

Radio Spectrum TEST REPORT

Report No.: 170300654TWN-001
Model No.: ATSFOCUS01
Issued Date: Jul. 10, 2018

Applicant: Advanced Thinking Systems Ltd.
Deepdale House, East Street, Hambledon, Hampshire, United Kingdom, PO7 4RZ

Test Method/ Standard: 47 CFR FCC Part 15.247 & ANSI C63.10 2013
KDB 558074 D01 v04
KDB 662911 D01 v02r01

Test Site: 960839

Test By: Intertek Testing Services Taiwan Ltd.,
Hsinchu Laboratory
No. 11, Lane 275, Ko-Nan 1 Street, Chia-Tung Li,
Shiang-Shan District, Hsinchu City, Taiwan

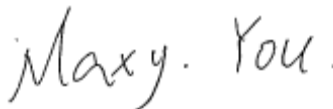
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Revision History

Report No.	Issue Date	Revision Summary
170300654TWN-001	Jul. 10, 2018	Original report

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Summary of Test Data

Test Requirement	Applicable Rule (Section 15.247)	Result
Minimum 6 dB Bandwidth	15.247(a)(2)	Pass
Maximum Peak Conducted Output Power	15.247(b)(3)	Pass
Power Spectral Density	15.247(e)	Pass
Emissions In Non-Restricted Frequency Bands	15.247(d)	Pass
Emissions In Restricted Frequency Bands (Radiated emission measurements)	15.247(d), 15.205, 15.209	Pass
Emission On The Band Edge	15.247(d), 15.205	Pass
AC Power Line Conducted Emission	15.207	Pass
Antenna Requirement	15.203	Pass

1. General information

1.1. Identification of the EUT

Product:	Multimedia Player
Model No.:	ATSFOCUS01
Operating Frequency:	2412 MHz ~ 2462 MHz for 802.11b, 802.11g, 802.11n HT20
Channel Number:	11 channels for 2412 MHz ~ 2462 MHz
Frequency of Each Channel:	2412+5 k, k = 0 ~ 10 for 802.11b, 802.11g, 802.11n HT20
Access scheme:	DSSS, OFDM
Rated Power:	1. DC 3.7 V from battery 2. DC 5 V from USB for charging
Power Cord:	N/A
Sample Received:	Mar. 17, 2017
Test Date(s):	June. 28, 2017 ~ July. 26, 2017 & Jul. 04, 2018

Note 1: The test report only allows to be revised within three years from its original issued date unless further standard or the requirement was noticed.

Note 2: When determining the test conclusion, the Measurement Uncertainty of test has been considered.

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1.2. Description of the EUT

Modulation mode	Transmit path	
	Chain 0 / Main	Chain 1 / AUX
802.11b	V	X
802.11g	V	X
802.11n (HT20)	V	X

1.3. Antenna description

The EUT uses a permanently connected antenna.

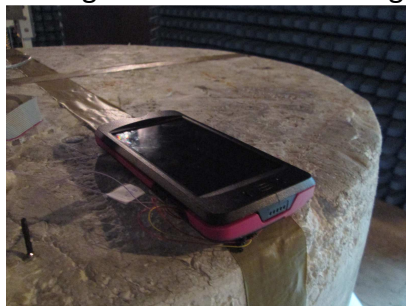
Antenna Gain : 2 dBi
Antenna Type : chip antenna
Connector Type : Fixed

1.4. Operation mode

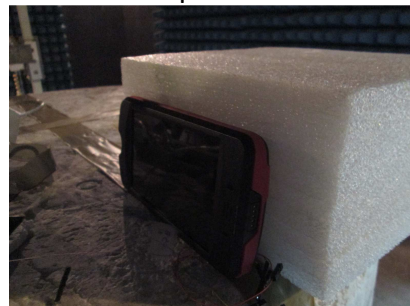
The EUT was supplied with DC 3.7 V from battery.

TX-MODE is based on a specific test program “UniTest”, and the program can select different frequency and modulation.

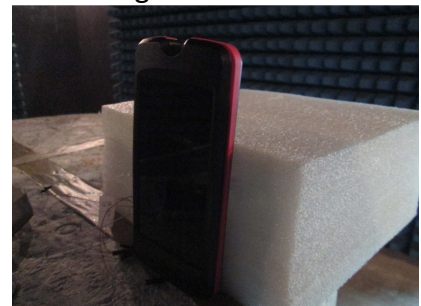
The signal is maximized through rotation and placement in the three orthogonal axes.



X axis



Y axis



Z axis

After verifying three axes, we found the maximum electromagnetic field was occurred at X axis. The final test data was executed under this configuration.

With individual verifying, the maximum output power were found out 1 Mbps data rate for 802.11b mode, 6 Mbps data rate for 802.11g mode and, 6.5 Mbps data rate for 802.11n(HT20) mode the final tests were executed under these conditions recorded in this report individually.

Mode	Channel	Data rate(Mbps)	AV Power(dBm)
802.11b	ch6	1	15.66
802.11b	ch6	2	15.53
802.11b	ch6	5.5	15.47
802.11b	ch6	11	15.36
802.11g	ch6	6	10.22
802.11g	ch6	9	10.19
802.11g	ch6	12	10.11
802.11g	ch6	18	10.03
802.11g	ch6	24	9.89
802.11g	ch6	36	9.81
802.11g	ch6	48	9.82
802.11g	ch6	54	9.67
802.11n(HT20)	ch6	MCS0	10.25
802.11n(HT20)	ch6	MCS1	10.20
802.11n(HT20)	ch6	MCS2	10.03
802.11n(HT20)	ch6	MCS3	9.86
802.11n(HT20)	ch6	MCS4	9.67
802.11n(HT20)	ch6	MCS5	9.58
802.11n(HT20)	ch6	MCS6	9.61
802.11n(HT20)	ch6	MCS7	9.54

1.5. Applied test modes and channels

Test items	Mode	Data Rate (Mbps)	Channel	Antenna
Maximum Conducted Output Power	802.11b	1	1,6,11	Chain0
	802.11g	6	1,6,11	Chain0
	802.11n (HT20)	6.5	1,6,11	Chain0
Power Spectrum Density	802.11b	1	1,6,11	Chain0
	802.11g	6	1,6,11	Chain0
	802.11n (HT20)	6.5	1,6,11	Chain0
Emission BW	802.11b	1	1,6,11	Chain0
	802.11g	6	1,6,11	Chain0
	802.11n (HT20)	6.5	1,6,11	Chain0
Radiated spurious Emission 9kHz~1GHz	Worst Case			
Emissions In Restricted Frequency Bands (Radiated emission measurements)	802.11b	1	1,6,11	Chain0
	802.11g	6	1,6,11	Chain0
	802.11n (HT20)	6.5	1,6,11	Chain0
Emission on The Band Edge	802.11b	1	1,6,11	Chain0
	802.11g	6	1,6,11	Chain0
	802.11n (HT20)	6.5	1,6,11	Chain0
AC Line Conducted Emission	Normal Link			

1.6. Power setting of test software

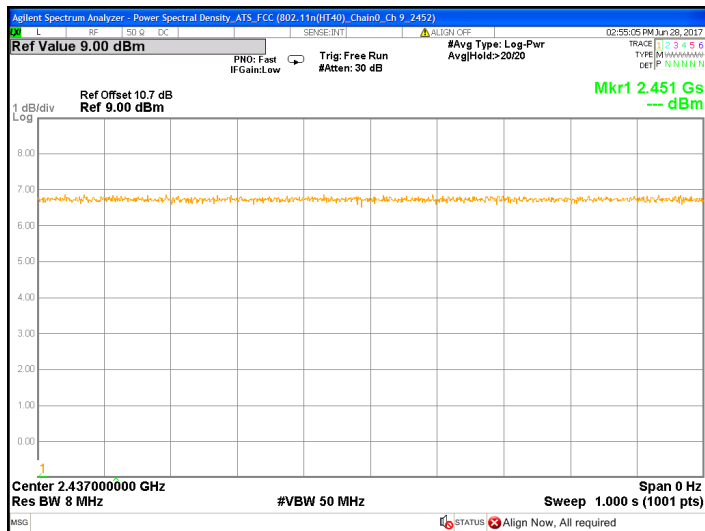
Channels & power setting software provided by the client was used to change the operating channels as well as the output power level and is going to be installed in the final end product.

Test software: UniTest			
Mode	Channel	Frequency	Power setting (Chain0)
802.11b	1	2412	63
	6	2437	63
	11	2462	63
802.11g	1	2412	63
	6	2437	63
	11	2462	63
802.11n (HT 20)	1	2412	63
	6	2437	63
	11	2462	63

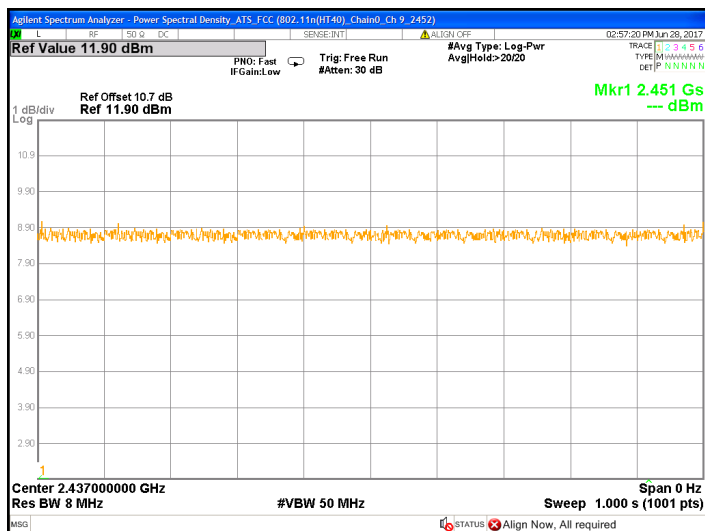
Note: The EUT was programmed to be in continuously transmitting mode and the transmit duty cycle is not less than 98%.

Mode	Chain	Channel	Frequency (MHz)	Data rate (Mbps)	Signal on time(s)	Total signal transmit time(s)	Duty cycle	Duty Cycle factor
802.11b	Chain 0	6	2437	1	1.00	1.00	1.00	0.00
802.11g	Chain 0	6	2437	6	1.00	1.00	1.00	0.00
802.11n (HT20)	Chain 0	6	2437	6.5	1.00	1.00	1.00	0.00

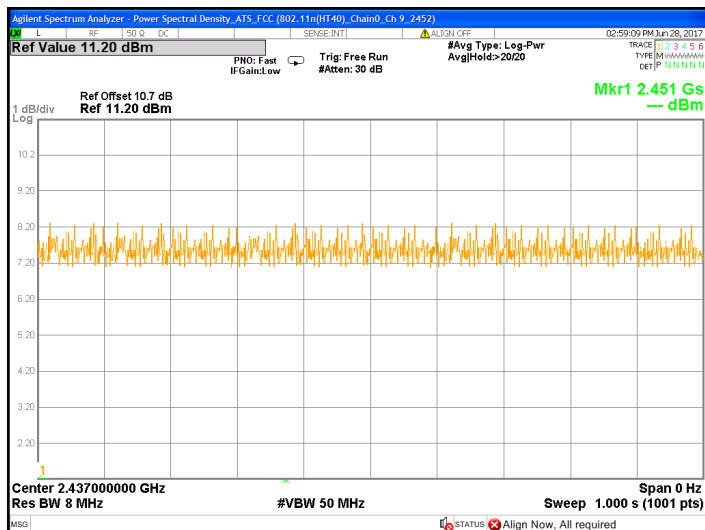
Chain0 : Ducty Cycle @ 802.11b Mode Ch6



Chain0 : Ducty Cycle @ 802.11g Mode Ch6



Chain0 : Ducty Cycle @ 802.11n(HT20) Mode Ch6



1.7. Peripherals equipment

Peripherals	Brand	Model No.	Serial No.	Data cable
Notebook PC	DELL	Latitude D610	2YWZK1S	RS232 0.5 meter × 1

2. Minimum 6 dB Bandwidth

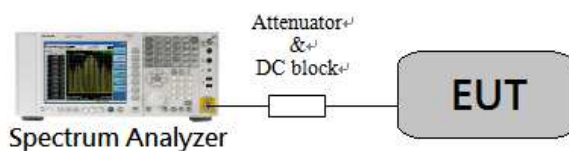
2.1. Instrument Setting

Spectrum Parameter	Setting
Detector	Peak
RBW	100kHz
VBW	$\geq 3 \times \text{RBW}$
Sweep	Auto couple
Trace	Allow the trace to stabilize.
Span	Between two times and five times the occupied bandwidth
Attenuation	Auto

2.2. Test Procedure

- Step 1 The transmitter output was connected to the spectrum analyzer.
- Step 2 Test was performed in accordance with clause 8.1 option1 of KDB 558074 D01.
- Step 3 Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission

2.3. Test Diagram



2.4. Limit

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

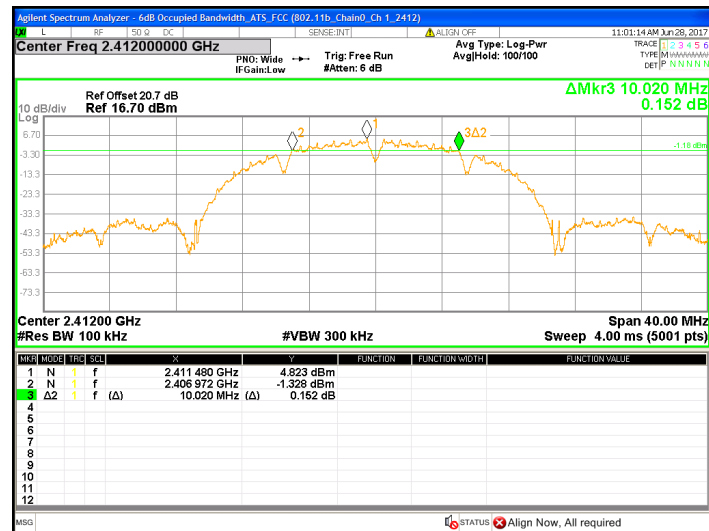
2.5. Operating Environment Condition

Temperature (°C) : 25
 Relative Humidity (%) : 50
 Atmospheric Pressure (hPa) : 1008
 Test Date : 6/28/2017

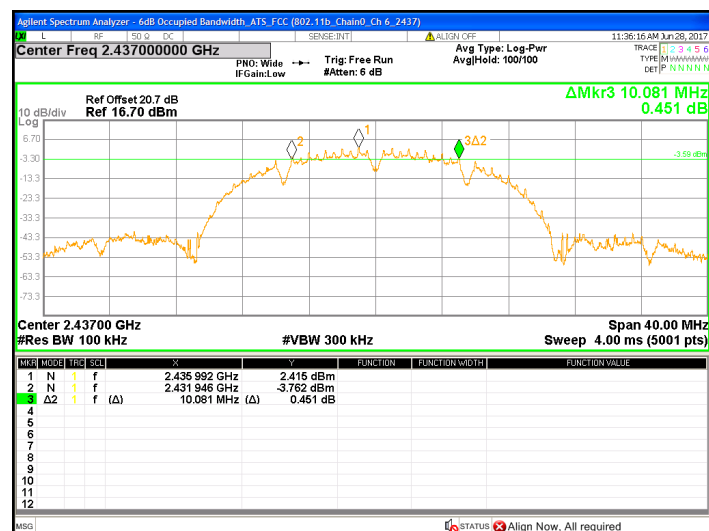
2.6. Test Results

Mode	Chain	Ch	Freq.(MHz)	6dB BW(MHz)	Limit(MHz)
802.11b	Chain0	1	2412	10.020	>0.5
802.11b	Chain0	6	2437	10.081	>0.5
802.11b	Chain0	11	2462	9.592	>0.5
802.11g	Chain0	1	2412	16.307	>0.5
802.11g	Chain0	6	2437	16.094	>0.5
802.11g	Chain0	11	2462	16.091	>0.5
802.11n (HT20)	Chain0	1	2412	16.933	>0.5
802.11n (HT20)	Chain0	6	2437	16.929	>0.5
802.11n (HT20)	Chain0	11	2462	17.008	>0.5

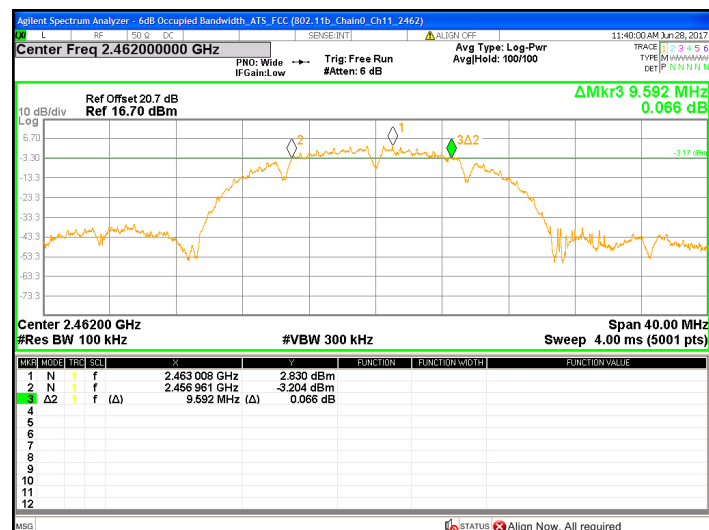
Chain0 : 6dB Bandwidth @ 802.11b Mode Ch 1



