TESTING LABORATORY
CERTIFICATE #4820.01

FCC PART 15.247

TEST REPORT

For

WTS Positioning Solutions AB

Wallingatan 18, Stockholm, Sweden, 111 24

FCC ID: 2AR8M-TRAX4G

Report Type:	Product Name:
Original Report	Trax G+

Report Number:	RGMA181010003-00A
Report Date:	2019-01-28
Reviewed By:	Jerry Zhang EMC Manager
Test Laboratory:	Bay Area Compliance Laboratories Corp. (Dongguan) No.69 Pulongcun, Puxinhu Industry Area, Tangxia, Dongguan, Guangdong, China Tel: +86-769-86858888 Fax: +86-769-86858891 www.baclcorp.com.cn

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GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

EUT Name:	Trax G+
EUT Model:	Trax 4.1.7
Operation Frequency:	2402-2480 MHz
Maximum Peak Output Power (Conducted):	-1.86 dBm
Modulation Type:	GFSK
Rated Input Voltage:	DC 3.7V or charged by wireless charger
External Dimension:	55mm(L)*38mm(W)*10.7mm(H)
Serial Number:	181010003
EUT Received Date:	2018-10-10

Objective

This report is prepared on behalf of *WTS Positioning Solutions AB 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 Rules Part 15-Subpart C, section 15.203, 15.205, 15.207, 15.209, 15.247 rules.

Related Submittal(s)/Grant(s)

FCC Part 24E PCB submissions with FCC ID: 2AR8M-TRAX4G

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 KDB 558074 D01 15.247 Meas Guidance v05.

All emissions measurement was performed and Bay Area Compliance Laboratories Corp. (Dongguan).

Measurement Uncertainty

Parameter	Measurement Uncertainty
Occupied Channel Bandwidth	±5 %
RF output power, conducted	±0.61dB
Power Spectral Density, conducted	±0.61 dB
Unwanted Emissions, radiated	30M~200MHz: 4.55 dB,200M~1GHz: 5.92 dB, 1G~6GHz: 4.98 dB, 6G~18GHz: 5.89 dB, 18G~26.5G:5.47 dB,26.5G~40G:5.63 dB
Unwanted Emissions, conducted	±1.5 dB
Temperature	±1℃
Humidity	±5%
DC and low frequency voltages	±0.4%
Duty Cycle	1%
AC Power Lines Conducted Emission	3.12 dB (150 kHz to 30 MHz)

Test Facility

The Test site used by Bay Area Compliance Laboratories Corp. (Dongguan) to collect test data is located on the No.69 Pulongcun, Puxinhu Industry Area, Tangxia, Dongguan, Guangdong, China.

The lab has been recognized as the FCC accredited lab under the KDB 974614 D01 and is listed in the FCC Public Access Link (PAL) database, FCC Registration No. : 897218, the FCC Designation No. : CN1220.

The lab has been recognized by Innovation, Science and Economic Development Canada to test to Canadian radio equipment requirements, the CAB identifier: CN0022.

SYSTEM TEST CONFIGURATION

Description of Test Configuration

The system was configured for testing in engineering mode.

This device supports BLE 1Mbps and 2Mbps modes, 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.

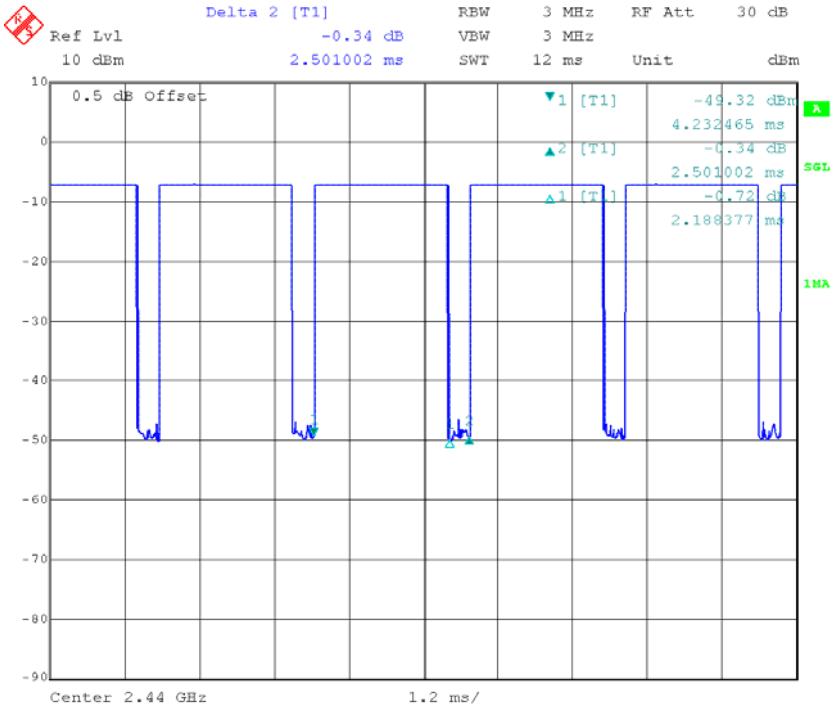
EUT Exercise Software

No software was used during test, the device was configured to ingineering mode by manufacturer, the system configured maximum power level as default setting, test modes switched by key.

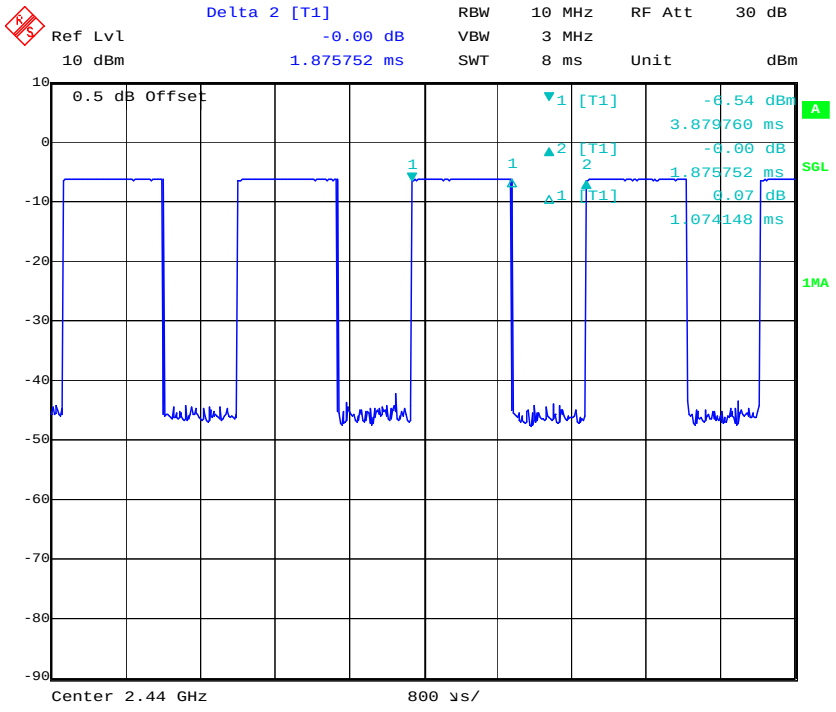
The duty cycle as below:

Mode	T_{on} (ms)	T_{on+off} (ms)	Duty Cycle (%)
BLE (1Mbps)	2.19	2.50	87.6
BLE (2Mbps)	1.07	1.88	56.9

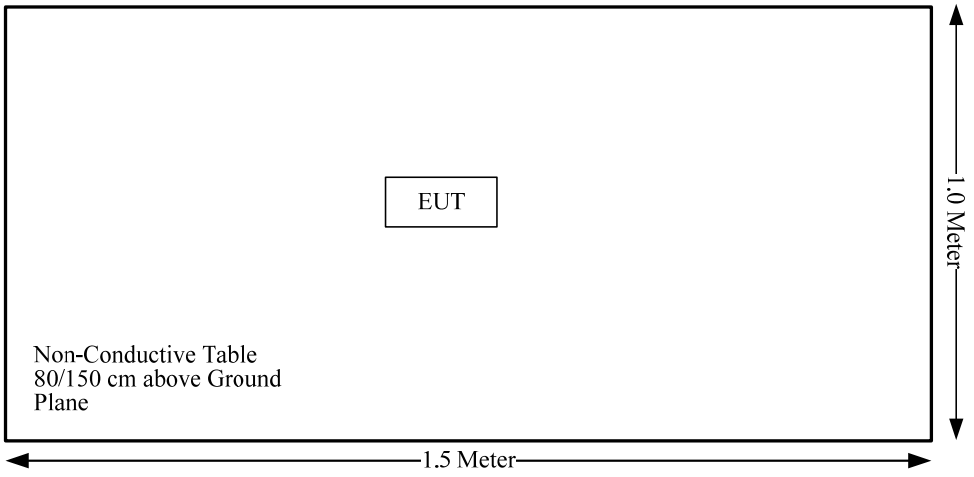
1 Mbps


Delta 2 [T1]
RBW 3 MHz
RF Att 30 dB
Ref Lvl
-0.34 dB
VBW 3 MHz
10 dBm
2.501002 ms
SWT 12 ms
Unit dBm
0.5 dB Offset
1 [T1] -49.32 dBm
4.232465 ms
2 [T1] -0.34 dB
2.501002 ms
1 [T1] -0.72 dB
2.188377 ms
A
SGL
1MA
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
Center 2.44 GHz
1.2 ms/
Date: 12.JAN.2019 17:43:31

2 Mbps


Delta 2 [T1]
RBW 10 MHz
RF Att 30 dB
Ref Lvl
-0.00 dB
VBW 3 MHz
10 dBm
1.875752 ms
SWT 8 ms
Unit dBm
0.5 dB Offset
1 [T1] -6.54 dBm
3.879760 ms
2 [T1] -0.00 dB
1.875752 ms
1 [T1] 0.07 dB
1.074148 ms
A
SGL
1MA
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
Center 2.44 GHz
800 µs/
Date: 24.JAN.2019 09:27:41

Block Diagram of Test Setup



SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Result
FCC §15.247 (i) & §1.1310 & §2.1093	RF Exposure	Compliance
§15.203	Antenna Requirement	Compliance
§15.207 (a)	AC Line Conducted Emissions	Not Applicable
§15.205, §15.209, §15.247(d)	Spurious Emissions	Compliance
§15.247 (a)(2)	6 dB 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

Not Applicable: the device was powered by battery when operation.

FCC §15.247 (i) & §1.1310 & §2.1093- RF EXPOSURE

Applicable Standard

According to§15.247(i) and §1.1310, systems operating under the provisions of this section shall be operated in a manner that ensure that the public is not exposed to radio frequency energy level in excess of the Commission's guideline.

According to KDB447498 D01 General RF Exposure Guidance v06:

The 1-g and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at test separation distances ≤ 50 mm are determined by:
[(max. power of channel, including tune-up tolerance, mW)/(min. test separation distance, mm)] · [√f(GHz)] ≤ 3.0 for 1-g SAR and ≤ 7.5 for 10-g extremity SAR, where

- f(GHz) is the RF channel transmit frequency in GHz
- Power and distance are rounded to the nearest mW and mm before calculation
- The result is rounded to one decimal place for comparison
- 3.0 and 7.5 are referred to as the numeric thresholds in the step 2 below

The test exclusions are applicable only when the minimum test separation distance is ≤ 50 mm and for transmission frequencies between 100 MHz and 6 GHz. When the minimum test separation distance is < 5 mm, a distance of 5 mm according to 5) in section 4.1 is applied to determine SAR test exclusion.

