

TEST REPORT

FCC ID: 2AG87DLM168N

Product: Wi-Fi® Radio Transceiver

Model No.: ACM-DB-3

Additional Model No.: DLM168

Trade Mark: N/A

Report No.: TCT170221E005

Issued Date: Feb. 27, 2017

Issued for:

Doodle Labs (SG) Pte Ltd

150 Kampong Ampat, KA Centre, Suite #05-03, Singapore 368324

Issued By:

Shenzhen Tongce Testing Lab.

1F, Leinuo Watch Building, Fuyong Town, Baoan Dist, Shenzhen, China

TEL: +86-755-27673339

FAX: +86-755-27673332

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1. Test Certification

Product:	Wi-Fi® Radio Transceiver
Model No.:	ACM-DB-3
Additional Model No.:	DLM168
Applicant:	Doodle Labs (SG) Pte Ltd
Address:	150 Kampong Ampat, KA Centre, Suite #05-03, Singapore 368324
Manufacturer:	Doodle Labs (SG) Pte Ltd
Address:	150 Kampong Ampat, KA Centre, Suite #05-03, Singapore 368324
Date of Test:	Jan. 14, 2016 – Feb. 24, 2017
Applicable Standards:	FCC CFR Title 47 Part 15 Subpart E Section 15.407:2014 KDB662911 D01 Multiple Transmitter Output v02r01 789033 D02 General UNII Test Procedures New Rules v01r02 RSS-247:2015, RSS-Gen:2014

The above equipment has been tested by Shenzhen Tongce Testing Lab. 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.

Tested By:

Beryl Zhao

Beryl Zhao

Date:

Feb. 24, 2017

Reviewed By:

Joe Zhou

Joe Zhou

Date:

Feb. 27, 2017

Approved By:

Tomsin

Tomsin

Date:

Feb. 27, 2017

2. Test Result Summary

Requirement	CFR 47 Section	IC Rule	Result
Antenna requirement	§15.203	RSS-247, 6.2	PASS
AC Power Line Conducted Emission	§15.207	RSS GEN, 8.8	PASS
Maximum Conducted Output Power	§15.407(a) §2.1046	RSS-247, 6.2	PASS
6dB Emission Bandwidth	§15.407(a) §2.1049	RSS-247, 6.2	PASS
26dB Emission Bandwidth & 99% Occupied Bandwidth	§15.407(a) §2.1049	RSS-247, 6.2	PASS
Power Spectral Density	§15.407(a)	RSS-247, 6.2	PASS
Restricted Bands around fundamental frequency	§15.407(a)	RSS-247, 6.2	PASS
Radiated Emission	§15.407(a) §2.1053	RSS-247, 6.2	PASS
Frequency Stability	§15.407(g) §2.1055	--	PASS

Note:

1. PASS: Test item meets the requirement.
2. Fail: Test item does not meet the requirement.
3. N/A: Test case does not apply to the test object.
4. The test result judgment is decided by the limit of test standard.

3. EUT Description

Product Name:	Wi-Fi® Radio Transceiver
Product Type:	WLAN(3TX, 3RX)
Radio Type:	3x3 MIMO
Model :	ACM-DB-3
Additional Model:	DLM168
Trade Mark:	N/A
Operation Frequency:	Band I: 5180MHz~5240MHz Band IV: 5745MHz~5825MHz
Channel Bandwidth:	802.11a :20MHz 802.11n :20MHz, 40MHz 802.11ac : 20MHz, 40MHz, 80MHz.
Modulation Technology:	Orthogonal Frequency Division Multiplexing(OFDM)
Modulation Type	256QAM, 64QAM, 16QAM, BPSK, QPSK
Antenna Type:	R-SMA antenna
Antenna Gain:	Band I: 5180MHz~5240MHz: 3dBi Band IV: 5745MHz~5825MHz: 3dBi
Power Supply:	DC 3.3V
Model difference :	All models above are identical in interior structure, electrical circuits and components, and just model names are different for the marketing requirement.

Band I (5150MHz~5250MHz) Power level setup in software

Mode	Channel	Frequency	Soft set
11a	CH36	5180	14
11a	CH44	5220	17
11a	CH48	5240	14
11n(HT20)	CH36	5180	14
11n(HT20)	CH44	5220	18
11n(HT20)	CH48	5240	14
11n(HT40)	CH38	5190	14
11n(HT40)	CH46	5230	14
11ac(HT20)	CH36	5180	14
11ac(HT20)	CH44	5220	17
11ac(HT20)	CH48	5240	14
11ac(HT40)	CH38	5190	14
11ac(HT40)	CH46	5230	14
11ac(HT80)	CH42	5210	14

Band IV (5725 - 5850 MHz) Power level setup in software

Mode	Channel	Frequency	Soft set
11a	CH149	5745	13
11a	CH157	5785	19
11a	CH165	5825	13
11n (HT20)	CH149	5745	13
11n (HT20)	CH157	5785	19
11n (HT20)	CH165	5825	13
11n (HT40)	CH151	5755	13
11n (HT40)	CH159	5795	13
11ac (HT20)	CH149	5745	13
11ac (HT20)	CH157	5785	19
11ac (HT20)	CH165	5825	13
11ac (HT40)	CH151	5755	13
11ac (HT40)	CH159	5795	13
11ac (HT80)	CH155	5775	13

Note: The Soft set value is the internal setting required to meet the requirements and does not necessarily mean the 'dBm' value

Operation Frequency each of channel

20MHz		40MHz		80MHz	
Channel	Frequency	Channel	Frequency	Channel	Frequency
36	5180	38	5190	42	5210
40	5200	46	5230	155	5775
44	5220	151	5755		
48	5240	159	5795		
149	5745				
153	5765				
157	5785				
161	5805				
165	5825				

Note:

In section 15.31(m), regards to the operating frequency range over 10 MHz, the Lowest frequency, the middle frequency, and the highest frequency of channel were selected to perform the test, and the selected channel see below:

For 802.11a/n(HT20)/ac(HT20)

Band I (5150 - 5250 MHz)			Band IV (5725 - 5850 MHz)		
Channel Number	Channel	Frequency (MHz)	Channel Number	Channel	Frequency (MHz)
36	Low	5180	149	Low	5745
44	Mid	5220	157	Mid	5785
48	High	5240	165	High	5825

For 802.11n (HT40)/ac(HT40)

Band I (5150 - 5250 MHz)			Band IV (5725 - 5850 MHz)		
Channel Number	Channel	Frequency (MHz)	Channel Number	Channel	Frequency (MHz)
38	Low	5190	151	Low	5755
46	High	5230	159	High	5795

For 802.11ac(HT80)

Band I (5150 - 5250 MHz)			Band IV (5725 - 5850 MHz)		
Channel Number	Channel	Frequency (MHz)	Channel Number	Channel	Frequency (MHz)
42	Low	5210	155	Low	5775

4. Genera Information

4.1. Test environment and mode

Operating Environment:	
Temperature:	25.0 °C
Humidity:	56 % RH
Atmospheric Pressure:	1010 mbar
Test Mode:	
Engineering mode:	Keep the EUT in continuous transmitting by select channel and modulations(The value of duty cycle is 100%)
<p>The sample was placed 0.8m/1.5m for blow/above 1GHz above the ground plane of 3m chamber. Measurements in both horizontal and vertical polarities were performed. During the test, each emission was maximized by: having the EUT continuously working, investigated all operating modes, rotated about all 3 axis (X, Y & Z) and considered typical configuration to obtain worst position, manipulating interconnecting cables, rotating the turntable, varying antenna height from 1m to 4m in both horizontal and vertical polarizations. The emissions worst-case are shown in Test Results of the following pages.</p>	

We have verified the construction and function in typical operation. All the test modes were carried out with the EUT in transmitting operation, which was shown in this test report and defined as follows:

Per-scan all kind of data rate in lowest channel, and found the follow list which it was worst case.

Mode	Data rate
802.11a	6Mbps
802.11n(HT20)	6.5 Mbps
802.11n(HT40)	13.5 Mbps
802.11ac(HT20)	6.5 Mbps
802.11ac(HT40)	13.5Mbps
802.11ac(HT80)	V0

Final Test Mode:

Operation mode:	Keep the EUT in continuous transmitting with modulation
-----------------	---

4.2. Description of Support Units

The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

Equipment	Model No.	Serial No.	FCC ID	Trade Name
Intel NUC	D54250WYKH	G6YK4390029 U	DOC	Intel

Note:

- All the equipment/cables were placed in the worst-case configuration to maximize the emission during the test.*
- Grounding was established in accordance with the manufacturer's requirements and conditions for the intended use.*
- For conducted measurements (Output Power, Emission Bandwidth, Power Spectral Density, Spurious Emissions), the antenna of EUT is connected to the test equipment via temporary antenna connector, the antenna connector is soldered on the antenna port of EUT, and the temporary antenna connector is listed in the Test Instruments.*

5. Facilities and Accreditations

5.1. Facilities

The test facility is recognized, certified, or accredited by the following organizations:

- FCC - Registration No.: 572331
Shenzhen Tongce Testing Lab
The 3m Semi-anechoic chamber has been registered and fully described in a report with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files.
- IC - Registration No.: 10668A-1
The 3m Semi-anechoic chamber of Shenzhen TCT Testing Technology Co., Ltd. has been registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing
- CNAS - Registration No.: CNAS L6165
Shenzhen TCT Testing Technology Co., Ltd. is accredited to ISO/IEC 17025:2005 General Requirements for the Competence of Testing and Calibration laboratories for the competence of testing. The Registration No. is CNAS L6165.

5.2. Location

Shenzhen Tongce Testing Lab

Address: 1F, Leinuo Watch Building, Fuyong Town, Baoan Dist, Shenzhen, China

Tel: 86-755-36638142

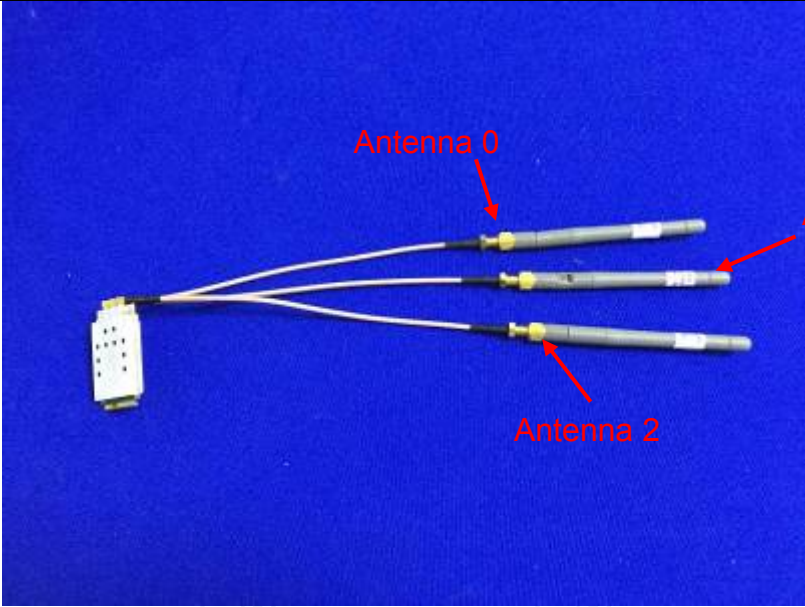
5.3. Measurement Uncertainty

The reported uncertainty of measurement $y \pm U$, where expanded uncertainty U is based on a standard uncertainty multiplied by a coverage factor of $k=2$, providing a level of confidence of approximately 95 %.

No.	Item	MU
1	Conducted Emission	$\pm 2.56\text{dB}$
2	RF power, conducted	$\pm 0.12\text{dB}$
3	Spurious emissions, conducted	$\pm 0.11\text{dB}$
4	All emissions, radiated(<1G)	$\pm 3.92\text{dB}$
5	All emissions, radiated(>1G)	$\pm 4.28\text{dB}$
6	Temperature	$\pm 0.1^\circ\text{C}$
7	Humidity	$\pm 1.0\%$

6. Test Results and Measurement Data

6.1. Antenna requirement

Standard requirement:	FCC Part15 C Section 15.203 /247(c)
15.203 requirement: An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.	
E.U.T Antenna:	
The EUT three antennas are R-SMA antennas which permanently attached, and the best case gain of the antennas all are 3dBi.	
	

6.2. Conducted Emission

6.2.1. Test Specification

Test Requirement:	FCC Part15 C Section 15.207/RSS-GEN, 8.8														
Test Method:	ANSI C63.10:2013														
Frequency Range:	150 kHz to 30 MHz														
Receiver setup:	RBW=9 kHz, VBW=30 kHz, Sweep time=auto														
Limits:	<table border="1"> <thead> <tr> <th rowspan="2">Frequency range (MHz)</th> <th colspan="2">Limit (dBuV)</th> </tr> <tr> <th>Quasi-peak</th> <th>Average</th> </tr> </thead> <tbody> <tr> <td>0.15-0.5</td> <td>66 to 56*</td> <td>56 to 46*</td> </tr> <tr> <td>0.5-5</td> <td>56</td> <td>46</td> </tr> <tr> <td>5-30</td> <td>60</td> <td>50</td> </tr> </tbody> </table>	Frequency range (MHz)	Limit (dBuV)		Quasi-peak	Average	0.15-0.5	66 to 56*	56 to 46*	0.5-5	56	46	5-30	60	50
Frequency range (MHz)	Limit (dBuV)														
	Quasi-peak	Average													
0.15-0.5	66 to 56*	56 to 46*													
0.5-5	56	46													
5-30	60	50													
Test Setup:	<p><i>Remark</i> E.U.T: Equipment Under Test LISN: Line Impedance Stabilization Network Test table height=0.8m</p>														
Test Mode:	Tx Mode														
Test Procedure:	<ol style="list-style-type: none"> The E.U.T and simulators are connected to the main power through a line impedance stabilization network (L.I.S.N.). This provides a 50ohm/50uH coupling impedance for the measuring equipment. The peripheral devices are also connected to the main power through a LISN that provides a 50ohm/50uH coupling impedance with 50ohm termination. (Please refer to the block diagram of the test setup and photographs). Both sides of A.C. line are checked for maximum conducted interference. In order to find the maximum emission, the relative positions of equipment and all of the interface cables must be changed according to ANSI C63.10: 2013 on conducted measurement. 														
Test Result:	PASS														

6.2.2. Test Instruments

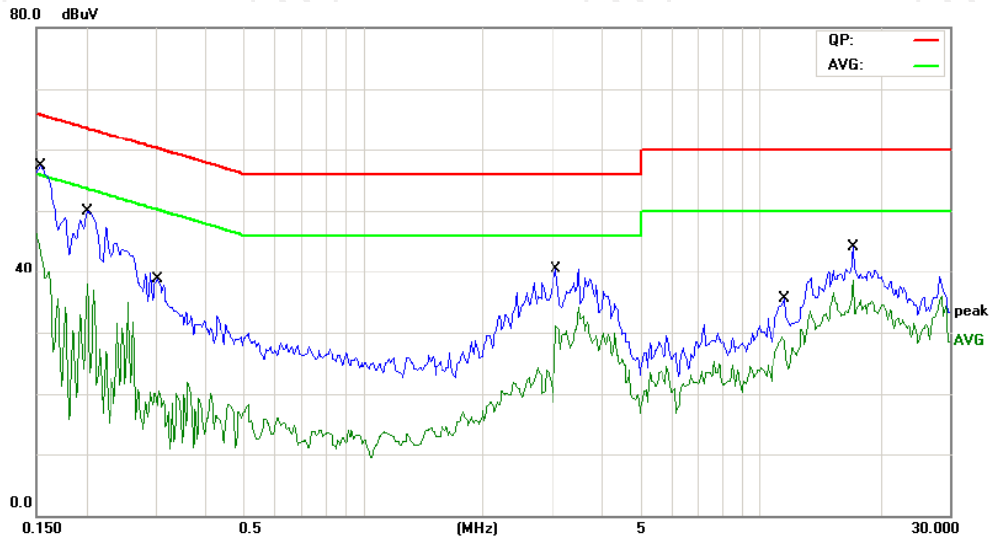
Conducted Emission Shielding Room Test Site (843)				
Equipment	Manufacturer	Model	Serial Number	Calibration Due
EMI Test Receiver	R&S	ESCS30	100139	Nov. 16, 2015
LISN	Schwarzbeck	NSLK 8126	8126453	Nov. 29, 2015
Coax cable	TCT	CE-05	N/A	Nov. 15, 2015
EMI Test Software	Shurple Technology	EZ-EMC	N/A	N/A

Note: The calibration interval of the above test instruments is 12 months and the calibrations are traceable to international system unit (SI).

