FCC PART 15.247

TEST REPORT

For

Light & Effects Technology Co., Ltd

No2 Xinda Road, Hi-Tech West Zone, Chengdu, China

FCC ID: 2AG6C-LEB01

Report Type:	**Product Name:**
Original Report	Lettin HQ Smart Hub & Gateway

Report Number:	RSC180409004-0C
Report Date:	2018-05-09
Reviewed By:	Sula Huang Engineering Director
Test Laboratory:	Bay Area Compliance Laboratories Corp. (Chengdu) No.5040, Huilongwan Plaza, No. 1, Shawan Road, Jinniu District, Chengdu, Sichuan, China Tel: 028-65525123 Fax: 028-65525125 www.baclcorp.com

TABLE OF CONTENTS

GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

The **Light & Effects Technology Co., Ltd**, model number: **LE-CO03P78A (FCC ID: 2AG6C-LEB01)** or the "EUT" as referred to in this report was the **Lettin HQ Smart Hub & Gateway**.

Mechanical Description of EUT

The EUT was measured approximately: 78.5 mm(L) x 78.5 mm(W) x 37 mm(H).

Rated input voltage: DC 5V from AC adapter.

AC Adapter information:
Manufacturer: Asian Power Devices Inc.
Model: WB-10E05R
Input: AC 100-240V, 50-60Hz, 0.4A Max.
Output: DC 5V, 2A

**All measurement and test data in this report were gathered from final production sample, serial number: 180409004/01 (assigned by BACL). It may have deviation from any other sample. The EUT supplied by the applicant was received on 2018-04-04, and EUT complied with test requirement.*

Objective

This report is prepared on behalf of ***Light & Effects Technology Co., Ltd*** in accordance with Part 2, Subpart J, Part 15, Subparts A and C of the Federal Communications Commission's rules.

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

Related Submittal(s)/Grant(s)

No.

Measurement Uncertainty

Item			Uncertainty
AC power line conducted emission			2.71 dB
Radiated Emission(Field Strength)	30MHz-200MHz	H	4.57 dB
		V	4.81 dB
	200MHz-1GHz	H	5.69 dB
		V	6.07 dB
	1GHz-6GHz		5.49 dB
	6GHz-18GHz		5.57 dB
	18GHz-40GHz		5.48 dB
Conducted RF Power			±0.61dB
Power Spectrum Density			±0.61dB
Occupied Bandwidth			±5%
Humidity			±5%
Temperature			±1℃

Test Methodology

All measurements contained in this report were conducted with:

1. ANSI C63.10-2013 American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.

2. KDB558074 D01 DTS Meas Guidance v04.

Test Facility

The Test site used by Bay Area Compliance Laboratories Corp. (Chengdu) to collect test data is located No.5040, Huilongwan Plaza, No. 1, Shawan Road, Jinniu District, Chengdu, Sichuan, China.

The test site has been approved by the FCC under the KDB 974614 D01 and is listed in the FCC Public Access Link (PAL) database, FCC Registration No. : 910975, the FCC Designation No. : CN1186.

The test site has been registered with ISED Canada under ISED Canada Registration Number 3062C-1.

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	-	-

For 802.11b, 802.11g, 802.11n-HT20 mode, 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 Zigbee mode, 4 channels are provided for testing:

Channel	Frequency (MHz)
11	2405
15	2425
20	2450
25	2475

EUT was tested with channel 11, 15, 20 and 25.

For Wi-Fi mode:

802.11b/g support SISO mode, 802.11n supports SISO and MIMO mode, according to pretest, 802.11n MIMO mode was worst. So, 802.11n MIMO mode test data was recorded in the report.

EUT Exercise Software

The software “QA Tool” and “Test” were used for testing, which was provided by manufacturer.

The worst-case data rates are determined to be as follows for each mode based upon investigations by measuring the average power and PSD across all data rates bandwidths, and modulations.
For 802.11b, 802.11g, 802.11n-HT20, 802.11n-HT40 mode, the maximum power setting provided by the manufacturer is below:

Test Mode	Test Software Version	QA Tool		
802.11b	Test Frequency	2412 MHz	2437 MHz	2462 MHz
	Data Rate	1Mbps	1 Mbps	1 Mbps
	Power Level Antenna 0	1E	1E	1E
	Power Level Antenna 1	1E	1E	1E
802.11g	Test Frequency	2412 MHz	2437 MHz	2462 MHz
	Data Rate	6 Mbps	6 Mbps	6 Mbps
	Power Level Antenna 0	1D	1D	1D
	Power Level Antenna 1	1E	1E	1E
802.11n-HT20	Test Frequency	2412 MHz	2437 MHz	2462 MHz
	Data Rate	MCS0	MCS0	MCS0
	Power Level Antenna 0	17	17	17
	Power Level Antenna 1	17	17	17
802.11n-HT40	Test Frequency	2422 MHz	2437 MHz	2452 MHz
	Data Rate	MCS0	MCS0	MCS0
	Power Level Antenna 0	15	15	15
	Power Level Antenna 1	15	15	15

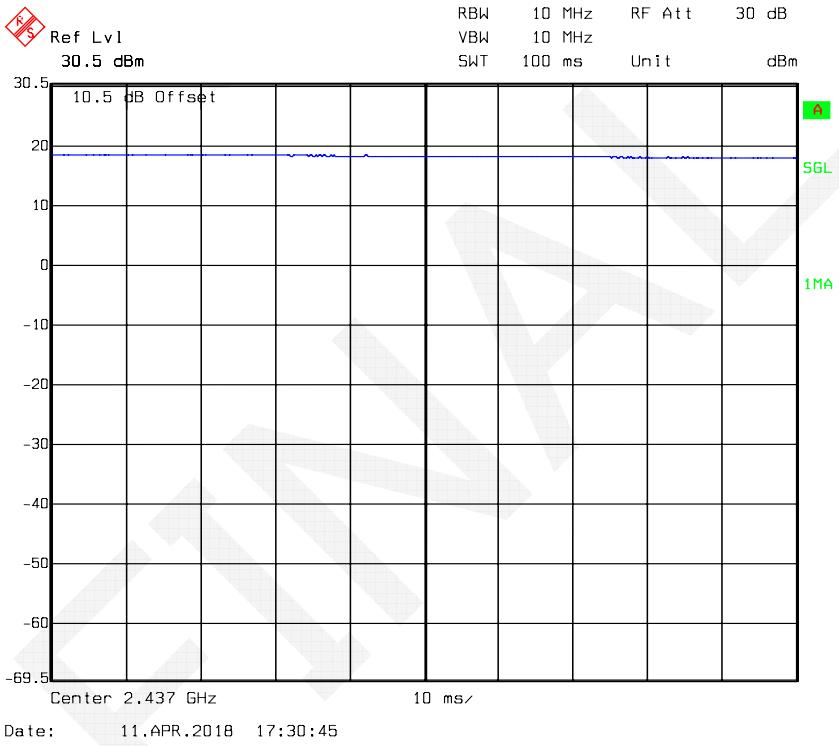
For Zigbee mode, the maximum power setting provided by the manufacturer is below:

Test Mode	Test Software Version	Test			
Zigbee	Test Frequency	2405 MHz	2425 MHz	2450 MHz	2475 MHz
	Data Rate	Default	Default	Default	Default
	Power Level	Default	Default	Default	Default

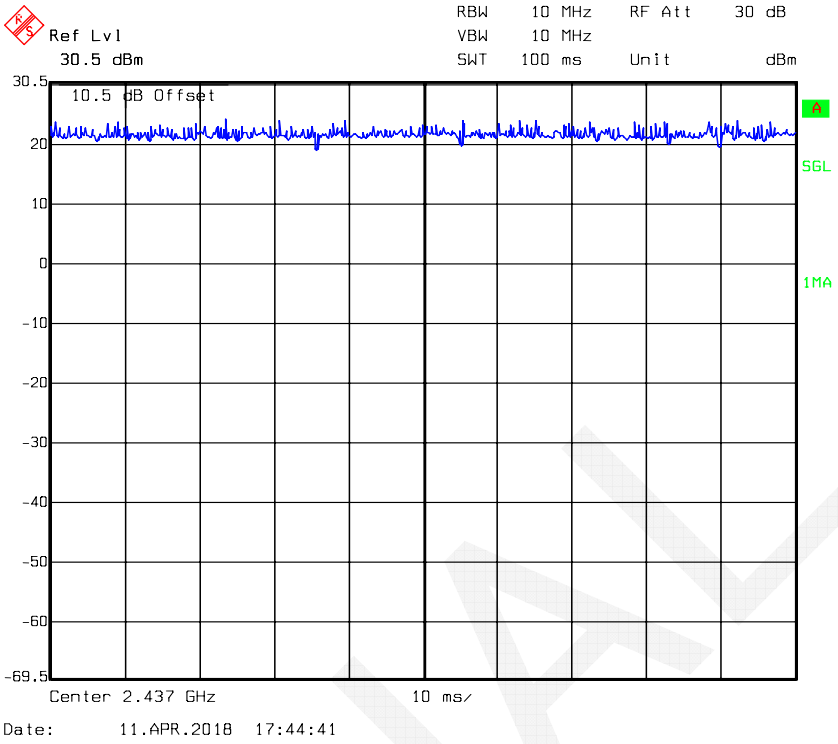
The software configured maximum duty cycle as below:

Mode	T_{on} (ms)	T_{on+off} (ms)	Duty Cycle (%)
802.11b	100	100	100
802.11g	100	100	100
802.11n-HT20	100	100	100
802.11n-HT40	100	100	100
Zigbee	100	100	100

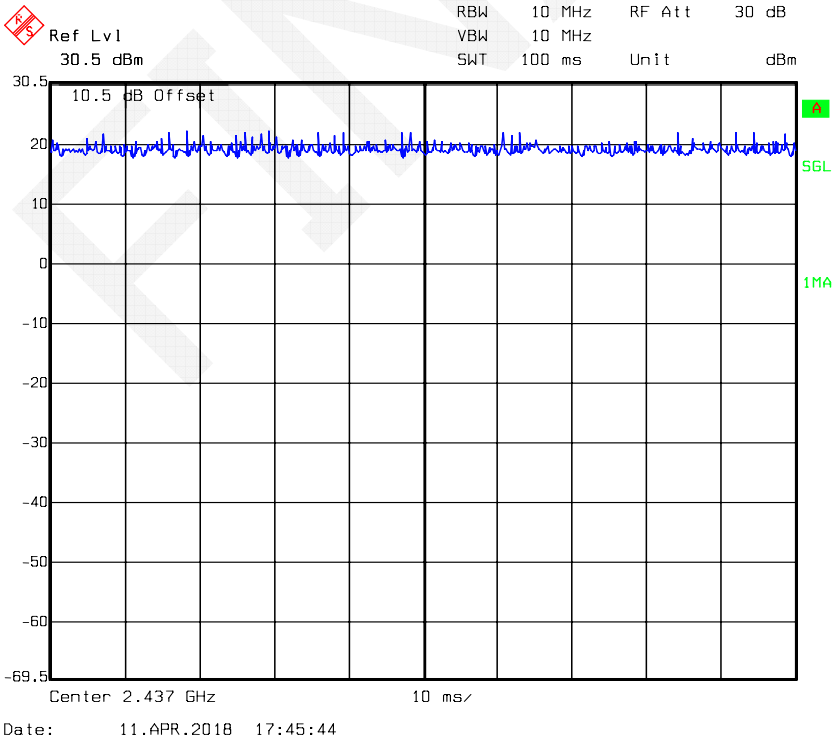
802.11b mode



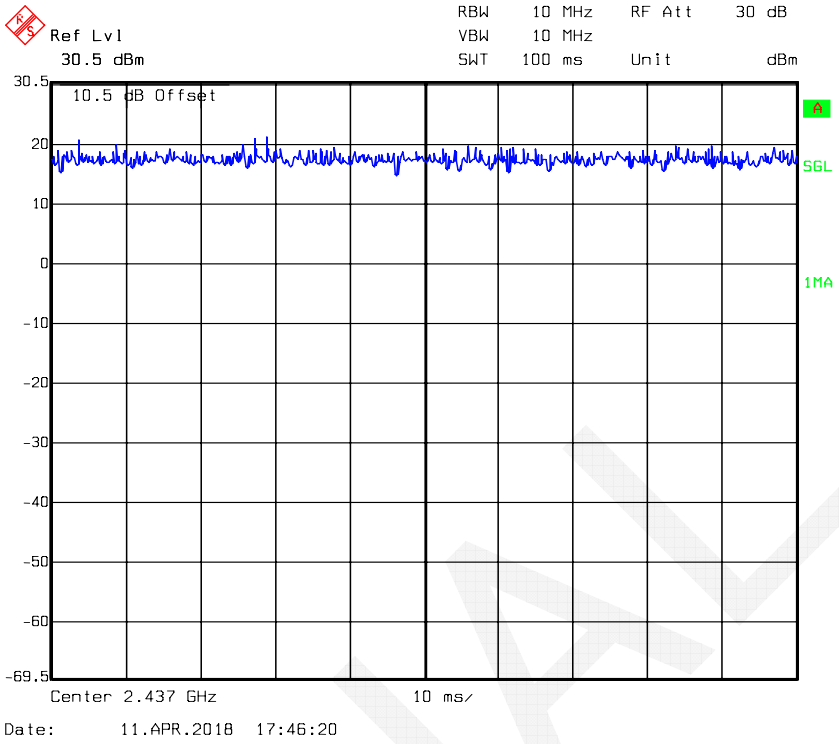
802.11g mode



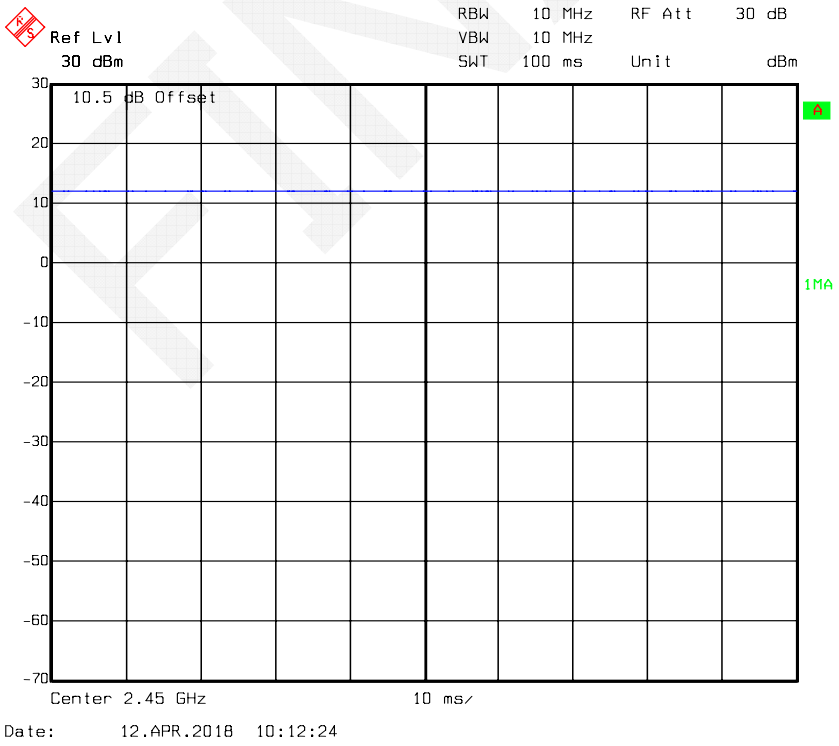
802.11n-HT20 mode



802.11n-HT40 mode



Zigbee mode



Support Equipment List and Details

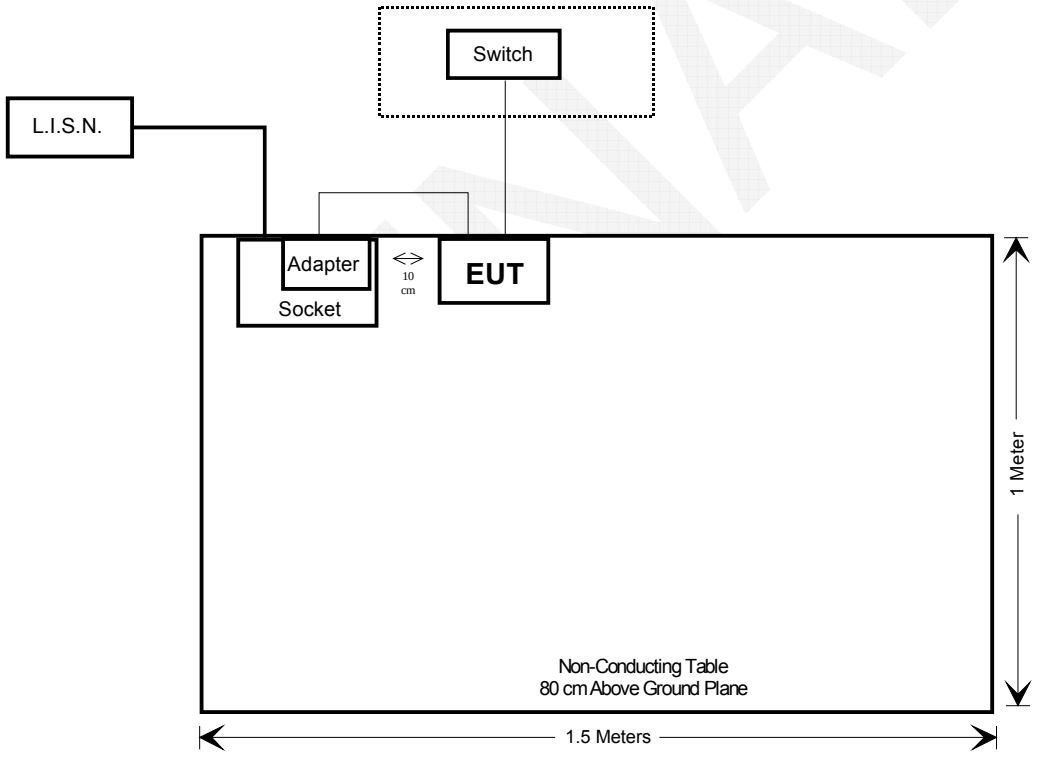
Manufacturer	Description	Model	Serial Number
DL	Switch	DL-S1005PM	None

External I/O Cable

Cable Description	Length (m)	From	To
Unshielded RJ45 Cable	10	EUT	Switch

Block Diagram of Test Setup

Conducted emissions test：



Test Equipments List

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Conducted Emission					
Rohde & Schwarz	EMI Test Receiver	ESCS 30	836858/0016	2017-12-02	2018-12-01
Rohde & Schwarz	L.I.S.N.	ENV216	100018	2017-05-20	2018-05-19
Rohde & Schwarz	RF Limiter	ESH3Z2	DE14781	2017-11-10	2018-11-09
N/A	Conducted Cable	L-E003	N/A	2017-11-10	2018-11-09
Rohde & Schwarz	EMC32	N/A	V 8.52.0	N/A	N/A
Radiated Emission					
EMCT	Semi-Anechoic Chamber	966	N/A	2017-05-18	2022-05-17
Sonoma	Pre-Amplifier	310N	186684	2017-08-18	2018-08-17
Rohde & Schwarz	EMI Test Receiver	ESIB 40	100215	2017-09-12	2018-09-11
Rohde & Schwarz	EMI Test Receiver	ESCI	100028	2017-05-20	2018-05-19
A.H. Systems, Inc	Amplifier	PAM-0118P	467	2017-08-10	2018-08-09
EM Electronics	RF Pre-Amplifier	EM18G40	060725	2018-03-28	2019-03-27
SUNOL SCIENCES	Broadband Antenna	JB3	A121808	2017-05-19	2020-05-18
ETS	Horn Antenna	3115	003-6076	2017-05-19	2020-05-18
A.H. Systems, Inc	Horn Antenna	SAS-574	510	2017-05-19	2020-05-18
INMET	Attenuator	18N-6dB	64671	2017-11-10	2018-11-09
Sinoscite.,Co Ltd	Reject Band Filter	BSF 2402-2480MN	0898-005	2017-11-10	2018-11-09
N/A	RF Cable (below 1GHz)	L-E005	N/A	2017-11-10	2018-11-09
N/A	RF Cable (below 1GHz)	T-E128	N/A	2017-11-10	2018-11-09
N/A	RF Cable (below 1GHz)	T-E129	N/A	2017-11-10	2018-11-09
N/A	RF Cable (above 1GHz)	T-E069	N/A	2017-11-10	2018-11-09
Micro-coax	RF Cable (above 1GHz)	T-E209	MFR 64639 2310	2018-03-14	2019-03-13
Rohde & Schwarz	EMC32	N/A	V 8.52.0	N/A	N/A
E-Microwave	DC Block	EMDCB-00036	OE01304225	2017-12-09	2018-12-08
N/A	RF Cable	N/A	N/A	Each Time	/

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
RF Conducted Test					
Rohde & Schwarz	Spectrum Analyzer	FSEM30	100018	2017-05-18	2018-05-17
WEINSCHEL ENGINEERING	Attenuator	1A10dB	AA4135	2017-11-10	2018-11-09
Agilent	USB Wideband Power Sensor	U2021XA	MY53320008	2018-01-19	2019-01-18
N/A	RF Cable	NO.3	N/A	2017-11-10	2018-11-09
E-Microwave	DC Block	EMDCB-00036	OE01304225	2017-12-09	2018-12-08
N/A	RF Cable	N/A	N/A	Each Time	/

*** Statement of Traceability:** BACL (Chengdu) attested that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Result
FCC §15.247 & §1.1310 & §2.1091	Maximum Permissible Exposure (MPE)	Compliance
§15.203	Antenna Requirement	Compliance
§15.207 (a)	AC Line Conducted Emissions	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 & §1.1310 & §2.1091- MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Applicable Standard

According to subpart 15.247 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/f²)	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.

Per 447498 D01 General RF Exposure Guidance v06**,** simultaneous transmission MPE test exclusion applies when the sum of the MPE for all simultaneous transmitting antennas incorporated in a host device, based on the calculated/estimated, numerically modeled or measured field strengths or power density, is ≤ 1.0.

Calculated Formulary:

Predication of MPE limit at a given distance

$$S = PG/4\pi R^2$$

Where:
S = 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);

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

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

The rated tune-up output power and antenna gain in the below table:

Calculated Data:

MPE evaluation for single transmission:

Mode	Frequency Range	Antenna Gain		Tune-up Conducted Power		Evaluation Distance	Power Density	Limit
	MHz	dBi	numeric	dBm	mW	cm	mW/cm^2	mW/cm^2
Wi-Fi	2412-2462	6.00	3.98	17.50	56.23	20	0.045	1.00
Zigbee	2405-2475	3.00	2.00	13.50	22.39	20	0.009	1.00

Note: The Wi-Fi(2.4G) and Zigbee can transmit simultaneously.

MPE evaluation for simultaneous transmission:

2.4 G(Wi-Fi) and Zigbee can transmit at the same time, MPE evaluation is as below formula:

PD1/Limit1+PD2/Limit2+……＜1, PD (Power Density)

MPE evaluation:

Max MPE of 2.4G(Wi-Fi) + Max MPE of Zigbee =0.045/1+0.009/1=0.054＜1.0

Result: MPE evaluation of single and simultaneous transmission meet the requirement of standard.

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.

Antenna Connector Construction

The EUT has one PCB Zigbee antenna and two PCB Wi-Fi antennas, which was permanently attached and Wi-Fi antenna gain is 6dBi, Zigbee antenna gain is 3dBi, fulfill the requirement of this section. Please refer to the EUT photos.

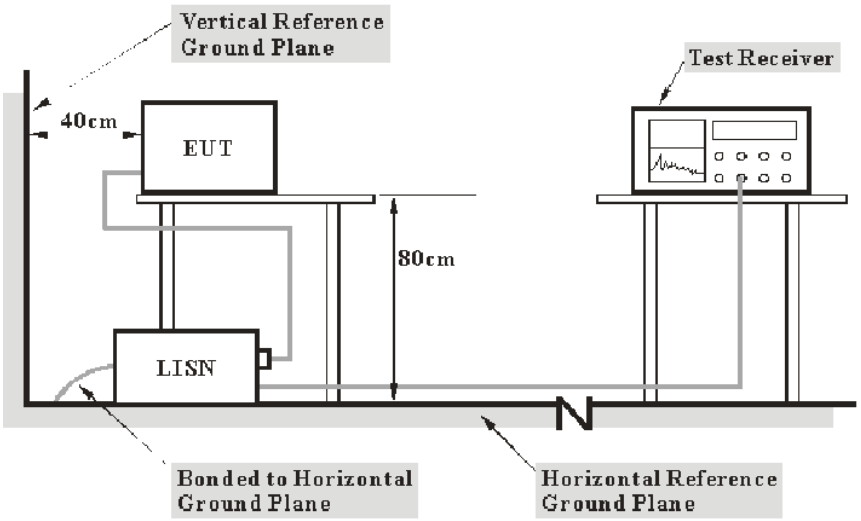
Result: Compliant.

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.

