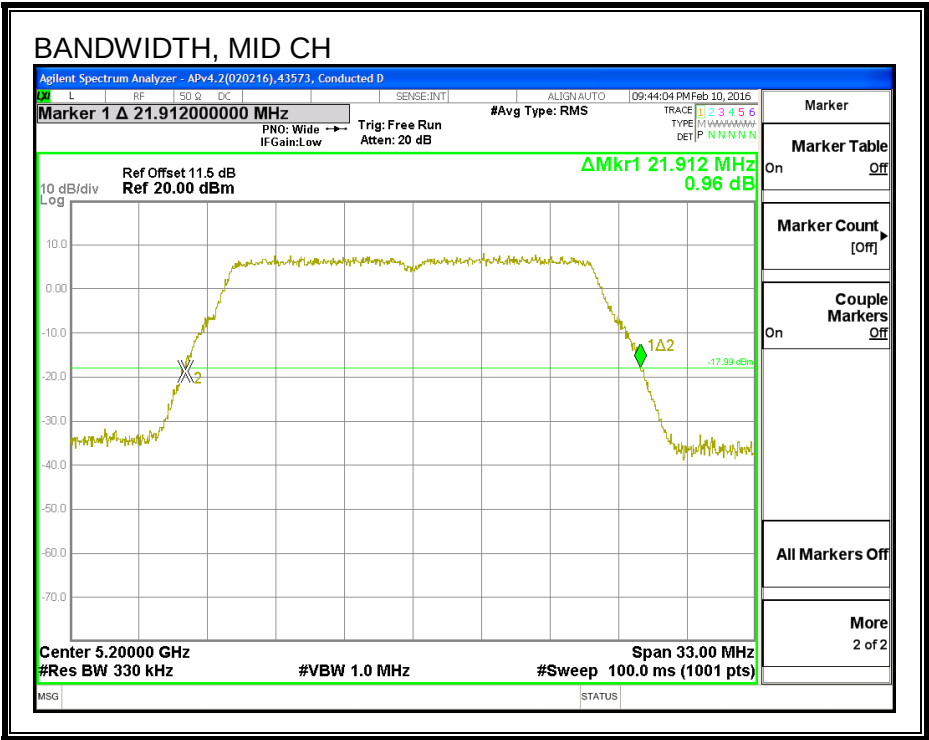
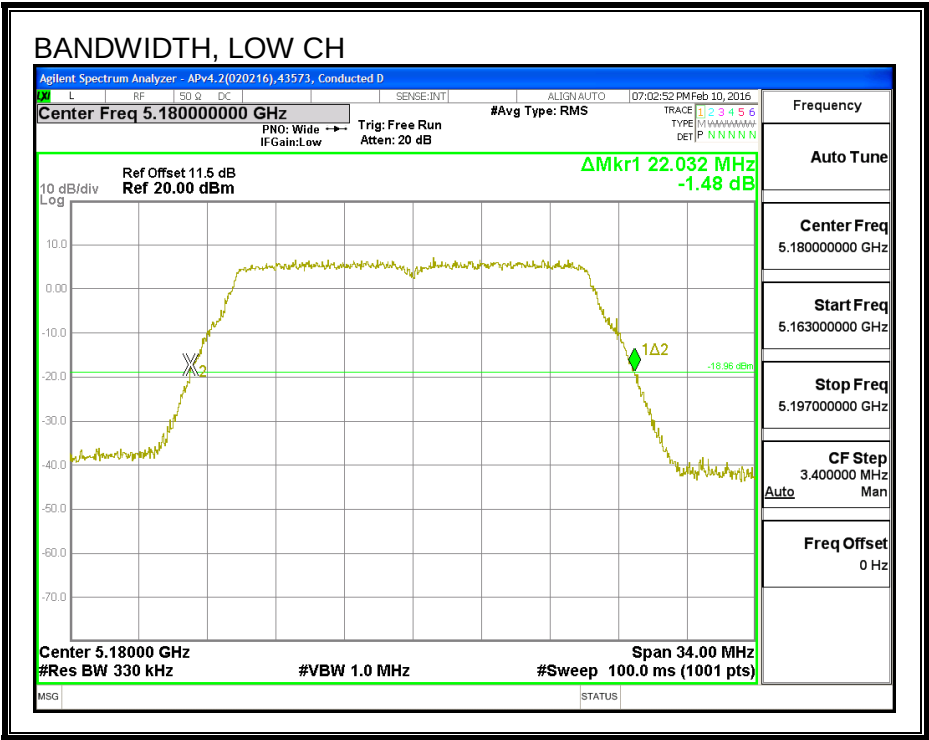
LIMITS

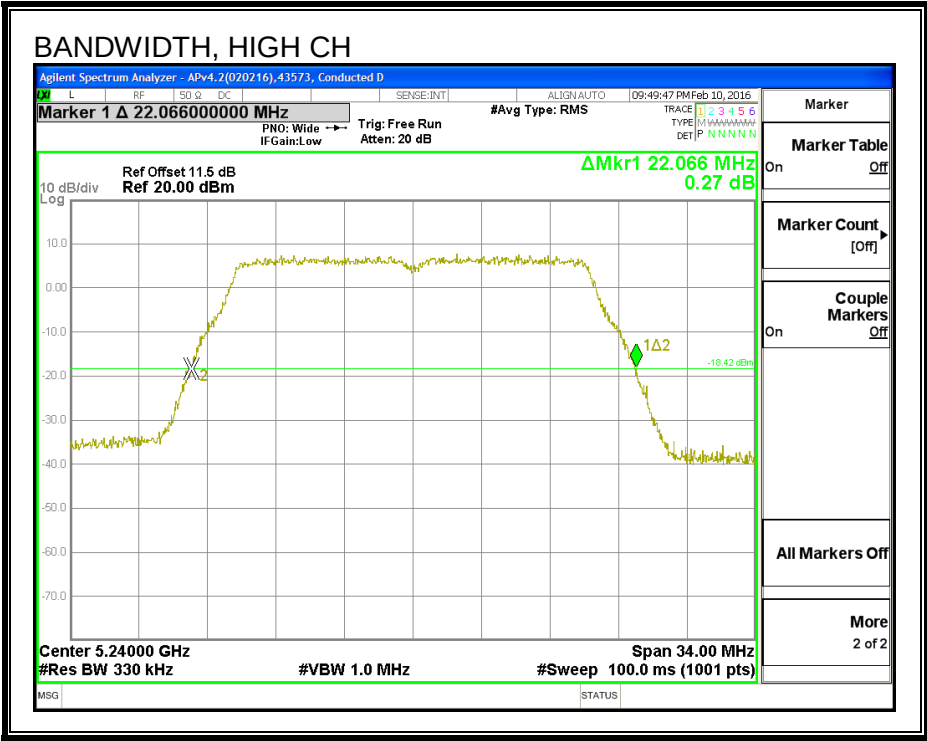
None; for reporting purposes only.

RESULTS

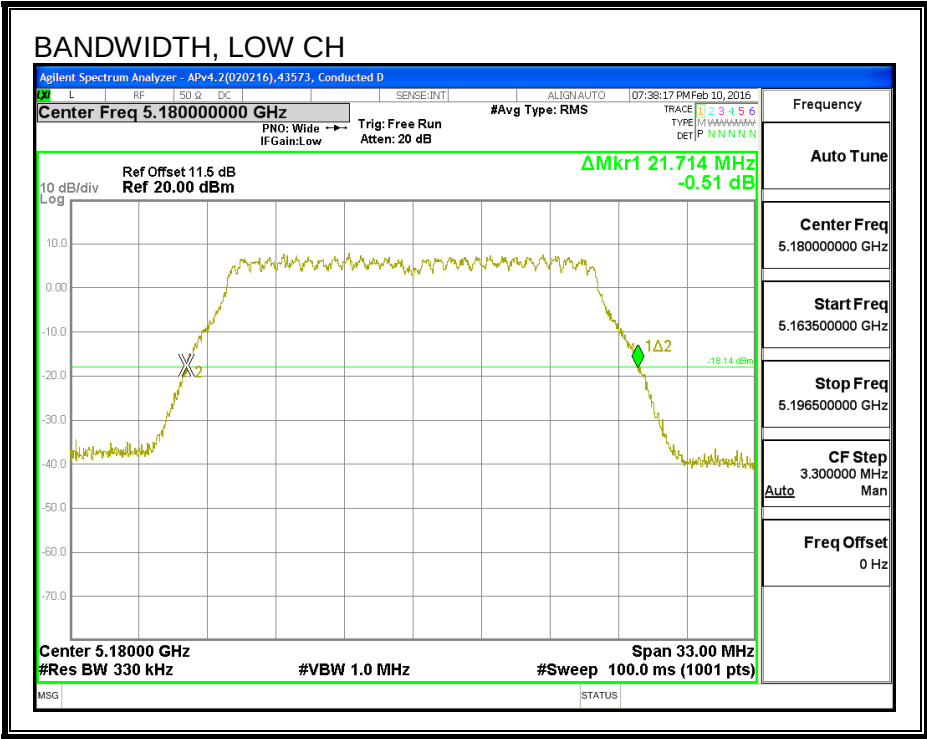
Channel	Frequency (MHz)	26 dB BW Chain 0 (MHz)	26 dB BW Chain 1 (MHz)
Low	5180	22.03	21.71
Mid	5200	21.91	21.91
High	5240	22.07	21.98

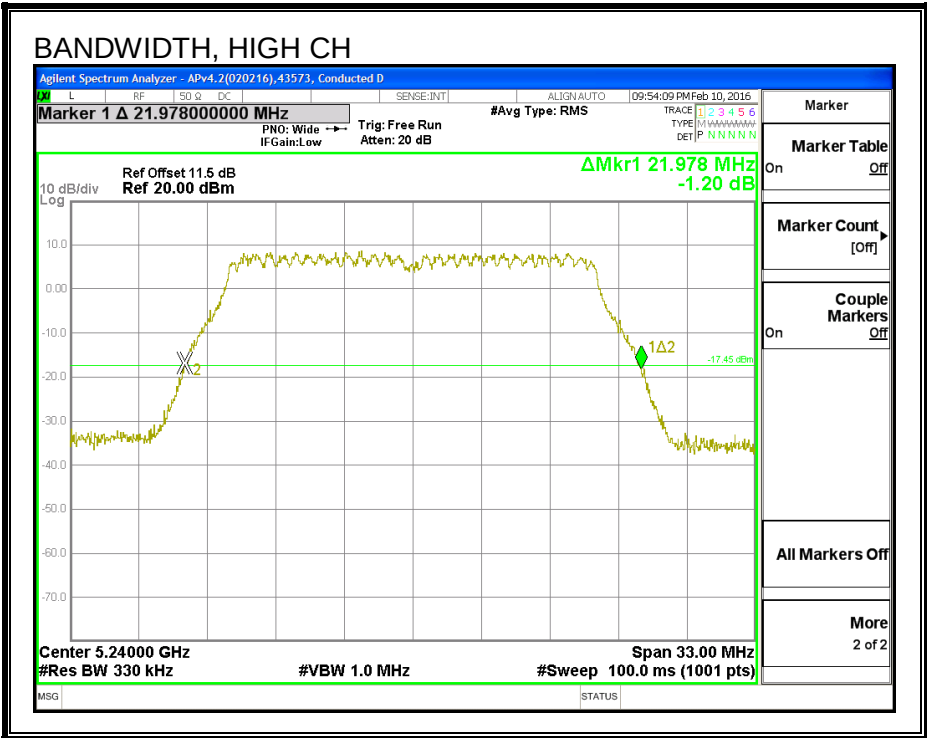
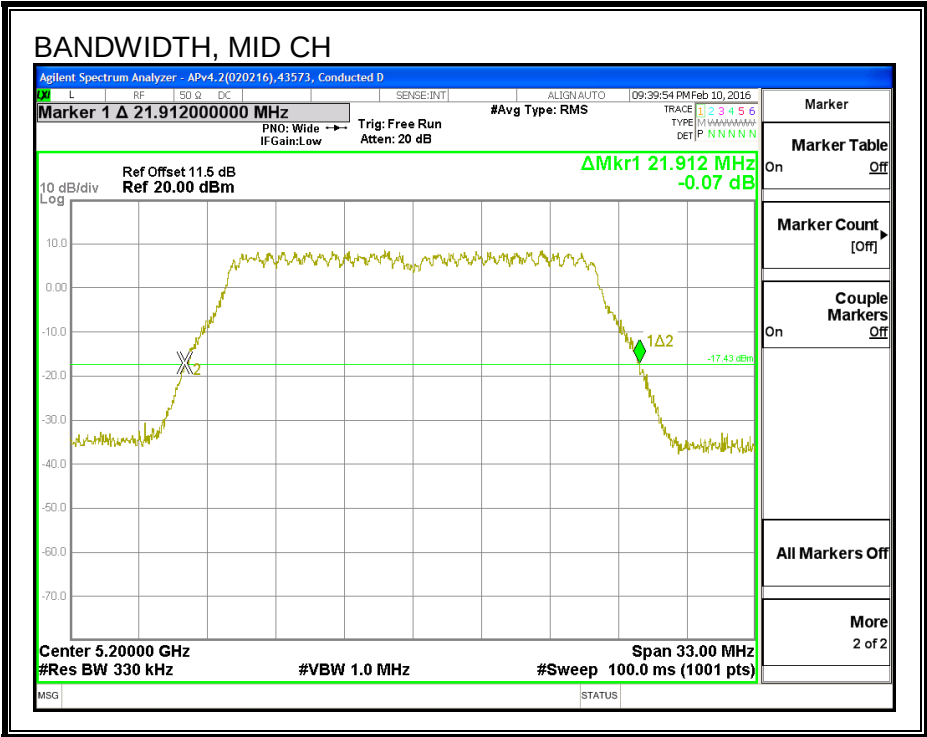
26 DB BANDWIDTH, CHAIN 0





26 DB BANDWIDTH, CHAIN 1





8.3.2. 99% BANDWIDTH

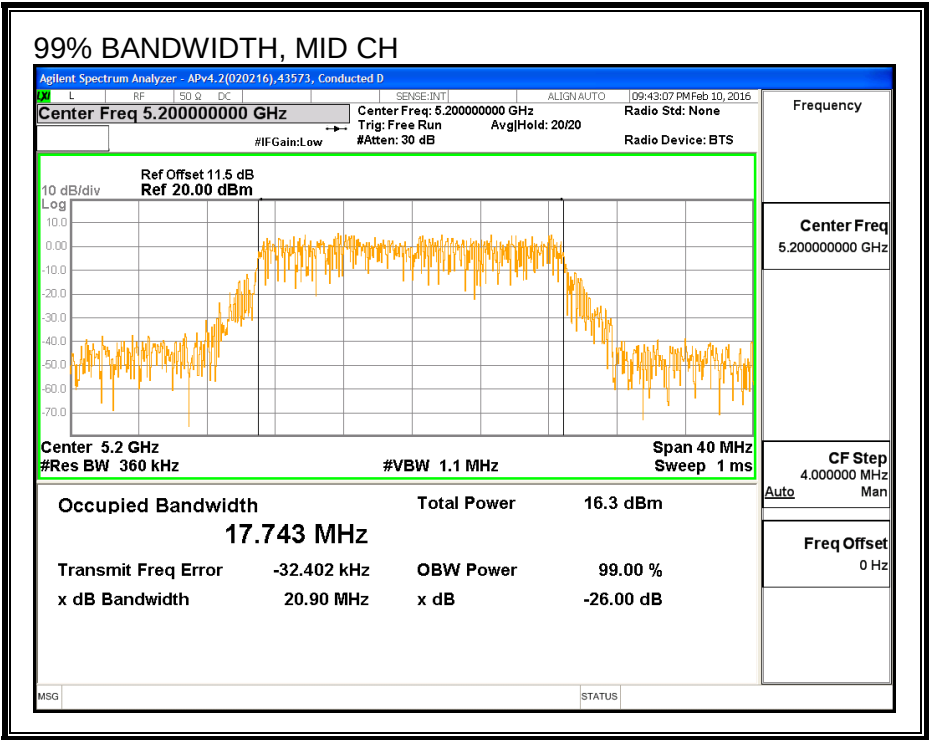
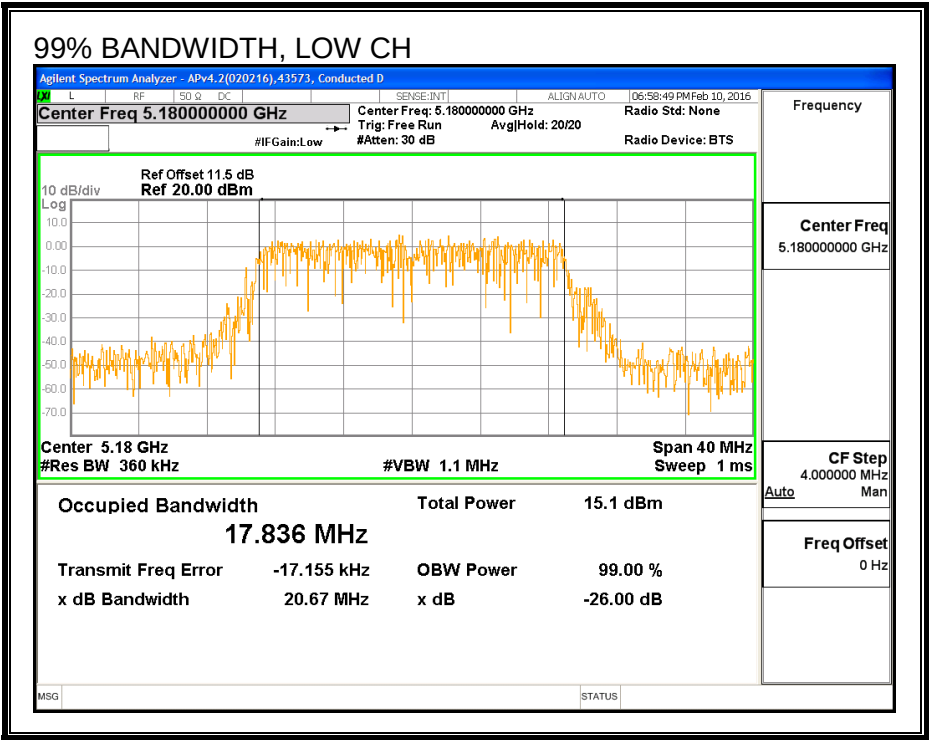
LIMITS

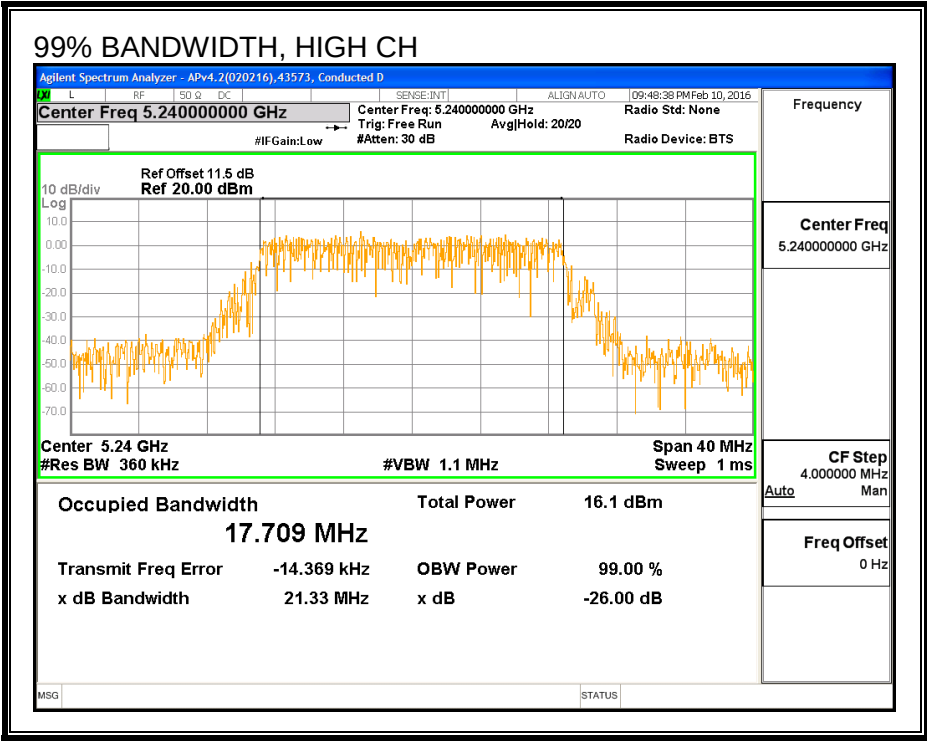
None; for reporting purposes only.

