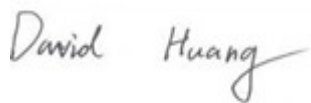


RF TEST REPORT



Report No.: 16050031-FCC-R-V2

Supersede Report No.: N/A

Applicant	Quectel Wireless Solutions Co., Ltd.	
Product Name	WiFi Module	
Model No.	FC20-N	
Serial No.	N/A	
Test Standard	FCC Part 15.247: 2016, ANSI C63.10: 2013	
Test Date	February 07 to March 01, 2017	
Issue Date	April 18, 2017	
Test Result	☒ Pass ☐ Fail	
Equipment complied with the specification ☒		
Equipment did not comply with the specification ☐		
		
Loren Luo 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

Test Report No.	16050031-FCC-R-V2
Page	3 of 51

This page has been left blank intentionally.

CONTENTS

1. REPORT REVISION HISTORY	5
2. CUSTOMER INFORMATION.....	5
3. TEST SITE INFORMATION	5
4. EQUIPMENT UNDER TEST (EUT) INFORMATION	6
5. TEST SUMMARY	7
6. MEASUREMENTS, EXAMINATION AND DERIVED RESULTS.....	8
6.1 ANTENNA REQUIREMENT	8
6.2 DTS (6 DB&20 DB) CHANNEL BANDWIDTH	9
6.3 MAXIMUM OUTPUT POWER.....	15
6.4 POWER SPECTRAL DENSITY	19
6.5 BAND-EDGE & UNWANTED EMISSIONS INTO RESTRICTED FREQUENCY BANDS	23
6.6 AC POWER LINE CONDUCTED EMISSIONS.....	29
6.7 RADIATED SPURIOUS EMISSIONS & RESTRICTED BAND.....	35
ANNEX A. TEST INSTRUMENT	41
ANNEX B. EUT AND TEST SETUP PHOTOGRAPHS.....	42
ANNEX C. TEST SETUP AND SUPPORTING EQUIPMENT.....	46
ANNEX D. USER MANUAL / BLOCK DIAGRAM / SCHEMATICS / PARTLIST	50
ANNEX E. DECLARATION OF SIMILARITY	51

1. Report Revision History

Report No.	Report Version	Description	Issue Date
16050031-FCC-R	NONE	Original	March 02, 2017
16050031-FCC-R-V1	V1	Product Name/Description of EUT:Wifi change to WiFi	April 12, 2017
16050031-FCC-R-V2	V2	Changed the antenna type	April 18, 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 Module
Main Model:	FC20-N
Serial Model:	N/A
Date EUT received:	February 06, 2017
Test Date(s):	February 07 to March 01, 2017
Equipment Category :	DTS
Antenna Gain:	WIFI: 3dBi
Antenna Type:	Fixed external antenna
Type of Modulation:	802.11b/g/n: DSSS, OFDM,
RF Operating Frequency (ies):	WIFI: 802.11b/g/n(20M): 2412-2462 MHz WIFI: 802.11n(40M): 2422-2452 MHz
Max. Output Power:	802.11b: 15.91dBm 802.11g: 13.76dBm 802.11n(20M): 13.81dBm 802.11n(40M): 12.92dBm
Number of Channels:	WIFI :802.11b/g/n(20M): 11CH WIFI :802.11n(40M): 7CH
Port:	N/A
Input Power:	Main supply voltage: 3.3V, 500mA IO supply voltage: 1.8V
Trade Name :	Quectel
FCC ID:	XMR201703FC20N

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 and Radiated Spurious Emissions	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:

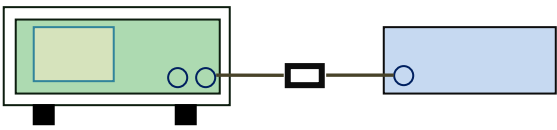
An non-standard and Reverse polarity interface attached Fixed External antenna for WIFI, the gain is 3dBi for WIFI.

The antenna meets up with the ANTENNA REQUIREMENT.

Result: Compliance.

6.2 DTS (6 dB&20 dB) Channel Bandwidth

Temperature	23 °C
Relative Humidity	52%
Atmospheric Pressure	1010mbar
Test date :	February 10, 2017
Tested By :	Loren Luo

Spec	Item	Requirement	Applicable
§ 15.247(a)(2) RSS Gen(4.6.1)	a)	6dB BW ≥ 500kHz; 20dB BW ≥ 500kHz;	☒
	b)	99% BW: For FCC reference only; required by IC.	☒
Test Setup	 Spectrum Analyzer EUT		
Test Procedure	558074 D01 DTS MEAS Guidance v03r03, 8.1 DTS bandwidth <u>6dB bandwidth</u> - Set RBW = 100 kHz. - Set the video bandwidth (VBW) ≥ 3 × RBW. - Detector = Peak. - Trace mode = max hold. - Sweep = auto couple. - Allow the trace to stabilize. - 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. <u>20dB bandwidth</u> C63.10 Occupied Bandwidth (OBW=20dB bandwidth) - Set RBW = 1%-5% OBW. - Set the video bandwidth (VBW) ≥ 3 x RBW. - Set the span range between 2 times and 5 times of the OBW. - Sweep time=Auto, Detector=PK, Trace=Max hold. - Once the reference level is established, the equipment is conditioned with typical 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

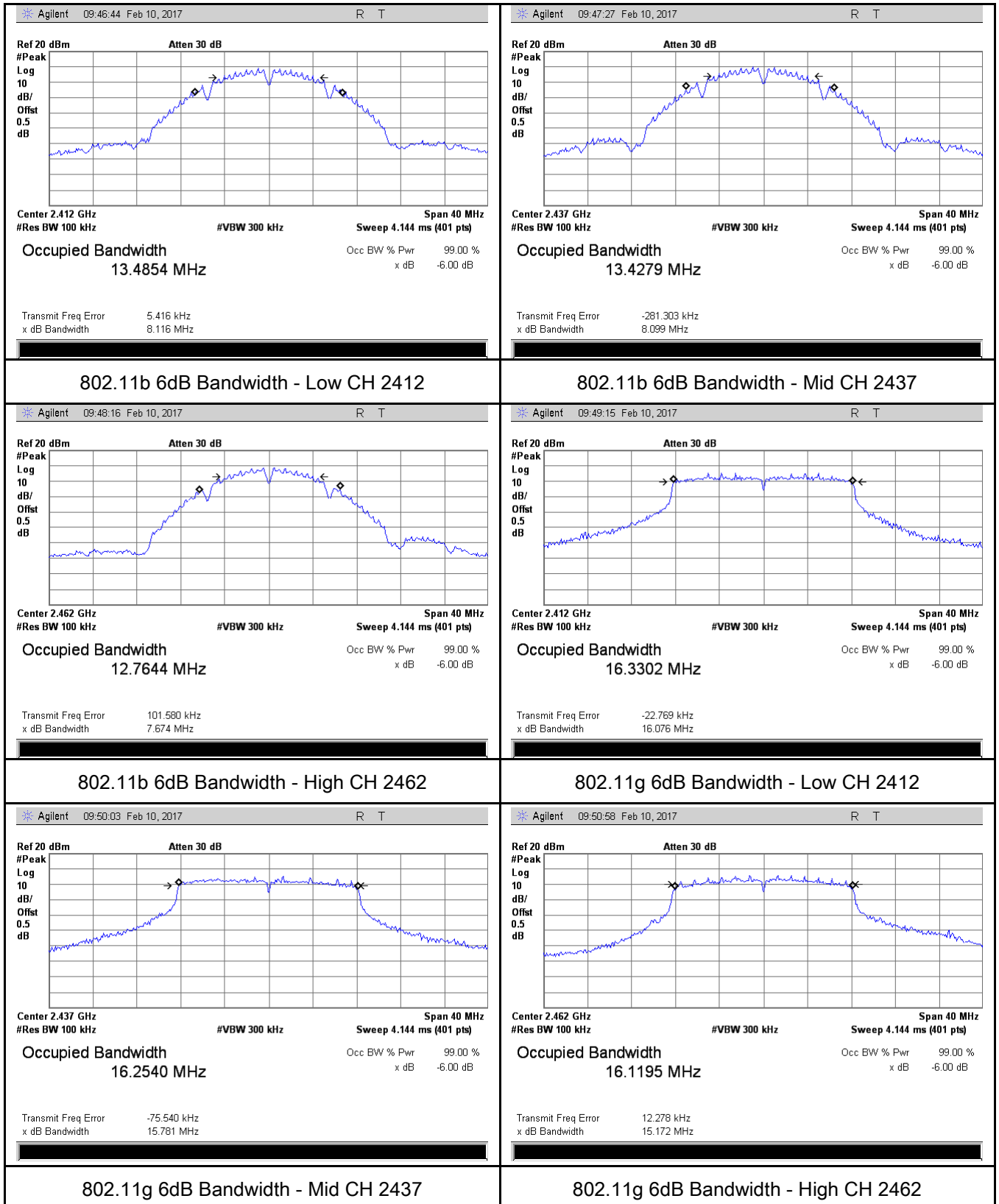
Test Plot ☒ Yes (See below) ☐ N/A

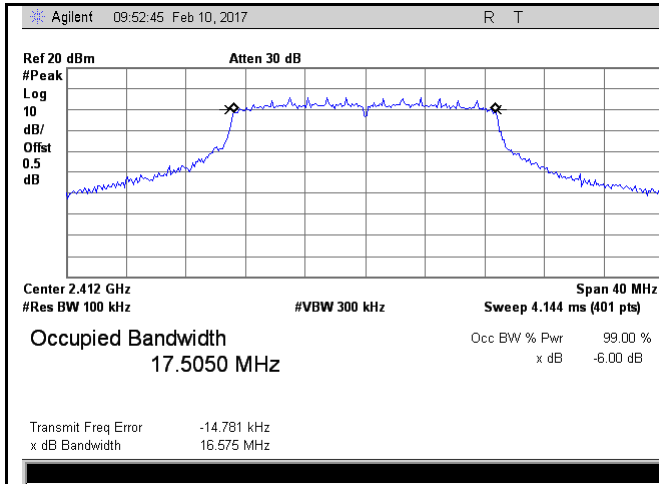
Measurement result

Test mode	CH	Freq (MHz)	6dB Bandwidth (MHz)	20dB Bandwidth (MHz)	Limit (MHz)
802.11b	Low	2412	8.116	15.315	≥ 0.5
	Mid	2437	8.099	15.632	≥ 0.5
	High	2462	7.674	14.756	≥ 0.5
802.11g	Low	2412	16.076	18.152	≥ 0.5
	Mid	2437	15.781	17.985	≥ 0.5
	High	2462	15.172	17.874	≥ 0.5
802.11n (20M)	Low	2412	16.575	19.154	≥ 0.5
	Mid	2437	15.988	19.088	≥ 0.5
	High	2462	15.154	18.771	≥ 0.5
802.11n (40M)	Low	2422	35.155	39.110	≥ 0.5
	Mid	2437	35.177	39.550	≥ 0.5
	High	2452	34.078	39.441	≥ 0.5