6.2.3. Test data

Please refer to following diagram for individual

Conducted Emission on Line Terminal of the power line (150 kHz to 30MHz)



Site Chamber #2 Phase: **L1** Temperature: 23 (C)
Limit: FCC Part 15B Class B Conduction(QP) Power: AC 120V/60Hz Humidity: 54 %

No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV	Limit dBuV	Over dB	Detector	Comment
1	*	0.1539	37.46	11.49	48.95	65.78	-16.83	QP	
2		0.1539	24.96	11.49	36.45	55.78	-19.33	AVG	
3		0.2008	29.88	11.46	41.34	63.57	-22.23	QP	
4		0.2008	16.36	11.46	27.82	53.57	-25.75	AVG	
5		0.3023	17.46	11.41	28.87	60.18	-31.31	QP	
6		0.3023	5.65	11.41	17.06	50.18	-33.12	AVG	
7		3.0508	19.44	11.30	30.74	56.00	-25.26	QP	
8		3.0508	8.88	11.30	20.18	46.00	-25.82	AVG	
9		11.5313	12.08	11.38	23.46	60.00	-36.54	QP	
10		11.5313	7.76	11.38	19.14	50.00	-30.86	AVG	
11		17.1289	22.21	11.17	33.38	60.00	-26.62	QP	
12		17.1289	17.90	11.17	29.07	50.00	-20.93	AVG	

Note:

Freq. = Emission frequency in MHz

Reading level (dBuV) = Receiver reading

Corr. Factor (dB) = attenuator factor + Cable loss

Measurement (dBuV) = Reading level (dBuV) + Corr. Factor (dB)

Limit (dBuV) = Limit stated in standard

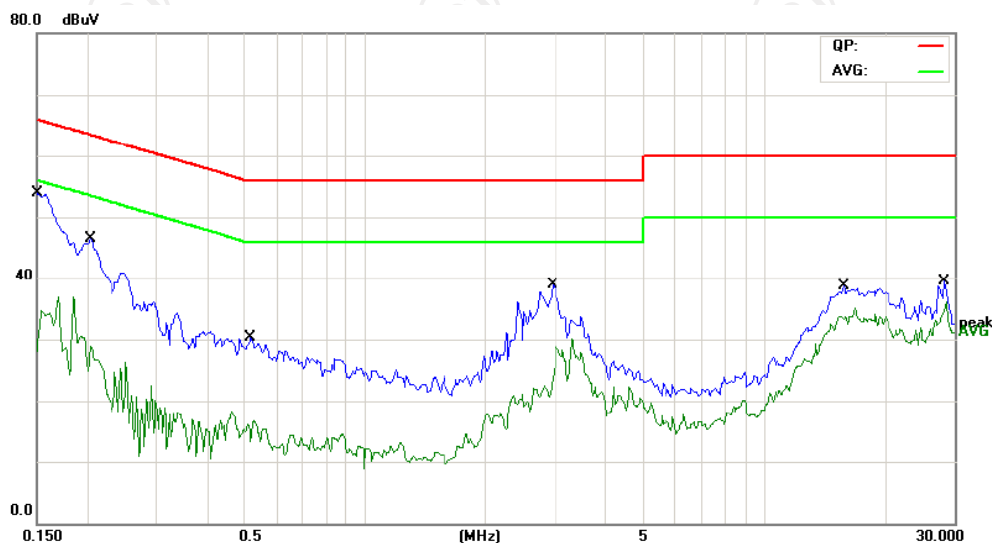
Margin (dB) = Measurement (dBuV) – Limits (dBuV)

Q.P. =Quasi-Peak

AVG =average

* is meaning the worst frequency has been tested in the frequency range 150 kHz to 30MHz.

Conducted Emission on Neutral Terminal of the power line (150 kHz to 30MHz)



Site Chamber #2 Phase: **N** Temperature: 23 (C)
 Limit: FCC Part 15B Class B Conduction(QP) Power: AC 120V/60Hz Humidity: 54 %

No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Over	Detector	Comment
		MHz	dBuV	dB	dBuV	dBuV	dB		
1	*	0.1500	36.97	11.49	48.46	65.99	-17.53	QP	
2		0.1500	22.70	11.49	34.19	55.99	-21.80	AVG	
3		0.2047	29.68	11.46	41.14	63.41	-22.27	QP	
4		0.2047	16.53	11.46	27.99	53.41	-25.42	AVG	
5		0.5172	13.01	11.29	24.30	56.00	-31.70	QP	
6		0.5172	3.34	11.29	14.63	46.00	-31.37	AVG	
7		2.9547	17.73	11.34	29.07	56.00	-26.93	QP	
8		2.9547	7.68	11.34	19.02	46.00	-26.98	AVG	
9		15.7179	22.35	11.48	33.83	60.00	-26.17	QP	
10		15.7179	17.81	11.48	29.29	50.00	-20.71	AVG	
11		28.2656	19.90	10.61	30.51	60.00	-29.49	QP	
12		28.2656	15.62	10.61	26.23	50.00	-23.77	AVG	

Note:

- Freq. = Emission frequency in MHz
- Reading level (dBuV) = Receiver reading
- Corr. Factor (dB) = attenuator factor + Cable loss
- Measurement (dBuV) = Reading level (dBuV) + Corr. Factor (dB)
- Limit (dBuV) = Limit stated in standard
- Margin (dB) = Measurement (dBuV) – Limits (dBuV)
- Q.P. =Quasi-Peak
- AVG =average
- * is meaning the worst frequency has been tested in the frequency range 150 kHz to 30MHz.

6.3. Maximum Conducted Output Power

6.3.1. Test Specification

Test Requirement:	FCC Part15 E Section 15.407(a)& Part 2 J Section 2.1046 / RSS-247, 6.2	
Test Method:	KDB662911 D01 Multiple Transmitter Output v02r01 KDB789033 D02 General UNII Test Procedures New Rules v01r02 Section E	
Limit:	Frequency Band (MHz)	Limit
	5150-5250	1W for indoor access point
	5250-5350	250 mW or 11 dBm + 10log B, whichever is less.
	5470-5725	250 mW or 11 dBm + 10log B, whichever is less.
	5725-5850	1 W
	Note: Where "B" is the 26 dB emissions bandwidth in MHz.	
	RSS-247, 6.2	
	Frequency Band (MHz)	Limit
	5150-5250	N/A
	5250-5350	250 mW or 11 dBm + 10log B, whichever is less.
	5470-5725	250 mW or 11 dBm + 10log B, whichever is less.
	5725-5850	1 W
	Note: Where "B" is the 99% emissions bandwidth in MHz.	
	The maximum e.i.r.p. shall not exceed:	
	Frequency Band (MHz)	Limit
5150-5250	200 mW or 10 dBm + 10log B, whichever is less.	
5250-5350	1W or 17 dBm + 10log B, whichever is less.	
5470-5725	1W or 17 dBm + 10log B, whichever is less.	
5725-5850	N/A	
Note: Where "B" is the 99% emissions bandwidth in MHz.		

6.3.3. Test Data

Configuration Band I (5150 - 5250 MHz) / Antenna 0+Antenna 1+ Antenna 2								
Mode	Test channel	Maximum Conducted (Average) Output Power (dBm)				FCC Limit (dBm)	IC Limit (dBm)	Result
		Ant0	Ant1	Ant2	Total			
11a	CH36	9.38	9.15	9.31	14.05	28.2	N/A	PASS
11a	CH44	9.53	9.27	9.62	14.25	28.2	N/A	PASS
11a	CH48	9.22	8.78	9.35	13.89	28.2	N/A	PASS
11n(HT20)	CH36	7.98	8.89	8.82	13.35	28.2	N/A	PASS
11n(HT20)	CH44	9.49	9.56	9.53	14.30	28.2	N/A	PASS
11n(HT20)	CH48	9.22	9.71	9.35	14.20	28.2	N/A	PASS
11n(HT40)	CH38	7.55	8.24	8.13	12.75	28.2	N/A	PASS
11n(HT40)	CH46	7.99	7.36	8.42	12.72	28.2	N/A	PASS
11ac(HT20)	CH36	8.06	8.74	8.95	13.37	28.2	N/A	PASS
11ac(HT20)	CH44	9.32	9.45	9.61	14.23	28.2	N/A	PASS
11ac(HT20)	CH48	9.18	9.49	9.47	14.15	28.2	N/A	PASS
11ac(HT40)	CH38	7.62	8.11	8.34	12.80	28.2	N/A	PASS
11ac(HT40)	CH46	8.10	7.55	8.26	12.75	28.2	N/A	PASS
11ac(HT80)	CH42	7.78	7.50	8.39	12.68	28.2	N/A	PASS

Note: $G_{ANT}=3\text{dBi}$, $\text{Array Gain}=10\log(N_{ANT}/N_{SS})=4.8\text{dBi}$, $\text{Directional Gain}=G_{ANT} + \text{Array Gain}=7.8\text{dBi}$,

So $\text{limit}=30-(7.8-6)=28.2\text{dBm}$

Configuration Band IV (5725 - 5850 MHz) / Antenna 0+Antenna 1+ Antenna 2								
Mode	Test channel	Maximum Conducted (Average) Output Power (dBm)				FCC Limit (dBm)	IC Limit (dBm)	Result
		Ant0	Ant1	Ant2	Total			
11a	CH149	13.65	13.28	13.95	18.41	28.2	28.2	PASS
11a	CH157	18.61	19.89	18.75	23.89	28.2	28.2	PASS
11a	CH165	13.85	13.68	13.26	18.37	28.2	28.2	PASS
11n (HT20)	CH149	13.15	13.08	13.45	18.00	28.2	28.2	PASS
11n (HT20)	CH157	18.51	19.79	17.64	23.51	28.2	28.2	PASS
11n (HT20)	CH165	13.45	13.75	13.67	18.40	28.2	28.2	PASS
11n (HT40)	CH151	13.45	13.47	13.68	18.31	28.2	28.2	PASS
11n (HT40)	CH159	13.54	13.49	13.41	18.25	28.2	28.2	PASS
11ac (HT20)	CH149	13.36	12.62	13.71	18.02	28.2	28.2	PASS
11ac (HT20)	CH157	18.47	19.82	19.21	23.97	28.2	28.2	PASS
11ac (HT20)	CH165	13.52	13.51	13.87	18.41	28.2	28.2	PASS
11ac (HT40)	CH151	20.12	19.21	18.09	23.99	28.2	28.2	PASS
11ac (HT40)	CH159	19.87	18.77	18.56	23.88	28.2	28.2	PASS
11ac(HT80)	CH155	18.43	19.59	18.65	23.69	28.2	28.2	PASS

Note 1: $G_{ANT}=3\text{dBi}$, $\text{Array Gain}=10\log(N_{ANT}/N_{SS})=4.8\text{dBi}$, $\text{Directional Gain}=G_{ANT} + \text{Array Gain}=7.8\text{dBi}$,
So $\text{limit}=30-(7.8-6)=28.2\text{dBm}$

EIRP

Band I (5150 - 5250 MHz)								
Mode	Test channel	Total Conducted Output Power (dBm)	EIRP Power Total (dBm)	EIRP Power Total(mW)	99% EBW (MHz)	10dBm+ 10logB (mW)	IC Limit (mW)	Result
11a	CH36	14.05	21.85	153.1087	17.50	175	175	PASS
11a	CH44	14.25	22.05	160.3245	17.13	171	171	PASS
11a	CH48	13.89	21.69	147.5707	17.07	171	171	PASS
11n(HT20)	CH36	13.35	21.15	130.3167	18.20	182	182	PASS
11n(HT20)	CH44	14.30	22.10	162.181	18.25	183	183	PASS
11n(HT20)	CH48	14.20	22.00	158.4893	18.15	182	182	PASS
11n(HT40)	CH38	12.75	20.55	113.5011	36.82	368	200	PASS
11n(HT40)	CH46	12.72	20.52	112.7197	36.70	367	200	PASS
11ac(HT20)	CH36	13.37	21.17	130.9182	18.20	182	182	PASS
11ac(HT20)	CH44	14.23	22.03	159.5879	18.14	181	181	PASS
11ac(HT20)	CH48	14.15	21.95	156.6751	18.23	182	182	PASS
11ac(HT40)	CH38	12.80	20.60	114.8154	36.71	367	200	PASS
11ac(HT40)	CH46	12.75	20.55	113.5011	36.70	367	200	PASS
11ac(HT80)	CH42	12.68	20.48	111.6863	72.21	722.	200	PASS


Note1: The limit is 200 mW or 10 dBm + 10log B, whichever is less. Where "B" is the 99% emissions

Note2: The E.I.R.P = P_{Total Conducted Output Power} + Directional Gain;

$G_{ANT} = 3dB_i$, Array Gain = $10\log(N_{ANT}/N_{SS}) = 4.8dB_i$, Directional Gain = $G_{ANT} + \text{Array Gain} = 7.8dB_i$

6.4. 6dB Emission Bandwidth

6.4.1. Test Specification

Test Requirement:	FCC CFR47 Part 15 Section 15.407(e)& Part 2 J Section 2.1049/ RSS-247, 6.2
Test Method:	KDB662911 D01 Multiple Transmitter Output v02r01 KDB789033 D02 General UNII Test Procedures New Rules v01r02 Section C
Limit:	>500kHz
Test Setup:	 <p style="text-align: center;">Spectrum Analyzer EUT</p>
Test Mode:	Transmitting mode with modulation
Test Procedure:	<ol style="list-style-type: none"> 1. KDB789033 D02 General UNII Test Procedures New Rules v01r02 Section C 2. Set to the maximum power setting and enable the EUT transmit continuously. 3. Make the measurement with the spectrum analyzer's resolution bandwidth (RBW) = 100 kHz. Set the Video bandwidth (VBW) = 300 kHz. In order to make an accurate measurement. The 6dB bandwidth must be greater than 500 kHz. 4. Measure and record the results in the test report.
Test Result:	PASS

6.4.2. Test Instruments

RF Test Room				
Equipment	Manufacturer	Model	Serial Number	Calibration Due
Spectrum Analyzer	Agilent	N9020A	MY49100060	Sep. 12, 2016
RF cable	TCT	RE-06	N/A	Sep. 12, 2016
Antenna Connector	TCT	RFC-01	N/A	Sep. 12, 2016

Note: The calibration interval of the above test instruments is 12 months and the calibrations are traceable to international system unit (SI).

