

FCC PART 15.247

TEST REPORT

For

GTO Access Systems, LLC

3121 Hartsfield Road, Tallahassee, Florida 32303, USA

FCC ID: I6H-MM136KP

Report Type: Original Report	Product Name: MIGHTY MULE RETAIL KEYPAD
Report Number: RDG170905006-00B	
Report Date: 2017-11-22	
Jerry Zhang	
Reviewed By:	EMC Manager <i>Jerry Zhang</i>
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

Note: This test report is prepared for the customer shown above and for the device described herein. It may not be duplicated or used in part without prior written consent from Bay Area Compliance Laboratories Corp. (Dongguan).

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GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

EUT Name:	MIGHTY MULE RETAIL KEYPAD
EUT Model:	MM136K
FCC ID:	I6H-MM136KP
Rated Input Voltage:	DC6.0V from battery or AC/DC 8~24V from AC/DC port
External Dimension:	22.1cm(L)*8.4cm(W)*6.8cm(H)
Serial Number:	170905006
EUT Received Date:	2017-09-05

Objective

This report is prepared on behalf of **GTO Access Systems, LLC** 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 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)

FCC Part 15C DSC submissions with FCC ID: I6H-MM136KP.
Part of system submissions with FCC ID: I6H-MM136G3BASE.

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	$\pm 5\%$
RF output power, conducted	$\pm 0.61\text{ dB}$
Power Spectral Density, conducted	$\pm 0.61\text{ dB}$
Unwanted Emissions, radiated	30M~200MHz: 4.58 dB for Horizontal, 4.59 dB for Vertical 200M~1GHz: 4.83 dB for Horizontal, 5.85 dB for Vertical 1G~6GHz: 4.45 dB, 6G~26.5GHz: 5.23 dB
Unwanted Emissions, conducted	$\pm 1.5\text{ dB}$
Temperature	$\pm 1^\circ\text{C}$
Humidity	$\pm 5\%$
DC and low frequency voltages	$\pm 0.4\%$
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

Bay Area Compliance Laboratories Corp. (Dongguan) has been accredited to ISO/IEC 17025 by CNAS(Lab code: L5662). And accredited to ISO/IEC 17025 by NVLAP(Test Laboratory Accreditation Certificate Number 500069-0), the FCC Designation No. CN5002 under the KDB 974614 D01.

The Federal Communications Commission has the reports on file and is listed under FCC Registration No.: 273710. The test site has been approved by the FCC for public use and is listed in the FCC Public Access Link (PAL) database.

Bay Area Compliance Laboratories Corp. (Dongguan) was registered with ISED Canada under ISED Canada Registration Number 3062D.

SYSTEM TEST CONFIGURATION

Description of Test Configuration

The system was configured for testing in an engineering mode. 60 hopping channels are provided:

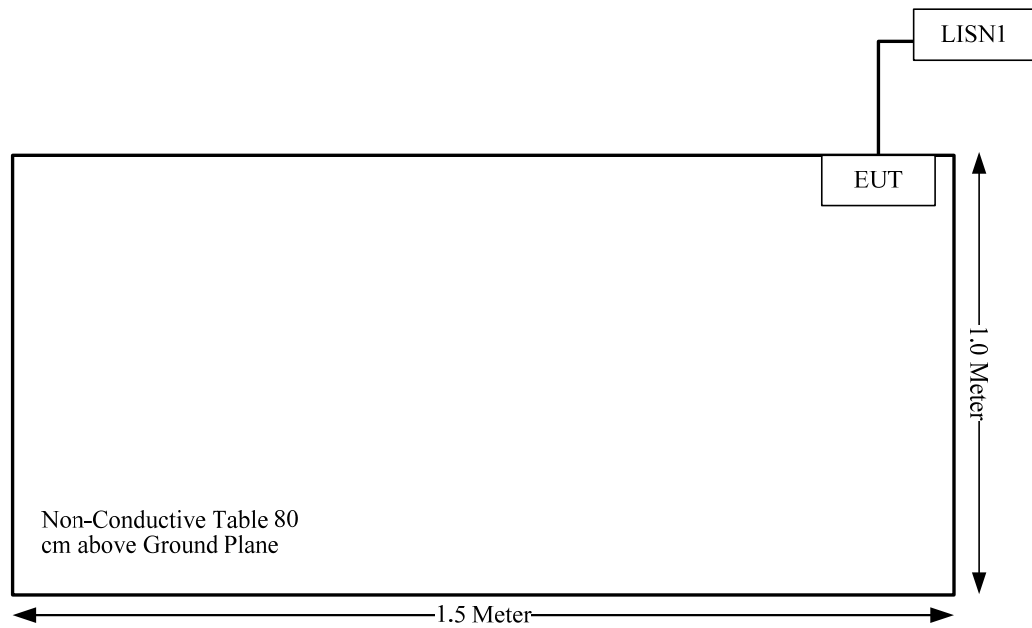
Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
1	907.5	16	911.25	31	915	46	918.75
2	907.75	17	911.5	32	915.25	47	919
3	908	18	911.75	33	915.5	48	919.25
4	908.25	19	912	34	915.75	49	919.5
5	908.5	20	912.25	35	916	50	919.75
6	908.75	21	912.5	36	916.25	51	920
7	909	22	912.75	37	916.5	52	920.25
8	909.25	23	913	38	916.75	53	920.5
9	909.5	24	913.25	39	917	54	920.75
10	909.75	25	913.5	40	917.25	55	921
11	910	26	913.75	41	917.5	56	921.25
12	910.25	27	914	42	917.75	57	921.5
13	910.5	28	914.25	43	918	58	921.75
14	910.75	29	914.5	44	918.25	59	922
15	911	30	914.75	45	918.5	60	922.25

Channel 1, 31, 60 were selected to test.

EUT Exercise Software

The engineering mode configured the maximum power as default setting.

Block Diagram of Test Setup



SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Result
FCC §15.247 (i) & §1.1310 & §2.1091	Maximum Permissible Exposure (MPE)	Compliance
§15.203	Antenna Requirement	Compliance
§15.207 (a)	Conducted Emissions	Compliance
§15.205, §15.209, §15.247(d)	Spurious Emissions	Compliance
§15.247 (a)(1)	20 dB Bandwidth	Compliance
§15.247(a)(1)	Channel Separation Test	Compliance
§15.247(a)(1)(i)	Time of Occupancy (Dwell Time)	Compliance
§15.247(a)(1)(i)	Quantity of hopping channel Test	Compliance
§15.247(b)(2)	Peak Output Power Measurement	Compliance
§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/cm²);

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

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

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

Calculated Data:

Frequency (MHz)	Antenna Gain		Tune-up Power		Evaluation Distance (cm)	Power Density (mW/cm ²)	MPE Limit (mW/cm ²)
	(dBi)	(numeric)	(dBm)	(mW)			
907.5-922.25	0	1.00	7	5.01	20.00	0.0010	0.605

Result: Compliance, The device meets MPE requirement for Devices Used by the General Public (Uncontrolled Environment) at distance ≥ 20 cm.

