FCC RF Verification Test Report

For

Beijing InHand Networks Technology Co., Ltd

Test Standards:	Part 15C Subpart C §15.247
Product Description:	Industrial cellular router
Tested Model:	IR611-S
Additional Model No.:	N/A
Brand Name:	InHand
FCC ID:	2AANYIR611S
Classification	(DTS) Digital Transmission System
Report No.:	EC1909032RF01
Tested Date:	2019-10-09 to 2019-10-29
Issued Date:	2019-10-29
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Approved By:	Bacon Wu / RF Manager

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Note: This report was based on the test report No.180119001RFC-1.

Report Revise Record

Report Version	Revise Time	Issued Date	Valid Version	Notes
V1.0	/	2019.10.29	Valid	Original Report

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Summary Of Test Result

FCC Rule	IC Rule	Description	Limit	Result	Remark
15.247(a)(2)	RSS-247 5.2(a)	6dB Bandwidth	≥ 0.5MHz	Note 1	-
-	RSS-Gen 6.7	99% Bandwidth	-	Note 1	-
15.247(b)(3)	RSS-247 A5.4(d)	Peak Output Power	≤ 30dBm	Pass	-
15.247(e)	RSS-247 5.2(b)	Power Spectral Density	≤ 8dBm/3kHz	Note 1	-
15.247(d)	RSS-247 5.5	Conducted Band Edges and Spurious Emission	≤ 20dBc	Note 1	-
15.247(d)	RSS-247 5.5	Radiated Band Edges and Spurious Emission	15.209(a) & 15.247(d)	Note 2	Under limit 4.65 dB at 539.250 MHz
15.207	RSS-GEN 8.8	AC Conducted Emission	15.207(a)	Note 1	-
15.203 & 15.247(b)	N/A	Antenna Requirement	N/A	Pass	-

Note 1: Refer to test report No.180119001RFC-1.

Note 2: According to the test report No.180119001RFC-1, only the worst case 802.11b low channel mode was reported.

1 Test Laboratory

1.1 Test facility

CNAS (accreditation number: L11138)

Hunan Ecloud Testing Technology Co., Ltd. has obtained the accreditation of China National Accreditation Service for Conformity Assessment (CNAS).

FCC (Designation number: CN1244 , Test Firm Registration Number: 793308)

Hunan Ecloud Testing Technology Co., Ltd. has been listed on the US Federal Communications Commission list of test facilities recognized to perform electromagnetic emissions measurements.

ISED(CAB identifier: CN0012, ISED# :24347)

Hunan Ecloud Testing Technology Co., Ltd. has been listed on the Wireless Device Testing Laboratories list of innovation, Science and Economic Development Canada to test to Canadian radio equipment requirements.

A2LA (Certificate Code : 4895.01)

Hunan Ecloud Testing Technology Co., Ltd. has been listed by American Association for Laboratory Accreditation to perform electromagnetic emission measurement.

2 General Description

2.1 Applicant

Beijing InHand Networks Technology Co., Ltd
302, floor 3, building 103, lize zhongyuan, chaoyang district, Beijing

2.2 Manufacturer

Beijing InHand Networks Technology Co., Ltd
302, floor 3, building 103, lize zhongyuan, chaoyang district, Beijing

2.3 General Description Of EUT

Product	Industrial cellular router	
Model No.	IR611-S	
Additional No.	N/A	
Difference Description	N/A	
FCC ID	2AANYIR611S	
Power Supply	12 Vdc From Adapter Input AC120V/60Hz	
Modulation Type	**WIFI**	802.11b : DSSS 802.11g/n : OFDM
	WCDMA	BPSK
	LTE	QPSK, 16QAM
Operating Frequency	**WIFI**	2412MHz~2462MHz
	WCDMA	826.4 MHz ~ 846.6 MHz (FOR WCDMA 850) 1852.4 MHz ~ 1907.6 MHz (FOR WCDMA 1900)
	LTE	LTE Band 2: 1805.7 MHz ~ 1909.3MHz LTE Band 4: 1710.7 MHz ~ 1754.3 MHz LTE Band 5: 824.7 MHz ~ 848.3 MHz LTE Band 12: 699.7 MHz ~ 715.3 MHz
Max. Peak Output Power	SISO_Chain 1 802.11b : 18.28 dBm (0.067 W) 802.11g : 20.06 dBm (0.101 W) SISO_Chain 2 802.11b : 19.61 dBm (0.091 W) 802.11g : 21.40 dBm (0.138 W) MIMO_Chain 1+2 802.11n HT20 : 23.80 dBm (0.240 W) 802.11n HT40 : 23.60 dBm (0.229 W)	
Antenna Type	Chain 1	

	Sucker antenna with 3dBi gain Chain 2 Sucker antenna with 3dBi gain
HW Version	V3.4
SW Version	V2.3.0
I/O Ports	Refer to user's manual

NOTE:

1. For a more detailed features description, please refer to the manufacturer's specifications or the user's manual.
2. For the test results, the EUT had been tested with all conditions. But only the worst case was shown in test report.
3. Antenna listed as below

Cable No.	Description	Connector	Length	Supplied by
1	WIFI Antenna	SMA	2.5m	Applicant
2	WIFI Antenna	SMA	2.5m	Applicant
3	4G Antenna	SMA-J	2.0m	Applicant
4	4G Antenna	SMA-J	2.0m	Applicant

2.4 Modification of EUT

No modifications are made to the EUT during all test items.

2.5 Applicable Standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

- FCC Part 15 Subpart C §15.247
- ANSI C63.10-2013
- KDB 558074 D01 15.247 Meas Guidance v05r02

Remark:

1. This EUT has also been tested and complied with the requirements of FCC Part 15, Subpart B, recorded in a separate test report.

3 Test Configuration of Equipment Under Test

3.1 Descriptions of Test Mode

11 channels are provided for 802.11b, 802.11g and 802.11n(HT20):

CHANNEL	FREQUENCY	CHANNEL	FREQUENCY
1	2412 MHz	7	2442 MHz
2	2417 MHz	8	2447 MHz
3	2422 MHz	9	2452 MHz
4	2427 MHz	10	2457 MHz
5	2432 MHz	11	2462 MHz
6	2437 MHz		

7 channels are provided for 802.11n(HT40):

CHANNEL	FREQUENCY	CHANNEL	FREQUENCY
		7	2442 MHz
		8	2447 MHz
3	2422 MHz	9	2452 MHz
4	2427 MHz		
5	2432 MHz		
6	2437 MHz		

The transmitter has a maximum peak conducted output power as follows:

Frequency Range(MHz)	Mode	Rate	Output Power(dBm)
2412~2462	802.11b	1 Mbps	Chain 0: 18.28 Chain 1: 19.61
2412~2462	802.11g	6 Mbps	Chain 0: 20.06 Chain 1: 21.40
2412~2462	802.11n HT20	MCS8	23.80
2422~2452	802.11n HT40	MCS8	23.60

a. Radiated emission and power line conducted emission were performed with the EUT set to transmit at the channel with highest output power as worst-case scenario.

3.2 Test Mode

3.2.1 Antenna Port Conducted Measurement

Summary table of Test Cases				
Test Item	Modulation			
	802.11 b	802.11 g	802.11n HT20	802.11n HT40
Conducted Test Cases	Mode 1: CH01 Mode 2: CH06 Mode 3: CH011	Mode 4: CH01 Mode 5: CH06 Mode 6: CH011	Mode 7: CH01 Mode 8: CH06 Mode 9: CH011	Mode 10: CH03 Mode 11: CH06 Mode 12: CH09

3.2.2 Radiated Emission Test (Below 1GHz)

Radiated Test Cases	Modulation
	Mode 1: 802.11 b CH01

Note : 1. Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, XYZ axis, antenna ports (if EUT with antenna diversity architecture) and packet type. Y orientation was worst-case orientation; therefore, all final radiated testing was performed with the EUT in Y orientation.

2. Following channel(s) was (were) selected for the final test as listed above

3.2.3 Radiated Emission Test (Above 1GHz)

Test Item	Modulation			
	802.11 b	802.11 g	802.11n HT20	802.11n HT40
Radiated Test Cases	Mode 1: CH01 Mode 2: CH06 Mode 3: CH011	Mode 4: CH01 Mode 5: CH06 Mode 6: CH011	Mode 7: CH01 Mode 8: CH06 Mode 9: CH011	Mode 10: CH03 Mode 11: CH06 Mode 12: CH09

Note : 1. The fundamental of the EUT was investigated in three orthogonal orientations X, Y and Z it was determined that Y orientation was worst-case orientation; therefore, all final radiated testing was performed with the EUT in Y orientation.

2. Following channel(s) was (were) selected for the final test as listed above

3. For frequency above 18GHz, the measured value is much lower than the limit, therefore, it is not reflected in the report.

3.2.4 Power Line Conducted Emission Test:

AC Conducted Emission	Mode 1 : RJ45(LAN) Link + WLAN Link + Adapter

3.3 Support Equipment

Support equipment

Manufacturer	Description	Model	Serial Number	Certificate	Supplied by
Lenovo	PC	Xiaoxinchao5000	PF0QPQMH	DOC	Ecloud

Support adapter

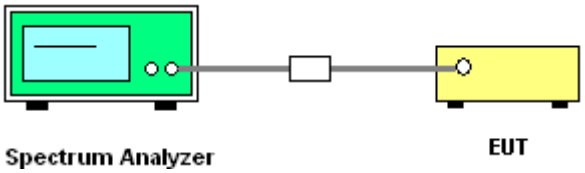
Adapter	
Brand:	KUANTEN
Model:	KT10W120100CHD
Input:	AC 100-240V, 50/60Hz, 0.4A
Output:	DC 12V, 1A
Supplied by	Applicant

3.4 Test Setup

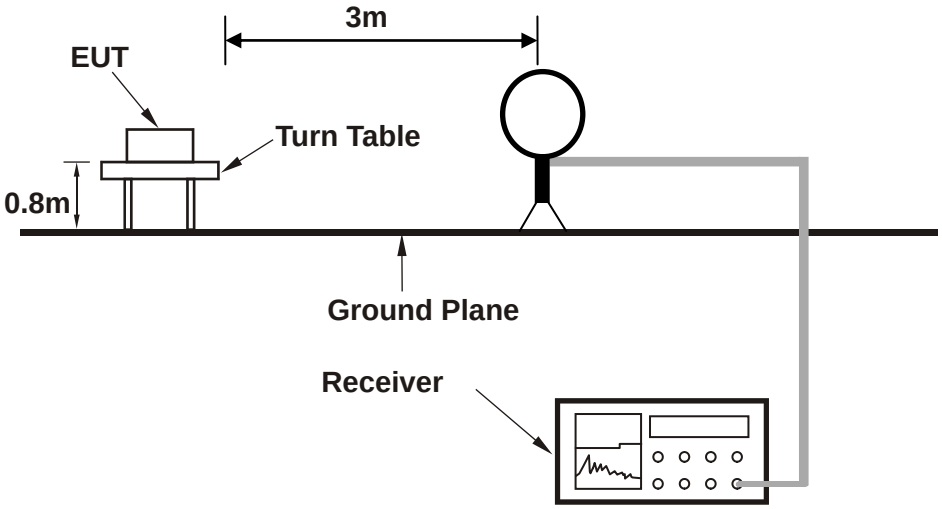
The EUT is continuously communicating to the Bluetooth tester during the tests.

EUT was set in the Hidden menu mode to enable BT communications.

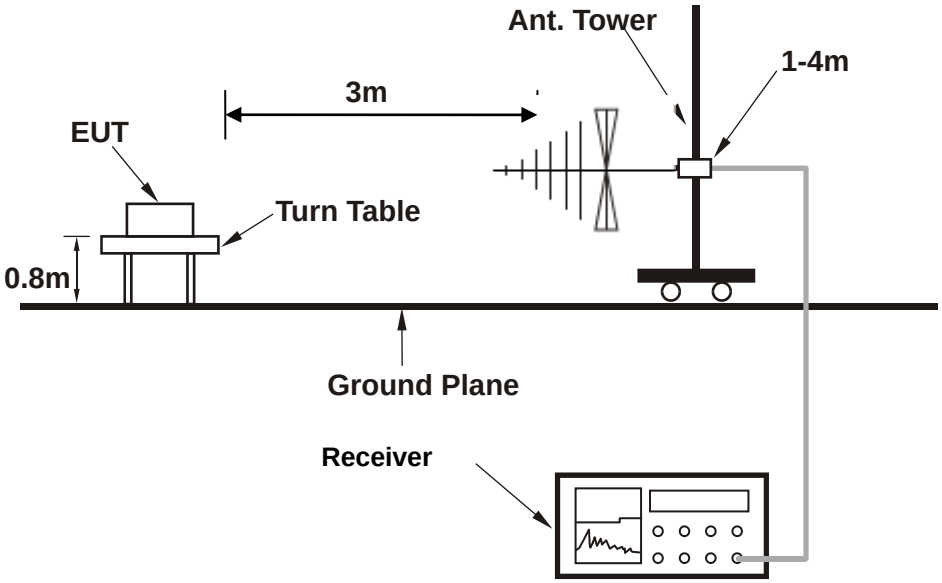
Setup diagram for Conducted Test



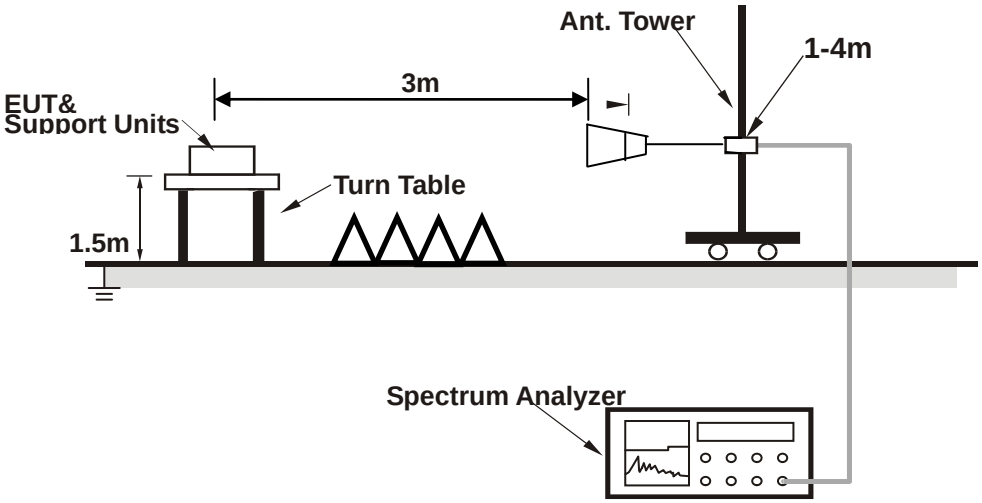
Setup diagram for Raidation(9KHz~30MHz) Test



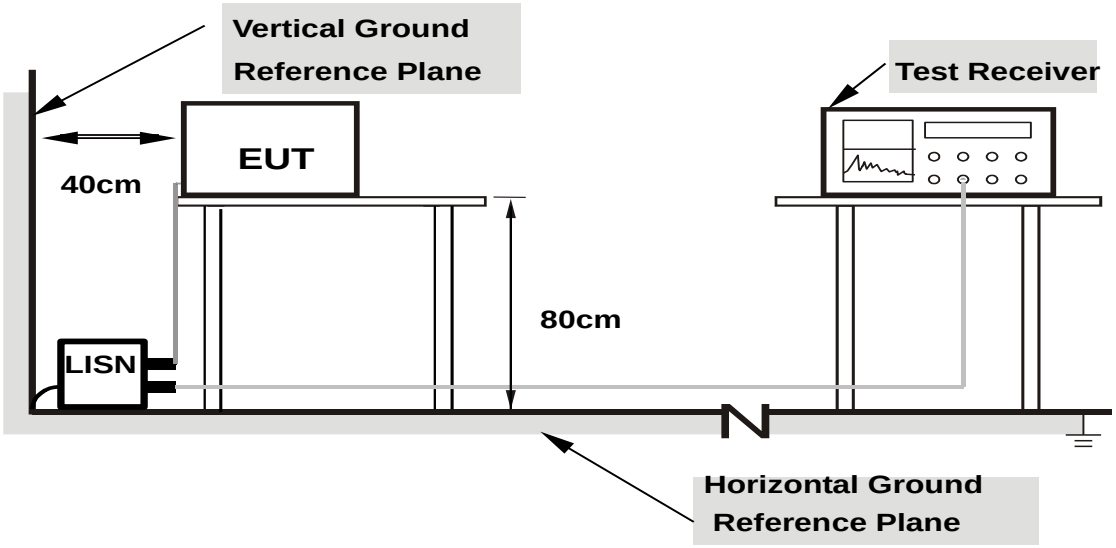
Setup diagram for Raidation(Below 1G) Test



Setup diagram for Raidation(Above1G) Test



Setup diagram for AC Conducted Emission Test



Note: 1.Support units were connected to second LISN.

2.Both of LISNs (AMN) are 80 cm from EUT and at least 80 from other units and other metal planes

3.5 Measurement Results Explanation Example

For all conducted test items:

The offset level is set in the spectrum analyzer to compensate the RF cable loss and attenuator factor between EUT conducted output port and spectrum analyzer. With the offset compensation, the spectrum analyzer reading level is exactly the EUT RF output level.

