

Test Report No. 7191166853-EEC17/03
dated 23 Oct 2017



PSB Singapore

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FORMAL REPORT ON TESTING IN ACCORDANCE WITH
47 CFR FCC Parts 15B & C
(IEEE 802.11 Wi-Fi)
OF AN
E-Log & Fleet Management Device [Model : DC700]
[FCC ID : A4C01006A]

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FCC REG. NO. 994109 (Test Firm Registration Number)
SG0002 (Designation Number)

IND. CANADA REG. NO. 2932I-1 (3m and 10m Semi-Anechoic Chamber, Science Park)
2932N-1 (10m Semi-Anechoic Chamber, International Business Park)

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LA-2007-0381-F LA-2007-0385-E
LA-2007-0382-B LA-2007-0386-C
LA-2007-0383-G LA-2010-0464-D

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TEST SUMMARY

The product was tested in accordance with the customer's specifications.

Test Results Summary

Test Standard	Description	Pass / Fail
47 CFR FCC Part 15		
15.107(a), 15.207	Conducted Emissions	Not Applicable *See Note 8
15.109(a), 15.205, 15.209	Radiated Emissions (Spurious Emissions inclusive Restricted Bands Requirement)	Pass *See Modification 1
15.247(a)(2)	Spectrum Bandwidth (6dB Bandwidth Measurement)	Pass
15.247(b)(3)	Maximum Peak Power	Pass
15.247(d)	RF Conducted Spurious Emissions (Non-Restricted Bands)	Pass
15.247(d)	RF Conducted Spurious Emissions (Restricted Bands)	Pass *See Modification 1
15.247(d)	Band Edge Compliance (Conducted)	Pass
15.247(d)	Band Edge Compliance (Radiated)	Pass
15.247(e)	Peak Power Spectral Density	Pass
1.1310	Maximum Permissible Exposure	Pass



TEST SUMMARY

Notes

1. The channels as listed below, under the different configurations were tested for 802.11b WLAN.

<u>Transmit Channel</u>	<u>Frequency (GHz)</u>	<u>Modulation</u>	<u>Data Rate</u>
Channel 1 (Lower Channel)	2.412	DBPSK	1Mbps
Channel 6 (Middle Channel)	2.437	DBPSK	1Mbps
Channel 11 (Upper Channel)	2.462	DBPSK	1Mbps
Channel 1 (Lower Channel)	2.412	DBPSK	2Mbps
Channel 6 (Middle Channel)	2.437	DBPSK	2Mbps
Channel 11 (Upper Channel)	2.462	DBPSK	2Mbps
Channel 1 (Lower Channel)	2.412	DBPSK	11Mbps
Channel 6 (Middle Channel)	2.437	DBPSK	11Mbps
Channel 11 (Upper Channel)	2.462	DBPSK	11Mbps

2. The channels as listed below, under the different configurations were tested for 802.11g WLAN.

<u>Transmit Channel</u>	<u>Frequency (GHz)</u>	<u>Modulation</u>	<u>Data Rate</u>
Channel 1 (Lower Channel)	2.412	BPSK	9Mbps
Channel 6 (Middle Channel)	2.437	BPSK	9Mbps
Channel 11 (Upper Channel)	2.462	BPSK	9Mbps
Channel 1 (Lower Channel)	2.412	QPSK	18Mbps
Channel 6 (Middle Channel)	2.437	QPSK	18Mbps
Channel 11 (Upper Channel)	2.462	QPSK	18Mbps
Channel 1 (Lower Channel)	2.412	16QAM	36Mbps
Channel 6 (Middle Channel)	2.437	16QAM	36Mbps
Channel 11 (Upper Channel)	2.462	16QAM	36Mbps
Channel 1 (Lower Channel)	2.412	64QAM	54Mbps
Channel 6 (Middle Channel)	2.437	64QAM	54Mbps
Channel 11 (Upper Channel)	2.462	64QAM	54Mbps

TEST SUMMARY

3. The channels as listed below, under the different configurations were tested for 802.11n(20MHz) WLAN.

<u>Transmit Channel</u>	<u>Frequency (GHz)</u>	<u>Modulation</u>	<u>Data Rate</u>
Channel 1 (Lower Channel) Channel 6 (Middle Channel) Channel 11 (Upper Channel)	2.412 2.437 2.462	BPSK BPSK BPSK	6.5Mbps 6.5Mbps 6.5Mbps
Channel 1 (Lower Channel) Channel 6 (Middle Channel) Channel 11 (Upper Channel)	2.412 2.437 2.462	QPSK QPSK QPSK	19.5Mbps 19.5Mbps 19.5Mbps
Channel 1 (Lower Channel) Channel 6 (Middle Channel) Channel 11 (Upper Channel)	2.412 2.437 2.462	16QAM 16QAM 16QAM	39Mbps 39Mbps 39Mbps
Channel 1 (Lower Channel) Channel 6 (Middle Channel) Channel 11 (Upper Channel)	2.412 2.437 2.462	64QAM 64QAM 64QAM	65Mbps 65Mbps 65Mbps

4. The channels as listed below, under the different configurations were tested for 802.11n(40MHz) WLAN.

<u>Transmit Channel</u>	<u>Frequency (GHz)</u>	<u>Modulation</u>	<u>Data Rate</u>
Channel 3 (Lower Channel) Channel 7 (Middle Channel) Channel 11 (Upper Channel)	2.422 2.442 2.462	BPSK BPSK BPSK	13.5Mbps 13.5Mbps 13.5Mbps
Channel 1 (Lower Channel) Channel 6 (Middle Channel) Channel 11 (Upper Channel)	2.412 2.437 2.462	QPSK QPSK QPSK	40.5Mbps 40.5Mbps 40.5Mbps
Channel 3 (Lower Channel) Channel 7 (Middle Channel) Channel 11 (Upper Channel)	2.422 2.442 2.462	16QAM 16QAM 16QAM	81Mbps 81Mbps 81Mbps
Channel 3 (Lower Channel) Channel 7 (Middle Channel) Channel 11 (Upper Channel)	2.422 2.442 2.462	64QAM 64QAM 64QAM	135Mbps 135Mbps 135Mbps

5. The EUT is a Class B device when in non-transmitting state and meets the 47 CFR FCC Part15B Class B requirements.
6. All test measurement procedures are according to ANSI C63.4: 2014, ANSI C63.10: 2013 and KDB 558074 D01 DTS Measurement Guidance V04.

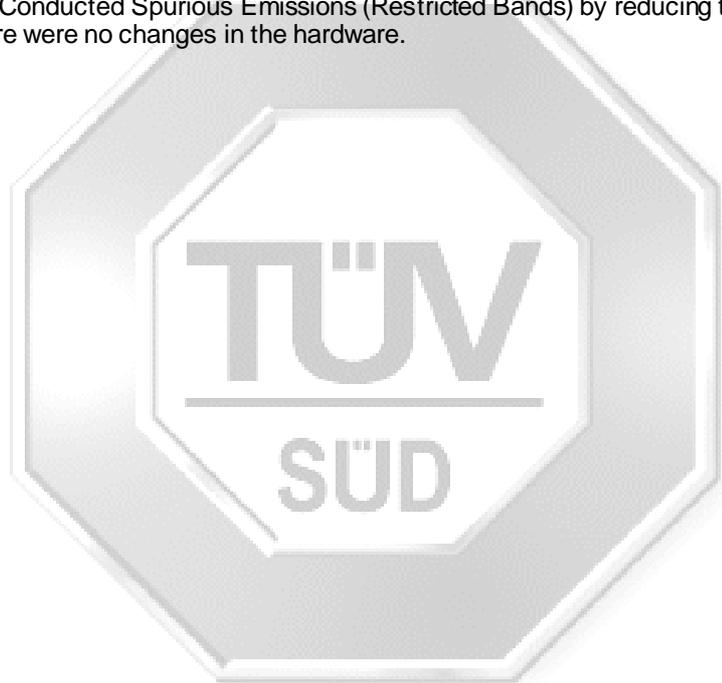


TEST SUMMARY

7. The maximum measured RF power of the Equipment Under Test is 18.6dBm.
8. The Equipment Under Test (EUT) is a battery operated device and contains no provision for public utility connections.
9. The EUT was tested using fully charged batteries with DC voltage of 12.5Vdc.

Modifications

The EUT was brought to compliance to Radiated Emissions (Spurious Emissions inclusive Restricted Bands Requirement) and RF Conducted Spurious Emissions (Restricted Bands) by reducing the transmit power in the test firmware. There were no changes in the hardware.



PRODUCT DESCRIPTION

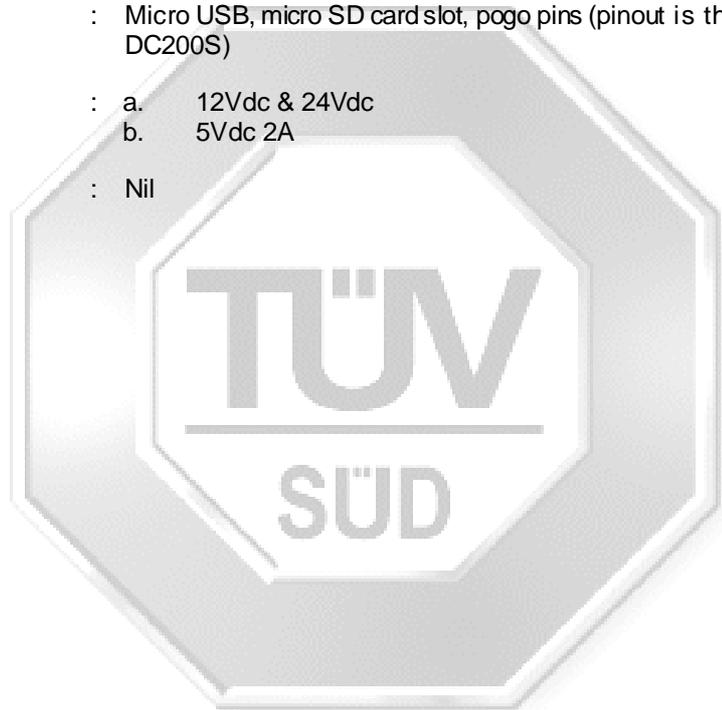
Description	: The Equipment Under Test (EUT) is an E-Log And Fleet Management Device . It consists of a. DC200S. b. Tablet.
Applicant	: A4C-RM Acquisition LLC 855 Woods Drive Skokies IL 60077, USA
Manufacturer	: PCI Limited 35 Pioneer Road North Singapore 628475
Factory (ies)	: Pt PCI Elektronik Internasional Panbil Industrial Estate Factory C Lot 2-3 Jalan Ahmad Yani, Muka Kuning, Batam 29433 Indonesia
Model Number	: DC700
FCC ID	: A4C01006A
Serial Number	: Nil
Microprocessor	: a. STMicroelectronics STM32F767ZIT6 & IC ARM CORTEXM7 STM32 32-Bit LQFP144 b. MTK8163
Operating / Transmitting Frequency	: a. PCS850 - 824MHz – 849MHz (uplink) - 869MHz – 894MHz (downlink) PCS1900 - 1850MHz – 1910MHz (uplink) - 1930MHz – 1990MHz (downlink) b. 2402MHz-2480MHz (Bluetooth) c. 2412-2462 (WLAN 802.11b/g/n)
Clock / Oscillator Frequency	: 16MHz & 1.3GHz
Modulation/ Emissions Designator	: a. PCS 850 - 300KGXW (PCS 850) b. PCS1900 - 300KGXW c. Bluetooth - Gaussian Frequency Shift Keying (GFSK) - $\pi/4$ -Differential Quadrature Phase-Shift Keying (DQPSK) - 8 Differential Phase Shift Keying (DPSK) d. WLAN: refers to note 1, 2 , 3, 4



PRODUCT DESCRIPTION

Continued

- Antenna Gain : a. DC200S
- 0.11dBi (PCS 850)
- 2.38dBi (PCS 1900)
- 3 dBi (WLAN, Bluetooth)
b. Tablet
- 2.75dBi (WLAN, Bluetooth)
- Port / Connectors : Micro USB, micro SD card slot, pogo pins (pinout is the same as mating DC200S)
- Rated Input Power : a. 12Vdc & 24Vdc
b. 5Vdc 2A
- Accessories : Nil





SUPPORTING EQUIPMENT DESCRIPTION

The EUT was tested as a stand-alone unit without any supporting equipment.



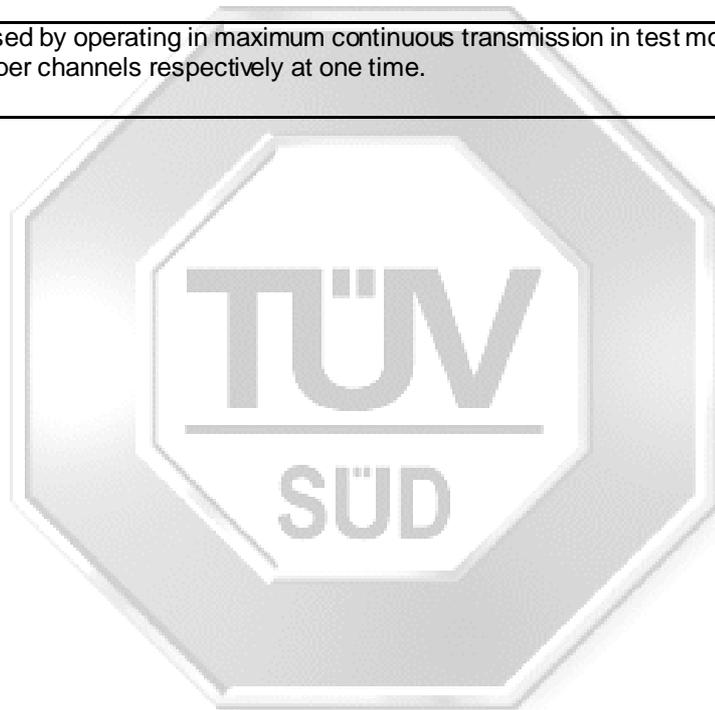


EUT OPERATING CONDITIONS

47 CFR FCC Part 15

1. Radiated Emissions (Spurious Emissions inclusive Restricted Bands Requirement)
2. Spectrum Bandwidth (6dB Bandwidth Measurement)
3. Maximum Peak Power
4. RF Conducted Spurious Emissions Emission (Non-Restricted Bands)
5. RF Conducted Spurious Emissions Emission (Restricted Bands)
6. Band Edge Compliance (Conducted)
7. Band Edge Compliance (Radiated)
8. Peak Power Spectral Density
9. Maximum Permissible Exposure

The EUT was exercised by operating in maximum continuous transmission in test mode, i.e transmitting at lower, middle and upper channels respectively at one time.





RADIATED EMISSION TEST

47 CFR FCC Part 15.205 Restricted Bands

MHz		MHz		MHz		GHz	
0.090	- 0.110	16.42	- 16.423	399.9	- 410	4.5	- 5.15
0.495	- 0.505	16.69475	- 16.69525	608	- 614	5.35	- 5.46
2.1735	- 2.1905	16.80425	- 16.80475	960	- 1240	7.25	- 7.75
4.125	- 4.128	25.5	- 25.67	1300	- 1427	8.025	- 8.5
4.17725	- 4.17775	37.5	- 38.25	1435	- 1626.5	9.0	- 9.2
4.20725	- 4.20775	73	- 74.6	1645.5	- 1646.5	9.3	- 9.5
6.215	- 6.218	74.8	- 75.2	1660	- 1710	10.6	- 12.7
6.26775	- 6.26825	108	- 121.94	1718.8	- 1722.2	13.25	- 13.4
6.31175	- 6.31225	123	- 138	2200	- 2300	14.47	- 14.5
8.291	- 8.294	149.9	- 150.05	2310	- 2390	15.35	- 16.2
8.362	- 8.366	156.52475	- 156.52525	2483.5	- 2500	17.7	- 21.4
8.37625	- 8.38675	156.7	- 156.9	2690	- 2900	22.01	- 23.12
8.41425	- 8.41475	162.0125	- 167.17	3260	- 3267	23.6	- 24.0
12.29	- 12.293	167.72	- 173.2	3332	- 3339	31.2	- 31.8
12.51975	- 12.52025	240	- 285	3345.8	- 3358	36.43	- 36.5
12.57675	- 12.57725	322	- 335.4	3600	- 4400	Above 38.6	
13.36	- 13.41						

47 CFR FCC Parts 15.109(a) and 15.209 Radiated Emission Limits

Frequency Range (MHz)	Quasi-Peak Limit Values (dBµV/m)
0.009 - 0.490	20 log [2400 / F (kHz)] @ 300m
0.490 - 1.705	20 log [24000 / F (kHz)] @ 30m
1.705 - 30.0	30.0 @ 30m
30 - 88	40.0 @ 3m
88 - 216	43.5 @ 3m
216 - 960	46.0 @ 3m
Above 960	54.0* @ 3m

* For frequency bands 9kHz – 90kHz, 110kHz – 490kHz and above 1GHz, average detector was used. A peak limit of 20dB above the average limit does apply.

47 CFR FCC Parts 15.109(a) and 15.209 Radiated Emission Test Instrumentation

Instrument	Model	S/No	Cal Due Date
R&S EMI Test Receiver	ESU40	100355	14 Sep 2018
EMCO Loop Ant (ext)_red_00134413	6502	134413	28 Oct 2017
TDK RF Solutions Hybrid Log Periodic Antenna (30MHz-3GHz)	HLP-3003C	130237	21 Oct 2018
Eletro-Metrics Double Ridged Antenna (Horn) Antenna (1-18GHz)	EM-6961	6525	08 Apr 2018
ETS Horn Antenna (18GHz-40GHz) (Ref)	3116	0004-2474	18 Oct 2018
Sonoma Preamplifier (9kHz – 1GHz)	310N	270640	27 Dec 2017
R&S Preamplifier (1GHz -18GHz)	SCU18	102191	10 Mar 2018
Agilent Preamplifier(1GHz-26.5GHz) (PA18)	8449D	3008A02305	12 Oct 2018
Toyo Preamplifier (26.5GHz-40GHz)	HAP26-40W	00000005	18 Oct 2018
Micro-tronics Bandstop Filter (2.4GHz)	BRM50701-02	007	13 Aug 2018



RADIATED EMISSION TEST

47 CFR FCC Parts 15.109(a) and 15.209 Radiated Emission Test Setup

1. The EUT and supporting equipment were set up in accordance with the requirements of the standard on top of a 1.5m X 1.0m X 0.8m high, non-metallic table for measurement up to 1GHz. For measurement above 1GHz, 1.5m height table was used.
2. The filtered power supply for the EUT and supporting equipment were tapped from the appropriate power sockets located on the turntable.
3. The relevant broadband antenna was set at the required test distance away from the EUT and supporting equipment boundary.

47 CFR FCC Parts 15.109(a) and 15.209 Radiated Emission Test Method

1. The EUT was switched on and allowed to warm up to its normal operating condition.
2. A prescan was carried out to pick the worst emission frequencies from the EUT. For EUT which is a portable device, the prescan was carried out by rotating the EUT through three orthogonal axes to determine which altitude and equipment arrangement produces such emissions.
3. The test was carried out at the selected frequency points obtained from the prescan in step 2. Maximization of the emissions, was carried out by rotating the EUT, changing the antenna polarization, and adjusting the antenna height in the following manner:
 - a. Vertical or horizontal polarisation (whichever gave the higher emission level over a full rotation of the EUT) was chosen.
 - b. The EUT was then rotated to the direction that gave the maximum emission.
 - c. Finally, the antenna height was adjusted to the height that gave the maximum emission.
4. A Quasi-peak measurement was made for that frequency point if it was less than or equal to 1GHz. For frequency point in the range of 9kHz – 90kHz, 110kHz – 490kHz and above 1GHz, both Peak and Average measurements were carried out.
5. Steps 3 and 4 were repeated for the next frequency point, until all selected frequency points were measured.
6. The frequency range covered was from the lowest radio frequency signal generated from the EUT, without going below 9kHz to 10th harmonics of the EUT fundamental frequency, using the loop antenna for frequency below 30MHz, Bi-log antenna for frequencies from 30MHz up to 1GHz, and the Horn antenna above 1GHz.

Sample Calculation Example

At 300 MHz	Q-P limit (Class B) = 46.0 dB μ V/m
Log-periodic antenna factor & cable loss at 300 MHz = 18.5 dB	
Q-P reading obtained directly from EMI Receiver = 40.0 dB μ V/m (Calibrated level including antenna factors & cable losses)	
Therefore, Q-P margin = 46.0 - 40.0 = 6.0	i.e. 6.0 dB below Q-P limit



RADIATED EMISSION TEST

47 CFR FCC Parts 15.109(a), 15.205 and 15.209 Radiated Emission Results

Test Input Power	12.5Vdc	Temperature	24°C
Test Distance	3m (<30MHz) 3m (≥30MHz – 25GHz)	Relative Humidity	60%
Modulation	802.11n(20MHz) @ 65Mbps (Worst)	Atmospheric Pressure	1030mbar
		Tested By	Kelvin Cheng / Dylan Lin

Spurious Emissions ranging from 9kHz – 30MHz (for 9kHz – 90kHz, 110kHz – 490kHz) *See Note 4

Freq (GHz)	Peak Value (dBμV/m)	Peak Limit (dBμV/m)	Peak Margin (dB)	AV Value (dBμV/m)	AV Limit (dBμV/m)	AV Margin (dB)	Height (cm)	Azimuth (Degrees)	Pol (H/V)	Ch
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Spurious Emissions ranging from 9kHz – 30MHz *See Note 4

Frequency (MHz)	Q-P Value (dBμV/m)	Q-P Limit (dBμV/m)	Q-P Margin (dB)	Height (cm)	Azimuth (Degrees)	Pol (H/V)	Channel
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Spurious Emissions ranging from 30MHz – 1GHz

Frequency (MHz)	Q-P Value (dBμV/m)	Q-P Limit (dBμV/m)	Q-P Margin (dB)	Height (cm)	Azimuth (Degrees)	Pol (H/V)	Channel (Worst)
56.5540	21.4	40.0	18.6	170	81	V	6
267.8130	34.0	46.0	12.0	100	122	H	6
332.1330	43.7	46.0	2.3	300	237	V	6
600.0160	33.4	46.0	12.6	100	0	V	6
725.9890	32.0	46.0	14.0	120	193	V	6
779.9790	36.3	46.0	9.7	100	57	V	6



RADIATED EMISSION TEST

47 CFR FCC Parts 15.109(a), 15.205 and 15.209 Radiated Emission Results

Spurious Emissions above 1GHz – 25GHz

Freq (GHz)	Peak Value (dBµV/m)	Peak Limit (dBµV/m)	Peak Margin (dB)	AV Value (dBµV/m) <small>*See Note 2</small>	AV Limit (dBµV/m)	AV Margin (dB) <small>*See Note 3</small>	Height (cm)	Azimuth (Degrees)	PoI (H/V)	Ch
1.7691	44.9	74.0	29.1	--	54.0	9.1	199	115	H	1
4.8641	49.2	74.0	24.8	--	54.0	4.8	201	78	H	1
13.8029	43.7	74.0	30.3	--	54.0	10.3	101	114	H	1
14.6361	45.0	74.0	29.0	--	54.0	9.0	199	131	V	1
16.5147	47.2	74.0	26.8	--	54.0	6.8	199	297	V	1
17.7419	48.2	74.0	25.8	--	54.0	5.8	199	221	V	1

Spurious Emissions above 1GHz – 25GHz

Freq (GHz)	Peak Value (dBµV/m)	Peak Limit (dBµV/m)	Peak Margin (dB)	AV Value (dBµV/m) <small>*See Note 2</small>	AV Limit (dBµV/m)	AV Margin (dB) <small>*See Note 3</small>	Height (cm)	Azimuth (Degrees)	PoI (H/V)	Ch
4.8277	50.0	74.0	24.0	--	54.0	4.0	199	150	H	6
4.9067	48.3	74.0	25.7	--	54.0	5.7	201	49	V	6
5.6596	49.6	74.0	24.4	--	54.0	4.4	301	54	V	6
13.7271	44.6	74.0	29.4	--	54.0	9.4	101	100	V	6
16.0451	46.5	74.0	27.5	--	54.0	7.5	199	349	V	6
17.7419	48.0	74.0	26.0	--	54.0	6.0	199	90	V	6

Spurious Emissions above 1GHz – 25GHz

Freq (GHz)	Peak Value (dBµV/m)	Peak Limit (dBµV/m)	Peak Margin (dB)	AV Value (dBµV/m) <small>*See Note 2</small>	AV Limit (dBµV/m)	AV Margin (dB) <small>*See Note 3</small>	Height (cm)	Azimuth (Degrees)	PoI (H/V)	Ch
4.9188	49.3	74.0	24.7	--	54.0	4.7	201	208	V	11
5.2467	50.8	74.0	23.2	--	54.0	3.2	301	32	V	11
5.5928	49.7	74.0	24.3	--	54.0	4.3	100	338	H	11
14.8331	45.0	74.0	29.0	--	54.0	9.0	100	270	H	11
16.6208	46.6	74.0	27.4	--	54.0	7.4	199	8	V	11
17.7570	48.6	74.0	25.4	--	54.0	5.4	199	148	V	11



RADIATED EMISSION TEST

Notes

1. All possible modes of operation were investigated. Only the worst case emissions measured, using the correct CISPR detectors, are reported. All other emissions were relatively insignificant.
2. As the measured peak shows compliance to the average limit, as such no average measurement was required.
3. The average margin indicates the margin of the measured peak value below the average limit.
4. The measurement was done at 3m. The measured results were extrapolated to the specified test limits as specified in § 15.209 (a) based on 40dB/decade.
5. "--" indicates no emissions were found and shows compliance to the limits.
6. Quasi-peak measurement was used for frequency measurement up to 1GHz. Average and peak measurements were used for emissions above 1GHz. The average measurement was done by averaging over a complete cycle of the pulse train, including the blanking interval as the pulse train duration does not exceed 0.1 second.
7. A "positive" margin indicates a PASS as it refers to the margin present below the limit line at the particular frequency. Conversely, a "negative" margin indicates a FAIL.
8. EMI receiver Resolution Bandwidth (RBW) and Video Bandwidth (VBW) settings:

<u>30MHz - 1GHz</u>	
RBW: 120kHz	VBW: 1MHz
<u>>1GHz</u>	
RBW: 1MHz	VBW: 3MHz
9. The upper frequency of radiated emission investigations was according to requirements stated in Section 15.33(a) for intentional radiators & Section 15.33(b) for unintentional radiators.
10. The channel in the table refers to the transmit channel of the EUT.
11. Radiated Emissions Measurement Uncertainty
All test measurements carried out are traceable to national standards. The uncertainty of the measurement at a confidence level of approximately 95%, with a coverage factor of 2, in the range 30MHz – 25GHz is ± 4.0 dB.



SPECTRUM BANDWIDTH (6dB BANDWIDTH MEASUREMENT) TEST

47 CFR FCC Part 15.247(a)(2) Spectrum Bandwidth (6dB Bandwidth Measurement) Limits

The EUT shows compliance to the requirements of this section, which states that the minimum bandwidth of the EUT employing digital modulation techniques shall be at least 500kHz.

47 CFR FCC Part 15.247(a)(2) Spectrum Bandwidth (6dB Bandwidth Measurement) Test Instrumentation

Instrument	Model	S/No	Cal Due Date
Agilent Spectrum Analyzer	E4440A	MY45304764	04 Jan 2018
BK Precision Multi Range DC Power Supply	9111	459G14131	23 Nov 2017

47 CFR FCC Part 15.247(a)(2) Spectrum Bandwidth (6dB Bandwidth Measurement) Test Setup

1. The EUT and supporting equipment were set up as shown in the setup photo.
2. The power supply for the EUT was connected to a filtered mains.
3. The RF antenna connector was connected to the spectrum analyser via a low-loss coaxial cable.
4. The resolution bandwidth (RBW) and the video bandwidth (VBW) of the spectrum analyser were respectively set to the following:
RBW = 100kHz
VBW = 3 times RBW
5. All other supporting equipment were powered separately from another filtered mains.

47 CFR FCC Part 15.247(a)(2) Spectrum Bandwidth (6dB Bandwidth Measurement) Test Method

1. The EUT was switched on and allowed to warm up to its normal operating condition. The EUT was then configured to operate in the test mode at lower channel with specified modulation and data rate.
2. The center frequency of the spectrum analyser was set to the transmitting frequency with the frequency span wide enough to capture the 6dB bandwidth of the transmitting frequency.
3. The spectrum analyser was set to max hold to capture the transmitting frequency. The signal capturing was continuous until no further changes were observed.
4. The peak of the transmitting frequency was detected with the marker peak function of the spectrum analyser. The frequencies below the 6dB peak frequency at lower (f_L) and upper (f_H) sides of the transmitting frequency were marked and measured by using the marker-delta function of the spectrum analyser.
5. The 6dB bandwidth of the transmitting frequency is the frequency difference between the marked lower and upper frequencies, $|f_H - f_L|$.
6. Repeat steps 1 to 5 with all possible modulations and data rates.
7. The steps 2 to 6 were repeated with the transmitting frequency was set to middle and upper channel respectively.



SPECTRUM BANDWIDTH (6dB BANDWIDTH MEASUREMENT) TEST

47 CFR FCC Part 15.247(a)(2) Spectrum Bandwidth (6dB Bandwidth Measurement) Results

Test Input Power	12.5Vdc	Temperature	24°C
Attached Plots	1 – 45	Relative Humidity	60%
		Atmospheric Pressure	1030mbar
		Tested By	Chang Wai Kit

802.11b

Channel	Channel Frequency (GHz)	6dB Bandwidth (MHz)	Limit (MHz)	Modulation @ Data Rate
1 (<i>lower ch</i>)	2.412	8.539	≥ 500	DBPSK @ 1Mbps
		8.788	≥ 500	DQPSK @ 2Mbps
		8.703	≥ 500	CCK @ 11Mbps
6 (<i>mid ch</i>)	2.437	9.128	≥ 500	DBPSK @ 1Mbps
		9.831	≥ 500	DQPSK @ 2Mbps
		9.473	≥ 500	CCK @ 11Mbps
11 (<i>upper ch</i>)	2.462	9.111	≥ 500	DBPSK @ 1Mbps
		9.125	≥ 500	DQPSK @ 2Mbps
		9.186	≥ 500	CCK @ 11Mbps

802.11g

Channel	Channel Frequency (GHz)	6dB Bandwidth (MHz)	Limit (MHz)	Modulation @ Data Rate
1 (<i>lower ch</i>)	2.412	16.115	≥ 500	BPSK @ 9Mbps
		16.023	≥ 500	QPSK @ 18Mbps
		16.130	≥ 500	16QAM @ 36Mbps
		15.069	≥ 500	64QAM @ 54Mbps
6 (<i>mid ch</i>)	2.437	16.363	≥ 500	BPSK @ 9Mbps
		16.371	≥ 500	QPSK @ 18Mbps
		16.345	≥ 500	16QAM @ 36Mbps
		16.438	≥ 500	64QAM @ 54Mbps
11 (<i>upper ch</i>)	2.462	16.311	≥ 500	BPSK @ 9Mbps
		16.318	≥ 500	QPSK @ 18Mbps
		16.342	≥ 500	16QAM @ 36Mbps
		16.416	≥ 500	64QAM @ 54Mbps



SPECTRUM BANDWIDTH (6dB BANDWIDTH MEASUREMENT) TEST

47 CFR FCC Part 15.247(a)(2) Spectrum Bandwidth (6dB Bandwidth Measurement) Results

802.11n (20MHz)

Channel	Channel Frequency (GHz)	6dB Bandwidth (MHz)	Limit (MHz)	Modulation @ Data Rate
1 (lower ch)	2.412	17.369	≥ 500	BPSK @ 6.5Mbps
		17.330	≥ 500	QPSK @ 19.5Mbps
		16.033	≥ 500	16QAM @ 39Mbps
		17.256	≥ 500	64QAM @ 65Mbps
6 (mid ch)	2.437	17.588	≥ 500	BPSK @ 6.5Mbps
		17.667	≥ 500	QPSK @ 19.5Mbps
		17.634	≥ 500	16QAM @ 39Mbps
		17.596	≥ 500	64QAM @ 65Mbps
11 (upper ch)	2.462	17.581	≥ 500	BPSK @ 6.5Mbps
		17.624	≥ 500	QPSK @ 19.5Mbps
		17.603	≥ 500	16QAM @ 39Mbps
		17.568	≥ 500	64QAM @ 65Mbps

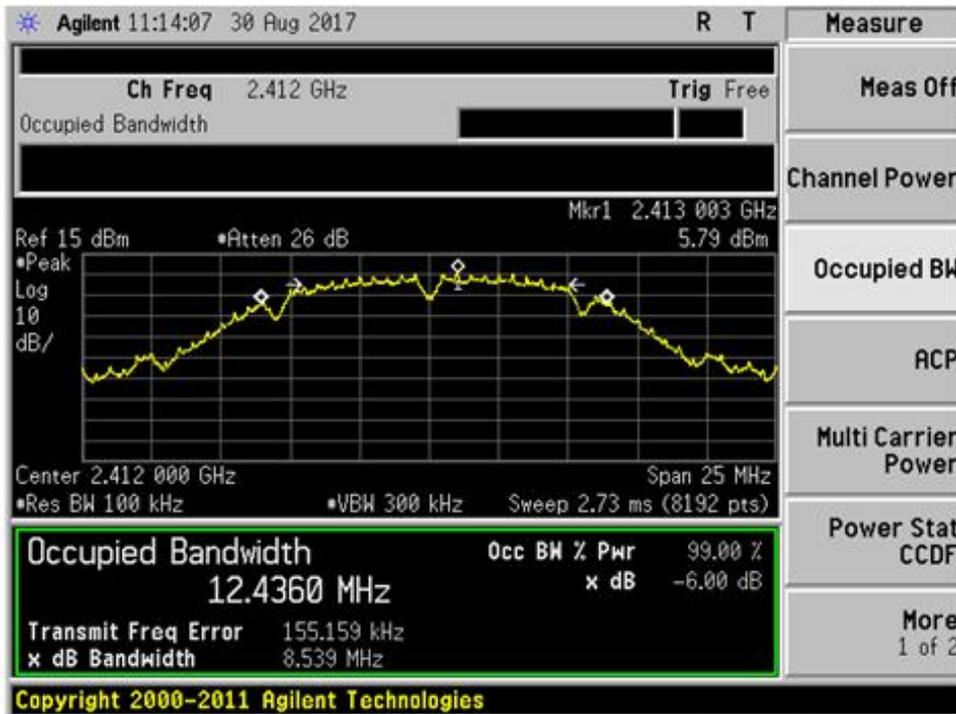
802.11n (40MHz)

Channel	Channel Frequency (GHz)	6dB Bandwidth (MHz)	Limit (MHz)	Modulation @ Data Rate
3 (lower ch)	2.422	34.807	≥ 500	BPSK @ 13.5Mbps
		33.862	≥ 500	QPSK @ 40.5Mbps
		35.028	≥ 500	16QAM @ 81Mbps
		35.090	≥ 500	64QAM @ 135Mbps
7 (mid ch)	2.442	36.340	≥ 500	BPSK @ 13.5Mbps
		35.161	≥ 500	QPSK @ 40.5Mbps
		35.417	≥ 500	16QAM @ 81Mbps
		35.420	≥ 500	64QAM @ 135Mbps
11 (upper ch)	2.462	35.690	≥ 500	BPSK @ 13.5Mbps
		35.126	≥ 500	QPSK @ 40.5Mbps
		35.411	≥ 500	16QAM @ 81Mbps
		35.122	≥ 500	64QAM @ 135Mbps



