



## FCC 47 CFR PART 15 SUBPART C

### CERTIFICATION TEST REPORT

*For*

**1080p FHD Wi-Fi Deterrence Camera**

**MODEL NUMBER: W281AA-Z**

**ADDITIONAL MODEL NUMBER: W281AA, W281AAx, W281AAx-y, (x can be blank or any letter A-Z, y can be blank or any letter A-Z)**

**PROJECT NUMBER: 4789059198**

**REPORT NUMBER: 4789059198-1**

**FCC ID: UCZ-W281AA-Z**

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*Prepared for*

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Revision History

Rev.	Issue Date	Revisions	Revised By
V0	8/10/2019	Initial Issue	

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## 1. ATTESTATION OF TEST RESULTS

### Applicant Information

Company Name: LOREX Technology Inc.  
Address: 250 Royal Crest Court, Markham, ON L3R 3S1 Canada

### Manufacturer Information

Company Name: LOREX Technology Inc.  
Address: 250 Royal Crest Court, Markham, ON L3R 3S1 Canada

### Factory Information

Company Name: ZHEJIANG DAHUA VISION TECHNOLOGY CO.,LTD  
Address: No.1199, Bin'an road, Binjiang District, Hangzhou,  
P.R.China.

Company Name: ZHEJIANG DAHUA ZHILIAN CO.,LTD.  
Address: No.28, Dongqiao Road, Dongzhou Street, Fuyang District,  
Hangzhou,P.R.China.

### EUT Description

Product Name: 1080p FHD Wi-Fi Deterrence Camera  
Model Name: W281AA-Z  
Additional No.: W281AA, W281AAx, W281AAx-y, (x can be blank or any letter A-Z, y can be blank or any letter A-Z)  
Sample Number: 2369250  
Data of Receipt Sample: Jun. 24, 2019  
Date Tested: Jun. 24, 2019~ Aug. 9, 2019

APPLICABLE STANDARDS	
STANDARD	TEST RESULTS
CFR 47 Part 15 Subpart C	PASS



Summary of Test Results			
Clause	Test Items	FCC/IC Rules	Test Results
1	6db DTS Bandwidth	FCC 15.247 (a) (2)	Complied
2	Peak Conducted Power	FCC 15.247 (b) (3)	Complied
3	Power Spectral Density	FCC 15.247 (e)	Complied
4	Conducted Band edge And Spurious emission	FCC 15.247 (d)	Complied
5	Radiated Band edges and Spurious emission	FCC 15.247 (d) FCC 15.209 FCC 15.205	Complied
6	Conducted Emission Test For AC Power Port	FCC 15.207	Complied
7	Antenna Requirement	FCC 15.203	Complied

Remark:

1) The measurement result for the sample received is <Pass> according to < ANSI C63.10-2013, FCC CFR 47 Part 2, FCC CFR 47 Part 15C> when <Accuracy Method> decision rule is applied.

Prepared By:

*Tom Tang*

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Engineer Project Associate

Reviewed By:

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Chris Zhong  
Senior Project Engineer

Authorized By:

*Scholl Zhang*

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Scholl Zhang  
Laboratory Leader



## 2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with FCC KDB 558074 D01 15.247 Meas Guidance v05r02, KDB 414788 D01 Radiated Test Site v01r01, ANSI C63.10-2013, FCC CFR 47 Part 2, FCC CFR 47 Part 15.

## 3. FACILITIES AND ACCREDITATION

Accreditation Certificate	<p><b>A2LA (Certificate No.: 4829.01)</b> <b>UL-CCIC COMPANY LIMITED has been assessed and proved to be in compliance with A2LA.</b></p> <p><b>FCC (FCC Designation No.: CN1247)</b> <b>UL-CCIC COMPANY LIMITED has been recognized to perform compliance testing on equipment subject to the Commission's Declaration of Conformity (DoC) and Certification rules.</b></p> <p><b>IC (IC Designation No.: 25056)</b> <b>UL-CCIC COMPANY LIMITED has been recognized to perform compliance testing on equipment subject to the Commission's Declaration of Conformity (DoC) and Certification rules.</b></p>
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Note 1: All tests measurement facilities use to collect the measurement data are located at No. 2, Chengwan Road, Suzhou Industrial Park, Suzhou 215122, People's Republic of 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 OFS.

Note 3: The test anechoic chamber in UL-CCIC COMPANY LIMITED 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 recognized national standards.

### 4.2. MEASUREMENT UNCERTAINTY

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

Test Item	Uncertainty
Conduction emission	3.00dB
Radiation Emission test(include Fundamental emission) (9KHz-30MHz)	3.32dB
Radiation Emission test(include Fundamental emission) (30MHz-1GHz)	3.27dB
Radiation Emission test (1GHz to 26GHz)( include Fundamental emission)	3.80dB (1GHz-18Gz) 4.11dB (18GHz-26.5Gz)

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:	1080p FHD Wi-Fi Deterrence Camera
Model No.:	W281AA-Z
Operating Frequency:	IEEE 802.11b/g/n(HT20): 2412MHz to 2462MHz IEEE 802.11n(HT40): 2422MHz to 2452MHz IEEE 802.11a/n/ac 20MHz:5180MHz to 5240MHz, 5745 MHz -5825 MHz IEEE 802.11n/ac 40MHz:5190MHz to 5230MHz, 5755 MHz -5795 MHz IEEE 802.11ac 80MHz: 5230MHz, 5775 MHz
	Remark: For this test report just for the 2.4GHz part
Type of Modulation:	IEEE for 802.11b: DSSS (CCK, DQPSK, DBPSK) IEEE for 802.11g: OFDM (64QAM, 16QAM, QPSK, BPSK) IEEE for 802.11n (HT20 and HT40): OFDM (64QAM, 16QAM, QPSK, BPSK) IEEE for 802.11a: OFDM (BPSK,QPSK,16QAM,64QAM) IEEE for 802.ac : OFDM (BPSK,QPSK,16QAM,64QAM,256QAM)
Channels Step:	Channels with 5MHz step
Sample Type:	Fixed production
Test power grade:	38 (manufacturer declare)
Test software of EUT:	Secure CRT (manufacturer declare)
Antenna Type:	PCB Antenna
Antenna Gain:	Antenna1: 4.35 dBi Antenna2: 4.67 dBi
Adapter	NAME:SWITCHING POWER SUPPLY MODEL:S0188YU1200150 INPUT:100-240V,50/60Hz, 600mA OUTPUT:5V/9V/12V ■■■ 3A/2A/1.5A

Remark:

Model No.:

Number:	Name:	Number:	Name:	Number:	Name:
1	W281AA-Z	2	W281AA	3	W281AAx
4	W281AAx-y				

Remark: x can be blank or any letter A-Z, y can be blank or any letter A-Z

Only the main model **W281AA-Z** was tested and only the data of this model is shown in this test report. Since Their electrical circuit design, layout, components used and internal wiring are identical, only the model name and selling area are different.

## 5.2. MAXIMUM OUTPUT POWER

Number of Transmit Chains (NTX)	IEE Std. 802.11	Channel Number	Max PK Conducted Power (dBm)
1	IEEE 802.11B SISO	1-11[11]	16.97
1	IEEE 802.11G SISO	1-11[11]	16.66
2	IEEE 802.11nHT20 MIMO	1-11[11]	18.75
2	IEEE 802.11nHT40 MIMO	3-9[7]	19.46

Remark: For this product, it has two antennas, antenna1 and antenna2, the 802.11B &802.11G modes can only support the SISO technical, but the ant1 and ant2 of this product can transmitter in the same time under those modes. For the 802.11N HT20 and 802.11N HT40 can support 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		

Channel List for 802.11n (40 MHz)							
Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
3	2422	5	2432	7	2442	9	2452
4	2427	6	2437	8	2447		

#### 5.4. TEST CHANNEL CONFIGURATION

Test Mode	Test Channel	Frequency
WiFi TX(802.11b)	LCH, MCH , HCH	2412MHz, 2437MHz, 2462MHz
WiFi TX(802.11g)	LCH, MCH , HCH	2412MHz, 2437MHz, 2462MHz
WiFi TX(802.11n HT20)	LCH, MCH , HCH	2412MHz, 2437MHz, 2462MHz
WiFi TX(802.11n HT40)	LCH, MCH, HCH	2422MHz, 2437MHz, 2452MHz

#### 5.5. THE WORSE CASE POWER SETTING PARAMETER

The Worse Case Power Setting Parameter under 2400 ~ 2483.5MHz Band							
Test Software		SecureCRT					
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	38	38	38	/		
802.11g	1/2	38	38	38			
802.11n HT20	1/2	38	38	38			
802.11n HT40	1/2	/			38	38	38

## 5.6. DESCRIPTION OF AVAILABLE ANTENNAS

Ant.	Frequency (MHz)	Antenna Type	Antenna Gain (dBi)	Directional gain(dBi)
1	2400-2483.5	PCB Antenna	4.35	7.54
2	2400-2483.5	PCB Antenna	4.67	

Note:

- 1) Directional gain=  $10\log [(10^{G1/20} + 10^{G2/20})^2 / N_{ANT}] = 7.54 \text{ dBi}$
- 2)  $N_{ANT}$ : the number of Antenna
- 3) For this product, it has two antennas, antenna1 and antenna2, the 802.11B & 802.11G modes can only support the SISO technical, but the ant1 and ant2 of this product can transmitter in the same time under those modes. For the 802.11N HT20 and 802.11N HT40 can support both the SISO and MIMO technical.

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

## 5.7. THE WORSE CASE CONFIGURATIONS

For the product, there two transmission antennas, and pre-testing both of them, only the worse data for the antenna is recorded in the report.

Worst-case data rates as provided by the client were:

802.11b mode: 1 Mbps  
802.11b mode: 6 Mbps  
802.11n HT20 mode: MCS0  
802.11n HT40 mode: MCS0

## 5.8. TEST ENVIRONMENT

Environment Parameter	Selected Values During Tests	
Relative Humidity	55 ~ 65%	
Atmospheric Pressure:	1025Pa	
Temperature	TN	23 ~ 28°C
Voltage :	VL	N/A
	VN	AC 120V
	VH	N/A

Note: VL= Lower Extreme Test Voltage

VN= Nominal Voltage

VH= Upper Extreme Test Voltage

TN= Normal Temperature

## 5.9. DESCRIPTION OF TEST SETUP

### SUPPORT EQUIPMENT

Item	Equipment	Brand Name	Model Name	Description
1	Laptop	ThinkPad	E550c	N/A
2	Fixed Frequency Board	N/A	N/A	Supply by UL Lab

### I/O PORT

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

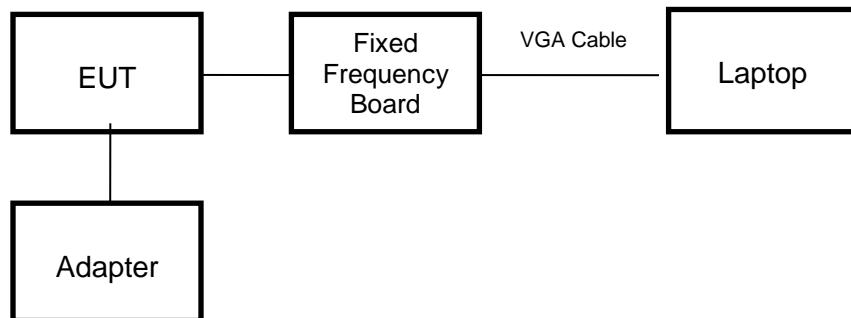
### ACCESSORY

Item	Accessory	Brand Name	Model Name	Description
1	SD Card	Kingston	32GB	Supply by UL Lab
2	VGA Cable	N/A	N/A	Supply by UL Lab

### TEST SETUP

The EUT can work in an engineer mode with a software through a table PC.

### SETUP DIAGRAM FOR TESTS





## 5.10. MEASURING INSTRUMENT AND SOFTWARE USED

Conducted Emissions (Instrument)							
Used	Equipment	Manufacturer	Model No.	Serial No.	Upper Last Cal.	Last Cal.	Next Cal.
<input checked="" type="checkbox"/>	EMI Test Receiver	R&S	ESR3	126700	2017-12-14	2018-12-13	2019-12-12
<input checked="" type="checkbox"/>	Two-Line V-Network	R&S	ENV216	126701	2017-12-14	2018-12-13	2019-12-12
<input checked="" type="checkbox"/>	Artificial Mains Networks	R&S	ENY81	126711	2017-12-14	2018-12-13	2019-12-12
Software							
Used	Description		Manufacturer	Name	Version		
<input checked="" type="checkbox"/>	Test Software for Conducted disturbance		R&S	EMC32	Ver. 9.25		
Radiated Emissions (Instrument)							
Used	Equipment	Manufacturer	Model No.	Serial No.	Upper Last Cal.	Last Cal.	Next Cal.
<input checked="" type="checkbox"/>	Spectrum Analyzer	Keysight	N9010B	MY57110128	2018-05-30	2019-05-29	2020-05-28
<input checked="" type="checkbox"/>	EMI test receiver	R&S	ESR26	1267603	2017-12-14	2018-12-13	2019-12-22
<input checked="" type="checkbox"/>	Receiver Antenna (9kHz-30MHz)	Schwarzbeck	FMZB 1513	513-265	2018-06-17	2019-06-16	2020-06-15
<input checked="" type="checkbox"/>	Receiver Antenna (30MHz-1GHz)	SunAR RF Motion	JB1	126704	N/A	2019-01-28	2022-01-27
<input checked="" type="checkbox"/>	Receiver Antenna (1GHz-18GHz)	R&S	HF907	126705	2018-01-27	2019-01-26	2020-01-26
<input checked="" type="checkbox"/>	Receiver Antenna (18GHz-26.5GHz)	Schwarzbeck	BBHA9170	126706	2018-02-07	2019-02-06	2020-02-05
<input checked="" type="checkbox"/>	Receiver Antenna (26.5GHz-40GHz)	TOYO	HAP 26-40W	00000012	2018-07-25	2019-07-23	2020-07-22
<input checked="" type="checkbox"/>	Pre-amplification (To 1GHz)	R&S	SCU-03D	134666	2018-02-07	2019-02-06	2020-02-05
<input checked="" type="checkbox"/>	Pre-amplification (To 18GHz)	Compliance Direction System Inc.	PAP-1G18-50	14140-13467	N/A	2019-03-18	2020-03-17
<input checked="" type="checkbox"/>	Pre-amplification (To 26.5GHz)	R&S	SCU-26D	134668	2018-02-07	2019-02-06	2020-02-05
<input checked="" type="checkbox"/>	Band Reject Filter	Wainwright	WRCJV8-2350-2400-2483.5-2533.5-40SS	1	2018-05-30	2019-05-29	2020-05-28
<input checked="" type="checkbox"/>	Highpass Filter	Wainwright	WHKX10-2700-3000-18000-40SS	2	2018-05-30	2019-05-29	2020-05-28
Software							
Used	Description		Manufacturer	Name	Version		
<input checked="" type="checkbox"/>	Test Software for Radiated disturbance		Tonscend	JS32	V1.0		
Other instruments							
Used	Equipment	Manufacturer	Model No.	Serial No.	Upper Last Cal.	Last Cal.	Next Cal.
<input checked="" type="checkbox"/>	Spectrum Analyzer	Keysight	N9010B	MY57110128	2018-05-30	2019-05-29	2020-05-28



<input checked="" type="checkbox"/>	Power Meter	Keysight	U2021XA	MY57110002	2018-06-13	2019-06-12	2020-06-11
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## 6. MEASUREMENT METHODS

No.	Test Item	KDB Name	Section
1	6dB Bandwidth	KDB 558074 D01 15.247 Meas Guidance v05r02	8.2
2	Peak Output Power	KDB 558074 D01 15.247 Meas Guidance v05r02	8.3.1.3/8.3.2.3
3	Power Spectral Density	KDB 558074 D01 15.247 Meas Guidance v05r02	8.4
4	Out-of-band emissions in non-restricted bands	KDB 558074 D01 15.247 Meas Guidance v05r02	8.5
5	Out-of-band emissions in restricted bands	KDB 558074 D01 15.247 Meas Guidance v05r02	8.6
6	Band-edge	KDB 558074 D01 15.247 Meas Guidance v05r02	8.7
7	Conducted Emission Test For AC Power Port	ANSI C63.10-2013	6.2

## 7. ANTENNA PORT TEST RESULTS

### 7.1. ON TIME AND DUTY CYCLE

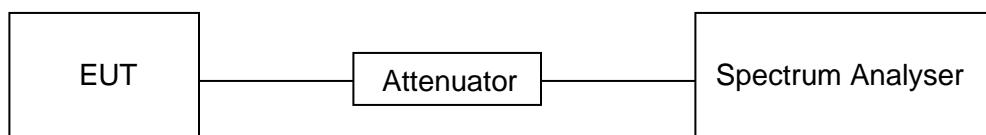
#### LIMITS

None; for reporting purposes only

#### PROCEDURE

FCC KDB 558074 Zero-Span Spectrum Analyzer Method

#### TEST SETUP



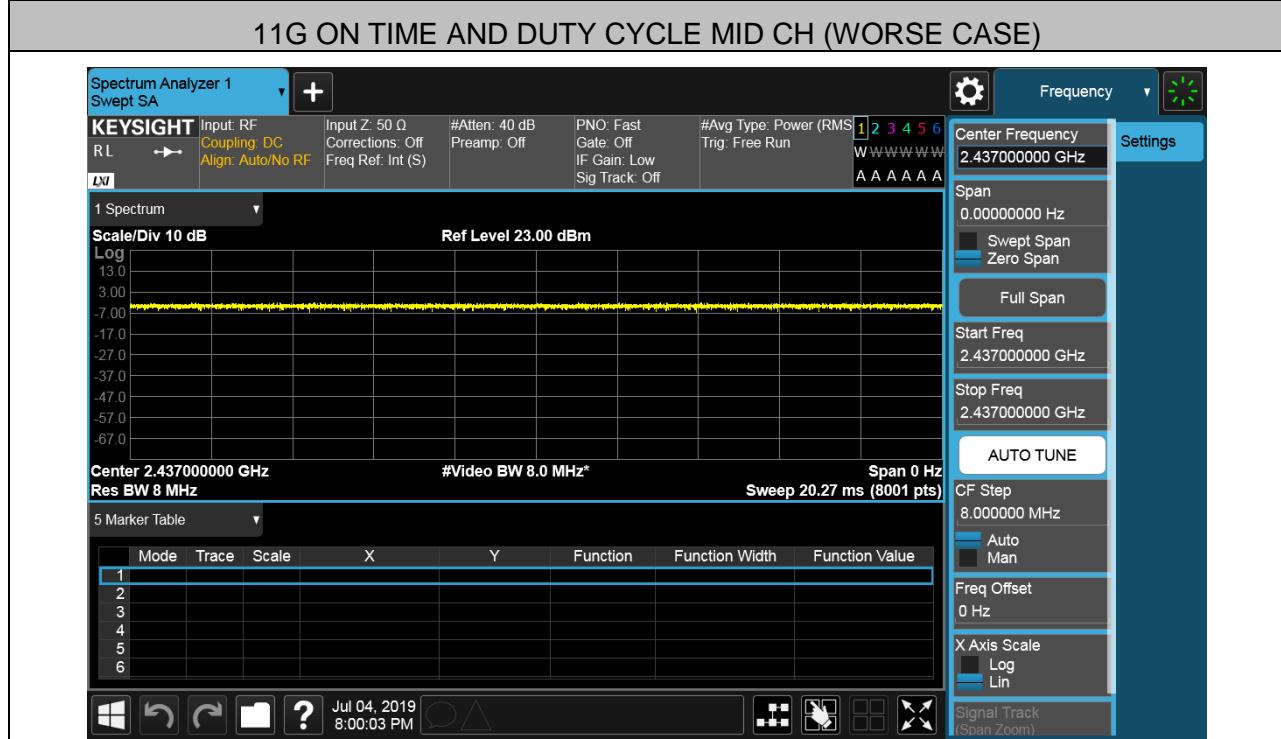
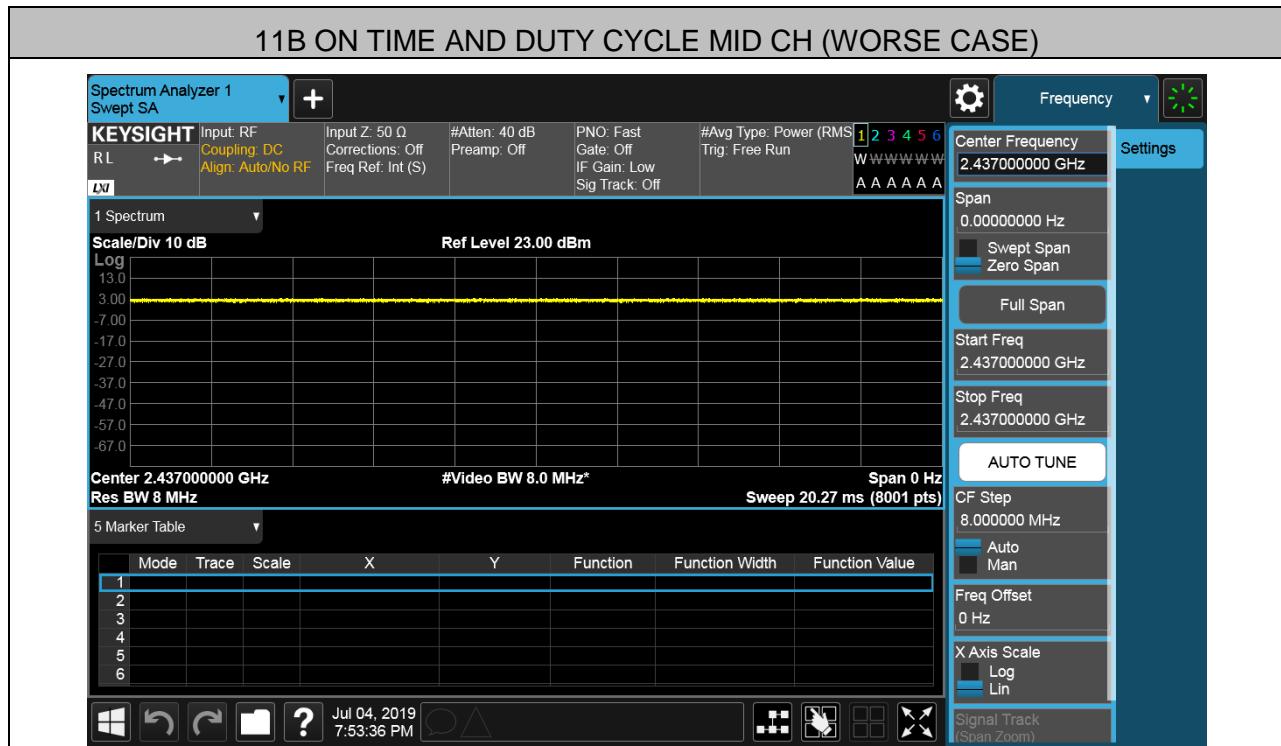
#### TEST ENVIRONMENT

