

FCC PART 15.247

TEST REPORT

For

Queclink Wireless Solutions Co.,Ltd

3 Floor, Building 2, No.717 Yishan Road, Xuhui District, shanghai, 200233 China

FCC ID: YQD-EA00004

Report Type: Original Report	Product Type: Telematics Device
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Report Number:	RSHA191223002-00A
Report Date:	2020-01-22
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GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

Applicant	Queclink Wireless Solutions Co.,Ltd
Tested Model	EA00004
Product Type	Telematics Device
Power Supply	DC 12-60V
RF Function	2.4G Wi-Fi, BLE(1Mbps), BLE(2Mbps)
Operating Band/Frequency	2.4G Wi-Fi: 2412-2462MHz BLE(1Mbps)/BLE(2Mbps): 2402-2480MHz
Channel Number	2.4G Wi-Fi: 11, BLE(1Mbps)/BLE(2Mbps): 40
Channel Separation	2.4G Wi-Fi: 5MHz, BLE(1Mbps)/BLE(2Mbps): 2MHz
Modulation Type	BLE(1Mbps)/BLE(2Mbps): GFSK; 2.4G Wi-Fi: OFDM,DSSS
Antenna Type	2.4G Wi-Fi: Ceramic Antenna BLE: Ceramic Antenna
Maximum Antenna Gain	2.4G Wi-Fi: -0.36dBi BLE(1Mbps)/BLE(2Mbps): 2.94dBi

**All measurement and test data in this report was gathered from production sample serial number: 20191223002.
(Assigned by the BACL. The EUT supplied by the applicant was received on 2019-12-23)*

Objective

This report is prepared on behalf of *Queclink Wireless Solutions Co.,Ltd* in accordance with Part 2-Subpart J, Part 15-Subparts A and C of the Federal Communication Commissions rules.

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

Related Submittal(s)/Grant(s)

No related submittal.

Test Methodology

All measurements contained in this report were conducted with ANSI C63.10-2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices and FCC KDB 558074 D01 15.247 Meas Guidance v05r02.

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

Measurement Uncertainty

Item		Uncertainty
AC Power Lines Conducted Emissions		3.19dB
RF conducted test with spectrum		0.9dB
RF Output Power with Power meter		0.5dB
Radiated emission	30MHz~1GHz	6.11dB
	1GHz~6GHz	4.45dB
	6GHz~18GHz	5.23dB
	18GHz~40GHz	5.65dB
Occupied Bandwidth		0.5kHz
Temperature		1.0°C
Humidity		6%

Otherwise required by the applicant or Product Regulations, Decision Rule in this report did not consider the uncertainty.

Test Facility

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

Bay Area Compliance Laboratories Corp. (Kunshan) Lab is accredited to ISO/IEC 17025 by A2LA (Lab code: 4323.01) and the FCC designation No. CN1185 under the FCC KDB 974614 D01 and CAB identifier CN0004 under the ISED requirement. The facility also complies with the radiated and AC line conducted test site criteria set forth in ANSI C63.4-2014.

SYSTEM TEST CONFIGURATION

Description of Test Configuration

Test channel list is as below:

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

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

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

Channel	Frequency (MHz)	Channel	Frequency (MHz)
0	2402	20	2442
1	2404
...
...
18	2438	38	2478
19	2440	39	2480

Equipment Modifications

No modification was made to the EUT tested.

EUT Exercise Software

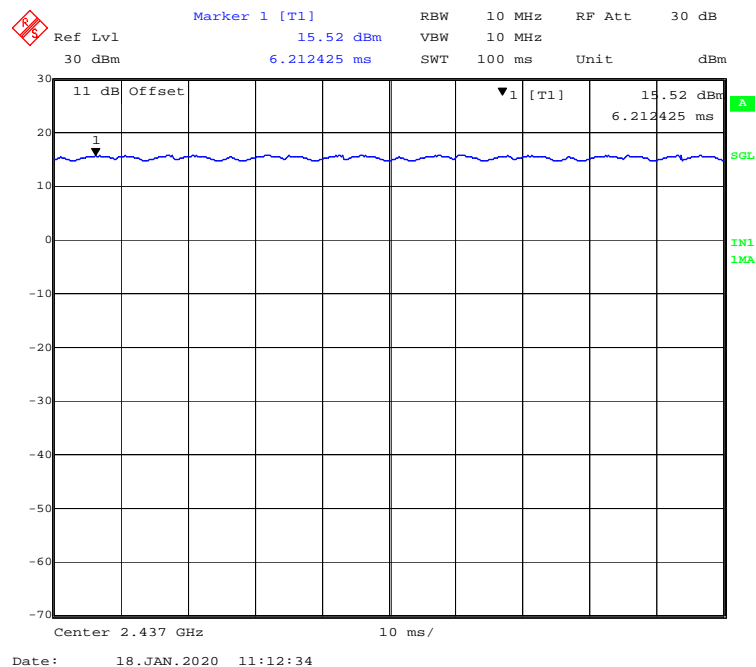
RF test tool: Wi-Fi test tool for 2.4G Wi-Fi and SSCOM V5.13.1 for BLE

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

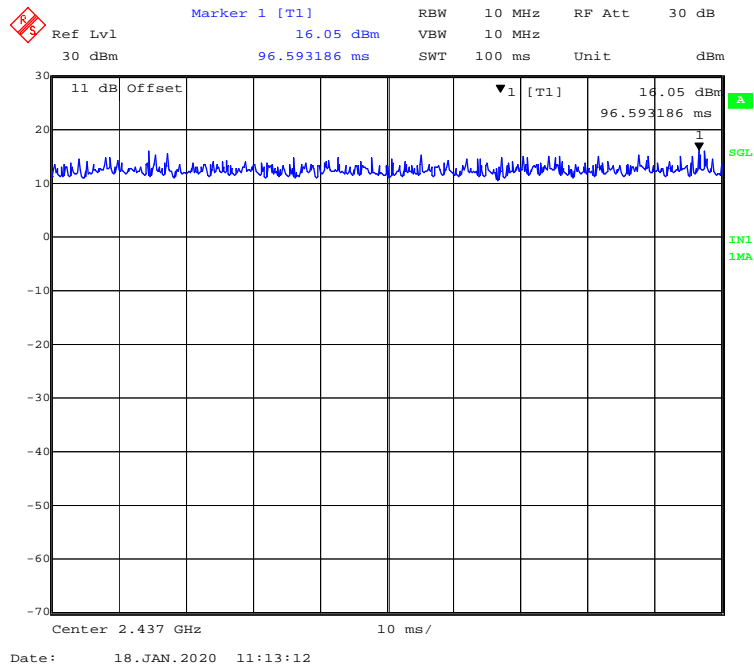
Mode	Data Rate	Channel	Power Level
802.11b	1 Mbps	Low	13
		Middle	14
		High	16
802.11g	6 Mbps	Low	14
		Middle	15
		High	18
802.11n-HT20	MCS0	Low	13
		Middle	14
		High	16
BLE	1Mbps	/	Default
BLE	2Mbps	/	Default

Duty Cycle:

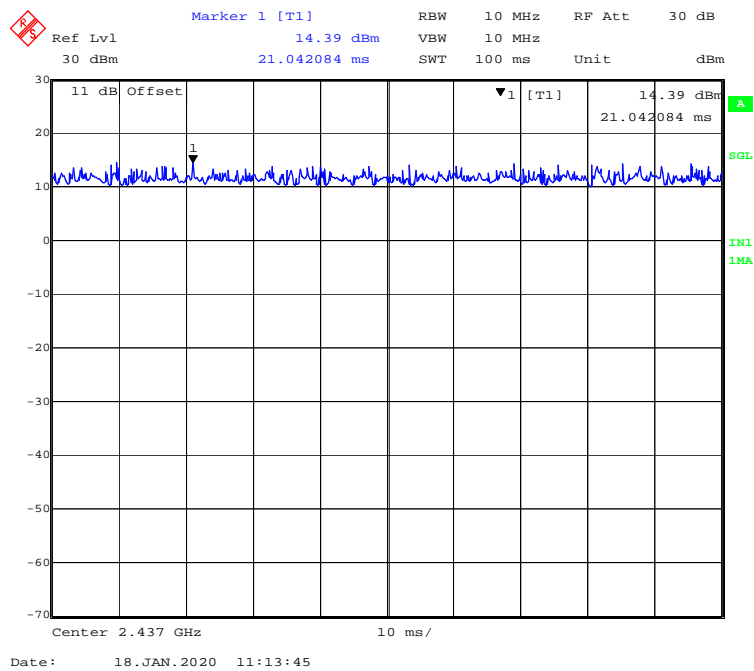
802.11b Mode Middle Channel



802.11g Mode Middle Channel

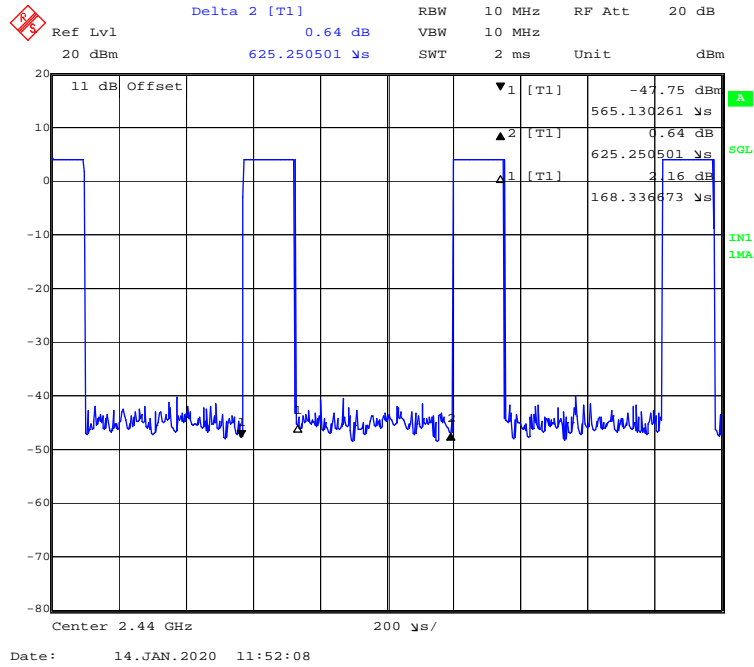


802.11n-HT20 Mode Middle Channel



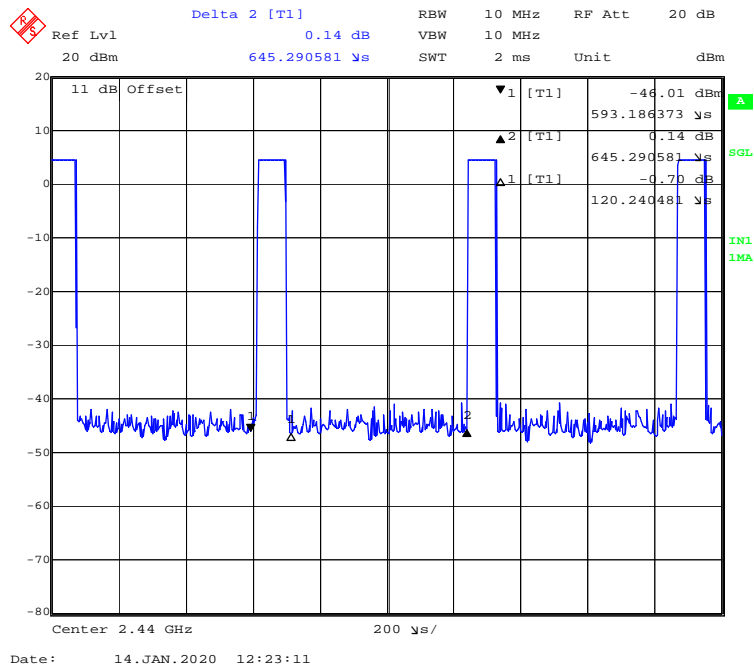
BLE Mode Duty Cycle 1Mbps:

Middle Channel



2Mbps:

Middle Channel



Mode	Duty Cycle (%)	T(ms)	1/T(kHz)	10log(1/x)
802.11b	100	/	/	0
802.11g	100	/	/	0
802.11n-HT20	100	/	/	0
BLE 1Mbps	26.88	0.168	5.95	5.71
BLE 2Mbps	18.60	0.120	8.33	7.3

Note: “x” means the Duty Cycle.

Support Equipment List and Details

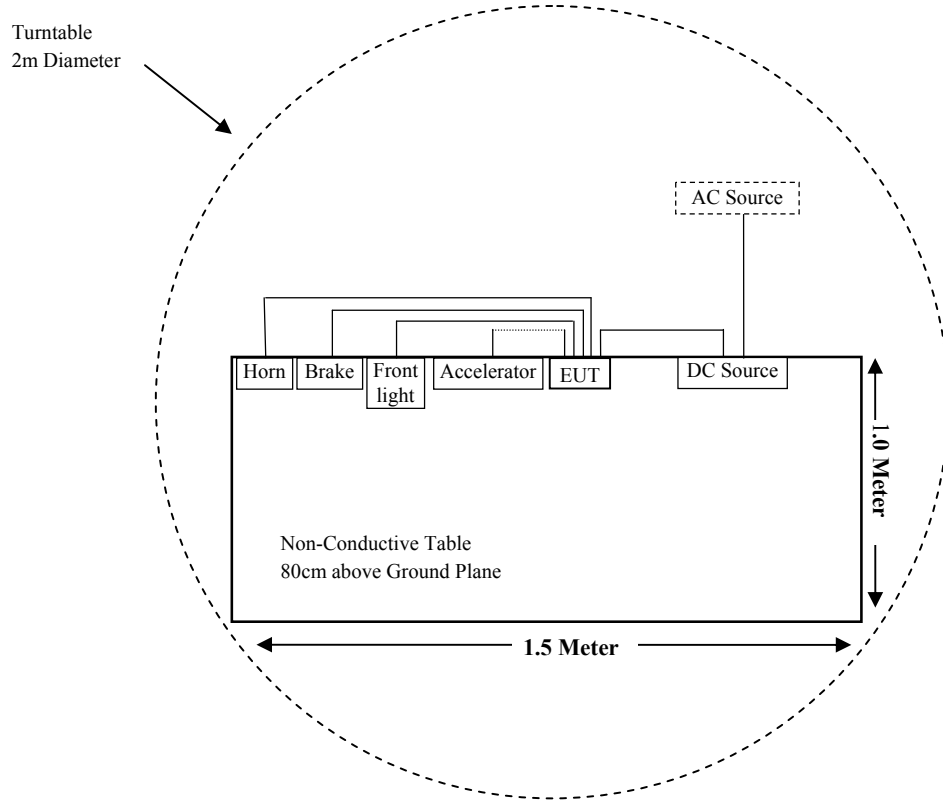
Manufacturer	Description	Model	Serial Number
QUECLINK	Horn	/	/
QUECLINK	Brake	/	/
QUECLINK	Front light	/	/
QUECLINK	Accelerator	/	/
BEST	DC Power Supply	PS-1502D+	DC001

External I/O Cable

Cable Description	Length (m)	From Port	To
Cable	1.0	EUT	Horn
Cable	1.0	EUT	Brake
Cable	1.0	EUT	Front light
Cable	1.0	EUT	Accelerator
DC Cable	1.0	EUT	DC Power Supply

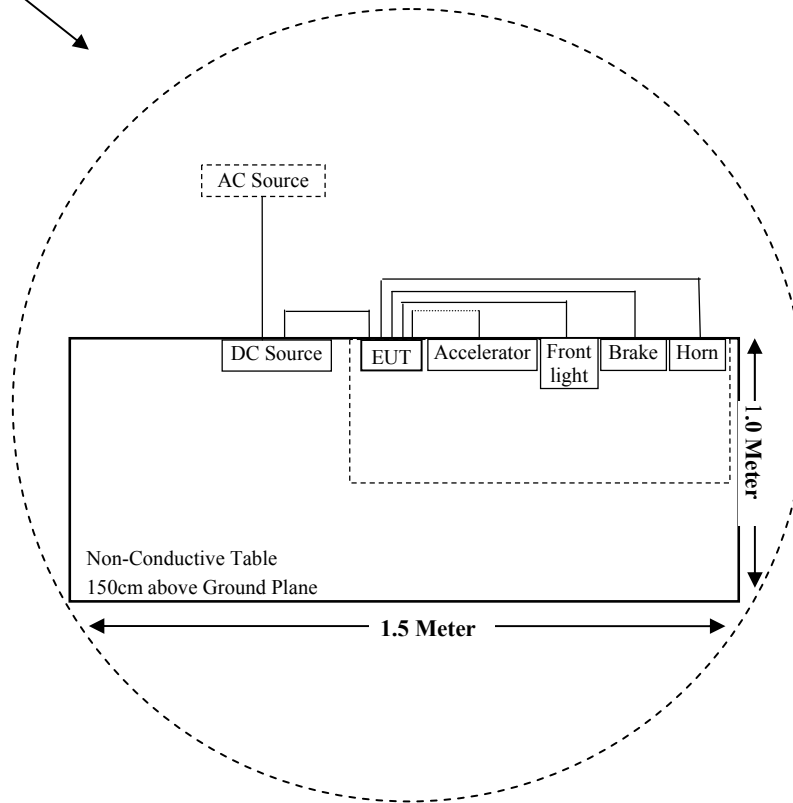
Block Diagram of Test Setup

For Radiated Emissions (Below 1GHz):



For Radiated Emissions (Above 1GHz):

Turntable
2m Diameter



SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Result
§15.247 (I), §1.1310 & §2.1091	Maximum Permissible Exposure (MPE)	Compliant
§15.203	Antenna Requirement	Compliant
§15.207 (a)	AC Line Conducted Emissions	Not Applicable (See Note)
§15.247(d)	Spurious Emissions at Antenna Port	Compliant
§15.205, §15.209, §15.247(d)	Spurious Emissions	Compliant
§15.247 (a)(2)	6 dB Emission Bandwidth	Compliant
§15.247(b)(3)	Maximum Conducted Output Power	Compliant
§15.247(d)	Band Edge	Compliant
§15.247(e)	Power Spectral Density	Compliant

Note: The EUT is powered by battery.

TEST EQUIPMENT LIST

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Radiated Emission Test (Chamber 3#)					
Rohde & Schwarz	EMI Test Receiver	ESR	1316.3003K03-101746-zn	2019-07-11	2020-07-10
Sunol Sciences	Broadband Antenna	JB3	A090413-1	2019-12-26	2022-12-25
Sonoma Instrument	Pre-amplifier	310N	171205	2019-08-14	2020-08-13
Audix	Test Software	e3	V9	/	/
MICRO-COAX	Coaxial Cable	Cable-8	008	2019-08-15	2020-08-14
MICRO-COAX	Coaxial Cable	Cable-9	009	2019-08-15	2020-08-14
MICRO-COAX	Coaxial Cable	Cable-10	010	2019-08-15	2020-08-14
Radiated Emission Test (Chamber 2#)					
Rohde & Schwarz	EMI Test Receiver	ESU40	100207	2019-08-27	2020-08-26
ETS-LINDGREN	Horn Antenna	3115	9207-3900	2017-07-15	2020-07-14
ETS-LINDGREN	Horn Antenna	3116	00084159	2019-12-12	2022-12-11
A.H.Systems, inc	Amplifier	2641-1	491	2019-02-20	2020-02-19
EM Electronics Corporation	Amplifier	EM18G40G	060726	2019-03-22	2020-03-21
MICRO-TRONICS	Band Reject Filter	BRM50702	G024	2019-08-05	2020-08-04
Narda	Attenuator	10dB	010	2019-08-15	2020-08-14
Rohde & Schwarz	Auto test Software	EMC32	100361	/	/
MICRO-COAX	Coaxial Cable	Cable-6	006	2019-08-15	2020-08-14
MICRO-COAX	Coaxial Cable	Cable-11	011	2019-08-15	2020-08-14
MICRO-COAX	Coaxial Cable	Cable-12	012	2019-08-15	2020-08-14
MICRO-COAX	Coaxial Cable	Cable-13	013	2019-08-15	2020-08-14
RF Conducted Test					
Rohde & Schwarz	EMI Test Receiver	ESIB26	100146	2019-11-30	2020-11-29
Agilent	Power Meter	N1912A	MY5000492	2019-11-18	2020-11-17
Agilent	Power Sensor	N1921A	MY54210024	2019-11-18	2020-11-17
Narda	Attenuator	10dB	010	2019-08-15	2020-08-14
QUECLINK	RF Cable	QUECLINK C01	C01	Each Time	/

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

FCC §1.1310 & §2.1091- MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Applicable Standard

According to subpart 15.247 (i) and subpart 1.1310, 2.1091 systems operating under the provisions of this section shall be operated in a manner that ensures the public is not exposed to RF energy level in excess of the communication guidelines.

Limits for General Population/Uncontrolled Exposure				
Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm²)	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

Calculated Formulary:

Predication of MPE limit at a given distance

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

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

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

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

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

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

Calculated Data (worst case):

Mode	Frequency (MHz)	Maximum Antenna Gain		Tune-up Conducted Power		Evaluation Distance (cm)	Power Density (mW/cm ²)	MPE Limit (mW/cm ²)
		(dBi)	(numeric)	(dBm)	(mW)			
Wi-Fi	2412	-0.36	0.92	17.00	50.12	20	0.0092	1.00
BLE 1Mbps	2402	2.94	1.97	4.50	2.82	20	0.0010	1.00
BLE 2Mbps	2402	2.94	1.97	4.50	2.82	20	0.0010	1.00
GSM850	824.2	-0.66	0.86	26.00	398.11	20	0.0681	0.55
GSM1900	1850.2	1.74	1.49	23.00	199.53	20	0.0592	1.23
WCDMA B2	1852.4	1.74	1.49	25.00	316.23	20	0.0939	1.23
WCDMA B4	1712.4	1.74	1.49	25.00	316.23	20	0.0939	1.14
WCDMA B5	826.4	-0.66	0.86	25.00	316.23	20	0.0540	0.55
LTE B2	1850.7	1.74	1.49	25.00	316.23	20	0.0939	1.23
LTE B4	1710.7	1.74	1.49	25.00	316.23	20	0.0939	1.14
LTE B5	824.7	-0.66	0.86	25.00	316.23	20	0.0540	0.55
LTE B7	2502.5	2.32	1.71	25.00	316.23	20	0.1073	1.00
LTE B12	699.7	-0.66	0.86	25.00	316.23	20	0.0540	0.47
LTE B13	779.5	-0.51	0.89	25.00	316.23	20	0.0559	0.52
LTE B25	1850.7	2.32	1.71	25.00	316.23	20	0.1073	1.00
LTE B26(814-824)	814.7	-0.66	0.86	25.00	316.23	20	0.0540	0.54
LTE B26(824-849)	824.7	-0.66	0.86	25.00	316.23	20	0.0540	0.55
LTE B38	2572.5	2.28	1.69	25.00	316.23	20	0.1063	1.00
LTE B41	2498.5	2.28	1.69	25.00	316.23	20	0.1063	1.00

Note:

- (1) The tune-up output powers are all declared by the Manufacturer.
 (2) The LTE module FCC ID: XMR201903EG25G.
 (3) Wi-Fi & BLE & GSM/WCDMA/LTE can transmit simultaneously; the worst condition is Wi-Fi & BLE & GSM850 as below:

$$\sum_i \frac{S_i}{S_{Limit,i}} = 0.0092/1.00 + 0.0010/1.00 + 0.0681/0.55 = 0.1340 < 1.0$$

Conclusion: The device meets MPE at distance 20cm.

FCC §15.203 - ANTENNA REQUIREMENT

Applicable Standard

According to § 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the user of a standard antenna jack or electrical connector is prohibited. The structure and application of the EUT were analyzed to determine Compliance with section §15.203 of the rules. §15.203 state that the subject device must meet the following criteria:

- a. Antenna must be permanently attached to the unit.
 - b. Antenna must use a unique type of connector to attach to the EUT.
- Unit must be professionally installed, and installer shall be responsible for verifying that the correct antenna is employed with the unit.

And according to FCC 47 CFR section 15.247 (b), if the transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

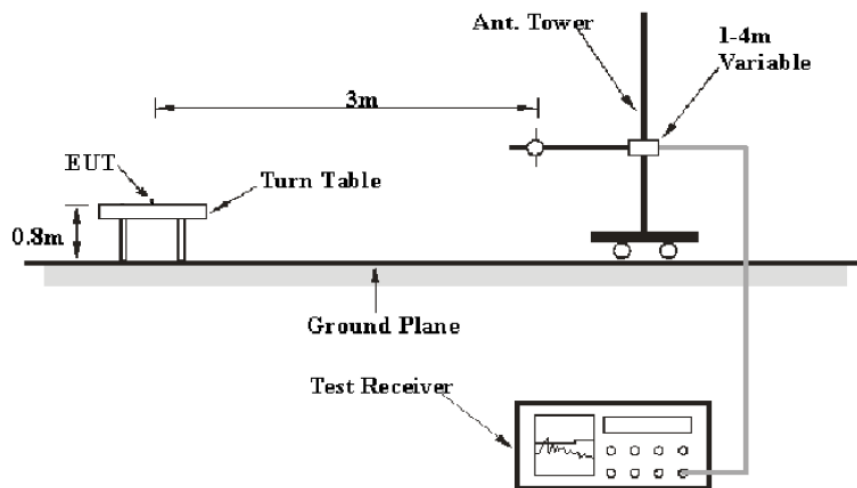
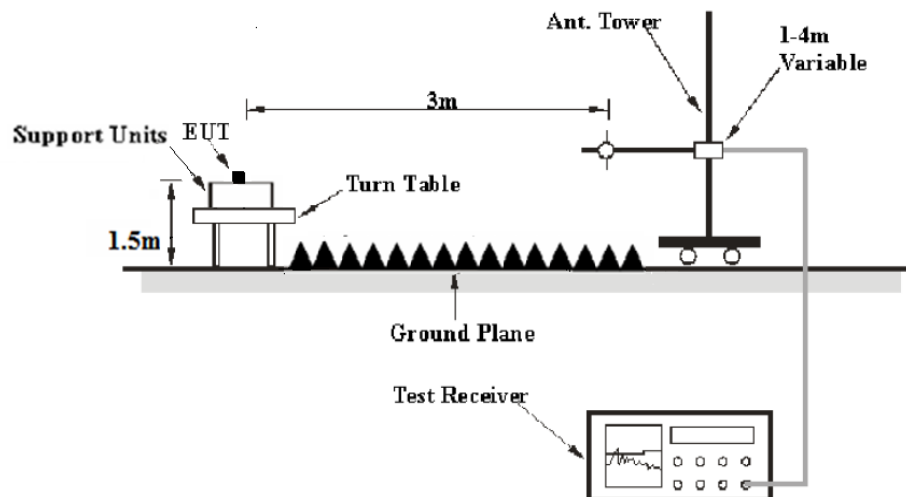
Antenna Connector Construction

The EUT has a Ceramic antenna for Wi-Fi and a Ceramic antenna for BLE, the antenna gain is -0.36 dBi for Wi-Fi and 2.94 dBi for BLE, which is permanently attached to the unit, fulfill the requirement of this section. Please refer to the EUT photos.

