TESTING LABORATORY
CERTIFICATE #4820.01

FCC PART 15.247

TEST REPORT

For

Xiamen Milesight IoT Co., Ltd.

4/F,NO. 63-2 Wanghai Road, 2nd Software Park,Xiamen ,China

FCC ID: 2AYHY-UG67

Report Type:	Product Name:
Original Report	LoRaWAN Gateway

Report Number:	RXM210219051-00B
Report Date:	2021-09-10
Reviewed By:	Ivan Cao Assistant manager
Test Laboratory:	Bay Area Compliance Laboratories Corp. (Dongguan) No.12, Pulong East 1st Road, Tangxia Town, 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:		LoRaWAN Gateway
EUT Model:		UG67-L04AF-915M
Multiple Models:		UG67-L00AF-915M, UG67-915M
Operation Frequency:		902.3MHz~914.9MHz
Maximum Peak Output Power (Conducted):		20.17 dBm
Modulation Type:		LoRa
Antenna Gain▲:		2.0 dBi(internal Antenna) 4.0 dBi(External Antenna)
Rated Input Voltage:		DC 56V from POE
Adapter Information	**Model:**	NET-P15-56IN
	Input:	100-240V 0.4A 50/60Hz
	Output:	56V
Serial Number:		RXM210219051-RF-S1
EUT Received Date:		2021.02.20
EUT Received Status:		Good

Note: The series product, models UG67-L04AF-915M, UG67-L00AF-915M, UG67-915M are electrically identical, the model UG67-L04AF-915M was fully tested. The difference between them please refer to the declaration letter for details.
Note: the device contains a certified WWAN Module, FCC ID: XMR201909EC25AFX.

Objective

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

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

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 558074 D01 15.247 Meas Guidance v05r02.

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
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)

Note: Otherwise required by the applicant or Product Regulations, Decision Rule in this report did not consider the uncertainty. The extended uncertainty given in this report is obtained by combining the standard uncertainty times the coverage factor K with the 95% confidence interval.

Test Facility

The Test site used by Bay Area Compliance Laboratories Corp. (Dongguan) to collect test data is located on the No.12, Pulong East 1st Road, Tangxia Town, 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.

Declarations

BACL is not responsible for the authenticity of any test data provided by the applicant. Data included from the applicant that may affect test results are marked with a triangle symbol “▲”. Customer model name, addresses, names, trademarks etc. are not considered data

Unless otherwise stated the results shown in this test report refer only to the sample(s) tested.

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SYSTEM TEST CONFIGURATION

Description of Test Configuration

The device was a hopping transmitter(125 kHz Lora), employs 64 hopping channels:

Test Channel	Frequency (MHz)	Test Channel	Frequency (MHz)
0	902.3	32	908.7
1	902.5	33	908.9
2	902.7	34	909.1
~	~	~	~
~	~	~	~
~	~	~	~
~	~	~	~
29	908.1	61	914.5
30	908.3	62	914.7
31	908.5	63	914.9

Frequency 902.3 MHz, 908.5 MHz and 914.9MHz were selected to test.

The devices have 4 antennas for Lora, two internal antennas and two external antennas. Only the internal or external antennas were configured to use by system. Internal or external Antenna 1 is for transmitting, Antenna 2 for receiving.

EUT Exercise Software

The ' PUTTY ' was used during test, which was provided by manufacturer. The maximum power level was configured by the software as below table▲:

Channel	Test Frequency (MHz)	Power Level Setting	
		Internal	External
Low	902.3	18	18
Middle	908.5	18	18
High	914.9	18	18

Equipment Modifications

No modification was made to the EUT.

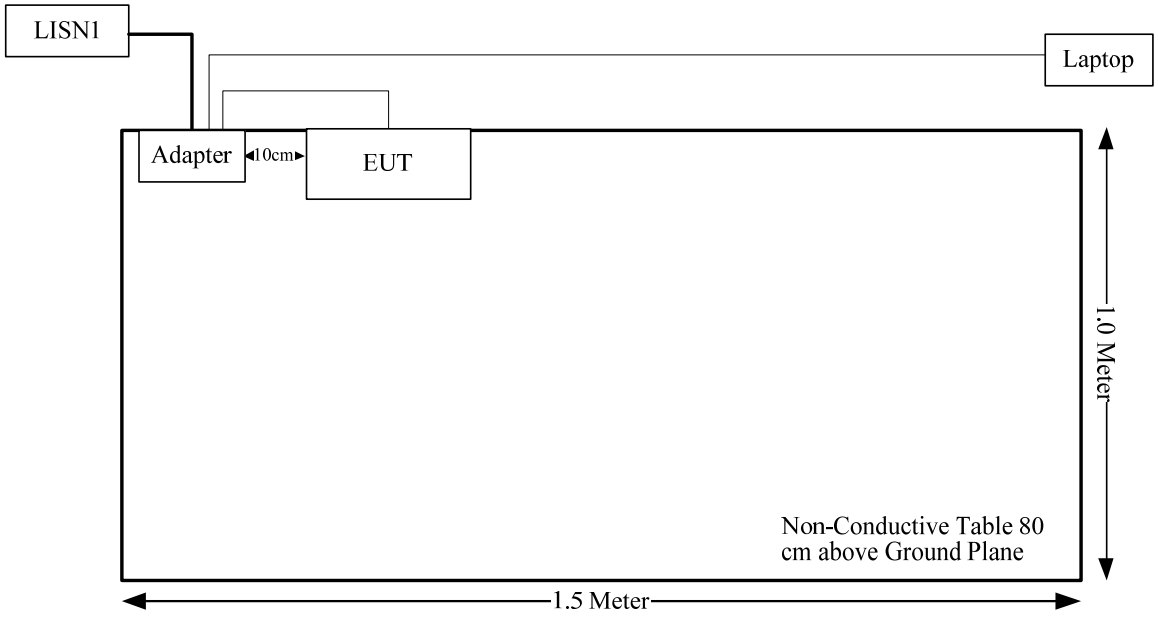
Local Support Equipment List and Details

Manufacturer	Description	Model	Serial Number
DELL	Laptop	E6410	QDS-BRCM1017

Support Cable List and Details

Cable Description	Shielding Type	Ferrite Core	Length (m)	From Port	To
RJ45	No	No	10	POE	Laptop
RJ45	No	No	3	POE	EUT

Block Diagram of Test Setup



SUMMARY OF TEST RESULTS

Rules	Description of Test	Result
FCC§15.247 (i) & §1.1310 & §2.1091	Maximum Permissible Exposure (MPE)	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)	Emission Bandwidth	Compliance
FCC §15.247(a)(1)	Channel Separation Test	Compliance
FCC§15.247(f)	Time of Occupancy (Dwell Time)	Compliance
FCC§15.247(a)(1)(i)	Quantity of hopping channel Test	Compliance
FCC§15.247(b)(2)	Peak Output Power Measurement	Compliance
FCC§15.247(d)	Band Edges	Compliance

FCC §15.247 (i) & §1.1310 & §2.1091- MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Applicable Standard

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

Limits for Maximum Permissible Exposure (MPE) (§1.1310, §2.1091)

(B) Limits for General Population/Uncontrolled Exposure				
Frequency Range (MHz)	**Electric Field Strength (V/m)**	**Magnetic Field Strength (A/m)**	**Power Density (mW/cm^2)**	**Averaging Time (minutes)**
0.3–1.34	614	1.63	*(100)	30
1.34–30	824/f	2.19/f	*(180/f^2)	30
30–300	27.5	0.073	0.2	30
300–1500	/	/	f/1500	30
1500–100,000	/	/	1.0	30

f = frequency in MHz; * = Plane-wave equivalent power density;

According to §1.1310 and §2.1091 RF exposure is calculated.

Calculation formula:

Prediction of power density at the distance of the applicable MPE limit
$S = PG/4\pi R^2$ = power density (in appropriate units, e.g. mW/cm^2);
P = power input to the antenna (in appropriate units, e.g., mW);
G = power gain of the antenna in the direction of interest relative to an isotropic radiator, the power gain factor, is normally numeric gain;
R = distance to the center of radiation of the antenna (appropriate units, e.g., cm);

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

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

Calculated Data:

Mode	Frequency (MHz)	Antenna Gain		Conducted output power including Tune-up Tolerance		Evaluation Distance (cm)	Power Density (mW/cm^2)	MPE Limit (mW/cm^2)
		(dBi)	(numeric)	(dBm)	(mW)			
WLAN	2412-2462	2	1.58	17	50.12	20.00	0.02	1.0
Lora-DSS	902.3-914.9	4	2.51	21	125.89	20.00	0.06	0.60
Lora-DTS	903-927.5	4	2.51	11	12.59	20.00	0.01	0.60
WCDMA B2	1850-1910	2	1.58	25	316.23	20.00	0.10	1.0
WCDMA B4	1710-1755	2	1.58	25	316.23	20.00	0.10	1.0
WCDMA B5	824-849	2	1.58	25	316.23	20.00	0.10	0.55
LTE B2	1850-1910	2	1.58	25	316.23	20.00	0.10	1.0
LTE B4	1710-1755	2	1.58	25	316.23	20.00	0.10	1.0
LTE B5	824-849	2	1.58	25	316.23	20.00	0.10	0.55
LTE B12	699-716	2	1.58	25	316.23	20.00	0.10	0.47
LTE B13	777-787	2	1.58	25	316.23	20.00	0.10	0.52
LTE B14	788-798	2	1.58	25	316.23	20.00	0.10	0.53
LTE B66	1710-1780	2	1.58	25	316.23	20.00	0.10	1.0
LTE B71	663-698	2	1.58	25	316.23	20.00	0.10	0.44

The WLAN 2.4G,Lora and WWAN can transmit simultaneously:

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

$=S_{WLAN}/S_{limit\text{-}WLAN}+ S_{WWAN}/S_{limit\text{-}WWAN}+ S_{Lora}/S_{limit\text{-}Lora}$

=0.02/1+0.10/0.44+0.06/0.60

=0.35

< 1.0

Result: The device meet FCC MPE at **20 cm** distance

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 Connector Construction

The EUT has 2 external antennas and 2 internal antennas arrangement for Lora, one internal antenna for Wi-Fi. The device must be professionally installed, and installer shall be responsible for verifying that the correct antenna is employed with the unit, fulfill the requirement of this section. Please refer to the EUT photos.

Radios	Antenna Type	input impedance (Ohm)	Antenna Gain /Frequency Range
Wi-Fi	PCB	50	2 dBi/2.4~2.5GHz
Lora External Anetnna 1	Dipole	50	4.0 dBi/902~928 MHz
Lora External Anetnna 2	Dipole	50	4.0 dBi/902~928 MHz
Lora Internal Anetnna 1	PIFA	50	2.0 dBi/902~928 MHz
Lora Internal Anetnna 2	PIFA	50	2.0 dBi/902~928 MHz

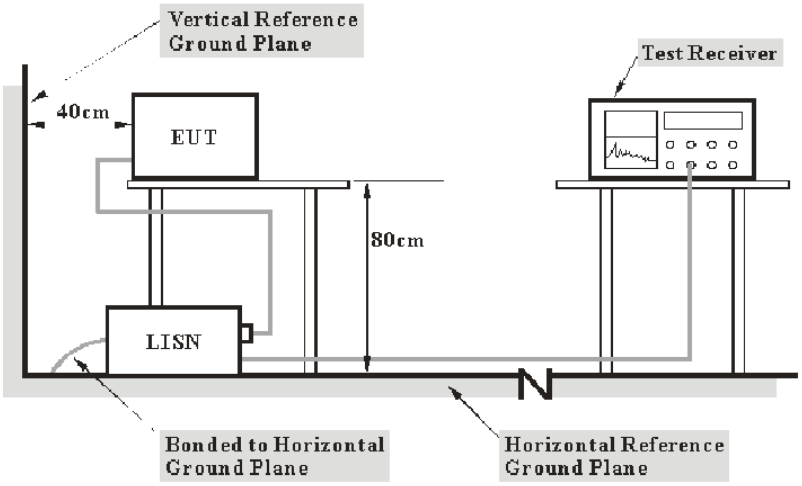
Result: Compliance.

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.

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.

The frequency and amplitude of the six highest ac power-line conducted emissions relative to the limit, measured over all the current-carrying conductors of the EUT power cords, and the operating frequency or frequency to which the EUT is tuned (if appropriate), should be reported, unless such emissions are more than 20 dB below the limit. AC power-line conducted emissions measurements are to be separately carried out only on each of the phase ("hot") line(s) and (if used) on the neutral line(s), but not on the ground [protective earth] line(s). If less than six emission frequencies are within 20 dB of the limit, then the noise level of the measuring instrument at representative frequencies should be reported. The specific conductor of the power-line cord for each of the reported emissions should be identified. Measure the six highest emissions with respect to the limit on each current-carrying conductor of each power cord associated with the EUT (but not the power cords of associated or peripheral equipment that are part of the test configuration). Then, report the six highest emissions with respect to the limit from among all the measurements identifying the frequency and specific current-carrying conductor identified with the emission. The six highest emissions should be reported for each of the current-carrying conductors, or the six highest emissions may be reported over all the current-carrying conductors.

