FCC PART 15.247

TEST REPORT

For

ESPRESSIF SYSTEMS (SHANGHAI) PTE LTD

456 Bibo Road Room A201, Shanghai, China

FCC ID: 2AC7Z-ESPWROOM32

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

Test Engineer:	Peter Jiang
Report Number:	RKS161017001-00B
Report Date:	2016-11-16
Reviewed By:	Jesse Huang EMC Manager
Prepared By:	Bay Area Compliance Laboratories Corp. (Kunshan) Chenghu Road,Kunshan Development Zone No.248,Kunshan, Jiangsu, 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)

The ESPRESSIF SYSTEMS (SHANGHAI) PTE LTD's product, model number: ESP-WROOM-32 (FCC ID: 2AC7Z-ESPWROOM32) or the "EUT" in this report was a WIFI &Bluetooth Module, which was measured approximately:18mm(L)×25.5mm(W)×2.8 mm(H), rated input voltage: DC 3.3V.

** All measurement and test data in this report was gathered from production sample serial number: 20161012001.*

(Assigned by BACL, Kunshan). The EUT was received on 2016-10-12.

Objective

This report is prepared on behalf of ESPRESSIF SYSTEMS (SHANGHAI) PTE LTD in accordance with Part 2-Subpart J, Part 15-Subparts A, B 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)

Part 15.247 DSS submissions with FCC ID: 2AC7Z-ESPWROOM32.

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 v03r05.

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 with RF radiated emission is 5.91 dB for 30MHz-1GHz.and 4.92 dB for above 1GHz, 1.95dB for conducted measurement.

Test Facility

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

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 Bluetooth LE mode, 40 channels are provided for 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

SecureCRT

The worst condition was performed under:
802.11b: Data rate:1 Mbps, Power level: 20
802.11g: Data rate: 6 Mbps, Power level: 20
802.11n-HT20: Data rate: MCS0, Power level: 20
802.11n-HT40: Data rate: MCS0, Power level: 20
BLE: Power lever 7

Support Equipment List and Details

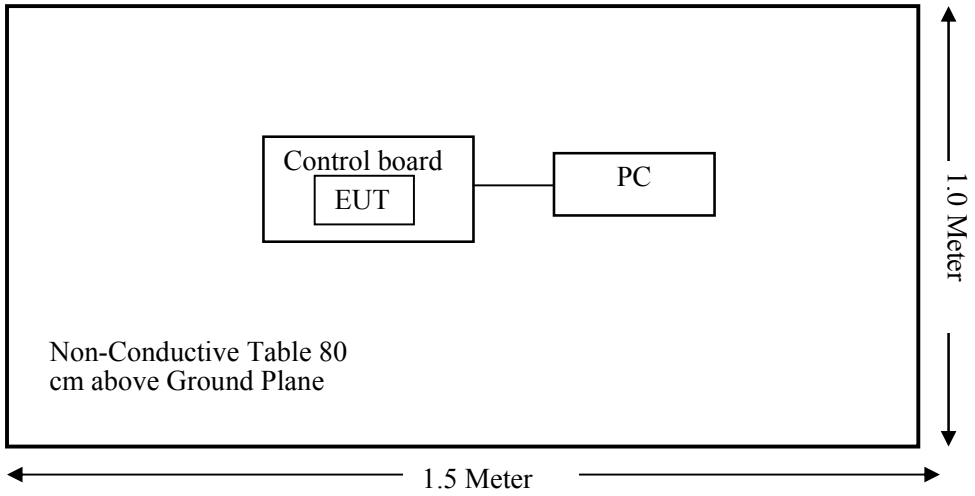
Manufacturer	Description	Model	Serial Number
/	Controlboard	/	/
DELL	PC	GX620	D65874152

External I/O Cable

Cable Description	Shielding Type	Length (m)	From Port	To
Power Cable	Un-shielding	0.9	EUT	PC

Block Diagram of Test Setup

For Radiated Emissions (Below 1 GHz):



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

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	Antenna Gain		AV Output Power		Evaluation Distance	Power Density	MPE Limit
	(MHz)	(dBi)	(numeric)	(dBm)	(mW)	(cm)	(mW/cm^2)	(mW/cm^2)
802.11b	2412	2	1.58	17.00	50.12	20	0.0158	1
802.11g	2412	2	1.58	17.00	50.12	20	0.0158	1
802.11n HT20	2412	2	1.58	17.00	50.12	20	0.0158	1
802.11n HT40	2422	2	1.58	17.00	50.12	20	0.0158	1
BLE	2440	2	1.58	8.00	6.31	20	0.0020	1

Note: The target power : 802.11b, 802.11g, 802.11n HT20, 802.11n HT40:15±2dBm,
BLE: 6±2dBm,
Which 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 2.0 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

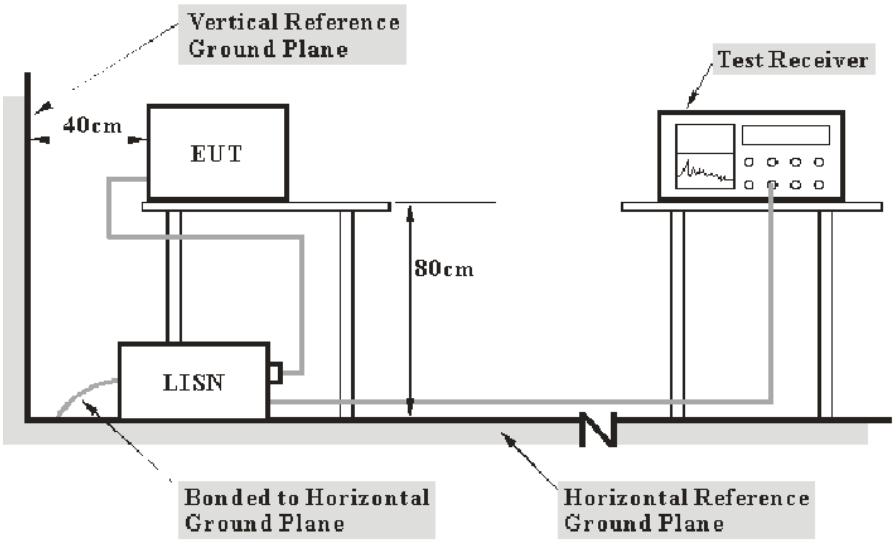
Measurement Uncertainty

Input quantities to be considered for conducted disturbance measurements maybe receiver reading, attenuation of the connection between LISN and receiver, LISN voltage division factor, LISN VDF frequency interpolation and receiver related input quantities, etc.

Based on CISPR 16-4-2:2011, the expended combined standard uncertainty of conducted disturbance test at Bay Area Compliance Laboratories Corp. (Kunshan) is shown as below. And the uncertainty will not be taken into consideration for the test data recorded in the report.

Port	Expanded Measurement uncertainty
AC Mains	3.26 dB (k=2, 95% level of confidence)
CAT 3	3.70 dB (k=2, 95% level of confidence)
CAT 5	3.86 dB (k=2, 95% level of confidence)
CAT 6	4.64 dB (k=2, 95% level of confidence)

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.

The adapter was connected to a 120 VAC/60 Hz power source.

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.

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Rohde & Schwarz	EMI Test Receiver	ESCS30	934115/007	2015-11-12	2016-11-11
Rohde & Schwarz	LISN	ESH3-Z5	862770/011	2015-11-12	2016-11-11
Rohde & Schwarz	LISN	ESH3-Z5	892239/018	2016-07-04	2017-07-03
FCC	ISN	FCC-TLISN-T8-02	20376	2016-06-23	2017-06-22
MICRO-COAX	Coaxial line	UFB-293B-1-0480-50X50	97F0173	2016-10-01	2017-10-01
Rohde & Schwarz	CE Test software	EMC 32	V 09.10.0	--	--

*** 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).

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, the worst margin reading as below:

Wi-Fi Mode: 13.03dB at **0.175000 MHz** in the **Line** conducted mode
BLE: 14.01 dB at **0.175000 MHz** in the **Neutral** conducted mode

Refer to CISPR16-4-2:2011 and CISPR 16-4-1:2009, the measured level complies with the limit if

$$L_m + U_{(Lm)} \leq L_{lim} + U_{cispr}$$

In BACL, $U_{(Lm)}$ is less than U_{cispr}, if L_m is less than L_{lim}, it implies that the EUT complies with the limit.

Test Data

Environmental Conditions

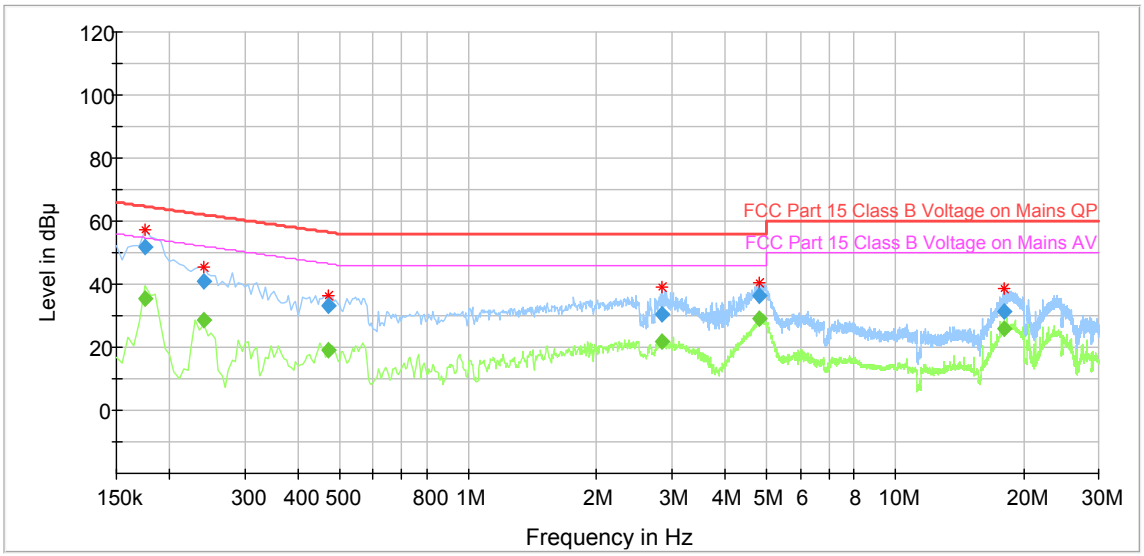
Temperature:	23 ℃
Relative Humidity:	56 %
ATM Pressure:	101.0 kPa

The testing was performed by Peter Jiang on 2016-10-19.

Test Mode: Transmitting

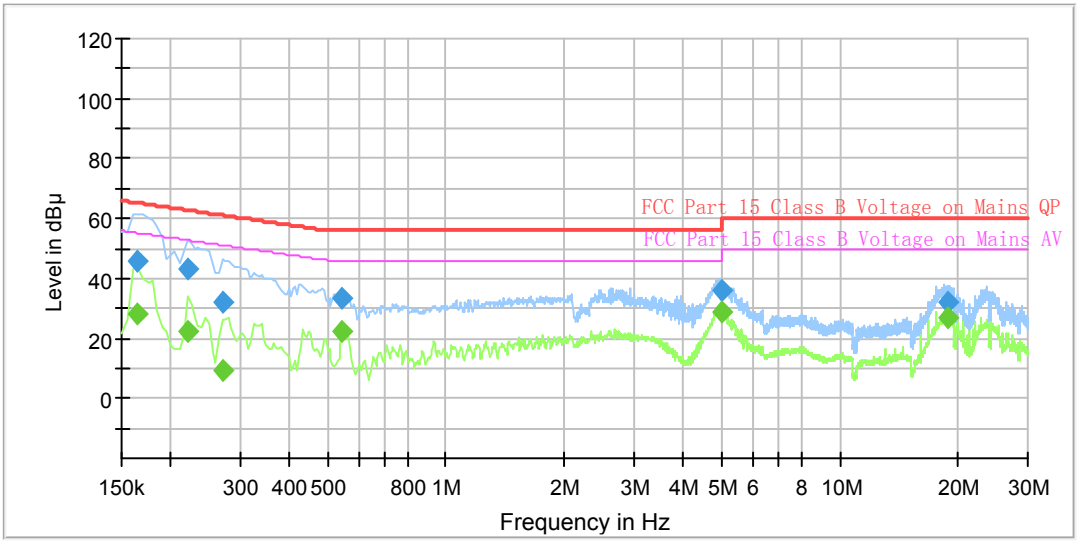
Wi-Fi Mode:

AC 120V/60 Hz, Line



Frequency (MHz)	QuasiPeak (dBµV)	Average (dB µ V)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)	Comment
0.175000	---	35.51	9.000	L1	10.3	19.21	54.72	Compliance
0.175000	51.69	---	9.000	L1	10.3	13.03	64.72	Compliance
0.240000	---	28.74	9.000	L1	10.3	23.36	52.10	Compliance
0.240000	40.71	---	9.000	L1	10.3	21.39	62.10	Compliance
0.470000	---	19.04	9.000	L1	10.3	27.47	46.51	Compliance
0.470000	33.21	---	9.000	L1	10.3	23.30	56.51	Compliance
2.855000	---	21.70	9.000	L1	10.4	24.30	46.00	Compliance
2.855000	30.61	---	9.000	L1	10.4	25.39	56.00	Compliance
4.820000	---	29.20	9.000	L1	10.5	16.80	46.00	Compliance
4.820000	36.26	---	9.000	L1	10.5	19.74	56.00	Compliance
18.020000	---	25.89	9.000	L1	10.5	24.11	50.00	Compliance
18.020000	31.35	---	9.000	L1	10.5	28.65	60.00	Compliance

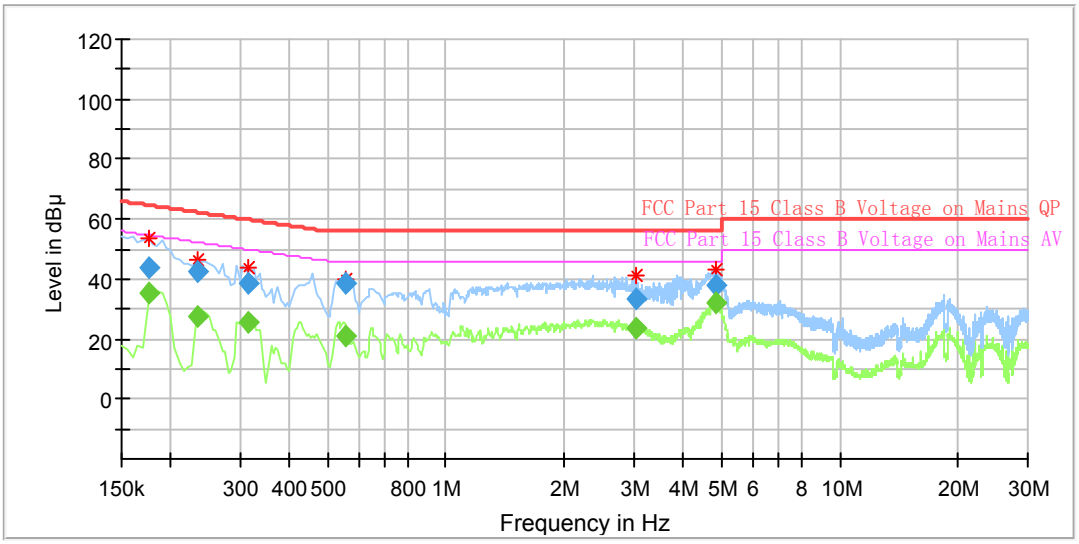
AC 120V/60 Hz, Neutral



Frequency (MHz)	QuasiPeak (dBµV)	Average (dB µ V)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)	Comment
0.165000	---	27.88	9.000	N	10.3	27.33	55.21	Compliance
0.165000	45.74	---	9.000	N	10.3	19.47	65.21	Compliance
0.220000	---	22.38	9.000	N	10.3	30.44	52.82	Compliance
0.220000	43.15	---	9.000	N	10.3	19.67	62.82	Compliance
0.270000	---	9.08	9.000	N	10.3	42.04	51.12	Compliance
0.270000	32.36	---	9.000	N	10.3	28.76	61.12	Compliance
0.545000	---	22.42	9.000	N	10.3	23.58	46.00	Compliance
0.545000	33.22	---	9.000	N	10.3	22.78	56.00	Compliance
4.990000	---	29.09	9.000	N	10.6	16.91	46.00	Compliance
4.990000	36.30	---	9.000	N	10.6	19.70	56.00	Compliance
18.810000	---	26.72	9.000	N	10.5	23.28	50.00	Compliance
18.810000	31.95	---	9.000	N	10.5	28.05	60.00	Compliance

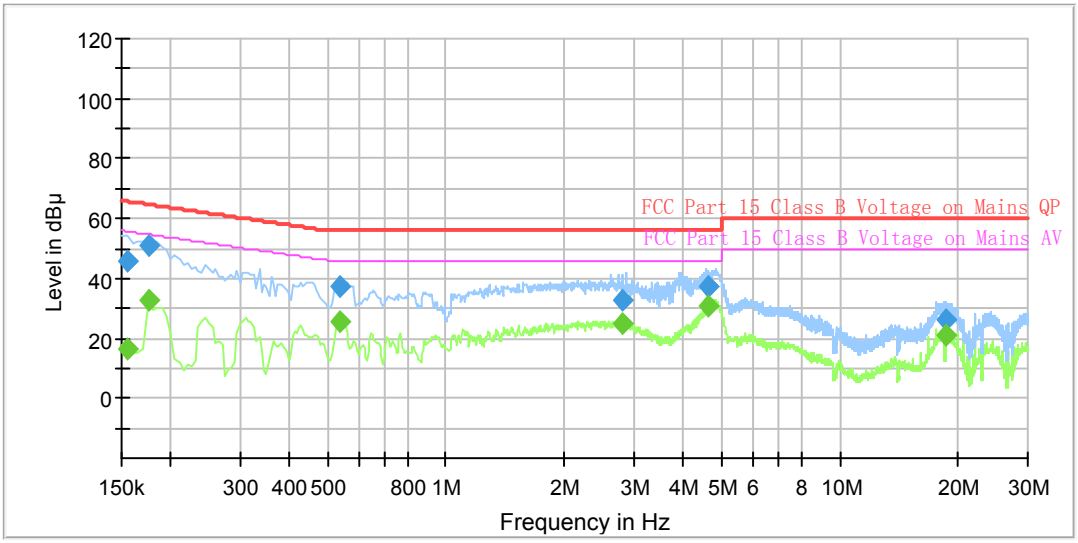
BLE Mode:

AC 120V/60 Hz, Line



Frequency (MHz)	QuasiPeak (dBµV)	Average (dB µ V)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)	Comment
0.175000	---	35.28	9.000	L1	10.3	19.44	54.72	Compliance
0.175000	43.80	---	9.000	L1	10.3	20.92	64.72	Compliance
0.235000	---	27.48	9.000	L1	10.3	24.79	52.27	Compliance
0.235000	42.55	---	9.000	L1	10.3	19.72	62.27	Compliance
0.315000	---	25.85	9.000	L1	10.3	23.99	49.84	Compliance
0.315000	38.32	---	9.000	L1	10.3	21.52	59.84	Compliance
0.555000	---	21.05	9.000	L1	10.3	24.95	46.00	Compliance
0.555000	38.45	---	9.000	L1	10.3	17.55	56.00	Compliance
3.035000	---	23.68	9.000	L1	10.4	22.32	46.00	Compliance
3.035000	33.49	---	9.000	L1	10.4	22.51	56.00	Compliance
4.860000	---	31.95	9.000	L1	10.5	14.05	46.00	Compliance
4.860000	38.20	---	9.000	L1	10.5	17.80	56.00	Compliance

AC 120V/60 Hz, Neutral



Frequency (MHz)	QuasiPeak (dBµV)	Average (dB µ V)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)	Comment
0.155000	---	16.73	9.000	N	10.3	39.00	55.73	Compliance
0.155000	45.64	---	9.000	N	10.3	20.09	65.73	Compliance
0.175000	---	32.45	9.000	N	10.3	22.27	54.72	Compliance
0.175000	50.71	---	9.000	N	10.3	14.01	64.72	Compliance
0.535000	---	25.29	9.000	N	10.3	20.71	46.00	Compliance
0.535000	37.41	---	9.000	N	10.3	18.59	56.00	Compliance
2.805000	---	24.65	9.000	N	10.5	21.35	46.00	Compliance
2.805000	32.72	---	9.000	N	10.5	23.28	56.00	Compliance
4.635000	---	30.92	9.000	N	10.5	15.08	46.00	Compliance
4.635000	37.11	---	9.000	N	10.5	18.89	56.00	Compliance
18.600000	---	21.09	9.000	N	10.5	28.91	50.00	Compliance
18.600000	26.10	---	9.000	N	10.5	33.90	60.00	Compliance

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

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

Applicable Standard

FCC §15.247 (d); §15.209; §15.205;

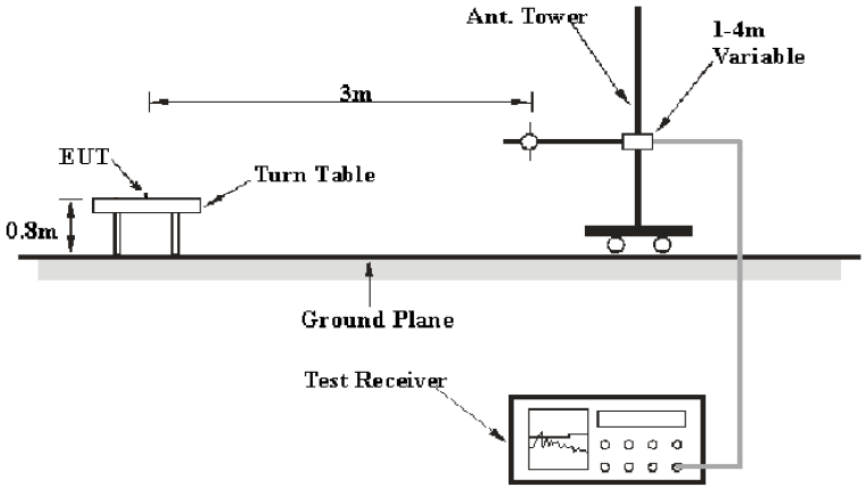
Measurement Uncertainty

All measurements involve certain levels of uncertainties, especially in field of EMC. The factors contributing to uncertainties are spectrum analyzer, cable loss, antenna factor calibration, antenna directivity, antenna factor variation with height, antenna phase center variation, antenna factor frequency interpolation, measurement distance variation, site imperfections, mismatch (average), and system repeatability.

