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Report No.: SHEMA180800661202

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## TEST REPORT

**Application No.:** SHEMA1808006612CR  
**FCC:** N82-KOHLER032  
**IC ID:** 4554A-KOHLER032  
**Applicant:** Kohler Co.  
**Address of Applicant:** 444 Highland Drive KOHLER, WI 53044  
**Manufacturer:** Shanghai Kohler Electronics., Ltd.  
**Address of Manufacturer:** No. 1955, Fengxiang Road, Baoshan Area, Shanghai, PRC Post code: 200444  
**Factory:** Shanghai Kohler Electronics., Ltd.  
**Address of Factory:** No. 1955, Fengxiang Road, Baoshan Area, Shanghai, PRC Post code: 200444

**Equipment Under Test (EUT):**

**EUT Name:** UART CLOUD MODULE  
**Model No.:** 1365472  
**Trade mark:** KOHLER  
**Standard(s) :** 47 CFR Part 15, Subpart C 15.247  
RSS-247 Issue 2, February 2017  
RSS-Gen Issue 5, April 2018

**Date of Receipt:** 2018-08-07  
**Date of Test:** 2018-08-08 to 2018-08-28  
**Date of Issue:** 2018-09-10

<b>Test Result:</b>	Pass*
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\* In the configuration tested, the EUT complied with the standards specified above.



Parlam Zhan  
E&E Section Manager

The manufacturer should ensure that all products in series production are in conformity with the product sample detailed in this report. If the product in this report is used in any configuration other than that detailed in the report, the manufacturer must ensure the new system complies with all relevant standards. Any mention of SGS International Electrical Approvals or testing done by SGS International Electrical Approvals in connection with, distribution or use of the product described in this report must be approved by SGS International Electrical Approvals in writing.

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Revision Record			
Version	Description	Date	Remark
00	Original	2018-09-10	/

Authorized for issue by:			
		Vincent Zhu	
		_____ Vincent Zhu / Project Engineer	
		Parlam Zhan	
		_____ Parlam Zhan / Reviewer	



## 2 Test Summary

Radio Spectrum Technical Requirement				
Item	Standard	Method	Requirement	Result
Antenna Requirement	47 CFR Part 15, Subpart C 15.247	N/A	47 CFR Part 15, Subpart C 15.203 & 15.247(c)	Pass

Radio Spectrum Matter Part				
Item	Standard	Method	Requirement	Result
Conducted Emissions at AC Power Line (150kHz-30MHz)	47 CFR Part 15, Subpart C 15.247	ANSI C63.10 (2013) Section 6.2	47 CFR Part 15, Subpart C 15.207	Pass (Note1)
Minimum 6dB Bandwidth	47 CFR Part 15, Subpart C 15.247	ANSI C63.10 (2013) Section 11.8.1	47 CFR Part 15, Subpart C 15.247a(2)	Pass (Note1)
Conducted Peak Output Power	47 CFR Part 15, Subpart C 15.247	ANSI C63.10 (2013) Section 11.9.1	47 CFR Part 15, Subpart C 15.247(b)(3)	Pass
Power Spectrum Density	47 CFR Part 15, Subpart C 15.247	ANSI C63.10 (2013) Section 11.10.2	47 CFR Part 15, Subpart C 15.247(e)	Pass
Conducted Band Edges Measurement	47 CFR Part 15, Subpart C 15.247	ANSI C63.10 (2013) Section 11.13.3.2	47 CFR Part 15, Subpart C 15.247(d)	Pass (Note1)
Conducted Spurious Emissions	47 CFR Part 15, Subpart C 15.247	ANSI C63.10 (2013) Section 11.11	47 CFR Part 15, Subpart C 15.247(d)	Pass (Note1)
Radiated Emissions which fall in the restricted bands	47 CFR Part 15, Subpart C 15.247	ANSI C63.10 (2013) Section 6.10.5	47 CFR Part 15, Subpart C 15.209 & 15.247(d)	Pass
Radiated Spurious Emissions	47 CFR Part 15, Subpart C 15.247	ANSI C63.10 (2013) Section 6.4,6.5,6.6	47 CFR Part 15, Subpart C 15.209 & 15.247(d)	Pass
99% Bandwidth	RSS-247 Issue 2, February 2017	ANSI C63.10 Section 6.9.3	RSS-Gen Section 6.6	Pass
Frequency Stability	RSS-Gen April 2018	RSS-Gen Section 6.11	RSS-Gen Section 8.11	Pass (Note2)

Note 1: Refer to test report 15020044-FCC-R1

Note 2: Frequency stability requested in RSS GEN S8.11 has been complied since the result of band edge can demonstrate.

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## 4 General Information

### 4.1 Details of E.U.T.

Power supply:	DC 12V
Antenna Gain	2dBi
Antenna Type	PCB Antenna
Channel Spacing	5MHz
Modulation Type	802.11b: DSSS (CCK, DQPSK, DBPSK) 802.11g/n: OFDM (64QAM, 16QAM, QPSK, BPSK)
Number of Channels	802.11b/g/n(HT20):11
Operation Frequency	802.11b/g/n(HT20): 2412MHz to 2462MHz

### 4.2 Description of Support Units

Description	Manufacturer	Model No.	Serial No.
Config-rx-tx	/	V1.0	/
Laptop	Lenovo	ThinkPad X100e	/
Serial port adapter plate	/	Test Plate 3	/

### 4.3 Measurement Uncertainty

No.	Item	Measurement Uncertainty
1	Radio Frequency	7.25 x 10-8
2	Timeout	2s
3	Duty cycle	0.37%
4	Occupied Bandwidth	3%
5	RF conducted power	0.75dB
6	RF power density	2.84dB
7	Conducted Spurious emissions	0.75dB
8	RF Radiated power	4.5dB (Below 1GHz) 4.8dB (Above 1GHz)
9	Radiated Spurious emission test	4.2dB (Below 30MHz) 4.4dB (30MHz-1GHz) 4.6dB (1GHz-18GHz) 5.2dB (Above 18GHz)
10	Temperature test	1°C
11	Humidity test	3%
12	Supply voltages	1.5%
13	Time	3%

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



#### **4.4 Test Location**

All tests were performed at:

SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd. E&E Lab

588 West Jindu Road, Xinqiao, Songjiang, 201612 Shanghai, China

Tel: +86 21 6191 5666      Fax: +86 21 6191 5678

No tests were sub-contracted.

#### **4.5 Test Facility**

The test facility is recognized, certified, or accredited by the following organizations:

- CNAS (No. CNAS L0599)**

CNAS has accredited SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd. to ISO/IEC 17025:2005 General Requirements for the Competence of Testing and Calibration Laboratories (CNAS-CL01 Accreditation Criteria for the Competence of Testing and Calibration Laboratories) for the competence in the field of testing.

- NVLAP (Certificate No. 201034-0)**

SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd. is accredited by the National Voluntary Laboratory Accreditation Program(NVLAP). Certificate No. 201034-0.

- FCC –Designation Number: CN5033**

SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd. has been recognized as an accredited testing laboratory.

Designation Number: CN5033. Test Firm Registration Number: 479755.

- Industry Canada (IC) – IC Assigned Code: 8617A**

The 3m Semi-anechoic chamber of SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd. has been registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing with Registration No.: 8617A-1.

- VCCI (Member No.: 3061)**

The 3m Semi-anechoic chamber and Shielded Room of SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd. has been registered in accordance with the Regulations for Voluntary Control Measures with Registration No.: R-13868, C-14336, T-12221, G-10830 respectively.

#### **4.6 Deviation from Standards**

None

#### **4.7 Abnormalities from Standard Conditions**

None



## 5 Equipment List

Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
<b>Conducted Test</b>					
Spectrum Analyzer	R&S	FSP-30	SHEM002-1	2017-12-20	2018-12-19
Spectrum Analyzer	Agilent	N9020A	SHEM181-1	2018-08-13	2019-08-12
Signal Generator	R&S	SMR20	SHEM006-1	2018-08-13	2019-08-12
Signal Generator	Agilent	N5182A	SHEM182-1	2018-08-13	2019-08-12
Communication Tester	R&S	CMW270	SHEM183-1	2018-08-13	2019-08-12
Switcher	Tonscend	JS0806	SHEM184-1	2018-08-13	2019-08-12
Power Sensor	Keysight	U2021XA * 4	SHEM184-1	2018-08-13	2019-08-12
Splitter	Anritsu	MA1612A	SHEM185-1	/	/
Coupler	e-meca	803-S-1	SHEM186-1	/	/
High-low Temp Cabinet	Suzhou Zhihe	TL-40	SHEM087-1	2017-09-25	2020-09-24
AC Power Stabilizer	WOCEN	6100	SHEM045-1	2017-12-26	2018-12-25
DC Power Supply	QJE	QJ30003SII	SHEM046-1	2017-12-26	2018-12-25
Conducted test Cable	/	RF01~RF04	/	2017-12-26	2018-12-25
<b>Radiated Test</b>					
EMI test Receiver	R&S	ESU40	SHEM051-1	2017-12-20	2018-12-19
Spectrum Analyzer	R&S	FSP-30	SHEM002-1	2017-12-20	2018-12-19
Loop Antenna (9kHz-30MHz)	Schwarzbeck	FMZB1519	SHEM135-1	2017-04-10	2020-04-09
Antenna (25MHz-2GHz)	Schwarzbeck	VULB9168	SHEM048-1	2017-02-28	2020-02-27
Antenna (25MHz-3GHz)	Schwarzbeck	HL562	SHEM010-1	2017-02-28	2020-02-27
Horn Antenna (1-8GHz)	Schwarzbeck	HF906	SHEM009-1	2017-10-24	2020-10-23
Horn Antenna (1-18GHz)	Schwarzbeck	BBHA9120D	SHEM050-1	2017-01-14	2020-01-13
Horn Antenna (14-40GHz)	Schwarzbeck	BBHA 9170	SHEM049-1	2017-12-03	2020-12-02
Pre-amplifier (9KHz-2GHz)	CLAVIIO	BDLNA-0001	SHEM164-1	2018-08-13	2019-08-12
Pre-amplifier (1-18GHz)	CLAVIIO	BDLNA-0118	SHEM050-2	2018-08-13	2019-08-12
High-amplifier (14-40GHz)	Schwarzbeck	10001	SHEM049-2	2017-12-20	2018-12-19
Signal Generator	R&S	SMR40	SHEM058-1	2018-08-13	2019-08-12
Band Filter	LORCH	9BRX-875/X150	SHEM156-1	/	/
Band Filter	LORCH	13BRX-1950/X500	SHEM083-2	/	/
Band Filter	LORCH	5BRX-2400/X200	SHEM155-1	/	/
Band Filter	LORCH	5BRX-5500/X1000	SHEM157-2	/	/
High pass Filter	Wainwright	WHK3.0/18G	SHEM157-1	/	/
High pass Filter	Wainwright	WHKS1700	SHEM157-3	/	/
Semi/Fully Anechoic	ST	11*6*6M	SHEM078-2	2017-07-22	2020-07-21
RE test Cable	/	RE01, RE02, RE06	/	2017-12-26	2018-12-25

## 6 Radio Spectrum Technical Requirement

### 6.1 Antenna Requirement

#### 6.1.1 Test Requirement:

47 CFR Part 15, Subpart C 15.203 & 15.247(c)

#### 6.1.2 Conclusion

Standard Requirement:

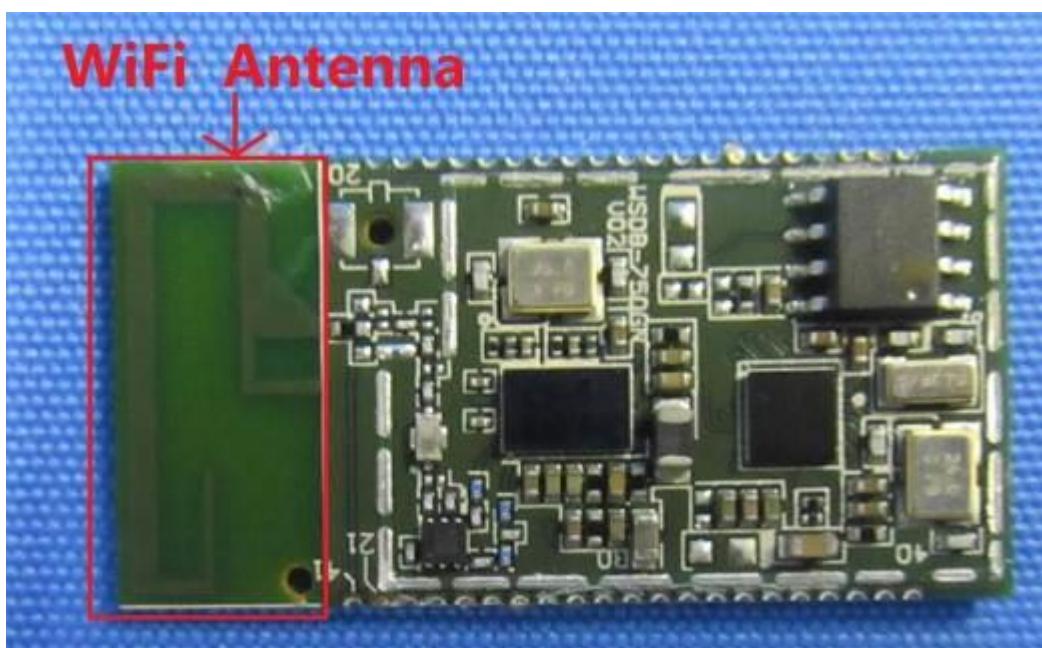
An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

15.247(b) (4) requirement:

The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

EUT Antenna:

The antenna is PCB antenna and no consideration of replacement. The best case gain of the antenna is 2dBi.



## **7 Radio Spectrum Matter Test Results**

### **7.1 Conducted Peak Output Power**

Test Requirement 47 CFR Part 15, Subpart C 15.247(b)(3)

Test Method: ANSI C63.10 (2013) Section 11.9.1

Limit:

<b>Frequency range(MHz)</b>	<b>Output power of the intentional radiator(watt)</b>
902-928	1 for $\geq 50$ hopping channels
	0.25 for $25 \leq$ hopping channels $< 50$
	1 for digital modulation
2400-2483.5	1 for $\geq 75$ non-overlapping hopping channels
	0.125 for all other frequency hopping systems
	1 for digital modulation
5725-5850	1 for frequency hopping systems and digital modulation

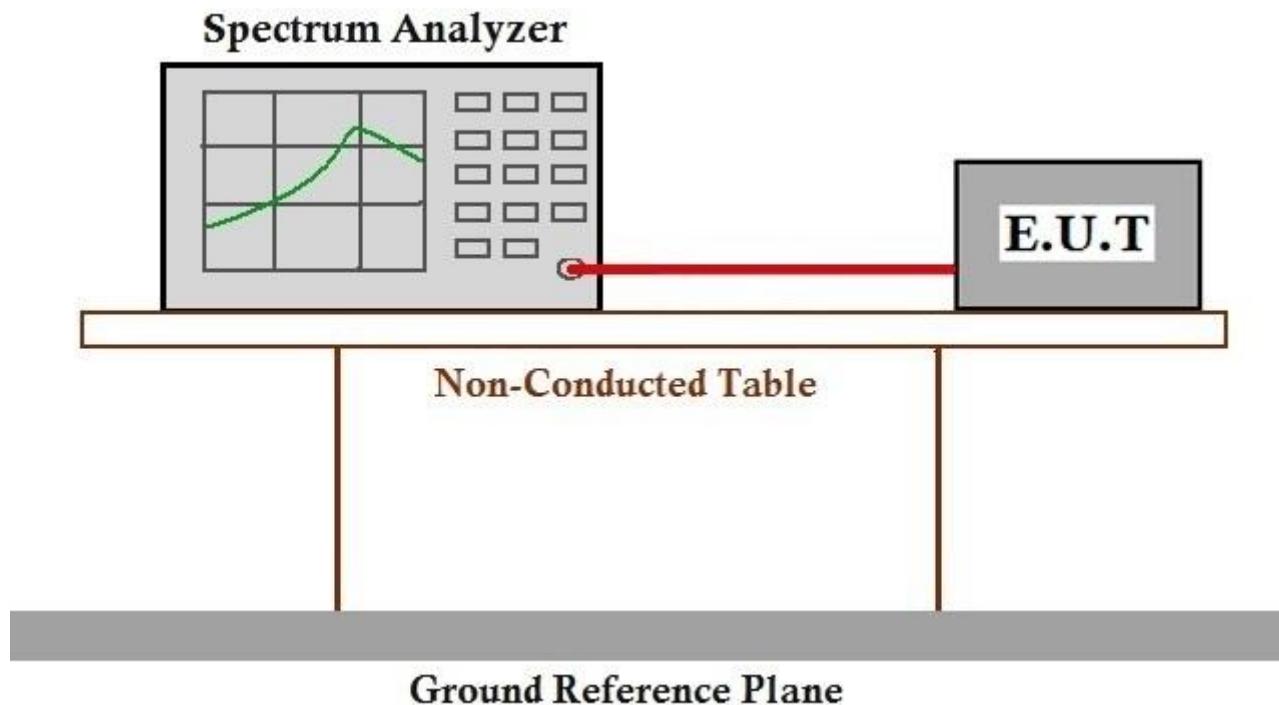
### 7.1.1 E.U.T. Operation

Operating Environment:

Temperature: 22 °C      Humidity: 50 % RH      Atmospheric Pressure: 1002 mbar

Test mode b:TX mode\_Keep the EUT in continuously transmitting mode with all modulation types. All data rates for each modulation type have been tested and found the data rate @ 1Mbps is the worst case of IEEE 802.11b; data rate @ 6Mbps is the worst case of IEEE 802.11g; data rate @ 6.5Mbps is the worst case of IEEE 802.11n(HT20). Only the data of worst case is recorded in the report.

### 7.1.2 Test Setup Diagram



### 7.1.3 Measurement Procedure and Data

The detailed test data see: Appendix B SHEMA180800661202

## 7.2 Radiated Emissions which fall in the restricted bands

Test Requirement 47 CFR Part 15, Subpart C 15.209 & 15.247(d)

Test Method: ANSI C63.10 (2013) Section 6.10.5

Limit:

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

Remark: The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90kHz, 110-490kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation.

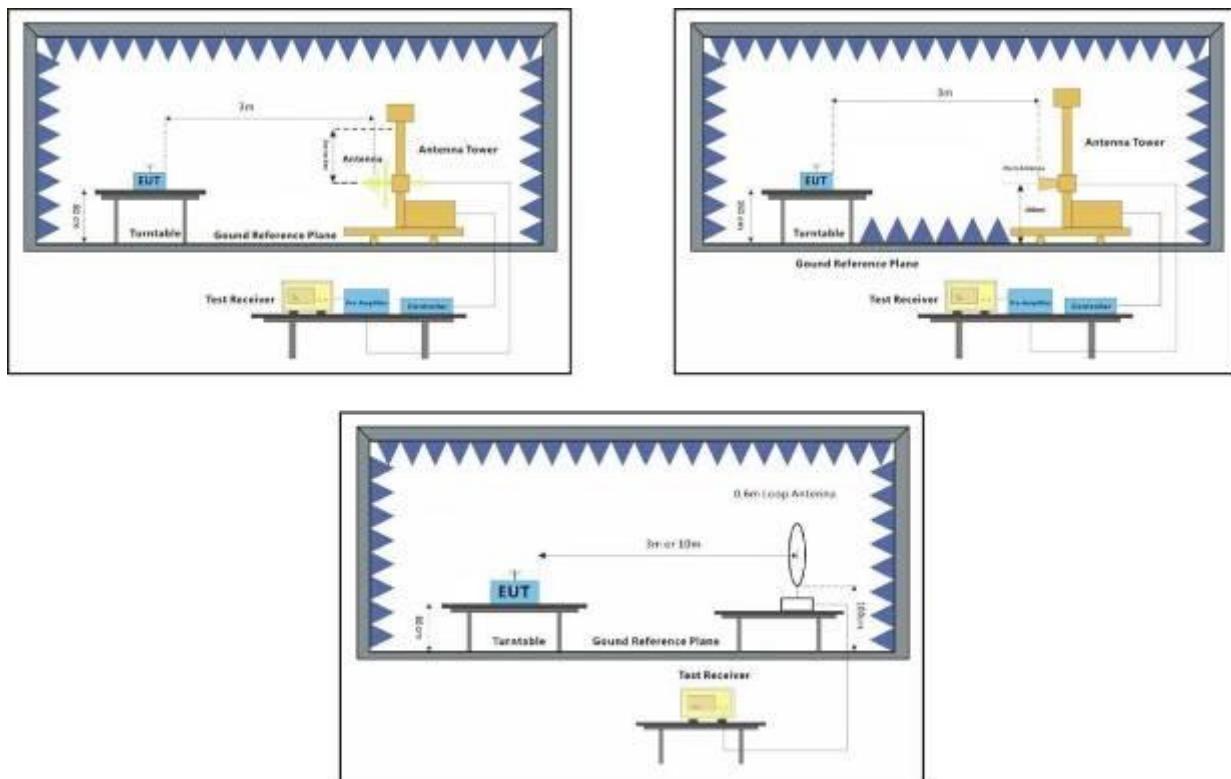
### 7.2.1 E.U.T. Operation

#### Operating Environment:

Temperature: 22 °C      Humidity: 50 % RH      Atmospheric Pressure: 1002 mbar

Test mode b:TX mode\_Keep the EUT in continuously transmitting mode with all modulation types. All data rates for each modulation type have been tested and found the data rate @ 1Mbps is the worst case of IEEE 802.11b; data rate @ 6Mbps is the worst case of IEEE 802.11g; data rate @ 6.5Mbps is the worst case of IEEE 802.11n(HT20). Only the data of worst case is recorded in the report.