SPECTRUM BANDWIDTH (6dB BANDWIDTH MEASUREMENT) TEST

Spectrum Bandwidth (6dB Bandwidth Measurement) Plots – 802.11b



Plot 1 - Channel 1 (lower ch) @DBPSK 1Mbps

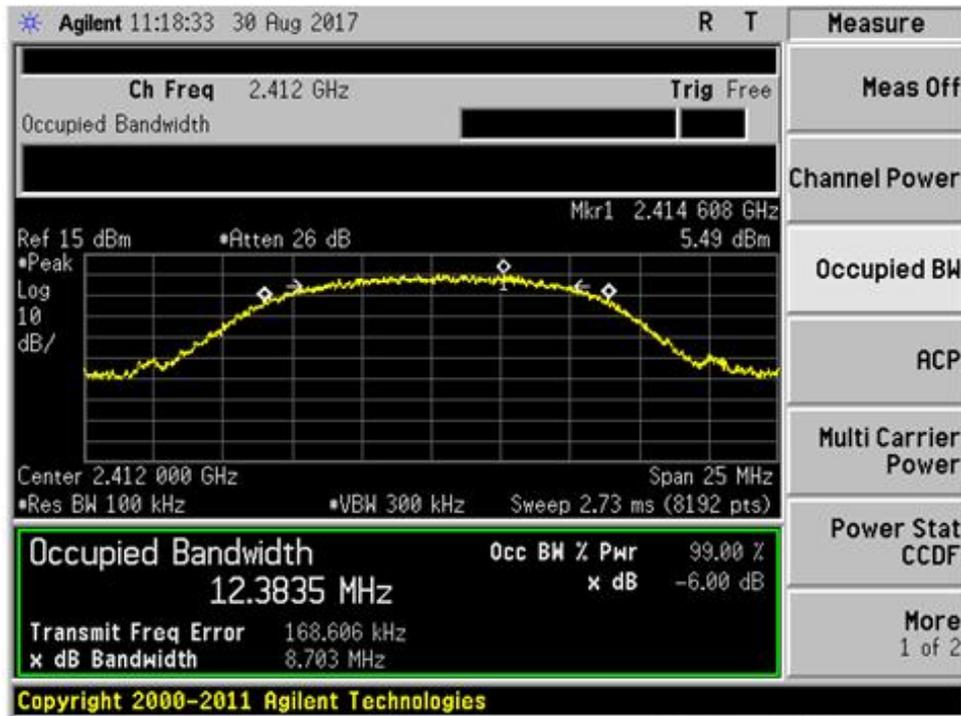


Plot 2 - Channel 1 (lower ch) @DQPSK 2Mbps



SPECTRUM BANDWIDTH (6dB BANDWIDTH MEASUREMENT) TEST

Spectrum Bandwidth (6dB Bandwidth Measurement) Plots – 802.11b

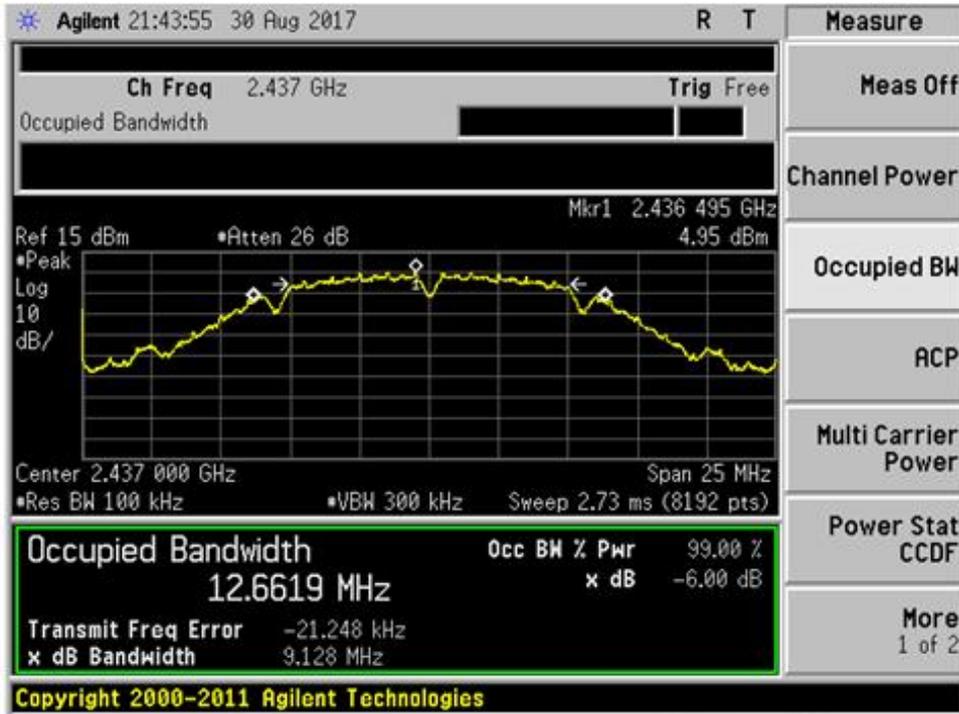


Plot 3 - Channel 1 (lower ch) @ CCK 11Mbps

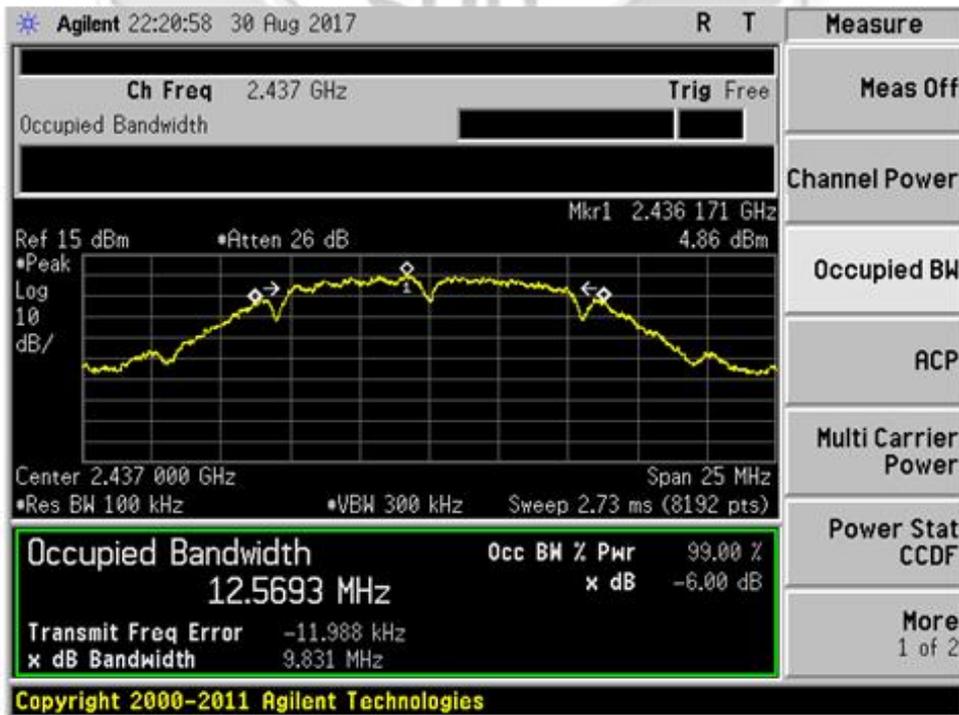


SPECTRUM BANDWIDTH (6dB BANDWIDTH MEASUREMENT) TEST

Spectrum Bandwidth (6dB Bandwidth Measurement) Plots – 802.11b



Plot 4 - Channel 6 (middle ch) @DBPSK 1Mbps

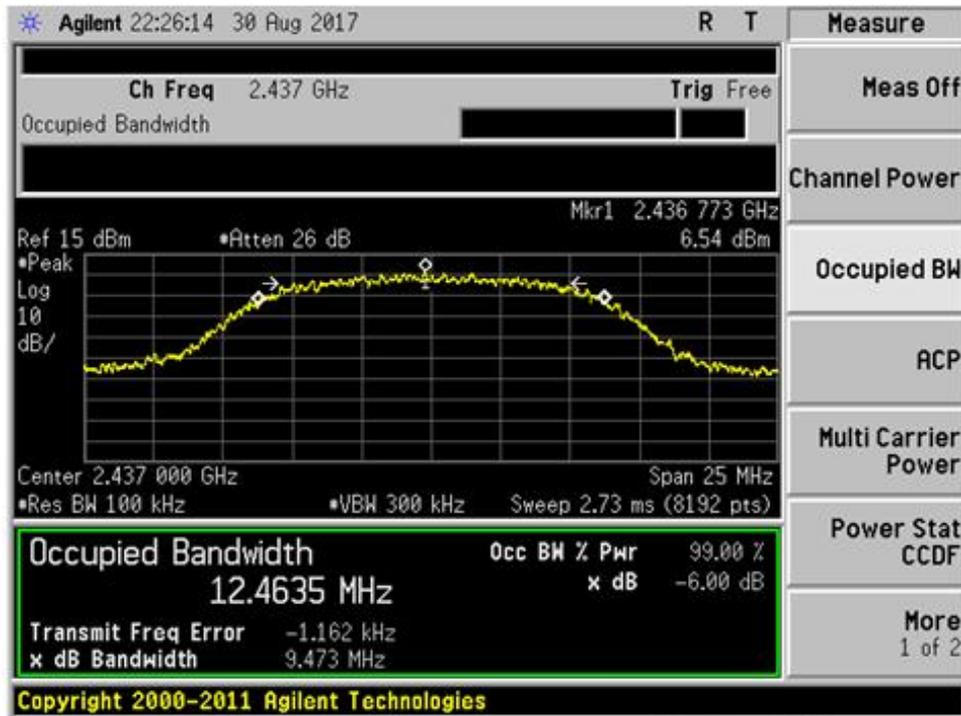


Plot 5 - Channel 6 (middle ch) @DQPSK 2Mbps



SPECTRUM BANDWIDTH (6dB BANDWIDTH MEASUREMENT) TEST

Spectrum Bandwidth (6dB Bandwidth Measurement) Plots – 802.11b

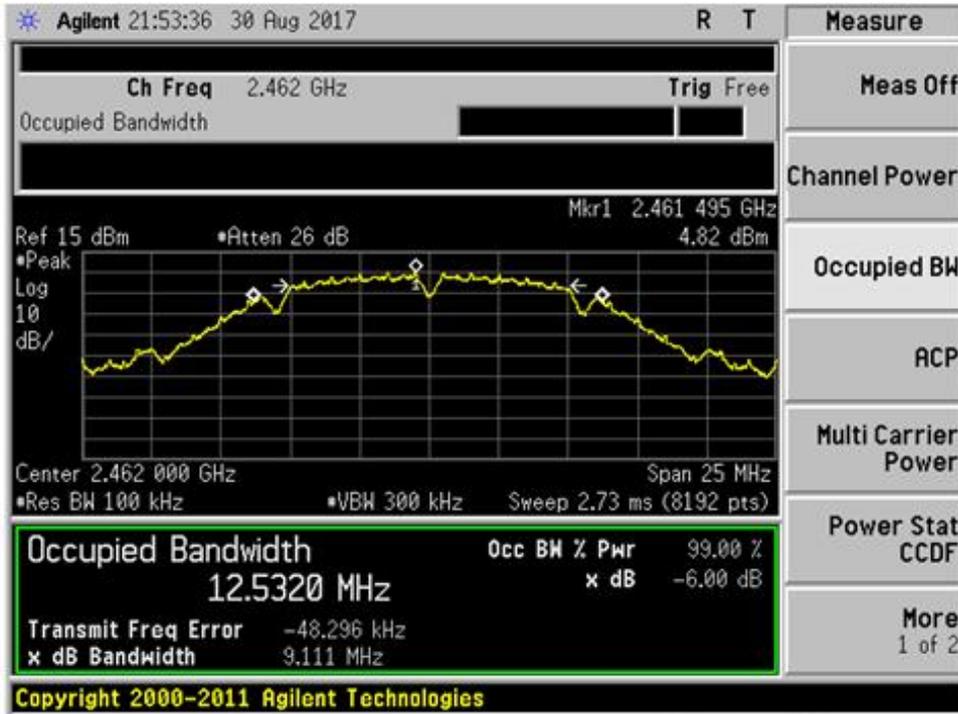


Plot 6 - Channel 6 (middle ch) @CCK 11Mbps



SPECTRUM BANDWIDTH (6dB BANDWIDTH MEASUREMENT) TEST

Spectrum Bandwidth (6dB Bandwidth Measurement) Plots – 802.11b



Plot 7 - Channel 11 (upper ch) @DBPSK 1Mbps

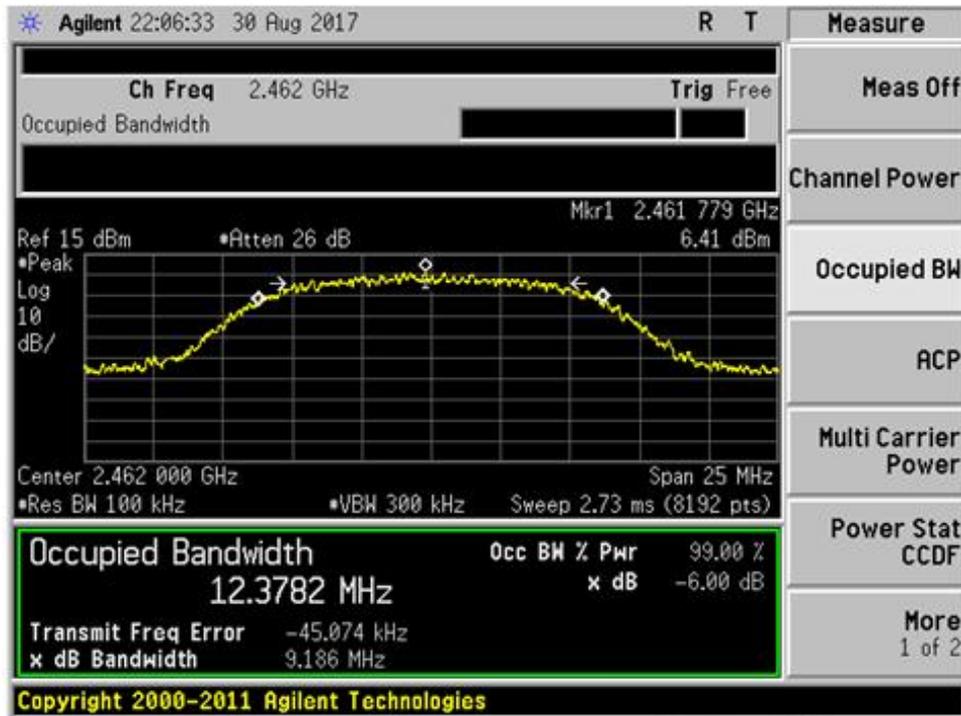


Plot 8 - Channel 11 (upper ch) @DQPSK 2Mbps



SPECTRUM BANDWIDTH (6dB BANDWIDTH MEASUREMENT) TEST

Spectrum Bandwidth (6dB Bandwidth Measurement) Plots – 802.11b

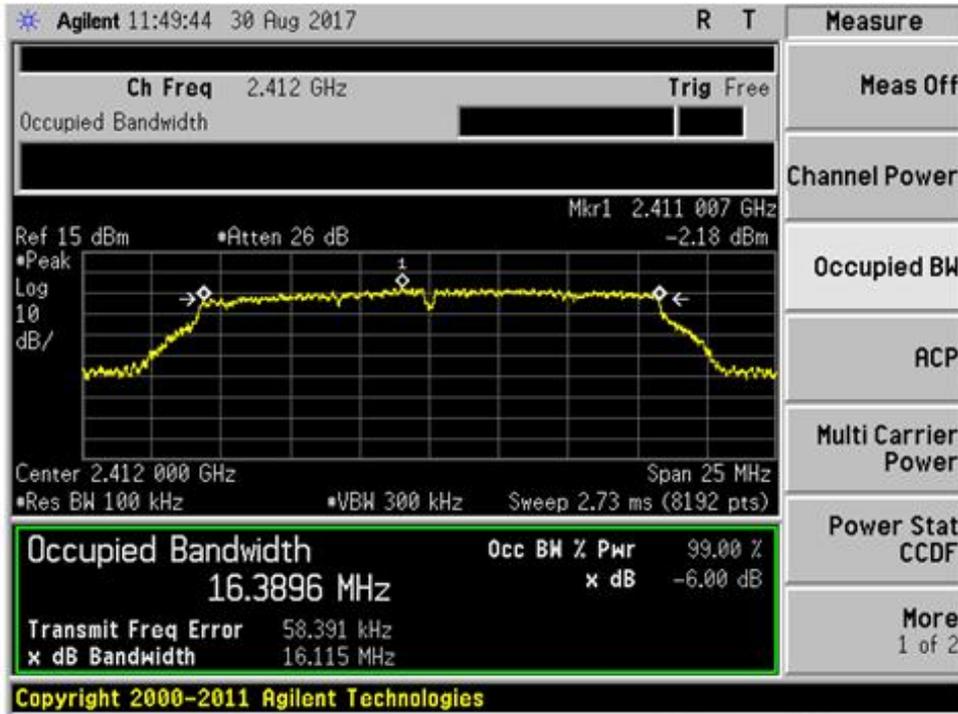


Plot 9 - Channel 11 (upper ch) @CCK 11Mbps

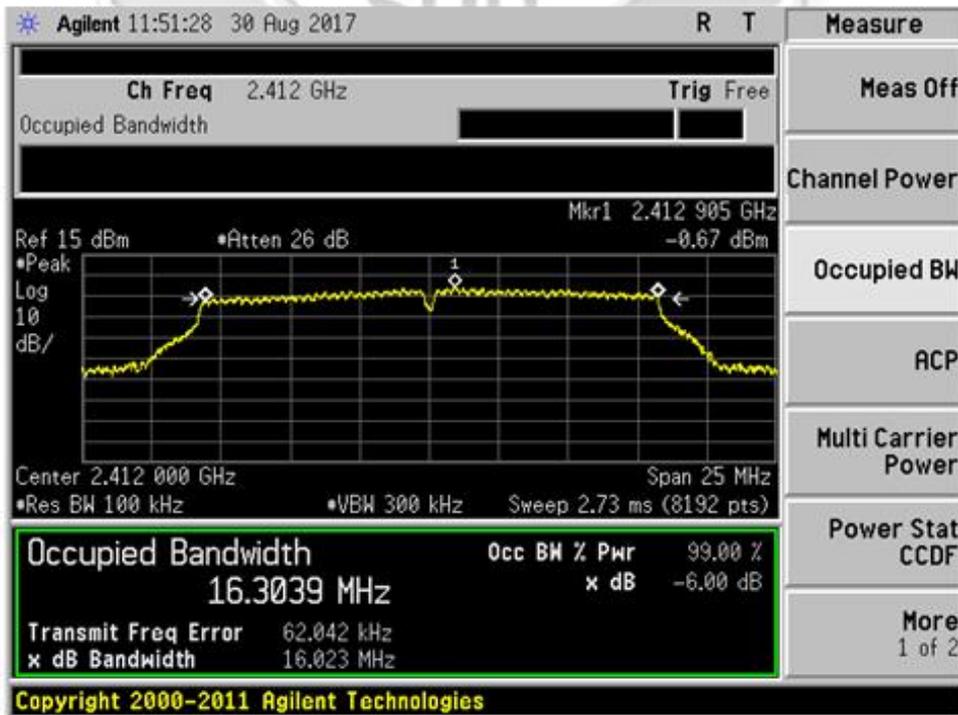


SPECTRUM BANDWIDTH (6dB BANDWIDTH MEASUREMENT) TEST

Spectrum Bandwidth (6dB Bandwidth Measurement) Plots – 802.11g



Plot 10 - Channel 1 (lower ch) @BPSK 9Mbps

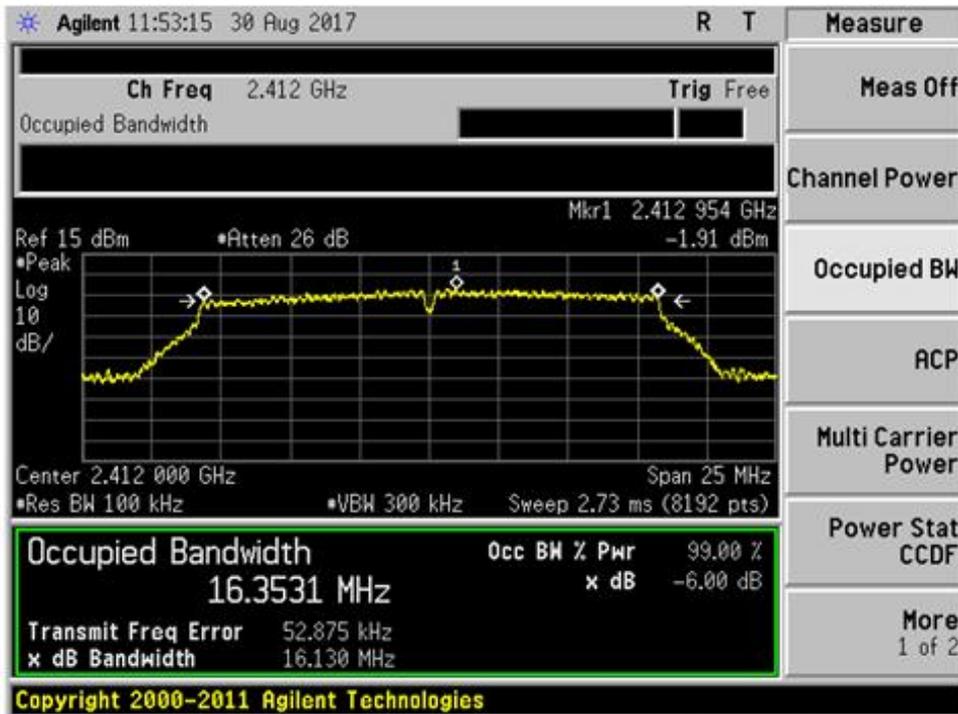


Plot 11 - Channel 1 (lower ch) @QPSK 18Mbps

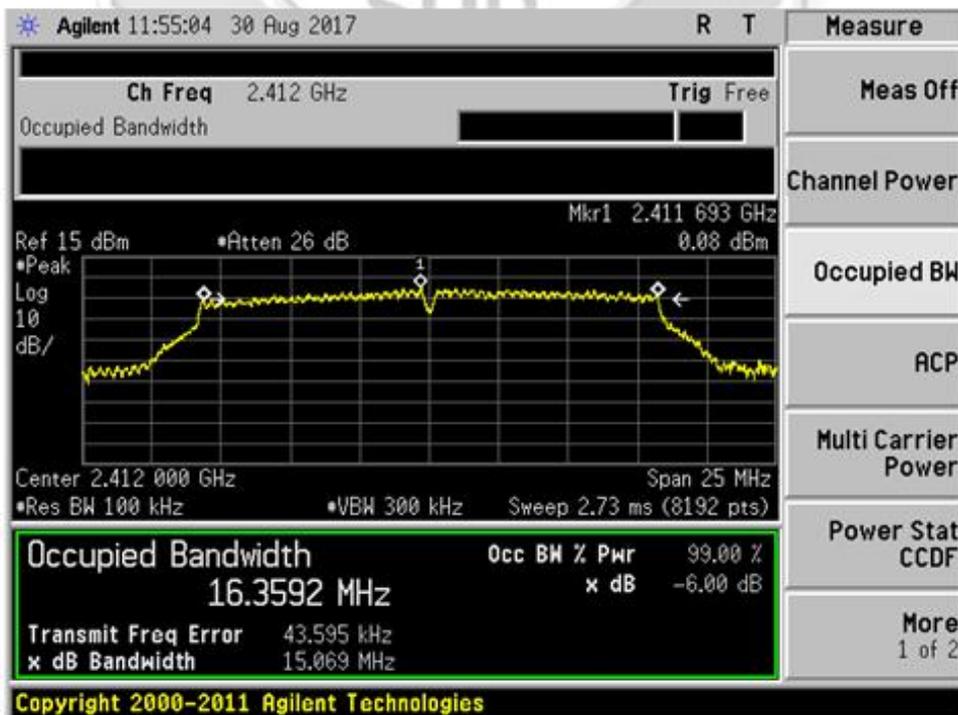


SPECTRUM BANDWIDTH (6dB BANDWIDTH MEASUREMENT) TEST

Spectrum Bandwidth (6dB Bandwidth Measurement) Plots – 802.11g



Plot 12 - Channel 1 (lower ch) @16QAM 36Mbps

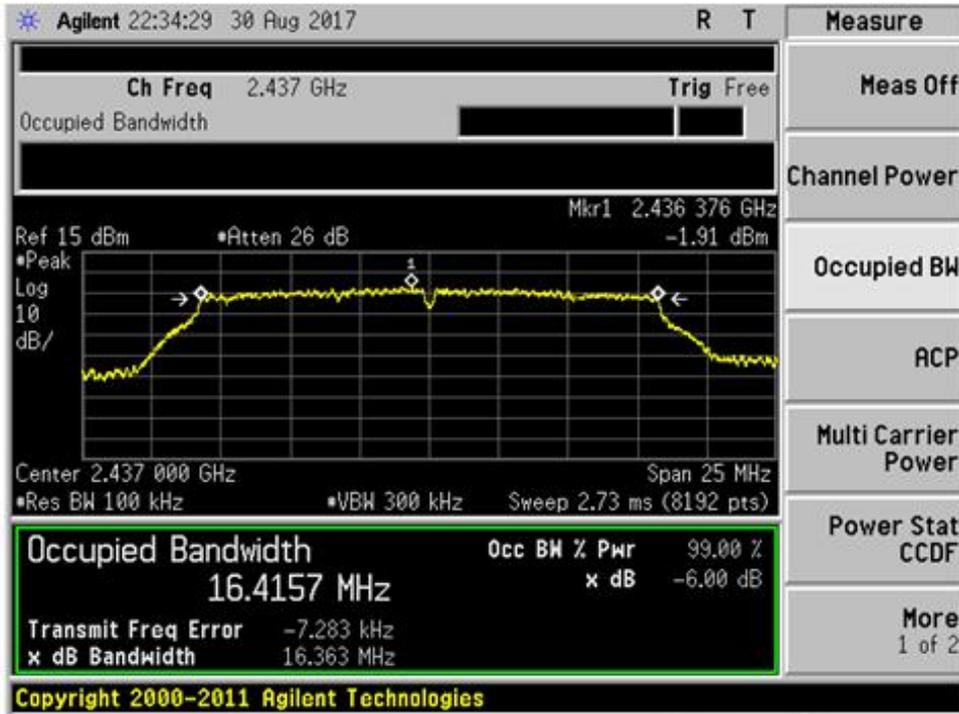


Plot 13 - Channel 1 (lower ch) @64QAM 54Mbps

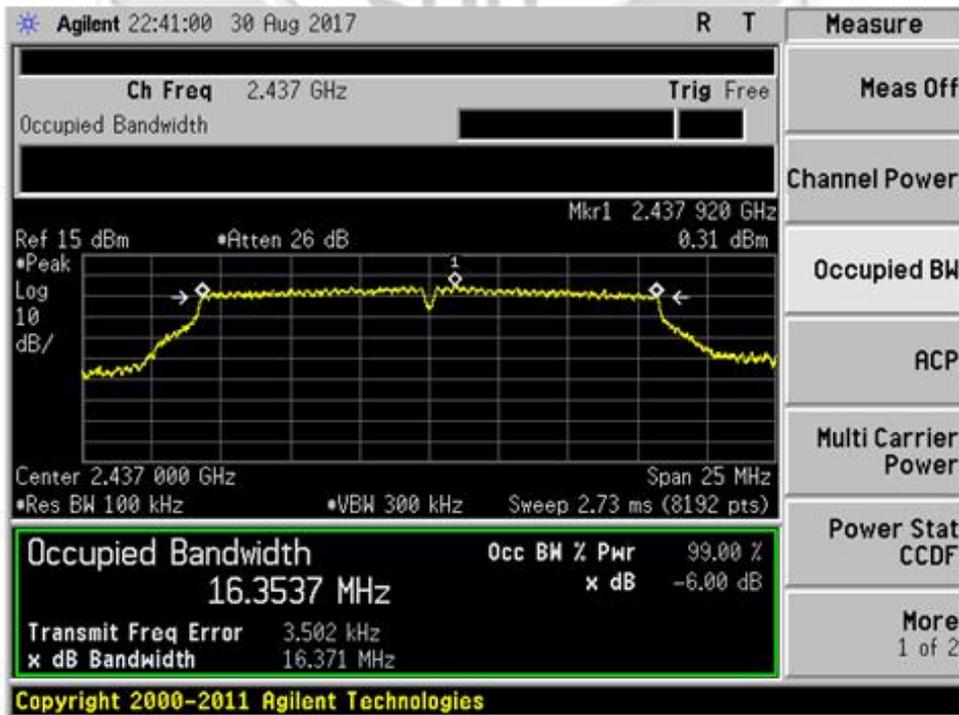


SPECTRUM BANDWIDTH (6dB BANDWIDTH MEASUREMENT) TEST

Spectrum Bandwidth (6dB Bandwidth Measurement) Plots – 802.11g



Plot 14 - Channel 6 (middle ch) @BPSK 9Mbps

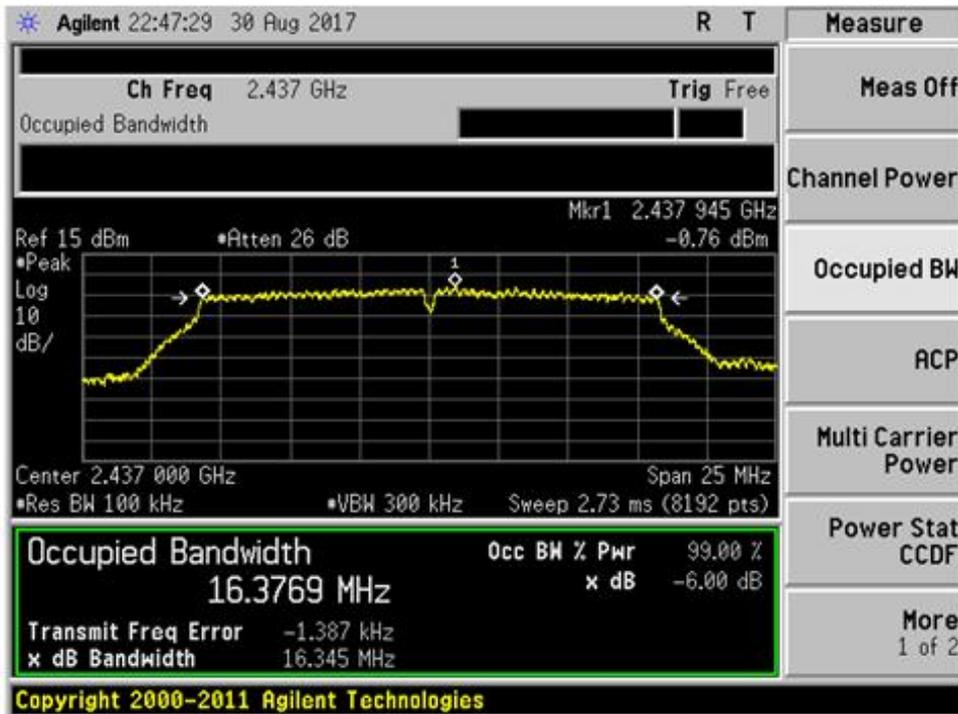


Plot 15 - Channel 6 (middle ch) @QPSK 18Mbps



SPECTRUM BANDWIDTH (6dB BANDWIDTH MEASUREMENT) TEST

Spectrum Bandwidth (6dB Bandwidth Measurement) Plots – 802.11g



Plot 16 - Channel 6 (middle ch) @16QAM 36Mbps

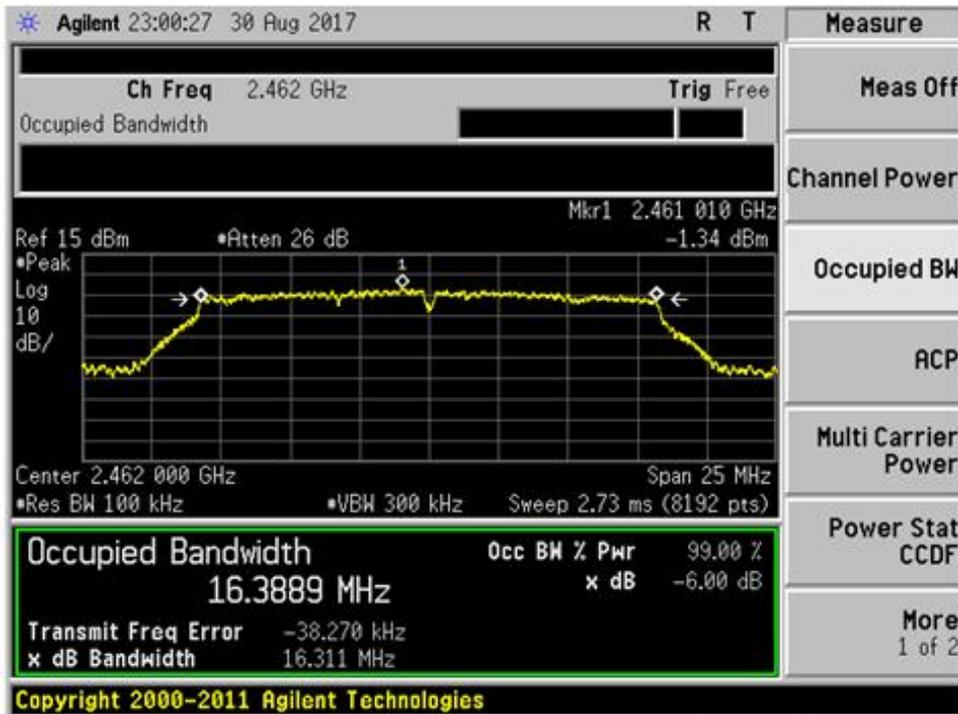


Plot 17 - Channel 6 (middle ch) @64QAM 54Mbps

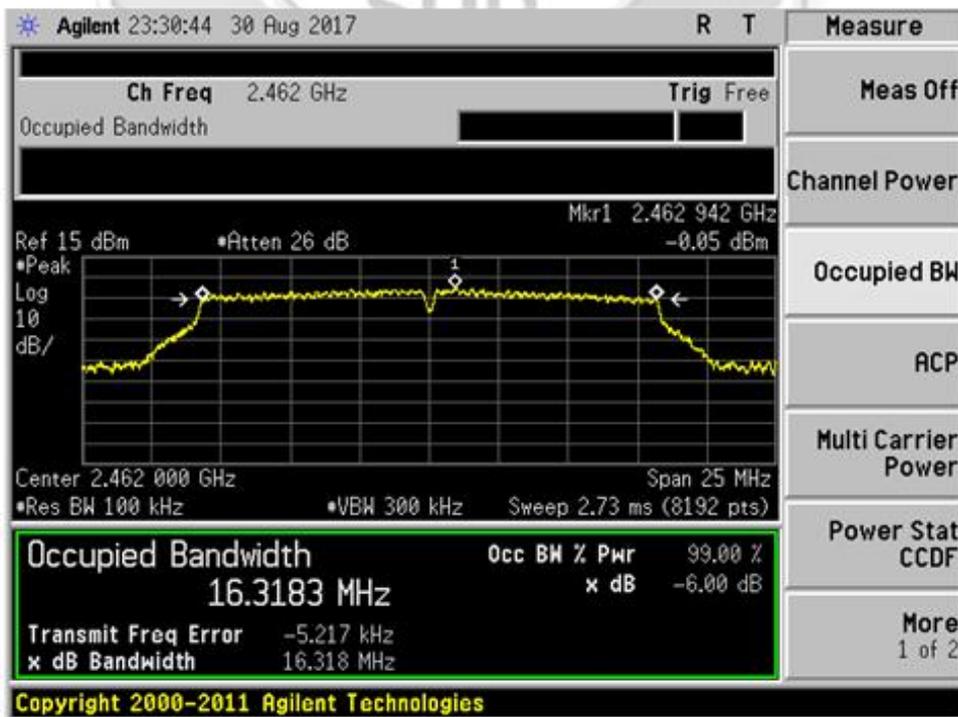


SPECTRUM BANDWIDTH (6dB BANDWIDTH MEASUREMENT) TEST

Spectrum Bandwidth (6dB Bandwidth Measurement) Plots – 802.11g



Plot 18 - Channel 11 (upper ch) @BPSK 9Mbps

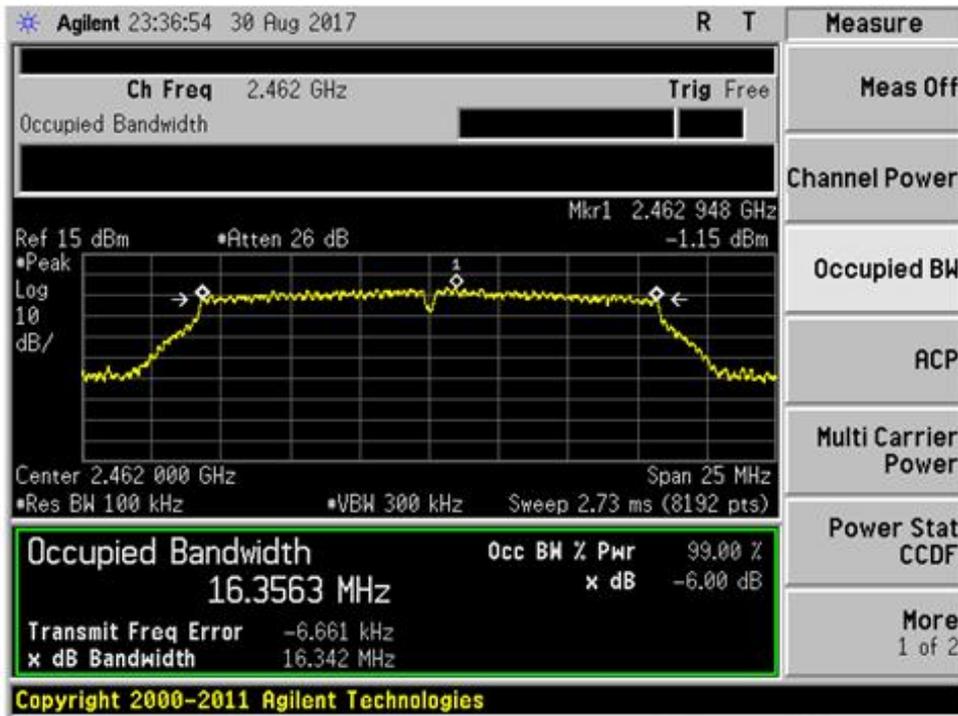


Plot 19 - Channel 11 (upper ch) @QPSK 18Mbps



SPECTRUM BANDWIDTH (6dB BANDWIDTH MEASUREMENT) TEST

Spectrum Bandwidth (6dB Bandwidth Measurement) Plots – 802.11g



Plot 20 - Channel 11 (upper ch) @16QAM 36Mbps

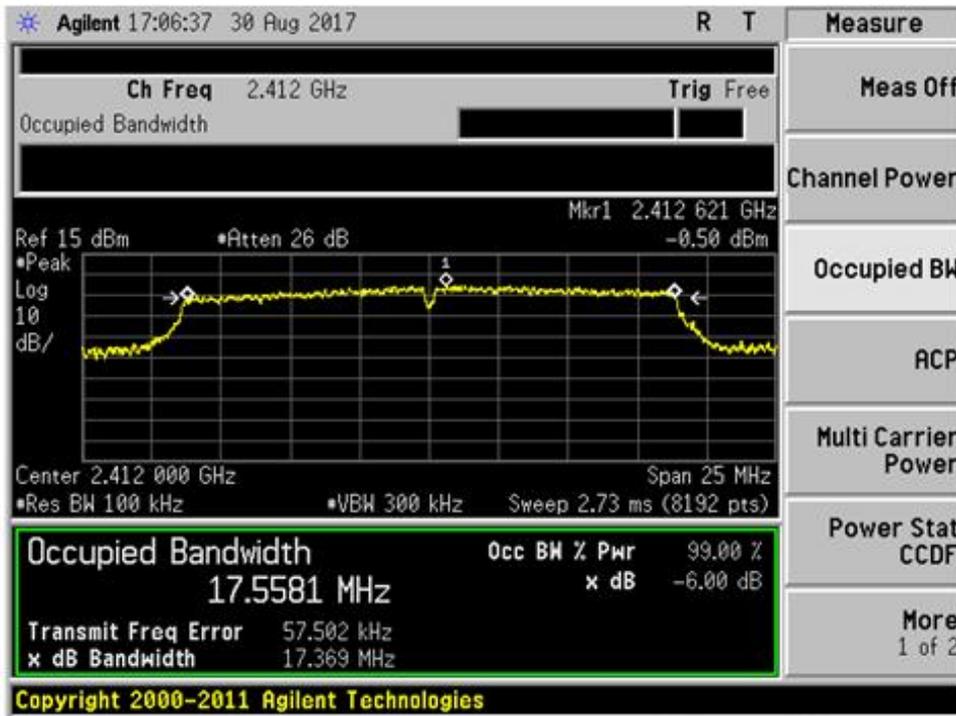


Plot 21 - Channel 11 (upper ch) @64QAM 54Mbps

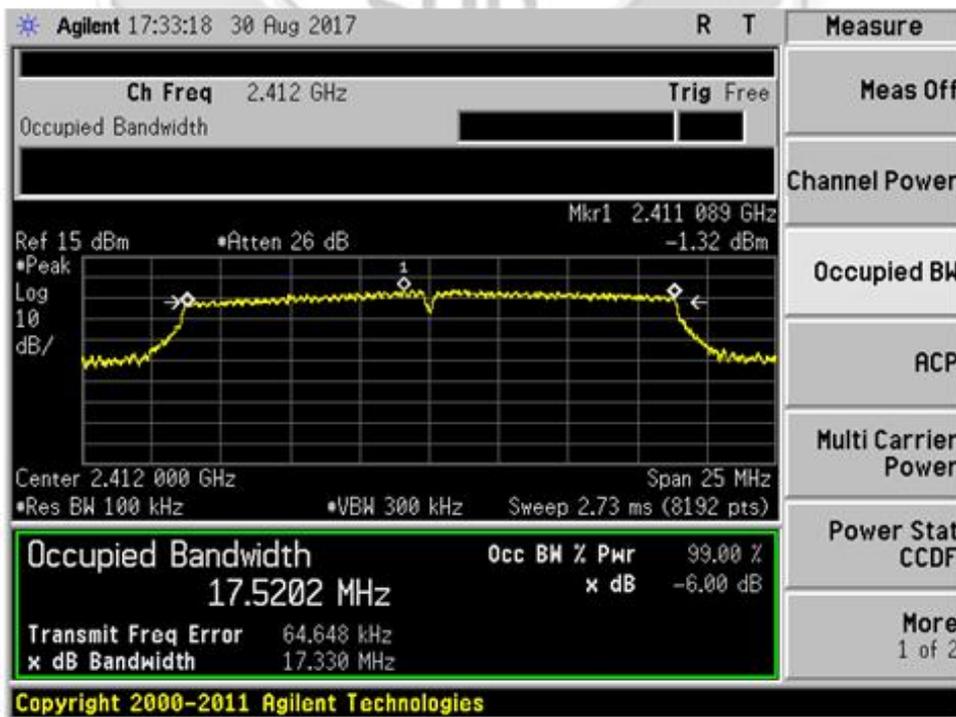


SPECTRUM BANDWIDTH (6dB BANDWIDTH MEASUREMENT) TEST

Spectrum Bandwidth (6dB Bandwidth Measurement) Plots – 802.11n (20MHz)



Plot 22 - Channel 1 (lower ch) @BPSK 6.5Mbps

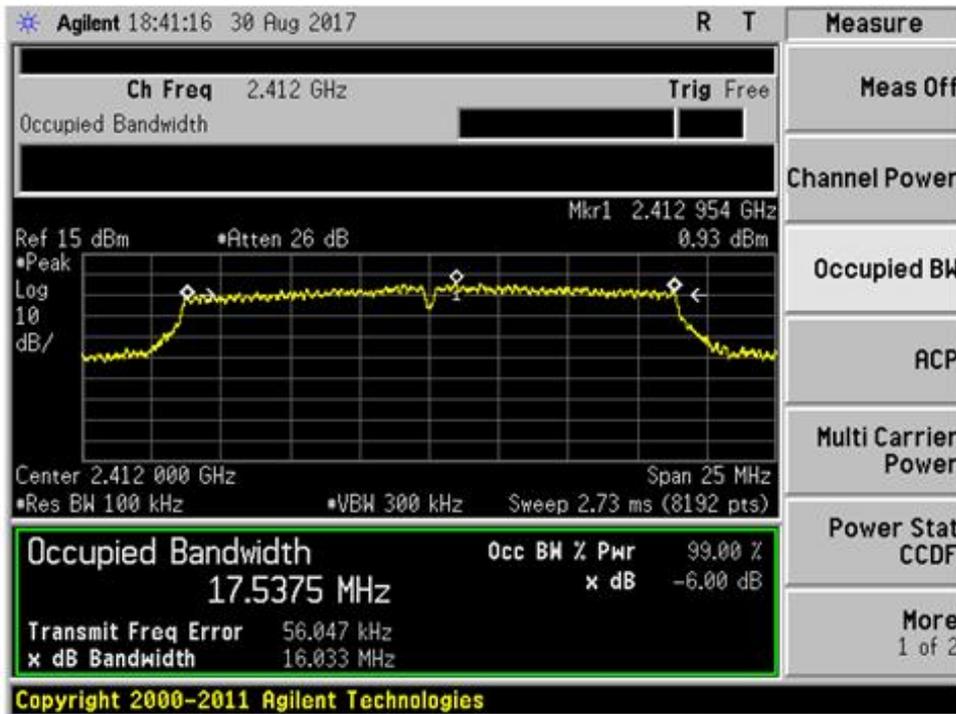


Plot 23 - Channel 1 (lower ch) @QPSK 19.5Mbps

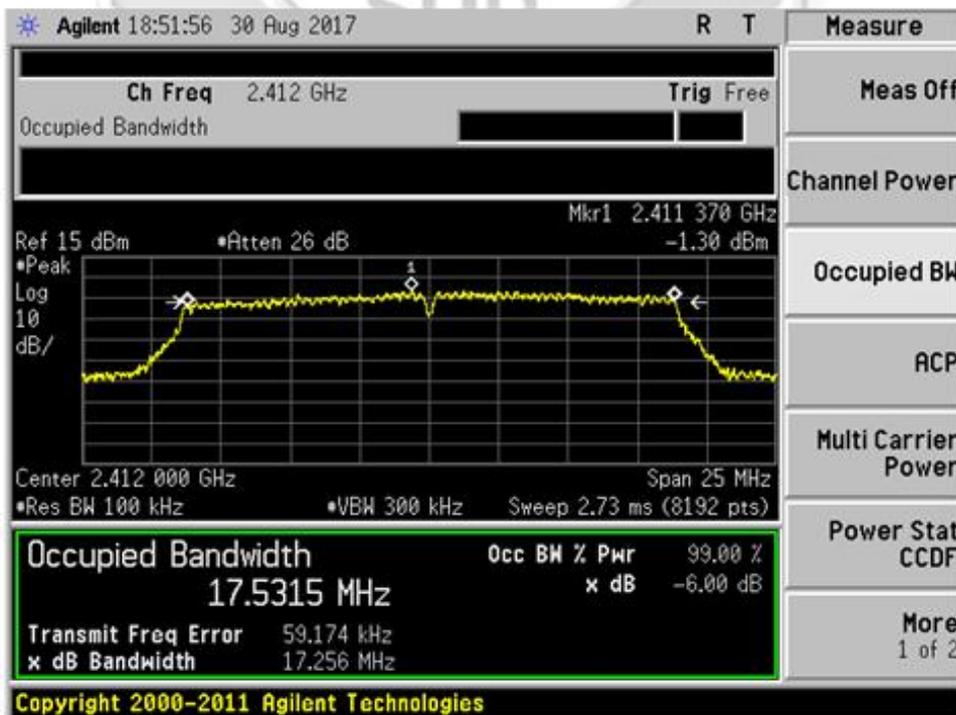


SPECTRUM BANDWIDTH (6dB BANDWIDTH MEASUREMENT) TEST

Spectrum Bandwidth (6dB Bandwidth Measurement) Plots – 802.11n (20MHz)



Plot 24 - Channel 1 (lower ch) @16QAM 39Mbps

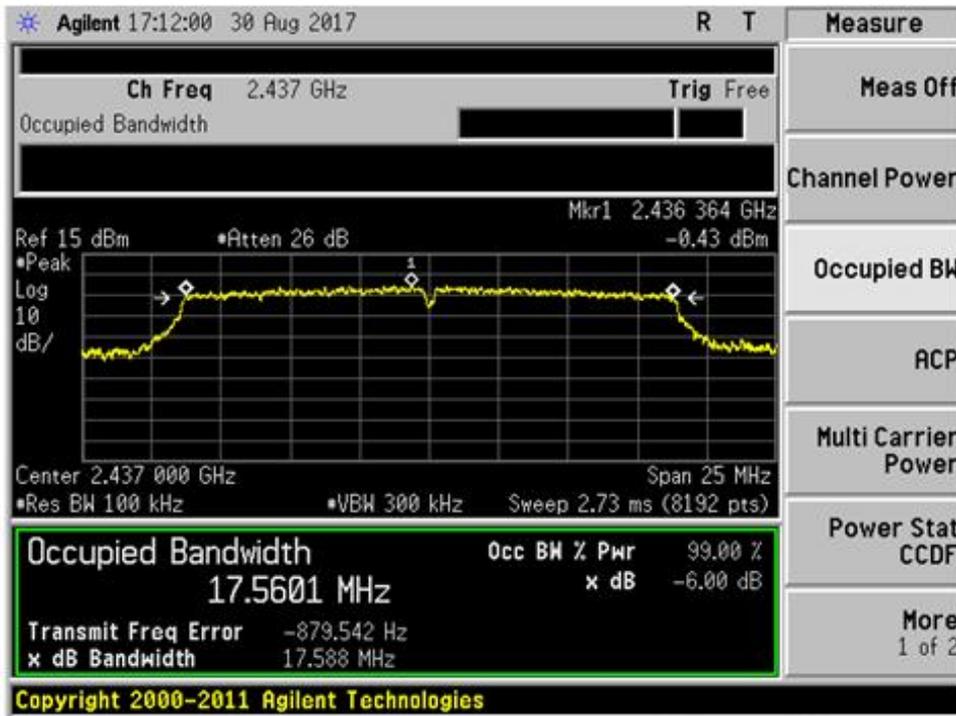


Plot 25 - Channel 1 (lower ch) @64QAM 65Mbps

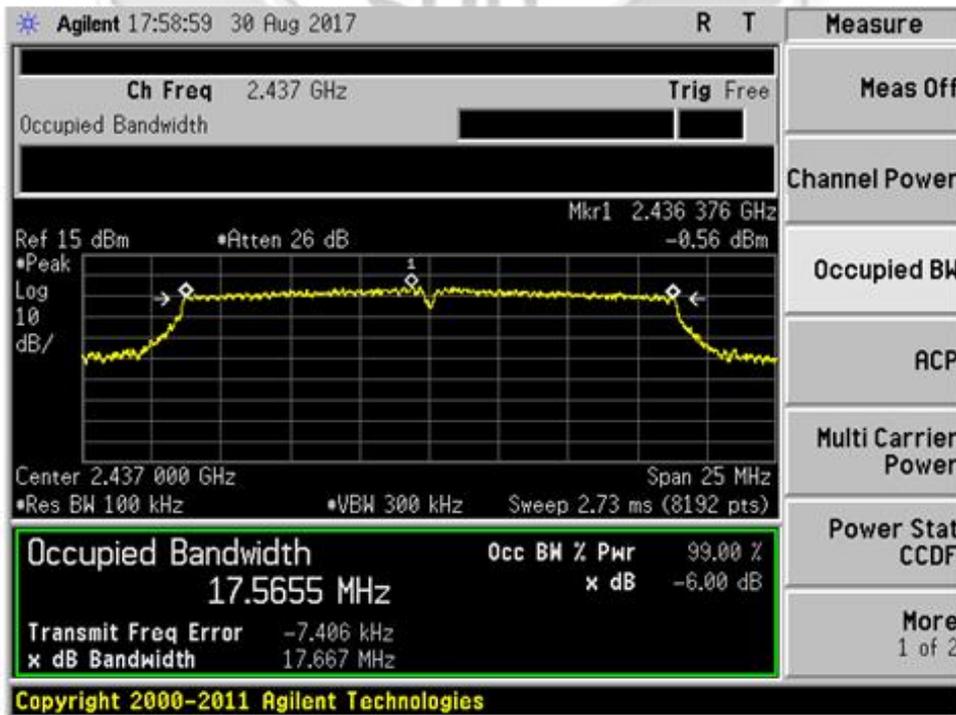


SPECTRUM BANDWIDTH (6dB BANDWIDTH MEASUREMENT) TEST

Spectrum Bandwidth (6dB Bandwidth Measurement) Plots – 802.11n (20MHz)



Plot 26 - Channel 6 (middle ch) @BPSK 6.5Mbps

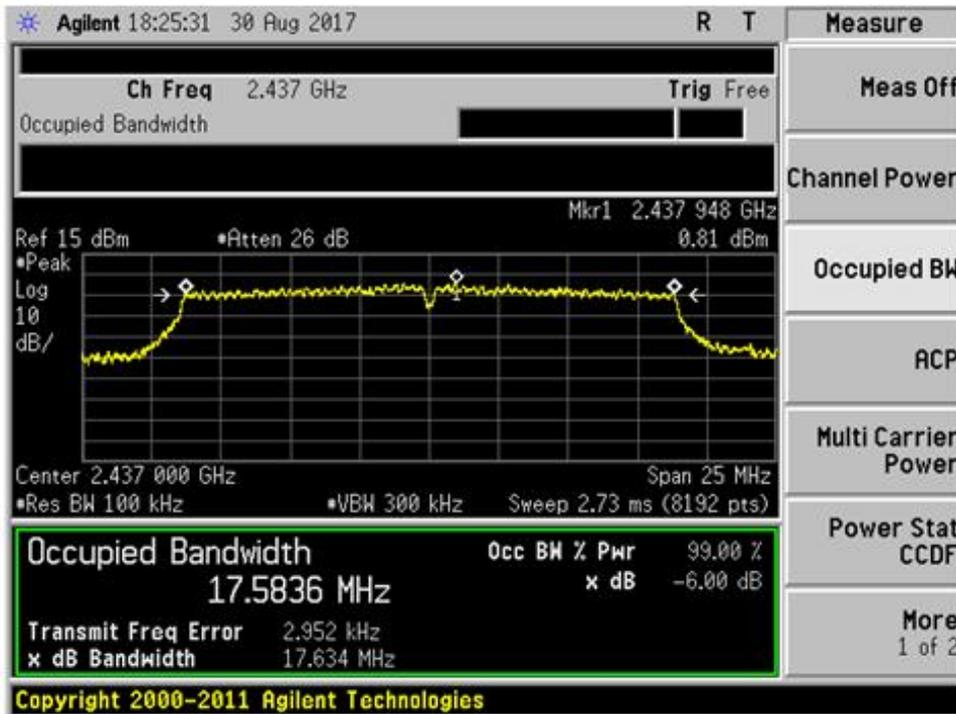


Plot 27 - Channel 6 (middle ch) @QPSK 19.5Mbps

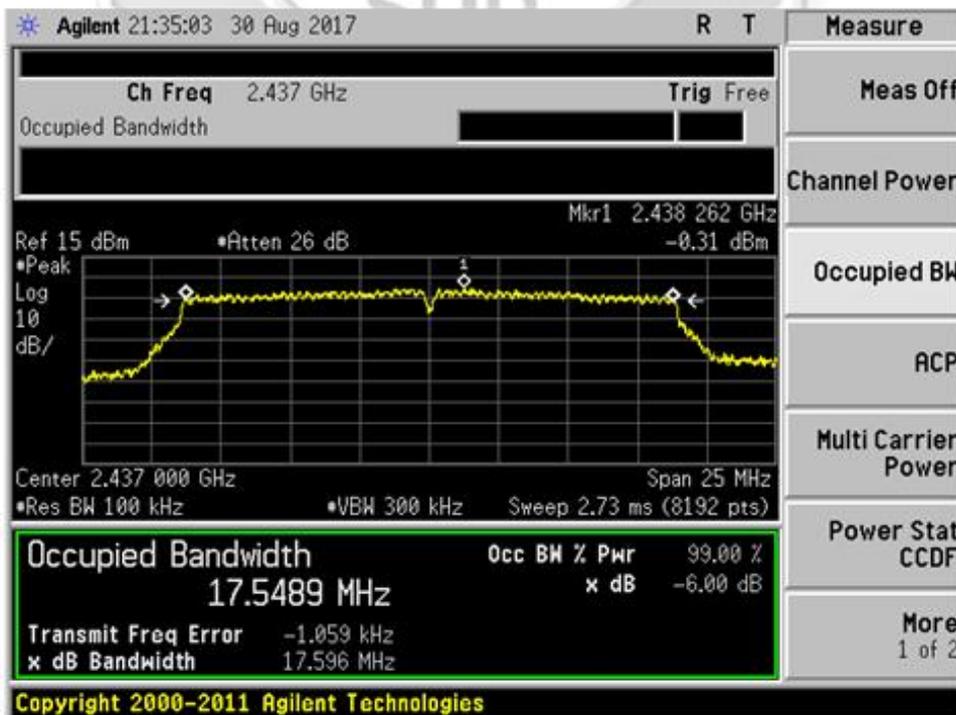


SPECTRUM BANDWIDTH (6dB BANDWIDTH MEASUREMENT) TEST

Spectrum Bandwidth (6dB Bandwidth Measurement) Plots – 802.11n (20MHz)