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:

Margin = Limit – Corrected Amplitude

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	LISN	ENV 216	101614	2020-09-12	2021-09-12
R&S	EMI Test Receiver	ESCI	101121	2020-07-07	2021-07-07
MICRO-COAX	Coaxial Cable	C-NJNJ-50	C-0200-01	2020-09-05	2021-09-05
R&S	Test Software	EMC32	Version 9.10.00	N/A	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

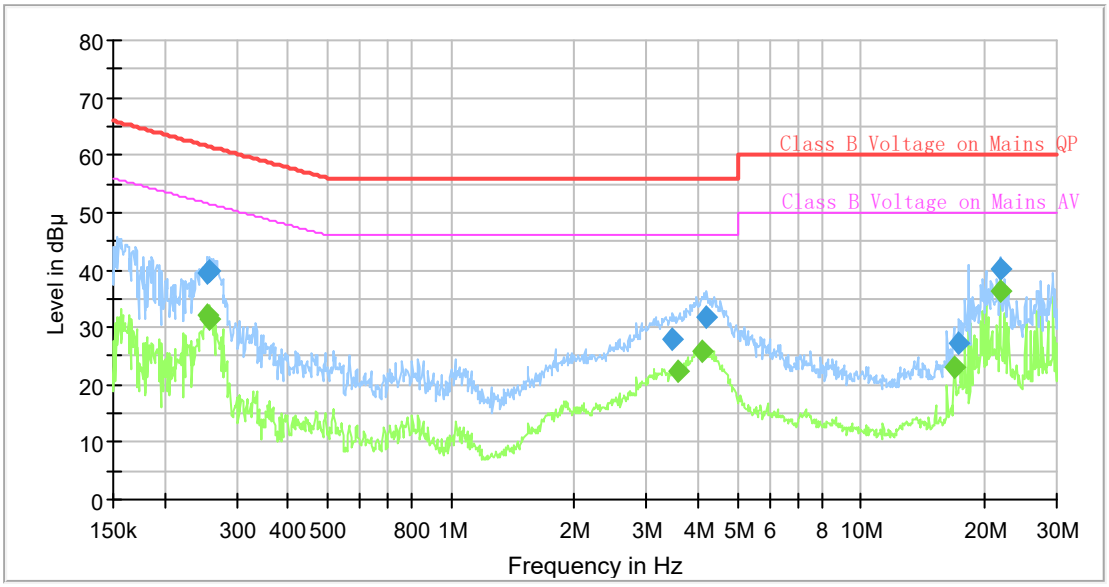
Environmental Conditions

Temperature:	24.8℃
Relative Humidity:	67%
ATM Pressure:	101.0kPa
Test by:	Walker Chen
Test Date:	2021-03-17

Test Result: Compliance

Test Mode: *Transmitting*

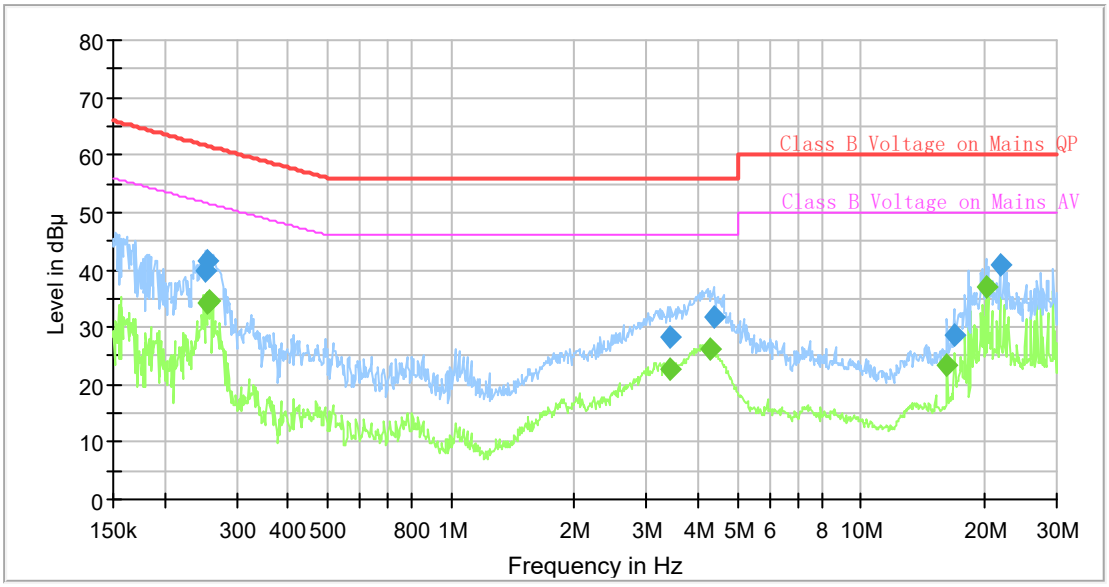
AC120V, 60 Hz, Line:



Final_Result

Frequency (MHz)	QuasiPeak (dB µ V)	Average (dB µ V)	Limit (dB µ V)	Margin (dB)	Bandwidth (kHz)	Line	Corr. (dB)
0.254504	---	32.25	51.61	19.36	9.000	L1	9.6
0.254504	39.32	---	61.61	22.29	9.000	L1	9.6
0.257055	---	31.54	51.53	19.99	9.000	L1	9.6
0.257055	39.79	---	61.53	21.74	9.000	L1	9.6
3.473043	28.06	---	56.00	27.94	9.000	L1	9.7
3.560742	---	22.46	46.00	23.54	9.000	L1	9.7
4.114871	---	25.92	46.00	20.08	9.000	L1	9.7
4.197788	31.64	---	56.00	24.36	9.000	L1	9.7
16.879195	---	23.20	50.00	26.80	9.000	L1	10.1
17.305416	27.23	---	60.00	32.77	9.000	L1	10.1
21.876959	---	36.36	50.00	13.64	9.000	L1	10.0
21.876959	40.02	---	60.00	19.98	9.000	L1	10.0

AC120V, 60 Hz, Neutral:



Final_Result

Frequency (MHz)	QuasiPeak (dB µ V)	Average (dB µ V)	Limit (dB µ V)	Margin (dB)	Bandwidth (kHz)	Line	Corr. (dB)
0.251977	40.00	---	61.69	21.69	9.000	N	9.6
0.254504	---	34.34	51.61	17.27	9.000	N	9.6
0.255776	41.58	---	61.57	19.99	9.000	N	9.6
0.257055	---	34.50	51.53	17.03	9.000	N	9.6
3.404442	---	22.72	46.00	23.28	9.000	N	9.6
3.438571	28.39	---	56.00	27.61	9.000	N	9.6
4.261070	---	26.30	46.00	19.70	9.000	N	9.6
4.368668	31.95	---	56.00	24.05	9.000	N	9.6
16.218969	---	23.39	50.00	26.61	9.000	N	9.9
16.879195	28.52	---	60.00	31.48	9.000	N	9.9
20.199004	---	37.08	50.00	12.92	9.000	N	9.9
21.876959	41.01	---	60.00	18.99	9.000	N	9.9

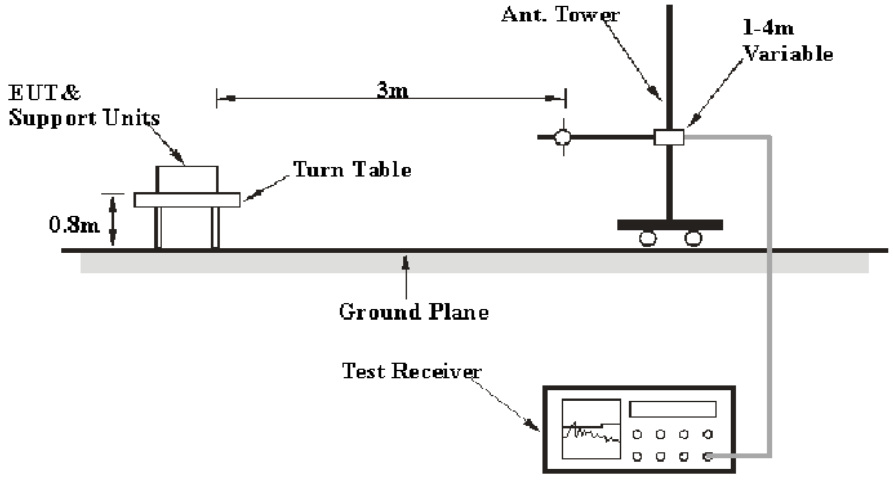
FCC §15.209, §15.205 & §15.247(d) - SPURIOUS EMISSIONS

Applicable Standard

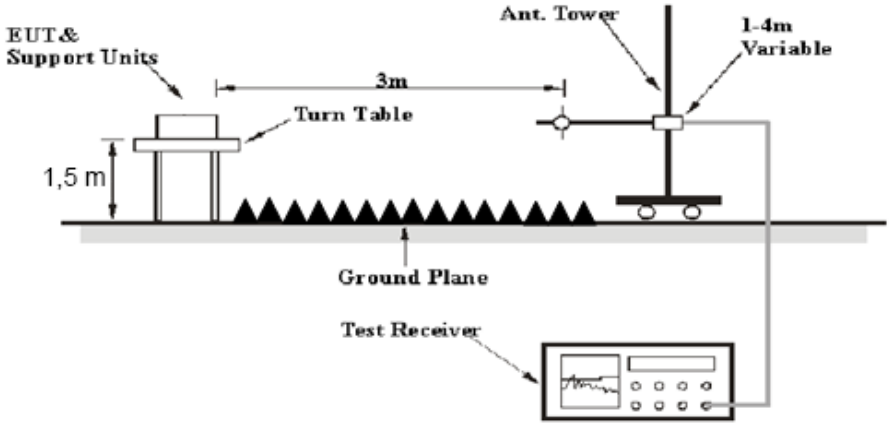
FCC §15.247 (d); §15.209; §15.205.

EUT Setup

Below 1GHz:



Above 1GHz:



The radiated emission below 1GHz tests were performed in the 3 meters chamber test site A, above 1GHz tests were performed in the 3 meters chamber test site A, 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 10 GHz.

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

Frequency Range	RBW	Video B/W	IF B/W	Measurement
30 MHz – 1000 MHz	120 kHz	300 kHz	120 kHz	QP
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
Radiation Below 1GHz					
Sunol Sciences	Antenna	JB3	A060611-1	2020-11-10	2023-11-10
R&S	EMI Test Receiver	ESR3	102453	2020-09-12	2021-09-12
Unknown	Coaxial Cable	C-NJNJ-50	C-0075-01	2021-09-05	2022-09-05
Unknown	Coaxial Cable	C-NJNJ-50	C-0400-01	2021-09-05	2022-09-05
Unknown	Coaxial Cable	C-NJNJ-50	C-1400-01	2021-05-06	2022-05-05
Sonoma	Amplifier	310N	372193	2021-07-18	2022-07-17
Farad	Test Software	EZ-EMC	V1.1.4.2	N/A	N/A
Radiation Above 1GHz					
ETS-Lindgren	Horn Antenna	3115	000 527 35	2018-10-12	2021-10-12
Agilent	Spectrum Analyzer	E4440A	SG43360054	2021-07-22	2022-07-21
Unknown	Coaxial Cable	C-SJSJ-50	C-0800-01	2020-09-05	2021-09-05
Mini-Circuit	Amplifier	ZVA-213-S+	54201245	2020-09-05	2021-09-05
Farad	Test Software	EZ-EMC	V1.1.4.2	N/A	N/A
E-Microwave	Band-stop Filters	OBSF-902-928-D	OE02012122	2021-06-16	2022-06-15

**** 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:

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

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

Margin = Limit – Corrected Amplitude

Test Data

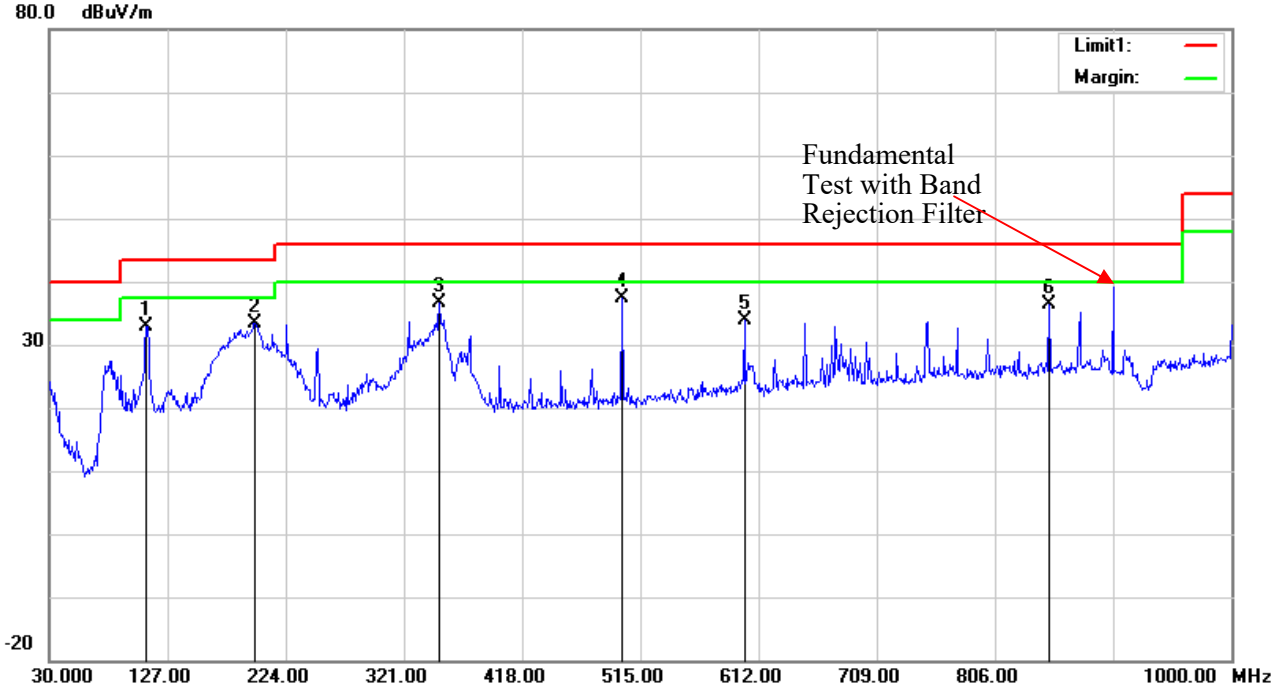
Environmental Conditions

Test Items	Radiation Below 1GHz	Radiation Above 1GHz
Temperature:	28.4°C	27.8°C
Relative Humidity:	61 %	50 %
ATM Pressure:	100.6kPa	100.6kPa
Tester:	Joker Chen	Lee Li
Test Date:	2021-09-06	2021-08-30