RESULTS

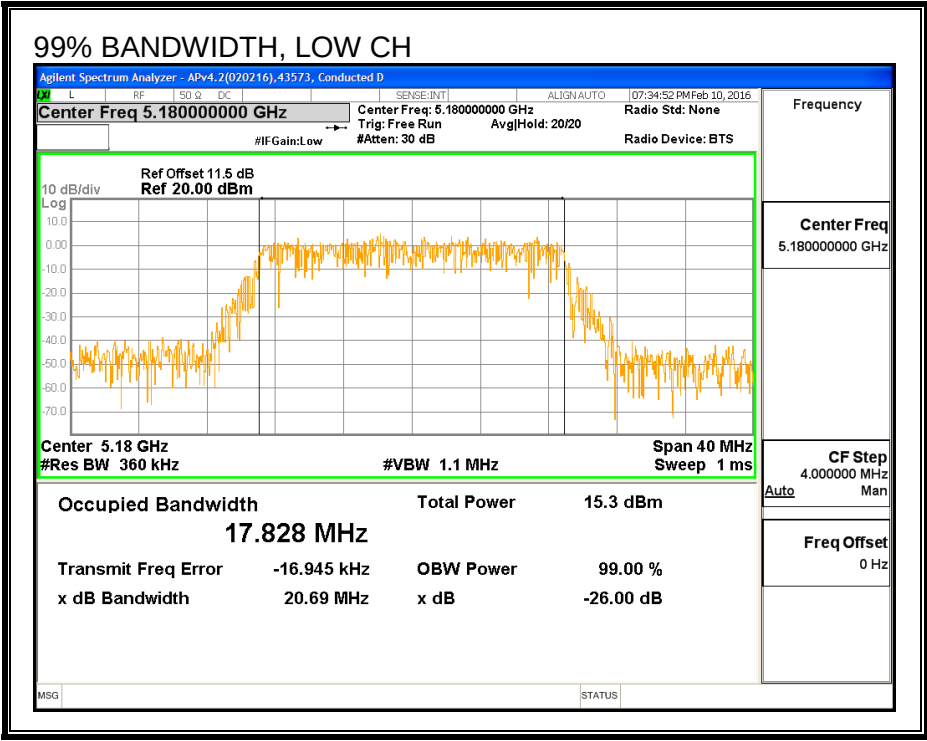
Channel	Frequency (MHz)	99% BW Chain 0 (MHz)	99% BW Chain 1 (MHz)
Low	5180	17.836	17.828
Mid	5200	17.743	17.847
High	5240	17.709	17.760

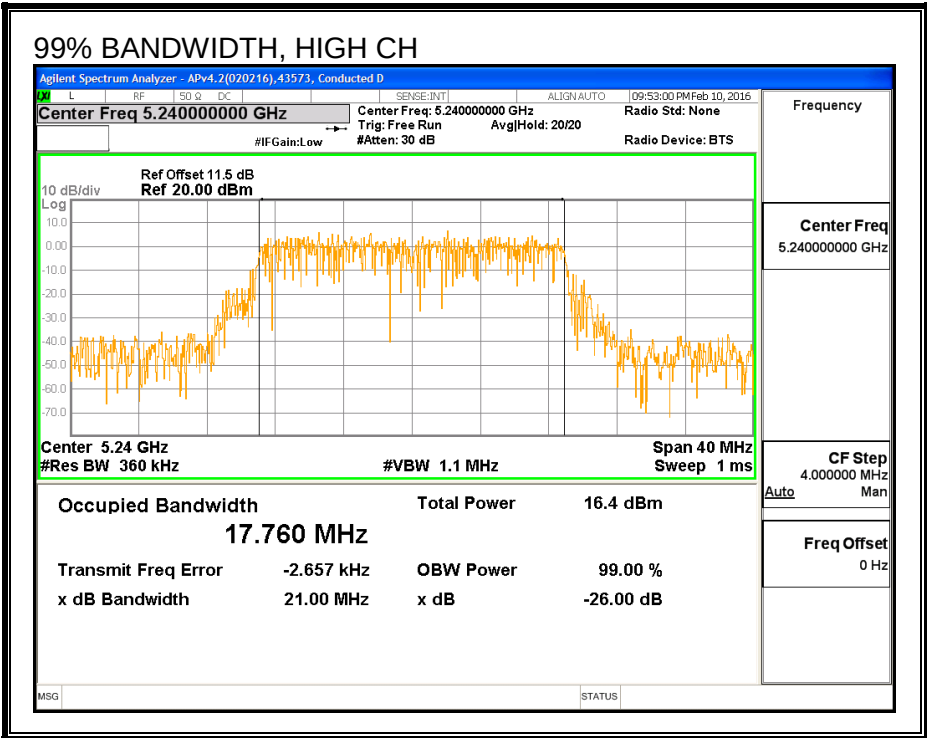
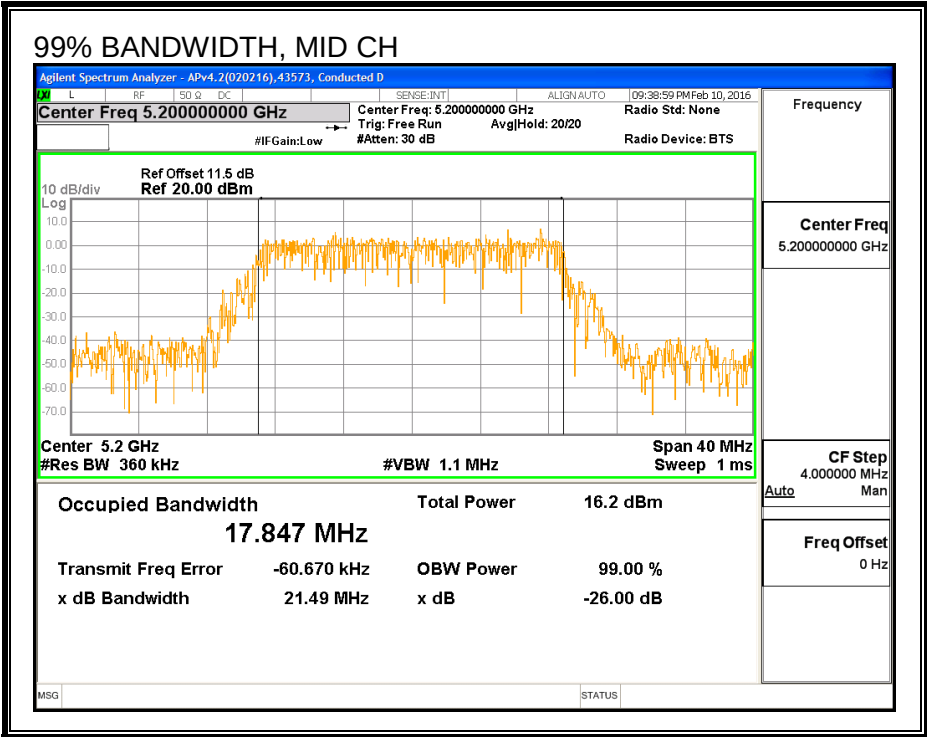
99% BANDWIDTH, CHAIN 0





99% BANDWIDTH, CHAIN 1





8.3.3. AVERAGE POWER (FCC)

LIMITS

None; for reporting purposes only.

TEST PROCEDURE

Measurements perform using a wideband gated RF power meter.

RESULTS

Channel	Frequency (MHz)	Chain 0 Power (dBm)	Chain 1 Power (dBm)	Total Power (dBm)
Low	5180	14.93	14.92	17.93
Mid	5200	15.84	15.86	18.86
High	5240	15.85	15.84	18.86

8.3.4. OUTPUT POWER AND PSD (FCC)

LIMITS

FCC §15.407 (a) (1)

(i) For an outdoor access point operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. The maximum e.i.r.p. at any elevation angle above 30 degrees as measured from the horizon must not exceed 125 mW (21 dBm).

(ii) For an indoor access point operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

(iii) For fixed point-to-point access points operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W. Fixed point-to-point U-NII devices may employ antennas with directional gain up to 23 dBi without any corresponding reduction in the maximum conducted output power or maximum power spectral density. For fixed point-to-point transmitters that employ a directional antenna gain greater than 23 dBi, a 1 dB reduction in maximum conducted output power and maximum power spectral density is required for each 1 dB of antenna gain in excess of 23 dBi. Fixed, point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications, and multiple colocated transmitters transmitting the same information. The operator of the U-NII device, or if the equipment is professionally installed, the installer, is responsible for ensuring that systems employing high gain directional antennas are used exclusively for fixed, point-to-point operations.

(iv) For mobile and portable client devices in the 5.15-5.25 GHz band, the maximum conducted output power over the frequency band of operation shall not exceed 250 mW provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

TEST PROCEDURE

Measurements perform using a wideband gated RF power meter provided that the gate parameters are adjusted such that the power is measured only when the EUT is transmitting at its maximum power control level. Since the measurement is made only during the ON time of the transmitter, no duty cycle correction factor is required.

DIRECTIONAL ANTENNA GAIN

The TX chains are uncorrelated and the antenna gain is unequal among the chains. The directional gain is:

Chain 0 Antenna Gain (dBi)	Chain 1 Antenna Gain (dBi)	Uncorrelated Chains Directional Gain (dBi)
3.11	2.90	3.01

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

Chain 0 Antenna Gain (dBi)	Chain 1 Antenna Gain (dBi)	Correlated Chains Directional Gain (dBi)
3.11	2.90	6.02

RESULTS

Antenna Gain and Limits

Channel	Frequency (MHz)	Directional Gain for Power (dBi)	Directional Gain for PSD (dBi)	Power Limit (dBm)	PSD Limit (dBm)
Low	5180	3.01	6.02	24.00	10.98
Mid	5200	3.01	6.02	24.00	10.98
High	5240	3.01	6.02	24.00	10.98

Duty Cycle CF (dB)	0.00	Included in Calculations of Corr'd PSD
--------------------	------	--

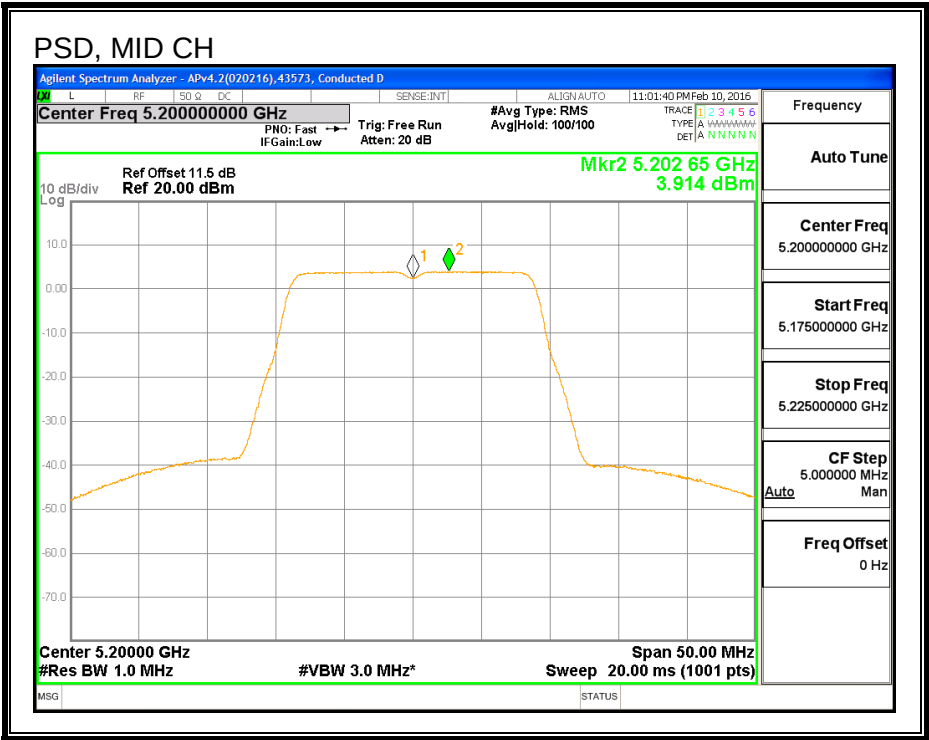
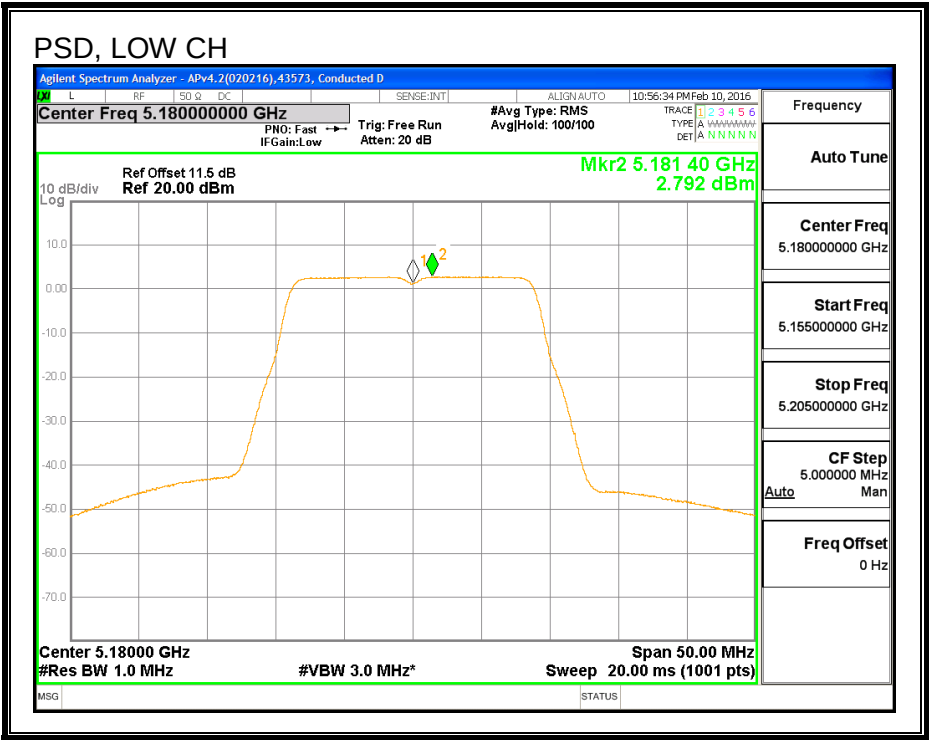
Output Power Results

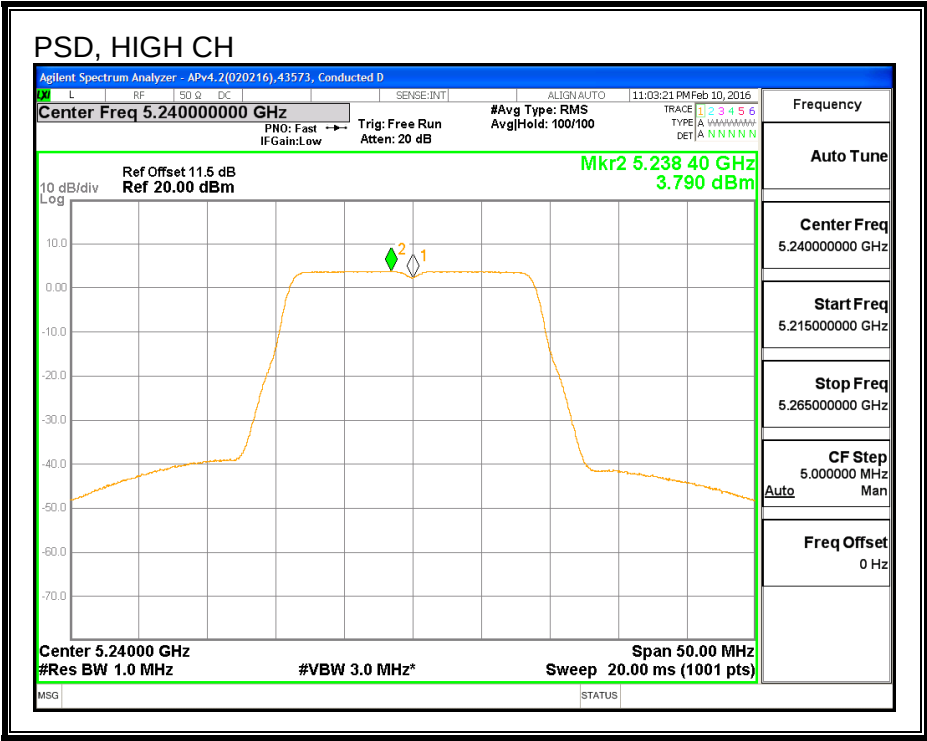
Channel	Frequency (MHz)	Chain 0 Meas Power (dBm)	Chain 1 Meas Power (dBm)	Total Corr'd Power (dBm)	Power Limit (dBm)	Power Margin (dB)
Low	5180	14.93	14.92	17.93	24.00	-6.07
Mid	5200	15.84	15.86	18.86	24.00	-5.14
High	5240	15.85	15.84	18.86	24.00	-5.14