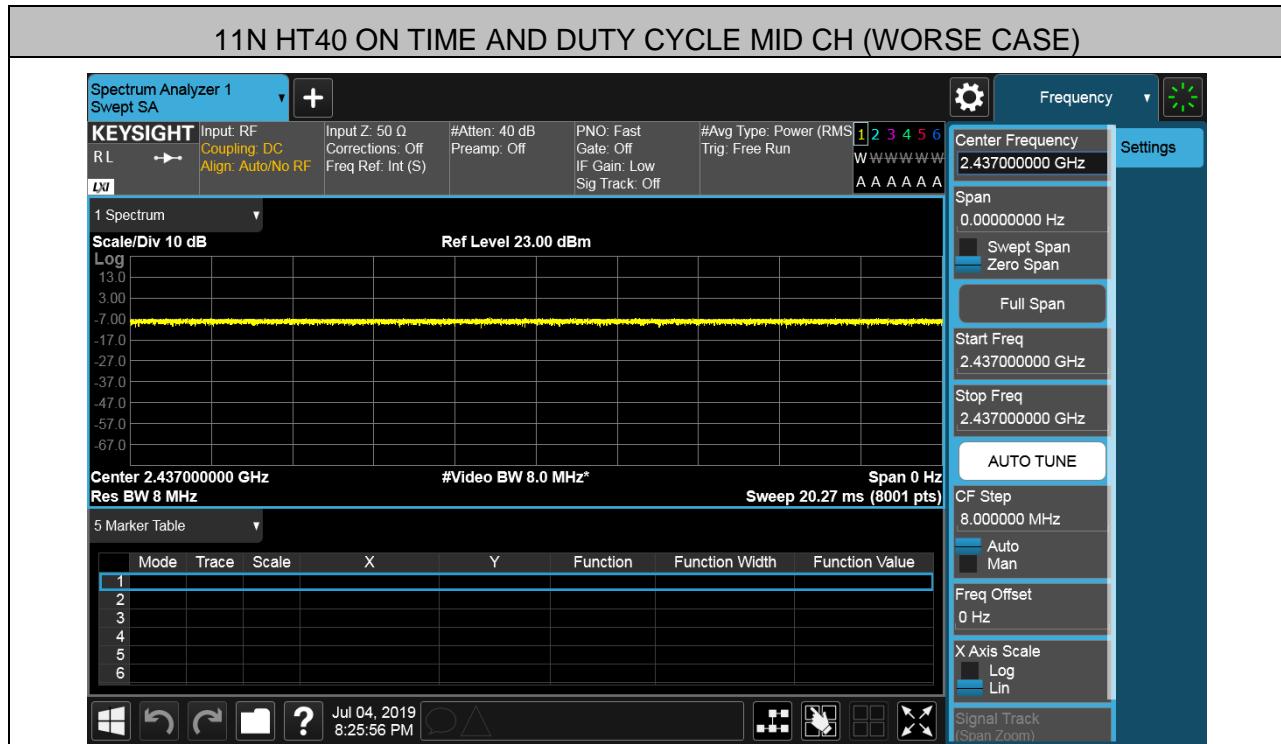
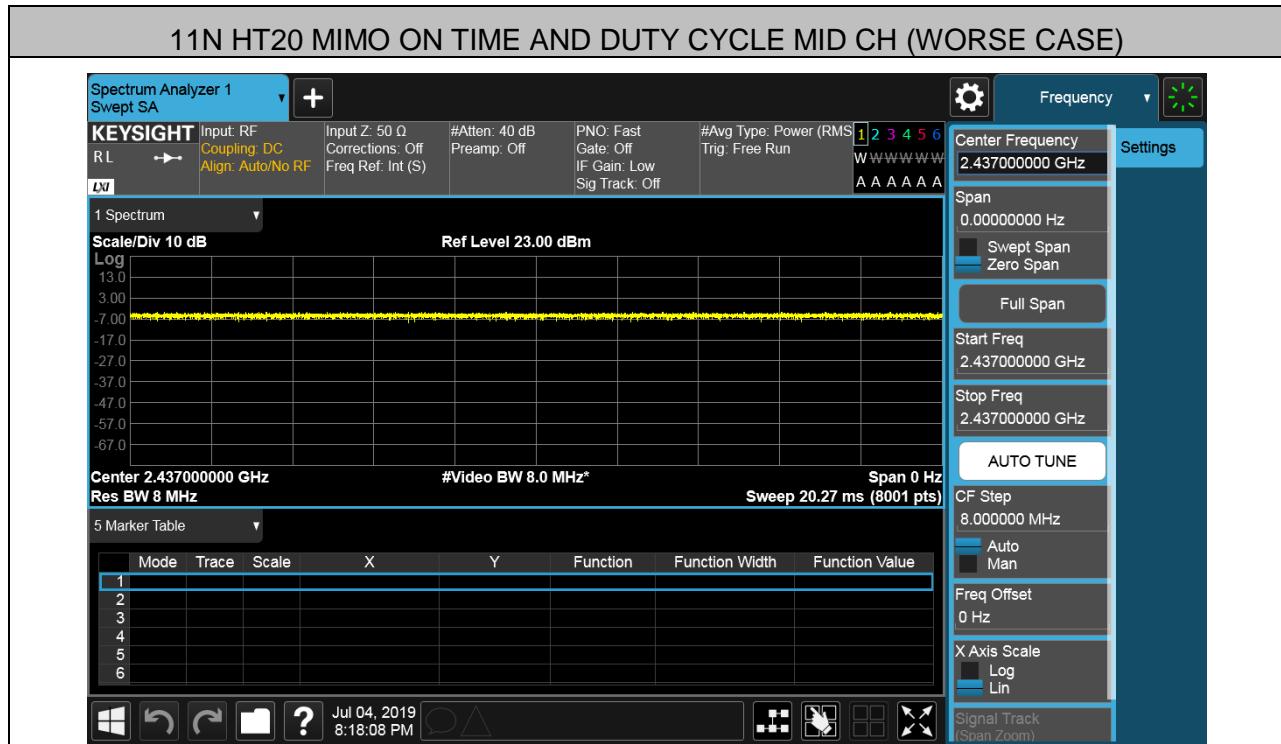
Temperature	22°C	Relative Humidity	56%
Atmosphere Pressure	101kPa	Test Voltage	AC 120V

#### RESULTS

Mode	On Time (msec)	Period (msec)	Duty Cycle x (Linear)	Duty Cycle (%)	Duty Cycle Correction Factor (db)	1/T Minimum VBW (KHz)
11B	100	100	1	100	0	0.01
11G	100	100	1	100	0	0.01
11N20 MIMO	100	100	1	100	0	0.01
11N40 MIMO	100	100	1	100	0	0.01

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.





## 7.2. 6 dB BANDWIDTH

### LIMITS

FCC Part15 (15.247) Subpart C			
Section	Test Item	Limit	Frequency Range (MHz)
FCC 15.247(a)(2)	6dB Bandwidth	>= 500KHz	2400-2483.5

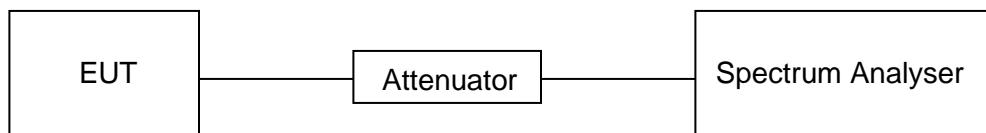
### TEST PROCEDURE

Refer to FCC KDB 558074, 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 6 dB Bandwidth :100K
VBW	For 6dB Bandwidth : $\geq 3 \times$ 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 relative to the maximum level measured in the fundamental emission.

### TEST SETUP



## RESULTS

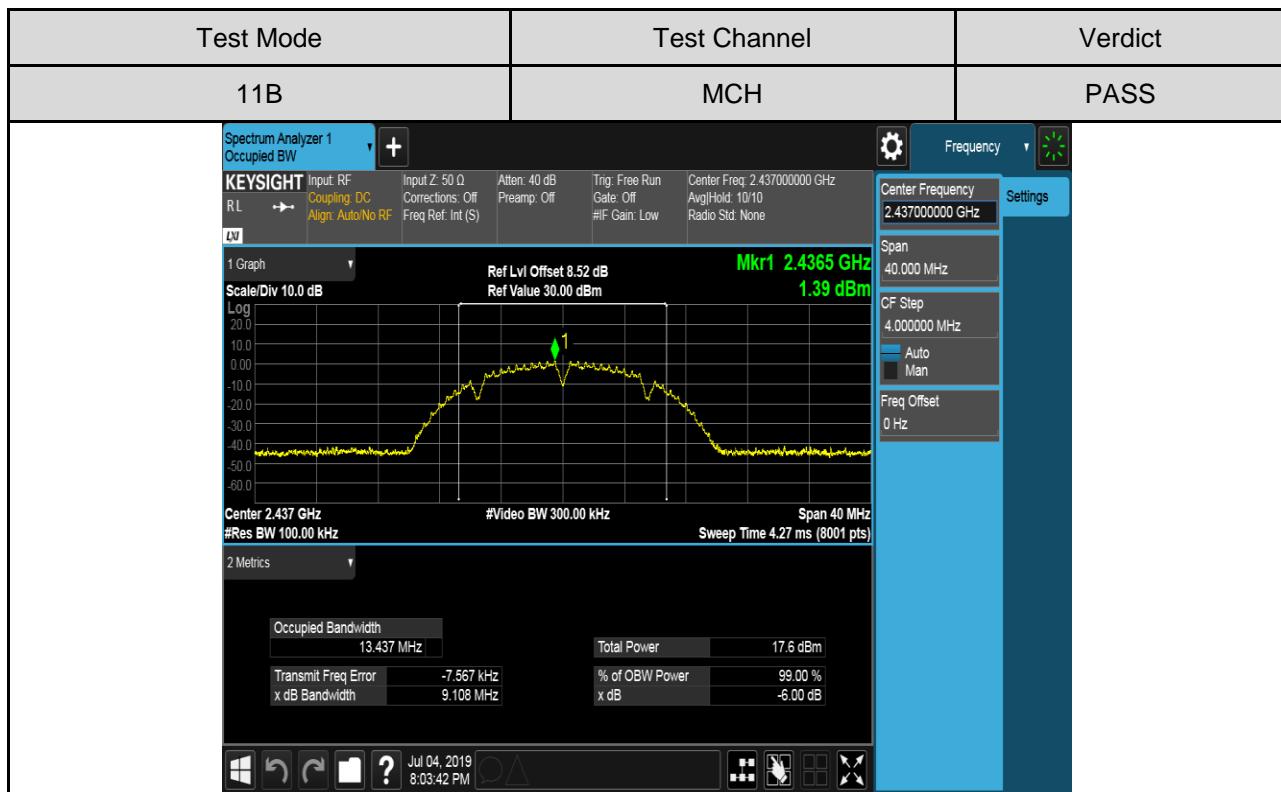
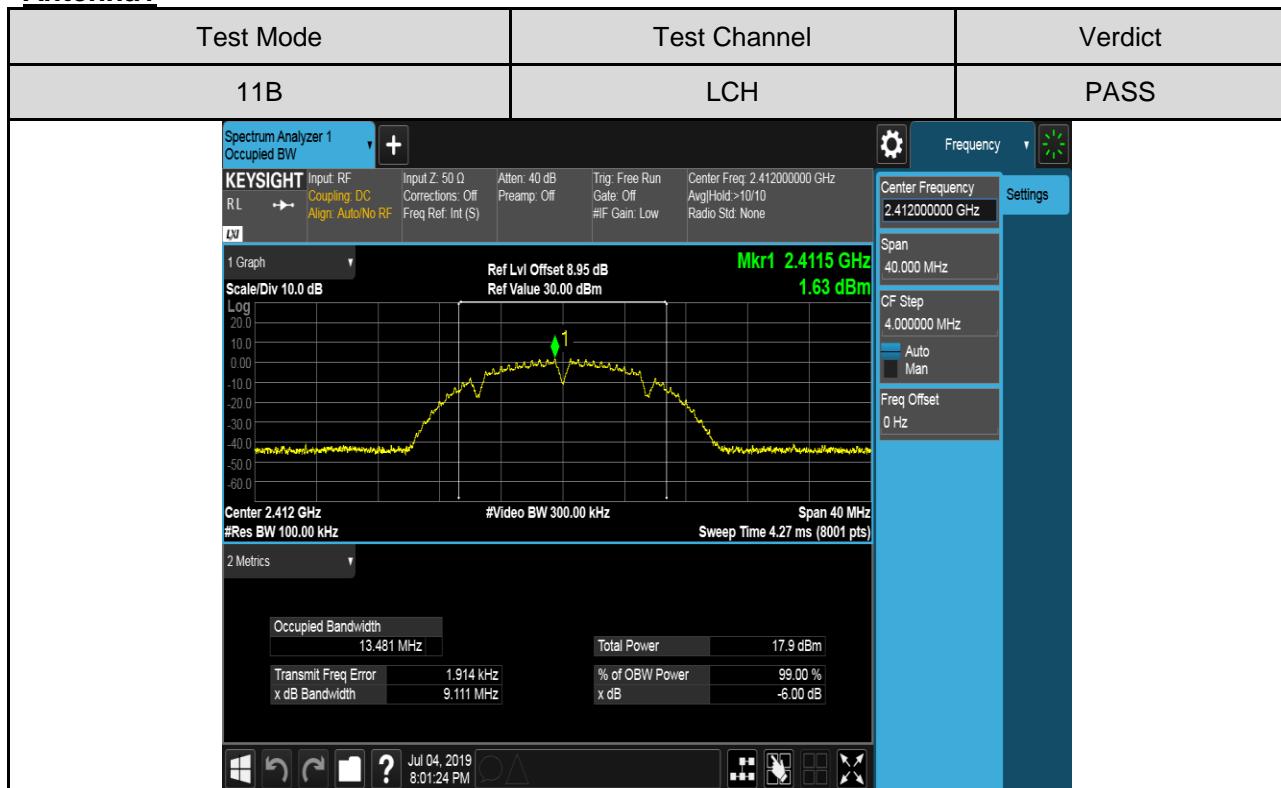
Test Mode	Test Antenna	Test Channel	6dB bandwidth (MHz)	Result
11B SISO	Antenna 1	LCH	9.11	Pass
		MCH	9.11	Pass
		HCH	9.11	Pass
	Antenna 2	LCH	9.11	Pass
		MCH	9.11	Pass
		HCH	9.11	Pass
11G SISO	Antenna 1	LCH	16.54	Pass
		MCH	16.52	Pass
		HCH	16.50	Pass
	Antenna 2	LCH	16.54	Pass
		MCH	16.52	Pass
		HCH	16.50	Pass
11N20MIMO	Antenna 1	LCH	17.63	Pass
		MCH	17.61	Pass
		HCH	17.64	Pass
	Antenna 2	LCH	17.63	Pass
		MCH	17.61	Pass
		HCH	17.64	Pass
11N40MIMO	Antenna 1	LCH	36.42	Pass
		MCH	36.47	Pass
		HCH	36.46	Pass
	Antenna 2	LCH	36.42	Pass
		MCH	36.47	Pass
		HCH	36.46	Pass