When an antenna qualifies for the standalone SAR test exclusion of 4.3.1 and also transmits simultaneously with other antennas, the standalone SAR value must be estimated according to the following to determine the simultaneous transmission SAR test exclusion criteria: [(max. power of channel, including tune-up tolerance, mW) / (min. test separation distance, mm)]·[√f(GHz)/x] W/kg, for test separation distances ≤ 50 mm; where x = 7.5 for 1-g SAR and x = 18.75 for 10-g SAR.

Measurement Result

Operation modes	Frequency (MHz)	Maximum Power (dBm)	Duty Cycle (%)	Time based average Power (mW)	Separated distance from user (mm)	Calculated value	Exempt from Test? (Yes/No)
Band 2	1850-1910	25	0.07	0.22	0	0.06	Yes
BLE	2402-2480	-1	100	0.79	0	0.25	Yes

The maximum transmission rate when active is once every 10 second and the data consist of 140bytes. For Cat-NB1, the lowest data rate 20 kbit/s every transmission will last for less than 0,007s with a resulting dutycycle of <0.07%. Please refer to the attention letter for more detail.

WWAN and Bluetooth can transmit Simultaneously:

Operation modes	Frequency (MHz)	Maximum Power (dBm)	Duty Cycle (%)	Time based average Power (mW)	Separated distance from user (mm)	SAR estimation (W/kg)
Band 2	1850-1910	25	0.07	0.22	0	0.01
BLE	2402-2480	-1	100	0.79	0	0.03

SAR estimation=
[(max. power of channel, including tune-up tolerance, mW) / (min. test separation distance, mm)]·[√f(GHz)/x] W/kg, for test separation distances ≤ 50 mm; where x = 7.5 for 1-g SAR and x = 18.75 for 10-g SAR.

ΣSAR= 0.01+0.03=0.04 W/kg < 1.6 W/kg

So the SAR test is not necessary.

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.
c. Unit must be professionally installed, and installer shall be responsible for verifying that the correct antenna is employed with the unit.

Antenna Information And Connector Construction

The EUT has one Chip antenna arrangement for BT, and the antenna gain is -8.9 dBi, fulfill the requirement of this section. Please refer to the EUT photos.

Result: Compliance.

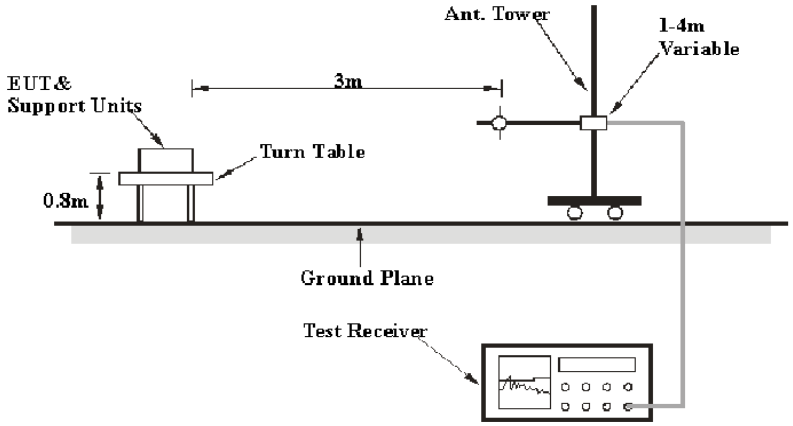
FCC §15.209, §15.205, §15.247(d) - SPURIOUS EMISSIONS

Applicable Standard

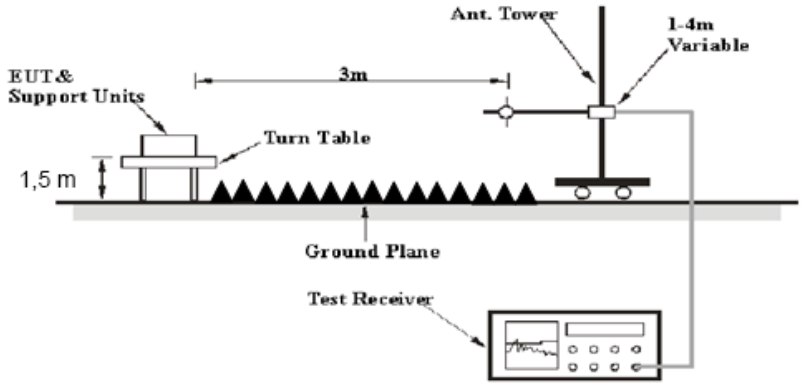
FCC §15.247 (d); §15.209; §15.205

EUT Setup

Below 1GHz:



Above 1GHz:



The radiated emission tests were performed in the 10 meters chamber test site for the range 30MHz to 1GHz and the 3 meters chamber A test site for above 1GHz, using the setup accordance with the ANSI C63.10-2013. The specification used was the FCC 15.209, and FCC 15.247 limits.

The spacing between the peripherals was 10 cm.

EMI Test Receiver & Spectrum Analyzer Setup

The system was investigated from 30 MHz to 25 GHz.

During the radiated emission test, the EMI test receiver & Spectrum Analyzer Setup were set with the following configurations:

30MHz-1000MHz:

Measurement	RBW	Video B/W	IF B/W
QP	120 kHz	300 kHz	120kHz

Above 1GHz:

Measurement	Duty cycle	RBW	Video B/W
PK	Any	1MHz	3 MHz
Ave.	>98%	1MHz	10 Hz
	<98%	1MHz	1/T

Note: T is minimum transmission duration

If the maximized peak measured value complies with the QP/Average limit, then it is unnecessary to perform an QP/Average measurement

Test Procedure

Maximizing procedure was performed on the highest emissions to ensure that the EUT complied with all installation combinations.

Data was recorded in Quasi-peak detection mode for frequency range of 30 MHz-1 GHz, peak and Average detection modes for frequencies above 1 GHz.

Corrected Amplitude & Margin Calculation

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

Corrected Amplitude = Meter Reading + Antenna Factor + Cable Loss - Amplifier Gain

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

Margin = Limit –Corrected Amplitude

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	EMI Test Receiver	ESCI	100035	2018-08-03	2019-08-03
Farad	Test Software	EZ-EMC	V1.1.4.2	N/A	N/A
Sunol Sciences	Antenna	JB3	A060611-3	2017-07-21	2019-07-21
Unknown	Coaxial Cable	C-NJNJ-50	C-0400-02	2018-09-05	2019-09-05
Unknown	Coaxial Cable	C-NJNJ-50	C-0075-02	2018-09-05	2019-09-05
Unknown	Coaxial Cable	C-NJNJ-50	C-2200-01	2018-09-05	2019-09-05
HP	Amplifier	8447F	2443A01912	2018-09-05	2019-09-05
Agilent	Spectrum Analyzer	E4440A	SG43360054	2019-01-04	2020-01-04
ETS-Lindgren	Horn Antenna	3115	000 527 35	2018-10-12	2021-10-12
Ducommun Technolagies	Horn Antenna	ARH-4223-02	1007726-01 1304	2016-11-18	2019-11-18
Unknown	Coaxial Cable	C-SJSJ-50	C-0800-01	2018-09-05	2019-09-05
Unknown	Coaxial Cable	C-2.4J2.4J-50	C-0700-02	2018-06-27	2019-06-27
MITEQ	Amplifier	AFS42-00101800-25-S-42	2001271	2018-09-05	2019-09-05
Quinstar	Amplifier	QLW-18405536-JO	15964001001	2018-06-27	2019-06-27
E-Microwave	Band-stop Filters	OBSF-2400-2483.5-S	OE01601525	2018-06-16	2019-06-16
Micro-tronics	High Pass Filter	HPM50111	S/N-G217	2018-06-16	2019-06-16

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

Test Data

Environmental Conditions

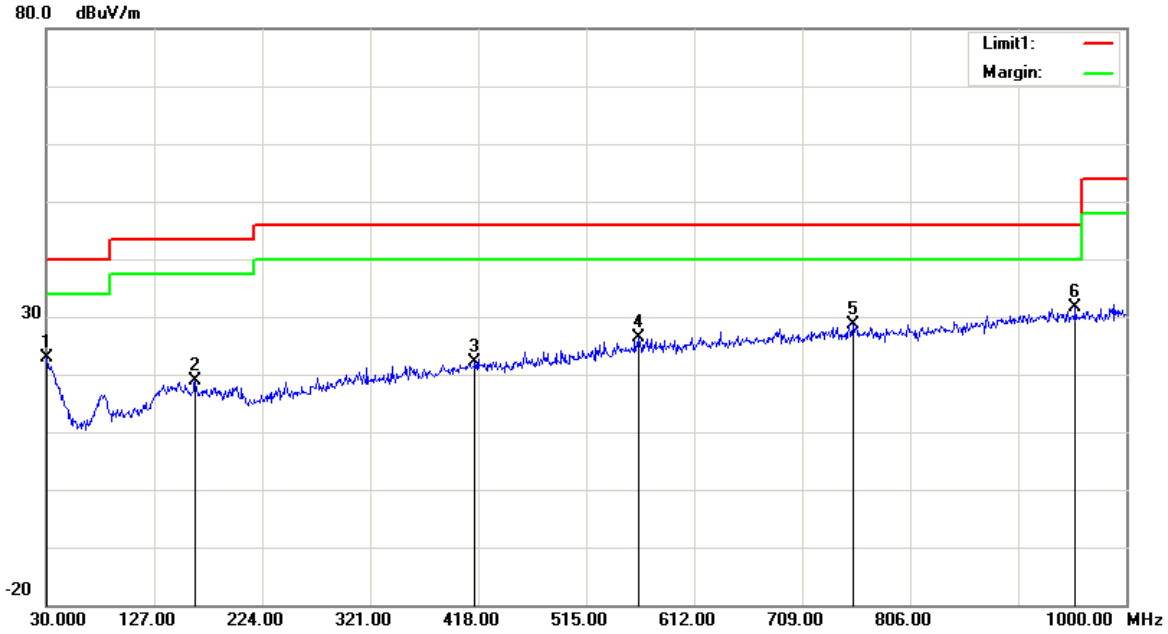
Temperature:	22.3~23.8°C
Relative Humidity:	42~53 %
ATM Pressure:	100.2~101.2 kPa