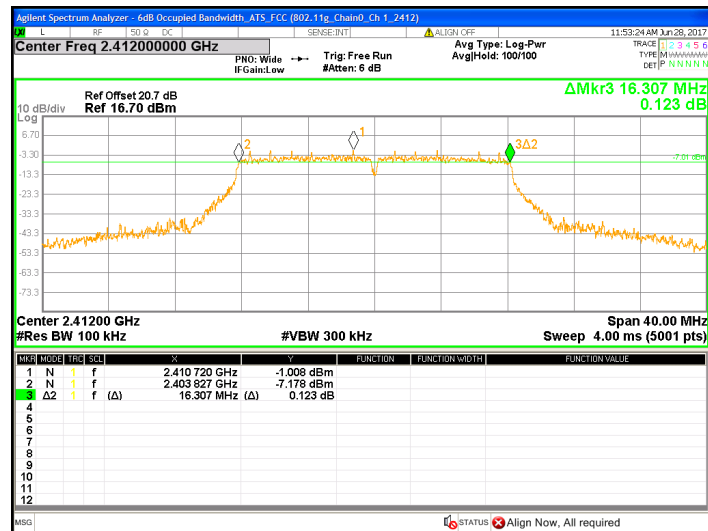
Chain0 : 6dB Bandwidth @ 802.11b Mode Ch 6



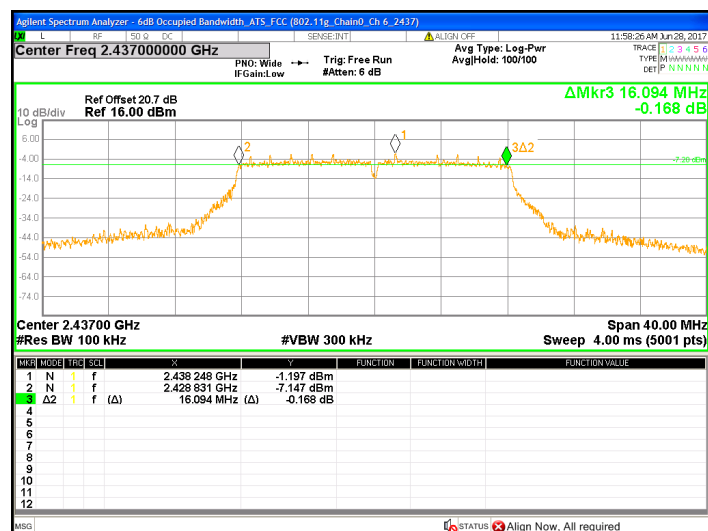
Chain0 : 6dB Bandwidth @ 802.11b Mode Ch11



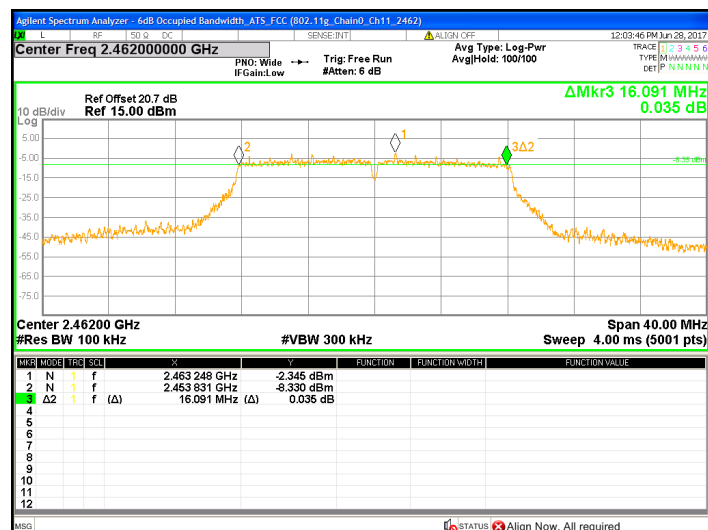
Chain0 : 6dB Bandwidth @ 802.11g Mode Ch 1



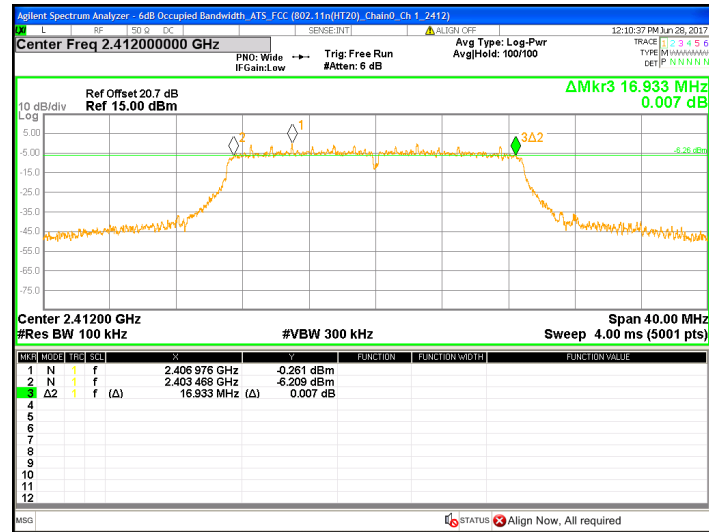
Chain0 : 6dB Bandwidth @ 802.11g Mode Ch 6



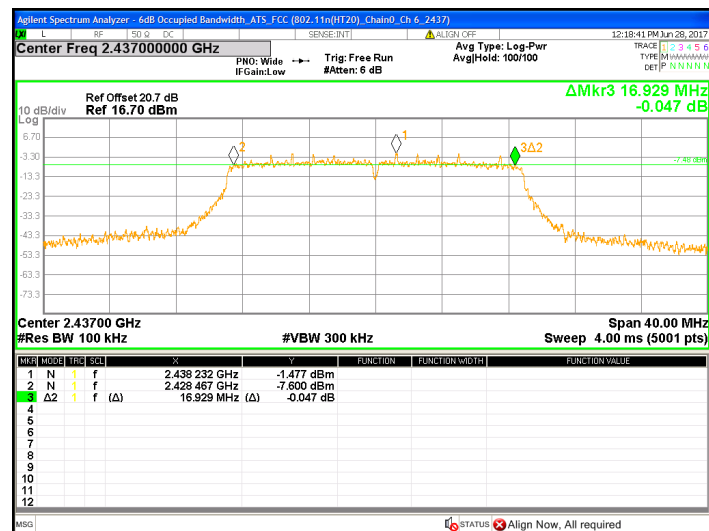
Chain0 : 6dB Bandwidth @ 802.11g Mode Ch11



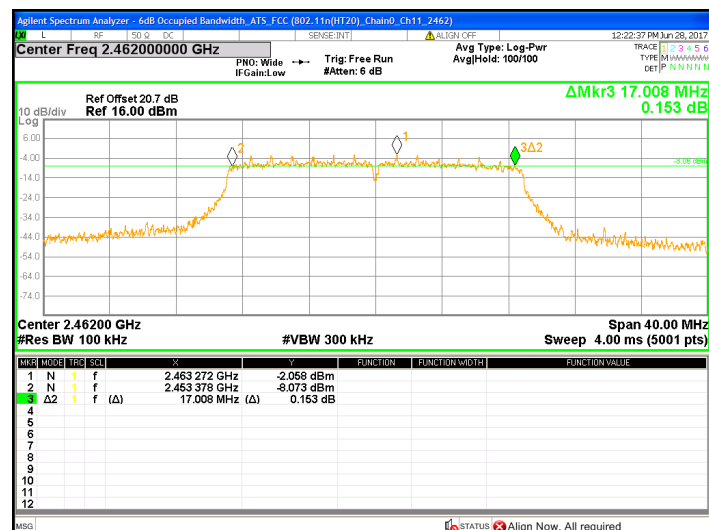
Chain0 : 6dB Bandwidth @ 802.11n(HT20) Mode Ch 1



Chain0 : 6dB Bandwidth @ 802.11n(HT20) Mode Ch 6



Chain0 : 6dB Bandwidth @ 802.11n(HT20) Mode Ch11



3. Maximum Peak Conducted Output Power

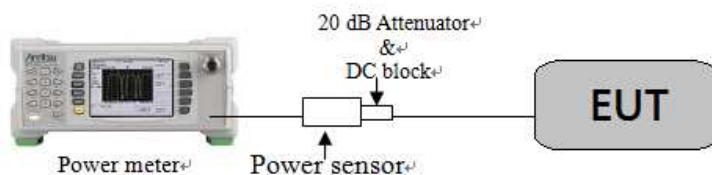
3.1. Instrument Setting

Power Meter Parameter	Setting
Bandwidth	65MHz bandwidth is greater than the EUT emission bandwidth
Detector	Peak & Average

3.2. Test Procedure

Test procedures refer to clause 9.1.3 peak power meter method and clause 9.2.3.2 measurement using a gated RF average power meter of KDB 558074 D01.

3.3. Test Diagram



3.4. Limit

For systems using digital modulation in the 2400-2483.5 MHz: 1 Watt (30dBm)

3.5. Operating Environment Condition

Temperature (°C) : 25
Relative Humidity (%) : 50
Atmospheric Pressure (hPa) : 1008
Test Date : 7/24/2017

3.6. Test Results

Mode	Chain	Channel	Pk Output Power (dBm)	Pk Output Power (mW)	Av Output Power (dBm)	Av Output Power(mw)	Limit (dBm)	Margin (dB)
802.11b	Chain0	1	18.10	64.57	15.00	31.62	30.00	-11.90
802.11b	Chain0	6	18.60	72.44	15.66	34.26	30.00	-11.40
802.11b	Chain0	11	16.90	48.98	14.48	31.38	30.00	-13.10
802.11g	Chain0	1	13.40	21.88	10.40	23.80	30.00	-16.60
802.11g	Chain0	6	13.20	20.89	10.22	23.42	30.00	-16.80
802.11g	Chain0	11	12.10	16.22	9.61	21.71	30.00	-17.90
802.11n (HT20)	Chain0	1	12.40	17.38	10.40	22.80	30.00	-17.60
802.11n (HT20)	Chain0	6	12.20	16.60	10.25	22.45	30.00	-17.80
802.11n (HT20)	Chain0	11	11.10	12.88	9.11	20.21	30.00	-18.90

4. Power Spectral Density

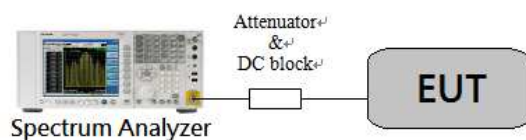
4.1. Instrument Setting

Spectrum Function	Setting
Detector	Peak
RBW	≥ 3 kHz
VBW	$\geq 3 \times$ RBW
Sweep	Auto couple
Trace	Max hold
Span	1.5 times x 6dB bandwidth
Attenuation	Auto

4.2. Test Procedure

- Step 1 Test procedure refer to clause 10.2 method PKPSD (peak PSD) of KDB 558074 D01 and clause E) 2) c) of KDB 662911 D01 measure and sum spectral maxima across the outputs.
- Step 2 Using the maximum conducted output power in the fundamental emission demonstrates compliance. The EUT must be configured to transmit continuously at full power over the measurement duration.
- Step 3 Use the peak marker function to determine the maximum amplitude level within the RBW.

4.3. Test Diagram



4.4. Limit

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

4.5. Operating Environment Condition

Temperature (°C) : 25
 Relative Humidity (%) : 50
 Atmospheric Pressure (hPa) : 1008
 Test Date : 6/28/2017

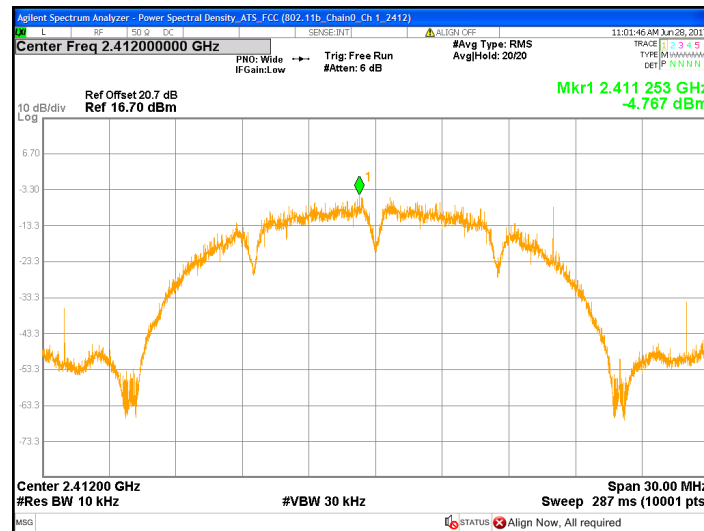
4.6. Test Results

Mode	Channel	Freq.(MHz)	RBW factor (dB)	PSD in 10 kHz (dBm)	PSD in 3 kHz (dBm)	Limit (dBm)	PSD (dBm)
802.11b	1	2412	5.229	-4.767	-9.996	8	-17.996
802.11b	6	2437	5.229	-0.427	-5.656	8	-13.656
802.11b	11	2462	5.229	3.451	-1.778	8	-9.778
802.11g	1	2412	5.229	-9.2	-14.429	8	-22.429
802.11g	6	2437	5.229	-10.951	-16.18	8	-24.18
802.11g	11	2462	5.229	-10.625	-15.854	8	-23.854
802.11n(HT20)	1	2412	5.229	-8.441	-13.67	8	-21.67
802.11n(HT20)	6	2437	5.229	-11.115	-16.344	8	-24.344
802.11n(HT20)	11	2462	5.229	-10.646	-15.875	8	-23.875

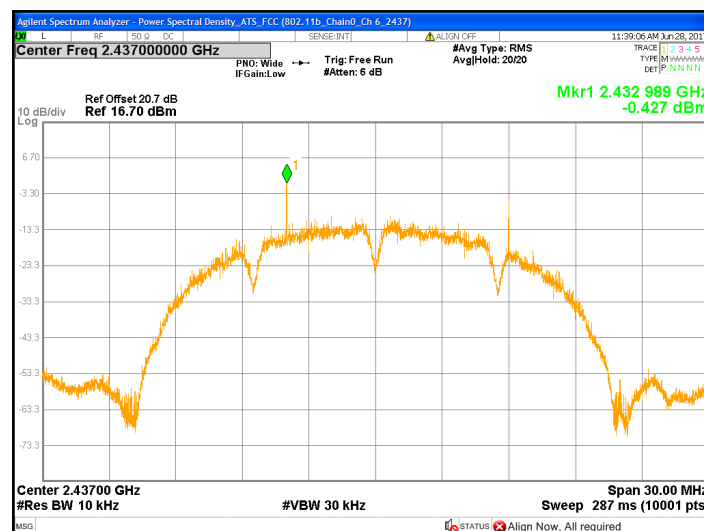
Note1: RBW Correction = $10 \cdot \log(10\text{kHz}/3\text{kHz}) = 5.229$

Note2: PSD in 3kHz = PSD in 10kHz – RBW Correction

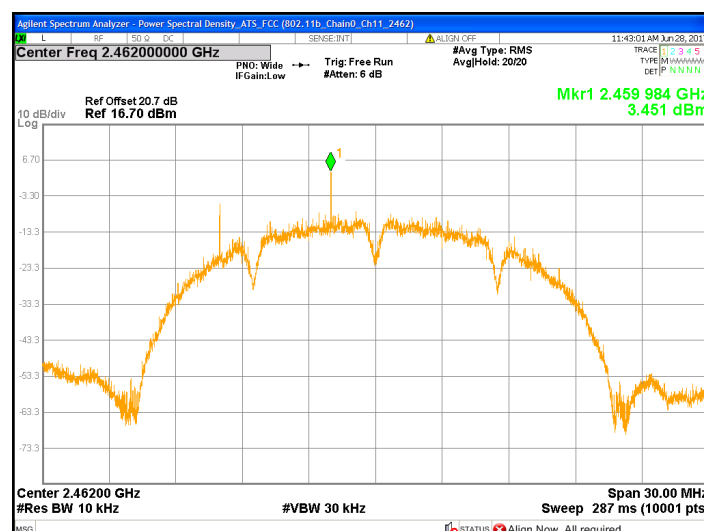
Chain0 : Power Spectral Density @ 802.11b Mode Ch 1



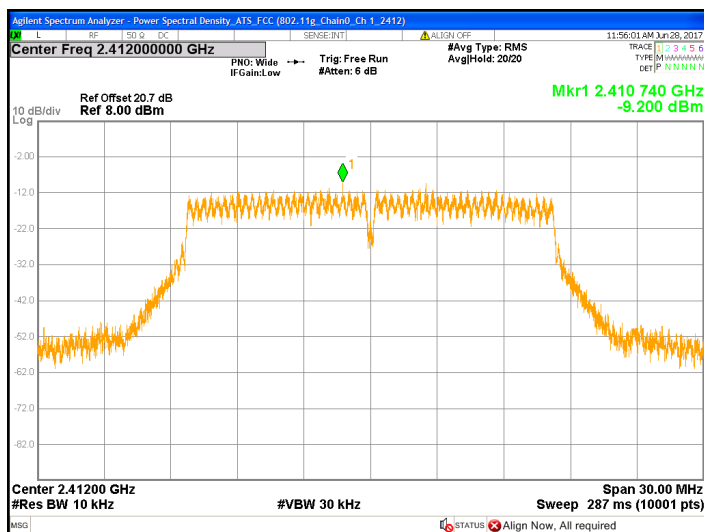
Chain0 : Power Spectral Density @ 802.11b Mode Ch 6