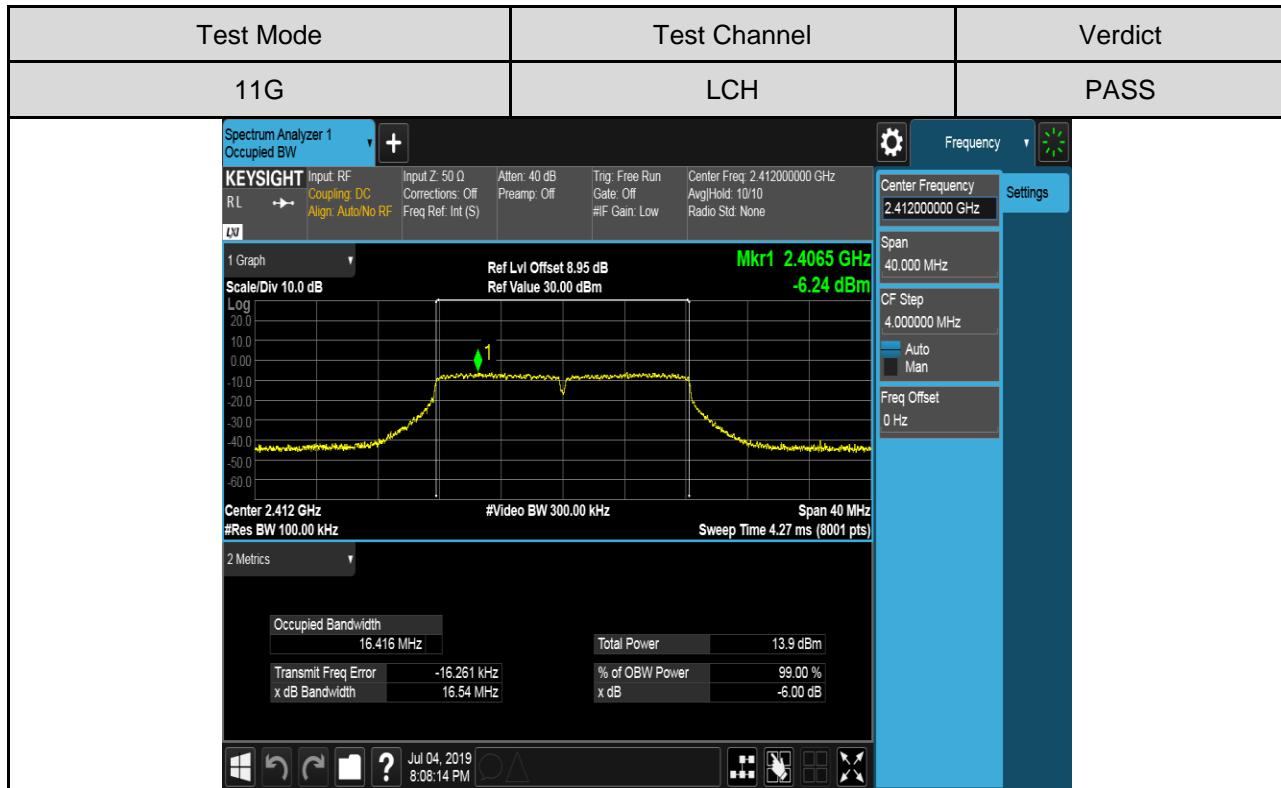
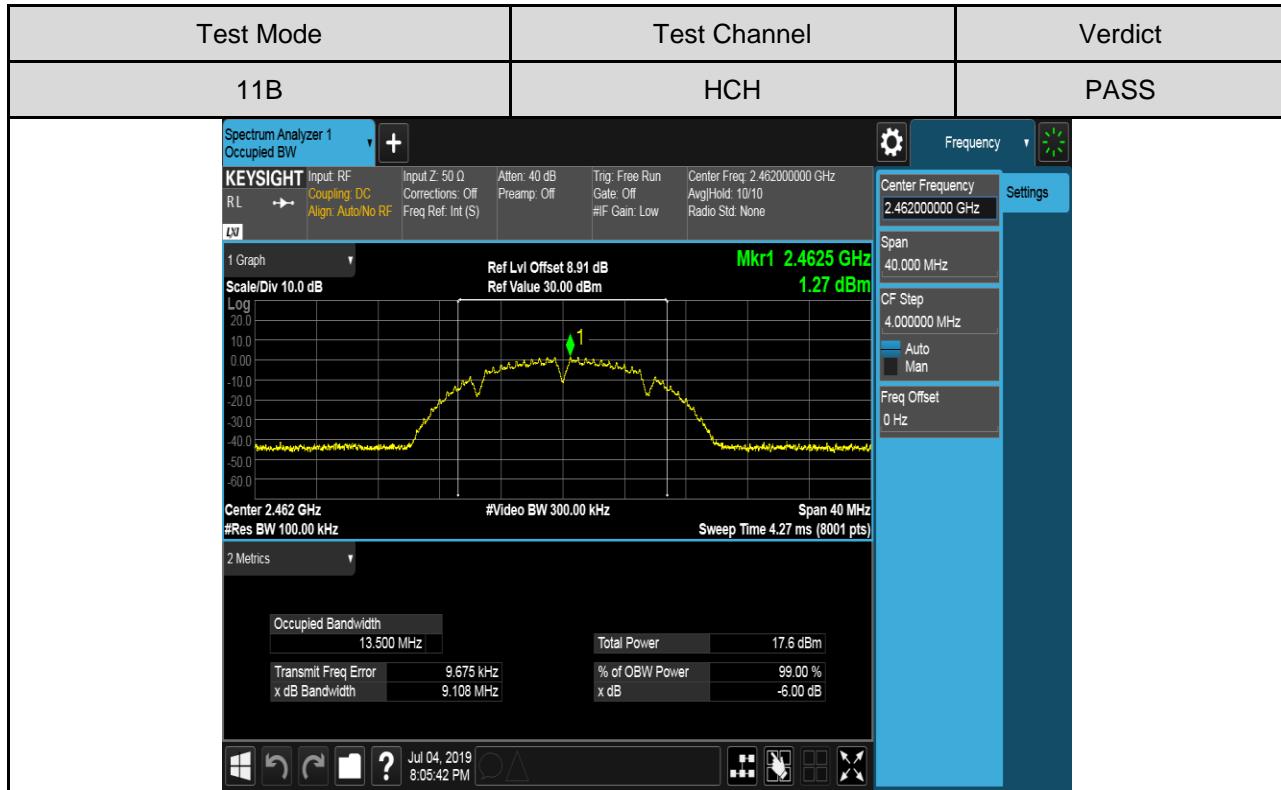
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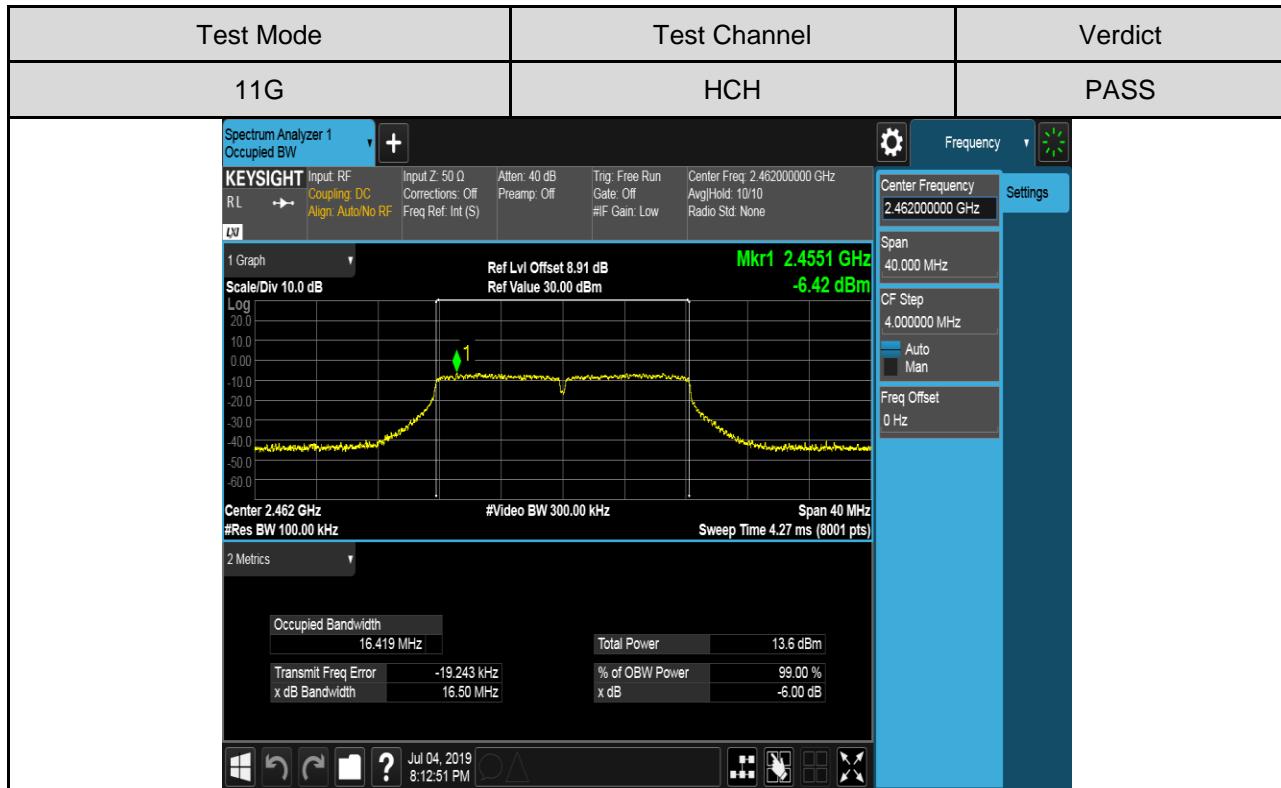
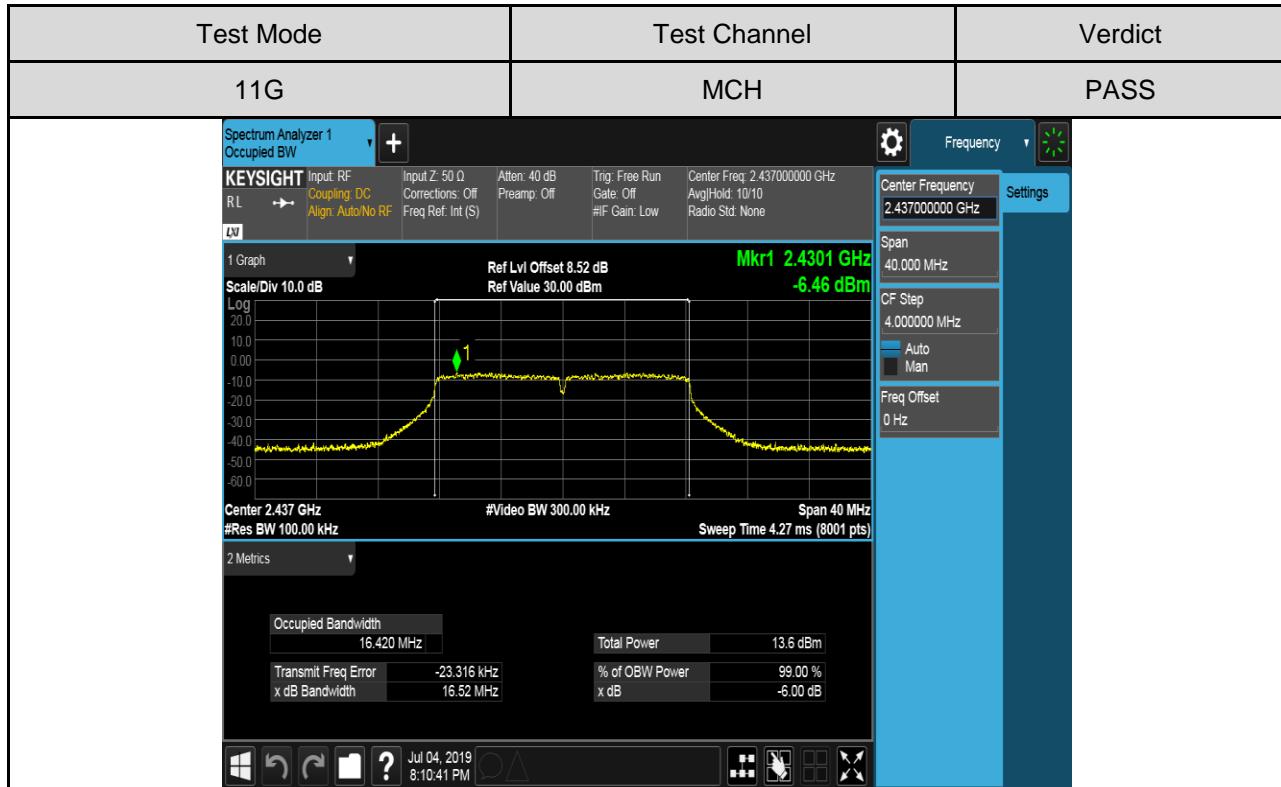
- 1) For this product, it has two antennas, antenna1 and antenna2, the 802.11B &802.11G modes can only support the SISO technical, but the ant1 and ant2 of this product can transmitter in the same time under those modes. For the 802.11N HT20 and 802.11N HT40 can support both the SISO and MIMO technical.
- 2) Pre-testing all test modes, only the data of worst case is included in this report.

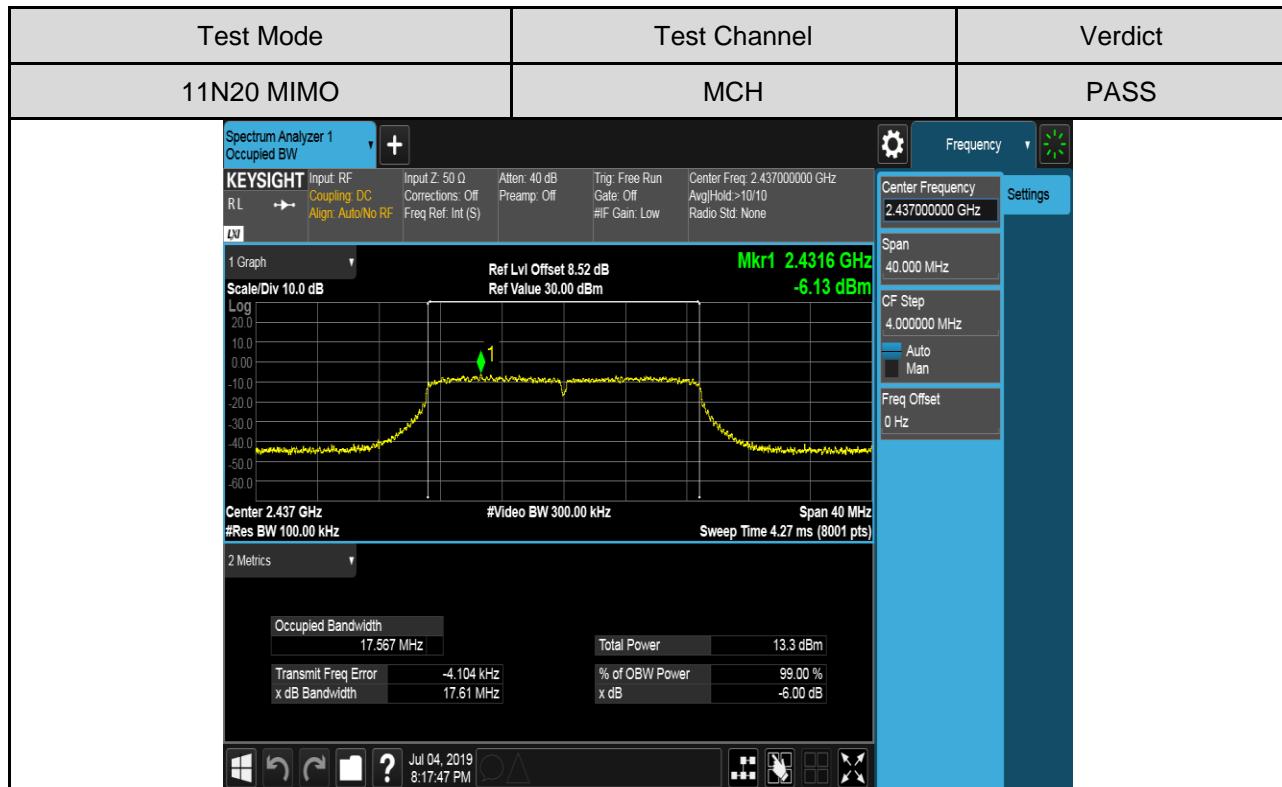
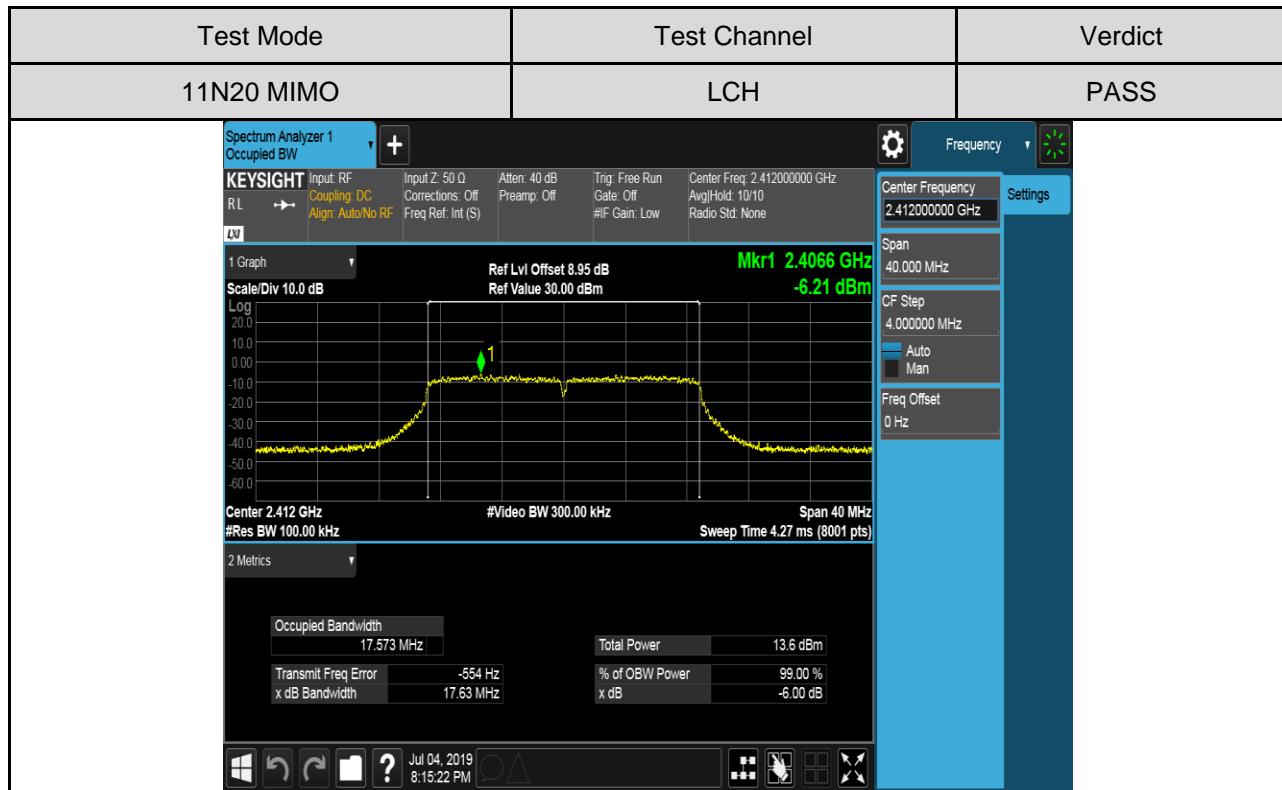
## Test Graphs

