FCC PART 15.247

TEST REPORT

For

ESPRESSIF SYSTEMS (SHANGHAI) PTE LTD

456 Bibo Road Room A201,Shanghai,China

FCC ID: 2AC7Z-ESP32WROVER

Report Type:	Product Type:
Original Report	WIFI &Bluetooth Module

Test Engineer:	Belle Cheng
Report Number:	RKS170517002-00B
Report Date:	2017-05-25
Reviewed By:	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-WROVER
Product Type	WIFI &Bluetooth Module
Dimension	18 mm(L)×31.4 mm(W)×3.3mm(H)
Power Supply	DC 3.3V

**All measurement and test data in this report was gathered from production sample serial number: 20170426002 (Assigned by the BACL. The EUT supplied by the applicant was received on 2017-04-26)*

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 Commissions 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 submissions with FCC ID: 2AC7Z-ESP32WROVER.

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℃
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.

Test site at Bay Area Compliance Laboratories Corp. (Kunshan) has been fully described in reports submitted to the Federal Communication Commission (FCC). The details of these reports have been found to be in compliance with the requirements of Section 2.948 of the FCC Rules on November 06, 2014. The facility also complies with the radiated and AC line conducted test site criteria set forth in ANSI C63.4-2014.

The Federal Communications Commission has the reports on file and is listed under FCC Registration No.: 815570. The test site has been approved by the FCC for public use and is listed in the FCC Public Access Link (PAL) database.

SYSTEM TEST CONFIGURATION

Description of Test Configuration

For 802.11b, 802.11g and 802.11n-HT20 mode, 11 channels are provided to testing:

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

EUT was tested with Channel 1, 6 and 11.

For 802.11n-HT40 mode, 7 channels are provided to testing

Channel	Frequency (MHz)	Channel	Frequency (MHz)
3	2422	8	2447
4	2427	9	2452
5	2432	/	/
6	2437	/	/
7	2442	/	/

EUT was tested with Channel 3, 6 and 9.

For BLE mode, 40 channels are provided to testing:

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

EUT was tested with channel 0, 19 and 39.

Equipment Modifications

No modification was made to the EUT tested.

EUT Exercise Software

RF test tool : ESP32_RF_TEST_BIN_V1.1.1

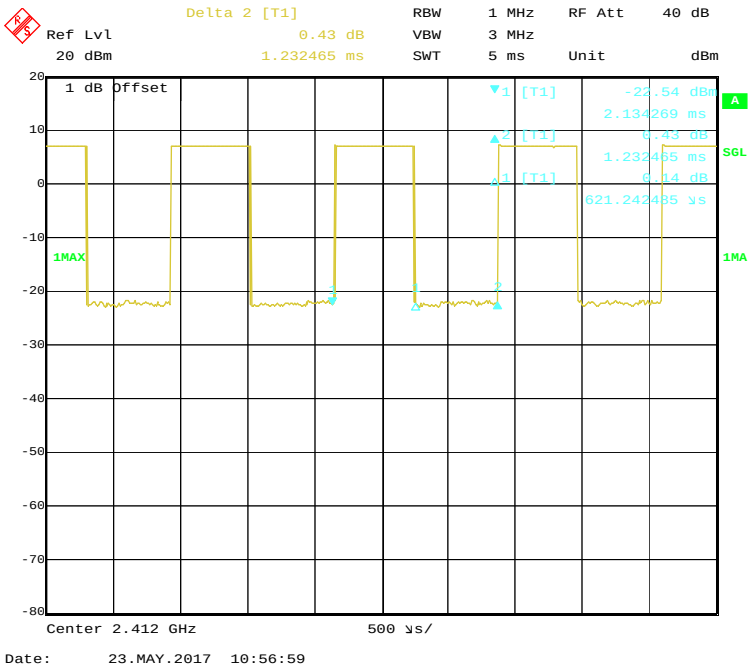
The device was tested with 85.60% duty cycle and the worst case was performed as below:

Mode	Data rate	Power level
802.11b	1 Mbps	ATT 4
802.11g	6 Mbps	ATT 12
802.11n-HT20	MCS0	ATT 16
802.11n-HT40	MCS0	ATT 16
BLE	/	6

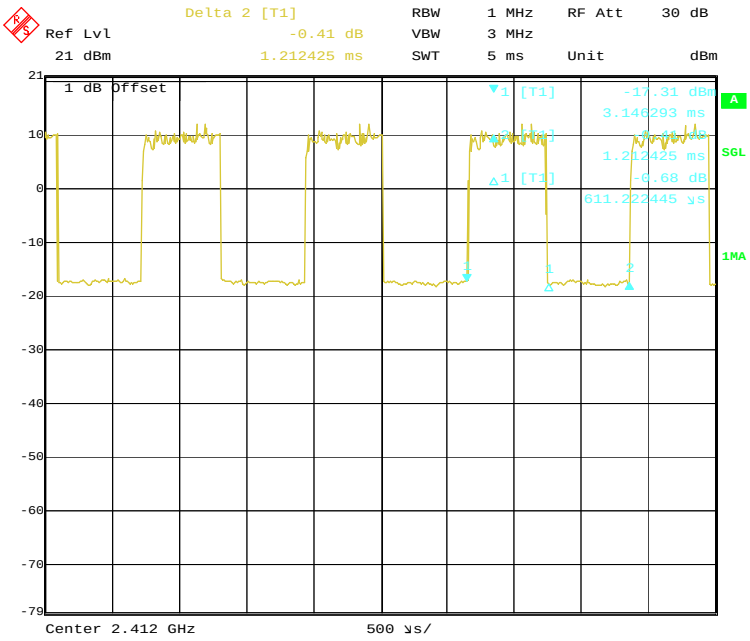
Pre-scan with all the data rates, the above data rates are the worst case for Wi-Fi test.

Duty Cycle:

802.11b Mode Low Channel duty cycle



802.11g Mode Low Channel duty cycle



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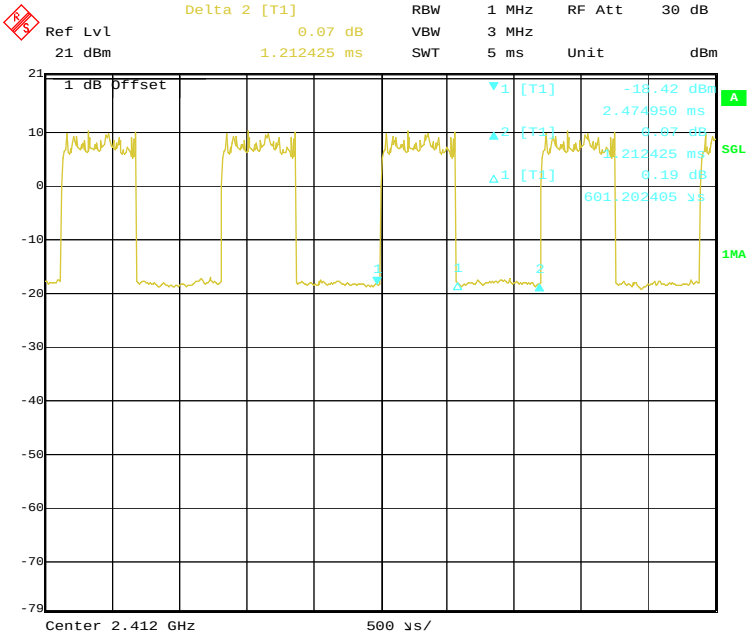
802.11n20 Mode Low Channel duty cycle



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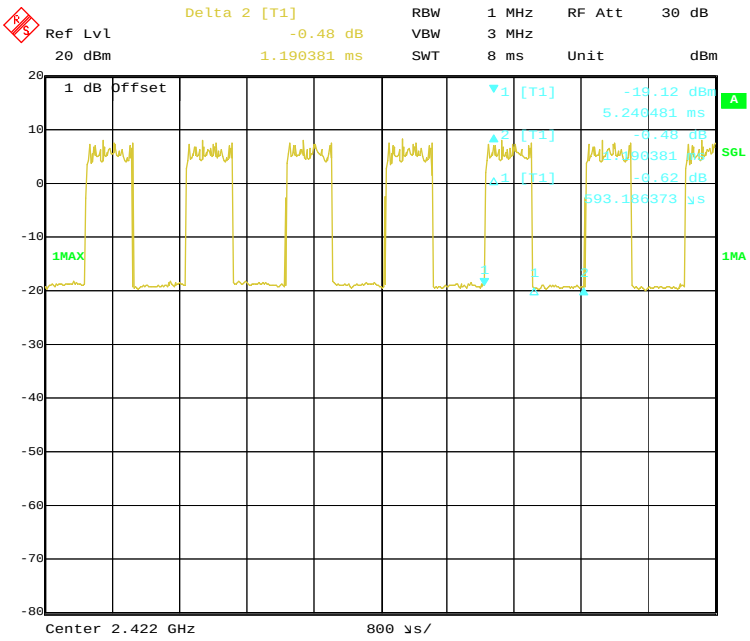
802.11n40 Mode Low Channel duty cycle



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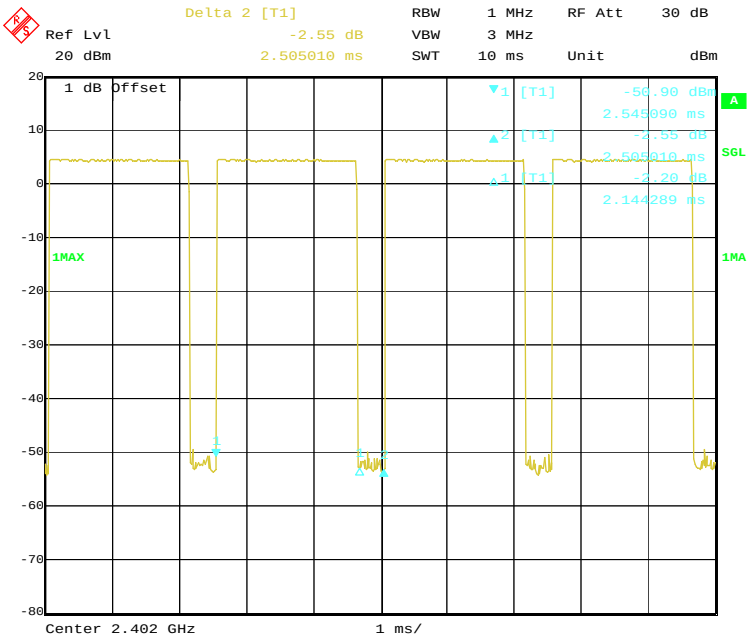
BLE Mode Low Channel duty cycle



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Band	Duty Cycle (%)	T(ms)	1/T(kHz)	VBW Setting	10log(1/x)
802.11b	50.41	0.621	1.610	3kHz	2.97
802.11g	50.41	0.611	1.637	3kHz	2.97
802.11n-HT20	49.59	0.601	1.664	3kHz	3.05
802.11n-HT40	49.83	0.593	1.686	3kHz	3.03
BLE	85.60	2.144	0.466	1kHz	0.68

Support Equipment List and Details

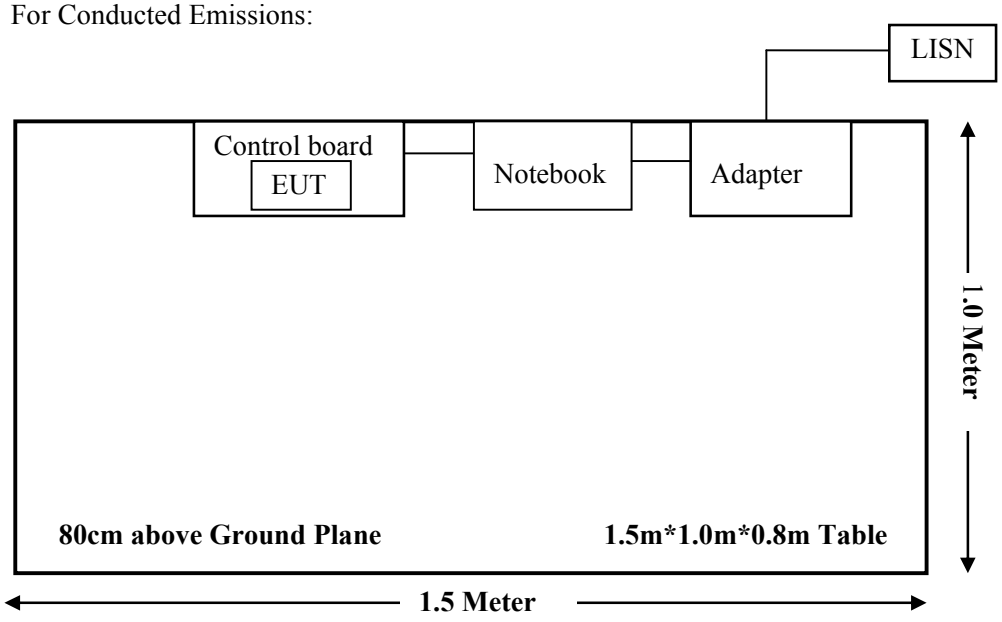
Manufacturer	Description	Model	Serial Number
/	Control Board	ESP32-WROVER	/
DELL	Notebook	GX620	D65874152
DELL	Adapter	LA90PM130	/

External I/O Cable

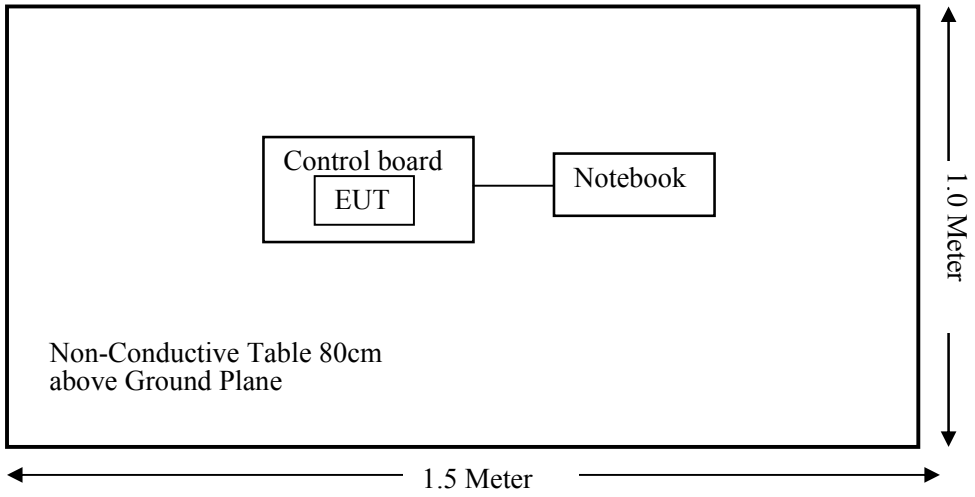
Cable Description	Shielding Type	Length (m)	From Port	To
USB Cable	Unshielding	1.0	Control Board	Notebook

Block Diagram of Test Setup

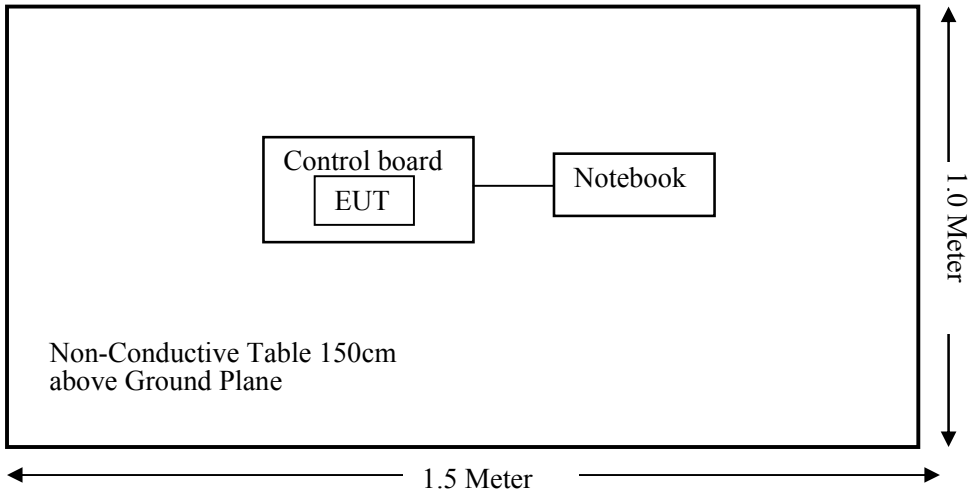
For Conducted Emissions:



For Radiated Emissions (Below 1GHz):



For Radiated Emissions (Above 1GHz):



SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Result
§15.247 (i), §1.1307 (b) (1)& §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					
Rohde & Schwarz	EMI Test Receiver	ESCI	100195	2016-11-25	2017-11-24
Rohde & Schwarz	Signal Analyzer	FSIQ26	100048	2016-11-25	2017-11-24
Sunol Sciences	Broadband Antenna	JB3	A090314-2	2016-01-09	2019-01-08
ETS	Horn Antenna	3115	6229	2016-01-11	2019-01-10
ETS-LINDGREN	Horn Antenna	3116	00084159	2016-10-18	2019-10-17
Sonoma Instrunent	Pre-amplifier	330N	160904	2016-10-21	2017-10-20
Narda	Pre-amplifier	AFS42-00101800	2001270	2016-12-12	2017-12-11
R&S	Auto test Software	EMC32	100361	/	/
Haojintech	Coaxial Cable	Cable-1	001	2016-12-12	2017-12-11
Haojintech	Coaxial Cable	Cable-2	002	2016-12-12	2017-12-11
Haojintech	Coaxial Cable	Cable-3	003	2016-12-12	2017-12-11
MICRO-COAX	Coaxial Cable	Cable-4	004	2016-12-12	2017-12-11
MICRO-COAX	Coaxial Cable	Cable-5	005	2016-12-12	2017-12-11
RF Conducted Test					
Rohde & Schwarz	Signal Analyzer	FSIQ26	836131/009	2016-09-21	2017-09-20
Agilent	Power Meter	N1912A	MY5000492	2016-11-18	2017-11-17
Agilent	Power Sensor	N1921A	MY54210024	2016-11-18	2017-11-17
ESPRESSIF	RF Cable	N/A	N/A	2017-05-17	2018-05-16
Conducted Emission Test					
Rohde & Schwarz	EMI Test Receiver	ESCI	100195	2016-11-25	2017-11-24
Rohde & Schwarz	LISN	ESH3-Z5	862770/011	2016-10-10	2017-10-09
ROHDE&SCHWARZ	LISN	ENV216	3560655016	2016-11-25	2017-11-24
Rohde & Schwarz	CE Test software	EMC 32	100357	/	/
MICRO-COAX	Coaxial Cable	Cable-6	006	2016-09-08	2017-09-07

*** 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/cm^2);
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);

Calculated Data:

Mode	Frequency Range	Antenna Gain		Target Output Power	Output Power		Evaluation Distance	Power Density	MPE Limit
	(MHz)	(dBi)	(numeric)	(dBm)	(dBm)	(mW)	(cm)	(mW/cm^2)	(mW/cm^2)
BT(BDR)	2402-2480	2.00	1.58	0.5±1	1.50	1.41	20	0.0004	1.0
BT(EDR)	2402-2480	2.00	1.58	3±1	4.00	2.51	20	0.0008	1.0
BLE	2402-2480	2.00	1.58	4±1	5.00	3.16	20	0.0010	1.0
802.11b	2412~2472	2.00	1.58	17.5±1	18.50	70.79	20	0.0223	1.0
802.11g		2.00	1.58	14±1	15.00	31.62	20	0.0100	1.0
802.11n HT20		2.00	1.58	13±1	14.00	25.12	20	0.0079	1.0
802.11n HT40	2422~2452	2.00	1.58	13±1	14.00	25.12	20	0.0079	1.0

Note: For the above target output power are all declared by the manufacturer.

