RF TEST REPORT for Intentional Radiator

No. 160602638SHA-001

Applicant	:	Hansong(Nanjing) Technology Ltd 8th Kangping Road, Jiangning Economy&Technology Development Zone, Nanjing, 211106, China
Manufacturer	:	Hansong(Nanjing) Technology Ltd 8th Kangping Road, Jiangning Economy&Technology Development Zone, Nanjing, 211106, China
Product Name	:	Play-Fi Wireless Module
Type/Model	:	Caprica 2L

SUMMARY

The equipment complies with the requirements according to the following standard(s):

47CFR Part 15 (2016): Radio Frequency Devices

ANSI C63.10 (2013): American National Standard for Testing Unlicensed Wireless Devices

RSS-247 Issue 1 (May 2015): Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices

RSS-Gen Issue 4 (November 2014): General Requirements for Compliance of Radio Apparatus

Date of issue: August 9, 2016

Prepared by:

Wade Zhang (*Project Engineer*)

Reviewed by:

Daniel Zhao (*Reviewer*)

Description of Test Facility

Name:	Intertek Testing Services Limited Shanghai
Address:	Building No.86, 1198 Qinzhou Road(North), Shanghai 200233, P.R. China
FCC Registration Number:	236597
IC Assigned Code:	2042B-1
Name of contact:	Jonny Jing
Tel:	+86 21 61278271
Fax:	+86 21 54262353

Content

1. Test Summary

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Test Items	FCC Reference	IC REFERANCE	Result
Minimum 6dB Bandwidth	15.247(a)(2)	RSS-247 Issue 1 Annex 5.2	Pass
Output power	15.247(b)	RSS-247 Issue 1 Annex 5.4	Pass
Power spectrum density	15.247(e)	RSS-247 Issue 1 Annex 5.2	Pass
Emissions in non-restricted frequency bands	15.247(d)	RSS-247 Issue 1 Annex 5.5	Pass
Emissions in restricted frequency bands	15.247(d) & 15.205 & 15.209	RSS-Gen Issue 4 Clause 8.9	Pass
Power line conducted emission	15.207	RSS-Gen Issue 4 Clause 8.8	NA

Note: NA =Not Applicable

2. General Information

2.1 Applicant Information

Applicant	:	Hansong(Nanjing) Technology Ltd 8th Kangping Road, Jiangning Economy&Technology Development Zone, Nanjing, 211106, China
Name of contact	:	Anya Sun
Tel	:	0086-025-66604242
Fax	:	0086-025-66612098
Manufacturer	:	Hansong(Nanjing) Technology Ltd 8th Kangping Road, Jiangning Economy&Technology Development Zone, Nanjing, 211106, China

2.2 Identification of the EUT

Equipment	:	Play-Fi Wireless Module
Type/model	:	Caprica 2L
FCC ID	:	XCO-PLAYFI0754
IC	:	7756A-PLAYFI0754

2.3 Technical specification

Operation Frequency Band	:	2412~2462 MHz
Type of Modulation	:	CCK,BPSK,QPSK,DSSS,OFDM OFDM(BPSK,QPSK,16QAM,64QAM)
EUT Modes of Modulation	:	802.11b/g; 802.11n HT20,HT40;
Channel Number	:	11Channel for 2412MHz~2462MHz for 11b,11g,11n(H20); 7 Channel for 2422MHz~2452MHz for 11n HT40;
Description of EUT	:	The EUT is a WIFI module, it support 2.4G band and 5G Bands. And there have only one model. We tested it and listed the 2.4G band results in this report.
Port identification	:	/
Rating	:	100-240V ~ 50/60Hz
Declared Temperature range	:	0°C ~ 50°C
Category of EUT	:	Class B
EUT type	:	☒ Table top☐ Floor standing
Sample received date	:	July 21, 2016
Sample Identification No	:	*0160721-19-001*
Date of test	:	July 21, 2016 ~ August 20, 2016

Antenna List:

No.	Model	Type	Band(s)	Max Peak Gain(dBi)
1	RC12WFI0237A1	FPCB	2.4GHz - 2.5GHz	4.2
			5GHz - 5.875 GHz	4.5
2	RC1WFI0779A	FPCB	2.4GHz - 2.5GHz	3.0
			5GHz - 5.875 GHz	2.7
3	RC1WFI0886A	Dipole	2.4GHz - 2.5GHz	1.1
			5GHz - 5.875 GHz	2.9

NOTE:
1: This device does not support CDD transmissions for 802.11a/b/g mode.

2: For CDD transmissions, If all antennas have the same gain, G_{ANT}, Directional gain = G_{ANT} + Array Gain, where Array Gain is as follows.

- For power spectral density (PSD) measurements on all devices,
  Array Gain = 10 log(N_{ANT}/N_{SS}) dB.

- For power measurements on IEEE 802.11 devices,
  Array Gain = 0 dB (i.e., no array gain) for $N_{ANT} \leq 4$;
  Array Gain = 0 dB (i.e., no array gain) for channel widths ≥ 40 MHz for any N_{ANT};
  Array Gain = 5 log(N_{ANT}/N_{SS}) dB or 3 dB, whichever is less, for 20-MHz channel widths with $N_{ANT} \geq 5$.

3. Test Specification

3.1 Instrument list

Selected	Equipment	Type	Manu.	Internal no.	Cal. Date	Due date
☒	PXA Analyzer	N9030A	Agilent	EC5338	2016/3/4	2017/3/3
☒	Vector SG	N5182B	Agilent	EC5175	2016/3/4	2017/3/3
☒	Power sensor	U2021XA	Agilent	EC5338-1	2016/3/4	2017/3/3
☒	MXG Analog SG	N5181A	Agilent	EC5338-2	2016/3/4	2017/3/3
☒	Power meter	N1911A/N1921A	Agilent	EC4318	2016/4/10	2017/4/9
☒	EMI Receiver	ESCS 30	R&S	EC 2107	2015/10/20	2016/10/19
☒	A.M.N.	ESH2-Z5	R&S	EC 3119	2015/12/16	2017/12/15
☒	I.S.N.	FCC-TLISN-T8-02	FCC	EC3756	2016/2/16	2017/2/15
☒	EMI chamber	3m	Albatross	EC 3048	2016/5/5	2017/5/4
☒	Test Receiver	ESIB 26	R&S	EC 3045	2015/10/20	2016/10/19
☒	Test Receiver	ESCI 7	R&S	EC4501	2016/2/24	2017/2/23
☒	Bilog Antenna	CBL 6112D	TESEQ	EC 4206	2016/5/30	2017/5/29
☒	Horn antenna	HF 906	R&S	EC 3049	2015/9/12	2016/9/11
☒	Horn antenna	HAP18-26W	TOYO	EC 4792-3	2014/6/12	2017/6/11
☒	Pre-amplifier	Pre-amp 18	R&S	EC 5262	2016/5/24	2017/5/23
☒	Pre-amplifier	Tpa0118-40	R&S	EC 4792-2	2016/4/11	2017/4/10
☒	Shielded room	-	Zhongyu	EC 2838	2016/1/9	2017/1/8

3.2 Test Standard

47CFR Part 15 (2016): Radio Frequency Devices

ANSI C63.10 (2013): American National Standard for Testing Unlicensed Wireless Devices

RSS-247 Issue 1 (May 2015): Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices

RSS-Gen Issue 4 (November 2014): General Requirements for Compliance of Radio Apparatus

3.3 Mode of operation during the test / Test peripherals used

Operation Frequency each of channel For 802.11b/g/n(HT20/HT40)							
Channel	Frequency	Channel	Frequency	Channel	Frequency	Channel	Frequency
1	2412MHz	4	2427MHz	7	2442MHz	10	2457MHz
2	2417MHz	5	2432MHz	8	2447MHz	11	2462MHz
3	2422MHz	6	2437MHz	9	2452MHz	/	

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

Modulation	Lowest(MHz)	Middle(MHz)	Highest(MHz)
802.11b	2412	2437	2462
802.11g	2412	2437	2462
802.11n(HT20)	2412	2437	2462
802.11n(HT40)	2422	2437	2452

While testing transmitting mode of EUT, the internal modulation and continuously transmission was applied.

The test setting software and command is offered by the manufactory.

We have verified the construction and function in typical operation. All the test modes were carried out with the EUT in transmitting operation, the pre-scan for all data rates in each modulation and bands was tested, and the worst case was found and used in all test cases.

After this pre-scan, we choose the following table of the data rata as the final test mode.

Modulation	Data rate
802.11b	1Mbps
802.11g	6Mbps
802.11n HT20	MCS0
802.11n HT40	MCS0
Duty cycle setting during the transmission is 100% with maximum power setting for all modulations.	

Test Mode description:

Radiated test construction:
Mode 1: EUT with antenna 1;
Mode 2: EUT with antenna 2;
Mode 3: EUT with antenna 3;

Conducted test construction:
Mode 4: EUT RF port connected to SPA directly;

Test peripherals used:

Item No	Description	Band and Model	S/No
1	Laptop computer	HP ProBook 6470b	NA
2	RS-232 cable	1.8m Unshieling	NA
3	RF Engineering Board	Hansong	NA
4	Power Supply Adaptor	DYS650-180280W-K	NA
Note: The accessories are used for configuration only and not used during test.			

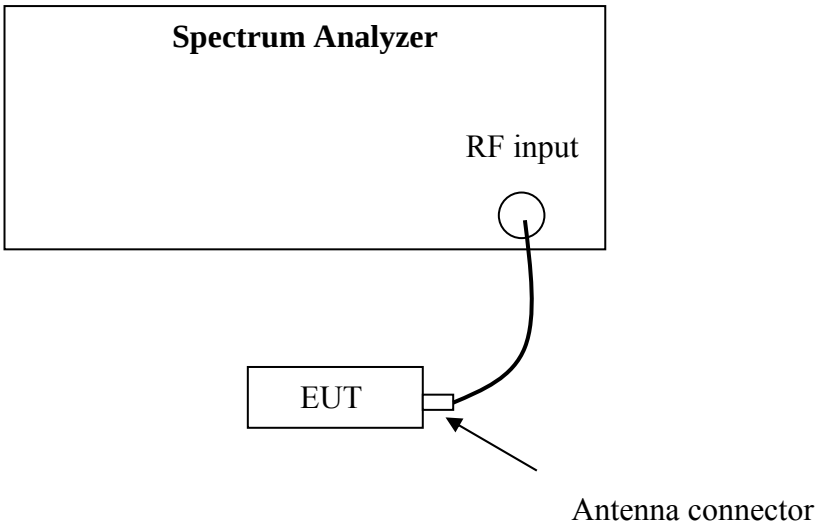
4. Minimum 6dB Bandwidth

Test result: PASS

4.1 Limit

For systems using digital modulation techniques that may operate in the 902 - 928 MHz, 2400 - 2483.5 MHz and 5725 - 5850 MHz bands, the minimum 6 dB bandwidth shall be at least 500 kHz.

4.2 Test Configuration



4.3 Test Procedure and test setup

The minimum 6dB bandwidth per FCC §15.247(a)(2) is measured using the Spectrum Analyzer according to DTS test procedure of "KDB558074 D01 DTS Meas Guidance v03r02" for compliance to FCC 47CFR 15.247 requirements(clause 8.2).

a) Set RBW = 100 kHz.
b) Set the video bandwidth (VBW) ≥ 3RBW.
c) Detector = Peak.
d) Trace mode = max hold.
e) Sweep = auto couple.
f) Allow the trace to stabilize.
g) 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.

4.4 Test Protocol

Temperature: 22°C
Relative Humidity: 53%

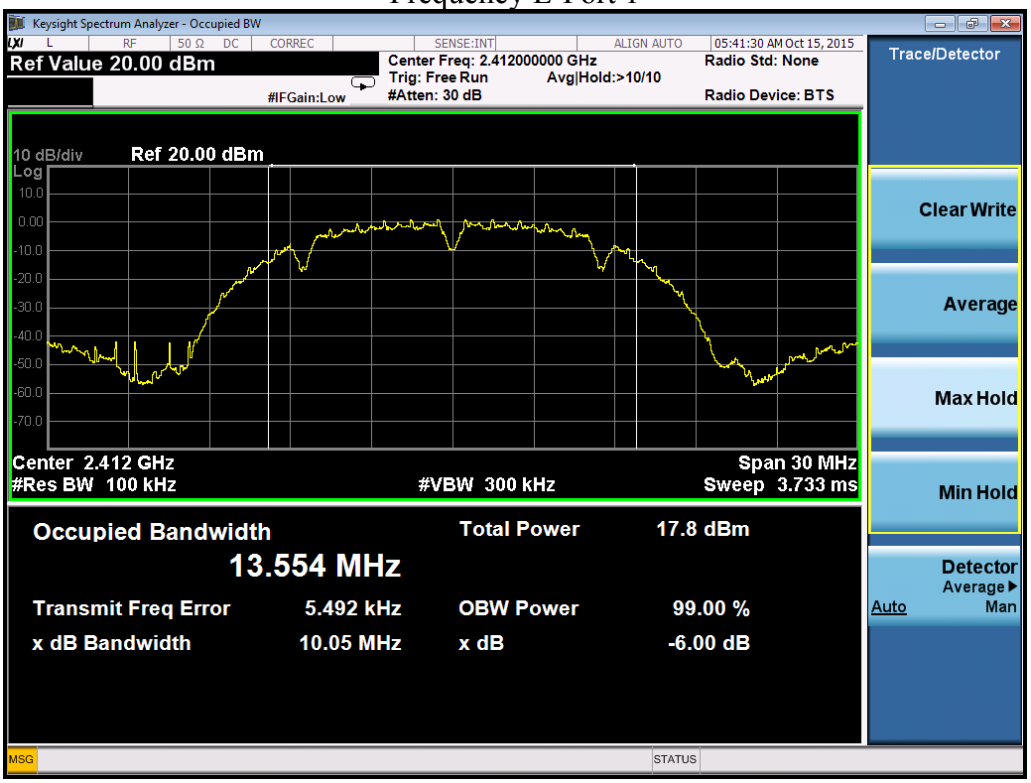
Mode	CH	6dB Emission Bandwidth (MHz)		Limit (MHz)
		Port 1	Port 2	
802.11b	L	10.05	10.05	⩾0.5
	M	10.05	10.05	
	H	10.05	10.05	
802.11g	L	16.55	16.56	
	M	16.53	16.56	
	H	16.38	16.54	
802.11n(HT20)	L	17.81	17.80	
	M	17.80	17.79	
	H	17.60	17.79	
802.11n(HT40)	L	36.42	36.52	
	M	36.40	36.45	
	H	36.50	36.41	

Mode	CH	99% Occupy Bandwidth (MHz)		Limit (MHz)
		Port 1	Port 2	
802.11b	L	13.554	13.545	NA
	M	13.550	13.556	
	H	13.547	13.563	
802.11g	L	16.434	16.430	
	M	16.437	16.439	
	H	16.436	16.437	
802.11n(HT20)	L	17.668	17.669	
	M	17.667	17.668	
	H	17.668	17.670	
802.11n(HT40)	L	36.217	36.222	
	M	36.221	36.221	
	H	36.222	36.217	

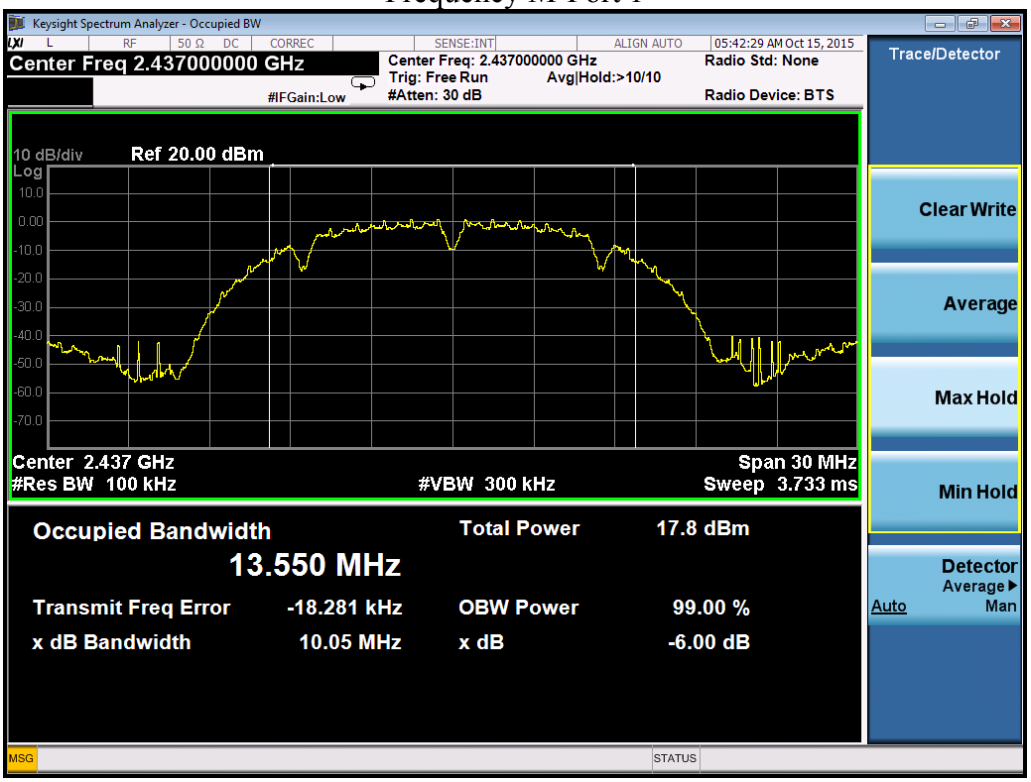
Test plot as follows:

802.11b

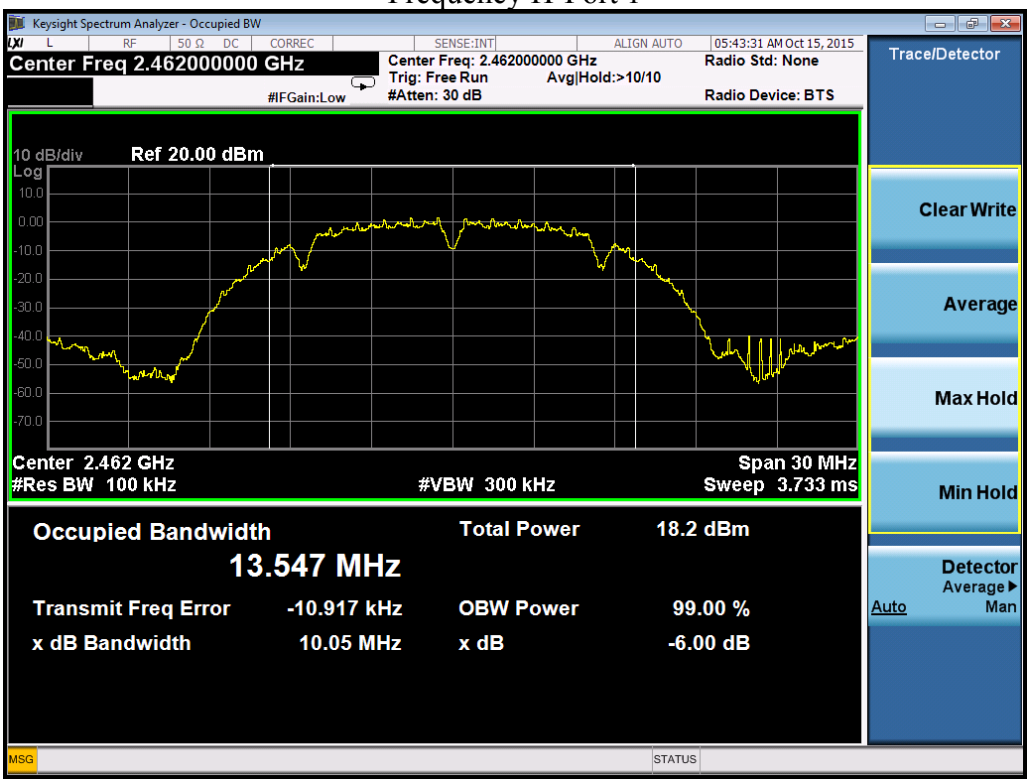
Frequency L-Port 1



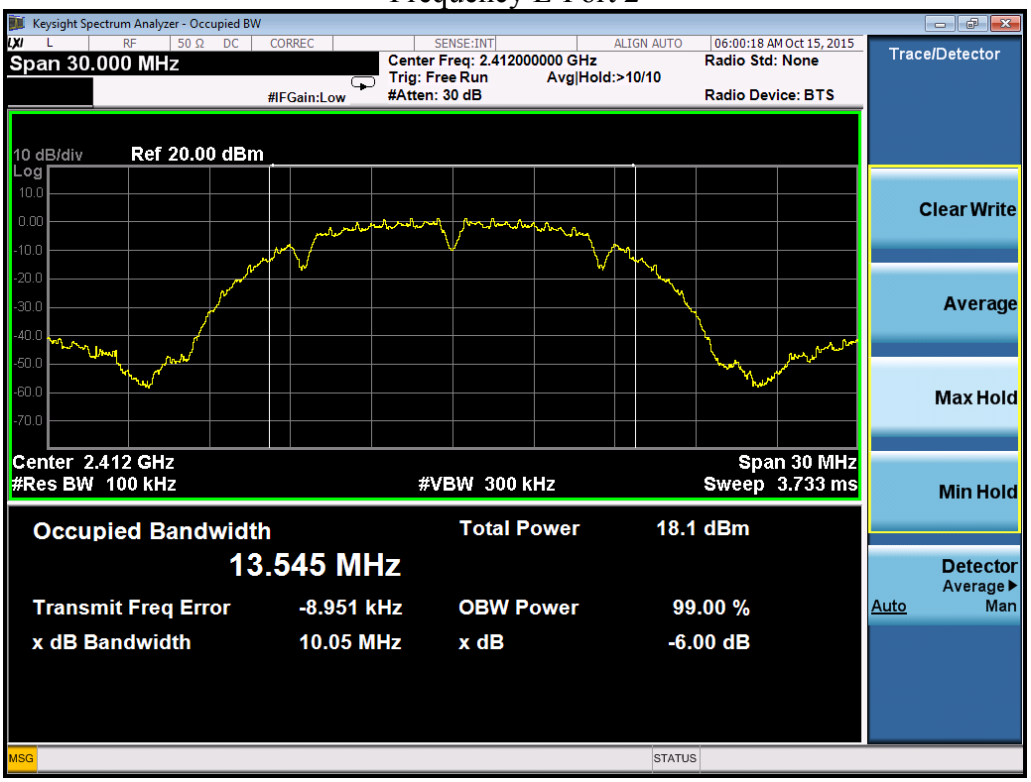
Frequency M-Port 1



Frequency H-Port 1



Frequency L-Port 2



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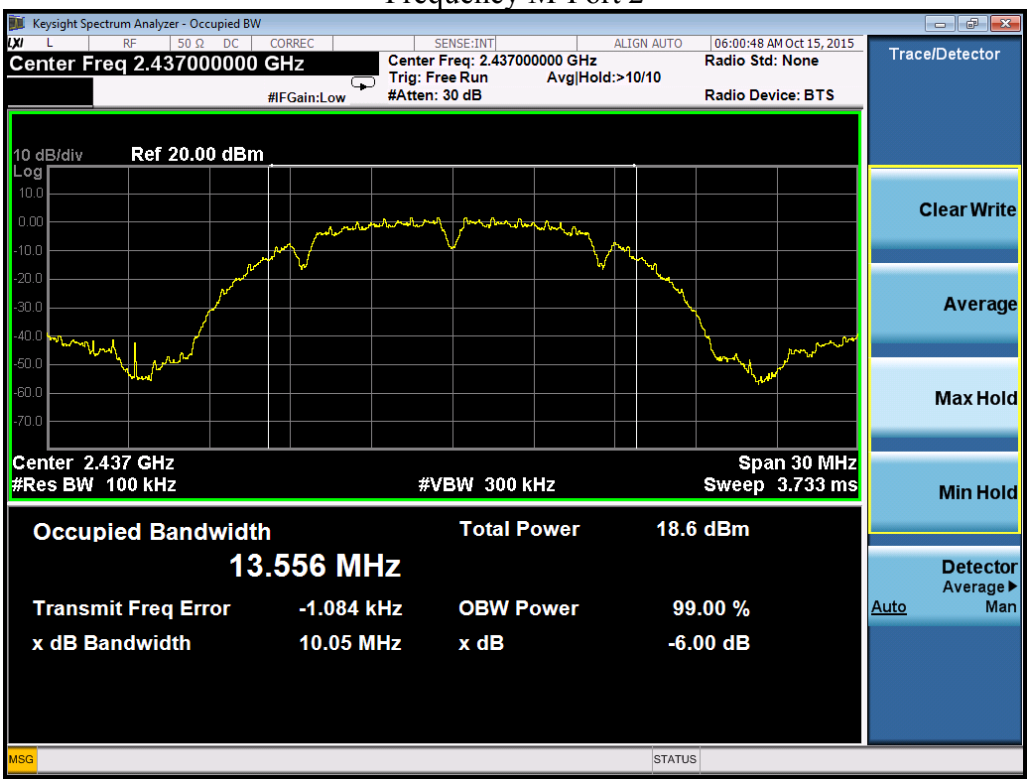
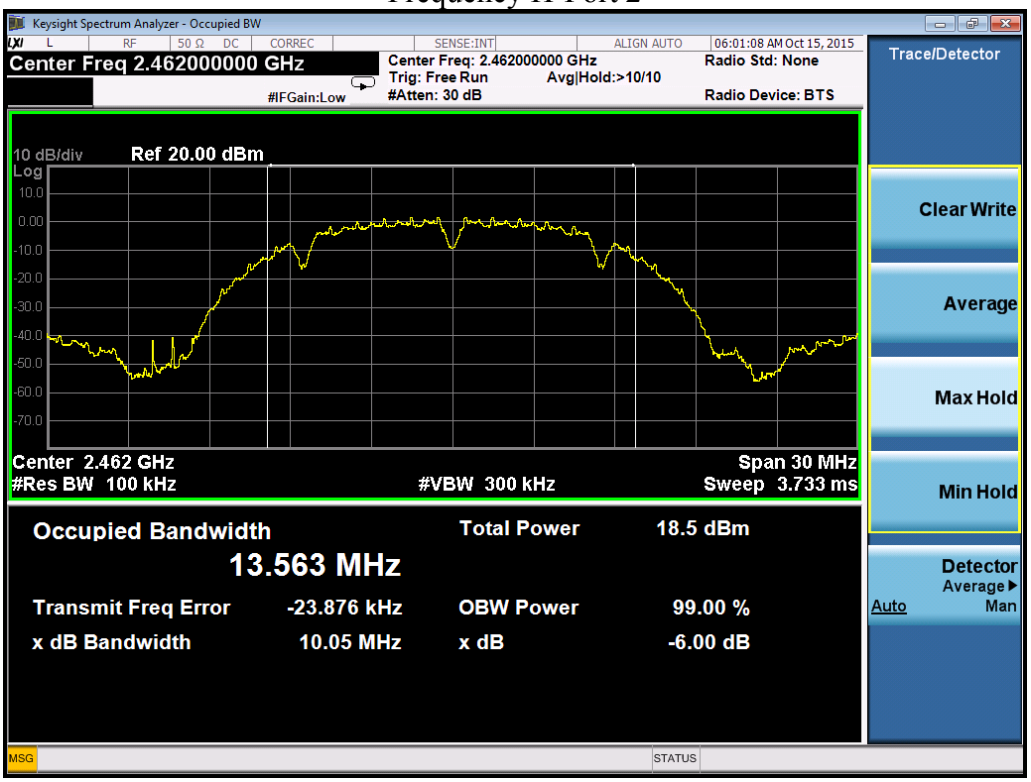
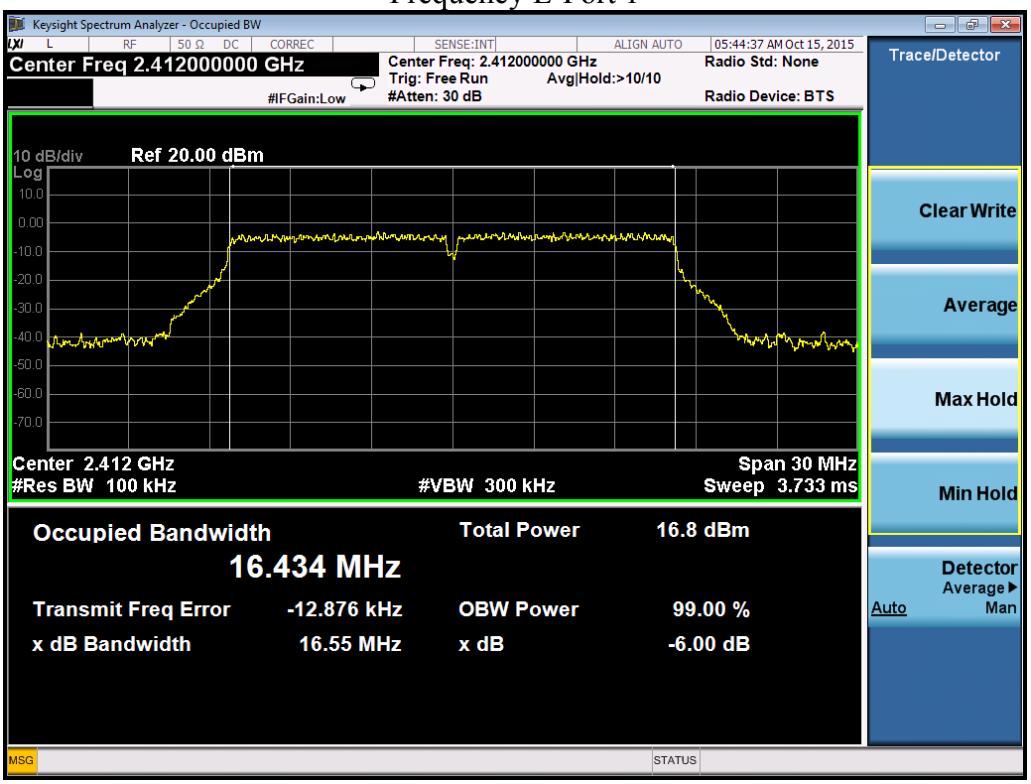


Frequency H-Port 2

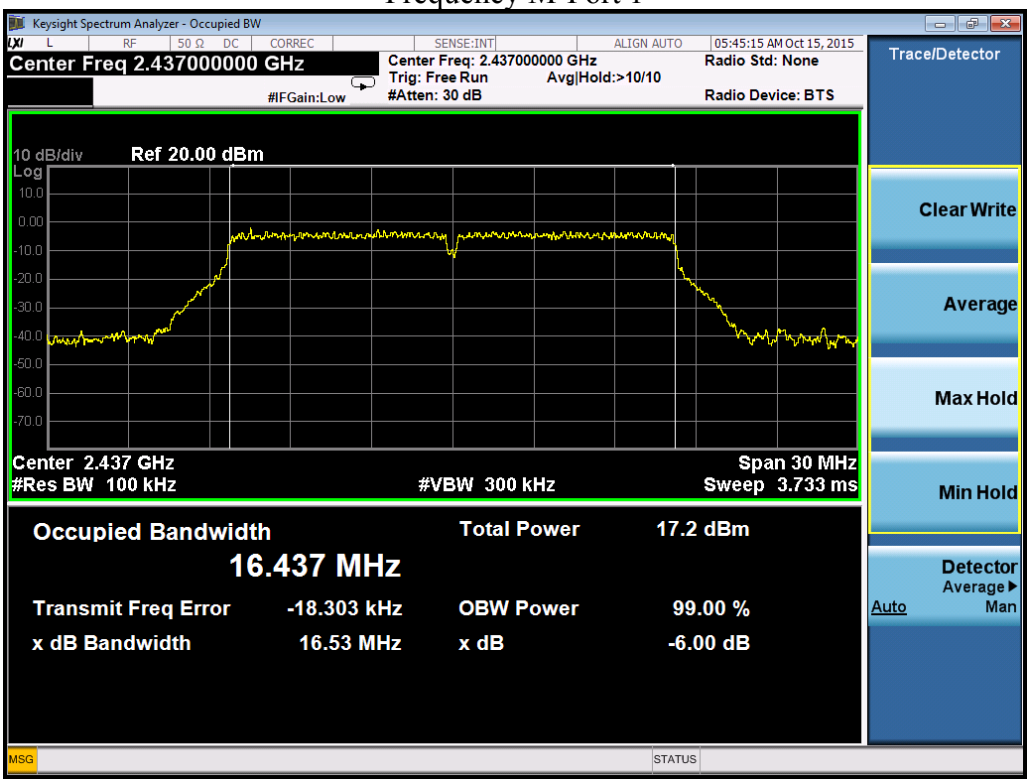


802.11g

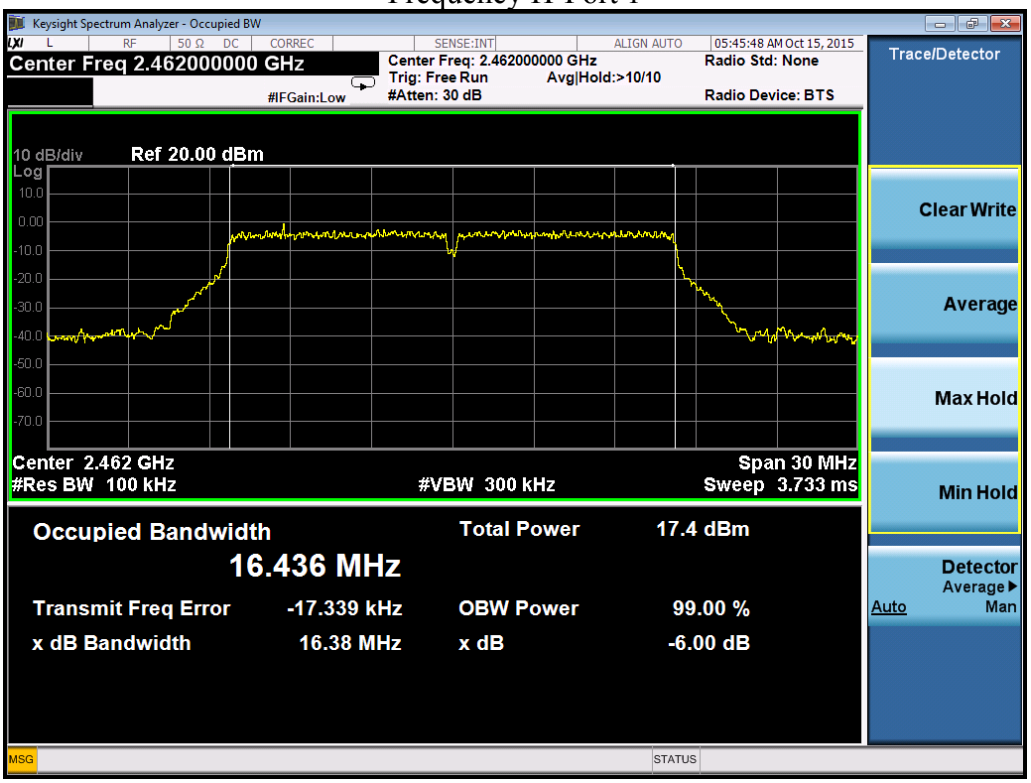
Frequency L-Port 1



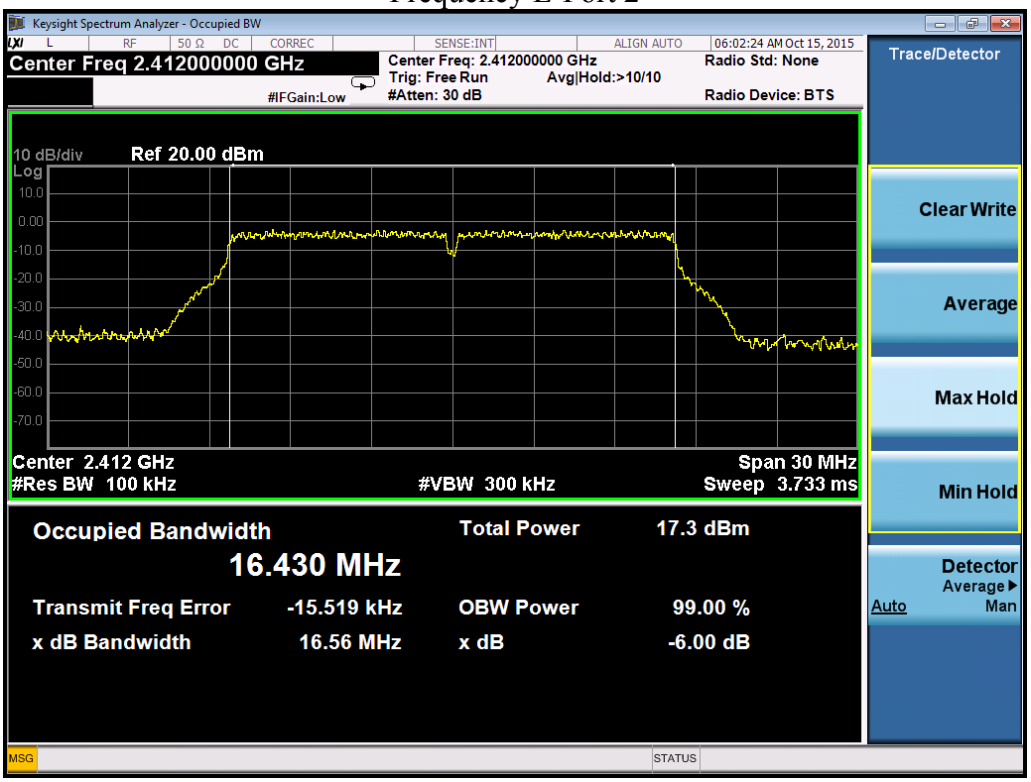
Frequency M-Port 1



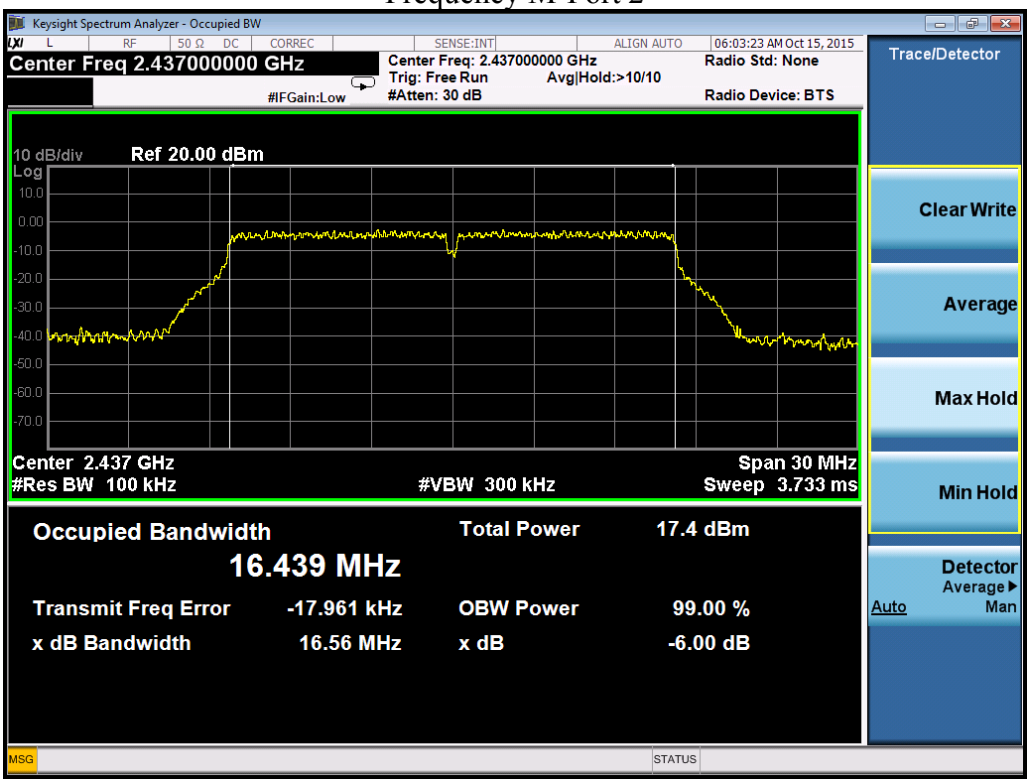
Frequency H-Port 1



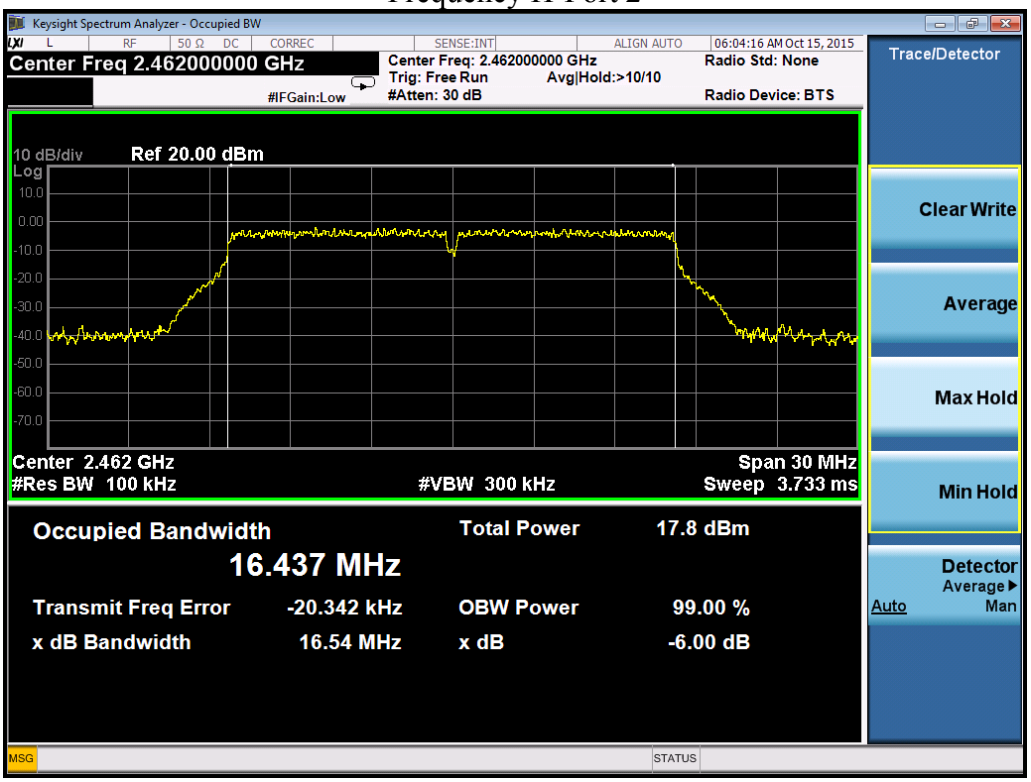
Frequency L-Port 2



Frequency M-Port 2

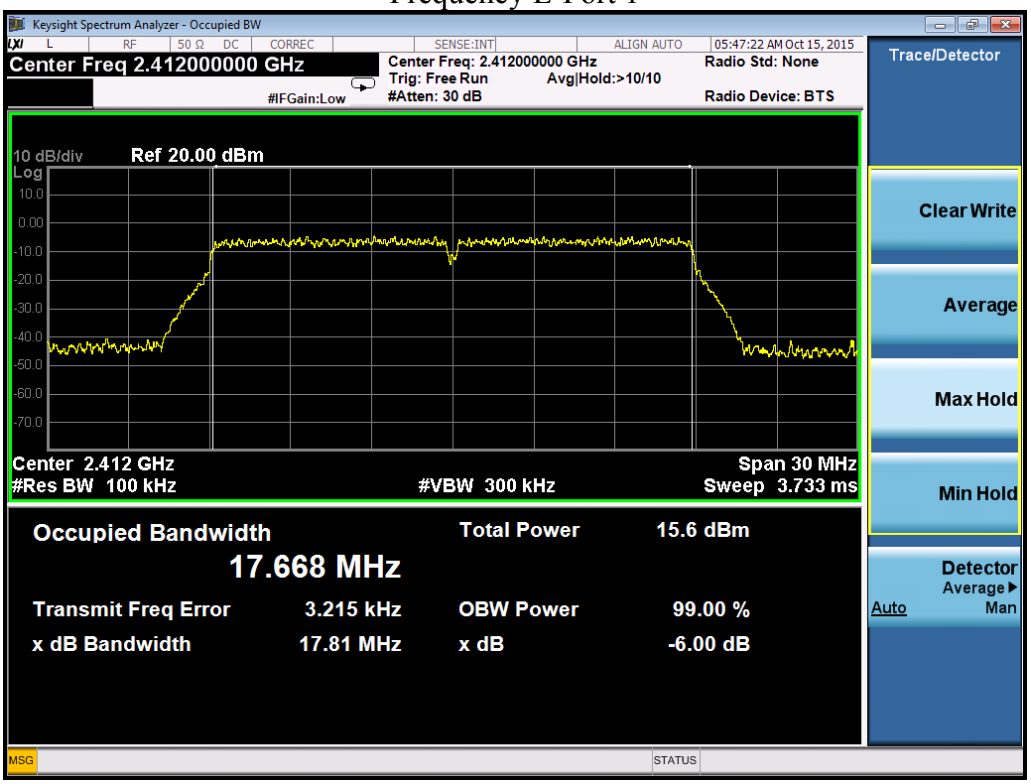


Frequency H-Port 2

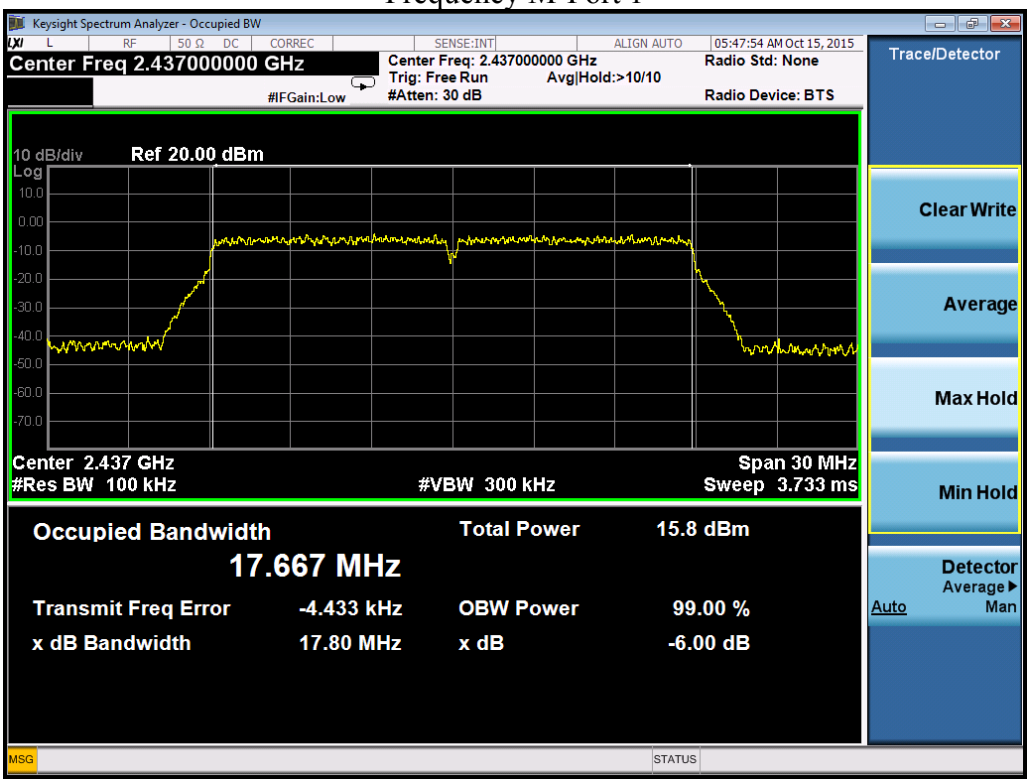


802.11n (HT20)