PSD Results

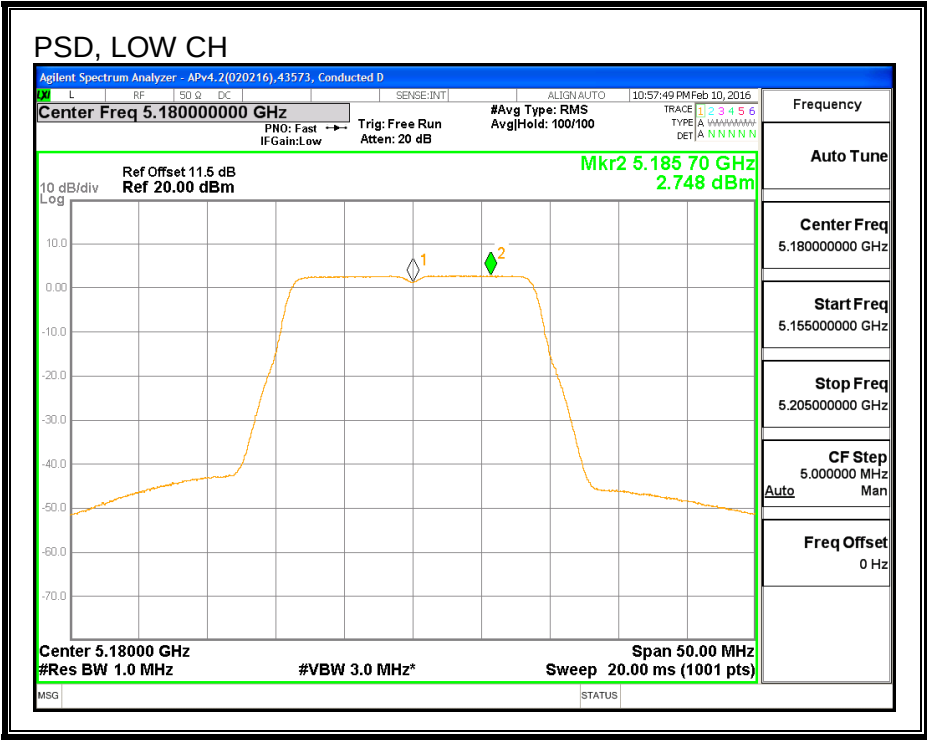
Channel	Frequency (MHz)	Chain 0 Meas PSD (dBm)	Chain 1 Meas PSD (dBm)	Total Corr'd PSD (dBm)	PSD Limit (dBm)	PSD Margin (dB)
Low	5180	2.79	2.75	5.78	10.98	-5.20
Mid	5200	3.91	3.94	6.93	10.98	-4.05
High	5240	3.79	3.78	6.80	10.98	-4.18

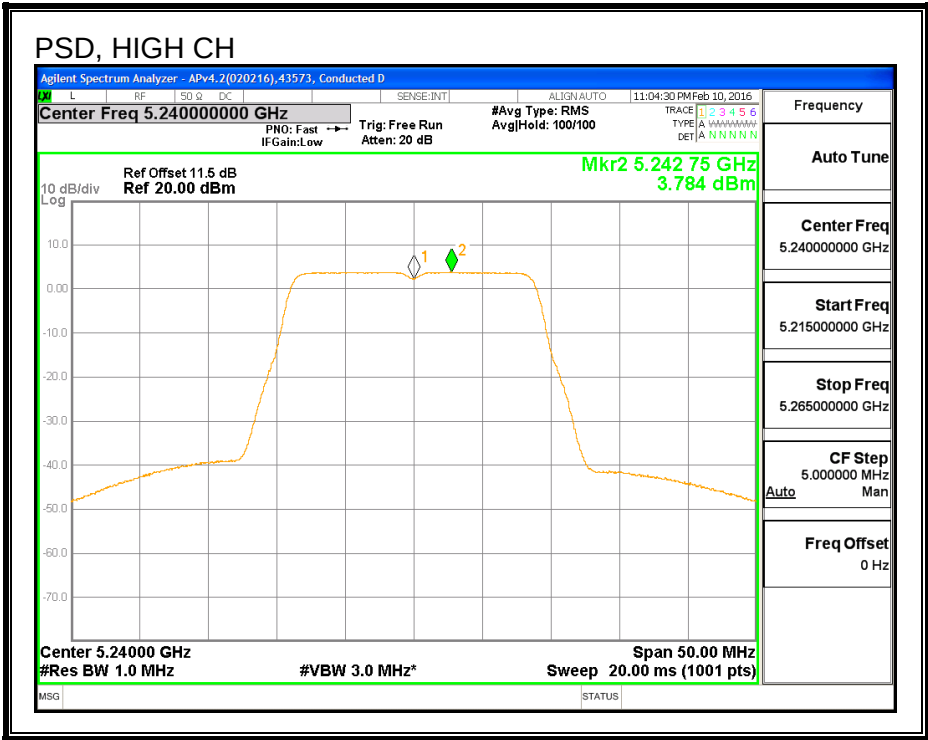
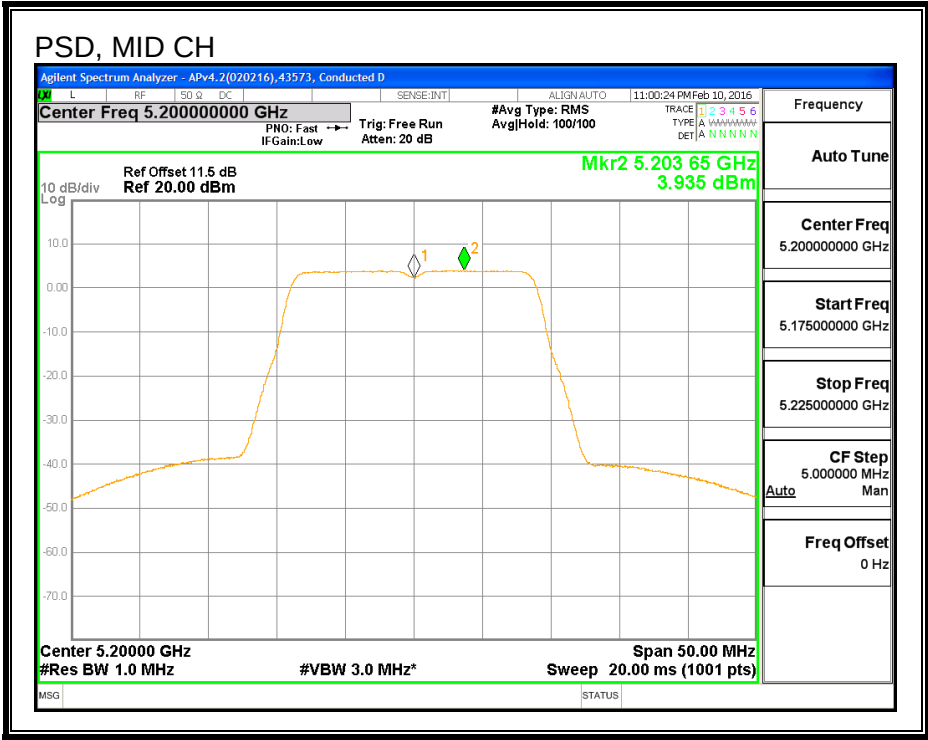
PSD, CHAIN 0





PSD, CHAIN 1





8.4. 802.11n HT20 2Tx STBC MODE IN THE 5.2 GHz BAND

8.4.1. 26 dB BANDWIDTH

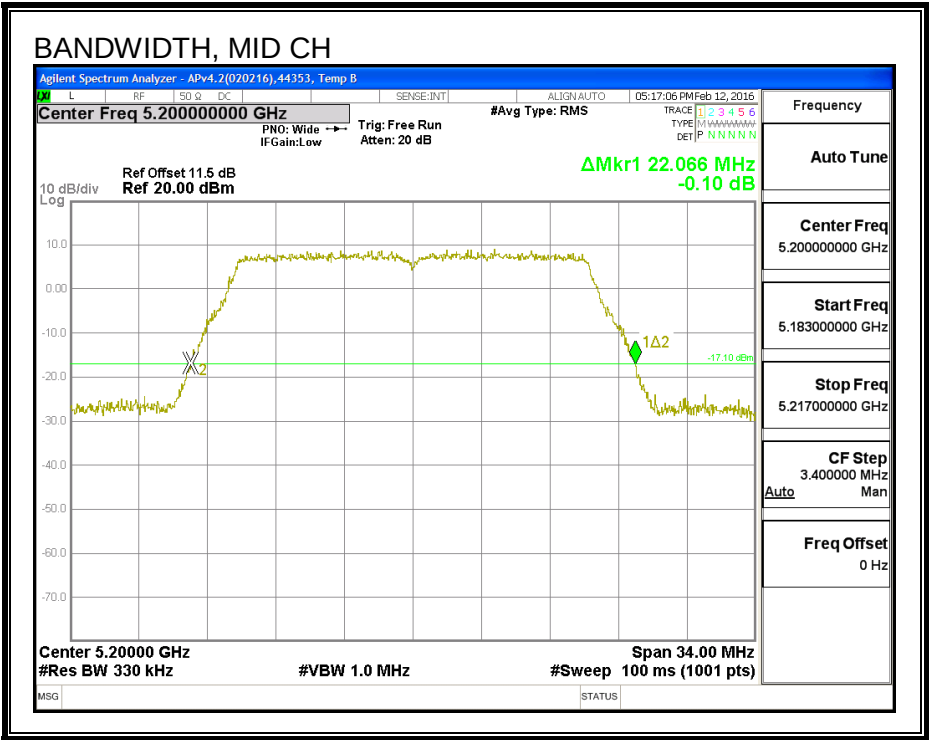
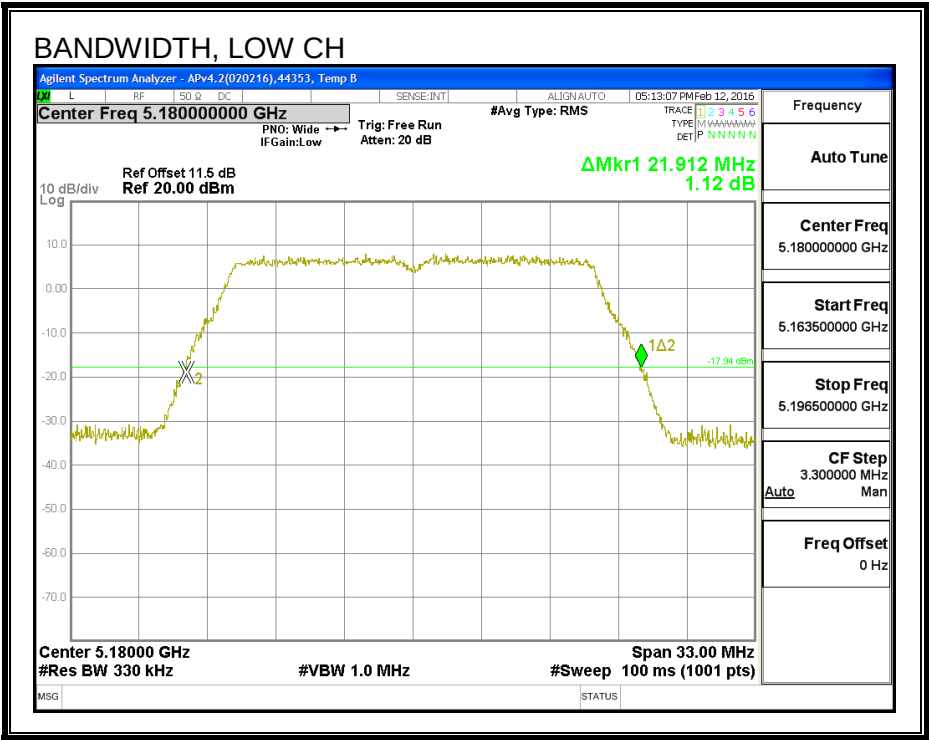
LIMITS

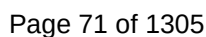
None; for reporting purposes only.

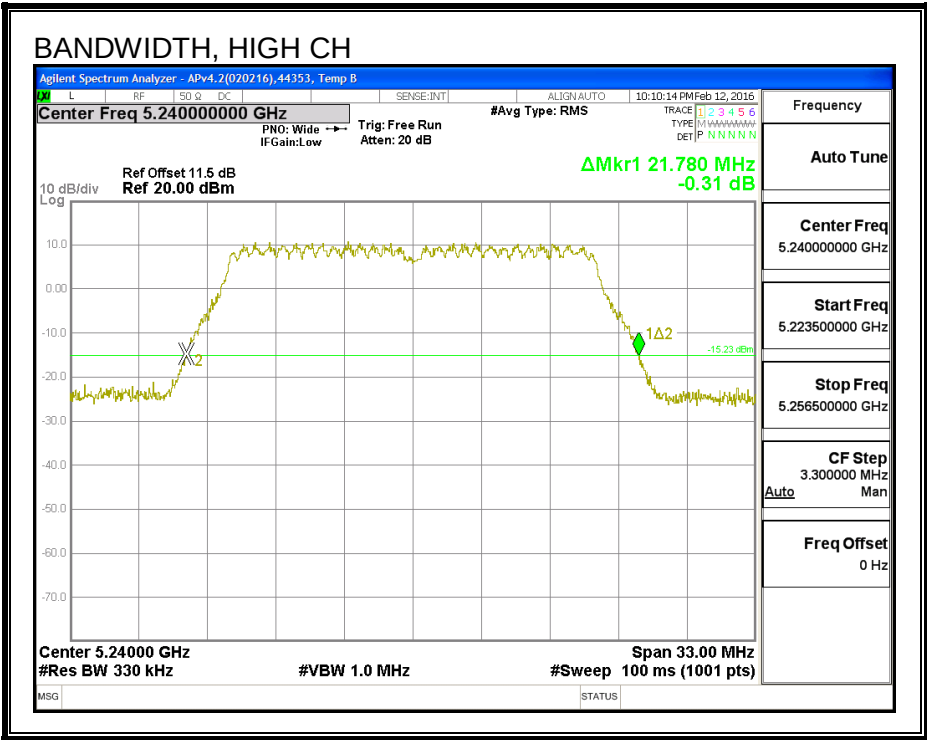
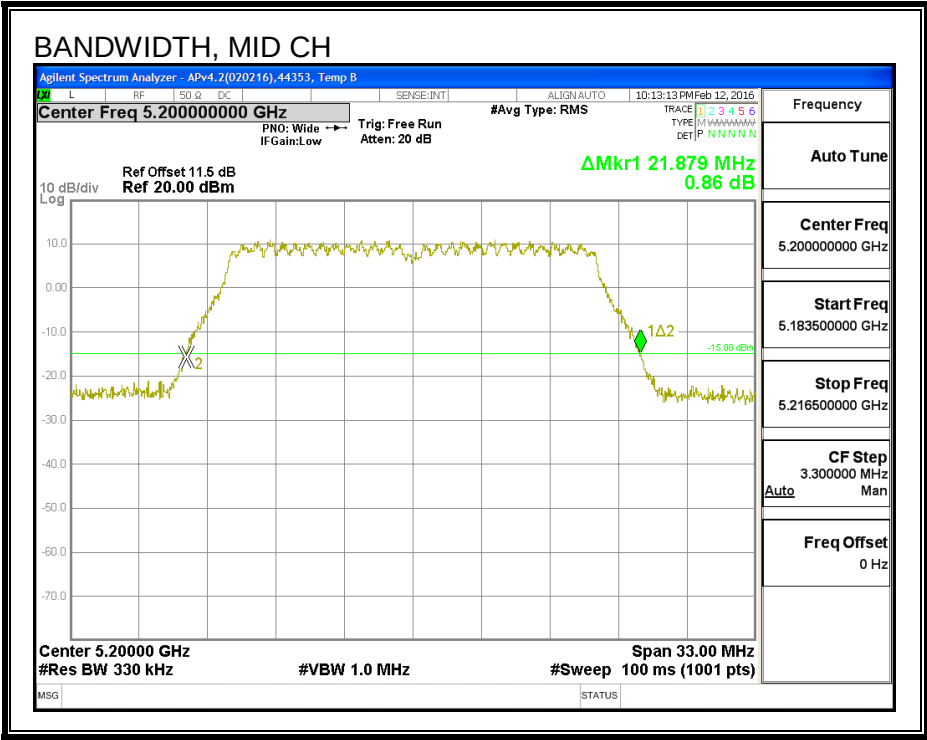
RESULTS

Channel	Frequency (MHz)	26 dB BW Chain 0 (MHz)	26 dB BW Chain 1 (MHz)
Low	5180	21.91	21.91
Mid	5200	22.07	21.88
High	5240	22.07	21.78

26 DB BANDWIDTH, CHAIN 0







8.4.2. 99% BANDWIDTH

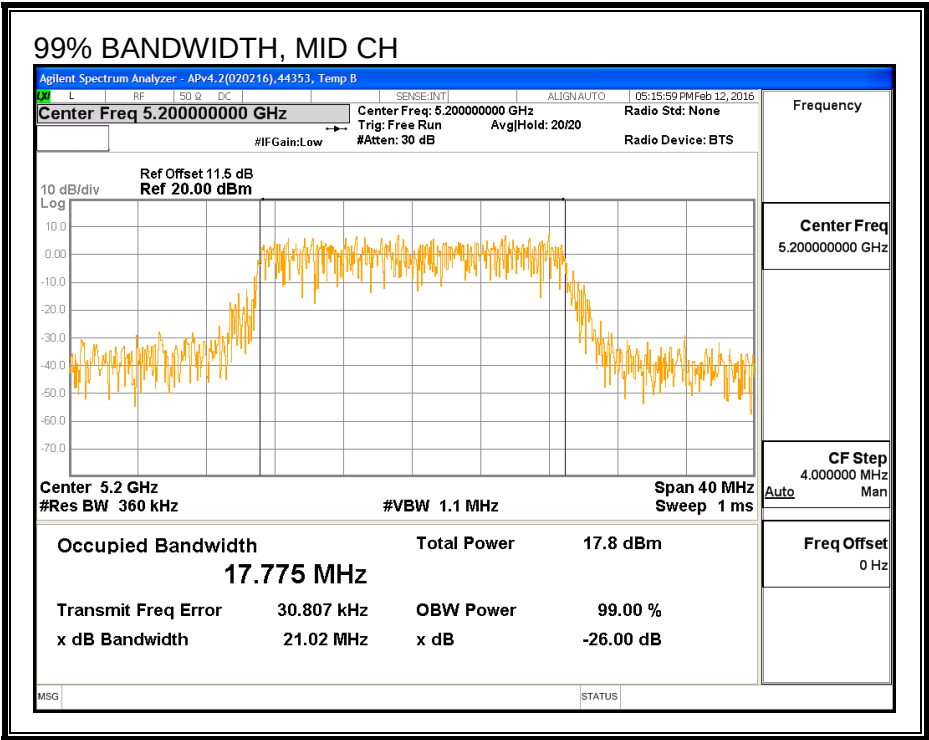
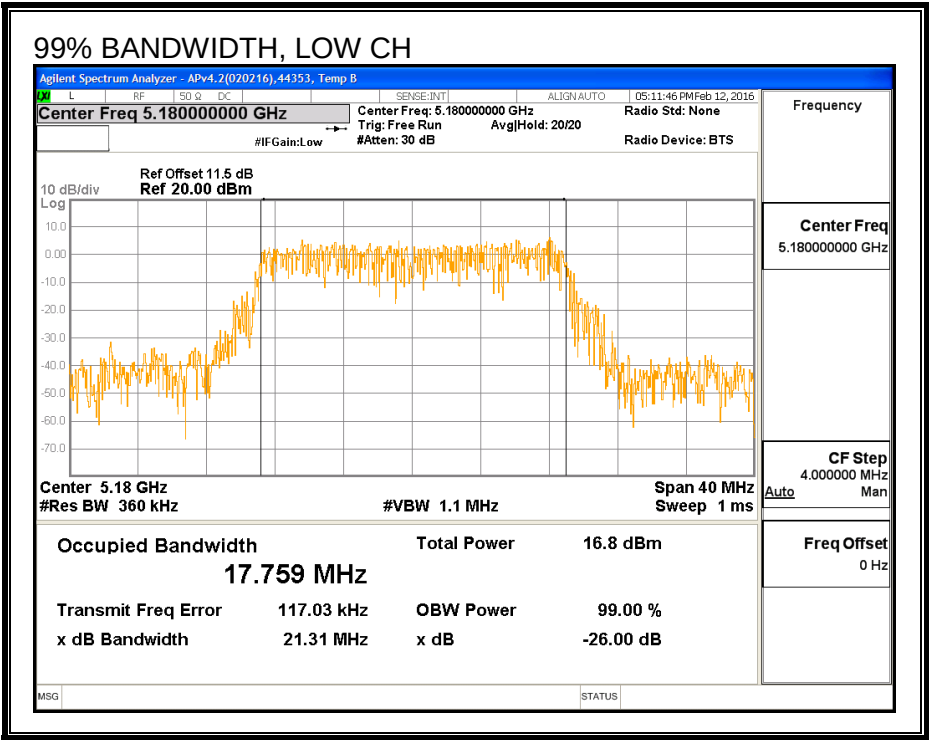
LIMITS