The adapter was connected to a 120 V/60 Hz AC 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 EUT's adapter was connected to 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 Amplitude & Margin Calculation

The basic equation is as follows:

$V_C = V_R + A_C + VDF$
$C_f = A_C + VDF$

Herein,
V_C (cord. Reading): corrected voltage amplitude
V_R: reading voltage amplitude
A_c: attenuation caused by cable loss
VDF: voltage division factor of AMN
C_f: Correction Factor

The "**Margin**" column of the following data tables indicates the degree of compliance within 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 Data

Environmental Conditions

Temperature:	25 °C
Relative Humidity:	58 %
ATM Pressure:	94.5 kPa

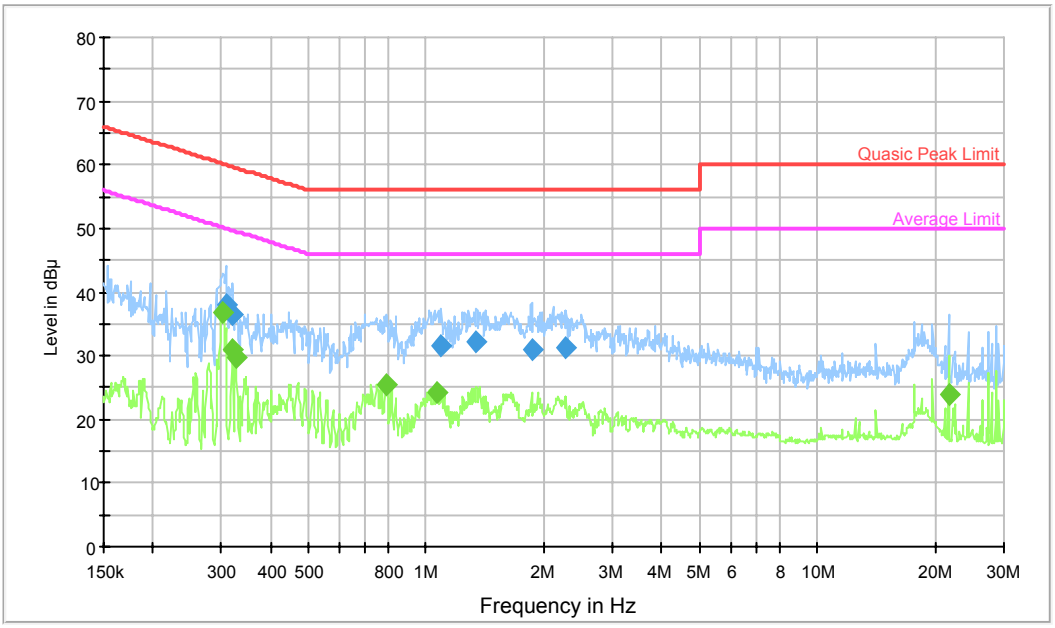
** The testing was performed by Tom Tang on 2018-04-12.*

Test Mode: Transmitting

For Wi-Fi Mode

802.11b Low Channel-worst case

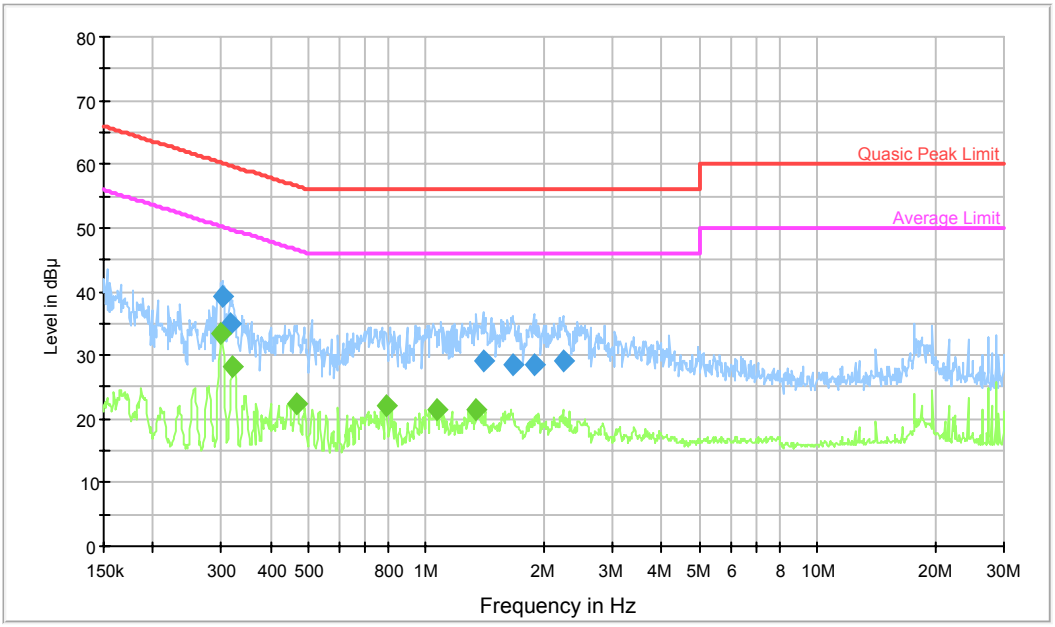
AC120V/60Hz, Line:



Frequency (MHz)	QuasiPeak (dBµV)	Bandwidth (kHz)	Line	Corrected Factor (dB)	Margin (dB)	Limit (dBµV)
0.307723	37.9	9.000	L1	19.7	22.1	60.0
0.321537	36.5	9.000	L1	19.7	23.2	59.7
1.095167	31.5	9.000	L1	19.7	24.5	56.0
1.347825	32.1	9.000	L1	19.8	23.9	56.0
1.862363	30.9	9.000	L1	19.8	25.1	56.0
2.282883	31.3	9.000	L1	19.8	24.7	56.0

Frequency (MHz)	Average (dBµV)	Bandwidth (kHz)	Line	Corrected Factor (dB)	Margin (dB)	Limit (dBµV)
0.301642	36.8	9.000	L1	19.7	13.4	50.2
0.321537	31.1	9.000	L1	19.7	18.6	49.7
0.325411	29.7	9.000	L1	19.7	19.9	49.6
0.789434	25.4	9.000	L1	19.7	20.6	46.0
1.069248	24.1	9.000	L1	19.7	21.9	46.0
21.691906	24.0	9.000	L1	20.2	26.0	50.0

AC120V/60Hz, Neutral



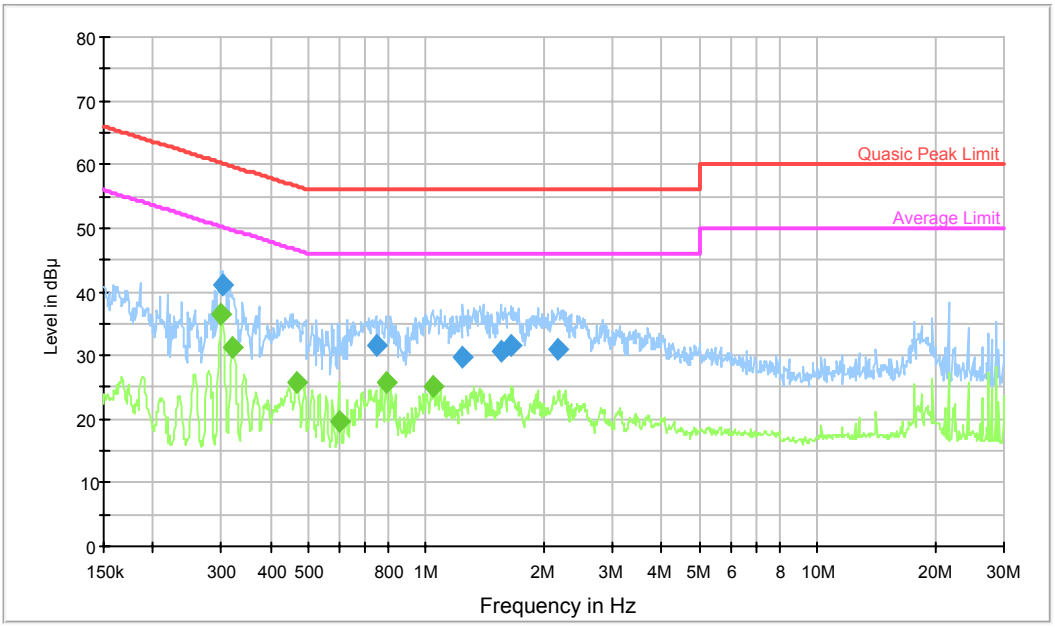
Frequency (MHz)	QuasiPeak (dBµV)	Bandwidth (kHz)	Line	Corrected Factor (dB)	Margin (dB)	Limit (dBµV)
0.301642	39.2	9.000	N	19.5	21.0	60.2
0.316443	35.0	9.000	N	19.5	24.8	59.8
1.397131	29.1	9.000	N	19.5	26.9	56.0
1.658772	28.4	9.000	N	19.5	27.6	56.0
1.884801	28.6	9.000	N	19.5	27.4	56.0
2.237768	29.1	9.000	N	19.5	26.9	56.0

Frequency (MHz)	Average (dBµV)	Bandwidth (kHz)	Line	Corrected Factor (dB)	Margin (dB)	Limit (dBµV)
0.299243	33.4	9.000	N	19.5	16.9	50.3
0.321537	28.3	9.000	N	19.5	21.4	49.7
0.467950	22.3	9.000	N	19.5	24.3	46.6
0.789434	22.1	9.000	N	19.5	23.9	46.0
1.064988	21.6	9.000	N	19.5	24.4	46.0
1.347825	21.6	9.000	N	19.5	24.4	46.0

For Zigbee Mode

Low Channel-worst case

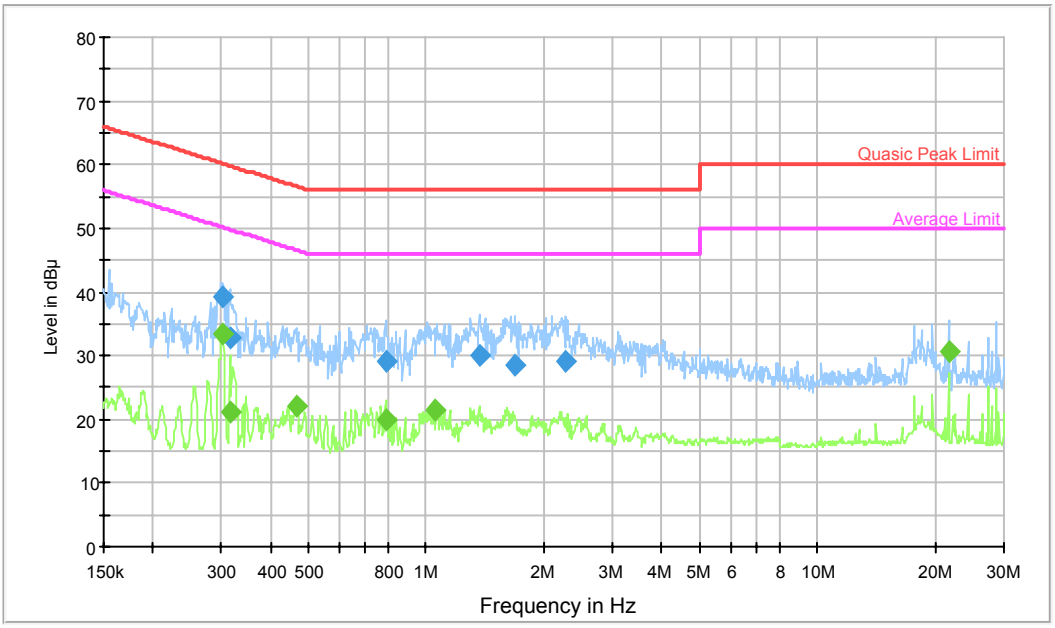
AC120V/60Hz, Line:



Frequency (MHz)	QuasiPeak (dBµV)	Bandwidth (kHz)	Line	Corrected Factor (dB)	Margin (dB)	Limit (dBµV)
0.301642	40.9	9.000	L1	19.7	19.3	60.2
0.743550	31.5	9.000	L1	19.8	24.5	56.0
1.244398	29.8	9.000	L1	19.7	26.2	56.0
1.549935	30.6	9.000	L1	19.8	25.4	56.0
1.645581	31.7	9.000	L1	19.8	24.3	56.0
2.167432	31.1	9.000	L1	19.8	24.9	56.0

Frequency (MHz)	Average (dBµV)	Bandwidth (kHz)	Line	Corrected Factor (dB)	Margin (dB)	Limit (dBµV)
0.299243	36.6	9.000	L1	19.7	13.7	50.3
0.321537	31.2	9.000	L1	19.7	18.5	49.7
0.467950	25.8	9.000	L1	19.8	20.8	46.6
0.599363	19.7	9.000	L1	19.8	26.3	46.0
0.789434	25.9	9.000	L1	19.7	20.1	46.0
1.043941	25.1	9.000	L1	19.8	20.9	46.0

AC120V/60Hz, Neutral



Frequency (MHz)	QuasiPeak (dBµV)	Bandwidth (kHz)	Line	Corrected Factor (dB)	Margin (dB)	Limit (dBµV)
0.301642	39.2	9.000	N	19.5	21.0	60.2
0.315183	32.9	9.000	N	19.5	26.9	59.8
0.789434	29.2	9.000	N	19.5	26.8	56.0
1.369520	30.0	9.000	N	19.5	26.0	56.0
1.685472	28.5	9.000	N	19.5	27.5	56.0
2.282883	29.0	9.000	N	19.6	27.0	56.0

Frequency (MHz)	Average (dBµV)	Bandwidth (kHz)	Line	Corrected Factor (dB)	Margin (dB)	Limit (dBµV)
0.301642	33.3	9.000	N	19.5	16.9	50.2
0.315183	21.2	9.000	N	19.5	28.6	49.8
0.467950	22.2	9.000	N	19.5	24.4	46.6
0.789434	19.9	9.000	N	19.5	26.1	46.0
1.048117	21.4	9.000	N	19.5	24.6	46.0
21.691906	30.6	9.000	N	20.0	19.4	50.0

Note:
1) Correction Factor =LISN VDF (Voltage Division Factor) + Cable Loss + Transient Limiter Attenuation
The corrected factor has been input into the transducer of the test software.
2) Corrected Amplitude = Reading + Correction Factor
3) Margin = Limit – Corrected Amplitude

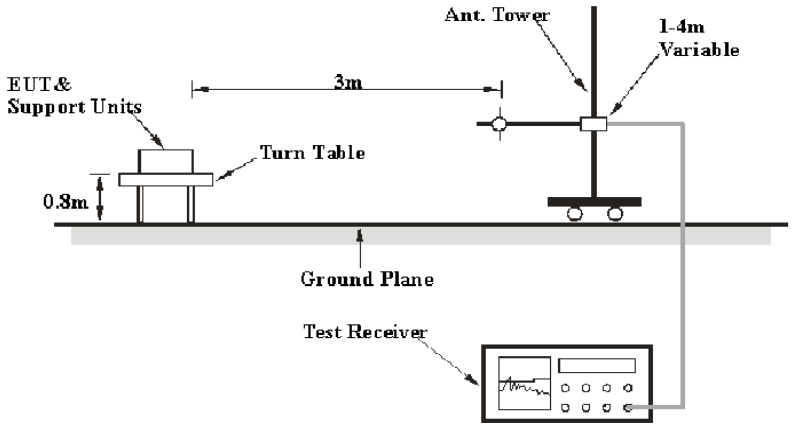
FCC §15.209, §15.205 & §15.247(d) - SPURIOUS EMISSIONS

Applicable Standard

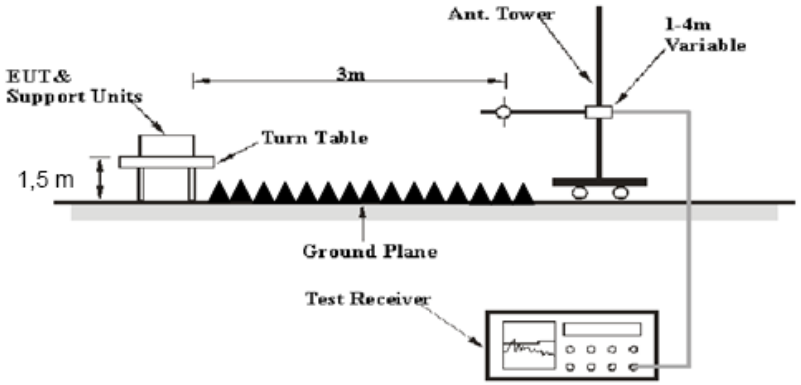
FCC §15.247 (d); §15.209; §15.205;

EUT Setup

Below 1GHz:



Above 1GHz:



The radiated emission tests were performed in the 3 meters chamber 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.

The external I/O cables were draped along the test table and formed a bundle 30 to 40 cm long in the middle.

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

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	Measurement
30 MHz – 1000 MHz	120 kHz	300 kHz	120 kHz	QP

Frequency Range	RBW	Video B/W	Duty Cycle	Measurement
Above 1 GHz	1MHz	3 MHz	Any	PK
	1MHz	10Hz	>98%	AV
	1MHz	1/T	<98%	AV

Note: T is Transmission Duration

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 Loss 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 Data

Environmental Conditions

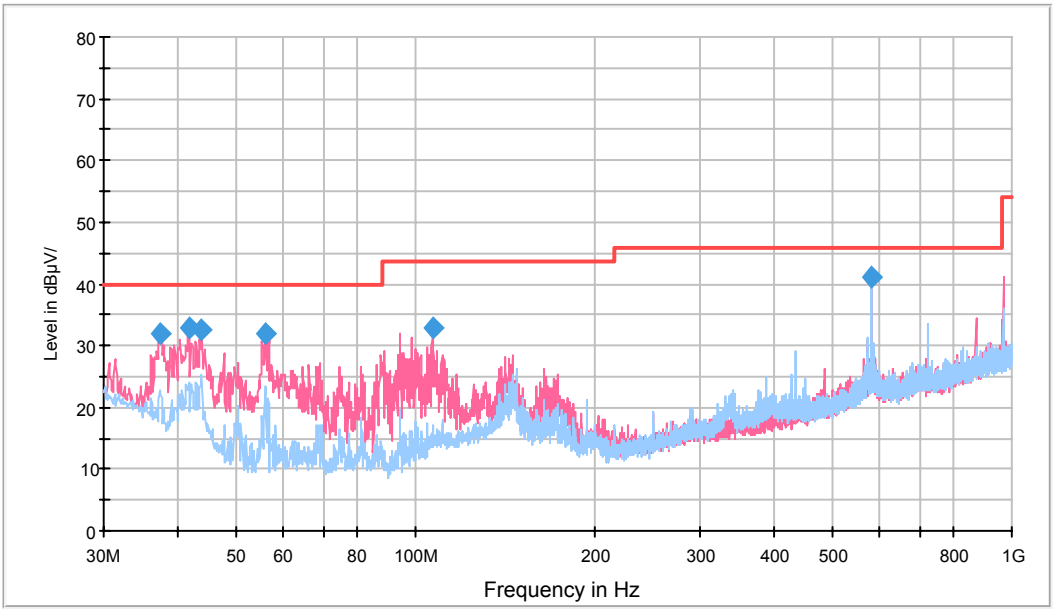
Temperature:	25 ~28 °C
Relative Humidity:	49 ~ 50 %
ATM Pressure:	95.6 ~ 96.0 kPa

The testing was performed by Tom Tang on 2018-04-14 and 2018-05-03.

Test mode: Transmitting

For Wi-Fi Mode

30MHz-1GHz: *(802.11b Low Channel-worst case)*



Frequency (MHz)	QuasicPeak (dBµV/m)	Height (cm)	Polarization	Azimuth (deg)	Corrected Factor (dB/m)	Margin (dB)	Limit (dBµV/m)
37.396250	32.0	100.0	V	15.0	-9.6	8.0	40.0
41.640000	32.8	100.0	V	291.0	-12.3	7.2	40.0
43.822500	32.7	105.0	V	254.0	-13.6	7.3	40.0
55.826250	32.0	100.0	V	359.0	-17.5	8.0	40.0
106.751250	32.8	110.0	V	158.0	-13.6	10.7	43.5
580.111250	41.0	120.0	H	240.0	-4.7	*5.0	46.0

**Within measurement uncertainty!*

1GHz-25GHz:

802.11b Mode
Antenna 0 (Worst Case)

Frequency	Receiver		Rx Antenna		Cable loss	Amplifier Gain	Corrected Amplitude	Limit	Margin
	Reading	Measurement	Polar	Factor					
MHz	dBµV	PK/AV	H/V	dB(1/m)	dB	dB	dBµV/m	dBµV/m	dB
Low Channel: 2412 MHz									
2412	77.58	PK	H	28.74	3.07	0.00	109.39	N/A	N/A
2412	73.44	AV	H	28.74	3.07	0.00	105.25	N/A	N/A
2412	69.29	PK	V	28.74	3.07	0.00	101.10	N/A	N/A
2412	64.57	AV	V	28.74	3.07	0.00	96.38	N/A	N/A
2390	29.67	PK	H	28.67	3.06	0.00	61.40	74.00	12.60
2390	15.41	AV	H	28.67	3.06	0.00	47.14	54.00	6.86
4824	63.77	PK	H	33.91	4.36	44.72	57.32	74.00	16.68
4824	58.17	AV	H	33.91	4.36	44.72	51.72	54.00	*2.28
7236	43.78	PK	H	36.43	5.42	44.00	41.63	74.00	32.37
7236	29.73	AV	H	36.43	5.42	44.00	27.58	54.00	26.42
Middle Channel: 2437 MHz									
2437	78.33	PK	H	28.81	3.09	0.00	110.23	N/A	N/A
2437	74.15	AV	H	28.81	3.09	0.00	106.05	N/A	N/A
2437	71.26	PK	V	28.81	3.09	0.00	103.16	N/A	N/A
2437	66.79	AV	V	28.81	3.09	0.00	98.69	N/A	N/A
4874	63.19	PK	H	34.05	4.39	44.72	56.91	74.00	17.09
4874	57.84	AV	H	34.05	4.39	44.72	51.56	54.00	*2.44
7311	45.09	PK	H	36.54	5.44	44.20	42.87	74.00	31.13
7311	32.58	AV	H	36.54	5.44	44.20	30.36	54.00	23.64
High Channel: 2462 MHz									
2462	78.96	PK	H	28.89	3.10	0.00	110.95	N/A	N/A
2462	74.48	AV	H	28.89	3.10	0.00	106.47	N/A	N/A
2462	73.02	PK	V	28.89	3.10	0.00	105.01	N/A	N/A
2462	68.83	AV	V	28.89	3.10	0.00	100.82	N/A	N/A
2483.5	29.17	PK	H	28.95	3.12	0.00	61.24	74.00	12.76
2483.5	15.68	AV	H	28.95	3.12	0.00	47.75	54.00	6.25
4924	62.53	PK	H	34.19	4.42	44.71	56.43	74.00	17.57
4924	57.34	AV	H	34.19	4.42	44.71	51.24	54.00	*2.76
7386	46.19	PK	H	36.64	5.46	44.40	43.89	74.00	30.11
7386	35.06	AV	H	36.64	5.46	44.40	32.76	54.00	21.24

802.11g Mode
Antenna 0 (Worst Case)

Frequency	Receiver		Rx Antenna		Cable loss	Amplifier Gain	Corrected Amplitude	Limit	Margin
	Reading	Measurement	Polar	Factor					
MHz	dBµV	PK/AV	H/V	dB(1/m)	dB	dB	dBµV/m	dBµV/m	dB
Low Channel: 2412 MHz									
2412	77.42	PK	H	28.74	3.07	0.00	109.23	N/A	N/A
2412	67.97	AV	H	28.74	3.07	0.00	99.78	N/A	N/A
2412	72.31	PK	V	28.74	3.07	0.00	104.12	N/A	N/A
2412	62.62	AV	V	28.74	3.07	0.00	94.43	N/A	N/A
2390	34.02	PK	H	28.67	3.06	0.00	65.75	74.00	8.25
2390	17.05	AV	H	28.67	3.06	0.00	48.78	54.00	*5.22
4824	65.42	PK	H	33.91	4.36	44.72	58.97	74.00	15.03
4824	52.41	AV	H	33.91	4.36	44.72	45.96	54.00	8.04
7236	43.26	PK	H	36.43	5.42	44.00	41.11	74.00	32.89
7236	30.06	AV	H	36.43	5.42	44.00	27.91	54.00	26.09
Middle Channel: 2437 MHz									
2437	78.39	PK	H	28.81	3.09	0.00	110.29	N/A	N/A
2437	68.49	AV	H	28.81	3.09	0.00	100.39	N/A	N/A
2437	73.33	PK	V	28.81	3.09	0.00	105.23	N/A	N/A
2437	63.77	AV	V	28.81	3.09	0.00	95.67	N/A	N/A
4874	64.58	PK	H	34.05	4.39	44.72	58.30	74.00	15.70
4874	51.03	AV	H	34.05	4.39	44.72	44.75	54.00	9.25
7311	45.08	PK	H	36.54	5.44	44.20	42.86	74.00	31.14
7311	31.80	AV	H	36.54	5.44	44.20	29.58	54.00	24.42
High Channel: 2462 MHz									
2462	79.23	PK	H	28.89	3.10	0.00	111.22	N/A	N/A
2462	68.91	AV	H	28.89	3.10	0.00	100.90	N/A	N/A
2462	74.33	PK	V	28.89	3.10	0.00	106.32	N/A	N/A
2462	64.85	AV	V	28.89	3.10	0.00	96.84	N/A	N/A
2483.5	35.42	PK	H	28.95	3.12	0.00	67.49	74.00	6.51
2483.5	20.52	AV	H	28.95	3.12	0.00	52.59	54.00	*1.41
4924	63.71	PK	H	34.19	4.42	44.71	57.61	74.00	16.39
4924	49.63	AV	H	34.19	4.42	44.71	43.53	54.00	10.47
7386	46.89	PK	H	36.64	5.46	44.40	44.59	74.00	29.41
7386	33.48	AV	H	36.64	5.46	44.40	31.18	54.00	22.82

802.11n-HT20 Mode
MIMO mode (Worst Case)

Frequency	Receiver		Rx Antenna		Cable loss	Amplifier Gain	Corrected Amplitude	Limit	Margin
	Reading	Measurement	Polar	Factor					
MHz	dBµV	PK/AV	H/V	dB(1/m)	dB	dB	dBµV/m	dBµV/m	dB
Low Channel: 2412 MHz									
2412	74.67	PK	H	28.74	3.07	0.00	106.48	N/A	N/A
2412	62.86	AV	H	28.74	3.07	0.00	94.67	N/A	N/A
2412	68.86	PK	V	28.74	3.07	0.00	100.67	N/A	N/A
2412	58.25	AV	V	28.74	3.07	0.00	90.06	N/A	N/A
2390	29.97	PK	H	28.67	3.06	0.00	61.70	74.00	12.30
2390	15.49	AV	H	28.67	3.06	0.00	47.22	54.00	6.78
4824	65.12	PK	H	33.91	4.36	44.72	58.67	74.00	15.33
4824	51.06	AV	H	33.91	4.36	44.72	44.61	54.00	9.39
7236	44.38	PK	H	36.43	5.42	44.00	42.23	74.00	31.77
7236	30.68	AV	H	36.43	5.42	44.00	28.53	54.00	25.47
Middle Channel: 2437 MHz									
2437	76.42	PK	H	28.81	3.09	0.00	108.32	N/A	N/A
2437	65.29	AV	H	28.81	3.09	0.00	97.19	N/A	N/A
2437	71.18	PK	V	28.81	3.09	0.00	103.08	N/A	N/A
2437	60.74	AV	V	28.81	3.09	0.00	92.64	N/A	N/A
4874	62.77	PK	H	34.05	4.39	44.72	56.49	74.00	17.51
4874	48.38	AV	H	34.05	4.39	44.72	42.10	54.00	11.90
7311	45.08	PK	H	36.54	5.44	44.20	42.86	74.00	31.14
7311	31.59	AV	H	36.54	5.44	44.20	29.37	54.00	24.63
High Channel: 2462 MHz									
2462	77.95	PK	H	28.89	3.10	0.00	109.94	N/A	N/A
2462	67.45	AV	H	28.89	3.10	0.00	99.44	N/A	N/A
2462	73.41	PK	V	28.89	3.10	0.00	105.40	N/A	N/A
2462	63.03	AV	V	28.89	3.10	0.00	95.02	N/A	N/A
2483.5	34.75	PK	H	28.95	3.12	0.00	66.82	74.00	7.18
2483.5	19.52	AV	H	28.95	3.12	0.00	51.59	54.00	*2.41
4924	60.23	PK	H	34.19	4.42	44.71	54.13	74.00	19.87
4924	45.41	AV	H	34.19	4.42	44.71	39.31	54.00	14.69
7386	45.68	PK	H	36.64	5.46	44.40	43.38	74.00	30.62
7386	32.32	AV	H	36.64	5.46	44.40	30.02	54.00	23.98

802.11n-HT40 Mode
MIMO Mode (Worst Case)

Frequency	Receiver		Rx Antenna		Cable loss	Amplifier Gain	Corrected Amplitude	Limit	Margin
	Reading	Measurement	Polar	Factor					
MHz	dBµV	PK/AV	H/V	dB(1/m)	dB	dB	dBµV/m	dBµV/m	dB
Low Channel: 2422 MHz									
2422	73.63	PK	H	28.77	3.08	0.00	105.48	N/A	N/A
2422	62.72	AV	H	28.77	3.08	0.00	94.57	N/A	N/A
2422	66.72	PK	V	28.77	3.08	0.00	98.57	N/A	N/A
2422	55.89	AV	V	28.77	3.08	0.00	87.74	N/A	N/A
2390	36.72	PK	H	28.67	3.06	0.00	68.45	74.00	5.55
2390	20.52	AV	H	28.67	3.06	0.00	52.25	54.00	*1.75
4844	56.58	PK	H	33.96	4.38	44.72	50.20	74.00	23.80
4844	43.71	AV	H	33.96	4.38	44.72	37.33	54.00	16.67
7266	43.66	PK	H	36.47	5.43	44.08	41.48	74.00	32.52
7266	30.38	AV	H	36.47	5.43	44.08	28.20	54.00	25.80
Middle Channel: 2437 MHz									
2437	74.17	PK	H	28.81	3.09	0.00	106.07	N/A	N/A
2437	63.24	AV	H	28.81	3.09	0.00	95.14	N/A	N/A
2437	67.60	PK	V	28.81	3.09	0.00	99.50	N/A	N/A
2437	56.69	AV	V	28.81	3.09	0.00	88.59	N/A	N/A
4874	56.97	PK	H	34.05	4.39	44.72	50.69	74.00	23.31
4874	43.49	AV	H	34.05	4.39	44.72	37.21	54.00	16.79
7311	44.15	PK	H	36.54	5.44	44.20	41.93	74.00	32.07
7311	30.84	AV	H	36.54	5.44	44.20	28.62	54.00	25.38
High Channel: 2452 MHz									
2452	74.69	PK	H	28.86	3.10	0.00	106.65	N/A	N/A
2452	63.57	AV	H	28.86	3.10	0.00	95.53	N/A	N/A
2452	68.46	PK	V	28.86	3.10	0.00	100.42	N/A	N/A
2452	57.36	AV	V	28.86	3.10	0.00	89.32	N/A	N/A
2483.5	33.63	PK	H	28.95	3.12	0.00	65.70	74.00	8.30
2483.5	18.34	AV	H	28.95	3.12	0.00	50.41	54.00	*3.59
4904	57.31	PK	H	34.13	4.41	44.71	51.14	74.00	22.86
4904	43.09	AV	H	34.13	4.41	44.71	36.92	54.00	17.08
7356	44.57	PK	H	36.60	5.45	44.32	42.30	74.00	31.70
7356	31.26	AV	H	36.60	5.45	44.32	28.99	54.00	25.01

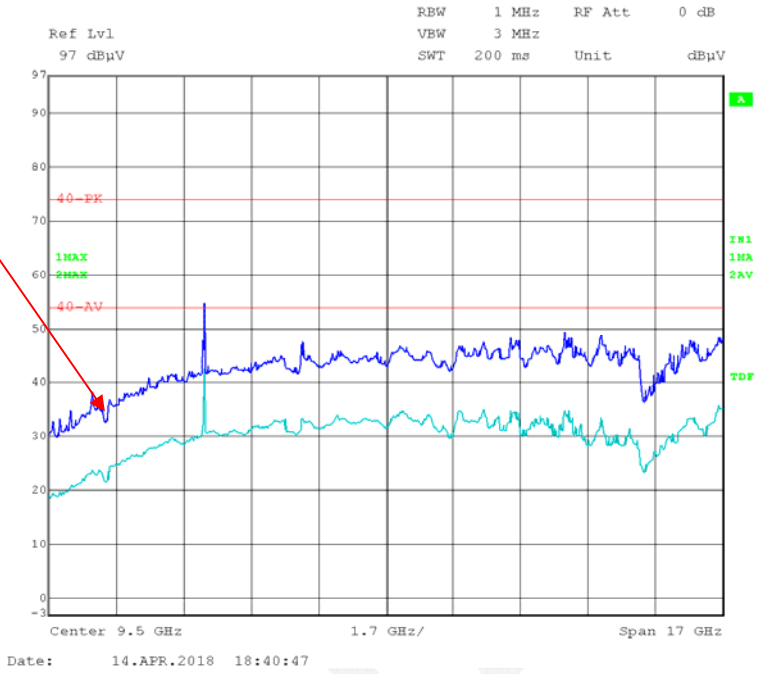
Note:
Corrected Amplitude = Corrected Factor + Reading
Corrected Factor=Antenna factor (RX) + Cable Loss – Amplifier Factor
Margin = Limit- Corr. Amplitude

Spurious emissions more than 20 dB below the limit were not reported.