Test Mode: Transmitting

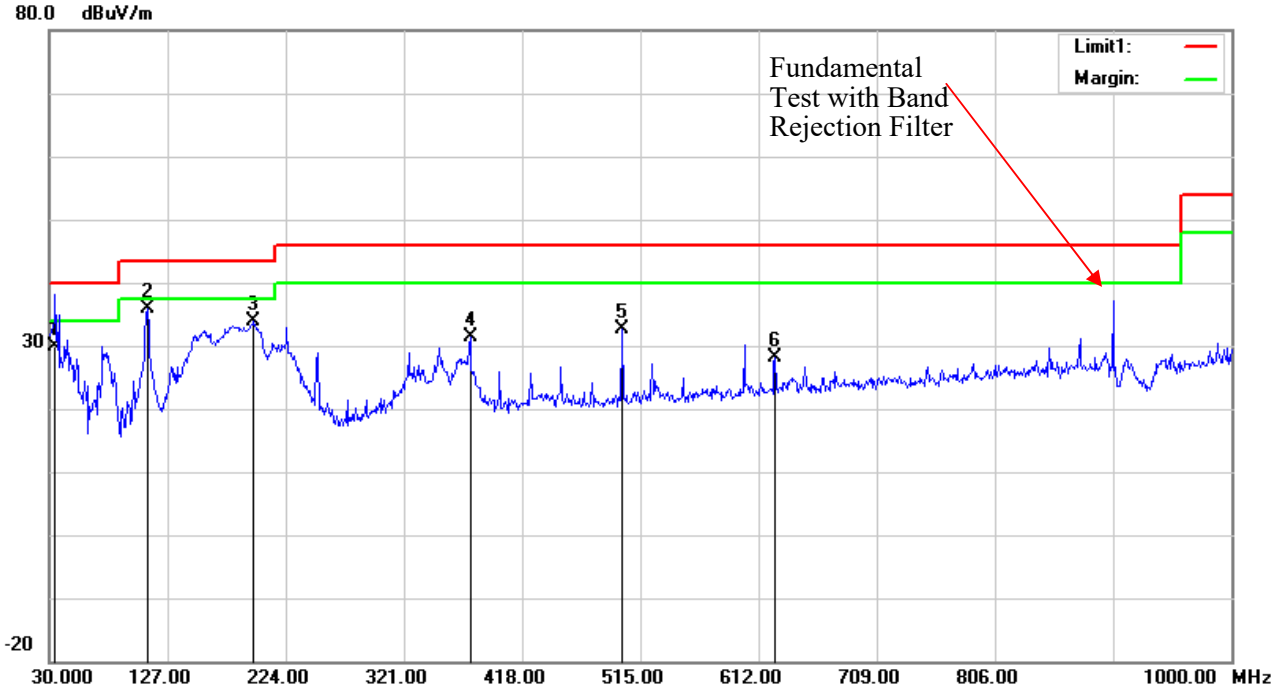
1)30MHz-1GHz(External Antenna Middle channel was the worst)

Horizontal:



Frequency (MHz)	Receiver Reading (dBµV)	Detector	Correction Factor (dB/m)	Cord. Amp. (dBµV/m)	Limit (dBµV/m)	Margin (dB)
109.5400	45.50	peak	-12.52	32.98	43.50	10.52
198.7800	45.94	peak	-12.45	33.49	43.50	10.01
350.1000	46.02	peak	-9.43	36.59	46.00	9.41
500.4500	43.24	peak	-5.84	37.40	46.00	8.60
600.3600	38.60	peak	-4.67	33.93	46.00	12.07
850.6200	36.92	peak	-0.64	36.28	46.00	9.72

Vertical:



Frequency (MHz)	Receiver Reading (dBµV)	Detector	Correction Factor (dB/m)	Cord. Amp. (dBµV/m)	Limit (dBµV/m)	Margin (dB)
34.8500	37.61	QP	-7.70	29.91	40.00	10.09
110.5100	48.10	peak	-12.33	35.77	43.50	7.73
197.8100	46.45	peak	-12.60	33.85	43.50	9.65
375.3200	40.18	peak	-8.87	31.31	46.00	14.69
500.4500	38.39	peak	-5.84	32.55	46.00	13.45
625.5800	32.02	peak	-3.97	28.05	46.00	17.95

2) Bandedge, and above 1GHz:
Internal Antenna:

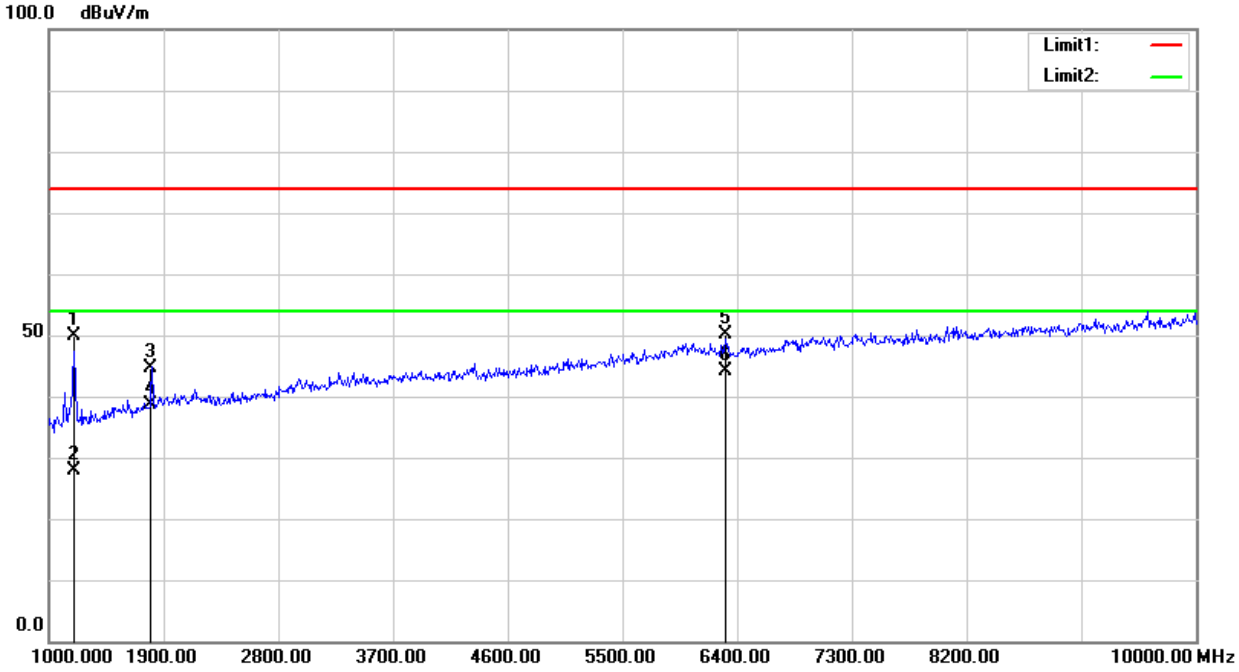
Frequency (MHz)	Receiver		Rx Antenna		Cable loss (dB)	Amplifier Gain (dB)	Corrected Amplitude (dBµV/m)	Limit (dBµV/m)	Margin (dB)
	Reading (dBµV)	Detector	Polar (H/V)	Factor (dB/m)					
Low Channel: 902.3MHz									
902.30	72.70	QP	H	22.35	3.70	0.00	98.75	N/A	N/A
902.30	67.10	QP	V	22.35	3.70	0.00	93.15	N/A	N/A
902.00	14.30	QP	H	22.34	3.70	0.00	40.34	78.75	38.41
1804.60	42.63	PK	H	26.48	1.66	25.80	44.97	74.00	29.03
1804.60	36.32	AV	H	26.48	1.66	25.80	38.66	54.00	15.34
2706.90	37.18	PK	H	29.04	1.88	26.11	41.99	74.00	32.01
2706.90	25.48	AV	H	29.04	1.88	26.11	30.29	54.00	23.71
3609.20	36.25	PK	H	31.54	2.41	25.95	44.25	74.00	29.75
3609.20	24.02	AV	H	31.54	2.41	25.95	32.02	54.00	21.98
5413.80	36.32	PK	H	33.96	3.61	25.39	48.50	74.00	25.50
5413.80	26.74	AV	H	33.96	3.61	25.39	38.92	54.00	15.08
Middle Channel: 908.5MHz									
908.50	76.50	QP	H	22.40	3.65	0.00	102.55	N/A	N/A
908.50	68.80	QP	V	22.40	3.65	0.00	94.85	N/A	N/A
1817.00	42.44	PK	H	26.53	1.66	25.85	44.78	74.00	29.22
1817.00	36.13	AV	H	26.53	1.66	25.85	38.47	54.00	15.53
2725.50	36.92	PK	H	29.11	1.89	26.10	41.82	74.00	32.18
2725.50	25.29	AV	H	29.11	1.89	26.10	30.19	54.00	23.81
3634.00	36.02	PK	H	31.59	2.45	25.94	44.12	74.00	29.88
3634.00	23.83	AV	H	31.59	2.45	25.94	31.93	54.00	22.07
5451.00	36.22	PK	H	34.02	3.58	25.35	48.47	74.00	25.53
5451.00	26.41	AV	H	34.02	3.58	25.35	38.66	54.00	15.34
High Channel: 914.9MHz									
914.90	70.90	QP	H	22.40	3.69	0.00	96.99	N/A	N/A
914.90	68.70	QP	V	22.40	3.69	0.00	94.79	N/A	N/A
928.00	14.00	QP	H	22.56	3.78	0.00	40.34	76.99	36.65
1829.80	42.05	PK	H	26.59	1.66	25.91	44.39	74.00	29.61
1829.80	35.77	AV	H	26.59	1.66	25.91	38.11	54.00	15.89
2744.70	36.53	PK	H	29.18	1.91	26.10	41.52	74.00	32.48
2744.70	24.97	AV	H	29.18	1.91	26.10	29.96	54.00	24.04
3659.60	35.63	PK	H	31.65	2.50	25.93	43.85	74.00	30.15
3659.60	23.42	AV	H	31.65	2.50	25.93	31.64	54.00	22.36

External Antenna:

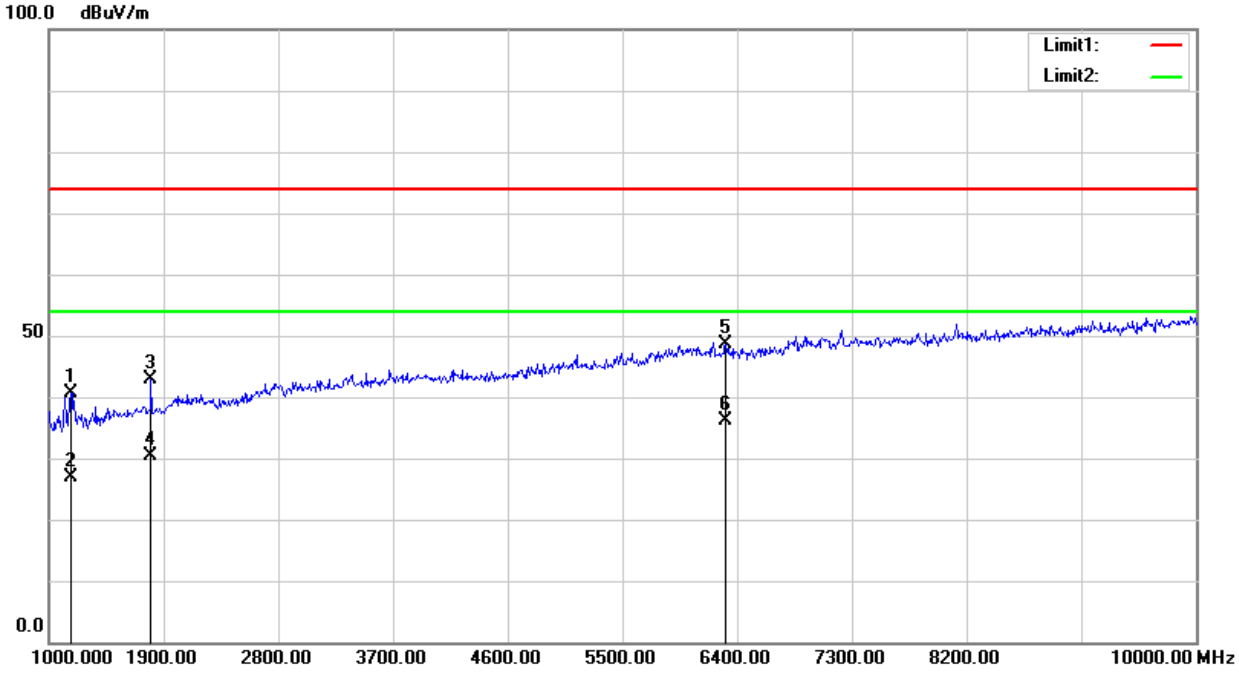
Frequency (MHz)	Receiver		Rx Antenna		Cable loss (dB)	Amplifier Gain (dB)	Corrected Amplitude (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	Detector	Polar (H/V)	Factor (dB/m)					
Low Channel: 902.3MHz									
902.30	72.30	QP	V	22.35	3.70	0.00	98.35	N/A	N/A
902.30	66.40	QP	H	22.35	3.70	0.00	92.45	N/A	N/A
902.00	18.90	QP	V	22.34	3.70	0.00	44.94	78.35	33.41
1804.60	41.18	PK	V	26.48	1.66	25.80	43.52	74.00	30.48
1804.60	32.47	AV	V	26.48	1.66	25.80	34.81	54.00	19.19
2706.90	37.34	PK	V	29.04	1.88	26.11	42.15	74.00	31.85
2706.90	25.64	AV	V	29.04	1.88	26.11	30.45	54.00	23.55
3609.20	36.41	PK	V	31.54	2.41	25.95	44.41	74.00	29.59
3609.20	24.18	AV	V	31.54	2.41	25.95	32.18	54.00	21.82
Middle Channel: 908.5MHz									
908.50	74.30	QP	V	22.40	3.65	0.00	100.35	N/A	N/A
908.50	70.80	QP	H	22.40	3.65	0.00	96.85	N/A	N/A
1817.00	40.91	PK	V	26.53	1.66	25.85	43.25	74.00	30.75
1817.00	32.20	AV	V	26.53	1.66	25.85	34.54	54.00	19.46
2725.50	37.01	PK	V	29.11	1.89	26.10	41.91	74.00	32.09
2725.50	25.37	AV	V	29.11	1.89	26.10	30.27	54.00	23.73
3634.00	36.17	PK	V	31.59	2.45	25.94	44.27	74.00	29.73
3634.00	23.91	AV	V	31.59	2.45	25.94	32.01	54.00	21.99
High Channel: 914.9MHz									
914.90	70.70	QP	V	22.40	3.69	0.00	96.79	N/A	N/A
914.90	67.20	QP	H	22.40	3.69	0.00	93.29	N/A	N/A
928.00	14.00	QP	V	22.56	3.78	0.00	40.34	76.79	36.45
1829.80	41.54	PK	V	26.59	1.66	25.91	43.88	74.00	30.12
1829.80	32.83	AV	V	26.59	1.66	25.91	35.17	54.00	18.83
2744.70	37.73	PK	V	29.18	1.91	26.10	42.72	74.00	31.28
2744.70	26.23	AV	V	29.18	1.91	26.10	31.22	54.00	22.78
3659.60	36.71	PK	V	31.65	2.50	25.93	44.93	74.00	29.07
3659.60	24.54	AV	V	31.65	2.50	25.93	32.76	54.00	21.24

Worst plots(Internal antenna Low channel)

Horizontal



Vertical



FCC §15.247(a) (1) - CHANNEL SEPARATION TEST

Applicable Standard

According to FCC §15.247(a) (1)

Frequency hopping systems shall have hoping 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	EMI Test Receiver	ESR3	102724	2021-06-21	2022-06-20
Unknown	Coaxial Cable	C-SJ00-0010	C0010/01	Each time	N/A
E-Microwave	Coaxial Attenuators	EMCA20-2RN-2	OE0120328	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 RBW 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:	27~27.6℃
Relative Humidity:	62~69%
ATM Pressure:	99.5~100.4 kPa
Tester:	Jack Zhou
Test Date:	2021-08-20~2021-08-22

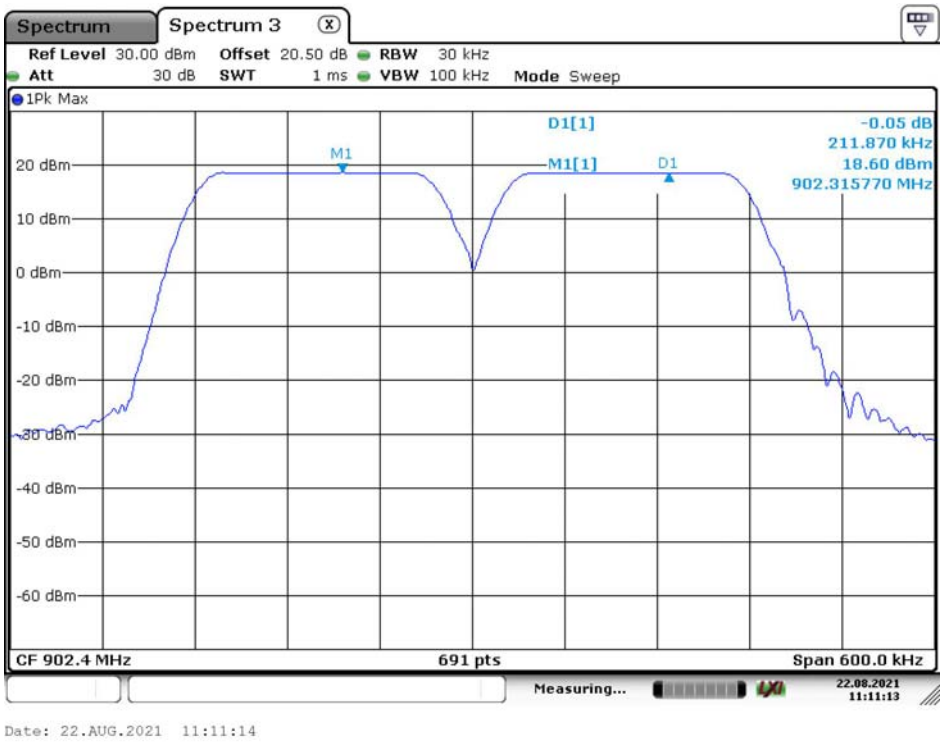
Test Result: Compliance. Please refer to following tables and plots

Test Mode: Transmitting

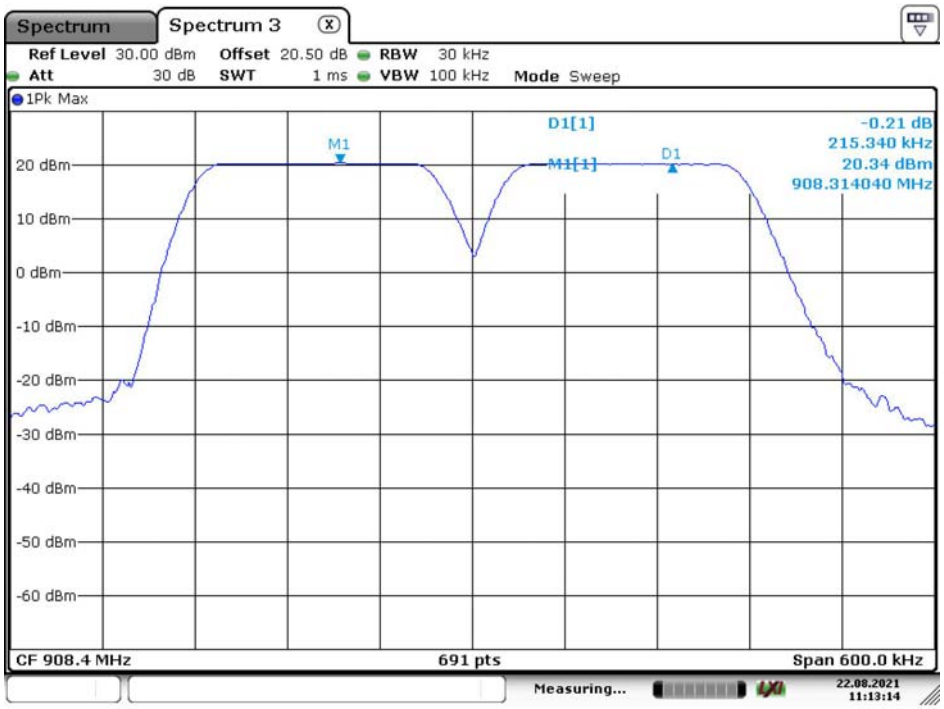
Test Antenna	Channel	Frequency (MHz)	Channel Separation (MHz)	Limit (MHz)
Internal	Low	902.3	0.212	0.136
	Middle	908.5	0.215	0.135
	High	914.9	0.208	0.135
External	Low	902.3	0.217	0.135
	Middle	908.5	0.219	0.135
	High	914.9	0.220	0.135

Internal Antenna:

Low Channel

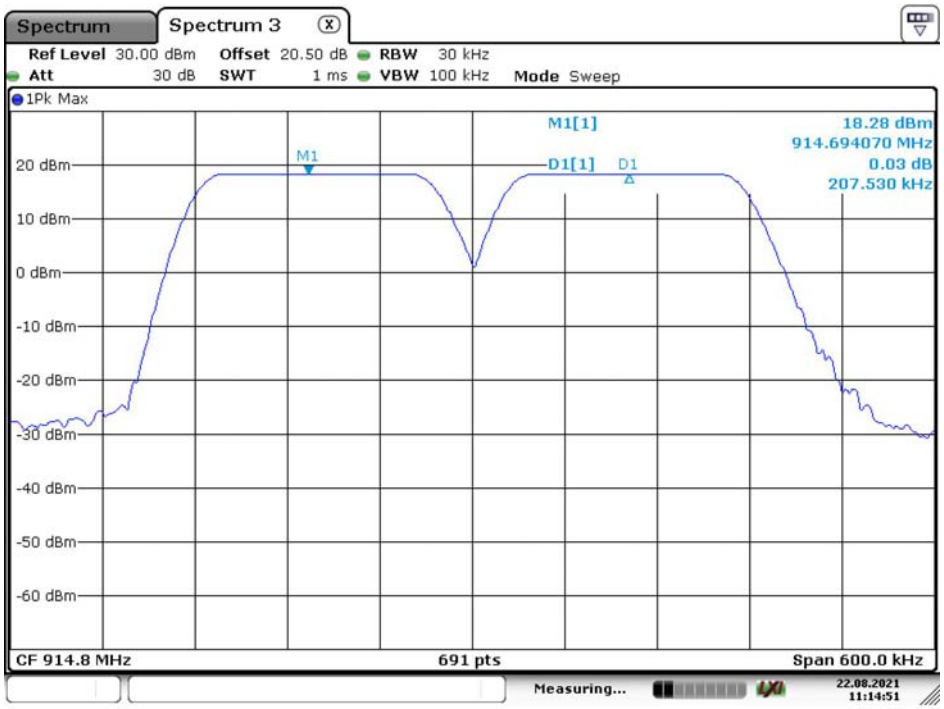


Middle Channel



Date: 22.AUG.2021 11:13:15

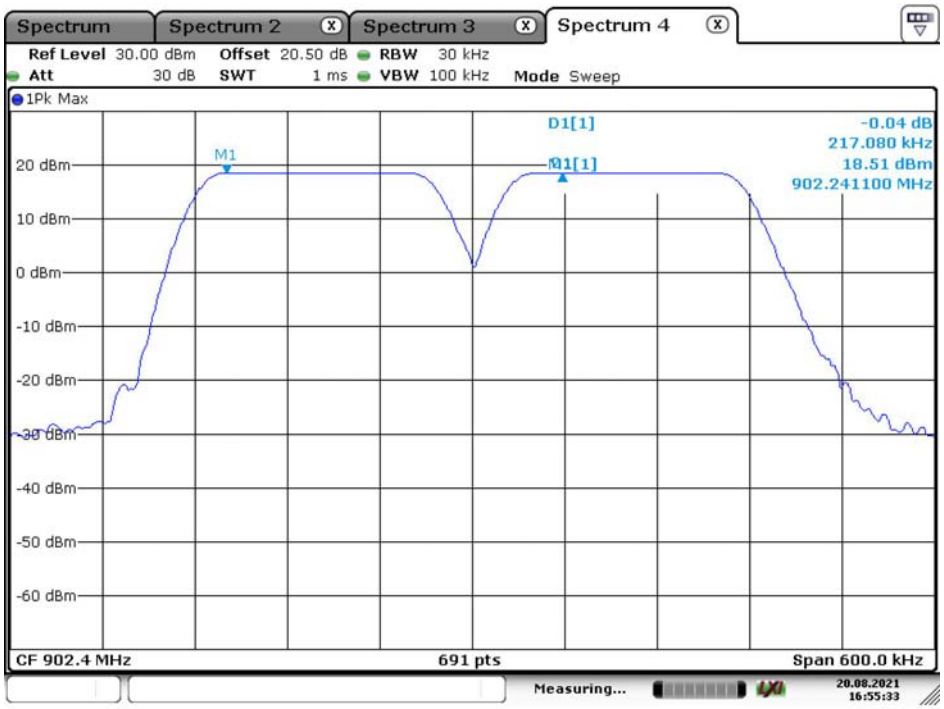
High Channel



Date: 22.AUG.2021 11:14:52

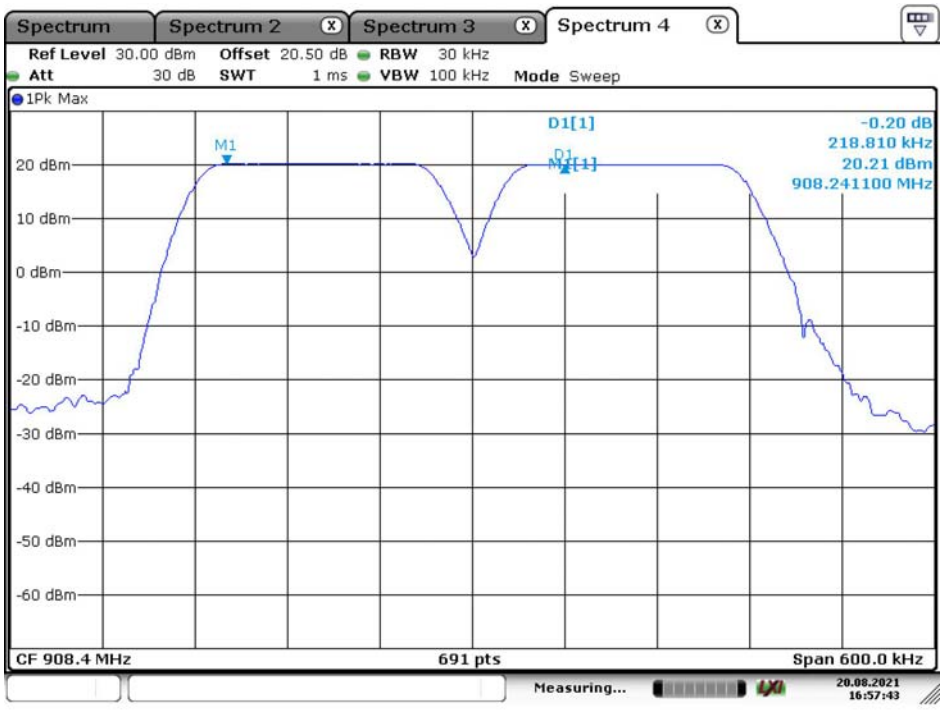
External Antenna:

Low Channel



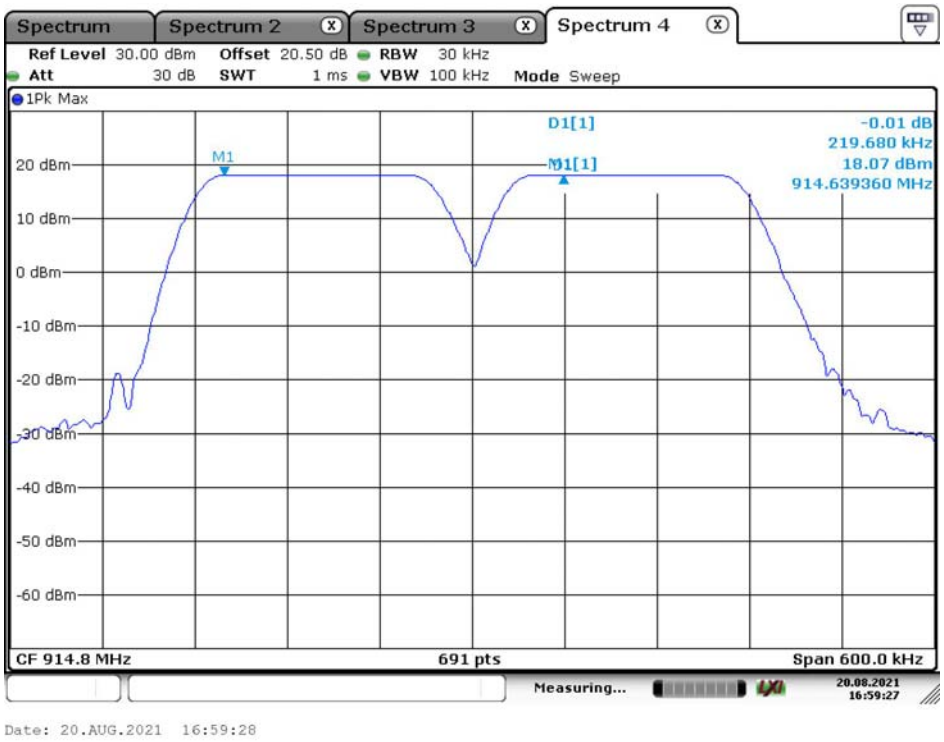
Date: 20.AUG.2021 16:55:34

Middle Channel



Date: 20.AUG.2021 16:57:43

High Channel



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

Applicable Standard

According to FCC §15.247(a) (1)

(i) For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

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.
5. Use Occupied bandwidth test function, measure the 99% Occupied bandwidth.
6. 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	EMI Test Receiver	ESR3	102724	2021-06-21	2022-06-20
Unknown	Coaxial Cable	C-SJ00-0010	C0010/01	Each time	N/A
E-Microwave	Coaxial Attenuators	EMCA20-2RN-2	OE0120328	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:	27~27.6℃
Relative Humidity:	62~69%
ATM Pressure:	99.5~100.4 kPa
Tester:	Jack Zhou
Test Date:	2021-08-20~2021-08-22

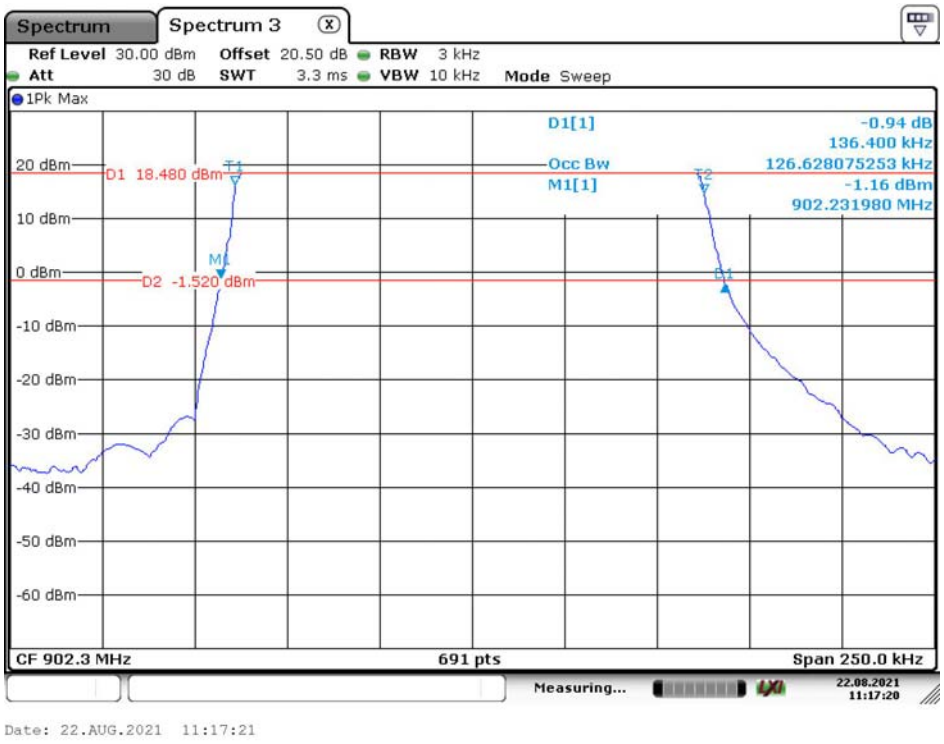
Test Result: Compliance. Please refer to following tables and plots

Test Mode: Transmitting

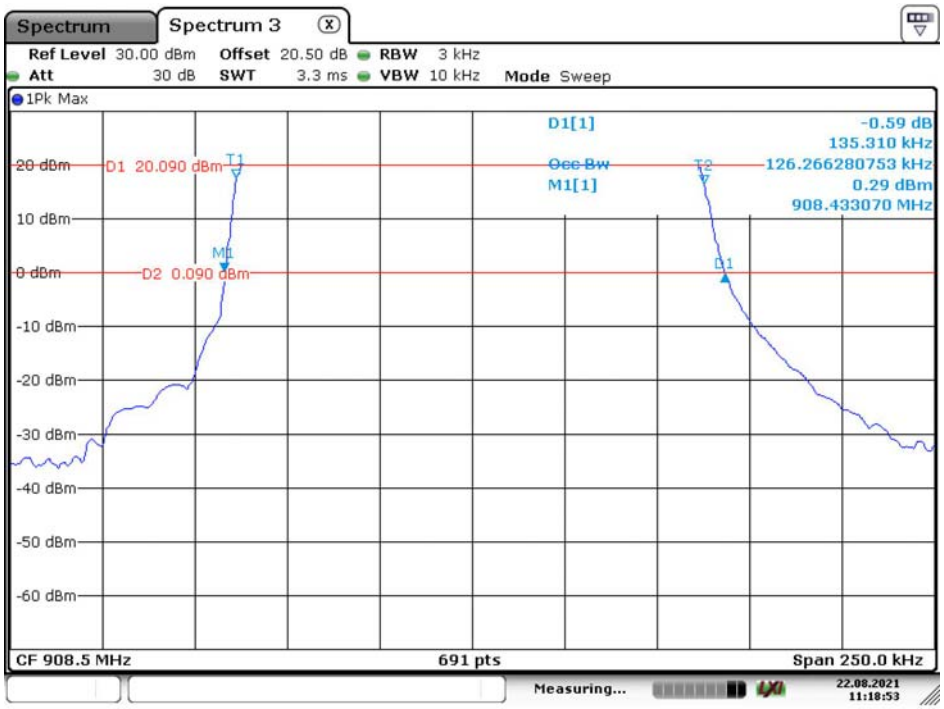
Test Antenna	Channel	Frequency (MHz)	20 dB Bandwidth (MHz)
Internal	Low	902.3	0.136
	Middle	908.5	0.135
	High	914.9	0.135
External	Low	902.3	0.135
	Middle	908.5	0.135
	High	914.9	0.135

20dB Bandwidth:
Internal Anetnna:

Low Channel

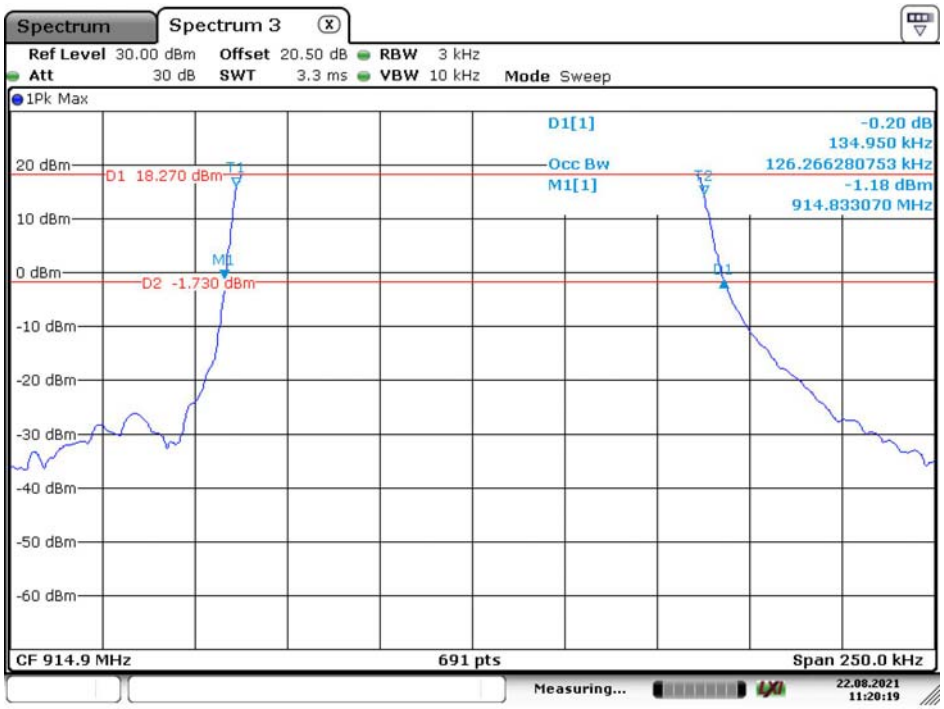


Middle Channel



Date: 22.AUG.2021 11:18:53

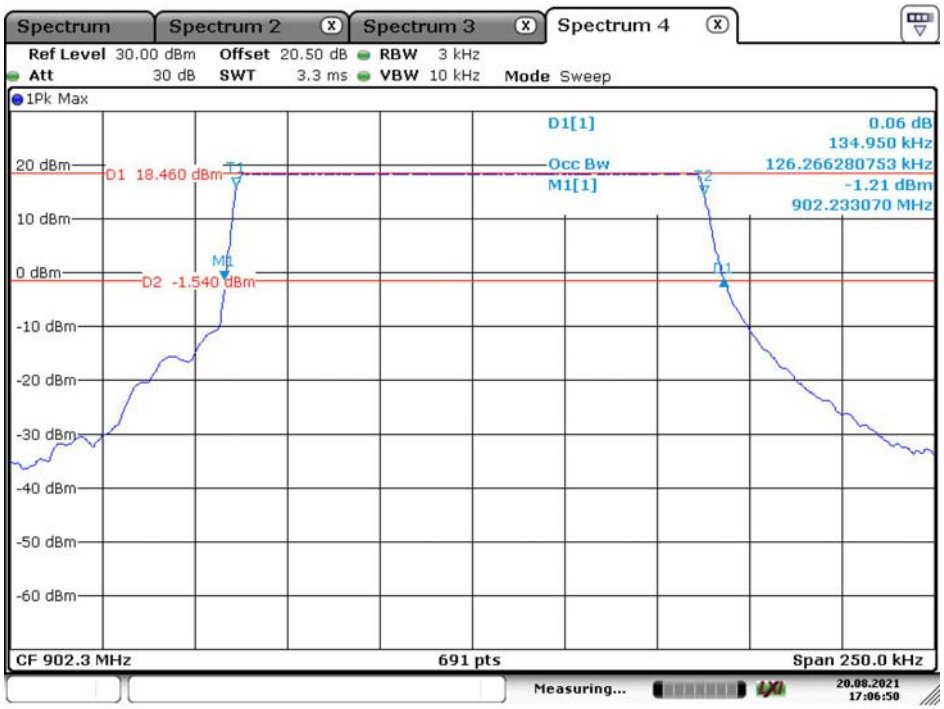
High Channel



Date: 22.AUG.2021 11:20:19

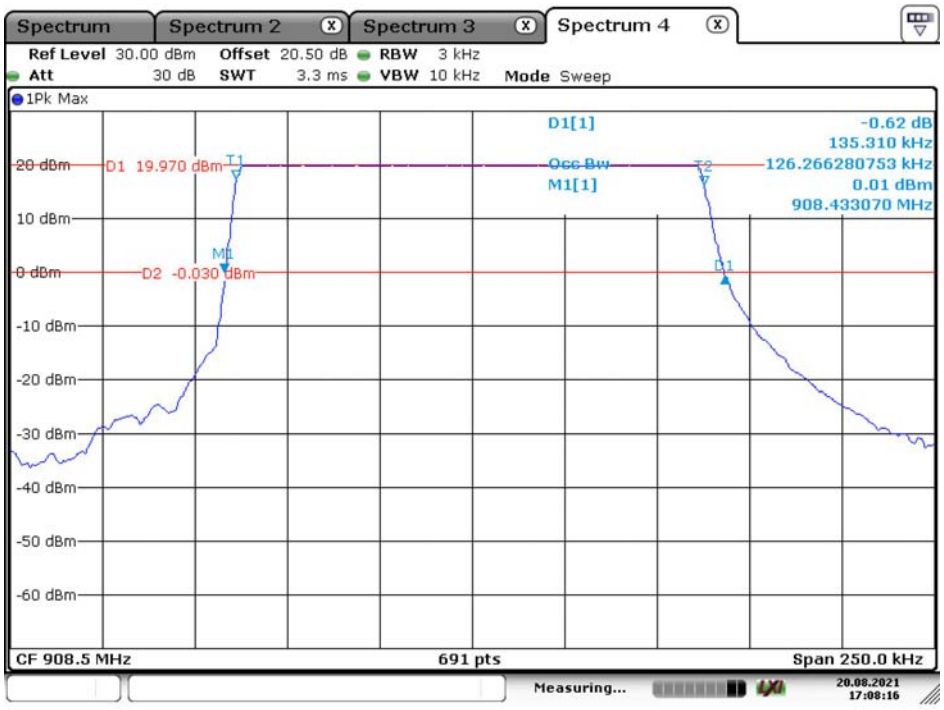
External Antenna:

Low Channel



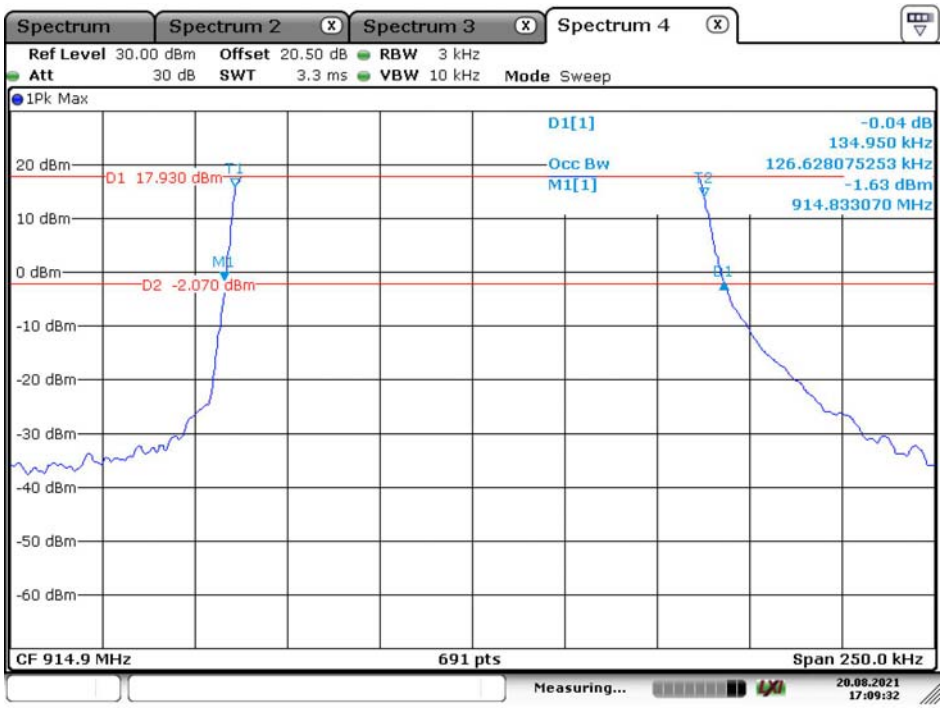
Date: 20.AUG.2021 17:06:50

Middle Channel



Date: 20.AUG.2021 17:08:17

High Channel



Date: 20.AUG.2021 17:09:33

FCC §15.247(a) (1) (i) - QUANTITY OF HOPPING CHANNEL TEST

Applicable Standard

According to FCC §15.247(a) (1) (i)

For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

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	EMI Test Receiver	ESR3	102724	2021-06-21	2022-06-20
Unknown	Coaxial Cable	C-SJ00-0010	C0010/01	Each time	N/A
E-Microwave	Coaxial Attenuators	EMCA20-2RN-2	OE0120328	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

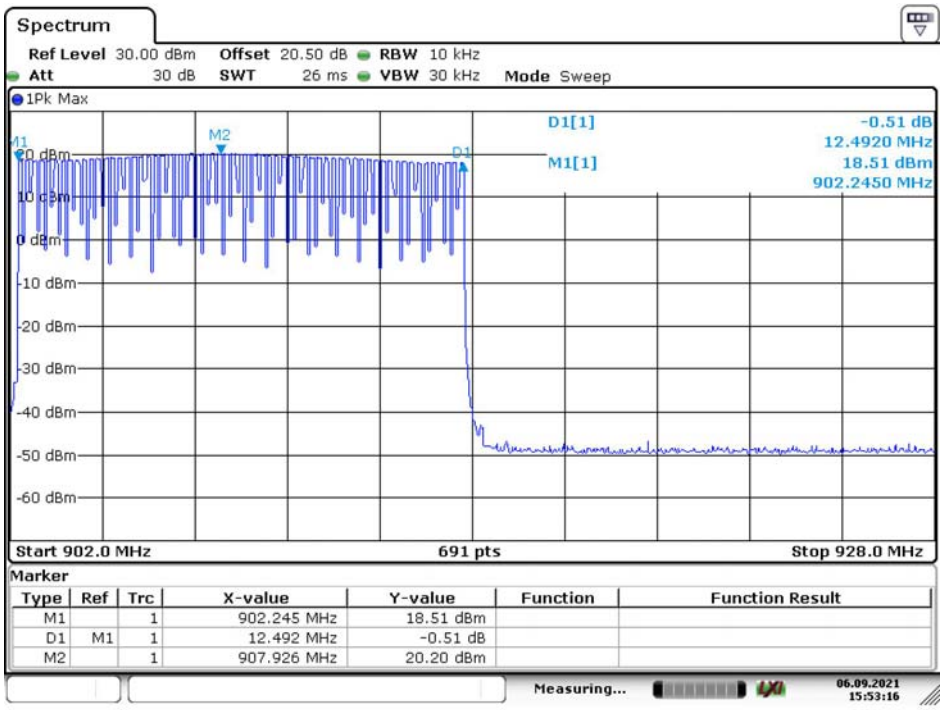
Temperature:	28.3℃
Relative Humidity:	79%
ATM Pressure:	100.6 kPa
Tester:	Jack Zhou
Test Date:	2021-09-06

Test Result: Compliance. Please refer to following tables and plots

Test Mode: Transmitting

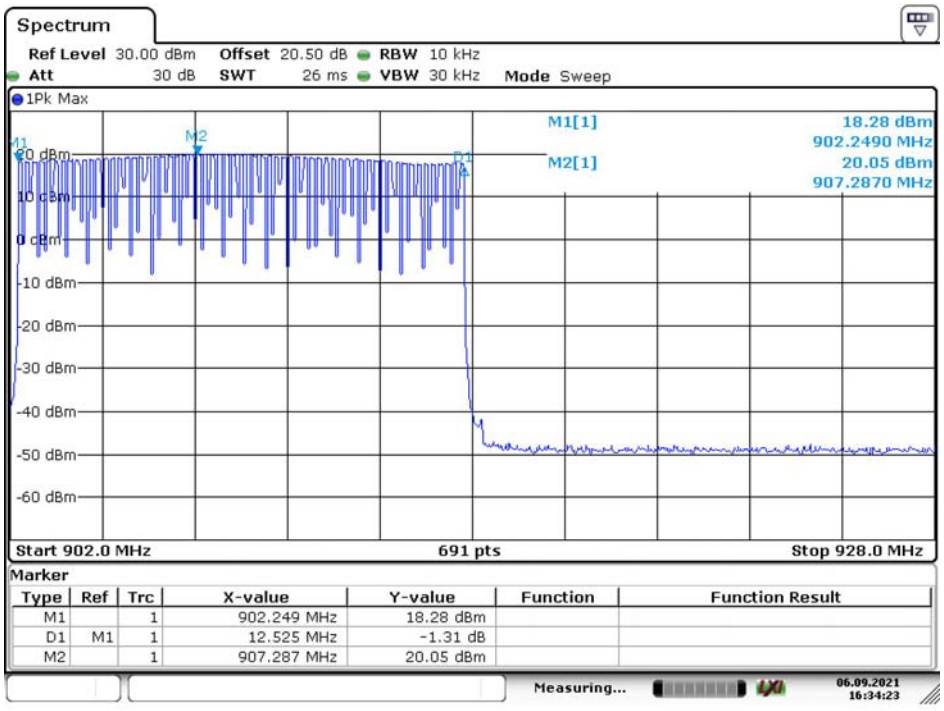
Frequency Range (MHz)	Number of Hopping Channel	Limit
902.3-914.9	64	≥50

Number of Hopping Channels Internal Antennna



Date: 6.SEP.2021 15:53:17

Number of Hopping Channels External Antennna



Date: 6.SEP.2021 16:34:23

FCC §15.247(f) - TIME OF OCCUPANCY (DWELL TIME)

Applicable Standard

According to FCC §15.247
(f) For the purposes of this section, hybrid systems are those that employ a combination of both frequency hopping and digital modulation techniques. The frequency hopping operation of the hybrid system, with the direct sequence or digital modulation operation turned-off, shall have an average time of occupancy on any frequency not to exceed 0.4 seconds within a time period in seconds equal to the number of hopping frequencies employed multiplied by 0.4. The power spectral density conducted from the intentional radiator to the antenna due to the digital modulation operation of the hybrid system, with the frequency hopping operation turned off, shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

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	EMI Test Receiver	ESR3	102724	2021-06-21	2022-06-20
Unknown	Coaxial Cable	C-SJ00-0010	C0010/01	Each time	N/A
E-Microwave	Coaxial Attenuators	EMCA20-2RN-2	OE0120328	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

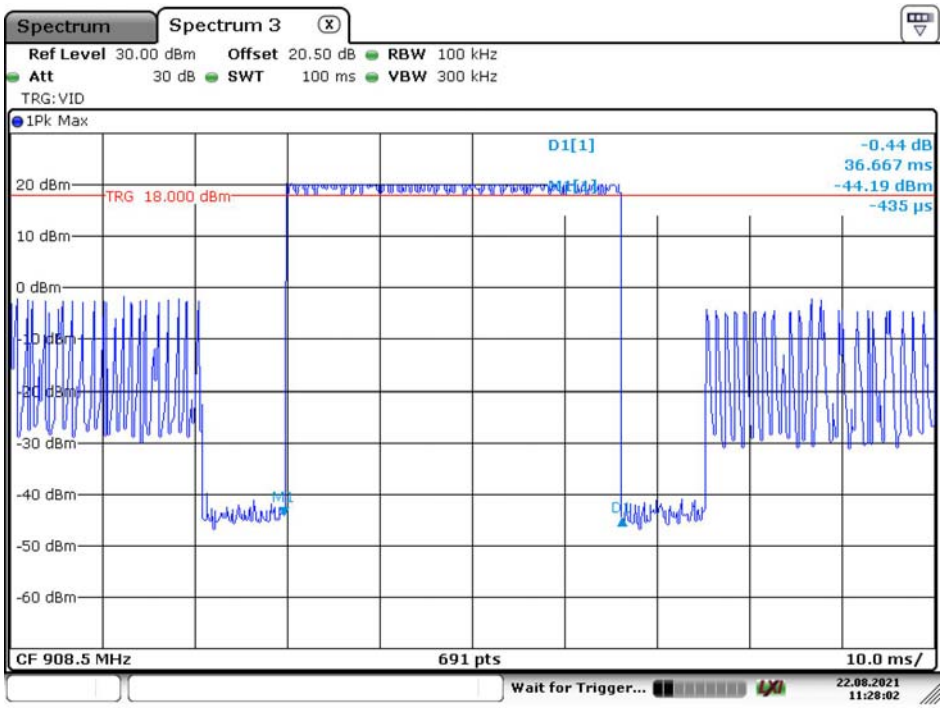
Environmental Conditions

Temperature:	27℃
Relative Humidity:	62%
ATM Pressure:	100 kPa
Tester:	Jack Zhou
Test Date:	2021-08-22