Result: Compliant.

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

FCC §15.247 (d); §15.209; §15.205;

EUT Setup**Below 1 GHz:****Above 1GHz:**

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

EMI Test Receiver Setup

The system was investigated from 30 MHz to 25 GHz.

During the radiated emission test, the EMI test receiver 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	3 MHz	/	Ave.

Test Procedure

According to ANSI C63.10-2013 clause 6.5, 6.6 and 6.7.

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 mode for frequencies above 1 GHz.

Factor & Over Limit Calculation – Below 1GHz

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

$$\text{Factor} = \text{Antenna Factor} + \text{Cable Loss} - \text{Amplifier Gain}$$

The “**Over Limit**” column of the following data tables indicates the degree of compliance with the applicable limit. For example, an Over Limit of 7 dB means the emission is 7 dB above the limit. The equation for Over Limit calculation is as follows:

$$\text{Over Limit (dB)} = \text{Read level (dB}\mu\text{V)} + \text{Factor (dB)} - \text{Limit (dB}\mu\text{V)}$$

Corrected Amplitude & Margin Calculation – Above 1GHz

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

$$\text{Corrected Amplitude (dB}\mu\text{V/m)} = \text{Meter Reading (dB}\mu\text{V)} + \text{Antenna Factor (dB/m)} + \text{Cable Loss (dB)} - \text{Amplifier Gain (dB)}$$

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:

$$\text{Margin (dB)} = \text{Limit (dB}\mu\text{V/m)} - \text{Corrected Amplitude (dB}\mu\text{V/m)}$$

Test Results Summary

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

Test Data**Environmental Conditions**

Temperature:	20.1~21.5 °C
Relative Humidity:	50~52 %
ATM Pressure:	101.2~101.5 kPa

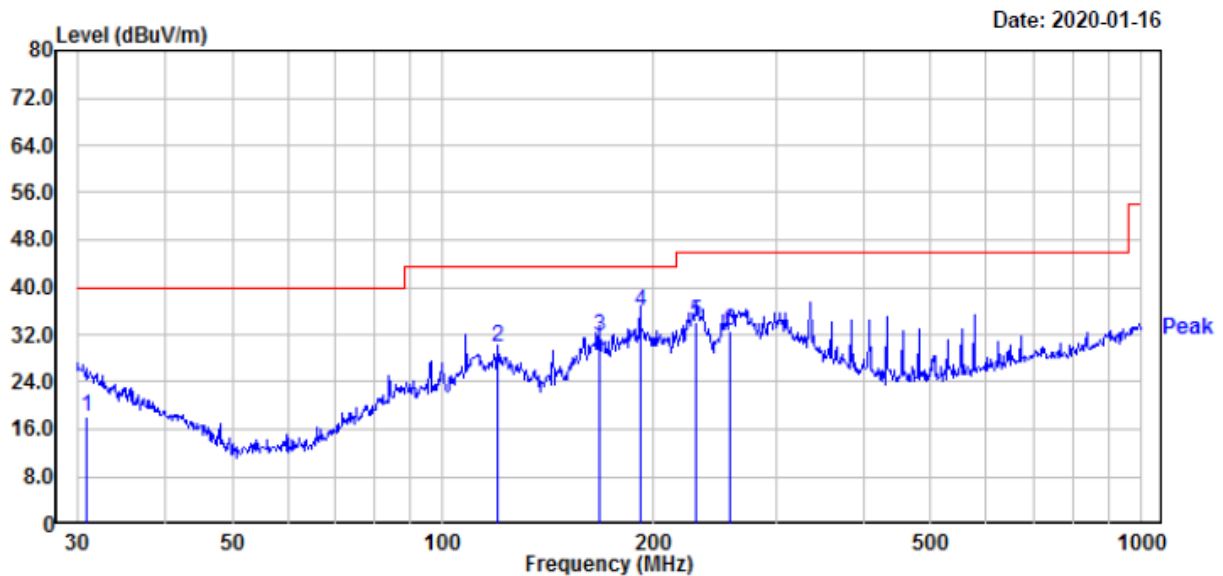
The testing was performed by CK Huang from 2020-01-14 to 2020-01-22.

Test Result: Compliant.

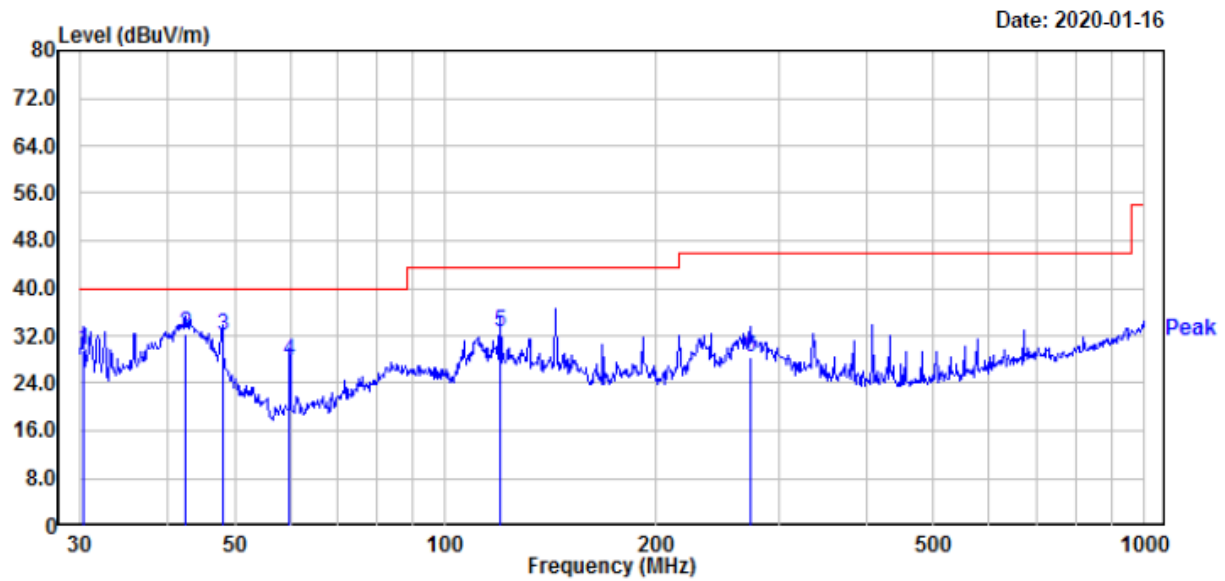
EUT operation mode: Transmitting

For Wi-Fi Mode:**Spurious Emission Test:****30MHz-1GHz:**

Pre-scan with 802.11b, 802.11g and 802.11n-HT20 modes of operation in the X,Y and Z axes of orientation, the worst case **middle channel of 802.11b mode in X-axis of orientation** was recorded

Horizontal

	Freq	Read Level	Factor	Level	Limit Line	Over Limit	APos	TPos	Remark
	MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	cm	deg	
1	30.85	21.90	-3.84	18.06	40.00	-21.94	200	131	QP
2	119.86	40.50	-10.68	29.82	43.50	-13.68	200	325	QP
3	167.82	44.10	-12.43	31.67	43.50	-11.83	200	343	QP
4	191.75	48.00	-12.17	35.83	43.50	-7.67	200	282	QP
5	230.91	47.30	-13.10	34.20	46.00	-11.80	100	285	QP
6	257.42	44.30	-11.74	32.56	46.00	-13.44	200	270	QP

Vertical

	Freq	Read Level	Factor	Level	Limit Line	Over Limit	APos	TPos	Remark
	MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	cm	deg	
1	30.32	33.10	-3.39	29.71	40.00	-10.29	100	259	QP
2	42.45	45.10	-12.79	32.31	40.00	-7.69	100	141	QP
3	47.99	47.80	-15.84	31.96	40.00	-8.04	100	321	QP
4	59.86	45.40	-17.55	27.85	40.00	-12.15	100	285	QP
5	119.86	43.40	-10.68	32.72	43.50	-10.78	100	333	QP
6	273.23	39.40	-10.94	28.46	46.00	-17.54	200	317	QP

1GHz-18GHz:**802.11b Mode:**

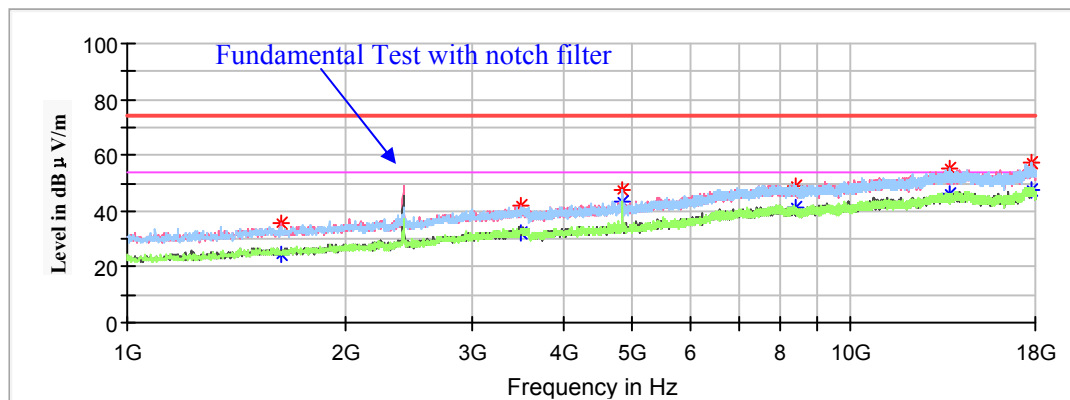
(Pre-scan in the X,Y and Z axes of orientation, the worst case **X-axis of orientation** was recorded)

Note:

1. This test was performed with the 2.4-2.5GHz notch filter.
2. Corrected Factor (dB/m) = Antenna factor (RX) (dB/m) + Cable Loss (dB) – Amplifier Factor (dB)
 Corrected Amplitude (dBμV/m) = Corrected Factor (dB/m) + Reading (dBμV)
 Margin (dB) = Limit (dBμV/m) – Corrected Amplitude (dBμV/m)

Low Channel: 2412MHz

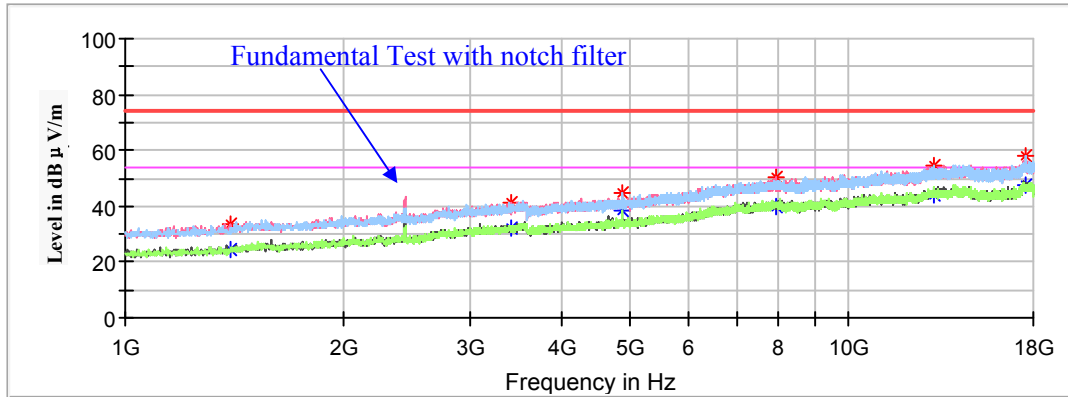
Full Spectrum



Frequency (MHz)	Corrected Amplitude		Rx Antenna		Turntable Degree	Corrected Factor (dB/m)	Limit (dBμV/m)	Margin (dB)
	MaxPeak (dBμV/m)	Average (dBμV/m)	Height (cm)	Polar (H/V)				
1627.300000	---	24.73	150.0	V	344.0	-9.5	54.00	29.27
1627.300000	35.36	---	150.0	V	344.0	-9.5	74.00	38.64
3492.200000	---	32.17	150.0	V	301.0	-3.6	54.00	21.83
3492.200000	41.75	---	150.0	V	301.0	-3.6	74.00	32.25
4824.000000	---	43.29	200.0	H	20.0	-0.5	54.00	10.71
4824.000000	47.66	---	200.0	H	20.0	-0.5	74.00	26.34
8374.600000	---	40.91	150.0	H	0.0	6.5	54.00	13.09
8374.600000	49.10	---	150.0	H	0.0	6.5	74.00	24.90
13724.500000	---	45.99	200.0	H	222.0	12.2	54.00	8.01
13724.500000	55.24	---	200.0	H	222.0	12.2	74.00	18.76
17806.200000	---	47.29	150.0	H	23.0	13.8	54.00	6.71
17806.200000	57.17	---	150.0	H	23.0	13.8	74.00	16.83

Middle Channel: 2437MHz

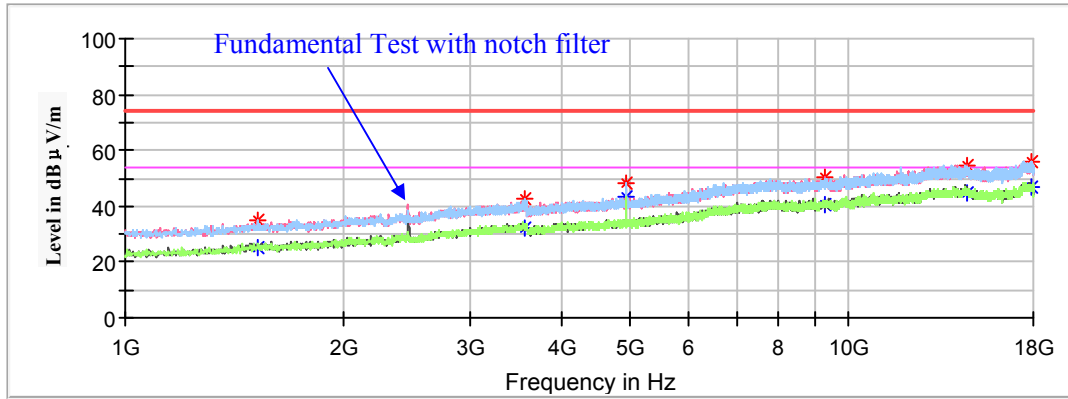
Full Spectrum



Frequency (MHz)	Corrected Amplitude		Rx Antenna		Turntable Degree	Corrected Factor (dB/m)	Limit (dB μ V/m)	Margin (dB)
	MaxPeak (dB μ V/m)	Average (dB μ V/m)	Height (cm)	Polar (H/V)				
1394.400000	---	24.53	150.0	V	257.0	-10.5	54.00	29.47
1394.400000	33.65	---	150.0	V	257.0	-10.5	74.00	40.35
3414.000000	---	32.18	150.0	V	355.0	-3.7	54.00	21.82
3414.000000	41.10	---	150.0	V	355.0	-3.7	74.00	32.90
4874.000000	---	38.41	150.0	H	50.0	-0.5	54.00	15.59
4874.000000	45.03	---	150.0	H	50.0	-0.5	74.00	28.97
7937.700000	---	40.04	200.0	V	64.0	6.9	54.00	13.96
7937.700000	50.61	---	200.0	V	64.0	6.9	74.00	23.39
13105.700000	---	43.98	200.0	H	160.0	12.0	54.00	10.02
13105.700000	54.87	---	200.0	H	169.0	12.0	74.00	19.13
17515.500000	---	47.42	150.0	H	79.0	14.3	54.00	6.58
17515.500000	57.75	---	150.0	H	79.0	14.3	74.00	16.25

High Channel: 2462MHz

Full Spectrum



Frequency (MHz)	Corrected Amplitude		Rx Antenna		Turntable Degree	Corrected Factor (dB/m)	Limit (dBμV/m)	Margin (dB)
	MaxPeak (dBμV/m)	Average (dBμV/m)	Height (cm)	Polar (H/V)				
1527.000000	---	24.99	200.0	V	0.0	-9.8	54.00	29.01
1527.000000	35.15	---	200.0	V	0.0	-9.8	74.00	38.85
3577.200000	---	32.05	150.0	H	7.0	-3.3	54.00	21.95
3577.200000	42.90	---	150.0	H	7.0	-3.3	74.00	31.10
4924.000000	---	43.19	150.0	H	48.0	-0.4	54.00	10.81
4924.000000	47.92	---	150.0	H	48.0	-0.4	74.00	26.08
9268.800000	---	40.45	150.0	V	213.0	7.7	54.00	13.55
9268.800000	50.32	---	150.0	V	213.0	7.7	74.00	23.68
14605.100000	---	45.02	200.0	V	91.0	12.5	54.00	8.98
14605.100000	54.71	---	200.0	V	91.0	12.5	74.00	19.29
17852.100000	---	46.54	200.0	V	91.0	13.7	54.00	7.46
17852.100000	55.97	---	200.0	V	91.0	13.7	74.00	18.03

802.11g Mode:

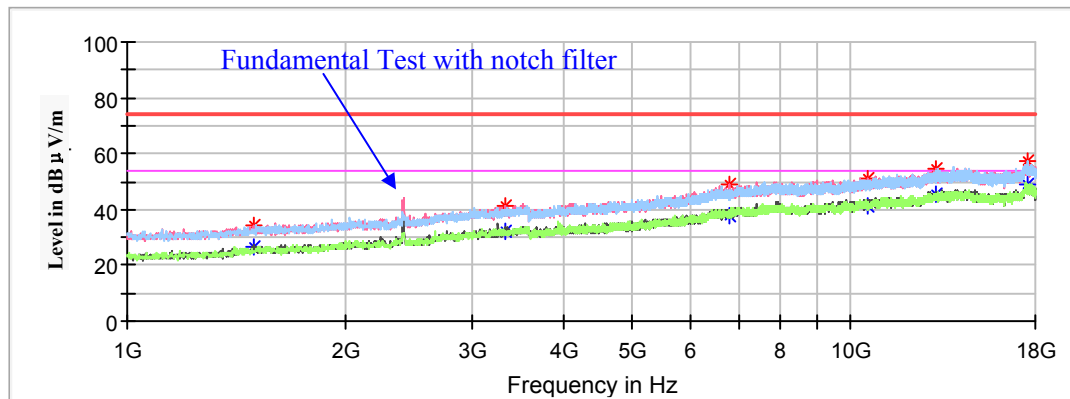
(Pre-scan in the X,Y and Z axes of orientation, the worst case **X-axis of orientation** was recorded)

Note:

1. This test was performed with the 2.4-2.5GHz notch filter.
2. Corrected Factor (dB/m) = Antenna factor (RX) (dB/m) + Cable Loss (dB) – Amplifier Factor (dB)
 Corrected Amplitude (dBμV/m) = Corrected Factor (dB/m) + Reading (dBμV)
 Margin (dB) = Limit (dBμV/m) – Corrected Amplitude (dBμV/m)

Low Channel: 2412MHz

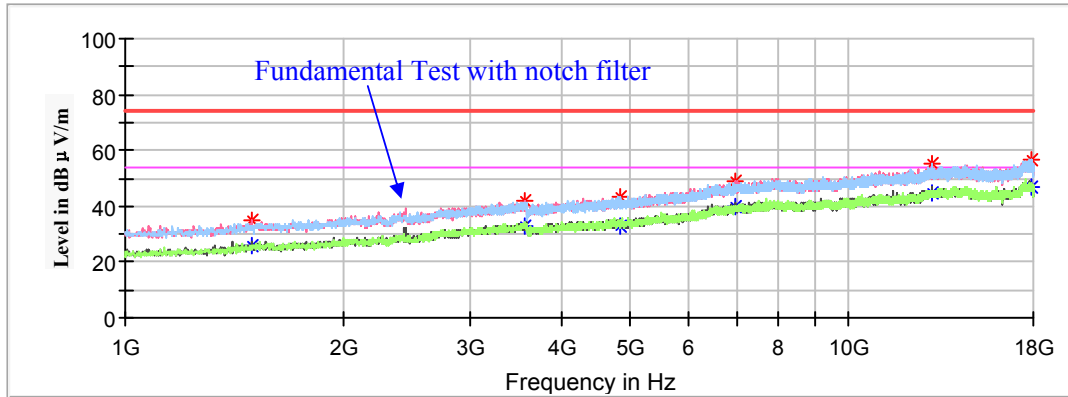
Full Spectrum



Frequency (MHz)	Corrected Amplitude		Rx Antenna		Turntable Degree	Corrected Factor (dB/m)	Limit (dBμV/m)	Margin (dB)
	MaxPeak (dBμV/m)	Average (dBμV/m)	Height (cm)	Polar (H/V)				
1493.000000	---	26.83	150.0	V	68.0	-10.0	54.00	27.17
1493.000000	34.49	---	150.0	V	68.0	-10.0	74.00	39.51
3332.400000	---	31.85	200.0	V	1.0	-3.8	54.00	22.15
3332.400000	41.48	---	200.0	V	1.0	-3.8	74.00	32.52
6795.300000	---	37.96	200.0	V	48.0	5.0	54.00	16.04
6795.300000	48.76	---	200.0	V	48.0	5.0	74.00	25.24
10564.200000	---	41.22	200.0	V	7.0	9.1	54.00	12.78
10564.200000	51.09	---	200.0	V	7.0	9.1	74.00	22.91
13148.200000	---	45.46	150.0	V	356.0	12.0	54.00	8.54
13148.200000	54.84	---	150.0	V	356.0	12.0	74.00	19.16
17532.500000	---	48.64	200.0	H	10.0	14.2	54.00	5.36
17532.500000	57.18	---	200.0	H	10.0	14.2	74.00	16.82

Middle Channel: 2437MHz

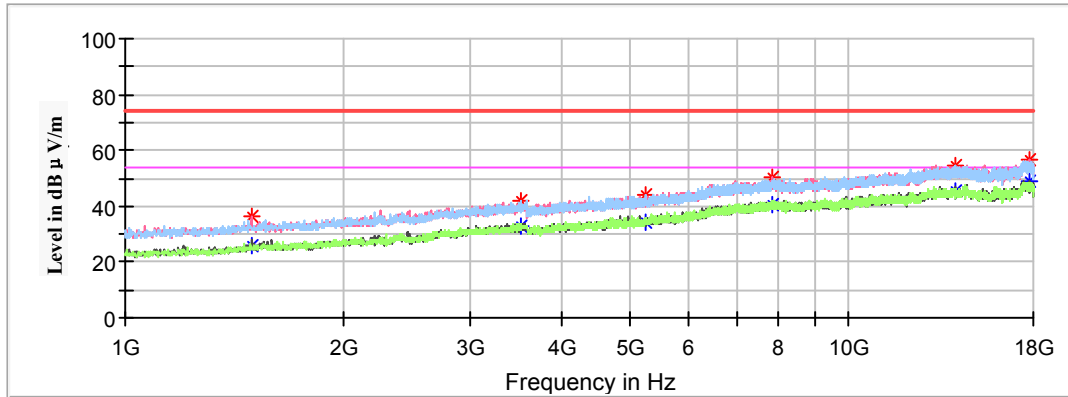
Full Spectrum



Frequency (MHz)	Corrected Amplitude		Rx Antenna		Turntable Degree	Corrected Factor (dB/m)	Limit (dB μ V/m)	Margin (dB)
	MaxPeak (dB μ V/m)	Average (dB μ V/m)	Height (cm)	Polar (H/V)				
1494.700000	---	26.06	200.0	V	212.0	-10.0	54.00	27.94
1494.700000	35.23	---	200.0	V	212.0	-10.0	74.00	38.77
3568.700000	---	32.84	200.0	V	212.0	-3.3	54.00	21.16
3568.700000	41.85	---	200.0	V	212.0	-3.3	74.00	32.15
4874.000000	---	33.01	200.0	H	163.0	-0.5	54.00	20.99
4874.000000	43.40	---	200.0	H	163.0	-0.5	74.00	30.60
6972.100000	---	39.69	150.0	V	313.0	5.3	54.00	14.31
6972.100000	48.87	---	150.0	V	313.0	5.3	74.00	25.13
13051.300000	---	44.56	150.0	H	350.0	12.0	54.00	9.44
13051.300000	55.21	---	150.0	H	350.0	12.0	74.00	18.79
17921.800000	---	46.64	150.0	H	0.0	13.6	54.00	7.36
17921.800000	56.84	---	150.0	H	0.0	13.6	74.00	17.16

High Channel: 2462MHz

Full Spectrum



Frequency (MHz)	Corrected Amplitude		Rx Antenna		Turntable Degree	Corrected Factor (dB/m)	Limit (dBμV/m)	Margin (dB)
	MaxPeak (dBμV/m)	Average (dBμV/m)	Height (cm)	Polar (H/V)				
1493.000000	---	26.01	150.0	V	208.0	-10.0	54.00	27.99
1493.000000	36.21	---	150.0	V	208.0	-10.0	74.00	37.79
3521.100000	---	32.79	200.0	H	298.0	-3.5	54.00	21.21
3521.100000	41.96	---	200.0	H	298.0	-3.5	74.00	32.04
5238.100000	---	33.99	150.0	H	27.0	0.5	54.00	20.01
5238.100000	43.97	---	150.0	H	27.0	0.5	74.00	30.03
7847.600000	---	40.43	200.0	V	14.0	6.8	54.00	13.57
7847.600000	50.43	---	200.0	V	14.0	6.8	74.00	23.57
14023.700000	---	45.40	150.0	H	71.0	12.5	54.00	8.60
14023.700000	54.84	---	150.0	H	71.0	12.5	74.00	19.16
17785.800000	---	48.78	200.0	V	255.0	13.8	54.00	5.22
17785.800000	56.41	---	200.0	V	255.0	13.8	74.00	17.59

802.11n-HT20 Mode:

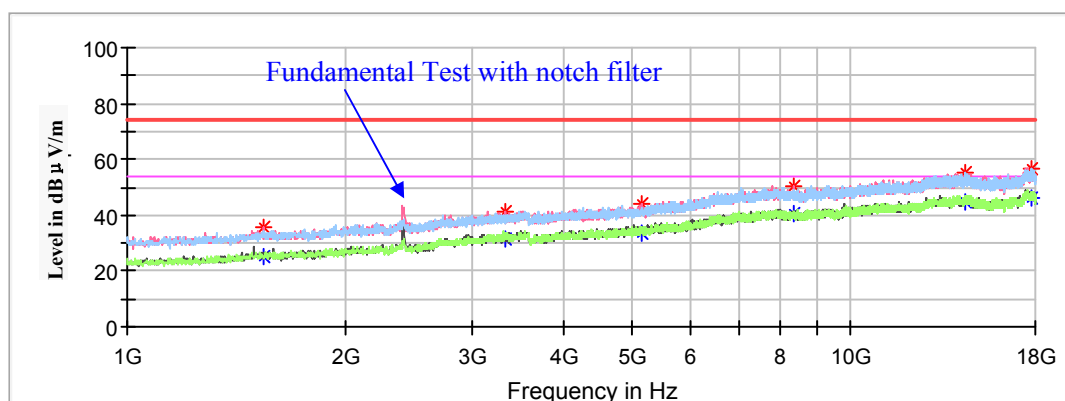
(Pre-scan in the X,Y and Z axes of orientation, the worst case **X-axis of orientation** was recorded)