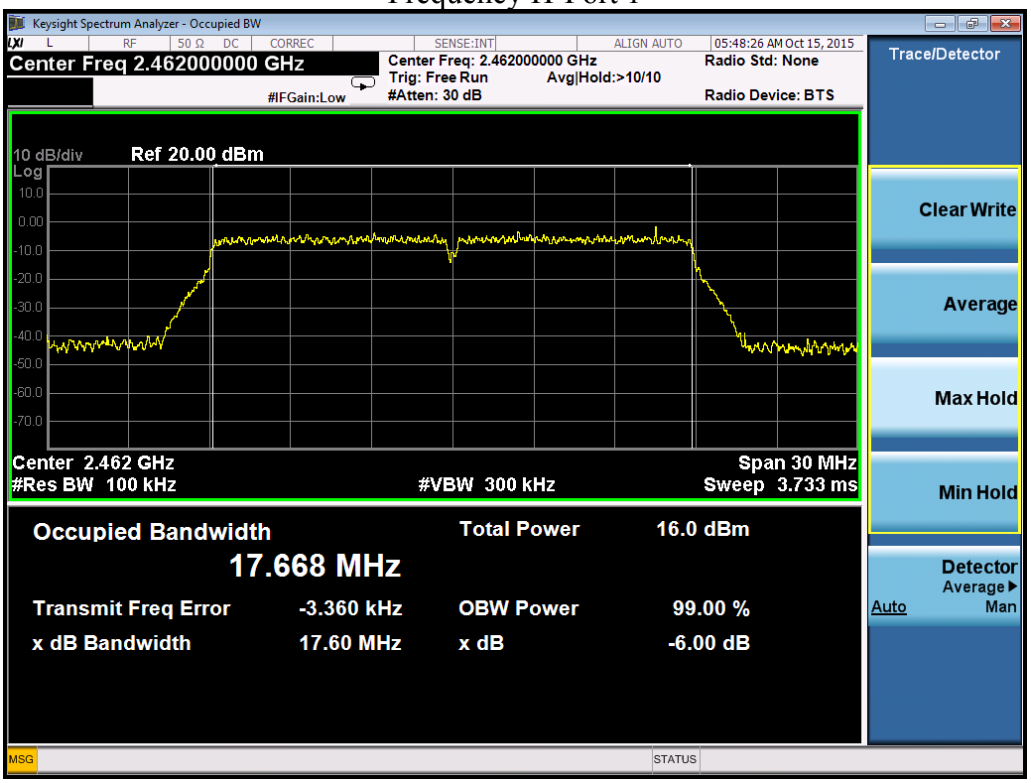
Frequency L-Port 1



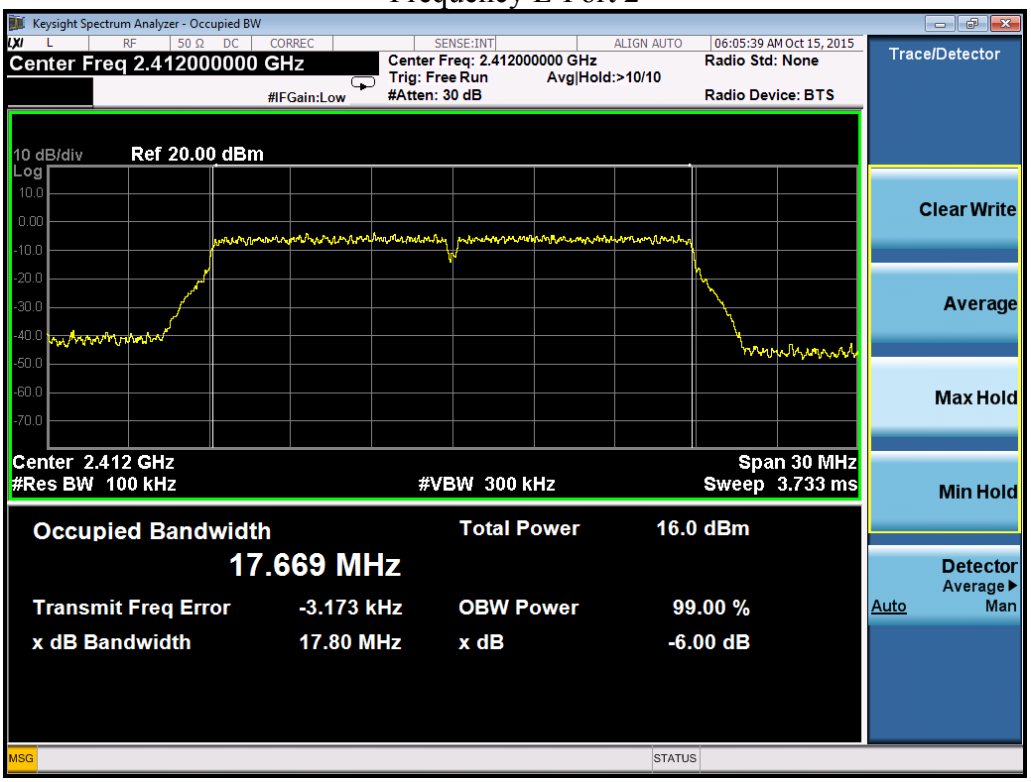
Frequency M-Port 1



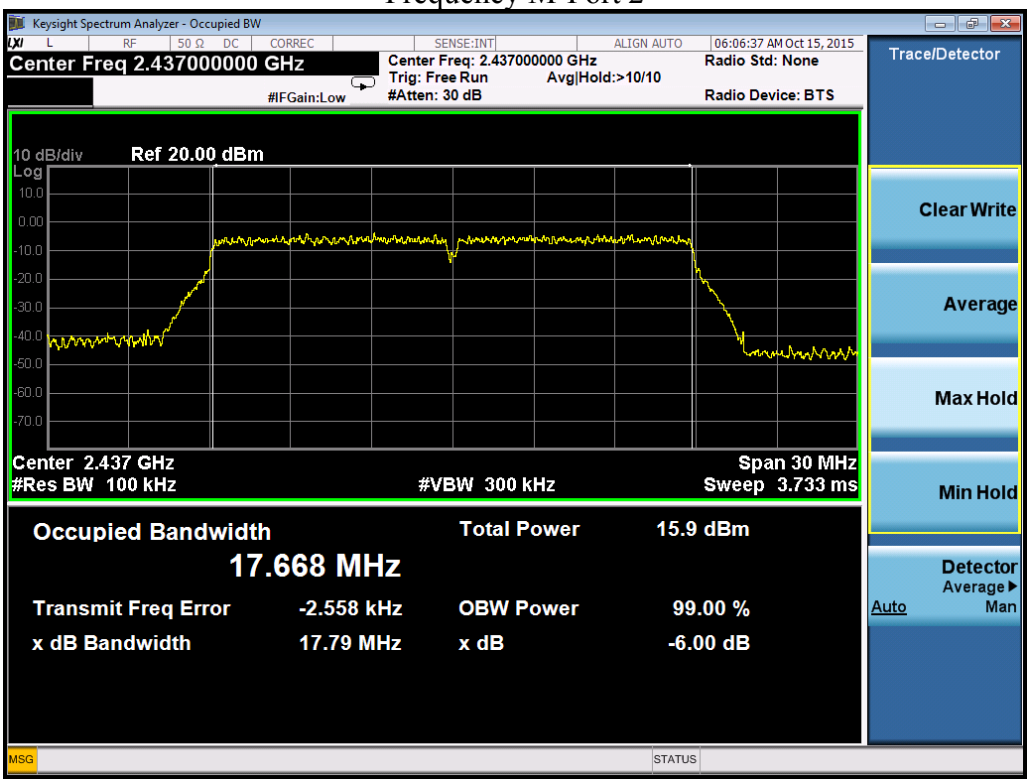
Frequency H-Port 1



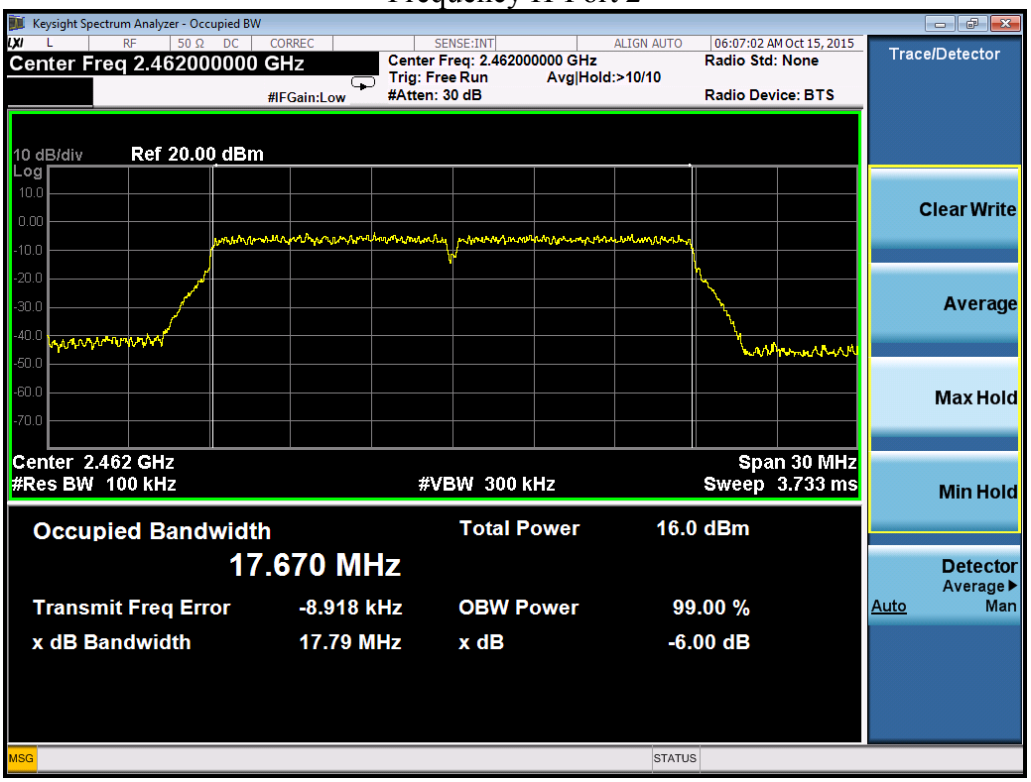
Frequency L-Port 2



Frequency M-Port 2

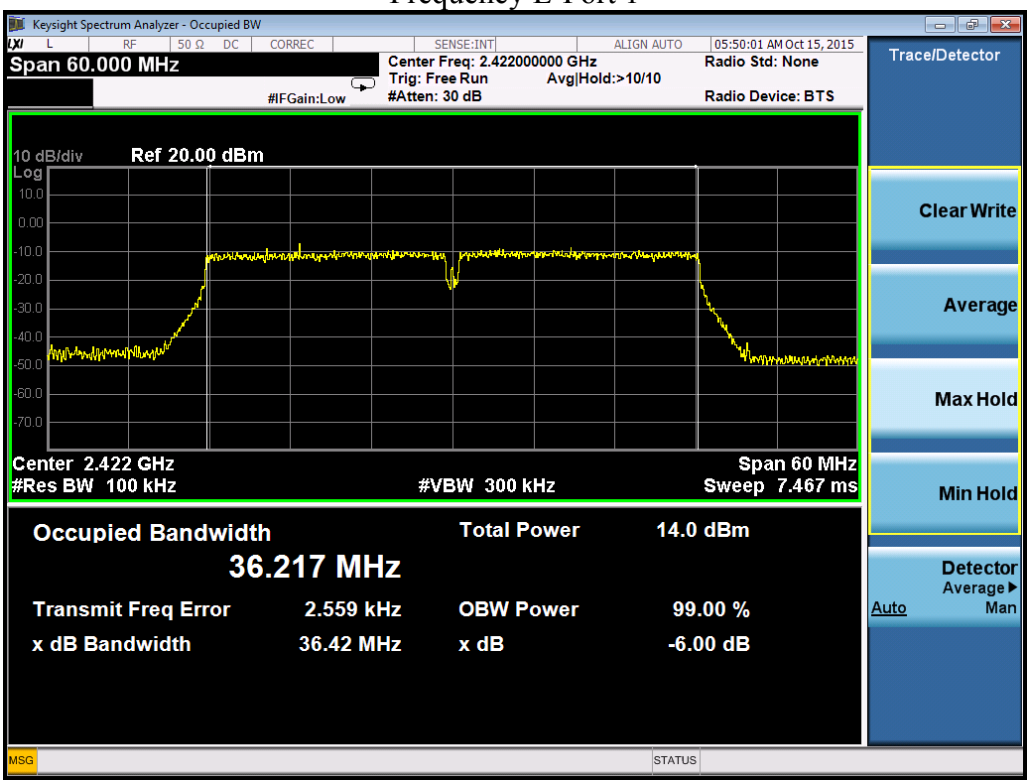


Frequency H-Port 2

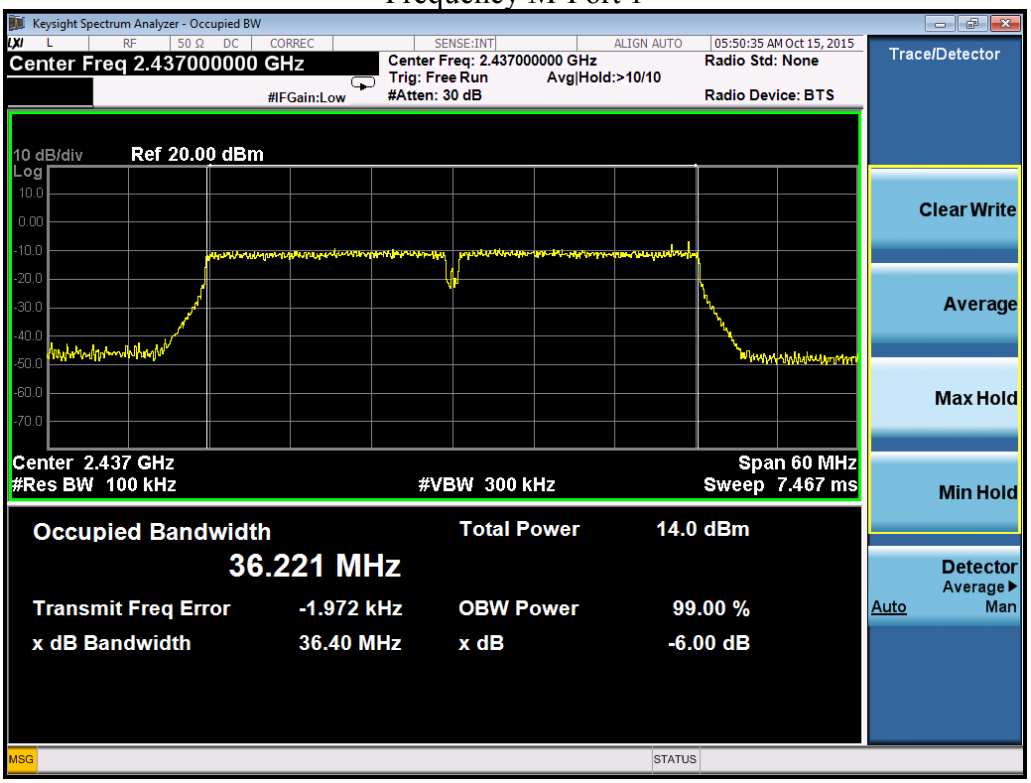


802.11n (HT40)

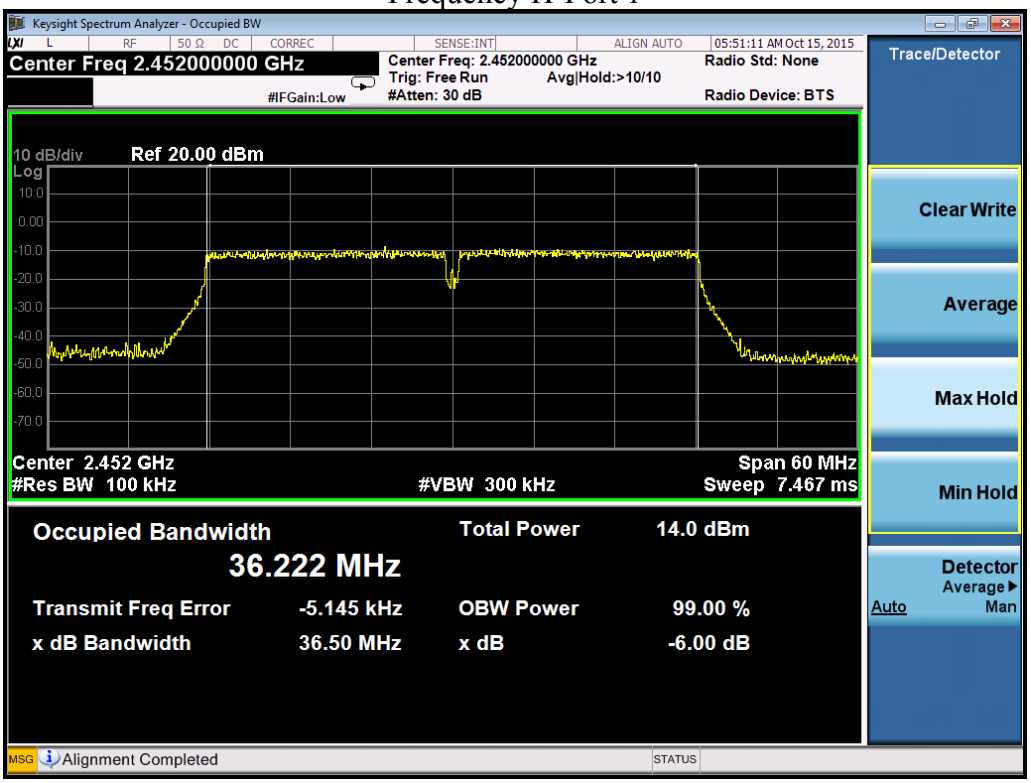
Frequency L-Port 1



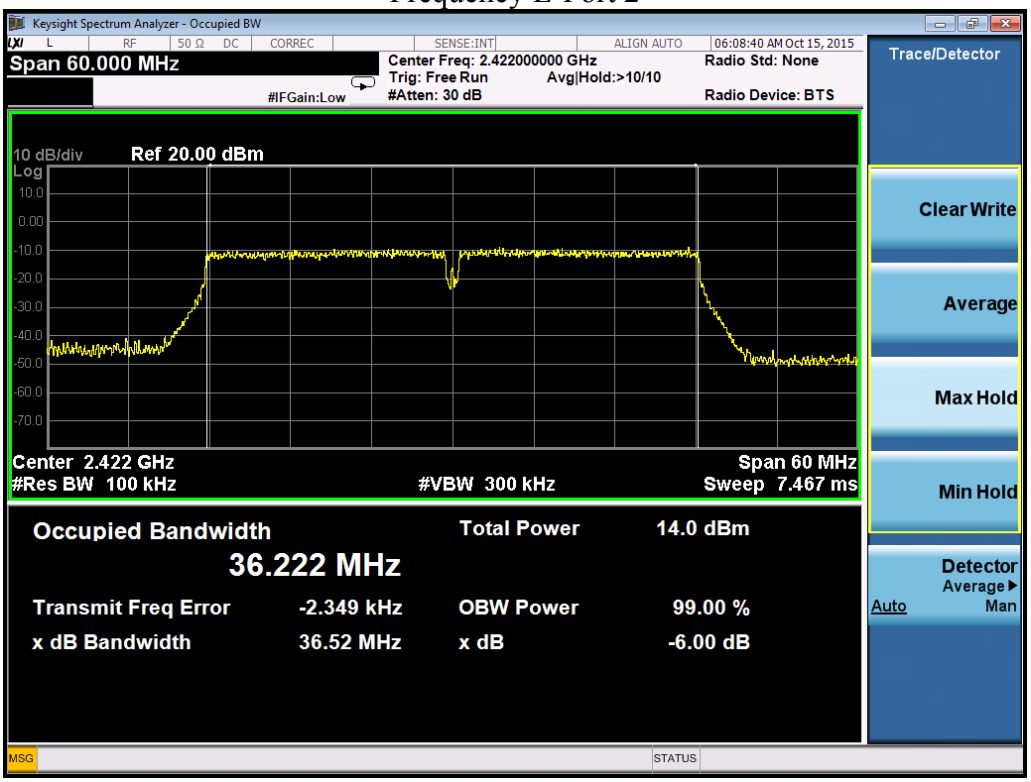
Frequency M-Port 1



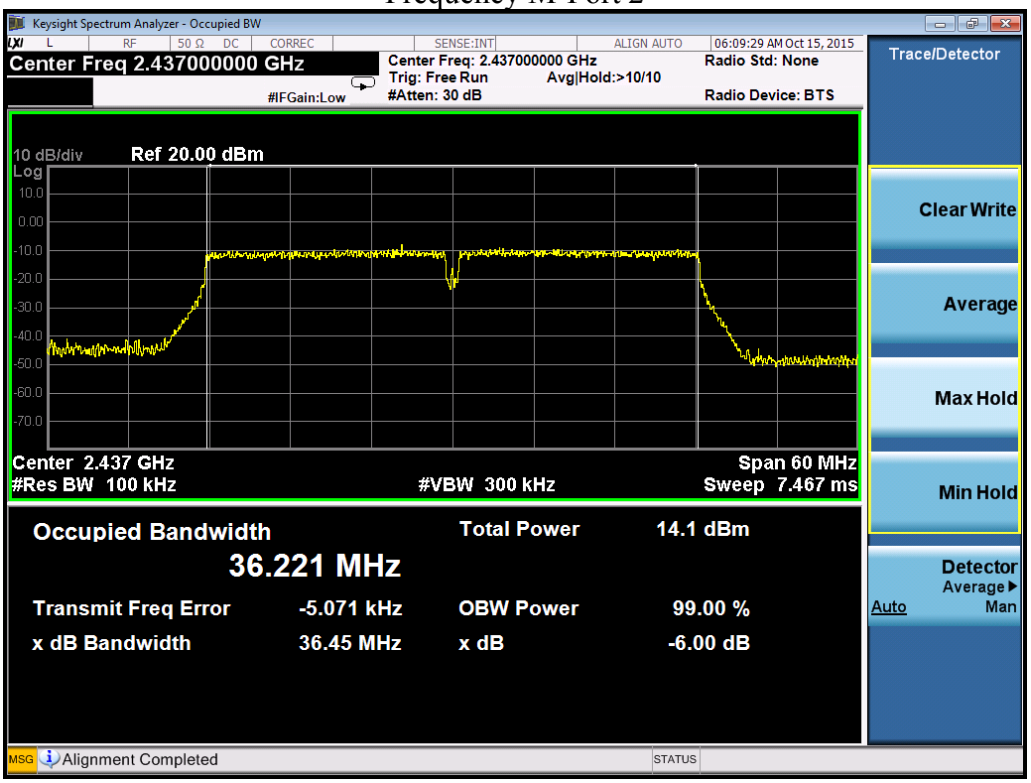
Frequency H-Port 1



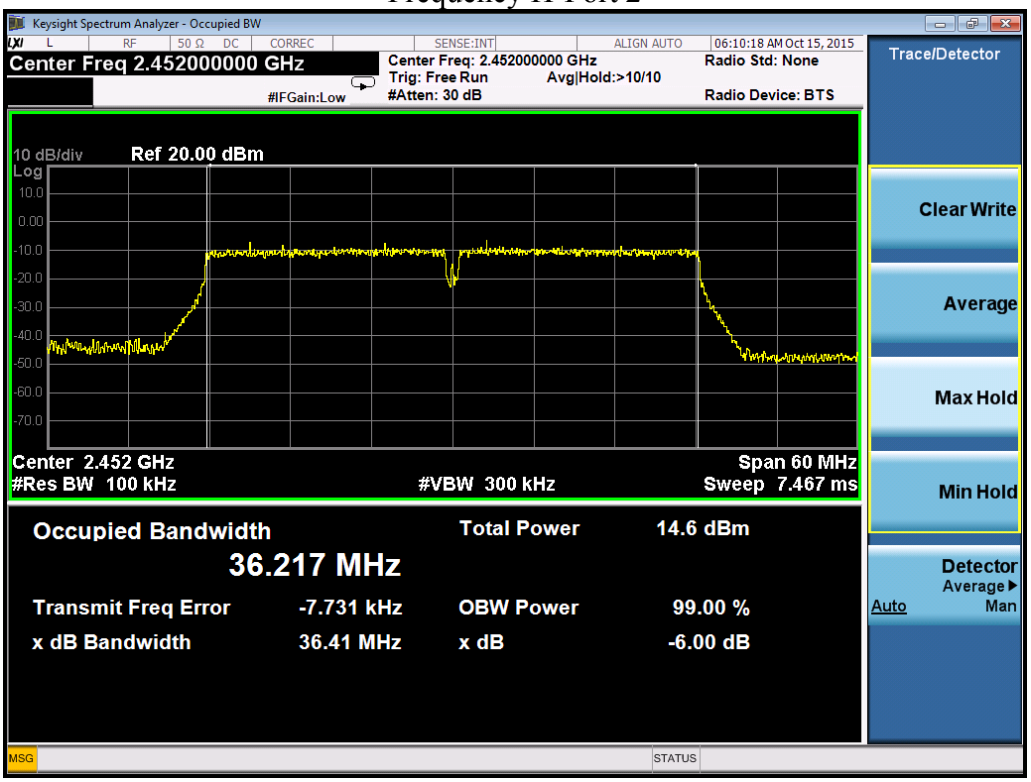
Frequency L-Port 2



Frequency M-Port 2



Frequency H-Port 2



5. Maximum Conducted Output power

Test result: Pass

5.1 Test limit

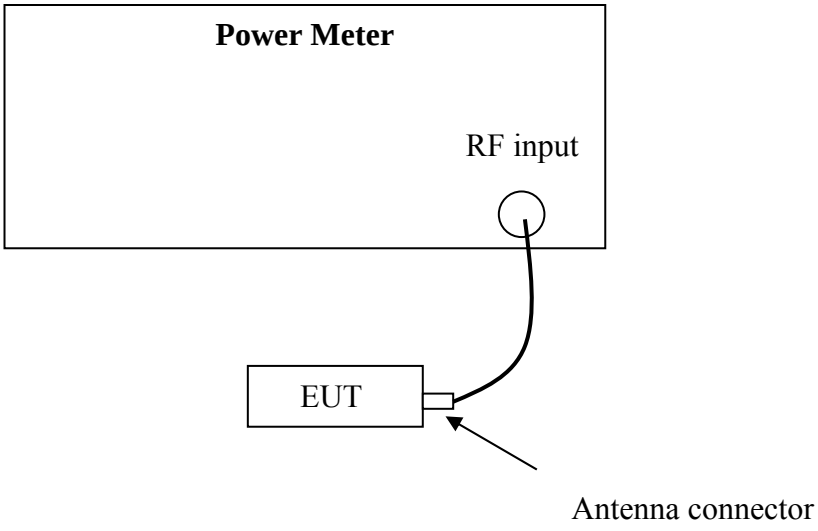
☐ For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt

☐ For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts

☒ For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt.

If the transmitting antenna of directional gain greater than 6dBi is used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi. If there have a beam forming type, the limit should be the minimum of 30dBm and 30+ (6 –antenna gain-beam forming gain).

5.2 Test Configuration



5.3 Test procedure and test setup

The EUT was tested according to DTS test procedure of "KDB558074 D01 DTS Meas Guidance v03r02" for compliance to FCC 47CFR 15.247 requirements (clause 9.1.2).