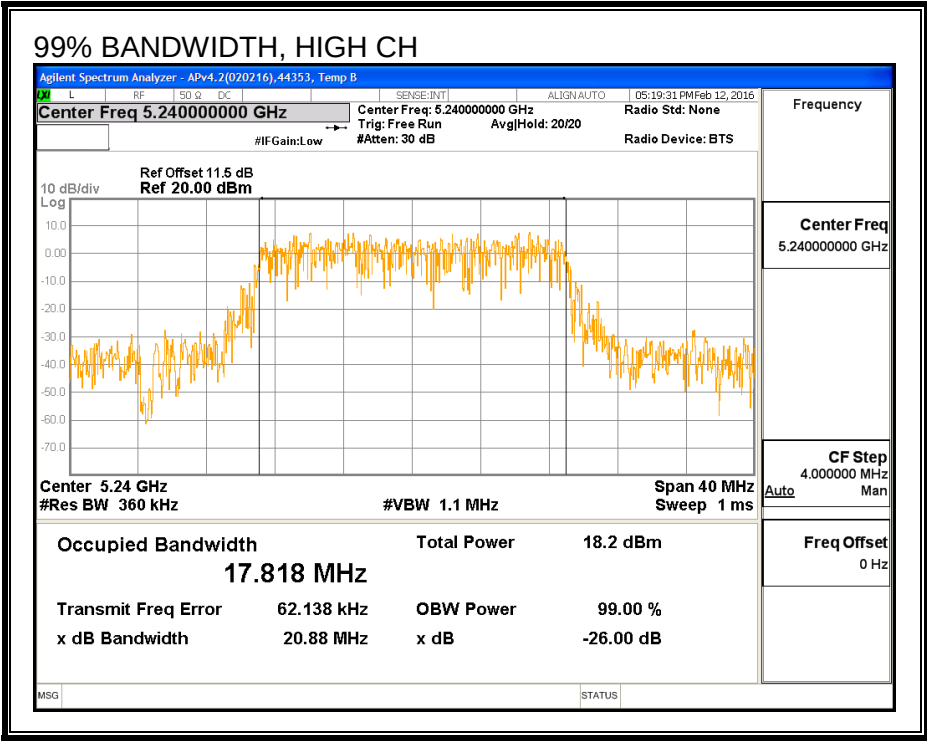
None; for reporting purposes only.

RESULTS

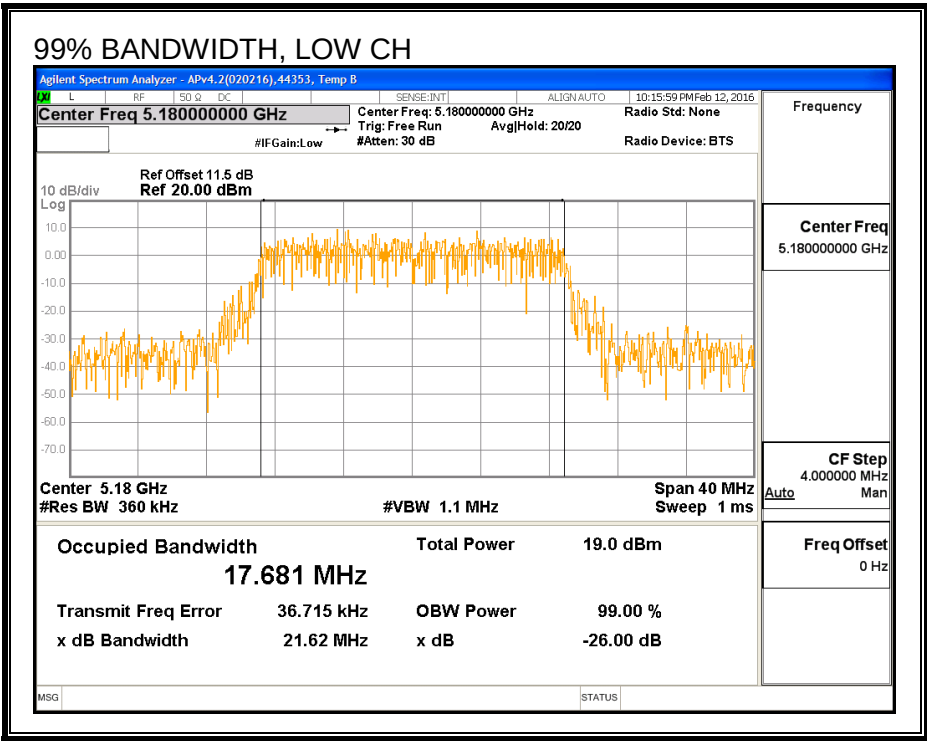
Channel	Frequency (MHz)	99% BW Chain 0 (MHz)	99% BW Chain 1 (MHz)
Low	5180	17.759	17.681
Mid	5200	17.775	17.832
High	5240	17.818	17.777

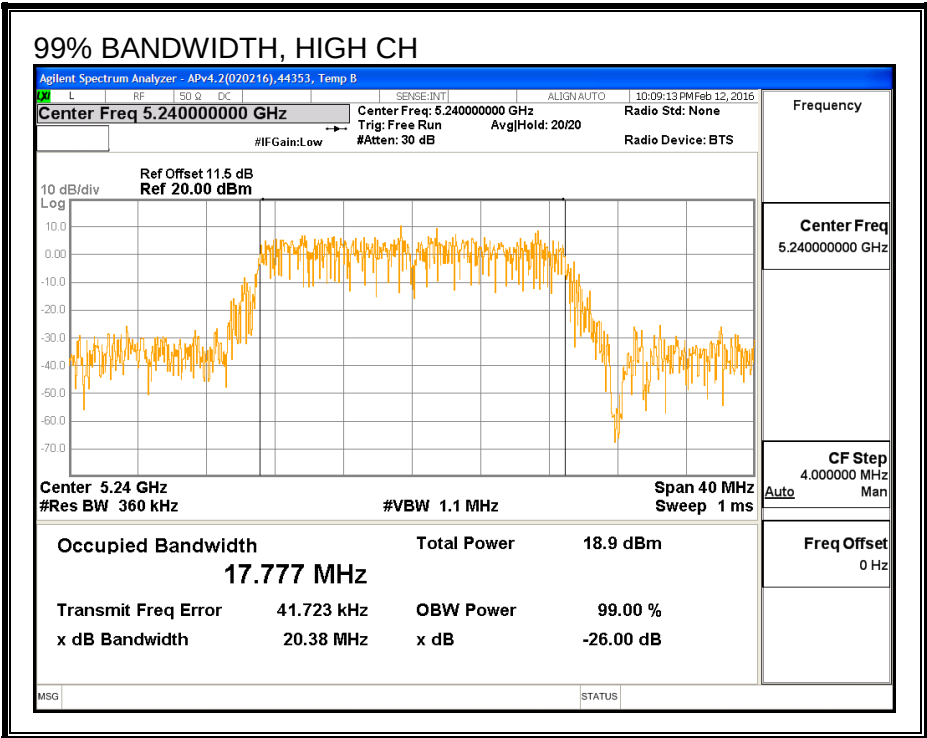
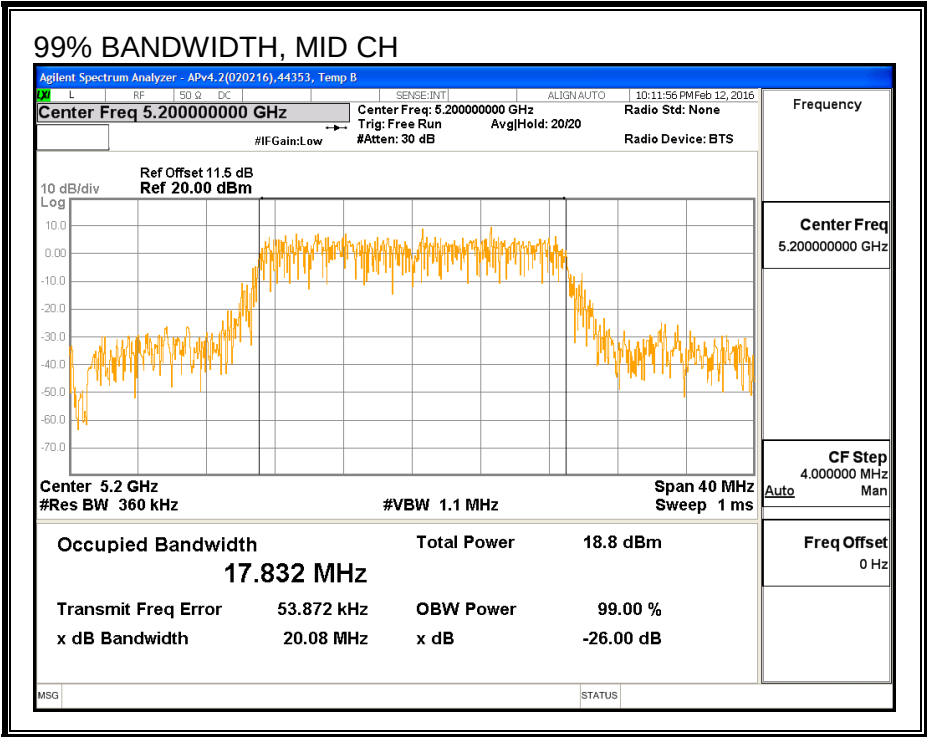
99% BANDWIDTH, CHAIN 0





99% BANDWIDTH, CHAIN 1





8.4.3. AVERAGE POWER (FCC)

LIMITS

None; for reporting purposes only.

TEST PROCEDURE

Measurements perform using a wideband gated RF power meter.

RESULTS

Average Power Results

Channel	Frequency (MHz)	Chain 0 Power (dBm)	Chain 1 Power (dBm)	Total Power (dBm)
Low	5180	14.82	14.90	17.87
Mid	5200	16.91	16.91	19.92
High	5240	16.95	16.78	19.88

8.4.4. OUTPUT POWER AND PSD (FCC)

LIMITS

FCC §15.407 (a) (1)

(i) For an outdoor access point operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. The maximum e.i.r.p. at any elevation angle above 30 degrees as measured from the horizon must not exceed 125 mW (21 dBm).

(ii) For an indoor access point operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

(iii) For fixed point-to-point access points operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W. Fixed point-to-point U-NII devices may employ antennas with directional gain up to 23 dBi without any corresponding reduction in the maximum conducted output power or maximum power spectral density. For fixed point-to-point transmitters that employ a directional antenna gain greater than 23 dBi, a 1 dB reduction in maximum conducted output power and maximum power spectral density is required for each 1 dB of antenna gain in excess of 23 dBi. Fixed, point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications, and multiple colocated transmitters transmitting the same information. The operator of the U-NII device, or if the equipment is professionally installed, the installer, is responsible for ensuring that systems employing high gain directional antennas are used exclusively for fixed, point-to-point operations.

(iv) For mobile and portable client devices in the 5.15-5.25 GHz band, the maximum conducted output power over the frequency band of operation shall not exceed 250 mW provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

TEST PROCEDURE

Measurements perform using a wideband gated RF power meter provided that the gate parameters are adjusted such that the power is measured only when the EUT is transmitting at its maximum power control level. Since the measurement is made only during the ON time of the transmitter, no duty cycle correction factor is required.

DIRECTIONAL ANTENNA GAIN

The TX chains are uncorrelated and the antenna gain is unequal among the chains. The directional gain is:

Chain 0 Antenna Gain (dBi)	Chain 1 Antenna Gain (dBi)	Uncorrelated Chains Directional Gain (dBi)
3.11	2.90	3.01

RESULTS

Antenna Gain and Limits

Channel	Frequency (MHz)	Directional Gain for Power (dBi)	Directional Gain for PSD (dBi)	Power Limit (dBm)	PSD Limit (dBm)
Low	5180	3.01	3.01	24.00	11.00
Mid	5200	3.01	3.01	24.00	11.00
High	5240	3.01	3.01	24.00	11.00

Duty Cycle CF (dB)	0.00	Included in Calculations of Corr'd PSD
--------------------	------	--

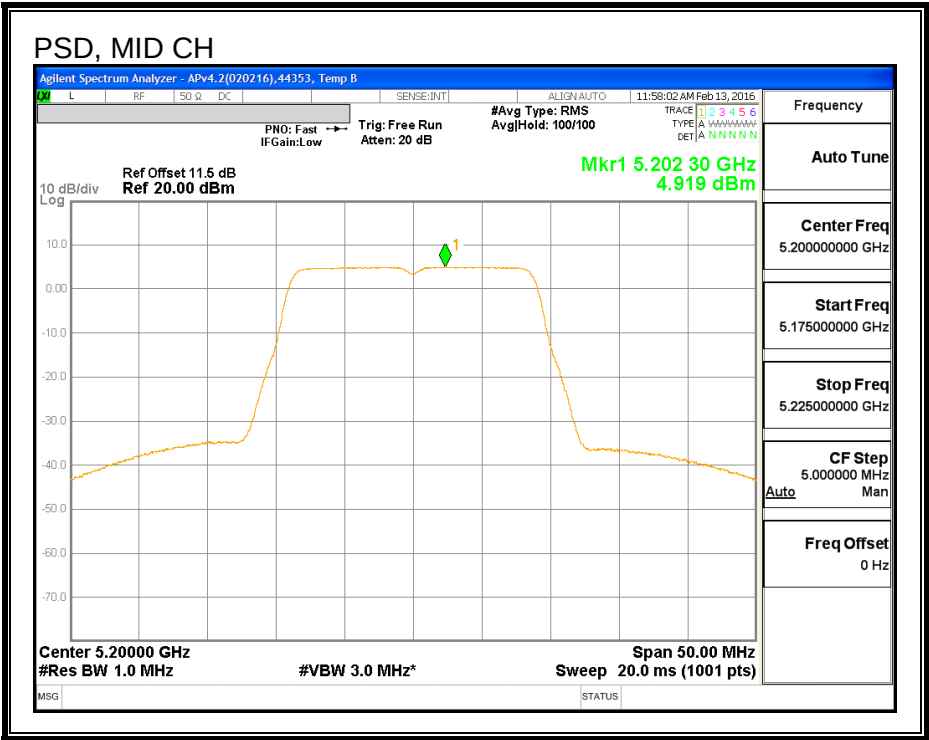
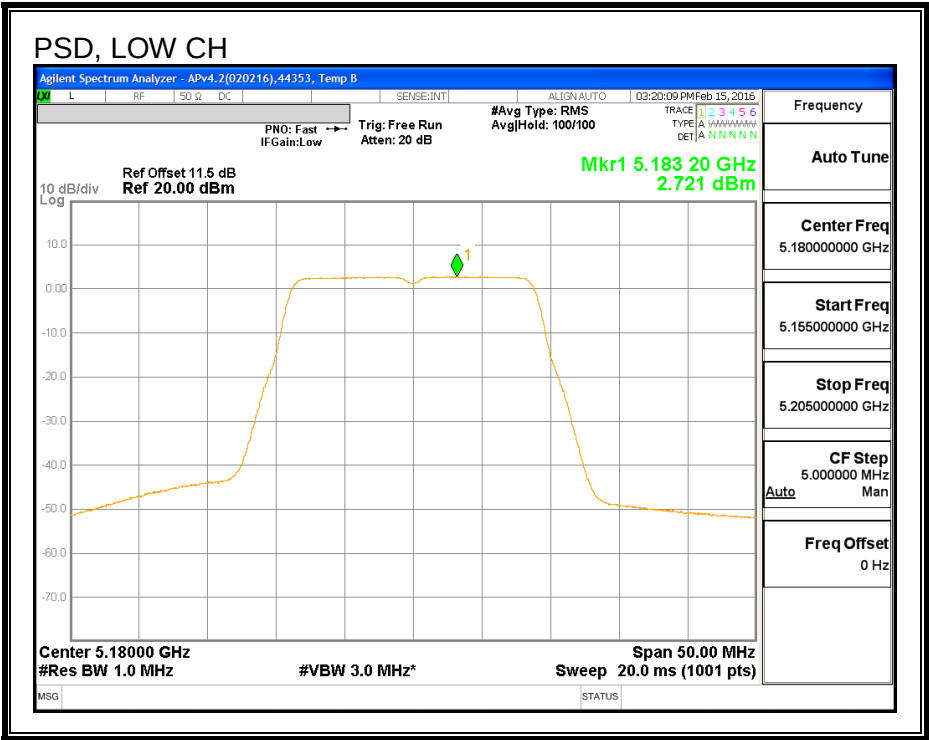
Output Power Results