Note:

1. This test was performed with the 2.4-2.5GHz notch filter.
2. Corrected Factor (dB/m) = Antenna factor (RX) (dB/m) + Cable Loss (dB) – Amplifier Factor (dB)
 Corrected Amplitude (dBμV/m) = Corrected Factor (dB/m) + Reading (dBμV)
 Margin (dB) = Limit (dBμV/m) – Corrected Amplitude (dBμV/m)

Low Channel: 2412MHz

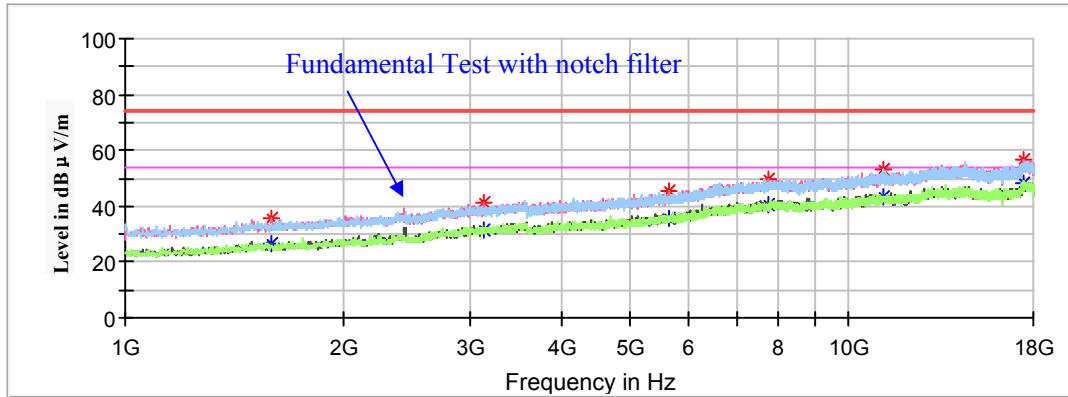
Full Spectrum



Frequency (MHz)	Corrected Amplitude		Rx Antenna		Turntable Degree	Corrected Factor (dB/m)	Limit (dBμV/m)	Margin (dB)
	MaxPeak (dBμV/m)	Average (dBμV/m)	Height (cm)	Polar (H/V)				
1545.700000	---	24.90	150.0	V	334.0	-9.8	54.00	29.10
1545.700000	35.39	---	150.0	V	334.0	-9.8	74.00	38.61
3327.300000	---	31.69	200.0	V	162.0	-3.8	54.00	22.31
3327.300000	41.17	---	200.0	V	162.0	-3.8	74.00	32.83
5131.000000	---	33.75	200.0	V	162.0	0.2	54.00	20.25
5131.000000	44.08	---	200.0	V	162.0	0.2	74.00	29.92
8323.600000	---	40.48	150.0	V	116.0	6.5	54.00	13.52
8323.600000	50.55	---	150.0	V	116.0	6.5	74.00	23.45
14382.400000	---	44.75	150.0	H	43.0	12.7	54.00	9.25
14382.400000	55.53	---	150.0	H	43.0	12.7	74.00	18.47
17726.300000	---	46.20	200.0	H	14.0	13.9	54.00	7.80
17726.300000	56.55	---	200.0	H	14.0	13.9	74.00	17.45

Middle Channel: 2437MHz

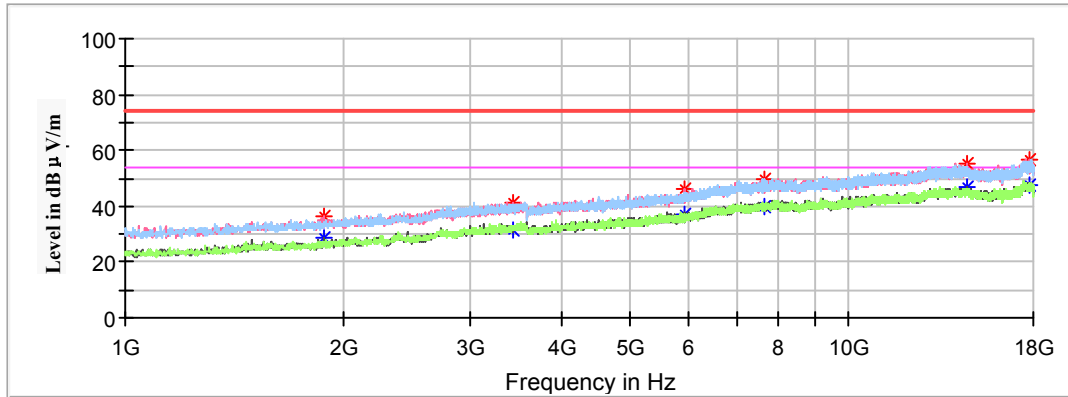
Full Spectrum



Frequency (MHz)	Corrected Amplitude		Rx Antenna		Turntable Degree	Corrected Factor (dB/m)	Limit (dBμV/m)	Margin (dB)
	MaxPeak (dBμV/m)	Average (dBμV/m)	Height (cm)	Polar (H/V)				
1593.300000	---	26.27	150.0	V	74.0	-9.6	54.00	27.73
1593.300000	35.44	---	150.0	V	74.0	-9.6	74.00	38.56
3130.100000	---	31.70	150.0	V	246.0	-4.2	54.00	22.30
3130.100000	40.93	---	150.0	V	246.0	-4.2	74.00	33.07
5630.800000	---	35.57	200.0	V	358.0	1.6	54.00	18.43
5630.800000	45.52	---	200.0	V	358.0	1.6	74.00	28.48
7725.200000	---	40.51	200.0	V	6.0	6.5	54.00	13.49
7725.200000	49.91	---	200.0	V	6.0	6.5	74.00	24.09
11145.600000	---	43.69	200.0	H	231.0	9.8	54.00	10.31
11145.600000	53.25	---	200.0	H	231.0	9.8	74.00	20.75
17469.600000	---	47.91	150.0	V	260.0	14.1	54.00	6.09
17469.600000	56.40	---	150.0	V	260.0	14.1	74.00	17.60

High Channel: 2462MHz

Full Spectrum

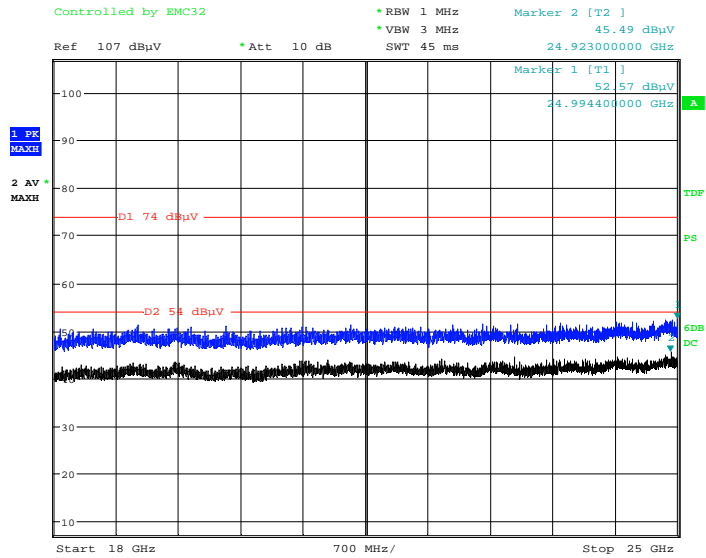


Frequency (MHz)	Corrected Amplitude		Rx Antenna		Turntable Degree	Corrected Factor (dB/m)	Limit (dBμV/m)	Margin (dB)
	MaxPeak (dBμV/m)	Average (dBμV/m)	Height (cm)	Polar (H/V)				
1882.300000	---	28.87	200.0	V	308.0	-8.6	54.00	25.13
1882.300000	36.19	---	200.0	V	308.0	-8.6	74.00	37.81
3429.300000	---	31.43	200.0	V	85.0	-3.7	54.00	22.57
3429.300000	41.44	---	200.0	V	85.0	-3.7	74.00	32.56
5943.600000	---	36.95	200.0	V	259.0	2.2	54.00	17.05
5943.600000	45.97	---	200.0	V	259.0	2.2	74.00	28.03
7669.100000	---	39.79	150.0	H	211.0	6.4	54.00	14.21
7669.100000	49.72	---	150.0	H	211.0	6.4	74.00	24.28
14594.900000	---	47.16	150.0	V	149.0	12.5	54.00	6.84
14594.900000	54.95	---	150.0	V	149.0	12.5	74.00	19.05
17773.900000	---	47.37	150.0	V	117.0	13.8	54.00	6.63
17773.900000	56.73	---	150.0	V	117.0	13.8	74.00	17.27

18GHz-25GHz:

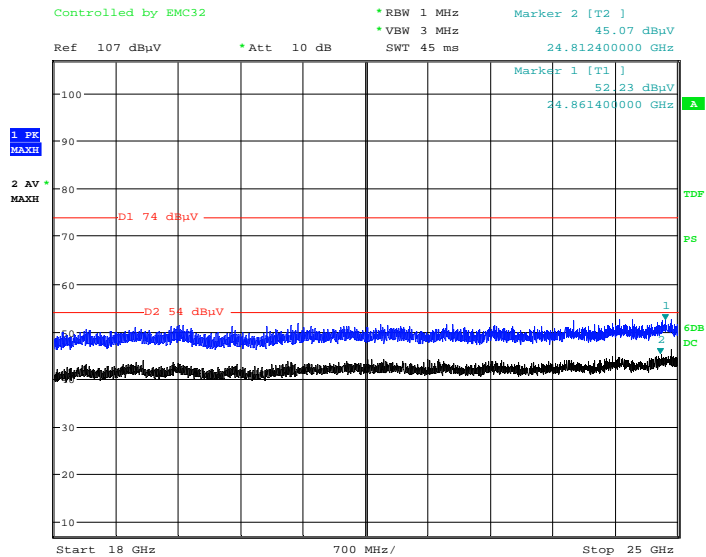
Pre-scan with 802.11b, 802.11g and 802.11n-HT20 modes of operation in the X,Y and Z axes of orientation, the worst case **middle channel of 802.11b mode in X-axis of orientation** was recorded

Horizontal



Date: 18.JAN.2020 15:55:44

Vertical



Date: 18.JAN.2020 16:11:43

Restricted Bands Emissions Test:

Note:

1. Corrected Factor (dB/m) = Antenna factor (RX) (dB/m) + Cable Loss (dB) – Amplifier Factor (dB)

Corrected Amplitude (dB μ V/m) = Corrected Factor (dB/m) + Reading (dB μ V)Margin (dB) = Limit (dB μ V/m) – Corrected Amplitude (dB μ V/m)**802.11b Mode:** (Pre-scan in the X,Y and Z axes of orientation, the worst case X-axis of orientation was recorded)

Frequency (MHz)	Corrected Amplitude		Rx Antenna		Turntable Degree	Corrected Factor (dB/m)	Limit (dBμV/m)	Margin (dB)
	MaxPeak (dBμV/m)	Average (dBμV/m)	Height (cm)	Polar (H/V)				
Low Channel: 2412MHz								
2390.000000	---	51.56	150.0	V	58.0	2.8	54.00	2.44
2390.000000	56.59	---	150.0	V	58.0	2.8	74.00	17.41
2390.000000	---	50.11	200.0	H	329.0	2.8	54.00	3.89
2390.000000	55.08	---	200.0	H	329.0	2.8	74.00	18.92
High Channel: 2462MHz								
2483.500000	56.74	---	150.0	V	52.0	3.0	74.00	17.26
2483.500000	---	51.65	150.0	V	52.0	3.0	54.00	2.35
2483.500000	55.32	---	200.0	H	171.0	3.0	74.00	18.68
2483.500000	---	50.27	200.0	H	171.0	3.0	54.00	3.73

802.11g Mode: (Pre-scan in the X,Y and Z axes of orientation, the worst case X-axis of orientation was recorded)

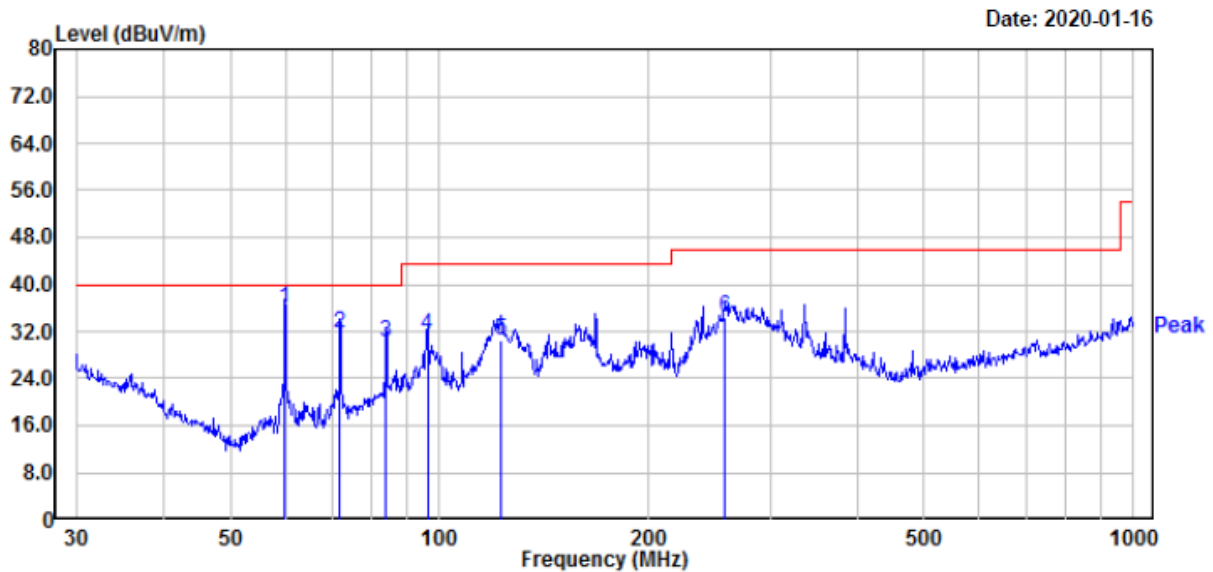
Frequency (MHz)	Corrected Amplitude		Rx Antenna		Turntable Degree	Corrected Factor (dB/m)	Limit (dBμV/m)	Margin (dB)
	MaxPeak (dBμV/m)	Average (dBμV/m)	Height (cm)	Polar (H/V)				
Low Channel: 2412MHz								
2390.000000	51.59	---	150.0	V	68.0	2.8	74.00	22.41
2390.000000	---	44.30	150.0	V	68.0	2.8	54.00	9.70
2390.000000	---	43.29	150.0	H	75.0	2.8	54.00	10.71
2390.000000	50.54	---	150.0	H	75.0	2.8	74.00	23.46
High Channel: 2462MHz								
2483.500000	53.22	---	150.0	V	106.0	3.0	74.00	20.78
2483.500000	---	44.21	150.0	V	106.0	3.0	54.00	9.79
2483.500000	52.57	---	150.0	H	245.0	3.0	74.00	21.43
2483.500000	---	43.44	150.0	H	245.0	3.0	54.00	10.56

802.11n-HT20 Mode: (Pre-scan in the X,Y and Z axes of orientation, the worst case X-axis of orientation was recorded)

Frequency (MHz)	Corrected Amplitude		Rx Antenna		Turntable Degree	Corrected Factor (dB/m)	Limit (dBμV/m)	Margin (dB)
	MaxPeak (dBμV/m)	Average (dBμV/m)	Height (cm)	Polar (H/V)				
Low Channel: 2412MHz								
2390.000000	51.25	---	200.0	V	89.0	2.8	74.00	22.75
2390.000000	---	43.63	200.0	V	89.0	2.8	54.00	10.37
2390.000000	---	42.65	100.0	H	195.0	2.8	54.00	11.35
2390.000000	50.81	---	100.0	H	195.0	2.8	74.00	23.19
High Channel: 2462MHz								
2483.500000	51.28	---	200.0	V	111.0	3.0	74.00	22.72
2483.500000	---	43.88	200.0	V	111.0	3.0	54.00	10.12
2483.500000	50.08	---	150.0	H	227.0	3.0	74.00	23.92
2483.500000	---	42.77	150.0	H	227.0	3.0	54.00	11.23

For BLE 1Mbps Mode:**Spurious Emission Test:****30MHz-1GHz**

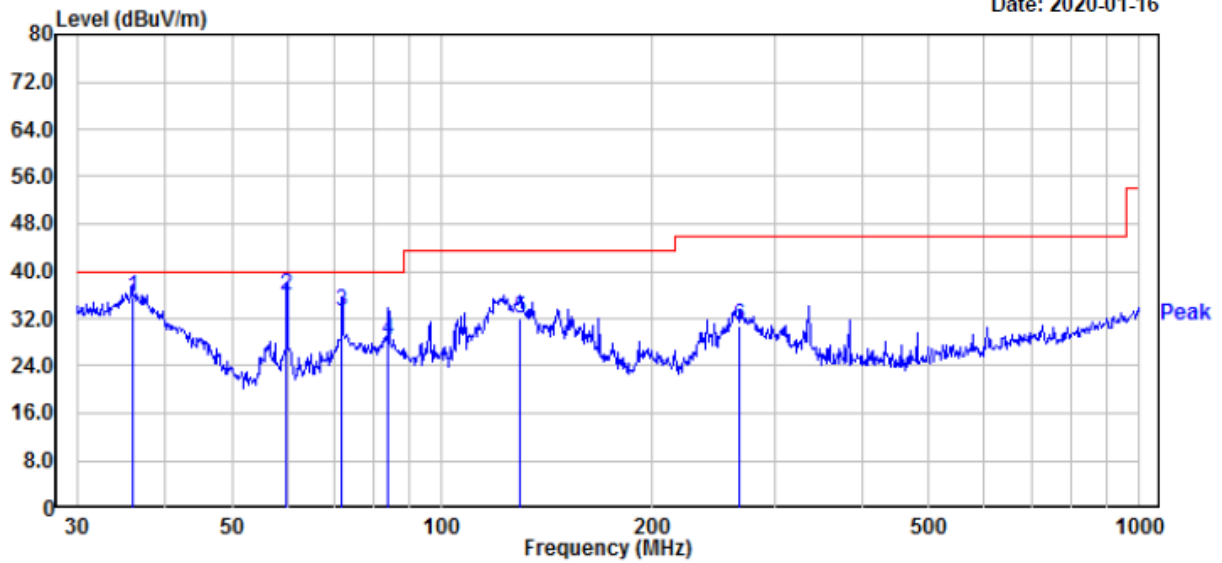
(Pre-scan with low, middle and high channels of operation in the X,Y and Z axes of orientation, the worst case **middle channel of operation in the X axis of orientation** was recorded)

Horizontal

	Read			Limit	Over	APos	TPos	
	Freq	Level	Factor	Level	Line	Limit		Remark
	MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	cm	deg
1	59.86	53.60	-17.55	36.05	40.00	-3.95	200	185 QP
2	71.83	48.59	-16.93	31.66	40.00	-8.34	200	185 QP
3	83.82	47.51	-17.21	30.30	40.00	-9.70	200	172 QP
4	96.10	47.10	-15.65	31.45	43.50	-12.05	200	141 QP
5	122.83	41.40	-10.81	30.59	43.50	-12.91	200	351 QP
6	258.33	46.10	-11.69	34.41	46.00	-11.59	100	268 QP

Vertical

Date: 2020-01-16



	Freq	Read Level	Factor	Level	Limit Line	Over Limit	APos	TPos	Remark
	MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	cm	deg	
1	36.00	43.60	-8.12	35.48	40.00	-4.52	100	153	QP
2	59.86	53.60	-17.55	36.05	40.00	-3.95	100	178	QP
3	71.83	49.99	-16.93	33.06	40.00	-6.94	100	316	QP
4	83.82	45.71	-17.21	28.50	40.00	-11.50	100	147	QP
5	129.47	43.30	-11.20	32.10	43.50	-11.40	100	354	QP
6	267.55	42.01	-11.24	30.77	46.00	-15.23	200	330	QP

1GHz-18GHz

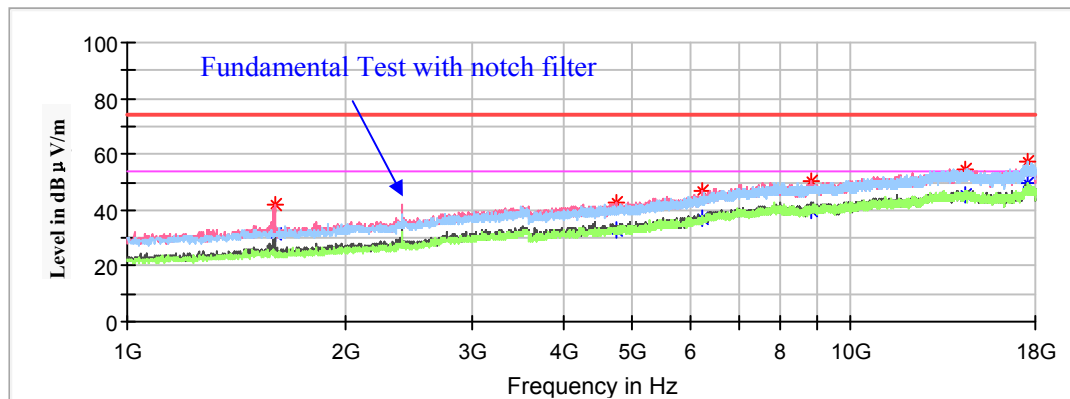
(Pre-scan in the X,Y and Z axes of orientation, the worst case **X-axis of orientation** was recorded)

Note:

1. This test was performed with the 2.4-2.5GHz notch filter.
2. Corrected Factor (dB/m) = Antenna factor (RX) (dB/m) + Cable Loss (dB) – Amplifier Factor (dB)
 Corrected Amplitude (dB μ V/m) = Corrected Factor (dB/m) + Reading (dB μ V)
 Margin (dB) = Limit (dB μ V/m) – Corrected Amplitude (dB μ V/m)

Low Channel: 2402MHz

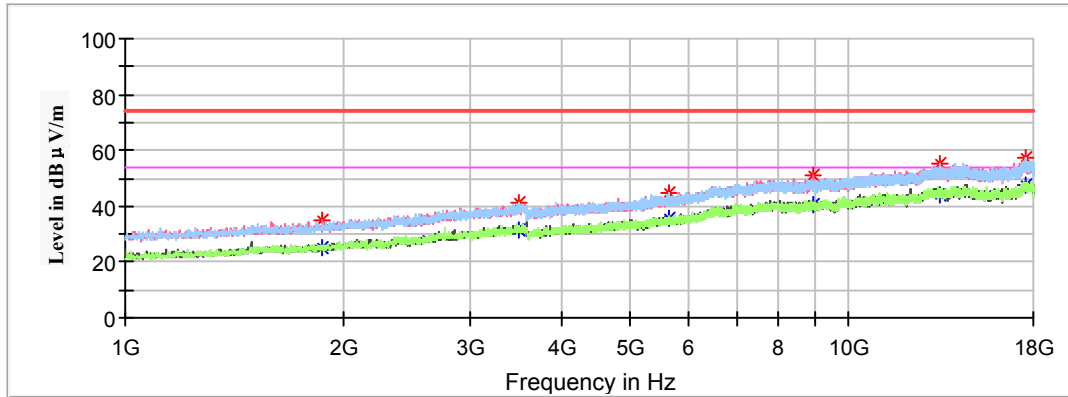
Full Spectrum



Frequency (MHz)	Corrected Amplitude		Rx Antenna		Turntable Degree	Corrected Factor (dB/m)	Limit (dB μ V/m)	Margin (dB)
	MaxPeak (dB μ V/m)	Average (dB μ V/m)	Height (cm)	Polar (H/V)				
1598.400000	---	31.69	150.0	V	263.0	-9.6	54.00	22.31
1598.400000	41.86	---	150.0	V	263.0	-9.6	74.00	32.14
4740.000000	---	32.90	200.0	V	0.0	-0.6	54.00	21.10
4740.000000	42.61	---	200.0	V	0.0	-0.6	74.00	31.39
6222.400000	---	37.15	150.0	V	199.0	3.2	54.00	16.85
6222.400000	46.87	---	150.0	V	199.0	3.2	74.00	27.13
8830.200000	50.02	---	150.0	V	352.0	7.2	74.00	23.98
8830.200000	---	40.06	150.0	V	352.0	7.2	54.00	13.94
14428.300000	---	45.25	200.0	V	1.0	12.7	54.00	8.75
14428.300000	54.78	---	200.0	V	1.0	12.7	74.00	19.22
17552.900000	---	49.48	150.0	H	358.0	14.2	54.00	4.52
17552.900000	57.18	---	150.0	H	358.0	14.2	74.00	16.82

Middle Channel: 2440MHz

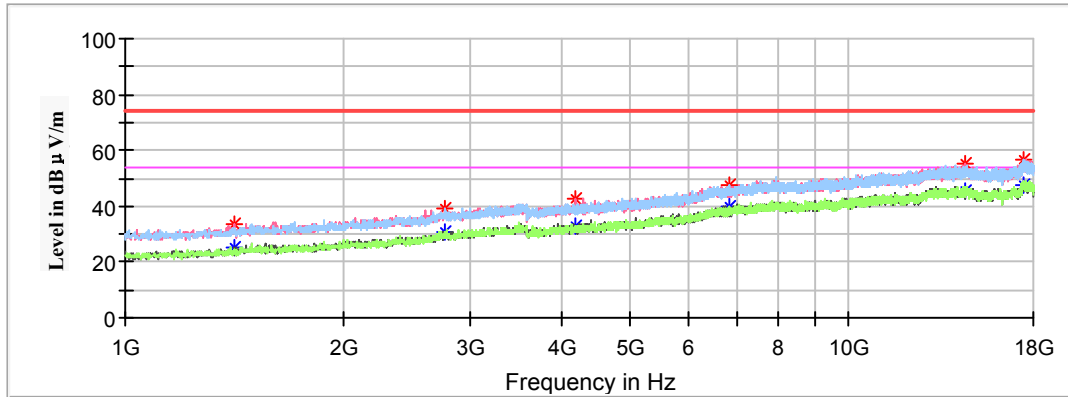
Full Spectrum



Frequency (MHz)	Corrected Amplitude		Rx Antenna		Turntable Degree	Corrected Factor (dB/m)	Limit (dB μ V/m)	Margin (dB)
	MaxPeak (dB μ V/m)	Average (dB μ V/m)	Height (cm)	Polar (H/V)				
1873.800000	---	24.99	150.0	V	0.0	-8.7	54.00	29.01
1873.800000	35.13	---	150.0	V	0.0	-8.7	74.00	38.87
3500.700000	---	31.26	200.0	V	205.0	-3.5	54.00	22.74
3500.700000	41.37	---	200.0	V	205.0	-3.5	74.00	32.63
5634.200000	---	35.42	150.0	V	133.0	1.6	54.00	18.58
5634.200000	44.89	---	150.0	V	133.0	1.6	74.00	29.11
8952.600000	---	40.36	200.0	V	139.0	7.6	54.00	13.64
8952.600000	50.87	---	200.0	V	139.0	7.6	74.00	23.13
13370.900000	---	44.04	200.0	H	345.0	12.0	54.00	9.96
13370.900000	55.41	---	200.0	H	345.0	12.0	74.00	18.59
17510.400000	---	47.50	150.0	H	78.0	14.3	54.00	6.50
17510.400000	57.16	---	150.0	H	78.0	14.3	74.00	16.84