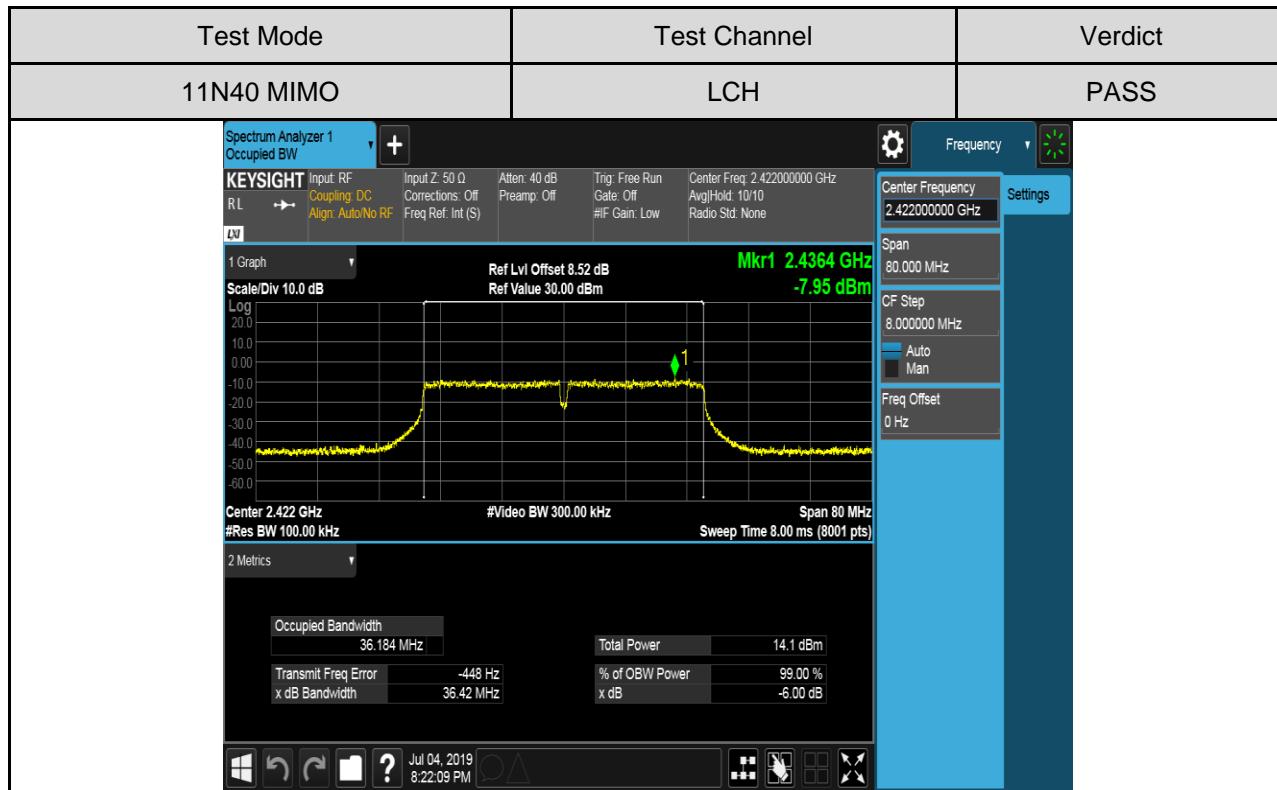
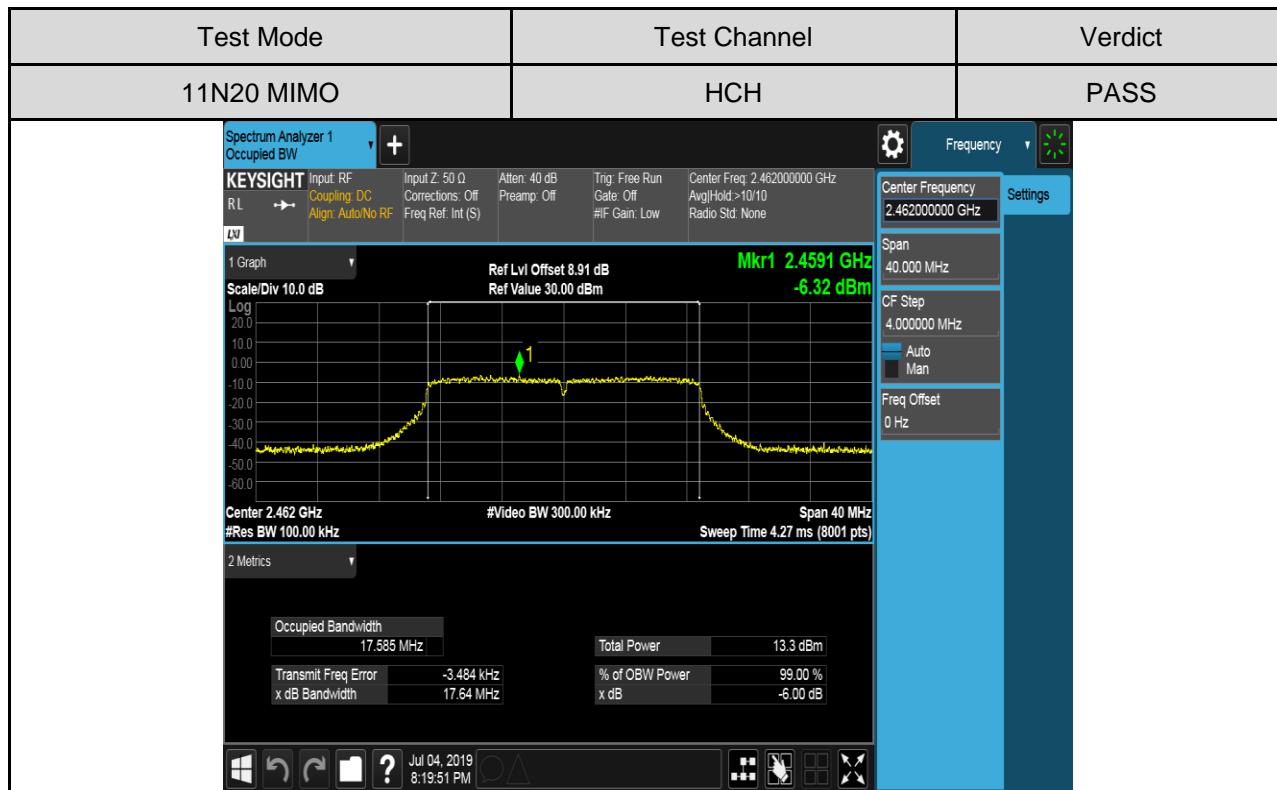
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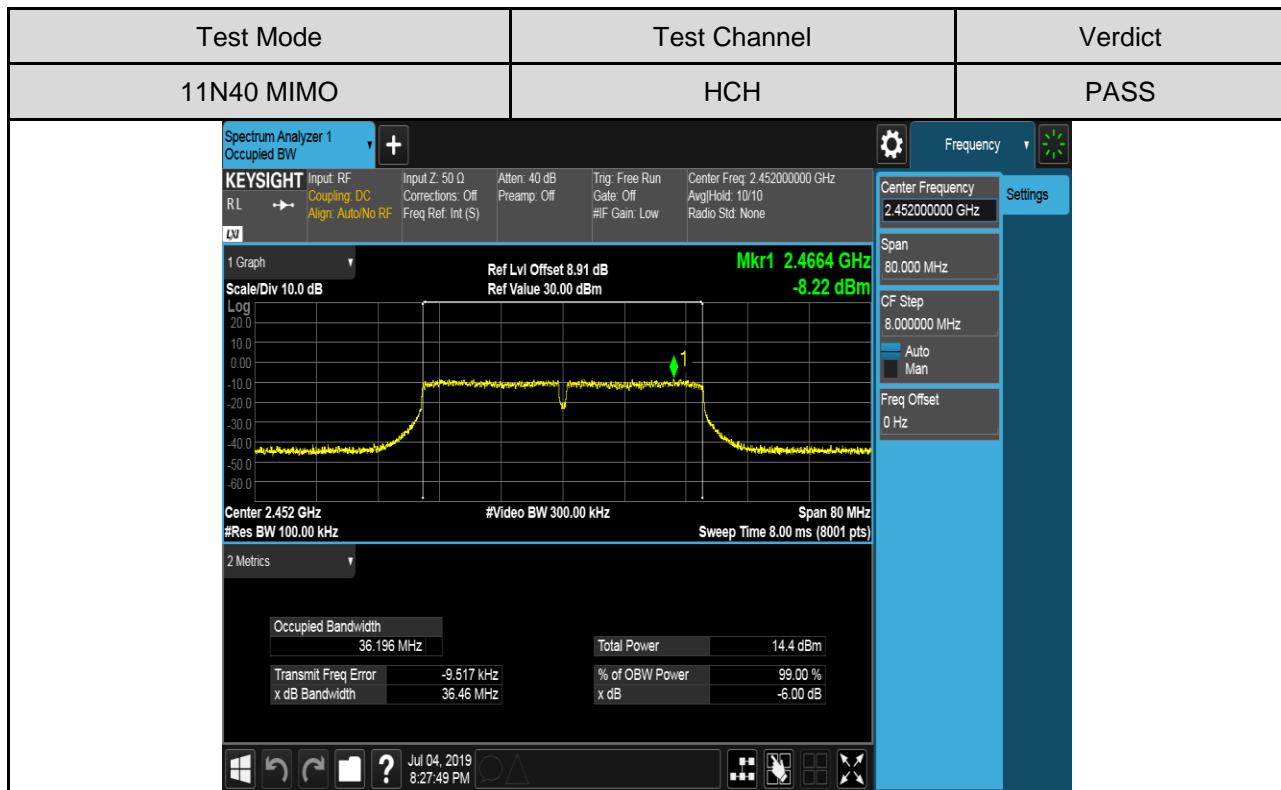
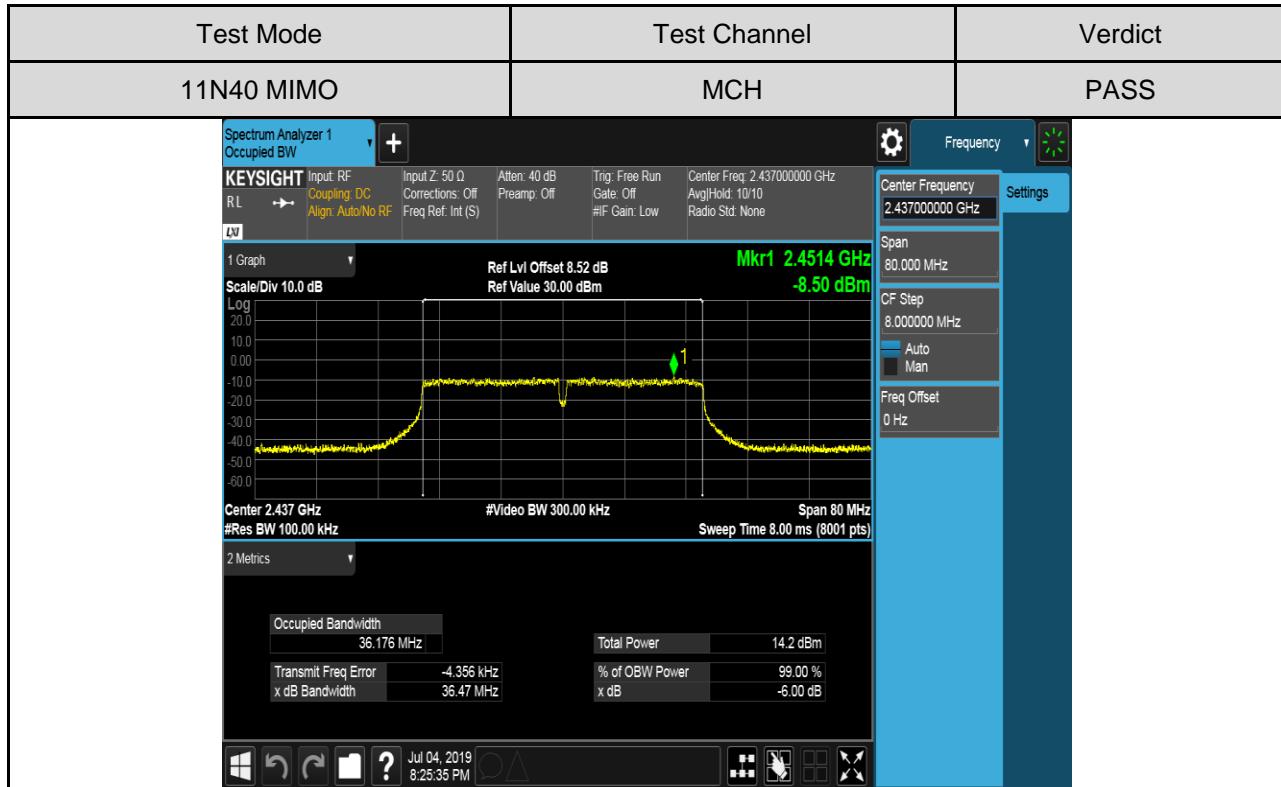




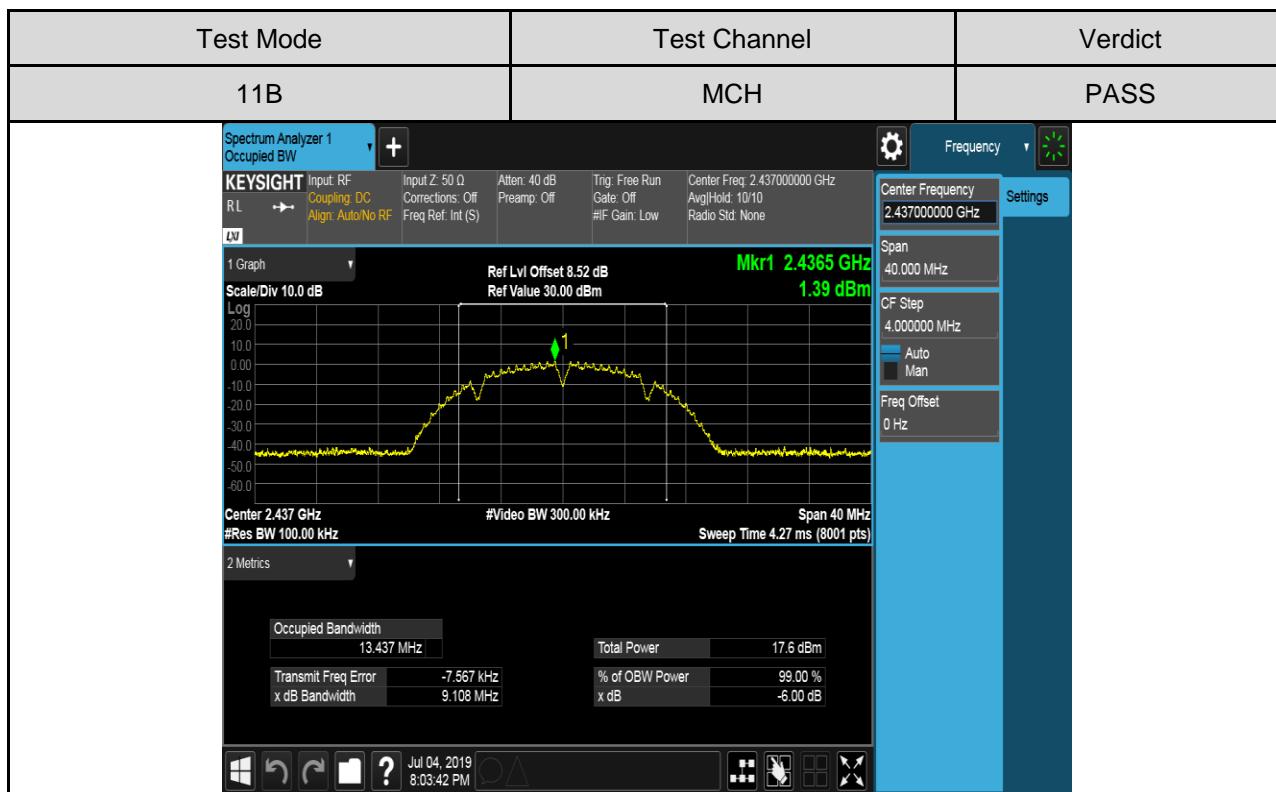


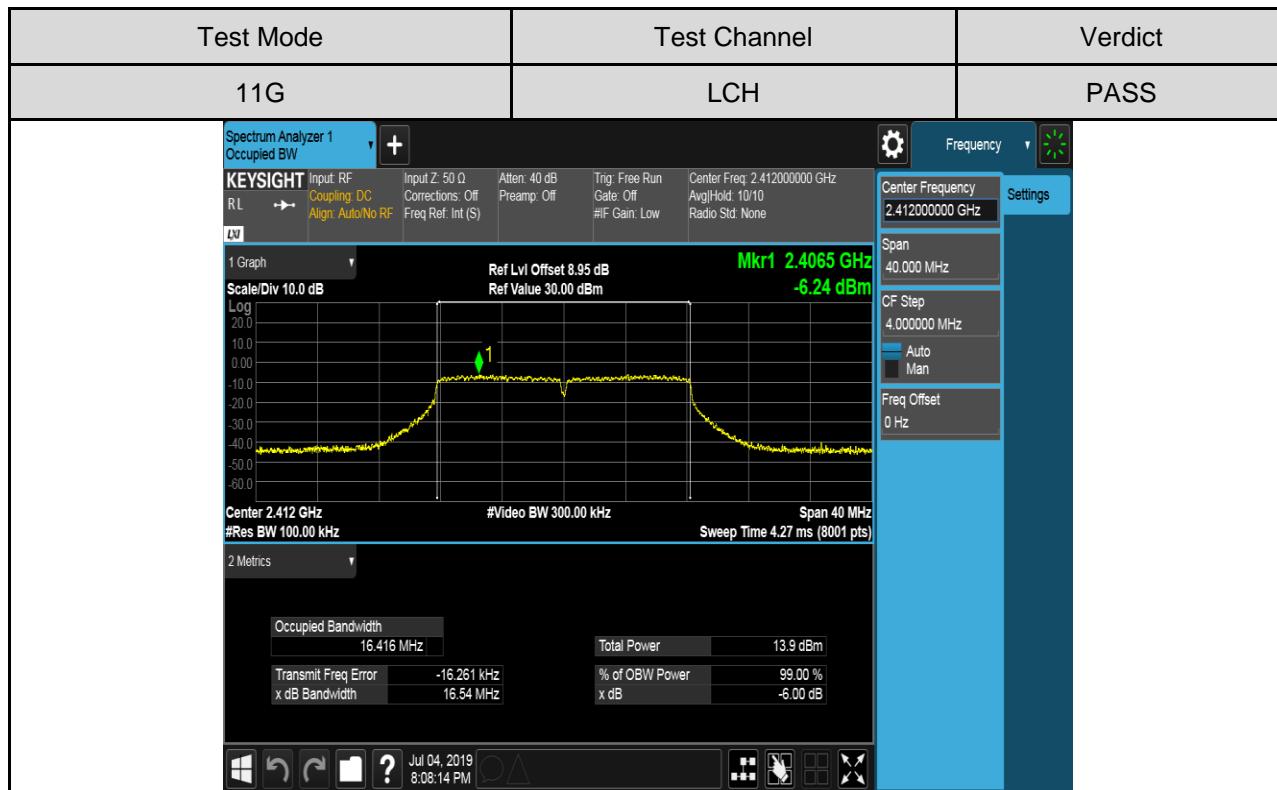


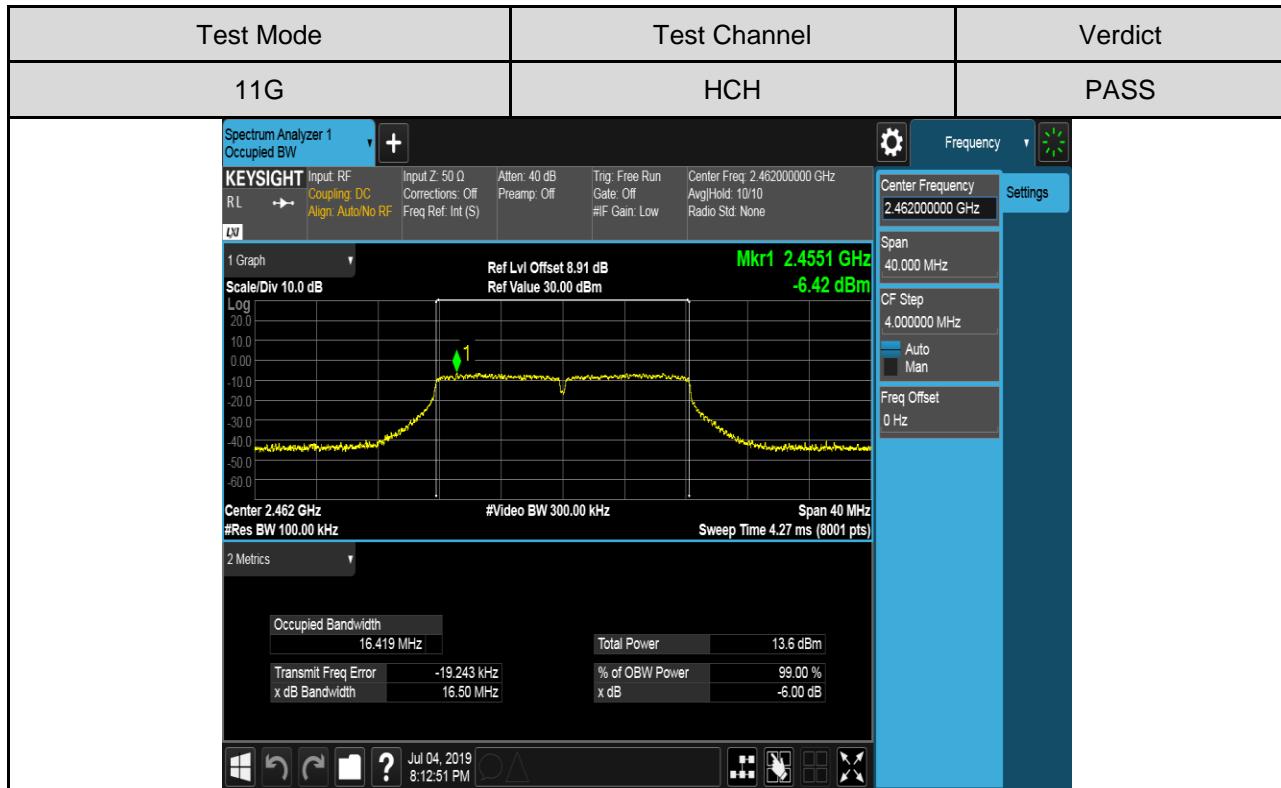
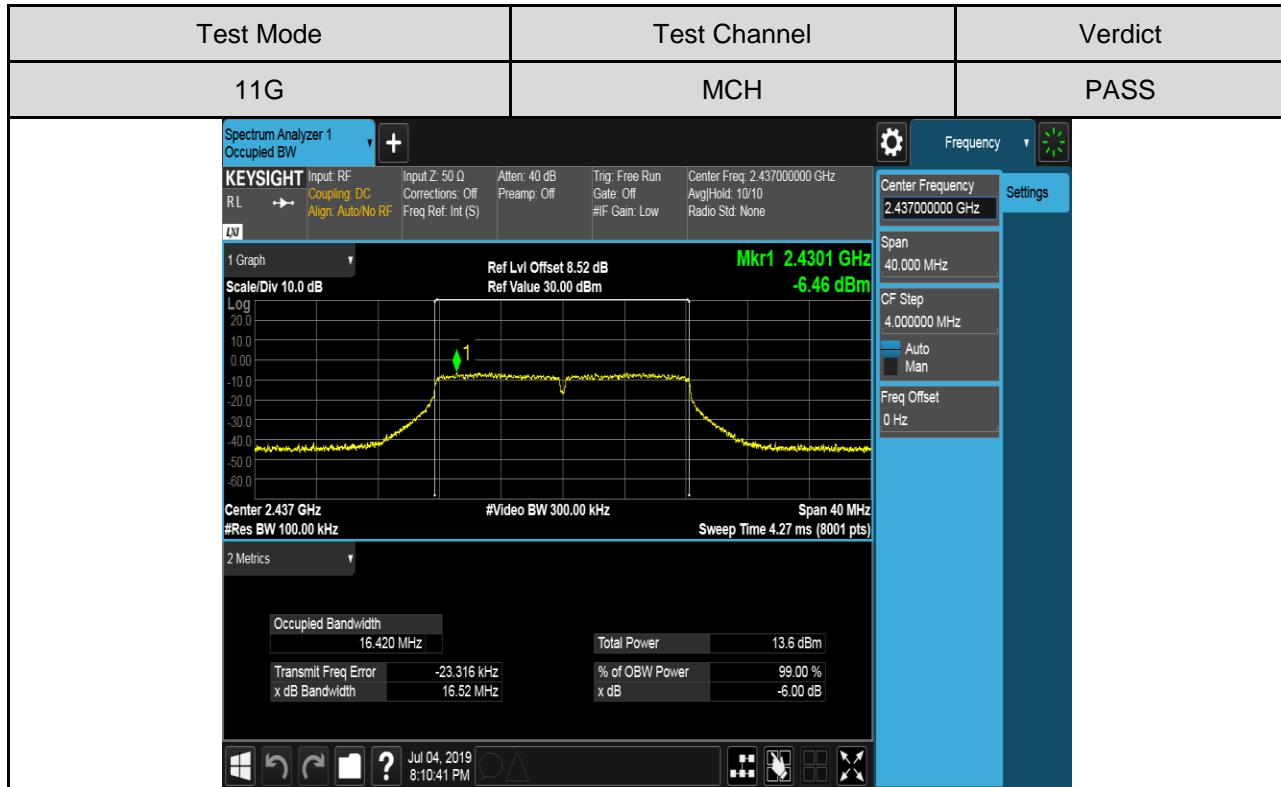