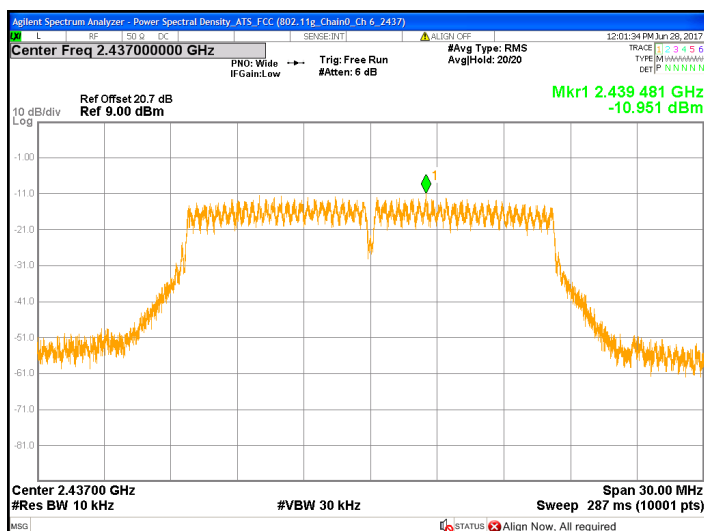
Chain0 : Power Spectral Density @ 802.11b Mode Ch11



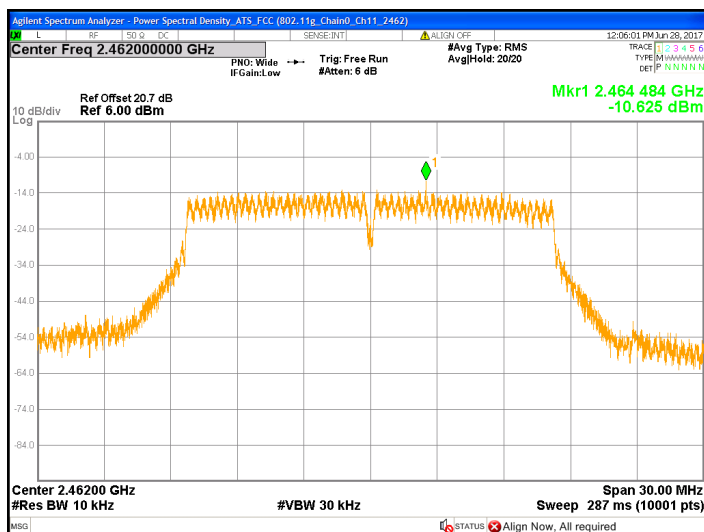
Chain0 : Power Spectral Density @ 802.11g Mode Ch 1



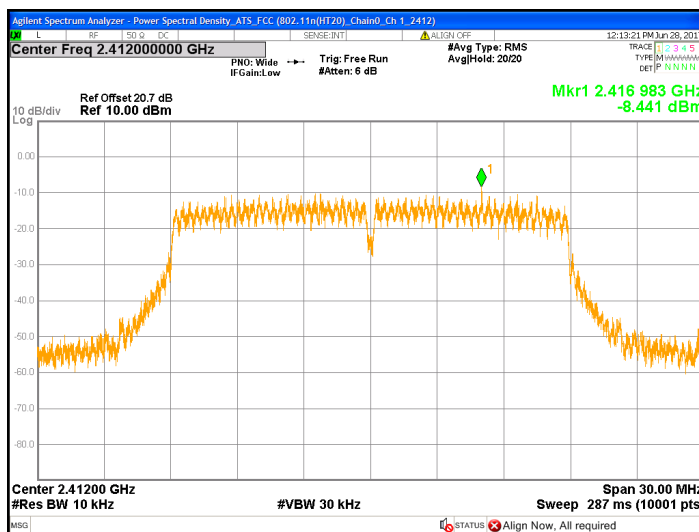
Chain0 : Power Spectral Density @ 802.11g Mode Ch 6



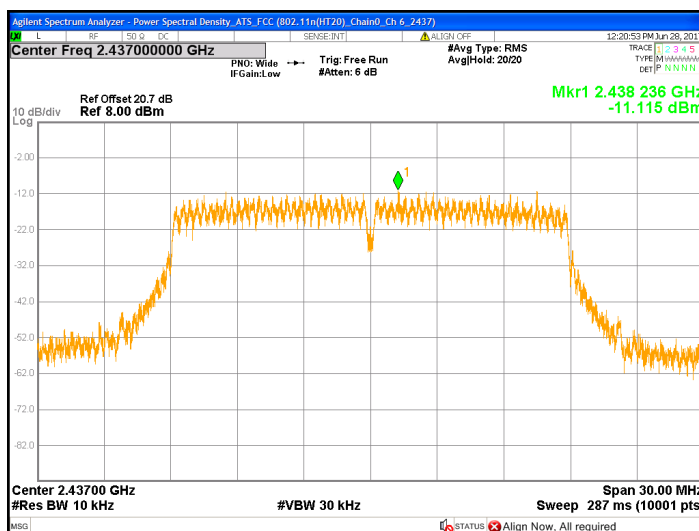
Chain0 : Power Spectral Density @ 802.11g Mode Ch11



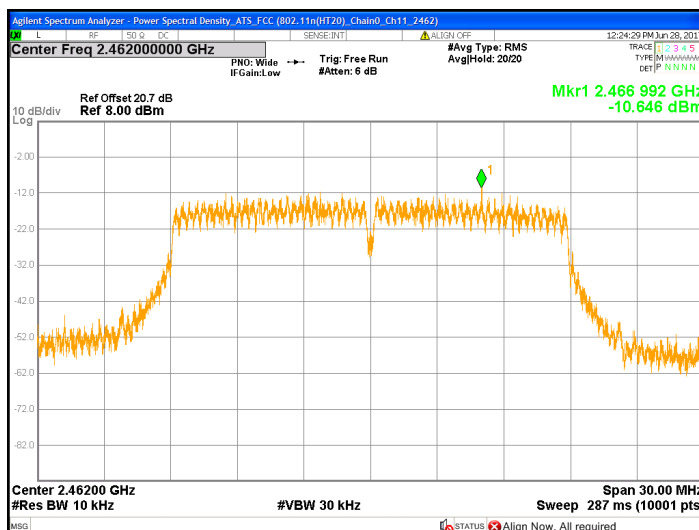
Chain0 : Power Spectral Density @ 802.11n(HT20) Mode Ch 1



Chain0 : Power Spectral Density @ 802.11n(HT20) Mode Ch 6



Chain0 : Power Spectral Density @ 802.11n(HT20) Mode Ch11



5. Emissions in Non-Restricted Frequency Bands

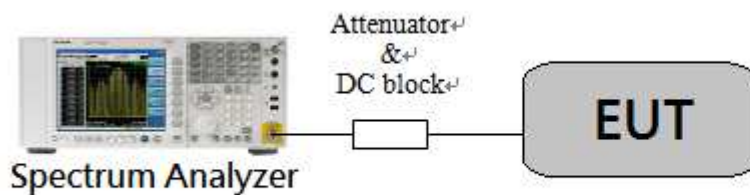
5.1. Instruments Setting

Spectrum Function	Setting (Reference Level)	Setting (Emission Level)
Detector	Peak	Peak
RBW	≥ 100 kHz	≥ 100 kHz
VBW	$\geq 3 \times$ RBW	$\geq 3 \times$ RBW
Sweep	Auto couple	Auto couple
Trace	Max hold	Max hold
Span	≥ 1.5 time 6dB bandwidth	
Attenuation	Auto	Auto

5.2. Test Procedure

- Step 1 The procedure was used in antenna-port conducted and connected to the spectrum analyzer.
- Step 2 Set instrument center frequency to center frequency.
- Step 3 Use the parameter configured in clause 6.3 to measure.
- Step 4 Use the peak marker function to determine the maximum amplitude level.

5.3. Test Diagram



5.4. Limit

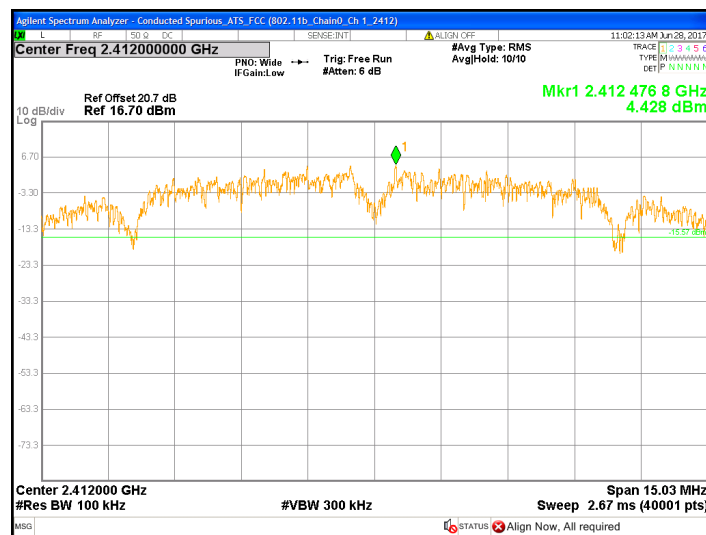
The peak output power measured in any 100 kHz bandwidth outside of the authorized frequency band shall be attenuated by at least 20 dB relative to the maximum in-band peak PSD level in 100 kHz

5.5. Operating Environment Condition

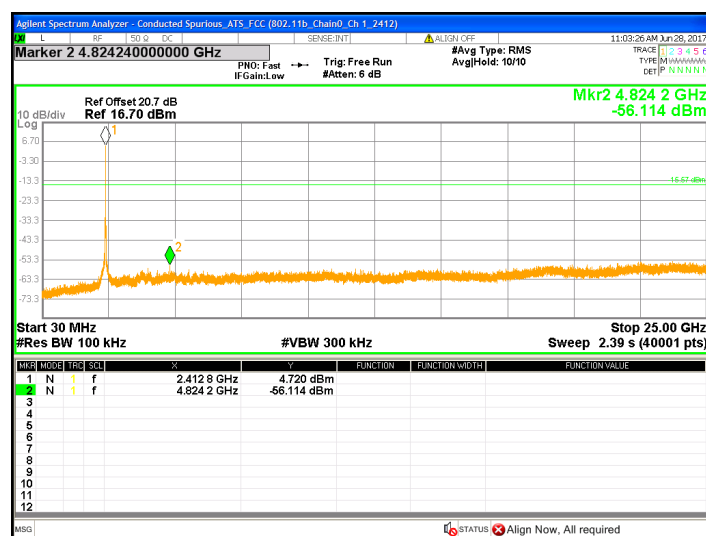
Temperature (°C) :	25
Relative Humidity (%) :	50
Atmospheric Pressure (hPa) :	1008
Test Date :	6/28/2017

5.6. Test Results

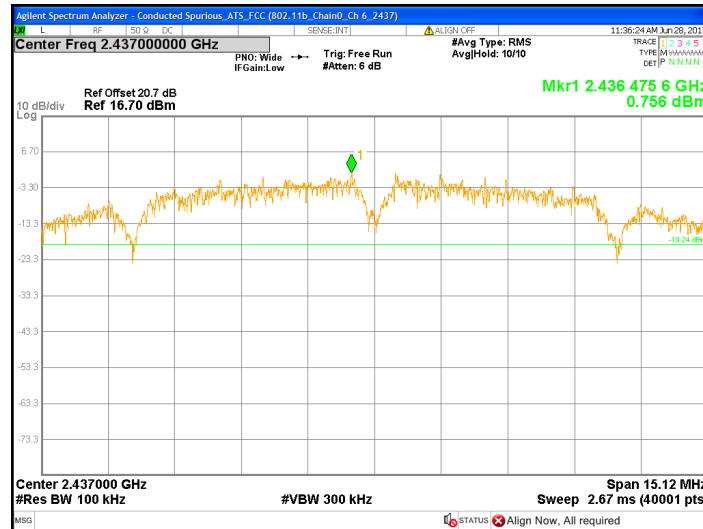
Chain0 : Conducted Spurious @ 802.11b Mode Ch 1



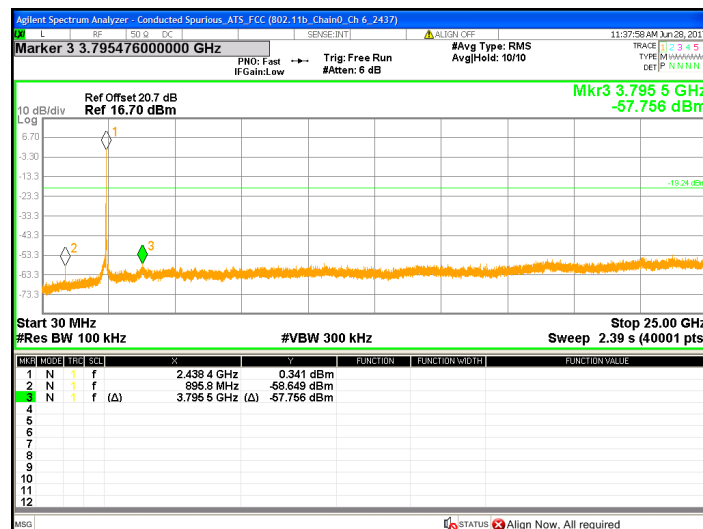
Chain0 : Conducted Spurious @ 802.11b Mode Ch 1



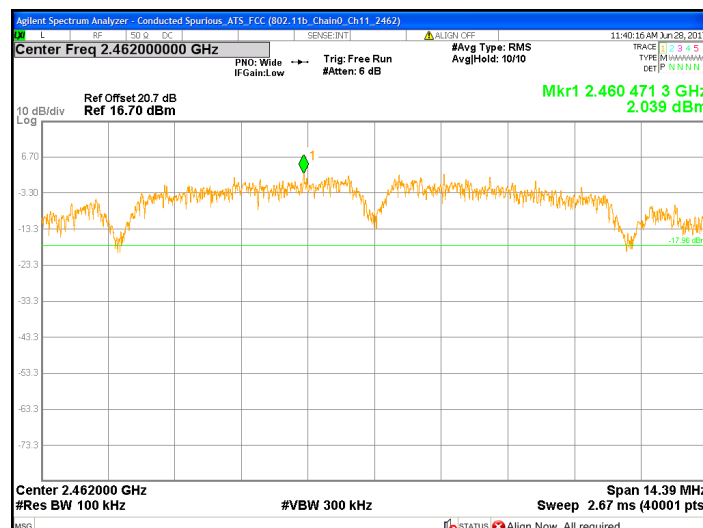
Chain0 : Conducted Spurious @ 802.11b Mode Ch 6



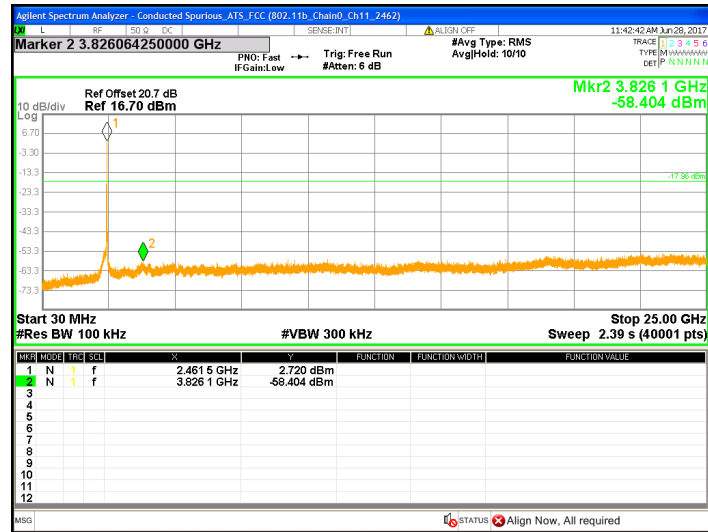
Chain0 : Conducted Spurious @ 802.11b Mode Ch 6



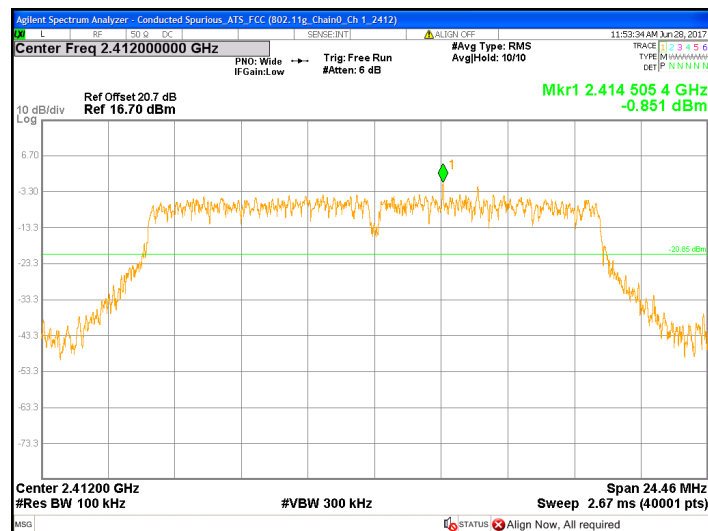
Chain0 : Conducted Spurious @ 802.11b Mode Ch11



