

ELECTROMAGNETIC EMISSIONS COMPLIANCE REPORT

INTENTIONAL RADIATOR CERTIFICATION TO FCC PART 15 SUBPART C REQUIREMENT

OF

Applicant: United Integrated Services Co., Ltd.
5F, No. 3, Lane 7, Baogao Rd., Xindian Dist., New Taipei City 23144,
Taiwan

Product Name: Wireless Gateway with Siren

Brand Name: UIS

Model No.: NGW-230A

Model Difference: N/A

FCC ID: XBTNGW-230A

Report Number: E2/2018/90007

FCC Rule Part: §15.247, Cat: DTS

Issue Date: Oct. 17, 2018

Date of Test: Jul. 25, 2017 ~ Jul. 26, 2017(Radiated)
Sep. 04, 2018 ~ Oct. 01, 2018(Conducted)

Date of EUT Received: Jul. 25, 2017(Radiated); Sep. 04, 2018(Conducted)

We hereby certify that:

The above equipment was tested by SGS Taiwan Ltd. Electronics & Communication Laboratory. The test data, data evaluation, test procedures, and equipment configurations shown in this report were made in accordance with the procedures given in ANSI C63.10:2013 and the energy emitted by the sample EUT tested as described in this report is in compliance with conducted and radiated emission limits.

The test results of this report relate only to the tested sample identified in this report.

Tested By:

Aken Huang
Aken Huang / Engineer

Approved By:

CHUN-CHIEH CHEN
CHUN CHIEH CHEN / Asst.
Supervisor



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t (886-2) 2299-3279

f (886-2) 2298-0488

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1 GENERAL INFORMATION

1.1 Product description

General:

Product Name:	Wireless Gateway with Siren	
Brand Name:	UIS	
Marketing Name:	Wireless Gateway with Siren	
Model No.:	NGW-230A	
Model Difference:	N/A	
Software version:	N/A	
Hardware version:	N/A	
Power Supply:	5Vdc from AC/DC adapter	
	Adapter:	Model No.: HK-AR-050A200-US Supplier: HON-KWANG

WLAN 2.4GHz:

Wi-Fi	Frequency Range	Channels	Rated Power	Modulation Technology
11b/g	2412-2462	11	b: 23.36dBm g: 26.70dBm	DSSS, OFDM
11n	HT20 2412-2462	11	HT20:26.68dBm	OFDM
11n	HT40 2422-2452	9	HT40:26.71dBm	OFDM
Modulation type:		CCK, DQPSK, DBPSK for DSSS 64QAM, 16QAM, QPSK, BPSK for OFDM		
Antenna Designation:		Dipole Antenna, P/N: 1995510002A0 Gain: 3dBi		
Transition Rate:		802.11 b: 1/2/5.5/11 Mbps 802.11 g: 6/9/12/18/24/36/48/54 Mbps 802.11 n_20MHz: 6.5 – 72.2Mbps 802.11 n_40MHz: 13.5 - 150.0Mbps		

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1.2 Test Methodology of Applied Standards

FCC Part 15, Subpart C §15.247

FCC KDB 558074 D01 DTS Meas. Guidance v05

ANSI C63.10:2013

Note: All test items have been performed and record as per the above standards.

1.3 Test Facility

SGS Taiwan Ltd. Electronics & Communication Laboratory No.2, Keji 1st Rd.,
Guishan District, Taoyuan City, Taiwan 333 (TAF code 0513)

FCC Registration Number and Designation are: 735305 / TW0002

1.4 Special Accessories

There are no special accessories used while test was conducted.

1.5 Equipment Modifications

There was no modification incorporated into the EUT.

1.6 Radiated Emission Test Sites For Measurements From 9 kHz To 30 MHz

Radiated emission below 30MHz is measured in a 9m*9m*6m semi-anechoic chamber,
the measurements correspond to those obtained at an open-field test site.

There is a comparison data of both open-field test site and semi-Anechoic chamber, and the
result came out very similar.

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2 SYSTEM TEST CONFIGURATION

2.1 EUT Configuration

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner which intends to maximize its emission characteristics in a continuous normal application.

2.2 EUT Exercise

An engineering test mode (software/firmware) that applicant provided was utilized to manipulate the EUT into transmit, selection of the test channel, and modulation scheme.

2.3 Test Procedure

2.3.1 Conducted Emissions

The EUT is placed on a table which is 0.8 m above ground plane. Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30 MHz. The CISPR Quasi-Peak and Average detector mode is employed according to §15.207. The two LISNs provide 50 µH/50 ohm of coupling impedance for the measuring instrument. Both lines of the power mains connected to the EUT were checked for maximum conducted interference.

2.3.2 Conducted Test (RF)

The active antenna port of the unlicensed wireless device is connected to the spectrum analyzer with attenuator to protect the instrumentation. If a second antenna port is available, it is tested at one operating frequency, with other port(s) appropriately terminated, to verify it has similar output characteristics as the fully tested port.

2.3.3 Radiated Emissions

The EUT is placed on a turn table. For emissions testing at or below 1 GHz, the table height shall be 0.8 m above the reference ground plane. For emission measurements above 1 GHz, the table height shall be 1.5 m. The turn table shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3m away from the receiving antenna which varied from 1m to 4m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the max. emission, the relative positions of this transmitter (EUT) was rotated through three orthogonal axes and measurement procedures for electric field radiated emissions above 1 GHz the EUT measurement is to be made "while keeping the antenna in the 'cone of radiation' from that area and pointed at the area both in azimuth and elevation, with polarization oriented for maximum response." is still within the 3dB illumination BW of the measurement antenna.

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2.4 Configuration of Tested System

Conducted (Antenna Port) & Radiated Emission

Conduction



Table 2-1 Equipment Used in Tested System

Item	Equipment	Mfr/Brand	Model/Type No.	Series No.	Data Cable	Power Cord
1.	Notebook	DELL	E5400	3704625136	Shielded	Unshielded
2.	Bluetooth Test Software	N/A	N/A	N/A	N/A	N/A
3.	Test Tool Kit	N/A	N/A	N/A	N/A	N/A

3 SUMMARY OF TEST RESULTS

FCC Rules	Description Of Test	Result
§15.207(a)	AC Power Line Conducted Emission	Compliant
§15.247(b) (3)	Peak Output Power	Compliant
§15.247(a)(2)	6dB & 99% Emission Bandwidth	Compliant
§15.247(d)	Conducted Band Edge and Spurious Emission	Compliant
§15.247(d)	Radiated Band Edge and Spurious Emission	Compliant
§15.247(e)	Power Spectral Density	Compliant
§15.203 §15.247(b)	Antenna Requirement	Compliant

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4 DESCRIPTION OF TEST MODES

4.1 Operated in 2400 ~ 2483.5MHz Band

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

4.2 The Worst Test Modes and Channel Details

1. The EUT has been tested under operating condition.
2. Test program used to control the EUT for staying in continuous transmitting and receiving mode is programmed.
3. Investigation has been done on all the possible configurations for searching the worst case.

RADIATED EMISSION TEST:

RADIATED EMISSION TEST (BELOW 1 GHz)				
MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION	DATA RATE (Mbps)
802.11g	1 to 11	1,6,11	OFDM	6

RADIATED EMISSION TEST (ABOVE 1 GHz)				
MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION	DATA RATE (Mbps)
802.11b	1 to 11	1, 6, 11	DSSS	1
802.11g	1 to 11	1, 6, 11	OFDM	6
802.11n (HT20)	1 to 11	1, 6, 11	OFDM	MCS 0
802.11n (HT40)	3 to 9	3, 6, 9	OFDM	MCS 0

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Note:

The field strength of radiation emission was measured as EUT stand-up position (H mode) and lie down position (E1, E2 mode) for 802.11b/g/n WLAN Transmitter for channel Low, Mid and High, the worst case E2 position was reported.

ANTENNA PORT CONDUCTED MEASUREMENT:

CONDUCTED TEST				
MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION	DATA RATE (Mbps)
802.11b	1 to 11	1, 6, 11	DSSS	1
802.11g	1 to 11	1, 6, 11	OFDM	6
802.11n (HT20)	1 to 11	1, 6, 11	OFDM	MCS 0
802.11n (HT40)	3 to 9	3, 6, 9	OFDM	MCS 0

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5 MEASUREMENT UNCERTAINTY

Test Items	Uncertainty
AC Power Line Conducted Emission	+/- 2.586 dB
Peak Output Power	+/- 0.84 dB
6dB Bandwidth	+/- 51.33 Hz
100 KHz Bandwidth Of Frequency Band Edges	+/- 0.84 dB
Peak Power Density	+/- 1.3 dB
Temperature	+/- 0.65 °C
Humidity	+/- 4.6 %
DC / AC Power Source	DC= +/- 0.13%, AC= +/- 0.2%

Radiated Spurious Emission:

Measurement uncertainty (Polarization : Vertical)	9kHz – 30MHz: +/- 2.87 dB
	30MHz - 180MHz: +/- 3.37dB
	180MHz -417MHz: +/- 3.19dB
	0.417GHz-1GHz: +/- 3.19dB
	1GHz - 18GHz: +/- 4.04dB
	18GHz - 40GHz: +/- 4.04dB

Measurement uncertainty (Polarization : Horizontal)	9kHz – 30MHz: +/- 2.87 dB
	30MHz - 167MHz: +/- 4.22dB
	167MHz -500MHz: +/- 3.44dB
	0.5GHz-1GHz: +/- 3.39dB
	1GHz - 18GHz: +/- 4.08dB
	18GHz - 40GHz: +/- 4.08dB

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

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6 CONDUCTED EMISSION TEST

6.1 Standard Applicable

Frequency range within 150kHz to 30MHz shall not exceed the Limit table as below.

Frequency range MHz	Limits dB(μV)	
	Quasi-peak	Average
0.15 to 0.50	66 to 56	56 to 46
0.50 to 5	56	46
5 to 30	60	50
Note 1.The lower limit shall apply at the transition frequencies 2.The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz.		

6.2 Measurement Equipment Used

Conducted Emission Test Site					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
EMI Test Receiver	R&S	ESCI 7	100950	12/12/2016	12/11/2017
Coaxial Cables	N/A	N30N30-1042-150cm	N/A	08/30/2016	08/29/2017
LISN	Schwarzbeck	NSLK 8127	8127-648	06/18/2017	06/17/2018
Test Software	Farad	EZ-EMC	Ver. SGS-03A2	N.C.R.	N.C.R.

6.3 EUT Setup

1. The conducted emission tests were performed in the test site, using the setup in accordance with the ANSI 63.10:2013.
2. The AC/DC Power adaptor of EUT was plug-in LISN. The EUT was placed flushed with the rear of the table.
3. The LISN was connected with 120Vac/60Hz power source.

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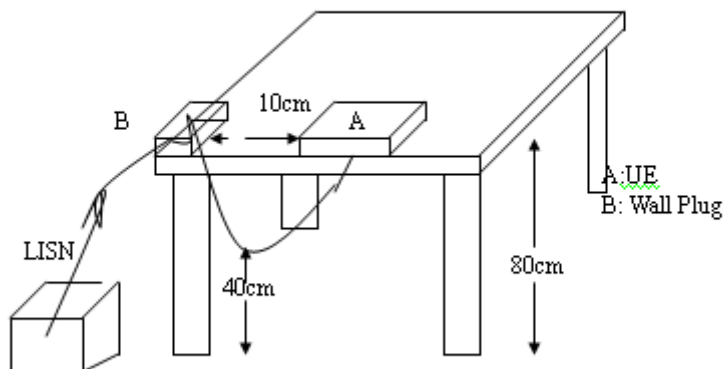
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6.4 Test SET-UP (Block Diagram of Configuration)



6.5 Measurement Procedure

1. The EUT was placed on a table which is 0.8m above ground plane.
2. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
3. Repeat above procedures until all phases of power being supplied by given UE are completed

6.6 Measurement Result

Note: Refer to next page for measurement data and plots.

Note2: The * reveals the worst-case results that closet to the limit.

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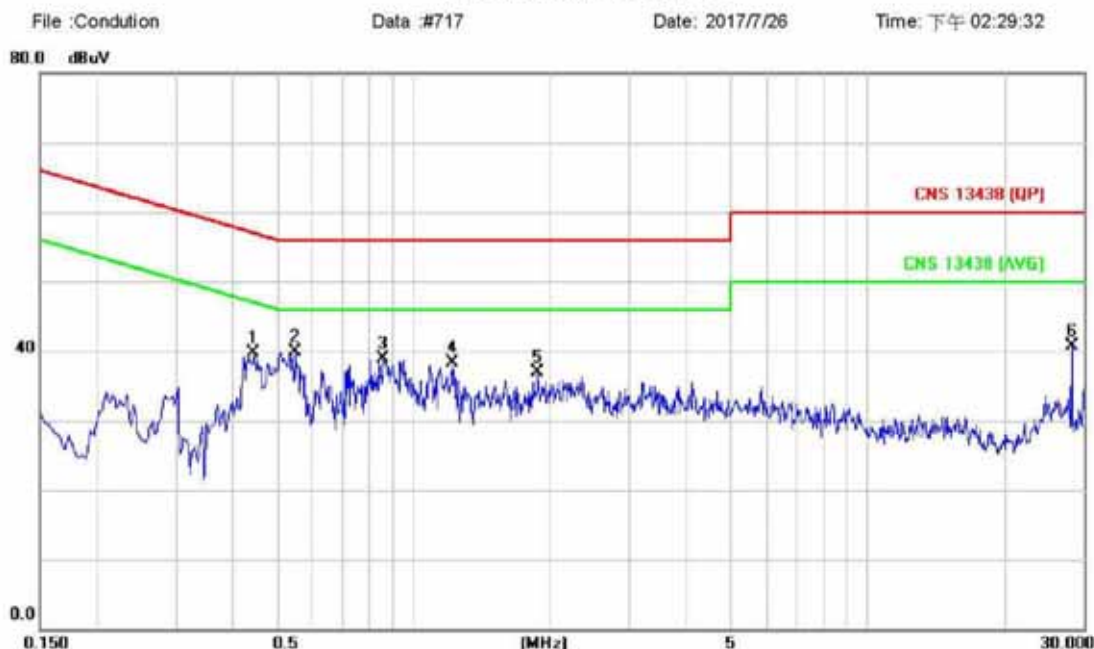
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AC POWER LINE CONDUCTED EMISSION TEST DATA

Operation Mode:	operation mode	Test By:	Jerry
-----------------	----------------	----------	-------

Site : Conduction Room	Phase: L1	Temperature: 25 °C
Limit: CNS 13438 (QP)	Power: AC 110V/60Hz	Humidity: 61 %
Mode:		
Note:		

Conducted Emission



No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Over	Detector	Comment
		MHz	dBuV	dB	dBuV	dBuV	dB		
1		0.4460	19.58	20.04	39.62	56.95	-17.33	peak	
2	*	0.5500	19.88	20.11	39.99	56.00	-16.01	peak	
3		0.8580	19.00	19.94	38.94	56.00	-17.06	peak	
4		1.2220	18.24	20.01	38.25	56.00	-17.75	peak	
5		1.8860	16.48	20.48	36.96	56.00	-19.04	peak	
6		28.2900	20.17	20.47	40.64	60.00	-19.36	peak	

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Site : Conduction Room
Limit: CNS 13438 (QP)
Mode:
Note:

Phase: **N**
Power: AC 110V/60Hz

Temperature: 25 °C
Humidity: 61 %

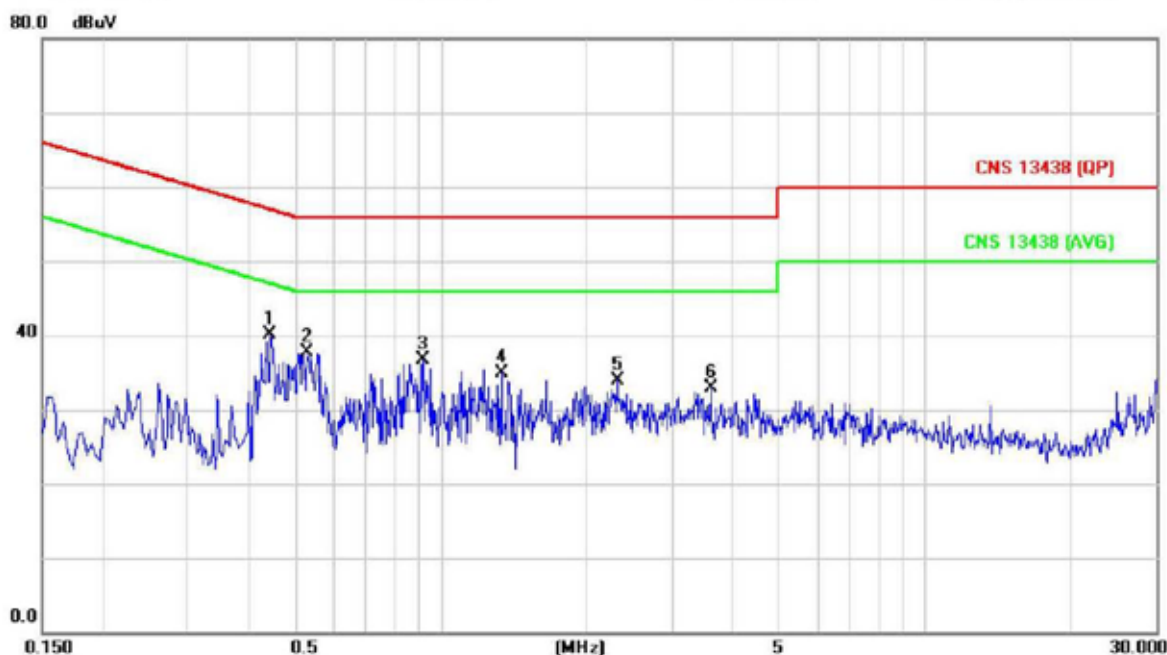
Conducted Emission

File :Conduction

Data :#718

Date: 2017/7/26

Time: 下午 02:30:21



No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Over	Detector	Comment
		MHz	dBuV	dB	dBuV	dBuV	dB		
1	*	0.4460	20.20	19.90	40.10	56.95	-16.85	peak	
2		0.5300	17.83	19.97	37.80	56.00	-18.20	peak	
3		0.9220	16.91	19.76	36.67	56.00	-19.33	peak	
4		1.3340	14.96	19.94	34.90	56.00	-21.10	peak	
5		2.3140	13.62	20.37	33.99	56.00	-22.01	peak	
6		3.6220	12.72	20.17	32.89	56.00	-23.11	peak	

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7 DUTY CYCLE OF TEST SIGNAL

Pre-analysis Check: While conducting average power measurement, duty cycle of each mode shall be checked to ensure its duty cycle in order to compensate for the loss due to insufficient ratio of duty cycle.

All duty cycle is pre-scanned, and result as obtained below shows only the most representative ones where duty cycle is conducted as the given transmission with given virtual operation that expresses the percentage.

