

FCC PART 15.247 TEST REPORT

For

Chengdu XGimi Technology Co., Ltd.

Building A4, Tianfu Software Park, Hi-tech Zone, Chengdu, China

FCC ID: 2AFENXHAD01

Report Type: Original Report	Product Name: LED Projector
Report Number: RSC180725001-0C	
Report Date: 2018-08-27	
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FINAL

GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

The **Chengdu XGimi Technology Co., Ltd.**, model number: **XHAD01 (FCC ID: 2AFENXHAD01)** or the "EUT" as referred to in this report was one **LED Projector**.

Mechanical Description of EUT

The EUT was measured approximately: 202 mm (L) x 202 mm (W) x 135 mm (H)..

Rated input voltage: DC18V from adapter.

AC adapter information:

Manufacturer: SHENZHEN HUNTKEY ELECTRIC CO., LTD.

Model: HDZ1501-3F

Input: 100-240V~ 60/50Hz 2.5A Max

Output: 18VDC, 8.33A

Note: The products, test model: XHAD01, multiple models: XHAD02, XHAD03, XHAD04, XHAD05, XHAD06, XHAD07, XHAD08, XHAD09, XHAD10, XHAD11, XHAD12, XHAD13, XHAD14, XHAD15, XHAD16, XHAD17, XHAD18, XHAD19, XHAD20. Their differences were presented in Product Difference Statement provided by the applicant of this report. So we selected model XHAD01 to fully test.

**All measurement and test data in this report was gathered from final production sample, serial number: 180725001/01 (assigned by the BACL, Chengdu). It may have deviation from any other sample. The EUT supplied by the applicant was received on 2018-07-11, and EUT conformed to test requirement.*

Objective

This report is prepared on behalf of **Chengdu XGimi 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)

FCC Part 15.247 DSS submissions with FCC ID: 2AFENXHAD01

FCC Part 15.407 NII submissions with FCC ID: 2AFENXHAD01

FCC Part 15.247 DTS submissions with FCC ID: 2AFENB914C

Measurement Uncertainty

Item			Uncertainty
AC power line conducted emission			2.93 dB
Radiated Emission(Field Strength)	30MHz-200MHz	H	4.63 dB
		V	4.88 dB
	200MHz-1GHz	H	5.02 dB
		V	6.06 dB
	1GHz-6GHz		4.51 dB
	6GHz-18GHz		4.49 dB
	18GHz-40GHz		5.48 dB
Conducted RF Power			±0.61dB
Power Spectrum Density			±0.61dB
Occupied Bandwidth			±5%
Conducted Emission			±1.5dB
Humidity			±5%
Temperature			±1°C

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

The system was configured in testing mode, which was provided by manufacturer.

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

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

For 802.11b, 802.11g, and 802.11n HT20 modes were 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	7	2442
4	2427	8	2447
5	2432	9	2452
6	2437	-	-

802.11n HT40 was tested with Channel 3, 6 and 9.

802.11b/g supports SISO, 802.11n supports SISO and MIMO mode. For Radiated Emission, according to pretest, the worst case for 802.11b/g is Antenna 1, the worst case for 802.11n is MIMO mode. So 802.11b/g Antenna 1 & 802.11n MIMO mode test data were recorded in the report.

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

The worst condition (maximum power with maximum duty cycle) was setting by the software as following table:

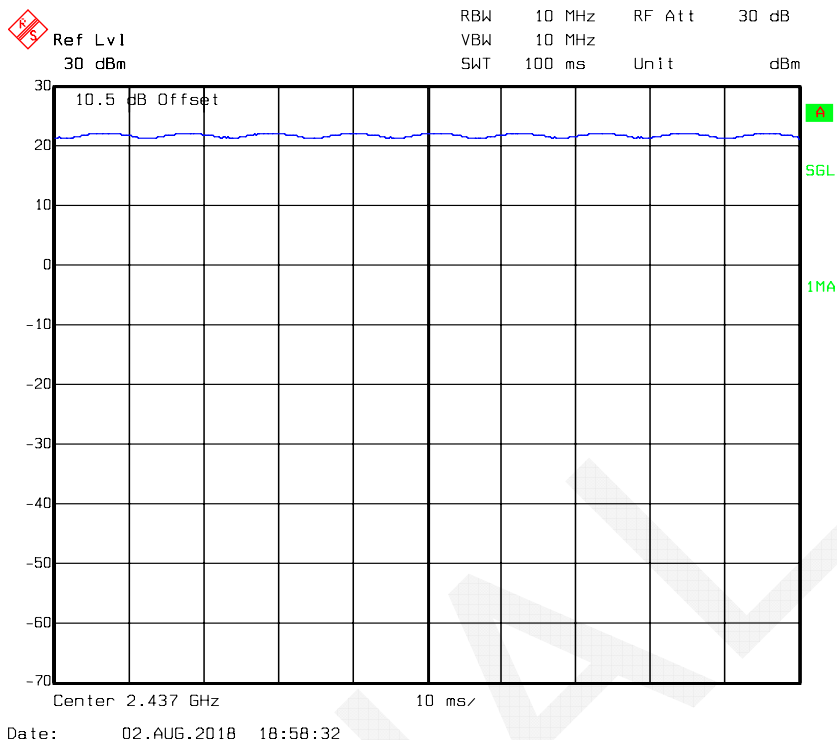
Test Mode	Test Software Version	QA Tool		
802.11b	Test Frequency	2412MHz	2437MHz	2462MHz
	Data Rate	CCK 1M	CCK 1M	CCK 1M
	Power Level Setting Antenna 1	1C	1C	1C
	Power Level Setting Antenna 2	1C	1C	1C
802.11g	Test Frequency	2412MHz	2437MHz	2462MHz
	Data Rate	OFDM 6M	OFDM 6M	OFDM 6M
	Power Level Setting Antenna 1	1C	1C	1C
	Power Level Setting Antenna 2	1C	1C	1C
802.11n-HT20	Test Frequency	2412MHz	2437MHz	2462MHz
	Data Rate	MCS0	MCS0	MCS0
	Power Level Setting Antenna 1	1A	1A	1A
	Power Level Setting Antenna 2	1A	1A	1A
802.11n-HT40	Test Frequency	2422MHz	2437MHz	2452MHz
	Data Rate	MCS0	MCS0	MCS0
	Power Level Setting Antenna 1	1A	1A	1A
	Power Level Setting Antenna 2	1A	1A	1A

Test Mode	Test Software Version	WCN-Combo-Tool		
BLE	Test Frequency	2402MHz	2440MHz	2480MHz
	Data Rate	Default	Default	Default
	Power Level Setting	Default	Default	Default

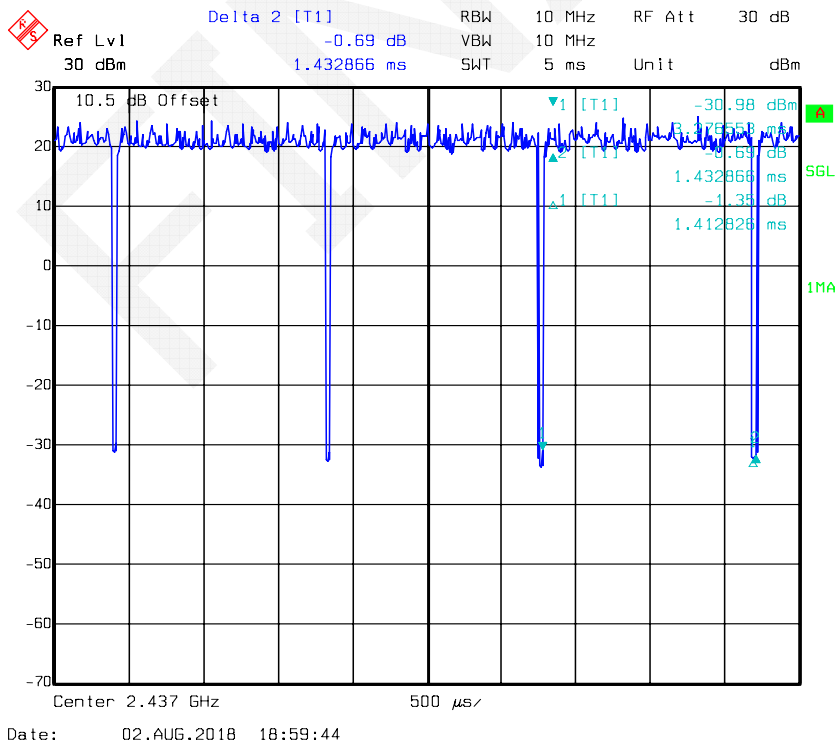
Duty Cycle information is below:

Mode	T _{on} (ms)	T _{on+off} (ms)	Duty Cycle (%)
802.11b	100	100	100.00
802.11g	1.41	1.43	98.60
802.11n-HT20	1.32	1.34	98.51
802.11n-HT40	0.66	0.69	95.65
BLE	100	100	100

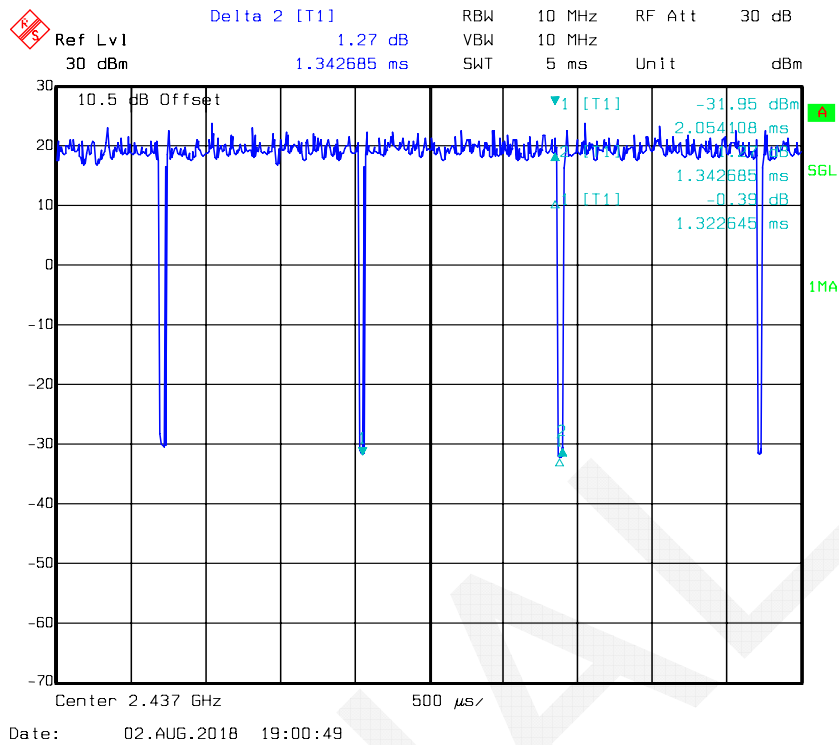
802.11b



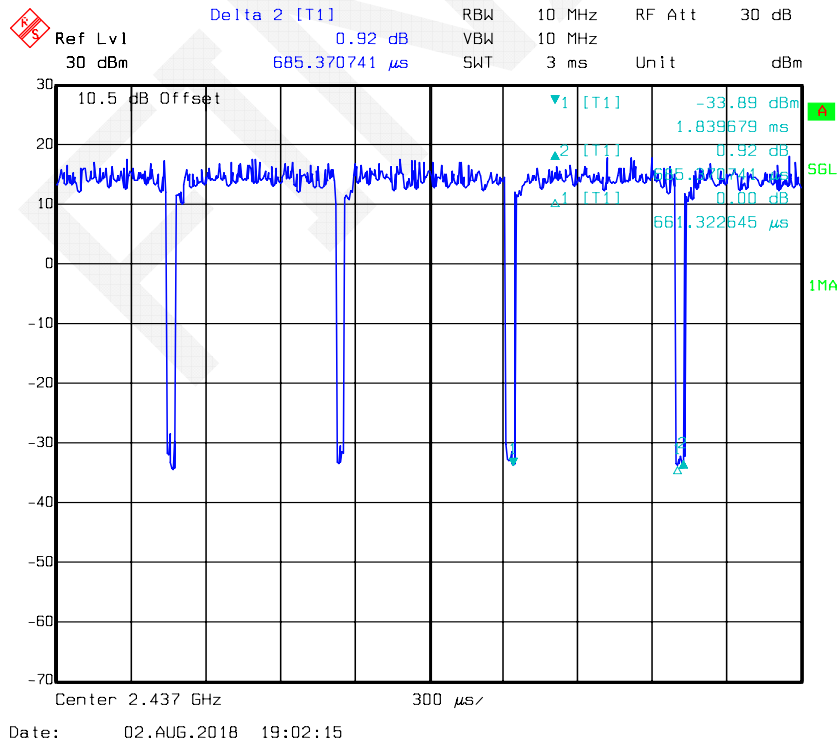
802.11g



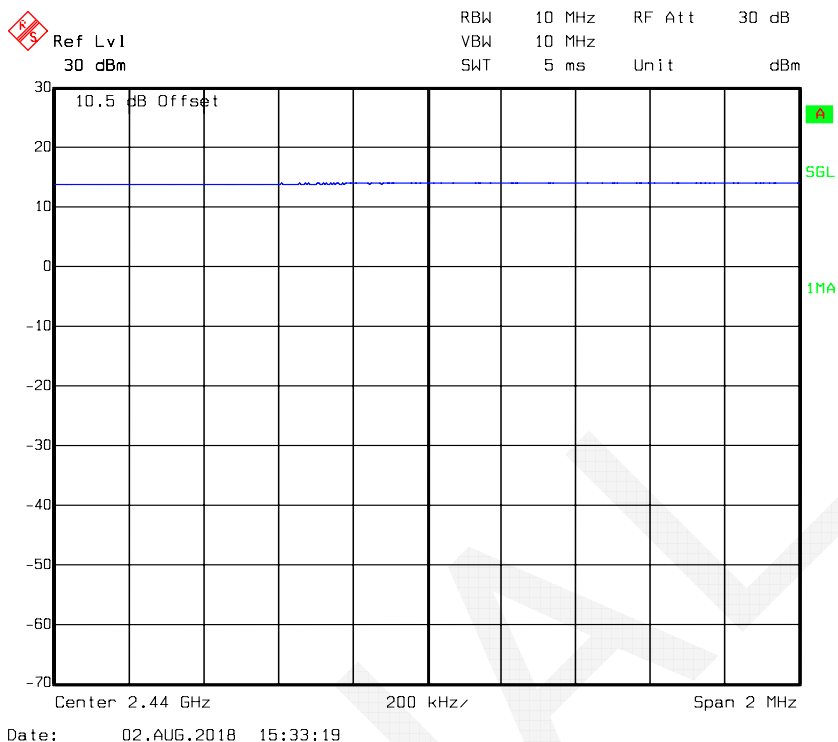
802.11n-HT20



802.11n-HT40



Bluetooth LE mode



Support Equipment List and Details

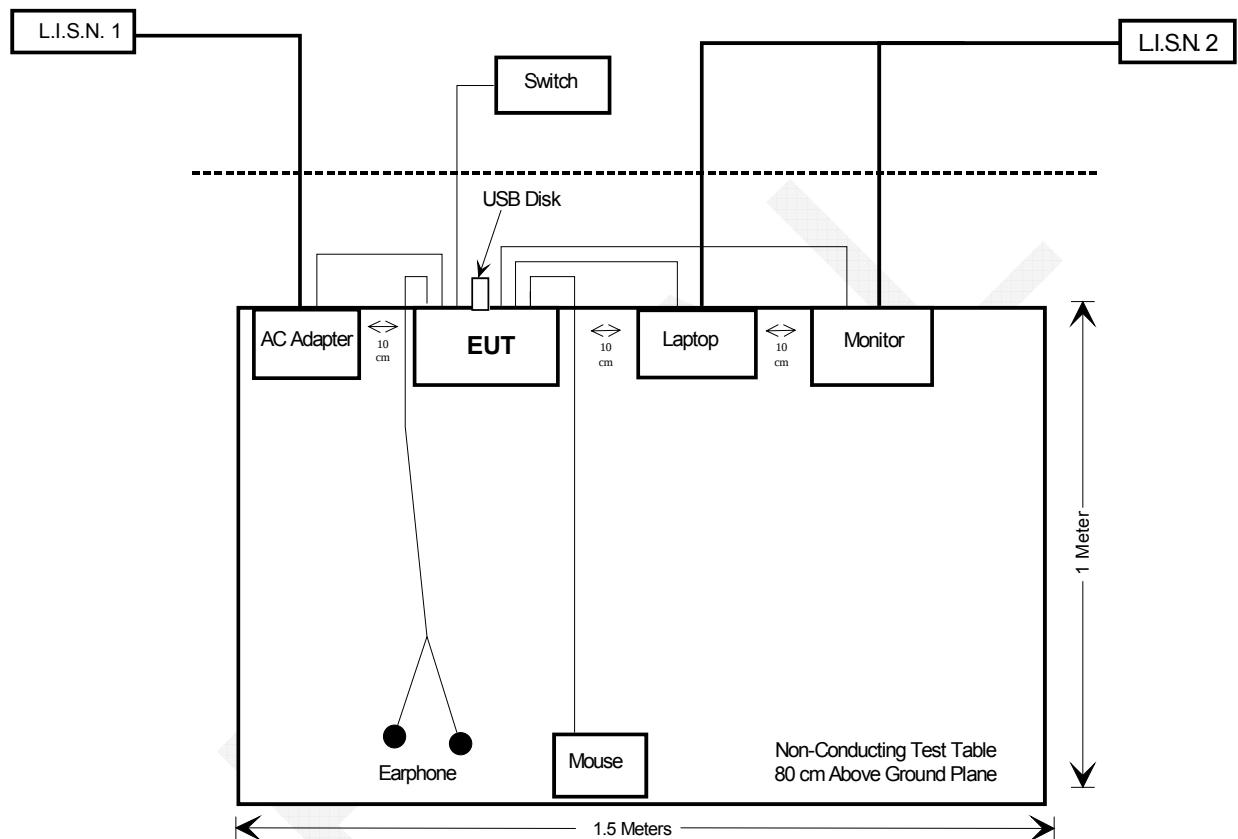
Manufacturer	Description	Model Number	Serial Number
PHILIPS	Monitor	227ELH	NA
Logitech	Mouse	M-U0004	810-001808
PLUM	Earphone	NA	None
SONY	Laptop	SVF143A1QT	None
Kingston	Flash USB Disk	DTSE9	7869951
DL	Switch	DL-S1005PM	None

External I/O Cable

Cable Description	Length (m)	From	To
Unshielded RJ45 Cable	8.0	EUT	Laptop
Shielded detachable HDMI Cable	1.8	EUT	Switch
Shielded detachable HDMI Cable	1.2	EUT	Monitor
Unshielded Earphone Cable	1.2	EUT	Earphone
Unshielded USB-mouse Cable	1.8	EUT	Mouse

Block Diagram of Test Setup

Conducted Emissions



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

TEST EQUIPMENTS LIST

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Conducted Emission					
Rohde & Schwarz	EMI Test Receiver	ESCS 30	836858/0016	2018-04-18	2019-04-17
Rohde & Schwarz	L.I.S.N.	ENV216	100018	2018-04-18	2019-04-17
EMCO	L.I.S.N.	3810/2BR	9509-1102	2017-12-02	2018-12-01
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	2020-05-17
Sonoma	Pre-Amplifier	310N	186684	2017-08-18	2018-08-17
Rohde & Schwarz	EMI Test Receiver	ESIB 40	100215	2018-04-18	2019-04-17
Rohde & Schwarz	EMI Test Receiver	ESCI	100028	2018-04-18	2019-04-17
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

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
RF Conducted Test					
Rohde & Schwarz	Spectrum Analyzer	FSEM30	100018	2018-05-09	2019-05-08
WEINSCHL ENGINEERING	Attenuator	1A10dB	AA4135	2017-11-10	2018-11-09
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).

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/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.

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/cm²);

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

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

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

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

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

Calculated Data:

MPE evaluation for single transmission:

Mode	Frequency Range (MHz)	Antenna Gain		Tune-up Conducted Power		Evaluation Distance (cm)	Power Density (mW/cm ²)	MPE Limit (mW/cm ²)
		(dBi)	(numeric)	(dBm)	(mW)			
WLAN	2412-2462	3.20	2.09	18.00	63.10	20	0.026	1.00
	5150-5250	4.60	2.88	15.50	35.48	20	0.020	1.00
	5725-5850	4.60	2.88	15.50	35.48	20	0.020	1.00
BT3.0	2402-2480	3.30	2.14	7.50	5.62	20	0.002	1.00
BLE	2402-2480	3.30	2.14	7.50	5.62	20	0.002	1.00

Note: Wi-Fi(2.4G or 5G) & Bluetooth can transmit simultaneously.

MPE evaluation for simultaneous transmission:

Wi-Fi and Bluetooth can transmit at the same time, MPE evaluation is as below formula:

$PD1/Limit1 + PD2/Limit2 + \dots < 1$, PD (Power Density)

MPE evaluation:

Wi-Fi and Bluetooth:

Max MPE of Wi-Fi(2.4G) + Max MPE of Bluetooth = $0.026/1.0 + 0.002/1.0 = 0.028 < 1.0$

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 used three built in FPC antennas (antenna 1: 2.4G&5GHz Wi-Fi; antenna 2: 2.4G/5G Wi-Fi; antenna 3: BT3.0/4.0), which connected to the main board with IPEX socket, fulfill the requirement of this section, Please refer to the EUT internal photos.

Antenna Information as follows:

Antenna	Antenna Model Number	Manufacturer	Band	Antenna Gain	Connector
1	01-10-M00088	ZHONGSHAN B&T TECHNOLOGY Co.,Ltd	Wi-Fi 2.4GHz	2.8 dBi	IPEX
			Wi-Fi 5GHz	4.6 dBi	IPEX
2	01-10-M00089	ZHONGSHAN B&T TECHNOLOGY Co.,Ltd	Wi-Fi 2.4GHz	3.2 dBi	IPEX
			Wi-Fi 5GHz	4.4 dBi	IPEX
3	01-10-M00090	ZHONGSHAN B&T TECHNOLOGY Co.,Ltd	BT3.0/4.0	3.3 dBi	IPEX

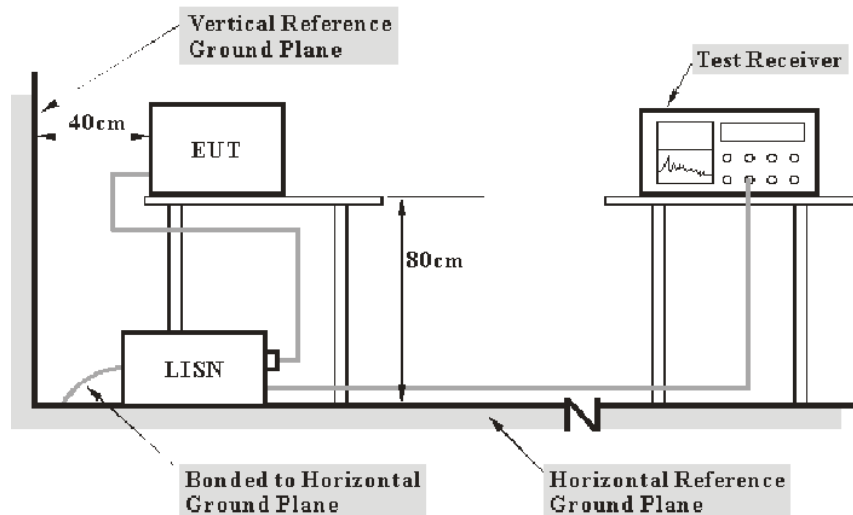
Result: Compliance.

FCC §15.207 (a) – AC LINE CONDUCTED EMISSIONS

Applicable Standard

FCC§15.207

EUT Setup



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

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

The spacing between the peripherals was 10 cm.

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

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 first L.I.S.N.

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:

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

Test Data

Environmental Conditions

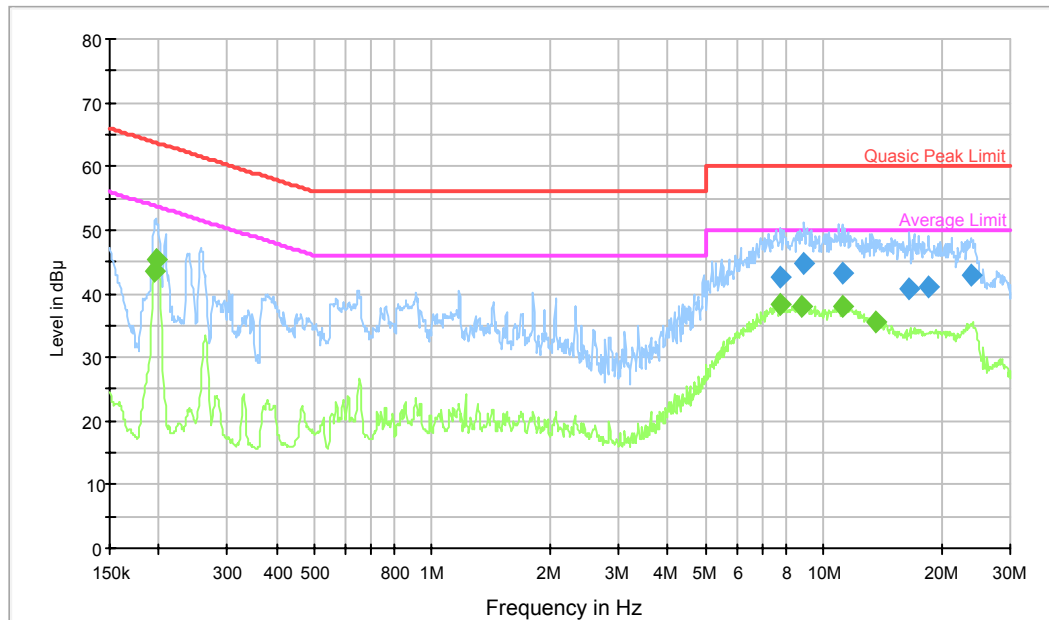
Temperature:	29 °C
Relative Humidity:	66 %
ATM Pressure:	95.1 kPa

The testing was performed by Tom Tang on 2018-07-31.

