

FCC PART 15.247

TEST REPORT

For

HENAN ESHOW ELECTRONIC COMMERCE CO., LTD

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GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

EUT Name:	Wireless Transmission System
EUT Model:	TT105
Multiple Models:	T129, T130, T131, TT101, TT102, TT103, TT104, TT106, TT107, TT108, TT109, TT110, TT111, TT112, TT113, TT114, TT115, TT116, TT117, TT118, TT119
Operation Frequency:	2405.377-2477.569MHz
Maximum Output Power (Conducted):	7.87 dBm
Modulation Type:	GFSK
Rated Input Voltage:	3.7Vdc from Battery or DC 5V from Charger Port
External Dimension:	86mm(L)*50mm(W)*19mm(H)
Serial Number:	190730006
EUT Received Date:	2019-08-06
EUT Status:	The test samples were in good condition.

Notes: Model TT105 was selected for fully testing, the detailed information about the difference among model T129, T130, T131, TT101, TT102, TT103, TT104, TT106, TT107, TT108, TT109, TT110, TT111, TT112, TT113, TT114, TT115, TT116, TT117, TT118, TT119, and Model TT105 can be referred to the declaration letter which was stated and guaranteed by the manufacturer.

Objective

This report is prepared on behalf of HENAN ESHOW ELECTRONIC COMMERCE CO., LTD in accordance with Part 2, Subpart J, Part 15, Subparts A and C of the Federal Communications Commission's rules

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

Related Submittal(s)/Grant(s)

No related submittal.

Test Methodology

All measurements detailed in this Test Report were performed in accordance with ANSI C63.10-2013 "American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices".

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 °C
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. The device employs total 36 Hopping Channels as below:

Channel	Frequency (MHz)	Channel	Frequency (MHz)
1	2405.377	19	2442.762
2	2407.425	20	2444.801
3	2409.473	21	2446.849
4	2411.521	22	2448.897
5	2413.569	23	2450.945
6	2415.617	24	2452.993
7	2417.665	25	2455.041
8	2419.713	26	2457.089
9	2421.761	27	2459.137
10	2423.809	28	2461.185
11	2425.857	29	2463.233
12	2427.905	30	2465.281
13	2430.465	31	2467.329
14	2432.513	32	2469.377
15	2434.561	33	2471.425
16	2436.609	34	2473.473
17	2438.657	35	2475.521
18	2440.753	36	2477.569

EUT was tested with Channel 2405.377MHz, 2440.753MHz, 2477.569MHz.

EUT Exercise Software

No software was used in test, the test mode only switched by keys.

Equipment Modifications

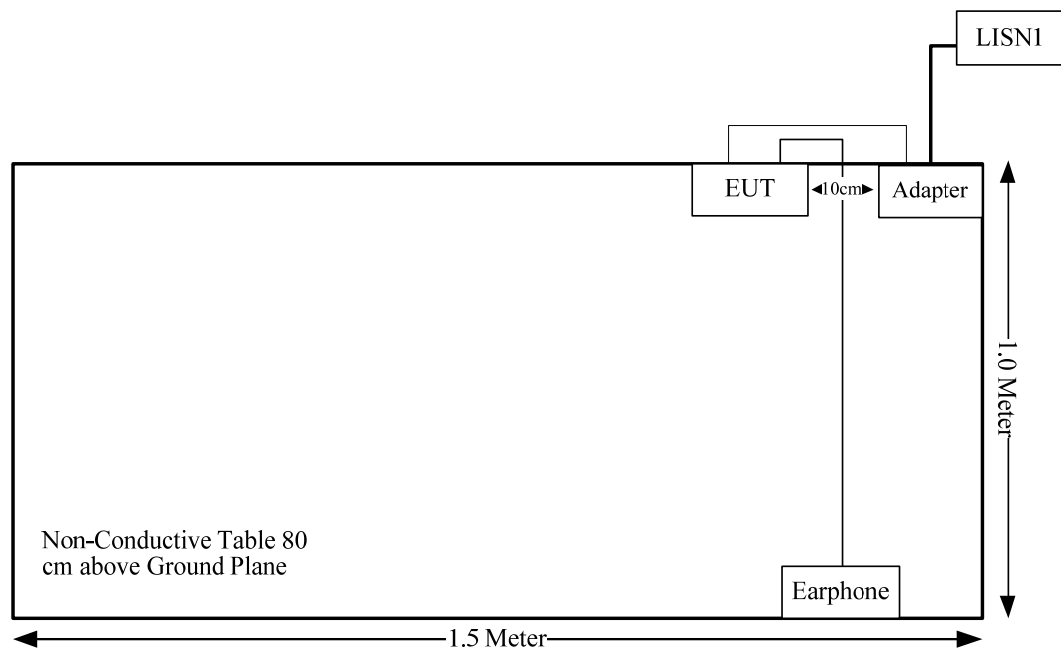
No modification was made to the EUT.

Local Support Equipment List and Details

Manufacturer	Description	Model	Serial Number
Switching Adapter	adapter	PS06C050K1000UU	Unknown
Unknown	Earphone	Unknown	Unknown

Support Cable List and Details

Cable Description	Shielding Type	Ferrite Core	Length (m)	From Port	To
DC Cable	yes	No	0.5	Adapter	EUT
Earphone Cable	No	No	1.0	EUT	Earphone

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
FCC §15.203	Antenna requirement	Compliance
FCC §15.207(a)	AC line conducted emissions	Compliance
FCC §15.205, §15.209, §15.247(d)	Spurious emissions	Compliance
FCC §15.247(a)(1)	Channel separation	Compliance
FCC §15.247(a)(1)	20 dB bandwidth	Compliance
FCC §15.247(a)(1)(iii)	Quantity of hopping channel test	Compliance
FCC §15.247(a)(1)(iii)	Time of occupancy (dwell time)	Compliance
FCC §15.247(b)(1)	Peak output power measurement	Compliance
FCC §15.247(d)	Band edges	Compliance

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:

$[(\text{max. power of channel, including tune-up tolerance, mW})/(\text{min. test separation distance, mm})] \cdot [\sqrt{f(\text{GHz})}]$
 ≤ 3.0 for 1-g SAR and ≤ 7.5 for 10-g extremity SAR, where

- $f(\text{GHz})$ 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.

Measurement Result

The max conducted power including tune-up tolerance is 8 dBm (6.3 mW).

$[(\text{max. power of channel, mW})/(\text{min. test separation distance, mm})][\sqrt{f(\text{GHz})}]$
 $= 6.3/5 \cdot (\sqrt{2.477569}) = 2.0 < 3.0$

So the stand-alone SAR evaluation is not necessary.

FCC §15.203 - ANTENNA REQUIREMENT

Applicable Standard

According to FCC § 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 use of a standard antenna jack or electrical connector is prohibited.

Antenna Connector Construction

The EUT has one internal antenna arrangement, and the antenna gain is 0 dBi, fulfill the requirement of this section. Please refer to the EUT photos.

Result: Compliance.

FCC §15.207 (a) – AC LINE CONDUCTED EMISSIONS

Applicable Standard

FCC§15.207(a)

EUT Setup



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

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

The spacing between the peripherals was 10 cm.

The adapter was connected to the main LISN with a 120 V/60 Hz AC power source.

EMI Test Receiver Setup

The EMI test receiver was set to investigate the spectrum from 150 kHz to 30 MHz.

During the conducted emission test, the EMI test receiver was set with the following configurations:

Frequency Range	IF B/W
150 kHz – 30 MHz	9 kHz

Test Procedure

During the conducted emission test, the adapter was connected to the outlet of the first LISN.

Maximizing procedure was performed on the six (6) highest emissions of the EUT.

All data was recorded in the Quasi-peak and average detection mode.

Corrected Amplitude & Margin Calculation

The basic equation is as follows:

$$V_C = V_R + A_C + VDF$$

Herein,

V_C : corrected voltage amplitude

V_R : reading voltage amplitude

A_C : attenuation caused by cable loss

VDF : voltage division factor of AMN or ISN

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

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

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Unknown	Coaxial Cable	C-NJNJ-50	C-0200-01	2018-09-05	2019-09-05
R&S	Test Software	EMC32	Version8.53.0	N/A	N/A
R&S	Two-line V-network	ENV 216	101614	2018-12-10	2019-12-10
R&S	EMI Test Receiver	ESPI	100120	2019-05-09	2020-05-09

* **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).