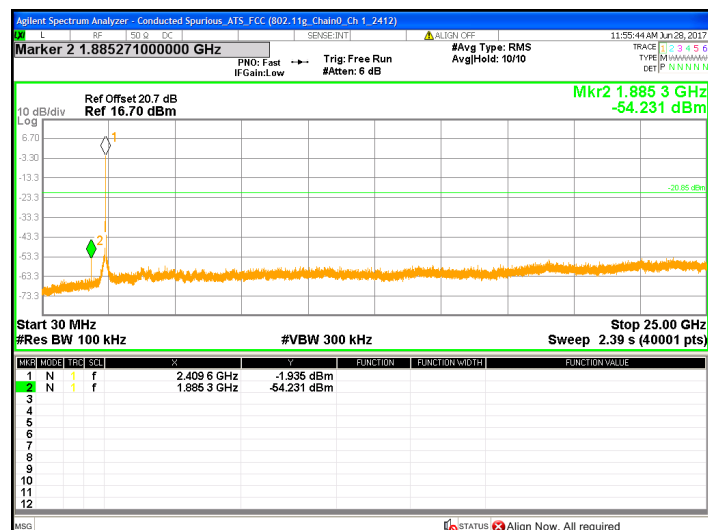
Chain0 : Conducted Spurious @ 802.11b Mode Ch11



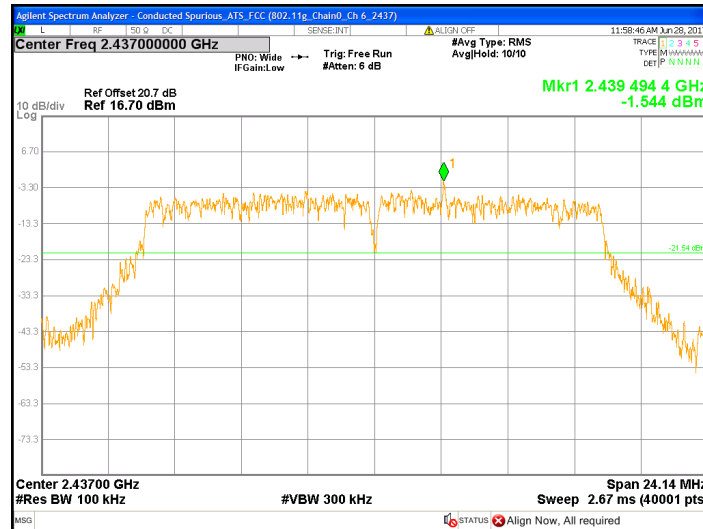
Chain0 : Conducted Spurious @ 802.11g Mode Ch 1



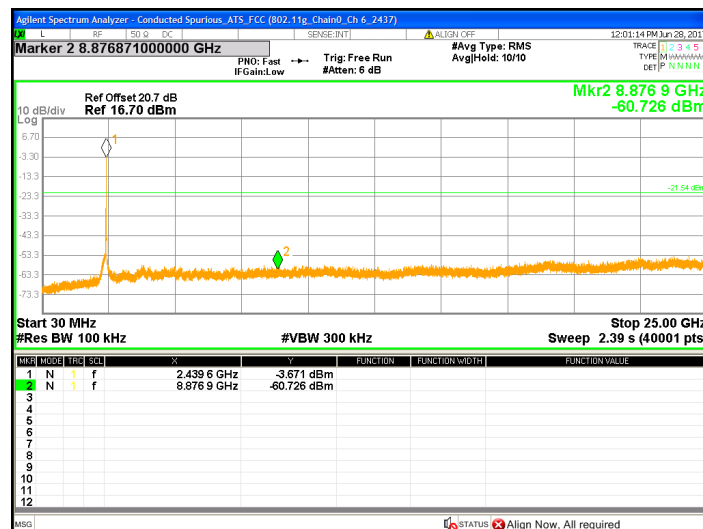
Chain0 : Conducted Spurious @ 802.11g Mode Ch 1



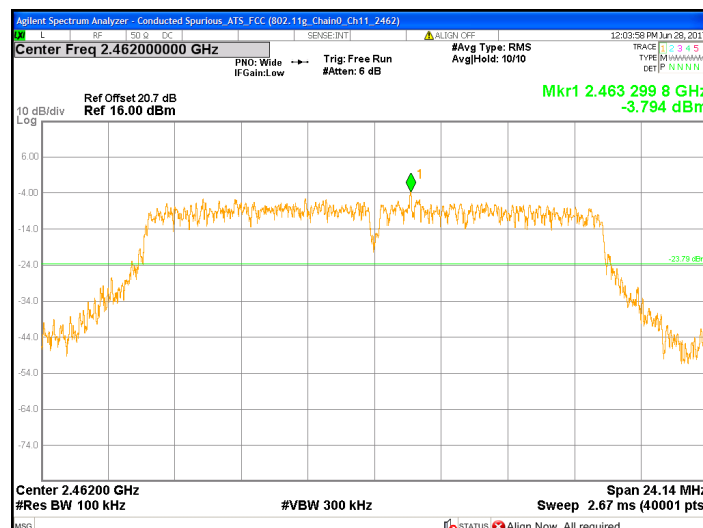
Chain0 : Conducted Spurious @ 802.11g Mode Ch 6



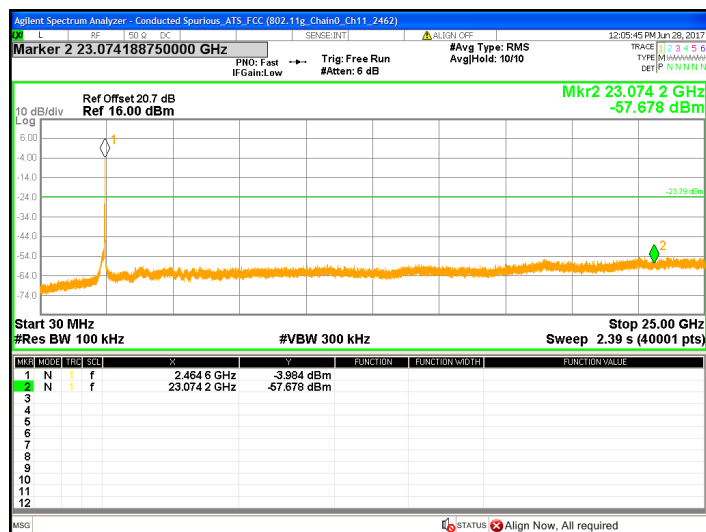
Chain0 : Conducted Spurious @ 802.11g Mode Ch 6



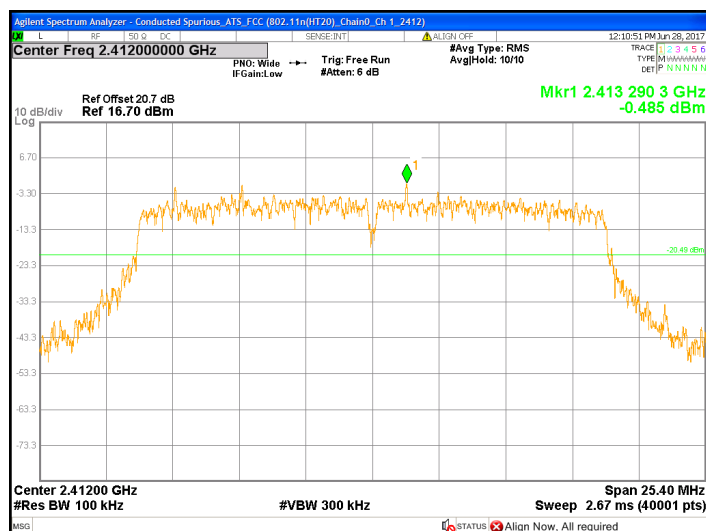
Chain0 : Conducted Spurious @ 802.11g Mode Ch11



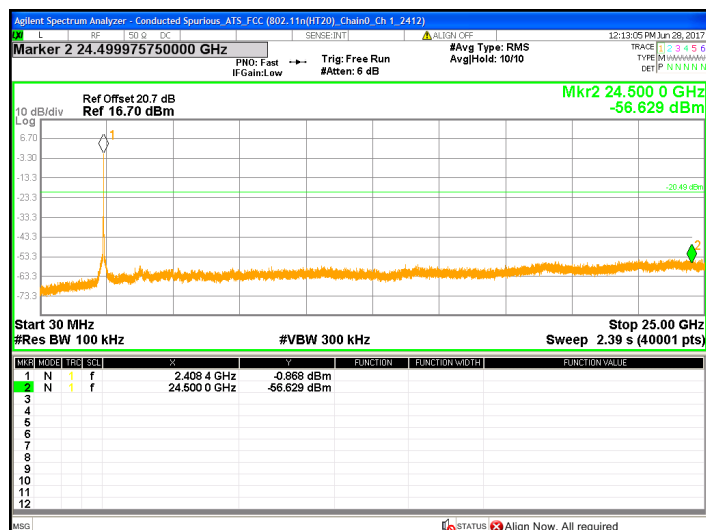
Chain0 : Conducted Spurious @ 802.11g Mode Ch11



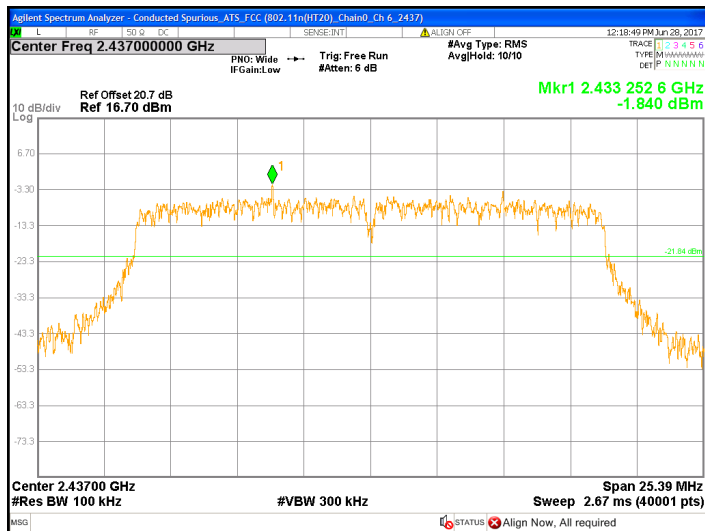
Chain0 : Conducted Spurious @ 802.11n(HT20) Mode Ch 1



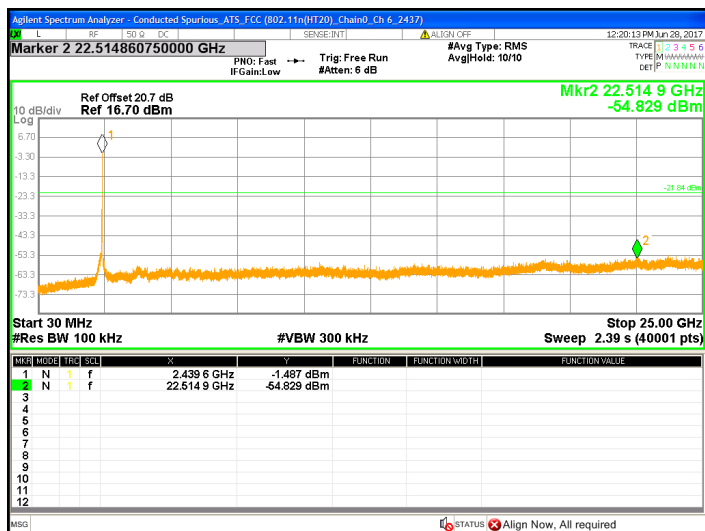
Chain0 : Conducted Spurious @ 802.11n(HT20) Mode Ch 1



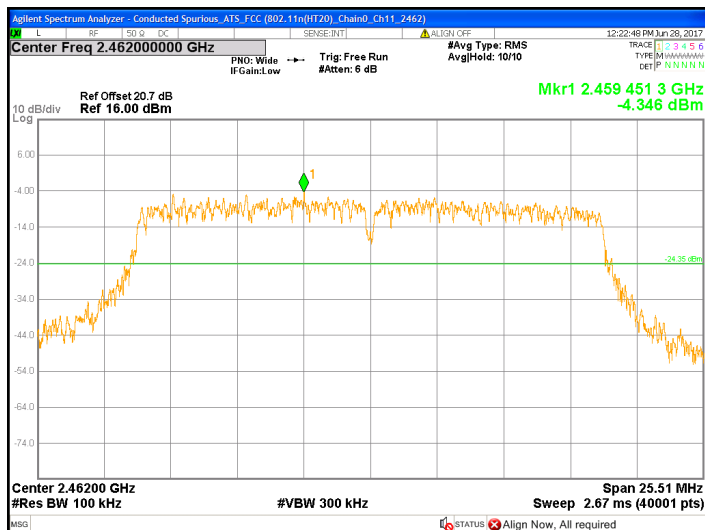
Chain0 : Conducted Spurious @ 802.11n(HT20) Mode Ch 6



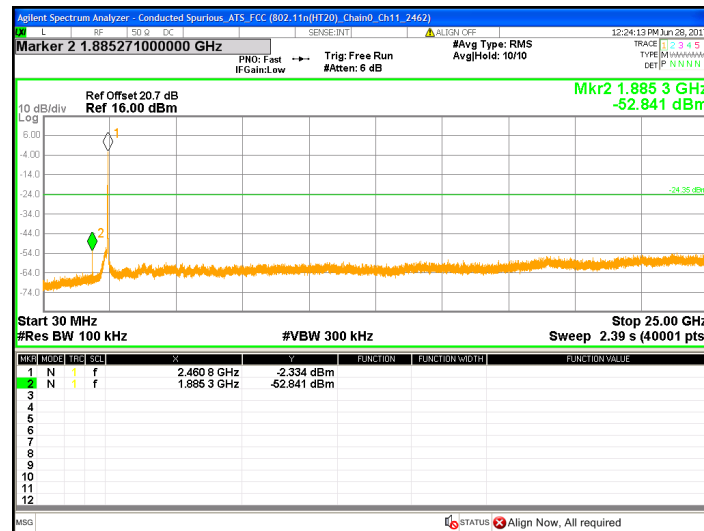
Chain0 : Conducted Spurious @ 802.11n(HT20) Mode Ch 6



Chain0 : Conducted Spurious @ 802.11n(HT20) Mode Ch11



Chain0 : Conducted Spurious @ 802.11n(HT20) Mode Ch11



6. Emissions in Restricted Frequency Bands (Radiated emission measurements)

6.1. Instrument Setting

Receiver Function	Setting (Below 1GHz)	Setting (Above 1GHz)
Detector	QP	Peak
RBW	9-150 kHz ; 200-300 Hz 0.15-30 MHz; 9-10 kHz 30-1000 MHz; 100-120 kHz	1MHz
VBW	$\geq 3 \times$ RBW	3MHz
Sweep	Auto couple	Auto couple
Start Frequency	9 kHz	1GHz
Stop Frequency	1 GHz	Tenth harmonic
Attenuation	Auto	Auto

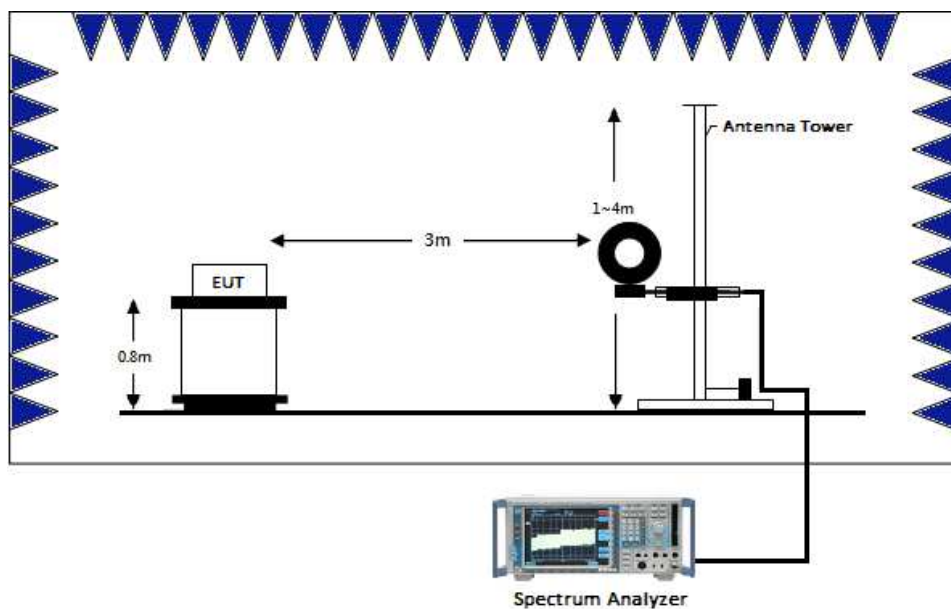
6.2. Test Procedure

- Step 1 Configure the EUT according to ANSI C63.10:2013. The EUT was placed on the top of the turntable 0.8 meter (below 1GHz) and 1.5 meter (above 1GHz) above ground. The center of the receiving antenna mounted on the top of a height-variable antenna tower was placed 3 meters far away from the turntable.
- Step 2 Power on the EUT and all the companion devices. The turntable was rotated by 360 degree to find the position of the maximum emission level.
- Step 3 The height of the receiving antenna was varied between one meter and four meters above ground to find the maximum emission field strength of the both horizontal and vertical polarization.
- Step 4 If find the frequencies above the limit or below within 3dB, the antenna tower was scan (from 1m to 4m) and then the turntable was rotated to find the maximum reading.
- Step 5 Set the test-receiver system to peak or CISPR quasi-peak detector with specified bandwidth under maximum hold mode.
- Step 6 For emissions above 1GHz, use 1MHz VBW and 3MHz RBW for reading in spectrum analyzer.
Place the measurement antenna away from each area of the EUT determined to be a source of emissions at the specified measurement distance, while keeping the measurement antenna aimed at the source of emissions at each frequency of significant emissions, with polarization oriented for maximum response.
- Step 7 If the emissions level of the EUT in peak mode was 3dB lower than the average limit specified then testing will be stopped and peak values of the EUT will be reported. Otherwise, the emissions which do not have 3dB margin will be measured using the quasi-peak method for below 1GHz.