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 external antenna with a unique coupling to the EUT, 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 EUT was connected to the main lisn with a 8 or 24 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
R&S	EMI Test Receiver	ESCS 30	830245/006	2016-12-08	2017-12-08
R&S	L.I.S.N	ESH2-Z5	892107/021	2016-09-25	2017-09-25
R&S	Two-line V-network	ENV 216	3560.6550.12	2016-12-08	2017-12-08
R&S	Test Software	EMC32	Version8.53.0	N/A	N/A
N/A	Coaxial Cable	C-NJNJ-50	C-0200-01	2017-09-05	2018-09-05

* **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

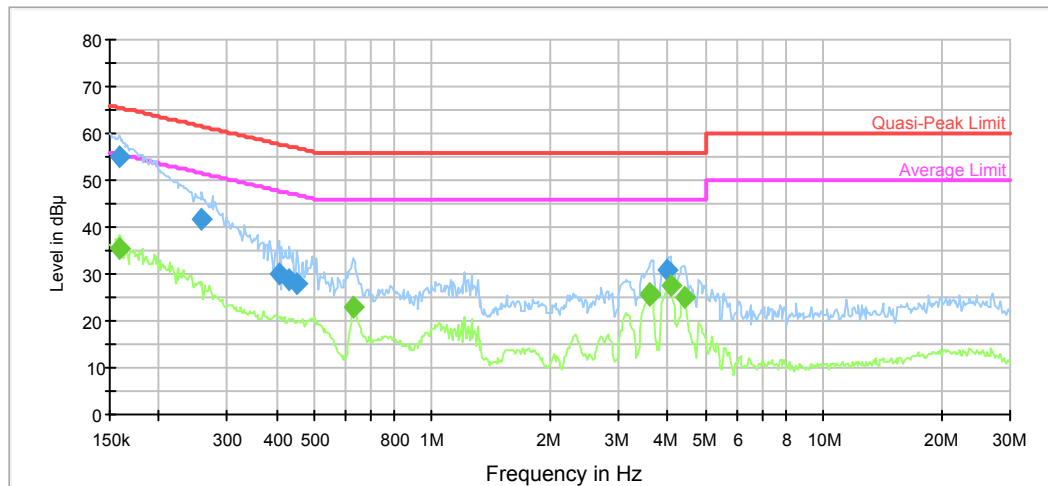
Environmental Conditions

Temperature:	27.1 °C
Relative Humidity:	40 %
ATM Pressure:	100.2 kPa

The testing was performed by Alex You on 2017-09-07.

Test Mode: Transmitting(AC 24V was the worst)

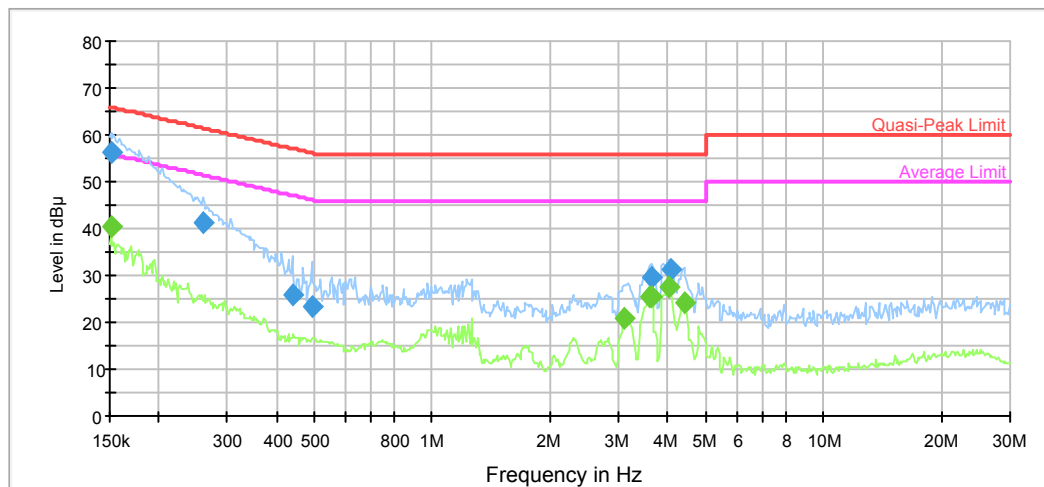
AC24V, 60 Hz, Line:



Frequency (MHz)	QuasiPeak (dBμV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)	Comment
0.158604	55.0	9.000	L1	11.1	10.5	65.5	Compliance
0.257874	41.9	9.000	L1	10.3	19.6	61.5	Compliance
0.406123	30.1	9.000	L1	10.0	27.6	57.7	Compliance
0.432855	28.8	9.000	L1	9.9	28.4	57.2	Compliance
0.450448	28.1	9.000	L1	9.9	28.8	56.9	Compliance
3.997889	30.6	9.000	L1	9.8	25.4	56.0	Compliance

Frequency (MHz)	Average (dBμV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)	Comment
0.158604	35.4	9.000	L1	11.1	20.1	55.5	Compliance
0.629488	22.7	9.000	L1	9.8	23.3	46.0	Compliance
3.575883	25.2	9.000	L1	9.8	20.8	46.0	Compliance
3.604490	25.9	9.000	L1	9.8	20.1	46.0	Compliance
4.062112	27.4	9.000	L1	9.8	18.6	46.0	Compliance
4.399032	24.9	9.000	L1	9.8	21.1	46.0	Compliance

AC24V, 60 Hz, Neutral:



Frequency (MHz)	QuasiPeak (dBμV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)	Comment
0.151200	56.3	9.000	N	11.2	9.6	65.9	Compliance
0.259937	41.4	9.000	N	10.3	20.0	61.4	Compliance
0.439808	25.9	9.000	N	9.9	31.2	57.1	Compliance
0.491712	23.3	9.000	N	9.9	32.8	56.1	Compliance
3.633326	29.4	9.000	N	9.8	26.6	56.0	Compliance
4.062112	31.1	9.000	N	9.8	24.9	56.0	Compliance

Frequency (MHz)	Average (dBμV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)	Comment
0.151200	40.3	9.000	N	11.2	15.6	55.9	Compliance
3.098088	20.7	9.000	N	9.8	25.3	46.0	Compliance
3.575883	25.6	9.000	N	9.8	20.4	46.0	Compliance
3.633326	25.4	9.000	N	9.8	20.6	46.0	Compliance
4.029873	27.4	9.000	N	9.8	18.6	46.0	Compliance
4.399032	24.3	9.000	N	9.8	21.7	46.0	Compliance

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

Applicable Standard

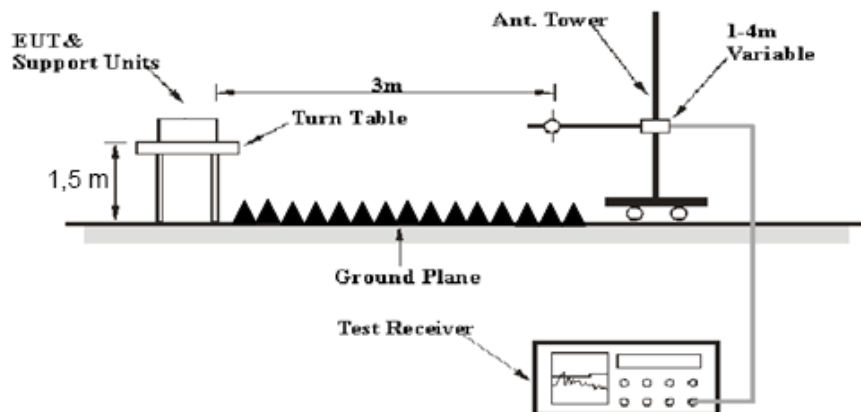
FCC §15.247 (d); §15.209; §15.205;

EUT Setup

Below 1GHz:



Above 1GHz:



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

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

The spacing between the peripherals was 10 cm.