Test Mode: Transmitting

Wi-Fi Mode (802.11n-HT40 Mode_High Channel-worst case)

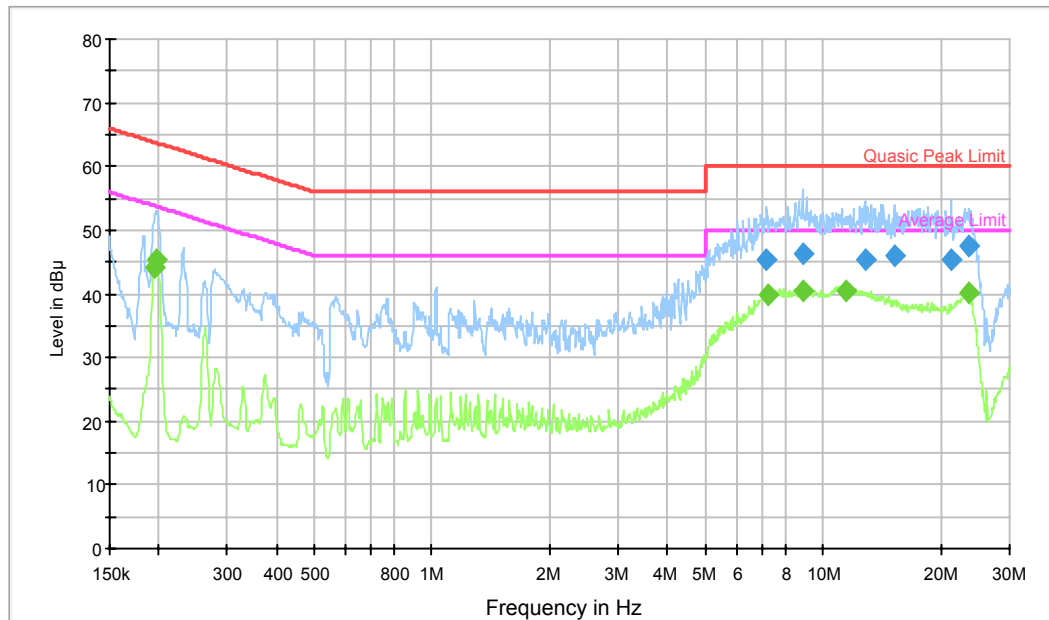
AC120 V, 60 Hz, Line:



Frequency (MHz)	QuasiPeak (dBμV)	Bandwidth (kHz)	Line	Corrected Factor (dB)	Margin (dB)	Limit (dBμV)
7.744614	42.7	9.000	L1	19.9	17.3	60.0
8.941563	44.8	9.000	L1	19.9	15.2	60.0
11.136986	43.2	9.000	L1	20.0	16.8	60.0
16.601180	40.7	9.000	L1	20.1	19.3	60.0
18.564485	41.1	9.000	L1	20.1	18.9	60.0
23.777878	42.8	9.000	L1	20.2	17.2	60.0

Frequency (MHz)	Average (dBμV)	Bandwidth (kHz)	Line	Corrected Factor (dB)	Margin (dB)	Limit (dBμV)
0.195217	43.6	9.000	L1	19.7	10.2	53.8
0.198359	45.3	9.000	L1	19.7	8.4	53.7
7.775593	38.4	9.000	L1	19.9	11.6	50.0
8.835117	37.9	9.000	L1	19.9	12.1	50.0
11.136986	37.9	9.000	L1	20.0	12.1	50.0
13.597320	35.5	9.000	L1	20.0	14.5	50.0

AC120 V, 60 Hz, Neutral:

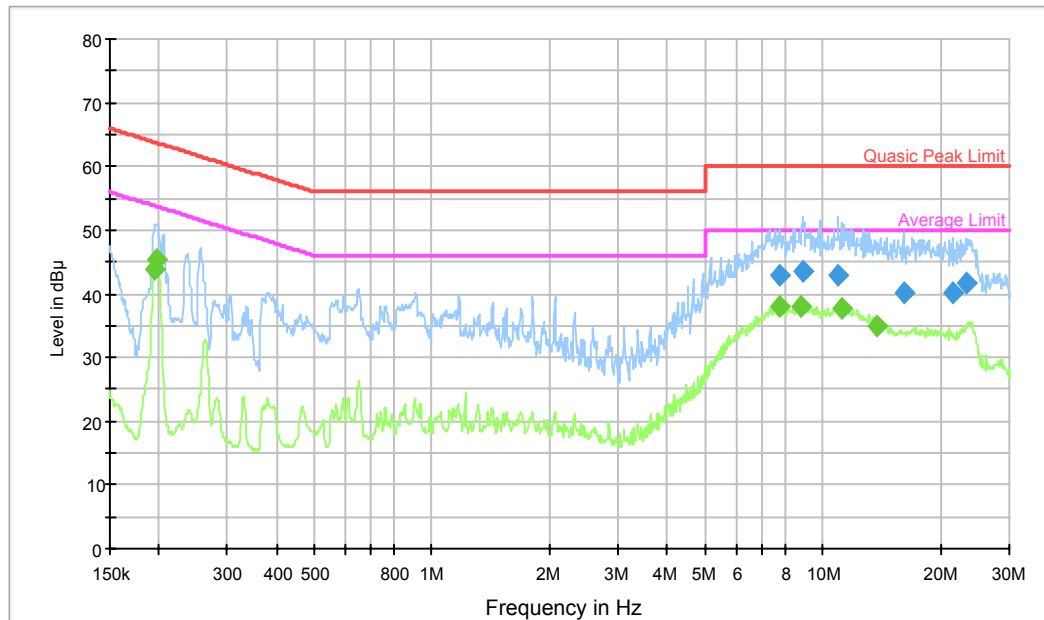


Frequency (MHz)	QuasiPeak (dBμV)	Bandwidth (kHz)	Line	Corrected Factor (dB)	Margin (dB)	Limit (dBμV)
7.178922	45.5	9.000	N	19.8	14.5	60.0
8.870458	46.4	9.000	N	19.9	13.6	60.0
12.807006	45.3	9.000	N	20.0	14.7	60.0
15.205380	46.0	9.000	N	20.0	14.0	60.0
21.263225	45.4	9.000	N	20.1	14.6	60.0
23.588791	47.5	9.000	N	20.2	12.5	60.0

Frequency (MHz)	Average (dBμV)	Bandwidth (kHz)	Line	Corrected Factor (dB)	Margin (dB)	Limit (dBμV)
0.195217	44.1	9.000	N	19.7	9.7	53.8
0.198359	45.5	9.000	N	19.7	8.2	53.7
7.236469	40.0	9.000	N	19.9	10.0	50.0
8.870458	40.5	9.000	N	19.9	9.5	50.0
11.452589	40.6	9.000	N	20.0	9.5	50.0
23.588791	40.1	9.000	N	20.2	9.9	50.0

BLE Mode (High Channel-worst case)

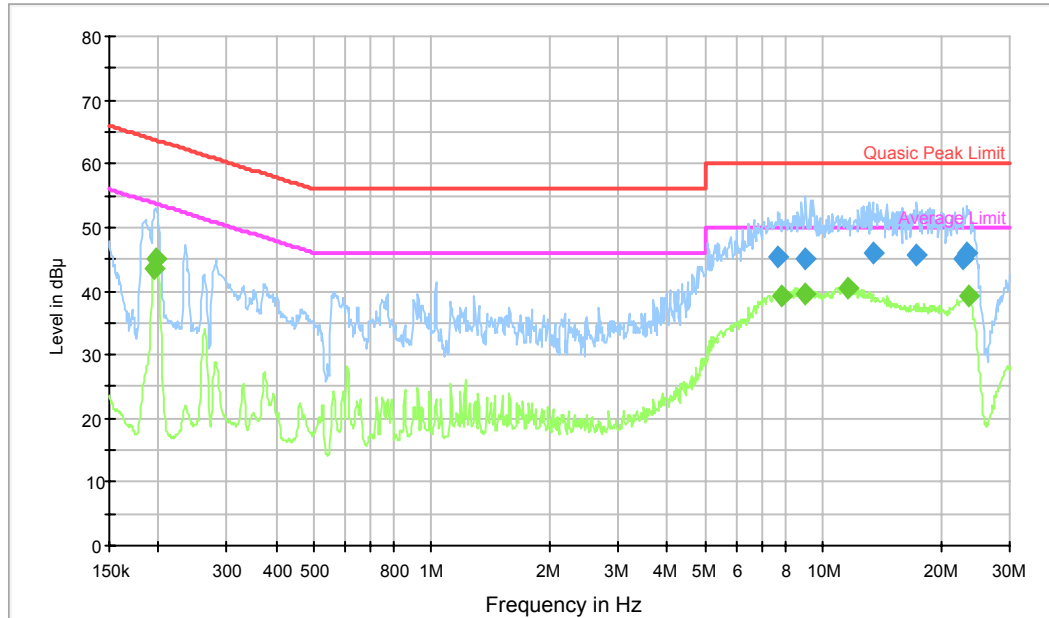
AC120 V, 60 Hz, Line:



Frequency (MHz)	QuasiPeak (dBμV)	Bandwidth (kHz)	Line	Corrected Factor (dB)	Margin (dB)	Limit (dBμV)
7.744614	43.0	9.000	L1	19.9	17.0	60.0
8.905940	43.5	9.000	L1	19.9	16.5	60.0
10.916894	43.0	9.000	L1	20.0	17.0	60.0
16.079378	40.0	9.000	L1	20.0	20.0	60.0
21.519406	40.2	9.000	L1	20.1	19.8	60.0
23.215114	41.8	9.000	L1	20.2	18.2	60.0

Frequency (MHz)	Average (dBμV)	Bandwidth (kHz)	Line	Corrected Factor (dB)	Margin (dB)	Limit (dBμV)
0.195217	43.9	9.000	L1	19.7	9.9	53.8
0.197569	45.4	9.000	L1	19.7	8.3	53.7
7.775593	38.1	9.000	L1	19.9	11.9	50.0
8.764858	37.9	9.000	L1	19.9	12.1	50.0
11.136986	37.8	9.000	L1	20.0	12.2	50.0
13.816186	35.0	9.000	L1	20.0	15.0	50.0

AC120 V, 60 Hz, Neutral:



Frequency (MHz)	QuasiPeak (dBμV)	Bandwidth (kHz)	Line	Corrected Factor (dB)	Margin (dB)	Limit (dBμV)
7.683027	45.3	9.000	N	19.9	14.7	60.0
9.049292	45.1	9.000	N	19.9	14.9	60.0
13.381921	46.1	9.000	N	20.0	13.9	60.0
17.346417	45.7	9.000	N	20.1	14.3	60.0
22.847357	45.2	9.000	N	20.2	14.8	60.0
23.307975	46.0	9.000	N	20.2	14.0	60.0

Frequency (MHz)	Average (dBμV)	Bandwidth (kHz)	Line	Corrected Factor (dB)	Margin (dB)	Limit (dBμV)
0.195217	43.6	9.000	N	19.7	10.2	53.8
0.196781	45.1	9.000	N	19.7	8.6	53.7
7.837922	39.3	9.000	N	19.9	10.7	50.0
9.049292	39.7	9.000	N	19.9	10.3	50.0
11.590570	40.4	9.000	N	20.0	9.6	50.0
23.494811	39.1	9.000	N	20.2	10.9	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

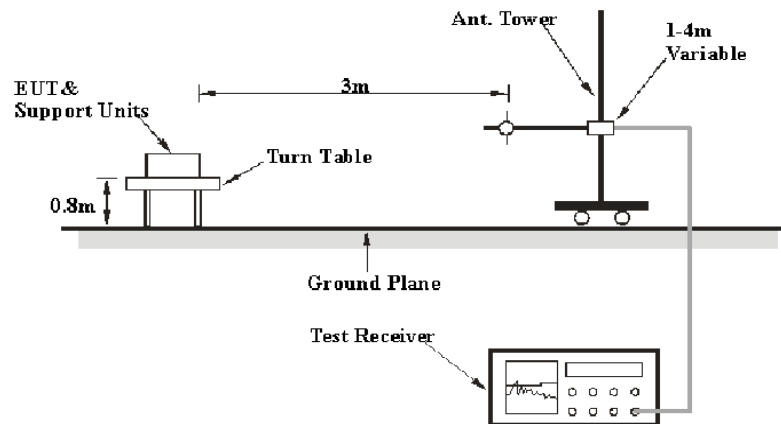
FCC §15.209, §15.205 & §15.247(d) - SPURIOUS EMISSIONS

Applicable Standard

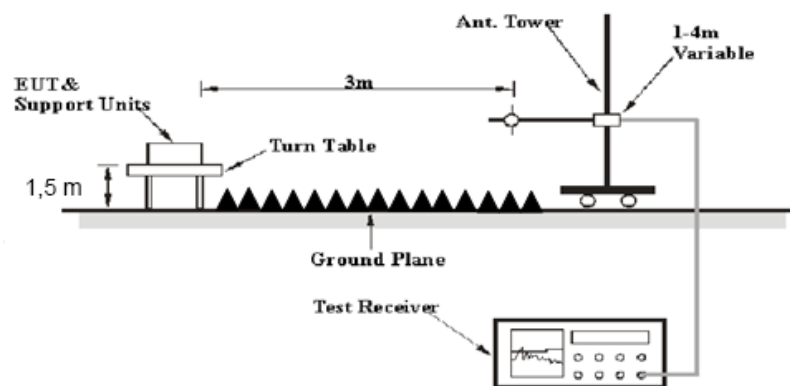
FCC §15.247 (d); §15.209; §15.205;

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 spacing between the peripherals was 10 cm.

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

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 Setup was set with the following configurations:

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

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:

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

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

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

Test Data

Environmental Conditions

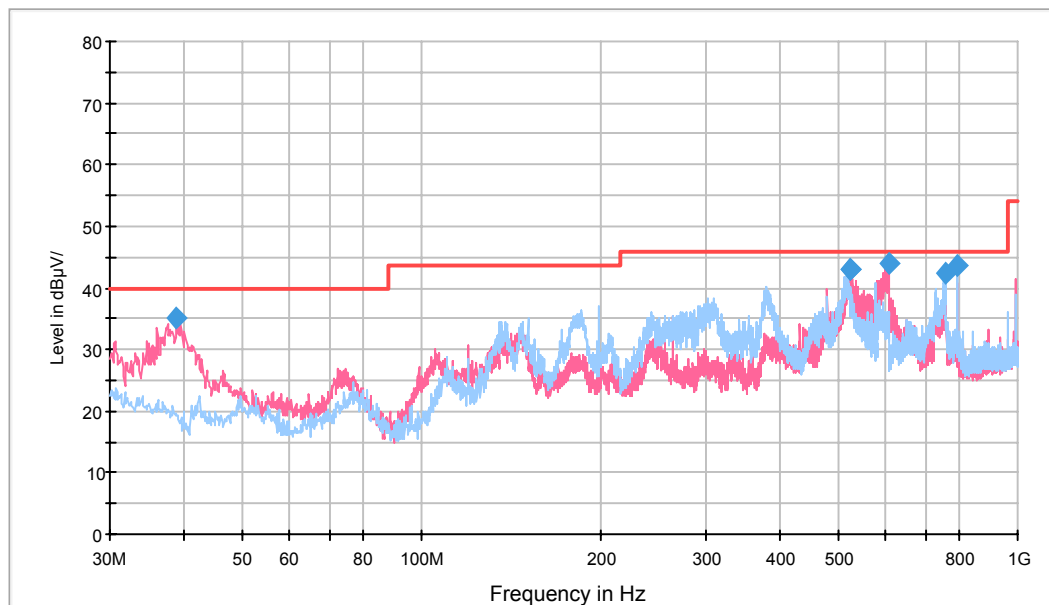
Temperature:	29 °C
Relative Humidity:	49 %
ATM Pressure:	95.0 kPa

* The testing was performed by Tom Tang on 2018-08-06.

Test Mode: Transmitting

Wi-Fi Mode

30 MHz to 1 GHz (802.11n-HT40 Mode_High Channe-worst case)



Frequency (MHz)	QuasicPeak (dBμV/m)	Height (cm)	Polarization	Azimuth (deg)	Corrected Factor (dB/m)	Margin (dB)	Limit (dBμV/m)
38.851250	35.0	100.0	V	48.0	-10.5	5.0	40.0
522.153750	42.9	100.0	V	330.0	-6.2	*3.1	46.0
525.185000	42.9	100.0	V	322.0	-6.1	*3.1	46.0
607.028750	44.0	100.0	V	8.0	-4.3	*2.0	46.0
758.591250	42.4	100.0	H	200.0	-2.7	*3.6	46.0
792.056250	43.7	100.0	H	19.0	-1.9	*2.3	46.0

*Within measurement uncertainty!

Above 1 GHz

802.11b Mode (SISO)-ANT 1

Frequency	Receiver		Rx Antenna		Cable loss	Amplifier Gain	Corrected Amplitude	Limit	Margin
	Reading	Measurement	Polar	Factor					
MHz	dBμV	PK/AV	H/V	(dB/m)	dB	dB	dBμV/m	dBμV/m	dB
Frequency: 2412MHz									
2412	77.65	PK	H	28.74	3.07	0.00	109.46	N/A	N/A
2412	73.15	AV	H	28.74	3.07	0.00	104.96	N/A	N/A
2412	76.26	PK	V	28.74	3.07	0.00	108.07	N/A	N/A
2412	71.47	AV	V	28.74	3.07	0.00	103.28	N/A	N/A
2390	28.89	PK	H	28.67	3.06	0.00	60.62	74.00	13.38
2390	16.21	AV	H	28.67	3.06	0.00	47.94	54.00	6.06
4824	57.65	PK	H	33.91	4.36	44.72	51.20	74.00	22.80
4824	53.65	AV	H	33.91	4.36	44.72	47.20	54.00	6.80
7236	46.87	PK	H	36.43	5.42	44.00	44.72	74.00	29.28
7236	34.11	AV	H	36.43	5.42	44.00	31.96	54.00	22.04
Frequency: 2437MHz									
2437	77.96	PK	H	28.81	3.09	0.00	109.86	N/A	N/A
2437	73.67	AV	H	28.81	3.09	0.00	105.57	N/A	N/A
2437	76.78	PK	V	28.81	3.09	0.00	108.68	N/A	N/A
2437	71.79	AV	V	28.81	3.09	0.00	103.69	N/A	N/A
4874	58.33	PK	H	34.05	4.39	44.72	52.05	74.00	21.95
4874	54.45	AV	H	34.05	4.39	44.72	48.17	54.00	5.83
7311	47.98	PK	H	36.54	5.44	44.20	45.76	74.00	28.24
7311	35.42	AV	H	36.54	5.44	44.20	33.20	54.00	20.80
Frequency: 2462MHz									
2462	78.14	PK	H	28.89	3.10	0.00	110.13	N/A	N/A
2462	73.78	AV	H	28.89	3.10	0.00	105.77	N/A	N/A
2462	76.84	PK	V	28.89	3.10	0.00	108.83	N/A	N/A
2462	72.01	AV	V	28.89	3.10	0.00	104.00	N/A	N/A
2483.5	29.82	PK	H	28.95	3.12	0.00	61.89	74.00	12.11
2483.5	16.81	AV	H	28.95	3.12	0.00	48.88	54.00	5.12
4924	58.43	PK	H	34.19	4.42	44.71	52.33	74.00	21.67
4924	55.09	AV	H	34.19	4.42	44.71	48.99	54.00	5.01
7386	48.48	PK	H	36.64	5.46	44.40	46.18	74.00	27.82
7386	36.67	AV	H	36.64	5.46	44.40	34.37	54.00	19.63

802.11g Mode (SISO)-ANT 1

Frequency	Receiver		Rx Antenna		Cable loss	Amplifier Gain	Corrected Amplitude	Limit	Margin
	Reading	Measurement	Polar	Factor					
MHz	dBμV	PK/AV	H/V	(dB/m)	dB	dB	dBμV/m	dBμV/m	dB
Frequency: 2412MHz									
2412	75.73	PK	H	28.74	3.07	0.00	107.54	N/A	N/A
2412	66.24	AV	H	28.74	3.07	0.00	98.05	N/A	N/A
2412	73.55	PK	V	28.74	3.07	0.00	105.36	N/A	N/A
2412	63.77	AV	V	28.74	3.07	0.00	95.58	N/A	N/A
2390	29.23	PK	V	28.67	3.06	0.00	60.96	74.00	13.04
2390	16.95	AV	V	28.67	3.06	0.00	48.68	54.00	5.32
4824	57.19	PK	V	33.91	4.36	44.72	50.74	74.00	23.26
4824	43.31	AV	V	33.91	4.36	44.72	36.86	54.00	17.14
7236	46.74	PK	V	36.43	5.42	44.00	44.59	74.00	29.41
7236	33.41	AV	V	36.43	5.42	44.00	31.26	54.00	22.74
Frequency: 2437MHz									
2437	75.87	PK	H	28.81	3.09	0.00	107.77	N/A	N/A
2437	66.33	AV	H	28.81	3.09	0.00	98.23	N/A	N/A
2437	73.49	PK	V	28.81	3.09	0.00	105.39	N/A	N/A
2437	62.93	AV	V	28.81	3.09	0.00	94.83	N/A	N/A
4874	57.50	PK	H	34.05	4.39	44.72	51.22	74.00	22.78
4874	43.07	AV	H	34.05	4.39	44.72	36.79	54.00	17.21
7311	47.06	PK	H	36.54	5.44	44.20	44.84	74.00	29.16
7311	33.60	AV	H	36.54	5.44	44.20	31.38	54.00	22.62
Frequency: 2462MHz									
2462	76.47	PK	H	28.89	3.10	0.00	108.46	N/A	N/A
2462	66.75	AV	H	28.89	3.10	0.00	98.74	N/A	N/A
2462	73.98	PK	V	28.89	3.10	0.00	105.97	N/A	N/A
2462	62.56	AV	V	28.89	3.10	0.00	94.55	N/A	N/A
2483.5	35.47	PK	H	28.95	3.12	0.00	67.54	74.00	6.46
2483.5	19.61	AV	H	28.95	3.12	0.00	51.68	54.00	*2.32
4924	58.13	PK	H	34.19	4.42	44.71	52.03	74.00	21.97
4924	43.88	AV	H	34.19	4.42	44.71	37.78	54.00	16.22
7386	47.64	PK	H	36.64	5.46	44.40	45.34	74.00	28.66
7386	34.27	AV	H	36.64	5.46	44.40	31.97	54.00	22.03

*Within measurement uncertainty!

802.11n-HT20 Mode (MIMO)

Frequency	Receiver		Rx Antenna		Cable loss	Amplifier Gain	Corrected Amplitude	Limit	Margin
	Reading	Measurement	Polar	Factor					
MHz	dBμV	PK/AV	H/V	(dB/m)	dB	dB	dBμV/m	dBμV/m	dB
Frequency: 2412MHz									
2412	74.74	PK	H	28.74	3.07	0.00	106.55	N/A	N/A
2412	64.73	AV	H	28.74	3.07	0.00	96.54	N/A	N/A
2412	72.49	PK	V	28.74	3.07	0.00	104.30	N/A	N/A
2412	62.56	AV	V	28.74	3.07	0.00	94.37	N/A	N/A
2390	34.26	PK	H	28.67	3.06	0.00	65.99	74.00	8.01
2390	17.06	AV	H	28.67	3.06	0.00	48.79	54.00	5.21
4824	55.49	PK	H	33.91	4.36	44.72	49.04	74.00	24.96
4824	40.56	AV	H	33.91	4.36	44.72	34.11	54.00	19.89
7236	46.13	PK	H	36.43	5.42	44.00	43.98	74.00	30.02
7236	33.11	AV	H	36.43	5.42	44.00	30.96	54.00	23.04
Frequency: 2437MHz									
2437	75.95	PK	H	28.81	3.09	0.00	107.85	N/A	N/A
2437	66.52	AV	H	28.81	3.09	0.00	98.42	N/A	N/A
2437	73.65	PK	V	28.81	3.09	0.00	105.55	N/A	N/A
2437	63.83	AV	V	28.81	3.09	0.00	95.73	N/A	N/A
4874	56.26	PK	H	34.05	4.39	44.72	49.98	74.00	24.02
4874	40.92	AV	H	34.05	4.39	44.72	34.64	54.00	19.36
7311	46.82	PK	H	36.54	5.44	44.20	44.60	74.00	29.40
7311	33.65	AV	H	36.54	5.44	44.20	31.43	54.00	22.57
Frequency: 2462MHz									
2462	76.89	PK	H	28.89	3.10	0.00	108.88	N/A	N/A
2462	67.93	AV	H	28.89	3.10	0.00	99.92	N/A	N/A
2462	74.46	PK	V	28.89	3.10	0.00	106.45	N/A	N/A
2462	64.59	AV	V	28.89	3.10	0.00	96.58	N/A	N/A
2483.5	31.95	PK	H	28.95	3.12	0.00	64.02	74.00	9.98
2483.5	18.89	AV	H	28.95	3.12	0.00	50.96	54.00	*3.04
4924	56.42	PK	H	34.19	4.42	44.71	50.32	74.00	23.68
4924	41.14	AV	H	34.19	4.42	44.71	35.04	54.00	18.96
7386	47.28	PK	H	36.64	5.46	44.40	44.98	74.00	29.02
7386	33.82	AV	H	36.64	5.46	44.40	31.52	54.00	22.48

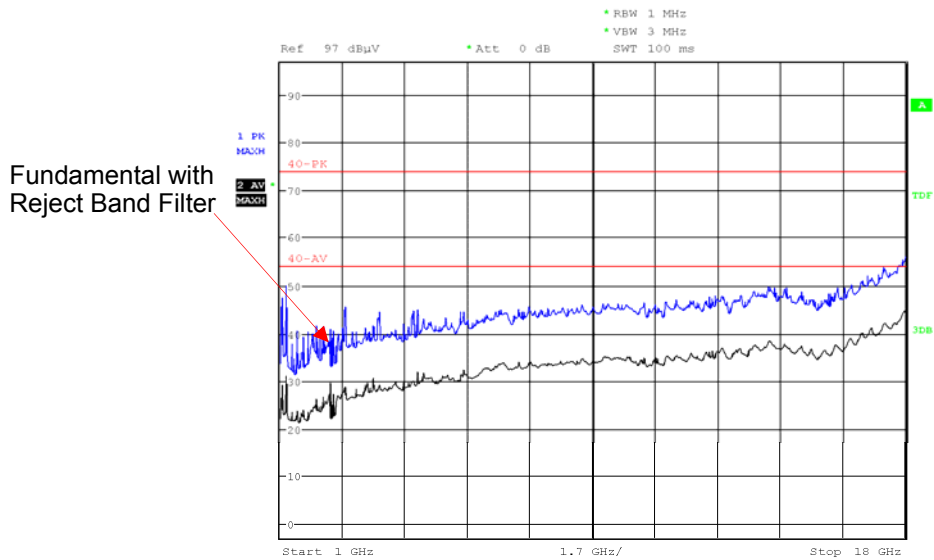
*Within measurement uncertainty!

