RF TEST REPORT

Report No.: 16050028-FCC-R1

Supersede Report No.: N/A

Applicant	Quectel Wireless Solutions Co., Ltd.
Product Name	Wifi& BT Module
Model No.	FC20
Serial No.	N/A
Test Standard	FCC Part 15.247: 2016, ANSI C63.10: 2013
Test Date	February 07 to March 02, 2017
Issue Date	March 03, 2017
Test Result	☑ Pass ☐ Fail
Equipment complied with the specification	☑
Equipment did not comply with the specification	☐

Leen Yang	David Huang	
Leen Yang Test Engineer	David Huang Checked By	

This test report may be reproduced in full only

Test result presented in this test report is applicable to the tested sample only

Issued by:

SIEMIC (SHENZHEN-CHINA) LABORATORIES

Zone A, Floor 1, Building 2 Wan Ye Long Technology Park

South Side of Zhoushi Road, Bao' an District, Shenzhen, Guangdong China 518108

Phone: +86 0755 2601 4629801 Email: China@siemic.com.cn

Laboratories Introduction

SIEMIC, headquartered in the heart of Silicon Valley, with superior facilities in US and Asia, is one of the leading independent testing and certification facilities providing customers with one-stop shop services for Compliance Testing and Global Certifications.

In addition to testing and certification, SIEMIC provides initial design reviews and compliance management throughout a project. Our extensive experience with China, Asia Pacific, North America, European, and International compliance requirements, assures the fastest, most cost effective way to attain regulatory compliance for the global markets.

Accreditations for Conformity Assessment

Country/Region	Scope
USA	EMC, RF/Wireless, SAR, Telecom
Canada	EMC, RF/Wireless, SAR, Telecom
Taiwan	EMC, RF, Telecom, SAR, Safety
Hong Kong	RF/Wireless, SAR, Telecom
Australia	EMC, RF, Telecom, SAR, Safety
Korea	EMI, EMS, RF, SAR, Telecom, Safety
Japan	EMI, RF/Wireless, SAR, Telecom
Singapore	EMC, RF, SAR, Telecom
Europe	EMC, RF, SAR, Telecom, Safety

This page has been left blank intentionally.

CONTENTS

1. Report Revision History

Report No.	Report Version	Description	Issue Date
16050028-FCC-R1	NONE	Original	March 03, 2017

2. Customer information

Applicant Name	Quectel Wireless Solutions Co., Ltd.
Applicant Add	RM501,Building 13,No.99 TianZhou Road,Xuhui District,Shanghai,China
Manufacturer	Quectel Wireless Solutions Co., Ltd.
Manufacturer Add	RM501,Building 13,No.99 TianZhou Road,Xuhui District,Shanghai,China

3. Test site information

Lab performing tests	SIEMIC (Shenzhen-China) LABORATORIES
Lab Address	Zone A, Floor 1, Building 2 Wan Ye Long Technology Park South Side of Zhoushi Road, Bao' an District, Shenzhen, Guangdong China 518108
FCC Test Site No.	718246
IC Test Site No.	4842E-1
Test Software	Radiated Emission Program-To Shenzhen v2.0

4. Equipment under Test (EUT) Information

Description of EUT:	Wifi& BT Module
Main Model:	FC20
Serial Model:	N/A
Date EUT received:	February 06, 2017
Test Date(s):	February 07 to March 02, 2017
Equipment Category：	DTS
Antenna Gain:	Bluetooth/BLE: 3dBi WIFI(2.4G): 3 dBi WIFI(5150-5250MHz): 3 dBi WIFI(5250-5350MHz): 3 dBi WIFI(5470-5725MHz): 3 dBi WIFI(5725-5850MHz): 3 dBi **(Note: The radio module will be sold without antenna, this antenna only used limited to ERP/EIRP or radiated spurious emission test.)**
Antenna type :	Fixed External antenna
Type of Modulation:	Bluetooth: GFSK, π /4DQPSK, 8DPSK BLE: GFSK 802.11b: DSSS 802.11g/n20/n40/ac20/ac40/ac80: OFDM
RF Operating Frequency (ies):	WIFI: 802.11b/g/n(20M): 2412-2462 MHz(TX/RX) WIFI: 802.11n(40M): 2422-2452 MHz(TX/RX) 802.11ac 20: 5180-5240 MHz; 5260-5320 MHz; 5500-5700 MHz; 5745-5825 MHz； (TX/RX) 802.11ac 40: 5190-5230 MHz; 5270-5310 MHz; 5510-5710 MHz; 5755-5795 MHz；(TX/RX) 802.11ac 80: 5210 MHz; 5290 MHz; 5530-5690 MHz; 5775 MHz；(TX/RX) Bluetooth& BLE: 2402-2480 MHz

Conducted Power:	802.11b:15.83dBm 802.11g:13.91dBm 802.11n(20M):13.96dBm 802.11n(40M):12.82dBm
Number of Channels:	WIFI :802.11b/g/n(20M): 11CH WIFI :802.11n(40M): 7CH WIFI :802.11ac20: 24CH WIFI :802.11ac40: 12CH WIFI :802.11ac80: 6CH Bluetooth: 79CH BLE: 40CH
Port:	N/A
Input Power:	Main supply voltage: 3.3V, 500mA IO supply voltage: 1.8V
Trade Name :	Quectel
FCC ID:	XMR201703FC20

5. Test Summary

The product was tested in accordance with the following specifications.

All testing has been performed according to below product classification:

FCC Rules	Description of Test	Result
§15.203	Antenna Requirement	Compliance
§15.247 (a)(2)	DTS (6 dB&20 dB) CHANNEL BANDWIDTH	Compliance
§15.247(b)(3)	Conducted Maximum Output Power	Compliance
§15.247(e)	Power Spectral Density	Compliance
§15.247(d)	Band-Edge & Unwanted Emissions into Restricted Frequency Bands	Compliance
§15.207 (a),	AC Power Line Conducted Emissions	Compliance
§15.205, §15.209, §15.247(d)	Radiated Spurious Emissions & Unwanted Emissions into Restricted Frequency Bands	Compliance

Measurement Uncertainty

Emissions		
Test Item	**Description**	**Uncertainty**
Band-Edge & Unwanted Emissions into Restricted Frequency Bands and Radiated Spurious Emissions & Unwanted Emissions into Restricted Frequency Bands	Confidence level of approximately 95% (in the case where distributions are normal), with a coverage factor of 2 (for EUTs < 0.5m X 0.5m X 0.5m)	+5.6dB/-4.5dB
-	-	-

6. Measurements, Examination And Derived Results

6.1 Antenna Requirement

Applicable Standard

According to § 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the user of a standard antenna jack or electrical connector is prohibited.
The structure and application of the EUT were analyzed to determine compliance with section §15.203 of the rules. §15.203 state that the subject device must meet the following criteria:

a. Antenna must be permanently attached to the unit.

b. Antenna must use a unique type of connector to attach to the EUT.

Unit must be professionally installed, and installer shall be responsible for verifying that the correct antenna is employed with the unit.
And according to FCC 47 CFR section 15.247 (b), if the transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

Antenna Connector Construction

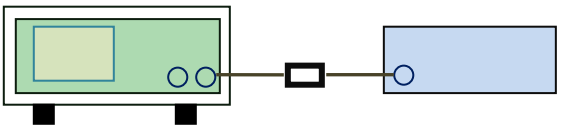
The EUT has 1 antenna:
An non-standard and Reverse polarity interface attached Fixed External antenna for Bluetooth/BLE/2.4G WIFI/5G WIFI, the gain is 3dBi for Bluetooth/BLE/2.4G WIFI, the gain is 3dBi for 5150-5250MHz/5250-5350MHz/5470-5725 MHz / 5725-2850MHz MHz 5G WIFI.

The antenna meets up with the ANTENNA REQUIREMENT.

Result: Compliance.

6.2 DTS (6 dB&20 dB) Channel Bandwidth

Temperature	24°C
Relative Humidity	52%
Atmospheric Pressure	1007mbar
Test date :	February 10, 2017
Tested By :	Leen Yang

Spec	Item	Requirement	Applicable
§ 15.247(a)(2)	a)	6dB BW≥ 500kHz; 20dB BW≥ 500kHz;	☑
RSS Gen(4.6.1)	b)	99% BW: For FCC reference only; required by IC.	☑
Test Setup			
Test Procedure	558074 D01 DTS MEAS Guidance v03r03, 8.1 DTS bandwidth 6dB bandwidth a) Set RBW = 100 kHz. b) Set the video bandwidth (VBW) ≥ 3 × RBW. c) Detector = Peak. d) Trace mode = max hold. e) Sweep = auto couple. f) Allow the trace to stabilize. g) Measure the maximum width of the emission that is constrained by the freq uencies associated with the two outermost amplitude points (upper and lower fr equencies) that are attenuated by 6 dB relative to the maximum level measure d in the fundamental emission. 20dB bandwidth C63.10 Occupied Bandwidth (OBW=20dB bandwidth) 1. Set RBW = 1%-5% OBW. 2. Set the video bandwidth (VBW) ≥ 3 x RBW. 3. Set the span range between 2 times and 5 times of the OBW. 4. Sweep time=Auto, Detector=PK, Trace=Max hold. 5. Once the reference level is established, the equipment is conditioned with t		

	ypical modulating signals to produce the worst- case (i.e., the widest) bandwidth. Unless otherwise specified for an unlicensed wireless device, measure the bandwidth at the 20 dB levels with respect to the reference level.
Remark	
Result	☑ Pass ☐ Fail

Test Data ☑ Yes ☐ N/A

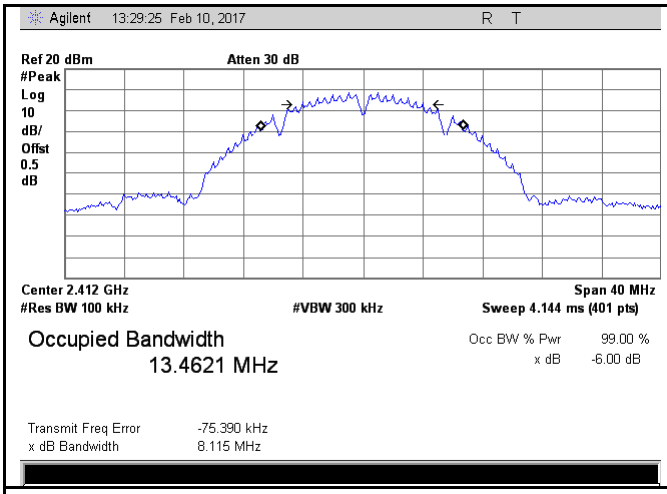
Test Plot ☑ Yes (See below) ☐ N/A

Measurement result

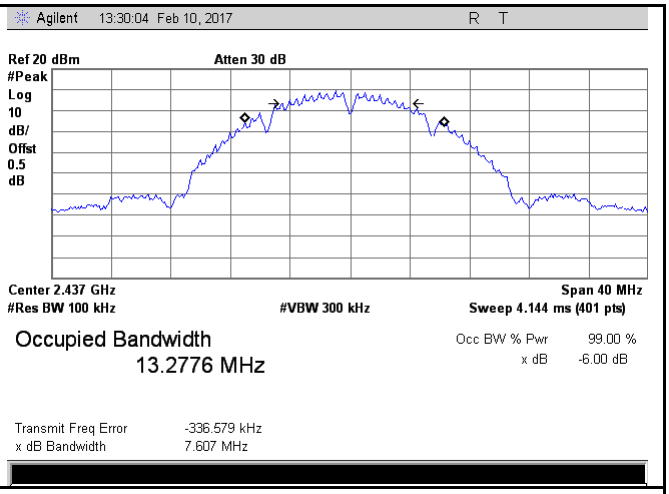
Test mode	CH	Freq (MHz)	6dB Bandwidth (MHz)	20dB Bandwidth (MHz)	Limit (MHz)
802.11b	Low	2412	8.115	15.359	≥ 0.5
	Mid	2437	7.607	15.256	≥ 0.5
	High	2462	7.558	14.715	≥ 0.5
802.11g	Low	2412	15.961	18.242	≥ 0.5
	Mid	2437	15.433	17.897	≥ 0.5
	High	2462	15.083	17.682	≥ 0.5
802.11n (20M)	Low	2412	16.931	19.226	≥ 0.5
	Mid	2437	15.965	19.032	≥ 0.5
	High	2462	15.153	18.756	≥ 0.5
802.11n (40M)	Low	2422	32.638	38.949	≥ 0.5
	Mid	2437	34.019	39.297	≥ 0.5
	High	2452	35.243	39.563	≥ 0.5