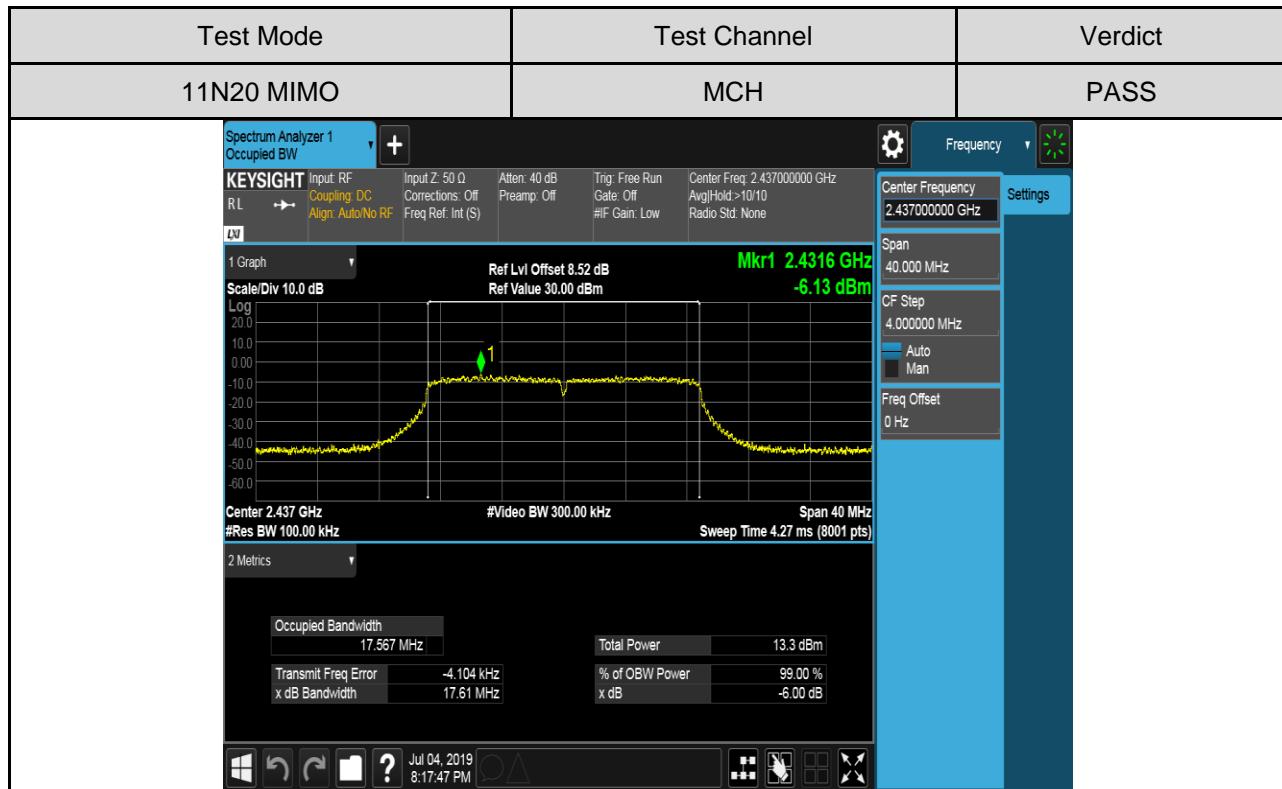
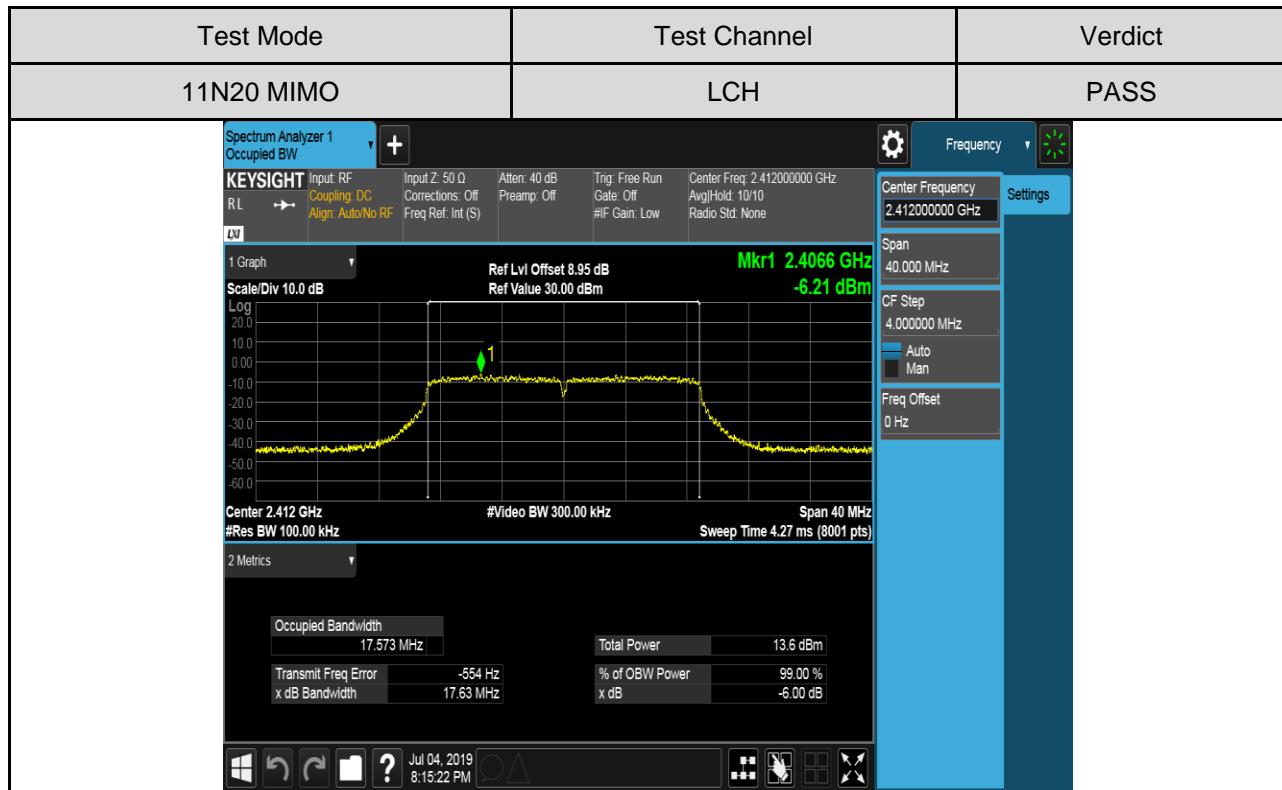


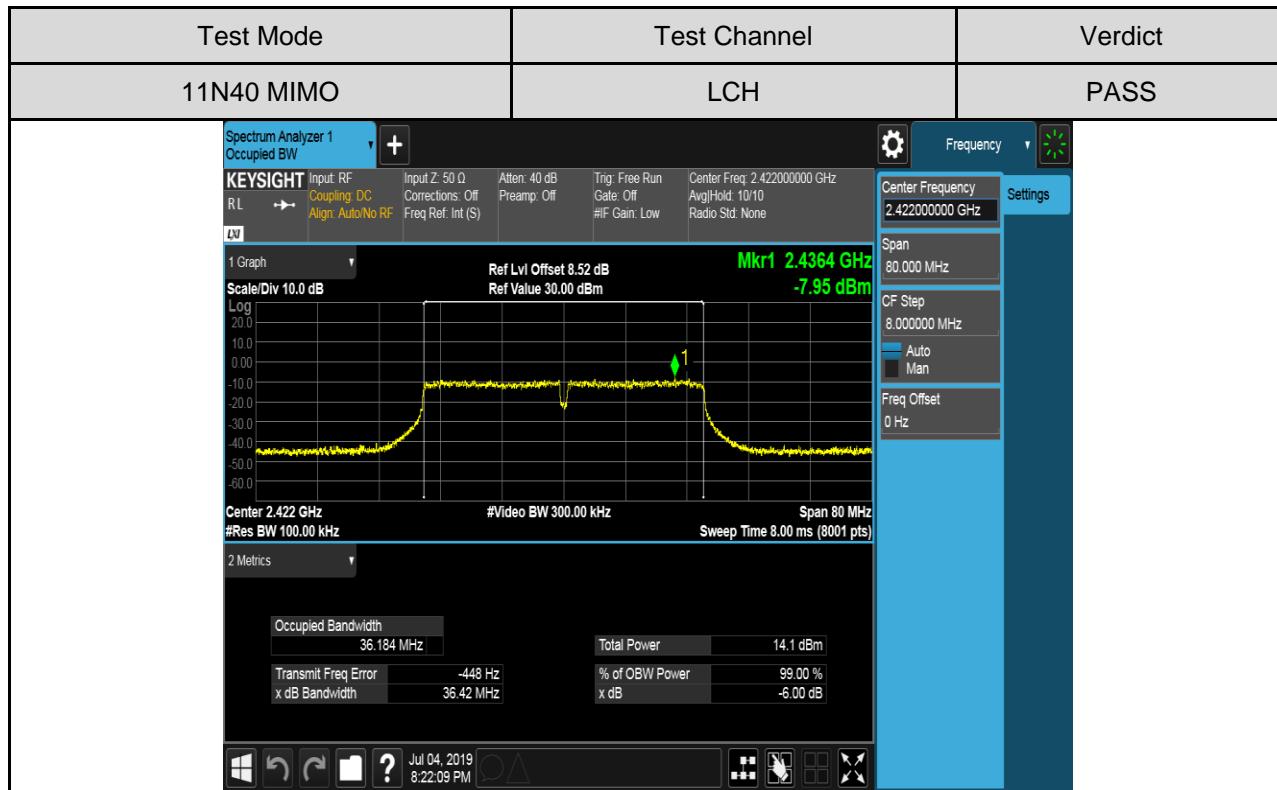
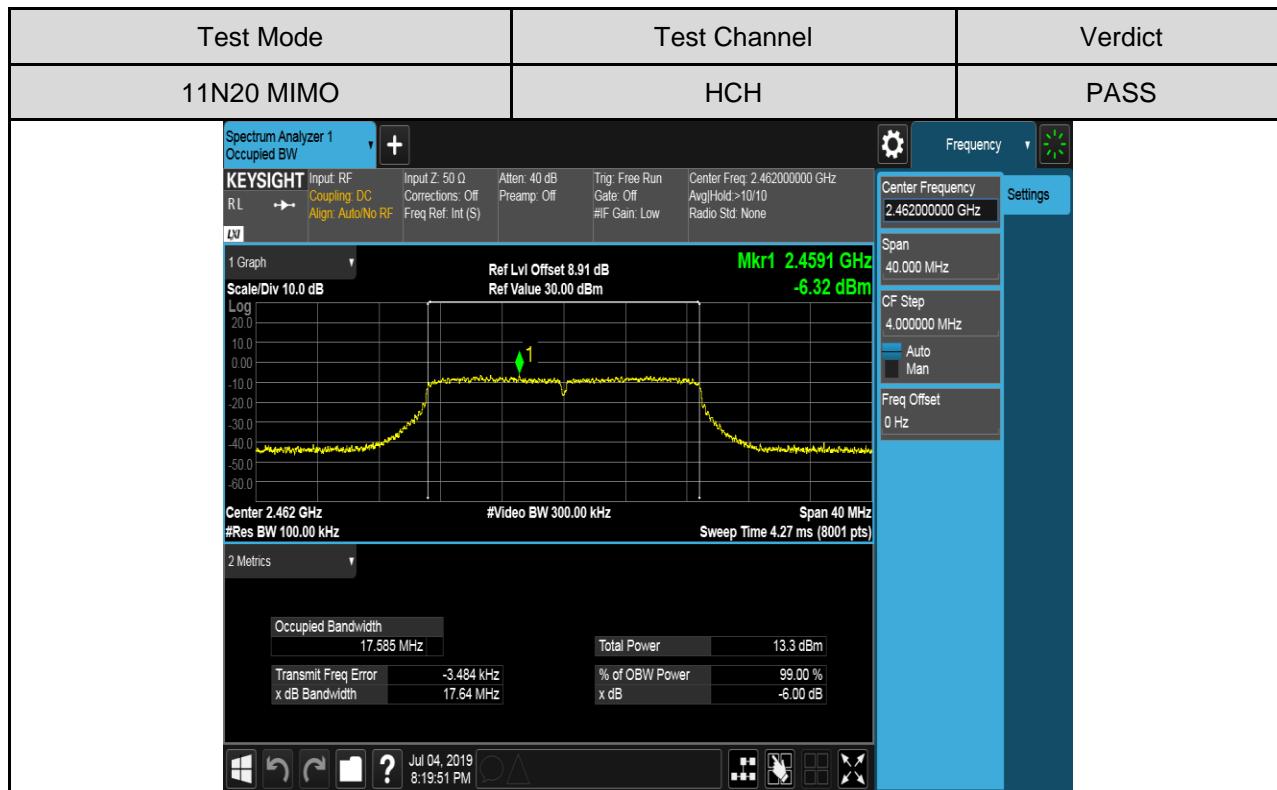
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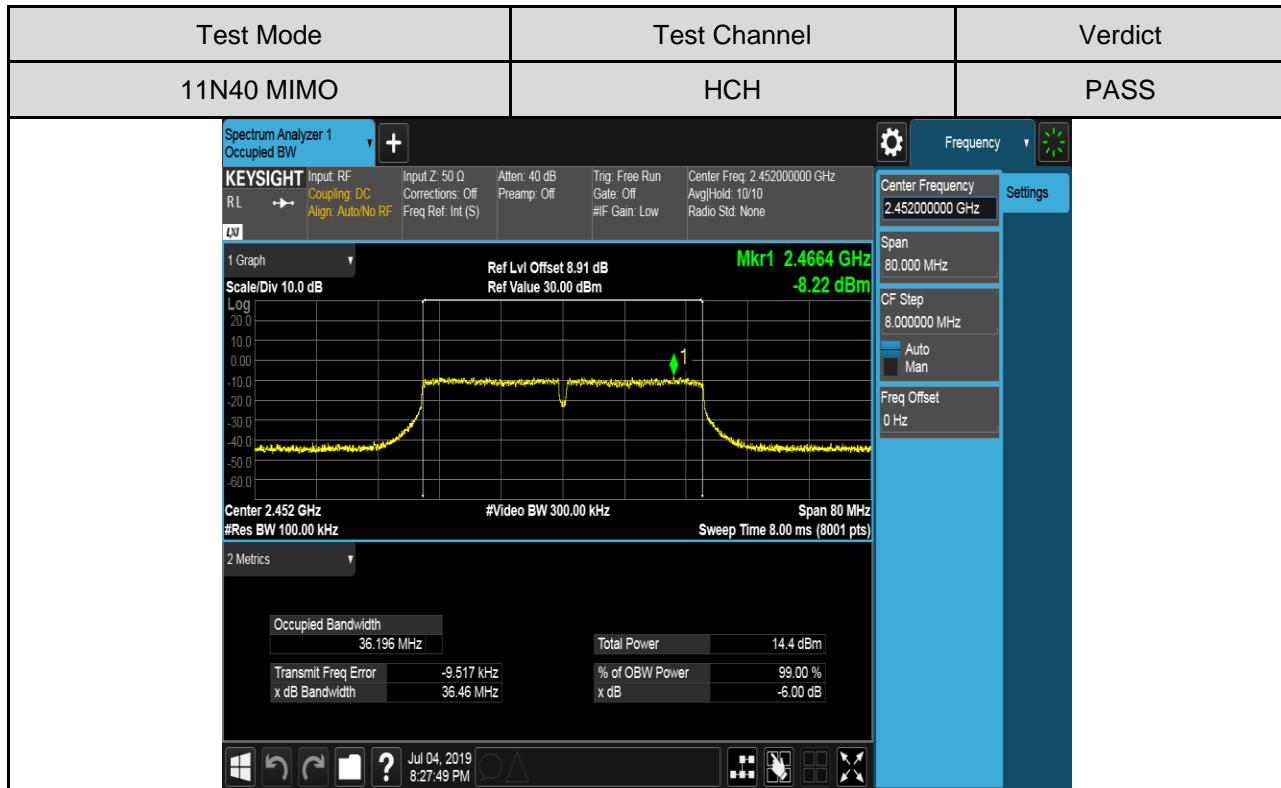
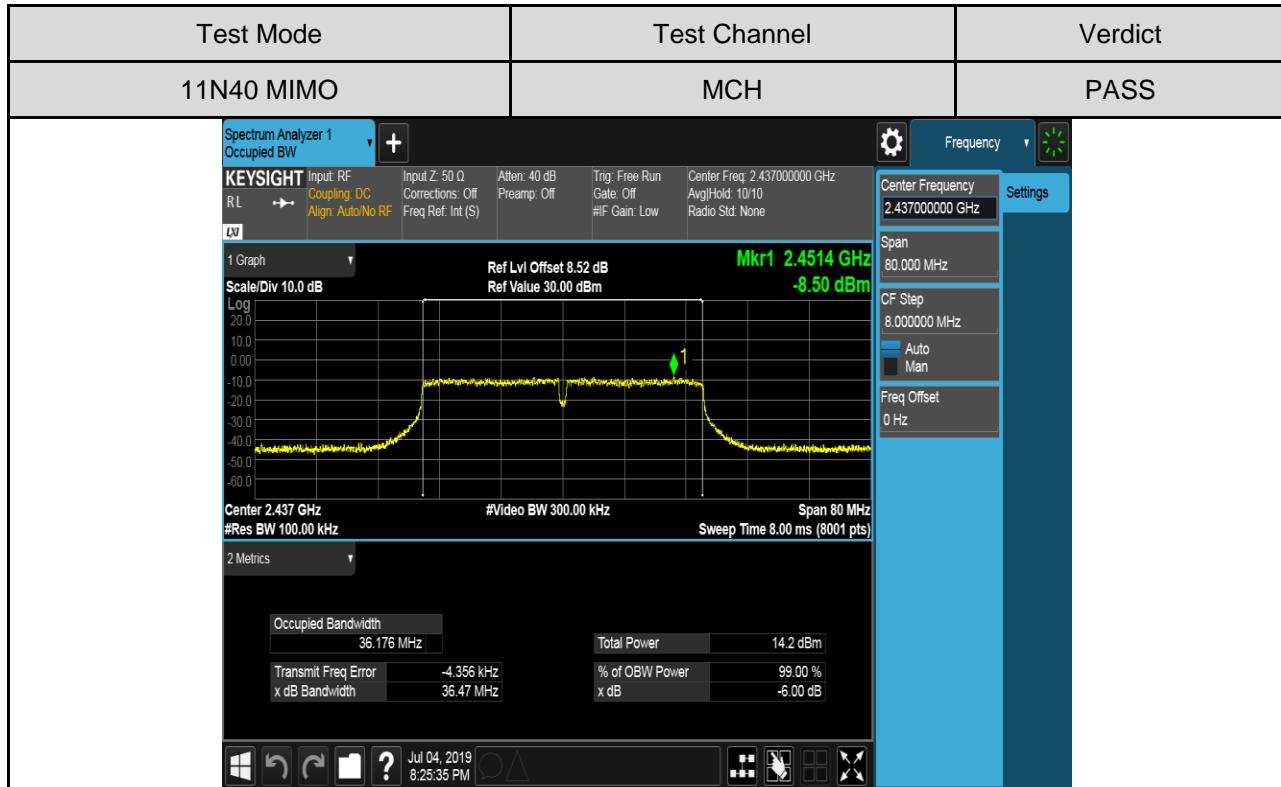












### 7.3. PEAK CONDUCTED OUTPUT POWER

#### LIMITS

FCC Part15 (15.247) , Subpart C			
Section	Test Item	Limit	Frequency Range (MHz)
FCC 15.247(b)(3)	Peak Output Power	1 watt or 30dBm	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</p> <p>Directional gain = <math>10\log [(10^{G1/20} + 10^{G2/20})^2 / N_{ANT}] = 7.54 &gt; 6\text{dBi}</math>, where the NANT is the numbers of antenna. So, the power limit shall be reduced to <math>30 - (7.54 - 6) = 28.46 \text{ dBm}</math></p>			

#### TEST PROCEDURE

Place the EUT on the table and set it in the transmitting mode.

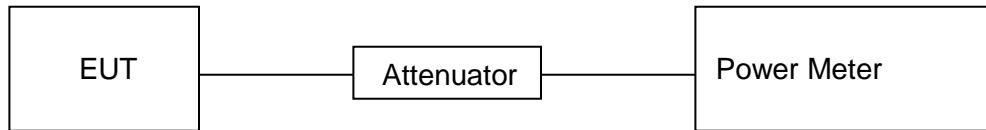
Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the Power sensor.

Measure the power of each channel.

Peak Detector use for Peak result.

AVG Detector use for AVG result.