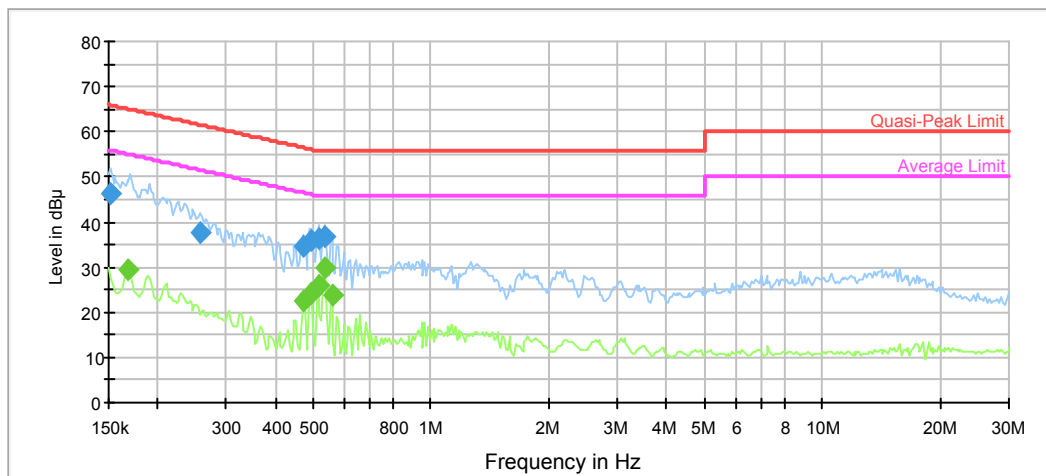
Test Data

Environmental Conditions

Temperature:	27.6 °C
Relative Humidity:	48 %
ATM Pressure:	100.4 kPa
Test by:	Sky Lu
Test Date:	2019-08-28

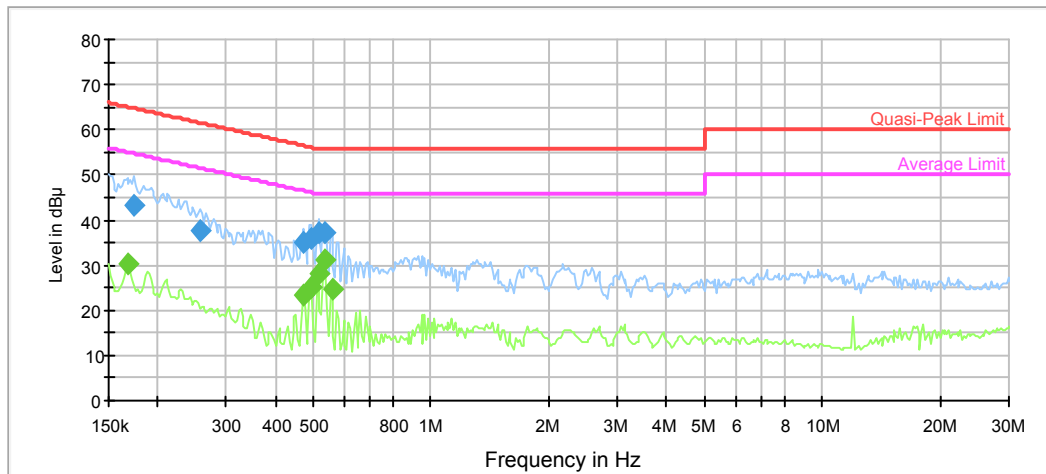
Test Result: Compliance

Test Mode: *Transmitting*

AC120V, 60 Hz, Line:

Frequency (MHz)	QuasiPeak (dBμV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
0.151500	46.1	9.000	L1	11.2	19.8	65.9
0.256712	37.5	9.000	L1	10.3	24.0	61.5
0.471031	34.7	9.000	L1	9.9	21.8	56.5
0.495058	35.9	9.000	L1	9.9	20.2	56.1
0.515160	36.5	9.000	L1	9.9	19.5	56.0
0.536077	36.9	9.000	L1	9.9	19.1	56.0

Frequency (MHz)	Average (dBμV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
0.167350	29.5	9.000	L1	10.9	25.6	55.1
0.471031	22.6	9.000	L1	9.9	23.9	46.5
0.495058	24.1	9.000	L1	9.9	22.0	46.1
0.515160	26.2	9.000	L1	9.9	19.8	46.0
0.536077	29.9	9.000	L1	9.9	16.1	46.0
0.557844	23.7	9.000	L1	9.8	22.3	46.0

AC120V, 60 Hz, Neutral:

Frequency (MHz)	QuasiPeak (dBμV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
0.174145	43.2	9.000	N	10.8	21.6	64.8
0.256712	37.8	9.000	N	10.3	23.7	61.5
0.471031	35.0	9.000	N	9.9	21.5	56.5
0.495058	36.1	9.000	N	9.9	20.0	56.1
0.515160	37.2	9.000	N	9.9	18.8	56.0
0.536077	37.4	9.000	N	9.9	18.6	56.0

Frequency (MHz)	Average (dBμV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
0.167350	30.1	9.000	N	10.9	25.0	55.1
0.471031	23.4	9.000	N	9.9	23.1	46.5
0.495058	25.1	9.000	N	9.9	21.0	46.1
0.515160	27.9	9.000	N	9.9	18.1	46.0
0.536077	30.9	9.000	N	9.9	15.1	46.0
0.557844	24.7	9.000	N	9.8	21.3	46.0

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 below 1GHz tests were performed in the 3 meters chamber A, above 1GHz tests were performed in the 3 meters chamber B, using the setup accordance with the ANSI C63.10-2013. The specification used was the FCC 15.209, and FCC 15.247 limits.

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

The spacing between the peripherals was 10 cm.

EMI Test Receiver & Spectrum Analyzer Setup

The system was investigated from 30 MHz to 25 GHz.

According to FCC public notice: DA-00-705, during the radiated emission test, the EMI test receiver & Spectrum Analyzer Setup were set with the following configurations:

Frequency Range	RBW	Video B/W	IF B/W	Measurement
30 MHz – 1000 MHz	120 kHz	300 kHz	120 kHz	QP
Above 1 GHz	1MHz	3 MHz	/	PK
	1MHz	10 Hz	/	AV

If the maximized peak measured value complies with under the QP/Average limit more than 6dB, 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.

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	EMI Test Receiver	ESCI	100035	2019-08-03	2020-08-03
Farad	Test Software	EZ-EMC	V1.1.4.2	N/A	N/A
Sunol Sciences	Antenna	JB3	A060611-2	2017-08-25	2020-08-25
Unknown	Coaxial Cable	C-NJNJ-50	C-1000-01	2018-10-05	2019-10-05
Unknown	Coaxial Cable	C-NJNJ-50	C-0400-02	2018-10-05	2019-10-05
Unknown	Coaxial Cable	C-NJNJ-50	C-0530-01	2018-10-24	2019-10-24
HP	Amplifier	8447D	2727A05902	2018-10-05	2019-10-05
Agilent	Spectrum Analyzer	E4440A	SG43360054	2019-05-09	2020-05-09
ETS-Lindgren	Horn Antenna	3115	000 527 35	2018-10-12	2021-10-12
Ducommun Technologies	Horn Antenna	ARH-4223-02	1007726-01 1304	2016-11-18	2019-11-18
Unknown	Coaxial Cable	C-SJSJ-50	C-0800-01	2018-10-05	2019-10-05
MICRO-COAX	Coaxial Cable	UFA147-1-2362-100100	64639 231029-001	2019-02-24	2020-02-24
MITEQ	Amplifier	AFS42-00101800-25-S-42	2001271	2018-10-05	2019-10-05
Quinstar	Amplifier	QLW-18405536-JO	15964001001	2019-06-27	2020-06-27
E-Microwave	Band-stop Filters	OBSF-2400-2483.5-S	OE01601525	2019-06-16	2020-06-16
Micro-tronics	High Pass Filter	HPM50111	S/N-G217	2019-06-16	2020-06-16

* **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).

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:

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

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

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

Test Data

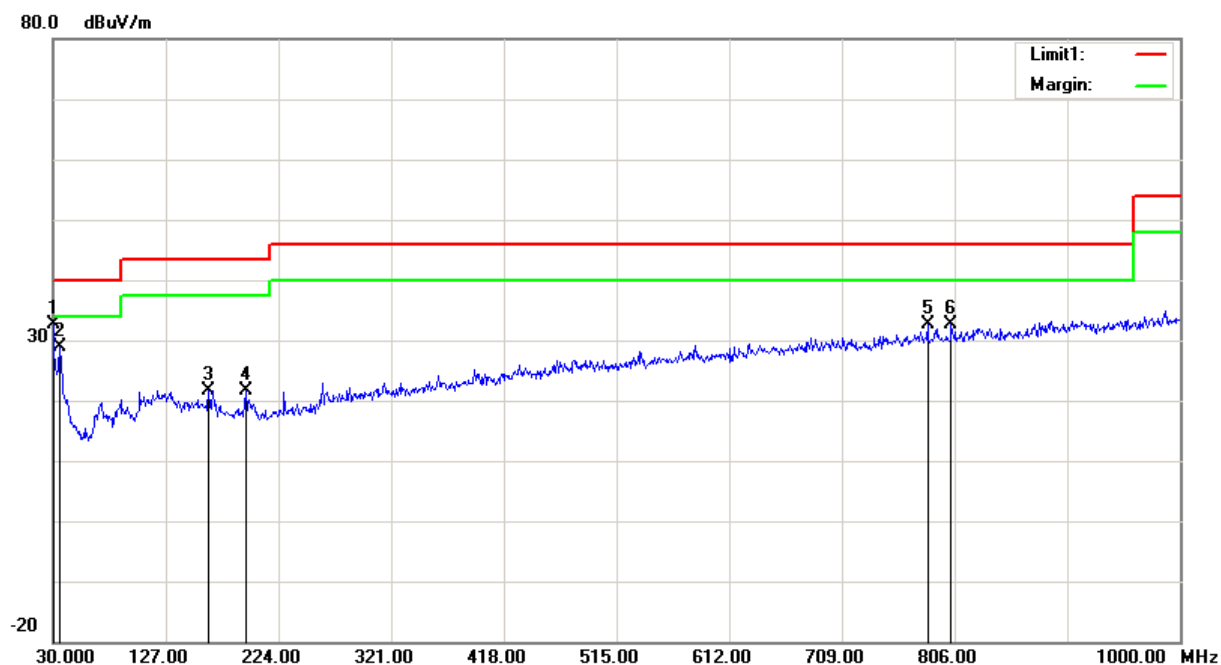
Environmental Conditions

Test Items	Radiation Below 1GHz	Radiation Above 1GHz
Temperature:	27°C	26.6°C
Relative Humidity:	50%	44%
ATM Pressure:	100.2 kPa	101.1 kPa
Tester:	Tyler Pan	Neil Liao
Test Date:	2019-08-13	2019-09-24

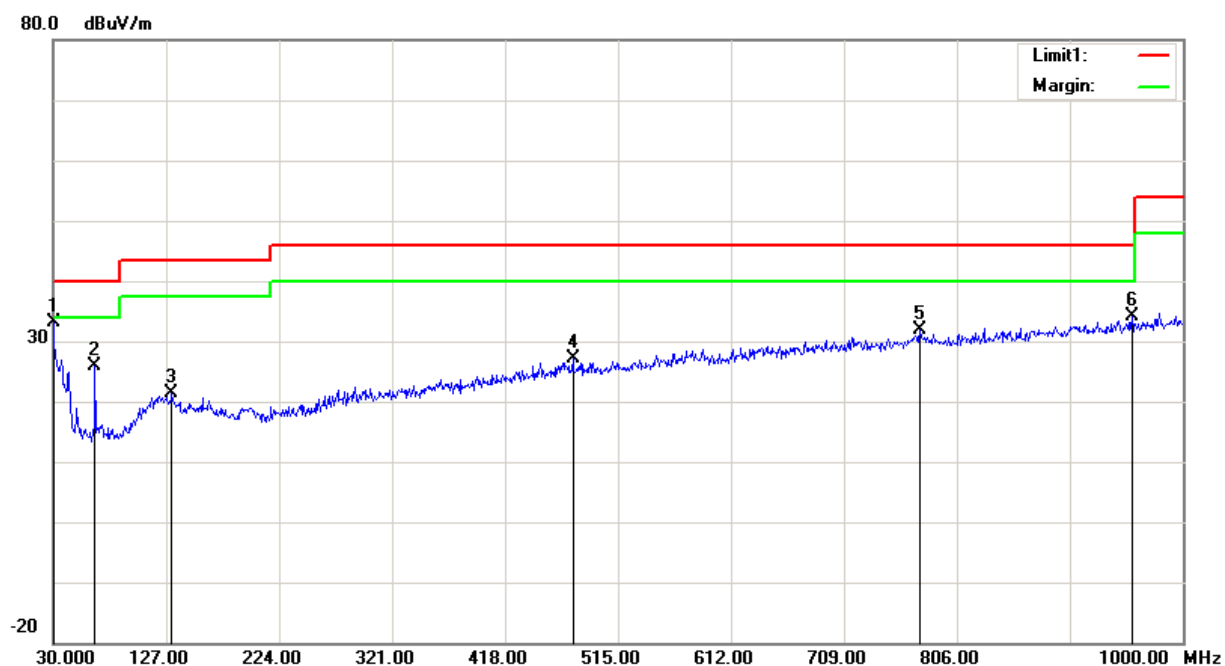
Test Mode: Transmitting

1) 30MHz-1GHz (middle channel was the worst)

Horizontal:



Frequency (MHz)	Receiver Reading (dBμV)	Remark	Correction Factor (dB/m)	Cord. Amp. (dBμV/m)	Limit (dBμV/m)	Margin (dB)
30.0000	31.02	peak	1.72	32.74	40.00	7.26
35.8200	31.47	peak	-2.59	28.88	40.00	11.12
163.8600	27.89	peak	-6.16	21.73	43.50	21.77
195.8700	28.35	peak	-6.60	21.75	43.50	21.75
782.7200	28.29	peak	4.38	32.67	46.00	13.33
803.0900	28.05	peak	4.51	32.56	46.00	13.44

Vertical:

Frequency (MHz)	Receiver Reading (dBμV)	Remark	Correction Factor (dB/m)	Cord. Amp. (dBμV/m)	Limit (dBμV/m)	Margin (dB)
30.0000	31.51	peak	1.72	33.23	40.00	6.77
65.8900	37.59	peak	-11.60	25.99	40.00	14.01
131.8500	26.23	peak	-4.89	21.34	43.50	22.16
476.2000	27.57	peak	-0.36	27.21	46.00	18.79
773.9900	27.58	peak	4.35	31.93	46.00	14.07
956.3500	33.31	peak	0.89	34.20	46.00	11.80

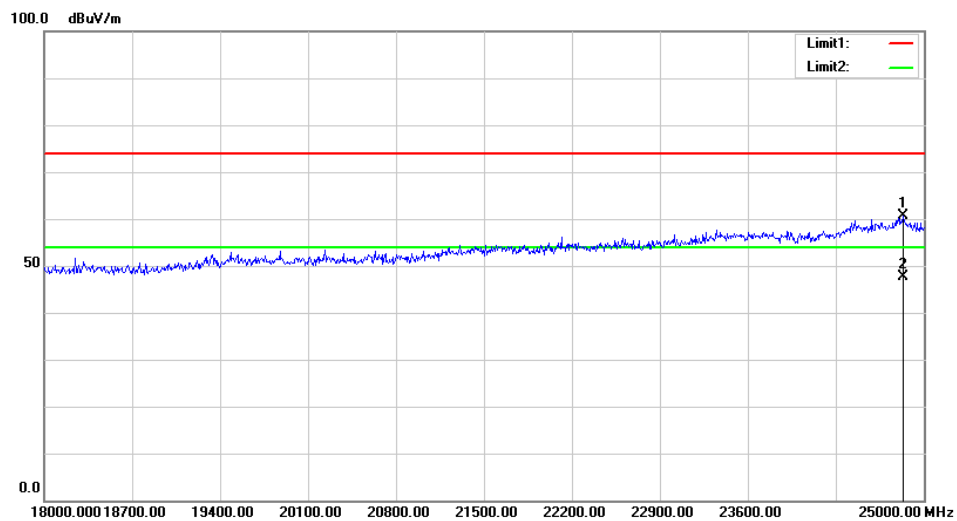
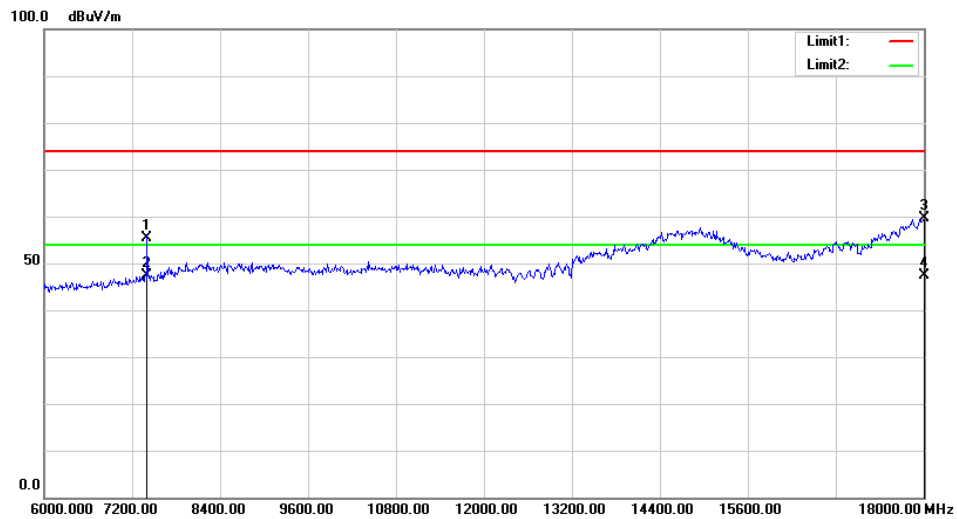
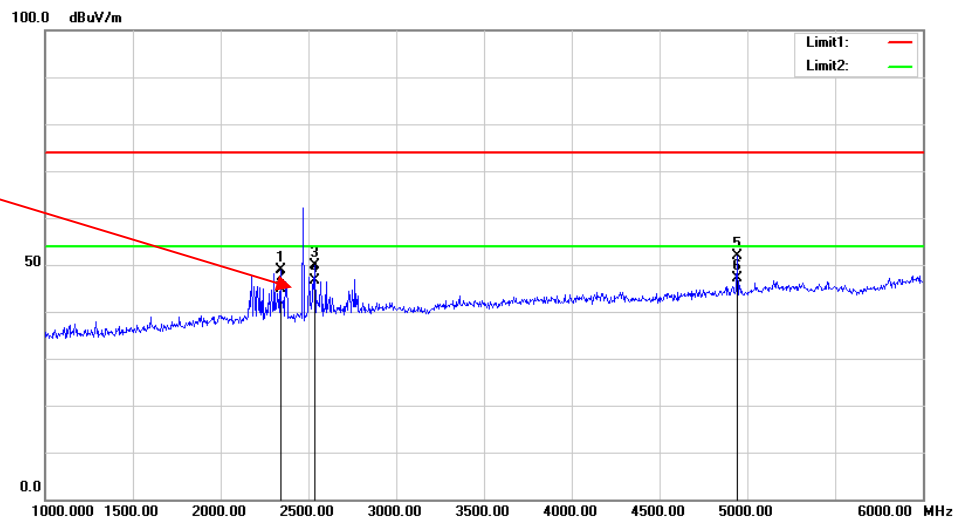
2)1GHz-25GHz:

Frequency (MHz)	Receiver		Rx Antenna		Cable loss (dB)	Amplifier Gain (dB)	Corrected Amplitude (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	Remark	Polar (H/V)	Factor (dB/m)					
Low Channel: 2405.377 MHz									
2405.377	70.58	PK	H	28.11	1.80	0.00	100.49	N/A	N/A
2405.377	67.49	AV	H	28.11	1.80	0.00	97.40	N/A	N/A
2405.377	74.38	PK	V	28.11	1.80	0.00	104.29	N/A	N/A
2405.377	71.54	AV	V	28.11	1.80	0.00	101.45	N/A	N/A
2390.00	28.33	PK	V	28.08	1.80	0.00	58.21	74.00	15.79
2390.00	13.21	AV	V	28.08	1.80	0.00	43.09	54.00	10.91
4810.75	55.97	PK	V	32.92	3.18	37.20	54.87	74.00	19.13
4810.75	49.62	AV	V	32.92	3.18	37.20	48.52	54.00	5.48
7216.13	53.44	PK	V	35.76	4.80	37.24	56.76	74.00	17.24
7216.13	45.93	AV	V	35.76	4.80	37.24	49.25	54.00	4.75
2309.00	57.58	PK	V	27.92	1.75	36.43	50.82	74.00	23.18
2309.00	53.32	AV	V	27.92	1.75	36.43	46.56	54.00	7.44
2341.40	61.32	PK	V	27.98	1.77	36.43	54.64	74.00	19.36
2341.40	57.07	AV	V	27.98	1.77	36.43	50.39	54.00	3.61
2374.40	57.87	PK	V	28.05	1.79	36.42	51.29	74.00	22.71
2374.40	53.55	AV	V	28.05	1.79	36.42	46.97	54.00	7.03
2505.20	56.60	PK	V	28.32	1.85	36.37	50.40	74.00	23.60
2505.20	51.47	AV	V	28.32	1.85	36.37	45.27	54.00	8.73
2537.60	56.50	PK	V	28.44	1.86	36.37	50.43	74.00	23.57
2537.60	51.69	AV	V	28.44	1.86	36.37	45.62	54.00	8.38
Middle Channel: 2440.753 MHz									
2440.753	71.47	PK	H	28.18	1.82	0.00	101.47	N/A	N/A
2440.753	68.58	AV	H	28.18	1.82	0.00	98.58	N/A	N/A
2440.753	74.94	PK	V	28.18	1.82	0.00	104.94	N/A	N/A
2440.753	72.04	AV	V	28.18	1.82	0.00	102.04	N/A	N/A
4881.51	57.12	PK	V	33.06	3.27	37.21	56.24	74.00	17.76
4881.51	48.89	AV	V	33.06	3.27	37.21	48.01	54.00	5.99
7322.26	53.84	PK	V	36.04	4.62	37.38	57.12	74.00	16.88
7322.26	45.39	AV	V	36.04	4.62	37.38	48.67	54.00	5.33
2310.80	59.75	PK	V	27.92	1.76	36.43	53.00	74.00	21.00
2310.80	55.14	AV	V	27.92	1.76	36.43	48.39	54.00	5.61
2343.20	58.17	PK	V	27.99	1.77	36.43	51.50	74.00	22.50
2343.20	52.43	AV	V	27.99	1.77	36.43	45.76	54.00	8.24
2376.20	62.14	PK	V	28.05	1.79	36.42	55.56	74.00	18.44
2376.20	58.05	AV	V	28.05	1.79	36.42	51.47	54.00	2.53
2507.60	60.56	PK	V	28.33	1.85	36.37	54.37	74.00	19.63
2507.60	56.03	AV	V	28.33	1.85	36.37	49.84	54.00	4.16
2540.00	55.60	PK	V	28.44	1.86	36.37	49.53	74.00	24.47
2540.00	51.34	AV	V	28.44	1.86	36.37	45.27	54.00	8.73

Frequency (MHz)	Receiver		Rx Antenna		Cable loss (dB)	Amplifier Gain (dB)	Corrected Amplitude (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	Remark	Polar (H/V)	Factor (dB/m)					
High Channel: 2477.569 MHz									
2477.569	71.41	PK	H	28.26	1.84	0.00	101.51	N/A	N/A
2477.569	68.55	AV	H	28.26	1.84	0.00	98.65	N/A	N/A
2477.569	75.46	PK	V	28.26	1.84	0.00	105.56	N/A	N/A
2477.569	72.09	AV	V	28.26	1.84	0.00	102.19	N/A	N/A
2483.50	25.67	PK	V	28.27	1.84	0.00	55.78	74.00	18.22
2483.50	13.46	AV	V	28.27	1.84	0.00	43.57	54.00	10.43
4955.14	58.18	PK	V	33.21	3.23	37.24	57.38	74.00	16.62
4955.14	50.25	AV	V	33.21	3.23	37.24	49.45	54.00	4.55
7432.71	53.91	PK	V	36.33	4.43	37.52	57.15	74.00	16.85
7432.71	45.57	AV	V	36.33	4.43	37.52	48.81	54.00	5.19
2307.80	58.32	PK	V	27.92	1.75	36.43	51.56	74.00	22.44
2307.80	55.97	AV	V	27.92	1.75	36.43	49.21	54.00	4.79
2340.20	59.12	PK	V	27.98	1.77	36.43	52.44	74.00	21.56
2340.20	56.61	AV	V	27.98	1.77	36.43	49.93	54.00	4.07
2373.20	57.45	PK	V	28.05	1.79	36.42	50.87	74.00	23.13
2373.20	53.36	AV	V	28.05	1.79	36.42	46.78	54.00	7.22
2537.00	56.44	PK	V	28.43	1.86	36.37	50.36	74.00	23.64
2537.00	51.67	AV	V	28.43	1.86	36.37	45.59	54.00	8.41
2569.40	55.87	PK	V	28.55	1.87	36.38	49.91	74.00	24.09
2569.40	50.40	AV	V	28.55	1.87	36.38	44.44	54.00	9.56