### 7.2.2 Test Setup Diagram



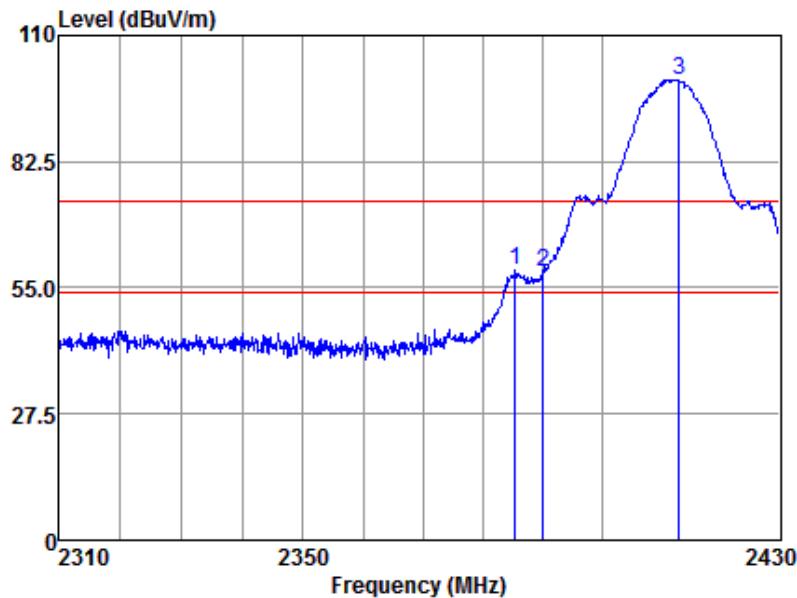
### **7.2.3 Measurement Procedure and Data**

- a. For below 1GHz, the EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 or 10 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
- b. For above 1GHz, the EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter fully-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
- c. The EUT was set 3 or 10 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- d. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- e. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters (for the test frequency of below 30MHz, the antenna was tuned to heights 1 meter) and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- f. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
- g. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.
- h. Test the EUT in the lowest channel, the middle channel, the Highest channel.
- i. The radiation measurements are performed in X, Y, Z axis positioning for Transmitting mode, and found the X axis positioning which it is the worst case.
- j. Repeat above procedures until all frequencies measured was complete.

Remark 1: Level= Read Level+ Cable Loss+ Antenna Factor- Preamp Factor

Remark 2: For frequencies above 1GHz, the field strength limits are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation. For the emissions whose peak level is lower than the average limit, only the peak measurement is shown in the report.

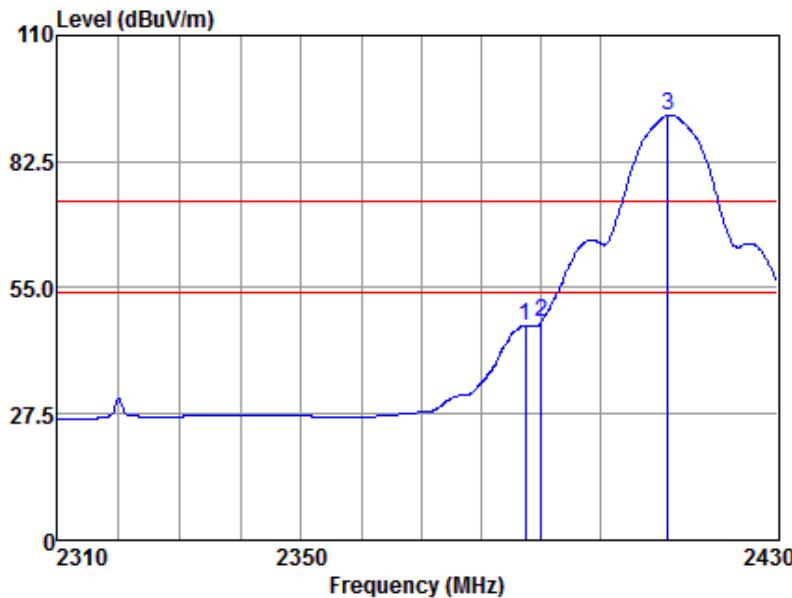
Mode:b; Polarization:Horizontal; Modulation:b; bandwidth:20MHz; Channel:Low

**Antenna Polarity :HORIZONTAL**

Read Freq	Antenna Level	Cable Factor	Preamp Loss	Emission Factor	Limit Level	Over Line	Limit	Over Remark
MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m	dB	
2385.37	63.72	26.03	6.47	37.36	58.86	74.00	-15.14	Peak
2390.00	63.43	26.03	6.47	37.36	58.57	74.00	-15.43	Peak
2413.08	105.22	26.08	6.50	37.36	100.44	74.00	26.44	Peak

Note: Emission Level=Read Level+Antenna Factor+Cable loss+Preamp Factor

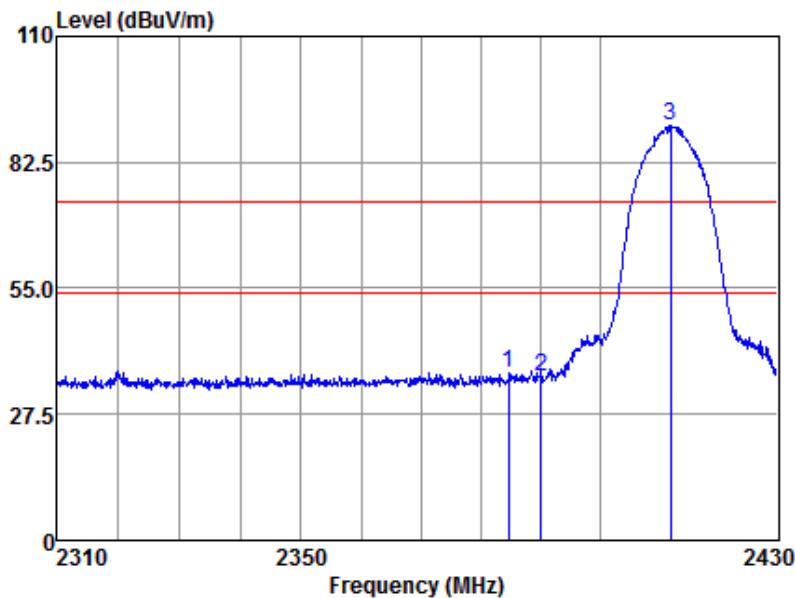
Mode:b; Polarization:Horizontal; Modulation:b; bandwidth:20MHz; Channel:Low

**Antenna Polarity :HORIZONTAL**

Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit	Over Line	Limit	Remark
MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m		dB	
2387.43	51.69	26.03	6.47	37.36	46.83	54.00	-7.17	Average	
2390.00	52.19	26.03	6.47	37.36	47.33	54.00	-6.67	Average	
2411.49	97.41	26.08	6.50	37.36	92.63	54.00	38.63	Average	

Note: Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

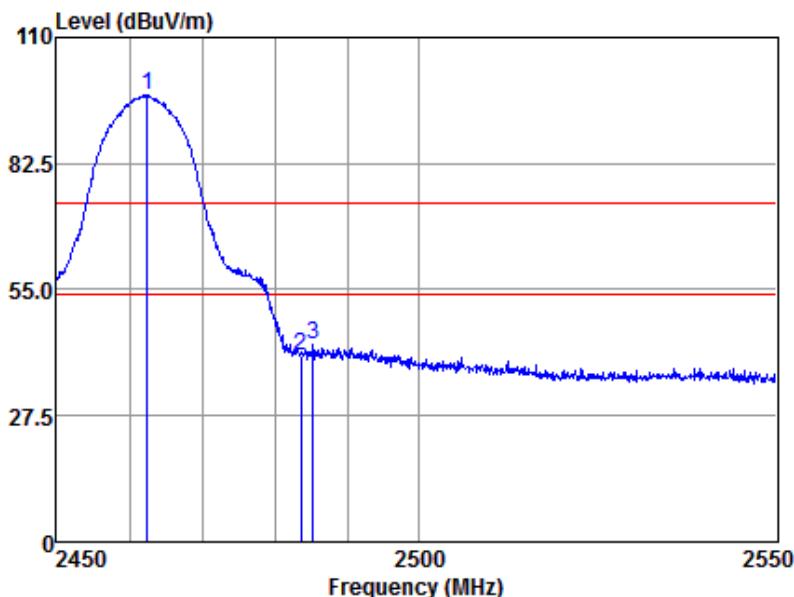
Mode:b; Polarization:Vertical; Modulation:b; bandwidth:20MHz; Channel:Low

**Antenna Polarity :VERTICAL**

Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m	dB	
2384.65	41.36	26.03	6.47	37.36	36.50	74.00	-37.50	Peak
2390.00	40.48	26.03	6.47	37.36	35.62	74.00	-38.38	Peak
2411.98	95.26	26.08	6.50	37.36	90.48	74.00	16.48	Peak

Note: Emission Level=Read Level+Antenna Factor+Cable loss+Preamp Factor

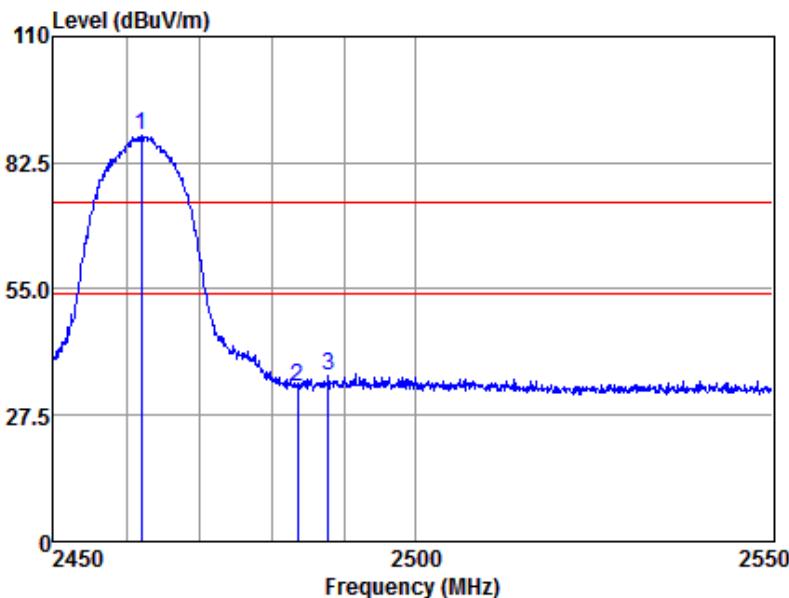
Mode:b; Polarization:Horizontal; Modulation:b; bandwidth:20MHz; Channel:High

**Antenna Polarity :HORIZONTAL**

Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit	Over Line	Limit	Remark
MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m		dB	
2462.48	102.09	26.15	6.68	37.46	97.46	74.00	23.46	Peak	
2483.50	45.02	26.18	6.80	37.51	40.49	74.00	-33.51	Peak	
2485.24	47.63	26.18	6.80	37.51	43.10	74.00	-30.90	Peak	

Note: Emission Level=Read Level+Antenna Factor+Cable loss+Preamp Factor

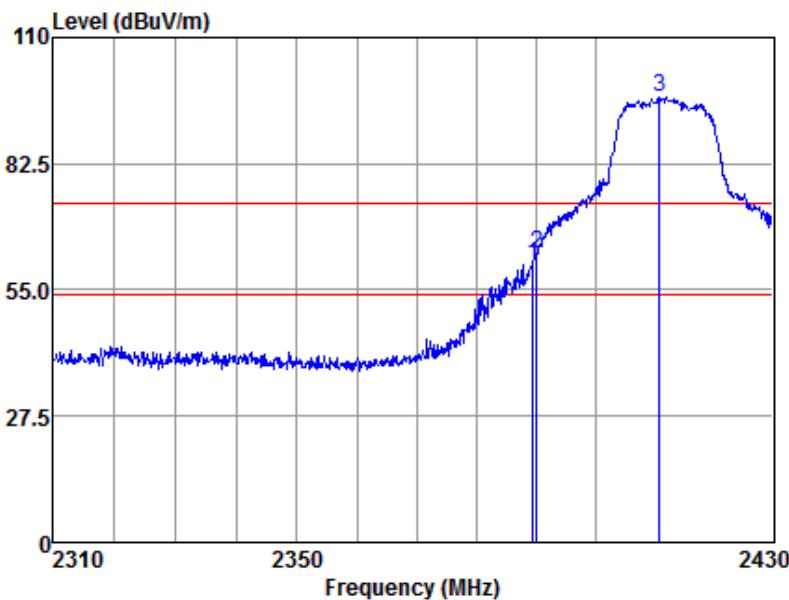
Mode:b; Polarization:Vertical; Modulation:b; bandwidth:20MHz; Channel:High

**Antenna Polarity :VERTICAL**

Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit	Over Line	Limit	Remark
MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m		dB	
2461.99	92.95	26.15	6.68	37.46	88.32	74.00	14.32	Peak	
2483.50	38.35	26.18	6.80	37.51	33.82	74.00	-40.18	Peak	
2487.83	40.50	26.18	6.80	37.51	35.97	74.00	-38.03	Peak	

Note: Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

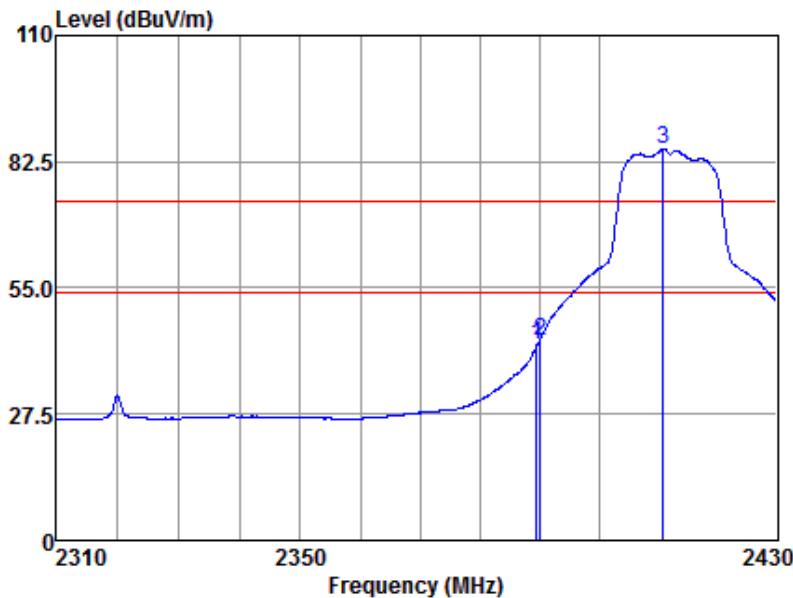
Mode:b; Polarization:Horizontal; Modulation:g; bandwidth:20MHz; Channel:Low

**Antenna Polarity :HORIZONTAL**

Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit	Over Line	Limit	Remark
MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m	dB		
2389.48	65.25	26.03	6.47	37.36	60.39	74.00	-13.61	Peak	
2390.00	67.75	26.03	6.47	37.36	62.89	74.00	-11.11	Peak	
2410.88	101.88	26.06	6.50	37.35	97.09	74.00	23.09	Peak	

Note: Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

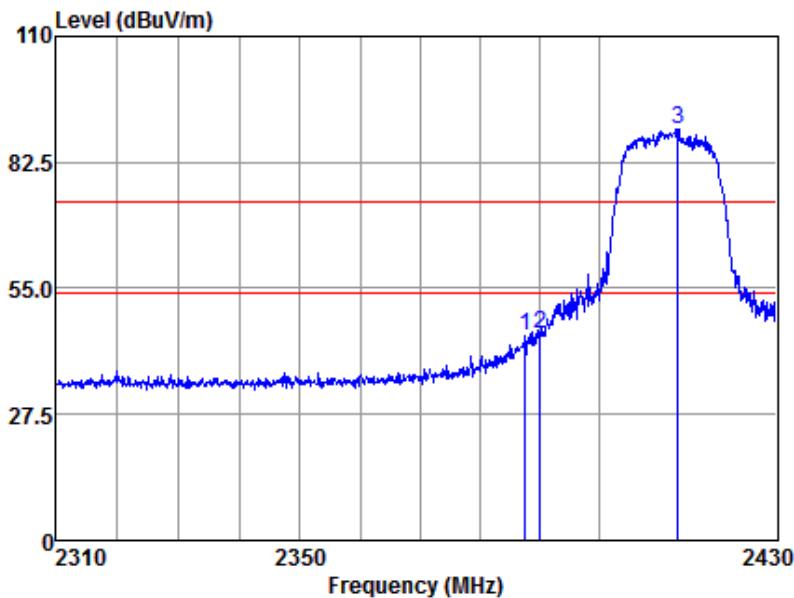
Mode:b; Polarization:Horizontal; Modulation:g; bandwidth:20MHz; Channel:Low

**Antenna Polarity :HORIZONTAL**

Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit	Over Line	Limit	Remark
MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m		dB	
2389.48	47.29	26.03	6.47	37.36	42.43	54.00	-11.57	Average	
2390.00	48.43	26.03	6.47	37.36	43.57	54.00	-10.43	Average	
2410.88	90.00	26.06	6.50	37.35	85.21	54.00	31.21	Average	

Note: Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

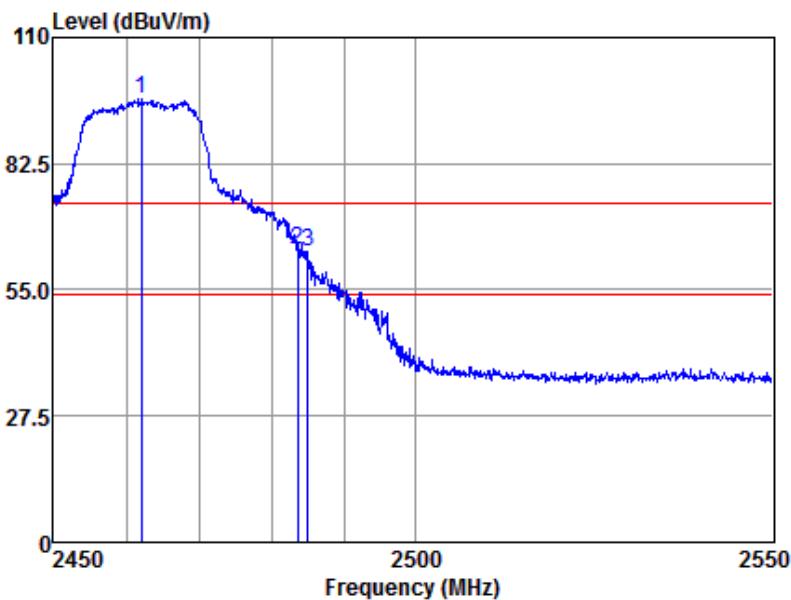
Mode:b; Polarization:Vertical; Modulation:g; bandwidth:20MHz; Channel:Low

