

FCC PART 15.247

TEST REPORT

For

ESPRESSIF SYSTEMS (SHANGHAI) PTE LTD

456 Bibo Road Room A201, Shanghai, China

FCC ID: 2AC7Z-ESP32PICOKIT

Report Type: Original Report	Product Type: WIFI & Bluetooth Development Board
Test Engineer: <u>Ada Yu</u> <i>Ada Yu</i>	
Report Number: <u>RSHA171024001-00B</u>	
Report Date: <u>2017-11-21</u>	
Reviewed By:	<i>Oscar Ye</i>
Oscar Ye RF Leader	
Prepared By: Bay Area Compliance Laboratories Corp. (Kunshan) No.248 Chenghu Road, Kunshan, Jiangsu province, China Tel: +86-0512-86175000 Fax: +86-0512-88934268 www.baclcorp.com.cn	

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GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

Applicant	ESPRESSIF SYSTEMS (SHANGHAI) PTE LTD
Tested Model	ESP32-PICO-KIT
Product Type	WIFI & Bluetooth Development Board
Dimension	52.0 mm(L)×20.3 mm(W)×10.0 mm(H)
Power Supply	DC 5V from USB Port

**All measurement and test data in this report was gathered from production sample serial number: 20171024001.
(Assigned by the BACL. The EUT supplied by the applicant was received on 2017-10-24)*

Objective

This report is prepared on behalf of ESPRESSIF SYSTEMS (SHANGHAI) PTE LTD in accordance with Part 2-Subpart J, Part 15-Subparts A and C of the Federal Communication Commission's rules.

The tests were performed in order to determine compliance with FCC Part 15, Subpart C, and section 15.203, 15.205, 15.207, 15.209 and 15.247 rules.

Related Submittal(s)/Grant(s)

FCC Part15.247 DSS submission with FCC ID: 2AC7Z-ESP32PICOKIT.

Test Methodology

All measurements contained in this report were conducted with ANSI C63.10-2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices and FCC KDB558074 D01 DTS Meas Guidance v04.

All emissions measurement was performed at Bay Area Compliance Laboratories Corp. (Kunshan). The radiated testing was performed at an antenna-to-EUT distance of 3 meters.

Measurement Uncertainty

Item		Uncertainty
AC Power Lines Conducted Emissions		3.19 dB
RF conducted test with spectrum		0.9dB
RF Output Power with Power meter		0.5dB
Radiated emission	30MHz~1GHz	6.11dB
	1GHz~6GHz	4.45dB
	6GHz~18GHz	5.23dB
Occupied Bandwidth		0.5kHz
Temperature		1.0°C
Humidity		6%

Test Facility

The test site used by Bay Area Compliance Laboratories Corp. (Kunshan) to collect test data is located on the No.248 Chenghu Road, Kunshan, Jiangsu province, China.

Bay Area Compliance Laboratories Corp. (Kunshan) Lab is accredited to ISO/IEC 17025 by A2LA (Lab code: 4323.01) and the FCC designation No. CN1185 under the FCC KDB 974614 D01. The facility also complies with the radiated and AC line conducted test site criteria set forth in ANSI C63.4-2014.

SYSTEM TEST CONFIGURATION

Description of Test Configuration

Test channel list is as below:

For 802.11b, 802.11g and 802.11n-HT20 mode, EUT was tested with Channel 1, 6 and 11;

For 802.11n-HT40 mode, EUT was tested with Channel 3, 6 and 9.

Channel	Frequency (MHz)	Channel	Frequency (MHz)
1	2412	7	2442
2	2417	8	2447
3	2422	9	2452
4	2427	10	2457
5	2432	11	2462
6	2437	/	/

For BLE mode, EUT was tested with channel 0, 19 and 39.

Channel	Frequency (MHz)	Channel	Frequency (MHz)
0	2402	20	2442
1	2404	...	...
...	...	...	...
...	...	...	...
...	...	38	2478
19	2440	39	2480

Equipment Modifications

No modification was made to the EUT tested.

EUT Exercise Software

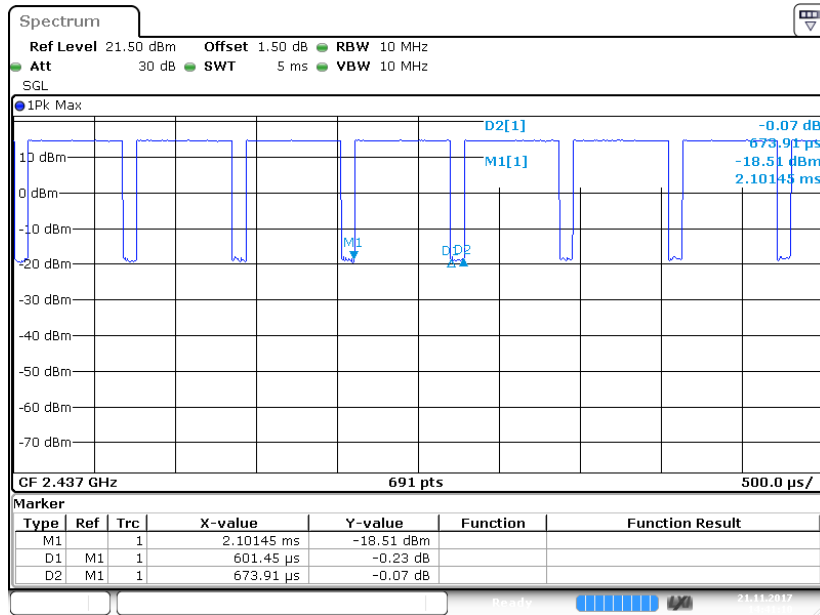
RF test tool: SecureCRT

Pre-scan with all the data rates, and the worst case was performed as below:

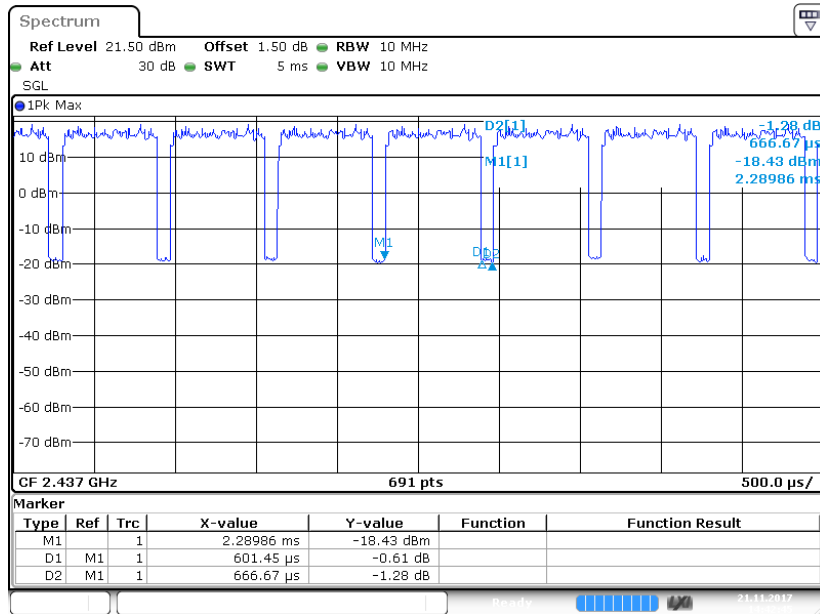
Mode	Data rate	Power level
802.11b	1 Mbps	20
802.11g	6 Mbps	20
802.11n-HT20	MCS0	20
802.11n-HT40	MCS0	20
BLE	/	6

Duty Cycle:

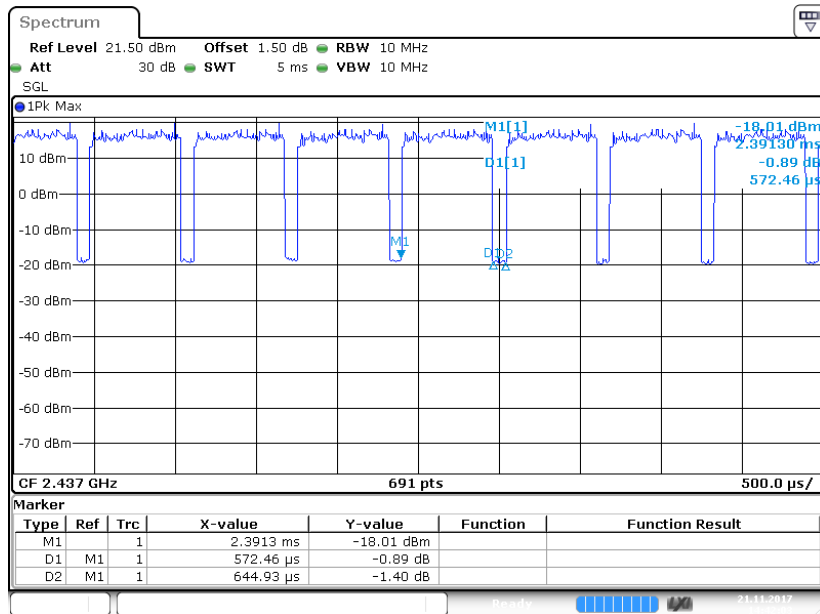
802.11b Mode Middle Channel



802.11g Mode Middle Channel

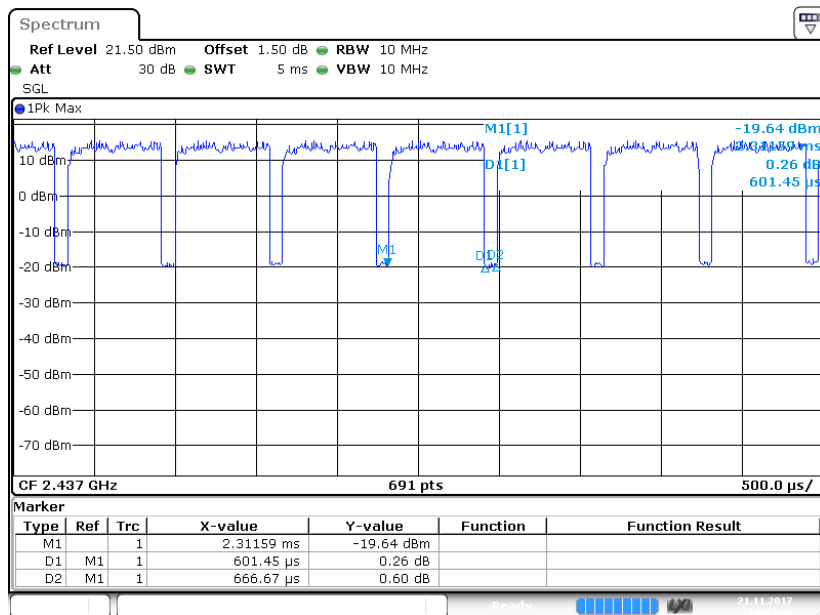


802.11n-HT20 Mode Middle Channel



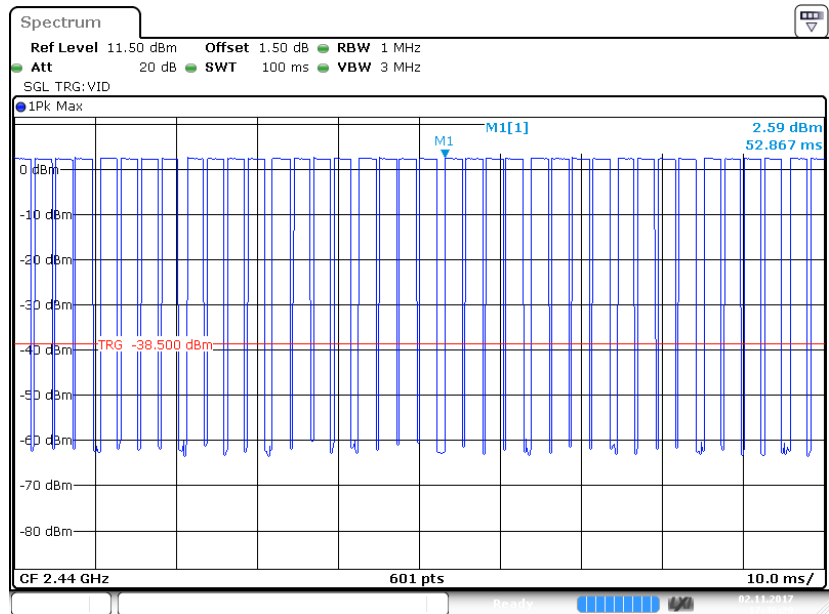
Date: 21 NOV 2017 14:42:03

802.11n-HT40 Mode Middle Channel

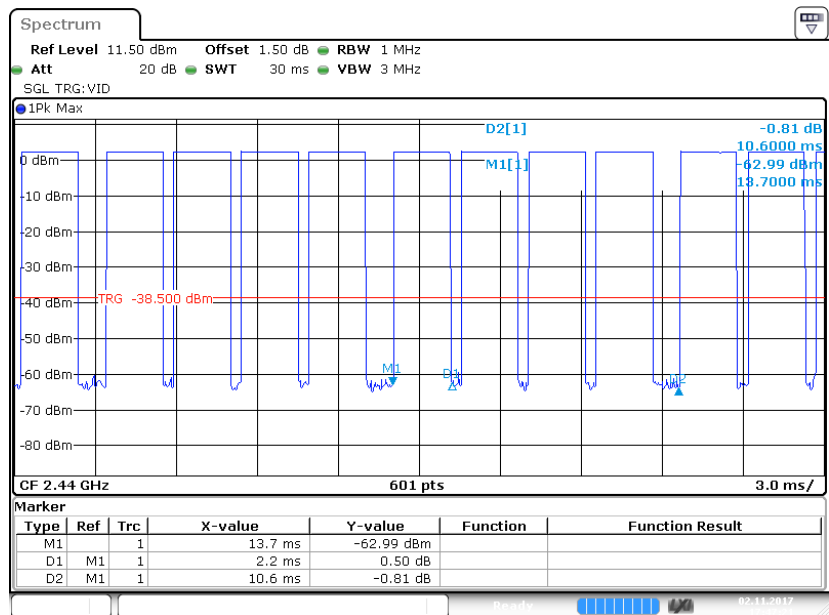


Date: 21 NOV 2017 14:43:46

BLE Mode Middle Channel



Date: 2 NOV 2017 17:46:29



Date: 2 NOV 2017 17:47:20

Mode	Duty Cycle (%)	T(us)	1/T(kHz)	10log(1/x)
802.11b	89.17	601	1.66	0.50
802.11g	90.10	601	1.66	0.45
802.11n-HT20	88.68	572	1.75	0.52
802.11n-HT40	90.10	601	1.66	0.45
BLE	83.02	8800	0.11	0.81

Note: "x" means duty cycle.

Support Equipment List and Details

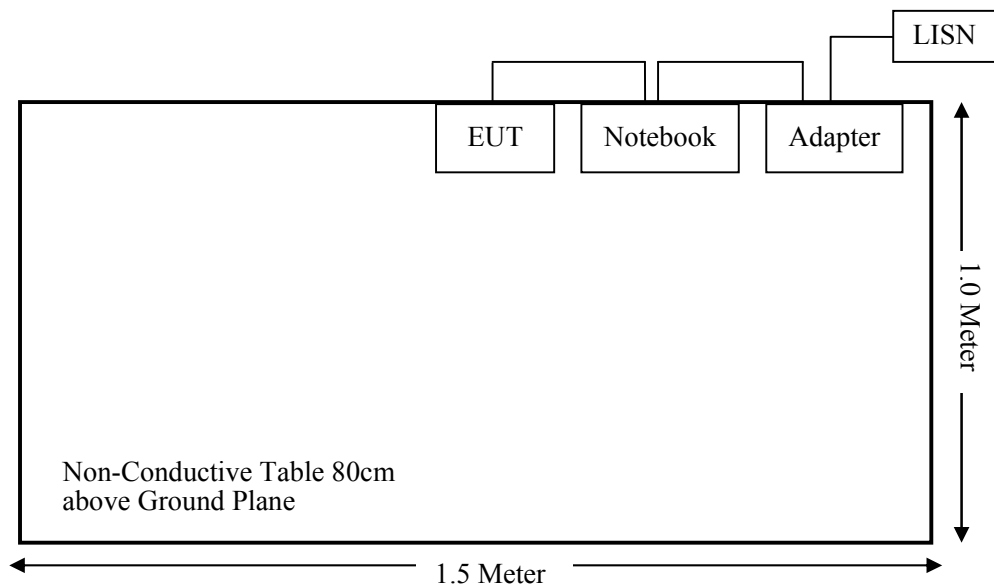
Manufacturer	Description	Model	Serial Number
DELL	Notebook	GX620	D65874152
DELL	Adapter	LA65NS0-00	DF263

External I/O Cable

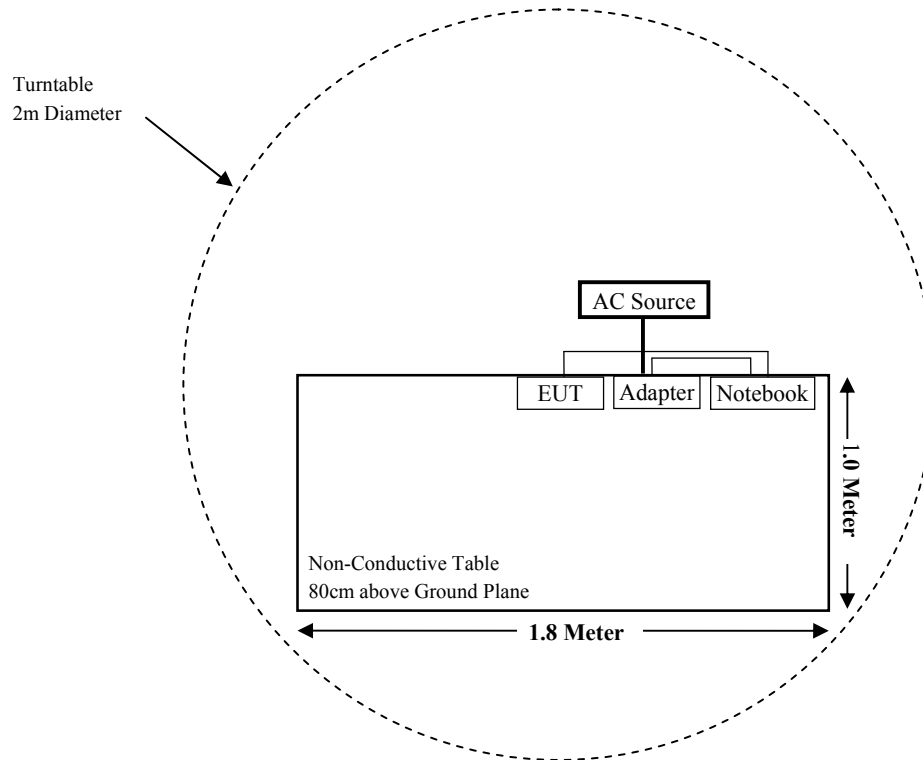
Cable Description	Length (m)	From Port	To
USB Cable	0.8	EUT	Notebook

Block Diagram of Test Setup

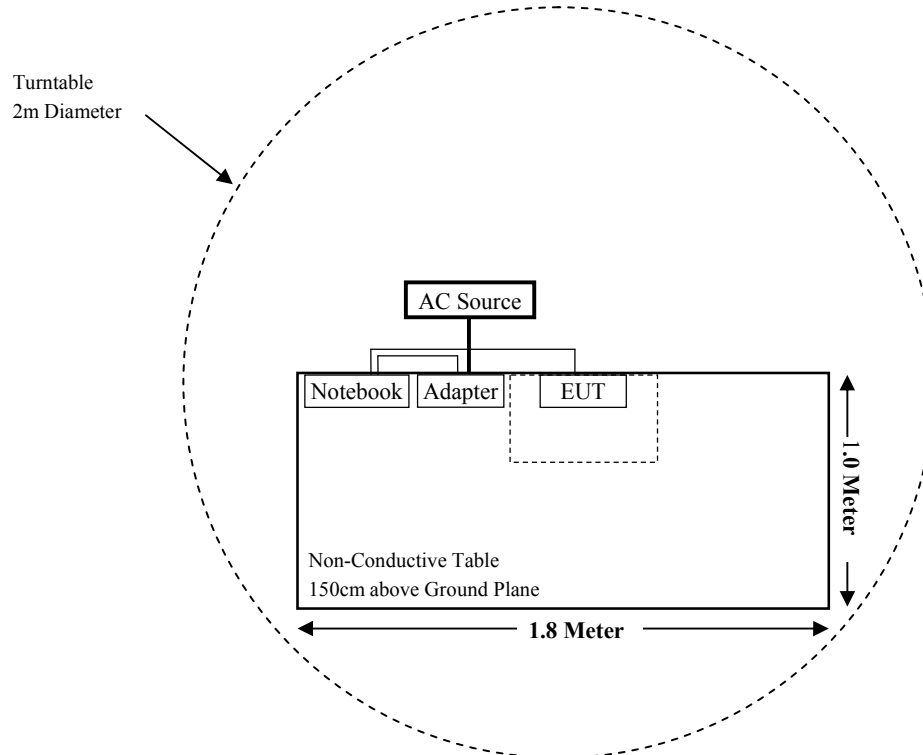
For Conducted Emissions:



For Radiated Emissions(Below 1GHz):



For Radiated Emissions(Above 1GHz):



SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Result
§15.247 (i), §1.1310 & §2.1091	Maximum Permissible Exposure (MPE)	Compliance
§15.203	Antenna Requirement	Compliance
§15.207 (a)	AC Line Conducted Emissions	Compliance
§15.247(d)	Spurious Emissions at Antenna Port	Compliance
§15.205, §15.209, §15.247(d)	Spurious Emissions	Compliance
§15.247 (a)(2)	6 dB Emission Bandwidth	Compliance
§15.247(b)(3)	Maximum Conducted Output Power	Compliance
§15.247(d)	100 kHz Bandwidth of Frequency Band Edge	Compliance
§15.247(e)	Power Spectral Density	Compliance

TEST EQUIPMENT LIST

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Radiated Emission Test (Chamber 1#)					
Rohde & Schwarz	EMI Test Receiver	ESCI	100195	2016-11-25	2017-11-24
Sunol Sciences	Broadband Antenna	JB3	A040914-2	2016-01-09	2019-01-08
Sonoma Instrument	Pre-amplifier	310N	171205	2017-08-15	2018-08-14
Rohde & Schwarz	Auto test Software	EMC32	100361	/	/
MICRO-COAX	Coaxial Cable	Cable-8	008	2017-08-15	2018-08-14
MICRO-COAX	Coaxial Cable	Cable-9	009	2017-08-15	2018-08-14
MICRO-COAX	Coaxial Cable	Cable-10	010	2017-08-15	2018-08-14
Radiated Emission Test (Chamber 2#)					
Rohde & Schwarz	EMI Test Receiver	ESU40	100207	2017-08-27	2018-08-26
ETS-LINDGREN	Horn Antenna	3115	6229	2016-01-11	2019-01-10
ETS-LINDGREN	Horn Antenna	3116	00084159	2016-10-18	2019-10-17
Narda	Pre-amplifier	AFS42-00101800	2001270	2016-12-12	2017-12-11
Heatsink Required	Amplifier	QLW-18405536-J0	15964001009	2016-12-12	2017-12-11
SINOSCITE	Band Reject Filter	BSF2402-2480MN-0898	/	2017-08-05	2018-08-04
Rohde & Schwarz	Auto test Software	EMC32	100361	/	/
MICRO-COAX	Coaxial Cable	Cable-6	006	2017-08-15	2018-08-14
MICRO-COAX	Coaxial Cable	Cable-11	011	2017-08-15	2018-08-14
MICRO-COAX	Coaxial Cable	Cable-12	012	2017-08-15	2018-08-14
MICRO-COAX	Coaxial Cable	Cable-13	013	2017-08-15	2018-08-14
RF Conducted Test					
Rohde & Schwarz	Signal Analyzer	FSV40	101116	2017-07-22	2018-07-21
Agilent	Power Meter	N1912A	MY5000492	2016-12-18	2017-12-17
Agilent	Power Sensor	N1921A	MY54210024	2016-12-18	2017-12-17
Picosecond	DC Block	5500A-110	131047	2017-09-23	2018-09-22
ESPRESSIF	RF Cable	N/A	N/A	/	/
Conducted Emission Test					
Rohde & Schwarz	EMI Test Receiver	ESCI	100195	2016-11-25	2017-11-24
Rohde & Schwarz	LISN	ESH3-Z5	862770/011	2017-10-10	2018-10-09
Rohde & Schwarz	LISN	ENV216	3560655016	2016-11-25	2017-11-24
BACL	BACL-EMC	V1.0	CE001	/	/
Narda	Attenuator/6dB	10690812-2	26850-6	2017-01-10	2018-01-09
MICRO-COAX	Coaxial Cable	Cable-15	015	2017-08-15	2018-08-14

* **Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Kunshan) attests that all calibrations have been performed in accordance to requirements that traceable to National Primary Standards and International System of Units (SI).