Plot 28 - Channel 6 (middle ch) @16QAM 39Mbps



Plot 29 - Channel 6 (middle ch) @64QAM 65Mbps

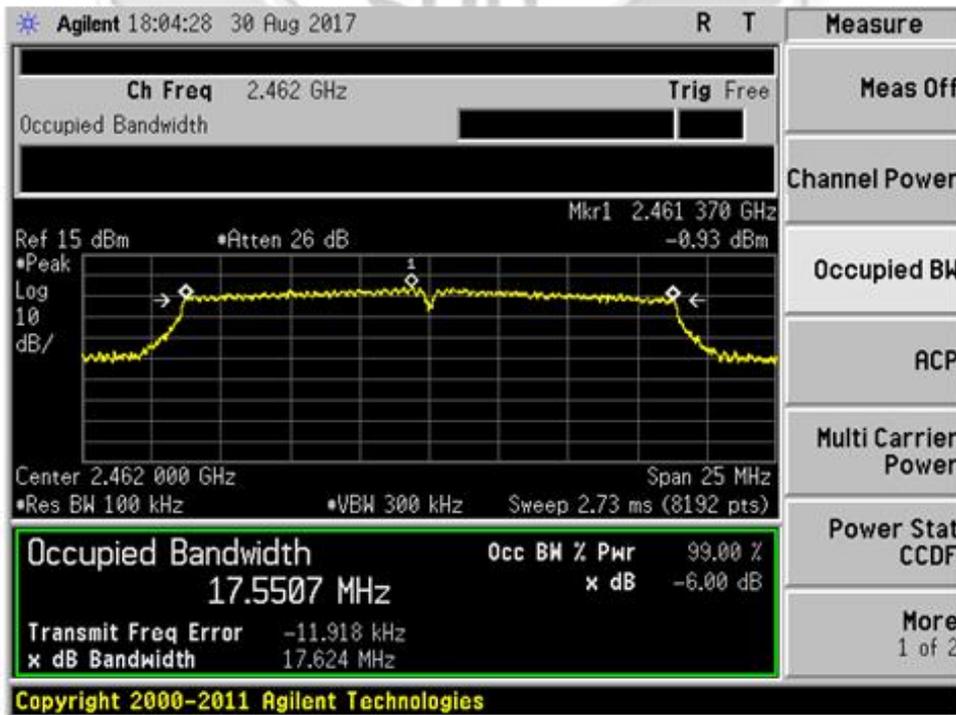


SPECTRUM BANDWIDTH (6dB BANDWIDTH MEASUREMENT) TEST

Spectrum Bandwidth (6dB Bandwidth Measurement) Plots – 802.11n (20MHz)



Plot 30 - Channel 11 (upper ch) @BPSK 6.5Mbps

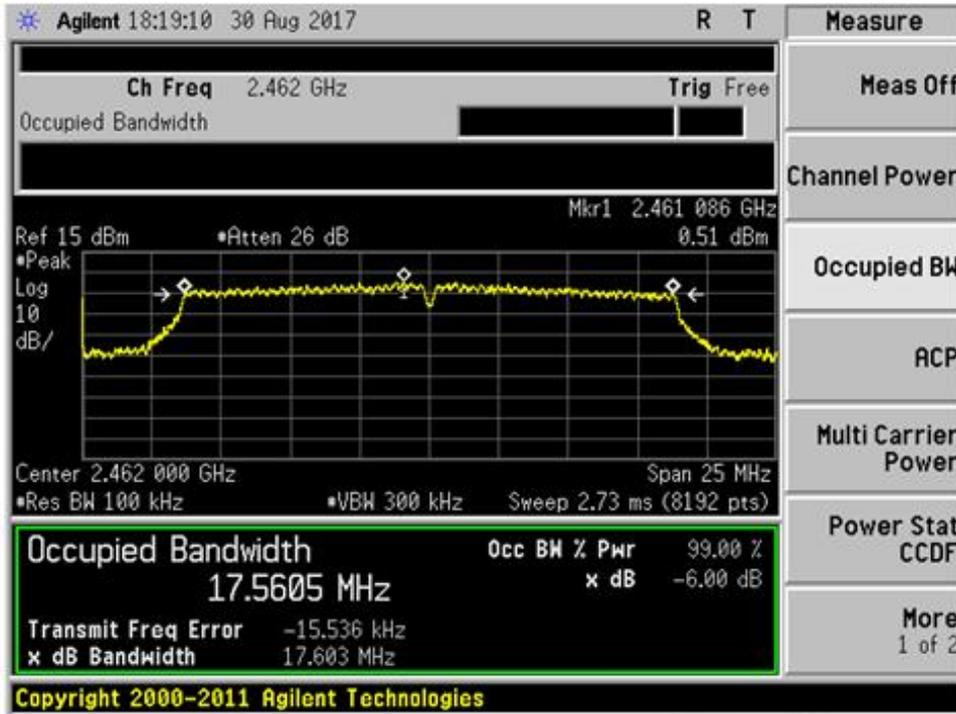


Plot 31 - Channel 11 (upper ch) @QPSK 19.5Mbps

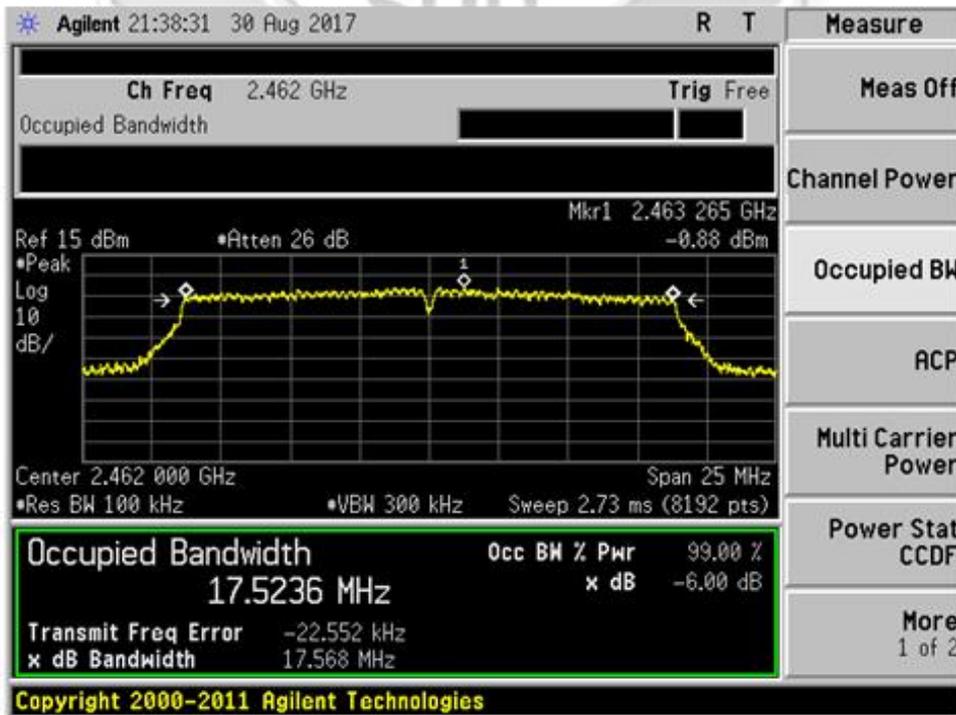


SPECTRUM BANDWIDTH (6dB BANDWIDTH MEASUREMENT) TEST

Spectrum Bandwidth (6dB Bandwidth Measurement) Plots – 802.11n (20MHz)



Plot 32 - Channel 11 (upper ch) @16QAM 39Mbps

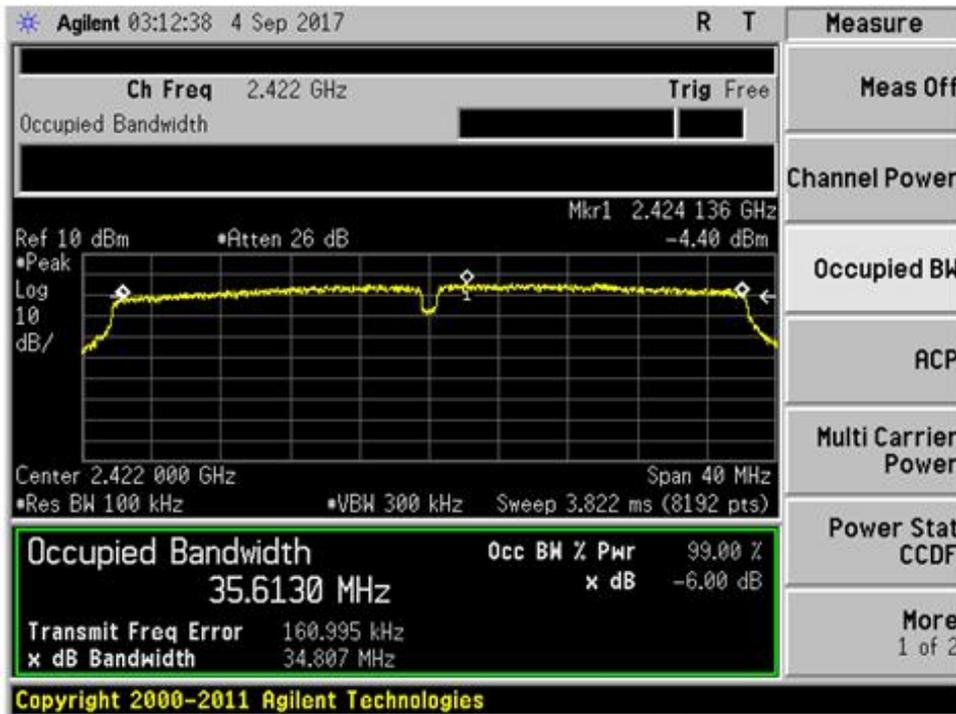


Plot 33 - Channel 11 (upper ch) @64QAM 65Mbps

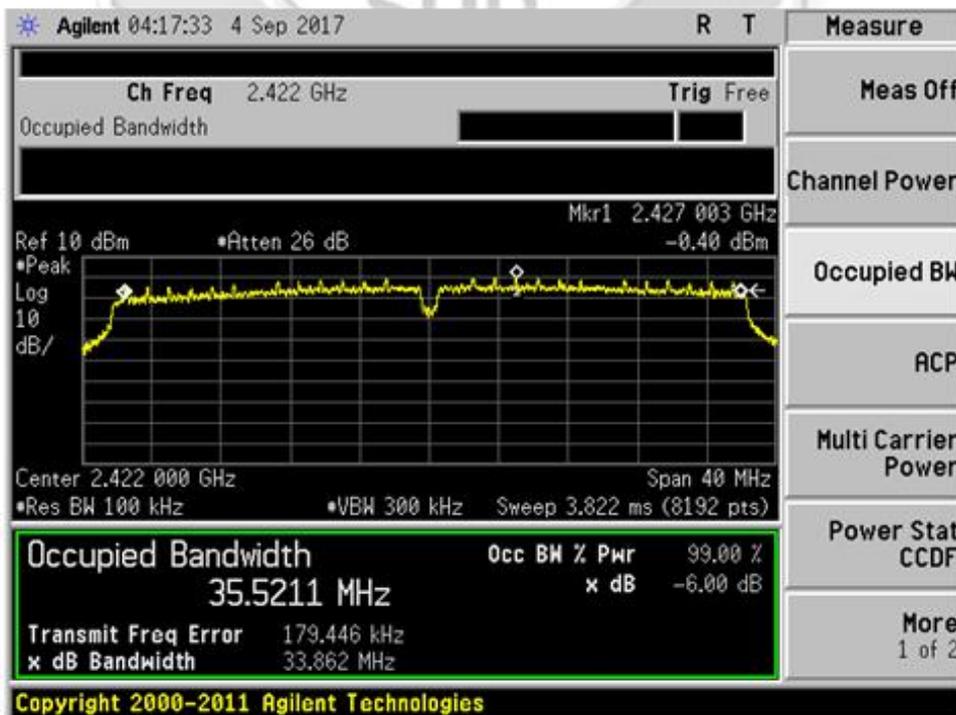


SPECTRUM BANDWIDTH (6dB BANDWIDTH MEASUREMENT) TEST

Spectrum Bandwidth (6dB Bandwidth Measurement) Plots – 802.11n (40MHz)



Plot 34 - Channel 1 (lower ch) @BPSK 13.5Mbps

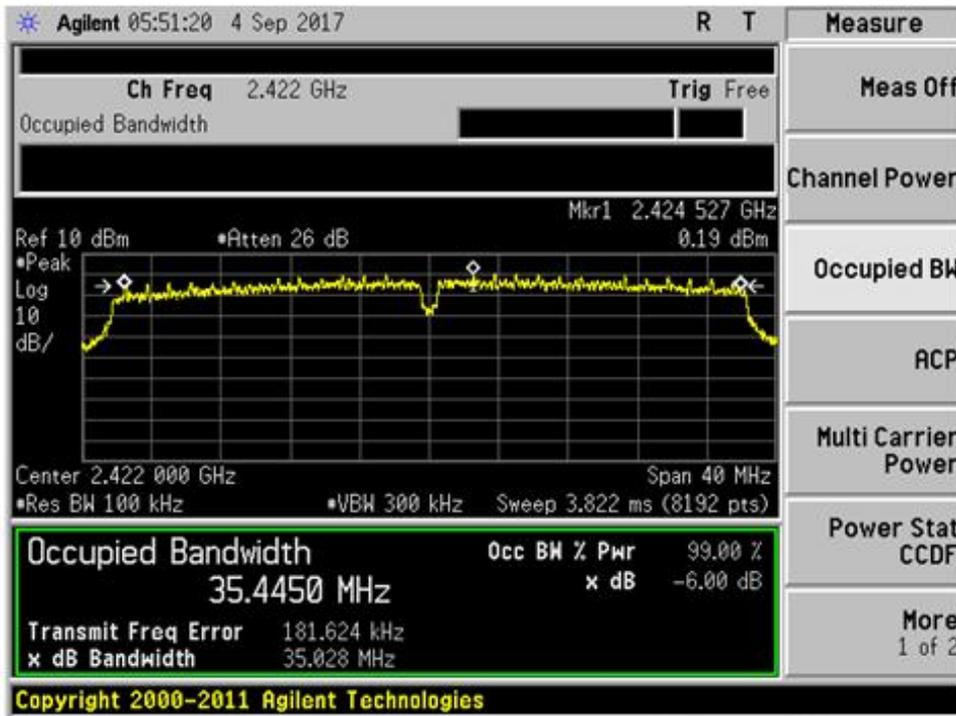


Plot 35 - Channel 1 (lower ch) @QPSK 40.5Mbps

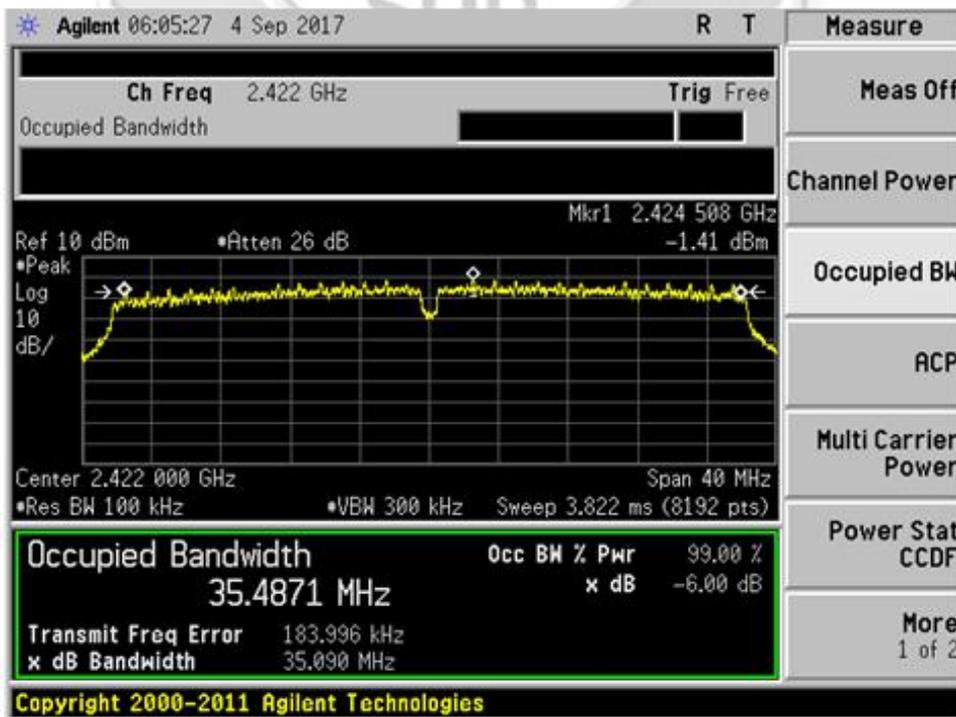


SPECTRUM BANDWIDTH (6dB BANDWIDTH MEASUREMENT) TEST

Spectrum Bandwidth (6dB Bandwidth Measurement) Plots – 802.11n (40MHz)



Plot 36 - Channel 1 (lower ch) @16QAM 81Mbps

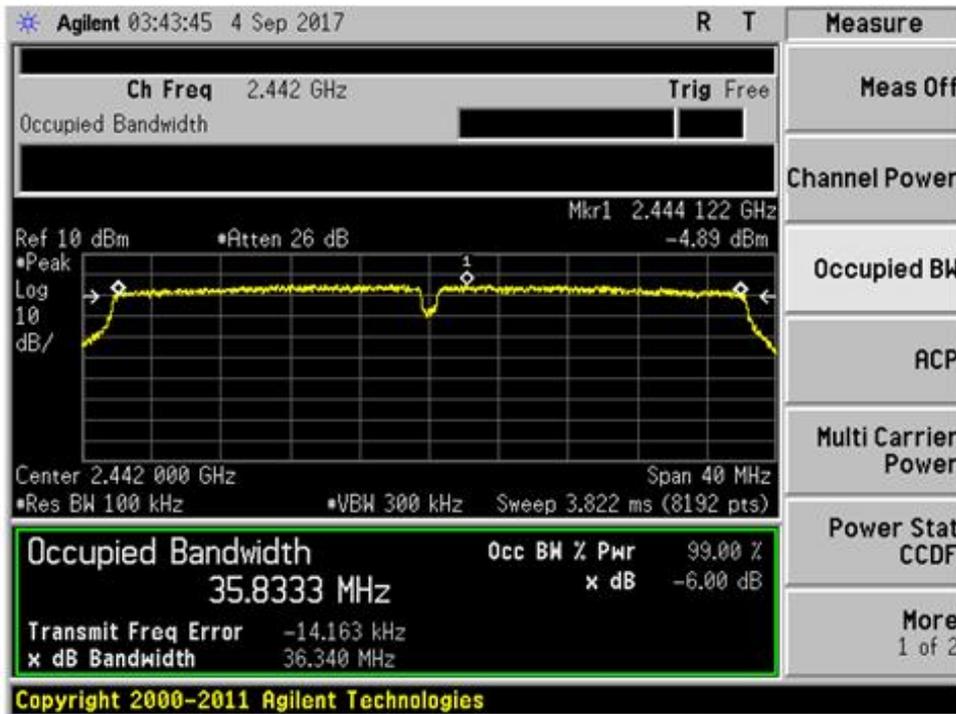


Plot 37 - Channel 1 (lower ch) @64QAM 135Mbps

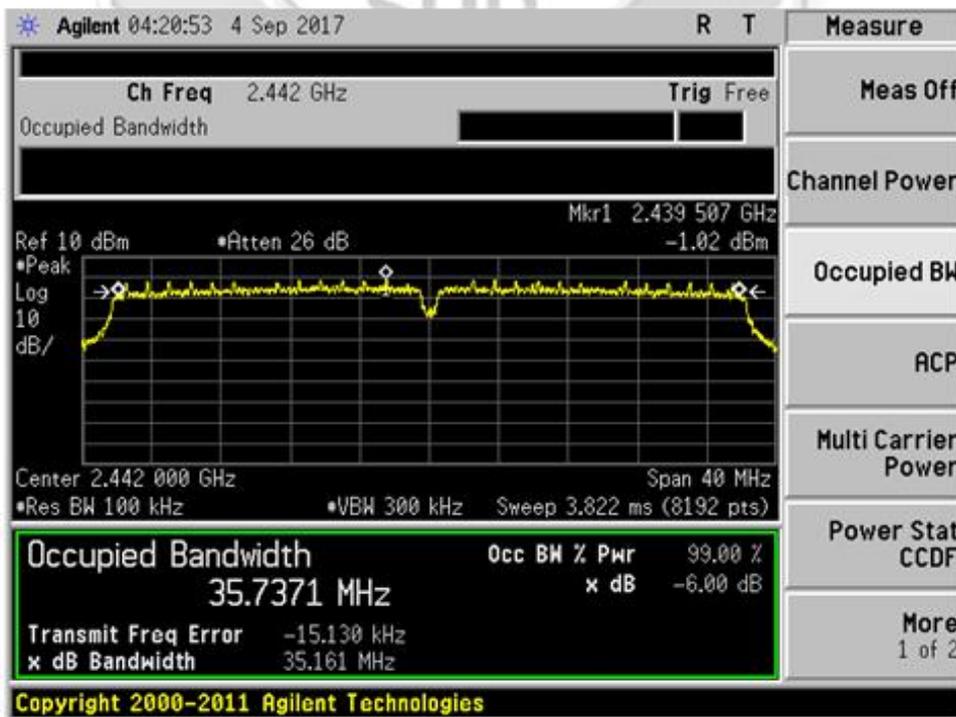


SPECTRUM BANDWIDTH (6dB BANDWIDTH MEASUREMENT) TEST

Spectrum Bandwidth (6dB Bandwidth Measurement) Plots – 802.11n (40MHz)



Plot 38 - Channel 6 (middle ch) @BPSK 13.5Mbps

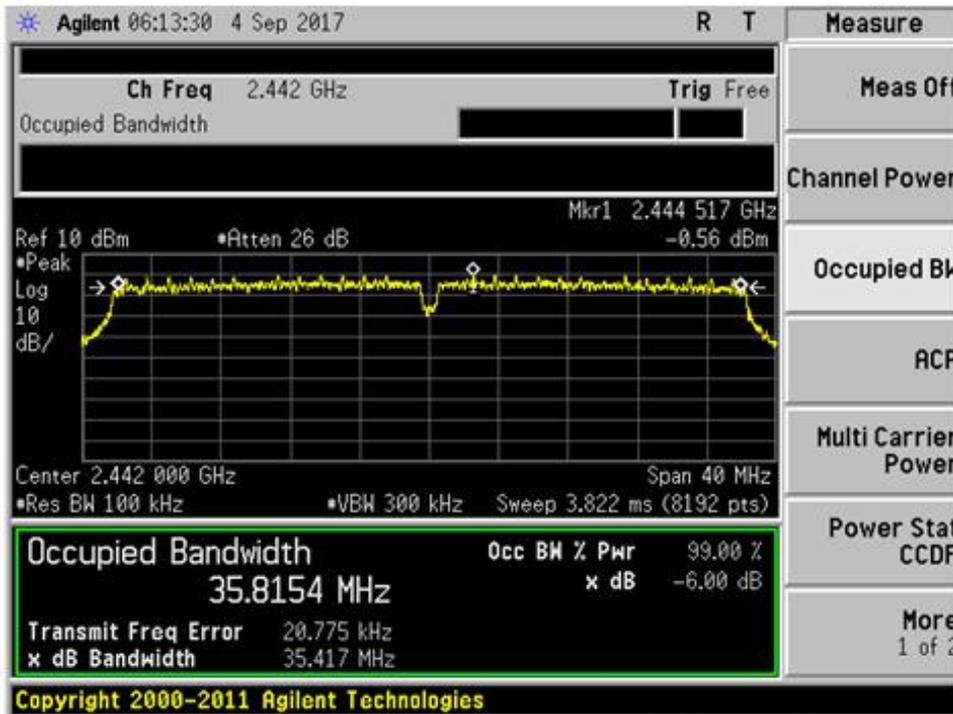


Plot 39 - Channel 6 (middle ch) @QPSK 40.5Mbps

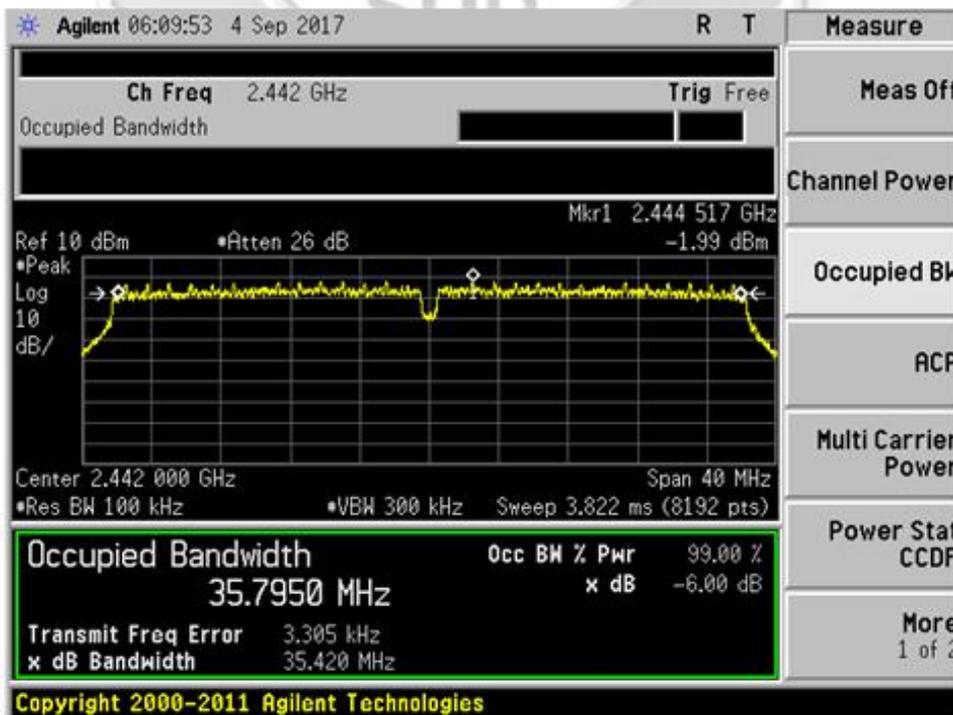


SPECTRUM BANDWIDTH (6dB BANDWIDTH MEASUREMENT) TEST

Spectrum Bandwidth (6dB Bandwidth Measurement) Plots – 802.11n (40MHz)



Plot 40 - Channel 6 (middle ch) @16QAM 81Mbps

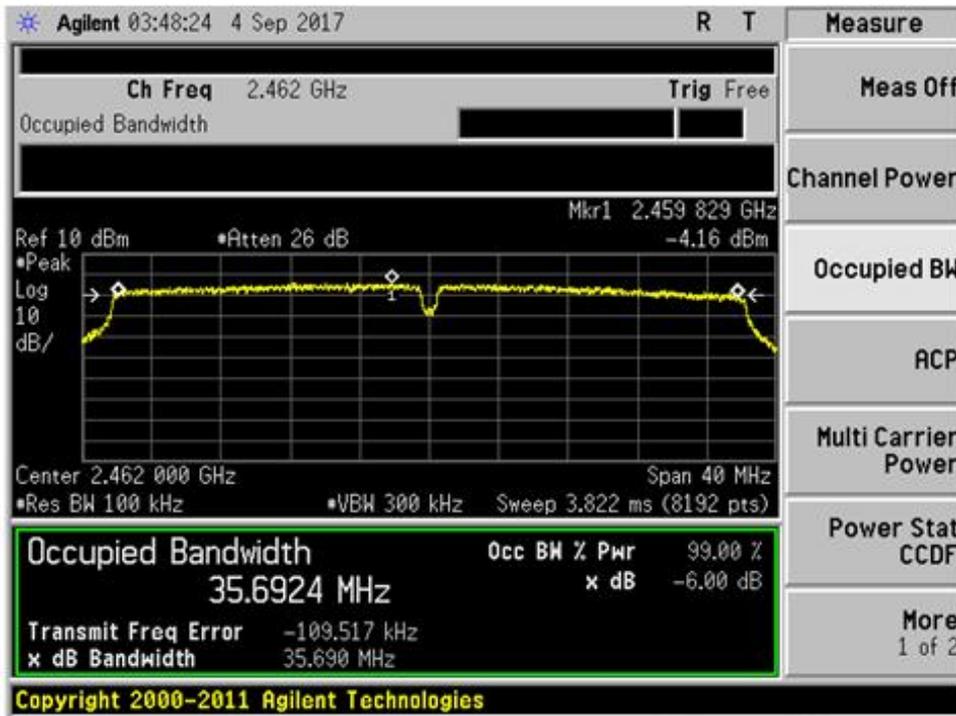


Plot 41 - Channel 6 (middle ch) @64QAM 135Mbps

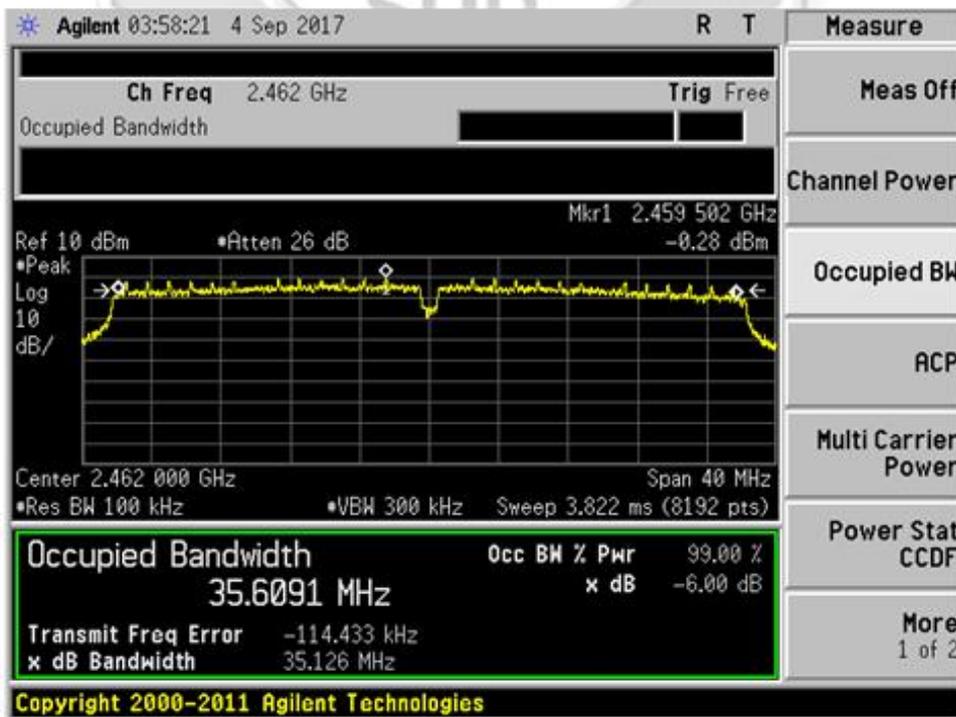


SPECTRUM BANDWIDTH (6dB BANDWIDTH MEASUREMENT) TEST

Spectrum Bandwidth (6dB Bandwidth Measurement) Plots – 802.11n (40MHz)



Plot 42 - Channel 11 (upper ch) @BPSK 13.5Mbps

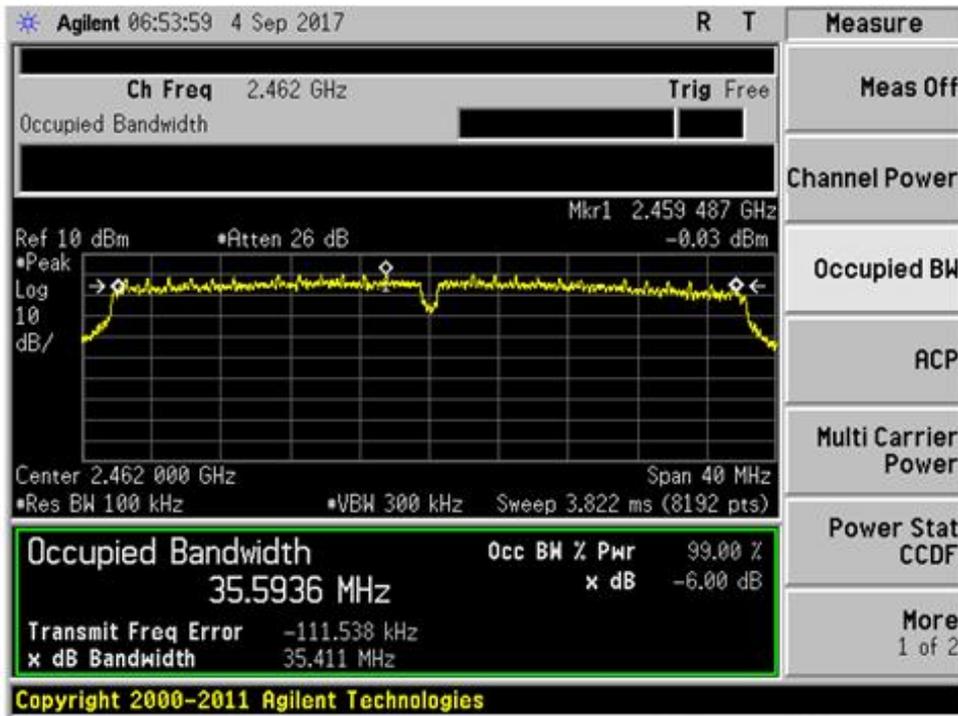


Plot 43 - Channel 11 (upper ch) @QPSK 40.5Mbps

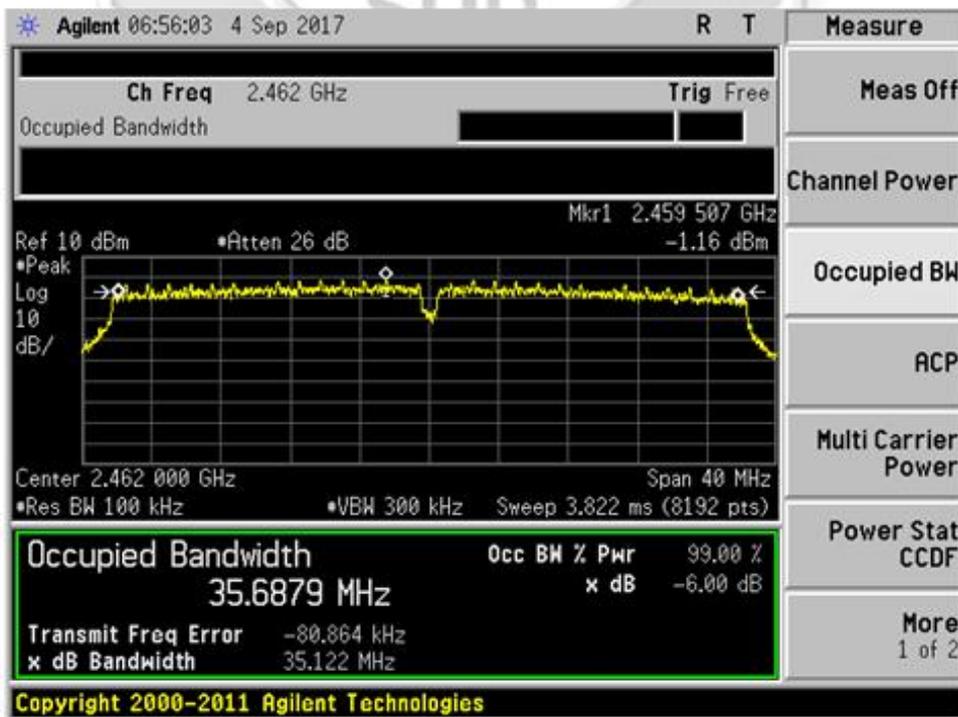


SPECTRUM BANDWIDTH (6dB BANDWIDTH MEASUREMENT) TEST

Spectrum Bandwidth (6dB Bandwidth Measurement) Plots – 802.11n (40MHz)



Plot 44 - Channel 11 (upper ch) @16QAM 81Mbps



Plot 45 - Channel 11 (upper ch) @64QAM 135Mbps



MAXIMUM PEAK POWER TEST

47 CFR FCC Part 15.247(b)(3) Maximum Peak Power Limits

The EUT shows compliance to the requirements of this section, which states the maximum peak power of the EUT employing digital modulation shall not exceed 1W (30dBm).

47 CFR FCC Part 15.247(b)(3) Maximum Peak Power Test Instrumentation

Instrument	Model	S/No	Cal Due Date
Boonton Electronics RF Power Meter	4532	72901	26 Aug 2018
Boonton Electronics Peak Power Sensor	56218-S/1	1417	26 Aug 2018
BK Precision Multi Range DC Power Supply	9111	459G14131	23 Nov 2017

47 CFR FCC Part 15.247(b)(3) Maximum Peak Power Test Setup

1. The EUT and supporting equipment were set up as shown in the setup photo.
2. The power supply for the EUT was connected to a filtered mains.
3. The RF antenna connector was connected to the power meter.
4. All other supporting equipment were powered separately from another filtered mains.

47 CFR FCC Part 15.247(b)(3) Maximum Peak Power Test Method

1. The EUT was switched on and allowed to warm up to its normal operating condition. The EUT was then configured to operate in the test mode at lower channel with specified modulation and data rate.
2. The maximum peak power of the transmitting frequency was detected and recorded.
3. Repeat steps 1 to 2 with all possible modulations and data rates.
4. The steps 2 to 3 were repeated with the transmitting frequency was set to middle and upper respectively.



MAXIMUM PEAK POWER TEST

47 CFR FCC Part 15.247(b)(3) Maximum Peak Power Results

Test Input Power	12.5Vdc	Temperature	24°C
Antenna Gain	2.75 dBi	Relative Humidity	60%
		Atmospheric Pressure	1030mbar
		Tested By	Chang Wai Kit

802.11b

Channel	Channel Frequency (GHz)	Maximum Peak Power (W)	Limit (W)	Modulation @ Data Rate
1 (lower ch)	2.412	0.0339	1.0	DBPSK @ 1Mbps
		0.0347	1.0	DQPSK @ 2Mbps
		0.0316	1.0	CCK @ 11Mbps
6 (mid ch)	2.437	0.0708	1.0	DBPSK @ 1Mbps
		0.0708	1.0	DQPSK @ 2Mbps
		0.0724	1.0	CCK @ 11Mbps
11 (upper ch)	2.462	0.0661	1.0	DBPSK @ 1Mbps
		0.0661	1.0	DQPSK @ 2Mbps
		0.0219	1.0	CCK @ 11Mbps

802.11g

Channel	Channel Frequency (GHz)	Maximum Peak Power (W)	Limit (W)	Modulation @ Data Rate
1 (lower ch)	2.412	0.0245	1.0	BPSK @ 9Mbps
		0.0229	1.0	QPSK @ 18Mbps
		0.0200	1.0	16QAM @ 36Mbps
		0.0195	1.0	64QAM @ 54Mbps
6 (mid ch)	2.437	0.0447	1.0	BPSK @ 9Mbps
		0.0427	1.0	QPSK @ 18Mbps
		0.0380	1.0	16QAM @ 36Mbps
		0.0355	1.0	64QAM @ 54Mbps
11 (upper ch)	2.462	0.0263	1.0	BPSK @ 9Mbps
		0.0257	1.0	QPSK @ 18Mbps
		0.0240	1.0	16QAM @ 36Mbps
		0.0234	1.0	64QAM @ 54Mbps



SPECTRUM BANDWIDTH (6dB BANDWIDTH MEASUREMENT) TEST

47 CFR FCC Part 15.247(b)(3) Maximum Peak Power Results

Test Input Power	12.5Vdc	Temperature	24°C
Antenna Gain	2.75 dBi	Relative Humidity	60%
		Atmospheric Pressure	1030mbar
		Tested By	Chang Wai Kit

802.11n (20MHz)

Channel	Channel Frequency (GHz)	Maximum Peak Power (W)	Limit (W)	Modulation @ Data Rate
1 (lower ch)	2.412	0.0224	1.0	BPSK @ 6.5Mbps
		0.0209	1.0	QPSK @ 19.5Mbps
		0.0200	1.0	16QAM @ 39Mbps
		0.0195	1.0	64QAM @ 65Mbps
6 (mid ch)	2.437	0.0447	1.0	BPSK @ 6.5Mbps
		0.0427	1.0	QPSK @ 19.5Mbps
		0.0398	1.0	16QAM @ 39Mbps
		0.0316	1.0	64QAM @ 65Mbps
11 (upper ch)	2.462	0.0269	1.0	BPSK @ 6.5Mbps
		0.0257	1.0	QPSK @ 19.5Mbps
		0.0245	1.0	16QAM @ 39Mbps
		0.0234	1.0	64QAM @ 65Mbps

802.11n (40MHz)

Channel	Channel Frequency (GHz)	Maximum Peak Power (W)	Limit (W)	Modulation @ Data Rate
3 (lower ch)	2.422	0.0166	1.0	BPSK @ 13.5Mbps
		0.0162	1.0	QPSK @ 40.5Mbps
		0.0145	1.0	16QAM @ 81Mbps
		0.0123	1.0	64QAM @ 135Mbps
7 (mid ch)	2.442	0.0389	1.0	BPSK @ 13.5Mbps
		0.0372	1.0	QPSK @ 40.5Mbps
		0.0324	1.0	16QAM @ 81Mbps
		0.0204	1.0	64QAM @ 135Mbps
11 (upper ch)	2.462	0.0447	1.0	BPSK @ 13.5Mbps
		0.0398	1.0	QPSK @ 40.5Mbps
		0.0389	1.0	16QAM @ 81Mbps
		0.0200	1.0	64QAM @ 135Mbps

Notes

1. Nil.



RF CONDUCTED SPURIOUS EMISSIONS (NON-RESTRICTED BANDS) TEST

47 CFR FCC Part 15.247(d) RF Conducted Spurious Emissions (Non-Restricted Bands) Limits

The EUT shows compliance to the requirements of this section, which states in any 100kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator (EUT) is operating, the radio frequency power that is produced by the EUT shall be at least 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power.

47 CFR FCC Part 15.247(d) RF Conducted Spurious Emissions (Non-Restricted Bands) Test Instrumentation

Instrument	Model	S/No	Cal Due Date
Agilent Spectrum Analyzer	E4440A	MY45304764	04 Jan 2018
BK Precision Multi Range DC Power Supply	9111	459G14131	23 Nov 2017

47 CFR FCC Part 15.247(d) RF Conducted Spurious Emissions (Non-Restricted Bands) Test Setup

1. The EUT and supporting equipment were set up as shown in the setup photo.
2. The power supply for the EUT was connected to a filtered mains.
3. The RF antenna connector was connected to the spectrum analyser via a low-loss coaxial cable.
4. The resolution bandwidth (RBW) and the video bandwidth (VBW) of the spectrum analyser were respectively set to 100kHz and times of RBW.
5. All other supporting equipment were powered separately from another filtered mains.

47 CFR FCC Part 15.247(d) RF Conducted Spurious Emissions (Non-Restricted Bands) Test Method

1. The EUT was switched on and allowed to warm up to its normal operating condition. The EUT was then configured to operate in the test mode, with the transmitting frequency was set to lower channel with specified modulation and data rate.
2. The start and stop frequencies of the spectrum analyser were set to 30MHz and 10GHz.
3. The spectrum analyser was set to max hold to capture any spurious emissions within the span. The signal capturing was continuous until no further spurious emissions were detected.
4. The steps 2 to 3 were repeated with frequency span was set from 10GHz to 25GHz.
5. Repeat steps 1 to 4 with all possible modulations and data rates.
6. The steps 2 to 5 were repeated with the transmitting frequency was set to middle and upper channel respectively.



RF CONDUCTED SPURIOUS EMISSIONS (NON-RESTRICTED BANDS) TEST

47 CFR FCC Part 15.247(d) RF Conducted Spurious Emissions (Non-Restricted Bands) Results

Test Input Power	12.5Vdc	Temperature	24°C
Attached Plots	46 – 135	Relative Humidity	60%
		Atmospheric Pressure	1030mbar
		Tested By	Chang Wai Kit

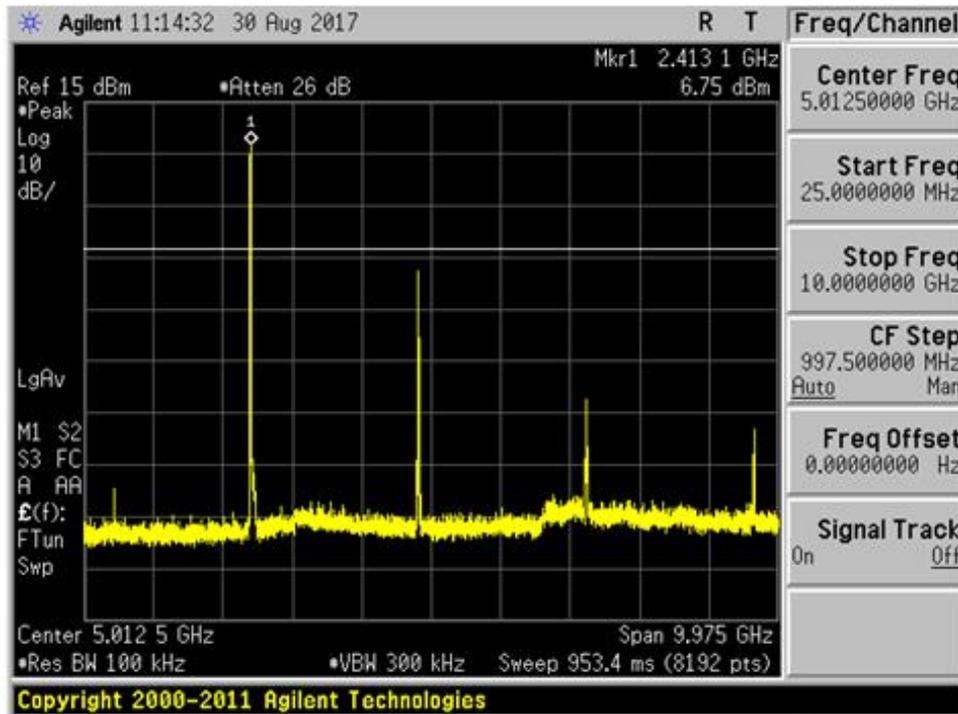
All spurious signals found were below the specified limit. Please refer to the attached plots.