**Antenna Polarity :VERTICAL**

Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m	dB	
2387.55	49.40	26.03	6.47	37.36	44.54	74.00	-29.46	Peak
2390.00	49.90	26.03	6.47	37.36	45.04	74.00	-28.96	Peak
2413.44	94.40	26.08	6.50	37.36	89.62	74.00	15.62	Peak

Note: Emission Level=Read Level+Antenna Factor+Cable loss+Preamp Factor

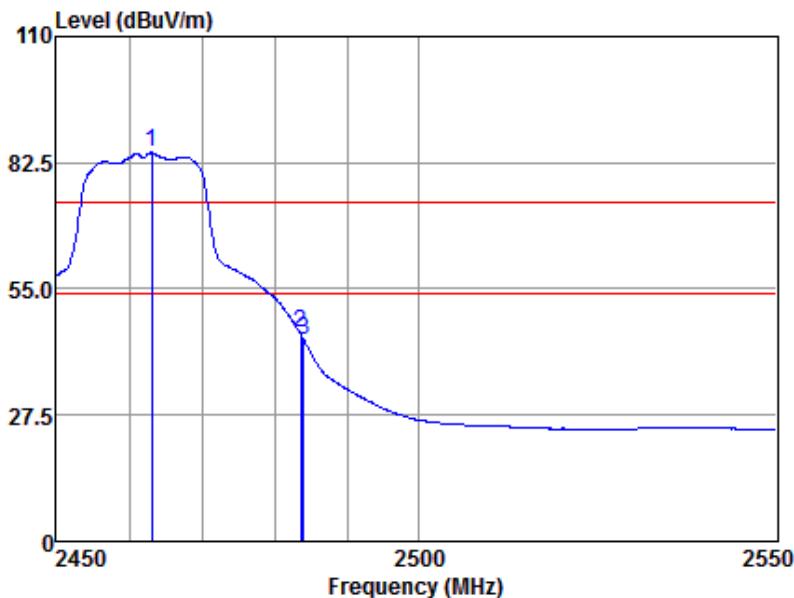
Mode:b; Polarization:Horizontal; Modulation:g; bandwidth:20MHz; Channel:High

**Antenna Polarity :HORIZONTAL**

Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit	Over Line	Limit	Remark
MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m	dB		
2462.09	101.07	26.15	6.68	37.46	96.44	74.00	22.44		Peak
2483.50	68.14	26.18	6.80	37.51	63.61	74.00	-10.39		Peak
2484.94	68.01	26.18	6.80	37.51	63.48	74.00	-10.52		Peak

Note: Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

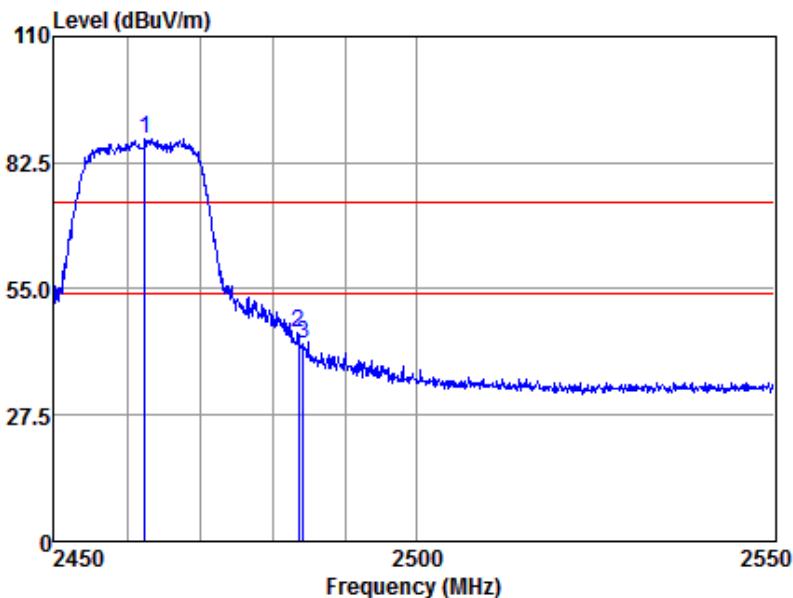
Mode:b; Polarization:Horizontal; Modulation:g; bandwidth:20MHz; Channel:High

**Antenna Polarity :HORIZONTAL**

Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m	dB	
2463.07	89.30	26.15	6.68	37.46	84.67	54.00	30.67	Average
2483.50	49.81	26.18	6.80	37.51	45.28	54.00	-8.72	Average
2483.95	48.56	26.18	6.80	37.51	44.03	54.00	-9.97	Average

Note: Emission Level=Read Level+Antenna Factor+Cable loss+Preamp Factor

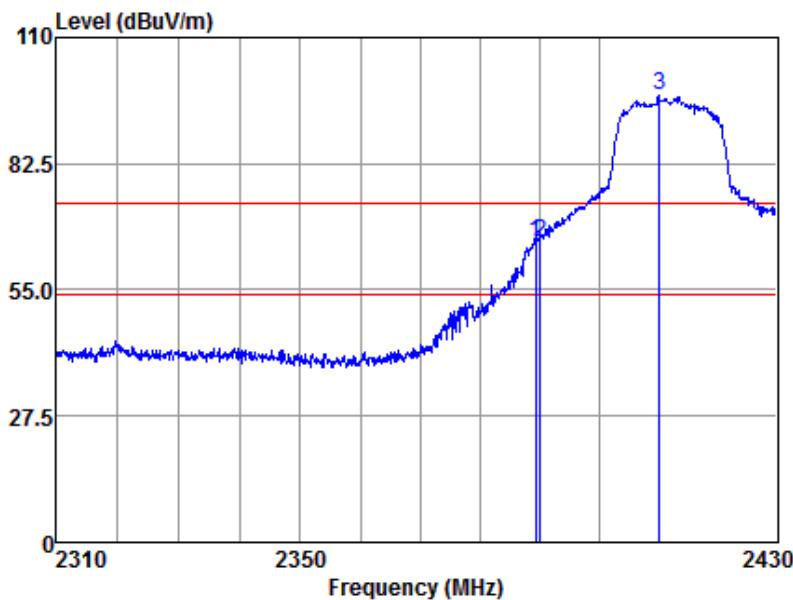
Mode:b; Polarization:Vertical; Modulation:g; bandwidth:20MHz; Channel:High

**Antenna Polarity :VERTICAL**

Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit	Over Line	Over Limit	Remark
MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m	dB		
2462.38	92.34	26.15	6.68	37.46	87.71	74.00	13.71	Peak	
2483.50	49.87	26.18	6.80	37.51	45.34	74.00	-28.66	Peak	
2484.15	47.42	26.18	6.80	37.51	42.89	74.00	-31.11	Peak	

Note: Emission Level=Read Level+Antenna Factor+Cable loss+Preamp Factor

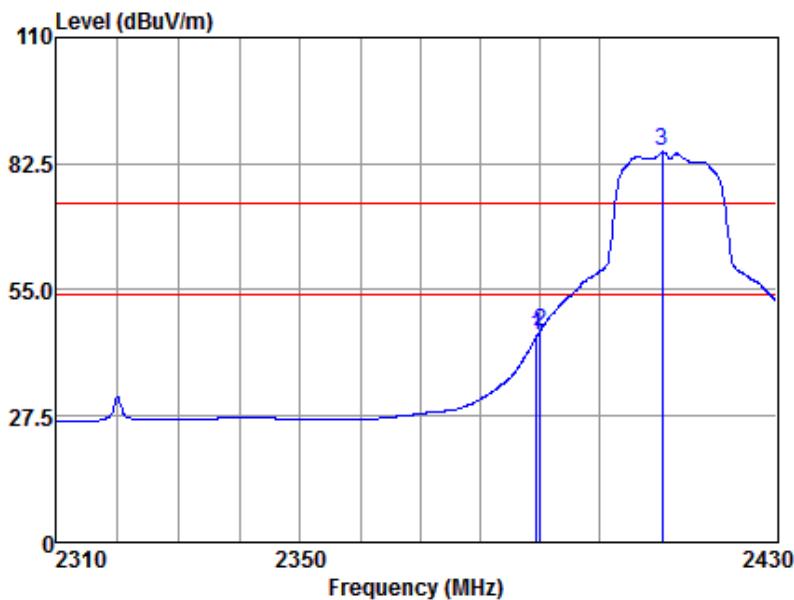
Mode:b; Polarization:Horizontal; Modulation:n; bandwidth:20MHz; Channel:Low

**Antenna Polarity :HORIZONTAL**

Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit	Over Line	Over Limit	Remark
MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m	dB		
2389.24	70.11	26.03	6.47	37.36	65.25	74.00	-8.75	Peak	
2390.00	70.16	26.03	6.47	37.36	65.30	74.00	-8.70	Peak	
2410.15	102.10	26.06	6.50	37.35	97.31	74.00	23.31	Peak	

Note: Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

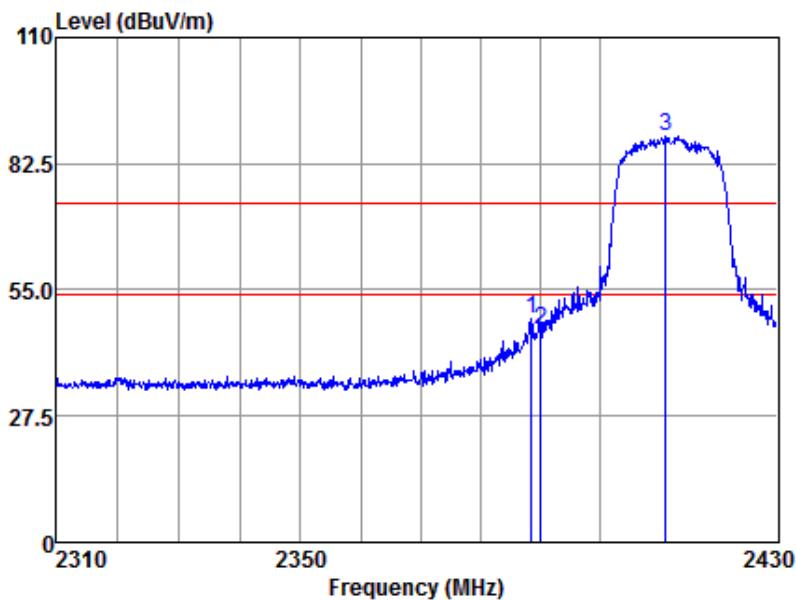
Mode:b; Polarization:Horizontal; Modulation:n; bandwidth:20MHz; Channel:Low

**Antenna Polarity :HORIZONTAL**

Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit	Over Line	Limit	Remark
MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m		dB	
2389.48	49.79	26.03	6.47	37.36	44.93	54.00	-9.07	Average	
2390.00	50.78	26.03	6.47	37.36	45.92	54.00	-8.08	Average	
2410.76	89.87	26.06	6.50	37.35	85.08	54.00	31.08	Average	

Note: Emission Level=Read Level+Antenna Factor+Cable loss+Preamp Factor

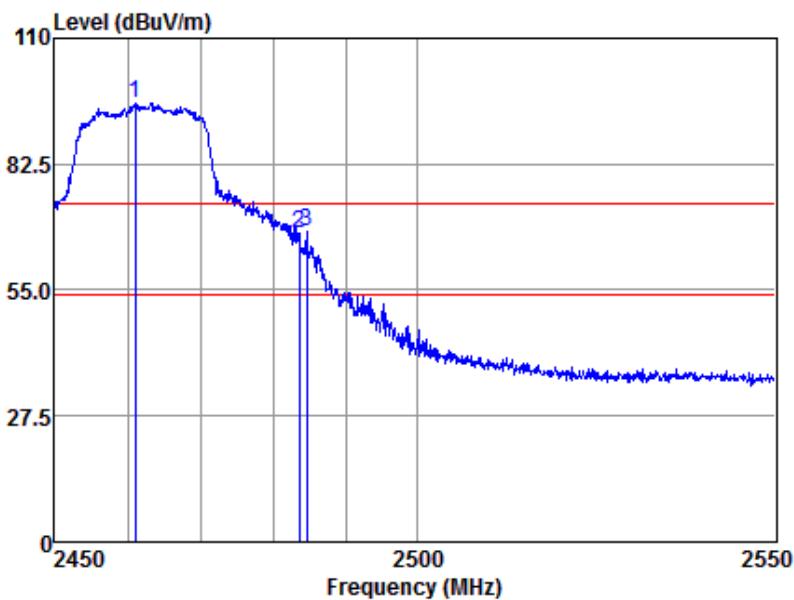
Mode:b; Polarization:Vertical; Modulation:n; bandwidth:20MHz; Channel:Low

**Antenna Polarity :VERTICAL**

Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m	dB	
2388.52	53.60	26.03	6.47	37.36	48.74	74.00	-25.26	Peak
2390.00	51.20	26.03	6.47	37.36	46.34	74.00	-27.66	Peak
2411.12	93.47	26.06	6.50	37.35	88.68	74.00	14.68	Peak

Note: Emission Level=Read Level+Antenna Factor+Cable loss+Preamp Factor

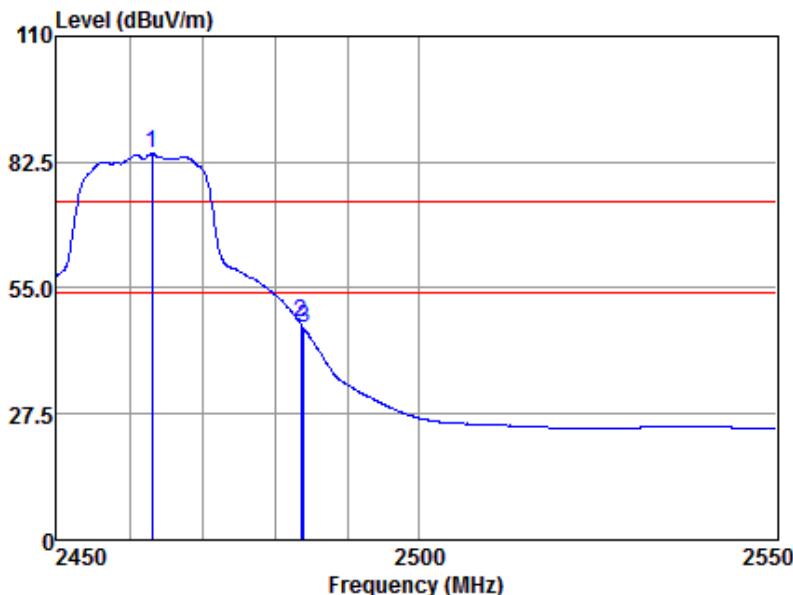
Mode:b; Polarization:Horizontal; Modulation:n; bandwidth:20MHz; Channel:High

**Antenna Polarity :HORIZONTAL**

Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m	dB	
2461.00	100.45	26.15	6.68	37.46	95.82	74.00	21.82	Peak
2483.50	71.95	26.18	6.80	37.51	67.42	74.00	-6.58	Peak
2484.55	72.37	26.18	6.80	37.51	67.84	74.00	-6.16	Peak

Note: Emission Level=Read Level+Antenna Factor+Cable loss+Preamp Factor

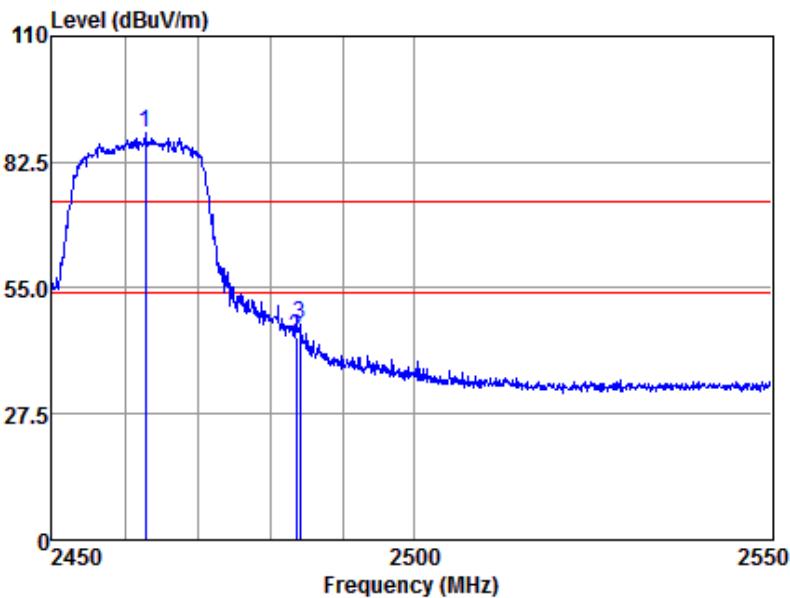
Mode:b; Polarization:Horizontal; Modulation:n; bandwidth:20MHz; Channel:High

**Antenna Polarity :HORIZONTAL**

Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit	Over Line	Limit	Remark
MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m		dB	
2463.07	88.95	26.15	6.68	37.46	84.32	54.00	30.32	Average	
2483.50	51.87	26.18	6.80	37.51	47.34	54.00	-6.66	Average	
2483.95	50.87	26.18	6.80	37.51	46.34	54.00	-7.66	Average	

Note: Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

Mode:b; Polarization:Vertical; Modulation:n; bandwidth:20MHz; Channel:High

**Antenna Polarity :VERTICAL**

Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Over Remark
MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m	dB	
2462.78	93.36	26.15	6.68	37.46	88.73	74.00	14.73	Peak
2483.50	48.65	26.18	6.80	37.51	44.12	74.00	-29.88	Peak
2484.05	51.75	26.18	6.80	37.51	47.22	74.00	-26.78	Peak

Note: Emission Level=Read Level+Antenna Factor+Cable loss+Preamp Factor

### **7.3 Radiated Spurious Emissions**

Test Requirement 47 CFR Part 15, Subpart C 15.209 & 15.247(d)

Test Method: ANSI C63.10 (2013) Section 6.4,6.5,6.6

Limit:

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

Remark: The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90kHz, 110-490kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation.

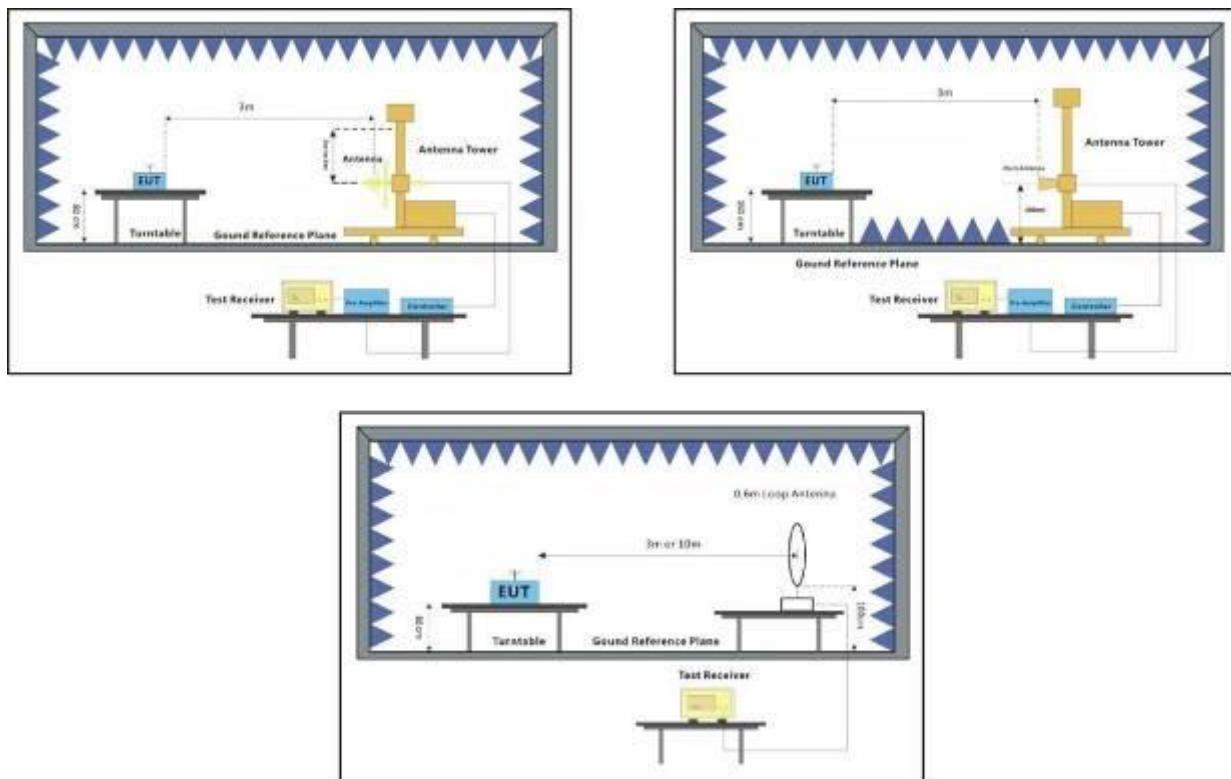
### 7.3.1 E.U.T. Operation

Operating Environment:

Temperature: 22 °C      Humidity: 50 % RH      Atmospheric Pressure: 1002 mbar

Test mode      b:TX mode\_Keep the EUT in continuously transmitting mode with all modulation types. All data rates for each modulation type have been tested and found the data rate @ 1Mbps is the worst case of IEEE 802.11b; data rate @ 6Mbps is the worst case of IEEE 802.11g; data rate @ 6.5Mbps is the worst case of IEEE 802.11n(HT20). Only the data of worst case is recorded in the report.

