



**CFR 47 FCC PART 15 SUBPART C
ISED RSS-247 ISSUE 2**

TEST REPORT

2K 4ch 1HDD wireless Recorder

MODEL NUMBER: W2K4NVR

PROJECT NUMBER: 4788689317

REPORT NUMBER: 4788689317-1

FCC ID: SMHW2K4NVR

IC: 4593A-W2K4NVR

ISSUE DATE: Nov. 17, 2018

Prepared for

Circus World Displays Limited

Prepared by

**UL Verification Services (Guangzhou) Co., Ltd, Song Shan Lake Branch
Building 10, Innovation Technology Park, No. 1, Li Bin Road, Song Shan Lake
Hi-Tech Development Zone Dongguan, People's Republic of China**

Tel: +86 769 22038881

Fax: +86 769 33244054

Website: www.ul.com



Revision History

<u>Rev.</u>	<u>Issue Date</u>	<u>Revisions</u>	<u>Revised By</u>
V0	11/17/2018	Initial Issue	



Summary of Test Results			
Clause	Test Items	FCC/IC Rules	Test Results
1	6dB Bandwidth and 99% Occupied Bandwidth	FCC Part 15.247 (a) (2) RSS-247 Clause 5.2 (a) ISED RSS-Gen Clause 6.7	Pass
2	Peak Conducted Output Power	FCC Part 15.247 (b) (3) RSS-247 Clause 5.4 (e)	Pass
3	Power Spectral Density	FCC Part 15.247 (e) RSS-247 Clause 5.2 (b)	Pass
4	Conducted Bandedge and Spurious Emission	FCC Part 15.247 (d) RSS-247 Clause 5.5	Pass
5	Radiated Bandedge and Spurious Emission	FCC Part 15.247 (d) FCC Part 15.209 FCC Part 15.205 RSS-247 Clause 5.5 RSS-GEN Clause 8.9	Pass
6	Conducted Emission Test For AC Power Port	FCC Part 15.207 RSS-GEN Clause 8.8	Pass
7	Antenna Requirement	FCC Part 15.203 RSS-GEN Clause 8.3	Pass
Remark: 1) For this product, it has two antennas, antenna1 and antenna2, the 802.11B SISO&802.11G SISO modes are use the SISO technical, but the ant1 and ant2 can transmitter in the same time under these modes. The 802.11N(HT20) is use both the SISO and MIMO technical. 2) Pre-testing Antenna 1 and Antenna2, and pre-testing SISO and MIMO modes, only the data of the worse case is shown in this test repot.			



TABLE OF CONTENTS

1. ATTESTATION OF TEST RESULTS	6
2. TEST METHODOLOGY	7
3. FACILITIES AND ACCREDITATION	7
4. CALIBRATION AND UNCERTAINTY	8
4.1. <i>MEASURING INSTRUMENT CALIBRATION</i>	8
4.2. <i>CMEASUREMENT UNCERTAINTY</i>	8
5. EQUIPMENT UNDER TEST	9
5.1. <i>DESCRIPTION OF EUT</i>	9
5.2. <i>MAXIMUM OUTPUT POWER</i>	9
5.3. <i>CHANNEL LIST</i>	10
5.4. <i>TEST CHANNEL CONFIGURATION</i>	10
5.5. <i>THE WORSE CASE CONFIGURATIONS</i>	11
5.6. <i>DESCRIPTION OF AVAILABLE ANTENNAS</i>	12
5.7. <i>DESCRIPTION OF TEST SETUP</i>	13
6. MEASURING INSTRUMENT AND SOFTWARE USED	14
7. MEASUREMENT METHODS	15
8. ANTENNA PORT TEST RESULTS	16
8.1. <i>ON TIME AND DUTY CYCLE</i>	16
8.2. <i>6 dB DTS BANDWIDTH AND 99% OCCUPIED BANDWIDTH</i>	19
8.2.1. 802.11b MODE.....	20
8.2.2. 802.11g MODE.....	24
8.2.3. 802.11n HT20 MODE	28
8.3. <i>PEAK CONDUCTED OUTPUT POWER</i>	32
8.3.1. 802.11b MODE-SISO	33
8.3.2. 802.11g MODE-SISO	34
8.3.3. 802.11n HT20 MODE-MIMO	35
8.4. <i>POWER SPECTRAL DENSITY</i>	36
8.4.1. 802.11b MODE.....	37
8.4.1. 802.11g MODE.....	41
8.4.2. 802.11n HT20 MODE	45
8.5. <i>CONDUCTED BANDEDGE AND SPURIOUS EMISSIONS</i>	49
8.5.1. 802.11b MODE.....	51
8.5.1. 802.11g MODE.....	64
8.5.1. 802.11n HT20 MODE	78
9. RADIATED TEST RESULTS	92



9.1.	<i>RESTRICTED BANDEDGE</i>	98
9.1.1.	802.11b MODE	98
9.1.2.	802.11g MODE	102
9.1.3.	802.11n HT20 MODE	106
9.2.	<i>SPURIOUS EMISSIONS (1~18GHz)</i>	110
9.2.1.	802.11b MODE	110
9.2.2.	802.11g MODE	116
9.2.3.	802.11n HT20 MODE	122
9.3.	<i>SPURIOUS EMISSIONS (18~25GHz)</i>	128
9.3.1.	802.11G MODE	128
9.4.	<i>SPURIOUS EMISSIONS (0.03 ~ 1 GHz)</i>	130
9.4.1.	802.11G MODE	130
9.5.	<i>SPURIOUS EMISSIONS BELOW 30M</i>	132
9.5.1.	802.11G MODE	132
10.	AC POWER LINE CONDUCTED EMISSIONS	135
10.1.	802.11G MODE	136
11.	ANTENNA REQUIREMENTS	137



1. ATTESTATION OF TEST RESULTS

Applicant Information

Company Name: Circus World Displays Limited
Address: 4080 Montrose Rd., Niagara Falls, ON, L2H1J9, Canada

Manufacturer Information

Company Name: Circus World Displays Limited
Address: 4080 Montrose Rd., Niagara Falls, ON, L2H1J9, Canada

EUT Description

Product Name: 2K 4ch 1HDD wireless Recorder
Model Name: W2K4NVR
Trademark: DEFENDER
Sample Number: 1830071
Data of Receipt Sample: Sep 26, 2018
Date Tested: Sep 26, 2018~ Nov. 16, 2018

APPLICABLE STANDARDS	
STANDARD	TEST RESULTS
CFR 47 FCC PART 15 SUBPART C	PASS
ISED RSS-247 Issue 2	PASS
ISED RSS-GEN Issue 5	PASS

Tested By:

Check By:

Denny Huang
Engineer Project Associate
Approved By:

Shawn Wen
Laboratory Leader

Stephen Guo
Laboratory Manager



2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with KDB 558074 D01 DTS Meas Guidance v05, KDB 414788 D01 Radiated Test Site v01r01, KDB 662911 D01 Multiple Transmitter Output v02r01, CFR 47 FCC Part 2, CFR 47 FCC Part 15, ANSI C63.10-2013, ISED RSS-247 Issue 2 and ISED RSS-GEN Issue 5.

3. FACILITIES AND ACCREDITATION

Accreditation Certificate	<p>A2LA (Certificate No.: 4102.01) UL Verification Services (Guangzhou) Co., Ltd. Song Shan Lake Branch. has been assessed and proved to be in compliance with A2LA.</p> <p>FCC (FCC Designation No.: CN1187) UL Verification Services (Guangzhou) Co., Ltd. Song Shan Lake Branch. Has been recognized to perform compliance testing on equipment subject to the Commission's Declaration of Conformity (DoC) and Certification rules</p> <p>IC(Company No.: 21320) UL Verification Services (Guangzhou) Co., Ltd. Song Shan Lake Branch. has been registered and fully described in a report filed with ISED. The Company Number is 21320.</p> <p>VCCI (Registration No.: G-20019, R-20004, C-20012 and T-20011) UL Verification Services (Guangzhou) Co., Ltd. Song Shan Lake Branch. has been assessed and proved to be in compliance with VCCI, the Membership No. is 3793. Facility Name: Chamber D, the VCCI registration No. is G-20019 and R-20004 Shielding Room B , the VCCI registration No. is C-20012 and T-20011</p>
---------------------------	---

Note 1: All tests measurement facilities use to collect the measurement data are located at Building 10, Innovation Technology Park, Song Shan Lake Hi tech Development Zone, Dongguan, 523808, China

Note 2 : For below 30MHz, lab had performed measurements at test anechoic chamber and comparing to measurements obtained on an open field site. These measurements below 30MHz had been correlated to measurements performed on an OATS.

Note 3 : The test anechoic chamber in UL Verification Services (Guangzhou) Co., Ltd. Song Shan Lake Branch had been calibrated and compared to the open field sites and the test anechoic chamber is shown to be equivalent to or worst case from the open field site.



4. CALIBRATION AND UNCERTAINTY

4.1. MEASURING INSTRUMENT CALIBRATION

The measuring equipment utilized to perform the tests documented in this report has been calibrated in accordance with the manufacturer's recommendations, and is traceable to recognize national standards.

4.2. CMEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

Test Item	Uncertainty
Conduction emission	3.62dB
Radiation Emission test(include Fundamental emission) (9KHz-30MHz)	2.2dB
Radiation Emission test(include Fundamental emission) (30MHz-1GHz)	4.00dB
Radiation Emission test (1GHz to 26GHz)(include Fundamental emission)	5.78dB (1GHz-18Gz)
	5.23dB (18GHz-26Gz)

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



5. EQUIPMENT UNDER TEST

5.1. DESCRIPTION OF EUT

Product Name:	2K 4ch 1HDD wireless Recorder	
Model No.:	W2K4NVR	
Operating Frequency:	IEEE 802.11B SISO/g/n(HT20): 2412MHz to 2462MHz	
Type of Modulation:	IEEE for 802.11b: DSSS (CCK, DQPSK, DBPSK) IEEE for 802.11g: OFDM (64QAM, 16QAM, QPSK, BPSK) IEEE for 802.11n: OFDM (64QAM, 16QAM, QPSK, BPSK)	
Channel Number:	IEEE 802.11b, 802.11g, IEEE 802.11n(HT20): 11 Channels	
Channels Step:	Channels with 5MHz step	
Sample Type:	Fixed production	
Test power grade:	11B:9 (manufacturer declare) 11G:7 (manufacturer declare) 11N(HT20):7 (manufacturer declare)	
Test software of EUT:	Artgui (manufacturer declare)	
Antenna Type:	Dipole Antenna	
Antenna Gain:	Antenna 1:	5 dBi
	Antenna 2:	5 dBi
Power Supply	Adapter	Model:EUSA+24120-2000 INPUT:100-240V~,50/60Hz, 0.6A OUTPUT:12V 2A

5.2. MAXIMUM OUTPUT POWER

Frequency Range (MHz)	Number of Transmit Chains (NTX)	IEE Std. 802.11	Channel Number	Max PK Conducted Power-Antenna 1 (dBm)	Max PK Conducted Power-Antenna 2 (dBm)	Max PK Conducted Power-Antenna1+2 (dBm)
2412-2462	1/2	IEEE 802.11B SISO	1-11[11]	9.77	9.24	12.55
2412-2462	1/2	IEEE 802.11G SISO	1-11[11]	13.70	12.78	16.27
2412-2462	1/2	IEEE 802.11nHT20 MIMO	1-11[11]	13.29	12.47	15.80

Remark: For this product, it has two antennas, antenna1 and antenna2, the 802.11B SISO&802.11G SISO modes are use the SISO technical, but the ant1 and ant2 can transmitter in the same time under those modes. The 802.11N(HT20) is use both the SISO and MIMO technical.



5.3. CHANNEL LIST

Channel List for 802.11b/g/n (20 MHz)							
Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
1	2412	4	2427	7	2442	10	2457
2	2417	5	2432	8	2447	11	2462
3	2422	6	2437	9	2452	/	/

5.4. TEST CHANNEL CONFIGURATION

Test Mode	Test Channel	Frequency
WiFi TX(802.11b)	CH 1, CH 6, CH 11	2412MHz, 2437MHz, 2462MHz
WiFi TX(802.11g)	CH 1, CH 6, CH 11	2412MHz, 2437MHz, 2462MHz
WiFi TX(802.11n HT20)	CH 1, CH 6, CH 11	2412MHz, 2437MHz, 2462MHz



5.5. THE WORSE CASE CONFIGURATIONS

1TX Mode

The Worst Case Power Setting Parameter under 2400 ~ 2483.5MHz Band							
Test Software		cart					
Modulation Mode	Transmit Antenna Number	Test Channel					
		NCB: 20MHz			NCB: 40MHz		
		CH 1	CH 6	CH 11	CH 3	CH 6	CH 9
802.11b	1	9	9	9	N/A		
802.11g	1	7	7	7			
802.11n HT20	1	7	7	7			
802.11n HT40	1	N/A	N/A	N/A	N/A	N/A	N/A

2TX Mode

The Worst Case Power Setting Parameter under 2400 ~ 2483.5MHz Band							
Test Software		cart					
Modulation Mode	Transmit Antenna Number	Test Channel					
		NCB: 20MHz			NCB: 40MHz		
		CH 1	CH 6	CH 11	CH 3	CH 6	CH 9
802.11b	1&2	9	9	9	N/A		
802.11g	1&2	7	7	7			
802.11n HT20	1&2	7	7	7			
802.11n HT40	1&2	N/A	N/A	N/A	N/A	N/A	N/A



5.6. DESCRIPTION OF AVAILABLE ANTENNAS

Ant.	Frequency (MHz)	Antenna Type	Antenna Gain (dBi)	Directional gain(dBi)
1	2400-2483.5	Dipole Antenna	5	8.01
2	2400-2483.5	Dipole Antenna	5	

Note:

- 1) Directional gain= $10\log [(10^{G1/20} + 10^{G2/20})^2 / N_{ANT}] = 8.01$ dBi
- 2) N_{ANT} : the number of Antenna

Test Mode	Transmit and Receive Mode	Description
IEEE 802.11b	<input checked="" type="checkbox"/> 1TX, 1RX	Antenna1 or Antenna2 can be used as transmitting/receiving antenna independently.
IEEE 802.11g	<input checked="" type="checkbox"/> 1TX, 1RX	Antenna1 or Antenna2 can be used as transmitting/receiving antenna independently.
IEEE 802.11N (HT20) SISO	<input checked="" type="checkbox"/> 1TX, 1RX	Antenna1 or Antenna2 can be used as transmitting/receiving antenna independently.
IEEE 802.11N (HT20) MIMO	<input checked="" type="checkbox"/> 2TX, 2RX	Both antennas can be used as transmitting/receiving antenna.

5.7. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Item	Equipment	Brand Name	Model Name	FCC ID
1	Laptop	ThinkPad	T410	N/A

I/O CABLES

Cable No	Port	Connector Type	Cable Type	Cable Length(m)	Remarks
1	LAN	LAN	N/A	N/A	N/A

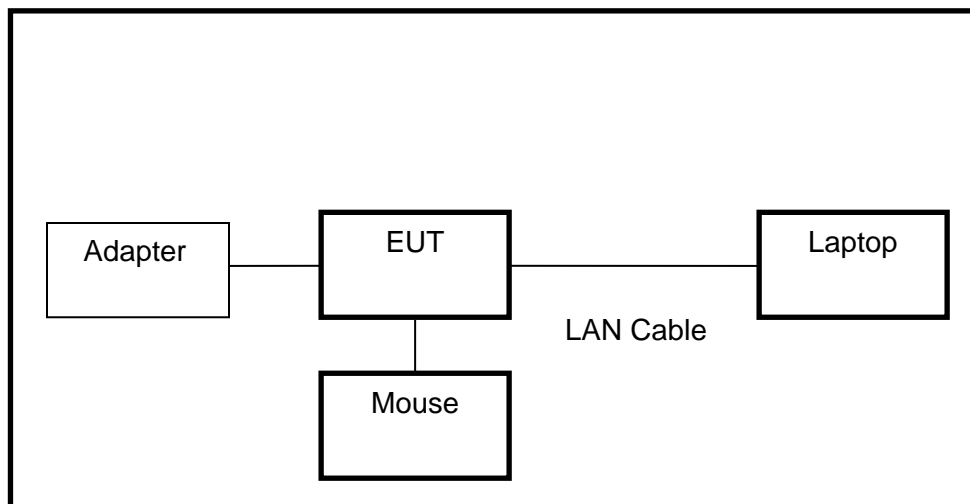
ACCESSORIES

Item	Accessory	Brand Name	Model Name	Description
1	Mouse	/	RTM 019	/

TEST SETUP

The EUT can work in engineering mode with a software through a Laptop.

SETUP DIAGRAM FOR TESTS





6. MEASURING INSTRUMENT AND SOFTWARE USED

Conducted Emissions(Instrument)						
Used	Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Next Cal.
<input checked="" type="checkbox"/>	EMI Test Receiver	R&S	ESR3	101961	Dec.12, 2017	Dec.11, 2018
<input checked="" type="checkbox"/>	Two-Line V-Network	R&S	ENV216	101983	Dec.12, 2017	Dec.11, 2018
<input checked="" type="checkbox"/>	Artificial Mains Networks	Schwarzbeck	NSLK 8126	8126465	Dec.12, 2017	Dec.11, 2018
Software						
Used	Description		Manufacturer	Name	Version	
<input checked="" type="checkbox"/>	Test Software for Conducted disturbance		UL	Antenna port	Ver. 7.2	
Radiated Emissions(Instrument)						
Used	Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Next Cal.
<input checked="" type="checkbox"/>	MXE EMI Receiver	KESIGHT	N9038A	MY56400036	Dec. 12, 2017	Dec. 11, 2018
<input checked="" type="checkbox"/>	Hybrid Log Periodic Antenna	TDK	HLP-3003C	130960	Jan.09, 2016	Jan.09, 2019
<input checked="" type="checkbox"/>	Preamplifier	HP	8447D	2944A09099	Dec. 12, 2017	Dec. 11, 2018
<input checked="" type="checkbox"/>	EMI Measurement Receiver	R&S	ESR26	101377	Dec.12, 2017	Dec.11, 2018
<input checked="" type="checkbox"/>	Horn Antenna	TDK	HRN-0118	130939	Jan. 09, 2016	Jan. 09, 2019
<input checked="" type="checkbox"/>	High Gain Horn Antenna	Schwarzbeck	BBHA-9170	691	Jan.06, 2016	Jan.06, 2019
<input checked="" type="checkbox"/>	Preamplifier	TDK	PA-02-0118	TRS-305-00066	Dec. 12, 2017	Dec. 11, 2018
<input checked="" type="checkbox"/>	Preamplifier	TDK	PA-02-2	TRS-307-00003	Dec.12, 2017	Dec.11, 2018
<input checked="" type="checkbox"/>	Loop antenna	Schwarzbeck	1519B	00008	Mar. 26, 2016	Mar. 26, 2019
<input checked="" type="checkbox"/>	Band Reject Filter	Wainwright	WRCJV8-2350-2400-2483.5-2533.5-40SS	4	Dec.12, 2017	Dec.11, 2018
Software						
Used	Description		Manufacturer	Name	Version	
<input checked="" type="checkbox"/>	Test Software for Radiated disturbance		Farad	EZ-EMC	Ver. UL-3A1	
Other instruments						
Used	Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Next Cal.
<input checked="" type="checkbox"/>	Spectrum Analyzer	Keysight	N9030A	MY55410512	Dec.12, 2017	Dec.11, 2018
<input checked="" type="checkbox"/>	Power Meter	Keysight	N9031A	MY55416024	Dec.12, 2017	Dec.11, 2018