5.4 Test protocol

Temperature: 22 °C
Relative Humidity: 53 %

Mode	Frequency (MHz)	Reading (dBm)		Max Power (mw)	Max Power (dBm)	Limit (dBm)	Margin (dB)
		Port 0	Port 1				
802.11b	2412	17.80	17.32	60.26	17.80	30.00	12.20
	2437	17.34	17.11	54.20	17.34	30.00	12.66
	2462	17.45	17.22	55.59	17.45	30.00	12.55
802.11g	2412	23.92	24.35	272.27	24.35	30.00	5.65
	2437	24.13	24.44	277.97	24.44	30.00	5.56
	2462	24.43	24.66	292.42	24.66	30.00	5.34
Mode	**Frequency (MHz)**	**Reading (dBm)**		**Total Power (mw)**	**Total Power (dBm)**	**Limit (dBm)**	**Margin (dB)**
		Port 0	**Port 1**				
802.11n20	2412	21.38	21.12	266.82	24.26	30.00	5.74
	2437	21.47	21.32	275.80	24.41	30.00	5.59
	2462	21.71	21.21	280.38	24.48	30.00	5.52
802.11n40	2422	20.36	20.43	219.05	23.41	30.00	6.59
	2437	20.51	20.12	215.26	23.33	30.00	6.67
	2452	20.57	20.44	224.69	23.52	30.00	6.48

Note:
1. Total power = $10 * \lg(10^{\text{port 0} / 10} + 10^{\text{port 1} / 10})$

6. Power spectrum density

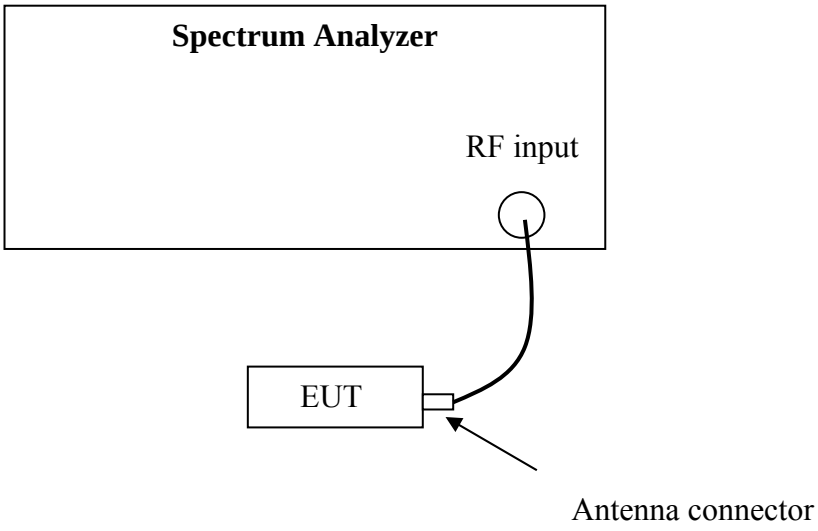
Test result: **Pass**

6.1 Test limit

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8dBm in any 3 kHz band during any time interval of continuous transmission.

If the transmitting antenna of directional gain greater than 6dBi is used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi. If there have a beam forming type, the limit should be the minimum of 8dBm/MHz and 8+ (6 –antenna gain-beam forming gain).

6.2 Test Configuration



6.3 Test procedure and test setup

The power output per FCC §15.247(e) was tested according to DTS test procedure of "KDB558074 D01 DTS Meas Guidance v03r02" (clause 10.2 Method PKPSD) for compliance to FCC 47CFR 15.247 requirements.

1) Set analyzer center frequency to DTS channel center frequency.
2) Set the span to 1.5 times the DTS bandwidth.
3) Set the RBW to: 3 kHz ≤ RBW ≤ 100 kHz.
4) Set the VBW ≥ 3 × RBW.
5) Detector = peak.
6) Sweep time = auto couple.
7) Trace mode = max hold.
8) Allow trace to fully stabilize.
9) Use the peak marker function to determine the maximum amplitude level within the RBW.
10) If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

6.4 Test Protocol

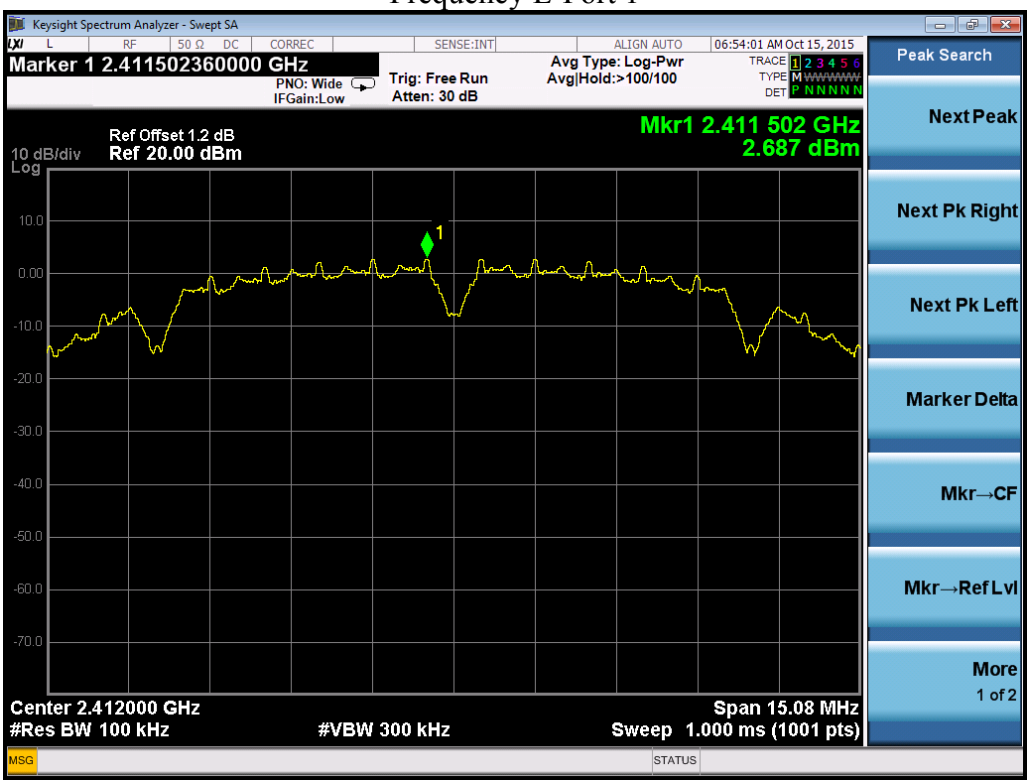
Temperature: 22 °C
Relative Humidity: 53 %

Mode	Frequency (MHz)	Reading (dBm/100KHz)		Max PSD (mw/100KHz)	Max PSD (dBm/100KHz)	Limit (dBm/3KHz)	Margin (dB)
		Port 0	Port 1				
802.11b	2412	2.687	3.442	2.21	3.44	8.00	4.56
	2437	2.792	3.315	2.15	3.32	8.00	4.69
	2462	2.895	3.295	2.14	3.30	8.00	4.71
802.11g	2412	-1.326	0.887	1.23	0.89	8.00	7.11
	2437	-0.027	1.201	1.32	1.20	8.00	6.80
	2462	-0.864	1.934	1.56	1.93	8.00	6.07
Mode	**Frequency (MHz)**	**Reading (dBm/100KHz)**		**Total PSD (mw/100KHz)**	**Total PSD (dBm/100KHz)**	**Limit (dBm/3KHz)**	**Margin (dB)**
		Port 0	**Port 1**				
802.11 n20	2412	-2.284	-1.932	1.23	0.91	8.00	7.09
	2437	-2.602	-2.028	1.18	0.70	8.00	7.30
	2462	-2.013	-1.556	1.33	1.23	8.00	6.77
802.11 n40	2422	-3.923	-5.730	0.67	-1.72	8.00	9.72
	2437	-4.964	-4.250	0.69	-1.58	8.00	9.58
	2452	-4.480	-3.511	0.80	-0.96	8.00	8.96

Test plot as follows:

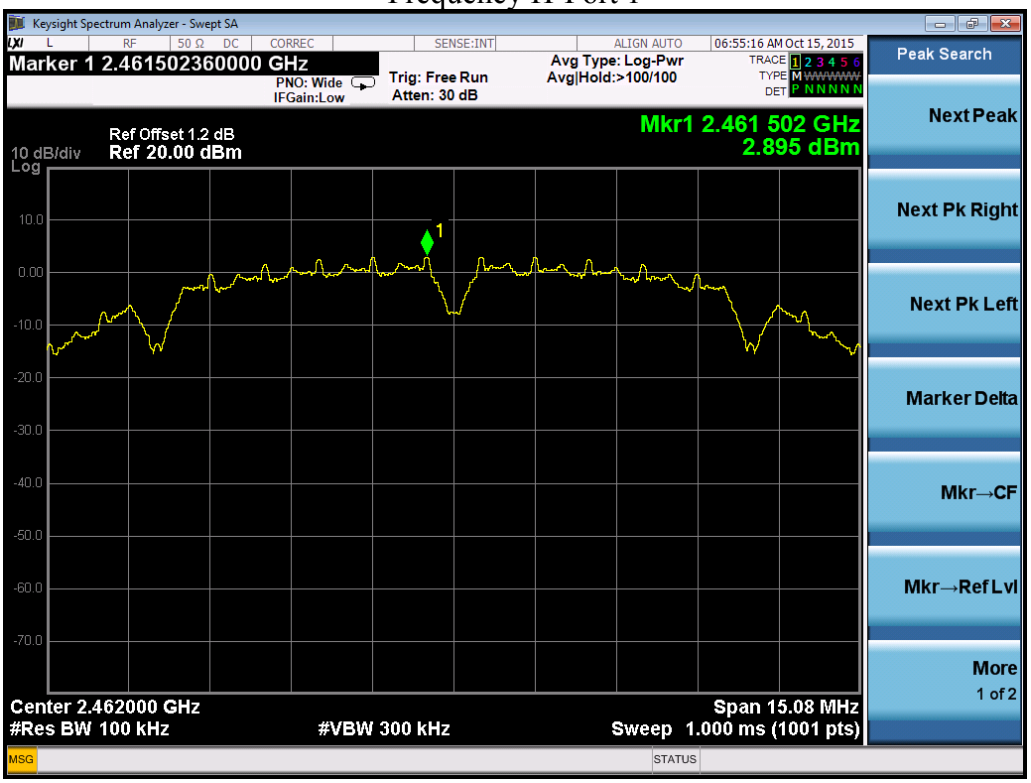
802.11b

Frequency L-Port 1

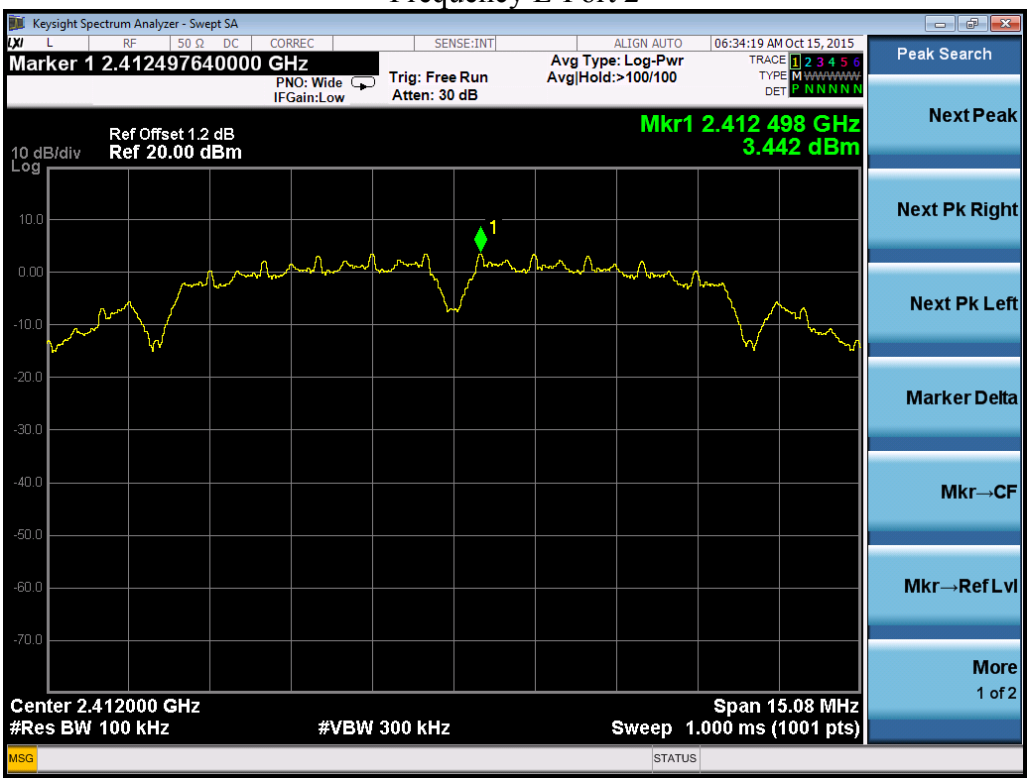


Frequency M-Port 1

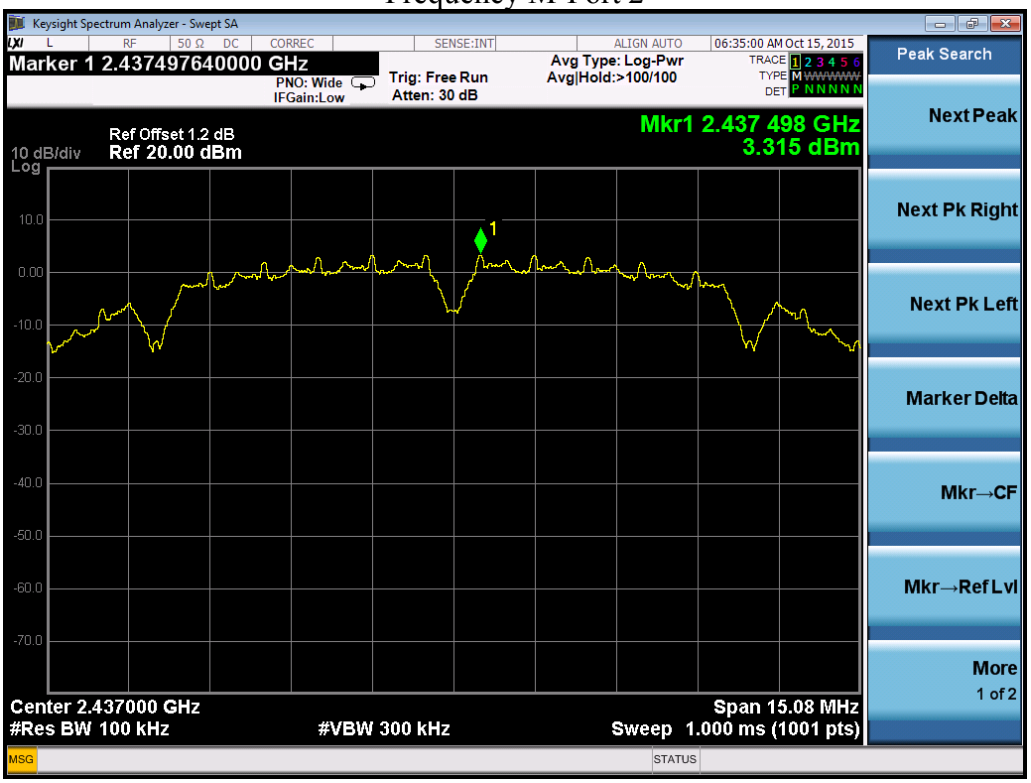
Frequency H-Port 1



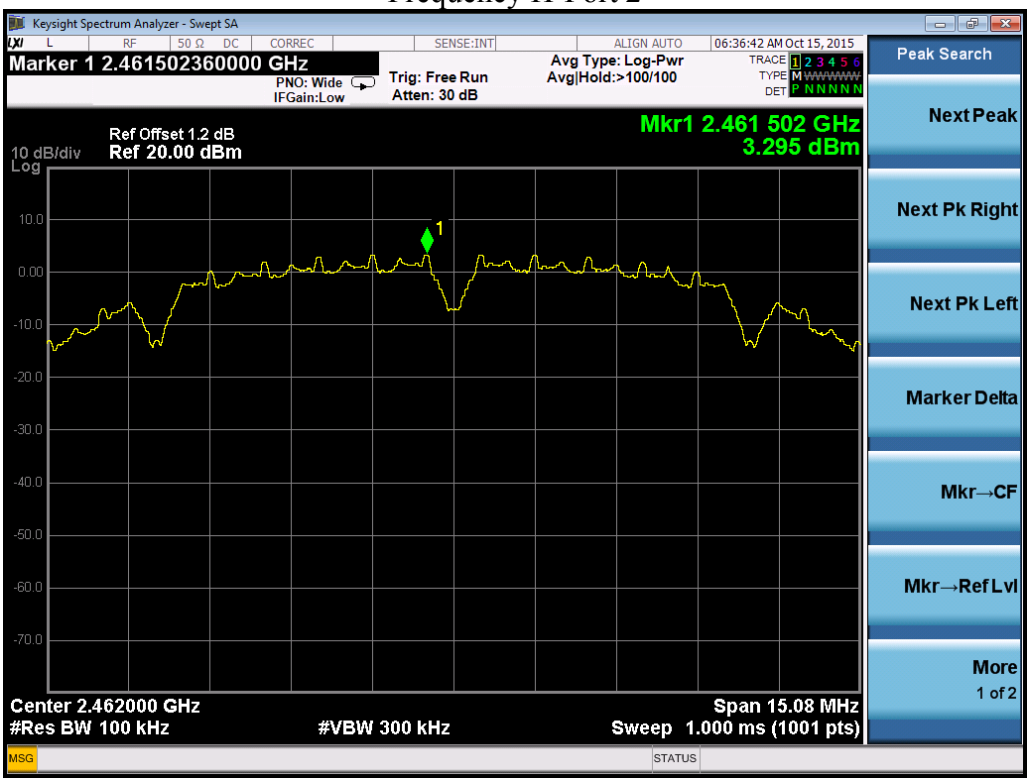
Frequency L-Port 2



Frequency M-Port 2

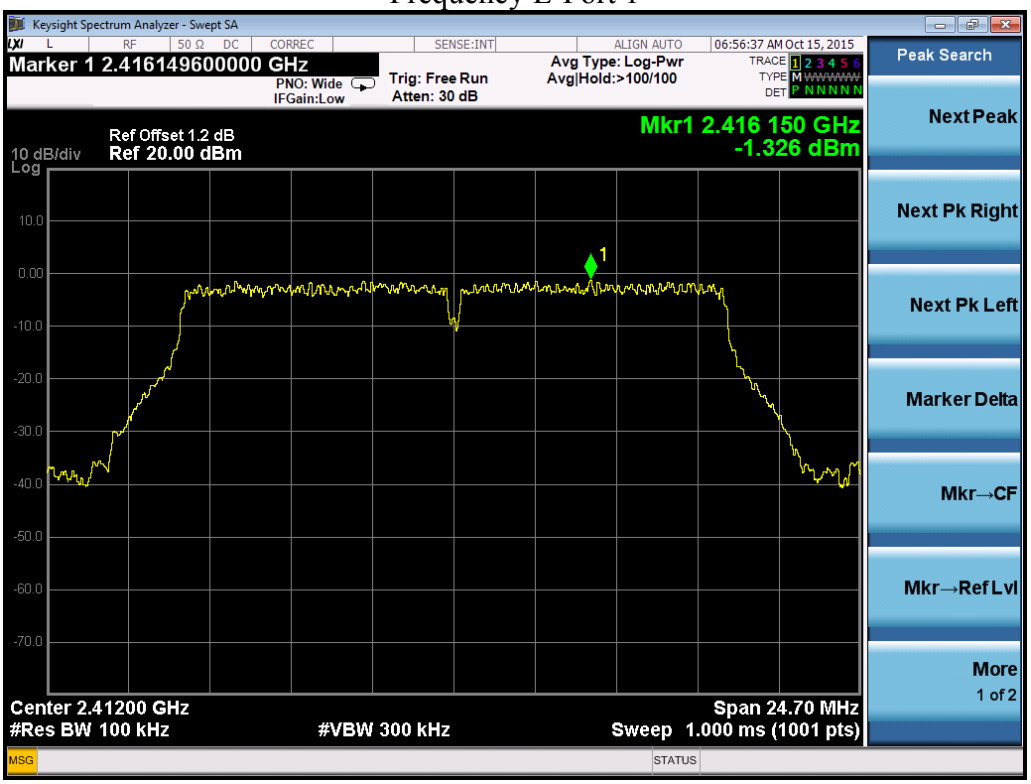


Frequency H-Port 2

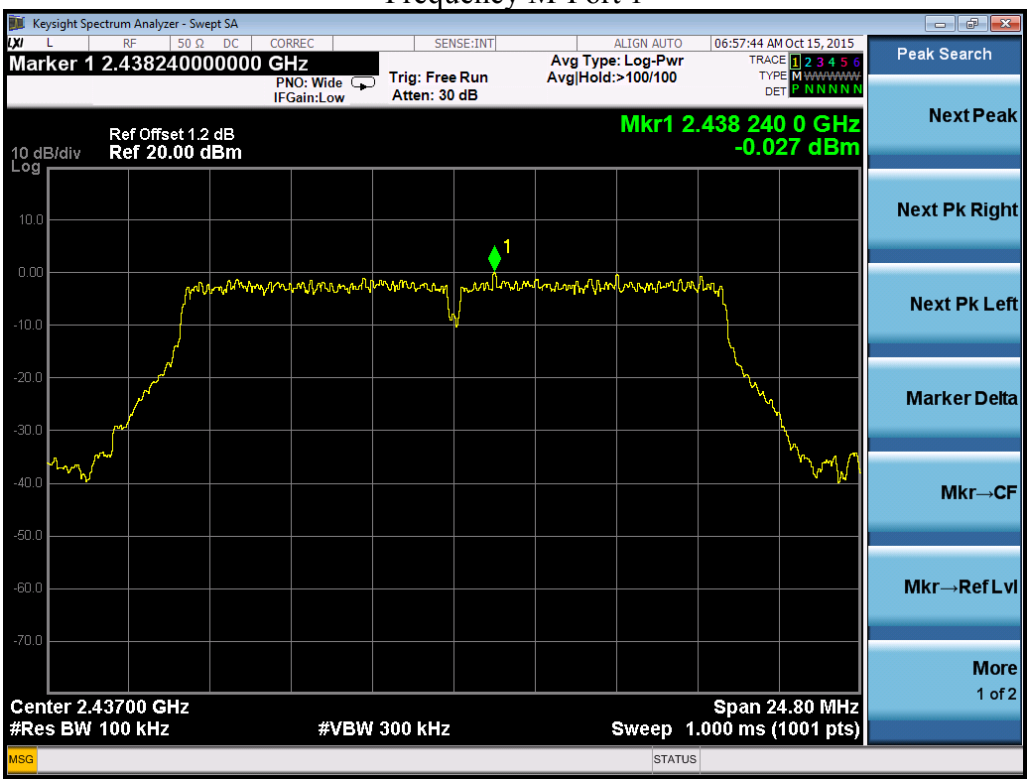


802.11g

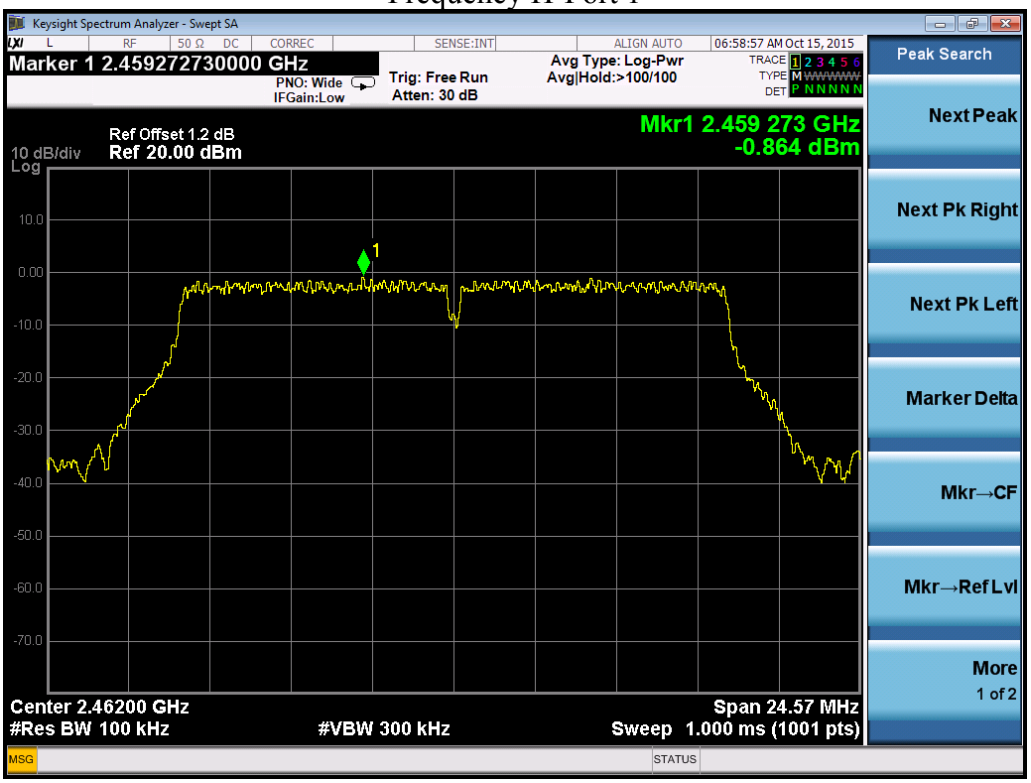
Frequency L-Port 1



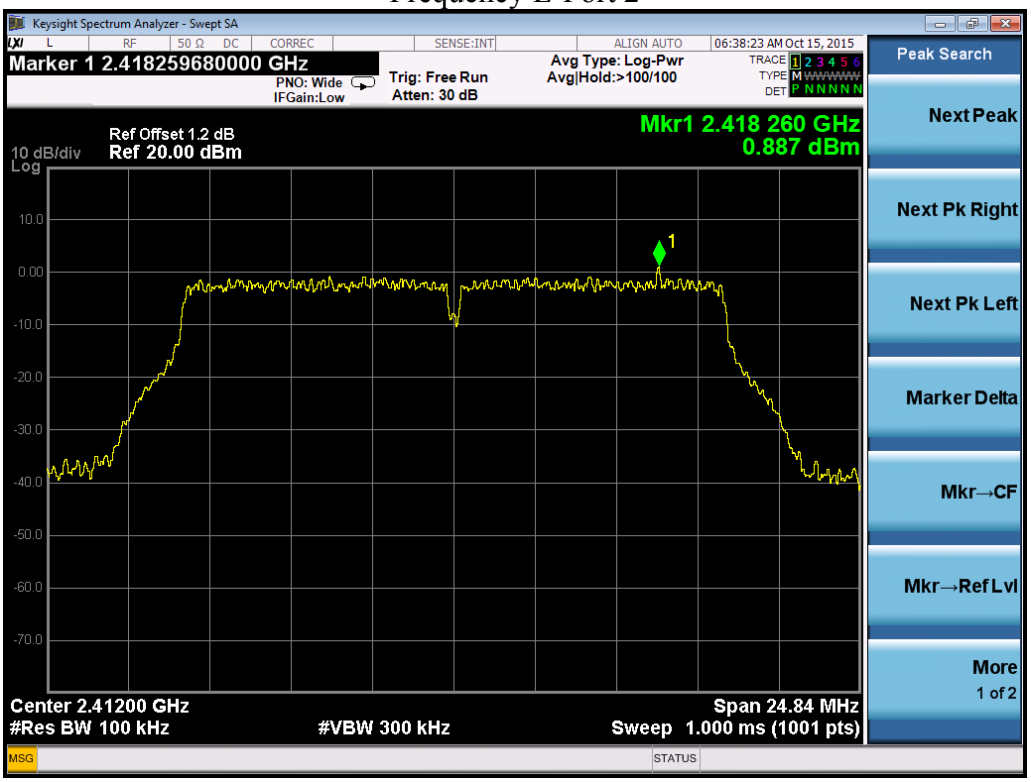
Frequency M-Port 1



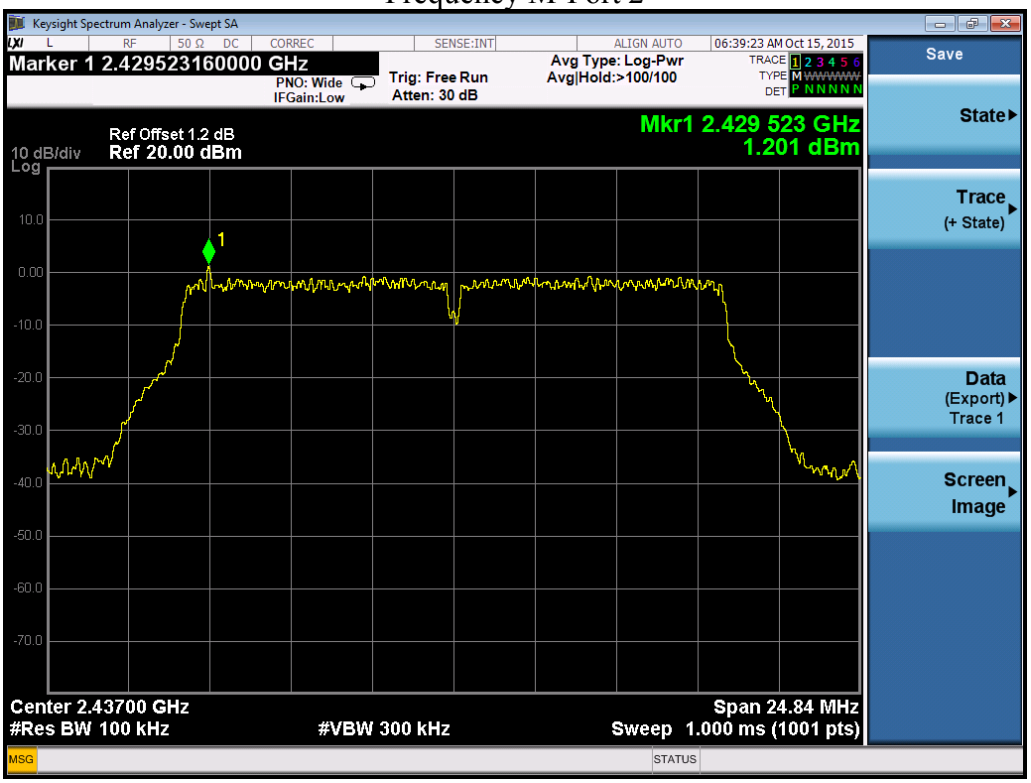
Frequency H-Port 1



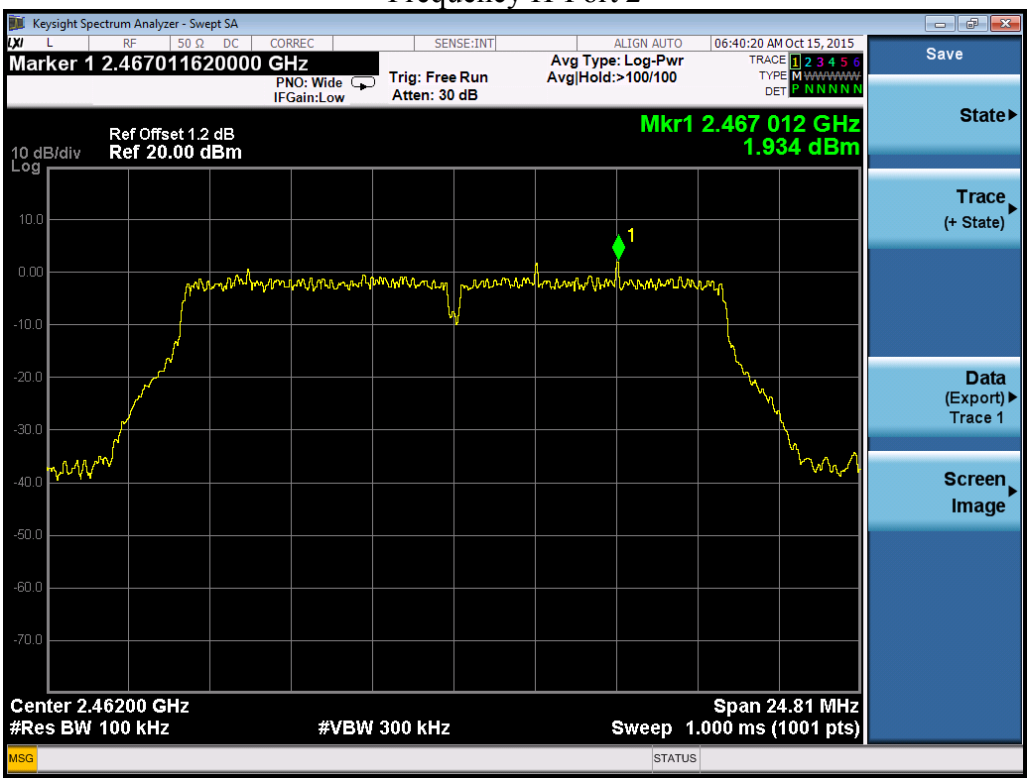
Frequency L-Port 2



Frequency M-Port 2

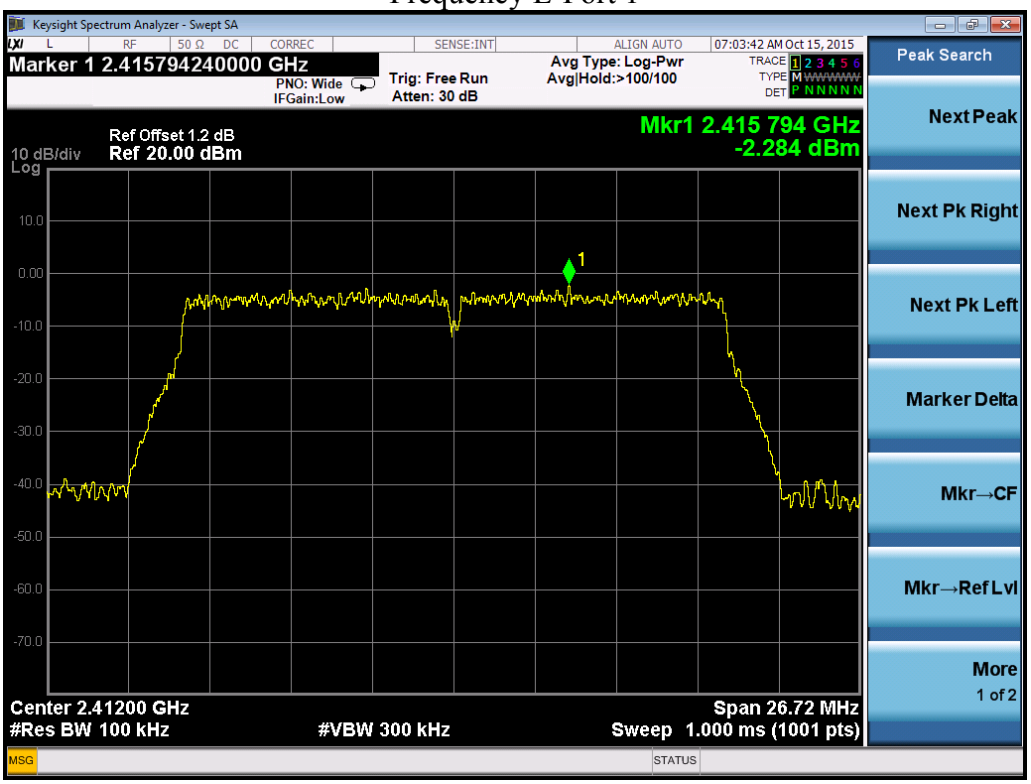


Frequency H-Port 2



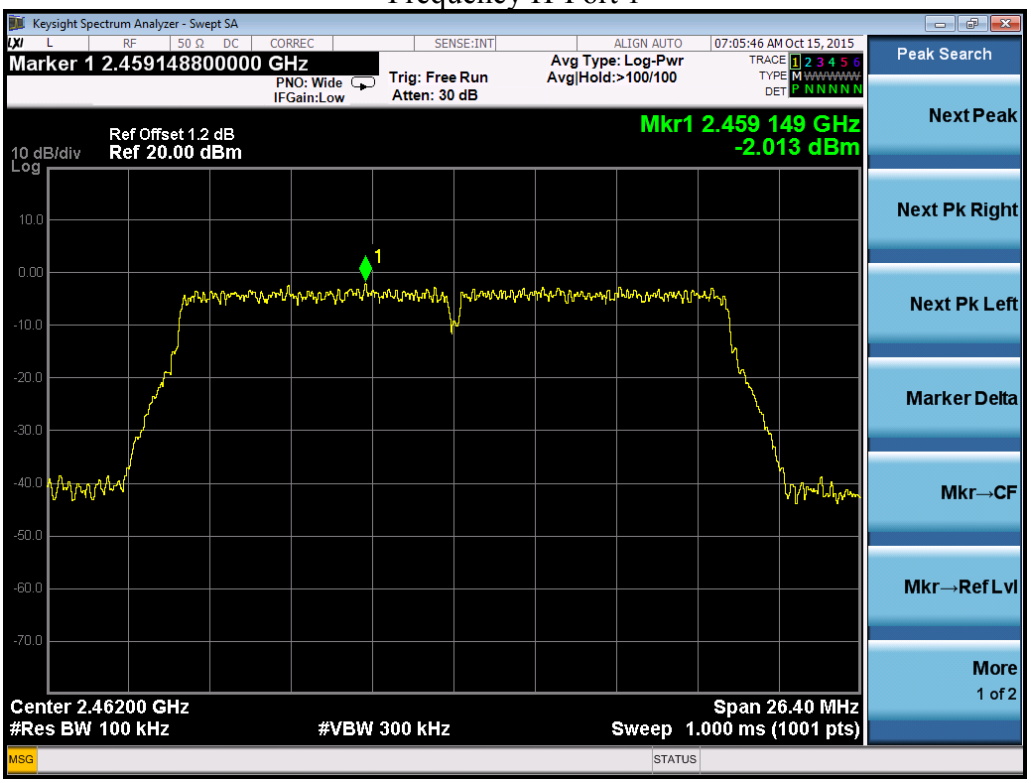
802.11n (HT20)

Frequency L-Port 1

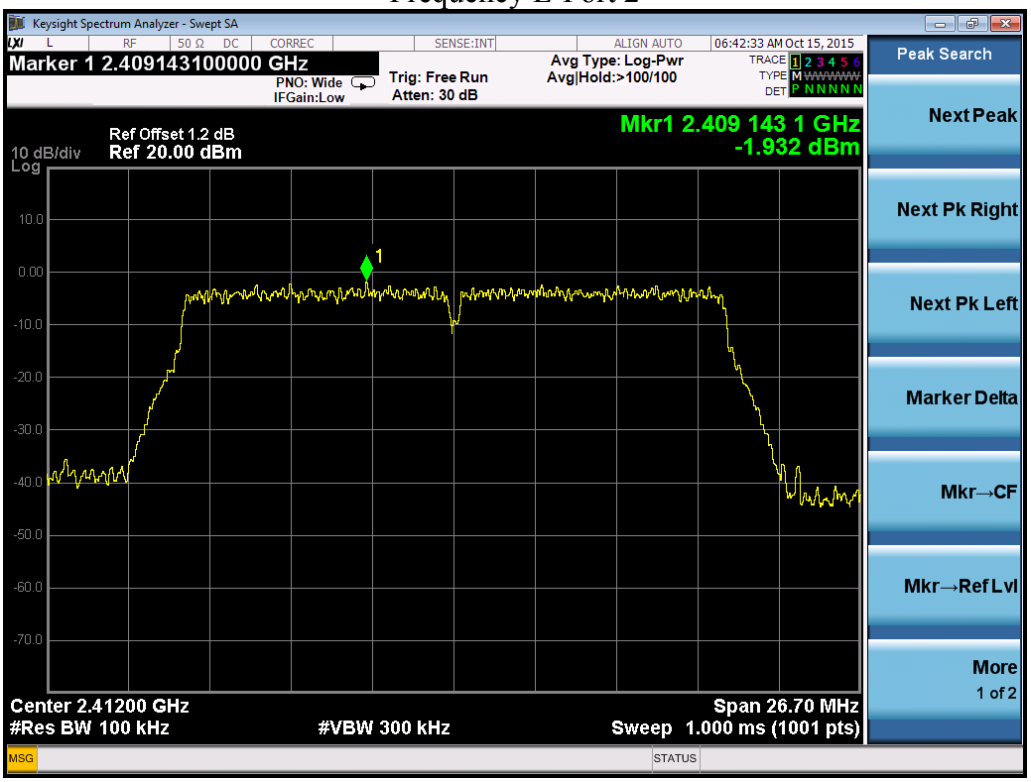


Frequency M-Port 1

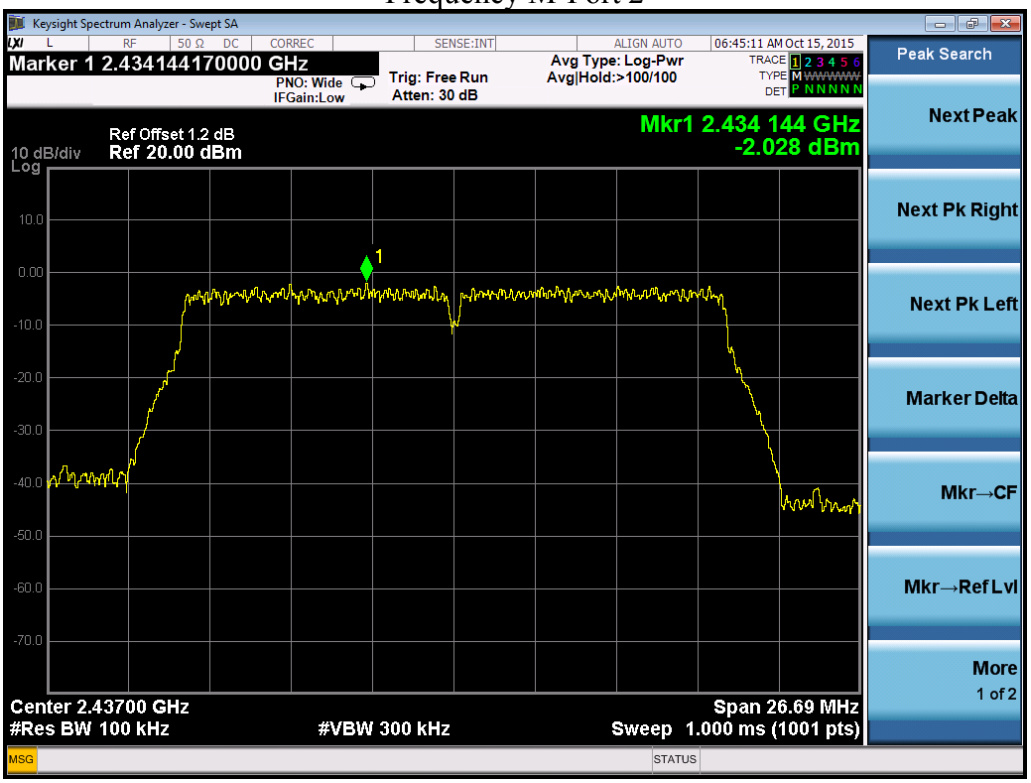
Frequency H-Port 1



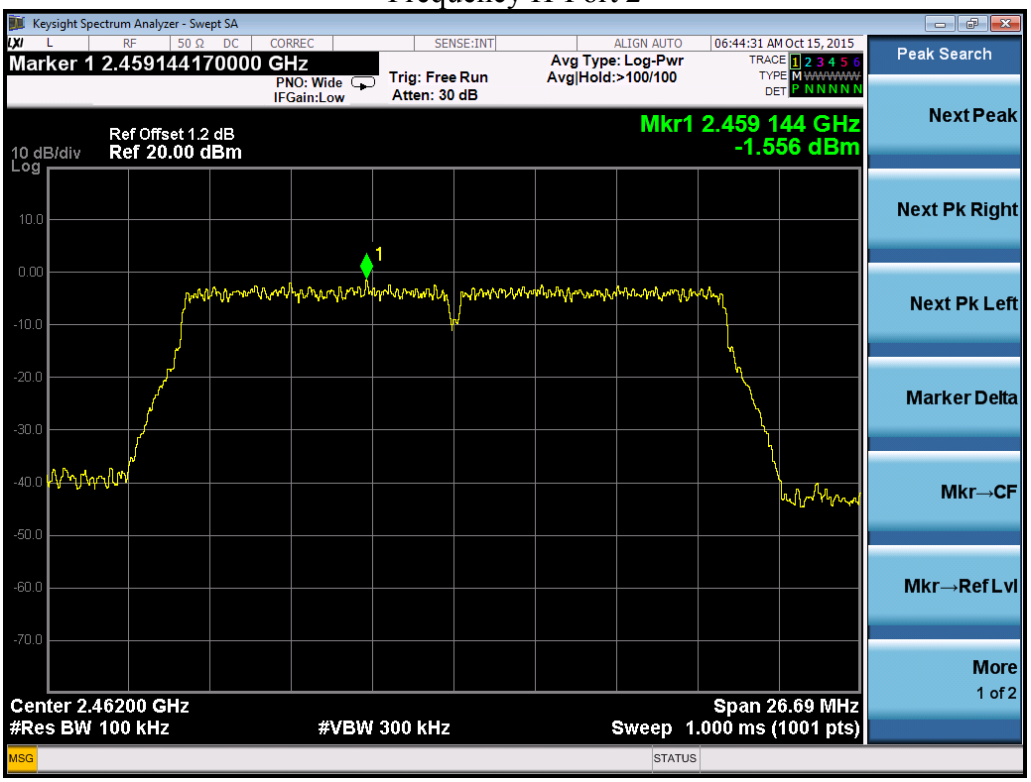
Frequency L-Port 2



Frequency M-Port 2

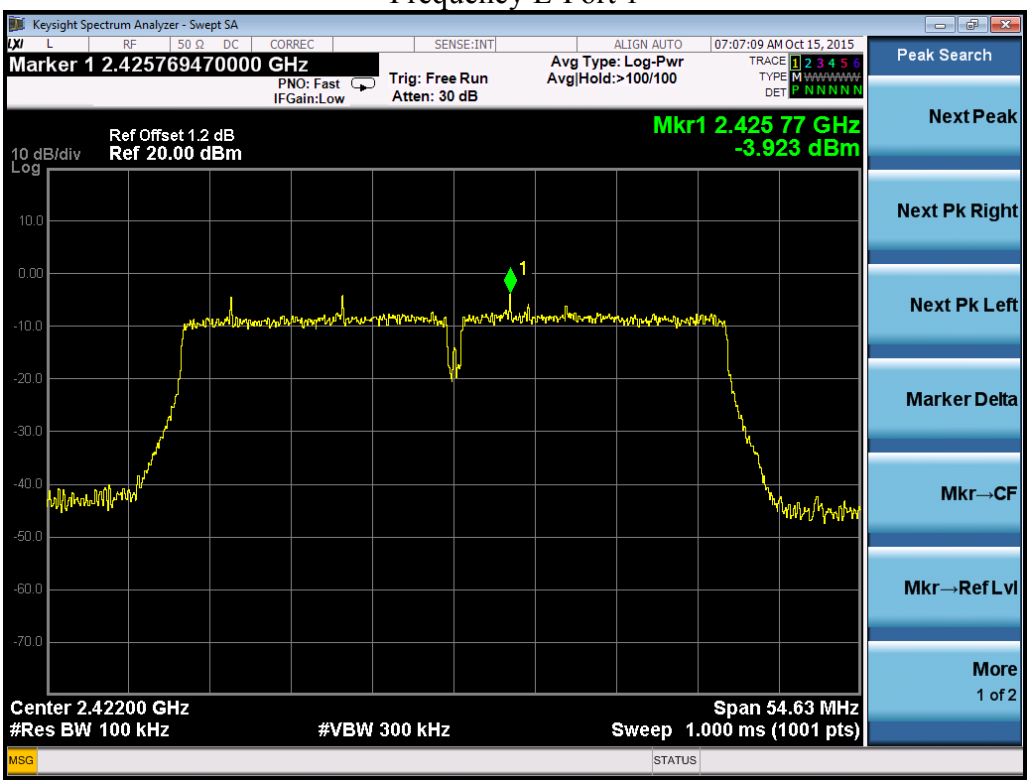


Frequency H-Port 2

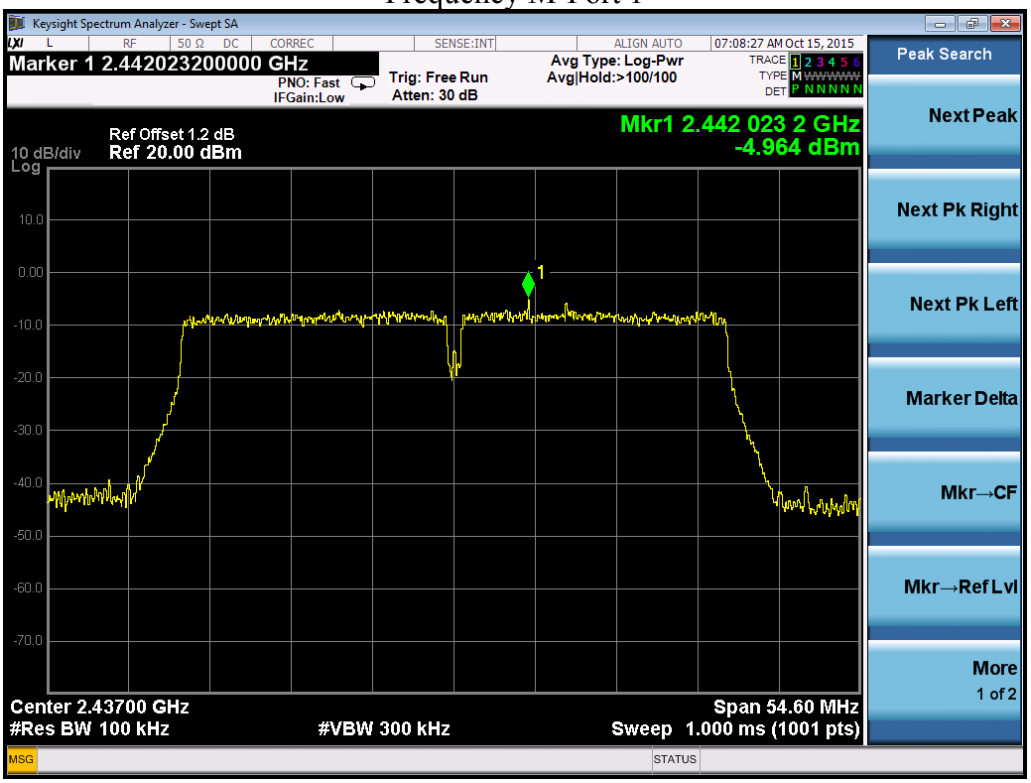


802.11n (HT40)