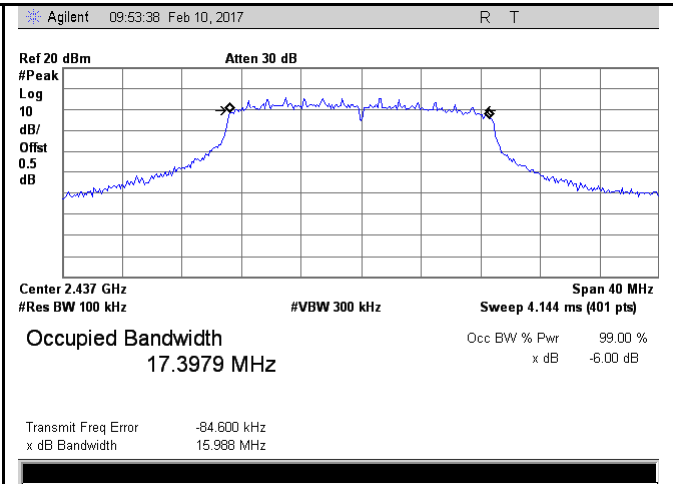
Test Plots

6dB Bandwidth measurement result

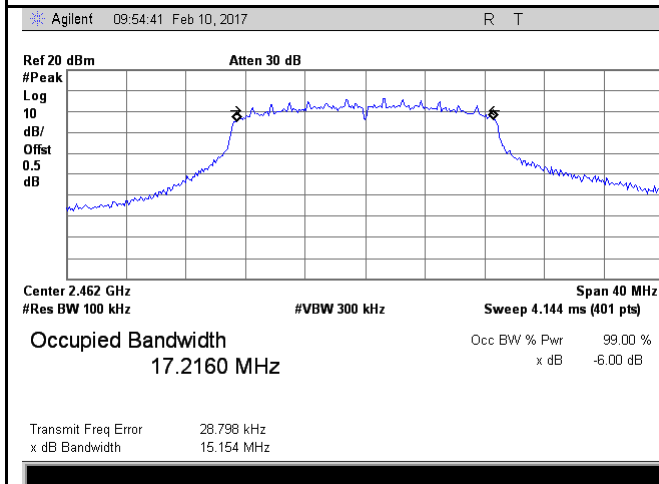




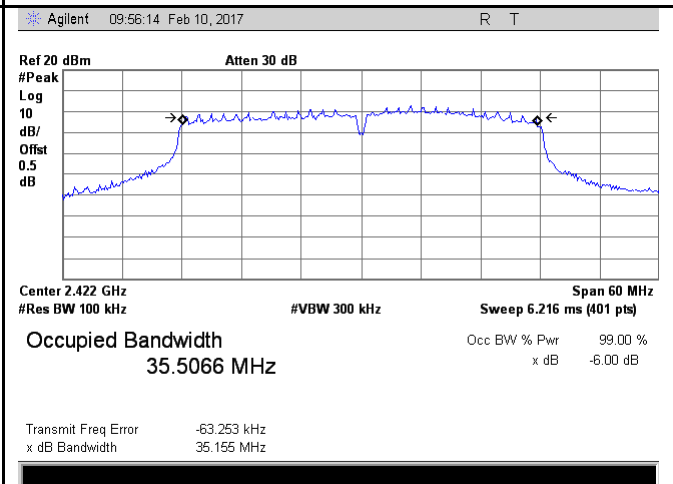
802.11n20 6dB Bandwidth - Low CH 2412



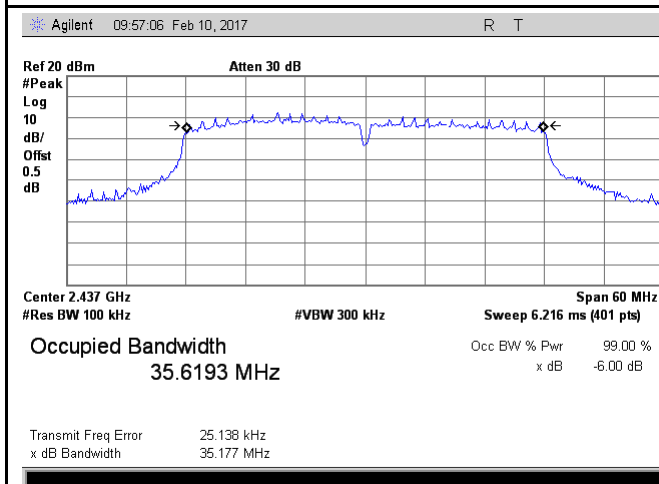
802.11n20 6dB Bandwidth - Mid CH 2437



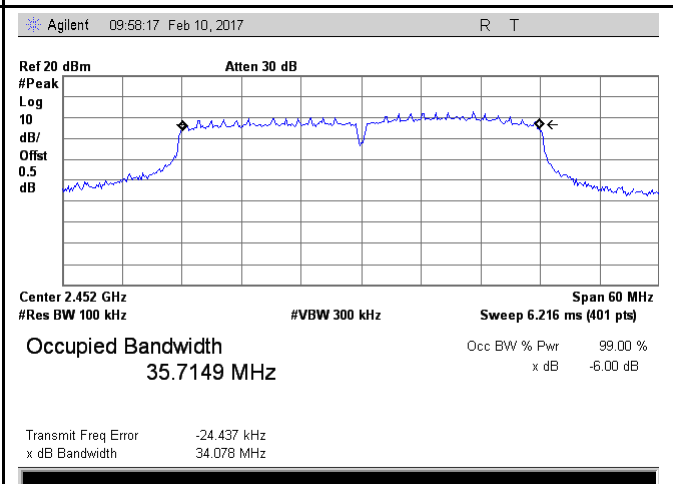
802.11n20 6dB Bandwidth - High CH 2462



802.11n40 6dB Bandwidth - Low CH 2422

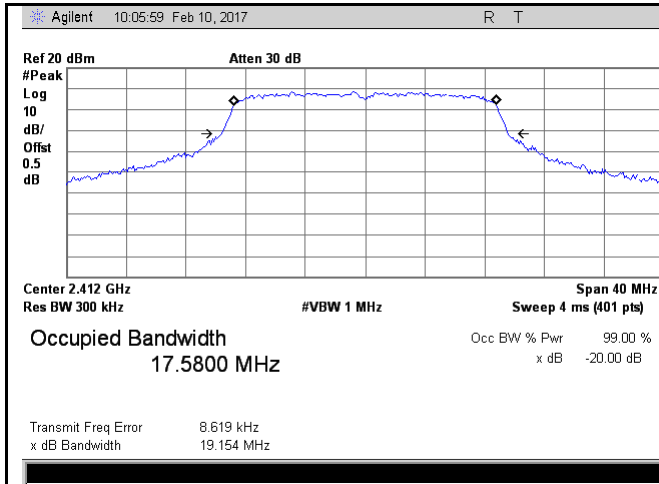


802.11n40 6dB Bandwidth - Mid CH 2437

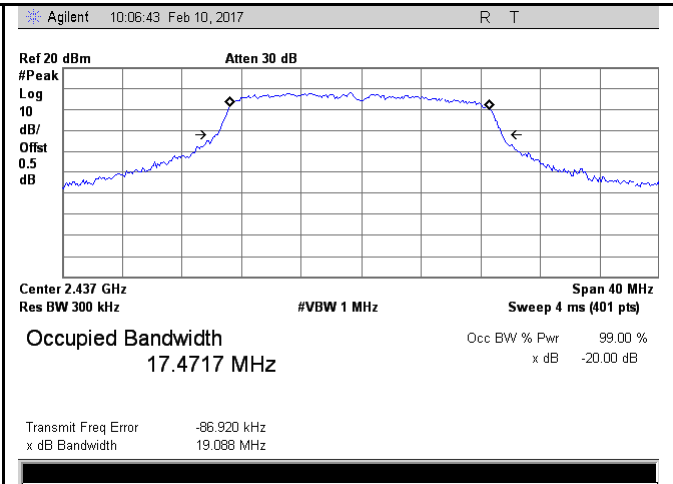


802.11n40 6dB Bandwidth - High CH 2452

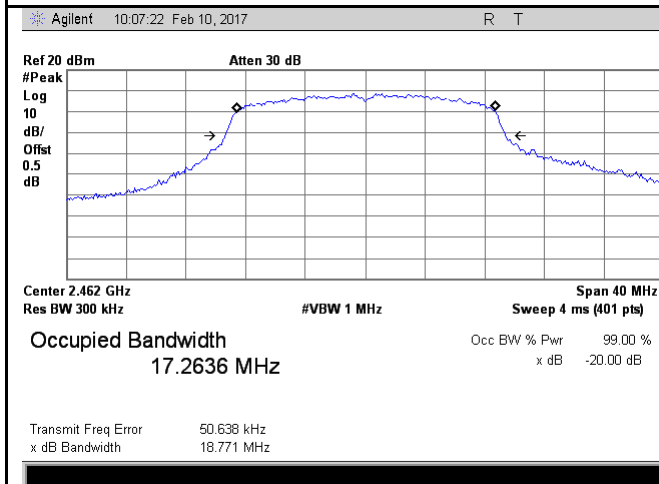
Agilent 10:00:00 Feb 10, 2017		R	T
Center 2.412 GHz Res BW 300 kHz #VBW 1 MHz Sweep 4 ms (401 pts) Span 40 MHz Occupied Bandwidth 13.4773 MHz Occ BW % Pwr 99.00 % x dB -20.00 dB Transmit Freq Error -37.659 kHz x dB Bandwidth 15.315 MHz			
802.11b 20dB Bandwidth - Low CH 2412			
Agilent 10:00:37 Feb 10, 2017 <th>R</th> <th>T</th>		R	T
Center 2.437 GHz Res BW 300 kHz #VBW 1 MHz Sweep 4 ms (401 pts) Span 40 MHz Occupied Bandwidth 13.4637 MHz Occ BW % Pwr 99.00 % x dB -20.00 dB Transmit Freq Error -256.945 kHz x dB Bandwidth 15.632 MHz			
802.11b 20dB Bandwidth - Mid CH 2437			
Agilent 10:01:27 Feb 10, 2017 <th>R</th> <th>T</th>		R	T
Center 2.462 GHz Res BW 300 kHz #VBW 1 MHz Sweep 4 ms (401 pts) Span 40 MHz Occupied Bandwidth 12.7911 MHz Occ BW % Pwr 99.00 % x dB -20.00 dB Transmit Freq Error 147.465 kHz x dB Bandwidth 14.756 MHz			
802.11b 20dB Bandwidth - High CH 2462			
Agilent 10:02:32 Feb 10, 2017 <th>R</th> <th>T</th>		R	T
Center 2.412 GHz Res BW 300 kHz #VBW 1 MHz Sweep 4 ms (401 pts) Span 40 MHz Occupied Bandwidth 16.4506 MHz Occ BW % Pwr 99.00 % x dB -20.00 dB Transmit Freq Error 2.469 kHz x dB Bandwidth 18.152 MHz			
802.11g 20dB Bandwidth - Low CH 2412			
Agilent 10:03:32 Feb 10, 2017 <th>R</th> <th>T</th>		R	T
Center 2.437 GHz Res BW 300 kHz #VBW 1 MHz Sweep 4 ms (401 pts) Span 40 MHz Occupied Bandwidth 16.4031 MHz Occ BW % Pwr 99.00 % x dB -20.00 dB Transmit Freq Error -82.897 kHz x dB Bandwidth 17.985 MHz			
802.11b 20dB Bandwidth - High CH 2462			
Agilent 10:04:30 Feb 10, 2017 <th>R</th> <th>T</th>		R	T
Center 2.462 GHz Res BW 300 kHz #VBW 1 MHz Sweep 4 ms (401 pts) Span 40 MHz Occupied Bandwidth 16.2127 MHz Occ BW % Pwr 99.00 % x dB -20.00 dB Transmit Freq Error 50.148 kHz x dB Bandwidth 17.874 MHz			
802.11g 20dB Bandwidth - Low CH 2412			
Agilent 10:05:30 Feb 10, 2017 <th>R</th> <th>T</th>		R	T
Center 2.412 GHz Res BW 300 kHz #VBW 1 MHz Sweep 4 ms (401 pts) Span 40 MHz Occupied Bandwidth 16.2127 MHz Occ BW % Pwr 99.00 % x dB -20.00 dB Transmit Freq Error -256.945 kHz x dB Bandwidth 15.632 MHz			
802.11g 20dB Bandwidth - High CH 2462			



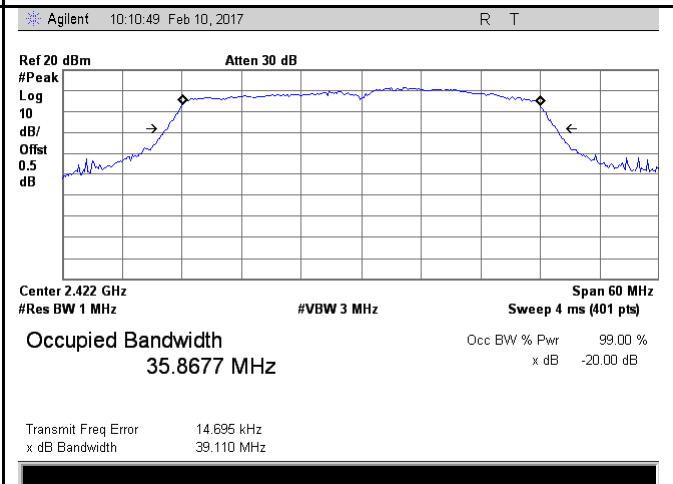
802.11n20 20dB Bandwidth - Low CH 2412



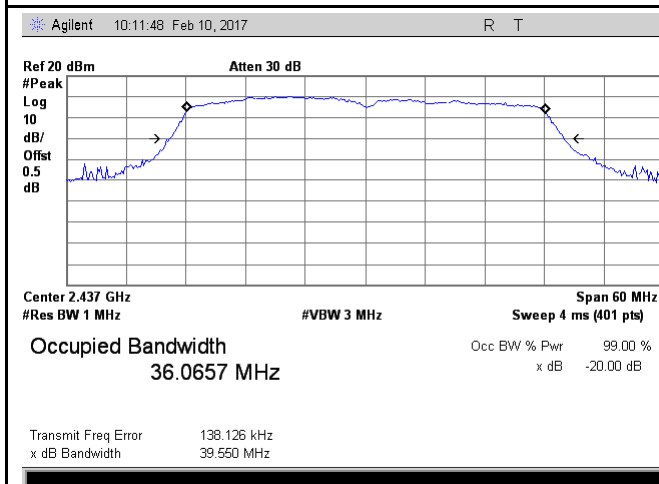
802.11n20 20dB Bandwidth - Mid CH 2437



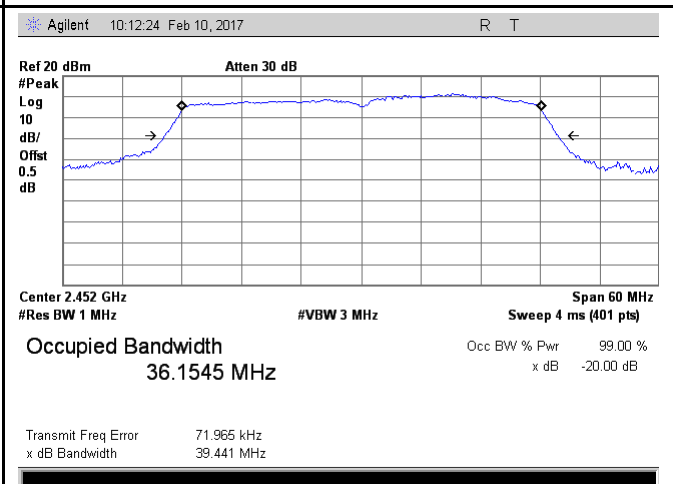
802.11n20 20dB Bandwidth - High CH 2462



802.11n40 20dB Bandwidth - Low CH 2422



802.11n40 20dB Bandwidth - Mid CH 2437

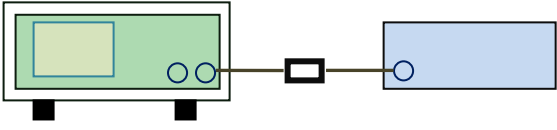


802.11n40 20dB Bandwidth - High CH 2452

6.3 Maximum Output Power

Temperature	23 °C
Relative Humidity	52%
Atmospheric Pressure	1010mbar
Test date :	February 10, 2017
Tested By :	Loren Luo

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	 Spectrum Analyzer EUT		
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 $\geq 3 \times$ RBW. - d) Number of points in sweep $\geq 2 \times$ span / RBW. (This gives bin-to-bin spacing $\leq$ 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 $\geq 98\%$, 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