6.4.3. Test data

ANT 0

Band IV (5725 - 5850 MHz)					
Mode	Test channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Limit (MHz)	Result
11a	CH149	5745	16.60	0.5	PASS
11a	CH157	5785	16.40	0.5	PASS
11a	CH165	5825	16.42	0.5	PASS
11n(HT20)	CH149	5745	17.72	0.5	PASS
11n(HT20)	CH157	5785	17.79	0.5	PASS
11n(HT20)	CH165	5825	17.67	0.5	PASS
11n(HT40)	CH151	5755	36.55	0.5	PASS
11n(HT40)	CH159	5795	36.56	0.5	PASS
11ac(HT20)	CH149	5745	17.59	0.5	PASS
11ac(HT20)	CH157	5785	17.61	0.5	PASS
11ac(HT20)	CH165	5825	17.61	0.5	PASS
11ac(HT40)	CH151	5755	36.55	0.5	PASS
11ac(HT40)	CH159	5795	36.48	0.5	PASS
11ac(HT80)	CH155	5775	76.31	0.5	PASS

ANT 1

Band IV (5725 - 5850 MHz)					
Mode	Test channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Limit (MHz)	Result
11a	CH149	5745	16.39	0.5	PASS
11a	CH157	5785	16.53	0.5	PASS
11a	CH165	5825	16.55	0.5	PASS
11n(HT20)	CH149	5745	17.68	0.5	PASS
11n(HT20)	CH157	5785	17.77	0.5	PASS
11n(HT20)	CH165	5825	17.62	0.5	PASS
11n(HT40)	CH151	5755	36.47	0.5	PASS
11n(HT40)	CH159	5795	36.52	0.5	PASS
11ac(HT20)	CH149	5745	17.74	0.5	PASS
11ac(HT20)	CH157	5785	17.75	0.5	PASS
11ac(HT20)	CH165	5825	17.80	0.5	PASS
11ac(HT40)	CH151	5755	36.50	0.5	PASS
11ac(HT40)	CH159	5795	36.38	0.5	PASS
11ac(HT80)	CH155	5775	76.41	0.5	PASS

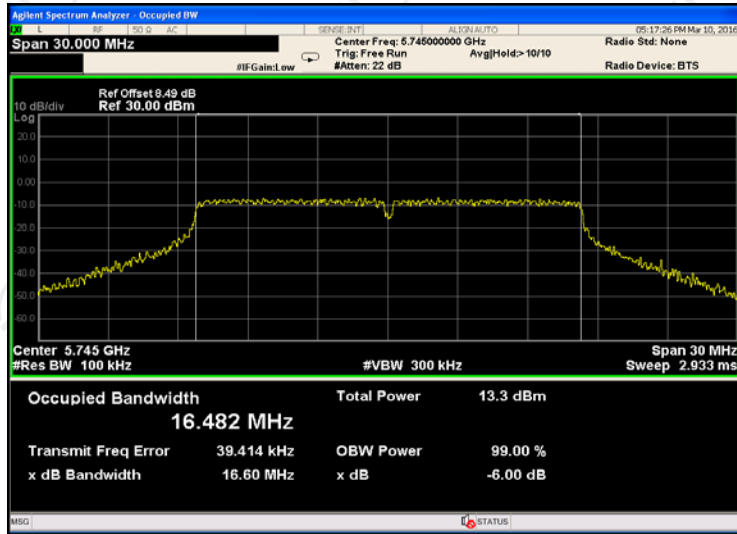
ANT 2

Band IV (5725 - 5850 MHz)					
Mode	Test channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Limit (MHz)	Result
11a	CH149	5745	16.56	0.5	PASS
11a	CH157	5785	16.45	0.5	PASS
11a	CH165	5825	16.56	0.5	PASS
11n(HT20)	CH149	5745	17.64	0.5	PASS
11n(HT20)	CH157	5785	17.82	0.5	PASS
11n(HT20)	CH165	5825	17.77	0.5	PASS
11n(HT40)	CH151	5755	36.44	0.5	PASS
11n(HT40)	CH159	5795	36.49	0.5	PASS
11ac(HT20)	CH149	5745	17.80	0.5	PASS
11ac(HT20)	CH157	5785	17.79	0.5	PASS
11ac(HT20)	CH165	5825	17.65	0.5	PASS
11ac(HT40)	CH151	5755	36.41	0.5	PASS
11ac(HT40)	CH159	5795	36.56	0.5	PASS
11ac(HT80)	CH155	5775	76.39	0.5	PASS

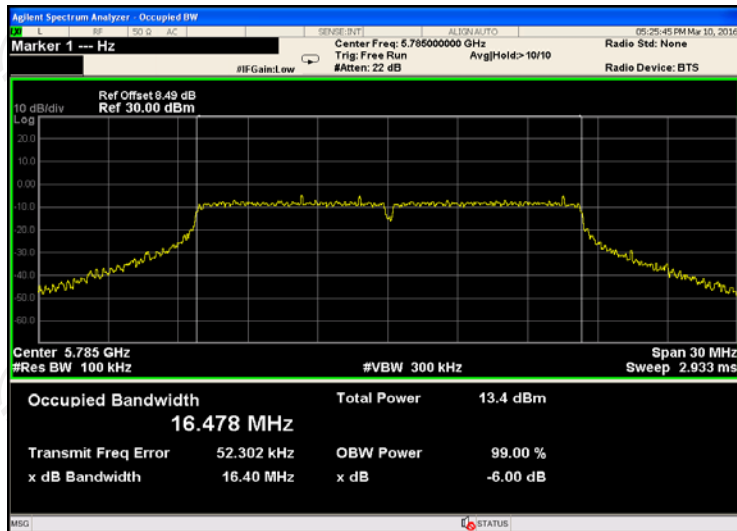
Test plots as follows:

ANT 0
Band IV (5725 – 5850 MHz)
11a

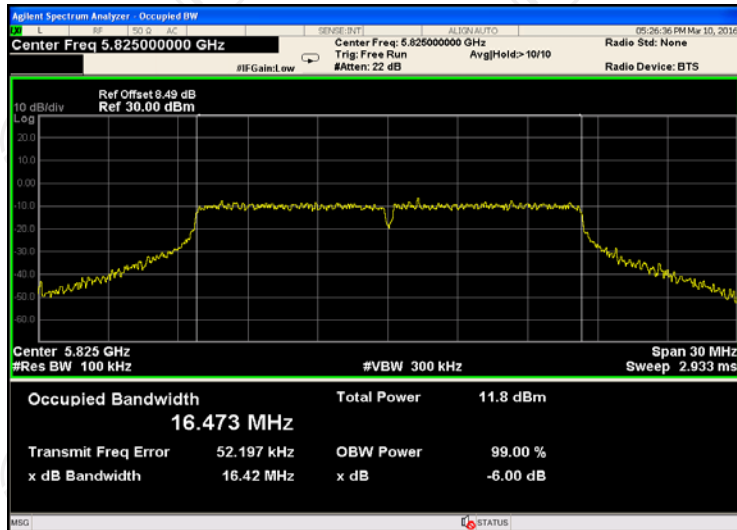
CH149



CH157

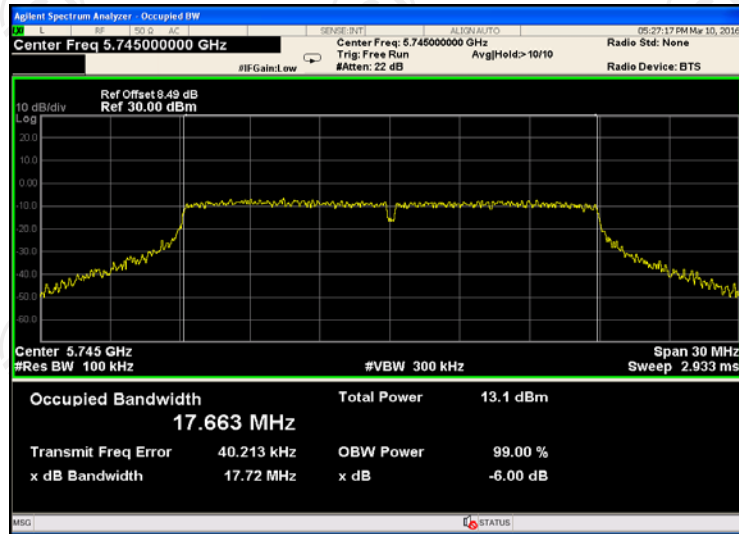


CH165

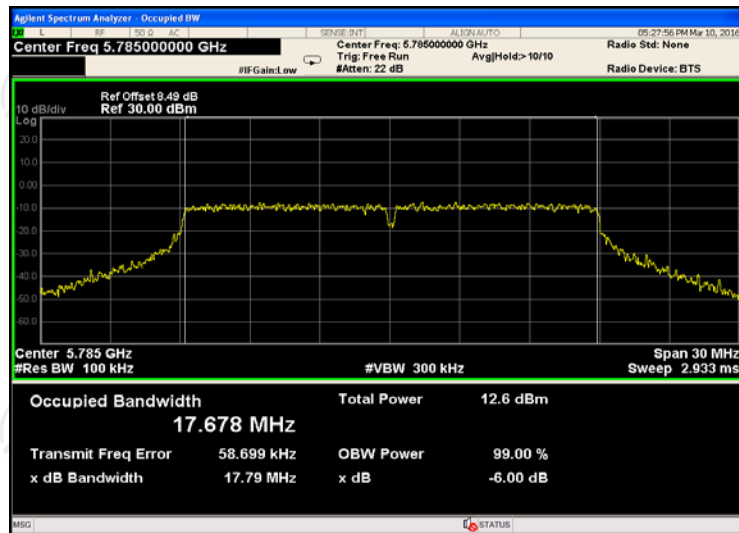


11n(HT20)

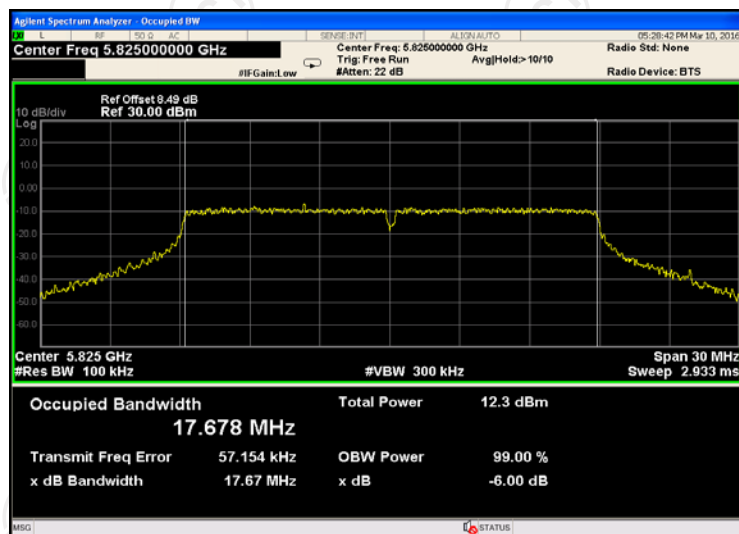
CH149



CH157

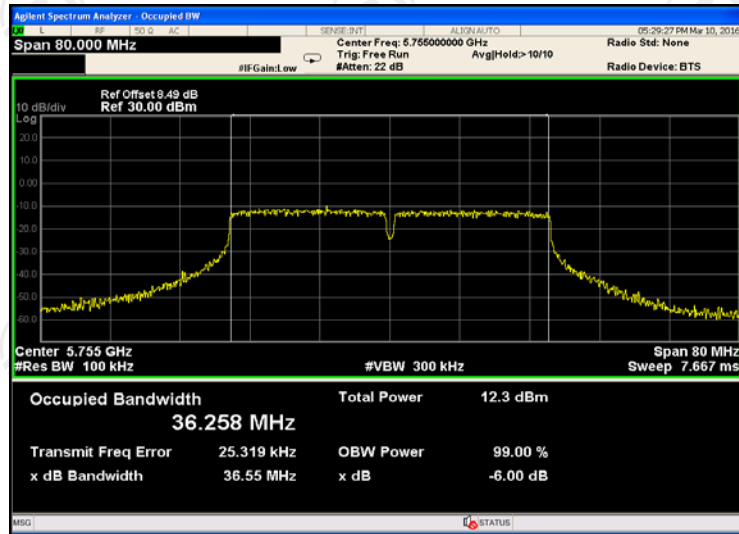


CH165

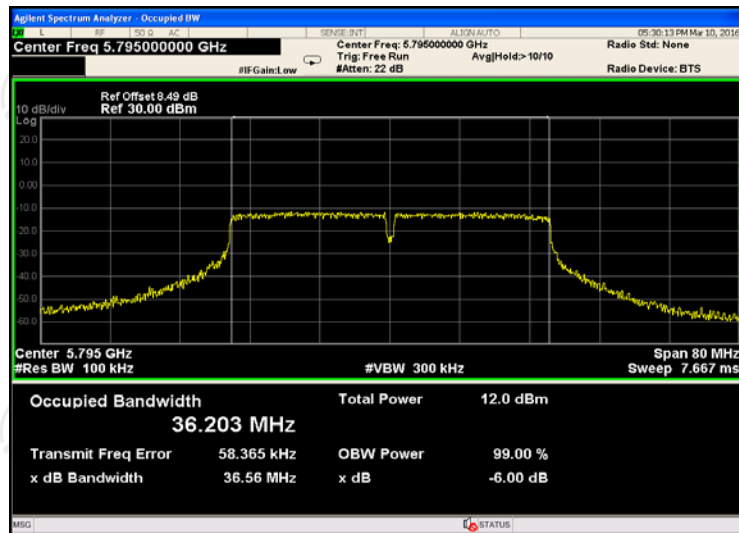


11n(HT40)

CH151

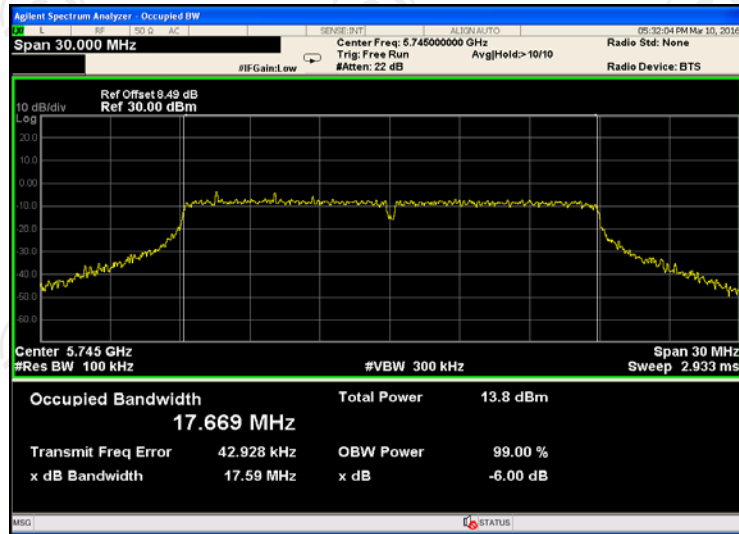


CH159

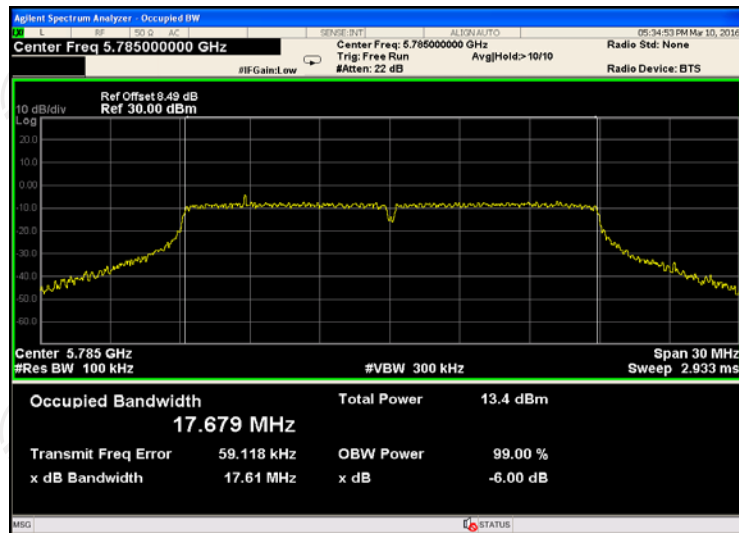


11ac(HT20)