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 PCB antenna arrangement for Wi-Fi & BLE, which the antenna gain is 2 dBi, fulfill the requirement of this section. Please refer to the EUT photos.

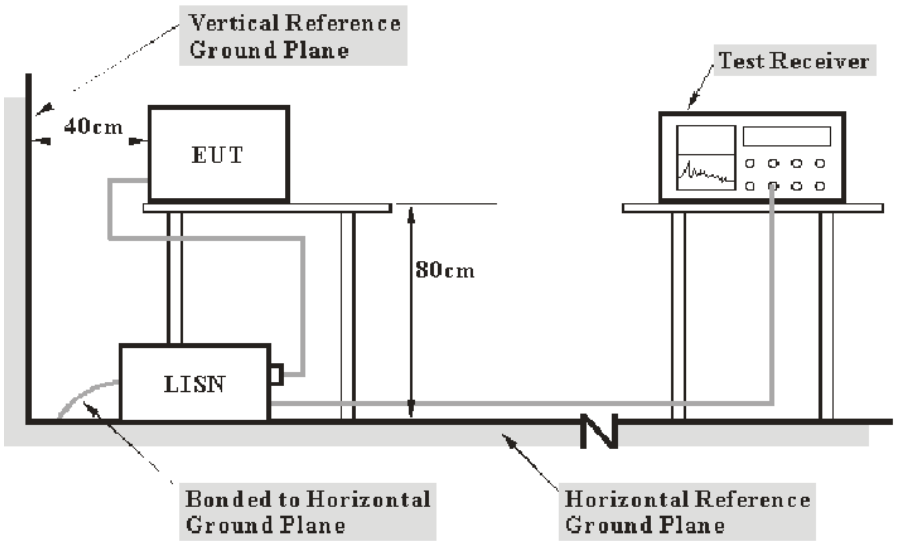
Result: Compliance.

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 80 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:

Correction Factor = LISN VDF + 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:

Margin = Limit – Corrected Amplitude

Test Results Summary

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

Test Data

Environmental Conditions

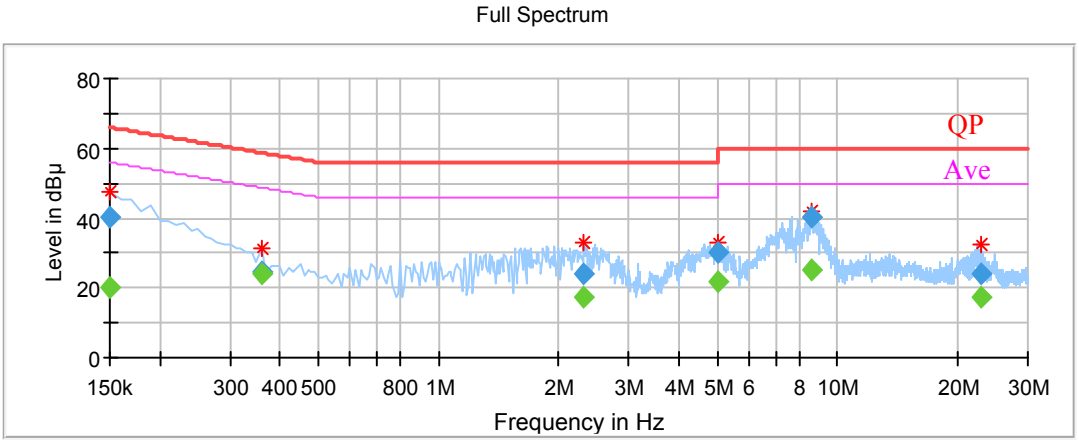
Temperature:	23 ℃
Relative Humidity:	55 %
ATM Pressure:	101.1kPa

The testing was performed by Belle Cheng on 2017-05-23.

EUT operation mode: Transmitting in 802.11b mode high channel(worst case) (for Wi-Fi Mode)

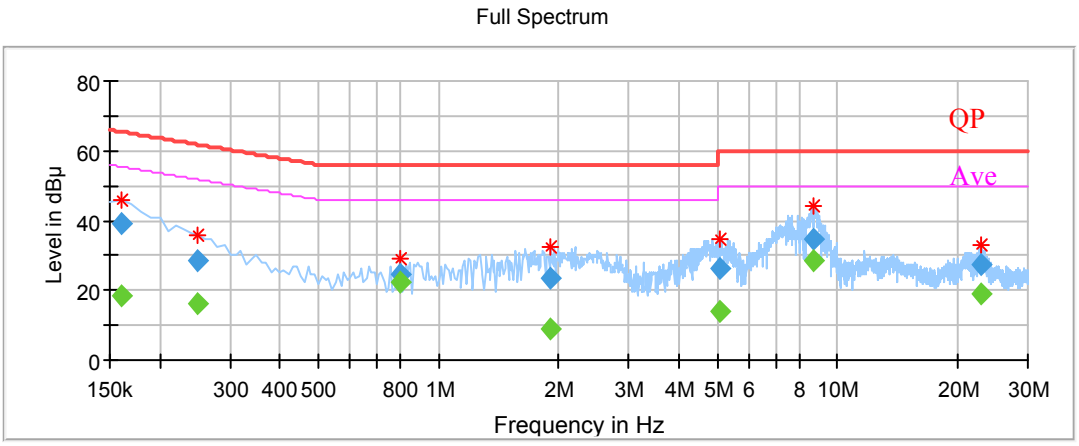
WIFI Mode:

AC 120V/60 Hz, Line



Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Bandwidth (kHz)	Line	Limit (dBµV)	Margin (dB)	Corr. (dB)	Comment
0.150000	---	20.12	9.000	L1	56.00	35.88	10.1	Compliance
0.150000	40.50	---	9.000	L1	66.00	25.50	10.1	Compliance
0.360000	---	23.80	9.000	L1	48.73	24.93	10.0	Compliance
0.360000	24.56	---	9.000	L1	58.73	34.17	10.0	Compliance
2.310000	---	17.19	9.000	L1	46.00	28.81	9.9	Compliance
2.310000	24.32	---	9.000	L1	56.00	31.68	9.9	Compliance
5.040000	---	21.63	9.000	L1	50.00	28.37	9.9	Compliance
5.040000	30.43	---	9.000	L1	60.00	29.57	9.9	Compliance
8.610000	---	24.91	9.000	L1	50.00	25.09	10.0	Compliance
8.610000	40.16	---	9.000	L1	60.00	19.84	10.0	Compliance
22.850000	---	17.10	9.000	L1	50.00	32.90	10.5	Compliance
22.850000	24.21	---	9.000	L1	60.00	35.79	10.5	Compliance

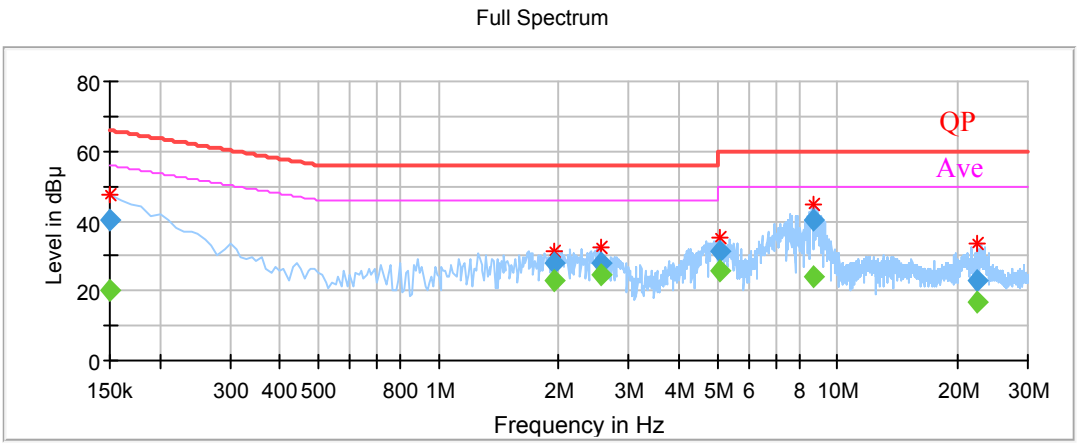
AC 120V/60 Hz, Neutral



Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Bandwidth (kHz)	Line	Limit (dBµV)	Margin (dB)	Corr. (dB)	Comment
0.160000	---	18.28	9.000	N	55.46	37.18	10.1	Compliance
0.160000	39.03	---	9.000	N	65.46	26.43	10.1	Compliance
0.250000	---	16.37	9.000	N	51.76	35.39	10.1	Compliance
0.250000	28.78	---	9.000	N	61.76	32.98	10.1	Compliance
0.800000	---	22.65	9.000	N	46.00	23.35	10.0	Compliance
0.800000	24.66	---	9.000	N	56.00	31.34	10.0	Compliance
1.910000	---	8.69	9.000	N	46.00	37.31	9.9	Compliance
1.910000	23.61	---	9.000	N	56.00	32.39	9.9	Compliance
5.070000	---	13.93	9.000	N	50.00	36.07	9.9	Compliance
5.070000	26.50	---	9.000	N	60.00	33.50	9.9	Compliance
8.690000	---	28.27	9.000	N	50.00	21.73	10.0	Compliance
8.690000	34.88	---	9.000	N	60.00	25.12	10.0	Compliance

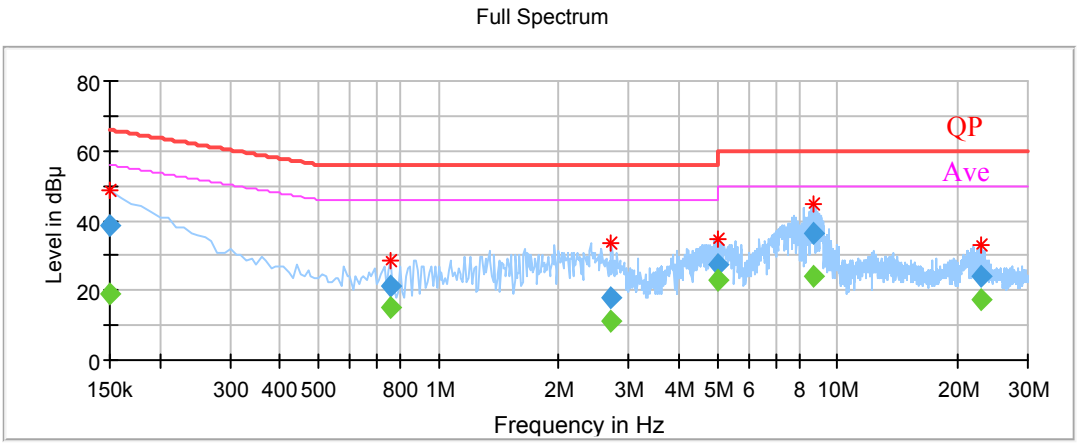
BLE Mode:

AC 120V/60 Hz, Line



Frequency (MHz)	QuasiPeak (dBµV)	Average (dB µ V)	Bandwidth (kHz)	Line	Limit (dBµV)	Margin (dB)	Corr. (dB)	Comment
0.150000	---	20.04	9.000	L1	56.00	35.96	10.1	Compliance
0.150000	40.36	---	9.000	L1	66.00	25.64	10.1	Compliance
1.960000	---	23.07	9.000	L1	46.00	22.93	9.9	Compliance
1.960000	27.92	---	9.000	L1	56.00	28.08	9.9	Compliance
2.540000	---	24.69	9.000	L1	46.00	21.31	9.9	Compliance
2.540000	28.04	---	9.000	L1	56.00	27.96	9.9	Compliance
5.080000	---	25.52	9.000	L1	50.00	24.48	9.9	Compliance
5.080000	31.28	---	9.000	L1	60.00	28.72	9.9	Compliance
8.690000	---	23.79	9.000	L1	50.00	26.21	10.0	Compliance
8.690000	40.26	---	9.000	L1	60.00	19.74	10.0	Compliance
22.350000	---	17.00	9.000	L1	50.00	33.00	10.4	Compliance
22.350000	23.19	---	9.000	L1	60.00	36.81	10.4	Compliance

AC 120V/60 Hz, Neutral



Frequency (MHz)	QuasiPeak (dBµV)	Average (dB µ V)	Bandwidth (kHz)	Line	Limit (dBµV)	Margin (dB)	Corr. (dB)	Comment
0.150000	---	18.80	9.000	N	56.00	37.20	10.1	Compliance
0.150000	38.69	---	9.000	N	66.00	27.31	10.1	Compliance
0.760000	---	15.31	9.000	N	46.00	30.69	10.0	Compliance
0.760000	21.36	---	9.000	N	56.00	34.64	10.0	Compliance
2.710000	---	11.21	9.000	N	46.00	34.79	9.9	Compliance
2.710000	17.77	---	9.000	N	56.00	38.23	9.9	Compliance
5.010000	---	22.82	9.000	N	50.00	27.18	9.9	Compliance
5.010000	27.50	---	9.000	N	60.00	32.50	9.9	Compliance
8.700000	---	23.82	9.000	N	50.00	26.18	10.0	Compliance
8.700000	36.58	---	9.000	N	60.00	23.42	10.0	Compliance
22.840000	---	17.62	9.000	N	50.00	32.38	10.2	Compliance
22.840000	24.10	---	9.000	N	60.00	35.90	10.2	Compliance

Note:

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

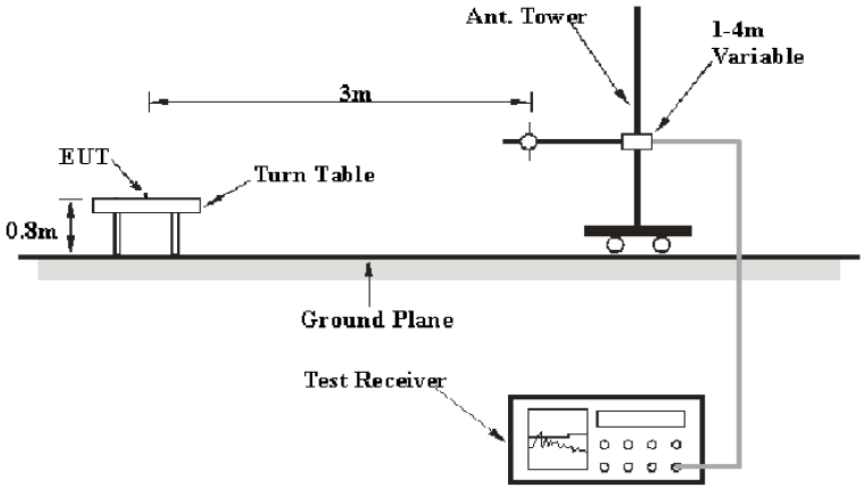
FCC §15.209, §15.205 & §15.247(d) - SPURIOUS EMISSIONS

Applicable Standard

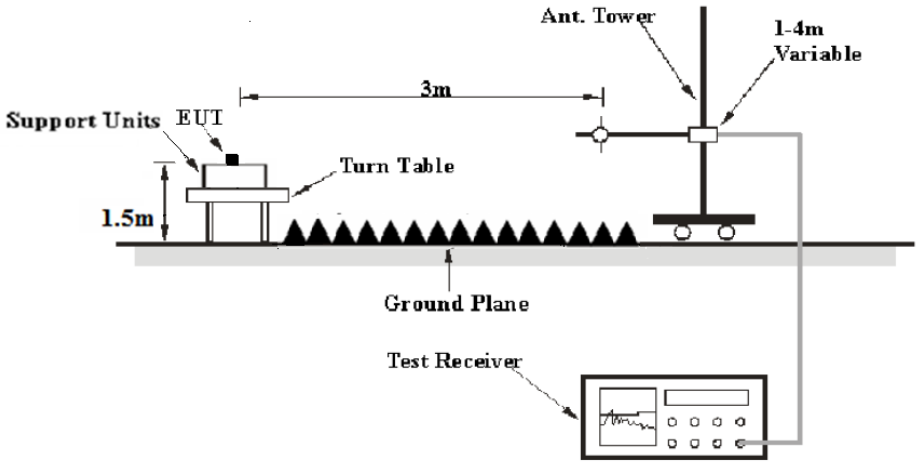
FCC §15.247 (d); §15.209; §15.205;

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 & Spectrum Analyzer Setup

The system was investigated from 30 MHz to 25 GHz.

During the radiated emission test, the EMI test receiver & Spectrum Analyzer Setup were 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

Frequency Range	RBW	Video B/W	Duty cycle	Detector
1GHz – 25GHz	1MHz	3 MHz	Any	PK
	1MHz	10 Hz	>98%	Ave.
	1MHz	1/T	<98%	

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:

Corrected Amplitude = Meter Reading + Antenna Factor + Cable Loss - 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:

Margin = Limit – 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:	24.1 ℃
Relative Humidity:	54 %
ATM Pressure:	101.2kPa

The testing was performed by Belle Cheng on 2017-05-18 to 2017-05-25.