#### TEST SETUP



## RESULTS

Maximum Peak Conducted Output Power(dBm)

Test Mode	Test Antenna	Test Channel	Maximum Peak Conducted Output Power(dBm)	EIRP (dBm)	Result
11B	Antenna 1	LCH	13.82	18.17	Pass
		MCH	13.57	17.92	Pass
		HCH	13.49	17.84	Pass
	Antenna 2	LCH	14.09	18.76	Pass
		MCH	14.09	18.76	Pass
		HCH	14.32	18.99	Pass
	Antenna 1+2	LCH	16.97	24.51	Pass
		MCH	16.85	24.39	Pass
		HCH	16.94	24.48	Pass
11G	Antenna 1	LCH	15.49	19.84	Pass
		MCH	15.17	19.52	Pass
		HCH	15.20	19.55	Pass
	Antenna 2	LCH	15.80	20.47	Pass
		MCH	15.85	20.52	Pass
		HCH	16.01	20.68	Pass
	Antenna 1+2	LCH	18.66	26.20	Pass
		MCH	18.53	26.07	Pass
		HCH	18.63	26.17	Pass
11N20MIMO	Antenna 1	LCH	15.55	19.90	Pass
		MCH	15.26	19.61	Pass
		HCH	15.25	19.60	Pass
	Antenna 2	LCH	15.89	20.56	Pass
		MCH	15.95	20.62	Pass
		HCH	16.18	20.85	Pass
	Antenna 1+2	LCH	18.73	26.27	Pass
		MCH	18.63	26.17	Pass
		HCH	18.75	26.29	Pass
11N40MIMO	Antenna 1	LCH	15.76	20.11	Pass
		MCH	15.70	20.05	Pass
		HCH	15.95	20.30	Pass
	Antenna 2	LCH	16.35	21.02	Pass



		MCH	16.49	21.16	Pass
		HCH	16.89	21.56	Pass
Antenna 1+2	LCH	19.08	26.62	Pass	
	MCH	19.12	26.66	Pass	
	HCH	19.46	27.00	Pass	

Remark:

- 1) For this product, it has two antennas, antenna1 and antenna2, the 802.11B &802.11G modes can only support the SISO technical, but the ant1 and ant2 of this product can transmitter in the same time under those modes. For the 802.11N HT20 and 802.11N HT40 can support both the SISO and MIMO technical.
- 2) Through pre-testing all the test modes of 11N 20 and 11N40, including SISO and MIMO, but only the data if worse case is included in this test report.

## 7.4. POWER SPECTRAL DENSITY

### LIMITS

FCC Part15 (15.247) , Subpart C			
Section	Test Item	Limit	Frequency Range (MHz)
FCC §15.247 (e)	Power Spectral Density	8 dBm in any 3 kHz band	2400-2483.5
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.			
2. Limit=30dBm – (Directional gain -6)dBi Directional gain = $10\log [(10^{G1/20} + 10^{G2/20})^2 / N_{ANT}] = 7.54 > 6\text{dBi}$ , where the NANT is the numbers of antenna. So, the power limit shall be reduced to $8 - (7.54 - 6) = 6.46 \text{ dBm}$			

### TEST PROCEDURE

Refer to FCC KDB 558074, 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	$1.5 \times \text{DTS bandwidth}$
Trace	Max hold
Sweep time	Auto couple.

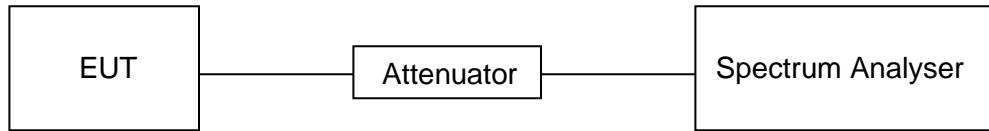
Allow trace to fully stabilize and use the peak marker function to determine the maximum amplitude level within the RBW.

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

### TEST ENVIRONMENT

Temperature	22°C	Relative Humidity	56%
Atmosphere Pressure	101kPa	Test Voltage	AC 120V

**TEST SETUP**



## RESULTS

Test Mode	Test Antenna	Test Channel	Maximum Peak power spectral density (dBm)	Result
11B	Antenna 1	LCH	-3.49	Pass
		MCH	-3.77	Pass
		HCH	-3.80	Pass
	Antenna 2	LCH	-3.24	Pass
		MCH	-3.24	Pass
		HCH	-2.95	Pass
	Antenna 1+2	LCH	-0.35	Pass
		MCH	-0.49	Pass
		HCH	-0.34	Pass
11G	Antenna 1	LCH	-9.05	Pass
		MCH	-8.86	Pass
		HCH	-8.96	Pass
	Antenna 2	LCH	-8.62	Pass
		MCH	-8.44	Pass
		HCH	-8.43	Pass
	Antenna 1+2	LCH	-6.03	Pass
		MCH	-5.54	Pass
		HCH	-5.68	Pass
11N20MIMO	Antenna 1	LCH	-9.14	Pass
		MCH	-9.46	Pass
		HCH	-9.38	Pass
	Antenna 2	LCH	-8.92	Pass
		MCH	-8.80	Pass
		HCH	-8.61	Pass
	Antenna 1+2	LCH	-6.02	Pass
		MCH	-6.11	Pass
		HCH	-5.97	Pass
11N40MIMO	Antenna 1	LCH	-11.39	Pass
		MCH	-11.28	Pass
		HCH	-11.05	Pass
	Antenna 2	LCH	-10.59	Pass
		MCH	-11.18	Pass



		HCH	-10.58	Pass
		LCH	-7.96	Pass
	Antenna 1+2	MCH	-8.22	Pass
		HCH	-7.80	Pass

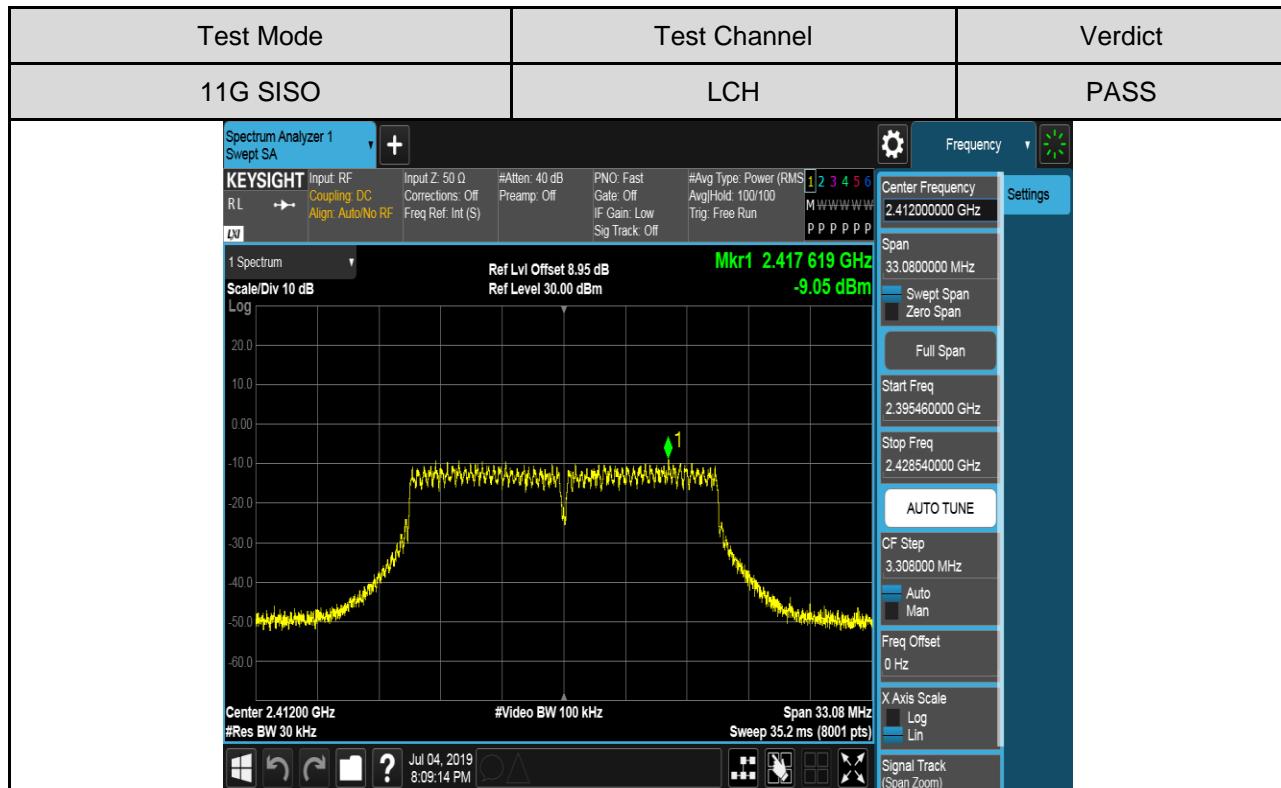
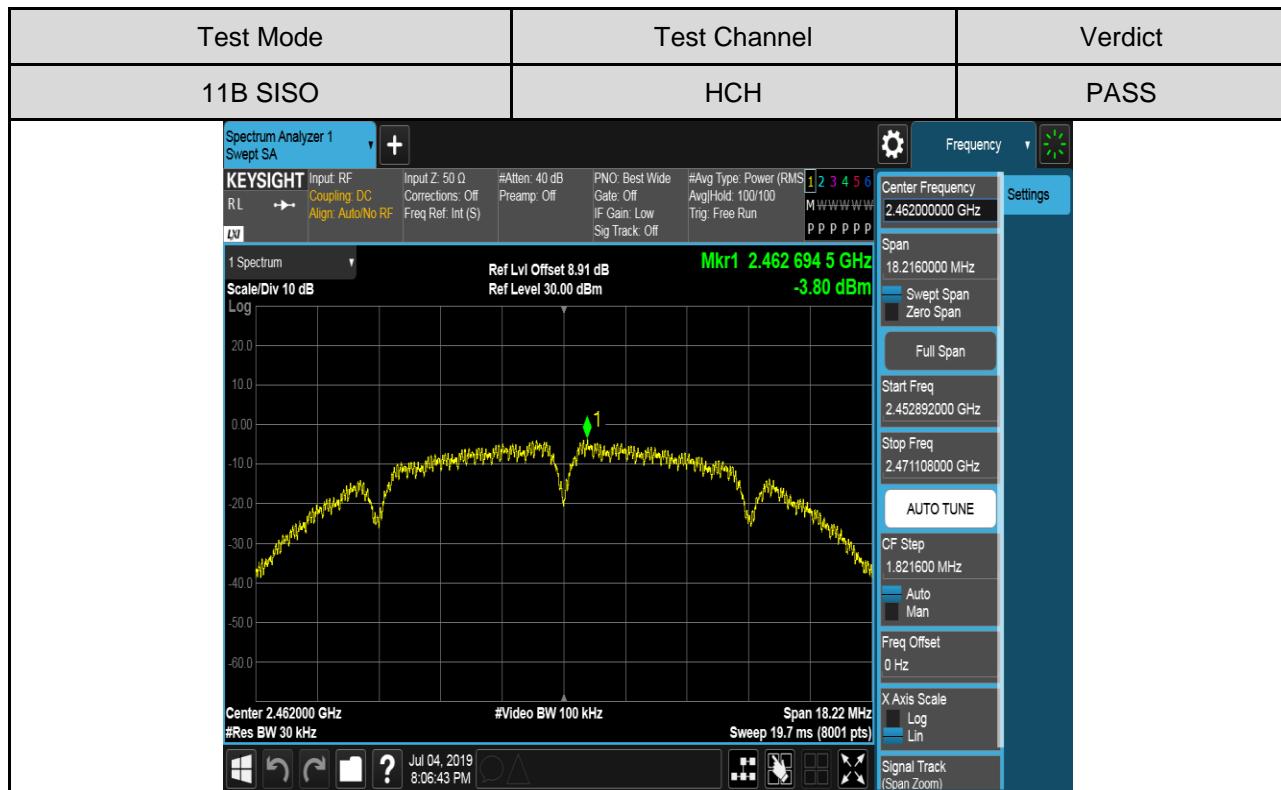
Remark:

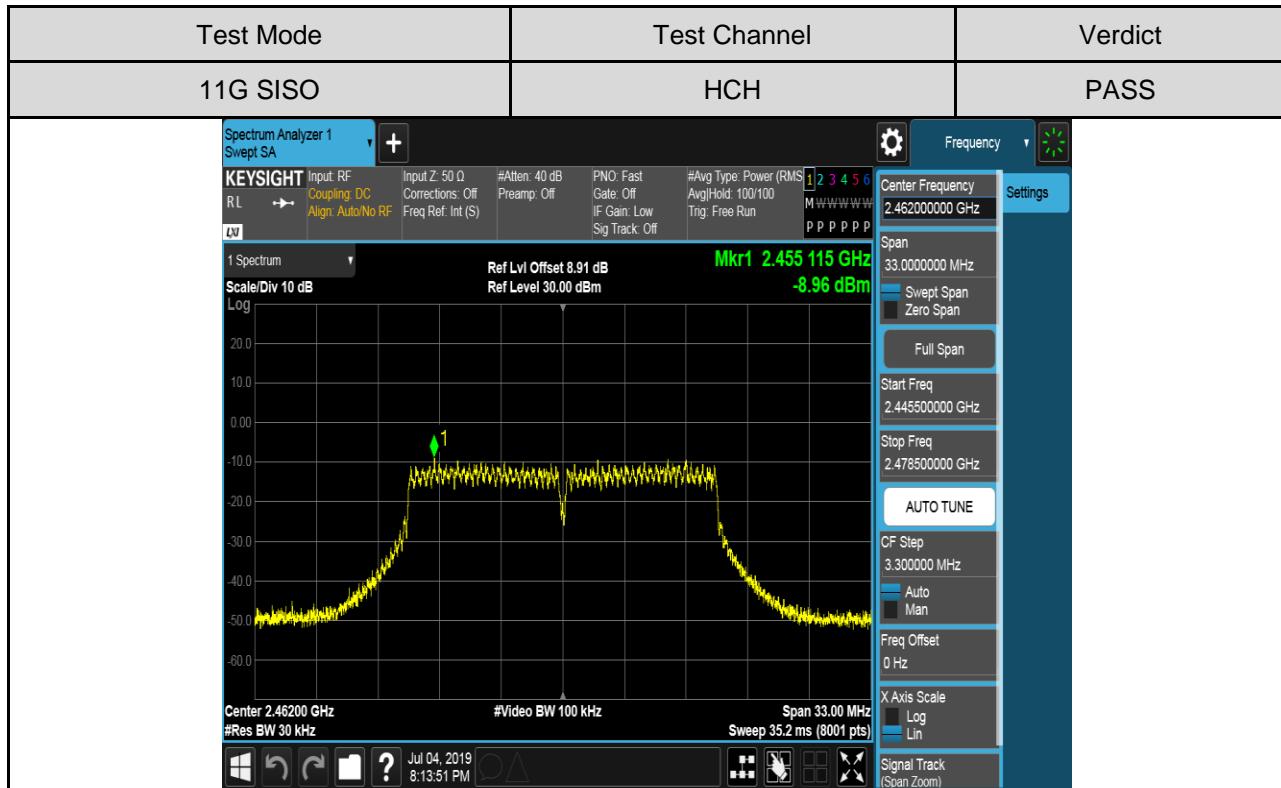
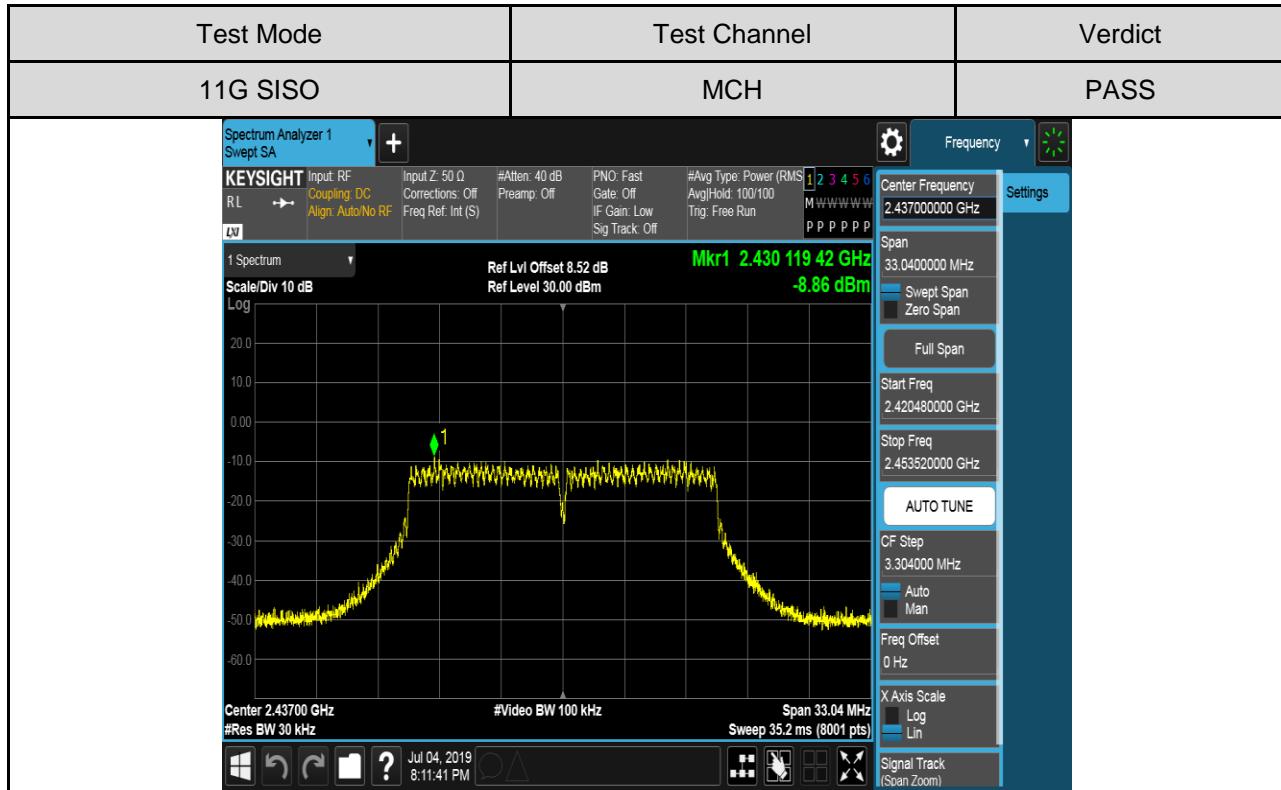
- 1) For this product, it has two antennas, antenna1 and antenna2, the 802.11B &802.11G modes can only support the SISO technical, but the ant1 and ant2 of this product can transmitter in the same time under those modes. For the 802.11N HT20 and 802.11N HT40 can support both the SISO and MIMO technical.
- 2) Through pre-testing all the test modes of 11N 20 and 11N40, including SISO and MIMO, but only the data if worse case is included in this test report.