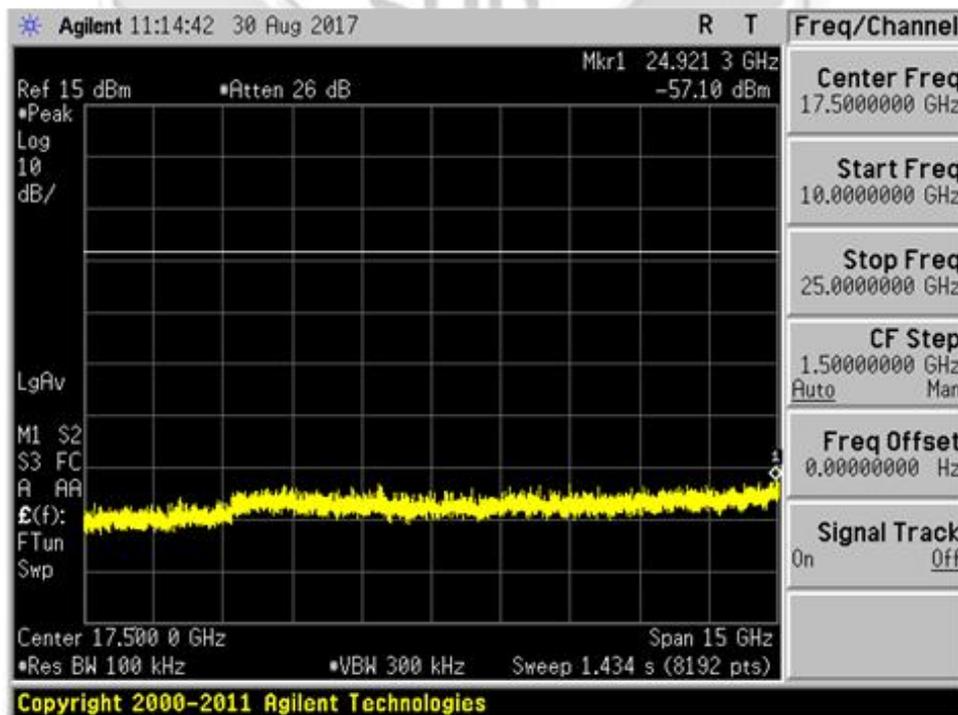


RF CONDUCTED SPURIOUS EMISSIONS (NON-RESTRICTED BANDS) TEST

RF Conducted Spurious Emissions (Non-Restricted Bands) Plots – 802.11b



Plot 46 – Channel 1 (lower ch) @DBPSK 1Mbps

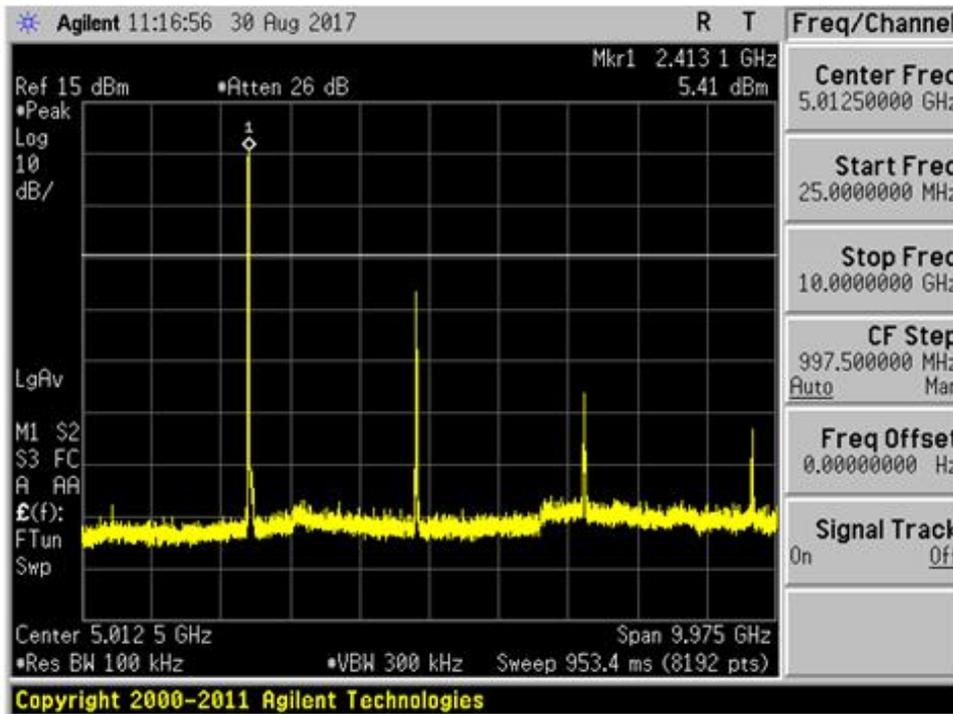


Plot 47 – Channel 1 (lower ch) @DBPSK 1Mbps

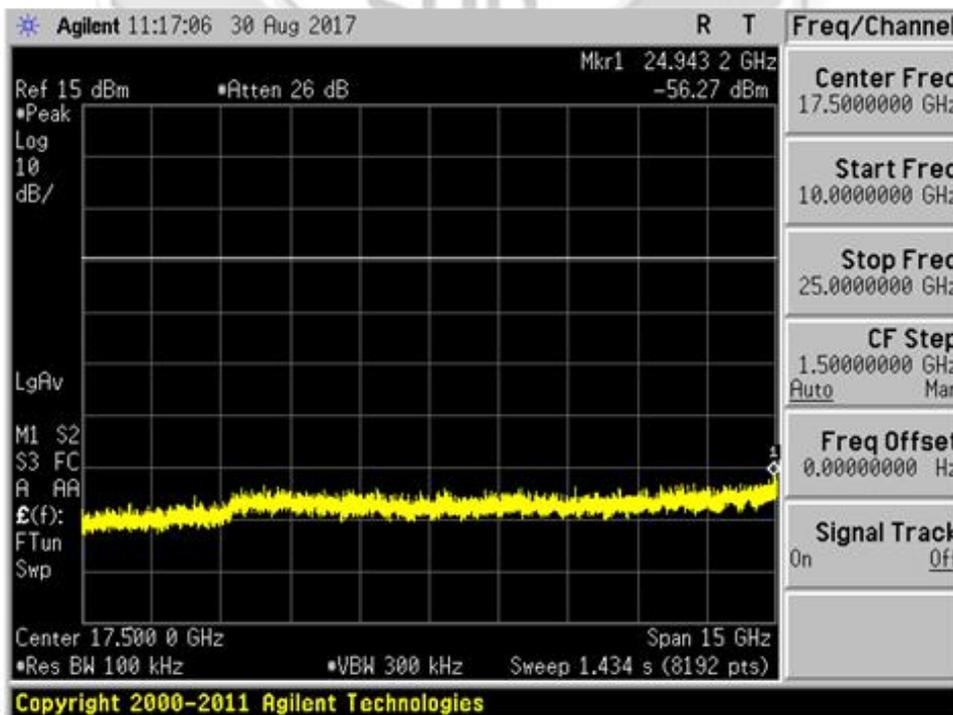


RF CONDUCTED SPURIOUS EMISSIONS (NON-RESTRICTED BANDS) TEST

RF Conducted Spurious Emissions (Non-Restricted Bands) Plots – 802.11b



Plot 48 – Channel 1 (lower ch) @DQPSK 2Mbps

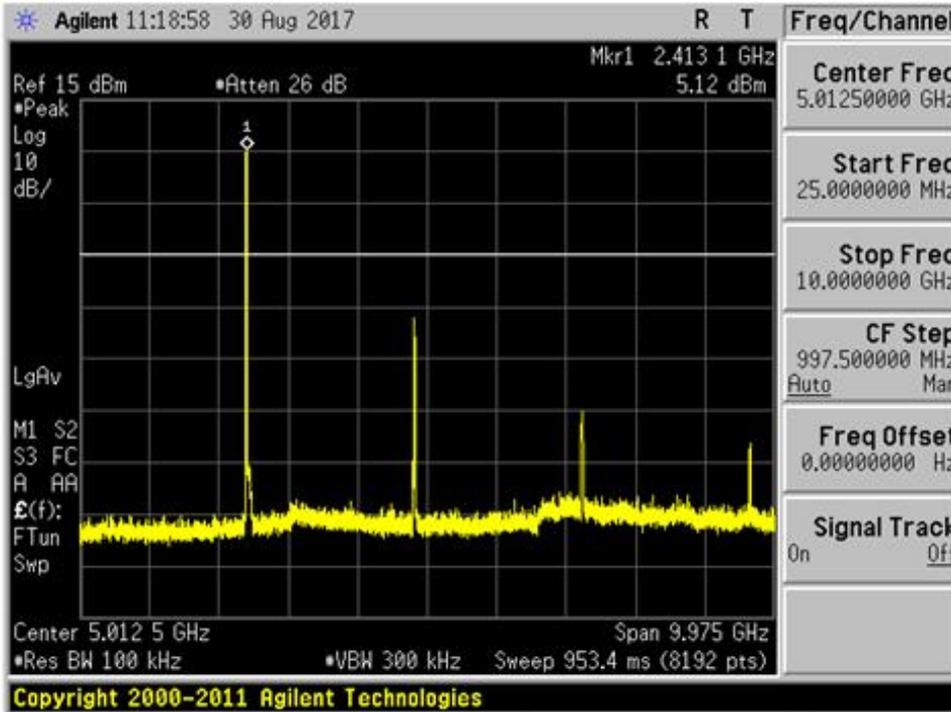


Plot 49 – Channel 1 (lower ch) @DQPSK 2Mbps

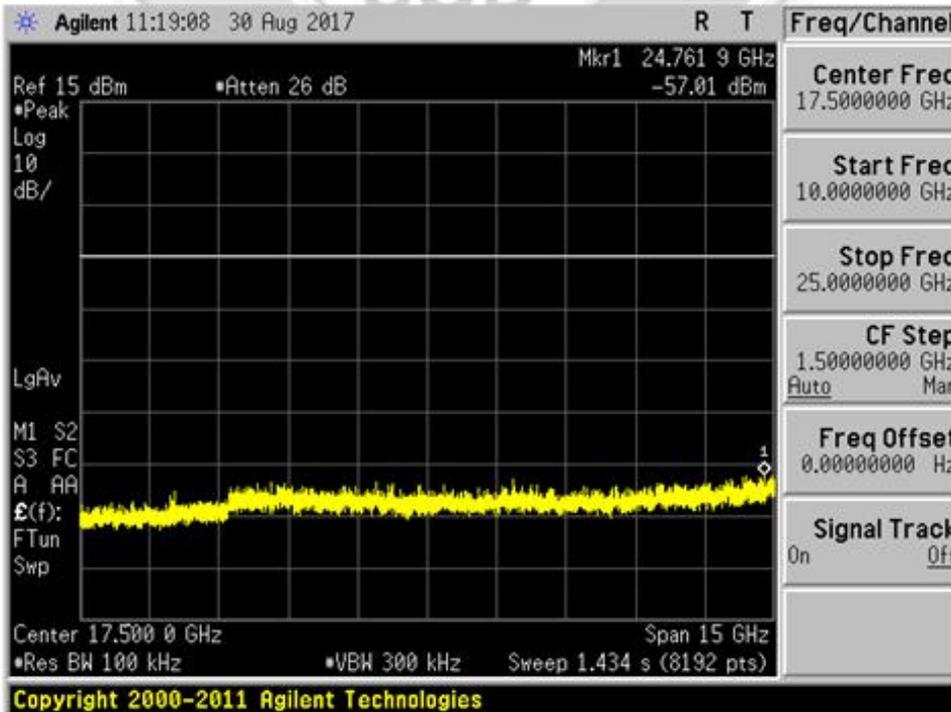


RF CONDUCTED SPURIOUS EMISSIONS (NON-RESTRICTED BANDS) TEST

RF Conducted Spurious Emissions (Non-Restricted Bands) Plots – 802.11b



Plot 50 – Channel 1 (lower ch) @CCK 11Mbps

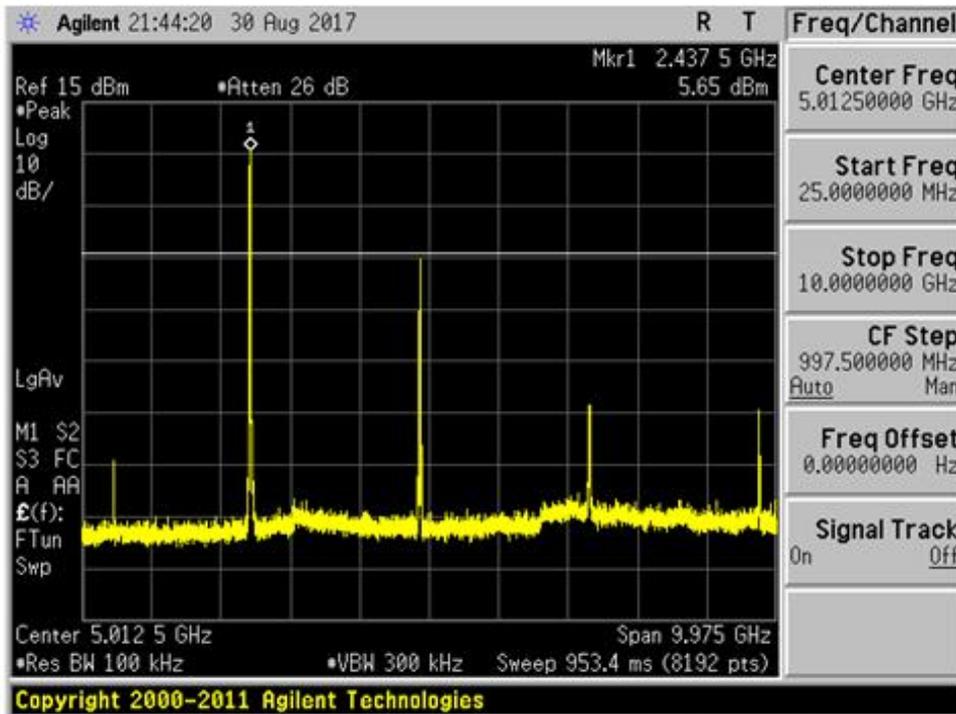


Plot 51 – Channel 1 (lower ch) @CCK 11Mbps

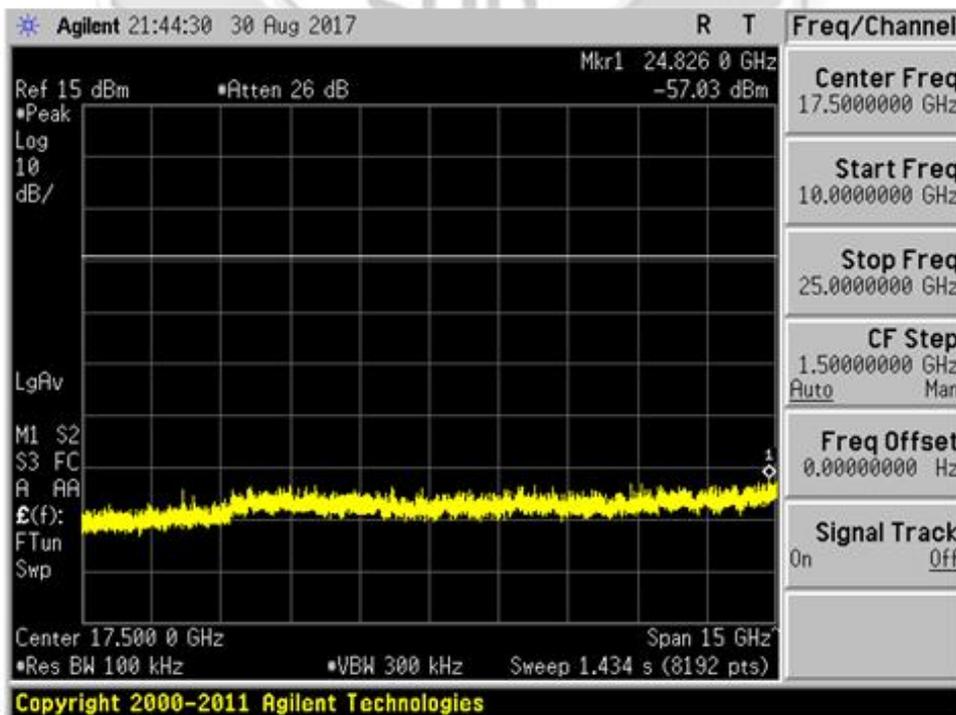


RF CONDUCTED SPURIOUS EMISSIONS (NON-RESTRICTED BANDS) TEST

RF Conducted Spurious Emissions (Non-Restricted Bands) Plots – 802.11b



Plot 52 – Channel 6 (middle ch) @DBPSK 1Mbps

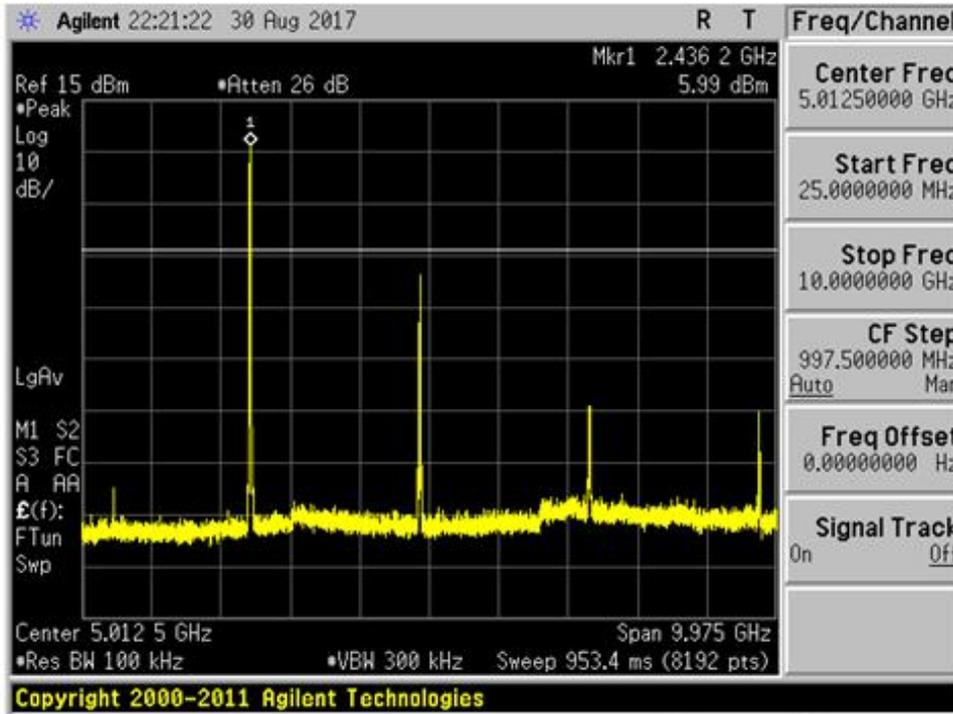


Plot 53 – Channel 6 (middle ch) @DBPSK 1Mbps

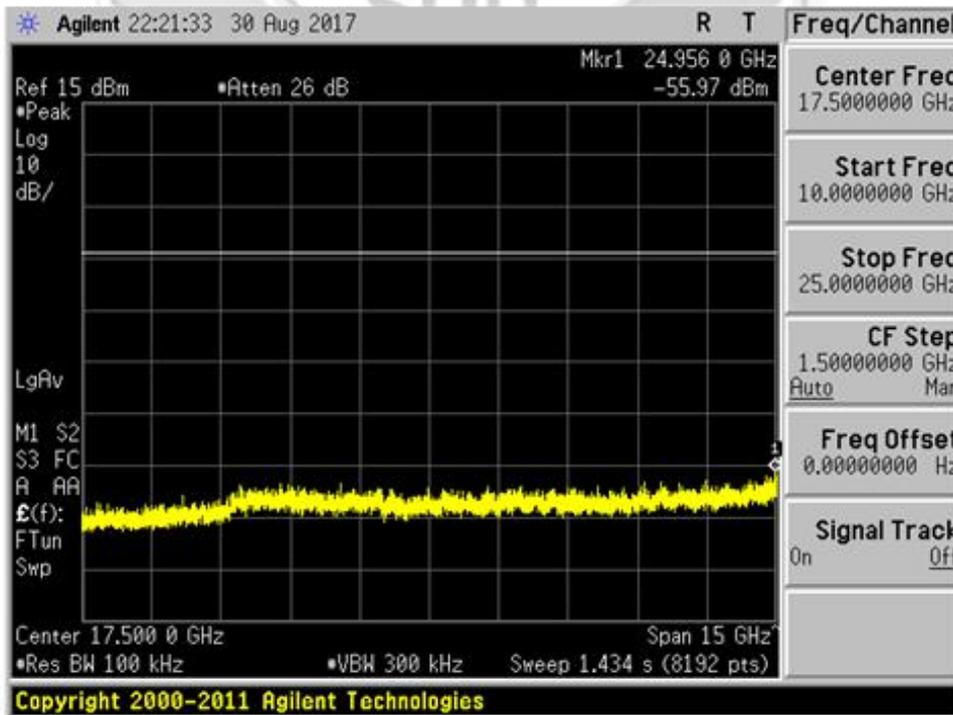


RF CONDUCTED SPURIOUS EMISSIONS (NON-RESTRICTED BANDS) TEST

RF Conducted Spurious Emissions (Non-Restricted Bands) Plots – 802.11b



Plot 54 – Channel 6 (middle ch) @DQPSK 2Mbps

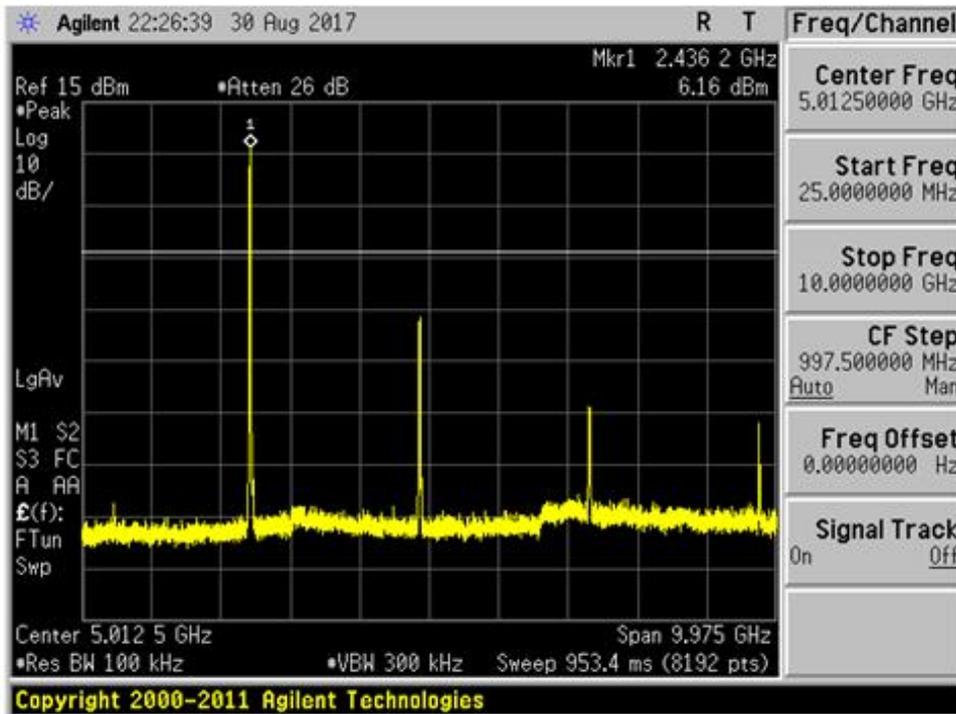


Plot 55 – Channel 6 (middle ch) @DQPSK 2Mbps

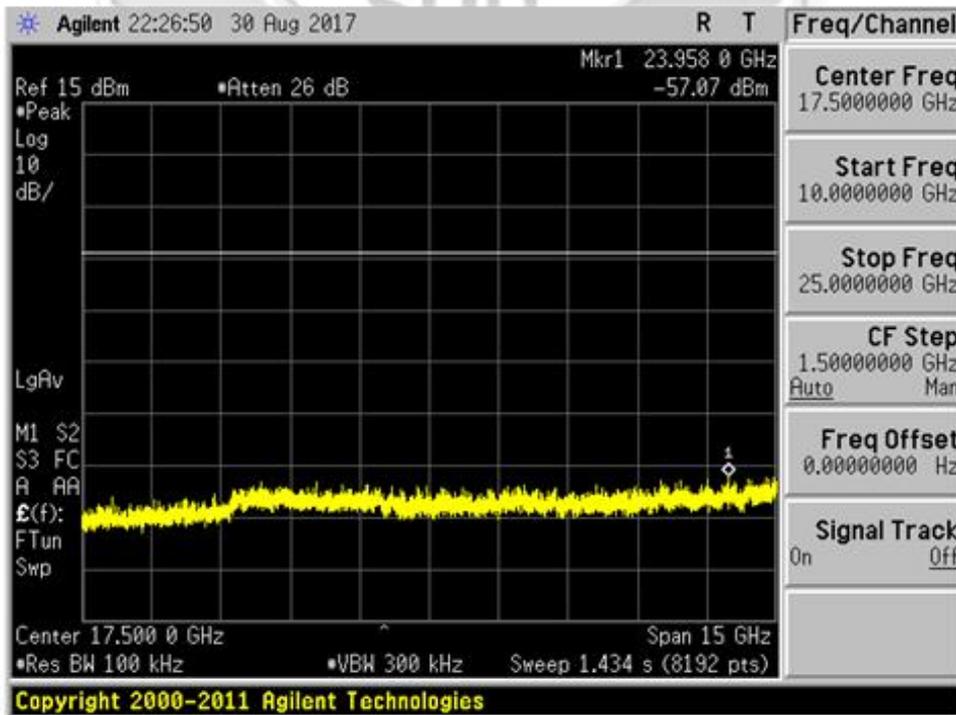


RF CONDUCTED SPURIOUS EMISSIONS (NON-RESTRICTED BANDS) TEST

RF Conducted Spurious Emissions (Non-Restricted Bands) Plots – 802.11b



Plot 56 – Channel 6 (middle ch) @CCK 11Mbps

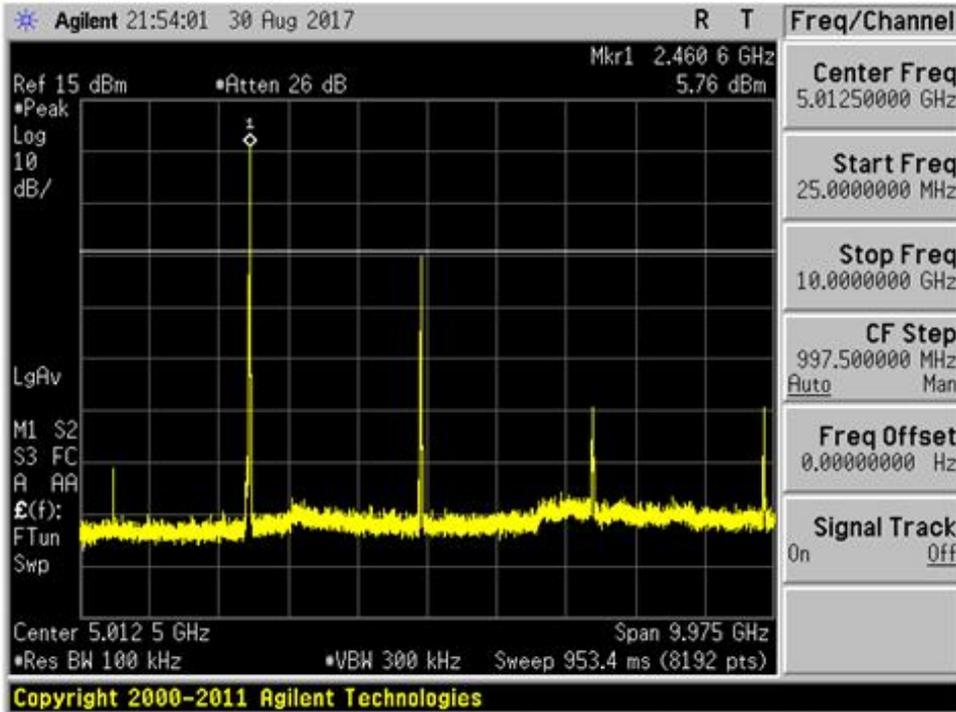


Plot 57 – Channel 6 (middle ch) @CCK 11Mbps

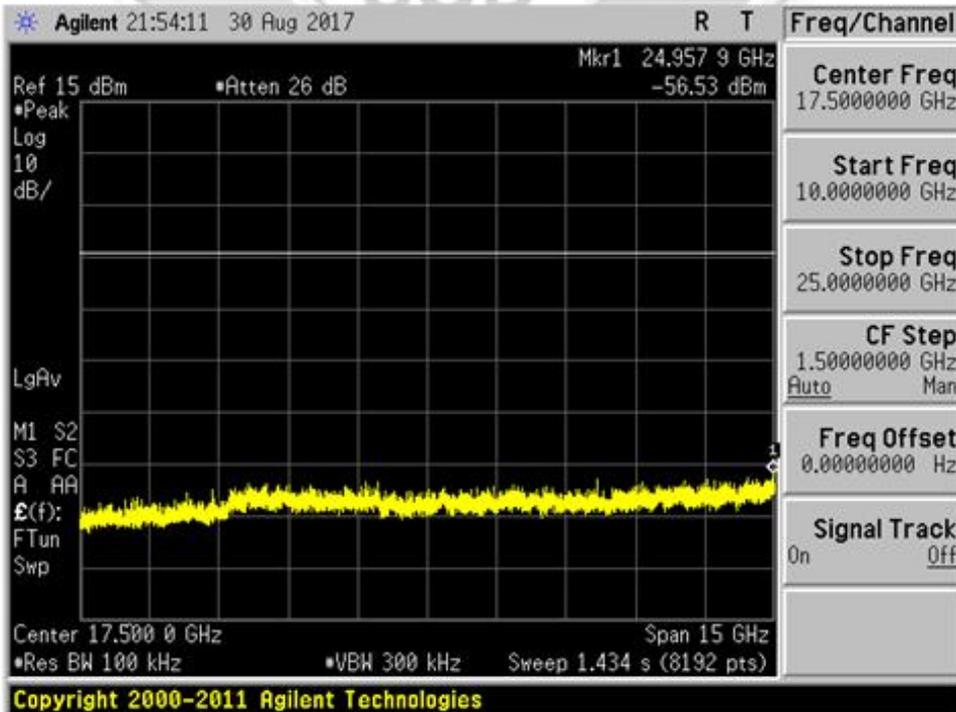


RF CONDUCTED SPURIOUS EMISSIONS (NON-RESTRICTED BANDS) TEST

RF Conducted Spurious Emissions (Non-Restricted Bands) Plots – 802.11b



Plot 58 – Channel 11 (upper ch) @DBPSK 1Mbps

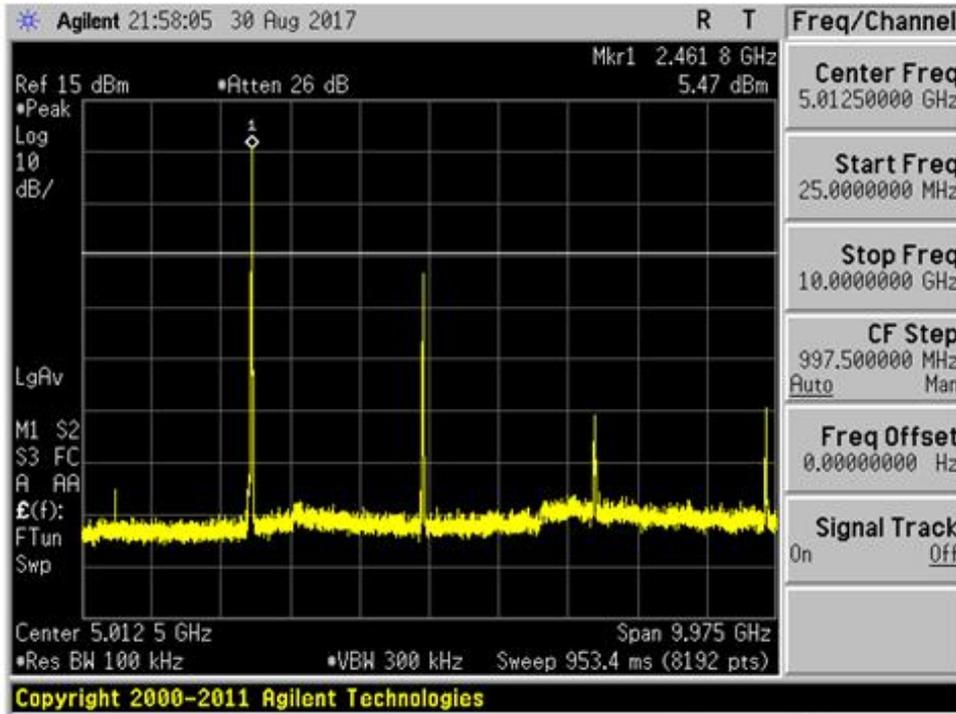


Plot 59 – Channel 11 (upper ch) @DBPSK 1Mbps

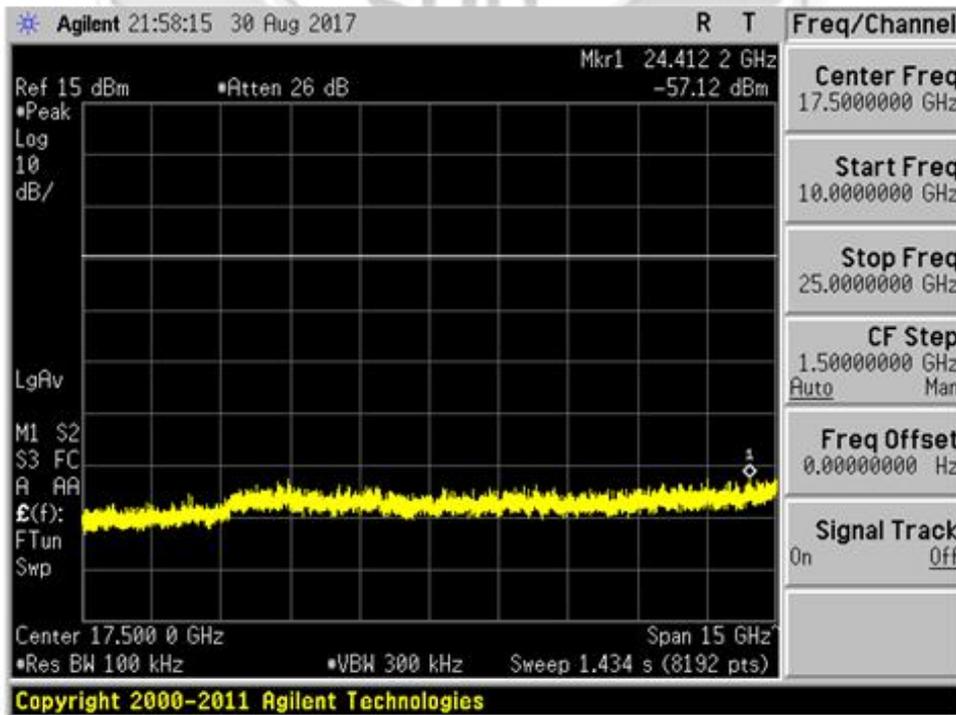


RF CONDUCTED SPURIOUS EMISSIONS (NON-RESTRICTED BANDS) TEST

RF Conducted Spurious Emissions (Non-Restricted Bands) Plots – 802.11b



Plot 60 – Channel 11 (upper ch) @DQPSK 2Mbps

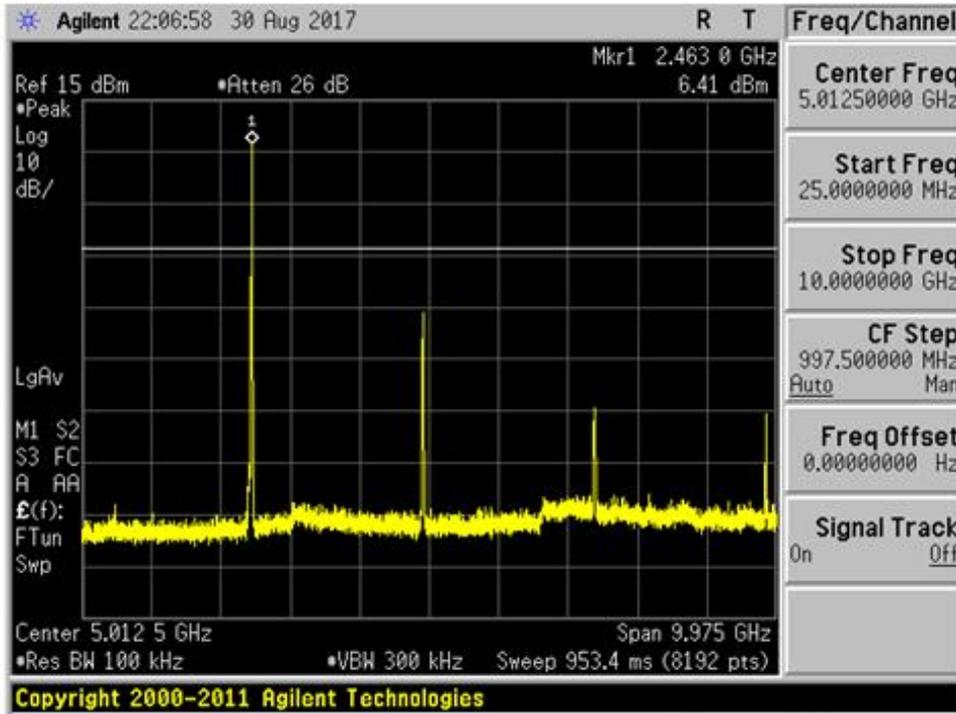


Plot 61 – Channel 11 (upper ch) @DQPSK 2Mbps

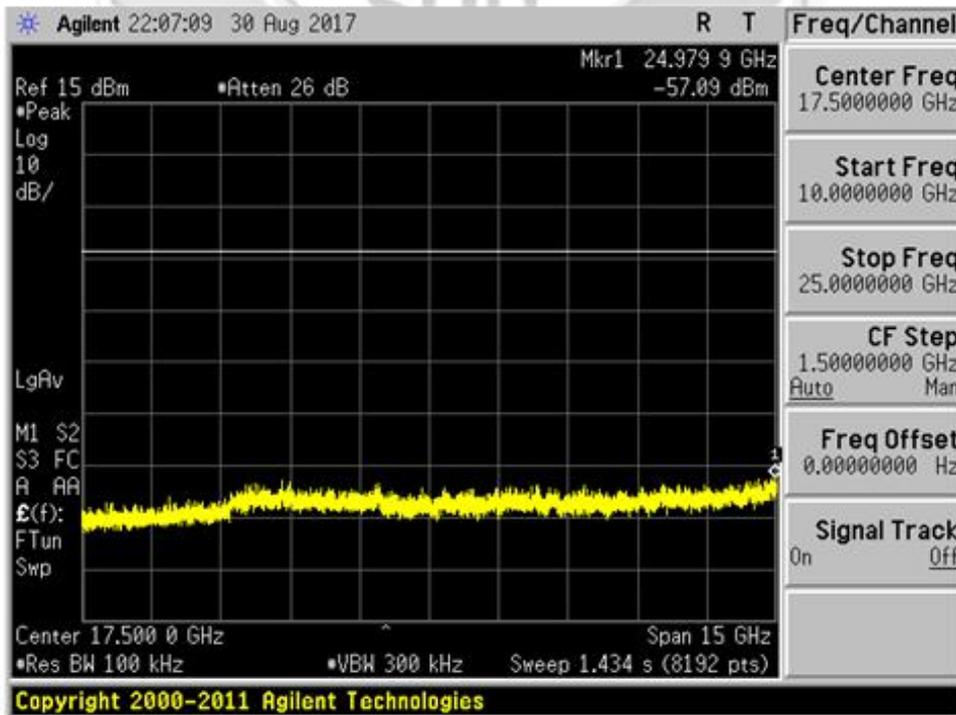


RF CONDUCTED SPURIOUS EMISSIONS (NON-RESTRICTED BANDS) TEST

RF Conducted Spurious Emissions (Non-Restricted Bands) Plots – 802.11b



Plot 62 – Channel 11 (upper ch) @CCK 11Mbps

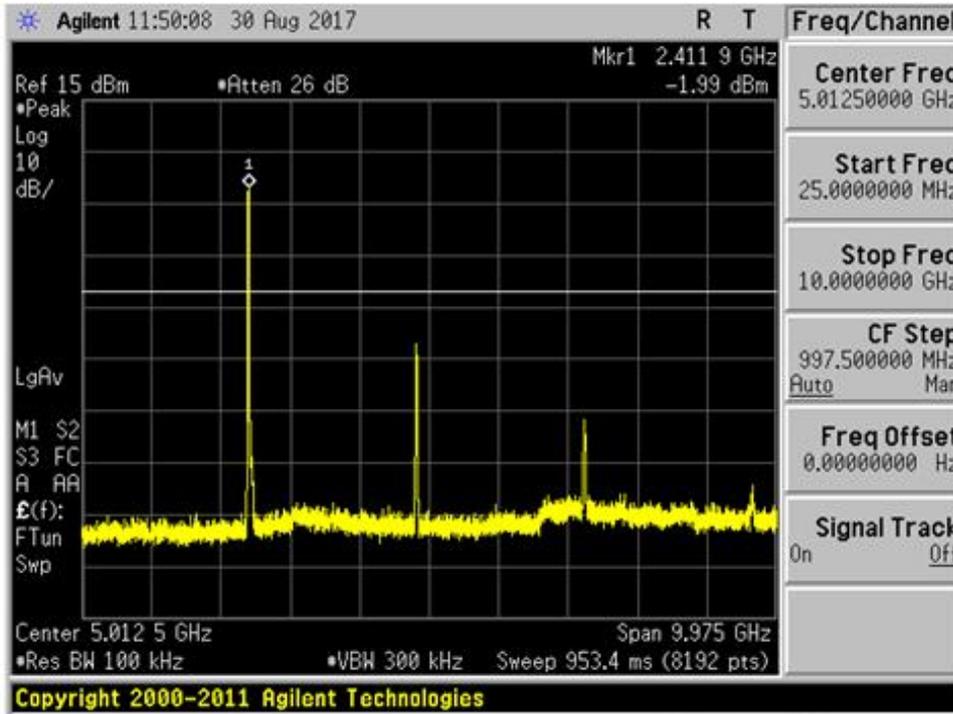


Plot 63 – Channel 11 (upper ch) @CCK 11Mbps

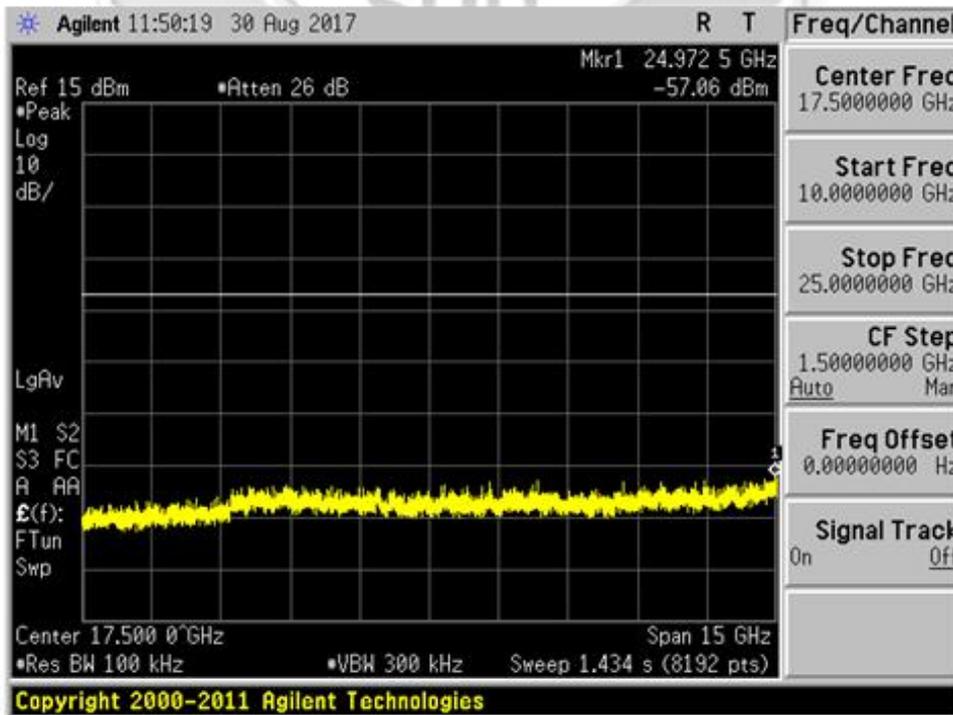


RF CONDUCTED SPURIOUS EMISSIONS (NON-RESTRICTED BANDS) TEST

RF Conducted Spurious Emissions (Non-Restricted Bands) Plots – 802.11g



Plot 64 – Channel 1 (lower ch) @BPSK 9Mbps

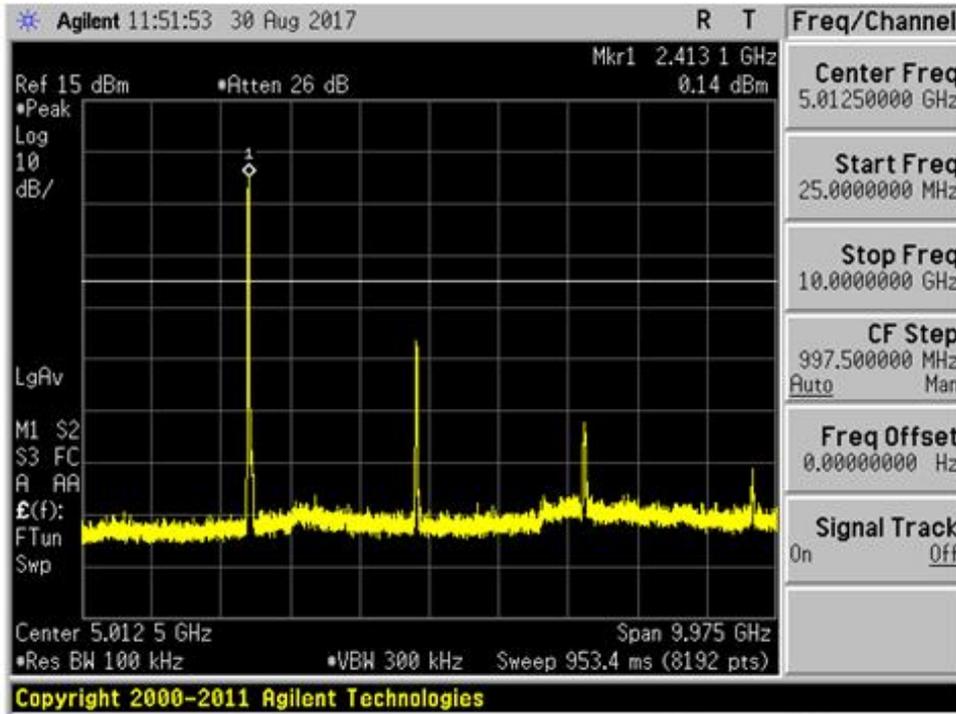


Plot 65 – Channel 1 (lower ch) @BPSK 9Mbps

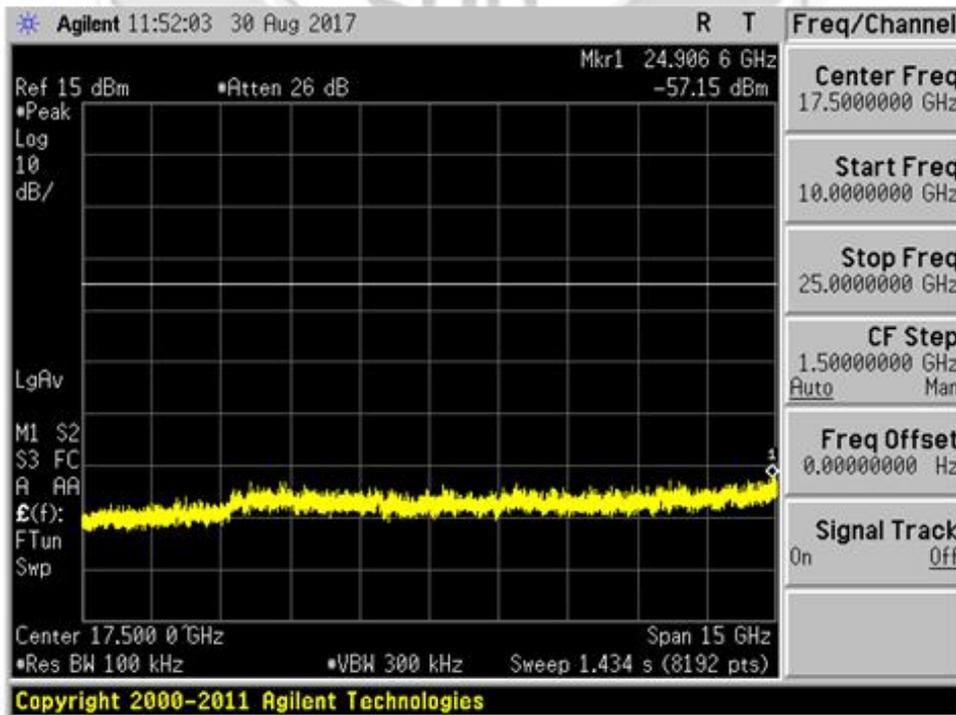


RF CONDUCTED SPURIOUS EMISSIONS (NON-RESTRICTED BANDS) TEST

RF Conducted Spurious Emissions (Non-Restricted Bands) Plots – 802.11g



Plot 66 – Channel 1 (lower ch) @QPSK 18Mbps

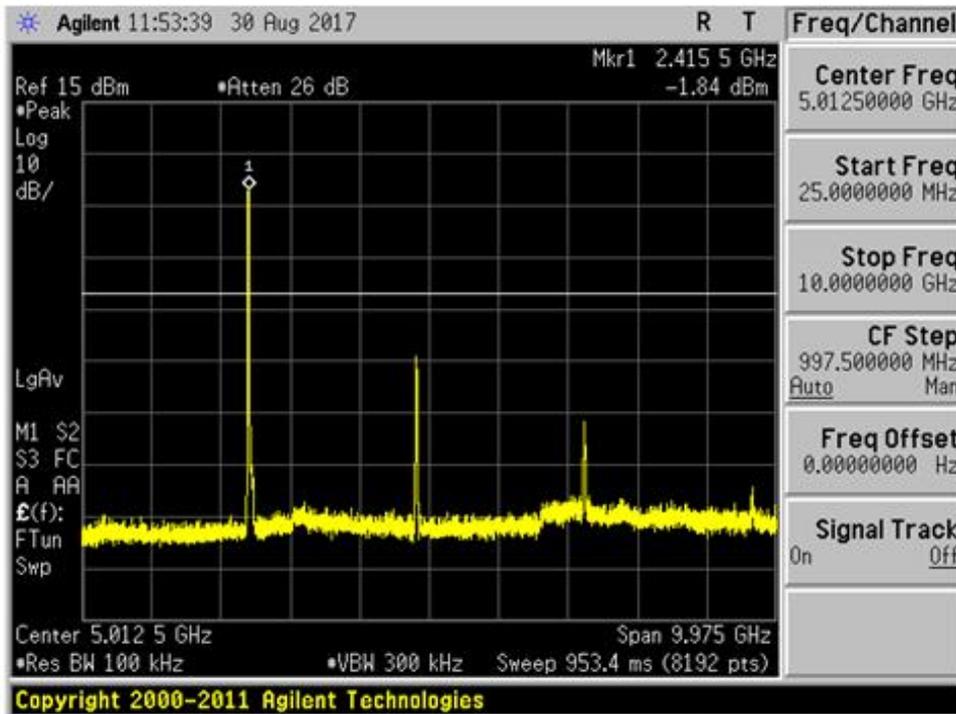