Test Plots

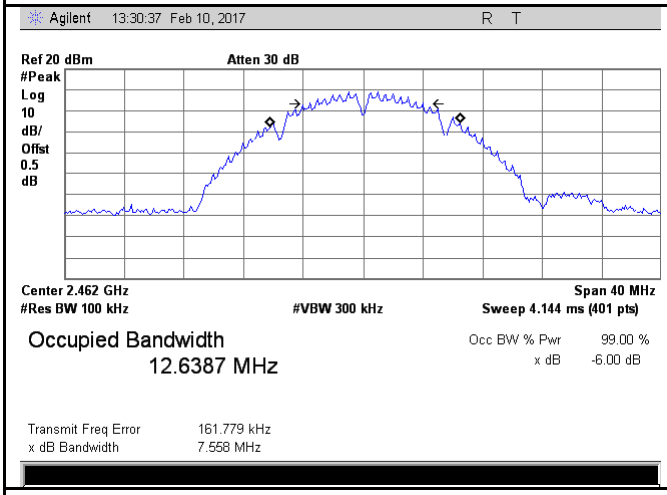
6dB Bandwidth measurement result



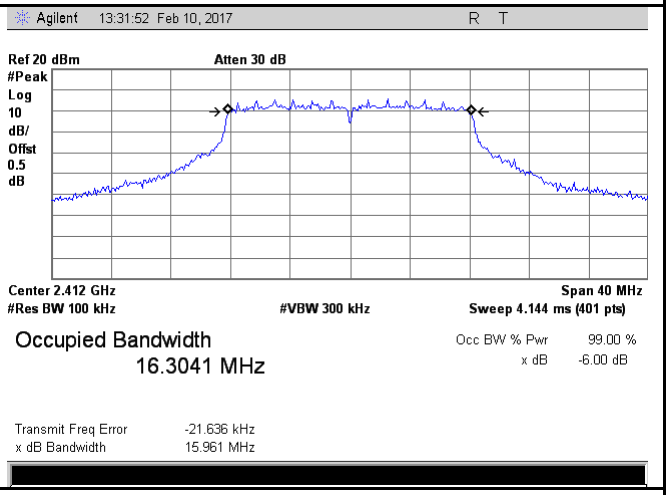
802.11b 6dB Bandwidth - Low CH 2412



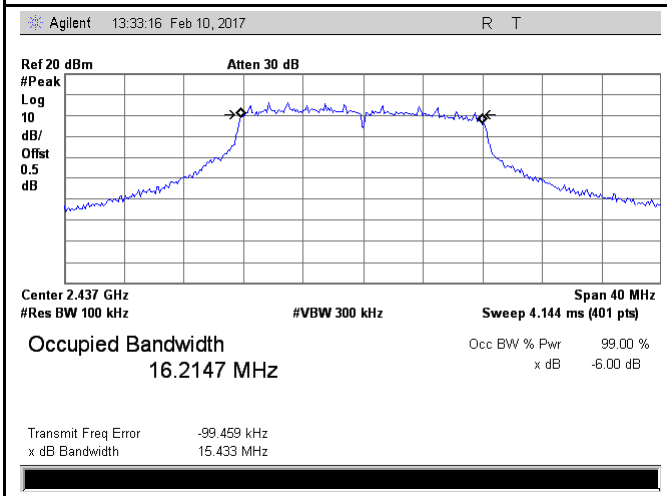
802.11b 6dB Bandwidth - Mid CH 2437



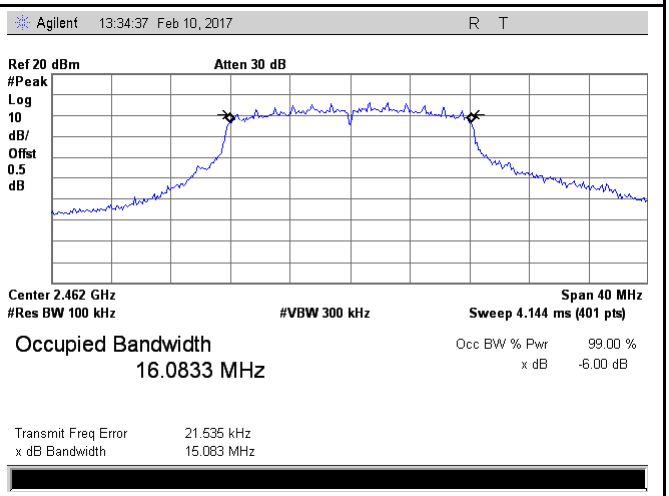
802.11b 6dB Bandwidth - High CH 2462



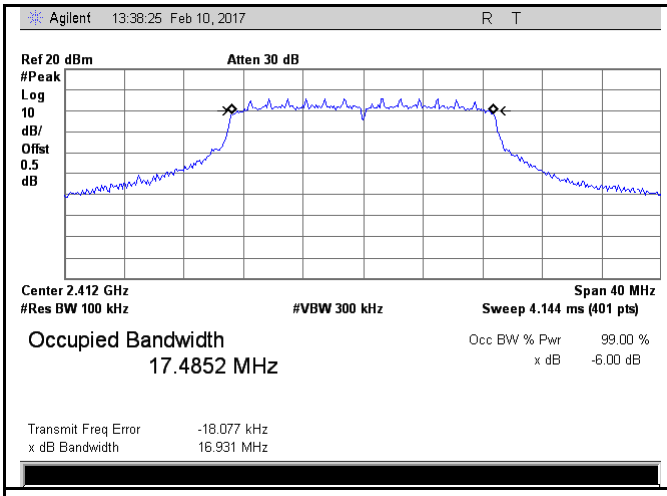
802.11g 6dB Bandwidth - Low CH 2412



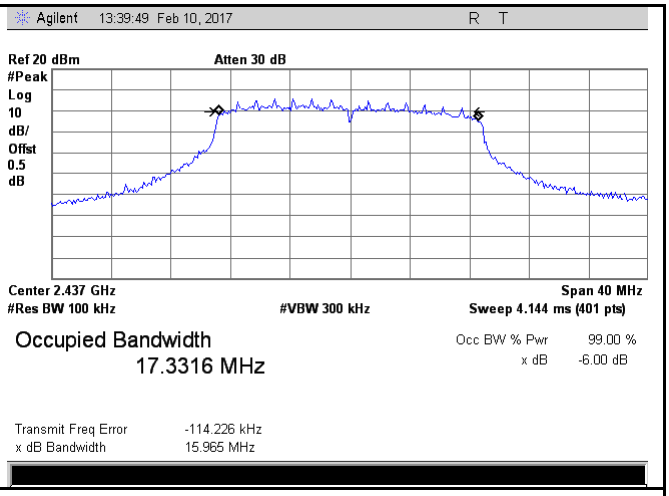
802.11g 6dB Bandwidth - Mid CH 2437



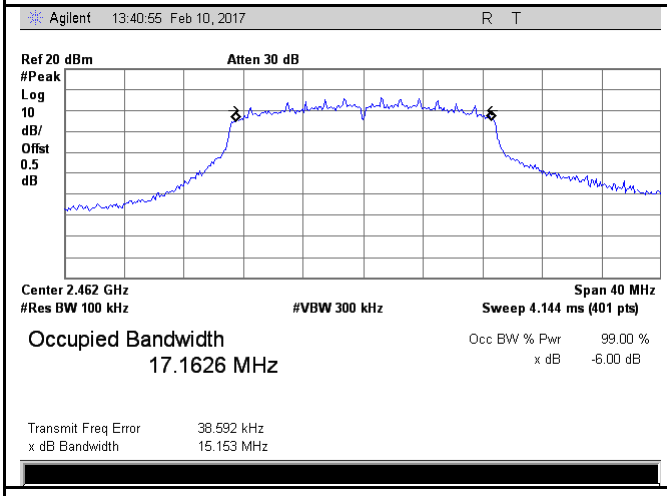
802.11g 6dB Bandwidth - High CH 2462



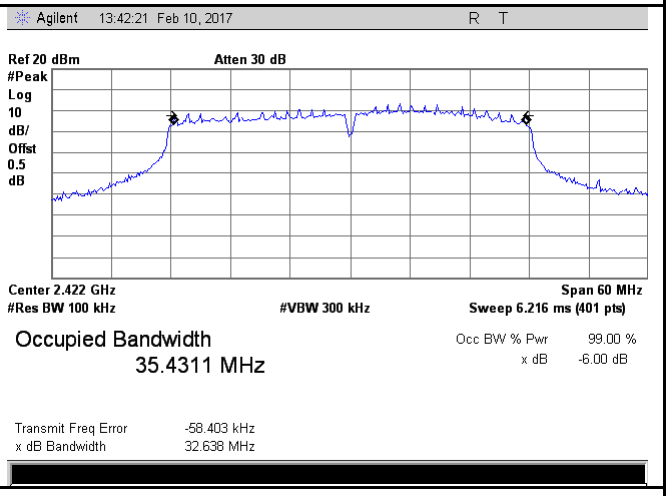
802.11n20 6dB Bandwidth - Low CH 2412



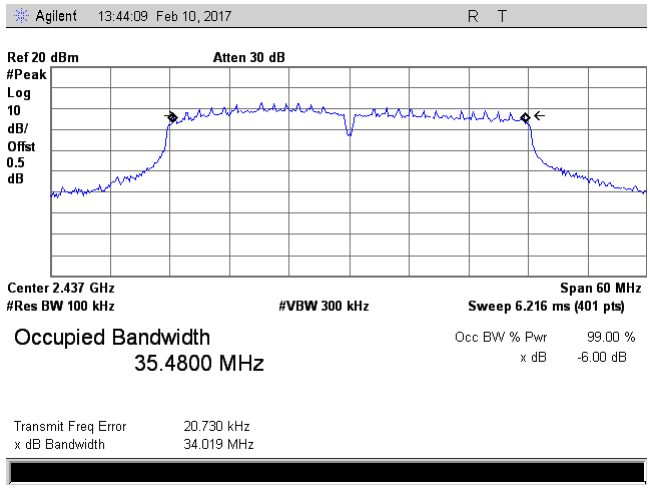
802.11n20 6dB Bandwidth - Mid CH 2437



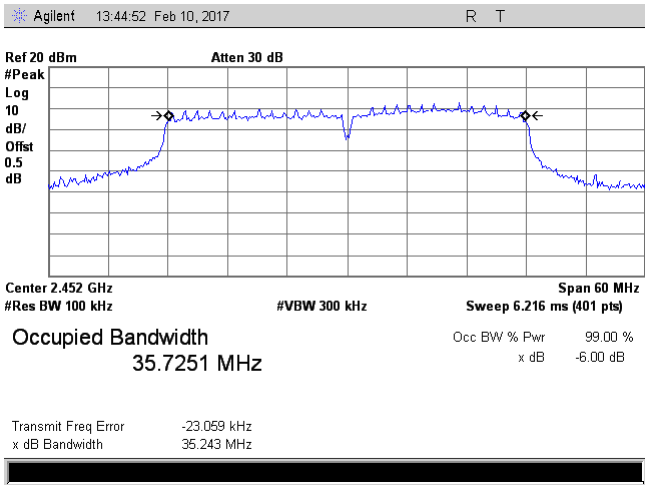
802.11n20 6dB Bandwidth - High CH 2462



802.11n40 6dB Bandwidth - Low CH 2422

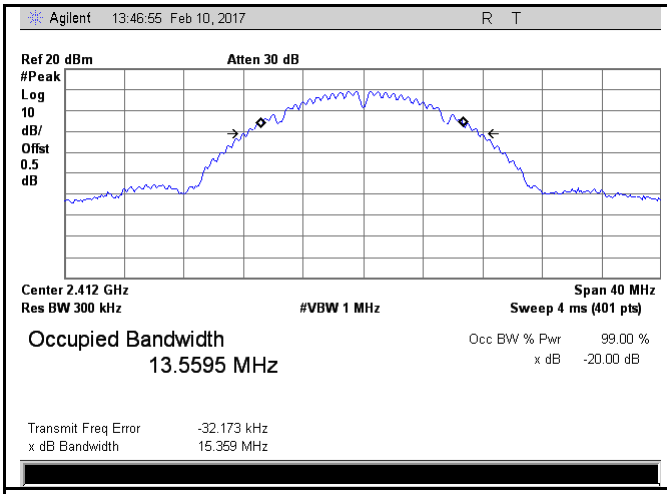


802.11n40 6dB Bandwidth - Mid CH 2437

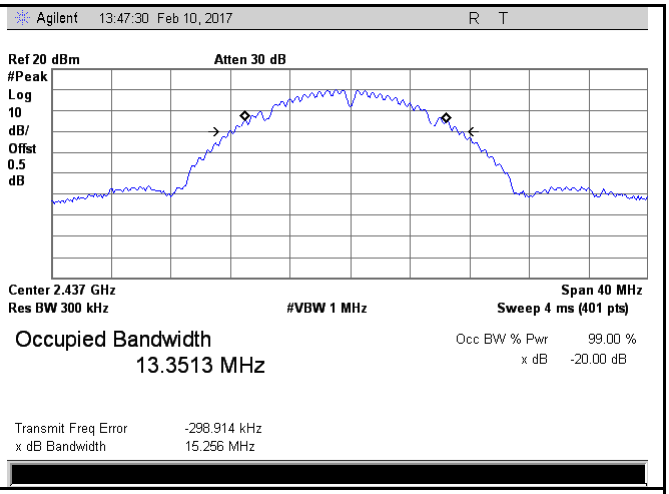


802.11n40 6dB Bandwidth - High CH 2452

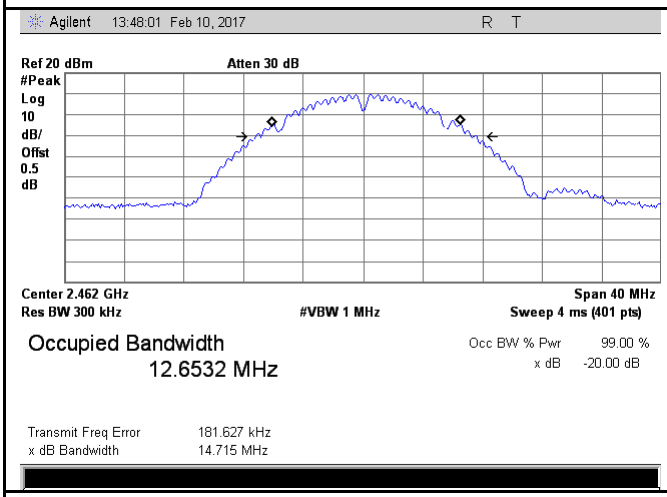
20 dB Bandwidth measurement result



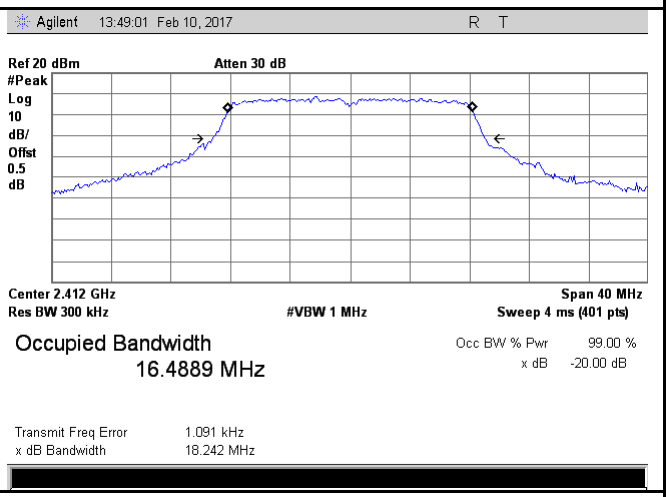
802.11b 20dB Bandwidth - Low CH 2412



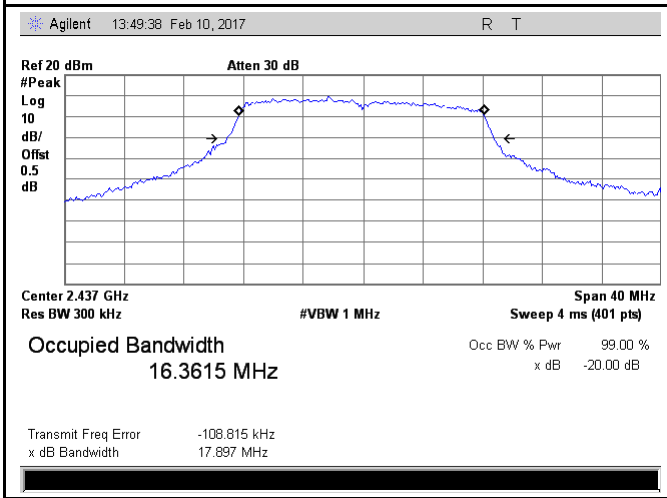
802.11b 20dB Bandwidth - Mid CH 2437



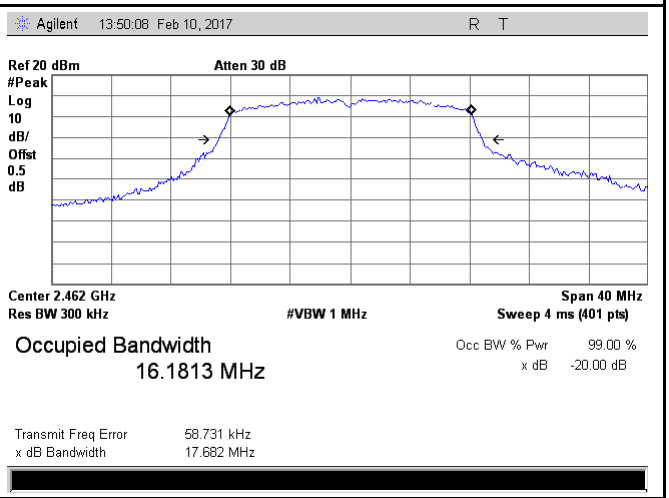
802.11b 20dB Bandwidth - High CH 2462



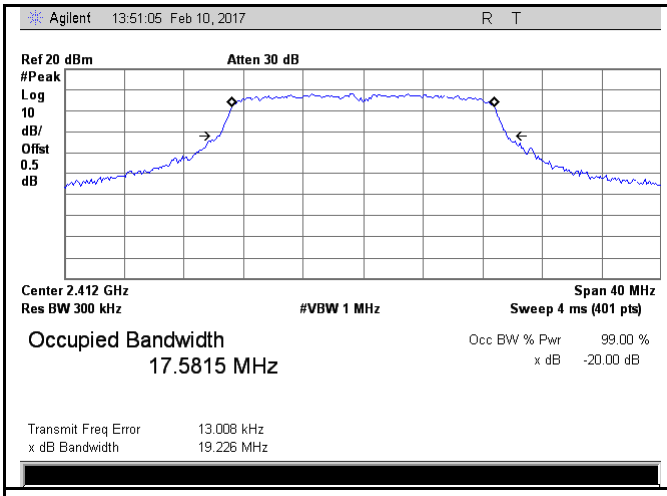
802.11g 20dB Bandwidth - Low CH 2412



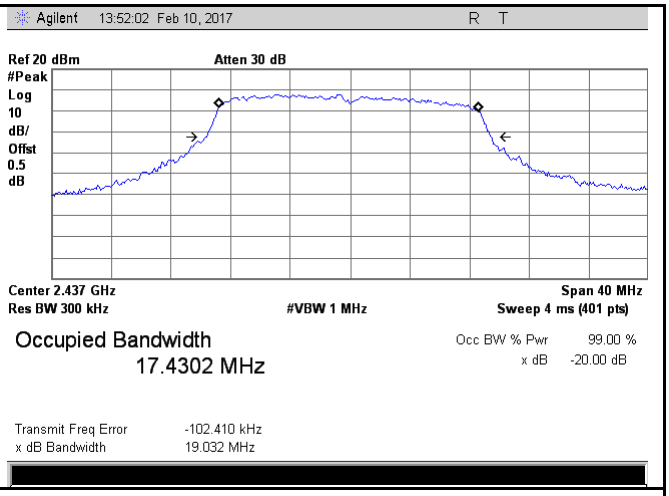
802.11g 20dB Bandwidth - Mid CH 2437



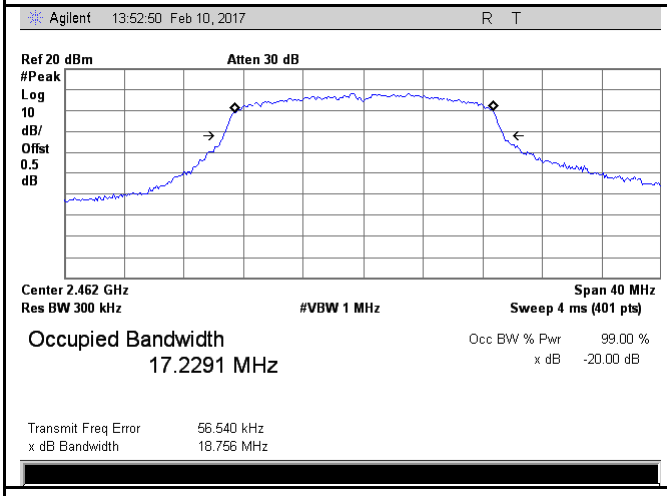
802.11g 20dB Bandwidth - High CH 2462



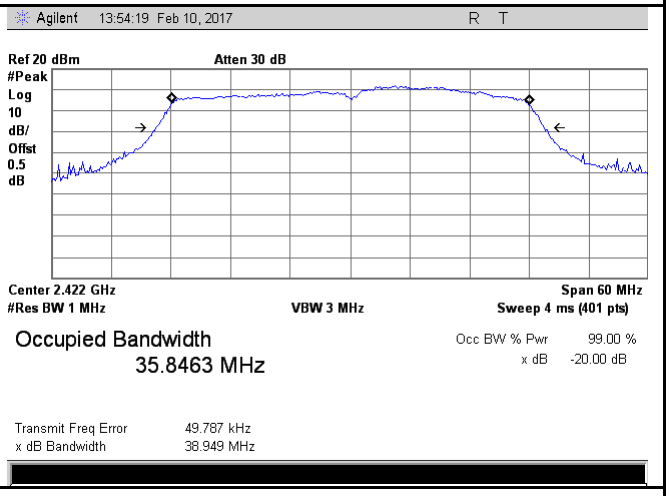
802.11n20 20dB Bandwidth - Low CH 2412



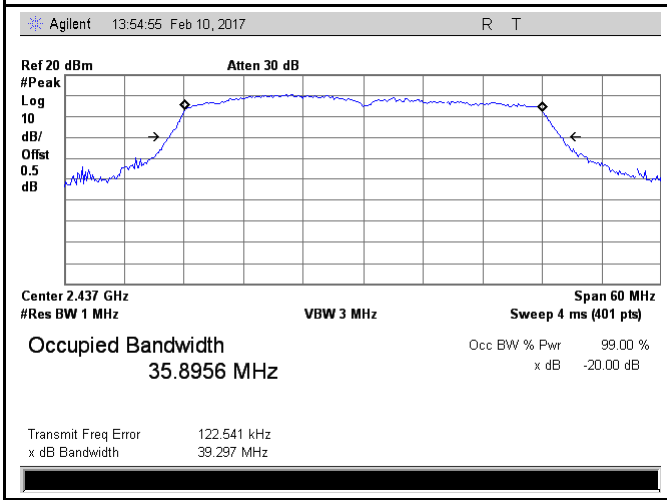
802.11n20 20dB Bandwidth - Mid CH 2437



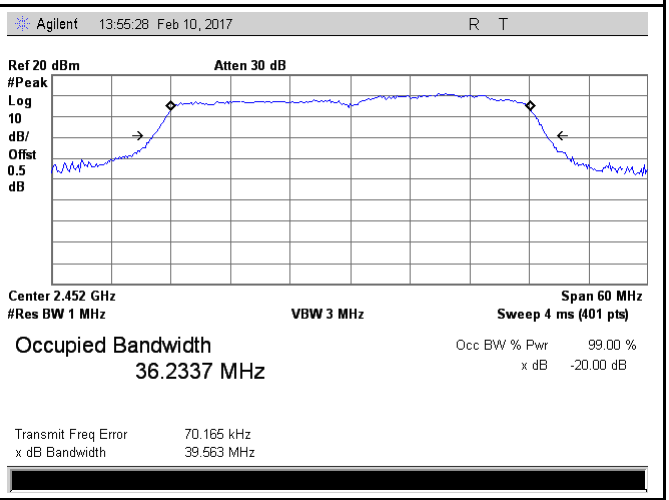
802.11n20 20dB Bandwidth - High CH 2462



802.11n40 20dB Bandwidth - Low CH 2422



802.11n40 20dB Bandwidth - Mid CH 2437

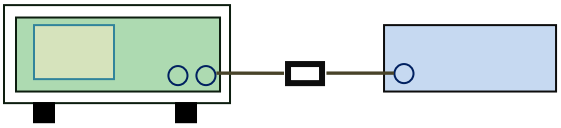


802.11n40 20dB Bandwidth - High CH 2452

6.3 Maximum Output Power

Temperature	24°C
Relative Humidity	52%
Atmospheric Pressure	1007mbar
Test date :	February 10, 2017
Tested By :	Leen Yang

Requirement(s):