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

30MHz-25GHz

802.11b Mode:

Frequency	Receiver		Turntable	Rx Antenna		Corrected Factor	Corrected Amplitude	FCC Part 15.247/205/209	
	Reading	Detector		Height	Polar			Limit	Margin
(MHz)	(dBμV)	(PK/QP/Ave.)	Degree	(cm)	(H/V)	(dB)	(dBμV/m)	(dBμV/m)	(dB)
Low Channel (2412 MHz)									
320.51	33.57	QP	29	156	H	1.33	34.90	46	11.10
2412.00	112.97	PK	150	202	V	-6.17	106.80	/	/
2412.00	108.67	Ave	150	202	V	-6.17	102.50	/	/
2412.00	107.06	PK	82	162	H	-6.17	100.89	/	/
2412.00	103.76	Ave	82	162	H	-6.17	97.59	/	/
2390.00	44.52	PK	78	215	H	-6.22	38.30	74	35.70
2390.00	31.20	Ave	78	215	H	-6.22	24.98	54	29.02
2400.00	53.24	PK	167	182	V	-6.19	47.05	74	26.95
2400.00	45.21	Ave	167	182	V	-6.19	39.02	54	14.98
1604.24	45.31	PK	158	217	V	-8.99	36.32	74	37.68
1604.24	31.68	Ave	158	217	V	-8.99	22.69	54	31.31
4824.00	57.69	PK	96	219	H	1.66	59.35	74	14.65
4824.00	45.81	Ave	96	219	H	1.66	47.47	54	6.53
7236.00	39.06	PK	84	176	H	7.58	46.64	74	27.36
7236.00	30.97	Ave	84	176	H	7.58	38.55	54	15.45

Frequency	Receiver		Turntable	Rx Antenna		Corrected Factor	Corrected Amplitude	FCC Part 15.247/205/209	
	Reading	Detector		Height	Polar			Limit	Margin
(MHz)	(dBµV)	(PK/QP/Ave.)	Degree	(cm)	(H/V)	(dB)	(dBµV/m)	(dBµV/m)	(dB)
Middle Channel (2437 MHz)									
320.51	34.12	QP	240	194	H	1.33	35.45	46	10.55
2437.00	112.29	PK	275	237	V	-6.11	106.18	/	/
2437.00	108.07	Ave	275	237	V	-6.11	101.96	/	/
2437.00	107.17	PK	63	162	H	-6.11	101.06	/	/
2437.00	103.21	Ave	63	162	H	-6.11	97.10	/	/
1604.24	50.08	PK	313	241	H	-8.99	41.09	74	32.91
1604.24	34.77	Ave	313	241	H	-8.99	25.78	54	28.22
3211.56	52.70	PK	348	150	V	-2.69	50.01	74	23.99
3211.56	42.00	Ave	348	150	V	-2.69	39.31	54	14.69
4874.00	56.49	PK	333	110	V	1.77	58.26	74	15.74
4874.00	48.24	Ave	333	110	V	1.77	50.01	54	3.99
6451.33	43.52	PK	22	103	H	5.73	49.25	74	24.75
6451.33	29.97	Ave	22	103	H	5.73	35.70	54	18.30
7311.00	43.22	PK	323	193	H	7.66	50.88	74	23.12
7311.00	31.79	Ave	323	193	H	7.66	39.45	54	14.55

Frequency	Receiver		Turntable	Rx Antenna		Corrected Factor	Corrected Amplitude	FCC Part 15.247/205/209	
	Reading	Detector		Height	Polar			Limit	Margin
(MHz)	(dBµV)	(PK/QP/Ave.)	Degree	(cm)	(H/V)	(dB)	(dBµV/m)	(dBµV/m)	(dB)
High Channel (2462 MHz)									
320.51	33.54	QP	44	207	H	1.33	34.87	46	11.13
2462.00	112.86	PK	267	102	V	-6.06	106.80	/	/
2462.00	108.95	Ave	267	102	V	-6.06	102.89	/	/
2462.00	107.81	PK	334	225	H	-6.06	101.75	/	/
2462.00	103.59	Ave	334	225	H	-6.06	97.53	/	/
2483.50	54.26	PK	104	201	H	-6.01	48.25	74	25.75
2483.50	45.34	Ave	104	201	H	-6.01	39.33	54	14.67
1604.24	49.48	PK	51	103	V	-8.99	40.49	74	33.51
1604.24	33.89	Ave	51	103	V	-8.99	24.90	54	29.10
4924.00	56.38	PK	181	161	V	1.89	58.27	74	15.73
4924.00	47.59	Ave	181	161	V	1.89	49.48	54	4.52
6451.33	43.97	PK	306	166	H	5.73	49.70	74	24.30
6451.33	29.31	Ave	306	166	H	5.73	35.04	54	18.96
7386.00	43.94	PK	39	143	H	7.73	51.67	74	22.33
7386.00	31.54	Ave	39	143	H	7.73	39.27	54	14.73

802.11g Mode:

Frequency	Receiver		Turntable	Rx Antenna		Corrected Factor	Corrected Amplitude	FCC Part 15.247/205/209	
	Reading	Detector		Height	Polar			Limit	Margin
(MHz)	(dBµV)	(PK/QP/Ave.)	Degree	(cm)	(H/V)	(dB)	(dBµV/m)	(dBµV/m)	(dB)
Low Channel (2412 MHz)									
320.51	33.94	QP	339	163	H	1.33	35.27	46	10.73
2412.00	111.11	PK	240	147	V	-6.17	104.94	/	/
2412.00	102.60	Ave	240	147	V	-6.17	96.43	/	/
2412.00	104.36	PK	306	228	H	-6.17	98.19	/	/
2412.00	96.59	Ave	306	228	H	-6.17	90.42	/	/
2390.00	44.50	PK	77	108	H	-6.22	38.28	74	35.72
2390.00	31.40	Ave	77	108	H	-6.22	25.18	54	28.82
2400.00	53.58	PK	296	226	V	-6.19	47.39	74	26.61
2400.00	45.65	Ave	296	226	V	-6.19	39.46	54	14.54
1604.24	45.70	PK	147	202	V	-8.99	36.71	74	37.29
1604.24	32.11	Ave	147	202	V	-8.99	23.12	54	30.88
4824.00	57.22	PK	330	177	H	1.66	58.88	74	15.12
4824.00	46.12	Ave	330	177	H	1.66	47.78	54	6.22
7236.00	42.68	PK	232	177	H	7.58	50.26	74	23.74
7236.00	31.17	Ave	232	177	H	7.58	38.75	54	15.25

Frequency	Receiver		Turntable	Rx Antenna		Corrected Factor	Corrected Amplitude	FCC Part 15.247/205/209	
	Reading	Detector		Height	Polar			Limit	Margin
(MHz)	(dBµV)	(PK/QP/Ave.)	Degree	(cm)	(H/V)	(dB)	(dBµV/m)	(dBµV/m)	(dB)
Middle Channel (2437 MHz)									
320.51	33.21	QP	71	123	H	1.33	34.54	46	11.46
2437.00	110.68	PK	138	175	V	-6.11	104.57	/	/
2437.00	101.96	Ave	138	175	V	-6.11	95.85	/	/
2437.00	104.53	PK	344	241	H	-6.11	98.42	/	/
2437.00	95.26	Ave	344	241	H	-6.11	89.15	/	/
1604.24	50.16	PK	159	132	H	-8.99	41.17	74	32.83
1604.24	35.13	Ave	159	132	H	-8.99	26.14	54	27.86
3211.56	52.82	PK	206	190	V	-2.69	50.13	74	23.87
3211.56	42.13	Ave	206	190	V	-2.69	39.44	54	14.56
4874.00	56.32	PK	332	107	V	1.77	58.09	74	15.91
4874.00	48.04	Ave	332	107	V	1.77	49.81	54	4.19
6451.33	43.35	PK	151	158	H	5.73	49.08	74	24.92
6451.33	30.06	Ave	151	158	H	5.73	35.79	54	18.21
7311.00	42.93	PK	106	218	H	7.66	50.59	74	23.41
7311.00	31.91	Ave	106	218	H	7.66	39.57	54	14.43

Frequency	Receiver		Turntable	Rx Antenna		Corrected Factor	Corrected Amplitude	FCC Part 15.247/205/209	
	Reading	Detector		Height	Polar			Limit	Margin
(MHz)	(dBµV)	(PK/QP/Ave.)	Degree	(cm)	(H/V)	(dB)	(dBµV/m)	(dBµV/m)	(dB)
High Channel (2462 MHz)									
320.51	32.46	QP	153	242	H	1.33	33.79	46	12.21
2462.00	111.21	PK	293	215	V	-6.06	105.15	/	/
2462.00	102.81	Ave	293	215	V	-6.06	96.75	/	/
2462.00	105.50	PK	240	240	H	-6.06	99.44	/	/
2462.00	96.90	Ave	240	240	H	-6.06	90.84	/	/
2483.50	53.96	PK	38	184	H	-6.01	47.95	74	26.05
2483.50	45.00	Ave	38	184	H	-6.01	38.99	54	15.01
1604.24	50.73	PK	166	236	V	-8.99	41.74	74	32.26
1604.24	33.86	Ave	166	236	V	-8.99	24.87	54	29.13
4924.00	55.66	PK	246	182	V	1.89	57.55	74	16.45
4924.00	46.65	Ave	246	182	V	1.89	48.54	54	5.46
6451.33	43.76	PK	276	231	H	5.73	49.49	74	24.51
6451.33	30.52	Ave	276	231	H	5.73	36.25	54	17.75
7386.00	43.66	PK	245	244	H	7.73	51.39	74	22.61
7386.00	32.40	Ave	245	244	H	7.73	40.13	54	13.87

802.11n-HT20 Mode:

Frequency	Receiver		Turntable	Rx Antenna		Corrected Factor	Corrected Amplitude	FCC Part 15.247/205/209	
	Reading	Detector		Height	Polar			Limit	Margin
(MHz)	(dBµV)	(PK/QP/Ave.)	Degree	(cm)	(H/V)	(dB)	(dBµV/m)	(dBµV/m)	(dB)
Low Channel (2412 MHz)									
320.51	34.25	QP	145	181	H	1.33	35.58	46	10.42
2412.00	110.84	PK	68	246	V	-6.17	104.67	/	/
2412.00	101.61	Ave	68	246	V	-6.17	95.44	/	/
2412.00	103.89	PK	128	224	H	-6.17	97.72	/	/
2412.00	94.50	Ave	128	224	H	-6.17	88.33	/	/
2390.00	44.66	PK	351	214	H	-6.22	38.44	74	35.56
2390.00	31.26	Ave	351	214	H	-6.22	25.04	54	28.96
2400.00	53.15	PK	69	213	V	-6.19	46.96	74	27.04
2400.00	45.66	Ave	69	213	V	-6.19	39.47	54	14.53
1604.24	46.10	PK	299	184	V	-8.99	37.11	74	36.89
1604.24	32.47	Ave	299	184	V	-8.99	23.48	54	30.52
4824.00	57.46	PK	58	220	H	1.66	59.12	74	14.88
4824.00	46.46	Ave	58	220	H	1.66	48.12	54	5.88
7236.00	42.21	PK	284	205	H	7.58	49.79	74	24.21
7236.00	31.19	Ave	284	205	H	7.58	38.77	54	15.23

Frequency	Receiver		Turntable	Rx Antenna		Corrected Factor	Corrected Amplitude	FCC Part 15.247/205/209	
	Reading	Detector		Height	Polar			Limit	Margin
(MHz)	(dBµV)	(PK/QP/Ave.)	Degree	(cm)	(H/V)	(dB)	(dBµV/m)	(dBµV/m)	(dB)
Middle Channel (2437 MHz)									
320.51	33.67	QP	246	112	H	1.33	35.00	46	11.00
2437.00	110.35	PK	221	206	V	-6.11	104.24	/	/
2437.00	101.13	Ave	221	206	V	-6.11	95.02	/	/
2437.00	104.74	PK	349	195	H	-6.11	98.63	/	/
2437.00	95.62	Ave	349	195	H	-6.11	89.51	/	/
1604.24	49.80	PK	133	116	H	-8.99	40.81	74	33.19
1604.24	34.76	Ave	133	116	H	-8.99	25.77	54	28.23
3211.56	53.29	PK	219	233	V	-2.69	50.60	74	23.40
3211.56	41.79	Ave	219	233	V	-2.69	39.10	54	14.90
4874.00	56.38	PK	320	134	V	1.77	58.15	74	15.85
4874.00	47.87	Ave	320	134	V	1.77	49.64	54	4.36
6451.33	42.90	PK	306	170	H	5.73	48.63	74	25.37
6451.33	29.81	Ave	306	170	H	5.73	35.54	54	18.46
7311.00	42.88	PK	196	232	H	7.66	50.54	74	23.46
7311.00	31.57	Ave	196	232	H	7.66	39.23	54	14.77

Frequency	Receiver		Turntable	Rx Antenna		Corrected Factor	Corrected Amplitude	FCC Part 15.247/205/209	
	Reading	Detector		Height	Polar			Limit	Margin
(MHz)	(dBµV)	(PK/QP/Ave.)	Degree	(cm)	(H/V)	(dB)	(dBµV/m)	(dBµV/m)	(dB)
High Channel (2462 MHz)									
320.51	34.29	QP	318	247	H	1.33	35.62	46	10.38
2462.00	111.32	PK	161	198	V	-6.06	105.26	/	/
2462.00	102.74	Ave	161	198	V	-6.06	96.68	/	/
2462.00	105.92	PK	285	132	H	-6.06	99.86	/	/
2462.00	96.63	Ave	285	132	H	-6.06	90.57	/	/
2483.50	54.10	PK	70	162	H	-6.01	48.09	74	25.91
2483.50	44.57	Ave	70	162	H	-6.01	38.56	54	15.44
1604.24	51.02	PK	329	123	V	-8.99	42.03	74	31.97
1604.24	33.95	Ave	329	123	V	-8.99	24.96	54	29.04
4924.00	56.08	PK	53	121	V	1.89	57.97	74	16.03
4924.00	47.01	Ave	53	121	V	1.89	48.90	54	5.10
6451.33	44.21	PK	30	133	H	5.73	49.94	74	24.06
6451.33	30.44	Ave	30	133	H	5.73	36.17	54	17.83
7386.00	43.65	PK	206	159	H	7.73	51.38	74	22.62
7386.00	32.40	Ave	206	159	H	7.73	40.13	54	13.87

802.11n-HT40 Mode:

Frequency	Receiver		Turntable	Rx Antenna		Corrected Factor	Corrected Amplitude	FCC Part 15.247/205/209	
	Reading	Detector		Height	Polar			Limit	Margin
(MHz)	(dBµV)	(PK/QP/Ave.)	Degree	(cm)	(H/V)	(dB)	(dBµV/m)	(dBµV/m)	(dB)
Low Channel (2422 MHz)									
320.51	33.66	QP	263	140	H	1.33	34.99	46	11.01
2422.00	108.13	PK	204	243	V	-6.14	101.99	/	/
2422.00	99.02	Ave	204	243	V	-6.14	92.88	/	/
2422.00	102.25	PK	296	117	H	-6.14	96.11	/	/
2422.00	92.35	Ave	296	117	H	-6.14	86.21	/	/
2390.00	44.27	PK	344	166	H	-6.22	38.05	74	35.95
2390.00	31.54	Ave	344	166	H	-6.22	25.32	54	28.68
2400.00	52.76	PK	5	113	V	-6.19	46.57	74	27.43
2400.00	45.41	Ave	5	113	V	-6.19	39.22	54	14.78
1604.24	45.11	PK	232	136	V	-8.99	36.12	74	37.88
1604.24	31.52	Ave	232	136	V	-8.99	22.53	54	31.47
4844.00	58.00	PK	63	233	H	1.70	59.70	74	14.30
4844.00	46.29	Ave	63	233	H	1.70	47.99	54	6.01
7266.00	42.63	PK	286	131	H	7.58	50.21	74	23.79
7266.00	31.02	Ave	286	131	H	7.58	38.60	54	15.40

Frequency	Receiver		Turntable	Rx Antenna		Corrected Factor	Corrected Amplitude	FCC Part 15.247/205/209	
	Reading	Detector		Height	Polar			Limit	Margin
(MHz)	(dBµV)	(PK/QP/Ave.)	Degree	(cm)	(H/V)	(dB)	(dBµV/m)	(dBµV/m)	(dB)
Middle Channel (2437 MHz)									
320.51	33.67	QP	47	207	H	1.33	35.00	46	11.00
2437.00	108.36	PK	319	180	V	-6.11	102.25	/	/
2437.00	99.01	Ave	319	180	V	-6.11	92.90	/	/
2437.00	101.54	PK	216	247	H	-6.11	95.43	/	/
2437.00	91.89	Ave	216	247	H	-6.11	85.78	/	/
1604.24	49.80	PK	158	244	H	-8.99	40.81	74	33.19
1604.24	34.76	Ave	158	244	H	-8.99	25.77	54	28.23
3211.56	53.29	PK	135	120	V	-2.69	50.60	74	23.40
3211.56	41.79	Ave	135	120	V	-2.69	39.10	54	14.90
4874.00	56.38	PK	14	189	V	1.77	58.15	74	15.85
4874.00	47.87	Ave	14	189	V	1.77	49.64	54	4.36
6451.33	42.90	PK	338	181	H	5.73	48.63	74	25.37
6451.33	29.81	Ave	338	181	H	5.73	35.54	54	18.46
7311.00	42.88	PK	150	221	H	7.66	50.54	74	23.46
7311.00	31.57	Ave	150	221	H	7.66	39.23	54	14.77

Frequency	Receiver		Turntable	Rx Antenna		Corrected Factor	Corrected Amplitude	FCC Part 15.247/205/209	
	Reading	Detector		Height	Polar			Limit	Margin
(MHz)	(dBµV)	(PK/QP/Ave.)	Degree	(cm)	(H/V)	(dB)	(dBµV/m)	(dBµV/m)	(dB)
High Channel (2452 MHz)									
320.51	33.51	QP	258	151	H	1.33	34.84	46	11.16
2452.00	107.76	PK	193	107	V	-6.08	101.68	/	/
2452.00	98.65	Ave	193	107	V	-6.08	92.57	/	/
2452.00	103.06	PK	174	246	H	-6.08	96.98	/	/
2452.00	93.95	Ave	174	246	H	-6.08	87.87	/	/
2483.50	54.10	PK	210	190	H	-6.01	48.09	74	25.91
2483.50	44.57	Ave	210	190	H	-6.01	38.56	54	15.44
1604.24	51.02	PK	67	247	V	-8.99	42.03	74	31.97
1604.24	33.95	Ave	67	247	V	-8.99	24.96	54	29.04
4904.00	56.08	PK	137	177	V	1.84	57.92	74	16.08
4904.00	47.01	Ave	137	177	V	1.84	48.85	54	5.15
6451.33	44.21	PK	26	195	H	5.73	49.94	74	24.06
6451.33	30.44	Ave	26	195	H	5.73	36.17	54	17.83
7356.00	43.65	PK	177	197	H	7.70	51.35	74	22.65
7356.00	32.40	Ave	177	197	H	7.70	40.10	54	13.90

BLE Mode:

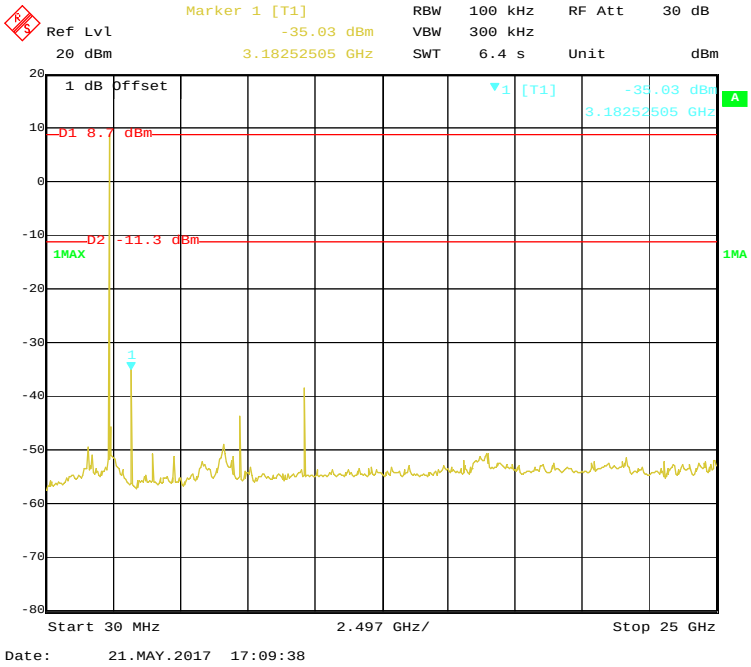
Frequency	Receiver		Turntable	Rx Antenna		Corrected Factor	Corrected Amplitude	FCC Part 15.247/205/209	
	Reading	Detector		Height	Polar			Limit	Margin
(MHz)	(dBµV)	(PK/QP/Ave.)	Degree	(cm)	(H/V)	(dB)	(dBµV/m)	(dBµV/m)	(dB)
Low Channel (2402 MHz)									
320.51	32.04	QP	222	174	V	1.33	33.37	46	12.63
2402.00	96.34	PK	40	133	V	-6.19	90.15	/	/
2402.00	94.63	Ave	40	133	V	-6.19	88.44	/	/
2402.00	92.76	PK	147	157	H	-6.19	86.57	/	/
2402.00	90.24	Ave	147	157	H	-6.19	84.05	/	/
2390.00	47.14	PK	53	138	H	-6.22	40.92	74	33.08
2390.00	33.07	Ave	53	138	H	-6.22	26.85	54	27.15
2400.00	49.14	PK	61	201	H	-6.19	42.95	74	31.05
2400.00	34.17	Ave	61	201	H	-6.19	27.98	54	26.02
3210.23	52.04	PK	274	164	V	-2.89	49.15	74	24.85
3210.23	41.34	Ave	274	164	V	-2.89	38.45	54	15.55
4804.00	50.24	PK	110	133	H	1.61	51.85	74	22.15
4804.00	42.97	Ave	110	133	H	1.61	44.58	54	9.42
7206.00	45.64	PK	331	108	H	7.55	53.19	74	20.81
7206.00	33.47	Ave	331	108	H	7.55	41.02	54	12.98