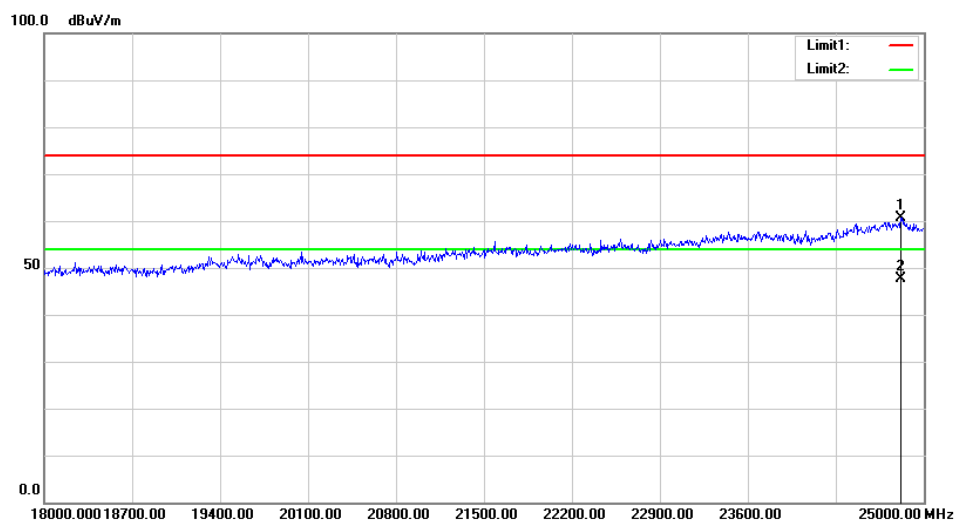
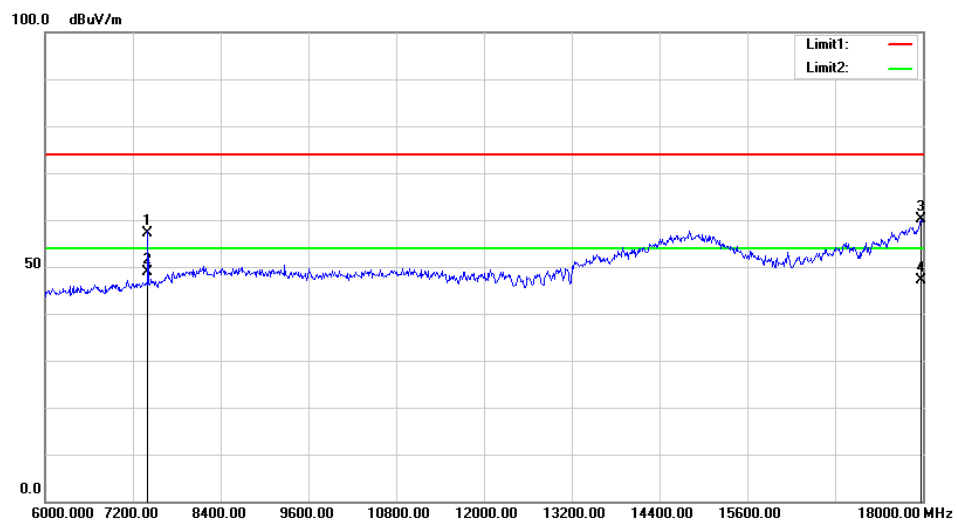
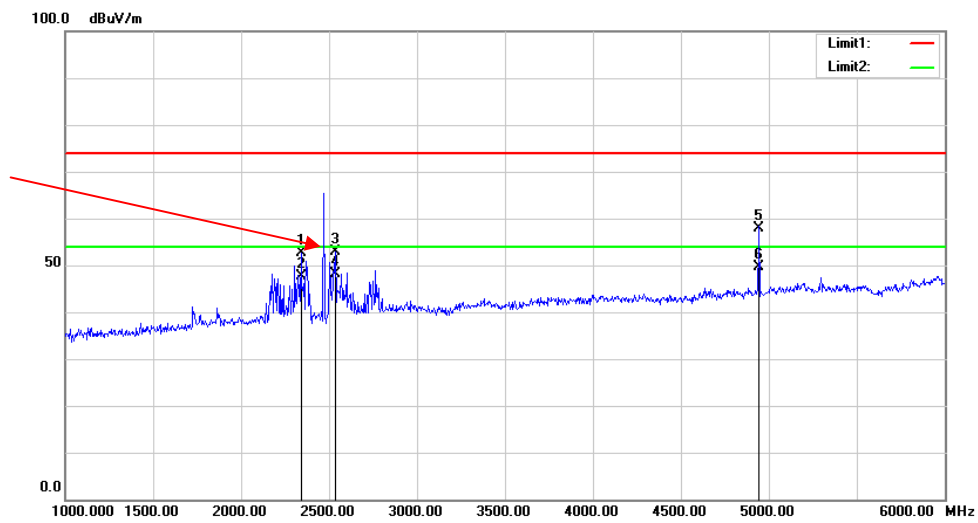
Worst plots (Middle channel was the worst)
Horizontal

Fundamental
Test with Band
Rejection Filter



Vertical

Fundamental
Test with Band
Rejection Filter



FCC §15.247(a) (1) - CHANNEL SEPARATION TEST**Applicable Standard**

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.50 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20dB bandwidth of the hopping channel, whichever is greater provided the systems operate with an output power no greater than 125 mW.

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	Spectrum Analyzer	FSV40	101474	2019-01-09	2020-01-09
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 Procedure

1. Set the EUT in transmitting mode, spectrum Bandwidth was set at 30 kHz, maxhold the channel.
2. Set the adjacent channel of the EUT maxhold another trace.
3. Measure the channel separation.

Test Data**Environmental Conditions**

Temperature:	27.2°C
Relative Humidity:	65 %
ATM Pressure:	100.2 kPa
Test by:	Blake Yang
Test Date:	2019-11-12

Test Result: Compliance.

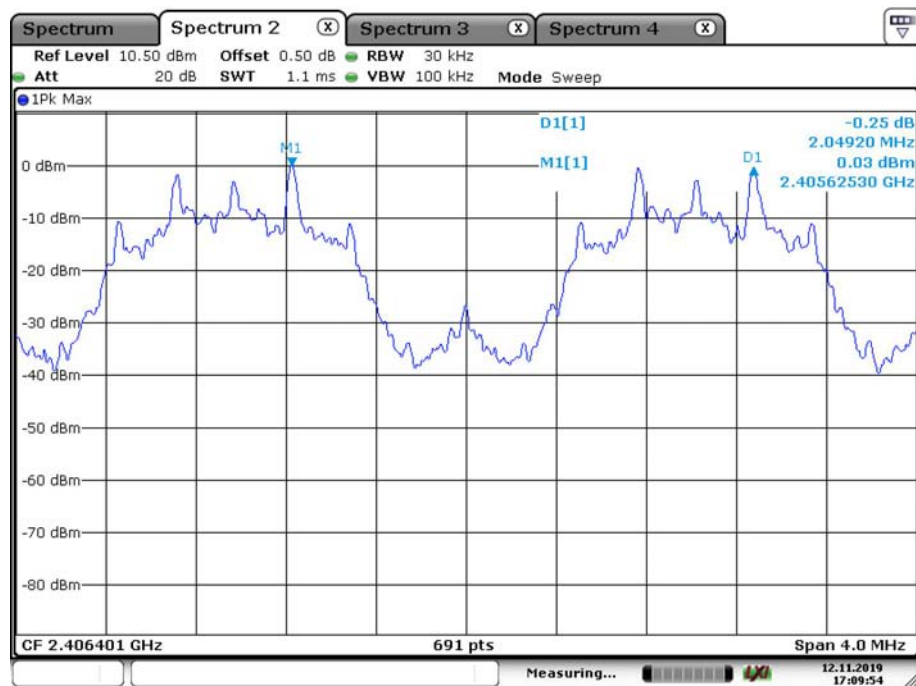
Please refer to following tables and plots

Test Mode: Transmitting

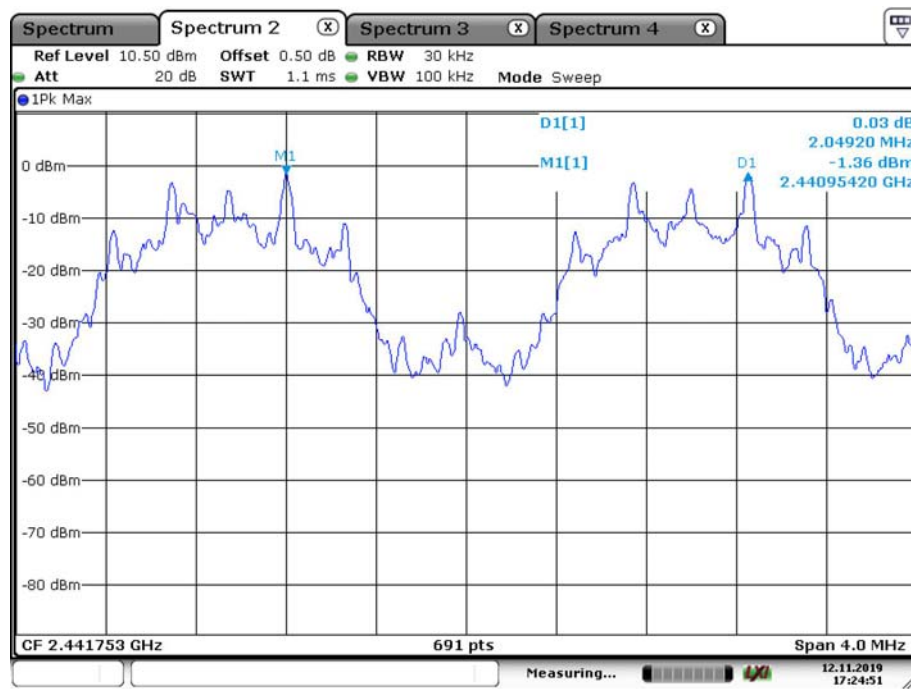
Channel	Frequency (MHz)	Channel Separation (MHz)	Limit (MHz)
Low	2405.377	2.049	0.77
Middle	2440.753	2.049	0.78
High	2477.569	2.049	0.75