Spec	Item	Requirement	Applicable
§15.247(b)(3),RSS210(A8.4)	a)	FHSS in 2400-2483.5MHz with ≥ 75 channels: ≤ 1 Watt	☐
	b)	FHSS in 5725-5850MHz: ≤ 1 Watt	☐
	c)	For all other FHSS in the 2400-2483.5MHz band: ≤ 0.125 Watt.	☐
	d)	FHSS in 902-928MHz with ≥ 50 channels: ≤ 1 Watt	☐
	e)	FHSS in 902-928MHz with ≥ 25 & <50 channels: ≤ 0.25 Watt	☐
	f)	DTS in 902-928MHz, 2400-2483.5MHz: ≤ 1 Watt	☑
Test Setup			
Test Procedure	558074 D01 DTS MEAS Guidance v03r03, 9.1.2 Integrated band power method Maximum output power measurement procedure - a) Set span to at least 1.5 times the OBW. - b) Set RBW = 1-5% of the OBW, not to exceed 1 MHz. - c) Set VBW ≥ 3 x RBW. - d) Number of points in sweep ≥ 2 × span / RBW. (This gives bin-to-bin spacing ≤ RBW/2, so that narrowband signals are not lost between frequency bins.) - e) Sweep time = auto. - f) Detector = RMS (i.e., power averaging), if available. Otherwise, use sample detector mode. - g) If transmit duty cycle < 98 %, use a sweep trigger with the level set to enable triggering only on full power pulses. The transmitter shall operate at maximum		

	power control level for the entire duration of every sweep. If the EUT transmits continuously (i.e., with no off intervals) or at duty cycle ≥ 98 %, and if each transmission is entirely at the maximum power control level, then the trigger shall be set to " free run" . - h) Trace average at least 100 traces in power averaging (i.e., RMS) mode. - i) Compute power by integrating the spectrum across the OBW of the signal using the instrument' s band power measurement function, with band limits set equal to the OBW band edges. If the instrument does not have a band power function, sum the spectrum levels (in power units) at intervals equal to the RBW extending across the entire OBW of the spectrum.
Remark	
Result	☑ Pass ☐ Fail

Test Data ☑ Yes ☐ N/A

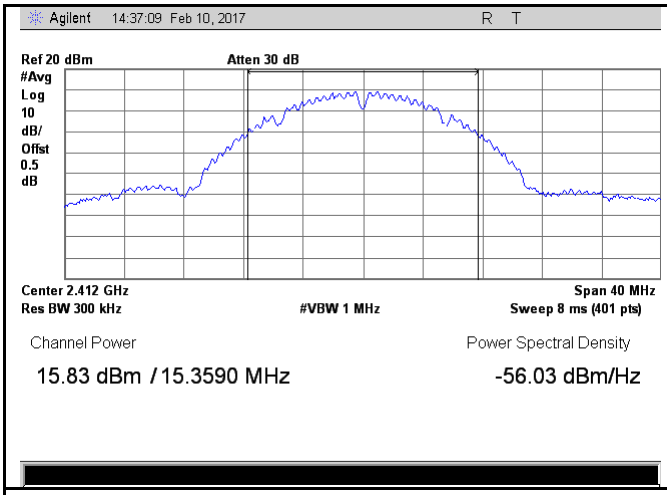
Test Plot ☑ Yes (See below) ☐ N/A

Output Power measurement result

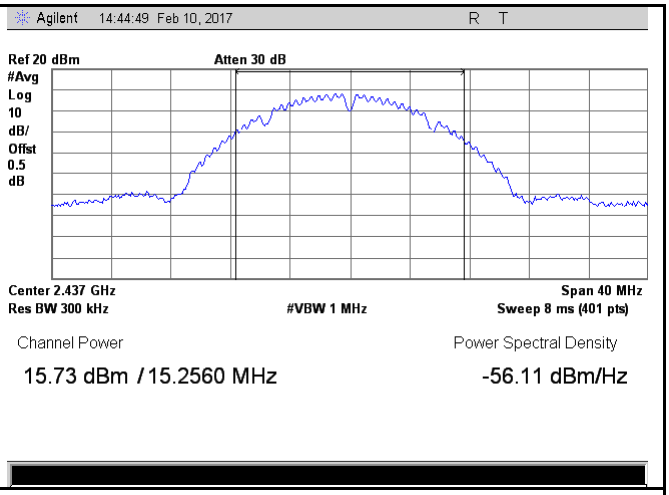
Type	Test mode	CH	Freq (MHz)	Conducted Power (dBm)	Limit (dBm)	Result
Output power	802.11b	Low	2412	**15.83**	30	Pass
		Mid	2437	15.73	30	Pass
		High	2462	15.60	30	Pass
	802.11g	Low	2412	13.85	30	Pass
		Mid	2437	**13.91**	30	Pass
		High	2462	13.62	30	Pass
	802.11n (20M)	Low	2412	13.95	30	Pass
		Mid	2437	**13.96**	30	Pass
		High	2462	13.79	30	Pass
	802.11n (40M)	Low	2422	12.79	30	Pass
		Mid	2437	12.81	30	Pass
		High	2452	**12.82**	30	Pass

Test Plots

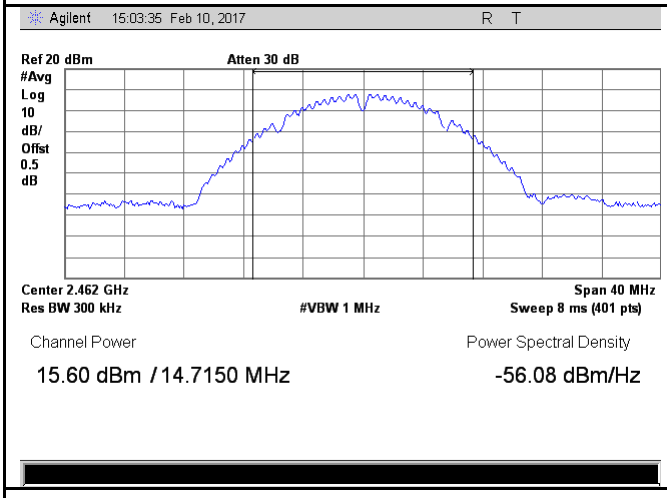
The Average Power



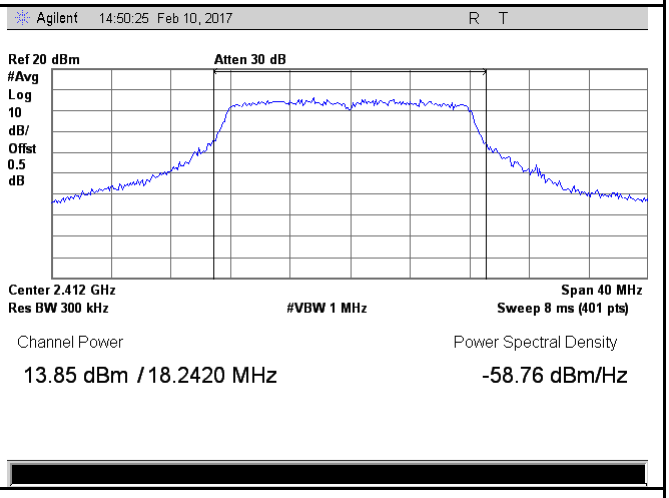
802.11b - AV Output power - Low CH 2412



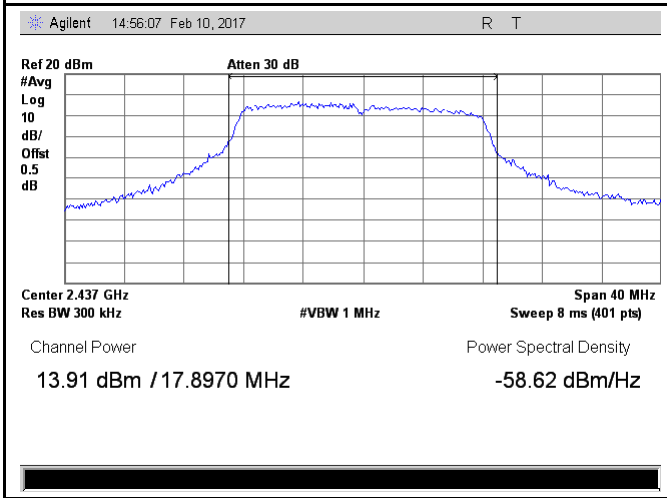
802.11b - AV Output power - Mid CH 2437



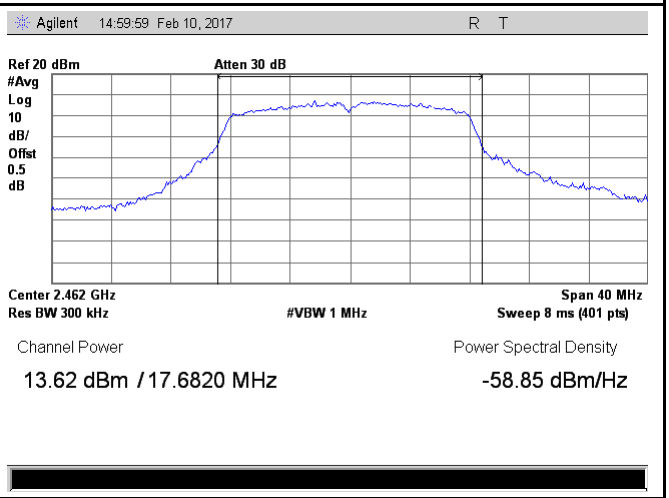
802.11b - AV Output power - High CH 2462



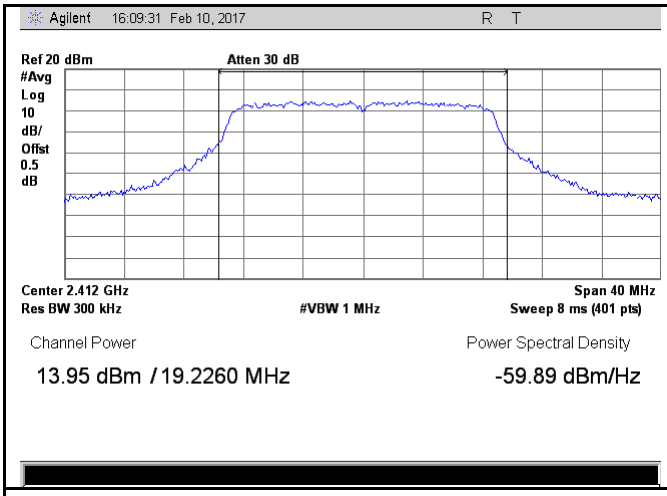
802.11g - AV Output power - Low CH 2412



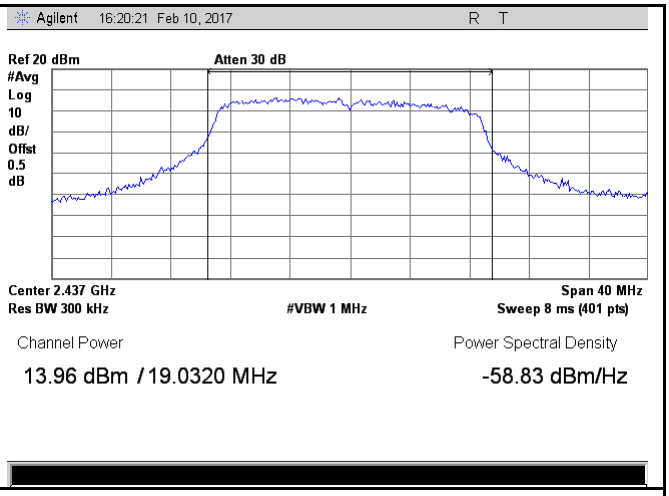
802.11g - AV Output power - Mid CH 2437



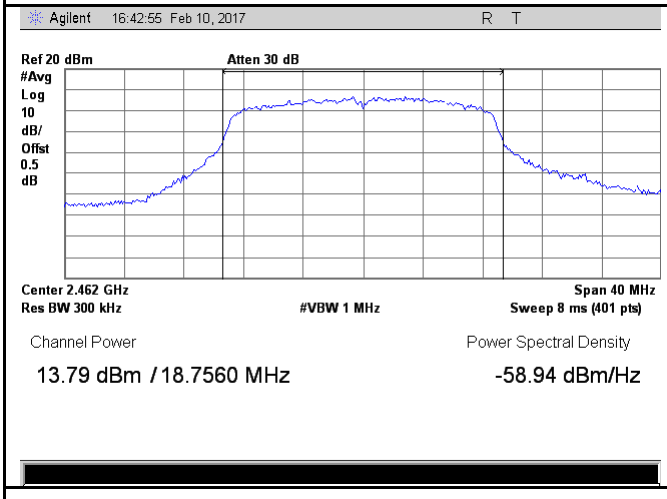
802.11g - AV Output power - High CH 2462



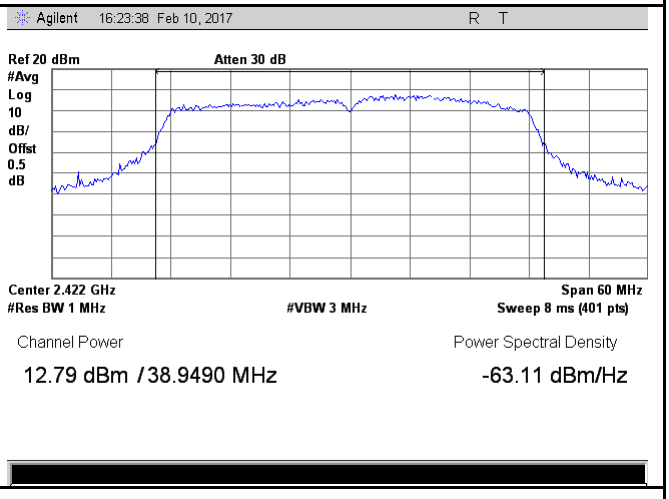
802.11n20 - AV Output power - Low CH 2412



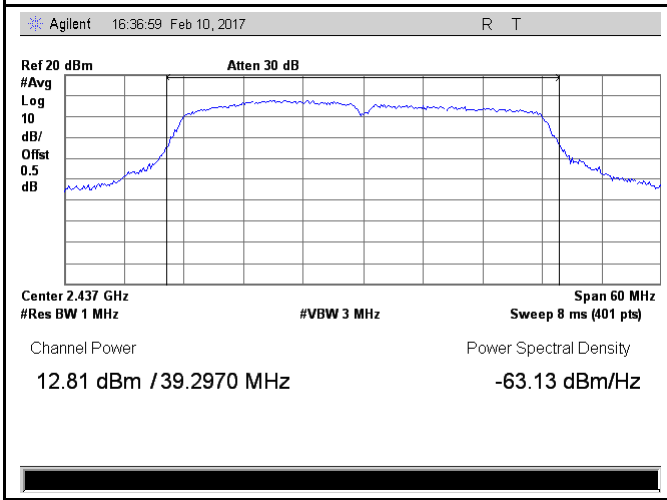
802.11n20 - AV Output power - Mid CH 2437



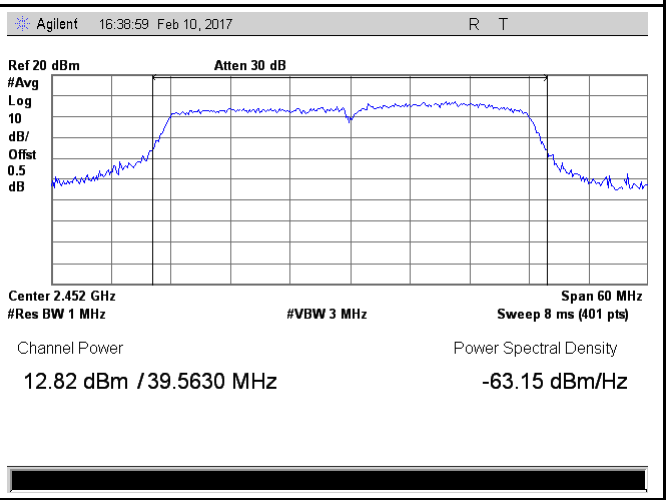
802.11n20 - AV Output power - High CH 2462



802.11n40 - AV Output power - Low CH 2422



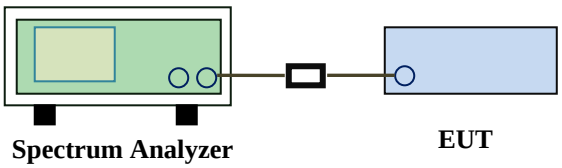
802.11n40 - AV Output power - Mid CH 2437



802.11n40 - AV Output power - High CH 2452

6.4 Power Spectral Density

Temperature	24°C
Relative Humidity	52%
Atmospheric Pressure	1007mbar
Test date :	February 10, 2017
Tested By :	Leen Yang

Spec	Item	Requirement	Applicable
§15.247(e)	a)	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.	☑
Test Setup			
Test Procedure	558074 D01 DTS MEAS Guidance v03r03, 10.2 power spectral density method power spectral density measurement procedure - a) Set analyzer center frequency to DTS channel center frequency. - b) Set the span to 1.5 times the DTS bandwidth. - c) Set the RBW to: 3 kHz ≤ RBW ≤ 100 kHz. - d) Set the VBW ≥ 3 × RBW. - e) Detector = peak. - f) Sweep time = auto couple. - g) Trace mode = max hold. - h) Allow trace to fully stabilize. - i) Use the peak marker function to determine the maximum amplitude level within the RBW. - j) If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.		
Remark			
Result	☑ Pass ☐ Fail		

Test Data ☑ Yes ☐ N/A

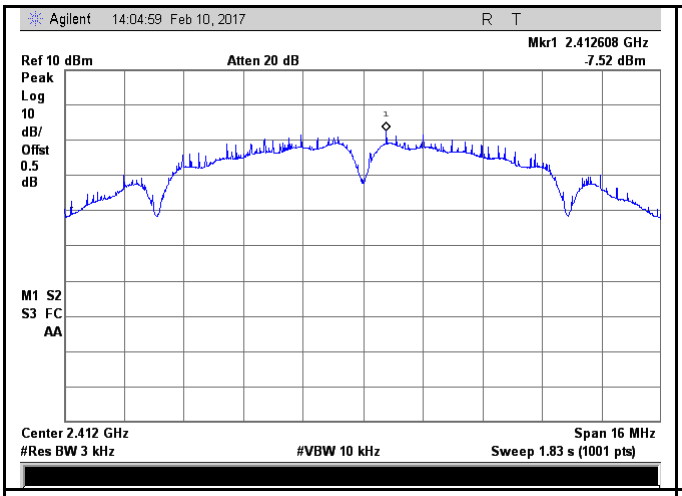
Test Plot ☑ Yes (See below) ☐ N/A

Power Spectral Density measurement result

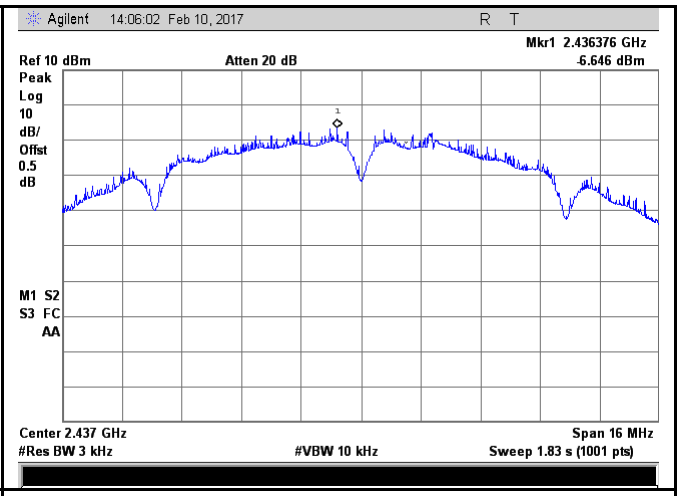
Type	Test mode	CH	Freq (MHz)	PSD (dBm)	Limit (dBm)	Result
PSD	802.11b	Low	2412	-7.520	8	Pass
		Mid	2437	-6.646	8	Pass
		High	2462	-7.488	8	Pass
	802.11g	Low	2412	-10.81	8	Pass
		Mid	2437	-9.523	8	Pass
		High	2462	-10.53	8	Pass
	802.11n (20M)	Low	2412	-8.528	8	Pass
		Mid	2437	-10.40	8	Pass
		High	2462	-8.431	8	Pass
	802.11n (40M)	Low	2422	-11.05	8	Pass
		Mid	2437	-13.66	8	Pass
		High	2452	-14.28	8	Pass