FCC§15.247 (i), §1.1310& §2.1091 –MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Applicable Standard

According to subpart 15.247(i) and subpart §1.1310, systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy level in excess of the Commission's guidelines.

Limits for Maximum Permissible Exposure (MPE) (§1.1310, §2.1091)

(B) Limits for General Population/Uncontrolled Exposure				
Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm ²)	Averaging Time (minutes)
0.3-1.34	614	1.63	*(100)	30
1.34-30	824/f	2.19/f	*(180/f ²)	30
30-300	27.5	0.073	0.2	30
300-1500	/		f/1500	30
1500-100,000	/		1.0	30

f = frequency in MHz; * = Plane-wave equivalent power density;
According to §1.1310 and §2.1091 RF exposure is calculated.

Calculated Formulary:

Predication of MPE limit at a given distance

$S = PG/4\pi R^2$ = power density (in appropriate units, e.g. mW/cm²);

P = power input to the antenna (in appropriate units, e.g., mW);

G = power gain of the antenna in the direction of interest relative to an isotropic radiator, the power gain factor, is normally numeric gain;

R = distance to the center of radiation of the antenna (appropriate units, e.g., cm);

For simultaneously transmit system, the calculated power density should comply with:

$$\sum_i \frac{S_i}{S_{Limit,i}} \leq 1$$

Measurement Result

Mode	Frequency Range	Antenna Gain		Target Output Power		Evaluation Distance	Power Density	MPE Limit	MPE Ratio
	(MHz)	(dBi)	(numeric)	(dBm)	(mW)	(cm)	(mW/cm ²)	(mW/cm ²)	
802.11b	2412~2462	4.00	2.51	20.5	112.20	20	0.0561	1.0	0.0561
802.11g		4.00	2.51	21.0	125.89	20	0.0629	1.0	0.0629
802.11 n-HT20		4.00	2.51	20.5	112.20	20	0.0561	1.0	0.0561
802.11 n-HT40	2422~2452	4.00	2.51	20.5	112.20	20	0.0561	1.0	0.0561
BT3.0	2402-2480	4.00	2.51	6.5	4.47	20	0.0022	1.0	0.0022
BLE		4.00	2.51	3.0	2.00	20	0.0010	1.0	0.0010

Note:

(1) The target output powers are all declared by the manufacturer.

(2) Wi-Fi and BT can transmit simultaneously, the worst condition is 802.11g mode of Wi-Fi & BT3.0 mode as below:

$$\sum_i \frac{S_i}{S_{Limit,i}} = 0.0629/1.00 + 0.0022/1 = 0.0629 + 0.0022 = 0.0651 < 1.0$$

Result: The device meet FCC MPE at 20 cm distance.

FCC §15.203 - 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.

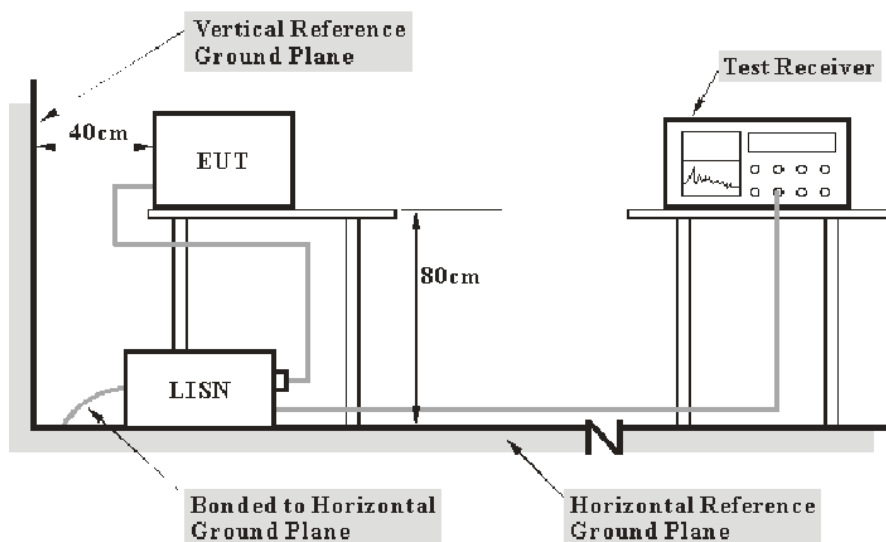
Antenna Connector Construction

The EUT has a 3D fixed antenna arrangement for Wi-Fi & Bluetooth, which the antenna gain is 4 dBi; fulfill the requirement of this section. Please refer to the EUT photos.

Result: Compliance.

FCC §15.207 (a) – AC LINE CONDUCTED EMISSIONS**Applicable Standard**

FCC§15.207

EUT Setup

Note: 1. Support units were connected to second LISN.
2. Both of LISNs (AMN) 80 cm from EUT and at the least 30 cm from other units and other metal planes support units.

The setup of EUT is according with per ANSI C63.10-2013 measurement procedure. The specification used was with the FCC Part 15.207 limits.

EMI Test Receiver Setup

The EMI test receiver was set to investigate the spectrum from 150 kHz to 30 MHz.

During the conducted emission test, the EMI test receiver was set with the following configurations:

Frequency Range	IF B/W
150 kHz – 30 MHz	9 kHz

Test Procedure

During the conducted emission test, the adapter was connected to the outlet of the LISN.

Maximizing procedure was performed on the six (6) highest emissions of the EUT.

All data was recorded in the Quasi-peak and average detection mode.

Corrected Factor & Margin Calculation

The Corrected factor is calculated by adding LISN VDF (Voltage Division Factor), Cable Loss and Transient Limiter Attenuation. The basic equation is as follows:

$$\text{Correction Factor} = \text{LISN VDF} + \text{Cable Loss}$$

The “**Margin**” column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of 7 dB means the emission is 7 dB below the limit. The equation for margin calculation is as follows:

$$\text{Margin} = \text{Limit} - \text{Reading}$$

Test Results Summary

According to the recorded data in following table, the EUT complied with the FCC Part 15.207.

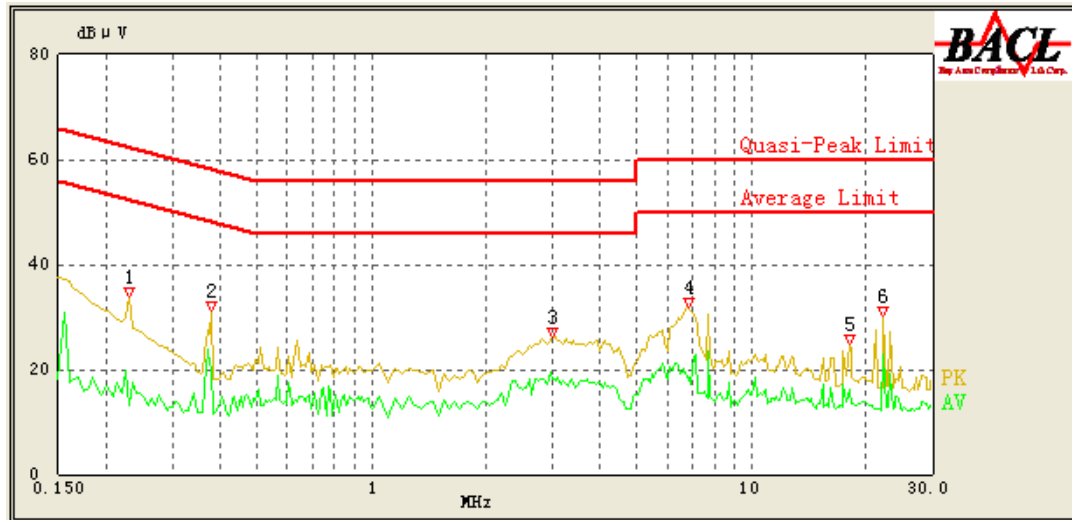
Test Data

Environmental Conditions

Temperature:	24.5 °C
Relative Humidity:	51 %
ATM Pressure:	101.2 kPa

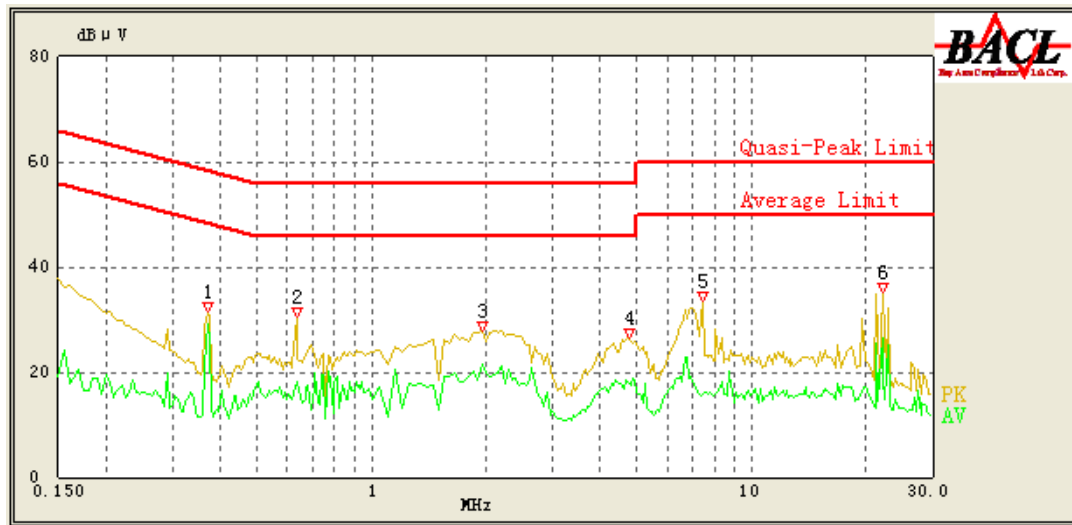
The testing was performed by Ada Yu on 2017-11-07.

EUT operation mode: Transmitting

Wi-Fi Mode:**AC 120V/60 Hz, Line**

Frequency (MHz)	Reading (dBμV)	Detector (PK/AV/QP)	Bandwidth (kHz)	Line	Corr. (dB)	Limit (dB μ V)	Margin (dB)	Comment
0.230	33.87	QP	9.000	L1	16.02	63.71	29.84	Compliance
0.230	13.28	AV	9.000	L1	16.02	53.71	40.43	Compliance
0.380	31.03	QP	9.000	L1	16.05	59.43	28.40	Compliance
0.380	20.60	AV	9.000	L1	16.05	49.43	28.83	Compliance
3.000	26.25	QP	9.000	L1	15.85	56.00	29.75	Compliance
3.000	18.24	AV	9.000	L1	15.85	46.00	27.76	Compliance
6.850	31.91	QP	9.000	L1	15.97	60.00	28.09	Compliance
6.850	18.52	AV	9.000	L1	15.97	50.00	31.48	Compliance
18.050	24.73	QP	9.000	L1	16.35	60.00	35.27	Compliance
18.050	16.11	AV	9.000	L1	16.35	50.00	33.89	Compliance
22.250	30.01	QP	9.000	L1	16.45	60.00	29.99	Compliance
22.200	22.84	AV	9.000	L1	16.45	50.00	27.16	Compliance

AC 120V/60 Hz, Neutral

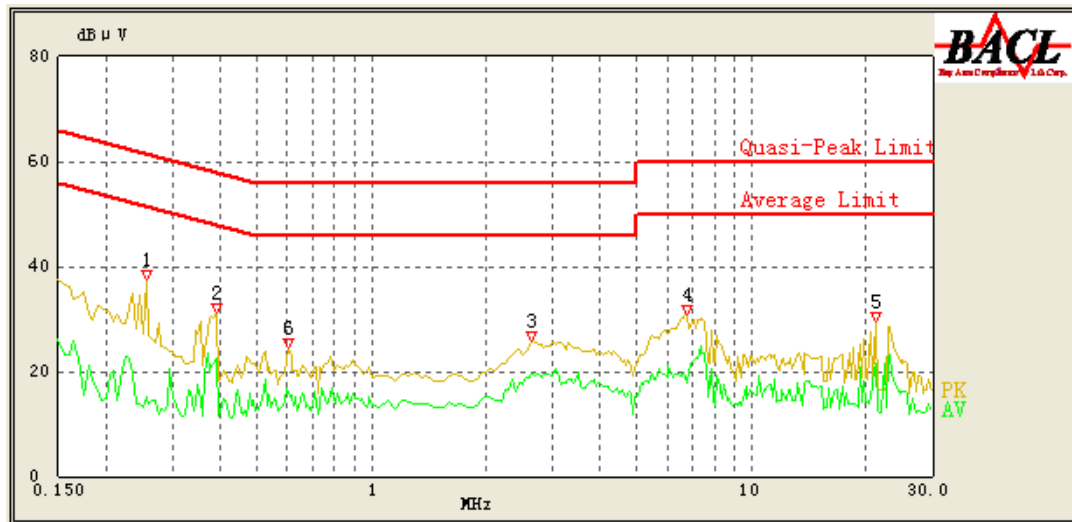


Frequency (MHz)	Reading (dBμV)	Detector (PK/AV/QP)	Bandwidth (kHz)	Line	Corr. (dB)	Limit (dB μ V)	Margin (dB)	Comment
0.370	31.58	QP	9.000	N	16.08	59.71	28.13	Compliance
0.370	29.15	AV	9.000	N	16.08	49.71	20.56	Compliance
0.635	30.44	QP	9.000	N	16.03	56.00	25.56	Compliance
0.635	18.02	AV	9.000	N	16.03	46.00	27.98	Compliance
1.950	27.99	QP	9.000	N	15.91	56.00	28.01	Compliance
1.950	21.59	AV	9.000	N	15.91	46.00	24.41	Compliance
4.750	26.66	QP	9.000	N	15.87	56.00	29.34	Compliance
4.700	18.27	AV	9.000	N	15.87	46.00	27.73	Compliance
7.450	33.47	QP	9.000	N	15.93	60.00	26.53	Compliance
7.400	15.64	AV	9.000	N	15.93	50.00	34.36	Compliance
22.100	35.06	QP	9.000	N	16.19	60.00	24.94	Compliance
22.100	26.54	AV	9.000	N	16.19	50.00	23.46	Compliance

Note:

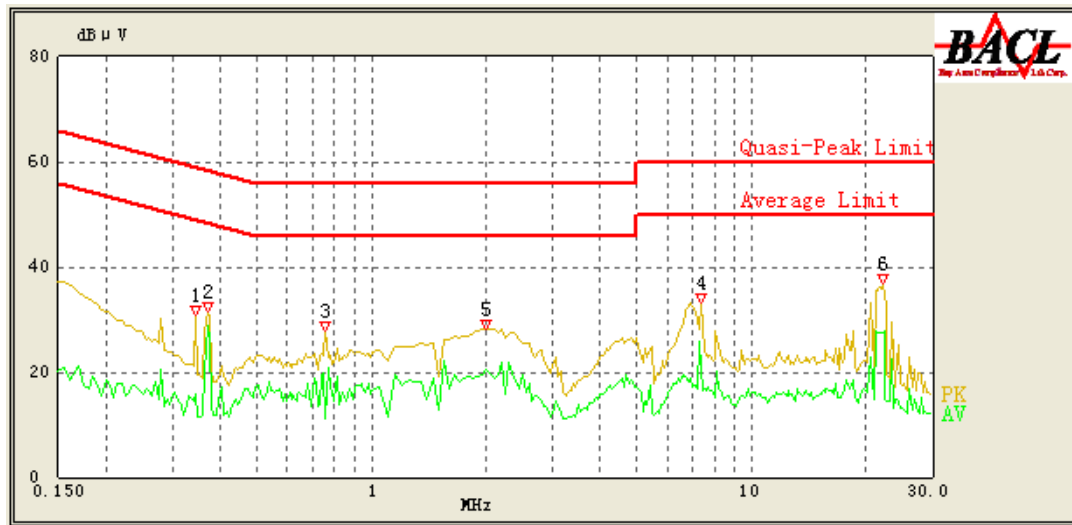
1) Corr.=LISN VDF (Voltage Division Factor) + Cable Loss

2) Margin = Limit – Reading

BLE Mode:**AC 120V/60 Hz, Line**

Frequency (MHz)	Reading (dBμV)	Detector (PK/AV/QP)	Bandwidth (kHz)	Line	Corr. (dB)	Limit (dBμV)	Margin (dB)	Comment
0.255	37.61	QP	9.000	L1	16.02	63.00	25.39	Compliance
0.255	15.13	AV	9.000	L1	16.02	53.00	37.87	Compliance
0.390	31.33	QP	9.000	L1	16.05	59.14	27.81	Compliance
0.390	22.44	AV	9.000	L1	16.05	49.14	26.70	Compliance
2.650	25.93	QP	9.000	L1	15.85	56.00	30.07	Compliance
2.650	19.84	AV	9.000	L1	15.85	46.00	26.16	Compliance
6.750	30.86	QP	9.000	L1	15.96	60.00	29.14	Compliance
6.750	17.74	AV	9.000	L1	15.96	50.00	32.26	Compliance
21.150	29.47	QP	9.000	L1	16.44	60.00	30.53	Compliance
21.150	21.56	AV	9.000	L1	16.44	50.00	28.44	Compliance
0.605	24.40	QP	9.000	L1	16.01	56.00	31.60	Compliance
0.610	15.04	AV	9.000	L1	16.01	46.00	30.96	Compliance

AC 120V/60 Hz, Neutral



Frequency (MHz)	Reading (dBμV)	Detector (PK/AV/QP)	Bandwidth (kHz)	Line	Corr. (dB)	Limit (dB μ V)	Margin (dB)	Comment
0.345	30.71	QP	9.000	N	16.08	60.43	29.72	Compliance
0.345	15.83	AV	9.000	N	16.08	50.43	34.60	Compliance
0.370	31.38	QP	9.000	N	16.08	59.71	28.33	Compliance
0.370	28.99	AV	9.000	N	16.08	49.71	20.72	Compliance
0.755	27.89	QP	9.000	N	15.98	56.00	28.11	Compliance
0.755	11.13	AV	9.000	N	15.98	46.00	34.87	Compliance
7.400	33.17	QP	9.000	N	15.93	60.00	26.83	Compliance
7.450	16.55	AV	9.000	N	15.93	50.00	33.45	Compliance
2.000	28.25	QP	9.000	N	15.91	56.00	27.75	Compliance
2.000	20.56	AV	9.000	N	15.91	46.00	25.44	Compliance
22.200	36.67	QP	9.000	N	16.20	60.00	23.33	Compliance
22.350	27.80	AV	9.000	N	16.20	50.00	22.20	Compliance

Note:

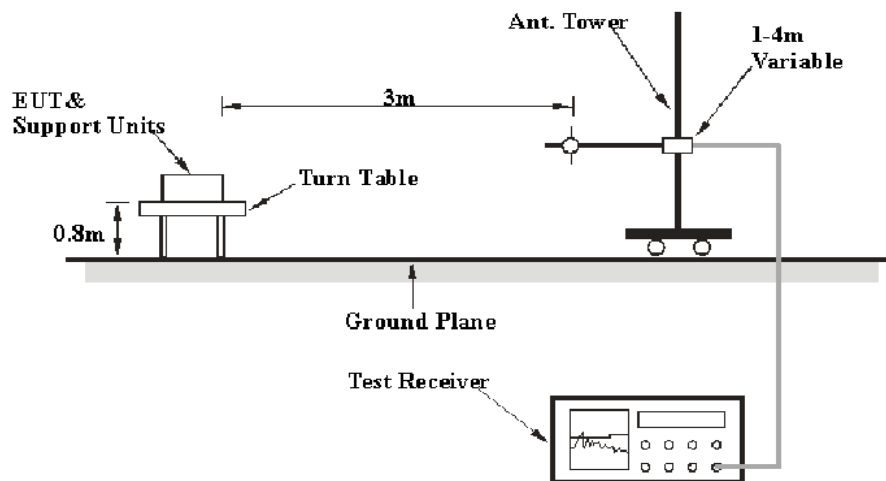
- 1) Corr.=LISN VDF (Voltage Division Factor) + Cable Loss
- 2) Margin = Limit – Reading

FCC §15.209, §15.205 & §15.247(d) - SPURIOUS EMISSIONS**Applicable Standard**

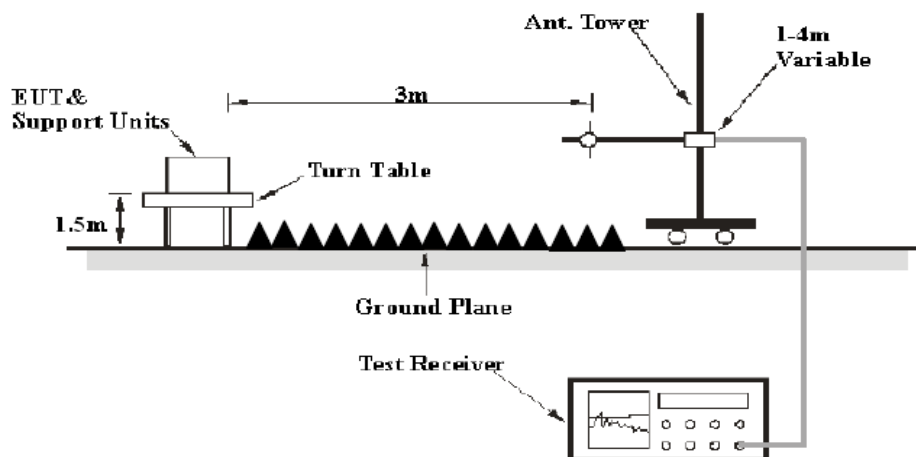
FCC §15.247 (d); §15.209; §15.205;

EUT Setup

Below 1 GHz:



Above 1GHz:



The radiated emission tests were performed in the 3 meters test site, using the setup accordance with the ANSI C63.10-2013. The specification used was the FCC 15.209, and FCC 15.247 limits.