### 7.3.2 Test Setup Diagram



### **7.3.3 Measurement Procedure and Data**

- a. For below 1GHz, the EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 or 10 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
- b. For above 1GHz, the EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter fully-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
- c. The EUT was set 3 or 10 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- d. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- e. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters (for the test frequency of below 30MHz, the antenna was tuned to heights 1 meter) and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- f. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
- g. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.
- h. Test the EUT in the lowest channel, the middle channel, the Highest channel.
- i. The radiation measurements are performed in X, Y, Z axis positioning for Transmitting mode, and found the X axis positioning which it is the worst case.
- j. Repeat above procedures until all frequencies measured was complete.

**Remark:**

- 1) For emission below 1GHz, through pre-scan found the worst case is the lowest channel. Only the worst case is recorded in the report.
- 2) The field strength is calculated by adding the Antenna Factor, Cable Factor & Preamplifier. The basic equation with a sample calculation is as follows:  
Final Test Level = Receiver Reading + Antenna Factor + Cable Factor – Preamplifier Factor
- 3) Scan from 9kHz to 25GHz, the disturbance above 18GHz and below 30MHz was very low. The points marked on above plots are the highest emissions could be found when testing, so only above points had been displayed. The amplitude of spurious emissions from the radiator which are attenuated more than 20dB below the limit need not be reported.
- 4) For frequencies above 1GHz, the field strength limits are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation. For the emissions whose peak level is lower than the average limit, only the peak measurement is shown

Mode:b; Polarization:Horizontal; Modulation:b; bandwidth:20MHz; Channel:Low

Frequency	RX_R	Factor	Emission	Limit	Over Limit	Detector
MHz	dBuV	dB	dBuV/m	dBuV/m	dB	
4824	42.03	6.40	48.43	54	-5.57	peak
7236	41.48	10.76	52.24	54	-1.76	peak
9648	36.46	14.37	50.83	54	-3.17	peak

Mode:b; Polarization:Vertical; Modulation:b; bandwidth:20MHz; Channel:Low

Frequency	RX_R	Factor	Emission	Limit	Over Limit	Detector
MHz	dBuV	dB	dBuV/m	dBuV/m	dB	
4824	41.21	6.40	47.61	54	-6.39	peak
7236	38.48	10.76	49.24	54	-4.76	peak
9648	32.82	14.37	47.19	54	-6.81	peak

Mode:b; Polarization:Horizontal; Modulation:b; bandwidth:20MHz; Channel:middle

Frequency	RX_R	Factor	Emission	Limit	Over Limit	Detector
MHz	dBuV	dB	dBuV/m	dBuV/m	dB	
4874	40.14	6.92	47.06	54	-6.94	peak
7311	39.39	11.08	50.47	54	-3.53	peak
9748	33.38	14.36	47.74	54	-6.26	peak

Mode:b; Polarization:Vertical; Modulation:b; bandwidth:20MHz; Channel:middle

Frequency	RX_R	Factor	Emission	Limit	Over Limit	Detector
MHz	dBuV	dB	dBuV/m	dBuV/m	dB	
4874	39.79	6.92	46.71	54	-7.29	peak
7311	35.48	11.08	46.56	54	-7.44	peak
9748	35.50	14.36	49.86	54	-4.14	peak

Mode:b; Polarization:Horizontal; Modulation:b; bandwidth:20MHz; Channel:High

Frequency	RX_R	Factor	Emission	Limit	Margin	Detector
MHz	dBuV	dB	dBuV/m	dBuV/m	dB	
4924	39.12	7.31	46.43	54	-7.57	peak
7386	34.37	11.41	45.78	54	-8.22	peak
9848	32.28	14.38	46.66	54	-7.34	peak

Mode:b; Polarization:Vertical; Modulation:b; bandwidth:20MHz; Channel:High

Frequency	RX_R	Factor	Emission	Limit	Over Limit	Detector
MHz	dBuV	dB	dBuV/m	dBuV/m	dB	
4924	42.79	7.31	50.10	54	-3.90	peak
7386	36.82	11.41	48.23	54	-5.77	peak
9848	34.90	14.38	49.28	54	-4.72	peak

Mode:b; Polarization:Horizontal; Modulation:g; bandwidth:20MHz; Channel:Low

Frequency	RX_R	Factor	Emission	Limit	Over Limit	Detector
MHz	dBuV	dB	dBuV/m	dBuV/m	dB	
4824	39.73	6.40	46.13	54	-7.87	peak
7236	39.31	10.76	50.07	54	-3.93	peak
9648	35.18	14.37	49.55	54	-4.45	peak

Mode:b; Polarization:Vertical; Modulation:g; bandwidth:20MHz; Channel:Low

Frequency	RX_R	Factor	Emission	Limit	Over Limit	Detector
MHz	dBuV	dB	dBuV/m	dBuV/m	dB	
4824	38.07	6.40	44.47	54	-9.53	peak
7236	39.30	10.76	50.06	54	-3.94	peak
9648	33.78	14.37	48.15	54	-5.85	peak

Mode:b; Polarization:Horizontal; Modulation:g; bandwidth:20MHz; Channel:middle

Frequency	RX_R	Factor	Emission	Limit	Over Limit	Detector
MHz	dBuV	dB	dBuV/m	dBuV/m	dB	
4874	39.34	6.92	46.26	54	-7.74	peak
7311	38.20	11.08	49.28	54	-4.72	peak
9748	34.12	14.36	48.48	54	-5.52	peak

Mode:b; Polarization:Vertical; Modulation:g; bandwidth:20MHz; Channel:middle

Frequency	RX_R	Factor	Emission	Limit	Over Limit	Detector
MHz	dBuV	dB	dBuV/m	dBuV/m	dB	
4874	43.36	6.92	50.28	54	-3.72	peak
7311	36.19	11.08	47.27	54	-6.73	peak
9748	33.19	14.36	47.55	54	-6.45	peak

Mode:b; Polarization:Horizontal; Modulation:g; bandwidth:20MHz; Channel:High

Frequency	RX_R	Factor	Emission	Limit	Over Limit	Detector
MHz	dBuV	dB	dBuV/m	dBuV/m	dB	
4924	38.89	7.31	46.20	54	-7.80	peak
7386	35.99	11.41	47.40	54	-6.60	peak
9848	31.72	14.38	46.10	54	-7.90	peak

Mode:b; Polarization:Vertical; Modulation:g; bandwidth:20MHz; Channel:High

Frequency	RX_R	Factor	Emission	Limit	Over Limit	Detector
MHz	dBuV	dB	dBuV/m	dBuV/m	dB	
4924	40.54	7.31	47.85	54	-6.15	peak
7386	38.47	11.41	49.88	54	-4.12	peak
9848	36.74	14.38	51.12	54	-2.88	peak

Mode:b; Polarization:Horizontal; Modulation:n; bandwidth:20MHz; Channel:Low

Frequency	RX_R	Factor	Emission	Limit	Over Limit	Detector
MHz	dBuV	dB	dBuV/m	dBuV/m	dB	
4824	42.69	6.40	49.09	54	-4.91	peak
7236	38.22	10.76	48.98	54	-5.02	peak
9648	33.93	14.37	48.30	54	-5.70	peak

Mode:b; Polarization:Vertical; Modulation:n; bandwidth:20MHz; Channel:Low

Frequency	RX_R	Factor	Emission	Limit	Over Limit	Detector
MHz	dBuV	dB	dBuV/m	dBuV/m	dB	
4824	40.99	6.40	47.39	54	-6.61	peak
7236	39.63	10.76	50.39	54	-3.61	peak
9648	34.91	14.37	49.28	54	-4.72	peak

Mode:b; Polarization:Horizontal; Modulation:n; bandwidth:20MHz; Channel:middle

Frequency	RX_R	Factor	Emission	Limit	Over Limit	Detector
MHz	dBuV	dB	dBuV/m	dBuV/m	dB	
4874	41.82	6.92	48.74	54	-5.26	peak
7311	38.04	11.08	49.12	54	-4.88	peak
9748	32.89	14.36	47.25	54	-6.75	peak

Mode:b; Polarization:Vertical; Modulation:n; bandwidth:20MHz; Channel:middle

Frequency	RX_R	Factor	Emission	Limit	Over Limit	Detector
MHz	dBuV	dB	dBuV/m	dBuV/m	dB	
4874	39.72	6.92	46.64	54	-7.36	peak
7311	38.88	11.08	49.96	54	-4.04	peak
9748	34.73	14.36	49.09	54	-4.91	peak

Mode:b; Polarization:Horizontal; Modulation:n; bandwidth:20MHz; Channel:High

Frequency	RX_R	Factor	Emission	Limit	Over Limit	Detector
MHz	dBuV	dB	dBuV/m	dBuV/m	dB	
4924	39.59	7.31	46.90	54	-7.10	peak
7386	39.33	11.41	50.74	54	-3.26	peak
9848	31.43	14.38	45.81	54	-8.19	peak

Mode:b; Polarization:Vertical; Modulation:n; bandwidth:20MHz; Channel:High

Frequency	RX_R	Factor	Emission	Limit	Over Limit	Detector
MHz	dBuV	dB	dBuV/m	dBuV/m	dB	
4924	40.50	7.31	47.81	54	-6.19	peak
7386	38.99	11.41	50.40	54	-3.60	peak
9848	35.63	14.38	50.01	54	-3.99	peak

## 7.4 99% Bandwidth

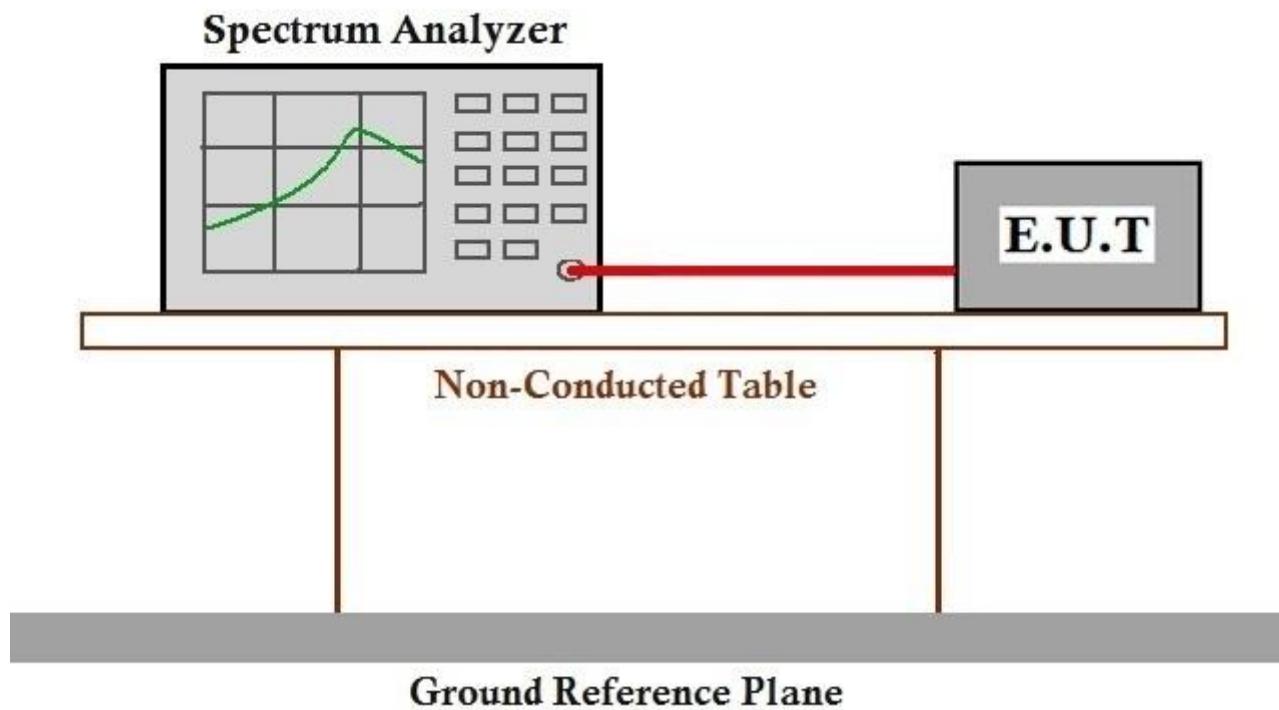
Test Requirement RSS-Gen Section 6.6  
Test Method: ANSI C63.10 Section 6.9.3

### 7.4.1 E.U.T. Operation

Operating Environment:

Temperature: 22 °C      Humidity: 50 % RH      Atmospheric Pressure: 1002 mbar  
Test mode: a:TX mode\_Keep the EUT in continuously transmitting mode with GFSK modulation

### 7.4.2 Test Setup Diagram



### 7.4.3 Measurement Procedure and Data

The detailed test data see: Appendix B SHEMA180800661202



## **8 Test Setup Photographs**

Refer to the < Test Setup photos-FCC>.

## **9 EUT Constructional Details**

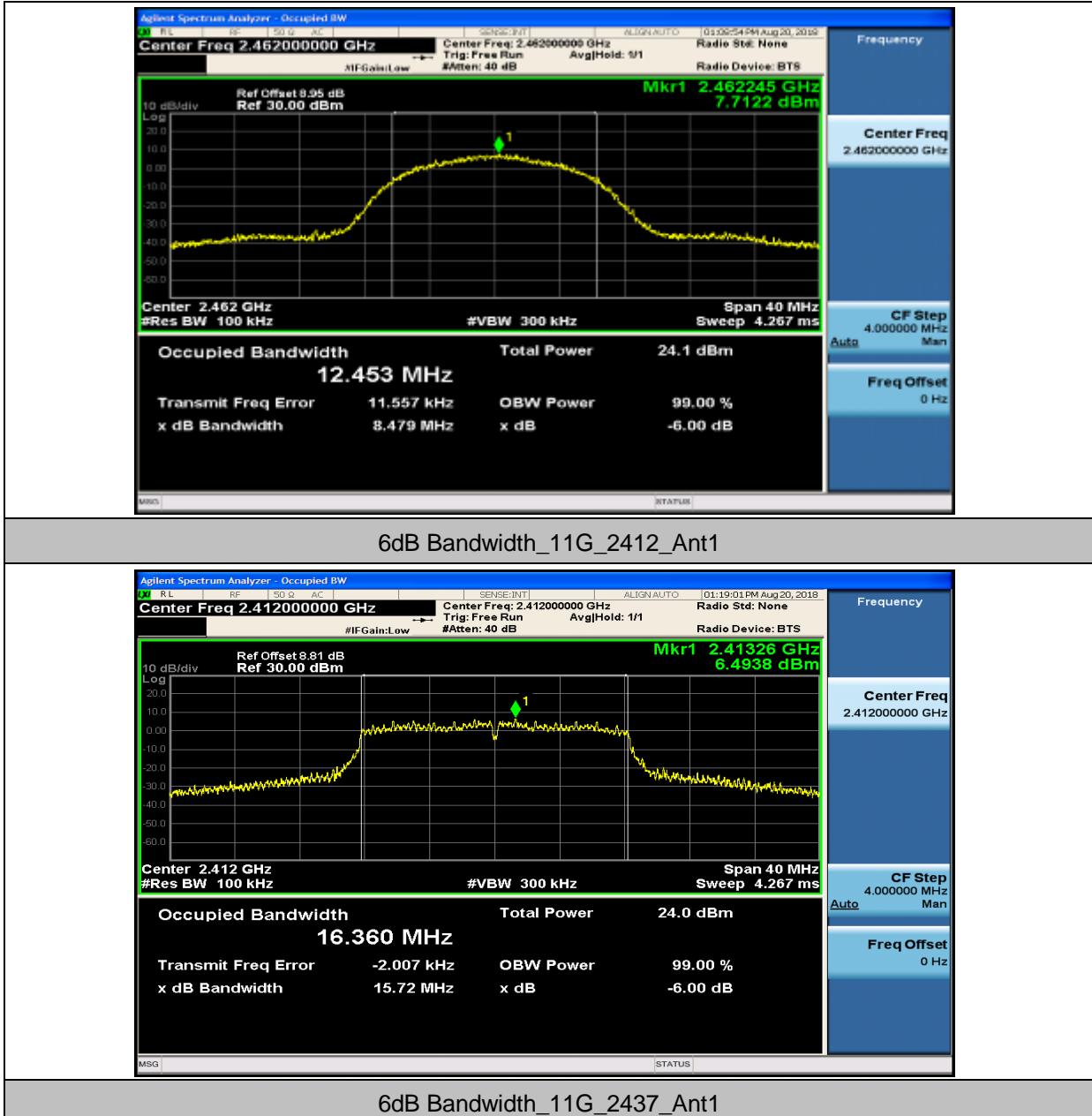
Refer to the < Photos >.