Test Plots

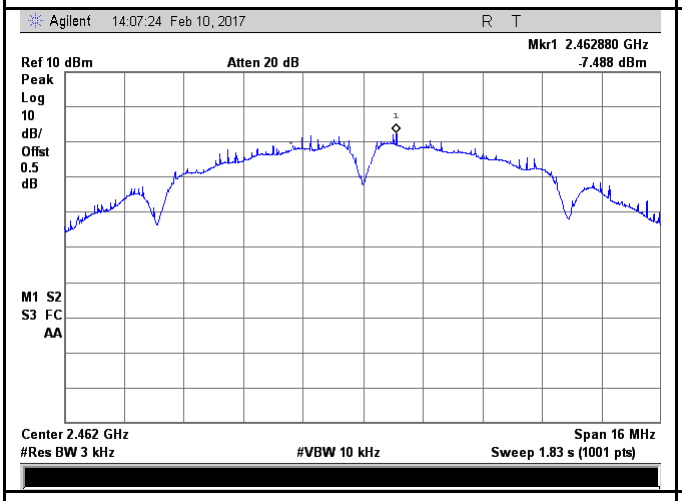
Power Spectral Density measurement result



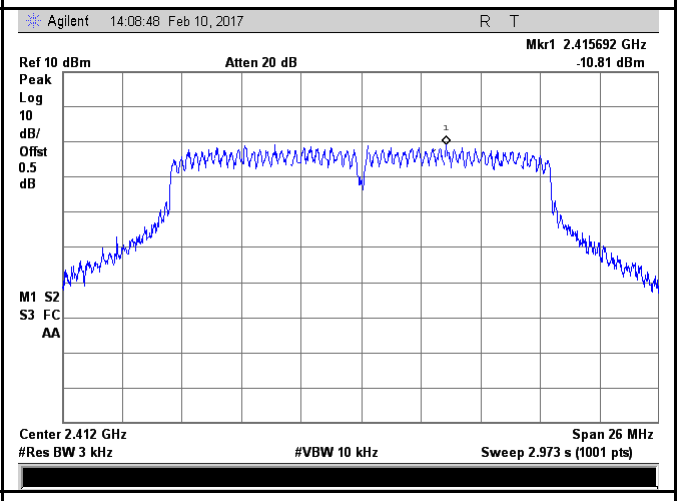
PSD - Low CH 2412 - 802.11b



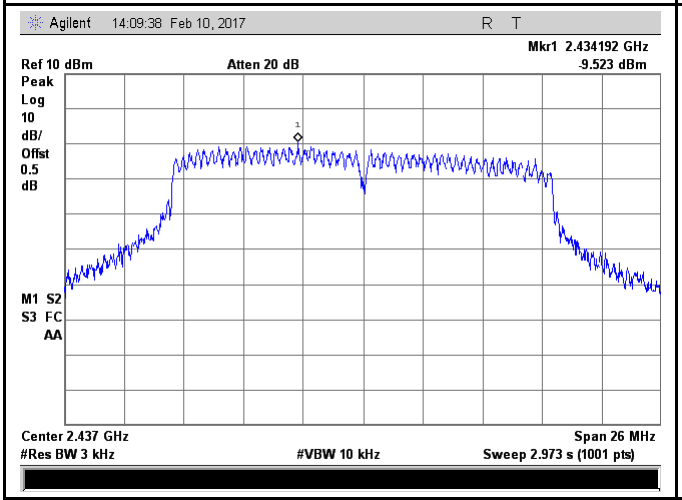
PSD - Mid CH 2437 – 802.11b



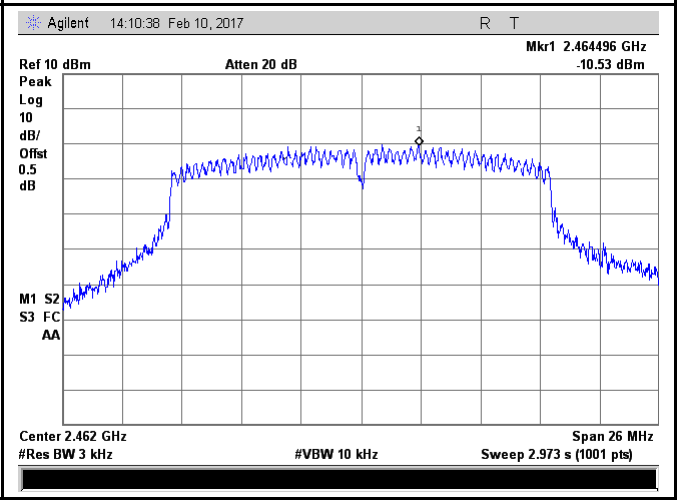
PSD - High CH 2462 - 802.11b



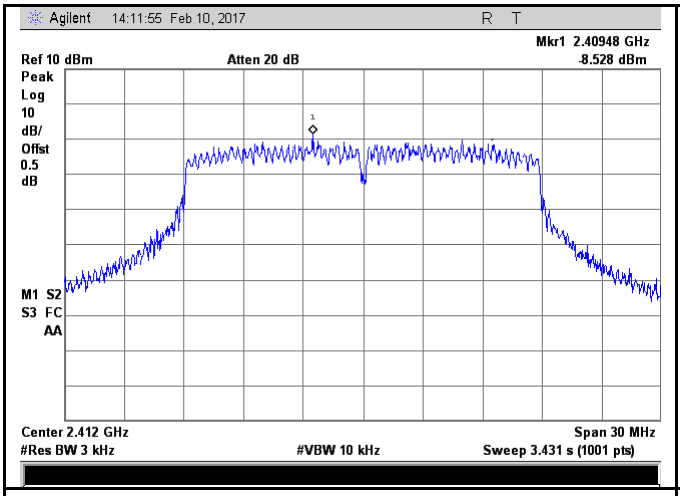
PSD - Low CH 2412 -802.11g



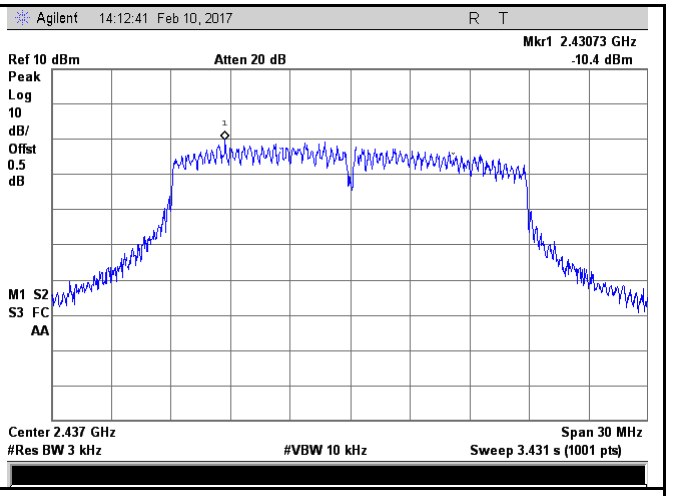
PSD - Mid CH 2437 – 802.11g



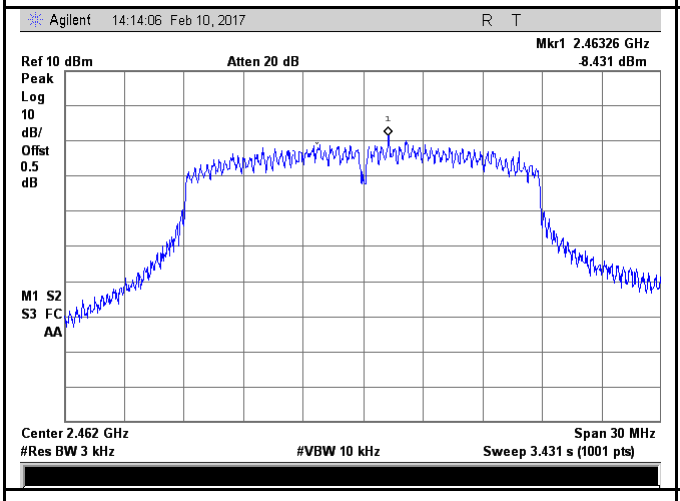
PSD - High CH 2462 - 802.11g



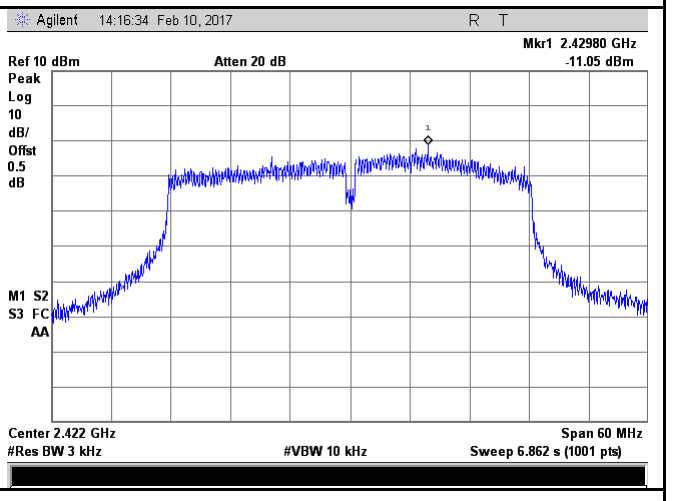
PSD - Low CH 2412 - 802.11n20



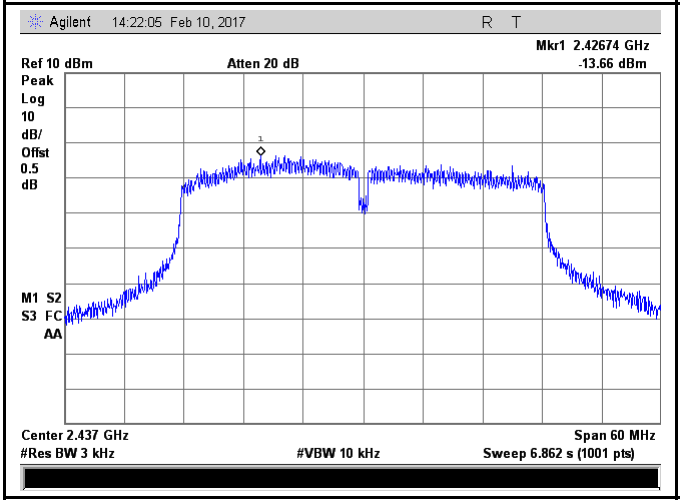
PSD - Mid CH 2437 – 802.11n20



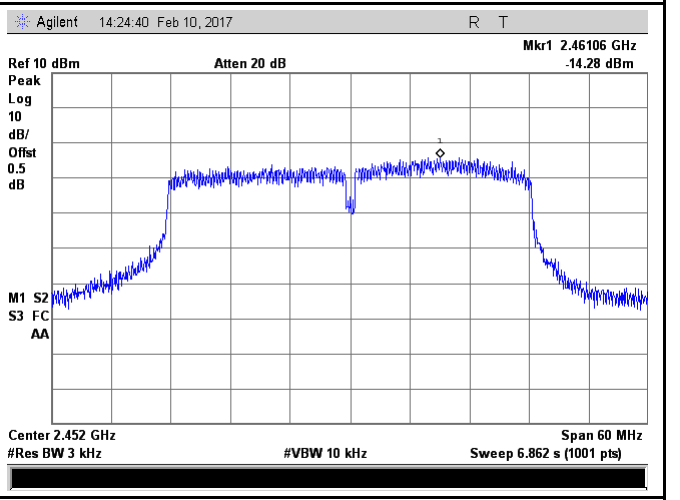
PSD - High CH 2472 - 802.11n20



PSD - Low CH 2422 - 802.11n40



PSD - Mid CH 2437 – 802.11n40

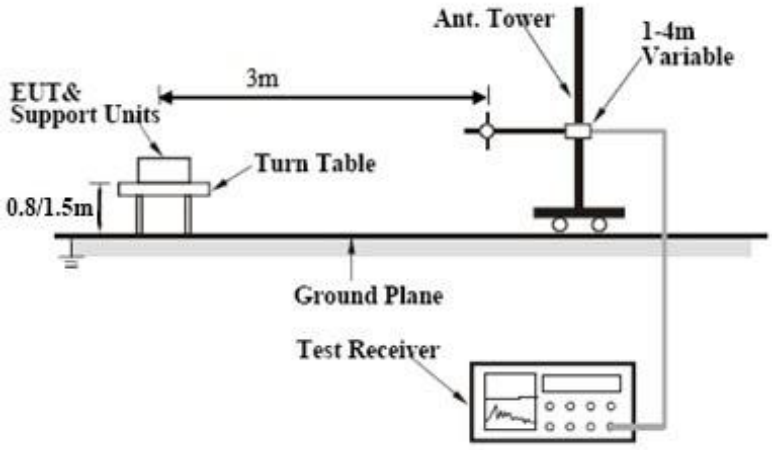


PSD - High CH 2452 - 802.11n40

6.5 Band-Edge & Unwanted Emissions into Restricted Frequency Bands

Temperature	25°C
Relative Humidity	57%
Atmospheric Pressure	1024mbar
Test date :	February 24, 2017
Tested By :	Leen Yang

Requirement(s):

Spec	Item	Requirement	Applicable
§15.247(d)	a)	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.	☑
Test Setup			
Test Procedure	Radiated Method Only - 1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator. - 2. Position the EUT without connection to measurement instrument. Put it on the Rotated table and turn on the EUT and make it operate in transmitting mode. Then set it to Low Channel and High Channel within its operating range, and make sure the instrument is operated in its linear range.		

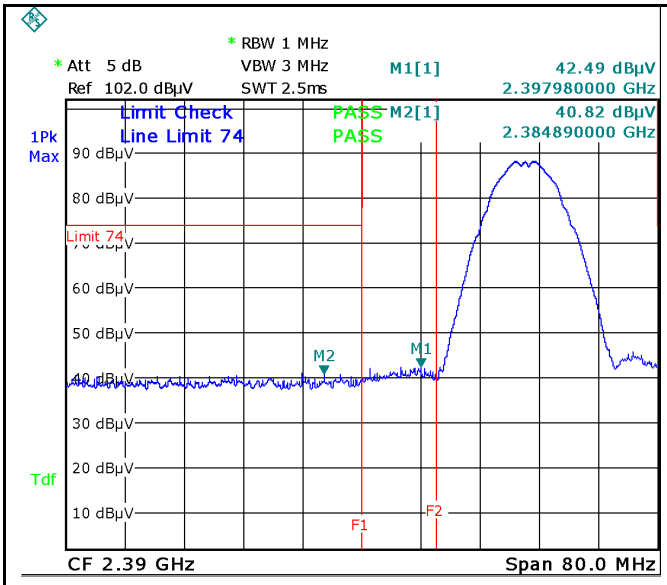
	- 3. First, set both RBW and VBW of spectrum analyzer to 100 kHz with a convenient frequency span including 100kHz bandwidth from band edge, check the emission of EUT, if pass then set Spectrum Analyzer as below: a. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 kHz for Quasiy Peak detection at frequency below 1GHz. b. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and video bandwidth is 3MHz with Peak detection for Peak measurement at frequency above 1GHz. c. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is 10Hz with Peak detection for Average Measurement as below at frequency above 1GHz. - 4. Measure the highest amplitude appearing on spectral display and set it as a reference level. Plot the graph with marking the highest point and edge frequency. - 5. Repeat above procedures until all measured frequencies were complete.
Remark	
Result	☑ Pass ☐ Fail

Test Data ☑ Yes ☐ N/A

Test Plot ☑ Yes (See below) ☐ N/A

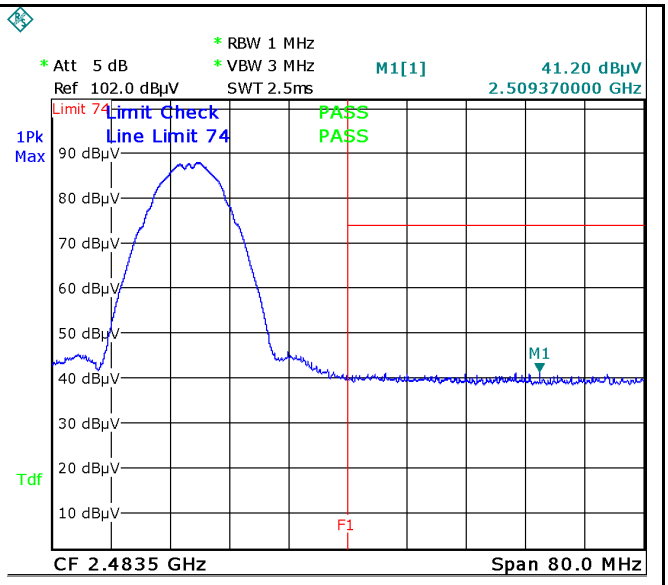
Test Plots

Band Edge measurement result



Band Edge, Left Side (Peak) - 802.11b

Note: F1 is frequency 2390MHz; F2 is frequency 2400MHz



Band Edge, Right Side (Peak) - 802.11b

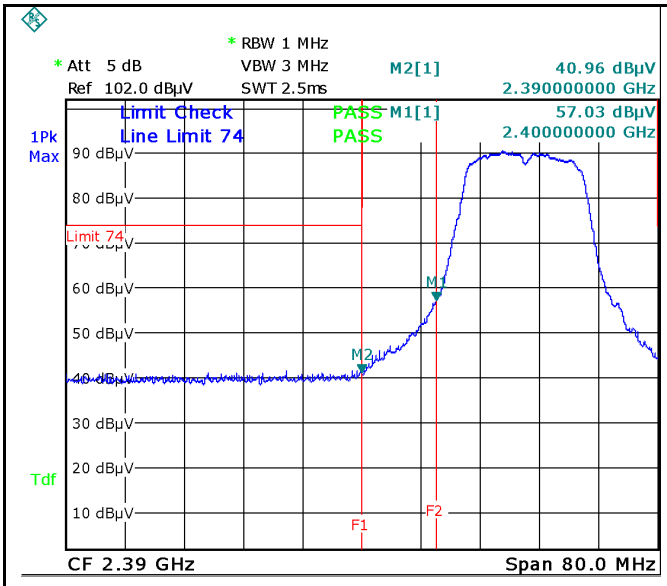
Note: F1 is frequency 2483.5MHz

Note: (no need if PK value less than the AV limit)

Note: (no need if PK value less than the AV limit)

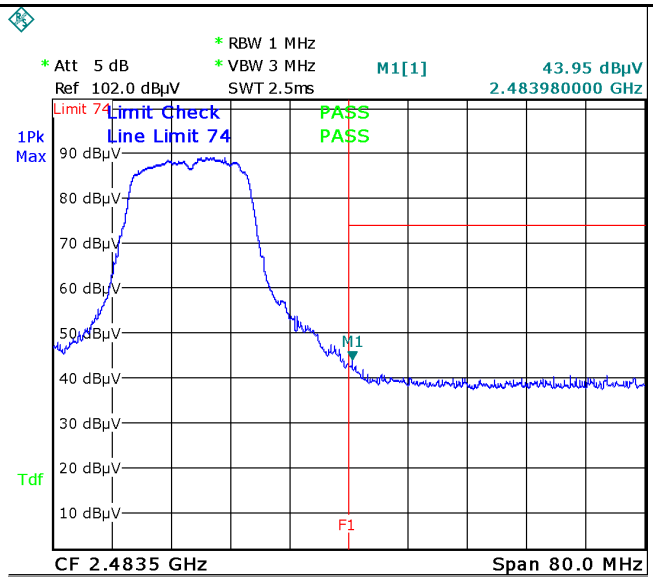
Band Edge, Left Side (Average) - 802.11b