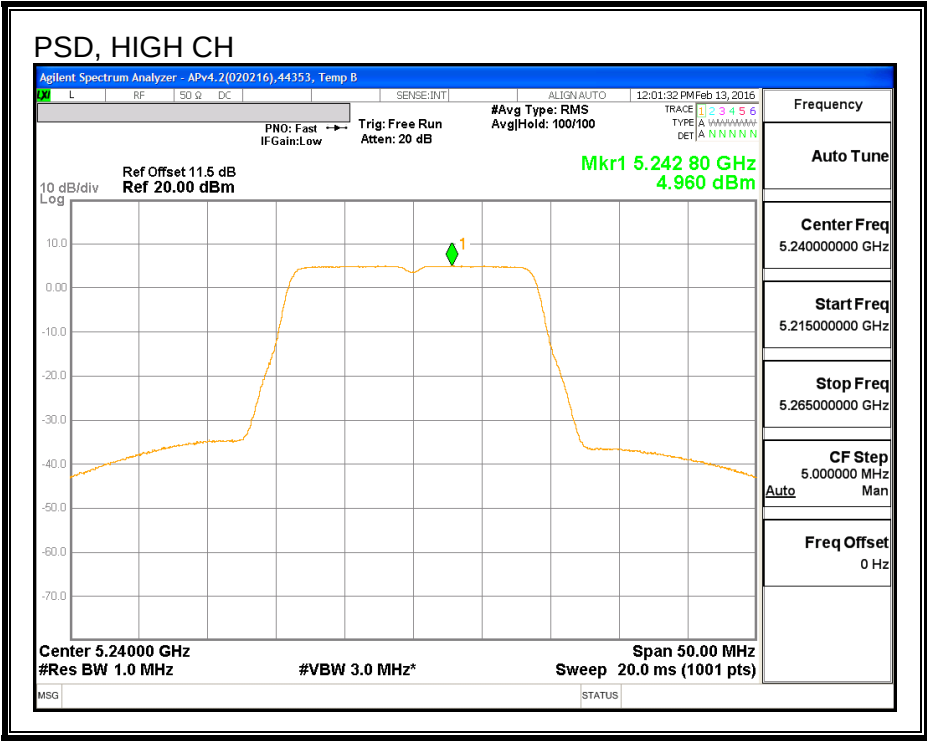
Channel	Frequency (MHz)	Chain 0 Meas Power (dBm)	Chain 1 Meas Power (dBm)	Total Corr'd Power (dBm)	Power Limit (dBm)	Power Margin (dB)
Low	5180	14.82	14.90	17.87	24.00	-6.13
Mid	5200	16.91	16.91	19.92	24.00	-4.08
High	5240	16.95	16.78	19.88	24.00	-4.12

PSD Results

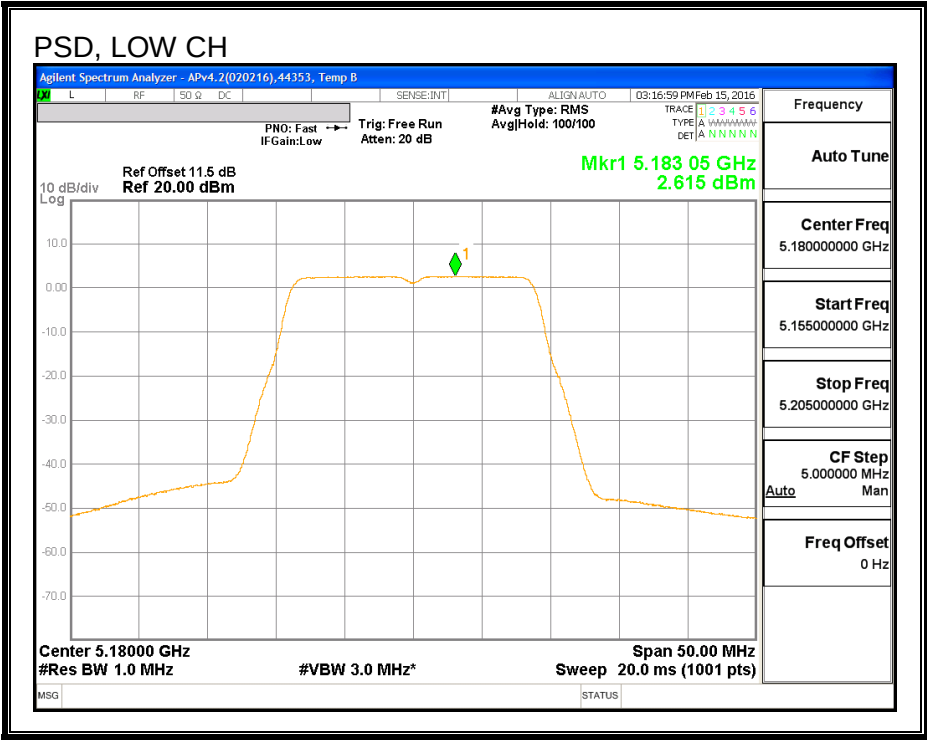
Channel	Frequency (MHz)	Chain 0 Meas PSD (dBm)	Chain 1 Meas PSD (dBm)	Total Corr'd PSD (dBm)	PSD Limit (dBm)	PSD Margin (dB)
Low	5180	2.72	2.62	5.68	11.00	-5.32
Mid	5200	4.92	4.91	7.93	11.00	-3.07
High	5240	4.96	4.87	7.92	11.00	-3.08

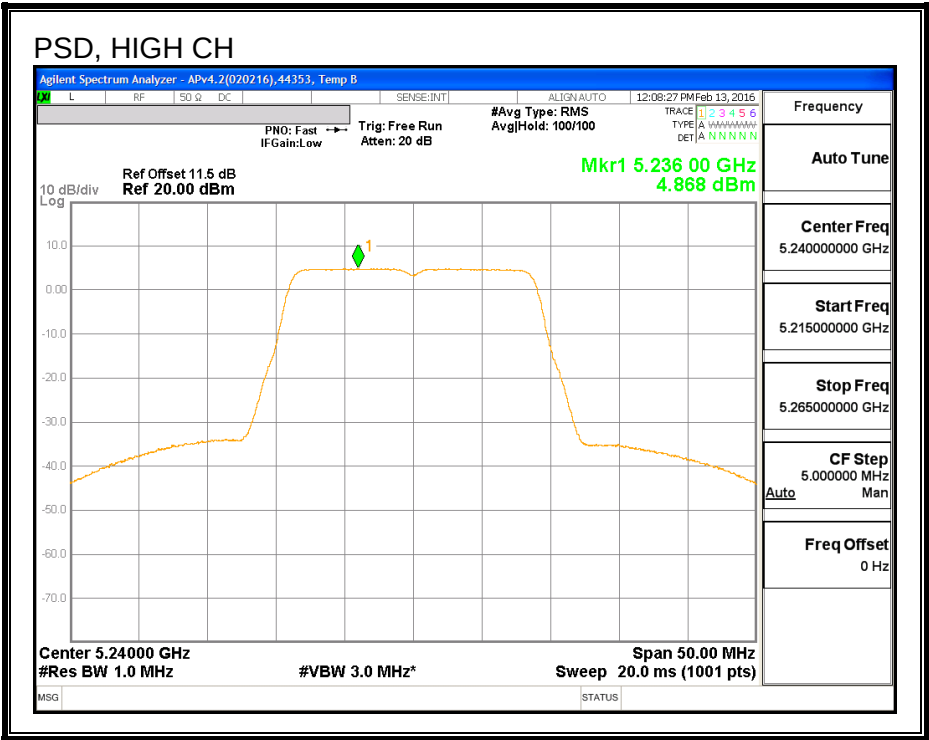
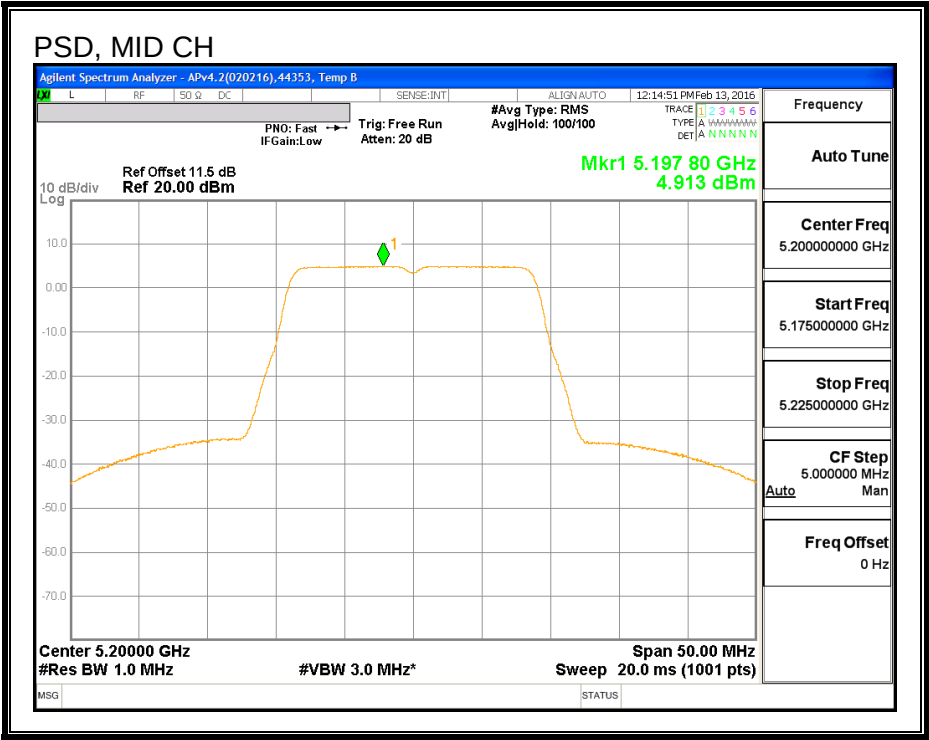
PSD, CHAIN 0





PSD, CHAIN 1





8.5. 802.11ac VHT20 2Tx BEAM FORMING MODE IN THE 5.2 GHz BAND

8.5.1. 26 dB BANDWIDTH

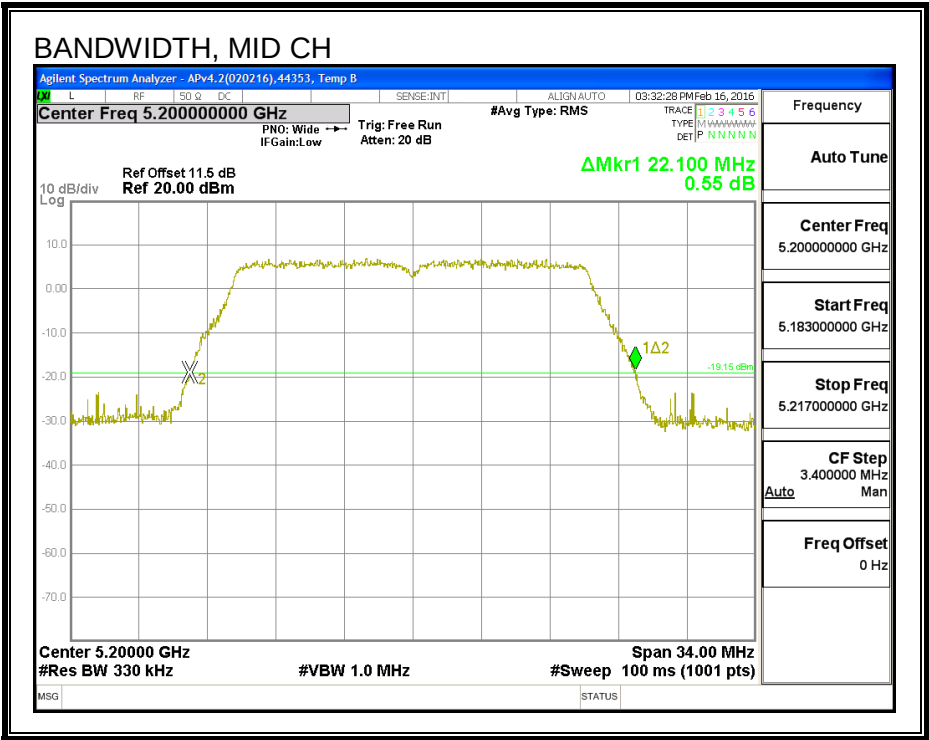
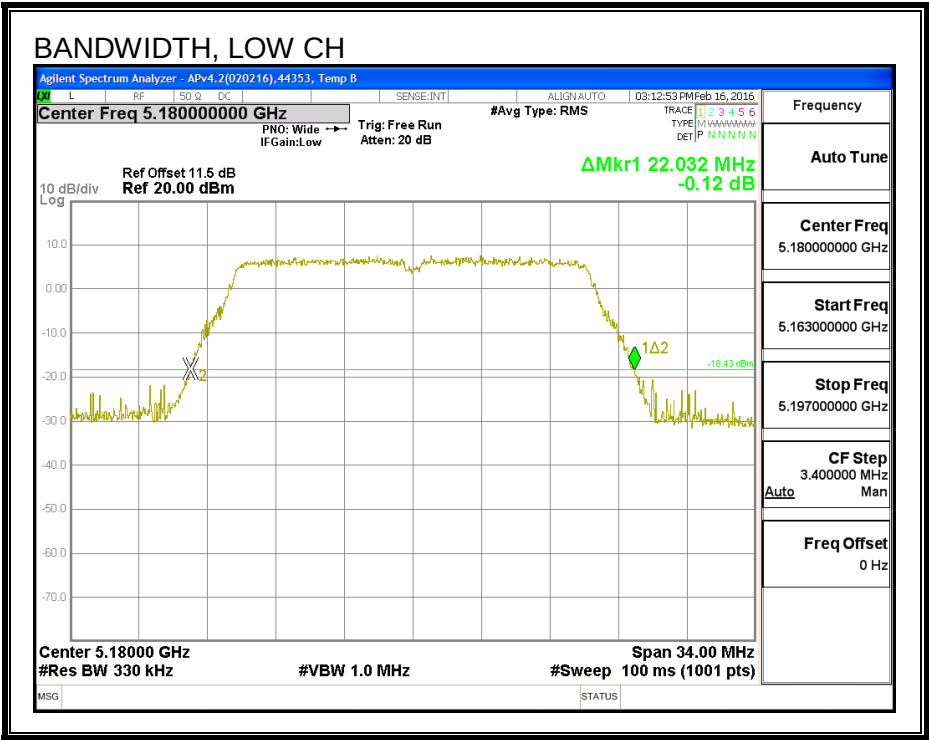
LIMITS

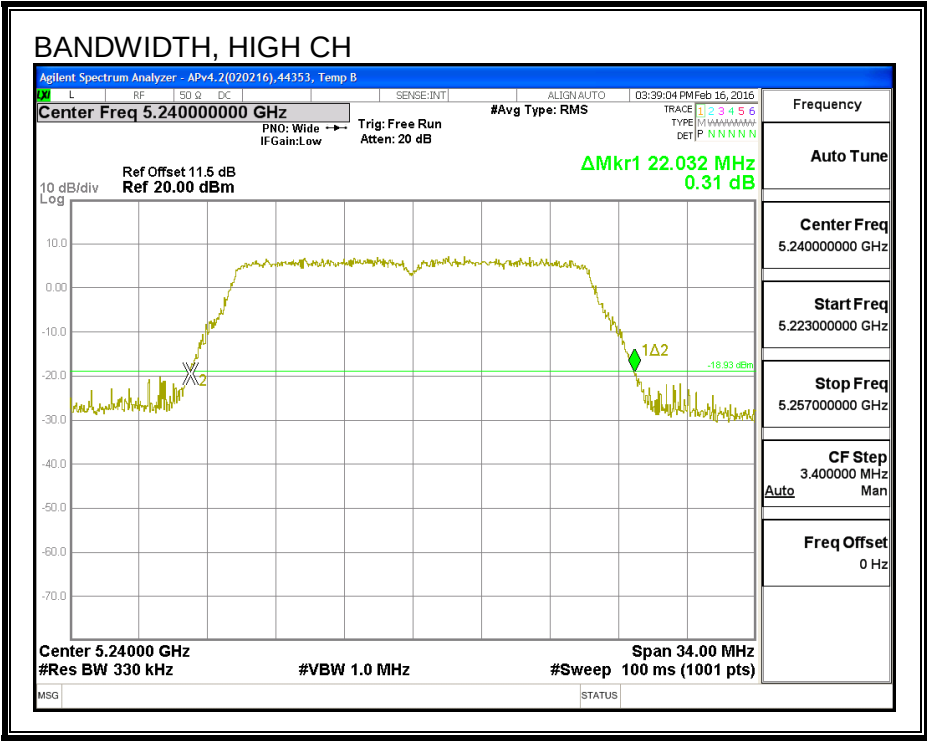
None; for reporting purposes only.