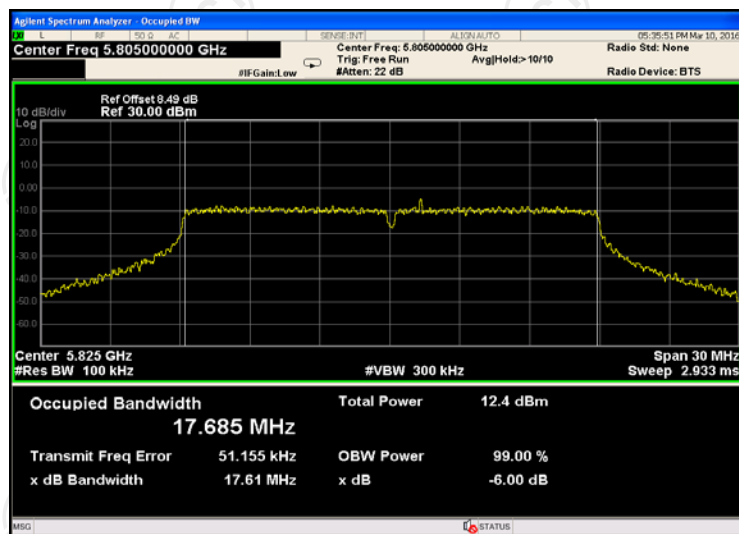
CH149



CH157

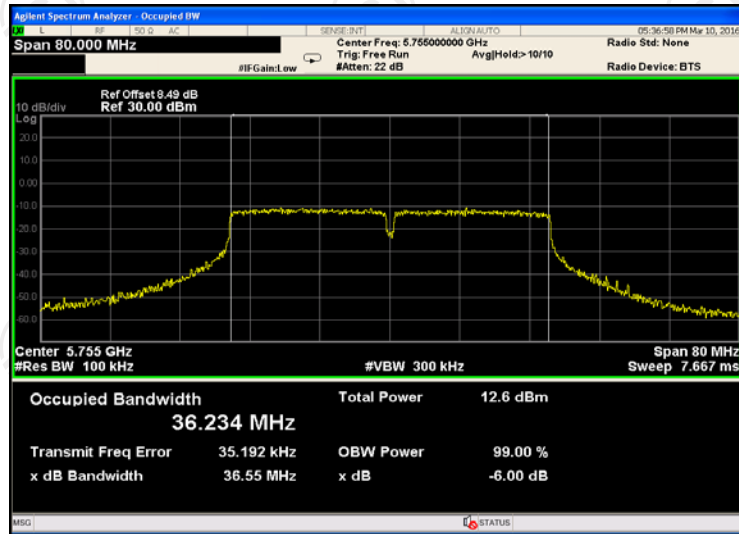


CH165

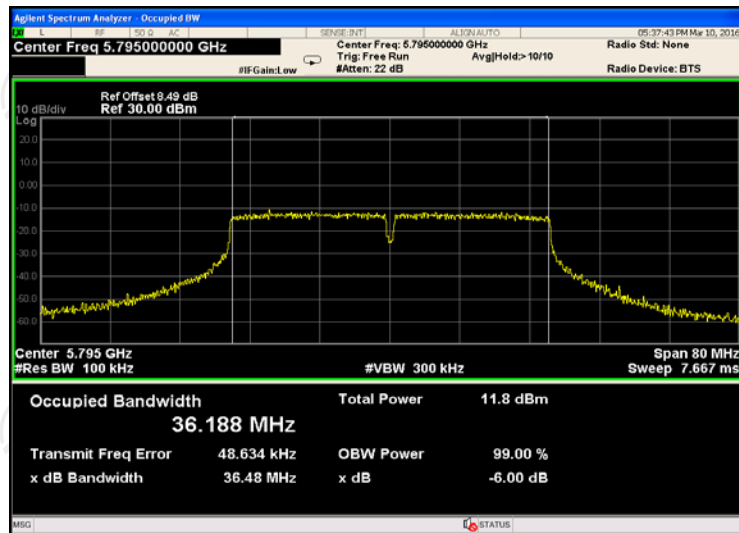


11ac(HT40)

CH151

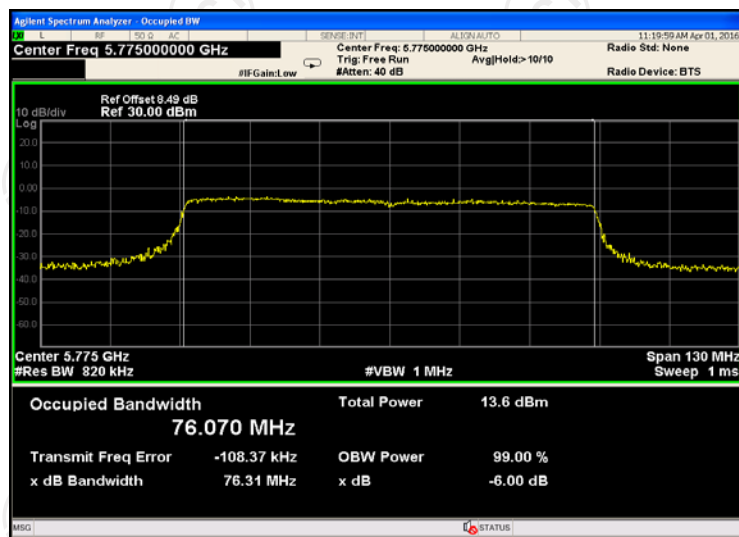


CH159



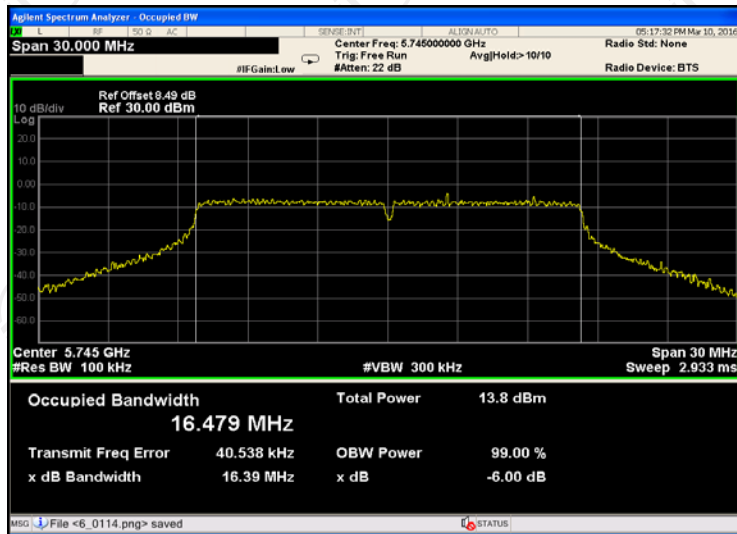
11ac(HT80)

CH155

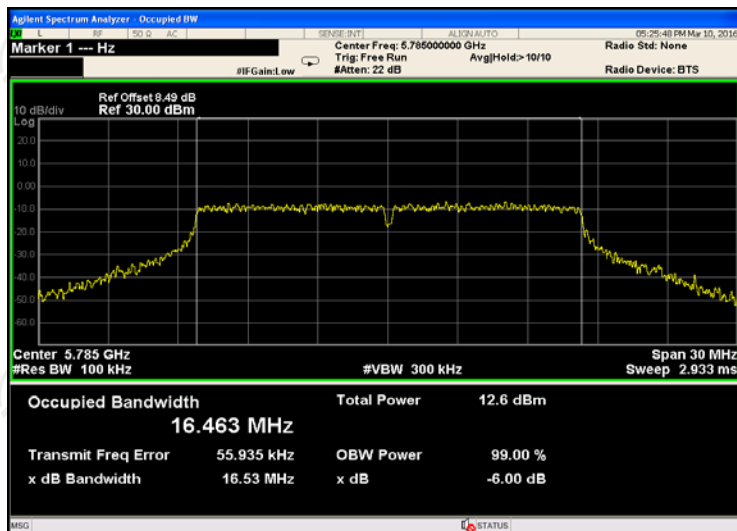


ANT 1
Band IV (5725 – 5850 MHz)
11a

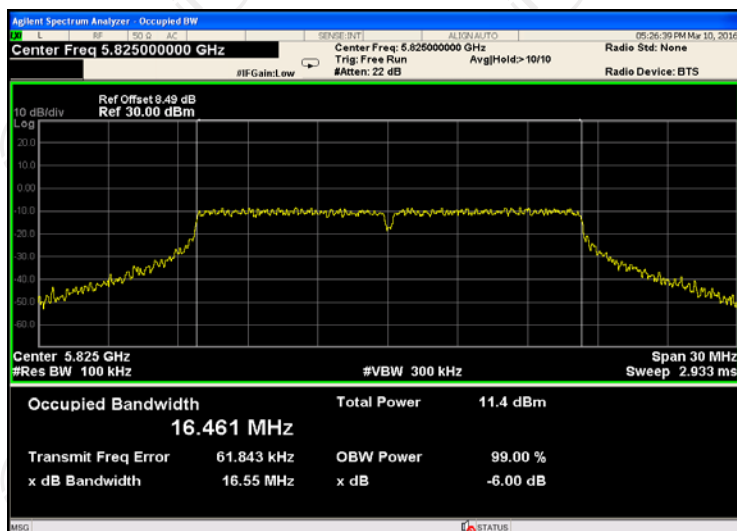
CH149



CH157

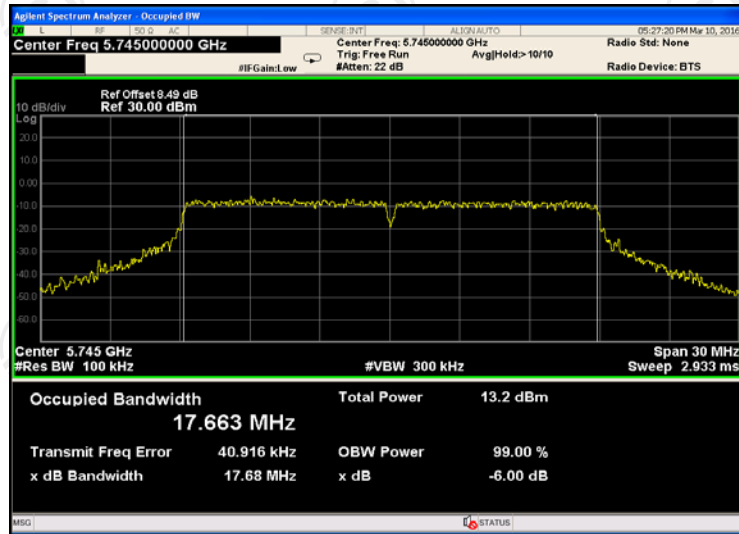


CH165

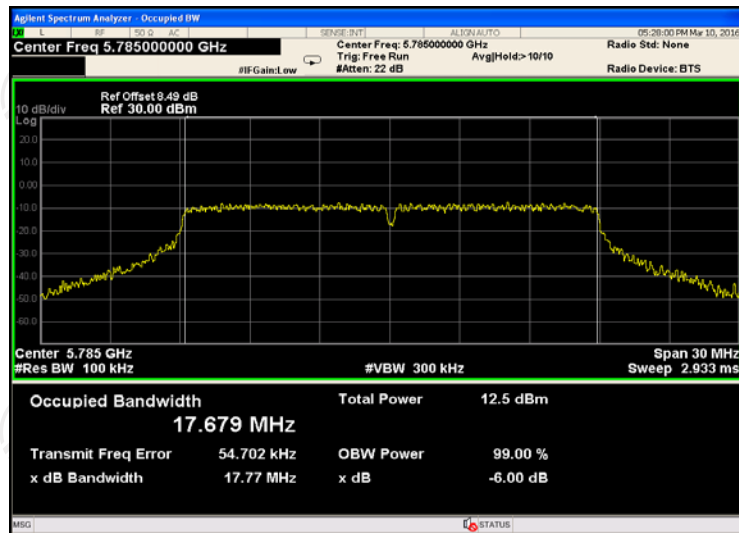


11n(HT20)

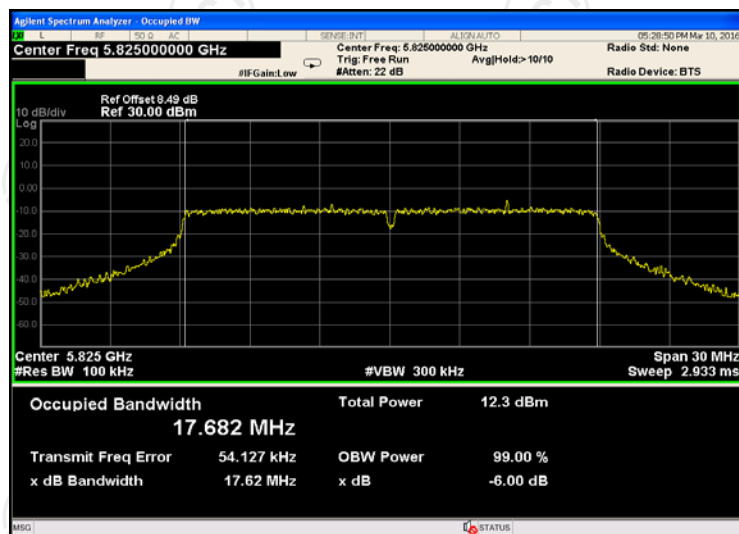
CH149



CH157

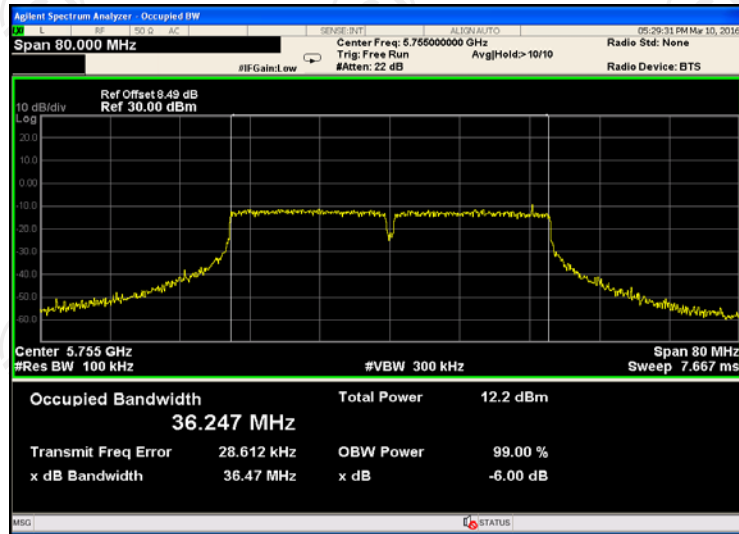


CH165

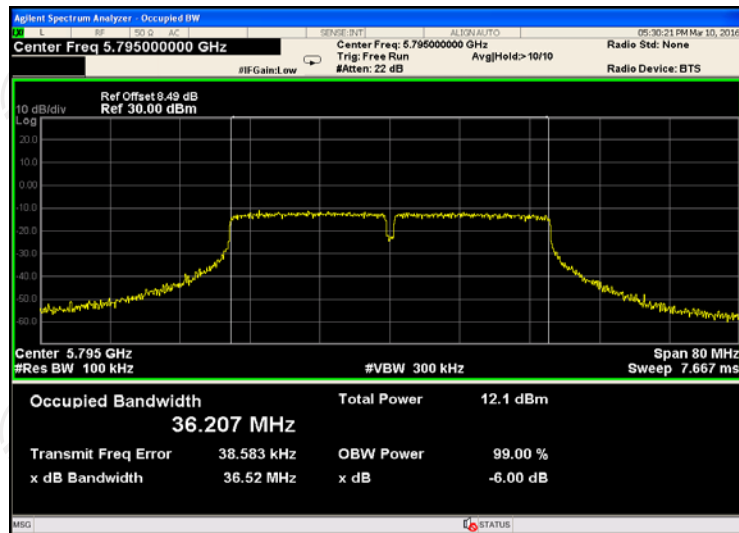


11n(HT40)