** The testing was performed by Vito Chen & Tyler Pan on 2019-01-10 and 2019-01-11.*

Test Mode: Transmitting

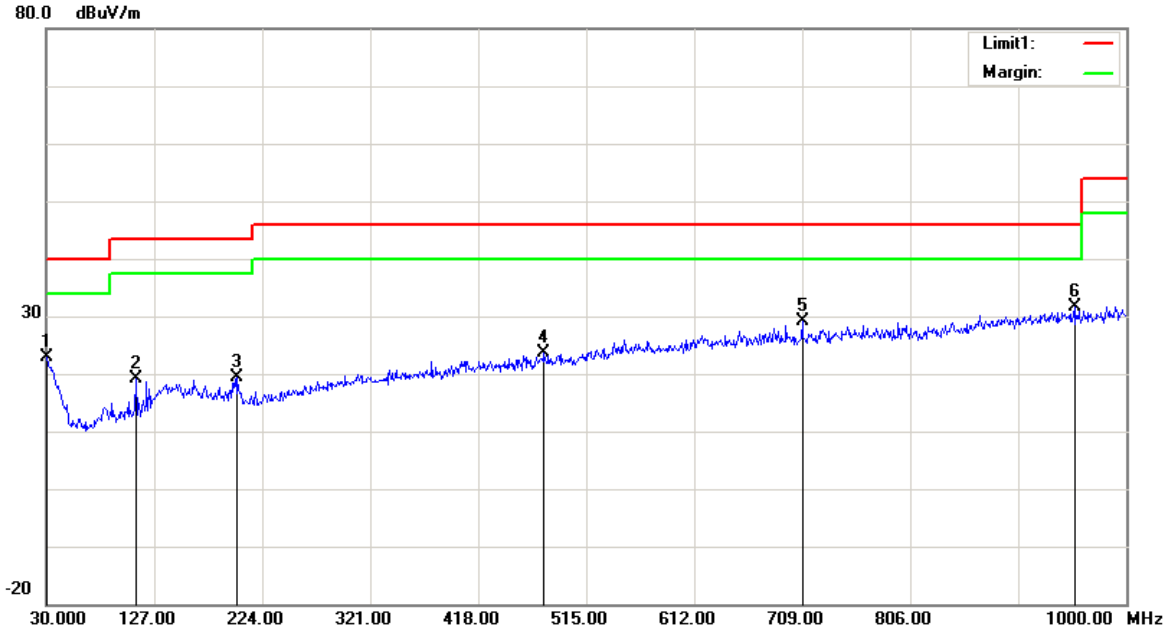
1) 30MHz-1GHz (2M high Channel was the worst):

Horizontal:



Frequency (MHz)	Receiver Reading (dBuV)	Detector	Correction Factor (dB/m)	Cord. Amp. (dBuV/m)	Limit (dBuV/m)	Margin (dB)
30.0000	27.32	peak	-4.33	22.99	40.00	17.01
163.8600	28.47	peak	-9.54	18.93	43.50	24.57
415.0900	26.90	peak	-4.85	22.05	46.00	23.95
561.5600	27.80	peak	-1.52	26.28	46.00	19.72
754.5900	27.99	peak	0.76	28.75	46.00	17.25
954.4100	26.86	peak	4.83	31.69	46.00	14.31

Vertical:



Frequency (MHz)	Receiver Reading (dBuV)	Detector	Correction Factor (dB/m)	Cord. Amp. (dBuV/m)	Limit (dBuV/m)	Margin (dB)
30.0000	27.28	peak	-4.33	22.95	40.00	17.05
110.5100	32.63	peak	-13.51	19.12	43.50	24.38
201.6900	28.83	peak	-9.47	19.36	43.50	24.14
477.1700	27.50	peak	-3.82	23.68	46.00	22.32
709.0000	28.95	peak	0.12	29.07	46.00	16.93
953.4400	26.68	peak	4.85	31.53	46.00	14.47

2) 1-25GHz:

1Mbps

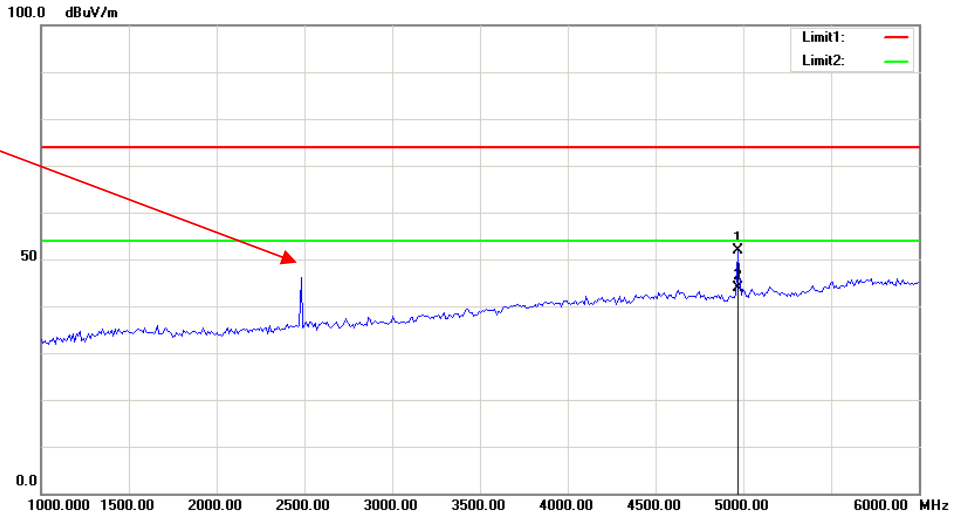
Frequency (MHz)	Receiver		Rx Antenna		Cable loss (dB)	Amplifier Gain (dB)	Corrected Amplitude (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	Detector (PK/QP/AV)	Polar (H/V)	Factor (dB/m)					
Low Channel: 2402 MHz									
2402.00	53.77	PK	H	24.82	3.34	0.00	81.93	N/A	N/A
2402.00	51.65	AV	H	24.82	3.34	0.00	79.81	N/A	N/A
2402.00	55.57	PK	V	24.82	3.34	0.00	83.73	N/A	N/A
2402.00	53.43	AV	V	24.82	3.34	0.00	81.59	N/A	N/A
2390.00	23.99	PK	V	24.80	3.33	0.00	52.12	74.00	21.88
2390.00	12.11	AV	V	24.80	3.33	0.00	40.24	54.00	13.76
4804.00	45.97	PK	V	29.71	4.58	27.36	52.90	74.00	21.10
4804.00	40.46	AV	V	29.71	4.58	27.36	47.39	54.00	6.61
7206.00	38.38	PK	V	33.93	5.59	27.19	50.71	74.00	23.29
7206.00	26.22	AV	V	33.93	5.59	27.19	38.55	54.00	15.45
Middle Channel: 2440 MHz									
2440.00	55.33	PK	H	24.89	3.36	0.00	83.58	N/A	N/A
2440.00	53.09	AV	H	24.89	3.36	0.00	81.34	N/A	N/A
2440.00	56.76	PK	V	24.89	3.36	0.00	85.01	N/A	N/A
2440.00	54.55	AV	V	24.89	3.36	0.00	82.80	N/A	N/A
4880.00	46.53	PK	V	29.86	4.56	27.55	53.40	74.00	20.60
4880.00	40.97	AV	V	29.86	4.56	27.55	47.84	54.00	6.16
7320.00	38.55	PK	V	34.11	5.69	27.26	51.09	74.00	22.91
7320.00	26.50	AV	V	34.11	5.69	27.26	39.04	54.00	14.96
High Channel: 2480 MHz									
2480.00	57.48	PK	H	24.96	3.38	0.00	85.82	N/A	N/A
2480.00	55.36	AV	H	24.96	3.38	0.00	83.70	N/A	N/A
2480.00	58.92	PK	V	24.96	3.38	0.00	87.26	N/A	N/A
2480.00	56.81	AV	V	24.96	3.38	0.00	85.15	N/A	N/A
2483.50	25.52	PK	V	24.97	3.38	0.00	53.87	74.00	20.13
2483.50	16.67	AV	V	24.97	3.38	0.00	45.02	54.00	8.98
4960.00	47.86	PK	V	30.02	4.58	27.37	55.09	74.00	18.91
4960.00	42.33	AV	V	30.02	4.58	27.37	49.56	54.00	4.44
7440.00	38.64	PK	V	34.30	5.79	27.22	51.51	74.00	22.49
7440.00	26.55	AV	V	34.30	5.79	27.22	39.42	54.00	14.58

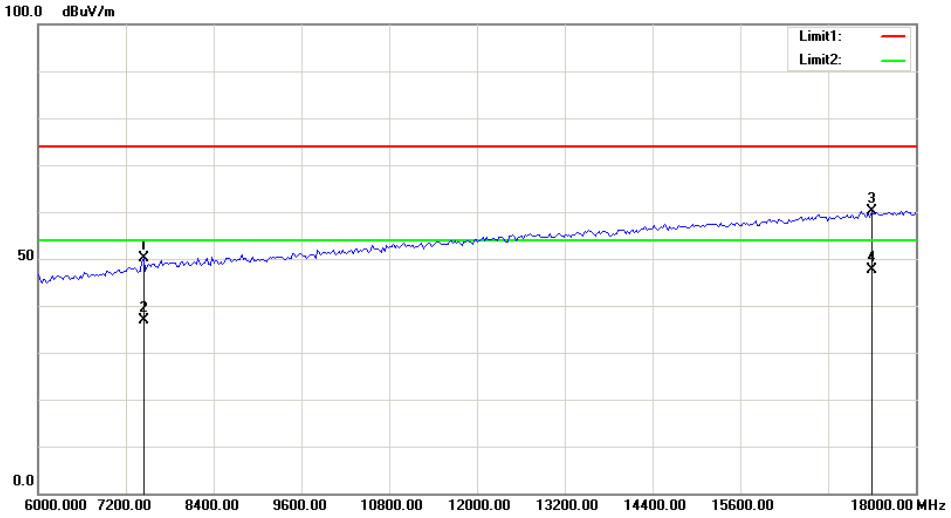
2Mbps:

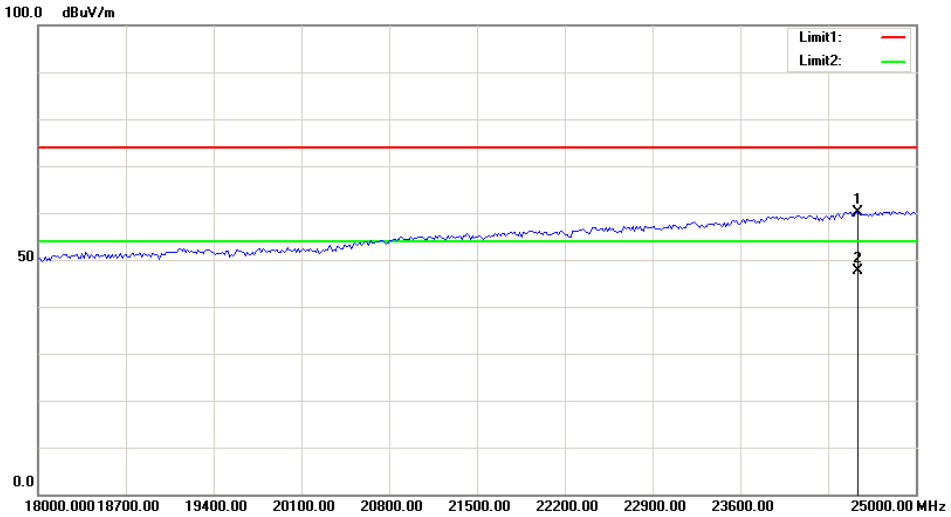
Frequency (MHz)	Receiver		Rx Antenna		Cable loss (dB)	Amplifier Gain (dB)	Corrected Amplitude (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	Detector (PK/QP/AV)	Polar (H/V)	Factor (dB/m)					
Low Channel: 2402 MHz									
2402.00	54.98	PK	H	24.82	3.34	0.00	83.14	N/A	N/A
2402.00	48.79	AV	H	24.82	3.34	0.00	76.95	N/A	N/A
2402.00	56.74	PK	V	24.82	3.34	0.00	84.90	N/A	N/A
2402.00	50.33	AV	V	24.82	3.34	0.00	78.49	N/A	N/A
2390.00	23.75	PK	V	24.80	3.33	0.00	51.88	74.00	22.12
2390.00	11.06	AV	V	24.80	3.33	0.00	39.19	54.00	14.81
4804.00	49.06	PK	V	29.71	4.58	27.36	55.99	74.00	18.01
4804.00	40.88	AV	V	29.71	4.58	27.36	47.81	54.00	6.19
7206.00	38.76	PK	V	33.93	5.59	27.19	51.09	74.00	22.91
7206.00	26.26	AV	V	33.93	5.59	27.19	38.59	54.00	15.41
Middle Channel: 2440 MHz									
2440.00	57.38	PK	H	24.89	3.36	0.00	85.63	N/A	N/A
2440.00	51.07	AV	H	24.89	3.36	0.00	79.32	N/A	N/A
2440.00	59.18	PK	V	24.89	3.36	0.00	87.43	N/A	N/A
2440.00	52.78	AV	V	24.89	3.36	0.00	81.03	N/A	N/A
4880.00	49.86	PK	V	29.86	4.56	27.55	56.73	74.00	17.27
4880.00	41.67	AV	V	29.86	4.56	27.55	48.54	54.00	5.46
7320.00	38.85	PK	V	34.11	5.69	27.26	51.39	74.00	22.61
7320.00	26.31	AV	V	34.11	5.69	27.26	38.85	54.00	15.15
High Channel: 2480 MHz									
2480.00	59.57	PK	H	24.96	3.38	0.00	87.91	N/A	N/A
2480.00	53.24	AV	H	24.96	3.38	0.00	81.58	N/A	N/A
2480.00	61.34	PK	V	24.96	3.38	0.00	89.68	N/A	N/A
2480.00	55.13	AV	V	24.96	3.38	0.00	83.47	N/A	N/A
2483.50	28.13	PK	V	24.97	3.38	0.00	56.48	74.00	17.52
2483.50	17.48	AV	V	24.97	3.38	0.00	45.83	54.00	8.17
4960.00	50.99	PK	V	30.02	4.58	27.37	58.22	74.00	15.78
4960.00	42.85	AV	V	30.02	4.58	27.37	50.08	54.00	3.92
7440.00	39.49	PK	V	34.30	5.79	27.22	52.36	74.00	21.64
7440.00	26.77	AV	V	34.30	5.79	27.22	39.64	54.00	14.36

Worst plots (2Mbps High Channel)
Horizontal

Fundamental
Test with Band
Rejection Filter

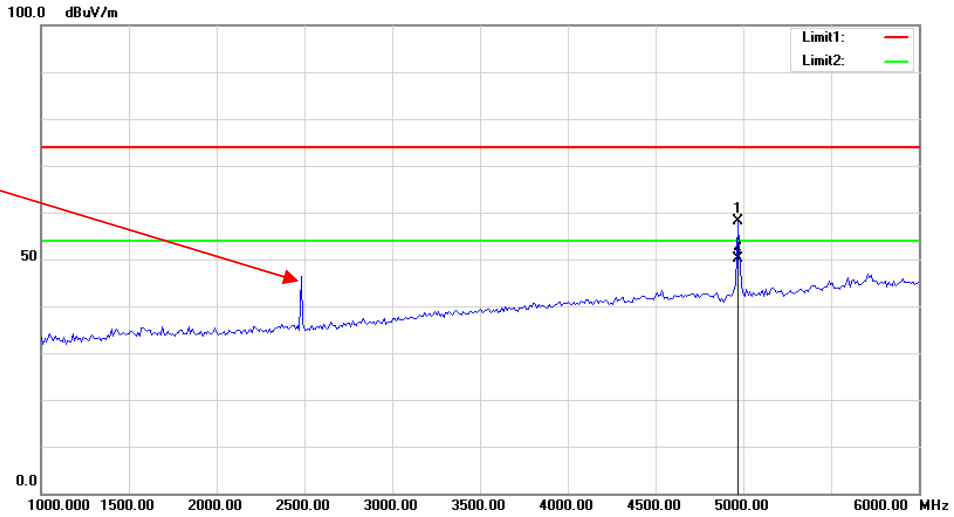


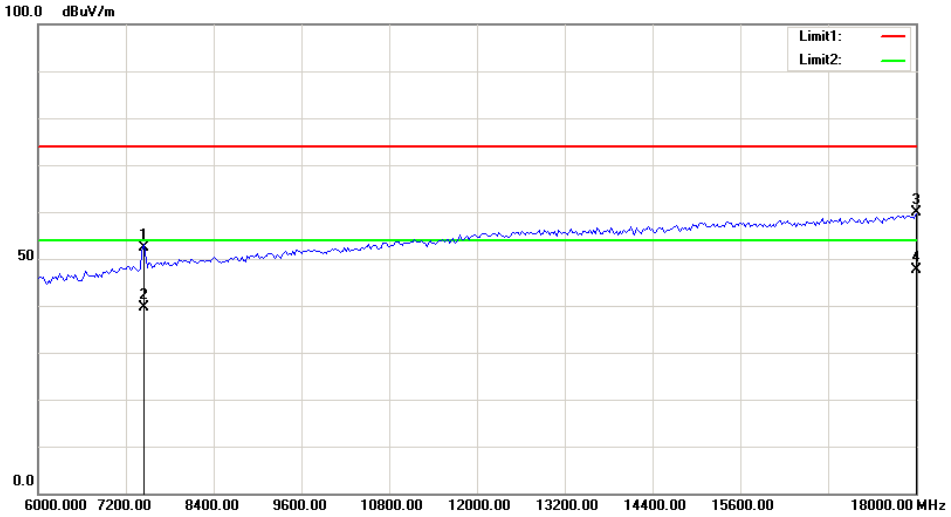


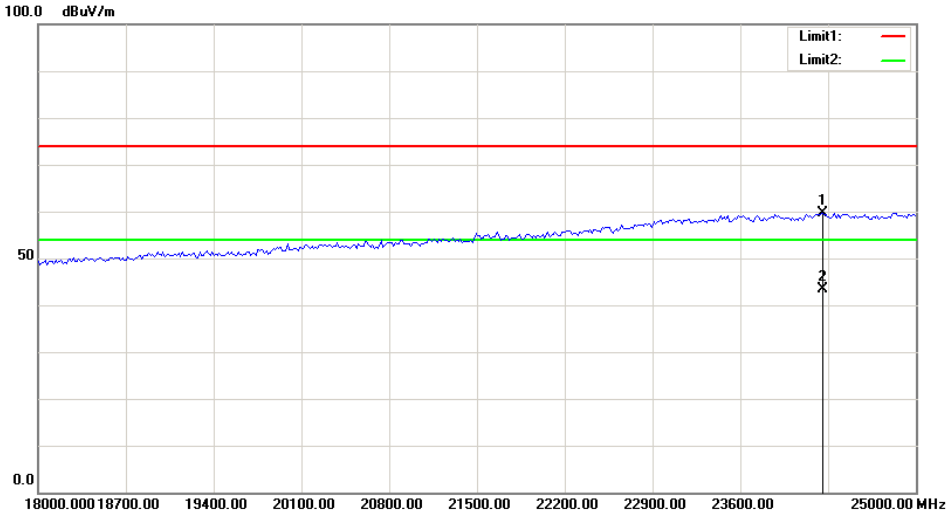


Vertical

Fundamental Test with Band Rejection Filter







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

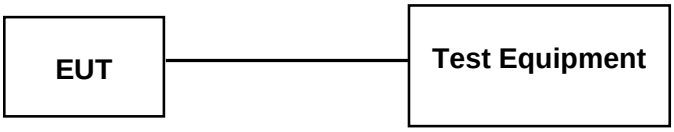
Applicable Standard

According to FCC §15.247(a) (2)

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

Test Procedure

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



Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Rohde & Schwarz	Signal Analyzer	FSIQ26	831929/005	2018-08-03	2019-08-03
Unknown	Coaxial Cable	C-SJ00-0010	C0010/01	Each time	N/A

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

Test Data

Environmental Conditions

Temperature:	24.2~26.3 °C
Relative Humidity:	37~51 %
ATM Pressure:	100.4~100.8 kPa

** The testing was performed by Andy Huang on 2019-01-12 & 2019-01-24.*

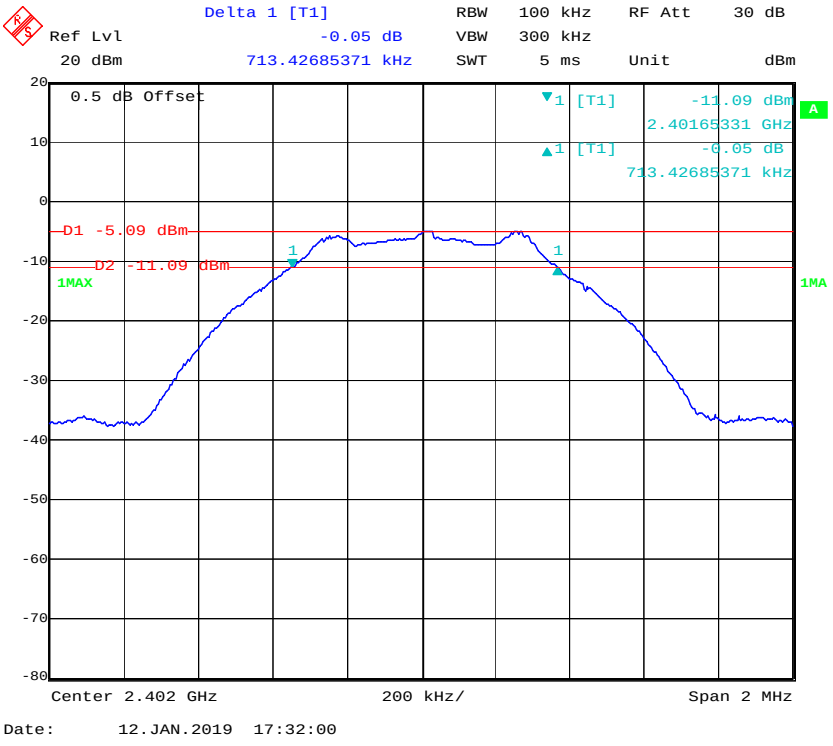
Test Mode: Transmitting

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

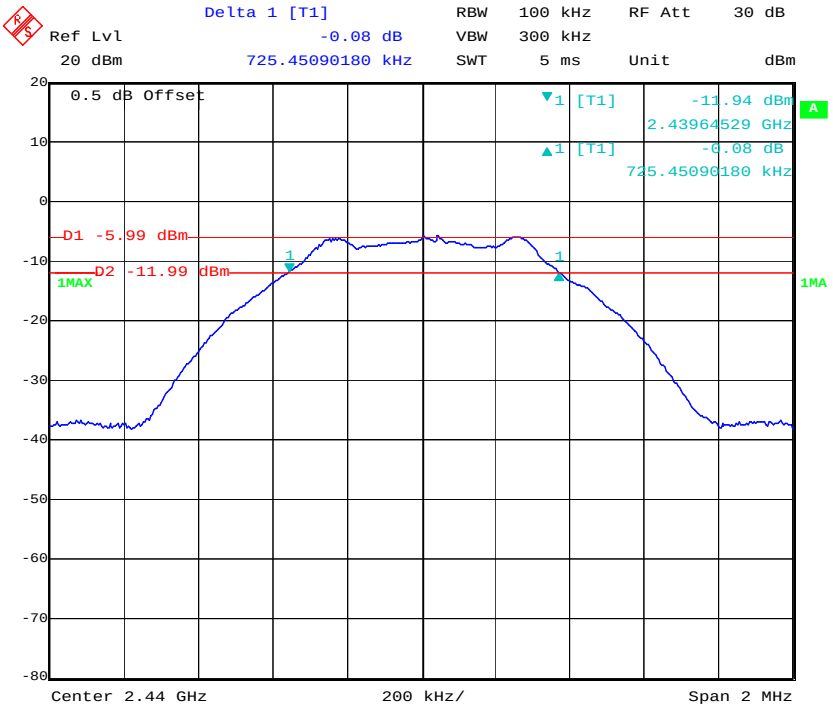
Mode	Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Limit (MHz)
BLE (1Mbps)	Low	2402	0.713	≥0.5
	Middle	2440	0.725	≥0.5
	High	2480	0.717	≥0.5
BLE (2Mbps)	Low	2402	1.226	≥0.5
	Middle	2440	1.210	≥0.5
	High	2480	1.234	≥0.5