RESULTS

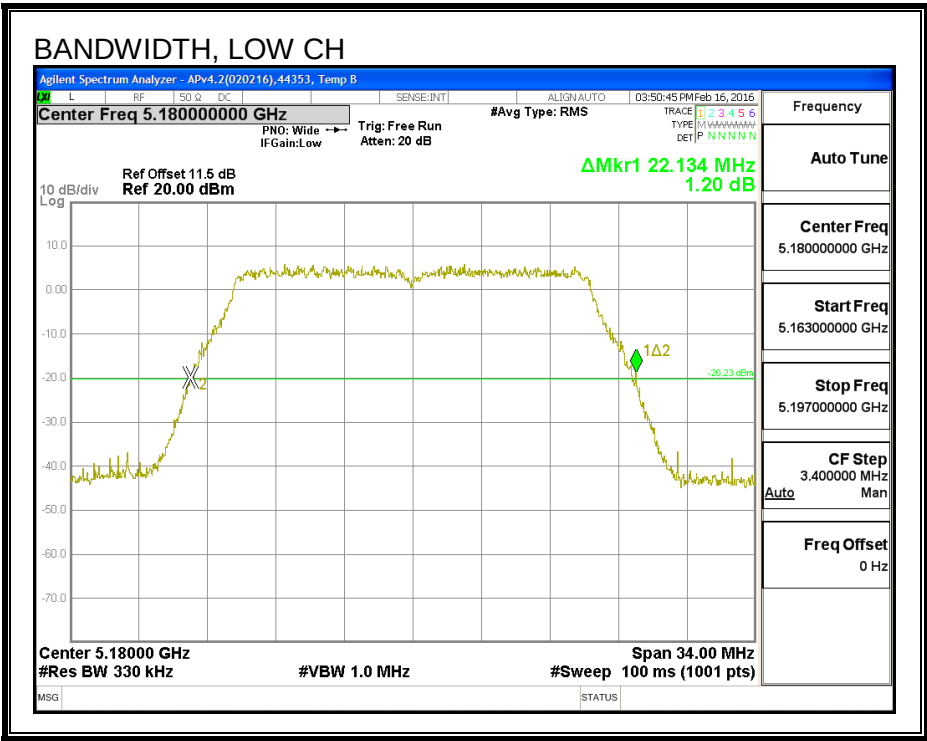
Channel	Frequency (MHz)	26 dB BW Chain 0 (MHz)	26 dB BW Chain 1 (MHz)
Low	5180	22.03	22.13
Mid	5200	22.10	21.95
High	5240	22.03	21.81

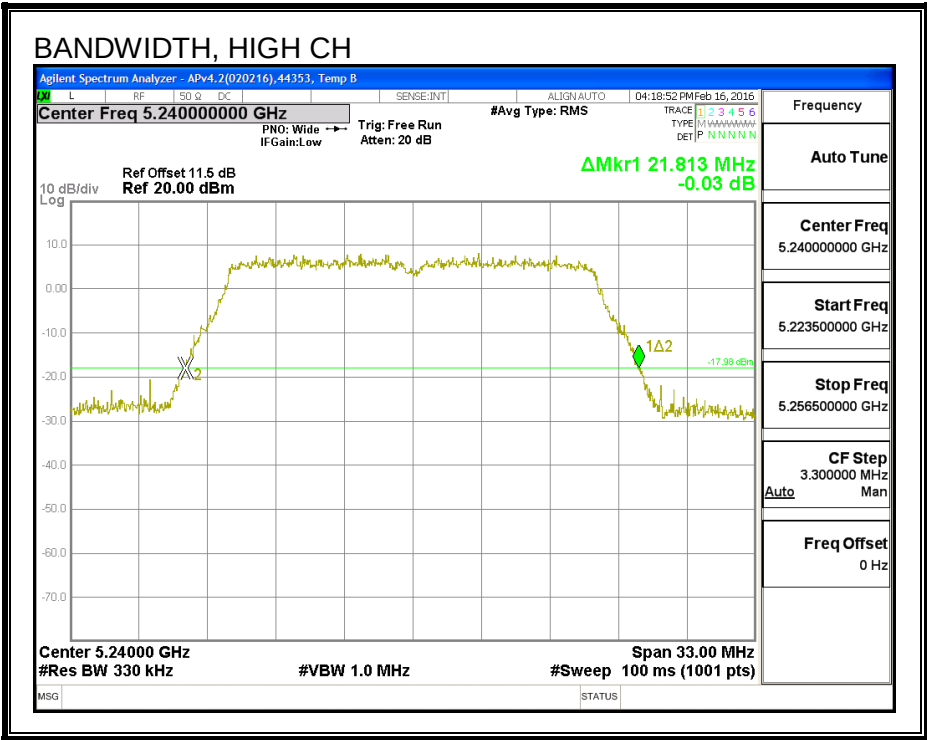
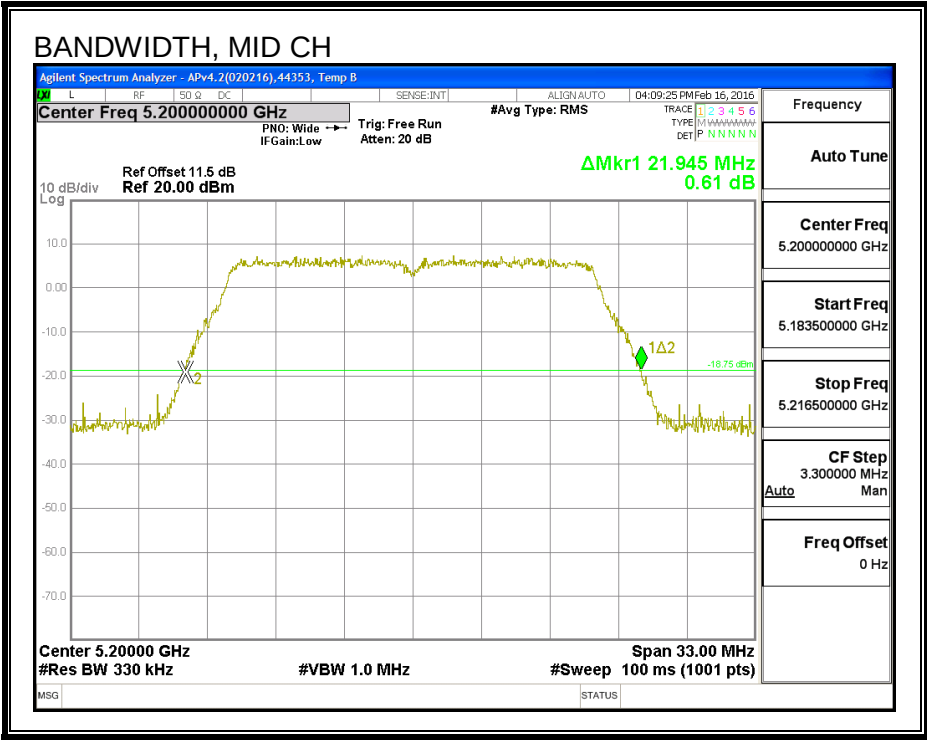
26 DB BANDWIDTH, CHAIN 0





26 DB BANDWIDTH, CHAIN 1





8.5.2. 99% BANDWIDTH

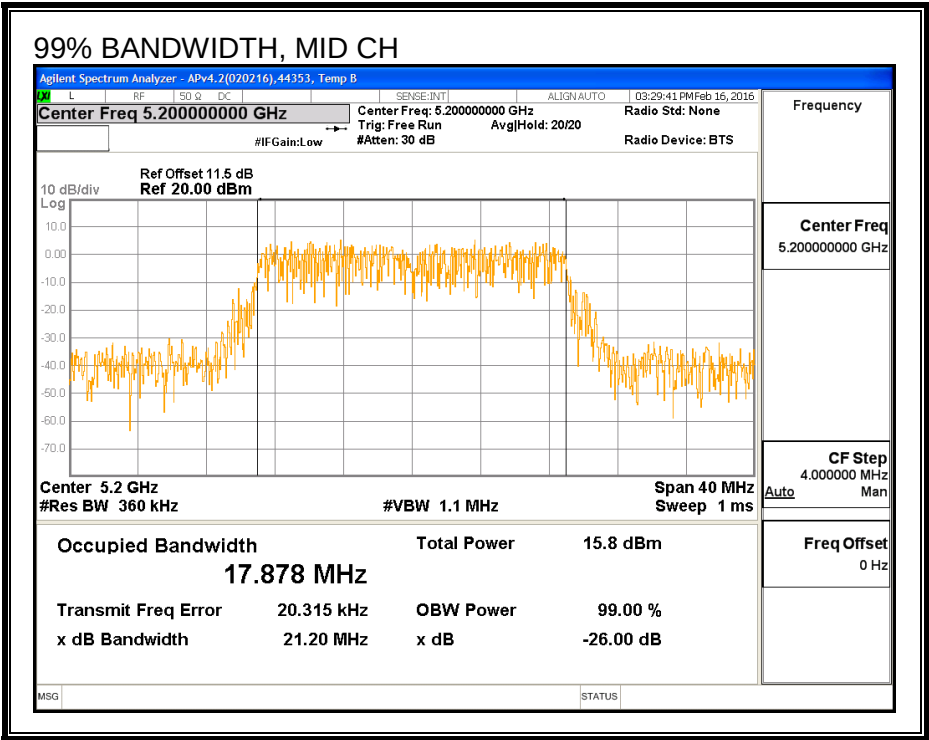
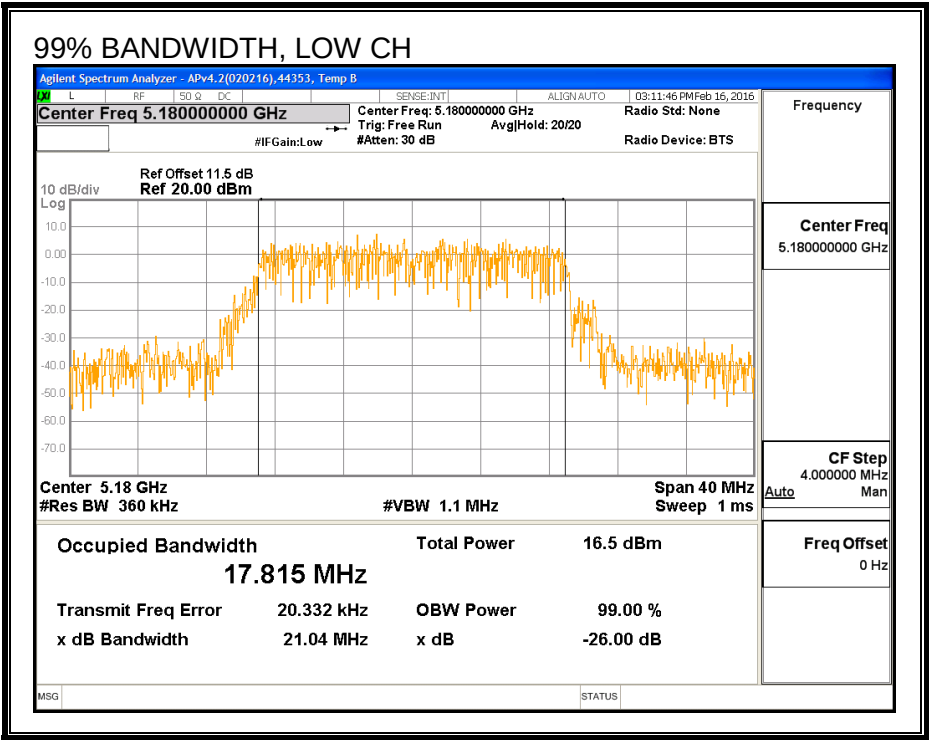
LIMITS

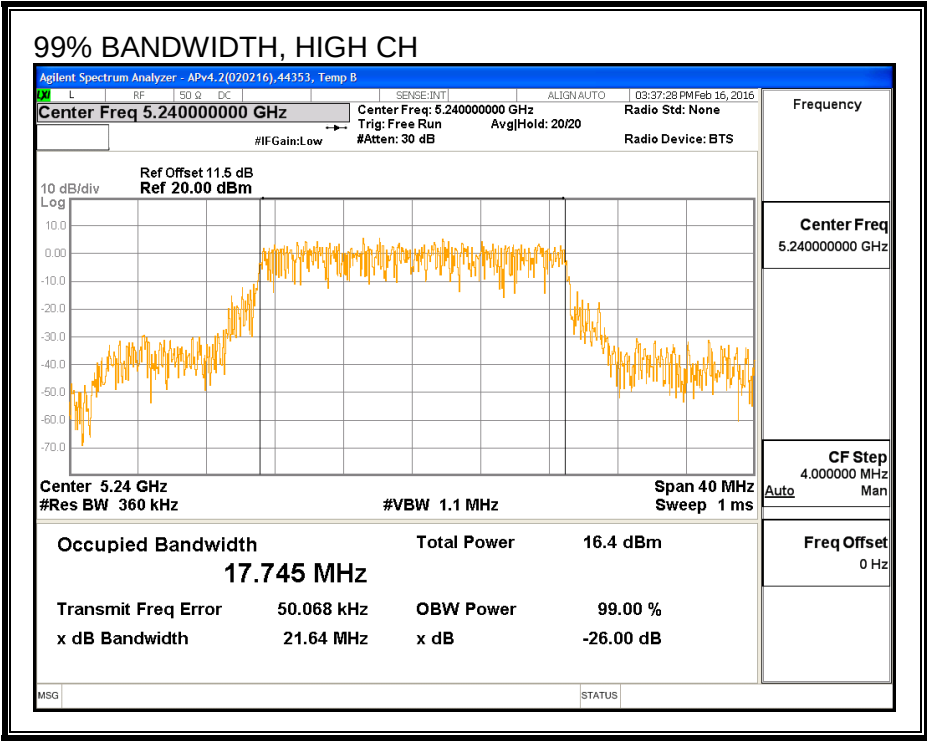
None; for reporting purposes only.

RESULTS

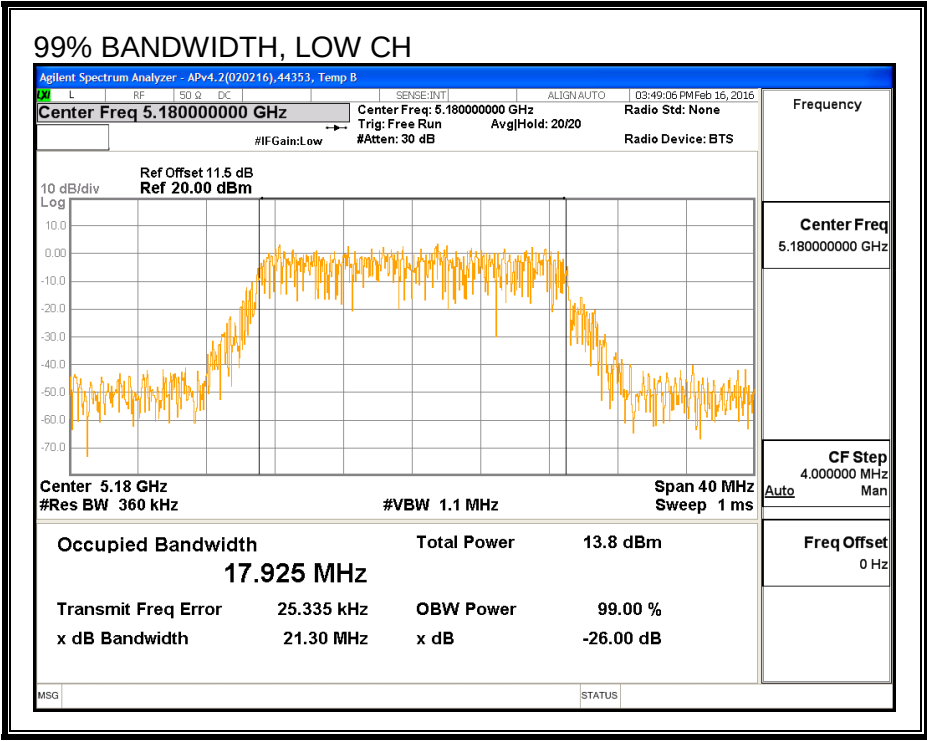
Channel	Frequency (MHz)	99% BW Chain 0 (MHz)	99% BW Chain 1 (MHz)
Low	5180	17.815	17.925
Mid	5200	17.878	17.984
High	5240	17.745	17.863

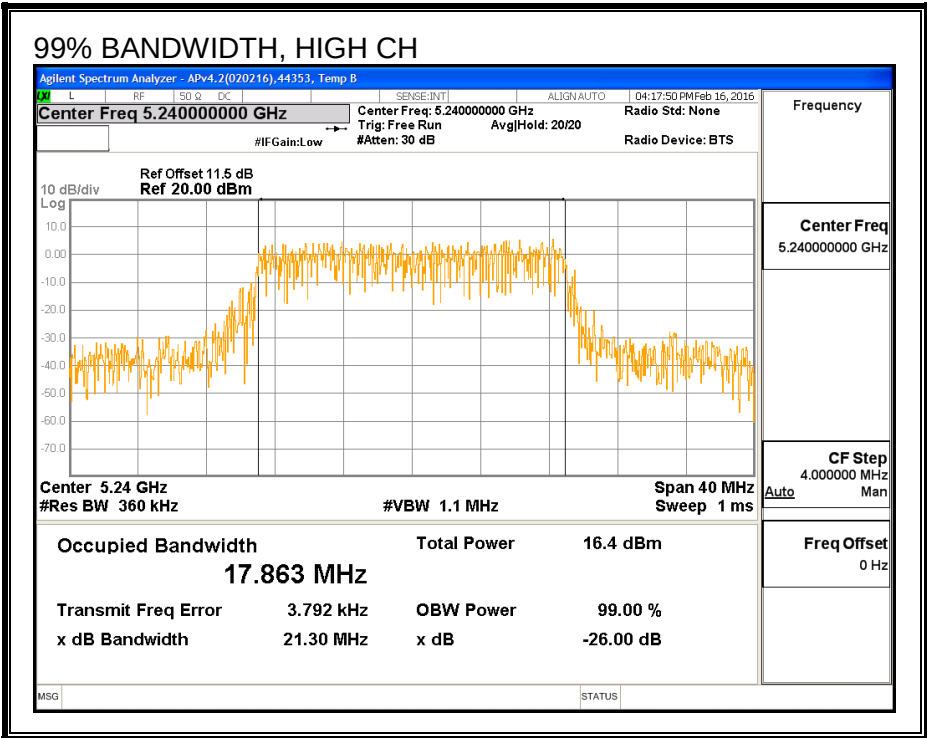
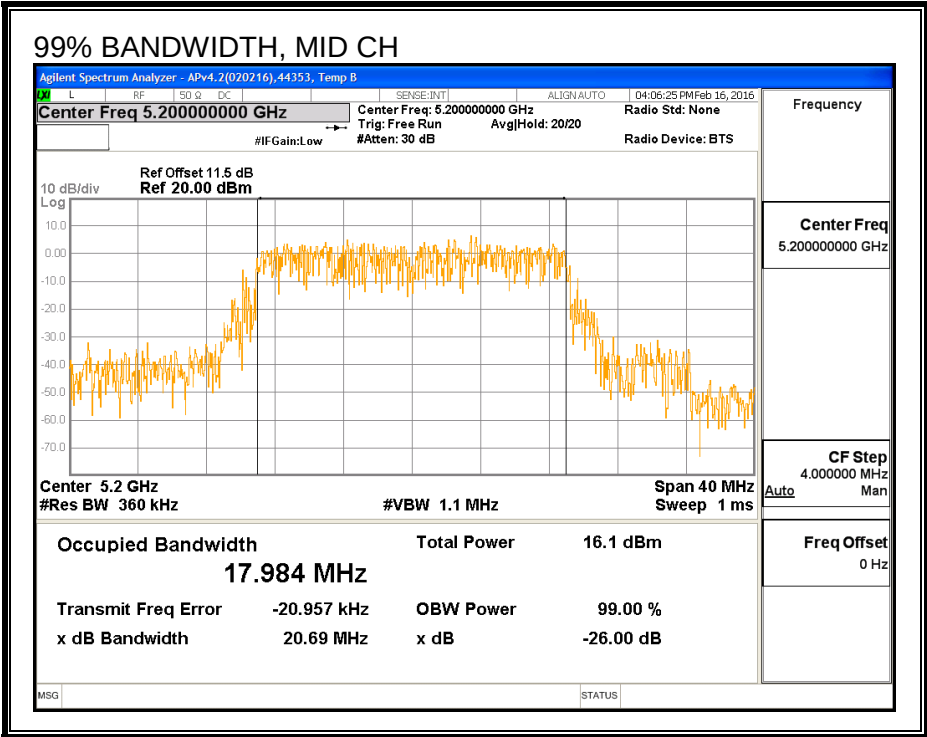
99% BANDWIDTH, CHAIN 0





99% BANDWIDTH, CHAIN 1





8.5.3. AVERAGE POWER (FCC)

LIMITS

None; for reporting purposes only.

TEST PROCEDURE

Measurements perform using a wideband gated RF power meter.

RESULTS

Channel	Frequency (MHz)	Chain 0 Power (dBm)	Chain 1 Power (dBm)	Total Power (dBm)
Low	5180	13.47	13.32	16.40
Mid	5200	15.93	15.91	18.93
High	5240	16.00	15.96	18.99

8.5.4. OUTPUT POWER AND PSD (FCC)

LIMITS

FCC §15.407 (a) (1)

(i) For an outdoor access point operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. The maximum e.i.r.p. at any elevation angle above 30 degrees as measured from the horizon must not exceed 125 mW (21 dBm).