Band Edge, Right Side (Average) - 802.11b



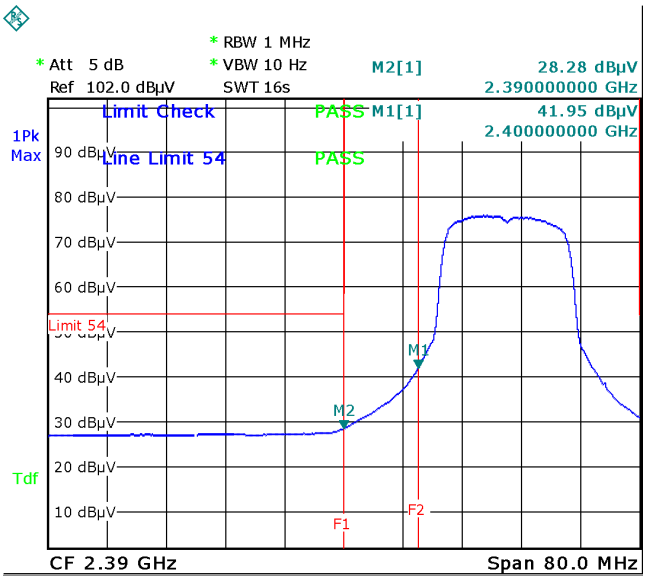
Band Edge, Left Side (Peak) - 802.11g

Note: F1 is frequency 2390MHz; F2 is frequency 2400MHz



Band Edge, Right Side (Peak) - 802.11g

Note: F1 is frequency 2483.5MHz



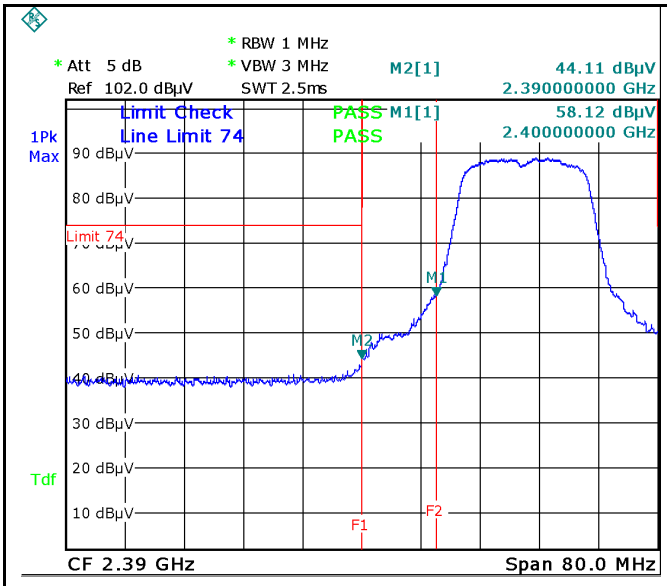
Band Edge, Left Side (Average) - 802.11g

Note: F1 is frequency 2390MHz; F2 is frequency 2400MHz

Note: (no need if PK value less than the AV limit)

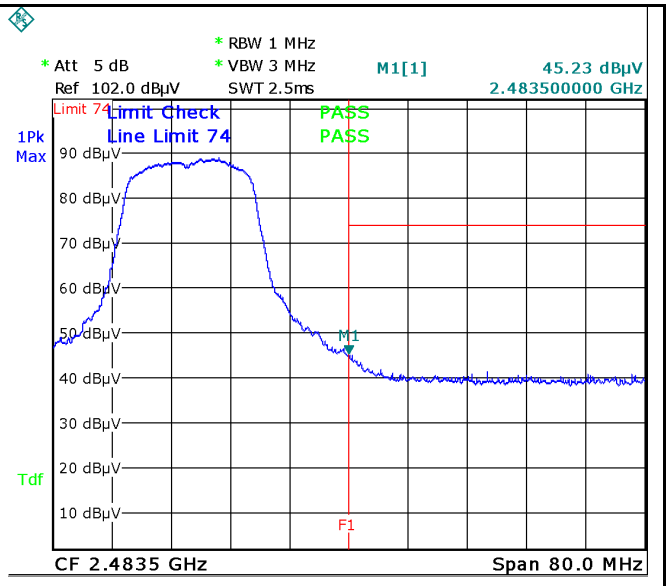
Band Edge, Right Side (Average) - 802.11g

Note: F1 is frequency 2483.5MHz



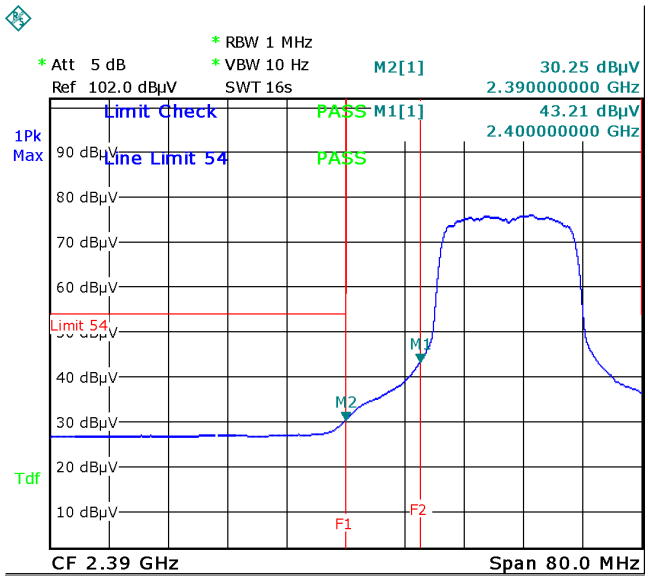
Band Edge, Left Side (Peak) - 802.11n20

Note: F1 is frequency 2390MHz; F2 is frequency 2400MHz



Band Edge, Right Side (Peak) - 802.11n20

Note: F1 is frequency 2483.5MHz



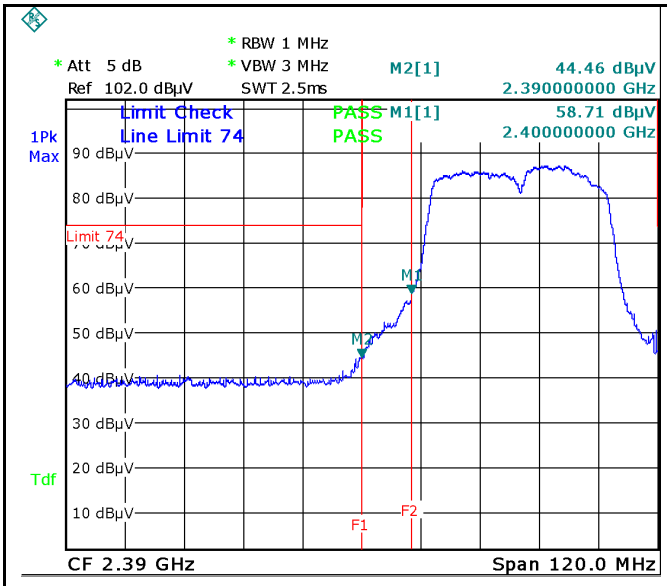
Band Edge, Left Side (Average) - 802.11n20

Note: F1 is frequency 2390MHz; F2 is frequency 2400MHz

Note: (no need if PK value less than the AV limit)

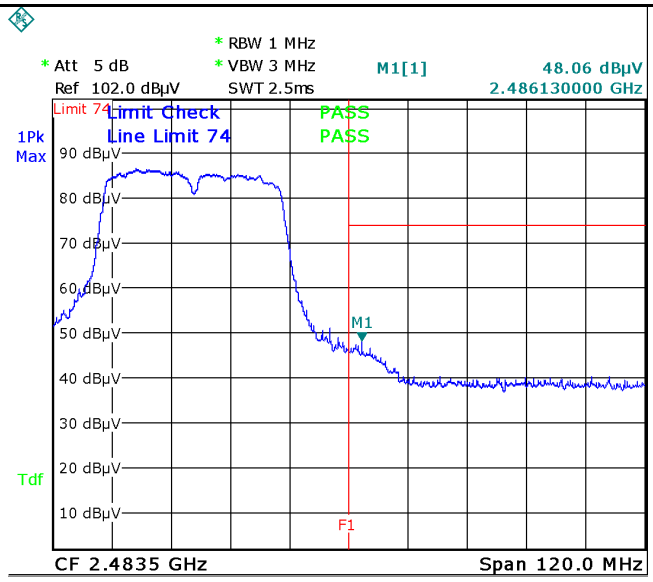
Band Edge, Right Side (Average) - 802.11n20

Note: F1 is frequency 2483.5MHz



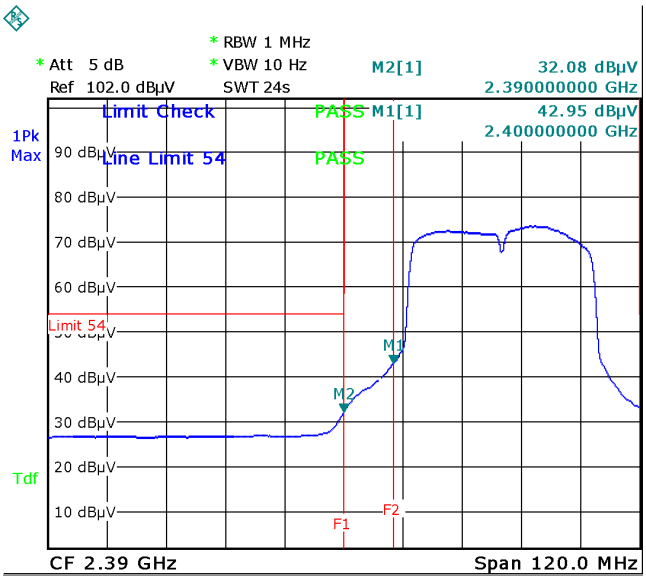
Band Edge, Left Side (Peak) - 802.11n40

Note: F1 is frequency 2390MHz; F2 is frequency 2400MHz



Band Edge, Right Side (Peak) - 802.11n40

Note: F1 is frequency 2483.5MHz



Band Edge, Left Side (Average) - 802.11n40

Note: F1 is frequency 2390MHz; F2 is frequency 2400MHz

Note: (no need if PK value less than the AV limit)

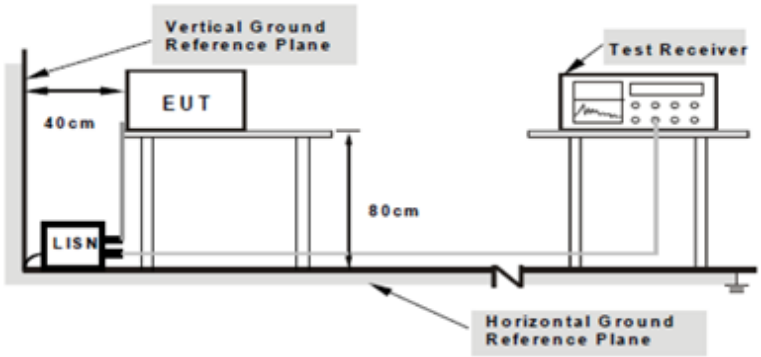
Band Edge, Right Side (Average) - 802.11n40

Note: F1 is frequency 2483.5MHz

6.6 AC Power Line Conducted Emissions

Temperature	25°C
Relative Humidity	57%
Atmospheric Pressure	1024mbar
Test date :	February 24, 2017
Tested By :	Leen Yang

Requirement(s):

<table>
<tr><th>Spec</th><th>Item</th><th>Requirement</th><th>Applicable</th></tr>
<tr><td>47CFR§15.207, RSS210 (A8.1)</td><td>a)</td><td>For Low-power radio-frequency devices that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 [mu] H/50 ohms line impedance stabilization network (LISN). The lower limit applies at the boundary between the frequencies ranges.
<table>
<tr><th rowspan="2">Frequency ranges (MHz)</th><th colspan="2">Limit (dBμV)</th></tr>
<tr><th>QP</th><th>Average</th></tr>
<tr><td>0.15 ~ 0.5</td><td>66 – 56</td><td>56 – 46</td></tr>
<tr><td>0.5 ~ 5</td><td>56</td><td>46</td></tr>
<tr><td>5 ~ 30</td><td>60</td><td>50</td></tr>
</table></td><td>☑</td></tr>
<tr><td>Test Setup</td><td colspan="3"> 

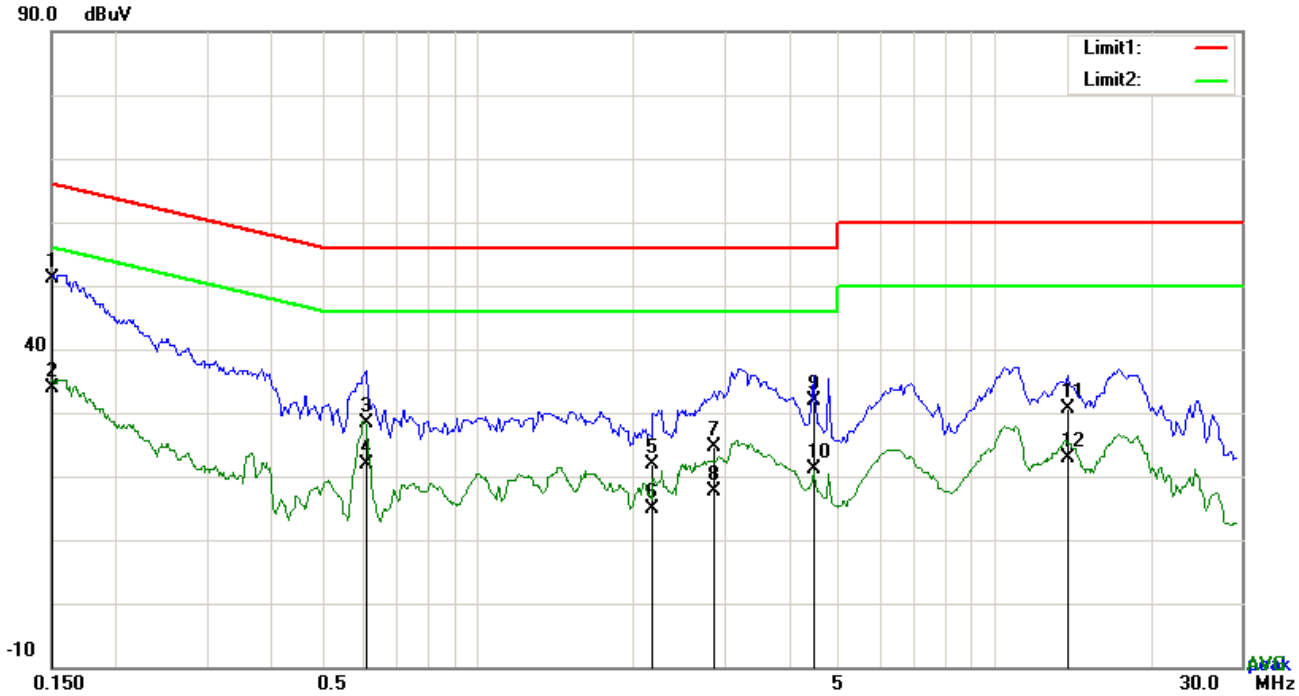
Note: 1.Support units were connected to second LISN.
2.Both of LISNs (AMN) are 80cm from EUT and at least 80cm from other units and other metal planes support units.</td></tr>
<tr><td>Procedure</td><td colspan="3">1. The EUT and supporting equipment were set up in accordance with the requirements of the standard on top of a 1.5m x 1m x 0.8m high, non-metallic table.
2. The power supply for the EUT was fed through a 50W/50mH EUT LISN, connected to filtered mains.
3. The RF OUT of the EUT LISN was connected to the EMI test receiver via a low-loss</td></tr>
</table>

	coaxial cable. 4. All other supporting equipment were powered separately from another main supply. 5. The EUT was switched on and allowed to warm up to its normal operating condition. 6. A scan was made on the NEUTRAL line (for AC mains) or Earth line (for DC power) over the required frequency range using an EMI test receiver. 7. High peaks, relative to the limit line, The EMI test receiver was then tuned to the selected frequencies and the necessary measurements made with a receiver bandwidth setting of 10 kHz. 8. Step 7 was then repeated for the LIVE line (for AC mains) or DC line (for DC power).
Remark	
Result	☑ Pass ☐ Fail

Test Data ☑ Yes ☐ N/A

Test Plot ☑ Yes (See below) ☐ N/A

Test Mode:	Transmitting Mode

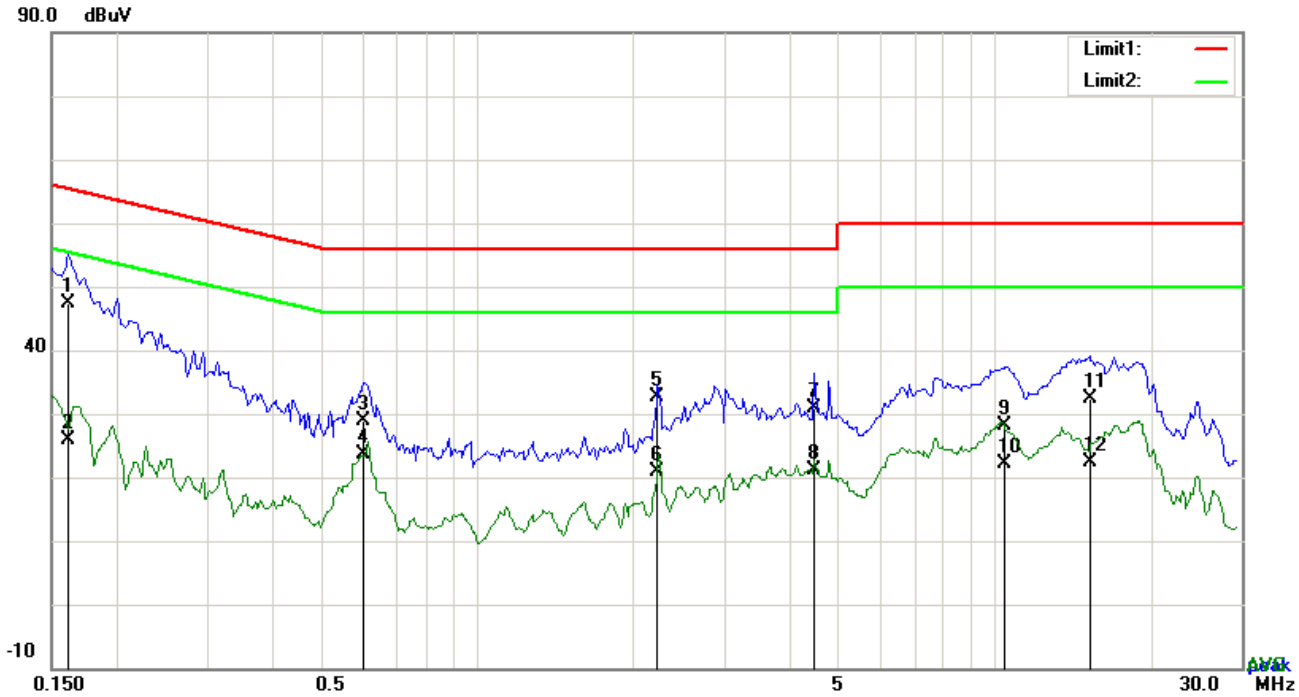


Test Data

Phase Line Plot at 120Vac, 60Hz

No.	P/L	Frequency (MHz)	Reading (dBµV)	Detector	Corrected (dB)	Result (dBµV)	Limit (dBµV)	Margin (dB)
1	L1	0.1500	41.19	QP	10.03	51.22	66.00	-14.78
2	L1	0.1500	23.75	AVG	10.03	33.78	56.00	-22.22
3	L1	0.6075	18.47	QP	10.03	28.50	56.00	-27.50
4	L1	0.6075	11.85	AVG	10.03	21.88	46.00	-24.12
5	L1	2.1783	11.74	QP	10.04	21.78	56.00	-34.22
6	L1	2.1783	4.87	AVG	10.04	14.91	46.00	-31.09
7	L1	2.8692	14.66	QP	10.05	24.71	56.00	-31.29
8	L1	2.8692	7.59	AVG	10.05	17.64	46.00	-28.36
9	L1	4.4540	21.71	QP	10.07	31.78	56.00	-24.22
10	L1	4.4540	11.00	AVG	10.07	21.07	46.00	-24.93
11	L1	13.8411	20.54	QP	10.21	30.75	60.00	-29.25
12	L1	13.8411	12.75	AVG	10.21	22.96	50.00	-27.04