Example:

The spectrum analyzer offset is derived from RF cable loss and attenuator factor.

Offset = RF cable loss + attenuator factor.

Following shows an offset computation example with cable loss 5 dB and 10dB attenuator.

Offset(dB) = RF cable loss(dB) + attenuator factor(dB).

= 5 + 10 = 15 (dB)

4 Test Result

4.1 6dB and 99% Bandwidth Measurement

4.1.1 Limit of 6dB and 99% Bandwidth

FCC §15.247 (a) (2)

IC RSS-247 5.2(a)

The minimum 6 dB bandwidth shall be at least 500 kHz.

4.1.2 Test Procedures

1. The testing follows FCC KDB Publication No. 558074 DTS D01 Meas. Guidance v05r02.
2. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
3. Turn on the EUT and connect it to measurement instrument.
4. Set to the maximum power setting and enable Transmitting the EUT transmit continuously
5. Make the measurement with the spectrum analyzer's resolution bandwidth (RBW) = 100 kHz. Set the Video bandwidth (VBW) = 300 kHz. In order to make an accurate measurement. The 6 dB bandwidth must be greater than 500 kHz.
6. For 99% Bandwidth Measurement, the spectrum analyzer's resolution bandwidth (RBW) = 100KHz and set the Video bandwidth (VBW) = 300KHz.

4.1.3 Test Result of 6dB and 99% Bandwidth

Refer to test report No.180119001RFC-1.

4.2 Output Power Measurement

4.2.1 Limit of Output Power

FCC §15.247 (b)(3)

IC RSS-247 A5.4(d)

For systems using digital modulation in the 2400-2483.5 MHz bands: 30dBm.

4.2.2 Test Procedures

Average power measurement procedure:

1. The testing follows the Measurement Procedure of ANSI C63.10-2013 section 11.9.2.2.4 Measurement using a spectrum analyzer.
2. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
3. Turn on the EUT and connect it to spectrum analyzer.
4. Set to the maximum power setting and enaBle Transmitting the EUT transmit continuously
5. Measure the duty cycle, x, of the transmitter output signal as described in below:
   a. Set the center frequency of the instrument to the center frequency of the transmission.
   b. Set RBW to the largest availaBle Transmitting value.
   c. Set detector = peak
6. Set span to at least 1.5*OBW.Set RBW=510KHz,VBW=2MHz, Number of points in sweep ≥ 2/3* span, Sweep time = auto. Detector = RMS
7. Allow the sweep to “free run”. Trace average 100 traces in RMS mode
8. Compute power by integrating the spectrum across the OBW of the signal using the instrument’s Channel power measurement function with band limits set equal to the OBW band edges.
9. Add 10 log (1/x), where x is the duty cycle.

Peak power measurement procedure:

1. Turn on the EUT and connec it to power meter.
2. Recorded the peak power.

4.2.3 Test Result of Output Power

Refer to Appendix A

4.3 Power Spectral Density Measurement

4.3.1 Limits of Power Spectral Density

FCC§15.247(e)

IC RSS-247 5.2(b)

The peak power spectral density shall not be greater than 8dBm in any 3kHz band at any time interval of continuous transmission.

4.3.2 Test Procedure

1. The testing follows Measurement Procedure 8.4 DTS maximum power spectral density level in the fundamental emission of ANSI C63.10-2013 section 11.9.2.2.4
2. Turn on the EUT and connect it to measurement instrument.
3. Measure the duty cycle, x, of the transmitter output signal as described in below:
   a. Set the center frequency of the instrument to the center frequency of the transmission.
   b. Set RBW to the largest availaBle Transmitting value.
   c. Set detector = peak
4. Set span to at least 1.5*OBW.Set RBW= 3 KHz,VBW=10 KHz, Number of points in sweep ≥ 2/3* span, Sweep time = auto.
5. Detector = power averaging (rms), Sweep time = auto couple, Trace mode = averaging (rms) mode over a minimum of 100 traces. Use the peak marker function to determine the maximum power level.
6. Add 10 log (1/x), where x is the duty cycle.
7. Measure and record the results in the test report.
8. The Measured power density (dBm)/ 100kHz is a reference level and used as 30dBc down limit line for Conducted Band Edges and Conducted Spurious Emission.

4.3.3 Test Result of Power Spectral Density

Refer to test report No.180119001RFC-1.

4.4 Conducted Band Edges and Spurious Emission Measurement

4.4.1 Limit of Conducted Band Edges and Spurious Emission

FCC §15.247 (d)

IC RSS-247 5.5

Maximum conducted (average) output power was used to determine compliance, then the peak power in any 100 kHz bandwidth outside of the authorized frequency band shall be attenuated by at least 30 dB relative to the maximum in-band peak PSD level in 100 kHz (i.e., 30 dBc).

4.4.2 Test Procedures

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Turn on the EUT and connect it to measurement instrument.
3. Set RBW = 100 kHz, VBW=300 kHz, Peak Detector. Unwanted Emissions measured in any 100 kHz bandwidth outside of the authorized frequency band shall be attenuated by at least 20 dB relative to the maximum in-band peak PSD level in 100 kHz when maximum peak conducted output power procedure is used. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, the attenuation required under this paragraph shall be 30 dB instead of 20 dB per 15.247(d).
4. Measure and record the results in the test report.
5. The RF fundamental frequency should be excluded against the limit line in the operating frequency band.

4.4.3 Test Result of Conducted Band Edges

Refer to test report No.180119001RFC-1.

4.4.4 Test Result of Conducted Spurious Emission

Refer to test report No.180119001RFC-1.

4.5 Radiated Band Edges and Spurious Emission Measurement

4.5.1 Limit of Radiated Band Edges and Spurious Emission

FCC §15.247 (d)

IC RSS-247 5.5

In any 100 kHz bandwidth outside the intentional radiator frequency band, all harmonics/spurious must be at least 20 dB below the highest emission level within the authorized band. In addition, radiated emissions which fall in the restricted bands must also comply with the FCC section 15.209 limits as below.

Frequency (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
0.009 – 0.490	2400/F(kHz)	300
0.490 – 1.705	24000/F(kHz)	30
1.705 – 30.0	30	30
30 – 88	100	3
88 – 216	150	3
216 - 960	200	3
Above 960	500	3

The high frequency, which above 18GHz, was pre-scanned and the result which was 20dB lower than the limit line was not reported.

4.5.2 Test Procedures

1. The EUT was placed on a turntable with 0.8 meter for frequency below 1GHz and 1.5 meter for frequency above 1GHz respectively above ground.
2. The measurement distance is 3 meter.
3. For each suspected emission, the EUT was arranged to its worst case and then tune the Antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level to comply with the guidelines.
4. Set to the maximum power setting and enable the EUT transmit continuously.
5. Use the following spectrum analyzer settings:
   (1) Span shall wide enough to fully capture the emission being measured;
   (2) Set RBW=100 kHz for f < 1 GHz, RBW=1MHz for f>1GHz ; VBW RBW; Sweep = auto; Detector function = peak; Trace = max hold for peak
   (3) For average measurement:
   VBW = 10 Hz, when duty cycle is no less than 98 percent.
   VBW ≥ 1/T, when duty cycle is less than 98 percent where T is the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation.

Band	Duty Cycle(%)	T(ms)	1/T(kHz)	VBW Setting
802.11b	97.66	8.68	0.115	300Hz
802.11g	87.58	1.44	0.694	1KHz
2.4GHz 802.11n HT20	86.74	1.33	0.752	1KHz
2.4GHz 802.11n HT40	76.22	0.65	1.54	3KHz

Refer to Appendix B

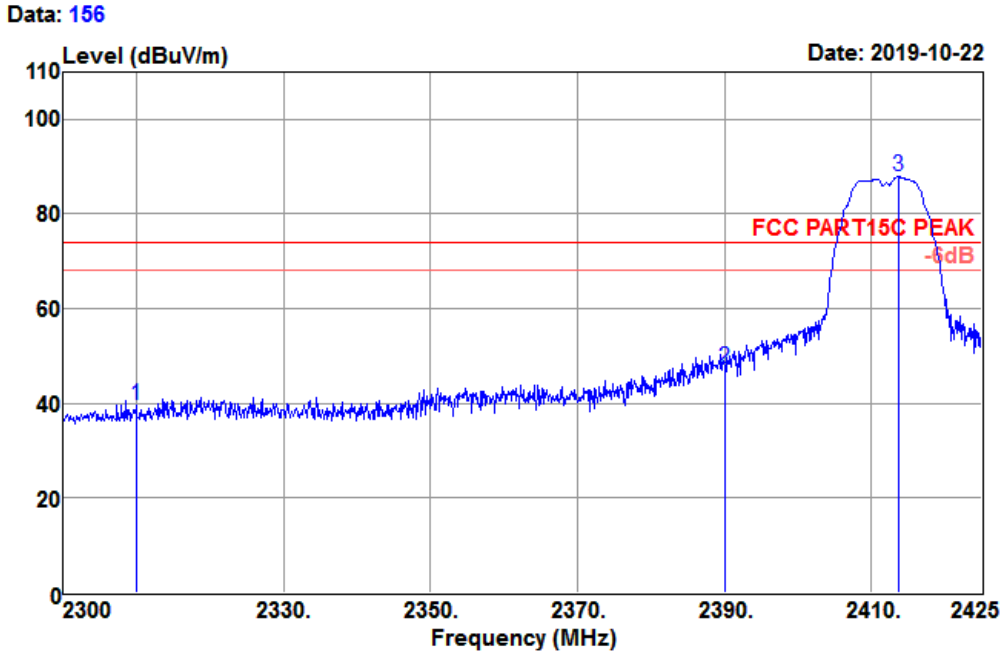
6. Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level

4.5.3 Test Results of Radiated Spurious Emissions (9 kHz ~ 30 MHz)

The low frequency, which started from 9 kHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit line per 15.31(o) was not reported.

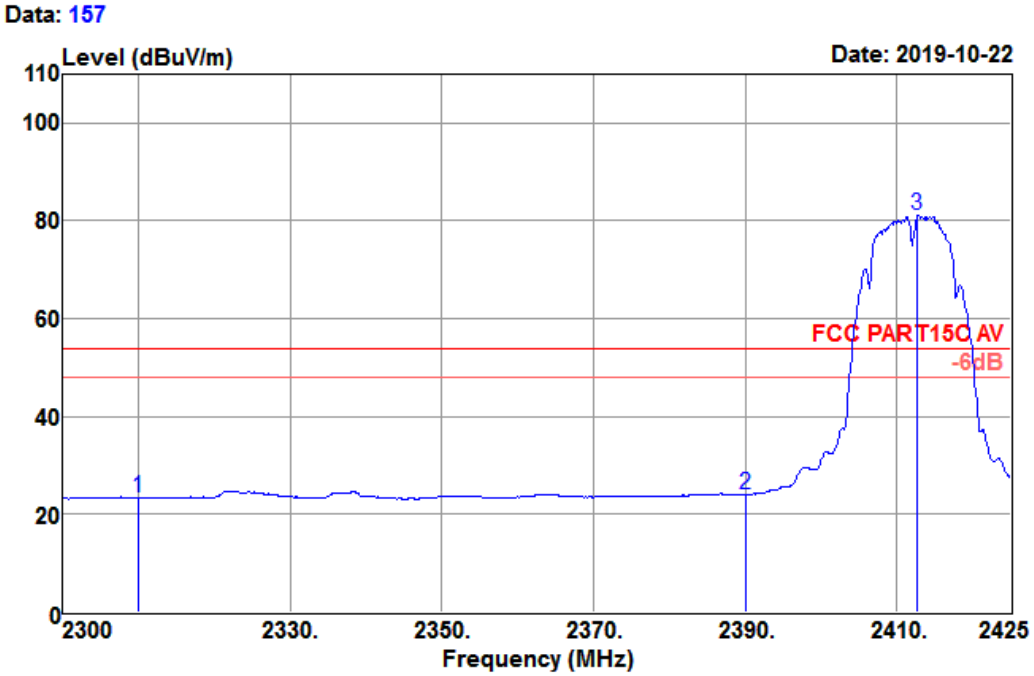
4.5.4 Test Result of Radiated Spurious at Band Edges

Test Mode :	802.11b CH01 (2412 MHz)	**Temperature :**	21~23℃
Test Engineer :	Jack Liu	**Relative Humidity :**	63~65%
Frequencey Range	2.3GHz~2.425GHz	**Polarization :**	Horizontal



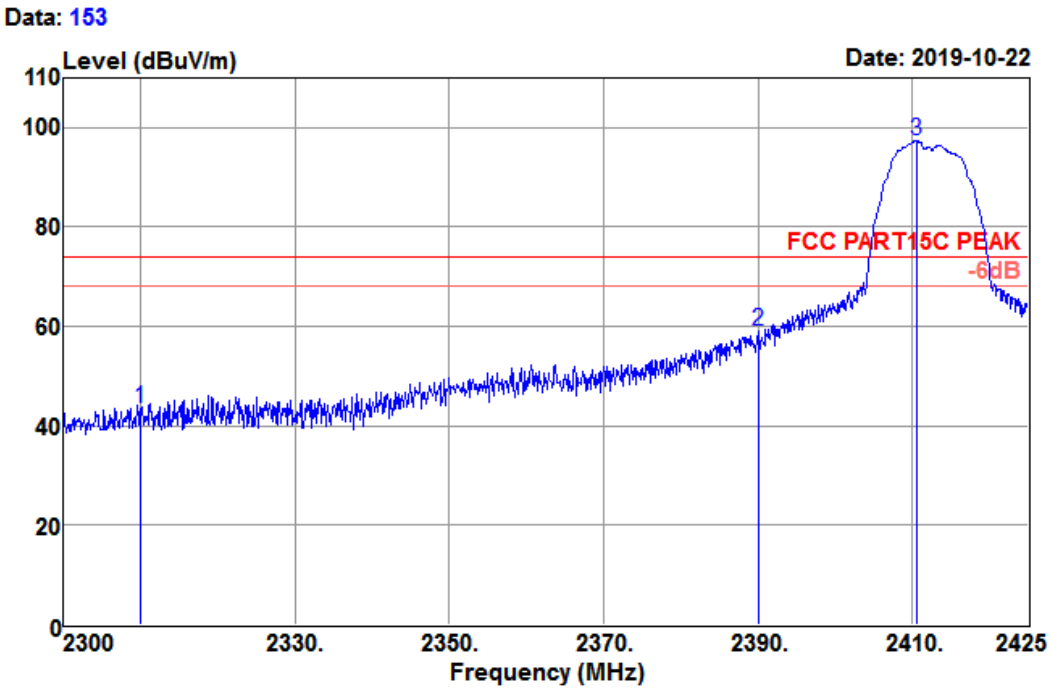
Freq	Reading level	Antenna factor	Cable loss	Preamp factor	level	Limit level	Over limit	Remark
MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB	
2310.000	44.56	26.91	3.48	35.43	39.52	74.00	-34.48	Peak
2390.000	52.21	27.11	3.53	35.55	47.30	74.00	-26.70	Peak
2413.625	92.73	27.18	3.55	35.58	87.88	74.00	13.88	Peak

Test Mode :	802.11b CH01 (2412 MHz)	Temperature :	21~23℃
Test Engineer :	Jack Liu	Relative Humidity :	63~65%
Frequencey Range	2.3GHz~2.425GHz	Polarization :	Horizontal



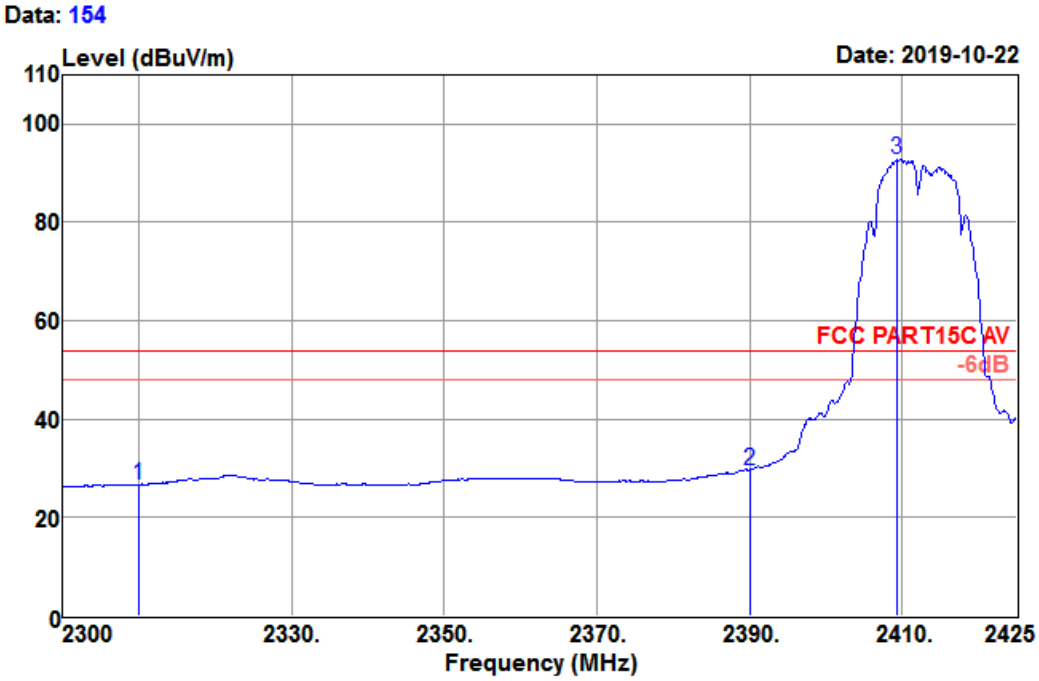
Freq	Reading level	Antenna factor	Cable loss	Preamp factor	level	Limit level	Over limit	Remark
MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB	
2310.000	28.44	26.91	3.48	35.43	23.40	54.00	-30.60	Average
2390.000	28.90	27.11	3.53	35.55	23.99	54.00	-30.01	Average
2412.750	85.96	27.17	3.55	35.58	81.10	54.00	27.10	Average