(ii) For an indoor access point operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

(iii) For fixed point-to-point access points operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W. Fixed point-to-point U-NII devices may employ antennas with directional gain up to 23 dBi without any corresponding reduction in the maximum conducted output power or maximum power spectral density. For fixed point-to-point transmitters that employ a directional antenna gain greater than 23 dBi, a 1 dB reduction in maximum conducted output power and maximum power spectral density is required for each 1 dB of antenna gain in excess of 23 dBi. Fixed, point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications, and multiple colocated transmitters transmitting the same information. The operator of the U-NII device, or if the equipment is professionally installed, the installer, is responsible for ensuring that systems employing high gain directional antennas are used exclusively for fixed, point-to-point operations.

(iv) For mobile and portable client devices in the 5.15-5.25 GHz band, the maximum conducted output power over the frequency band of operation shall not exceed 250 mW provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

TEST PROCEDURE

Measurements perform using a wideband gated RF power meter provided that the gate parameters are adjusted such that the power is measured only when the EUT is transmitting at its maximum power control level. Since the measurement is made only during the ON time of the transmitter, no duty cycle correction factor is required.

DIRECTIONAL ANTENNA GAIN

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

Chain 0 Antenna Gain (dBi)	Chain 1 Antenna Gain (dBi)	Correlated Chains Directional Gain (dBi)
3.11	2.90	6.02

RESULTS

Antenna Gain and Limits

Channel	Frequency (MHz)	Directional Gain for Power (dBi)	Directional Gain for PSD (dBi)	Power Limit (dBm)	PSD Limit (dBm)
Low	5180	6.02	6.02	23.98	10.98
Mid	5200	6.02	6.02	23.98	10.98
High	5240	6.02	6.02	23.98	10.98

Duty Cycle CF (dB)	0.12	Included in Calculations of Corr'd PSD
--------------------	------	--

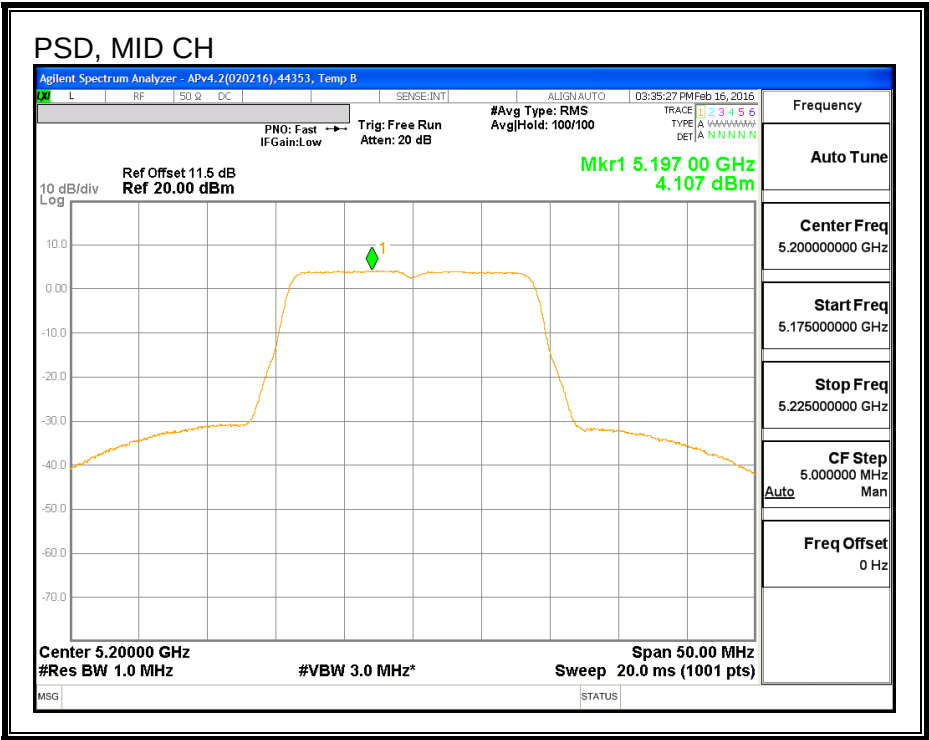
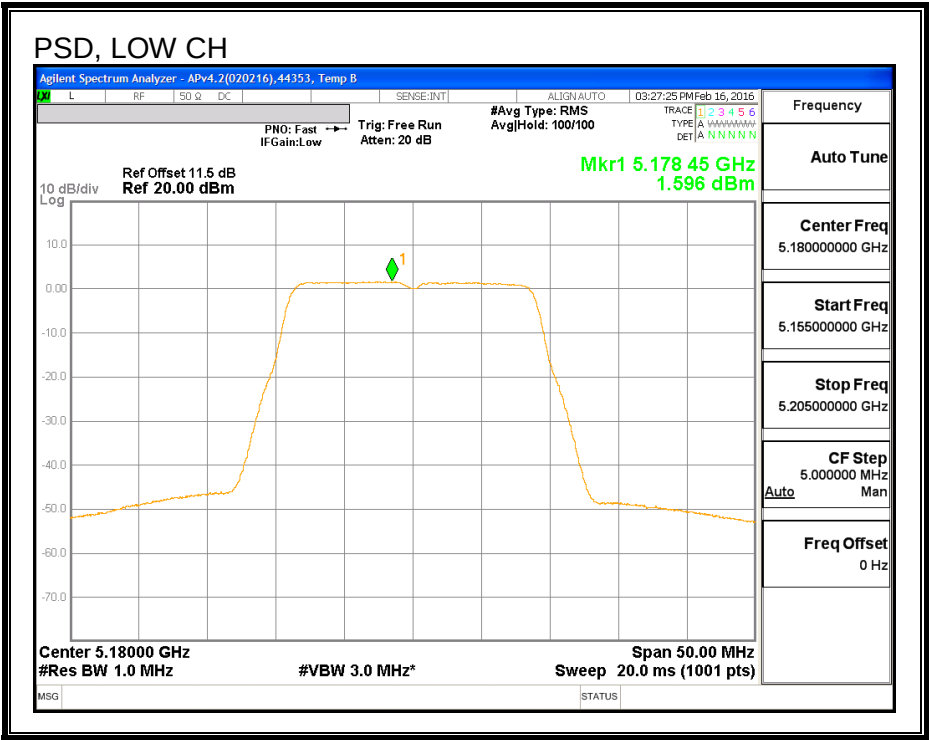
Output Power Results

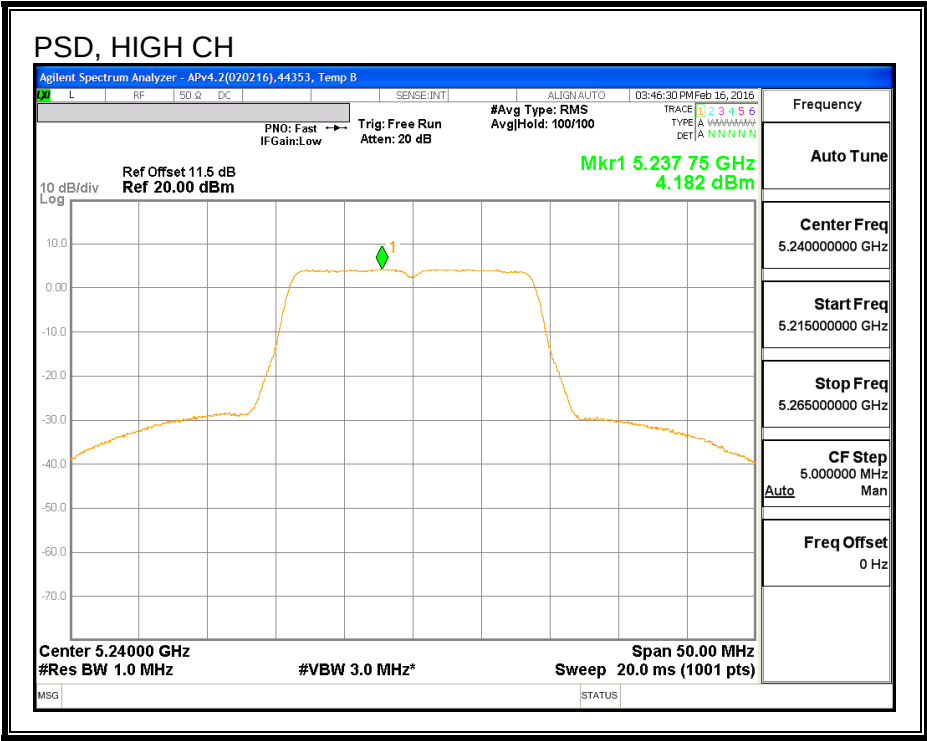
Channel	Frequency (MHz)	Chain 0 Meas Power (dBm)	Chain 1 Meas Power (dBm)	Total Corr'd Power (dBm)	Power Limit (dBm)	Power Margin (dB)
Low	5180	13.47	13.32	16.40	23.98	-7.58
Mid	5200	15.93	15.91	18.93	23.98	-5.05
High	5240	16.00	15.96	18.99	23.98	-4.99

PSD Results

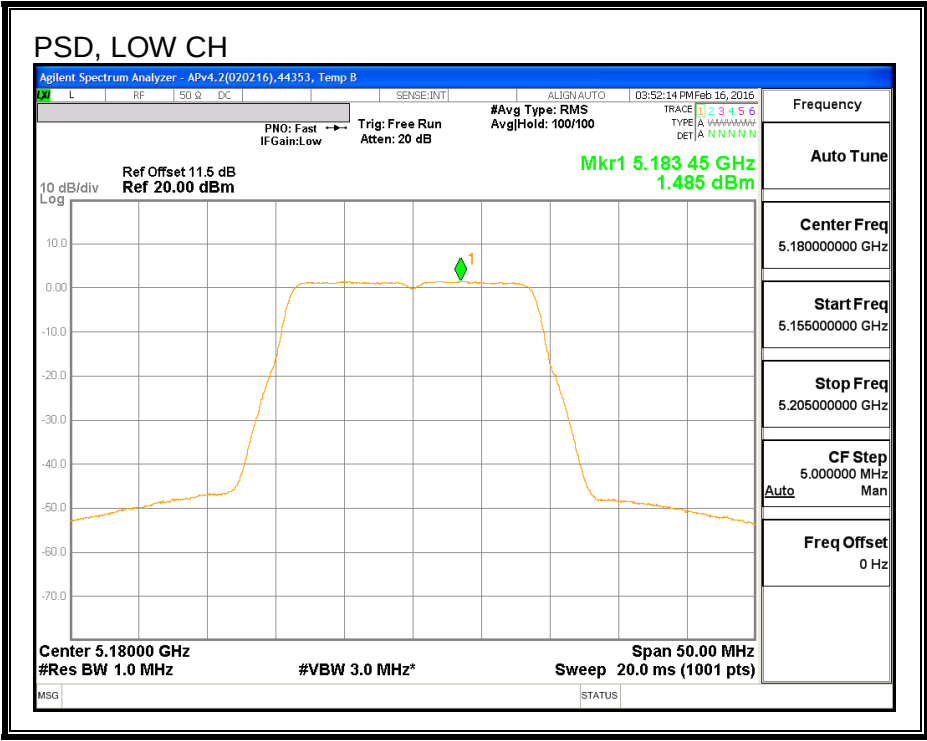
Channel	Frequency (MHz)	Chain 0 Meas PSD (dBm)	Chain 1 Meas PSD (dBm)	Total Corr'd PSD (dBm)	PSD Limit (dBm)	PSD Margin (dB)
Low	5180	1.60	1.49	4.67	10.98	-6.31
Mid	5200	4.11	4.06	7.21	10.98	-3.77
High	5240	4.18	4.15	7.29	10.98	-3.69

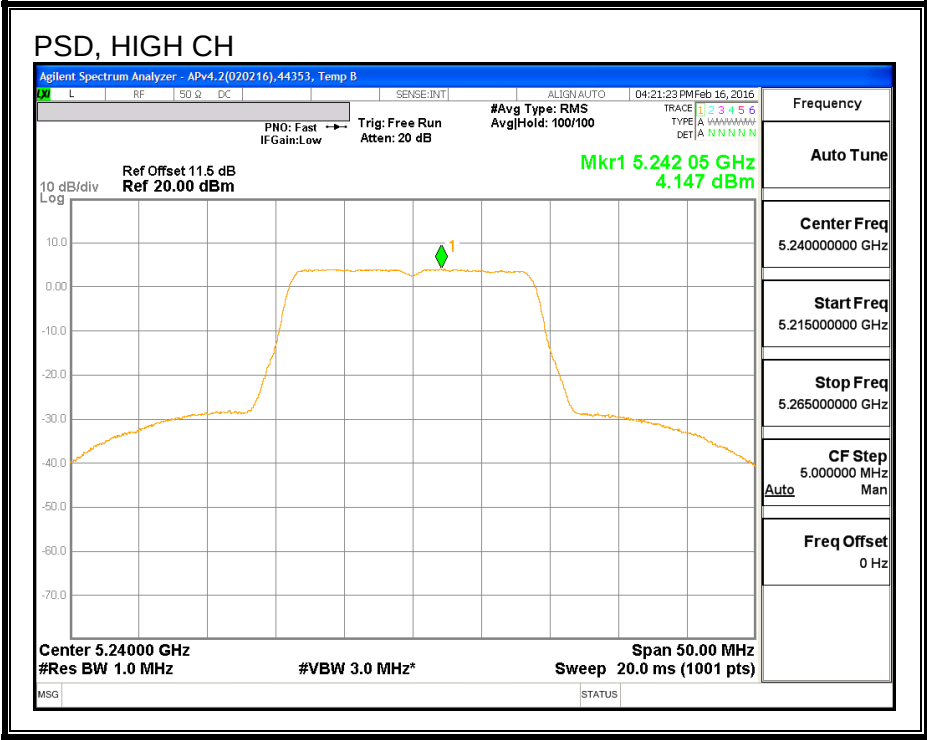
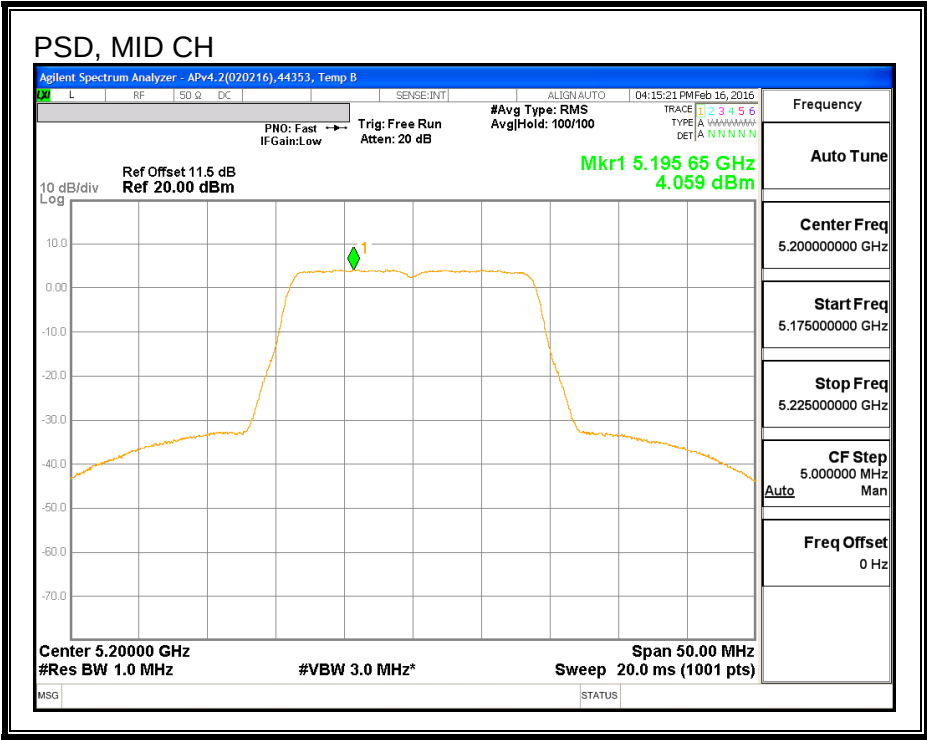
PSD, CHAIN 0





PSD, CHAIN 1





8.6. 802.11n HT40 CHAIN 0 MODE IN THE 5.2 GHz BAND

8.6.1. 26 dB BANDWIDTH

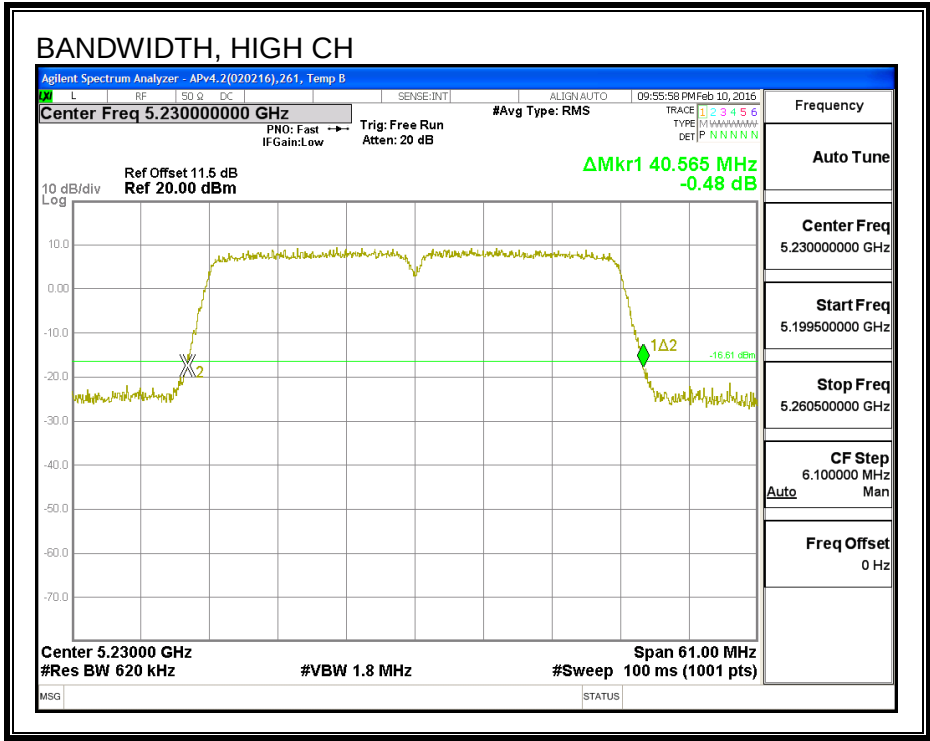
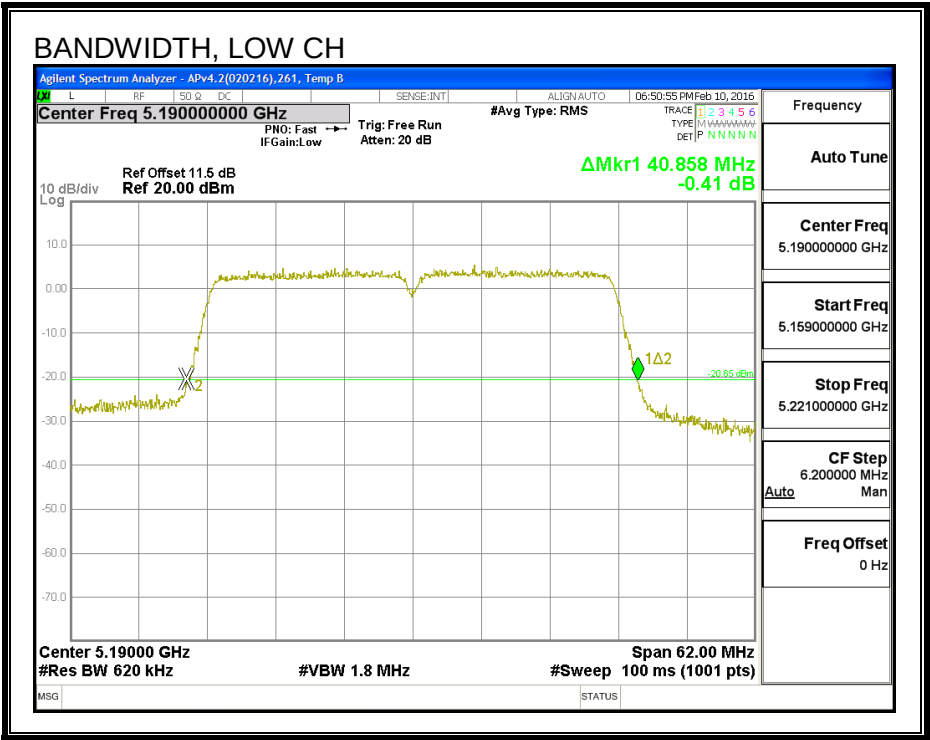
LIMITS

None; for reporting purposes only.