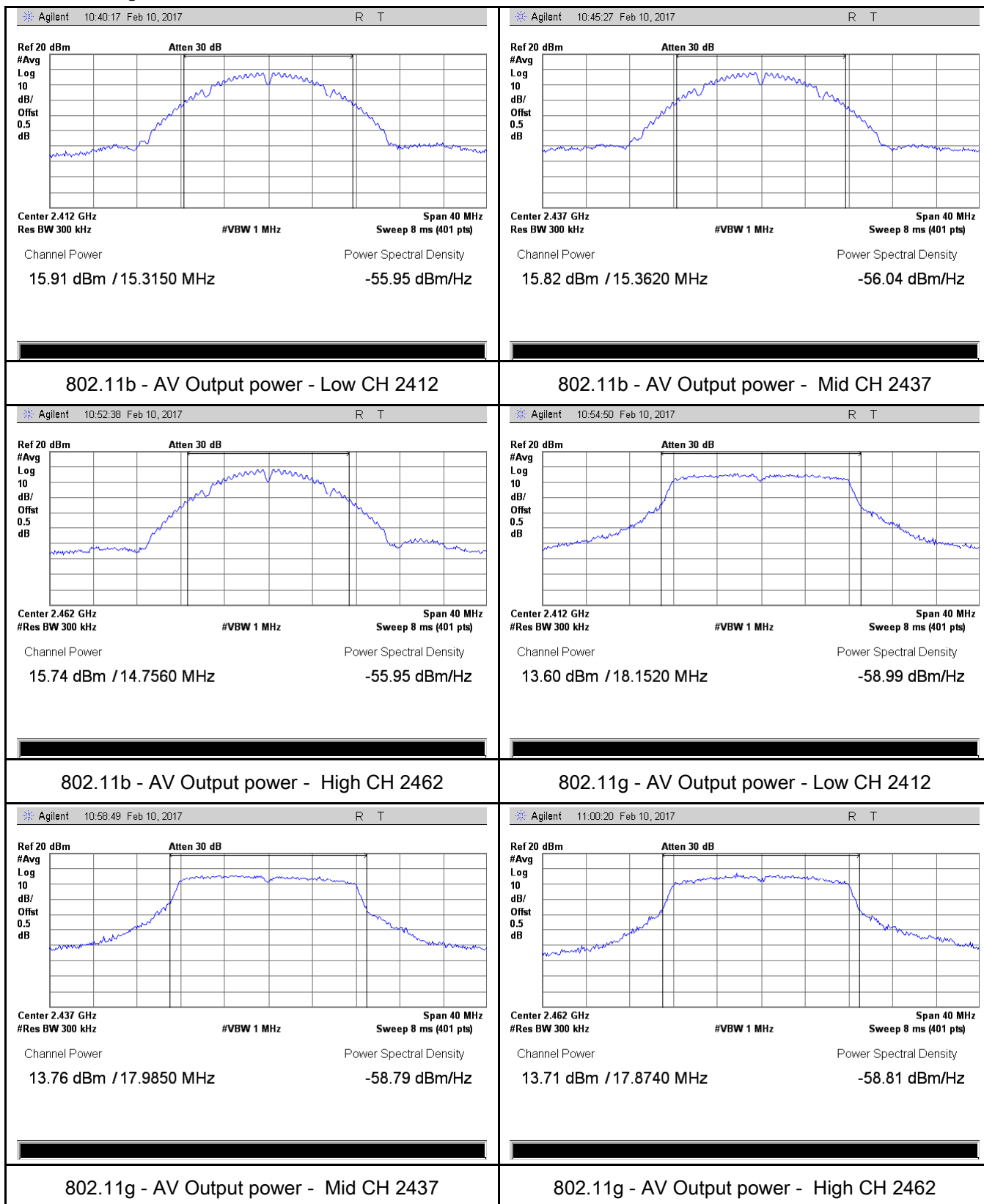
Test Plot ☒ Yes (See below) ☐ N/A

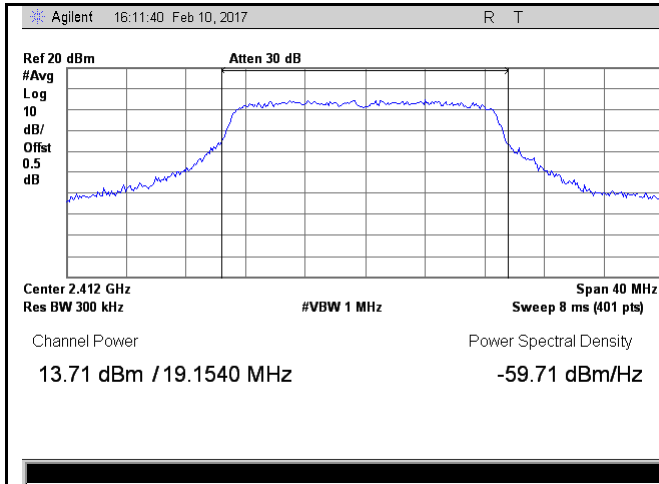
Output Power measurement result

Type	Test mode	CH	Frequency (MHz)	Conducted Power (dBm)	Limit (dBm)	Result
Output power	802.11b	Low	2412	15.91	30	Pass
		Mid	2437	15.82	30	Pass
		High	2462	15.74	30	Pass
	802.11g	Low	2412	13.60	30	Pass
		Mid	2437	13.76	30	Pass
		High	2462	13.71	30	Pass
	802.11n (20M)	Low	2412	13.71	30	Pass
		Mid	2437	13.81	30	Pass
		High	2462	13.71	30	Pass
	802.11n (40M)	Low	2422	12.92	30	Pass
		Mid	2437	12.75	30	Pass
		High	2452	12.78	30	Pass

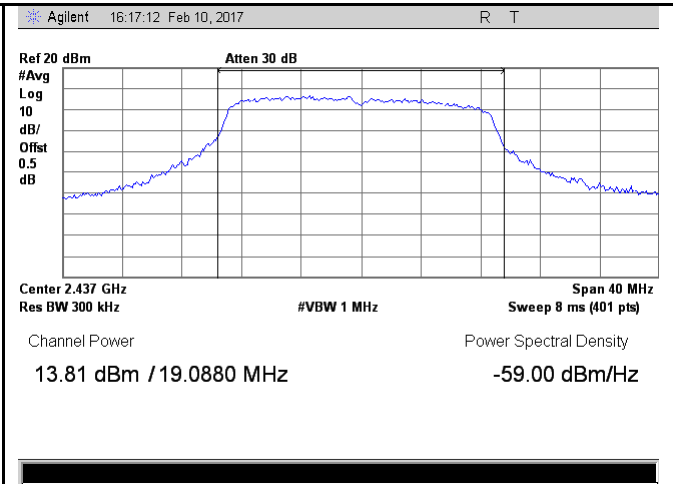
Test Plots

The Average Power

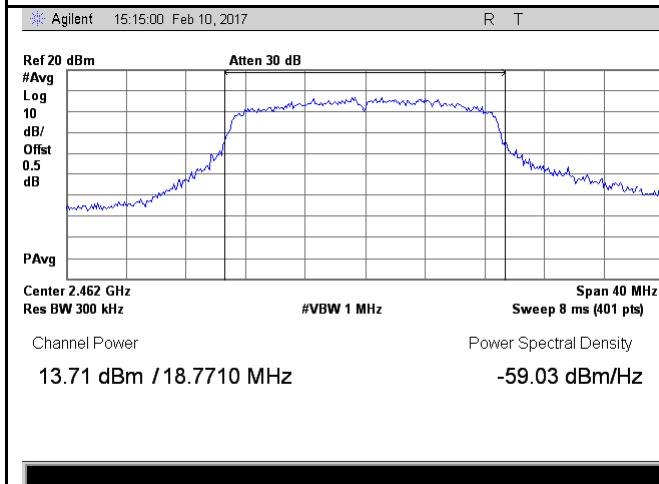




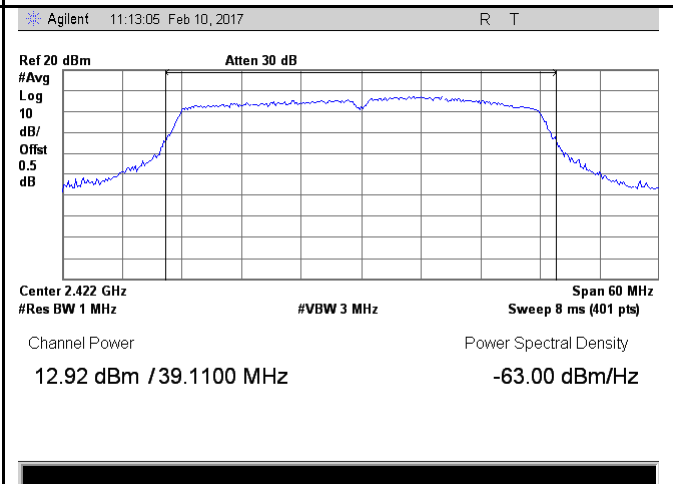
802.11n20 - AV Output power - Low CH 2412



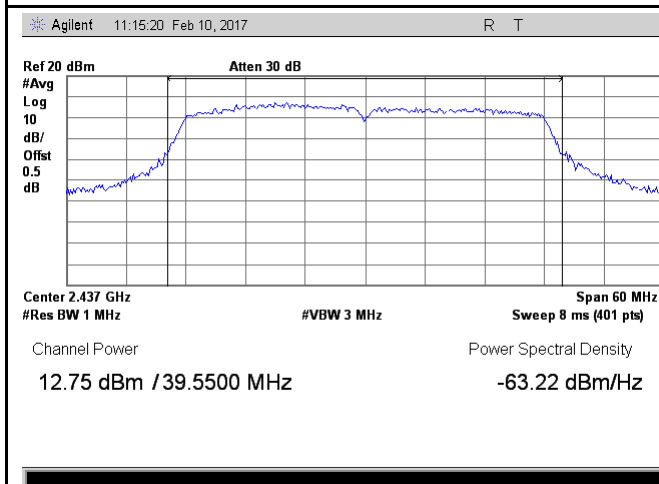
802.11n20 - AV Output power - Mid CH 2437



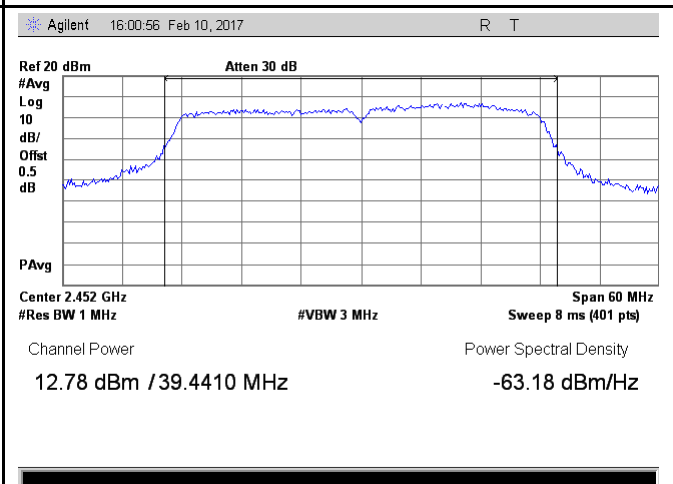
802.11n20 - AV Output power - High CH 2462



802.11n40 - AV Output power - Low CH 2422



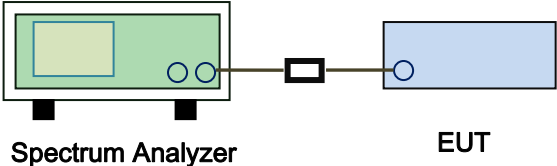
802.11n40 - AV Output power - Mid CH 2437



802.11n40 - AV Output power - High CH 2452

6.4 Power Spectral Density

Temperature	23 °C
Relative Humidity	52%
Atmospheric Pressure	1010mbar
Test date :	February 10, 2017
Tested By :	Loren Luo

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	 Spectrum Analyzer EUT		
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: $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$. - d) Set the VBW $\geq 3 \times \text{RBW}$. - 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		

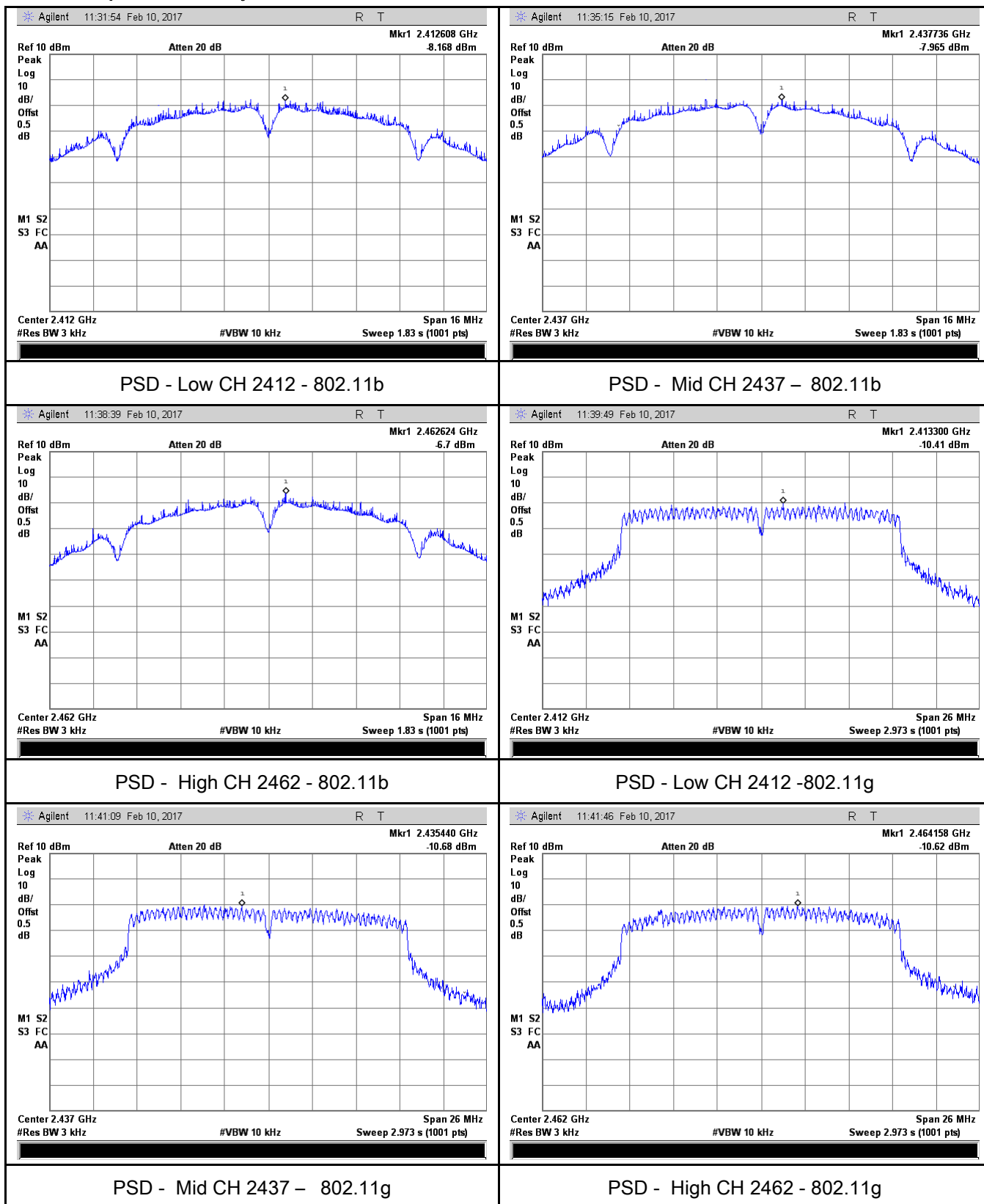
Test Data ☒ Yes ☐ N/A
 Test Plot ☒ Yes (See below) ☐ N/A

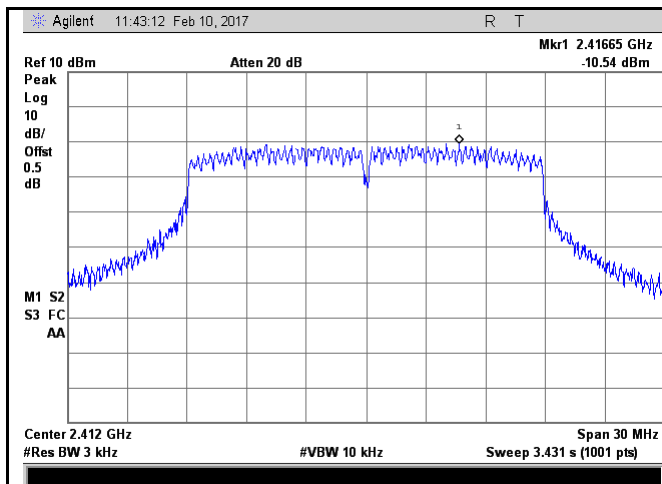
Power Spectral Density measurement result

Type	Test mode	CH	Freq (MHz)	PSD	Limit (dBm)	Result
				(dBm)		
PSD	802.11b	Low	2412	-8.168	8	Pass
		Mid	2437	-7.965	8	Pass
		High	2462	-6.700	8	Pass
	802.11g	Low	2412	-10.41	8	Pass
		Mid	2437	-10.68	8	Pass
		High	2462	-10.62	8	Pass
	802.11n (20M)	Low	2412	-10.54	8	Pass
		Mid	2437	-10.48	8	Pass
		High	2462	-8.895	8	Pass
	802.11n (40M)	Low	2422	-11.50	8	Pass
		Mid	2437	-12.60	8	Pass
		High	2452	-12.89	8	Pass