802.11n-HT40 Mode (MIMO)

Frequency	Receiver		Rx Antenna		Cable loss	Amplifier Gain	Corrected Amplitude	Limit	Margin
	Reading	Measurement	Polar	Factor					
MHz	dBμV	PK/AV	H/V	(dB/m)	dB	dB	dBμV/m	dBμV/m	dB
Frequency: 2422MHz									
2422	71.88	PK	H	28.77	3.08	0.00	103.73	N/A	N/A
2422	62.59	AV	H	28.77	3.08	0.00	94.44	N/A	N/A
2422	70.43	PK	V	28.77	3.08	0.00	102.28	N/A	N/A
2422	60.93	AV	V	28.77	3.08	0.00	92.78	N/A	N/A
2390	36.15	PK	H	28.67	3.06	0.00	67.88	74.00	6.12
2390	19.72	AV	H	28.67	3.06	0.00	51.45	54.00	*2.55
4844	51.12	PK	H	33.96	4.38	44.72	44.74	74.00	29.26
4844	38.56	AV	H	33.96	4.38	44.72	32.18	54.00	21.82
7266	46.25	PK	H	36.47	5.43	44.08	44.07	74.00	29.93
7266	33.04	AV	H	36.47	5.43	44.08	30.86	54.00	23.14
Frequency: 2437MHz									
2437	72.34	PK	H	28.81	3.09	0.00	104.24	N/A	N/A
2437	62.90	AV	H	28.81	3.09	0.00	94.80	N/A	N/A
2437	71.23	PK	V	28.81	3.09	0.00	103.13	N/A	N/A
2437	61.10	AV	V	28.81	3.09	0.00	93.00	N/A	N/A
4874	51.56	PK	H	34.05	4.39	44.72	45.28	74.00	28.72
4874	38.93	AV	H	34.05	4.39	44.72	32.65	54.00	21.35
7311	46.67	PK	H	36.54	5.44	44.20	44.45	74.00	29.55
7311	33.54	AV	H	36.54	5.44	44.20	31.32	54.00	22.68
Frequency: 2452MHz									
2452	72.69	PK	H	28.86	3.10	0.00	104.65	N/A	N/A
2452	62.75	AV	H	28.86	3.10	0.00	94.71	N/A	N/A
2452	71.58	PK	V	28.86	3.10	0.00	103.54	N/A	N/A
2452	60.99	AV	V	28.86	3.10	0.00	92.95	N/A	N/A
2483.5	38.46	PK	H	28.95	3.12	0.00	70.53	74.00	*3.47
2483.5	20.66	AV	H	28.95	3.12	0.00	52.73	54.00	*1.27
4904	51.56	PK	H	34.13	4.41	44.71	45.39	74.00	28.61
4904	38.91	AV	H	34.13	4.41	44.71	32.74	54.00	21.26
7356	46.83	PK	H	36.60	5.45	44.32	44.56	74.00	29.44
7356	33.59	AV	H	36.60	5.45	44.32	31.32	54.00	22.68

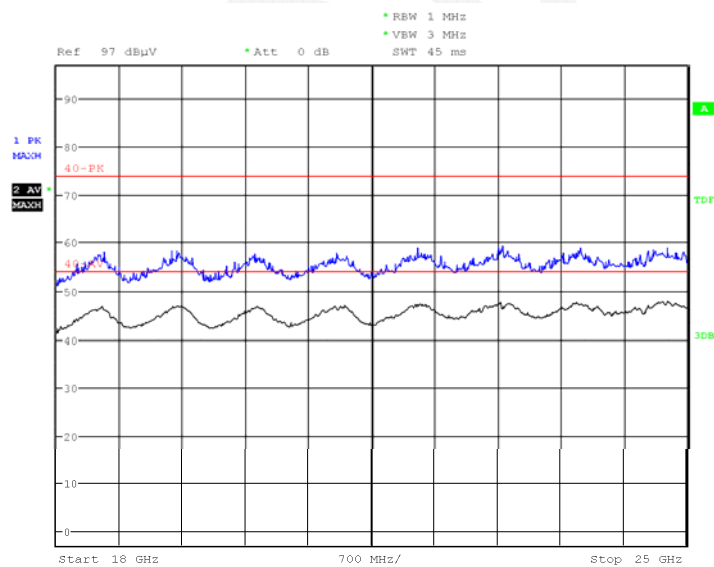
*Within measurement uncertainty!

802.11n-HT40 Mode: High Channel_Vertical_1GHz-18GHz



Date: 6.AUG.2018 17:10:59

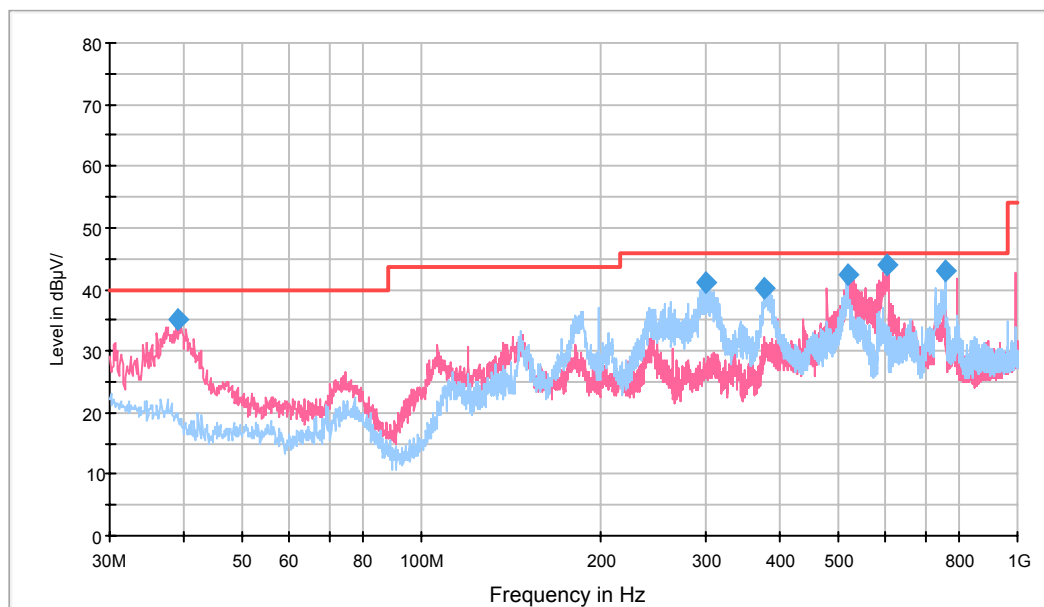
802.11n-HT40 Mode: High Channel_Vertical_18GHz-25GHz



Date: 6.AUG.2018 19:02:49

BLE Mode

30 MHz to 1 GHz-High channel-worst case



Frequency (MHz)	QuasicPeak (dBμV/m)	Height (cm)	Polarization	Azimuth (deg)	Corrected Factor (dB/m)	Margin (dB)	Limit (dBμV/m)
38.972500	35.0	100.0	V	55.0	-10.6	5.0	40.0
300.872500	41.1	100.0	H	135.0	-10.5	4.9	46.0
377.138750	40.2	115.0	H	155.0	-9.2	5.8	46.0
519.001250	42.4	100.0	V	335.0	-6.3	*3.6	46.0
605.088750	43.8	100.0	V	47.0	-4.3	*2.2	46.0
758.591250	42.9	100.0	H	180.0	-2.7	*3.1	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/m)	dB	dB	dBμV/m	dBμV/m	dB
frequency: 2402MHz									
2402	71.12	PK	H	28.71	3.06	0.00	102.89	N/A	N/A
2402	68.43	AV	H	28.71	3.06	0.00	100.20	N/A	N/A
2402	68.83	PK	V	28.71	3.06	0.00	100.60	N/A	N/A
2402	66.11	AV	V	28.71	3.06	0.00	97.88	N/A	N/A
2390	29.22	PK	H	28.67	3.06	0.00	60.95	74.00	13.05
2390	16.04	AV	H	28.67	3.06	0.00	47.77	54.00	6.23
4804	51.08	PK	H	33.85	4.35	44.73	44.55	74.00	29.45
4804	40.32	AV	H	33.85	4.35	44.73	33.79	54.00	20.21
7206	47.71	PK	H	36.39	5.41	43.92	45.59	74.00	28.41
7206	34.84	AV	H	36.39	5.41	43.92	32.72	54.00	21.28
frequency: 2440MHz									
2440	70.19	PK	H	28.82	3.09	0.00	102.10	N/A	N/A
2440	67.52	AV	H	28.82	3.09	0.00	99.43	N/A	N/A
2440	67.77	PK	V	28.82	3.09	0.00	99.68	N/A	N/A
2440	65.44	AV	V	28.82	3.09	0.00	97.35	N/A	N/A
4880	49.71	PK	H	34.06	4.40	44.72	43.45	74.00	30.55
4880	37.69	AV	H	34.06	4.40	44.72	31.43	54.00	22.57
7320	47.30	PK	H	36.55	5.44	44.22	45.07	74.00	28.93
7320	33.92	AV	H	36.55	5.44	44.22	31.69	54.00	22.31
frequency: 2480MHz									
2480	69.81	PK	H	28.94	3.12	0.00	101.87	N/A	N/A
2480	67.22	AV	H	28.94	3.12	0.00	99.28	N/A	N/A
2480	66.94	PK	V	28.94	3.12	0.00	99.00	N/A	N/A
2480	64.81	AV	V	28.94	3.12	0.00	96.87	N/A	N/A
2483.5	31.69	PK	H	28.95	3.12	0.00	63.76	74.00	10.24
2483.5	19.58	AV	H	28.95	3.12	0.00	51.65	54.00	*2.35
4960	48.93	PK	H	34.29	4.44	44.71	42.95	74.00	31.05
4960	35.75	AV	H	34.29	4.44	44.71	29.77	54.00	24.23
7440	47.08	PK	H	36.72	5.48	44.54	44.74	74.00	29.26
7440	33.23	AV	H	36.72	5.48	44.54	30.89	54.00	23.11

**Within measurement uncertainty!*

Note:

Corrected Amplitude = Corrected Factor + Reading

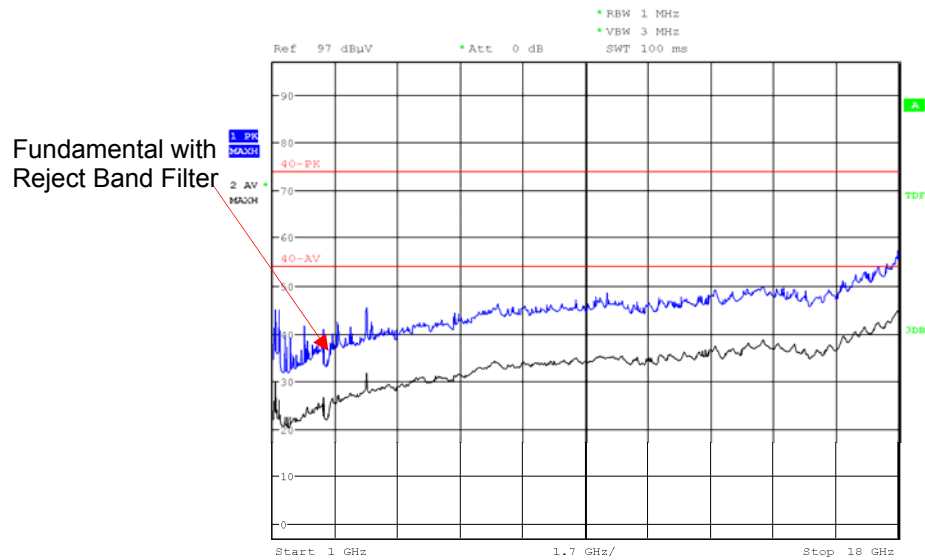
Corrected Factor=Antenna factor (RX) + Cable Loss – Amplifier Factor

Margin = Limit- Corrected Amplitude

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

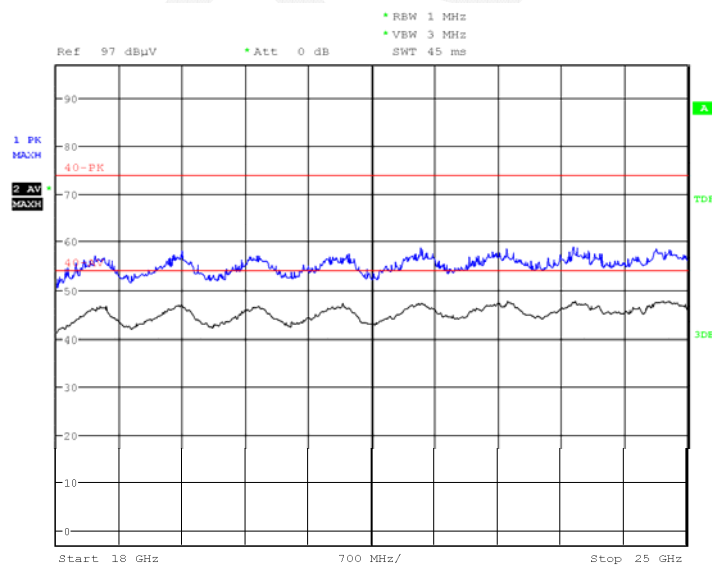
Please refer to the below pre-scan plot of worst case:

High Channel_Horizontal_1GHz-18GHz



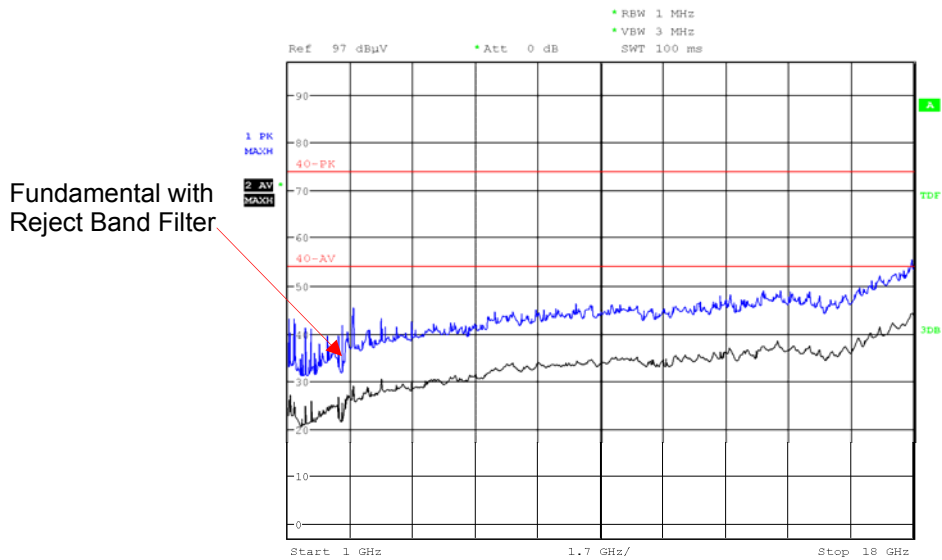
Date: 6.AUG.2018 17:23:32

High Channel_Horizontal_18GHz-25GHz



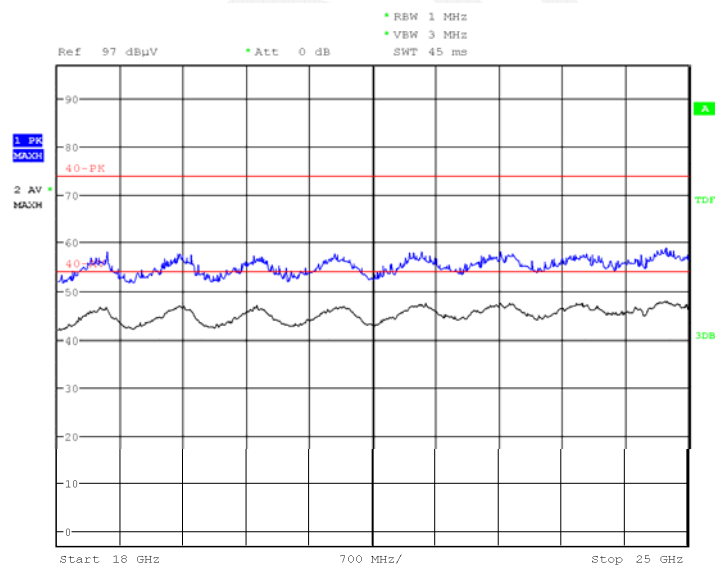
Date: 6.AUG.2018 19:06:52

High Channel_Vertical_1GHz-18GHz



Date: 6.AUG.2018 17:25:51

High Channel_Vertical_18GHz-25GHz



Date: 6.AUG.2018 19:08:55

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) $\geq 3 \times \text{RBW}$
- 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:	27 °C
Relative Humidity:	54 %
ATM Pressure:	94.8 kPa

* The testing was performed by Tom Tang on 2018-08-02.

Test Mode: Transmitting

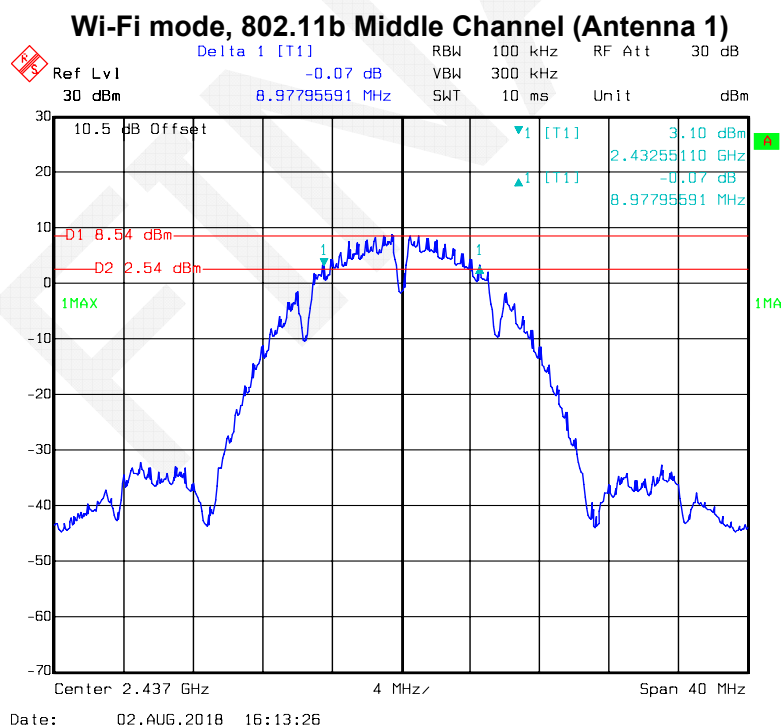
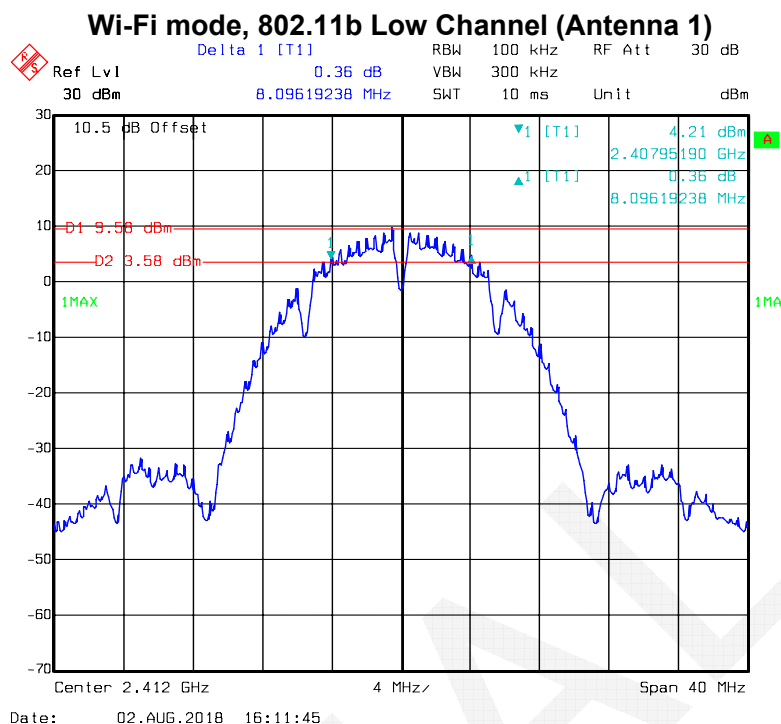
Test Result: Compliance. Please refer to the following table and plots.

Wi-Fi mode

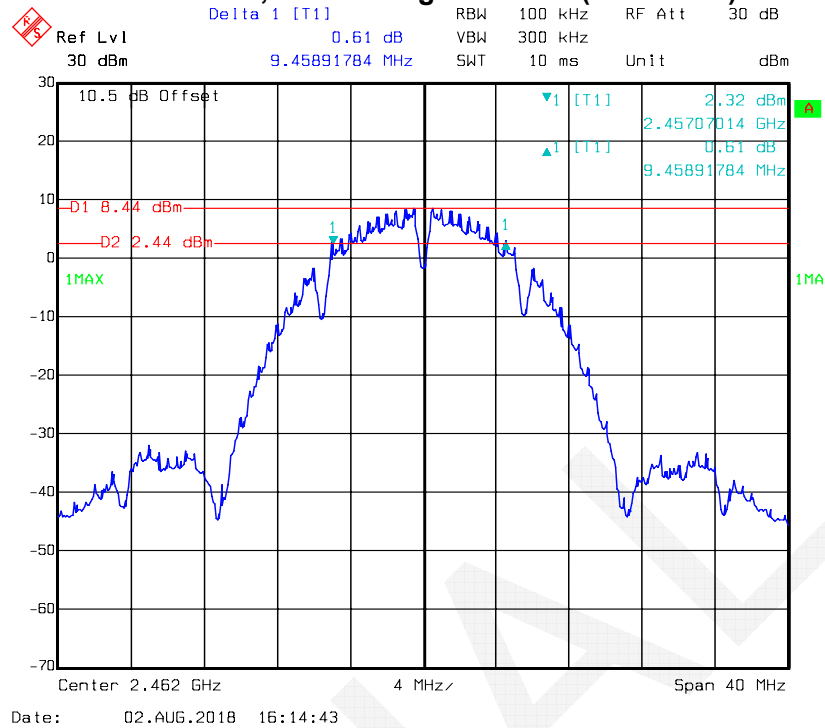
Mode	Channel	Frequency (MHz)	6dB Emission Bandwidth (MHz)		Limit (MHz)
			Antenna 1	Antenna 2	
802.11b	Low	2412	8.10	9.06	≥0.50
	Middle	2437	8.98	8.98	≥0.50
	High	2462	9.46	8.98	≥0.50
802.11g	Low	2412	15.39	15.23	≥0.50
	Middle	2437	15.23	15.23	≥0.50
	High	2462	15.39	15.39	≥0.50
802.11n-HT20	Low	2412	15.23	15.23	≥0.50
	Middle	2437	15.15	15.23	≥0.50
	High	2462	15.23	15.39	≥0.50
802.11n-HT40	Low	2422	35.59	35.59	≥0.50
	Middle	2437	35.59	35.43	≥0.50
	High	2452	35.59	35.59	≥0.50

BLE mode

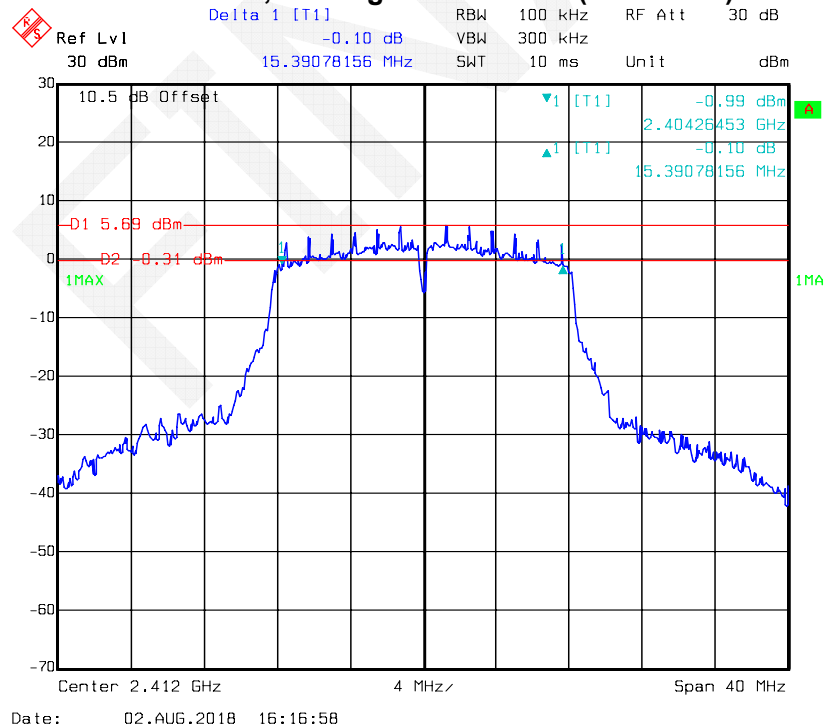
Mode	Channel	Frequency (MHz)	6dB Emission Bandwidth (MHz)	Limit (MHz)
BLE	Low	2402	0.71	≥0.50
	Middle	2440	0.71	≥0.50
	High	2480	0.71	≥0.50



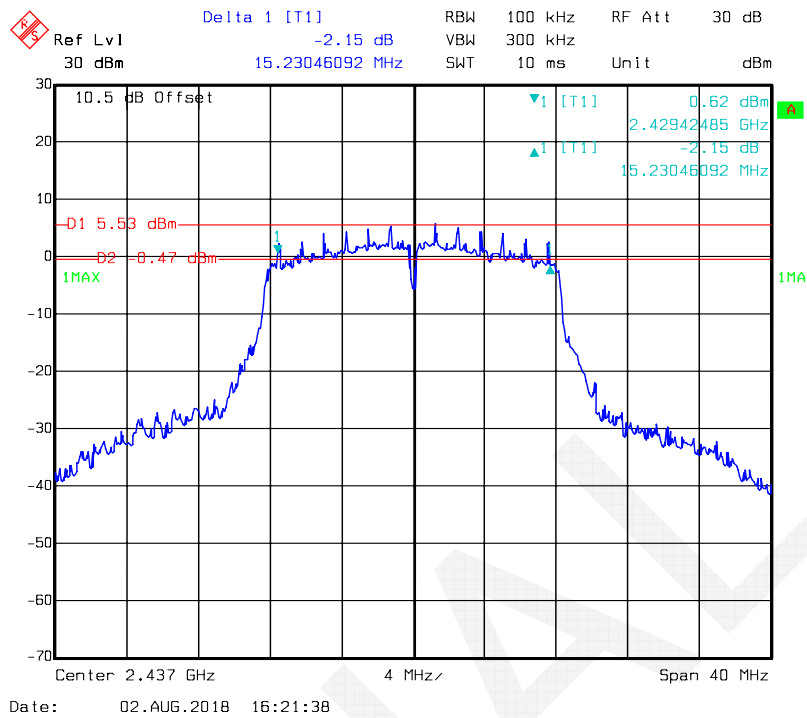
Wi-Fi mode, 802.11b High Channel (Antenna 1)



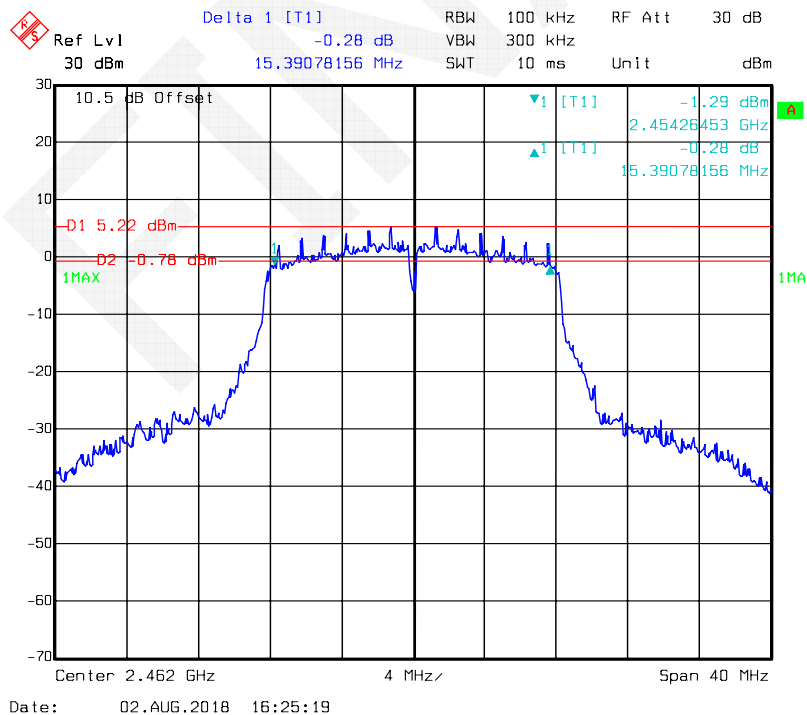
Wi-Fi mode, 802.11g Low Channel (Antenna 1)