Note: Limit = $(2/3) \times 20\text{dB bandwidth}$

Low Channel

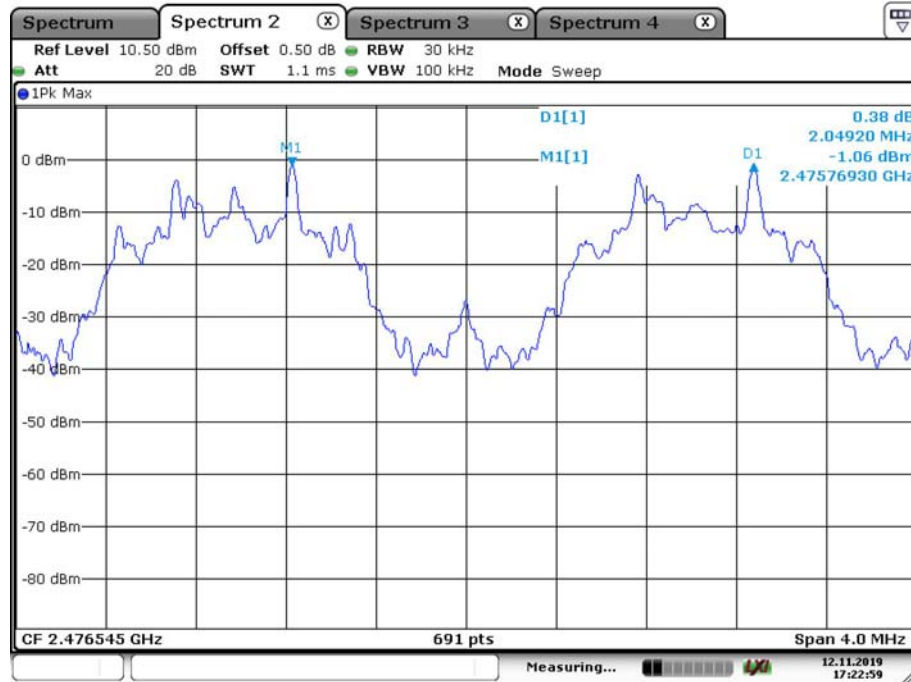


Middle Channel



Date: 12.NOV.2019 17:24:52

High Channel



Date: 12.NOV.2019 17:22:59

FCC §15.247(a) (1) – 20 dB BANDWIDTH TESTING**Applicable Standard**

Alternatively, frequency hopping systems operating in the 2400–2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

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 on the test table without connection to measurement instrument. Turn on the EUT. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.
3. Measure the frequency difference of two frequencies that were attenuated 20 dB from the reference level. Record the frequency difference as the emission bandwidth.
4. Repeat above procedures until all frequencies measured were complete.

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	Spectrum Analyzer	FSV40	101474	2019-01-09	2020-01-09
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**

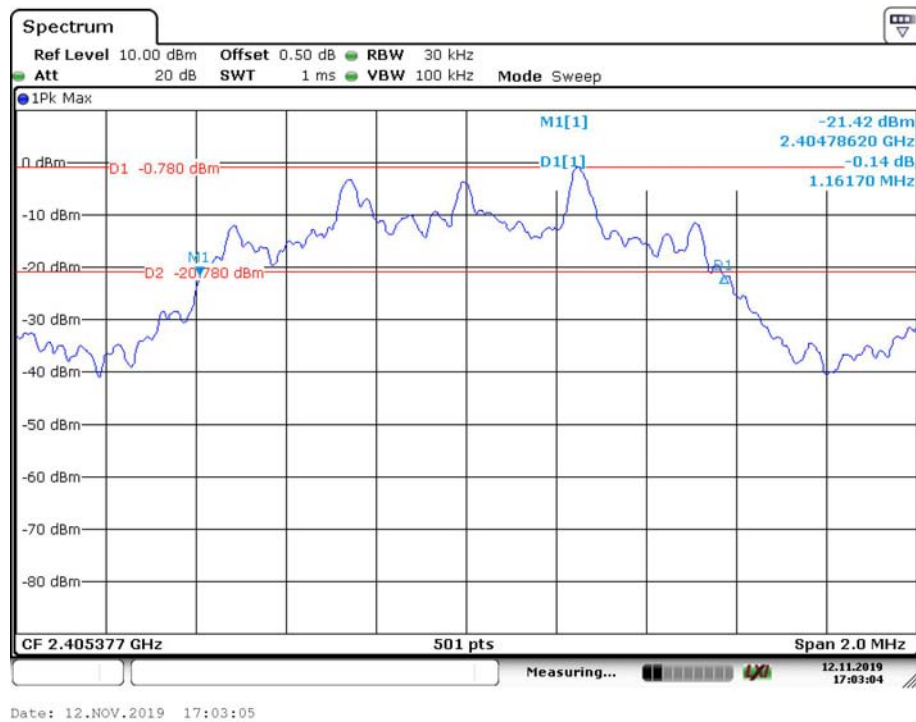
Temperature:	27.2°C
Relative Humidity:	65 %
ATM Pressure:	100.2 kPa
Test by:	Blake Yang
Test Date:	2019-11-12

Test Result: Compliance.

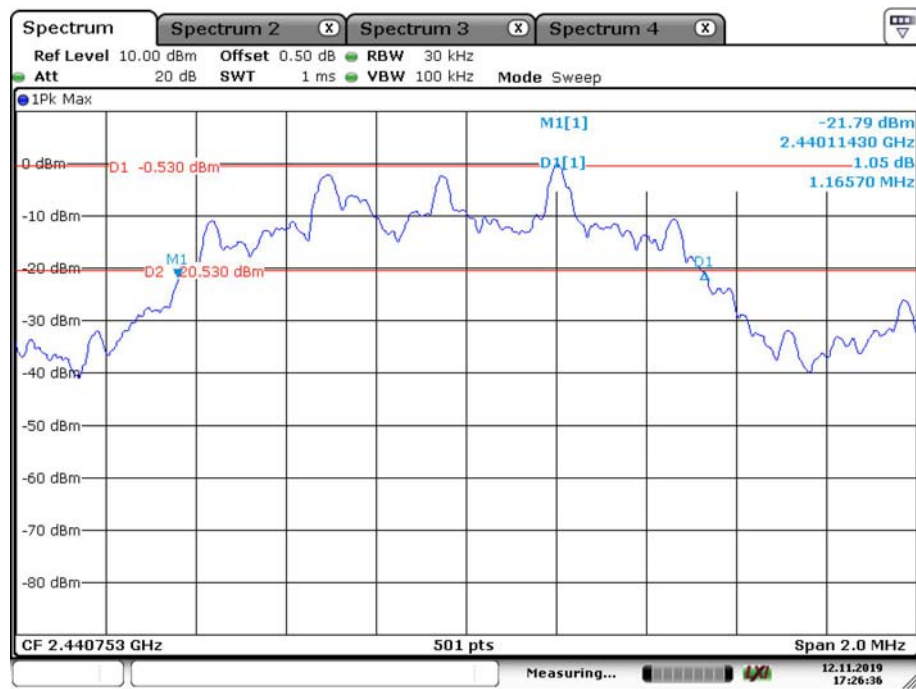
Please refer to following tables and plots

Test Mode: Transmitting

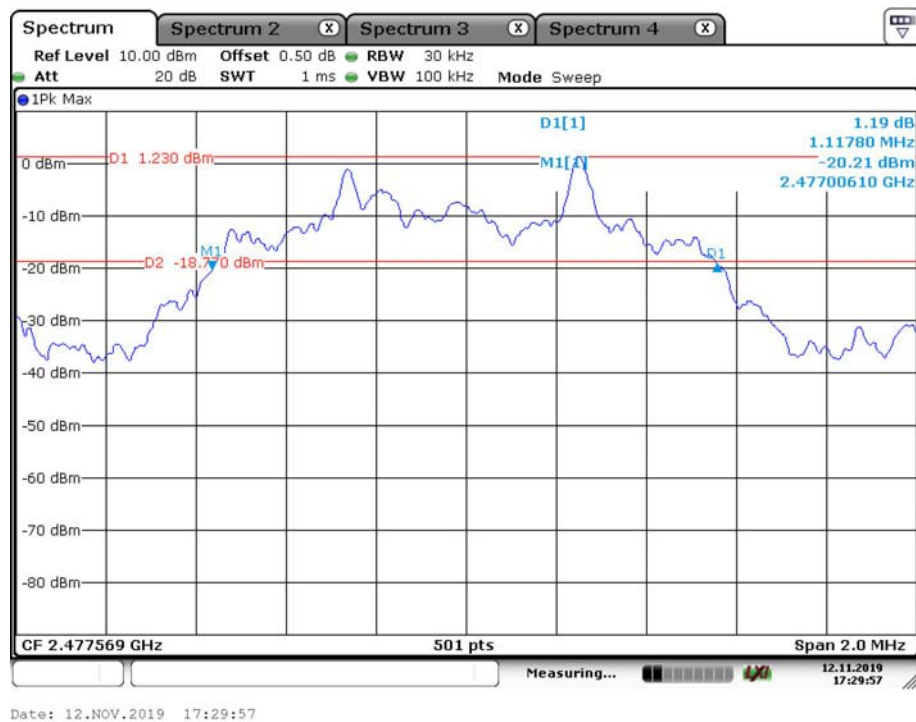
Channel	Frequency (MHz)	20 dB Bandwidth (MHz)
Low	2405.377	1.162
Middle	2440.753	1.166
High	2477.569	1.118

Low Channel

Middle Channel



High Channel



FCC §15.247(a) (1) (iii) - QUANTITY OF HOPPING CHANNEL TEST**Applicable Standard**

Frequency hopping systems in the 2400–2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

Test Procedure

1. Check the calibration of the measuring instrument (SA) using either an internal calibrator or a known signal from an external generator.
2. Set the EUT in hopping mode from first channel to last.
3. By using the Max-Hold function record the Quantity of the channel.