High Channel: 2480MHz

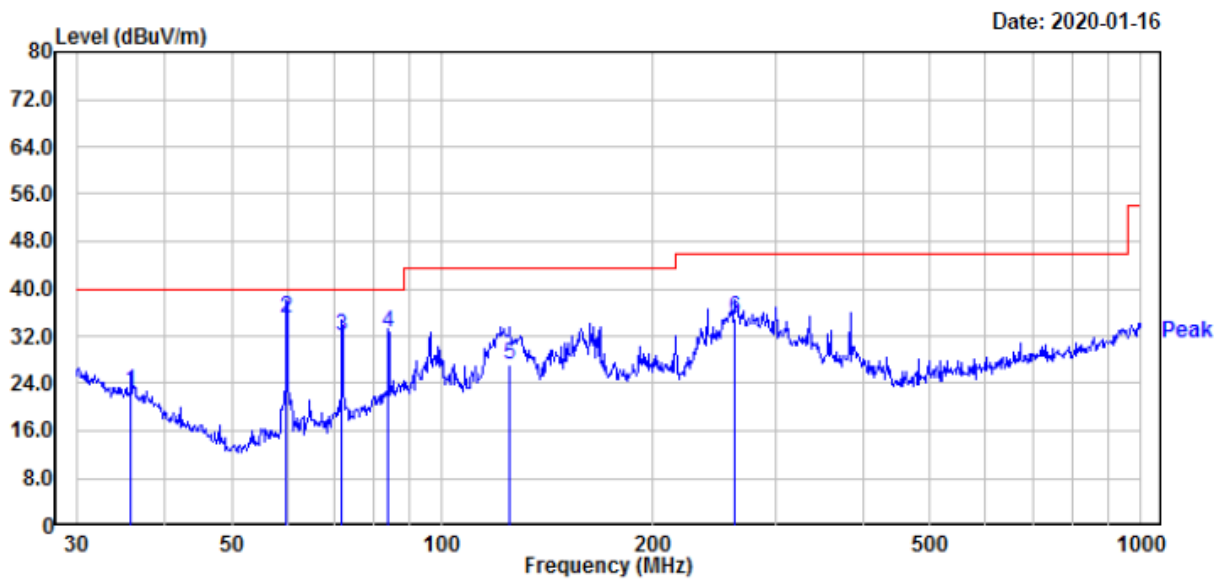
Full Spectrum



Frequency (MHz)	Corrected Amplitude		Rx Antenna		Turntable Degree	Corrected Factor (dB/m)	Limit (dB μ V/m)	Margin (dB)
	MaxPeak (dB μ V/m)	Average (dB μ V/m)	Height (cm)	Polar (H/V)				
1414.800000	---	24.93	150.0	V	176.0	-10.4	54.00	29.07
1414.800000	33.58	---	150.0	V	176.0	-10.4	74.00	40.42
2773.100000	---	30.53	200.0	H	68.0	-5.5	54.00	23.47
2773.100000	39.19	---	200.0	H	68.0	-5.5	74.00	34.81
4202.800000	---	32.91	150.0	V	323.0	-1.5	54.00	21.09
4202.800000	42.48	---	150.0	V	323.0	-1.5	74.00	31.52
6831.000000	---	39.53	200.0	H	291.0	5.0	54.00	14.47
6831.000000	47.89	---	200.0	H	291.0	5.0	74.00	26.11
14470.800000	---	45.58	200.0	V	18.0	12.7	54.00	8.42
14470.800000	54.94	---	200.0	V	18.0	12.7	74.00	19.06
17462.800000	---	47.29	150.0	H	98.0	14.1	54.00	6.71
17462.800000	56.94	---	150.0	H	98.0	14.1	74.00	17.06

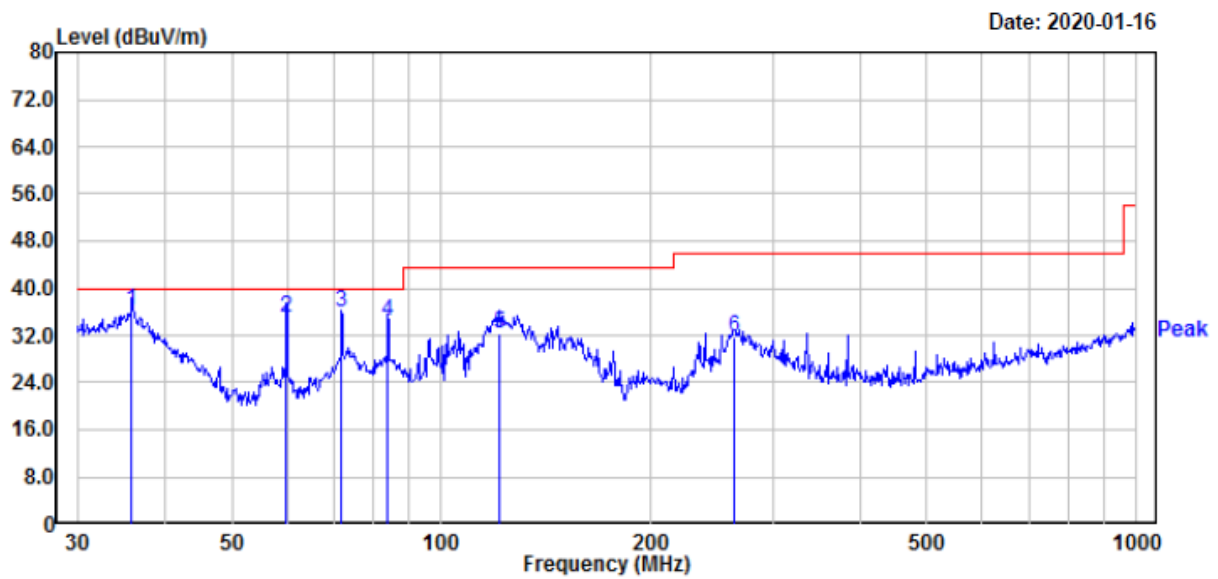
For BLE 2Mbps Mode:**Spurious Emission Test:****30MHz-1GHz**

(Pre-scan with low, middle and high channels of operation in the X,Y and Z axes of orientation, the worst case **middle channel of operation in the X axis of orientation** was recorded)

Horizontal

	Freq	Read Level	Factor	Level	Limit Line	Over Limit	APos	TPos	Remark
	MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	cm	deg	
1	35.87	30.81	-8.02	22.79	40.00	-17.21	200	213	QP
2	59.86	52.60	-17.55	35.05	40.00	-4.95	200	169	QP
3	71.83	48.79	-16.93	31.86	40.00	-8.14	200	169	QP
4	83.82	49.71	-17.21	32.50	40.00	-7.50	200	169	QP
5	125.01	38.10	-10.94	27.16	43.50	-16.34	200	330	QP
6	261.98	46.49	-11.50	34.99	46.00	-11.01	100	273	QP

Vertical



	Freq	Read Level	Factor	Level	Limit Line	Over Limit	APos	TPos	Remark
	MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	cm	deg	
1	35.87	44.21	-8.02	36.19	40.00	-3.81	100	159	QP
2	59.86	52.60	-17.55	35.05	40.00	-4.95	200	161	QP
3	71.83	52.79	-16.93	35.86	40.00	-4.14	100	248	QP
4	83.82	51.61	-17.21	34.40	40.00	-5.60	100	140	QP
5	121.55	42.90	-10.74	32.16	43.50	-11.34	100	171	QP
6	263.82	43.19	-11.41	31.78	46.00	-14.22	100	354	QP

1GHz-18GHz

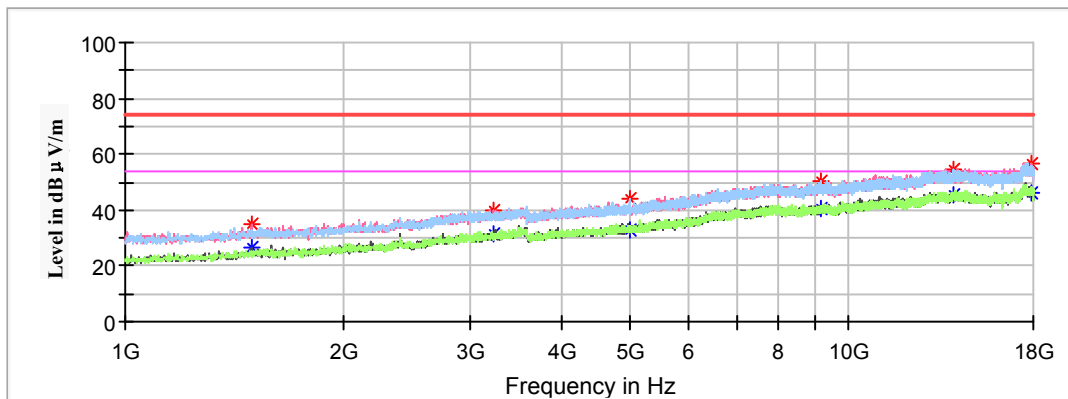
(Pre-scan in the X,Y and Z axes of orientation, the worst case **X-axis of orientation** was recorded)

Note:

1. This test was performed with the 2.4-2.5GHz notch filter.
2. Corrected Factor (dB/m) = Antenna factor (RX) (dB/m) + Cable Loss (dB) – Amplifier Factor (dB)
 Corrected Amplitude (dB μ V/m) = Corrected Factor (dB/m) + Reading (dB μ V)
 Margin (dB) = Limit (dB μ V/m) – Corrected Amplitude (dB μ V/m)

Low Channel: 2402MHz

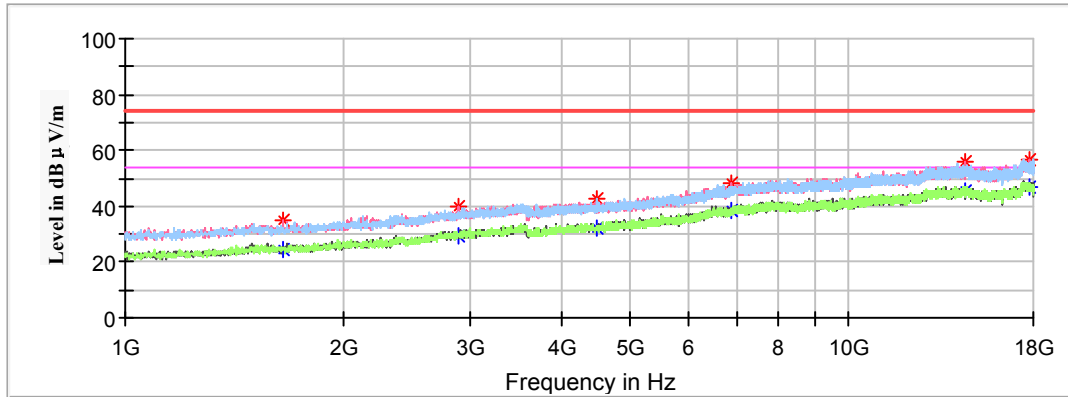
Full Spectrum



Frequency (MHz)	Corrected Amplitude		Rx Antenna		Turntable Degree	Corrected Factor (dB/m)	Limit (dB μ V/m)	Margin (dB)
	MaxPeak (dB μ V/m)	Average (dB μ V/m)	Height (cm)	Polar (H/V)				
1493.000000	---	26.32	200.0	V	292.0	-10.0	54.00	27.68
1493.000000	34.81	---	200.0	V	292.0	-10.0	74.00	39.19
3227.000000	---	31.15	200.0	V	68.0	-4.0	54.00	22.85
3227.000000	39.97	---	200.0	V	68.0	-4.0	74.00	34.03
4971.200000	---	32.77	200.0	H	331.0	-0.3	54.00	21.23
4971.200000	43.71	---	200.0	H	331.0	-0.3	74.00	30.29
9171.900000	---	40.23	150.0	H	206.0	7.7	54.00	13.77
9171.900000	50.58	---	150.0	H	206.0	7.7	74.00	23.42
13976.100000	---	45.24	150.0	H	36.0	12.5	54.00	8.76
13976.100000	54.85	---	150.0	H	36.0	12.5	74.00	19.15
17862.300000	---	46.02	200.0	V	182.0	13.7	54.00	7.98
17862.300000	56.72	---	200.0	V	182.0	13.7	74.00	17.28

Middle Channel: 2440MHz

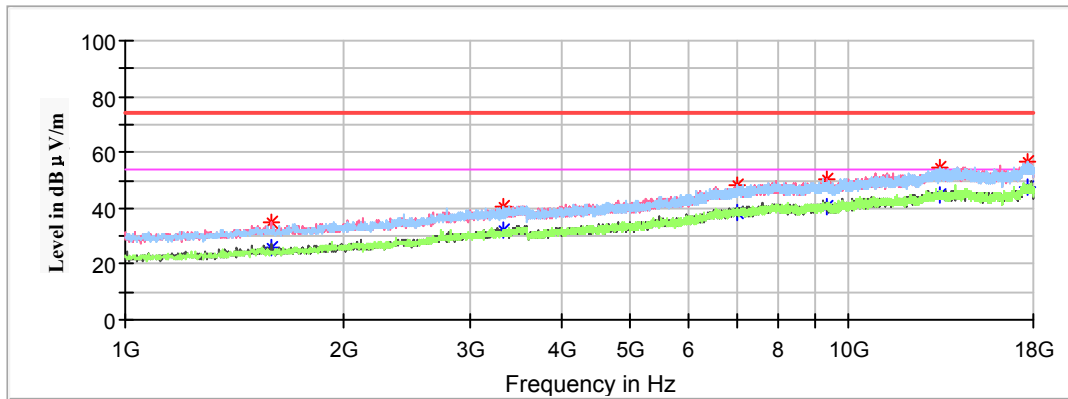
Full Spectrum



Frequency (MHz)	Corrected Amplitude		Rx Antenna		Turntable Degree	Corrected Factor (dB/m)	Limit (dBμV/m)	Margin (dB)
	MaxPeak (dBμV/m)	Average (dBμV/m)	Height (cm)	Polar (H/V)				
1651.100000	---	24.34	150.0	V	186.0	-9.4	54.00	29.66
1651.100000	34.68	---	150.0	V	186.0	-9.4	74.00	39.32
2888.700000	39.89	---	150.0	V	356.0	-4.9	74.00	34.11
2888.700000	---	29.38	150.0	V	356.0	-4.9	54.00	24.62
4476.500000	---	32.20	150.0	H	248.0	-1.0	54.00	21.80
4476.500000	42.64	---	150.0	H	248.0	-1.0	74.00	31.36
6866.700000	---	38.60	150.0	V	272.0	5.1	54.00	15.40
6866.700000	48.11	---	150.0	V	272.0	5.1	74.00	25.89
14501.400000	---	45.79	150.0	V	2.0	12.7	54.00	8.21
14501.400000	56.02	---	150.0	V	2.0	12.7	74.00	17.98
17802.800000	---	46.57	200.0	V	313.0	13.8	54.00	7.43
17802.800000	56.74	---	200.0	V	313.0	13.8	74.00	17.26

High Channel: 2480MHz

Full Spectrum

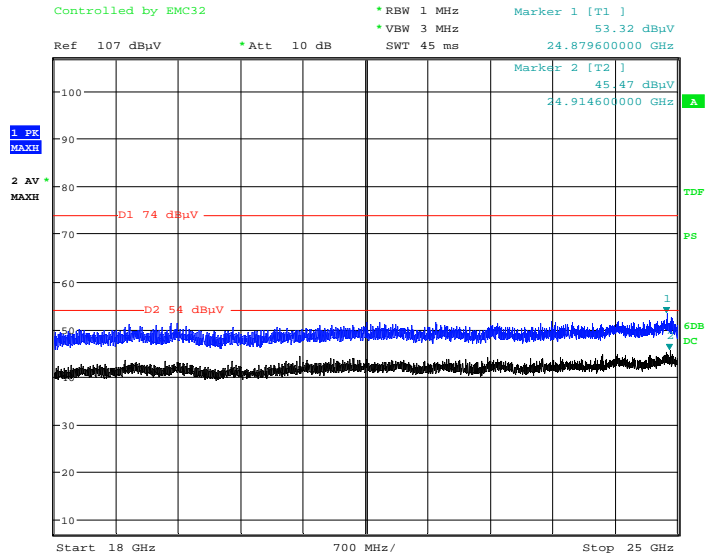


Frequency (MHz)	Corrected Amplitude		Rx Antenna		Turntable Degree	Corrected Factor (dB/m)	Limit (dBμV/m)	Margin (dB)
	MaxPeak (dBμV/m)	Average (dBμV/m)	Height (cm)	Polar (H/V)				
1591.600000	---	25.88	150.0	V	33.0	-9.6	54.00	28.12
1591.600000	34.67	---	150.0	V	33.0	-9.6	74.00	39.33
3339.200000	---	32.36	200.0	H	10.0	-3.8	54.00	21.64
3339.200000	40.31	---	200.0	H	10.0	-3.8	74.00	33.69
6992.500000	48.39	---	150.0	V	271.0	5.3	74.00	25.61
6992.500000	---	38.74	150.0	V	271.0	5.3	54.00	15.26
9314.700000	---	40.91	150.0	V	325.0	7.7	54.00	13.09
9314.700000	50.45	---	150.0	V	325.0	7.7	74.00	23.55
13340.300000	---	44.61	200.0	V	119.0	12.0	54.00	9.39
13340.300000	54.74	---	200.0	V	119.0	12.0	74.00	19.26
17631.100000	---	47.25	150.0	H	118.0	14.1	54.00	6.75
17631.100000	56.43	---	150.0	H	118.0	14.1	74.00	17.57

18GHz-25GHz

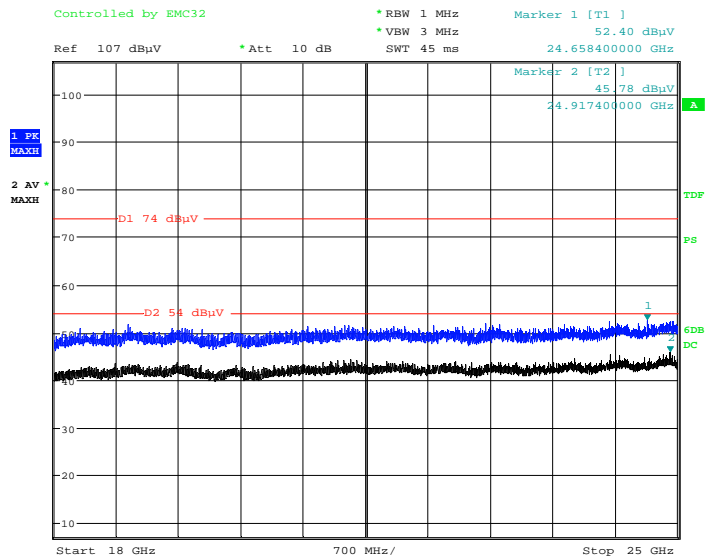
(Pre-scan with low, middle and high channels of operation in the X,Y and Z axes of orientation, the worst case **middle** channel of 2Mbps operation in the X axis of orientation was recorded)

Horizontal



Date: 18.JAN.2020 15:33:05

Vertical



Date: 18.JAN.2020 15:17:20

Restricted Bands Emissions Test:

(Pre-scan in the X,Y and Z axes of orientation, the worst case **X-axis of orientation** was recorded)

Note:

1. Corrected Factor (dB/m) = Antenna factor (RX) (dB/m) + Cable Loss (dB) – Amplifier Factor (dB)

Corrected Amplitude (dBμV/m) = Corrected Factor (dB/m) + Reading (dBμV)

Margin (dB) = Limit (dBμV/m) – Corrected Amplitude (dBμV/m)

BLE 1Mbps Mode

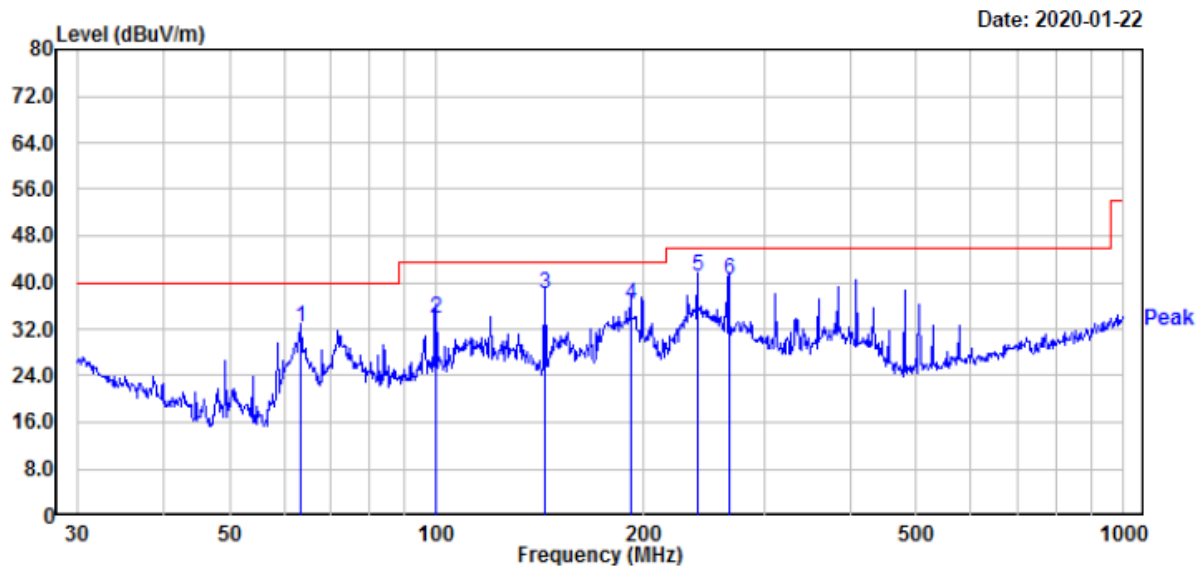
Frequency (MHz)	Corrected Amplitude		Rx Antenna		Turntable Degree	Corrected Factor (dB/m)	Limit (dBμV/m)	Margin (dB)
	MaxPeak (dBμV/m)	Average (dBμV/m)	Height (cm)	Polar (H/V)				
Low Channel: 2402MHz								
2390.000000	51.83	---	200.0	V	60.0	2.8	74.00	22.17
2390.000000	---	43.16	200.0	V	60.0	2.8	54.00	10.84
2390.000000	---	42.18	100.0	H	124.0	2.8	54.00	11.82
2390.000000	50.23	---	100.0	H	124.0	2.8	74.00	23.77
High Channel: 2480MHz								
2483.500000	---	44.28	100.0	V	32.0	3.0	54.00	9.72
2483.500000	51.22	---	100.0	V	32.0	3.0	74.00	22.78
2483.500000	---	43.14	200.0	H	233.0	3.0	54.00	10.86
2483.500000	50.56	---	200.0	H	233.0	3.0	74.00	23.44

BLE 2Mbps Mode

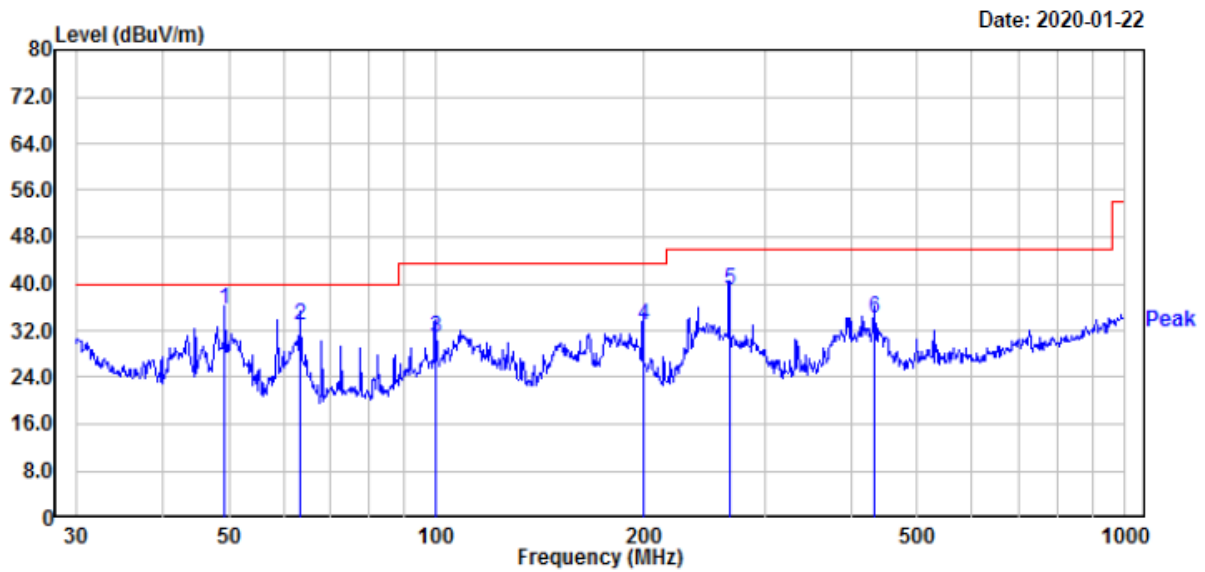
Frequency (MHz)	Corrected Amplitude		Rx Antenna		Turntable Degree	Corrected Factor (dB/m)	Limit (dBμV/m)	Margin (dB)
	MaxPeak (dBμV/m)	Average (dBμV/m)	Height (cm)	Polar (H/V)				
Low Channel: 2402MHz								
2390.000000	---	42.73	200.0	V	352.0	2.8	54.00	11.27
2390.000000	50.66	---	200.0	V	352.0	2.8	74.00	23.34
2390.000000	---	41.56	100.0	H	308.0	2.8	54.00	12.44
2390.000000	49.87	---	100.0	H	308.0	2.8	74.00	24.13
High Channel: 2480MHz								
2483.500000	---	43.55	200.0	V	342.0	3.0	54.00	10.45
2483.500000	51.10	---	200.0	V	342.0	3.0	74.00	22.90
2483.500000	---	42.69	200.0	H	235.0	3.0	54.00	11.31
2483.500000	50.24	---	200.0	H	235.0	3.0	74.00	23.76

Transmitting simultaneously test:**30MHz-1GHz**

(The worst case **middle channel of Wi-Fi 802.11b mode & middle channel of BLE 2Mbps mode & GSM850** in the **X axis of orientation** was recorded)