Formula:

$$\text{Duty Cycle} = \text{Ton} / (\text{Ton} + \text{Toff})$$

Measurement Procedure:

1. Set span = Zero
2. RBW = 8MHz
3. VBW = 8MHz,
4. Detector = Peak

Duty Cycle:

	Duty Cycle (%)	Duty Factor (dB)	1/T (kHz)	VBW setting (kHz)
802.11b	100.00	0.00	0.00	0.01
802.11g	100.00	0.00	0.00	0.01
802.11n_20	100.00	0.00	0.00	0.01
802.11n_40	100.00	0.00	0.00	0.01

Duty Cycle Factor: $10 * \log(1/1) = 0$

Duty Cycle Factor: $10 * \log(1/1) = 0$

Duty Cycle Factor: $10 * \log(1/1) = 0$

Duty Cycle Factor: $10 * \log(1/1) = 0$

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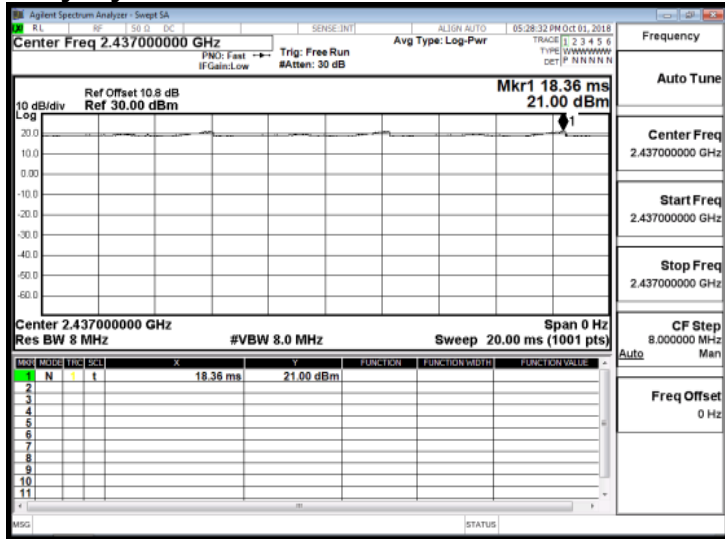
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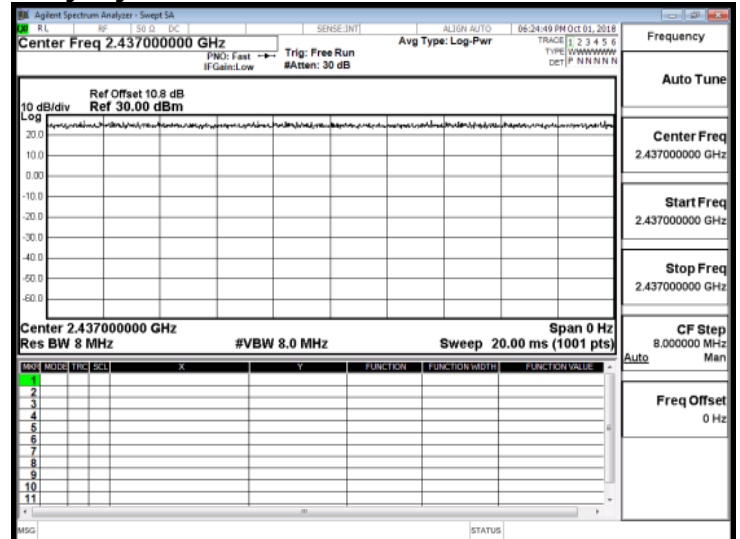
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7.1 DUTY CYCLE TEST SIGNAL Measurement Result

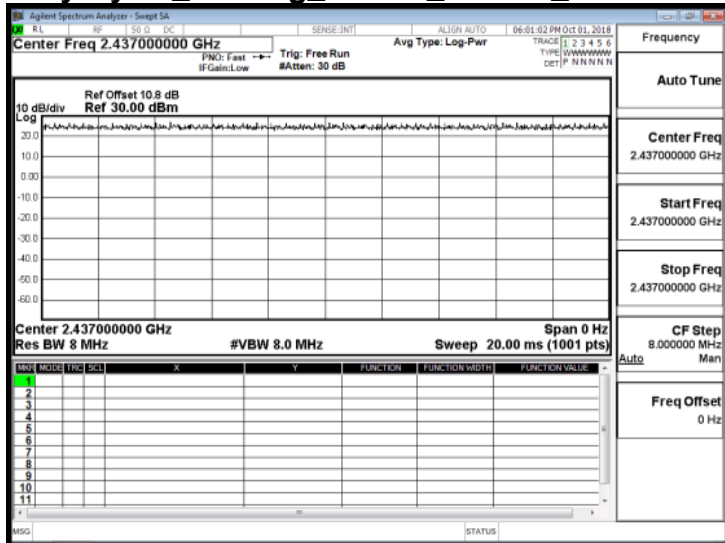
Duty Cycle_802.11b_20MHz_Chain0_2412MHz



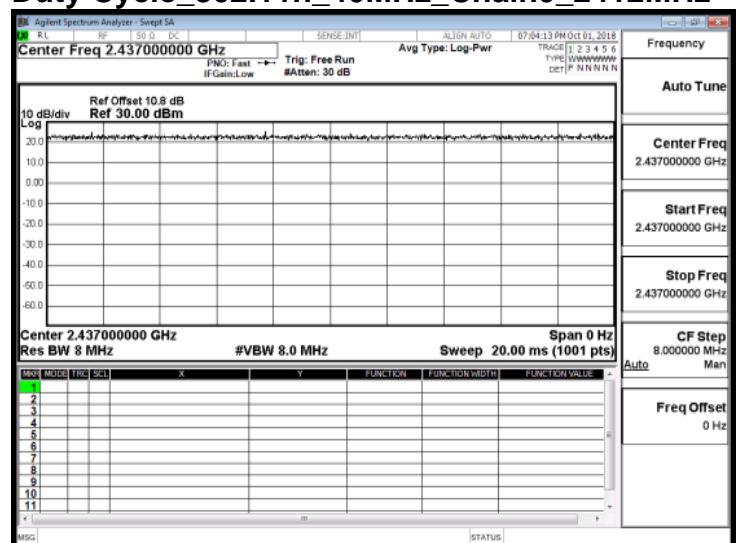
Duty Cycle_802.11n_20MHz_Chain0_2412MHz



Duty Cycle_802.11g_20MHz_Chain0_2412MHz



Duty Cycle_802.11n_40MHz_Chain0_2412MHz



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8 PEAK OUTPUT POWER MEASUREMENT

8.1 Standard Applicable

For systems using digital modulation in the 2400-2483.5 MHz bands, the limit for peak output power is 1Watt.

If the transmitting antenna of directional gain greater than 6dBi are used the peak output power from the intentional radiator shall be reduced below the above stated value by the amount in dB that the directional gain of the Antenna exceeds 6dBi.

In case of point-to-point operation, the limit has to be reduced by 1dB for every 3dB that the directional gain of Antenna exceeds 6dBi.

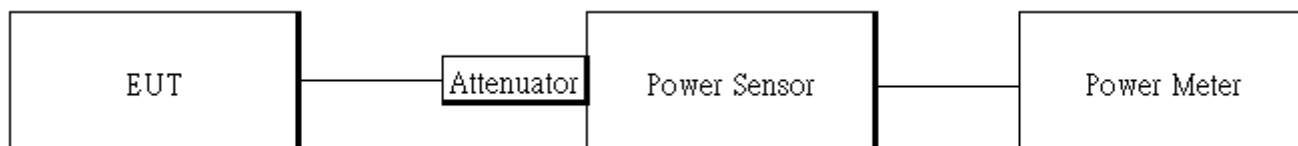
The antenna gain is not greater than 6 dBi. Therefore, reduction of power is not required.

8.2 Measurement Equipment Used

Conducted Emission Test Site					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Power Meter	Anritsu	ML2496A	1326001	08/09/2018	08/02/2019
Power Sensor	Anritsu	MA2411B	1315048	08/09/2018	08/02/2019
Power Sensor	Anritsu	MA2411B	1315049	08/09/2018	08/02/2019
Attenuator	Marvelous	MVE2213-10	RF30	12/26/2017	12/25/2018
Notebook	Lenovo	L420	S0011721	N/A	N/A

8.3 Test Set-up

Power Meter:



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8.4 Measurement Procedure

1. Place the EUT on the table and set it in transmitting mode.
2. The testing follows the Measurement Procedure of FCC KDB 558074 D01 DTS Meas. Guidance & ANSI C63.10.
3. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the power meter.

Power Meter:

It is used as the auxiliary test equipment to conduct the output power measurement.

4. Record the max. Reading as observed from Spectrum or Power Meter.

8.5 Measurement Result

802.11b Ch0					
CH	Freq. (MHz)	Data Rate	Peak Output Power (dBm)	Limit	RESULT
1	2412	1	23.36	1 Watt = 30.00 dBm	PASS
6	2437	1	18.39	1 Watt = 30.00 dBm	PASS
11	2462	1	19.66	1 Watt = 30.00 dBm	PASS
802.11b Ch0					
CH	Freq. (MHz)	Data Rate	Max. Avg. Output include tune up tolerance Power (dBm)	Limit	RESULT
1	2412	1	20.94	1 Watt = 30.00 dBm	PASS
6	2437	1	16.02	1 Watt = 30.00 dBm	PASS
11	2462	1	17.45	1 Watt = 30.00 dBm	PASS

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802.11g Ch0					
CH	Freq. (MHz)	Data Rate	Peak Output Power (dBm)	Limit	RESULT
1	2412	6	26.12	1 Watt = 30.00 dBm	PASS
6	2437	6	26.70	1 Watt = 30.00 dBm	PASS
11	2462	6	26.08	1 Watt = 30.00 dBm	PASS
802.11g Ch0					
CH	Freq. (MHz)	Data Rate	Max. Avg. Output include tune up tolerance Power (dBm)	Limit	RESULT
1	2412	6	17.71	1 Watt = 30.00 dBm	PASS
6	2437	6	20.09	1 Watt = 30.00 dBm	PASS
11	2462	6	17.34	1 Watt = 30.00 dBm	PASS

802.11n_HT20M Ch0					
CH	Freq. (MHz)	Data Rate	Peak Output Power (dBm)	Limit	RESULT
1	2412	MCS0	25.33	1 Watt = 30.00 dBm	PASS
6	2437	MCS0	26.68	1 Watt = 30.00 dBm	PASS
11	2462	MCS0	24.97	1 Watt = 30.00 dBm	PASS
802.11n_HT20M Ch0					
CH	Freq. (MHz)	Data Rate	Max. Avg. Output include tune up tolerance Power (dBm)	Limit	RESULT
1	2412	MCS0	16.67	1 Watt = 30.00 dBm	PASS
6	2437	MCS0	20.46	1 Watt = 30.00 dBm	PASS
11	2462	MCS0	16.40	1 Watt = 30.00 dBm	PASS

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802.11n_HT40M Ch0					
CH	Freq. (MHz)	Data Rate	Peak Output Power (dBm)	Limit	RESULT
3	2422	MCS0	24.96	1 Watt = 30.00 dBm	PASS
6	2437	MCS0	26.71	1 Watt = 30.00 dBm	PASS
9	2452	MCS0	24.27	1 Watt = 30.00 dBm	PASS
802.11n_HT40M Ch0					
CH	Freq. (MHz)	Data Rate	Max. Avg. Output include tune up tolerance Power (dBm)	Limit	RESULT
3	2422	MCS0	16.26	1 Watt = 30.00 dBm	PASS
6	2437	MCS0	20.94	1 Watt = 30.00 dBm	PASS
9	2452	MCS0	15.11	1 Watt = 30.00 dBm	PASS

offset 10.80 dB for SISO mode

*** Note: The duty cycle factor is compensated to obtain the maximum value of measurement in average.**

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9 6DB BANDWIDTH MEASUREMENT

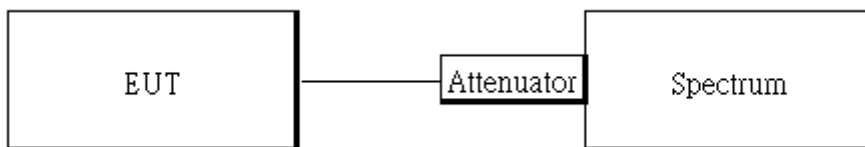
9.1 Standard Applicable

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

9.2 Measurement Equipment Used

Conducted Emission Test Site					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Spectrum Analyzer	Agilent	N9010A	MY51440113	06/20/2018	06/19/2019
Attenuator	Marvelous	MVE2213-10	RF30	12/26/2017	12/25/2018
DC Block	PASTERNAK	PE8210	RF29	12/26/2017	12/25/2018
Notebook	Lenovo	L420	S0011721	N/A	N/A

9.3 Test Set-up



9.4 Measurement Procedure

- Place the EUT on the table and set it in transmitting mode.
- The testing follows the Measurement Procedure of FCC KDB 558074 D01 DTS Meas. Guidance & ANSI C63.10
- Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
- For 6dB Bandwidth:
Set the spectrum analyzer as RBW = 100 kHz, VBW = 3*RBW, Span = 30M/50MHz, Detector=peak, Sweep=auto.
- Mark the peak frequency and -6dB (upper and lower) frequency.
- For 99% Bandwidth:
Set the spectrum analyzer as RBW=1%, VBW = 3*RBW, Span = 30M/50MHz, Detector=Sample, Sweep=auto.
- Turn on the 99% bandwidth function, max reading.
- Repeat above procedures until all frequency of interest measured was complete.

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9.5 Measurement Result

6dB Bandwidth

802.11b Ch0

Freq. (MHz)	6dB BW (kHz)	Limit (kHz)	Result
2412	10120.00	> 500	PASS
2437	10130.00	> 500	PASS
2462	10130.00	> 500	PASS

802.11g Ch0

Freq. (MHz)	6dB BW (kHz)	Limit (kHz)	Result
2412	16580.00	> 500	PASS
2437	16560.00	> 500	PASS
2462	16580.00	> 500	PASS

802.11_n_HT20 Ch0

Freq. (MHz)	6dB BW (kHz)	Limit (kHz)	Result
2412	17760.00	> 500	PASS
2437	17780.00	> 500	PASS
2462	17700.00	> 500	PASS

802.11_n_HT40 Ch0

Freq. (MHz)	6dB BW (kHz)	Limit (kHz)	Result
2422	36550.00	> 500	PASS
2437	36510.00	> 500	PASS
2452	36560.00	> 500	PASS

**Refer to next page for plots*

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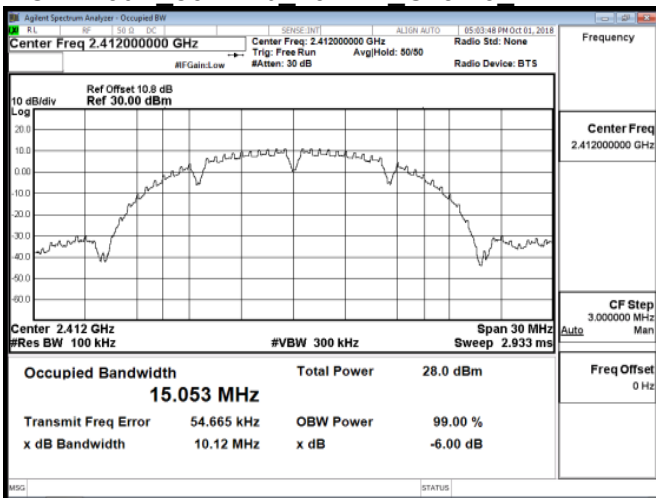
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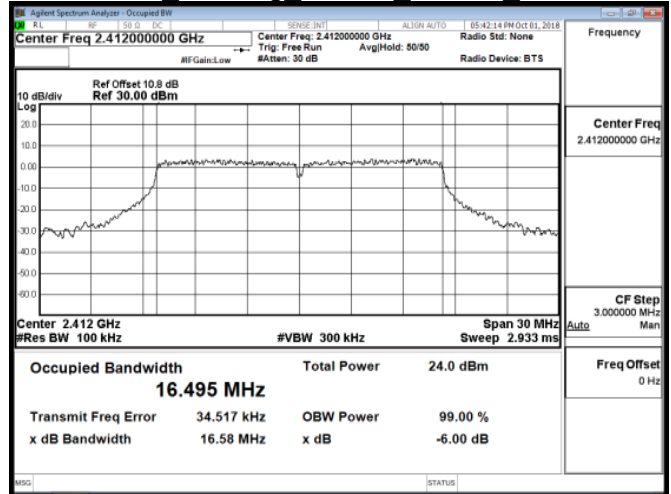
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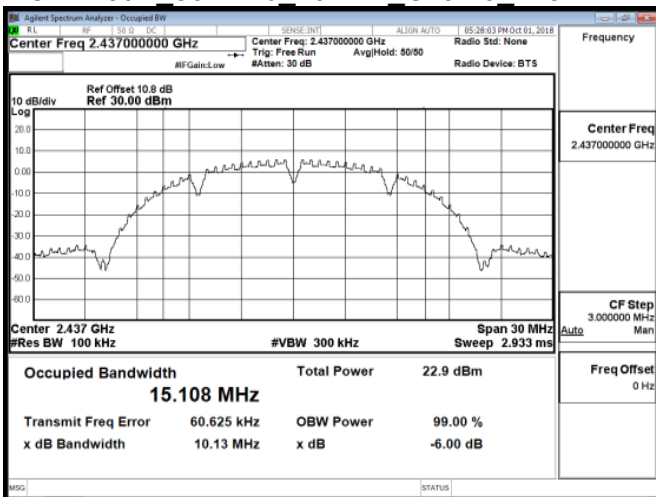
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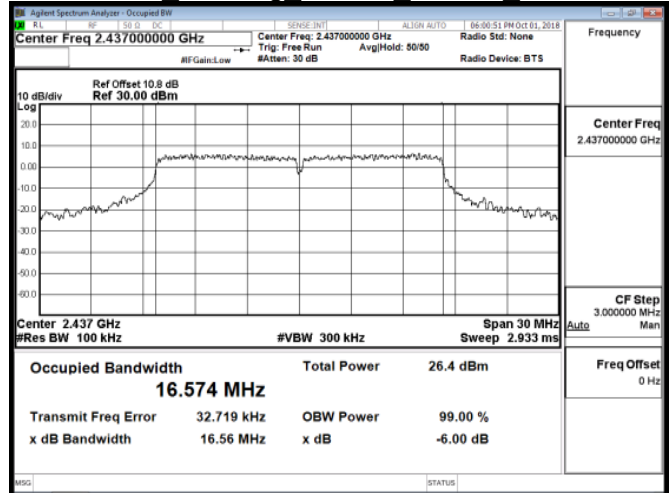
OBW 6dB 802.11g 20MHz Chain0 2412MHz