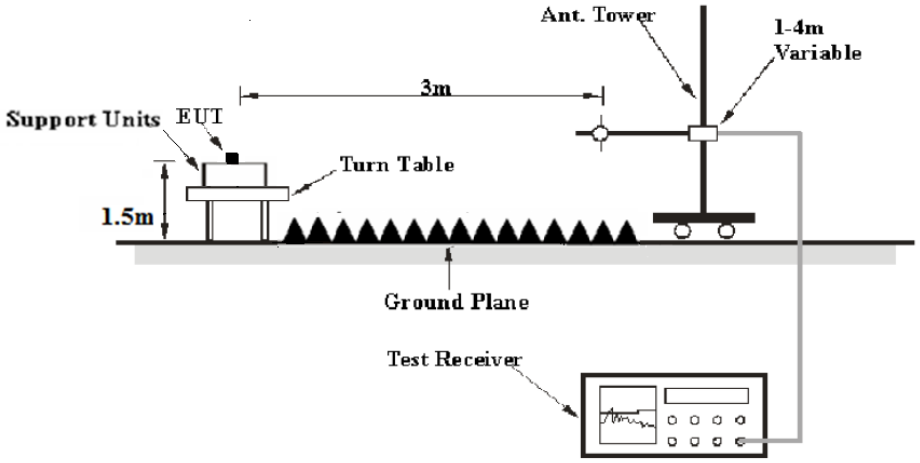
Based on CISPR 16-4-2:2011, the expended combined standard uncertainty of radiation emissions at Bay Area Compliance Laboratories Corp. (Kunshan) is 5.91 dB for 30MHz-1GHz and 4.92 dB for above 1GHz, 1.95dB for conducted measurement at antenna port. And the uncertainty will not be taken into consideration for the test data recorded in the report

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	100 kHz	300 kHz	120 kHz	QP
Above 1 GHz	1MHz	3 MHz	/	PK
	1MHz	10 Hz	/	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.

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Sonoma Instrunent	Amplifier	330	171377	2016-10-21	2017-10-21
Rohde & Schwarz	EMI Test Receiver	ESCI	100195	2016-11-12	2017-11-11
Sunol Sciences	Broadband Antenna	JB3	A090314-2	2016-01-09	2019-01-08
ETS	Horn Antenna	3115	6229	2016-11-07	2017-11-06
EMCO	Horn Antenna	3116	2516	2016-11-07	2019-11-06
Rohde & Schwarz	Signal Analyzer	FSIQ26	836131/009	2016-09-21	2017-09-21
Mini	Pre-amplifier	ZVA-183-S+	857001418	2016-09-16	2017-09-15
DUCOMMUN	Pre-amplifier	ALN-22093530-01	990147	2016-09-17	2017-09-16
champrotek	Chamber	Chamber A	1#	/	/
R&S	Auto test Software	EMC32	V 09.10.0	2015-12-16	2016-12-15
BACL	RF cable	KS-LAB-012	KS-LAB-012	2015-12-16	2016-12-15
BACL	RF cable	KS-LAB-010	KS-LAB-010	2016-09-16	2017-09-15

*** 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).

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.

Wi-Fi: 5.42 dB at **479.99875MHz** in the **Vertical** polarization for **802.11b Mode Middle Channel**
BLE: 6.35dB at **559.99215MHz** in the **Horizontal** polarization for **Middle Channel**

Refer to CISPR16-4-2:2011 and CISPR 16-4-1:2009, the measured level complies with the limit if

$$L_m + U_{(Lm)} \le L_{lim} + U_{cispr}$$

In BACL, $U_{(Lm)}$ is less than U_{cispr}, if L_m is less than L_{lim}, it implies that the EUT complies with the limit.

Test Data

Environmental Conditions

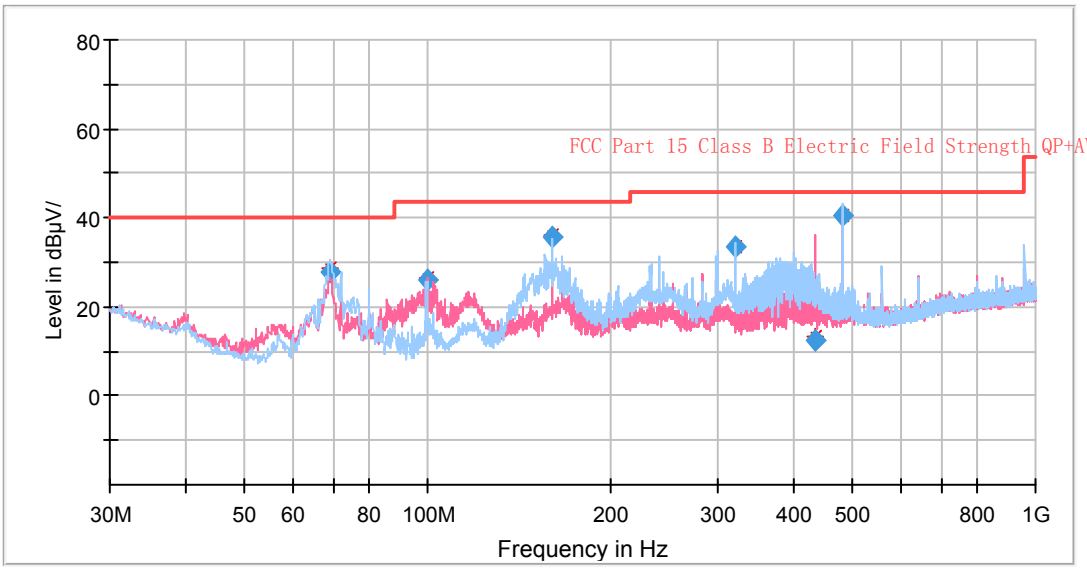
Temperature:	25 ℃
Relative Humidity:	55 %
ATM Pressure:	101.0 kPa

The testing was performed by Peter Jiang on 2016-10-27&2016-11-16.

30 MHz-1 GHz:

Wi-Fi Mode：

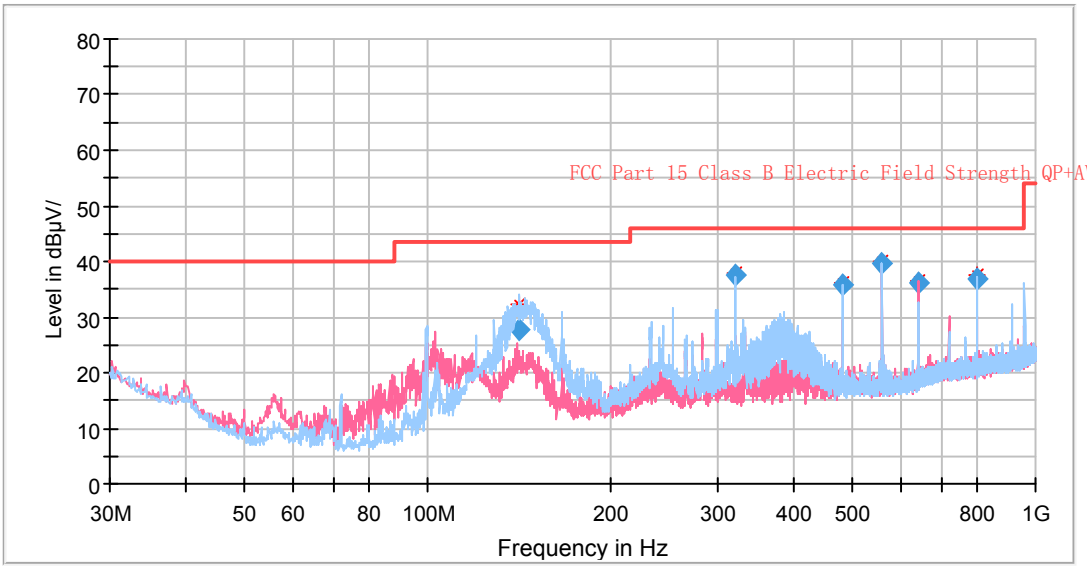
EUT operation mode: 802.11b middle channel (worst case)



Frequency (MHz)	Receiver		Turntable Degree	Rx Antenna		Corrected Factor (dB)	Corrected Amplitude (dBµV/m)	FCC Part 15.247/205/209	
	Reading (dBµV)	Detector (PK/QP/Ave.)		Height (cm)	Polar (H/V)			Limit (dBµV/m)	Margin (dB)
69.165000	44.85	QP	136.0	199.0	H	-17.1	27.75	40.00	12.25
99.877500	39.91	QP	224.0	101.0	V	-13.8	26.11	43.50	17.39
159.980000	48.32	QP	107.0	199.0	H	-12.4	35.92	43.50	7.58
319.990000	43.41	QP	263.0	101.0	H	-10.0	33.41	46.00	12.59
432.805000	20.17	QP	301.0	101.0	V	-7.5	12.67	46.00	33.33
479.998750	46.78	QP	71.0	199.0	V	-6.2	40.58	46.00	5.42

BLE Mode:

EUT operation mode: BLE middle channel (Worst case)



Frequency (MHz)	Receiver		Turntable Degree	Rx Antenna		Corrected Factor (dB)	Corrected Amplitude (dBµV/m)	FCC Part 15.247/205/209	
	Reading (dBµV)	Detector (PK/QP/Ave.)		Height (cm)	Polar (H/V)			Limit (dB µ V/m)	Margin (dB)
141.731350	39.71	QP	222	199.0	H	-12.0	27.71	43.50	15.79
319.996400	47.37	QP	67	101.0	H	-10.0	37.37	46.00	8.63
479.991500	42.02	QP	68	101.0	H	-6.2	35.82	46.00	10.18
559.992150	44.95	QP	318	199.0	H	-5.3	39.65	46.00	6.35
639.990750	40.16	QP	264	101.0	V	-4.1	36.06	46.00	9.94
800.009250	38.41	QP	210	101.0	H	-1.7	36.71	46.00	9.29

1GHz-25GHz

EUT operation mode: Transmitting

802.11b Mode

Frequency (MHz)	Receiver		Turntable Degree	Rx Antenna		Corrected Factor (dB)	Corrected Amplitude (dBμV/m)	FCC Part 15.247/205/209	
	Reading (dBμV)	Detector (PK/QP/Ave.)		Height (cm)	Polar (H/V)			Limit (dB μ V/m)	Margin (dB)
Low Channel (2412 MHz)									
2412.0	109.79	PK	50	155	V	-3.0	106.75	/	/
2412.0	105.24	Ave	50	155	V	-3.0	102.20	/	/
2412.0	105.03	PK	102	102	H	-3.0	101.99	/	/
2412.0	100.55	Ave	102	102	H	-3.0	97.51	/	/
2390.0	44.39	PK	60	158	V	-3.0	41.35	74	32.65
2390.0	31.82	Ave	60	158	V	-3.0	28.78	54	25.22
2400.0	46.43	PK	107	184	V	-3.0	43.39	74	30.61
2400.0	34.91	Ave	107	184	V	-3.0	31.87	54	22.13
4824.0	33.96	PK	221	224	H	7.2	41.15	74	32.85
4824.0	29.56	Ave	221	224	H	7.2	36.75	54	17.25
6620.0	31.79	PK	186	122	V	13.6	45.37	74	28.63
6620.0	22.54	Ave	186	122	V	13.6	36.12	54	17.88
7236.0	27.24	PK	105	220	H	16.0	43.24	74	30.76
7236.0	23.16	Ave	105	220	H	16.0	39.16	54	14.84
Middle Channel (2437 MHz)									
2437.0	109.38	PK	4	250	V	-3.0	106.36	/	/
2437.0	105.29	Ave	4	250	V	-3.0	102.27	/	/
2437.0	103.72	PK	161	230	H	-3.0	100.70	/	/
2437.0	98.95	Ave	161	230	H	-3.0	95.93	/	/
1477.0	44.40	PK	130	165	V	-7.0	37.42	74	36.58
1477.0	31.00	Ave	130	165	V	-7.0	24.02	54	29.98
1696.0	42.79	PK	273	187	H	-5.4	37.36	74	36.64
1696.0	34.31	Ave	273	187	H	-5.4	28.88	54	25.12
4874.0	32.70	PK	263	140	V	7.3	39.96	74	34.04
4874.0	28.43	Ave	263	140	V	7.3	35.69	54	18.31
6677.0	31.53	PK	53	244	H	13.8	45.32	74	28.68
6677.0	21.61	Ave	53	244	H	13.8	35.40	54	18.60
7311.0	27.92	PK	180	197	H	16.3	44.25	74	29.75
7311.0	22.87	Ave	180	197	H	16.3	39.20	54	14.80

Frequency (MHz)	Receiver		Turntable Degree	Rx Antenna		Corrected Factor (dB)	Corrected Amplitude (dBμV/m)	FCC Part 15.247/205/209	
	Reading (dBμV)	Detector (PK/QP/Ave.)		Height (cm)	Polar (H/V)			Limit (dBμV/m)	Margin (dB)
High Channel (2462 MHz)									
2462.0	109.96	PK	304	228	V	-3.0	106.95	/	/
2462.0	105.39	Ave	304	228	V	-3.0	102.38	/	/
2462.0	104.69	PK	241	214	H	-3.0	101.68	/	/
2462.0	100.66	Ave	241	214	H	-3.0	97.65	/	/
2483.5	42.64	PK	181	127	V	-3.0	39.65	74	34.35
2483.5	32.28	Ave	181	127	V	-3.0	29.29	54	24.71
2563.0	45.45	PK	281	126	V	4.2	49.65	74	24.35
2563.0	36.95	Ave	281	126	V	4.2	41.15	54	12.85
4924.0	33.39	PK	345	115	H	14.0	47.39	74	26.61
4924.0	29.18	Ave	345	115	H	14.0	43.18	54	10.82
6681.0	30.03	PK	202	247	H	13.8	43.83	74	30.17
6681.0	21.60	Ave	202	247	H	13.8	35.40	54	18.60
7386.0	27.92	PK	224	213	H	16.7	44.57	74	29.43
7386.0	22.45	Ave	224	213	H	16.7	39.10	54	14.90

802.11g Mode

Frequency (MHz)	Receiver		Turntable Degree	Rx Antenna		Corrected Factor (dB)	Corrected Amplitude (dBμV/m)	FCC Part 15.247/205/209	
	Reading (dBμV)	Detector (PK/QP/Ave.)		Height (cm)	Polar (H/V)			Limit (dBμV/m)	Margin (dB)
Low Channel (2412 MHz)									
2412.0	107.42	PK	342	113	V	-3.0	104.38	/	/
2412.0	103.27	Ave	342	113	V	-3.0	100.23	/	/
2412.0	101.88	PK	354	234	H	-3.0	98.84	/	/
2412.0	97.35	Ave	354	234	H	-3.0	94.31	/	/
2390.0	43.20	PK	277	208	V	-3.0	40.16	74	33.84
2390.0	32.09	Ave	277	208	V	-3.0	29.05	54	24.95
2400.0	46.51	PK	151	195	V	-3.0	43.47	74	30.53
2400.0	37.19	Ave	151	195	V	-3.0	34.15	54	19.85
4824.0	34.29	PK	44	250	H	7.2	41.48	74	32.52
4824.0	28.38	Ave	44	250	H	7.2	35.57	54	18.43
6620.0	29.26	PK	312	172	V	13.6	42.84	74	31.16
6620.0	21.20	Ave	312	172	V	13.6	34.78	54	19.22
7236.0	28.96	PK	245	224	H	16.0	44.96	74	29.04
7236.0	24.22	Ave	245	224	H	16.0	40.22	54	13.78

Frequency (MHz)	Receiver		Turntable Degree	Rx Antenna		Corrected Factor (dB)	Corrected Amplitude (dBμV/m)	FCC Part 15.247/205/209	
	Reading (dBμV)	Detector (PK/QP/Ave.)		Height (cm)	Polar (H/V)			Limit (dBμV/m)	Margin (dB)
Middle Channel (2437 MHz)									
2437.0	108.29	PK	59	139	V	-3.0	105.27	/	/
2437.0	104.25	Ave	59	139	V	-3.0	101.23	/	/
2437.0	103.62	PK	165	174	H	-3.0	100.60	/	/
2437.0	98.87	Ave	165	174	H	-3.0	95.85	/	/
1477.0	44.35	PK	86	149	V	-7.0	37.37	74	36.63
1477.0	33.47	Ave	86	149	V	-7.0	26.49	54	27.51
1696.0	43.89	PK	333	109	H	-5.4	38.46	74	35.54
1696.0	34.47	Ave	333	109	H	-5.4	29.04	54	24.96
4874.0	34.41	PK	26	131	V	7.3	41.67	74	32.33
4874.0	30.19	Ave	26	131	V	7.3	37.45	54	16.55
6677.0	31.50	PK	358	194	H	13.8	45.29	74	28.71
6677.0	21.46	Ave	358	194	H	13.8	35.25	54	18.75
7311.0	28.18	PK	267	157	H	16.3	44.51	74	29.49
7311.0	22.97	Ave	267	157	H	16.3	39.30	54	14.70
High Channel (2462 MHz)									
2462.0	109.27	PK	336	168	V	-3.0	106.26	/	/
2462.0	104.68	Ave	336	168	V	-3.0	101.67	/	/
2462.0	104.85	PK	357	154	H	-3.0	101.84	/	/
2462.0	100.69	Ave	357	154	H	-3.0	97.68	/	/
2483.5	44.04	PK	53	219	V	-3.0	41.05	74	32.95
2483.5	33.40	Ave	53	219	V	-3.0	30.41	54	23.59
2563.0	43.31	PK	234	244	V	4.2	47.51	74	26.49
2563.0	36.81	Ave	234	244	V	4.2	41.01	54	12.99
4924.0	32.39	PK	184	227	H	14.0	46.39	74	27.61
4924.0	27.17	Ave	184	227	H	14.0	41.17	54	12.83
6681.0	30.19	PK	225	196	H	13.8	43.99	74	30.01
6681.0	22.97	Ave	225	196	H	13.8	36.77	54	17.23
7386.0	26.89	PK	301	244	H	16.7	43.54	74	30.46
7386.0	21.63	Ave	301	244	H	16.7	38.28	54	15.72