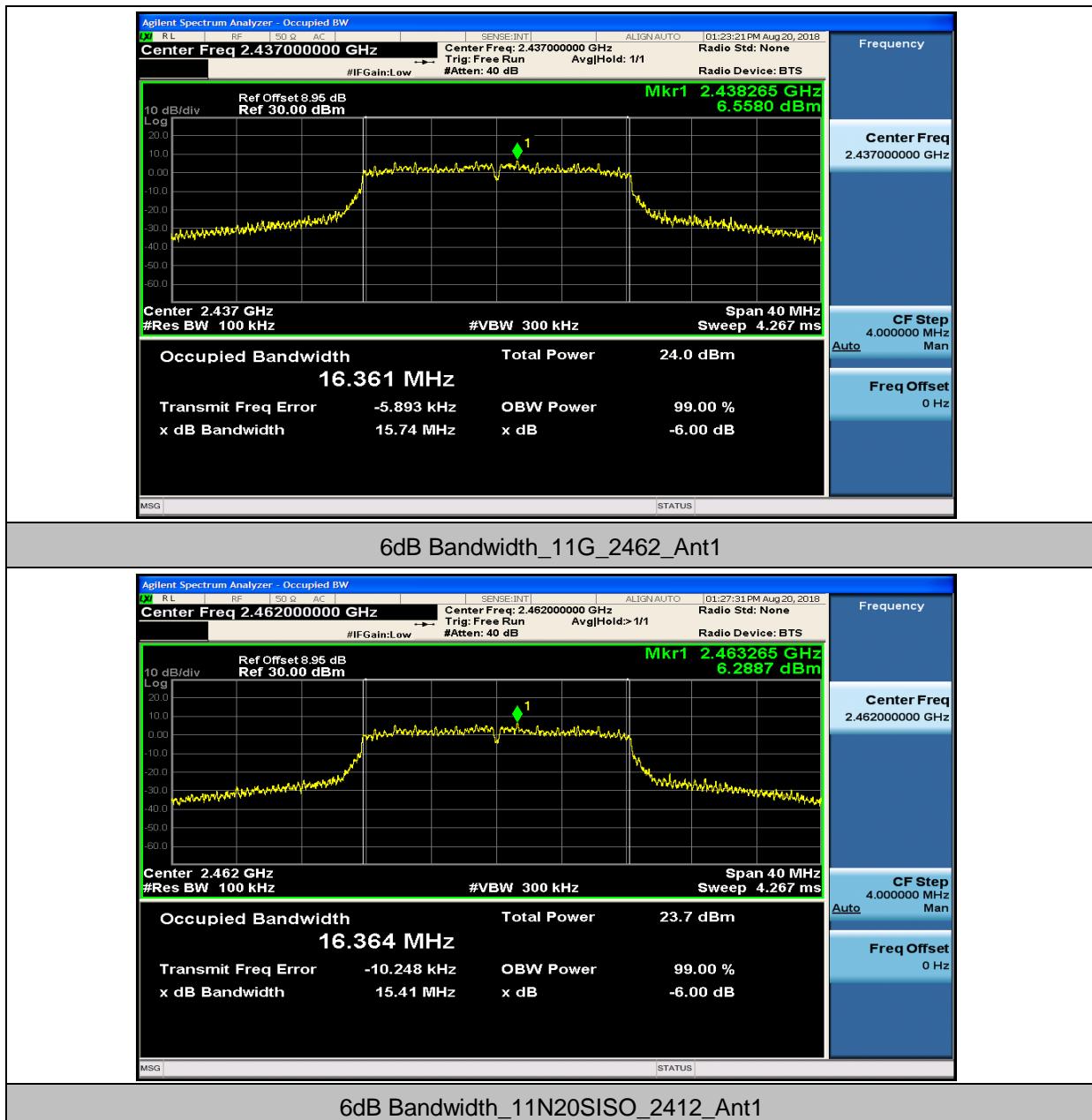
**Appendix B for SHEMA180800661202**

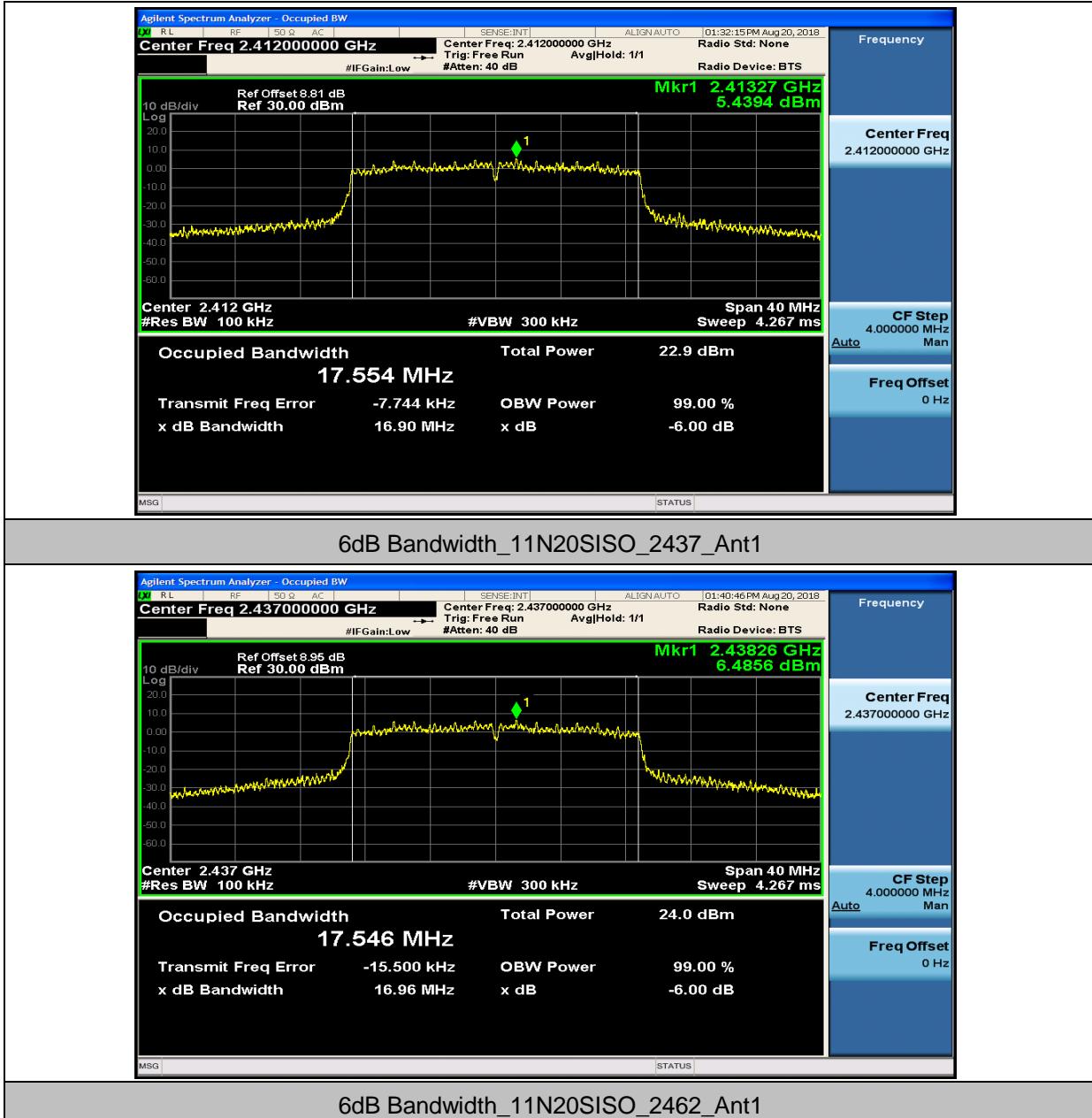
**1.6dB Bandwidth**

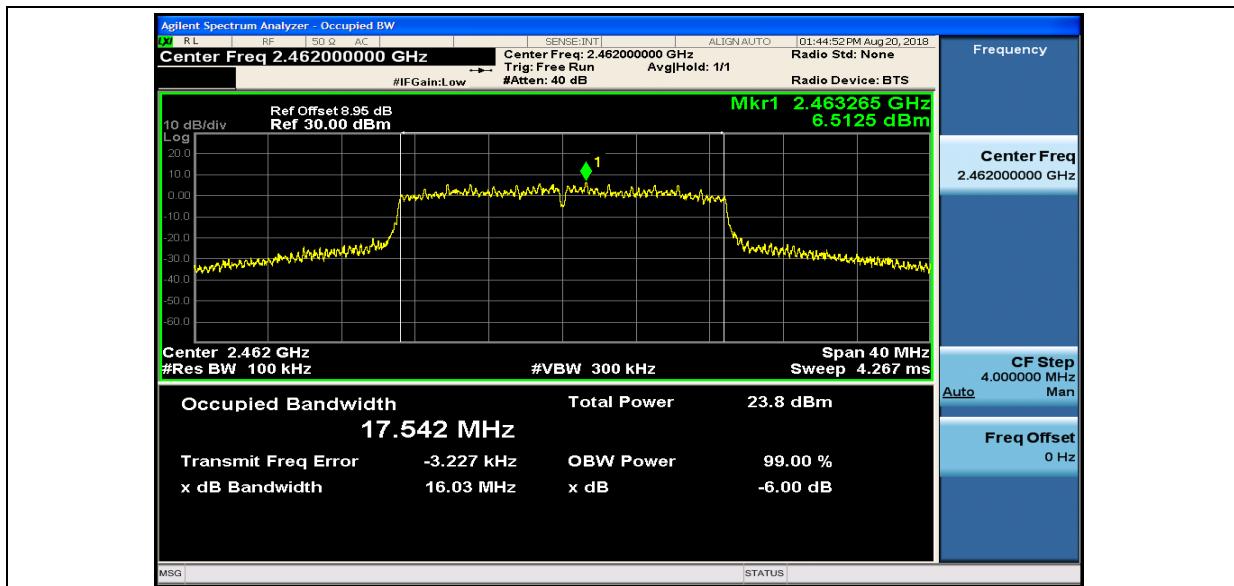
Test Mode	Test Channel	Ant	EBW[MHz]	Limit	Verdict
11B	2412	Ant1	8.18	0.5	PASS
11B	2437	Ant1	7.80	0.5	PASS
11B	2462	Ant1	8.48	0.5	PASS
11G	2412	Ant1	15.72	0.5	PASS
11G	2437	Ant1	15.74	0.5	PASS
11G	2462	Ant1	15.41	0.5	PASS
11N20SISO	2412	Ant1	16.90	0.5	PASS
11N20SISO	2437	Ant1	16.96	0.5	PASS
11N20SISO	2462	Ant1	16.03	0.5	PASS