1Mbps

Low Channel

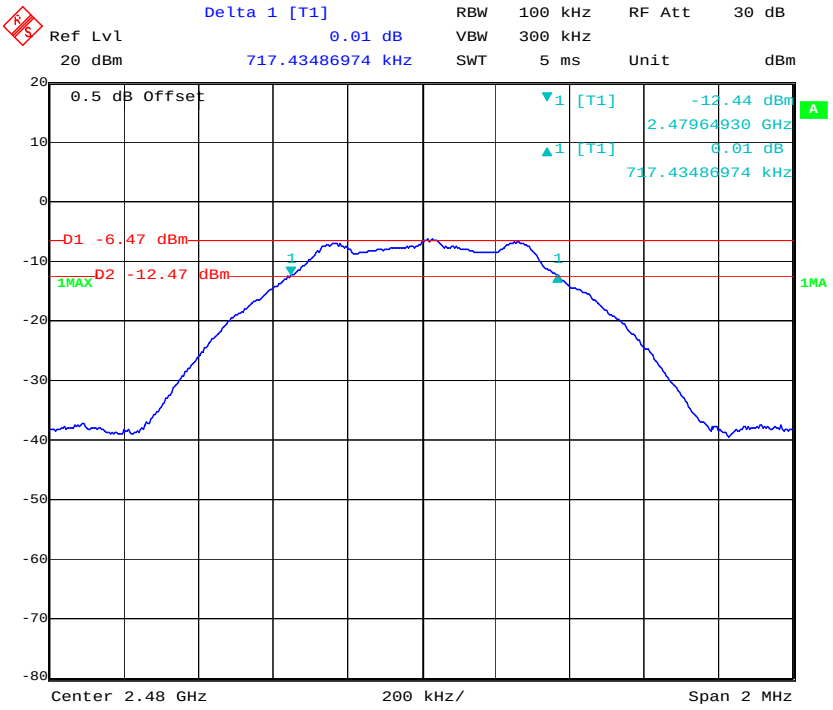


Middle Channel



Date: 12.JAN.2019 17:39:28

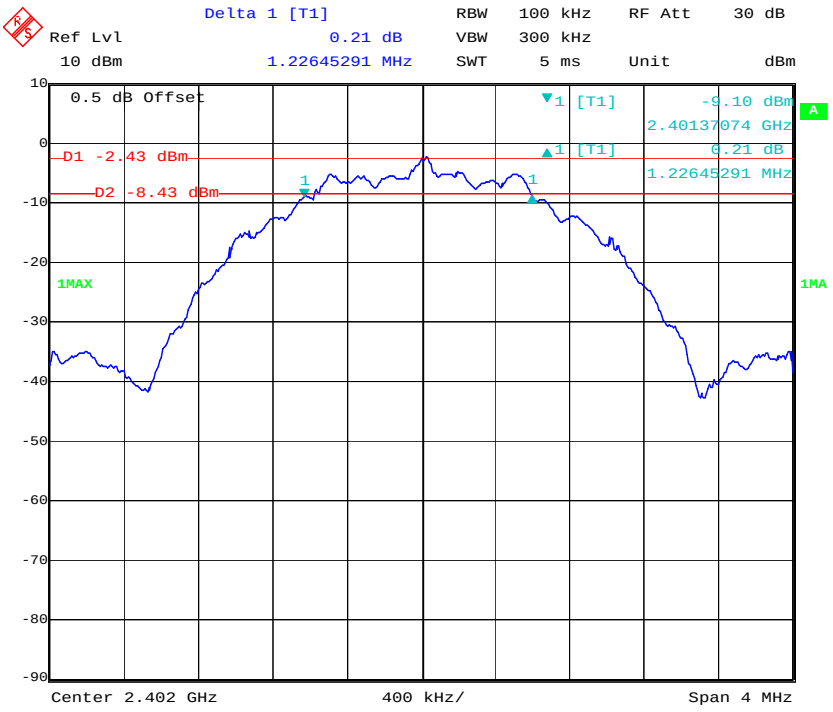
High Channel



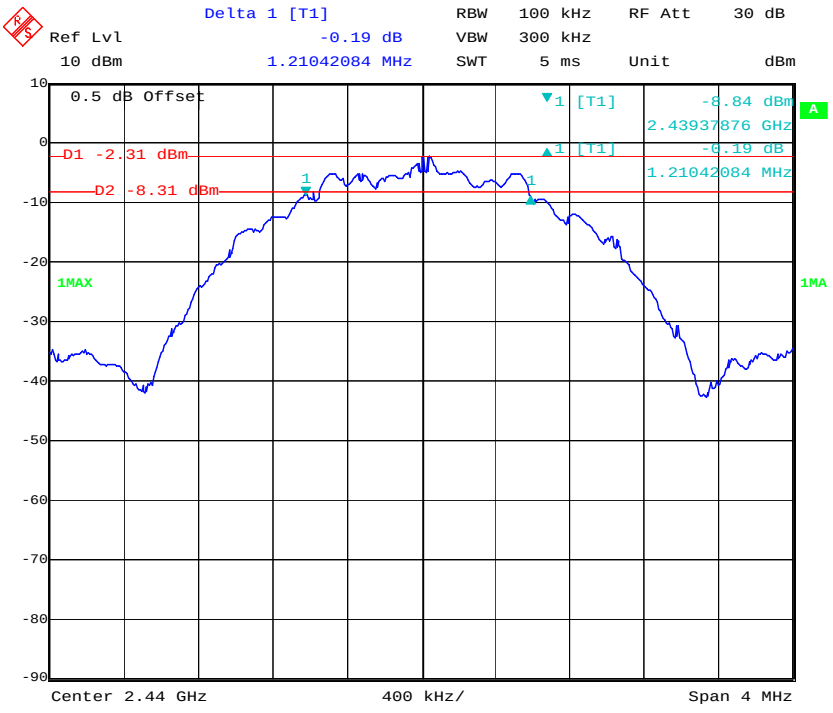
Date: 12.JAN.2019 17:35:47

2Mbps:

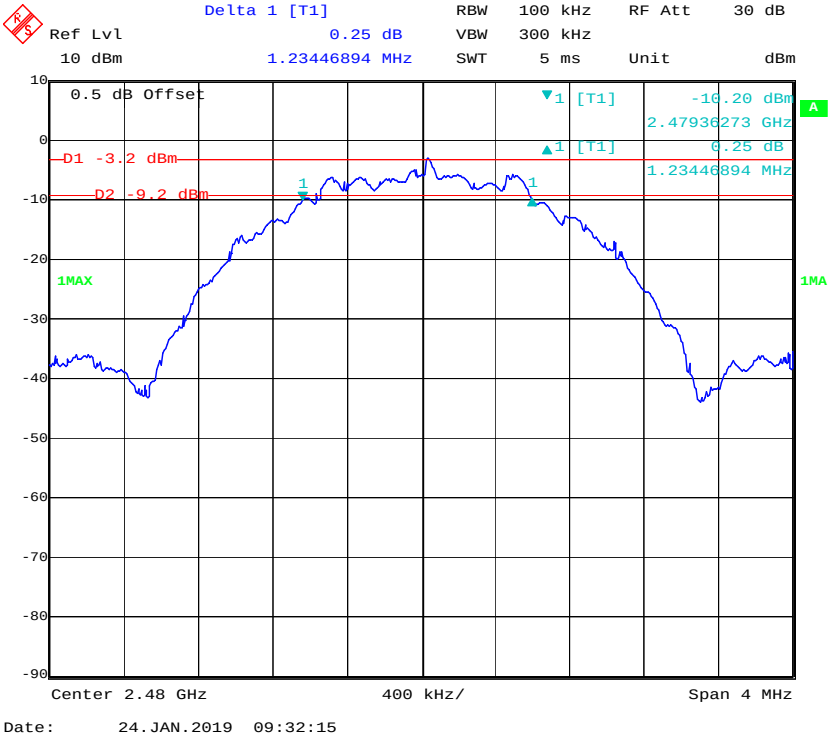
Low Channel



Middle Channel



High Channel



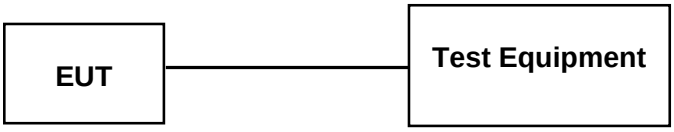
FCC §15.247(b) (3) - MAXIMUM PEAK CONDUCTED OUTPUT POWER

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.
4. Set the power Meter to test Peak output power, record the result as peak power.
5. Set the power meter to test average output power, record the result as average power.



Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Rohde & Schwarz	Signal Analyzer	FSIQ26	831929/005	2018-08-03	2019-08-03
Unknown	Coaxial Cable	C-SJ00-0010	C0010/01	Each time	N/A

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

Test Data

Environmental Conditions

Temperature:	24.2~26.3 °C
Relative Humidity:	37~51 %
ATM Pressure:	100.4~100.8 kPa

** The testing was performed by Andy Huang on 2019-01-12 & 2019-01-24.*

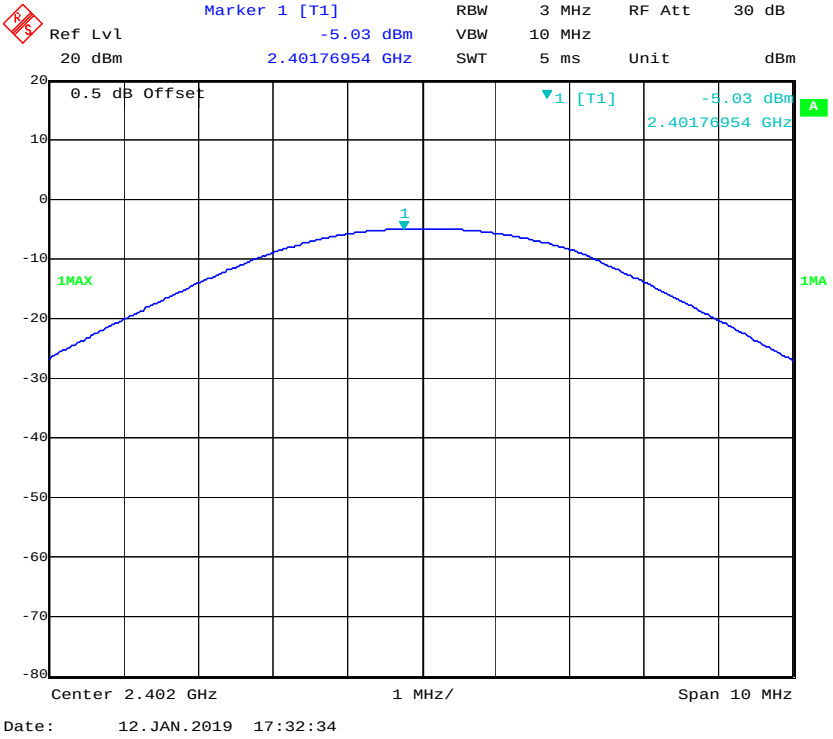
Test Mode: Transmitting

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

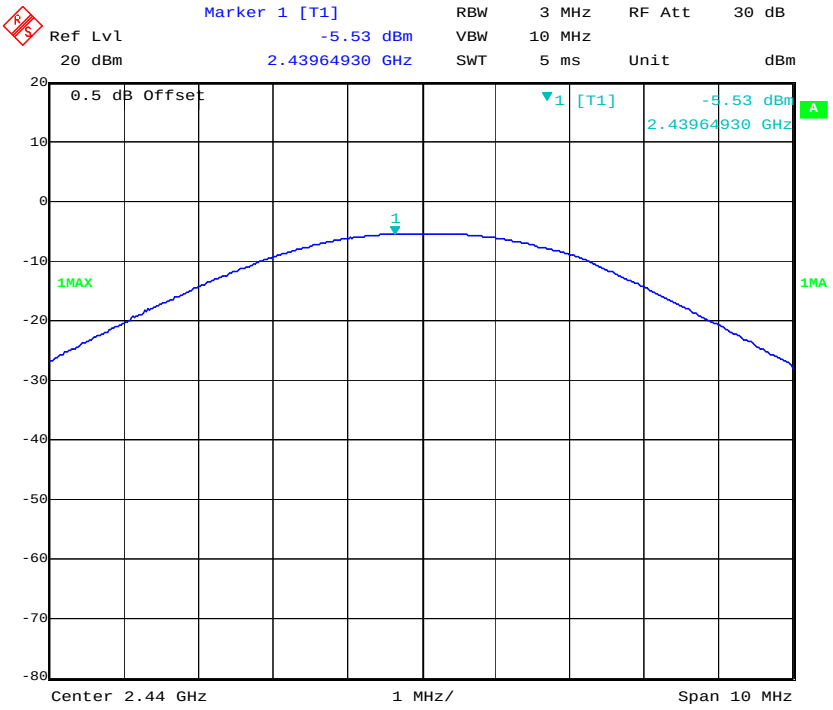
Mode	Channel	Frequency (MHz)	Max Peak Conducted Output Power (dBm)	Limit (dBm)
BLE (1Mbps)	Low	2402	-5.03	30
	Middle	2440	-5.53	30
	High	2480	-6.44	30
BLE (2Mbps)	Low	2402	-1.90	30
	Middle	2440	-1.86	30
	High	2480	-2.78	30

1Mbps:

Low Channel



Middle Channel



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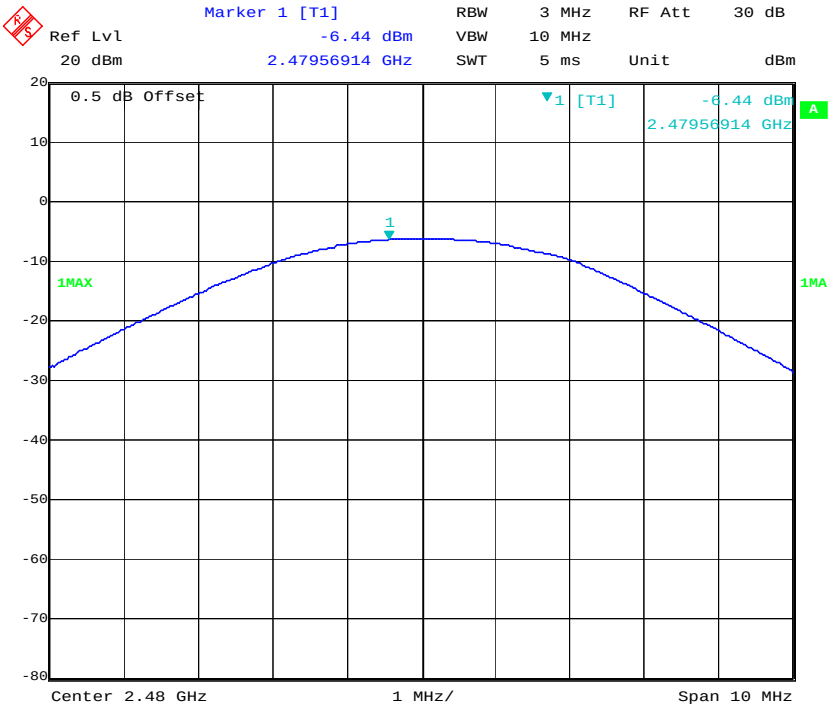
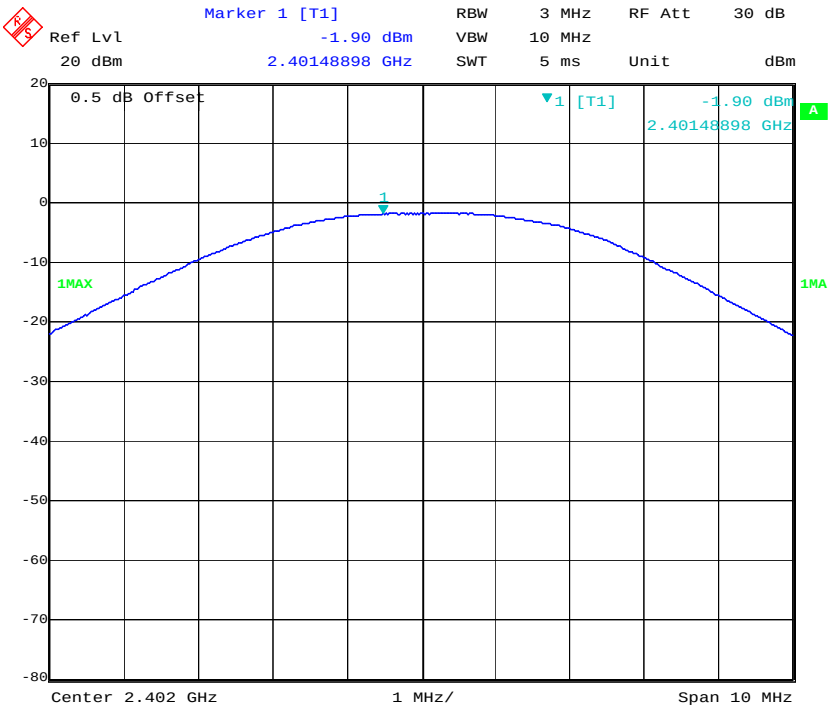
High Channel



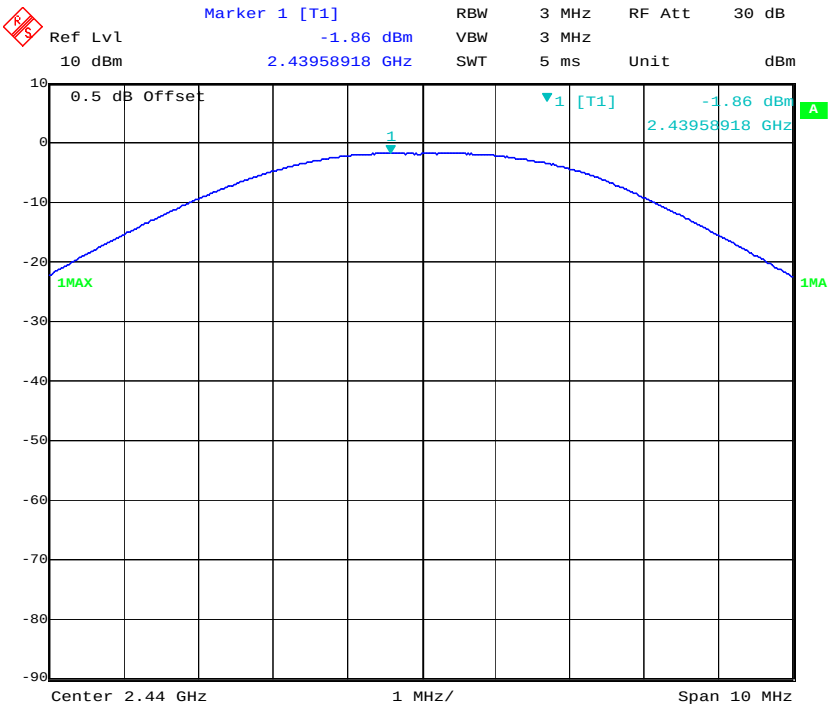
Date: 12.JAN.2019 17:36:09

2Mbps

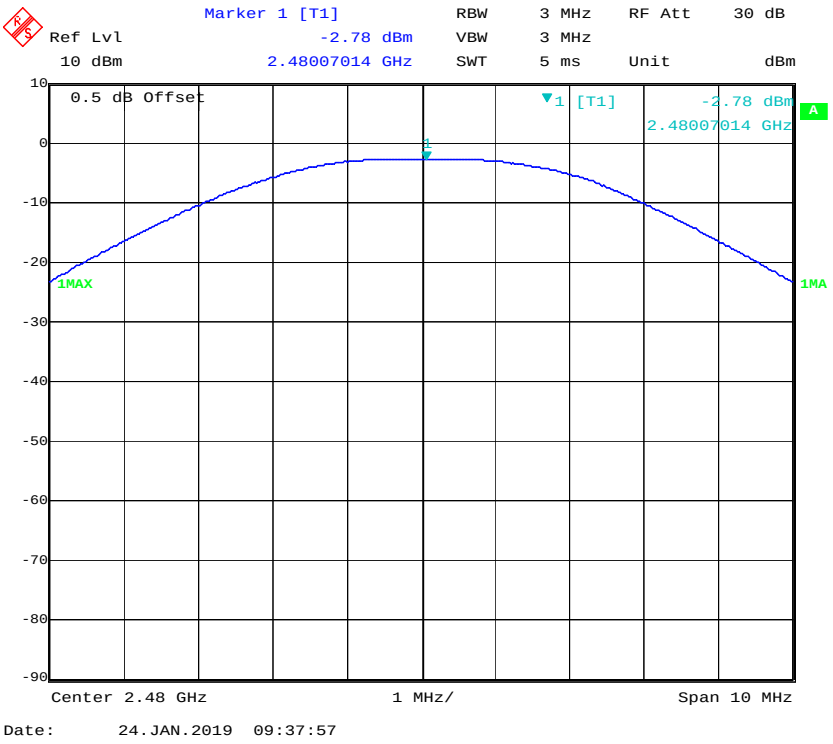
Low Channel



Middle Channel



High Channel



FCC §15.247(d) – 100 kHz BANDWIDTH OF FREQUENCY BAND EDGE

Applicable Standard

According to FCC§15.247(d):In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

Test Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range, and make sure the instrument is operated in its linear range.
3. Set RBW to 100 kHz and VBW of spectrum analyzer to 300 kHz with a convenient frequency span including 100 kHz bandwidth from band edge.
4. Measure the highest amplitude appearing on spectral display and set it as a reference level. Plot the graph with marking the highest point and edge frequency.
5. Repeat above procedures until all measured frequencies were complete.