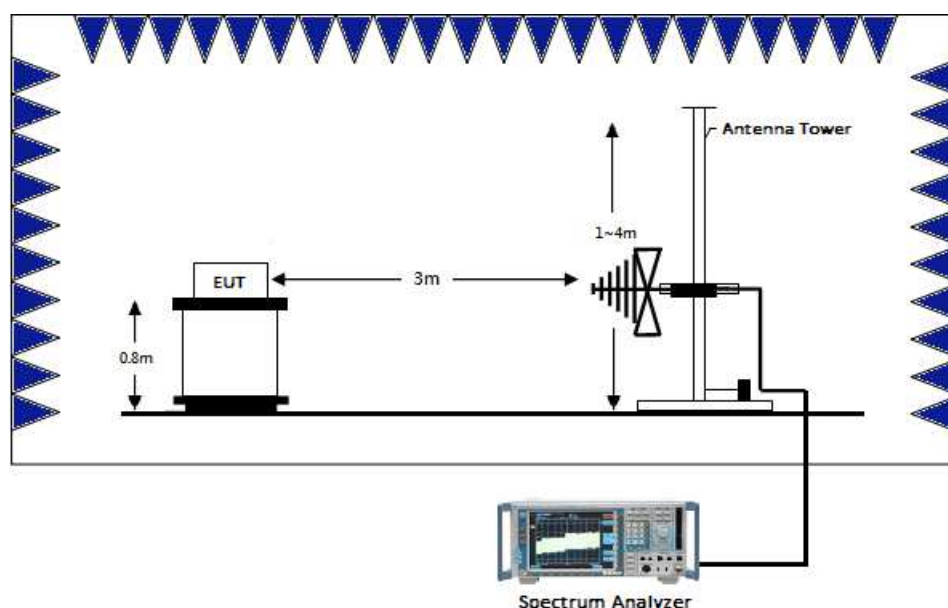
- Step 8 For testing above 1GHz, The emissions level of the EUT in peak mode was lower than average limit, then testing will be stopped and peak values of the EUT will be reported, otherwise, the emission will be measured in average mode again and reported.
- Step 9 In case the emission is lower than 30MHz, loop antenna has to be used for measurement and the recorded data should be quasi-peak measured by receiver.

6.3. Test Diagram

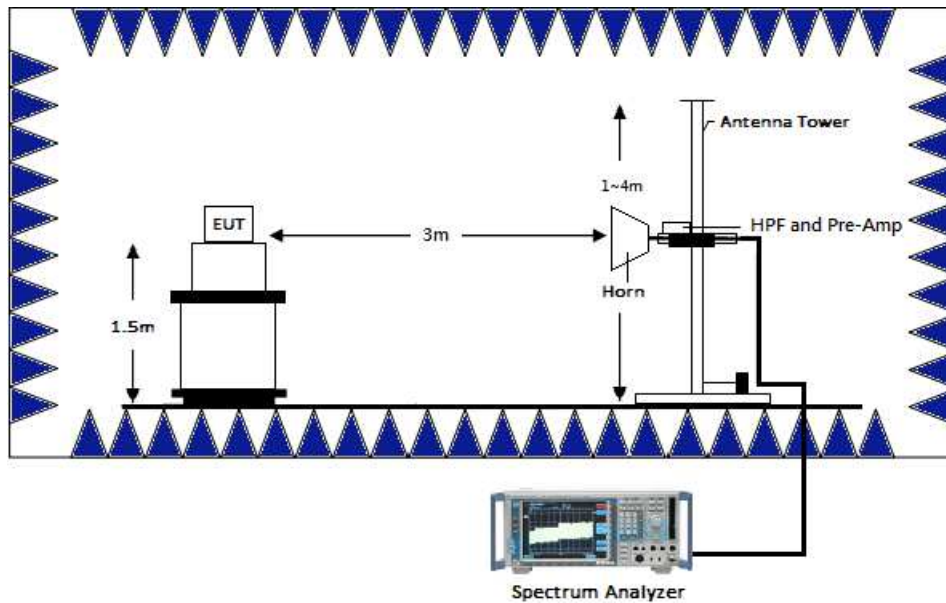
6.3.1. Radiated emission from 9kHz to 30MHz uses Loop Antenna:



6.3.2. Radiated emission below 1GHz using Bilog Antenna



6.3.3. Radiated emission above 1GHz using Horn Antenna



6.4. Limit

Frequency(MHz)	Field Strength(uV/m)	Measurement distance(m)
0.009~0.490	2400/F(kHz)	300
0.490~1.705	2400/F(kHz)	30
1.705~30	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

Remark:

1. In the above table, the tighter limit applies at the band edges.
2. Distance refers to the distance in meters between the measuring instrument antenna and the closed point of any part of the device or system

6.5. Operating Environment Condition

Temperature (°C) : 25
Relative Humidity (%) : 50
Atmospheric Pressure (hPa) : 1008
Test Date : 7/3/2017

6.6. Test Result

6.6.1. Measurement results: frequencies 9kHz to 30MHz

The test was performed on EUT under 802.11b/g/n continuously transmitting mode. The worst case occurred at 802.11b ch1

Mode	Channel	Detector	Freq. (MHz)	Factor (dB/m)	Reading(dBuV/m)	Corrected Reading (dBμV/m)	Limit (dBμV/m)	Margin (dB)
802.11b	1	QP	0.02	20.21	35.38	55.59	121.58	-65.99
802.11b	1	QP	0.04	20.04	28.20	48.24	115.56	-67.32
802.11b	1	QP	0.07	19.46	23.62	43.08	110.7	-67.62
802.11b	1	QP	0.09	19.14	27.85	46.99	108.52	-61.53
802.11b	1	QP	0.11	19.06	25.96	45.02	106.78	-61.76
802.11b	1	QP	0.13	19.05	24.5	43.55	105.33	-61.78
802.11b	1	QP	0.15	19.05	30.9	49.95	104.08	-54.13
802.11b	1	QP	0.39	19.01	32.87	51.87	95.78	-43.91
802.11b	1	QP	0.93	19.17	25.75	44.92	68.23	-23.31
802.11b	1	QP	1.40	19.17	21.57	40.74	64.68	-23.94
802.11b	1	QP	1.88	19.07	19.07	38.14	69.54	-31.4
802.11b	1	QP	2.24	19.00	16.59	35.59	69.54	-33.95

Remark: Factor = Antenna Factor + Cable Loss

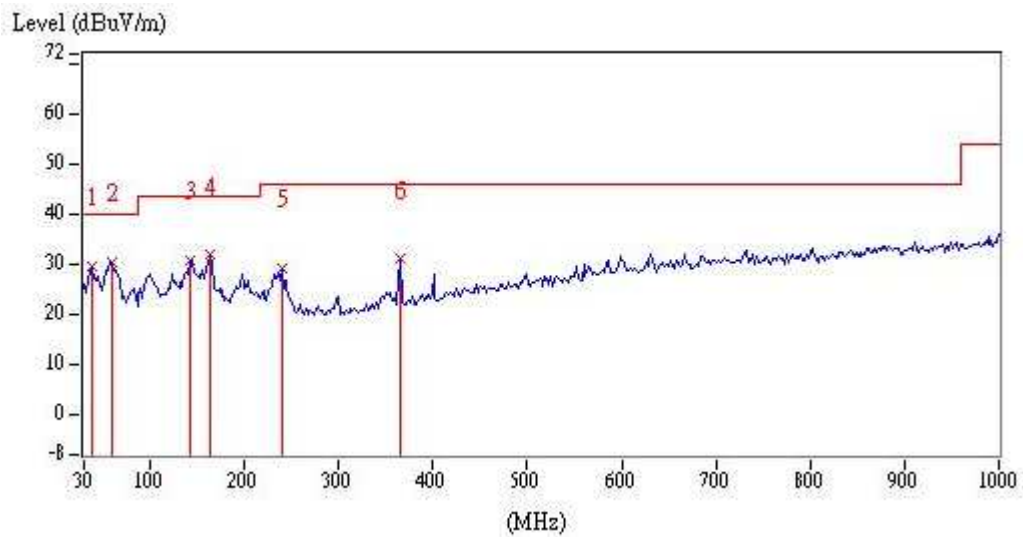
6.6.2. Measurement results: frequencies below 1 GHz

The test was performed on EUT under 802.11b/g/n continuously transmitting mode. The worst case occurred at 802.11b ch1

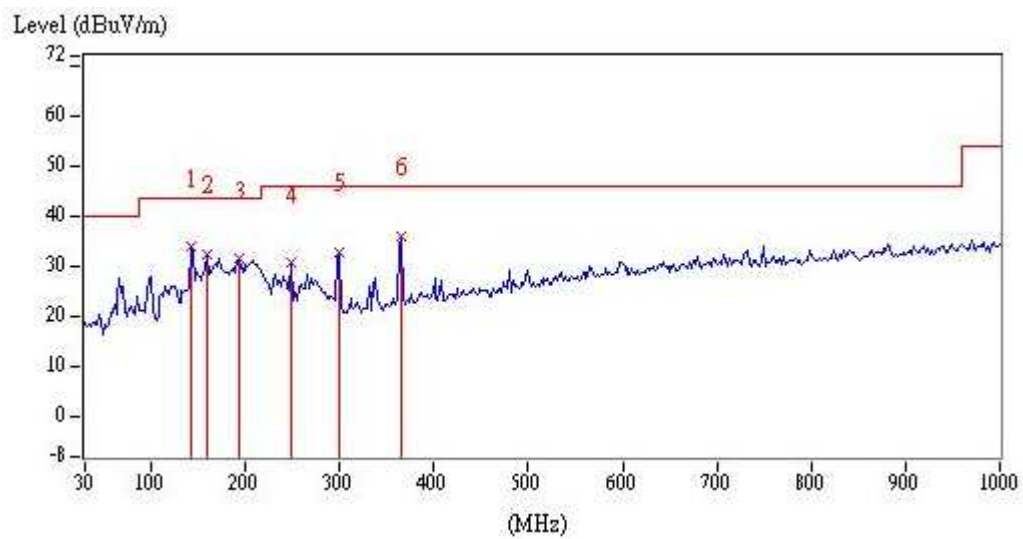
Mode	Ch	Chain	Ant Polarity	Detector	Freq. (MHz)	Factor (dB/m)	Reading (dBuV)	Corrected Reading (dBuV/m)	Limit (dBμV/m)	Margin (dB)
802.11b	1	Chain0	V	QP	37.76	19.77	9.87	29.64	40.00	-10.36
802.11b	1	Chain0	V	QP	59.10	19.50	11.08	30.58	40.00	-9.42
802.11b	1	Chain0	V	QP	142.52	20.37	10.50	30.87	43.50	-12.63
802.11b	1	Chain0	V	QP	163.86	20.64	11.30	31.94	43.50	-11.56
802.11b	1	Chain0	V	QP	239.52	19.61	9.60	29.21	46.00	-16.79
802.11b	1	Chain0	V	QP	365.62	23.44	7.58	31.02	46.00	-14.98
802.11b	1	Chain0	H	QP	142.52	20.37	13.43	33.80	43.50	-9.70
802.11b	1	Chain0	H	QP	159.98	20.69	11.73	32.42	43.50	-11.08
802.11b	1	Chain0	H	QP	192.96	18.00	13.54	31.54	43.50	-11.96
802.11b	1	Chain0	H	QP	249.22	19.96	10.70	30.66	46.00	-15.34
802.11b	1	Chain0	H	QP	299.66	21.74	11.07	32.81	46.00	-13.19
802.11b	1	Chain0	H	QP	365.62	23.44	12.69	36.13	46.00	-9.87

Remark: Factor = Antenna Factor + Cable Loss

Vertical



Horizontal



6.6.3. Measurement results: frequency above 1GHz to 25GHz

Mode	Ch	Chain	Ant Polarity	Detector	Freq. (MHz)	Preamplifier (dB)	Factor (dB/m)	Reading (dBμV)	Corrected Reading (dBμV/m)	Limit (dBμV/m)	Margin (dB)
802.11b	1	Chain0	V	PK	1064	39.17	29.08	13.27	42.35	74	-31.65
802.11b	1	Chain0	V	PK	1596	38.73	30.76	17.74	48.5	74	-25.5
802.11b	1	Chain0	V	PK	1860	38.51	33.43	13.94	47.37	74	-26.63
802.11b	1	Chain0	V	PK	2128	38.6	34.91	14.51	49.42	74	-24.58
802.11b	1	Chain0	V	PK	4824	40.03	3.07	46.1	49.17	74	-24.83
802.11b	1	Chain0	V	PK	7236	38.15	9.99	33.09	43.08	74	-30.92
802.11b	1	Chain0	H	PK	1060	39.17	29.08	12.34	41.42	74	-32.58
802.11b	1	Chain0	H	PK	1600	38.73	30.8	15.31	46.11	74	-27.89
802.11b	1	Chain0	H	PK	4824	40.03	3.07	49.41	52.48	74	-21.52
802.11b	1	Chain0	H	PK	7236	38.15	9.99	32.91	42.9	74	-31.1
802.11b	6	Chain0	V	PK	1060	39.17	29.08	12.38	41.46	74	-32.54
802.11b	6	Chain0	V	PK	1596	38.73	30.76	15.81	46.57	74	-27.43
802.11b	6	Chain0	V	PK	4874	39.94	3.26	50.1	53.37	74	-20.63
802.11b	6	Chain0	V	PK	7311	38.07	10.29	32.64	42.93	74	-31.07
802.11b	6	Chain0	H	PK	1064	39.17	29.08	12.81	41.89	74	-32.11
802.11b	6	Chain0	H	PK	1596	38.73	30.76	11.22	41.98	74	-32.02
802.11b	6	Chain0	H	PK	4874	39.94	3.26	48.35	51.61	74	-22.39
802.11b	6	Chain0	H	PK	7311	38.07	10.29	33.94	44.24	74	-29.76
802.11b	11	Chain0	V	PK	1364	38.92	29.57	11.22	40.79	74	-33.21
802.11b	11	Chain0	V	PK	1592	38.73	30.72	15.25	45.97	74	-28.03
802.11b	11	Chain0	V	PK	1864	38.5	33.47	13.07	46.54	74	-27.46
802.11b	11	Chain0	V	PK	4924	39.86	3.46	49.72	53.18	74	-20.82
802.11b	11	Chain0	V	PK	7386	37.99	10.6	30.47	41.07	74	-32.93
802.11b	11	Chain0	H	PK	1064	39.17	29.08	11.82	40.9	74	-33.1
802.11b	11	Chain0	H	PK	1408	38.89	29.64	10.83	40.47	74	-33.53
802.11b	11	Chain0	H	PK	1592	38.73	30.72	13.44	44.16	74	-29.84
802.11b	11	Chain0	H	PK	4924	39.86	3.46	46.6	50.06	74	-23.94
802.11b	11	Chain0	H	PK	7386	37.99	10.6	30.41	41.01	74	-32.99
802.11g	1	Chain0	V	PK	1600	38.73	30.8	14.17	44.97	74	-29.03
802.11g	1	Chain0	V	PK	4824	40.03	3.07	39.25	42.32	74	-31.68
802.11g	1	Chain0	V	PK	4980	39.76	3.67	38.49	42.16	74	-31.84
802.11g	1	Chain0	V	PK	7236	38.15	9.99	33.45	43.44	74	-30.56
802.11g	1	Chain0	H	PK	1600	38.73	30.8	16.85	47.65	74	-26.35
802.11g	1	Chain0	H	PK	4824	40.03	3.07	41.1	44.17	74	-29.83
802.11g	1	Chain0	H	PK	7236	38.15	9.99	32.72	42.71	74	-31.29
802.11g	6	Chain0	V	PK	1596	38.73	30.76	16.4	47.16	74	-26.84
802.11g	6	Chain0	V	PK	4874	39.94	3.26	42.19	45.45	74	-28.55
802.11g	6	Chain0	V	PK	7311	38.07	10.29	30.65	40.94	74	-33.06
802.11g	6	Chain0	H	PK	1600	38.73	30.8	14.35	45.15	74	-28.85
802.11g	6	Chain0	H	PK	4874	39.94	3.26	41.5	44.76	74	-29.24
802.11g	6	Chain0	H	PK	7311	38.07	10.29	30.68	40.97	74	-33.03
802.11g	11	Chain0	V	PK	1064	39.17	29.08	11.99	41.07	74	-32.93
802.11g	11	Chain0	V	PK	1328	38.95	29.51	12.2	41.71	74	-32.29
802.11g	11	Chain0	V	PK	1600	38.73	30.8	15.51	46.31	74	-27.69
802.11g	11	Chain0	V	PK	2124	38.6	34.9	13.21	48.12	74	-25.88
802.11g	11	Chain0	V	PK	4924	39.86	3.46	40.52	43.98	74	-30.02
802.11g	11	Chain0	V	PK	7386	37.99	10.6	29.8	40.4	74	-33.6