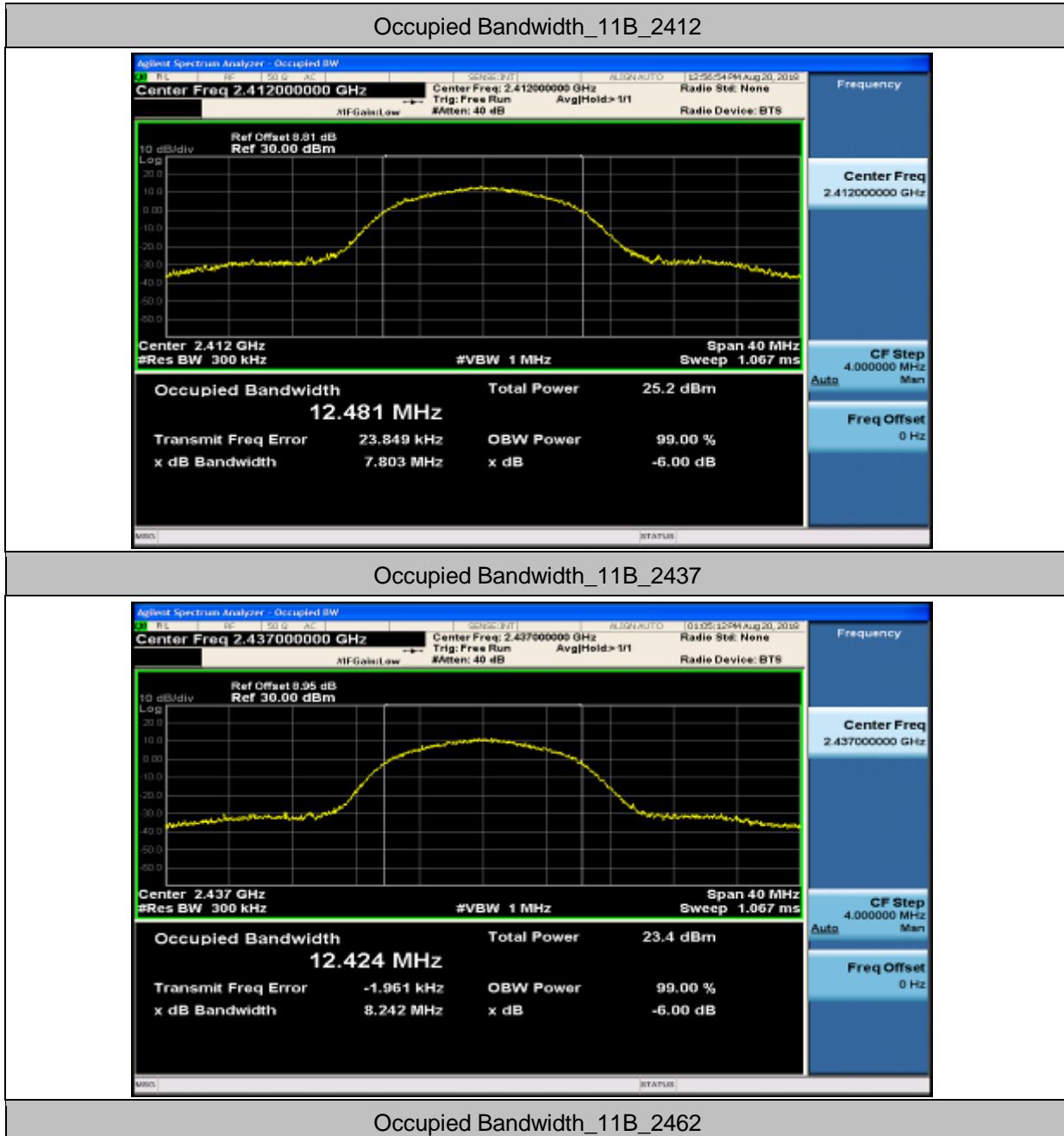


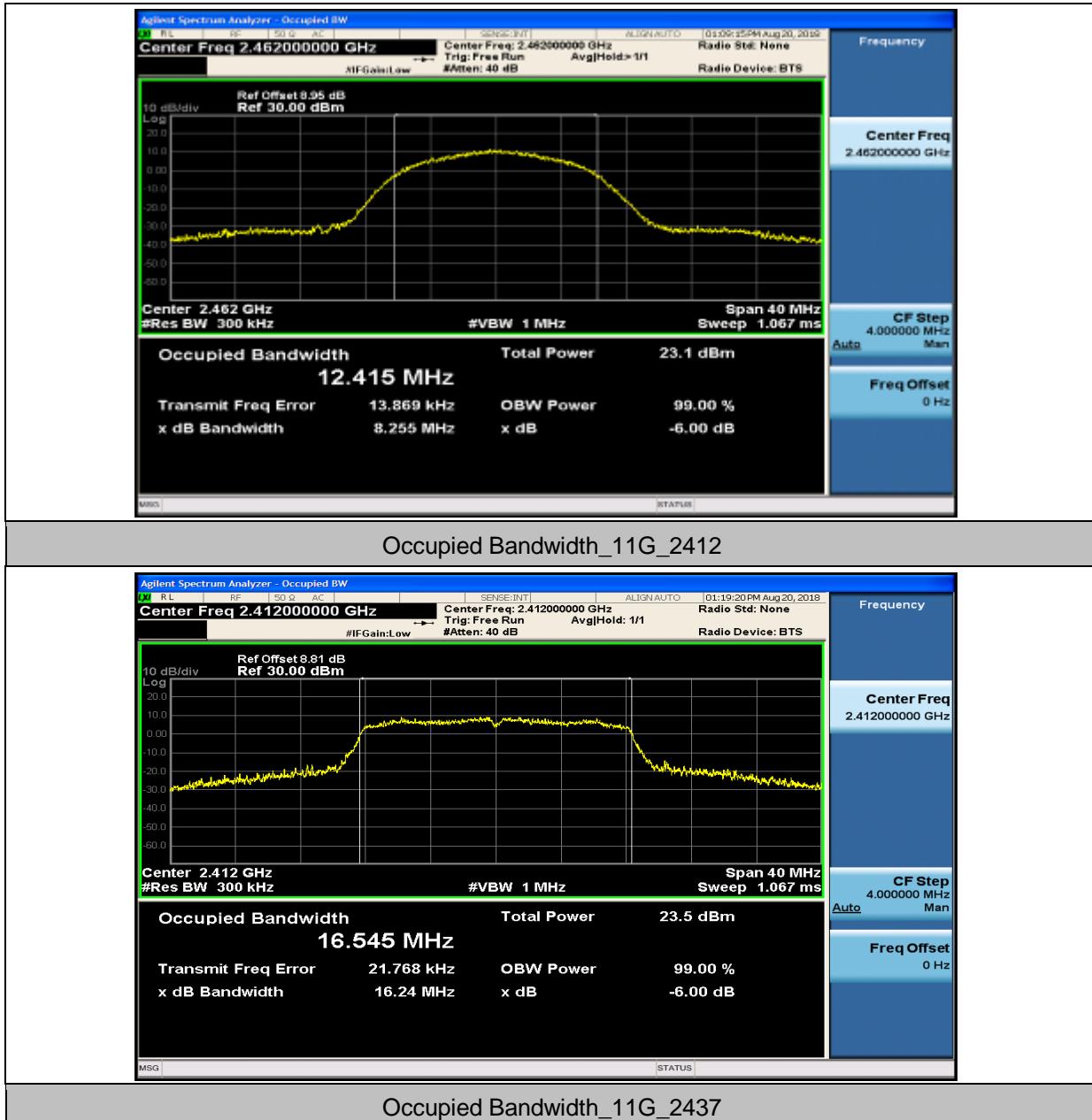


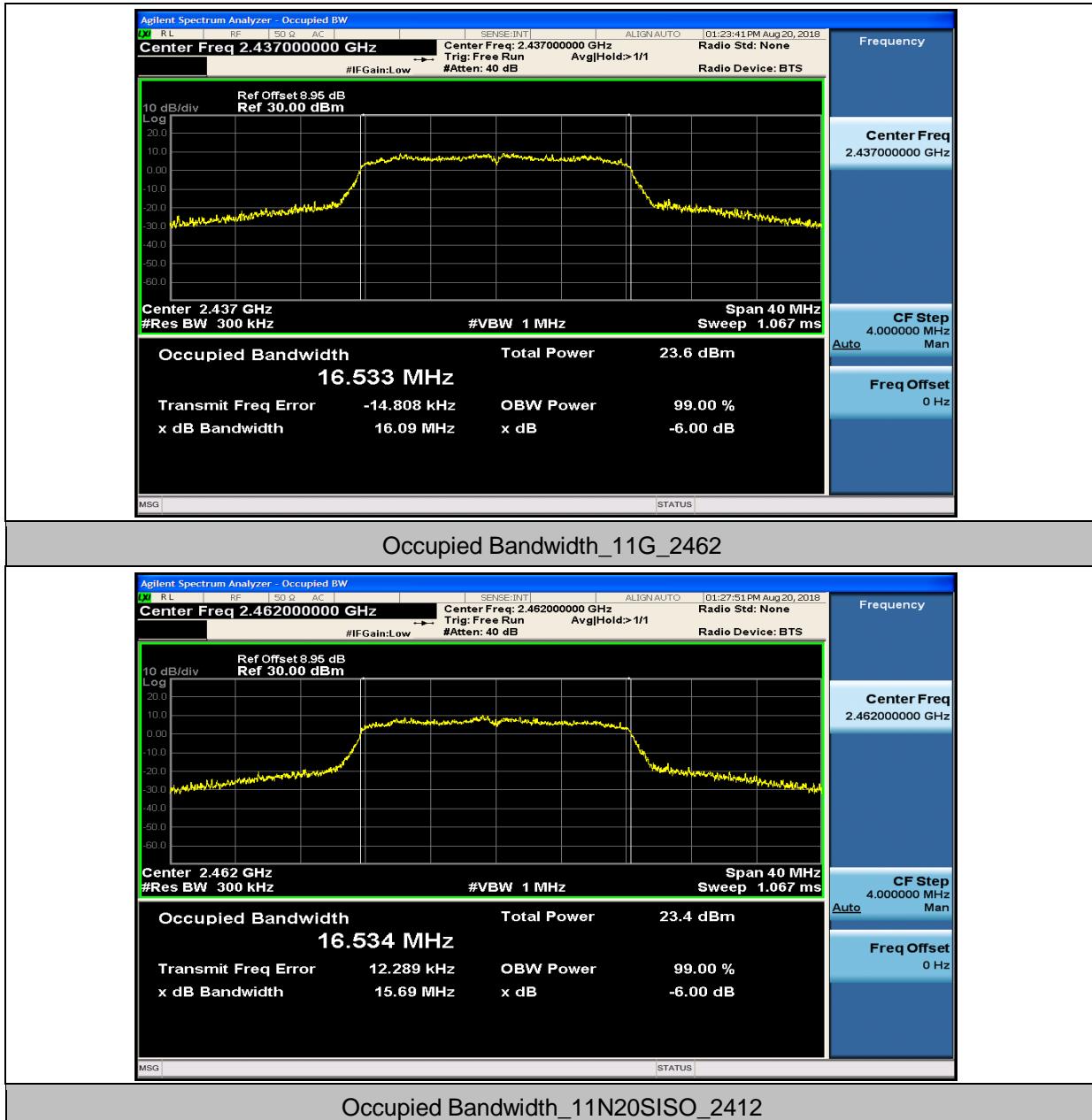


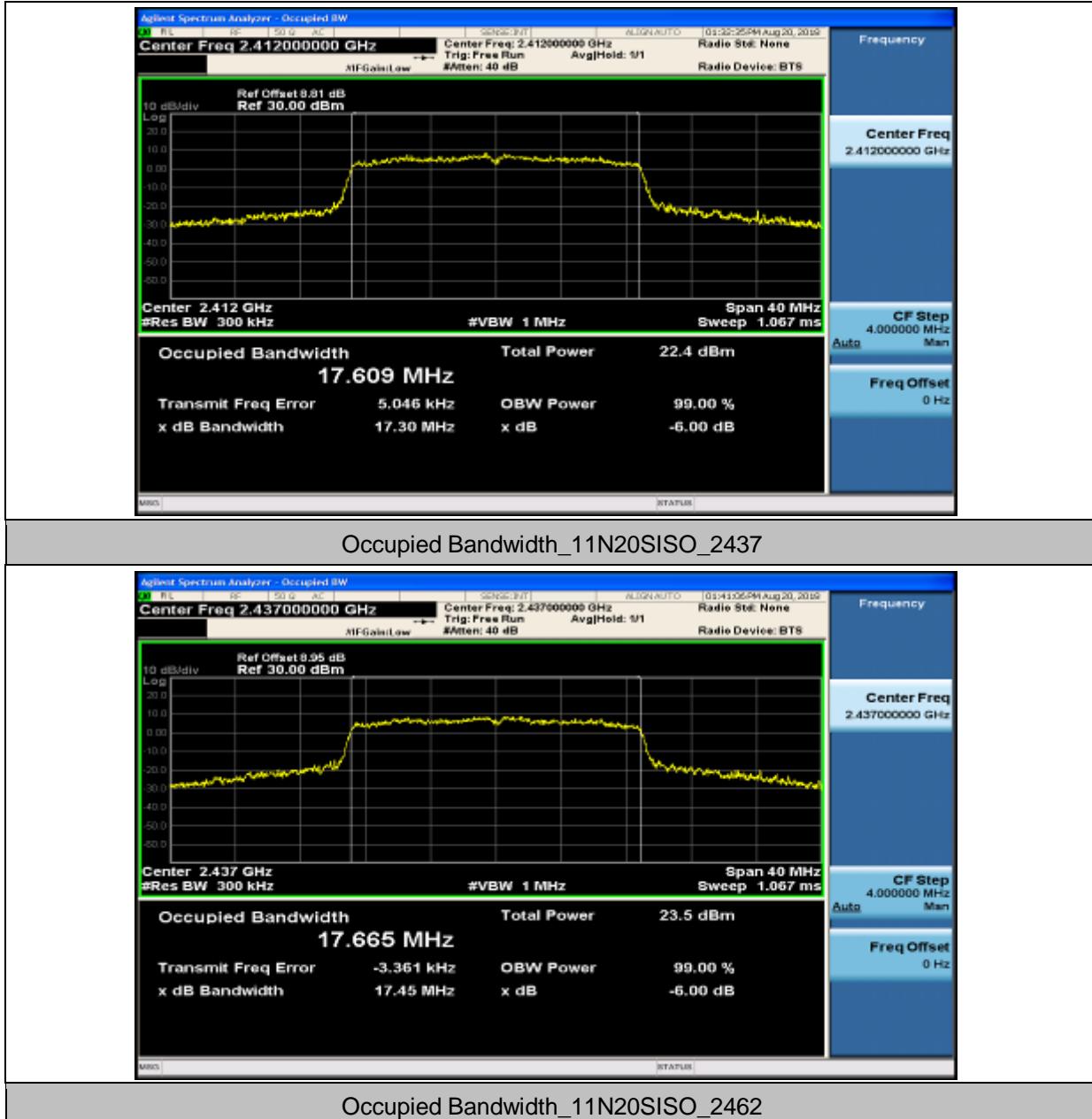
## **2.Occupied Bandwidth**

Test Mode	Test Channel	Ant	OBW[MHz]	Limit[MHz]	Verdict
11B	2412	Ant1	12.48	---	PASS
11B	2437	Ant1	12.42	---	PASS
11B	2462	Ant1	12.42	---	PASS
11G	2412	Ant1	16.55	---	PASS
11G	2437	Ant1	16.53	---	PASS
11G	2462	Ant1	16.53	---	PASS
11N20SISO	2412	Ant1	17.61	---	PASS
11N20SISO	2437	Ant1	17.67	---	PASS
11N20SISO	2462	Ant1	17.62	---	PASS







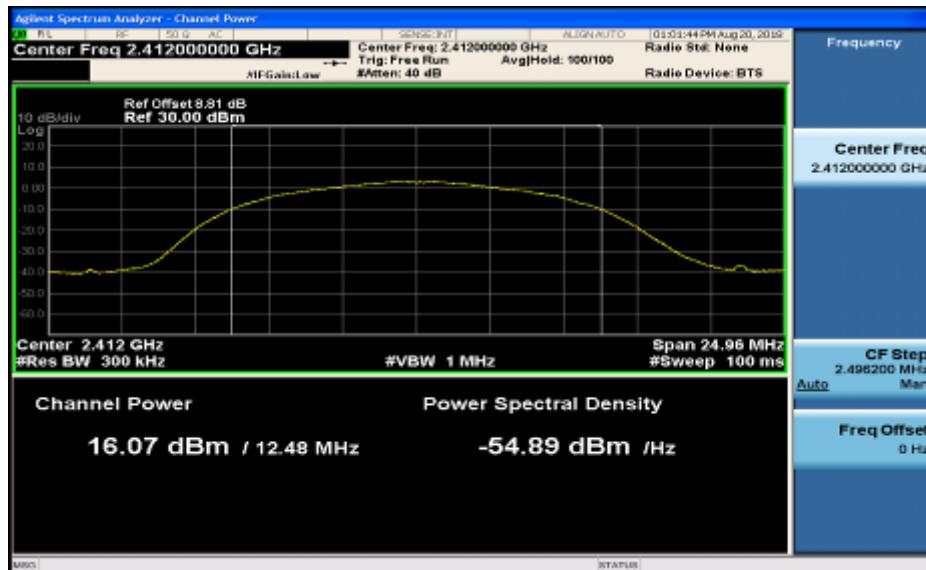
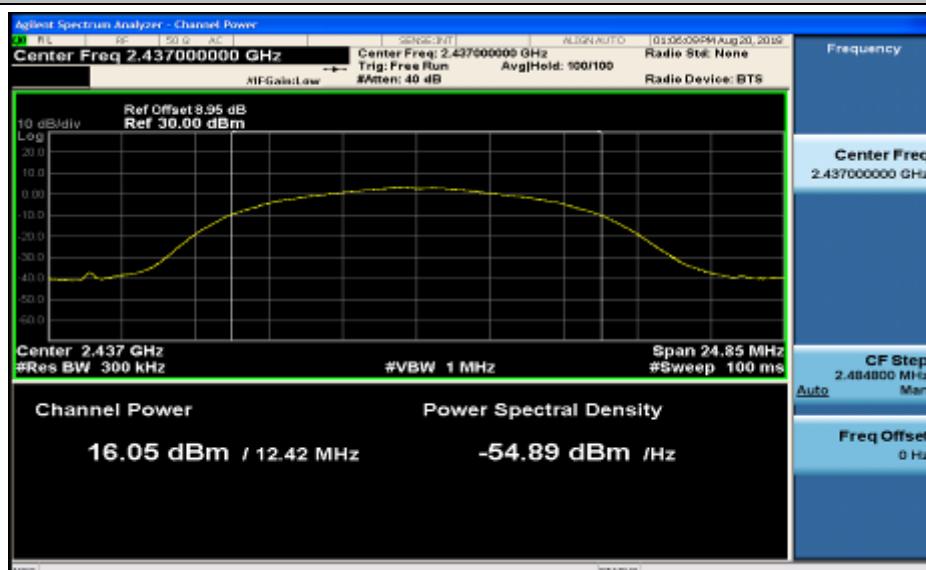


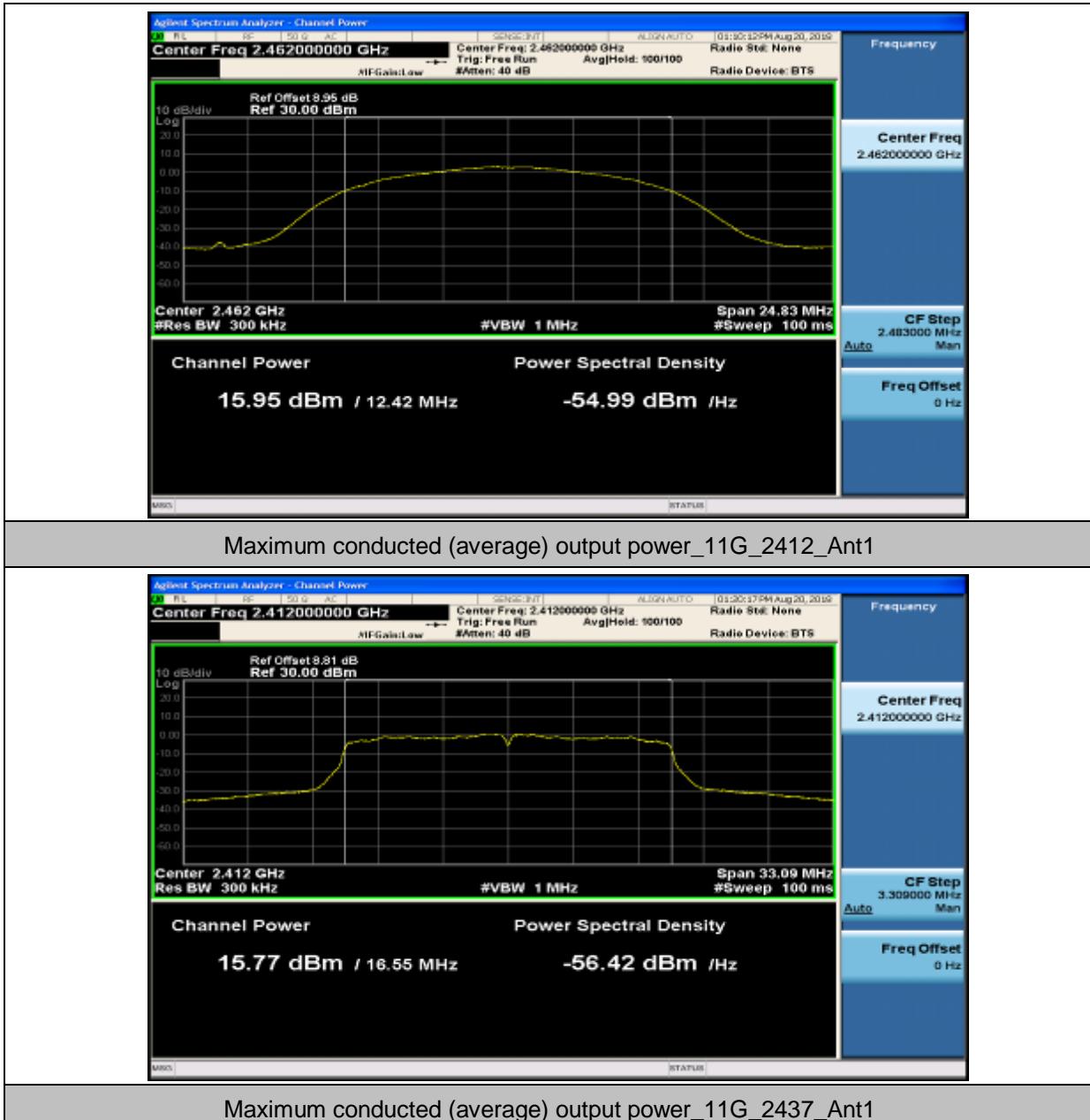


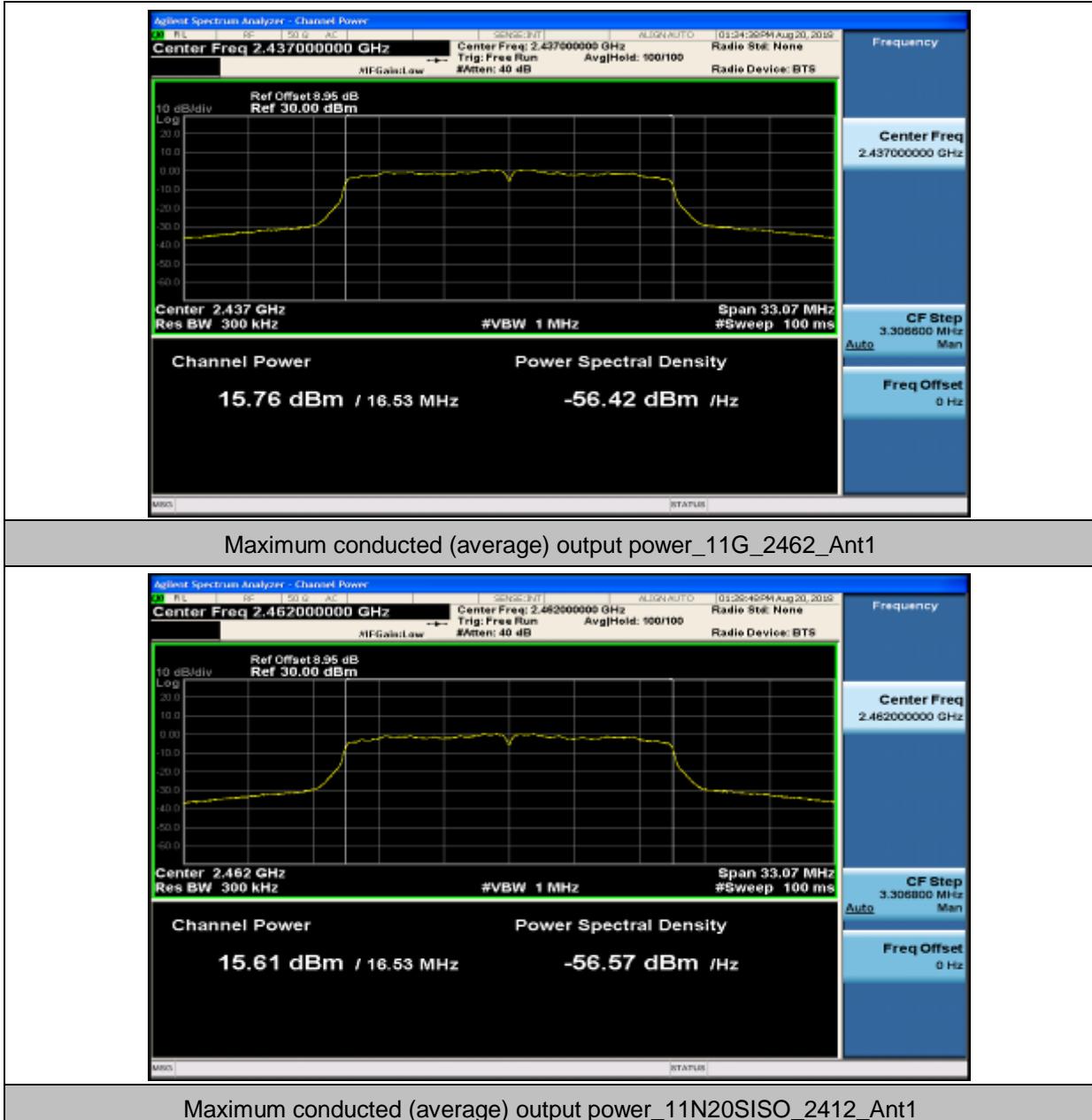


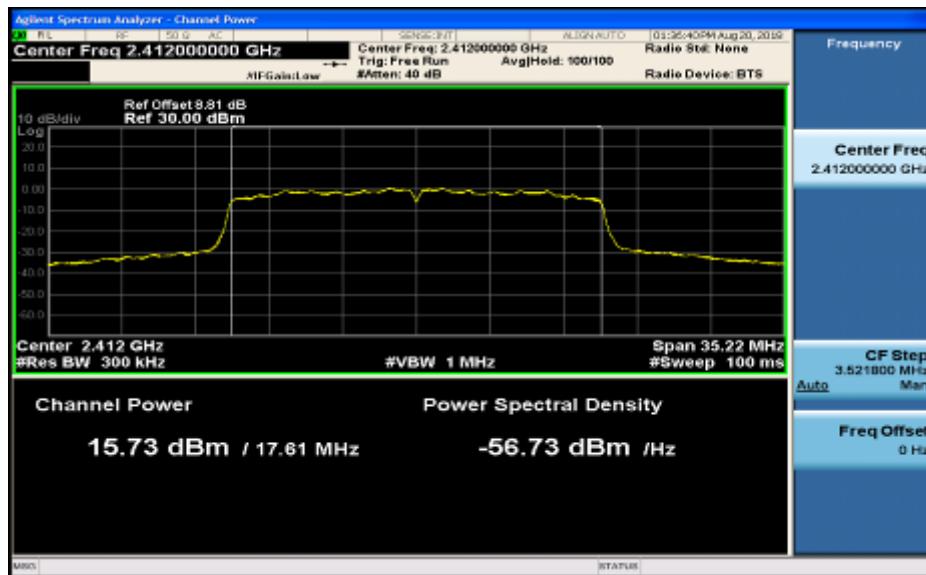
**3. Maximum conducted (average) output power**

Test Mode	Test Channel	Ant	Level [dBm]	10log(1/x) Factor[dB]	Power [dBm]	Limit [dBm]	Verdict
11B	2412	Ant1	16.07	0.20	16.28	30	PASS
11B	2437	Ant1	16.05	0.20	16.25	30	PASS
11B	2462	Ant1	15.95	0.20	16.16	30	PASS
11G	2412	Ant1	15.77	0.93	16.70	30	PASS
11G	2437	Ant1	15.76	0.93	16.69	30	PASS
11G	2462	Ant1	15.61	0.93	16.54	30	PASS
11N20SISO	2412	Ant1	15.73	1.06	16.79	30	PASS
11N20SISO	2437	Ant1	15.7	1.00	16.70	30	PASS
11N20SISO	2462	Ant1	15.5	1.03	16.53	30	PASS

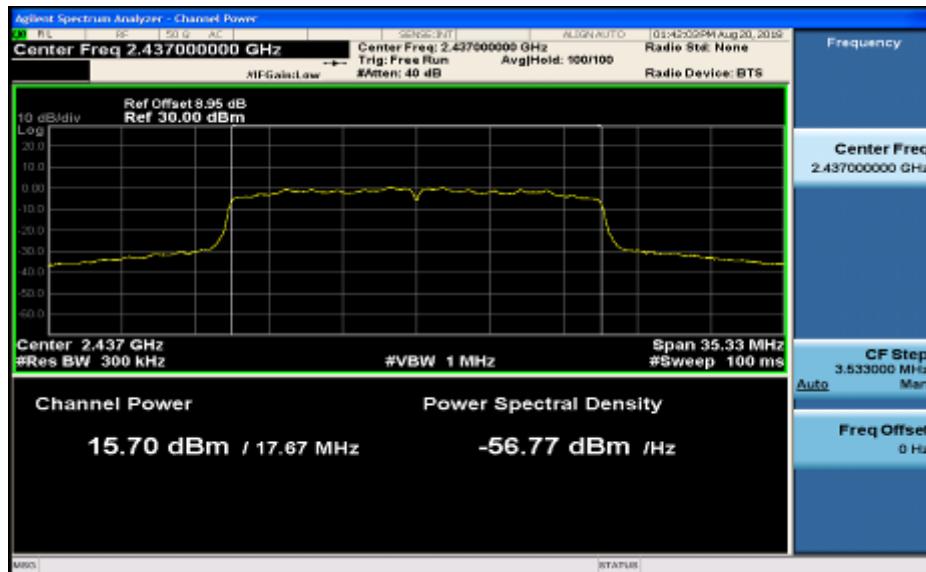
**Maximum conducted (average) output power\_11B\_2412\_Ant1****Maximum conducted (average) output power\_11B\_2437\_Ant1****Maximum conducted (average) output power\_11B\_2462\_Ant1**