EMI Test Receiver Setup

The system was investigated from 30 MHz to 25 GHz.

During the radiated emission test, the EMI test receiver was set with the following configurations:

Frequency Range	RBW	Video B/W	IF B/W	Detector
30 MHz – 1000 MHz	120 kHz	300 kHz	120 kHz	QP
Above 1GHz	1MHz	3 MHz	/	PK
	1MHz	3 MHz	/	Ave

Test Procedure

Maximizing procedure was performed on the highest emissions to ensure that the EUT complied with all installation combinations.

Data was recorded in Quasi-peak detection mode for frequency range of 30 MHz-1 GHz, peak and average detection modes for frequencies above 1 GHz.

Corrected Amplitude & Margin Calculation

The Corrected Amplitude is calculated by adding the Antenna Factor and Cable Loss, and subtracting the Amplifier Gain from the Meter Reading. The basic equation is as follows:

$$\text{Corrected Amplitude} = \text{Meter Reading} + \text{Antenna Factor} + \text{Cable Loss} - \text{Amplifier Gain}$$

The “**Margin**” column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of 7dB means the emission is 7dB below the limit. The equation for margin calculation is as follows:

$$\text{Margin} = \text{Limit} - \text{Corrected Amplitude}$$

Test Results Summary

According to the recorded data in following table, the EUT complied with the FCC Title 47, Part 15, Subpart C, section 15.205, 15.209 and 15.247.

Test Data**Environmental Conditions**

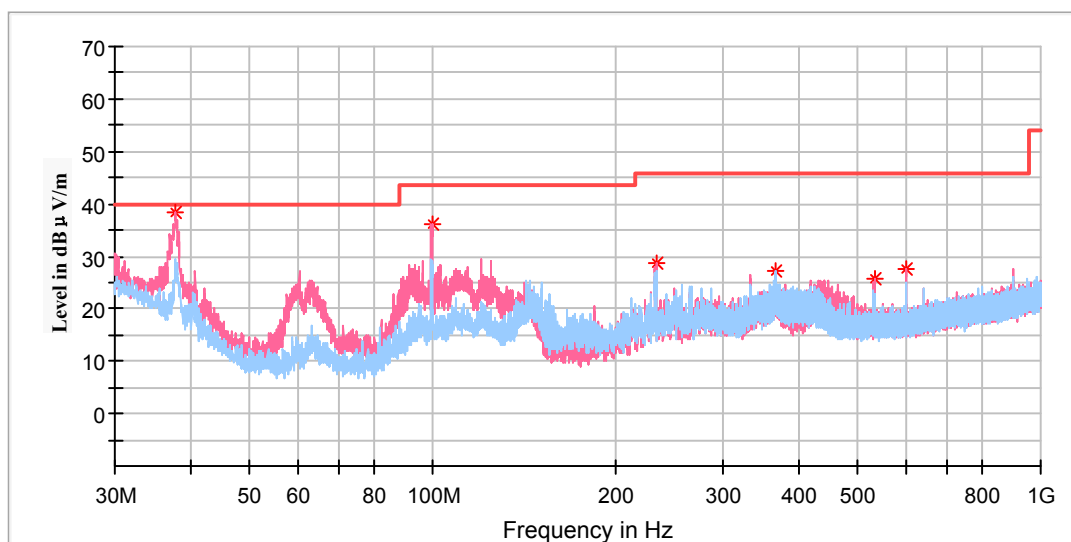
Temperature:	24.8 °C
Relative Humidity:	51 %
ATM Pressure:	101.0 kPa

The testing was performed by Ada Yu on 2017-11-02 to 2017-11-21.

EUT operation mode: Transmitting (Scan with X-Axis, Y-Axis and Z-Axis position, the worst case X-Axis was recorded)

Wi-Fi Mode:**30MHz-1G**

Full Spectrum



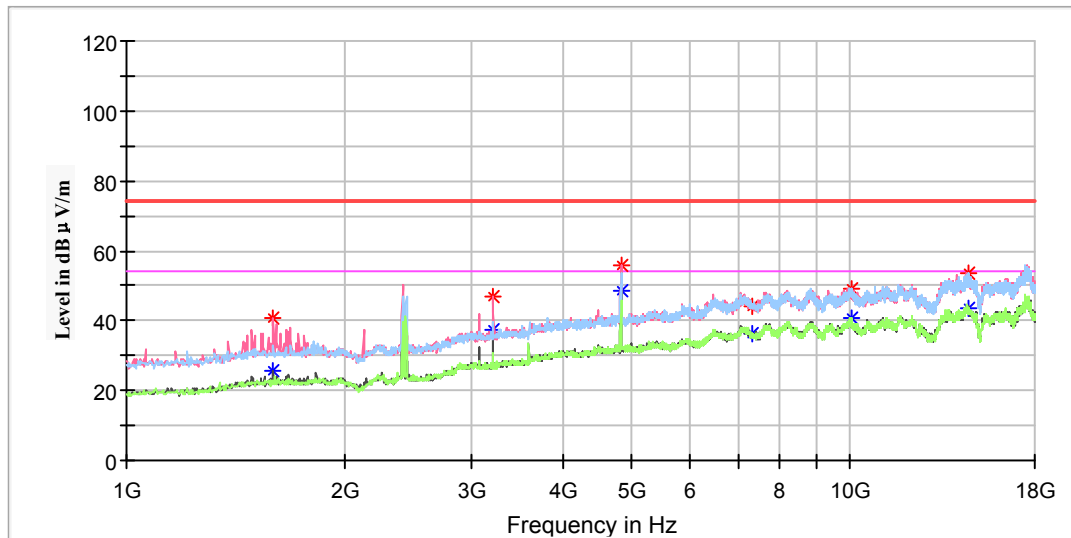
Frequency (MHz)	Corrected Amplitude	Rx Antenna		Turntable Degree	Corr. (dB)	Limit (dBμV/m)	Margin (dB)
	QuasiPeak (dBμV/m)	Height (cm)	Polar (H/V)				
37.792333	38.31	100.0	V	46.0	-14.6	40.00	1.69
99.937000	36.29	100.0	V	130.0	-21.1	43.50	7.21
233.215000	28.56	150.0	V	26.0	-19.5	46.00	17.44
365.490667	27.11	100.0	H	292.0	-17.2	46.00	18.89
533.268333	25.76	100.0	V	14.0	-13.4	46.00	20.24
600.004333	27.46	100.0	V	14.0	-13.0	46.00	18.54

802.11b:**Note:**

1. This test is performed with the 2.4-2.4835GHz band reject filter.
2. Corrected Factor = Antenna factor (RX) + Cable Loss – Amplifier Factor
Corrected Amplitude = Corrected Factor + Reading
Margin = Limit - Corrected. Amplitude
3. The other spurious emission which is 20dB to the limit was not recorded.

1G-25G**Low Channel: 2412MHz**

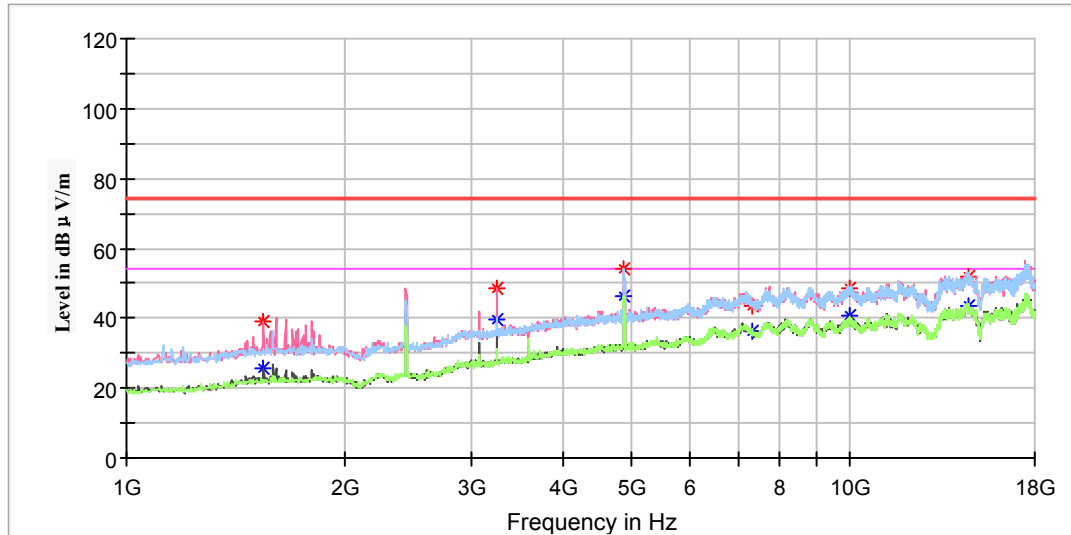
Full Spectrum



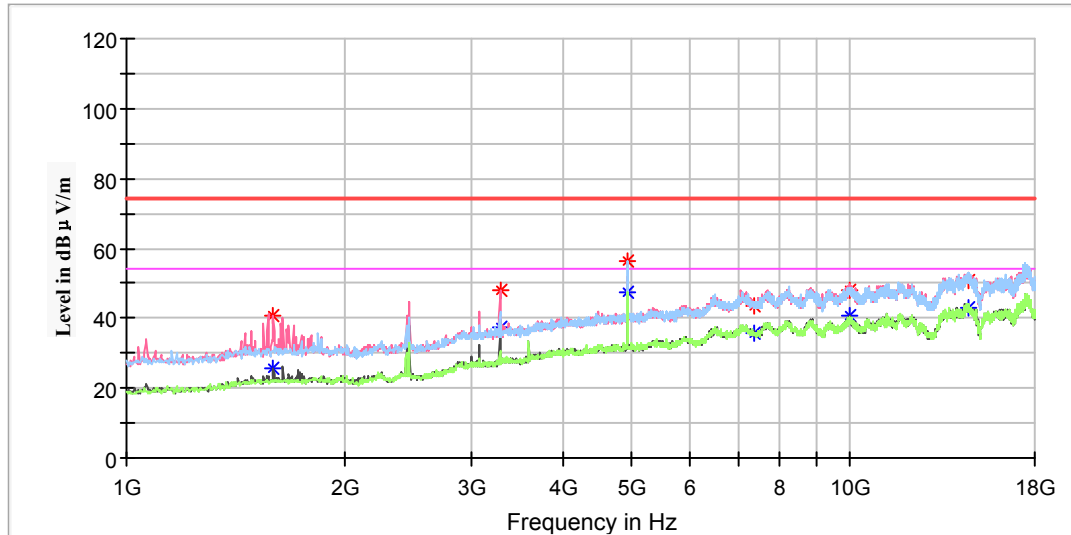
Frequency (MHz)	Corrected Amplitude		Rx Antenna		Turntable Degree	Corr. (dB)	Limit (dBμV/m)	Margin (dB)
	MaxPeak (dBμV /m)	Average (dBμV /m)	Height (cm)	Polar (H/V)				
1595.000000	---	25.52	250.0	V	141.0	-9.8	54.00	28.48
1595.000000	40.63	---	200.0	V	162.0	-9.8	74.00	33.37
3213.400000	---	37.39	200.0	V	226.0	-4.4	54.00	16.61
3213.400000	47.11	---	200.0	V	226.0	-4.4	74.00	26.89
4825.000000	---	48.41	150.0	V	241.0	-0.5	54.00	5.59
4825.000000	55.78	---	150.0	V	241.0	-0.5	74.00	18.22
7310.400000	---	36.21	250.0	V	23.0	6.6	54.00	17.79
7310.400000	44.02	---	200.0	V	215.0	6.6	74.00	29.98
10030.400000	---	40.78	200.0	H	102.0	9.2	54.00	13.22
10030.400000	49.18	---	200.0	H	102.0	9.2	74.00	24.82
14538.800000	---	43.81	250.0	V	199.0	16.6	54.00	10.19
14538.800000	53.52	---	250.0	V	199.0	16.6	74.00	20.48

Middle Channel: 2437MHz

Full Spectrum



Frequency (MHz)	Corrected Amplitude		Rx Antenna		Turntable Degree	Corr. (dB)	Limit (dBμV/m)	Margin (dB)
	MaxPeak (dBμV /m)	Average (dBμV /m)	Height (cm)	Polar (H/V)				
1547.400000	---	25.77	200.0	V	183.0	-10.0	54.00	28.23
1547.400000	39.33	---	200.0	V	183.0	-10.0	74.00	34.67
3247.400000	48.34	---	200.0	V	226.0	-4.3	74.00	25.66
3247.400000	---	39.48	200.0	V	226.0	-4.3	54.00	14.52
4872.600000	53.92	---	200.0	V	226.0	-0.4	74.00	20.08
4872.600000	---	46.41	200.0	V	226.0	-0.4	54.00	7.59
7310.400000	43.81	---	150.0	V	178.0	6.6	74.00	30.19
7310.400000	---	36.08	250.0	V	66.0	6.6	54.00	17.92
10003.200000	48.59	---	150.0	V	199.0	9.1	74.00	25.41
10003.200000	---	40.71	250.0	V	274.0	9.1	54.00	13.29
14579.600000	51.85	---	150.0	H	0.0	16.5	74.00	22.15
14579.600000	---	43.39	150.0	H	0.0	16.5	54.00	10.61

High Channel: 2462MHz**Full Spectrum**

Frequency (MHz)	Corrected Amplitude		Rx Antenna		Turntable Degree	Corr. (dB)	Limit (dBμV/m)	Margin (dB)
	MaxPeak (dBμV /m)	Average (dBμV /m)	Height (cm)	Polar (H/V)				
1595.000000	---	25.44	200.0	V	210.0	-9.8	54.00	28.56
1595.000000	40.98	---	200.0	V	210.0	-9.8	74.00	33.02
3281.400000	---	37.66	200.0	V	210.0	-4.2	54.00	16.34
3281.400000	47.79	---	200.0	V	210.0	-4.2	74.00	26.21
4920.200000	---	47.61	250.0	H	214.0	-0.4	54.00	6.39
4920.200000	56.27	---	250.0	H	214.0	-0.4	74.00	17.73
7385.200000	43.66	---	150.0	H	53.0	6.8	74.00	30.34
7385.200000	---	35.99	150.0	H	53.0	6.8	54.00	18.01
9993.000000	---	40.48	200.0	V	338.0	9.1	54.00	13.52
9993.000000	48.23	---	200.0	V	338.0	9.1	74.00	25.77
14589.800000	50.75	---	150.0	V	10.0	16.5	74.00	23.25
14589.800000	---	42.88	150.0	V	10.0	16.5	54.00	11.12

Radiation Spurious Restricted Band Edge:

Frequency (MHz)	Corrected Amplitude		Rx Antenna		Turntable Degree	Corr. (dB)	Limit (dBμV/m)	Margin (dB)
	MaxPeak (dBμV /m)	Average (dBμV /m)	Height (cm)	Polar (H/V)				
Left Restricted Band								
2390.002000	---	39.68	250.0	H	40.0	2.6	54.00	14.32
2390.002000	46.69	---	250.0	H	40.0	2.6	74.00	27.31
Right Restricted Band								
2483.520000	47.16	---	200.0	H	219.0	2.8	74.00	26.84
2483.520000	---	39.55	200.0	H	219.0	2.8	54.00	14.45

802.11g:**Note:**

1. This test is performed with the 2.4-2.4835GHz band reject filter.
2. Corrected Factor = Antenna factor (RX) + Cable Loss – Amplifier Factor
Corrected Amplitude = Corrected Factor + Reading
Margin = Limit - Corrected. Amplitude
3. The other spurious emission which is 20dB to the limit was not recorded.

1G-25G

Frequency (MHz)	Corrected Amplitude		Rx Antenna		Turntable Degree	Corr. (dB)	Limit (dBμV/m)	Margin (dB)
	MaxPeak (dBμV /m)	Average (dBμV /m)	Height (cm)	Polar (H/V)				
Low Channel:2412MHz								
1588.200000	---	28.87	250.0	V	202.0	-9.9	54.00	25.13
1588.200000	42.78	---	250.0	V	202.0	-9.9	74.00	31.22
1890.800000	---	31.21	150.0	V	319.0	-8.7	54.00	22.79
1890.800000	41.71	---	200.0	V	319.0	-8.7	74.00	32.29
4825.000000	---	46.33	150.0	V	236.0	-0.5	54.00	7.67
4825.000000	54.13	---	150.0	V	236.0	-0.5	74.00	19.87
7235.600000	44.16	---	150.0	H	33.0	6.4	74.00	29.84
7235.600000	---	36.83	150.0	H	33.0	6.4	54.00	17.17
11285.000000	---	40.88	250.0	H	134.0	12.1	54.00	13.12
11285.000000	49.05	---	250.0	H	134.0	12.1	74.00	24.95
14392.600000	---	43.32	150.0	V	236.0	16.7	54.00	10.68
14392.600000	54.43	---	250.0	V	236.0	16.7	74.00	19.57
Low Channel:2437MHz								
1591.600000	---	25.69	150.0	H	160.0	-9.8	54.00	28.31
1591.600000	35.96	---	150.0	H	139.0	-9.8	74.00	38.04
3247.400000	---	37.23	200.0	V	219.0	-4.3	54.00	16.77
3247.400000	46.26	---	250.0	V	219.0	-4.3	74.00	27.74
4876.000000	---	44.54	250.0	V	140.0	-0.4	54.00	9.46
4876.000000	53.04	---	250.0	V	140.0	-0.4	74.00	20.96
7310.400000	---	36.69	150.0	H	143.0	6.6	54.00	17.31
7310.400000	45.15	---	200.0	H	143.0	6.6	74.00	28.85
10020.200000	47.89	---	200.0	V	18.0	9.1	74.00	26.11
10020.200000	---	40.59	200.0	V	18.0	9.1	54.00	13.41
14433.400000	---	43.62	150.0	H	254.0	16.7	54.00	10.38
14433.400000	54.05	---	150.0	H	254.0	16.7	74.00	19.95

Frequency (MHz)	Corrected Amplitude		Rx Antenna		Turntable Degree	Corr. (dB)	Limit (dBμV/m)	Margin (dB)
	MaxPeak (dBμV /m)	Average (dBμV /m)	Height (cm)	Polar (H/V)				
High Channel:2462MHz								
1598.400000	---	24.66	150.0	V	170.0	-9.8	54.00	29.34
1598.400000	35.68	---	150.0	V	170.0	-9.8	74.00	38.32
3281.400000	---	35.33	150.0	V	205.0	-4.2	54.00	18.67
3281.400000	44.99	---	250.0	V	205.0	-4.2	74.00	29.01
4923.600000	50.35	---	200.0	H	145.0	-0.3	74.00	23.65
4923.600000	---	44.44	200.0	H	145.0	-0.3	54.00	9.56
7385.200000	---	35.32	250.0	V	339.0	6.8	54.00	18.68
7385.200000	43.35	---	200.0	V	3.0	6.8	74.00	30.65
10020.200000	---	39.74	150.0	V	145.0	9.1	54.00	14.26
10020.200000	49.76	---	150.0	V	145.0	9.1	74.00	24.24
14555.800000	---	42.73	150.0	H	0.0	16.6	54.00	11.27
14555.800000	53.11	---	250.0	H	0.0	16.6	74.00	20.89

Radiation Spurious Restricted Band Edge:

Frequency (MHz)	Corrected Amplitude		Rx Antenna		Turntable Degree	Corr. (dB)	Limit (dBμV/m)	Margin (dB)
	MaxPeak (dBμV /m)	Average (dBμV /m)	Height (cm)	Polar (H/V)				
Left Restricted Band								
2390.000000	---	39.76	142.0	V	89.0	2.6	54.00	14.24
2390.000000	46.40	---	142.0	V	89.0	2.6	74.00	27.60
Right Restricted Band								
2483.500000	---	39.13	242.0	V	166.0	2.8	54.00	14.87
2483.500000	46.49	---	242.0	V	166.0	2.8	74.00	27.51

802.11n-HT20:**Note:**

1. This test is performed with the 2.4-2.4835GHz band reject filter.
2. Corrected Factor = Antenna factor (RX) + Cable Loss – Amplifier Factor
Corrected Amplitude = Corrected Factor + Reading
Margin = Limit - Corrected. Amplitude
3. The other spurious emission which is 20dB to the limit was not recorded.

1G-25G

Frequency (MHz)	Corrected Amplitude		Rx Antenna		Turntable Degree	Corr. (dB)	Limit (dBμV/m)	Margin (dB)
	MaxPeak (dBμV /m)	Average (dBμV /m)	Height (cm)	Polar (H/V)				
Low Channel:2412MHz								
1496.400000	---	25.69	250.0	V	182.0	-10.3	54.00	28.31
1496.400000	36.00	---	250.0	V	182.0	-10.3	74.00	38.00
3213.400000	---	33.58	150.0	V	216.0	-4.4	54.00	20.42
3213.400000	43.15	---	200.0	V	204.0	-4.4	74.00	30.85
4825.000000	---	44.89	150.0	V	216.0	-0.5	54.00	9.11
4825.000000	53.22	---	150.0	V	216.0	-0.5	74.00	20.78
7235.600000	43.91	---	150.0	V	199.0	6.4	74.00	30.09
7235.600000	---	35.81	150.0	V	17.0	6.4	54.00	18.19
10023.600000	---	40.86	250.0	H	167.0	9.2	54.00	13.14
10023.600000	49.76	---	250.0	H	167.0	9.2	74.00	24.24
14525.200000	---	43.86	150.0	V	165.0	16.7	54.00	10.14
14525.200000	52.76	---	250.0	V	165.0	16.7	74.00	21.24
Low Channel:2437MHz								
1595.000000	---	27.94	150.0	V	186.0	-9.8	54.00	26.06
1595.000000	38.25	---	150.0	V	186.0	-9.8	74.00	35.75
3247.400000	---	34.74	200.0	V	159.0	-4.3	54.00	19.26
3247.400000	43.97	---	250.0	V	186.0	-4.3	74.00	30.03
4872.600000	---	44.33	250.0	V	218.0	-0.4	54.00	9.67
4872.600000	53.24	---	250.0	V	218.0	-0.4	74.00	20.76
7310.400000	43.44	---	150.0	V	161.0	6.6	74.00	30.56
7310.400000	---	35.91	200.0	V	161.0	6.6	54.00	18.09
12097.600000	---	39.42	200.0	V	218.0	12.5	54.00	14.58
12097.600000	48.39	---	200.0	V	218.0	12.5	74.00	25.61
14940.000000	---	41.38	150.0	V	348.0	15.6	54.00	12.62
14940.000000	50.80	---	150.0	V	348.0	15.6	74.00	23.20

Frequency (MHz)	Corrected Amplitude		Rx Antenna		Turntable Degree	Corr. (dB)	Limit (dBμV/m)	Margin (dB)
	MaxPeak (dBμV /m)	Average (dBμV /m)	Height (cm)	Polar (H/V)				
High Channel:2462MHz								
1890.800000	---	41.07	150.0	V	7.0	-8.7	54.00	12.93
1890.800000	44.18	---	150.0	V	7.0	-8.7	74.00	29.82
3281.400000	---	36.22	150.0	V	192.0	-4.2	54.00	17.78
3281.400000	46.85	---	250.0	V	192.0	-4.2	74.00	27.15
4923.600000	---	41.98	200.0	V	184.0	-0.3	54.00	12.02
4923.600000	49.98	---	200.0	V	184.0	-0.3	74.00	24.02
7385.200000	---	34.71	250.0	V	48.0	6.8	54.00	19.29
7385.200000	41.77	---	200.0	V	124.0	6.8	74.00	32.23
10156.200000	47.09	---	150.0	V	158.0	9.3	74.00	26.91
10156.200000	---	38.66	150.0	V	158.0	9.3	54.00	15.34
14467.400000	51.44	---	150.0	V	295.0	16.7	74.00	22.56
14467.400000	---	42.90	250.0	V	295.0	16.7	54.00	11.10

Radiation Spurious Restricted Band Edge:

Frequency (MHz)	Corrected Amplitude		Rx Antenna		Turntable Degree	Corr. (dB)	Limit (dBμV/m)	Margin (dB)
	MaxPeak (dBμV /m)	Average (dBμV /m)	Height (cm)	Polar (H/V)				
Left Restricted Band								
2390.000000	---	40.90	142.0	V	26.0	2.6	54.00	13.10
2390.000000	45.78	---	142.0	V	26.0	2.6	74.00	28.22
Right Restricted Band								
2483.500000	---	40.17	242.0	V	227.0	2.8	54.00	13.83
2483.500000	48.24	---	242.0	V	227.0	2.8	74.00	25.76

802.11n-HT40:**Note:**

1. This test is performed with the 2.4-2.4835GHz band reject filter.
2. Corrected Factor = Antenna factor (RX) + Cable Loss – Amplifier Factor
Corrected Amplitude = Corrected Factor + Reading
Margin = Limit - Corrected. Amplitude
3. The other spurious emission which is 20dB to the limit was not recorded.