802.11n-HT20 Mode

Frequency (MHz)	Receiver		Turntable Degree	Rx Antenna		Corrected Factor (dB)	Corrected Amplitude (dBμV/m)	FCC Part 15.247/205/209	
	Reading (dBμV)	Detector (PK/QP/Ave.)		Height (cm)	Polar (H/V)			Limit (dBμV/m)	Margin (dB)
Low Channel (2412 MHz)									
2412.0	107.75	PK	82	205	V	-3.0	104.71	/	/
2412.0	103.14	Ave	82	205	V	-3.0	100.10	/	/
2412.0	102.14	PK	105	184	H	-3.0	99.10	/	/
2412.0	97.37	Ave	105	184	H	-3.0	94.33	/	/
2390.0	45.82	PK	89	164	V	-3.0	42.78	74	31.22
2390.0	33.94	Ave	89	164	V	-3.0	30.90	54	23.10
2400.0	44.25	PK	159	144	V	-3.0	41.21	74	32.79
2400.0	35.33	Ave	159	144	V	-3.0	32.29	54	21.71
4824.0	32.56	PK	321	205	H	7.2	39.75	74	34.25
4824.0	27.75	Ave	321	205	H	7.2	34.94	54	19.06
6620.0	30.57	PK	235	179	V	13.6	44.15	74	29.85
6620.0	23.95	Ave	235	179	V	13.6	37.53	54	16.47
7236.0	26.60	PK	251	215	H	16.0	42.60	74	31.40
7236.0	22.47	Ave	251	215	H	16.0	38.47	54	15.53
Middle Channel (2437 MHz)									
2437.0	107.88	PK	182	121	V	-3.0	104.86	/	/
2437.0	103.10	Ave	182	121	V	-3.0	100.08	/	/
2437.0	103.86	PK	359	223	H	-3.0	100.84	/	/
2437.0	98.94	Ave	359	223	H	-3.0	95.92	/	/
1477.0	43.18	PK	159	182	V	-7.0	36.20	74	37.80
1477.0	31.16	Ave	159	182	V	-7.0	24.18	54	29.82
1696.0	44.99	PK	84	210	H	-5.4	39.56	74	34.44
1696.0	37.76	Ave	84	210	H	-5.4	32.33	54	21.67
4874.0	33.06	PK	186	154	V	7.3	40.32	74	33.68
4874.0	28.57	Ave	186	154	V	7.3	35.83	54	18.17
6677.0	29.04	PK	164	112	H	13.8	42.83	74	31.17
6677.0	21.23	Ave	164	112	H	13.8	35.02	54	18.98
7311.0	26.29	PK	293	177	H	16.3	42.62	74	31.38
7311.0	22.18	Ave	293	177	H	16.3	38.51	54	15.49

Frequency (MHz)	Receiver		Turntable Degree	Rx Antenna		Corrected Factor (dB)	Corrected Amplitude (dBμV/m)	FCC Part 15.247/205/209	
	Reading (dBμV)	Detector (PK/QP/Ave.)		Height (cm)	Polar (H/V)			Limit (dBμV/m)	Margin (dB)
High Channel (2462 MHz)									
2462.0	106.20	PK	108	246	V	-3.0	103.19	/	/
2462.0	102.12	Ave	108	246	V	-3.0	99.11	/	/
2462.0	102.93	PK	290	111	H	-3.0	99.92	/	/
2462.0	98.41	Ave	290	111	H	-3.0	95.40	/	/
2483.5	43.76	PK	15	104	V	-3.0	40.77	74	33.23
2483.5	33.81	Ave	15	104	V	-3.0	30.82	54	23.18
2563.0	42.04	PK	127	139	V	4.2	46.24	74	27.76
2563.0	35.95	Ave	127	139	V	4.2	40.15	54	13.85
4924.0	33.77	PK	189	170	H	14.0	47.77	74	26.23
4924.0	29.20	Ave	189	170	H	14.0	43.20	54	10.80
6681.0	29.35	PK	343	130	H	13.8	43.15	74	30.85
6681.0	21.32	Ave	343	130	H	13.8	35.12	54	18.88
7386.0	28.71	PK	30	168	H	16.7	45.36	74	28.64
7386.0	23.23	Ave	30	168	H	16.7	39.88	54	14.12

802.11n-HT40 Mode

Frequency (MHz)	Receiver		Turntable Degree	Rx Antenna		Corrected Factor (dB)	Corrected Amplitude (dBμV/m)	FCC Part 15.247/205/209	
	Reading (dBμV)	Detector (PK/QP/Ave.)		Height (cm)	Polar (H/V)			Limit (dBμV/m)	Margin (dB)
Low Channel (2422 MHz)									
2422.0	105.20	PK	307	180	V	-3.0	102.16	/	/
2422.0	98.28	Ave	307	180	V	-3.0	95.24	/	/
2422.0	100.70	PK	197	176	H	-3.0	97.66	/	/
2422.0	94.54	Ave	197	176	H	-3.0	91.50	/	/
2390.0	44.23	PK	219	125	V	-3.0	41.19	74	32.81
2390.0	32.11	Ave	219	125	V	-3.0	29.07	54	24.93
2400.0	44.16	PK	311	150	V	-3.0	41.12	74	32.88
2400.0	34.04	Ave	311	150	V	-3.0	31.00	54	23.00
4844.0	33.47	PK	14	102	H	7.2	40.66	74	33.34
4844.0	26.63	Ave	14	102	H	7.2	33.82	54	20.18
6620.0	29.23	PK	310	159	V	13.6	42.81	74	31.19
6620.0	22.92	Ave	310	159	V	13.6	36.50	54	17.50
7266.0	27.65	PK	211	116	H	16.0	43.65	74	30.35
7266.0	20.46	Ave	211	116	H	16.0	36.46	54	17.54

Frequency (MHz)	Receiver		Turntable Degree	Rx Antenna		Corrected Factor (dB)	Corrected Amplitude (dBμV/m)	FCC Part 15.247/205/209	
	Reading (dBμV)	Detector (PK/QP/Ave.)		Height (cm)	Polar (H/V)			Limit (dBμV/m)	Margin (dB)
Middle Channel (2437MHz)									
2437.0	105.13	PK	91	216	V	-3.0	102.11	/	/
2437.0	98.32	Ave	91	216	V	-3.0	95.30	/	/
2437.0	100.29	PK	350	142	H	-3.0	97.27	/	/
2437.0	94.13	Ave	350	142	H	-3.0	91.11	/	/
1477.0	43.15	PK	244	131	V	-7.0	36.17	74	37.83
1477.0	30.40	Ave	244	131	V	-7.0	23.42	54	30.58
1696.0	45.52	PK	343	187	H	-5.4	40.09	74	33.91
1696.0	34.35	Ave	343	187	H	-5.4	28.92	54	25.08
4874.0	33.17	PK	48	205	V	7.3	40.43	74	33.57
4874.0	26.19	Ave	48	205	V	7.3	33.45	54	20.55
6677.0	29.16	PK	19	228	H	13.8	42.95	74	31.05
6677.0	22.94	Ave	19	228	H	13.8	36.73	54	17.27
7311.0	27.54	PK	341	106	H	16.3	43.87	74	30.13
7311.0	20.48	Ave	341	106	H	16.3	36.81	54	17.19
High Channel (2452MHz)									
2452.0	99.38	PK	315	246	V	3.0	102.38	/	/
2452.0	92.95	Ave	315	246	V	3.0	95.95	/	/
2452.0	93.49	PK	132	122	H	3.0	96.49	/	/
2452.0	86.50	Ave	132	122	H	3.0	89.50	/	/
2483.5	43.54	PK	280	117	V	3.2	46.74	74	27.26
2483.5	33.97	Ave	280	117	V	3.2	37.17	54	16.83
2563.0	45.15	PK	25	113	V	4.2	49.35	74	24.65
2563.0	34.24	Ave	25	113	V	4.2	38.44	54	15.56
4904.0	34.17	PK	20	171	H	14.0	48.17	74	25.83
4904.0	26.46	Ave	20	171	H	14.0	40.46	54	13.54
6681.0	30.51	PK	88	209	H	13.8	44.31	74	29.69
6681.0	23.83	Ave	88	209	H	13.8	37.63	54	16.37
7356.0	28.88	PK	7	211	H	16.7	45.53	74	28.47
7356.0	22.80	Ave	7	211	H	16.7	39.45	54	14.55

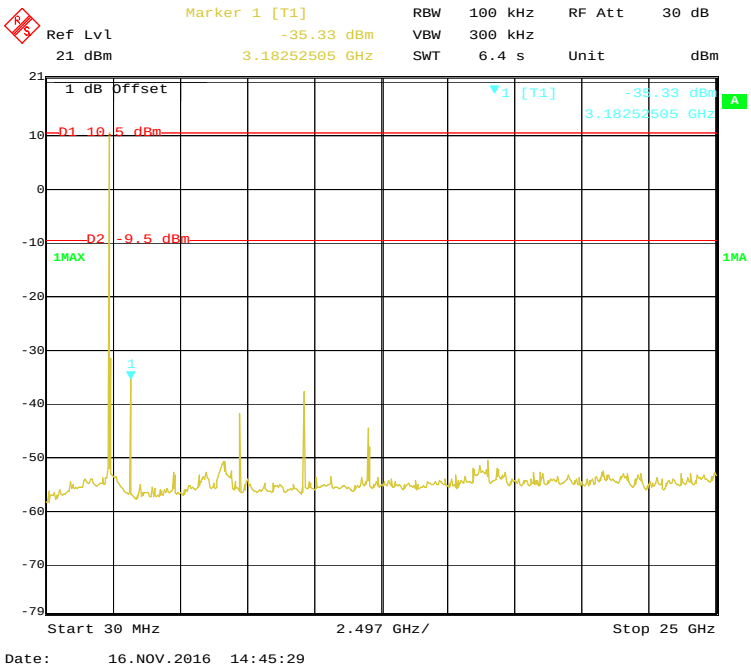
BLE Mode:

Frequency (MHz)	Receiver		Turntable Degree	Rx Antenna		Corrected Factor (dB)	Corrected Amplitude (dBμV/m)	FCC Part 15.247/205/209	
	Reading (dBμV)	Detector (PK/QP/Ave.)		Height (cm)	Polar (H/V)			Limit (dBμV/m)	Margin (dB)
Low Channel (2402 MHz)									
2402.0	101.55	PK	195	160	V	-3.4	98.15	/	/
2402.0	96.60	Ave	195	160	V	-3.4	93.20	/	/
2402.0	98.32	PK	46	191	H	-3.4	94.92	/	/
2402.0	93.93	Ave	46	191	H	-3.4	90.53	/	/
2390.0	45.65	PK	81	249	V	-3.4	42.25	74	31.75
2390.0	30.32	Ave	81	249	V	-3.4	26.92	54	27.08
2400.0	42.36	PK	281	199	V	-3.4	38.96	74	35.04
2400.0	35.85	Ave	281	199	V	-3.4	32.45	54	21.55
1613.7	34.53	PK	315	121	H	-6.0	28.52	74	45.48
1613.7	29.84	Ave	315	121	H	-6.0	23.83	54	30.17
4804.0	30.10	PK	72	205	V	7.2	37.26	74	36.74
4804.0	21.45	Ave	72	205	V	7.2	28.61	54	25.39
7236.0	26.76	PK	277	115	H	16.0	42.76	74	31.24
7236.0	21.78	Ave	277	115	H	16.0	37.78	54	16.22
Frequency (MHz)	Receiver		Turntable Degree	Rx Antenna		Corrected Factor (dB)	Corrected Amplitude (dBμV/m)	FCC Part 15.247/205/209	
	Reading (dBμV)	Detector (PK/QP/Ave.)		Height (cm)	Polar (H/V)			Limit (dBμV/m)	Margin (dB)
Middle Channel (2440MHz)									
2440.0	102.61	PK	50	107	V	-3.0	99.59	/	/
2440.0	97.66	Ave	50	107	V	-3.0	94.64	/	/
2440.0	96.98	PK	304	183	H	-3.0	93.96	/	/
2440.0	92.44	Ave	304	183	H	-3.0	89.42	/	/
1477.0	44.13	PK	77	248	V	-7.0	37.15	74	36.85
1477.0	31.79	Ave	77	248	V	-7.0	24.81	54	29.19
1696.0	46.63	PK	340	211	H	-5.4	41.20	74	32.80
1696.0	36.75	Ave	340	211	H	-5.4	31.32	54	22.68
4880.0	33.95	PK	13	220	V	7.3	41.21	74	32.79
4880.0	28.88	Ave	13	220	V	7.3	36.14	54	17.86
6677.0	30.30	PK	216	130	H	13.8	44.09	74	29.91
6677.0	21.92	Ave	216	130	H	13.8	35.71	54	18.29
7320.0	28.17	PK	223	223	H	16.3	44.50	74	29.50
7320.0	22.50	Ave	223	223	H	16.3	38.83	54	15.17

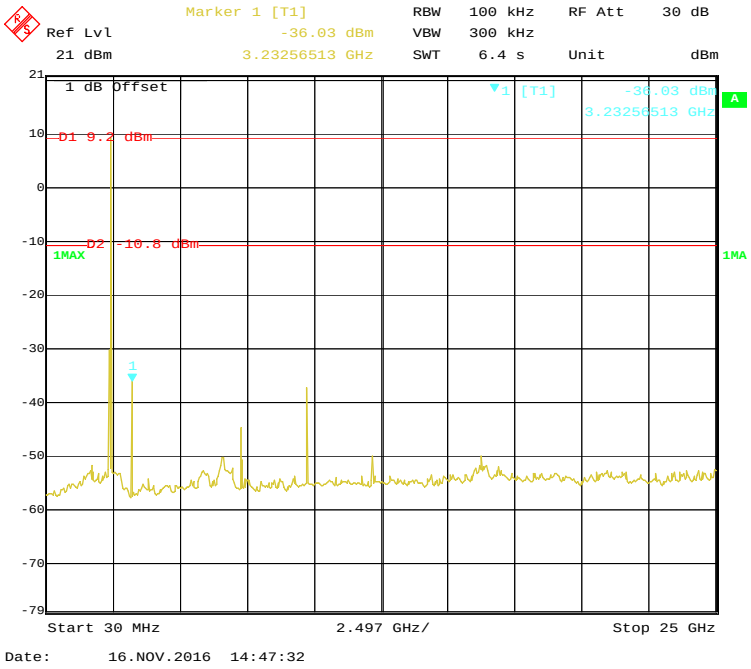
Frequency (MHz)	Receiver		Turntable Degree	Rx Antenna		Corrected Factor (dB)	Corrected Amplitude (dBμV/m)	FCC Part 15.247/205/209	
	Reading (dBμV)	Detector (PK/QP/Ave.)		Height (cm)	Polar (H/V)			Limit (dBμV/m)	Margin (dB)
High Channel (2480 MHz)									
2480.0	103.31	PK	230	235	V	-3.0	100.32	/	/
2480.0	98.75	Ave	230	235	V	-3.0	95.76	/	/
2480.0	98.06	PK	297	107	H	-3.0	95.07	/	/
2480.0	93.62	Ave	297	107	H	-3.0	90.63	/	/
2483.5	42.89	PK	326	249	V	-3.0	39.90	74	34.10
2483.5	32.38	Ave	326	249	V	-3.0	29.39	54	24.61
2563.0	44.44	PK	86	147	V	-2.6	41.84	74	32.16
2563.0	37.09	Ave	86	147	V	-2.6	34.49	54	19.51
4960.0	33.35	PK	342	202	H	14.0	47.35	74	26.65
4960.0	27.63	Ave	342	202	H	14.0	41.63	54	12.37
6681.0	29.52	PK	233	235	H	7.4	36.92	74	37.08
6681.0	23.23	Ave	233	235	H	7.4	30.63	54	23.37
7386.0	27.23	PK	85	246	H	19.8	47.03	74	26.97
7386.0	23.14	Ave	85	246	H	19.8	42.94	54	11.06