Test Mode:	Transmitting Mode

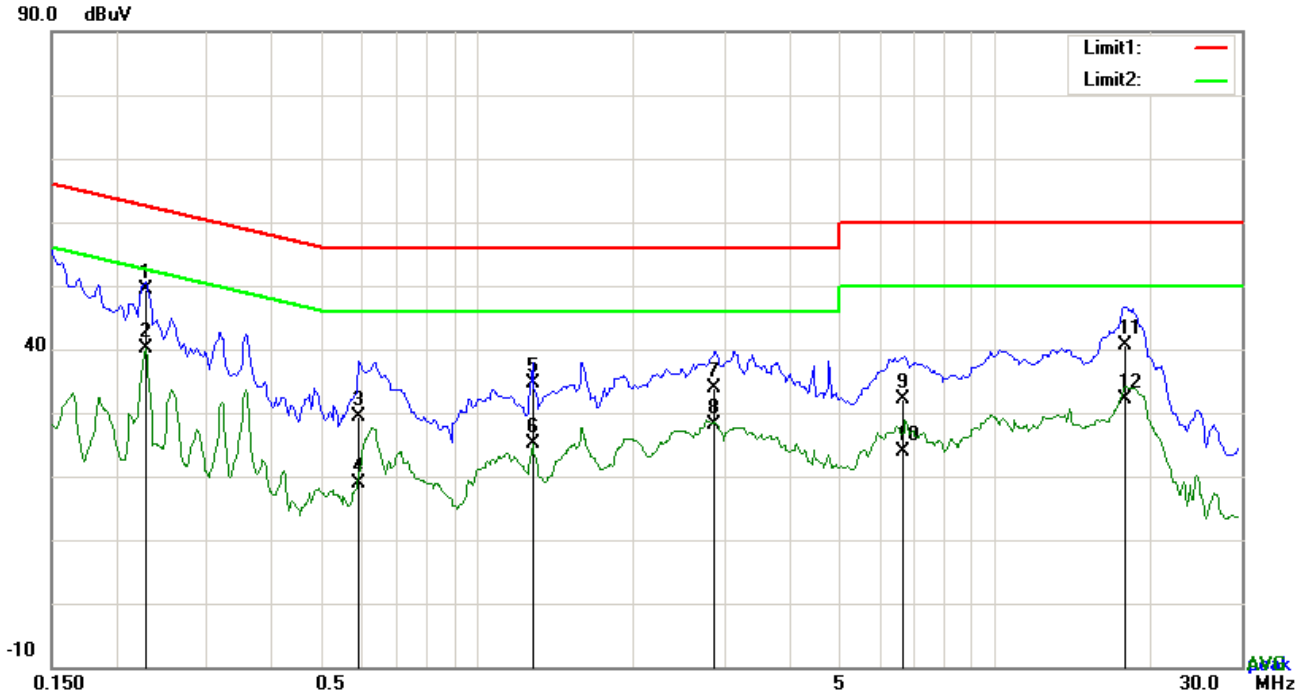


Test Data

Phase Neutral Plot at 120Vac, 60Hz

No.	P/L	Frequency (MHz)	Reading (dBµV)	Detector	Corrected (dB)	Result (dBµV)	Limit (dBµV)	Margin (dB)
1	N	0.1617	37.38	QP	10.02	47.40	65.38	-17.98
2	N	0.1617	15.92	AVG	10.02	25.94	55.38	-29.44
3	N	0.6024	18.86	QP	10.02	28.88	56.00	-27.12
4	N	0.6024	13.65	AVG	10.02	23.67	46.00	-22.33
5	N	2.2287	22.59	QP	10.04	32.63	56.00	-23.37
6	N	2.2287	10.80	AVG	10.04	20.84	46.00	-25.16
7	N	4.4664	20.85	QP	10.06	30.91	56.00	-25.09
8	N	4.4664	10.96	AVG	10.06	21.02	46.00	-24.98
9	N	10.4607	17.97	QP	10.15	28.12	60.00	-31.88
10	N	10.4607	11.86	AVG	10.15	22.01	50.00	-27.99
11	N	15.2655	22.13	QP	10.20	32.33	60.00	-27.67
12	N	15.2655	12.30	AVG	10.20	22.50	50.00	-27.50

Test Mode:	Transmitting Mode

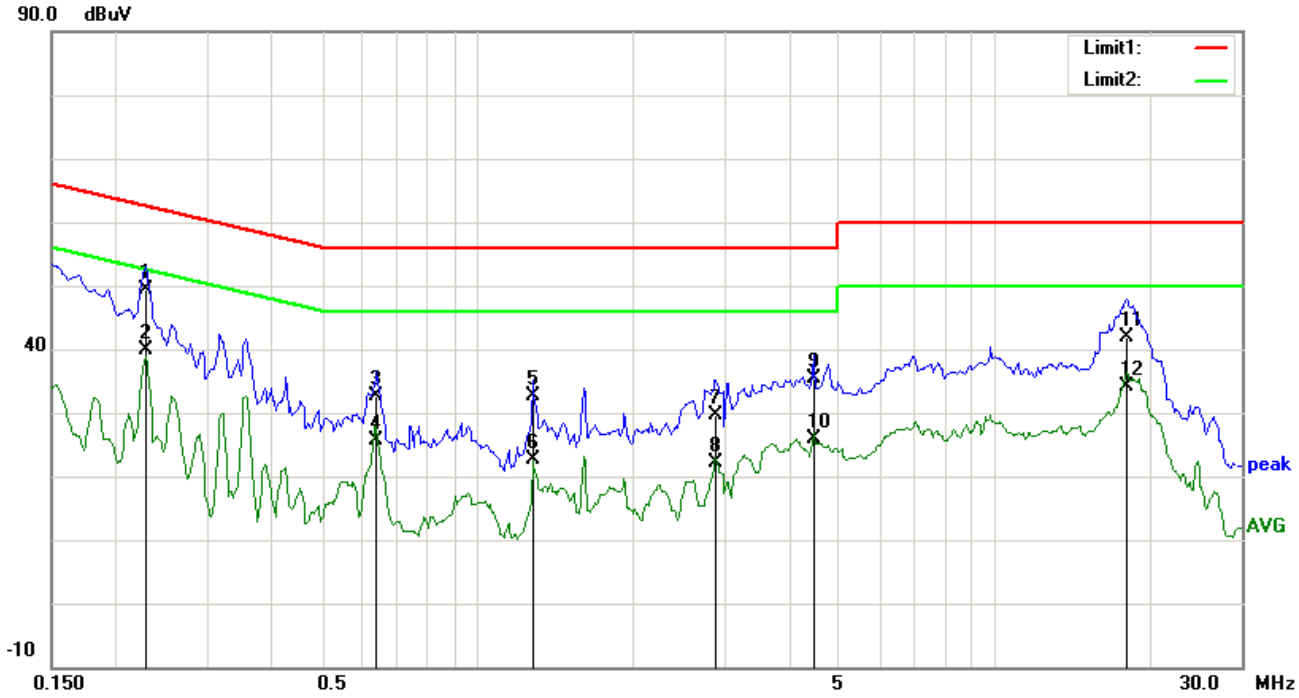


Test Data

Phase Line Plot at 240Vac, 60Hz

No.	P/L	Frequency (MHz)	Reading (dBµV)	Detector	Corrected (dB)	Result (dBµV)	Limit (dBµV)	Margin (dB)
1	L1	0.2280	39.47	QP	10.03	49.50	62.52	-13.02
2	L1	0.2280	30.09	AVG	10.03	40.12	52.52	-12.40
3	L1	0.5907	19.32	QP	10.03	29.35	56.00	-26.65
4	L1	0.5907	8.79	AVG	10.03	18.82	46.00	-27.18
5	L1	1.2771	24.53	QP	10.03	34.56	56.00	-21.44
6	L1	1.2771	14.99	AVG	10.03	25.02	46.00	-20.98
7	L1	2.8839	23.75	QP	10.05	33.80	56.00	-22.20
8	L1	2.8839	18.07	AVG	10.05	28.12	46.00	-17.88
9	L1	6.6272	22.05	QP	10.10	32.15	60.00	-27.85
10	L1	6.6272	13.68	AVG	10.10	23.78	50.00	-26.22
11	L1	17.9214	30.38	QP	10.27	40.65	60.00	-19.35
12	L1	17.9214	21.90	AVG	10.27	32.17	50.00	-17.83

Test Mode:	Transmitting Mode



Test Data

Phase Neutral Plot at 240Vac, 60Hz

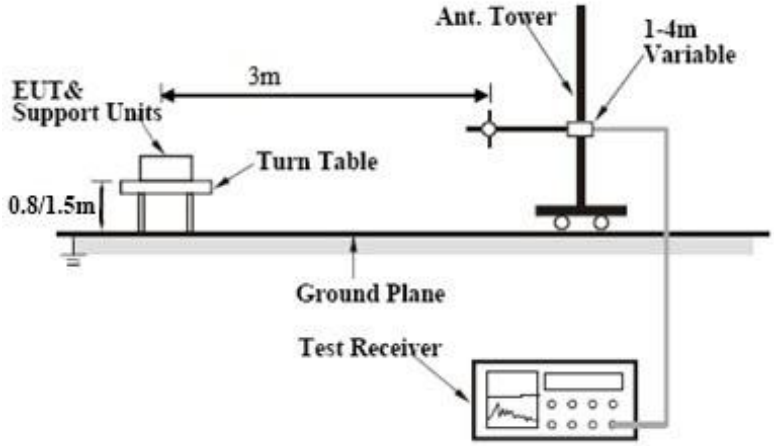
No.	P/L	Frequency (MHz)	Reading (dBµV)	Detector	Corrected (dB)	Result (dBµV)	Limit (dBµV)	Margin (dB)
1	N	0.2280	39.44	QP	10.02	49.46	62.52	-13.06
2	N	0.2280	29.79	AVG	10.02	39.81	52.52	-12.71
3	N	0.6375	22.49	QP	10.02	32.51	56.00	-23.49
4	N	0.6375	15.56	AVG	10.02	25.58	46.00	-20.42
5	N	1.2810	22.70	QP	10.03	32.73	56.00	-23.27
6	N	1.2810	12.70	AVG	10.03	22.73	46.00	-23.27
7	N	2.8878	19.48	QP	10.05	29.53	56.00	-26.47
8	N	2.8878	12.12	AVG	10.05	22.17	46.00	-23.83
9	N	4.4625	25.28	QP	10.06	35.34	56.00	-20.66
10	N	4.4625	15.81	AVG	10.06	25.87	46.00	-20.13
11	N	17.9799	31.64	QP	10.24	41.88	60.00	-18.12
12	N	17.9799	23.80	AVG	10.24	34.04	50.00	-15.96

6.7 Radiated Spurious Emissions &Restricted band & Restricted band emission

Temperature	25°C
Relative Humidity	57%
Atmospheric Pressure	1024mbar
Test date :	February 24, 2017
Tested By :	Leen Yang

Requirement(s):

<table>
<tr><th>Spec</th><th>Item</th><th>Requirement</th><th>Applicable</th></tr>
<tr><td rowspan="3">47CFR§15.247(d), RSS210 (A8.5)</td><td>a)</td><td>Except higher limit as specified elsewhere in other section, the emissions from the low-power radio-frequency devices shall not exceed the field strength levels specified in the following table and the level of any unwanted emissions shall not exceed the level of the fundamental emission. The tighter limit applies at the band edges
<table>
<tr><th>Frequency range (MHz)</th><th>Field Strength (μV/m)</th></tr>
<tr><td>30 – 88</td><td>100</td></tr>
<tr><td>88 – 216</td><td>150</td></tr>
<tr><td>216 960</td><td>200</td></tr>
<tr><td>Above 960</td><td>500</td></tr>
</table></td><td>☑</td></tr>
<tr><td>b)</td><td>For non-restricted band, 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 or 30dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, determined by the measurement method on output power to be used. Attenuation below the general limits specified in § 15.209(a) is not required
☒ 20 dB down ☐ 30 dB down</td><td>☑</td></tr>
<tr><td>c)</td><td>or restricted band, emission must also comply with the radiated emission limits specified in 15.209</td><td>☑</td></tr>
</table>

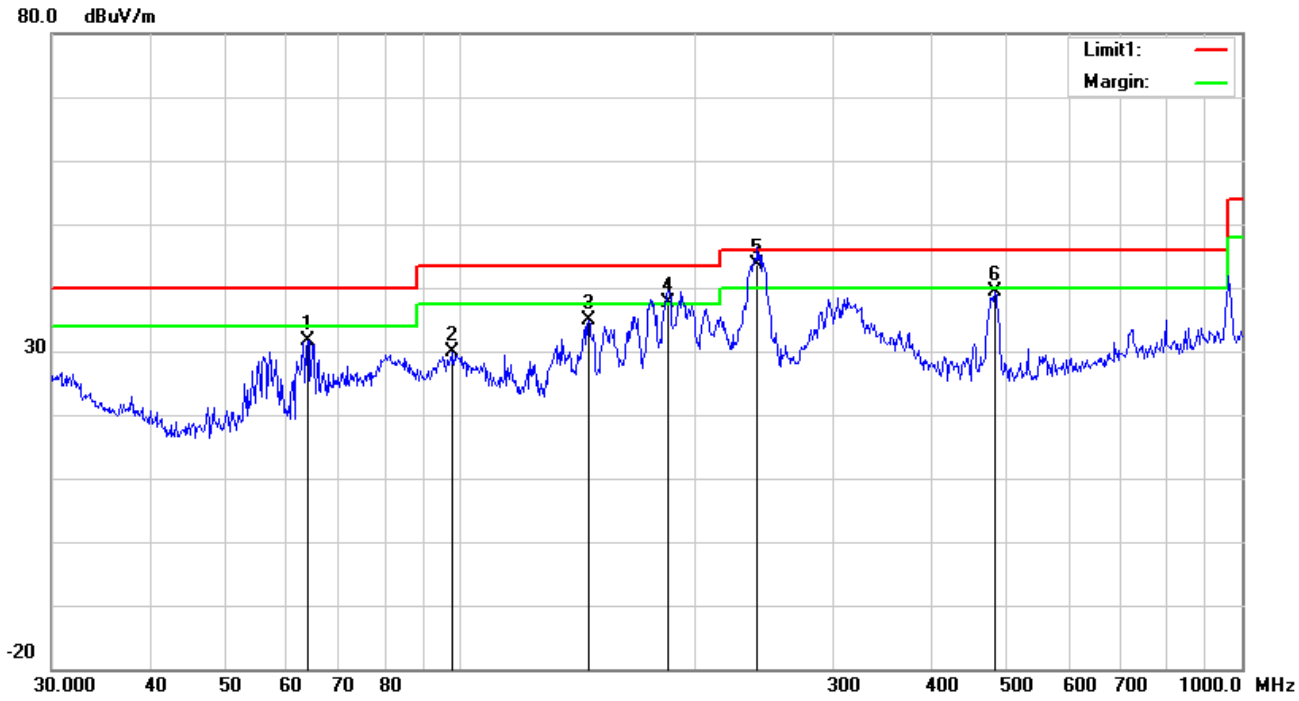
Test Setup	
Procedure	1. The EUT was switched on and allowed to warm up to its normal operating condition. 2. The test was carried out at the selected frequency points obtained from the EUT characterization. Maximization of the emissions, was carried out by rotating the EUT, changing the antenna polarization, and adjusting the antenna height in the following manner: a. Vertical or horizontal polarization (whichever gave the higher emission level over a full rotation of the EUT) was chosen. b. The EUT was then rotated to the direction that gave the maximum emission. c. Finally, the antenna height was adjusted to the height that gave the maximum emission. 3. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 kHz for Quasiy Peak detection at frequency below 1GHz. 4. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and video bandwidth is 3MHz with Peak detection for Peak measurement at frequency above 1GHz. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is 10Hz with Peak detection for Average Measurement as below at frequency above 1GHz. 5. Steps 2 and 3 were repeated for the next frequency point, until all selected frequency points were measured.
Remark	Different RF configuration has been evaluated but not much difference was found. The data presented here is the worst case data with EUT under 802.11n – HT20-2437MHz mode.
Result	☑ Pass ☐ Fail

Test Data ☑ Yes ☐ N/A

Test Plot ☑ Yes (See below) ☐ N/A

Test Mode:	WIFI Mode

(Below 1GHz)