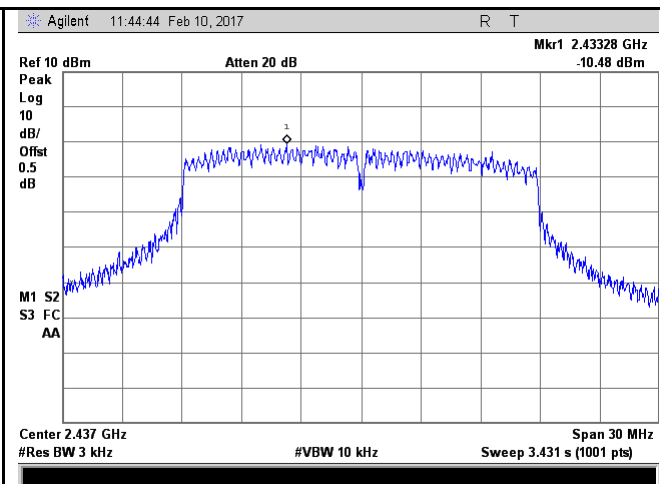
Test Plots

Power Spectral Density measurement result

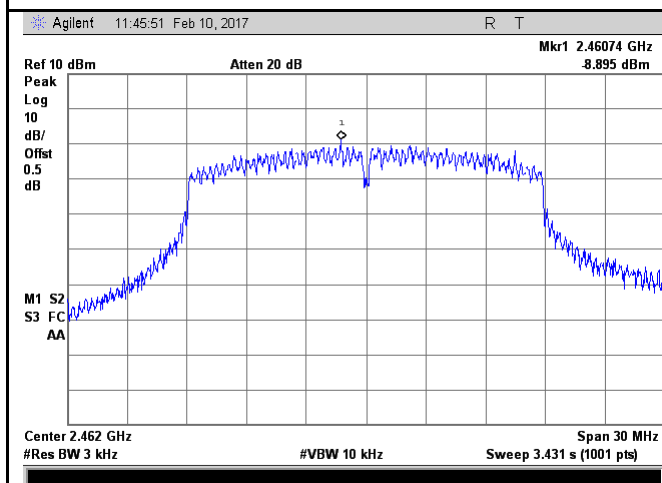




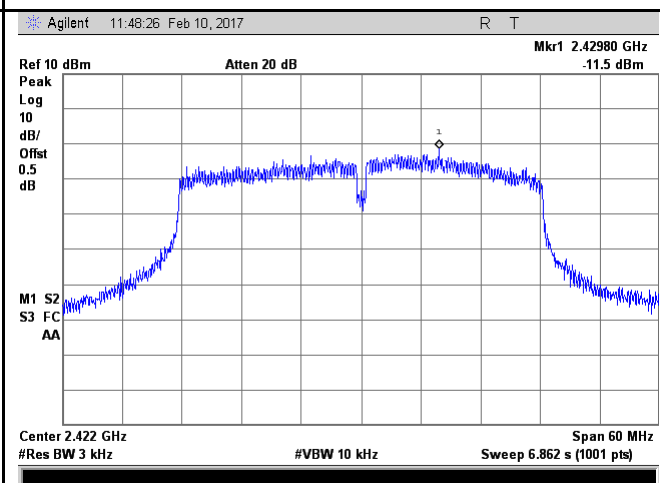
PSD - Low CH 2412 - 802.11n20



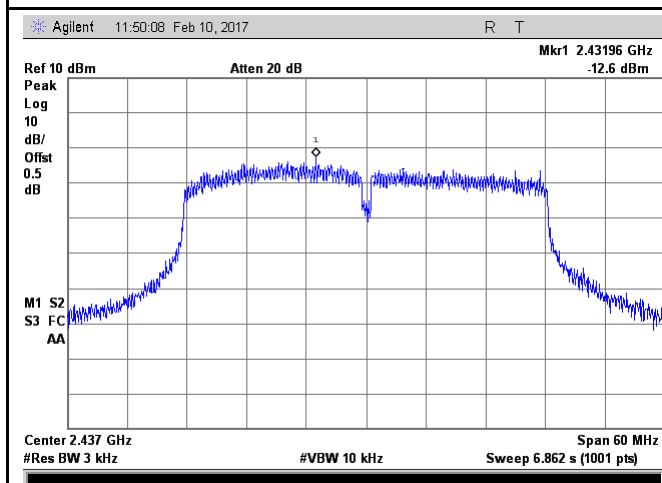
PSD - Mid CH 2437 - 802.11n20



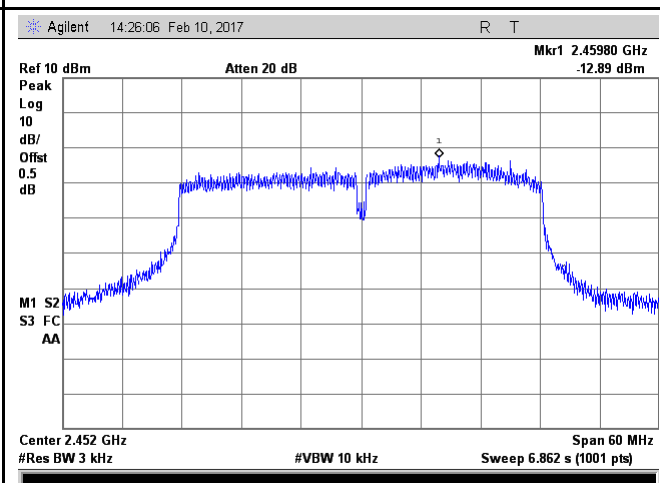
PSD - High CH 2472 - 802.11n20



PSD - Low CH 2422 - 802.11n40



PSD - Mid CH 2437 - 802.11n40



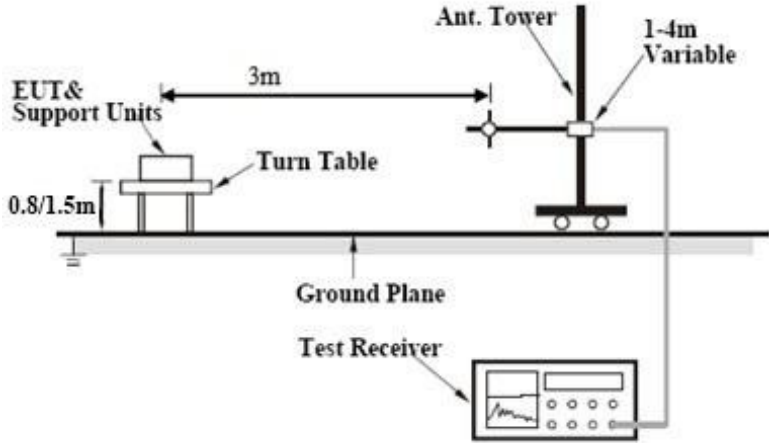
PSD - High CH 2452 - 802.11n40

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 :	Loren Luo

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	 The diagram illustrates the test setup for radiated emissions. It features a Turn Table with EUT & Support Units on it, positioned 3m from an Ant. Tower. The Ant. Tower has a 1-4m Variable antenna. The setup is on a Ground Plane. A Test Receiver is connected to the antenna.
------------	--

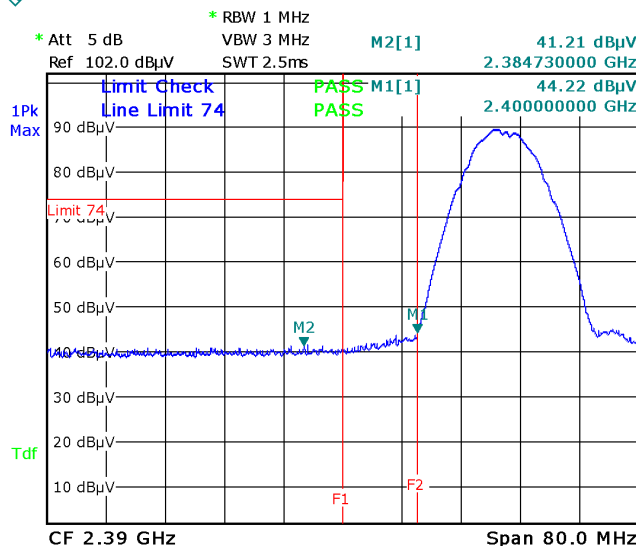
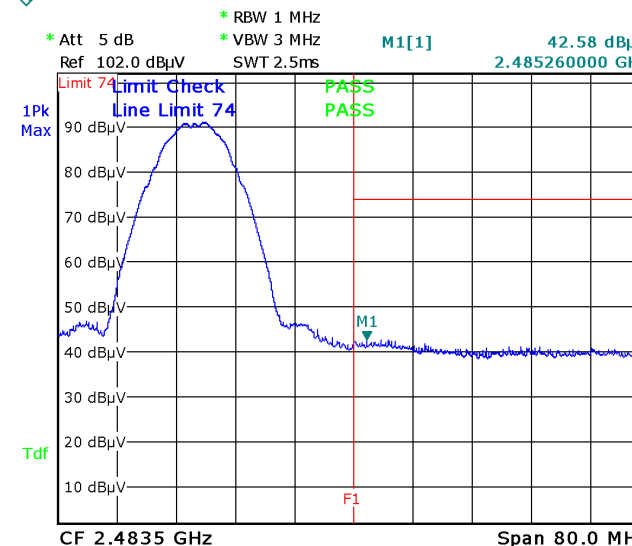
Test Procedure	Radiated Method Only 1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator. 2. Position the EUT without connection to measurement instrument. Put it on the Rotated table and turn on the EUT and make it operate 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.
----------------	---

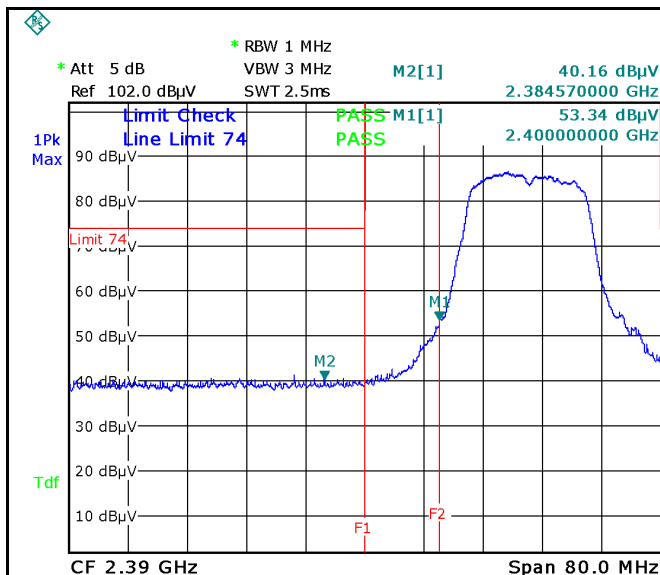
	- 3. First, set both RBW and VBW of spectrum analyzer to 100 kHz with a convenient frequency span including 100kHz bandwidth from band edge, check the emission of EUT, if pass then set Spectrum Analyzer as below: a. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 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

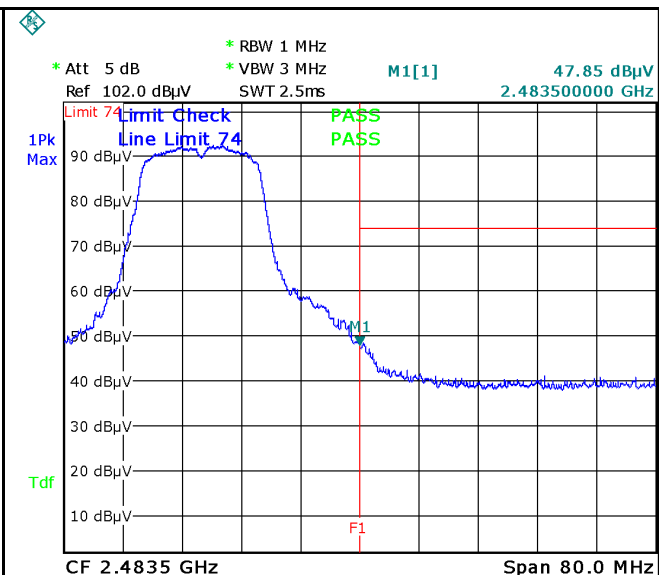
Band Edge measurement result

 Date: 24.FEB.2017 11:03:48	 Date: 24.FEB.2017 12:52:08
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



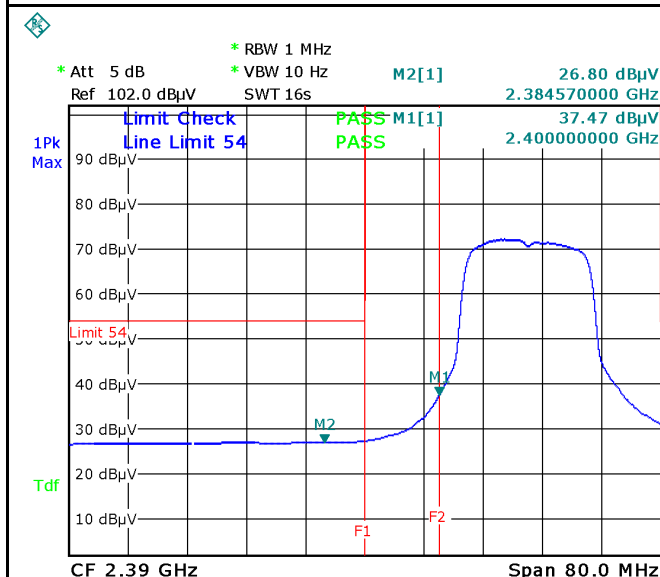
Date: 24.FEB.2017 11:07:43

Band Edge, Left Side (Peak) - 802.11g
Note: F1 is frequency 2390MHz; F2 is frequency 2400MHz