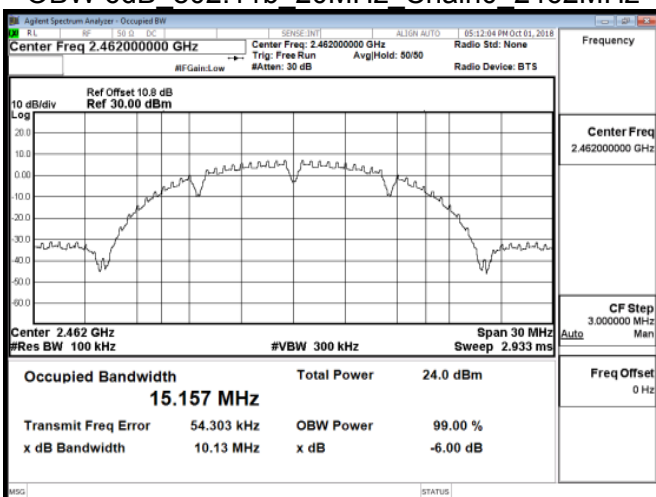
OBW 6dB 802.11b 20MHz Chain0 2437MHz



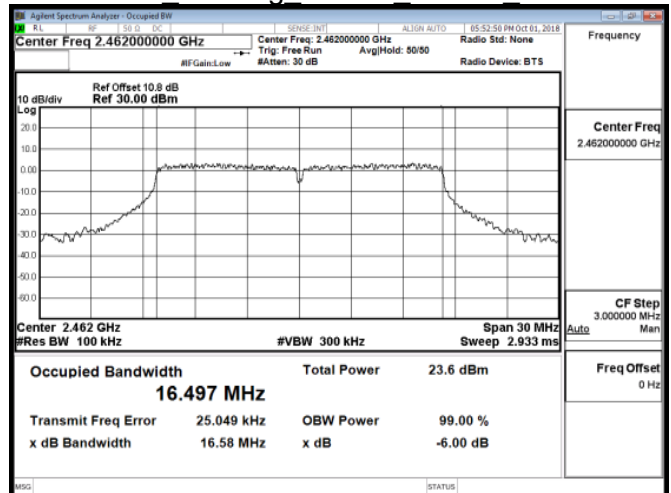
OBW 6dB 802.11g 20MHz Chain0 2437MHz



OBW 6dB 802.11b 20MHz Chain0 2462MHz



OBW 6dB 802.11g 20MHz Chain0 2462MHz



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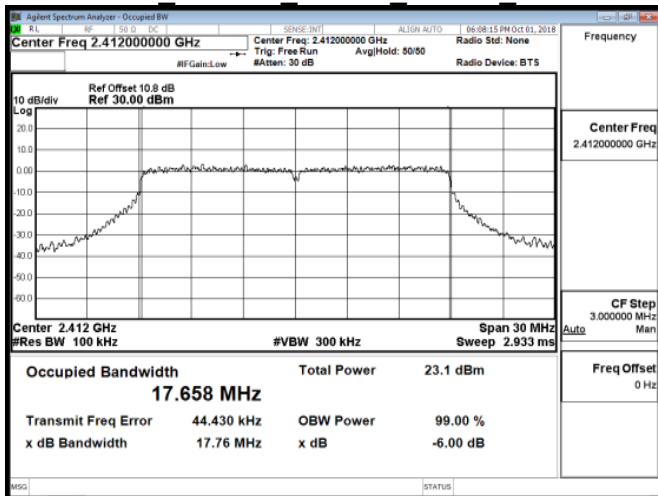
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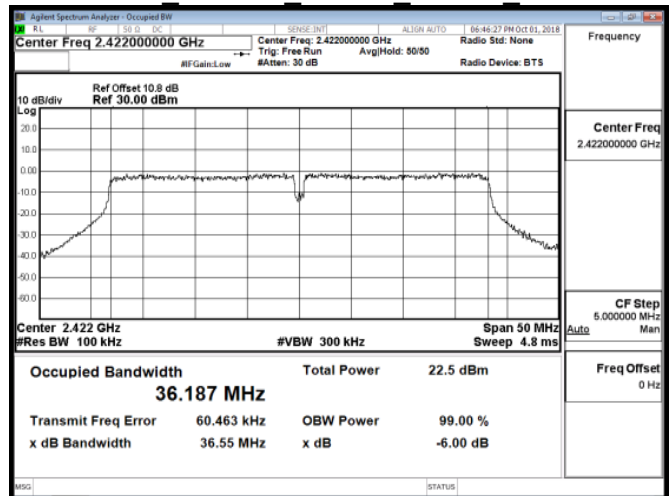
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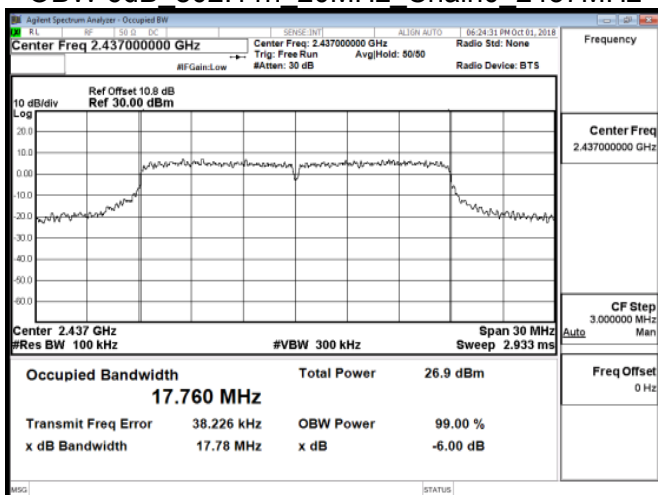
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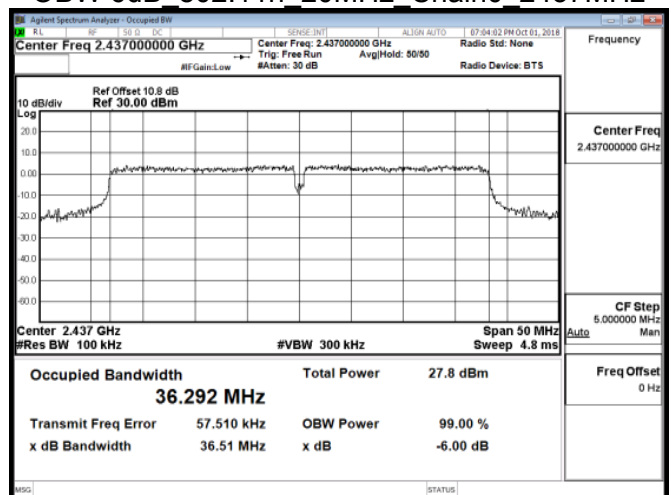
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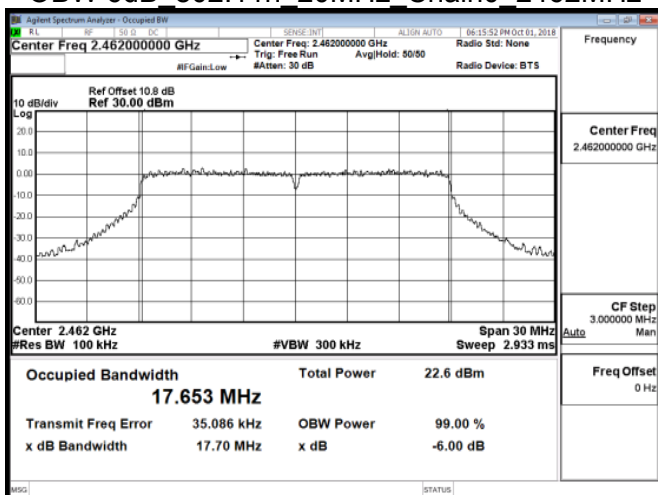
OBW 6dB 802.11n 20MHz Chain0 2437MHz



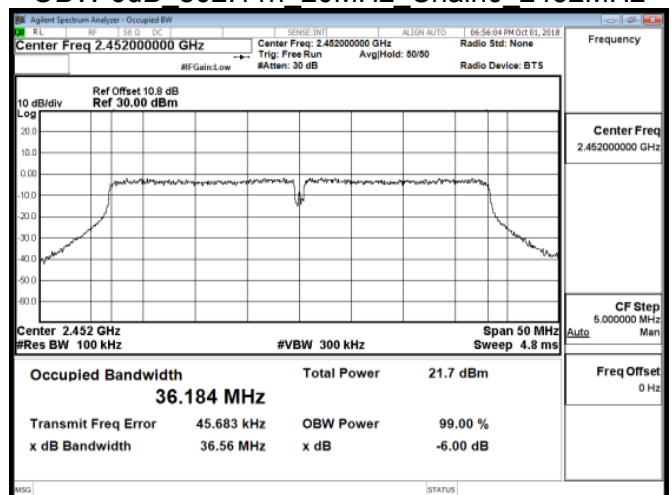
OBW 6dB 802.11n 20MHz Chain0 2437MHz



OBW 6dB 802.11n 20MHz Chain0 2462MHz



OBW 6dB 802.11n 20MHz Chain0 2452MHz



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10 CONDUCTED BAND EDGES AND SPURIOUS EMISSION MEASUREMENT

10.1 Standard Applicable

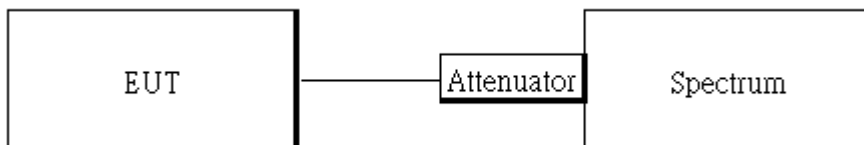
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a).

If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required.

10.2 Measurement Equipment Used

Conducted Emission Test Site					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Spectrum Analyzer	Agilent	N9010A	MY51440113	06/20/2018	06/19/2019
Attenuator	Marvelous	MVE2213-10	RF30	12/26/2017	12/25/2018
DC Block	PASTERNAK	PE8210	RF29	12/26/2017	12/25/2018
Notebook	Lenovo	L420	S0011721	N/A	N/A

10.3 Test SET-UP



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10.4 Measurement Procedure

Reference Level of Emission Limit:

1. Set analyzer center frequency to DTS channel center frequency.
2. The testing follows the Measurement Procedure of FCC KDB 558074 D01 DTS Meas. Guidance & ANSI C63.10
3. Set the span to 1.5 times the DTS channel bandwidth.
4. Set the RBW = 100kHz & VBW = 300 kHz.
5. Detector = peak.
6. Sweep time = auto couple.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Use the peak marker function to determine the maximum amplitude level.

Conducted Band Edge:

1. To connect Antenna Port of EUT to Spectrum.
2. The testing follows the Measurement Procedure of FCC KDB 558074 D01 DTS Meas. Guidance & ANSI C63.10
3. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
4. Set start to edge frequency, and stop frequency of spectrum analyzer so as to encompass the spectrum to be examined.
5. Set the spectrum analyzer as RBW=100 kHz, VBW=300 kHz, Detector = Peak, Sweep = auto
6. Mark the highest reading of the emission as the reference level measurement.
7. Set DL as the limit = reading on marker 1 – 20dBm
8. Marker on frequency, 2.3999GHz and 2.4836GHz, and examine shall 100 kHz immediately outside the authorized (2400~2483.5) be attenuated by 20dB at least relative to the maximum emission of power.
9. Repeat above procedures until all default test channel (low, middle, and high) was complete.

Conducted Spurious Emission:

1. To connect Antenna Port of EUT to Spectrum
2. The testing follows the Measurement Procedure of FCC KDB 558074 D01 DTS Meas. Guidance & ANSI C63.10
3. Set RBW = 100 kHz & VBW= 300 kHz, Detector =Peak, Sweep = Auto.
4. Allow trace to fully stabilize.
5. Use the peak marker function to determine the maximum power level in any 100 kHz band segment within the fundamental EBW.
6. Repeat above procedures until all default test channel measured were complete.

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10.5 Measurement Result

Reference Level of Limit 802.11b mode			Reference Level of Limit 802.11g mode		
Freq. (MHz)	PSD (dBm)	Reference Level of Limit (dBm)	Freq. (MHz)	PSD (dBm)	Reference Level of Limit (dBm)
2412	10.79	-9.21	2412	3.68	-16.32
2437	5.74	-14.26	2437	6.273	-13.73
2462	6.85	-13.15	2462	3.30	-16.70

Reference Level of Limit 802.11n20 mode			Reference Level of Limit 802.11n40 MODE		
Freq. (MHz)	PSD (dBm)	Reference Level of Limit (dBm)	Freq. (MHz)	PSD (dBm)	Reference Level of Limit (dBm)
2412	2.91	-17.09	2422	-1.09	-21.09
2437	7.129	-12.87	2437	3.866	-16.13
2462	2.78	-17.22	2452	-1.94	-21.94

offset **10.80** dB for SISO mode

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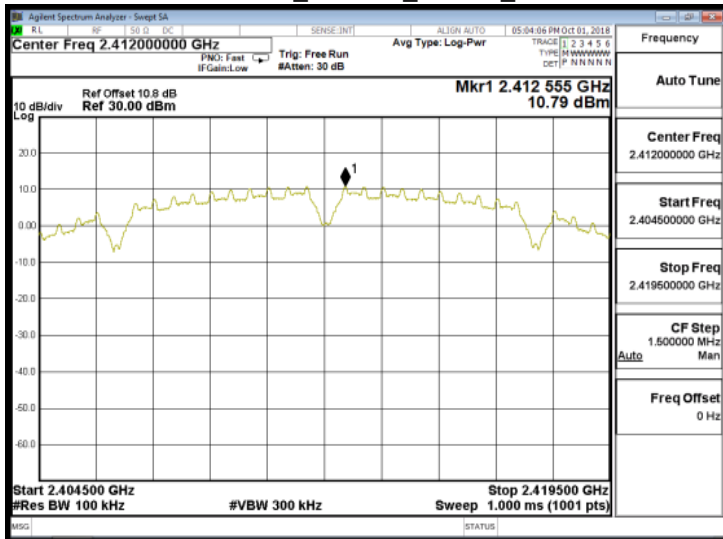
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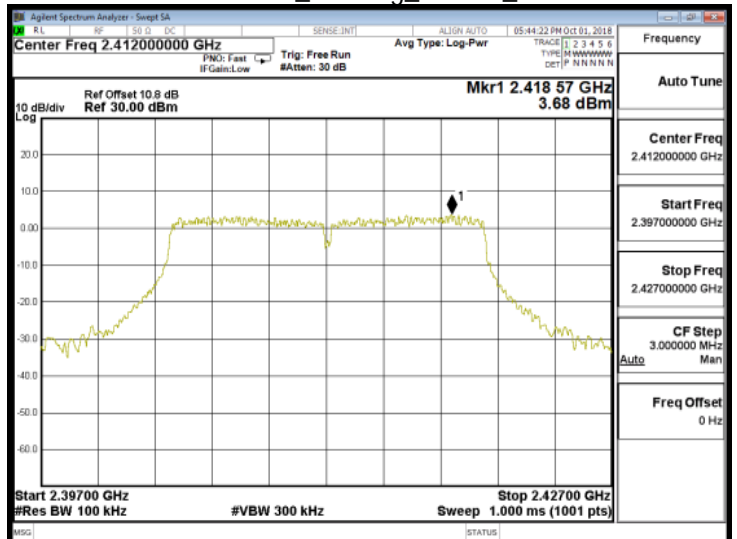
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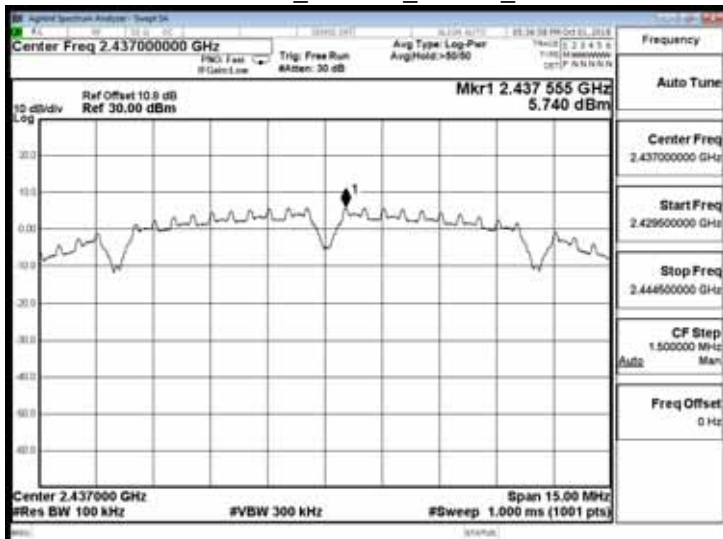
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Reference Level_802.11g_Chain0_2412MHz



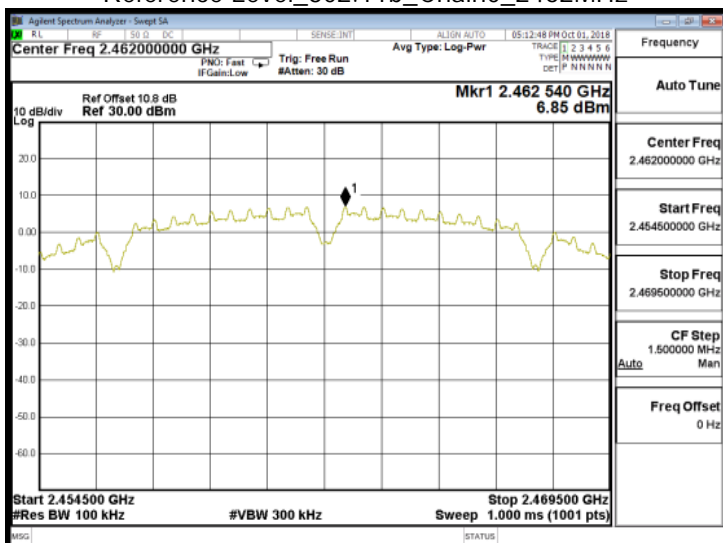
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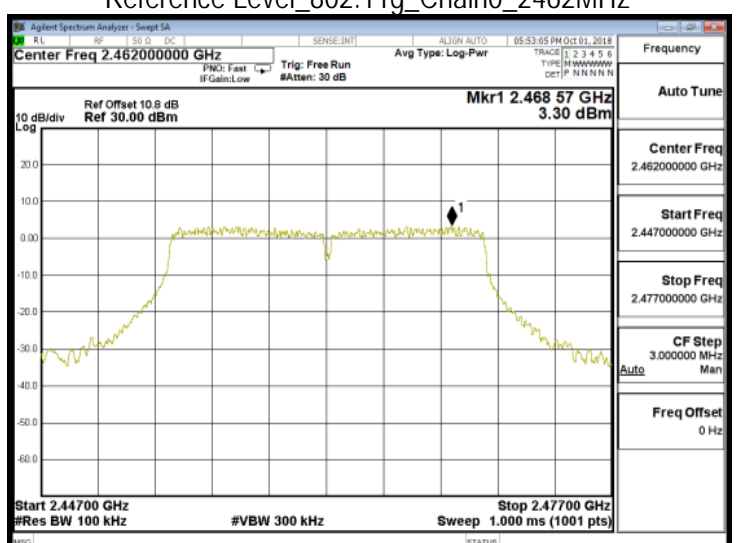
Reference Level_802.11g_Chain0_2437MHz