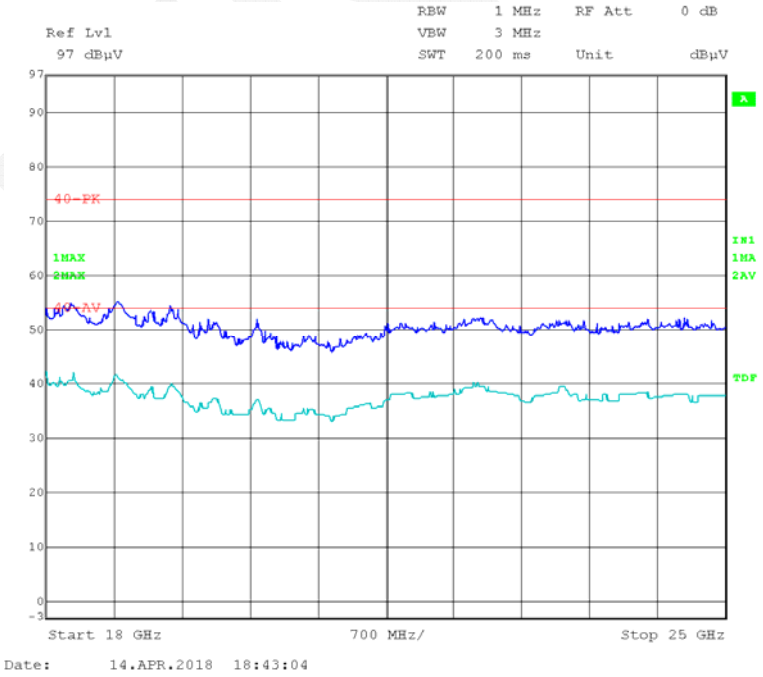
Please refer to the below pre-scan plot of worst case:

802.11g High Channel_Horizontal_1GHz-18GHz

Fundamental with Reject Band Filter

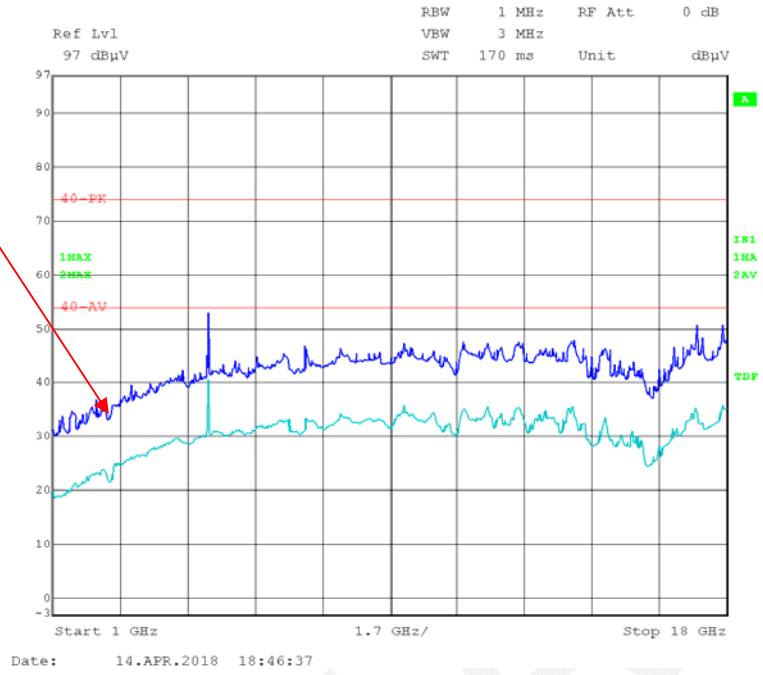


802.11g High Channel _Horizontal_18GHz-25GHz

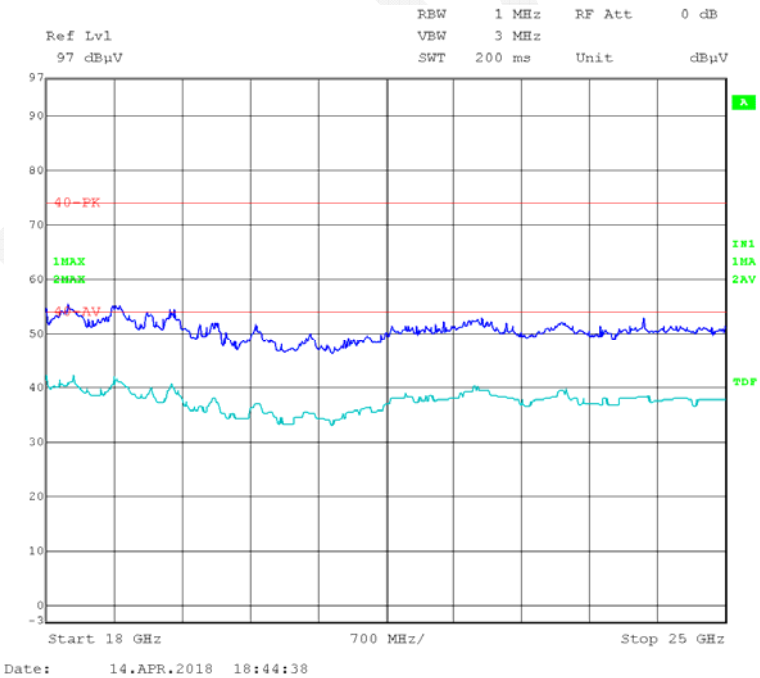


802.11g High Channel _Vertical_1GHz-18GHz

Fundamental with Reject Band Filter



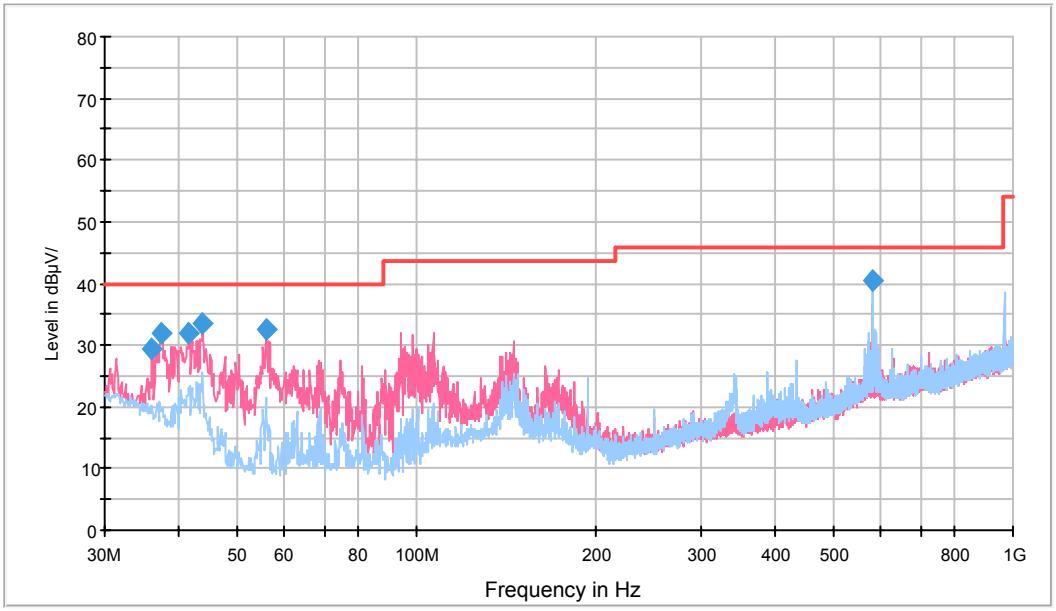
802.11g High Channel _Vertical_18GHz-25GHz



For Zigbee Mode

Low Channel-worst case

30MHz-1GHz:



Frequency (MHz)	QuasicPeak (dBµV/m)	Height (cm)	Polarization	Azimuth (deg)	Corrected Factor (dB/m)	Margin (dB)	Limit (dBµV/m)
36.062500	29.5	100.0	V	135.0	-8.8	10.5	40.0
37.275000	32.0	105.0	V	15.0	-9.6	8.0	40.0
41.518750	32.1	100.0	V	112.0	-12.2	7.9	40.0
43.701250	33.6	100.0	V	97.0	-13.5	6.4	40.0
55.947500	32.4	110.0	V	341.0	-17.5	7.6	40.0
580.111250	40.5	125.0	H	0.0	-4.7	*5.5	46.0

1GHz-25GHz:

Frequency	Receiver		Rx Antenna		Cable loss	Amplifier Gain	Corrected Amplitude	Limit	Margin
	Reading	Measurement	Polar	Factor					
MHz	dBμV	PK/AV	H/V	dB(1/m)	dB	dB	dBμV/m	dBμV/m	dB
2405 MHz									
2405	81.17	PK	H	28.72	3.07	0.00	112.96	N/A	N/A
2405	78.39	AV	H	28.72	3.07	0.00	110.18	N/A	N/A
2405	77.54	PK	V	28.72	3.07	0.00	109.33	N/A	N/A
2405	74.74	AV	V	28.72	3.07	0.00	106.53	N/A	N/A
2390	29.71	PK	H	28.67	3.06	0.00	61.44	74.00	12.56
2390	15.41	AV	H	28.67	3.06	0.00	47.14	54.00	6.86
4810	64.51	PK	H	33.87	4.36	44.73	58.01	74.00	15.99
4810	57.86	AV	H	33.87	4.36	44.73	51.36	54.00	*2.64
7215	59.31	PK	H	36.40	5.41	43.94	57.18	74.00	16.82
7215	52.75	AV	H	36.40	5.41	43.94	50.62	54.00	*3.38
9620	53.21	PK	H	37.99	6.23	44.64	52.79	74.00	21.21
9620	45.46	AV	H	37.99	6.23	44.64	45.04	54.00	8.96
2425 MHz									
2425	81.81	PK	H	28.78	3.08	0.00	113.67	N/A	N/A
2425	79.17	AV	H	28.78	3.08	0.00	111.03	N/A	N/A
2425	78.71	PK	V	28.78	3.08	0.00	110.57	N/A	N/A
2425	76.37	AV	V	28.78	3.08	0.00	108.23	N/A	N/A
4850	61.29	PK	H	33.98	4.38	44.72	54.93	74.00	19.07
4850	54.02	AV	H	33.98	4.38	44.72	47.66	54.00	6.34
7275	57.35	PK	H	36.49	5.43	44.10	55.17	74.00	18.83
7275	50.53	AV	H	36.49	5.43	44.10	48.35	54.00	5.65
9700	51.91	PK	H	38.12	6.27	44.56	51.74	74.00	22.26
9700	43.16	AV	H	38.12	6.27	44.56	42.99	54.00	11.01
2450 MHz									
2450	80.59	PK	H	28.85	3.10	0.00	112.54	N/A	N/A
2450	78.12	AV	H	28.85	3.10	0.00	110.07	N/A	N/A
2450	77.22	PK	V	28.85	3.10	0.00	109.17	N/A	N/A
2450	74.82	AV	V	28.85	3.10	0.00	106.77	N/A	N/A
4900	60.42	PK	H	34.12	4.41	44.71	54.24	74.00	19.76
4900	52.93	AV	H	34.12	4.41	44.71	46.75	54.00	7.25
7350	56.32	PK	H	36.59	5.45	44.30	54.06	74.00	19.94
7350	49.22	AV	H	36.59	5.45	44.30	46.96	54.00	7.04
9800	50.24	PK	H	38.28	6.31	44.46	50.37	74.00	23.63
9800	41.26	AV	H	38.28	6.31	44.46	41.39	54.00	12.61

Frequency	Receiver		Rx Antenna		Cable loss	Amplifier Gain	Corrected Amplitude	Limit	Margin
	Reading	Measurement	Polar	Factor					
MHz	dBµV	PK/AV	H/V	dB(1/m)	dB	dB	dBµV/m	dBµV/m	dB
2475 MHz									
2475	79.58	PK	H	28.93	3.11	0.00	111.62	N/A	N/A
2475	77.31	AV	H	28.93	3.11	0.00	109.35	N/A	N/A
2475	75.65	PK	V	28.93	3.11	0.00	107.69	N/A	N/A
2475	72.86	AV	V	28.93	3.11	0.00	104.90	N/A	N/A
2483.5	32.37	PK	H	28.95	3.12	0.00	64.44	74.00	9.56
2483.5	19.78	AV	H	28.95	3.12	0.00	51.85	54.00	*2.15
4950	61.97	PK	H	34.26	4.43	44.71	55.95	74.00	18.05
4950	55.21	AV	H	34.26	4.43	44.71	49.19	54.00	*4.81
7425	55.64	PK	H	36.70	5.48	44.50	53.32	74.00	20.68
7425	48.28	AV	H	36.70	5.48	44.50	45.96	54.00	8.04
9900	48.95	PK	H	38.44	6.36	44.36	49.39	74.00	24.61
9900	39.61	AV	H	38.44	6.36	44.36	40.05	54.00	13.95

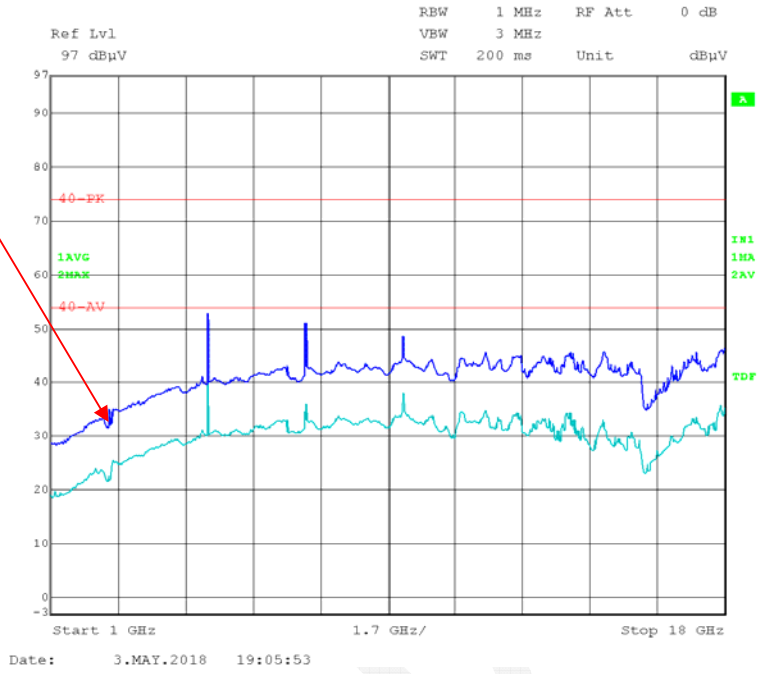
Note:
Corrected Amplitude = Corrected Factor + Reading
Corrected Factor=Antenna factor (RX) + Cable Loss – Amplifier Factor
Margin = Limit- Corr. Amplitude

Spurious emissions more than 20 dB below the limit were not reported.

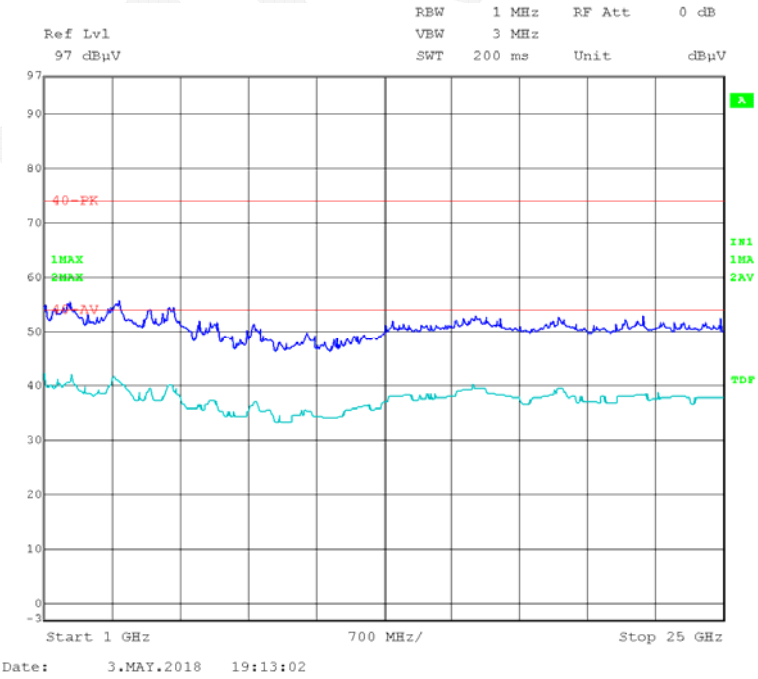
Please refer to the below pre-scan plot of worst case:

High Channel_Horizontal_1GHz-18GHz

Fundamental with Reject Band Filter

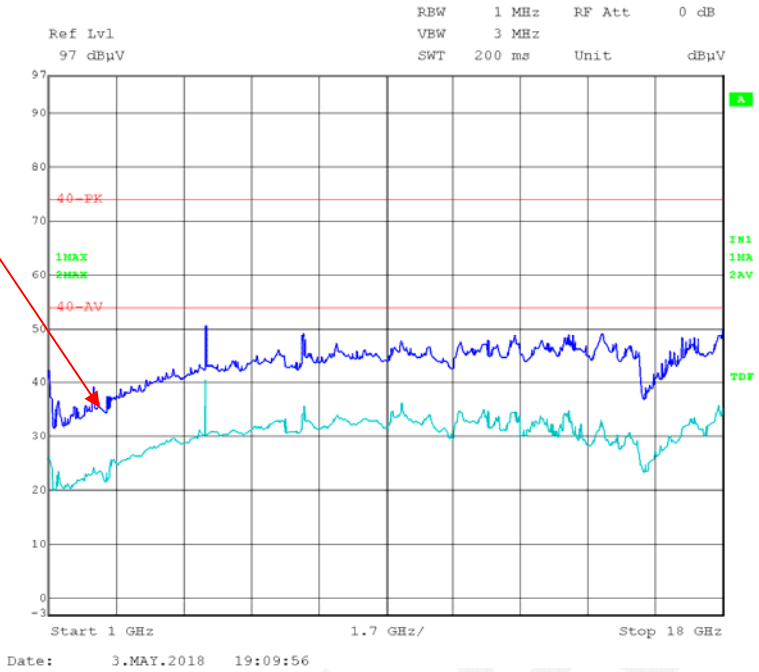


High Channel _Horizontal_18GHz-25GHz

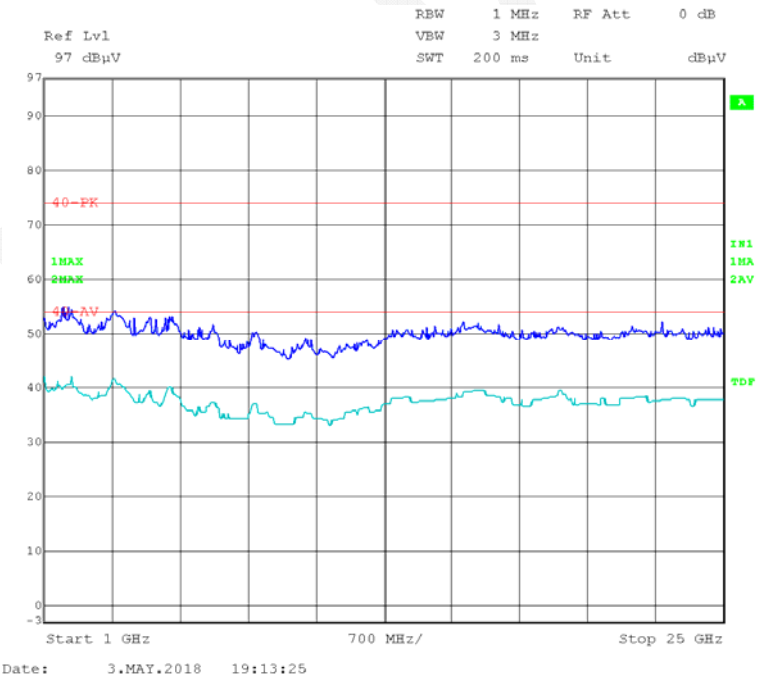


High Channel _Vertical_1GHz-18GHz

Fundamental with Reject Band Filter



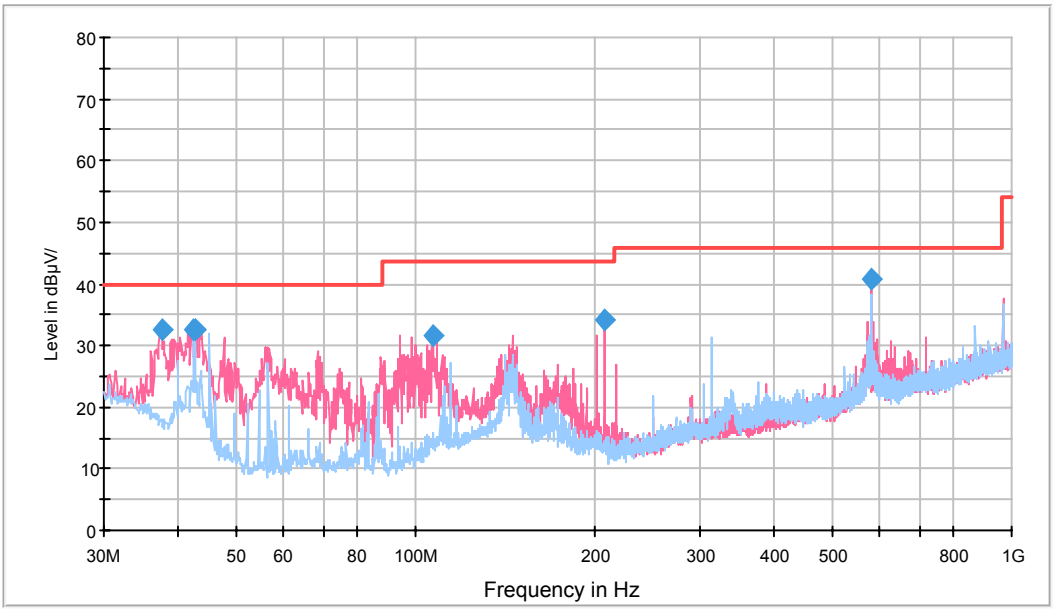
High Channel _Vertical_18GHz-25GHz



For co-location evaluation data

(802.11b Low Channel + Zigbee Low Channel work simultaneously) (worst case)

30 MHz to 1 GHz



Frequency (MHz)	QuasicPeak (dBµV/m)	Height (cm)	Polarization	Azimuth (deg)	Corrected Factor (dB/m)	Margin (dB)	Limit (dBµV/m)
37.517500	32.7	100.0	V	130.0	-9.7	7.3	40.0
42.488750	32.6	110.0	H	125.0	-12.8	7.4	40.0
42.610000	32.5	100.0	H	125.0	-12.9	7.5	40.0
106.751200	31.5	110.0	H	225.0	-13.6	12.0	43.5
206.903700	34.2	100.0	V	224.0	-13.8	9.3	43.5
580.111250	40.9	105.0	V	96.0	-4.7	*5.1	46.0

**Within measurement uncertainty!*

Above 1 GHz

Frequency	Receiver		Rx Antenna		Cable loss	Amplifier Gain	Corrected Amplitude	Limit	Margin
	Reading	Measurement	Polar	Factor					
MHz	dBµV	PK/AV	H/V	dB(1/m)	dB	dB	dBµV/m	dBµV/m	dB
1097	55.40	PK	H	24.03	2.08	43.41	38.10	74.00	35.90
1097	38.45	AV	H	24.03	2.08	43.41	21.15	54.00	32.85
2988	50.19	PK	H	30.56	3.41	44.26	39.90	74.00	34.10
2988	36.52	AV	H	30.56	3.41	44.26	26.23	54.00	27.77
2113	49.14	PK	V	27.84	2.87	43.75	36.10	74.00	37.90
2113	35.37	AV	V	27.84	2.87	43.75	22.33	54.00	31.67
2976	49.42	PK	V	30.52	3.41	44.26	39.09	74.00	34.91
2976	35.83	AV	V	30.52	3.41	44.26	25.50	54.00	28.50

Note:
Corrected Amplitude = Corrected Factor + Reading
Corrected Factor=Antenna factor (RX) + Cable Loss – Amplifier Factor
Margin = Limit- Corr. Amplitude

Spurious emissions more than 20 dB below the limit were not reported.

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

a) Set RBW = 100 kHz.
b) Set the video bandwidth (VBW) ≥ 3×RBW
c) Detector = Peak.
d) Trace mode = max hold.
e) Sweep = auto couple.
f) Allow the trace to stabilize.
g) Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

Test Data

Environmental Conditions

Temperature:	25 ~ 26 °C
Relative Humidity:	46 ~ 58 %
ATM Pressure:	94.5 ~ 94.8 kPa

The testing was performed by Tom Tang on 2018-04-11 and 2018-04-12.

Test Mode: Transmitting

Test Result: Compliant. Please refer to the following tables and plots.