Horizontal

	Freq	Read Level	Factor	Level	Limit Line	Over Limit	APos	TPos	Remark
	MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	cm	deg	
1	63.54	49.51	-17.33	32.18	40.00	-7.82	200	354	QP
2	99.88	48.60	-14.65	33.95	43.50	-9.55	200	306	QP
3	143.83	49.71	-11.82	37.89	43.50	-5.61	100	277	QP
4	191.75	48.40	-12.17	36.23	43.50	-7.27	100	346	QP
5	239.99	53.70	-12.74	40.96	46.00	-5.04	100	92	QP
6	266.61	51.60	-11.28	40.32	46.00	-5.68	100	86	QP

Vertical

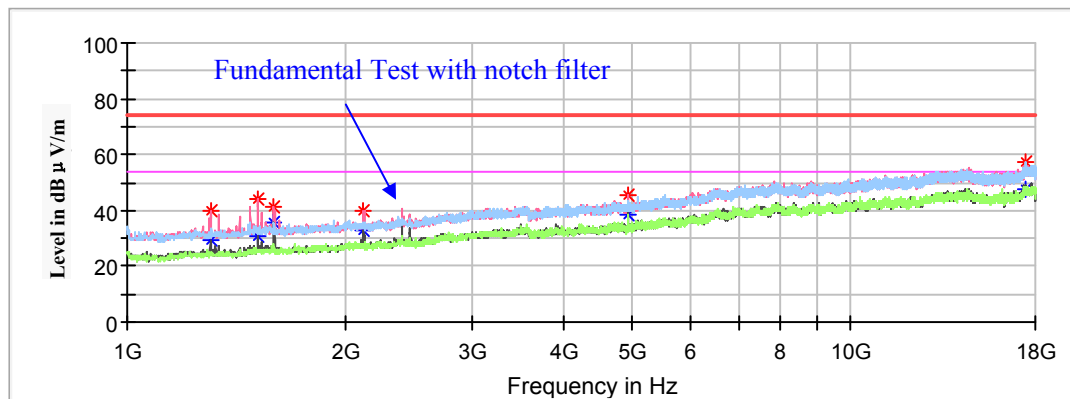
	Freq	Read Level	Factor	Level	Limit Line	Over Limit	APos	TPos	Remark
	MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	cm	deg	
1	49.36	52.30	-16.59	35.71	40.00	-4.29	100	108	QP
2	63.54	50.31	-17.33	32.98	40.00	-7.02	100	299	QP
3	99.88	45.37	-14.65	30.72	43.50	-12.78	200	259	QP
4	199.99	44.51	-11.62	32.89	43.50	-10.61	200	16	QP
5	266.61	50.10	-11.28	38.82	46.00	-7.18	200	154	QP
6	432.55	41.19	-6.96	34.23	46.00	-11.77	100	132	QP

1GHz-18GHz

Note:

1. This test was performed with the 2.4-2.5GHz notch filter.
2. Corrected Factor (dB/m) = Antenna factor (RX) (dB/m) + Cable Loss (dB) – Amplifier Factor (dB)
 Corrected Amplitude (dB μ V/m) = Corrected Factor (dB/m) + Reading (dB μ V)
 Margin (dB) = Limit (dB μ V/m) – Corrected Amplitude (dB μ V/m)

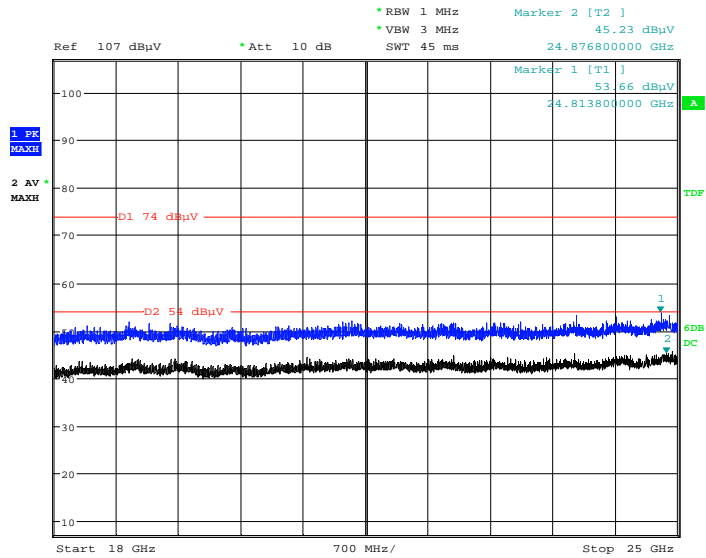
Full Spectrum



Frequency (MHz)	Corrected Amplitude		Rx Antenna		Turntable Degree	Corrected Factor (dB/m)	Limit (dB μ V/m)	Margin (dB)
	MaxPeak (dB μ V/m)	Average (dB μ V/m)	Height (cm)	Polar (H/V)				
1302.600000	---	29.34	150.0	V	324.0	-11.0	54.00	24.66
1302.600000	40.19	---	150.0	V	324.0	-11.0	74.00	33.81
1516.800000	---	30.84	200.0	V	302.0	-9.9	54.00	23.16
1516.800000	44.03	---	200.0	V	302.0	-9.9	74.00	29.97
1593.300000	41.24	---	150.0	V	313.0	-9.6	74.00	32.76
1593.300000	---	35.97	150.0	V	313.0	-9.6	54.00	18.03
2123.700000	---	33.11	100.0	V	330.0	-7.9	54.00	20.89
2123.700000	39.67	---	100.0	V	330.0	-7.9	74.00	34.33
4923.600000	---	38.22	200.0	H	16.0	-0.4	54.00	15.78
4923.600000	45.17	---	200.0	H	16.0	-0.4	74.00	28.83
17427.100000	---	47.29	200.0	H	269.0	13.9	54.00	6.71
17427.100000	57.10	---	200.0	H	269.0	13.9	74.00	16.90

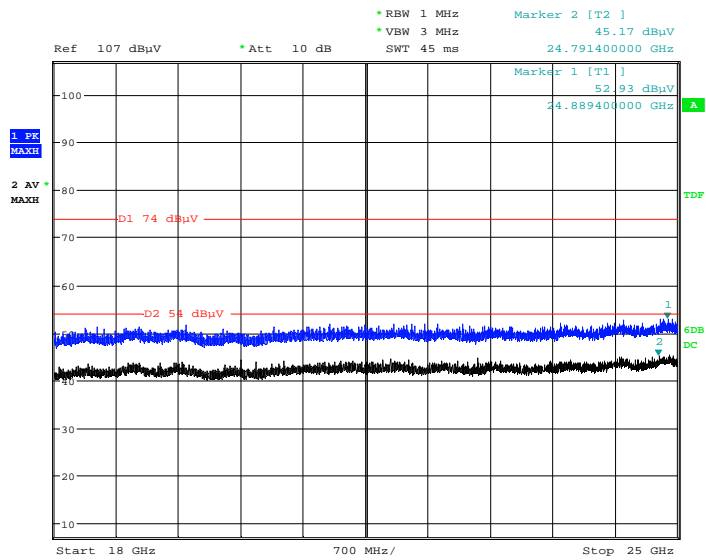
18GHz-25GHz

Horizontal

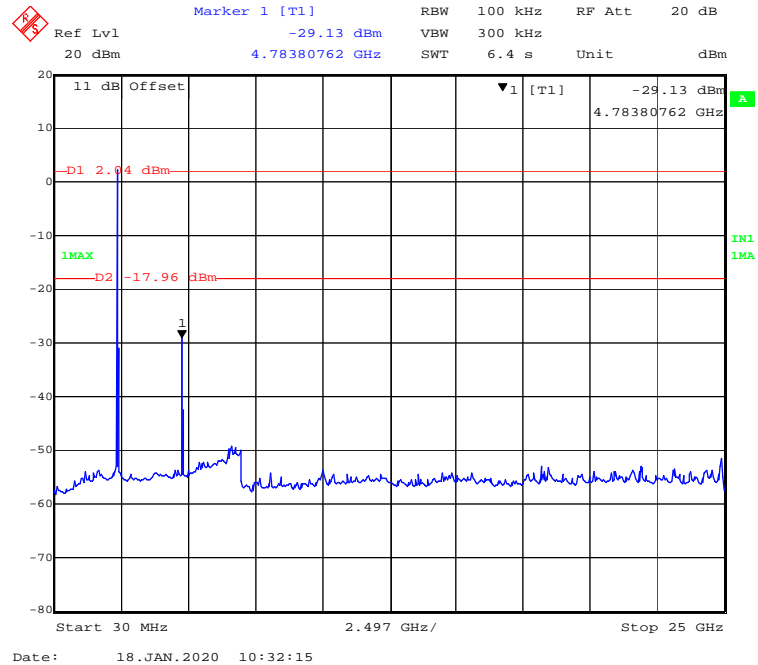
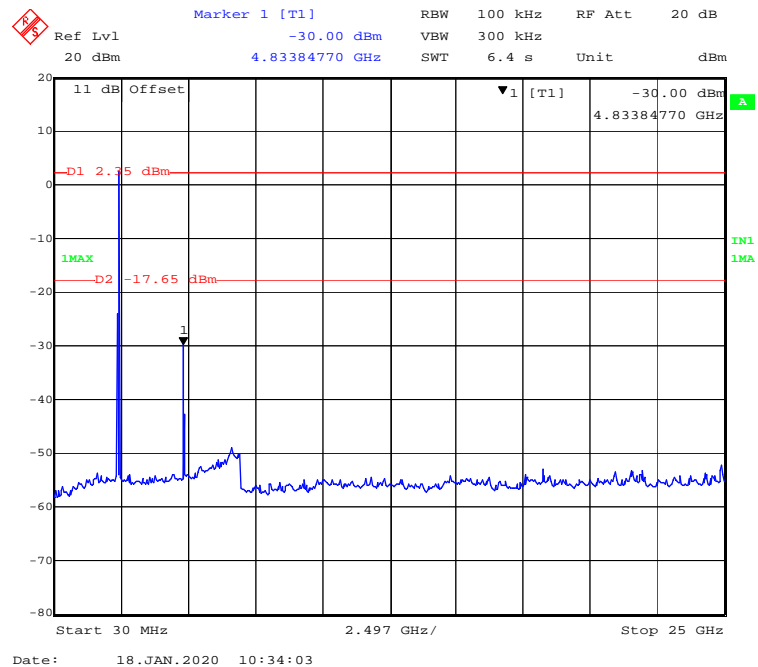


Date: 22.JAN.2020 10:34:48

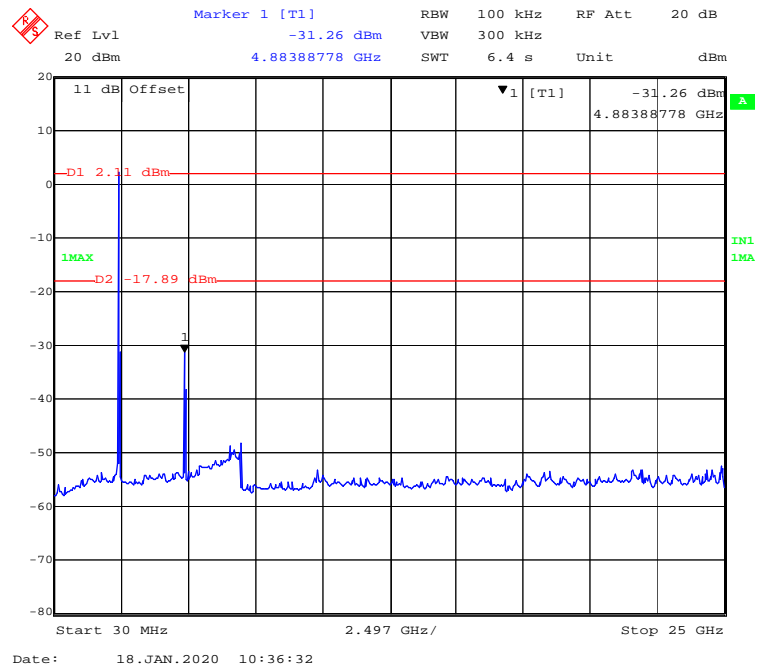
Vertical



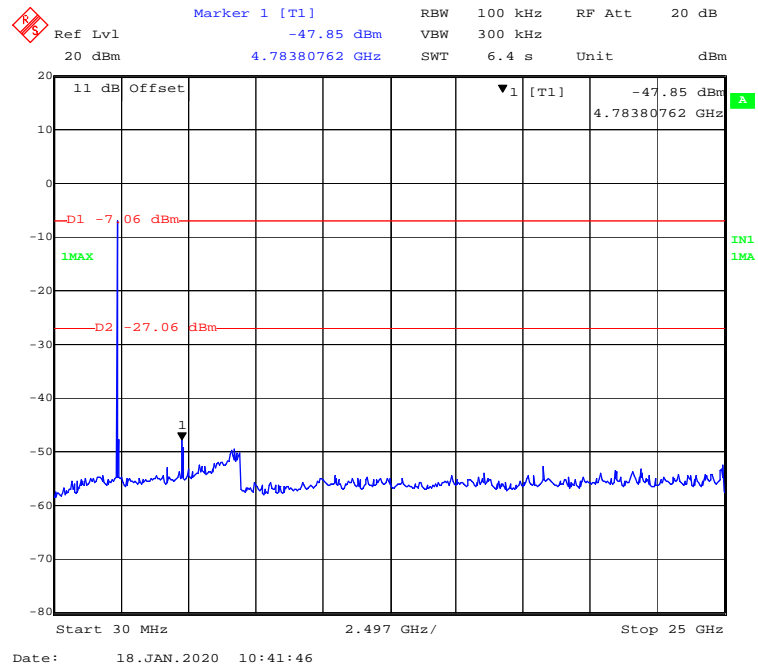
Date: 22.JAN.2020 11:00:16

Conducted Spurious Emissions at Antenna Port**802.11b Mode Low Channel****802.11b Mode Middle Channel**

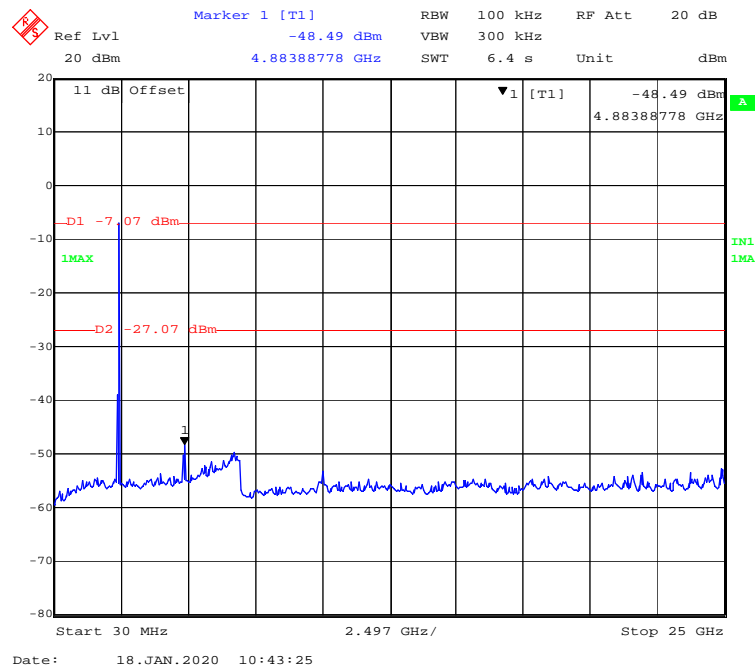
802.11b Mode High Channel



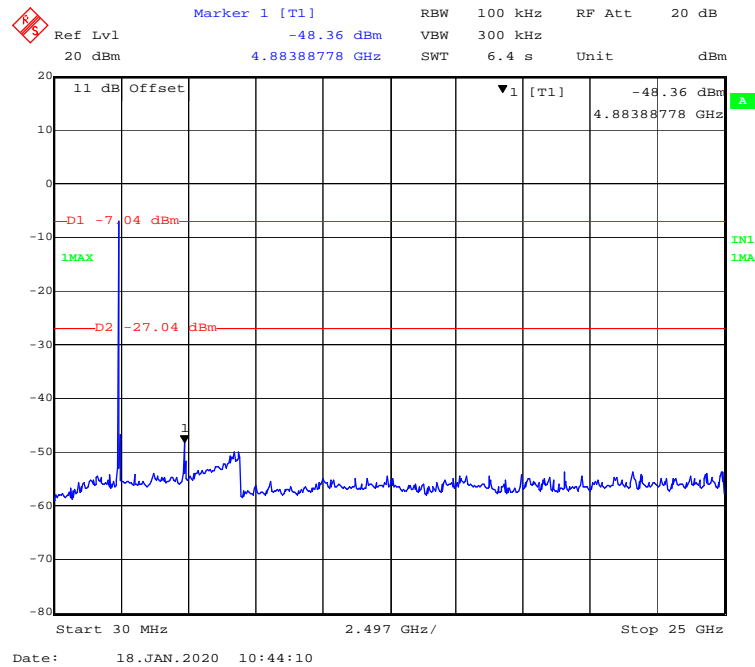
802.11g Mode Low Channel



802.11g Mode Middle Channel



802.11g Mode High Channel



Marker 1 [T1]
-49.03 dBm
RBW 100 kHz RF Att 20 dB
Ref Lvl 20 dBm 4.78380762 GHz SWT 6.4 s Unit dBm

11 dB Offset
▼ 1 [T1]
-49.03 dBm
4.78380762 GHz

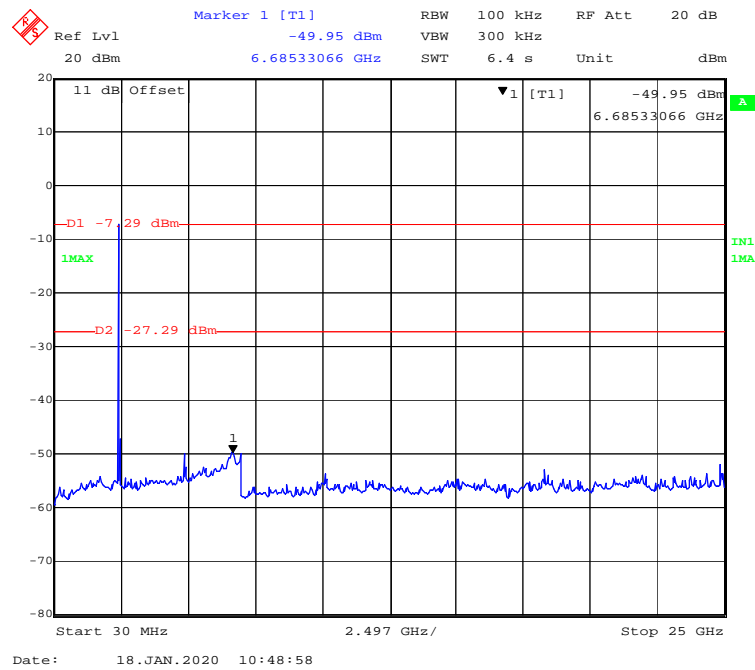
D1 -7.58 dBm
1MAX
D2 -27.58 dBm
IN1 1MA

Start 30 MHz 2.497 GHz/ Stop 25 GHz

Date: 18.JAN.2020 10:46:16

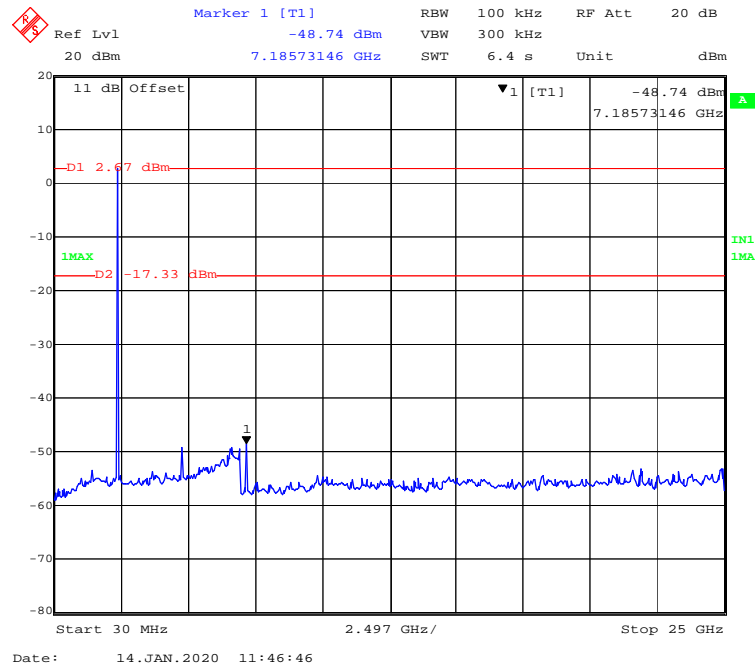
Ref Lvl 20 dBm
 Marker 1 [T1] -49.08 dBm
 RBW 100 kHz
 RF Att 20 dB
 Unit dBm
 6.63529058 GHz
 SWT 6.4 s
 -49.08 dBm
 6.63529058 GHz
 D1 -7.63 dBm
 1MAX
 D2 -27.63 dBm
 1
 Start 30 MHz
 2.497 GHz/
 Stop 25 GHz
 Date: 18.JAN.2020 10:48:02

802.11n-HT20 Mode High Channel

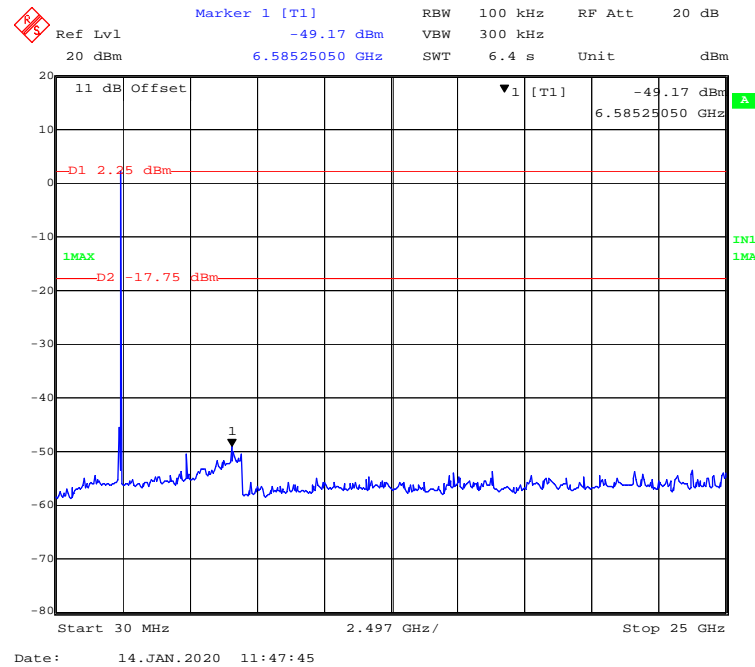


BLE 1Mbps Mode

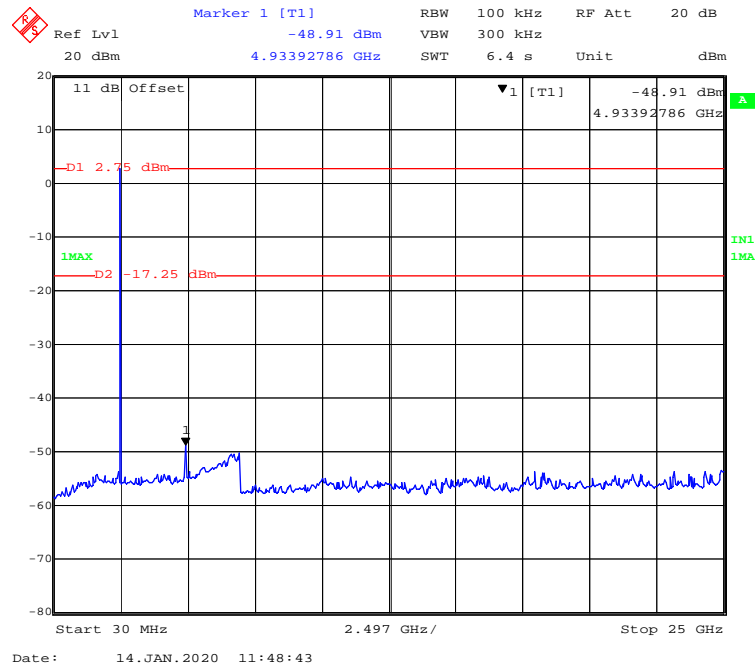
Low Channel



Middle Channel

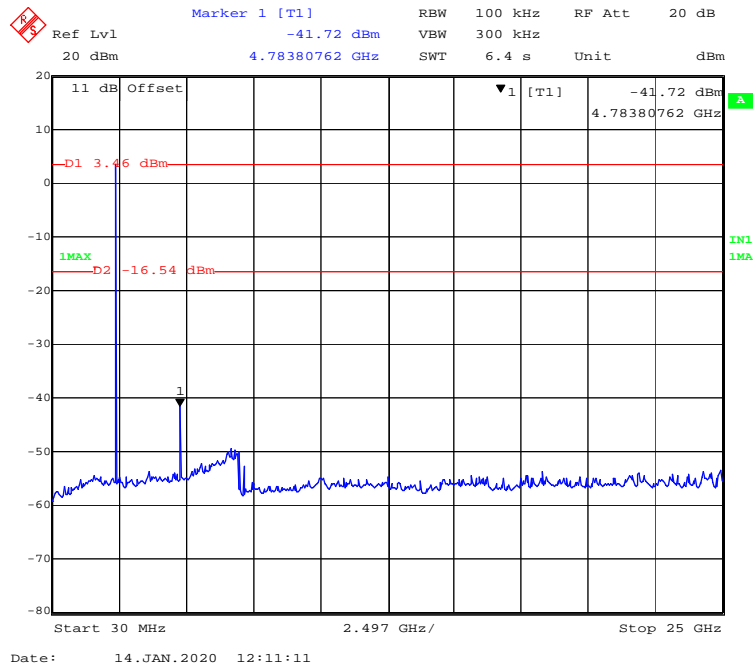


High Channel

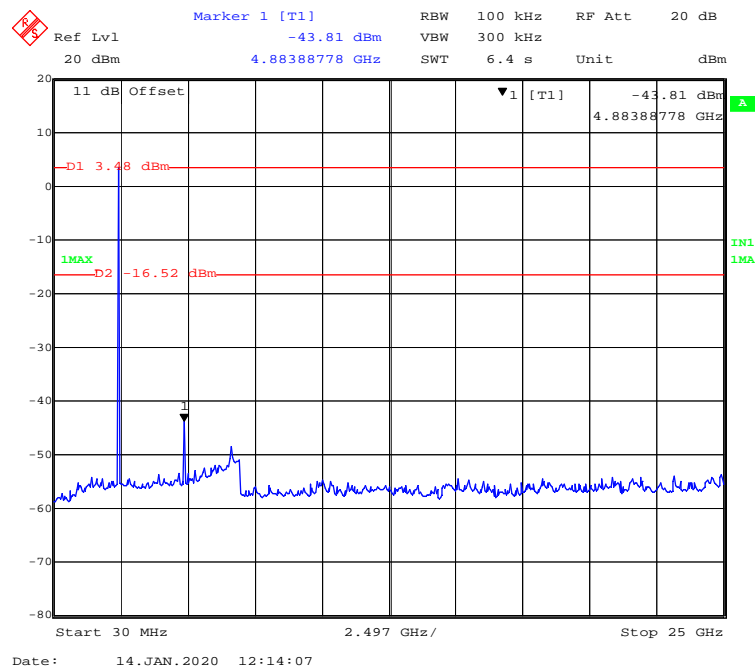


BLE 2Mbps Mode

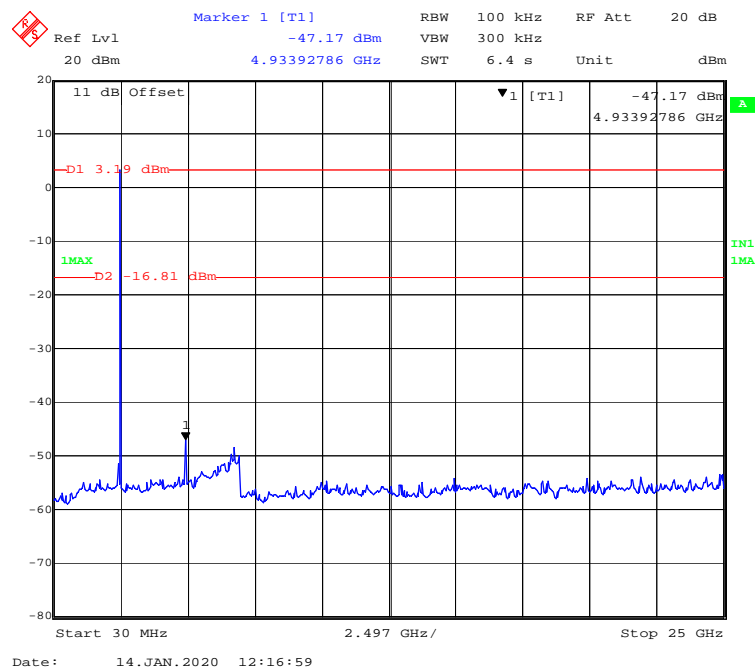
Low Channel



Middle Channel



High Channel



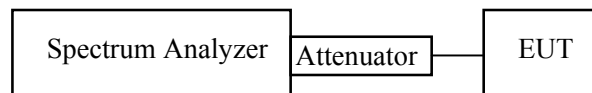
FCC §15.247(a) (2) – 6 dB EMISSION BANDWIDTH**Applicable Standard**

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

Test Procedure

According to ANSI C63.10-2013 sub-clause 11.8.1

1. Set RBW = 100 kHz.
2. Set the video bandwidth (VBW) $\geq 3 \times$ RBW.
3. Detector = Peak.
4. Trace mode = max hold.
5. Sweep = auto couple.
6. Allow the trace to stabilize.
7. 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:	20.2-21.1 °C
Relative Humidity:	48-50 %
ATM Pressure:	100.6-101.3 kPa

The testing was performed by CK Huang from 2020-01-14 to 2020-01-18.