Reference Level_802.11b_Chain0_2462MHz



Reference Level_802.11g_Chain0_2462MHz



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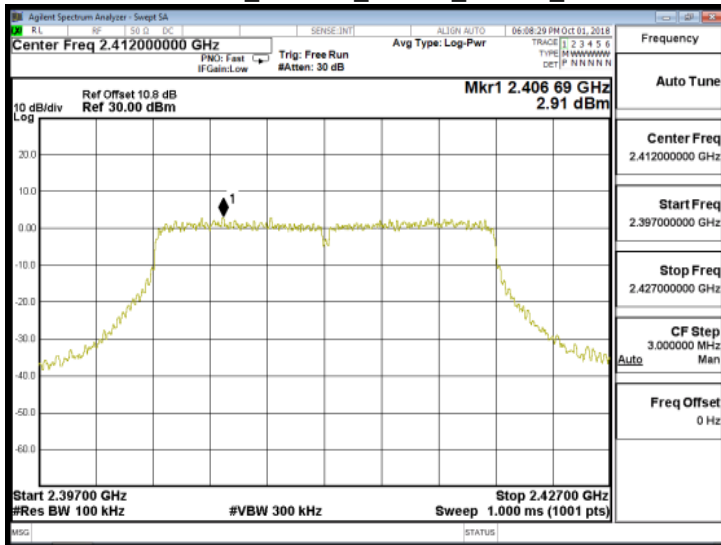
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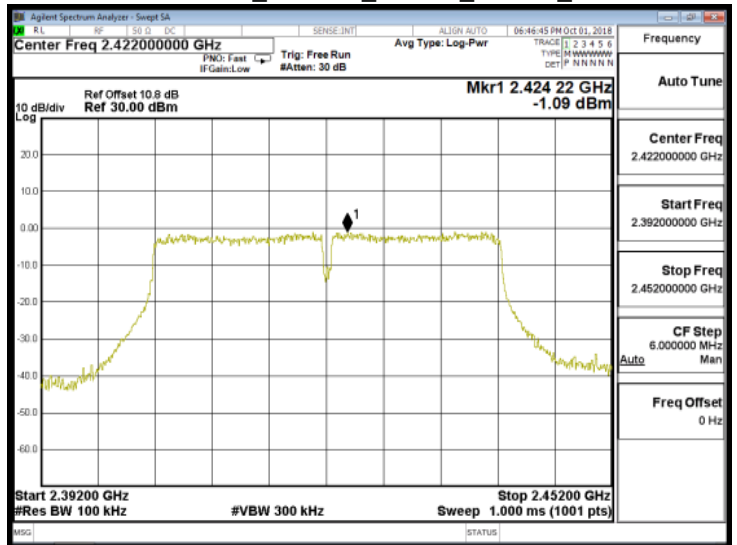
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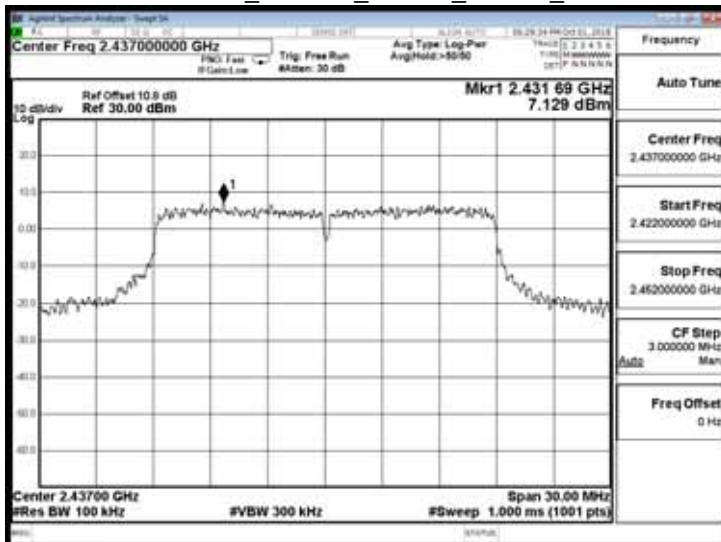
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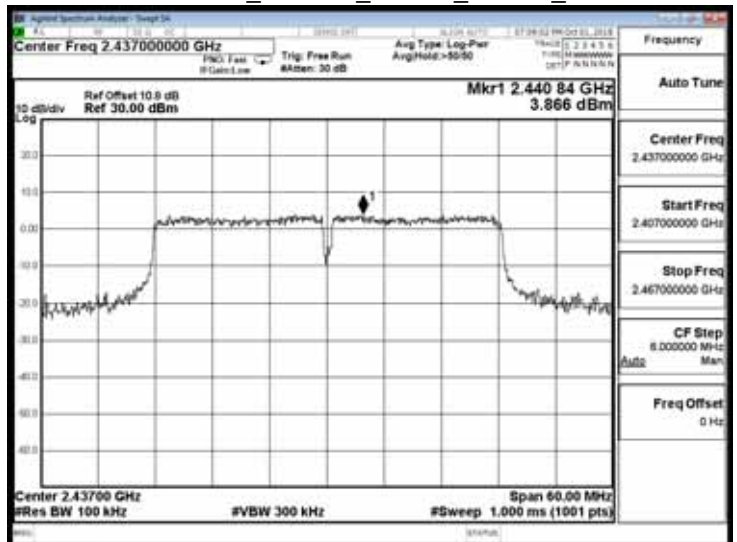
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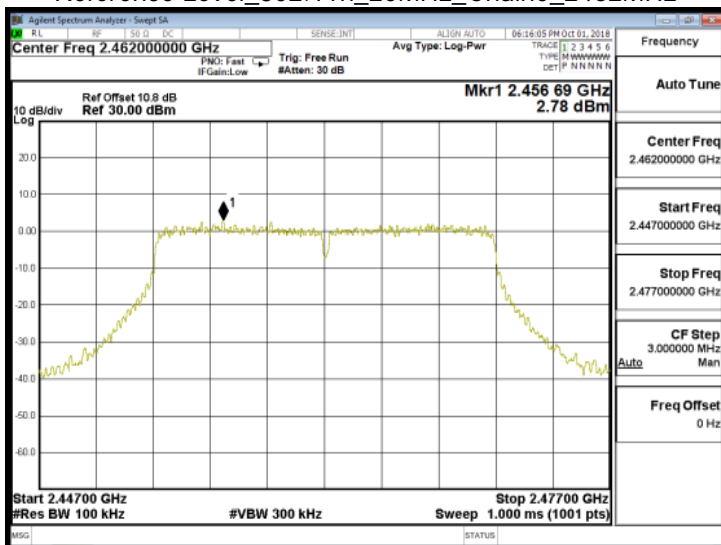
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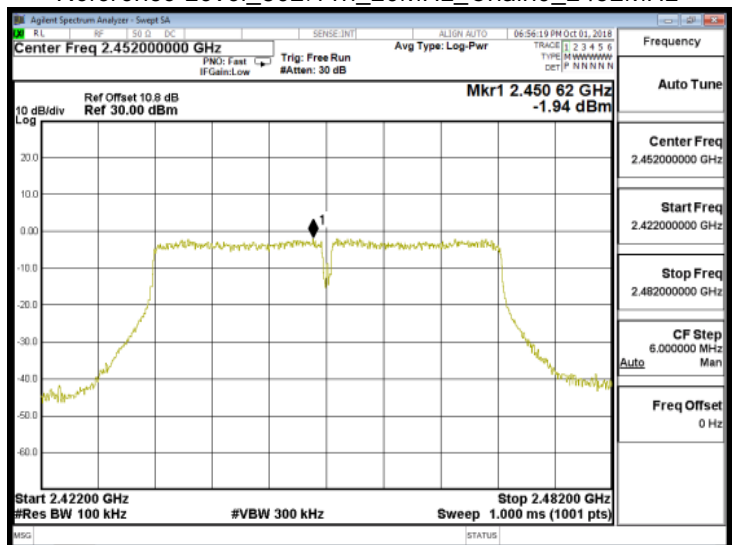
Reference Level_802.11n_20MHz_Chain0_2437MHz



Reference Level_802.11n_20MHz_Chain0_2462MHz



Reference Level_802.11n_20MHz_Chain0_2452MHz



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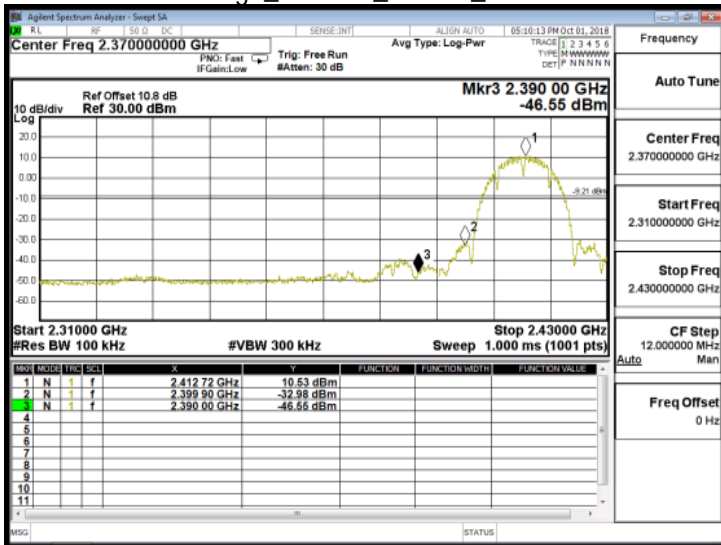
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f (886-2) 2298-0488

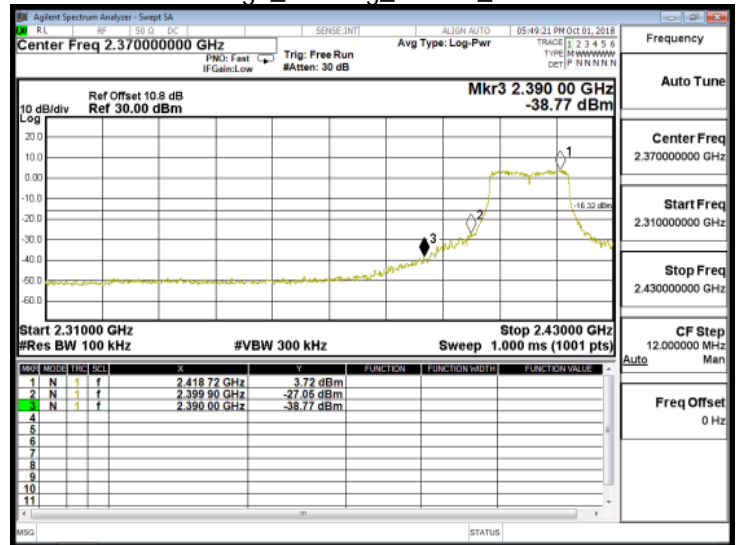
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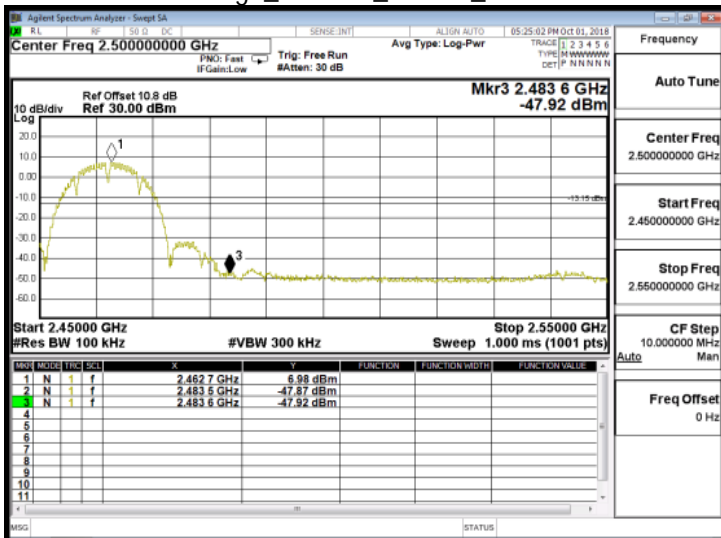
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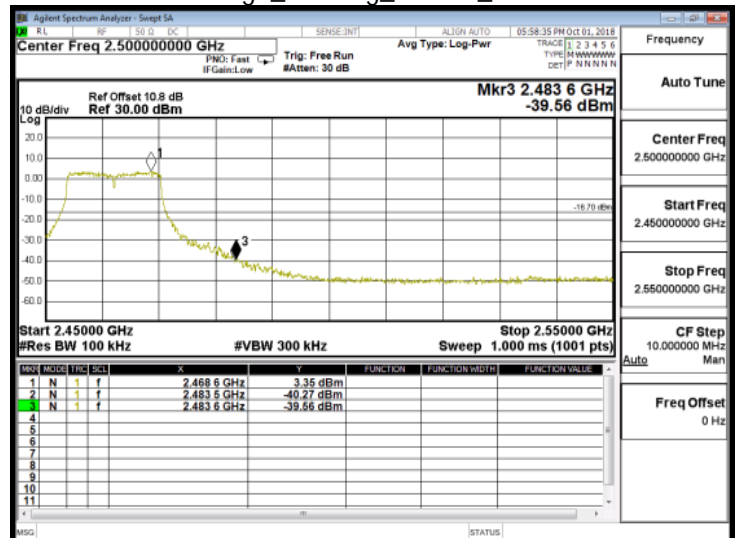
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Band Edge_802.11b_Chain0_2462MHz



Band Edge_802.11g_Chain0_2462MHz

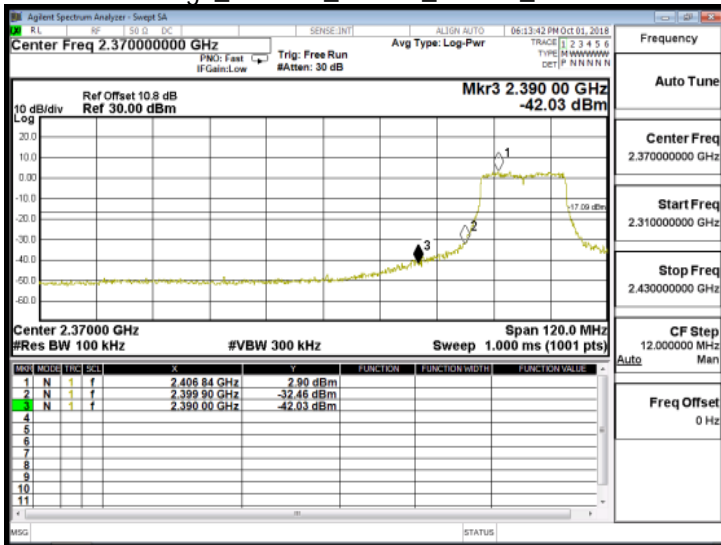


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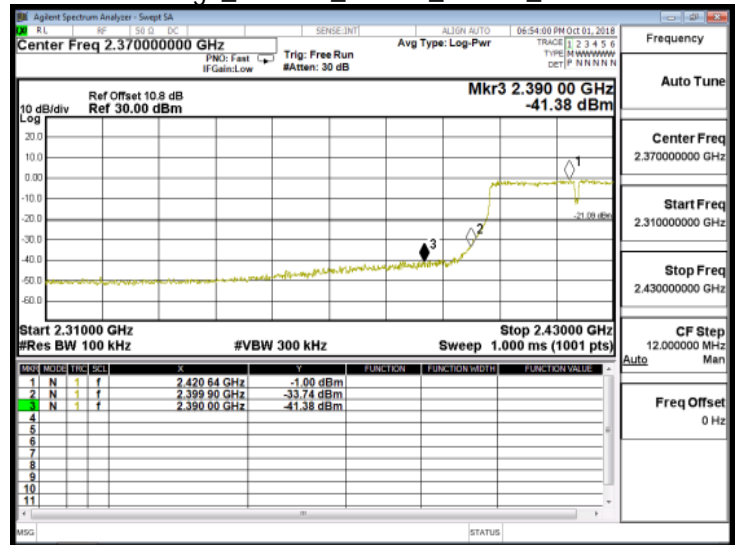
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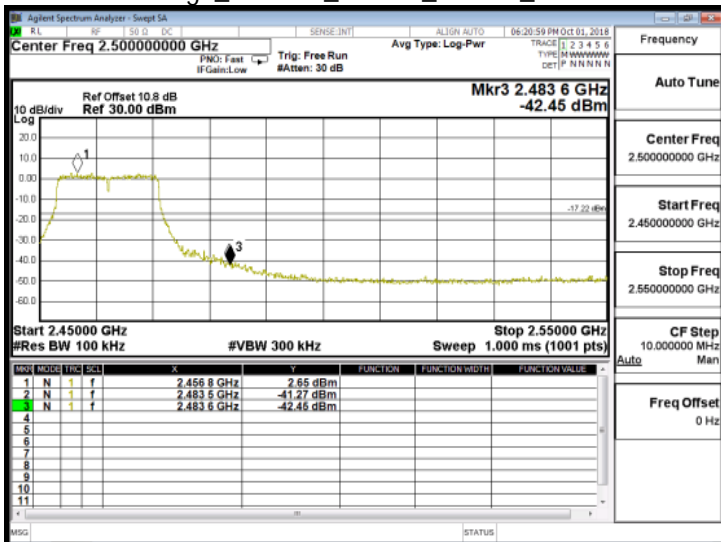
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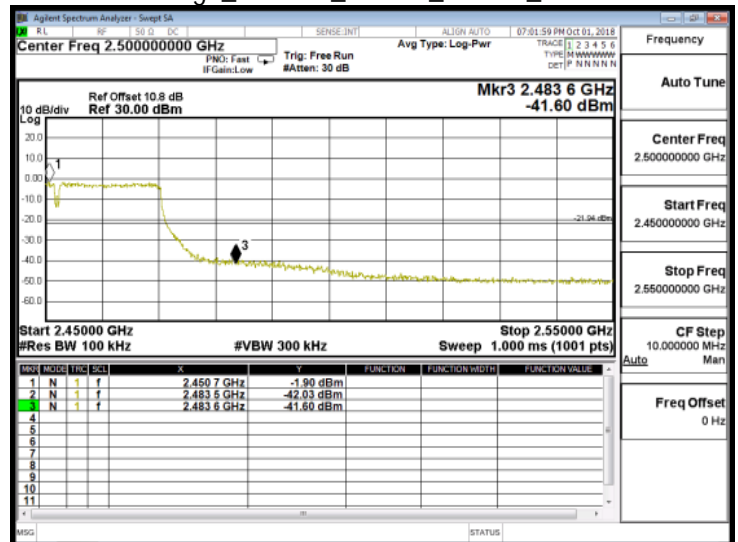
Band Edge_802.11n_40MHz_Chain0_2422MHz



Band Edge_802.11n_20MHz_Chain0_2462MHz



Band Edge_802.11n_20MHz_Chain0_2452MHz

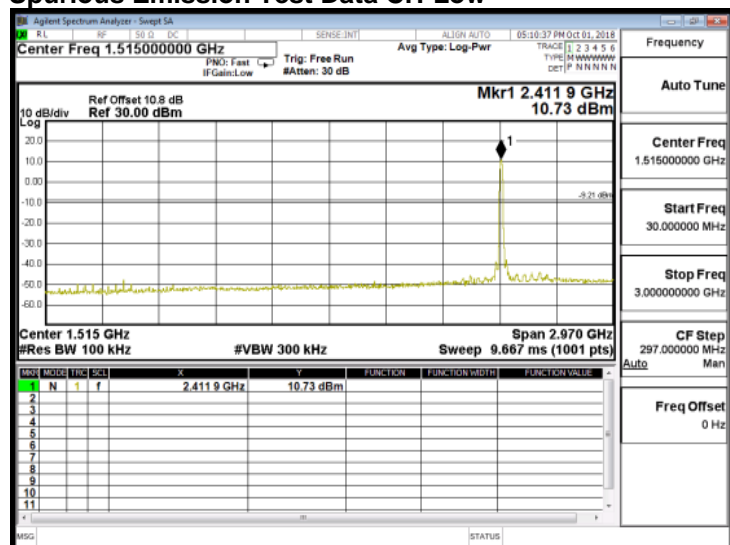


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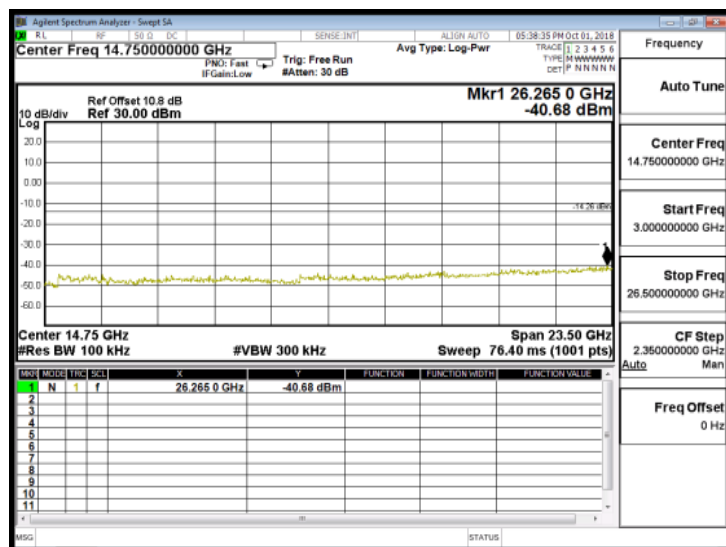
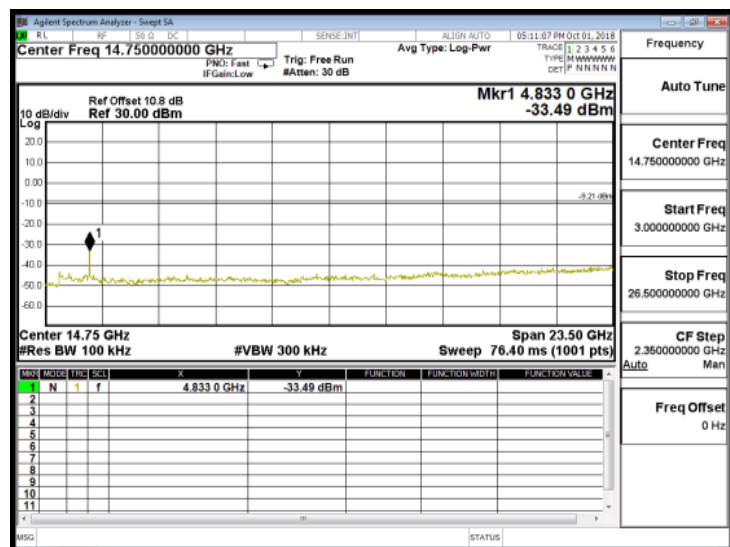
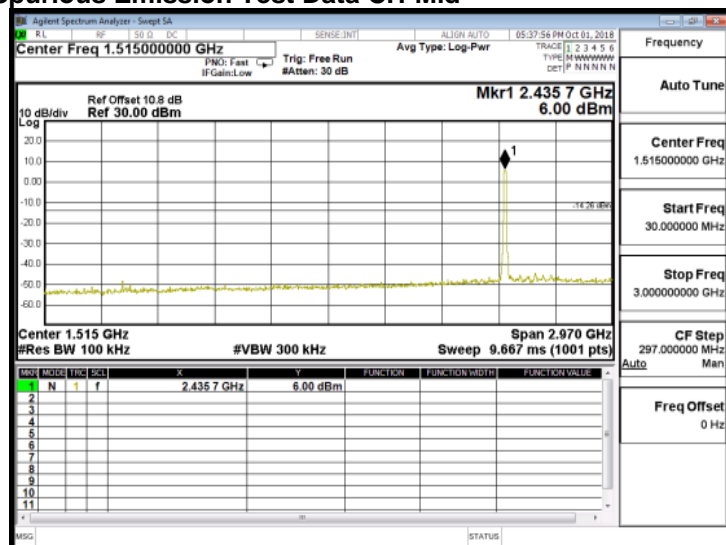
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802.11b Spurious Emission Test Data CH-Low