For Wi-Fi Mode

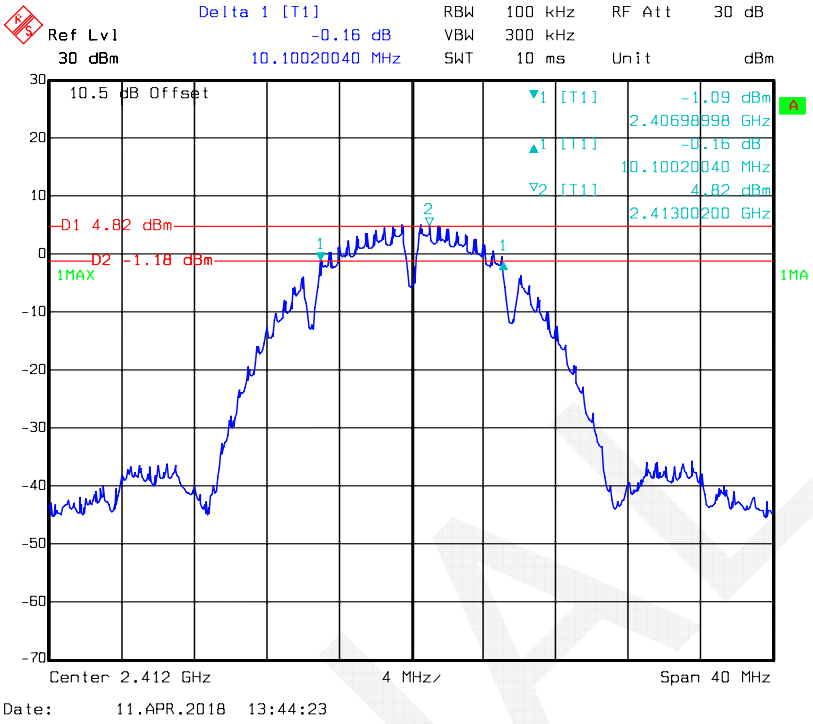
Test mode	Channel	Frequency (MHz)	6 dB Emission Bandwidth (MHz)		Limit (MHz)
			Antenna 0	Antenna 1	
802.11b	Low	2412	10.10	9.70	≥0.5
	Middle	2437	9.70	9.70	≥0.5
	High	2462	9.22	10.10	≥0.5
802.11g	Low	2412	15.23	15.23	≥0.5
	Middle	2437	15.23	15.15	≥0.5
	High	2462	15.23	15.23	≥0.5
802.11n-HT20	Low	2412	15.15	15.15	≥0.5
	Middle	2437	15.15	15.23	≥0.5
	High	2462	15.15	15.23	≥0.5
802.11n-HT40	Low	2422	35.11	35.27	≥0.5
	Middle	2437	35.11	35.27	≥0.5
	High	2452	35.11	33.99	≥0.5

For Zigbee Mode

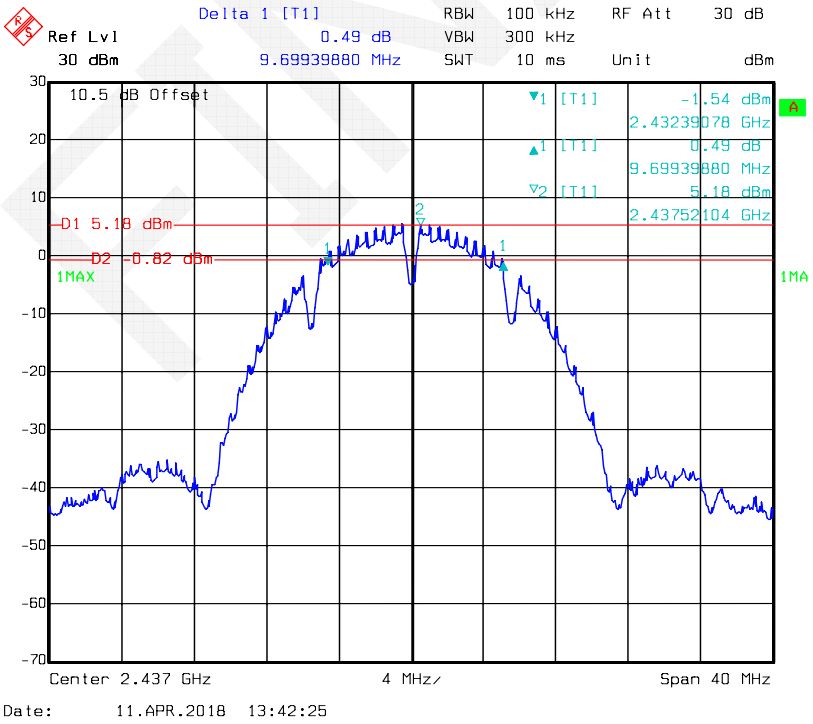
Test mode	Frequency (MHz)	6 dB Emission Bandwidth (MHz)	Limit (MHz)
Zigbee	2405	1.62	≥0.5
	2425	1.62	≥0.5
	2450	1.62	≥0.5
	2475	1.65	≥0.5