Test Result: Compliant.

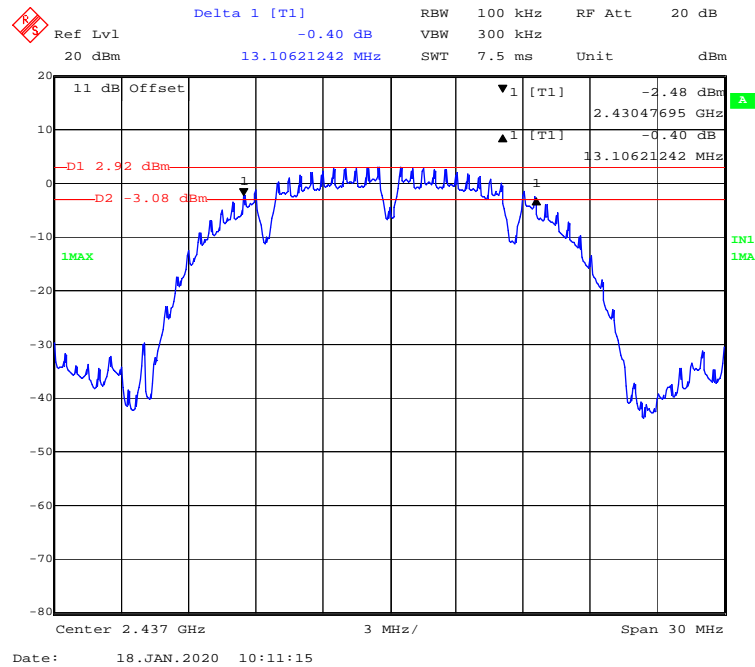
EUT operation mode: Transmitting

Channel	Frequency (MHz)	6 dB Emission Bandwidth (MHz)	Limit (MHz)
802.11b Mode			
Low	2412	13.107	≥ 0.5
Middle	2437	13.106	≥ 0.5
High	2462	13.587	≥ 0.5
802.11g Mode			
Low	2412	16.473	≥ 0.5
Middle	2437	16.533	≥ 0.5
High	2462	16.533	≥ 0.5
802.11n-HT20 Mode			
Low	2412	17.615	≥ 0.5
Middle	2437	17.615	≥ 0.5
High	2462	17.555	≥ 0.5
BLE 1Mbps Mode			
Low	2402	0.727	≥ 0.5
Middle	2440	0.727	≥ 0.5
High	2480	0.727	≥ 0.5
BLE 2Mbps Mode			
Low	2402	1.202	≥ 0.5
Middle	2440	1.202	≥ 0.5
High	2480	1.214	≥ 0.5

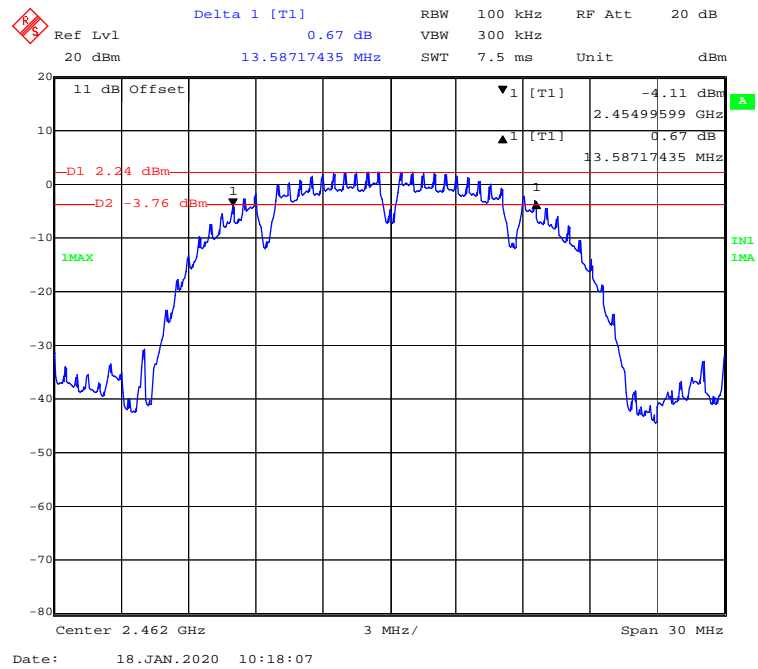
802.11b Mode Low Channel



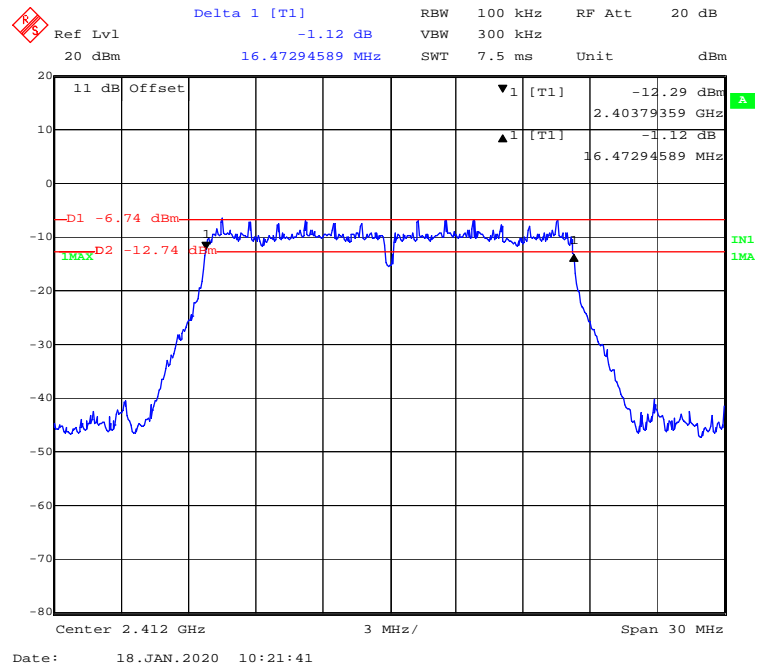
802.11b Mode Middle Channel



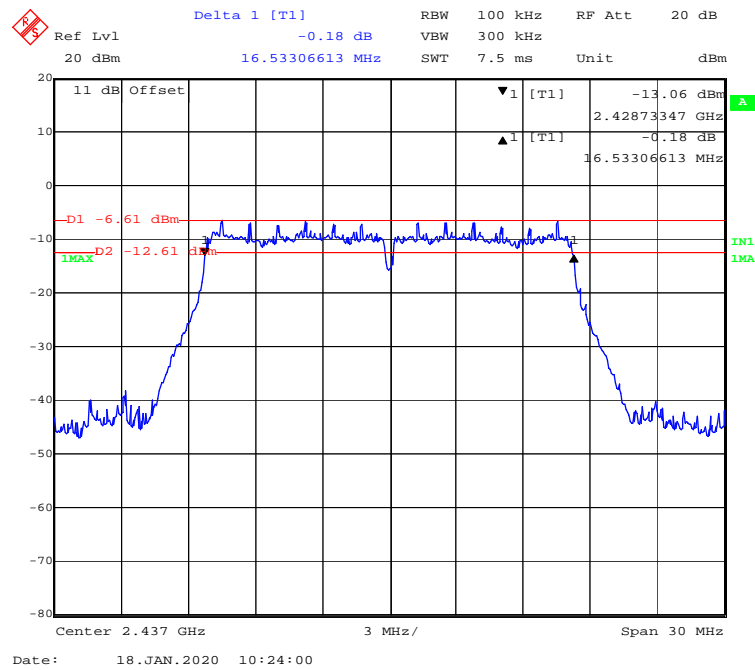
802.11b Mode High Channel



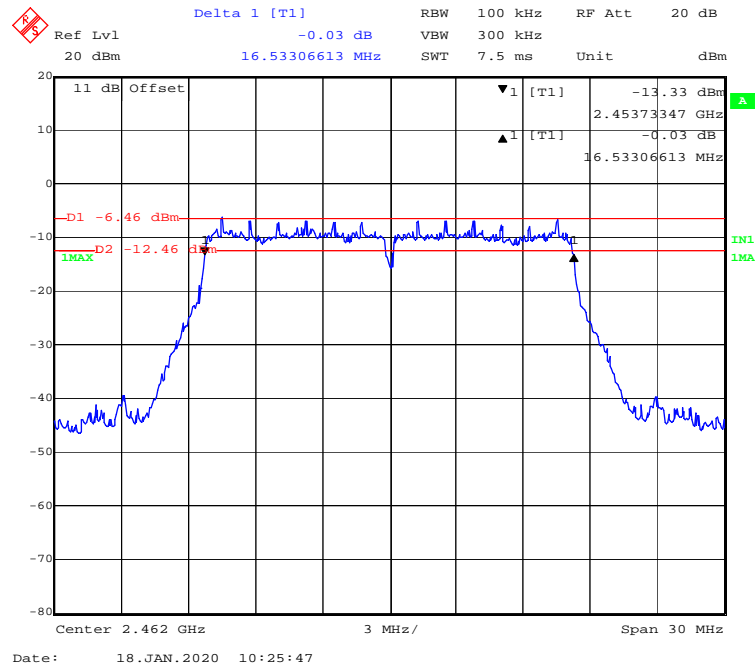
802.11g Mode Low Channel



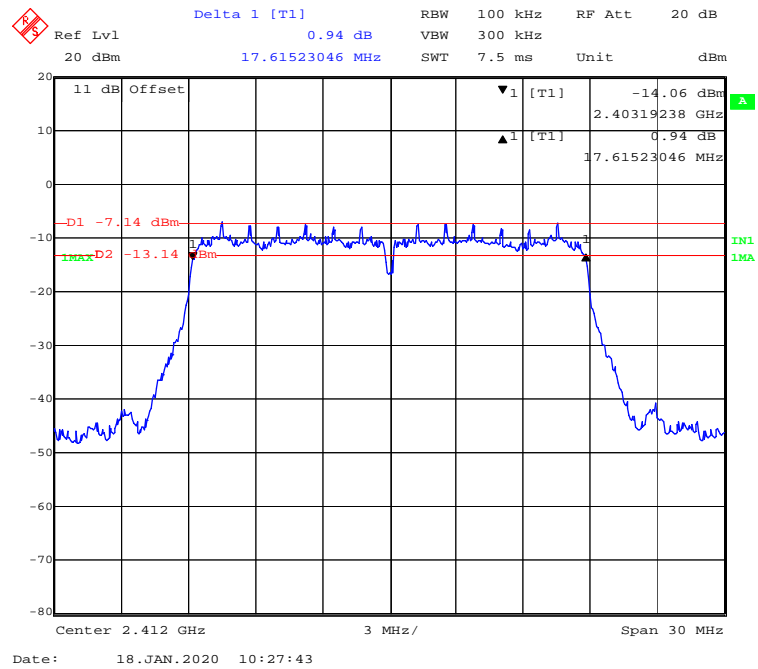
802.11g Mode Middle Channel



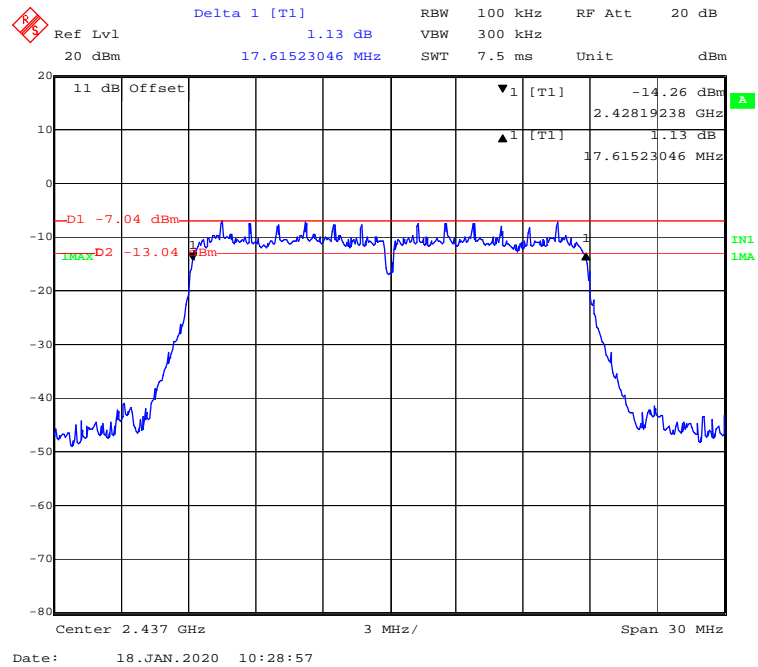
802.11g Mode High Channel



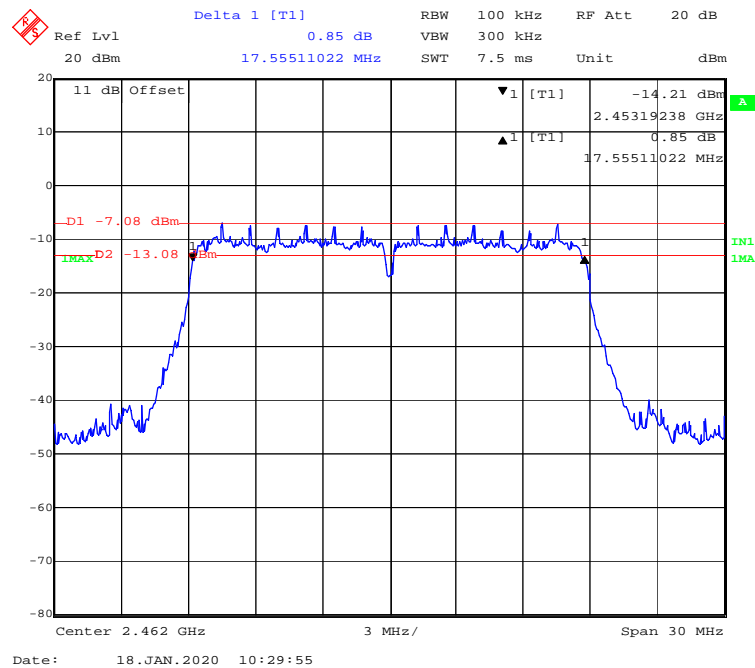
802.11n-HT20 Mode Low Channel



802.11n-HT20 Mode Middle Channel

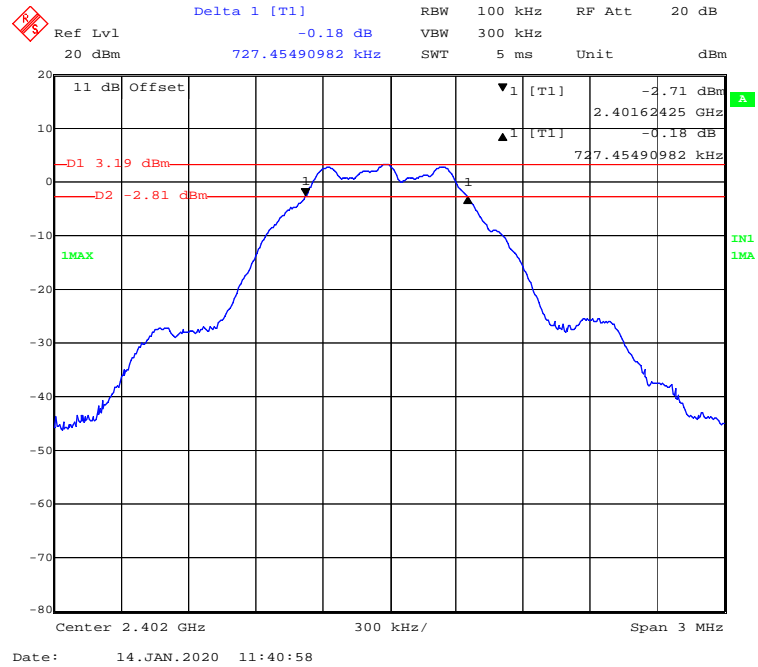


802.11n-HT20 Mode High Channel

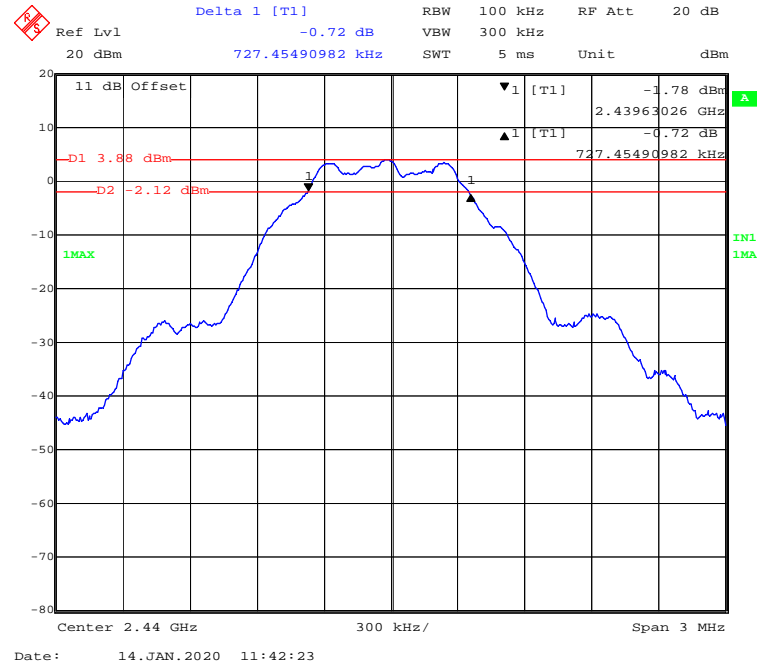


BLE 1Mbps Mode

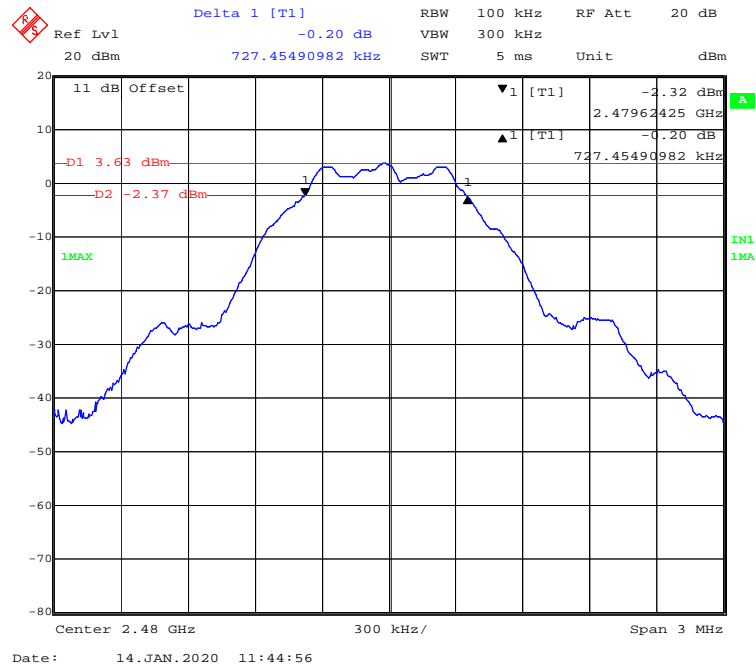
Low Channel



Middle Channel

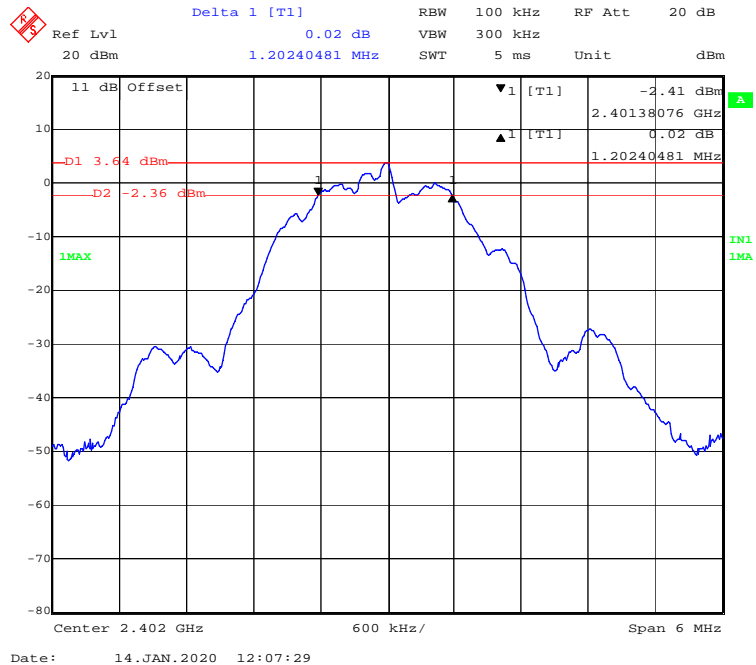


High Channel

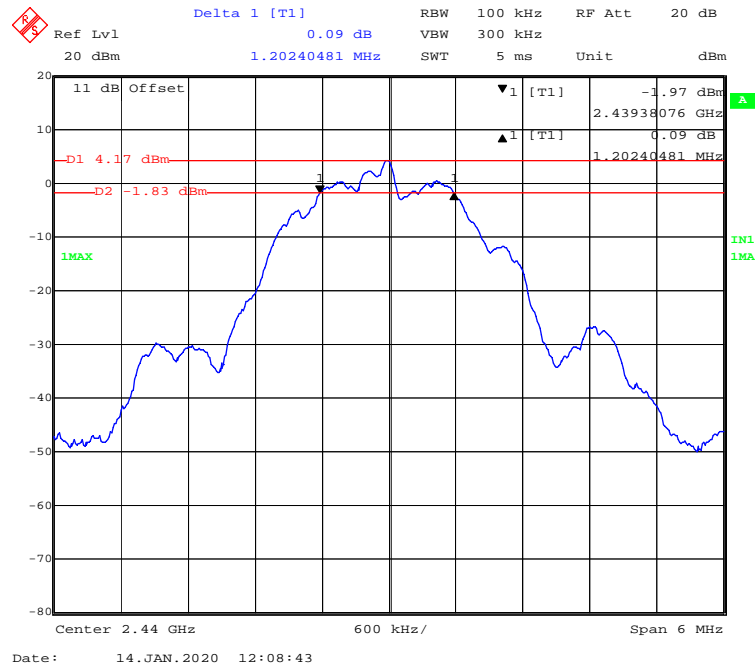


BLE 2Mbps Mode

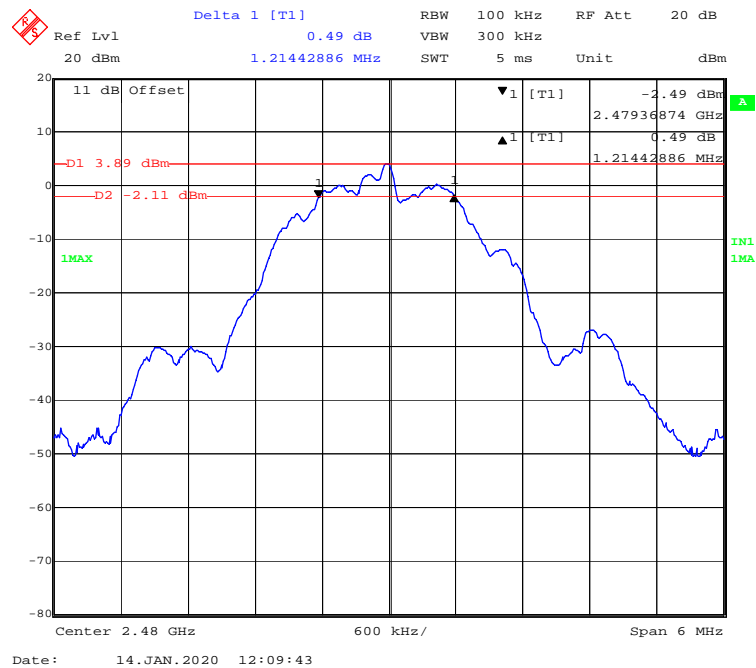
Low Channel



Middle Channel



High Channel



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

Applicable Standard

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

Test Procedure

For Wi-Fi:

According to ANSI C63.10-2013 sub-clause 11.9.1.3

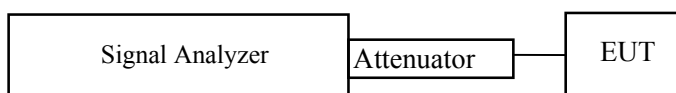
The maximum peak conducted output power may be measured using a broadband peak RF power meter. The power meter shall have a video bandwidth that is greater than or equal to the DTS bandwidth and shall use a fast-responding diode detector.