CH151

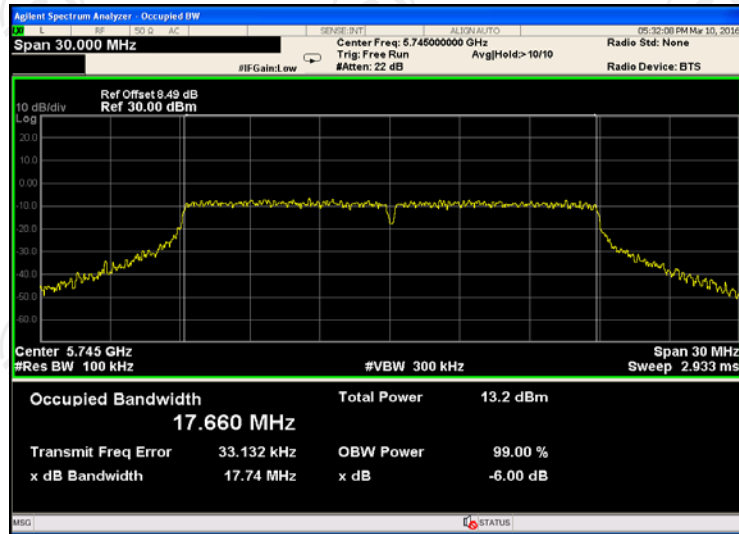


CH159

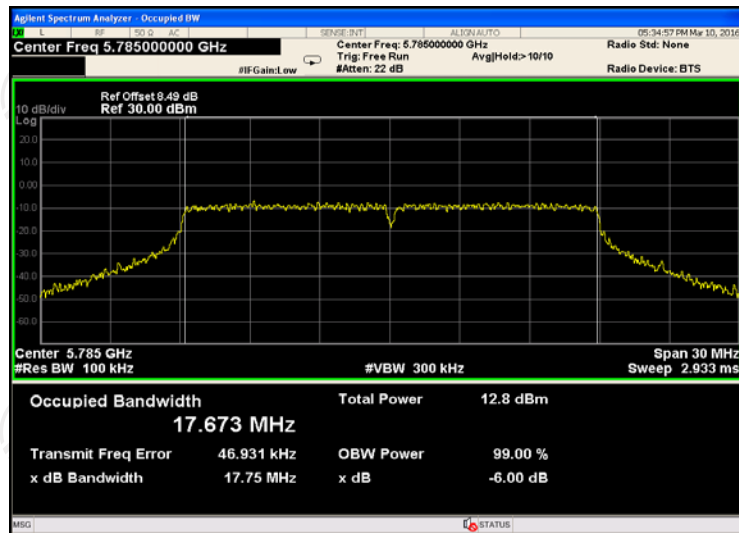


11ac(HT20)

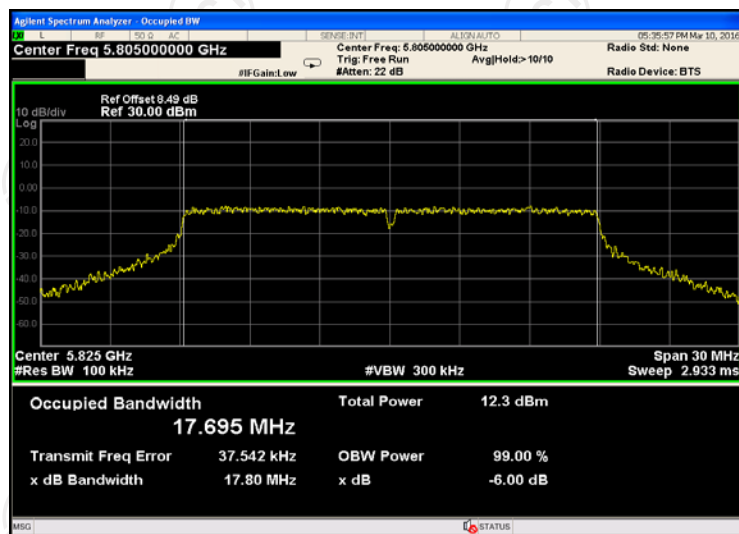
CH149



CH157

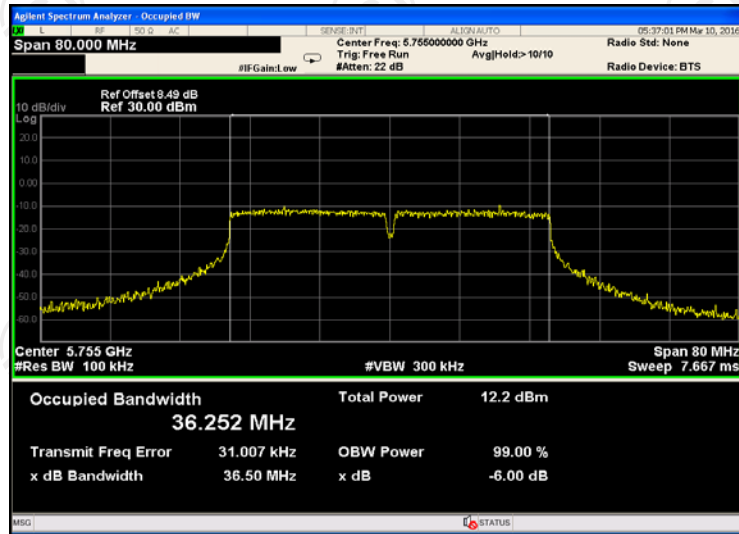


CH165

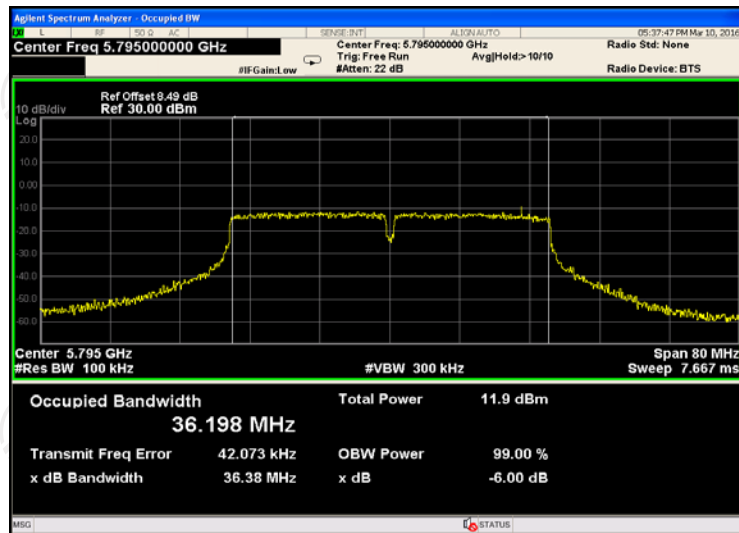


11ac(HT40)

CH151

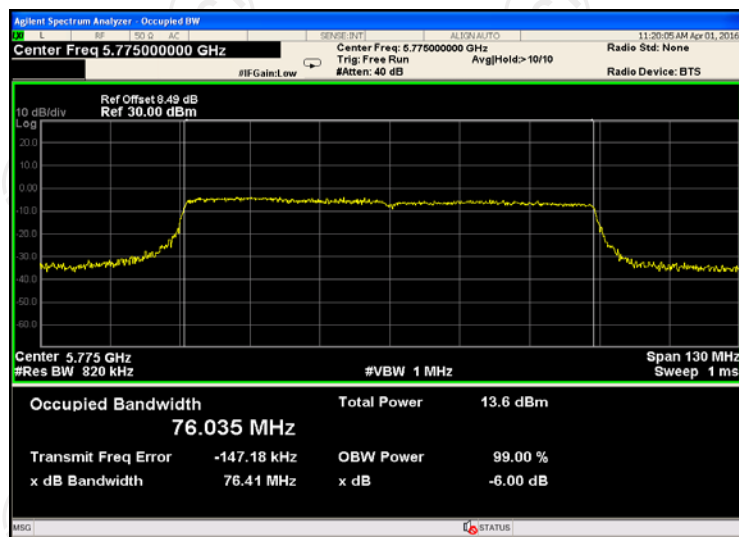


CH159



11ac(HT80)

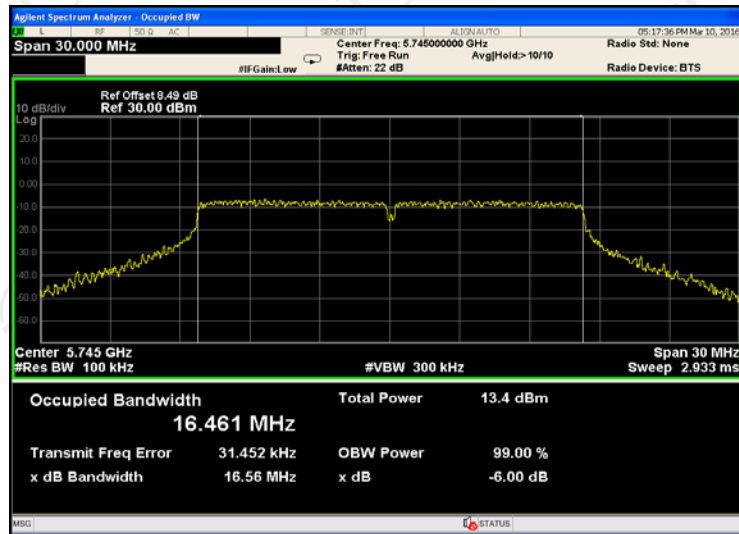
CH155



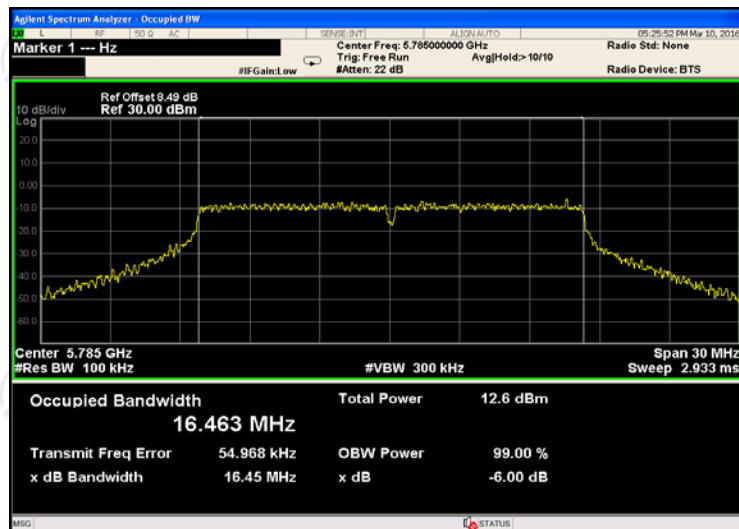
ANT 2
Band IV (5725 – 5850 MHz)

11a

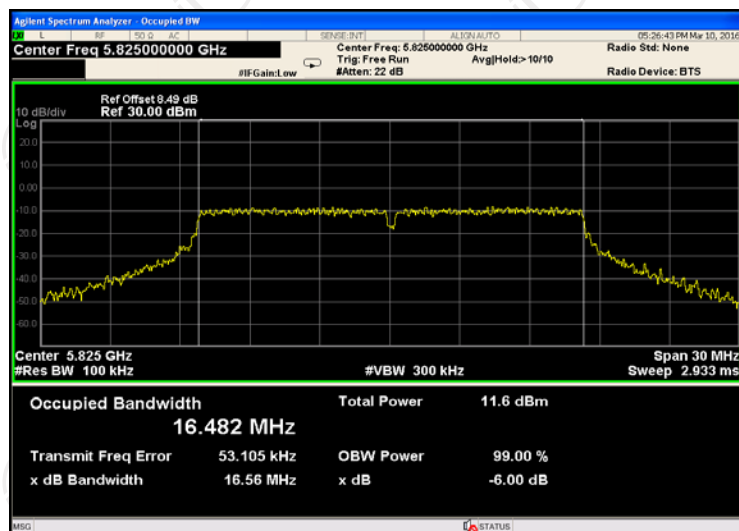
CH149



CH157

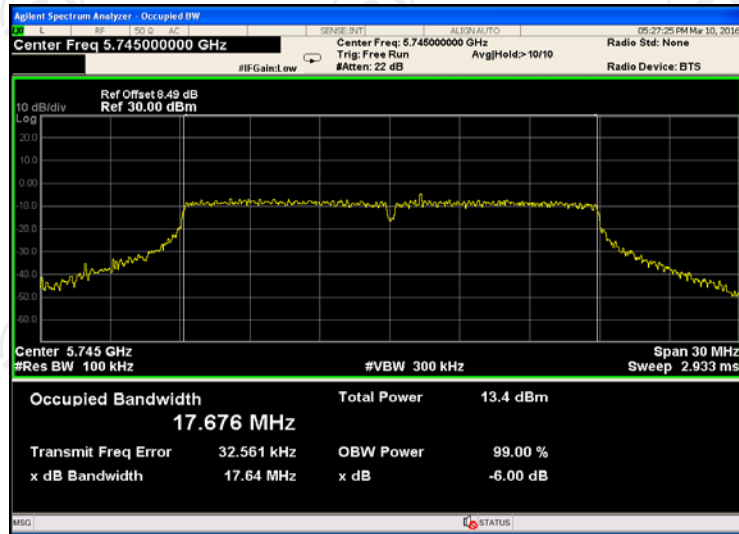


CH165

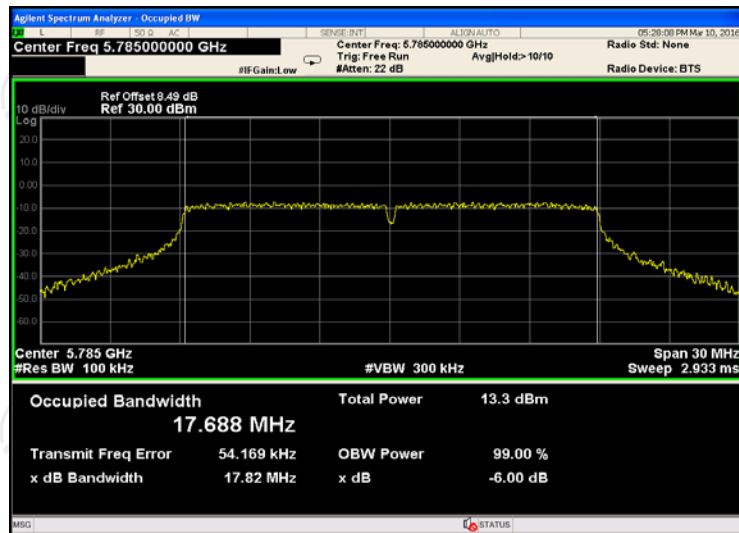


11n(HT20)