For Wi-Fi Mode

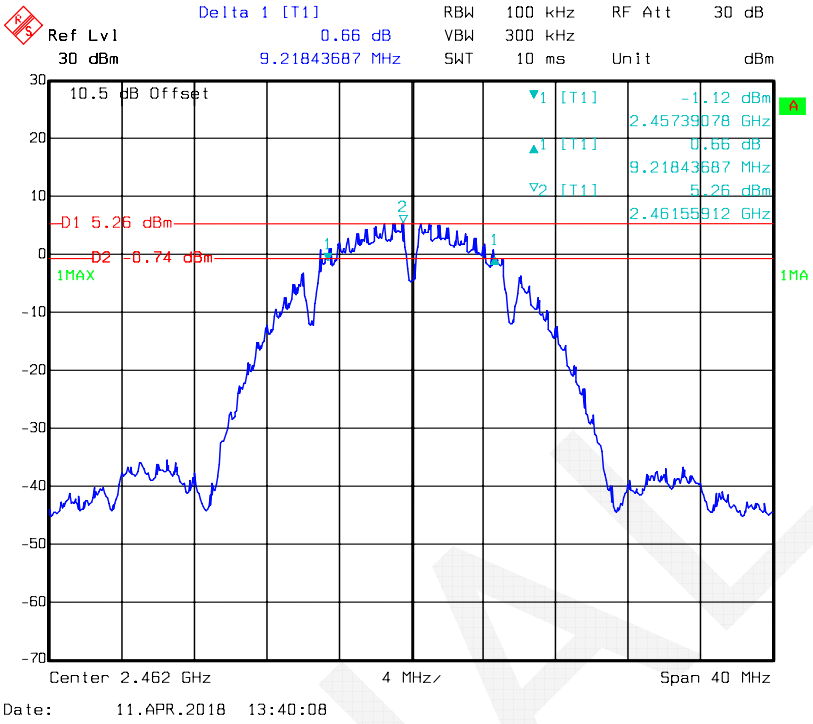
802.11b: Low Channel, Antenna 0



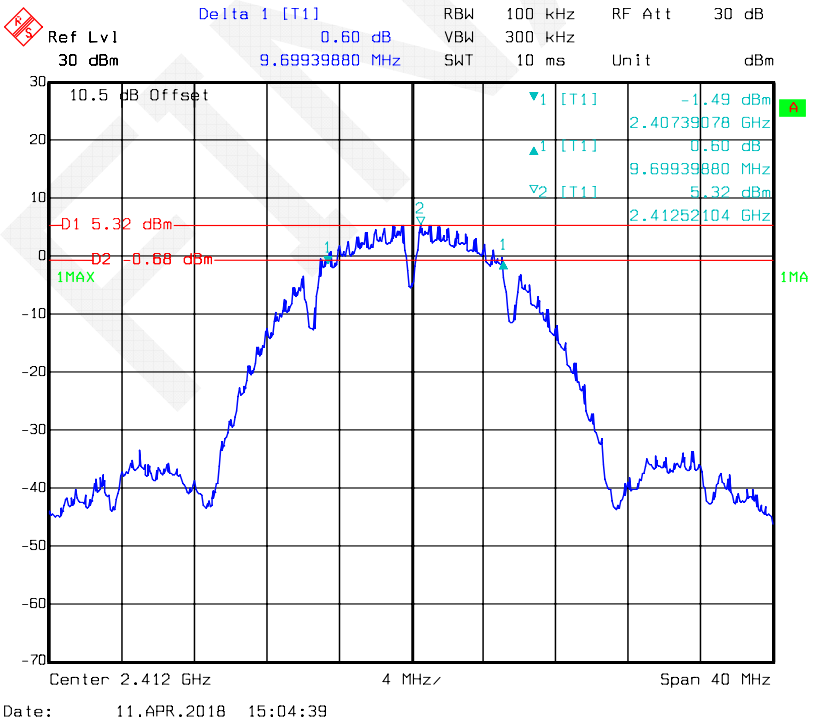
802.11b: Middle Channel, Antenna 0



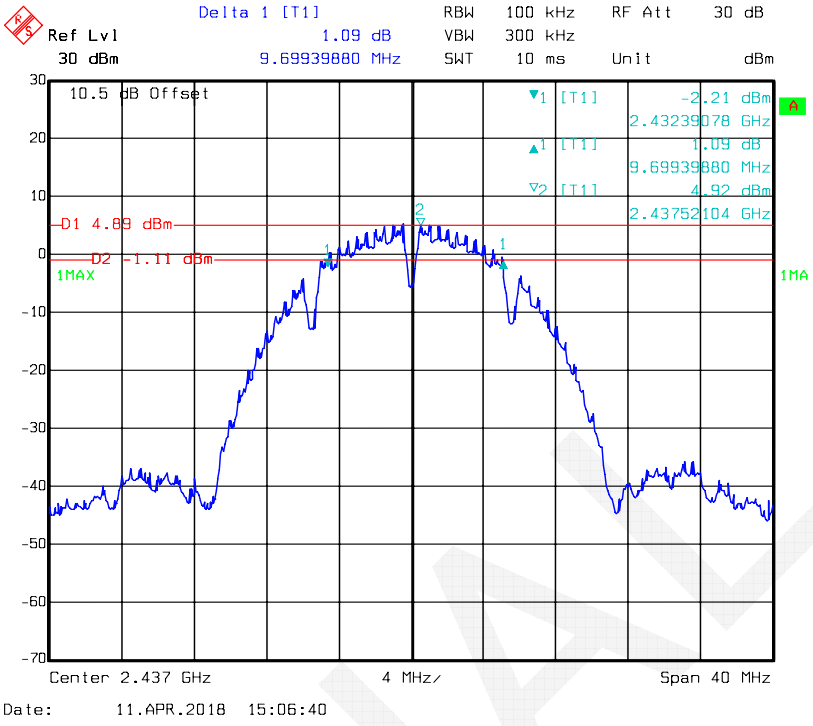
802.11b: High Channel, Antenna 0



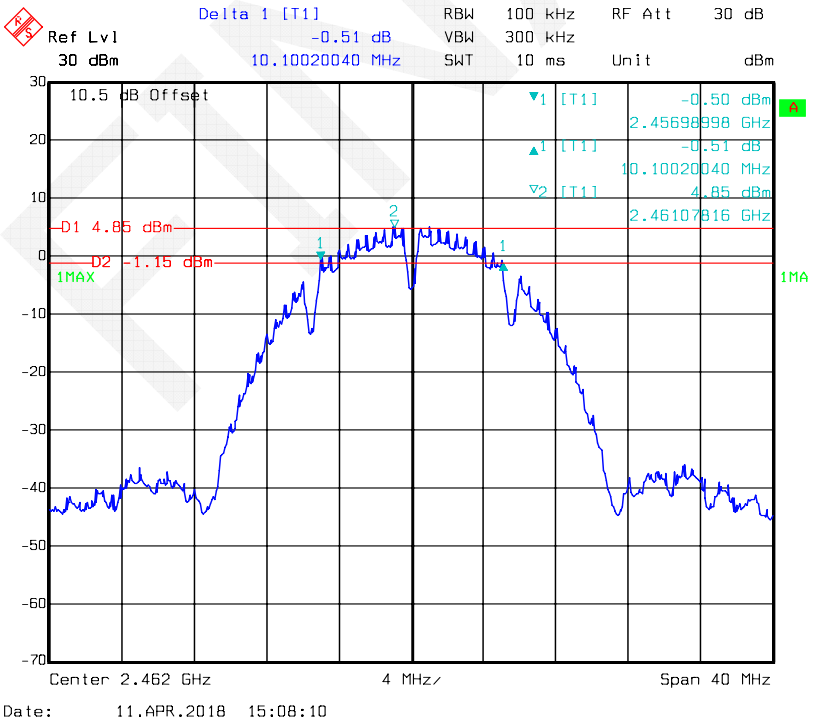
802.11b: Low Channel, Antenna 1



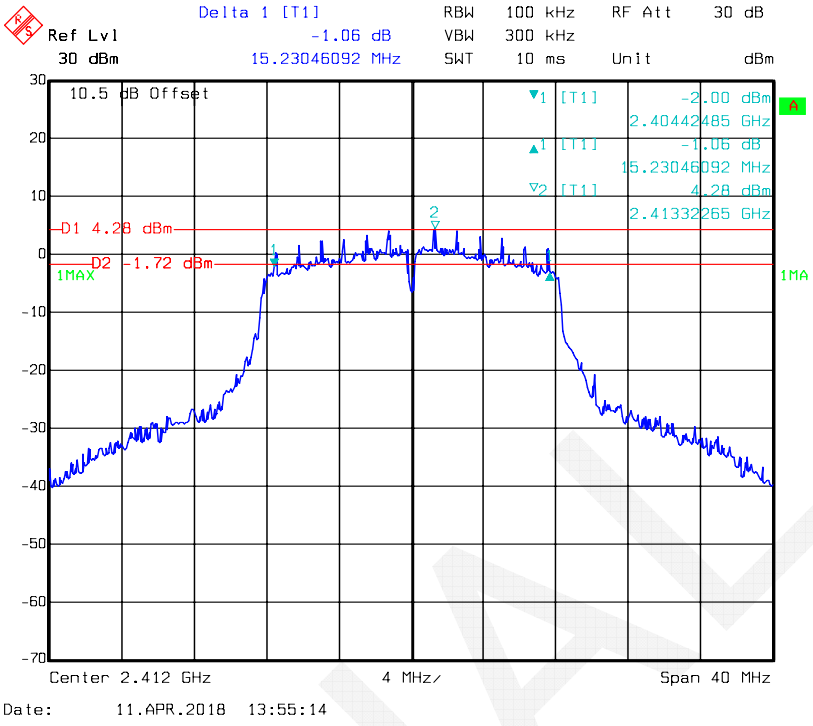
802.11b: Middle Channel, Antenna 1



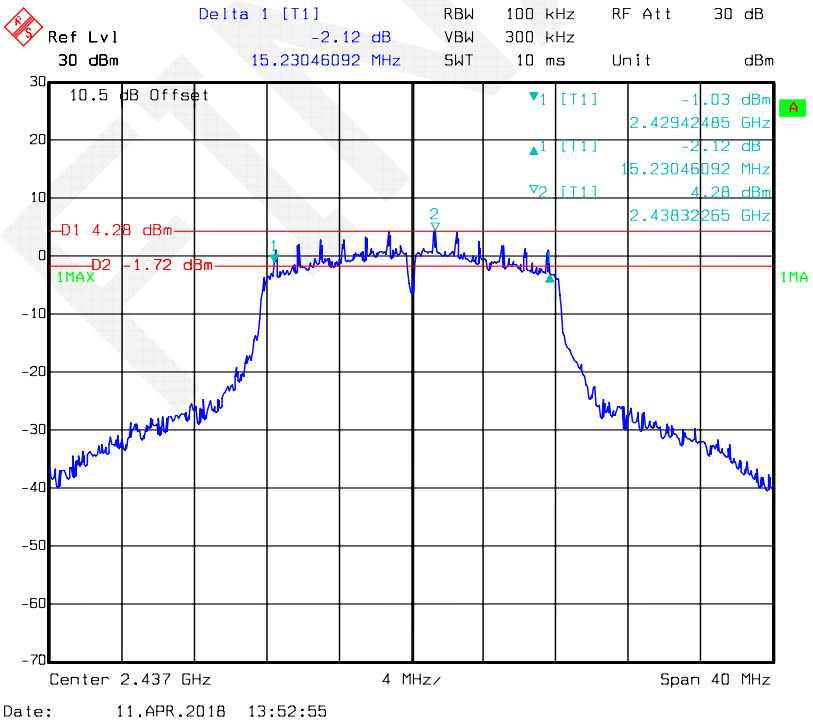
802.11b: High Channel, Antenna 1



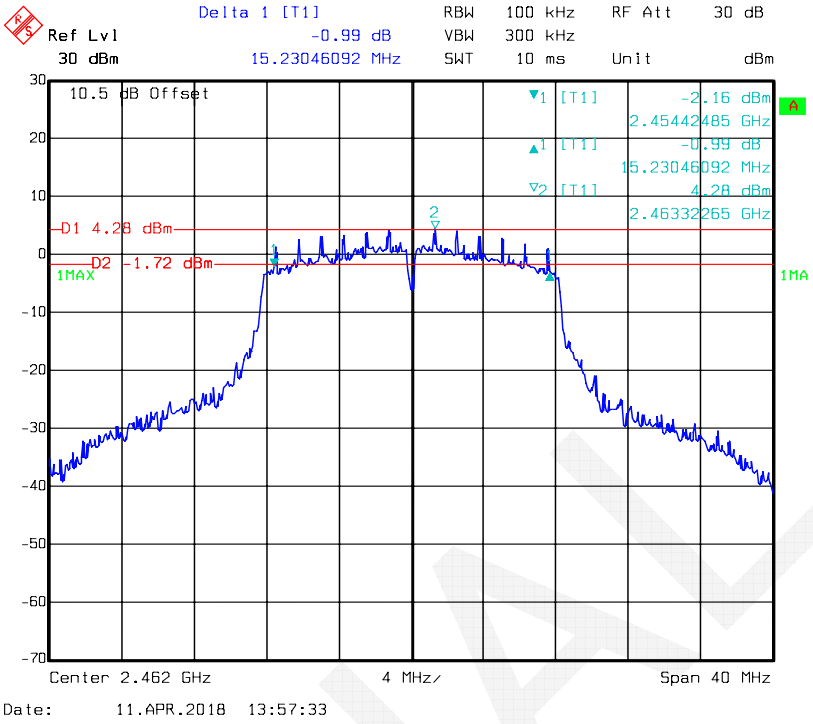
802.11g: Low Channel, Antenna 0



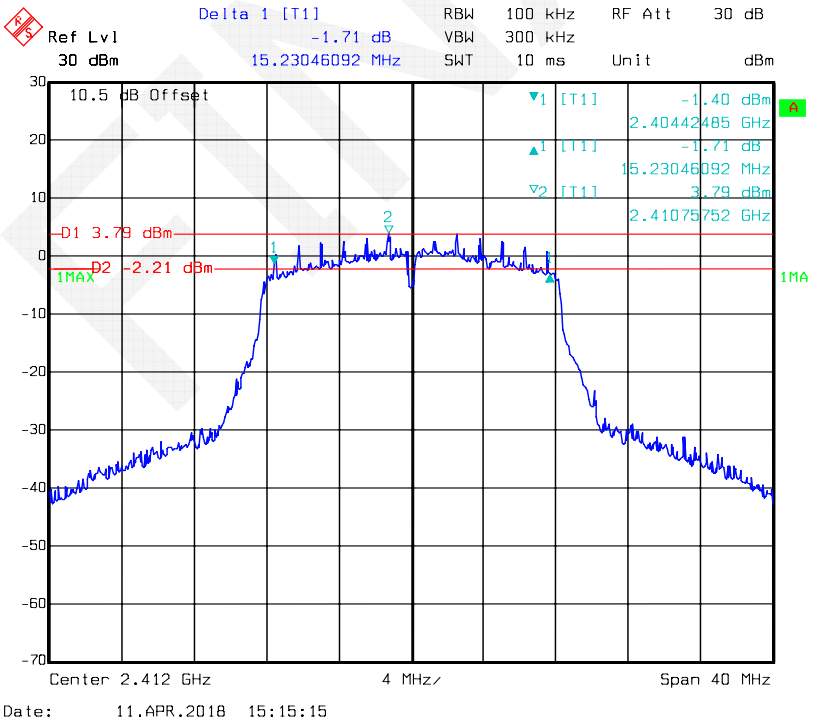
802.11g: Middle Channel, Antenna 0



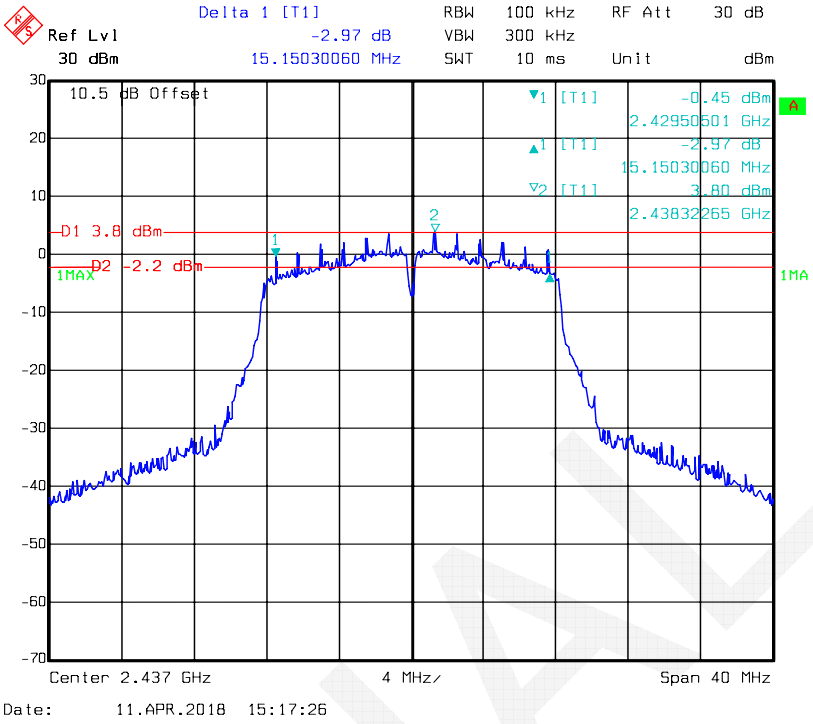
802.11g: High Channel, Antenna 0



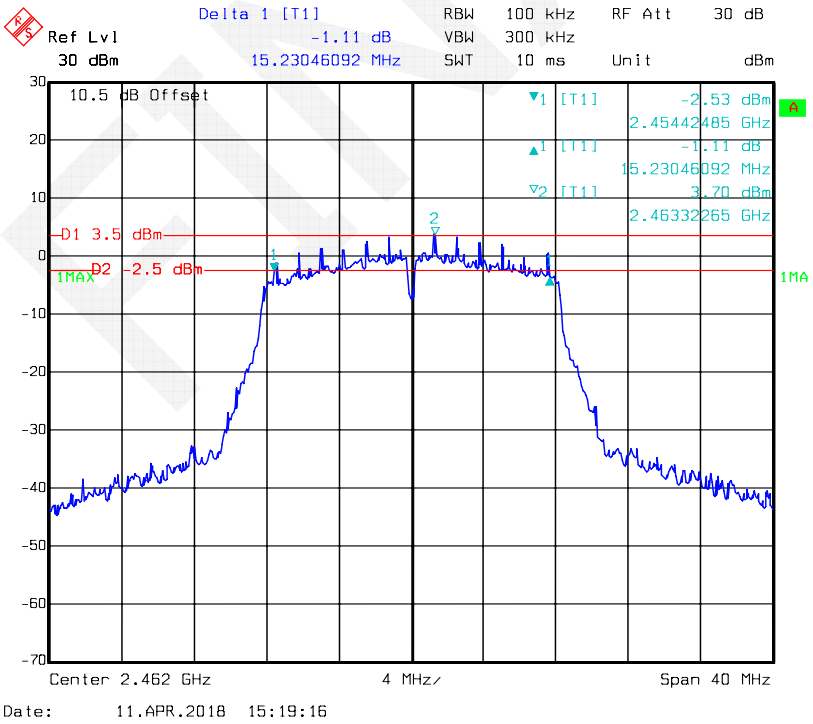
802.11g: Low Channel, Antenna 1



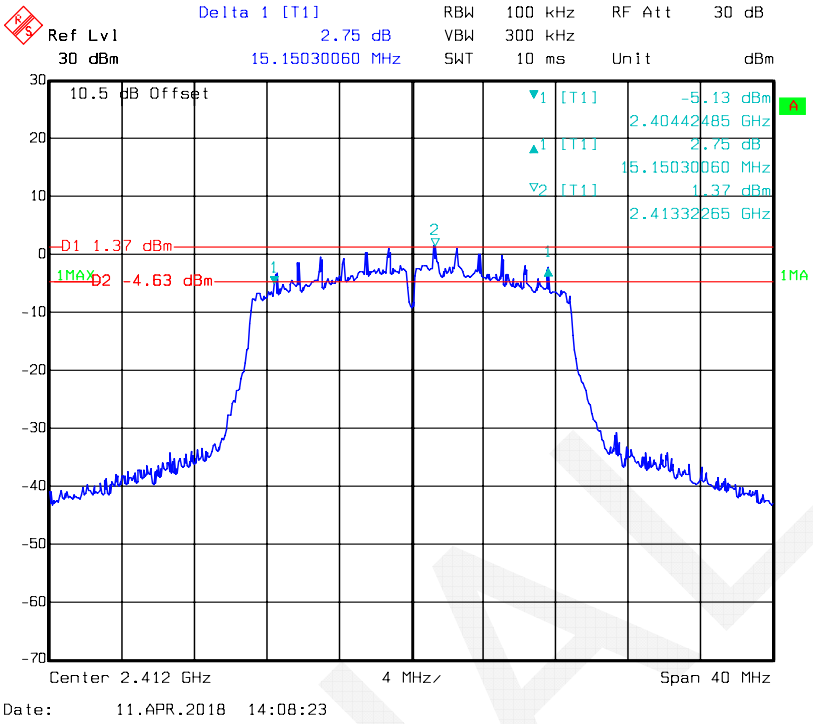
802.11g: Middle Channel, Antenna 1



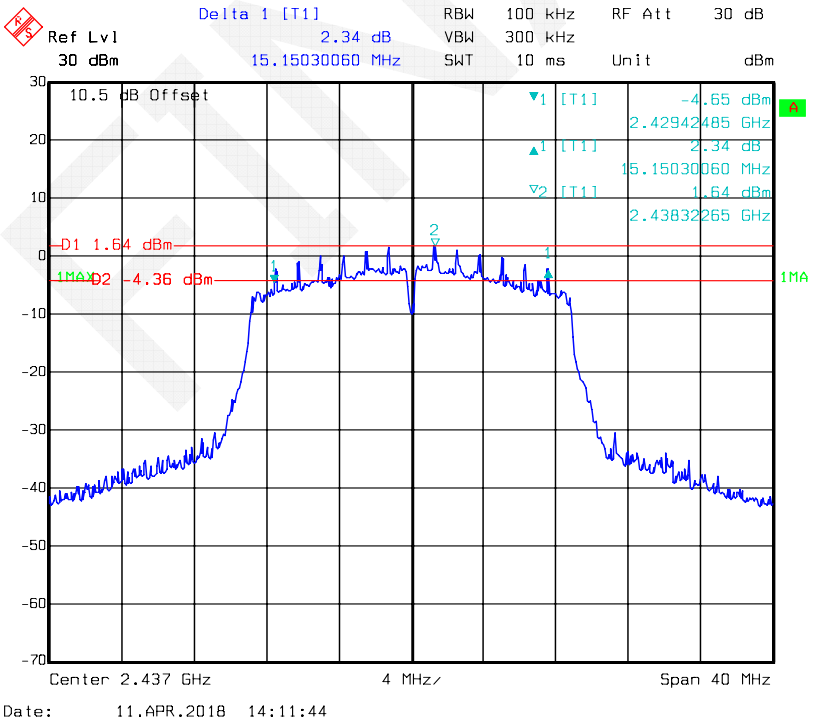
802.11g: High Channel, Antenna 1



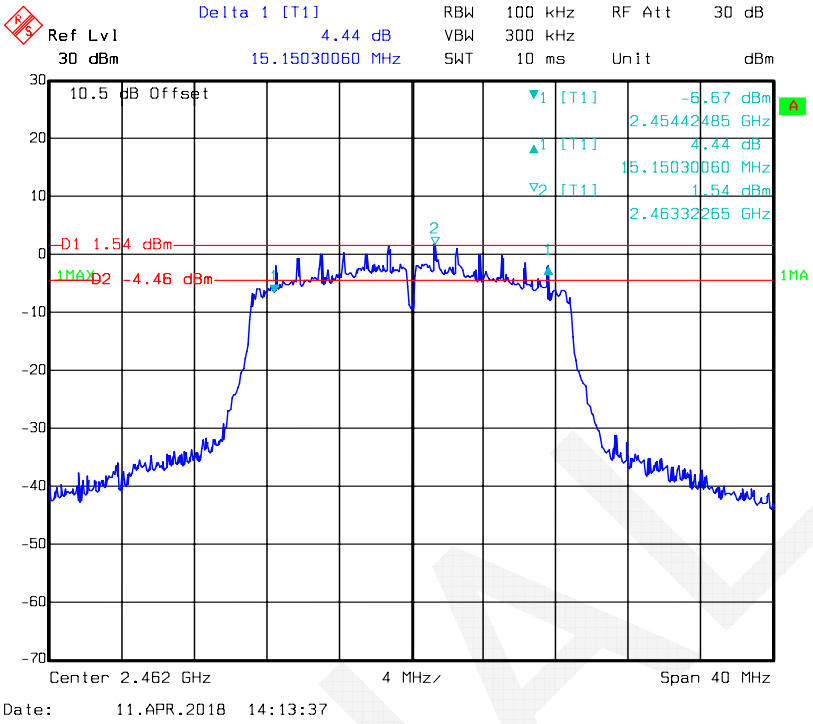
802.11n-HT20: Low Channel, Antenna 0



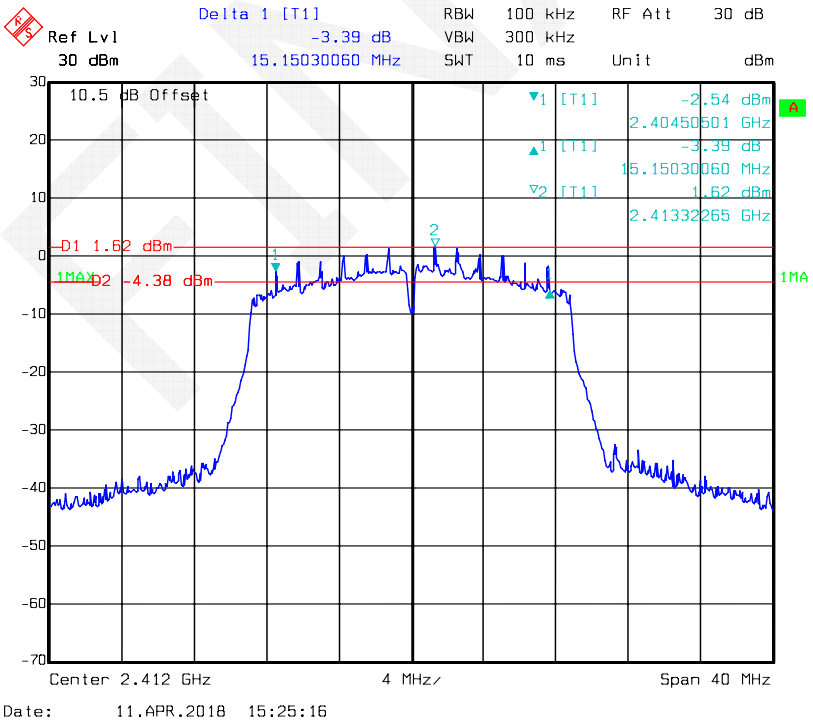
802.11n-HT20: Middle Channel, Antenna 0



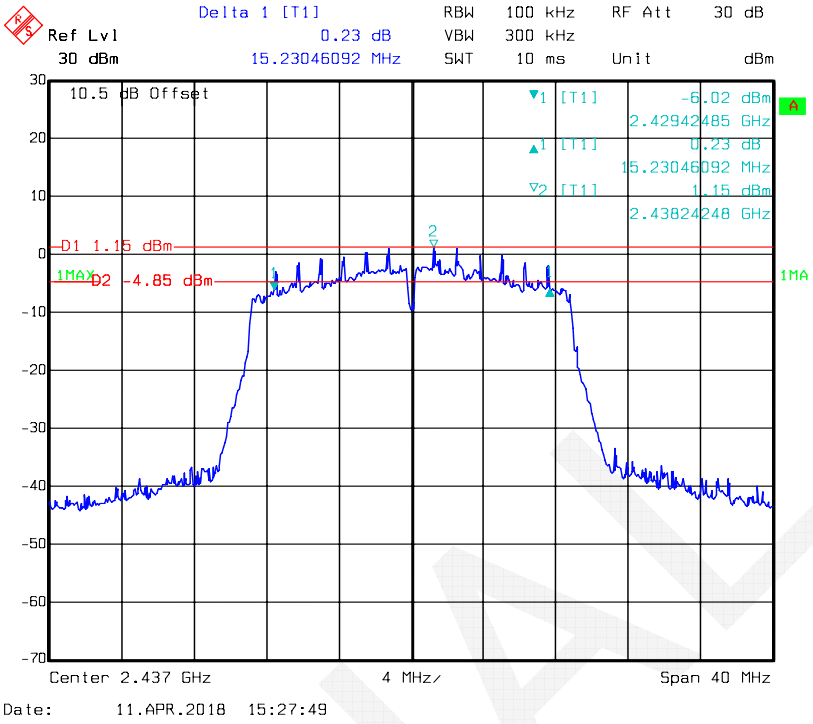
802.11n-HT20: High Channel, Antenna 0



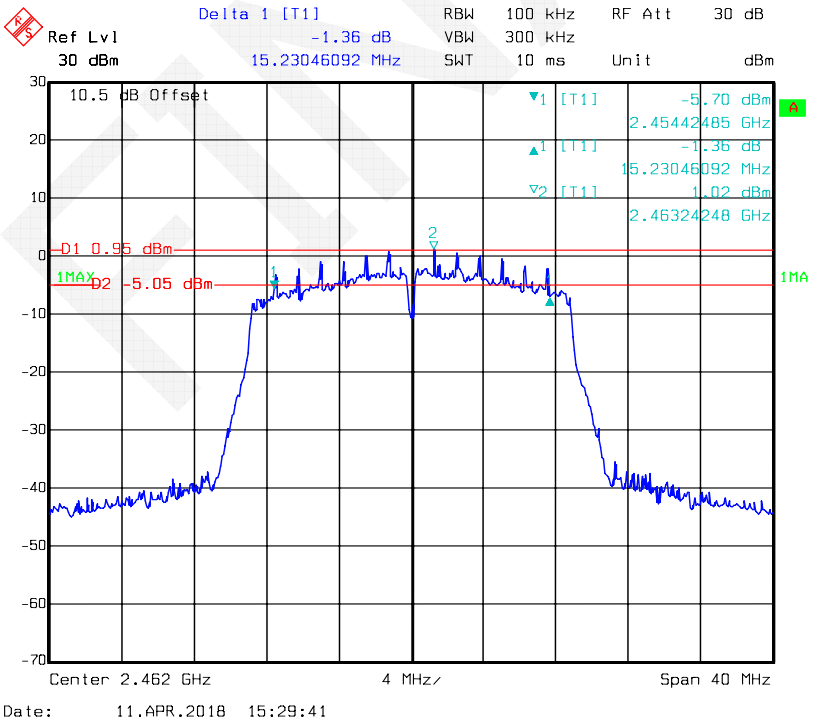
802.11n-HT20: Low Channel, Antenna 1



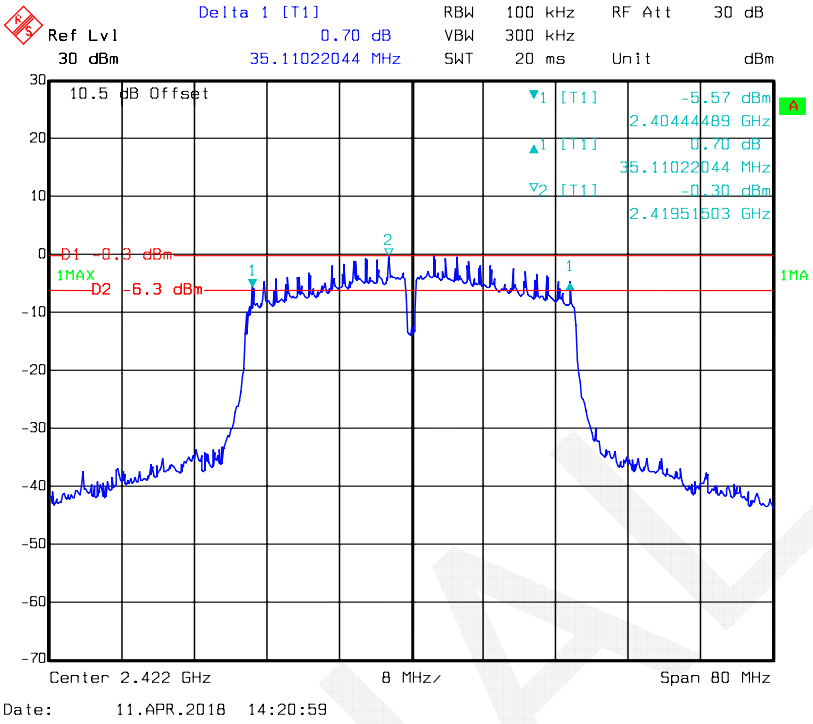
802.11n-HT20: Middle Channel, Antenna 1



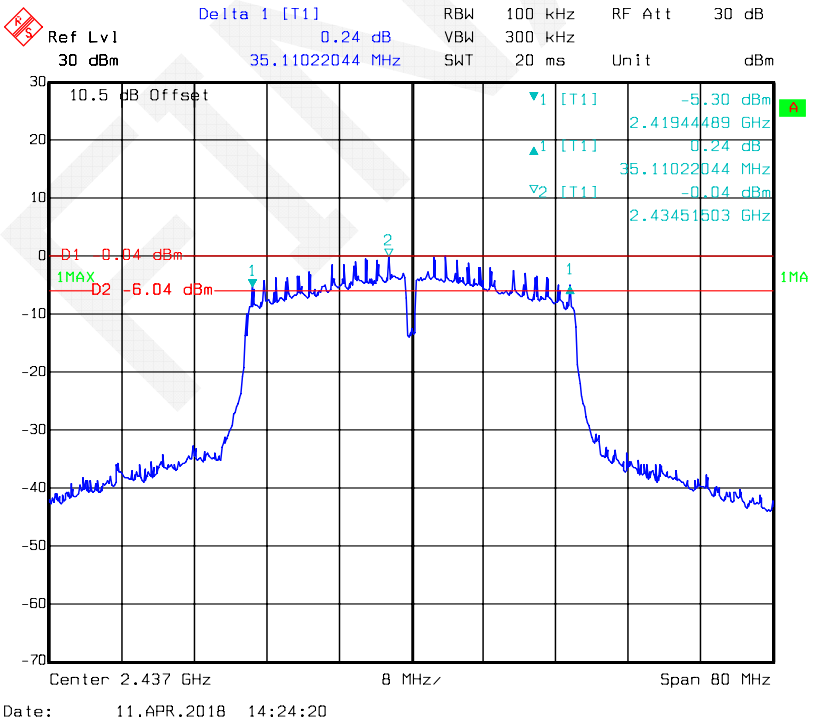
802.11n-HT20: High Channel, Antenna 1



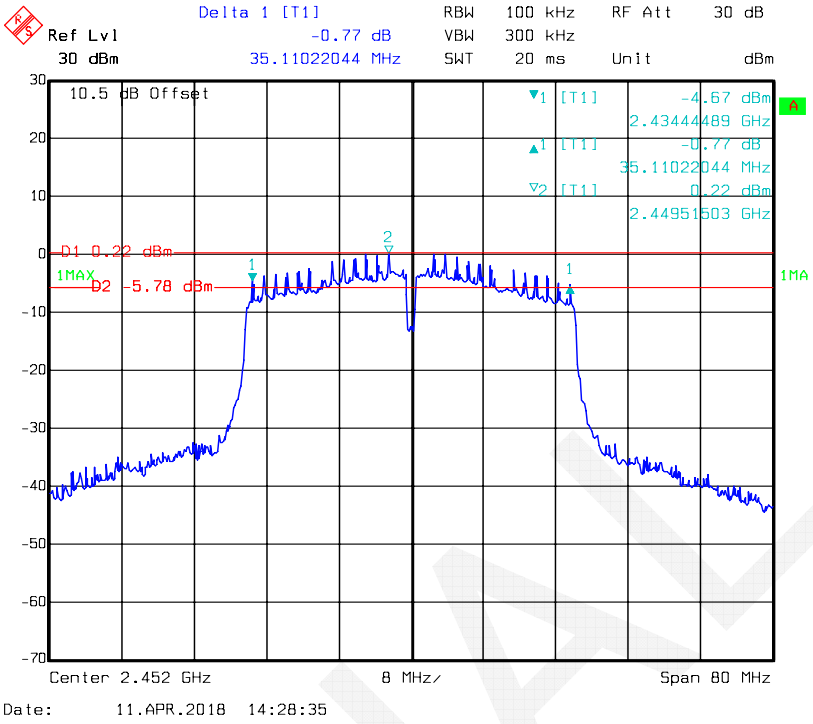
802.11n-HT40: Low Channel, Antenna 0



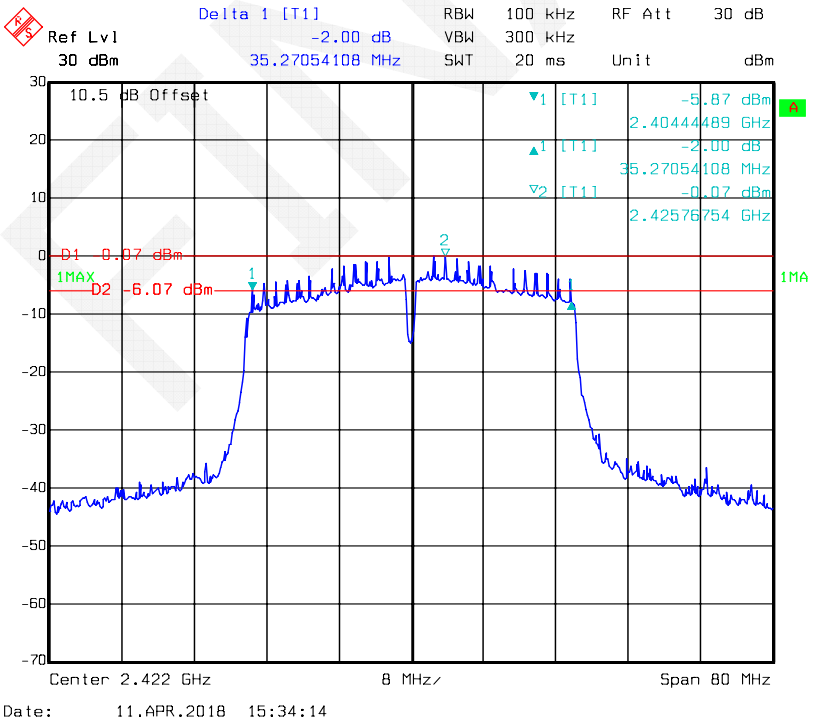
802.11n-HT40: Middle Channel, Antenna 0



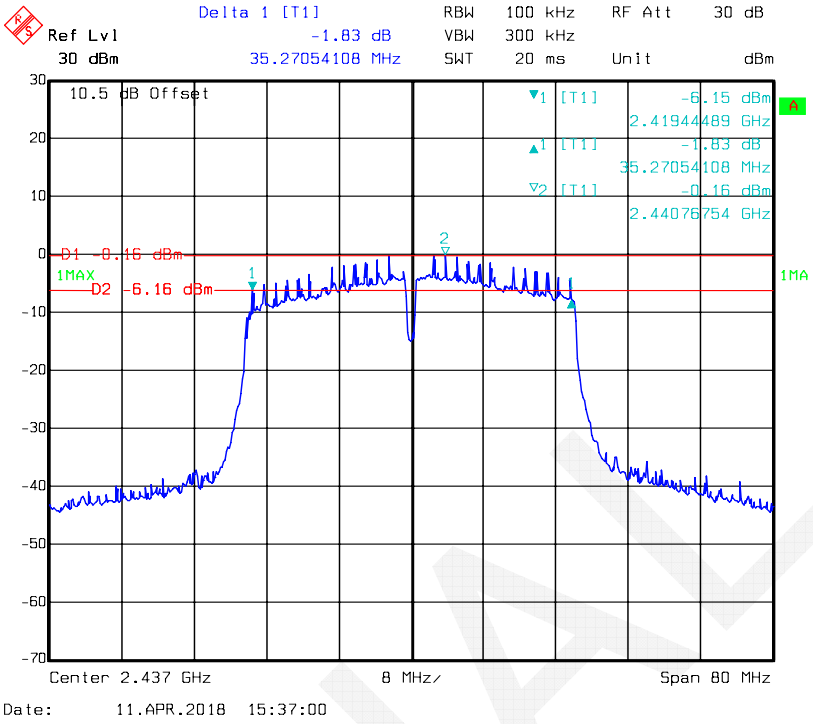
802.11n-HT40: High Channel, Antenna 0



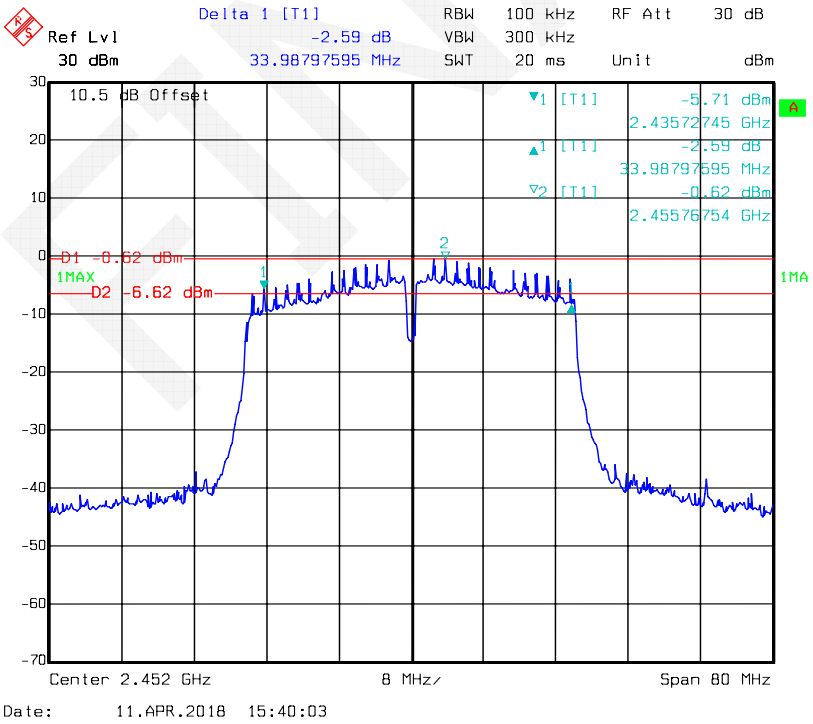
802.11n-HT40: Low Channel, Antenna 1



802.11n-HT40: Middle Channel, Antenna 1

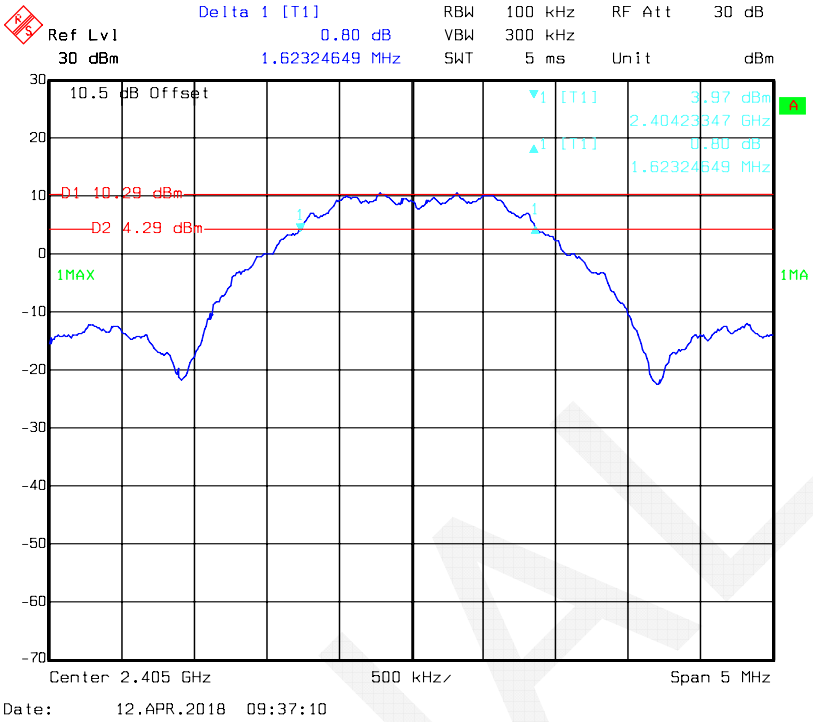


802.11n-HT40: High Channel, Antenna 1

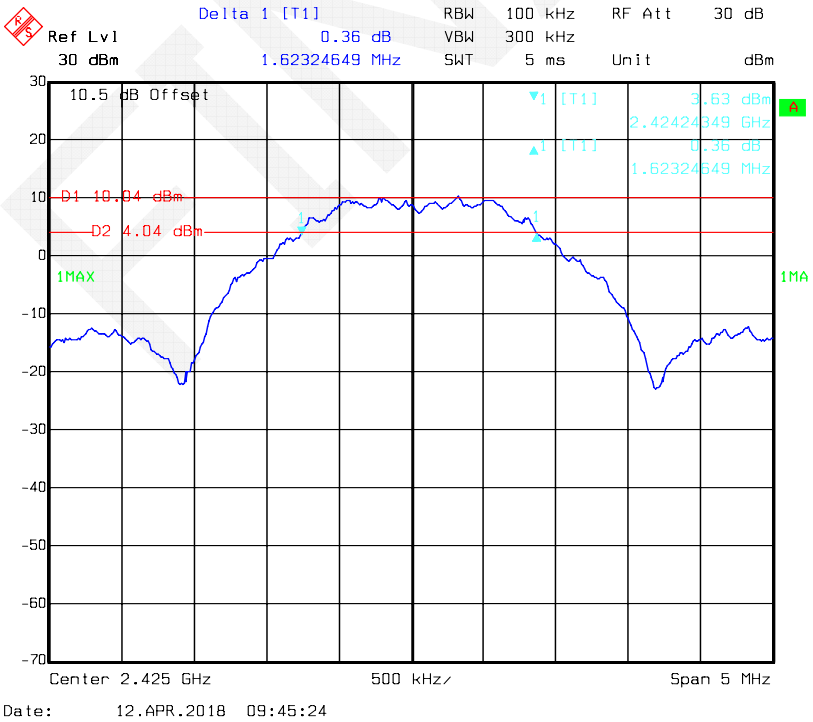


For Zigbee Mode

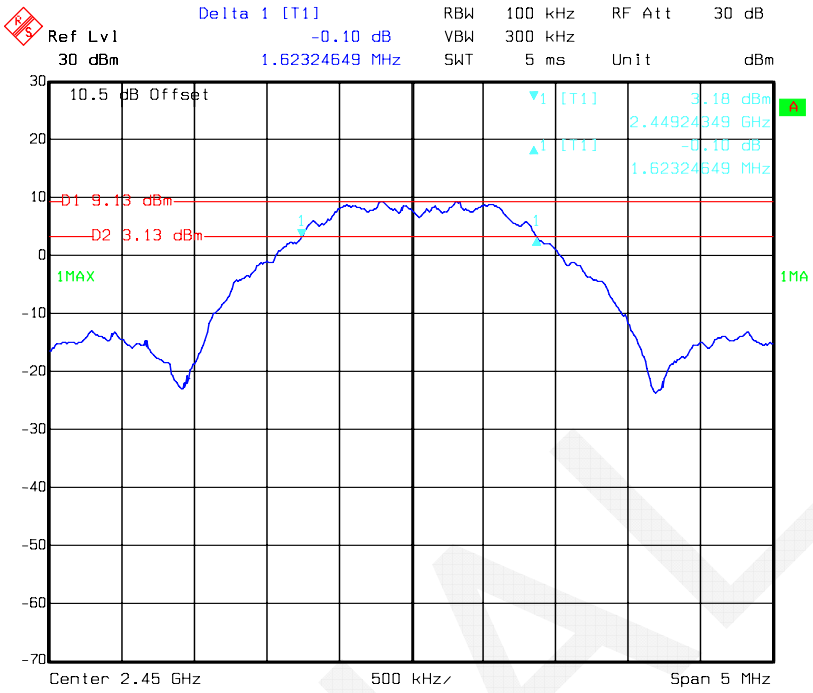
2405 MHz



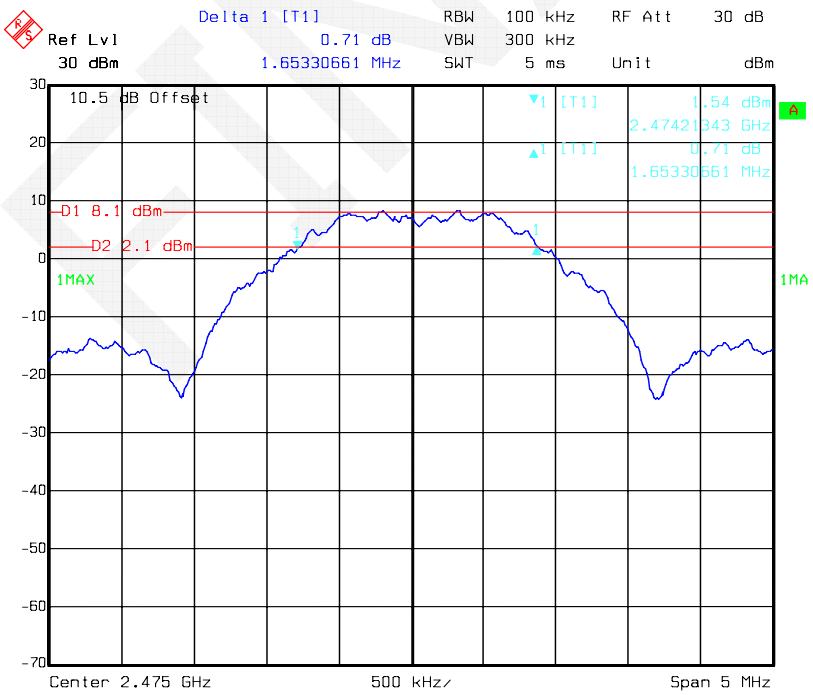
2425 MHz



2450 MHz



2475 MHz



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 test equipment.
3. Add a correction factor to the display.

Test Data

Environmental Conditions

Temperature:	26 °C
Relative Humidity:	60 %
ATM Pressure:	94.8 kPa

The testing was performed by Tom Tang on 2018-04-12.

Test Mode: Transmitting

Test Result: Compliant. Please refer to the following table.

For Wi-Fi Mode

Test Mode	Channel	Frequency (MHz)	Max Peak Conducted Output Power (dBm)		Total (dBm)	Limits (dBm)
			Antenna 0	Antenna 1	Antenna 0 + Antenna 1	
802.11b	Low	2412	18.46	18.62	/	30
	Middle	2437	18.67	18.43	/	30
	High	2462	18.86	18.27	/	30
802.11g	Low	2412	21.05	20.85	/	30
	Middle	2437	21.12	20.44	/	30
	High	2462	21.39	20.25	/	30
802.11n-HT20	Low	2412	17.89	18.29	21.10	30
	Middle	2437	18.18	17.85	21.03	30
	High	2462	18.43	17.64	21.06	30
802.11n-HT40	Low	2422	20.30	20.54	23.43	30
	Middle	2437	20.48	20.30	23.40	30
	High	2452	20.66	19.93	23.32	30

Test Mode	Channel	Frequency (MHz)	Max Average Conducted Output Power (dBm)		Total (dBm)	Limits (dBm)
			Antenna 0	Antenna 1	Antenna 0 + Antenna 1	
802.11b	Low	2412	16.78	17.07	/	30
	Middle	2437	17.12	16.90	/	30
	High	2462	17.36	16.74	/	30
802.11g	Low	2412	16.46	16.35	/	30
	Middle	2437	16.66	15.90	/	30
	High	2462	16.83	15.73	/	30
802.11n-HT20	Low	2412	13.43	13.69	16.57	30
	Middle	2437	13.68	13.41	16.56	30
	High	2462	13.78	13.09	16.46	30
802.11n-HT40	Low	2422	13.32	13.47	16.41	30
	Middle	2437	13.43	13.26	16.36	30
	High	2452	13.68	12.91	16.32	30

Note: The device employed Cyclic Delay Diversity (CDD) for 802.11 MIMO transmitting, per KDB 662911 D01 Multiple Transmitter Output v02r01, for power measurements on IEEE 802.11 devices:

Array Gain = 0 dB (i.e., no array gain) for NANT ≤ 4;

So:

Directional gain = GANT + Array Gain = 6dBi ≤ 6.0dBi.

No power limit was reduced in MIMO mode.

For Zigbee Mode

Test Mode	Frequency (MHz)	Max Peak Conducted Output Power (dBm)	Limits (dBm)
Zigbee	2405	13.39	30
	2425	13.14	30
	2450	12.38	30
	2475	11.49	30

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

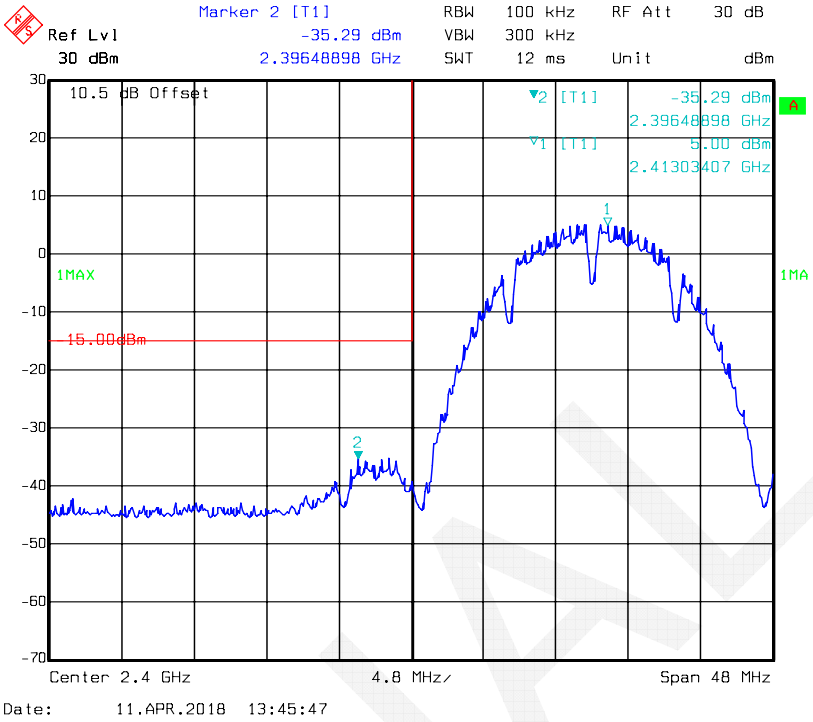
Temperature:	25 ~ 26 °C
Relative Humidity:	46 ~ 58 %
ATM Pressure:	94.5 ~ 94.8 kPa

The testing was performed by Tom Tang on 2018-04-11 and 2018-04-12.

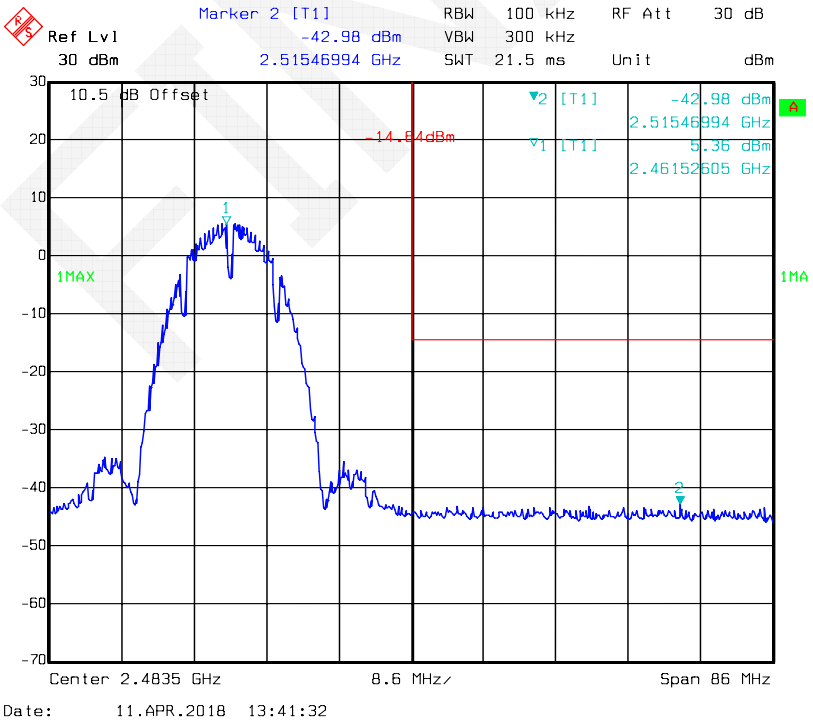
Test Result: Compliant. Please refer to following plots.