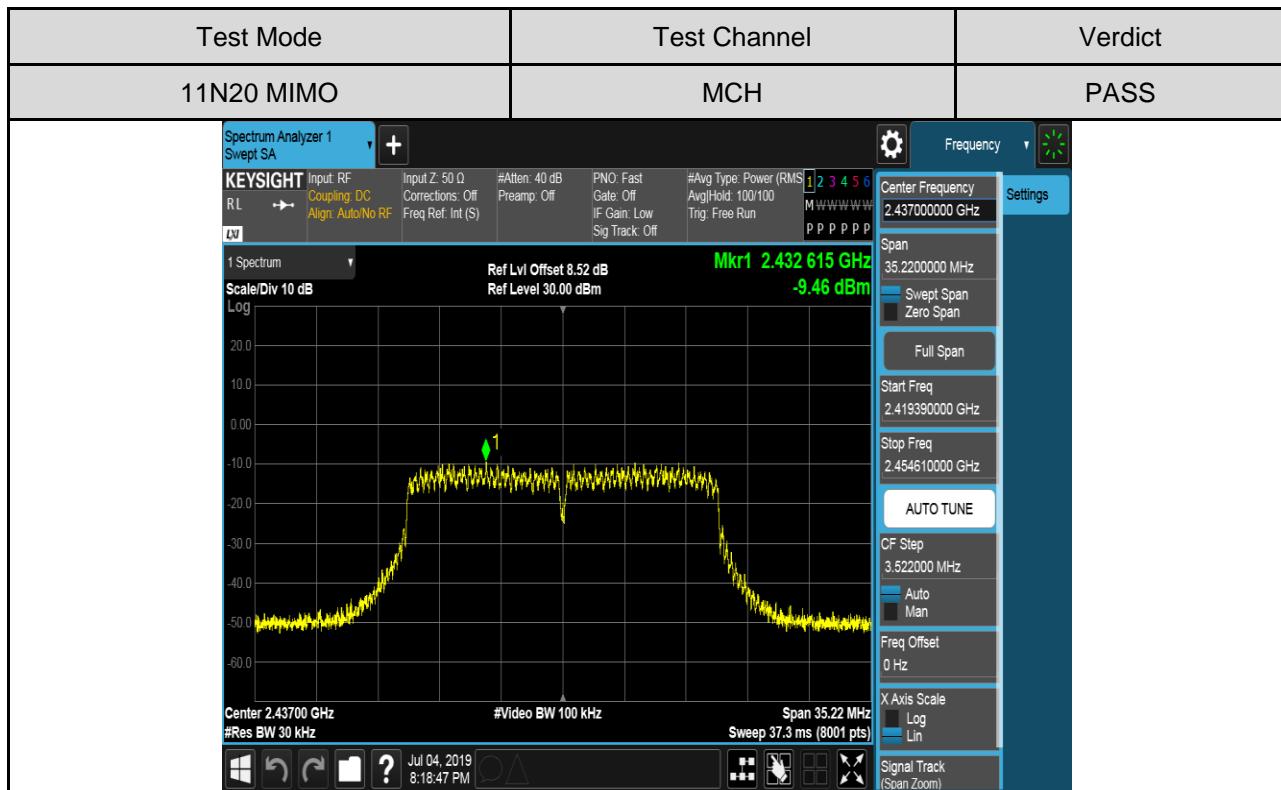
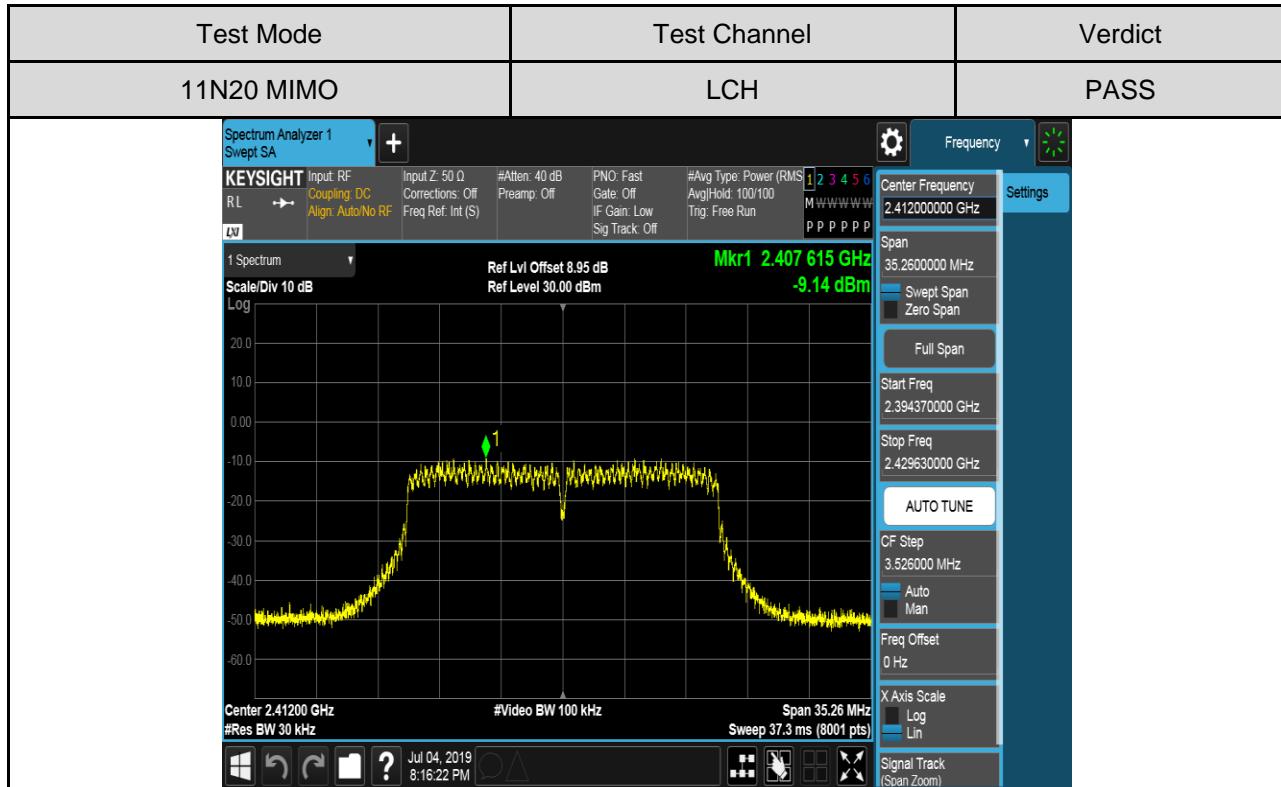
**Test Graphs:**

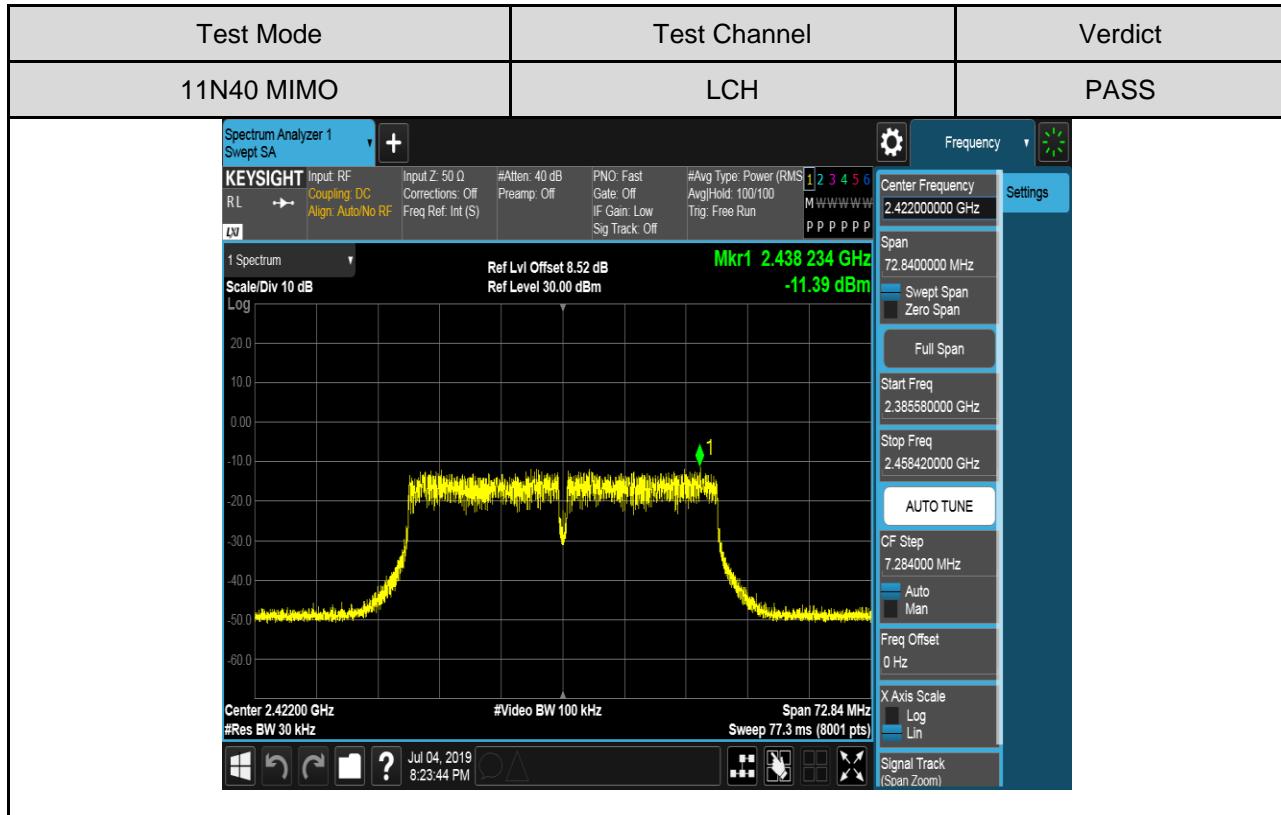
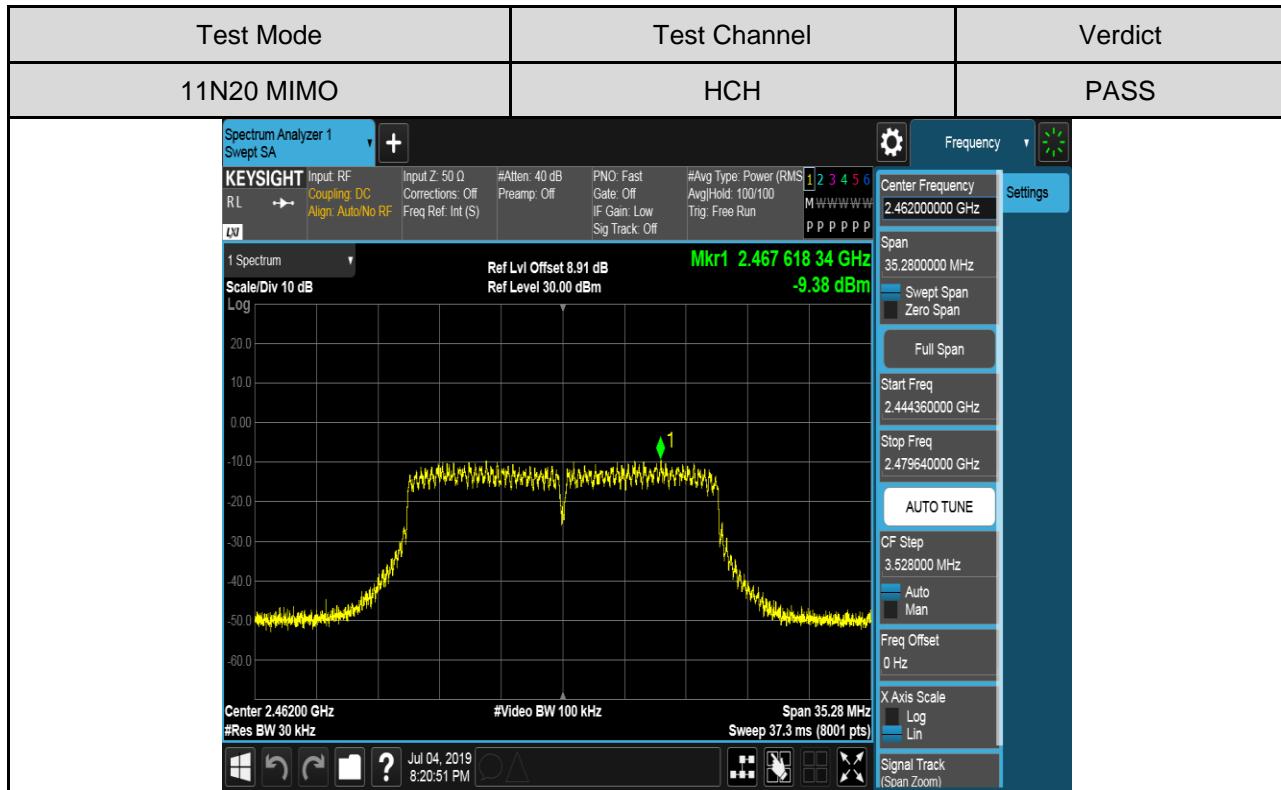
**Antenna1:**

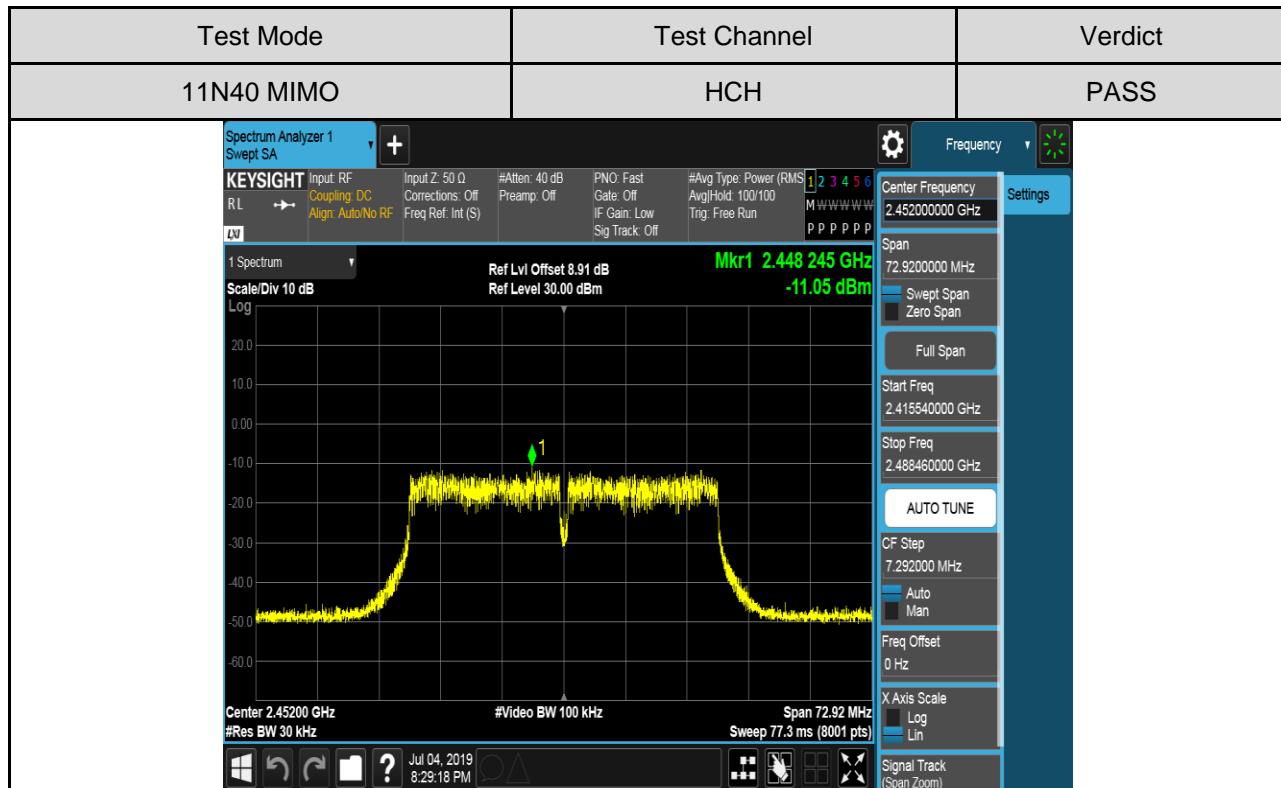
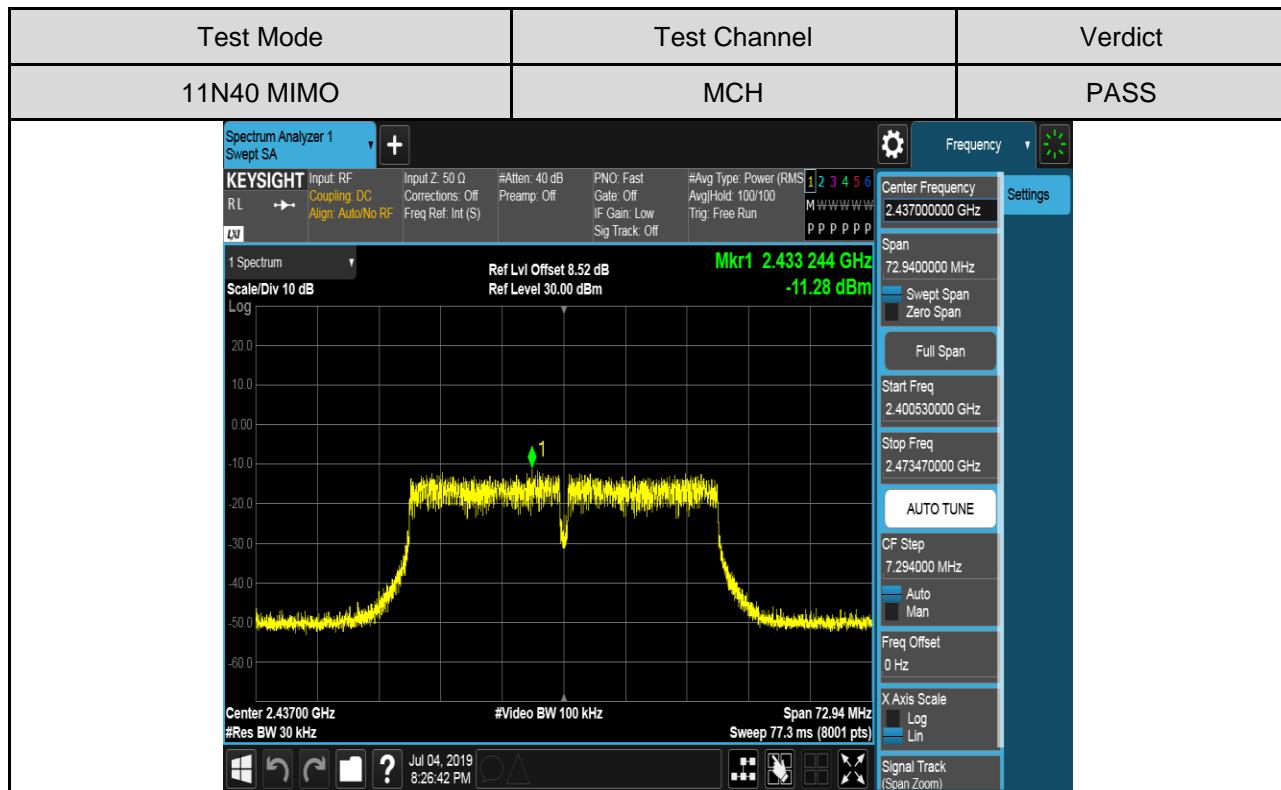












**Antenna2:**

Test Mode	Test Channel	Verdict
11B SISO	LCH	PASS
<p>Spectrum Analyzer 1 Swept SA</p> <p><b>KEYSIGHT</b> Input: RF      Input Z: 50 Ω      #Atten: 40 dB      PNO: Best Wide R.L. → Coupling: DC      Corrections: Off      Preamp: Off      Gate: Off Align: Auto/No RF      Freq Ref. Int (S)      IF Gain: Low      Avg Hold: 100/100 LN</p> <p>1 Spectrum      Ref Lvl Offset 8.95 dB      Mkr1 2.412 694 7 GHz Scale/Div 10 dB      Ref Level 30.00 dBm      -3.24 dBm Log</p> <p>Center 2.412000 GHz      #Video BW 100 kHz      Span 19.10 MHz #Res BW 30 kHz      Sweep 20.3 ms (8001 pts)</p> <p>Jul 04, 2019 8:32:11 PM</p>		

Test Mode	Test Channel	Verdict
11B SISO	MCH	PASS
<p>Spectrum Analyzer 1 Swept SA</p> <p><b>KEYSIGHT</b> Input: RF      Input Z: 50 Ω      #Atten: 40 dB      PNO: Best Wide R.L. → Coupling: DC      Corrections: Off      Preamp: Off      Gate: Off Align: Auto/No RF      Freq Ref. Int (S)      IF Gain: Low      Avg Hold: 100/100 LN</p> <p>1 Spectrum      Ref Lvl Offset 8.52 dB      Mkr1 2.437 697 0 GHz Scale/Div 10 dB      Ref Level 30.00 dBm      -3.24 dBm Log</p> <p>Center 2.437000 GHz      #Video BW 100 kHz      Span 18.22 MHz #Res BW 30 kHz      Sweep 19.7 ms (8001 pts)</p> <p>Jul 04, 2019 8:34:25 PM</p>		

Test Mode	Test Channel	Verdict
11B SISO	HCH	PASS
<div style="display: flex; justify-content: space-between;"> <div style="flex: 1;"> <p>Spectrum Analyzer 1 Swept SA</p> <p><b>KEYSIGHT</b> Input: RF Coupling: DC RL: → Align: Auto/No RF</p> <p>Input Z: 50 Ω Corrections: Off Freq Ref: Int (S)</p> <p>#Atten: 40 dB Preamp: Off Gate: Off</p> <p>PNO: Best Wide IF Gain: Low Trig: Free Run</p> <p>#Avg Type: Power (RMS) Avg Hold: 100/100 Sig Track: Off</p> <p>1 2 3 4 5 6 M W W W W W P P P P P P P</p> </div> <div style="flex: 1;"> <p>Frequency</p> <p>Center Frequency: 2.46200000 GHz</p> <p>Span: 18.226000 MHz</p> <p>Sweep Span: Swept Span Zero Span</p> <p>Full Span</p> <p>Start Freq: 2.452887000 GHz</p> <p>Stop Freq: 2.471113000 GHz</p> <p>AUTO TUNE</p> <p>Cf Step: 1.822600 MHz Auto / Man</p> <p>Freq Offset: 0 Hz</p> <p>X Axis Scale: Log / Lin</p> <p>Signal Track (Span Zoom)</p> </div> </div>		
<p>1 Spectrum</p> <p>Ref Lvl Offset 8.91 dB</p> <p>Ref Level 30.00 dBm</p> <p>Mkr1 2.462 694 9 GHz -2.95 dBm</p> <p>Log</p> <p>20.0</p> <p>10.0</p> <p>0.00</p> <p>-10.0</p> <p>-20.0</p> <p>-30.0</p> <p>-40.0</p> <p>-50.0</p> <p>-60.0</p> <p>Center 2.462000 GHz</p> <p>Video BW 100 kHz</p> <p>Span 18.23 MHz</p> <p>#Res BW 30 kHz</p> <p>Sweep 19.7 ms (8001 pts)</p>		

Test Mode	Test Channel	Verdict
11G SISO	LCH	PASS
<p><b>Spectrum Analyzer 1</b> Swept SA</p> <p><b>KEYSIGHT</b> Input: RF Coupling: DC RL: → Align: Auto/No RF</p> <p>Input Z: 50 Ω Corrections: Off Preamplifier: Off Freq Ref: Int (S)</p> <p>#Attenuation: 40 dB PNO: Fast Gate: Off IF Gain: Low Sig Track: Off</p> <p>#Avg Type: Power (RMS) AvgHold: 100/100 Trig: Free Run</p> <p>Mkr1 2.417619 GHz -8.62 dBm</p> <p>1 Spectrum Ref Lvl Offset 8.95 dB Ref Level 30.00 dBm</p> <p>Scale/Div 10 dB</p> <p>Log</p> <p>20.0 10.0 0.00 -10.0 -20.0 -30.0 -40.0 -50.0</p> <p>Center 2.41200 GHz #Video BW 100 kHz Span 33.08 MHz #Res BW 30 kHz Sweep 35.2 ms (8001 pts)</p> <p>Frequency Center Frequency 2.412000000 GHz Span 33.0800000 MHz Sweep Span Zero Span Full Span Start Freq 2.395460000 GHz Stop Freq 2.428540000 GHz AUTO TUNE CF Step 3.308000 MHz Auto Man Freq Offset 0 Hz X Axis Scale Log Signal Track (Span Zoom)</p>		