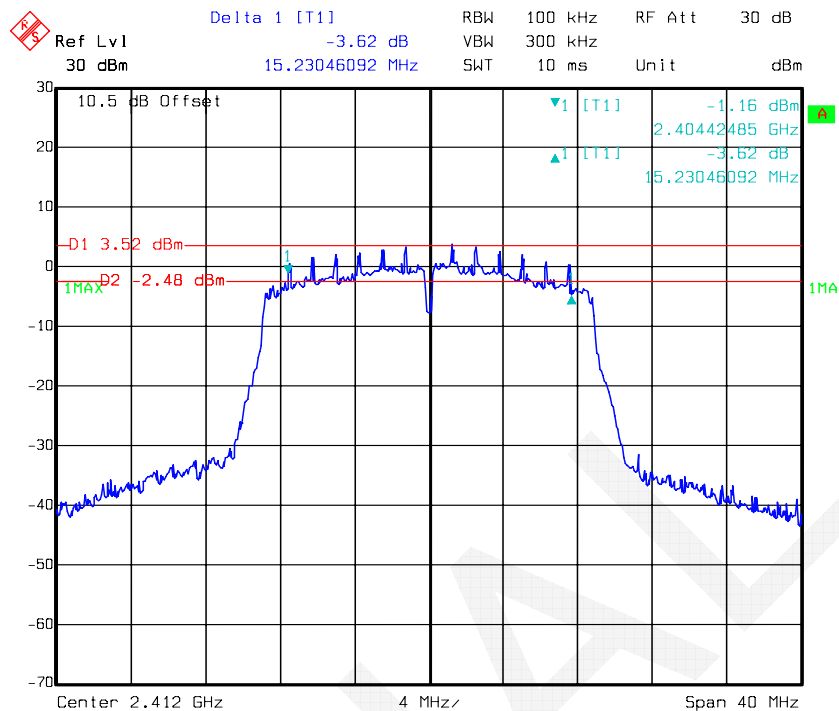
Wi-Fi mode, 802.11g Middle Channel (Antenna 1)



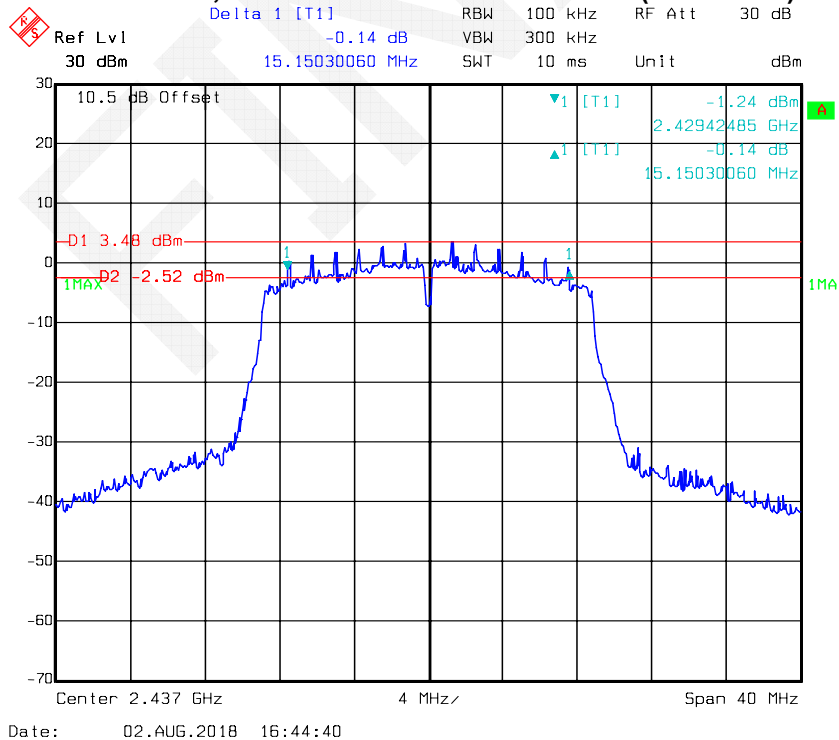
Wi-Fi mode, 802.11g High Channel (Antenna 1)



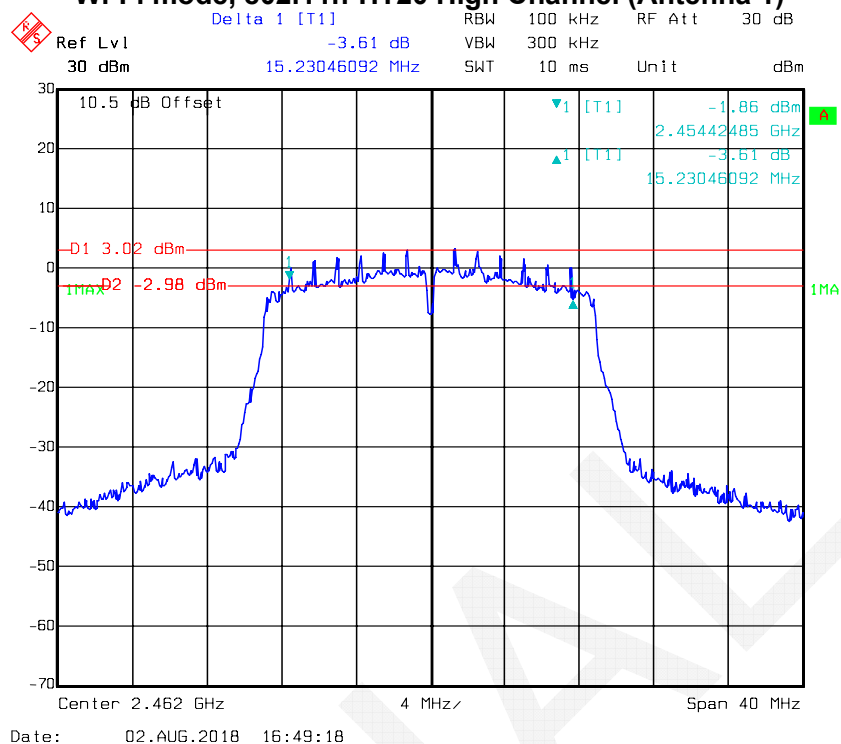
Wi-Fi mode, 802.11n-HT20 Low Channel (Antenna 1)



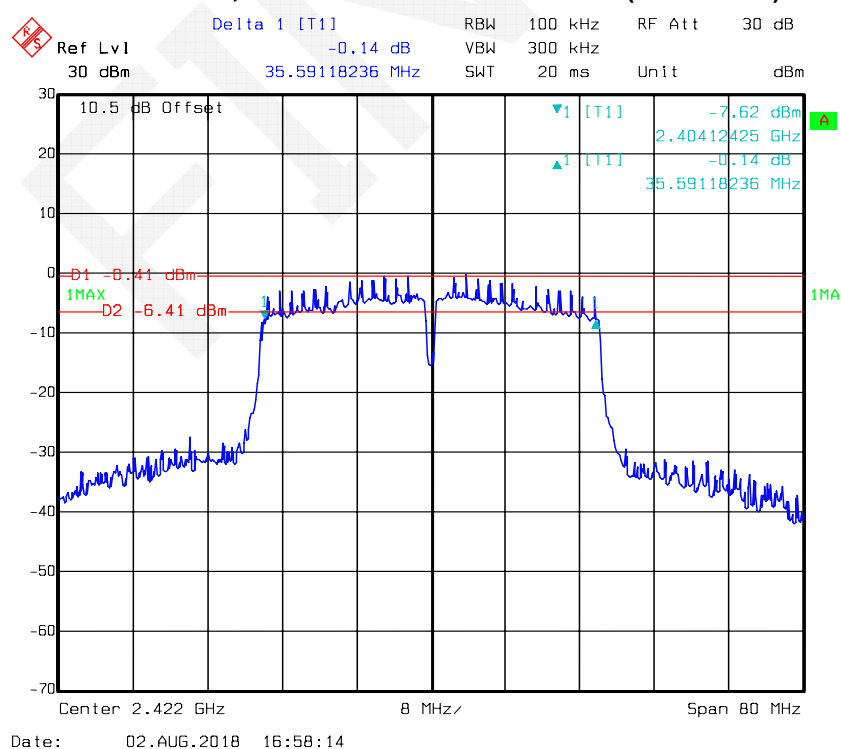
Wi-Fi mode, 802.11n-HT20 Middle Channel (Antenna 1)



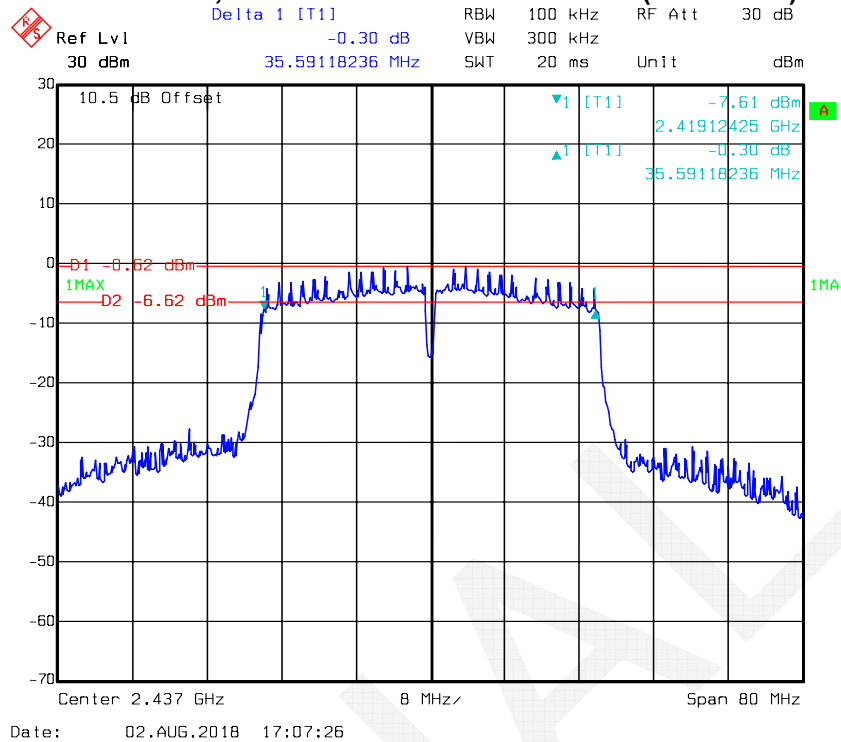
Wi-Fi mode, 802.11n-HT20 High Channel (Antenna 1)



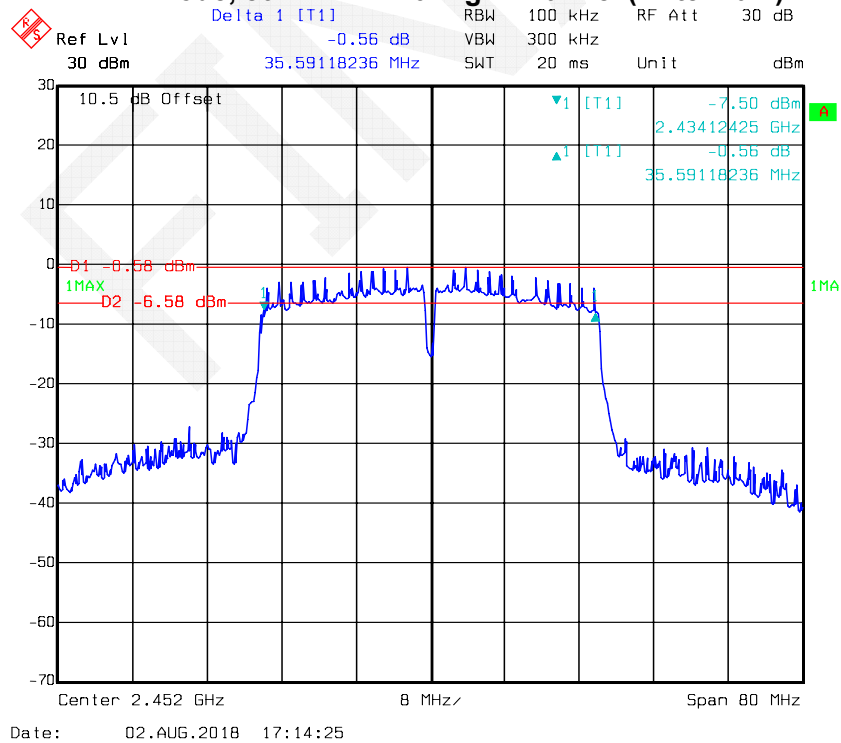
Wi-Fi mode, 802.11n-HT40 Low Channel (Antenna 1)



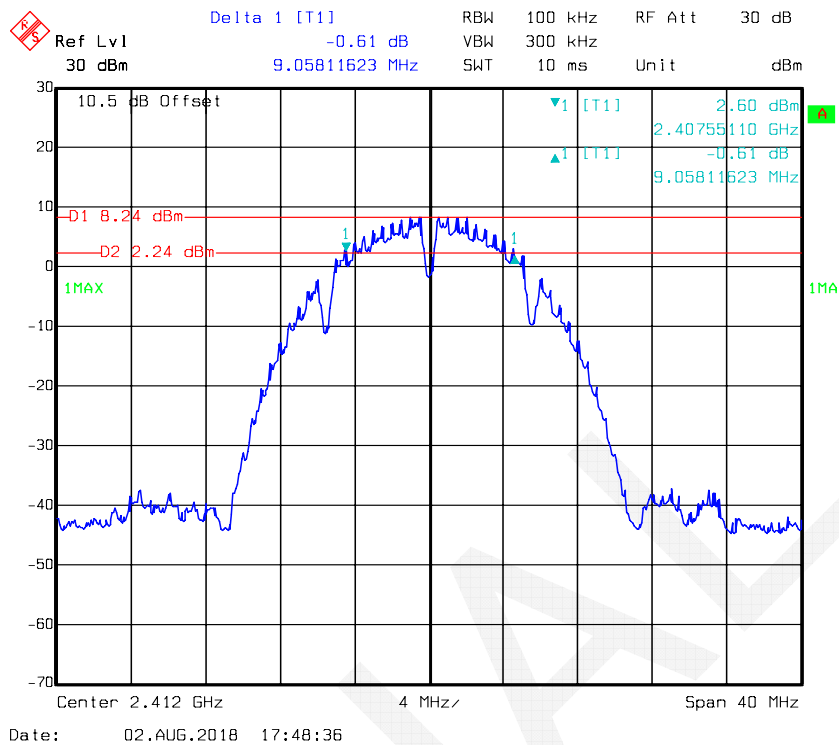
Wi-Fi mode, 802.11n-HT40 Middle Channel (Antenna 1)



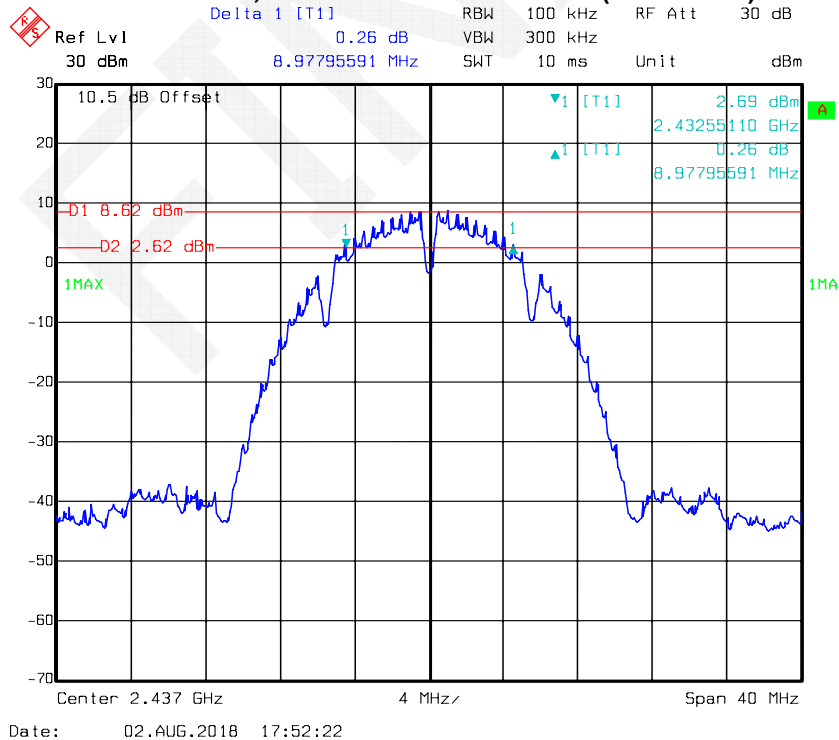
Wi-Fi mode, 802.11n-HT40 High Channel (Antenna 1)

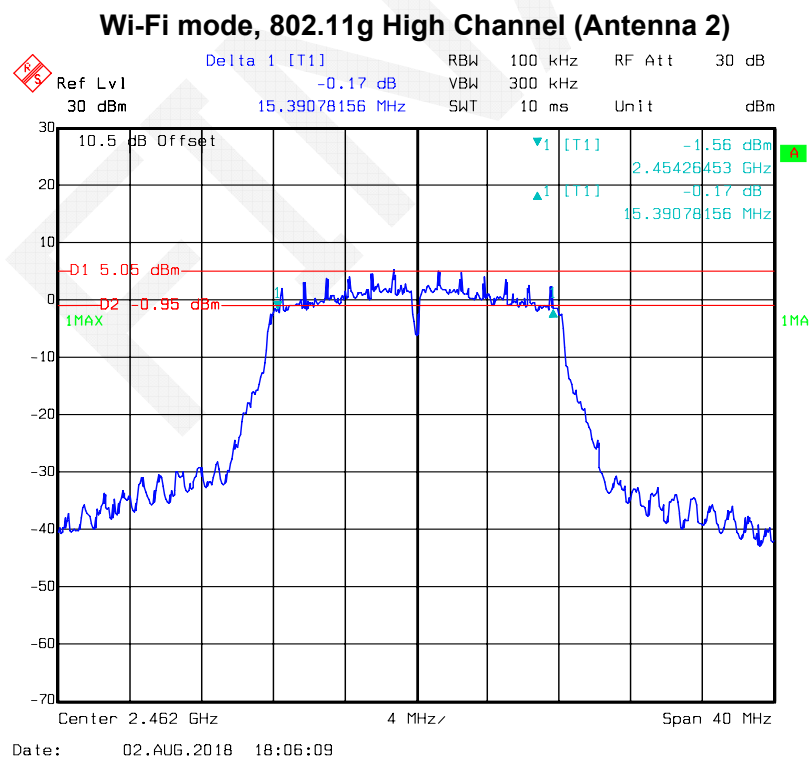
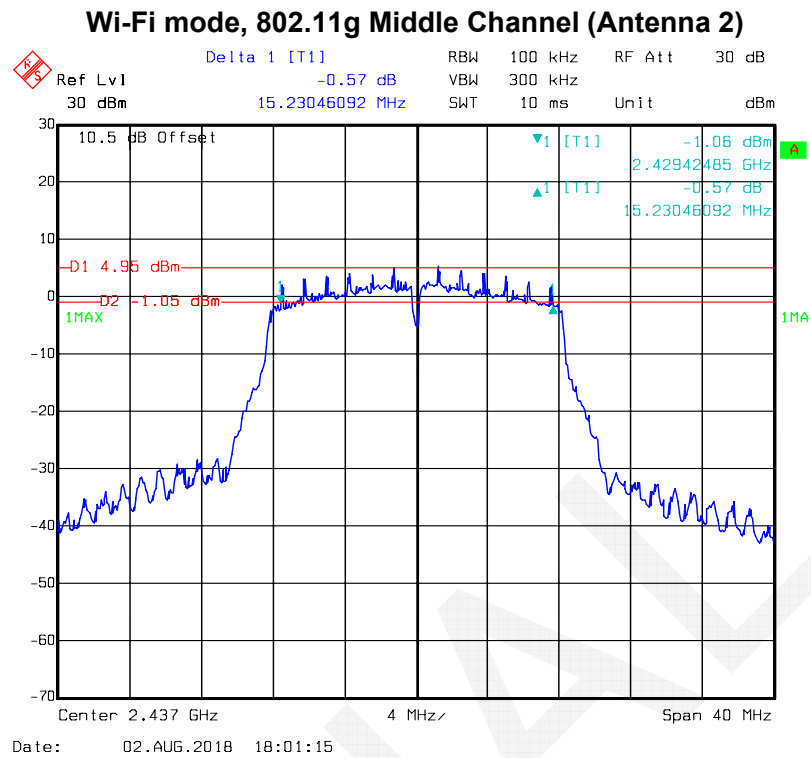


Wi-Fi mode, 802.11b Low Channel (Antenna 2)

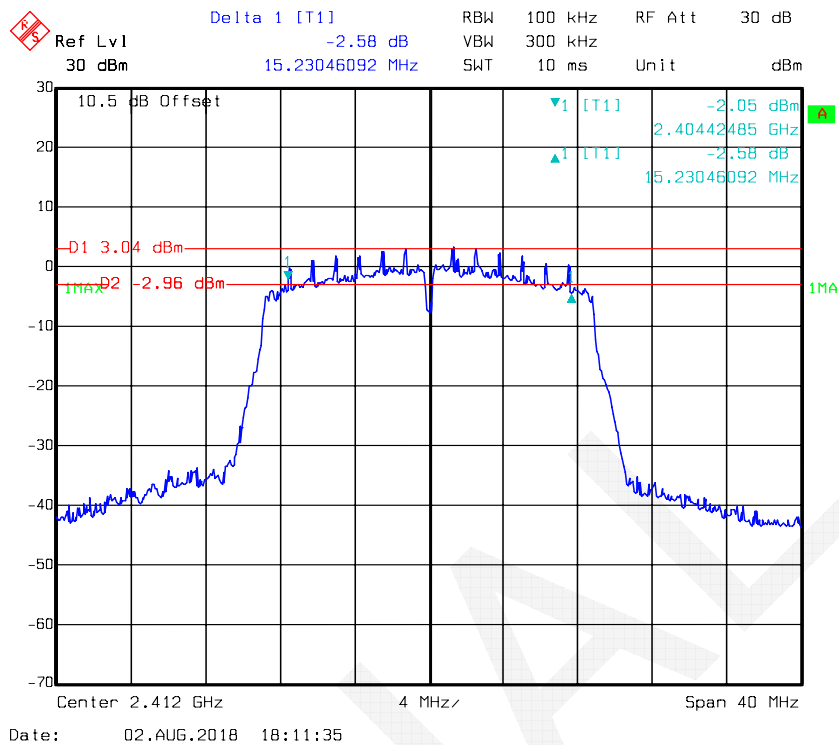


Wi-Fi mode, 802.11b Middle Channel (Antenna 2)

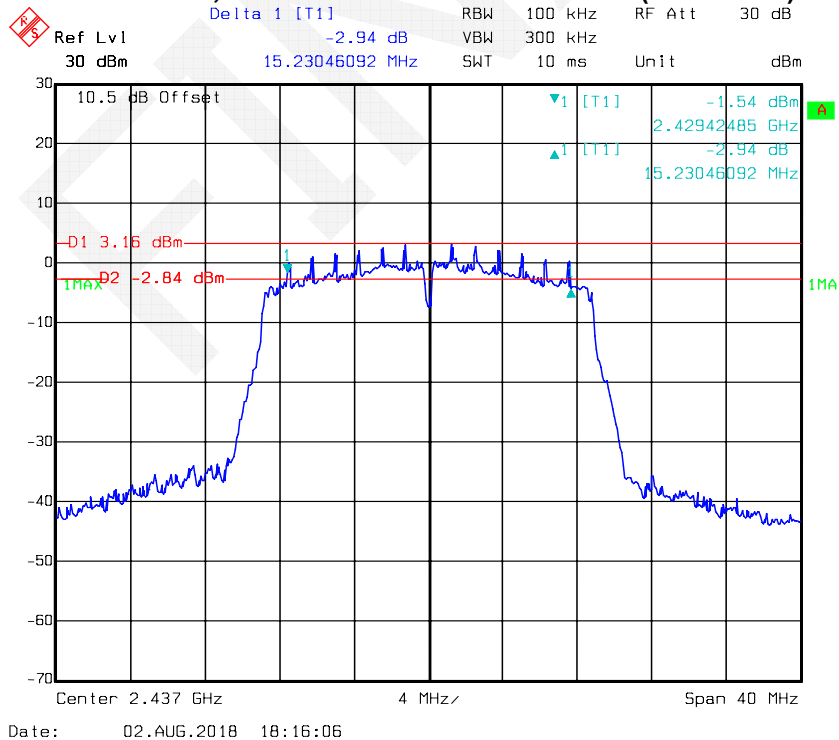




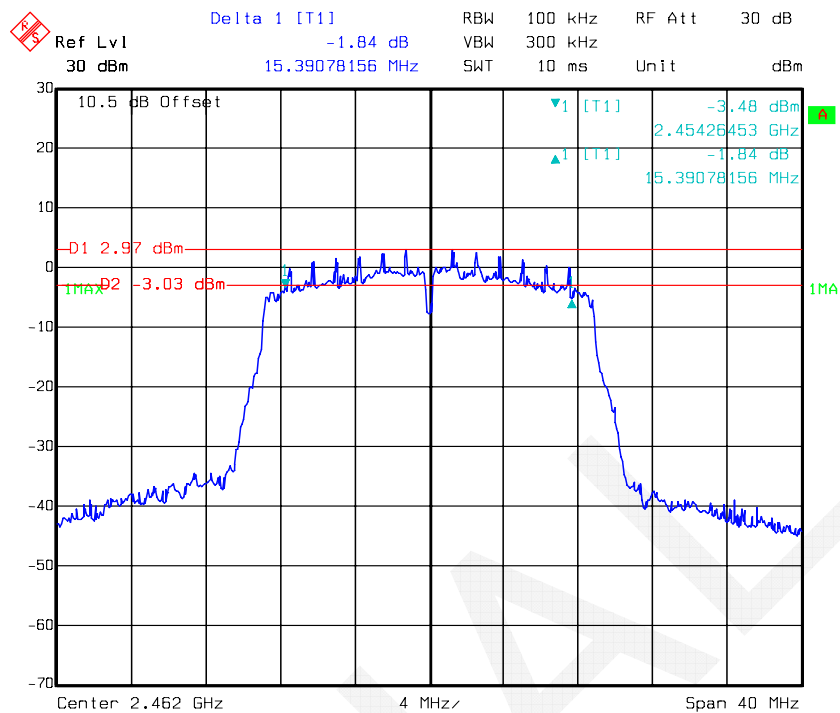
Wi-Fi mode, 802.11n-HT20 Low Channel (Antenna 2)