Mode	Ch	Chain	Ant Polarity	Detector	Freq. (MHz)	Preamp (dB)	Factor (dB/m)	Reading (dBμV)	Corrected Reading (dBμV/m)	Limit (dBμV/m)	Margin (dB)
802.11g	11	Chain0	H	PK	1396	38.9	29.62	11.96	41.58	74	-32.42
802.11g	11	Chain0	H	PK	1596	38.73	30.76	14.2	44.96	74	-29.04
802.11g	11	Chain0	H	PK	4924	39.86	3.46	43.3	46.76	74	-27.24
802.11g	11	Chain0	H	PK	7386	37.99	10.6	30.88	41.47	74	-32.53
802.11n	1	Chain0	V	PK	1064	39.17	29.08	15	44.08	74	-29.92
802.11n	1	Chain0	V	PK	1596	38.73	30.76	18.04	48.8	74	-25.2
802.11n	1	Chain0	V	PK	2500	39.22	35.1	13.35	48.45	74	-25.55
802.11n	1	Chain0	V	PK	4824	40.03	3.07	42.64	45.71	74	-28.29
802.11n	1	Chain0	V	PK	7236	38.15	9.99	31.1	41.09	74	-32.91
802.11n	1	Chain0	H	PK	1064	39.17	29.08	12.39	41.47	74	-32.53
802.11n	1	Chain0	H	PK	1592	38.73	30.72	13.64	44.36	74	-29.64
802.11n	1	Chain0	H	PK	4824	40.03	3.07	39.07	42.14	74	-31.86
802.11n	1	Chain0	H	PK	7236	38.15	9.99	30.51	40.5	74	-33.5
802.11n	6	Chain0	V	PK	1064	39.17	29.08	11.94	41.03	74	-32.97
802.11n	6	Chain0	V	PK	1436	38.86	29.69	12.28	41.97	74	-32.03
802.11n	6	Chain0	V	PK	1592	38.73	30.72	19.2	49.92	74	-24.08
802.11n	6	Chain0	V	PK	1860	38.51	33.43	12.4	45.82	74	-28.18
802.11n	6	Chain0	V	PK	4874	39.94	3.26	42.62	45.89	74	-28.11
802.11n	6	Chain0	V	PK	7311	38.07	10.29	29.7	39.99	74	-34.01
802.11n	6	Chain0	H	PK	1064	39.17	29.08	12.29	41.37	74	-32.63
802.11n	6	Chain0	H	PK	1596	38.73	30.76	14.62	45.38	74	-28.62
802.11n	6	Chain0	H	PK	4874	39.94	3.26	44.94	48.2	74	-25.8
802.11n	6	Chain0	H	PK	7311	38.07	10.29	29.87	40.17	74	-33.83
802.11n	11	Chain0	V	PK	1064	39.17	29.08	13.58	42.67	74	-31.33
802.11n	11	Chain0	V	PK	1596	38.73	30.76	17.46	48.22	74	-25.78
802.11n	11	Chain0	V	PK	4924	39.86	3.46	42.3	45.76	74	-28.24
802.11n	11	Chain0	V	PK	7386	37.99	10.6	31.06	41.66	74	-32.34
802.11n	11	Chain0	H	PK	1600	38.73	30.8	14.98	45.78	74	-28.22
802.11n	11	Chain0	H	PK	4924	39.86	3.46	42.06	45.52	74	-28.48
802.11n	11	Chain0	H	PK	7386	37.99	10.6	29.86	40.46	74	-33.54

Remark: Correction Factor = Antenna Factor + Cable Loss + High Pass Filter Loss - Pre_Amplifier Gain

7. Emission on Band Edge

7.1. Instrument Setting

Spectrum Function	Setting
Detector	Peak
RBW	1MHz
VBW	3MHz
Sweep	Auto couple
Restrict bands	2310 MHz ~ 2390 MHz 2483.5 MHz ~ 2500 MHz
Attenuation	Auto

7.2. Test Procedure

The test procedure is the same as Emissions in Restricted Frequency Bands (Radiated emission measurements).

7.3. Operating Environment Condition

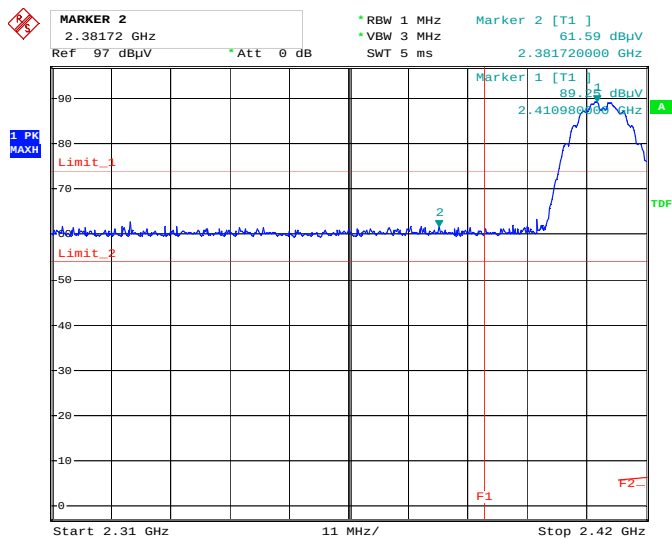
Temperature (°C) : 25
Relative Humidity (%) : 50
Atmospheric Pressure (hPa) : 1008
Test Date : 6/28/2017~7/5/2017

7.4. Test Results

Mode	Frequency (MHz)	Spectrum Analyzer Detector	Ant. Pol. (H/V)	Correction Factor (dB/m)	Reading (dBμV)	Corrected Reading (dBμV/m)	Limit @ 3 m (dBμV/m)	Margin (dB)	Restricted band (MHz)
802.11b Chain0	2381.72	PK	V	33.81	27.78	61.59	74	-12.41	2310~2390
	2390.00	AV	V	33.85	14.58	48.43	54	-5.57	
	2491.10	PK	V	34.34	27.43	61.77	74	-12.23	2483.5~2500
	2483.50	AV	V	34.30	13.30	47.60	54	-6.40	
802.11g Chain0	2335.66	PK	V	33.59	28.51	62.10	74	-11.90	2310~2390
	2390.00	AV	V	33.85	14.58	48.43	54	-5.57	
	2492.10	PK	V	34.34	26.24	60.58	74	-13.42	2483.5~2500
	2483.50	AV	V	34.30	13.35	47.65	54	-6.35	
802.11n (HT20) Chain0	2383.40	PK	V	33.82	28.17	61.99	74	-12.01	2310~2390
	2390.00	AV	V	33.85	14.56	48.41	54	-5.59	
	2484.80	PK	V	34.31	27.00	61.31	74	-12.69	2483.5~2500
	2483.50	AV	V	34.30	13.36	47.66	54	-6.34	

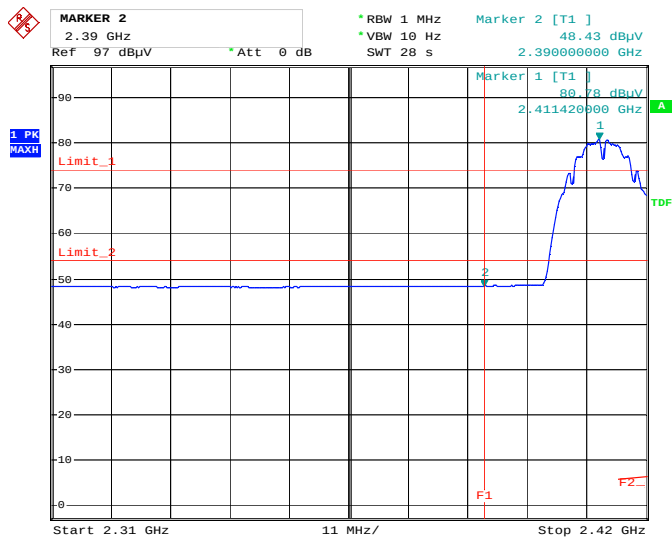
Remark: Correction Factor = Antenna Factor + Cable Loss