Date: 24.FEB.2017 12:54:12

Band Edge, Right Side (Peak) - 802.11g
Note: F1 is frequency 2483.5MHz

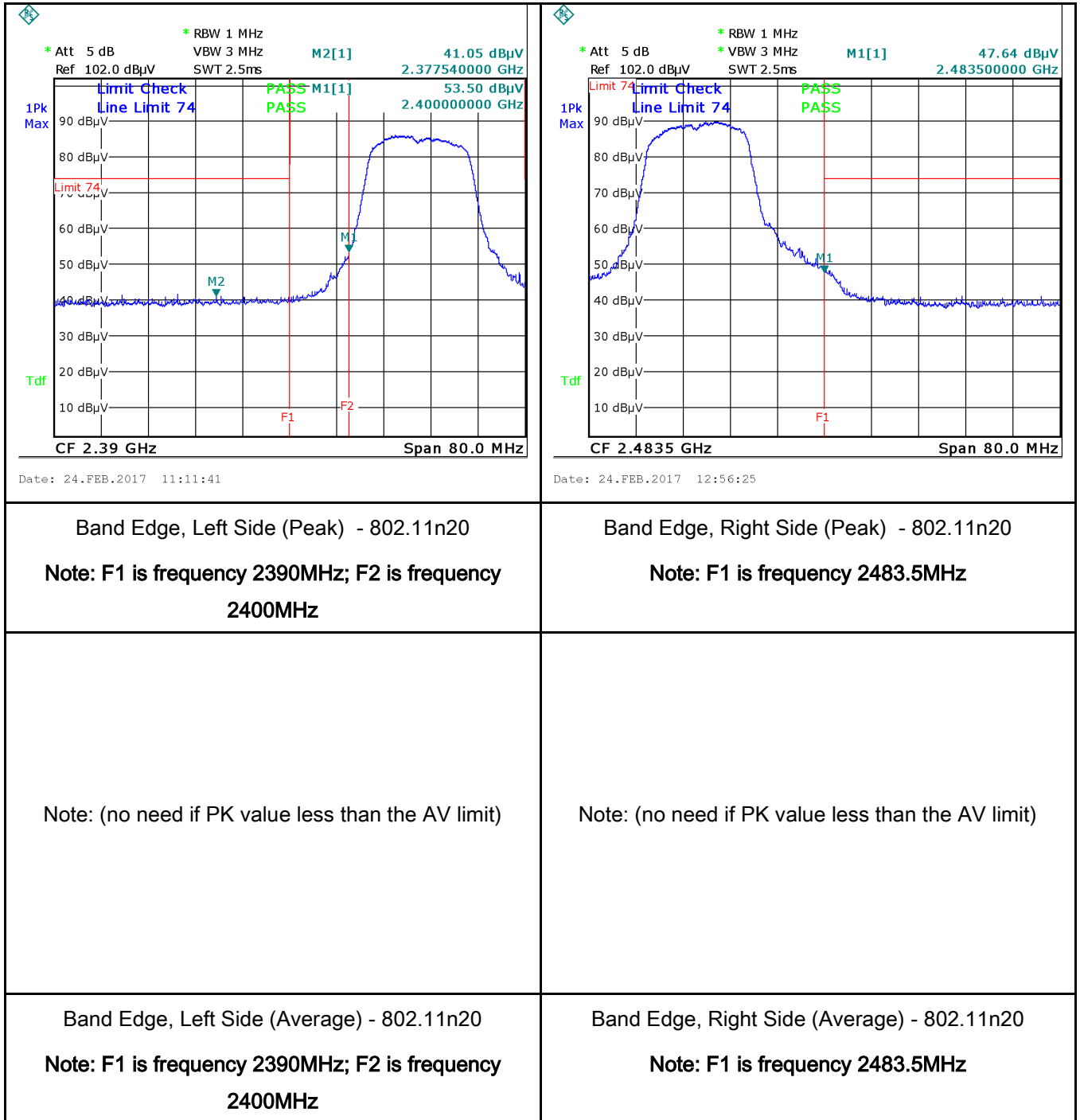


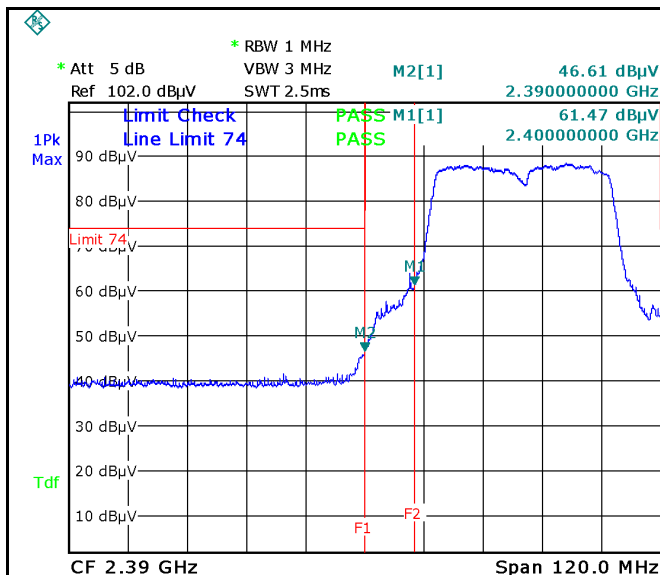
Date: 24.FEB.2017 11:09:04

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)

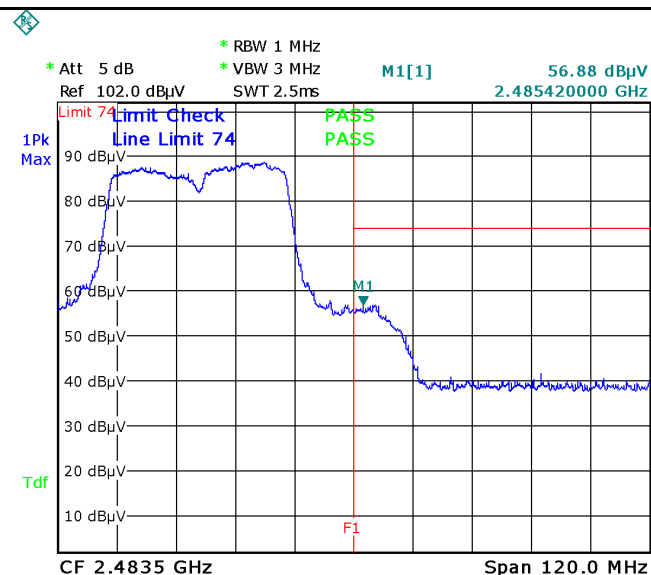
Band Edge, Right Side (Average) - 802.11g
Note: F1 is frequency 2483.5MHz





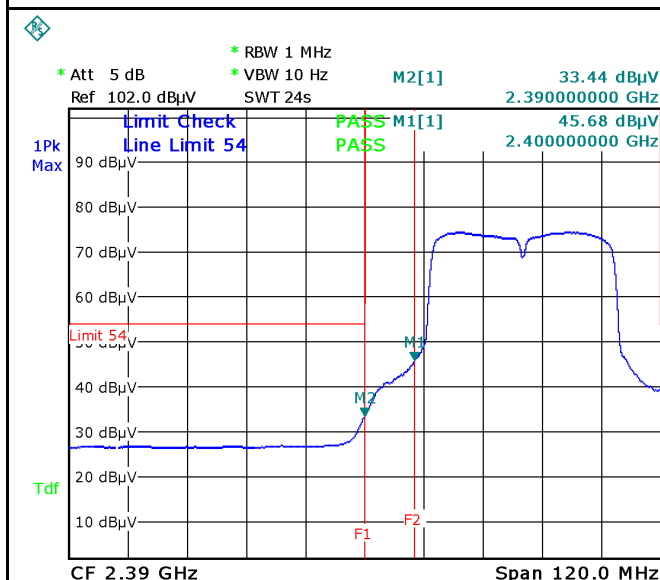
Date: 24.FEB.2017 11:21:38

Band Edge, Left Side (Peak) - 802.11n40
Note: F1 is frequency 2390MHz; F2 is frequency 2400MHz



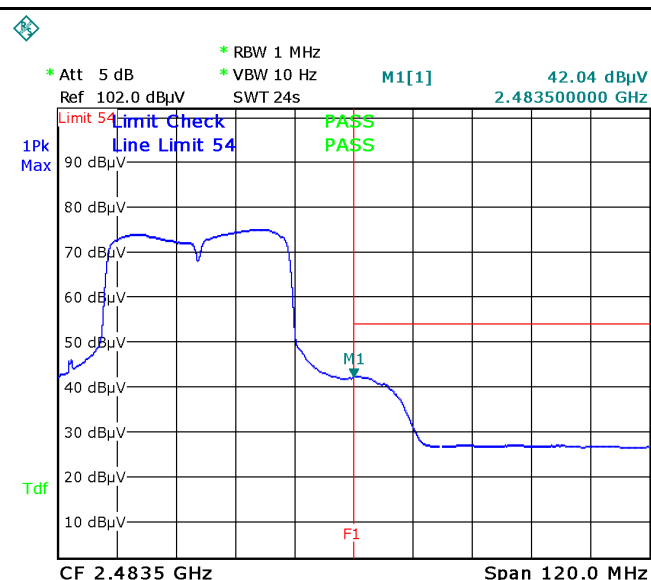
Date: 24.FEB.2017 12:59:12

Band Edge, Right Side (Peak) - 802.11n40
Note: F1 is frequency 2483.5MHz



Date: 24.FEB.2017 11:23:06

Band Edge, Left Side (Average) - 802.11n40
Note: F1 is frequency 2390MHz; F2 is frequency 2400MHz



Date: 24.FEB.2017 13:00:30

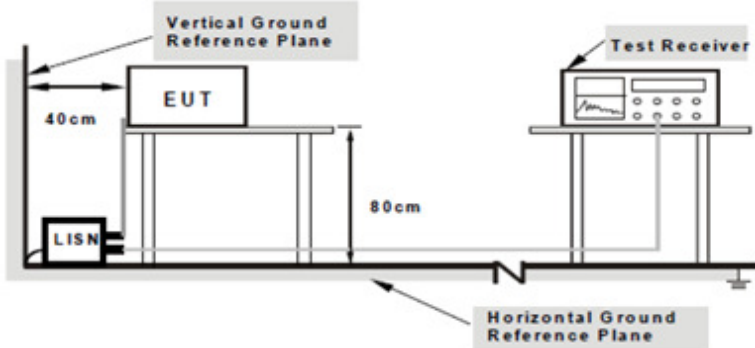
Band Edge, Right Side (Average) - 802.11n40
Note: F1 is frequency 2483.5MHz

6.6 AC Power Line Conducted Emissions

Temperature	22 °C
Relative Humidity	59%
Atmospheric Pressure	1017mbar
Test date :	February 17, 2017
Tested By :	Loren Luo

Requirement(s):

Spec	Item	Requirement	Applicable		
47CFR§15.207, RSS210 (A8.1)	a)	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.	☒		
		Frequency ranges (MHz)		Limit (dBµV)	
				QP	Average
		0.15 ~ 0.5		66 – 56	56 – 46
		0.5 ~ 5		56	46
5 ~ 30	60	50			

Test Setup	 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.
------------	---

Procedure	- 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. - The power supply for the EUT was fed through a 50W/50mH EUT LISN, connected to filtered mains. - The RF OUT of the EUT LISN was connected to the EMI test receiver via a low-loss
-----------	---

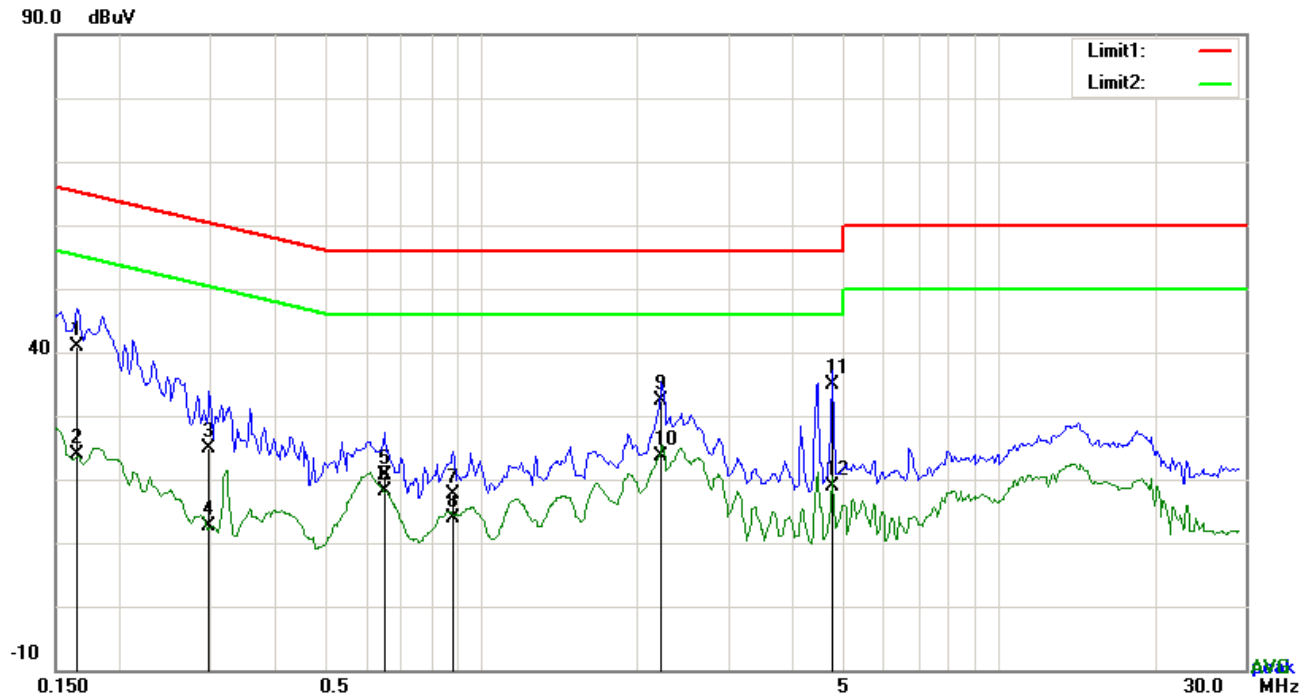
Test Report No.	16050031-FCC-R-V2
Page	30 of 51

	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

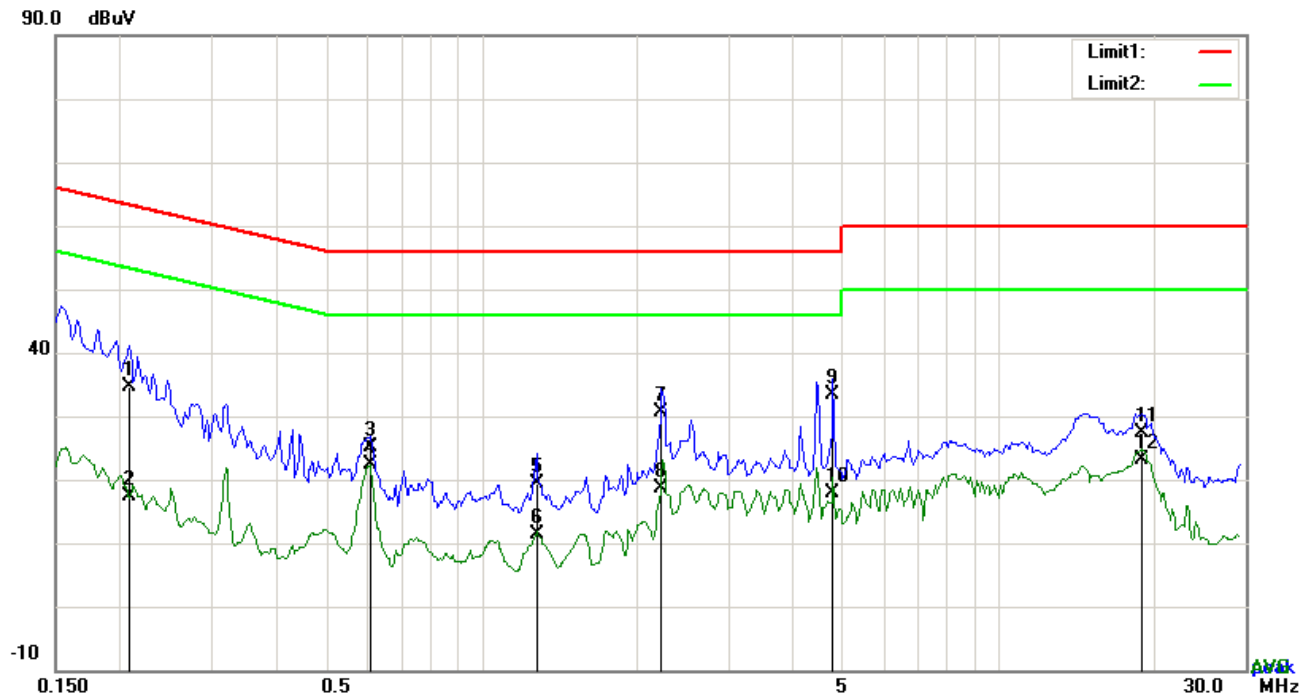


Test Data

Phase Line Plot at 120Vac, 60Hz

No.	P/L	Frequency (MHz)	Reading (dBμV)	Detector	Corrected (dB)	Result (dBμV)	Limit (dBμV)	Margin (dB)
1	L1	0.1656	30.91	QP	10.03	40.94	65.18	-24.24
2	L1	0.1656	13.95	AVG	10.03	23.98	55.18	-31.20
3	L1	0.2982	14.86	QP	10.03	24.89	60.29	-35.40
4	L1	0.2982	2.72	AVG	10.03	12.75	50.29	-37.54
5	L1	0.6492	10.62	QP	10.03	20.65	56.00	-35.35
6	L1	0.6492	8.09	AVG	10.03	18.12	46.00	-27.88
7	L1	0.8832	7.57	QP	10.03	17.60	56.00	-38.40
8	L1	0.8832	3.93	AVG	10.03	13.96	46.00	-32.04
9	L1	2.2287	22.40	QP	10.05	32.45	56.00	-23.55
10	L1	2.2287	13.66	AVG	10.05	23.71	46.00	-22.29
11	L1	4.7667	24.85	QP	10.08	34.93	56.00	-21.07
12	L1	4.7667	8.90	AVG	10.08	18.98	46.00	-27.02