Frequency	Receiver		Turntable	Rx Antenna		Corrected Factor	Corrected Amplitude	FCC Part 15.247/205/209	
	Reading	Detector		Height	Polar			Limit	Margin
(MHz)	(dBµV)	(PK/QP/Ave.)	Degree	(cm)	(H/V)	(dB)	(dBµV/m)	(dBµV/m)	(dB)
Middle Channel (2440 MHz)									
320.51	33.64	QP	232	178	V	1.33	34.97	46	11.03
2440.00	93.54	PK	40	153	V	-6.17	87.37	/	/
2440.00	91.61	Ave	40	153	V	-6.17	85.44	/	/
2440.00	88.47	PK	143	137	H	-6.17	82.30	/	/
2440.00	86.19	Ave	143	137	H	-6.17	80.02	/	/
1604.23	52.68	PK	217	205	H	-8.99	43.69	74	30.31
1604.23	41.31	Ave	217	205	H	-8.99	32.32	54	21.68
3211.68	44.69	PK	353	122	H	-2.89	41.80	74	32.20
3211.68	30.74	Ave	353	122	H	-2.89	27.85	54	26.15
4880.00	48.67	PK	85	118	V	1.79	50.46	74	23.54
4880.00	40.79	Ave	85	118	V	1.79	42.58	54	11.42
6451.24	44.01	PK	89	212	H	5.73	49.74	74	24.26
6451.24	30.36	Ave	89	212	H	5.73	36.09	54	17.91
7320.00	40.84	PK	169	182	H	7.67	48.51	74	25.49
7320.00	32.17	Ave	169	182	H	7.67	39.84	54	14.16

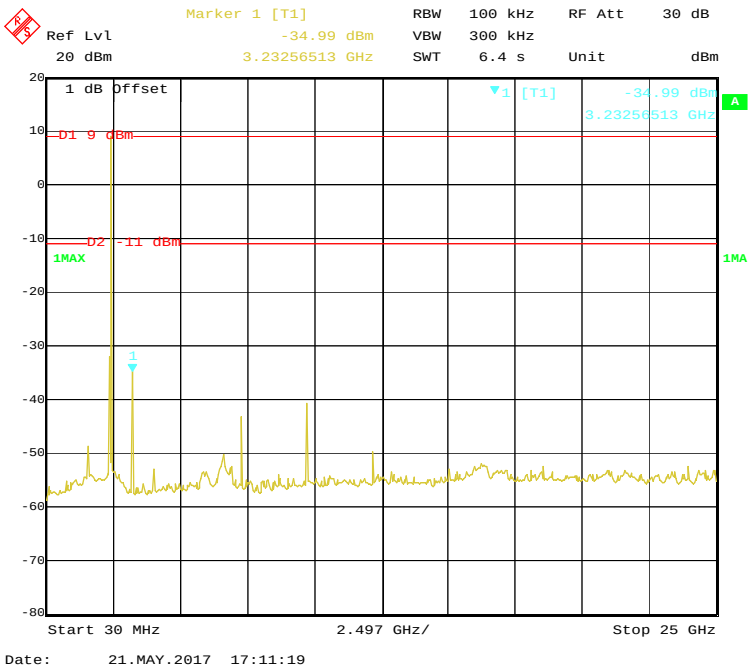
Frequency	Receiver		Turntable	Rx Antenna		Corrected Factor	Corrected Amplitude	FCC Part 15.247/205/209	
	Reading	Detector		Height	Polar			Limit	Margin
(MHz)	(dBµV)	(PK/QP/Ave.)	Degree	(cm)	(H/V)	(dB)	(dBµV/m)	(dBµV/m)	(dB)
High Channel (2480MHz)									
320.51	33.38	QP	146	118	V	1.33	34.71	46	11.29
2480.00	96.55	PK	233	211	V	-6.01	90.54	/	/
2480.00	94.38	Ave	233	211	V	-6.01	88.37	/	/
2480.00	92.47	PK	118	182	H	-6.01	86.46	/	/
2480.00	89.41	Ave	118	182	H	-6.01	83.40	/	/
2483.50	45.65	PK	23	134	H	-6.01	39.64	74	34.36
2483.50	31.89	Ave	23	134	H	-6.01	25.88	54	28.12
1605.22	49.48	PK	153	235	H	-8.99	40.49	74	33.51
1605.22	32.56	Ave	153	235	H	-8.99	23.57	54	30.43
4960.00	51.27	PK	275	180	V	1.97	53.24	74	20.76
4960.00	42.90	Ave	275	180	V	1.97	44.87	54	9.13
6454.87	44.96	PK	339	137	H	5.73	50.69	74	23.31
6454.87	35.04	Ave	339	137	H	5.73	40.77	54	13.23
7440.00	46.11	PK	187	126	H	7.79	53.90	74	20.10
7440.00	32.30	Ave	187	126	H	7.79	40.09	54	13.91