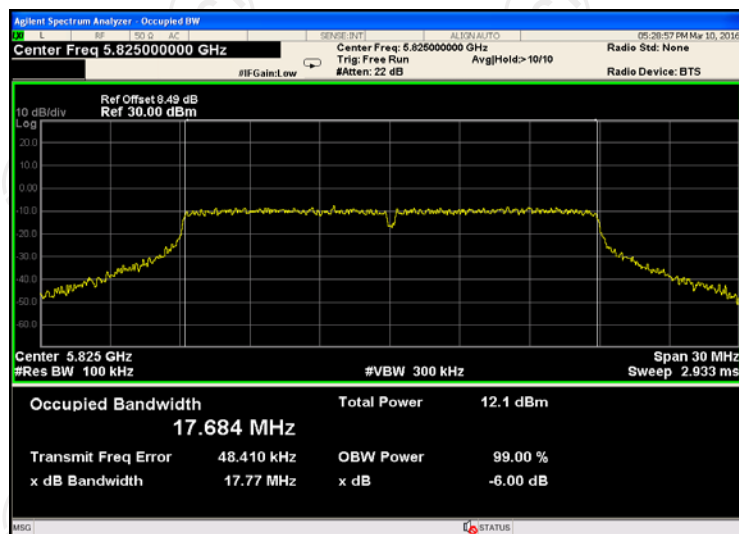
CH149



CH157

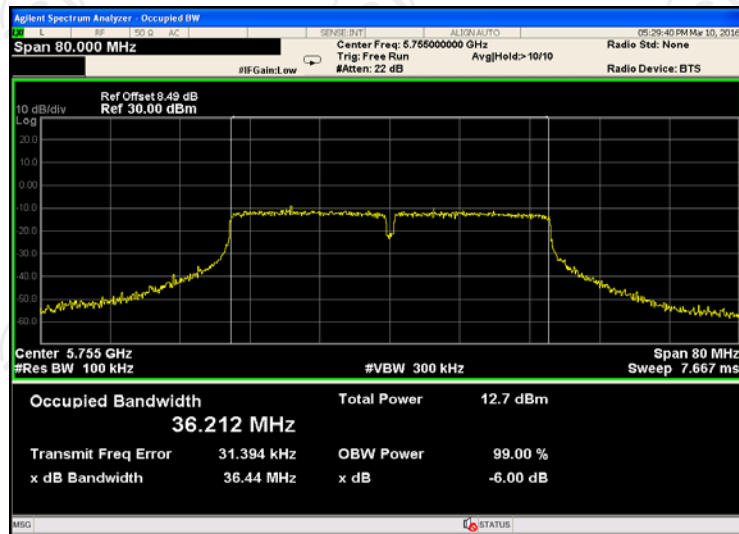


CH165

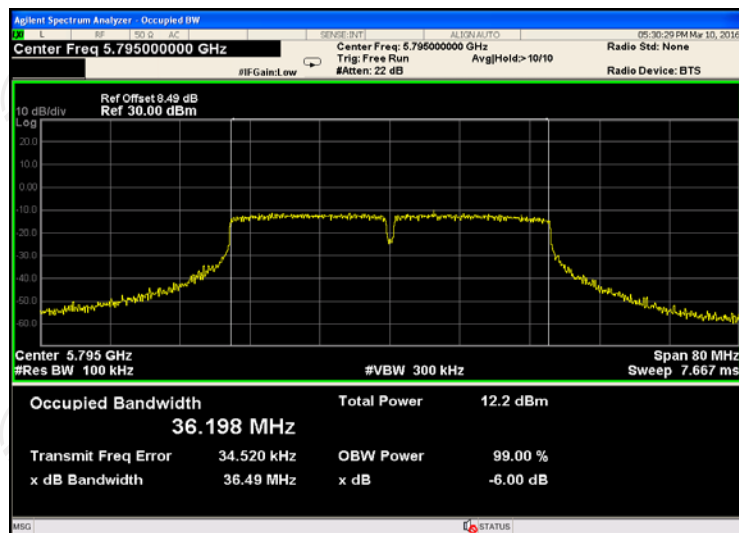


11n(HT40)

CH151

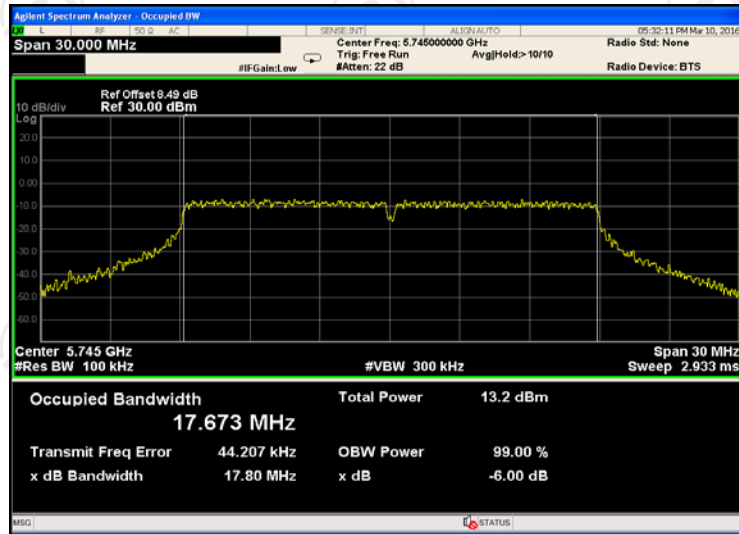


CH159

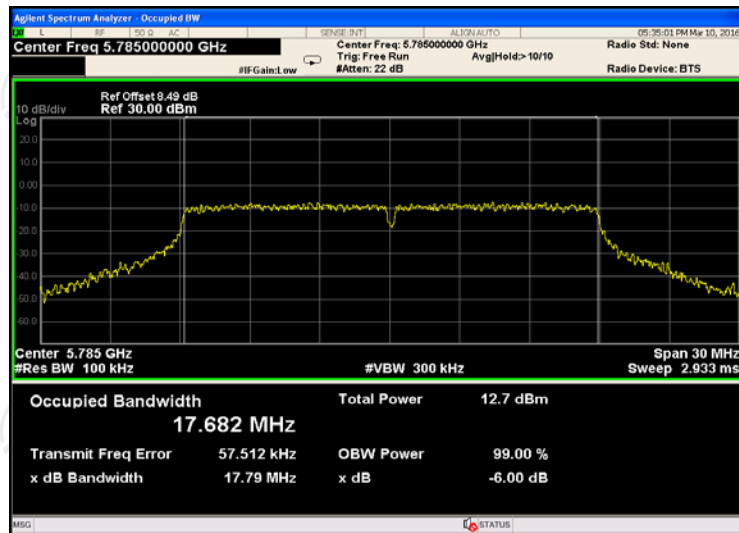


11ac(HT20)

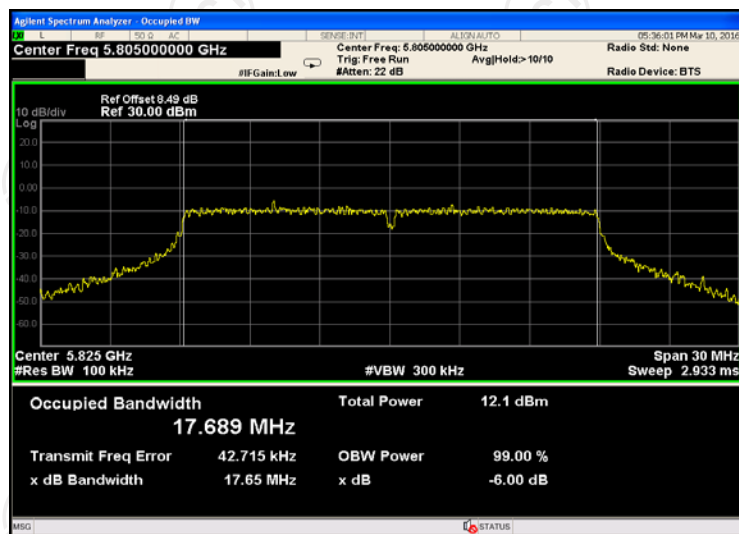
CH149



CH157

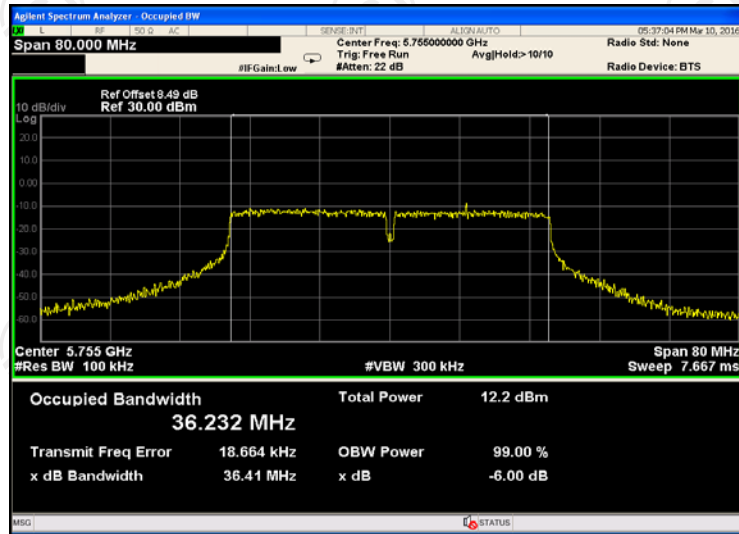


CH165

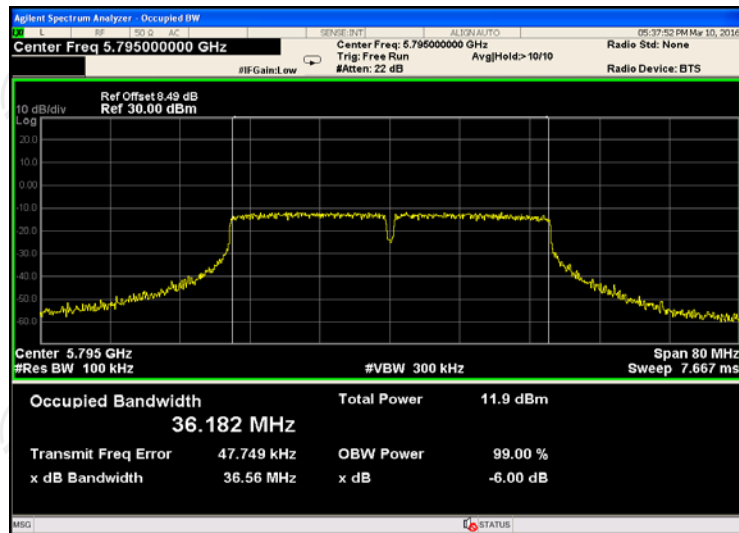


11ac(HT40)

CH151

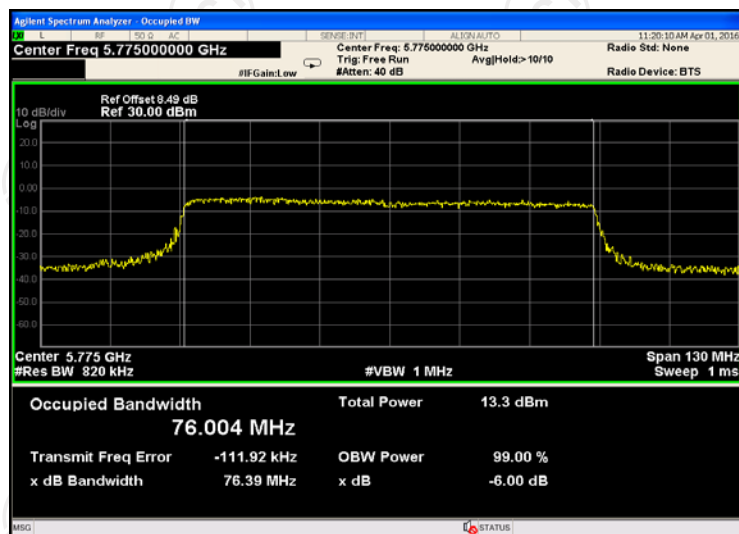


CH159




11ac(HT80)

CH155



6.5. 26dB Bandwidth and 99% Occupied Bandwidth

6.5.1. Test Specification

Test Requirement:	47 CFR Part 15C Section 15.407 (a)& Part 2 J Section 2.1049 / RSS-247, 6.2
Test Method:	KDB662911 D01 Multiple Transmitter Output v02r01 KDB789033 D02 General UNII Test Procedures New Rules v01r02 Section D
Limit:	No restriction limits
Test Setup:	 <p style="text-align: center;">Spectrum Analyzer EUT</p>
Test Mode:	Transmitting mode with modulation
Test Procedure:	<ol style="list-style-type: none"> 1. KDB789033 D02 General UNII Test Procedures New Rules v01r02 Section D 2. Set to the maximum power setting and enable the EUT transmit continuously. 3. Make the measurement with the spectrum analyzer's resolution bandwidth (RBW) = 100 kHz. Set the Video bandwidth (VBW) = 300 kHz. In order to make an accurate measurement. 4. Measure and record the results in the test report.
Test Result:	PASS

6.5.2. Test Instruments

RF Test Room				
Equipment	Manufacturer	Model	Serial Number	Calibration Due
Spectrum Analyzer	Agilent	N9020A	MY49100060	Sep. 12, 2016
RF cable	TCT	RE-06	N/A	Sep. 12, 2016
Antenna Connector	TCT	RFC-01	N/A	Sep. 12, 2016

Note: The calibration interval of the above test instruments is 12 months and the calibrations are traceable to international system unit (SI).