For Wi-Fi Mode

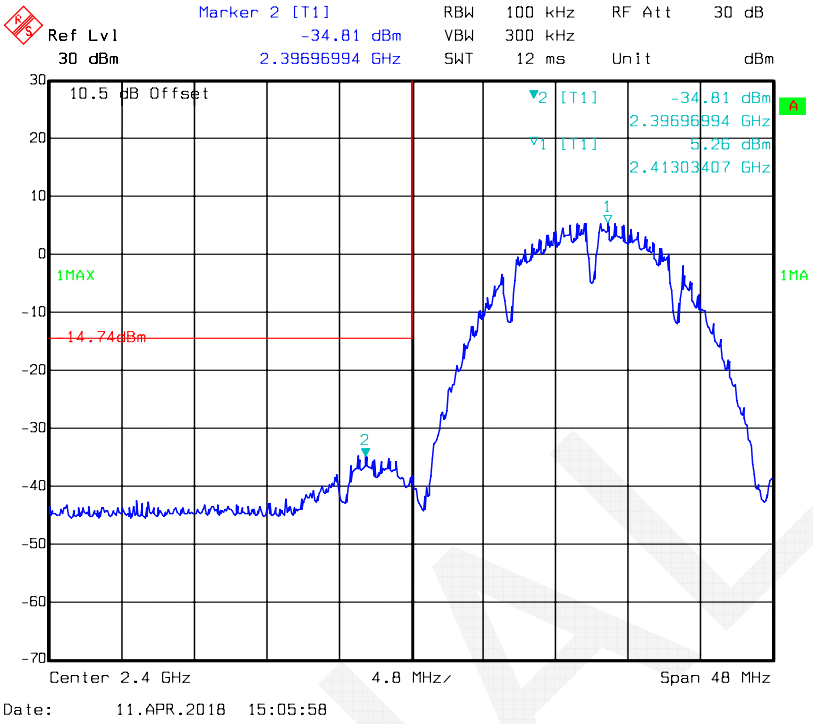
802.11b: Band Edge, Left Side, Antenna 0



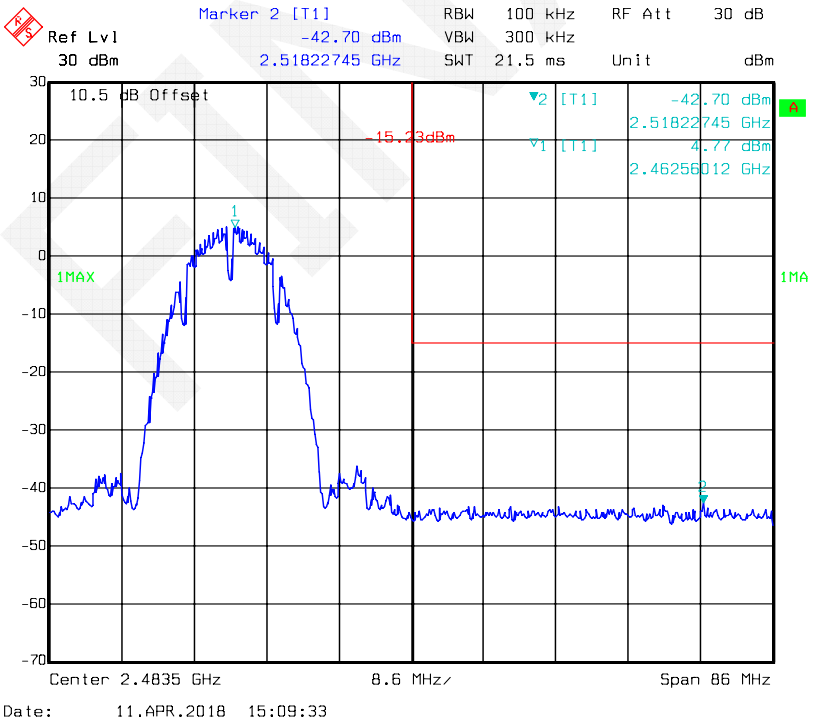
802.11b: Band Edge, Right Side, Antenna 0



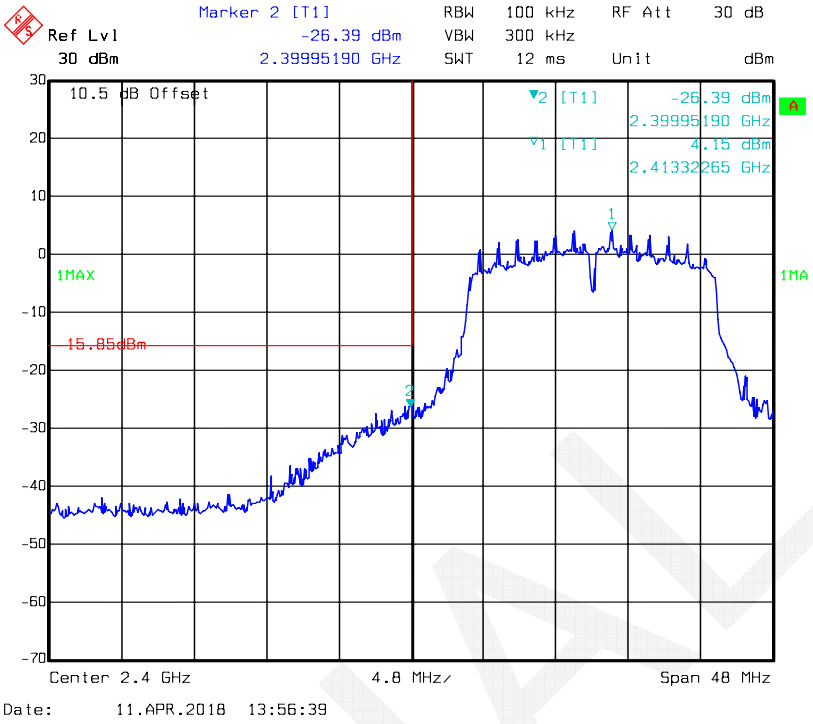
802.11b: Band Edge, Left Side, Antenna 1



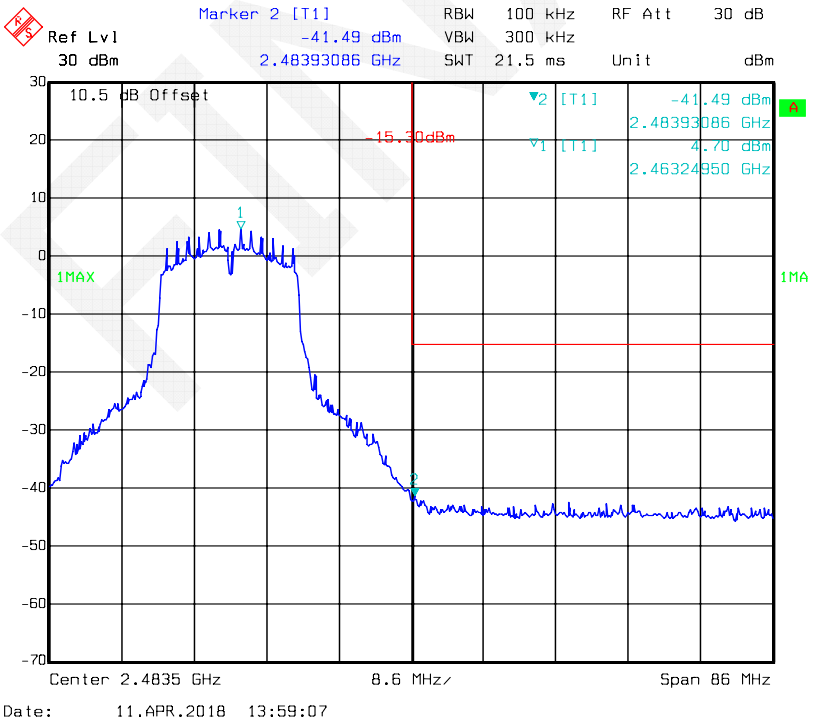
802.11b: Band Edge, Right Side, Antenna 1



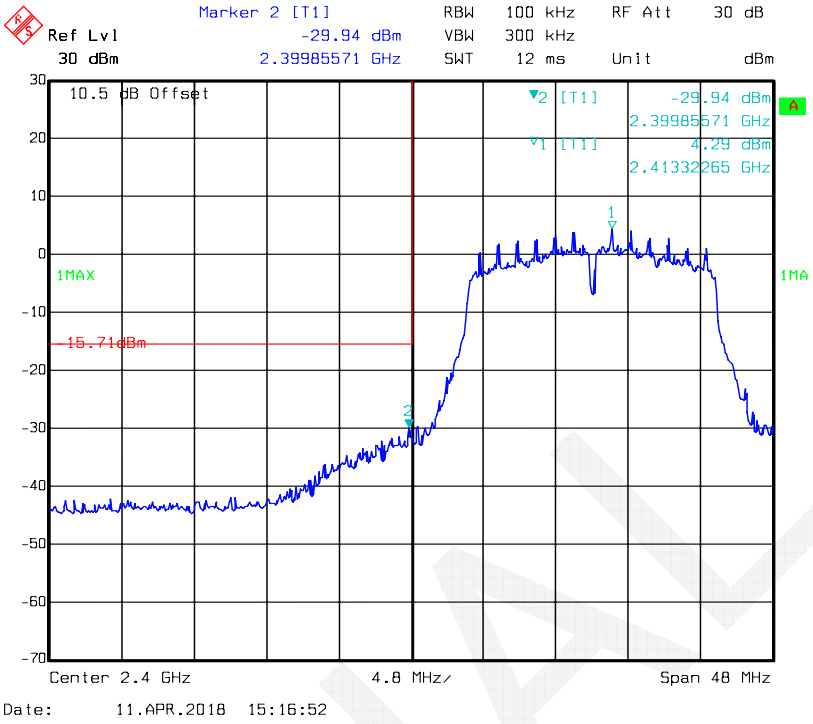
802.11g: Band Edge, Left Side, Antenna 0



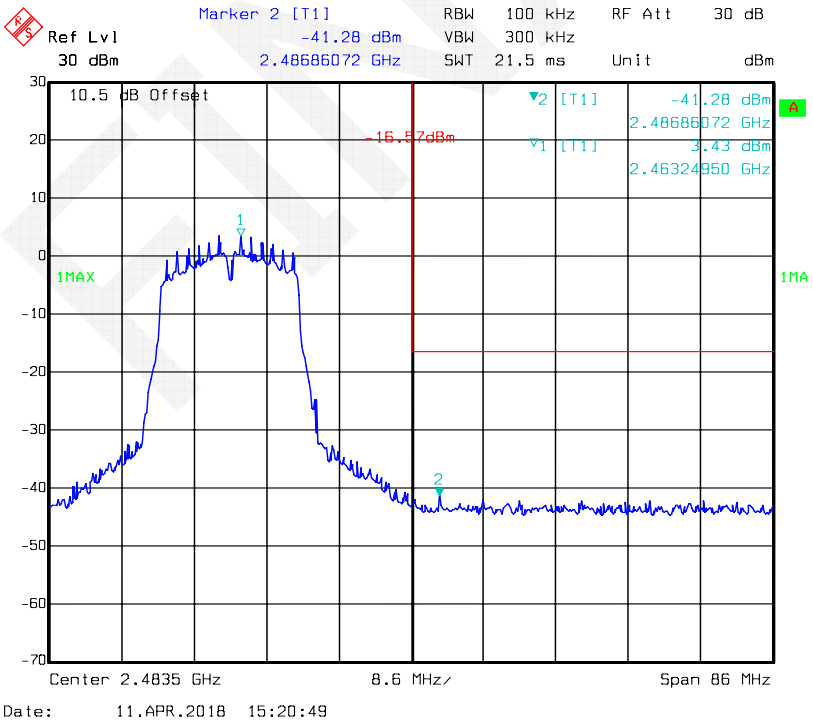
802.11g: Band Edge, Right Side, Antenna 0



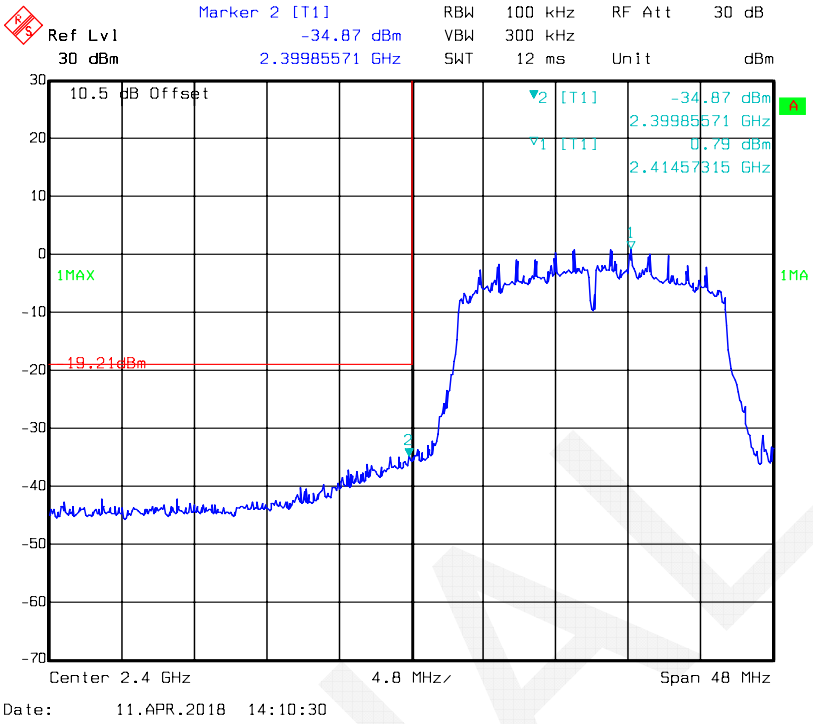
802.11g: Band Edge, Left Side, Antenna 1



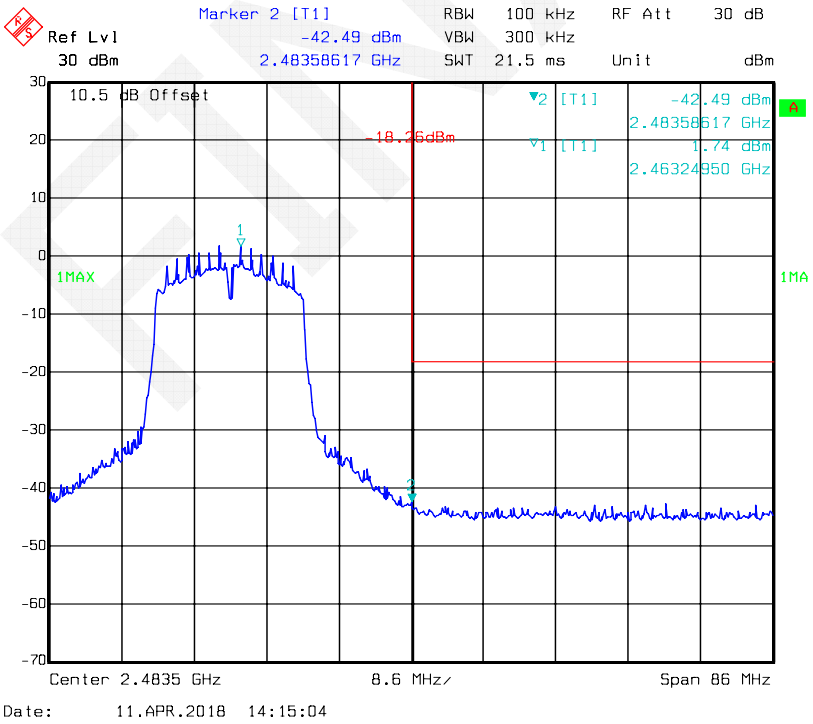
802.11g: Band Edge, Right Side, Antenna 1



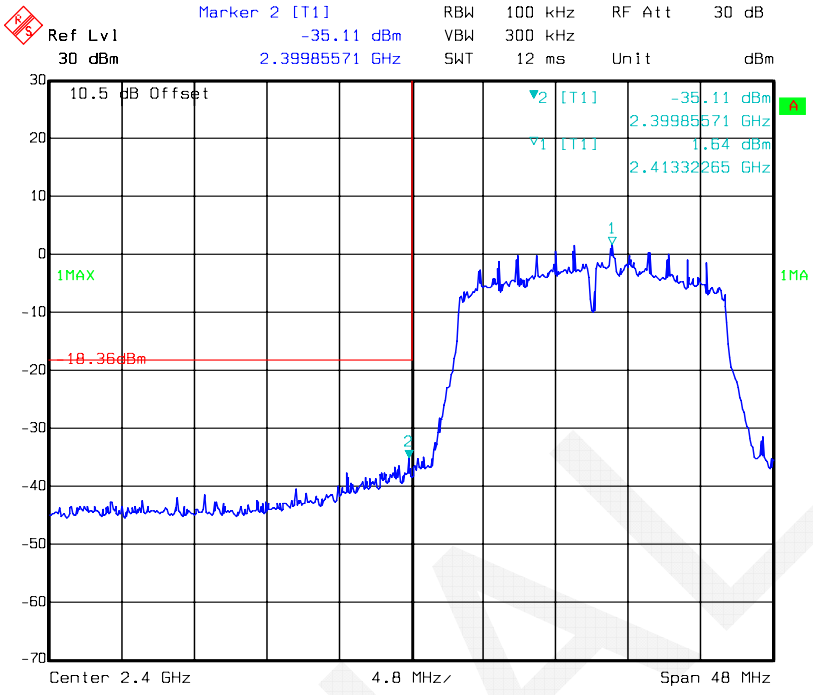
802.11n-HT20: Band Edge, Left Side, Antenna 0



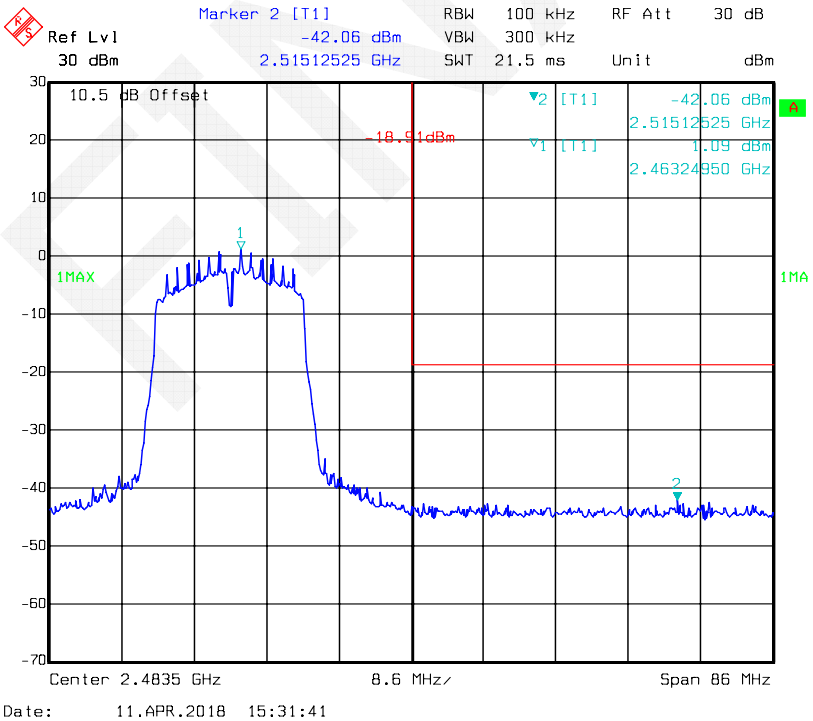
802.11n-HT20: Band Edge, Right Side, Antenna 0



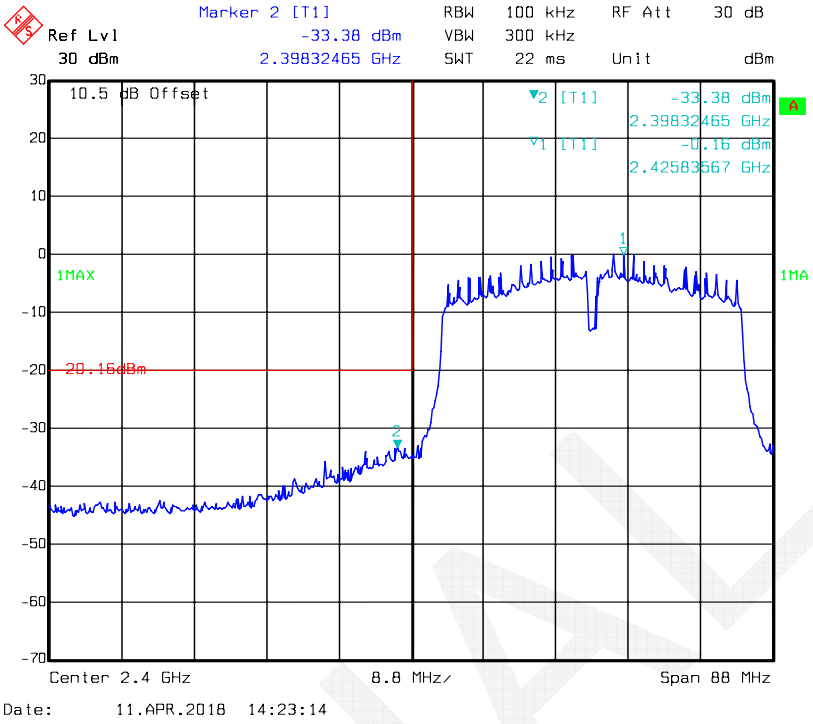
802.11n-HT20: Band Edge, Left Side, Antenna 1



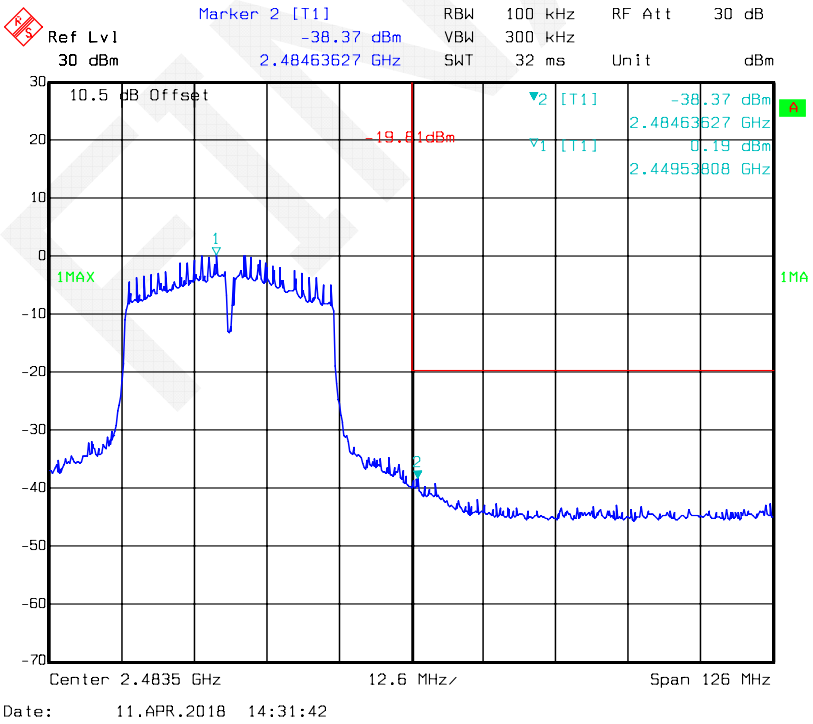
802.11n-HT20: Band Edge, Right Side, Antenna 1



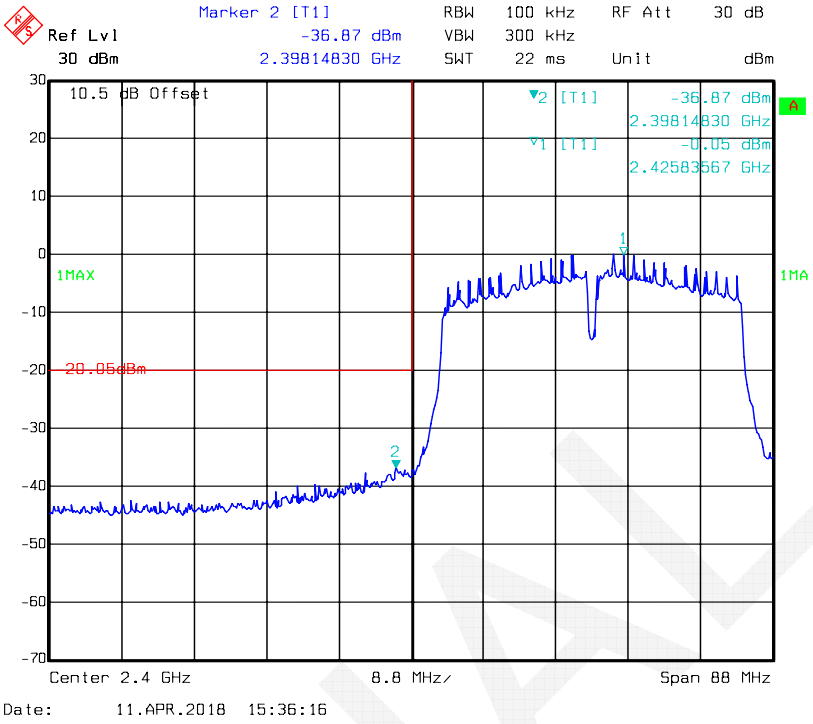
802.11n-HT40: Band Edge, Left Side, Antenna 0



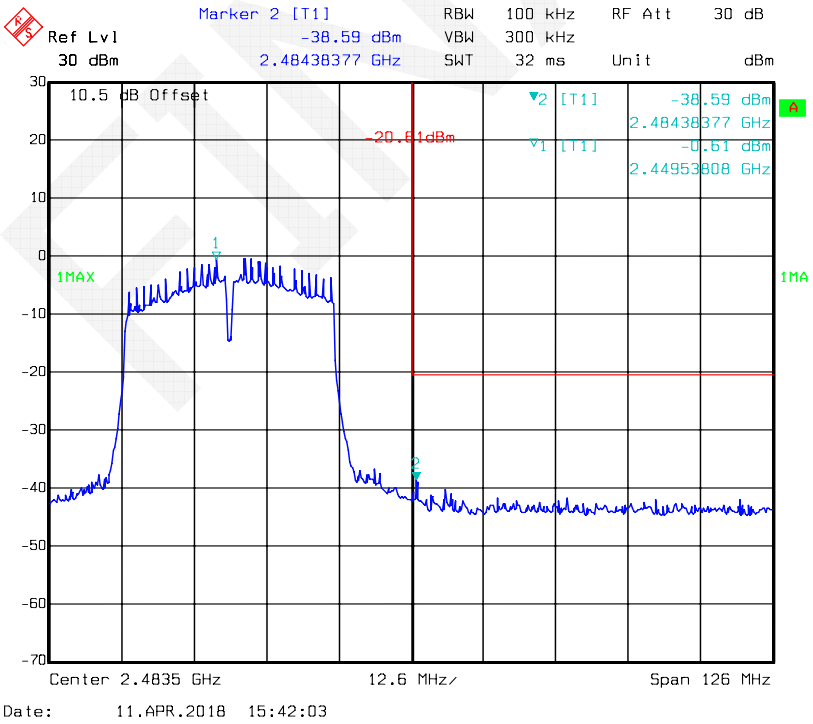
802.11n-HT40: Band Edge, Right Side, Antenna 0



802.11n-HT40: Band Edge, Left Side, Antenna 1

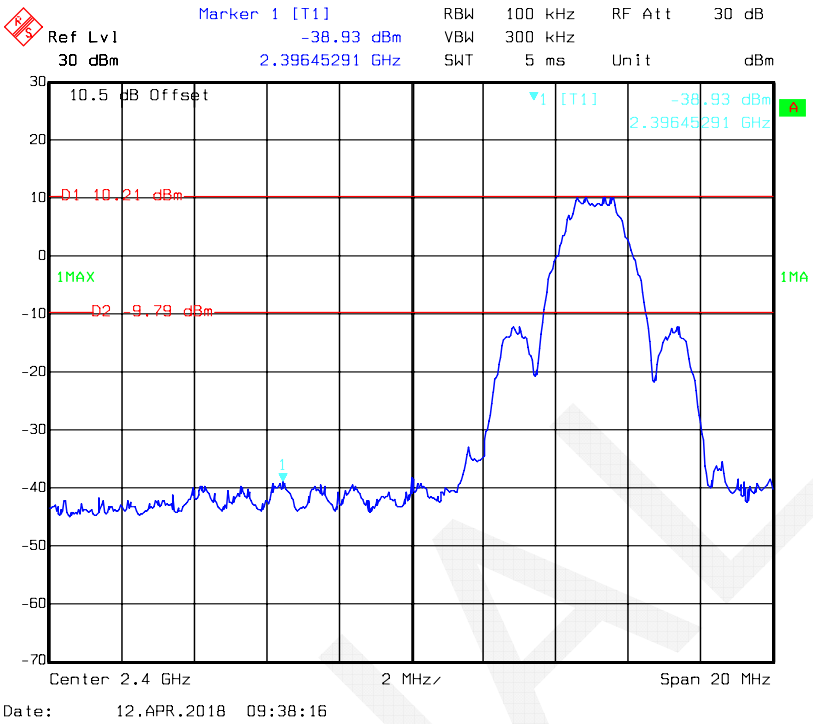


802.11n-HT40: Band Edge, Right Side, Antenna 1

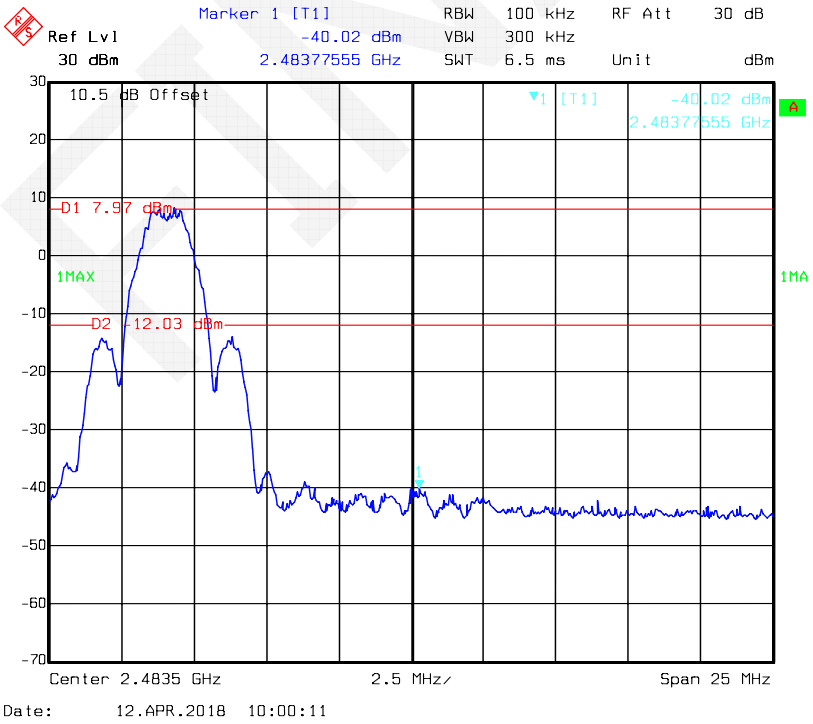


For Zigbee Mode

Band Edge, Left Side



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

a) Set analyzer center frequency to DTS channel center frequency.
b) Set the span to 1.5 times the DTS bandwidth.
c) Set the RBW to: 3 kHz ≤ RBW ≤ 100 kHz.
d) Set the VBW ≥ 3×RBW.
e) Detector = peak.
f) Sweep time = auto couple.
g) Trace mode = max hold.
h) Allow trace to fully stabilize.
i) Use the peak marker function to determine the maximum amplitude level within the RBW.
j) If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

Test Data

Environmental Conditions

Temperature:	25 ~ 26 °C
Relative Humidity:	46 ~ 58 %
ATM Pressure:	94.5 ~ 94.8 kPa

The testing was performed by Tom Tang on 2018-04-11 and 2018-04-12.