Conducted Spurious Emissions at Antenna Port

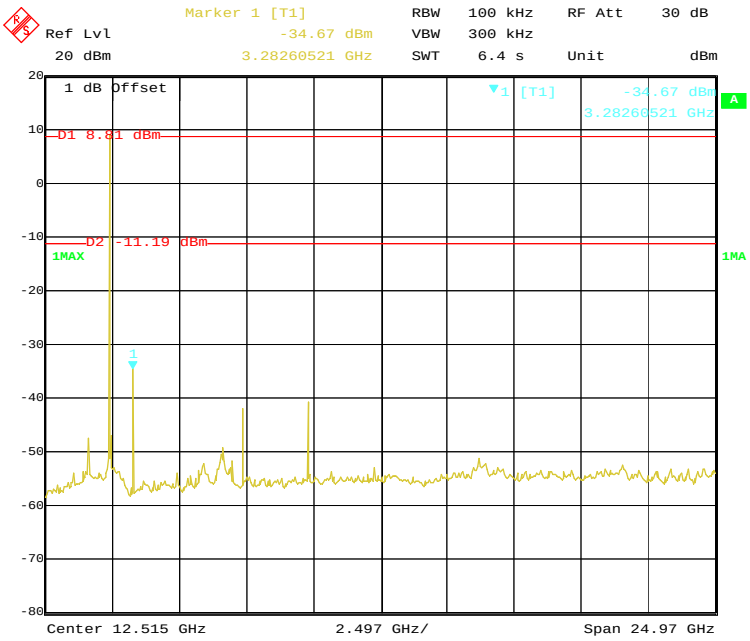
802.11b Low Channel



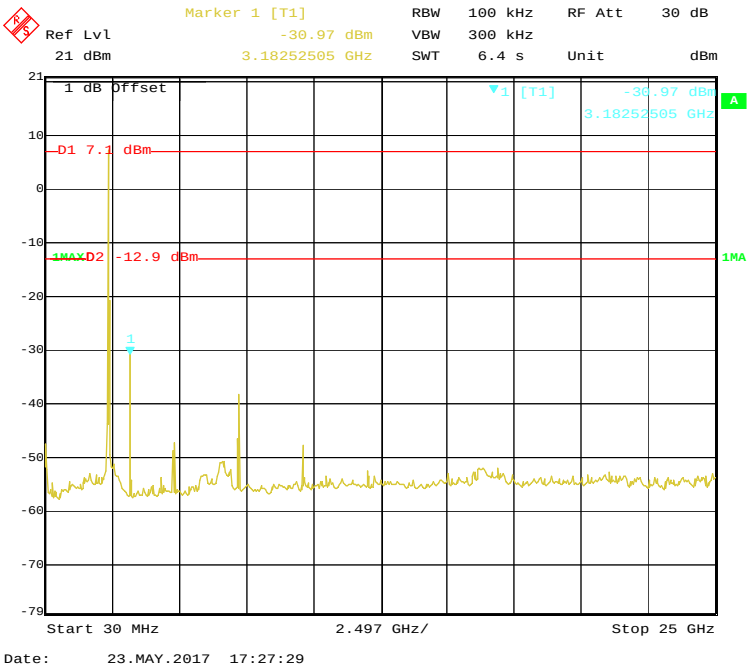
802.11b Middle Channel



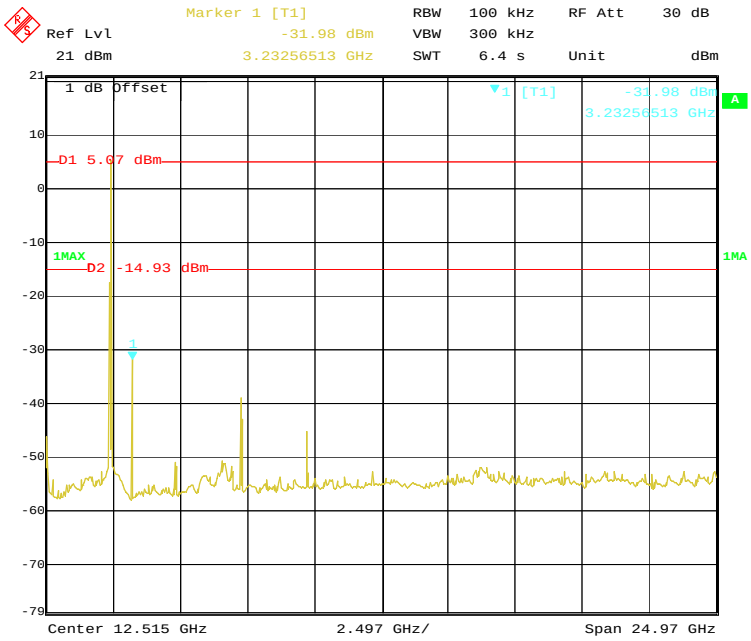
802.11b High Channel



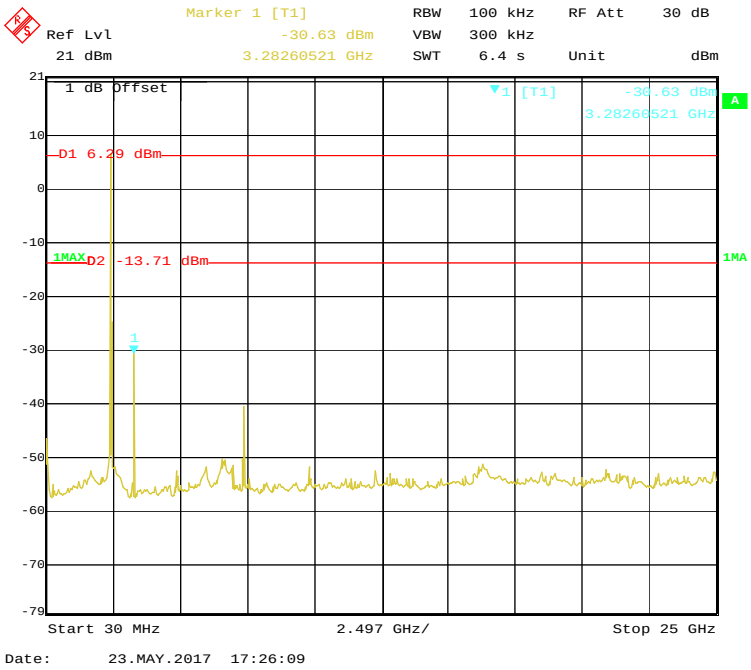
802.11g Low Channel



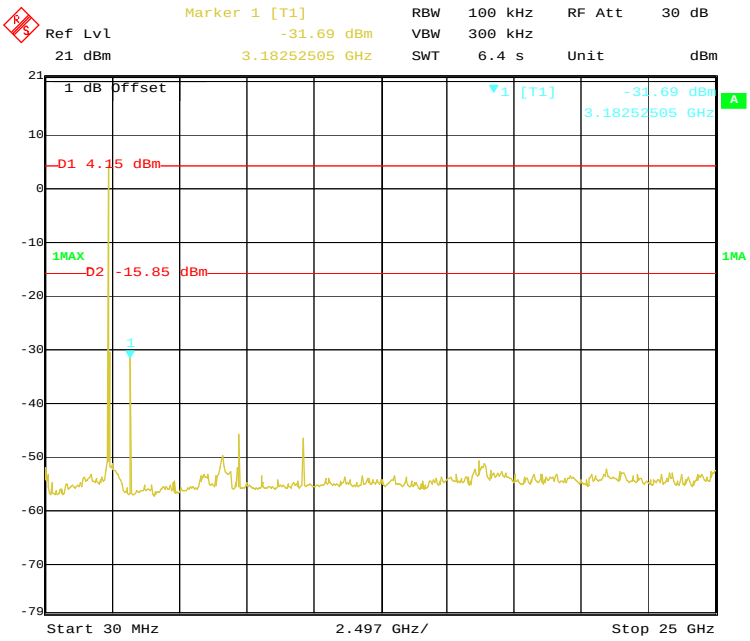
802.11g Middle Channel



802.11g High Channel

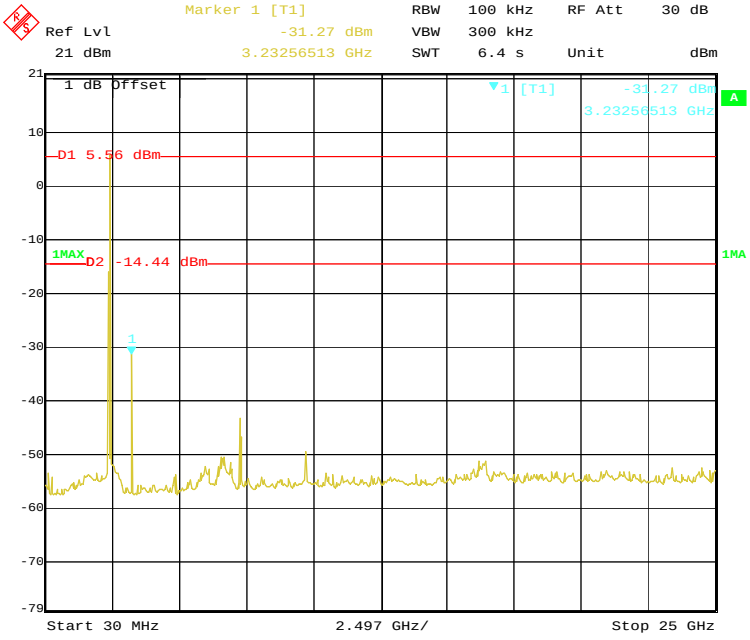


802.11n-HT20 Low Channel



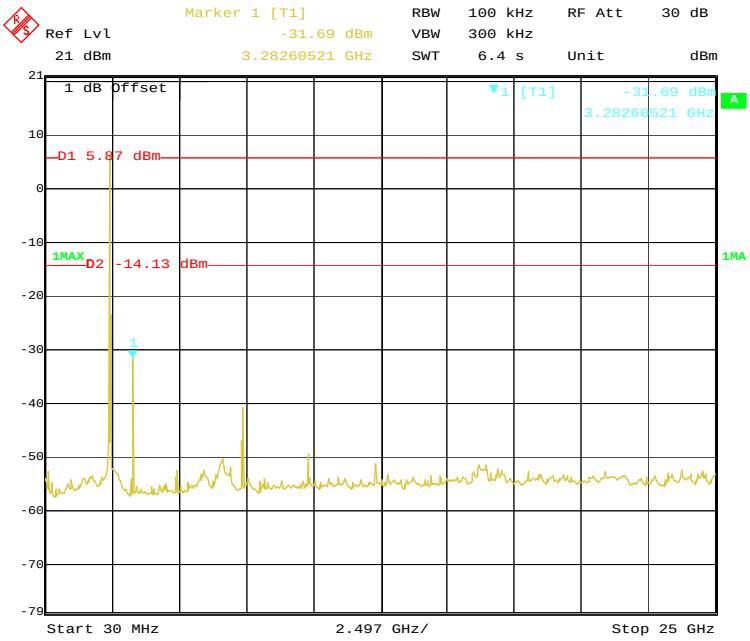
Date: 23.MAY.2017 18:43:30

802.11n-HT20 Middle Channel

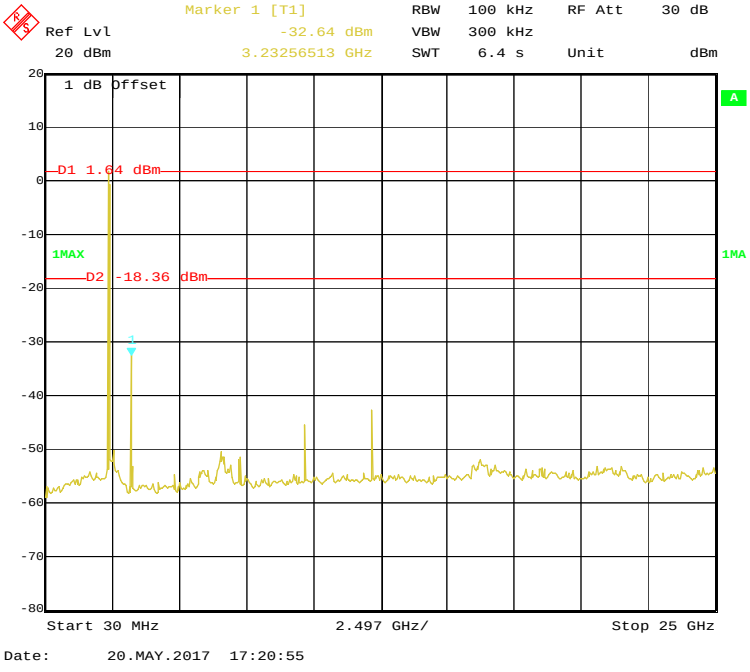


Date: 23.MAY.2017 18:44:57

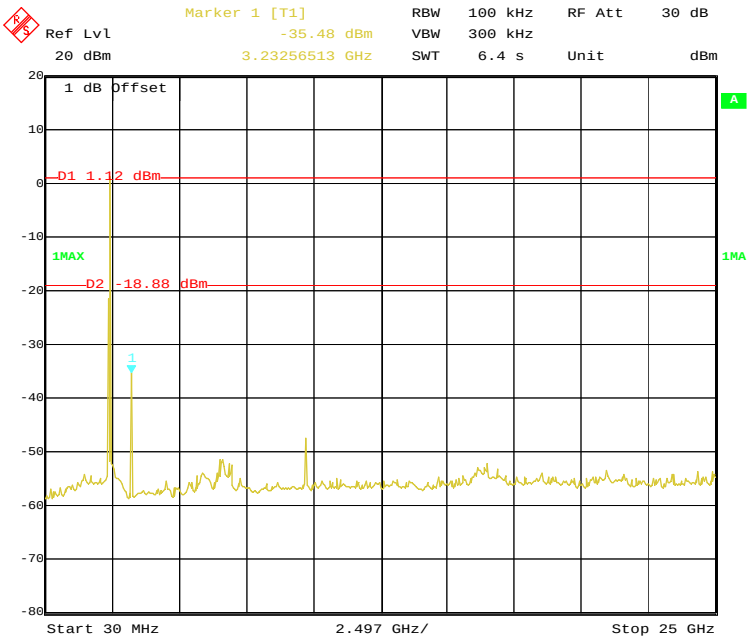
802.11n-HT20 High Channel



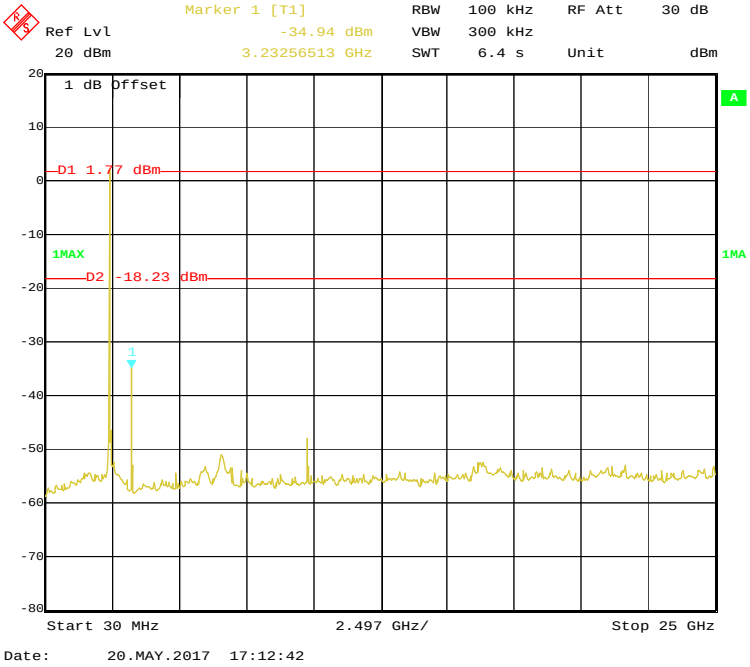
802.11n-HT40 Low Channel



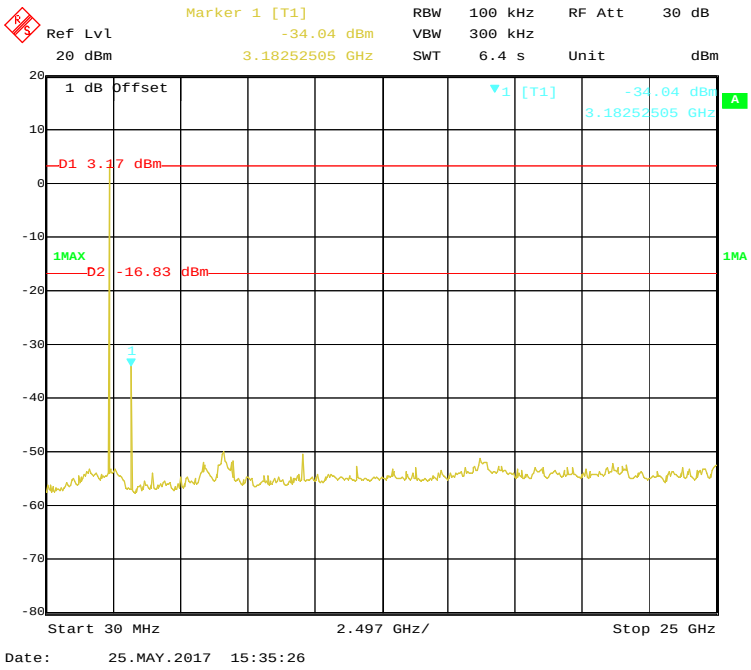
802.11n-HT40 Middle Channel



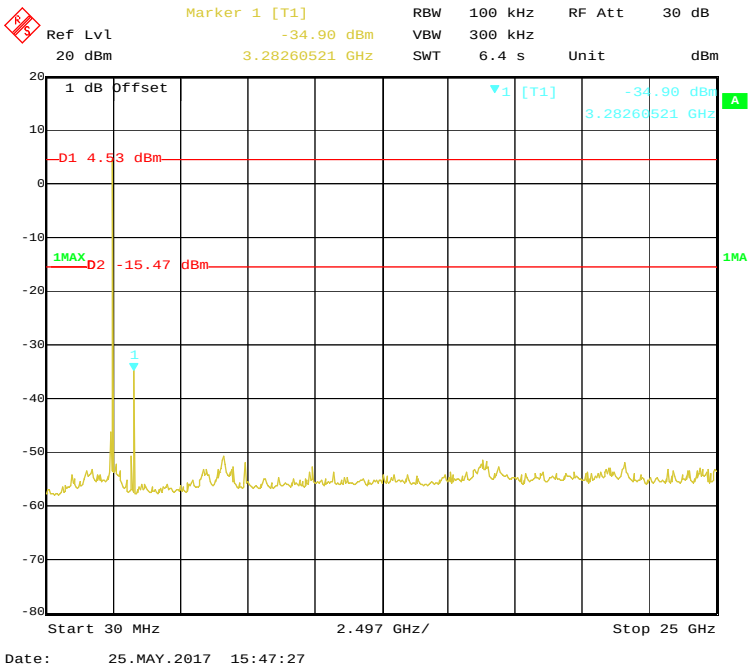
802.11n-HT40 High Channel



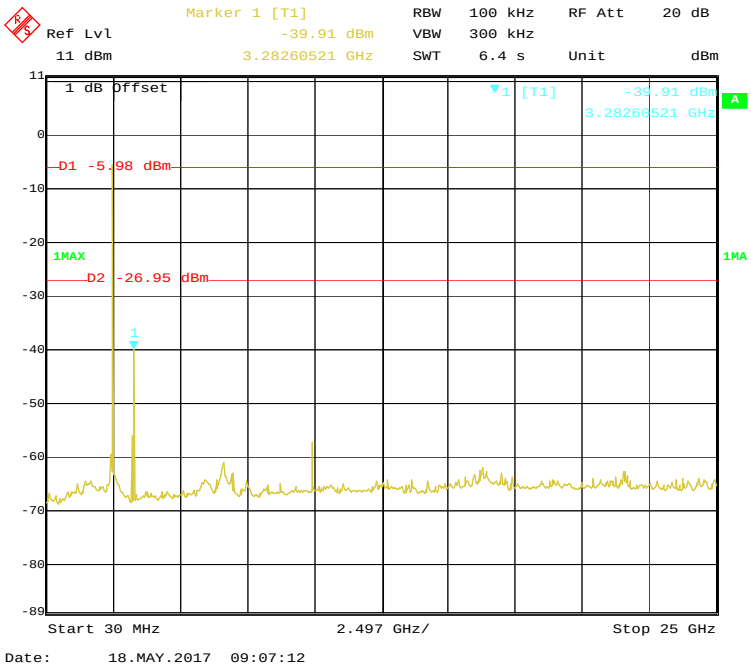
BLE Mode Low Channel



BLE Mode Middle Channel



BLE Mode High Channel



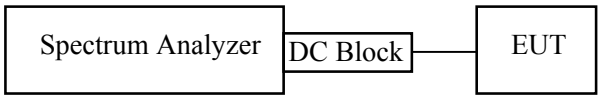
FCC §15.247(a) (2) – 6 dB EMISSION BANDWIDTH

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:	24.1 ℃
Relative Humidity:	55 %
ATM Pressure:	101.0 kPa

The testing was performed by Belle Cheng on 2017-05-18 to 2017-05-25.

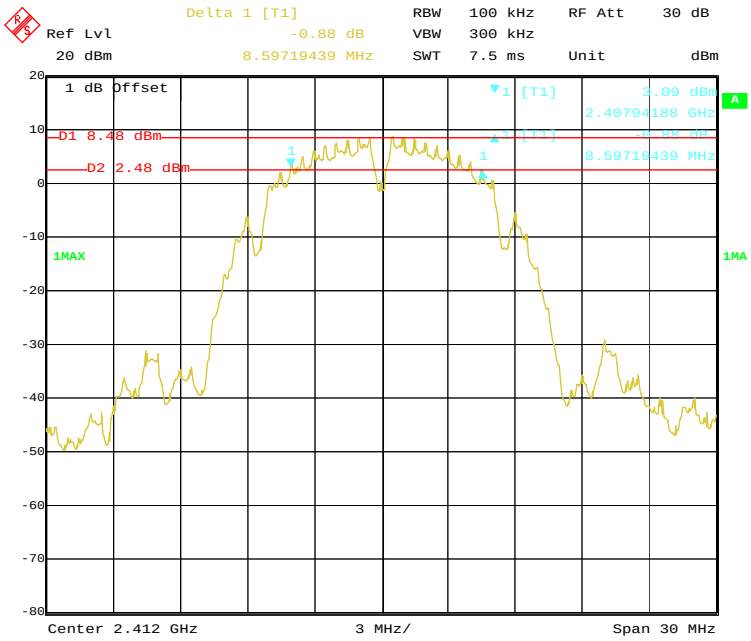
Test Result: Pass.

Please refer to the following tables and plots.

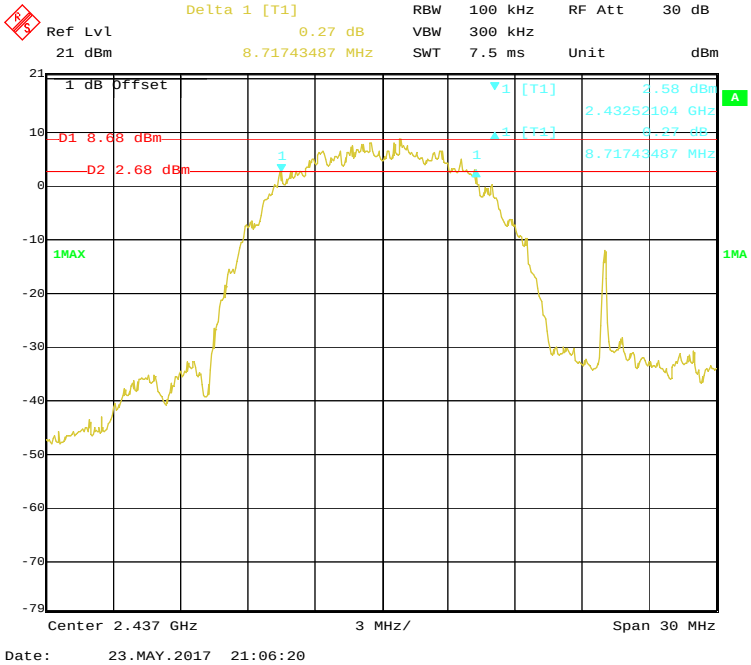
EUT operation mode: Transmitting

Channel	Frequency (MHz)	6 dB Emission Bandwidth (MHz)	Limit (MHz)
802.11b mode			
Low	2412	8.597	≥0.5
Middle	2437	8.717	≥0.5
High	2462	8.597	≥0.5
802.11g mode			
Low	2412	16.413	≥0.5
Middle	2437	16.413	≥0.5
High	2462	16.413	≥0.5
802.11n-HT20 mode			
Low	2412	17.675	≥0.5
Middle	2437	17.555	≥0.5
High	2462	17.495	≥0.5
802.11n-HT40 mode			
Low	2422	36.553	≥0.5
Middle	2437	36.553	≥0.5
High	2452	36.433	≥0.5
BLE mode			
Low	2402	0.681	≥0.5
Middle	2440	0.673	≥0.5
High	2480	0.673	≥0.5