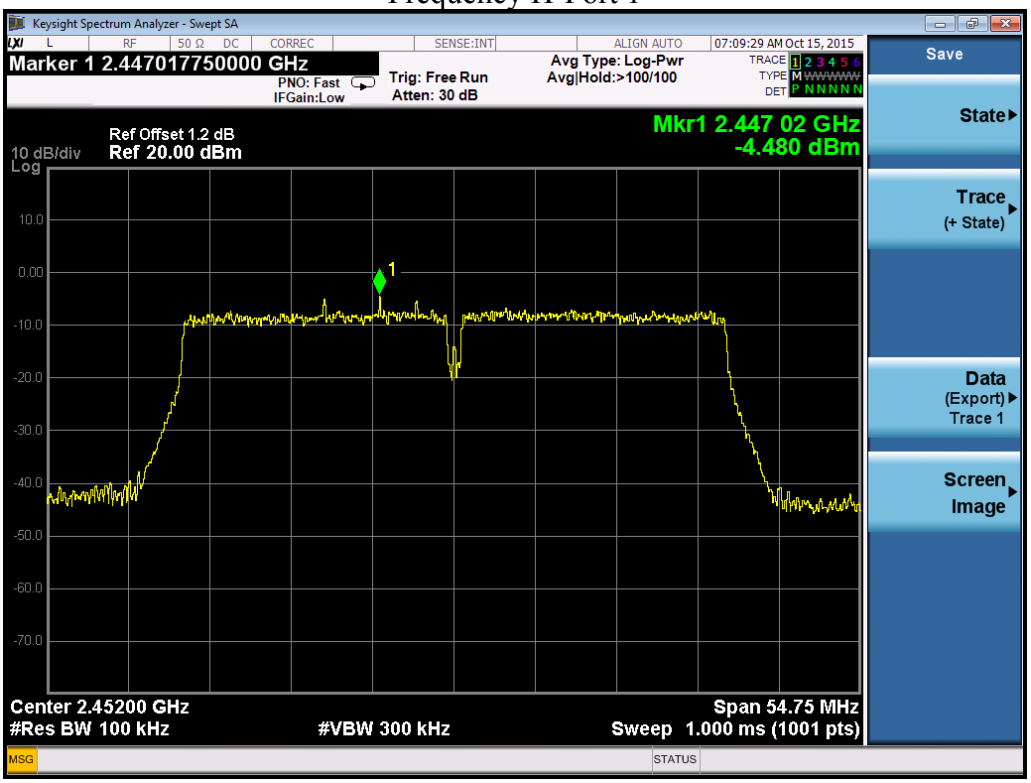
Frequency L-Port 1



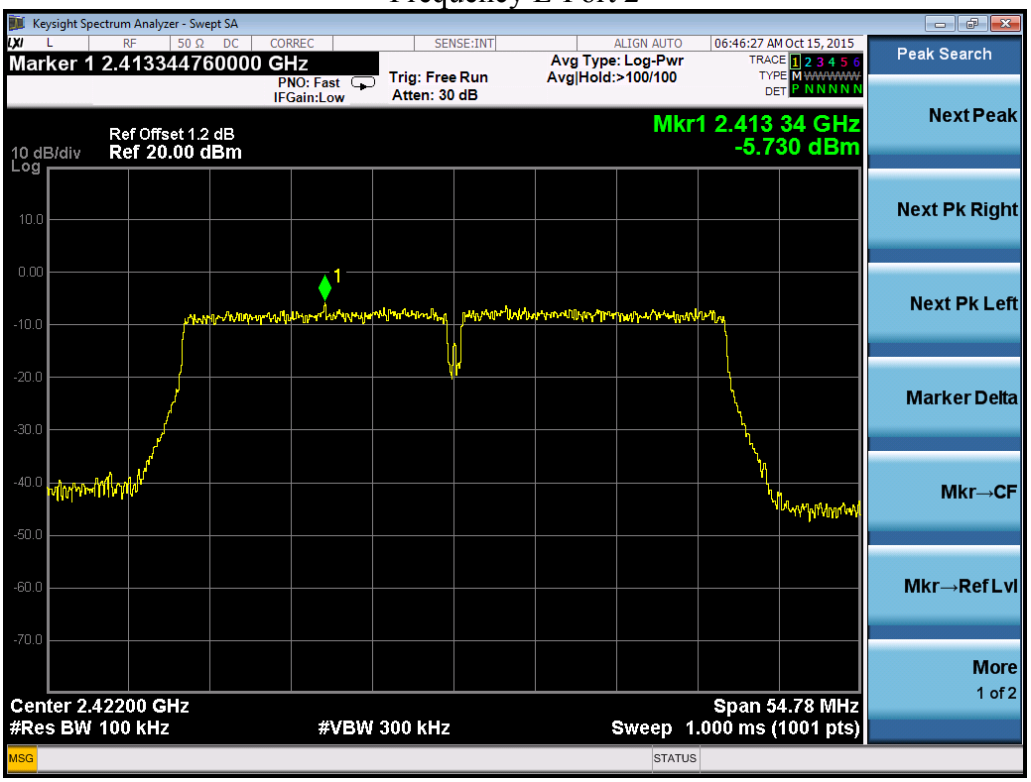
Frequency M-Port 1



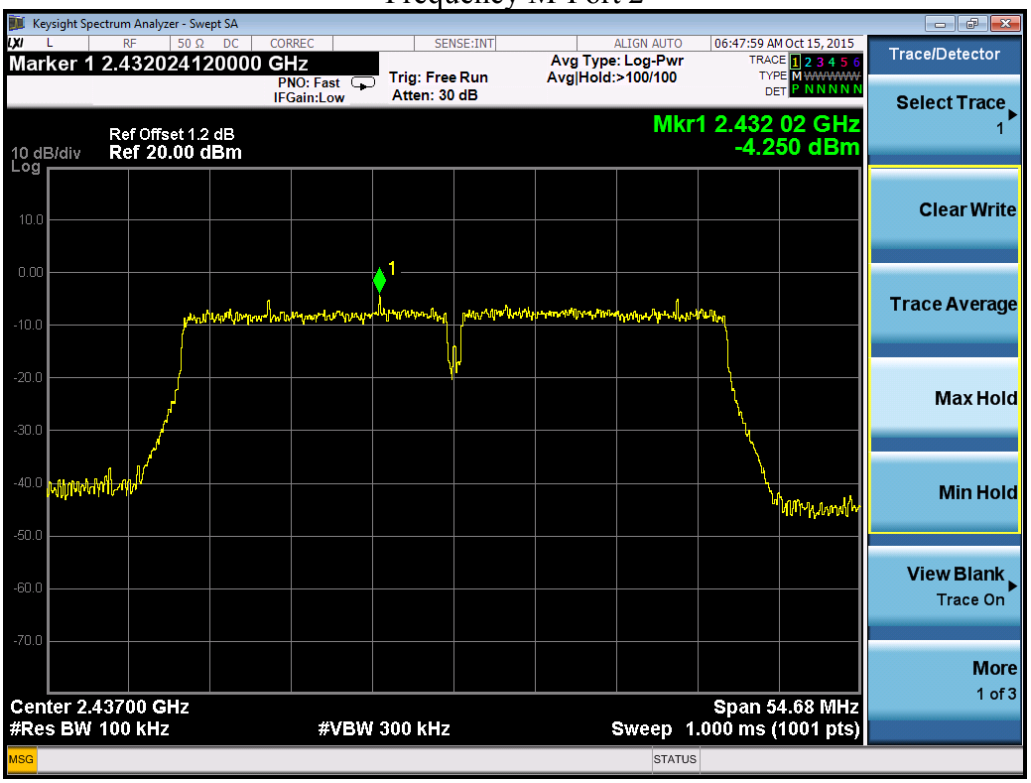
Frequency H-Port 1



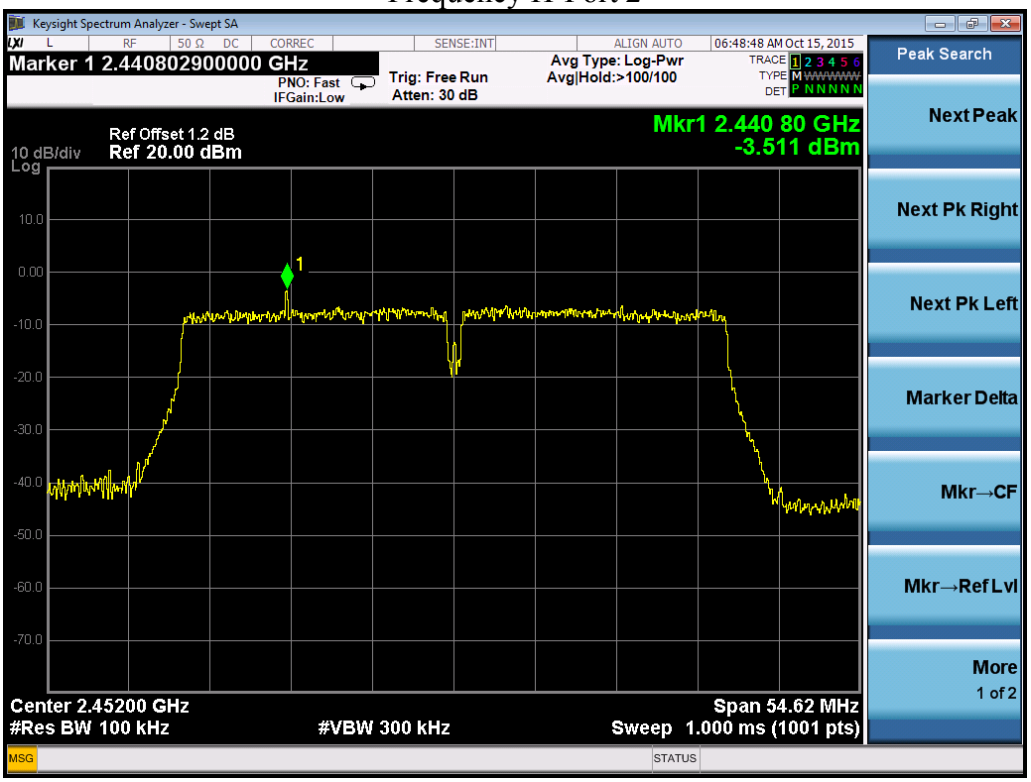
Frequency L-Port 2



Frequency M-Port 2



Frequency H-Port 2



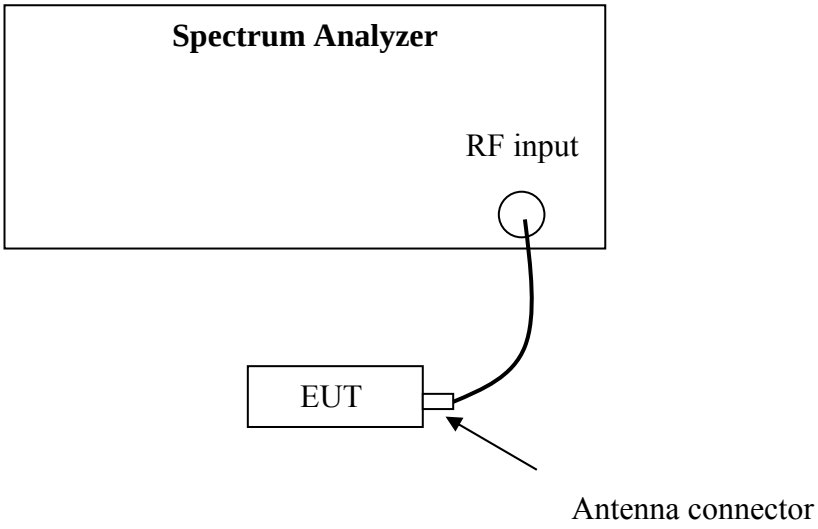
7. Emissions in non-restricted frequency bands

Test result: **Pass**

7.1 Test limit

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power.

7.2 Test Configuration



7.3 Test procedure and test setup

The Emission outside the frequency Band per FCC § 15.247(d) is measured using the Spectrum Analyzer with the resolutions bandwidth set at 100kHz, the video bandwidth set at 300kHz, and the SPAN>>RBW.

The EUT was tested according to DTS test procedure of "KDB558074 D01 DTS Meas Guidance v03r02" (clause 11.0) for compliance to FCC 47CFR 15.247 requirements.

7.4 Test Protocol

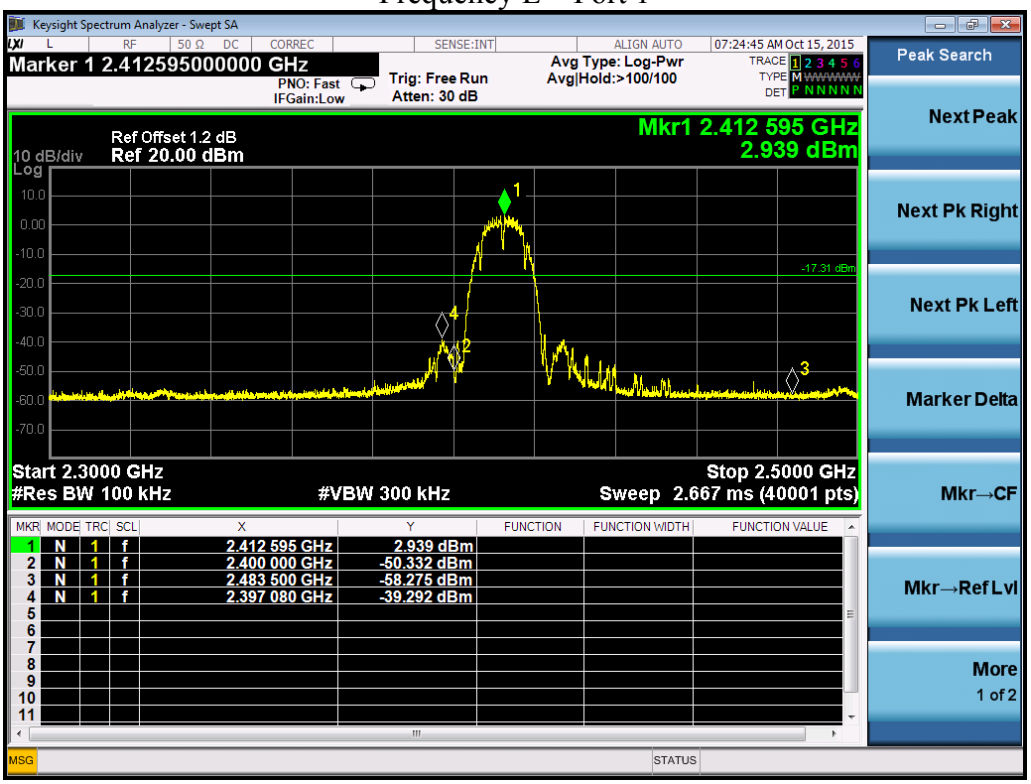
Temperature: 22 °C
Relative Humidity: 53 %

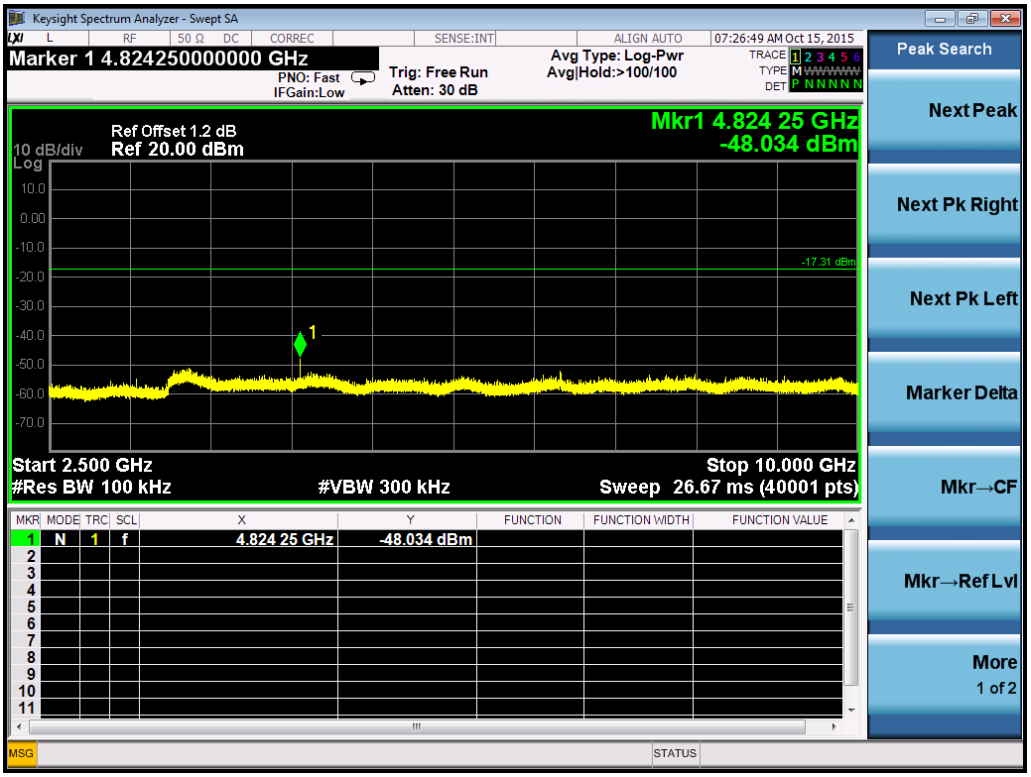
Test Mode	Frequency (MHz)	Results		Limit
		Port 1	Port 2	
802.11b	2412	Pass	Pass	>20dB
	2437	Pass	Pass	
	2462	Pass	Pass	
802.11g	2412	Pass	Pass	
	2437	Pass	Pass	
	2462	Pass	Pass	
802.11n20	2412	Pass	Pass	
	2437	Pass	Pass	
	2462	Pass	Pass	
802.11n40	2422	Pass	Pass	
	2437	Pass	Pass	
	2452	Pass	Pass	

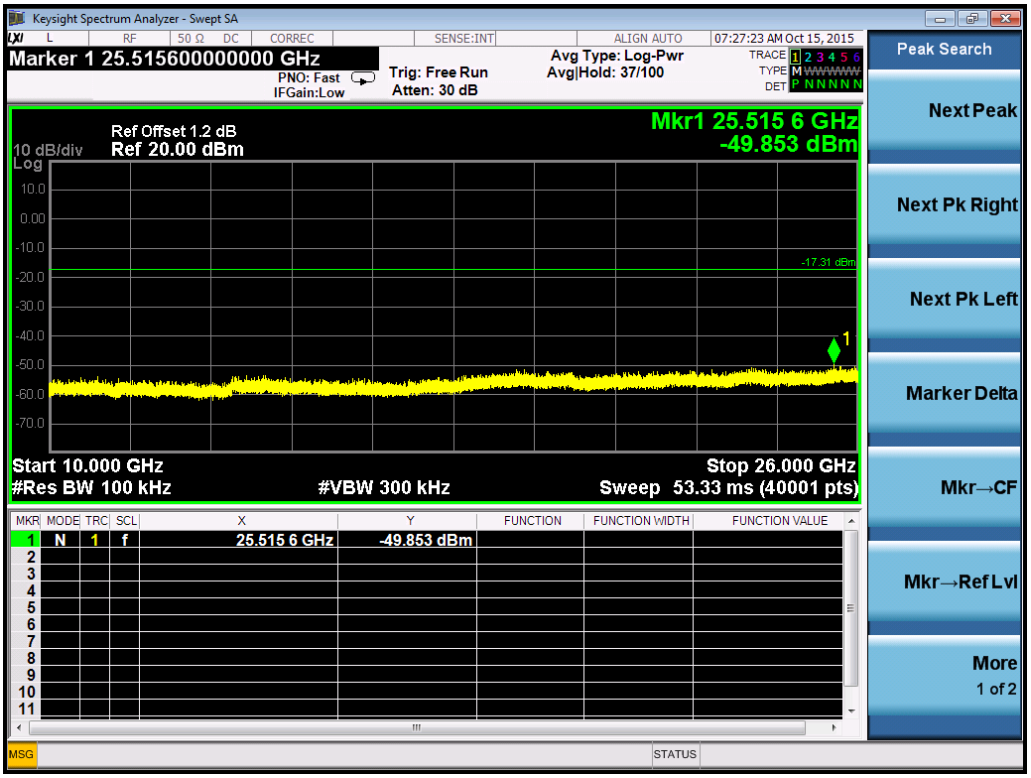
Test plot as follows:

802.11b

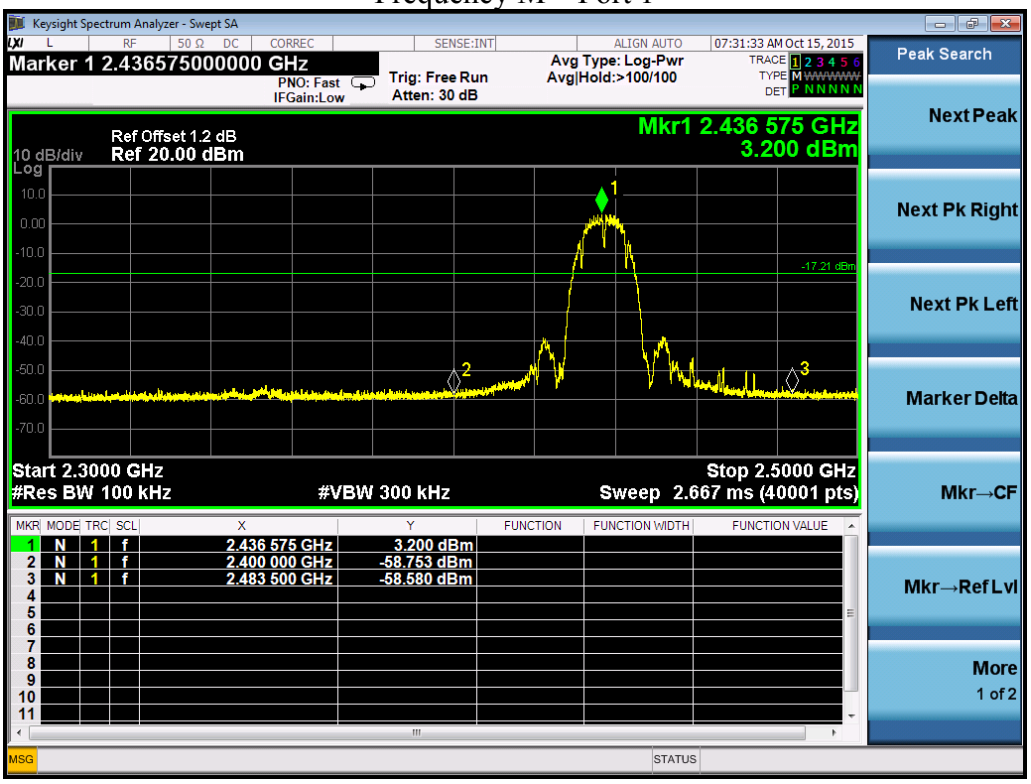
Frequency L – Port 1

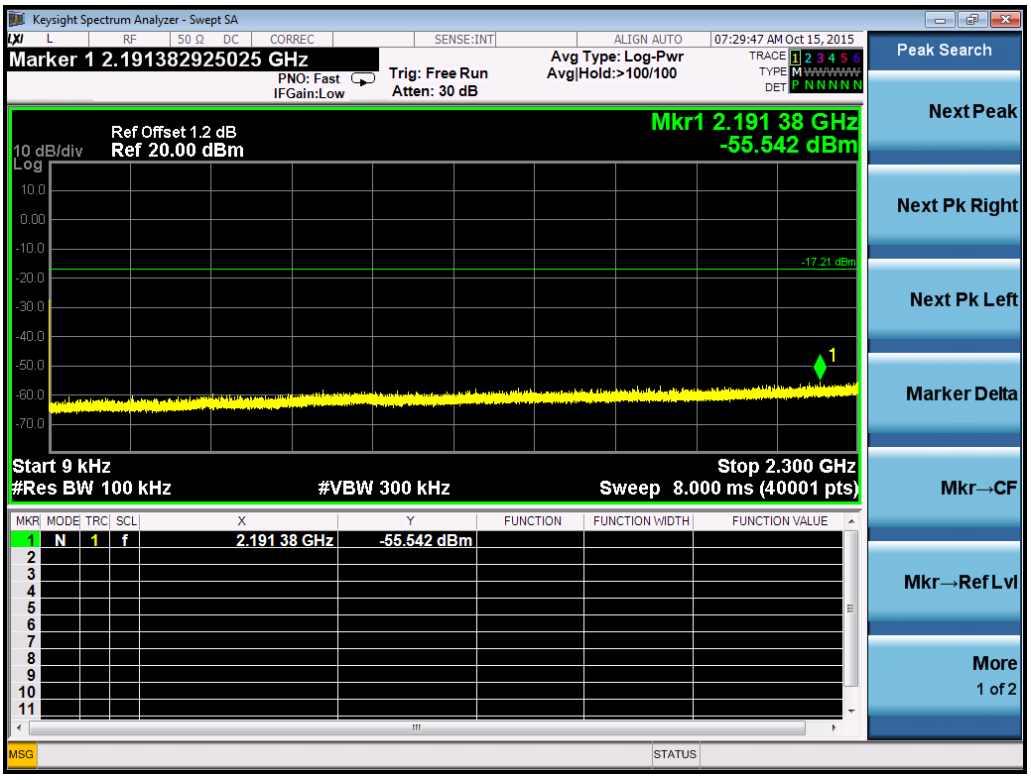


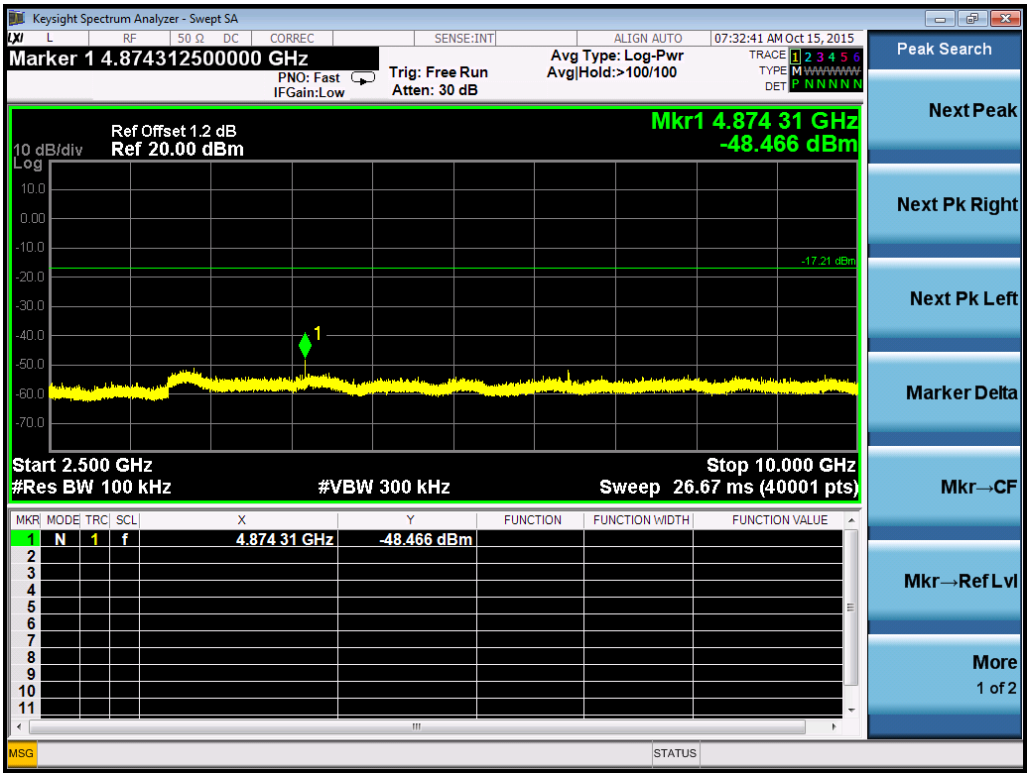


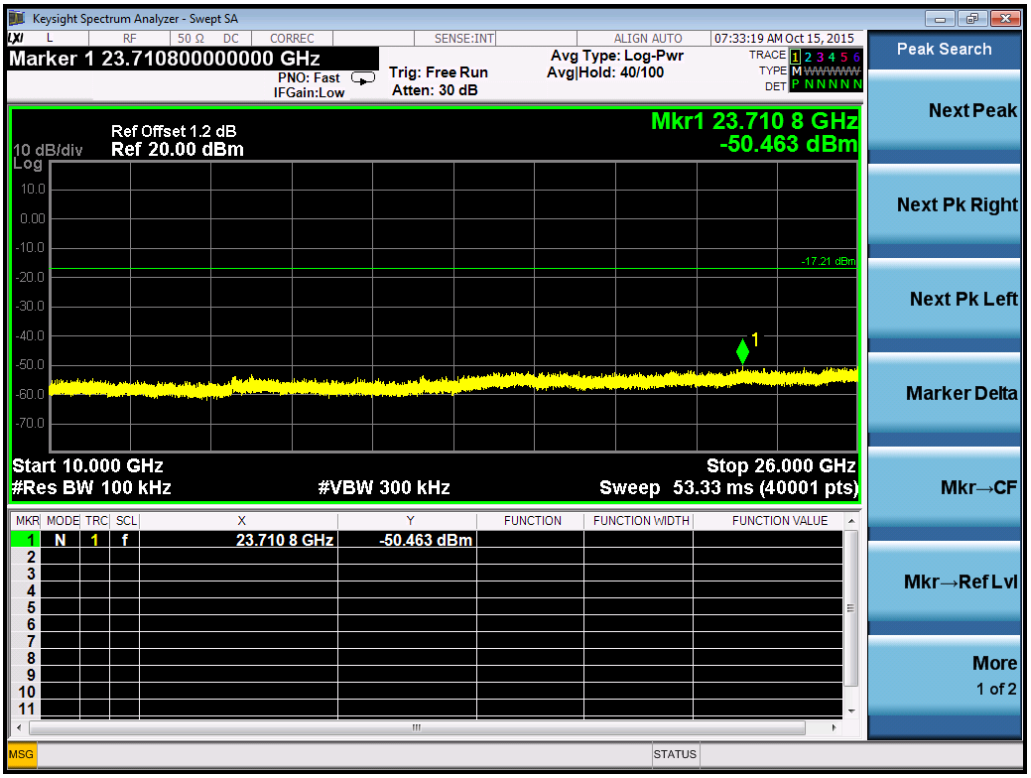


Frequency M – Port 1

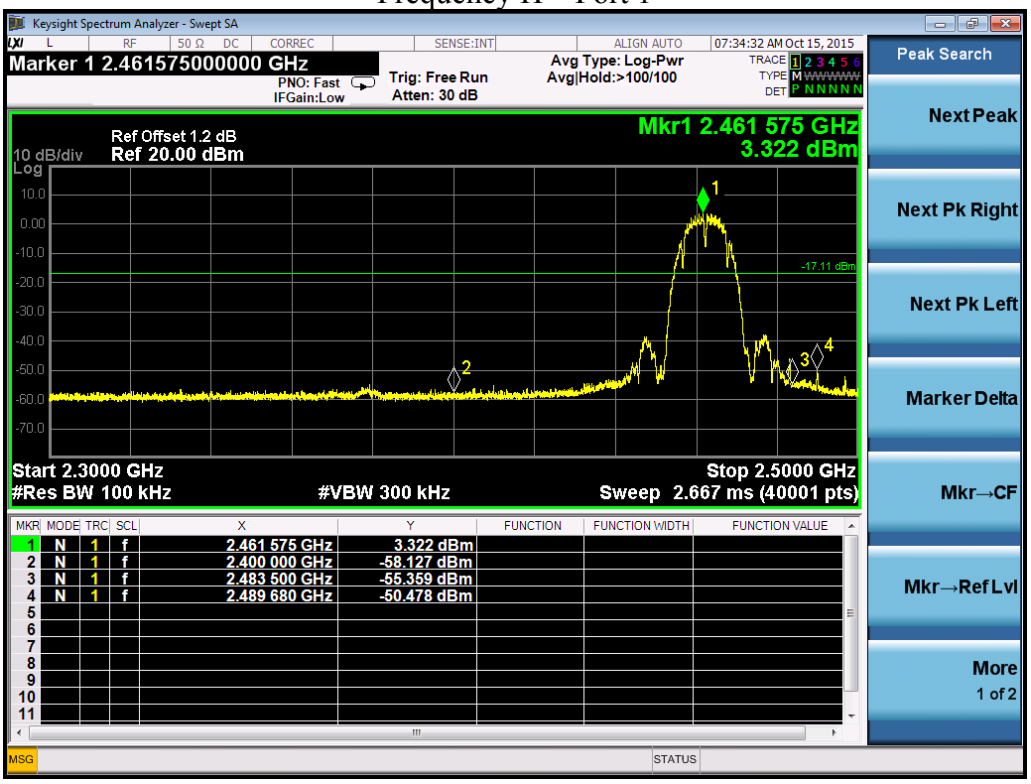


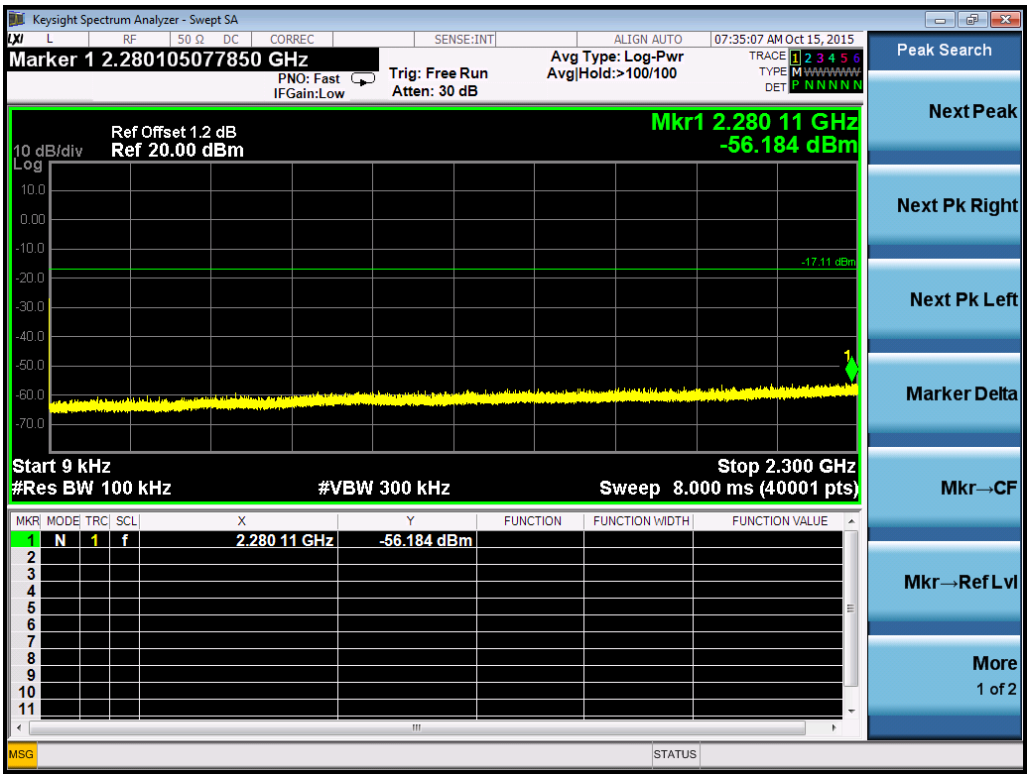


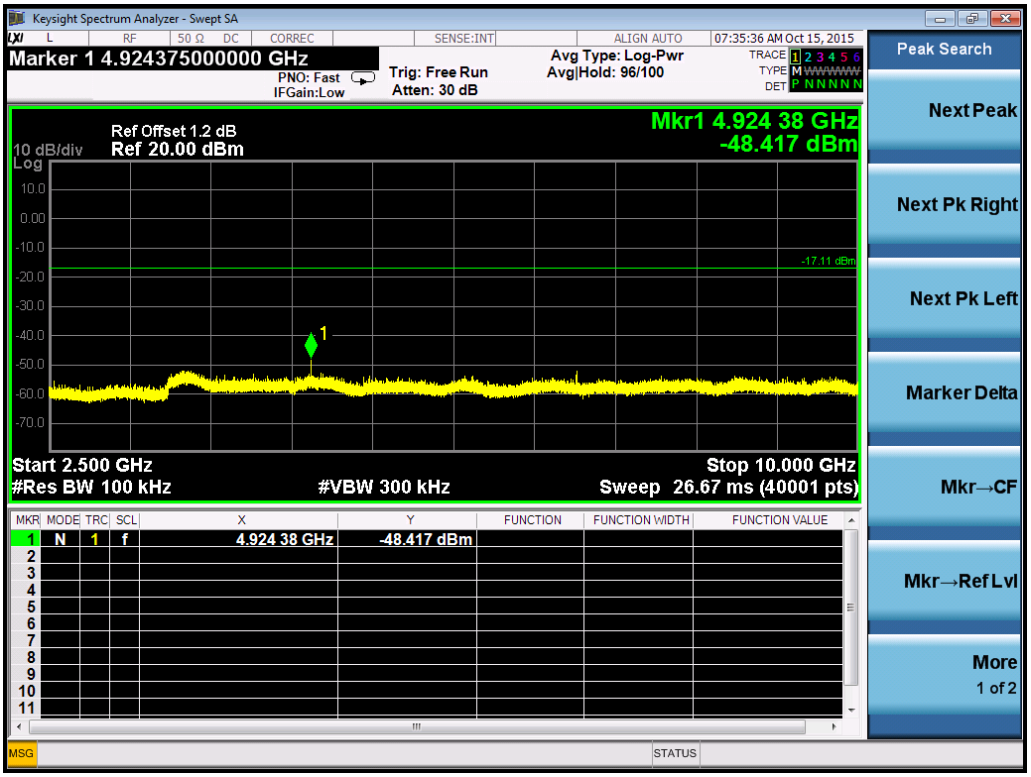


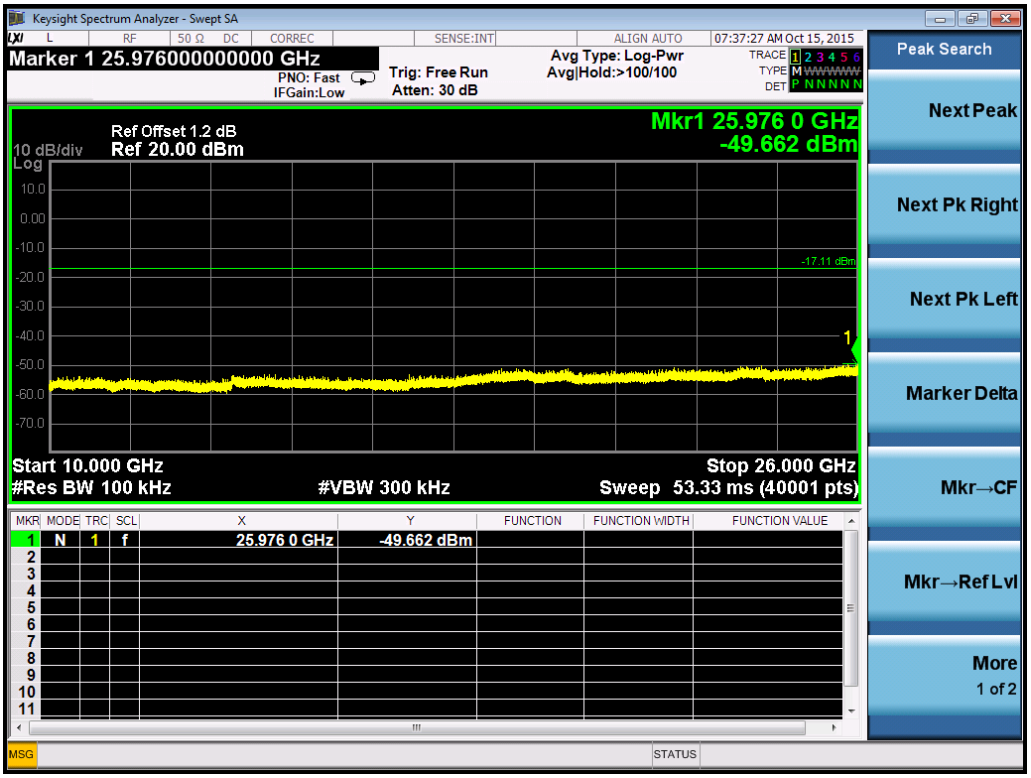


Frequency H – Port 1

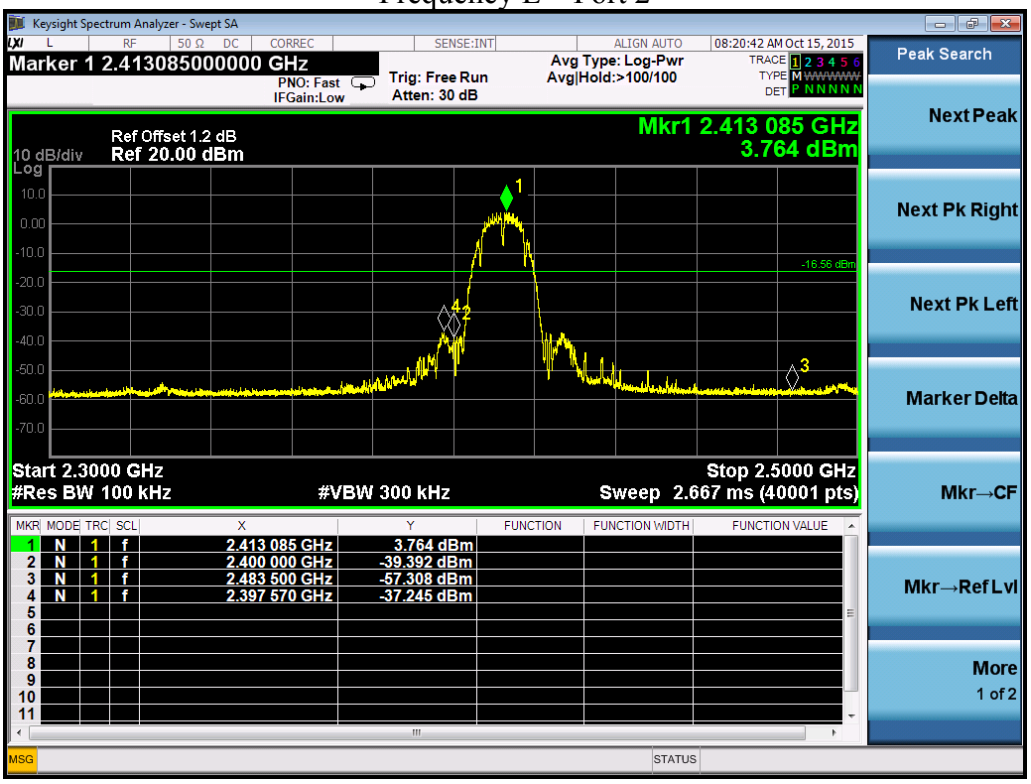


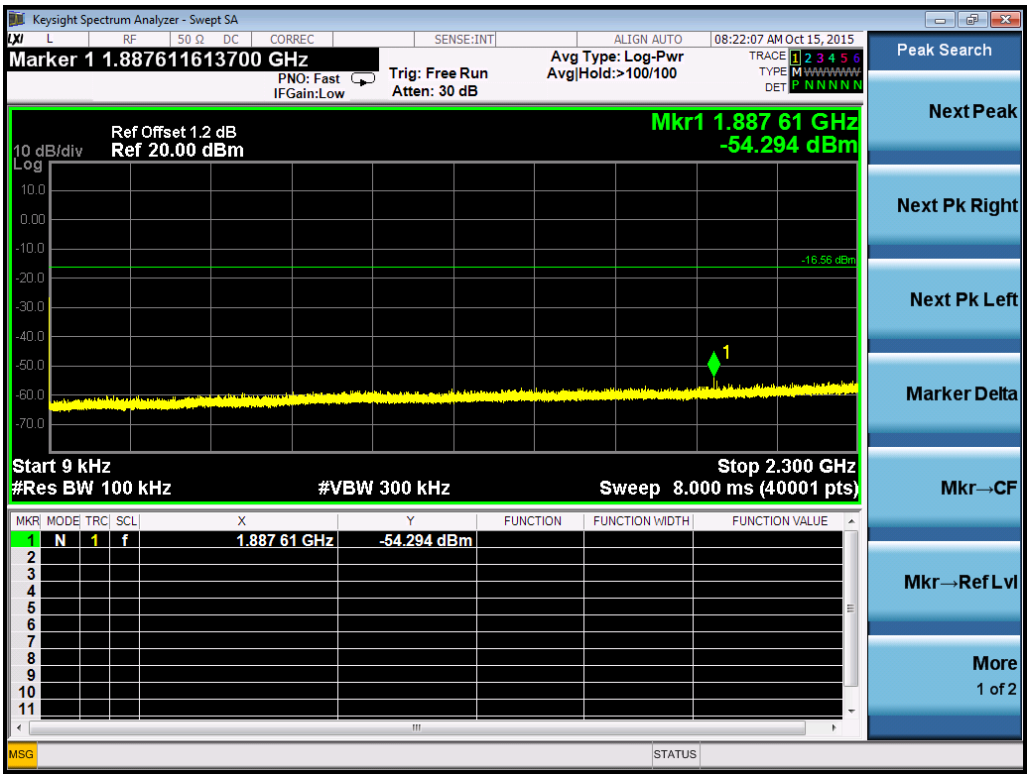


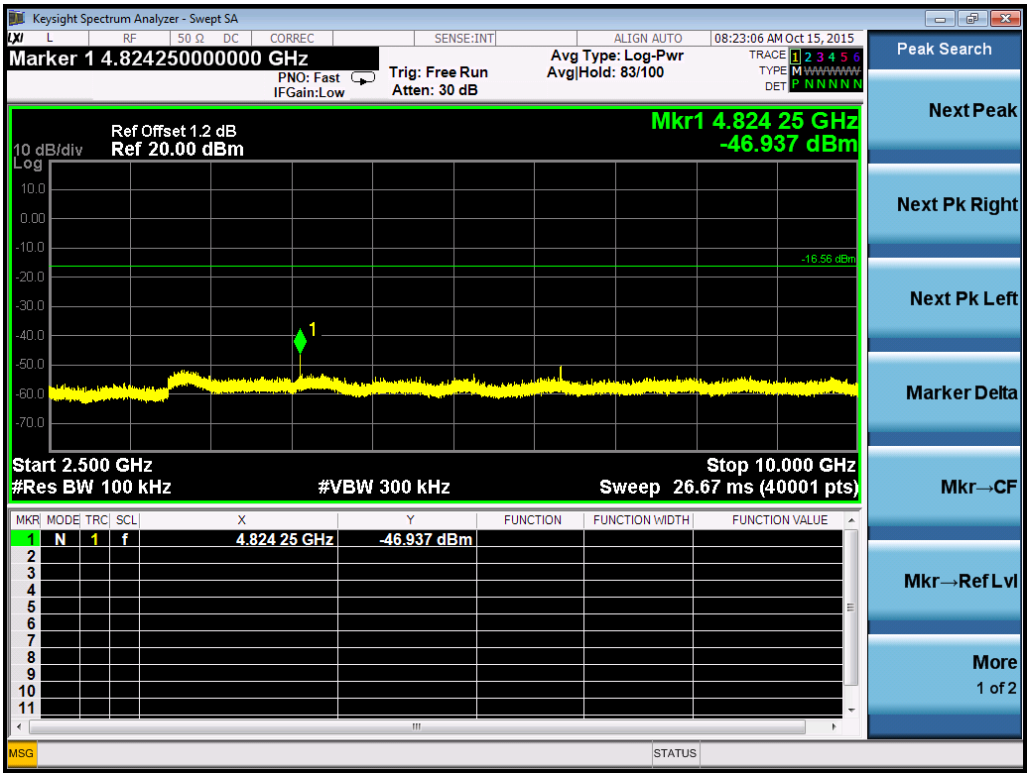


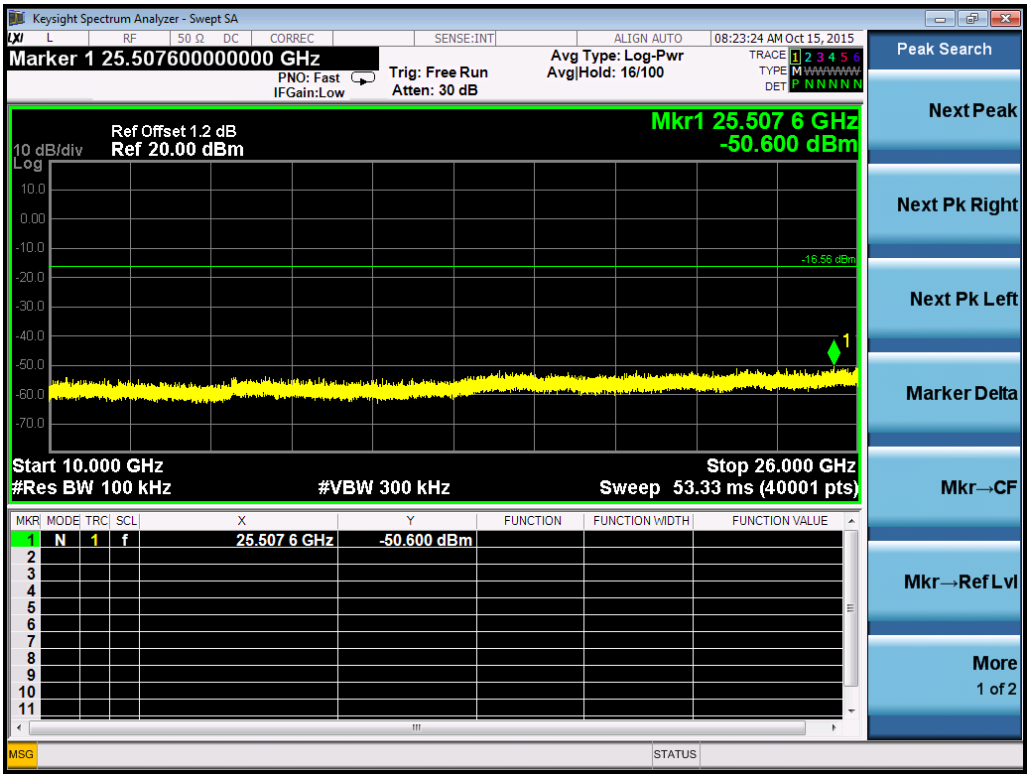