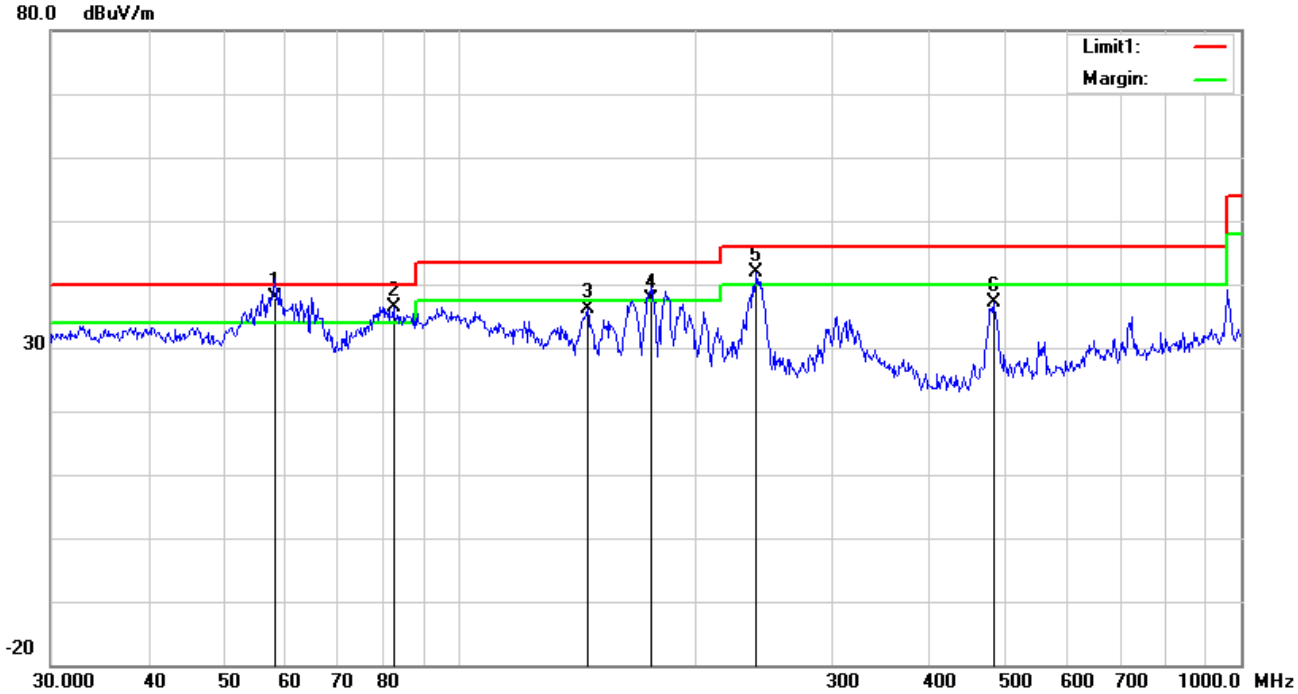


Test Data

Vertical Polarity Plot @3m

No.	P/L	Frequency	Reading	Detector	Ant_F	PA_G	Cab_L	Result	Limit	Margin	Height	Degree
		(MHz)	(dBuV/m)		(dB/m)	(dB)	(dB)	(dBuV/m)	(dBuV/m)	(dB)	(cm)	(°)
1	H	63.7588	45.74	peak	7.49	22.40	0.85	31.68	40.00	-8.32	100	274
2	H	97.7983	41.19	peak	9.87	22.32	1.06	29.80	43.50	-13.70	100	107
3	H	145.8611	43.23	QP	12.60	22.37	1.31	34.77	43.50	-8.73	200	253
4	H	184.4898	47.23	QP	11.25	22.28	1.44	37.64	43.50	-5.86	100	273
5	H	239.9873	52.72	QP	11.54	22.31	1.67	43.62	46.00	-2.38	100	141
6	H	483.9094	41.60	peak	17.38	21.84	2.33	39.47	46.00	-6.53	100	7

(Below 1GHz)



Test Data

Horizontal Polarity Plot @3m

No.	P/L	Frequency	Reading	Detector	Ant_F	PA_G	Cab_L	Result	Limit	Margin	Height	Degree
		(MHz)	(dBuV/m)		(dB/m)	(dB)	(dB)	(dBuV/m)	(dBuV/m)	(dB)	(cm)	(°)
1	V	58.2030	52.08	QP	7.50	22.40	0.76	37.94	40.00	-2.06	100	241
2	V	82.3589	50.04	QP	7.69	22.40	1.06	36.39	40.00	-3.61	100	169
3	V	145.8611	44.54	QP	12.60	22.37	1.31	36.08	43.50	-7.42	100	80
4	V	176.2686	47.19	QP	11.30	22.25	1.36	37.60	43.50	-5.90	100	241
5	V	239.9873	50.93	QP	11.54	22.31	1.67	41.83	46.00	-4.17	100	287
6	V	482.2156	39.36	peak	17.34	21.85	2.32	37.17	46.00	-8.83	100	138

Above 1GHz

Test Mode:	Transmitting Mode

Low Channel (2412 MHz) (b mode worst case)

Frequency (MHz)	S.A. Reading (dBμV)	Detector (PK/AV)	Polarity (H/V)	Ant. Factor (dB/m)	Cable Loss (dB)	Pre-Amp. Gain (dB)	Cord Amp. (dBμV/m)	Limit (dBμV/m)	Margin (dB)
4824	38.75	AV	V	33.8	6.86	32.69	46.72	54	-7.28
4824	38.11	AV	H	33.8	6.86	32.69	46.08	54	-7.92
4824	47.92	PK	V	33.8	6.86	32.69	55.89	74	-18.11
4824	47.56	PK	H	33.8	6.86	32.69	55.53	74	-18.47
17900	24.33	AV	V	45.12	11.57	32.11	48.91	54	-5.09
17900	23.46	AV	H	45.12	11.57	32.11	48.04	54	-5.96
17900	38.89	PK	V	45.12	11.57	32.11	63.47	74	-10.53
17900	39.05	PK	H	45.12	11.57	32.11	63.63	74	-10.37

Middle Channel (2437 MHz) (b mode worst case)

Frequency (MHz)	S.A. Reading (dBμV)	Detector (PK/AV)	Polarity (H/V)	Ant. Factor (dB/m)	Cable Loss (dB)	Pre-Amp. Gain (dB)	Cord Amp. (dBμV/m)	Limit (dBμV/m)	Margin (dB)
4874	38.81	AV	V	33.6	6.82	32.71	46.52	54	-7.48
4874	38.76	AV	H	33.6	6.82	32.71	46.47	54	-7.53
4874	47.89	PK	V	33.6	6.82	32.71	55.6	74	-18.4
4874	47.83	PK	H	33.6	6.82	32.71	55.54	74	-18.46
17933	24.16	AV	V	45.17	11.63	32.18	48.78	54	-5.22
17933	22.88	AV	H	45.17	11.63	32.18	47.5	54	-6.5
17933	39.34	PK	V	45.17	11.63	32.18	63.96	74	-10.04
17933	39.03	PK	H	45.17	11.63	32.18	63.65	74	-10.35

High Channel (2462 MHz) (b mode worst case)

Frequency (MHz)	S.A. Reading (dBμV)	Detector (PK/AV)	Polarity (H/V)	Ant. Factor (dB/m)	Cable Loss (dB)	Pre-Amp. Gain (dB)	Cord Amp. (dBμV/m)	Limit (dBμV/m)	Margin (dB)
4924	38.99	AV	V	33.83	6.95	32.79	46.98	54	-7.02
4924	38.75	AV	H	33.83	6.95	32.79	46.74	54	-7.26
4924	47.77	PK	V	33.83	6.95	32.79	55.76	74	-18.24
4924	48.24	PK	H	33.83	6.95	32.79	56.23	74	-17.77
17921	23.68	AV	V	45.19	11.61	32.24	48.24	54	-5.76
17921	23.96	AV	H	45.19	11.61	32.24	48.52	54	-5.48
17921	39.93	PK	V	45.19	11.61	32.24	64.49	74	-9.51
17921	39.11	PK	H	45.19	11.61	32.24	63.67	74	-10.33

Note:

*1, The testing has been conformed to 10*2462MHz=24,620MHz*
2, All other emissions more than 30 dB below the limit
3, X-Axis, Y-Axis and Z-Axis were investigated. The results above show only the worst case.

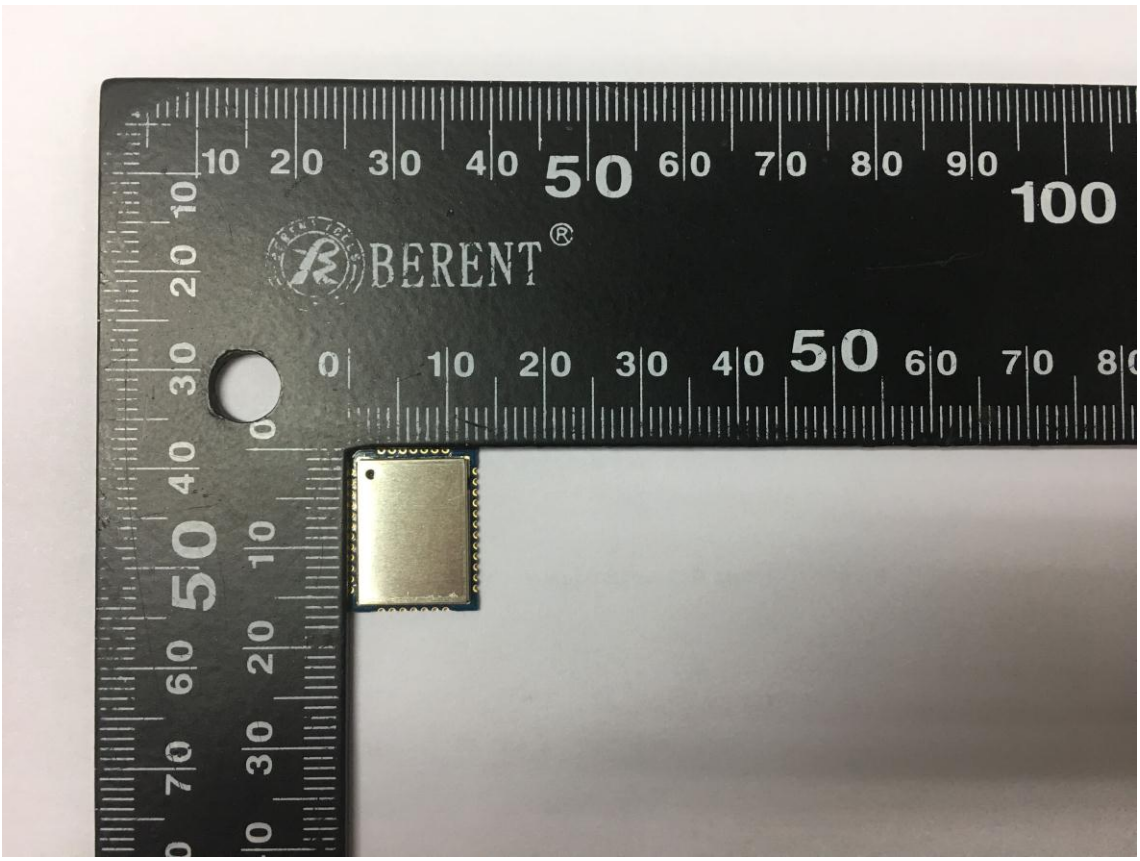
Annex A. TEST INSTRUMENT

Instrument	Model	Serial #	Cal Date	Cal Due	In use
AC Line Conducted					
EMI test receiver	ESCS30	8471241027	09/16/2016	09/15/2017	☑
Line Impedance	LI-125A	191106	09/24/2016	09/23/2017	☑
Line Impedance	LI-125A	191107	09/24/2016	09/23/2017	☑
LISN	ISN T800	34373	09/24/2016	09/23/2017	☑
Double Ridge Horn Antenna (1 ~18GHz)	AH-118	71283	09/23/2016	09/22/2017	☑
Transient Limiter	LIT-153	531118	08/31/2016	08/30/2017	☑
RF conducted test					
Agilent ESA-E SERIES	E4407B	MY45108319	09/16/2016	09/15/2017	☑
Power Splitter	1#	1#	08/31/2016	08/30/2017	☑
DC Power Supply	E3640A	MY40004013	09/16/2016	09/15/2017	☑
Radiated Emissions					
EMI test receiver	ESL6	100262	09/16/2016	09/15/2017	☑
Positioning Controller	UC3000	MF780208282	11/18/2016	11/18/2017	☑
OPT 010 AMPLIFIER (0.1-1300MHz)	8447E	2727A02430	08/31/2016	08/30/2017	☑
Microwave Preamplifier (1 ~ 26.5GHz)	8449B	3008A02402	03/24/2016	03/23/2017	☑
Bilog Antenna (30MHz~6GHz)	JB6	A110712	09/20/2016	09/19/2017	☑
Double Ridge Horn Antenna (1 ~18GHz)	AH-118	71283	09/23/2016	09/22/2017	☑
Universal Radio Communication Tester	CMU200	121393	09/24/2016	09/23/2017	☑