6.5.3. Test data

ANT 0 Band I

Mode	Test channel	Frequency (MHz)	26 dB Bandwidth (MHz)	99% Bandwidth (MHz)
11a	CH36	5180	27.08	17.503
11a	CH44	5220	24.50	17.131
11a	CH48	5240	23.31	17.069
11n(HT20)	CH36	5180	22.85	18.195
11n(HT20)	CH44	5220	24.61	18.252
11n(HT20)	CH48	5240	22.78	18.152
11n(HT40)	CH38	5190	44.97	36.823
11n(HT40)	CH46	5230	45.43	36.703
11ac(HT20)	CH36	5180	24.69	18.206
11ac(HT20)	CH44	5220	23.48	18.138
11ac(HT20)	CH48	5240	23.23	18.227
11ac(HT40)	CH38	5190	44.70	36.709
11ac(HT40)	CH46	5230	45.43	36.703
11ac(HT80)	CH42	5210	92.61	72.213

Band IV

Mode	Test channel	Frequency (MHz)	26 dB Bandwidth (MHz)	99% Bandwidth (MHz)
11a	CH149	5745	25.82	17.231
11a	CH157	5785	25.11	17.208
11a	CH161	5825	22.61	17.005
11n(HT20)	CH149	5745	34.99	18.838
11n(HT20)	CH157	5785	30.72	18.441
11n(HT20)	CH161	5825	25.73	18.213
11n(HT40)	CH151	5755	56.87	36.814
11n(HT40)	CH159	5795	60.87	36.903
11ac(HT20)	CH149	5745	31.48	18.455
11ac(HT20)	CH157	5785	30.16	18.396
11ac(HT20)	CH161	5805	27.78	18.290
11ac(HT40)	CH151	5755	61.64	37.058
11ac(HT40)	CH159	5795	63.27	36.901
11ac(HT80)	CH155	5775	89.33	75.944

**ANT 1
Band I**

Mode	Test channel	Frequency (MHz)	26 dB Bandwidth (MHz)	99% Bandwidth (MHz)
11a	CH36	5180	23.14	17.145
11a	CH44	5220	21.96	17.110
11a	CH48	5240	23.46	17.142
11n(HT20)	CH36	5180	23.86	18.127
11n(HT20)	CH44	5220	24.57	18.249
11n(HT20)	CH48	5240	23.09	18.198
11n(HT40)	CH38	5190	43.58	36.520
11n(HT40)	CH46	5230	45.47	36.729
11ac(HT20)	CH36	5180	24.69	18.230
11ac(HT20)	CH44	5220	23.58	18.216
11ac(HT20)	CH48	5240	24.11	18.296
11ac(HT40)	CH38	5190	42.92	36.467
11ac(HT40)	CH46	5230	45.47	36.729
11ac(HT80)	CH42	5210	89.22	76.078

Band IV

Mode	Test channel	Frequency (MHz)	26 dB Bandwidth (MHz)	99% Bandwidth (MHz)
11a	CH149	5745	25.17	17.250
11a	CH157	5785	24.47	17.206
11a	CH161	5825	24.11	17.115
11n(HT20)	CH149	5745	34.99	18.854
11n(HT20)	CH157	5785	30.72	18.565
11n(HT20)	CH161	5825	25.72	18.268
11n(HT40)	CH151	5755	57.14	36.921
11n(HT40)	CH159	5795	63.76	37.034
11ac(HT20)	CH149	5745	31.69	18.574
11ac(HT20)	CH157	5785	30.13	18.473
11ac(HT20)	CH161	5805	27.08	18.405
11ac(HT40)	CH151	5755	62.85	37.164
11ac(HT40)	CH159	5795	63.30	37.065
11ac(HT80)	CH155	5775	94.70	75.913

ANT 2 Band I

Mode	Test channel	Frequency (MHz)	26 dB Bandwidth (MHz)	99% Bandwidth (MHz)
11a	CH36	5180	23.13	17.149
11a	CH44	5220	21.59	17.053
11a	CH48	5240	23.46	17.156
11n(HT20)	CH36	5180	23.83	18.216
11n(HT20)	CH44	5220	23.54	18.203
11n(HT20)	CH48	5240	23.09	18.199
11n(HT40)	CH38	5190	44.44	36.581
11n(HT40)	CH46	5230	45.46	36.720
11ac(HT20)	CH36	5180	22.44	18.055
11ac(HT20)	CH44	5220	23.58	18.222
11ac(HT20)	CH48	5240	24.11	18.292
11ac(HT40)	CH38	5190	43.31	36.591
11ac(HT40)	CH46	5230	45.46	36.720
11ac(HT80)	CH42	5210	90.00	76.052

Band IV

Mode	Test channel	Frequency (MHz)	26 dB Bandwidth (MHz)	99% Bandwidth (MHz)
11a	CH149	5745	24.60	17.286
11a	CH157	5785	24.50	17.293
11a	CH161	5825	24.11	17.102
11n(HT20)	CH149	5745	34.99	18.857
11n(HT20)	CH157	5785	31.16	18.642
11n(HT20)	CH161	5825	25.71	18.275
11n(HT40)	CH151	5755	59.87	36.988
11n(HT40)	CH159	5795	63.76	37.120
11ac(HT20)	CH149	5745	32.31	18.611
11ac(HT20)	CH157	5785	30.13	18.537
11ac(HT20)	CH161	5805	27.32	18.419
11ac(HT40)	CH151	5755	62.85	37.213
11ac(HT40)	CH159	5795	67.90	37.110
11ac(HT80)	CH155	5775	90.44	75.966

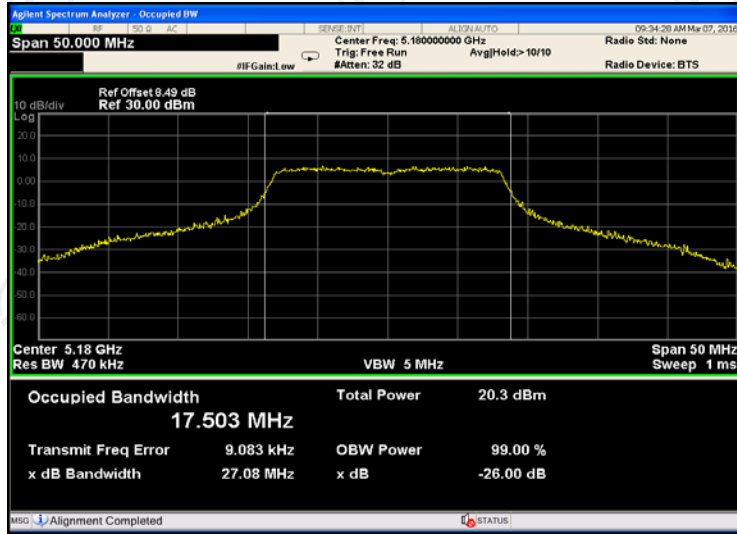
Test plots as follows:

ANT 0

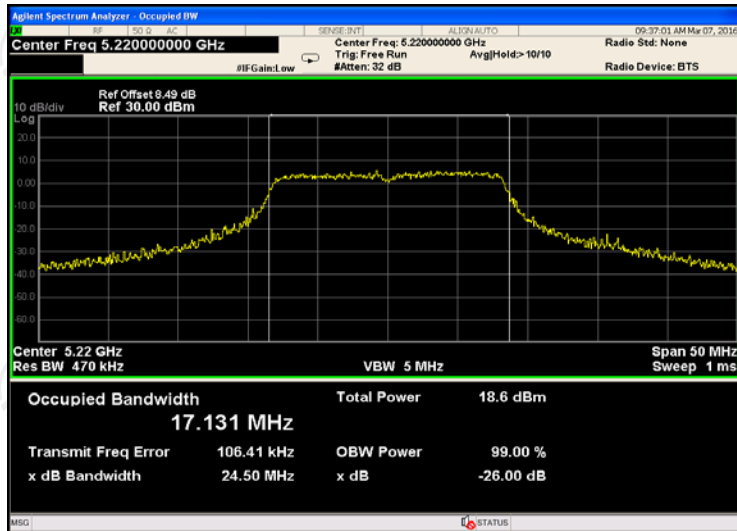
Band I (5150 – 5250 MHz)

11a

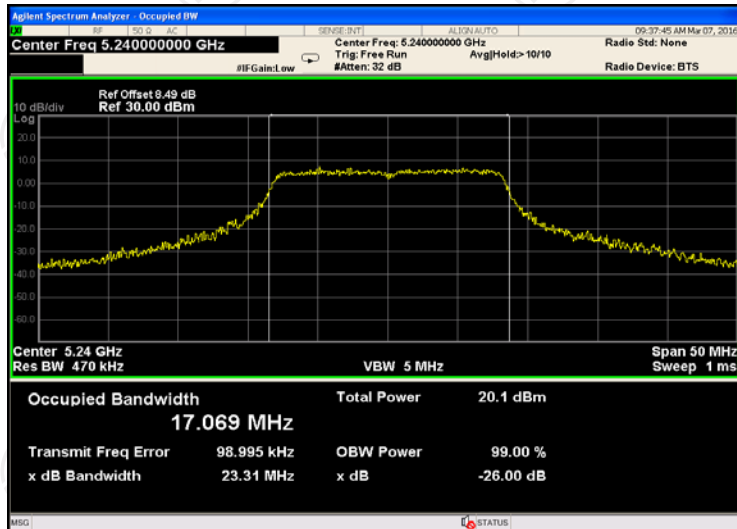
CH36



CH44

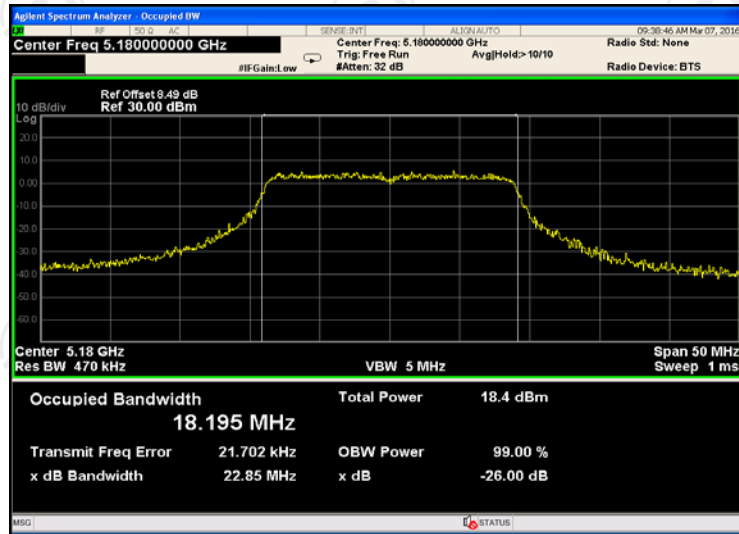


CH48

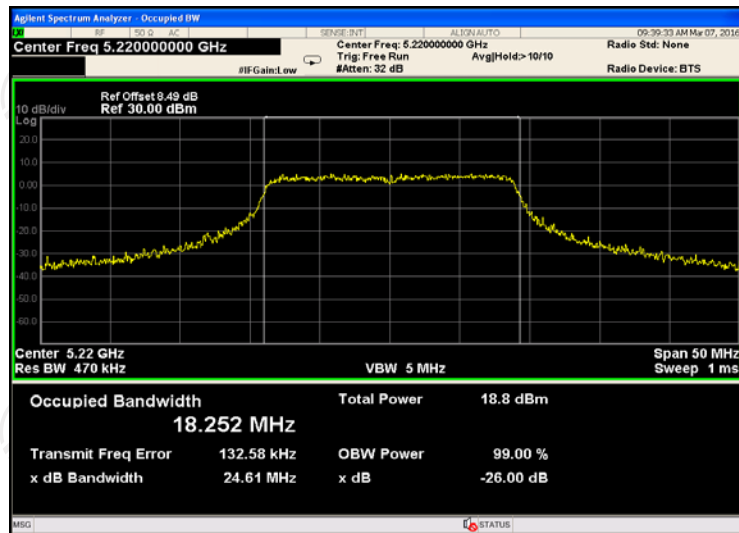


11n(HT20)

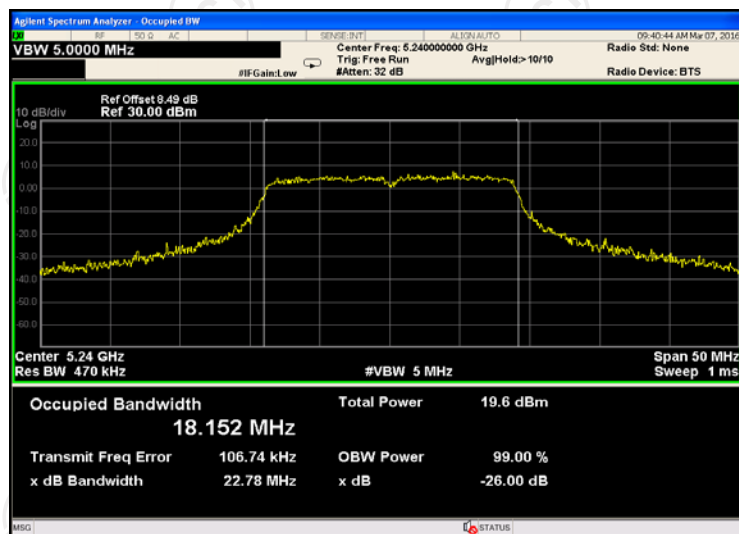
CH36



CH44

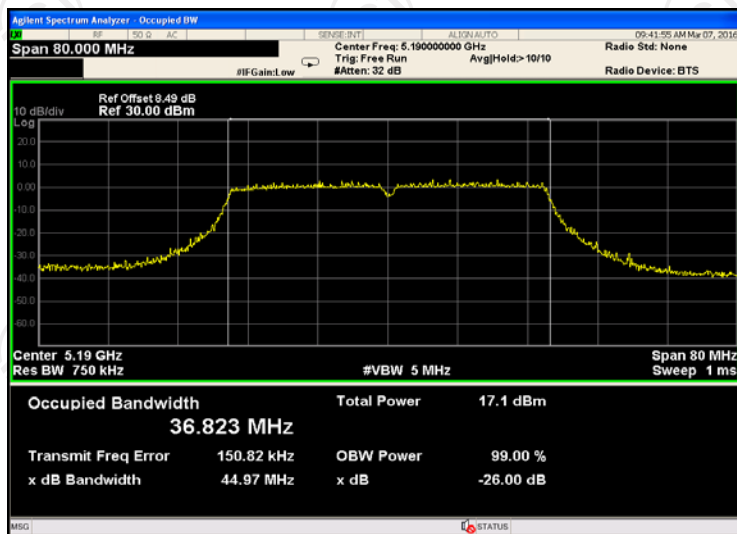


CH48

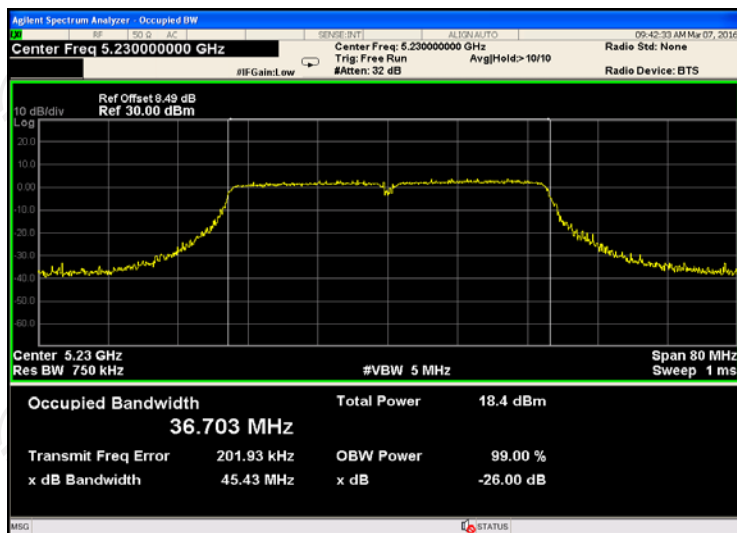


11n(HT40)

CH38

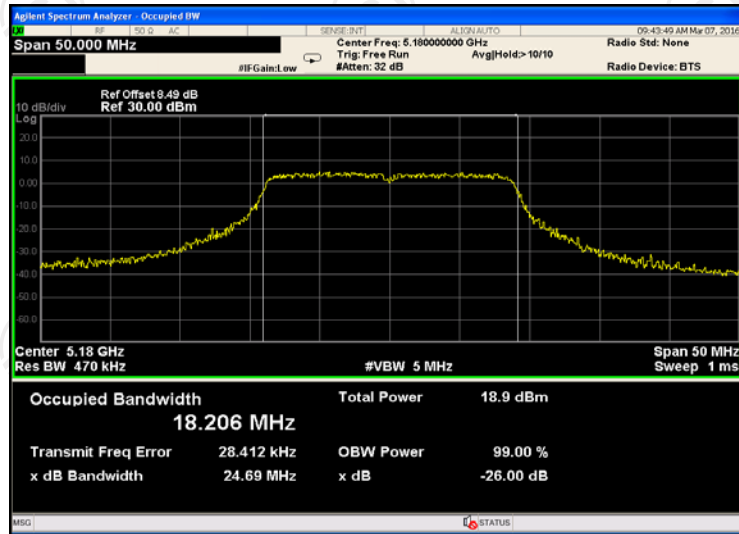


CH46

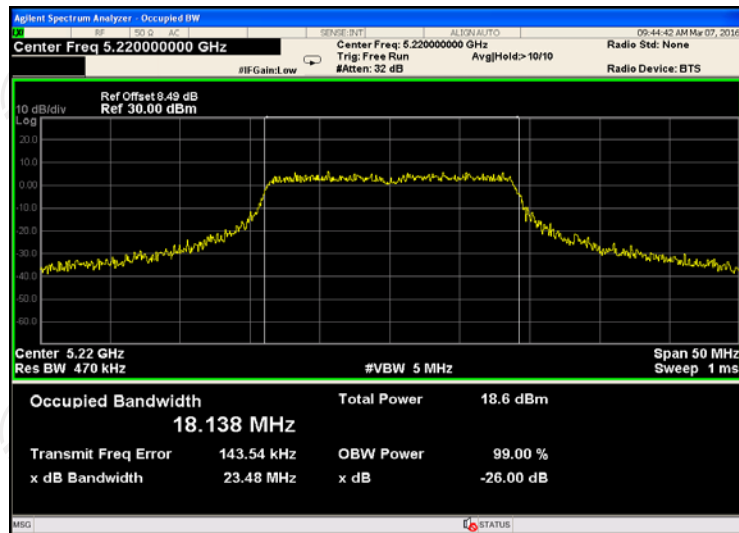


11ac(HT20)