Test Mode :	802.11b CH01 (2412 MHz)	Temperature :	21~23℃
Test Engineer :	Jack Liu	Relative Humidity :	63~65%
Frequencey Range	2.3GHz~2.425GHz	Polarization :	Vertical



Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV/m	Limit level dBuV/m	Over limit dB	Remark
2310.000	48.41	26.91	3.48	35.43	43.37	74.00	-30.63	Peak
2390.000	63.83	27.11	3.53	35.55	58.92	74.00	-15.08	Peak
2410.625	102.17	27.17	3.55	35.57	97.32	74.00	23.32	Peak

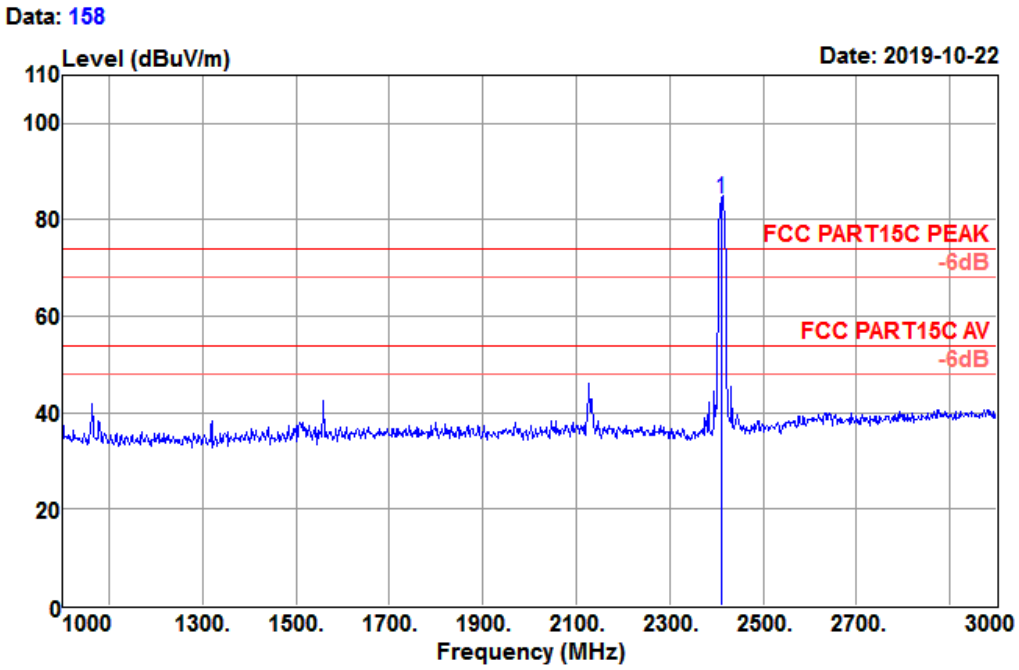
Test Mode :	802.11b CH01 (2412 MHz)	Temperature :	21~23℃
Test Engineer :	Jack Liu	Relative Humidity :	63~65%
Frequencey Range	2.3GHz~2.425GHz	Polarization :	Vertical



Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV/m	Limit level dBuV/m	Over limit dB	Remark
2310.000	31.76	26.91	3.48	35.43	26.72	54.00	-27.28	Average
2390.000	34.59	27.11	3.53	35.55	29.68	54.00	-24.32	Average
2409.250	97.84	27.16	3.55	35.57	92.98	54.00	38.98	Average

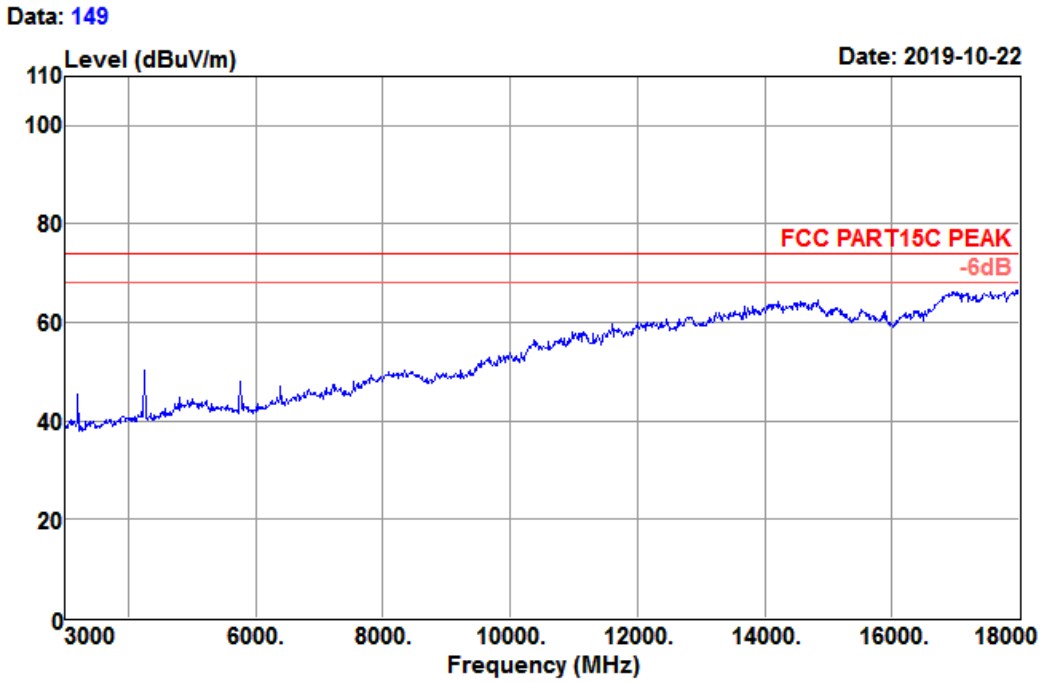
4.5.5 Test Result of Radiated Spurious Emission (1GHz ~ 10th Harmonic)

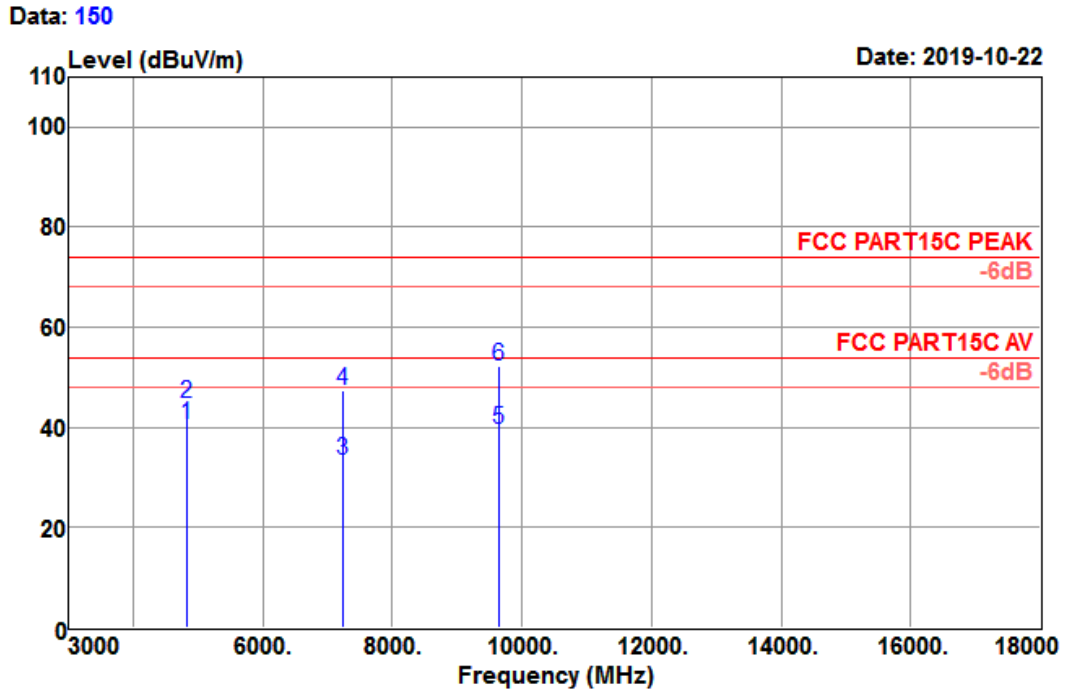
Test Mode :	802.11b CH01 (2412 MHz)	**Temperature :**	21~23℃
Test Engineer :	Jack Liu	**Relative Humidity :**	63~65%
Frequencey Range	1GHz~3GHz	**Polarization :**	Horizontal



Freq	Reading level	Antenna factor	Cable loss	Preamp factor	level	Limit level	Over limit	Remark
MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB	
2412.000	89.32	27.17	3.55	35.58	84.46	74.00	10.46	Peak

Test Mode :	802.11b CH01 (2412 MHz)	**Temperature :**	21~23℃
Test Engineer :	Jack Liu	**Relative Humidity :**	63~65%
Frequencey Range	3GHz~18GHz	**Polarization :**	Horizontal

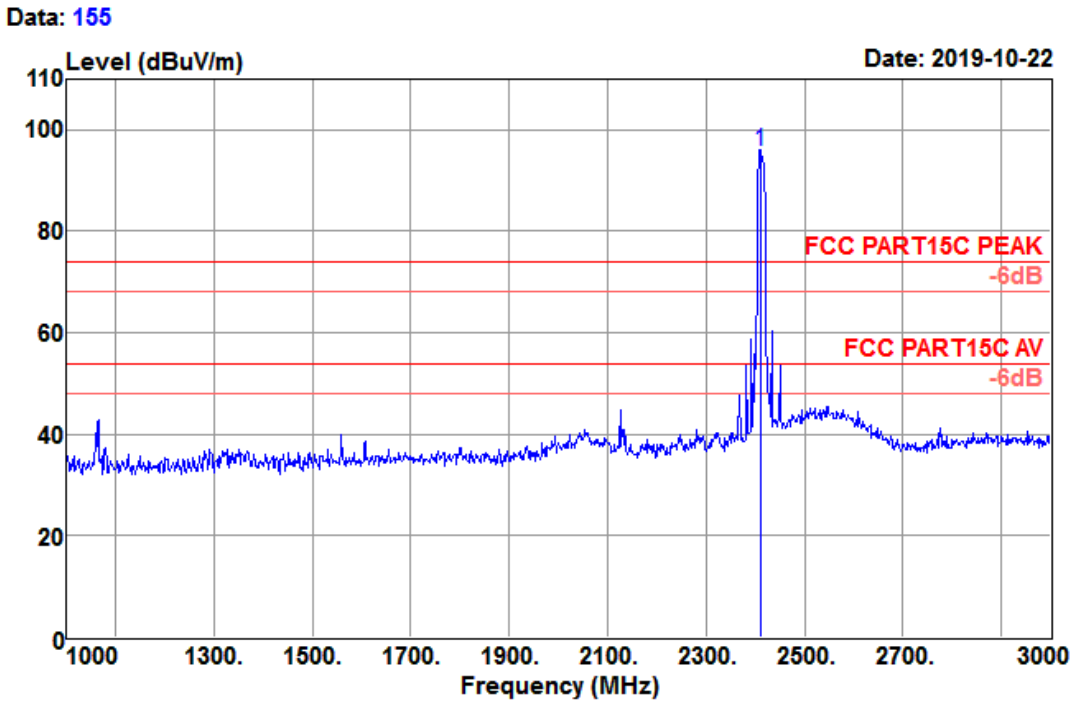




Freq	Reading level	Antenna factor	Cable loss	Preamp factor	level	Limit level	Over limit	Remark
MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB	
4824.000	38.42	31.28	5.56	34.84	40.42	54.00	-13.58	Average
4824.000	42.84	31.28	5.56	34.84	44.84	74.00	-29.16	Peak
7236.000	26.40	35.94	7.61	36.40	33.55	54.00	-20.45	Average
7236.000	40.20	35.94	7.61	36.40	47.35	74.00	-26.65	Peak
9648.000	27.75	37.87	10.41	36.40	39.63	54.00	-14.37	Average
9648.000	40.46	37.87	10.41	36.40	52.34	74.00	-21.66	Peak

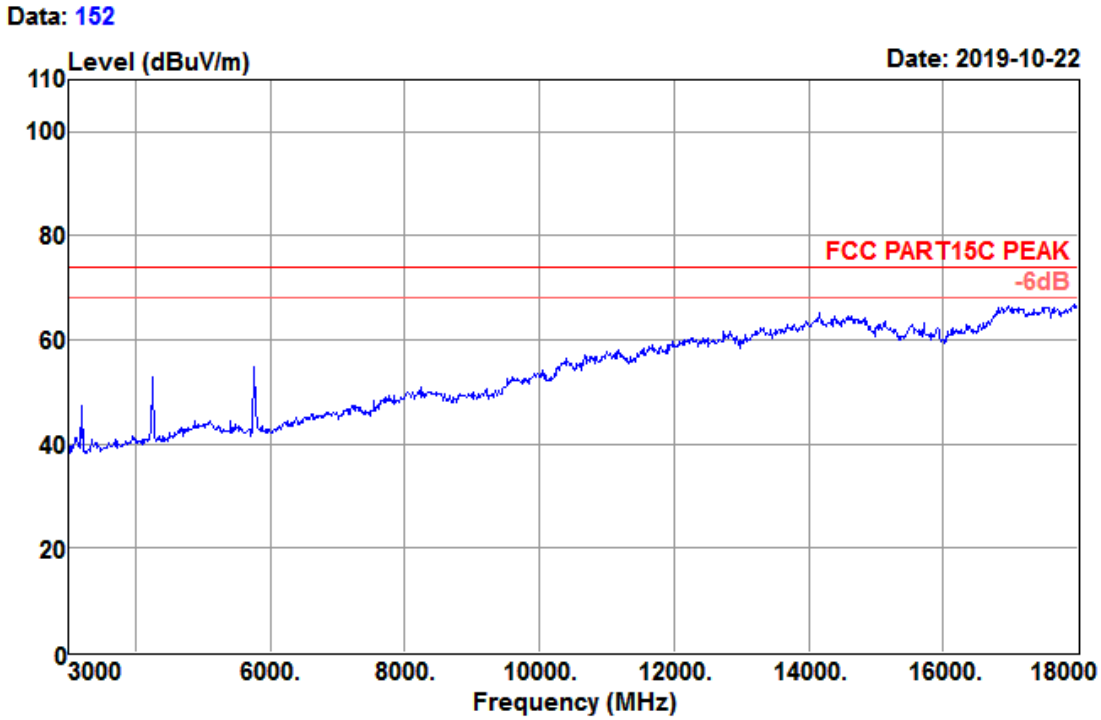
Note: Emission was scanned up to 26GHz; No emissions were detected above the noise floor which was at least 20dB below the specification limit.