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

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	100224	2017-09-01	2018-09-01
Sunol Sciences	Antenna	JB3	A060611-2	2017-08-25	2020-08-25
HP	Amplifier	8447D	2727A05902	2017-09-05	2018-09-05
Agilent	Spectrum Analyzer	E4440A	SG43360054	2016-12-08	2017-12-08
ETS-Lindgren	Horn Antenna	3115	000 527 35	2016-01-05	2019-01-04
MITEQ	Amplifier	AFS42-00101800-25-S-42	2001271	2017-09-05	2018-09-05
N/A	Coaxial Cable	C-NJNJ-50	C-0400-01	2017-09-05	2018-09-05
N/A	Coaxial Cable	C-NJNJ-50	C-0075-01	2017-09-05	2018-09-05
N/A	Coaxial Cable	C-NJNJ-50	C-1000-01	2017-09-05	2018-09-05
N/A	Coaxial Cable	C-SJSJ-50	C-0800-01	2017-09-05	2018-09-05
Farad	Test Software	EZ-EMC	V1.1.4.2	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).

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

Temperature:	26.8 °C
Relative Humidity:	28.8 %
ATM Pressure:	100.9 kPa

** The testing was performed by Blake Yang on 2017-10-09*

Test Mode: Transmitting(AC 24V was the worst)

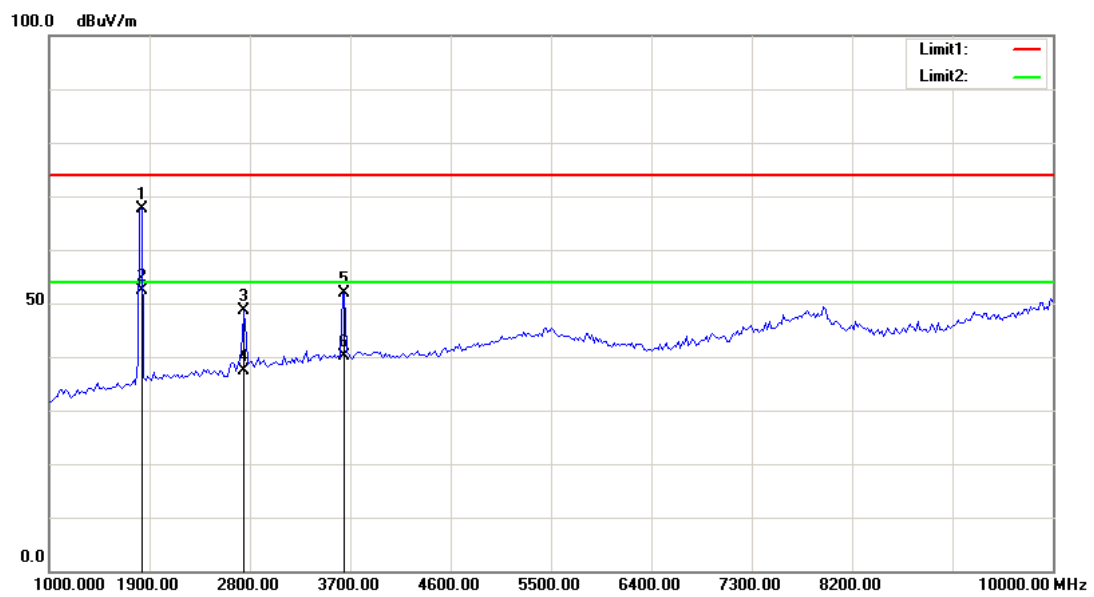
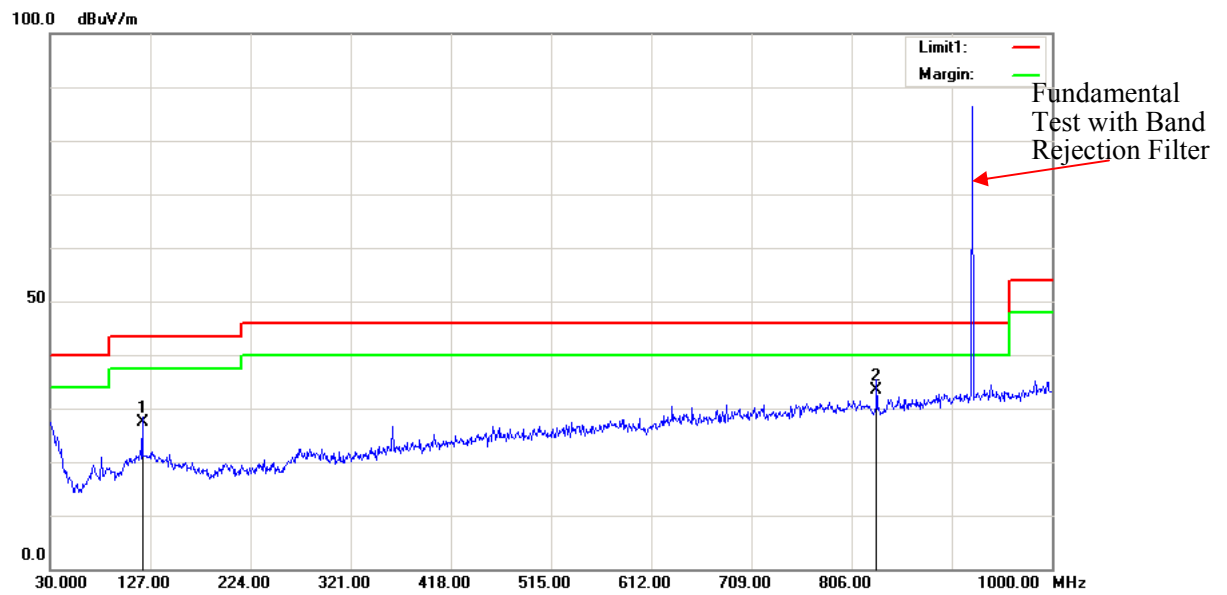
30MHz-10GHz:

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)					
Low Channel: 907.5 MHz									
907.50	72.10	QP	V	22.40	4.24	0.00	98.74	N/A	N/A
907.50	67.60	QP	H	22.40	4.24	0.00	94.24	N/A	N/A
902.00	16.80	QP	V	22.34	4.29	0.00	43.43	46.00	2.57
264.00	18.50	QP	H	12.80	1.99	0.00	33.29	46.00	12.71
1815.00	75.24	PK	H	26.52	1.66	35.92	67.50	74.00	6.50
1815.00	60.12	AV	H	26.52	1.66	35.92	52.38	54.00	1.62
1815.00	74.30	PK	V	26.52	1.66	35.92	66.56	74.00	7.44
1815.00	60.90	AV	V	26.52	1.66	35.92	53.16	54.00	0.84
2722.50	53.92	PK	H	29.10	1.89	36.48	48.43	74.00	25.57
2722.50	42.86	AV	H	29.10	1.89	36.48	37.37	54.00	16.63
2722.50	47.58	PK	V	29.10	1.89	36.48	42.09	74.00	31.91
2722.50	36.71	AV	V	29.10	1.89	36.48	31.22	54.00	22.78
3630.00	54.85	PK	H	31.59	2.45	37.09	51.80	74.00	22.20
3630.00	43.07	AV	H	31.59	2.45	37.09	40.02	54.00	13.98
3630.00	51.71	PK	V	31.59	2.45	37.09	48.66	74.00	25.34
3630.00	40.09	AV	V	31.59	2.45	37.09	37.04	54.00	16.96
Middle Channel: 915 MHz									
915.00	71.60	QP	V	22.40	4.21	0.00	98.21	N/A	N/A
915.00	65.50	QP	H	22.40	4.21	0.00	92.11	N/A	N/A
514.00	18.20	QP	H	17.60	3.02	0.00	38.82	46.00	7.18
273.00	18.40	QP	H	13.20	1.99	0.00	33.59	46.00	12.41
1830.00	73.26	PK	H	26.59	1.66	35.95	65.56	74.00	8.44
1830.00	58.44	AV	H	26.59	1.66	35.95	50.74	54.00	3.26
1830.00	73.10	PK	V	26.59	1.66	35.95	65.40	74.00	8.60
1830.00	59.77	AV	V	26.59	1.66	35.95	52.07	54.00	1.93
2745.00	50.26	PK	H	29.18	1.91	36.51	44.84	74.00	29.16
2745.00	37.46	AV	H	29.18	1.91	36.51	32.04	54.00	21.96
2745.00	53.48	PK	V	29.18	1.91	36.51	48.06	74.00	25.94
2745.00	40.25	AV	V	29.18	1.91	36.51	34.83	54.00	19.17
3660.00	51.42	PK	H	31.65	2.50	37.06	48.51	74.00	25.49
3660.00	38.87	AV	H	31.65	2.50	37.06	35.96	54.00	18.04
3660.00	53.67	PK	V	31.65	2.50	37.06	50.76	74.00	23.24
3660.00	40.26	AV	V	31.65	2.50	37.06	37.35	54.00	16.65

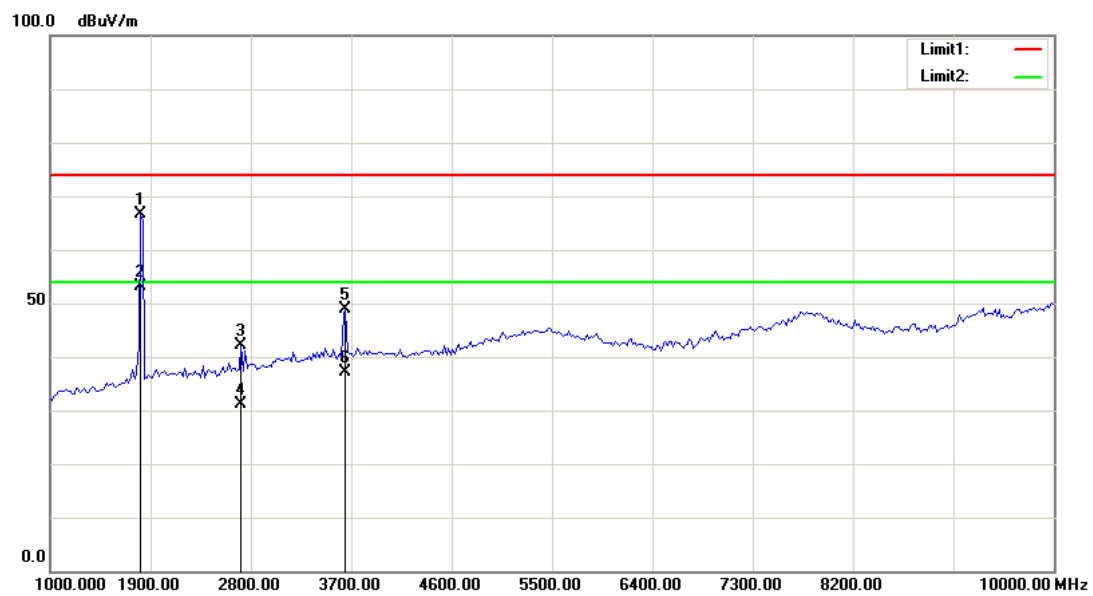
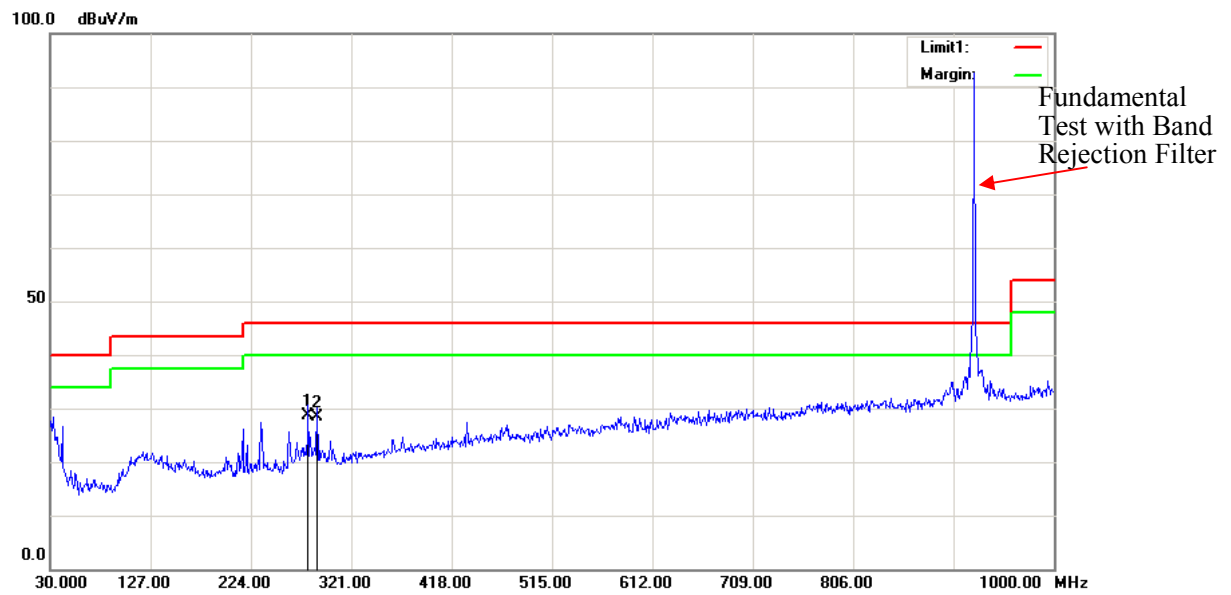
Frequency (MHz)	Receiver		Rx Antenna		Cable loss (dB)	Amplifier Gain (dB)	Corrected Amplitude (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	Detector	Polar (H/V)	Factor (dB)					
High Channel: 922.25 MHz									
922.25	71.50	QP	V	22.45	4.32	0.00	98.27	N/A	N/A
922.25	64.60	QP	H	22.45	4.32	0.00	91.37	N/A	N/A
928.00	16.60	QP	V	22.56	4.34	0.00	43.50	46.00	2.50
464.00	17.20	QP	H	17.24	2.76	0.00	37.20	46.00	8.8
1844.50	74.51	PK	H	26.65	1.66	35.97	66.85	74.00	7.15
1844.50	59.45	AV	H	26.65	1.66	35.97	51.79	54.00	2.21
1844.50	73.45	PK	V	26.65	1.66	35.97	65.79	74.00	8.21
1844.50	60.01	AV	V	26.65	1.66	35.97	52.35	54.00	1.65
2766.75	47.65	PK	H	29.26	1.92	36.53	42.30	74.00	31.70
2766.75	34.32	AV	H	29.26	1.92	36.53	28.97	54.00	25.03
2766.75	52.31	PK	V	29.26	1.92	36.53	46.96	74.00	27.04
2766.75	39.58	AV	V	29.26	1.92	36.53	34.23	54.00	19.77
3689.00	54.26	PK	H	31.72	2.56	37.03	51.51	74.00	22.49
3689.00	41.26	AV	H	31.72	2.56	37.03	38.51	54.00	15.49
3689.00	55.46	PK	V	31.72	2.56	37.03	52.71	74.00	21.29
3689.00	42.51	AV	V	31.72	2.56	37.03	39.76	54.00	14.24