Chain0 : Restricted Band Bandedge @ 802.11b Mode Ch1 PK



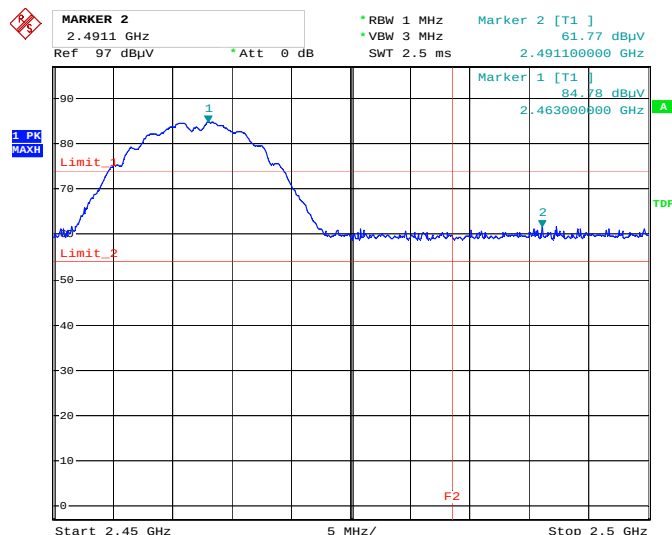
Date: 5.JUL.2017 12:47:45

Chain0 : Restricted Band Bandedge @ 802.11b Mode Ch1 AV



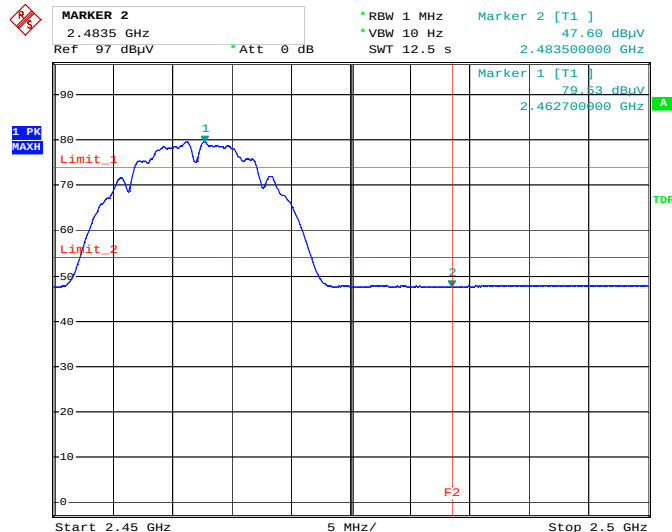
Date: 5.JUL.2017 12:49:35

Chain0 : Restricted Band Bandedge @ 802.11b Mode Ch11 PK



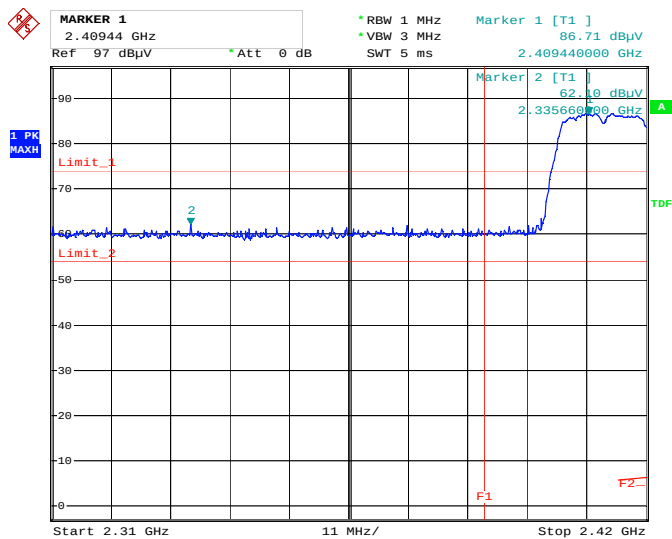
Date: 5.JUL.2017 13:09:29

Chain0 : Restricted Band Bandedge @ 802.11b Mode Ch11 AV



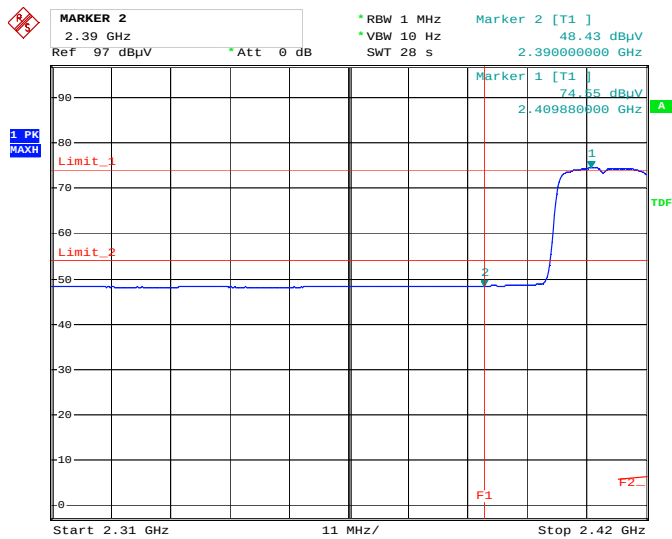
Date: 5.JUL.2017 13:14:11

Chain0 : Restricted Band Bandedge @ 802.11g Mode Ch1 PK



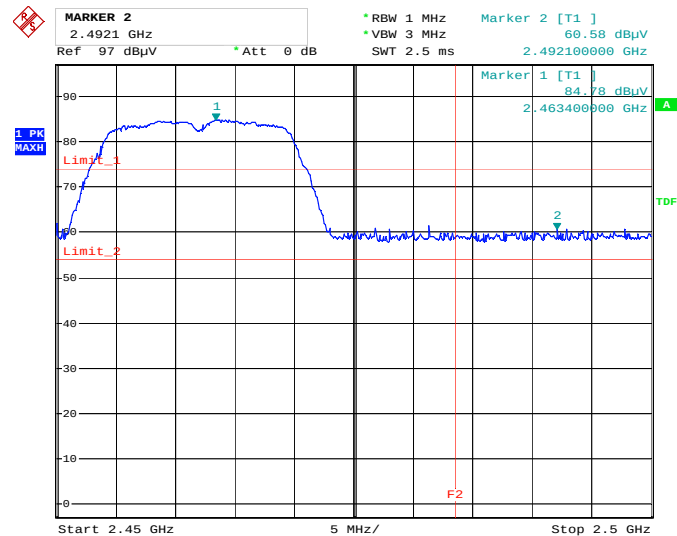
Date: 5.JUL.2017 12:51:06

Chain0 : Restricted Band Bandedge @ 802.11g Mode Ch1 AV



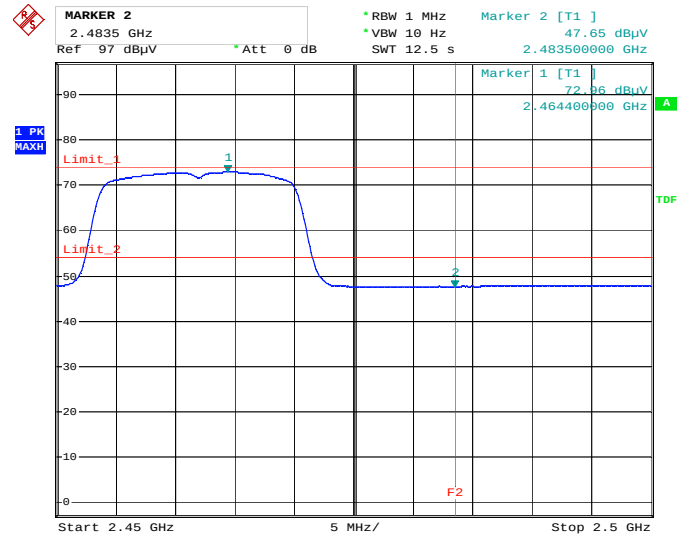
Date: 5.JUL.2017 12:54:42

Chain0 : Restricted Band Bandedge @ 802.11g Mode Ch11 PK



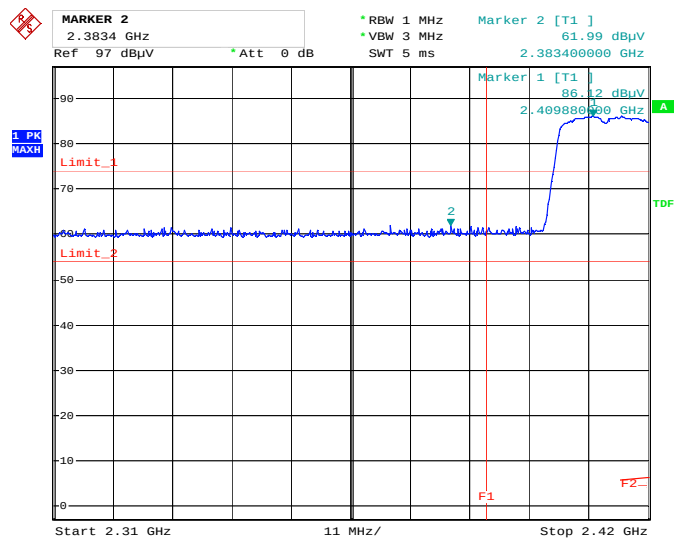
Date: 5.JUL.2017 13:15:34

Chain0 : Restricted Band Bandedge @ 802.11g Mode Ch11 AV



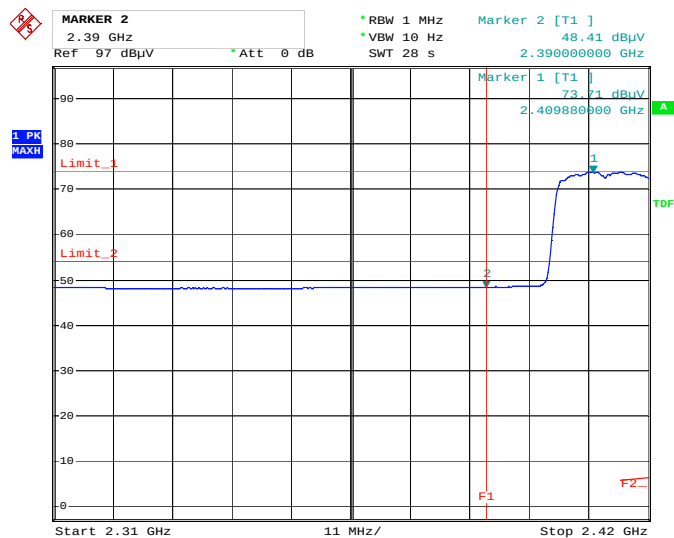
Date: 5.JUL.2017 13:16:26

Chain0 : Restricted Band Bandedge @ 802.11n(HT20) Mode Ch1 PK



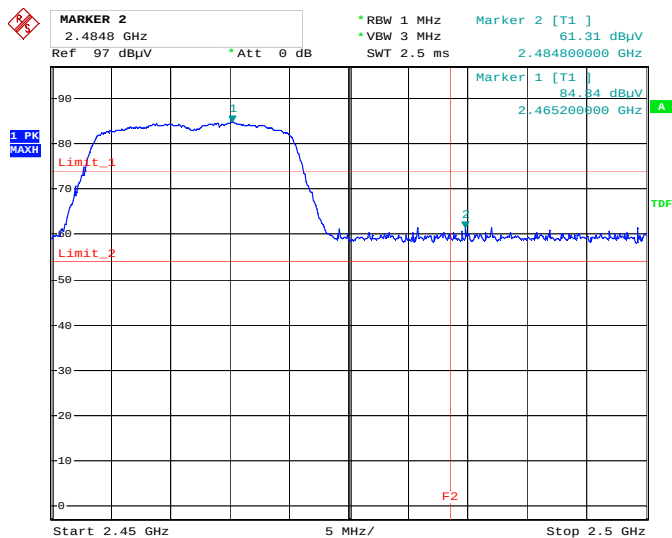
Date: 5.JUL.2017 12:56:40

Chain0 : Restricted Band Bandedge @ 802.11n(HT20) Mode Ch1 AV



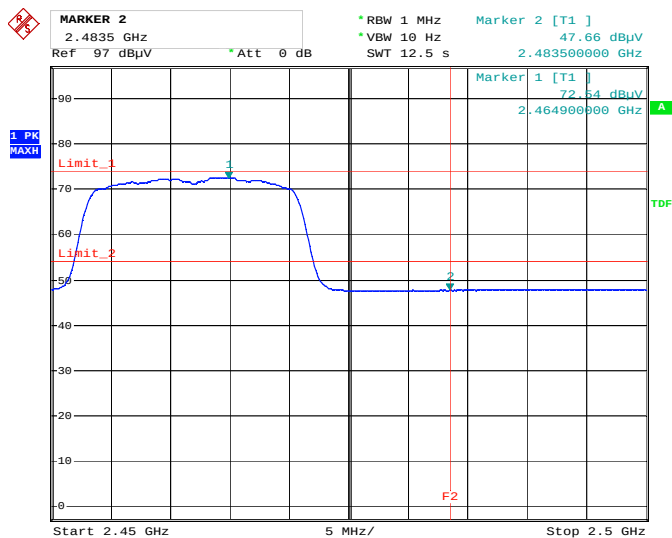
Date: 5.JUL.2017 12:59:47

Chain0 : Restricted Band Bandedge @ 802.11n(HT20) Mode Ch11 PK



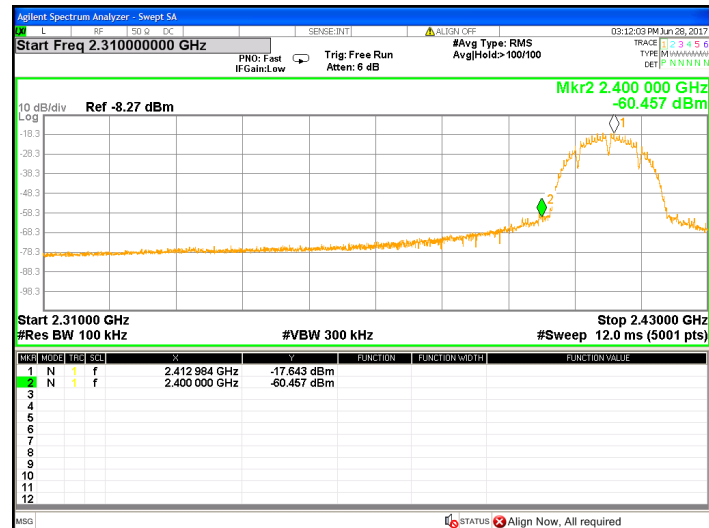
Date: 5.JUL.2017 13:17:59

Chain0 : Restricted Band Bandedge @ 802.11n(HT20) Mode Ch11 AV

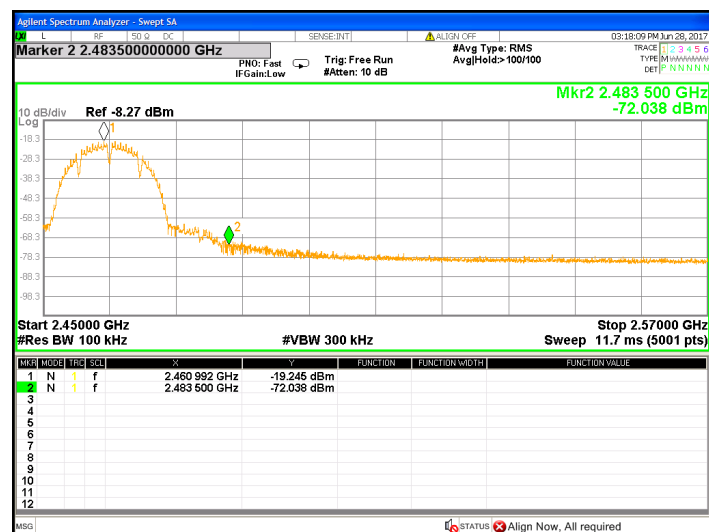


Date: 5.JUL.2017 13:19:05

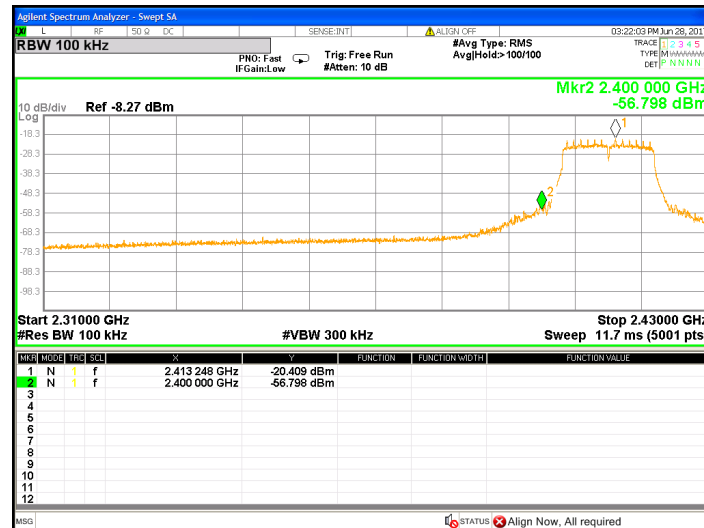
Chain0 : Authorized Band Bandedge @ 802.11b Mode Ch1



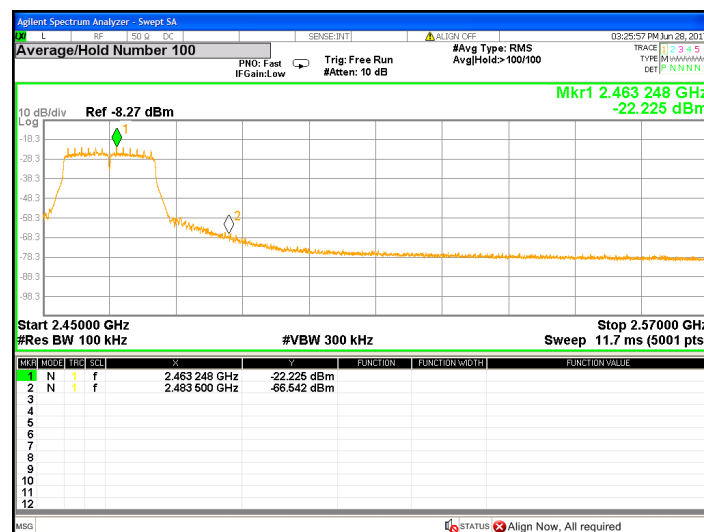
Chain0 : Authorized Band Bandedge @ 802.11b Mode Ch11



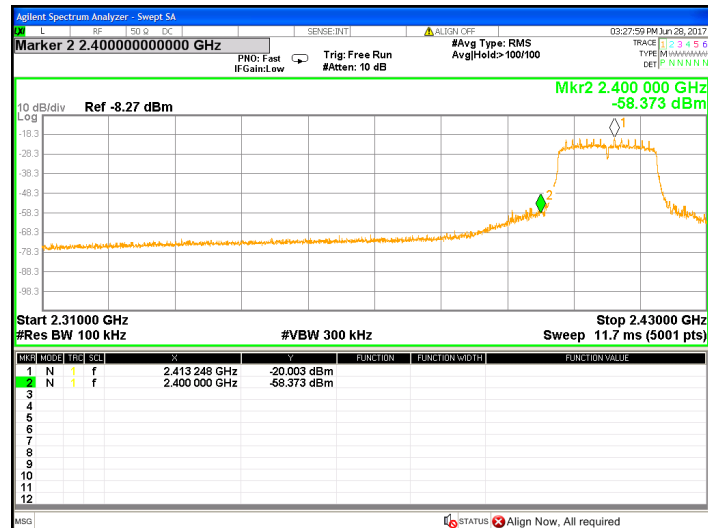
Chain0 : Authorized Band Bandedge @ 802.11g Mode Ch1



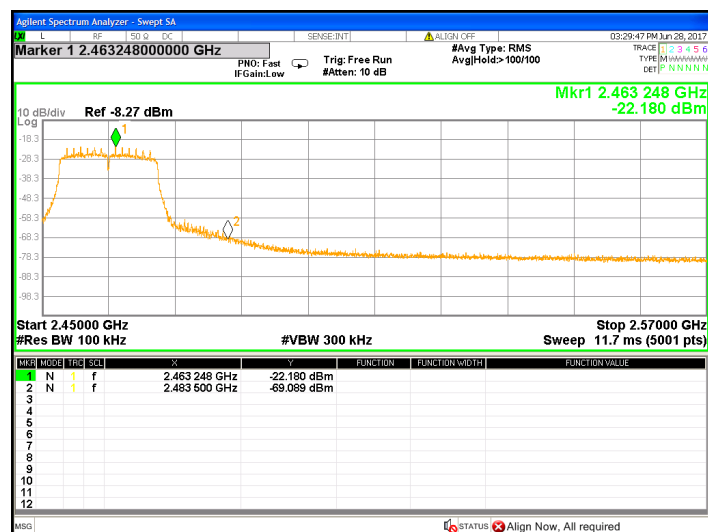
Chain0 : Authorized Band Bandedge @ 802.11g Mode Ch11



Chain0 : Authorized Band Bandedge @ 802.11n(HT20) Mode Ch1



Chain0 : Authorized Band Bandedge @ 802.11n(HT20) Mode Ch11



8. AC Power Line Conducted Emission

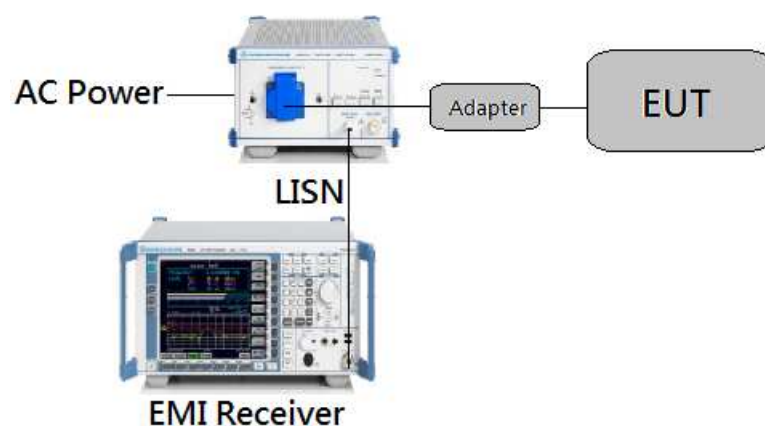
8.1. Measuring instrument setting

Receiver Function	Setting
Detector	QP
Start frequency	0.15MHz
Stop frequency	30MHz
IF bandwidth	9 kHz
Attenuation	10dB

8.2. Test Procedure

- Step 1 Configure the EUT according to ANSI C63.10:2013. The EUT or host of EHT has to be placed 0.4 meter far from the conducting wall of the shielding room and at least 80 centimeters from any other grounded conducting surface.
- Step 2 Connect EUT or host of EUT to the power mains through a line impedance stabilization network.
- Step 3 All the companion devices are connected to the other LISN. The LISN should provide 50Uh/50ohms coupling impedance.
- Step 4 The frequency range from 150 kHz to 30MHz was searched.
- Step 5 Set the test-receiver system to peak detector and specified bandwidth with maximum hold mode.
- Step 6 The measurement has to be done between each power line and ground at the power terminal.

8.3. Test Diagram



8.4. Limit

Freq. (MHz)	Conducted Limit (dBuV)	
	Q.P.	Ave.
0.15~0.50	66 – 56	56 – 46
0.50~5.00	56	46
5.00~30.0	60	50

8.5. Operating Environment Condition

Temperature (°C) : 25
Relative Humidity (%) : 50
Atmospheric Pressure (hPa) : 1008
Test Date : 7/24/2017 & 7/04/2018

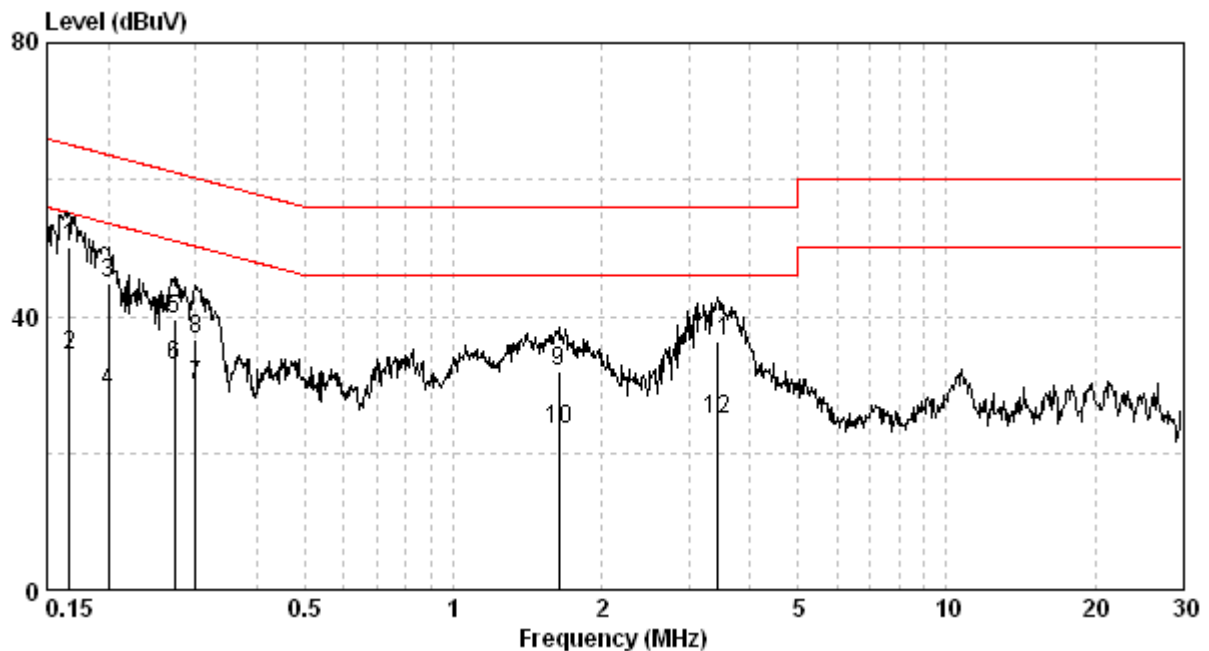
8.6. Test Results

Phase:	Live Line			
Temperature:	25	°C	Model No.:	ATSFOCUS01
Relative Humidity:	55	%	Test Date:	Jul. 24, 2017
Atmospheric Pressure:	1009	hPa	Test voltage:	120Vac, 60 Hz