Spurious Emission Test Data CH-Mid

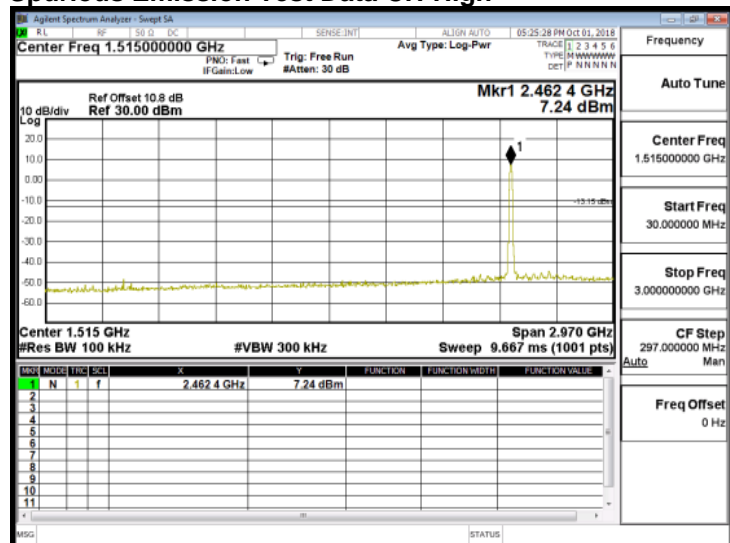


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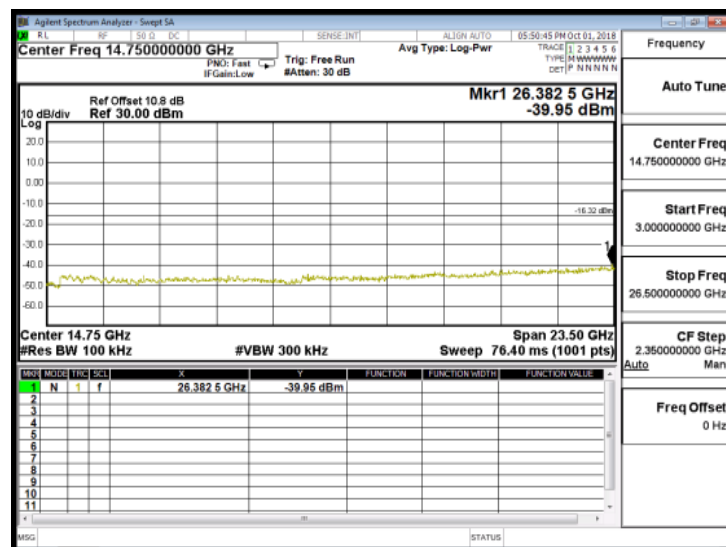
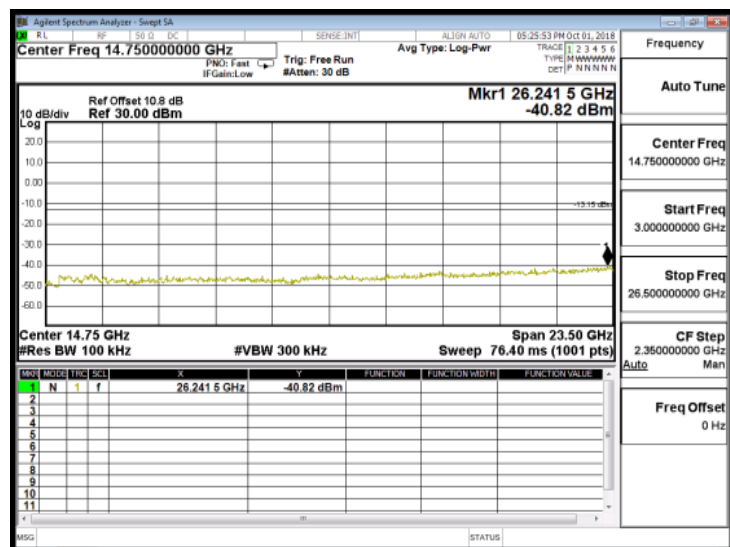
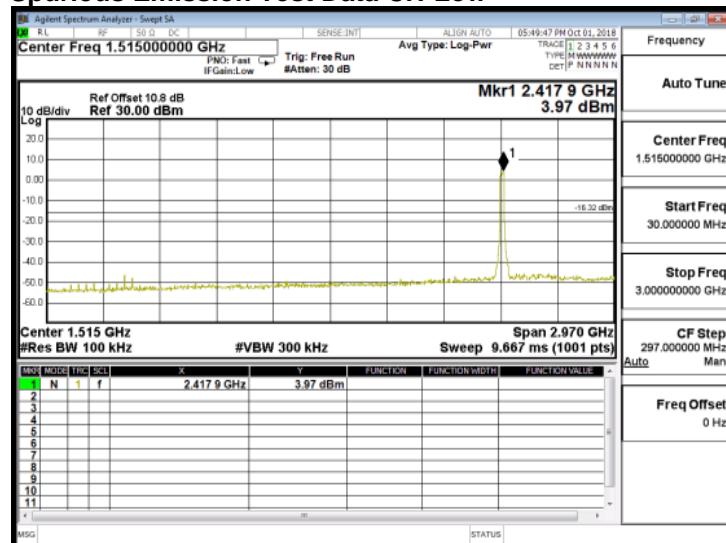
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Spurious Emission Test Data CH-High



802.11g

Spurious Emission Test Data CH-Low

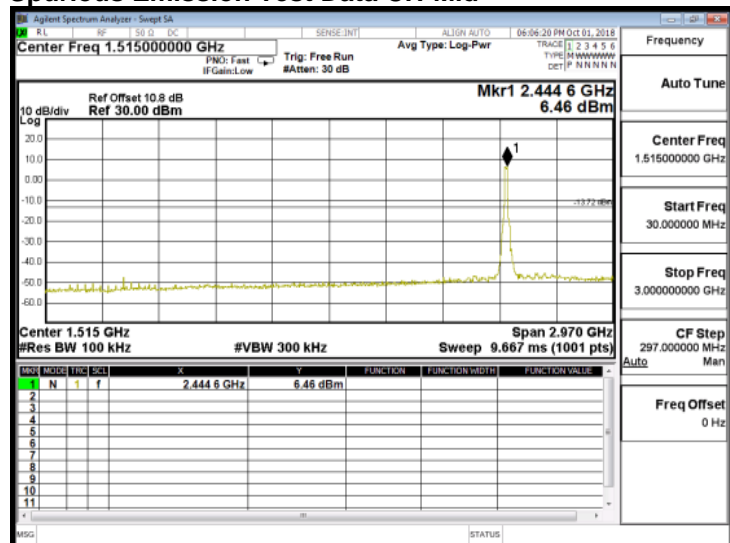


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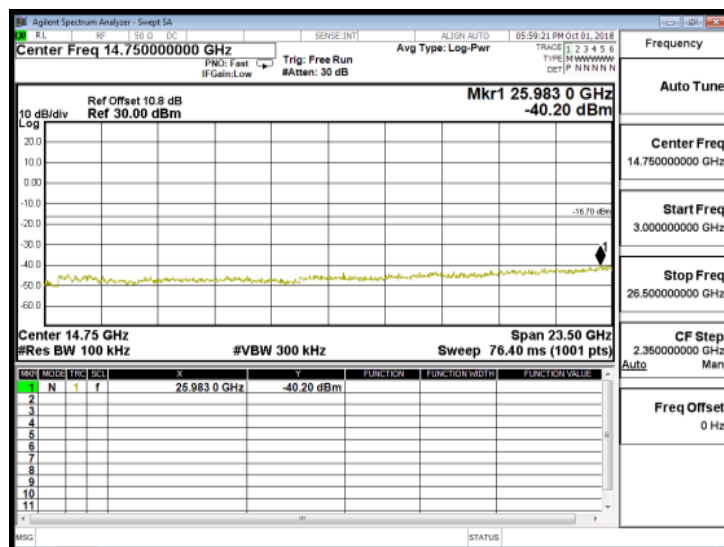
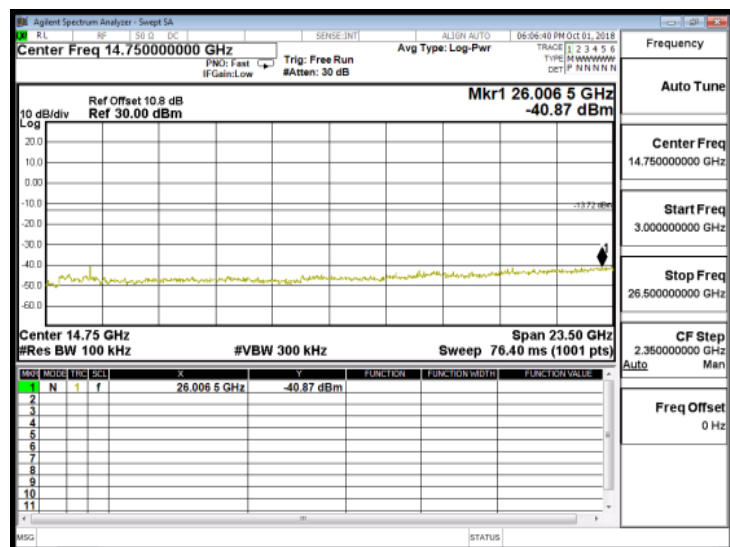
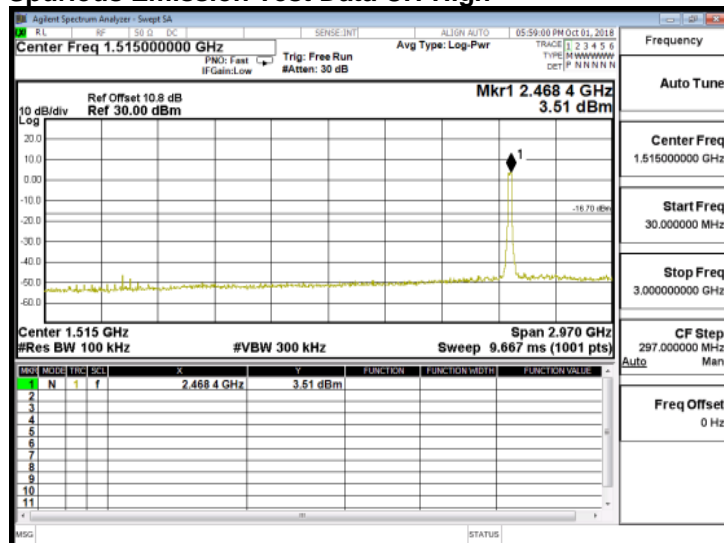
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Spurious Emission Test Data CH-Mid



Spurious Emission Test Data CH-High



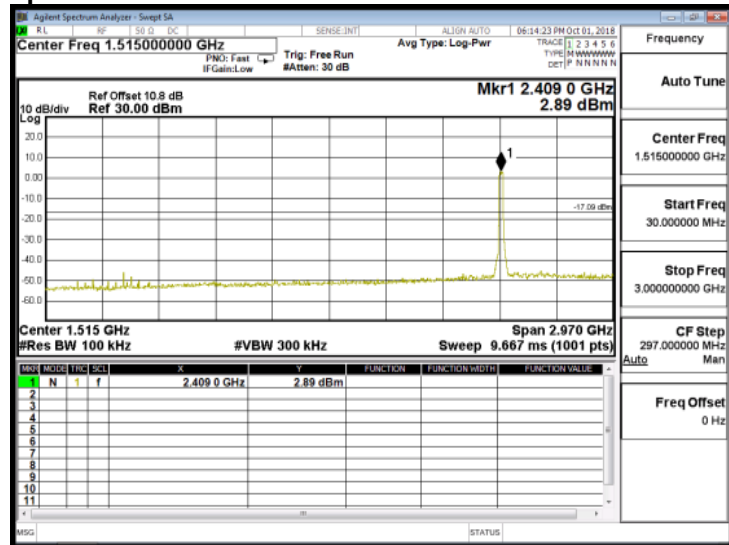
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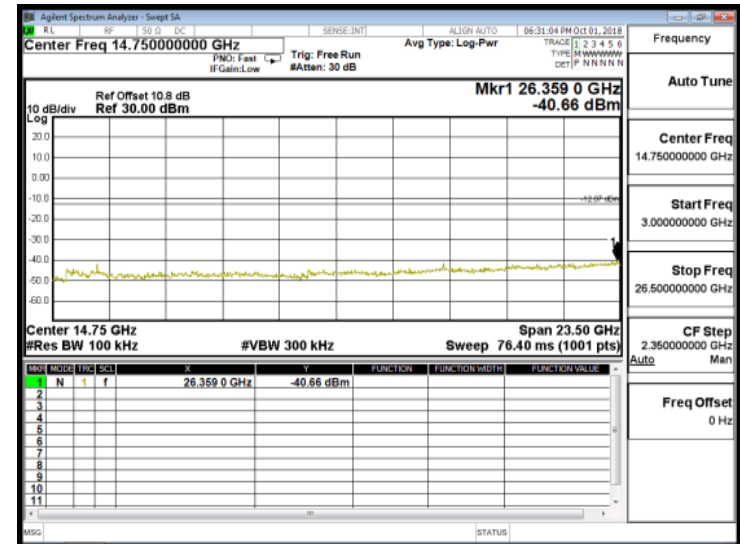
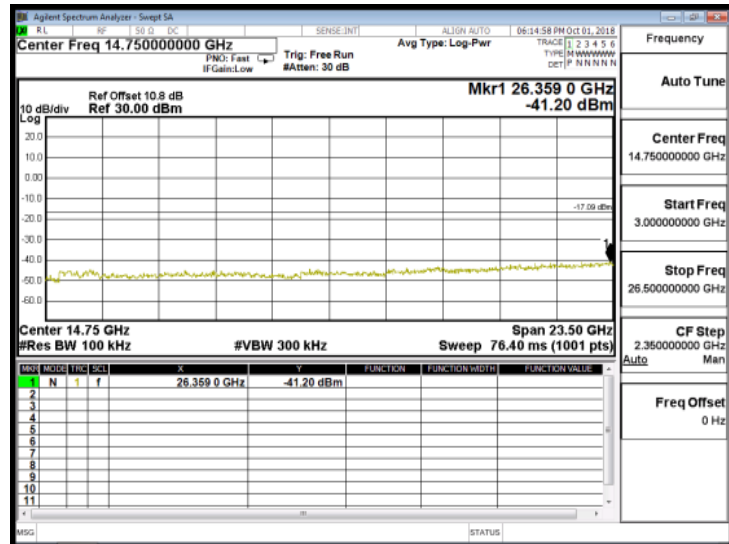
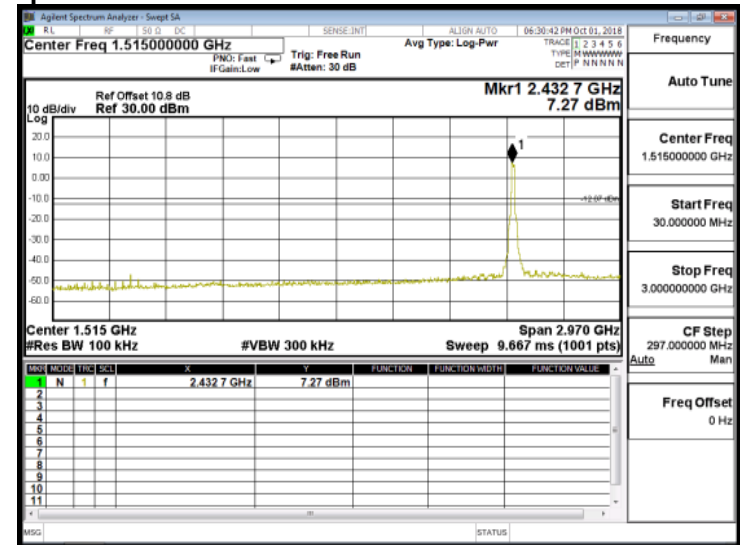
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802.11n_HT20

Spurious Emission Test Data CH-Low



Spurious Emission Test Data CH-Mid

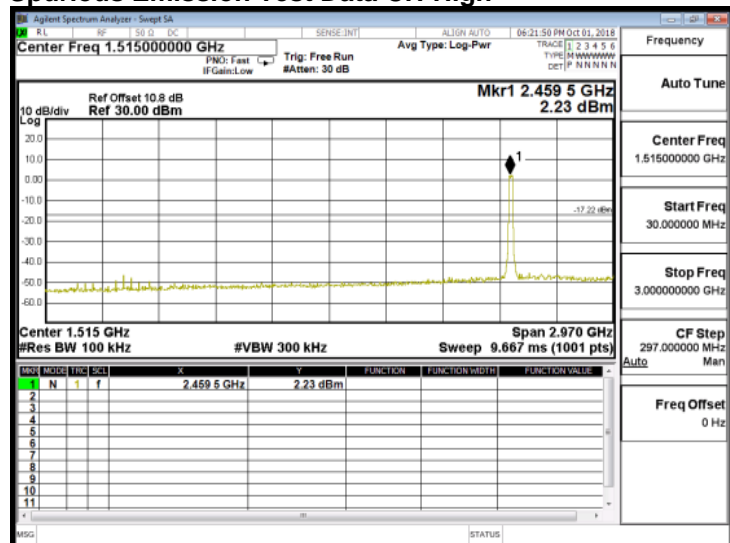


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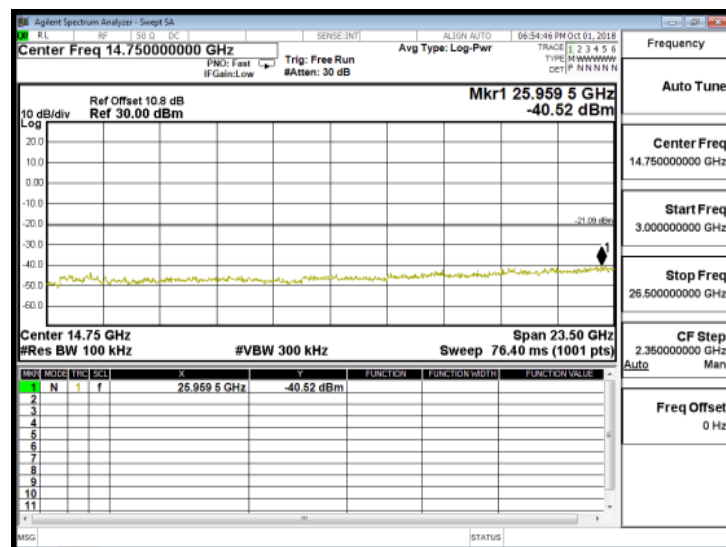
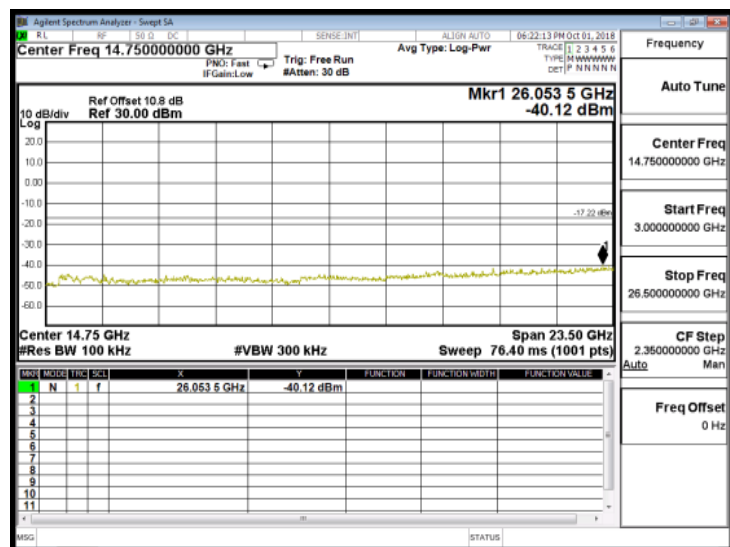
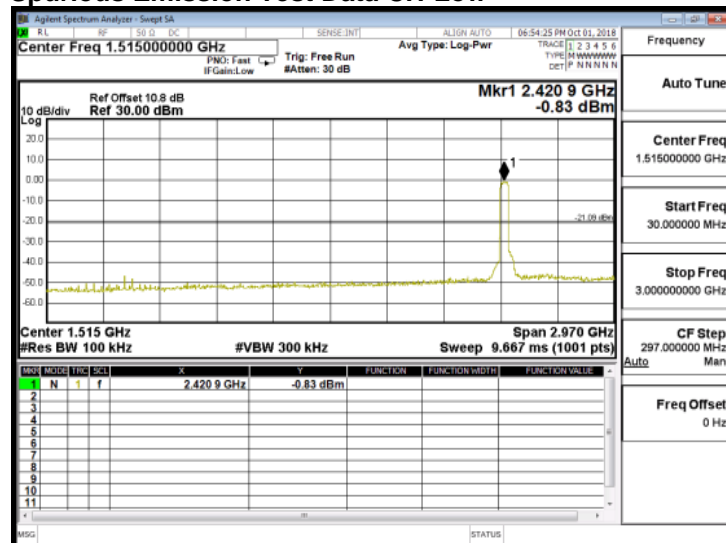
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Spurious Emission Test Data CH-High