<input checked="" type="checkbox"/>	Power Sensor	Keysight	N9323A	MY55440 013	Dec.12, 2017	Dec.11, 2018
-------------------------------------	--------------	----------	--------	----------------	--------------	--------------

7. MEASUREMENT METHODS

No.	Test Item	KDB Name	Section
1	6dB Bandwidth	KDB 558074 D01 DTS Meas Guidance v05	8.2
2	Peak Output Power	KDB 558074 D01 DTS Meas Guidance v05	8.3.1.3/8.3.2.3
3	Power Spectral Density	KDB 558074 D01 DTS Meas Guidance v05	8.4
4	Out-of-band emissions in non- restricted bands	KDB 558074 D01 DTS Meas Guidance v05	8.5
5	Out-of-band emissions in restricted bands	KDB 558074 D01 DTS Meas Guidance v05	8.6
6	Band-edge	KDB 558074 D01 DTS Meas Guidance v05	8.7
7	Conducted Emission Test For AC Power Port	ANSI C63.10-2013	6.2



8. ANTENNA PORT TEST RESULTS

8.1. ON TIME AND DUTY CYCLE

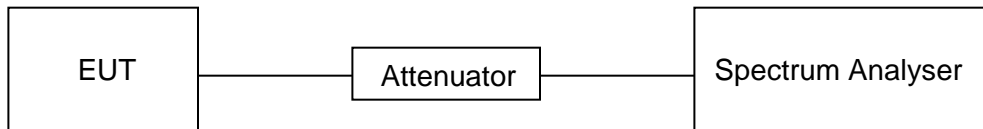
LIMITS

None; for reporting purposes only

PROCEDURE

KDB 558074 Zero-Span Spectrum Analyzer Method

TEST SETUP



TEST ENVIRONMENT

Temperature	25°C	Relative Humidity	58%
Atmosphere Pressure	101kPa	Test Voltage	DC 12.0V

RESULTS

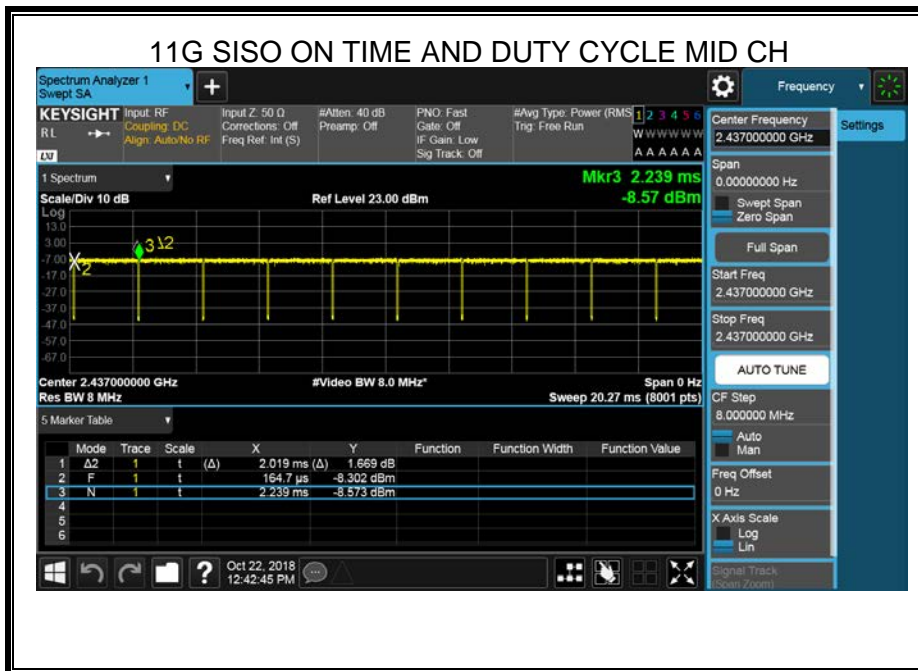
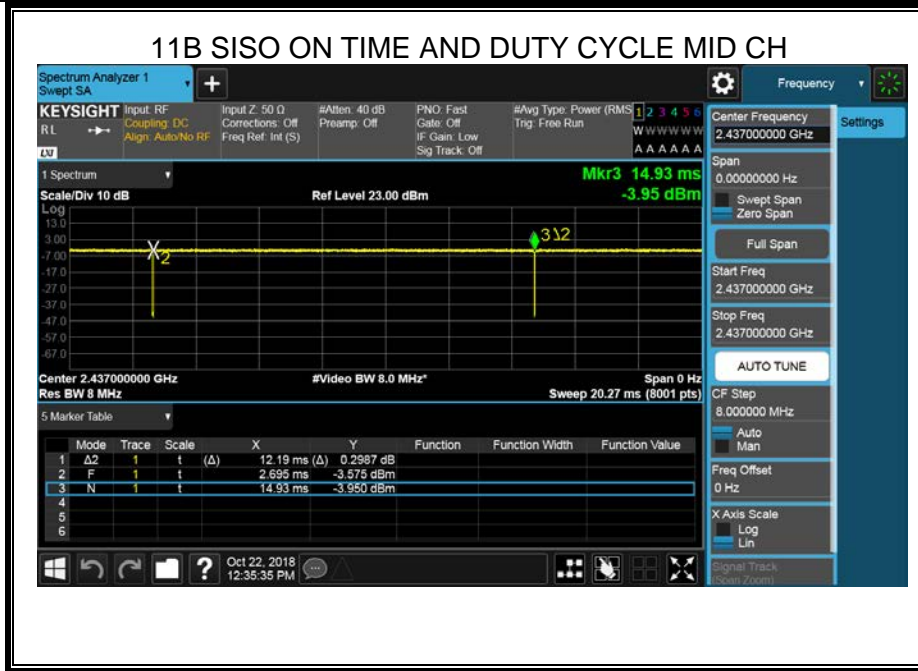
Mode	On Time (msec)	Period (msec)	Duty Cycle x (Linear)	Duty Cycle	Duty Cycle Correction Factor (db)	1/T Minimum VBW (KHz)
11B SISOSISO	12.19	12.235	1	0.9963	0.016	0.082
11G SISOSISO	2.019	2.074	1	0.9735	0.117	0.495
11N20MIMO	1.882	1.938	1	0.9711	0.127	0.531

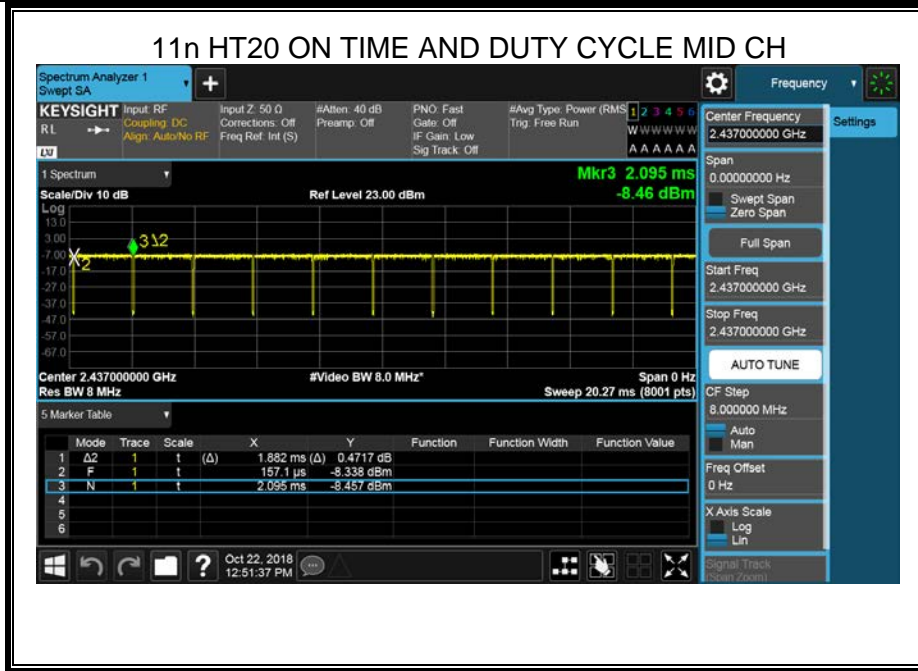
Note: 1) Duty Cycle Correction Factor= $10\log(1/x)$.

2) Where: x is Duty Cycle(Linear)

3) Where: T is On Time (transmit duration)

4) Pre-testing Antenna 1 and Antenna2, and pre-testing SISO and MIMO modes, only the data of worse case is shown in this test report.





Remark:

- 1) For the period time= N (the end time of the burst)- F (the start time of the burst)

8.2. 6 dB DTS BANDWIDTH AND 99% OCCUPIED BANDWIDTH

LIMITS

CFR 47 FCC Part15 (15.247) Subpart C ISED RSS-247 ISSUE 2			
Section	Test Item	Limit	Frequency Range (MHz)
CFR 47 FCC 15.247(a)(2) ISED RSS-247 5.2 (a)	6 dB Bandwidth	≥ 500KHz	2400-2483.5
ISED RSS-Gen Clause 6.7	99% Occupied Bandwidth	For reporting purposes only.	2400-2483.5

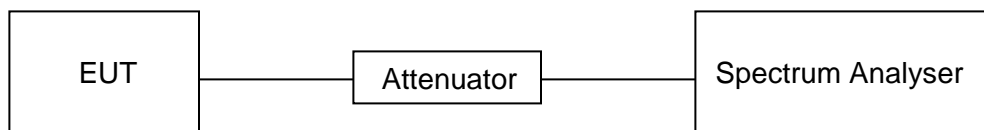
TEST PROCEDURE

Connect the UUT to the spectrum analyser and use the following settings:

Center Frequency	The centre frequency of the channel under test
Detector	Peak
RBW	For 6dB Bandwidth :100K For 99% Occupied Bandwidth :1% to 5% of the occupied bandwidth
VBW	For 6dB Bandwidth : ≥3 × RBW For 99% Occupied Bandwidth : approximately 3×RBW
Trace	Max hold
Sweep	Auto couple

Allow the trace to stabilize and measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB and 99% relative to the maximum level measured in the fundamental emission.

TEST SETUP



TEST ENVIRONMENT

Temperature	25°C	Relative Humidity	58%
Atmosphere Pressure	101kPa	Test Voltage	DC 12.0V

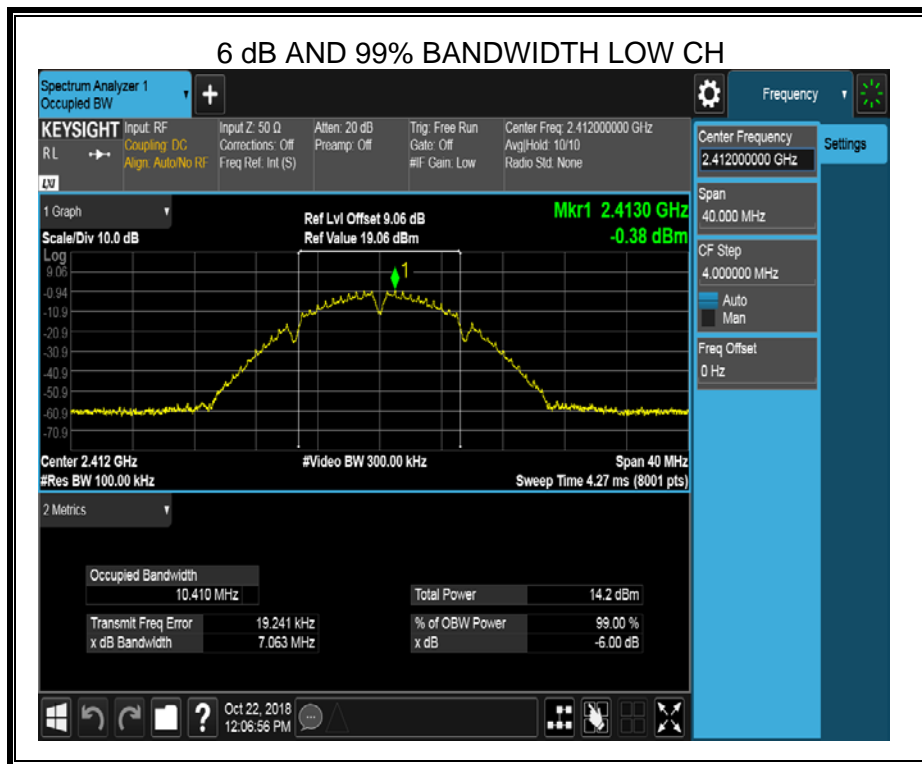
RESULTS

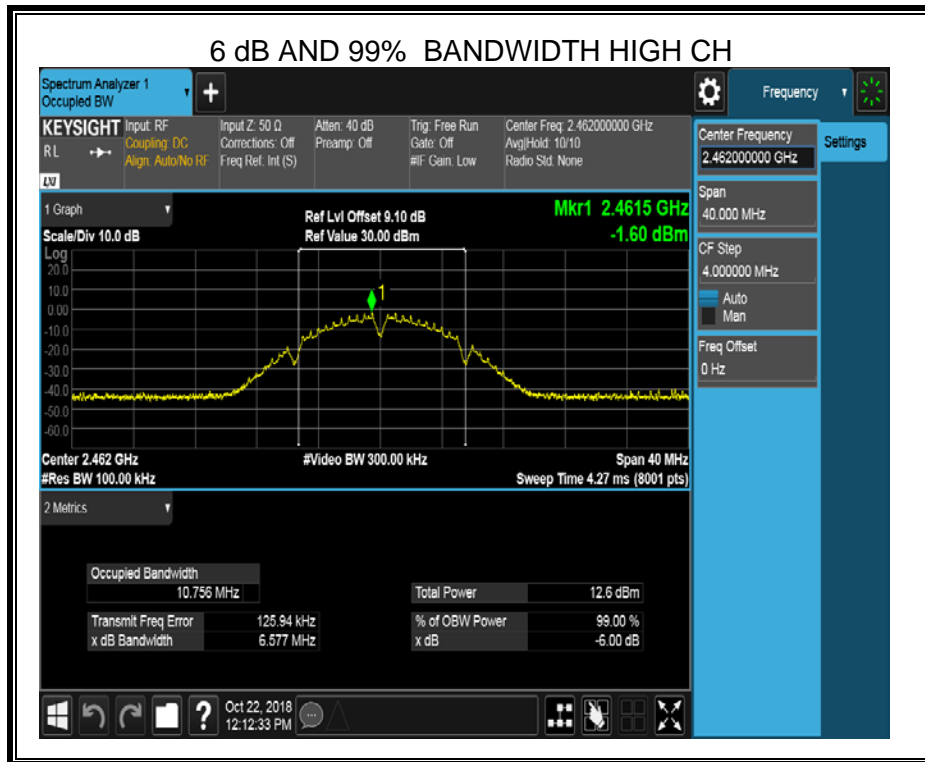
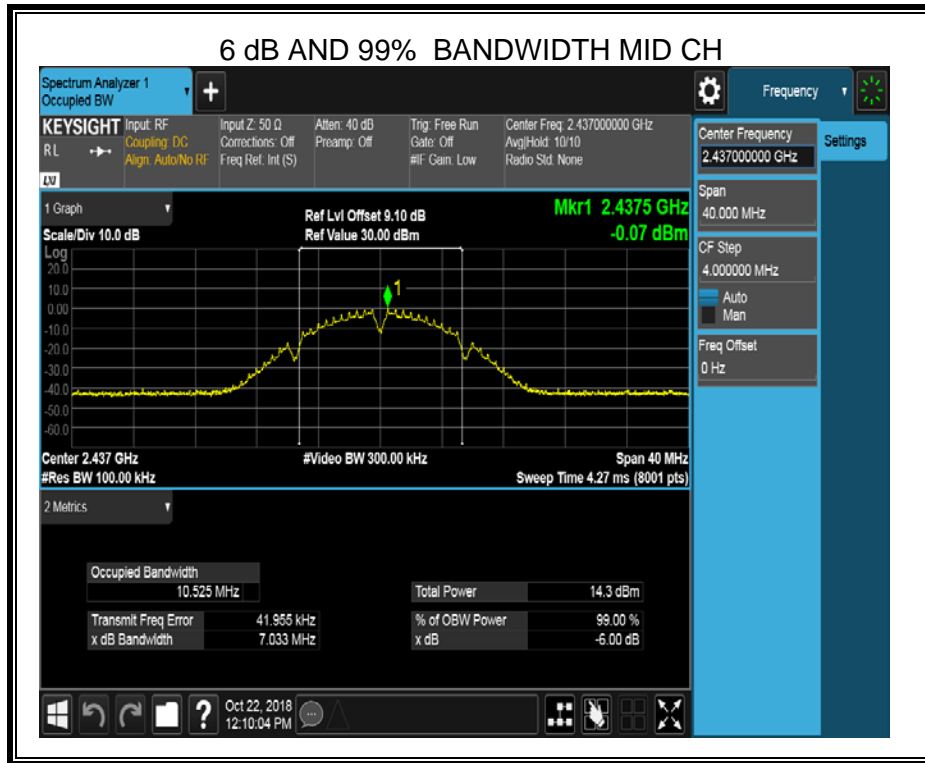
8.2.1. 802.11b MODE

ANTENNA 1

Channel	6dB bandwidth (MHz)	99% bandwidth (MHz)	Limit (kHz)	Result
Low	7.063	10.41	≥500	Pass
Middle	7.033	10.53	≥500	Pass
High	6.577	10.76	≥500	Pass

Remark: For this product, it has two antennas, antenna1 and antenna2, the 802.11B SISO&802.11G SISO modes are use the SISO technical, but the ant1 and ant2 can transmitter in the same time under these modes. The 802.11N(HT20) is use both the SISO and MIMO technical.