Test Mode: Transmitting Mode

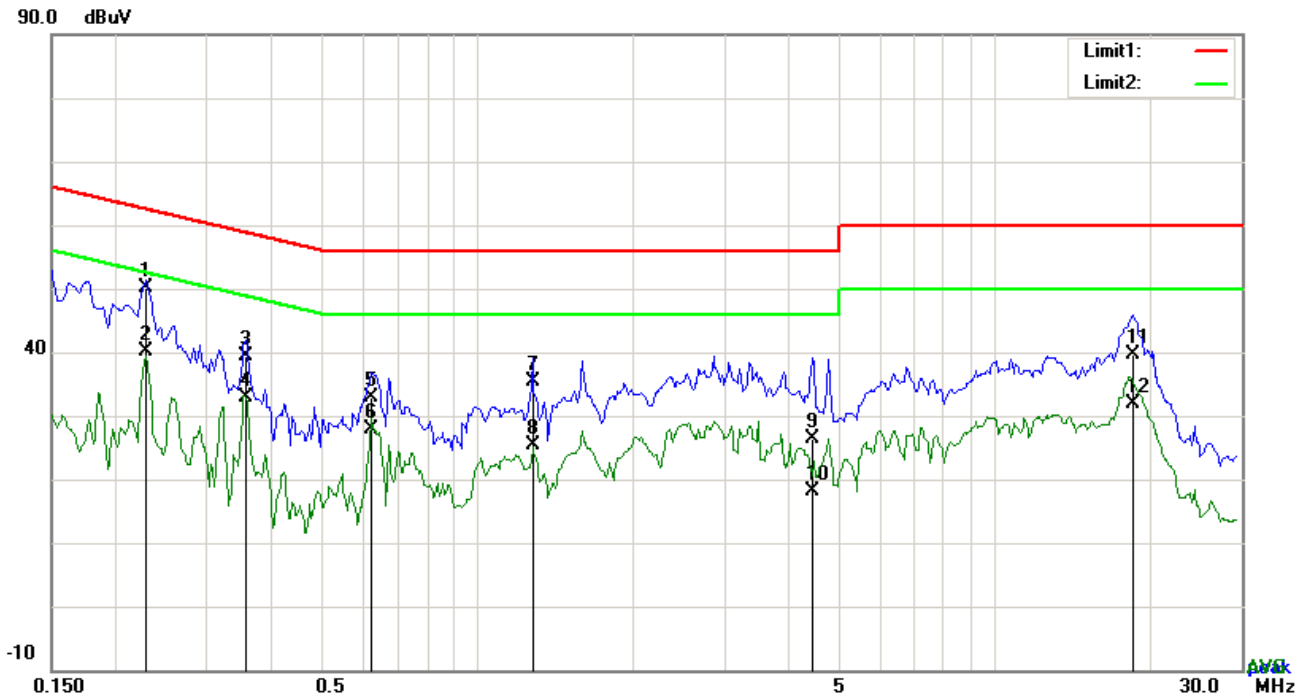


Test Data

Phase Neutral Plot at 120Vac, 60Hz

No.	P/L	Frequency (MHz)	Reading (dBμV)	Detector	Corrected (dB)	Result (dBμV)	Limit (dBμV)	Margin (dB)
1	N	0.2085	24.54	QP	10.02	34.56	63.26	-28.70
2	N	0.2085	7.41	AVG	10.02	17.43	53.26	-35.83
3	N	0.6102	15.22	QP	10.02	25.24	56.00	-30.76
4	N	0.6102	12.36	AVG	10.02	22.38	46.00	-23.62
5	N	1.2771	9.42	QP	10.03	19.45	56.00	-36.55
6	N	1.2771	1.44	AVG	10.03	11.47	46.00	-34.53
7	N	2.2365	20.71	QP	10.04	30.75	56.00	-25.25
8	N	2.2365	8.63	AVG	10.04	18.67	46.00	-27.33
9	N	4.7745	23.32	QP	10.07	33.39	56.00	-22.61
10	N	4.7745	7.88	AVG	10.07	17.95	46.00	-28.05
11	N	18.8769	17.18	QP	10.25	27.43	60.00	-32.57
12	N	18.8769	12.89	AVG	10.25	23.14	50.00	-26.86

Test Mode: Transmitting Mode

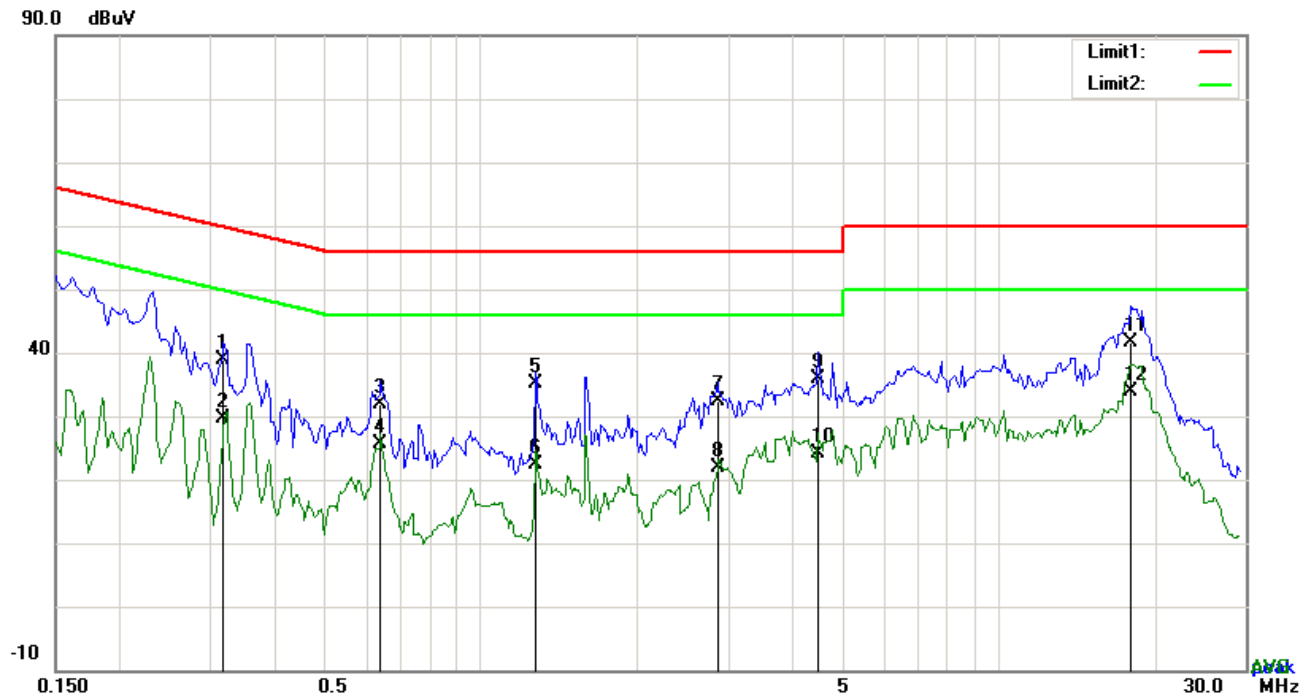


Test Data

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	40.08	QP	10.03	50.11	62.52	-12.41
2	L1	0.2280	30.09	AVG	10.03	40.12	52.52	-12.40
3	L1	0.3567	29.32	QP	10.03	39.35	58.80	-19.45
4	L1	0.3567	22.88	AVG	10.03	32.91	48.80	-15.89
5	L1	0.6219	22.96	QP	10.03	32.99	56.00	-23.01
6	L1	0.6219	17.74	AVG	10.03	27.77	46.00	-18.23
7	L1	1.2771	25.39	QP	10.03	35.42	56.00	-20.58
8	L1	1.2771	15.24	AVG	10.03	25.27	46.00	-20.73
9	L1	4.4430	16.26	QP	10.07	26.33	56.00	-29.67
10	L1	4.4430	8.10	AVG	10.07	18.17	46.00	-27.83
11	L1	18.4596	29.32	QP	10.28	39.60	60.00	-20.40
12	L1	18.4596	21.66	AVG	10.28	31.94	50.00	-18.06

Test Mode:	Transmitting Mode
-------------------	--------------------------



Test Data

Phase Neutral Plot at 240Vac, 60Hz

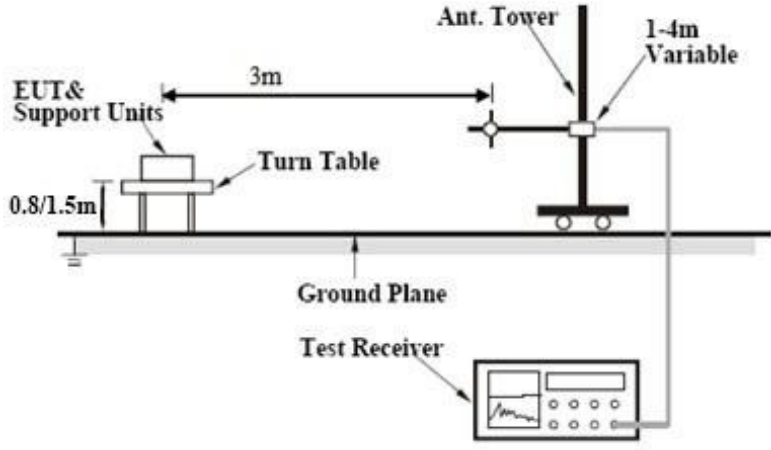
No.	P/L	Frequency (MHz)	Reading (dBμV)	Detector	Corrected (dB)	Result (dBμV)	Limit (dBμV)	Margin (dB)
1	N	0.3177	28.76	QP	10.02	38.78	59.77	-20.99
2	N	0.3177	19.49	AVG	10.02	29.51	49.77	-20.26
3	N	0.6375	21.98	QP	10.02	32.00	56.00	-24.00
4	N	0.6375	15.68	AVG	10.02	25.70	46.00	-20.30
5	N	1.2732	24.98	QP	10.03	35.01	56.00	-20.99
6	N	1.2732	12.28	AVG	10.03	22.31	46.00	-23.69
7	N	2.8683	22.22	QP	10.05	32.27	56.00	-23.73
8	N	2.8683	11.90	AVG	10.05	21.95	46.00	-24.05
9	N	4.4547	25.72	QP	10.06	35.78	56.00	-20.22
10	N	4.4547	14.04	AVG	10.06	24.10	46.00	-21.90
11	N	17.9526	31.41	QP	10.24	41.65	60.00	-18.35
12	N	17.9526	23.58	AVG	10.24	33.82	50.00	-16.18

6.7 Radiated Spurious Emissions & Restricted Band

Temperature	24 °C
Relative Humidity	53%
Atmospheric Pressure	1001mbar
Test date :	March 01, 2017
Tested By :	Loren Luo

Requirement(s):

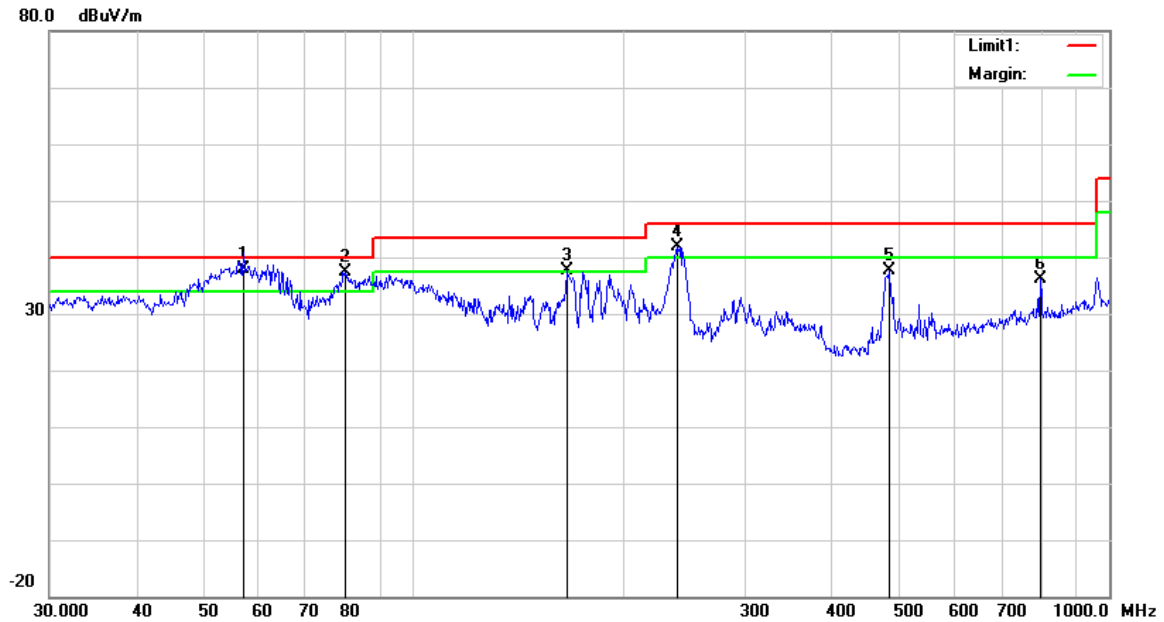
Spec	Item	Requirement	Applicable										
47CFR§15.247(d), RSS210 (A8.5)	a)	Except higher limit as specified elsewhere in other section, the emissions from the low-power radio-frequency devices shall not exceed the field strength levels specified in the following table and the level of any unwanted 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>	Frequency range (MHz)	Field Strength (µV/m)	30 – 88	100	88 – 216	150	216 960	200	Above 960	500	☒
	Frequency range (MHz)	Field Strength (µV/m)											
	30 – 88	100											
88 – 216	150												
216 960	200												
Above 960	500												
b)	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	☒											
c)	or restricted band, emission must also comply with the radiated emission limits specified in 15.209	☒											