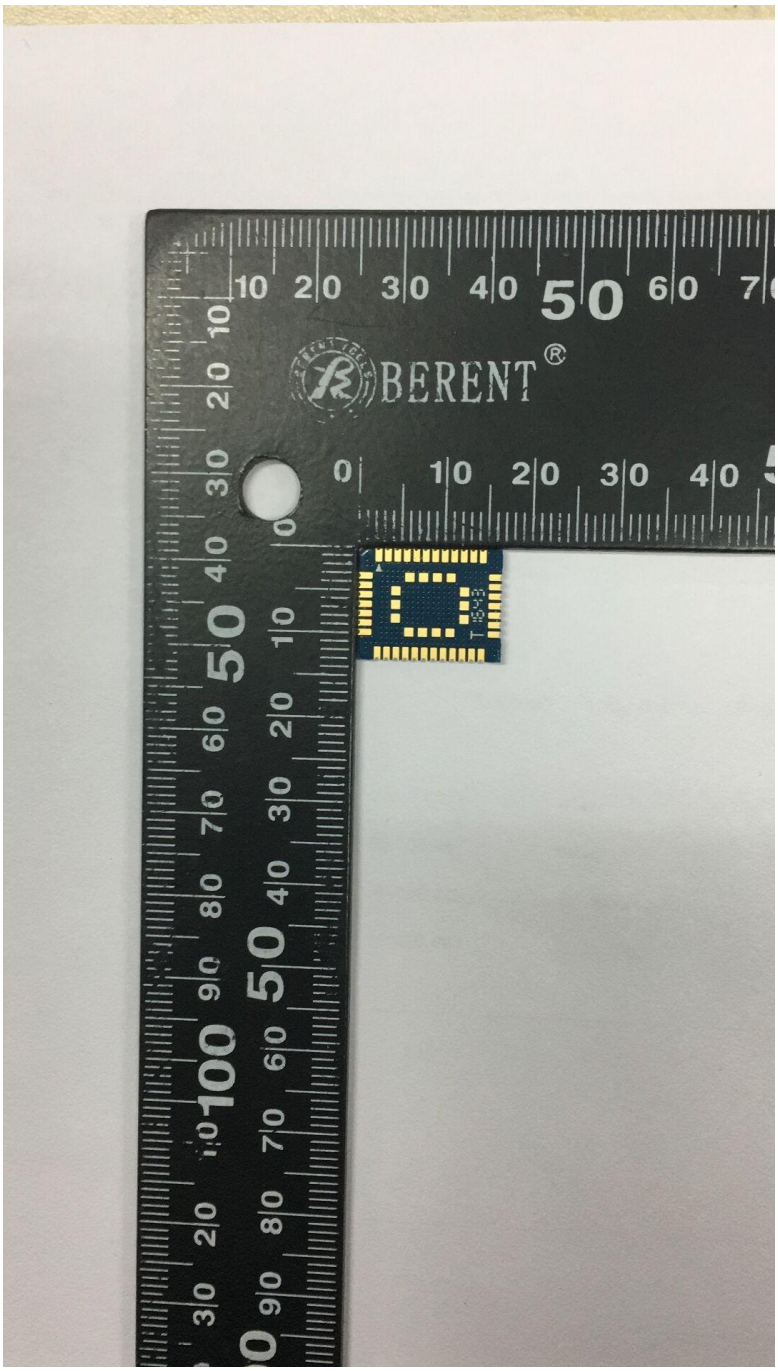
Annex B. EUT and Test Setup Photographs

Annex B.i. Photograph: EUT External Photo

EUT - Front View

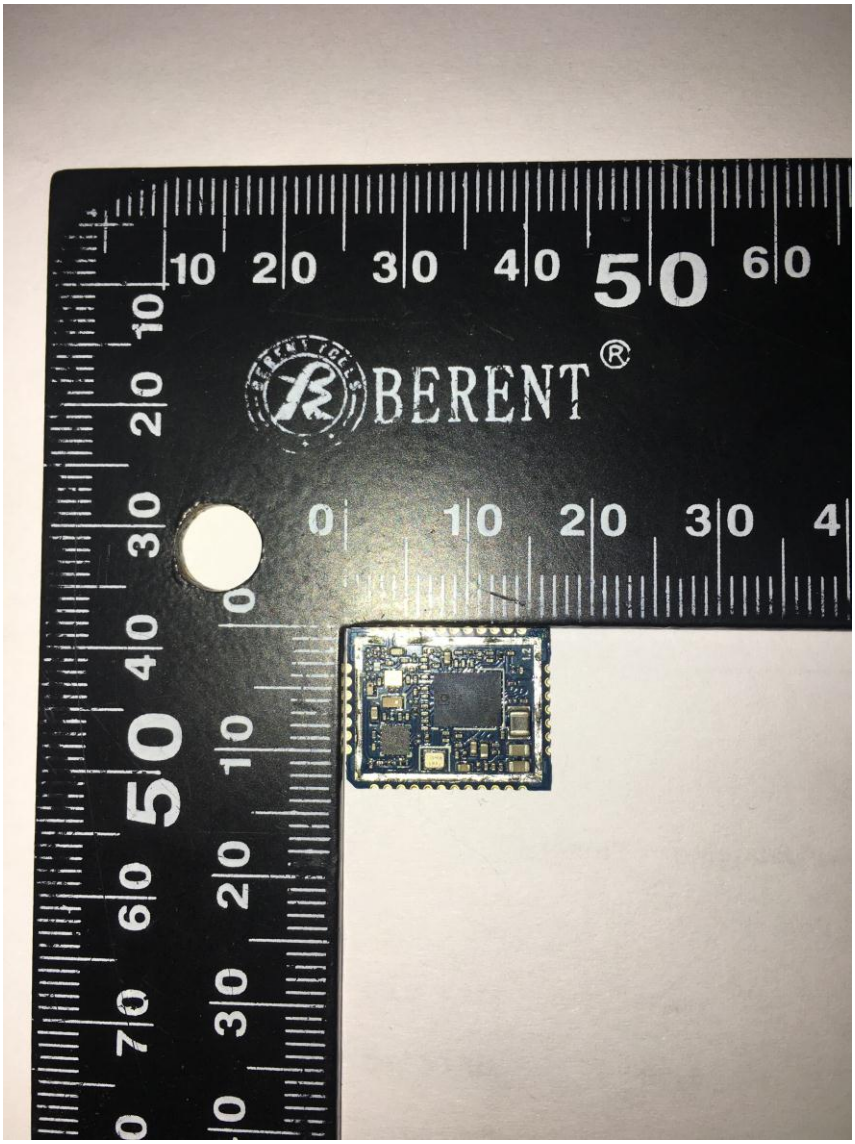


EUT - Rear View

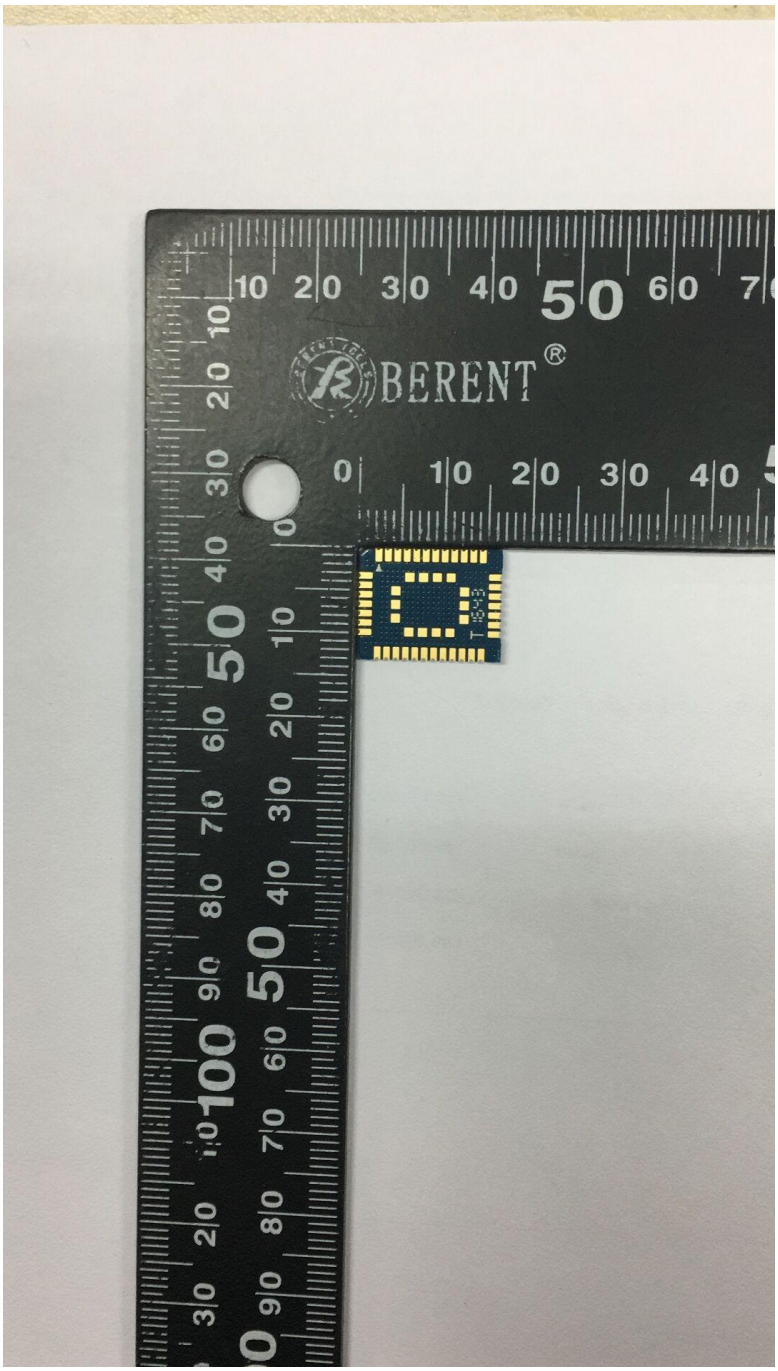


Annex B.ii. Photograph: EUT Internal Photo

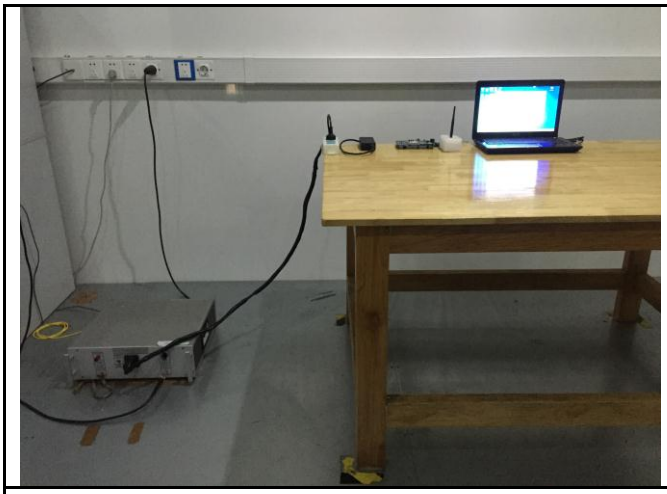
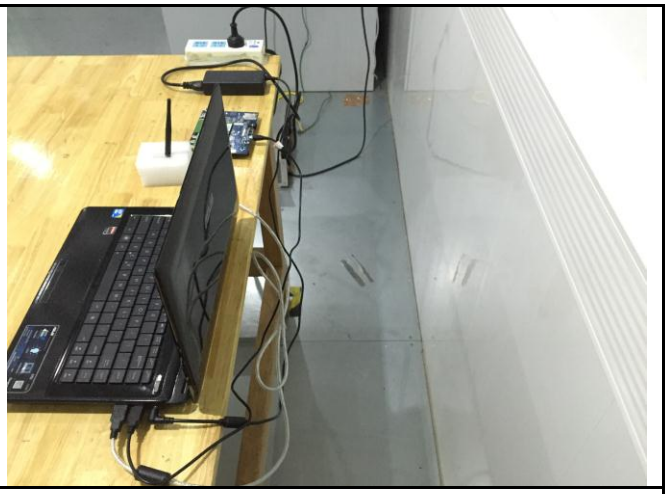
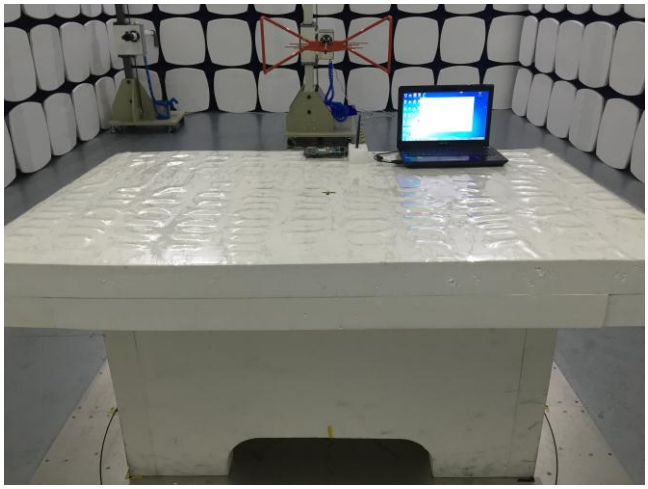
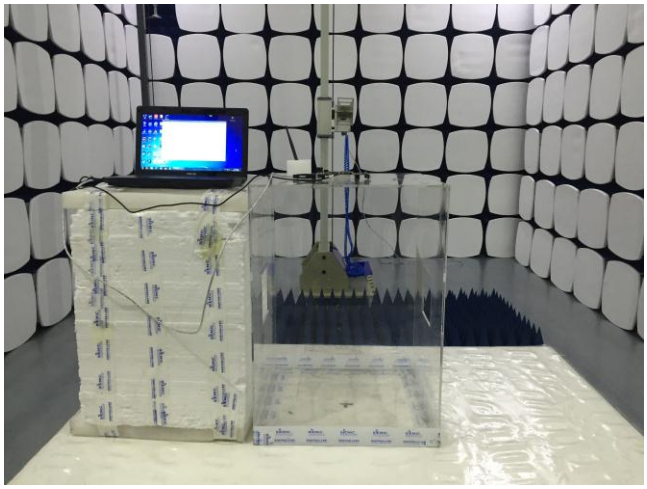
EUT- without Shielding – Front View



EUT - Rear View



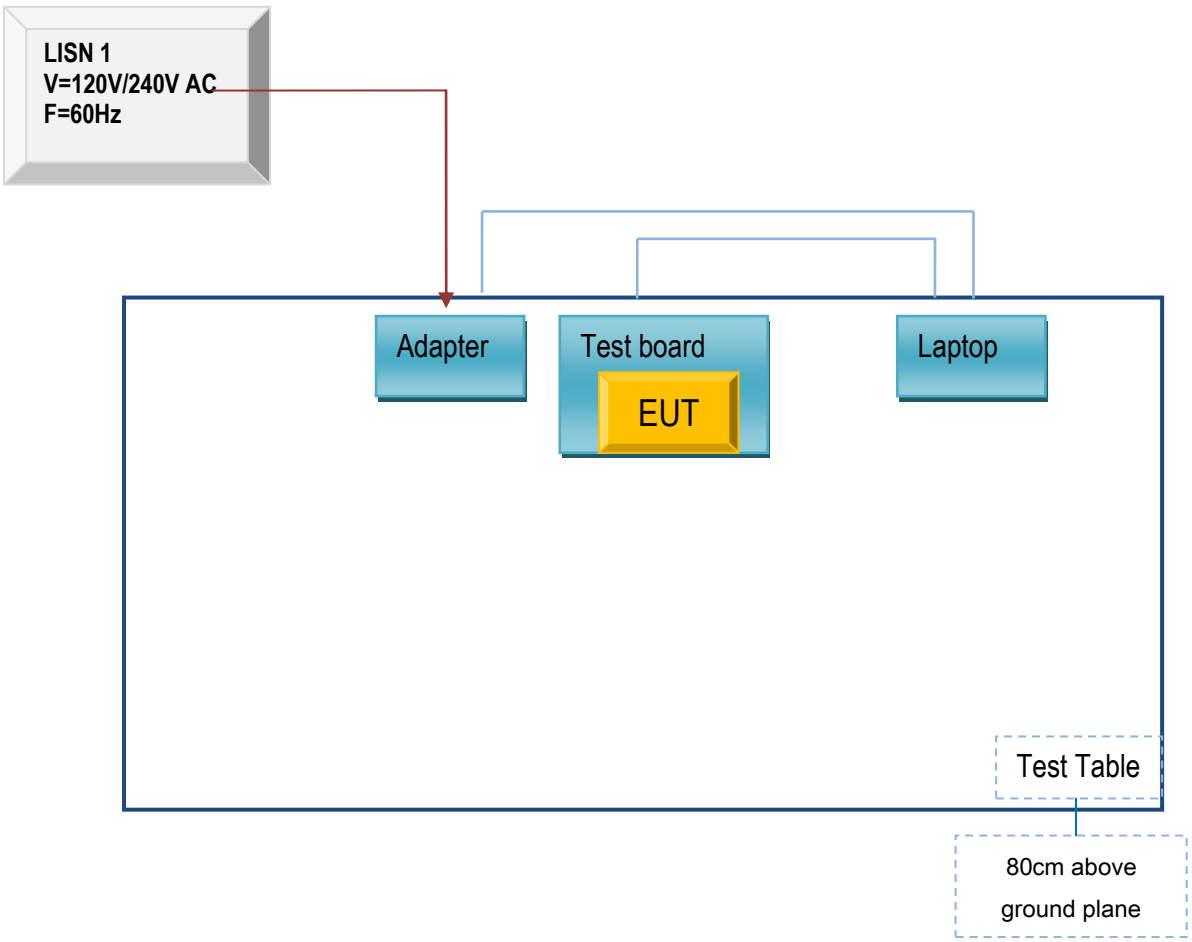
Annex B.iii. Photograph: Test Setup Photo

	
Conducted Emissions Test Setup Front View	Conducted Emissions Test Setup Side View
	
Radiated Spurious Emissions Test Setup Below 1GHz	Radiated Spurious Emissions Test Setup Above 1GHz

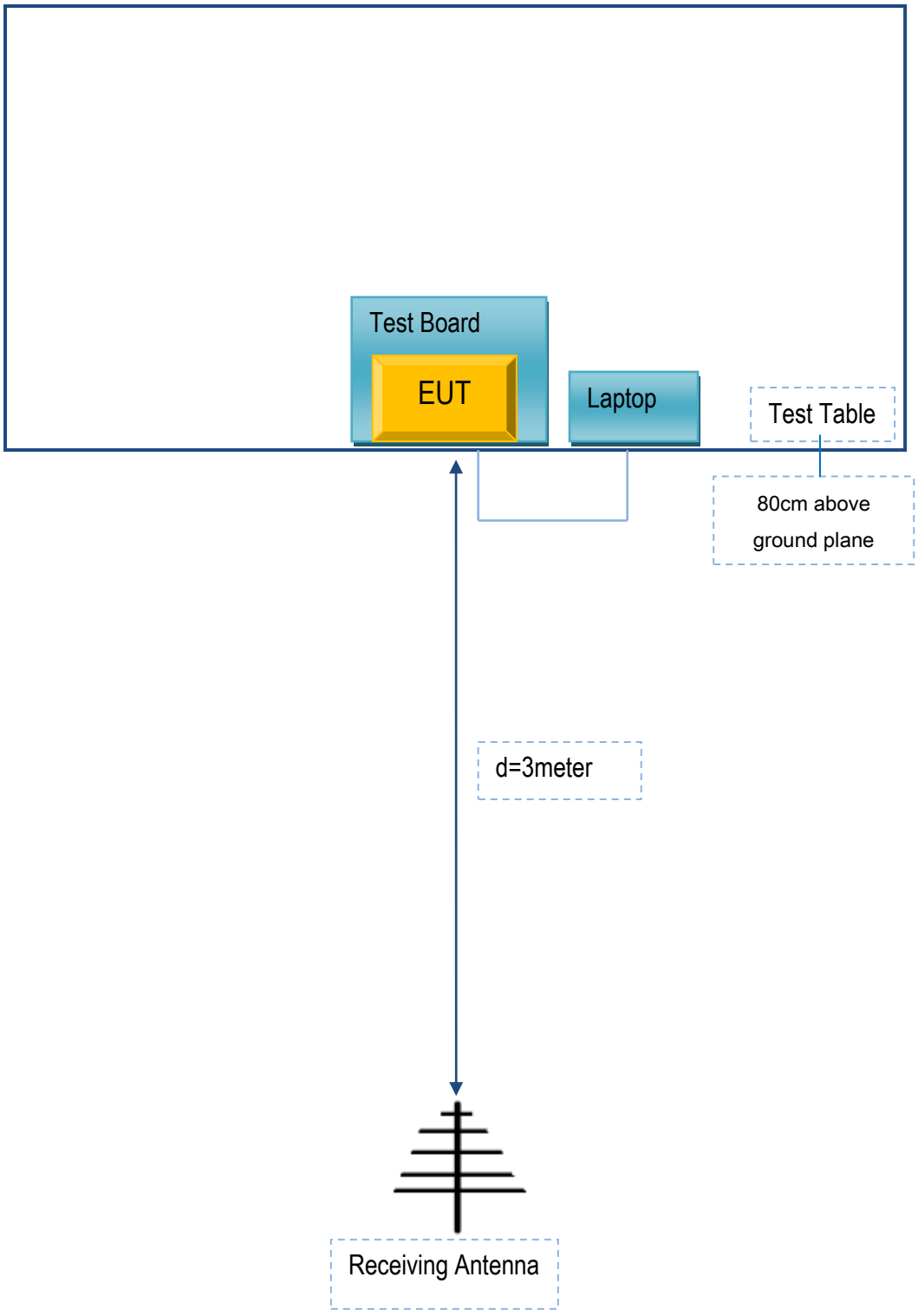
Annex C. TEST SETUP AND SUPPORTING EQUIPMENT

Annex C.ii. TEST SET UP BLOCK

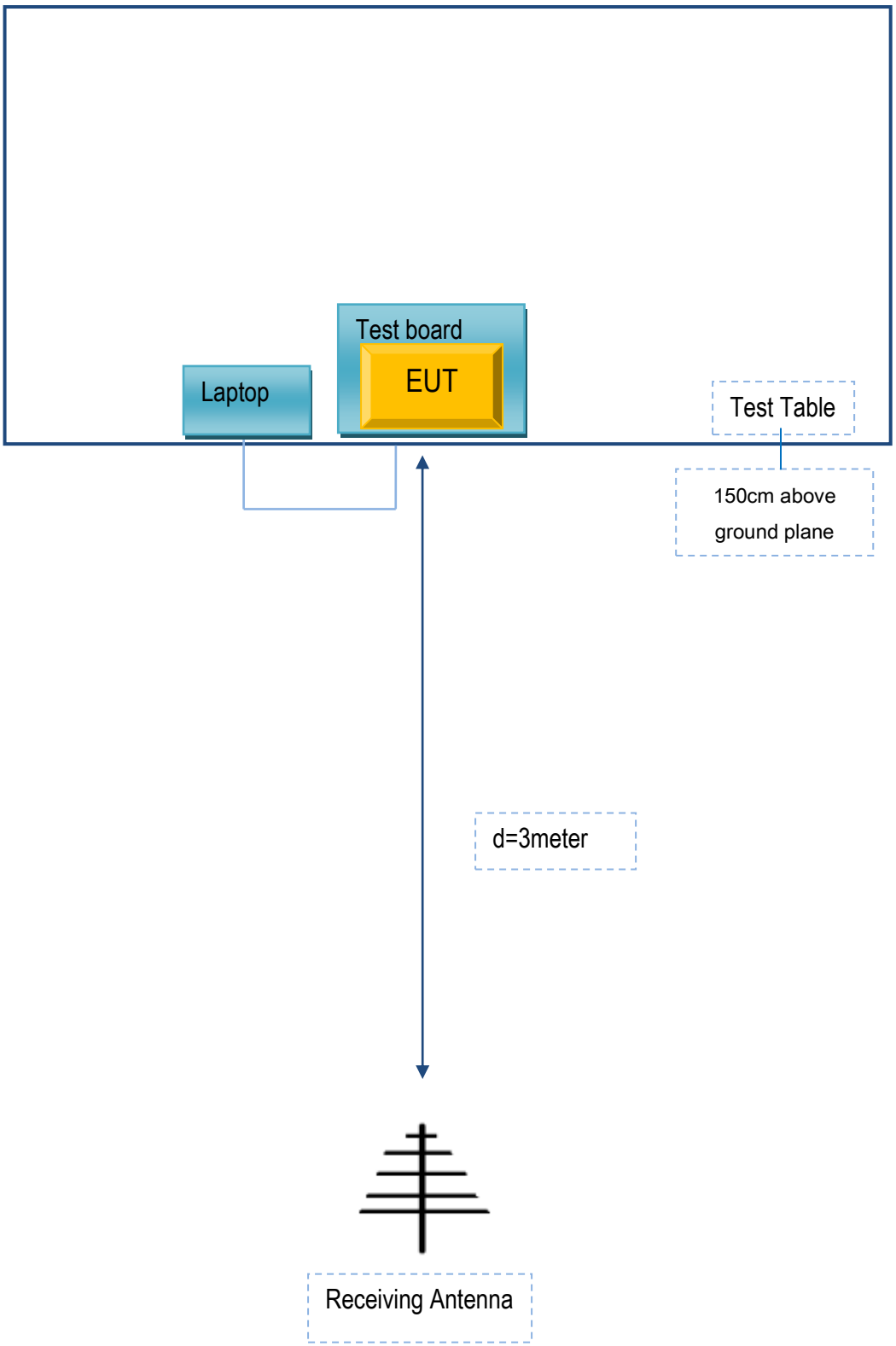
Block Configuration Diagram for AC Line Conducted Emissions



Block Configuration Diagram for Radiated Emissions （Below 1GHz）.



Block Configuration Diagram for Radiated Emissions （Above 1GHz）.



Annex C. il. SUPPORTING EQUIPMENT DESCRIPTION

The following is a description of supporting equipment and details of cables used with the EUT.

Supporting Equipment:

Manufacturer	Equipment Description	Model	Serial No
Lenovo	Laptop	E40	LR-1EHRX
Quectel Wireless Solutions Co., Ltd.	Test Board	Q1-A0770	MP87108N1000974

Supporting Cable:

Cable type	Shield Type	Ferrite Core	Length	Serial No
Power Cable	Un-shielding	No	0.8m	GT211032
USB Cable	Un-shielding	No	1m	MP87108N1000974

Annex D. User Manual / Block Diagram / Schematics / Partlist

N/A

Annex E. DECLARATION OF SIMILARITY

N/A