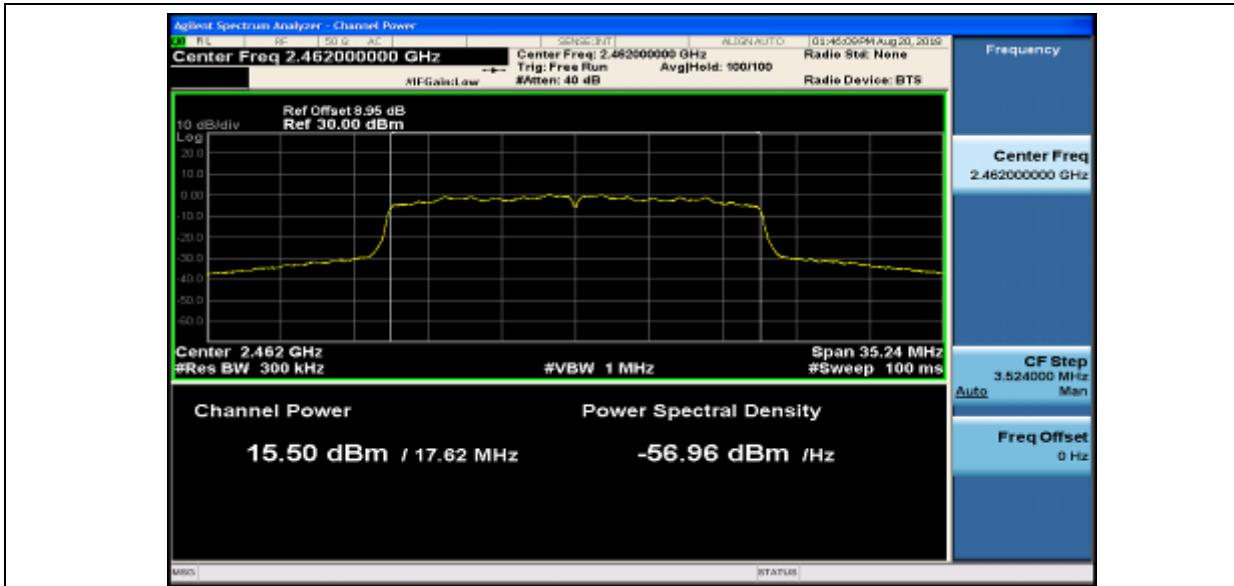




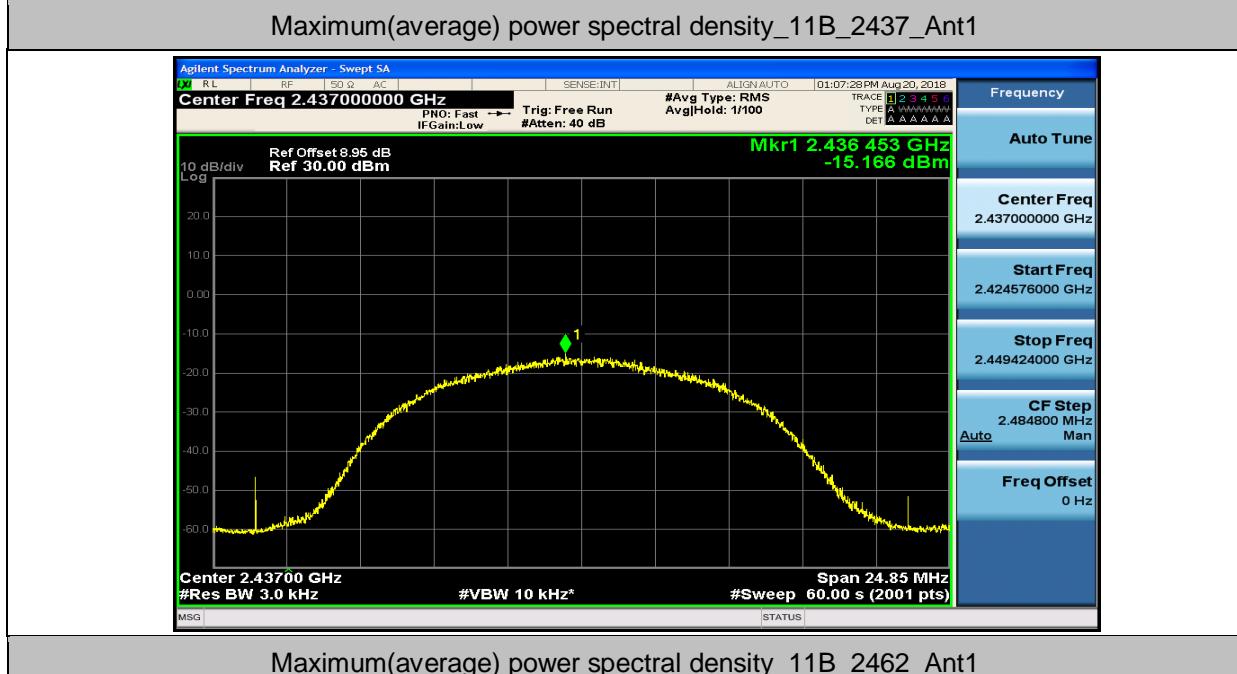
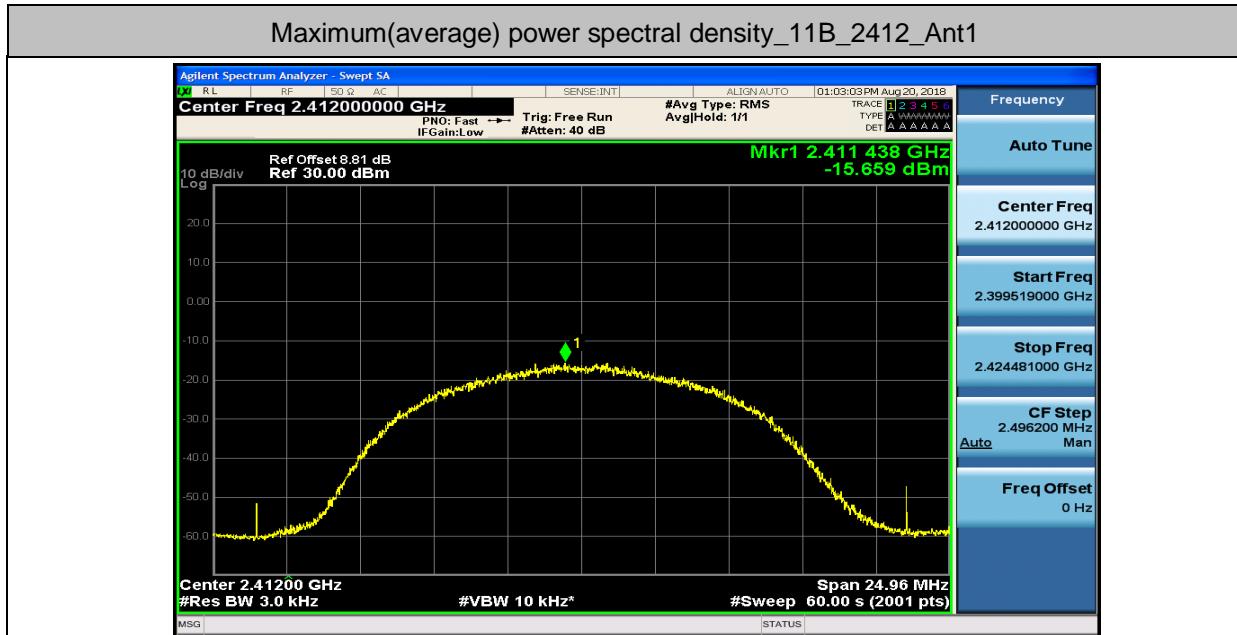
Maximum conducted (average) output power\_11N20SISO\_2437\_Ant1

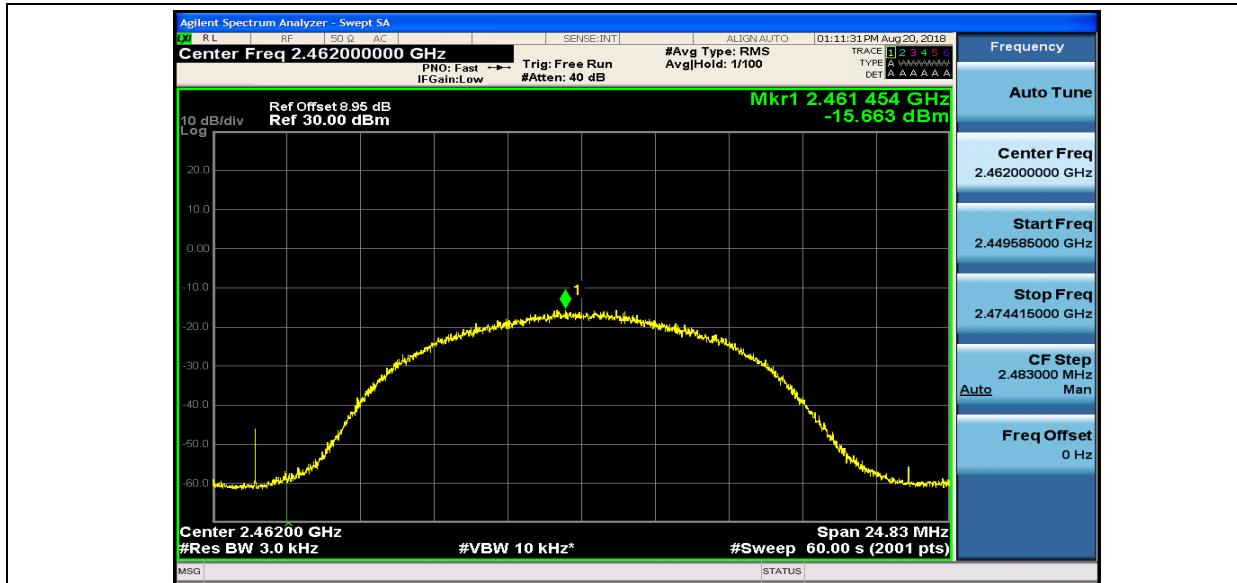


Maximum conducted (average) output power\_11N20SISO\_2462\_Ant1

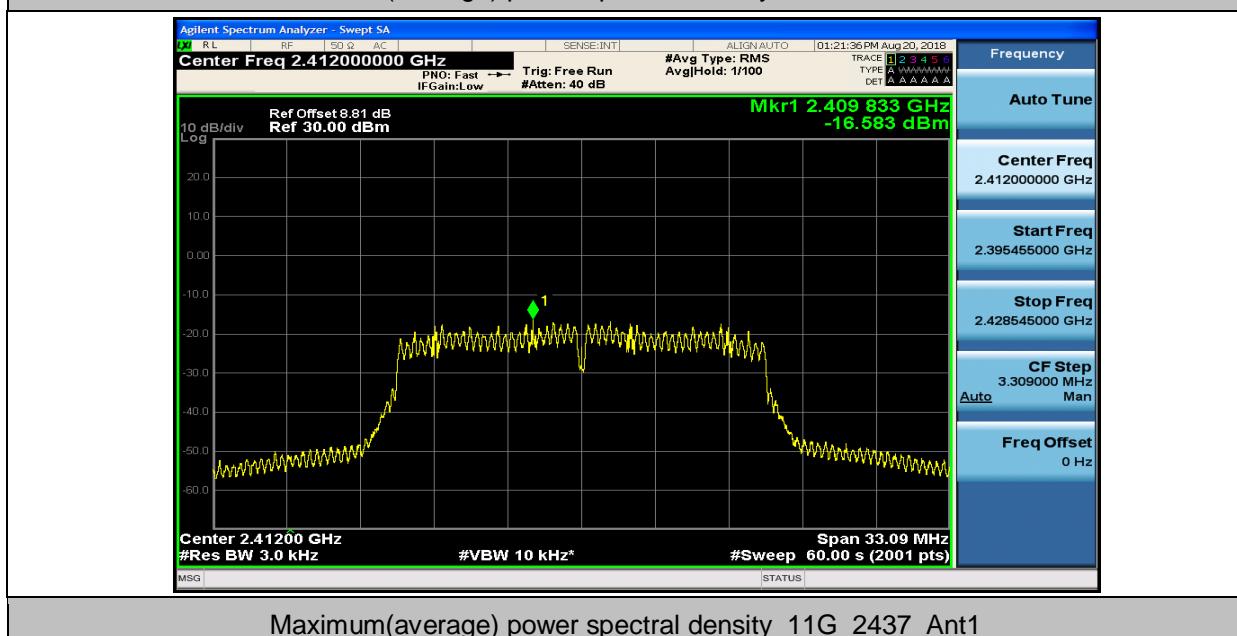
**4. Maximum(average) power spectral density**

Test Mode	Test Channel	Ant	Level [dBm/3kHz]	10log(1/x) Factor[dB]	PSD[dBm/3kHz]	Limit[dBm/3kHz]	Verdict
11B	2412	Ant1	-15.66	0.20	-15.46	8.00	PASS
11B	2437	Ant1	-15.17	0.20	-14.97	8.00	PASS
11B	2462	Ant1	-15.66	0.20	-15.46	8.00	PASS
11G	2412	Ant1	-16.58	0.93	-15.65	8.00	PASS
11G	2437	Ant1	-16.93	0.93	-16.00	8.00	PASS
11G	2462	Ant1	-17.06	0.93	-16.13	8.00	PASS
11N20SISO	2412	Ant1	-14.75	1.06	-13.69	8.00	PASS
11N20SISO	2437	Ant1	-14.37	1.00	-13.37	8.00	PASS
11N20SISO	2462	Ant1	-14.48	1.03	-13.45	8.00	PASS





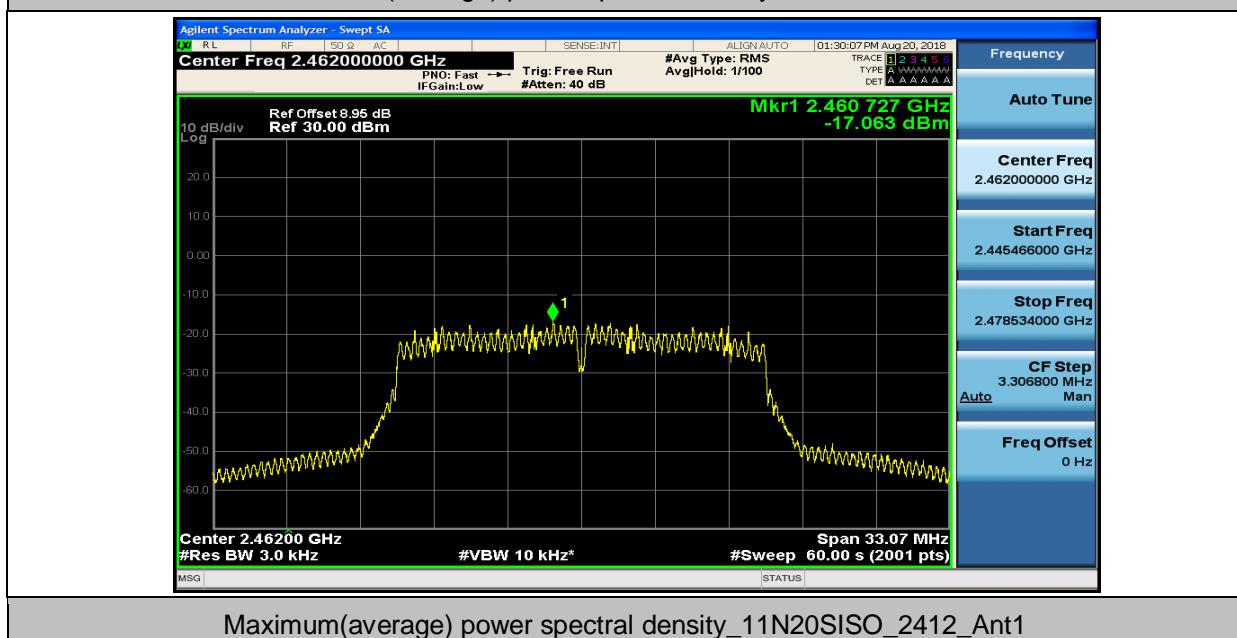
Maximum(average) power spectral density\_11G\_2412\_Ant1



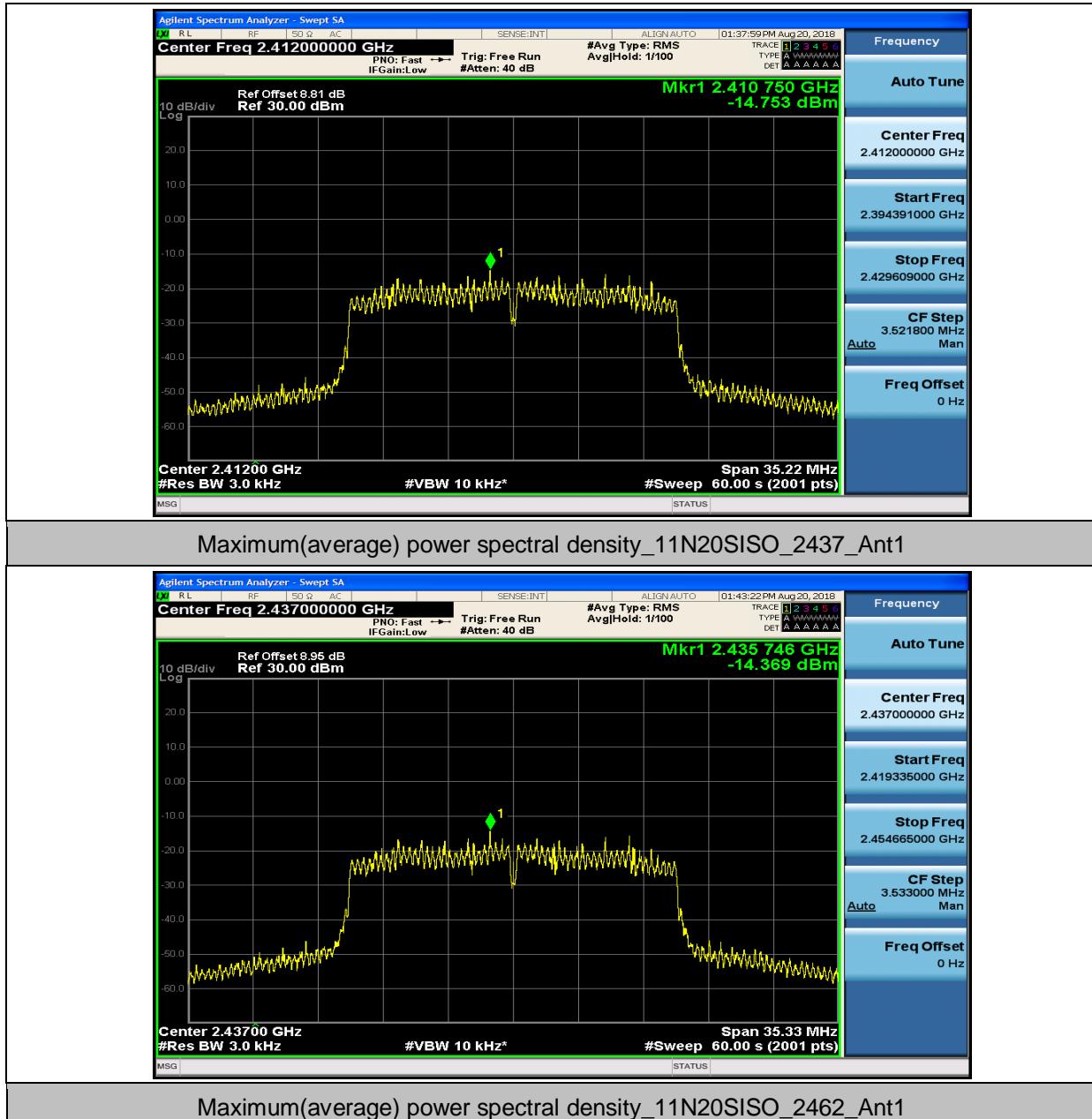
Maximum(average) power spectral density\_11G\_2437\_Ant1