Spurious Emissions at Antenna Port

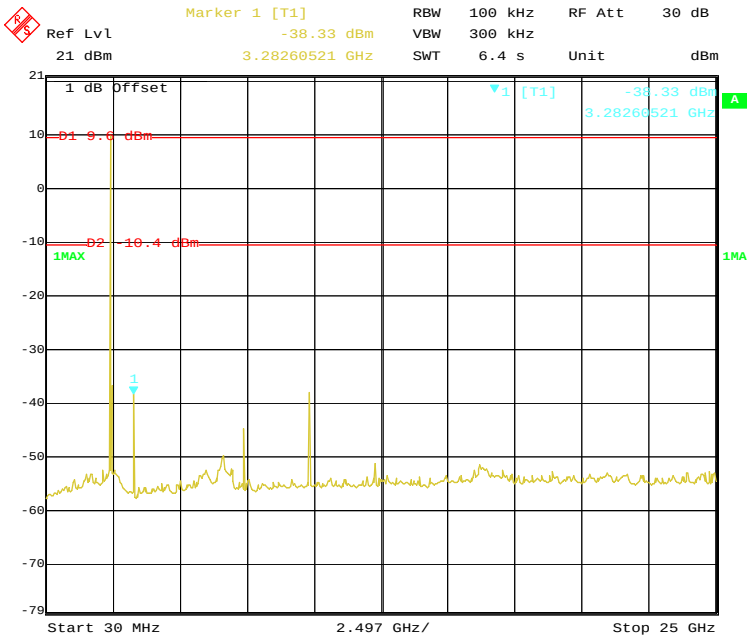
802.11b Low Channel



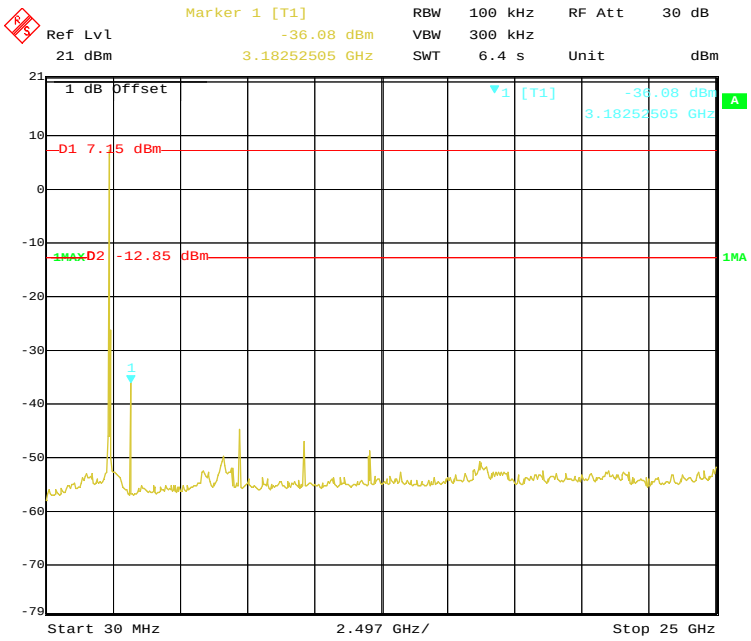
802.11b Middle Channel



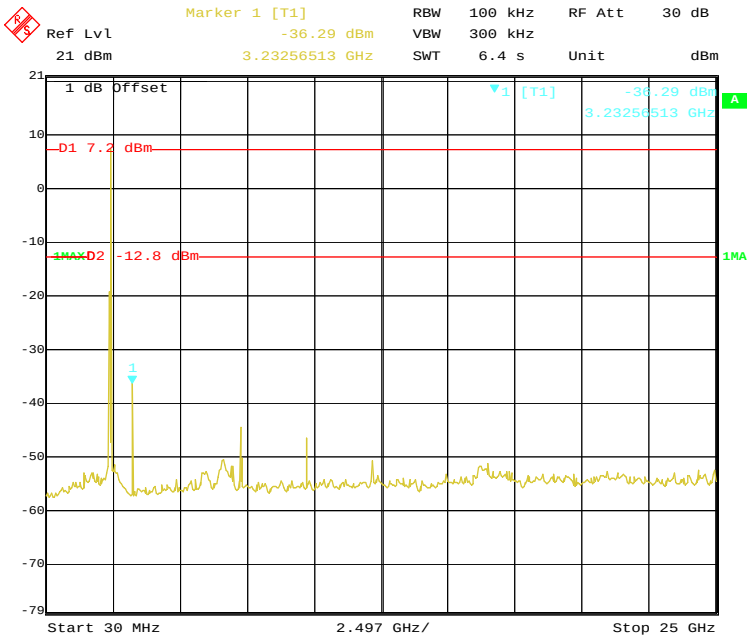
802.11b High Channel



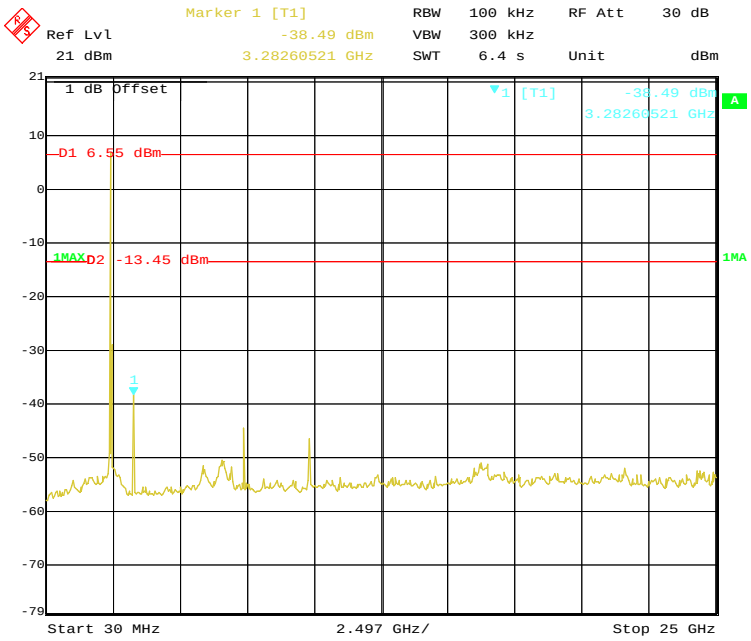
802.11g Low Channel



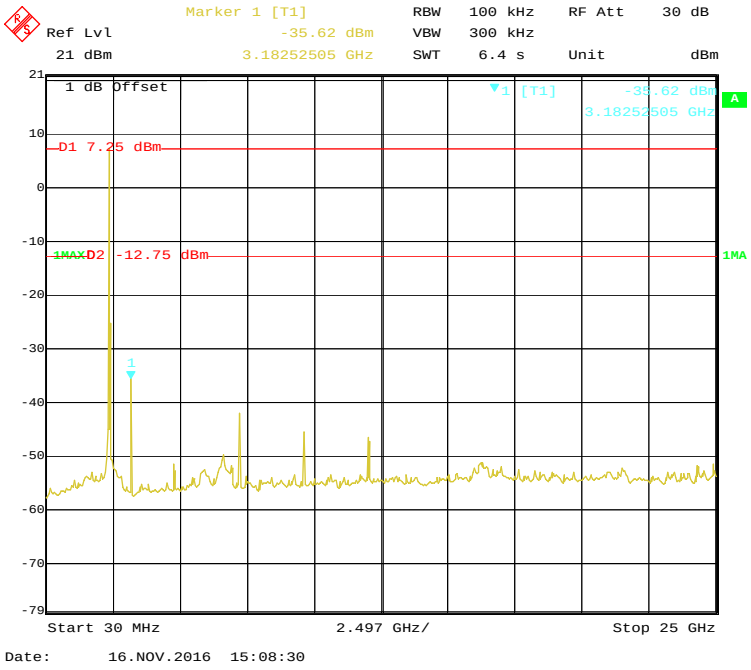
802.11g Middle Channel



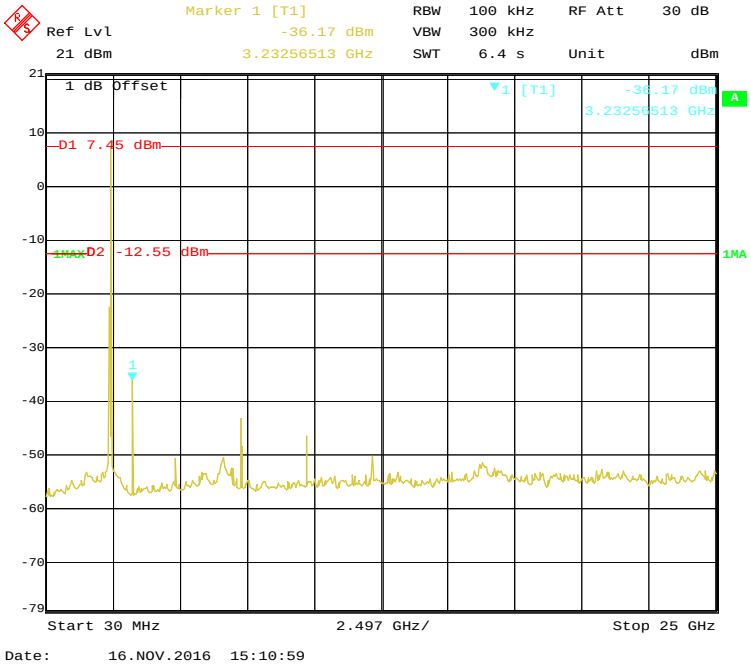
802.11g High Channel



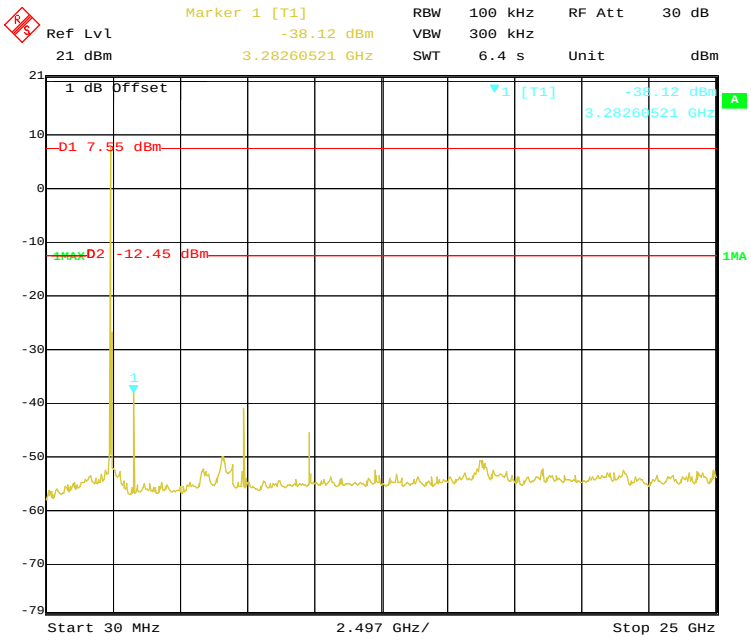
802.11n-HT20 Low Channel



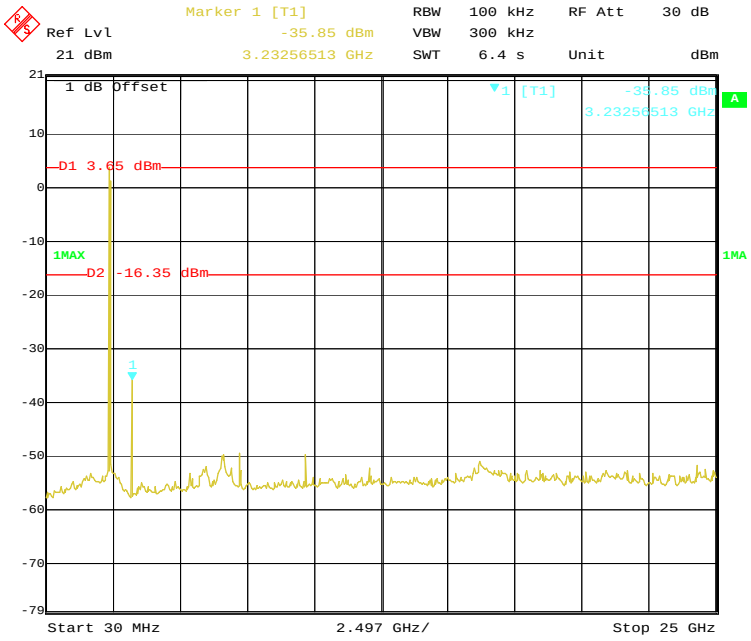
802.11n-HT20 Middle Channel



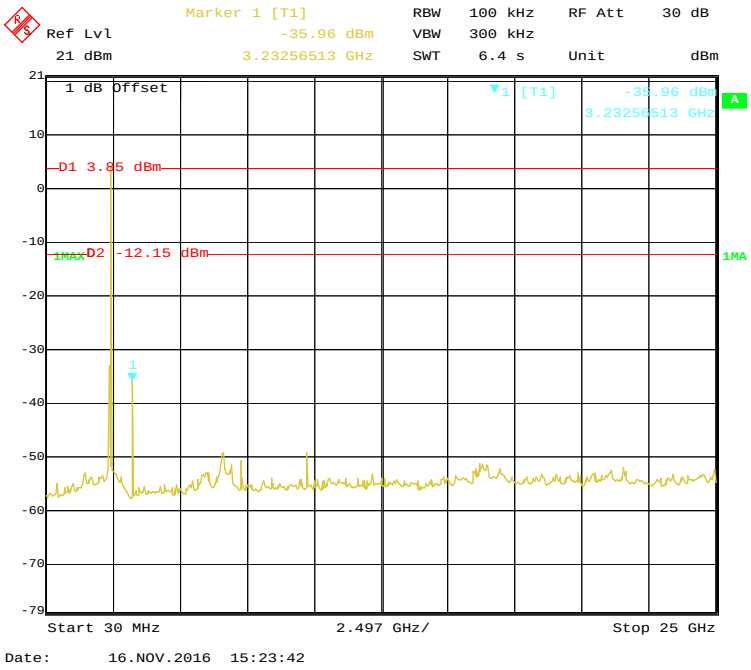
802.11n-HT20 High Channel



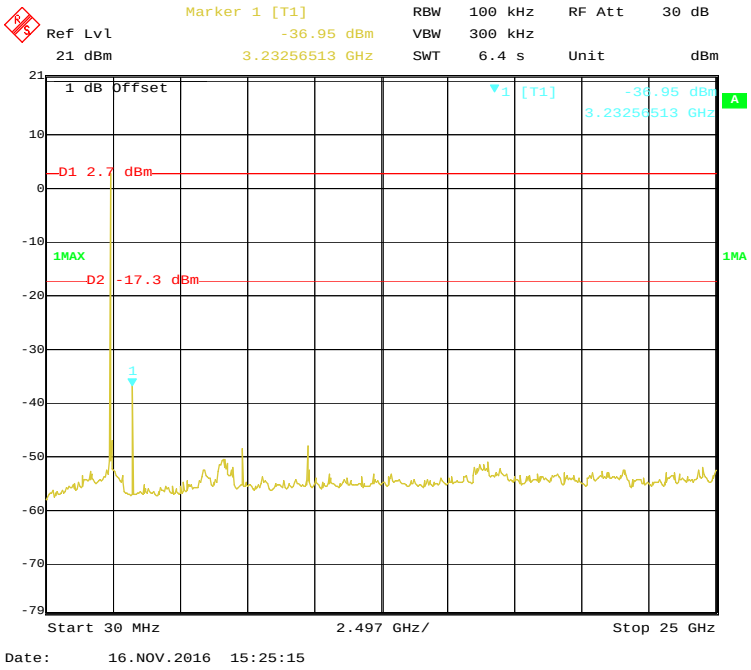
802.11n-HT40 Low Channel



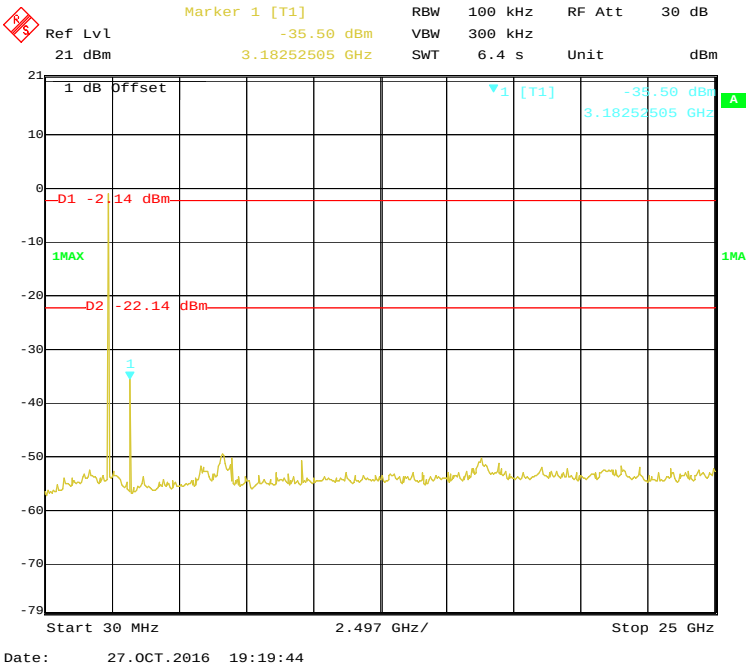
802.11n-HT40 Middle Channel



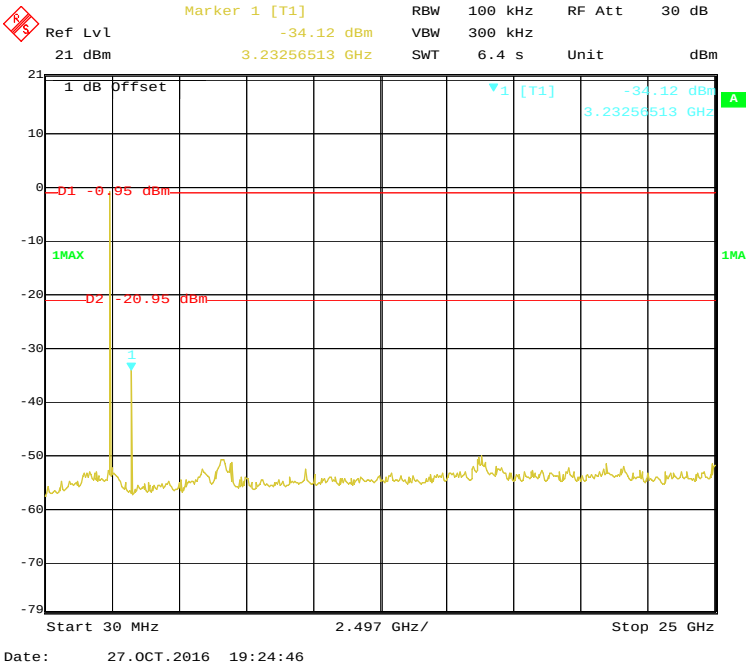
802.11n-HT40 High Channel



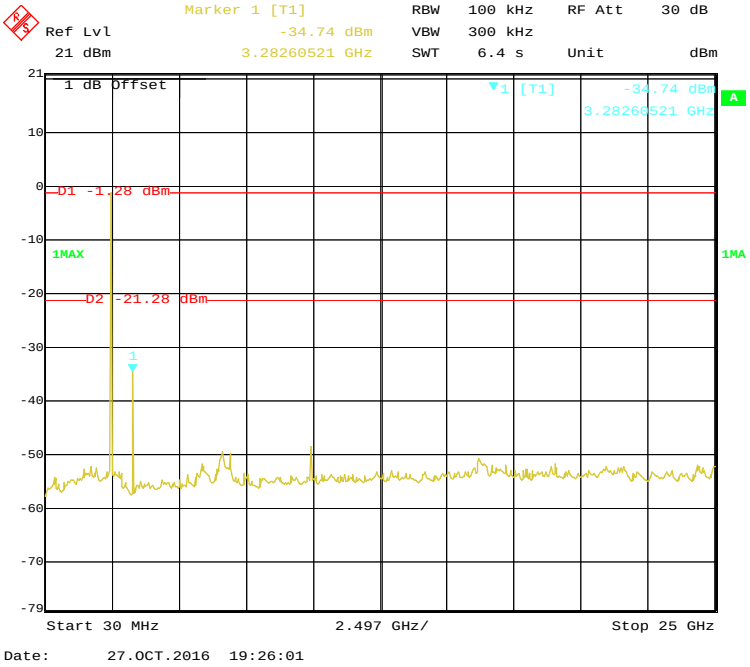
BLE Low Channel



BLE Middle Channel



BLE High Channel



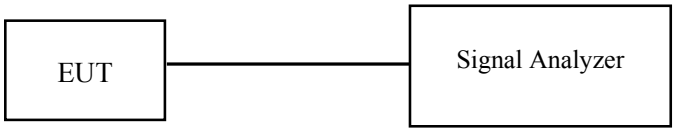
FCC §15.247(a) (2) – 6 dB EMISSION BANDWIDTH

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 Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Rohde & Schwarz	Signal Analyzer	FSIQ26	836131/009	2016-09-21	2017-09-21
BACL	RF cable	KS-LAB-012	KS-LAB-012	2015-12-16	2016-12-15

*** 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).

Test Data

Environmental Conditions

Temperature:	27 ℃
Relative Humidity:	55 %
ATM Pressure:	101.0 kPa

The testing was performed by Peter Jiang on 2016-10-16 to 2016-10-17.

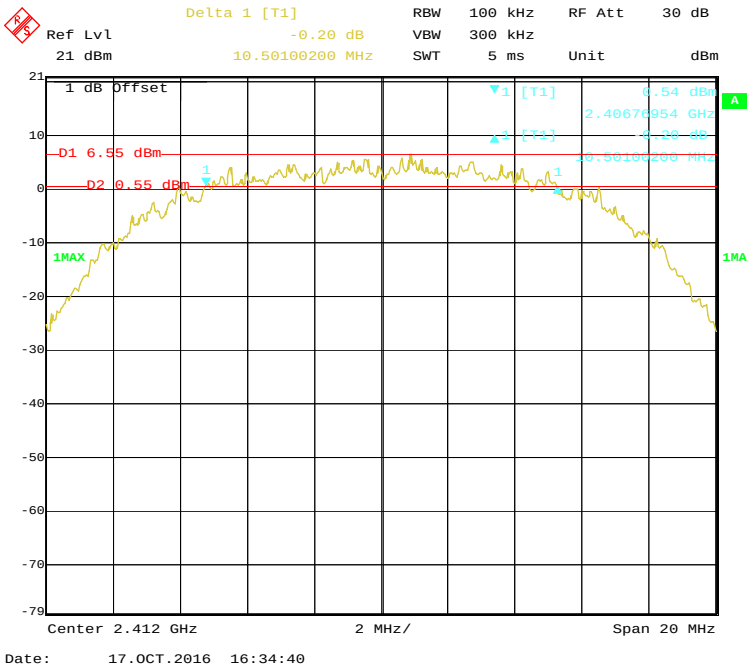
Test Result: Pass.