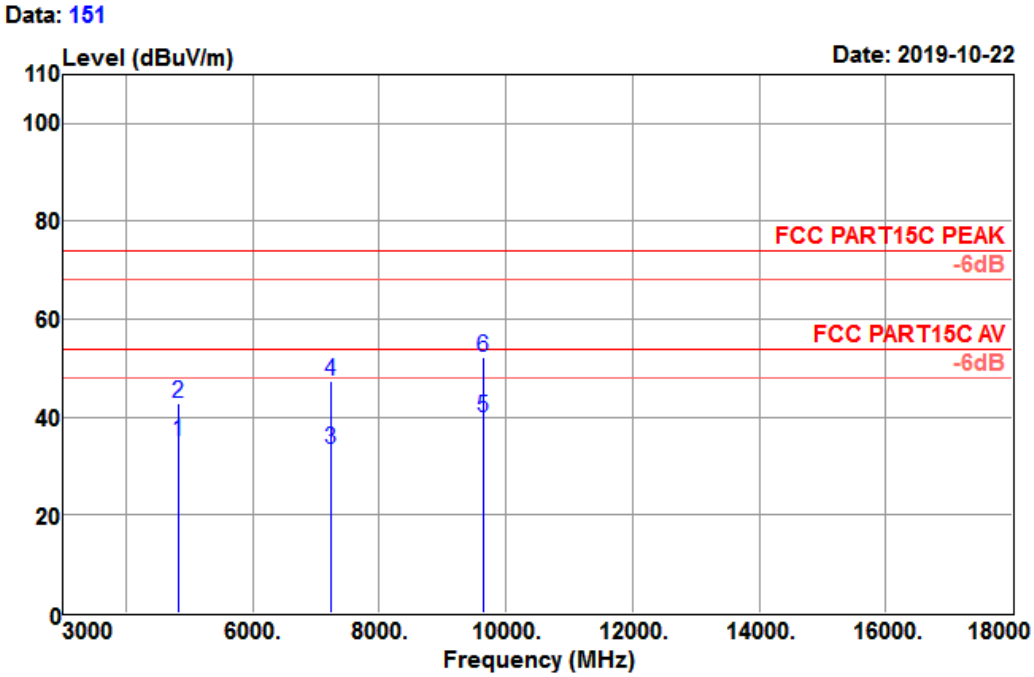
Test Mode :	802.11b CH01 (2412 MHz)	Temperature :	21~23℃
Test Engineer :	Jack Liu	Relative Humidity :	63~65%
Frequencey Range	1GHz~3GHz	Polarization :	Vertical



Freq	Reading level	Antenna factor	Cable loss	Preamp factor	level	Limit level	Over limit	Remark
MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB	
2412.000	100.69	27.17	3.55	35.58	95.83	74.00	21.83	Peak

Test Mode :	802.11b CH01 (2412 MHz)	Temperature :	21~23℃
Test Engineer :	Jack Liu	Relative Humidity :	63~65%
Frequencey Range	3GHz~18GHz	Polarization :	Vertical



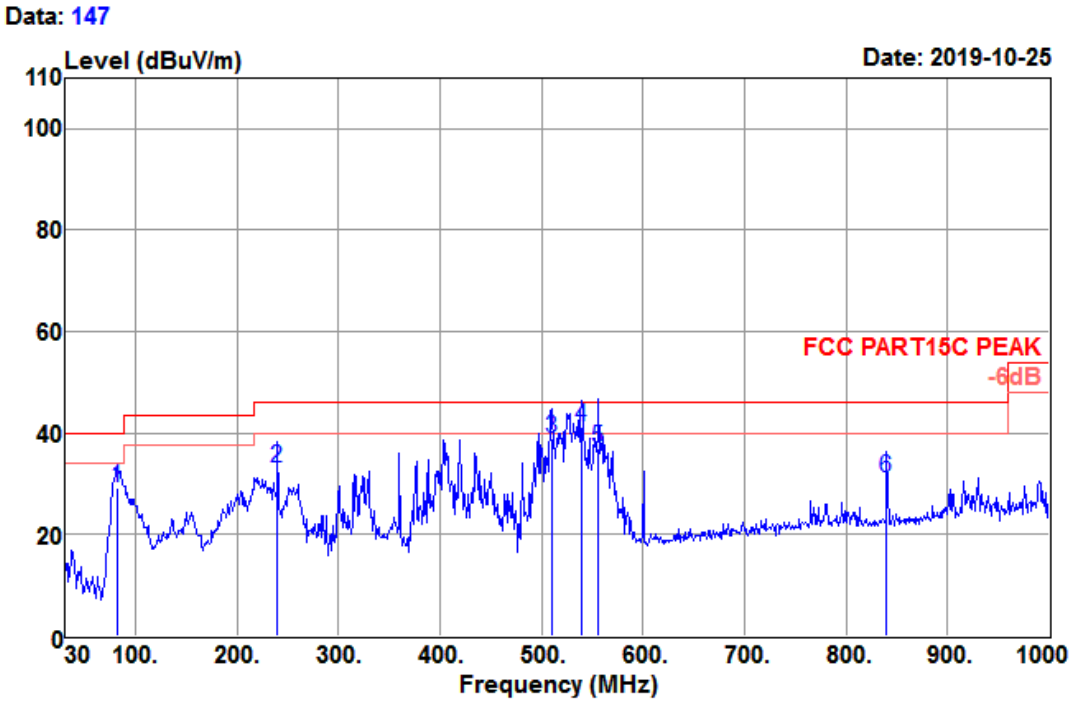


Freq	Reading level	Antenna factor	Cable loss	Preamp factor	level	Limit level	Over limit	Remark
MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB	
4824.000	32.93	31.28	5.56	34.84	34.93	54.00	-19.07	Average
4824.000	40.79	31.28	5.56	34.84	42.79	74.00	-31.21	Peak
7236.000	26.28	35.94	7.61	36.40	33.43	54.00	-20.57	Average
7236.000	40.08	35.94	7.61	36.40	47.23	74.00	-26.77	Peak
9648.000	28.21	37.87	10.41	36.40	40.09	54.00	-13.91	Average
9648.000	40.44	37.87	10.41	36.40	52.32	74.00	-21.68	Peak

Note: Emission was scanned up to 26GHz; No emissions were detected above the noise floor which was at least 20dB below the specification limit.

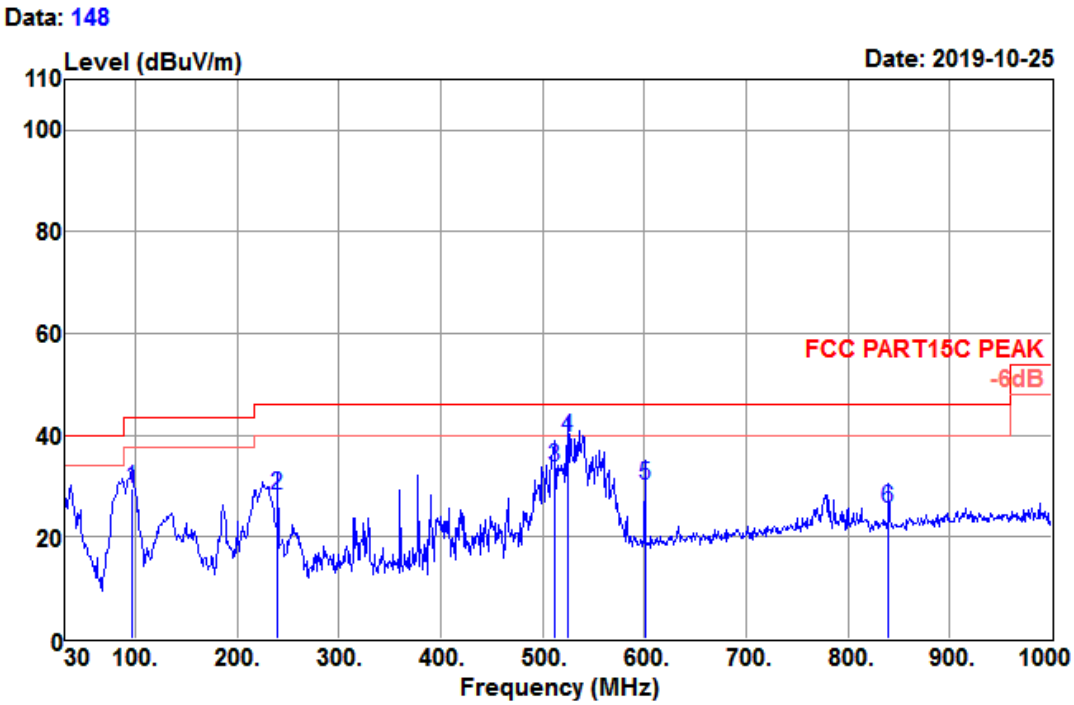
4.5.6 Test Result of Radiated Spurious Emission (30MHz ~ 1GHz)

Test Mode :	802.11b CH01 (2412 MHz)	**Temperature :**	21~23℃
Test Engineer :	Jack Liu	**Relative Humidity :**	63~65%
Frequencey Range	30MHz~1GHz	**Polarization :**	Horizontal



Freq	Reading level	Antenna factor	Cable loss	Preamp factor	level	Limit level	Over limit	Remark
MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB	
82.380	51.18	8.70	1.88	32.51	29.25	40.00	-10.75	QP
239.520	50.78	12.58	2.50	32.67	33.19	46.00	-12.81	QP
510.150	49.95	18.14	3.66	32.87	38.88	46.00	-7.12	QP
539.250	51.54	18.84	3.75	32.78	41.35	46.00	-4.65	QP
555.740	46.89	19.20	3.80	32.73	37.16	46.00	-8.84	QP
839.950	35.76	22.72	4.74	31.94	31.28	46.00	-14.72	QP

Test Mode :	802.11b CH01 (2412 MHz)	Temperature :	21~23℃
Test Engineer :	Jack Liu	Relative Humidity :	63~65%
Frequencey Range	30MHz~1GHz	Polarization :	Vertical



Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV/m	Limit level dBuV/m	Over limit dB	Remark
95.960	51.49	8.76	1.90	32.58	29.57	43.50	-13.93	QP
239.520	45.95	12.58	2.50	32.67	28.36	46.00	-17.64	QP
511.120	44.91	18.17	3.67	32.87	33.88	46.00	-12.12	QP
524.700	50.08	18.49	3.70	32.83	39.44	46.00	-6.56	QP
600.360	38.75	20.01	3.95	32.60	30.11	46.00	-15.89	QP
839.950	30.13	22.72	4.74	31.94	25.65	46.00	-20.35	QP

4.6 AC Conducted Emission Measurement

4.6.1 Limit of AC Conducted Emission

FCC §15.207

IC RSS-GEN 8.8

For equipment that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table.

Frequency of emission (MHz)	Conducted limit (dBμV)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

*Decreases with the logarithm of the frequency.

4.6.2 Test Procedures

1. The EUT was placed 0.4 meter from the conducting wall of the shielding room was kept at least 80 centimeters from any other grounded conducting surface.
2. Connect EUT to the power mains through a line impedance stabilization network (LISN).
3. All the support units are connecting to the other LISN.
4. The LISN provides 50 ohm coupling impedance for the measuring instrument.
5. The FCC states that a 50 ohm, 50 microhenry LISN should be used.
6. Both sides of AC line were checked for maximum conducted interference.
7. The frequency range from 150 kHz to 30 MHz was searched.
8. Set the test-receiver system to Peak Detect Function and specified bandwidth (IF Bandwidth = 9kHz) with Maximum Hold Mode. Then measurement is also conducted by Average Detector and Quasi-Peak Detector Function respectively.

4.6.3 Test Result of AC Conducted Emission

Refer to test report No.180119001RFC-1.

4.7 Antenna Requirements

4.7.1 Standard Applicable

According to antenna requirement of §15.203.

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that a broken antenna can be re-placed by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of Sections 15.211, 15.213, 15.217, 15.219, or 15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with Section 15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this Part are not exceeded..

And according to §15.247(4)(1), system operating in the 2400-2483.5MHz bands that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6dBi provided the maximum peak output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6dBi.

4.7.2 Antenna Connected Construction

An embedded-in antenna design is used.

4.7.3 Antenna Gain

The antenna peak gain of EUT is less than 6dBi. Therefore, it is not necessary to reduce maximum peak output power limi.

5 List of Measuring Equipment

Instrument	Manufacturer	Model No.	Serial No.	Calibration Date	Due Date	Remark
Spectrum Analyzer	Keysight	N9010A	MY56070788	2019/1/23	2020/1/22	Conducted
Power Sensor	Keysight	U2021XA	MY56510025	2019/1/23	2020/1/22	Conducted
Power Sensor	Keysight	U2021XA	MY57030005	2019/1/23	2020/1/22	Conducted
Power Sensor	Keysight	U2021XA	MY56510018	2019/1/23	2020/1/22	Conducted
Power Sensor	Keysight	U2021XA	MY56480002	2019/1/23	2020/1/22	Conducted
Thermal Chamber	Sanmtest	SMC-408-CD	2435	2019/05/09	2020/05/08	Conducted
Base Station	R&S	CMW 270	101231	2019/1/23	2020/1/22	Conducted
Signal Generator (Blocker)	Keysight	N5171B	MY56200661	2019/1/23	2020/1/22	Conducted

Instrument	Manufacturer	Model No.	Serial No.	Calibration Date	Due Date	Remark
Spectrum Analyzer	R&S	FSV 40	101433	2019/2/18	2020/2/17	Radiation
Amplifier	Sonoma	310	363917	2019/1/22	2020/1/21	Radiation
Amplifier	Schwarzbeck	BBV 9718	327	2019/1/22	2020/1/21	Radiation
Amplifier	Narda	TTA1840-35-HG	2034380	2019/05/15	2020/05/14	Radiation
Broadband Antenna	Schwarzbeck	VULB 9168	9168-757	2017-03-03	2020-03-02	Radiation
Horn Antenna	Schwarzbeck	BBHA 9120 D	1677	2017-03-03	2020-03-02	Radiation
Horn Antenna	COM-POWER	AH-1840	101117	2018-06-20	2021-06-19	Radiation
Test Software	Auidx	E3	6.111221a	N/A	N/A	Radiation
Filter	Micro-Tronics	BRM 50702	G266	N/A	N/A	Radiation

N/A: No Calibration Required

6 Uncertainty of Evaluation

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2:

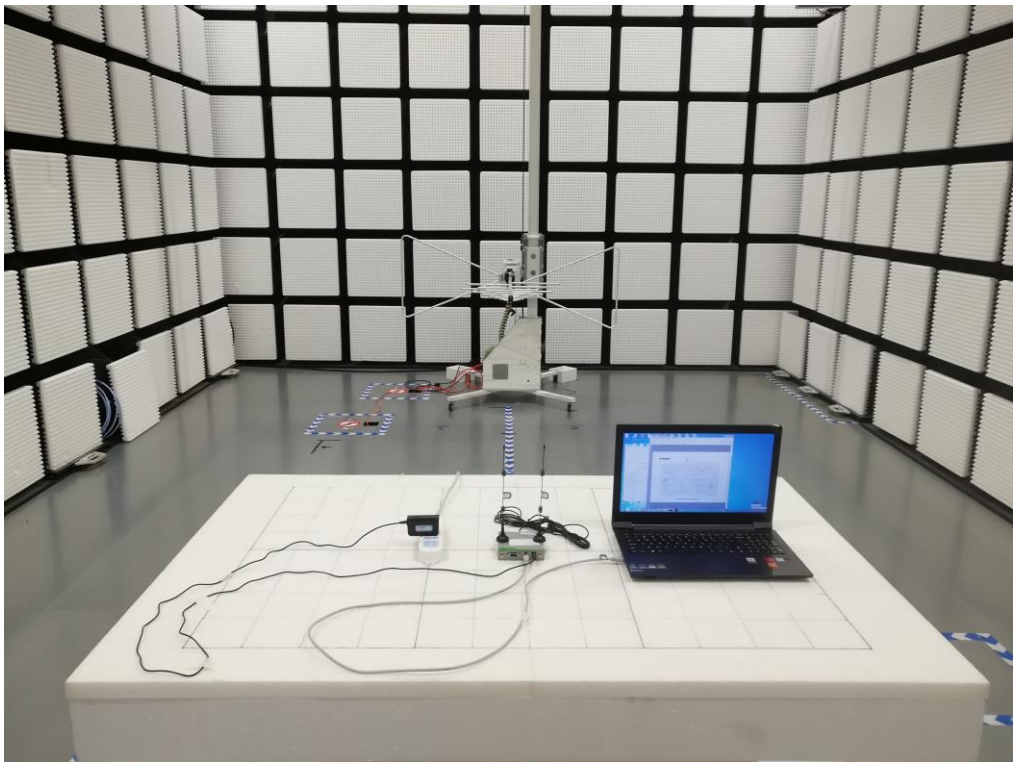
MEASUREMENT	FREQUENCY	UNCERTAINTY
Conducted emissions	9kHz~30MHz	2.67dB
Radiated emissions	30MHz ~ 1GMHz	5.05dB
	1GHz ~ 18GHz	5.06 dB
	18GHz ~ 40GHz	3.65dB

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

7 Setup Photographs

<Radiated Emission >

LF



HF

Appendix A: Maximum conducted output power

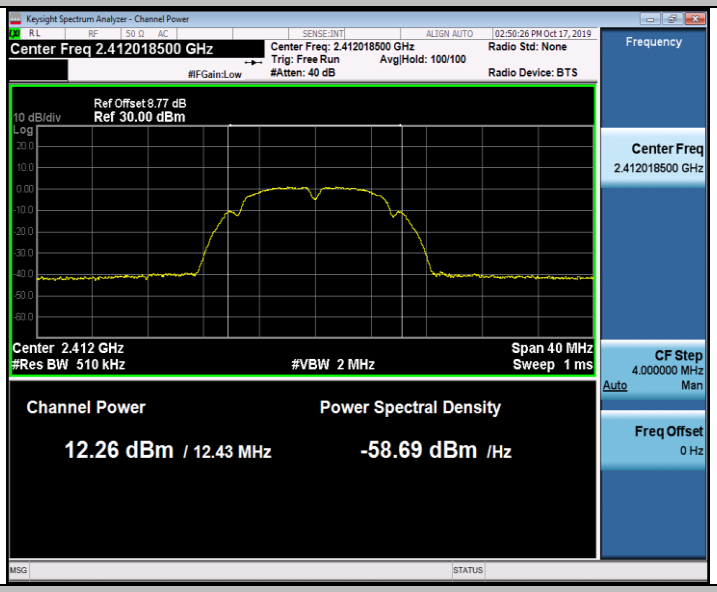
Peak Test Result

TestMode	Antenna	Channel	Result[dBm]	Limit[dBm]	Verdict
11B	Ant1	2412	18.28	<=30	PASS
	Ant2	2412	19.61	<=30	PASS
	Ant1	2437	16.54	<=30	PASS
	Ant2	2437	17.71	<=30	PASS
	Ant1	2462	16.60	<=30	PASS
	Ant2	2462	17.30	<=30	PASS
11G	Ant1	2412	18.89	<=30	PASS
	Ant2	2412	19.71	<=30	PASS
	Ant1	2437	20.06	<=30	PASS
	Ant2	2437	21.40	<=30	PASS
	Ant1	2462	19.89	<=30	PASS
	Ant2	2462	20.82	<=30	PASS
11N20MIMO	Ant1	2412	18.92	<=30	PASS
	Ant2	2412	19.69	<=30	PASS
	total	2412	22.3	<=30	PASS
	Ant1	2437	20.13	<=30	PASS
	Ant2	2437	21.41	<=30	PASS
	total	2437	23.8	<=30	PASS
	Ant1	2462	19.80	<=30	PASS
	Ant2	2462	20.91	<=30	PASS
	total	2462	23.4	<=30	PASS
11N40MIMO	Ant1	2422	18.97	<=30	PASS
	Ant2	2422	20.16	<=30	PASS
	total	2422	22.6	<=30	PASS
	Ant1	2437	19.92	<=30	PASS
	Ant2	2437	21.18	<=30	PASS
	total	2437	23.6	<=30	PASS
	Ant1	2452	19.29	<=30	PASS
	Ant2	2452	19.20	<=30	PASS
	total	2452	22.3	<=30	PASS