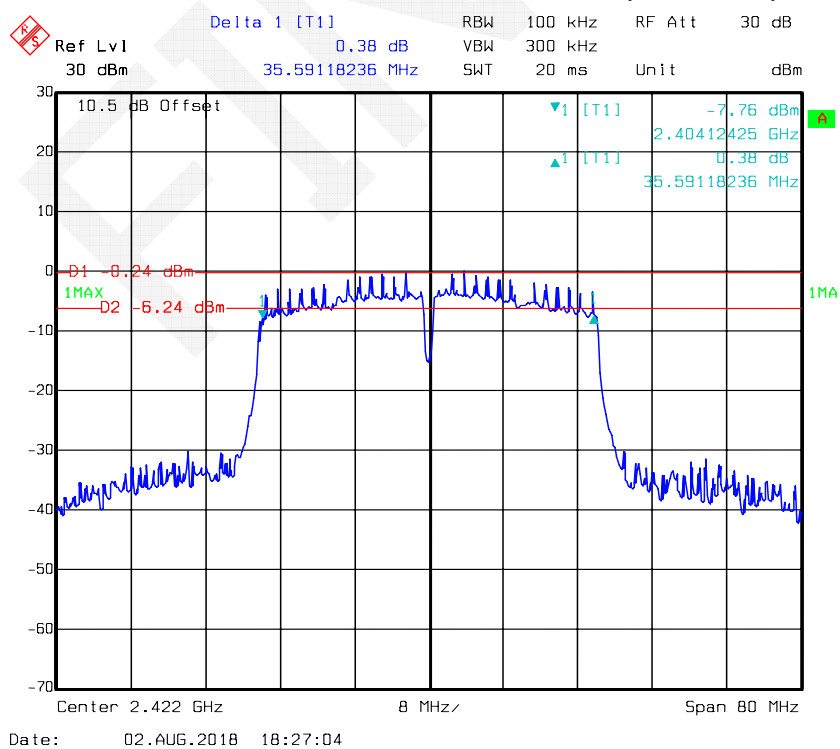
Wi-Fi mode, 802.11n-HT20 Middle Channel (Antenna 2)



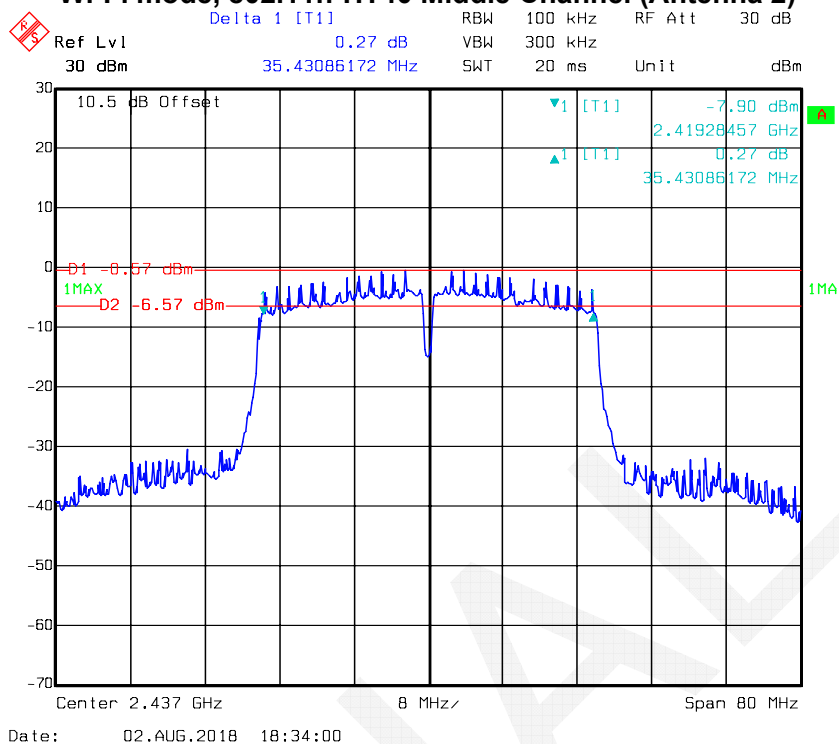
Wi-Fi mode, 802.11n-HT20 High Channel (Antenna 2)



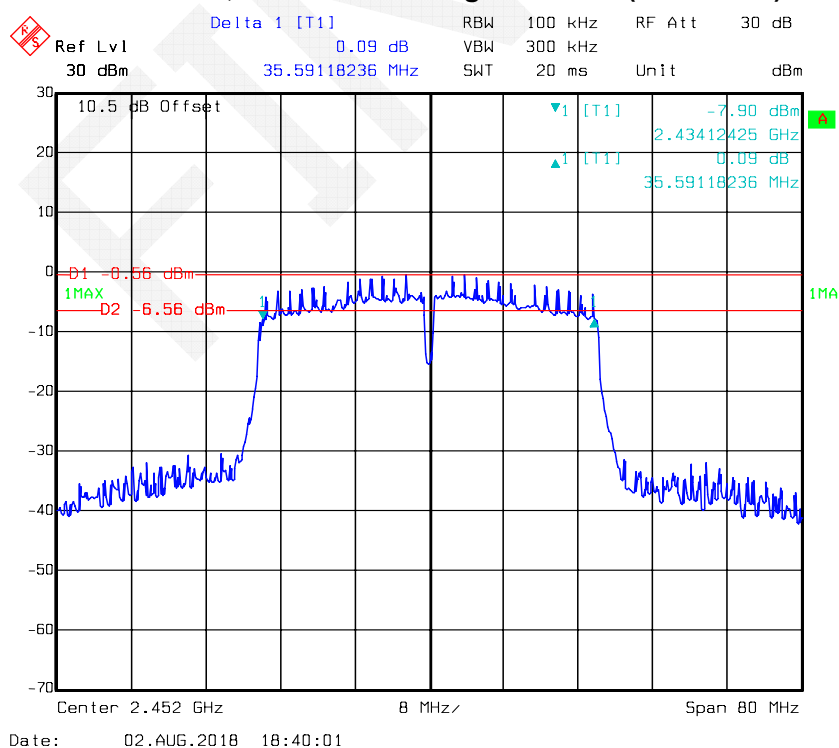
Wi-Fi mode, 802.11n-HT40 Low Channel (Antenna 2)



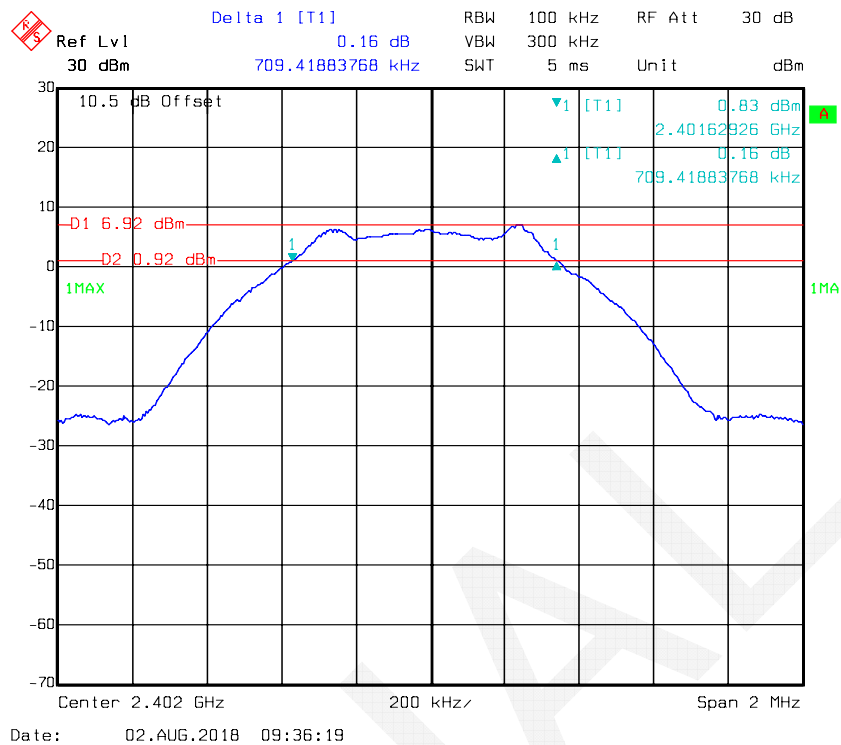
Wi-Fi mode, 802.11n-HT40 Middle Channel (Antenna 2)



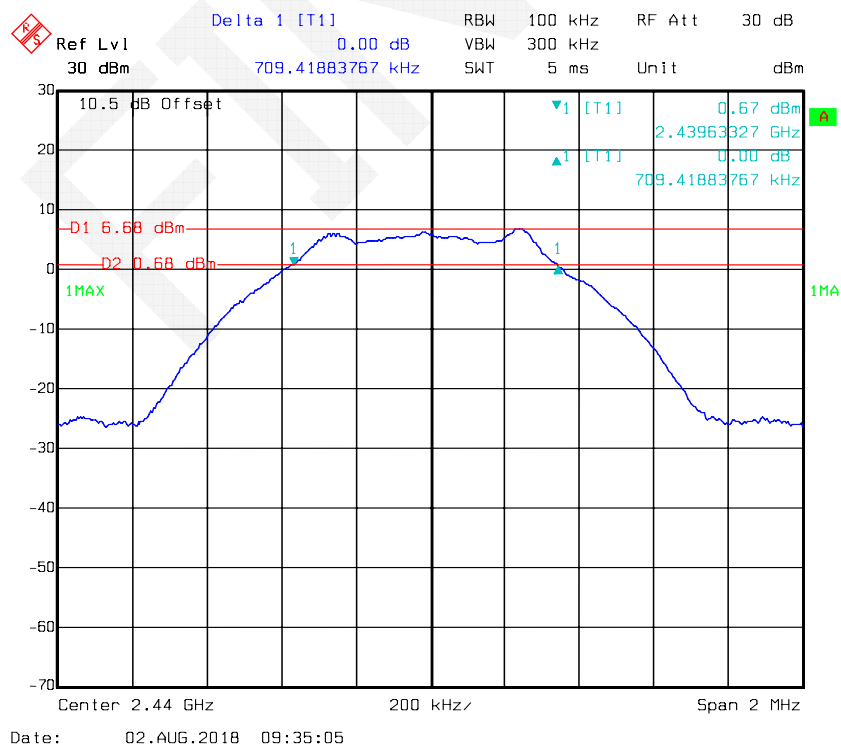
Wi-Fi mode, 802.11n-HT40 High Channel (Antenna 2)



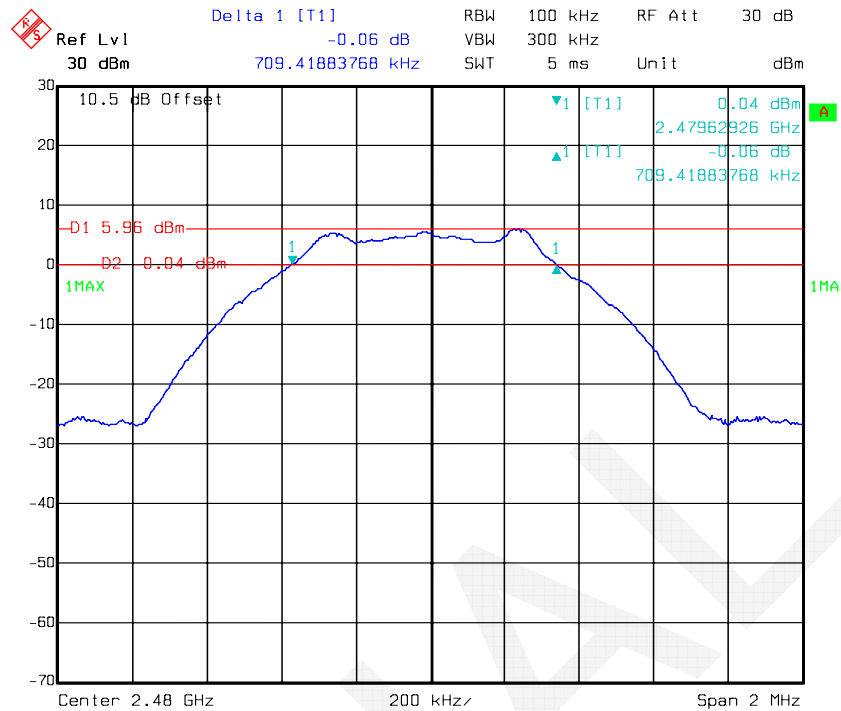
BLE mode, Low Channel



BLE mode, Middle Channel



BLE mode, High Channel



Date: 02.AUG.2018 09:38:35

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:	27 °C
Relative Humidity:	54 %
ATM Pressure:	94.8 kPa

* The testing was performed by Tom Tang on 2018-08-02.

Test Mode: Transmitting

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

Wi-Fi mode

Mode	Channel	Frequency (MHz)	Max Peak Conducted Output Power (dBm)		Total (dBm)	Limit (dBm)
			Antenna 1	Antenna 2		
802.11b	Low	2412	20.49	20.28	/	30
	Middle	2437	20.52	20.39	/	30
	High	2462	20.52	20.32	/	30
802.11g	Low	2412	23.82	23.56	/	30
	Middle	2437	23.50	23.26	/	30
	High	2462	23.42	23.36	/	30
802.11n-HT20	Low	2412	21.30	21.16	24.24	30
	Middle	2437	21.25	21.10	24.19	30
	High	2462	20.97	20.93	23.96	30
802.11n-HT40	Low	2422	20.64	20.78	23.72	30
	Middle	2437	20.49	20.58	23.55	30
	High	2452	20.54	20.55	23.56	30

Mode	Channel	Frequency (MHz)	Max Conducted Average Output Power (dBm)		Total (dBm)	Limit (dBm)
			Antenna 1	Antenna 2		
802.11b	Low	2412	17.54	17.06	/	30
	Middle	2437	17.32	17.04	/	30
	High	2462	17.19	17.18	/	30
802.11g	Low	2412	14.89	14.59	/	30
	Middle	2437	14.62	14.36	/	30
	High	2462	14.48	14.35	/	30
802.11n-HT20	Low	2412	12.36	12.12	15.25	30
	Middle	2437	12.32	12.08	15.21	30
	High	2462	12.03	11.88	14.97	30
802.11n-HT40	Low	2422	10.84	10.91	13.89	30
	Middle	2437	10.56	10.66	13.62	30
	High	2452	10.67	10.62	13.66	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:

So: Array Gain = 0 dB (i.e., no array gain) for $N_{ANT} \leq 4$;
 Directional gain = $G_{ANT} + \text{Array Gain} = 3.2 \text{ dBi} < 6.0 \text{ dBi}$.
 No power limit was reduced in MIMO mode.

BLE mode

Mode	Channel	Frequency (MHz)	Max Peak Conducted Output Power (dBm)	Limit (dBm)
BLE	Low	2402	7.10	30
	Middle	2440	6.86	30
	High	2480	6.10	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:	27 °C
Relative Humidity:	54 %
ATM Pressure:	94.8 kPa

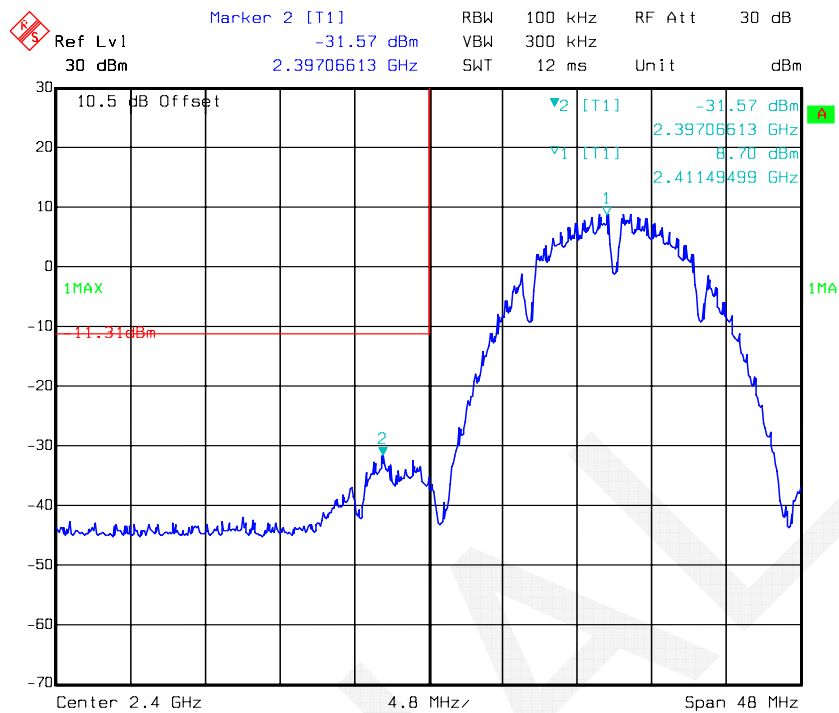
** The testing was performed by Tom Tang on 2018-08-02.*

Test mode: Transmitting

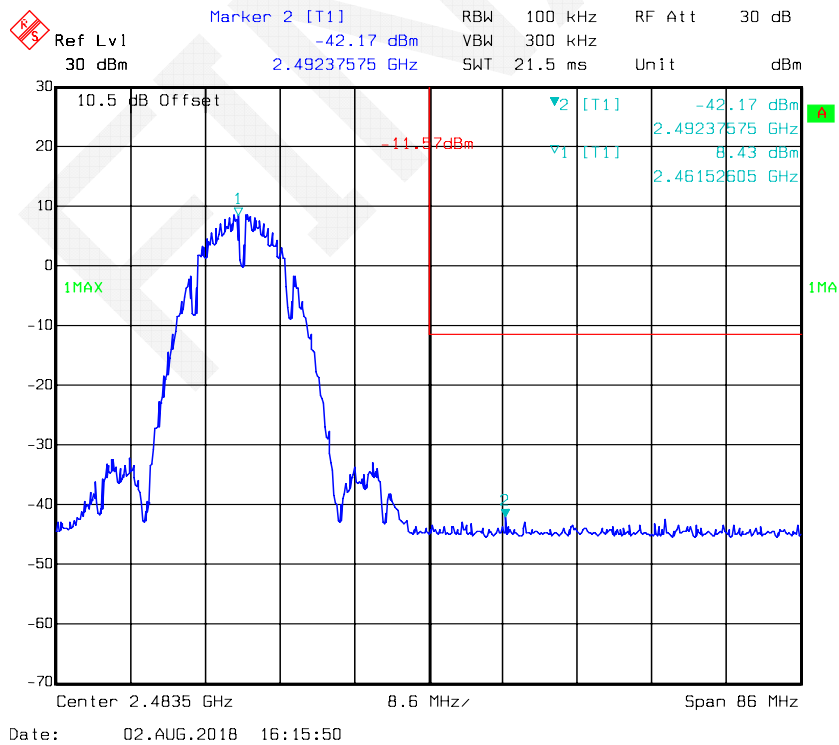
Test Result: Compliance. Please refer to following plots.

Wi-Fi mode

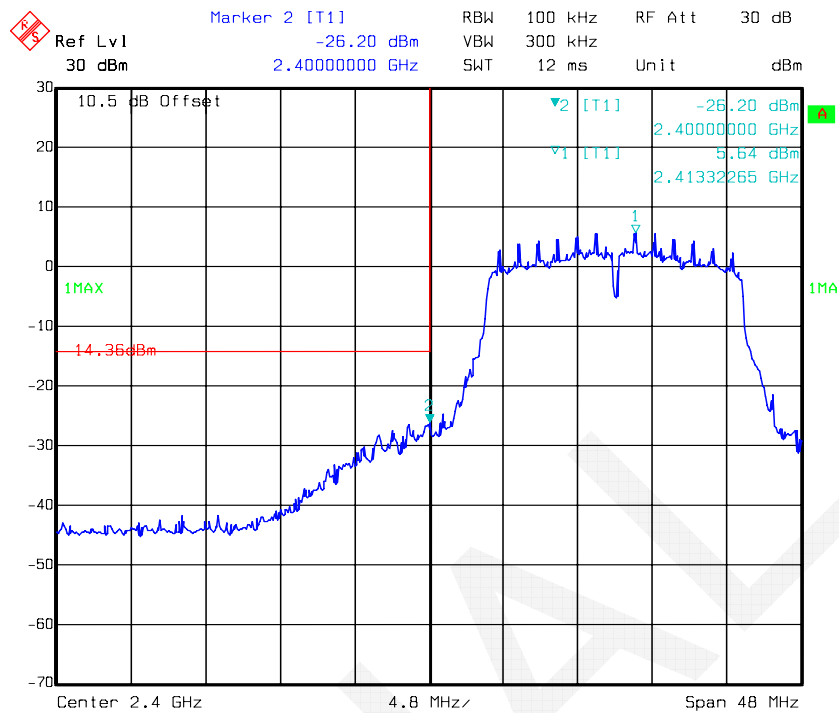
802.11b: Band Edge, Left Side (Antenna 1)



802.11b: Band Edge, Right Side (Antenna 1)

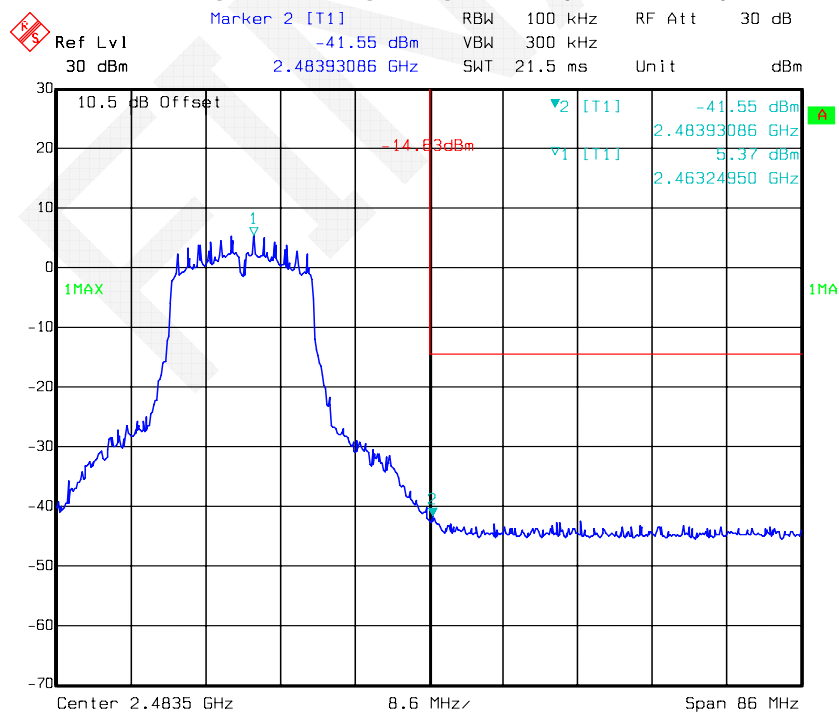


802.11g: Band Edge, Left Side (Antenna 1)



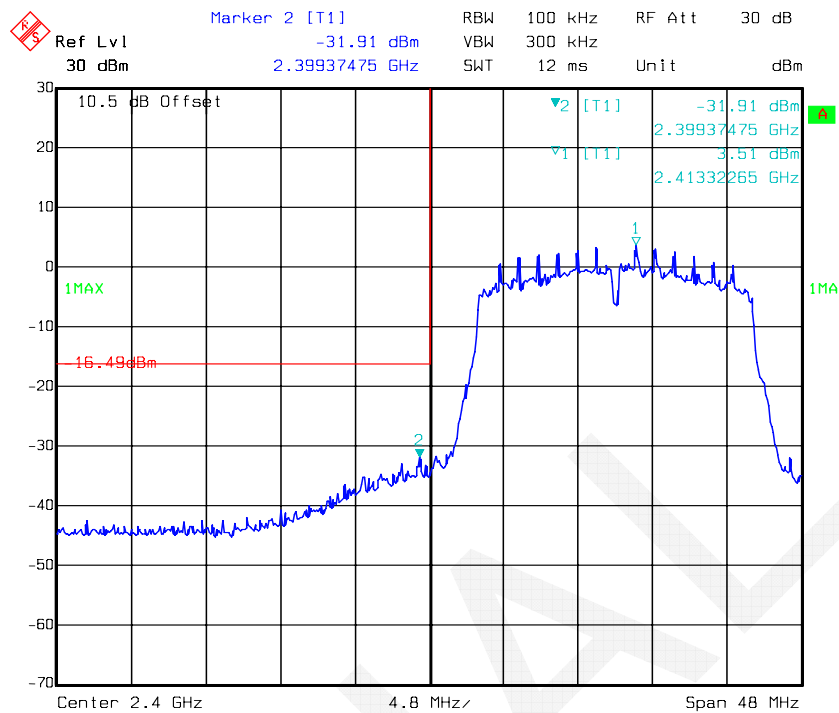
Date: 02.AUG.2018 16:21:06

802.11g: Band Edge, Right Side (Antenna 1)

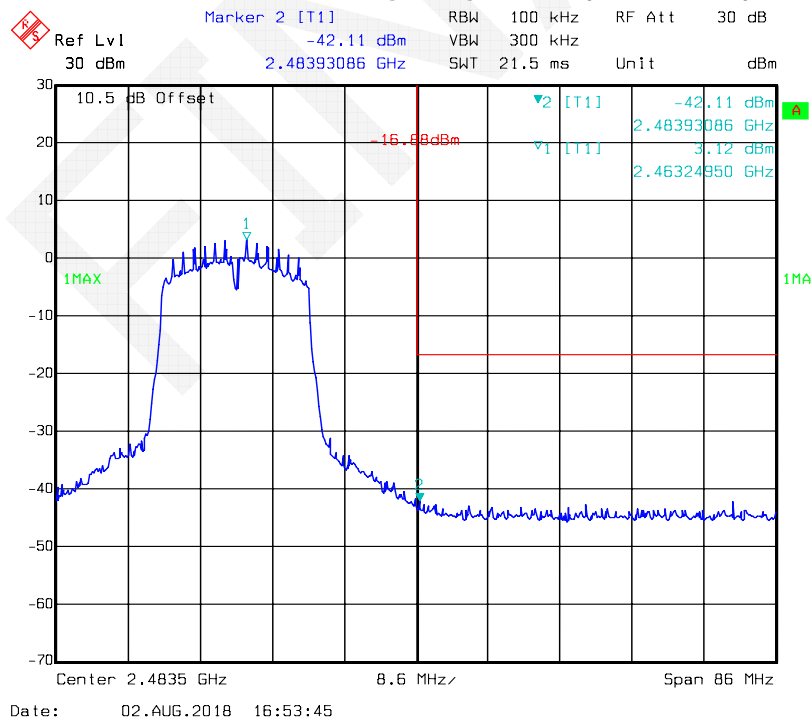


Date: 02.AUG.2018 16:30:04

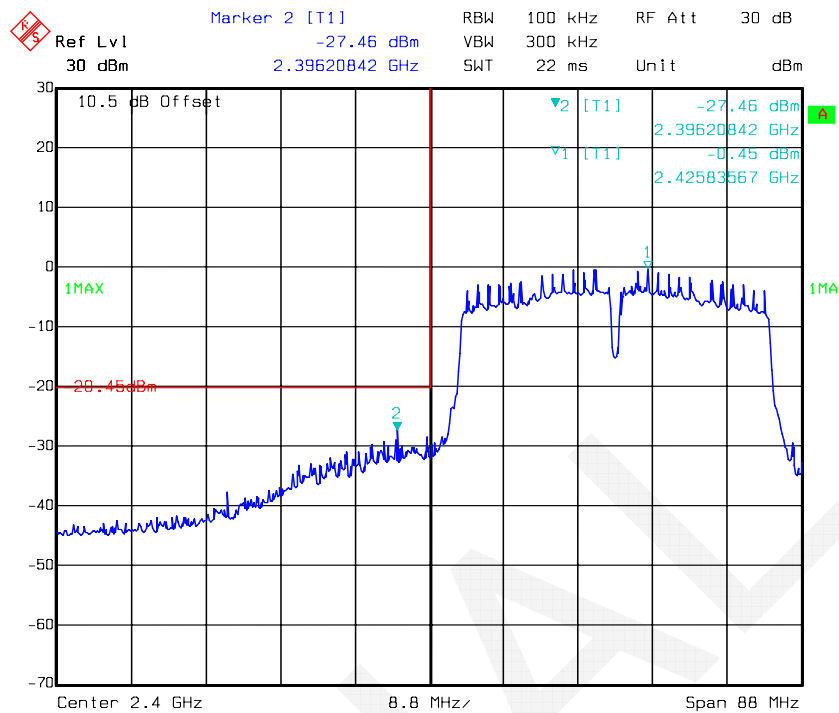
802.11n-HT20 Band Edge, Left Side (Antenna 1)