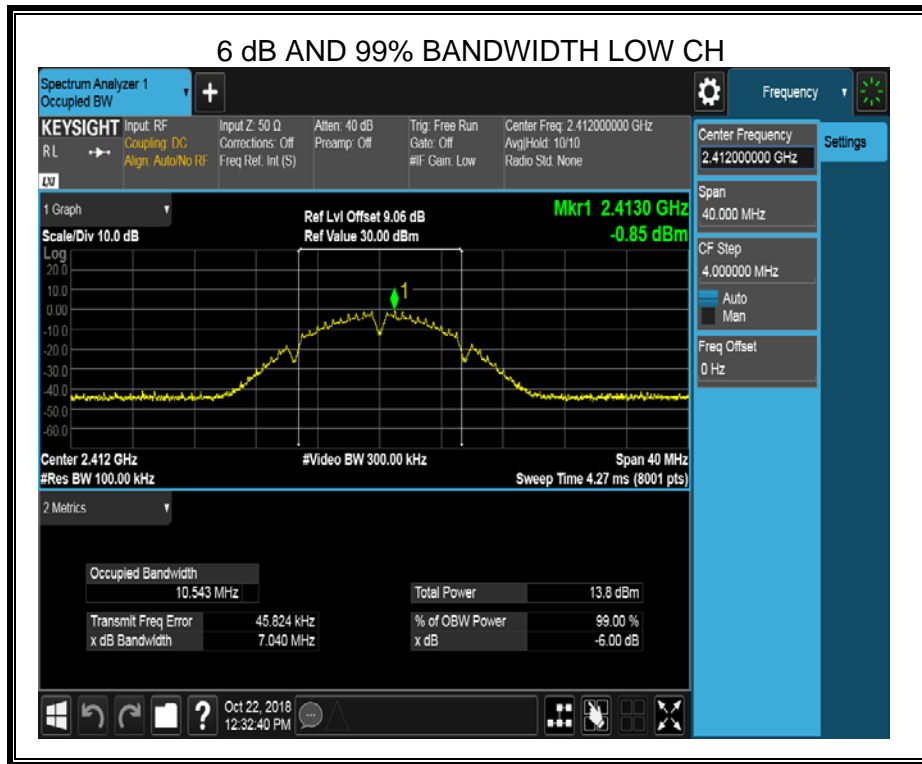


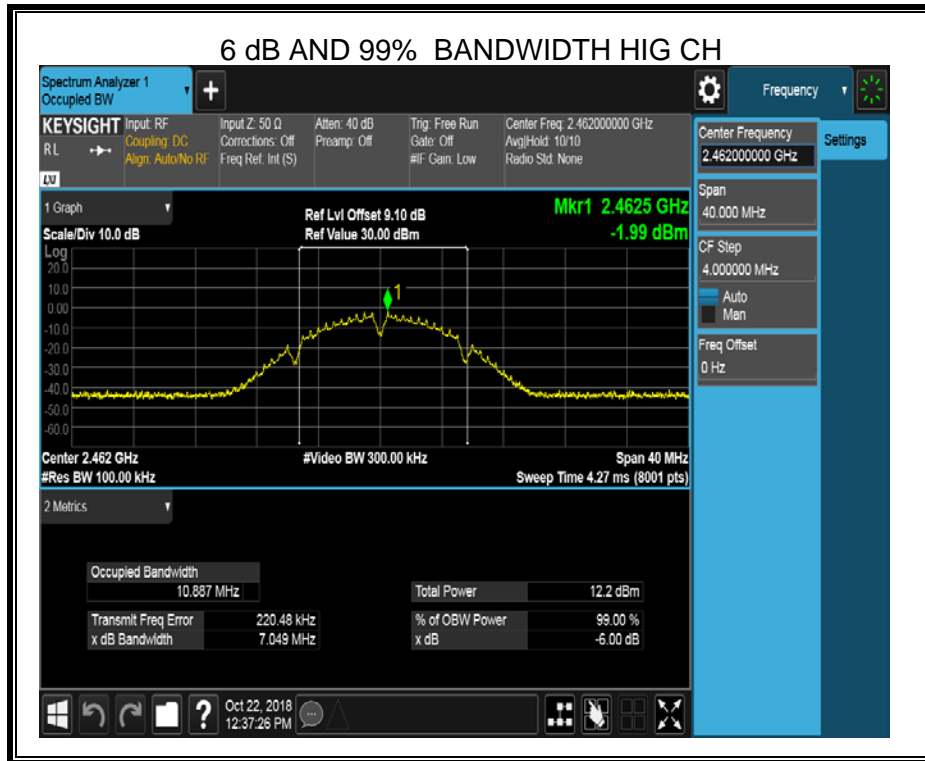
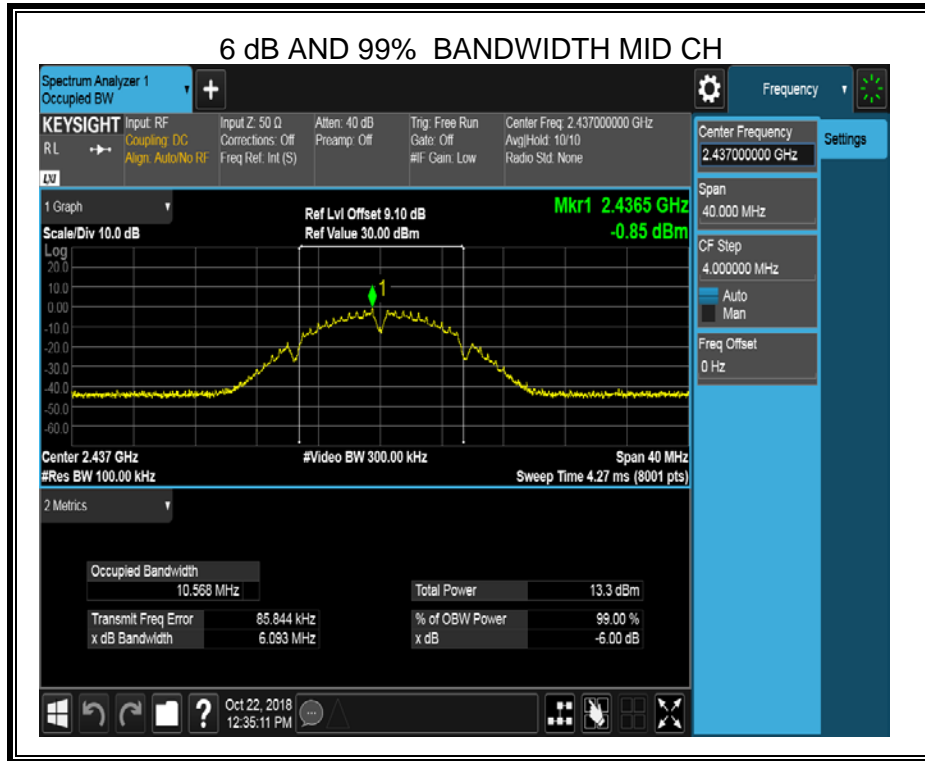


ANTENNA 2

Channel	6dB bandwidth (MHz)	99% bandwidth (MHz)	Limit (kHz)	Result
Low	7.040	10.54	≥500	Pass
Middle	6.093	10.57	≥500	Pass
High	7.049	10.89	≥500	Pass

Remark: For this product, it has two antennas, antenna1 and antenna2, the 802.11B SISO&802.11G SISO modes are use the SISO technical, but the ant1 and ant2 can transmitter in the same time under these modes. The 802.11N(HT20) is use both the SISO and MIMO technical.



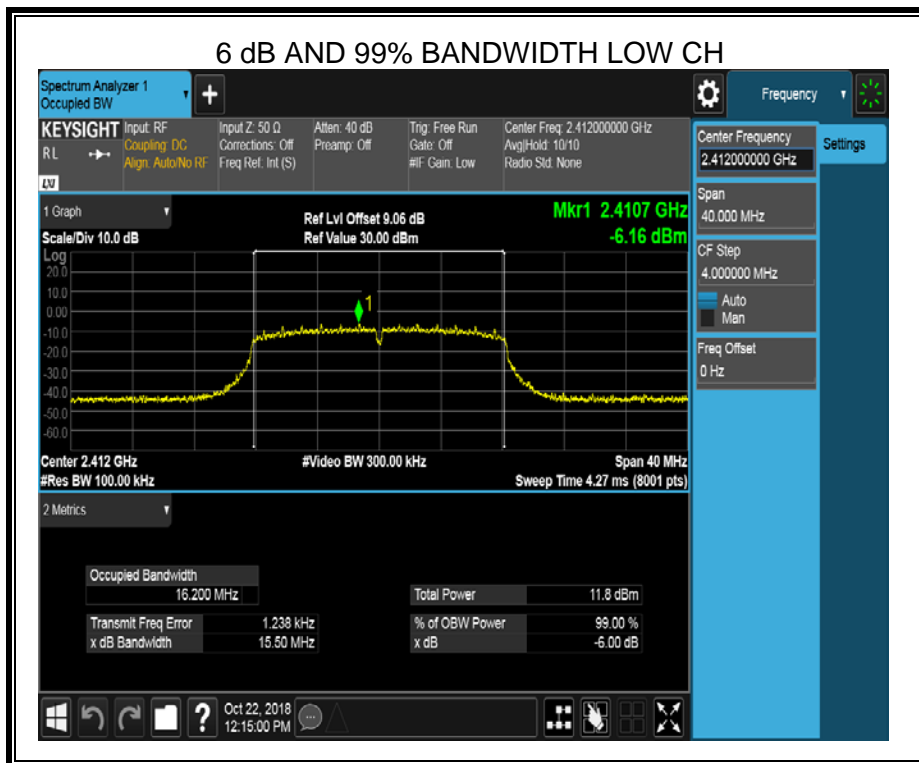


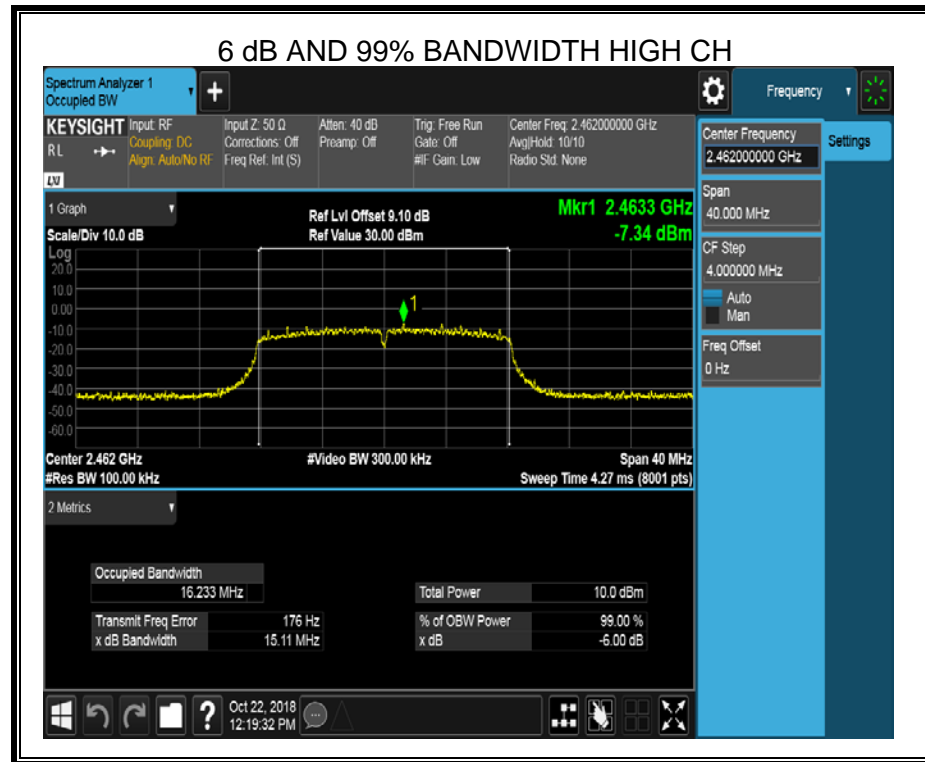
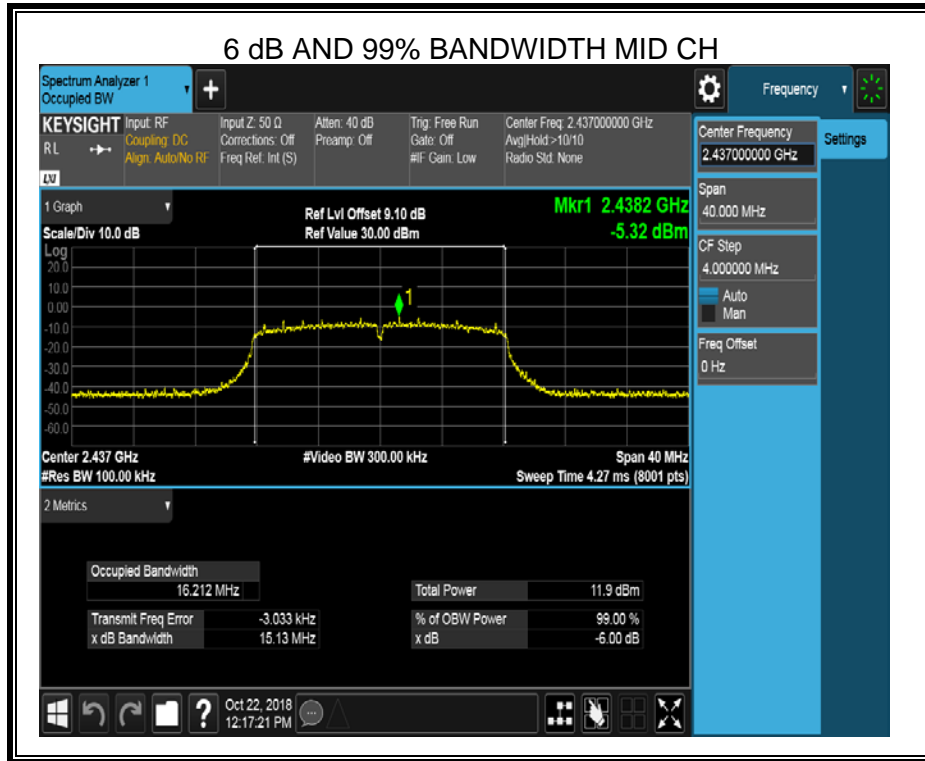
8.2.2. 802.11g MODE

ANTENNA 1

Channel	6dB bandwidth (MHz)	99% bandwidth (MHz)	Limit (kHz)	Result
Low	15.50	16.20	≥500	Pass
Middle	15.13	16.21	≥500	Pass
High	15.11	16.23	≥500	Pass

Remark: For this product, it has two antennas, antenna1 and antenna2, the 802.11B SISO&802.11G SISO modes are use the SISO technical, but the ant1 and ant2 can transmitter in the same time under these modes. The 802.11N(HT20) is use both the SISO and MIMO technical.

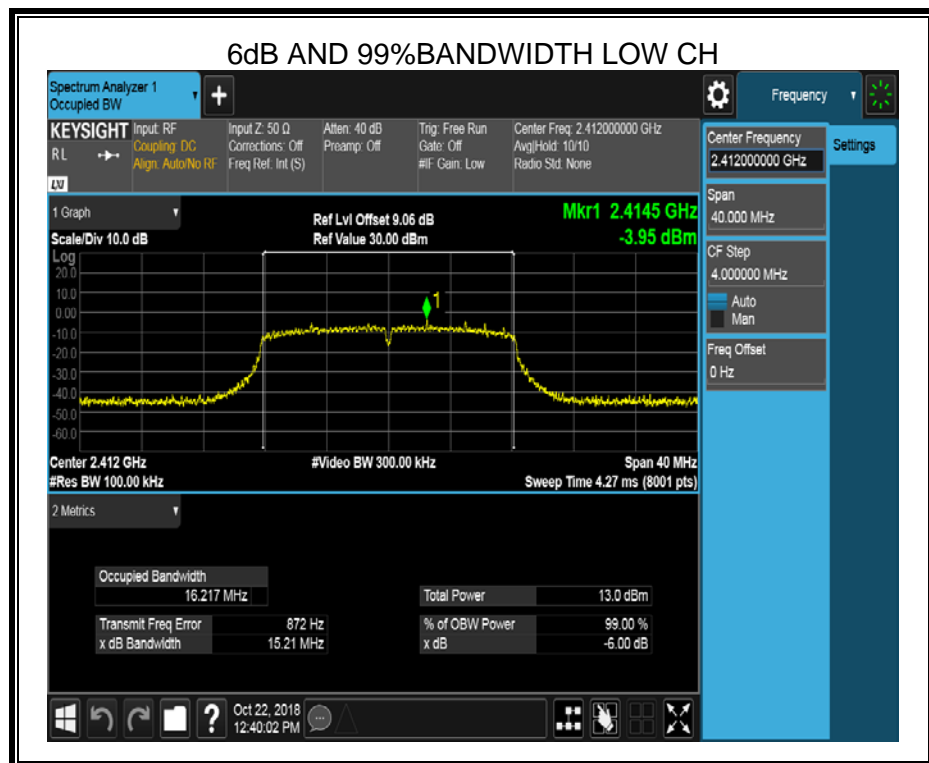


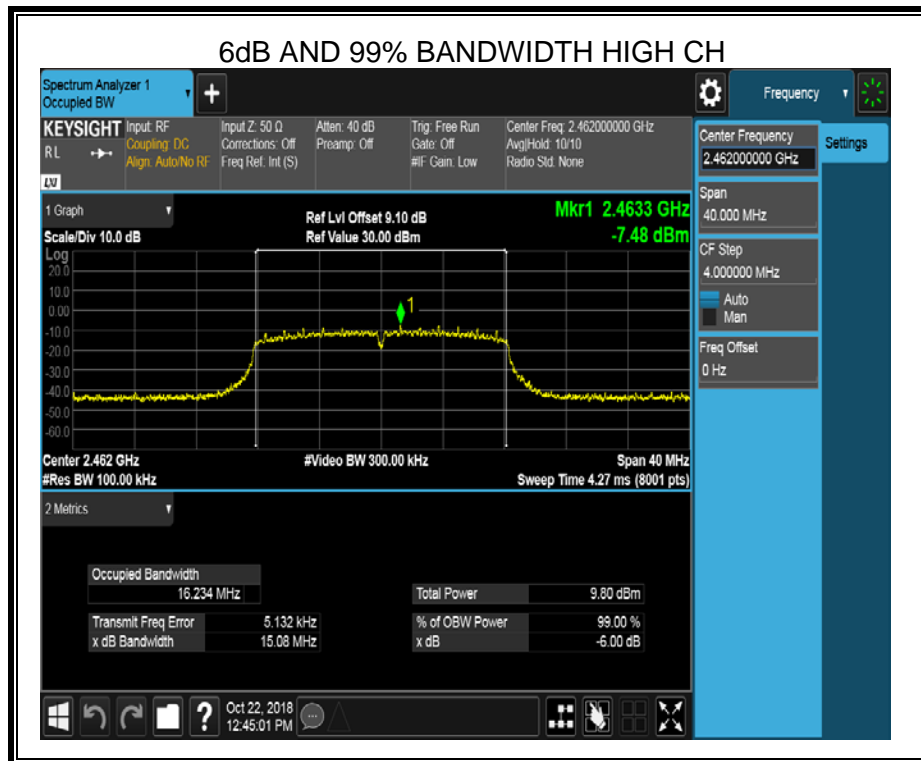
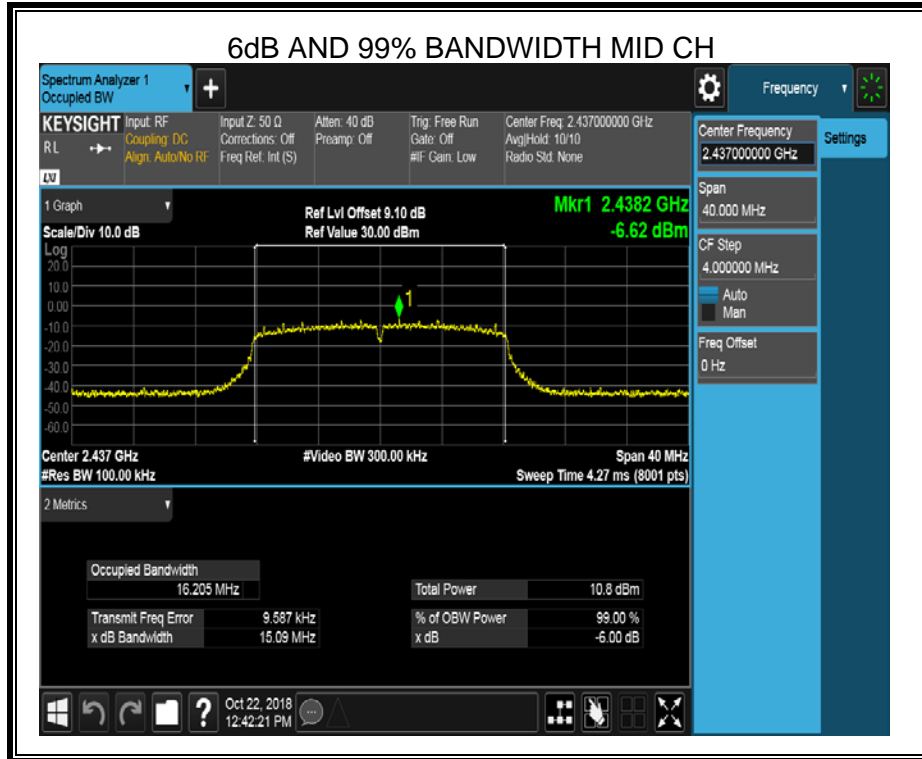


ANTENNA 2

Channel	6dB bandwidth (MHz)	99% bandwidth (MHz)	Limit (kHz)	Result
Low	15.50	16.20	≥500	Pass
Middle	15.13	16.21	≥500	Pass
High	15.11	16.23	≥500	Pass

Remark: For this product, it has two antennas, antenna1 and antenna2, the 802.11B SISO&802.11G SISO modes are use the SISO technical, but the ant1 and ant2 can transmitter in the same time under these modes. The 802.11N(HT20) is use both the SISO and MIMO technical.