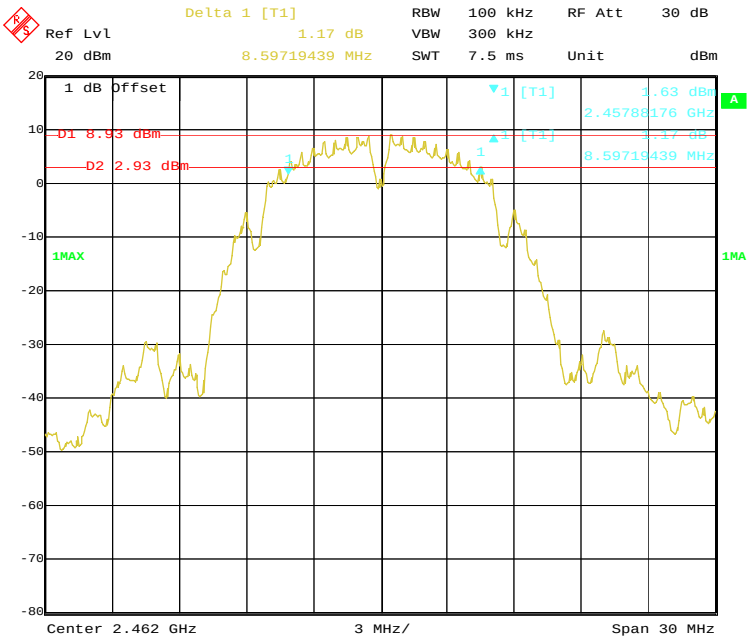
802.11b Low Channel



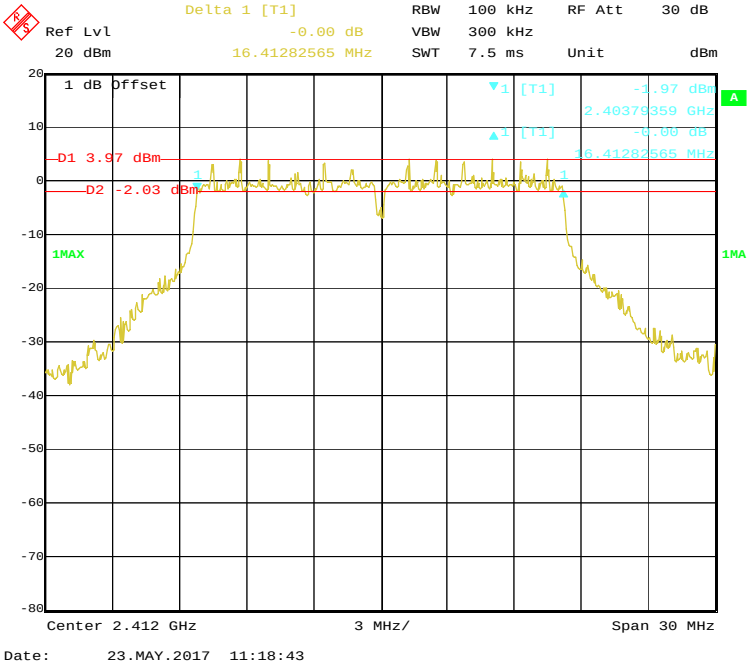
802.11b Middle Channel



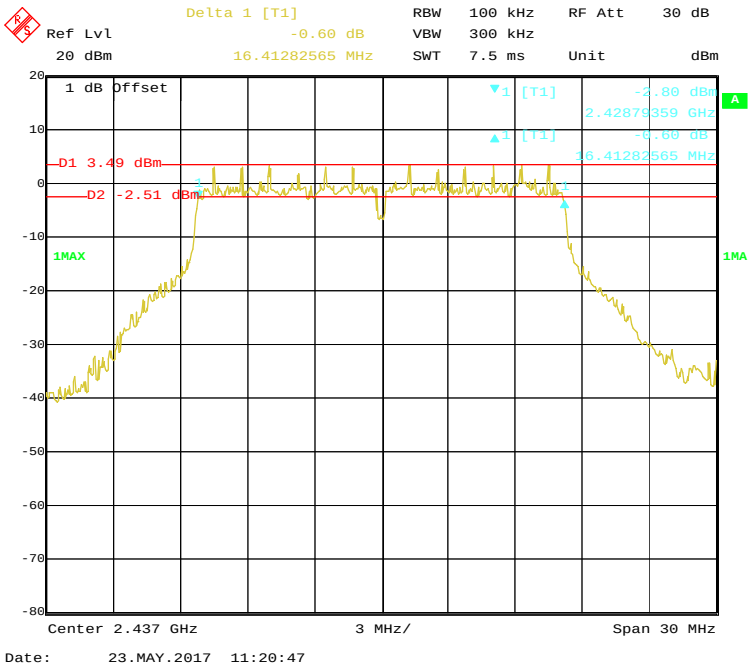
802.11b High Channel



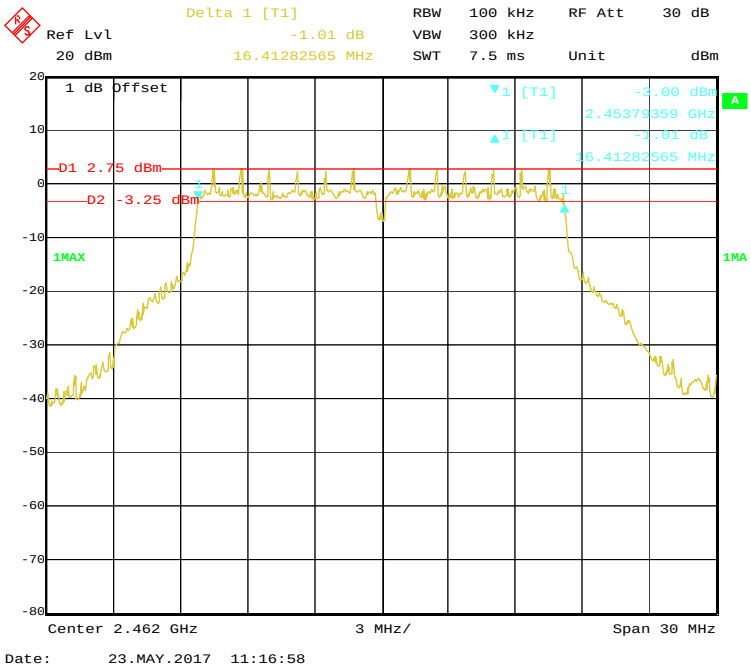
802.11g Low Channel



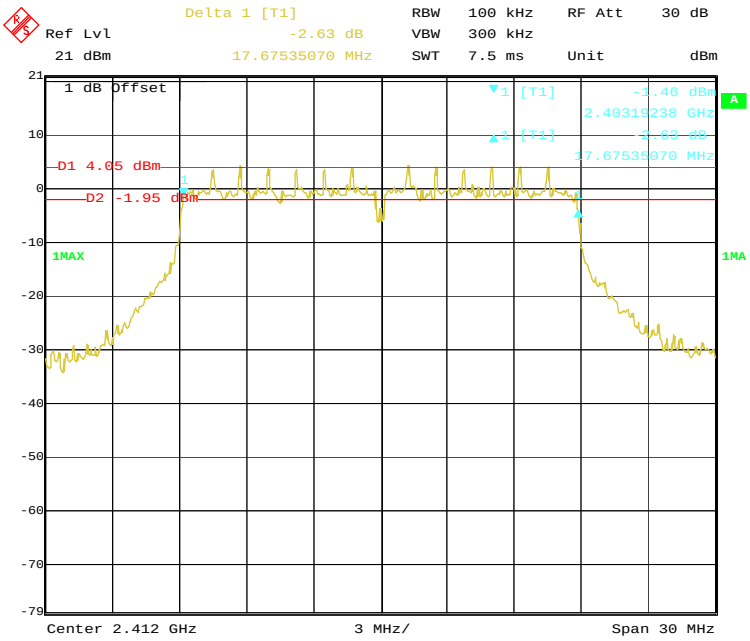
802.11g Middle Channel



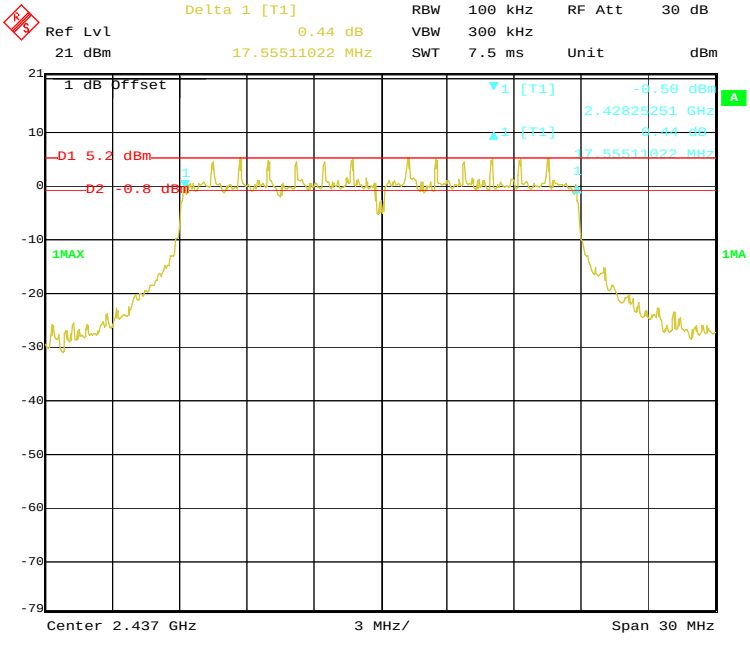
802.11g High Channel



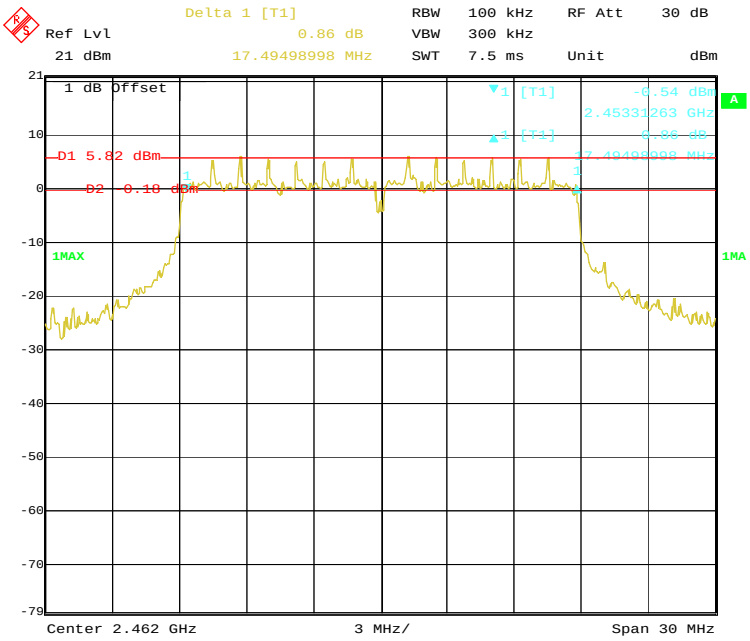
802.11n-HT20 Low Channel



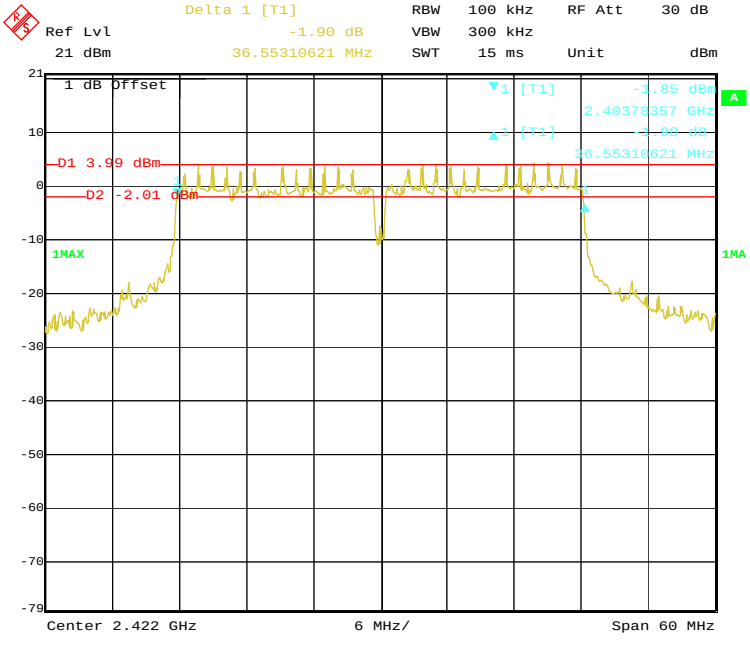
802.11n-HT20 Middle Channel



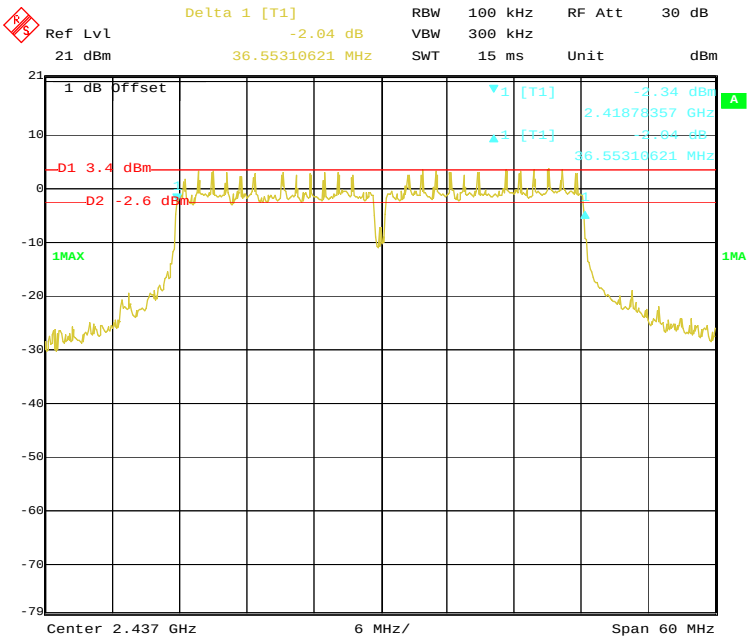
802.11n-HT20 High Channel



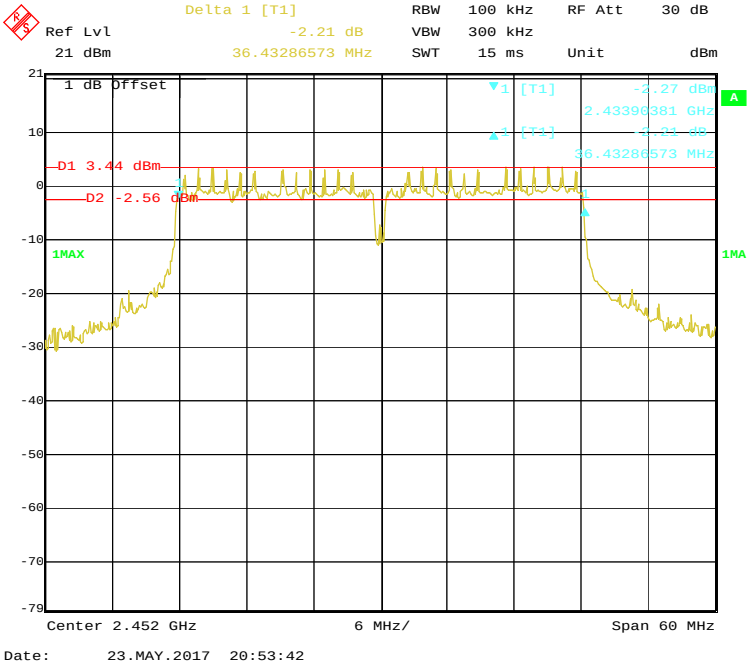
802.11n-HT40 Low Channel



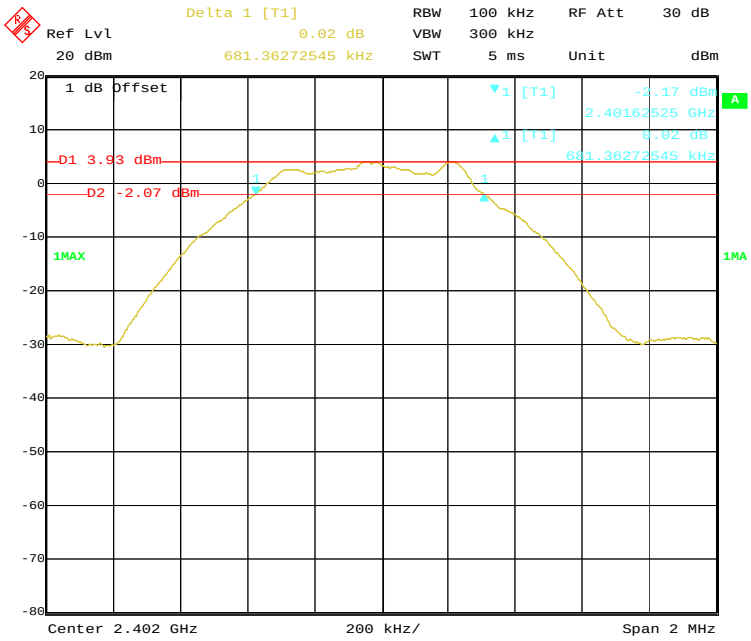
802.11n-HT40 Middle Channel



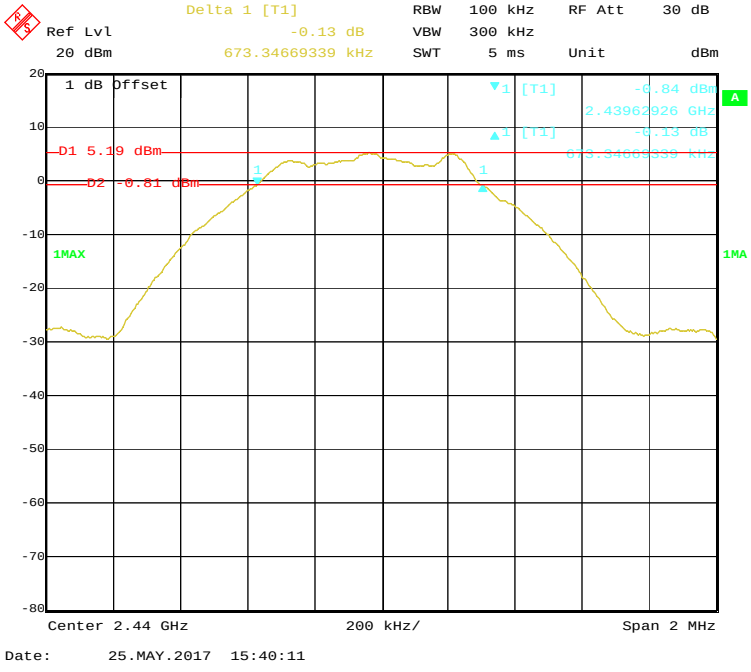
802.11n-HT40 High Channel



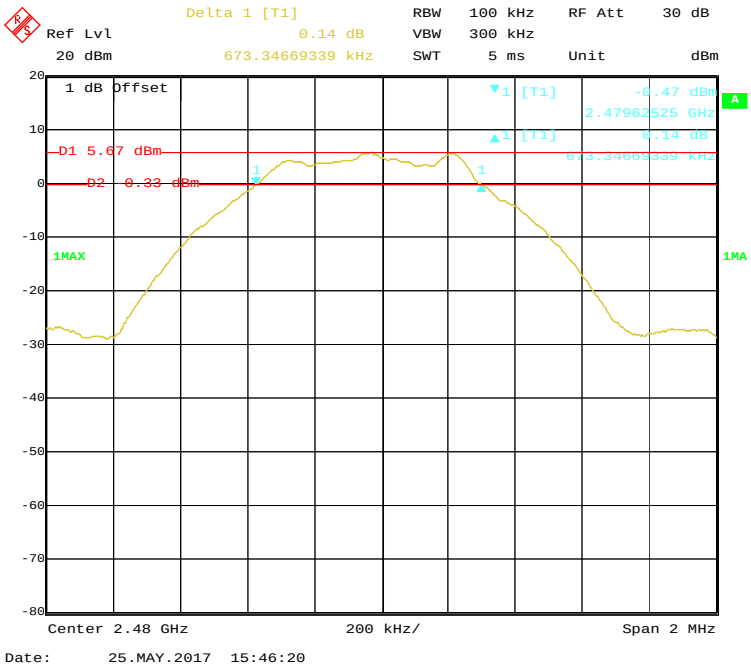
BLE Mode Low Channel



BLE Mode Middle Channel



BLE Mode High Channel



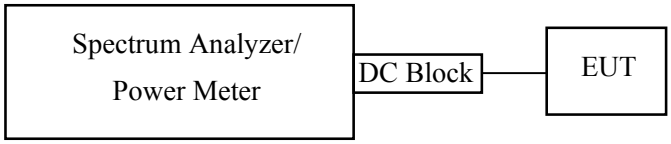
FCC §15.247(b) (3) - MAXIMUM CONDUCTED OUTPUT POWER

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

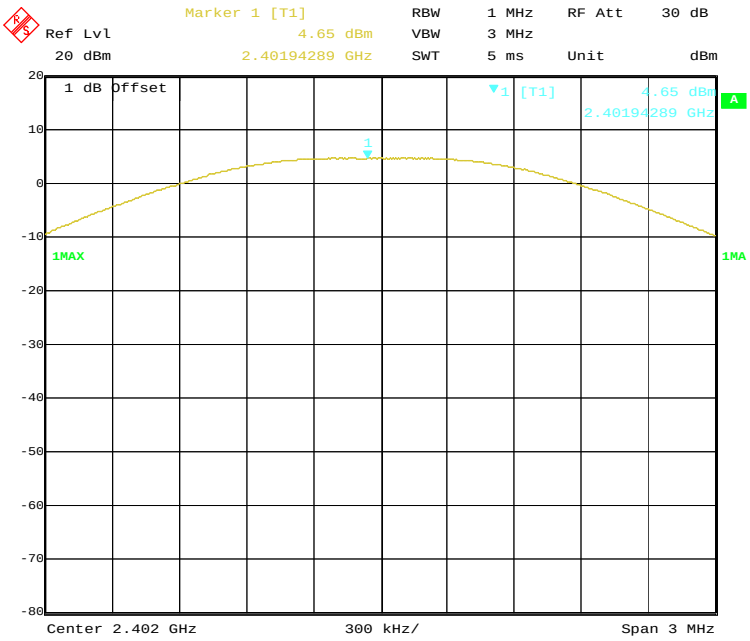
Temperature:	23.8℃
Relative Humidity:	54 %
ATM Pressure:	101.2 kPa

The testing was performed by Belle Cheng on2017-05-23 to 2017-05-25.

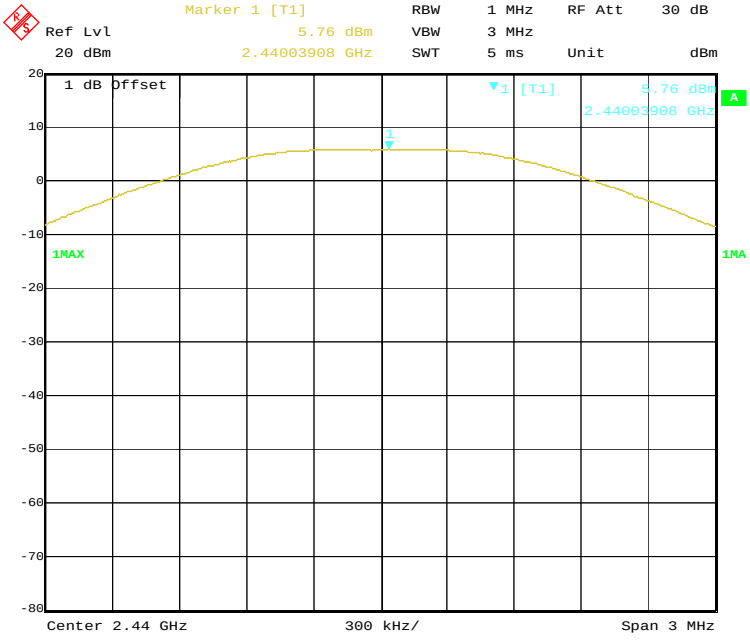
EUT operation mode: Transmitting

Mode	Frequency (MHz)	Max Conducted Peak Output Power (dBm)	Max Conducted Average Output Power (dBm)	Limit (dBm)	Result
802.11b					
Low	2412	21.03	16.88	30	Pass
Middle	2437	22.36	18.15	30	Pass
High	2462	21.56	17.31	30	Pass
802.11g					
Low	2412	22.32	14.52	30	Pass
Middle	2437	22.22	14.34	30	Pass
High	2462	21.49	14.41	30	Pass
802.11n-HT20					
Low	2412	22.10	13.64	30	Pass
Middle	2437	21.28	12.52	30	Pass
High	2462	21.46	12.98	30	Pass
802.11n-HT40					
Low	2422	21.77	13.75	30	Pass
Middle	2437	21.58	13.29	30	Pass
High	2452	21.56	12.84	30	Pass
BLE					
Low	2402	4.65	3.32	30	Pass
Middle	2440	5.76	4.43	30	Pass
High	2480	6.24	4.91	30	Pass

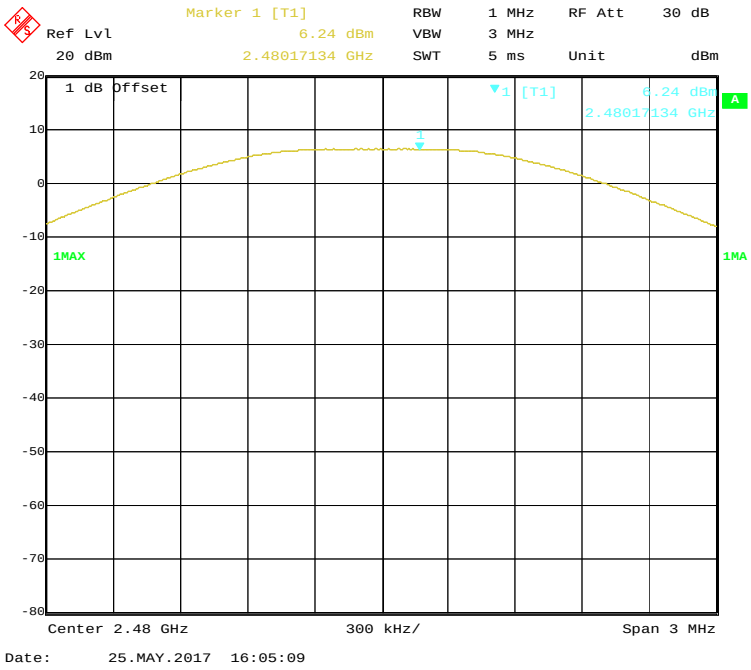
BLE Mode Low Channel



BLE Mode Middle Channel



BLE Mode High Channel



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

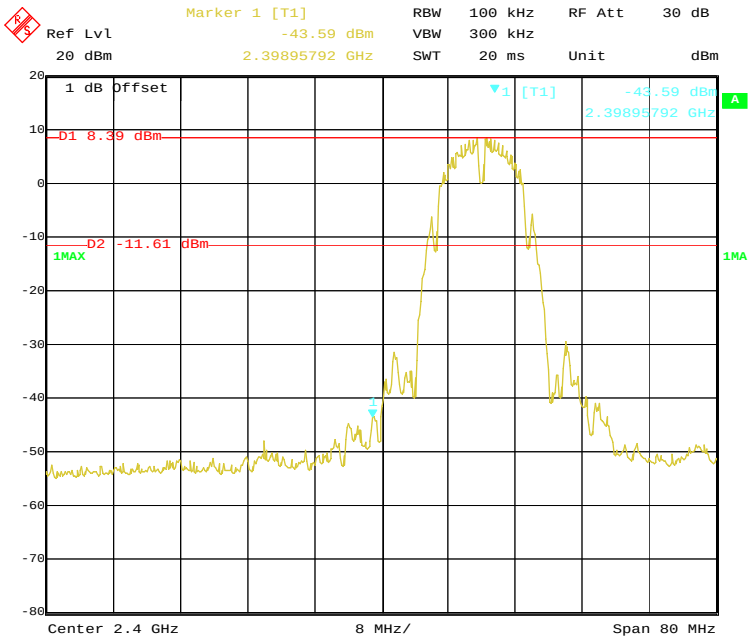
Temperature:	24.3 ℃
Relative Humidity:	55 %
ATM Pressure:	101.3 kPa

The testing was performed by Belle Cheng on 2017-05-18 to 2017-05-25.