Please refer to the following tables and plots.

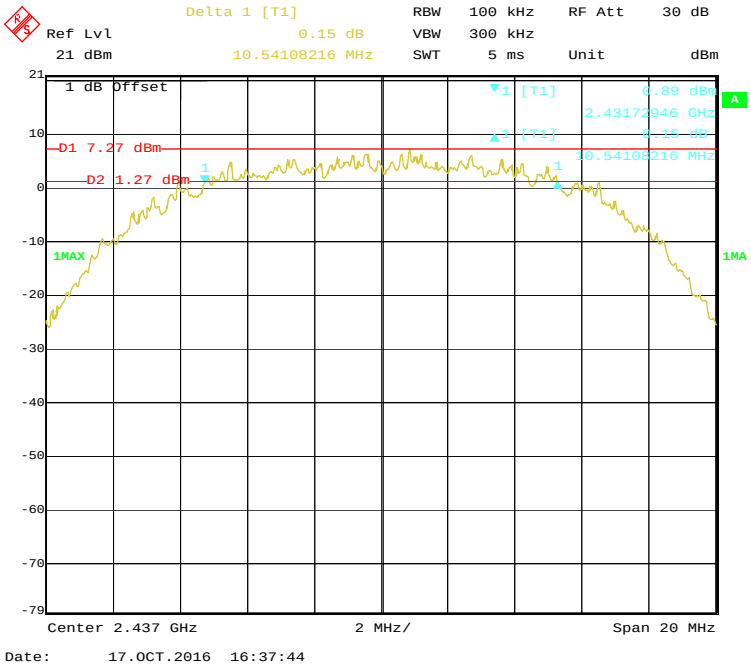
EUT operation mode: Transmitting

Channel	Frequency (MHz)	6 dB Emission Bandwidth (MHz)	Limit (kHz)
802.11b mode			
Low	2412	10.50	≥500
Middle	2437	10.54	≥500
High	2462	10.54	≥500
802.11g mode			
Low	2412	16.43	≥500
Middle	2437	16.43	≥500
High	2462	16.43	≥500
802.11n-HT20 mode			
Low	2412	17.68	≥500
Middle	2437	17.56	≥500
High	2462	17.64	≥500
802.11n-HT40 mode			
Low	2422	36.55	≥500
Middle	2437	36.55	≥500
High	2452	36.55	≥500
BLE mode			
Low	2402	0.691	≥500
Middle	2440	0.697	≥500
High	2480	0.691	≥500