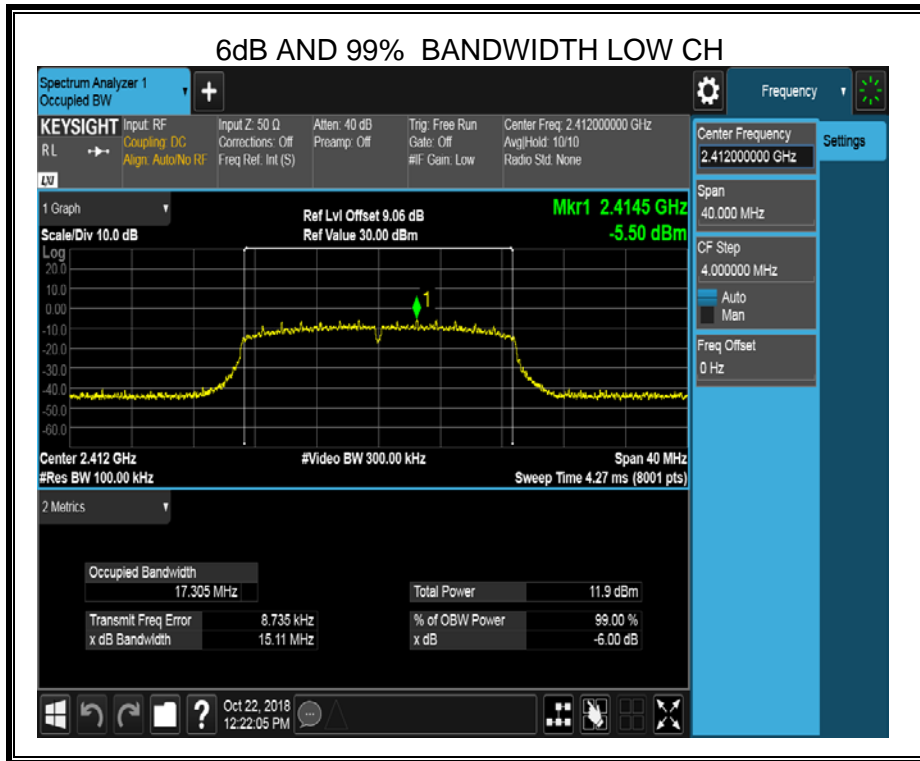


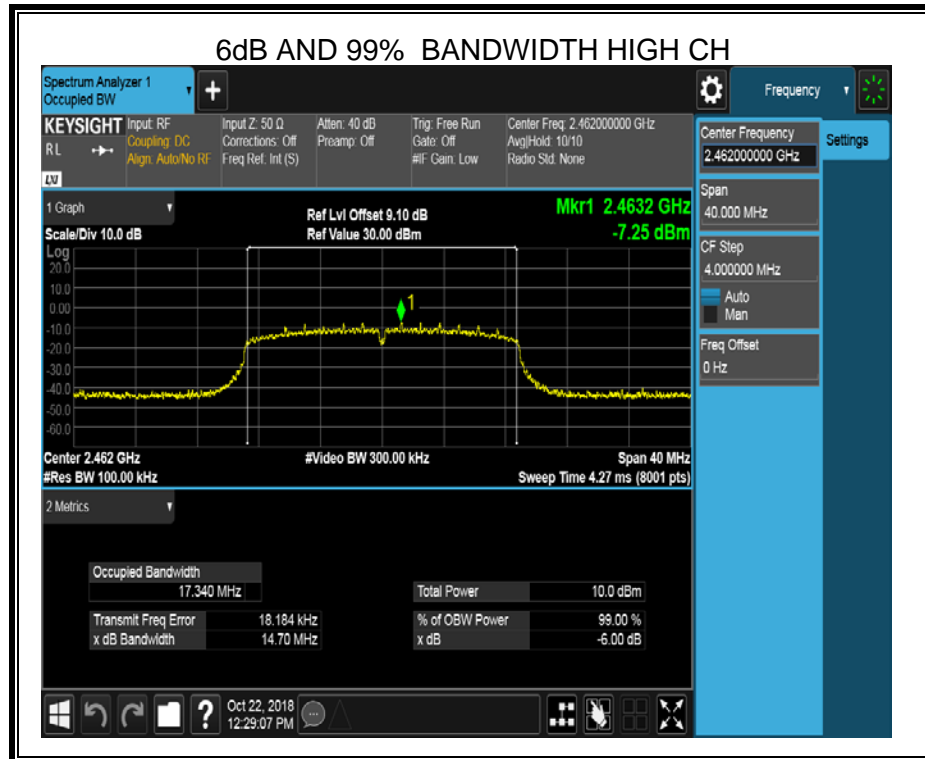
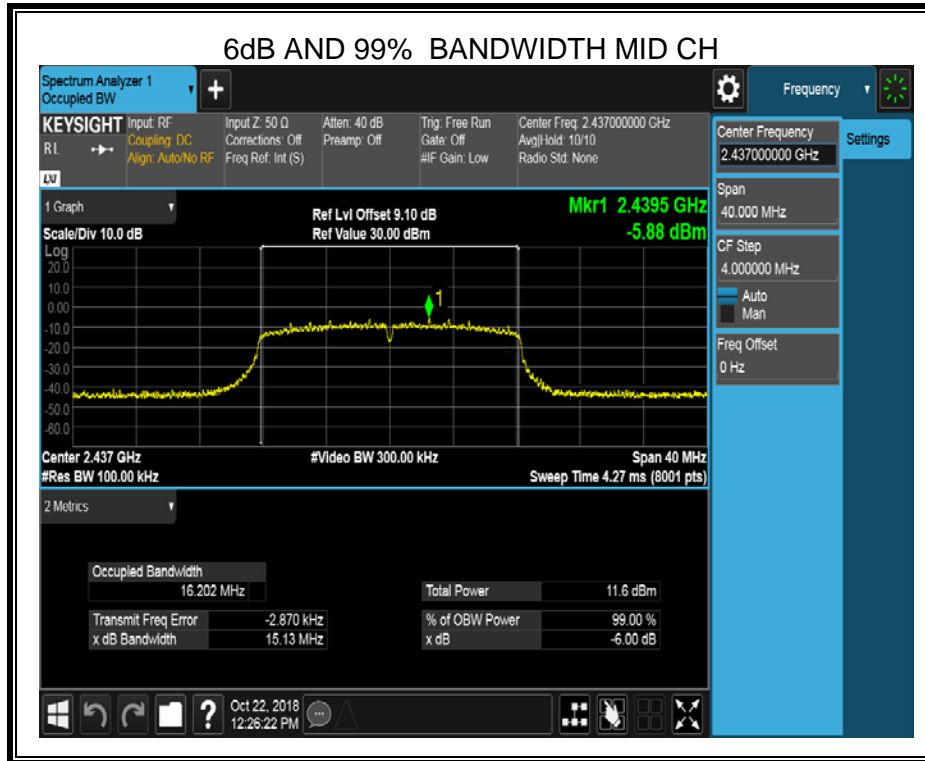
8.2.3. 802.11n HT20 MODE

ANTENNA 1

Channel	6dB bandwidth (MHz)	99% bandwidth (MHz)	Limit (kHz)	Result
Low	15.11	17.31	≥500	Pass
Middle	15.13	16.20	≥500	Pass
High	14.70	17.34	≥500	Pass

Remark: For this product, it has two antennas, antenna1 and antenna2, the 802.11B SISO&802.11G SISO modes are use the SISO technical, but the ant1 and ant2 can transmitter in the same time under these modes. The 802.11N(HT20) is use both the SISO and MIMO technical.

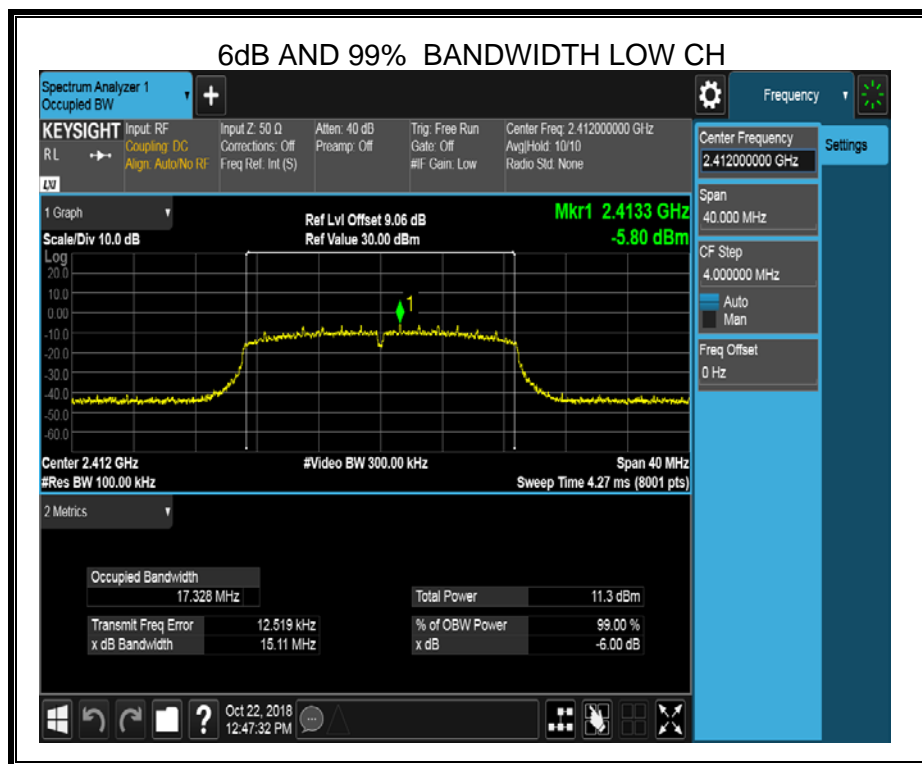


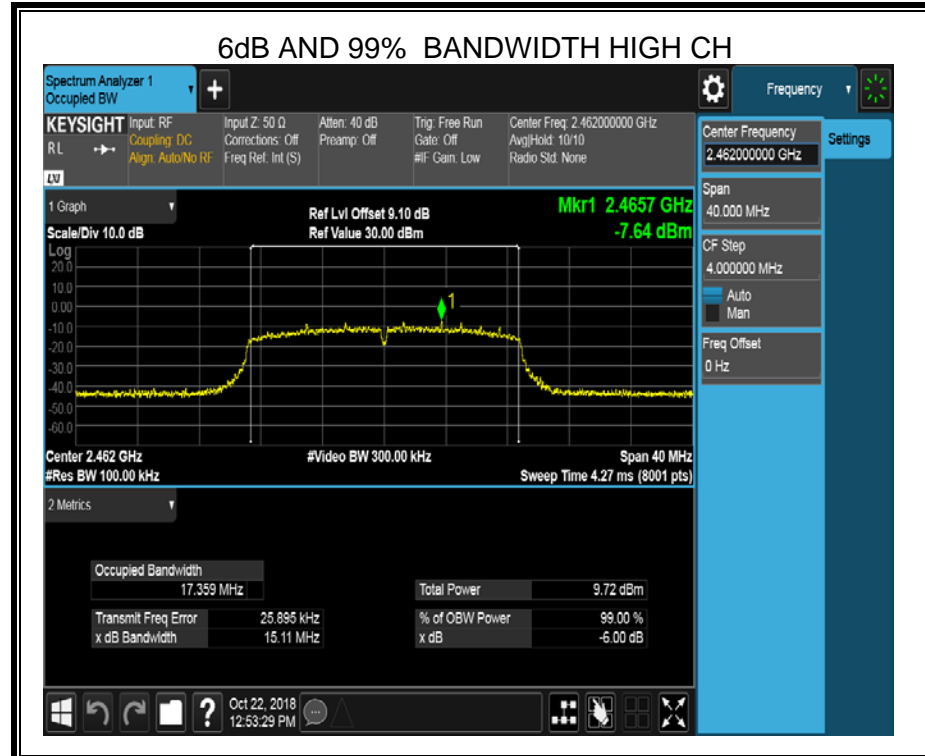
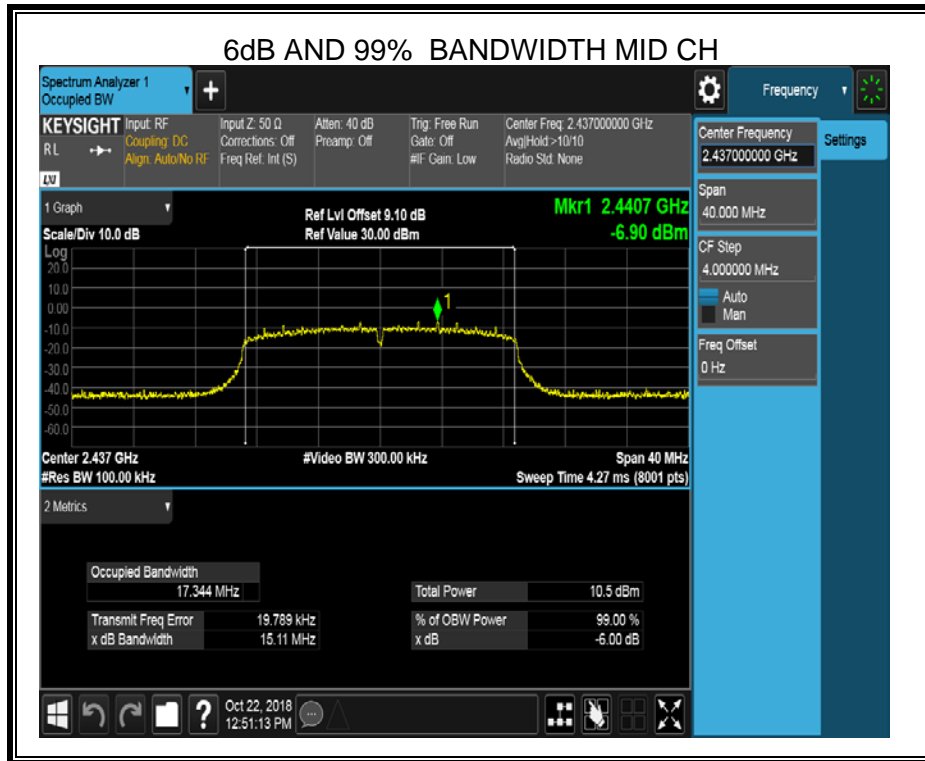


ANTENNA 2

Channel	6dB bandwidth (MHz)	99% bandwidth (MHz)	Limit (kHz)	Result
Low	15.11	17.33	≥500	Pass
Middle	15.11	17.34	≥500	Pass
High	15.11	17.36	≥500	Pass

Remark: For this product, it has two antennas, antenna1 and antenna2, the 802.11B SISO&802.11G SISO modes are use the SISO technical, but the ant1 and ant2 can transmitter in the same time under these modes. The 802.11N(HT20) is use both the SISO and MIMO technical.





Note: All modes and antennas had been tested, but only the worst data recorded in the report.

8.3. PEAK CONDUCTED OUTPUT POWER

LIMITS

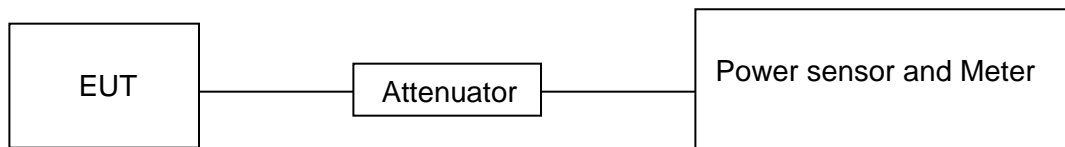
CFR 47 FCC Part15 (15.247) Subpart C ISED RSS-247 ISSUE 2			
Section	Test Item	Limit	Frequency Range (MHz)
CFR 47 FCC 15.247(b)(3) ISED RSS-247 5.4 (e)	Peak Output Power	1 watt or 30dBm (See Note 1/2)	2400-2483.5
<p>1. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.</p> <p>2. Limit=30dBm – (Directional gain -6)dBi Directional gain = $10\log [(10^{G1/20} + 10^{G2/20})^2 / N_{ANT}] = 8.01 > 6\text{dBi}$, where the N_{ANT} is the numbers of antenna. So, the power limit shall be reduced to $30 - (8.01 - 6) = 27.99 \text{ dBm}$</p>			

TEST PROCEDURE

Place the EUT on the table and set it in the transmitting mode.
 Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the Power sensor.

Measure peak power each channel.
 Peak Detector use for Peak result.
 AVG Detector use for AVG result.

TEST SETUP



TEST ENVIRONMENT

Temperature	25°C	Relative Humidity	58%
Atmosphere Pressure	101kPa	Test Voltage	DC 12.0V



RESULTS

8.3.1. 802.11b MODE-SISO

SISO MODE

Frequency (MHz)	ANT	Maximum PK Conducted Output Power (dBm)		Result
		Single	Total	
Low	1	9.77	12.52	PASS
	2	9.24		
Middle	1	9.72	12.14	
	2	8.45		
High	1	8.03	10.88	
	2	7.71		

Frequency (MHz)	ANT	Maximum AV Conducted Output Power (dBm)		Result
		Single	Total	
Low	1	7.25	10.09	PASS
	2	6.91		
Middle	1	7.24	9.82	
	2	6.34		
High	1	5.59	8.47	
	2	5.33		

Remark: For this product, it has two antennas, antenna1 and antenna2, the 802.11B SISO&802.11G SISO modes are use the SISO technical, but the ant1 and ant2 can transmitter in the same time under these modes. The 802.11N(HT20) is use both the SISO and MIMO technical.



8.3.2. 802.11g MODE-SISO

SISO MODE

Frequency (MHz)	ANT	Maximum PK Conducted Output Power (dBm)		Result
		Single	Total	
Low	1	13.70	16.27	PASS
	2	12.78		
Middle	1	13.40	15.86	
	2	12.21		
High	1	11.89	14.58	
	2	11.23		

Frequency (MHz)	ANT	Maximum AV Conducted Output Power (dBm)		Result
		Single	Total	
Low	1	5.54	9.41	PASS
	2	7.12		
Middle	1	5.09	8.94	
	2	6.64		
High	1	3.55	7.49	
	2	5.24		

Remark: For this product, it has two antennas, antenna1 and antenna2, the 802.11B SISO&802.11G SISO modes are use the SISO technical, but the ant1 and ant2 can transmitter in the same time under these modes. The 802.11N(HT20) is use both the SISO and MIMO technical.