Test Setup	
Procedure	- The EUT was switched on and allowed to warm up to its normal operating condition. - 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: - Vertical or horizontal polarization (whichever gave the higher emission level over a full rotation of the EUT) was chosen. - The EUT was then rotated to the direction that gave the maximum emission. - Finally, the antenna height was adjusted to the height that gave the maximum emission. - The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 kHz for Quasi Peak detection at frequency below 1GHz. - 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. - 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: Transmitting Mode

(Below 1GHz)

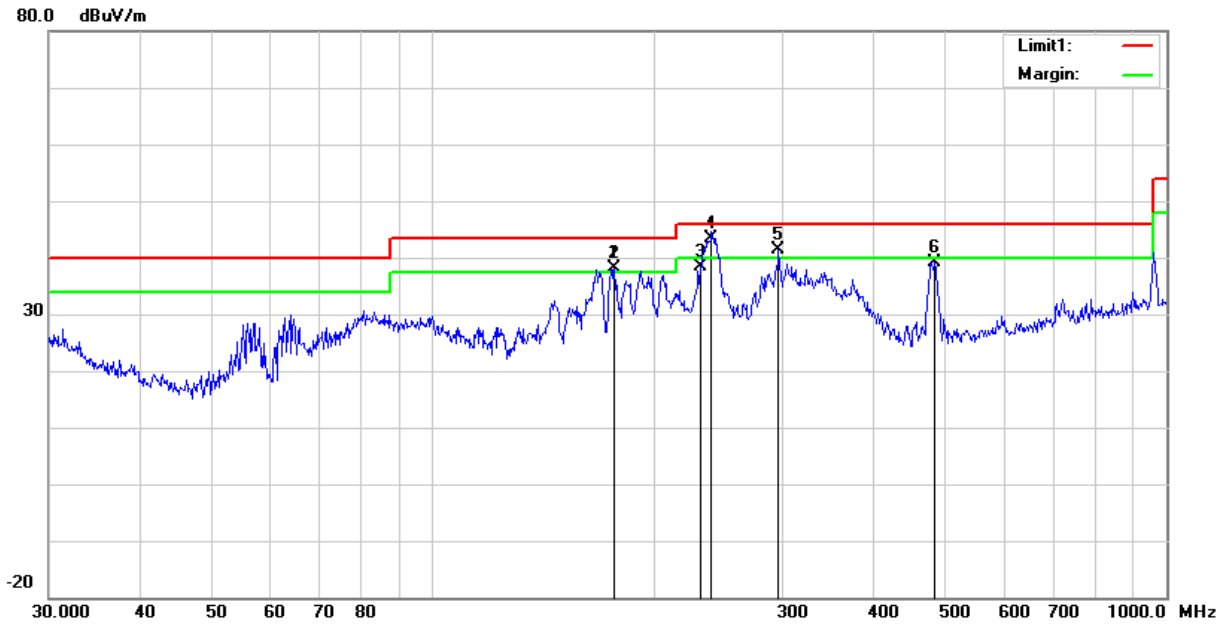


Test Data

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	V	56.9912	51.85	QP	7.63	22.40	0.77	37.85	40.00	-2.15	100	223
2	V	79.8003	51.26	QP	7.60	22.42	1.05	37.49	40.00	-2.51	200	347
3	V	166.0680	46.31	QP	12.11	22.26	1.37	37.53	43.50	-5.97	100	248
4	V	239.9873	51.04	QP	11.54	22.31	1.67	41.94	46.00	-4.06	100	235
5	V	482.2156	39.79	peak	17.34	21.85	2.32	37.60	46.00	-8.40	100	134
6	V	796.1830	32.89	peak	21.35	21.16	2.95	36.03	46.00	-9.97	100	269

(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	H	176.8878	47.70	QP	11.25	22.25	1.36	38.06	43.50	-5.44	100	58
2	H	176.8878	47.70	QP	11.25	22.25	1.36	38.06	43.50	-5.44	100	342
3	H	231.7179	47.34	QP	11.66	22.32	1.64	38.32	46.00	-7.68	100	266
4	H	239.9873	52.38	QP	11.54	22.31	1.67	43.28	46.00	-2.72	100	346
5	H	296.1836	48.40	QP	13.43	22.29	1.78	41.32	46.00	-4.68	100	325
6	H	482.2156	41.31	QP	17.34	21.85	2.32	39.12	46.00	-6.88	100	334

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	39.21	AV	V	33.8	6.86	32.69	47.18	54	-6.82
4824	38.47	AV	H	33.8	6.86	32.69	46.44	54	-7.56
4824	48.26	PK	V	33.8	6.86	32.69	56.23	74	-17.77
4824	47.61	PK	H	33.8	6.86	32.69	55.58	74	-18.42
17892	23.84	AV	V	45.12	11.57	32.11	48.42	54	-5.58
17892	22.94	AV	H	45.12	11.57	32.11	47.52	54	-6.48
17892	40.15	PK	V	45.12	11.57	32.11	64.73	74	-9.27
17892	39.54	PK	H	45.12	11.57	32.11	64.12	74	-9.88

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	38.41	AV	V	33.6	6.82	32.71	46.12	54	-7.88
4874	38.1	AV	H	33.6	6.82	32.71	45.81	54	-8.19
4874	47.83	PK	V	33.6	6.82	32.71	55.54	74	-18.46
4874	47.62	PK	H	33.6	6.82	32.71	55.33	74	-18.67
17919	24.15	AV	V	45.17	11.63	32.18	48.77	54	-5.23
17919	23.85	AV	H	45.17	11.63	32.18	48.47	54	-5.53
17919	40.06	PK	V	45.17	11.63	32.18	64.68	74	-9.32
17919	39.52	PK	H	45.17	11.63	32.18	64.14	74	-9.86

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	39.62	AV	V	33.83	6.95	32.79	47.61	54	-6.39
4924	39.17	AV	H	33.83	6.95	32.79	47.16	54	-6.84
4924	47.66	PK	V	33.83	6.95	32.79	55.65	74	-18.35
4924	47.32	PK	H	33.83	6.95	32.79	55.31	74	-18.69
17904	23.14	AV	V	45.19	11.61	32.24	47.7	54	-6.3
17904	22.97	AV	H	45.19	11.61	32.24	47.53	54	-6.47
17904	40.15	PK	V	45.19	11.61	32.24	64.71	74	-9.29
17904	39.67	PK	H	45.19	11.61	32.24	64.23	74	-9.77

Note:

1, The testing has been conformed to $10 \times 2462 \text{ MHz} = 24,620 \text{ MHz}$

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.

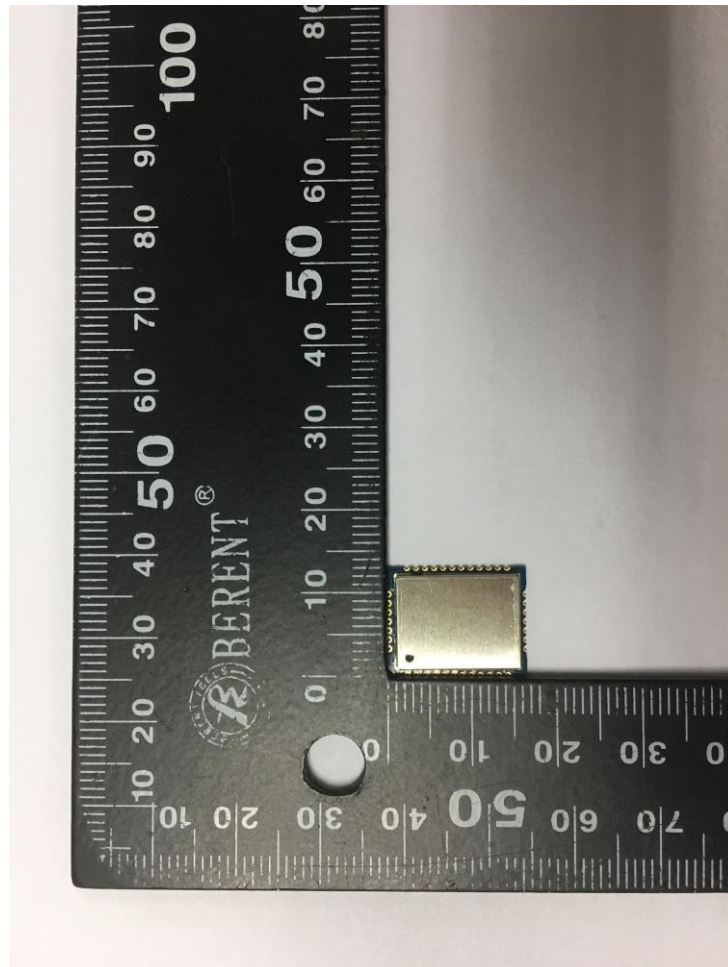
Annex A. TEST INSTRUMENT

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	11/17/2017	☒
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	☒