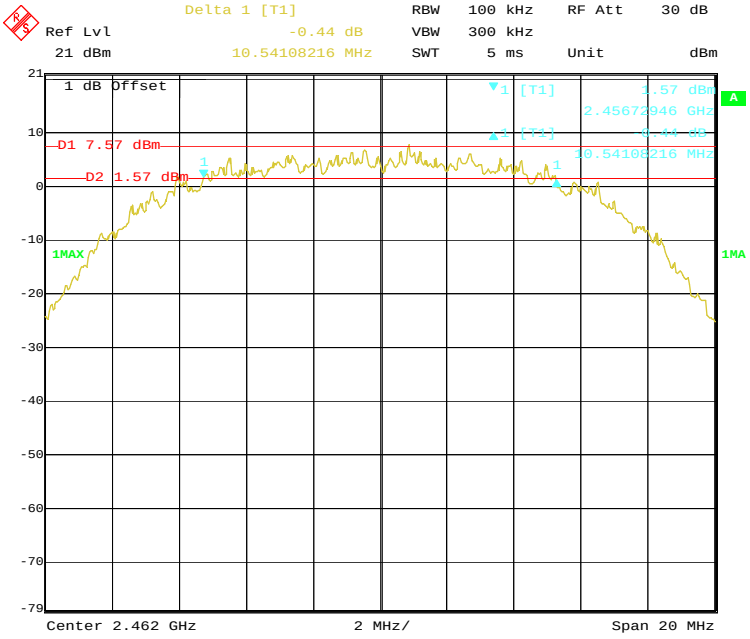
802.11b Low Channel



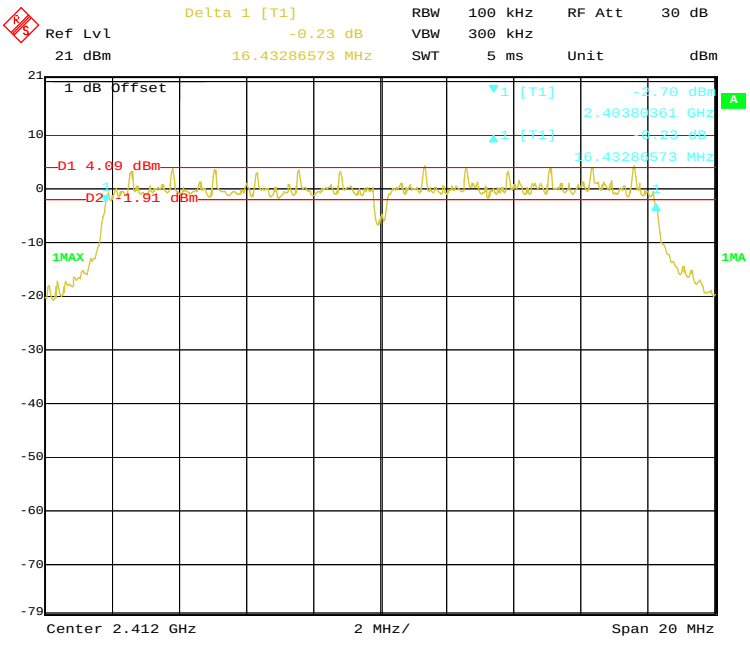
802.11b Middle Channel



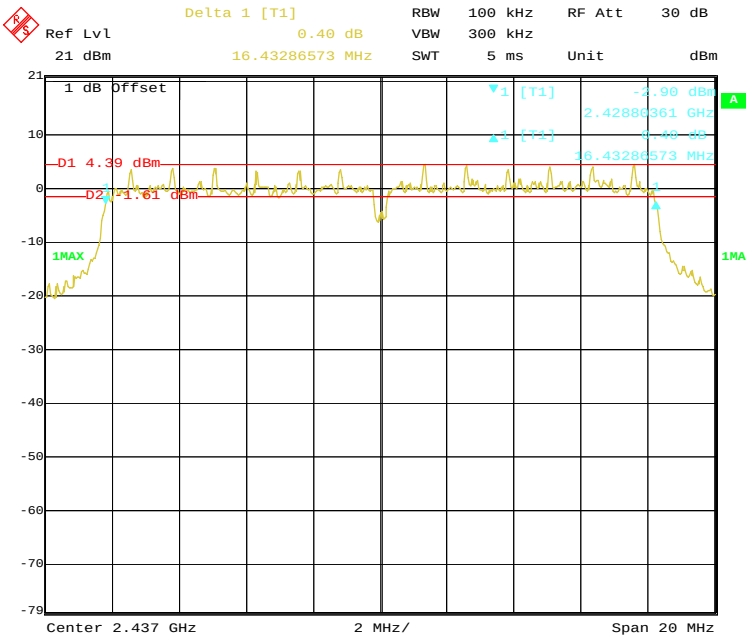
802.11b High Channel



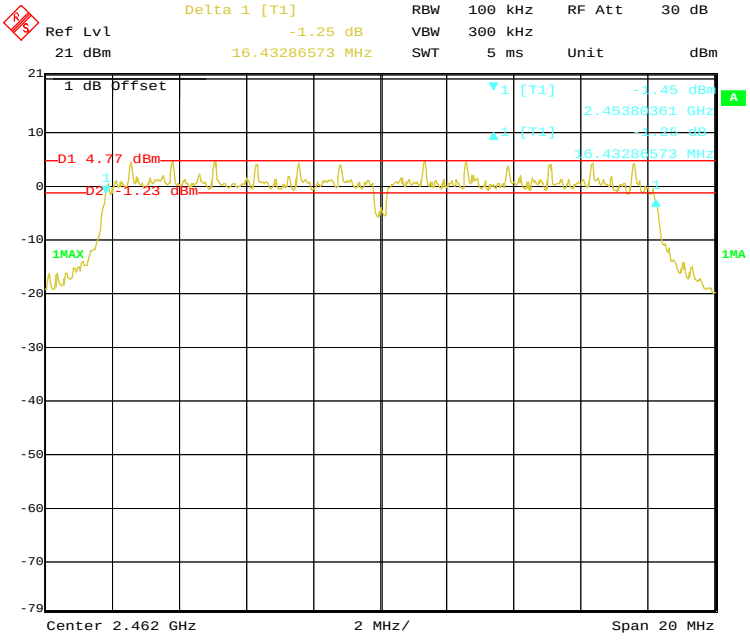
802.11g Low Channel



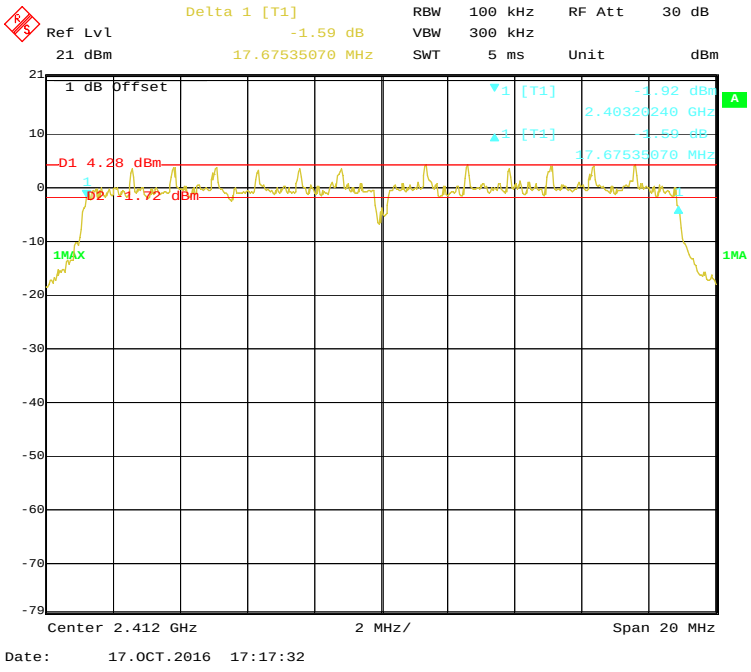
802.11g Middle Channel



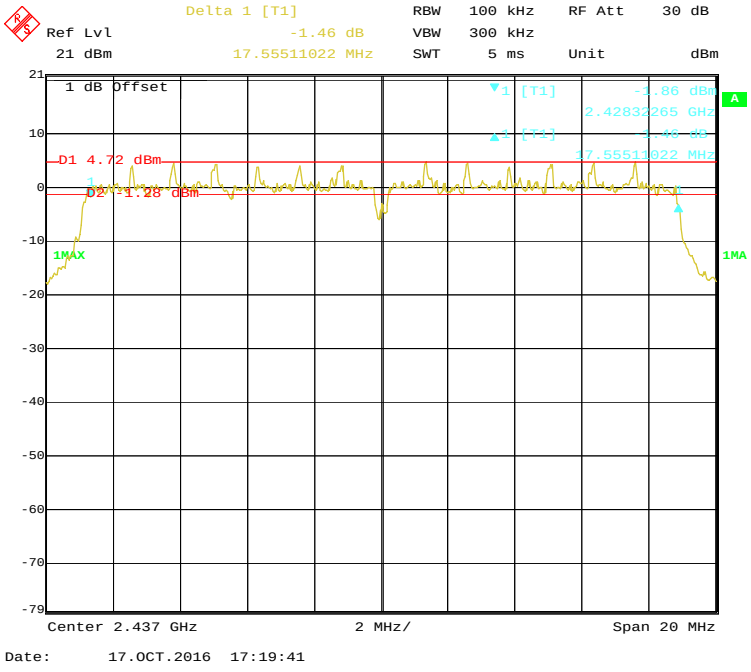
802.11g High Channel



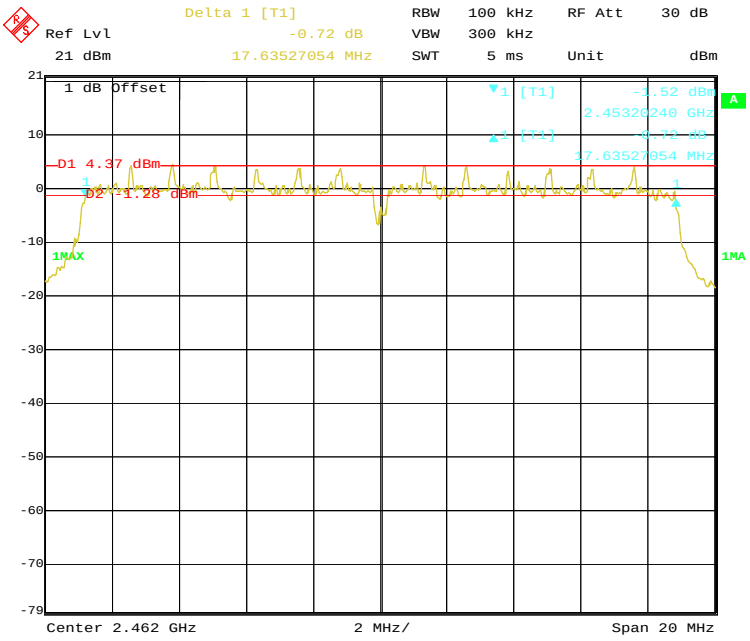
802.11n-HT20 Low Channel



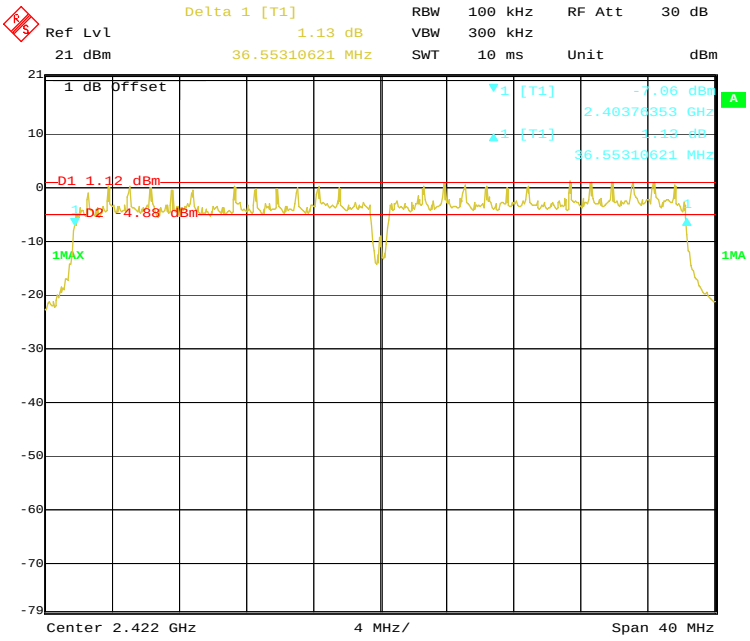
802.11n-HT20 Middle Channel



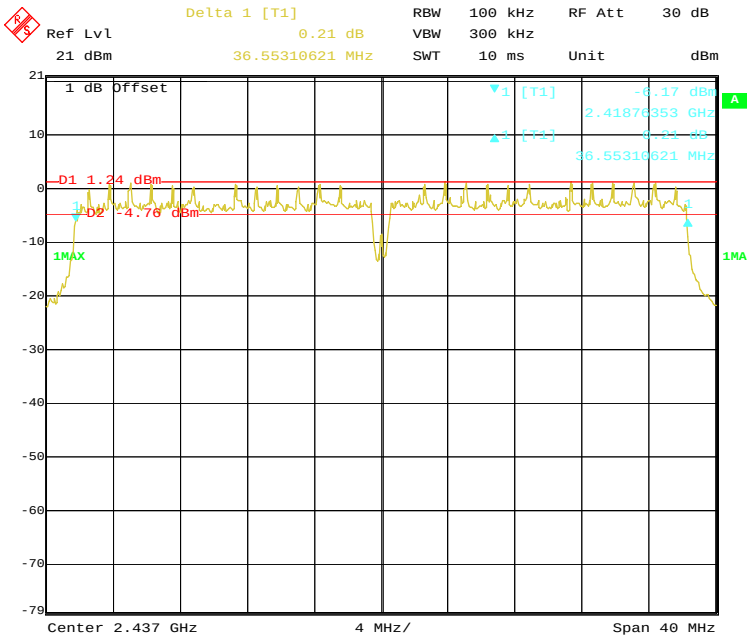
802.11n-HT20 High Channel



802.11n-HT40 Low Channel

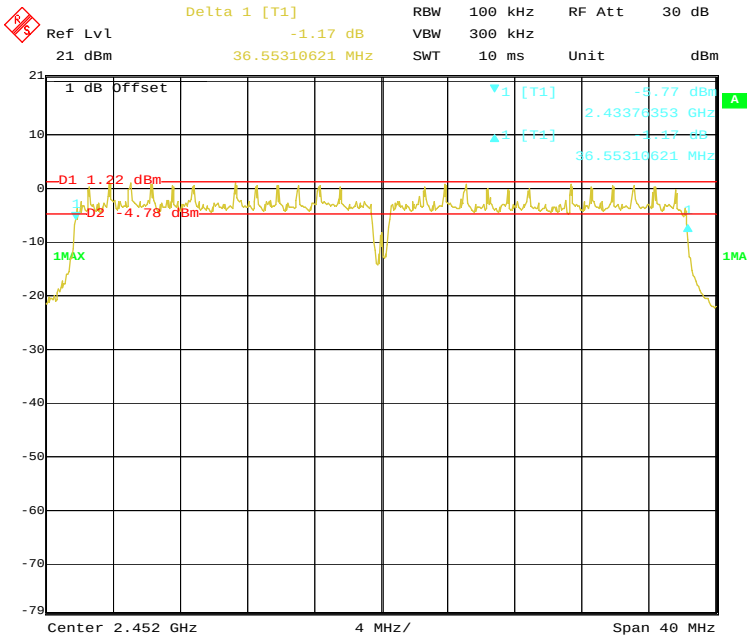


802.11n-HT40 Middle Channel



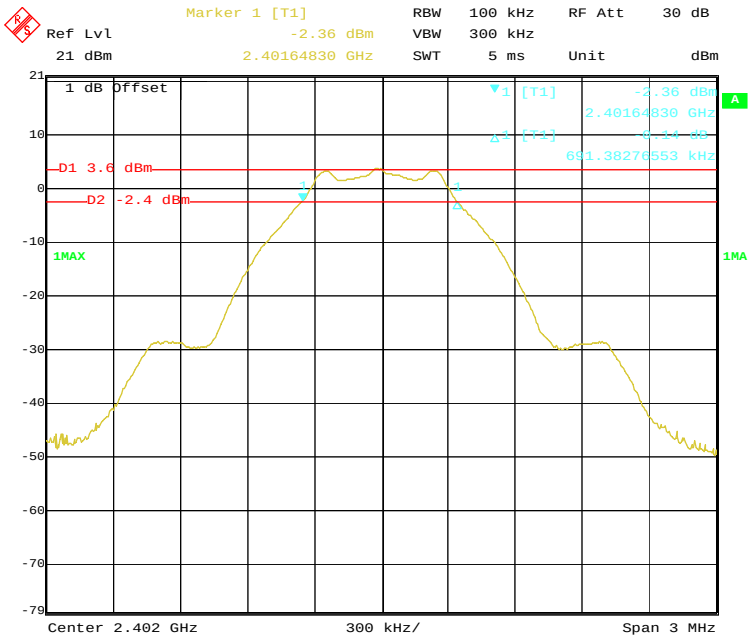
Date: 17.OCT.2016 17:37:28

802.11n-HT40 High Channel



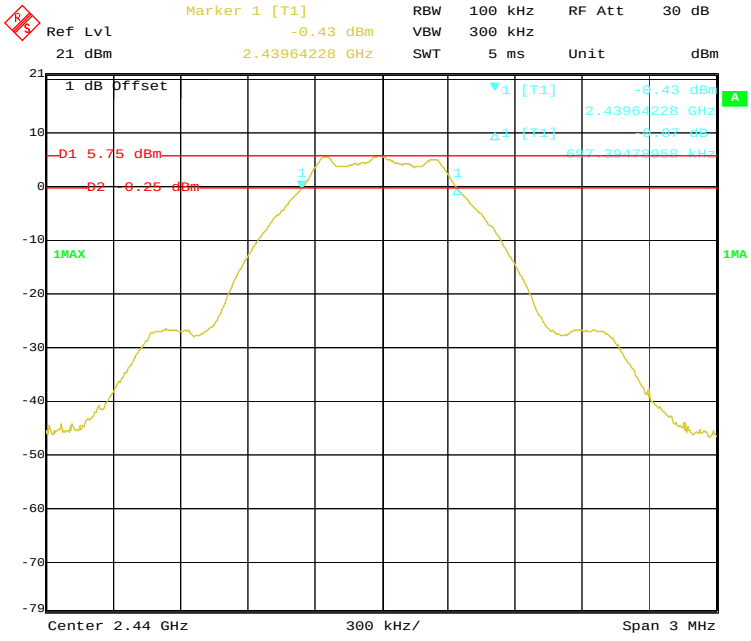
Date: 17.OCT.2016 17:39:56

BLE Low Channel



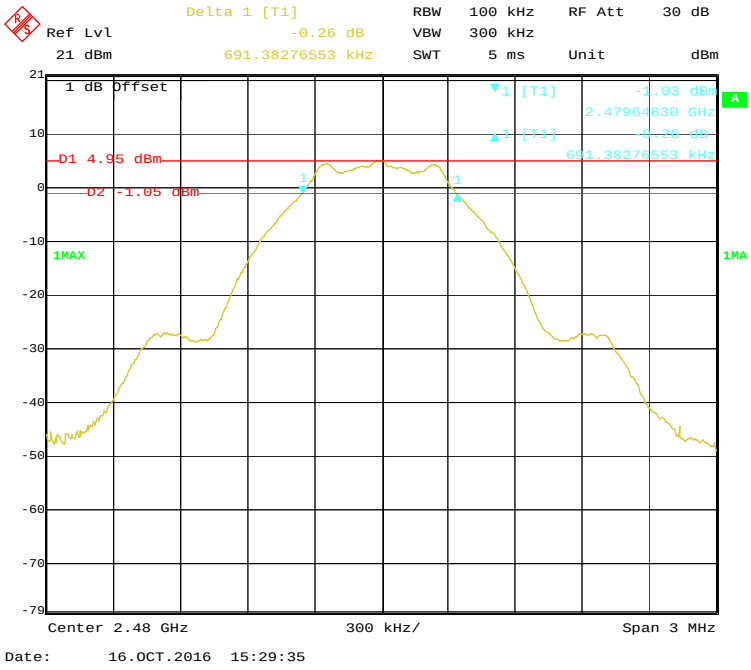
Date: 16.OCT.2016 15:15:08

BLE Middle Channel



Date: 16.OCT.2016 15:24:43

BLE High Channel



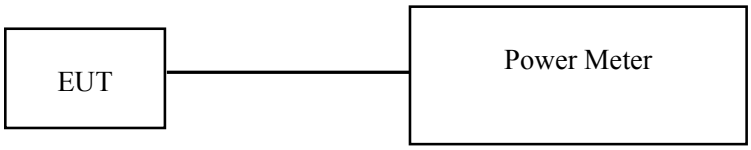
FCC §15.247(b) (3) - MAXIMUM CONDUCTED OUTPUT POWER

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 Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Rohde & Schwarz	OSP120 BASE UNIT	OSP120	101247	2016-07-04	2017-07-03
Agilent	Power Sensor	N1921A	MY54210016	2015-12-18	2016-12-17
Rohde & Schwarz	Signal Analyzer	FSIQ26	836131/009	2016-09-21	2017-09-21
BACL	RF cable	KS-LAB-012	KS-LAB-012	2015-12-16	2016-12-15

*** 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).

Test Data

Environmental Conditions

Temperature:	27 ℃
Relative Humidity:	55 %
ATM Pressure:	101.0 kPa

The testing was performed by Peter Jiang on 2016-10-20&2016-10-16.

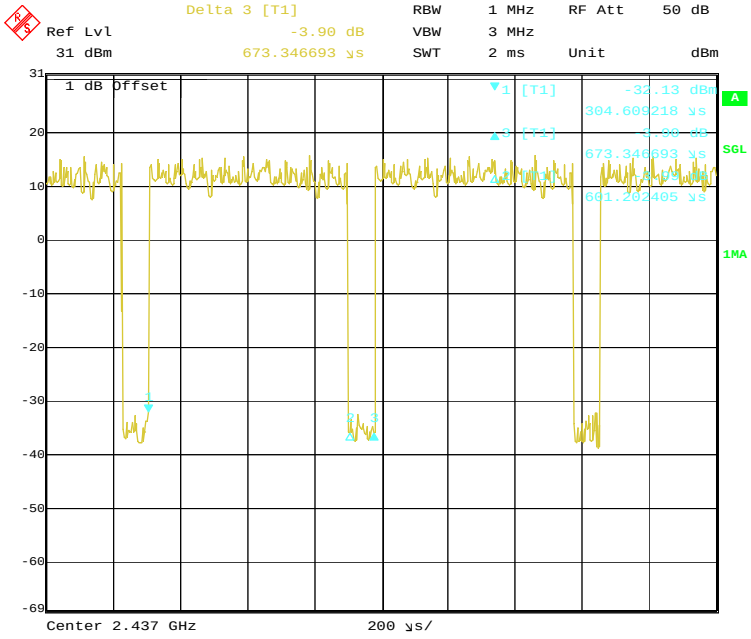
EUT operation mode: Transmitting

Wi-Fi Mode：

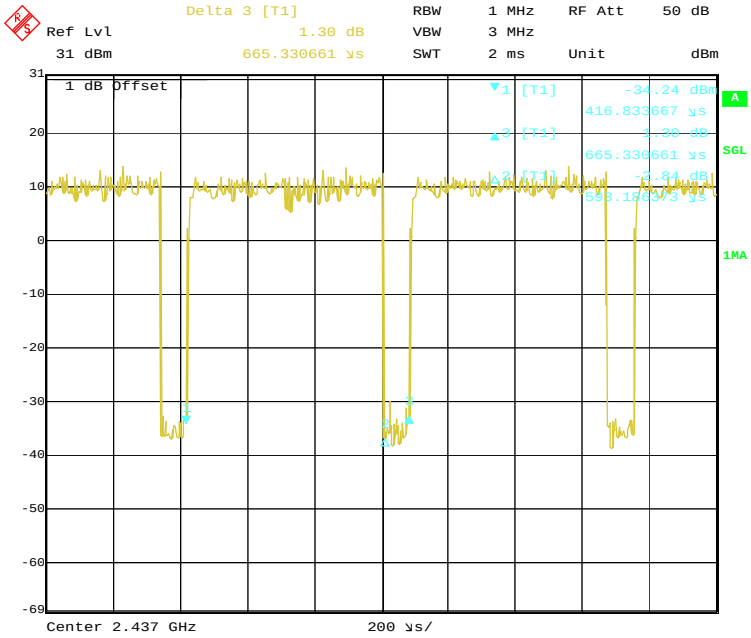
Channel	Frequency (MHz)	Max Conducted Peak Output Power (dBm)	Conducted Average Output Power Reading (dBm)	Corrected Factor 10log(1/x) (dB)	Conducted Average Output Power (dBm)	Limit (dBm)	Result
802.11b							
Low	2412	21.75	15.73	0.89	16.62	30	Pass
Middle	2437	21.48	15.43	0.89	16.32	30	Pass
High	2462	21.59	15.54	0.89	16.43	30	Pass
802.11g							
Low	2412	21.49	15.12	0.89	16.01	30	Pass
Middle	2437	21.48	15.03	0.89	15.92	30	Pass
High	2462	20.82	14.51	0.89	15.40	30	Pass
802.11n-HT20							
Low	2412	21.61	14.90	0.89	15.79	30	Pass
Middle	2437	21.26	14.58	0.89	15.47	30	Pass
High	2462	21.81	14.39	0.89	15.28	30	Pass
802.11n-HT40							
Low	2422	20.91	13.46	0.89	14.35	30	Pass
Middle	2437	20.37	12.94	0.89	13.83	30	Pass
High	2452	20.02	12.92	0.89	13.81	30	Pass

Note: x is the duty cycle. For 802.11b: x=0.893, 11g: x=0.892, 802.11n20: x=0.888, 802.11n40: x=0.891.
Conducted Average Output Power= Reading+ Corrected Factor
The reading value is reading from the test software.

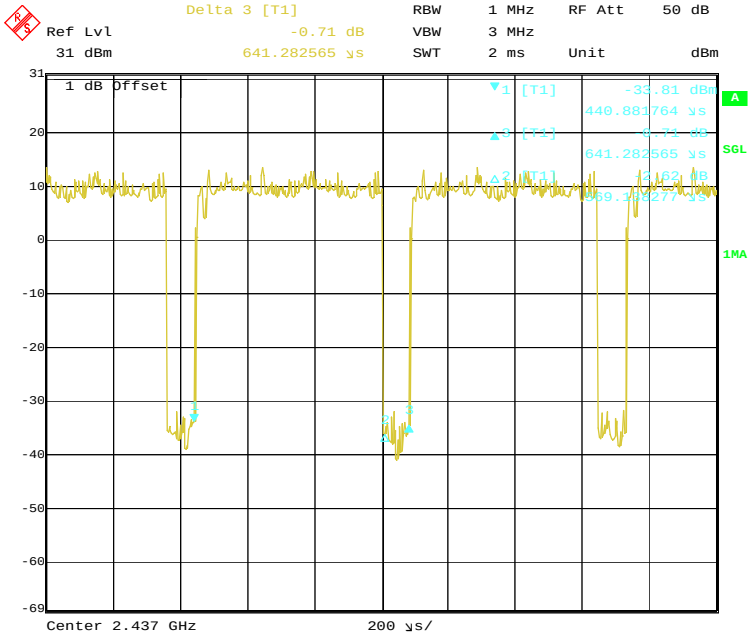
802.11b Mode Middle Channel



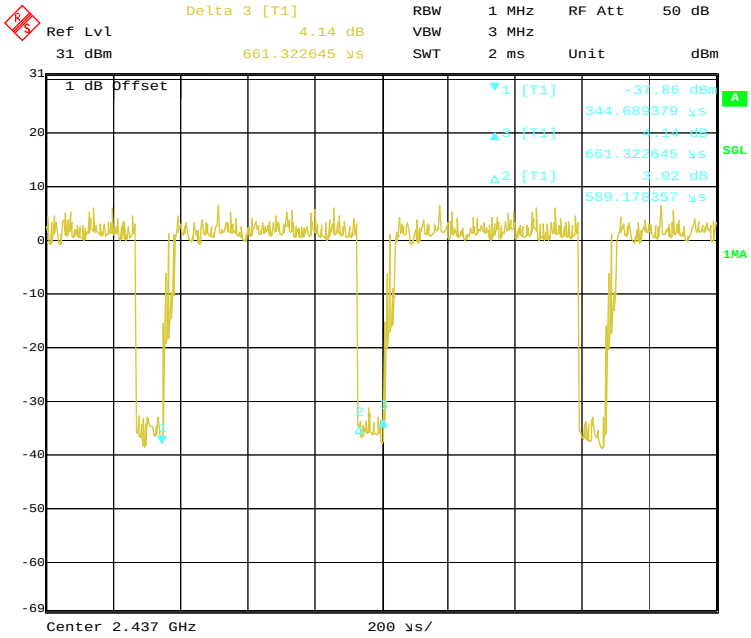
802.11g Mode Middle Channel



802.11n20 Mode Middle Channel



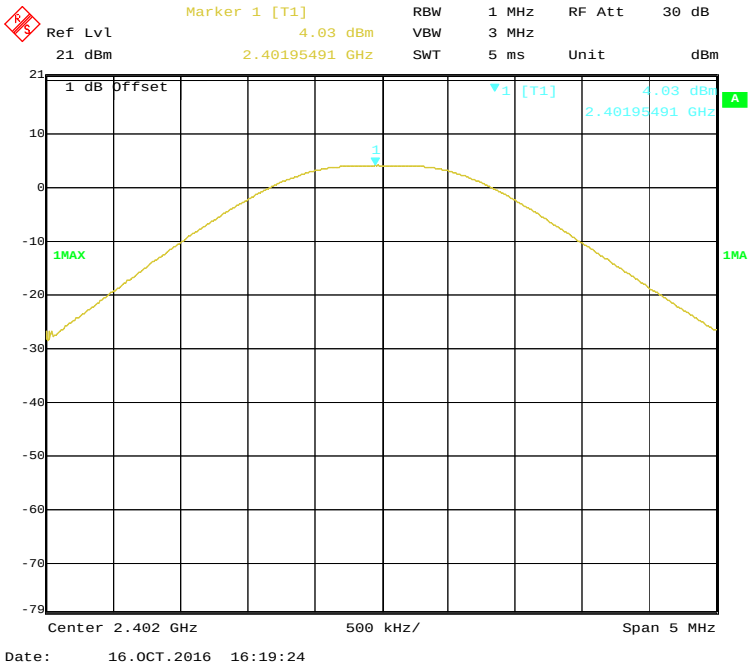
802.11n40 Mode Middle Channel



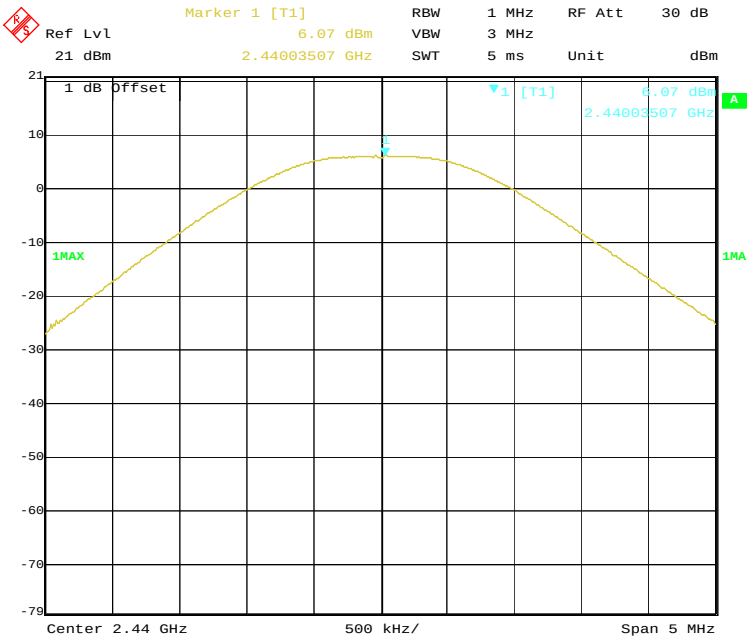
BLE Mode：

Channel	Frequency (MHz)	Max Conducted Average Output Power (dBm)	Max Conducted Peak Output Power (dBm)	Limit (dBm)	Result
Low	2402	1.94	4.03	30	Pass
Middle	2440	2.36	6.07	30	Pass
High	2480	2.01	5.35	30	Pass

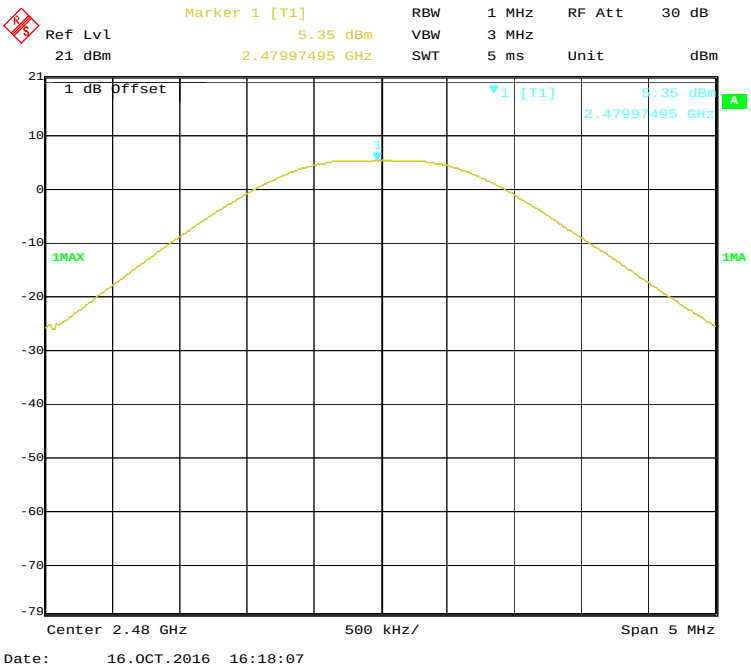
BLE Low Channel



BLE Middle Channel



BLE 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 Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Rohde & Schwarz	Signal Analyzer	FSIQ26	836131/009	2016-09-21	2017-09-21
BACL	TS 8997 Cable-01	T-KS-EMC086	T-KS-EMC086	2015-12-10	2016-12-09

*** 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).

Test Data

Environmental Conditions

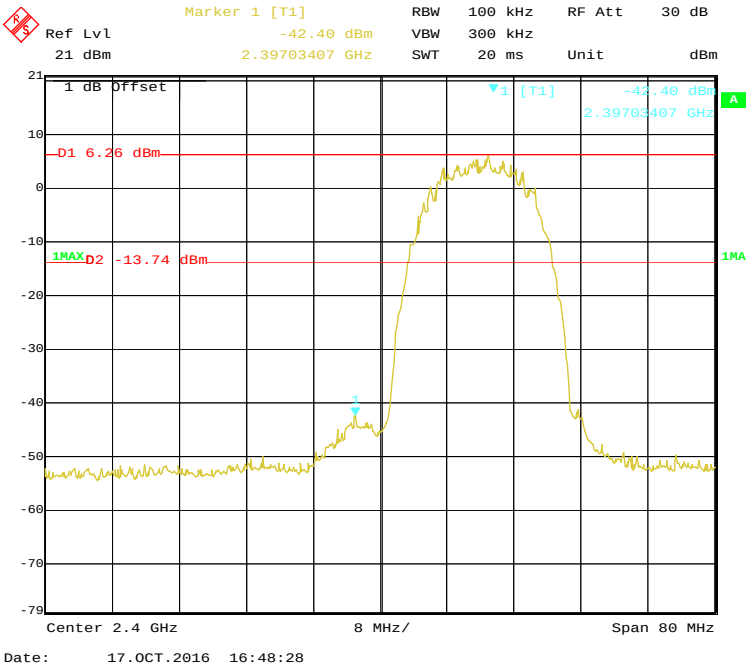
Temperature:	27 ℃
Relative Humidity:	55 %
ATM Pressure:	101.0 kPa

The testing was performed by Peter Jiang on 2016-10-16 to 2016-10-17.