8.3.3. 802.11n HT20 MODE-MIMO

MIMO MODE

Frequency (MHz)	ANT	Maximum PK Conducted Output Power (dBm)		Result
		Single	Total	
Low	1	13.09	15.80	PASS
	2	12.47		
Middle	1	13.29	15.75	
	2	12.12		
High	1	11.13	14.06	
	2	10.96		

Frequency (MHz)	ANT	Maximum AV Conducted Output Power (dBm)		Result
		Single	Total	
Low	1	5.27	9.18	PASS
	2	6.92		
Middle	1	4.86	8.76	
	2	6.48		
High	1	3.34	7.30	
	2	5.07		

Remark: For this product, it has two antennas, antenna1 and antenna2, the 802.11B SISO&802.11G SISO modes are use the SISO technical, but the ant1 and ant2 can transmitter in the same time under these modes. The 802.11N(HT20) is use both the SISO and MIMO technical.

8.4. POWER SPECTRAL DENSITY

LIMITS

CFR 47 FCC Part15 (15.247) Subpart C ISED RSS-247 ISSUE 2			
Section	Test Item	Limit	Frequency Range (MHz)
CFR 47 FCC §15.247 (e) ISED RSS-247 5.2 (b)	Power Spectral Density	8 dBm/3 kHz (See Note 1/2)	2400-2483.5
<p>1. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.</p> <p>2. Limit=8dBm – (Directional gain -6)dBi Directional gain = $10\log[(10G1/20G_{ANT} + 10 \log(N_{ANT}))]$ dBi, where N_{ANT} is the number of outputs, G_{ANT} is the Antenna gain. Directional gain = $10\log [(10^{G1/20} + 10^{G2/20})^2/N_{ANT}] = 8.01 > 6\text{dBi}$, where the N_{ANT} is the numbers of antenna. So, the power density limit shall be reduced to $8 - (8.01-6) = 5.99$ dBm in any 3KHz band.</p>			

TEST PROCEDURE

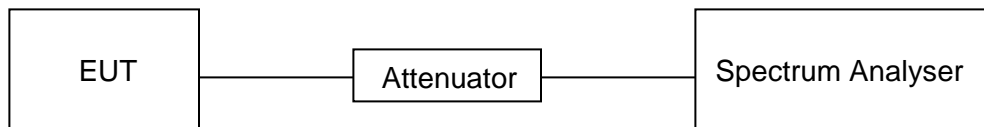
Connect the UUT to the spectrum analyser and use the following settings:

Center Frequency	The centre frequency of the channel under test
Detector	Peak
RBW	$3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$
VBW	$\geq 3 \times \text{RBW}$
Span	1.5 x DTS bandwidth
Trace	Max hold
Sweep time	Auto couple.

Allow trace to fully stabilize and use the peak marker function to determine the maximum amplitude level within the RBW.

If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

TEST SETUP





TEST ENVIRONMENT

Temperature	25°C	Relative Humidity	58%
Atmosphere Pressure	101kPa	Test Voltage	DC 12.0V

RESULTS

8.4.1. 802.11b MODE

SISO MODE

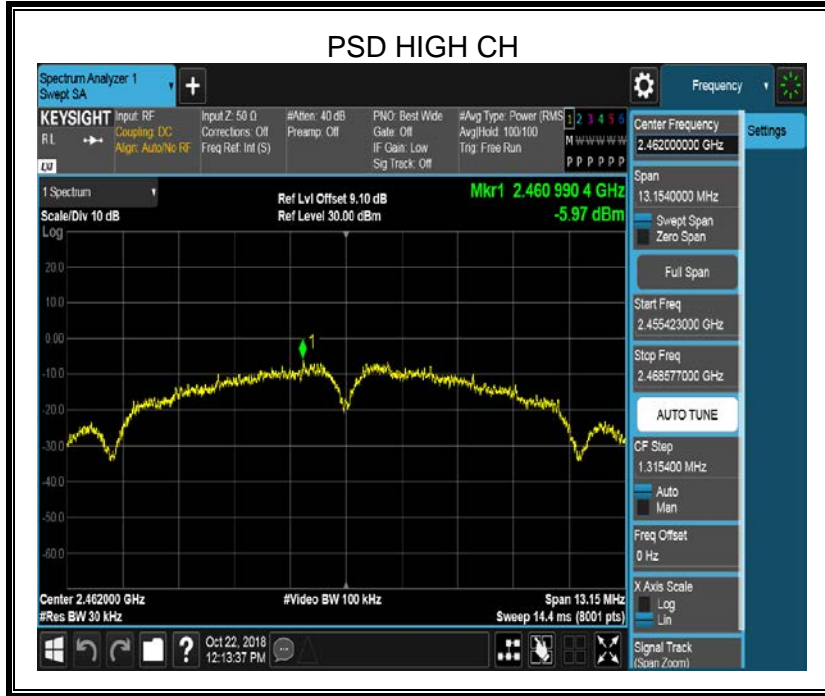
Frequency (MHz)	ANT	Power Spectral Density (dBm/3kHz)		Limit (dBm/3kHz)
		Single	Total	
Low	1	-4.89	-1.93	8
	2	-4.99		
Middle	1	-4.41	-1.89	
	2	-5.46		
High	1	-5.97	-3.41	
	2	-6.92		

Remark: For this product, it has two antennas, antenna1 and antenna2, the 802.11B SISO&802.11G SISO modes are use the SISO technical, but the ant1 and ant2 can transmitter in the same time under these modes. The 802.11N(HT20) is use both the SISO and MIMO technical, pre-testing both the SISO and MIMO modes, only the data of worse case is shown in this report.



ANTENNA 1





ANTENNA 2







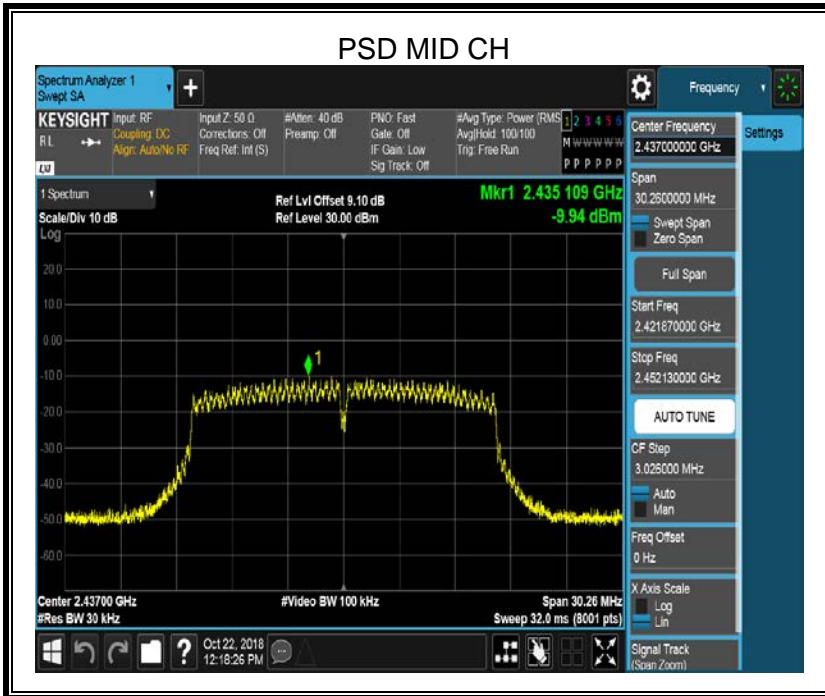
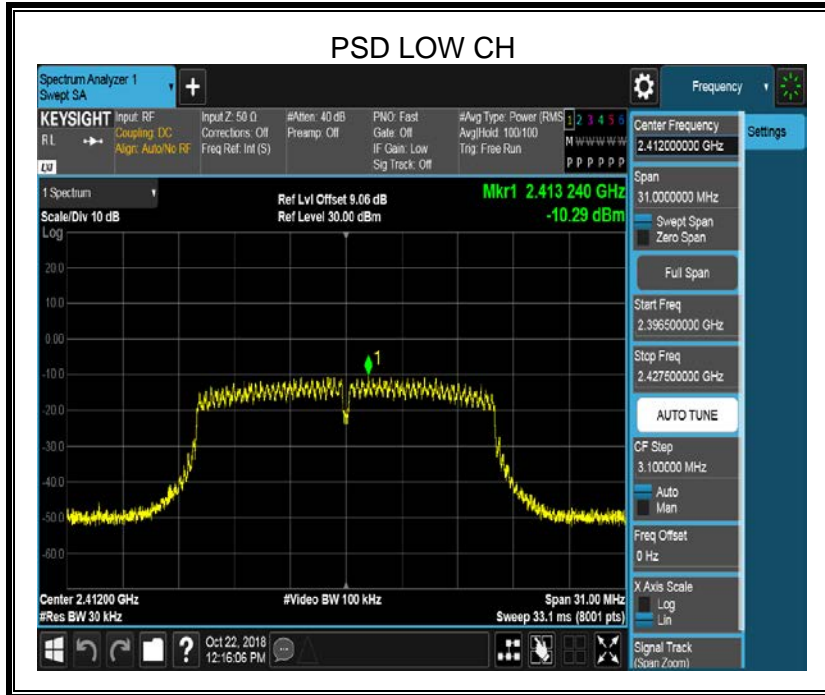
8.4.1. 802.11g MODE

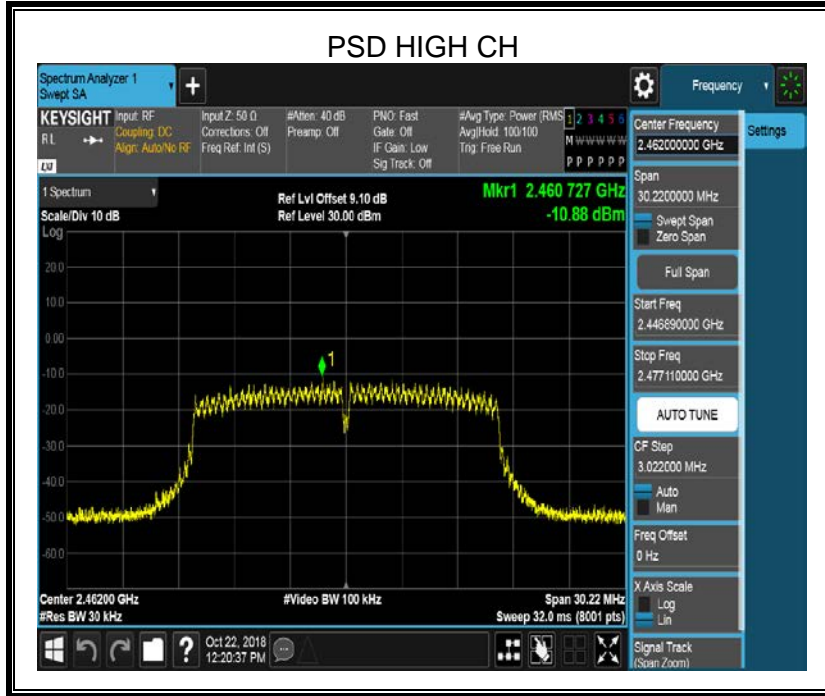
SISO MODE

Frequency (MHz)	ANT	Power Spectral Density (dBm/3kHz)		Limit (dBm/3kHz)
		Single	Total	
Low	1	-10.29	-7.42	8
	2	-10.57		
Middle	1	-9.94	-7.43	
	2	-11.00		
High	1	-10.88	-8.61	
	2	-12.51		

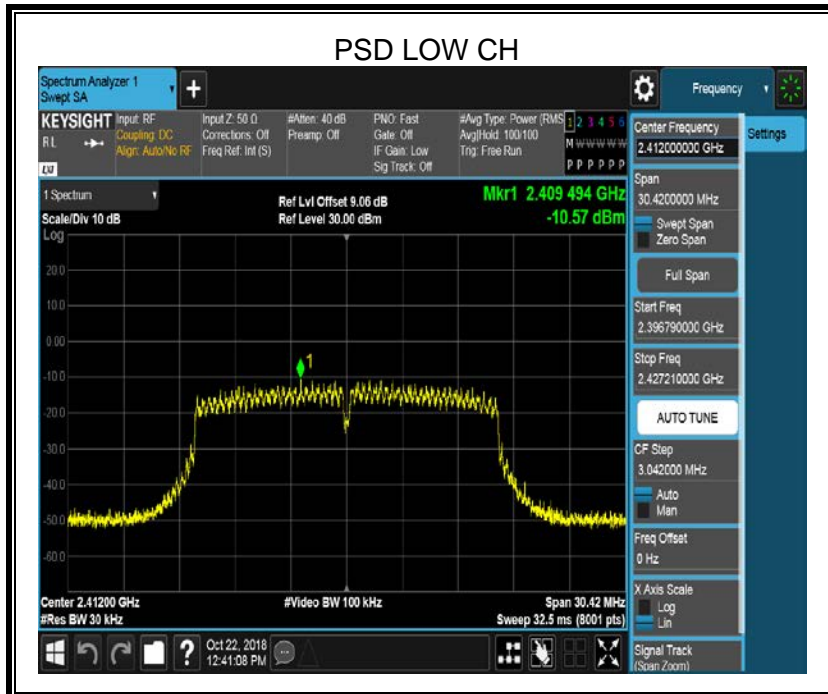
Remark: For this product, it has two antennas, antenna1 and antenna2, the 802.11B SISO&802.11G SISO modes are use the SISO technical, but the ant1 and ant2 can transmitter in the same time under these modes. The 802.11N(HT20) is use both the SISO and MIMO technical, pre-testing both the SISO and MIMO modes, only the data of worse case is shown in this report.

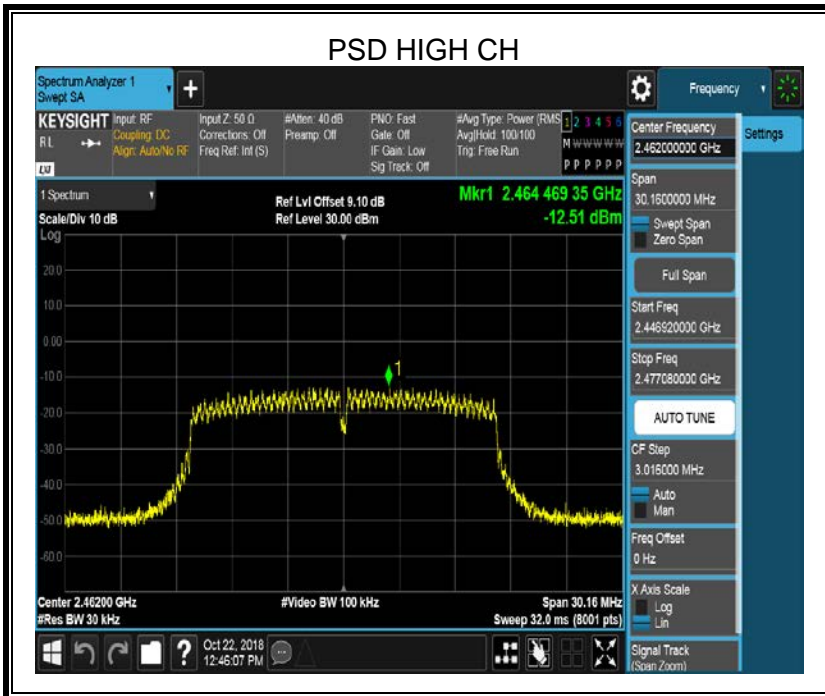
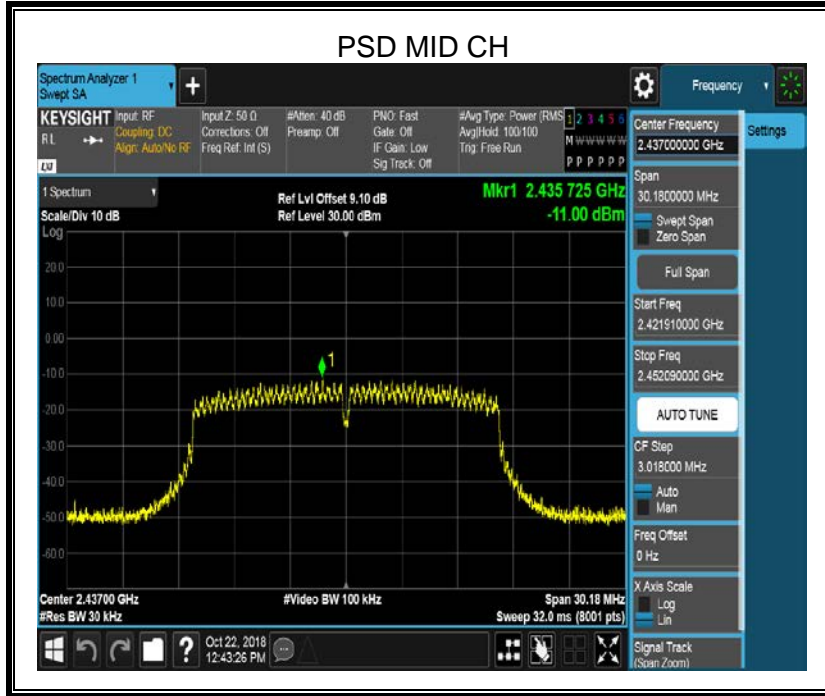
ANTENNA 1





ANTENNA 2







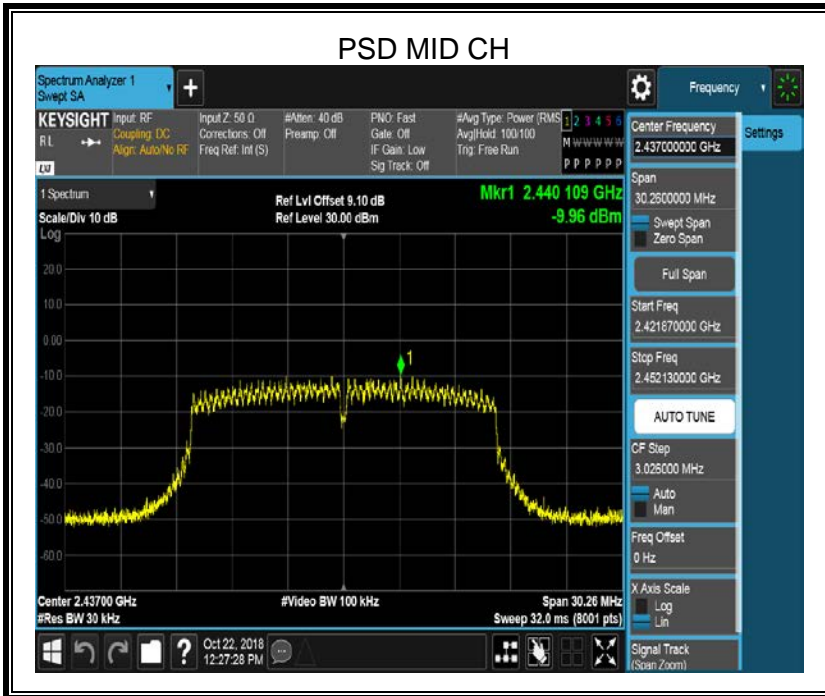
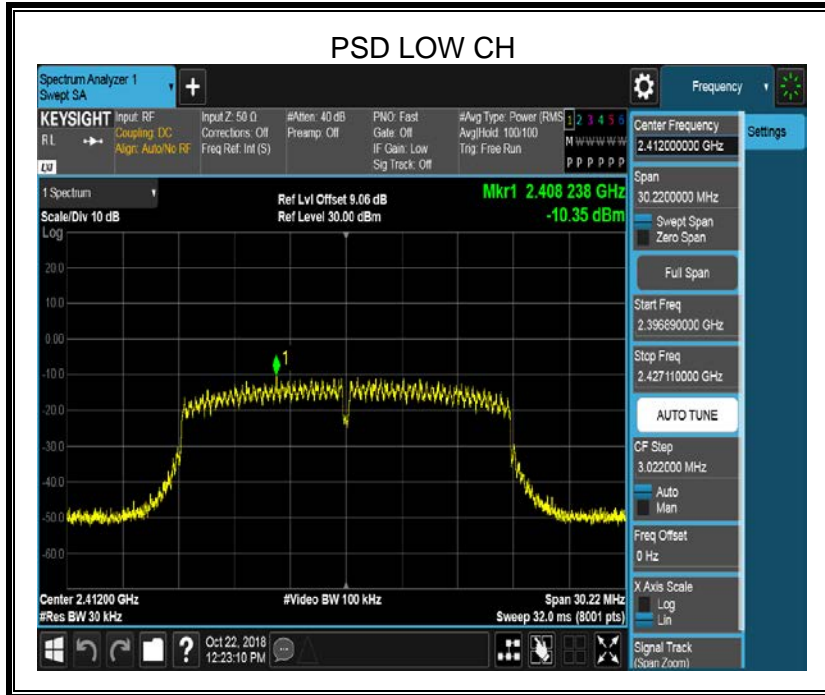
8.4.2. 802.11n HT20 MODE