802.11n_HT40

Spurious Emission Test Data CH-Low

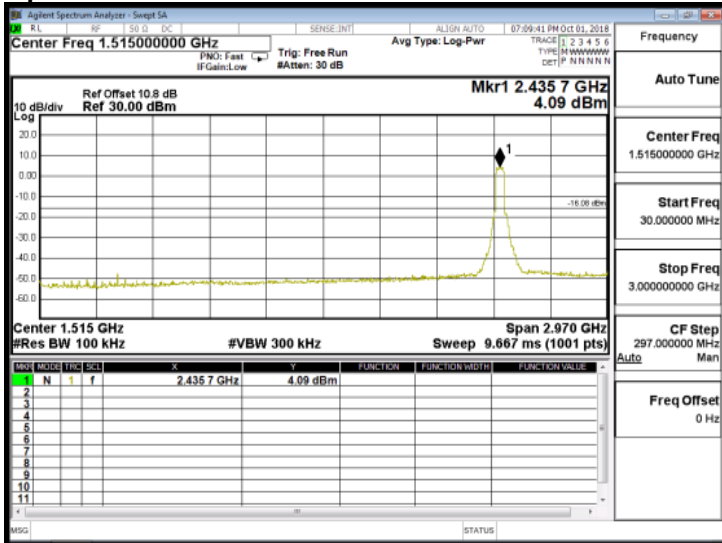


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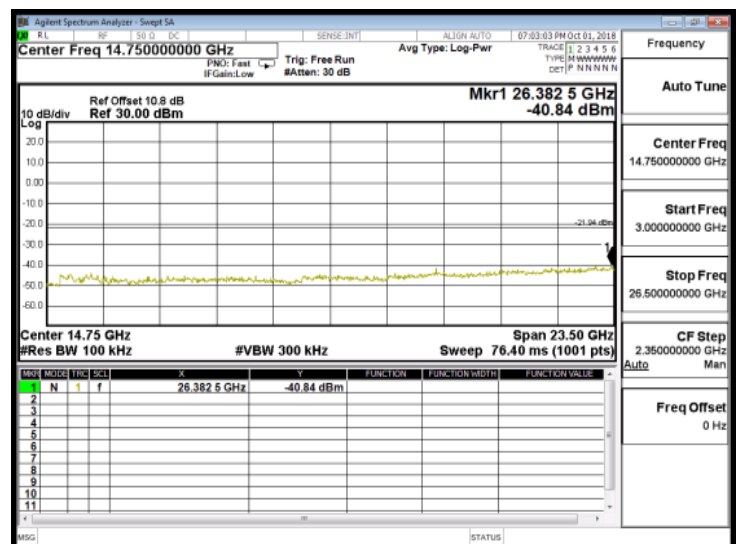
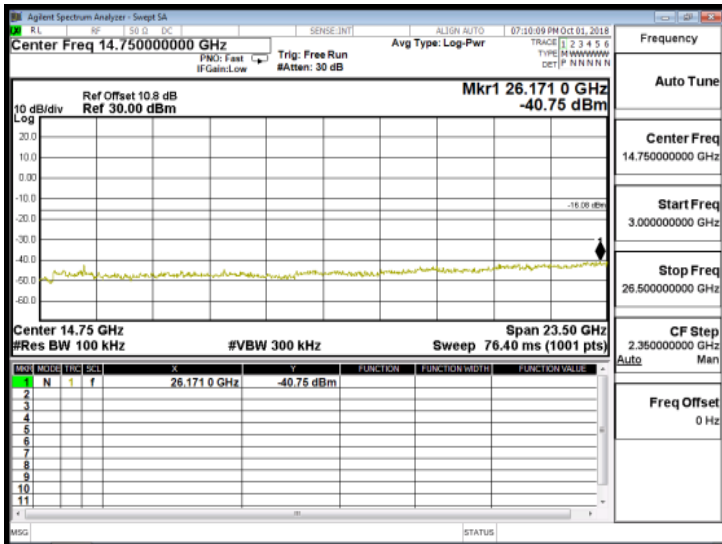
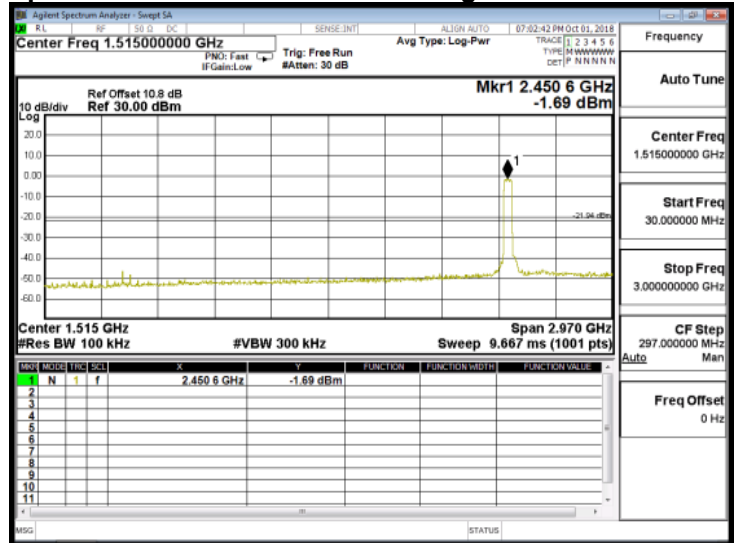
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Spurious Emission Test Data CH-Mid



Spurious Emission Test Data CH-High



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11 RADIATED BANDEDGE AND SPURIOUS EMISSION MEASUREMENT

11.1 Standard Applicable

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. In addition, radiated emissions which fall in the restricted bands must also comply with the §15.209 limit as below.

And according to §15.33(a) (1), for an intentional radiator operates below 10GHz, the frequency range of measurements: to the tenth harmonic of the highest fundamental frequency or to 40GHz, whichever is lower.

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

Note:

1. The lower limit shall apply at the transition frequencies.
2. Emission level (dBμV/m) = 20 log Emission level (dBμV/m)

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No.134,WuKungRoad,NewTaipeiIndustrialPark,WukuDistrict,NewTaipeiCity,Taiwan24803/新北市五股區新北產業園區五工路 134 號

t (886-2) 2299-3279

f (886-2) 2298-0488

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11.2 Measurement Equipment Used:

966 Chamber					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
EMI Test Receiver	R&S	ESU 40	100363	04/18/2017	04/17/2018
Loop Antenna	ETS-Lindgren	6502	00143303	12/23/2016	12/22/2017
Broadband Antenna	TESEQ	CBL 6112D	35240	11/03/2016	11/02/2017
Horn Antenna	ETS-Lindgren	3117	00143272	12/15/2016	12/16/2017
Horn Antenna	Schwarzbeck	BBHA9170	185	07/24/2017	07/23/2018
Pre Amplifier	EMC Instruments	EMC330	980096	12/12/2016	12/11/2017
Pre Amplifier	EMC Instruments	EMC0011830	980199	12/12/2016	12/11/2017
Pre Amplifier	R&S	SCU-18	10204	12/12/2016	12/11/2017
Pre Amplifier	R&S	SCU-26	100780	12/12/2016	12/11/2017
Coaxial Cable	Huber+Suhner	RG 214/U	966Rx 9K-30M	12/12/2016	12/11/2017
Coaxial Cable	Huber+Suhner	RG 214/U SUCOFLEX 104	966Rx 30M-3G	12/12/2016	12/11/2017
Coaxial Cable	Huber+Suhner	SUCOFLEX 104	966Rx 1G-18G	12/12/2016	12/11/2017
Coaxial Cable	Huber+Suhner	mini 141-12 SUCOFLEX 104	966Rx 18G-40G	12/12/2016	12/11/2017
Coaxial Cable	Huber+Suhner	SUCOFLEX 104	966Tx 30M-18G	12/12/2016	12/11/2017
Coaxial Cable	Huber+Suhner	SUCOFLEX 102	966Tx 18G-40G	12/12/2016	12/11/2017
Attenuator	WOKEN	218FS-10	RF27	12/12/2016	12/11/2017
Site NSA	SGS	966 Chamber C	SAC-C	03/02/2017	03/01/2018
Site VSWR	SGS	966 Chamber C	SAC-C	03/02/2017	03/01/2018
DC Power Supply	HOLA	DP-3003	D7070035	05/04/2017	05/03/2018
Controller	MF	MF-7802	N/A	N.C.R.	N.C.R.
Antenna Master	MF	N/A	N/A	N.C.R.	N.C.R.
Turn Table	MF	N/A	N/A	N.C.R.	N.C.R.
Test Software	World-Pallas	Dr. E	V 3.0 Lite	N.C.R.	N.C.R.

NOTE: N.C.R refers to Not Calibrated Required.

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t (886-2) 2299-3279

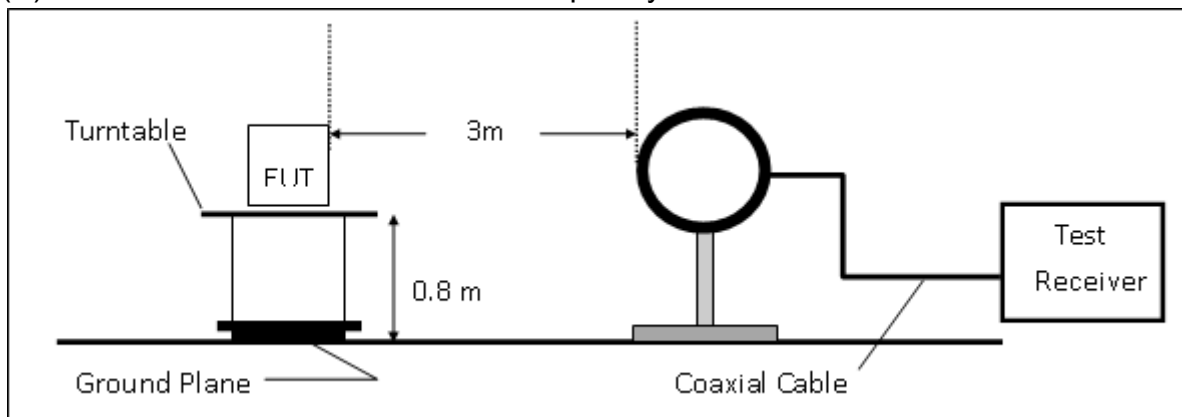
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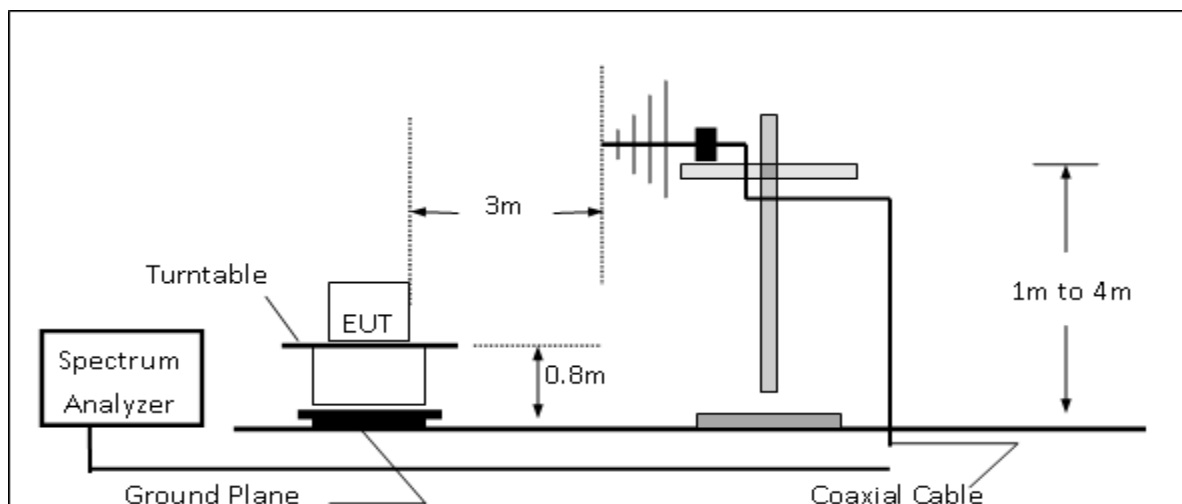
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11.3 Test SET-UP

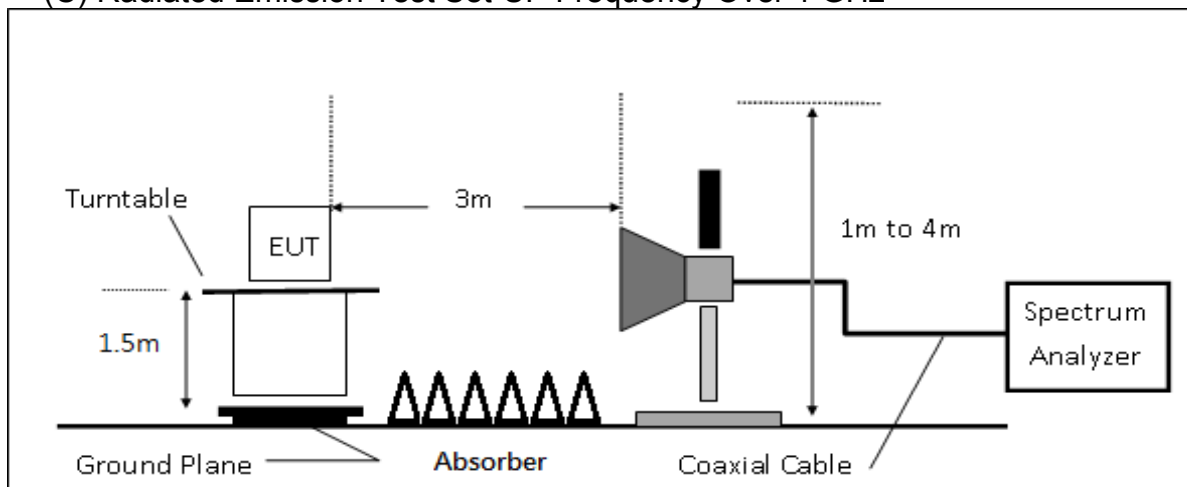
(A) Radiated Emission Test Set-UP Frequency Below 30MHz.



(B) Radiated Emission Test Set-UP, Frequency form 30MHz to 1000MHz



(C) Radiated Emission Test Set-UP Frequency Over 1 GHz



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11.4 Measurement Procedure

1. The testing follows the Measurement Procedure of FCC KDB 558074 D01 DTS Meas. Guidance & ANSI C63.10
2. The EUT was placed on a turn table with 0.8m for frequency < 1GHz and 1.5m for frequency > 1GHz above ground plane.
3. The turn table shall rotate 360 degrees to determine the position of maximum emission level.
4. EUT is set 3m away from the receiving antenna which varied from 1m to 4m to find out the highest emissions.
5. When measurement procedures for electric field radiated emissions above 1 GHz the EUT measurement is to be made "while keeping the antenna in the 'cone of radiation' from that area and pointed at the area both in azimuth and elevation, with polarization oriented for maximum response." is still within the 3dB illumination BW of the measurement antenna.
6. Set the spectrum analyzer as RBW=120 kHz and VBW=300 kHz for Peak Detector (PK) and Quasi-peak (QP) at frequency below 1 GHz.
7. Set the spectrum analyzer as RBW=1 MHz, VBW=3 MHz for Peak Detector at frequency above 1 GHz.
8. Set the spectrum analyzer as RBW=1 MHz, VBW=10 Hz (Duty cycle > 98%) or VBW $\geq 1/T$ (Duty cycle < 98%) for Average Detector at frequency above 1 GHz.
9. The test-receiver system was set to quasi-peak detect function and specified bandwidth with maximum hold mode when the test frequency is below 1 GHz.
10. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
11. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. On spectrum, change spectrum mode in linear display mode, and reduce VBW = 10Hz if average reading is measured.
12. Repeat above procedures until all default test channel measured were complete.

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11.5 Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor and subtracting the Amplifier Gain and Duty Cycle Correction Factor (if any) from the measured reading. The basic equation with a sample calculation is as follows:

$$FS = RA + AF + CL - AG$$

Where FS = Field Strength	CL = Cable Attenuation Factor (Cable Loss)
RA = Reading Amplitude	AG = Amplifier Gain
AF = Antenna Factor	

Actual FS(dBμV/m) = SPA. Reading level(dBμV) + Factor(dB)

Factor(dB) = Antenna Factor(dBμV/m) + Cable Loss(dB) – Pre_Amplifier Gain(dB)

11.6 Test Results of Radiated Spurious Emissions form 9 kHz to 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 per 15.31(o) was not reported.

11.7 Measurement Result

Note: Refer to next page spectrum analyzer data chart and tabular data sheets.