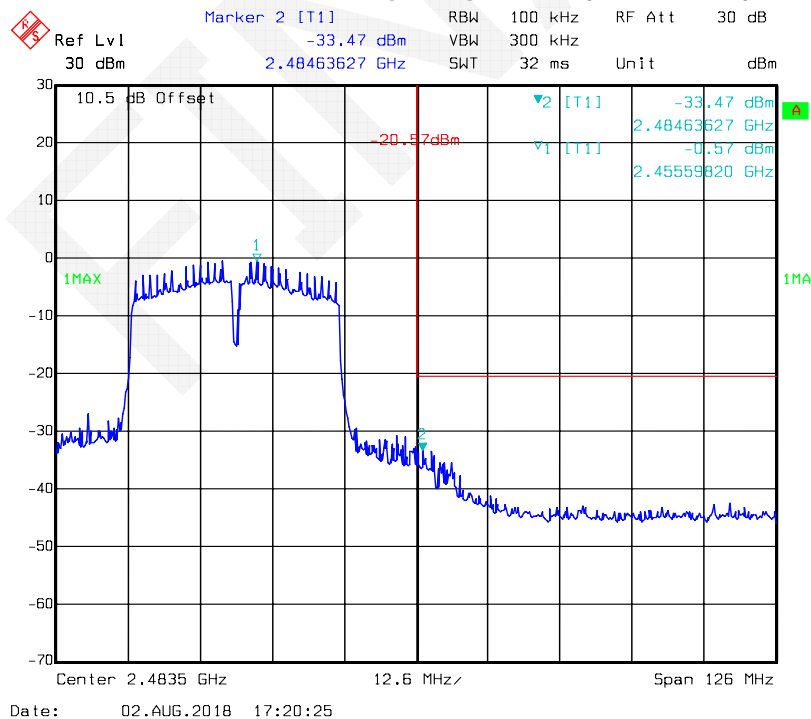
802.11n-HT20 Band Edge, Right Side (Antenna 1)



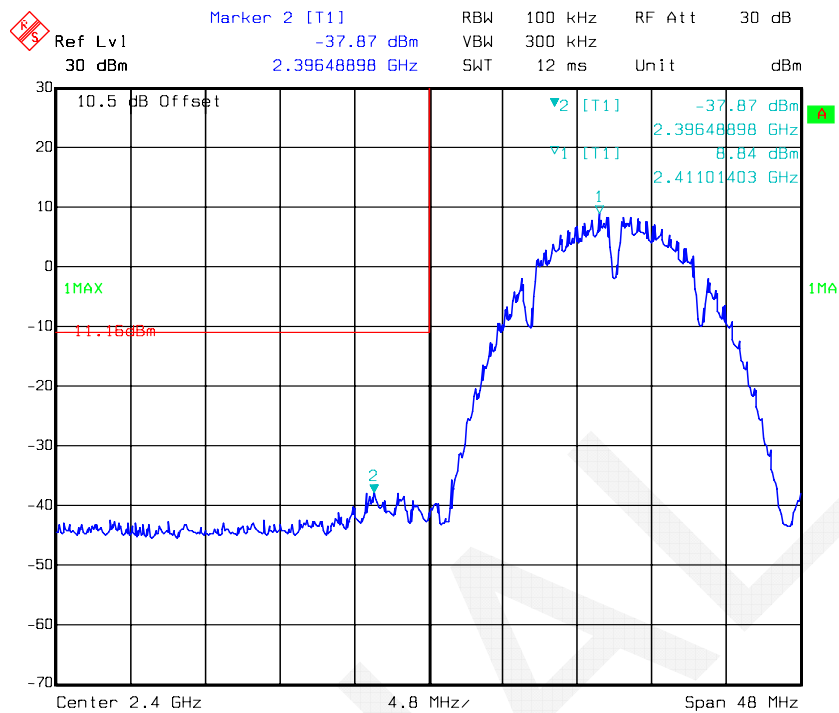
802.11n-HT40 Band Edge, Left Side (Antenna 1)



802.11n-HT40 Band Edge, Right Side (Antenna 1)

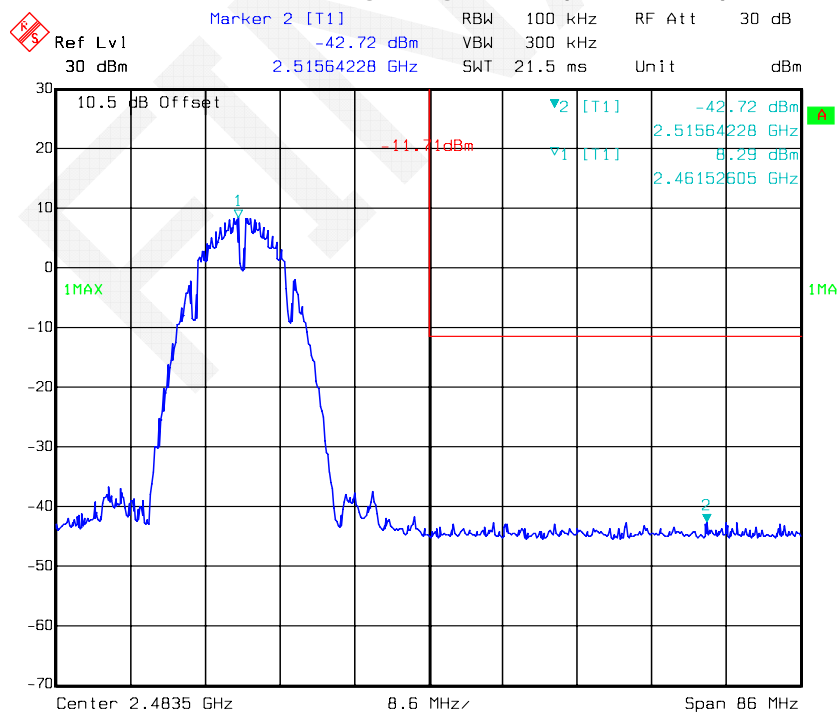


802.11b: Band Edge, Left Side (Antenna 2)



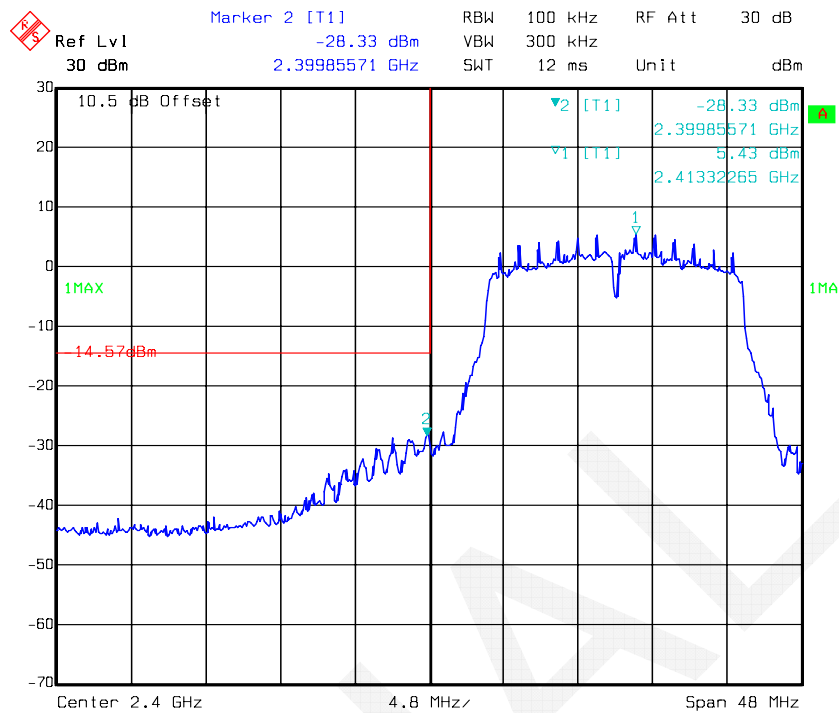
Date: 02.AUG.2018 17:51:22

802.11b: Band Edge, Right Side (Antenna 2)



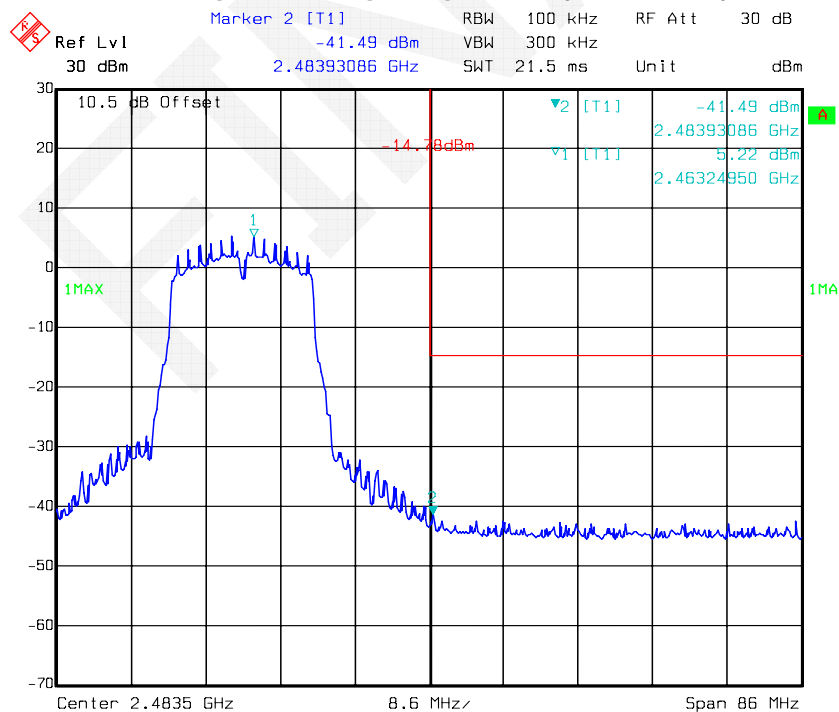
Date: 02.AUG.2018 17:54:58

802.11g: Band Edge, Left Side (Antenna 2)



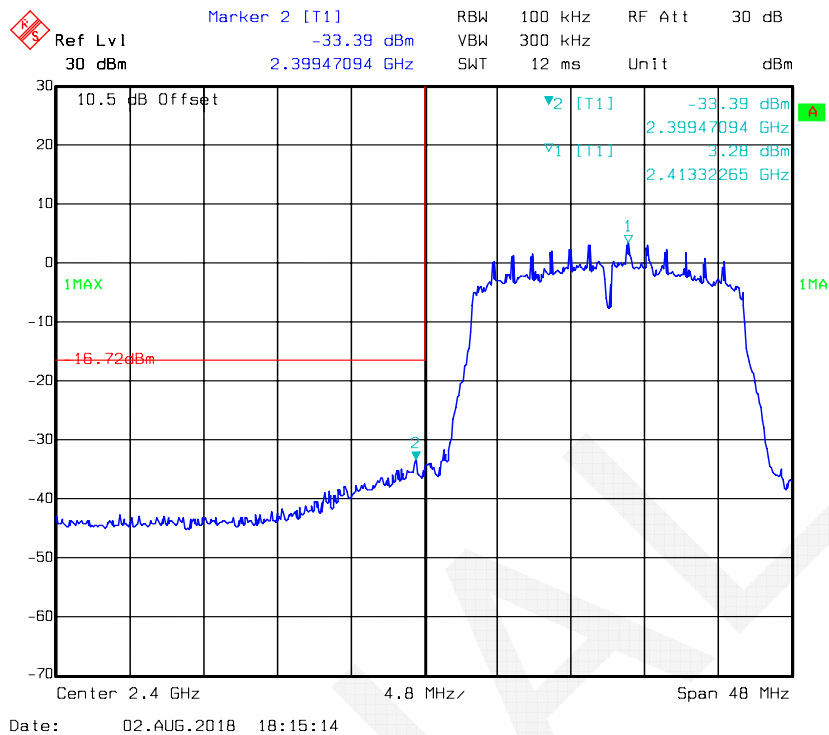
Date: 02.AUG.2018 17:57:25

802.11g: Band Edge, Right Side (Antenna 2)

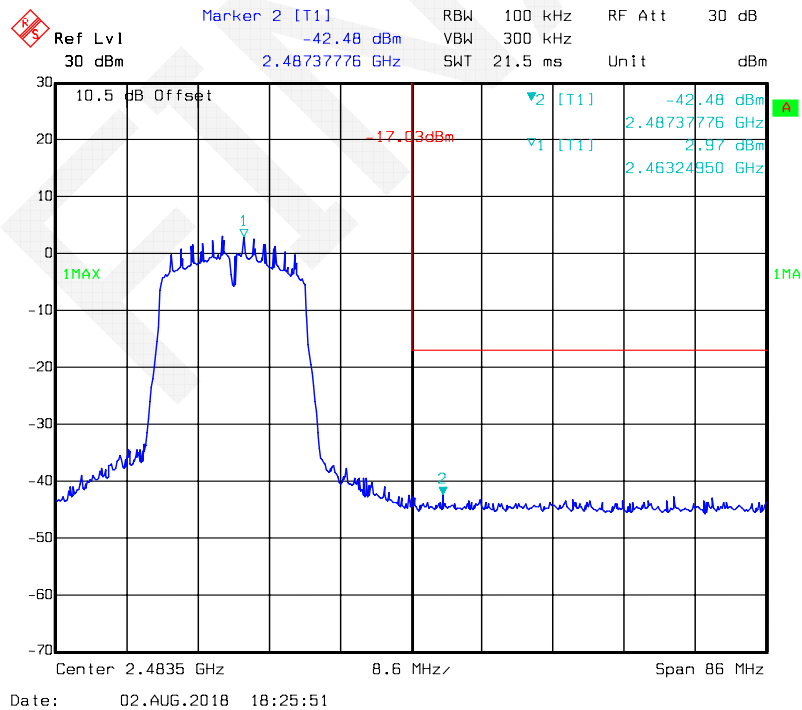


Date: 02.AUG.2018 18:09:42

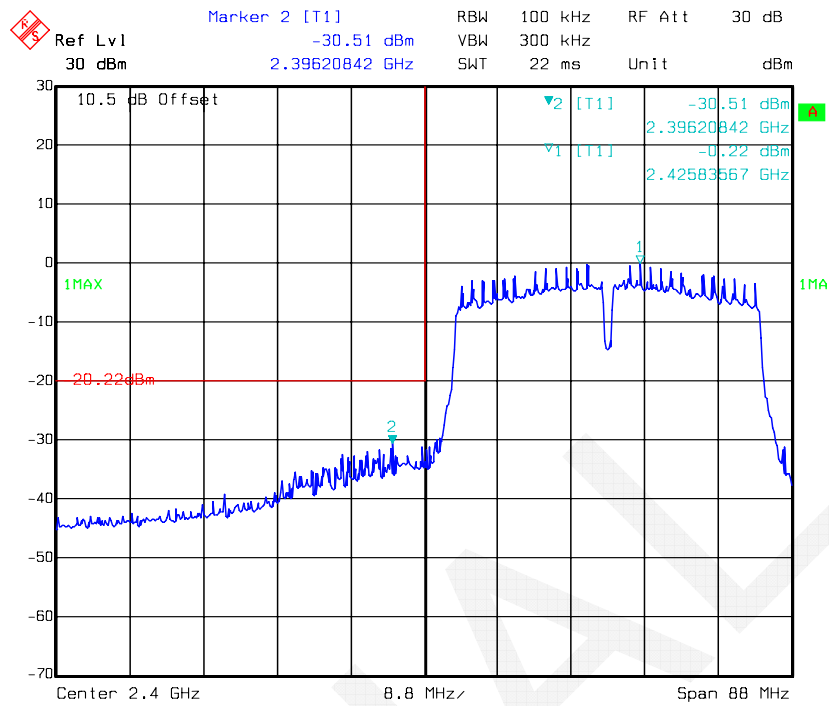
802.11n-HT20 Band Edge, Left Side (Antenna 2)



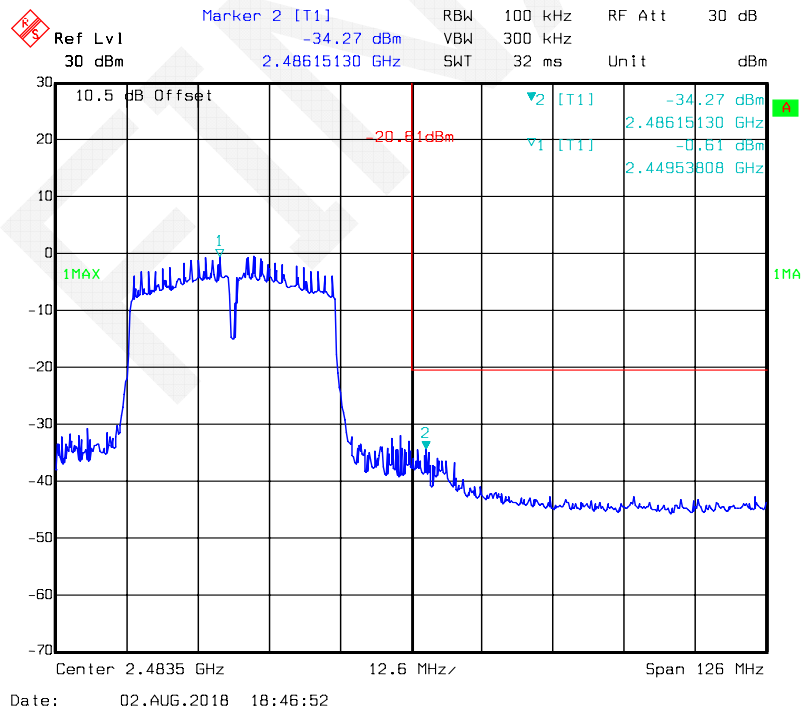
802.11n-HT20 Band Edge, Right Side (Antenna 2)



802.11n-HT40 Band Edge, Left Side (Antenna 2)

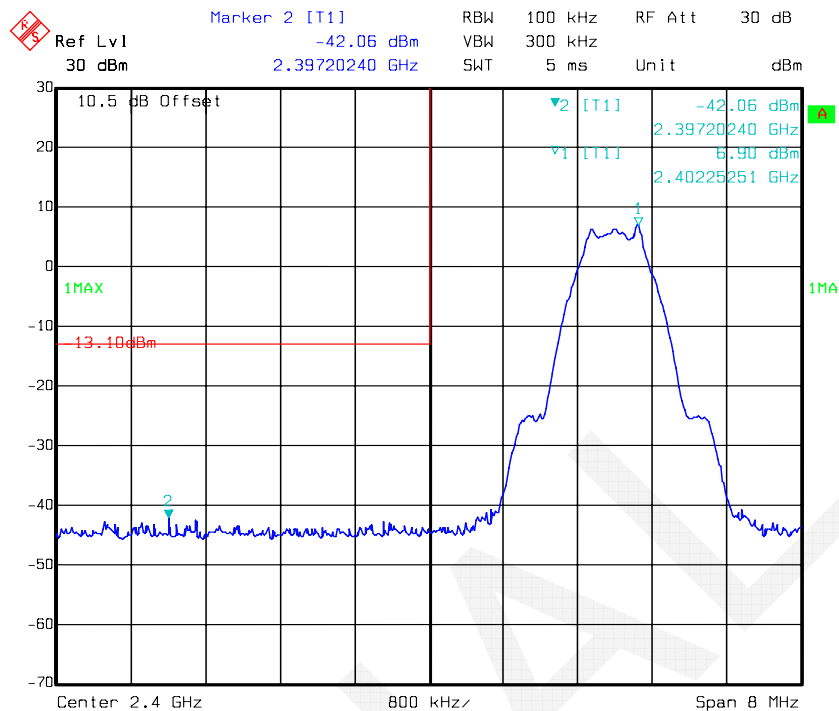


802.11n-HT40 Band Edge, Right Side (Antenna 2)



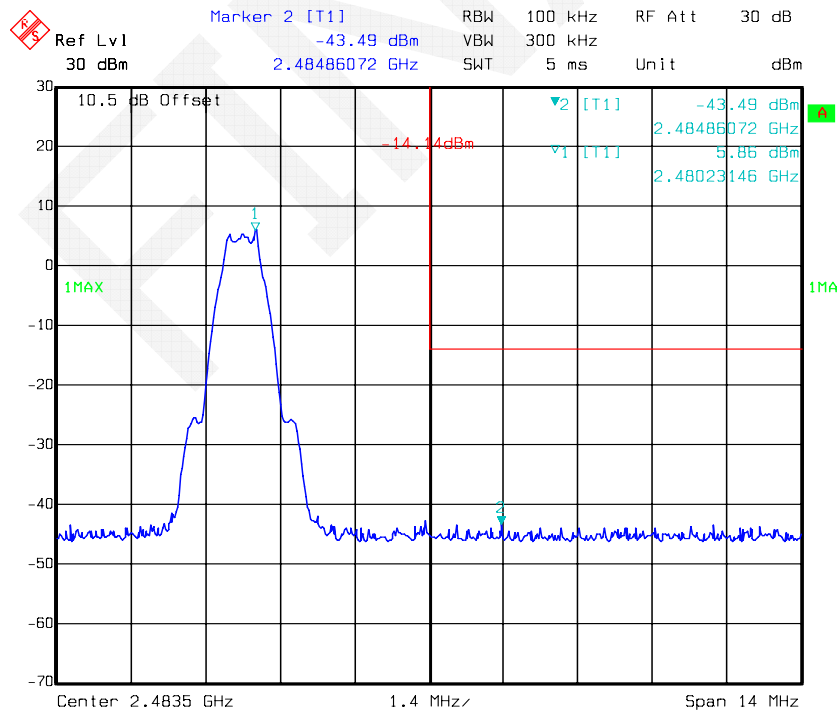
BLE mode

Band Edge, Left Side



Date: 02.AUG.2018 09:37:18

Band Edge, Right Side



Date: 02.AUG.2018 09:39:37

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: $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$.
- d) Set the VBW $\geq 3 \times \text{RBW}$.
- e) Detector = peak.
- f) Sweep time = auto couple.
- g) Trace mode = max hold.
- h) Allow trace to fully stabilize.
- i) Use the peak marker function to determine the maximum amplitude level within the RBW.
- j) If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

Test Data

Environmental Conditions

Temperature:	27 °C
Relative Humidity:	54 %
ATM Pressure:	94.8 kPa

** The testing was performed by Tom Tang on 2018-08-02.*

Test Mode: Transmitting

Test Result: Compliance. Please refer to the following table and plots

Wi-Fi mode

Mode	Channel	Frequency (MHz)	Power Spectral Density (dBm/3kHz)		Total (dBm/3kHz)	Limit (dBm/3kHz)
			Antenna 1	Antenna 2		
802.11b	Low	2412	-6.54	-7.16	/	8
	Middle	2437	-7.18	-7.75	/	8
	High	2462	-7.69	-7.51	/	8
802.11g	Low	2412	-8.71	-9.60	/	8
	Middle	2437	-8.76	-8.28	/	8
	High	2462	-8.83	-9.26	/	8
802.11n-HT20	Low	2412	-10.63	-10.14	-7.37	7.8
	Middle	2437	-10.48	-11.22	-7.82	7.8
	High	2462	-10.61	-10.27	-7.43	7.8
802.11n-HT40	Low	2422	-14.74	-14.53	-11.62	7.8
	Middle	2437	-15.76	-15.61	-12.67	7.8
	High	2452	-15.56	-15.19	-12.36	7.8

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 = $10 \log(N_{\text{ANT}}/N_{\text{SS}})$ dB.

So:

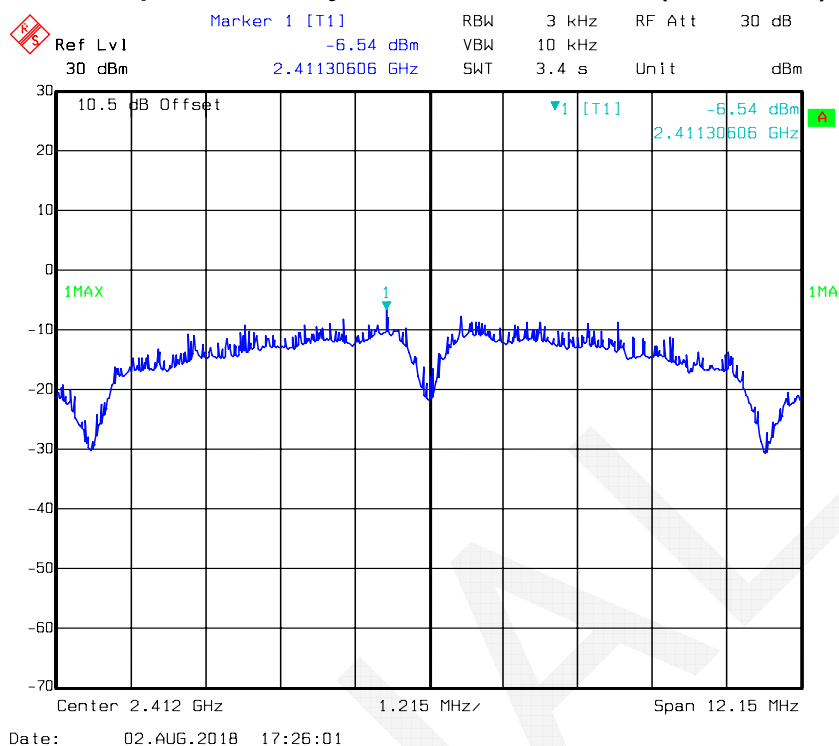
Directional gain = GANT + Array Gain = $3.2 + 10 \log(2) = 6.2 \text{ dBi} > 6 \text{ dBi}$
 Power density Limit was reduced 0.2dB in MIMO mode.