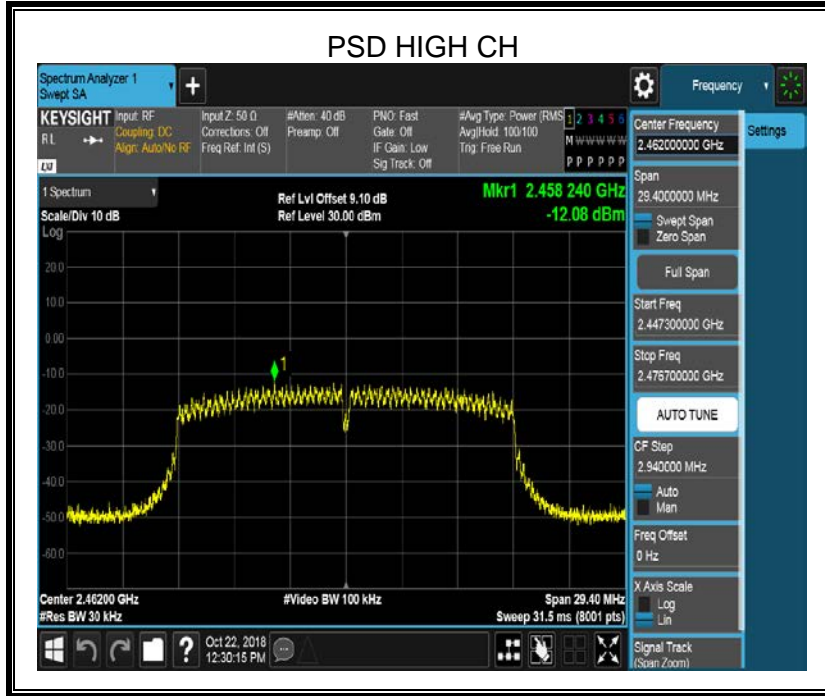
MIMO MODE

Frequency (MHz)	ANT	Power Spectral Density (dBm/3kHz)		Limit (dBm/3kHz)
		Single	Total	
Low	1	-10.35	-7.73	5.99
	2	-11.16		
Middle	1	-9.96	-7.59	
	2	-11.34		
High	1	-12.08	-9.32	
	2	-12.60		

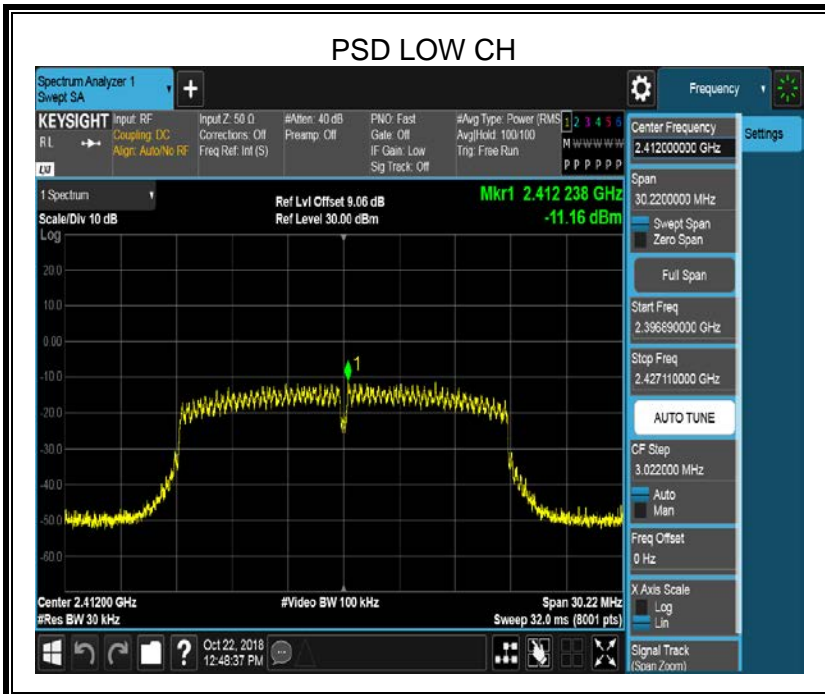
Remark: For this product, it has two antennas, antenna1 and antenna2, the 802.11B SISO&802.11G SISO modes are use the SISO technical, but the ant1 and ant2 can transmitter in the same time under these modes. The 802.11N(HT20) is use both the SISO and MIMO technical, pre-testing both the SISO and MIMO modes, only the data of worse case is shown in this report.

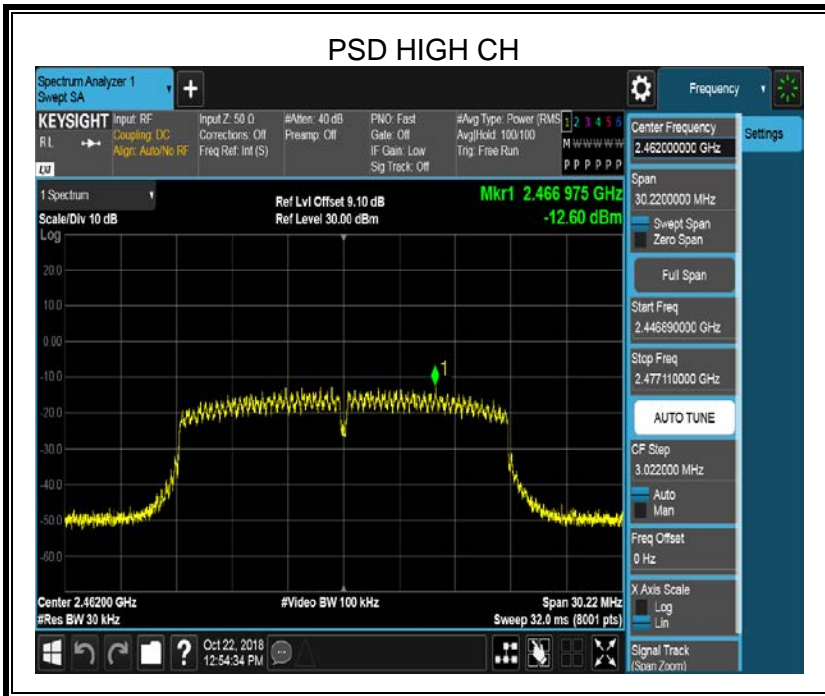
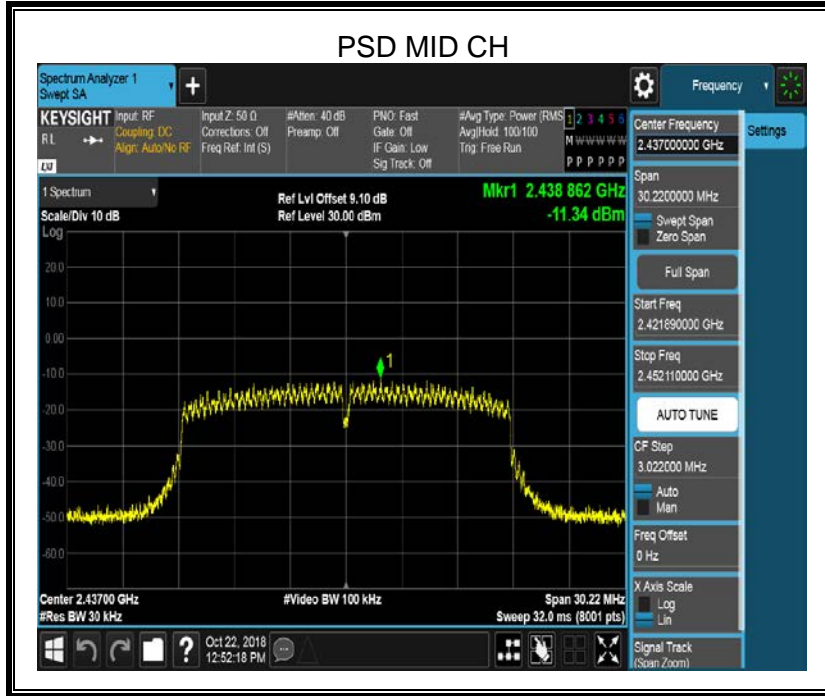
ANTENNA 1





ANTENNA 2







8.5. CONDUCTED BANDEGE AND SPURIOUS EMISSIONS

LIMITS

CFR 47 FCC Part15 (15.247) Subpart C ISED RSS-247 ISSUE 2		
Section	Test Item	Limit
CFR 47 FCC §15.247 (d) ISED RSS-247 5.5	Conducted Bandedge and Spurious Emissions	at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power
Remark: For this product, it has two antennas, antenna1 and antenna2, the 802.11B SISO&802.11G SISO modes are use the SISO technical, but the ant1 and ant2 can transmitter in the same time under these modes. The 802.11N(HT20) is use both the SISO and MIMO technical, pre-testing both the SISO and MIMO modes, only the data of worse case is shown in this report.		

TEST PROCEDURE

Connect the UUT to the spectrum analyser and use the following settings:

Center Frequency	The centre frequency of the channel under test
Detector	Peak
RBW	100K
VBW	$\geq 3 \times \text{RBW}$
Span	1.5 x DTS bandwidth
Trace	Max hold
Sweep time	Auto couple.

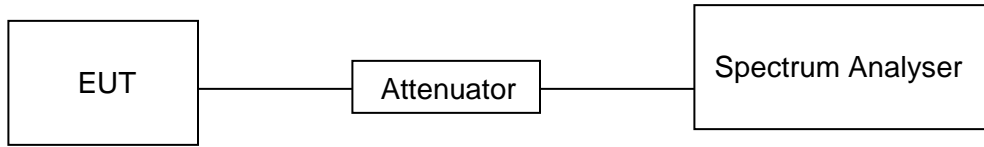
Use the peak marker function to determine the maximum PSD level.

Span	Set the center frequency and span to encompass frequency range to be measured
Detector	Peak
RBW	100K
VBW	$\geq 3 \times \text{RBW}$
measurement points	$\geq \text{span}/\text{RBW}$
Trace	Max hold
Sweep time	Auto couple.

Use the peak marker function to determine the maximum amplitude level.



TEST SETUP



TEST ENVIRONMENT

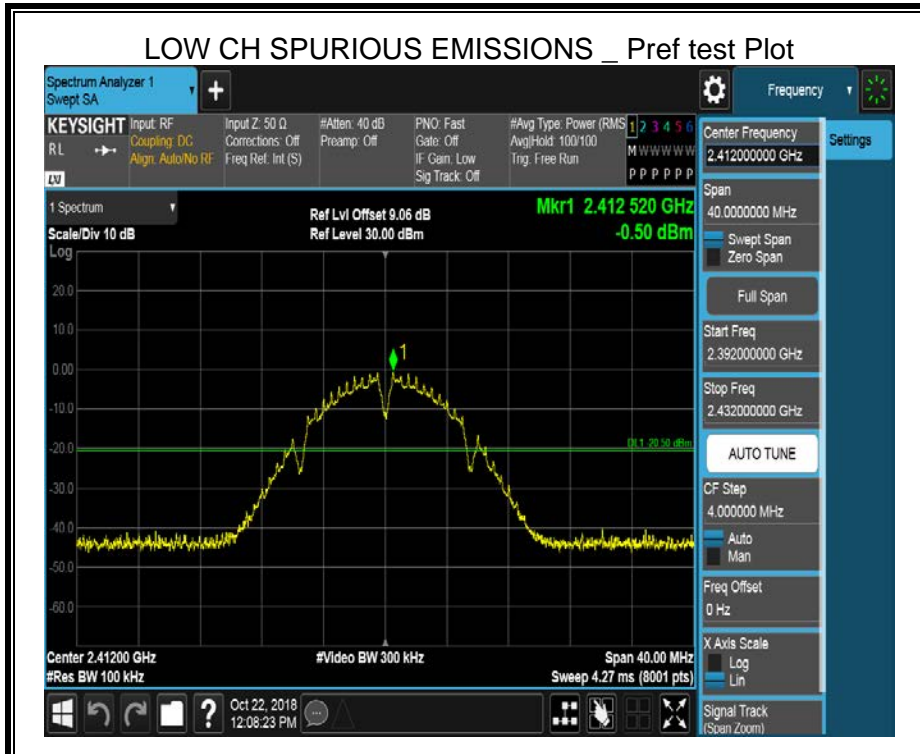
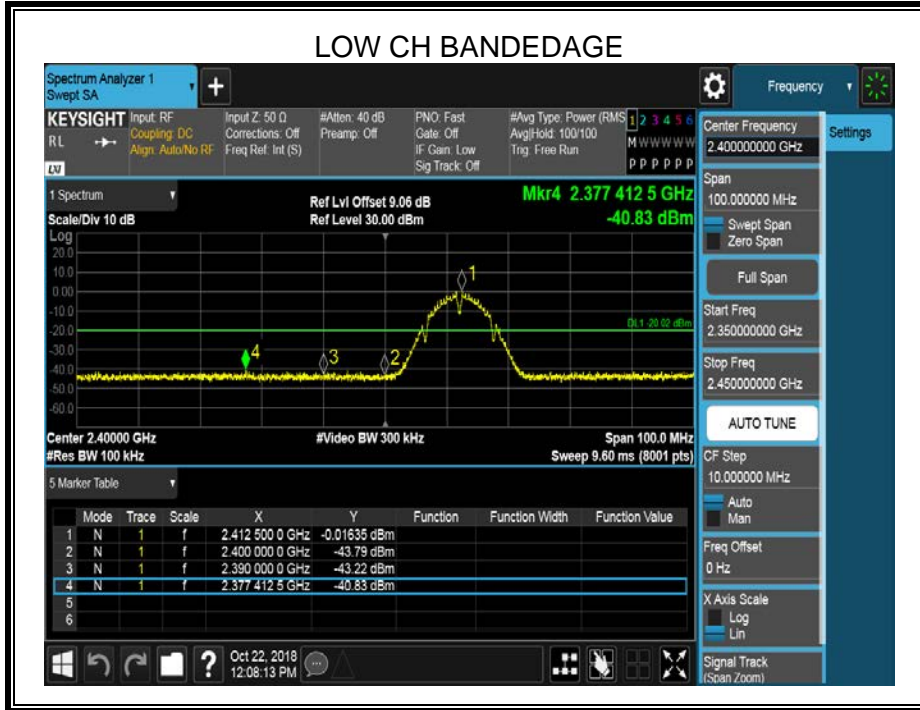
Temperature	25°C	Relative Humidity	58%
Atmosphere Pressure	101kPa	Test Voltage	DC 12.0V

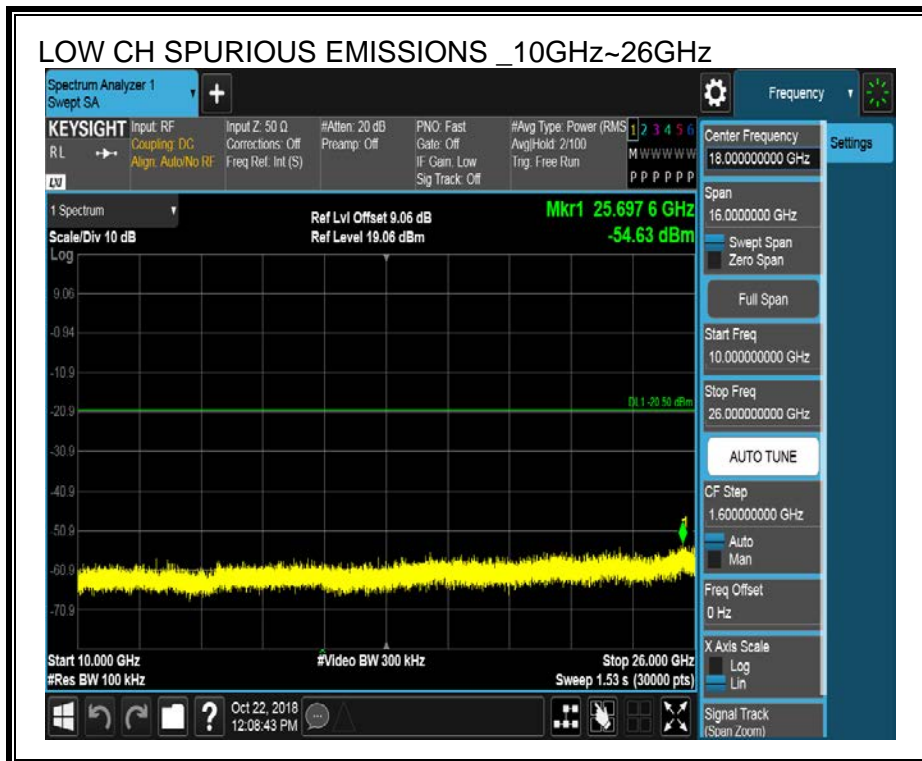
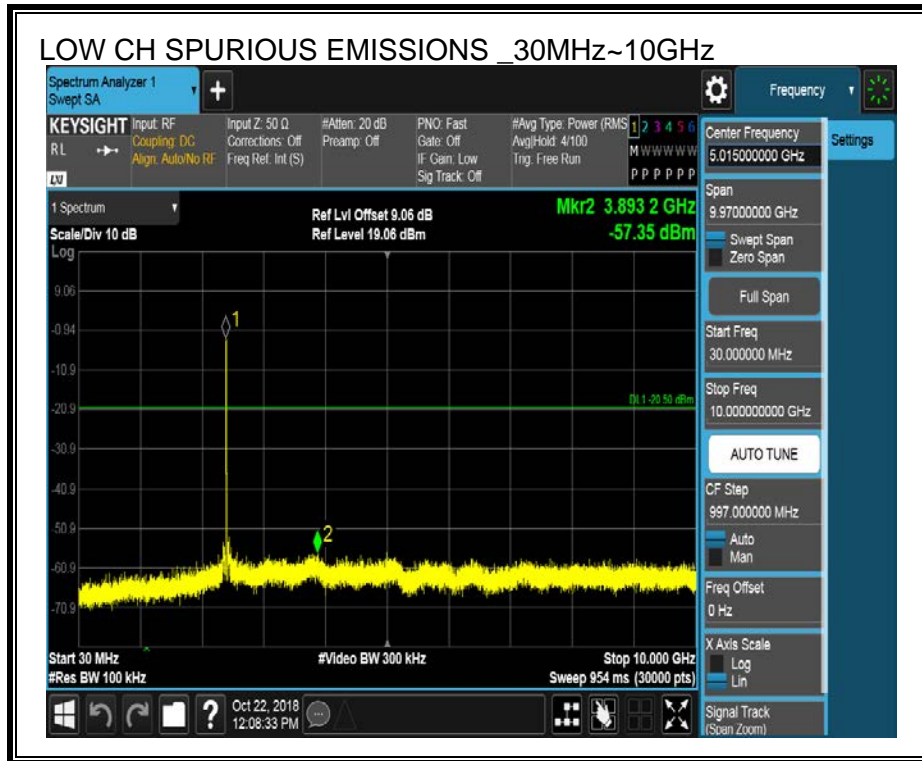
RESULTS