1G-25G

Frequency (MHz)	Corrected Amplitude		Rx Antenna		Turntable Degree	Corr. (dB)	Limit (dBμV/m)	Margin (dB)
	MaxPeak (dBμV /m)	Average (dBμV /m)	Height (cm)	Polar (H/V)				
Low Channel:2422MHz								
1496.400000	---	25.65	250.0	H	188.0	-10.3	54.00	28.35
1496.400000	35.74	---	250.0	H	188.0	-10.3	74.00	38.26
3227.000000	---	36.23	150.0	V	205.0	-4.3	54.00	17.77
3227.000000	45.81	---	200.0	V	205.0	-4.3	74.00	28.19
4845.400000	---	43.83	150.0	V	203.0	-0.5	54.00	10.17
4845.400000	51.59	---	150.0	V	203.0	-0.5	74.00	22.41
5998.000000	---	34.93	150.0	H	7.0	2.5	54.00	19.07
5998.000000	47.22	---	150.0	H	252.0	2.5	74.00	26.78
7266.200000	---	36.40	250.0	V	7.0	6.5	54.00	17.60
7266.200000	46.38	---	250.0	V	169.0	6.5	74.00	27.62
14814.200000	---	43.96	150.0	H	354.0	15.9	54.00	10.04
14814.200000	50.79	---	250.0	H	354.0	15.9	74.00	23.21
Low Channel:2437MHz								
1901.000000	---	28.94	150.0	V	23.0	-8.6	54.00	25.06
1901.000000	39.36	---	150.0	V	23.0	-8.6	74.00	34.64
3247.400000	---	38.19	200.0	V	227.0	-4.3	54.00	15.81
3247.400000	47.79	---	250.0	V	227.0	-4.3	74.00	26.21
4879.400000	---	42.07	250.0	H	137.0	-0.4	54.00	11.93
4879.400000	49.37	---	250.0	H	137.0	-0.4	74.00	24.63
7310.400000	---	36.20	150.0	V	276.0	6.6	54.00	17.80
7310.400000	45.01	---	200.0	V	276.0	6.6	74.00	28.99
10751.200000	---	38.38	200.0	H	173.0	10.7	54.00	15.62
10751.200000	46.11	---	200.0	H	0.0	10.7	74.00	27.89
14926.400000	---	42.04	150.0	H	7.0	15.7	54.00	11.96
14926.400000	50.19	---	150.0	H	7.0	15.7	74.00	23.81

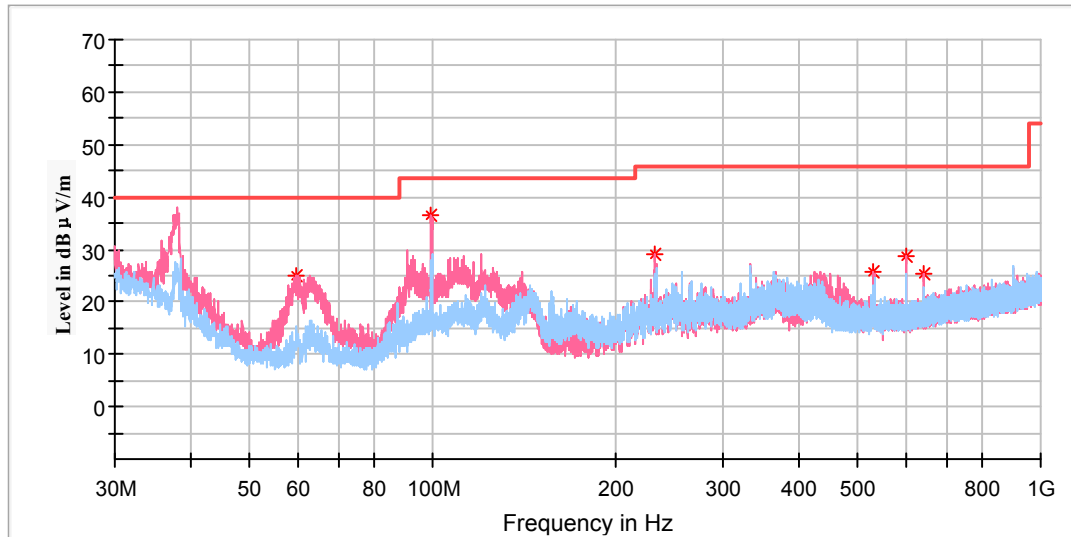
Frequency (MHz)	Corrected Amplitude		Rx Antenna		Turntable Degree	Corr. (dB)	Limit (dBμV/m)	Margin (dB)
	MaxPeak (dBμV /m)	Average (dBμV /m)	Height (cm)	Polar (H/V)				
High Channel:2452MHz								
1591.600000	38.74	---	150.0	V	177.0	-9.8	74.00	35.26
1591.600000	---	26.46	150.0	V	177.0	-9.8	54.00	27.54
3267.800000	47.02	---	150.0	V	211.0	-4.3	74.00	26.98
3267.800000	---	37.79	250.0	V	211.0	-4.3	54.00	16.21
4896.400000	48.84	---	200.0	V	218.0	-0.4	74.00	25.16
4896.400000	---	41.01	200.0	V	218.0	-0.4	54.00	12.99
7354.600000	---	36.05	250.0	V	92.0	6.7	54.00	17.95
7354.600000	43.48	---	200.0	V	92.0	6.7	74.00	30.52
9993.000000	47.19	---	150.0	V	19.0	9.1	74.00	26.81
9993.000000	---	39.25	150.0	V	19.0	9.1	54.00	14.75
14457.200000	---	43.34	150.0	V	25.0	16.7	54.00	10.66
14457.200000	52.04	---	250.0	V	25.0	16.7	74.00	21.96

Radiation Spurious Restricted Band Edge:

Frequency (MHz)	Corrected Amplitude		Rx Antenna		Turntable Degree	Corr. (dB)	Limit (dBμV/m)	Margin (dB)
	MaxPeak (dBμV /m)	Average (dBμV /m)	Height (cm)	Polar (H/V)				
Left Restricted Band								
2390.000000	---	39.87	142.0	V	109.0	2.6	54.00	14.13
2390.000000	47.75	---	142.0	V	125.0	2.6	74.00	26.25
Right Restricted Band								
2483.500000	---	40.93	200.0	H	252.0	2.8	54.00	13.07
2483.500000	48.05	---	200.0	H	252.0	2.8	74.00	25.95

BLE Mode:**30MHz-1G**

Full Spectrum



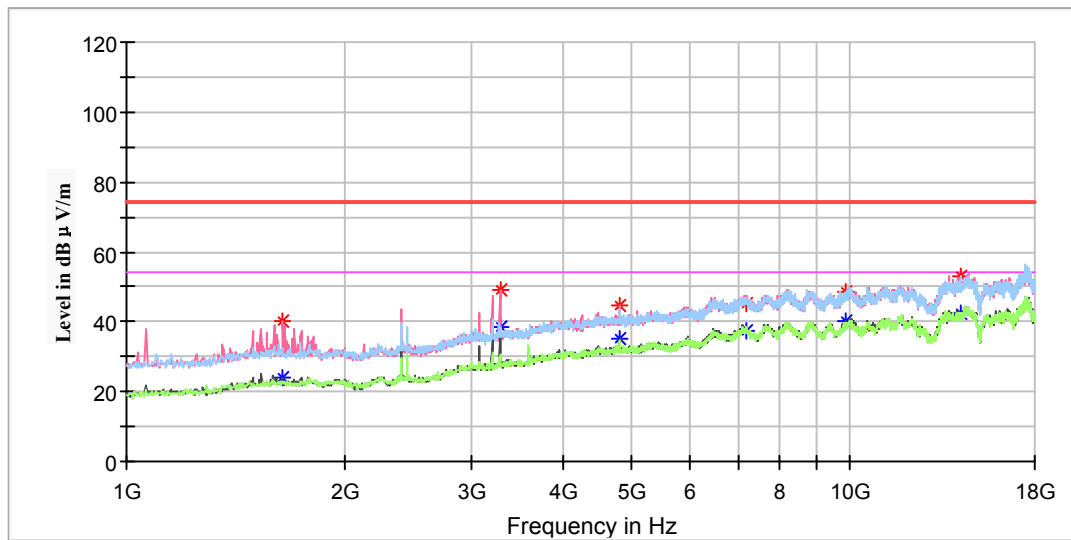
Frequency (MHz)	Corrected Amplitude	Rx Antenna		Turntable Degree	Corr. (dB)	Limit (dBμV/m)	Margin (dB)
	QuasiPeak (dBμV/m)	Height (cm)	Polar (H/V)				
59.617333	25.06	100.0	V	10.0	-23.1	40.00	14.94
99.549000	36.52	100.0	V	328.0	-21.2	43.50	6.98
232.309667	29.11	150.0	V	26.0	-19.5	46.00	16.89
530.875667	25.68	100.0	V	2.0	-13.4	46.00	20.32
600.004333	28.68	150.0	V	26.0	-13.0	46.00	17.32
640.033000	25.36	100.0	V	269.0	-12.2	46.00	20.64

Note:

1. This test is performed with the 2.4-2.4835GHz band reject filter.
2. Corrected Factor = Antenna factor (RX) + Cable Loss – Amplifier Factor
Corrected Amplitude = Corrected Factor + Reading
Margin = Limit - Corrected. Amplitude
3. The other spurious emission which is 20dB to the limit was not recorded.

1G-25G**Low Channel: 2402MHz**

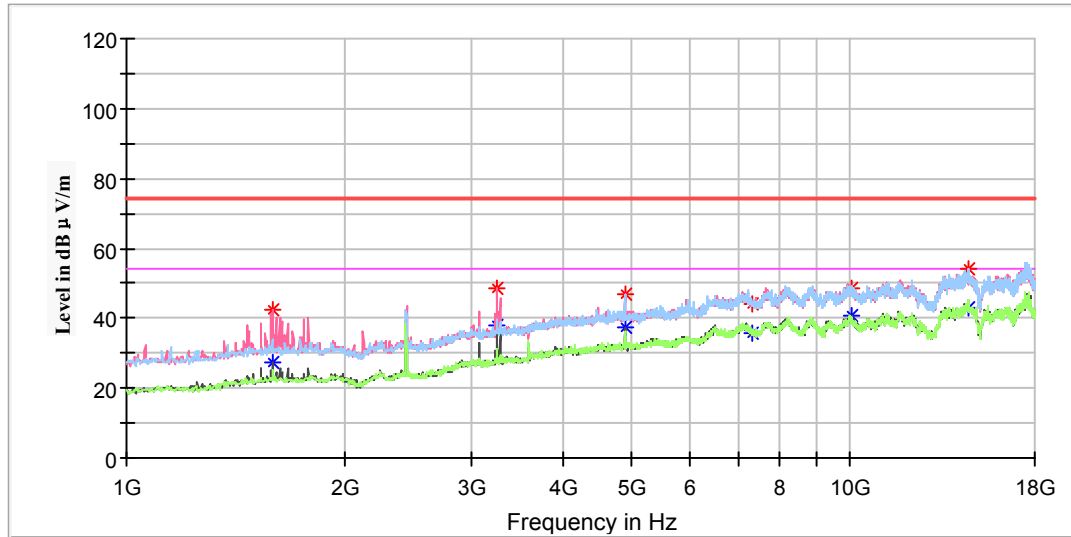
Full Spectrum



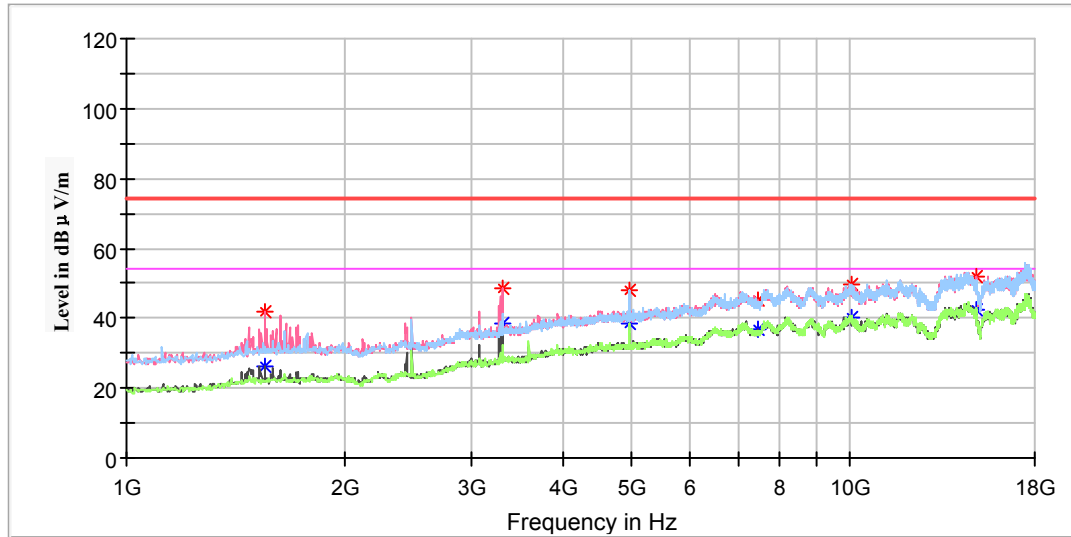
Frequency (MHz)	Corrected Amplitude		Rx Antenna		Turntable Degree	Corr. (dB)	Limit (dBμV/m)	Margin (dB)
	MaxPeak (dBμV/m)	Average (dBμV/m)	Height (cm)	Polar (H/V)				
1646.000000	---	23.92	150.0	V	209.0	-9.6	54.00	30.08
1646.000000	40.30	---	150.0	V	209.0	-9.6	74.00	33.70
3281.400000	49.07	---	150.0	V	220.0	-4.2	74.00	24.93
3281.400000	---	38.77	150.0	V	220.0	-4.2	54.00	15.23
4804.600000	44.55	---	150.0	V	230.0	-0.6	74.00	29.45
4804.600000	---	34.89	150.0	V	230.0	-0.6	54.00	19.11
7205.000000	---	37.60	250.0	H	204.0	6.3	54.00	16.40
7205.000000	45.39	---	150.0	H	215.0	6.3	74.00	28.61
9863.800000	---	40.37	200.0	V	64.0	9.0	54.00	13.63
9863.800000	48.39	---	250.0	V	177.0	9.0	74.00	25.61
14253.200000	53.16	---	150.0	H	161.0	16.7	74.00	20.84
14253.200000	---	42.51	150.0	H	161.0	16.7	54.00	11.49

Middle Channel: 2440MHz

Full Spectrum



Frequency (MHz)	Corrected Amplitude		Rx Antenna		Turntable Degree	Corr. (dB)	Limit (dBμV/m)	Margin (dB)
	MaxPeak (dBμV/m)	Average (dBμV/m)	Height (cm)	Polar (H/V)				
1591.600000	---	27.50	150.0	V	177.0	-9.8	54.00	26.50
1591.600000	42.56	---	150.0	V	177.0	-9.8	74.00	31.44
3250.800000	---	37.98	200.0	V	225.0	-4.3	54.00	16.02
3250.800000	48.31	---	200.0	V	225.0	-4.3	74.00	25.69
4879.400000	---	37.65	150.0	V	241.0	-0.4	54.00	16.35
4879.400000	46.73	---	150.0	V	241.0	-0.4	74.00	27.27
7320.600000	---	35.86	150.0	H	0.0	6.6	54.00	18.14
7320.600000	43.87	---	250.0	H	283.0	6.6	74.00	30.13
10037.200000	---	40.49	200.0	V	322.0	9.2	54.00	13.51
10037.200000	48.33	---	150.0	V	28.0	9.2	74.00	25.67
14545.600000	---	43.13	200.0	H	70.0	16.6	54.00	10.87
14545.600000	54.19	---	200.0	H	70.0	16.6	74.00	19.81

High Channel: 2480MHz**Full Spectrum**

Frequency (MHz)	Corrected Amplitude		Rx Antenna		Turntable Degree	Corr. (dB)	Limit (dBµV/m)	Margin (dB)
	MaxPeak (dBµV/m)	Average (dBµV/m)	Height (cm)	Polar (H/V)				
1554.200000	---	25.97	250.0	V	178.0	-10.0	54.00	28.03
1554.200000	41.81	---	250.0	V	178.0	-10.0	74.00	32.19
3305.200000	---	38.72	200.0	V	230.0	-4.2	54.00	15.28
3305.200000	48.51	---	200.0	V	230.0	-4.2	74.00	25.49
4957.600000	---	38.47	250.0	H	215.0	-0.3	54.00	15.53
4957.600000	47.95	---	250.0	H	215.0	-0.3	74.00	26.05
7439.600000	---	36.60	200.0	V	96.0	7.0	54.00	17.40
7439.600000	44.96	---	150.0	V	156.0	7.0	74.00	29.04
10016.800000	---	40.12	150.0	H	87.0	9.1	54.00	13.88
10016.800000	49.60	---	150.0	H	87.0	9.1	74.00	24.40
14912.800000	---	42.21	150.0	V	156.0	15.7	54.00	11.79
14912.800000	51.78	---	150.0	V	156.0	15.7	74.00	22.22

Radiation Spurious Restricted Band Edge:

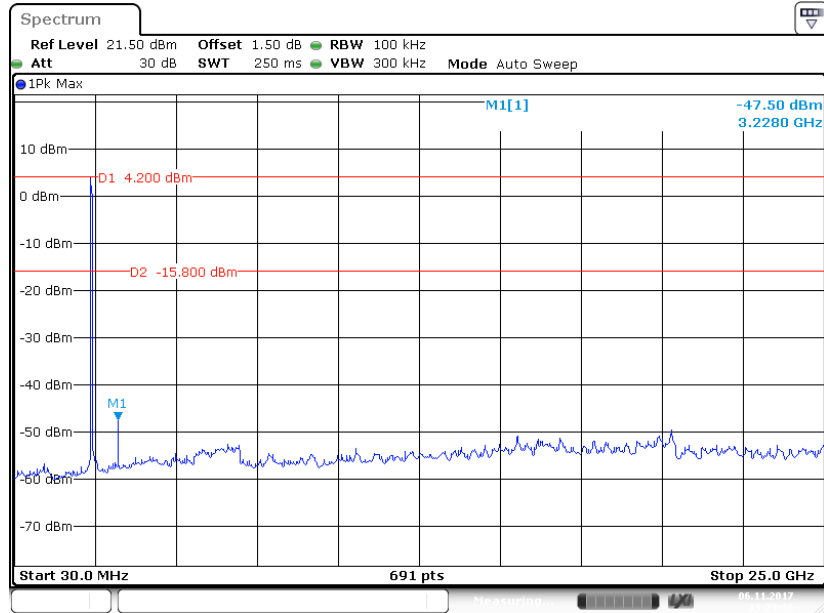
Frequency (MHz)	Corrected Amplitude		Rx Antenna		Turntable Degree	Corr. (dB)	Limit (dBμV/m)	Margin (dB)
	MaxPeak (dBμV/m)	Average (dBμV/m)	Height (cm)	Polar (H/V)				
Left Restricted Band								
2389.976000	---	38.71	150.0	V	232.0	2.6	54.00	15.29
2389.976000	46.74	---	200.0	V	245.0	2.6	74.00	27.26
Right Restricted Band								
2483.488000	46.44	---	150.0	V	202.0	2.8	74.00	27.56
2483.488000	---	41.33	150.0	V	202.0	2.8	54.00	12.67

Co-location Mode:

Frequency (MHz)	Corrected Amplitude			Rx Antenna		Turntable Degree	Corr. (dB)	Limit (dBμV/m)	Margin (dB)
	QuasiPeak (dBμV/m)	MaxPeak (dBμV/m)	Average (dBμV/m)	Height (cm)	Polar (H/V)				
99.553000	35.99	---	---	112.0	V	324.0	-21.2	43.50	7.51
1554.600000	---	---	25.86	226.0	V	168.0	-10.0	54.00	28.14
1554.600000	---	41.77	---	226.0	V	168.0	-10.0	74.00	32.23
3305.540000	---	---	38.69	202.0	V	228.0	-4.2	54.00	15.31
3305.540000	---	48.46	---	202.0	V	228.0	-4.2	74.00	25.54

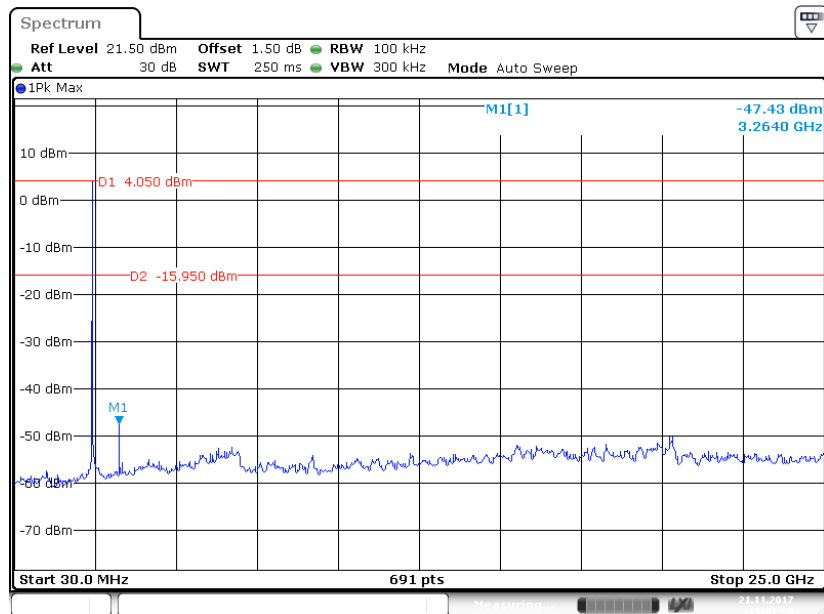
Conducted Spurious Emissions at Antenna Port