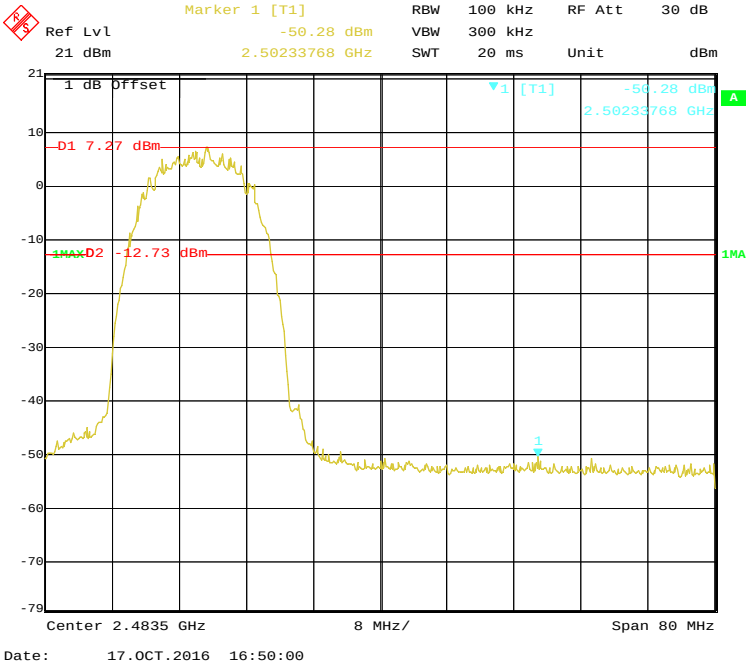
EUT operation mode: Transmitting

Please refer to the following table and plots.

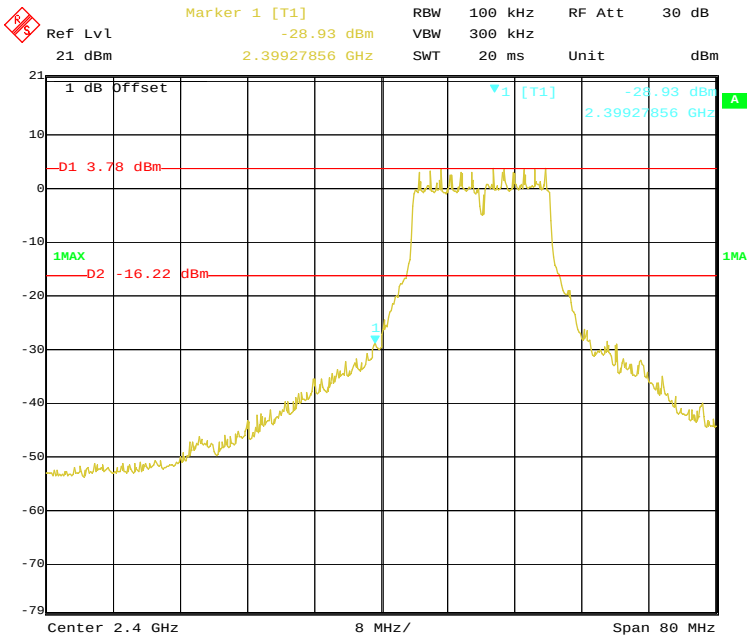
802.11b: Band Edge, Left Side



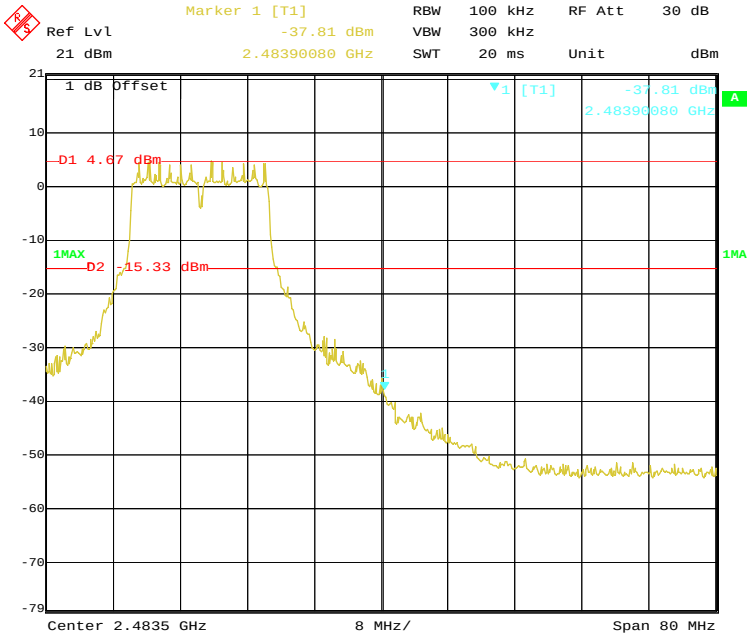
802.11b: Band Edge, Right Side



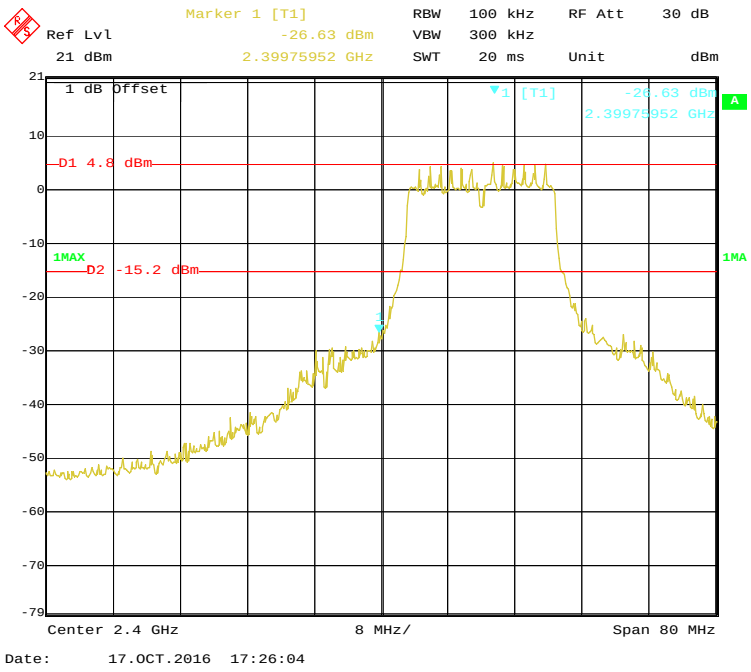
802.11g: Band Edge, Left Side



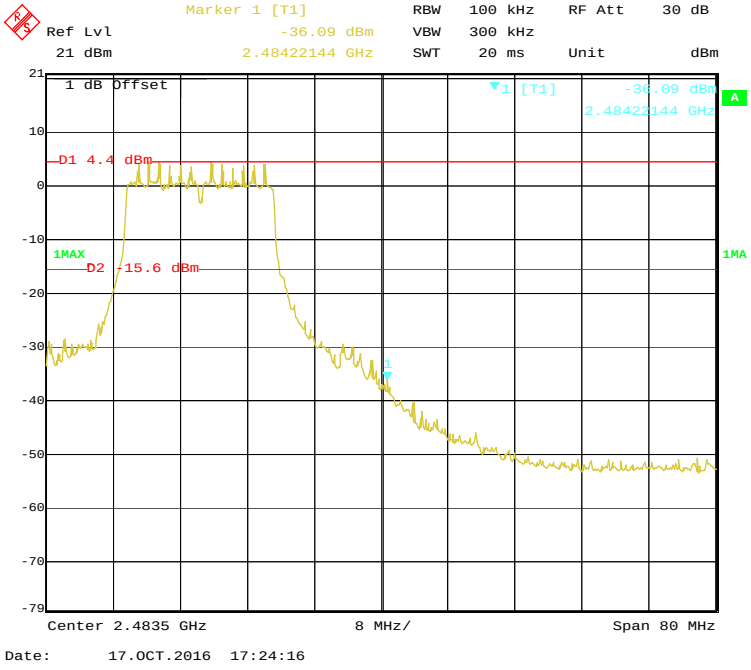
802.11g: Band Edge, Right Side



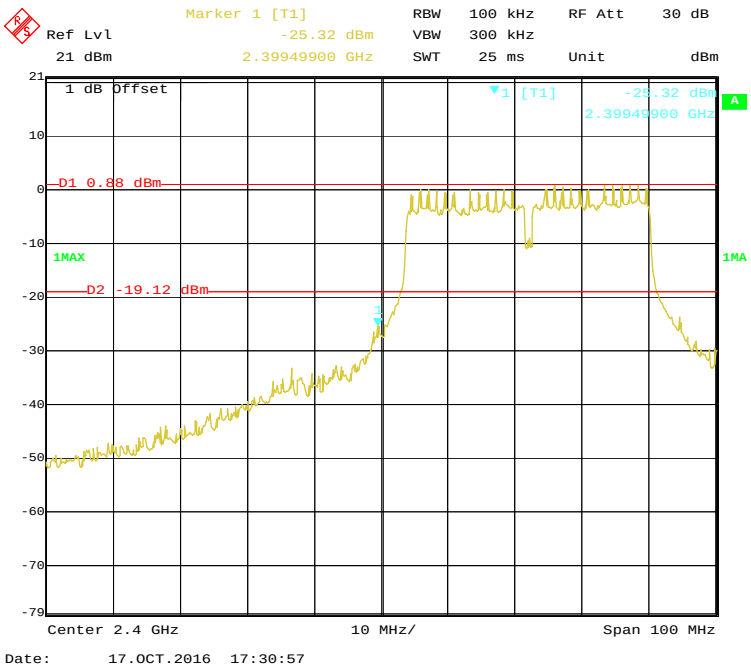
802.11n-HT20: Band Edge, Left Side



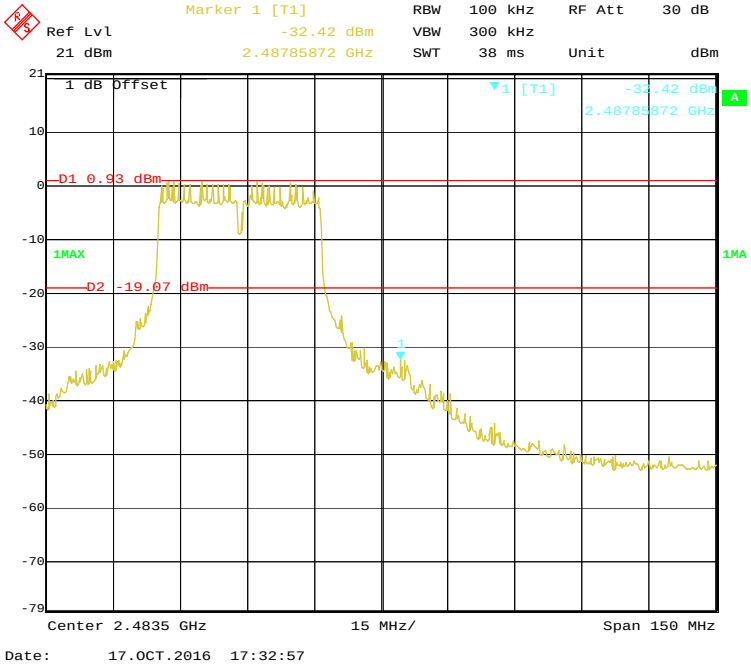
802.11n-HT20: Band Edge, Right Side



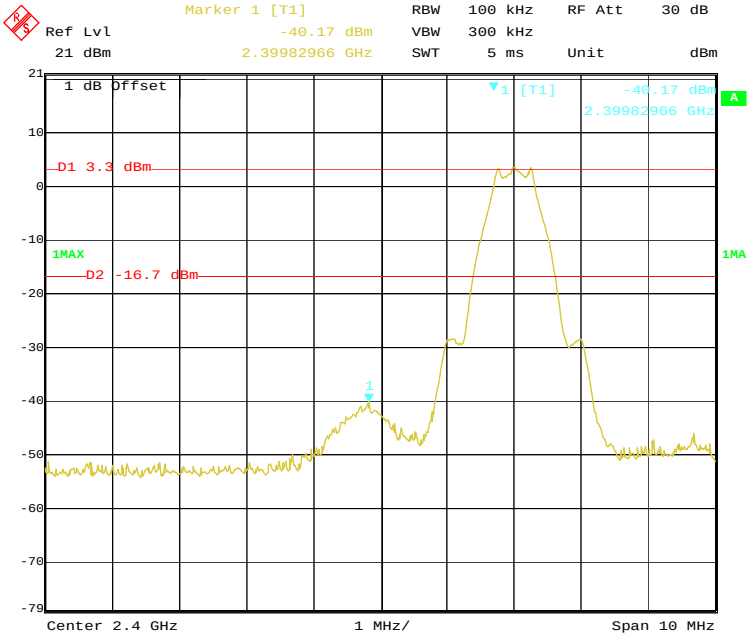
802.11n-HT40: Band Edge, Left Side



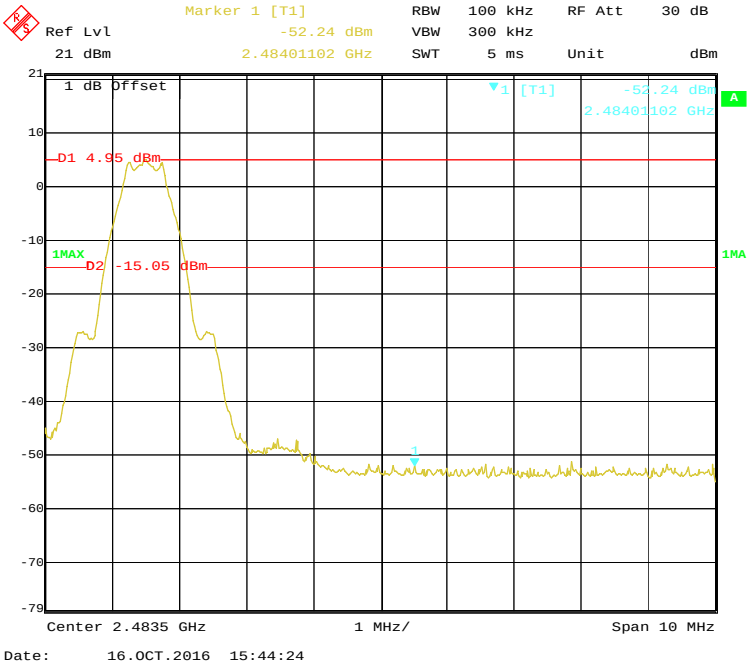
802.11n-HT40: Band Edge, Right Side



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 v03r05.

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 Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Rohde & Schwarz	Signal Analyzer	FSIQ26	836131/009	2016-09-21	2017-09-21
BACL	RF cable	KS-LAB-012	KS-LAB-012	2015-12-16	2016-12-15

*** 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).

Test Data

Environmental Conditions

Temperature:	27 ℃
Relative Humidity:	55 %
ATM Pressure:	101.0 kPa

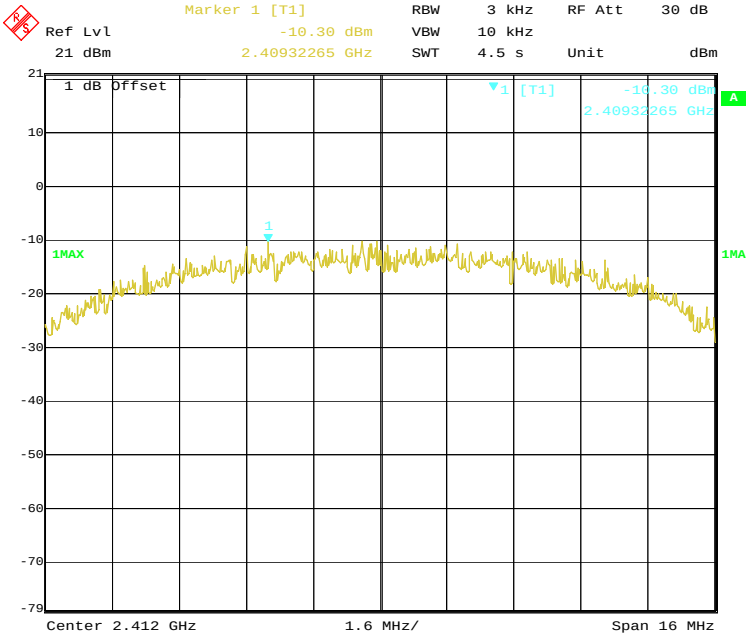
The testing was performed by Peter Jiang on 2016-10-16 to 2016-10-17.

EUT operation mode: Transmitting

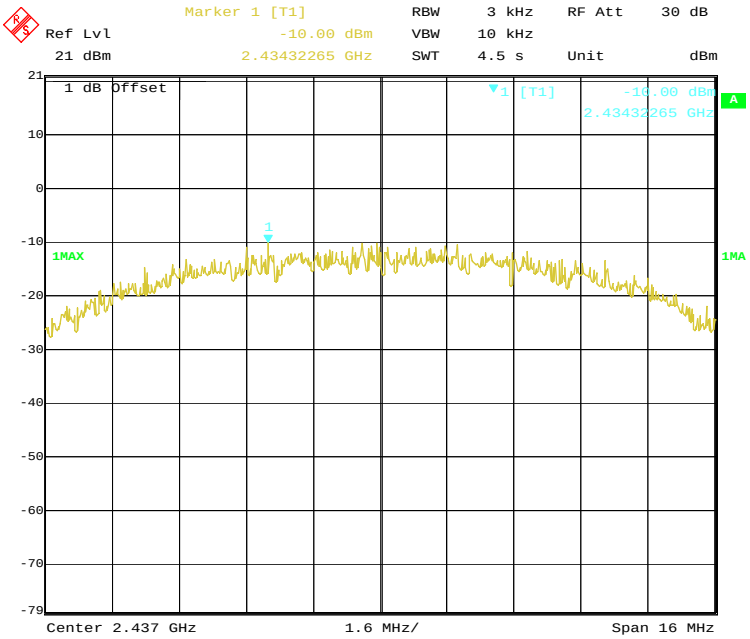
Test Result: Pass

Channel	Frequency (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)
802.11b mode			
Low	2412	-10.20	≤8
Middle	2437	-10.00	≤8
High	2462	-9.45	≤8
802.11g mode			
Low	2412	-11.51	≤8
Middle	2437	-11.13	≤8
High	2462	-10.83	≤8
802.11n-HT20 mode			
Low	2412	-11.01	≤8
Middle	2437	-11.73	≤8
High	2462	-11.67	≤8
802.11n-HT40 mode			
Low	2422	-13.31	≤8
Middle	2437	-12.52	≤8
High	2452	-13.61	≤8
BLE mode			
Low	2402	-9.22	≤8
Middle	2440	-7.21	≤8
High	2480	-6.71	≤8

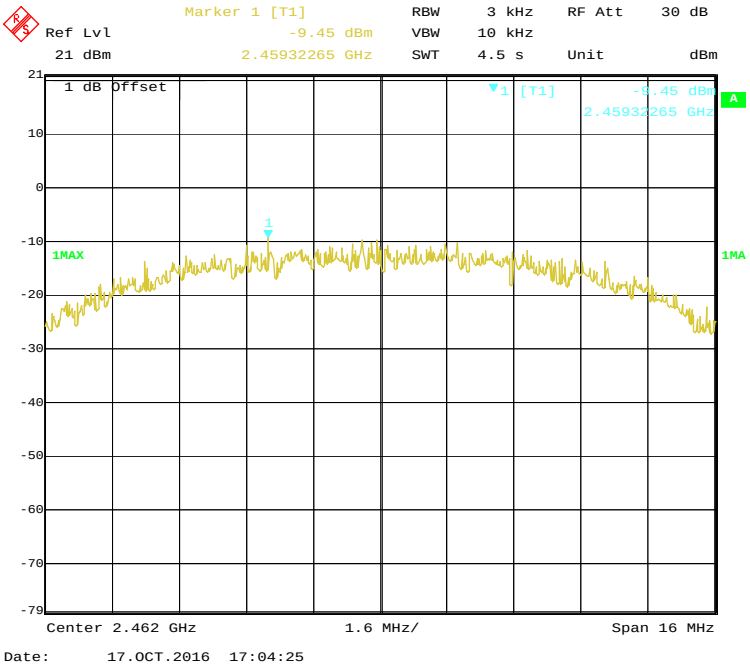
Power Spectral Density, 802.11b Low Channel