Worst mode plots(Low channel)

Horizontal:



Vertical:



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

Applicable Standard

(1) Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. 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. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	Spectrum Analyzer	FSU 26	200256	2016-12-08	2017-12-08
Unknown	RF Cable	0.1m	C-1	Each Time	/

* **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 10 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:	27.1 °C
Relative Humidity:	59 %
ATM Pressure:	101.4 kPa

* The testing was performed by Calvin Chen on 2017-11-20.

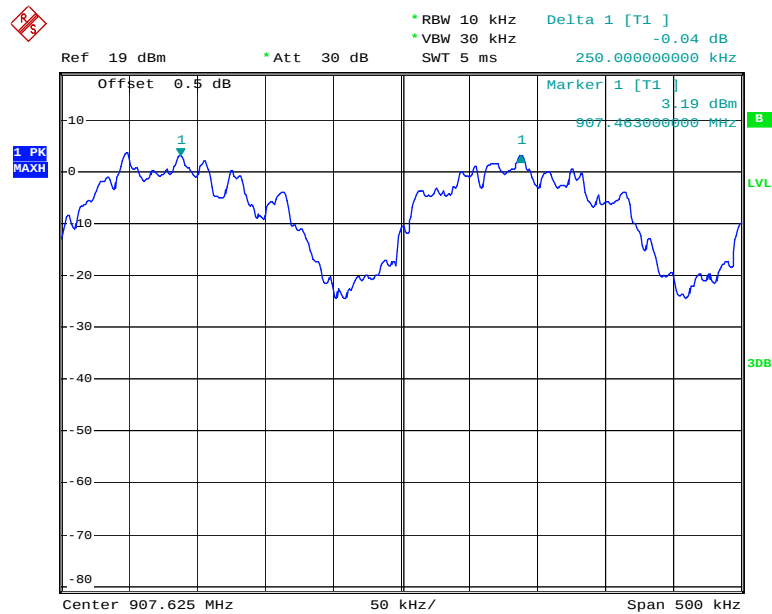
Test Result: Compliance.

Please refer to following tables and plots

Test Mode: Transmitting

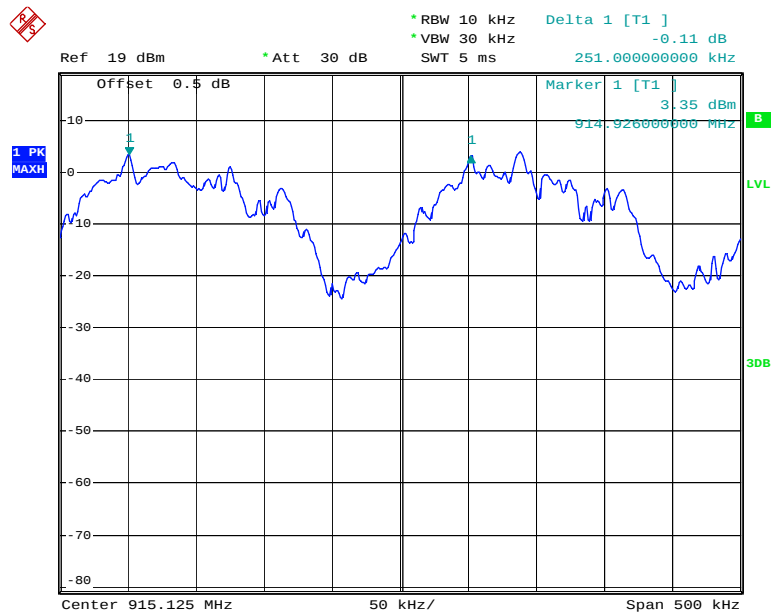
Channel	Frequency (MHz)	Channel Separation (kHz)	Limit (kHz)
Low	907.5	250	≥ 195.51
Middle	915	251	≥ 196.31
High	922.25	252	≥ 197.92

Low Channel



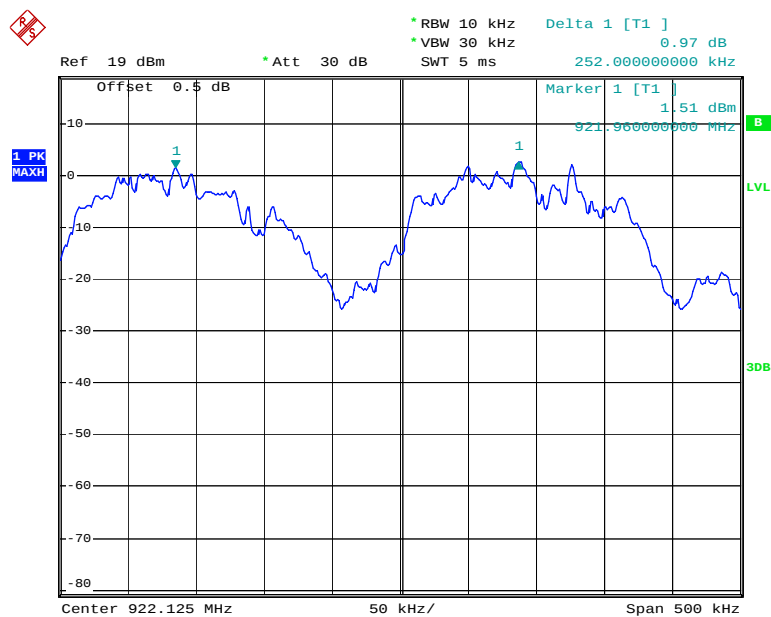
Date: 20.NOV.2017 10:10:02

Middle Channel



Date: 20.NOV.2017 10:17:08

High Channel



Date: 20.NOV.2017 10:18:18

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

Applicable Standard

(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.

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	Spectrum Analyzer	FSU 26	200256	2016-12-08	2017-12-08
N/A	Coaxial Cable	C-SJ00-0010	C0010/01	Each Time	/

* **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:	27.1 °C
Relative Humidity:	59 %
ATM Pressure:	101.4 kPa

* The testing was performed by Calvin Chen on 2017-11-20.