802.11b Low Channel



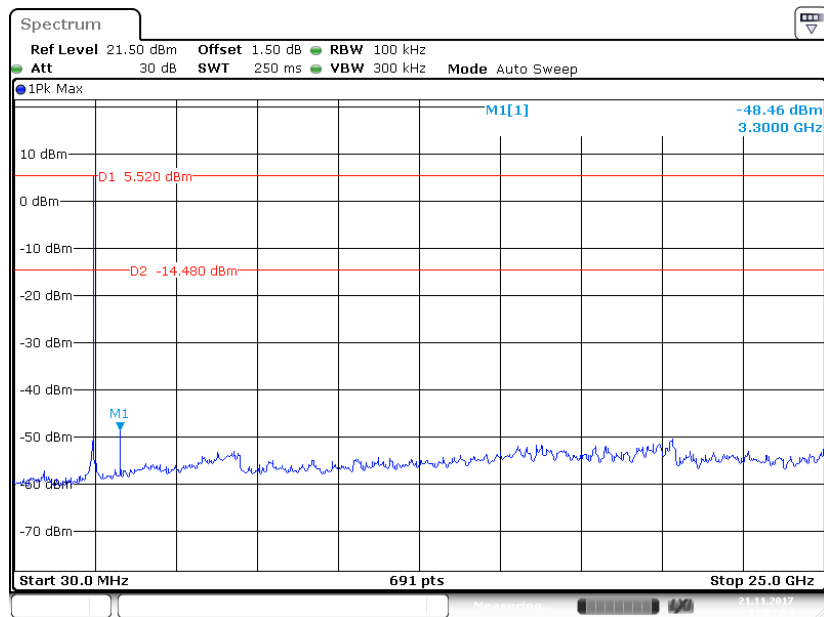
Date: 6 NOV 2017 13:23:36

802.11b Middle Channel



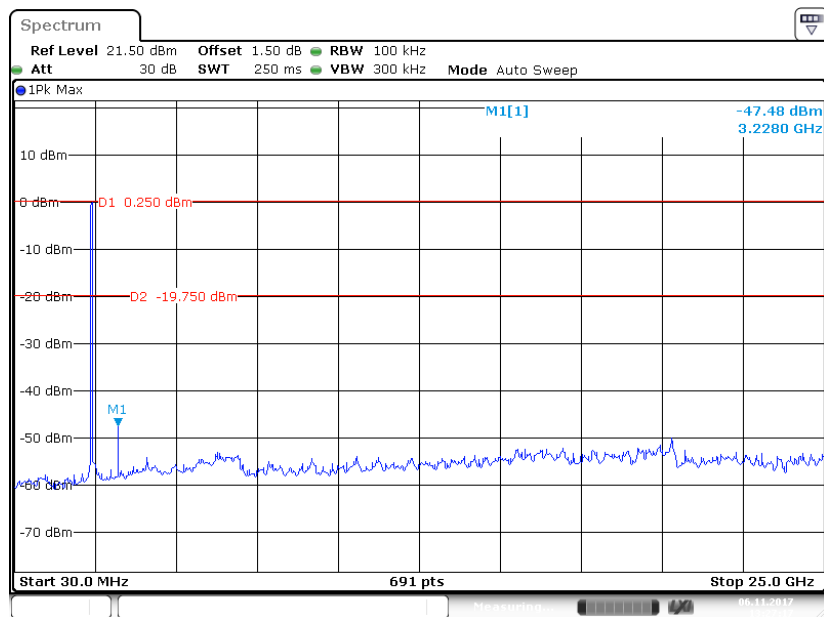
Date: 21 NOV 2017 15:07:31

802.11b High Channel



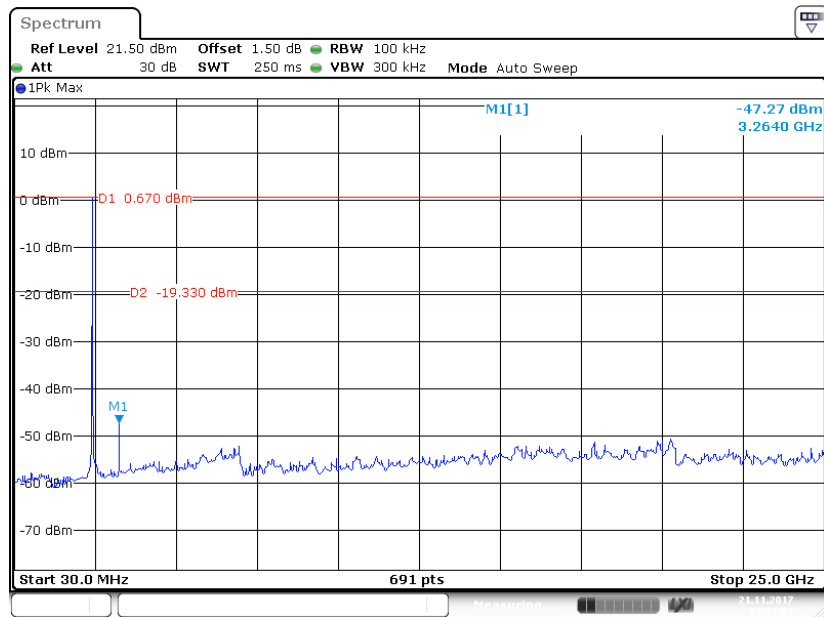
Date: 21.NOV.2017 15:08:50

802.11g Low Channel

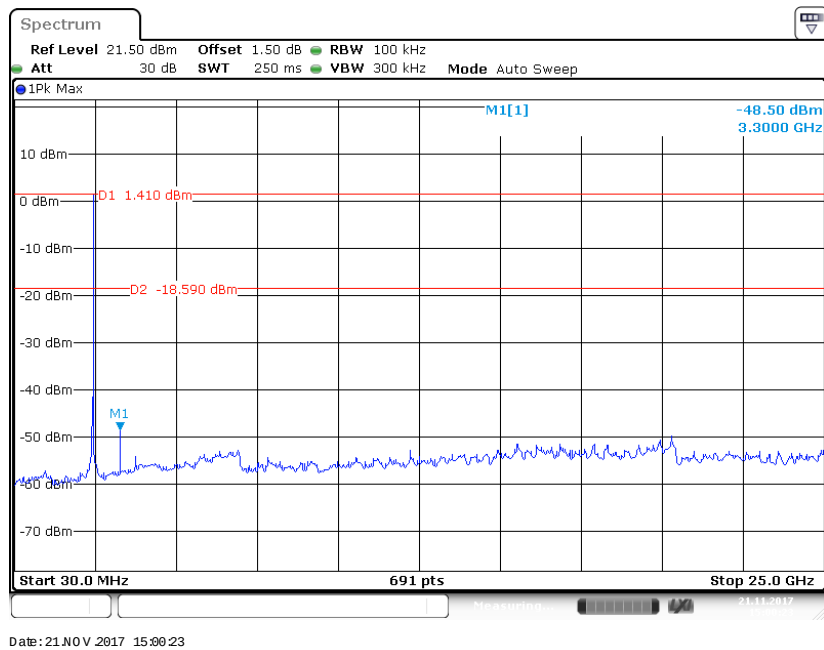


Date: 6.NOV.2017 13:27:17

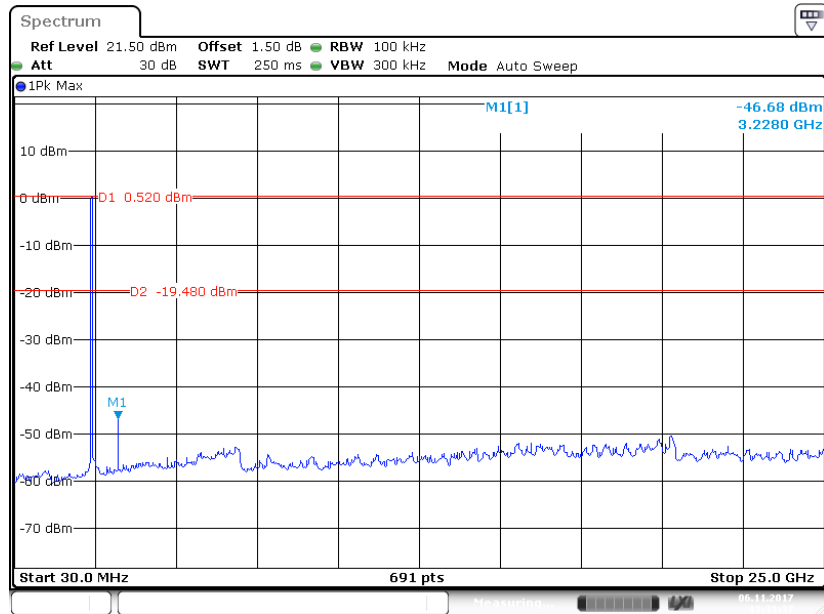
802.11g Middle Channel



802.11g High Channel

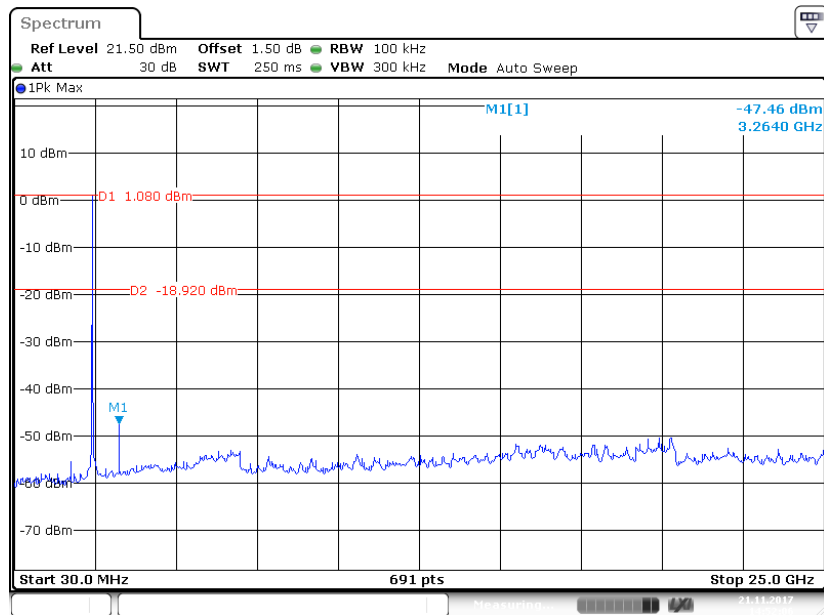


802.11n-HT20 Low Channel



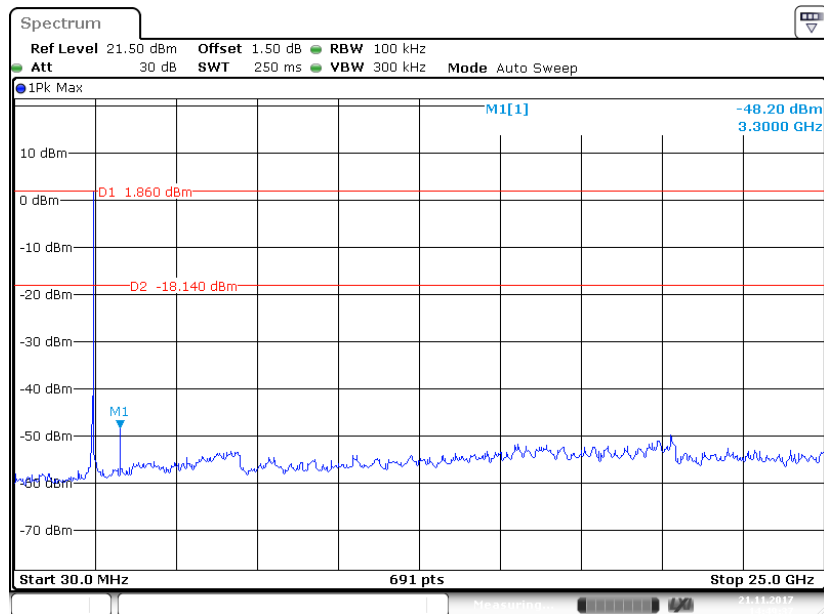
Date: 6 NOV 2017 13:31:37

802.11n-HT20 Middle Channel

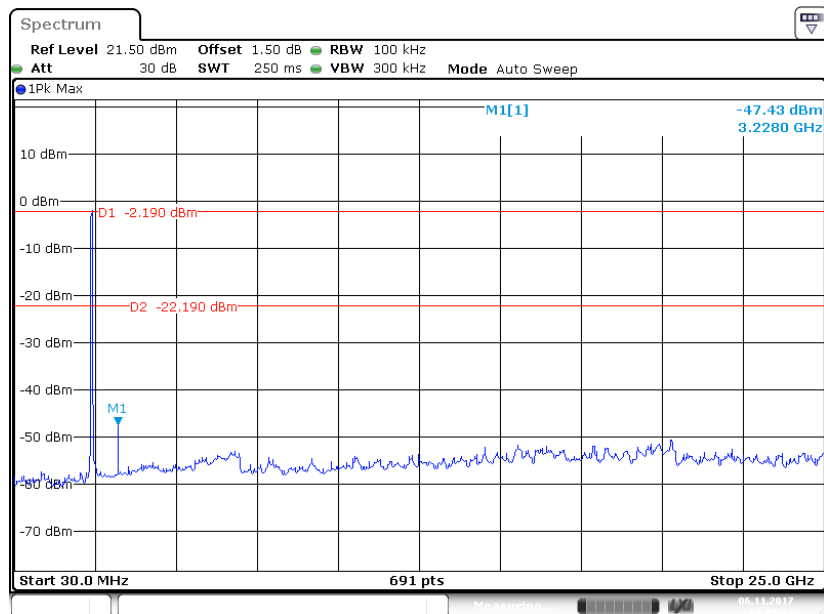


Date: 21 NOV 2017 14:52:07

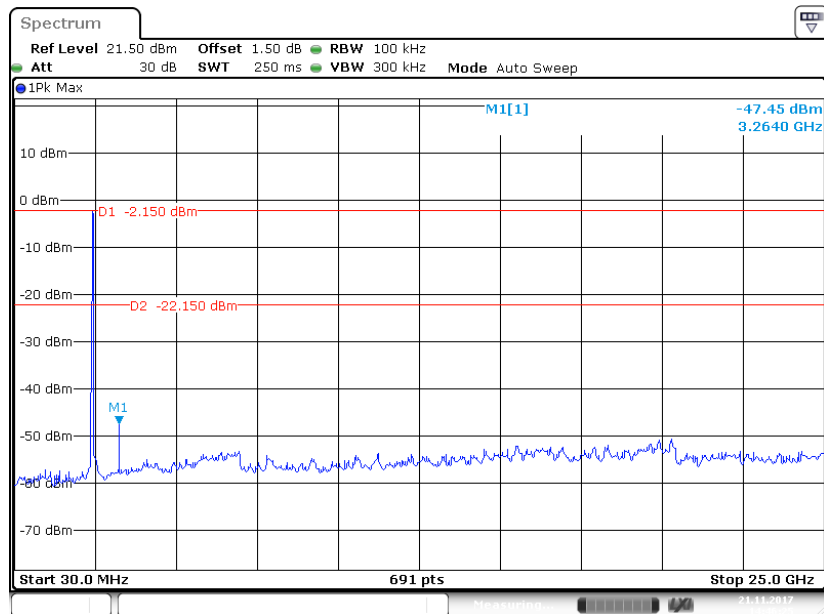
802.11n-HT20 High Channel



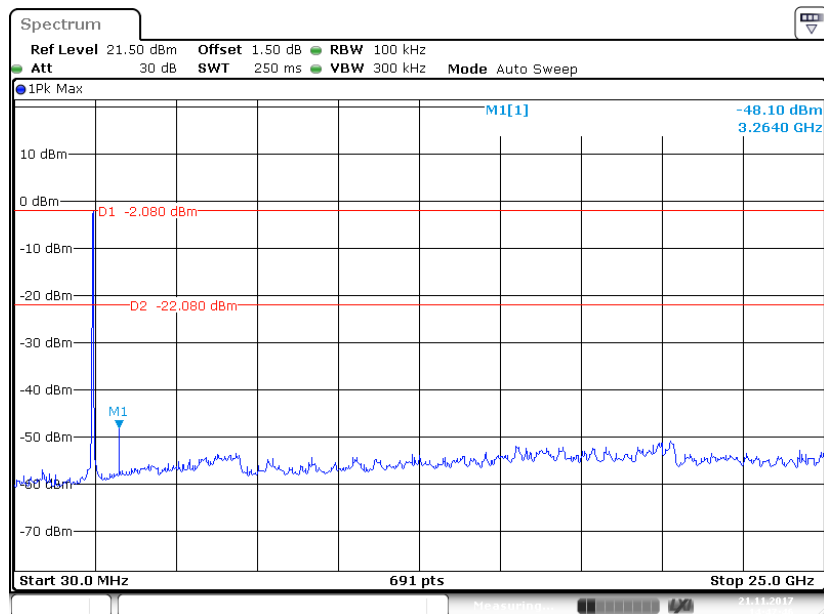
802.11n-HT40 Low Channel



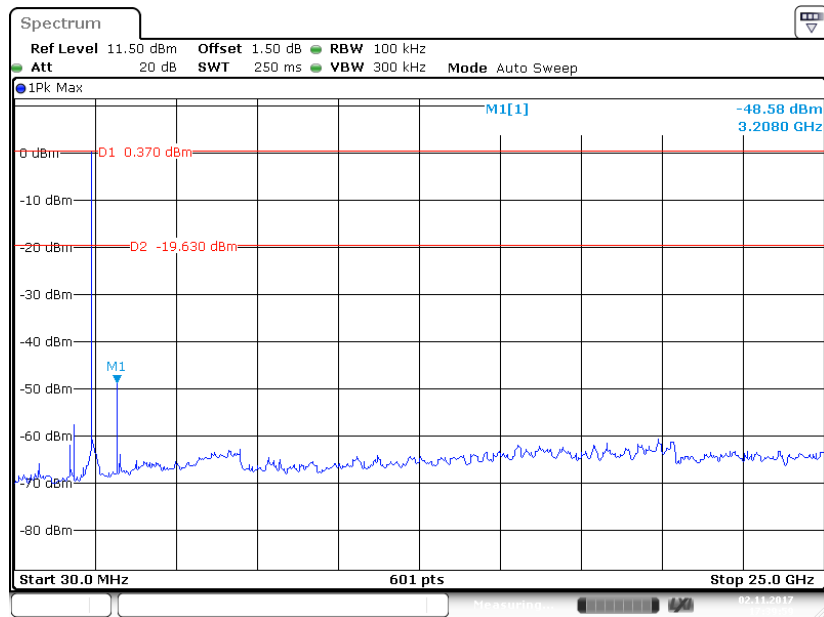
802.11n-HT40 Middle Channel



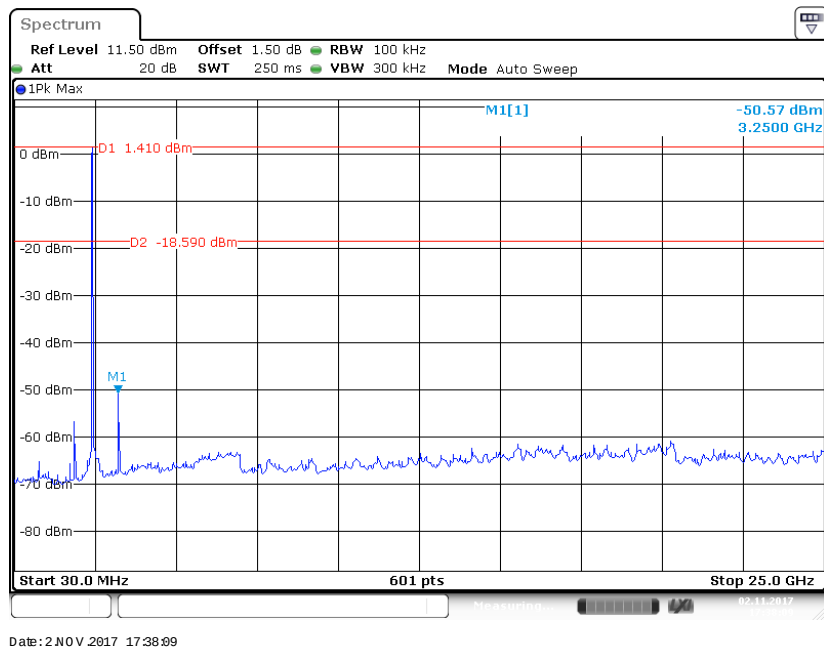
802.11n-HT40 High Channel



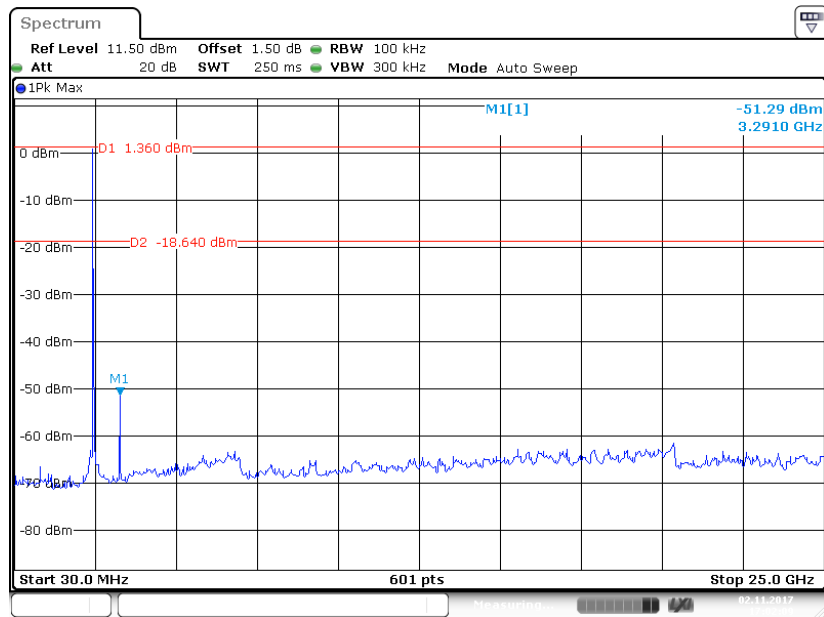
BLE Mode Low Channel



BLE Mode Middle Channel



BLE Mode High Channel

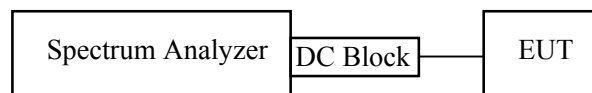


FCC §15.247(a) (2) – 6 dB EMISSION BANDWIDTH**Applicable Standard**

Systems using digital modulation techniques may operate in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

Test Procedure

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. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.
3. Measure the frequency difference of two frequencies that were attenuated 6 dB from the reference level. Record the frequency difference as the emission bandwidth.
4. Repeat above procedures until all frequencies measured were complete.