For BLE:

According to ANSI C63.10-2013 sub-clause 11.9.1.1

1. Set the RBW \geq DTS bandwidth.
2. Set VBW $\geq 3 \times$ RBW.
3. Set span $\geq 3 \times$ RBW
4. Sweep time = auto couple.
5. Detector = peak.
6. Trace mode = max hold.
7. Allow trace to fully stabilize.
8. Use peak marker function to determine the peak amplitude level.



Test Data**Environmental Conditions**

Temperature:	19.0-20.8 °C
Relative Humidity:	48-54 %
ATM Pressure:	101.0-101.2 kPa

The testing was performed by CK Huang from 2020-01-14 to 2020-01-18.

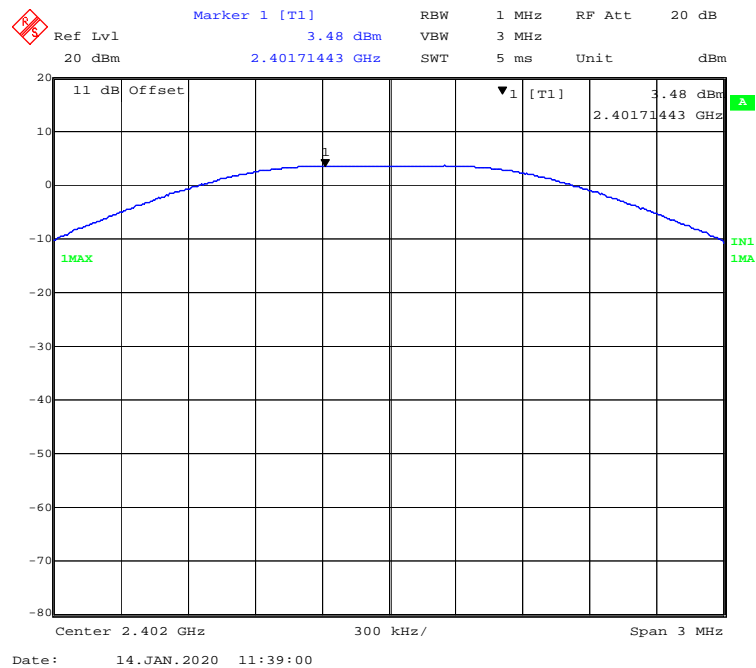
Test Result: Compliant.

EUT operation mode: Transmitting

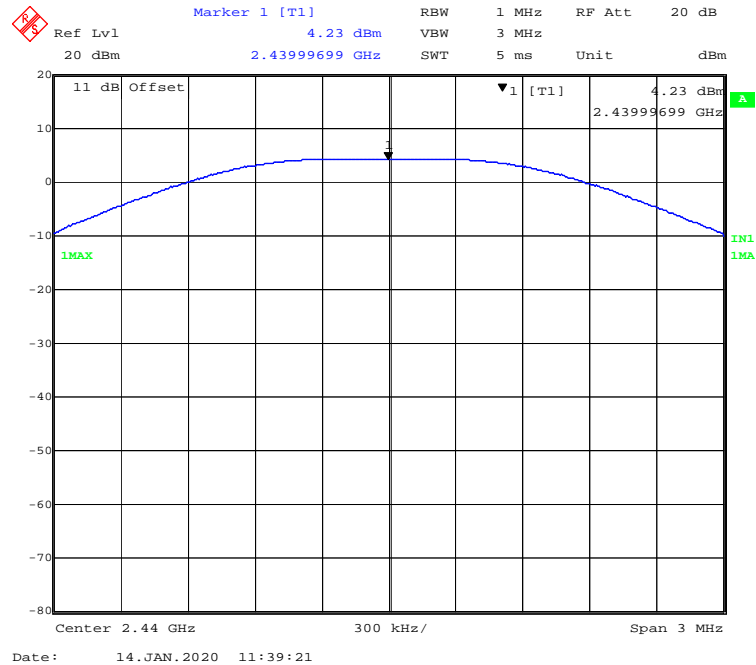
Channel	Frequency (MHz)	Max Conducted Peak Output Power (dBm)	Limit (dBm)	Result
802.11b Mode				
Low	2412	16.80	30	Pass
Middle	2437	16.92	30	Pass
High	2462	16.51	30	Pass
802.11g Mode				
Low	2412	13.32	30	Pass
Middle	2437	13.37	30	Pass
High	2462	13.50	30	Pass
802.11n-HT20 Mode				
Low	2412	12.67	30	Pass
Middle	2437	12.73	30	Pass
High	2462	12.65	30	Pass
BLE 1Mbps Mode				
Low	2402	3.48	30	Pass
Middle	2440	4.23	30	Pass
High	2480	3.86	30	Pass
BLE 2Mbps Mode				
Low	2402	3.87	30	Pass
Middle	2440	4.39	30	Pass
High	2480	4.12	30	Pass

BLE 1Mbps Mode

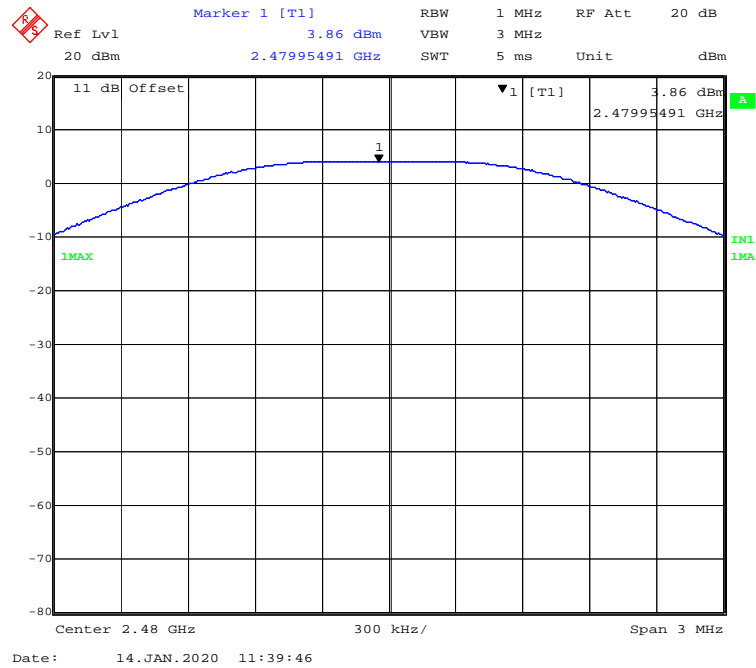
Low Channel



Middle Channel

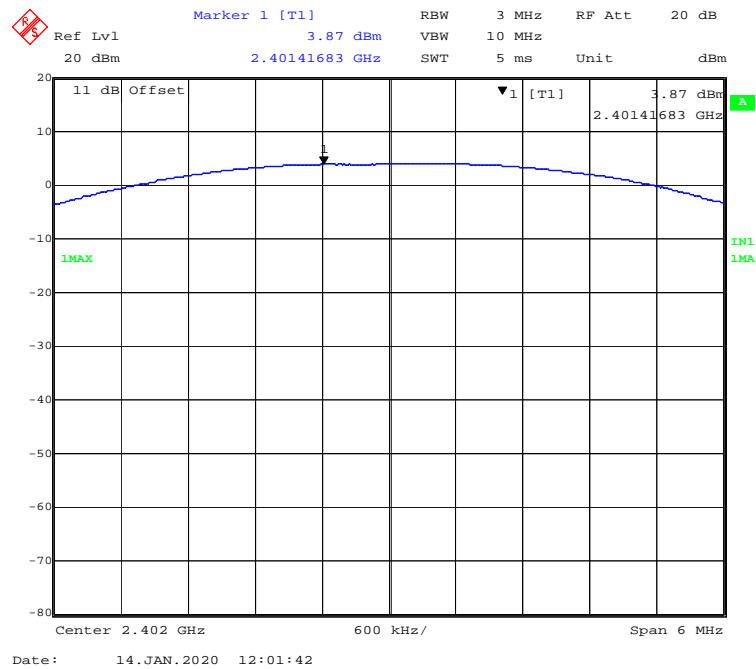


High Channel

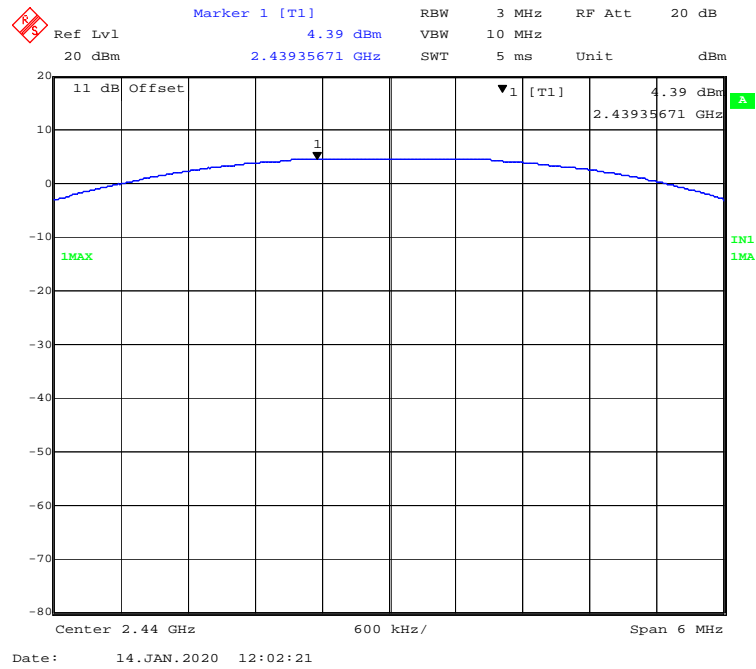


BLE 2Mbps Mode

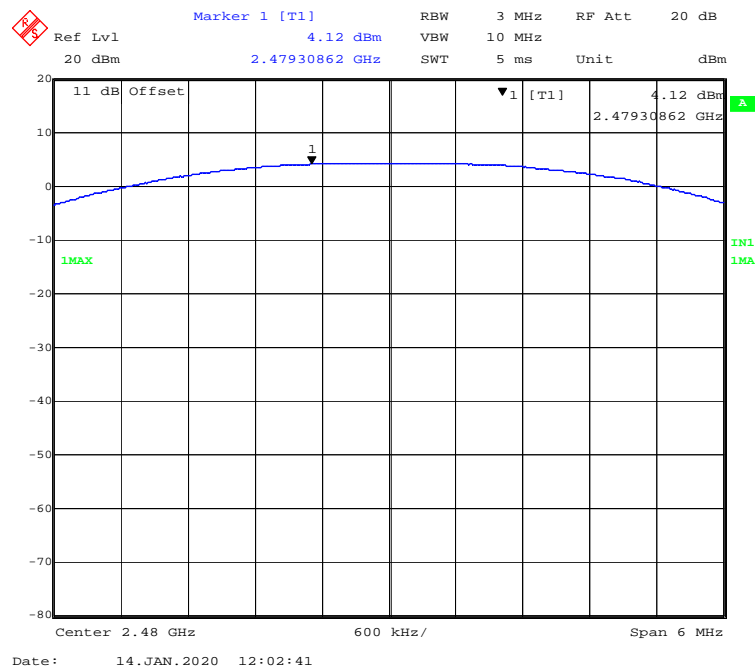
Low Channel



Middle Channel



High Channel



FCC §15.247(d) – 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

According to ANSI C63.10-2013 sub-clause 6.10.

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

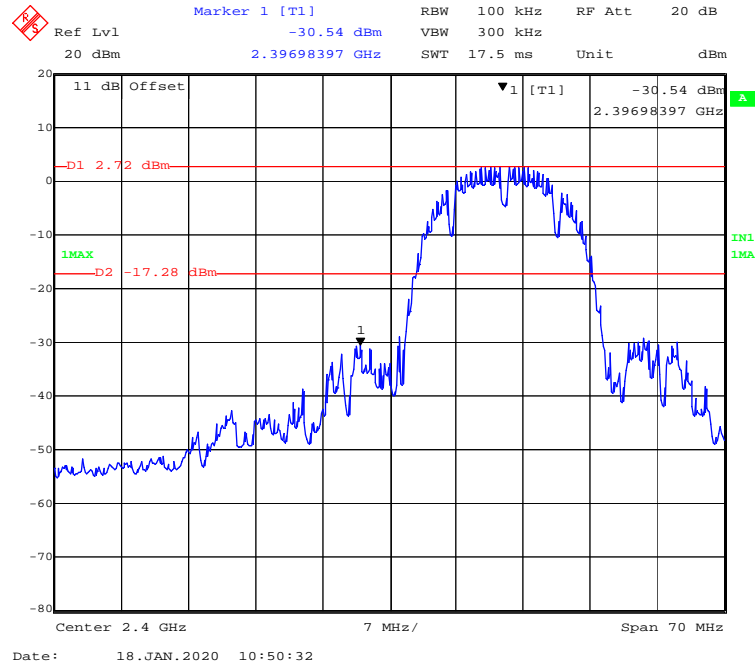
Temperature:	19.2-20.3 °C
Relative Humidity:	48-50 %
ATM Pressure:	100.6-101.3 kPa

The testing was performed by CK Huang from 2020-01-14 to 2020-01-18.

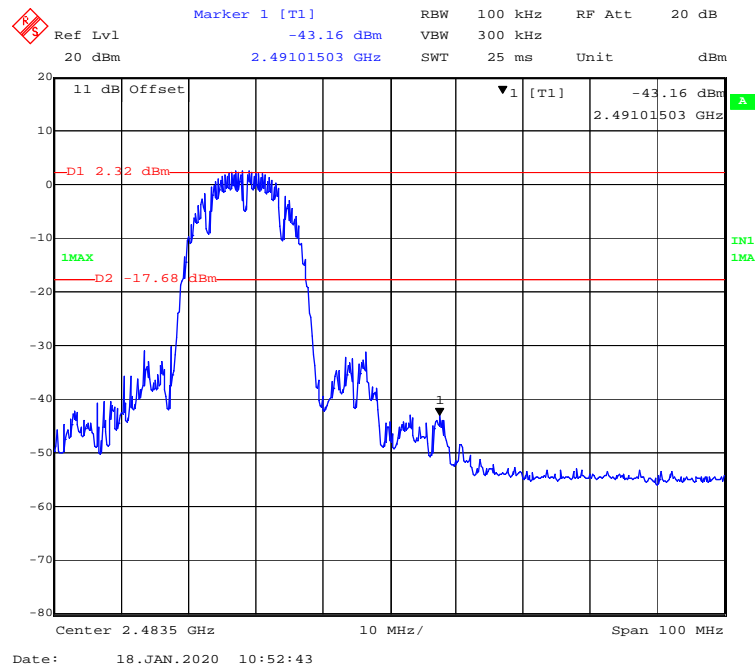
Test Result: Compliant.

EUT operation mode: Transmitting

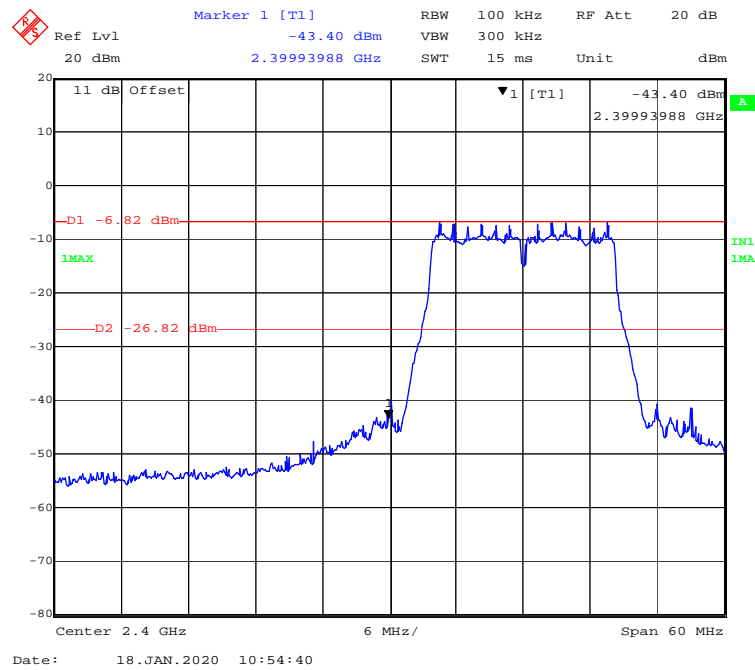
802.11b Mode Left Side



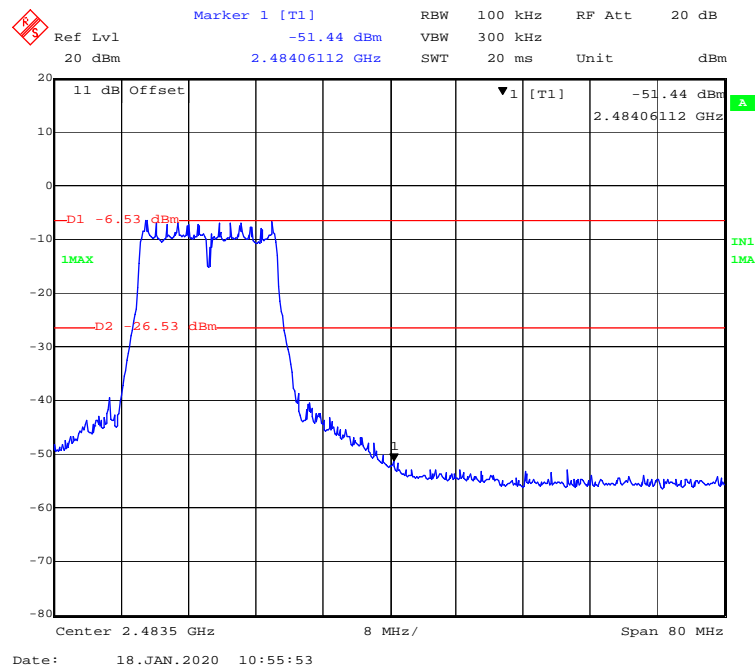
802.11b Mode Right Side



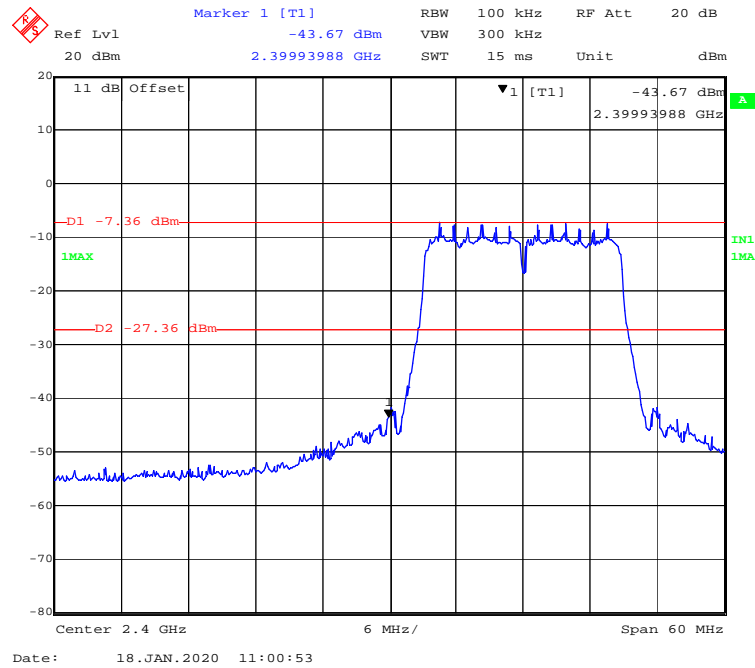
802.11g Mode Left Side



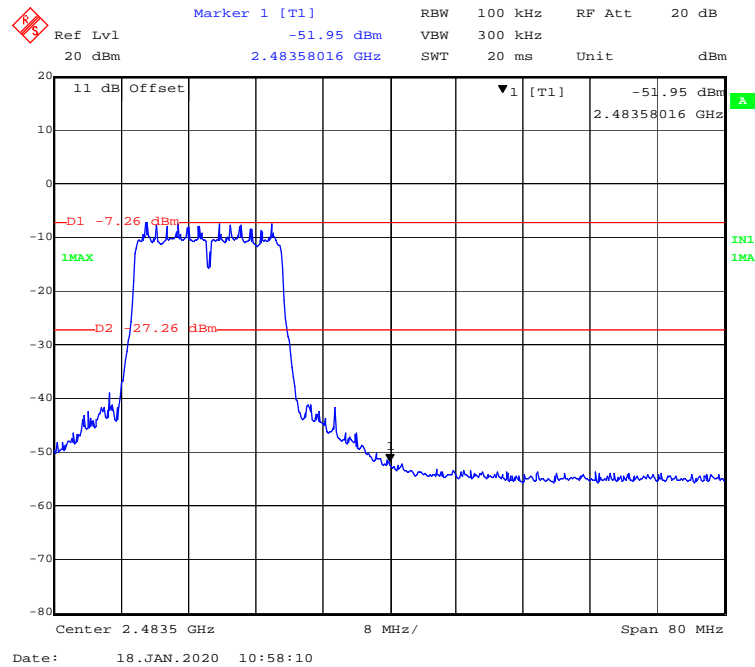
802.11g Mode Right Side

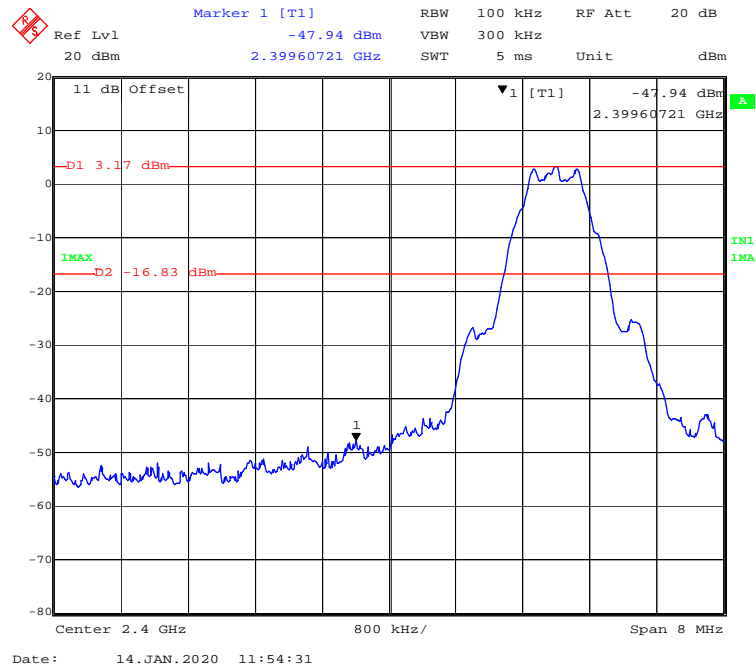
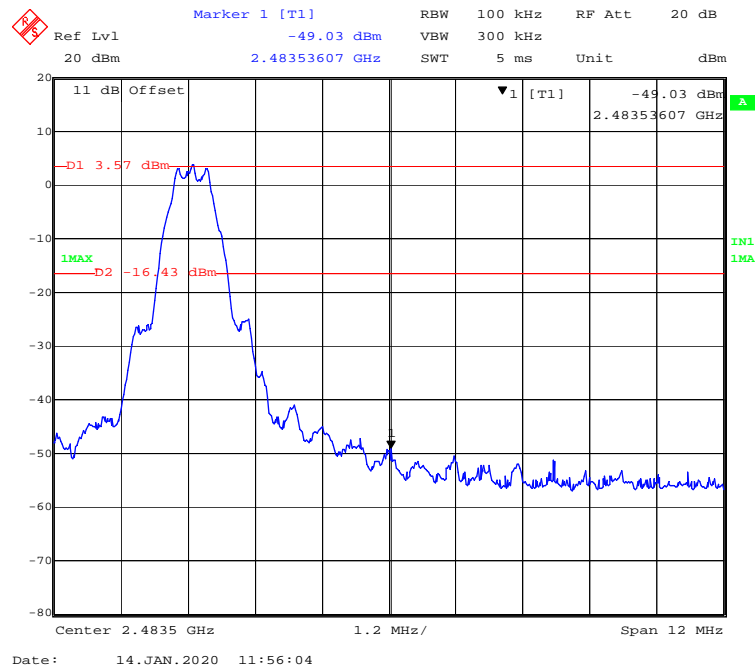


802.11n-HT20 Mode Left Side



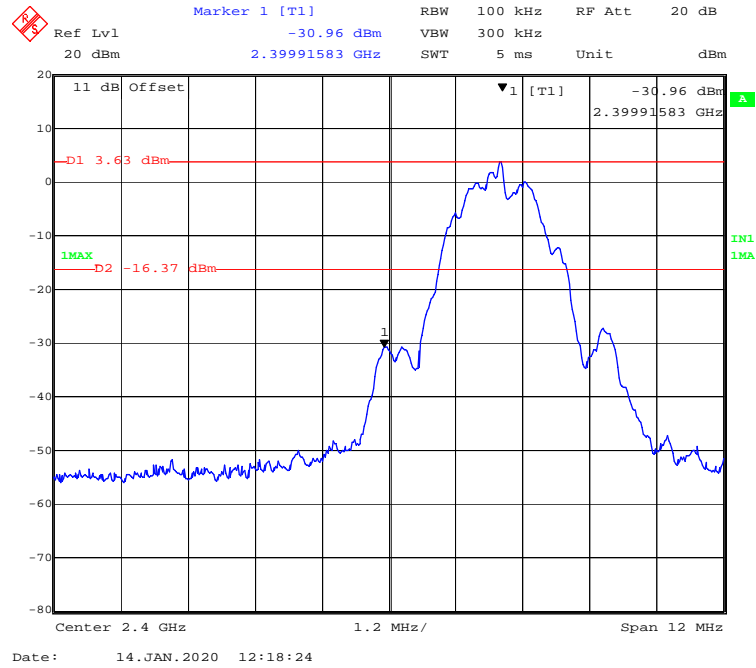
802.11n-HT20 Mode Right Side



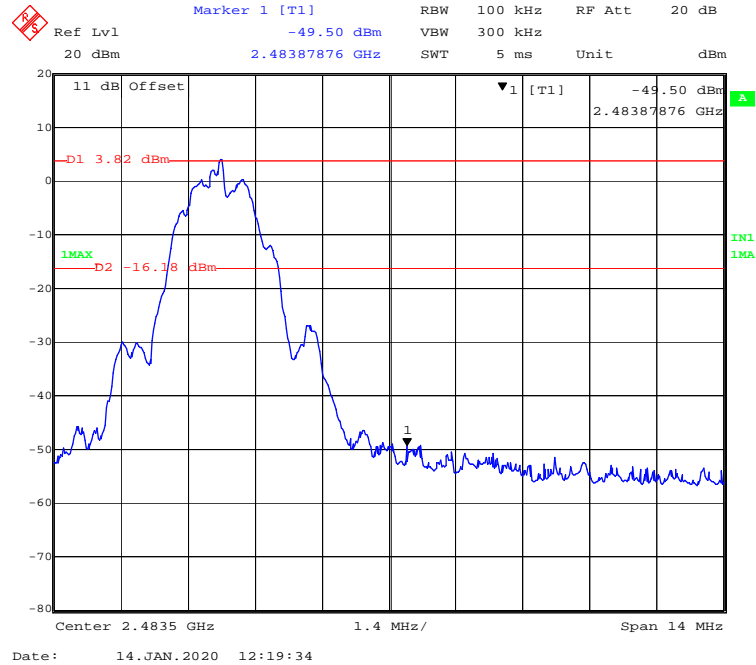
BLE 1Mbps Mode**Left Side****Right Side**

BLE 2Mbps Mode

Left Side



Right Side



FCC §15.247(e) - POWER SPECTRAL DENSITY

Applicable Standard

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

Test Procedure

According to ANSI C63.10-2013 sub-clause 11.10.2

The following procedure shall be used if maximum peak conducted output power was used to determine compliance, and it is optional if the maximum conducted (average) output power was used to determine compliance:

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

Test Data

Environmental Conditions

Temperature:	19.2-20.1 °C
Relative Humidity:	48-52 %
ATM Pressure:	101.1-101.3 kPa

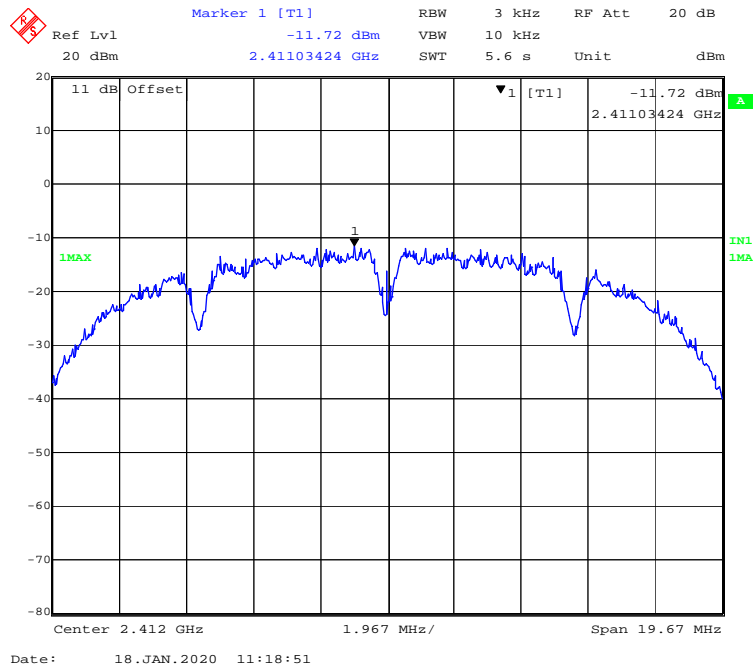
The testing was performed by CK Huang from 2020-01-14 to 2020-01-18.