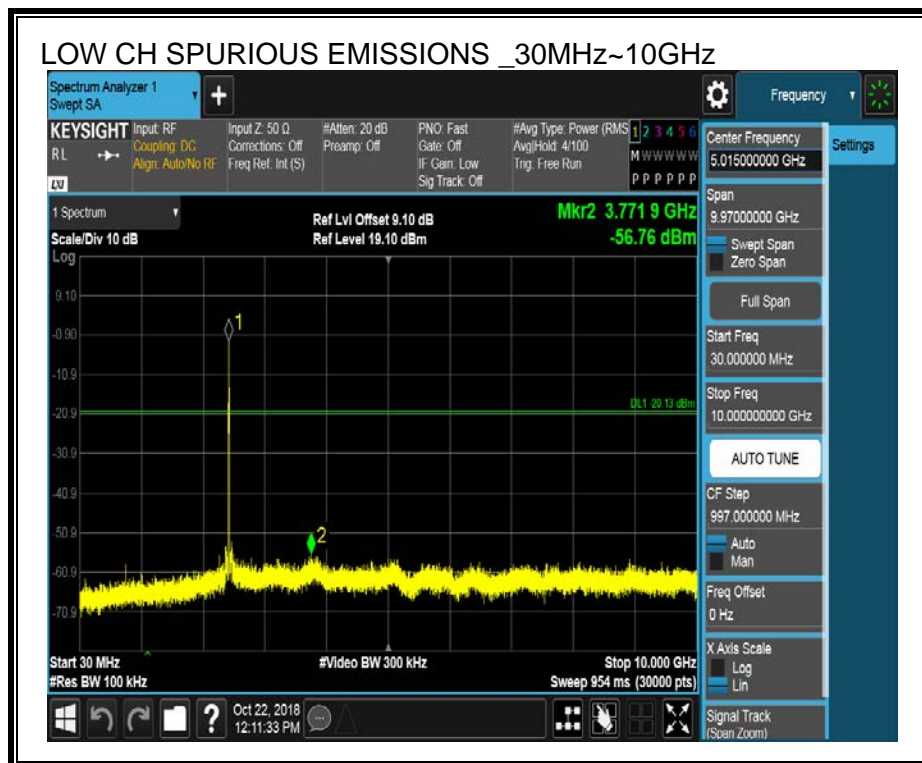
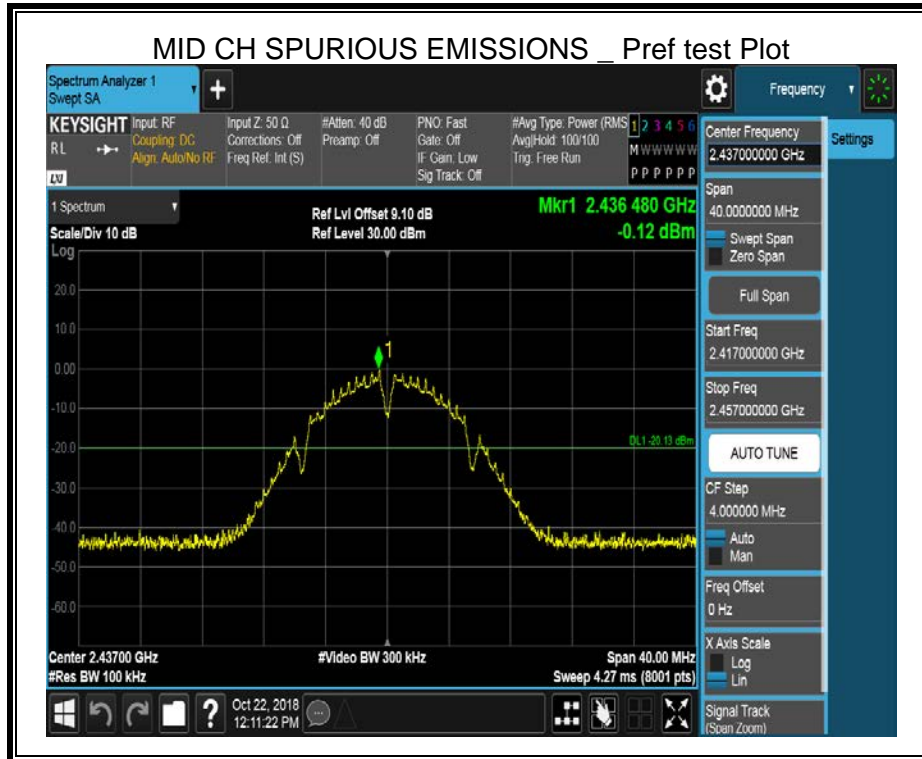
8.5.1. 802.11b MODE

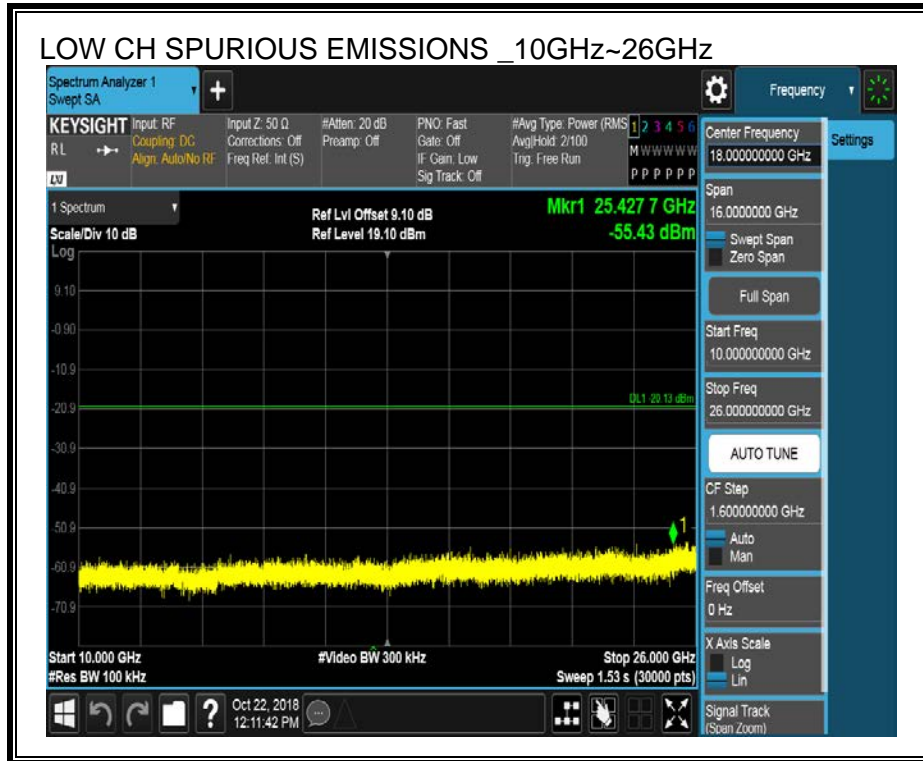
SISO MODE

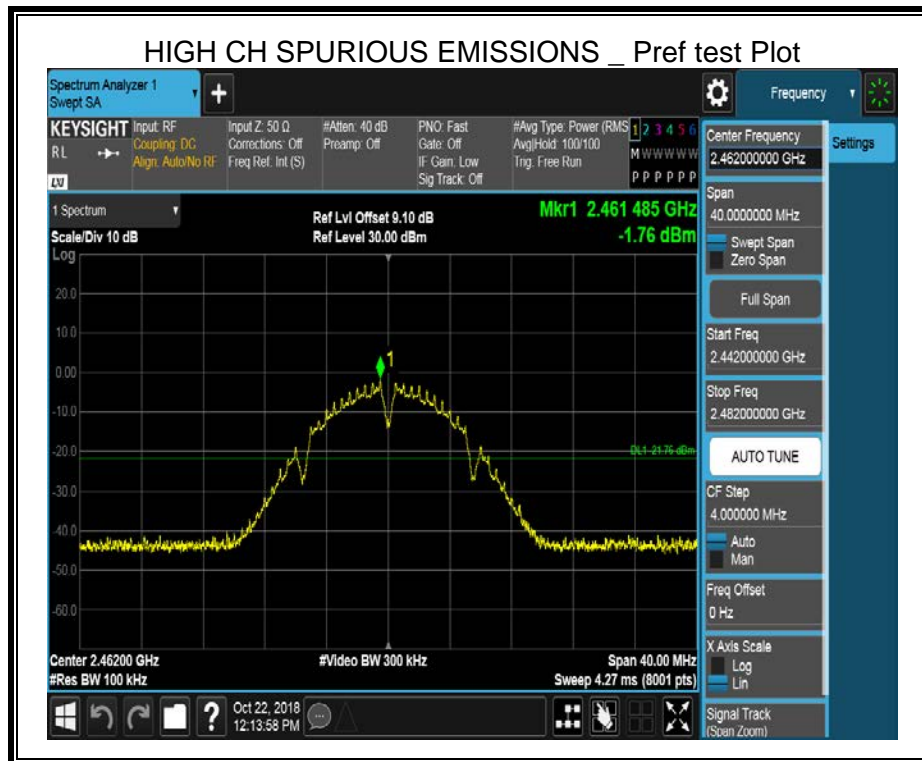
ANTENNA 1

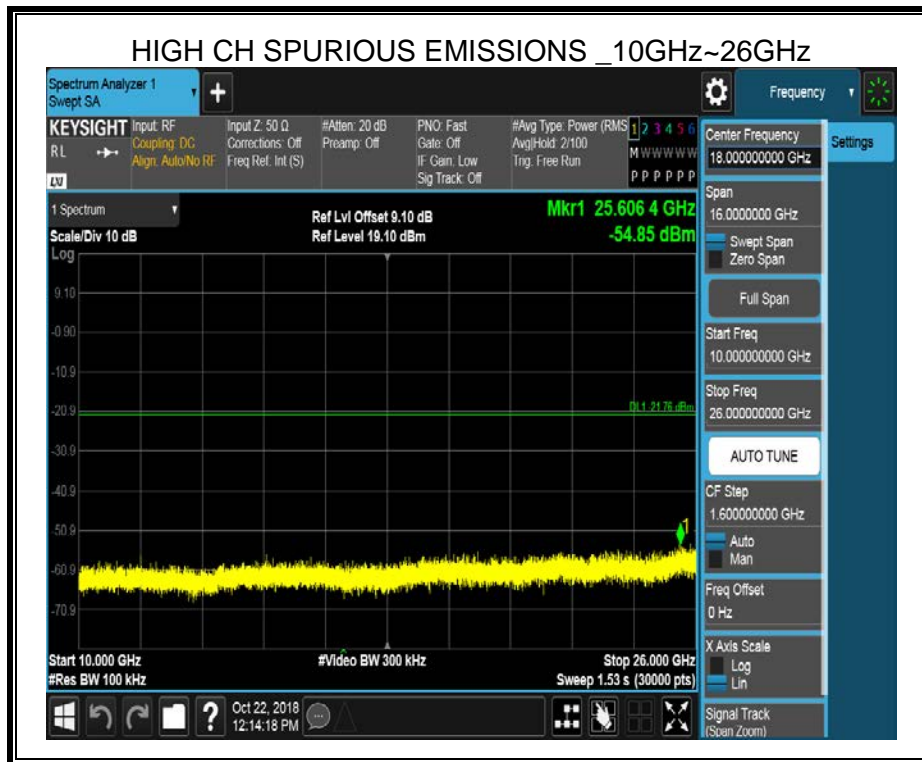
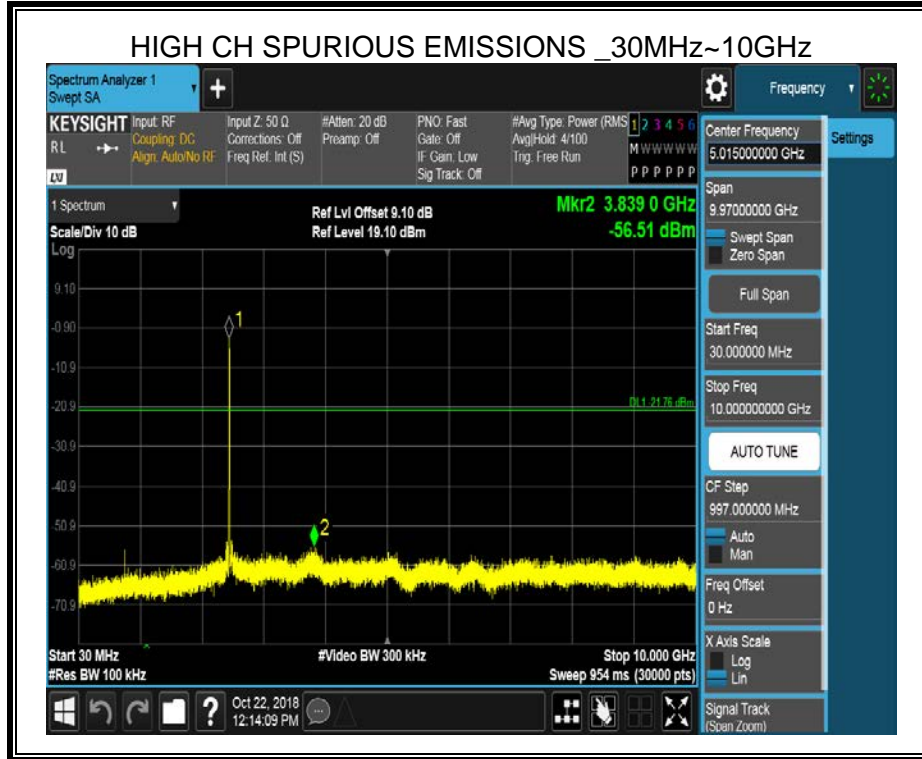






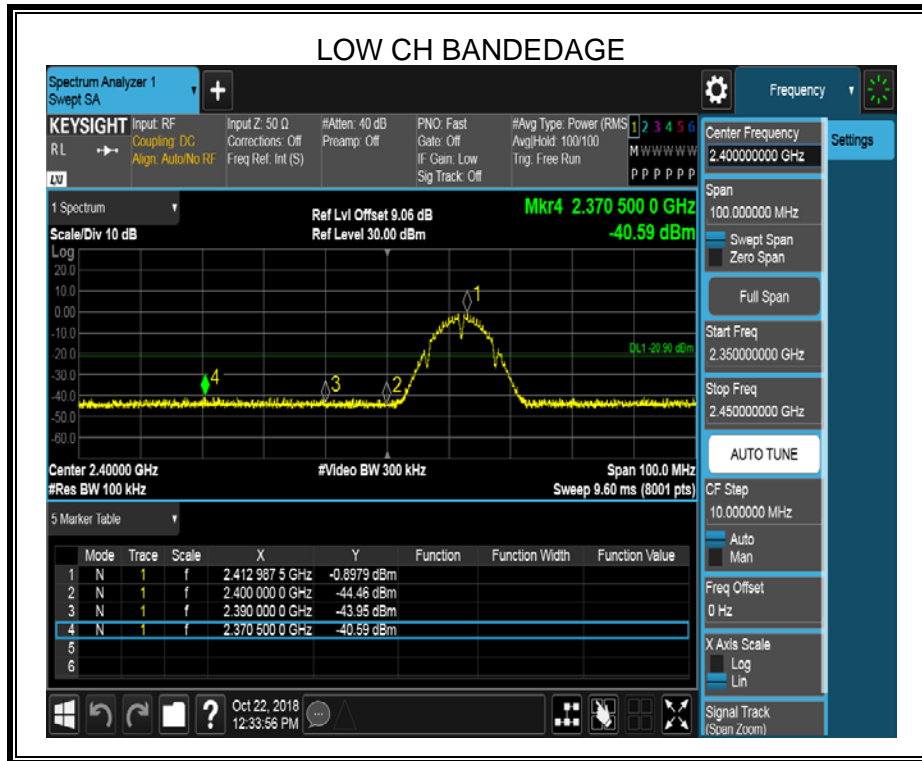


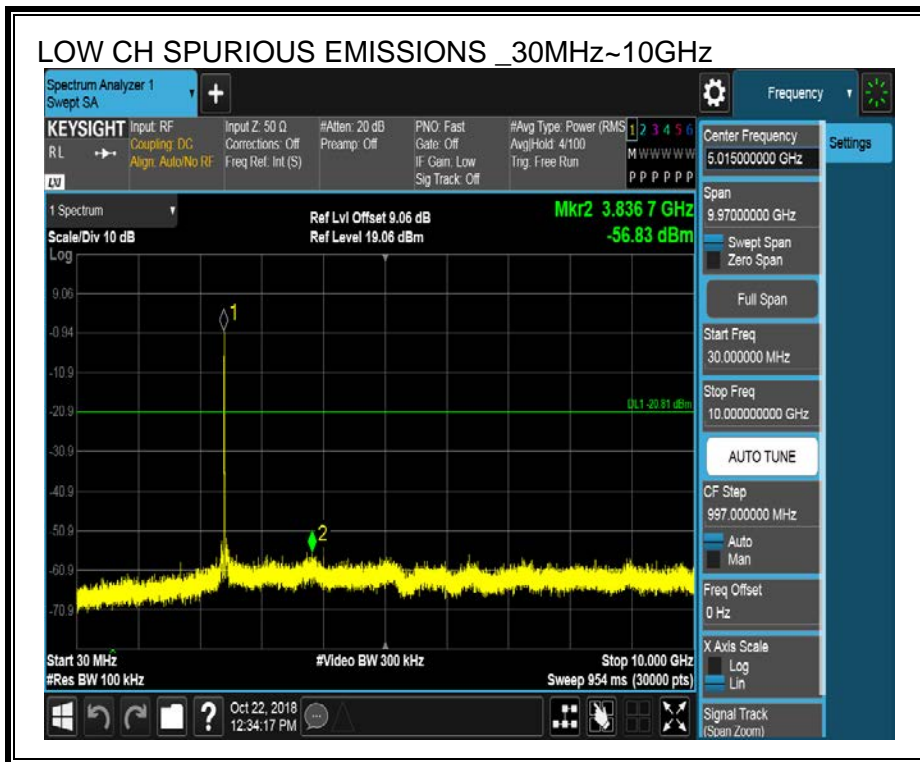
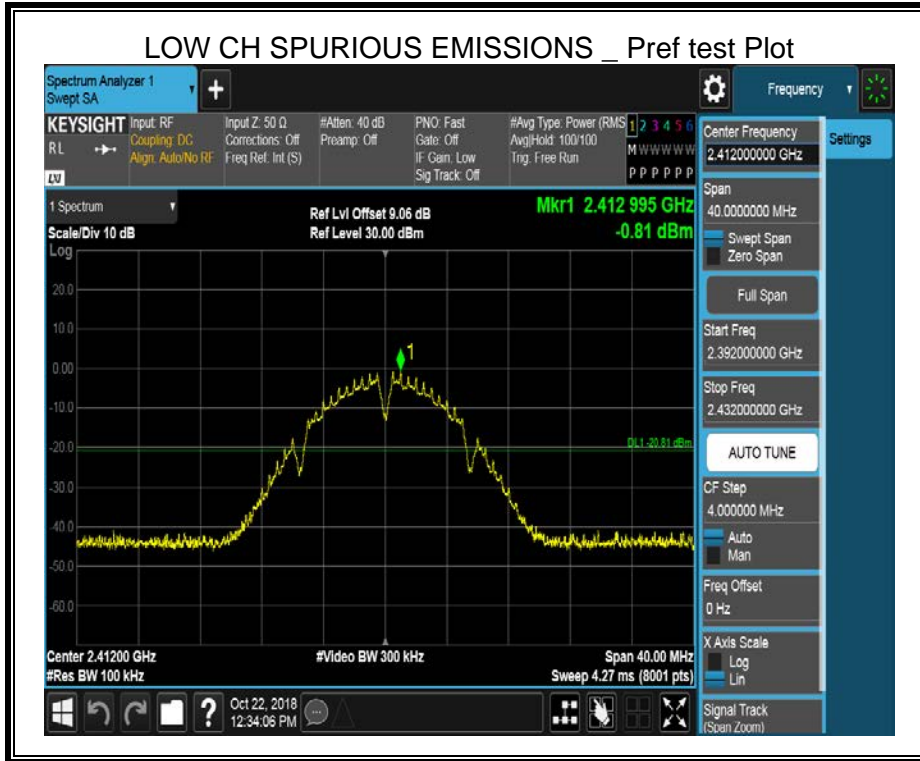