Plot 67 – Channel 1 (lower ch) @QPSK 18Mbps

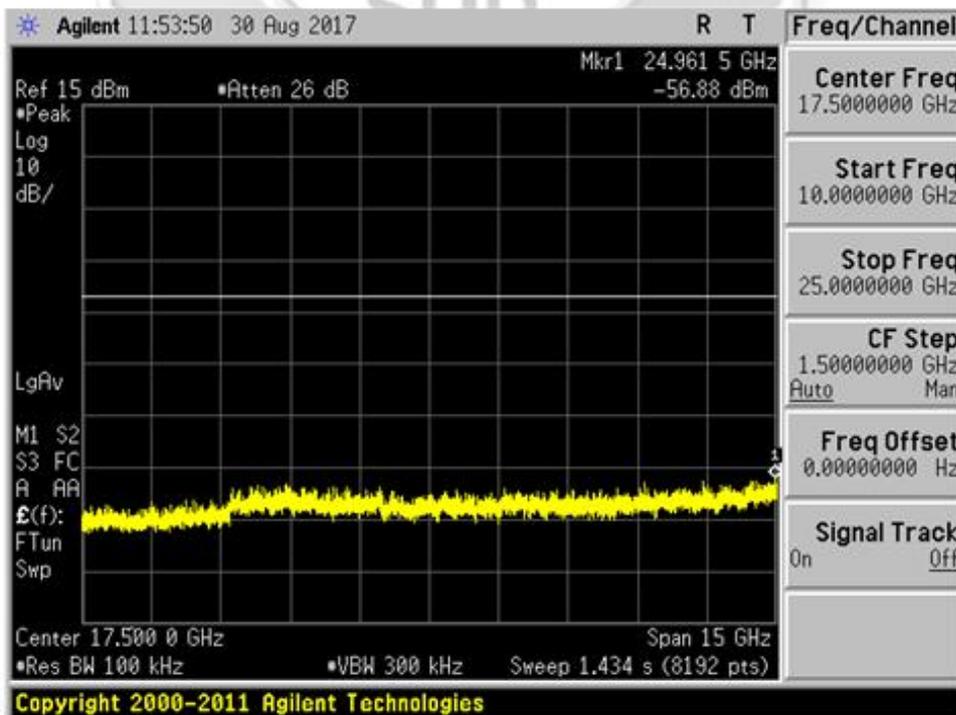


RF CONDUCTED SPURIOUS EMISSIONS (NON-RESTRICTED BANDS) TEST

RF Conducted Spurious Emissions (Non-Restricted Bands) Plots – 802.11g



Plot 68 – Channel 1 (lower ch) @16QAM 36Mbps

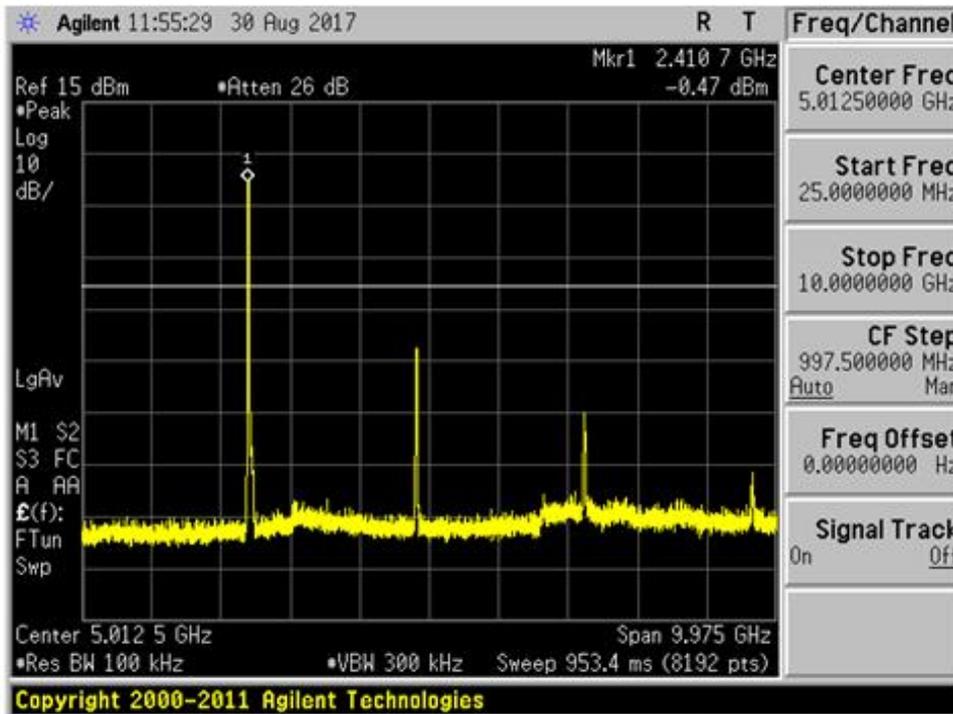


Plot 69 – Channel 1 (lower ch) @16QAM 36Mbps

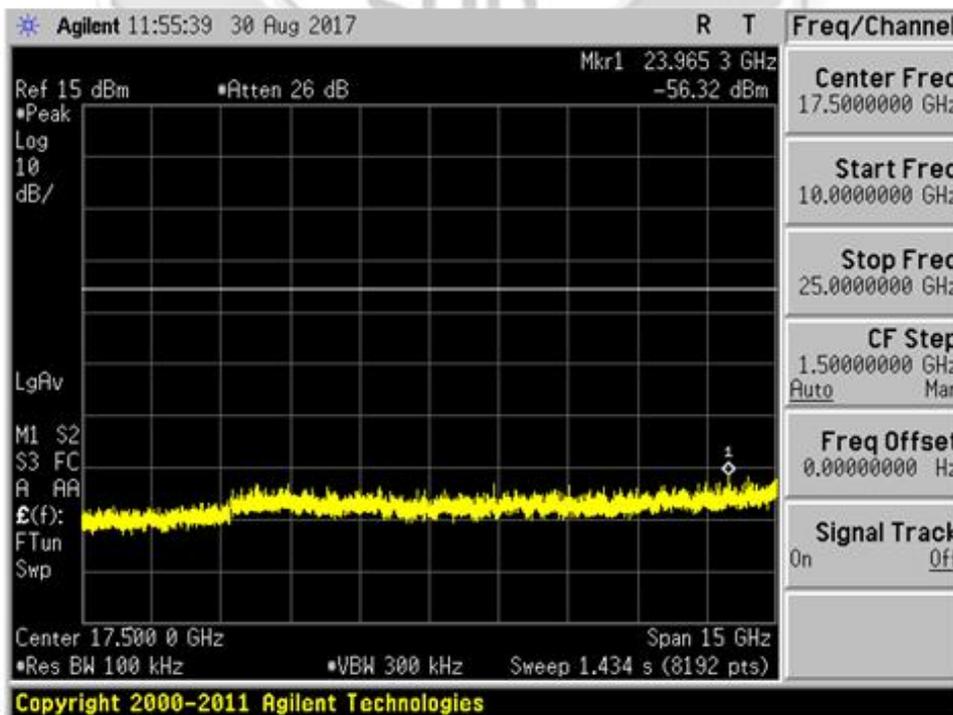


RF CONDUCTED SPURIOUS EMISSIONS (NON-RESTRICTED BANDS) TEST

RF Conducted Spurious Emissions (Non-Restricted Bands) Plots – 802.11g



Plot 70 – Channel 1 (lower ch) @64QAM 54Mbps

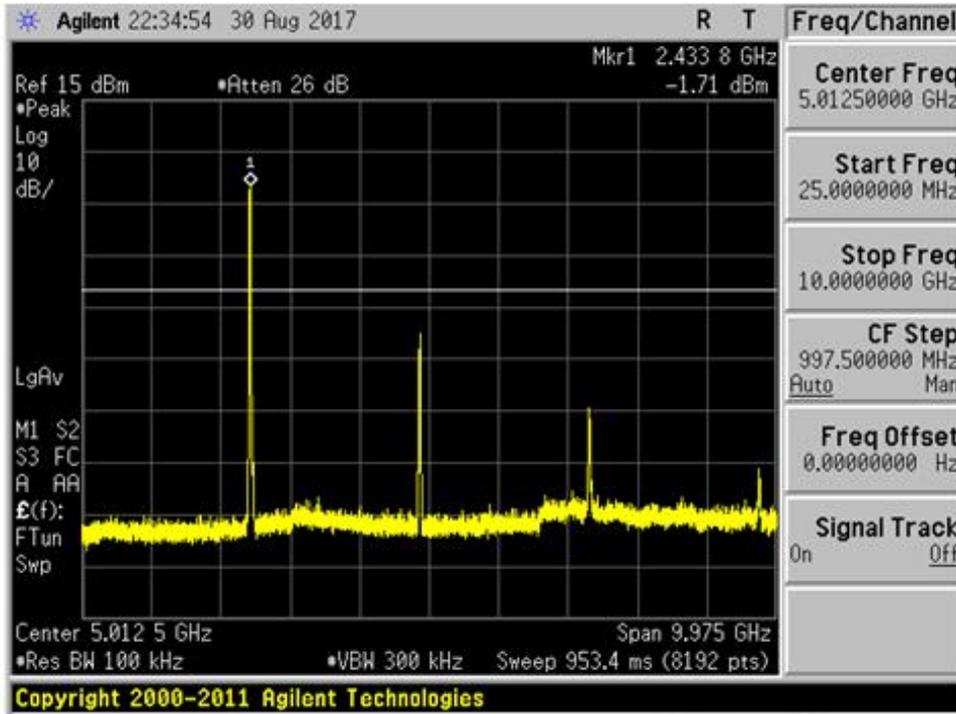


Plot 71 – Channel 1 (lower ch) @64QAM 54Mbps

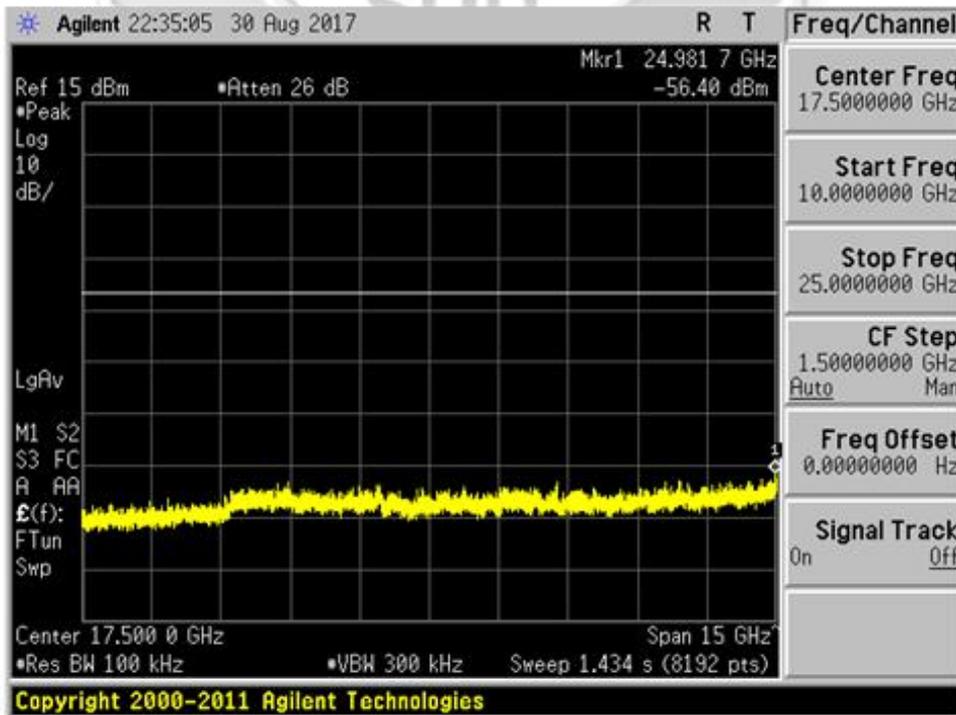


RF CONDUCTED SPURIOUS EMISSIONS (NON-RESTRICTED BANDS) TEST

RF Conducted Spurious Emissions (Non-Restricted Bands) Plots – 802.11g



Plot 72 – Channel 6 (middle ch) @BPSK 9Mbps

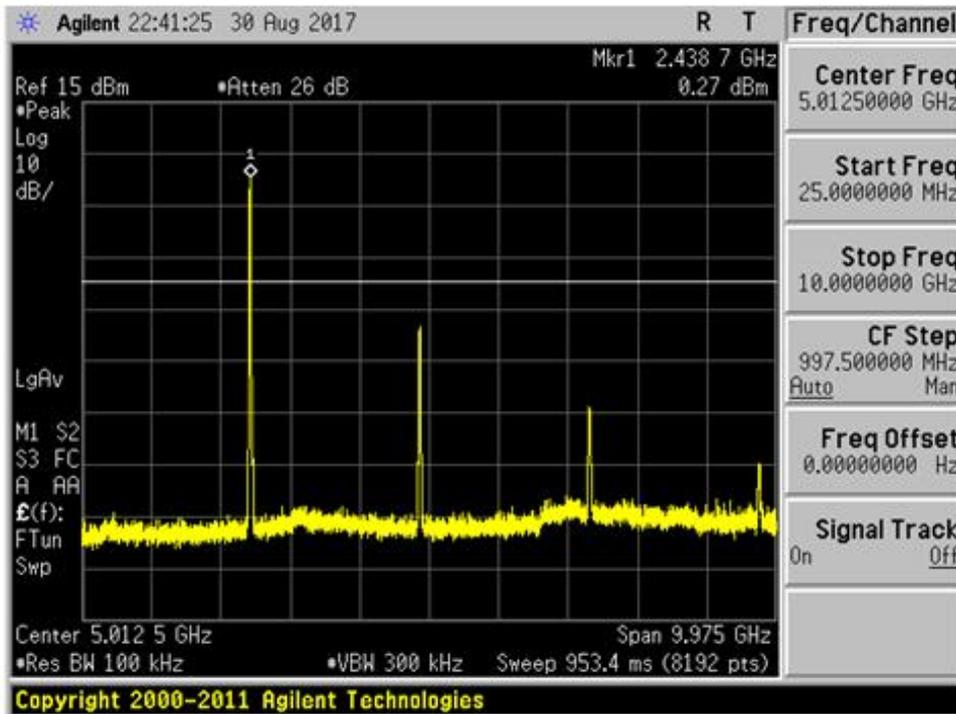


Plot 73 – Channel 6 (middle ch) @BPSK 9Mbps

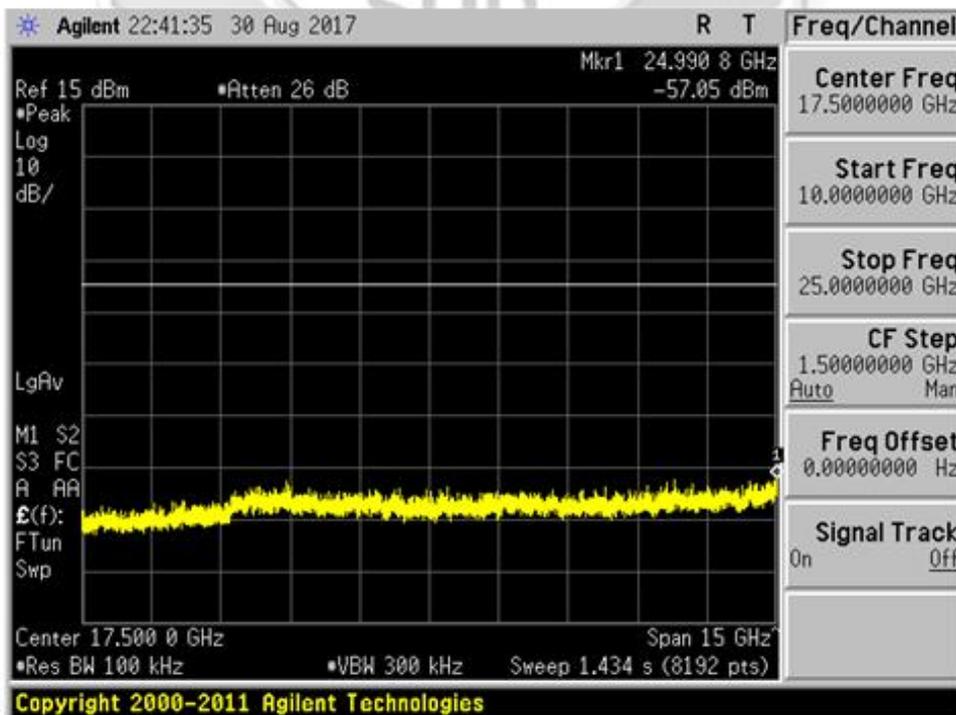


RF CONDUCTED SPURIOUS EMISSIONS (NON-RESTRICTED BANDS) TEST

RF Conducted Spurious Emissions (Non-Restricted Bands) Plots – 802.11g



Plot 74 – Channel 6 (middle ch) @QPSK 18Mbps

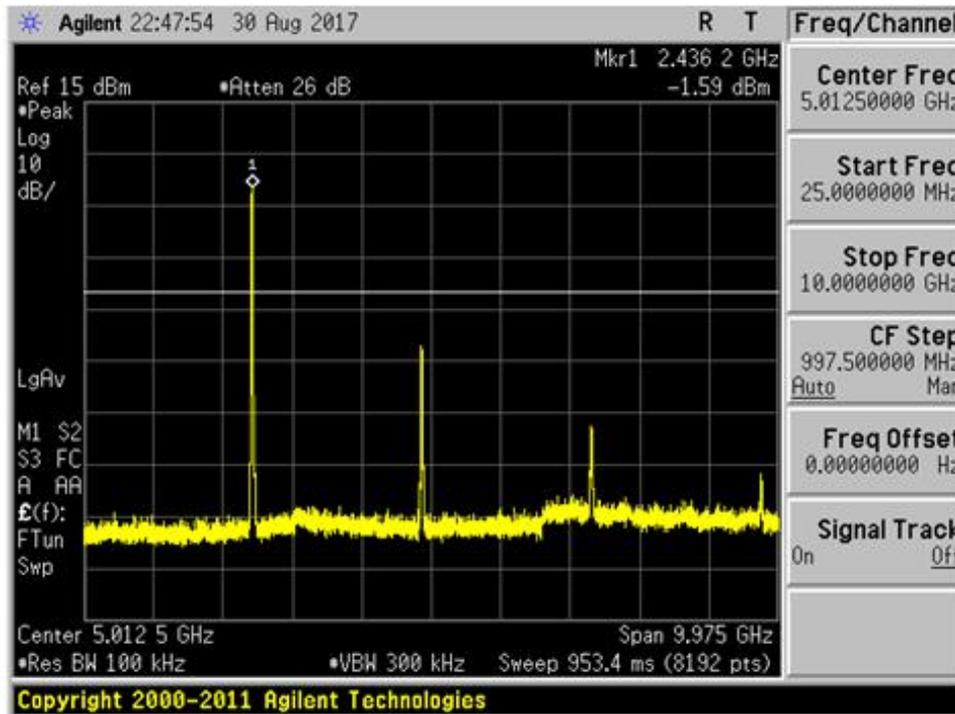


Plot 75 – Channel 6 (middle ch) @QPSK 18Mbps

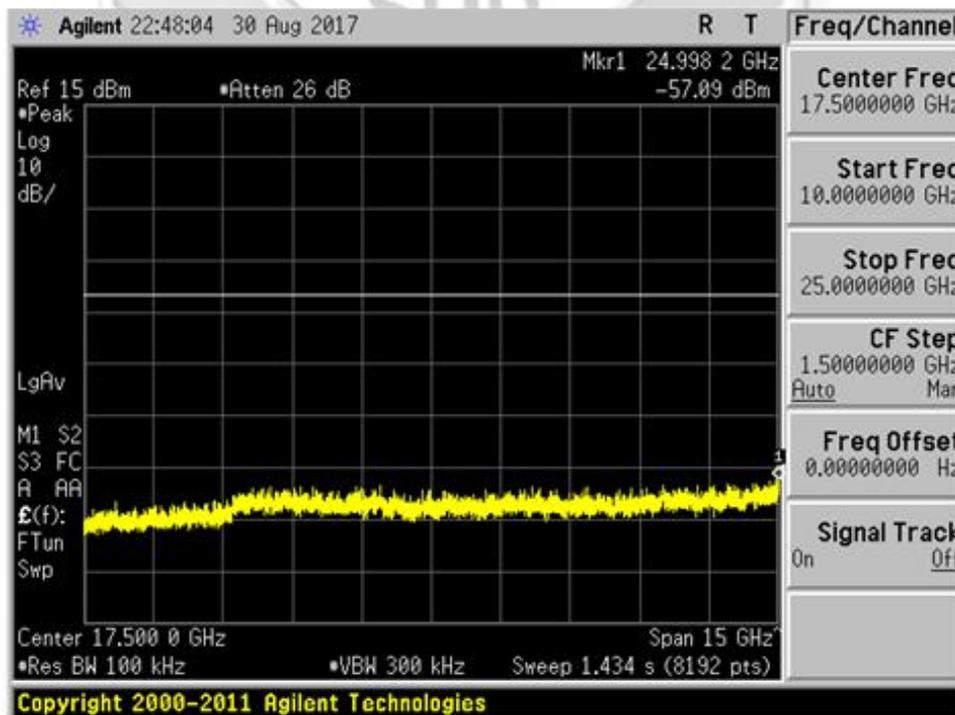


RF CONDUCTED SPURIOUS EMISSIONS (NON-RESTRICTED BANDS) TEST

RF Conducted Spurious Emissions (Non-Restricted Bands) Plots – 802.11g



Plot 76 – Channel 6 (middle ch) @16QAM 36Mbps

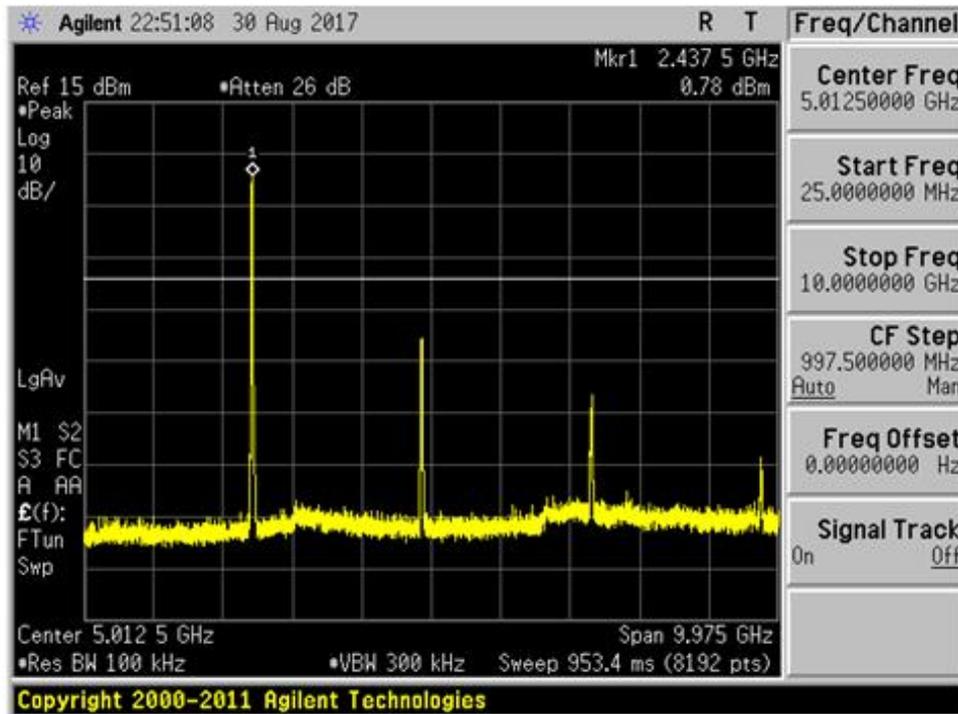


Plot 77 – Channel 6 (middle ch) @16QAM 36Mbps

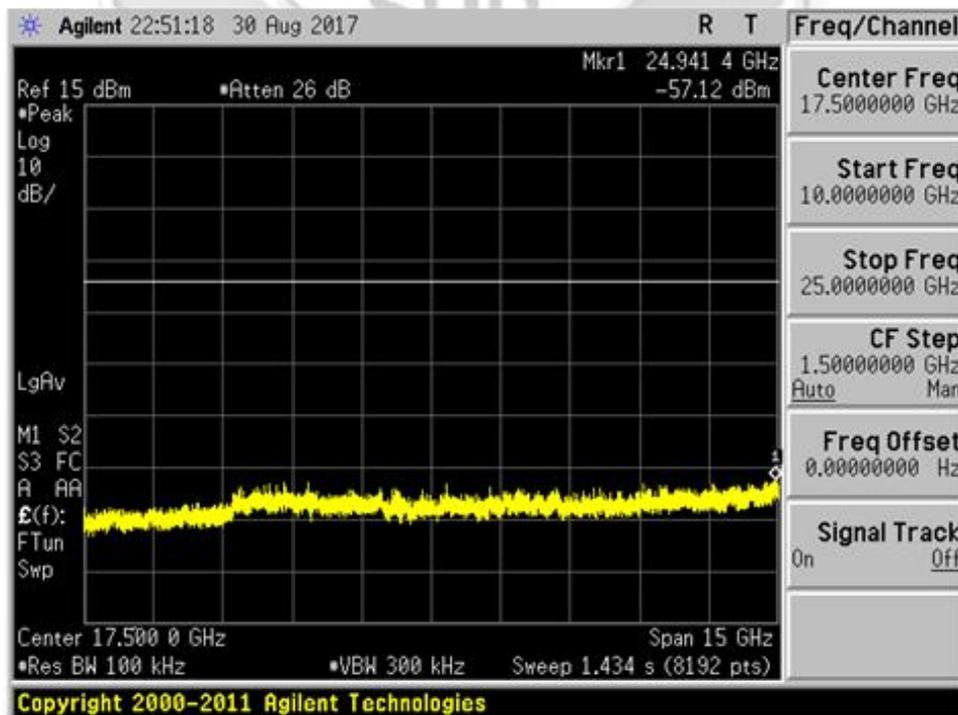


RF CONDUCTED SPURIOUS EMISSIONS (NON-RESTRICTED BANDS) TEST

RF Conducted Spurious Emissions (Non-Restricted Bands) Plots – 802.11g



Plot 78 – Channel 6 (middle ch) @64QAM 54Mbps

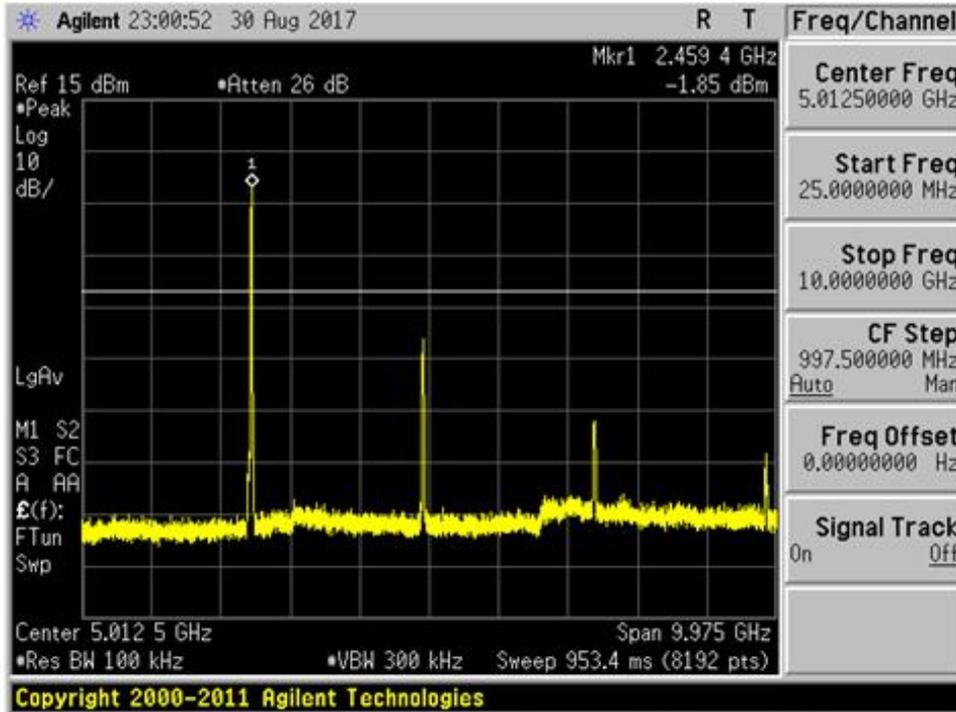


Plot 79 – Channel 6 (middle ch) @64QAM 54Mbps

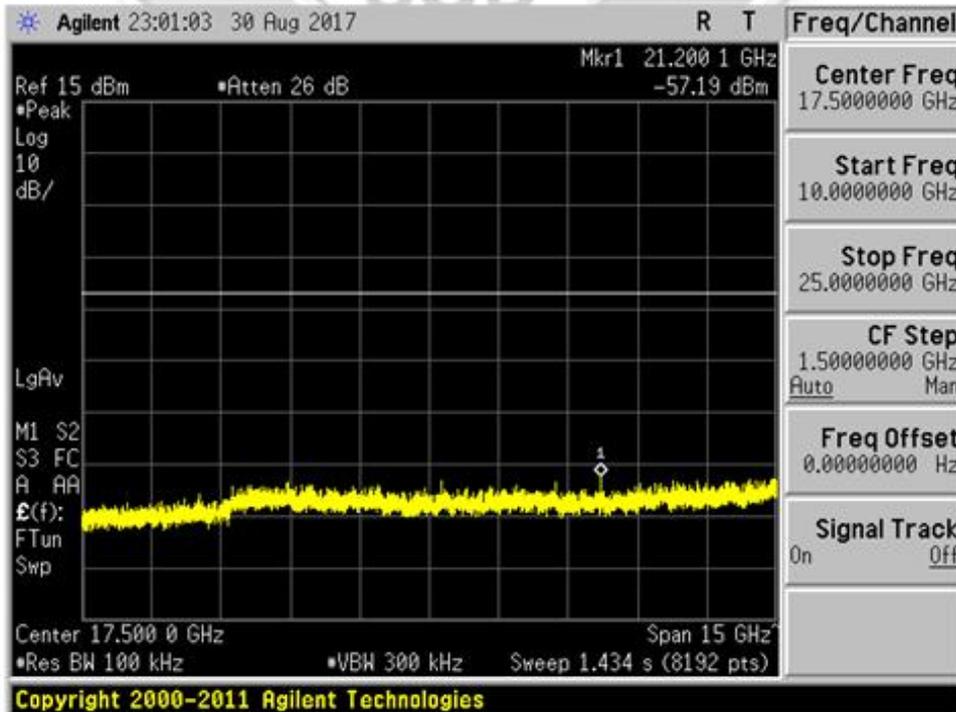


RF CONDUCTED SPURIOUS EMISSIONS (NON-RESTRICTED BANDS) TEST

RF Conducted Spurious Emissions (Non-Restricted Bands) Plots – 802.11g



Plot 80 – Channel 11 (upper ch) @BPSK 9Mbps

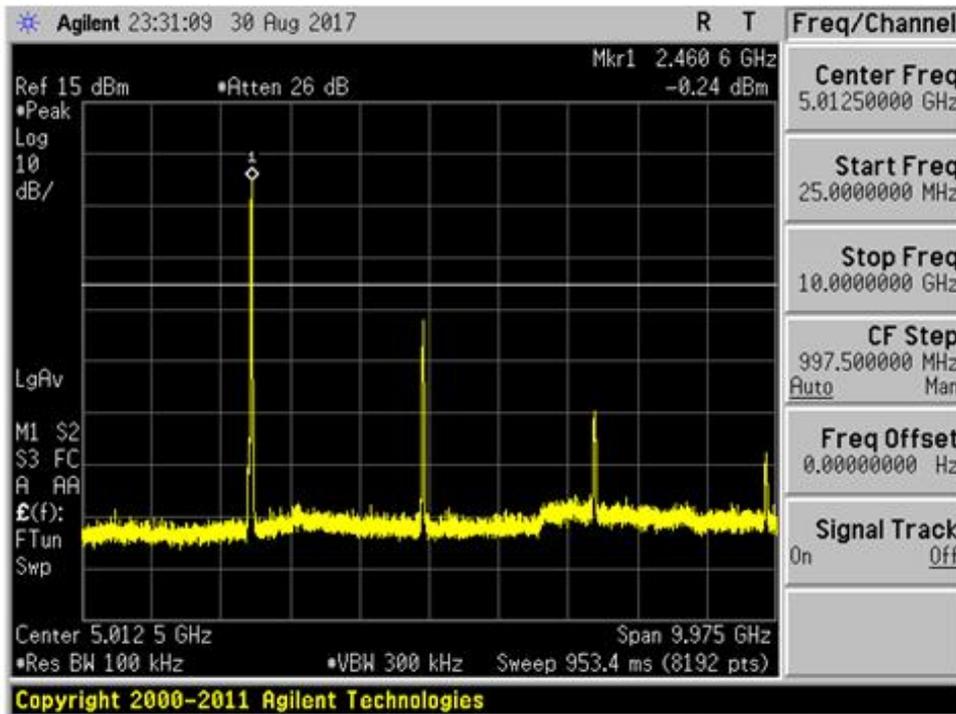


Plot 81 – Channel 11 (upper ch) @BPSK 9Mbps

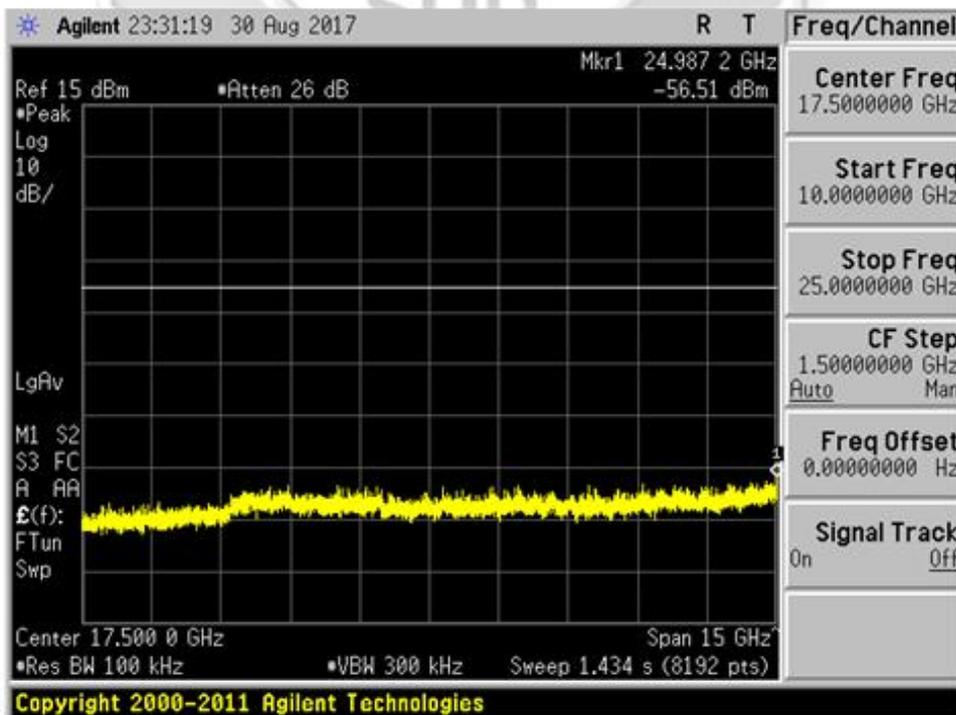


RF CONDUCTED SPURIOUS EMISSIONS (NON-RESTRICTED BANDS) TEST

RF Conducted Spurious Emissions (Non-Restricted Bands) Plots – 802.11g



Plot 82 – Channel 11 (upper ch) @QPSK 18Mbps

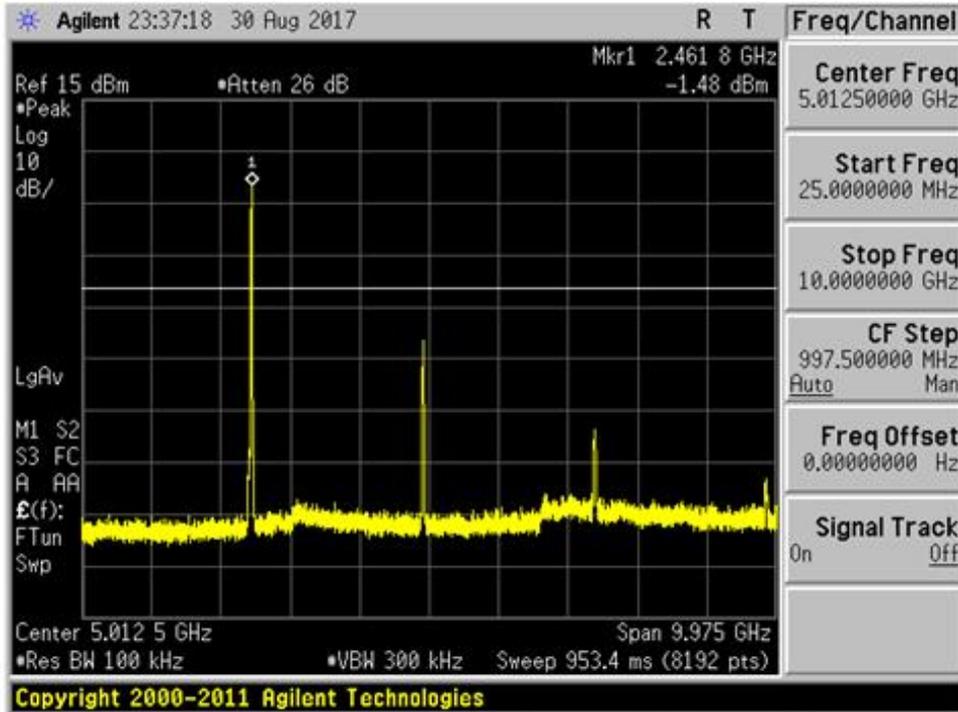


Plot 83 – Channel 11 (upper ch) @QPSK 18Mbps

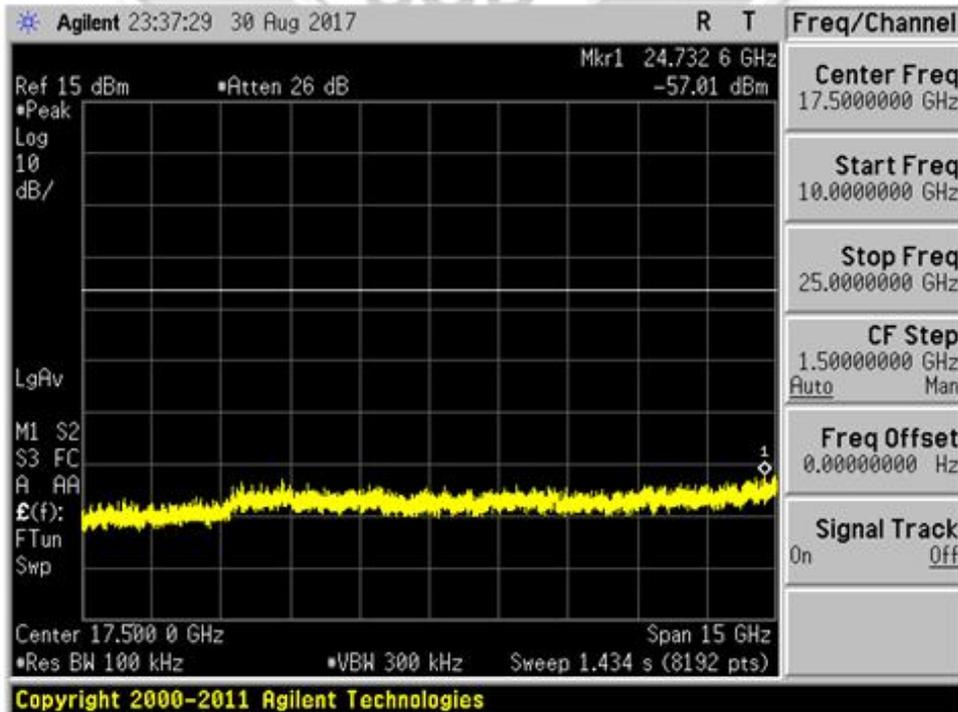


RF CONDUCTED SPURIOUS EMISSIONS (NON-RESTRICTED BANDS) TEST

RF Conducted Spurious Emissions (Non-Restricted Bands) Plots – 802.11g



Plot 84 – Channel 11 (upper ch) @16QAM 36Mbps

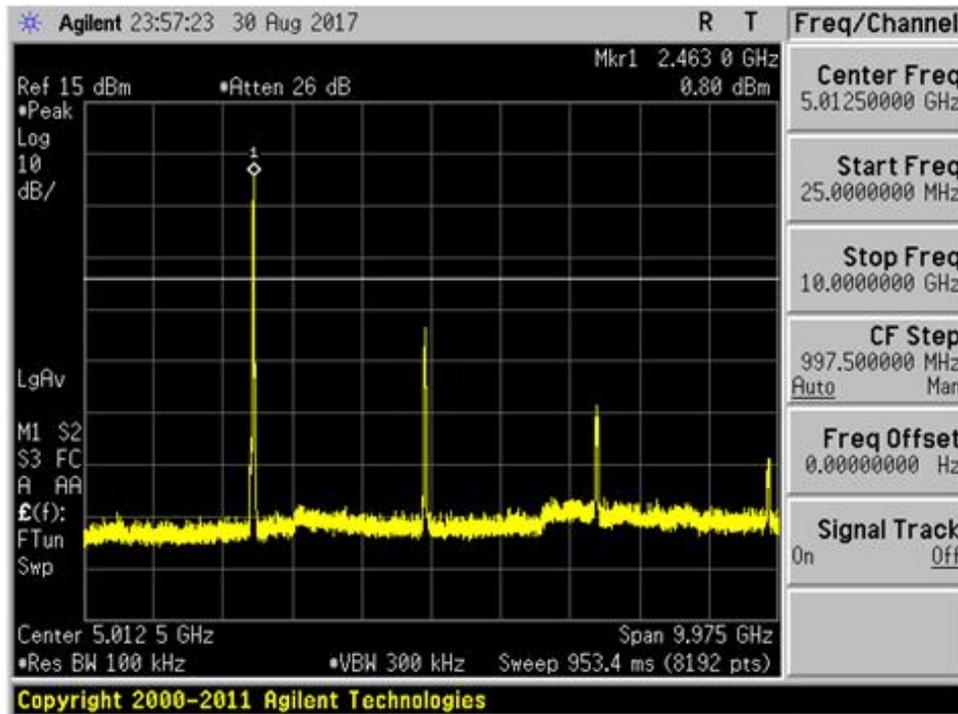


Plot 85 – Channel 11 (upper ch) @16QAM 36Mbps

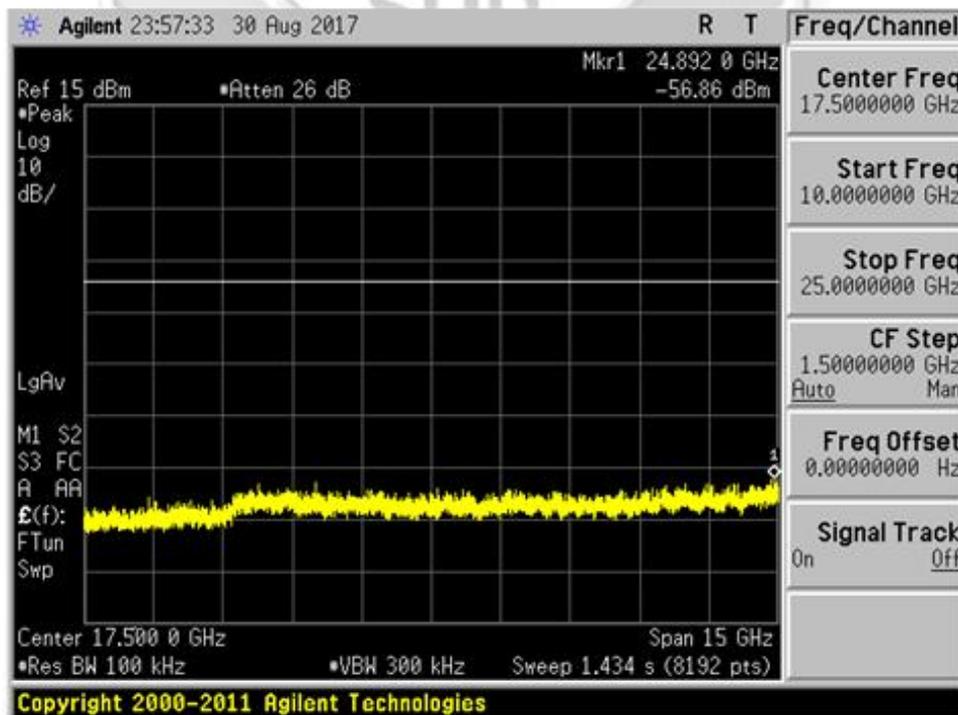


RF CONDUCTED SPURIOUS EMISSIONS (NON-RESTRICTED BANDS) TEST

RF Conducted Spurious Emissions (Non-Restricted Bands) Plots – 802.11g



Plot 86 – Channel 11 (upper ch) @64QAM 54Mbps

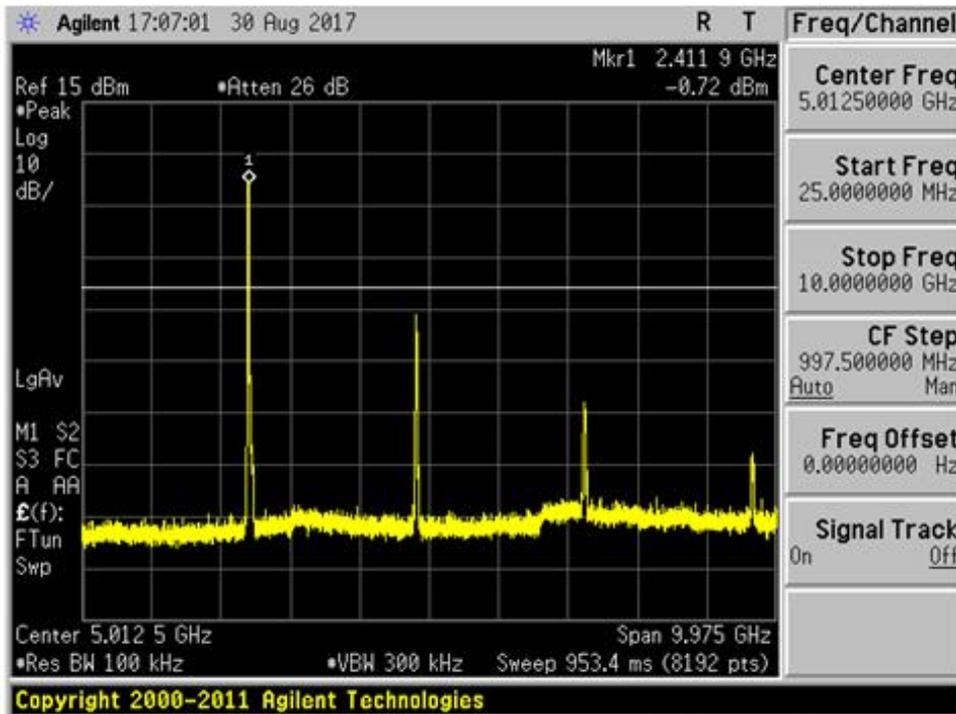


Plot 87 – Channel 11 (upper ch) @64QAM 54Mbps

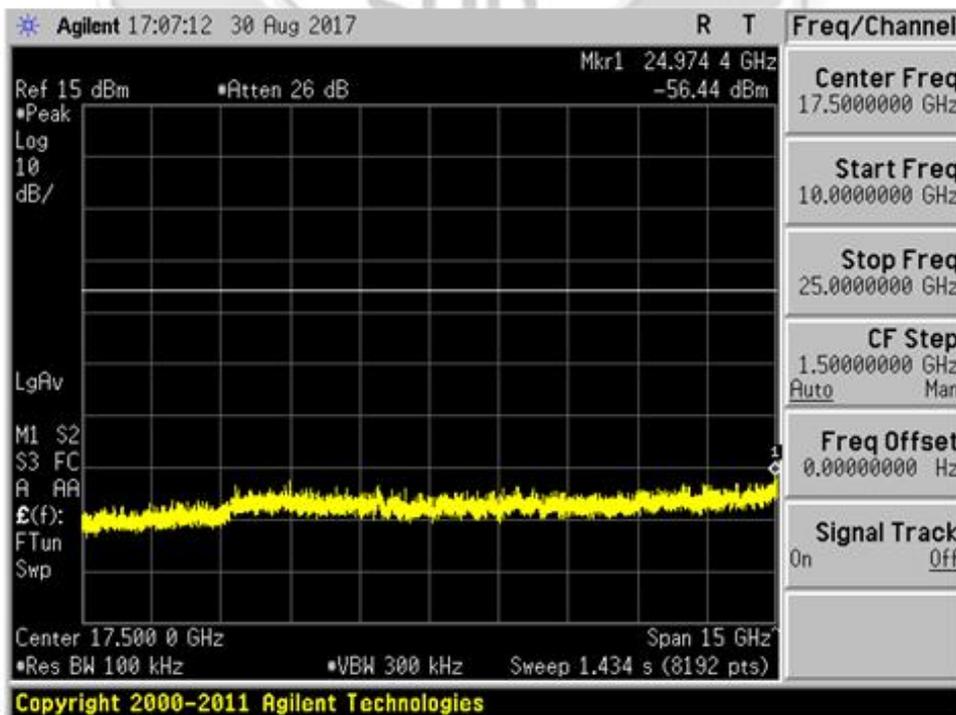


RF CONDUCTED SPURIOUS EMISSIONS (NON-RESTRICTED BANDS) TEST

RF Conducted Spurious Emissions (Non-Restricted Bands) Plots – 802.11n (20MHz)