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Rohde & Schwarz	Signal Analyzer	FSIQ26	831929/005	2018-08-03	2019-08-03
Unknown	Coaxial Cable	C-SJ00-0010	C0010/01	Each time	N/A

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

Test Data

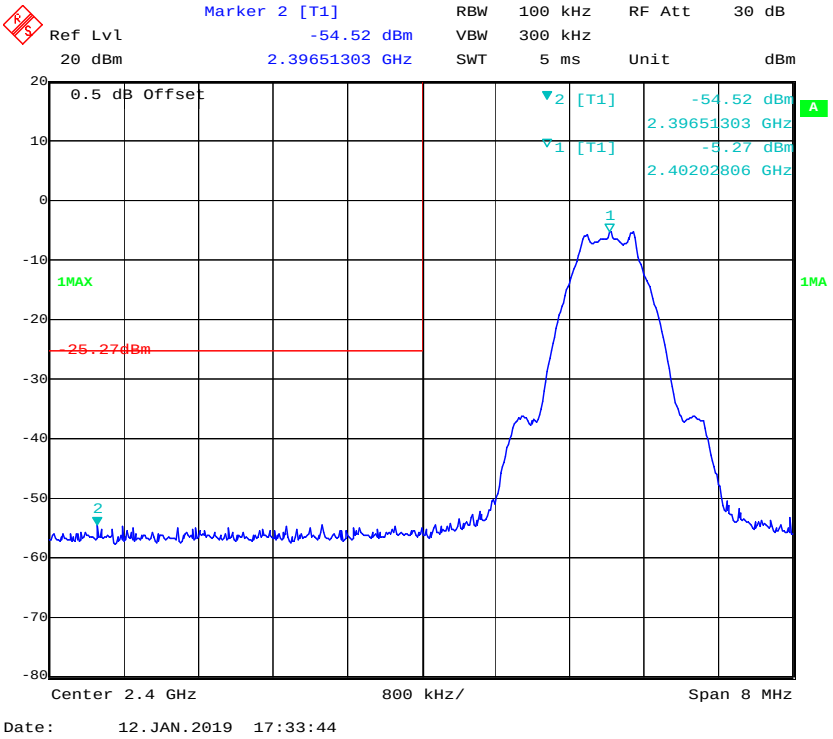
Environmental Conditions

Temperature:	24.2~26.3 °C
Relative Humidity:	37~51 %
ATM Pressure:	100.4~100.8 kPa

** The testing was performed by Andy Huang on 2019-01-12 & 2019-01-24.*

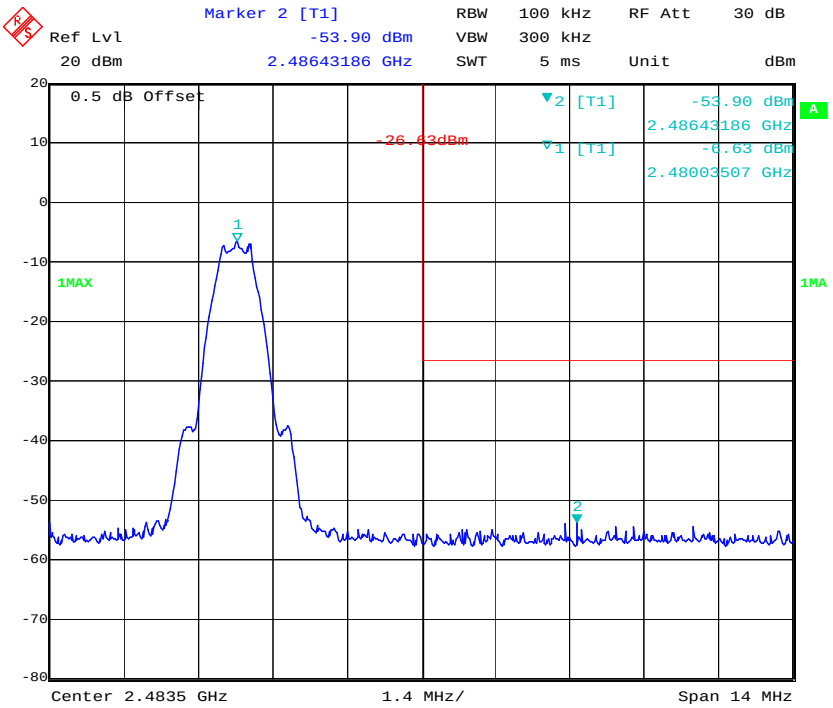
Test mode: Transmitting
Test Result: Compliance. Please refer to following plots.
1Mbps

Band Edge, Left Side



Date: 12.JAN.2019 17:33:44

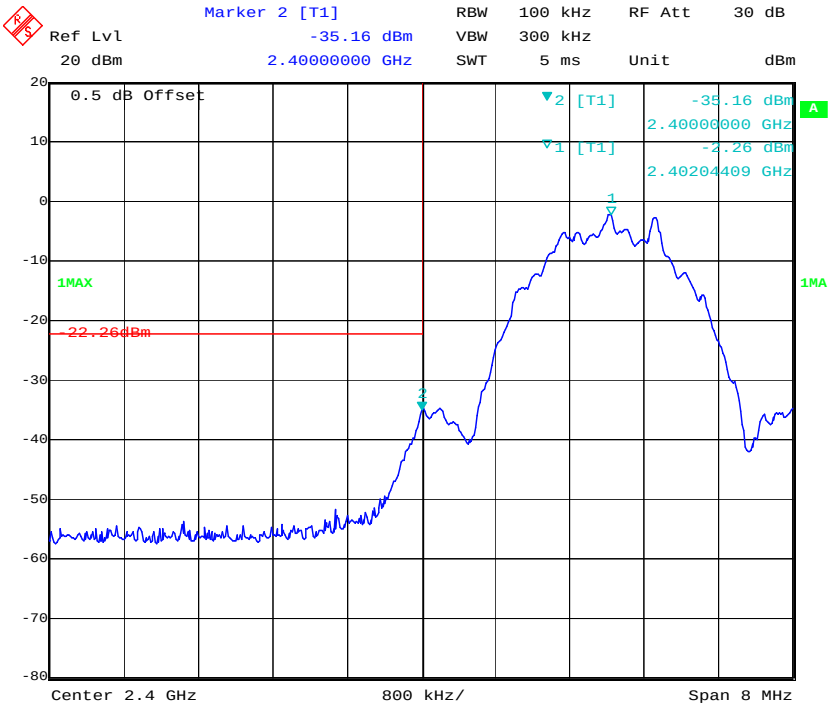
Band Edge, Right Side



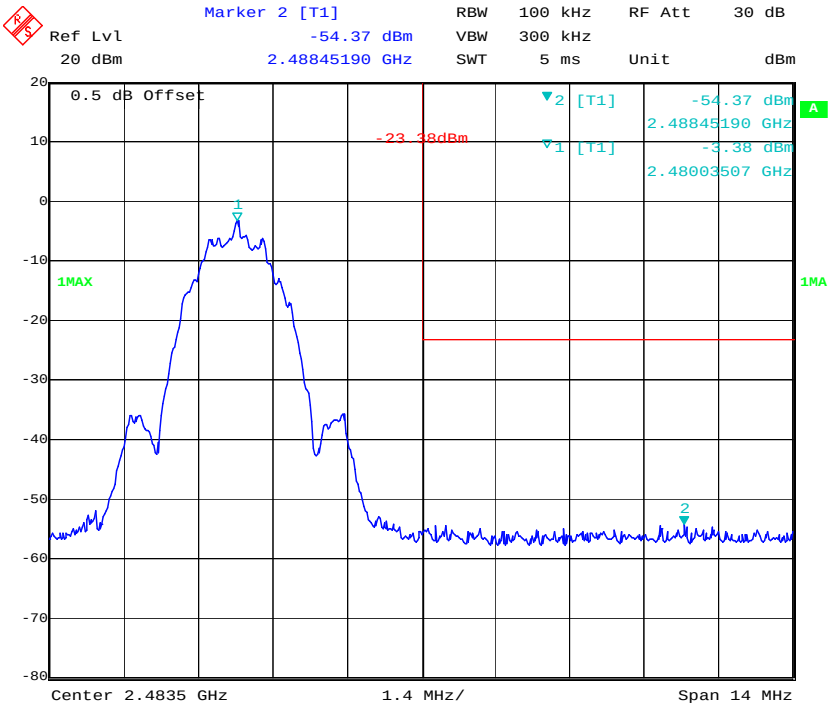
Date: 12.JAN.2019 17:37:37

2Mbps

Band Edge, Left Side



Band Edge, Right Side



FCC §15.247(e) - POWER SPECTRAL DENSITY

Applicable Standard

According to FCC§15.247(e):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

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 was set 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 the RBW = 3 kHz, VBW = 10 kHz, Set the span to 1.5 times the DTS bandwidth.
4. Use the peak marker function to determine the maximum amplitude level.

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Rohde & Schwarz	Signal Analyzer	FSIQ26	831929/005	2018-08-03	2019-08-03
Unknown	Coaxial Cable	C-SJ00-0010	C0010/01	Each time	N/A

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

Test Data

Environmental Conditions

Temperature:	24.2~26.3 °C
Relative Humidity:	37~51 %
ATM Pressure:	100.4~100.8 kPa