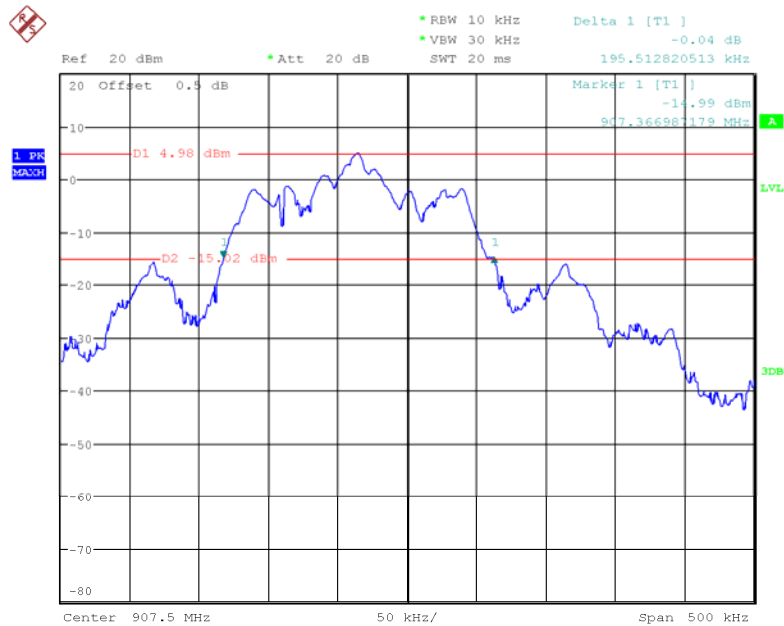
Test Result: Compliance.

Please refer to following tables and plots

Test Mode: Transmitting

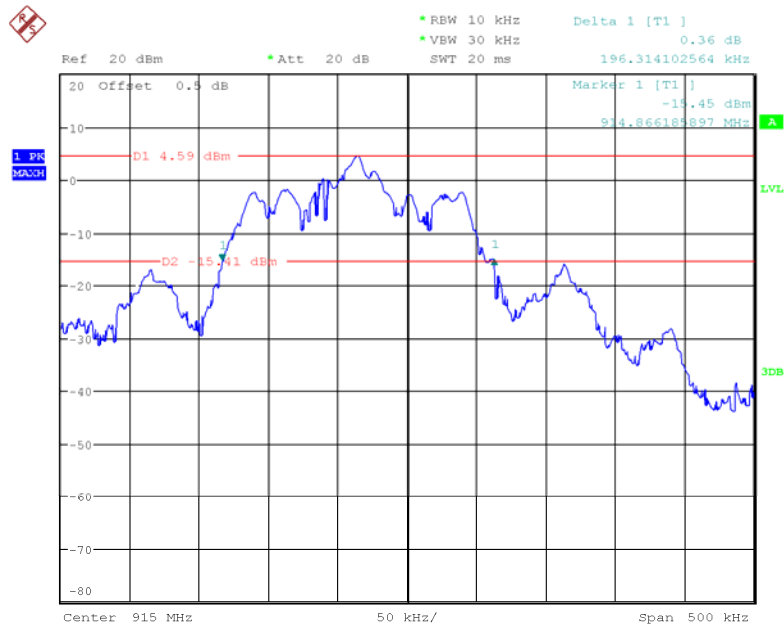
Channel	Frequency (MHz)	20 dB Bandwidth (kHz)	Limit (MHz)
Low	907.5	195.51	≤0.25
Middle	915	196.31	≤0.25
High	922.25	197.92	≤0.25

Low Channel



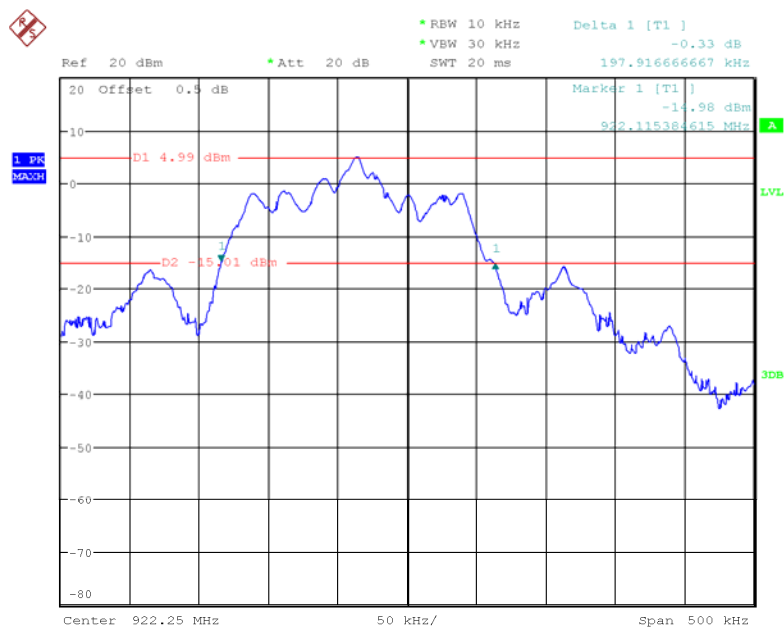
Date: 20.NOV.2017 14:42:44

Middle Channel



Date: 20.NOV.2017 14:44:56

High Channel



Date: 20.NOV.2017 14:48:14

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

(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	Spectrum Analyzer	FSU 26	200256	2016-12-08	2017-12-08
N/A	Coaxial Cable	C-SJ00-0010	C0010/01	Each Time	/

* **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:	27.1 °C
Relative Humidity:	59 %
ATM Pressure:	101.4 kPa

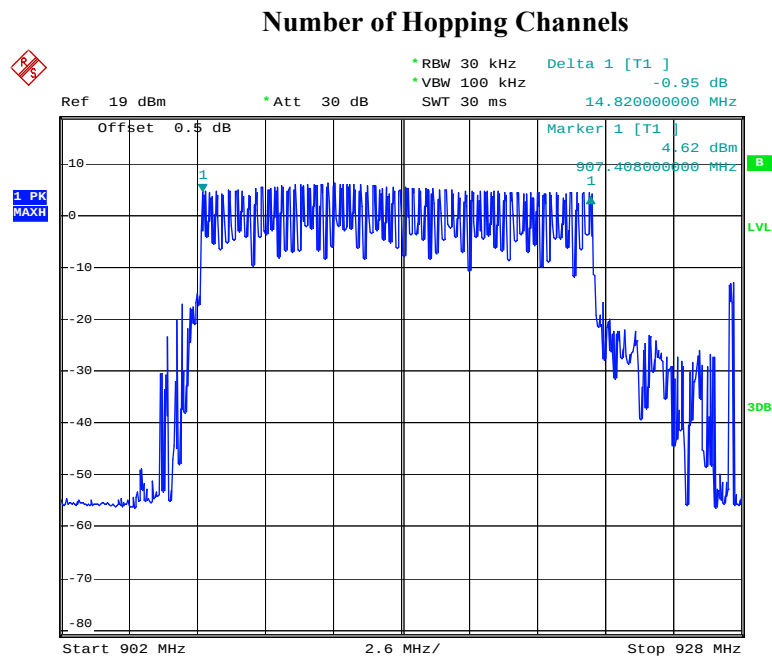
* The testing was performed by Calvin Chen on 2017-11-20.

Test Result: Compliance.

Please refer to following tables and plots

Test Mode: Transmitting

Frequency Range (MHz)	Number of Hopping Channel	Limit
902-928	60	≥ 50



Date: 20.NOV.2017 10:06:57

FCC §15.247(a) (1) (i) - TIME OF OCCUPANCY (DWELL TIME)**Applicable Standard**

(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

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	FSU 26	200256	2016-12-08	2017-12-08
N/A	Coaxial Cable	C-SJ00-0010	C0010/01	Each Time	/

* **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:	27.1 °C
Relative Humidity:	59 %
ATM Pressure:	101.4 kPa

* The testing was performed by Calvin Chen on 2017-11-20.