Plot 88 – Channel 1 (lower ch) @BPSK 6.5Mbps

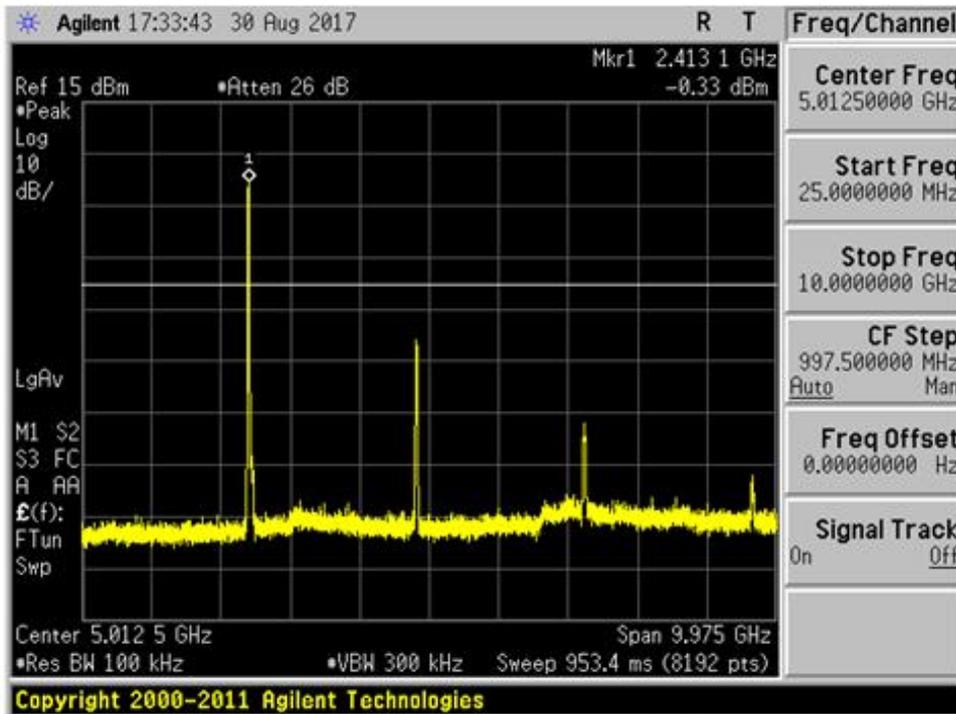


Plot 89 – Channel 1 (lower ch) @BPSK 6.5Mbps

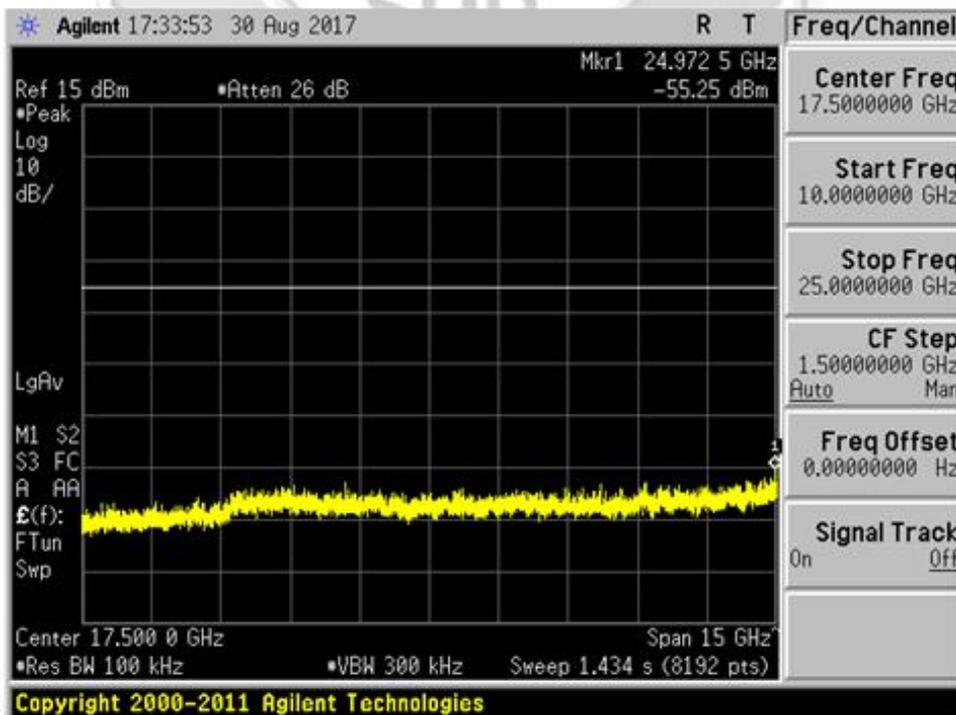


RF CONDUCTED SPURIOUS EMISSIONS (NON-RESTRICTED BANDS) TEST

RF Conducted Spurious Emissions (Non-Restricted Bands) Plots – 802.11n (20MHz)



Plot 90 – Channel 1 (lower ch) @QPSK 19.5Mbps

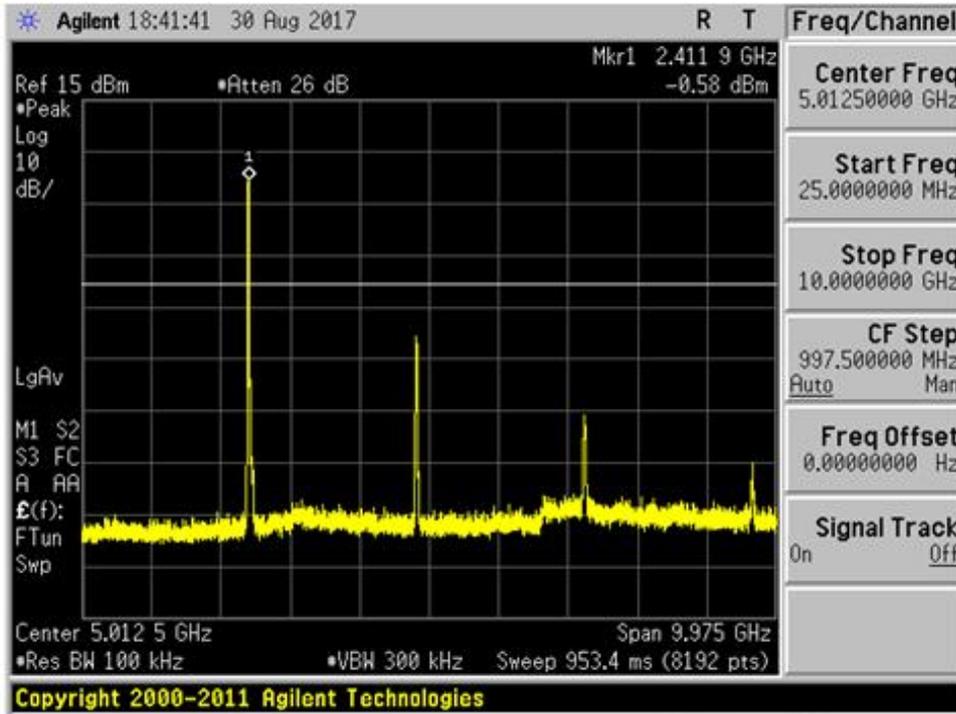


Plot 91 – Channel 1 (lower ch) @QPSK 19.5Mbps

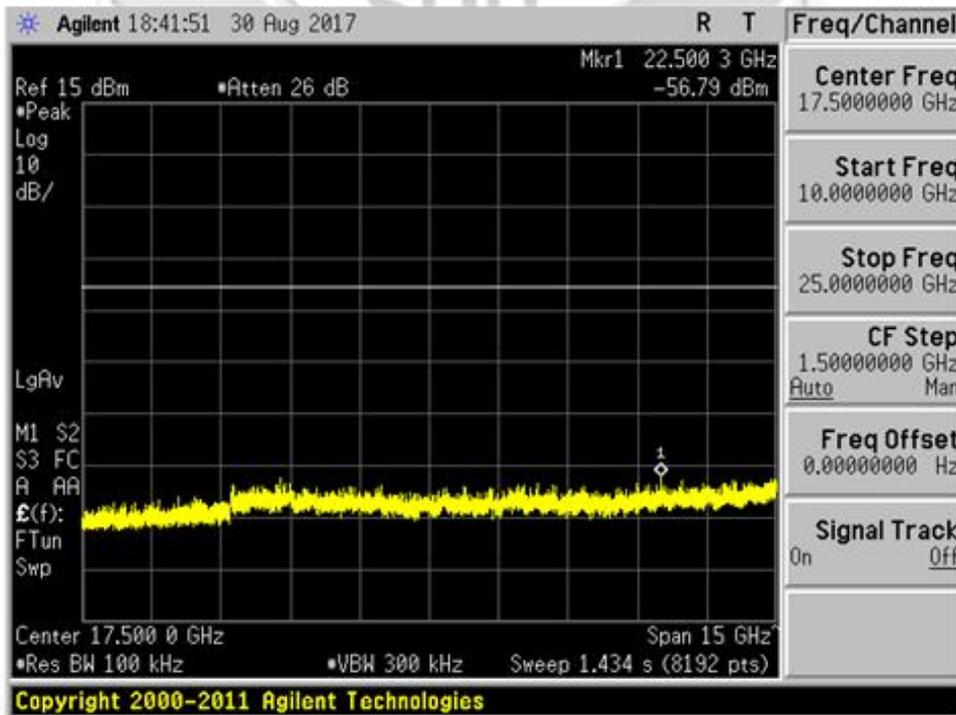


RF CONDUCTED SPURIOUS EMISSIONS (NON-RESTRICTED BANDS) TEST

RF Conducted Spurious Emissions (Non-Restricted Bands) Plots – 802.11n (20MHz)



Plot 92 – Channel 1 (lower ch) @16QAM 39Mbps

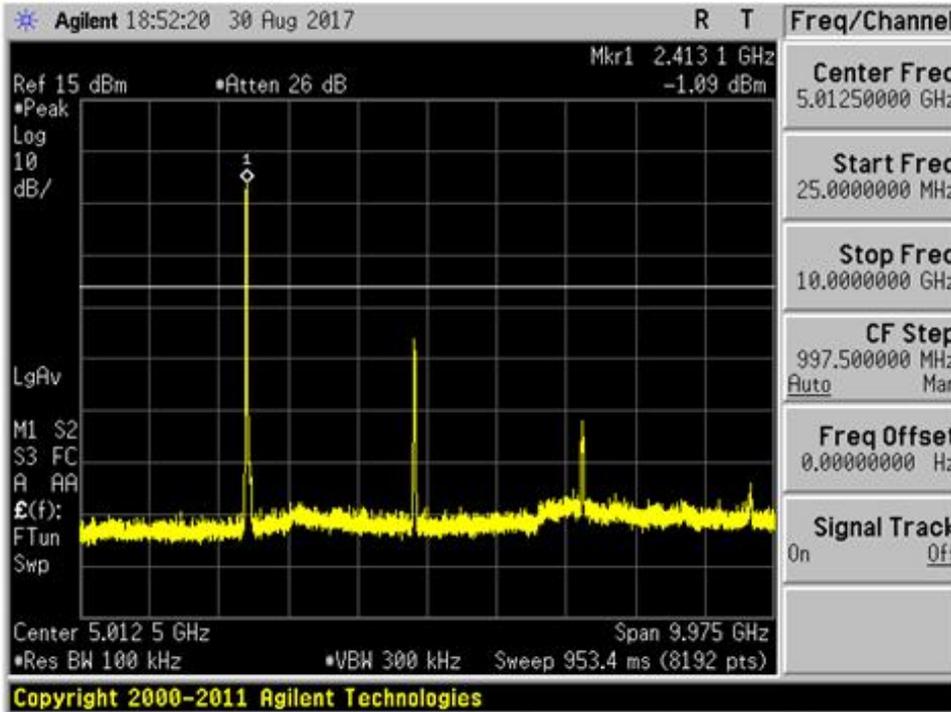


Plot 93 – Channel 1 (lower ch) @16QAM 39Mbps

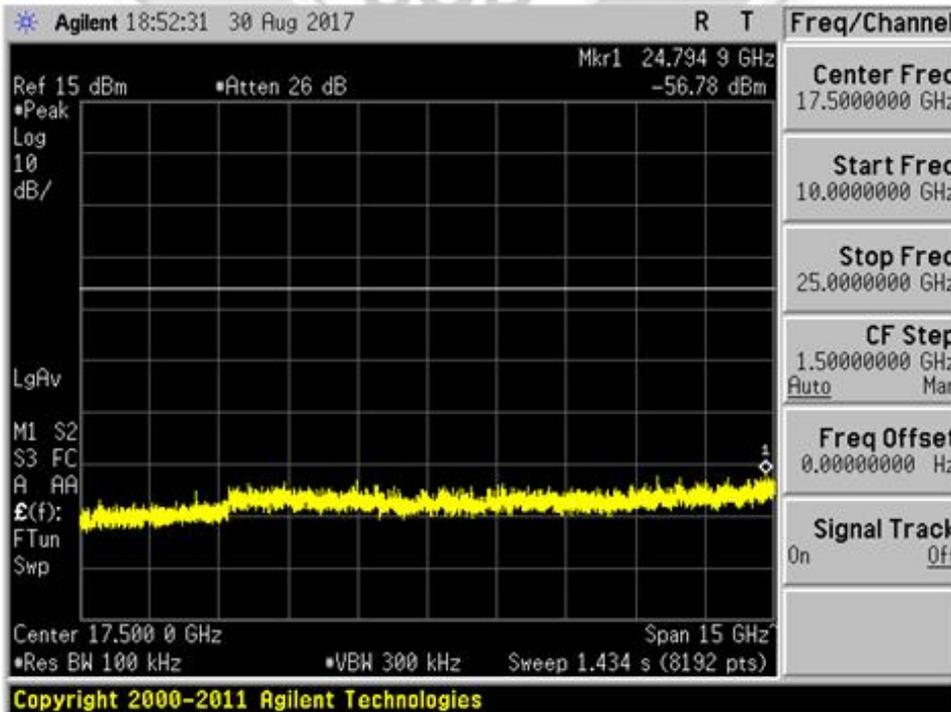


RF CONDUCTED SPURIOUS EMISSIONS (NON-RESTRICTED BANDS) TEST

RF Conducted Spurious Emissions (Non-Restricted Bands) Plots – 802.11n (20MHz)



Plot 94 – Channel 1 (lower ch) @64QAM 65Mbps

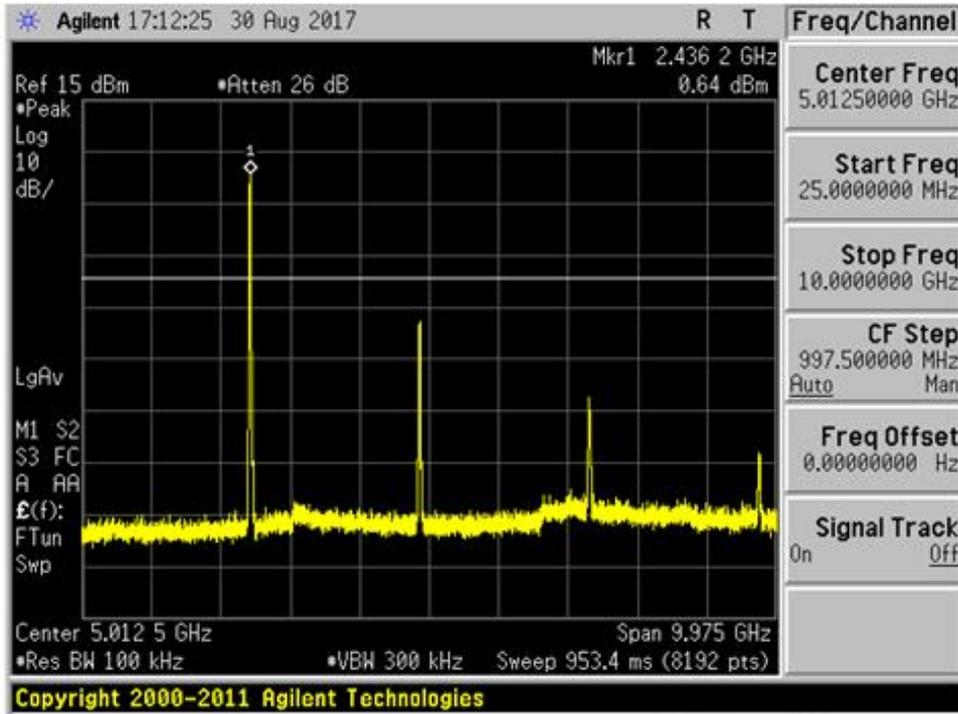


Plot 95 – Channel 1 (lower ch) @64QAM 65Mbps

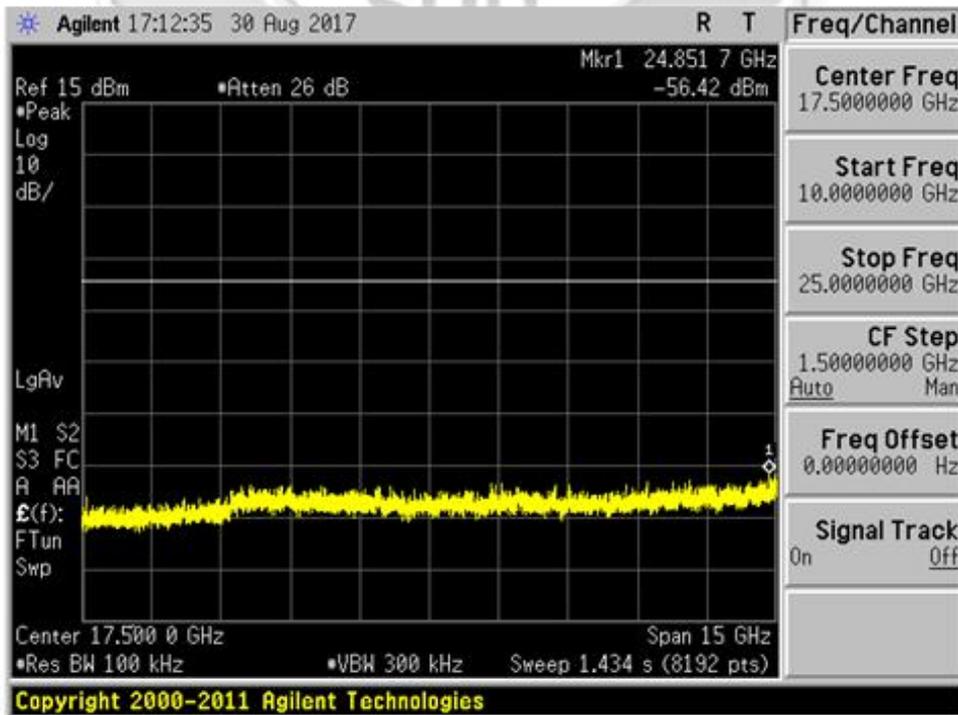


RF CONDUCTED SPURIOUS EMISSIONS (NON-RESTRICTED BANDS) TEST

RF Conducted Spurious Emissions (Non-Restricted Bands) Plots – 802.11n (20MHz)



Plot 96 – Channel 6 (middle ch) @BPSK 6.5Mbps

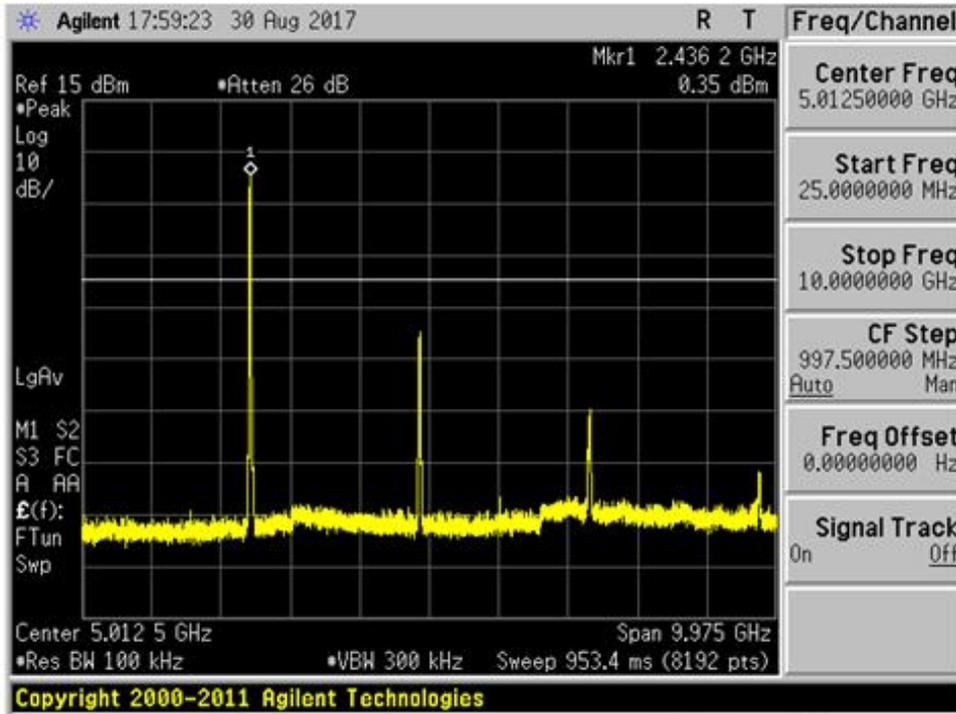


Plot 97 – Channel 6 (middle ch) @BPSK 6.5Mbps

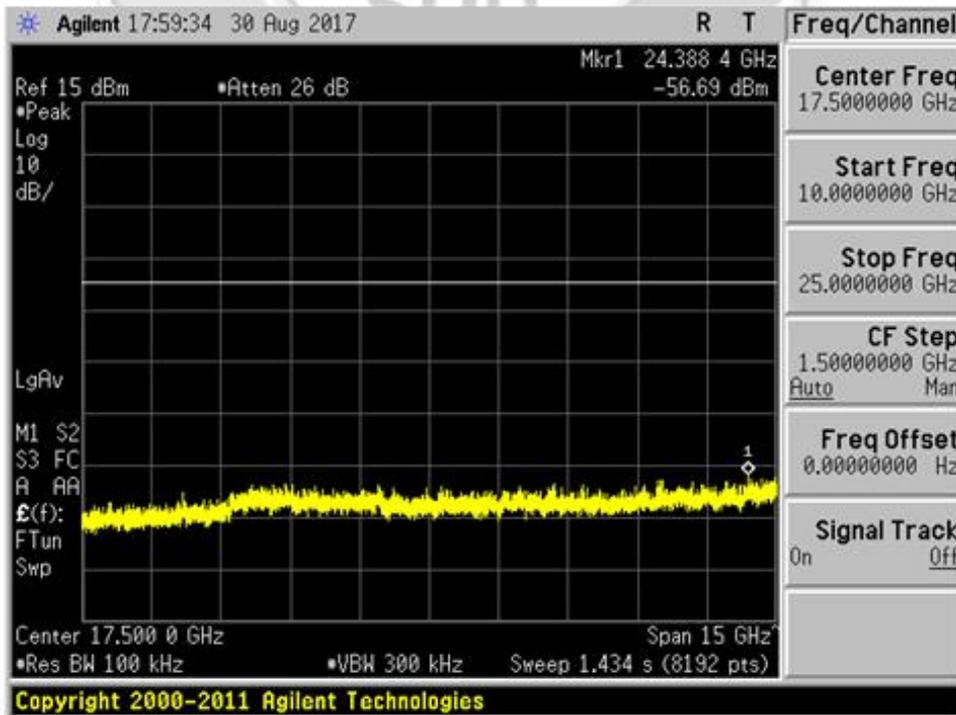


RF CONDUCTED SPURIOUS EMISSIONS (NON-RESTRICTED BANDS) TEST

RF Conducted Spurious Emissions (Non-Restricted Bands) Plots – 802.11n (20MHz)



Plot 98 – Channel 6 (middle ch) @QPSK 19.5Mbps

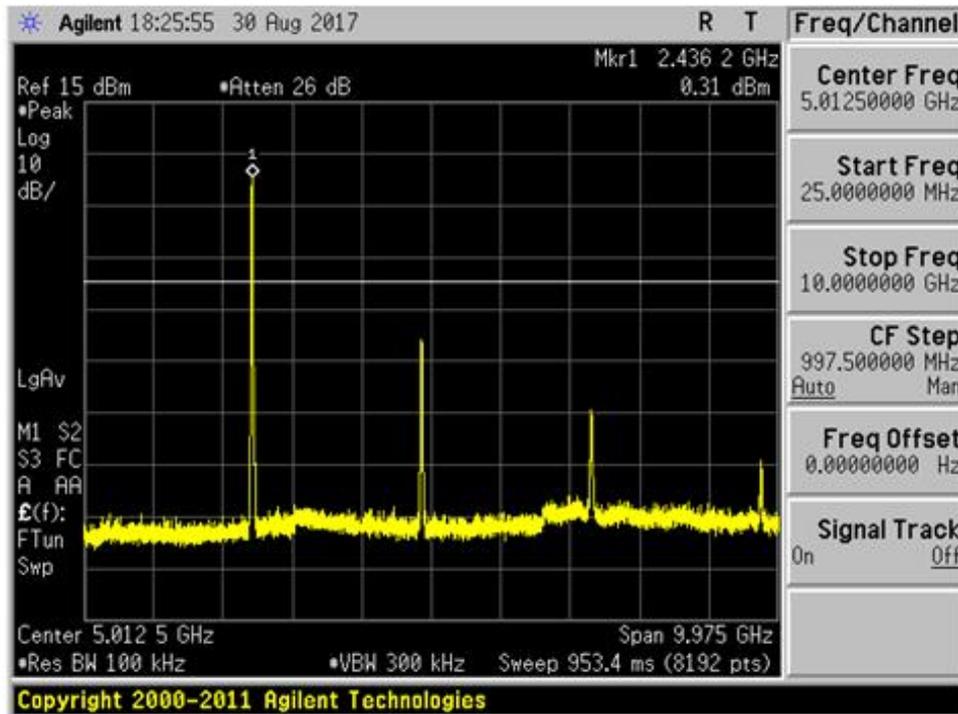


Plot 99 – Channel 6 (middle ch) @QPSK 19.5Mbps

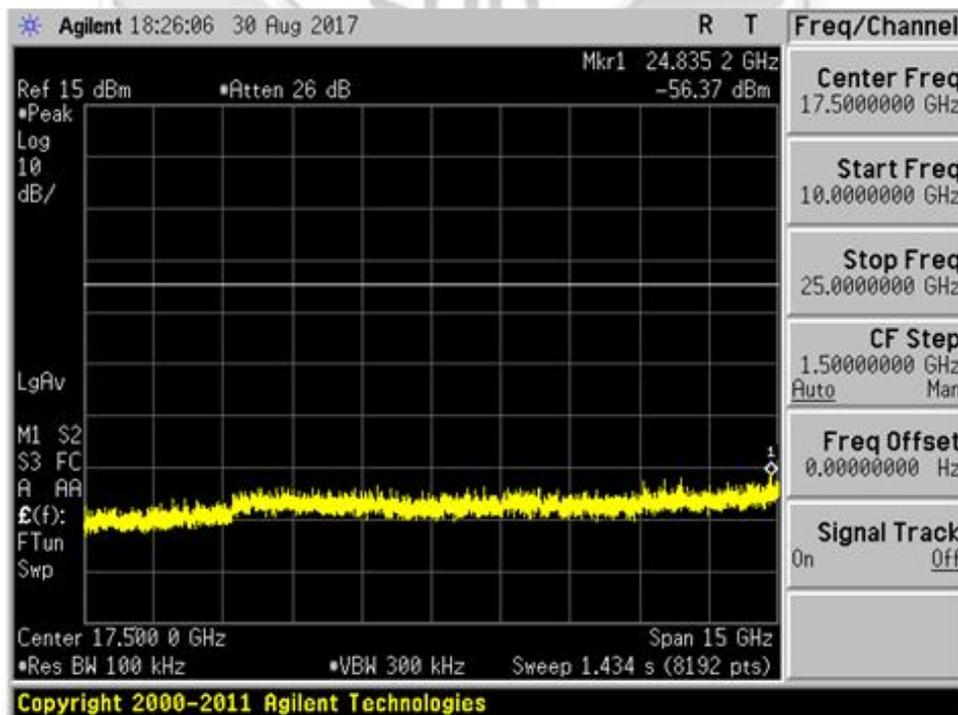


RF CONDUCTED SPURIOUS EMISSIONS (NON-RESTRICTED BANDS) TEST

RF Conducted Spurious Emissions (Non-Restricted Bands) Plots – 802.11n (20MHz)



Plot 100 – Channel 6 (middle ch) @16QAM 39Mbps

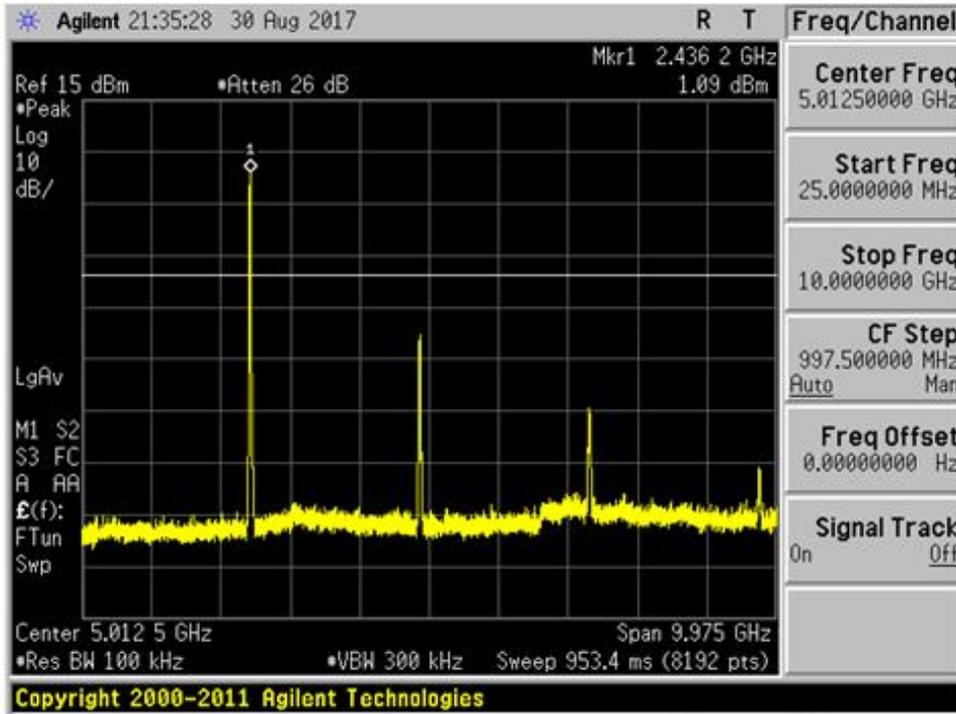


Plot 101 – Channel 6 (middle ch) @16QAM 39Mbps

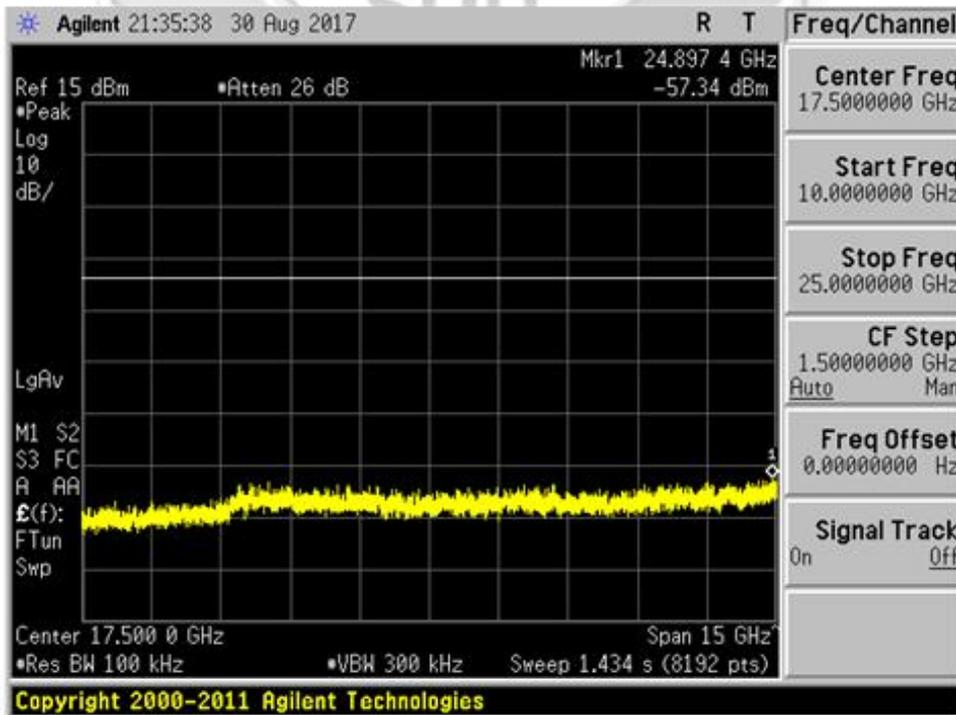


RF CONDUCTED SPURIOUS EMISSIONS (NON-RESTRICTED BANDS) TEST

RF Conducted Spurious Emissions (Non-Restricted Bands) Plots – 802.11n (20MHz)



Plot 102 – Channel 6 (middle ch) @64QAM 65Mbps

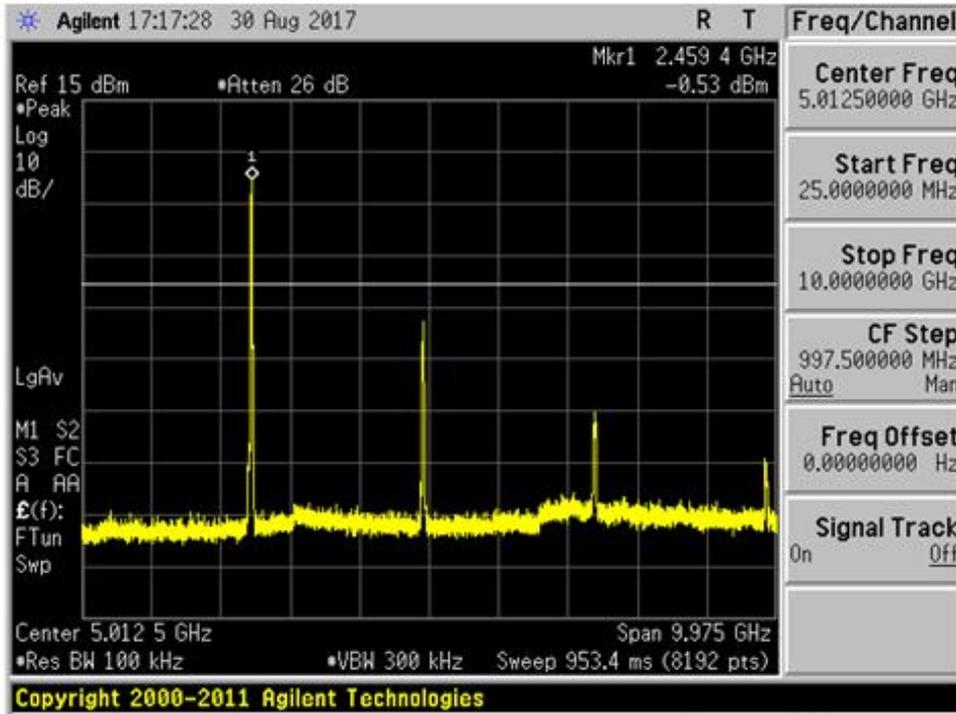


Plot 103 – Channel 6 (middle ch) @64QAM 65Mbps

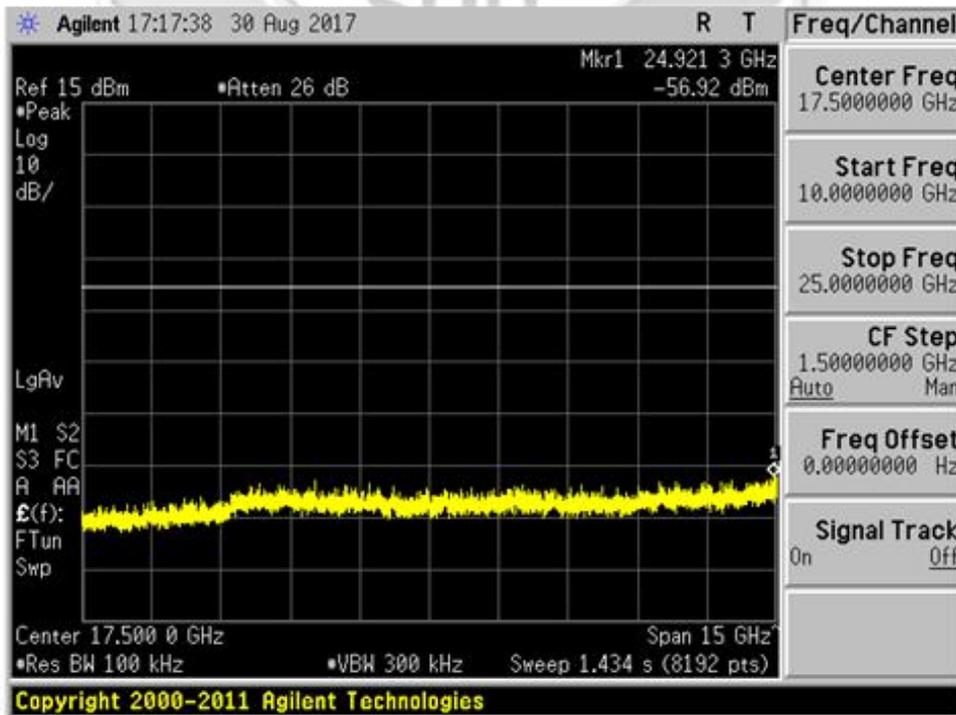


RF CONDUCTED SPURIOUS EMISSIONS (NON-RESTRICTED BANDS) TEST

RF Conducted Spurious Emissions (Non-Restricted Bands) Plots – 802.11n (20MHz)



Plot 104 – Channel 11 (upper ch) @BPSK 6.5Mbps

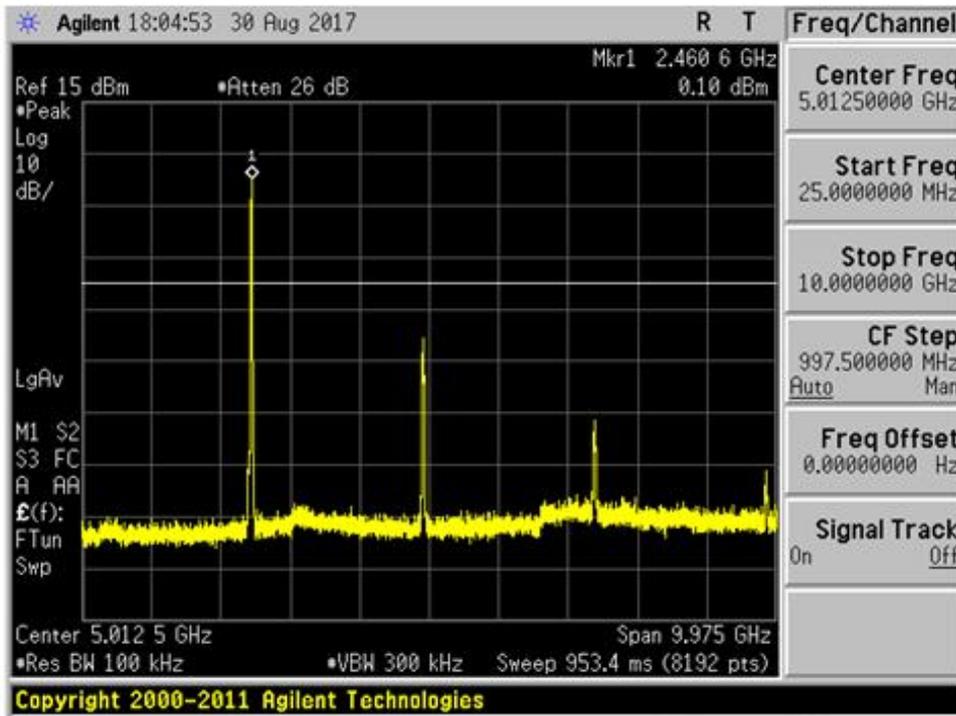


Plot 105 – Channel 11 (upper ch) @BPSK 6.5Mbps

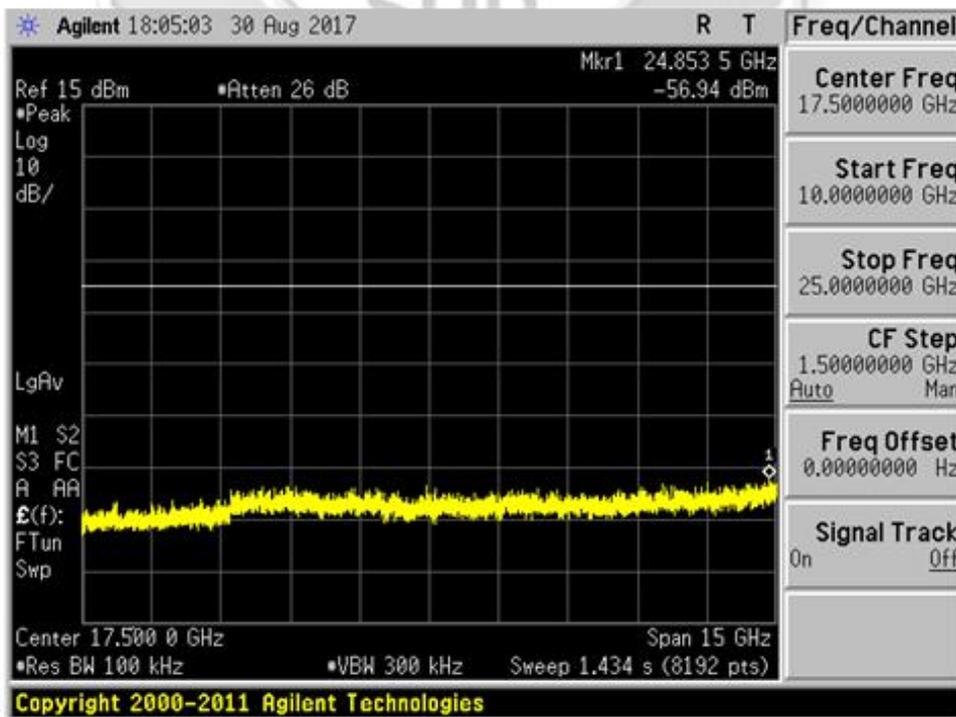


RF CONDUCTED SPURIOUS EMISSIONS (NON-RESTRICTED BANDS) TEST

RF Conducted Spurious Emissions (Non-Restricted Bands) Plots – 802.11n (20MHz)