Average Test Result

TestMode	Antenna	Channel	Result[dBm]	Limit[dBm]	Verdict
11B	Ant1	2412	12.26	<=30	PASS
	Ant2	2412	13.38	<=30	PASS
	Ant1	2437	14.19	<=30	PASS
	Ant2	2437	15.32	<=30	PASS
	Ant1	2462	14.13	<=30	PASS
	Ant2	2462	14.83	<=30	PASS
11G	Ant1	2412	13.00	<=30	PASS
	Ant2	2412	13.72	<=30	PASS
	Ant1	2437	14.17	<=30	PASS
	Ant2	2437	15.47	<=30	PASS
	Ant1	2462	13.90	<=30	PASS
	Ant2	2462	14.94	<=30	PASS
11N20MIMO	Ant1	2412	12.90	<=30	PASS
	Ant2	2412	13.73	<=30	PASS
	total	2412	16.3	<=30	PASS
	Ant1	2437	14.14	<=30	PASS
	Ant2	2437	15.35	<=30	PASS
	total	2437	17.8	<=30	PASS
	Ant1	2462	13.83	<=30	PASS
	Ant2	2462	14.72	<=30	PASS
	total	2462	17.3	<=30	PASS
11N40MIMO	Ant1	2422	13.14	<=30	PASS
	Ant2	2422	14.18	<=30	PASS
	total	2422	16.7	<=30	PASS
	Ant1	2437	13.87	<=30	PASS
	Ant2	2437	15.20	<=30	PASS
	total	2437	17.6	<=30	PASS
	Ant1	2452	13.14	<=30	PASS
	Ant2	2452	13.97	<=30	PASS
	total	2452	16.6	<=30	PASS

Test Graphs

11B_Ant1_2412

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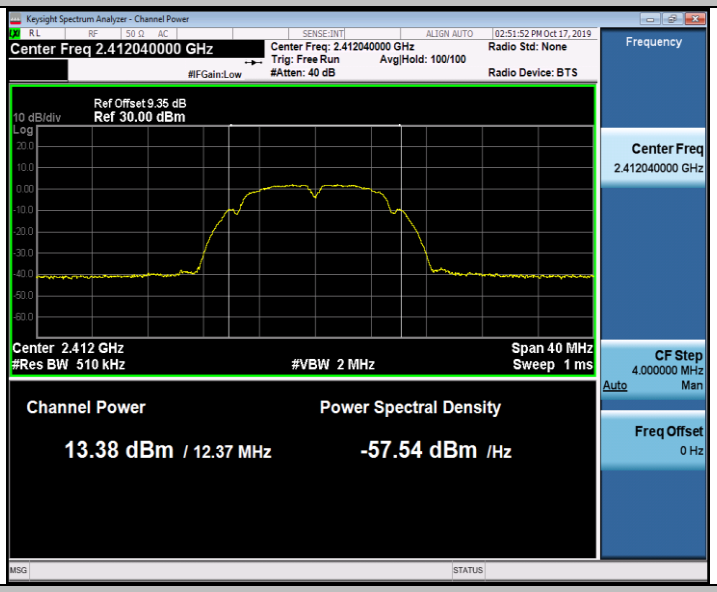
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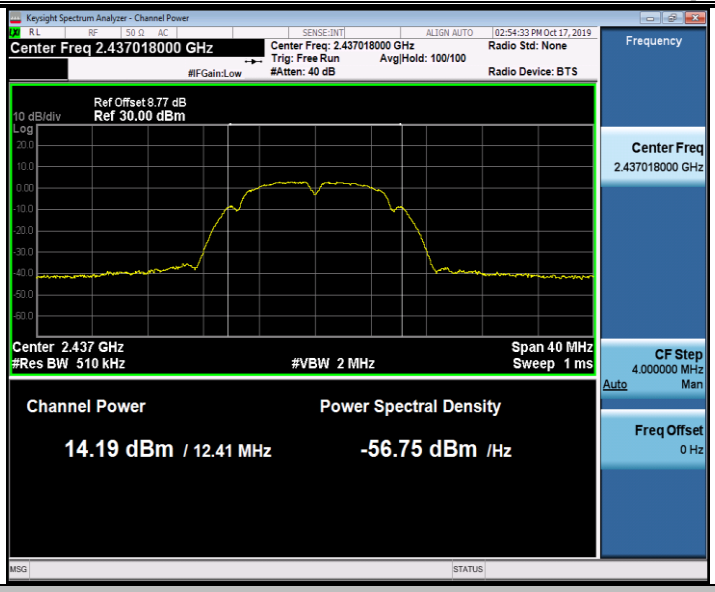

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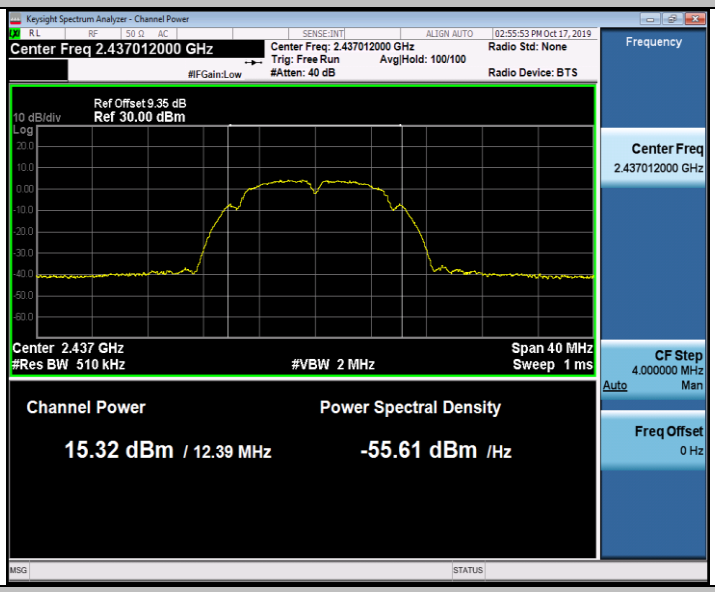
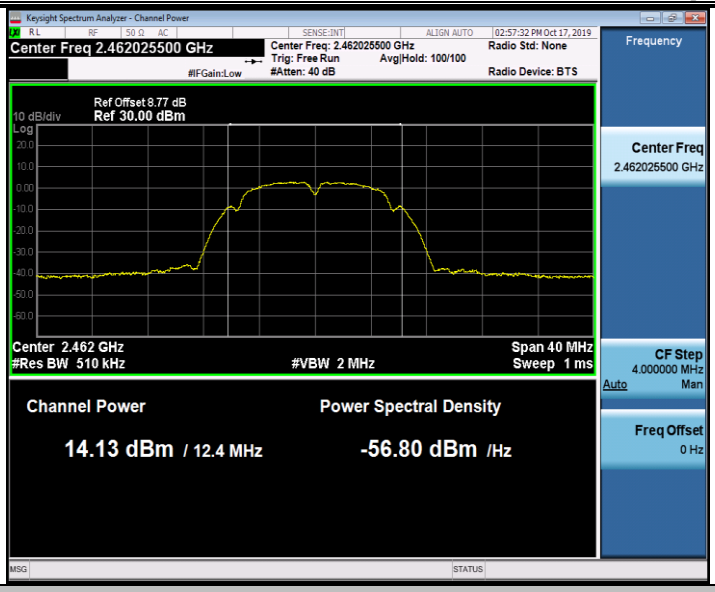


11B_Ant1_2462



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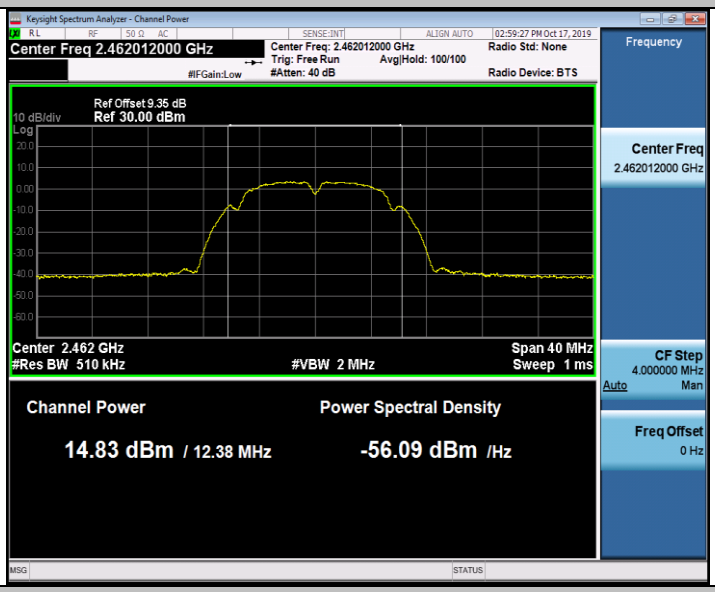

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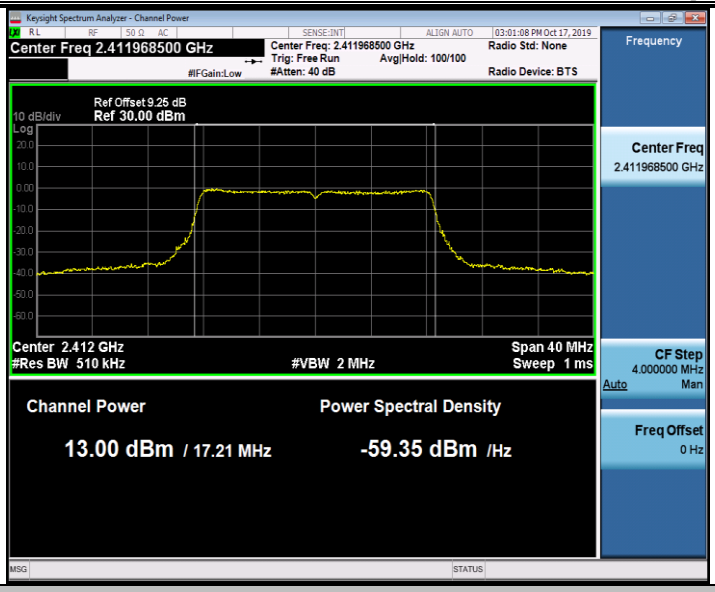

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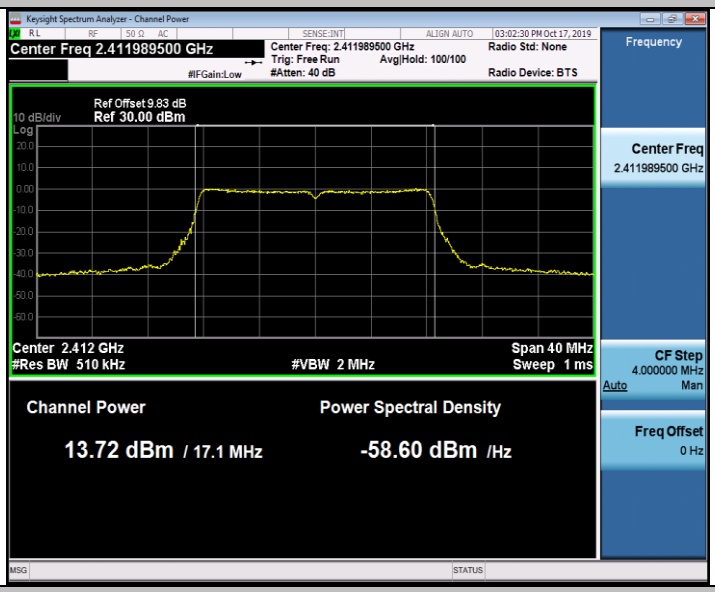

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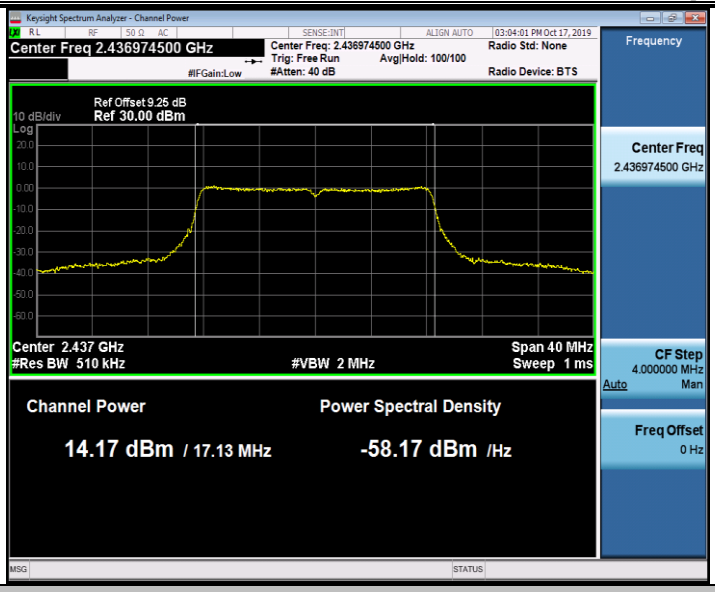

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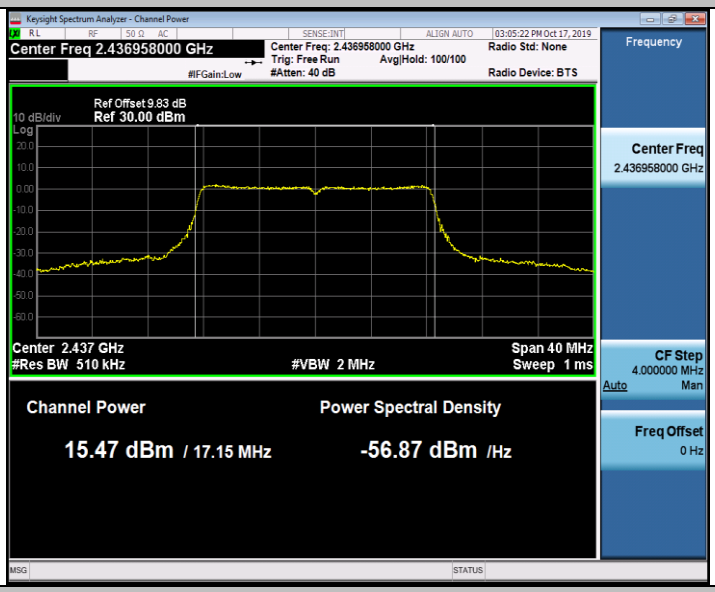

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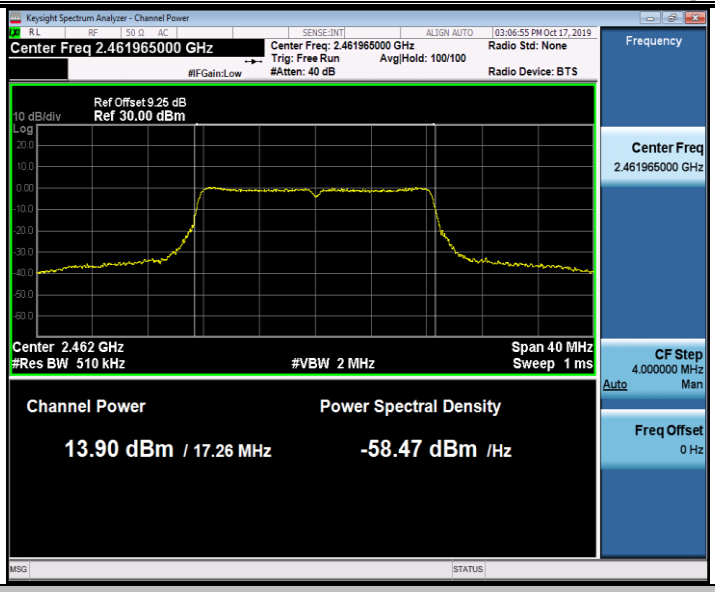