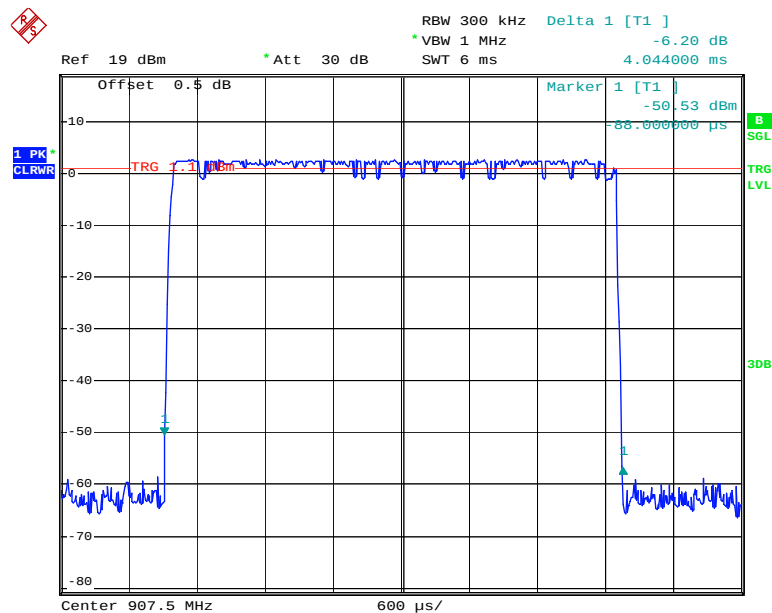
Test Result: Compliance.

Please refer to following tables and plots

Test Mode: Transmitting

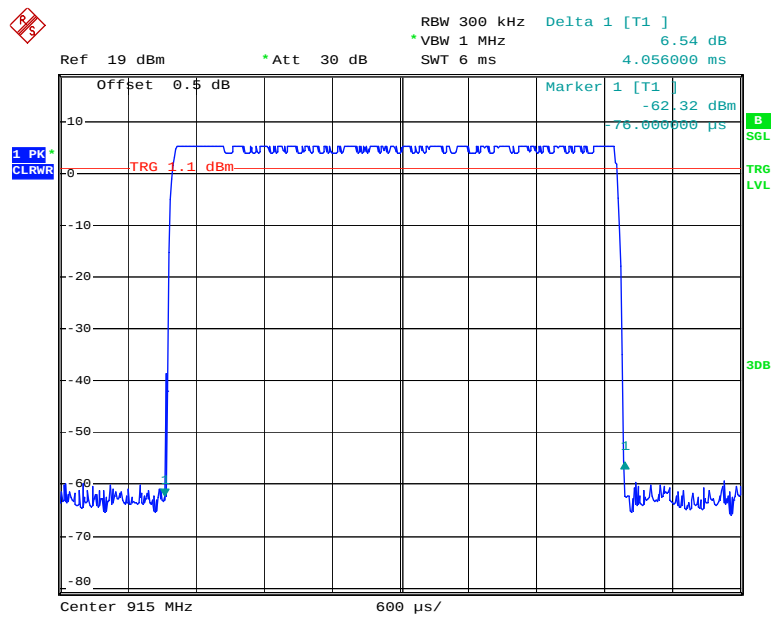
Channel	Occupancy Time For Single Hop (ms)	Hops in 10s	Hops in Observed Period	Dwell time (s)	Limit (s)	Result
Low	4.04	19	38	0.154	0.4	Compliance
Middle	4.06	19	38	0.154	0.4	Compliance
High	4.04	16	32	0.129	0.4	Compliance

Dwell time=Pulse time (ms) × hopping number per channel in Observed Period
Observed Period=20S
Hops in Observed Period= Hops in 10s ×Observed Period/10