Plot 106 – Channel 11 (upper ch) @QPSK 19.5Mbps

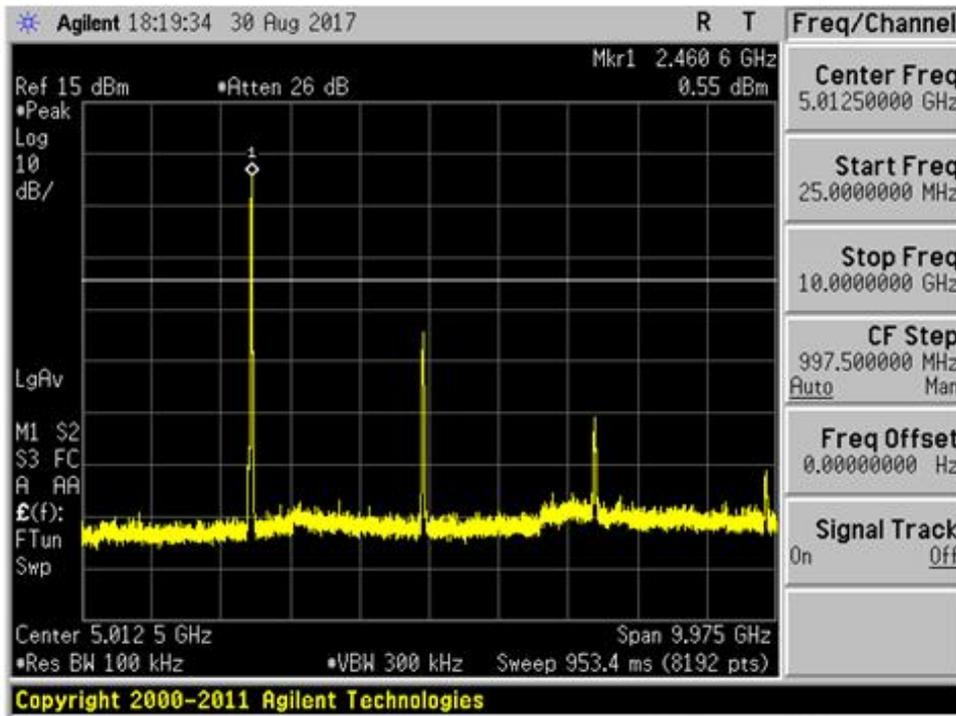


Plot 107 – Channel 11 (upper ch) @QPSK 19.5Mbps

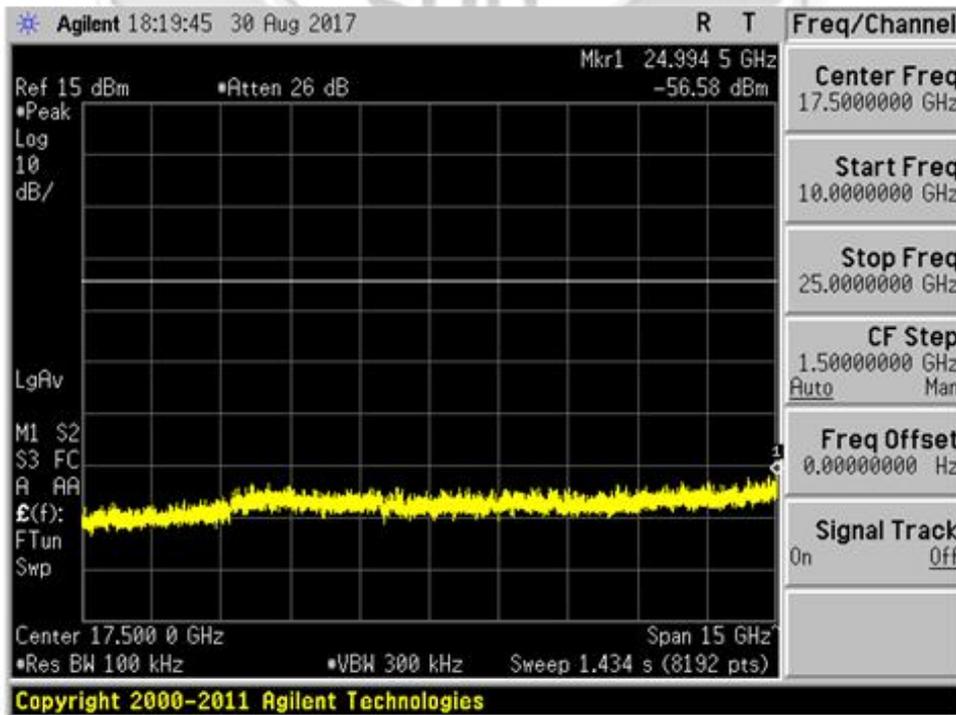


RF CONDUCTED SPURIOUS EMISSIONS (NON-RESTRICTED BANDS) TEST

RF Conducted Spurious Emissions (Non-Restricted Bands) Plots – 802.11n (20MHz)



Plot 108 – Channel 11 (upper ch) @16QAM 39Mbps

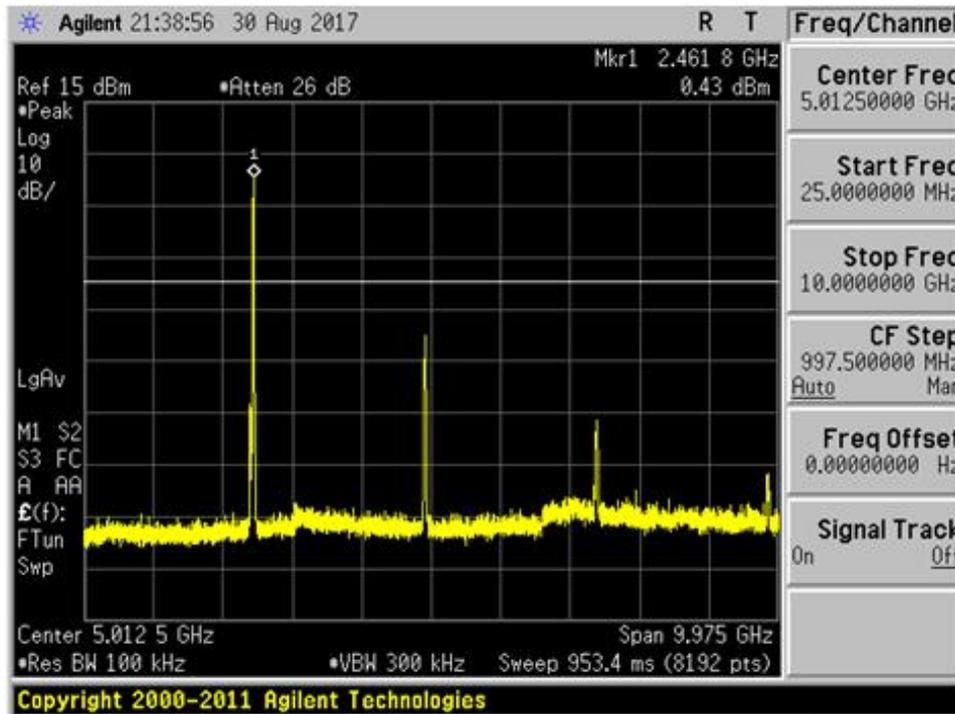


Plot 109 – Channel 11 (upper ch) @16QAM 39Mbps

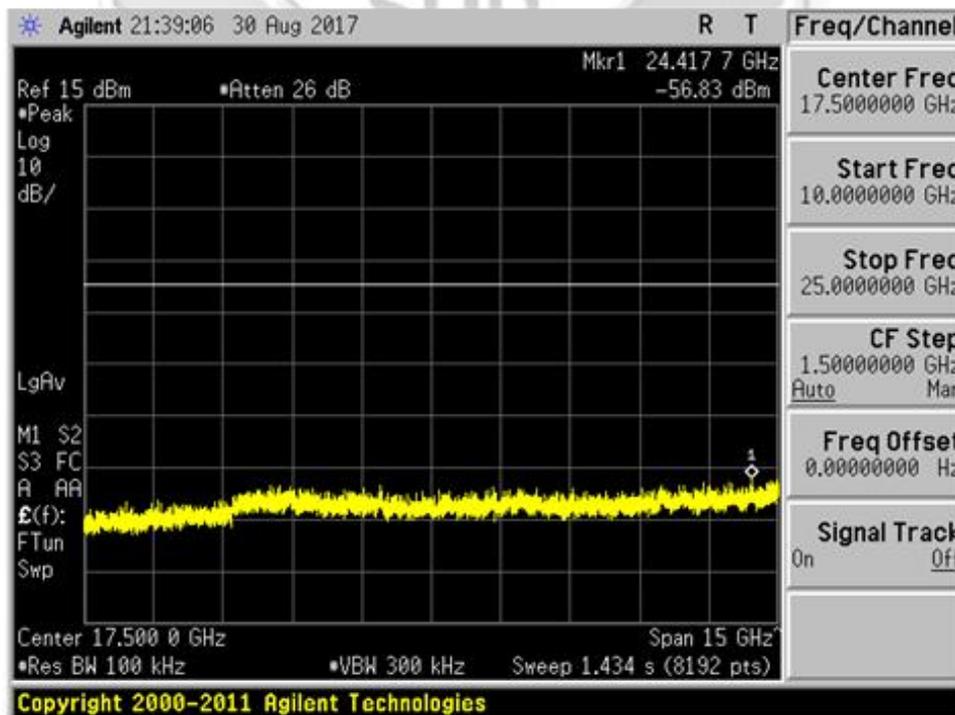


RF CONDUCTED SPURIOUS EMISSIONS (NON-RESTRICTED BANDS) TEST

RF Conducted Spurious Emissions (Non-Restricted Bands) Plots – 802.11n (20MHz)



Plot 110 – Channel 11 (upper ch) @64QAM 65Mbps

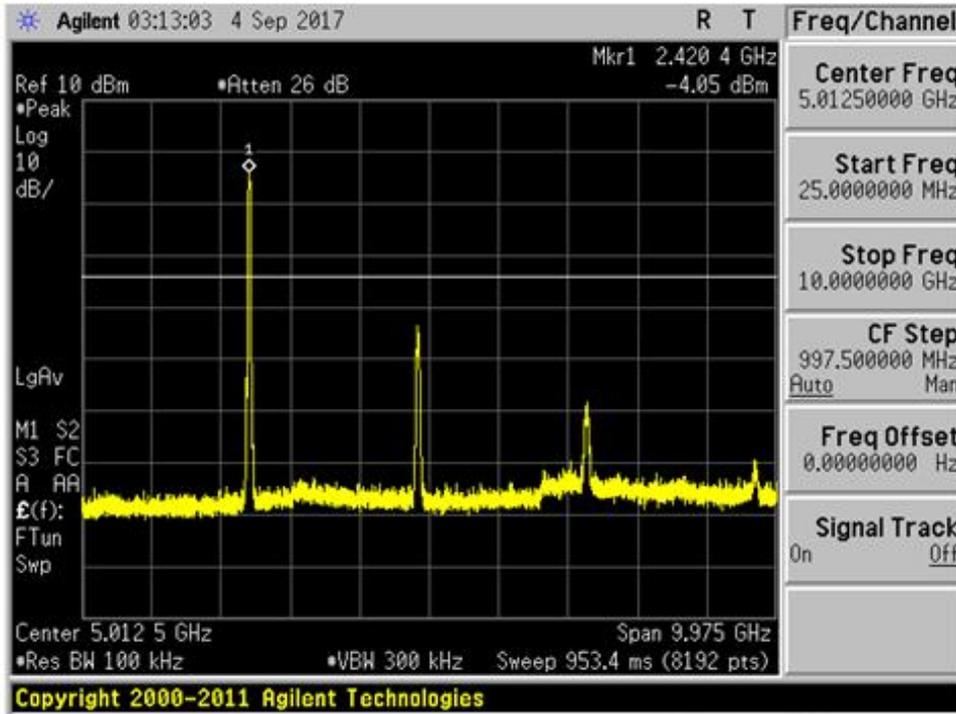


Plot 111 – Channel 11 (upper ch) @64QAM 65Mbps

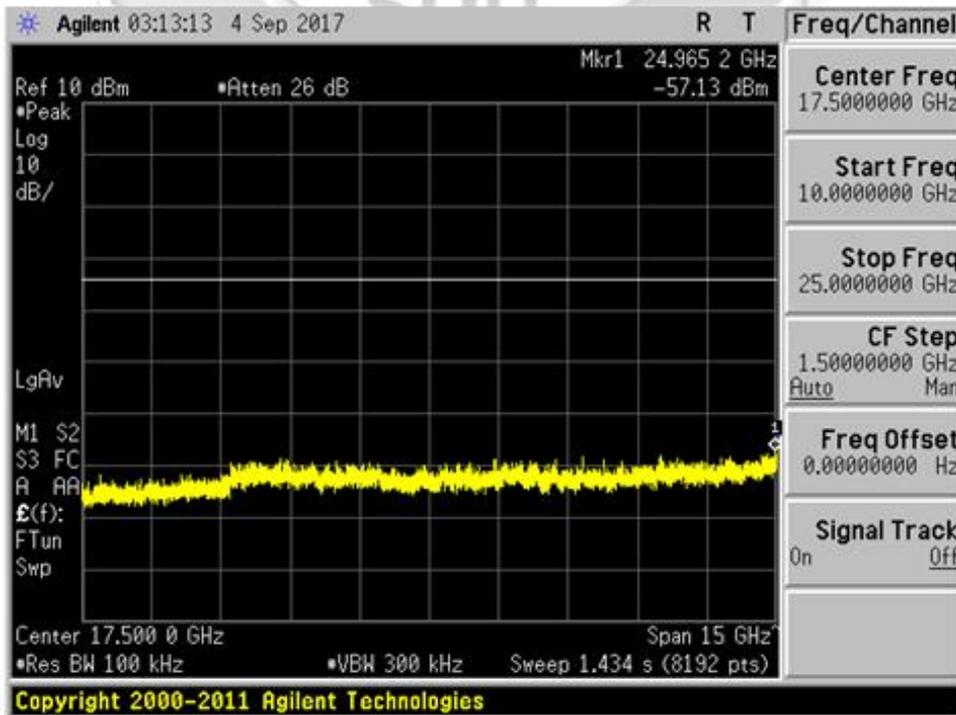


RF CONDUCTED SPURIOUS EMISSIONS (NON-RESTRICTED BANDS) TEST

RF Conducted Spurious Emissions (Non-Restricted Bands) Plots – 802.11n (40MHz)



Plot 112 – Channel 1 (lower ch) @BPSK 13.5Mbps

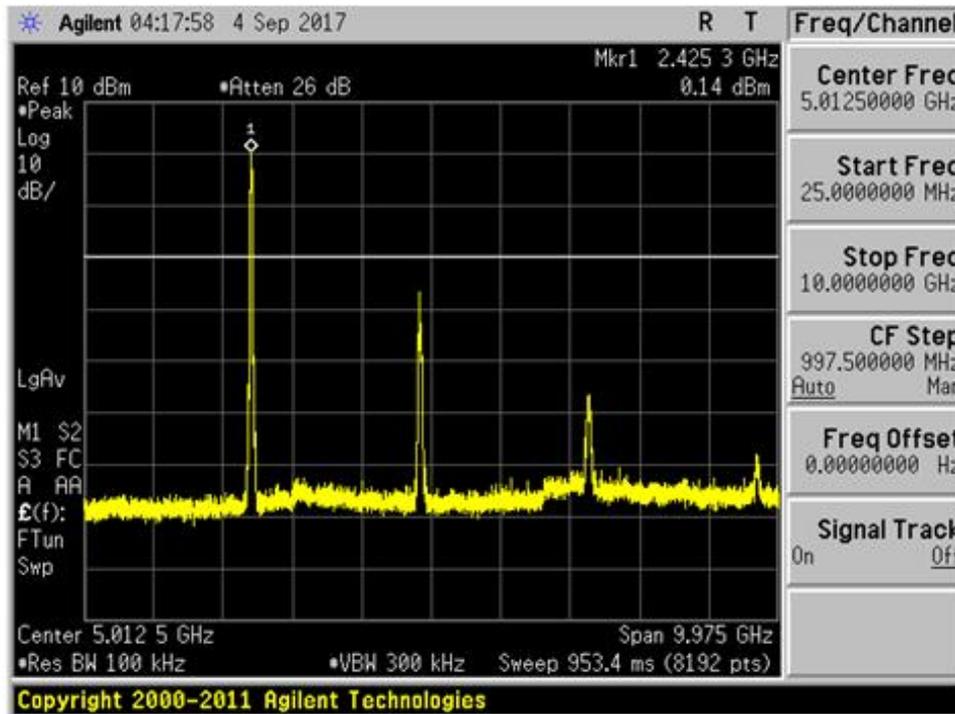


Plot 113 – Channel 1 (lower ch) @BPSK 13.5Mbps

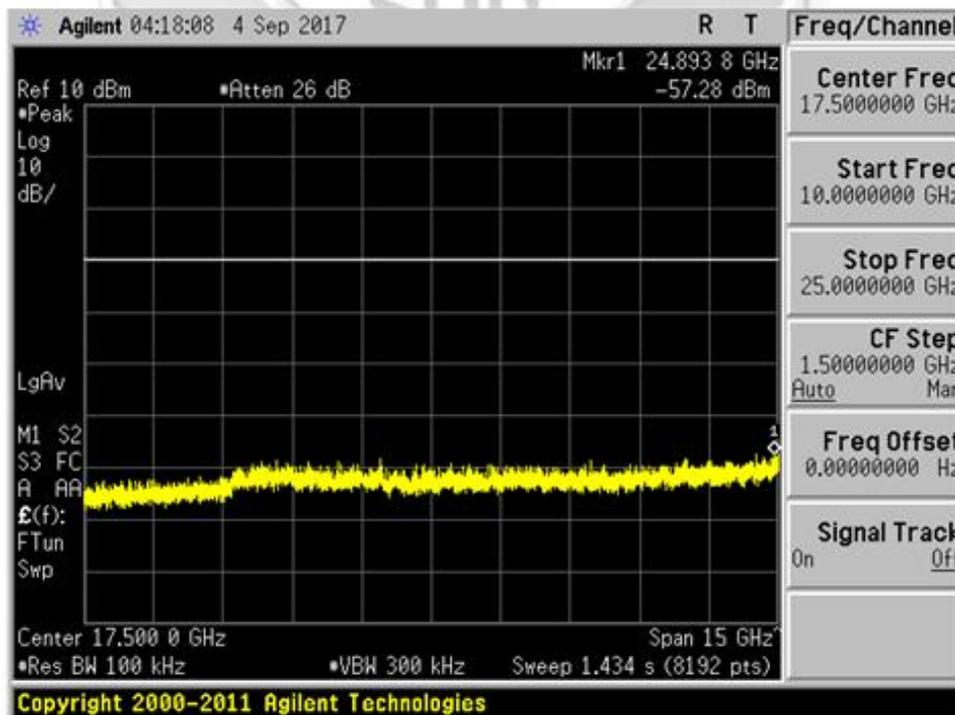


RF CONDUCTED SPURIOUS EMISSIONS (NON-RESTRICTED BANDS) TEST

RF Conducted Spurious Emissions (Non-Restricted Bands) Plots – 802.11n (40MHz)



Plot 114 – Channel 1 (lower ch) @QPSK 40.5Mbps

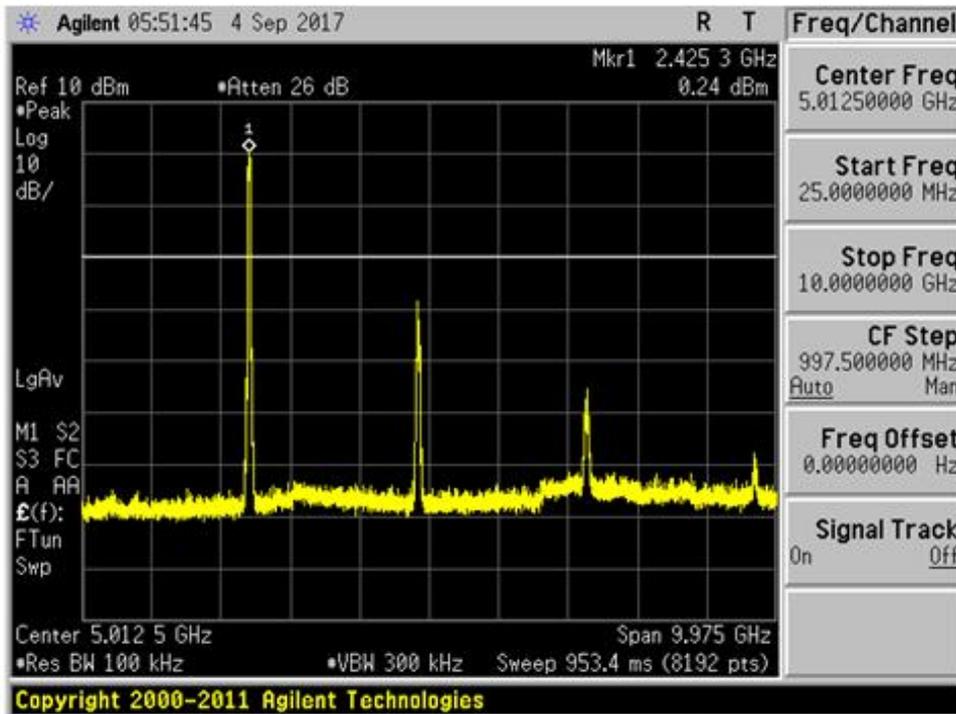


Plot 115 – Channel 1 (lower ch) @QPSK 40.5Mbps

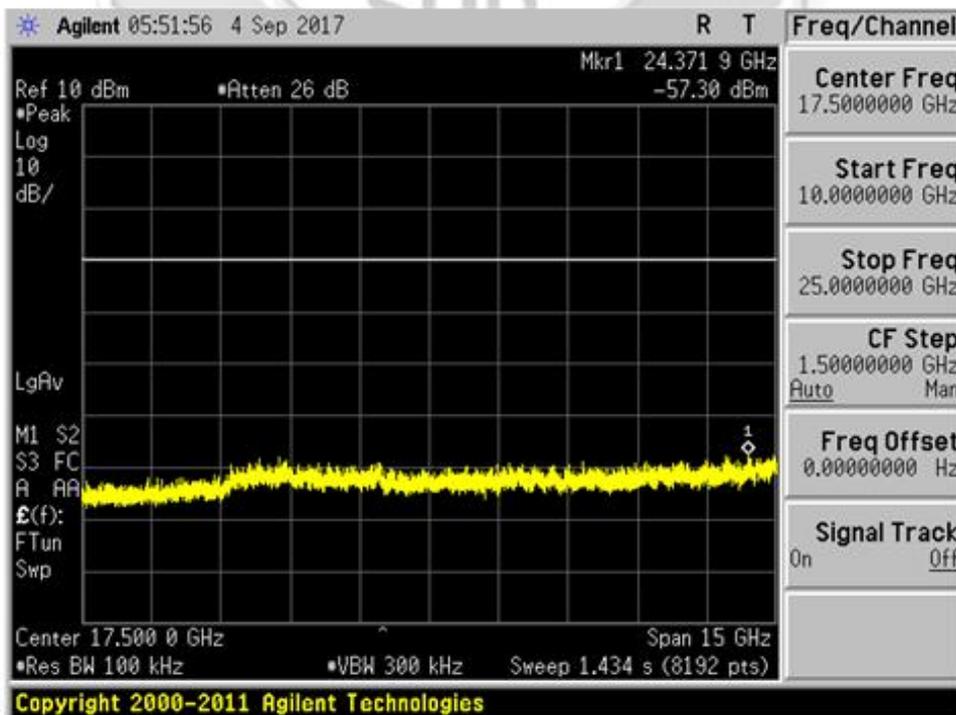


RF CONDUCTED SPURIOUS EMISSIONS (NON-RESTRICTED BANDS) TEST

RF Conducted Spurious Emissions (Non-Restricted Bands) Plots – 802.11n (40MHz)



Plot 116 – Channel 1 (lower ch) @16QAM 81Mbps

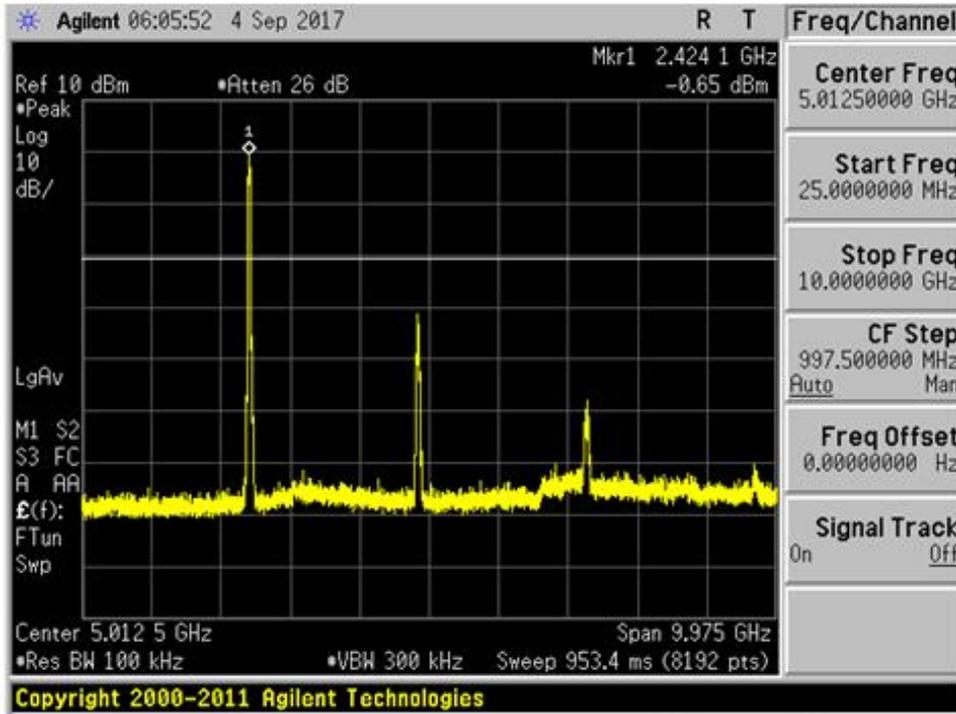


Plot 117 – Channel 1 (lower ch) @16QAM 81Mbps

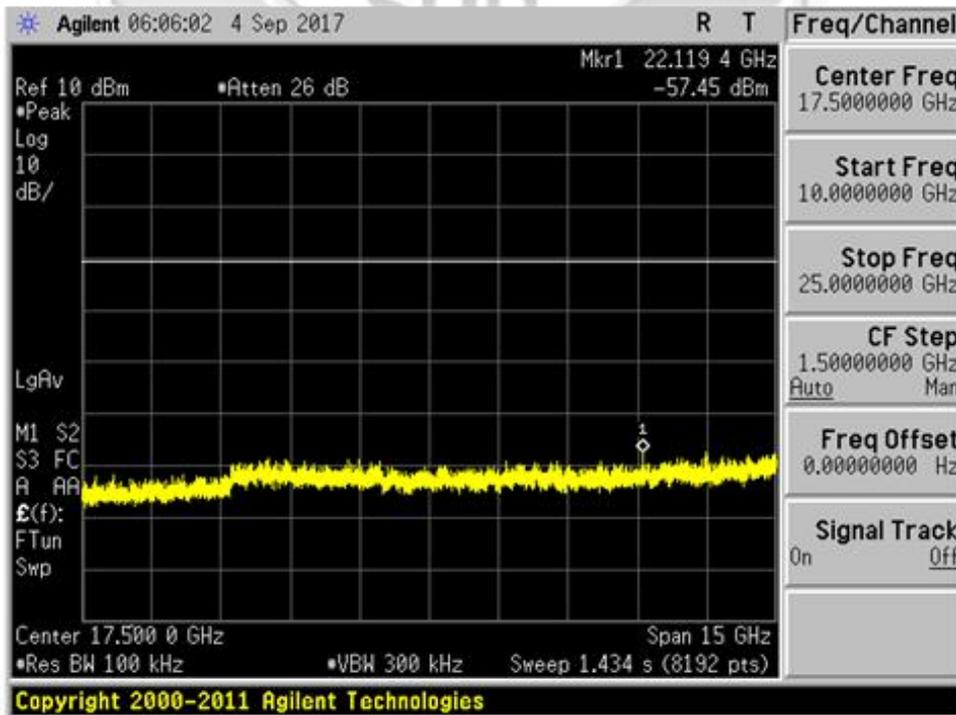


RF CONDUCTED SPURIOUS EMISSIONS (NON-RESTRICTED BANDS) TEST

RF Conducted Spurious Emissions (Non-Restricted Bands) Plots – 802.11n (40MHz)



Plot 118 – Channel 1 (lower ch) @64QAM 135Mbps

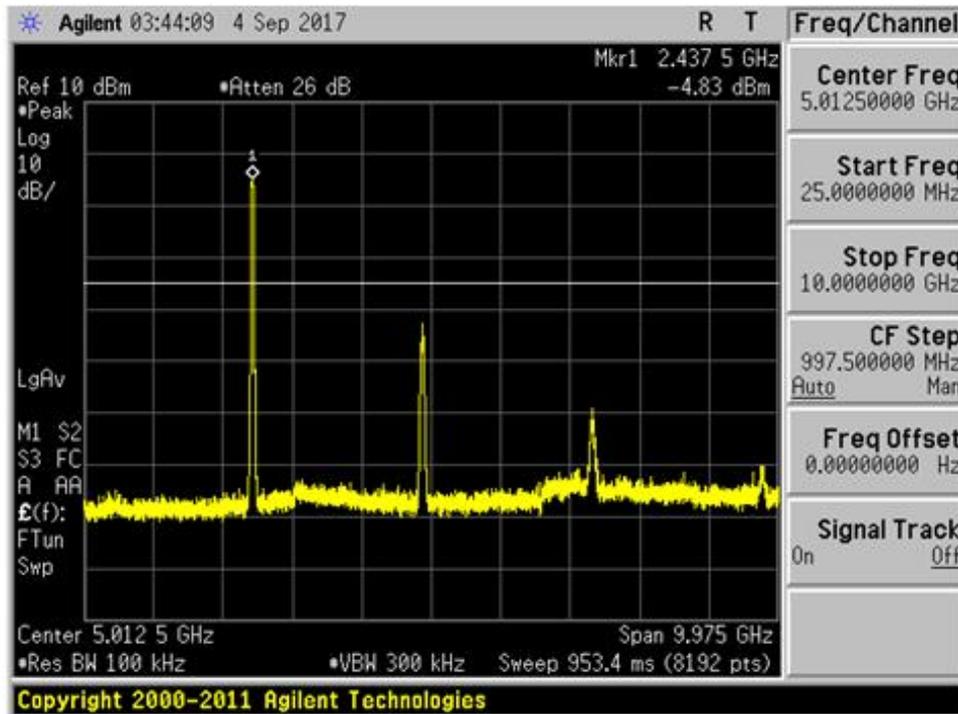


Plot 119 – Channel 1 (lower ch) @64QAM 135Mbps

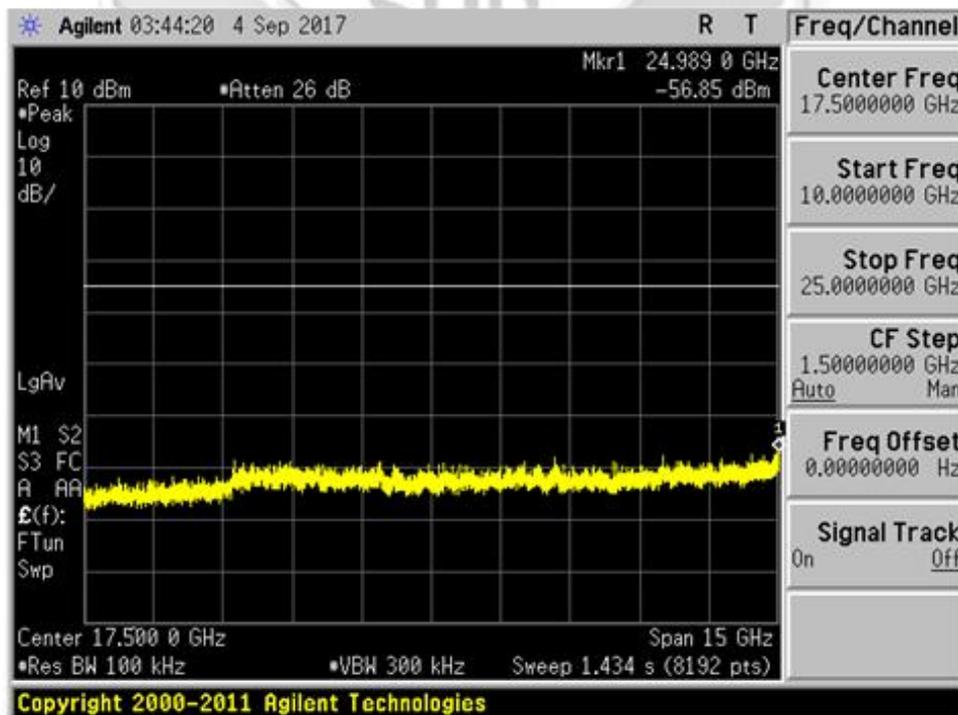


RF CONDUCTED SPURIOUS EMISSIONS (NON-RESTRICTED BANDS) TEST

RF Conducted Spurious Emissions (Non-Restricted Bands) Plots – 802.11n (40MHz)



Plot 120 – Channel 6 (middle ch) @BPSK 13.5Mbps

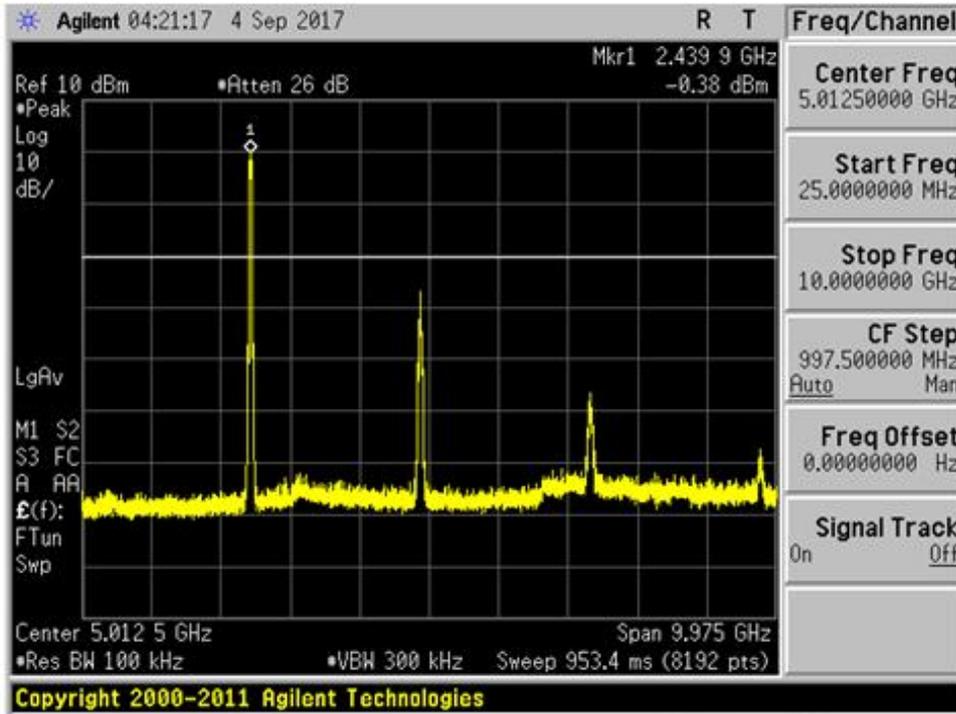


Plot 121 – Channel 6 (middle ch) @BPSK 13.5Mbps

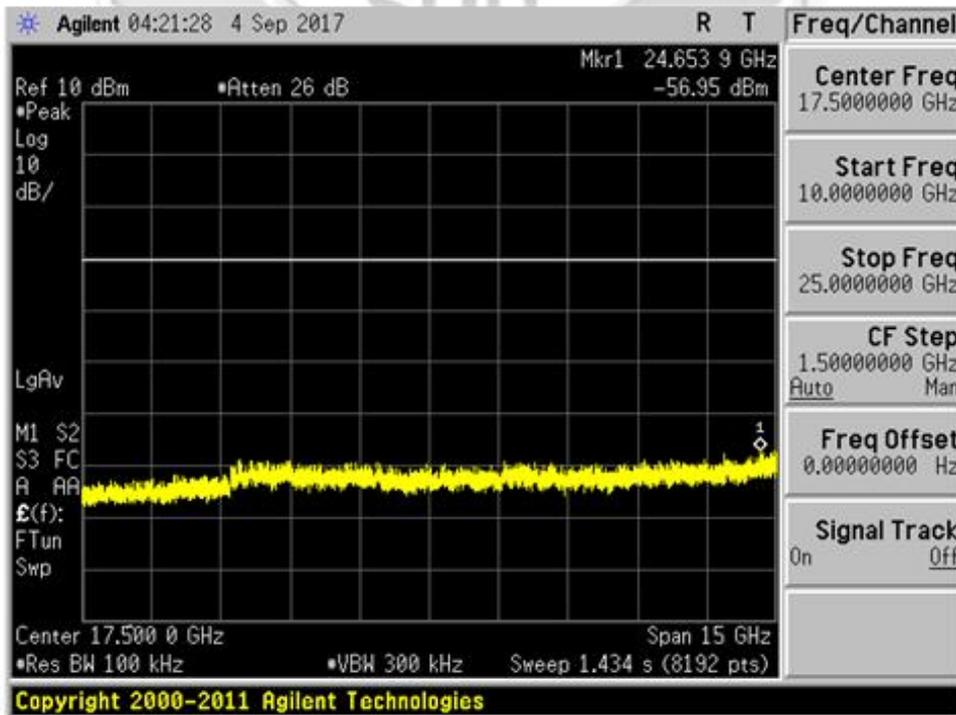


RF CONDUCTED SPURIOUS EMISSIONS (NON-RESTRICTED BANDS) TEST

RF Conducted Spurious Emissions (Non-Restricted Bands) Plots – 802.11n (40MHz)



Plot 122 – Channel 6 (middle ch) @QPSK 40.5Mbps

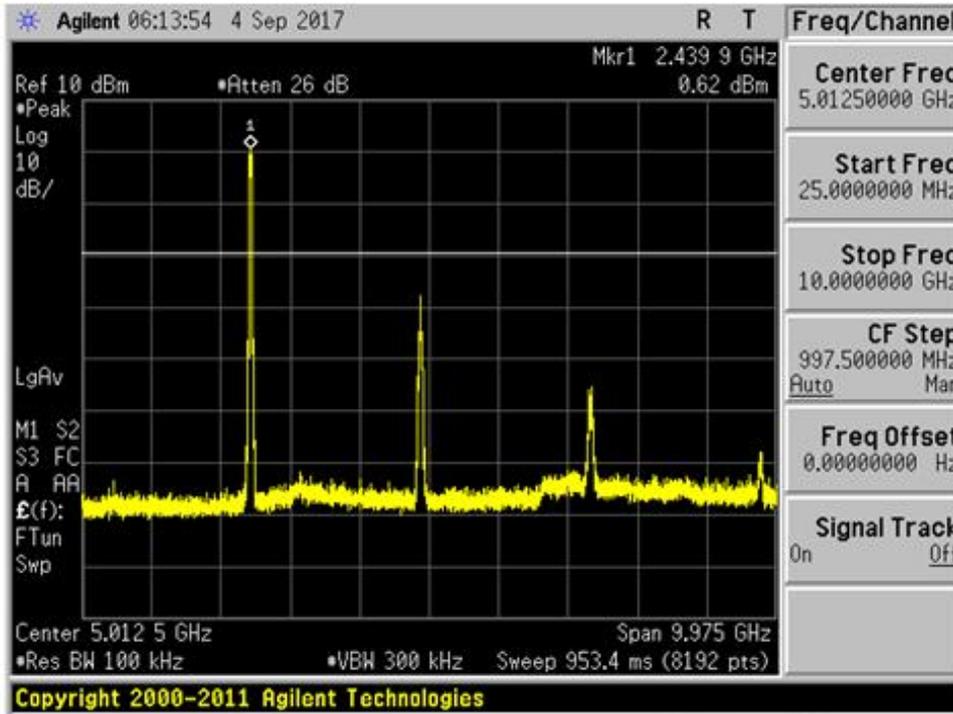


Plot 123 – Channel 6 (middle ch) @QPSK 40.5Mbps

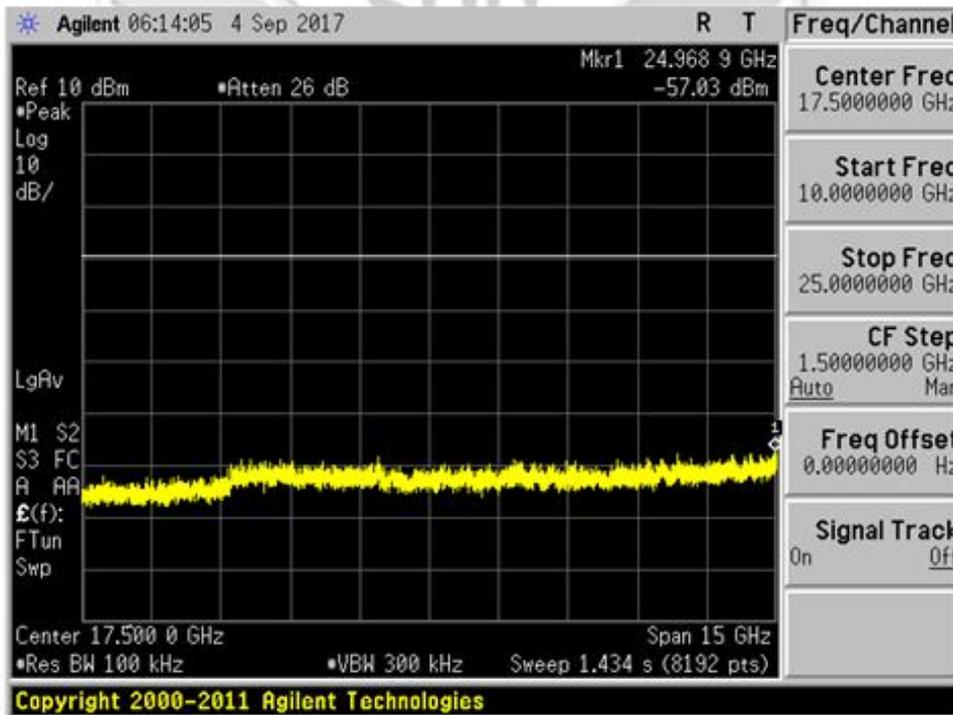


RF CONDUCTED SPURIOUS EMISSIONS (NON-RESTRICTED BANDS) TEST

RF Conducted Spurious Emissions (Non-Restricted Bands) Plots – 802.11n (40MHz)



Plot 124 – Channel 6 (middle ch) @16QAM 81Mbps

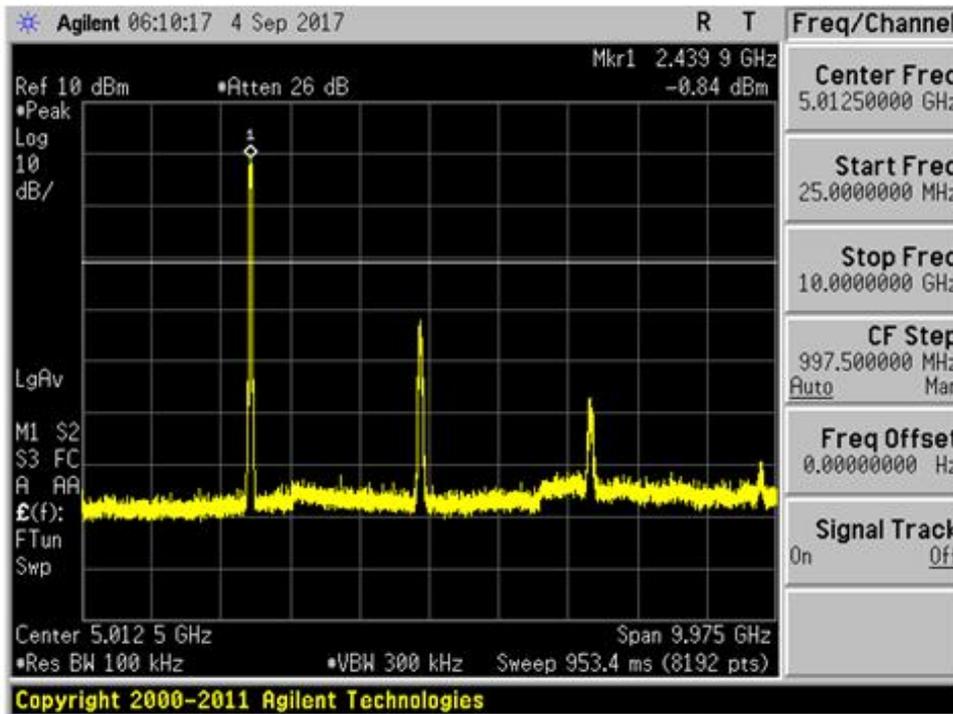


Plot 125 – Channel 6 (middle ch) @16QAM 81Mbps

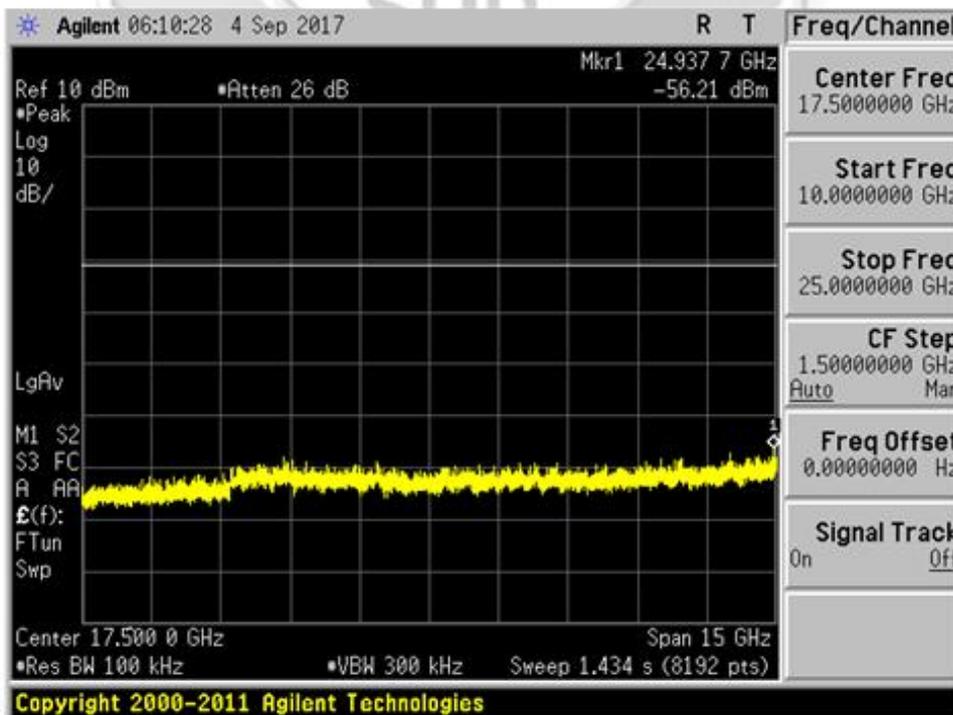


RF CONDUCTED SPURIOUS EMISSIONS (NON-RESTRICTED BANDS) TEST

RF Conducted Spurious Emissions (Non-Restricted Bands) Plots – 802.11n (40MHz)