**Test Data****Environmental Conditions**

Temperature:	24.8 °C
Relative Humidity:	51 %
ATM Pressure:	101.1 kPa

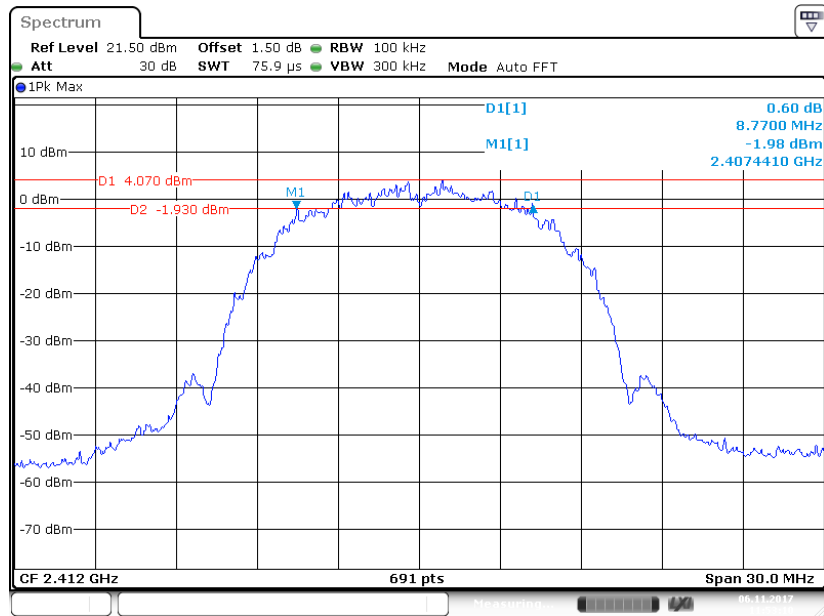
The testing was performed by Ada Yu on 2017-11-02 to 2017-11-21.

EUT operation mode: Transmitting

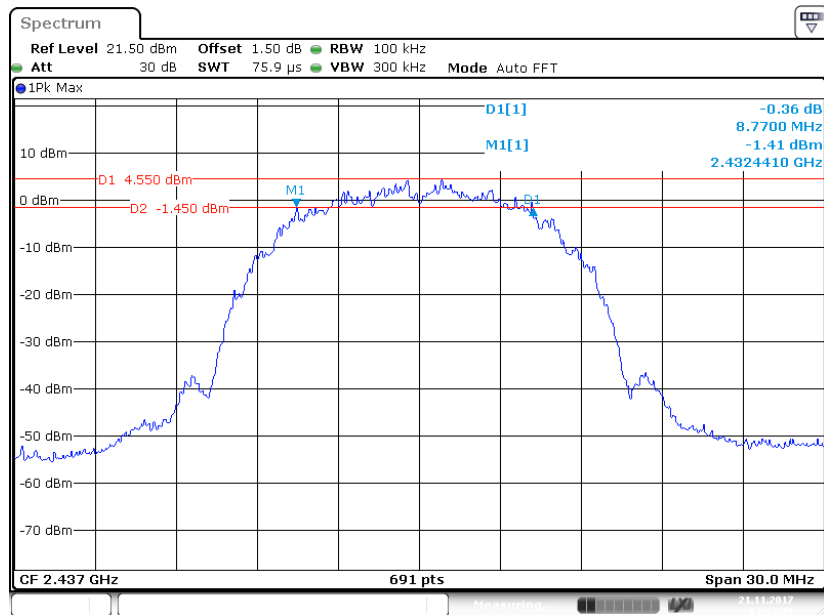
Test Result: Pass.

Channel	Frequency (MHz)	6 dB Emission Bandwidth (MHz)	Limit (MHz)
802.11b mode			
Low	2412	8.770	≥ 0.5
Middle	2437	8.770	≥ 0.5
High	2462	8.770	≥ 0.5
802.11g mode			
Low	2412	16.281	≥ 0.5
Middle	2437	16.237	≥ 0.5
High	2462	16.281	≥ 0.5
802.11n-HT20 mode			
Low	2412	16.324	≥ 0.5
Middle	2437	16.541	≥ 0.5
High	2462	16.324	≥ 0.5
802.11n-HT40 mode			
Low	2422	35.774	≥ 0.5
Middle	2437	35.687	≥ 0.5
High	2452	35.601	≥ 0.5
BLE mode			
Low	2402	0.639	≥ 0.5
Middle	2440	0.644	≥ 0.5
High	2480	0.639	≥ 0.5

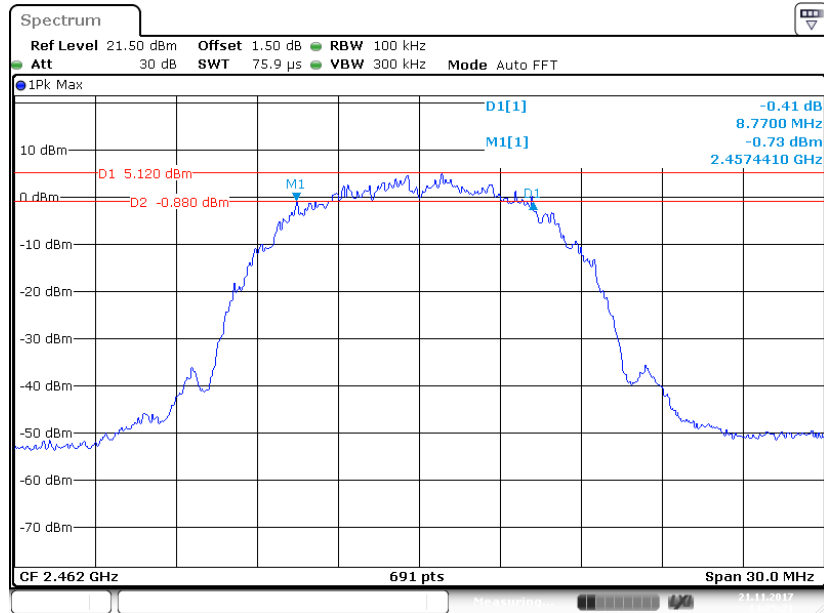
802.11b Low Channel



802.11b Middle Channel

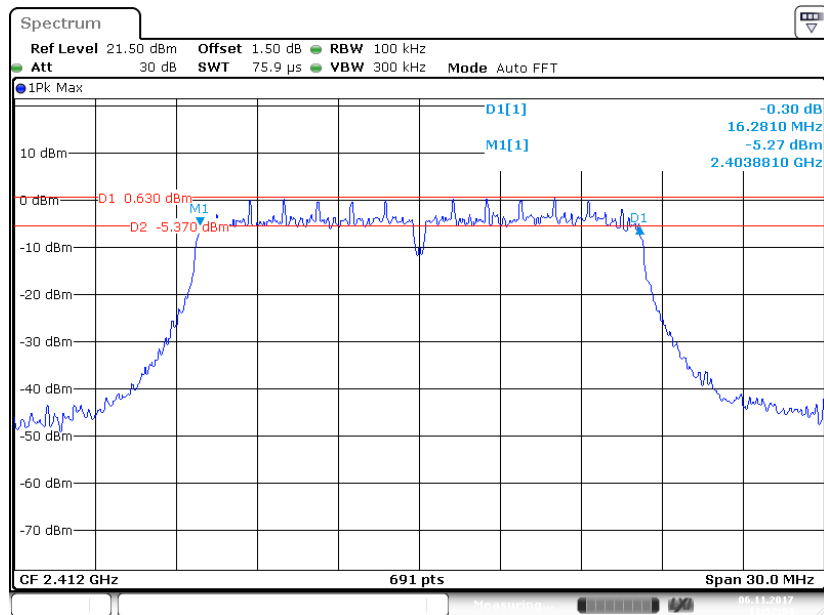


802.11b High Channel



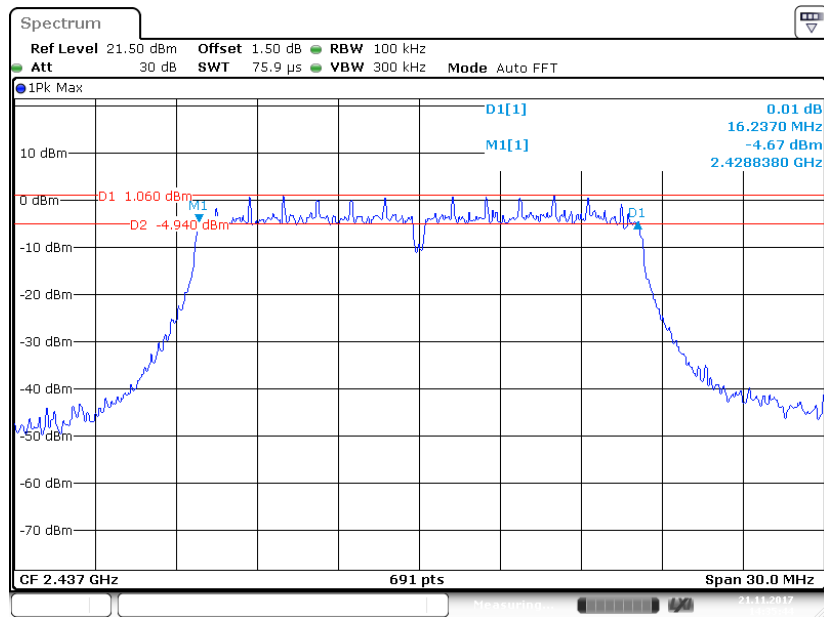
Date: 21 NOV 2017 14:25:22

802.11g Low Channel



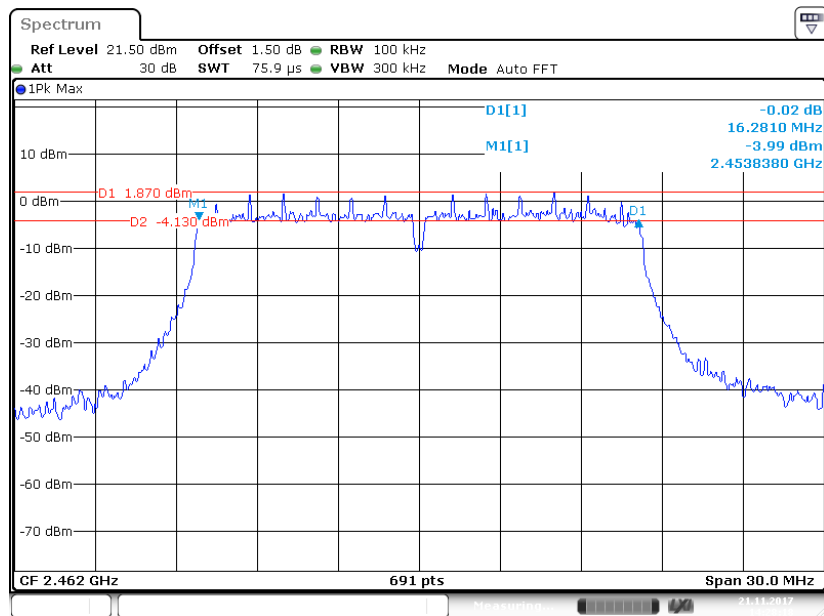
Date: 6 NOV 2017 11:52:04

802.11g Middle Channel



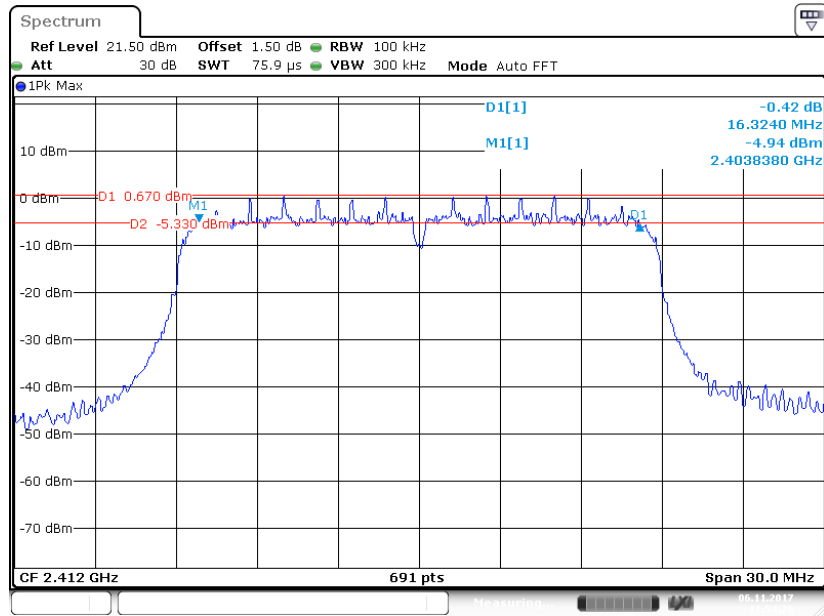
Date: 21.NOV.2017 14:35:44

802.11g High Channel

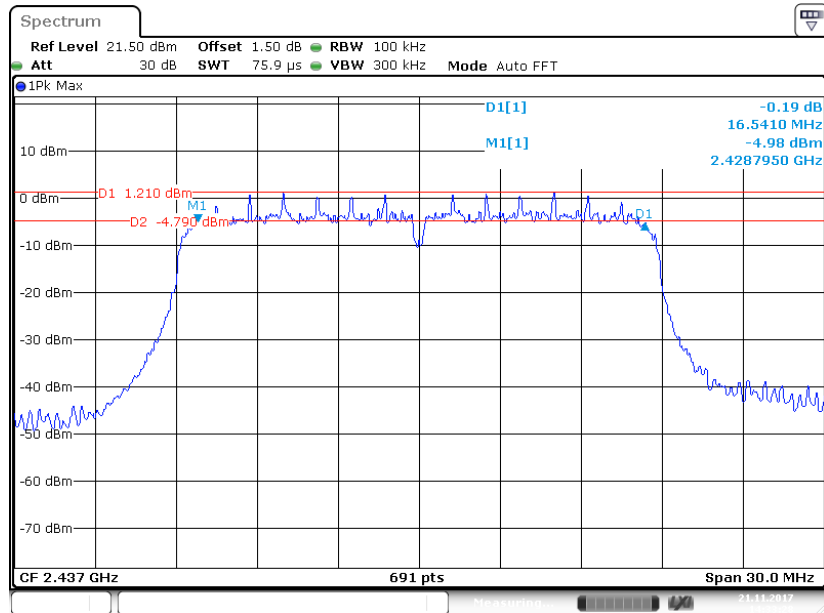


Date: 21.NOV.2017 14:28:18

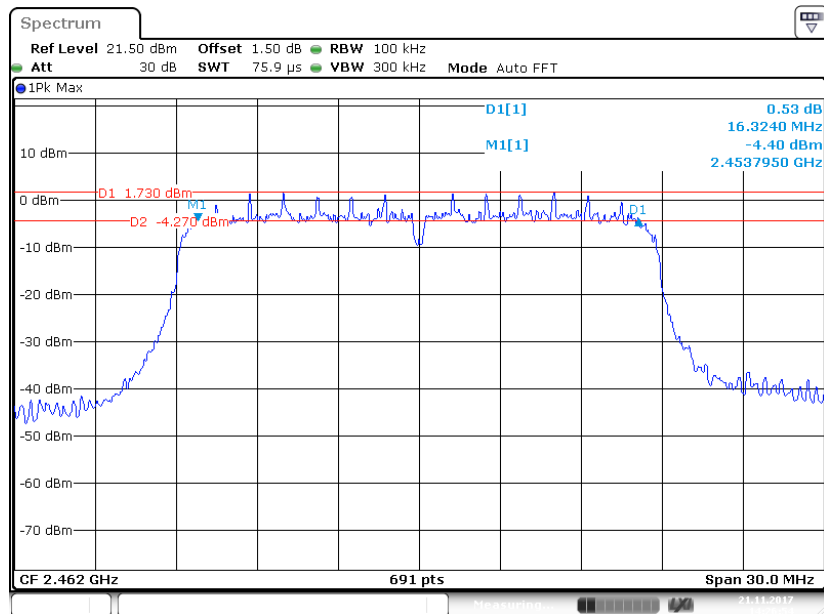
802.11n-HT20 Low Channel



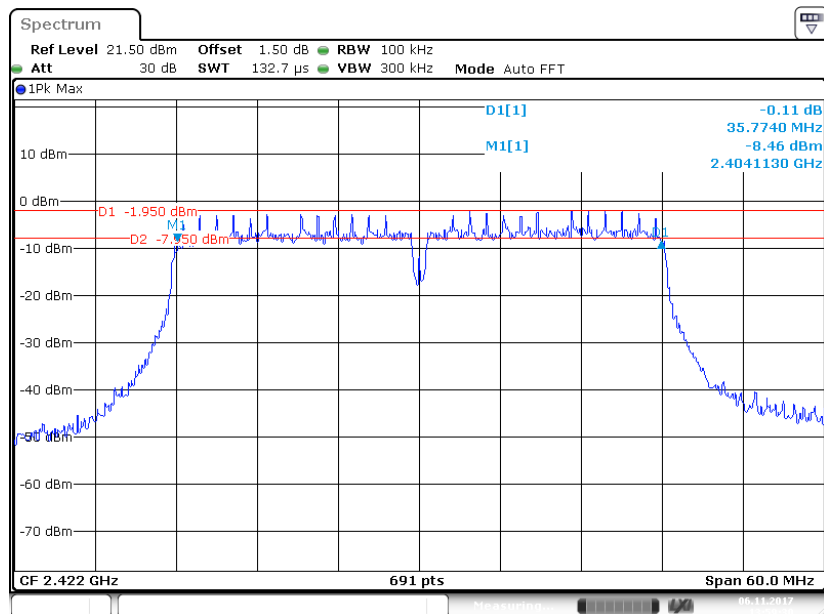
802.11n-HT20 Middle Channel



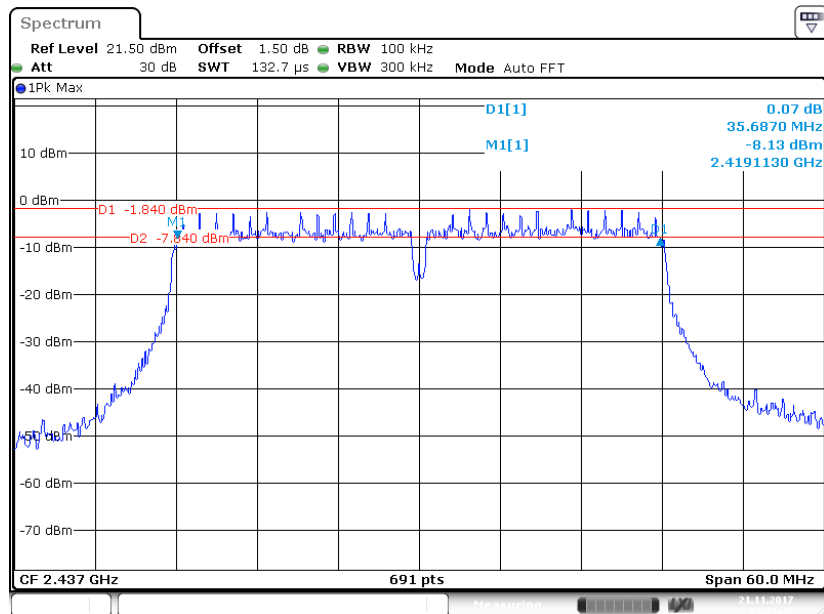
802.11n-HT20 High Channel



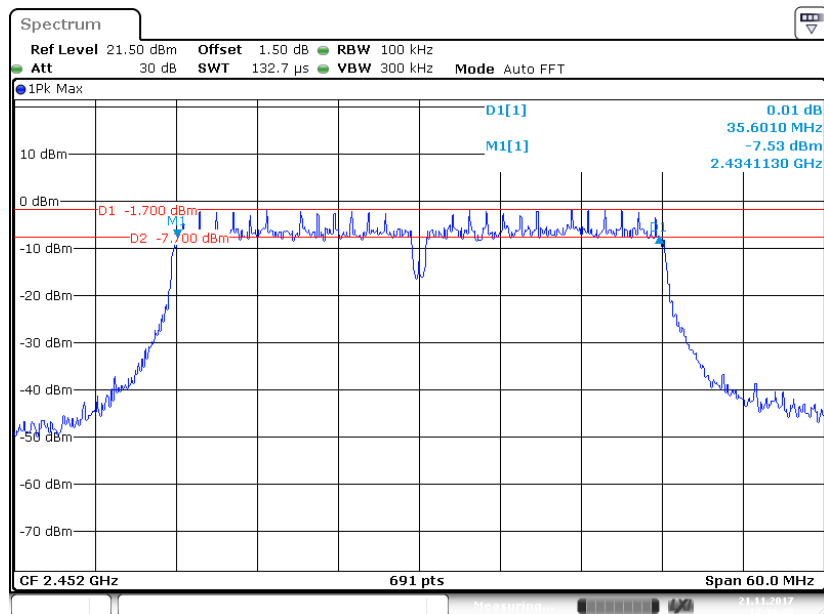
802.11n-HT40 Low Channel



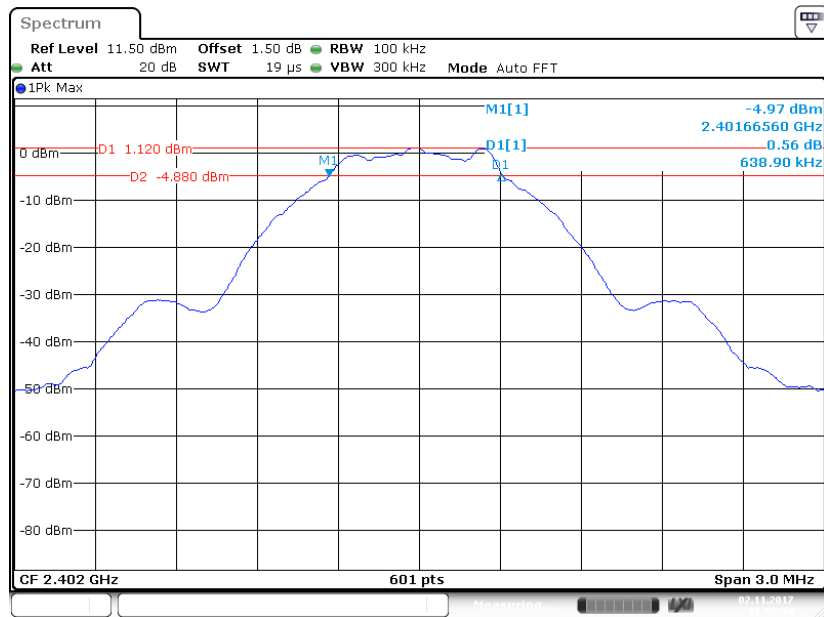
802.11n-HT40 Middle Channel



802.11n-HT40 High Channel

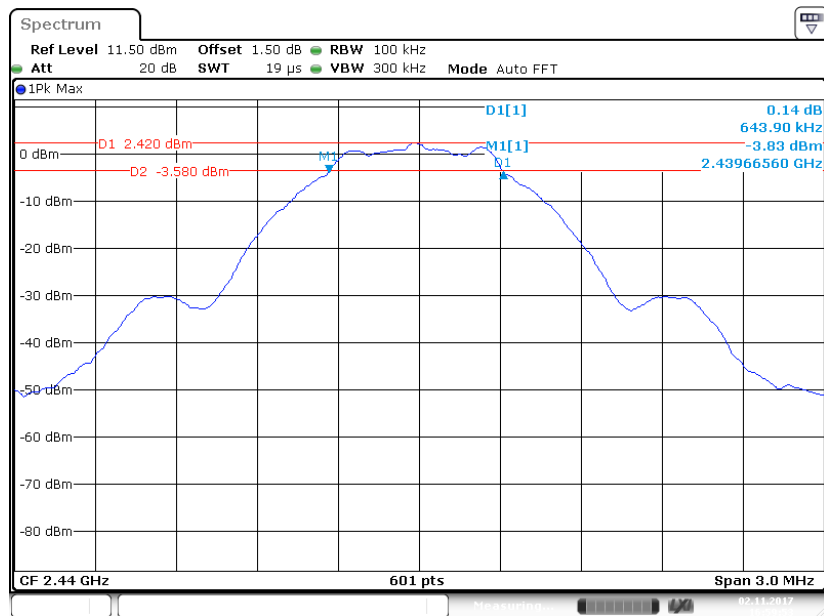


BLE Mode Low Channel



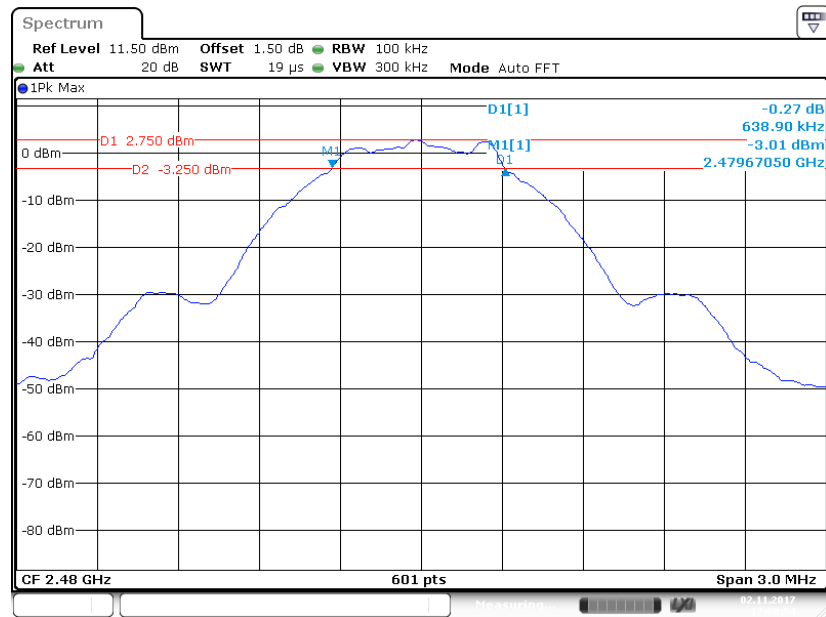
Date: 2 NOV 2017 16:58:54

BLE Mode Middle Channel



Date: 2 NOV 2017 16:59:54

BLE Mode High Channel



Date: 2 NOV 2017 17:00:54

FCC §15.247(b) (3) - MAXIMUM CONDUCTED OUTPUT POWER

Applicable Standard

According to FCC §15.247(b) (3), for systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.