RESULTS

Channel	Frequency (MHz)	26 dB Bandwidth (MHz)
Low	5190	40.86
High	5230	40.57

26 dB BANDWIDTH



8.6.2. 99% BANDWIDTH

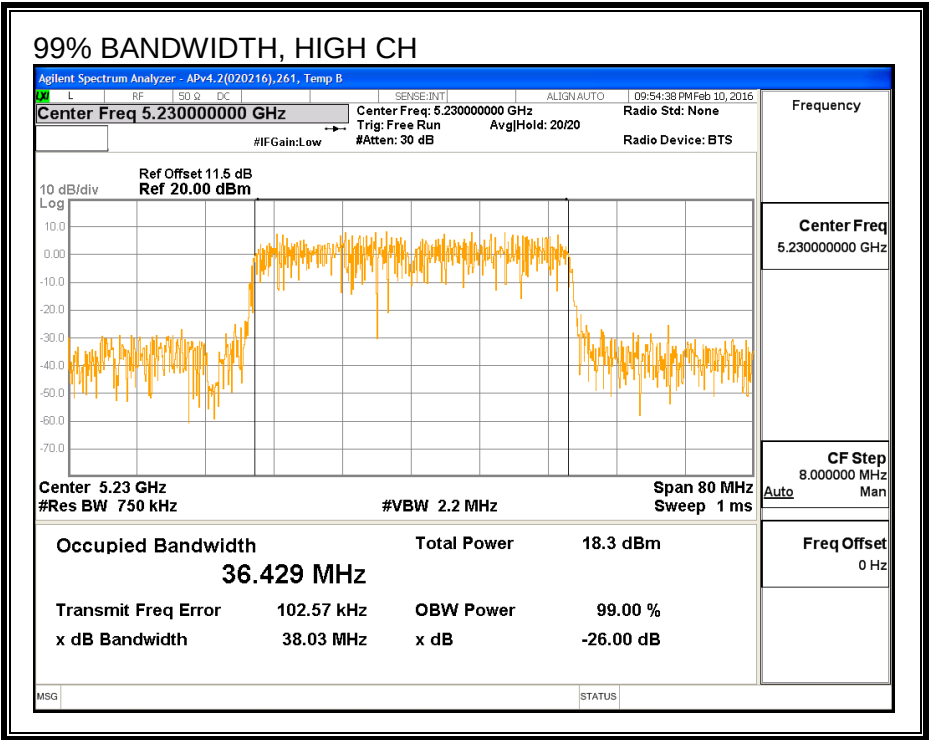
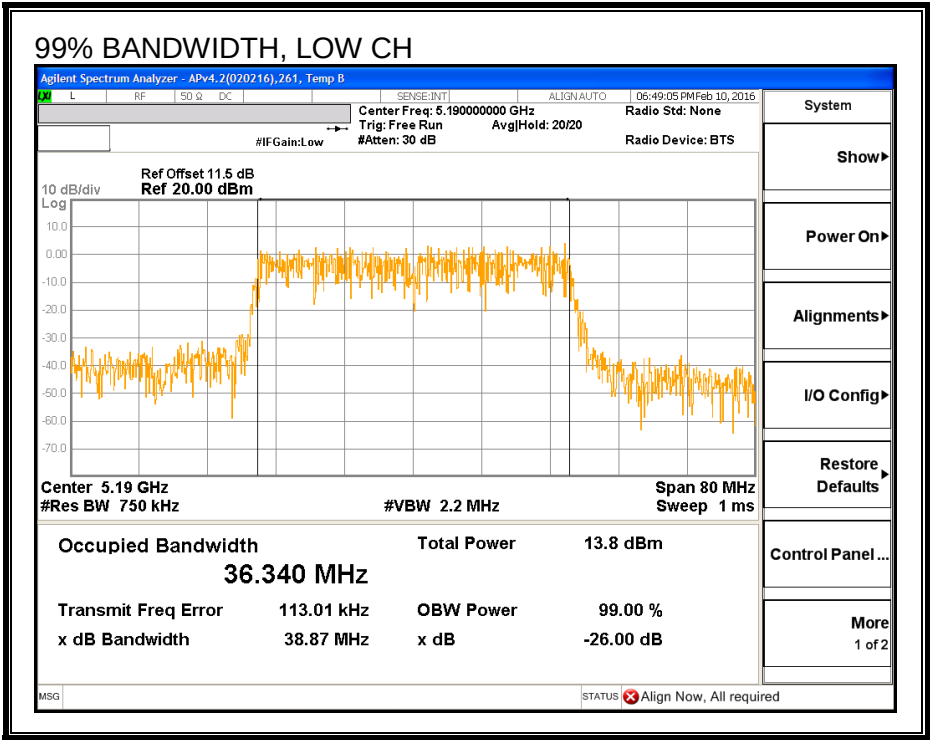
LIMITS

None; for reporting purposes only.

RESULTS

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	5190	36.340
High	5230	36.429

99% BANDWIDTH



8.6.3. AVERAGE POWER (FCC)

LIMITS

None; for reporting purposes only.

TEST PROCEDURE

Measurements perform using a wideband gated RF power meter.

RESULTS

Channel	Frequency (MHz)	Power (dBm)
Low	5190	13.45
High	5230	17.80

8.6.4. OUTPUT POWER AND PSD (FCC)

LIMITS

FCC §15.407 (a) (1)

(i) For an outdoor access point operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. The maximum e.i.r.p. at any elevation angle above 30 degrees as measured from the horizon must not exceed 125 mW (21 dBm).

(ii) For an indoor access point operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

(iii) For fixed point-to-point access points operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W. Fixed point-to-point U-NII devices may employ antennas with directional gain up to 23 dBi without any corresponding reduction in the maximum conducted output power or maximum power spectral density. For fixed point-to-point transmitters that employ a directional antenna gain greater than 23 dBi, a 1 dB reduction in maximum conducted output power and maximum power spectral density is required for each 1 dB of antenna gain in excess of 23 dBi. Fixed, point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications, and multiple collocated transmitters transmitting the same information. The operator of the U-NII device, or if the equipment is professionally installed, the installer, is responsible for ensuring that systems employing high gain directional antennas are used exclusively for fixed, point-to-point operations.

(iv) For mobile and portable client devices in the 5.15-5.25 GHz band, the maximum conducted output power over the frequency band of operation shall not exceed 250 mW provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

TEST PROCEDURE

Measurements perform using a wideband gated RF power meter provided that the gate parameters are adjusted such that the power is measured only when the EUT is transmitting at its maximum power control level. Since the measurement is made only during the ON time of the transmitter, no duty cycle correction factor is required.

DIRECTIONAL ANTENNA GAIN

There is only one transmitter output therefore the directional gain is equal to the antenna gain.

RESULTS

Antenna Gain and Limits

Channel	Frequency (MHz)	Directional Gain for Power (dBi)	Directional Gain for PSD (dBi)	Power Limit (dBm)	PSD Limit (dBm)
Low	5190	3.11	3.11	24.00	11.00
High	5230	3.11	3.11	24.00	11.00

Duty Cycle CF (dB)	0.00	Included in Calculations of Corr'PSD
--------------------	------	--------------------------------------

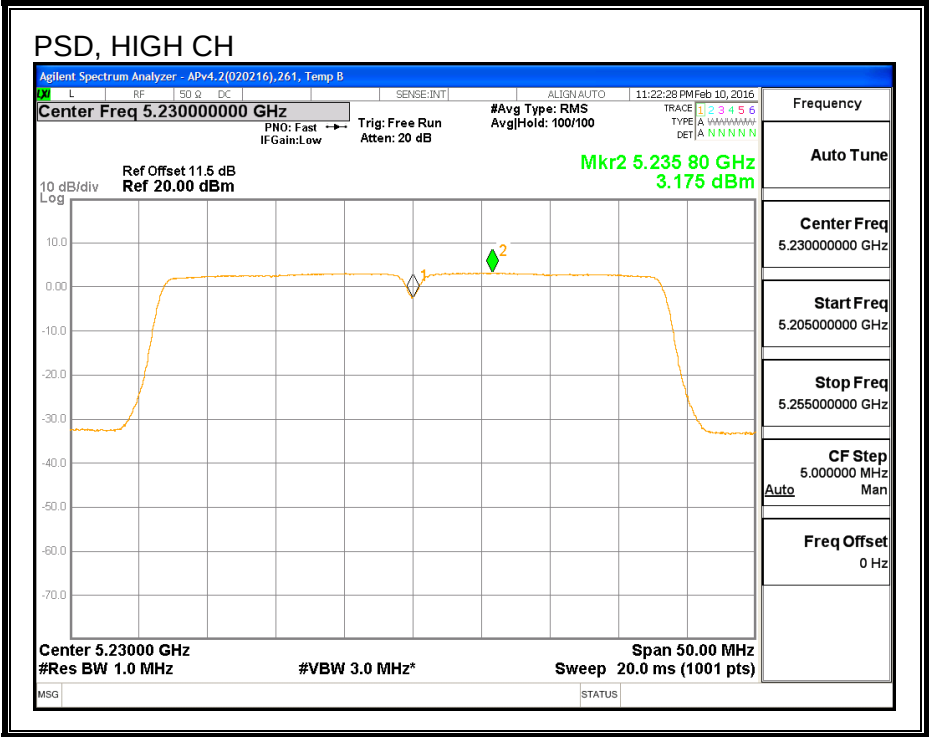
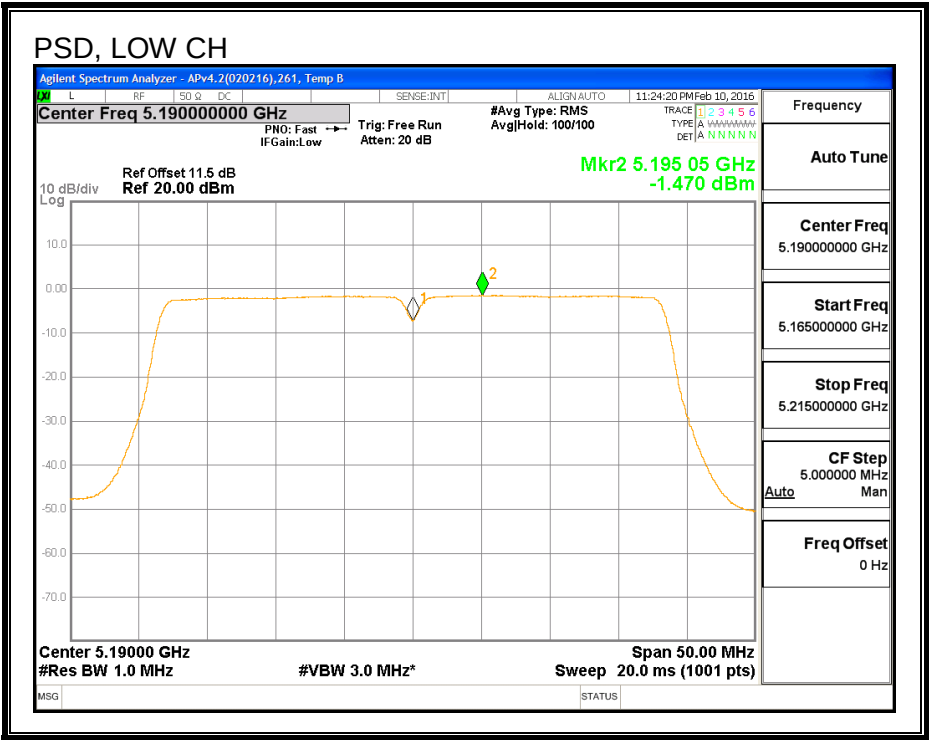
Output Power Results

Channel	Frequency (MHz)	Chain 0 Meas Power (dBm)	Total Corr'd Power (dBm)	Power Limit (dBm)	Power Margin (dB)
Low	5190	13.45	13.45	24.00	-10.55
High	5230	17.80	17.80	24.00	-6.20

PSD Results

Channel	Frequency (MHz)	Chain 0 Meas PSD (dBm)	Total Corr'd PSD (dBm)	PSD Limit (dBm)	PSD Margin (dB)
Low	5190	-1.47	-1.47	11.00	-12.47
High	5230	3.18	3.18	11.00	-7.83

PSD



8.7. 802.11n HT40 CHAIN 1 MODE IN THE 5.2 GHz BAND

8.7.1. 26 dB BANDWIDTH

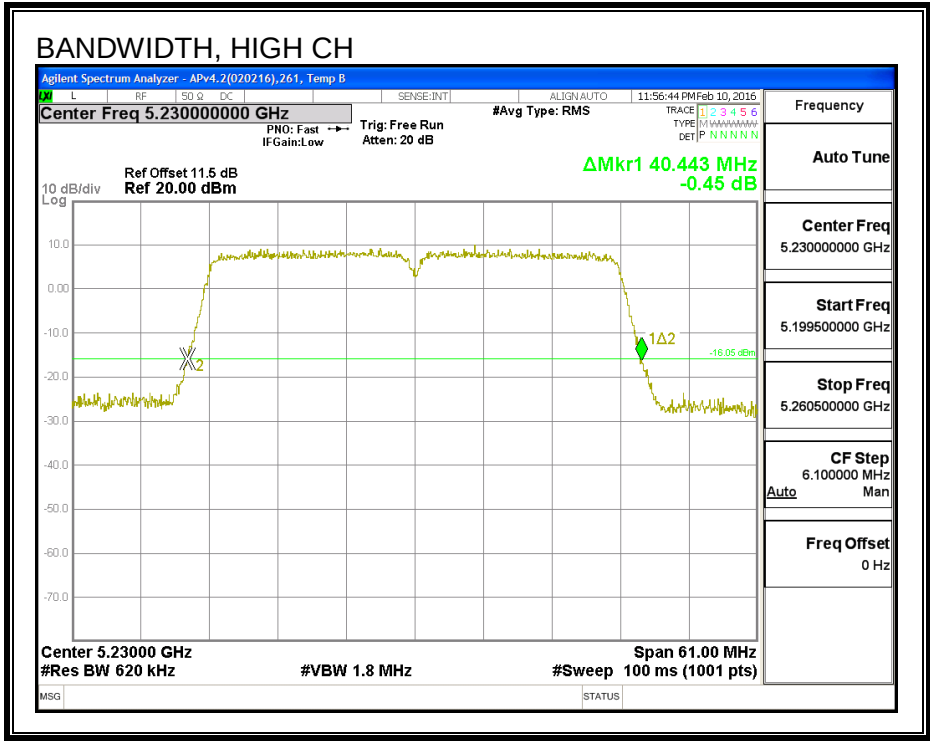
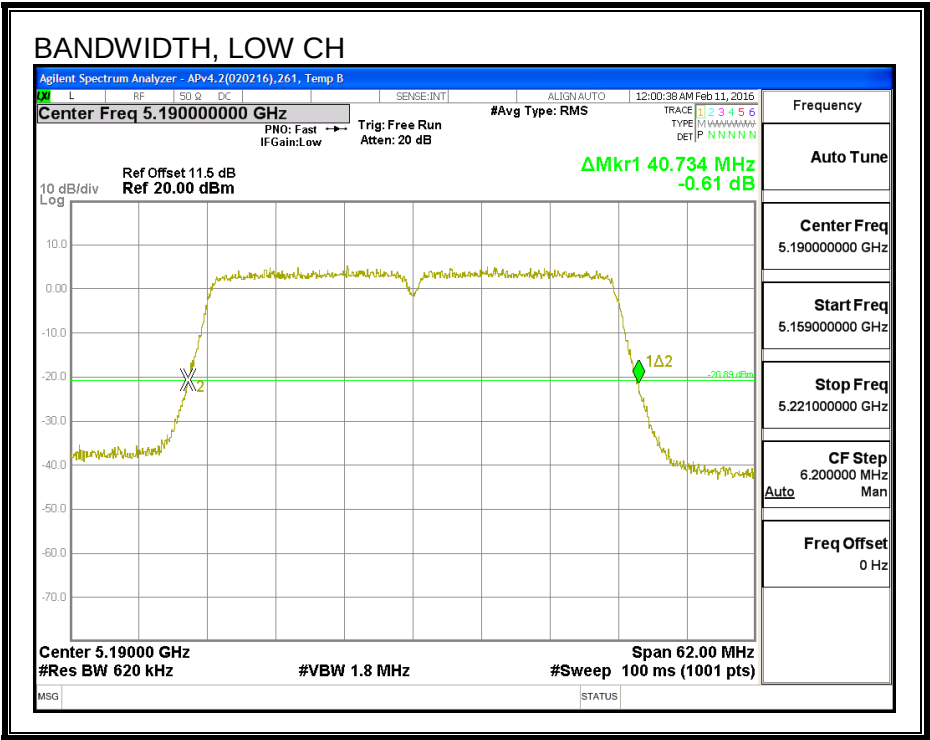
LIMITS

None; for reporting purposes only.

RESULTS

Channel	Frequency (MHz)	26 dB Bandwidth (MHz)
Low	5190	40.73
High	5230	40.44

26 dB BANDWIDTH



8.7.2. 99% BANDWIDTH

LIMITS

None; for reporting purposes only.

RESULTS

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	5190	36.328
High	5230	36.410