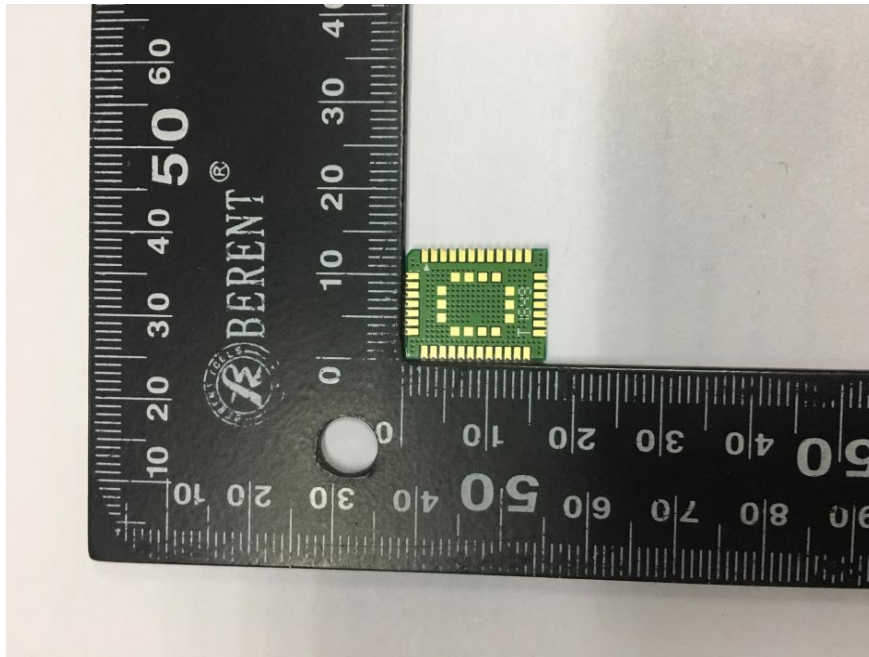
Annex B. EUT and Test Setup Photographs

Annex B.i. Photograph: EUT External Photo

EUT - Front view

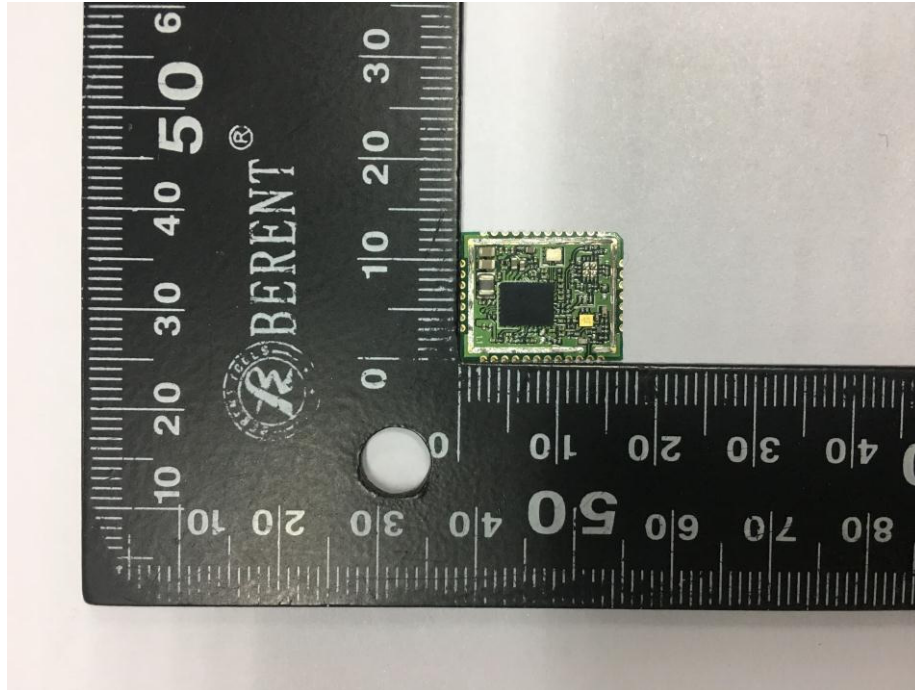


EUT - Rear view

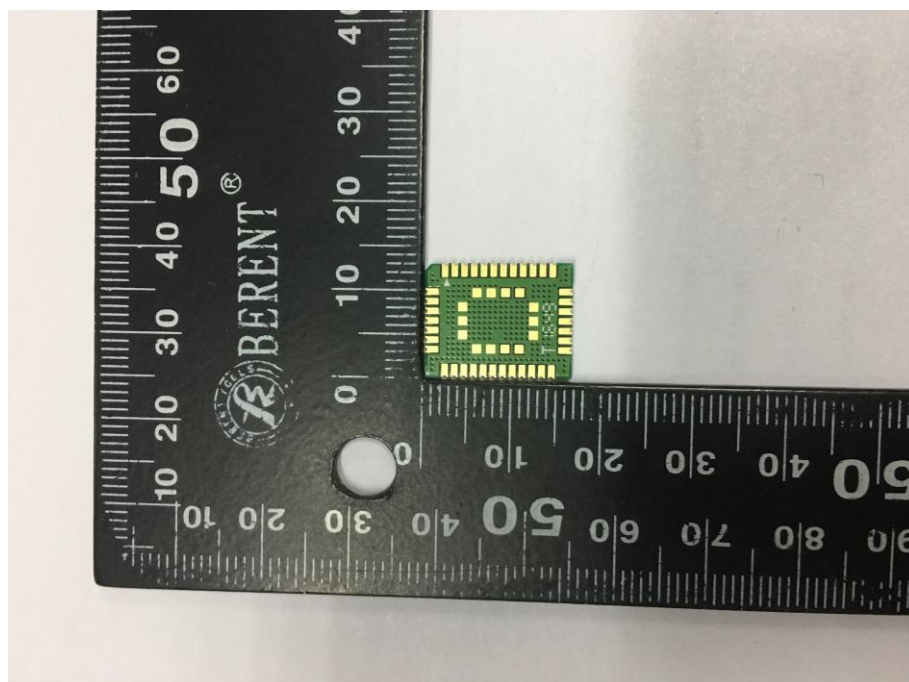


Annex B.ii. Photograph: EUT Internal Photo

EUT- without Shielding View



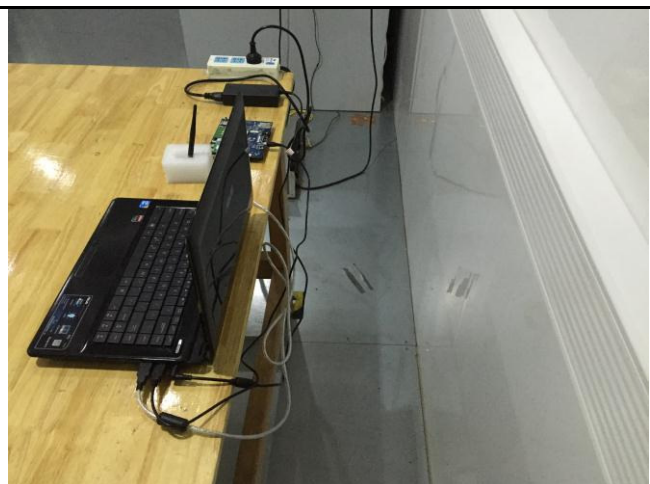
EUT - Rear view



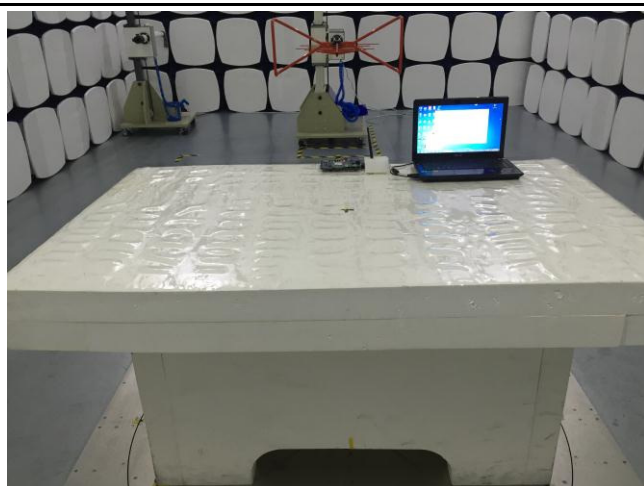
Annex B.iii. Photograph: Test Setup Photo



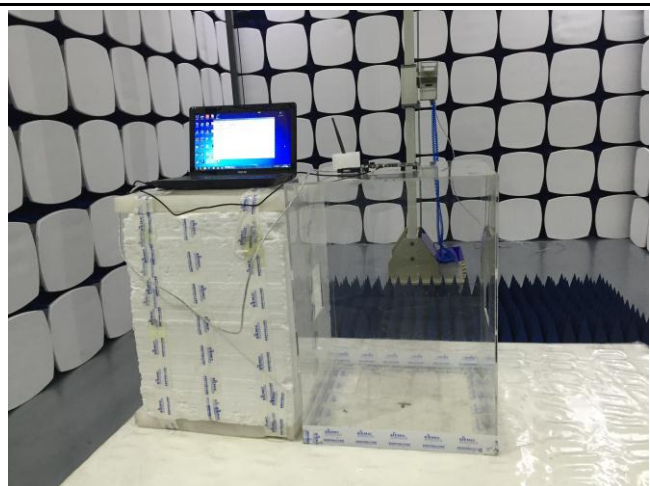
Conducted Emissions Test Setup Front View



Conducted Emissions Test Setup Side View



Radiated Spurious Emissions Test Setup Below 1GHz

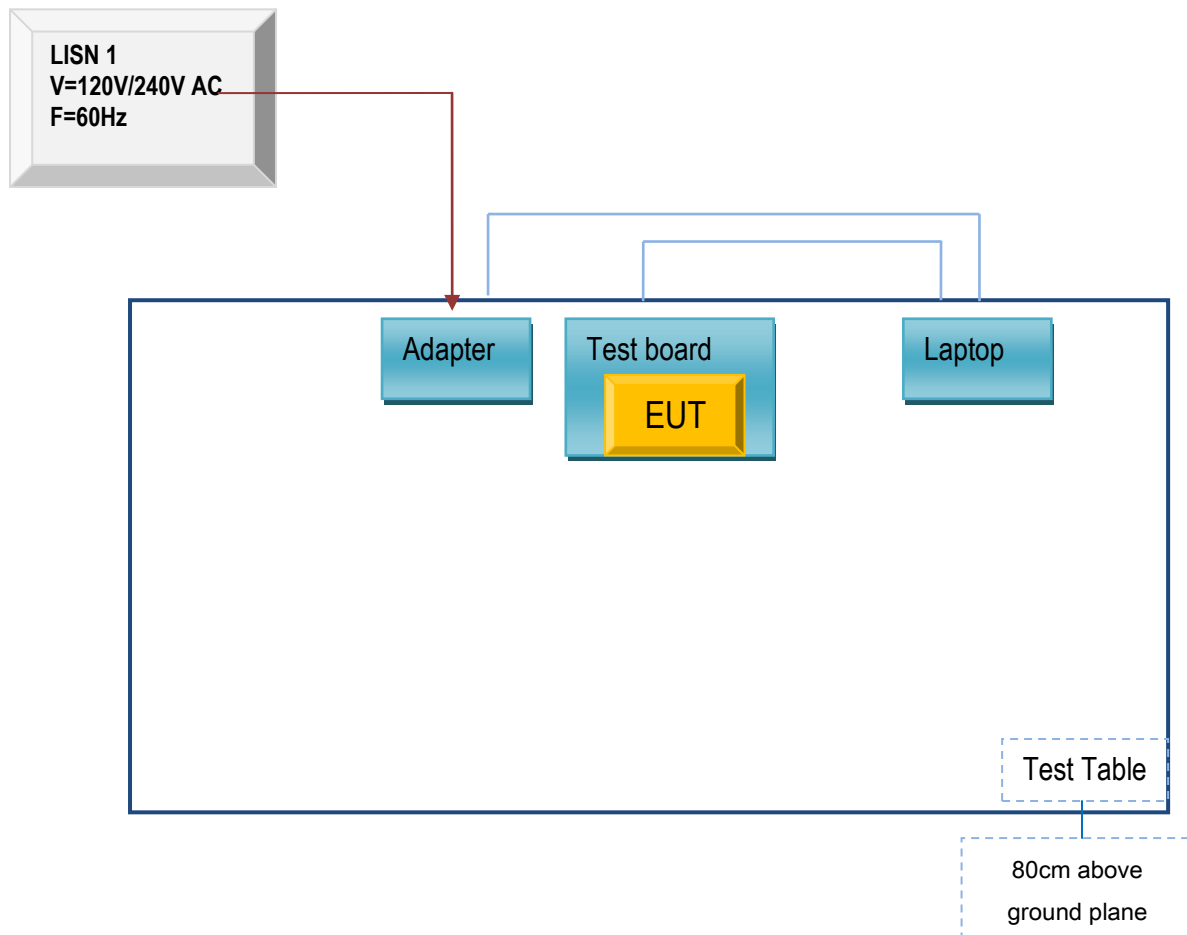


Radiated Spurious Emissions Test Setup Above
1GHz

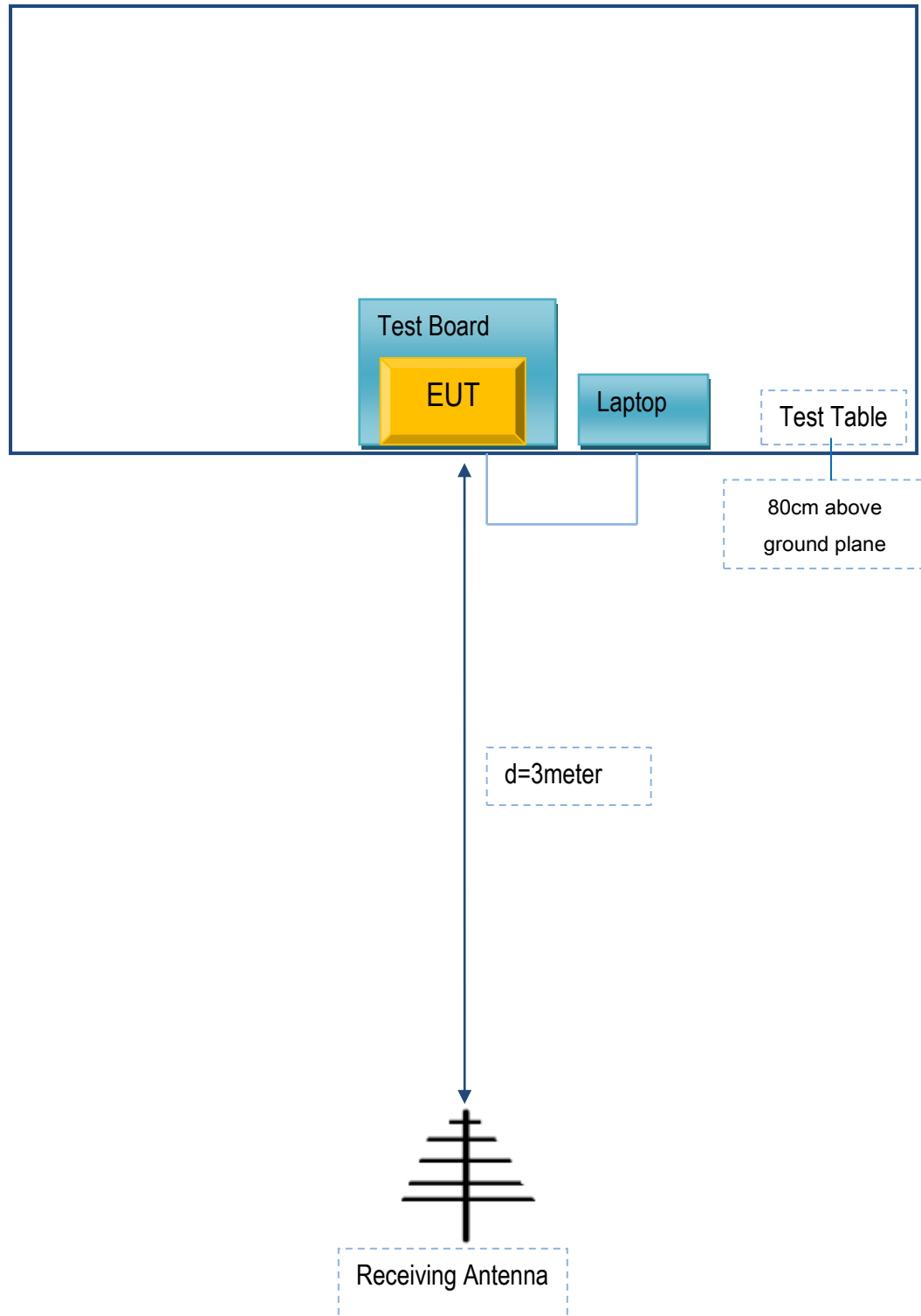
Annex C. TEST SETUP AND SUPPORTING EQUIPMENT

Annex C.ii. TEST SET UP BLOCK

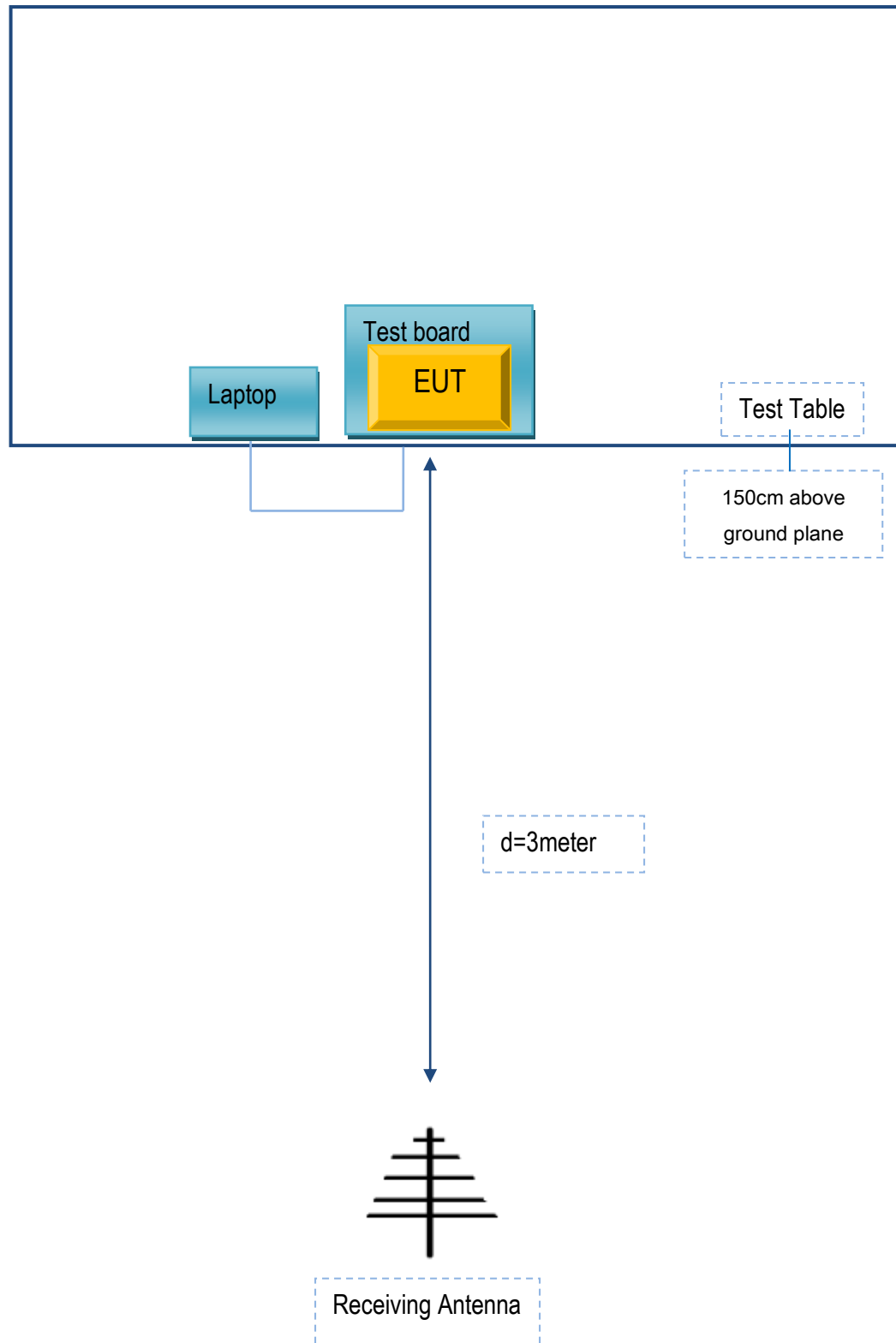
Block Configuration Diagram for AC Line Conducted Emissions



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



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



Annex C. ii. 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

Test Report No.	16050031-FCC-R-V2
Page	50 of 51

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

Please see the attachment

Test Report No.	16050031-FCC-R-V2
Page	51 of 51

Annex E. DECLARATION OF SIMILARITY

N/A