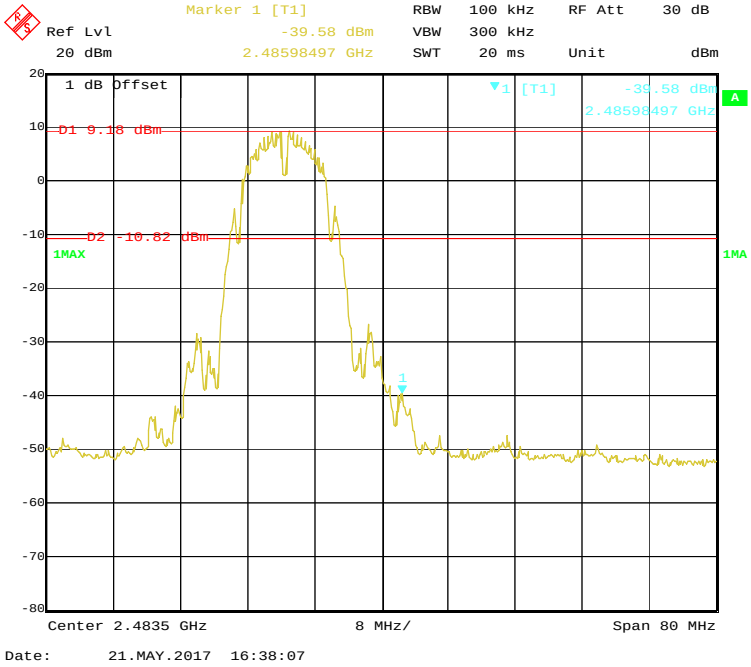
Test Result: *Compliance*

Please refer to the following table and plots.

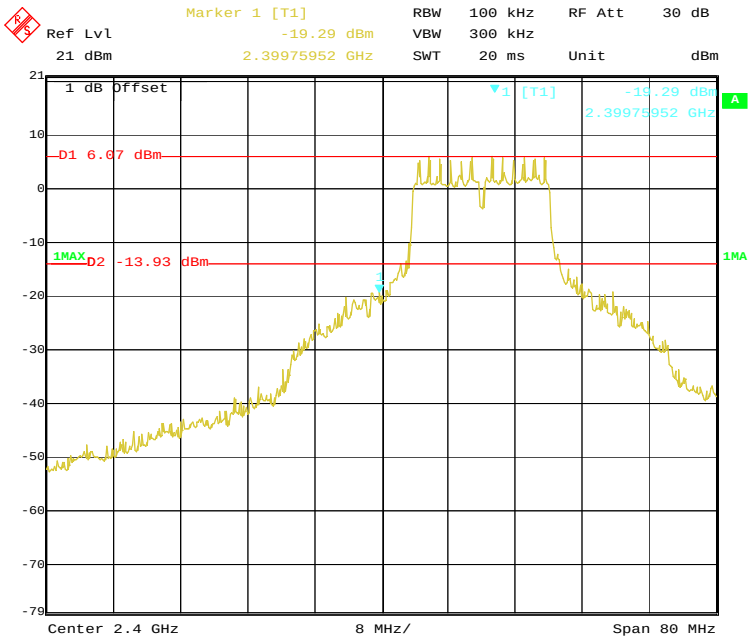
802.11b: Band Edge, Left Side



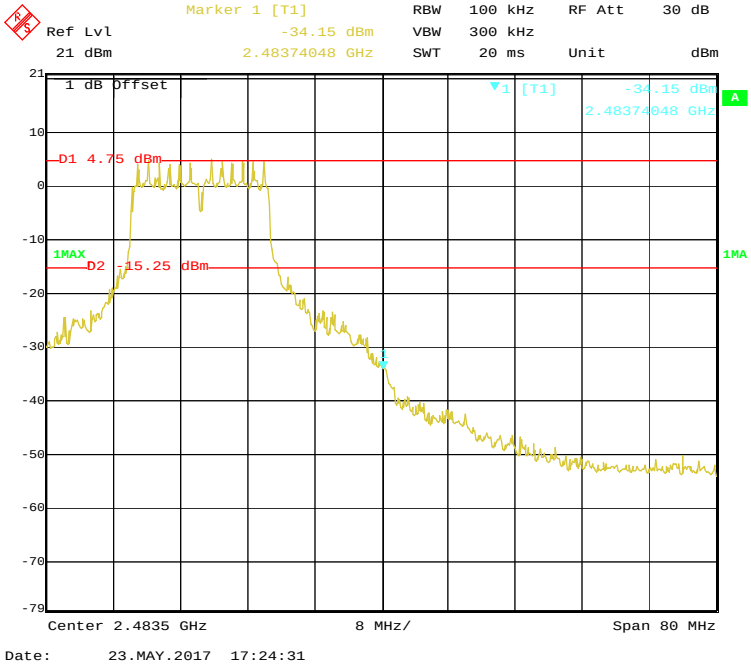
802.11b: Band Edge, Right Side



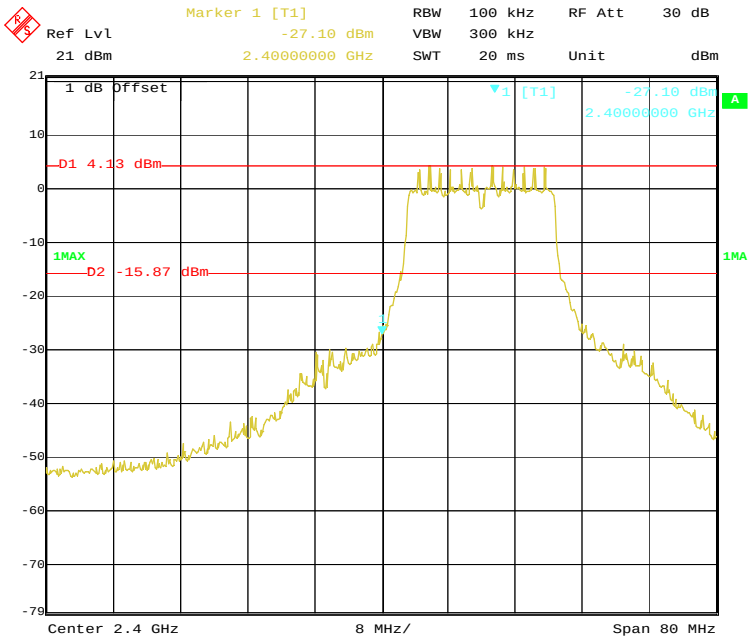
802.11g: Band Edge, Left Side



802.11g: Band Edge, Right Side



802.11n-HT20: Band Edge, Left Side



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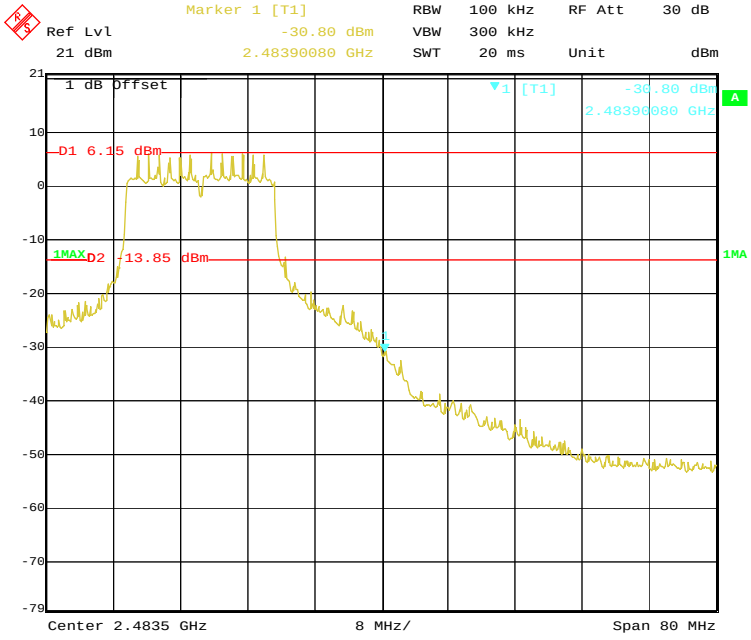
802.11n-HT20: Band Edge, Right Side



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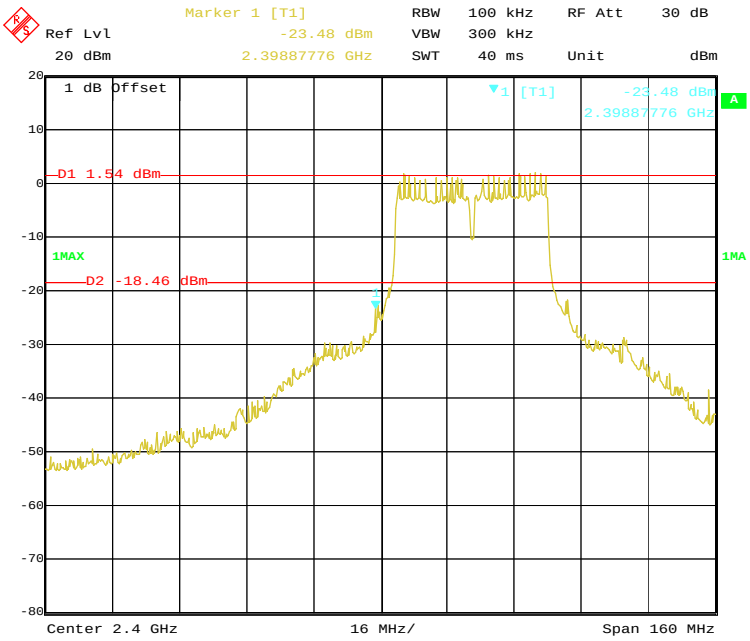
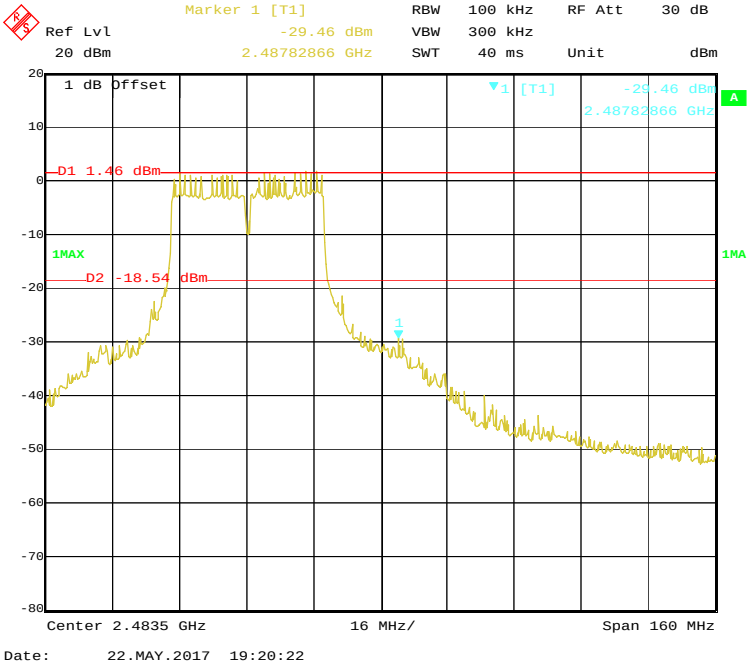
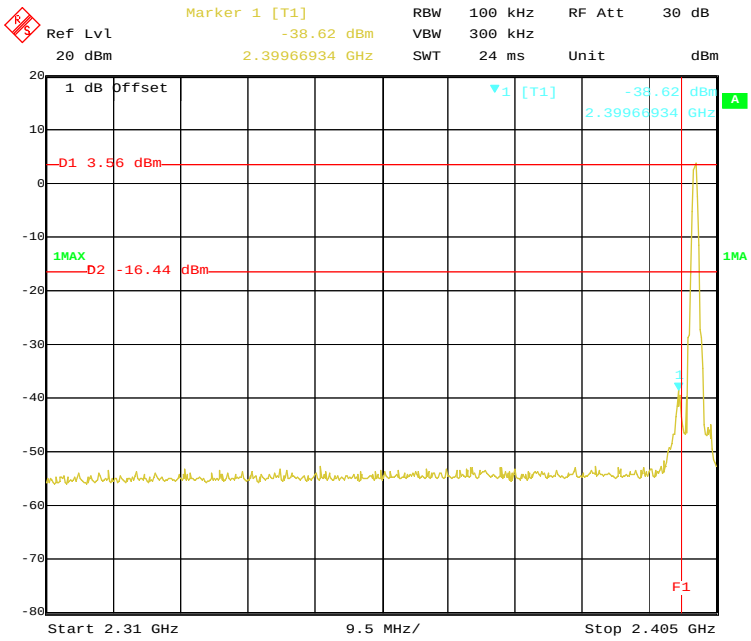
802.11n-HT40: Band Edge, Left Side



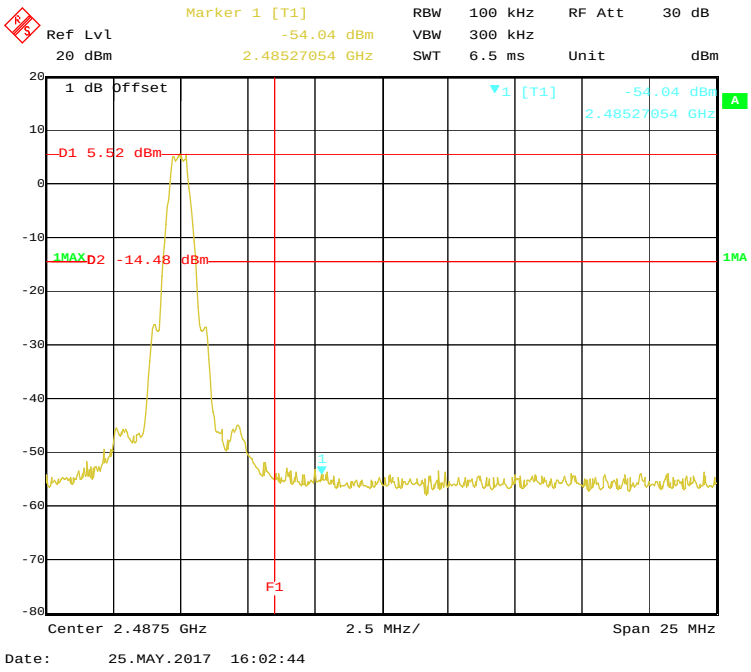
802.11n-HT40: Band Edge, Right Side



BLE: Band Edge, Left Side



BLE: Band Edge, Right Side



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.

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: 3kHz≤ RBW≤100 kHz.
3. Set the VBW ≥ 3×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:	24.1 ℃
Relative Humidity:	54 %
ATM Pressure:	101.3 kPa

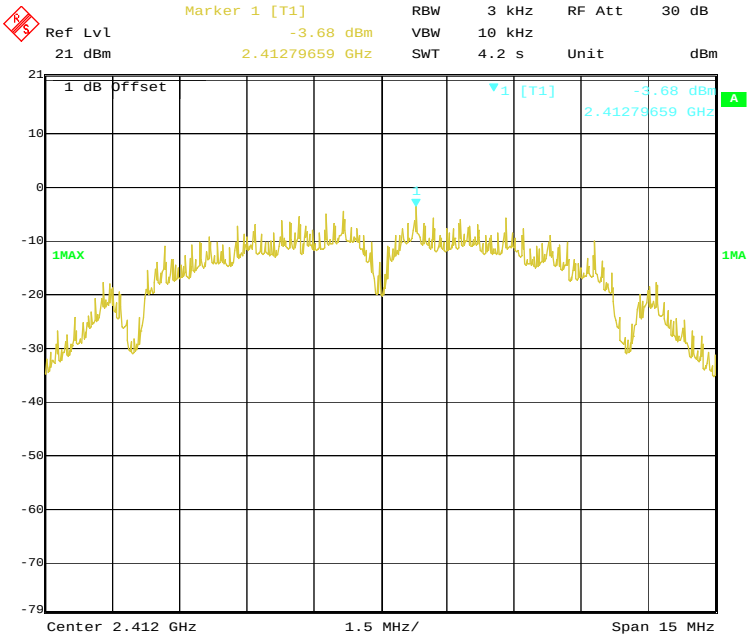
The testing was performed by Belle Cheng on 2017-05-20 to 2017-05-25.

EUT operation mode: Transmitting

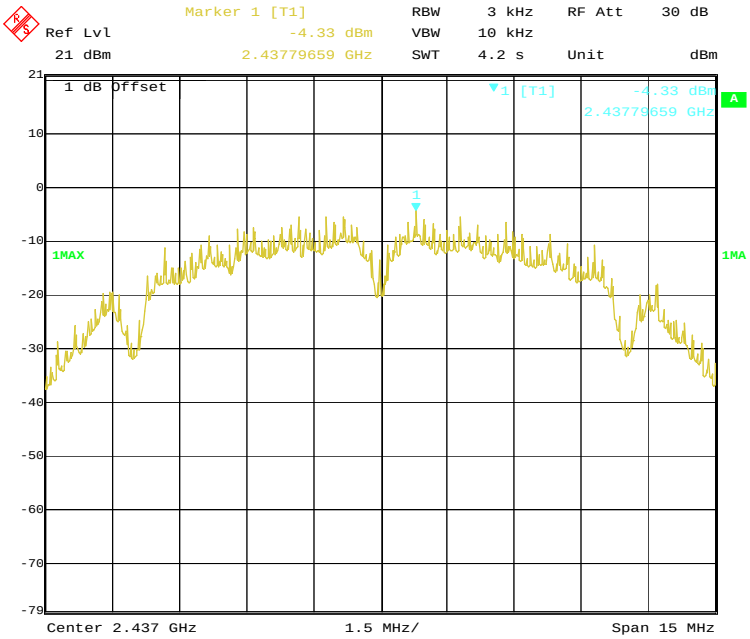
Test Result: Pass

Channel	Frequency (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)
802.11b mode			
Low	2412	-3.68	≤8
Middle	2437	-4.33	≤8
High	2462	-5.19	≤8
802.11g mode			
Low	2412	-10.02	≤8
Middle	2437	-10.56	≤8
High	2462	-10.56	≤8
802.11n-HT20 mode			
Low	2412	-11.61	≤8
Middle	2437	-10.78	≤8
High	2462	-10.12	≤8
802.11n-HT40 mode			
Low	2422	-13.19	≤8
Middle	2437	-12.58	≤8
High	2452	-12.61	≤8
BLE mode			
Low	2402	-10.79	≤8
Middle	2440	-9.15	≤8
High	2480	-9.44	≤8

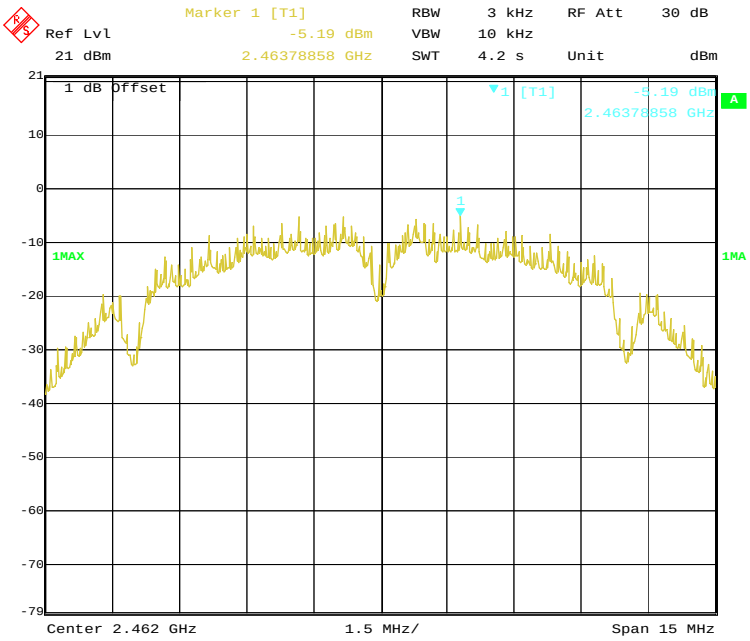
Power Spectral Density , 802.11b Low Channel