Test Mode: Transmitting

Test Result: Compliant. Please refer to the following tables and plots.

For Wi-Fi Mode

Test mode	Channel	Frequency (MHz)	PSD (dBm/3kHz)		Total PSD	Limit (dBm/3kHz)
			Antenna 0	Antenna 1	(dBm/3kHz)	
802.11b	Low	2412	-10.40	-10.37	/	≤8
	Middle	2437	-11.27	-10.16	/	≤8
	High	2462	-10.25	-11.11	/	≤8
802.11g	Low	2412	-12.94	-12.37	/	≤8
	Middle	2437	-12.07	-12.47	/	≤8
	High	2462	-11.42	-13.31	/	≤8
802.11n-HT20	Low	2412	-14.82	-13.35	-11.01	≤8
	Middle	2437	-13.61	-13.76	-10.67	≤8
	High	2462	-14.05	-13.34	-10.67	≤8
802.11n-HT40	Low	2422	-15.66	-16.42	-13.01	≤8
	Middle	2437	-14.97	-15.47	-12.20	≤8
	High	2452	-15.22	-15.94	-12.55	≤8

Note: The device employed Cyclic Delay Diversity (CDD) for 802.11 MIMO transmitting, per KDB 662911 D01 Multiple Transmitter Output v02r01, for power spectral density (PSD) measurements on the devices:

Array Gain = 10 log(NANT/NSS) dB.

So:

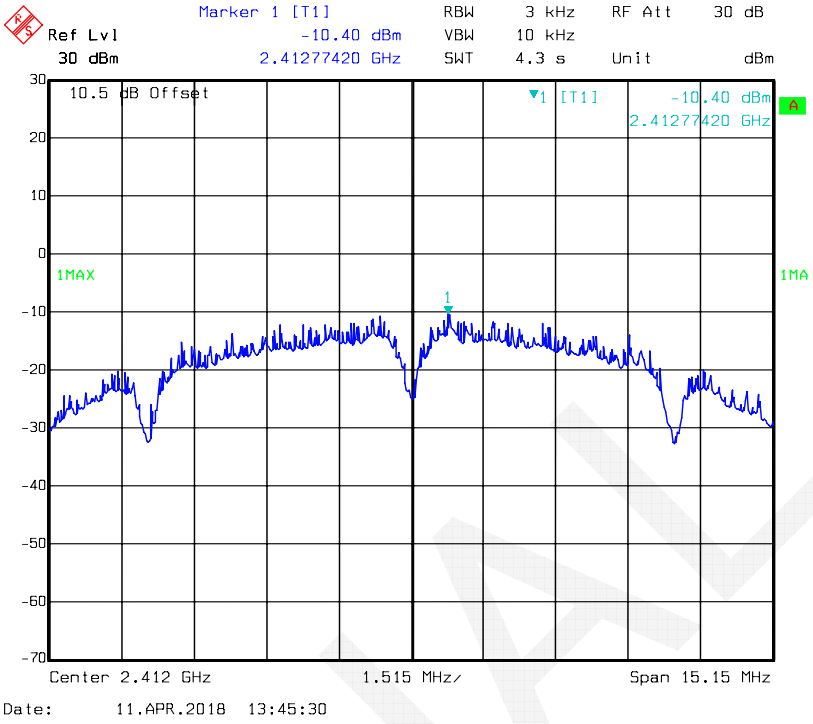
Directional gain = GANT + Array Gain = 6+10*log(1) =6dBi
No power density Limit was reduced in MIMO mode.

For Zigbee Mode

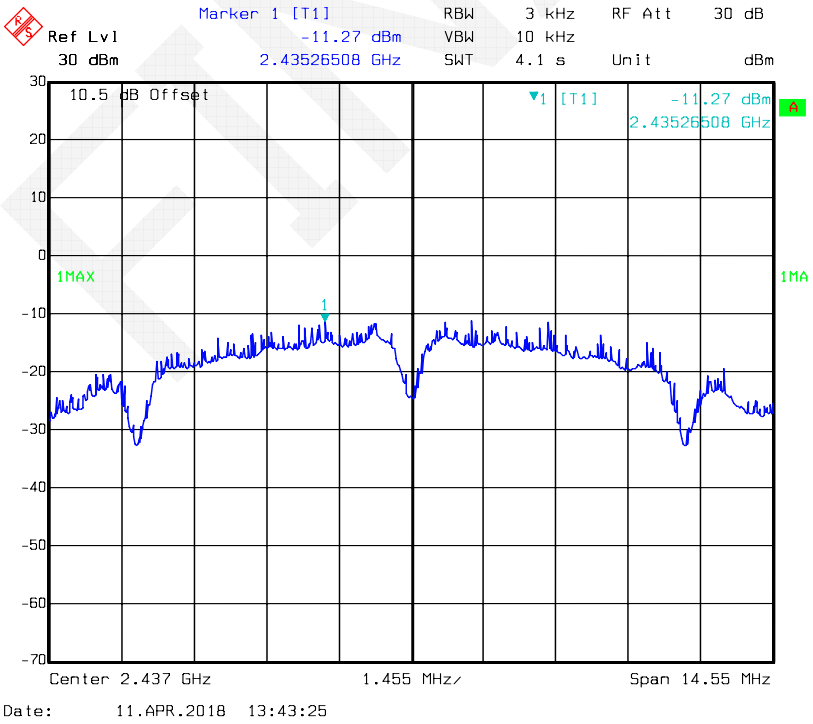
Test mode	Frequency (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)
Zigbee	2405	-0.89	≤8
	2425	-1.98	≤8
	2450	-2.80	≤8
	2475	-3.68	≤8