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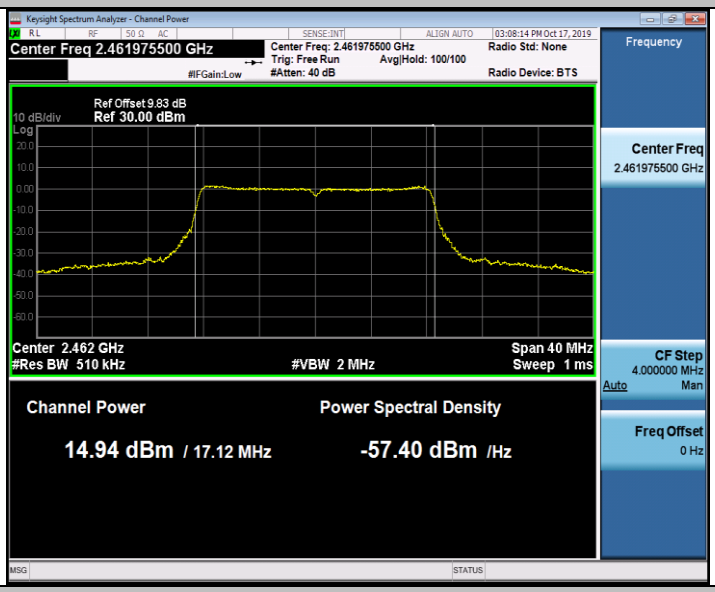

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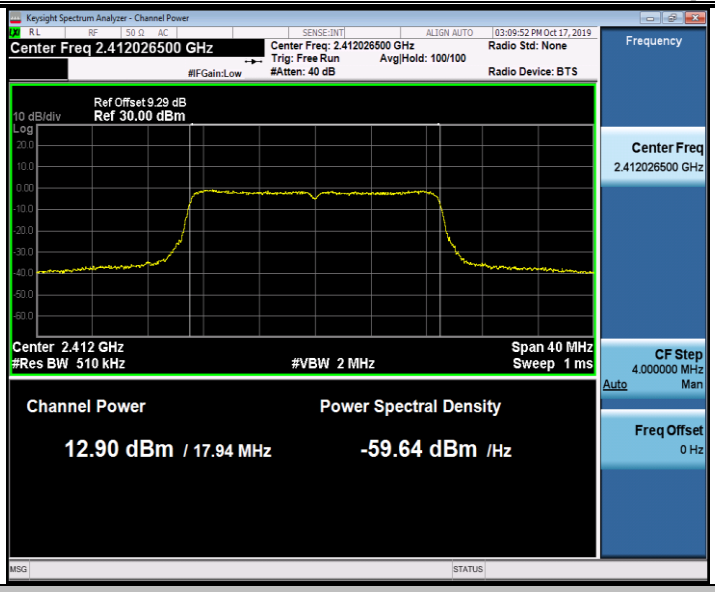

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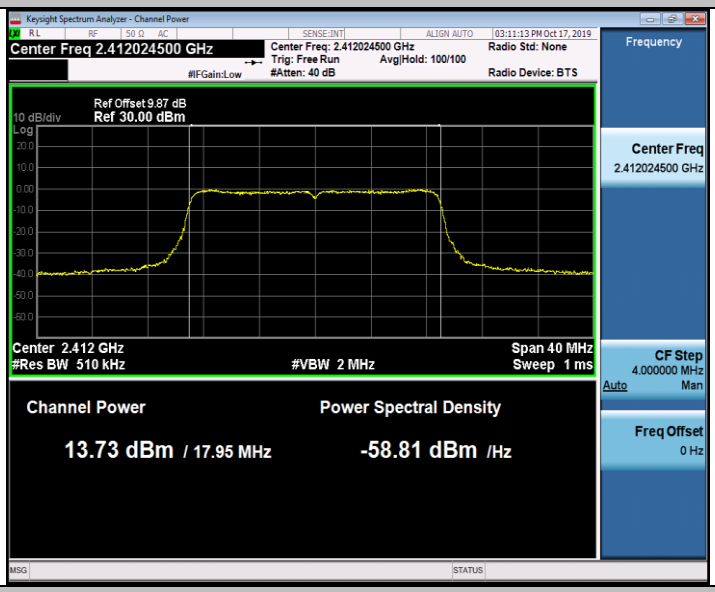
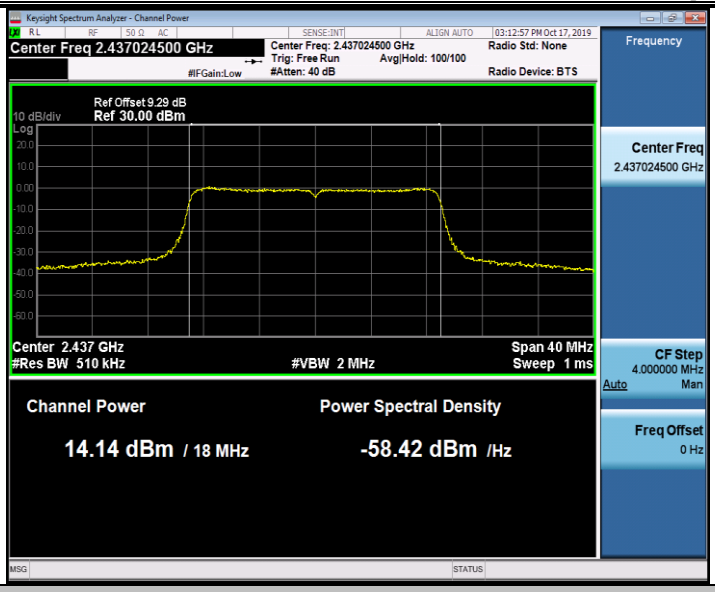


11N20MIMO_Ant1_2437



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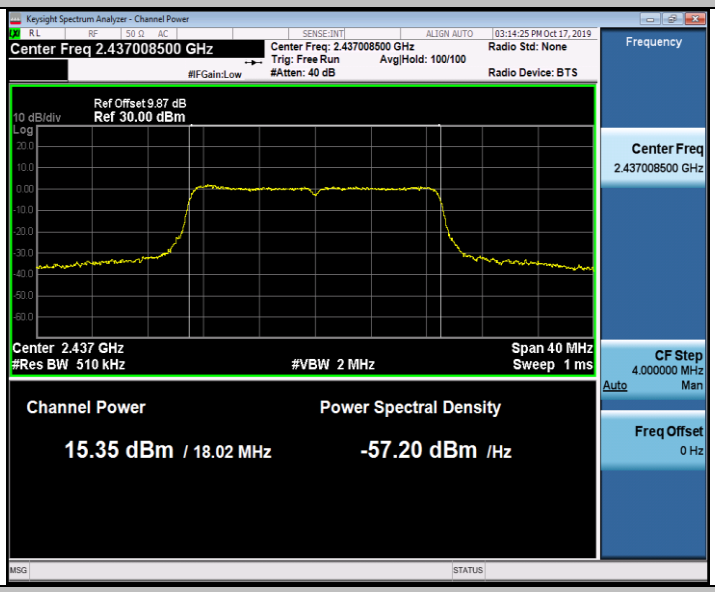

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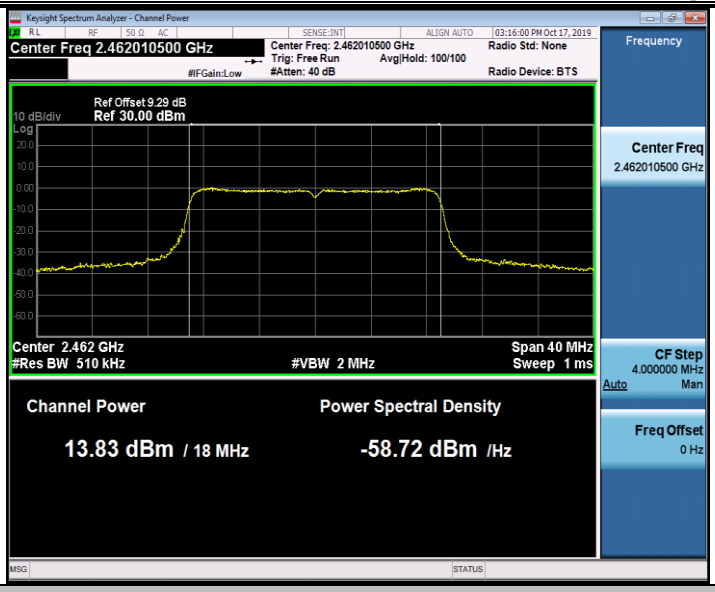
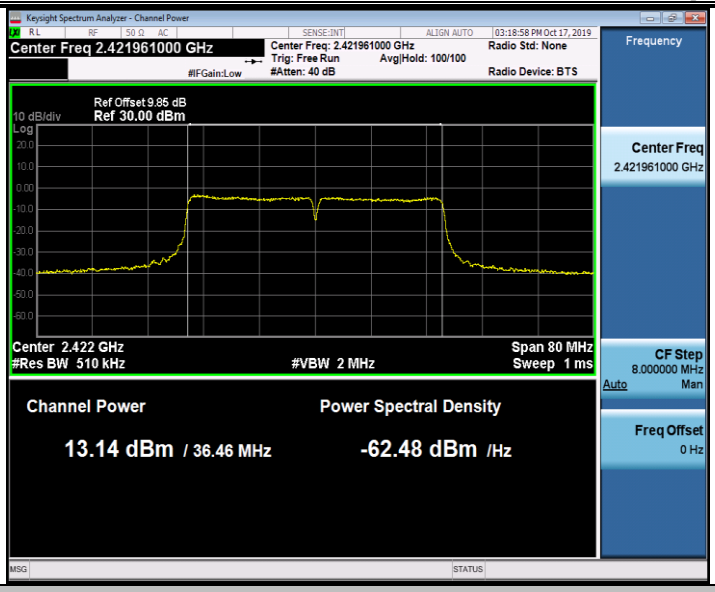


11N20MIMO_Ant2_2462

11N40MIMO_Ant1_2422



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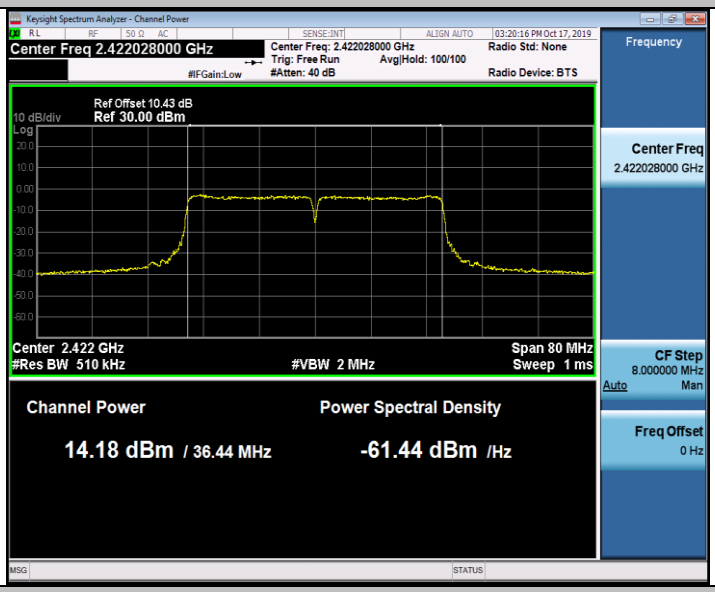
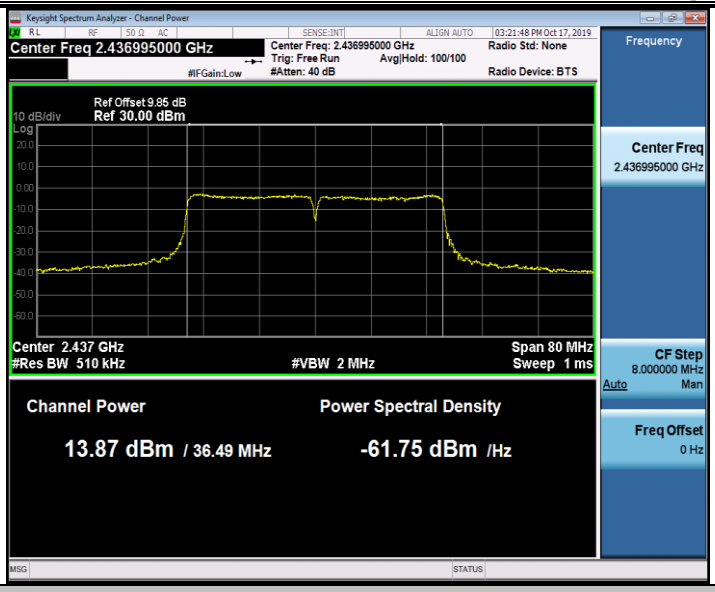


11N40MIMO_Ant1_2437



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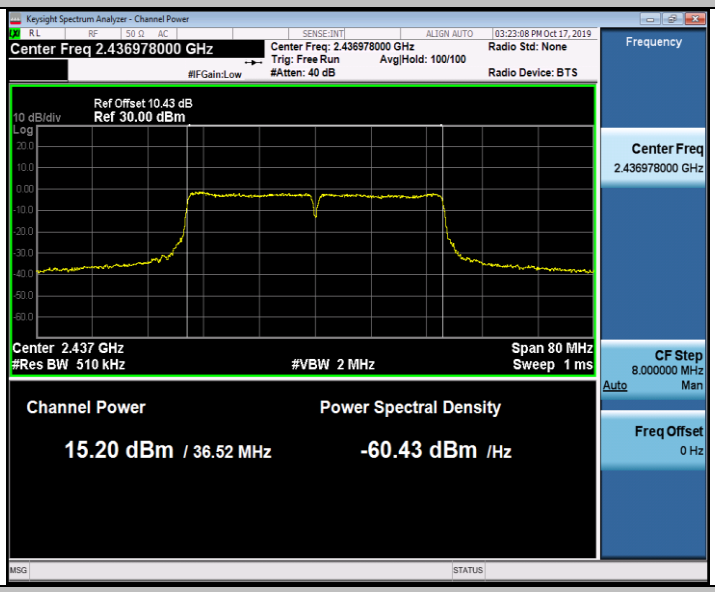

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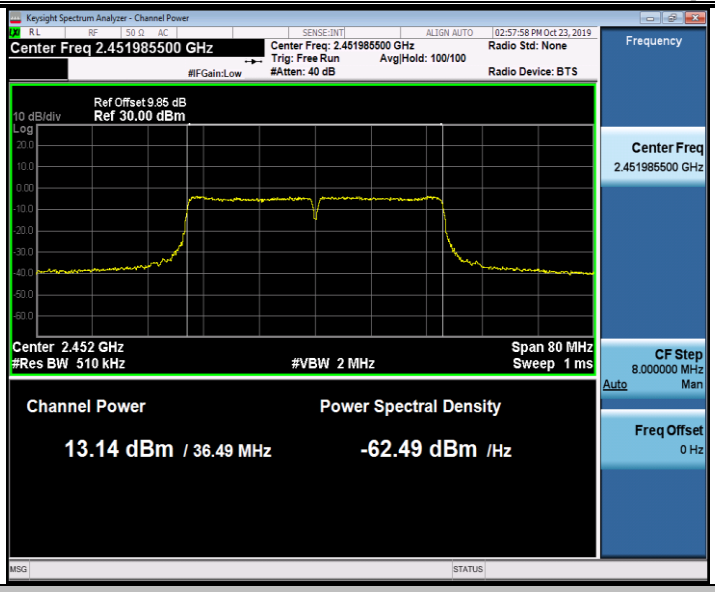

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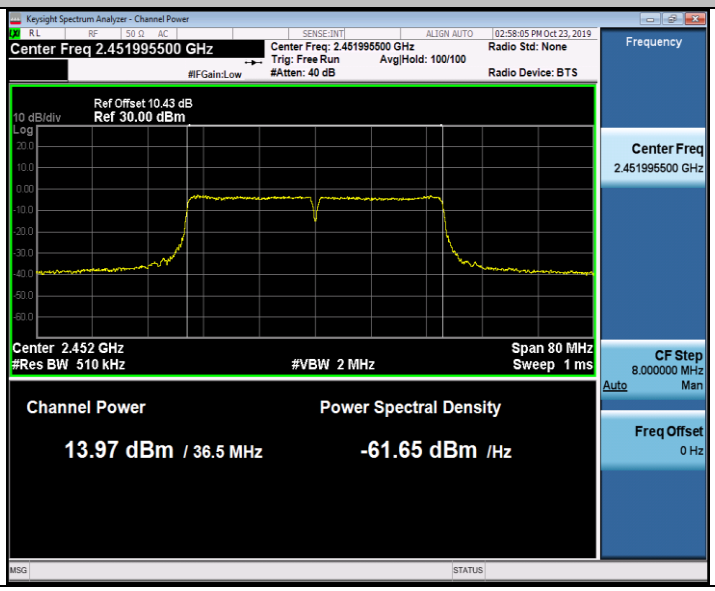