Test Result: Compliance. Please refer to following tables and plots
Test Mode: Transmitting

Test Antenna	Channel	Frequency (MHz)	Pulse Width (ms)	Real Observed Period (s)	Hopping number in Observed Period	Dwell Time (s)	Limit (s)
Internal	Middle	908.5	36.667	20	1	0.037	0.4
External	Middle	908.5	36.812	20	1	0.037	0.4
Note: Dwell time=Pulse width × hopping number per channel in Observed Period Observed Period=20s							

Middle Channel Internal Antenna



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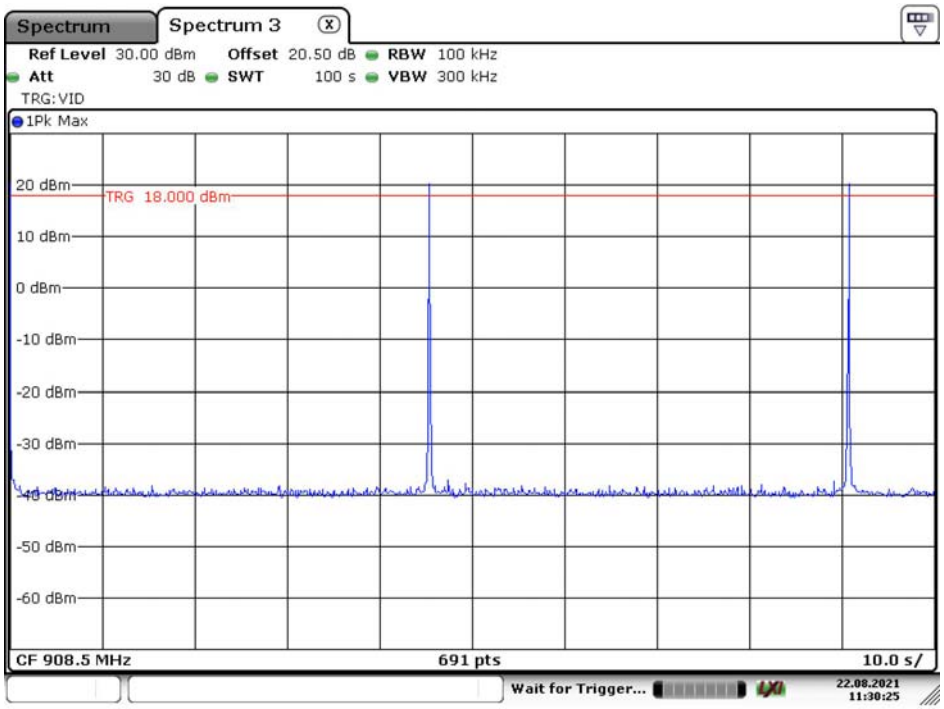
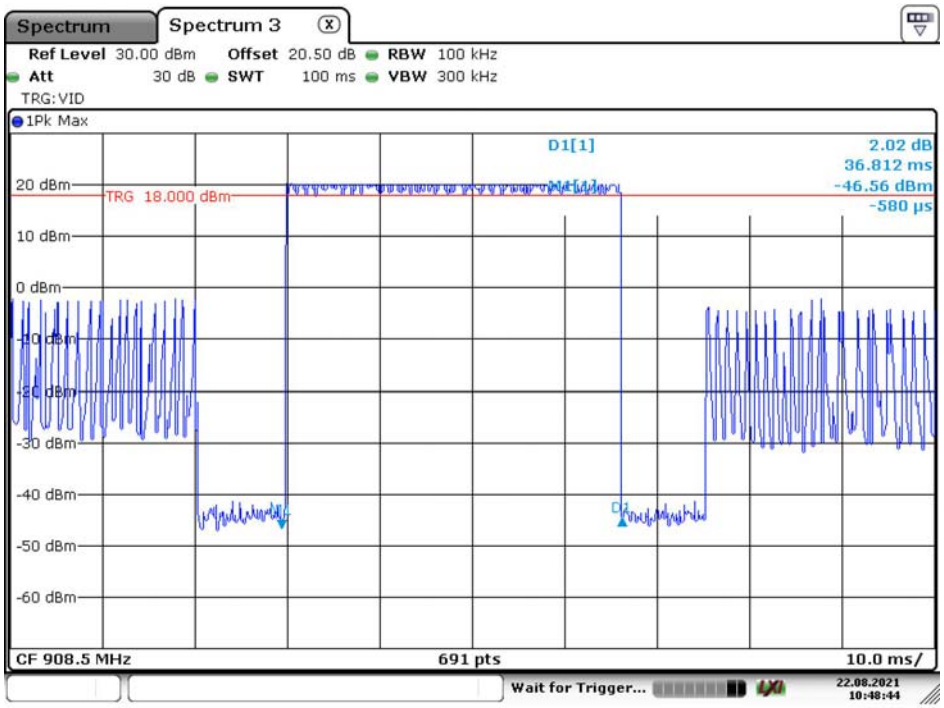


Date: 22.AUG.2021 11:30:26

Middle Channel External Antenna



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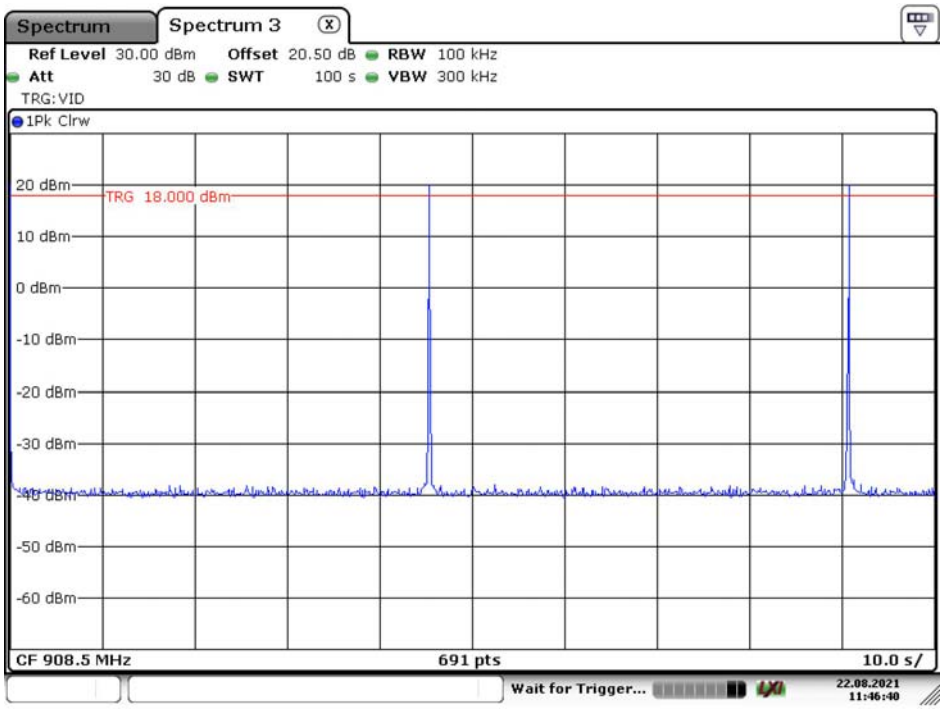


Date: 22.AUG.2021 11:46:40

FCC §15.247(b) (2) - PEAK OUTPUT POWER MEASUREMENT

Applicable Standard

According to FCC §15.247(b)(2)

For frequency hopping systems operating in the 902-928 MHz band: 1 watt for systems employing at least 50 hopping channels; and, 0.25 watts for systems employing less than 50 hopping channels, but at least 25 hopping channels, as permitted under paragraph (a)(1)(i) of this section.

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
Unknown	Coaxial Cable	C-SJ00-0010	C0010/01	Each time	N/A
E-Microwave	Coaxial Attenuators	EMCA20-2RN-2	OE0120328	Each time	N/A
Agilent	USB Wideband Power Sensor	U2022XA	MY5417006	2020-09-12	2021-09-12

**** 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:	25.6~28.3℃
Relative Humidity:	62~79%
ATM Pressure:	99.5~100.8 kPa
Tester:	Jack Zhou
Test Date:	2021-08-20~2021-09-06

Test Result: Compliance.

Test Mode: Transmitting

Test Antenna	Channel	Frequency (MHz)	Peak Conducted Output power (dBm)	Limit (dBm)
Internal	Low	902.3	18.5	30
	Middle	908.5	20.02	30
	High	914.9	18.24	30
External	Low	902.3	19.92	30
	Middle	908.5	20.17	30
	High	914.9	18.64	30

FCC §15.247(d) - BAND EDGES TESTING

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. 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	EMI Test Receiver	ESR3	102724	2021-06-21	2022-06-20
Unknown	Coaxial Cable	C-SJ00-0010	C0010/01	Each time	N/A
E-Microwave	Coaxial Attenuators	EMCA20-2RN-2	OE0120328	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

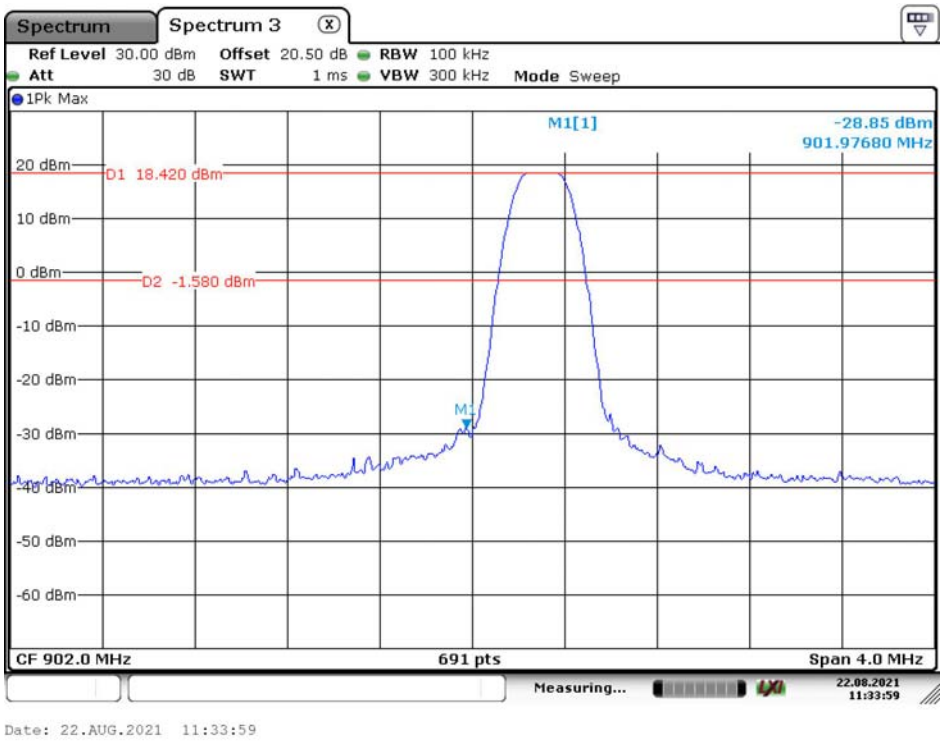
Temperature:	25.6~28.3℃
Relative Humidity:	62~79%
ATM Pressure:	99.5~100.8 kPa
Tester:	Jack Zhou
Test Date:	2021-08-20~2021-09-06

Test Result: Compliance

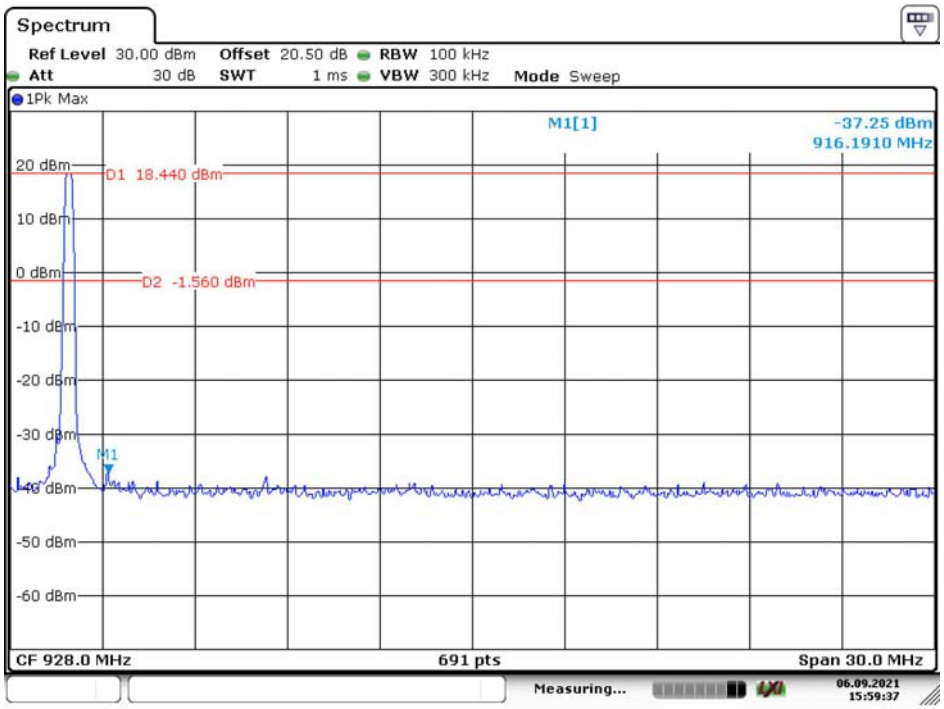
Internal Antenna:

Single mode:

Band Edge, Left Side



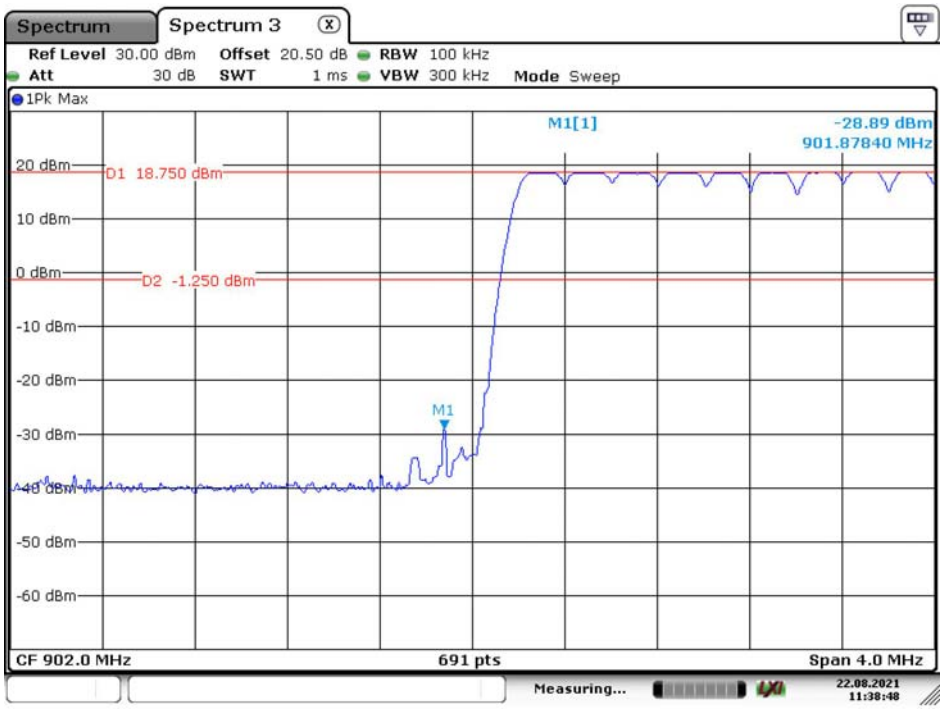
Band Edge, Right Side



Date: 6.SEP.2021 15:59:38

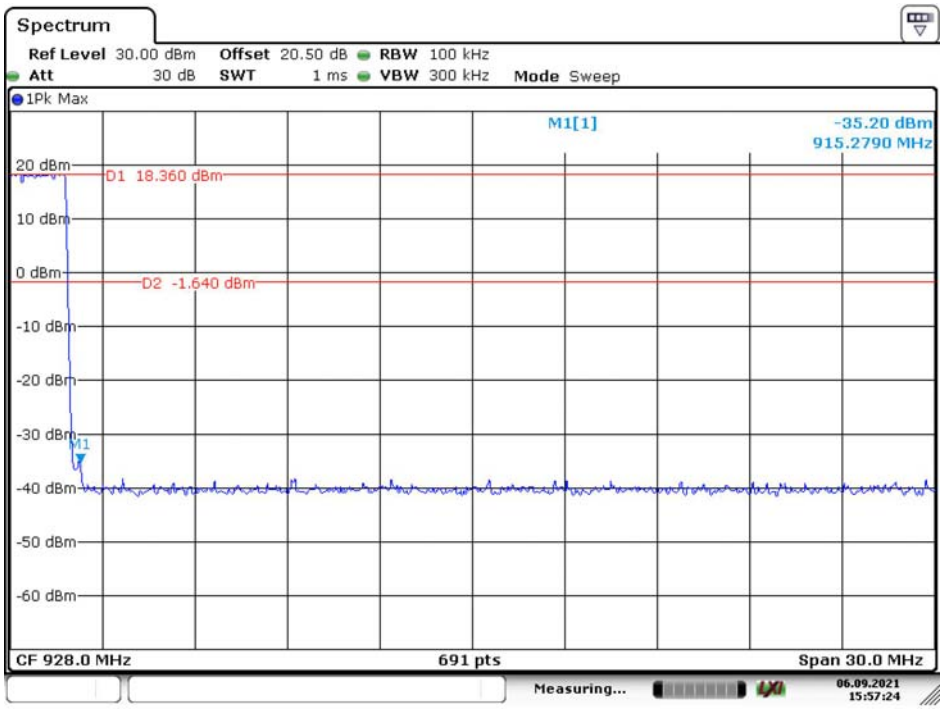
Hopping mode:

Band Edge, Left Side



Date: 22.AUG.2021 11:38:48

Band Edge, Right Side

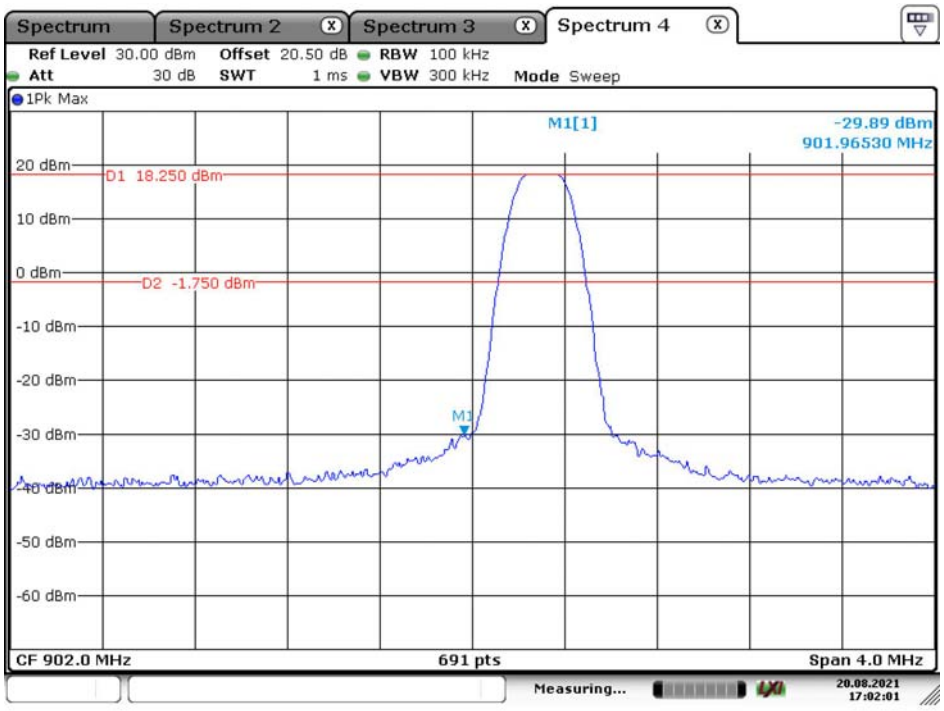


Date: 6.SEP.2021 15:57:25

External Antenna:

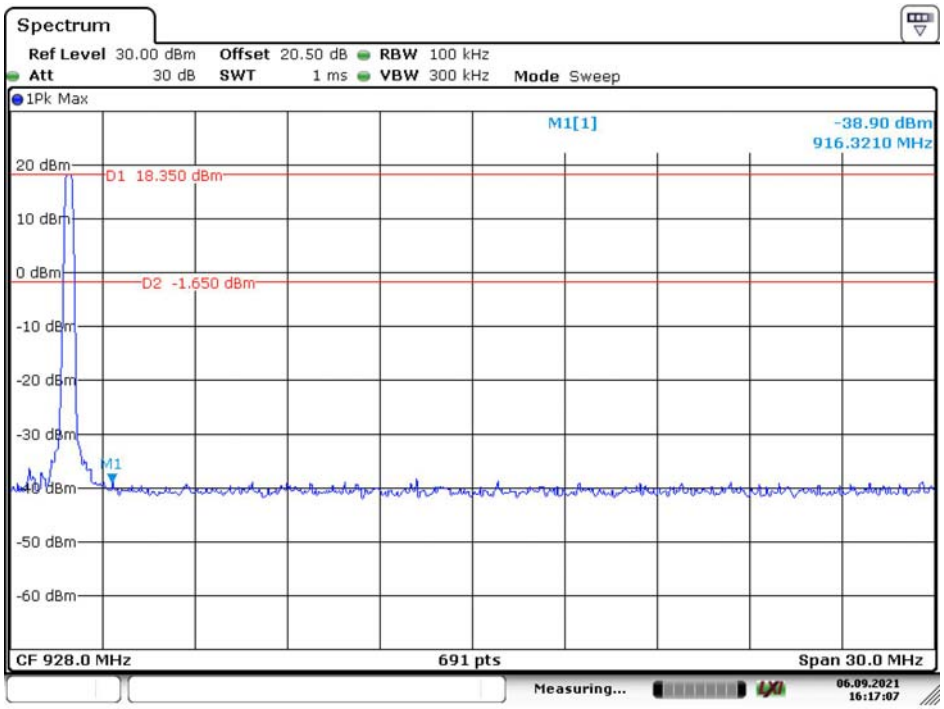
Single mode:

Band Edge, Left Side



Date: 20.AUG.2021 17:02:02

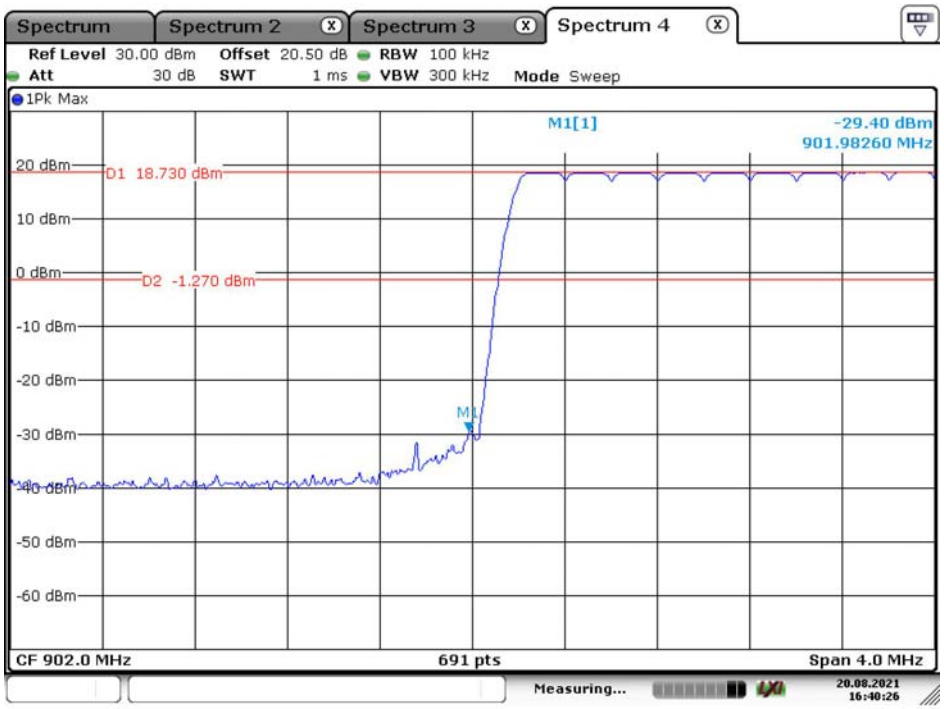
Band Edge, Right Side



Date: 6.SEP.2021 16:17:08

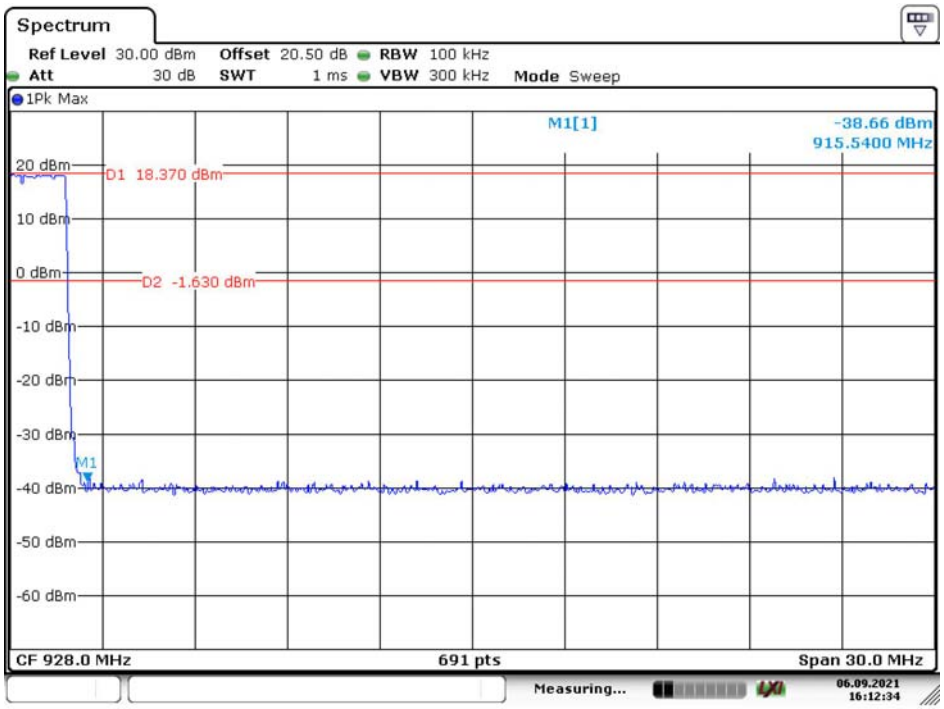
Hopping mode:

Band Edge, Left Side



Date: 20.AUG.2021 16:40:26

Band Edge, Right Side



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