Test Result: Compliant.

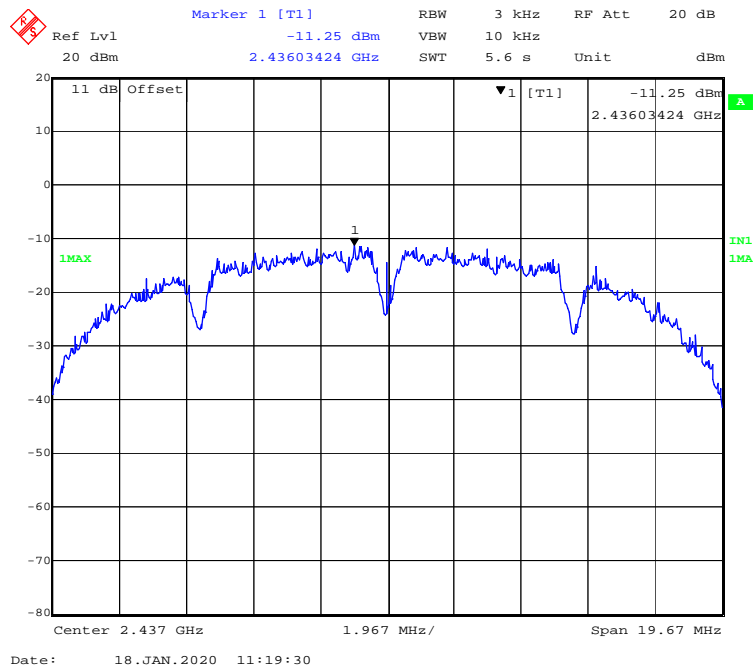
EUT operation mode: Transmitting

Channel	Frequency (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)
802.11b Mode			
Low	2412	-11.72	≤8
Middle	2437	-11.25	≤8
High	2462	-12.14	≤8
802.11g Mode			
Low	2412	-20.76	≤8
Middle	2437	-20.47	≤8
High	2462	-20.47	≤8
802.11n-HT20 mode			
Low	2412	-22.05	≤8
Middle	2437	-20.71	≤8
High	2462	-20.28	≤8
BLE 1Mbps Mode			
Low	2402	-13.18	≤8
Middle	2440	-12.61	≤8
High	2480	-12.89	≤8
BLE 2Mbps Mode			
Low	2402	-16.06	≤8
Middle	2440	-15.71	≤8
High	2480	-16.18	≤8

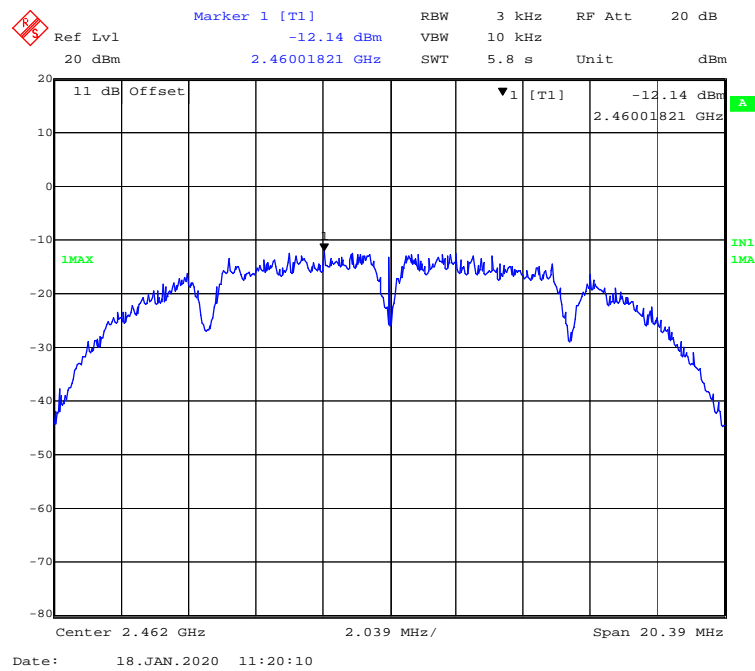
802.11b Mode Low Channel



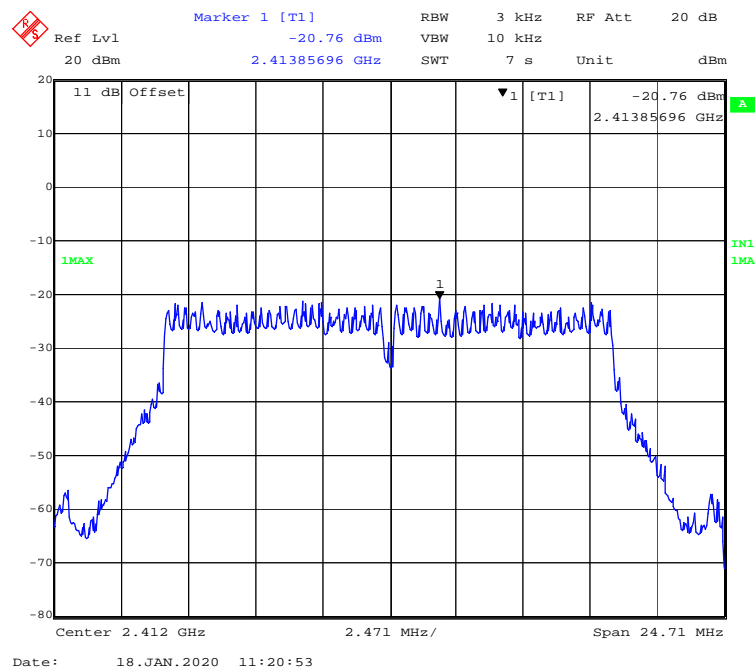
802.11b Mode Middle Channel



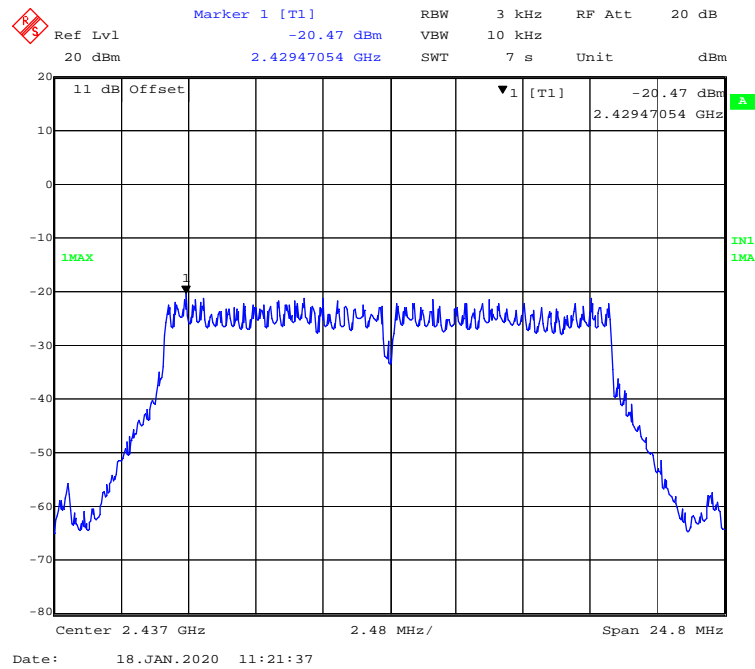
802.11b Mode High Channel



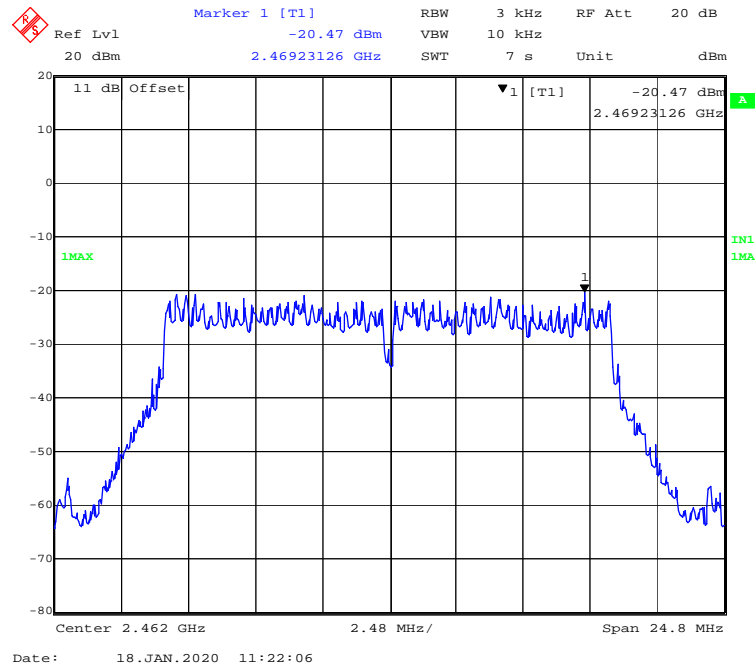
802.11g Mode Low Channel



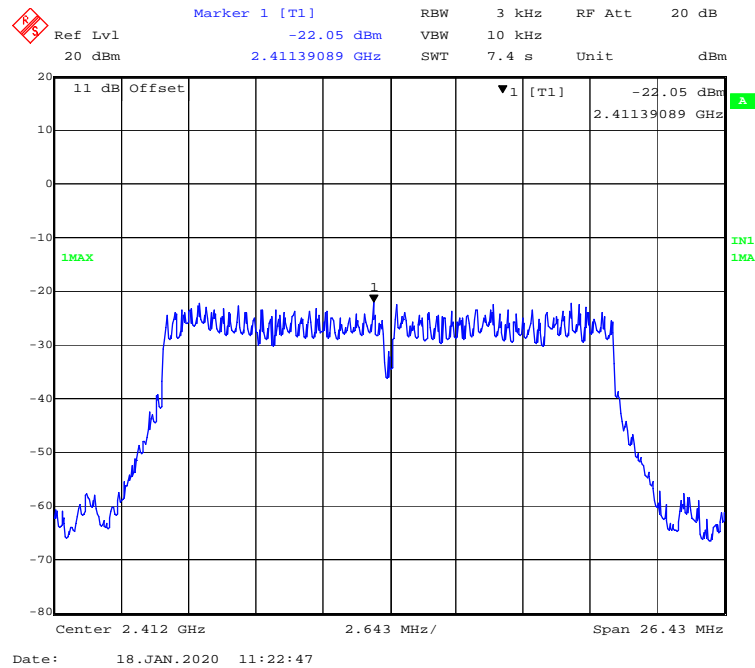
802.11g Mode Middle Channel



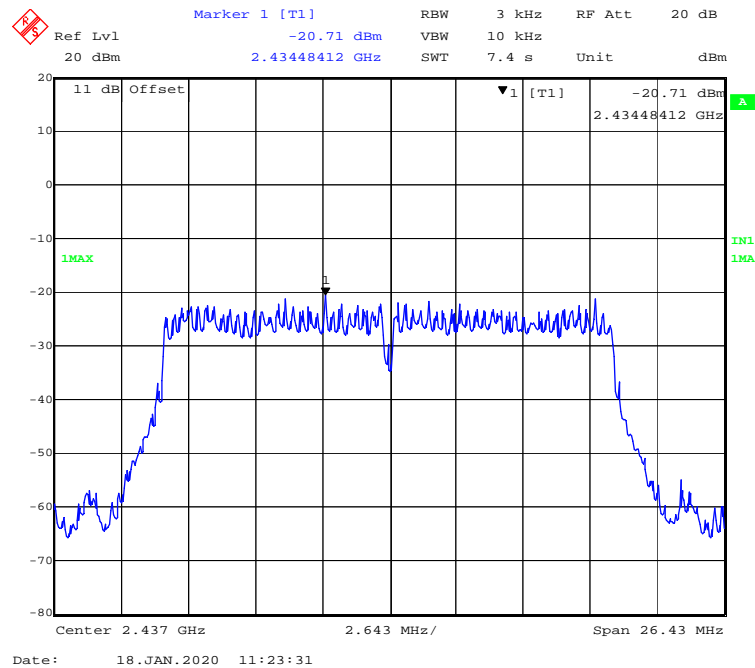
802.11g Mode High Channel



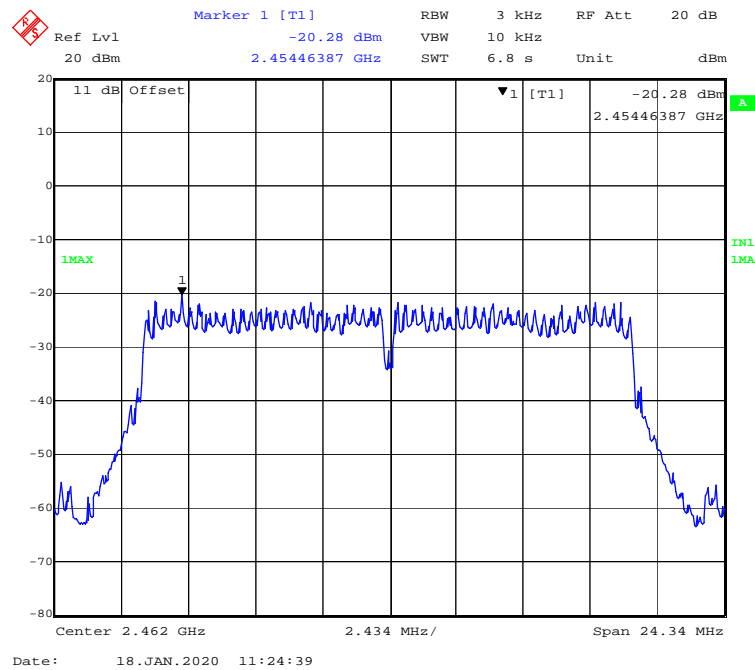
802.11n-HT20 Mode Low Channel



802.11n-HT20 Mode Middle Channel

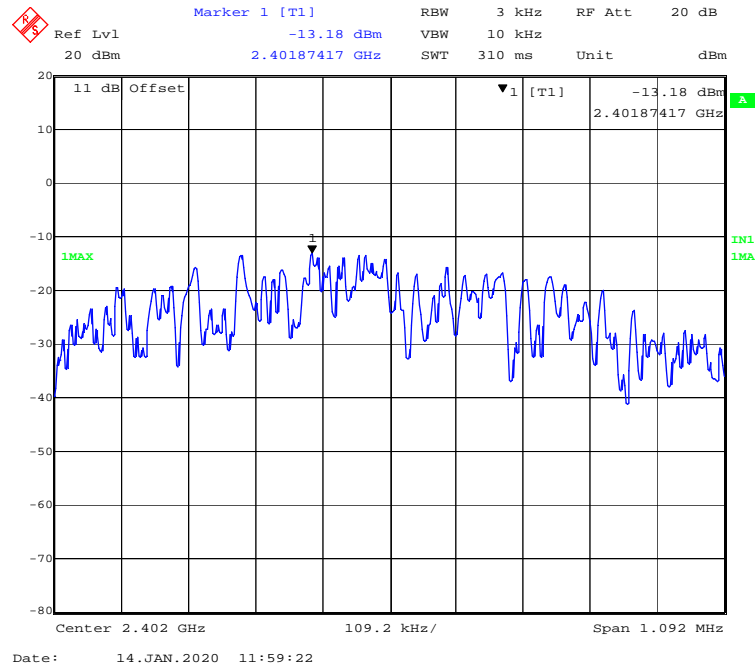


802.11n-HT20 Mode High Channel

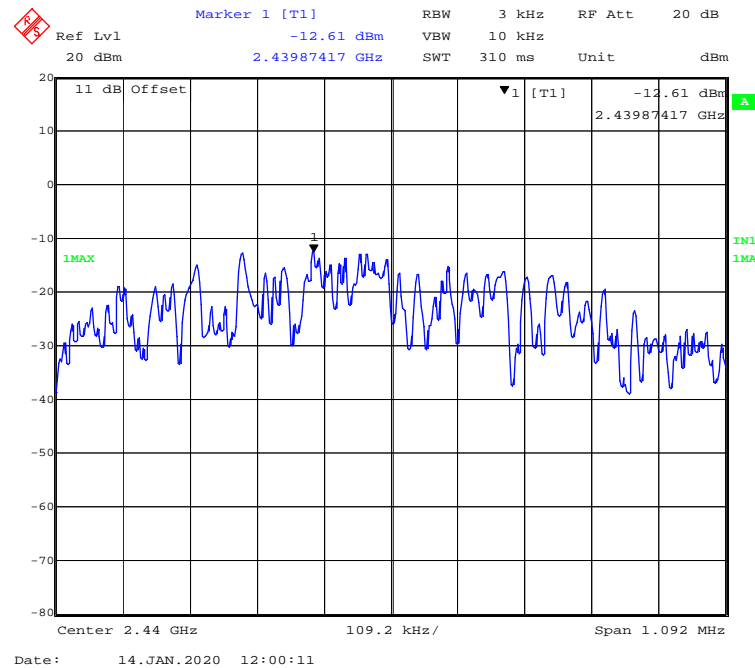


BLE 1Mbps Mode

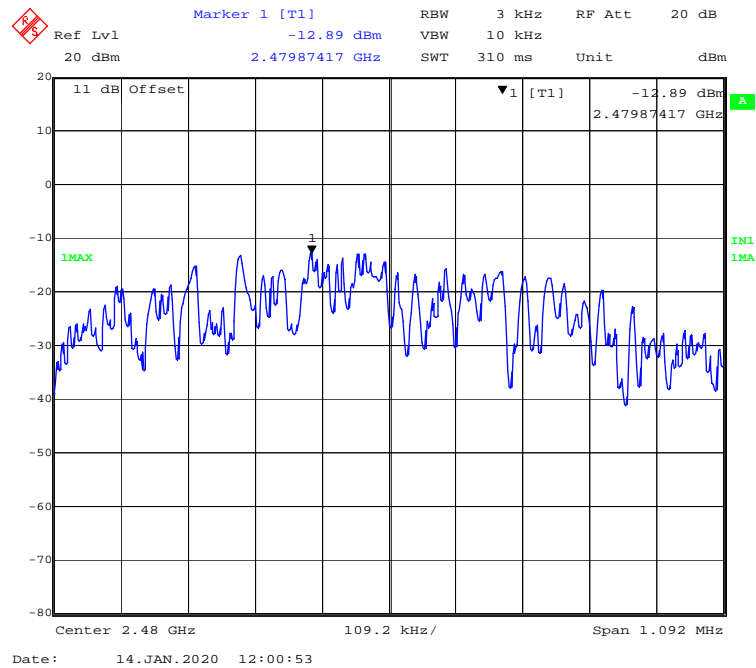
Low Channel



Middle Channel

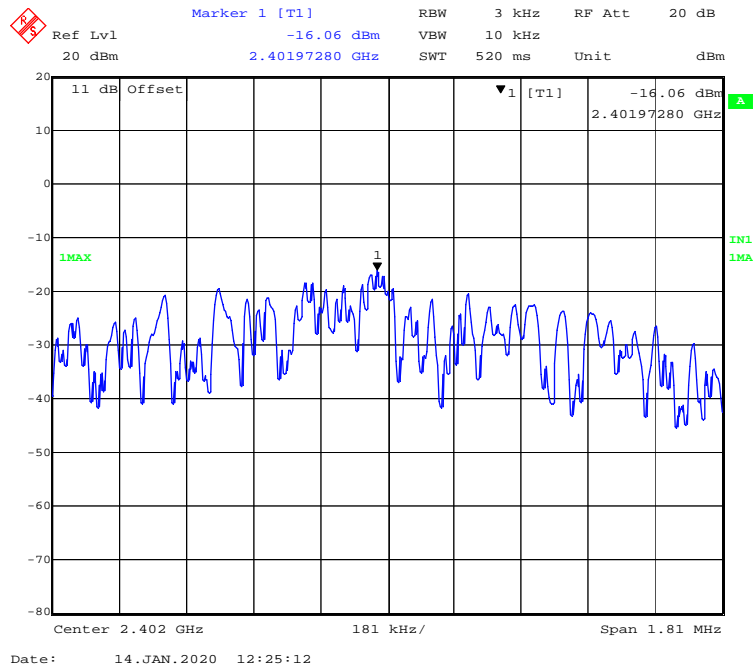


High Channel

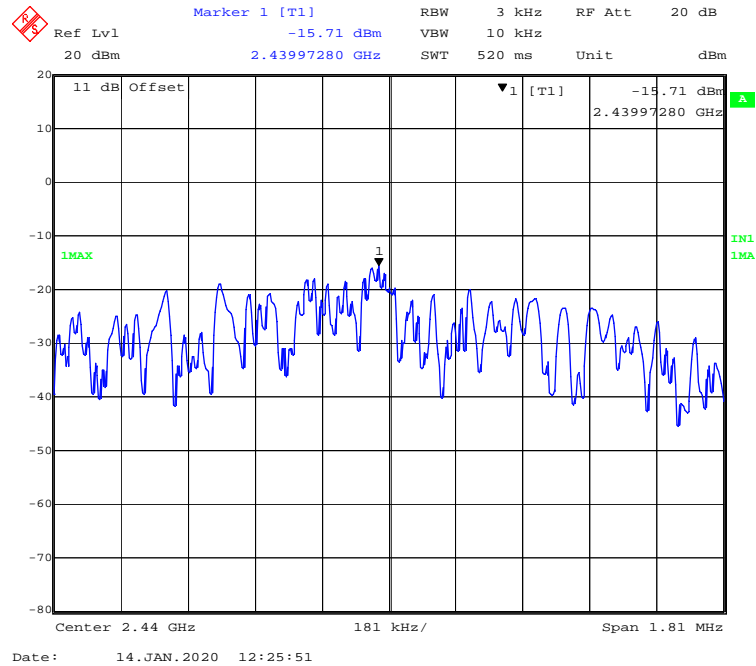


BLE 2Mbps Mode

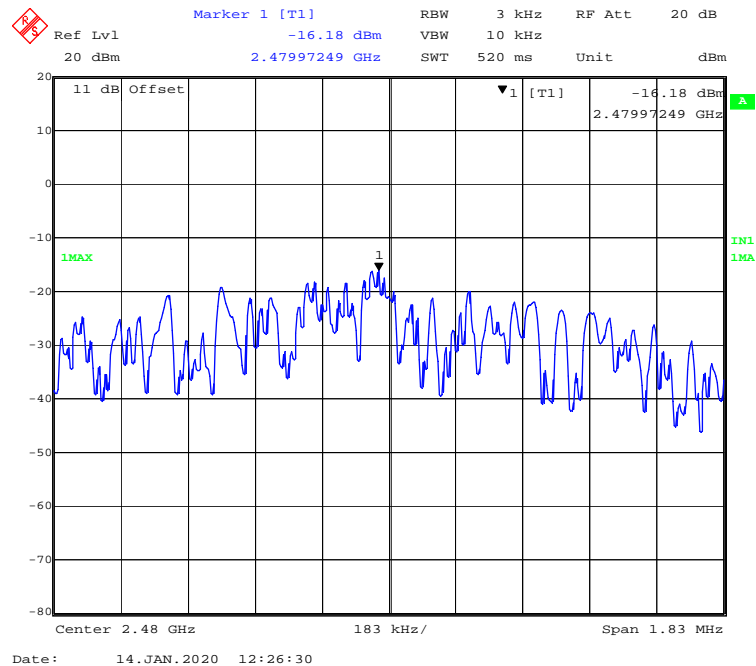
Low Channel



Middle Channel



High Channel



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