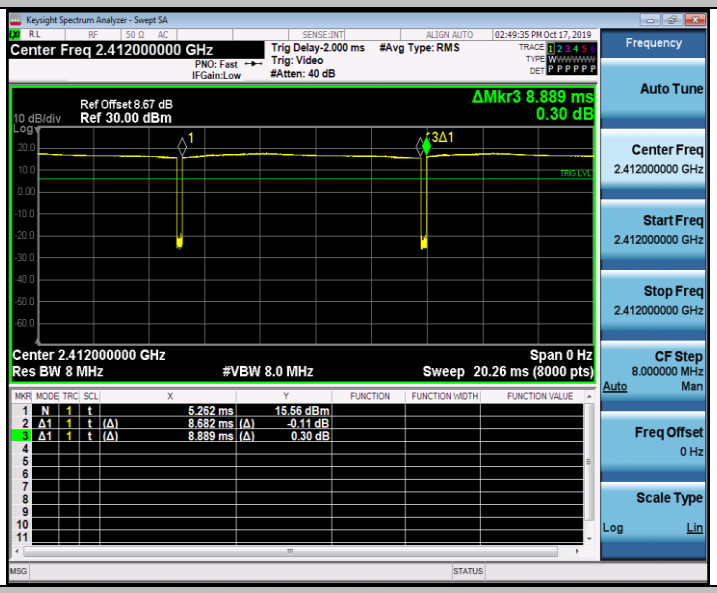
Appendix B: Duty Cycle

Test Result

TestMode	Antenna	Channel	Transmission Duration [ms]	Transmission Period [ms]	Duty Cycle [%]
11B	Ant1	2412	8.68	8.89	97.66
	Ant2	2412	8.68	8.89	97.69
	Ant1	2437	8.68	8.89	97.66
	Ant2	2437	8.68	8.89	97.66
	Ant1	2462	8.68	8.89	97.66
	Ant2	2462	8.68	8.89	97.66
11G	Ant1	2412	1.44	1.64	87.58
	Ant2	2412	1.44	1.64	87.58
	Ant1	2437	1.44	1.64	87.58
	Ant2	2437	1.44	1.64	87.50
	Ant1	2462	1.44	1.64	87.58
	Ant2	2462	1.44	1.64	87.58
11N20MIMO	Ant1	2412	1.33	1.54	86.74
	Ant2	2412	1.33	1.54	86.74
	Ant1	2437	1.33	1.54	86.74
	Ant2	2437	1.33	1.54	86.66
	Ant1	2462	1.33	1.54	86.66
	Ant2	2462	1.33	1.54	86.74
11N40MIMO	Ant1	2422	0.65	0.86	76.22
	Ant2	2422	0.65	0.86	76.22
	Ant1	2437	0.65	0.86	76.22
	Ant2	2437	0.65	0.86	76.22
	Ant1	2452	0.65	0.86	76.22
	Ant2	2452	0.65	0.86	76.22

Test Graphs

11B_Ant1_2412



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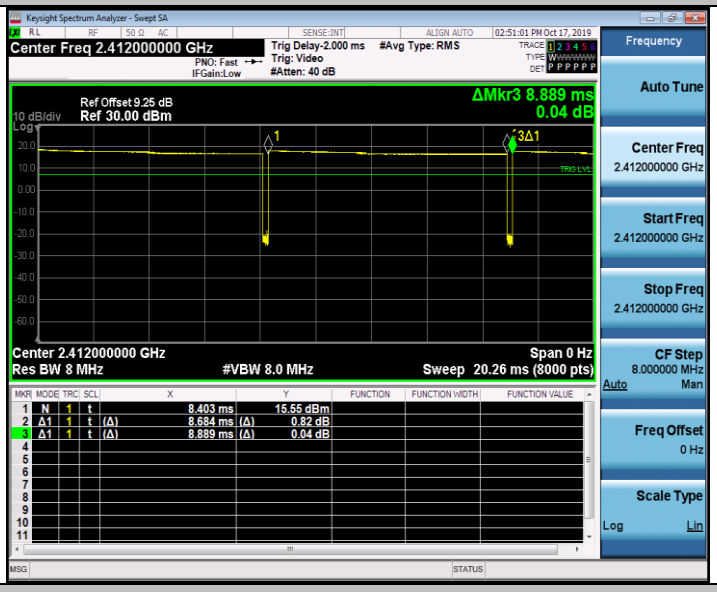

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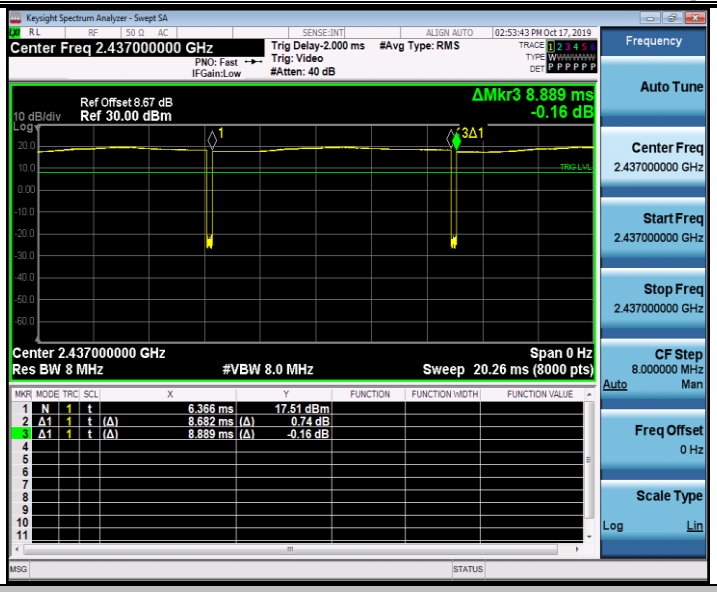

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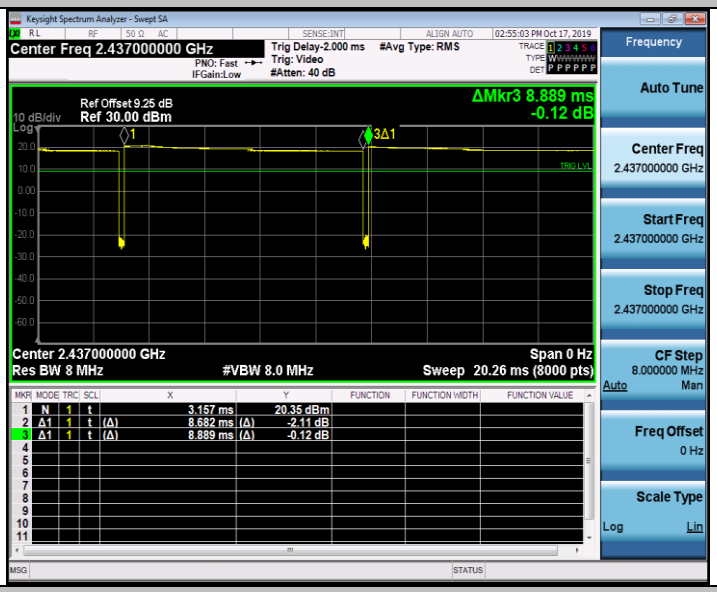
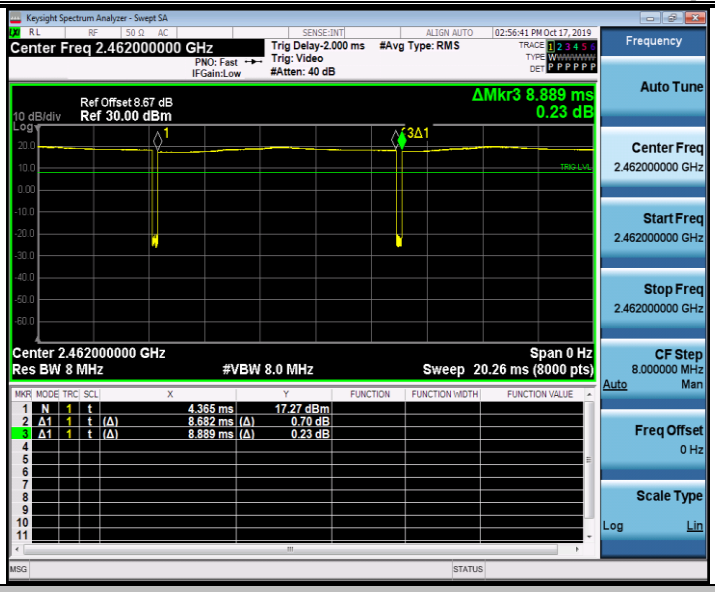


11B_Ant1_2462



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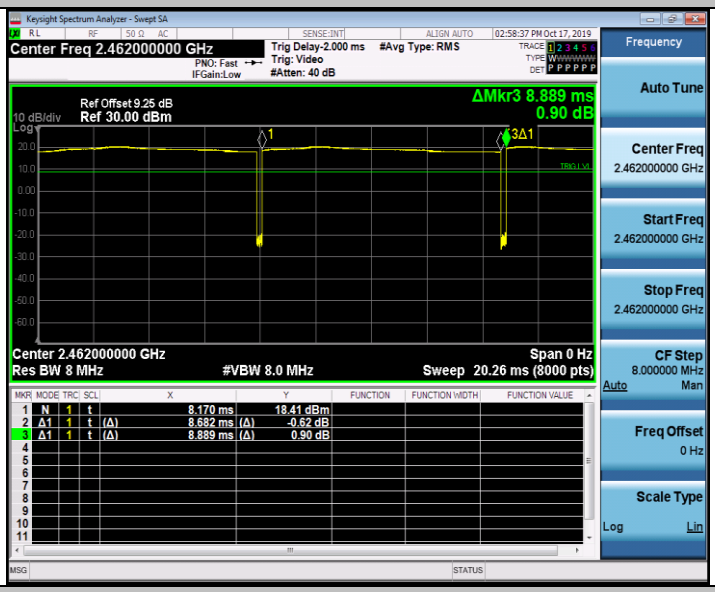

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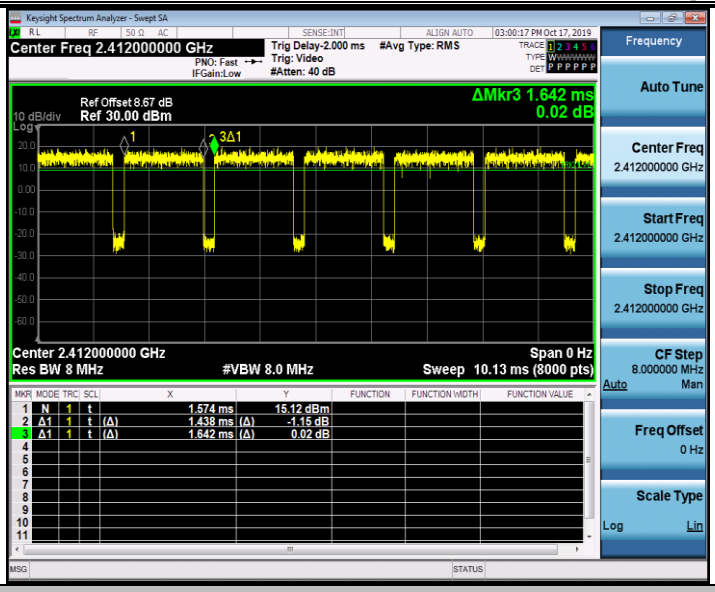

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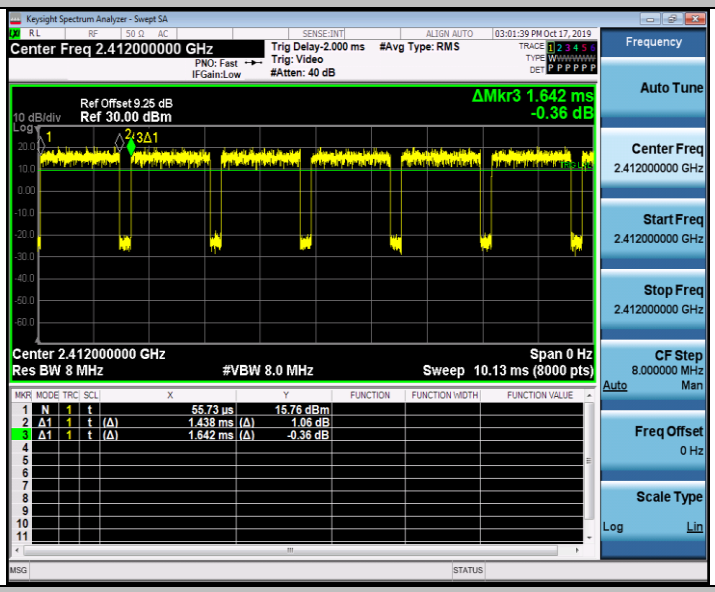

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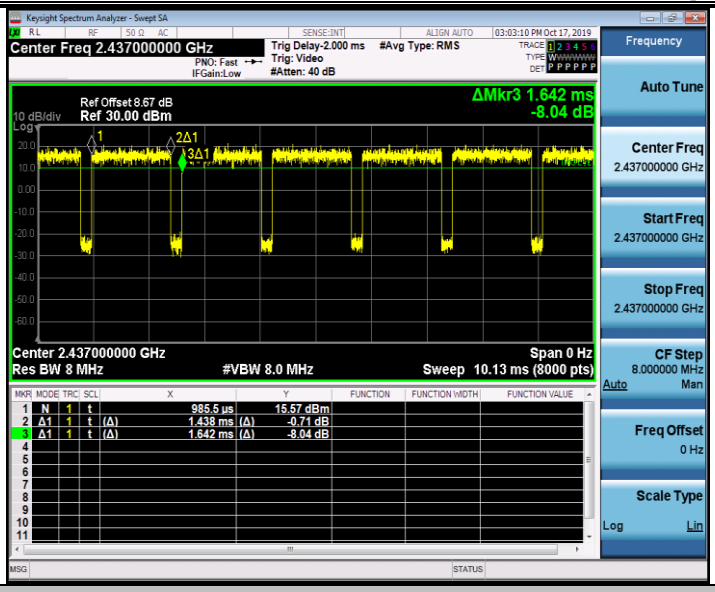

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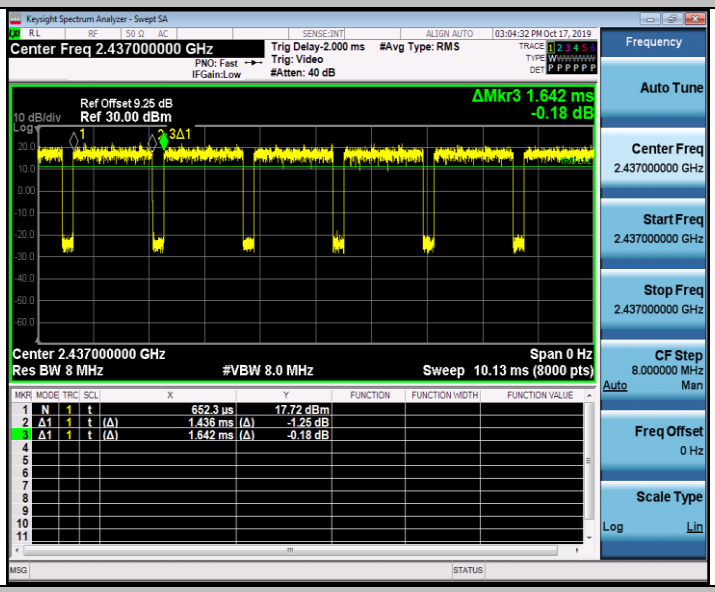

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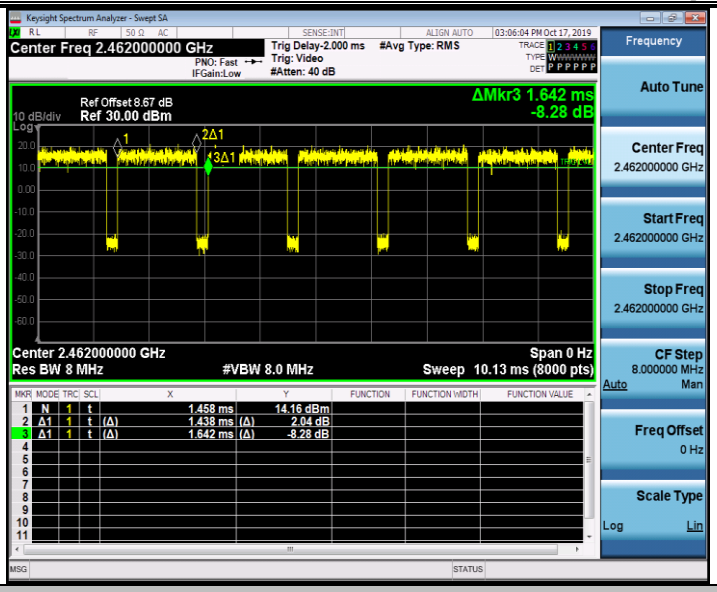

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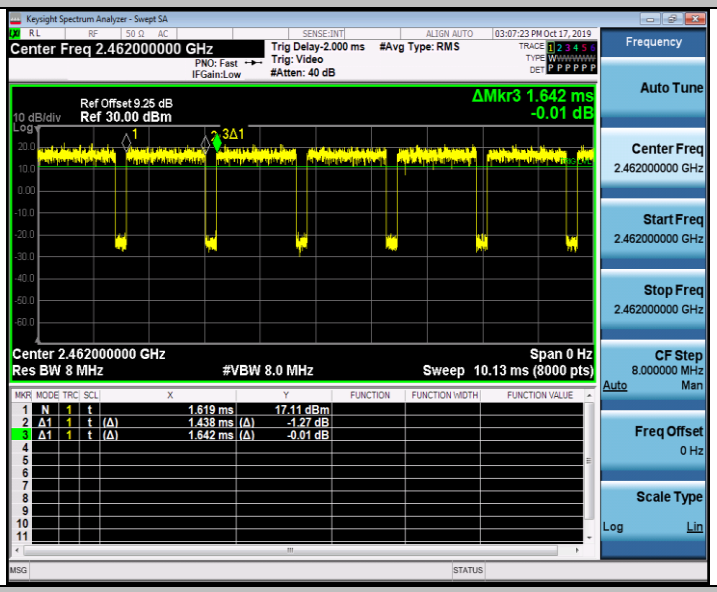