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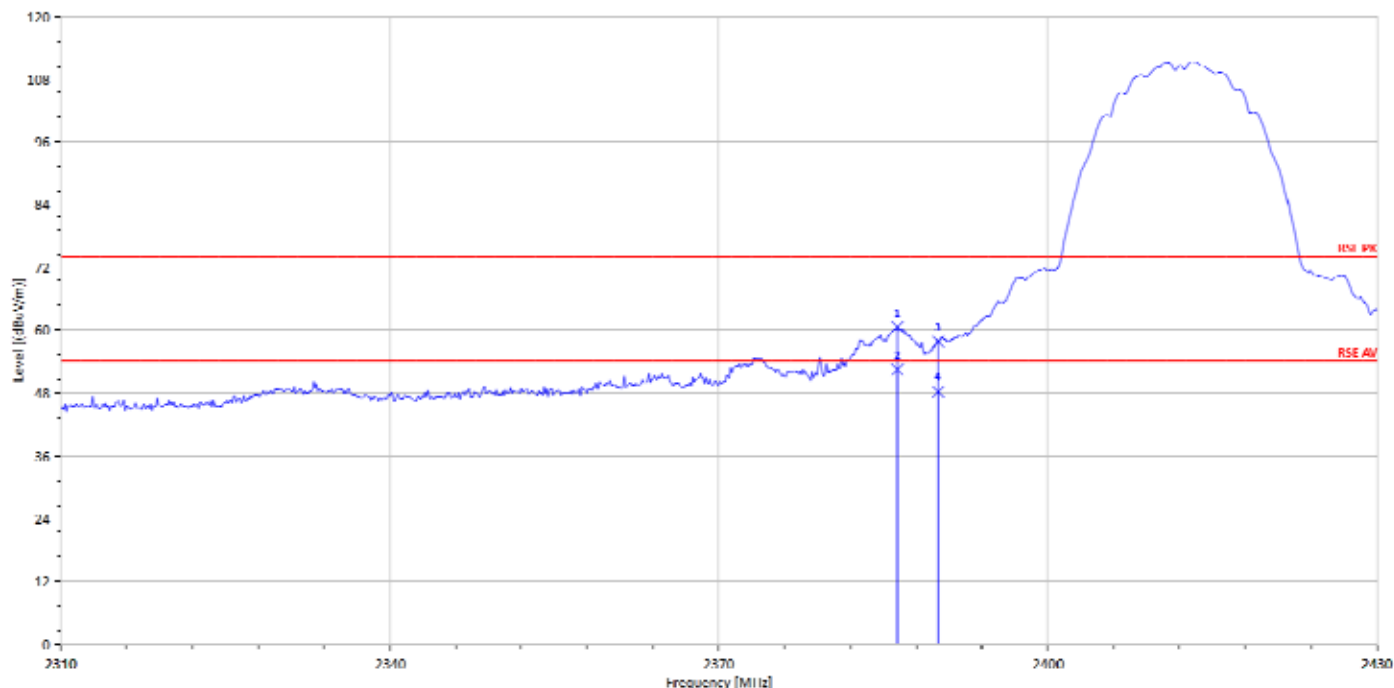
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Radiated Band Edge Measurement Result

Operation Mode :	802.11b	Test Date :	2017/7/25
Fundamental Frequency :	2412 MHz	Temp. / Humi. :	22.7deg_C/57RH
Operation Band :	BE CH Low	Test Engineer :	Enzo
EUT Pol. :	E2	Measurement Antenna Pol. :	Vertical



Freq.	Note	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	F/H/E/S	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
2386.32	S	Peak	59.66	0.87	60.53	74	-13.47
2386.32	S	Average	51.51	0.87	52.38	54	-1.62
2390.00	E	Peak	56.84	0.92	57.76	74	-16.24
2390.00	E	Average	47.38	0.92	48.30	54	-5.70

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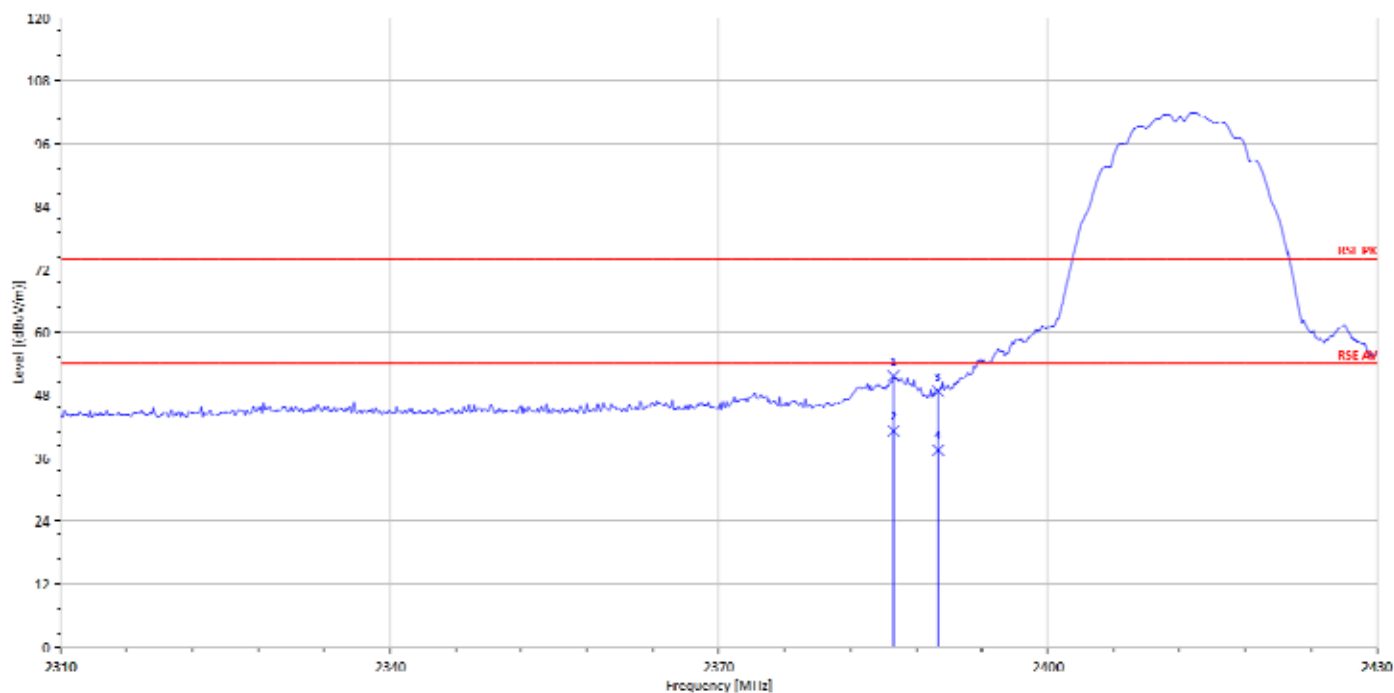
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Operation Mode : 802.11b Test Date : 2017/7/25
Fundamental Frequency : 2412 MHz Temp. / Humi. : 22.7deg_C/57RH
Operation Band : BE CH Low Test Engineer : Enzo
EUT Pol. : E2 Measurement Antenna Pol. : Horizontal



Freq.	Note	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	F/H/E/S	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
2385.96	S	Peak	50.73	0.86	51.60	74	-22.40
2385.96	S	Average	40.24	0.86	41.10	54	-12.90
2390.00	E	Peak	47.78	0.92	48.70	74	-25.30
2390.00	E	Average	36.52	0.92	37.44	54	-16.56

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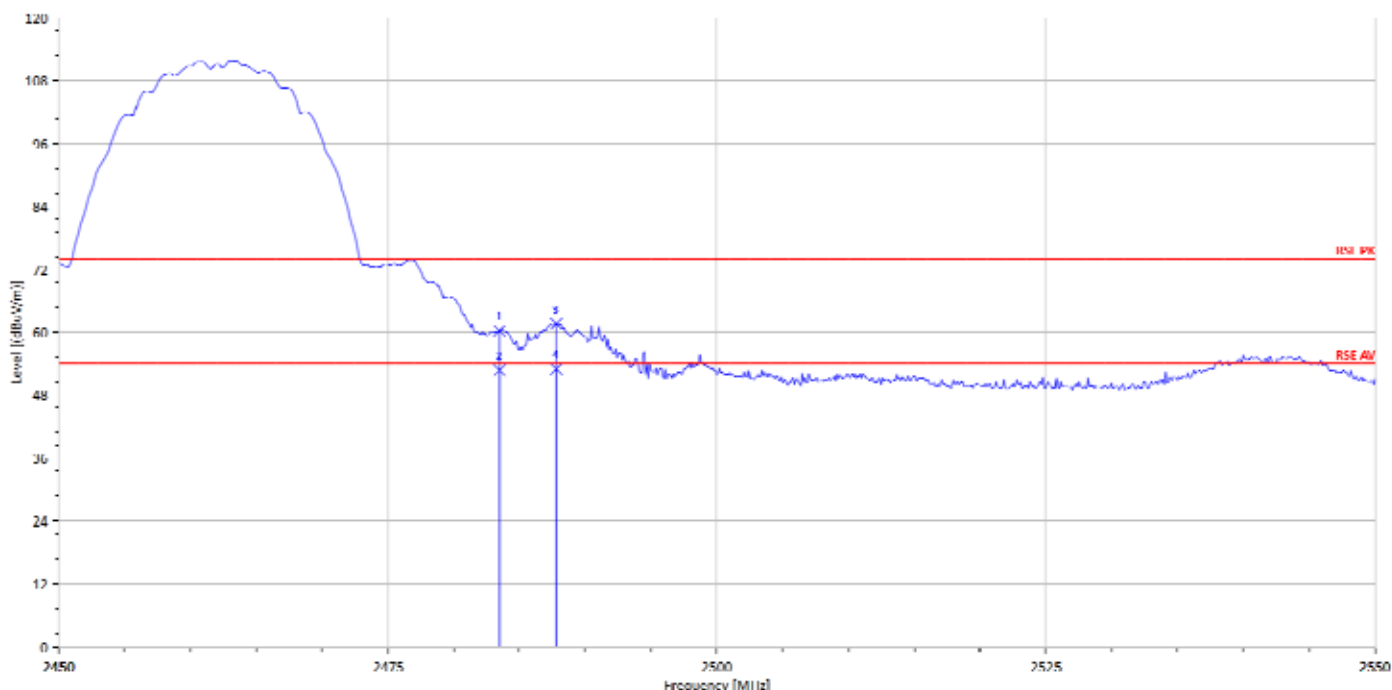
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Operation Mode : 802.11b Test Date : 2017/7/25
Fundamental Frequency : 2462 MHz Temp. / Humi. : 22.7 deg_C/57RH
Operation Band : BE CH High Test Engineer : Enzo
EUT Pol. : E2 Measurement Antenna Pol. : Vertical



Freq. MHz	Note F/H/E/S	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
2483.50	E	Peak	59.10	1.16	60.26	74	-13.74
2483.50	E	Average	51.57	1.16	52.73	54	-1.27
2487.80	S	Peak	60.44	1.15	61.59	74	-12.41
2487.80	S	Average	51.82	1.15	52.97	54	-1.03

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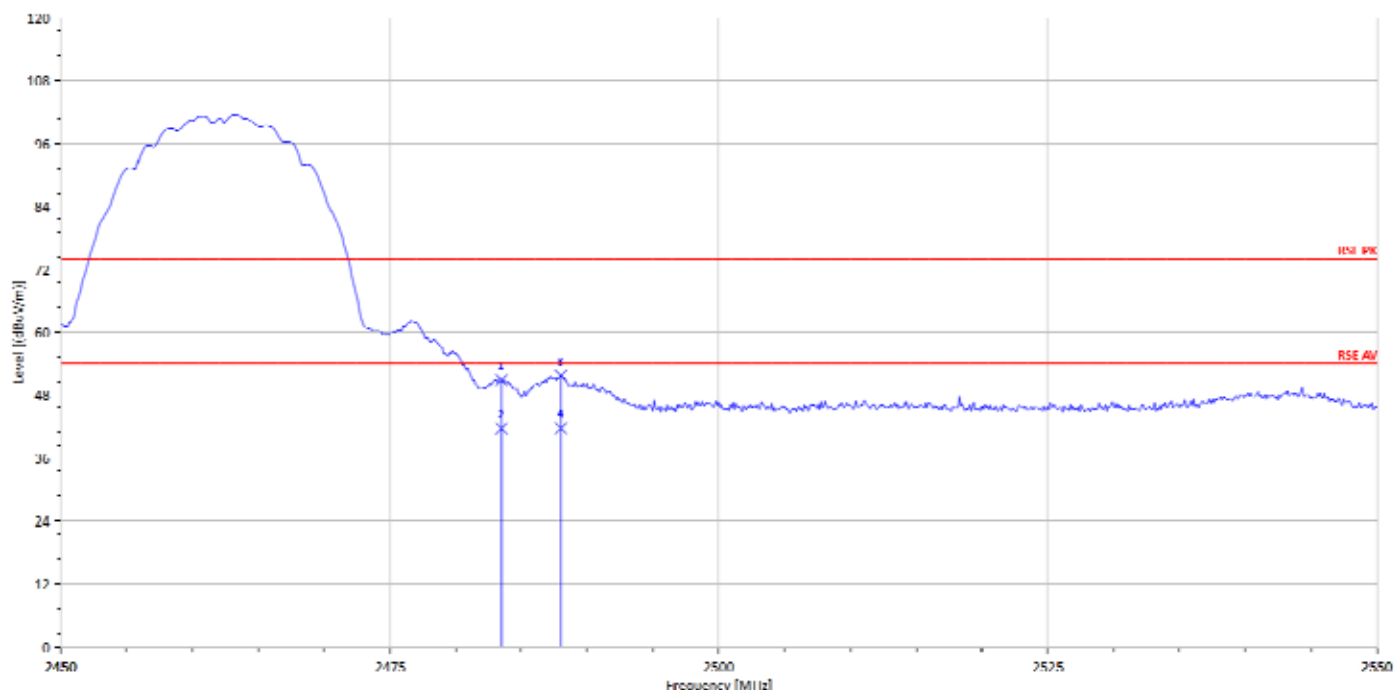
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Operation Mode :	802.11b	Test Date :	2017/7/25
Fundamental Frequency :	2462 MHz	Temp. / Humi. :	22.7 deg_C/57RH
Operation Band :	BE CH High	Test Engineer :	Enzo
EUT Pol. :	E2	Measurement Antenna Pol. :	Horizontal



Freq.	Note	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	F/H/E/S	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
2483.50	E	Peak	49.67	1.16	50.83	74	-23.17
2483.50	E	Average	40.42	1.16	41.58	54	-12.42
2488.00	S	Peak	50.54	1.15	51.69	74	-22.31
2488.00	S	Average	40.48	1.15	41.63	54	-12.37

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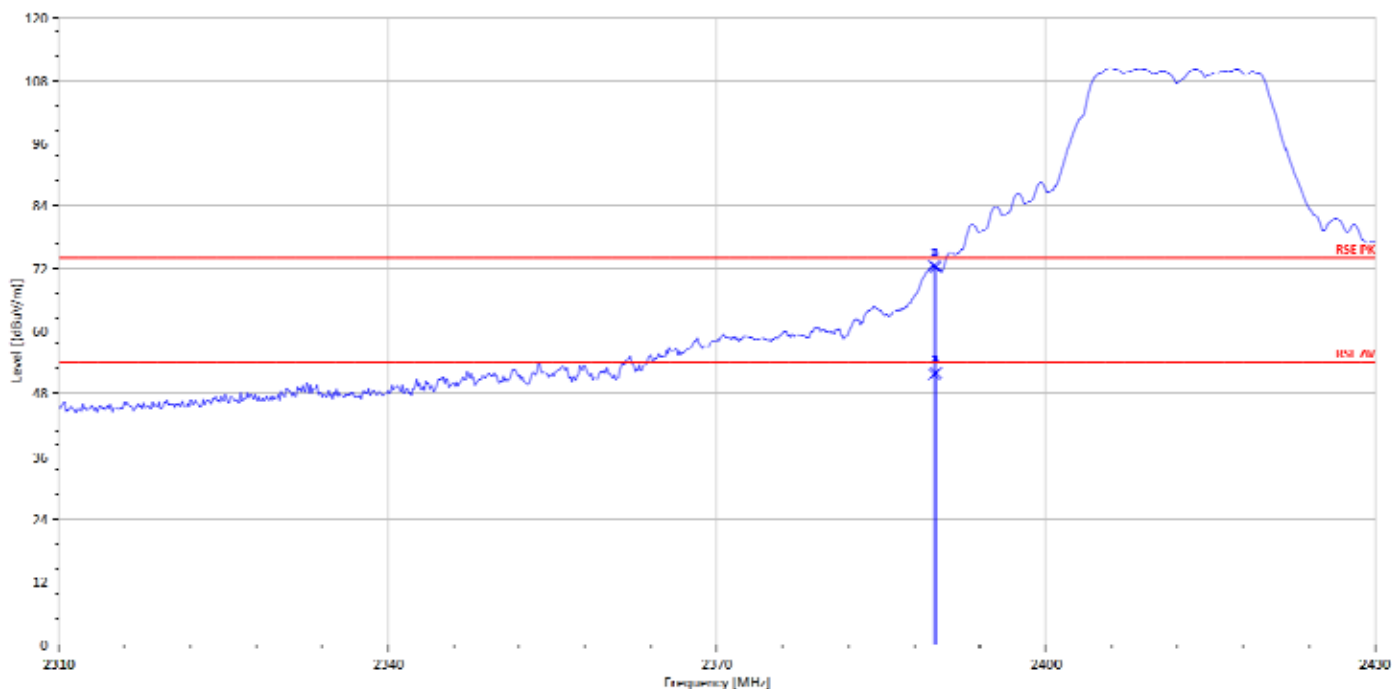
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Operation Mode :	802.11g	Test Date :	2017/7/25
Fundamental Frequency :	2412 MHz	Temp. / Humi. :	22.7deg_C/57RH
Operation Band :	BE CH Low	Test Engineer :	Enzo
EUT Pol. :	E2	Measurement Antenna Pol. :	Vertical



Freq. MHz	Note F/H/E/S	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
2389.80	S	Peak	71.47	0.92	72.39	74	-1.61
2389.80	S	Average	50.75	0.92	51.67	54	-2.33
2390.00	E	Peak	71.33	0.92	72.25	74	-1.75
2390.00	E	Average	50.96	0.92	51.88	54	-2.12

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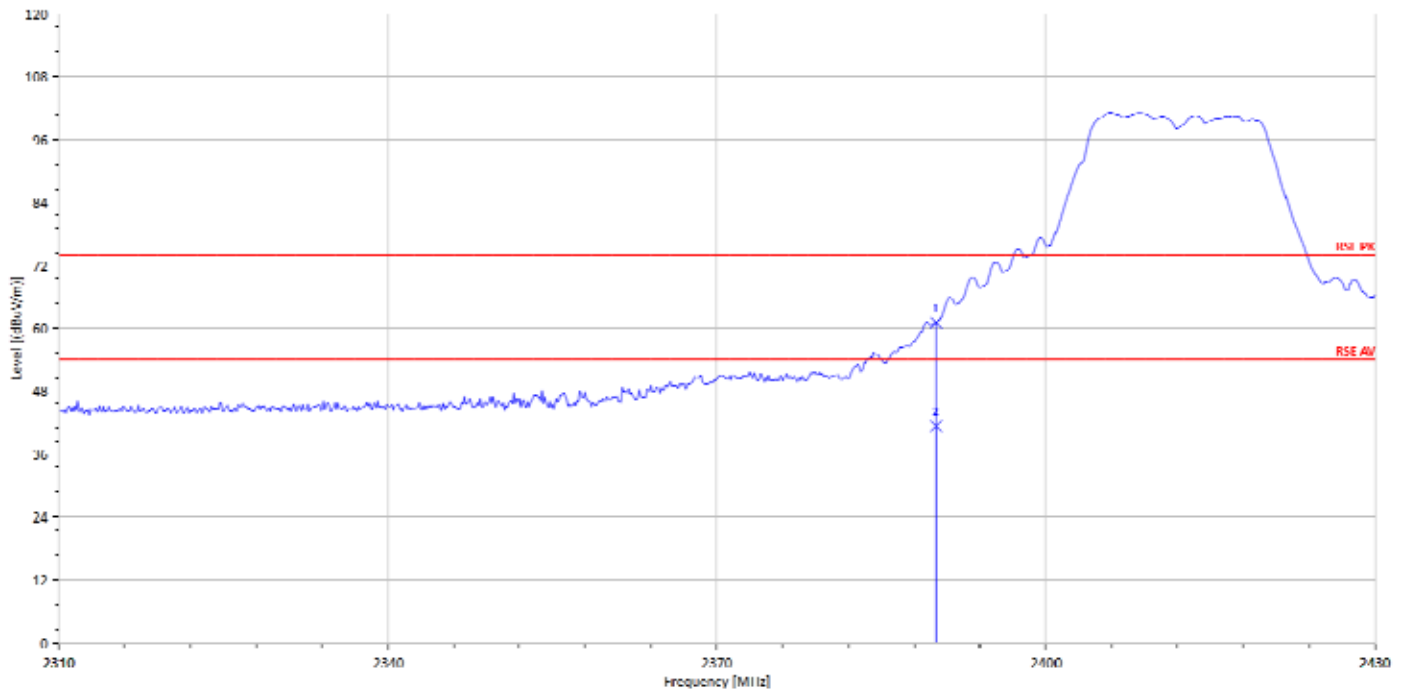
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Operation Band : BE CH Low Test Engineer : Enzo
EUT Pol. : E2 Measurement Antenna Pol. : Horizontal



Freq. MHz	Note F/H/E/S	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
2390.00	E	Peak	60.13	0.92	61.05	74	-12.95
2390.00	E	Average	40.35	0.92	41.27	54	-12.73