Frequency (MHz)	Corr. Factor (dB)	Level Qp (dBuV)	Limit Qp (dBuV)	Level Av (dBuV)	Limit Av (dBuV)	Margin (dB)	
						Qp	Av
0.167	9.70	50.19	65.12	34.20	55.12	-14.93	-20.92
0.200	9.70	44.90	63.62	28.94	53.62	-18.72	-24.68
0.272	9.70	39.65	61.07	32.71	51.07	-21.42	-18.36
0.300	9.70	36.53	60.24	29.91	50.24	-23.71	-20.33
1.636	9.72	31.83	56.00	23.44	46.00	-24.17	-22.56
3.417	9.75	36.43	56.00	24.81	46.00	-19.57	-21.19

Remark:

1. Corr. Factor (dB) = AMN Factor (dB) + Cable Loss (dB)
2. Over Limit (dB) = Level (dBuV) – Limit (dBuV)

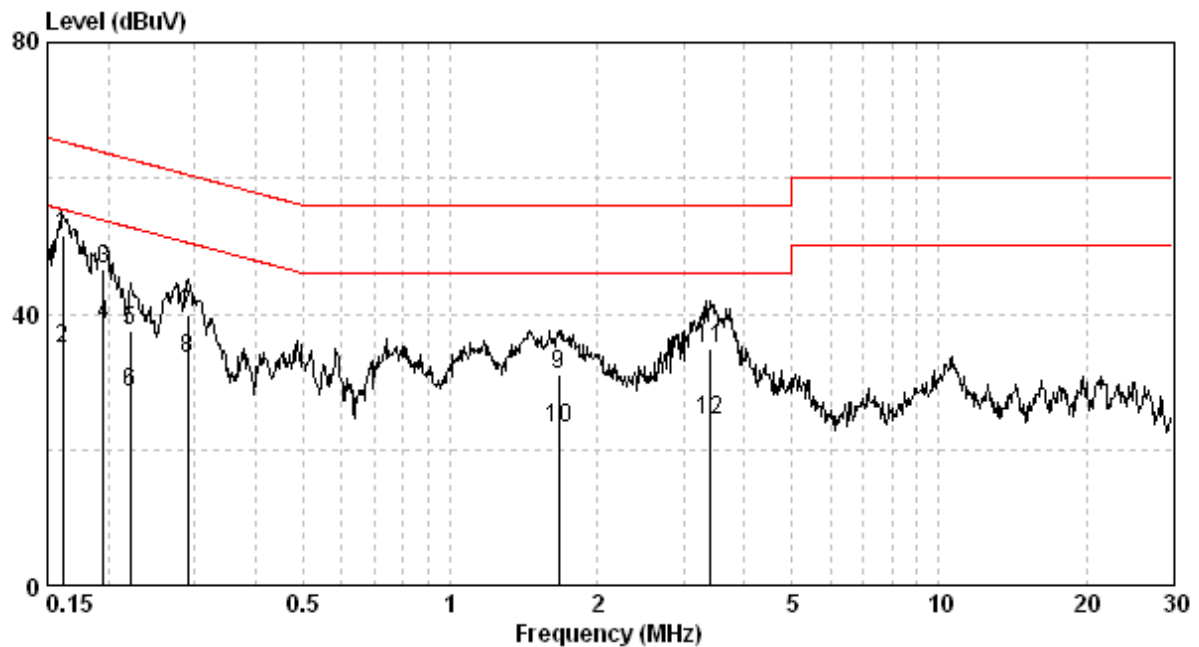


Phase:	Neutral Line			
Temperature:	25	°C	Model No.:	ATSFOCUS01
Relative Humidity:	55	%	Test Date:	Jul. 24, 2017
Atmospheric Pressure:	1009	hPa	Test voltage:	120Vac, 60 Hz

Frequency (MHz)	Corr. Factor (dB)	Level Qp (dBuV)	Limit Qp (dBuV)	Level Av (dBuV)	Limit Av (dBuV)	Margin (dB)	
						Qp	Av
0.162	9.73	51.58	65.38	34.73	55.38	-13.80	-20.65
0.195	9.73	46.48	63.80	38.28	53.80	-17.32	-15.52
0.222	9.73	37.53	62.74	28.52	52.74	-25.21	-24.22
0.291	9.73	39.91	60.50	33.35	50.50	-20.59	-17.15
1.671	9.74	31.20	56.00	23.08	46.00	-24.80	-22.92
3.399	9.75	34.88	56.00	24.28	46.00	-21.12	-21.72

Remark:

1. Corr. Factor (dB) = AMN Factor (dB) + Cable Loss (dB)
2. Over Limit (dB) = Level (dBuV) – Limit (dBuV)

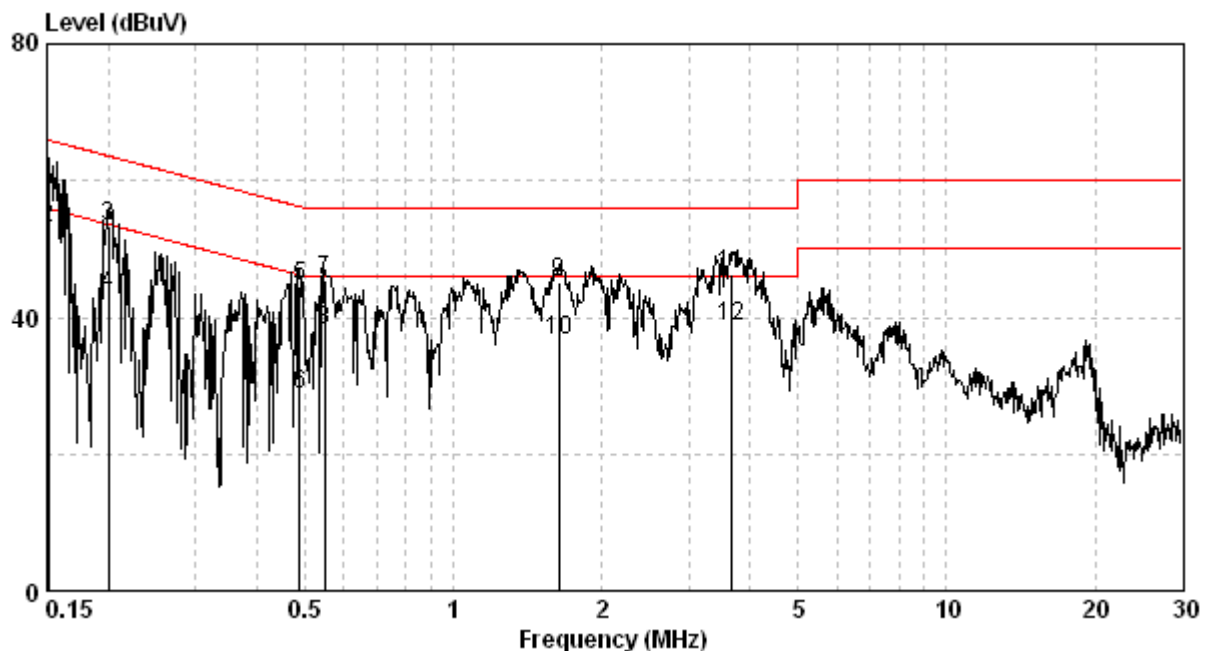


Phase:	Live Line			
Temperature:	25	°C	Model No.:	ATSFOCUS01
Relative Humidity:	55	%	Test Date:	Jul. 04, 2018
Atmospheric Pressure:	1009	hPa	Test voltage:	240Vac, 60 Hz

Frequency (MHz)	Corr. Factor (dB)	Reading QP (dBuV)	Level QP (dBuV)	Limit QP (dBuV)	Reading AV (dBuV)	Level AV (dBuV)	Limit AV (dBuV)	Margin (dB) QP	AV
0.151	9.73	51.73	61.46	65.96	43.34	53.07	55.96	-4.50	-2.89
0.200	9.73	43.67	53.40	63.62	33.65	43.38	53.62	-10.22	-10.24
0.489	9.74	34.94	44.68	56.19	18.93	28.67	46.19	-11.50	-17.52
0.549	9.75	35.60	45.35	56.00	28.35	38.10	46.00	-10.65	-7.90
1.636	9.82	35.23	45.05	56.00	26.87	36.69	46.00	-10.95	-9.31
3.681	9.85	36.33	46.18	56.00	28.88	38.73	46.00	-9.82	-7.27

Remark:

1. Corr. Factor (dB) = AMN Factor (dB) + Cable Loss (dB)
2. Over Limit (dB) = Level (dBuV) – Limit (dBuV)

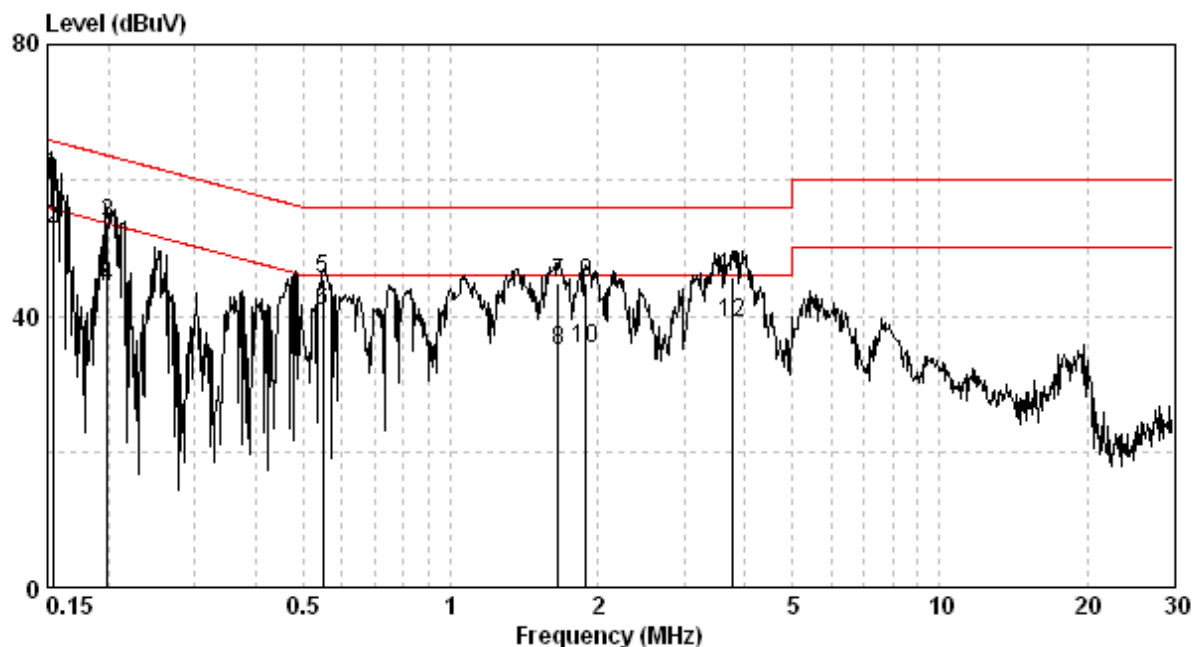


Phase:	Neutral Line			
Temperature:	25	°C	Model No.:	ATSFOCUS01
Relative Humidity:	55	%	Test Date:	Jul. 04, 2018
Atmospheric Pressure:	1009	hPa	Test voltage:	240Vac, 60 Hz

Frequency (MHz)	Corr. Factor (dB)	Reading QP (dBuV)	Level QP (dBuV)	Limit QP (dBuV)	Reading AV (dBuV)	Level AV (dBuV)	Limit AV (dBuV)	Margin QP (dB)	Margin AV (dB)
0.154	9.74	50.82	60.56	65.78	42.97	52.71	55.78	-5.22	-3.07
0.199	9.74	44.00	53.74	63.67	34.42	44.16	53.67	-9.93	-9.51
0.549	9.75	35.69	45.45	56.00	30.85	40.61	46.00	-10.55	-5.39
1.662	9.82	35.02	44.84	56.00	25.11	34.94	46.00	-11.16	-11.06
1.888	9.83	35.10	44.93	56.00	25.34	35.17	46.00	-11.07	-10.83
3.759	9.86	35.85	45.70	56.00	29.18	39.03	46.00	-10.30	-6.97

Remark:

1. Corr. Factor (dB) = AMN Factor (dB) + Cable Loss (dB)
2. Over Limit (dB) = Level (dBuV) – Limit (dBuV)



Appendix A: Test equipment list

Test Equipment/ Test site	Brand	Model No.	Serial No.	Calibration Date	Next Calibration Date
ESCI EMI Test Receiver	Rohde & Schwarz	ESCI	100018	2016/11/30	2017/11/29
Spectrum Analyzer	Rohde & Schwarz	FSP30	100137	2016/08/16	2017/08/15
Horn Antenna (1-18G)	SHWARZBECK	BBHA 9120 D	9120D-456	2014/08/29	2017/08/27
Horn Antenna (14-42G)	SHWARZBECK	BBHA 9170	BBHA9170159	2014/09/16	2017/09/14
Broadband Antenna	SHWARZBECK	VULB 9168	9168-172	2017/04/05	2018/04/04
Pre-Amplifier	EMC Co.	EMC12635SE	980205	2016/10/08	2017/10/07
Pre-Amplifier	MITEQ	JS4-26004000--27-8A	828825	2016/09/12	2017/09/11
Power Meter	Anritsu	ML2495A	0844001	2016/11/09	2017/11/08
Power Sensor	Anritsu	MA2411B	0738452	2016/11/09	2017/11/08
Signal Analyzer	Agilent	N9030A	MY51380492	2016/09/13	2017/09/12
966-2(A) Cable 9kHz~26.5GHz	SUHNER	SMA / EX 100	N/A	2016/08/16	2017/08/15
966-2(B) Cable 9kHz~26.5GHz	SUHNER	SUCOFLEX 104P	CB0005	2016/08/16	2017/08/15
RF Cable 9kHz~26.5GHz	SUHNER	SUCOFLEX 102	CB0006	2017/05/04	2018/05/03
966-2_3m Semi-Anechoic Chamber	966_2	CEM-966_2	N/A	2017/03/29	2018/03/28
High Pass Filter	Wainwright	WHKX3.0/18G-12SS	N/A	2017/06/02	2018/06/01
Active Loop Antenna	SCHWARZBECK MESS-ELEKTRONIC	FMZB1519	1519-067	2017/03/30	2018/03/29

Note: No Calibration Required (NCR).

Test Equipment/ Test site	Brand	Model No.	Serial No.	Calibration Date	Next Calibration Date
EMI Test Receiver	R&S	ESR7	101822	2017/06/01	2018/05/31
Two-Line V-Network	R&S	ENV216	101160	2016/11/16	2017/11/15
Two-Line -V-Network	R&S	ESH3-Z5	838979/014	2016/09/30	2017/09/29
CON-2 Shielded Room	N/A	N/A	N/A	NCR	NCR
CON-2 Cable	SUHNER	BNC / RG-58	2146637	2017/05/08	2018/05/07
Test software	Audix	e3	4.20040112L	NCR	NCR

Note: No Calibration Required (NCR).

Test Equipment/ Test site	Brand	Model No.	Serial No.	Calibration Date	Next Calibration Date
EMI Receiver	R&S	ESCI	100059	2017/11/13	2018/11/12
Two-Line V-Network	R&S	ENV216	101159	2018/06/01	2019/05/31
Two-Line -V-Network	R&S	ESH3-Z5	825562/003	2017/09/04	2018/09/03
CON-1 Shielded Room	N/A	N/A	N/A	NCR	NCR
CON-1 Cable	SUHNER	SUCOFLEX-104	26438414	2018/05/03	2019/05/02
Test software	Audix	e3	4.20040112L	NCR	NCR

Note: No Calibration Required (NCR).

Appendix B: Measurement Uncertainty

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

Item	Uncertainty
Vertically polarized radiated disturbances from 30MHz~1GHz in a semi-anechoic chamber at a distance of 3m	5.14 dB
Horizontally polarized radiated disturbances from 30MHz~1GHz in a semi-anechoic chamber at a distance of 3m	5.22 dB
Vertically polarized Radiated disturbances from 1GHz~18GHz in a semi-anechoic chamber at a distance of 3m	3.64 dB
Horizontally polarized Radiated disturbances from 1GHz~18GHz in a semi-anechoic chamber at a distance of 3m	3.64 dB
Vertically polarized Radiated disturbances from 18GHz~40GHz in a semi-anechoic chamber at a distance of 3m	2.68 dB
Horizontally polarized Radiated disturbances from 18GHz~40GHz in a semi-anechoic chamber at a distance of 3m	2.68 dB
Radiated disturbances from 9kHz~30MHz in a semi-anechoic chamber at a distance of 3m	3.54 dB
Emission on the Band Edge Test	3.64 dB
RF Antenna Conducted Spurious Test	1.22 dB
Maximum Output Power Test	0.42 dB
20dB Bandwidth Test	1.22 dB
Carrier Frequency Separation Test	1.22 dB
Number of Hopping Frequencies Test	1.22 dB
Time of Occupancy (Dwell Time) Test	1.22 dB
AC Power Line Conducted Emission	2.48 dB