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	Spectrum Analyzer	FSV40	101474	2019-01-09	2020-01-09
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**

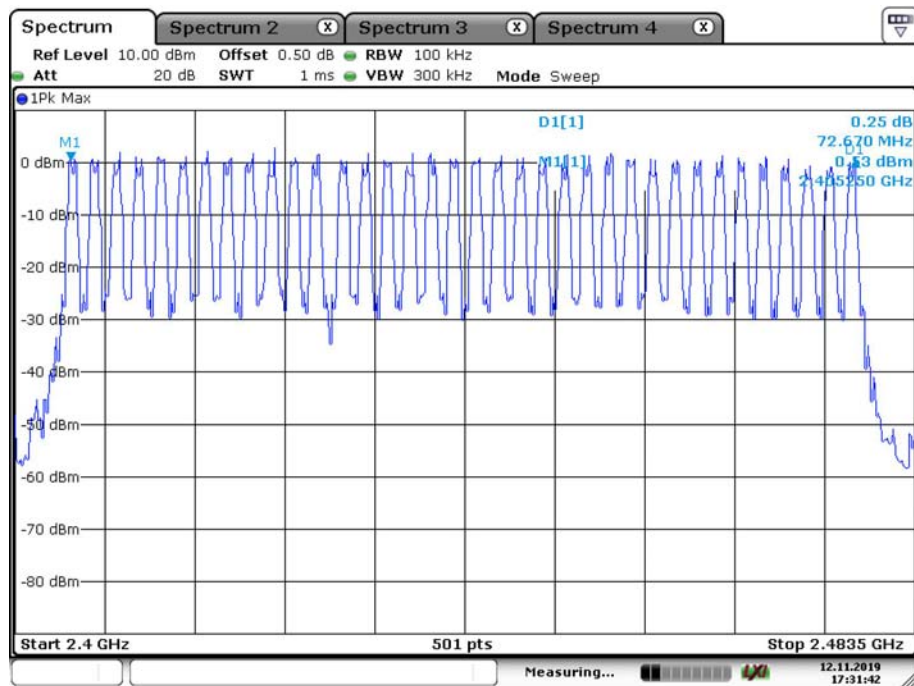
Temperature:	27.2°C
Relative Humidity:	65 %
ATM Pressure:	100.2 kPa
Test by:	Blake Yang
Test Date:	2019-11-12

Test Result: Compliance.

Please refer to following tables and plots

Test Mode: Transmitting

Frequency Range (MHz)	Number of Hopping Channel	Limit
2400-2483.5	36	≥15



Date: 12.NOV.2019 17:31:42

FCC §15.247(a) (1) (iii) - TIME OF OCCUPANCY (DWELL TIME)

Applicable Standard

Frequency hopping systems in the 2400-2483.5 MHz shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

Test Procedure

The EUT was worked in channel hopping; the time of single pulses was tested.

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	Spectrum Analyzer	FSV40	101474	2019-01-09	2020-01-09
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:	27.2°C
Relative Humidity:	65 %
ATM Pressure:	100.2 kPa
Test by:	Blake Yang
Test Date:	2019-11-12

Test Result: Compliance.

Please refer to following tables and plots

Test Mode: Transmitting

Channel	Real Observed Period (s)	Occupancy Time for Single Hop (ms)	Hops in Observed Period	Result (s)	Limit (s)
Middle	14.4	2.27	58	0.132	≤0.4
Note: Real observed period=36*400ms=14.4s					

Spectrum **Spectrum 2** **Spectrum 3** **Spectrum 4**

Ref Level 10.00 dBm Offset 0.50 dB RBW 1 MHz
 Att 20 dB SWT 14.4 s VBW 3 MHz

SGL

1Pk Clrw

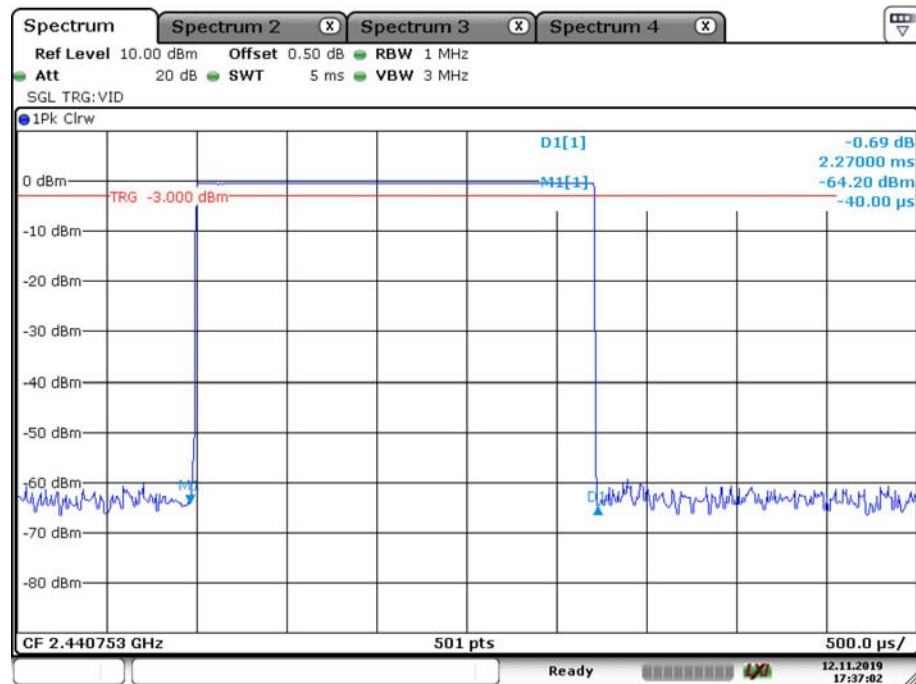
0 dBm
 -10 dBm
 -20 dBm
 -30 dBm
 -40 dBm
 -50 dBm
 -60 dBm
 -70 dBm
 -80 dBm

CF 2.440753 GHz 501 pts 1.44 s/

Ready

12.11.2019 17:41:09

Middle Channel-2



Page 33 of 40

FCC §15.247(b) (1) - PEAK OUTPUT POWER MEASUREMENT**Applicable Standard**

According to §15.247(b) (1), for frequency hopping systems operating in the 2400–2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725–5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400–2483.5 MHz band: 0.125 watts

Test Procedure

1. Place the EUT on a bench and set in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to one test equipment.
3. Add a correction factor to the display.

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Agilent	USB Wideband Power Sensor	U2022XA	MY5417006	2018-12-10	2019-12-10
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:	27.2°C
Relative Humidity:	65 %
ATM Pressure:	100.2 kPa
Test by:	Blake Yang
Test Date:	2019-11-12

Test Result: Compliance.

Test Mode: Transmitting

Channel	Frequency (MHz)	Peak Conducted Output power (dBm)	Limit (dBm)
Low	2405.377	5.81	21
Middle	2440.753	7.87	21
High	2477.569	7.62	21

Note: The data above was tested in conducted mode.

FCC §15.247(d) - BAND EDGES TESTING

Applicable Standard

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

Test Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Remove the antenna from the EUT and then connect to a low loss RF cable from the antenna port to a EMI test receiver, then turn on the EUT and make it operate in transmitting mode. Then set it to Low Channel and High Channel within its operating range, and make sure the instrument is operated in its linear range.
3. Set RBW/ VBW of spectrum analyzer to 100/300 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.