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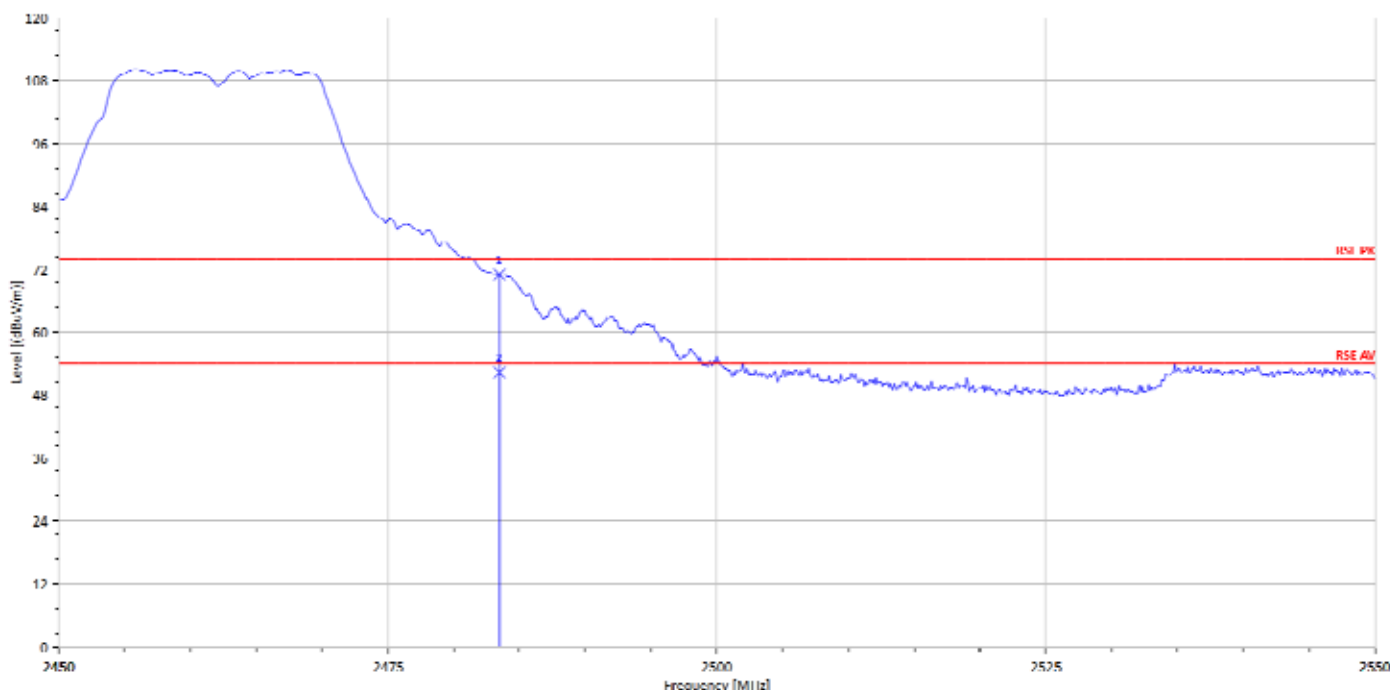
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 Operation Band : BE CH High Test Engineer : Enzo
 EUT Pol. : E2 Measurement Antenna Pol. : Vertical



Freq. MHz	Note F/H/E/S	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
2483.50	E	Peak	69.88	1.16	71.04	74	-2.96
2483.50	E	Average	51.14	1.16	52.30	54	-1.70

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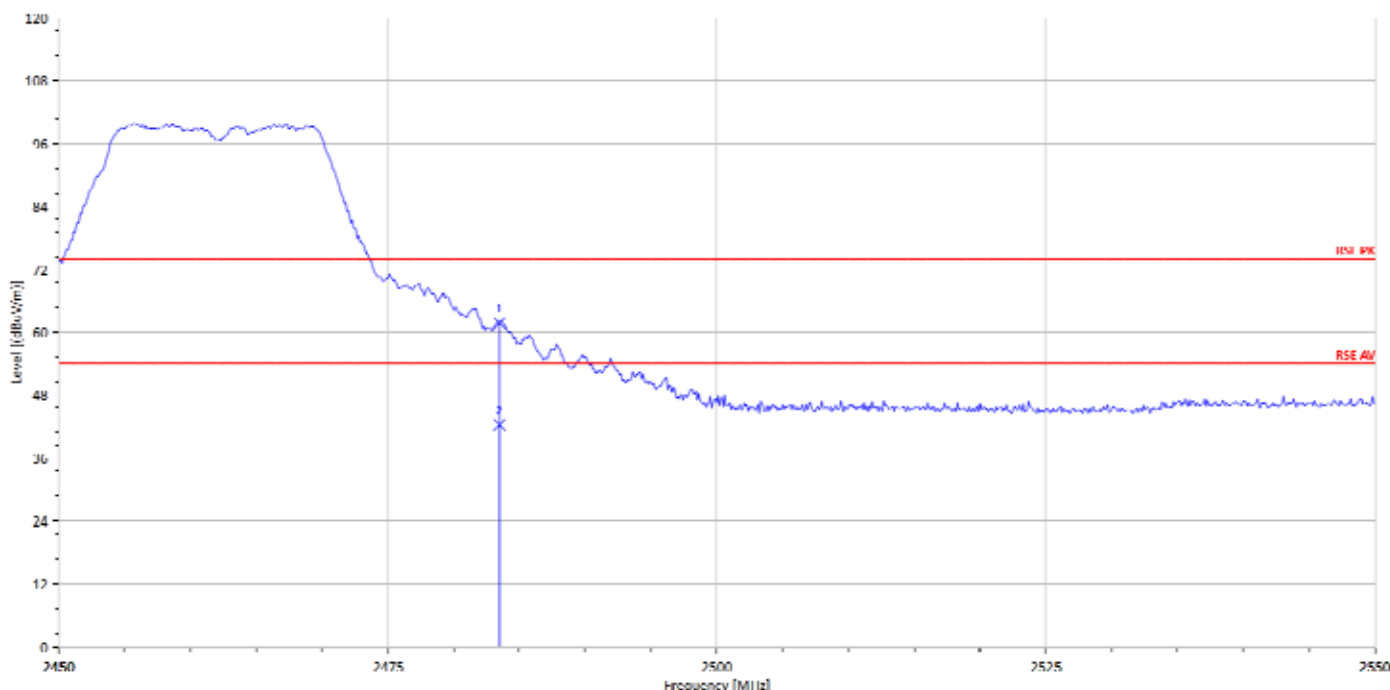
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 Operation Band : BE CH High Test Engineer : Enzo
 EUT Pol. : E2 Measurement Antenna Pol. : Horizontal



Freq. MHz	Note F/H/E/S	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
2483.50	E	Peak	60.59	1.16	61.75	74	-12.25
2483.50	E	Average	41.13	1.16	42.29	54	-11.71

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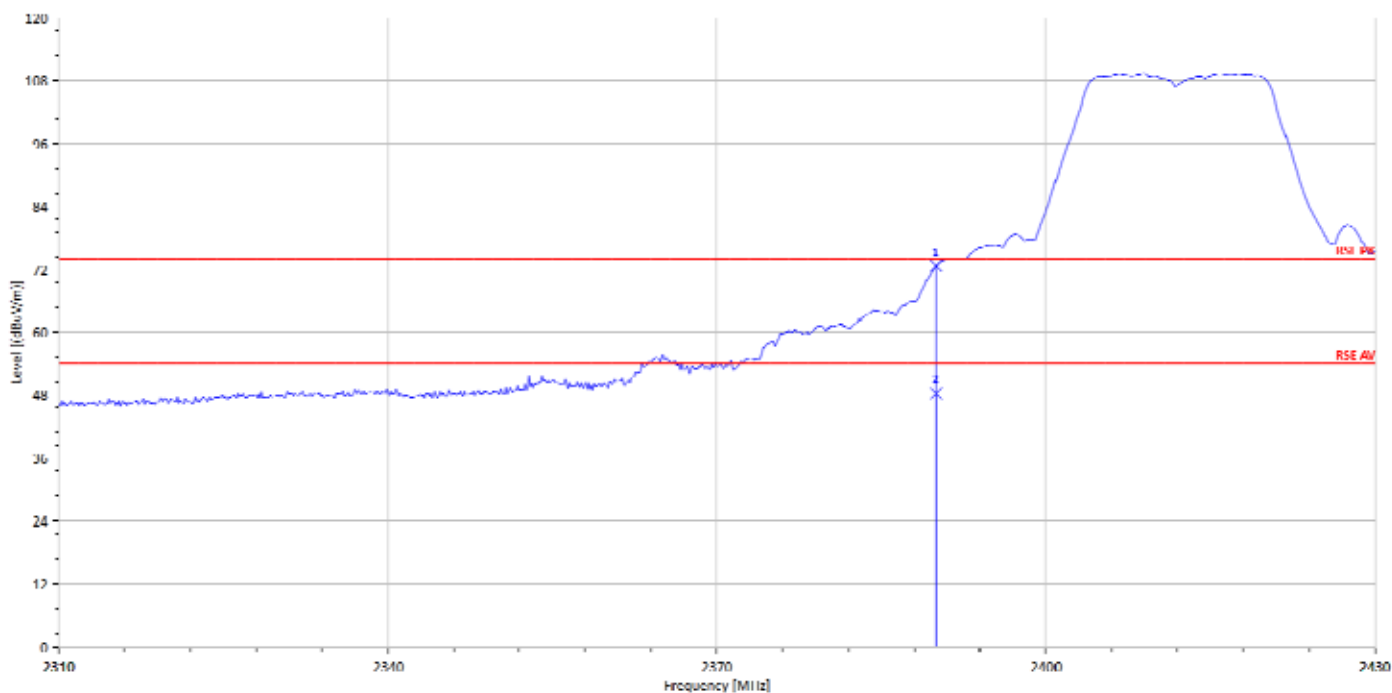
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Operation Mode : 802.11n20 Test Date : 2017/7/25
Fundamental Frequency : 2412 MHz Temp. / Humi. : 22.7deg_C/57RH
Operation Band : BE CH Low Test Engineer : Enzo
EUT Pol. : E2 Measurement Antenna Pol. : Vertical



Freq. MHz	Note F/H/E/S	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
2390.00	E	Peak	71.74	0.92	72.66	74	-1.34
2390.00	E	Average	47.34	0.92	48.26	54	-5.74

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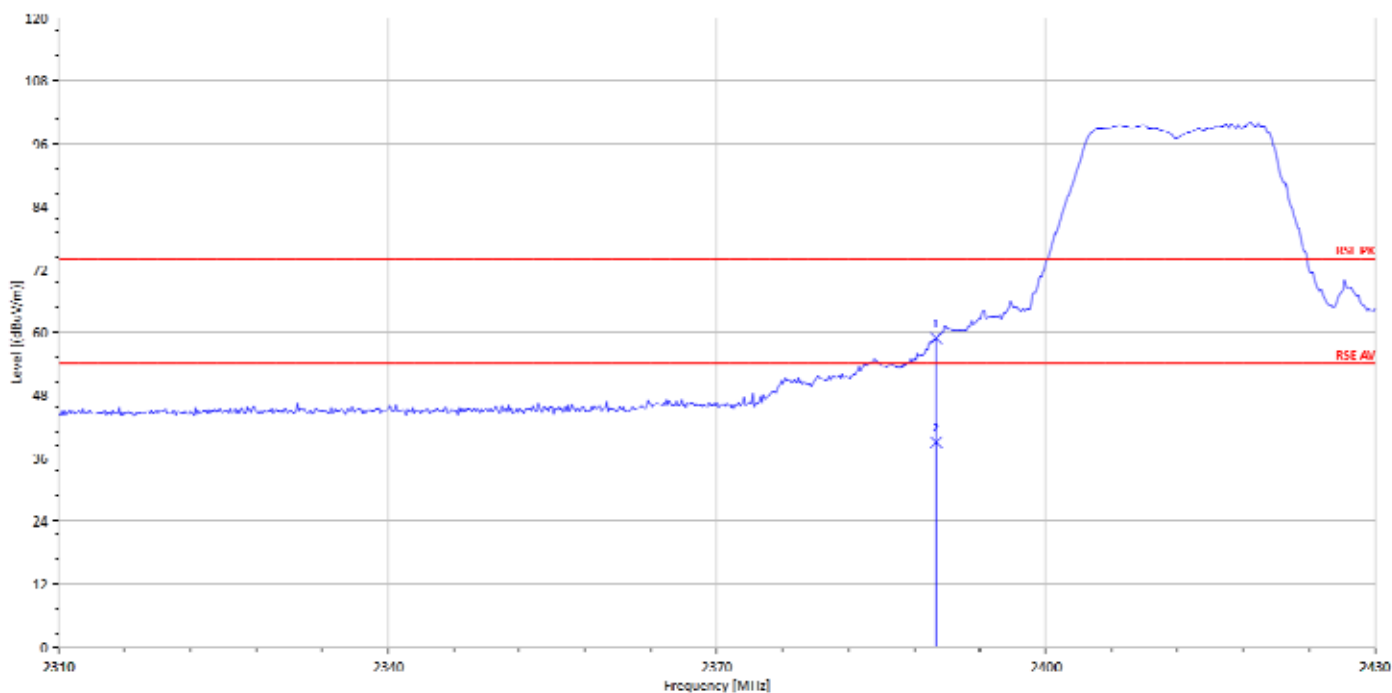
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Operation Mode :	802.11n20	Test Date :	2017/7/25
Fundamental Frequency :	2412 MHz	Temp. / Humi. :	22.7deg_C/57RH
Operation Band :	BE CH Low	Test Engineer :	Enzo
EUT Pol. :	E2	Measurement Antenna Pol. :	Horizontal



Freq. MHz	Note F/H/E/S	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
2390.00	E	Peak	57.96	0.92	58.88	74	-15.12
2390.00	E	Average	38.03	0.92	38.95	54	-15.05

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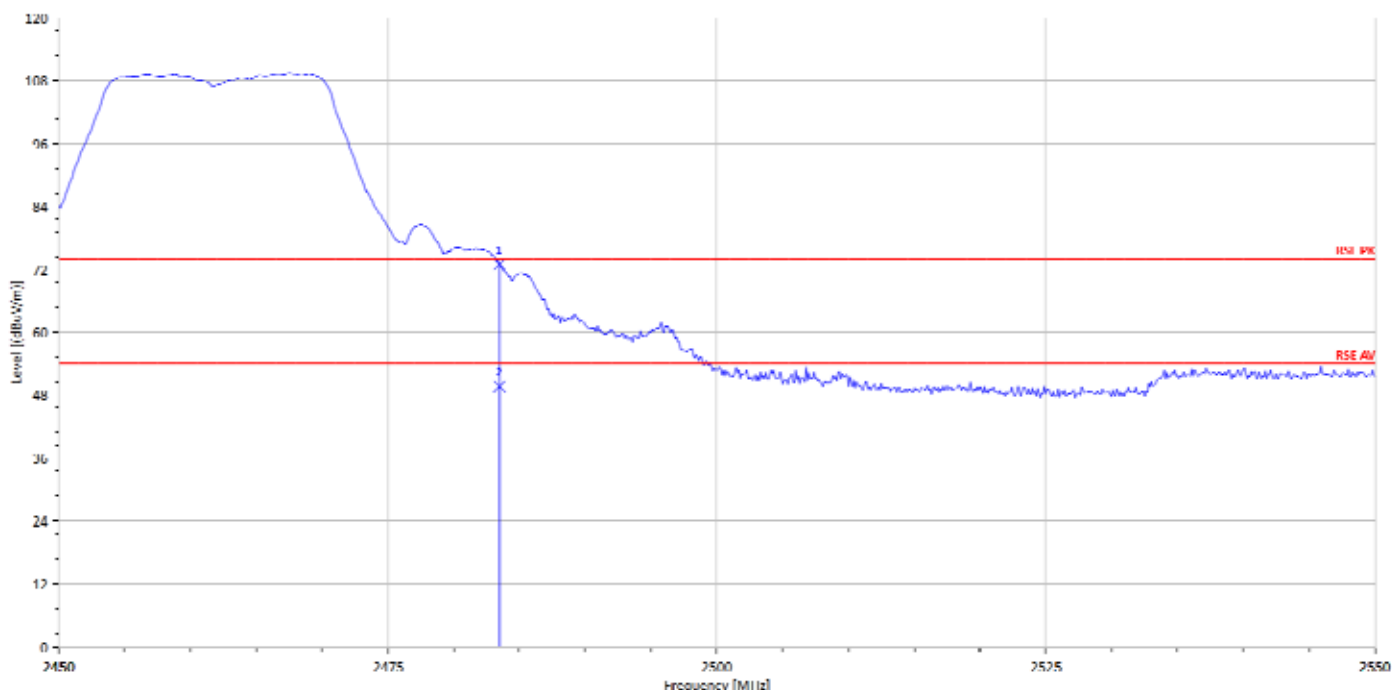
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Operation Mode : 802.11n20 Test Date : 2017/7/25
Fundamental Frequency : 2462 MHz Temp. / Humi. : 22.7 deg_C/57RH
Operation Band : BE CH High Test Engineer : Enzo
EUT Pol. : E2 Measurement Antenna Pol. : Vertical



Freq. MHz	Note F/H/E/S	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
2483.50	E	Peak	71.83	1.16	72.99	74	-1.01
2483.50	E	Average	48.46	1.16	49.62	54	-4.38

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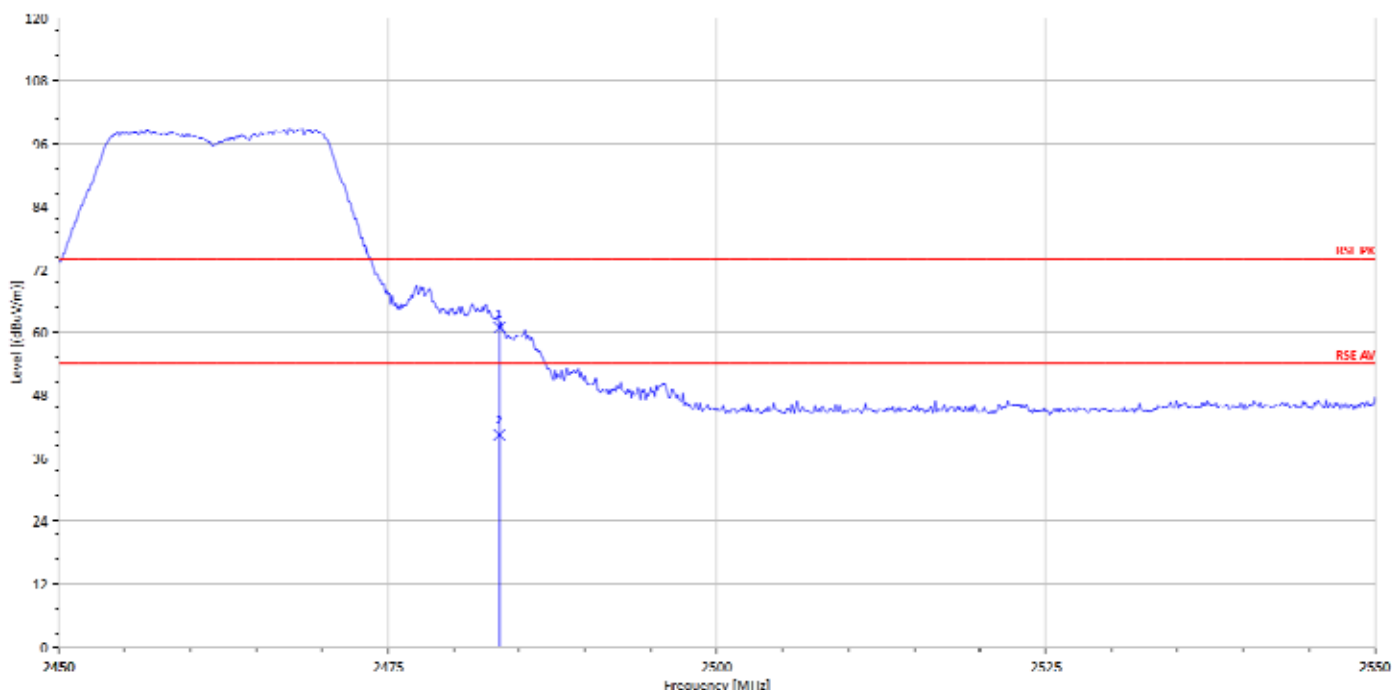
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Operation Mode : 802.11n20 Test Date : 2017/7/25
Fundamental Frequency : 2462 MHz Temp. / Humi. : 22.7 deg_C/57RH
Operation Band : BE CH High Test Engineer : Enzo
EUT Pol. : E2 Measurement Antenna Pol. : Horizontal



Freq. MHz	Note F/H/E/S	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
2483.50	E	Peak	59.73	1.16	60.89	74	-13.11
2483.50	E	Average	39.20	1.16	40.36	54	-13.64

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