Test Procedure

1. Place the EUT on a bench and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to one test equipment.
3. Add a correction factor to the display.



Test Data

Environmental Conditions

Temperature:	24.5 °C
Relative Humidity:	51 %
ATM Pressure:	101.0 kPa

The testing was performed by Ada Yu on 2017-11-02 to 2017-11-21.

EUT operation mode: Transmitting

Channel	Frequency (MHz)	Max Conducted Peak Output Power (dBm)	Limit (dBm)	Result
802.11b mode				
Low	2412	19.89	30	Pass
Middle	2437	19.56	30	Pass
High	2462	20.45	30	Pass
802.11g mode				
Low	2412	19.62	30	Pass
Middle	2437	19.93	30	Pass
High	2462	20.51	30	Pass
802.11n-HT20 mode				
Low	2412	19.64	30	Pass
Middle	2437	19.84	30	Pass
High	2462	20.41	30	Pass
802.11n-HT40 mode				
Low	2422	19.96	30	Pass
Middle	2437	19.97	30	Pass
High	2452	20.16	30	Pass
BLE mode				
Low	2402	1.34	30	Pass
Middle	2440	2.63	30	Pass
High	2480	2.91	30	Pass

FCC §15.247(d) – 100 kHz BANDWIDTH OF FREQUENCY BAND EDGE**Applicable Standard**

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. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

Test Procedure

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. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range, and make sure the instrument is operated in its linear range.
3. Set RBW to 100 kHz and VBW of spectrum analyzer to 300 kHz with a convenient frequency span including 100 kHz bandwidth from band edge.
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.

Test Data**Environmental Conditions**

Temperature:	24.5 °C
Relative Humidity:	51 %
ATM Pressure:	101.0 kPa

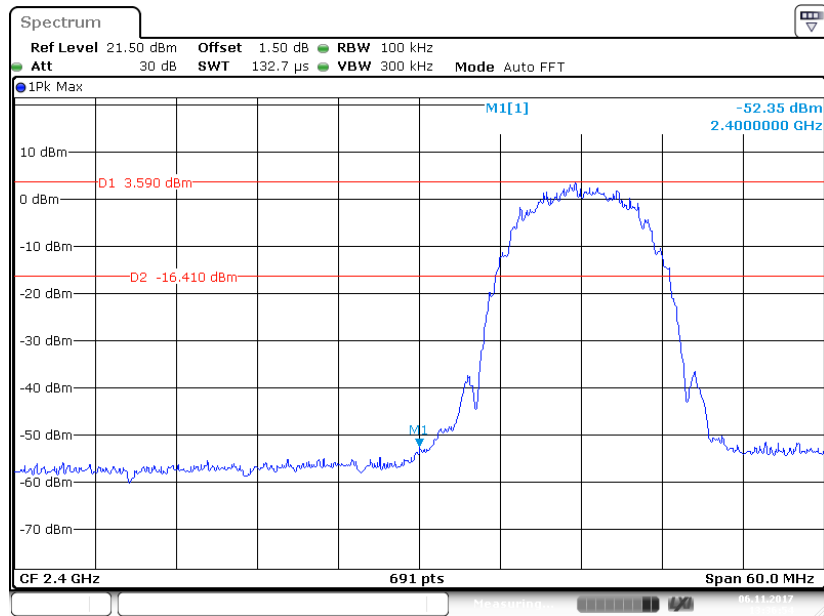
The testing was performed by Ada Yu on 2017-11-02 to 2017-11-21.

EUT operation mode: Transmitting

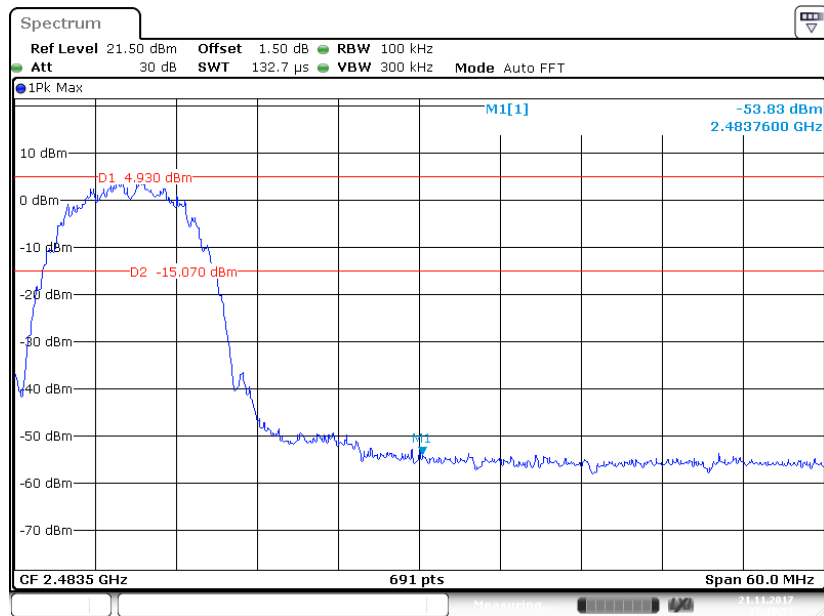
Test Result: *Compliance*

Band Edge

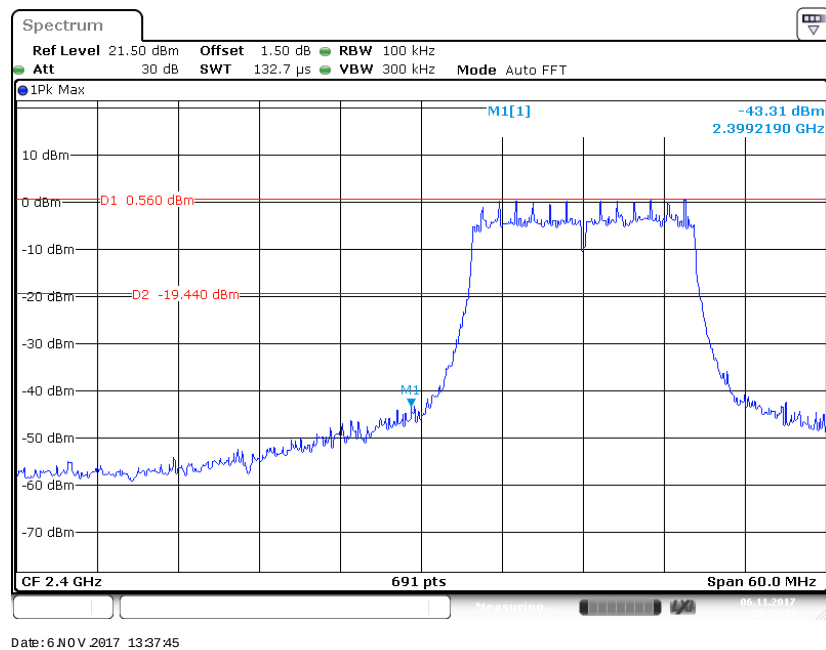
802.11b Mode Left Side



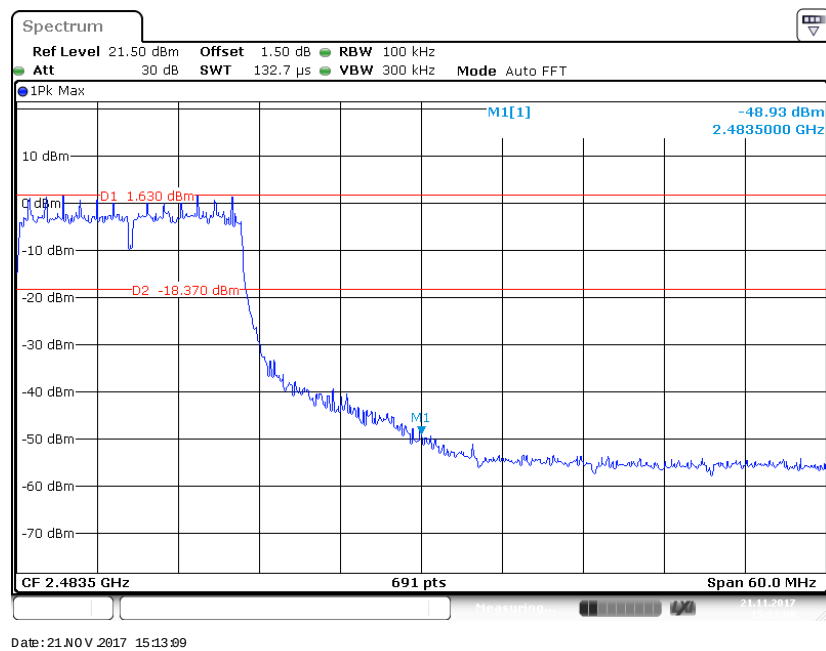
802.11b Mode Right Side



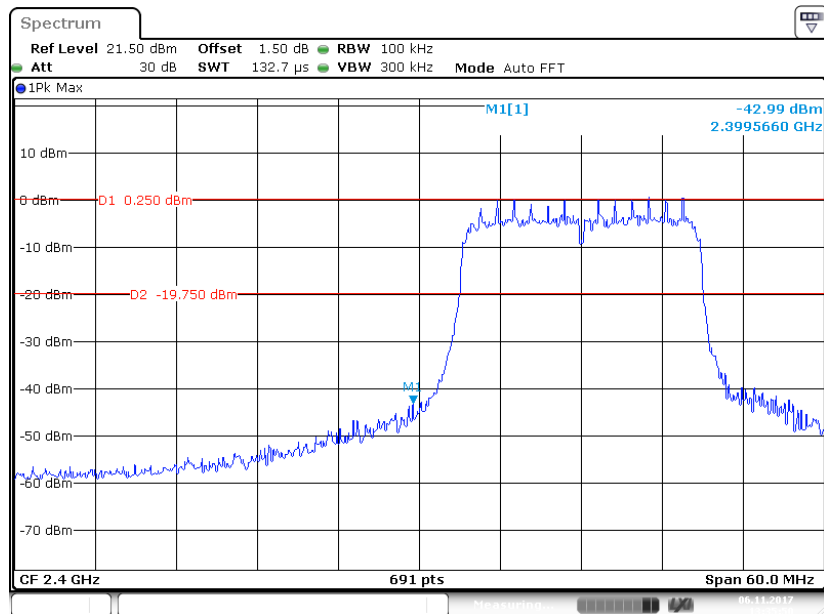
802.11g Mode Left Side



802.11g Mode Right Side

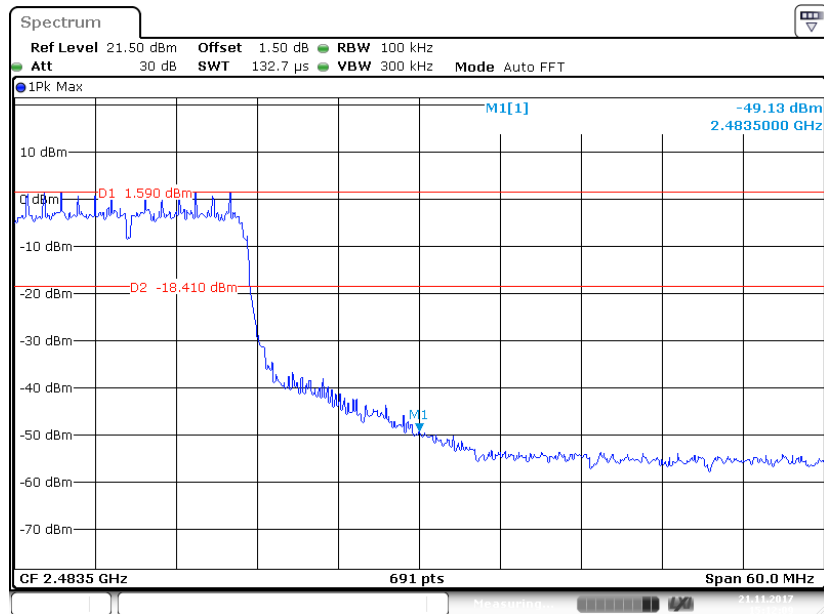


802.11n-HT20 Mode Left Side



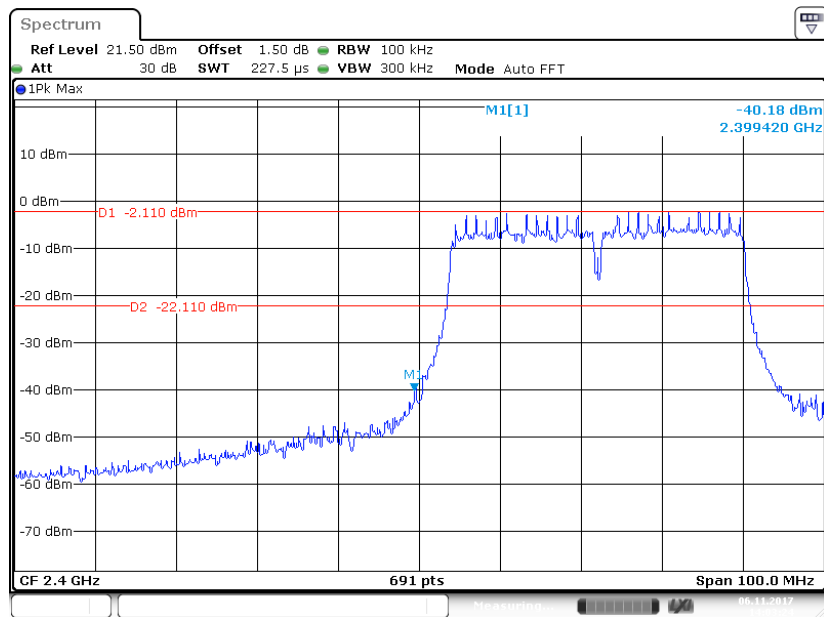
Date: 6 NOV 2017 13:35:50

802.11n-HT20 Mode Right Side



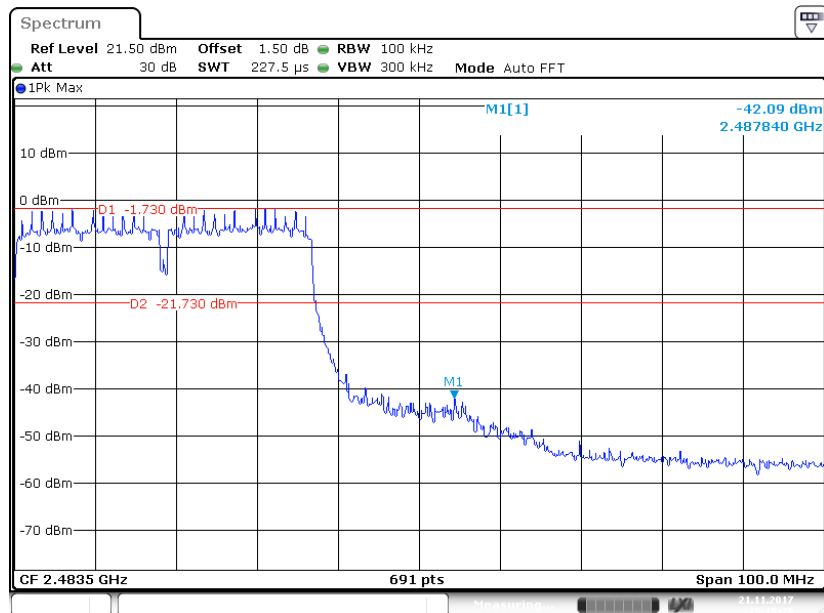
Date: 21 NOV 2017 15:12:99

802.11n-HT40 Mode Left Side



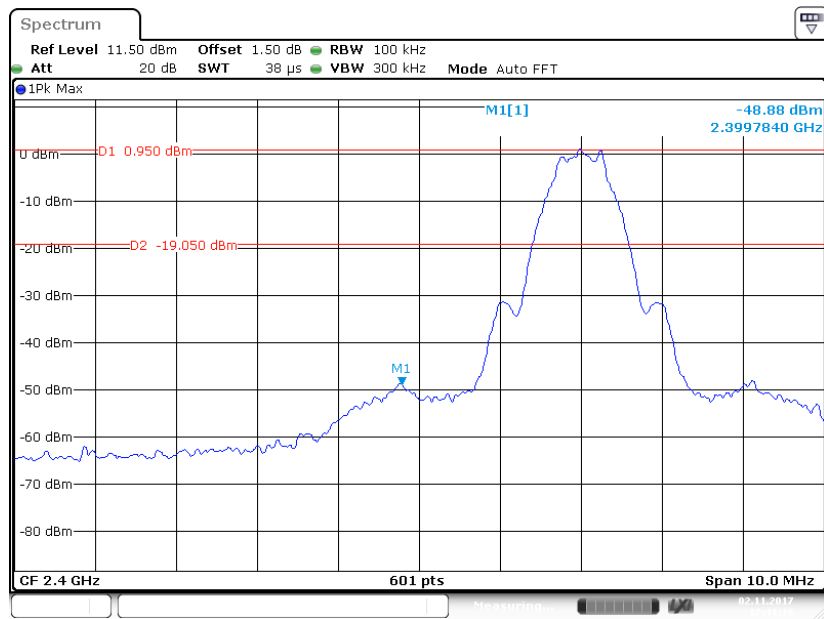
Date: 6 NOV 2017 14:03:24

802.11n-HT40 Mode Right Side



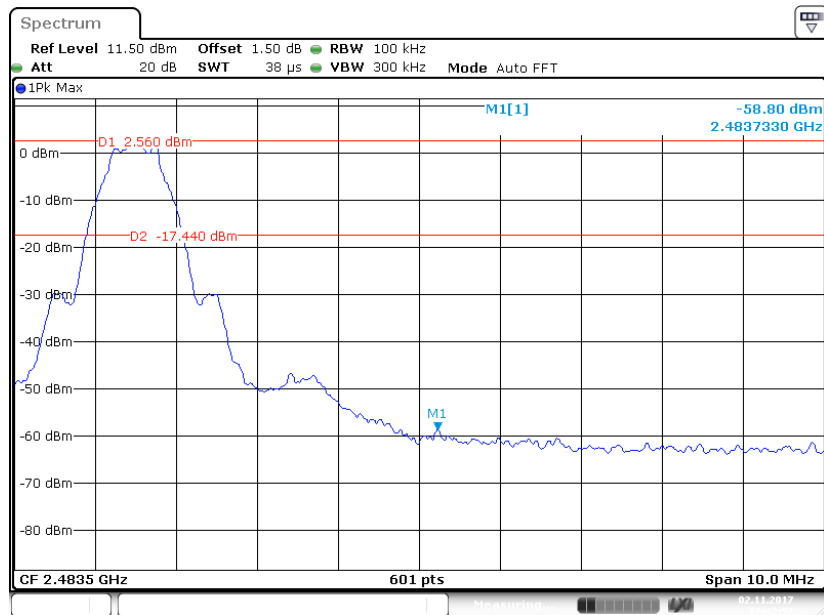
Date: 21 NOV 2017 15:15:26

BLE Mode Left Side



Date: 2 NOV 2017 17:41:16

BLE Mode Right Side



Date: 2 NOV 2017 17:42:57

FCC §15.247(e) - POWER SPECTRAL DENSITY

Applicable Standard

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

Test Procedure

According to KDB558074 D01 DTS Meas Guidance v04 sub-clause 10.2

1. Use this procedure when the maximum peak conducted output power in the fundamental emission is used to demonstrate compliance.
2. Set the RBW to: $3\text{kHz} \leq \text{RBW} \leq 100\text{ kHz}$.
3. Set the VBW $\geq 3 \times \text{RBW}$.
4. Set the span to 1.5 times the DTS bandwidth.
5. Detector = peak.
6. Sweep time = auto couple.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Use the peak marker function to determine the maximum amplitude level within the RBW.
10. If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

Test Data

Environmental Conditions

Temperature:	24.6°C
Relative Humidity:	51 %
ATM Pressure:	101.1 kPa

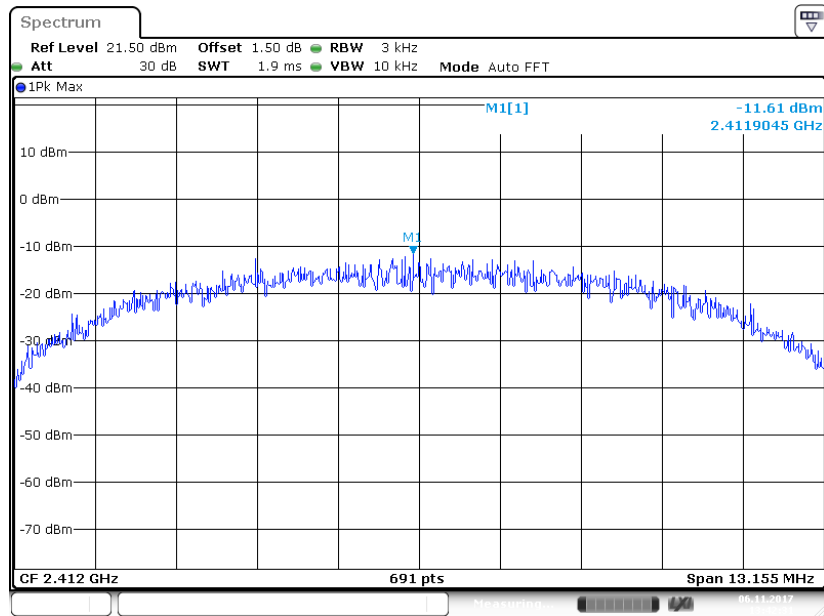
The testing was performed by Ada Yu on 2017-11-02 to 2017-11-21.