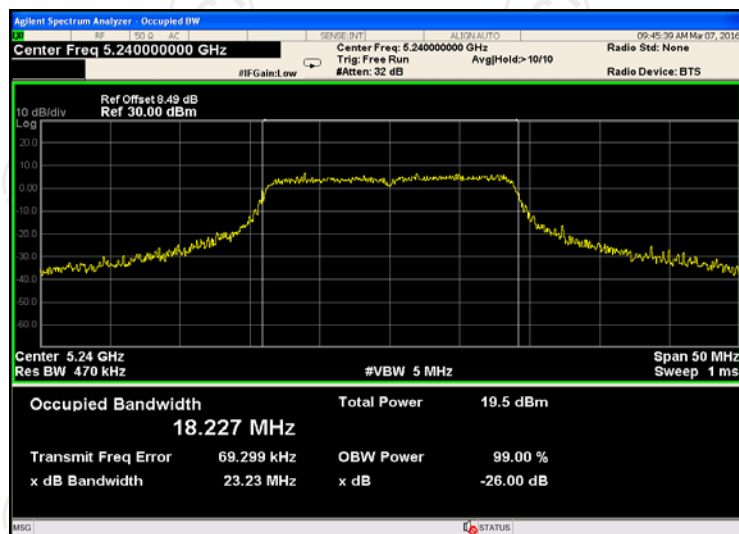
CH36



CH44

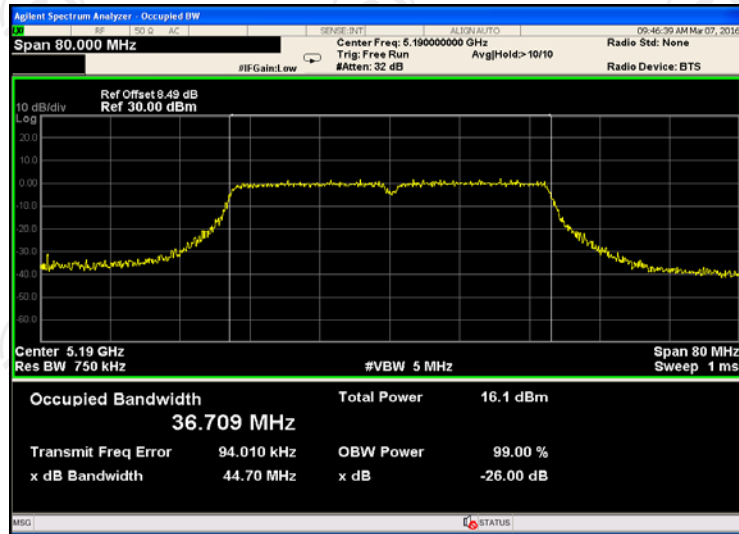


CH48

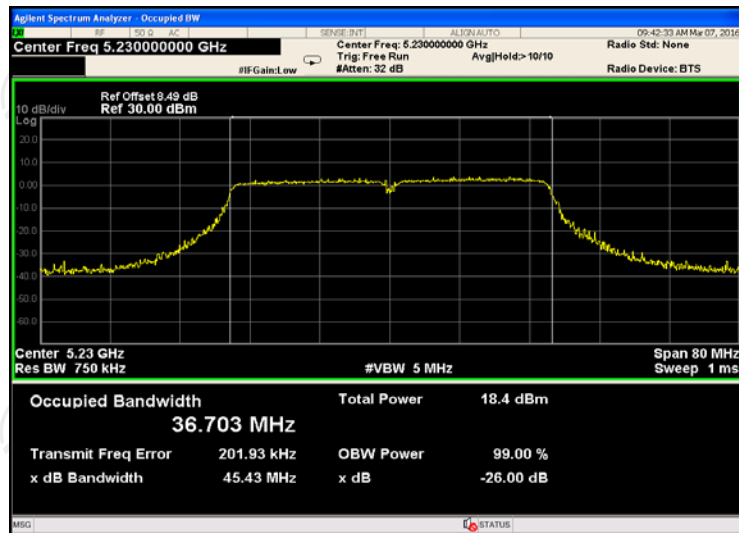


11ac(HT40)

CH38

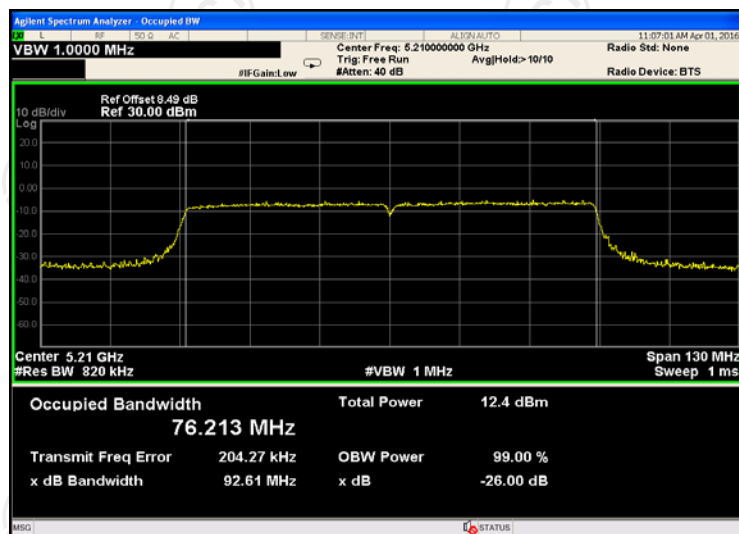


CH46



11ac(HT80)

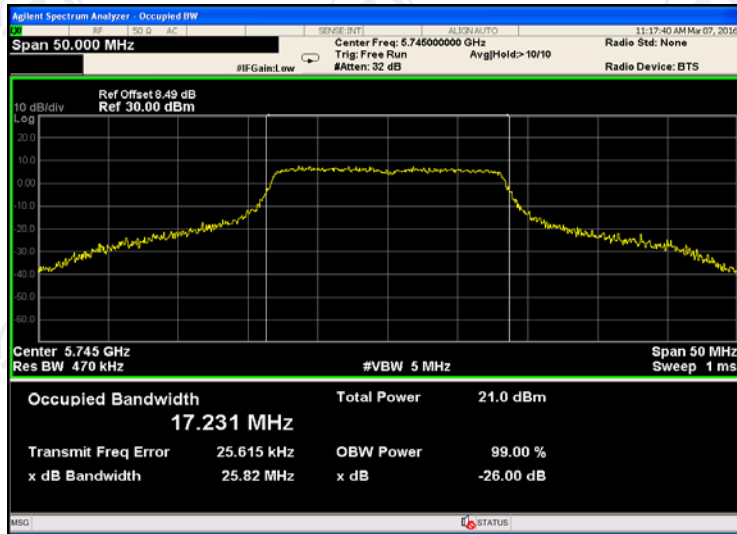
CH42



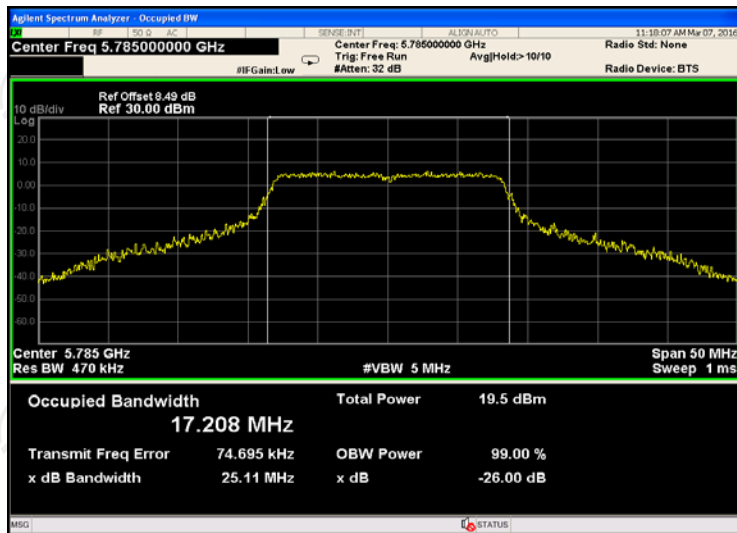
Band IV (5725 – 5850 MHz)

11a

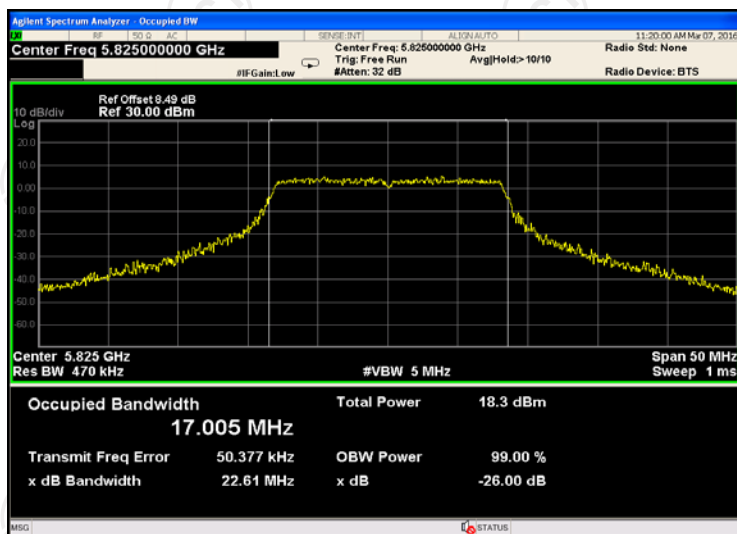
CH149



CH157

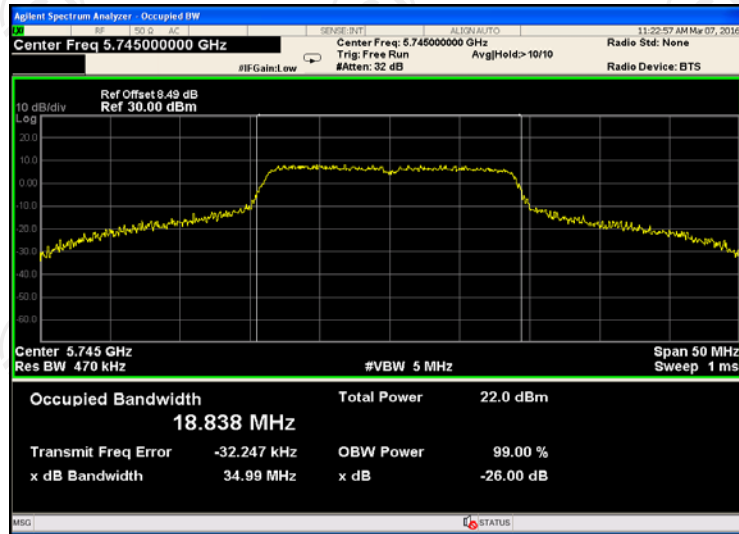


CH165

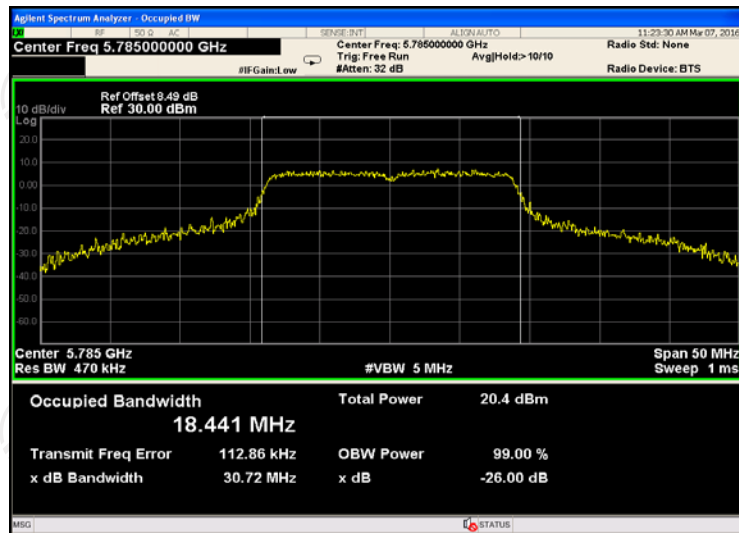


11n(HT20)

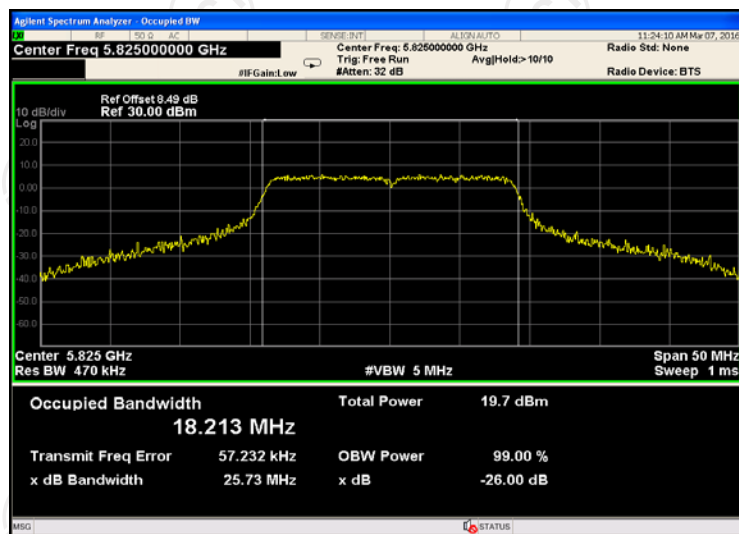
CH149



CH157

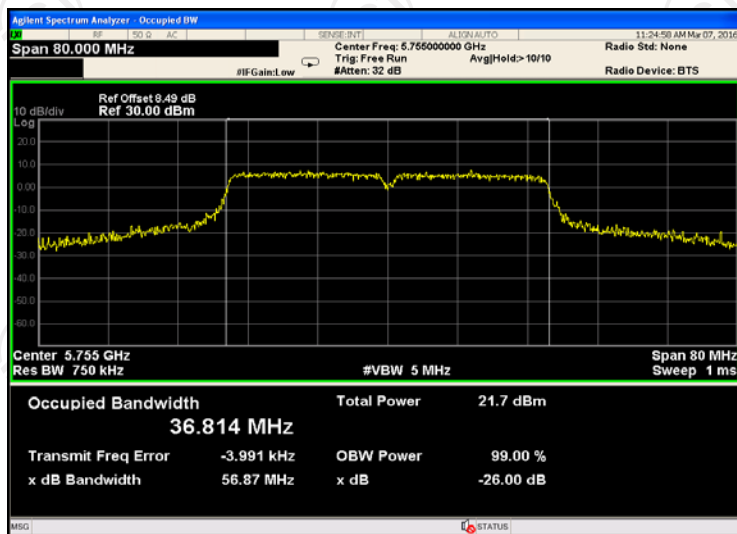


CH165



11n(HT40)

CH151



CH159