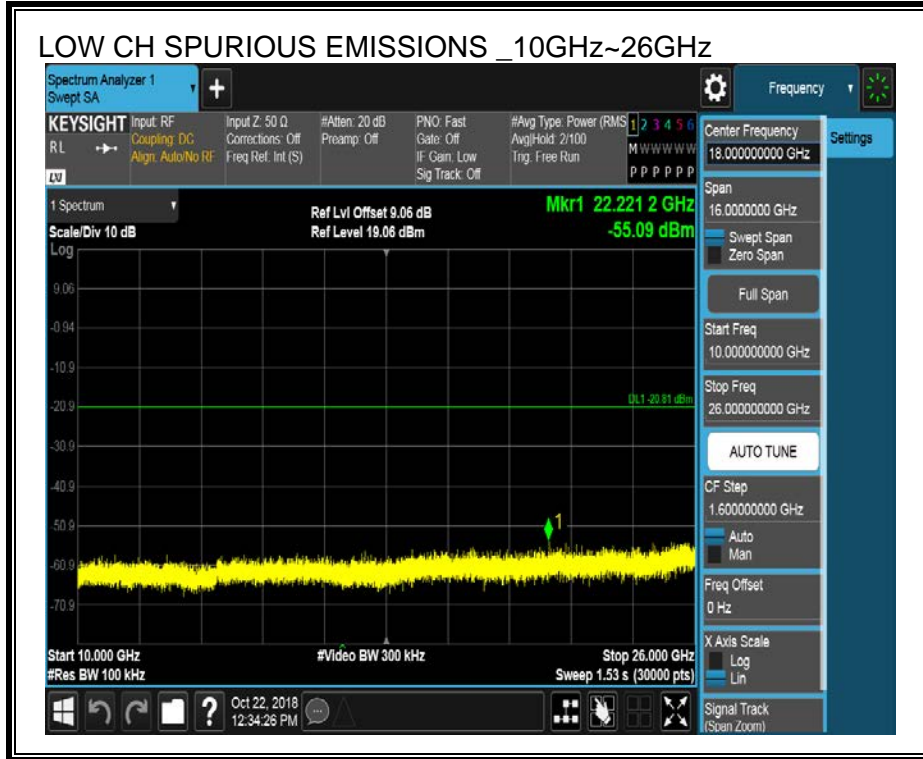


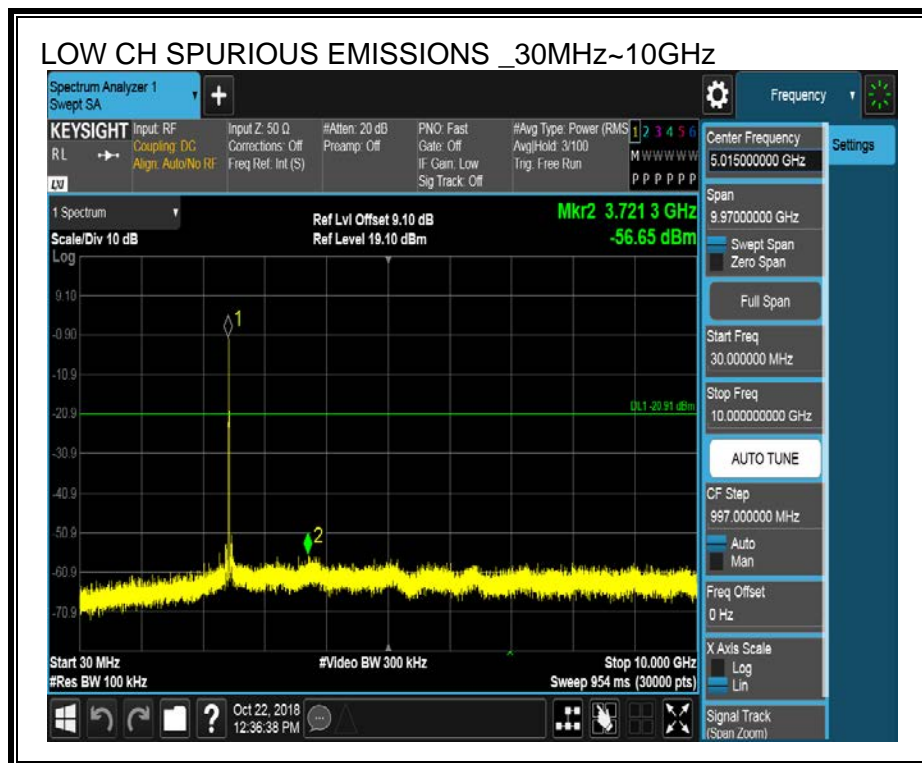
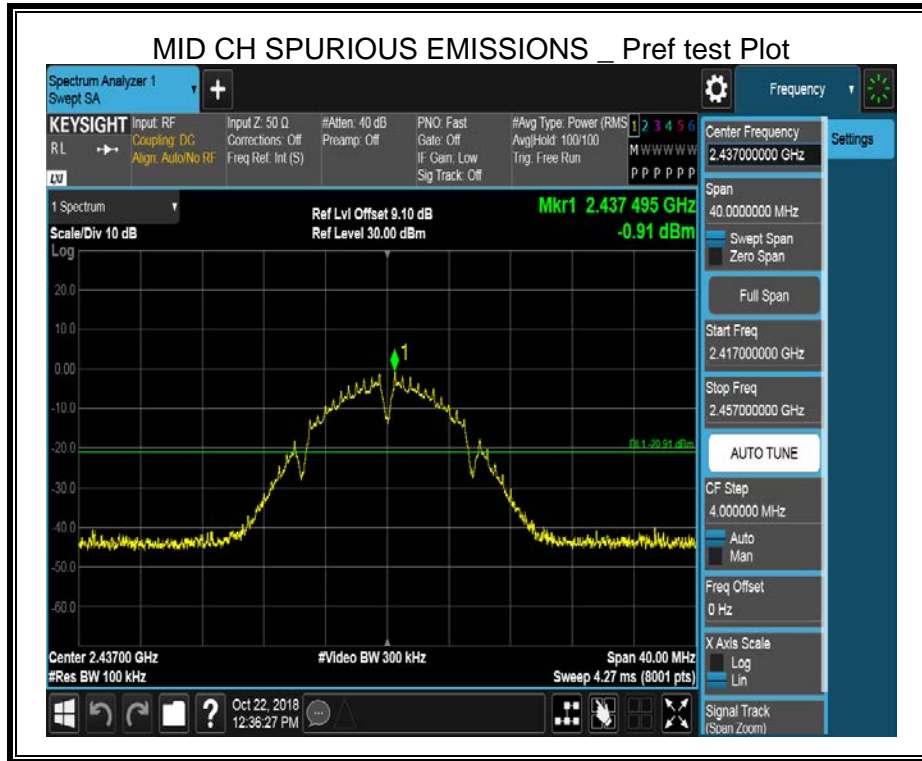


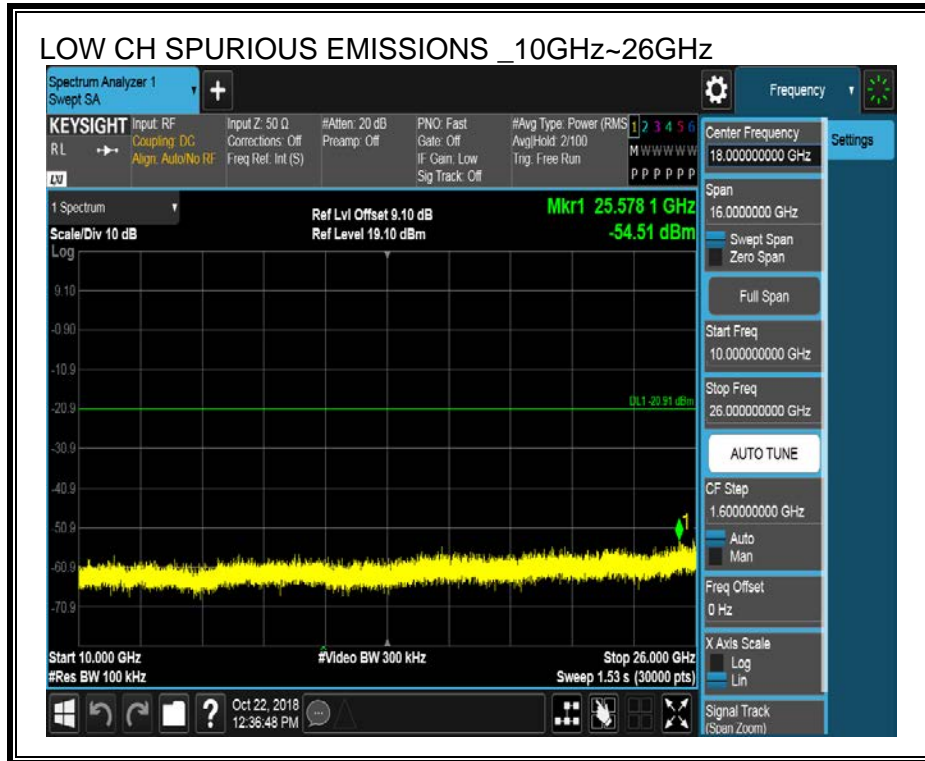
ANTENNA 2

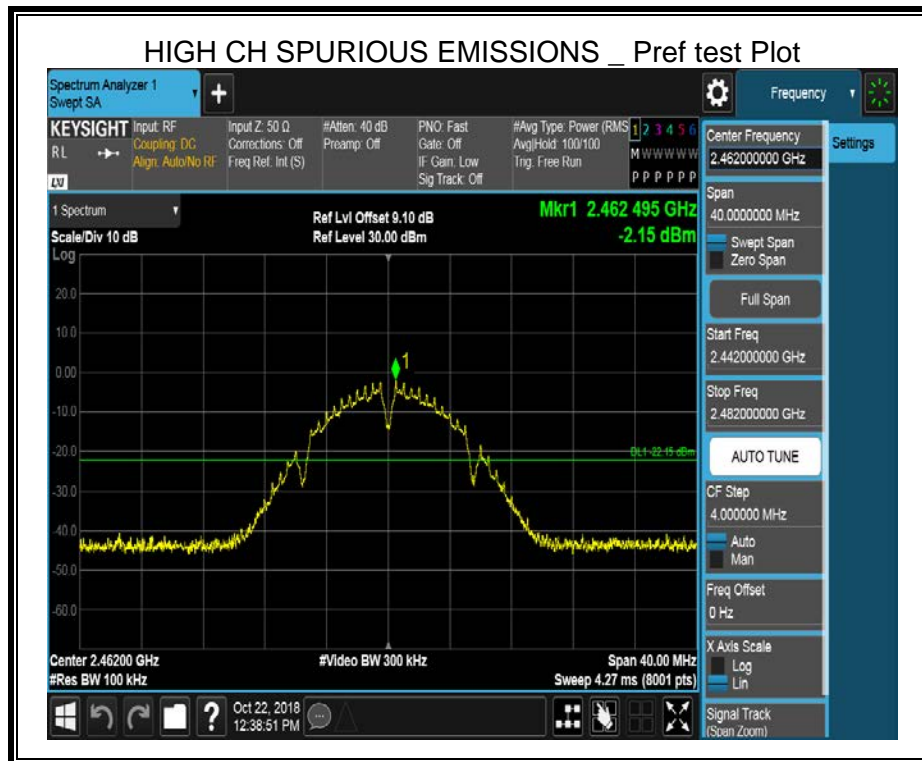
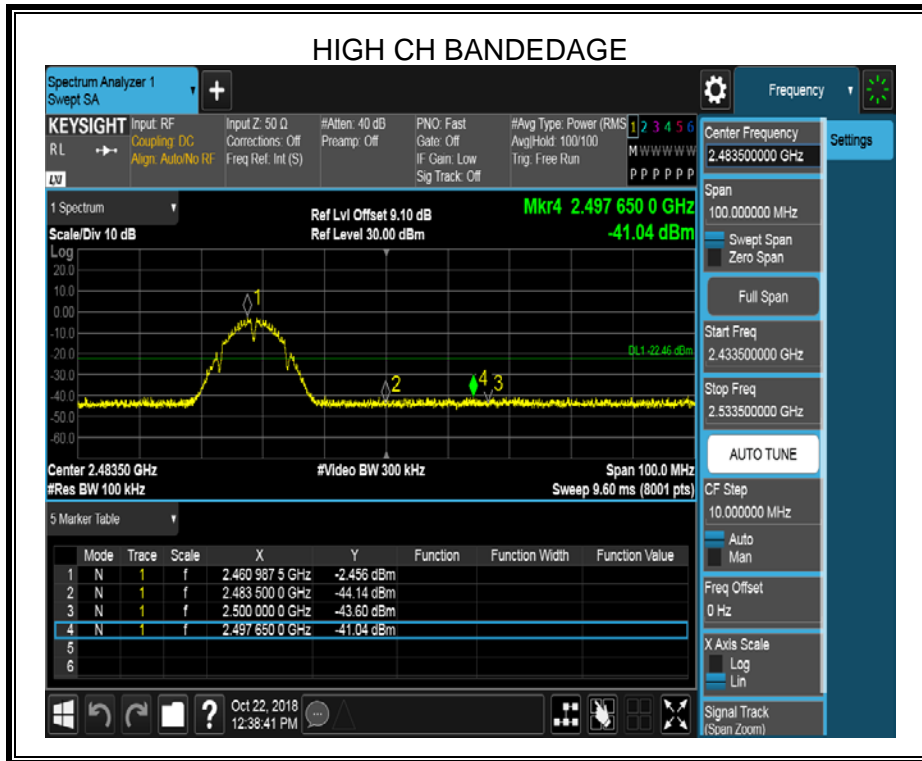


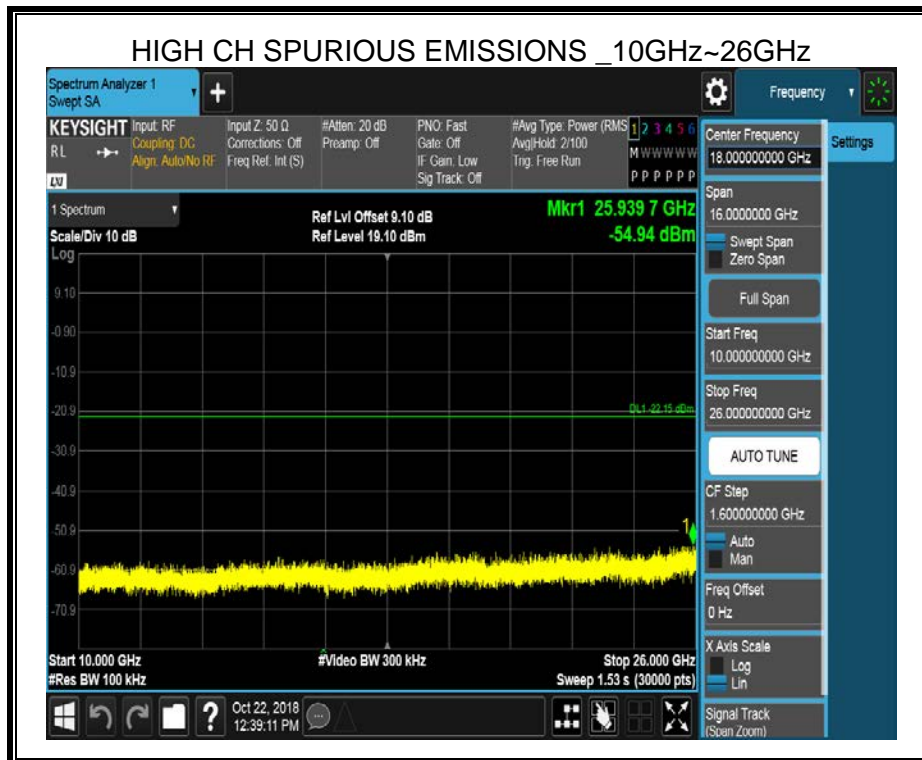
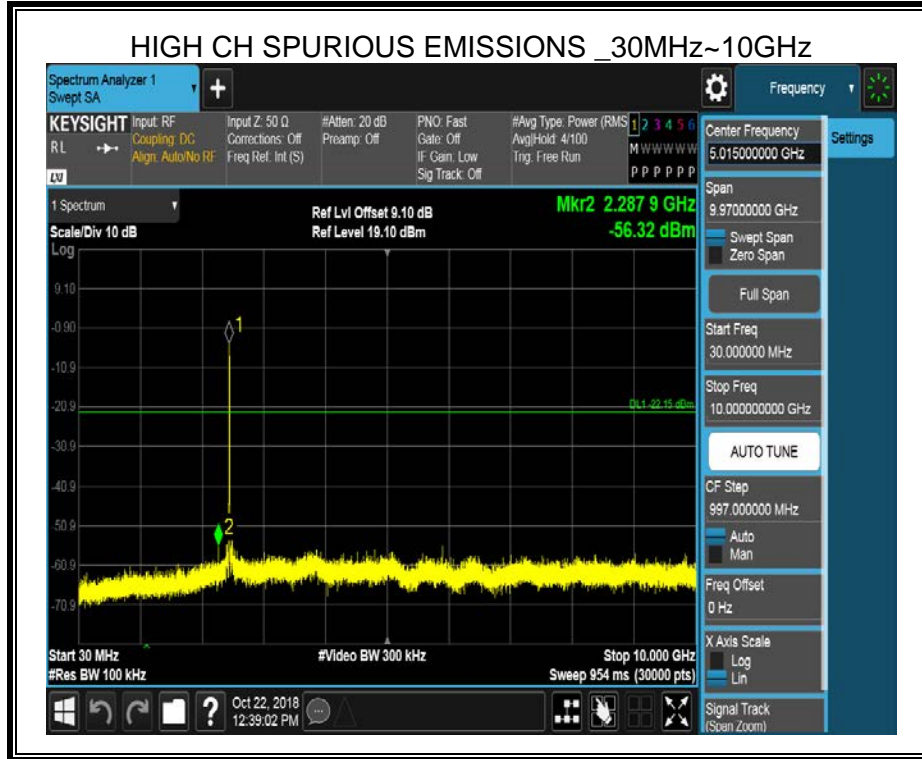












8.5.1. 802.11g MODE

SISO MODE

ANTENNA 1