BLE mode

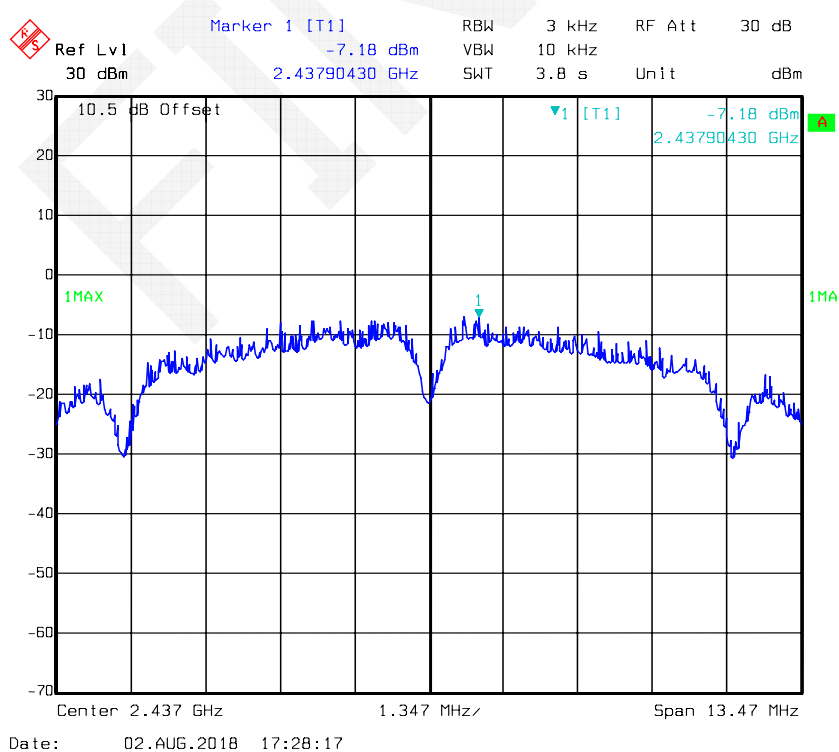
Mode	Channel	Frequency (MHz)	Power Spectral Density (dBm/3kHz)	Limit (dBm/3kHz)
BLE	Low	2402	-8.97	8
	Middle	2440	-9.08	8
	High	2480	-9.91	8

Wi-Fi mode

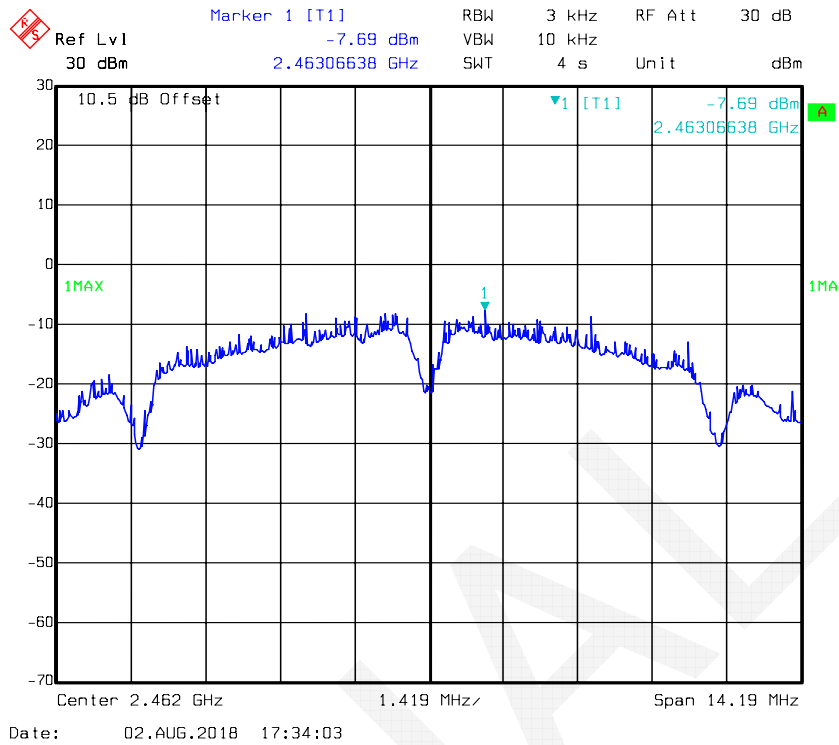
Power Spectral Density, 802.11b Low Channel (Antenna 1)



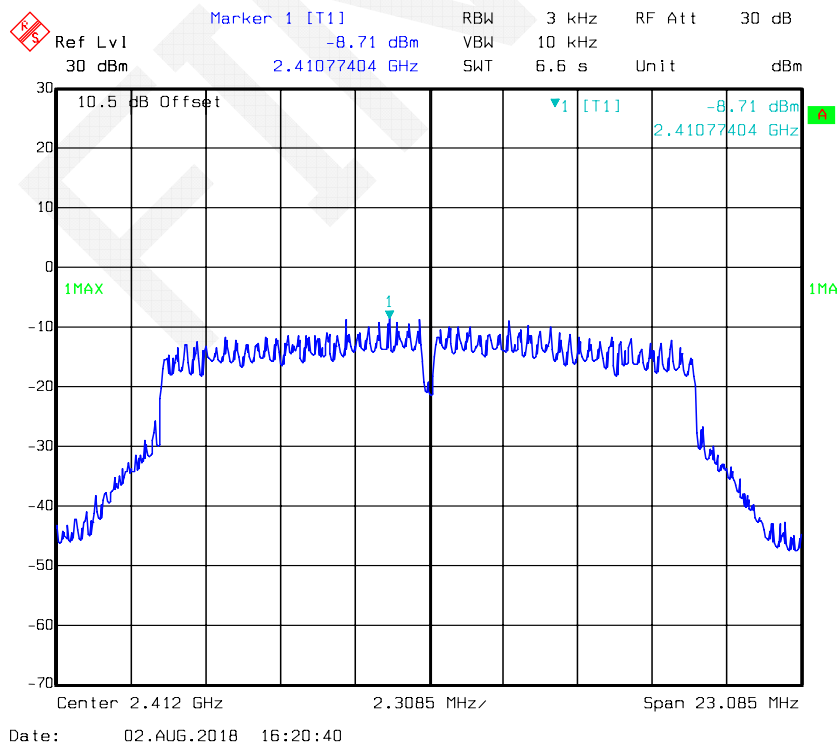
Power Spectral Density, 802.11b Middle Channel (Antenna 1)



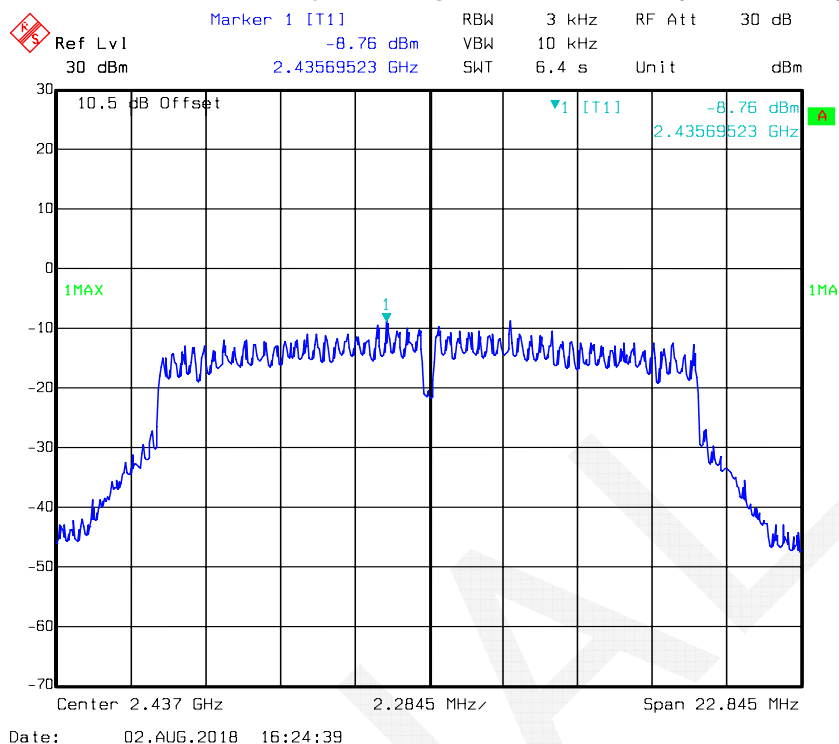
Power Spectral Density, 802.11b High Channel (Antenna 1)



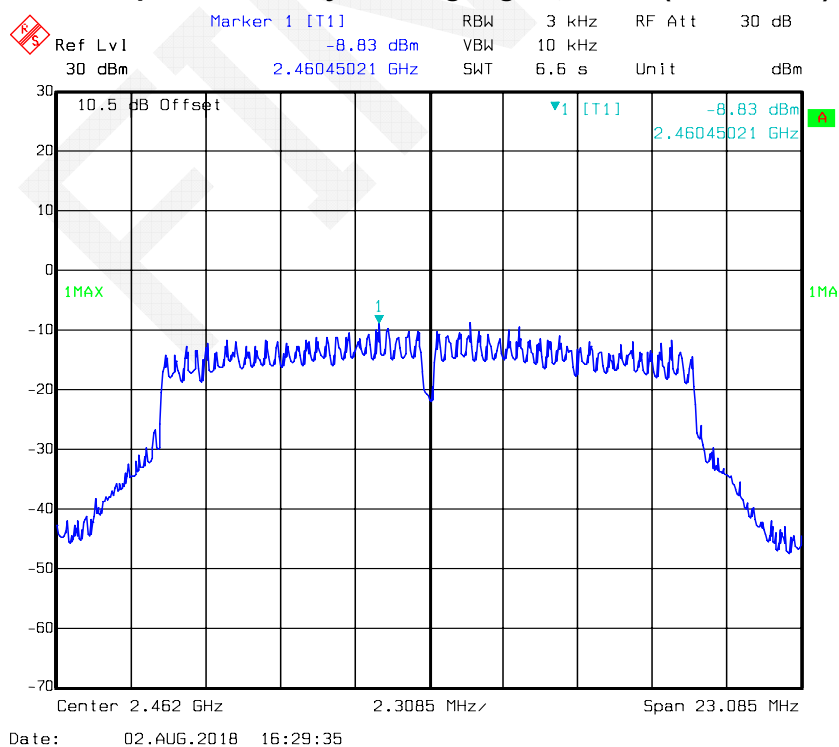
Power Spectral Density, 802.11g Low Channel (Antenna 1)



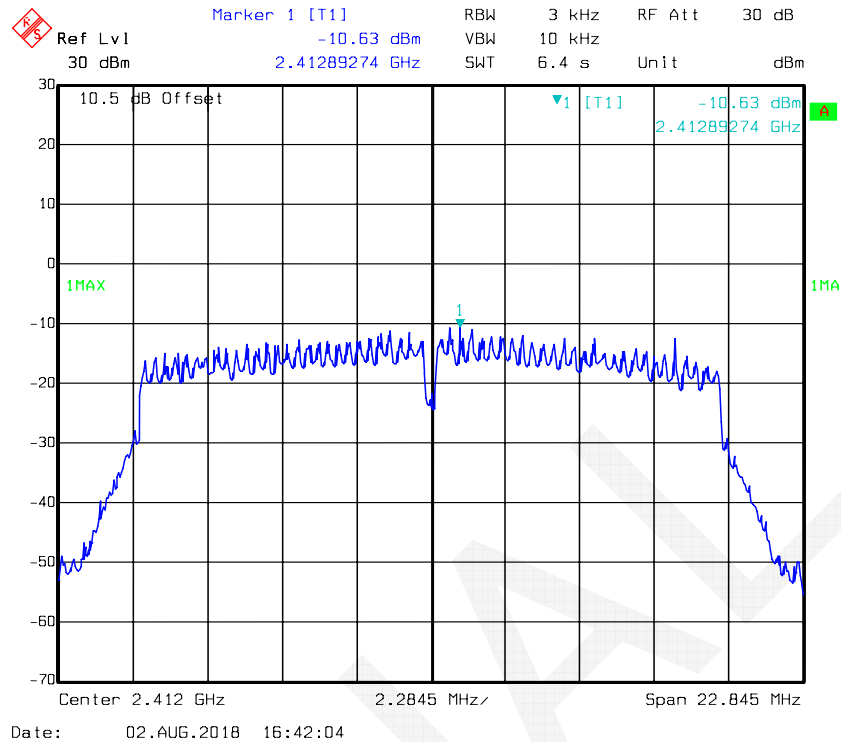
Power Spectral Density, 802.11g Middle Channel (Antenna 1)



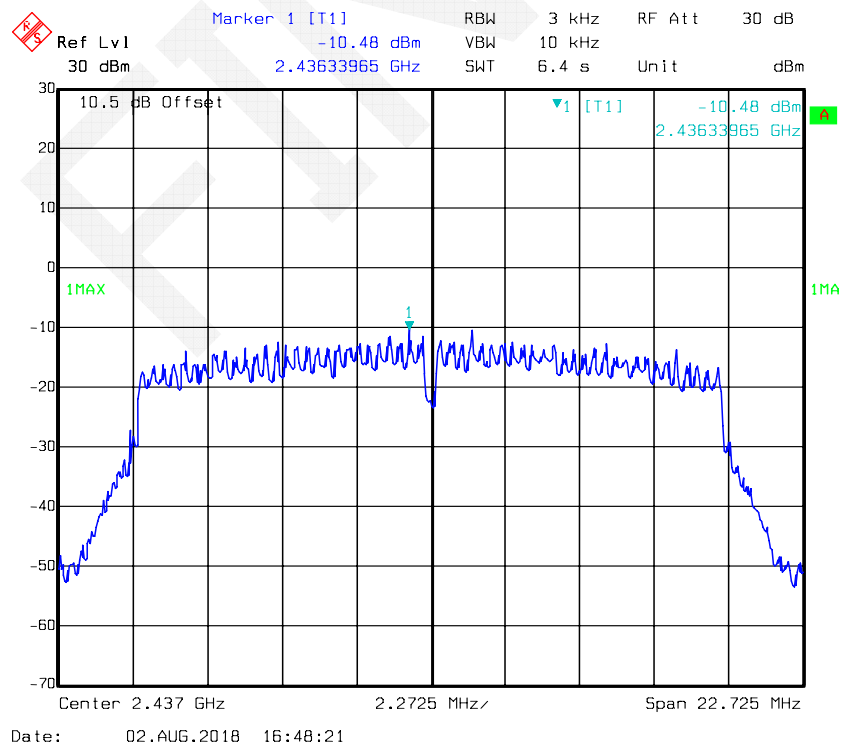
Power Spectral Density, 802.11g High Channel (Antenna 1)



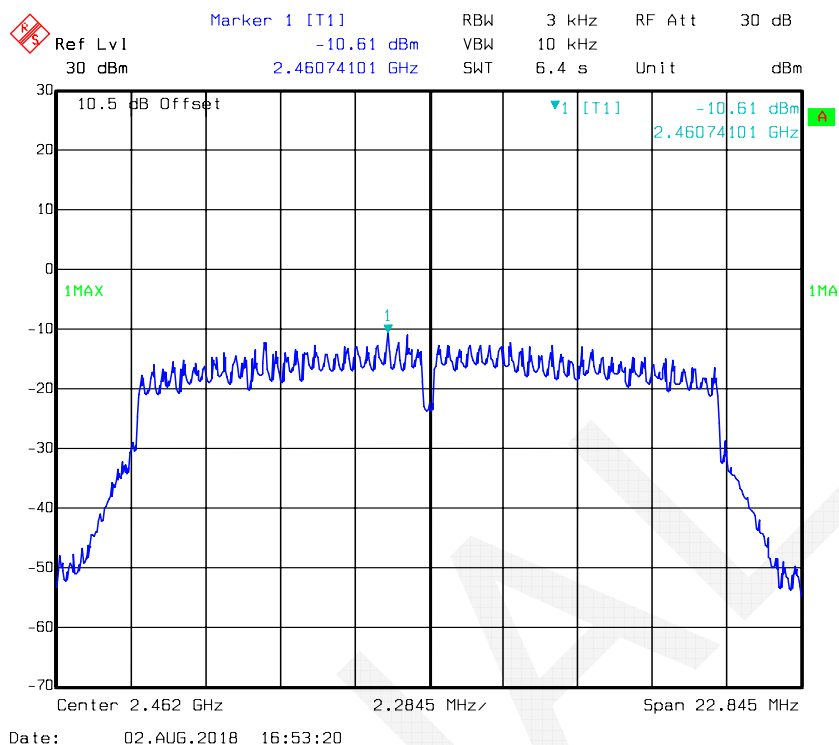
Power Spectral Density, 802.11n-HT20 Low Channel (Antenna 1)



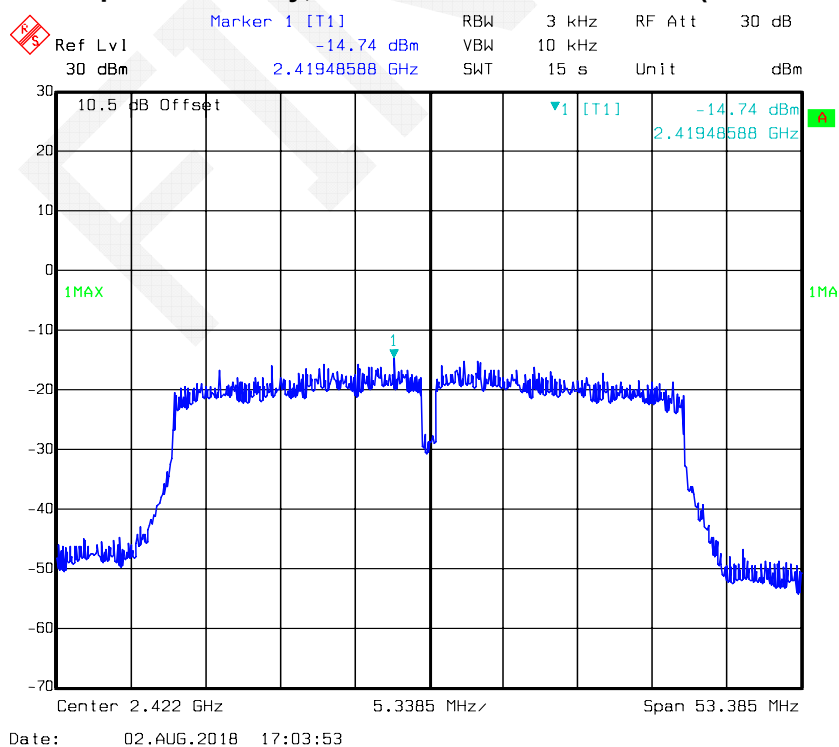
Power Spectral Density, 802.11n-HT20 Middle Channel (Antenna 1)



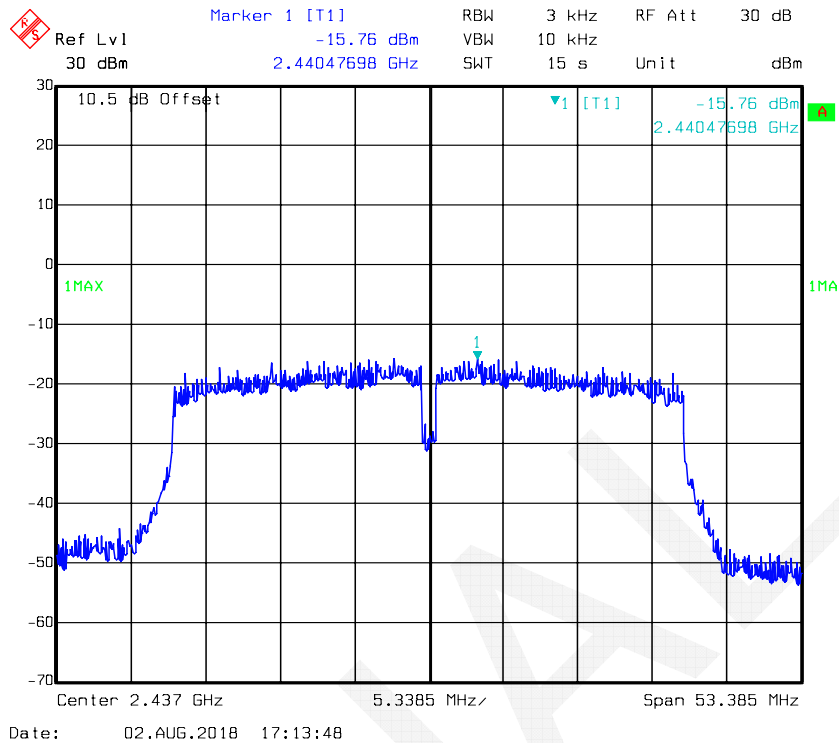
Power Spectral Density, 802.11n-HT20 High Channel (Antenna 1)



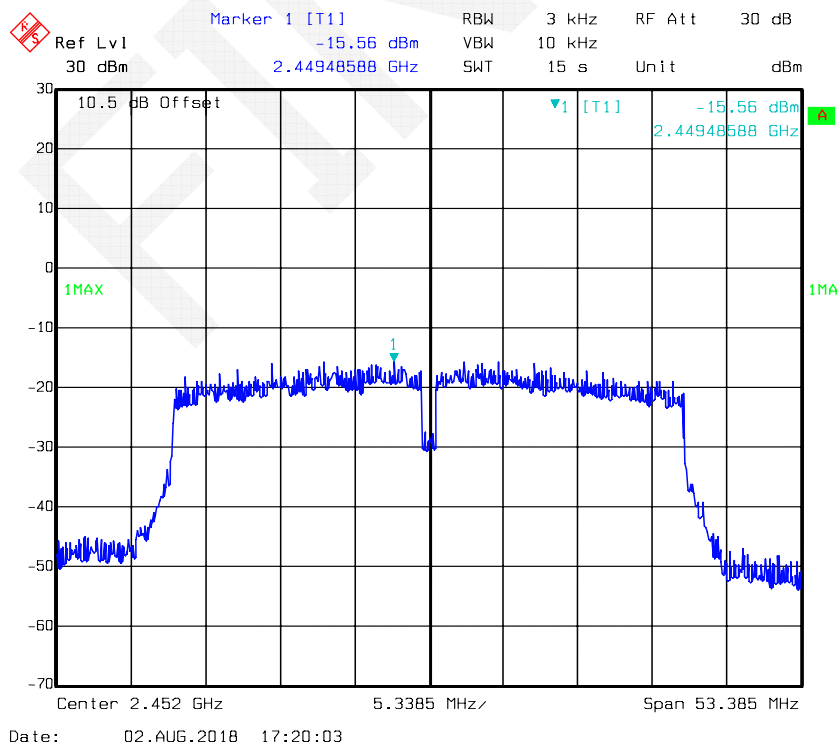
Power Spectral Density, 802.11n-HT40 Low Channel (Antenna 1)



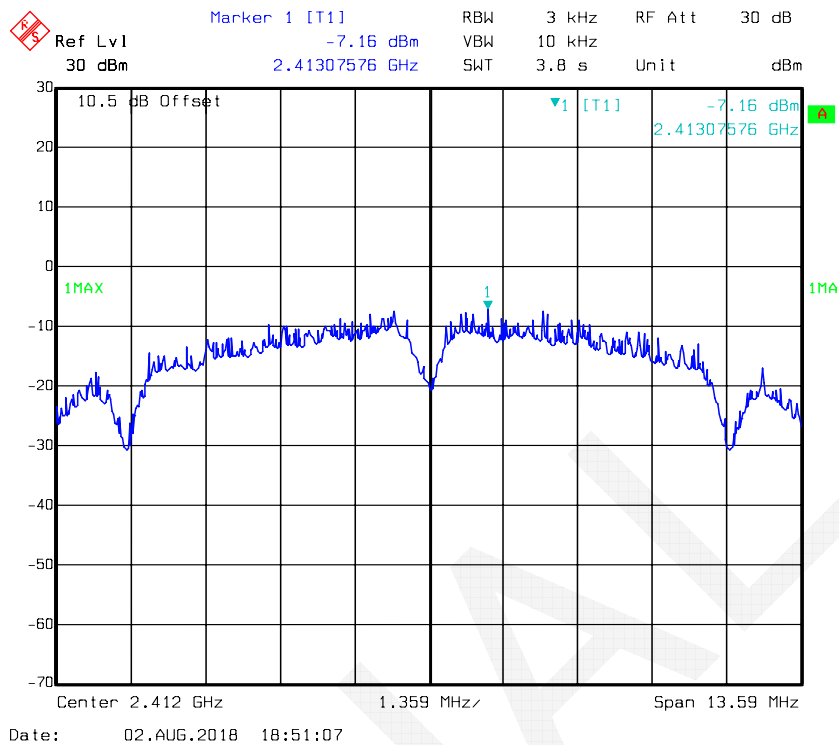
Power Spectral Density, 802.11n-HT40 Middle Channel (Antenna 1)



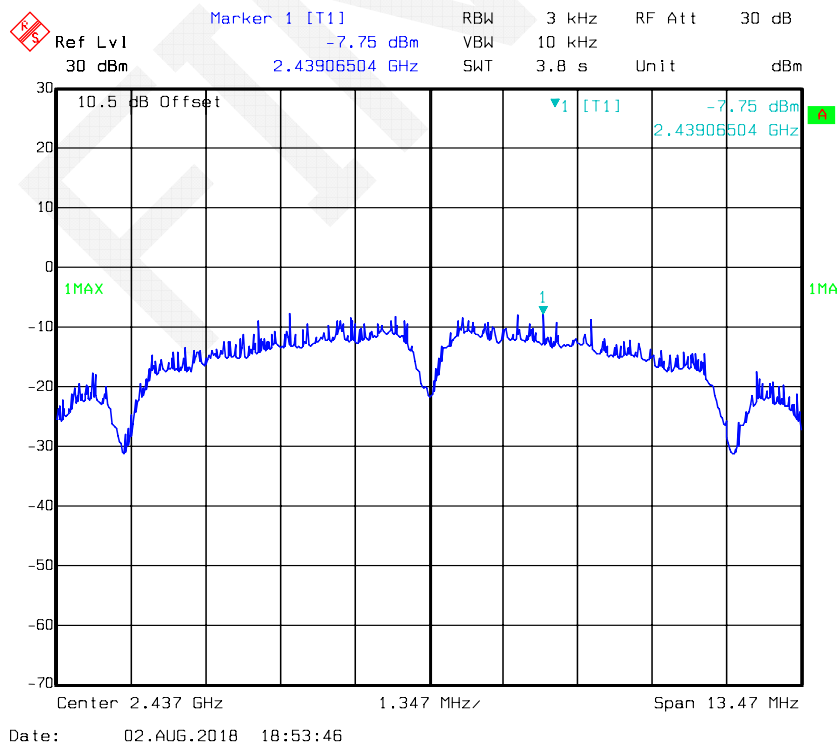
Power Spectral Density, 802.11n-HT40 High Channel (Antenna 1)