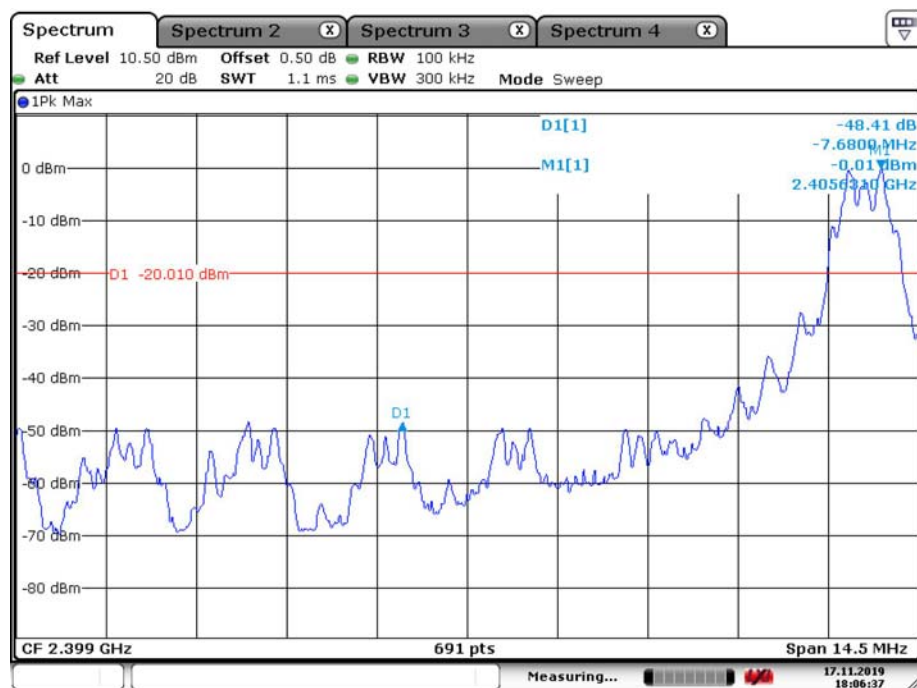
Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	Spectrum Analyzer	FSV40	101474	2019-01-09	2020-01-09
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).

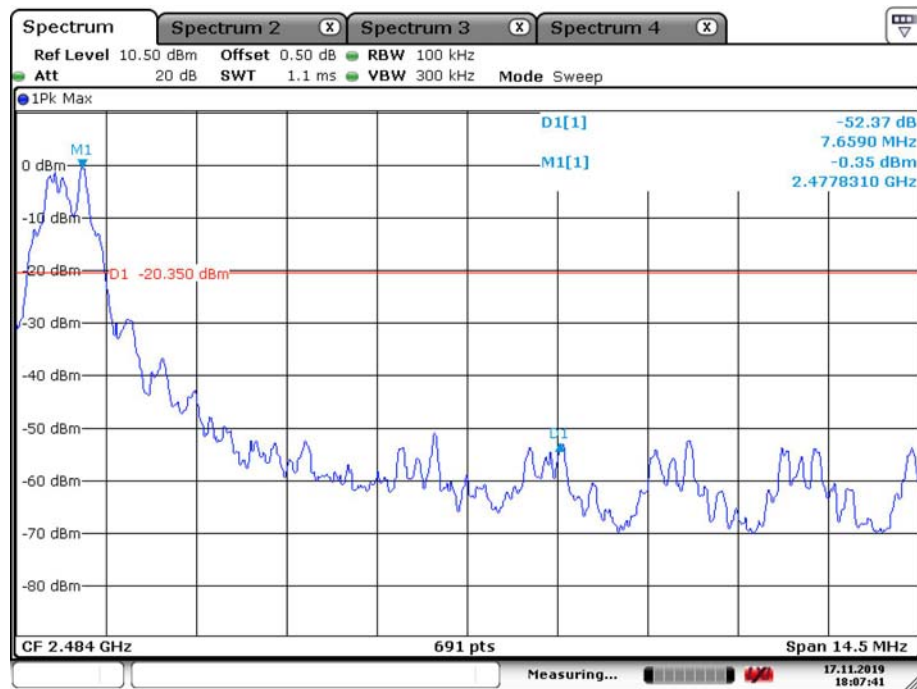
Test Data**Environmental Conditions**

Temperature:	25.8~27.2°C
Relative Humidity:	51~53 %
ATM Pressure:	100~101.7 kPa
Test by:	Blake Yang
Test Date:	2019-11-12~2019-11-17

Test Result: Compliance*Single Channel Mode,***Band Edge, Left Side**

Date: 17.NOV.2019 18:06:37

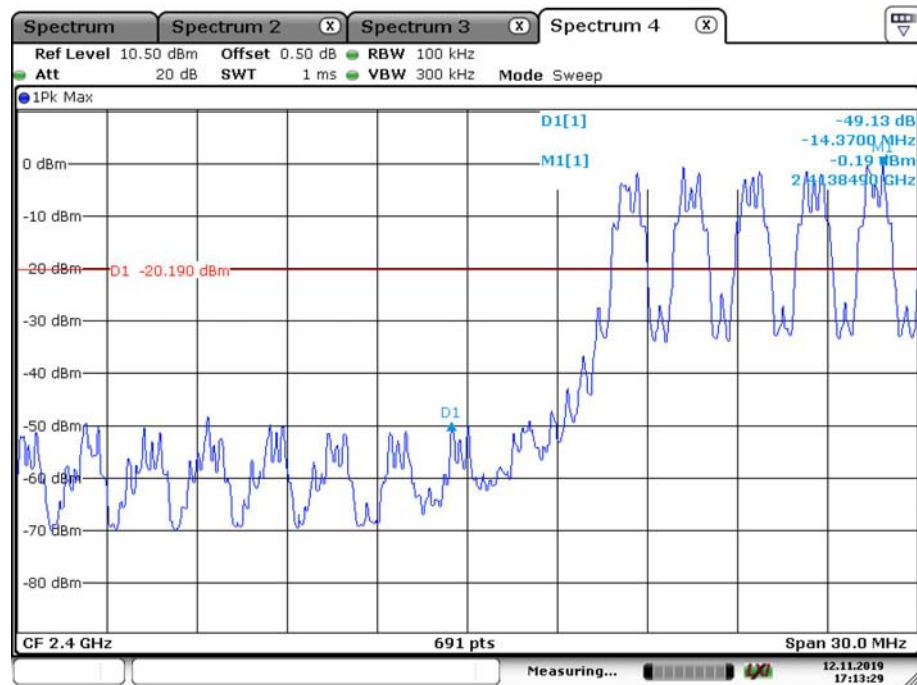
Band Edge, Right Side



Date: 17.NOV.2019 18:07:41

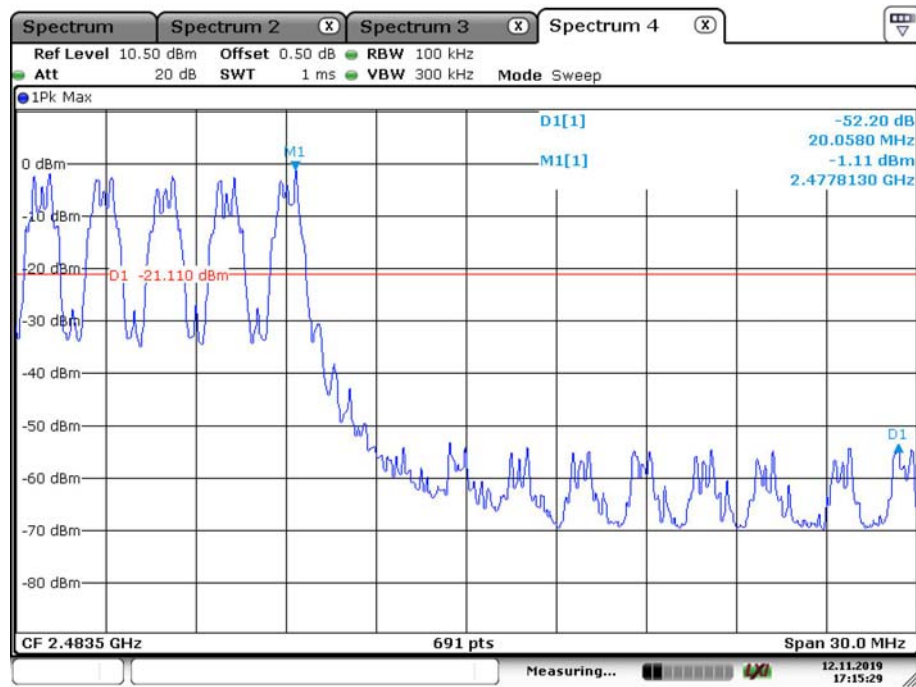
Hopping Mode,

Band Edge, Left Side



Date: 12.NOV.2019 17:13:30

Band Edge, Right Side



Date: 12.NOV.2019 17:15:30

Directions

1. The information marked # is provided by the applicant, the laboratory is not responsible for its authenticity and this information can affect the validity of the result in the test report.
2. Unless otherwise stated the results shown in this test report refer only to the sample(s) tested.
3. Otherwise required by the applicant or Product Regulations, Decision Rule in this report did not consider the uncertainty.
4. The extended uncertainty given in this report is obtained by combining the standard uncertainty times the coverage factor K with the 95% confidence interval.
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