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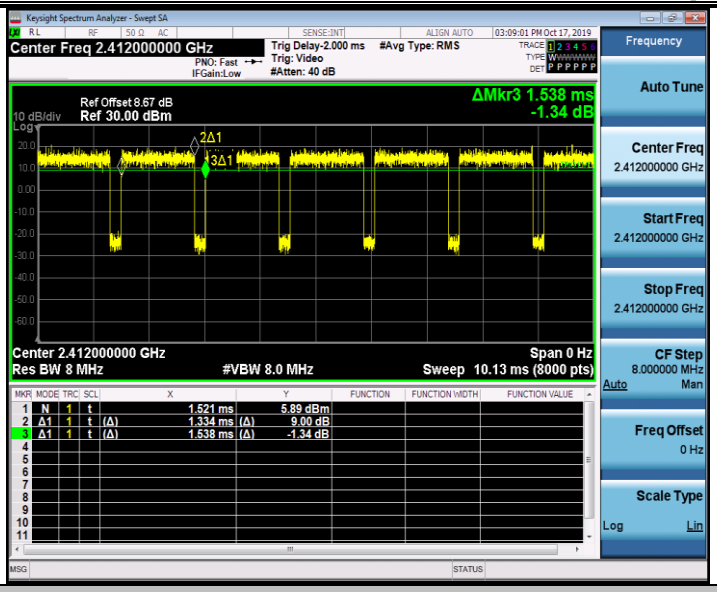

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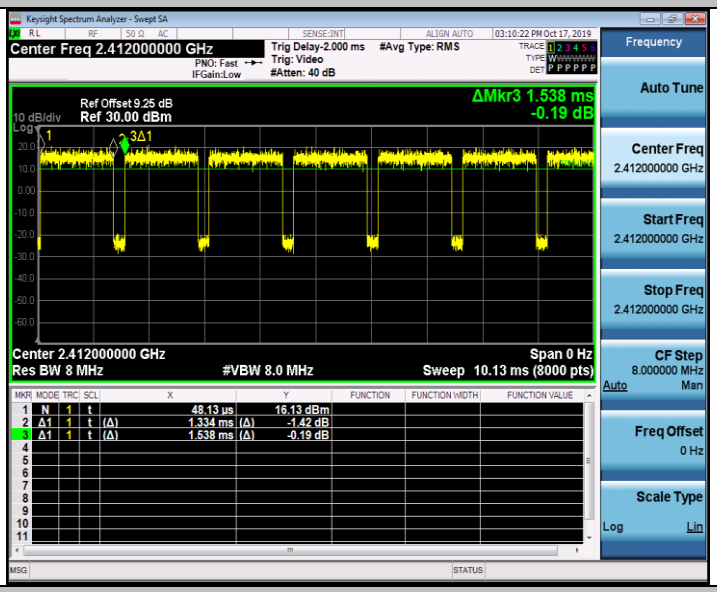

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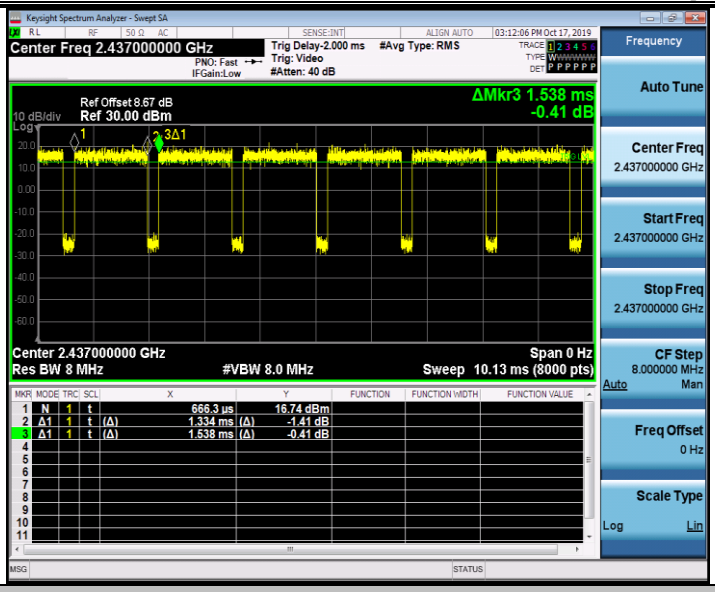

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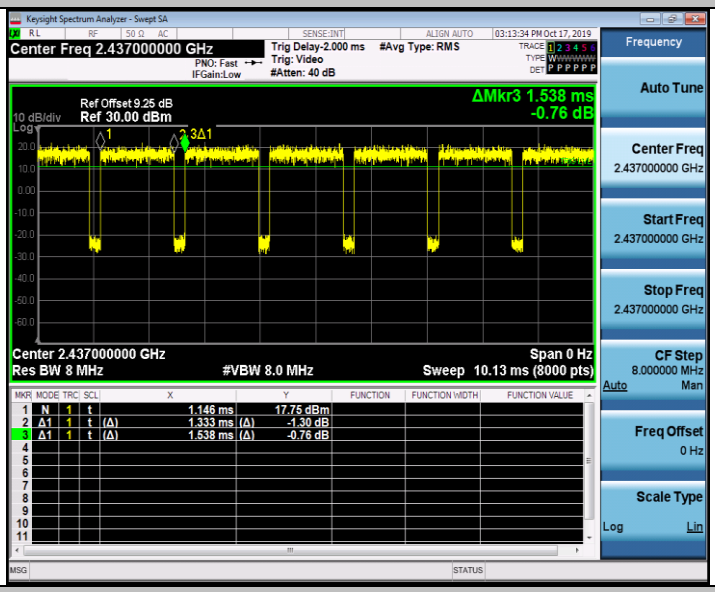

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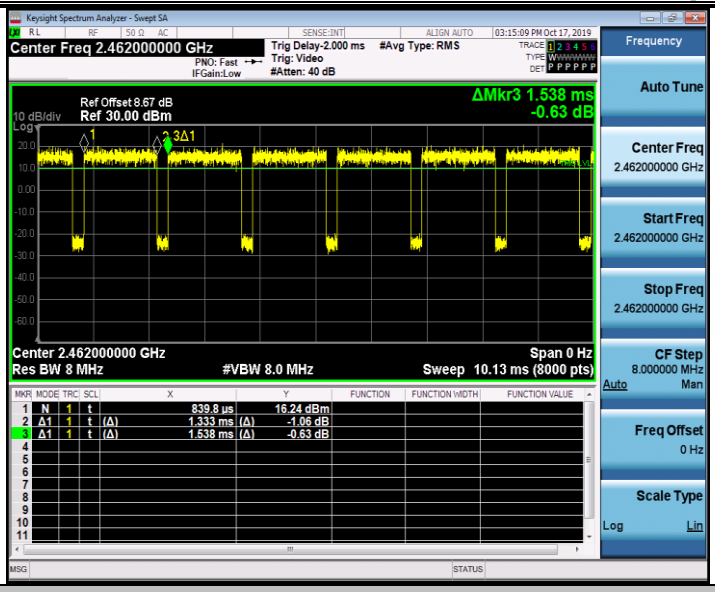

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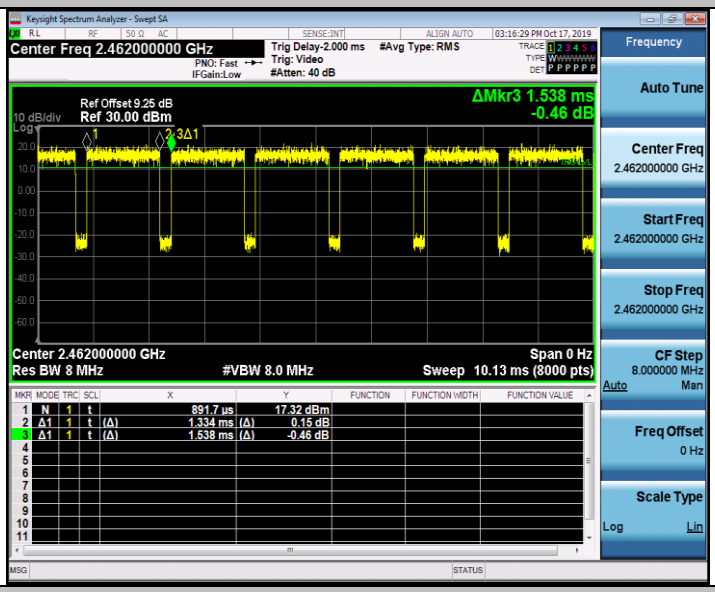

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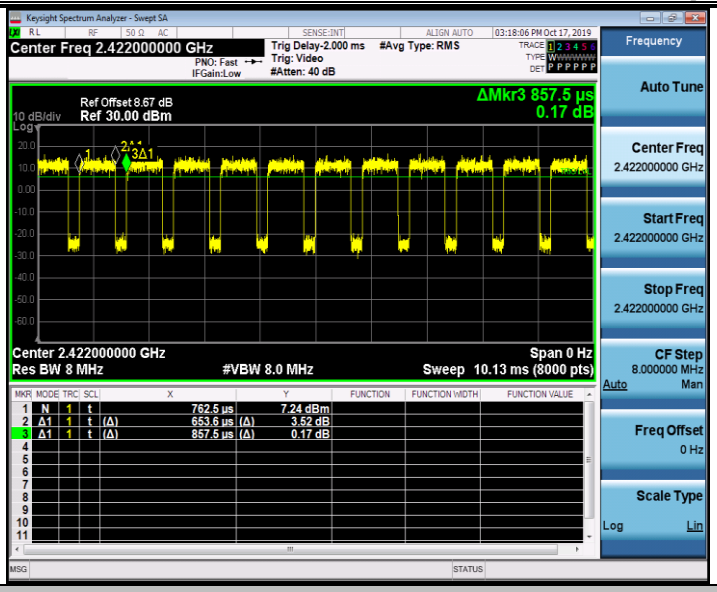

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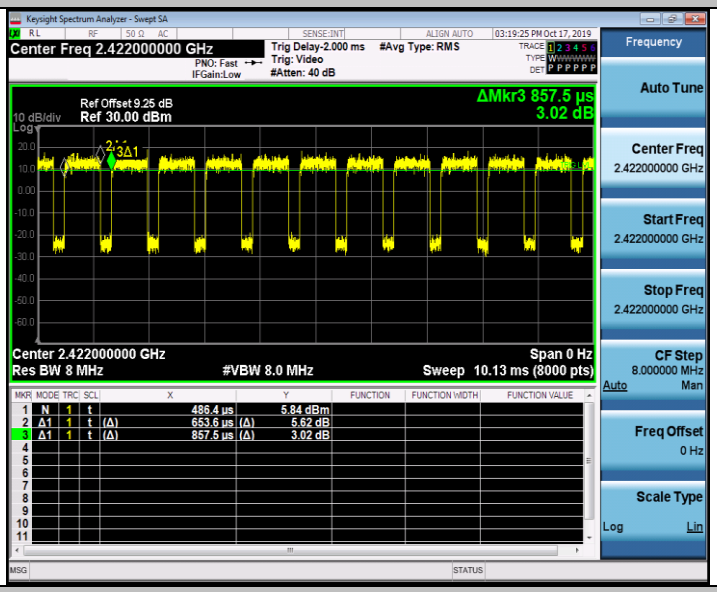

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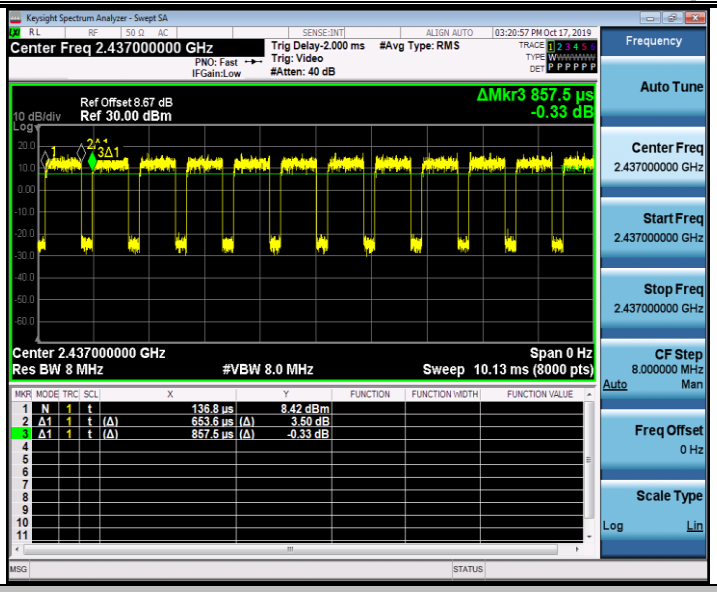

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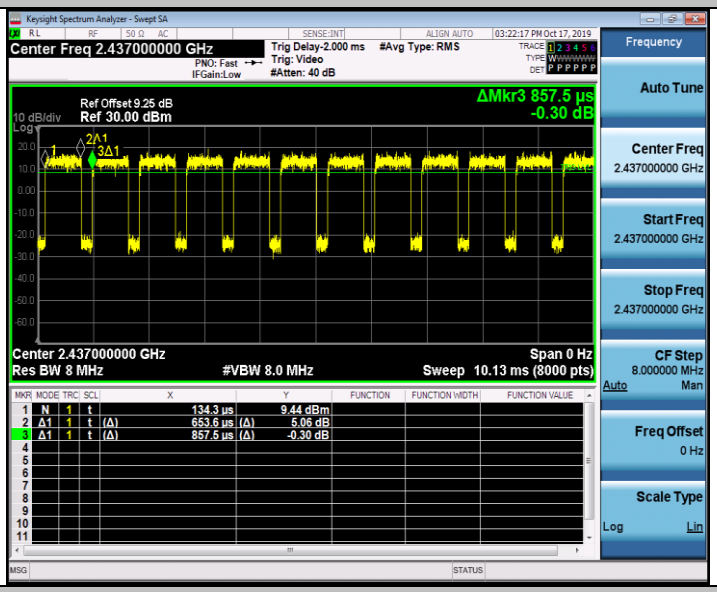

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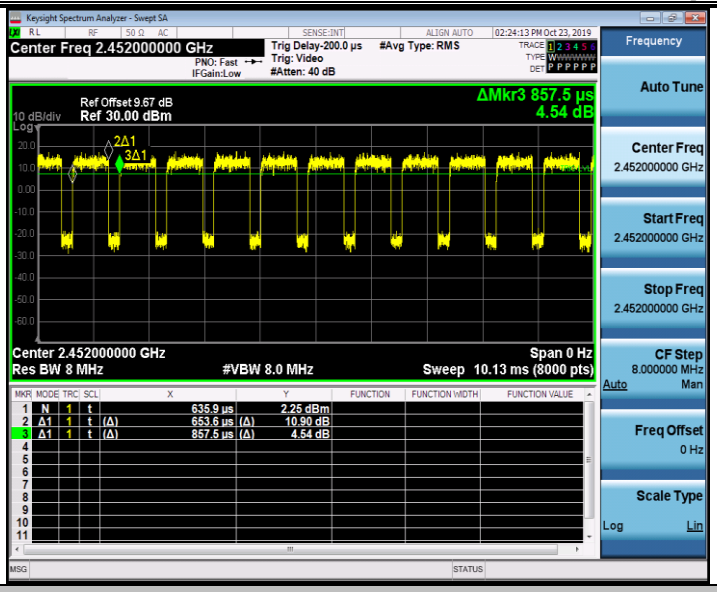

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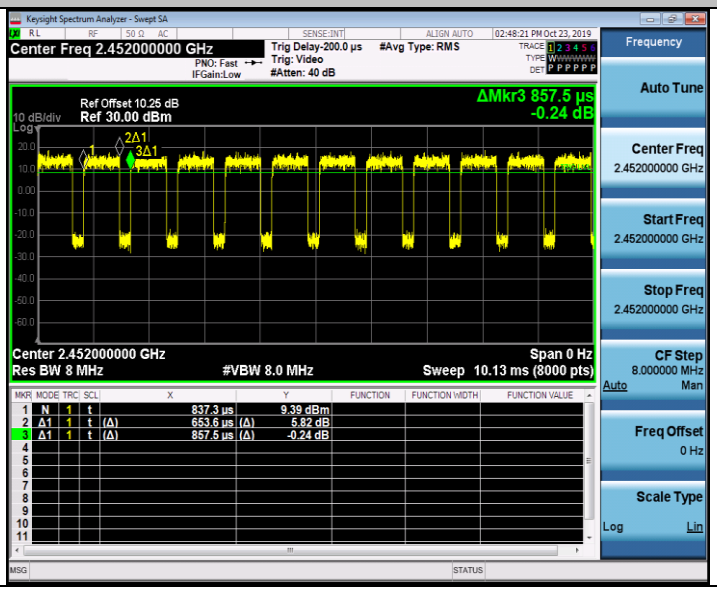

----------End of the report----------