** The testing was performed by Andy Huang on 2019-01-12 & 2019-01-24.*

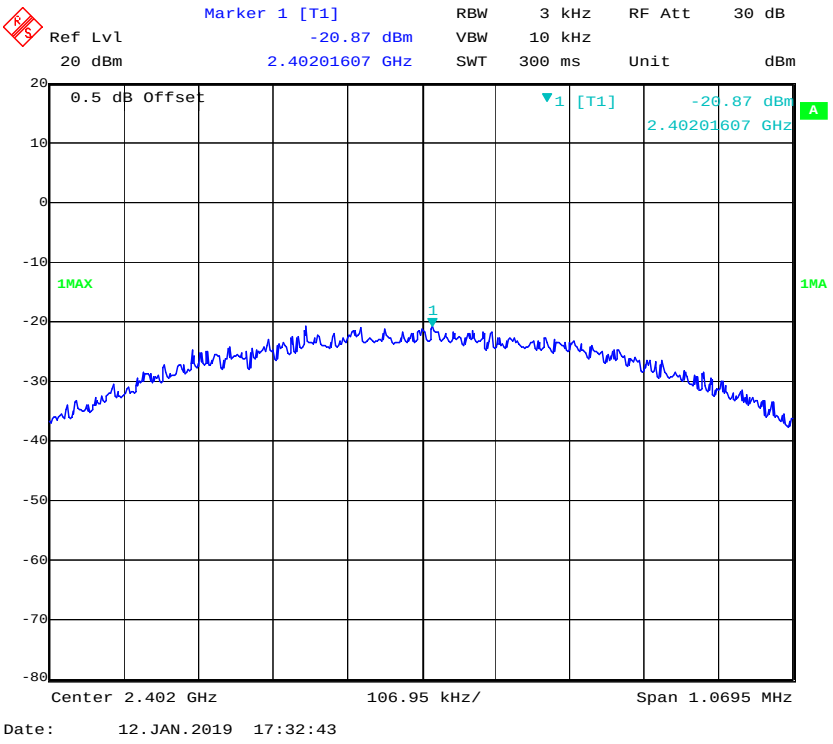
Test Mode: Transmitting

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

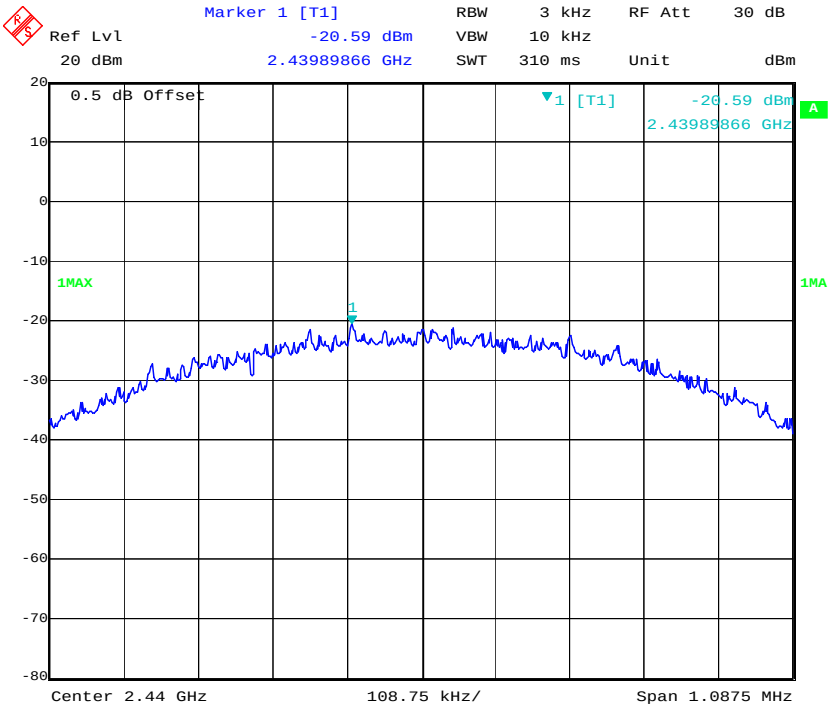
Mode	Channel	Frequency (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)
BLE (1Mbps)	Low	2402	-20.87	≤8
	Middle	2440	-20.59	≤8
	High	2480	-22.15	≤8
BLE (2Mbps)	Low	2402	-20.08	≤8
	Middle	2440	-20.12	≤8
	High	2480	-20.93	≤8

1Mbps

Power Spectral Density, Low Channel

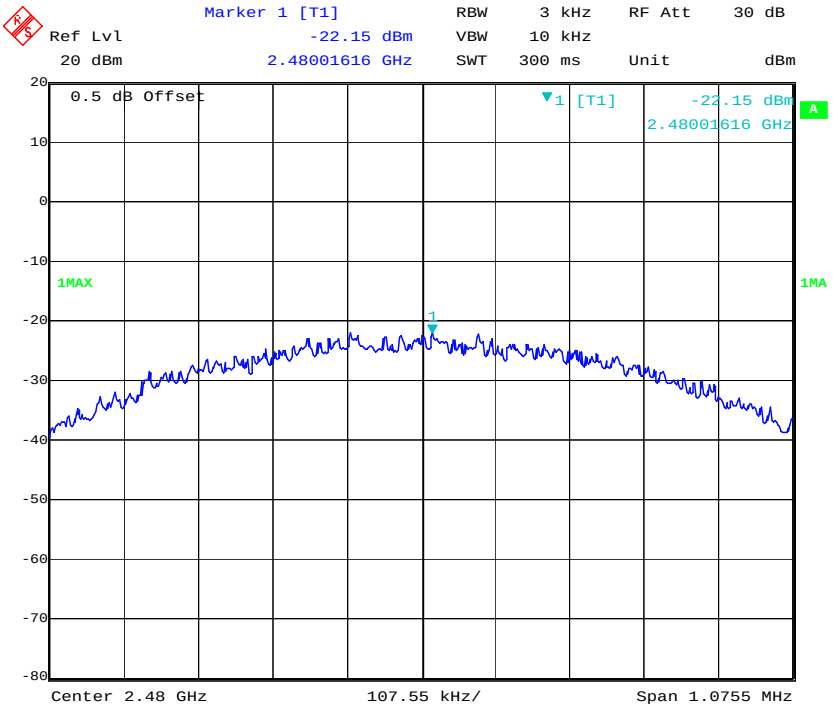


Power Spectral Density, Middle Channel



Date: 12.JAN.2019 17:40:02

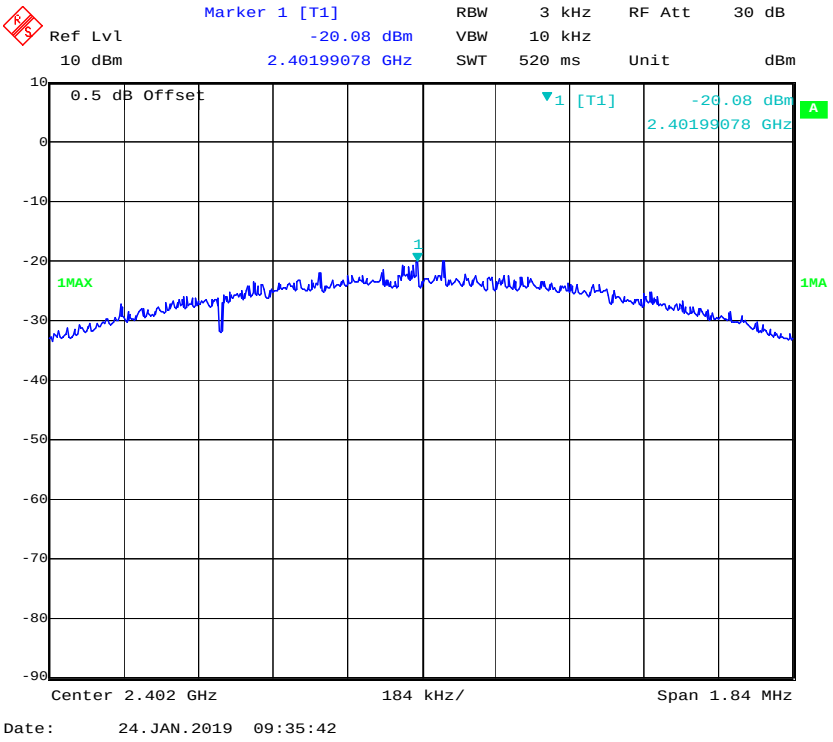
Power Spectral Density, High Channel



Date: 12.JAN.2019 17:36:21

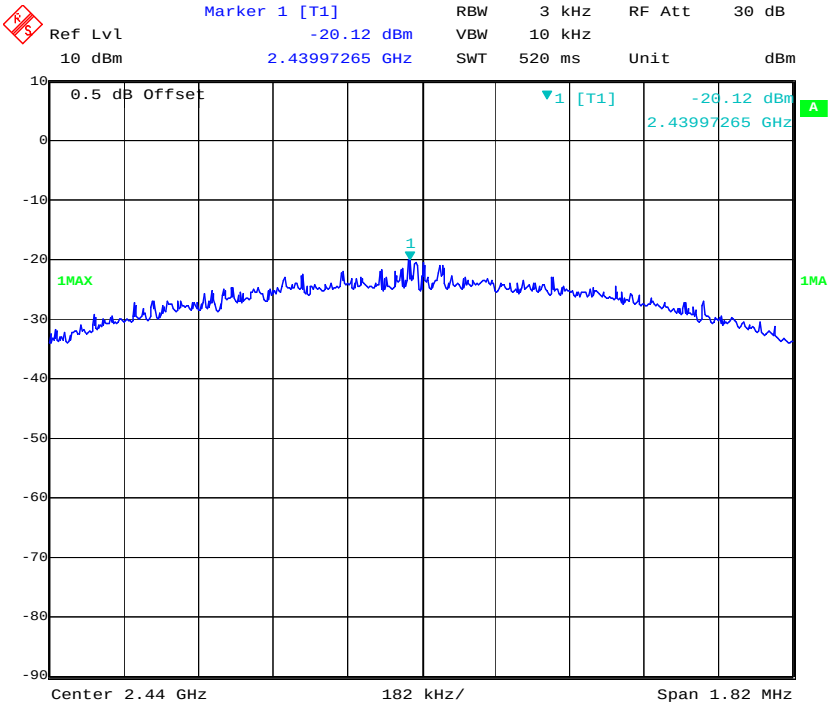
2Mbps

Power Spectral Density, Low Channel



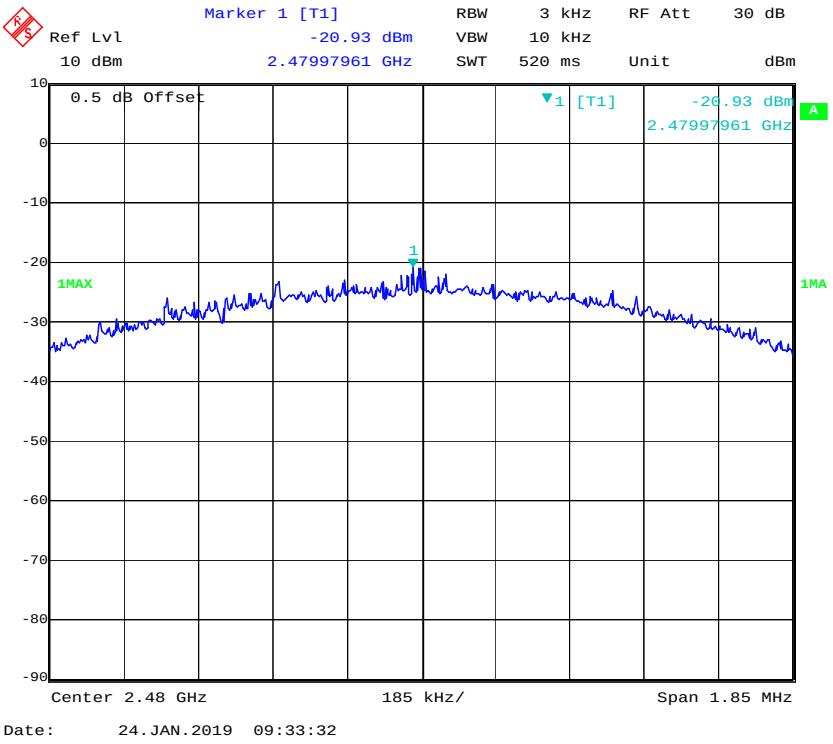
Date: 24.JAN.2019 09:35:42

Power Spectral Density, Middle Channel



Date: 24.JAN.2019 09:34:41

Power Spectral Density, High Channel



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