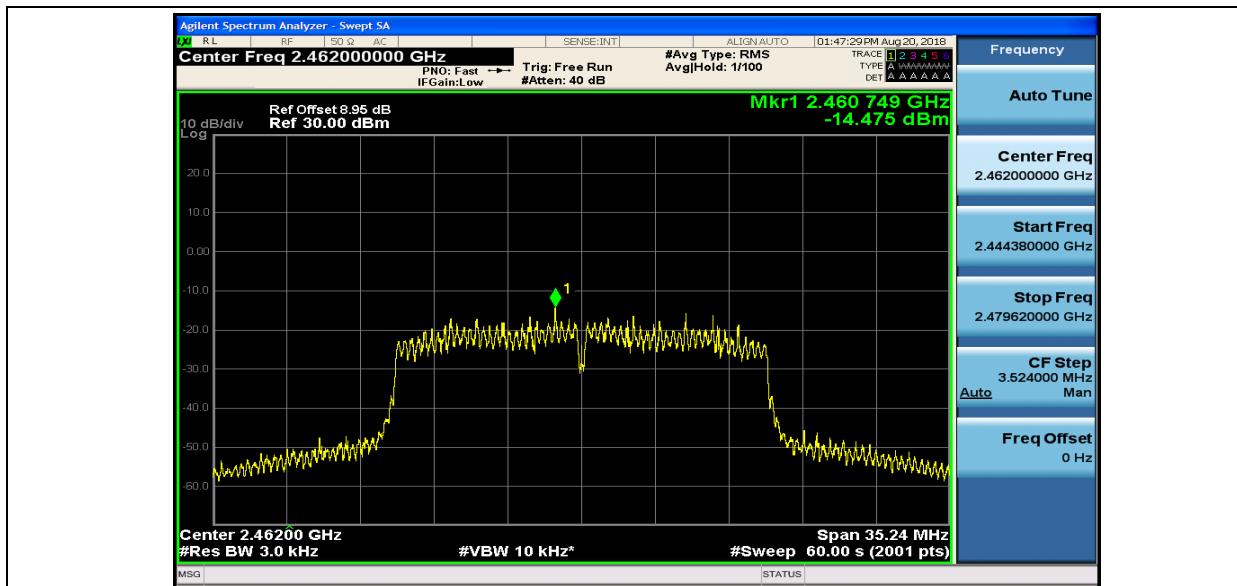


Maximum(average) power spectral density\_11G\_2462\_Ant1



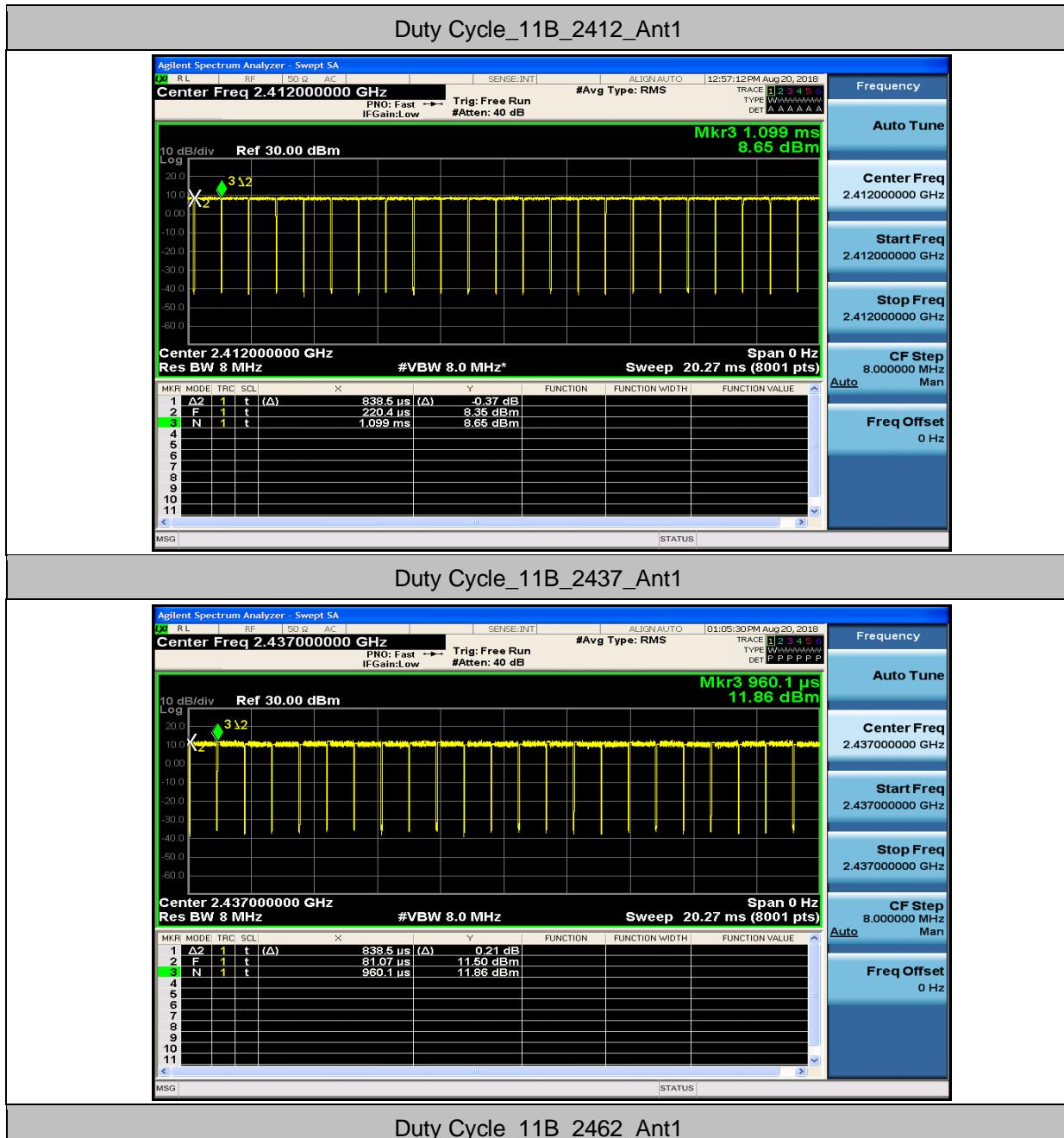
Maximum(average) power spectral density\_11N20SISO\_2412\_Ant1

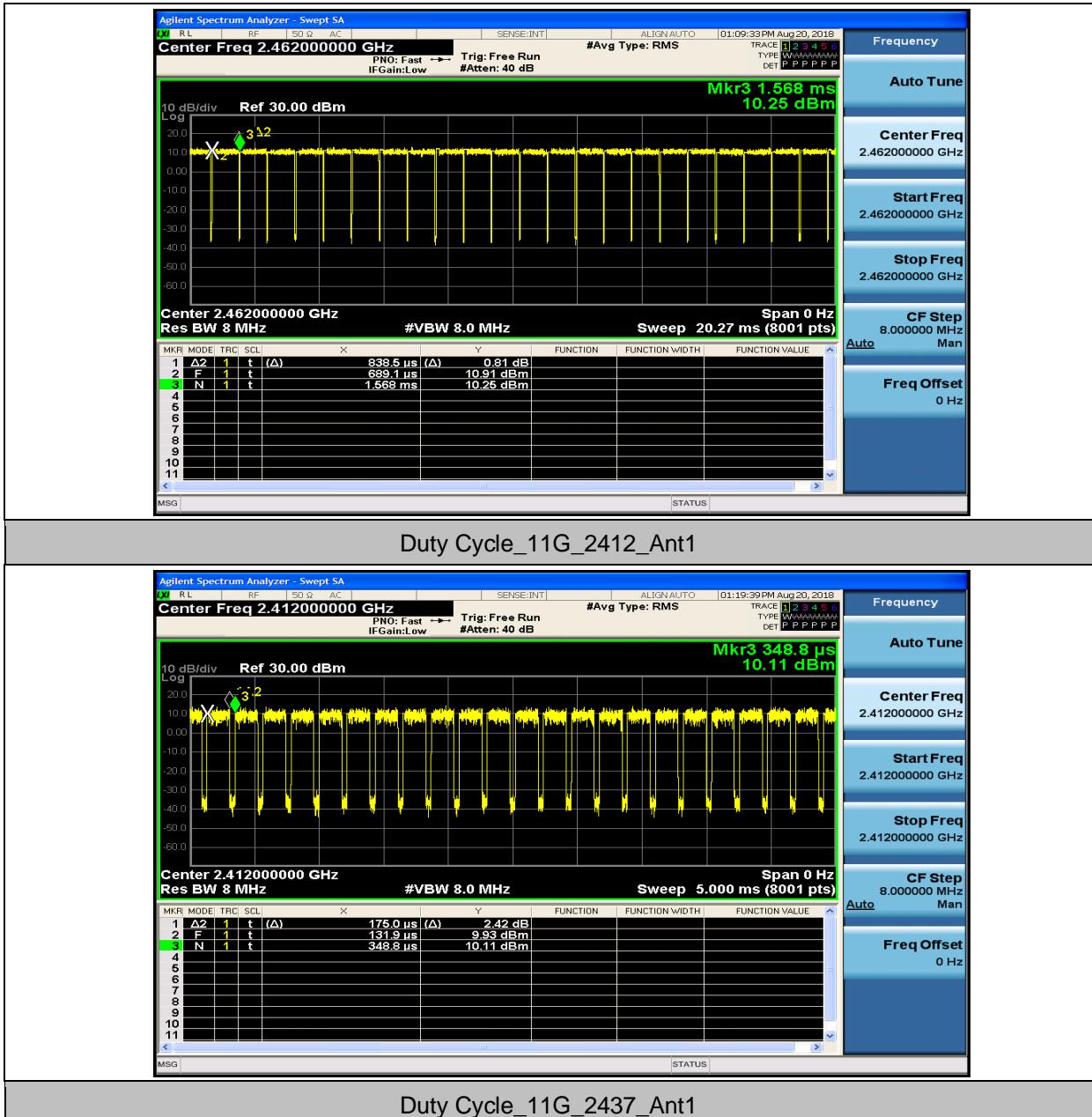


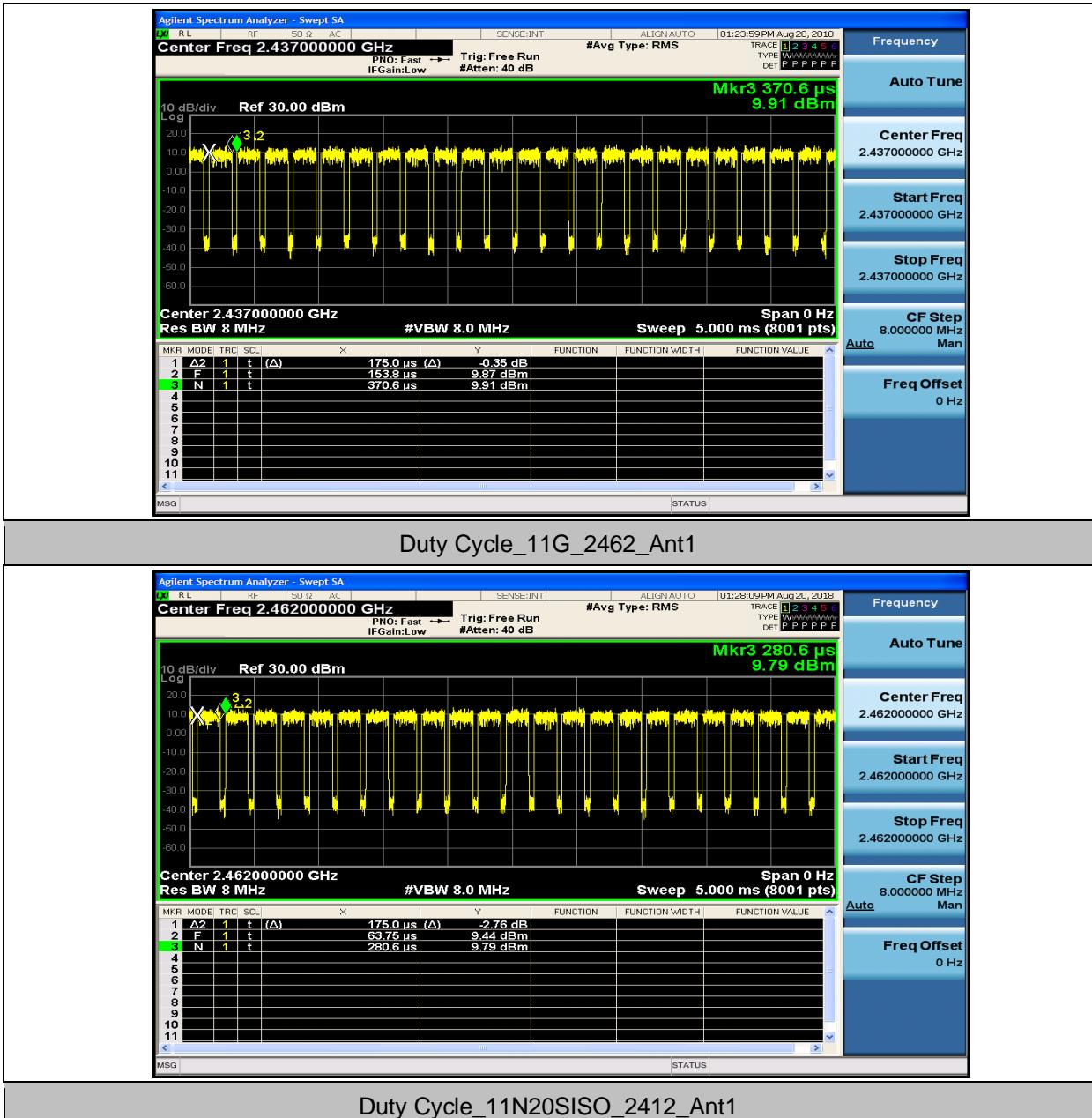


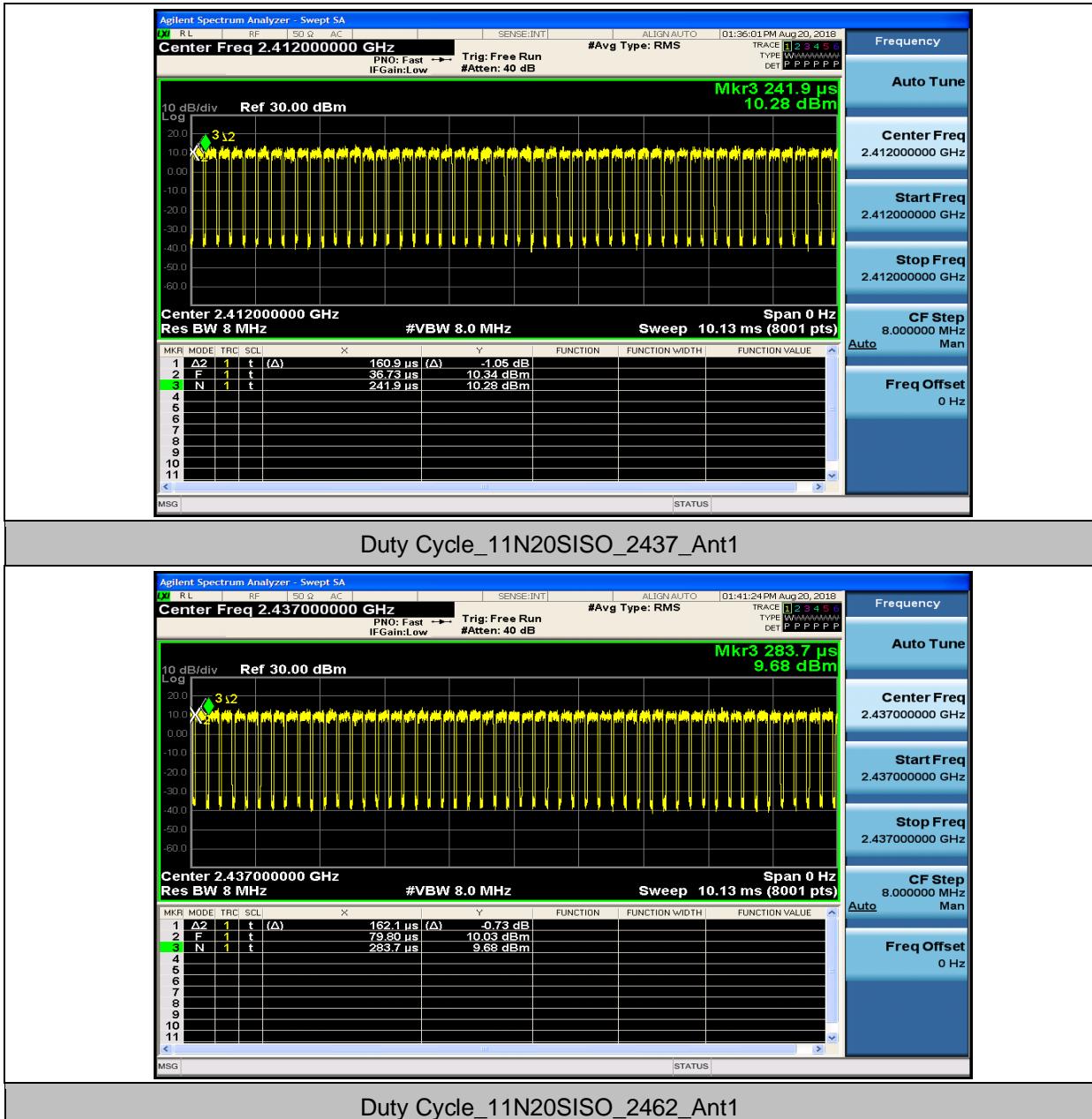
## 6.Duty Cycle

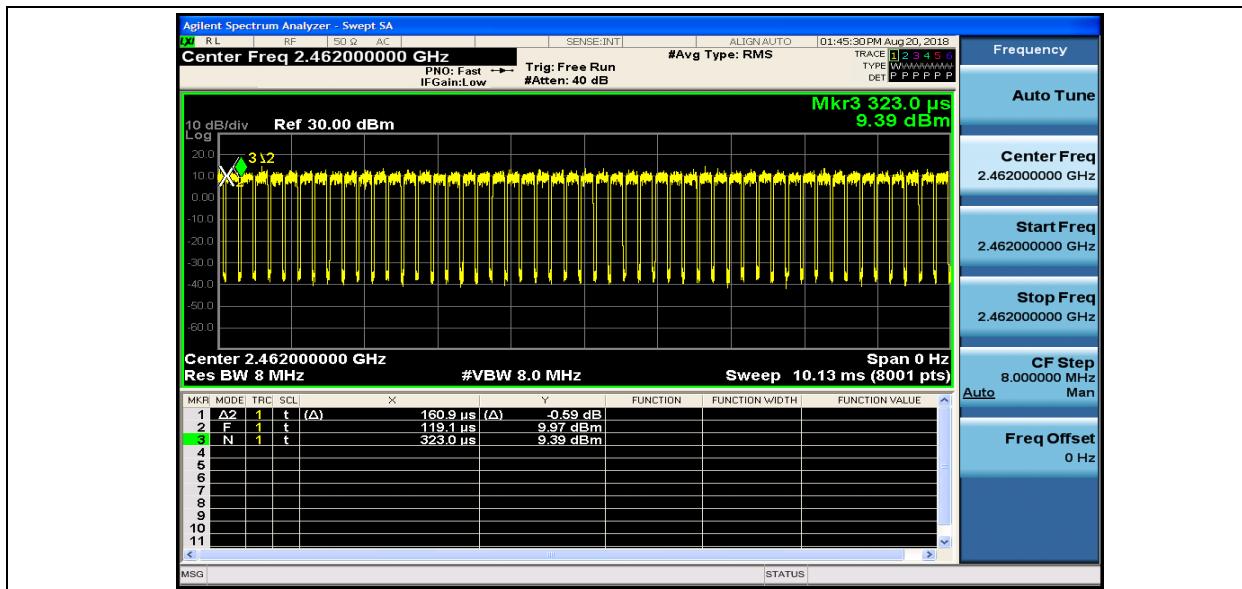
Test Mode	Test Channel	Ant	Duty Cycle[%]	10log(1/x) Factor[dB]
11B	2412	Ant1	95.39	0.20
11B	2437	Ant1	95.39	0.20
11B	2462	Ant1	95.39	0.20
11G	2412	Ant1	80.69	0.93
11G	2437	Ant1	80.69	0.93
11G	2462	Ant1	80.69	0.93
11N20SISO	2412	Ant1	78.40	1.06
11N20SISO	2437	Ant1	79.50	1.00
11N20SISO	2462	Ant1	78.88	1.03











**- End of the Report -**