Plot 126 – Channel 6 (middle ch) @64QAM 135Mbps

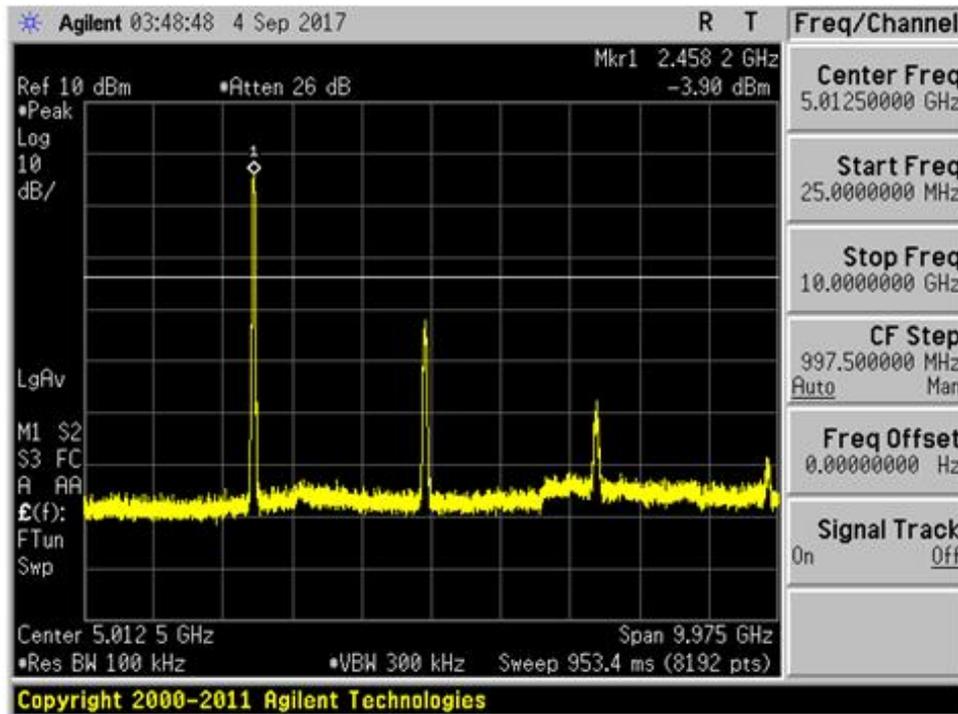


Plot 127 – Channel 6 (middle ch) @64QAM 135Mbps

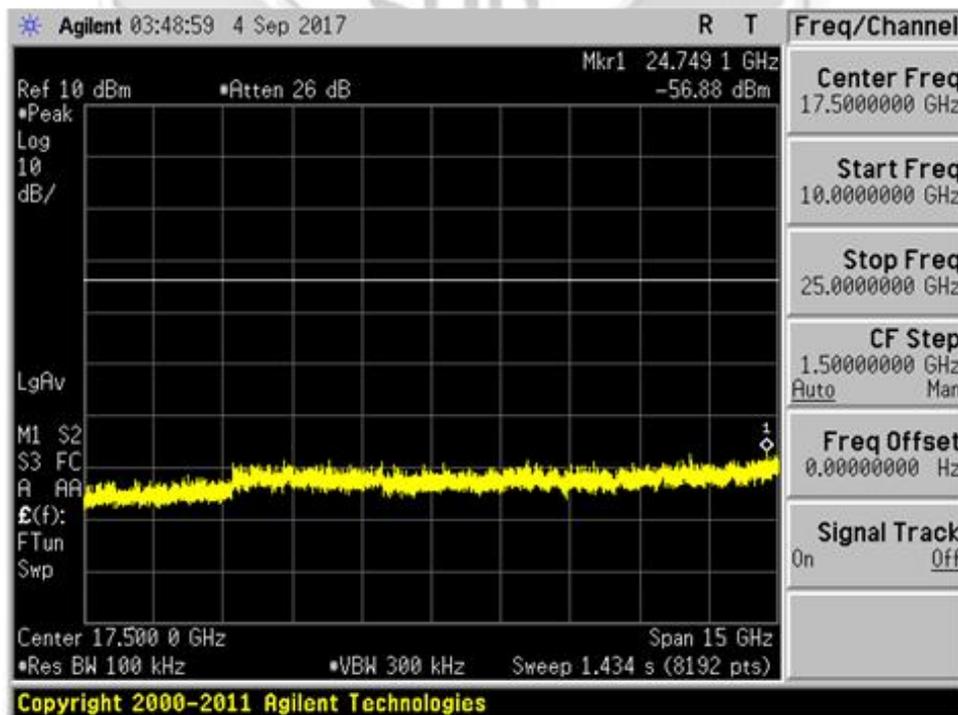


RF CONDUCTED SPURIOUS EMISSIONS (NON-RESTRICTED BANDS) TEST

RF Conducted Spurious Emissions (Non-Restricted Bands) Plots – 802.11n (40MHz)



Plot 128 – Channel 11 (upper ch) @BPSK 13.5Mbps

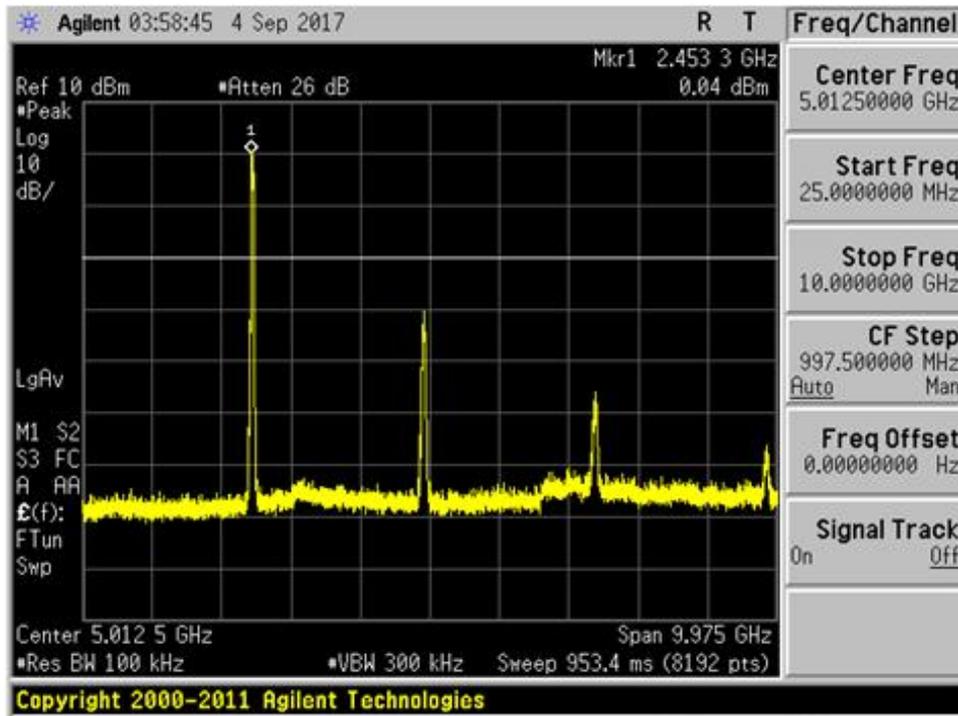


Plot 129 – Channel 11 (upper ch) @BPSK 13.5Mbps

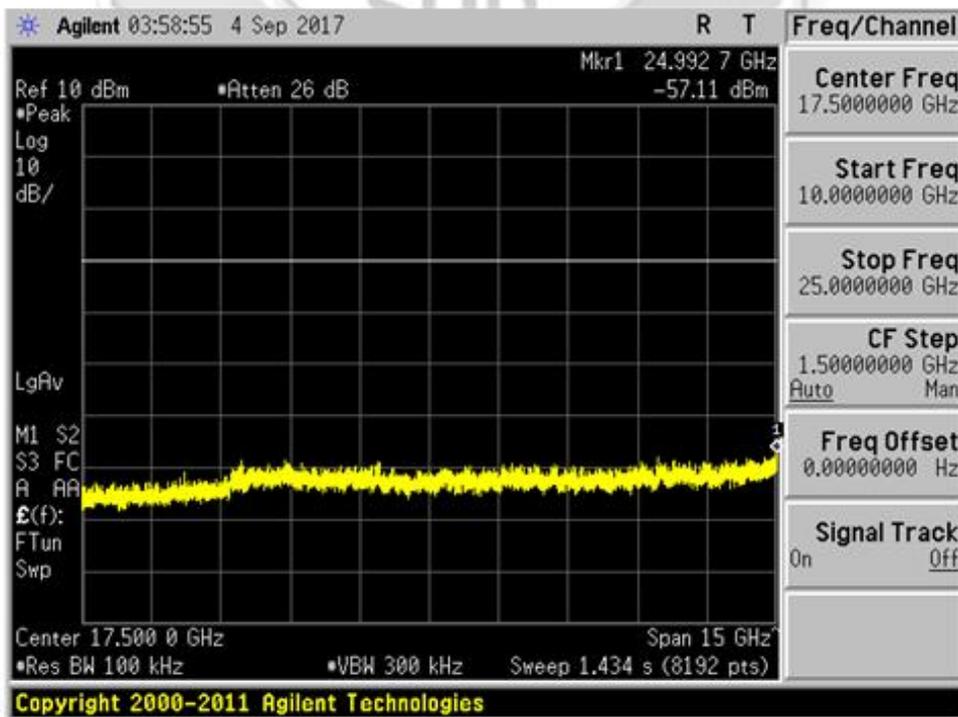


RF CONDUCTED SPURIOUS EMISSIONS (NON-RESTRICTED BANDS) TEST

RF Conducted Spurious Emissions (Non-Restricted Bands) Plots – 802.11n (40MHz)



Plot 130 – Channel 11 (upper ch) @QPSK 40.5Mbps

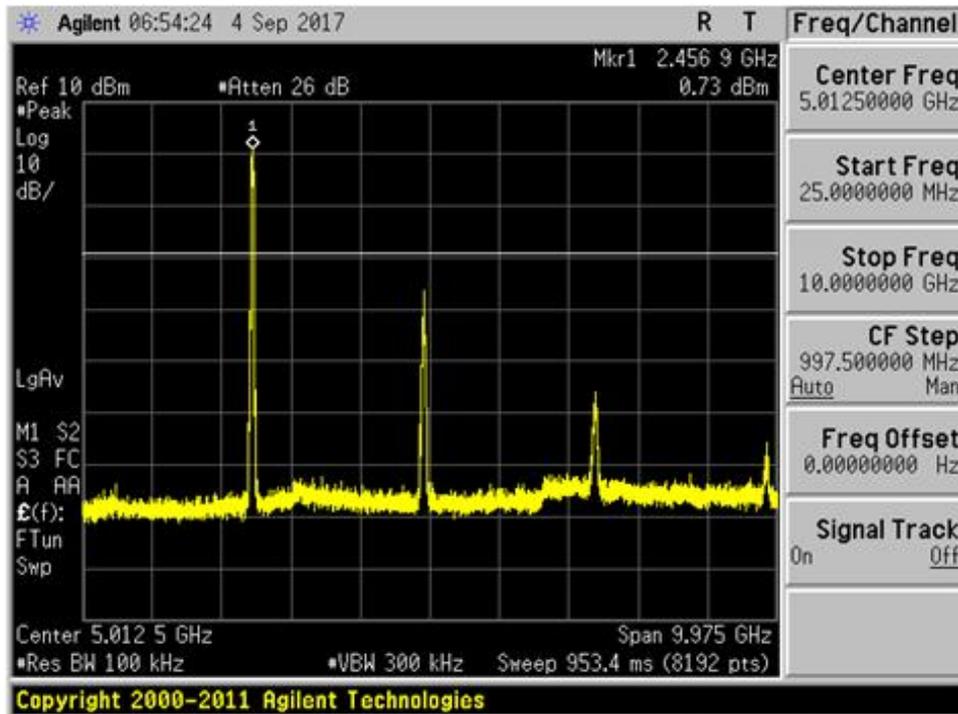


Plot 131 – Channel 11 (upper ch) @QPSK 40.5Mbps

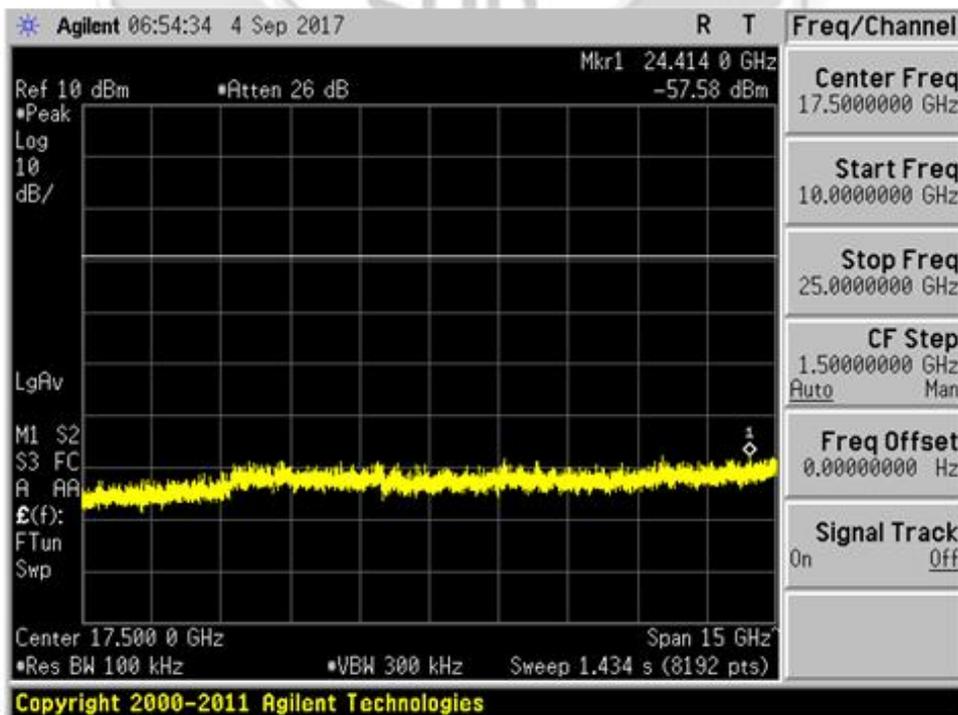


RF CONDUCTED SPURIOUS EMISSIONS (NON-RESTRICTED BANDS) TEST

RF Conducted Spurious Emissions (Non-Restricted Bands) Plots – 802.11n (40MHz)



Plot 132 – Channel 11 (upper ch) @16QAM 81Mbps

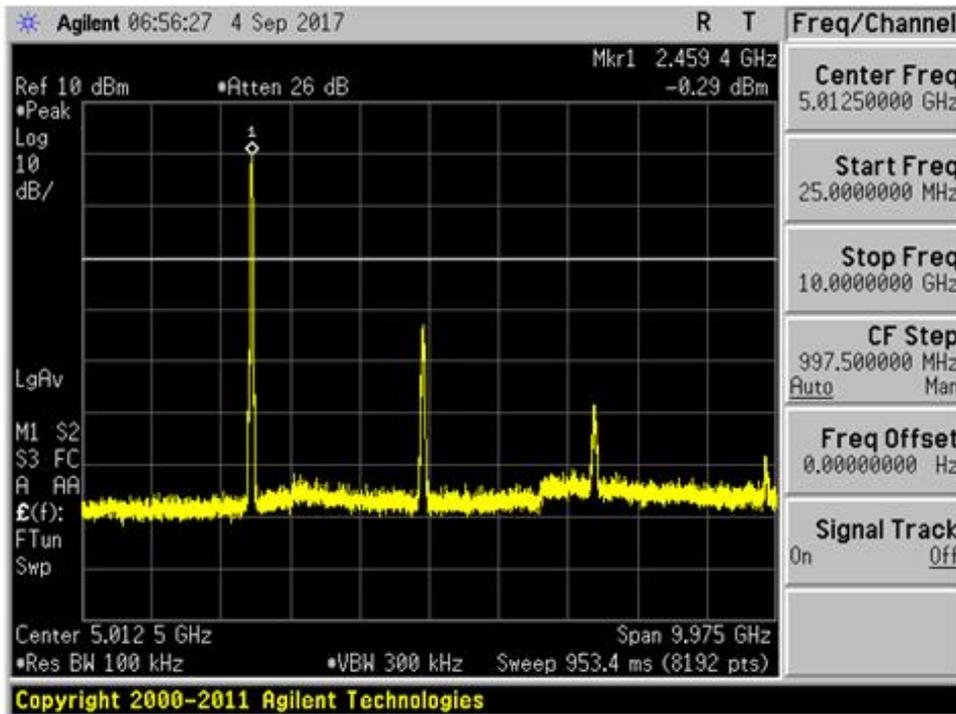


Plot 133 – Channel 11 (upper ch) @16QAM 81Mbps

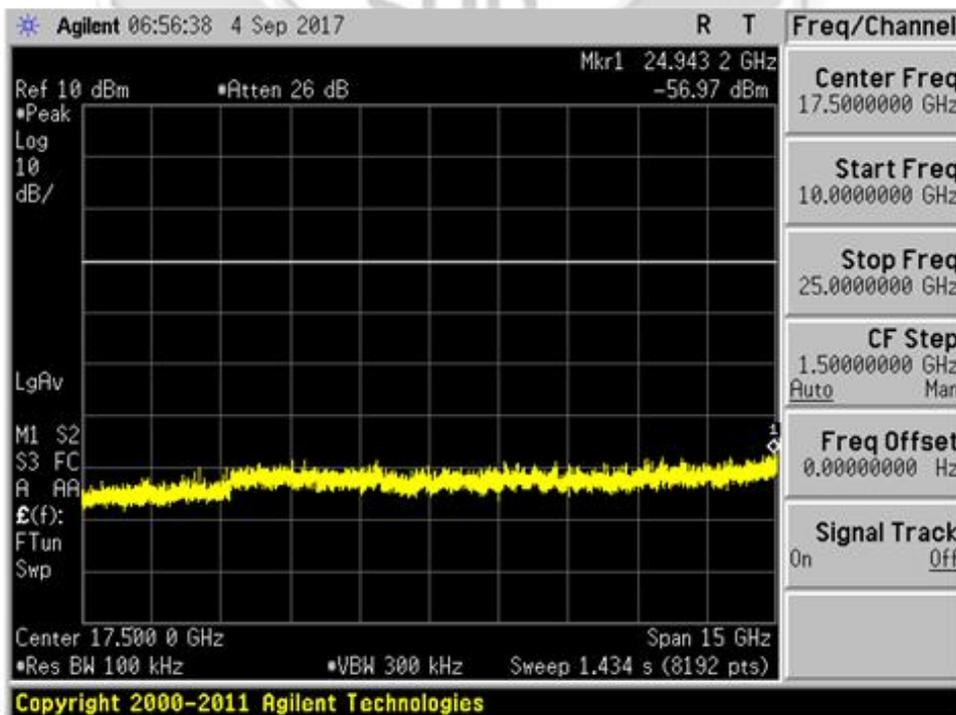


RF CONDUCTED SPURIOUS EMISSIONS (NON-RESTRICTED BANDS) TEST

RF Conducted Spurious Emissions (Non-Restricted Bands) Plots – 802.11n (40MHz)



Plot 134 – Channel 11 (upper ch) @64QAM 135Mbps



Plot 135 – Channel 11 (upper ch) @64QAM 135Mbps



RF CONDUCTED SPURIOUS EMISSIONS (RESTRICTED BANDS) TEST

47 CFR FCC Part 15.205 Restricted Bands

MHz		MHz		MHz		GHz	
0.090	- 0.110	16.42	- 16.423	399.9	- 410	4.5	- 5.15
0.495	- 0.505	16.69475	- 16.69525	608	- 614	5.35	- 5.46
2.1735	- 2.1905	16.80425	- 16.80475	960	- 1240	7.25	- 7.75
4.125	- 4.128	25.5	- 25.67	1300	- 1427	8.025	- 8.5
4.17725	- 4.17775	37.5	- 38.25	1435	- 1626.5	9.0	- 9.2
4.20725	- 4.20775	73	- 74.6	1645.5	- 1646.5	9.3	- 9.5
6.215	- 6.218	74.8	- 75.2	1660	- 1710	10.6	- 12.7
6.26775	- 6.26825	108	- 121.94	1718.8	- 1722.2	13.25	- 13.4
6.31175	- 6.31225	123	- 138	2200	- 2300	14.47	- 14.5
8.291	- 8.294	149.9	- 150.05	2310	- 2390	15.35	- 16.2
8.362	- 8.366	156.52475	- 156.52525	2483.5	- 2500	17.7	- 21.4
8.37625	- 8.38675	156.7	- 156.9	2690	- 2900	22.01	- 23.12
8.41425	- 8.41475	162.0125	- 167.17	3260	- 3267	23.6	- 24.0
12.29	- 12.293	167.72	- 173.2	3332	- 3339	31.2	- 31.8
12.51975	- 12.52025	240	- 285	3345.8	- 3358	36.43	- 36.5
12.57675	- 12.57725	322	- 335.4	3600	- 4400	Above 38.6	
13.36	- 13.41						

47 CFR FCC Part 15.247(d) RF Conducted Spurious Emissions (Restricted Bands) Limits

The EUT shows compliance to the requirements of this section, which states that emissions which fall in the restricted bands must comply with the radiated emission limits specified in the table below:

Frequency Range (MHz)	EIRP (dBm)	Radiated Emissions (dBµV/m)
0.009 – 0.490	-6.7 – (-41.4) **	67.6 – 20logF* @ 300m **
0.490 – 1.705	-41.4 – (-52.3) **	87.6 – 20logF* @ 30m **
1.705 – 30	-45.7	29.5 @ 30m
30 - 88	-55.2	40.0 @ 3m
88 - 216	-51.7	43.5 @ 3m
216 - 960	-49.2	46.0 @ 3m
>960	-41.2 ***	54.0 @ 3m ***
* F is frequency in kHz.		
** Decreasing linearly with the logarithm of the frequency.		
*** Above 1GHz, a peak limit of 20dB above the average limit does apply.		

47 CFR FCC Part 15.247(d) RF Conducted Spurious Emissions (Restricted Bands) Test Instrumentation

Instrument	Model	S/No	Cal Due Date
Agilent Spectrum Analyzer	E4440A	MY45304764	04 Jan 2018
BK Precision Multi Range DC Power Supply	9111	459G14131	23 Nov 2017

RF CONDUCTED SPURIOUS EMISSIONS (RESTRICTED BANDS) TEST

47 CFR FCC Part 15.247(d) RF Conducted Spurious Emissions (Restricted Bands) Test Setup

1. The EUT and supporting equipment were set up as shown in the setup photo.
2. The power supply for the EUT was connected to a filtered mains.
3. The RF antenna connector was connected to the spectrum analyser via a low-loss coaxial cable.
4. The resolution bandwidth (RBW) of the spectrum analyser was set to the following settings. The video bandwidth (VBW) was set to at least three times of the RBW.

Frequency (MHz)	RBW (kHz)
0.009 – 0.150	0.2
0.150 – 30.0	9.0
30.0 - 1000	100.0
> 1000	1000.0

5. The detector of the spectrum analyser was set to peak detection mode.
6. All other supporting equipment were powered separately from another filtered mains.

47 CFR FCC Part 15.247(d) RF Conducted Spurious Emissions (Restricted Bands) Test Method

1. Measurement in the range 9kHz – 1000MHz
 - 1.1 The EUT was switched on and allowed to warm up to its normal operating condition. The EUT was then configured to operate in the test mode, with the transmitting frequency was set to lower channel with specified modulation and data rate.
 - 1.2 The start and stop frequencies of the spectrum analyser were set according to the supported RBW.
 - 1.3 The spectrum analyser was set to max hold to capture any spurious emissions within the span. The signal capturing was continuous until no further spurious emissions were detected. The antenna gain of the EUT was added to the captured spurious emissions.
 - 1.4 No further measurement was required if all the captured emissions complied to the limits. Else, the spectrum analyser was set to zoom to the captured emission with the detector of the spectrum analyser was set to quasi-peak. The emission level of the captured frequency was measured.
 - 1.5 The step 1.4 was repeated until all the captured emissions which exceeding the limits were measured.
 - 1.6 Repeat steps 1.1 to 1.5 with all possible modulations and data rates.
 - 1.7 The steps 1.2 to 1.6 were repeated with the transmitting frequency was set to middle and upper channel respectively.
2. Measurement above 1000MHz
 - 2.1 The EUT was switched on and allowed to warm up to its normal operating condition. The EUT was then configured to operate in the test mode, with the transmitting frequency was set to lower channel with specified modulation and data rate.
 - 2.2 The start and stop frequencies of the spectrum analyser were set according to the supported frequency band of the set RBW with the number of points in a sweep was set to equal or greater than 2 times of the ratio of span over RBW.
 - 2.3 The detector of the spectrum analyser was set to power average (RMS) mode with the sweep time was set to equal or greater than 10 times of the product of number of measurement points in a sweep and transmission symbol time.
 - 2.4 The spectrum analyser was then allowed to capture any spurious emissions within a single sweep. The peak marker function of the spectrum analyser was used to locate the highest power level. The antenna gain of the EUT was added to the captured spurious emissions.
 - 2.5 The steps 2.2 to 2.4 were repeated until all the required frequency bands were measured.
 - 2.6 Repeat steps 2.1 to 2.5 with all possible modulations and data rates.
 - 2.7 The steps 2.2 to 2.6 were repeated with the transmitting frequency was set to middle and upper channel respectively.
 - 2.8 The measurements were repeated with the detector of the spectrum analyser was set to peak detecting mode. The sweep time was set to auto coupler.



RF CONDUCTED SPURIOUS EMISSIONS (RESTRICTED BANDS) TEST

47 CFR FCC Part 15.247(d) RF Conducted Spurious Emissions (Restricted Bands) Results

Test Input Power	12.5Vdc	Temperature	24°C
Attached Plots	136 – 405 (Peak)	Relative Humidity	60%
		Atmospheric Pressure	1030mbar
		Tested By	Chang Wai Kit

All spurious signals found were below the specified limit. Please refer to the attached plots.



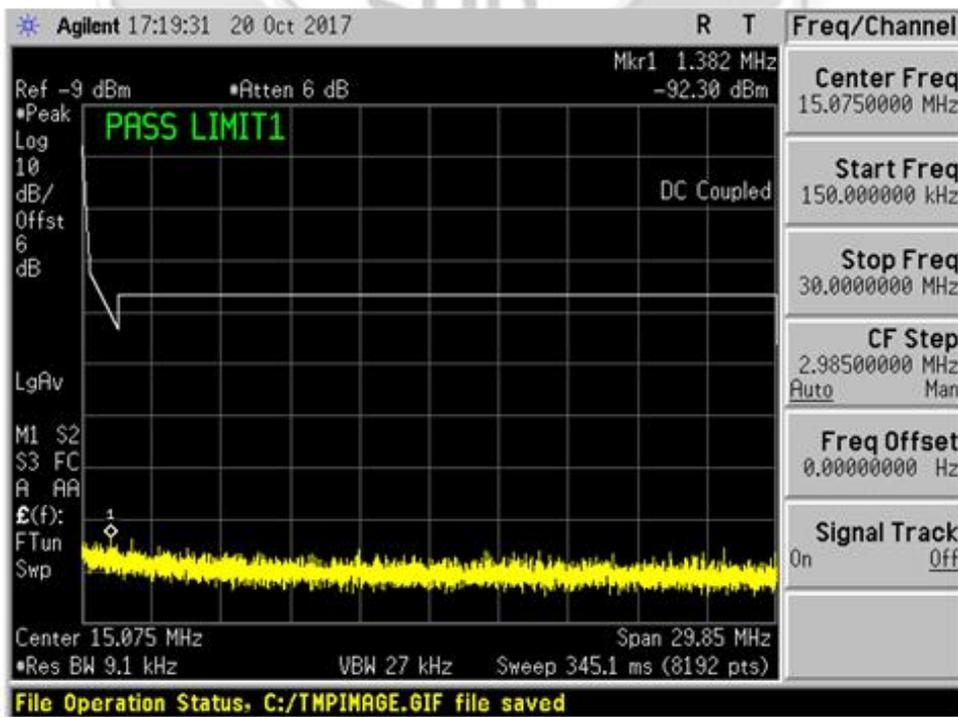


RF CONDUCTED SPURIOUS EMISSIONS (RESTRICTED BANDS) TEST

RF Conducted Spurious Emissions (Restricted) Plots – 802.11b Peak



Plot 136 – Channel 1 (lower ch) @DBPSK 1Mbps

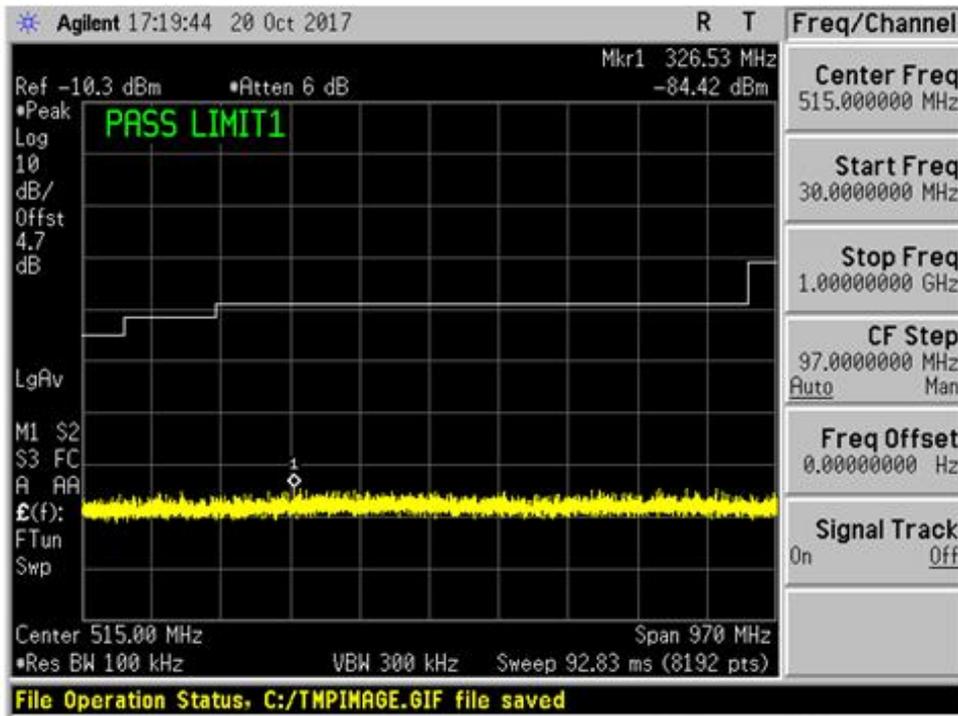


Plot 137 – Channel 1 (lower ch) @DBPSK 1Mbps

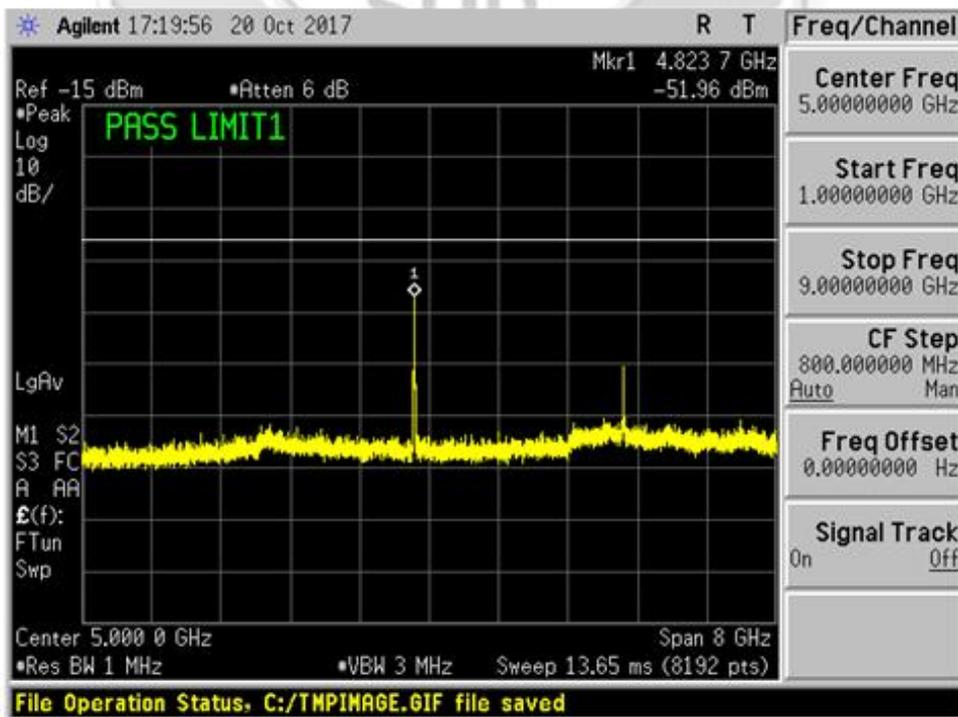


RF CONDUCTED SPURIOUS EMISSIONS (RESTRICTED BANDS) TEST

RF Conducted Spurious Emissions (Restricted) Plots – 802.11b Peak



Plot 138 – Channel 1 (lower ch) @DBPSK 1Mbps



Plot 139 – Channel 1 (lower ch) @DBPSK 1Mbps

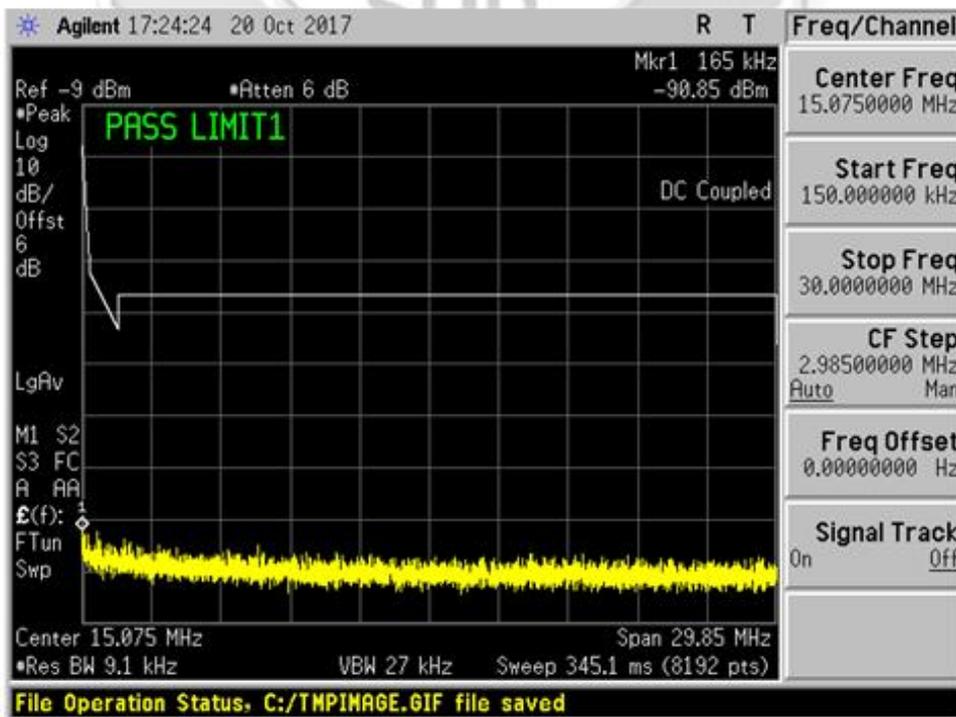


RF CONDUCTED SPURIOUS EMISSIONS (RESTRICTED BANDS) TEST

RF Conducted Spurious Emissions (Restricted) Plots – 802.11b Peak



Plot 142 – Channel 1 (lower ch) @DQPSK 2Mbps

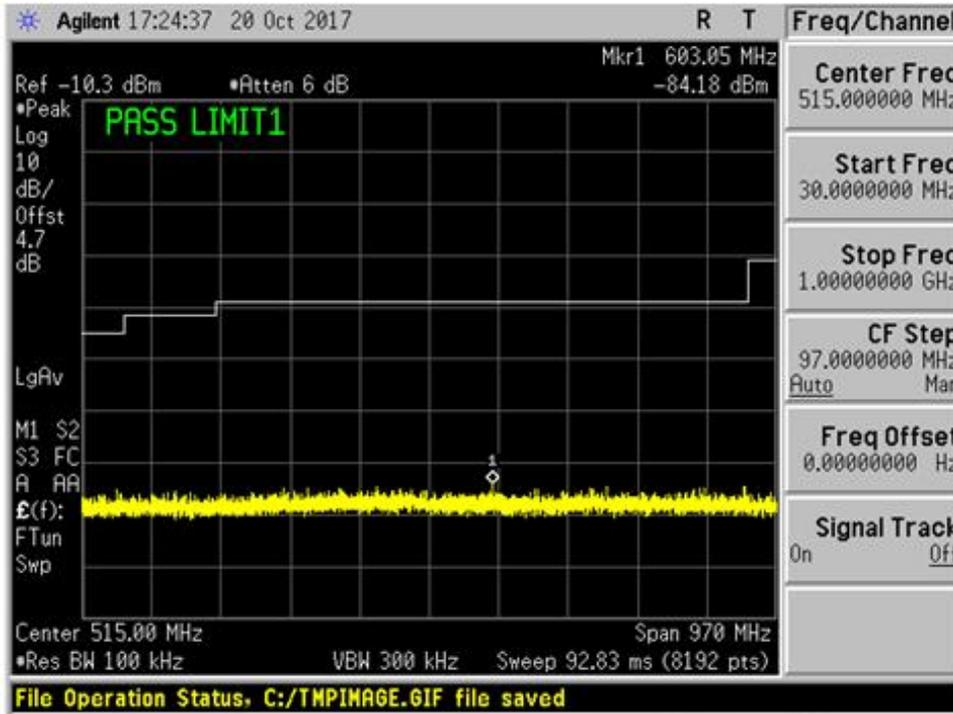


Plot 143 – Channel 1 (lower ch) @DQPSK 2Mbps

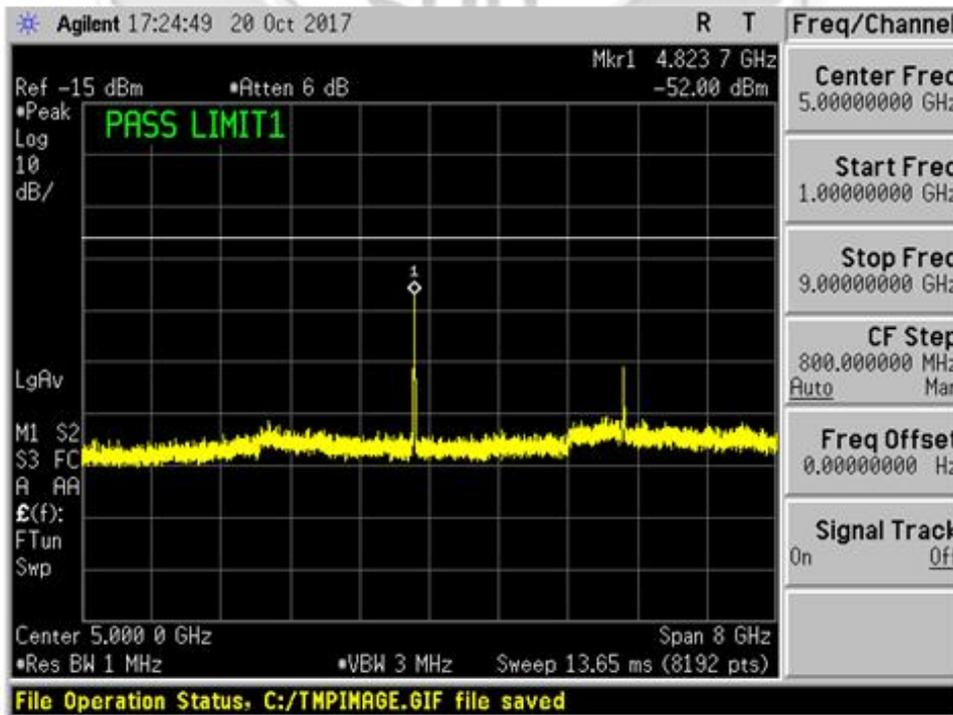


RF CONDUCTED SPURIOUS EMISSIONS (RESTRICTED BANDS) TEST

RF Conducted Spurious Emissions (Restricted) Plots – 802.11b Peak



Plot 144 – Channel 1 (lower ch) @DQPSK 2Mbps

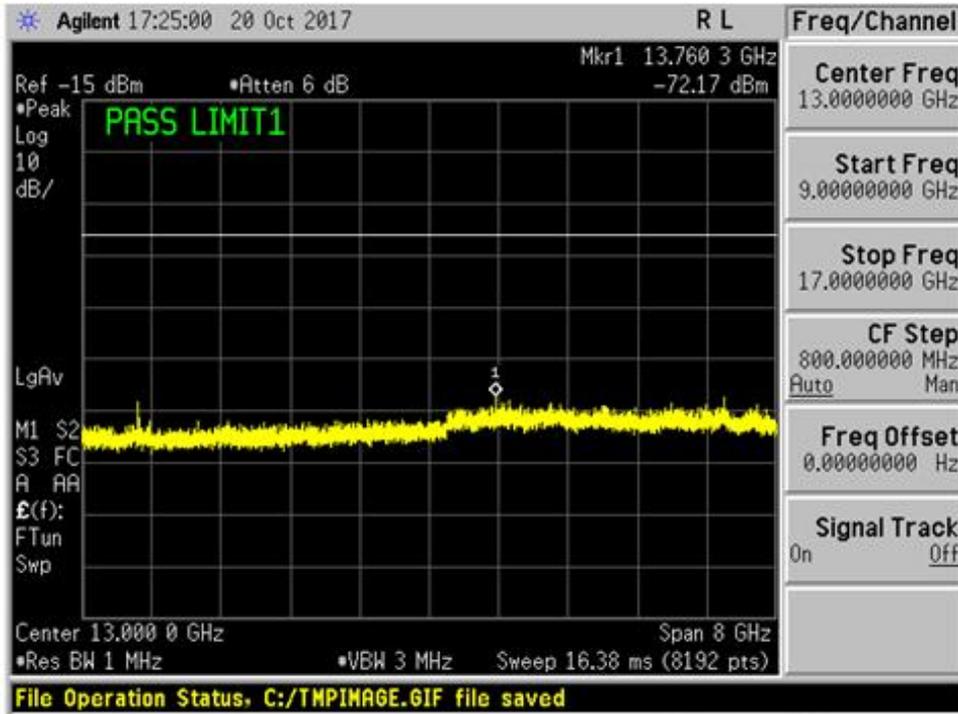


Plot 145 – Channel 1 (lower ch) @DQPSK 2Mbps

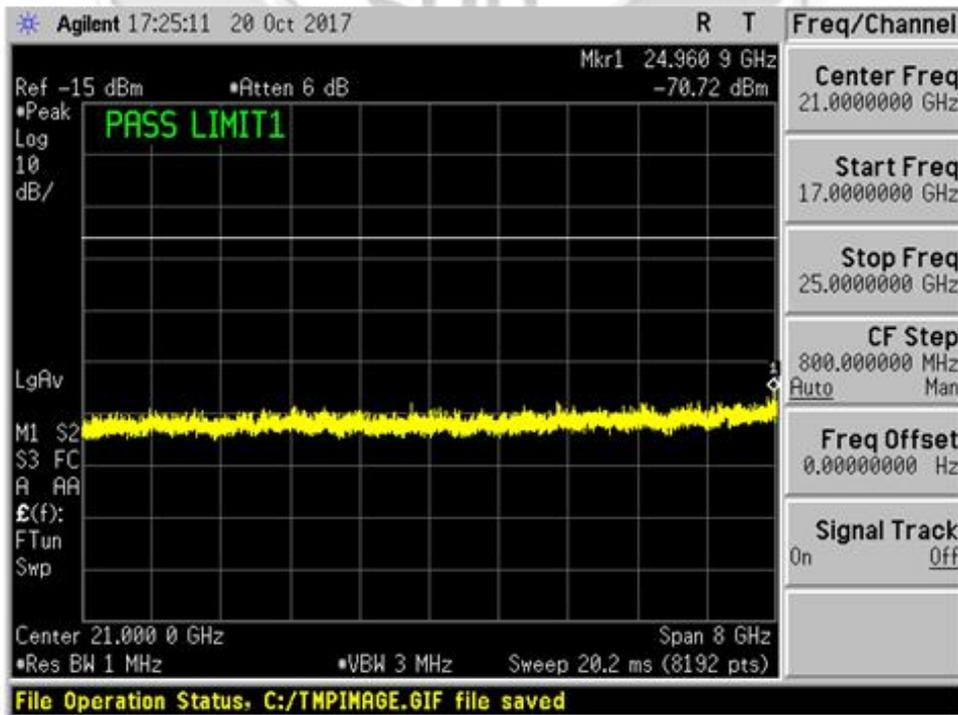


RF CONDUCTED SPURIOUS EMISSIONS (RESTRICTED BANDS) TEST

RF Conducted Spurious Emissions (Restricted) Plots – 802.11b Peak



Plot 146 – Channel 1 (lower ch) @DQPSK 2Mbps



Plot 147 – Channel 1 (lower ch) @DQPSK 2Mbps