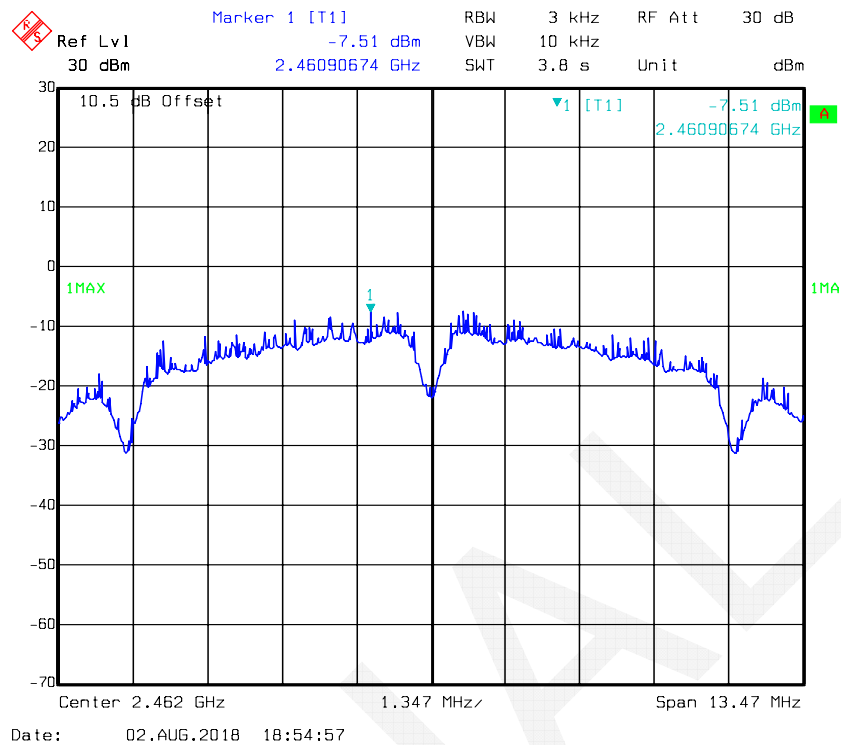
Power Spectral Density, 802.11b Low Channel (Antenna 2)



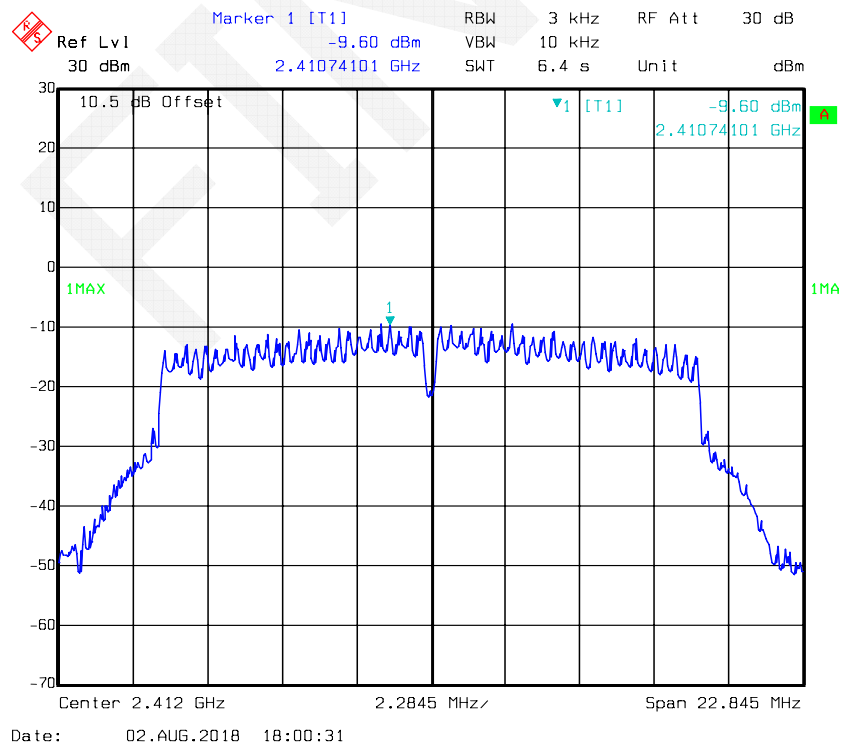
Power Spectral Density, 802.11b Middle Channel (Antenna 2)



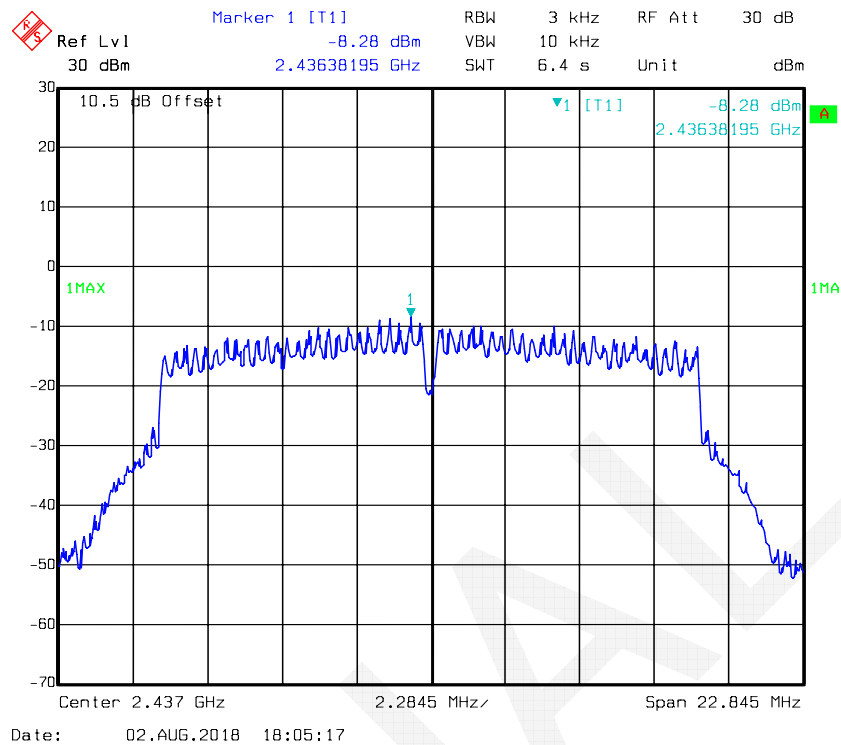
Power Spectral Density, 802.11b High Channel (Antenna 2)



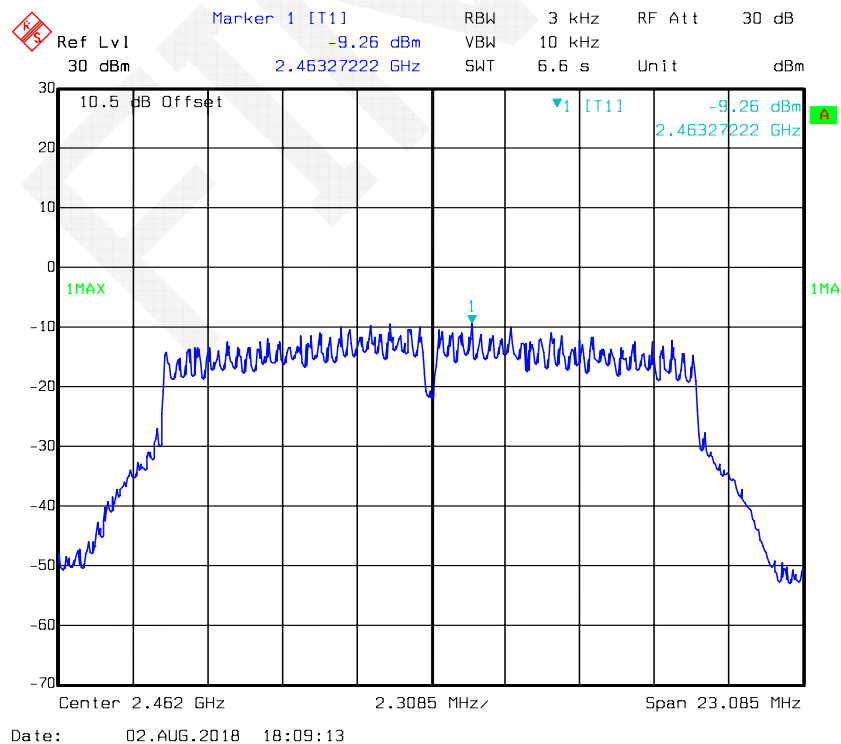
Power Spectral Density, 802.11g Low Channel (Antenna 2)



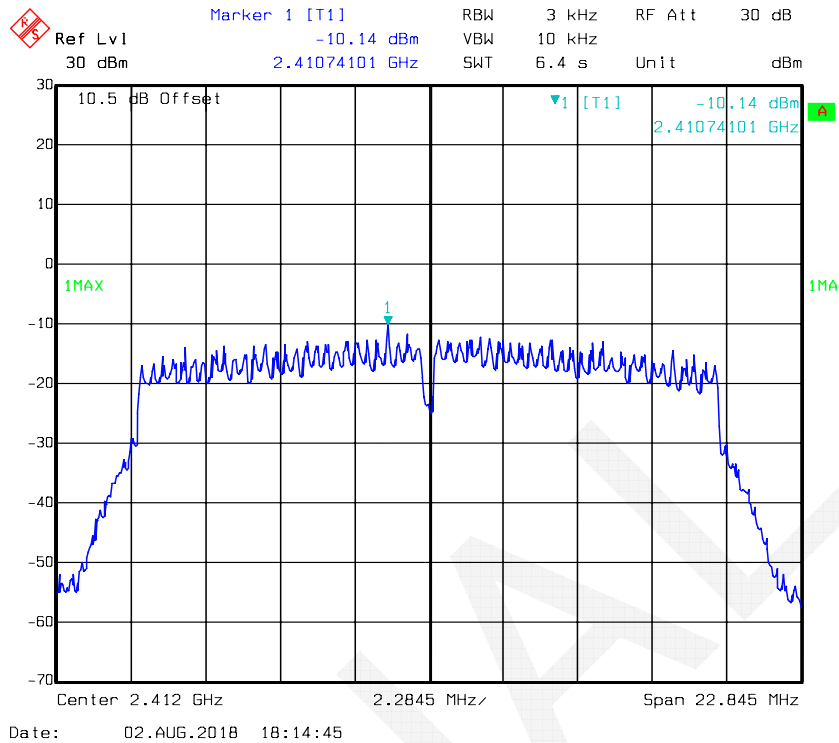
Power Spectral Density, 802.11g Middle Channel (Antenna 2)



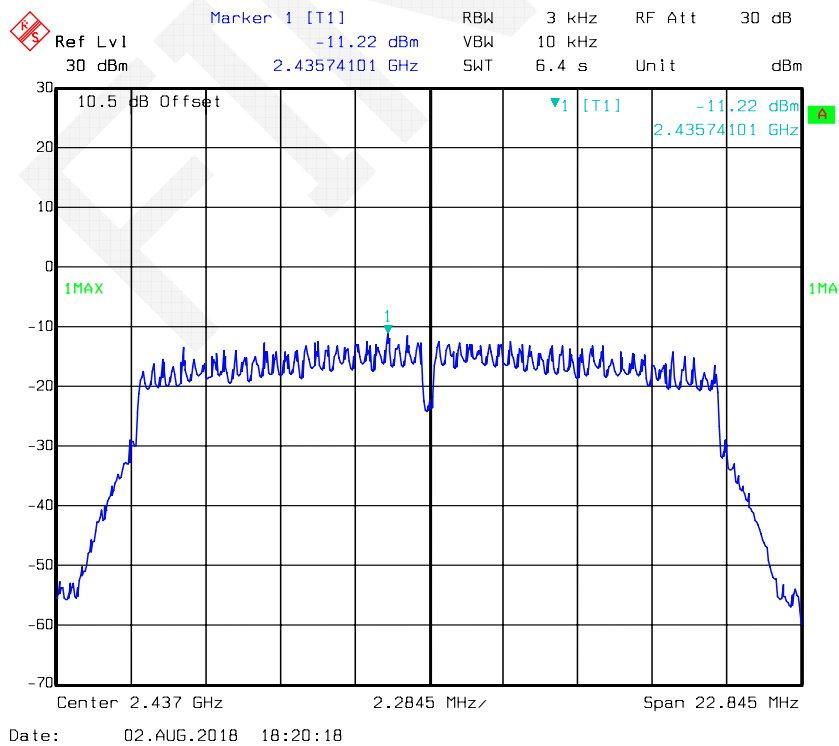
Power Spectral Density, 802.11g High Channel (Antenna 2)



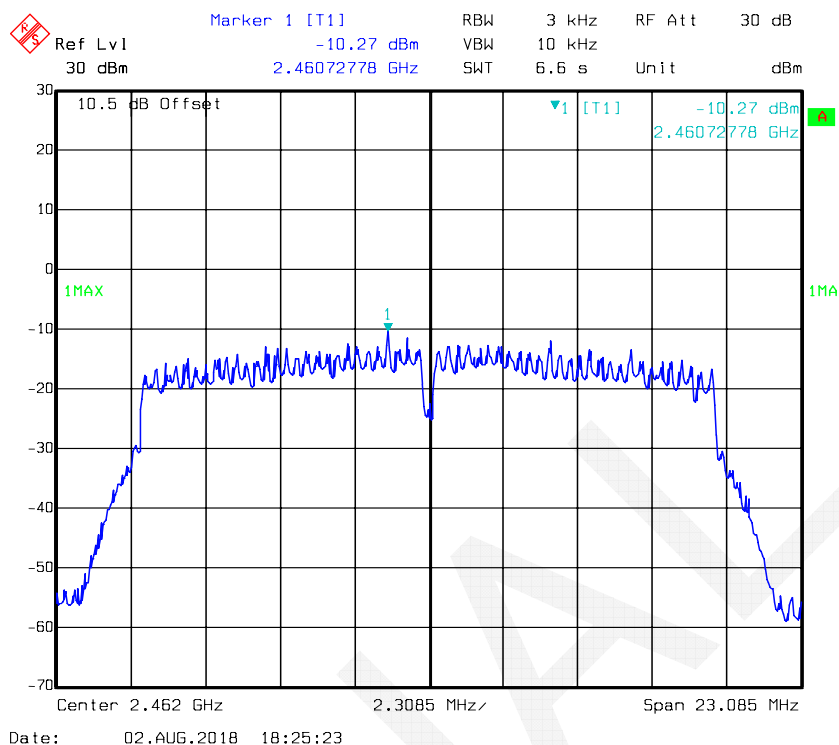
Power Spectral Density, 802.11n-HT20 Low Channel (Antenna 2)



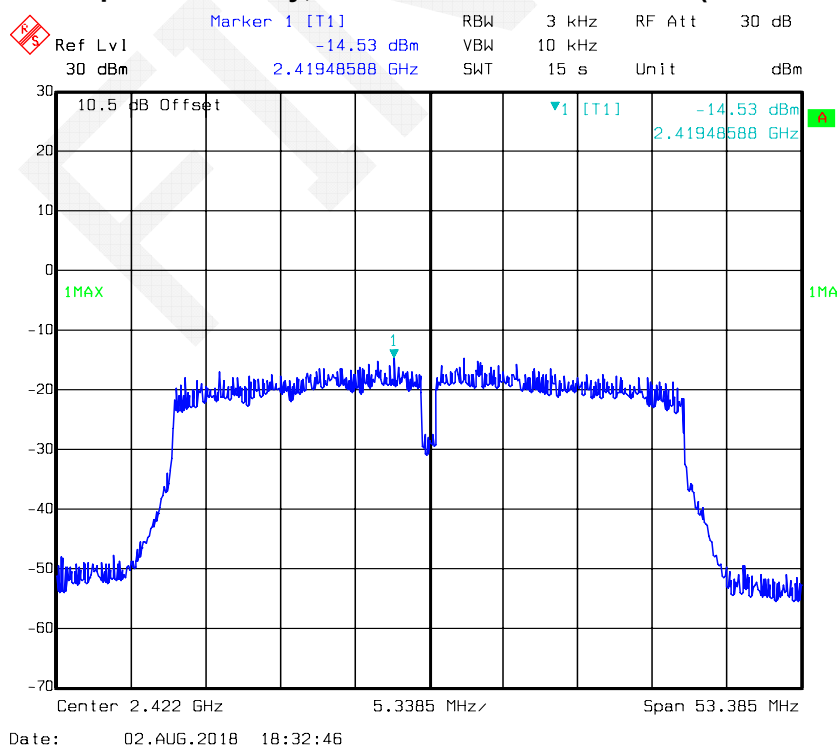
Power Spectral Density, 802.11n-HT20 Middle Channel (Antenna 2)



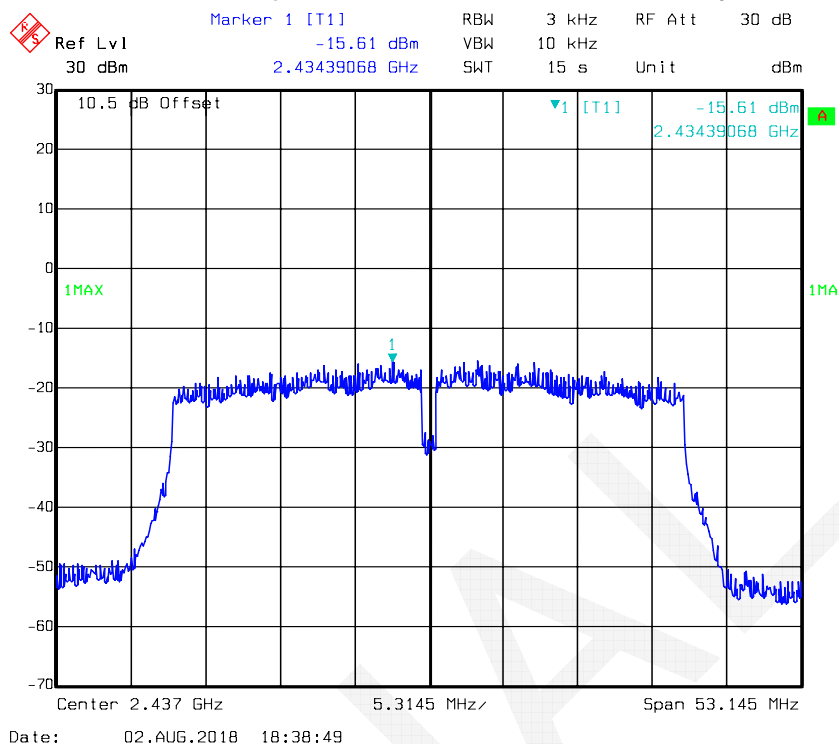
Power Spectral Density, 802.11n-HT20 High Channel (Antenna 2)



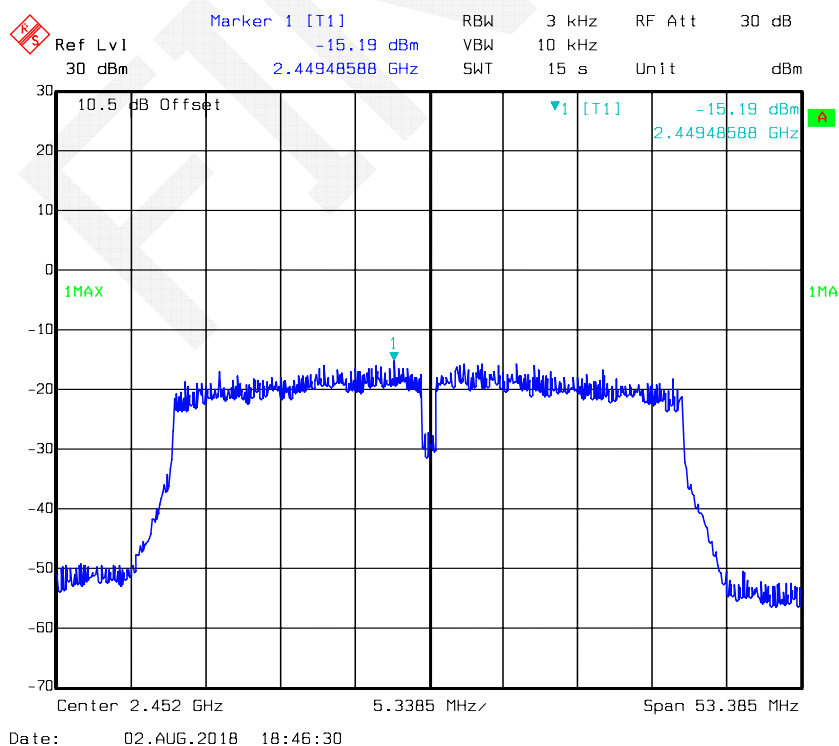
Power Spectral Density, 802.11n-HT40 Low Channel (Antenna 2)



Power Spectral Density, 802.11n-HT40 Middle Channel (Antenna 2)

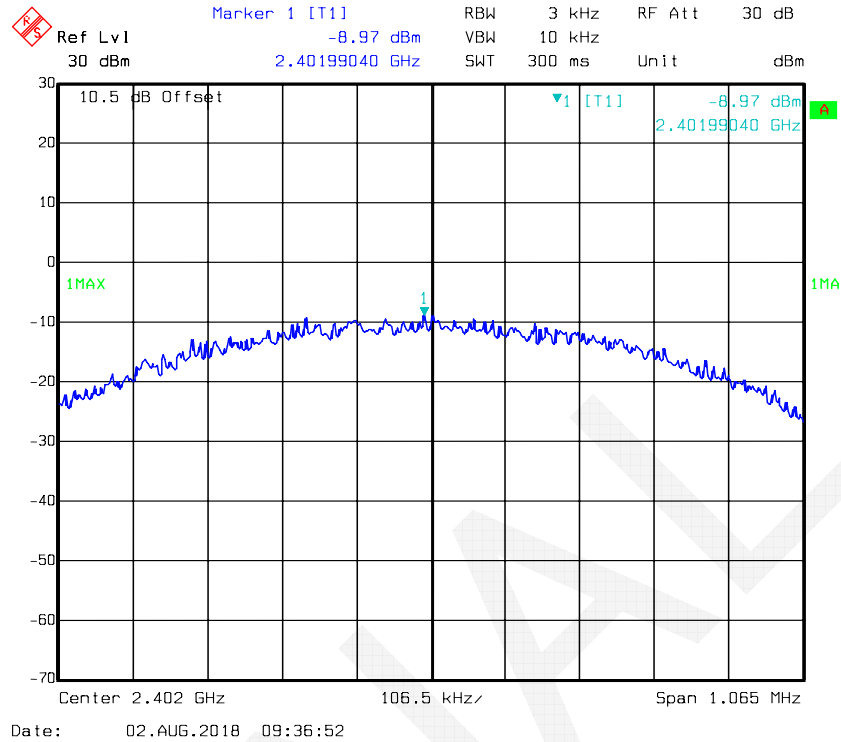


Power Spectral Density, 802.11n-HT40 High Channel (Antenna 2)

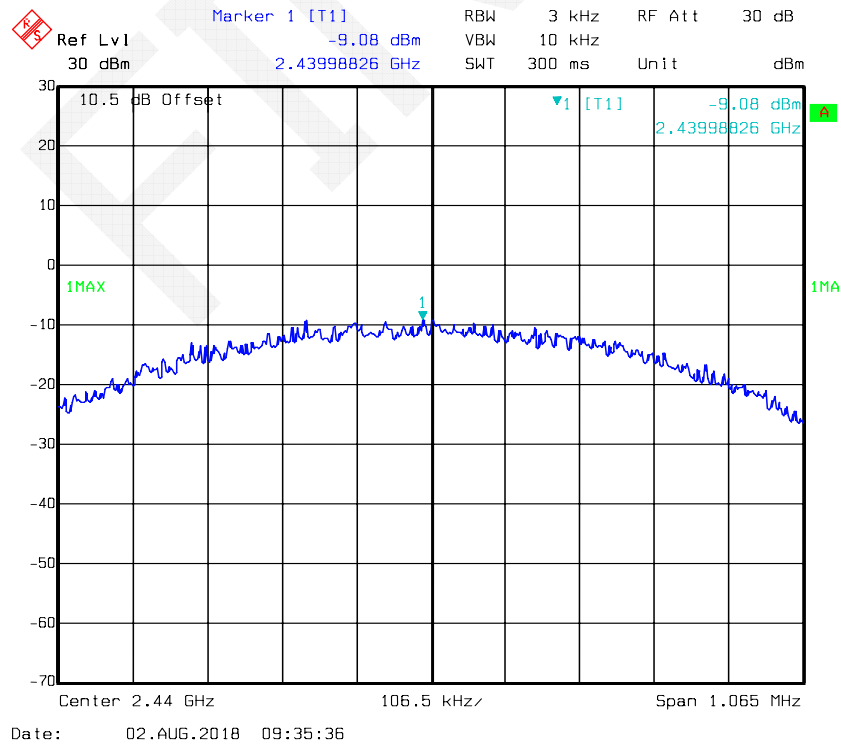


BLE mode

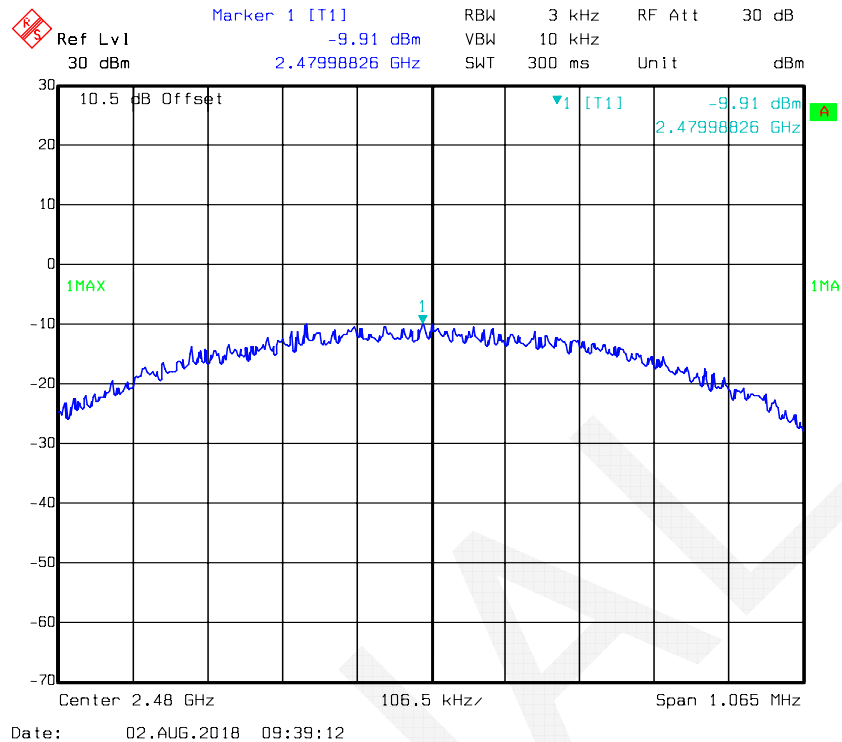
Power Spectral Density, Low Channel



Power Spectral Density, Middle Channel



Power Spectral Density, High Channel



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