Frequency L – Port 2

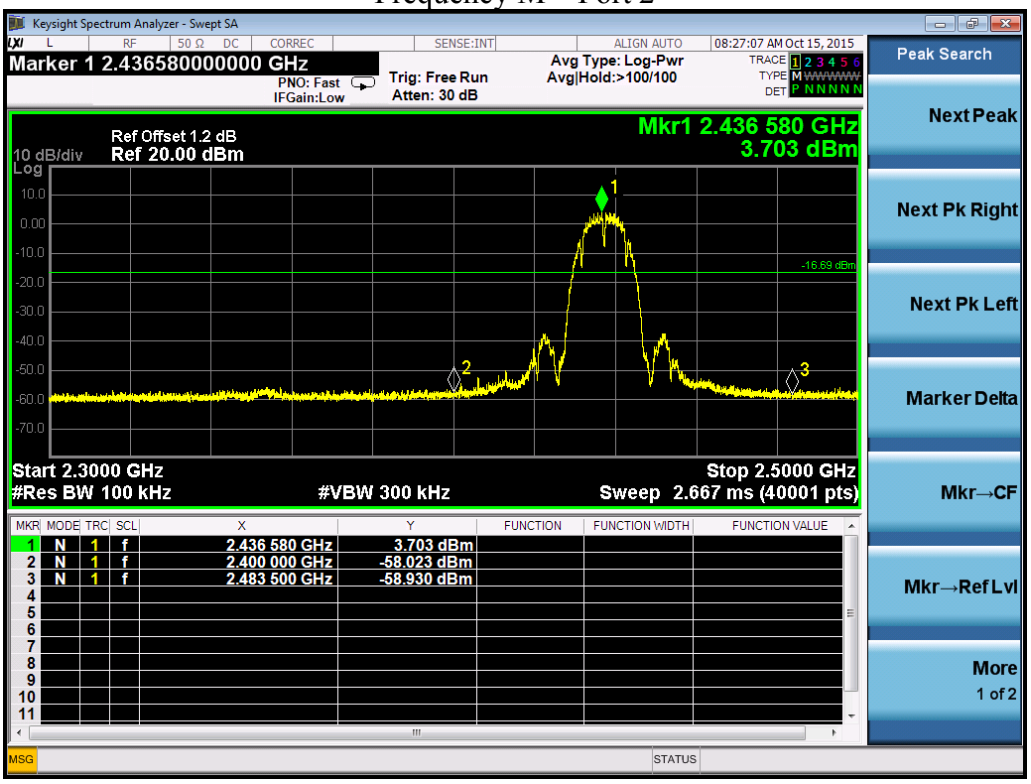


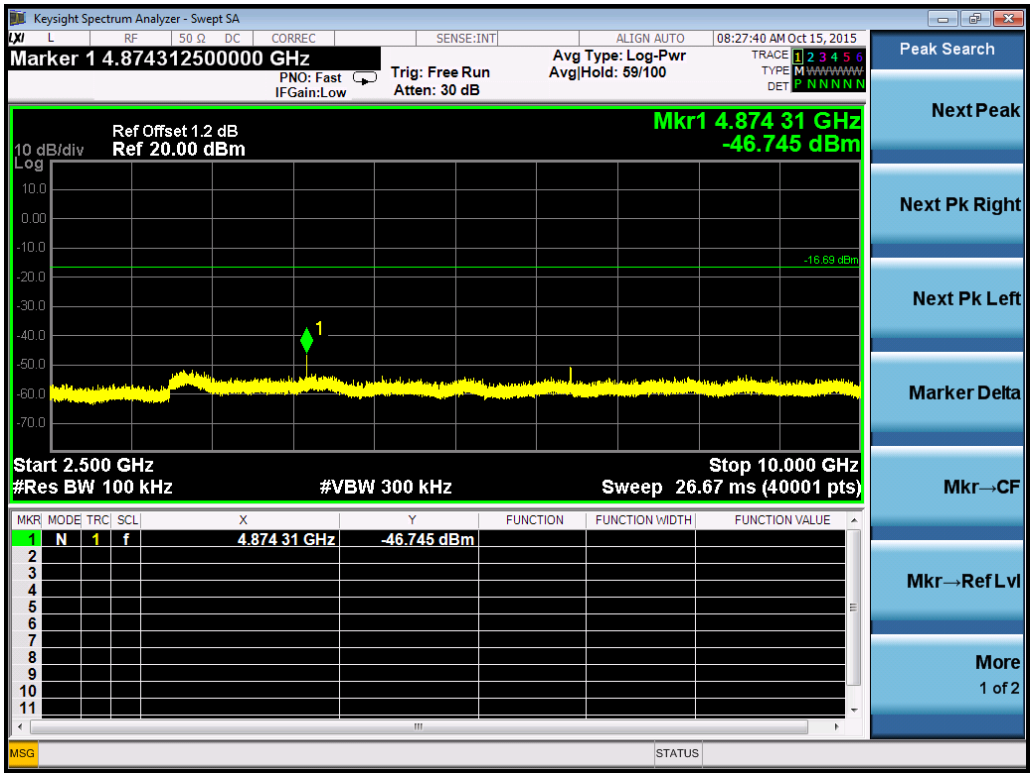


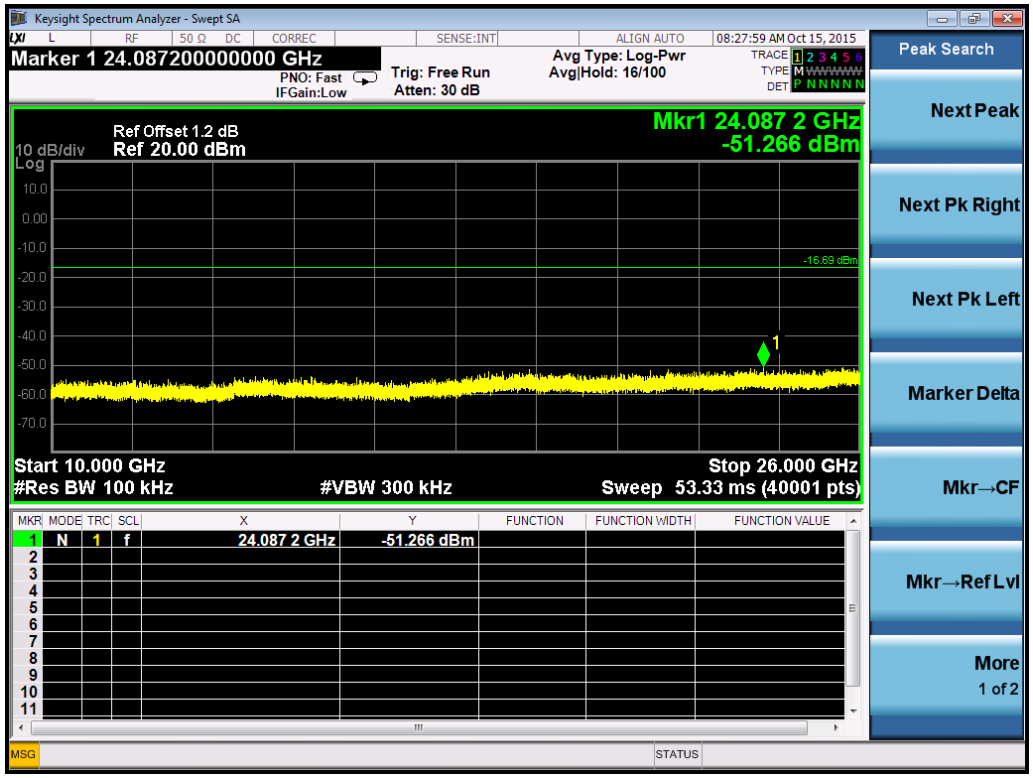




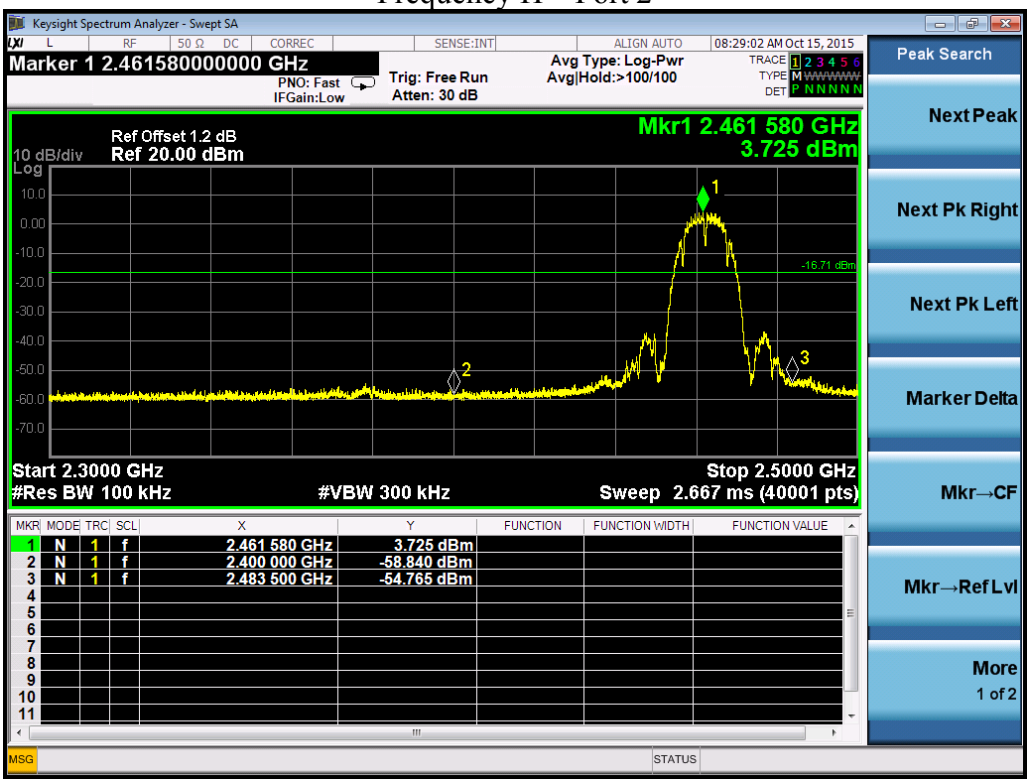
Frequency M – Port 2

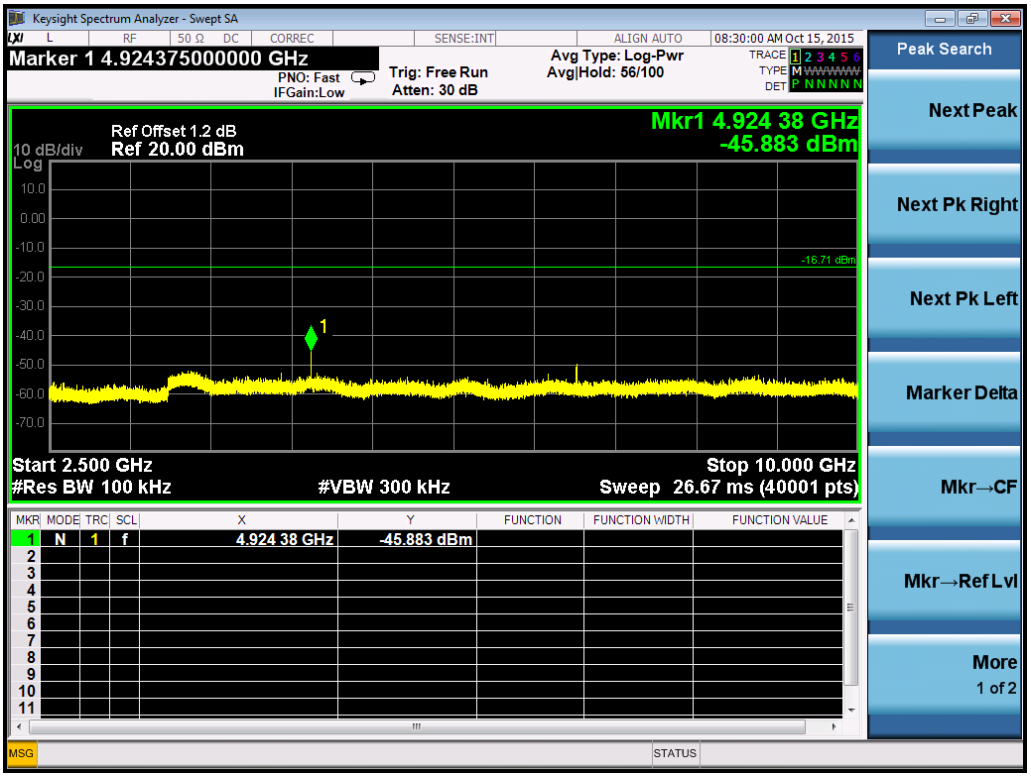


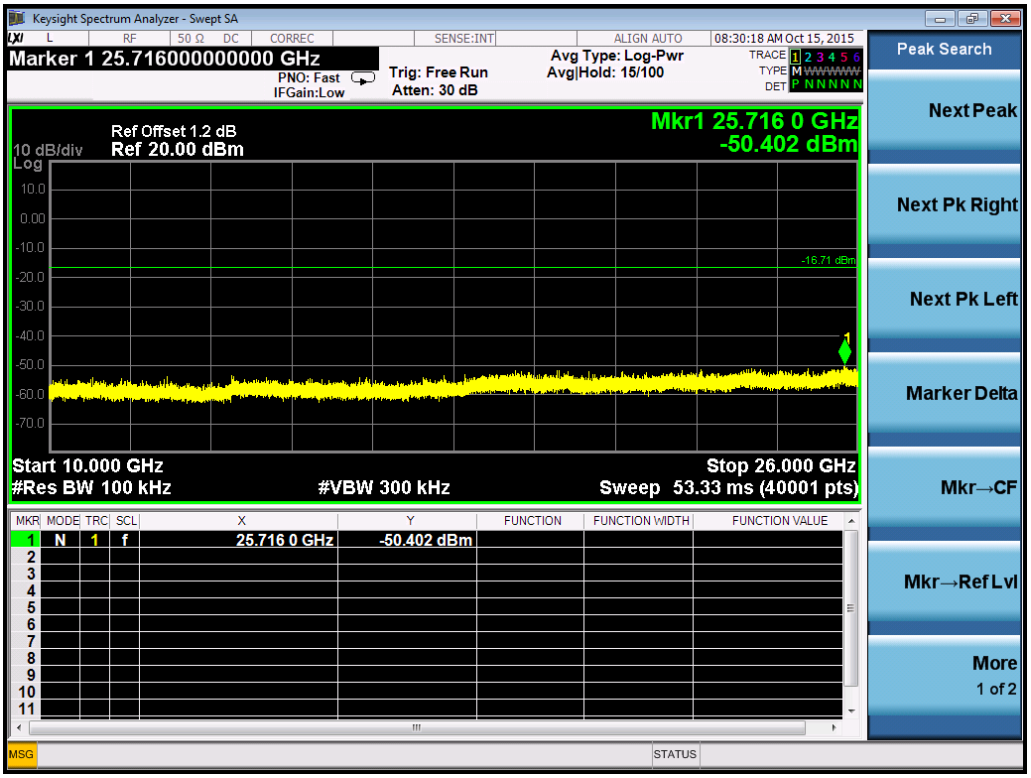




Frequency H – Port 2

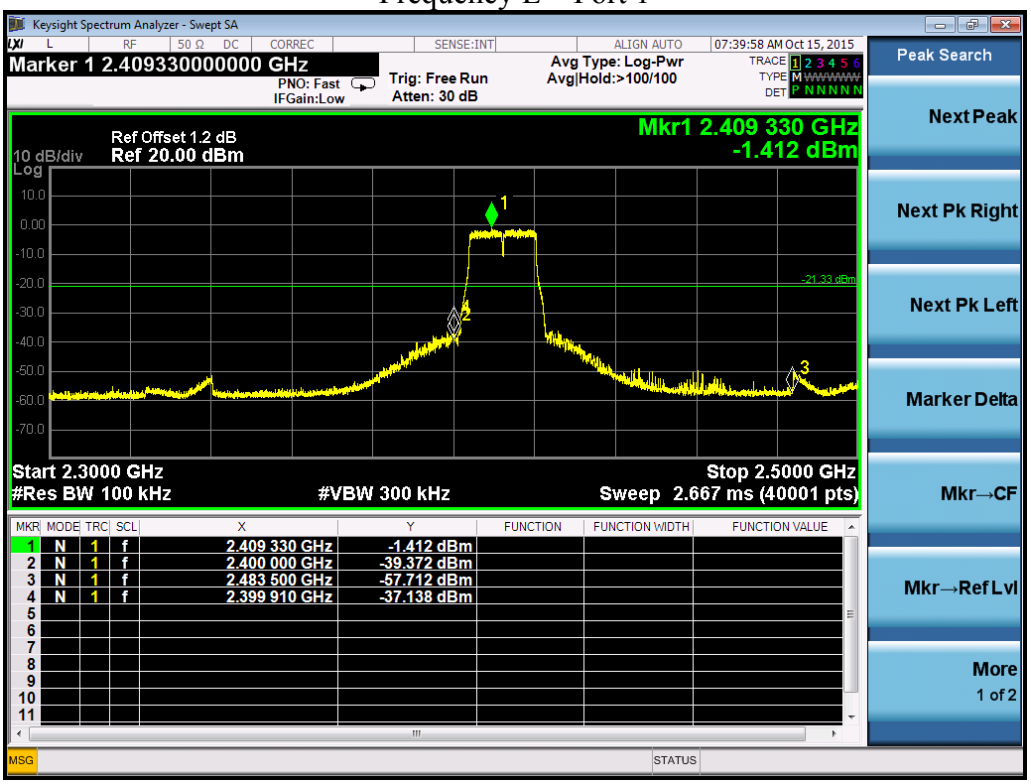


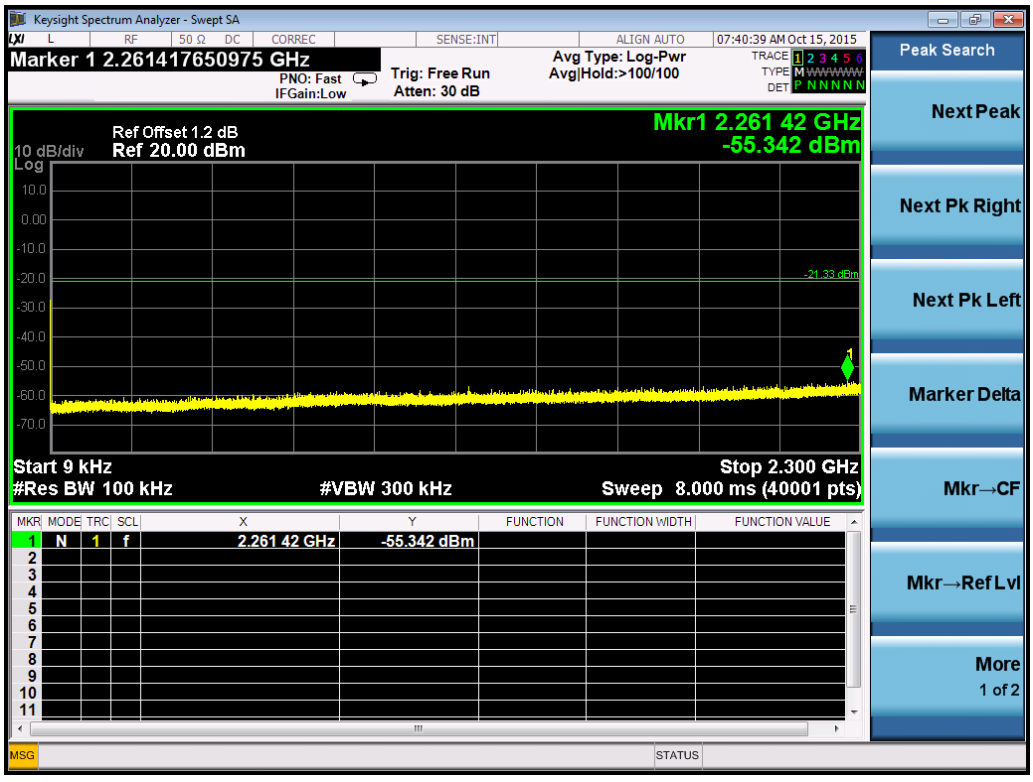


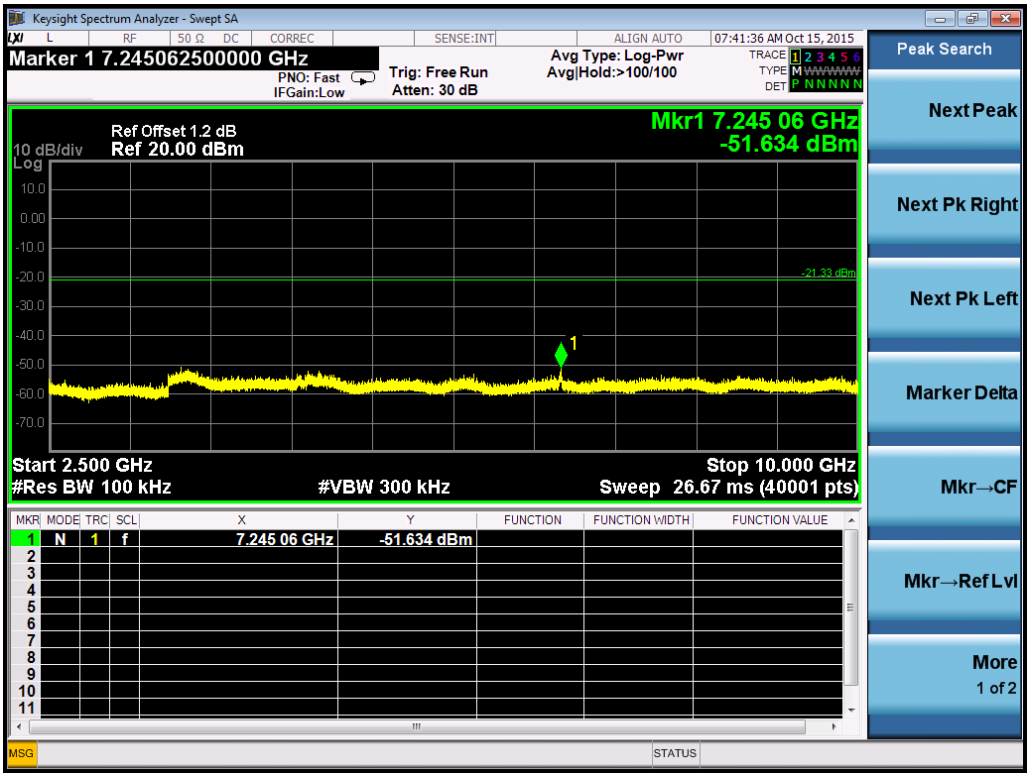


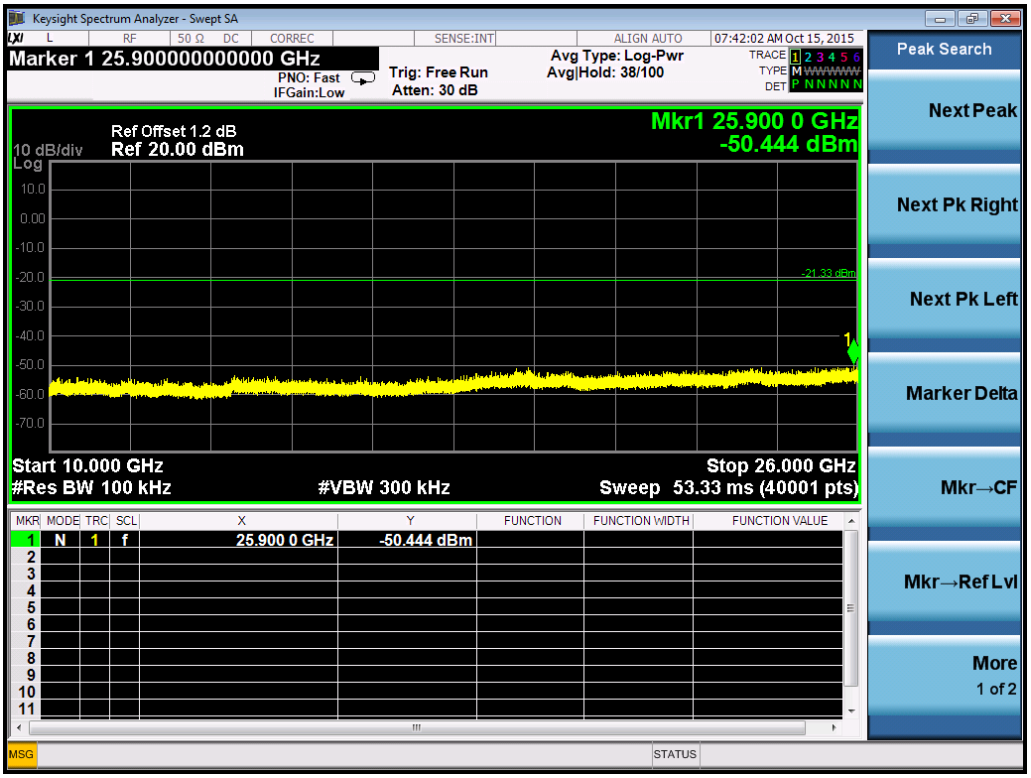
802.11g

Frequency L – Port 1









Frequency M – Port 1