Test Mode	Test Channel	Verdict
11G SISO	MCH	PASS

Spectrum Analyzer 1  
Swept SA

**KEYSIGHT** Input: RF  
Coupling: DC  
RL: → Align: Auto/No RF  
Input Z: 50 Ω  
Corrections: Off  
Preamp: Off  
PNO: Fast  
Gate: Off  
IF Gain: Low  
Sig Track: Off  
#Atten: 40 dB  
Freq Ref: Int (S)  
#Avg Type: Power (RMS)  
Avg/Hold: 100/100  
Trig: Free Run  
M: W W W W W  
P: P P P P P

1 Spectrum  
Ref Lvl Offset 8.52 dB  
Scale/Div 10 dB  
Ref Level 30.00 dBm  
Mkr1 2.430 115 GHz  
-8.44 dBm

Log  
20.0  
10.0  
0.00  
-10.0  
-20.0  
-30.0  
-40.0  
-50.0  
-60.0

Center 2.43700 GHz  
#Video BW 100 kHz  
Span 33.08 MHz  
#Res BW 30 kHz  
Swipe 35.2 ms (8001 pts)

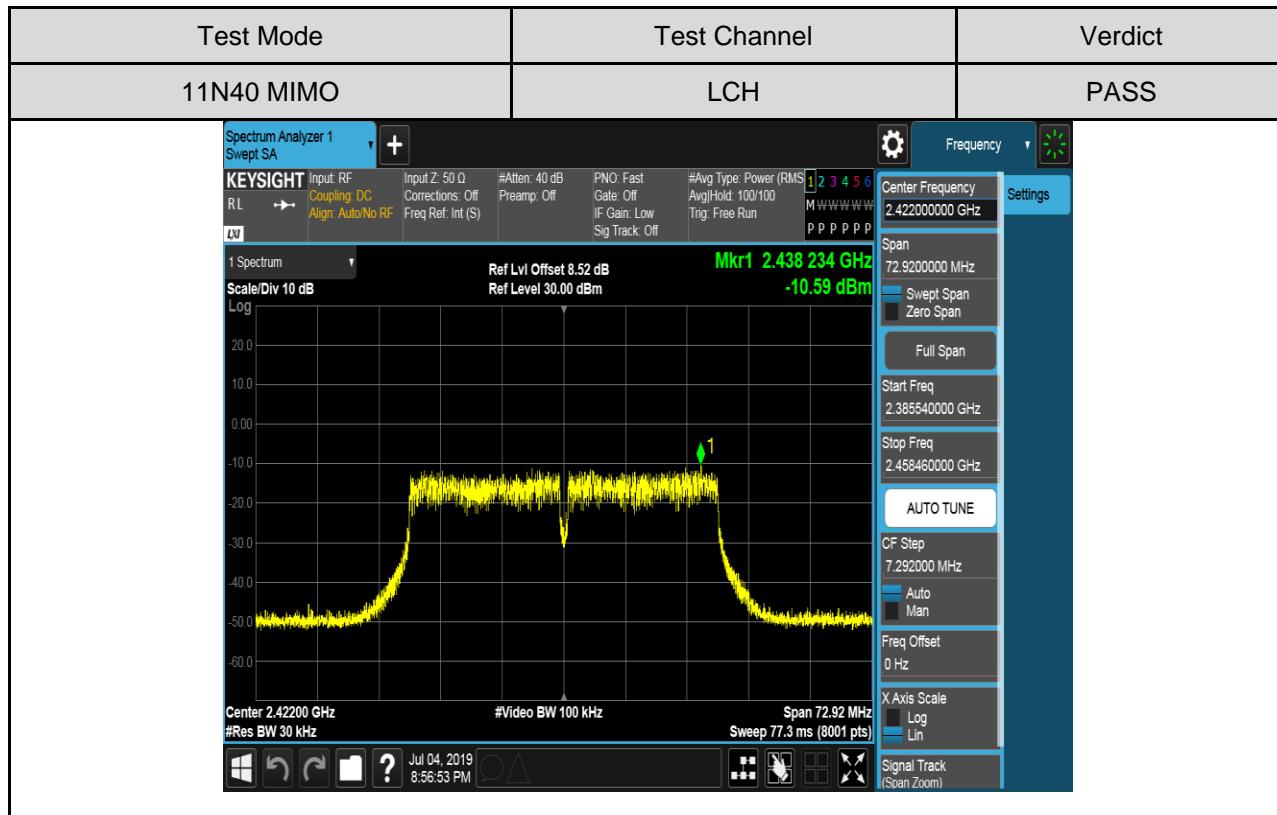
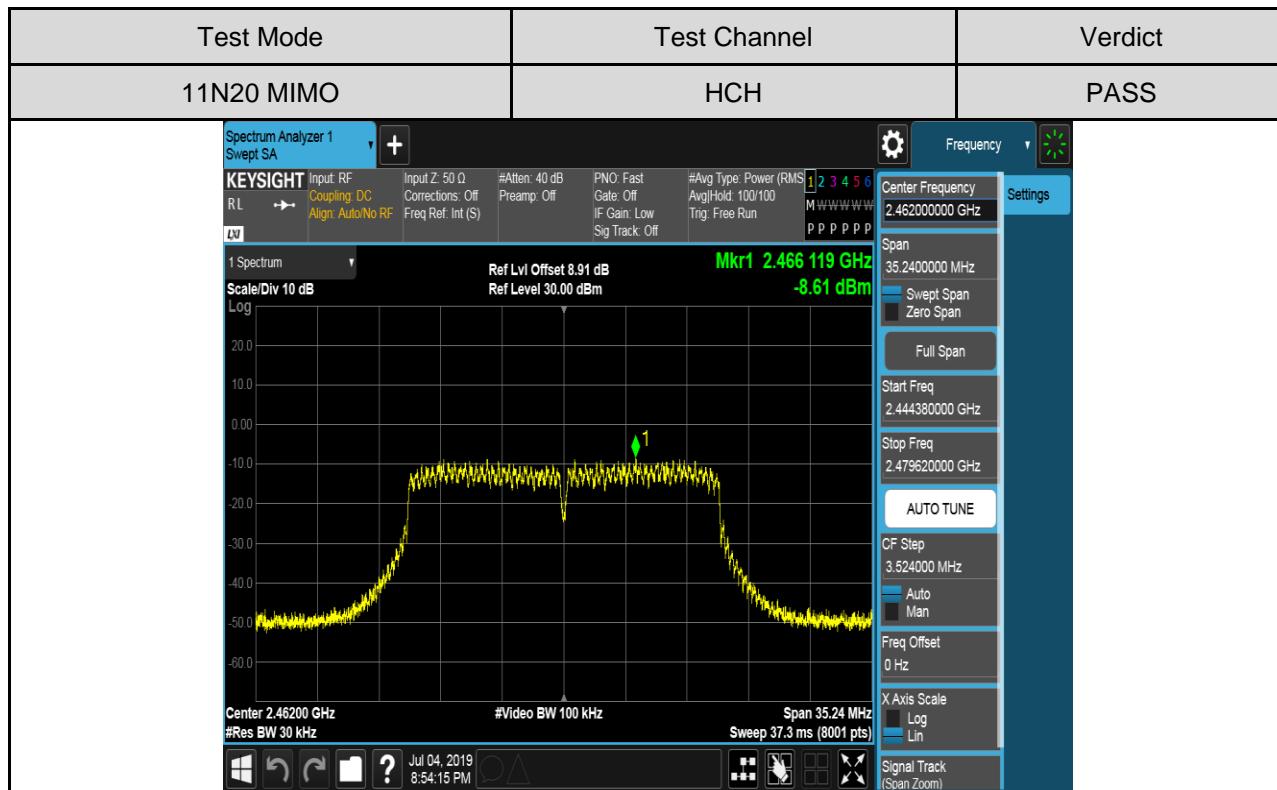
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2.43700000 GHz  
Span  
33.080000 MHz  
Swept Span  
Zero Span  
Full Span  
Start Freq  
2.42046000 GHz  
Stop Freq  
2.45354000 GHz  
AUTO TUNE  
CF Step  
3.308000 MHz  
Auto  
Man  
Freq Offset  
0 Hz  
X Axis Scale  
Log  
Lin  
Signal Track  
(Scan Zoom)

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8:44:09 PM

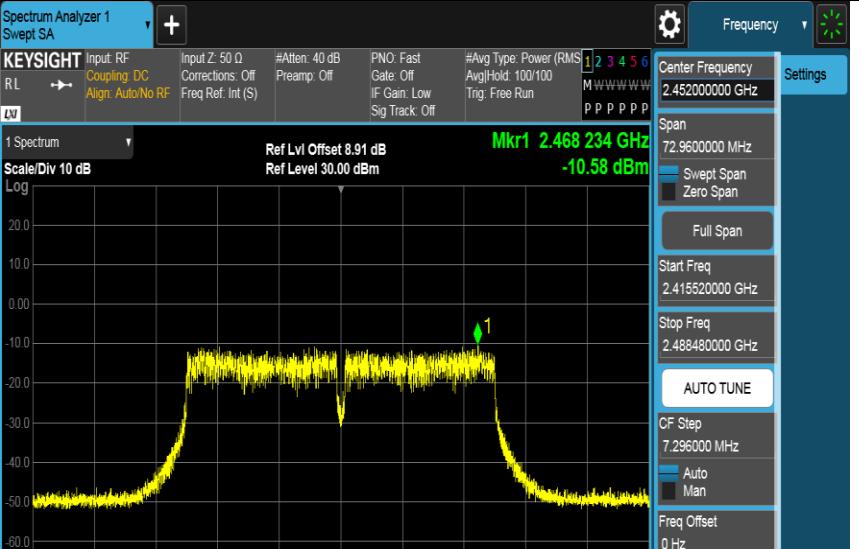
Test Mode	Test Channel	Verdict
11G SISO	HCH	PASS
<p><b>Spectrum Analyzer 1</b> Swept SA</p> <p><b>KEYSIGHT</b> Input: RF Coupling: DC RL: → Align: Auto/No RF</p> <p>Input Z: 50 Ω Corrections: Off Freq Ref: Int (S)</p> <p>#Atten: 40 dB Preamp: Off</p> <p>PNO: Fast Gate: Off IF Gain: Low</p> <p>#Avg Type: Power (RMS) 1 2 3 4 5 6</p> <p>Avg Hold: 100/100 Trig: Free Run</p> <p>M W W W W W P P P P P P</p> <p><b>1 Spectrum</b> Ref Lvl Offset 8.91 dB Ref Level 30.00 dBm</p> <p><b>Mkr1</b> 2.467 619 GHz -8.43 dBm</p> <p>Scale/Div 10 dB Log</p> <p>20.0 10.0 0.00 -10.0 -20.0 -30.0 -40.0 -50.0 -60.0</p> <p>Center 2.46200 GHz #Video BW 100 kHz Span 32.98 MHz</p> <p>#Res BW 30 kHz Sweep 35.2 ms (8001 pts)</p> <p><b>Frequency</b> Center Frequency 2.46200000 GHz Span 32.980000 MHz Swept Span Zero Span</p> <p><b>Settings</b></p> <p><b>Full Span</b> Start Freq 2.445510000 GHz Stop Freq 2.478490000 GHz</p> <p><b>AUTO TUNE</b></p> <p>CF Step 3.298000 MHz Auto Man</p> <p>Freq Offset 0 Hz</p> <p>X Axis Scale Log Lin</p> <p>Signal Track (Span Zoom)</p>		

Test Mode	Test Channel	Verdict
11N20 MIMO	LCH	PASS
 <p>Spectrum Analyzer 1 Swept SA</p> <p><b>KEYSIGHT</b> Input: RF Coupling: DC RL: → Align: Auto/No RF Freq Ref: Int (S)</p> <p>Input Z: 50 Ω Corrections: Off Preamp: Off</p> <p>PNO: Fast Gate: Off IF Gain: Low Sig Track: Off</p> <p>#Atten: 40 dB #Avg Type: Power (RMS) Avg Hold: 100/100 Trig: Free Run</p> <p>1 2 3 4 5 6 M W W W W W P P P P P P</p> <p>1 Spectrum Ref Lvl Offset 8.95 dB Scale/Div 10 dB Ref Level 30.00 dBm</p> <p>Mkr1 2.417 613 93 GHz -8.92 dBm</p> <p>Log</p> <p>20.0 10.0 0.00 -10.0 -20.0 -30.0 -40.0 -50.0 -60.0</p> <p>Center 2.41200 GHz #Video BW 100 kHz Span 35.28 MHz #Res BW 30 kHz Sweep 37.3 ms (8001 pts)</p>	<p>Frequency 2.41200000 GHz</p> <p>Settings</p> <p>Span 35.280000 MHz</p> <ul style="list-style-type: none"> <li>Swept Span</li> <li>Zero Span</li> </ul> <p>Full Span</p> <p>Start Freq 2.39436000 GHz</p> <p>Stop Freq 2.42964000 GHz</p> <p>AUTO TUNE</p> <p>CF Step 3.528000 MHz</p> <ul style="list-style-type: none"> <li>Auto</li> <li>Man</li> </ul> <p>Freq Offset 0 Hz</p> <p>X Axis Scale Log</p> <p>Signal Track (Span Zoom)</p>	

Test Mode	Test Channel	Verdict
11N20 MIMO	MCH	PASS
<p><b>Spectrum Analyzer 1</b> Swept SA</p> <p><b>KEYSIGHT</b> Input RF: Coupling: DC RL: Align: Auto/No RF</p> <p>Input Z: 50 Ω Corrections: Off Preamp: Off</p> <p>PNO: Fast Gate: Off IF Gain: Low Sig Track: Off</p> <p>#Atten: 40 dB #Avg Type: Power (RMS)</p> <p>#Avg Hold: 100/100 Trig: Free Run</p> <p>1 2 3 4 5 6 M W W W W W P P P P P P</p> <p>1 Spectrum Ref Lvl Offset 8.52 dB Ref Level 30.00 dBm</p> <p>Scale/Div 10 dB Log</p> <p>20.00 10.00 0.00 -10.00 -20.00 -30.00 -40.00 -50.00 -60.00</p> <p>Mkr1 2.432 615 GHz -8.80 dBm</p> <p>Center 2.43700 GHz #Video BW 100 kHz Span 35.26 MHz</p> <p>#Res BW 30 kHz Sweep 37.3 ms (8001 pts)</p> <p>Frequency 2.4370000 GHz</p> <p>Span 35.260000 MHz</p> <p>Start Freq 2.41937000 GHz</p> <p>Stop Freq 2.45463000 GHz</p> <p>AUTO TUNE</p> <p>CF Step 3.526000 MHz</p> <p>Auto Man</p> <p>Freq Offset 0 Hz</p> <p>X Axis Scale Log</p> <p>Signal Track (Scan Zoom)</p> <p>Jul 04, 2019 8:50:42 PM</p>		



Test Mode	Test Channel	Verdict
11N40 MIMO	MCH	PASS
<p><b>Spectrum Analyzer 1</b> Swept SA</p> <p><b>KEYSIGHT</b> Input: RF RL → Coupling: DC Align: Auto/No RF</p> <p>Input Z: 50 Ω Corrections: Off Freq Ref. Int (S)</p> <p>#Atten: 40 dB Preamp: Off</p> <p>PNO: Fast Gate: Off IF Gain: Low Sig Track: Off</p> <p>#Avg Type: Power (RMS) 1 2 3 4 5 6 Avg Hold: 100/100 Trig: Free Run</p> <p>M W W W W W P P P P P P</p> <p>1 Spectrum</p> <p>Ref Lvl Offset 8.52 dB</p> <p>Ref Level 30.00 dBm</p> <p>Mkr1 2.453 238 GHz -11.18 dBm</p> <p>Scale/Div 10 dB</p> <p>Log</p> <p>20.0 10.0 0.00 -10.0 -20.0 -30.0 -40.0 -50.0 -60.0</p> <p>Center 2.43700 GHz</p> <p>Video BW 100 kHz</p> <p>Span 72.90 MHz</p> <p>#Res BW 30 kHz</p> <p>Sweep 77.3 ms (8001 pts)</p> <p>Frequency 2.43700000 GHz</p> <p>Span 72.900000 MHz</p> <p>Start Freq 2.40055000 GHz</p> <p>Stop Freq 2.47345000 GHz</p> <p>AUTO TUNE</p> <p>CF Step 7.290000 MHz</p> <p>Auto Man</p> <p>Freq Offset 0 Hz</p> <p>X Axis Scale Log Lin</p> <p>Signal Track (Span Zoom)</p>		

Test Mode	Test Channel	Verdict
11N40 MIMO	HCH	PASS
 <p>The screenshot shows the Keysight Spectrum Analyzer interface. The top menu bar includes 'File', 'Edit', 'View', 'Measure', 'Analyze', 'Calibration', 'Marker', 'Math', 'Script', 'Help', and 'About'. The left sidebar has sections for 'Spectrum Analyzer 1' (Swept SA), 'KEYSIGHT' (Input RF, Coupling, RL, Align, Auto/No RF), 'PNO' (Fast, Off, Off, Off, Off, Off), '#Avg Type: Power (RMS)', 'Center Frequency' (2.45200000 GHz), 'Span' (72.960000 MHz), 'Scale/Div 10 dB', 'Log', 'Ref Lvl Offset 8.91 dB', 'Ref Level 30.00 dBm', 'Mkr1 2.468 234 GHz -10.58 dBm', 'Full Span', 'Start Freq' (2.41552000 GHz), 'Stop Freq' (2.48848000 GHz), 'AUTO TUNE', 'CF Step' (7.296000 MHz), 'Auto / Man', 'Freq Offset' (0 Hz), 'X Axis Scale' (Log), and 'Signal Track (Span Zoom)'. The main plot area shows a yellow spectrum with a sharp peak at 2.468 GHz. The x-axis is labeled 'Center 2.452000 GHz', 'Video BW 100 kHz', and 'Sweep 77.3 ms (8001 pts)'. The y-axis ranges from -60 to 20 dB.</p>		

## 7.5. CONDUCTED BANDEDGE AND SPURIOUS EMISSIONS

### LIMITS

FCC Part15 (15.247) , Subpart C		
Section	Test Item	Limit
FCC §15.247 (d)	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

### TEST PROCEDURE

Refer to FCC KDB 558074, connect the UUT to the spectrum analyser and use the following

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

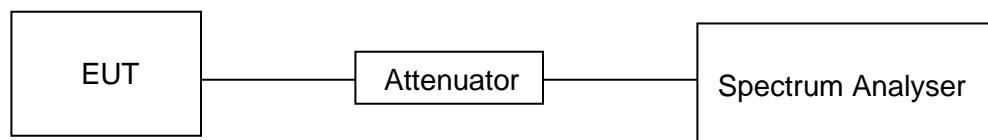
settings:

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	$\geq 3 \times$ RBW
measurement points	$\geq$ span/RBW
Trace	Max hold
Sweep time	Auto couple.

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

### TEST SETUP





**TEST ENVIRONMENT**

Temperature	22°C	Relative Humidity	56%
Atmosphere Pressure	101kPa	Test Voltage	AC 120V

**Part I :Conducted Bandedge****RESULTS TABLE**

Test Mode	Test Antenna	Test Channel	Carrier Power[dBm]	Max. Spurious Level [dBm]	Limit [dBm]	Verdict
11B	Antenna 1	2412	1.610	-40.995	-18.39	PASS
		2462	1.333	-41.094	-18.67	PASS
	Antenna 2	2412	1.831	-41.119	-18.17	PASS
		2462	2.158	-40.576	-17.84	PASS
11G	Antenna 1	2412	-6.311	-40.992	-26.31	PASS
		2462	-6.425	-40.967	-26.43	PASS
	Antenna 2	2412	-5.874	-41.076	-25.87	PASS
		2462	-5.272	-40.455	-25.27	PASS
11N20MIMO	Antenna 1	2412	-6.182	-40.977	-26.18	PASS
		2462	-6.360	-41.170	-26.36	PASS
	Antenna 2	2412	-5.975	-41.752	-25.98	PASS
		2462	-5.379	-41.184	-25.38	PASS
11N40MIMO	Antenna 1	2422	-8.149	-40.881	-28.15	PASS
		2452	-8.110	-40.763	-28.11	PASS
	Antenna 2	2422	-7.396	-41.443	-27.4	PASS
		2452	-6.874	-40.471	-26.87	PASS

Remark: Through pre-testing all the test modes of 11N 20 and 11N40, including SISO and MIMO, but only the data if worse case is included in this test report.