For Wi-Fi Mode

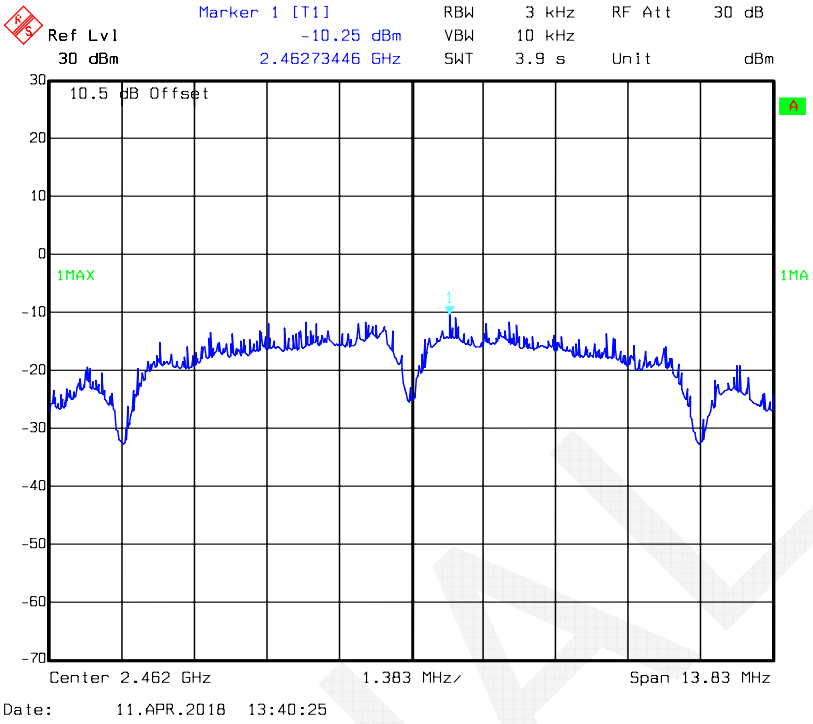
802.11b: Low Channel, Antenna 0



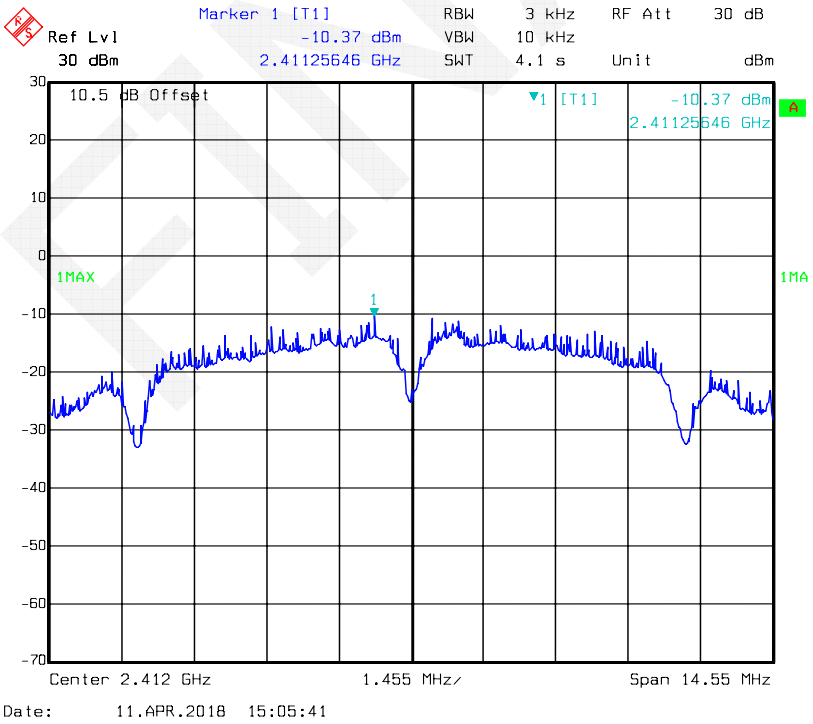
802.11b: Middle Channel, Antenna 0



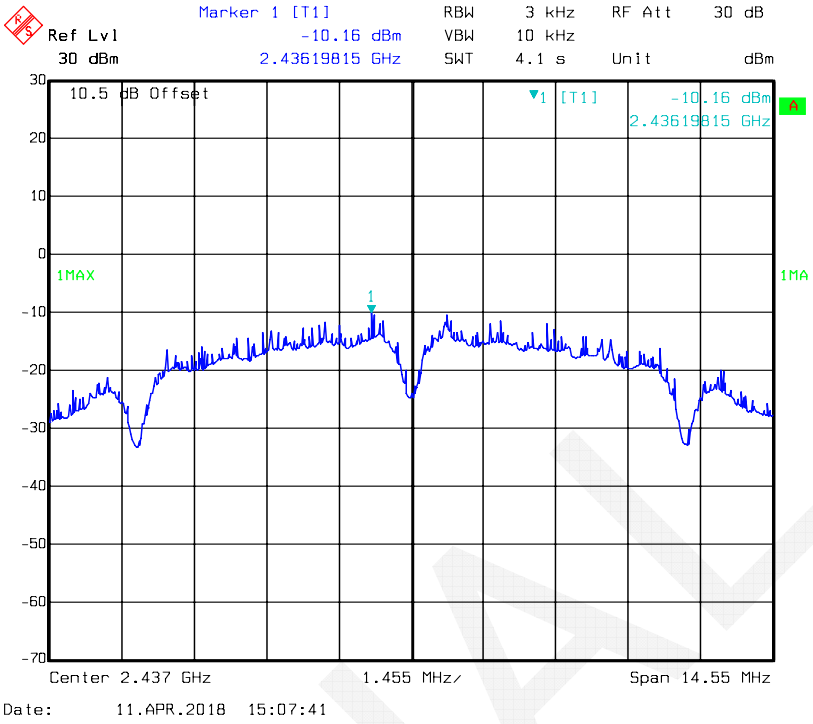
802.11b: High Channel, Antenna 0



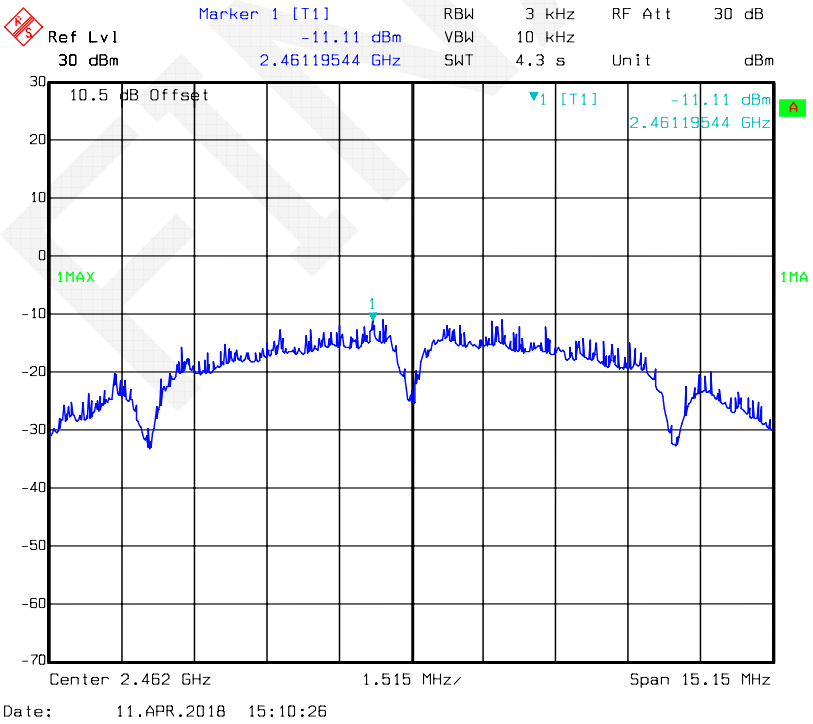
802.11b: Low Channel, Antenna 1



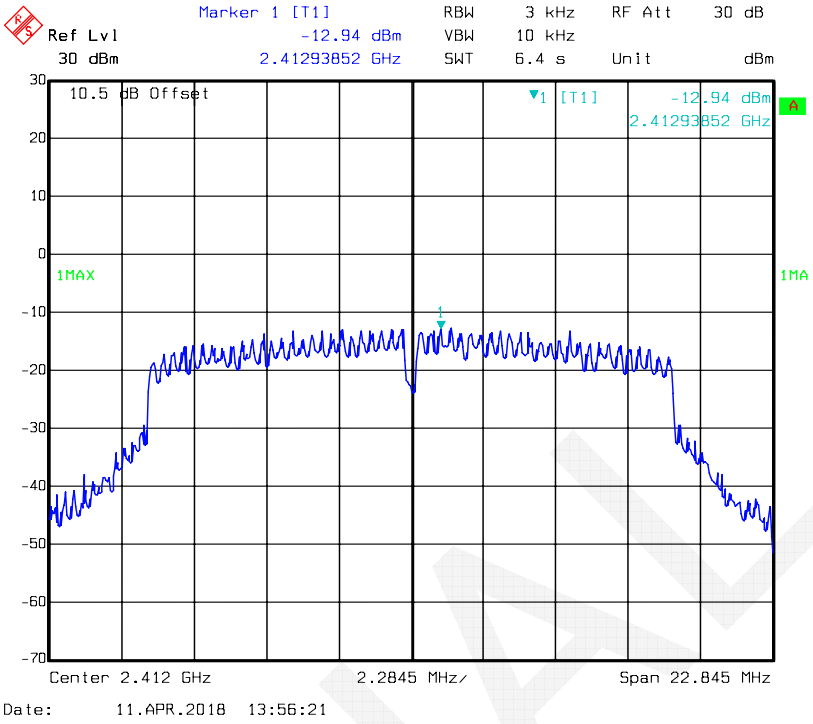
802.11b: Middle Channel, Antenna 1



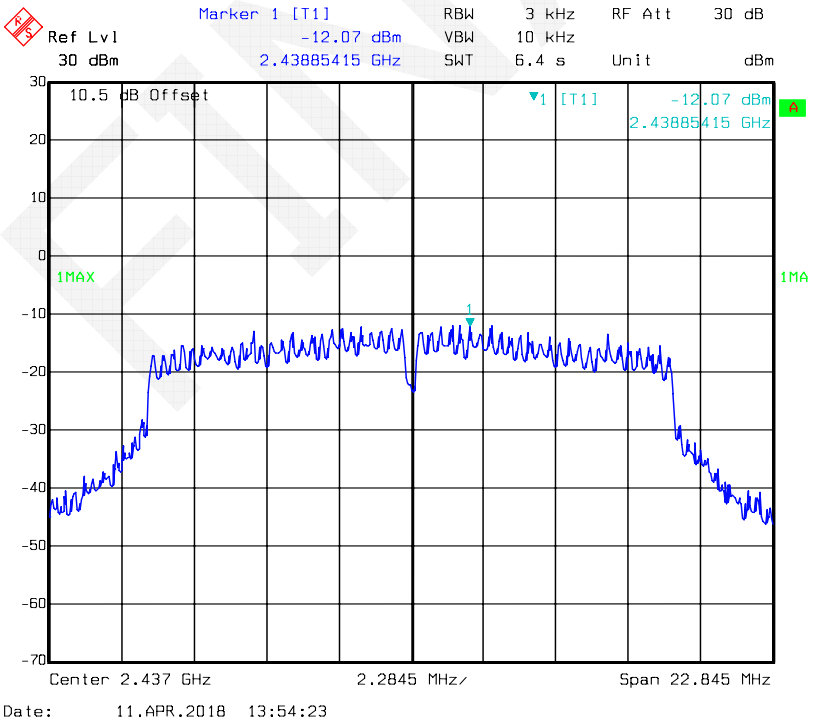
802.11b: High Channel, Antenna 1



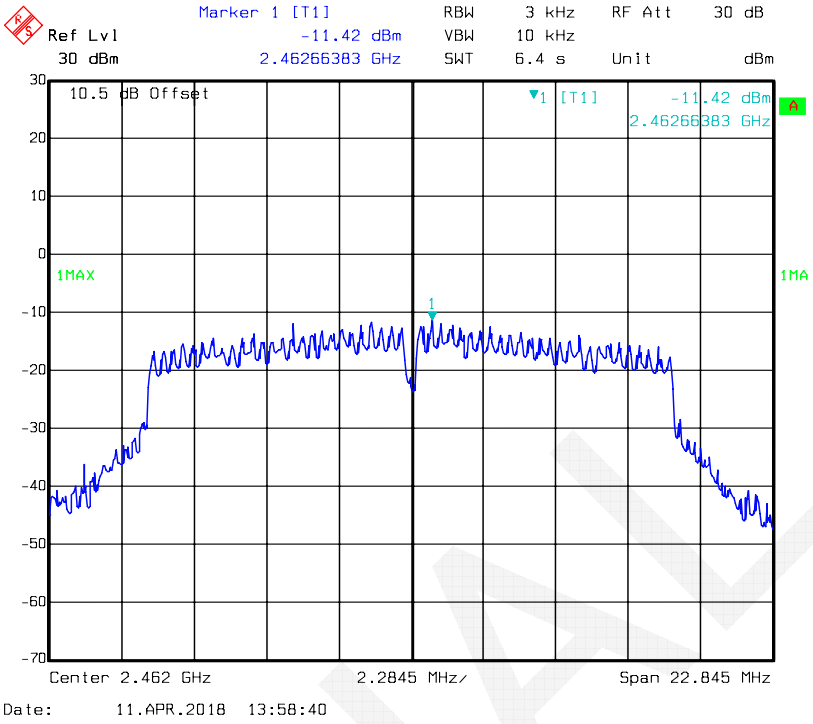
802.11g: Low Channel, Antenna 0



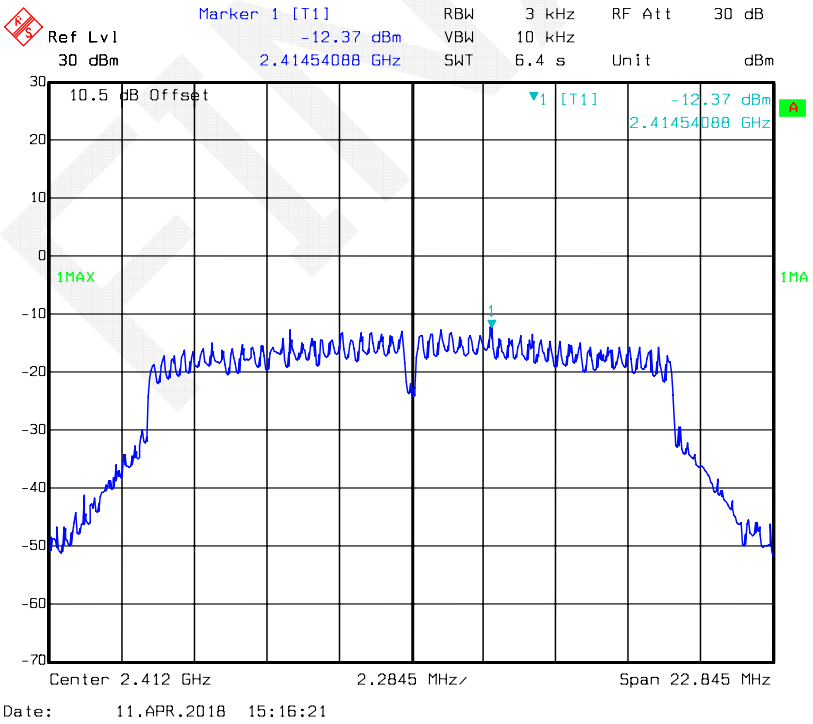
802.11g: Middle Channel, Antenna 0



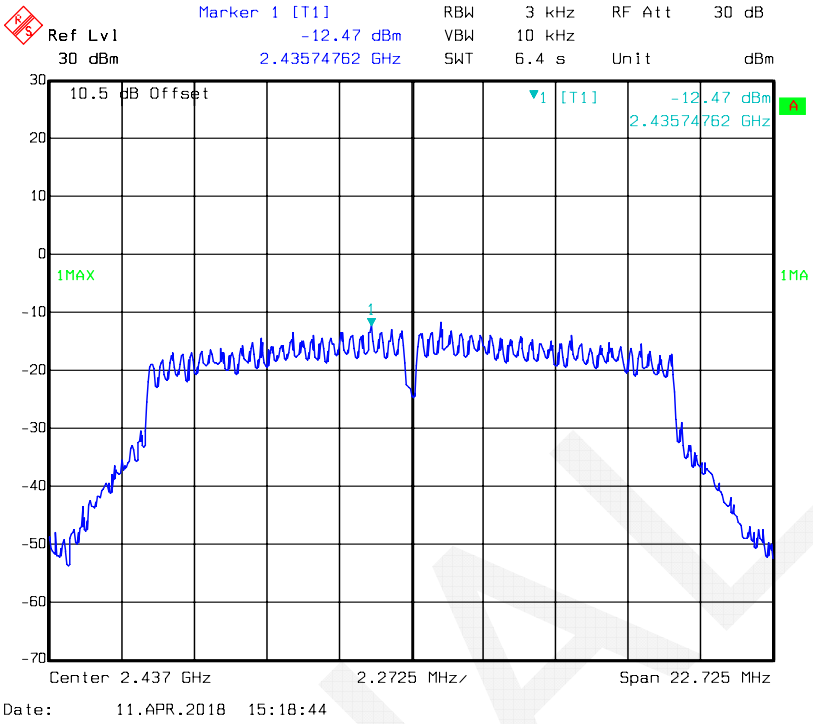
802.11g: High Channel, Antenna 0



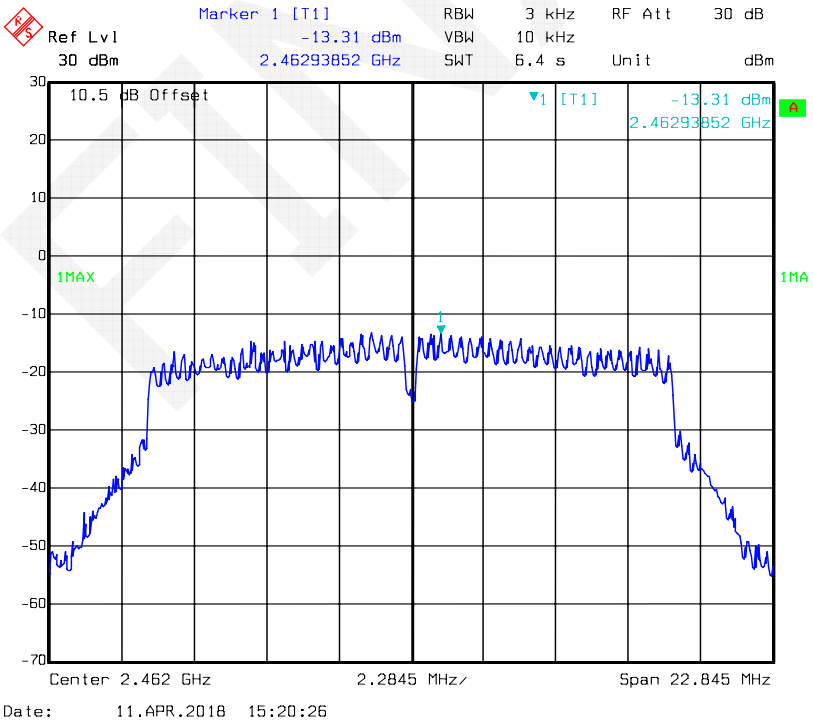
802.11g: Low Channel, Antenna 1



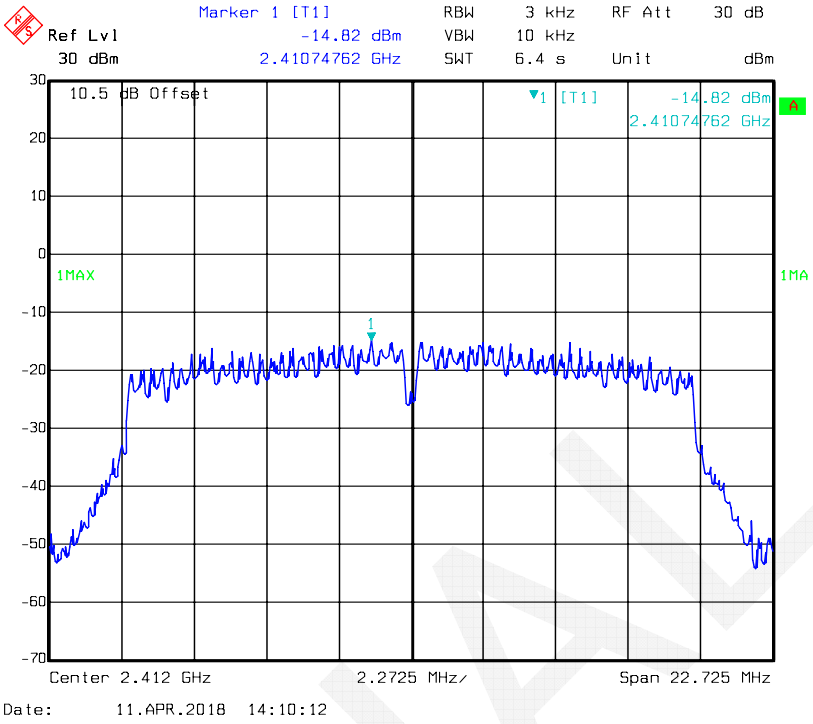
802.11g: Middle Channel, Antenna 1



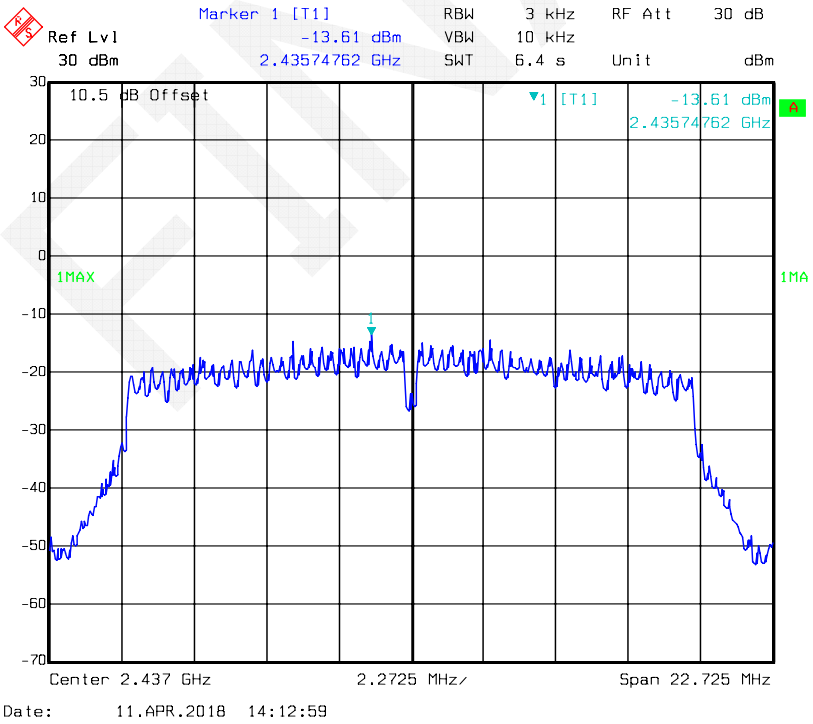
802.11g: High Channel, Antenna 1



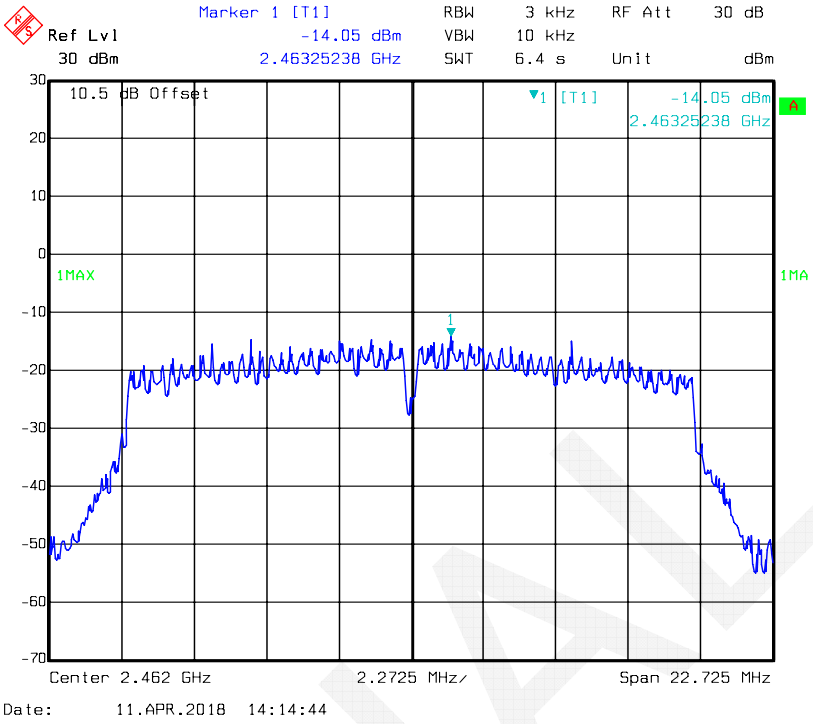
802.11n-HT20: Low Channel, Antenna 0



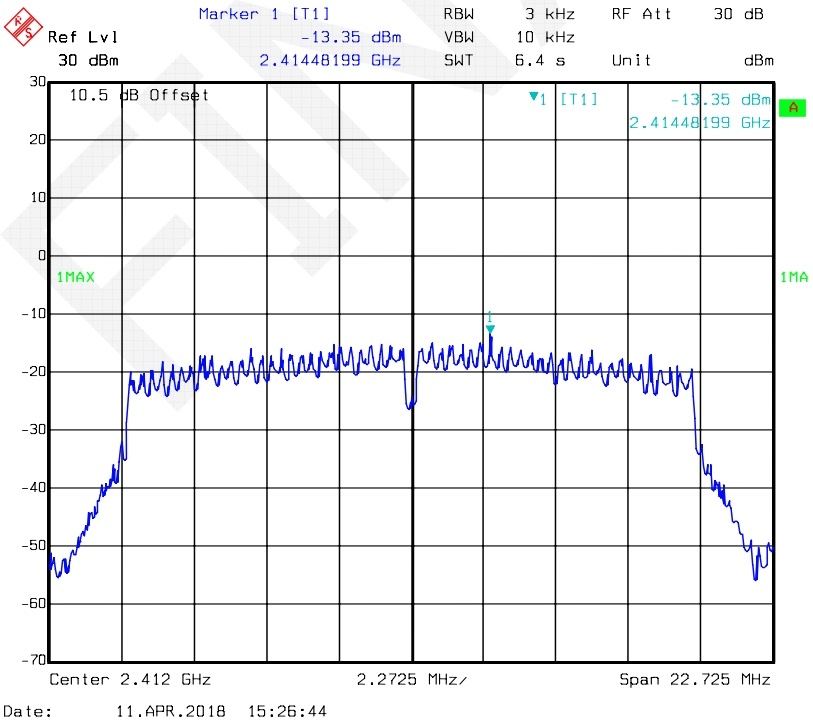
802.11n-HT20: Middle Channel, Antenna 0



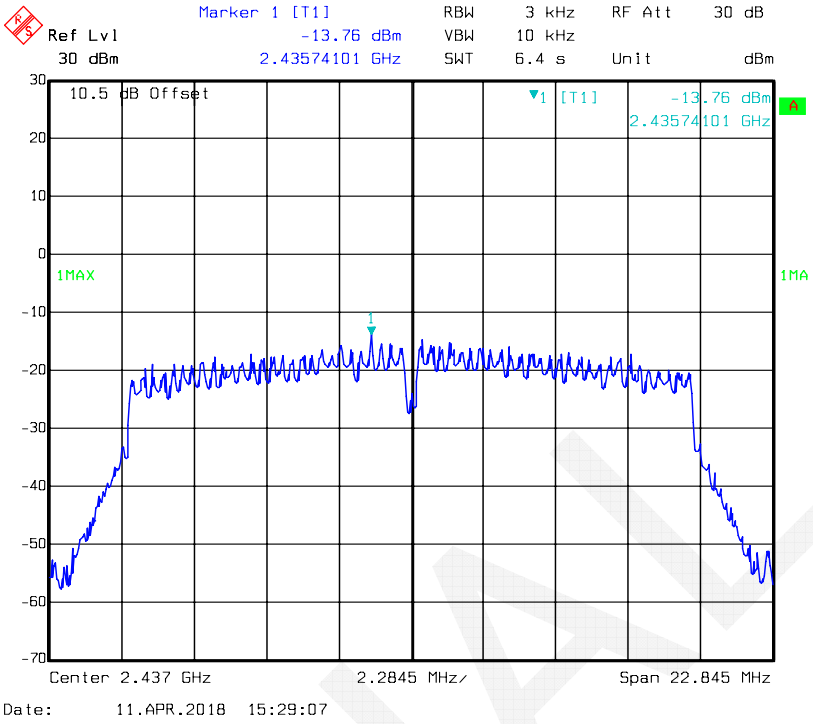
802.11n-HT20: High Channel, Antenna 0



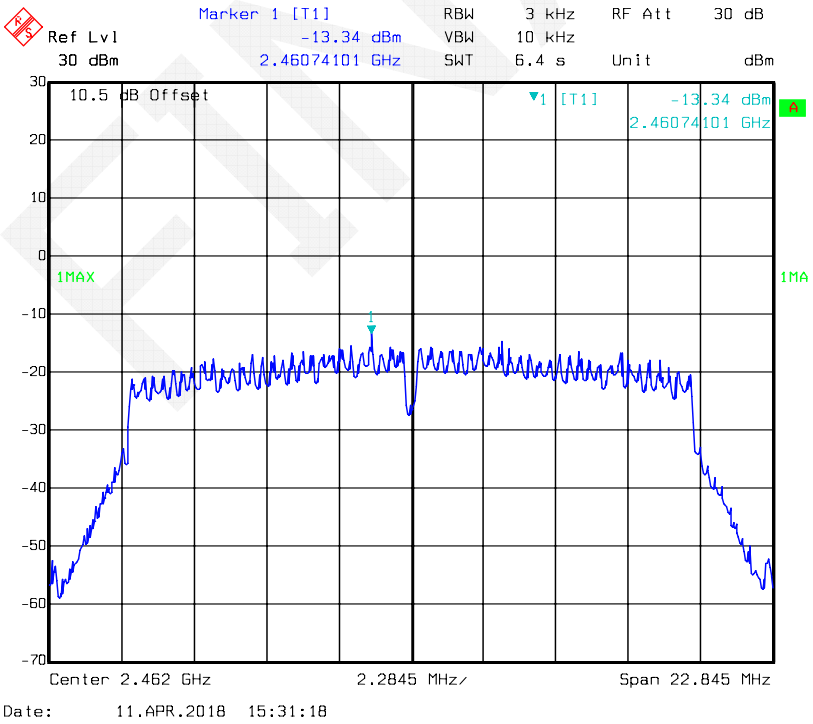
802.11n-HT20: Low Channel, Antenna 1



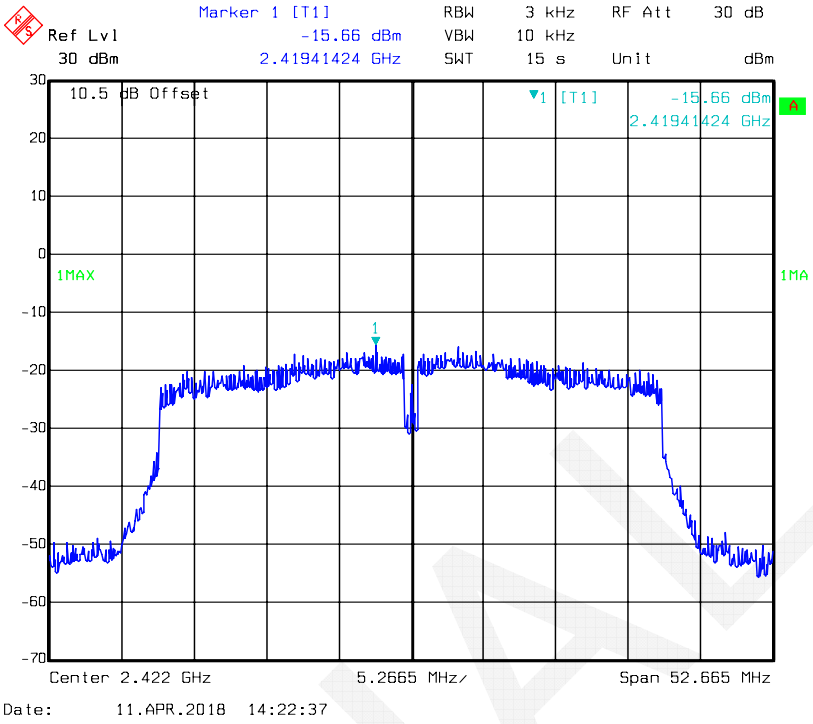
802.11n-HT20: Middle Channel, Antenna 1



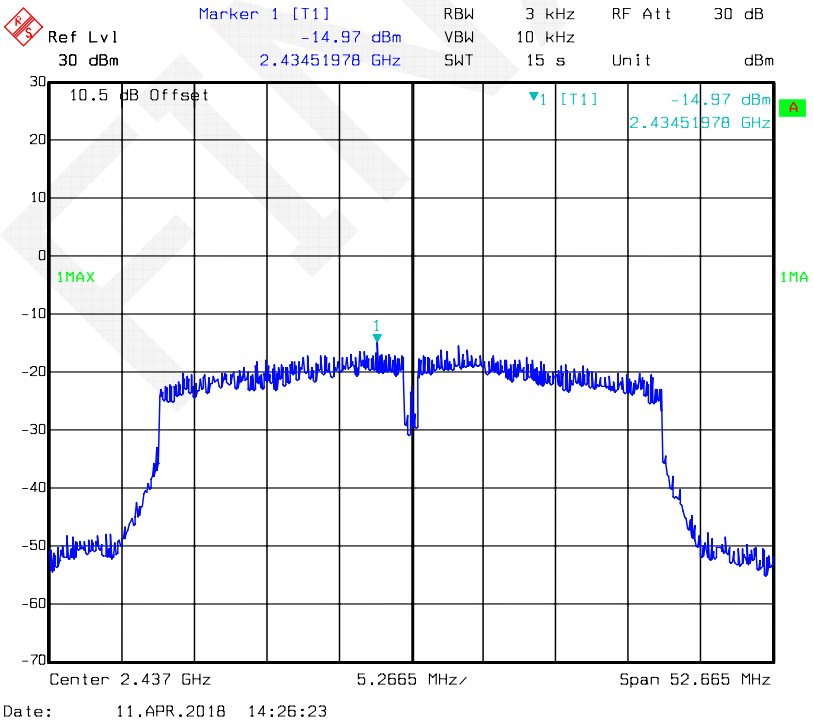
802.11n-HT20: High Channel, Antenna 1



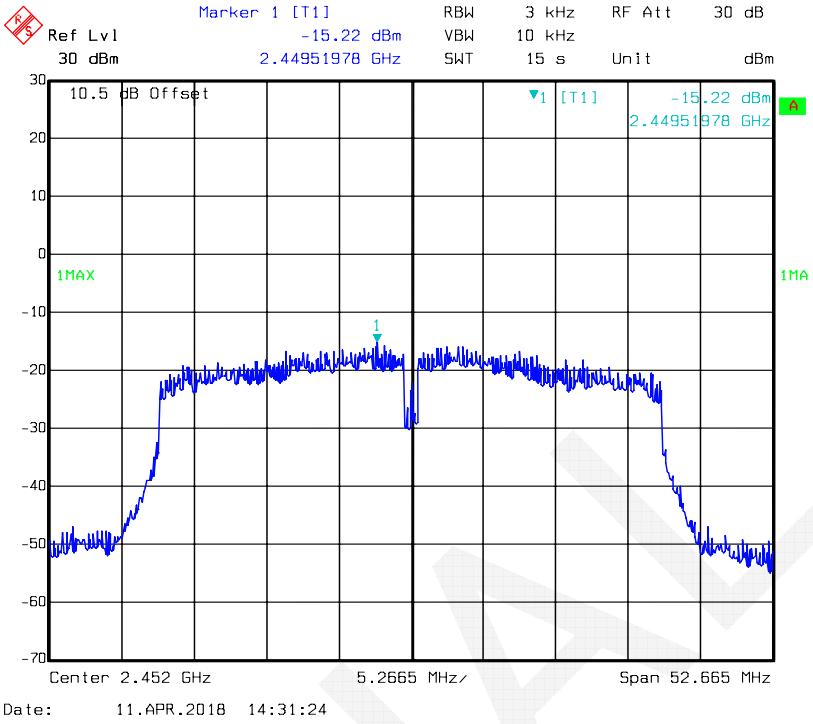
802.11n-HT40: Low Channel, Antenna 0



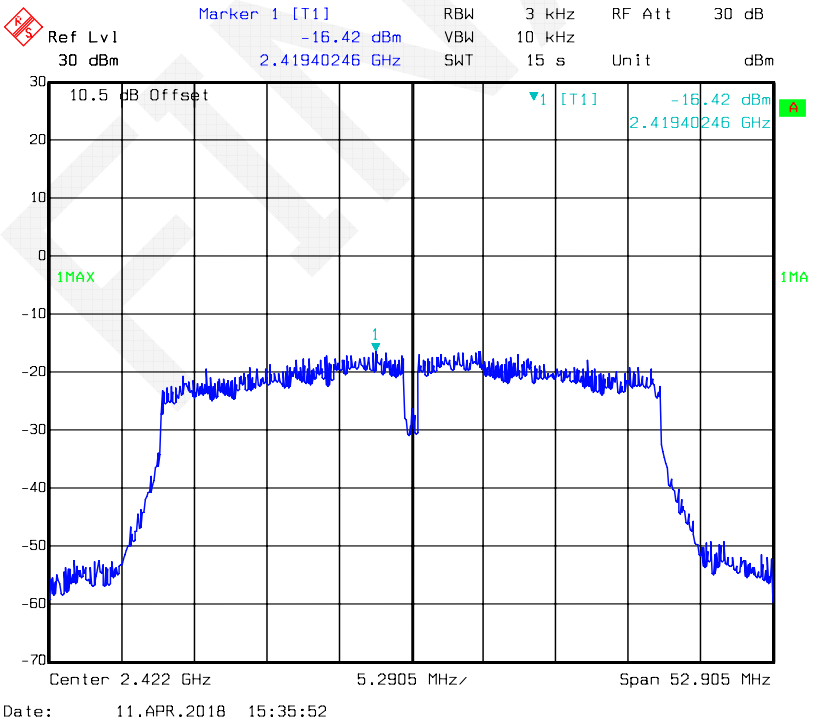
802.11n-HT40: Middle Channel, Antenna 0



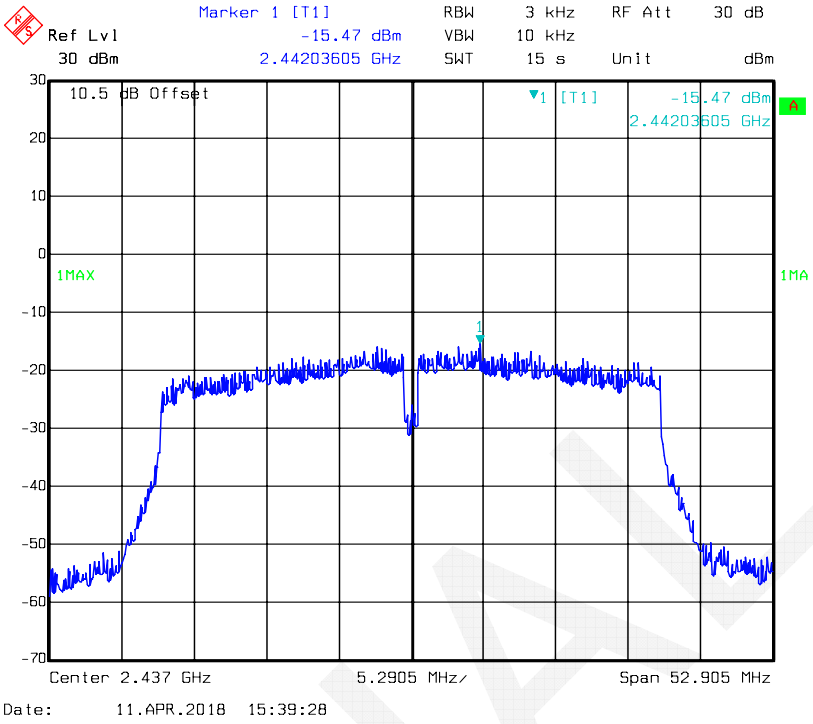
802.11n-HT40: High Channel, Antenna 0



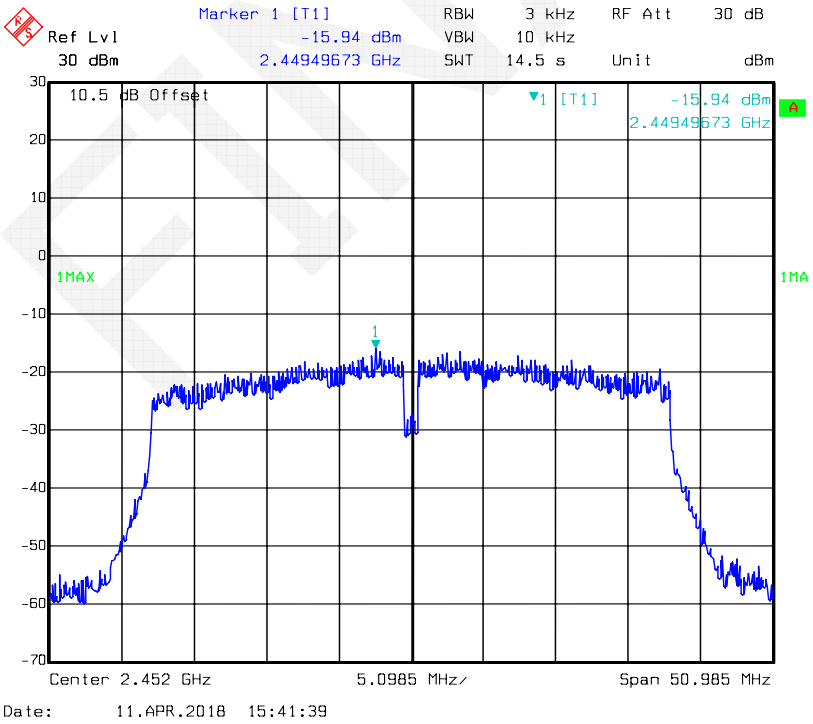
802.11n-HT40: Low Channel, Antenna 1



802.11n-HT40: Middle Channel, Antenna 1

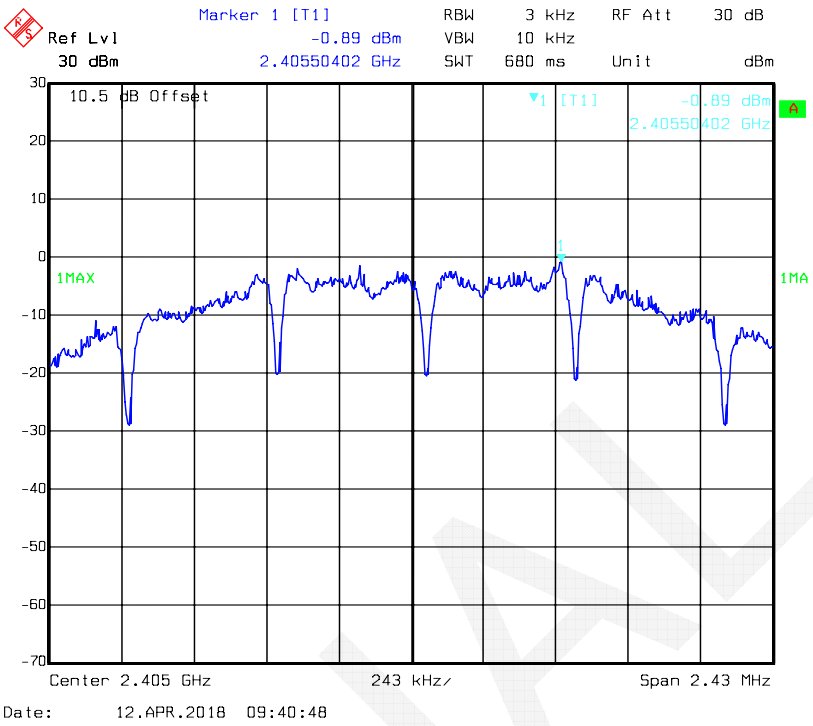


802.11n-HT40: High Channel, Antenna 1

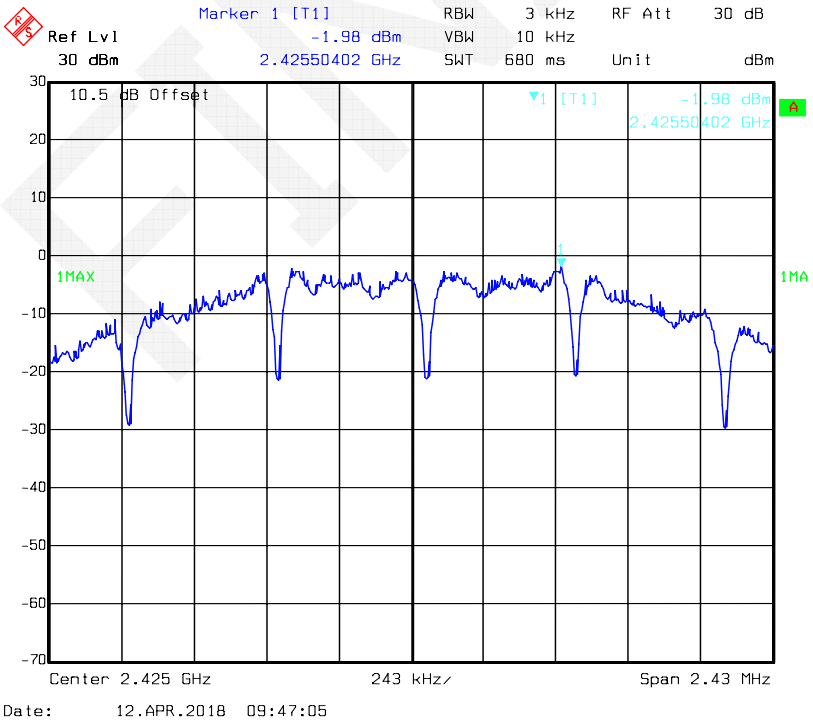


For Zigbee Mode

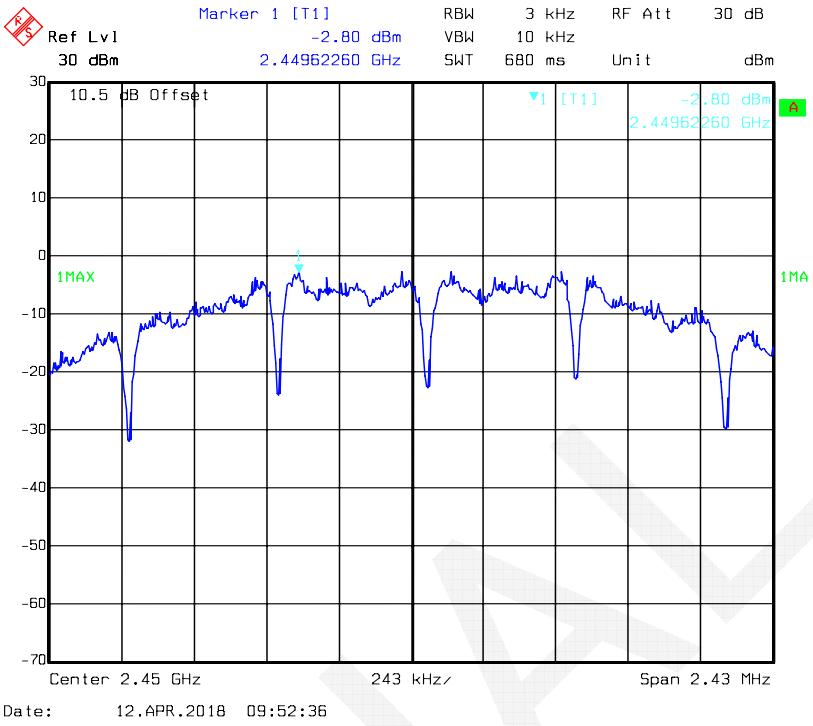
2405 MHz



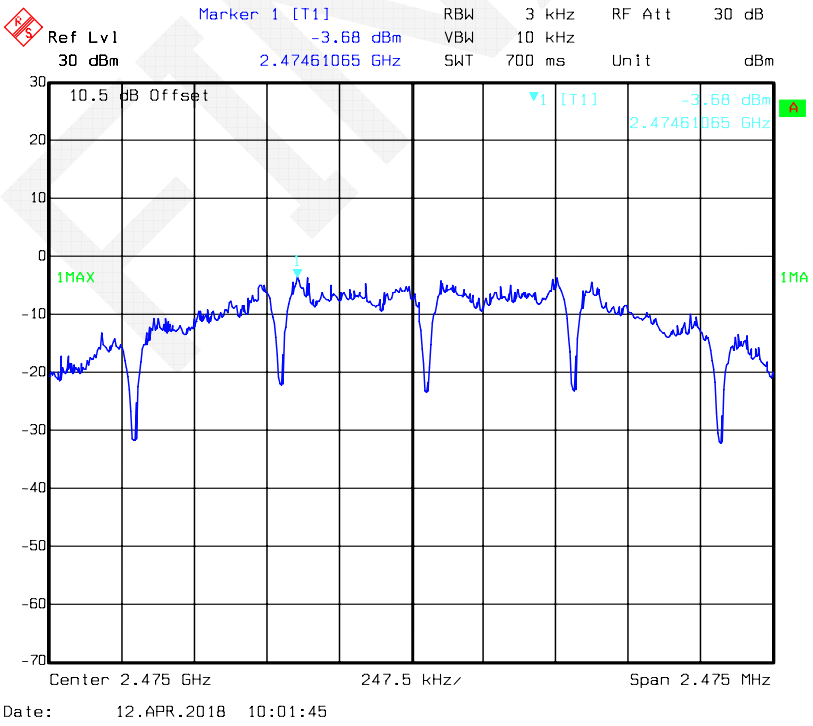
2425 MHz



2450 MHz



2475 MHz



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