EUT operation mode: Transmitting

Test Result: Pass

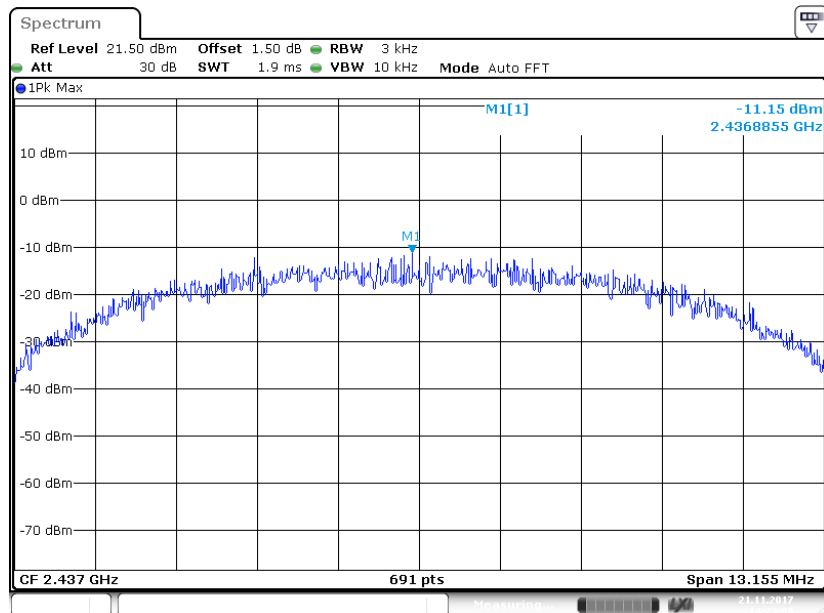
Channel	Frequency (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)
802.11b mode			
Low	2412	-11.61	≤ 8
Middle	2437	-11.15	≤ 8
High	2462	-10.53	≤ 8
802.11g mode			
Low	2412	-14.18	≤ 8
Middle	2437	-13.93	≤ 8
High	2462	-13.32	≤ 8
802.11n-HT20 mode			
Low	2412	-14.89	≤ 8
Middle	2437	-14.40	≤ 8
High	2462	-13.84	≤ 8
802.11n-HT40 mode			
Low	2422	-16.68	≤ 8
Middle	2437	-17.70	≤ 8
High	2452	-17.14	≤ 8
BLE mode			
Low	2402	-15.08	≤ 8
Middle	2440	-13.85	≤ 8
High	2480	-13.44	≤ 8

802.11b Low Channel

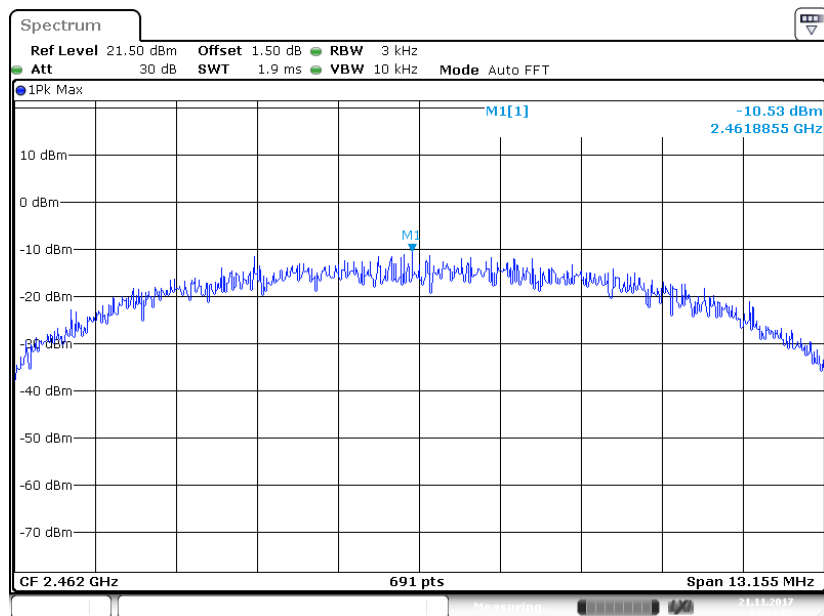


Date: 6 NOV 2017 13:42:32

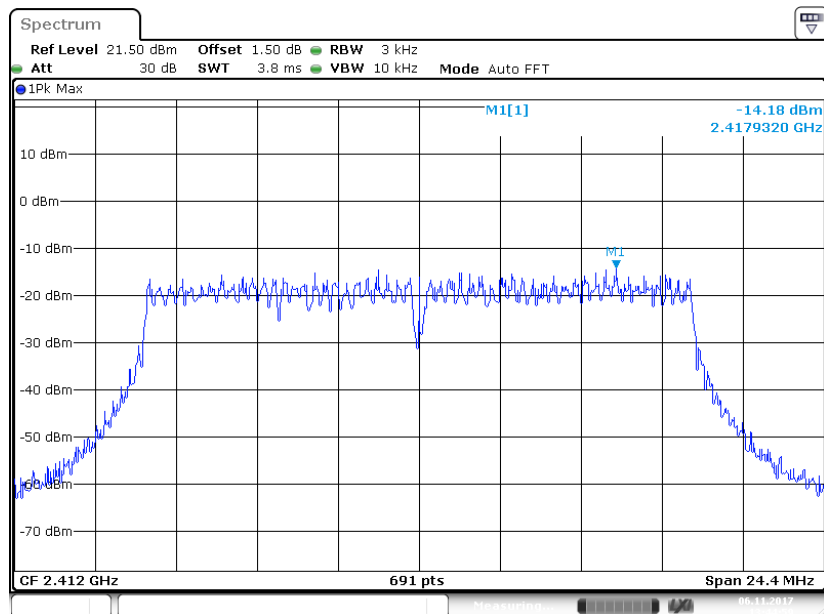
802.11b Middle Channel



Date: 21 NOV 2017 14:23:38

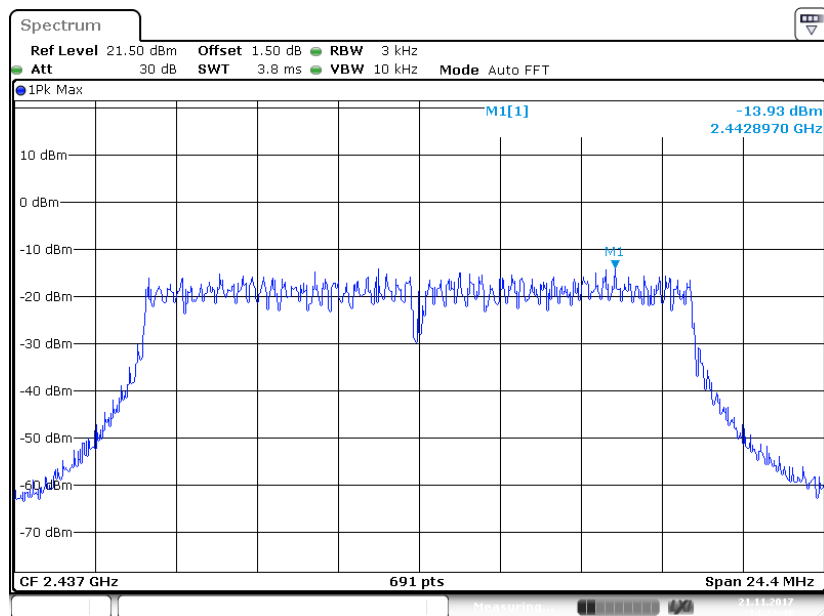
802.11b High Channel

Date: 21.NOV.2017 14:24:06

802.11g Low Channel

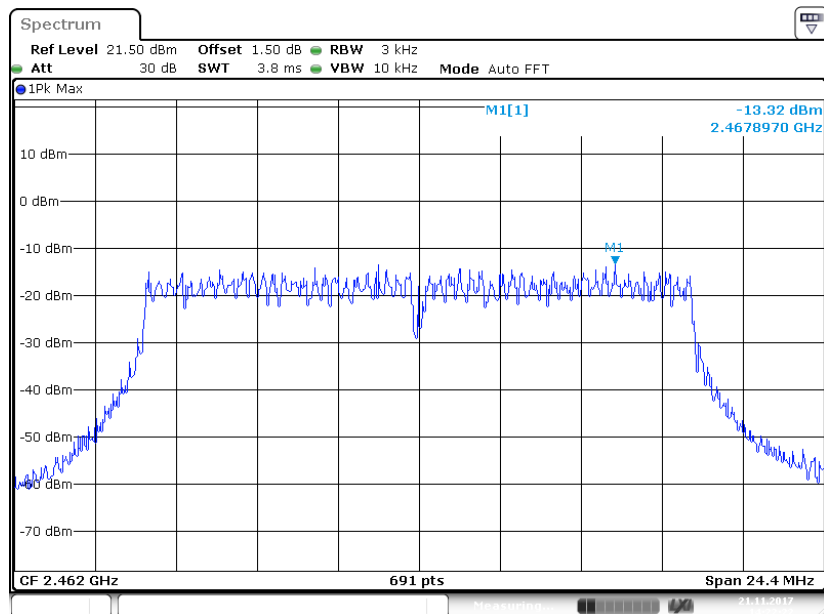
Date: 21.NOV.2017 13:45:00

802.11g Middle Channel



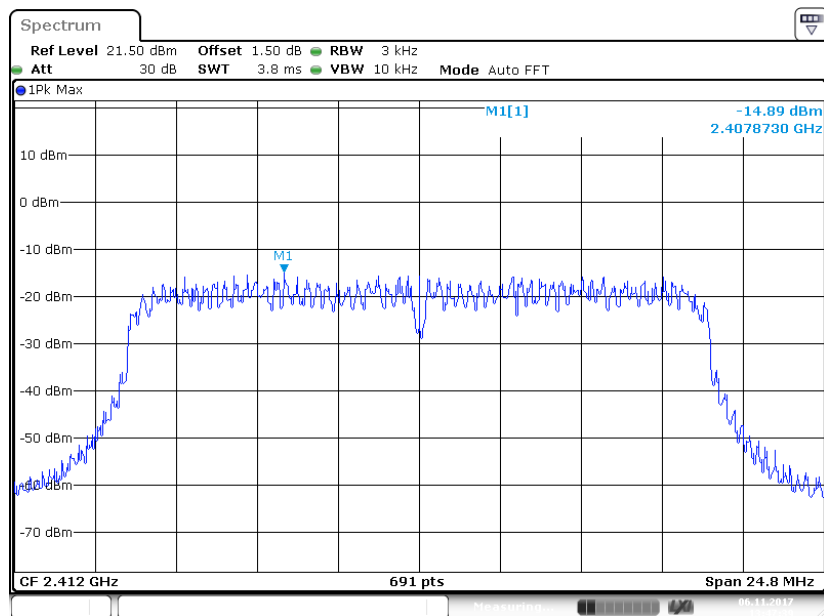
Date: 21.NOV.2017 14:22:49

802.11g High Channel



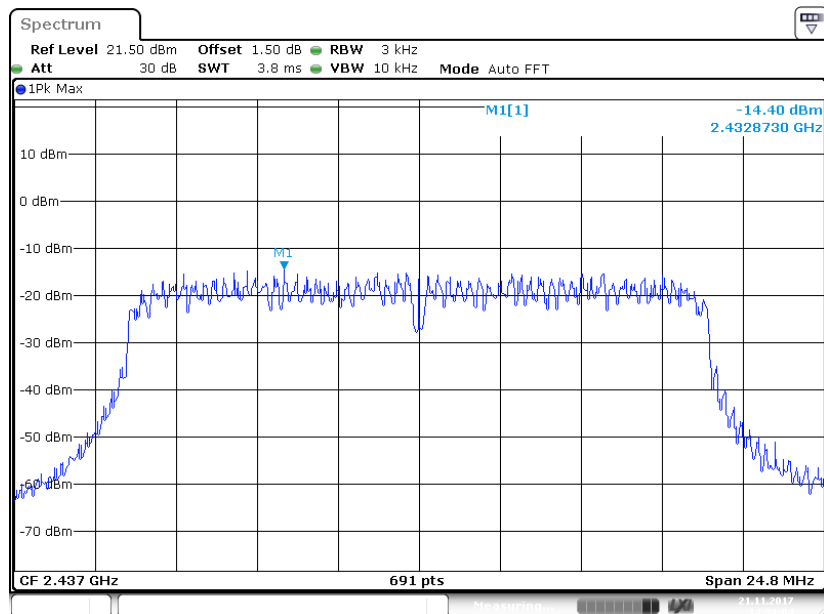
Date: 21.NOV.2017 14:22:22

802.11n-HT20 Low Channel



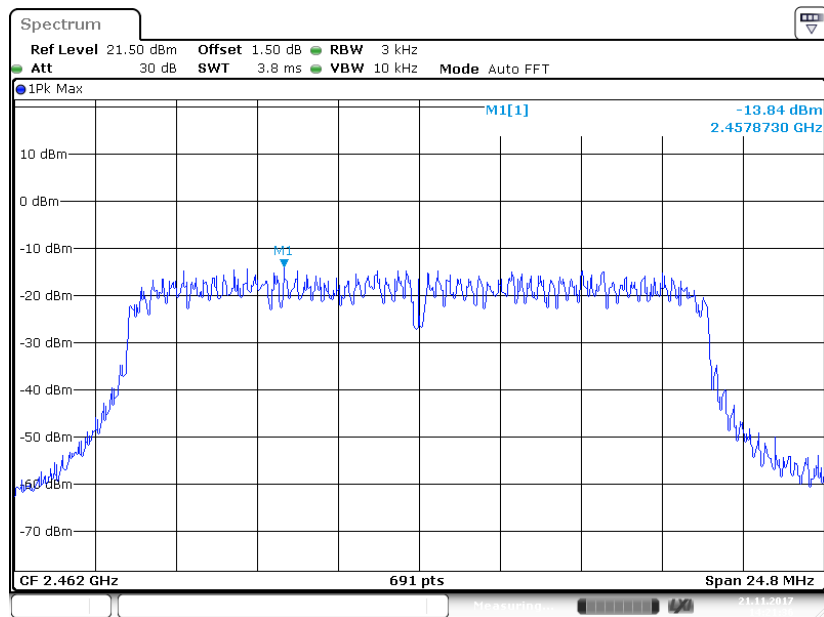
Date: 6 NOV 2017 13:47:38

802.11n-HT20 Middle Channel



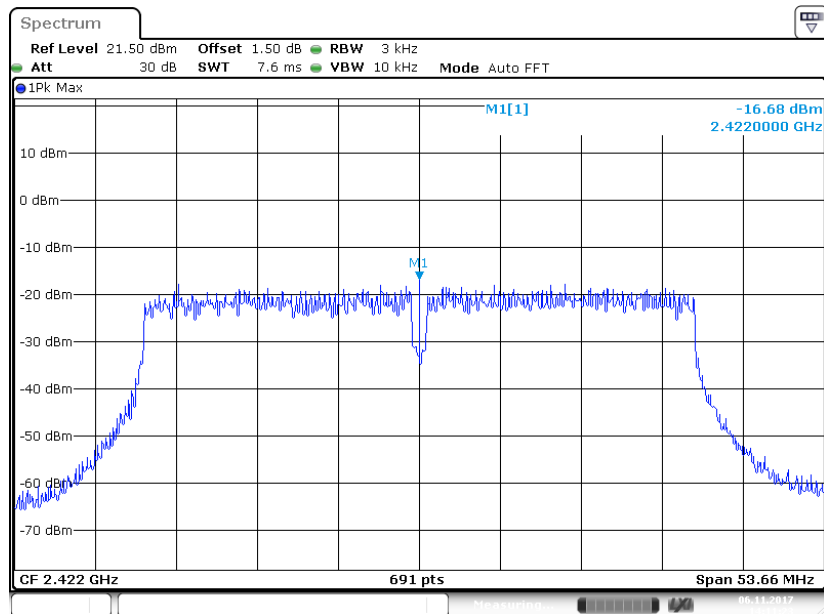
Date: 21 NOV 2017 14:21:04

802.11n-HT20 High Channel



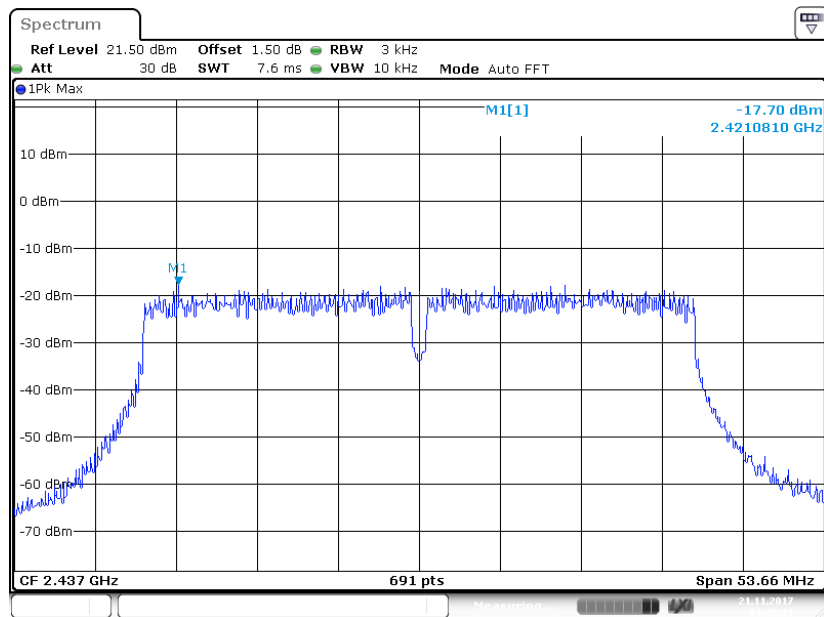
Date: 21 NOV 2017 14:21:37

802.11n-HT40 Low Channel



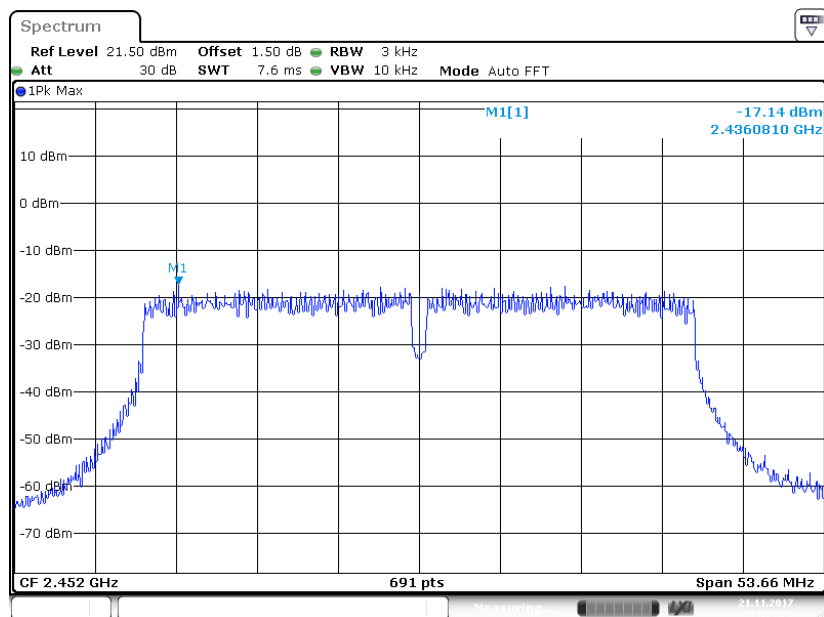
Date: 6 NOV 2017 14:11:24

802.11n-HT40 Middle Channel



Date: 21.NOV.2017 14:20:21

802.11n-HT40 High Channel



Date: 21.NOV.2017 14:19:21

Spectrum

Ref Level 11.50 dBm Offset 1.50 dB RBW 3 kHz
Att 20 dB SWT 632.1 μ s VBW 10 kHz Mode Auto FFT

1Pk Max

M1[1] -15.08 dBm
2.40199170 GHz

0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm

CF 2.402 GHz 601 pts Span 1.0 MHz

Measuring

02-11-2017

Spectrum

Ref Level 11.50 dBm Offset 1.50 dB RBW 3 kHz Att 20 dB SWT 632.1 μ s VBW 10 kHz Mode Auto FFT

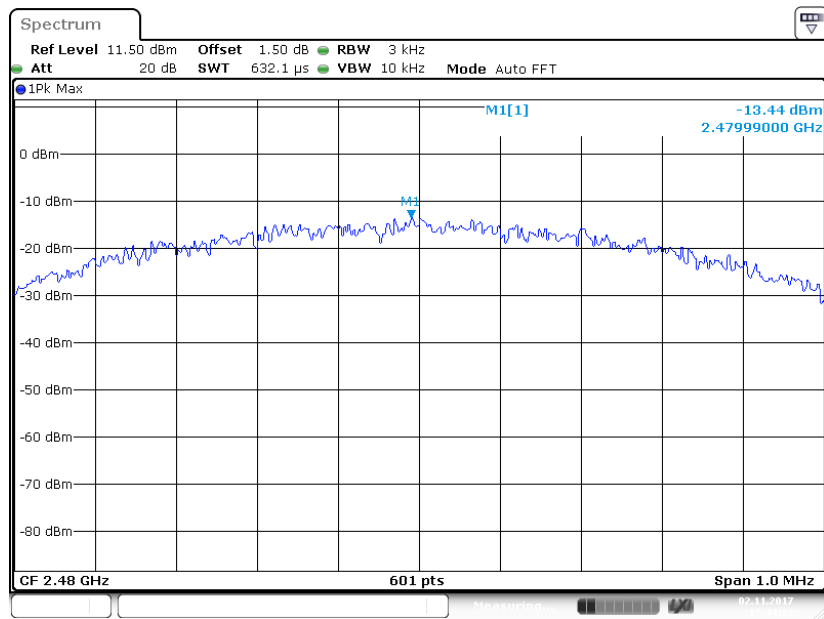
● 1Pk Max

M1[1] -13.85 dBm
2.43999170 GHz

CF 2.44 GHz 601 pts Span 1.0 MHz

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BLE High Channel



***** END OF REPORT *****