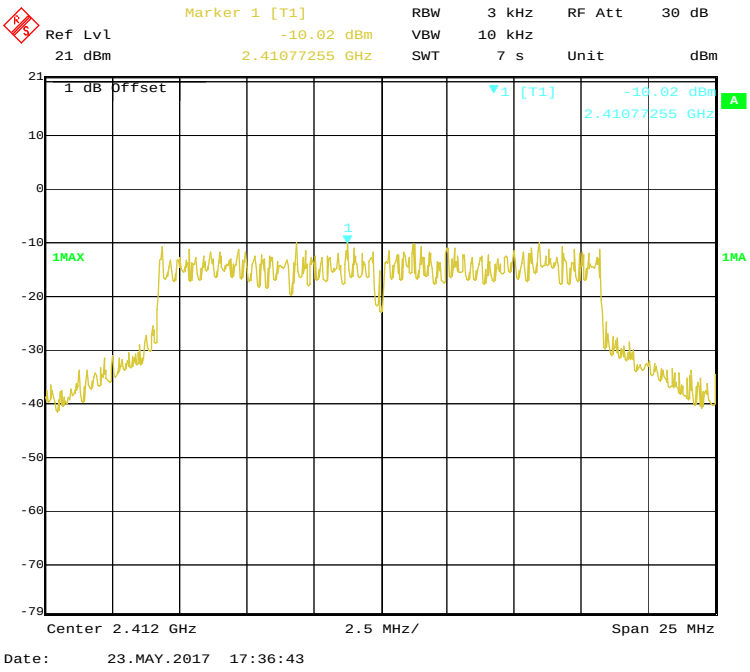
Power Spectral Density , 802.11b Middle Channel



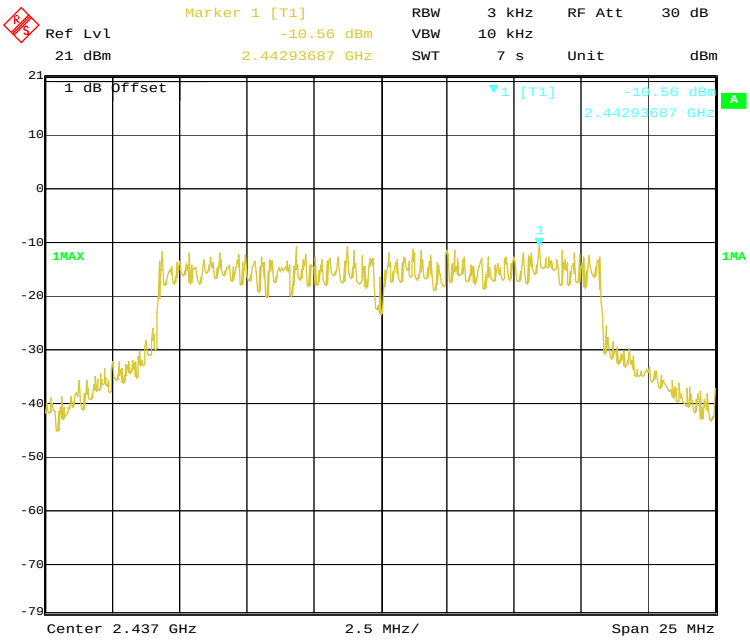
Power Spectral Density , 802.11b High Channel



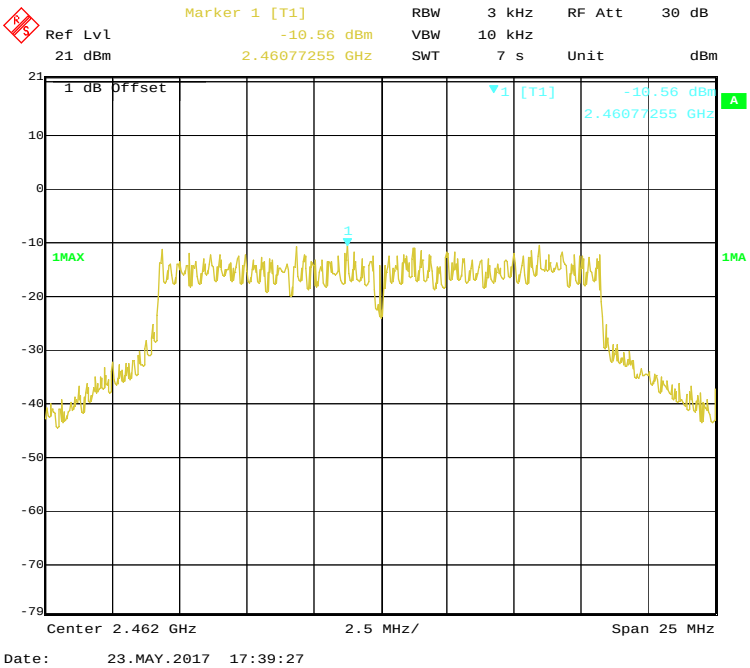
Power Spectral Density , 802.11g Low Channel



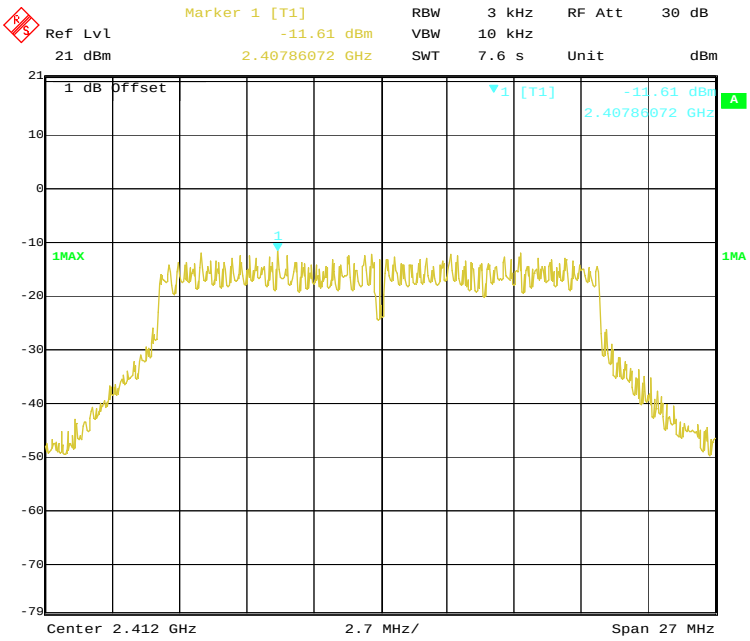
Power Spectral Density , 802.11g Middle Channel



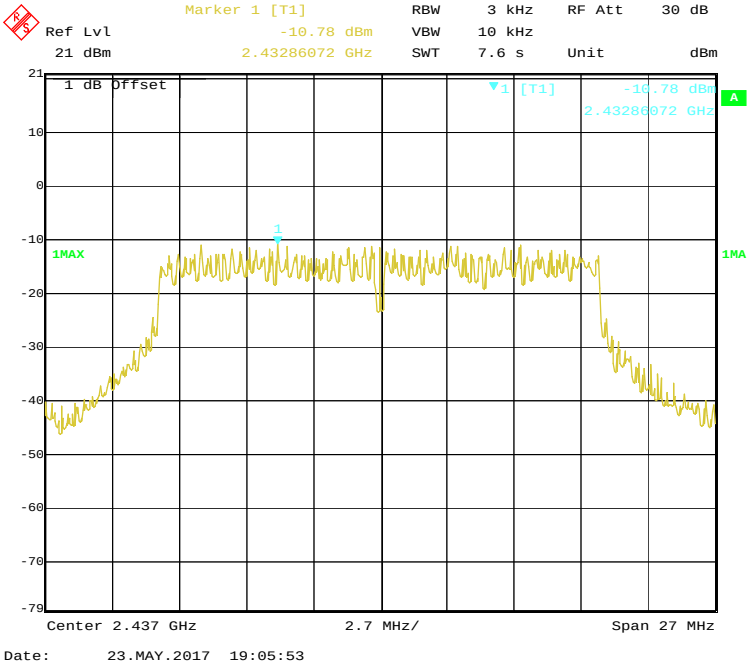
Power Spectral Density , 802.11g High Channel



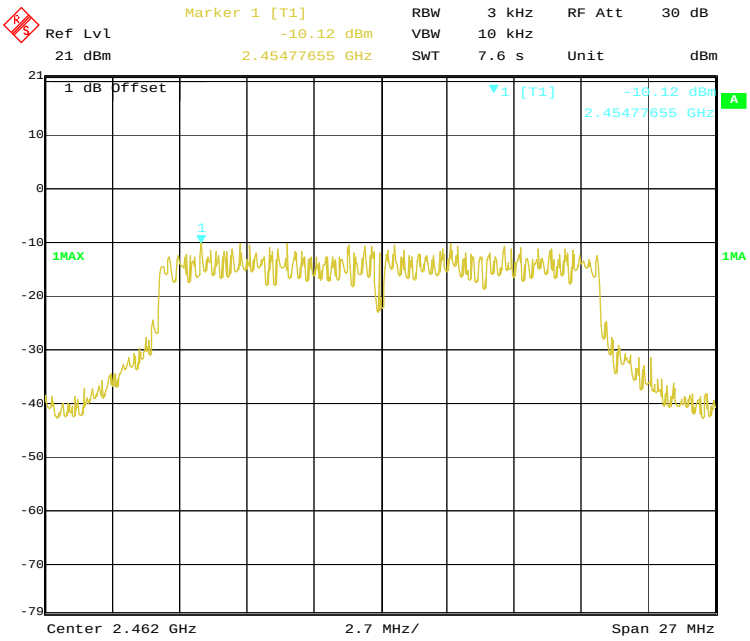
Power Spectral Density , 802.11n-HT20 Low Channel



Power Spectral Density , 802.11n-HT20 Middle Channel



Power Spectral Density , 802.11n-HT20 High Channel



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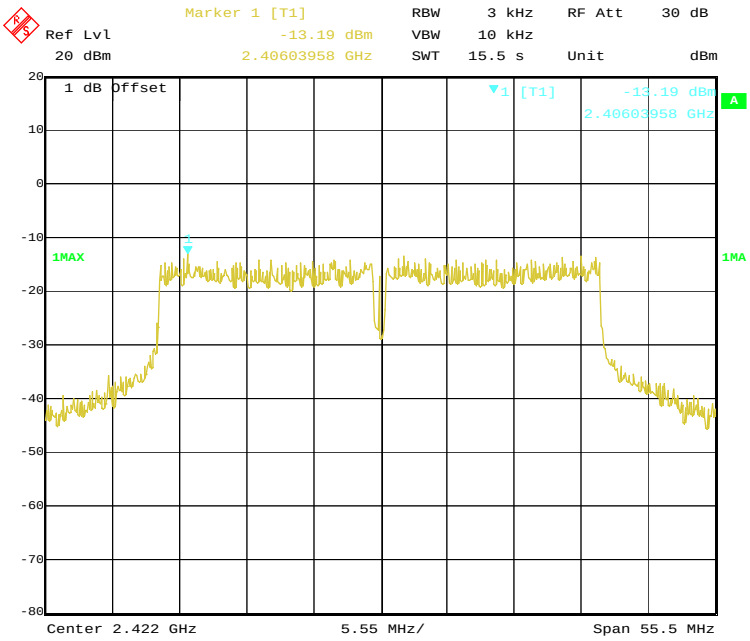
Power Spectral Density , 802.11n-HT40 Low Channel



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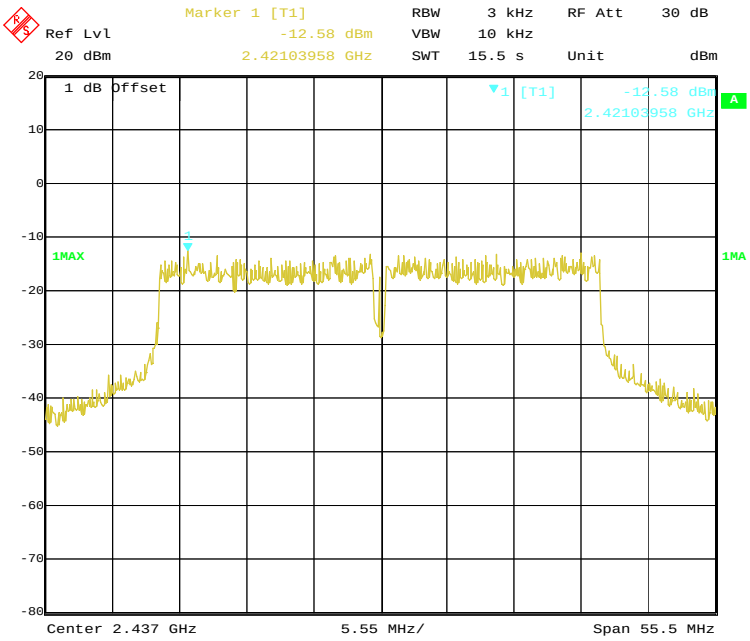
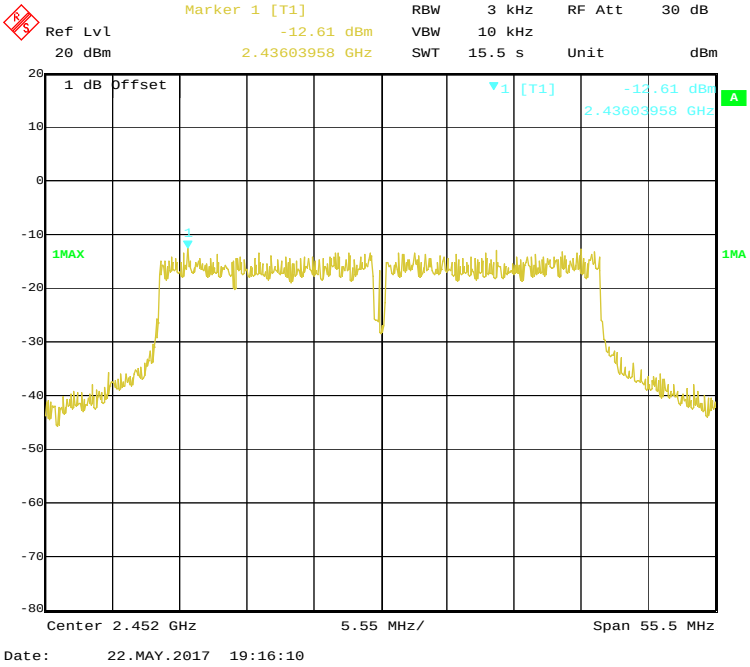
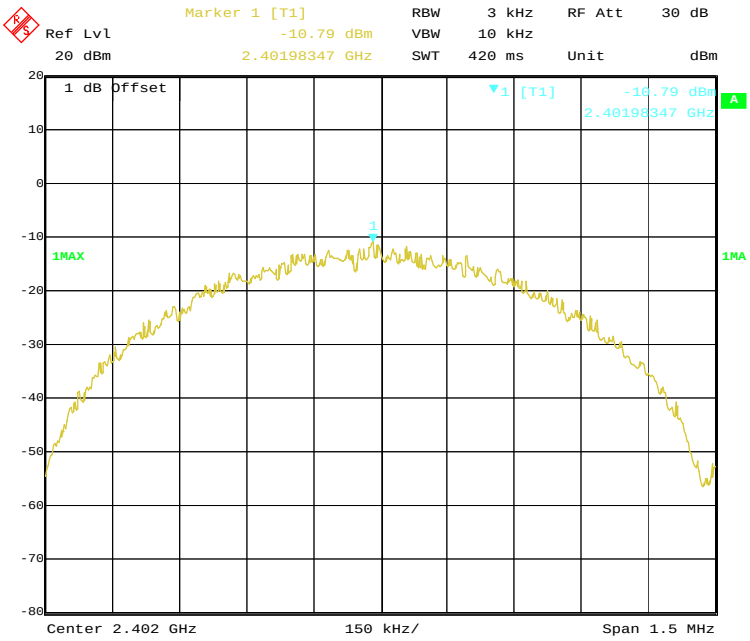
Power Spectral Density , 802.11n-HT40 Middle Channel



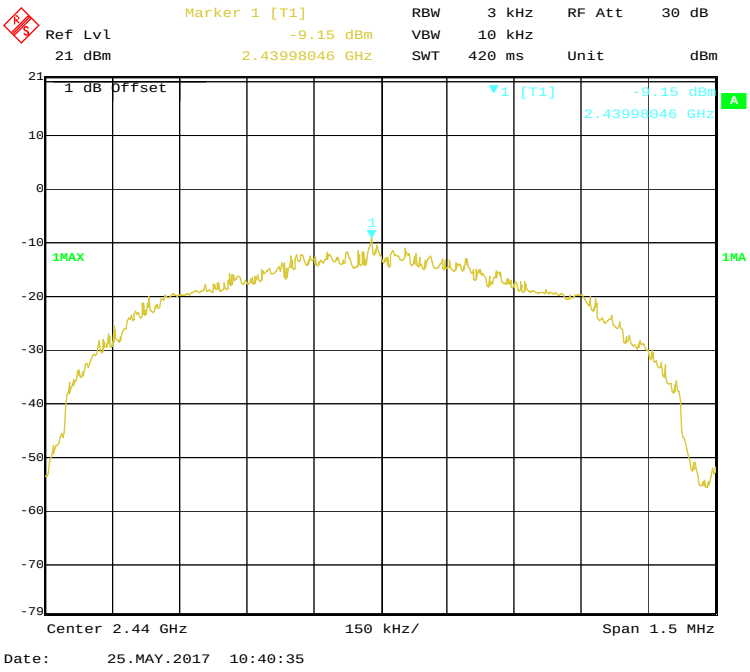
Power Spectral Density , 802.11n-HT40 High Channel



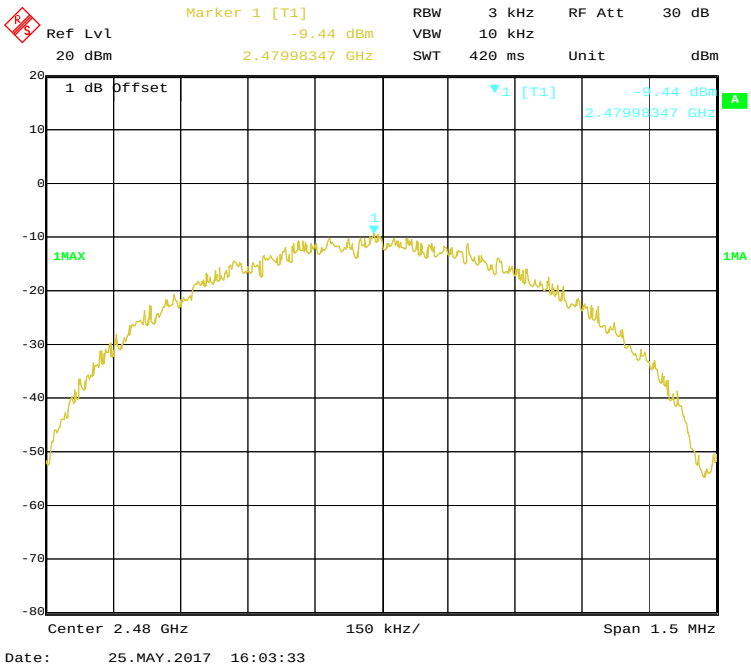
Power Spectral Density , BLE Mode Low Channel



Power Spectral Density , BLE Mode Middle Channel



Power Spectral Density , BLE Mode High Channel



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