Low Channel

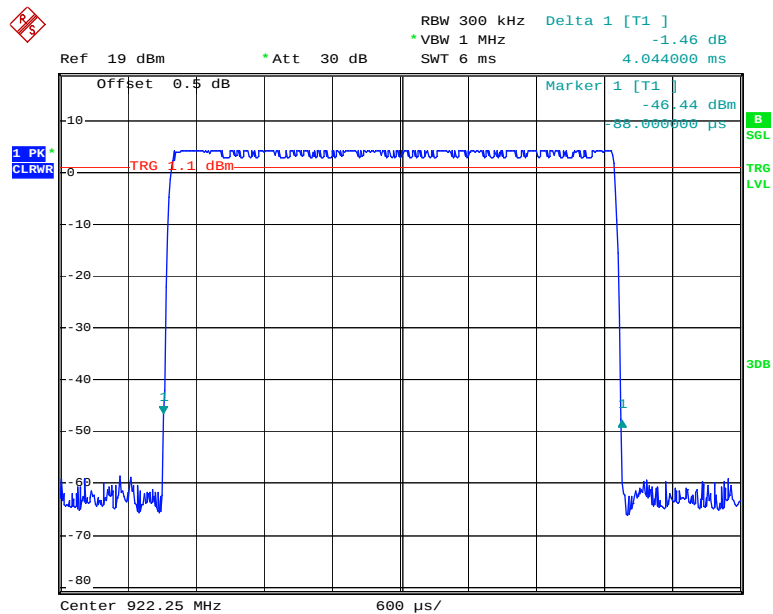
Date: 20.NOV.2017 09:56:54

Middle Channel



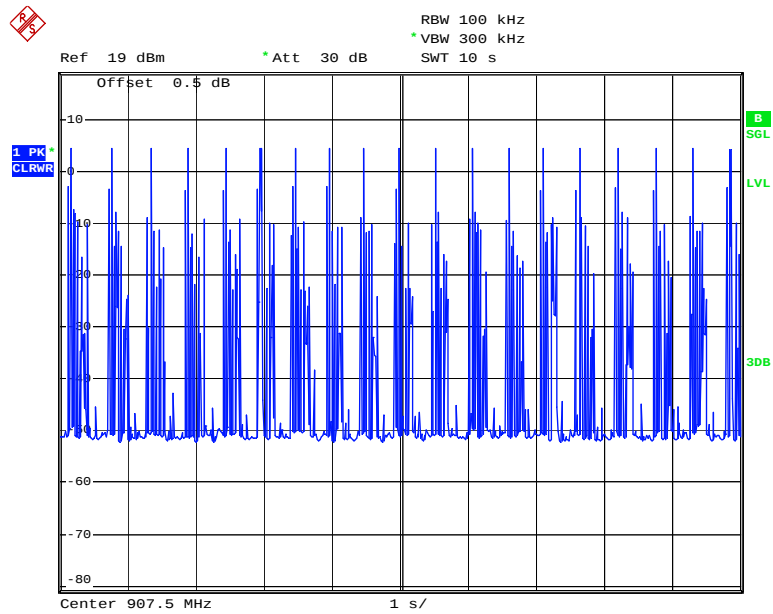
Date: 20.NOV.2017 09:56:12

High Channel



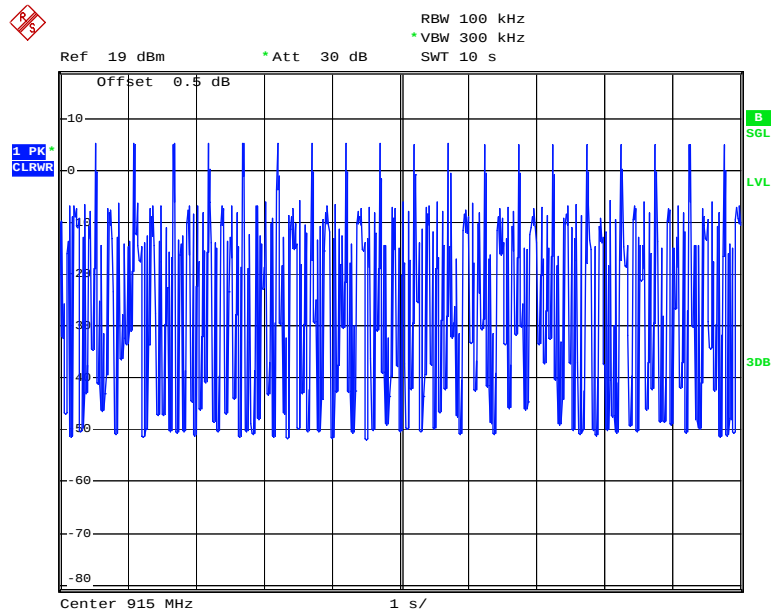
Date: 20.NOV.2017 09:57:28

10S: Low Channel



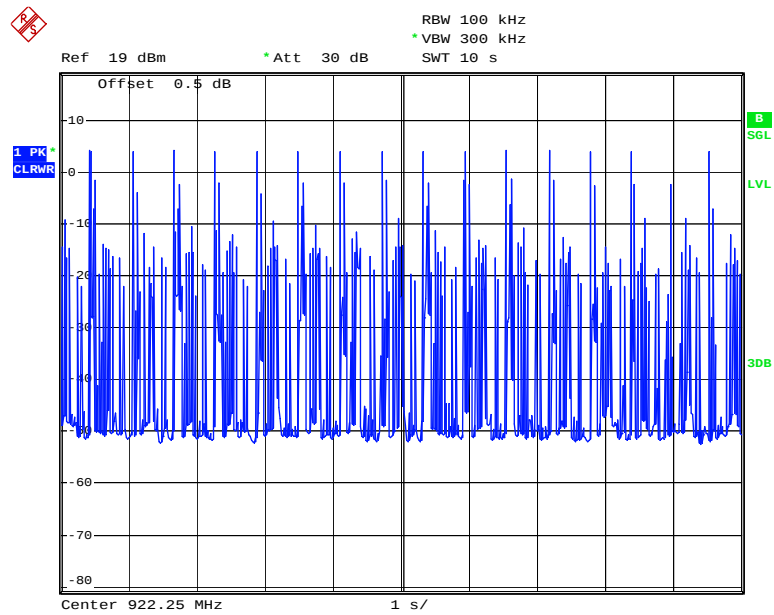
Date: 20.NOV.2017 10:00:59

10S: Middle Channel



Date: 20.NOV.2017 10:01:36

10S: High Channel



Date: 20.NOV.2017 10:02:18

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

According to §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
Agilent	Wideband Power Sensor	N1921A	MY54170013	2017-11-03	2018-11-03
Agilent	P-Series Power Meter	N1912A	MY5000448	2017-11-03	2018-11-03
N/A	Coaxial Cable	C-SJ00-0010	C0010/01	Each Time	/

* **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:	27.1 °C
Relative Humidity:	59 %
ATM Pressure:	101.4 kPa

* The testing was performed by Calvin Chen on 2017-11-20.

Test Result: Compliance.

Test Mode: Transmitting

Frequency (MHz)	Peak Conducted Output power (dBm)	Limit (dBm)
907.5	6.52	30
912.5	6.89	30
915	6.03	30
922.25	6.46	30

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	FSU 26	200256	2016-12-08	2017-12-08
N/A	Coaxial Cable	C-SJ00-0010	C0010/01	Each Time	/

* **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).

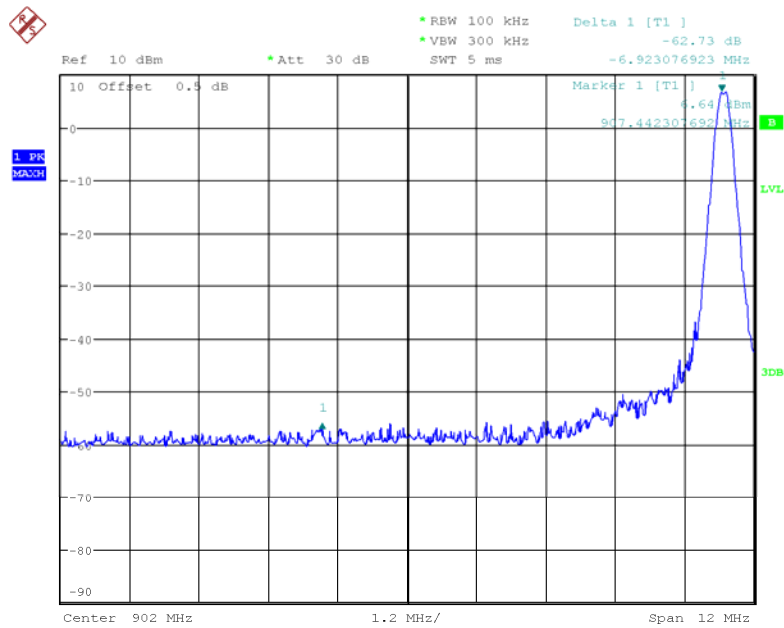
Test Data**Environmental Conditions**

Temperature:	28.6 °C
Relative Humidity:	49 %
ATM Pressure:	101.6 kPa

** The testing was performed by Calvin Chen on 2017-11-22.*

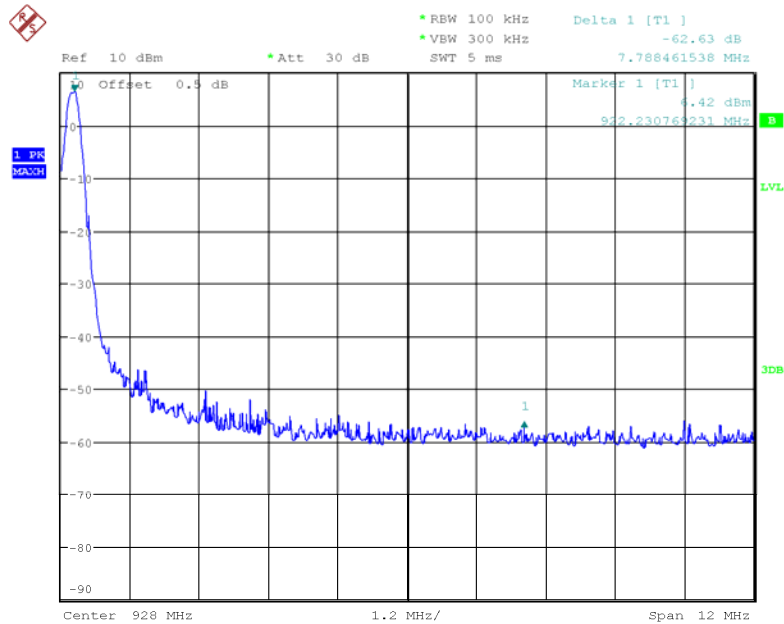
Test Result: Compliance(All emissions are under the fundamental more than 20dB)

Band Edge, Left Side



Date: 22.NOV.2017 15:59:49

Band Edge, Right Side



Date: 22.NOV.2017 16:00:32

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