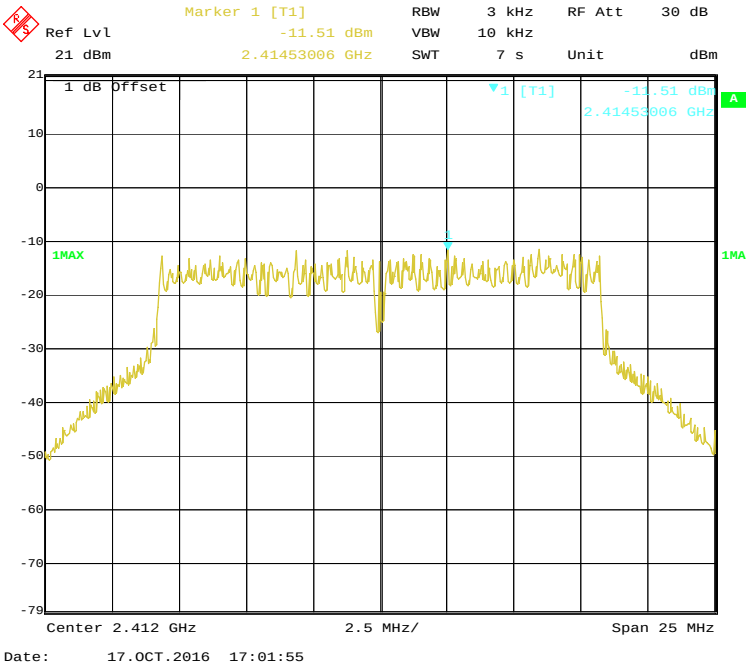
Power Spectral Density, 802.11b Middle Channel



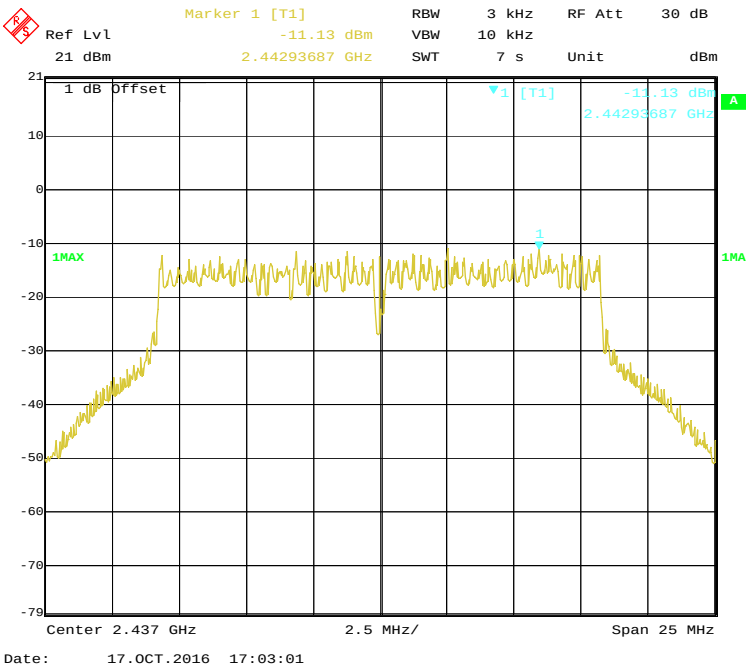
Power Spectral Density, 802.11b High Channel



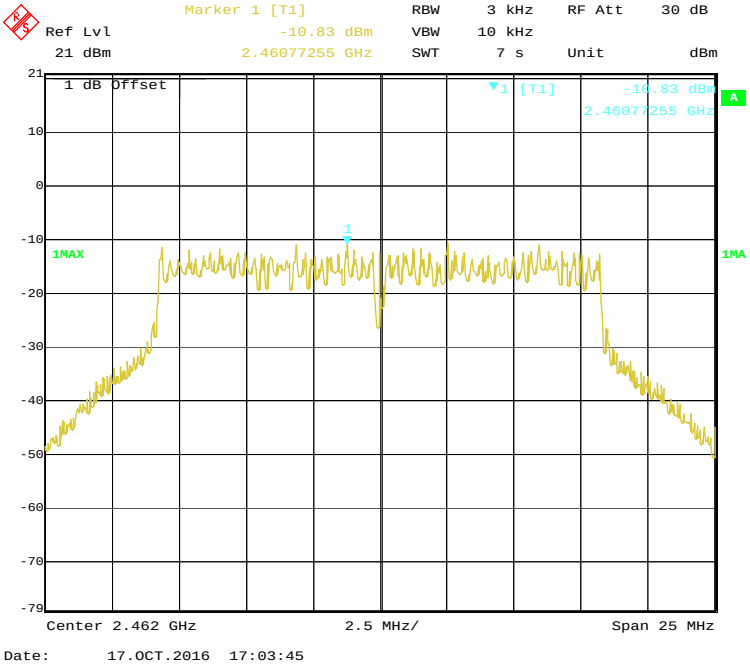
Power Spectral Density, 802.11g Low Channel



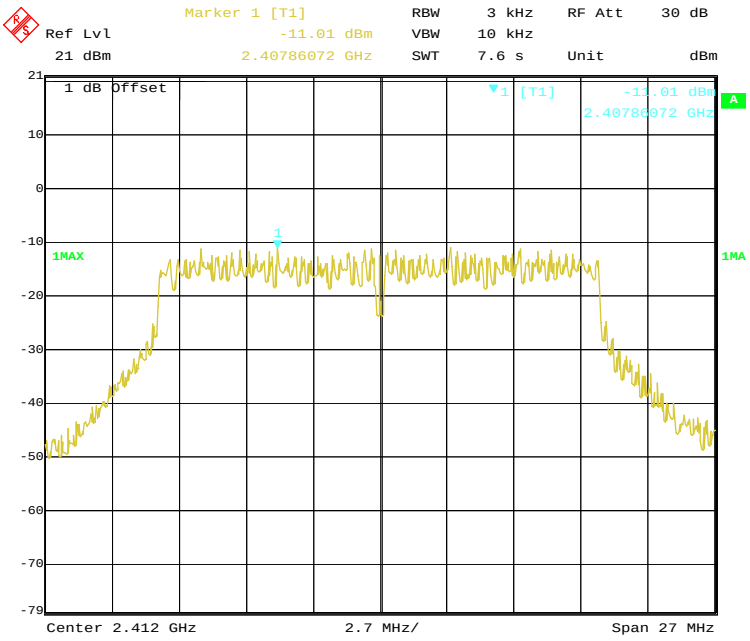
Power Spectral Density, 802.11g Middle Channel



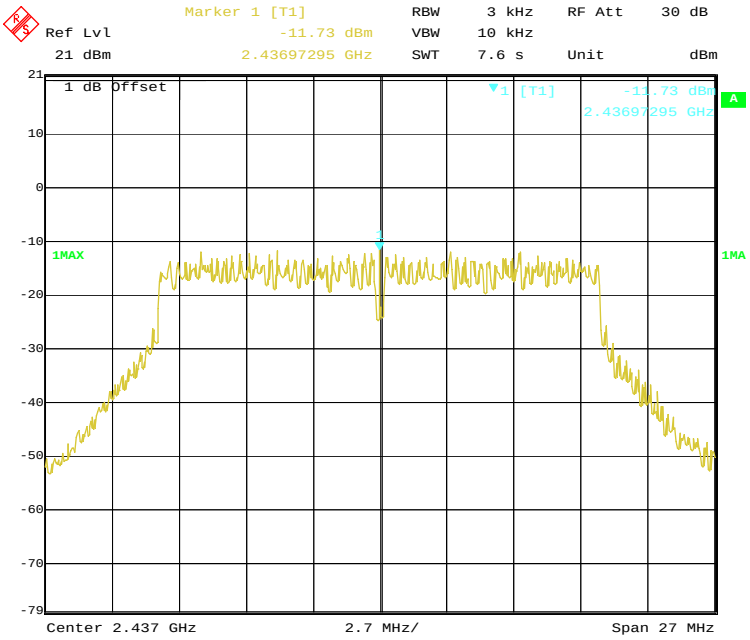
Power Spectral Density, 802.11g High Channel



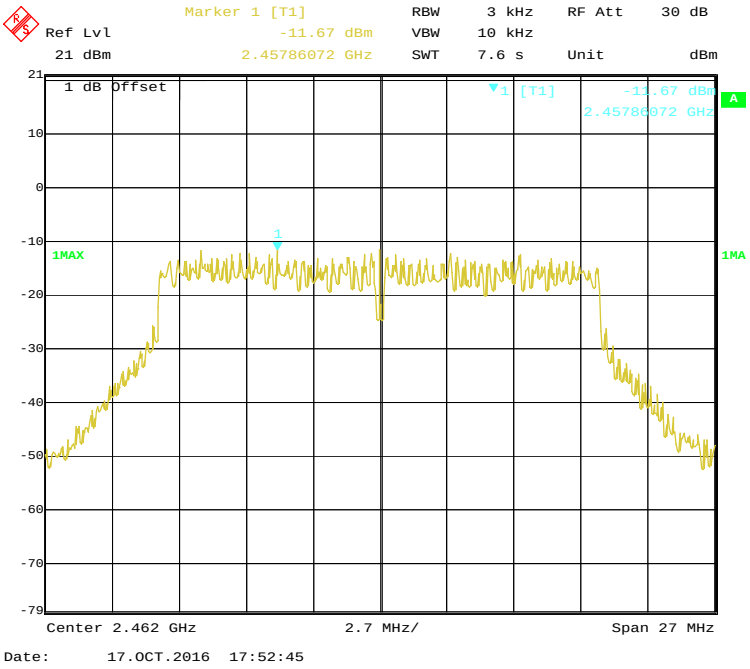
Power Spectral Density, 802.11n-HT20 Low Channel



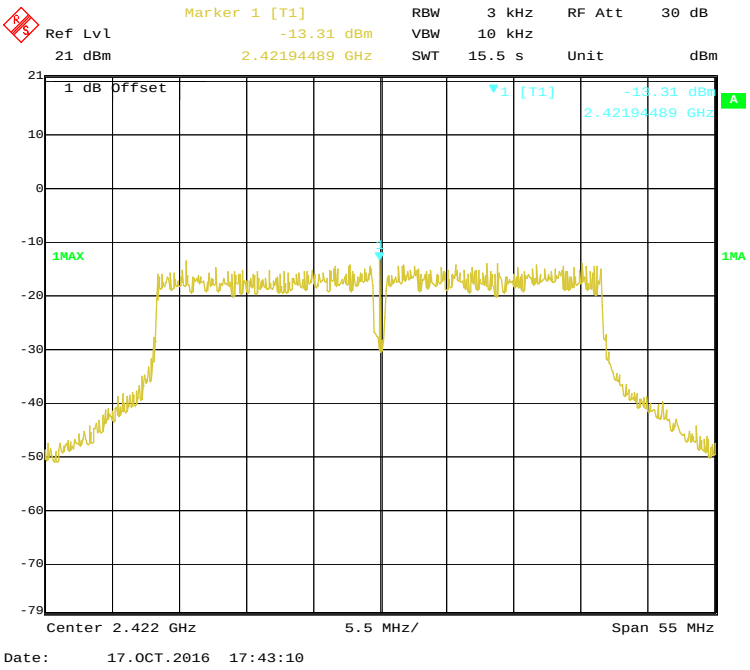
Power Spectral Density, 802.11n-HT20 Middle Channel



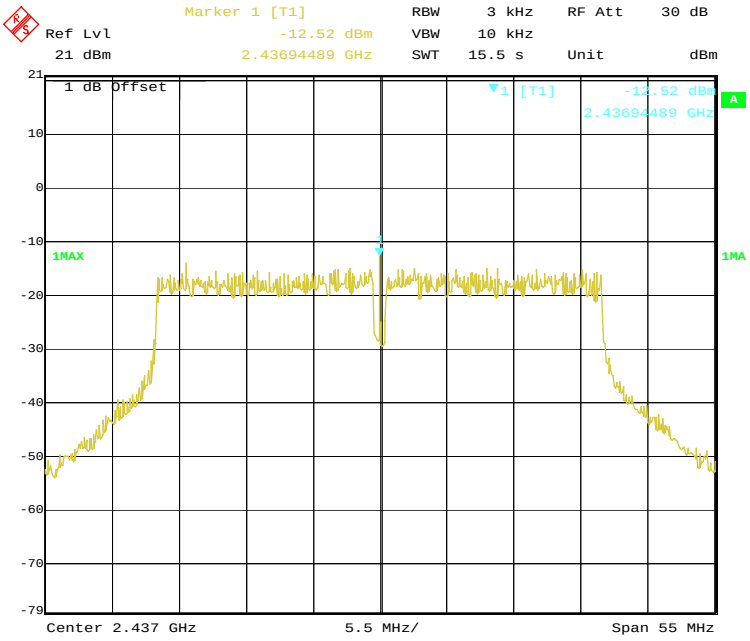
Power Spectral Density, 802.11n-HT20 High Channel



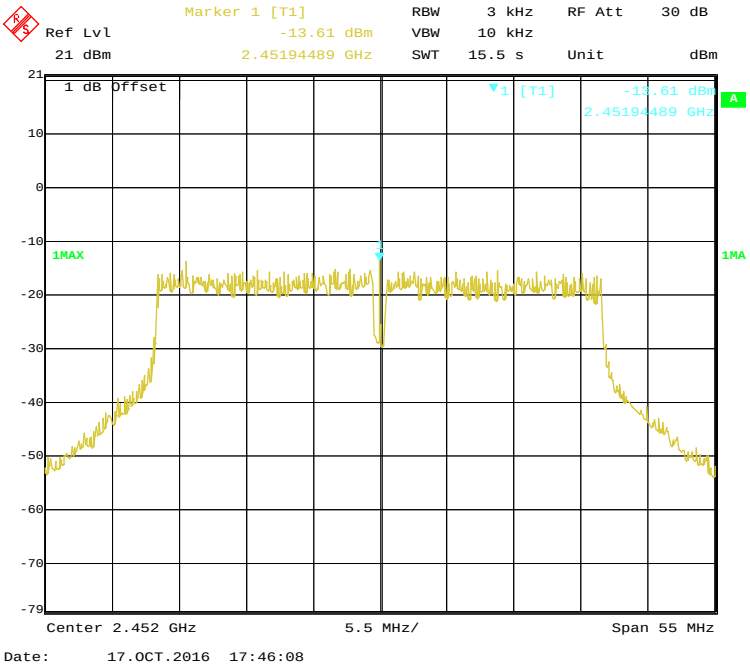
Power Spectral Density, 802.11n-HT40 Low Channel



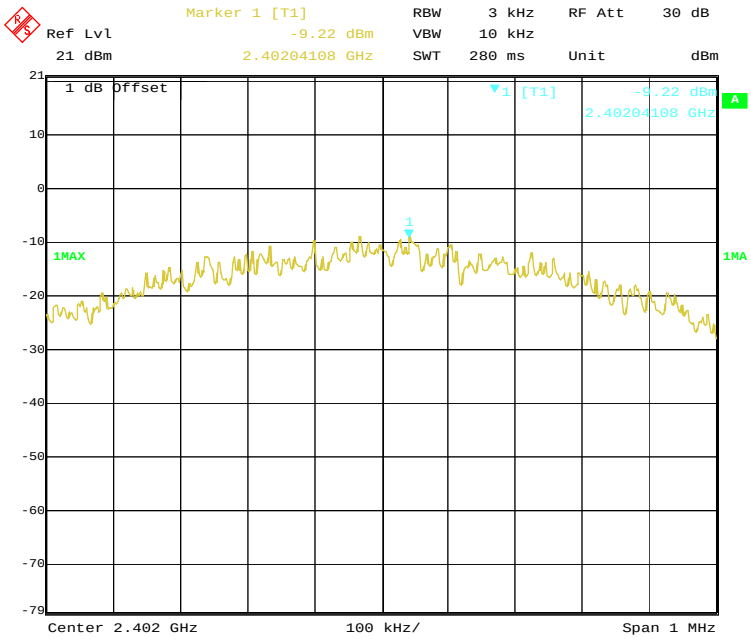
Power Spectral Density, 802.11n-HT40 Middle Channel



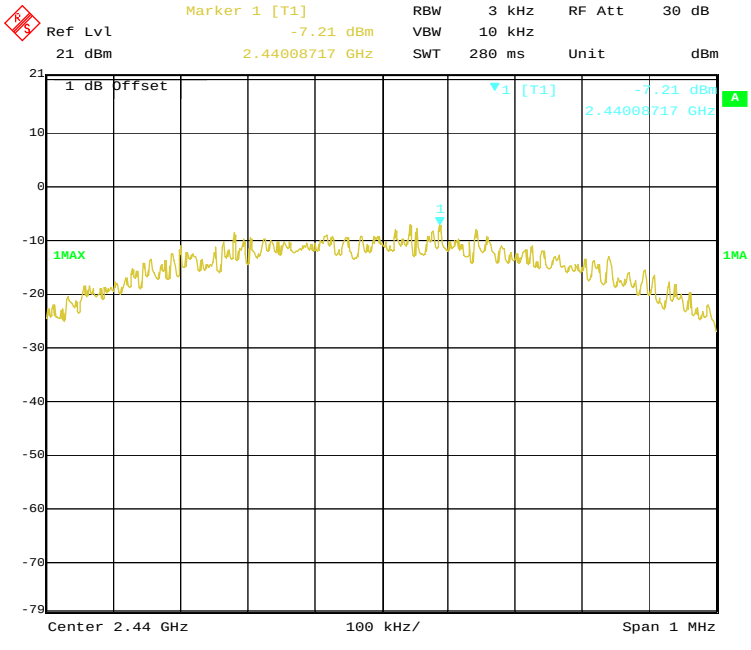
Power Spectral Density, 802.11n-HT40 High Channel



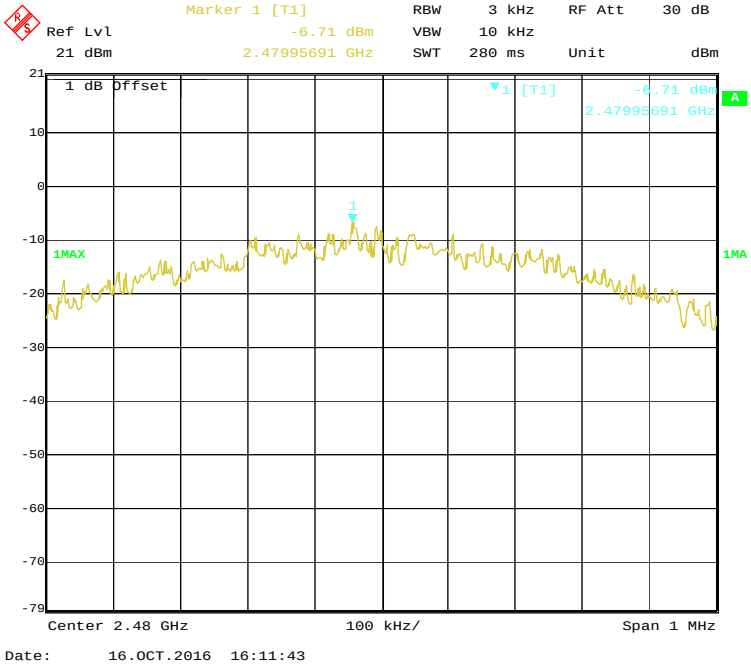
Power Spectral Density, BLE Low Channel



Power Spectral Density, BLE Middle Channel



Power Spectral Density, BLE High Channel



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